BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL
PRINCIPAL BENCH AT NEW DELHI
IN O.A No. 44 OF 2024

Jot Singh Bist ..... Applicant

Versus

State Of Uttarakhand and Ors.....Respondents

INDEX

Sr. No.	Particulars	Dated	Page No.
1.	**Reply on behalf of Respondent No. 5**	26.08.2024	1-12
2.	**Affidavit in support**	26.08.2024	13-14
3.	**Annexure R-1 (A copy of contract between** Rail Vikas Nigam Limited and M/s Megha Engineering and Infrastructures Ltd.)	02.09.2020	15-914
4.	**Annexure R-2** (letter dated 02.12.2021 sent by Respondent No.5 requesting for additional space for Muck dumping and reply/order of Respondent No.4 vide letter no 1276 dated 28.08.2021 designating additional space for Muck dumping)	02.12.2021	915-917
5.	**Annexure R-3 (**Copies of the orders by the GoUK)	19.01.2021 24.08.2021	918-932
6.	**Annexure R-4 (**A copy of the receipt issued by the State for the payment of Rs. 50,000/-	26.02.2021	933-938

	(Fifty Thousand Rupees only) Royalty paid by Respondent No. 5)		
7.	**Annexure R-5** (Order dated August 24, 2021)	**24.08.2021**	939-953
8.	Board Resolution	17.08.2024	954-955
9.	Vakalatnama	17.08.2024	956-957

THROUGH

ALPHA LEGAL ADVOCATES
C-53, BLOCK-C, JANGPURA EXTENTION,
NEW DELHI-110014.
EMAIL:INFO@ALCADVOCATES.COM

BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL
PRINCIPAL BENCH AT NEW DELHI
IN O.A No. 44 OF 2024

Jot Singh Bist ....Applicant

Versus

State Of Uttarakhand and Ors. ...Respondents

REPLY ON BEHALF OF RESPONDENT No. 5 TO THE JOINT COMMITTEE REPORT FILED THROUGH DISTRICT MAGISTRATE, RUDRAPRAYAG FILED ON 13.05.2024. SUBMITTED IN COMPLIANCE BY ORDER DATED 17.05.2024 PASSED BY THE HON'BLE NGT.

RESPECTFULLY SHOWETH: -

1. In the O.A No. 44/2024 registered in exercise of Suo Moto jurisdiction under Section 14 and 15 of NGT Act, 2010 the Hon'ble Tribunal passed an order on 17.05.2024 whereby the answering Respondent has been impleaded as a party / Respondent No. 5 to the Original Application based upon the Joint Committee Report filed dt. 13.05.2024 and was granted time to file response/objection to the Joint Committee report. At the outset, the answering Respondent denies the contentions of Joint Committee Report which are not specifically denied or transversed and are deemed to be denied in its entirety.

NOTARY RENU AGARWAL Delhi Regd. No. 17806 GOVT. OF INDIA

2. The answering Respondent i.e M/s Megha Engineering and Infrastructures Ltd., is a company incorporated under the Companies Act with its registered address as S-2, Technocrat Industrial Estate, Balangar, Hyderabad. 500037, Telengana, India. The Respondent no.5 is a multi-sector infrastructure company with a strong footprint across various sectors like hydrocarbons, electric buses, defence, telecom, power, transport, manufacturing, general and social infrastructure, irrigation, and drinking water.

3. At the outset, we would like to state the fact that Respondent no.5 is committed to making sure that while we advance and develop, we also keep our natural world safe and healthy for future generations. By following high environmental standards and using the latest technology, we work to reduce our impact on the environment and ensure our projects do not harm the ecosystems we work in.

4. That the project in question is for construction of Tunnels, Bridges and Formation Works from Chainage 91+228 to 101+339(FLS) under Package – 7B in connection with new Broad-Gauge Line between Rishikesh and Karanprayag (125km) in the State of Uttarakhand, India, was introduced. The proposed alignment for the Rishikesh-Karnaprayag railway project spans 125 km, traversing the Ganga and Alaknanda River valleys with substantial tunnel and bridge construction over deep gorges and valleys. This strategic infrastructure initiative aims to enhance connectivity within the Ganga/Alaknanda valley and is anticipated to bolster the economic and tourism sectors of Uttarakhand. Future developments may extend the line to Badrinath and Kedarnath.

NOTARY
RENU AGARWAL
Delhi
Regd. No. 17806
GOVT. OF INDIA

5. That a tender was issued for the project's implementation, and following the bidding process, the Respondent No. 5 won the bid and the contract was awarded to them the contract value, as specified in the contract agreement, is INR 17,45,55,63,272.00.

6. That a contract agreement (herein after referred to as "bid document PK-7B") for the construction of the above-mentioned project was signed between Rail Vikas Nigam Limited (herein referred to as Respondent No.4) and Respondent No.5 on September 2, 2020. As per the contract agreement the RVNL signed the said contract agreement as "EMPLOYER" and M/s Megha Engineering and Infrastructures Ltd. is shown as "CONTRACTOR". A copy of the contract is enclosed as **Annexure-1.**

7. This initiative represents a highly ambitious and significant endeavour in India. The proposed extension aims to link the project to Badrinath and Kedarnath through future developments. Upon its completion, this undertaking will significantly enhance connectivity within the Ganga/Alaknanda valley, thereby stimulating economic growth and boosting tourism in the Uttarakhand region.

8. The route of the project traverses challenging and steep mountainous terrain. Specifically, within the 7B alignment package, the project includes Tunnel T13 and the Tilani station yard.

NOTARY RENU AGARWAL Delhi Regd. No. 17806 GOVT. OF INDIA

9. That it is submitted that, the Respondent No.5 has not deviated from any mining rules or environmental guidelines, and adhered to the proper protocols placed under the contract. Respondent No.5 merely followed the guidelines laid by its employer i.e., Respondent No. 4. Respondent No. 5 utilized the

designated muck dumping zone as per the bid document PK-7B; however, the entire allocated area reached its full capacity during the course of construction. Consequently, the Respondent no.5 adhered to the prescribed procedures and requested an additional dumping site to ensure the smooth and efficient continuation of the contract. Respondent No. 4, RVNL, promptly facilitated this request through its project manager. Relevant correspondence regarding this matter i.e., the letter dated 02.12.2021 sent by Respondent No.5 requesting for additional space for Muck dumping and reply/order of Respondent No.4 vide letter no 1276 dated 28.08.2021 designating additional space for Muck dumping, is enclosed as **Annexure-2.**

10. That it is pertinent to mention that the Joint Committee has erred in its finding that Respondent No. 5 has been collecting useful mineral stone/muck from the tunnel construction without obtaining relevant permissions and without paying revenue/royalty, thus violating the Rule 8(6) of Chapter 3 of Uttarakhand Mineral "Prevention of Illegal Mining, Transportation and Storage" Rules 2021. It is further explained in detail by Respondent No. 5 in following para 11 and 12 of this reply

11. That it is pertinent to mention that Respondent No. 5 is legally authorized to utilize muck generated from tunnelling operations pursuant to Government of Uttarakhand (herein referred to as GoUK) Orders No. 123/VII-I/2021/8(16)/19 dated January 19, 2021, and No. 910/VII-A-I/2021/03(46)/2021 dated August 24, 2021, issued by the Audhyogik Vikas (Khanan) Anubhaga-1, Dehradun. Further it is reiterated that Respondent No. 5 is complying with the requirement to deposit the Royalty as stipulated by the GoUK. It is affirmed that Respondent No. 5 is appropriately utilizing the

NOTARY RENU AGARWAL Delhi Regd. No. 17806 GOVT. OF INDIA

muck generated from tunnel excavation as per the aforementioned permissions. Copies of the orders by the GoUK are enclosed as **ANNEXURE-3.**

12. That it is submitted that Respondent No. 5 is in compliance with the Rule 8(6) of Chapter 3 of Uttarakhand Mineral "Prevention of Illegal Mining, Transportation and Storage" Rules 2021. Thus, Respondent No.5 has meticulously adhered to all applicable regulations and statutory requirements governing the use of such materials. Respondent No.5 has duly paid the Royalty of Rs. 50,000/- (Fifty Thousand Rupees only) as per the State Rule 8(6). A copy of the receipt issued by the State for the payment of Rs. 50,000/- (Fifty Thousand Rupees only) Royalty paid by Respondent No. 5 in adherence of the Rule 8(6) is enclosed as **ANNEXURE- 4.**

13. That it is material to confirm the fact that Respondent No. 5 assumes full responsibility for the utilization of the usable muck at Chopra Gadera in the production of aggregates. This commitment is in accordance with the approval granted by the Government of Uttarakhand, as outlined in the Order dated August 24, 2021. This commitment ensures that all activities related to the muck are conducted in compliance with the government's guidelines. Respondent No.5 is ready to carefully assess the environmental impact of our projects and work closely with experts to apply the best practices. Copy of the above-mentioned order is enclosed as **ANNEXURE- 5.**

NOTARY RENU AGARWAL Delhi Regd. No. 17806 GOVT. OF INDIA

14. That it is submitted that the Executive Engineer of Irrigation Division, Rudraprayag informed that after complete utilization of the collected muck, it seems appropriate to develop the said Gadera as before by replacing the

damaged wire crates installed earlier and constructing new wire crates in the Chopra Gadera. It is hereby agreed that Respondent No.5 shall undertake the restoration work in close consultation with the Forest Department, relevant administrative authorities, and local villagers. This collaborative approach ensures that all restoration activities are conducted in alignment with environmental and community considerations, thereby reaffirming our commitment to responsible and effective restoration efforts. Respondent No.5 takes their responsibility for environmental protection very seriously. This means they don't just follow the rules—they go above and beyond to prevent any negative effects on nature.

15. That it is pertinent to mention, that the Joint Committee report mentions no water source has been found at the site yet describes the Gedera as rainy Gedera. Clearly indicating that Respondent No.5 was vigilant in keeping the Gadera safe and not damaging. At the same time, the report reiterates that compensation has been paid by Respondent No.4 to the Revenue Department for the loss caused by the collected maize, which is appropriate. Thus, no clarification on the same is needed by Respondent No.5.

Reply to the report of Deputy Forest Conservator, Rudraprayag Forest Division, Rudraprayag-

NOTARY
RENU AGARWAL
Delhi
Regd. No. 17806
GOVT. OF INDIA

16. That it is submitted that as per the report of the Deputy Forest Conservator, Rudraprayag Forest Division an additional 0.4589 hectares of civil forest land was found in addition to the proposed 0.8511 hectares of civil forest land. That Respondent No.5 noted that there has been an inadvertent overlap into areas. This may have occurred due to an oversight, and we are committed to promptly addressing and rectifying the issue as early as possible. Respondent

No.5's commitment to environmental protection goes beyond compliance; it is a core value that drives their operations and decision-making processes. Through their conscientious efforts, they aim to balance progress with preservation, demonstrating that economic development and environmental stewardship can coexist harmoniously.

17. That it is pertinent to mention that Forest Officer South Jakholi Range was directed to assess the damage caused to the forest wealth due to the debris disposal in the additional area. In lieu of the same and under Indian Forest Act, 1927 an amount of Rs. 4,61,291.00 (Four Lakh Sixty-One Thousand Two Hundred Ninety-One Rupees only) was deposited by Respondent No.5 for the damages caused to the environment and the same was deposited in the Forest Revenue. Respondent No. 5 assures that it will diligently implement all necessary precautions to prevent any further impact or harm. Respondent No.5 deeply recognizes the vital importance of environmental stewardship in all our projects. We are committed to integrating sustainable practices and stringent environmental safeguards into every phase of our work, from planning through execution

NOTARY
RENU AGARWAL
Delhi
Regd. No. 17806
GOVT. OF INDIA

18. That it is submitted that Respondent No.5 is a mere contractor of the said construction and Respondent No.4 i.e., RVNL is the actual Employer and authority of the said construction of Tunnels, Bridges and Formation Works from Chainage 91+228 to 101+339(FLS) under Package – 7B in connection with new Broad-Gauge Line between Rishikesh and Karanprayag (125km) in the State of Uttarakhand. As also reiterated in Clause 2.18.1 (a) of the bid document PK-7B i.e., the contract agreement between Respondent No.4 and Respondent No.5 that is reproduced herein, clearly reflects the responsibility

of Respondent No. 4 to acquire all necessary permissions referred in para 1, 2 and 7 of the report of Deputy Forest Conservator.

Clause 2.18 Other Provision: 2.18.1 Land: a) Employer has acquired land required for construction of permanent works and Muck dumping zones. Necessary forest clearances and possession of entire land (Government, forest and Private) has been obtained. Contractor will be made available entire acquired land for construction of permanent works.

Response to the report of Assistant Inspector General of Forests, Ministry of Environment, Forest and Climate Change, Regional Office, Dehradun:

19. That it is submitted that in relation to paragraph 1 and 2 of the report of Assistant Inspector General of Forests, Ministry of Environment, Forest and Climate Change, Regional Office, Dehradun, it is stated that proposal for work on the proposed site (forest land) was received by the Additional Chief Forest Conservator and Nodal Officer, Forest Conservation on the 27.04.2022.

20. That it is alleged that even before obtaining in-principal approval under the Forest (Conservation) Act, 1980, the work was being carried out on the proposed site (forest land). It is important to note that securing the necessary permissions from the relevant authorities was part of the responsibilities outlined in the contract agreement i.e., bid document PK-7B. The significance of this project cannot be overstated, as it is a major undertaking with the potential to transform connectivity and drive economic and tourism growth in Uttarakhand. Given the scale and complexity of the project, involving extensive infrastructure development and substantial manpower, it is imperative that strict adherence to timelines is maintained. Any deviation from the scheduled deadlines could

NOTARY RENU AGARWAL Delhi Regd. No. 17806 GOVT. OF INDIA

jeopardize the entire project, leading to significant delays and operational challenges. Effective project management and timely execution are crucial to prevent disruptions and ensure that the project remains on track, thereby avoiding potential chaos and ensuring the successful realization of its objectives. It is reiterated that Respondent No. 4, as the Employer as per the bid document PK-7B, was responsible for securing the necessary authorization from the relevant authority.

21. That it is submitted that even the survey report ensures the fact that Respondent No. 5 has not harmed any trees or the water bodies at the site of construction. Neither any trees were cut nor any debris was discharged in the Alaknanda River.

Reply on the investigation done by the committee and the data given by the Forest Department, Geology and Mining Department, Revenue Department:

22. That it is submitted that the allegations raised in the survey report in its para 1 have already been dealt with, in the above contentions. The same are being not repeated for the sake of brevity.

23. That it is submitted that even the survey report ensures the fact that Respondent No. 5 has not harmed Khasra No. 5363 Rauli, it is intact in its previous form and there has been no damage to the private land. We are committed to integrating sustainable practices and stringent environmental safeguards into every phase of our work, from planning through execution. Respondent No.5's dedication to minimizing ecological impact is reflected in our meticulous approach to environmental protection, ensuring that our projects not only enhance quality of life but also preserve the natural world for future generations. By adhering to rigorous environmental standards and employing advanced technologies, we

NOTARY RENU AGARWAL Delhi Regd. No. 17806 GOVT. OF INDIA

strive to reduce our carbon footprint and mitigate any adverse effects on the ecosystems we work within.

24. That it is submitted that even the survey report ensures the fact that Respondent No. 5 has not harmed any trees at the site of construction. The Respondent No.5 assures that it will take all necessary precautions to safeguard and protect the environment.

25. That it is submitted that even the survey report ensures the fact that Respondent No. 5 has not harmed Khasra No. 5363 Rauli, it is intact in its previous form and there has been no damage to the private land.

26. That it is submitted that the allegations raised in the survey report in its para 4 have already been dealt with, in the above contentions. The same are being not repeated for the sake of brevity. Yet, Respondent No. 5 reiterates that it has paid the mandated Royalty as per the order of GoUK. The muck is also being used for production of aggregates in a lawful and legitimate manner.

27. That it is submitted that the allegations raised in the survey report in its para 5 have already been dealt with, in the above contentions. The same are being not repeated for the sake of brevity.

28. That it is submitted that the allegations raised in the survey report in its para 6 have already been dealt with, in the above contentions. The same are being not repeated for the sake of brevity.

NOTARY RENU AGARWAL Delhi Regd. No. 17906 GOVT. OF INDIA

29. That it is submitted that the allegations raised in the survey report in its para 7 have already been dealt with, in the above contentions. The same are being not repeated for the sake of brevity.

30. That it is submitted that the allegations raised in the survey report in its para 8 have already been dealt with, in the above contentions. The same are being not repeated for the sake of brevity.

31. That Respondent No.5 understands how crucial it is to protect the environment in all our projects. We are dedicated to using sustainable practices and strict environmental controls at every step of our work. Our goal is to improve people's lives while also caring for nature. By following high environmental standards and using the latest technology, we work to reduce our impact on the environment and ensure our projects do not harm the ecosystems we work in.

32. This current project between RVNL and M/s MEIL represents a visionary and critical initiative for India, with far-reaching implications for national development. The proposed extension aims to connect key spiritual and tourist destinations, Badrinath and Kedarnath, through future enhancements. Once completed, this ambitious project will significantly enhance connectivity within the Ganga/Alaknanda valley, fostering economic growth and advancing tourism in Uttarakhand. Its completion will not only streamline travel and trade but also open new avenues for regional development, thereby contributing to India's broader economic and infrastructural progress. This project stands as a testament to India's commitment to creating integrated and sustainable growth across its diverse regions.

NOTARY RENU AGARWAL Delhi Regd. No. 17806 GOVT. OF INDIA

PRAYER

It is, therefore, respectfully prayed in the interest of justice and fair play that this Hon'ble Tribunal/Court may

a. Be pleased to dismiss the OA with respect to Respondent No.5 Impleaded as a party to the present Original Application,

b. The Hon'ble Tribunal may be pleased to issue any other appropriate order or direction as this Hon'ble Tribunal may deem fit and proper in the facts and circumstances of the instant case.

Medha Engineering & Infrastructure Pvt. Ltd. S-2, TIE, Balanagar, Hyderabad-37.

Respondent No.5

Place: New Delhi
Dated: 26 AUG 2024

THROUGH

Alpha Legal Consultants

ALPHA LEGAL ADVOCATES
C-53, BLOCK-C, JANGPURA EXTENTION,
NEW DELHI-110014
EMAIL:INFO@ALCADVOCATES.COM

I identified the deponant who has signed in my presence

NOTARY RENU AGARWAL Delhi Regd. No. 17606 GOVT. OF INDIA

Verification:

Verified that the contents of the above appeal contain in paras 1 to 32 are true and correct to my knowledge. No part of it is false and nothing has been concealed therein.

Medha Engineering & Infrastructure Pvt. Ltd. S-2, TIE, Balanagar, Hyderabad-37.

Respondent No.5

Place: New Delhi

Dated 26 AUG 2024

ATTESTED
NOTARY PUBLIC
(INDIA)
26 AUG 2024

BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL
PRINCIPAL BENCH AT NEW DELHI

IN O.A No. 44 OF 2024

Jot Singh Bist ....Applicant

Versus

State Of Uttarakhand and Ors ....Respondents

AFFIDAVIT

I, T. Ashok Reddy, S/o: T. Pratap Reddy, Aged about: 66 Years, the Authorized Representative of M/s Megha Engineering & Infrastructures Ltd., S-2, Technocrat Industrial Estate, Balanagar, Hyderabad. 500037, Telangana, do hereby solemnly affirm and declares as under:

i. That I am the Authorized Representative of the Respondent No. 5 in the Original Application and being well conversant with the facts of the case, am competent to swear this affidavit.

ii. That the deponent has gone through the contents mentioned in the accompanying reply which are true and correct to the best of my knowledge and belief. No part of it is wrong and nothing material has been concealed and misstated.

NOTARY
RENU AGARWAL
Delhi
Regd. No. 17806
GOVT. OF INDIA

iii. That the Annexures to the accompanying reply/objection are true/certified copies of their respective originals.

I identified the deponant who has signed in my presence

NOTARY GOVT. OF INDIA RENU AGARWAL Delhi Regd. No. 17806

Meghna Engineering & Infrastructures Ltd. S-2, TIE, Balanagar, Hyderabad-37.

Deponent

Verification:

Verified that the contents of above affidavit are true and correct to my knowledge and belief. Nothing material has been concealed or misstated therein.

26 AUG 2024

Verified at New Delhi on this day of August of 2024.

Meghna Engineering & Infrastructures Ltd. S-2, TIE, Balanagar, Hyderabad-37.

Deponent

26 AUG 2024

ATTESTED

NOTARY PUBLIC (INDIA)

ANNEXURE - 1

रेल विकास निगम लिमिटेड
Rail Vikas Nigam Limited

CA No.: RVNL/RKSH-KNPG/Tender/Tunnels/PK-7B/CA-52 Dated 02.09.2020

CONTRACT AGREEMENT

FOR

Construction of Tunnels, Bridges and Formation Works from Chainage 91+228 to 101+339(FLS) under Package – 7B in connection with new Broad Gauge Line between Rishikesh and Karanprayag (125km) in the State of Uttarakhand, India

BETWEEN

EMPLOYER: **Rail Vikas Nigam Limited,**
1st Floor, August Kranti Bhawan,
Bhikaji Cama Place, R.K. Puram,
New Delhi-110066.

AND

CONTRACTOR: **M/s. Megha Engineering & Infrastructures Limited**
S-2, Technocrate Industrial Estate,
Balanagar, Hyderabad-500037,
Telangana, India

CONTRACT VALUE: INR 17,45,55,63,272.00

रेल विकास निगम लिमिटेड
Rail Vikas Nigam Limited
(A Government of India Enterprise)

INDEX

CA No.: RVNL/RKSH-KNPG/Tender/Tunnels/PK-7B/CA-52 Dated 02.09.2020

CONTRACT AGREEMENT

FOR

Construction of Tunnels, Bridges and Formation Works from Chainage 91+228 to 101+339 (FLS) under Package – 7B in connection with Nw Single Broad Gauge Line between Rishikesh and Karanprayag (125km) in the State of Uttarakhand, India

BETWEEN

EMPLOYER: **Rail Vikas Nigam Limited, 1st Floor, August Kranti Bhawan, Bhikaji Cama Place, R.K. Puram, New Delhi-110066.**

AND

CONTRACTOR: **M/s. Megha Engineering & Infrastructures Limited S-2, Technocrate Industrial Estate, Balanagar, Hyderabad-500037, Telangana, India.**

CONTRACT VALUE: INR 17,45,55,63,272.00

S.No.	Description of Contents	Page No
1	Contract Agreement.	001-003
2	Performance Guarantee.	004-020
3	The Letter of Acceptance (LOA).	021-026
4	The Letter of Technical Bid & Technical Proposals	027-032
5	The Letter of Price Bid	033-034
6	The Power of Attorney	035-047
7	The Addendum & Corrigendum to the Tender Document	048-161
8	The Special/Particular Conditions of Contract. Part-A : Contract Data Part-B : Particular Conditions of Contract	162-205
9	The General Condition of Contract	206-313
10	The Works/Employer's Requirements	314-559
11	Geotechnical Baseline Report	560-678
12	The Completed Schedules including (Priced bill of Quantities)	679-712
13	Form KEYP-1, Form KEYP-2, Form P&M-1, Form P&M-2 (Letter of Comfort), Form INS-1 & Form INS-2.	713-732
14	Form MET -1 to Form MET -5	733-790
15	Contract Forms	791-809
16	Drawings	810-897

CONTRACT AGREEMENT

INDIA NON JUDICIAL

Government of National Capital Territory of Delhi

e-Stamp

सत्यमेव जयते

Certificate No.	:	IN-DL62839326977452S
Certificate Issued Date	:	30-Jul-2020 12:56 PM
Account Reference	:	IMPACC (IV)/ dl797803/ DELHI/ DL-DLH
Unique Doc. Reference	:	SUBIN-DLDL79780334158746776381S
Purchased by	:	MEGHA ENGINEERING AND INFRASTRUCTURES LTD
Description of Document	:	Article 5 General Agreement
Property Description	:	Not Applicable
Consideration Price (Rs.)	:	0 (Zero)
First Party	:	RAIL VIKAS NIGAM LIMITED
Second Party	:	MEGHA ENGINEERING AND INFRASTRUCTURES LTD
Stamp Duty Paid By	:	MEGHA ENGINEERING AND INFRASTRUCTURES LTD
Stamp Duty Amount(Rs.)	:	100 (One Hundred only)

Contract Agreement is सत्यापित/VETTED for Rs 1745,95,63,272/- only (Including GST) Rs One Thousand Seven hundred forty five crore fifty five lacs Sixty three thousand two hundred seventy two Only

वरिष्ठ प्रबन्धक (वित्त) एवं प्रा. / Sr. Manager (Finance) S.S.
रे. वि. नि. लि., नई दिल्ली / RVNL, New Delhi

Please write or type below this line

Contract Agreement

CA No.: RVNL/RKSH-KNPG/Tender/Tunnels/PK-7B/CA-52 Dated 02.09.2020

This AGREEMENT (hereinafter, together with all the appendices/attachments attached hereto called the "Contract) is made at New Delhi on the Second day of September 2020 between the **Rail Vikas Nigam Limited, 1st Floor, August Kranti Bhawan, Bhikaji Cama Place, R.K. Puram, New Delhi – 110066** on the one part (hereinafter called the "Employer") acting through the **Chairman & Managing Director** and **M/s. Megha Engineering & Infrastructures**

02/09/20

Statutory Alert:
1. The authenticity of this Stamp Certificate should be verified at "www.shcilestamp.com". Any discrepancy in the details on this Certificate and as available on the website renders it invalid.
2. The onus of checking the legitimacy is on the users of the certificate.
3. In case of any discrepancy please inform the Competent Authority.

Limited, S-2, Technocrat Industrial Estate, Balanagar, Hyderabad-500037, Telangana, India, (hereinafter called the "Contractor") on the other part the Contractor will be represented hereunder at all times by **Mr. N. Akhilesh Reddy**, Authorized Signatory).

WHEREAS the Employer desires that the Works known as **"Construction of Tunnels, Bridges and Formation Works from Chainage 91+228 to 101+339 (FLS) under Package – 7B in connection with new Broad Gauge Line between Rishikesh and Karanprayag (125km) in the State of Uttarakhand, India"** should be executed by the Contractor, and has accepted a Bid by the Contractor for the execution and completion of these Works and remedying of any defects therein,

The Employer and the Contractor agree as follows:

सत्यापित / VETTED

1. In this Agreement words and expression shall have the same meanings as are respectively assigned to them in the contract documents referred to.

2. The following documents shall be deemed to form and be read and constructed as part of the Agreement; This Agreement shall prevail over all other Contract documents.

   i) the Performance Security.

   ii) the Letter of Acceptance

   iii) the Letter of Technical Bid & Technical Proposal.

   iv) the Letter of Price Bid

   v) the Addendum and Corrigendum to the Tender Document

   vi) the Special/Particular Conditions of Contract.

   (a) Part-A: Contract Data
   (b) Part-B: Particular Conditions of Contract

   vii) the General Condition of Contract

   viii) the Works/Employers Requirements

   ix) the completed Schedules including (Priced bill of Quantities)

   x) Any other documents

3. In consideration of the payments to be made by the Employer to the Contractor as indicated in this Agreement, the Contractor hereby covenants with the Employer to execute the Works and to remedy defects therein in conformity in all respects with the provisions of the Contract.

02/09/2020

4. The Employer hereby covenants to pay the Contractor in consideration of execution and completion of the Works and the remedy of defects therein, the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

5. This is to certify that this Contract Agreement contains pages from S. No. 001 to 897 . Due to Covid-19 pandemic situation in the country only Pages From S. No. 001 to 003 have been signed physically and remaining pages are deemed to have been signed being uploaded on e-tendering portal and emails. In case of any discrepancy/dispute arises, then uploaded documents of the Employer along with A&Cs shall prevail.

VETTED / VETTED
JR(L-I)/C-II/RVNL/03/09/2020

IN WITNESS whereof the parties hereto have caused this Agreement to be executed in accordance with the laws of INDIA on the day, months and year indicated above.

Chief Manager (Finance) S.S. Jain (Dy. Manager (Finance) RVNL, New Delhi

For and on behalf of the Employer

02/09/2020

भानु प्रकाश / BHANU PRAKASH
कार्यपालक निदेशक / ऋषिकेश
Executive Director / RKSH
रेल विकास निगम लि० / Rail Vikas Nigam Ltd
(भारत सरकार का उद्यम) / (A Govt. of India Enterprise)
नई दिल्ली-110066 / New Delhi-110066

Signature of the authorized official

(BHANU PRAKASH)

Name of the official

Stamp/Seal of the Employer

in the presence of:

Sign of Witness

Name R. C. Sharma.

Address Manager/Civil/RVNIL.

For and on behalf of the Contractor

MEGHA ENGINEERING INFRASTRUCTURES LIMITED
S-2, T.E. Balanagar, Hyd-37.

02/09/20

Signature of the authorized official

(N. AKHILESH REDDY)

Name of the official

Stamp/Seal of the Contractor

in the presence of:

Sign of Witness

Name Lt Cdr P. Goswami (R)

Address AGM, MEIL, DELHI

PERFORMANCE BANK GUARANTEE

25-07-20 EH

E-7394

State Bank of India
Commercial Clients Group Branch
1st Floor, D.No.8-2-684/2/A
Anand Banjara Colony,
Road No.12, Banjara Hills
Hyderabad - 500 034
Tel 040-23421429, 23421423
Fax 040- 23421408
Email.ID: cmcsd.ccghyd@sbi.co.in

SR MANAGER (FINANCE)
RAIL VIKAS NIGAM LIMITED
1ST FLOOR AUGUST KRANTI BHAWAN
BHIKAJI CAMA PLACE
R K PURAM NEW DELHI 110066

CCG/HYD/CS/2020-21/224

Date: 19.08.2020

Dear Sir,

Confirmation of Bank Guarantee

With reference to your letter No. RVNL/RKSH/Pkg:7B/BG Conf. dated 04.08.2020, we confirm having issued/amended the following bank guarantee :

BG No.	Date of Issue	Amount in Rs.	Expiry date	Claim by date
1303920BG0000412	28-07-2020	55,51,19,461.00	22-10-2025	22-10-2026

The above guarantee has been issued at the request of M/S Megha Engg and Infrastructures Ltd in favour of THE CHAIRMAN AND MANAGING DIRECTOR RAIL VIKAS NIGAM LIMITED 1ST FLOOR AUGUST KRANTI BHAWAN BHIKAJI CAMA PLACE R K PURAM NEW DELHI 110066 It is signed by duly authorized officials of the Bank.

Yours faithfully,

Chief Manager (TF)

B. VIDYASAGAR
SS No. V-3220
CCG Br. (13039), HYD.

यूनियन बैंक Union Bank

क्षेत्रीय कार्यालय Regional Office

सिकंदराबाद Secunderabad

भवन - पहली मंजिल, बंगला नं 109, नया नं 1-7-252-254, ऑक्सफोर्ड स्ट्रीट, सरोजिनी देवी रोड, सिकंदराबाद
Address - First Floor, Bungalow No.109, New No.1-7-252-254, Oxford Street, Sarojini Devi Road, Secunderabad - 500 003
फोन Phone 040 27808300 ई-मेल email - zosec@unionbankofindia.com

पत्र संख्या Letter No. 2277/52/M-0057/272 दिनांक Date: 20.08.2020

सेवा में To,
Mr. Sunil Kr. Sharma
Sr Manager / Finance
1st Floor, August Kranti Bhawan,
Bhikajee Cama Place,
R.K Puram, New Delhi
110066

प्रिय महोदय Dear Sir,

विषय Reg. : **Bank Guarantee Confirmation –M/s Megha Engineering and Infrastructures Pvt Ltd**

संदर्भ Ref. : **Your Ref Lr no. F no RVNL/RKSH/Pkg:7B/BG conf dt 04.08.2020**

Referring to the above, we hereby confirm the issuance of the following Bank Guarantee by our Balanagar Branch issued on behalf of **M/s Megha Engineering and Infrastructures Pvt Ltd**

BG No.	Beneficiary	Amount (In Rs.)	Date of Issue	Expiry Date	Claim Expiry Date
005720IGPER0127	The Chariman and Managing Director, Rail Vikas Nigam Limited, 1st Floor, August Kranti Bhawan, Bhikaji Cama Place, R.K Puram, New Delhi Hyderabad 5000374	Rs.20,50,00,000/	27.07.2020	22.10.2025	22.10.2025

भवदीय Yours Faithfully

V Chandana

(V Chandana Sri Rupa)
Chief Manager
CC: Balanagar Branch

इण्डियन ओवरसीज़ बैंक
Indian Overseas Bank

दूरभाष Phone : 040-23468828
: 040 23468827
ईमेल email : iob0432@iob.in

राष्ट्रपति रोड शाखा : 4-2-25 to 28 & 32, पहली मंज़िल, राष्ट्रपति रोड, सिकंदराबाद - 500003 (तेलंगाना)
Rashtrapathi Road Branch:4-2-25 to 28 & 32, Ist Floor, Rashtrapathi Road,Secunderabad-500003 (Telangana)

IOB: RPR/ LG-CON/09/AUG-2020 Date: 21.08.2020

To,
M/s Chairman And Managing Director
Rail Vikas Nigam Ltd 1st Floor,
August Kranti Bhawan,
Bhikaji Kama Place RK Puram
New Delhi-110066

Dear Sir/Madam,

Confirmation of Bank Guarantee

We refer to your email dated 04.08.2020, and hereby confirm that we have issued the following Bank Guarantee favoring *"M/s Chairman And Managing Director,Rail Vikas Nigam Ltd 1st Floor,August Kranti Bhawan, Bhikaji Kama Place RK Puram, New Delhi-110066"* on behalf of M/s Megha Engineering & Infrastructures Limited.

Bank Guarantee Details:-

Sr. No	BG No	Amt in Rs.	Date of Issue	Valid Till	Claim Upto
1.	043271120000022	17,50,00,000/-	24.07.2020	22.10.2025	22.10.2026

Thanking you,
Yours faithfully,

Authorised Signatory

 Scanned with CamScanner

Megha Engineering & Infrastructures Ltd.

An ISO 9001-2015 Company

S-2, Technocrat Indl. Estate, Balanagar, Hyderabad-500037, Telangana, INDIA
Tel: +91-40-44336700 Fax: +91-40-44336800
E-mail: info@meil.in Visit us: www.meil.in U45202TG2006PLC050271

Lr. No.: MEIL/RVNL/RSKH-KNPG/PK-7B/20-21/04 Date: 29.07.2020

To,
The Executive Director/P/RKSH-KNPG,
Rail Vikas Nigam Limited,
August Kranti Bhawan,
Bhikaji Cama Place, R. K. Puram,
New Delhi – 110 066
E-mail: bhanu.dyce@gmail.com

(Kind Attn: Sh. Bhanu Prakash, Executive Director/P/RKSH-KNPG)

Dear Sir,

Sub: "CONSTRUCTION OF TUNNELS, BRIDGES AND FORMATION WORKS **FROM CHAINAGE 91+228 TO 101+339 (FLS) UNDER PACKAGE-7B IN CONNECTION WITH NEW BG LINE BETWEEN RISHIKESH AND KARANPRAYAG (125KM)** IN STATE OF UTTARAKHAND, INDIA – **Submission of Performance Security Bank Guarantee** - Reg.

Ref: 1) LOA No. 2020_RVNL_CORP_PROJ_TUNNEL/CONST/TENDER/RKSH-KNPG/PK-7B/PT.3 Dated: 09.07.2020
2) Our Letter No. MEIL/HO-PROJECTS/RVNL/RSKH-KNPG/PK-7B/20-21/01 Date: 29.07.2020

*****

With reference to the above and in continuation to our letter under reference 2nd cited, we are herewith submitting the following Bank Guarantees towards Performance Security for an amount equal to 6% of accepted contract price excluding GST i.e. **INR 93,51,19,461/- (Rupees Ninety Three Crores Fifty One Lakhs Nineteen Thousand Four Hundred Sixty One only).** The details of Bank Guarantees are as follows:

Sl. No.	Bank Guarantee No. & Date	Bank Guarantee Value (in Rs.)	Validity Period & Valid up to	Issued by
1.	1303920BG0000412, Dt: 28.07.2020	55,51,19,461.00/-	63 Months i.e. up to 22.10.2025	State Bank of India, Commercial Clients Group Branch-13039, Door No. 8-2-684/2/A, 1st Floor, Anand Banjara Colony, Road No. 12,

MEGHA ENGINEERING & INFRASTRUCTURES LTD. S-2, T.I.E., Balanagar, Hyd-37

meil

Sl. No.	Bank Guarantee No. & Date	Bank Guarantee Value (in Rs.)	Validity Period & Valid up to	Issued by
2.	005720IGPER0127, Dt: 27.07.2020	20,50,00,000.00/-	63 Months i.e. up to 22.10.2025	Union Bank of India (Erstwhile Andhra Bank) , Balanagar Branch, S-1, Technocrat Industrial Estate, Balanagar, Hyderabad - 500037
3.	043271120000022, Dt: 24.07.2020	17,50,00,000.00/-	63 Months i.e. up to 22.10.2025	Indian Overseas Bank, Rashtrapati Road Branch, Door No. #4-2-25 to 28& 32, Kasuva Complex, 1st Floor, R.P.Road, Secunderabad - 500003
	TOTAL	**93,51,19,461.00/-**		

We request you to kindly acknowledge the receipt of this letter and documents.

Thanking you,

Yours faithfully,
For Megha Engineering & Infrastructures Ltd

S-2, T.I.E., Balanagar, Hyd-37

J. Srinivas Kumar
Authorized Signatory

Encl: As above

P SANDHYA RANI
S.V.L.NO. 1/2007
H.NO. 8-3-677/1/2
YELLAREDDYGUDA
HYDERABAD - 500073
LICENSE NO: 06/2007

भारत
INDIA

89319 152955 JUL 27 2020 12:13
Rs.0000500 PB5932
NON-JUDICIAL STAMP DUTY TELANGANA

CONTRACT PERFORMANCE SECURITY BANK GUARANTEE

From:
State Bank of India
Commercial Clients Group Branch-13039,
Door No. 8-2-684/2/A, 1st Floor
Anand Banjara Colony, Road No.12, Banjara Hills
Hyderabad – 500 034

To The Chairman and Managing Director Rail Vikas Nigam Limited 1st Floor, August Kranti Bhawan Bhikaji Cama Place, R.K. Puram New Delhi – 110 066	BG No. 13039 20 BG 0000412 Date: 28 JUL 2020 BG Amount: **Rs.55,51,19,461/-** Valid up to: **22.10.2025** Claim validity up to: **22.10.2026**

WHEREAS, **Rail Vikas Nigam Limited,** (hereinafter called "the Employer") acting through the Chairman and Managing Director, Rail Vikas Nigam Limited, 1st Floor, August Kranti Bhawan, Bhikaji Cama Place, R.K. Puram, New Delhi – 110 066 has accepted the bid of **M/s. Megha Engineering and Infrastructures Limited,** having its Registered Office at S-2, Technocrat Industrial Estate, Balanagar, Hyderabad – 500 037 (hereinafter called "the Contractor") for the work of **"CONSTRUCTION OF TUNNELS, BRIDGES AND FORMATION WORKS FROM CHAINAGE 91+228 to 101+339 (FLS) UNDER PACKAGE-7B IN CONNECTION WITH NEW BG LINE BETWEEN RISHIKESH AND KARANPRAYAG (125KM) IN STATE OF UTTARAKHAND, INDIA,** vide Notification of Award No. **E-office File No.-2020_RVNL_CORP-PROJ_TUNNEL/CONST/TENDER/RKSH-KNPG/PK-7B/Pt-3, Dated: 09.07.2020.**

AND

WHEREAS, the contractor is required to furnish Performance Security for the sum of **Rs.55,51,19,461/- (Rupees fifty five crore fifty one lakh nineteen thousand four hundred sixty one only)** in the form of bank guarantee, being a condition precedent to the signing of the contract agreement.

WHEREAS, **State Bank of India,** with its Branch, Commercial Clients Group Branch-13039, Door No. 8-2-684/2/A, 1st Floor, Anand Banjara Colony, Road No.12, Banjara Hills, Hyderabad – 500 034 having our central office at Nariman Point, Mumbai (hereinafter called "the Bank"), acting through ..... A. JAYANTI Deputy Manager SS. No.J-3478 SBI, CCG Br.13039, Hyd. ..... **[Insert Name and Designation(s) of the authorised person of the Bank]**, have, at the request of the Contractor, agreed to give guarantee for performance security and additional performance security as hereinafter contained:

कृते भारतीय स्टेट बैंक
For STATE BANK OF INDIA

उप प्रबंधक (सि.एस.)
Deputy Manager (C.S.)
वाणिज्यिक ग्राहक समूह शाखा, हैदराबाद
Commercial Clients Group Br-13039, Hyd.

A. JAYANTI
Deputy Manager
SS. No.J-3478
CCG Br.13039, Hyd.

Contd....2

1303920BG0000412

:2: 1303920BG0000412

BG No.:
Date: 28 JUL 2020
Amount: **Rs.55,51,19,461/-**
Validity up to: **22.10.2025**
Claim validity up to: **22.10.2026**

1. KNOW ALL MEN by these present that I/We the undersigned Mr. Harjot Kaur & Mr. A Jayanti [**Insert name(s) of authorized representatives of the Bank**], being fully authorized to sign and incur obligations for and on behalf of the Bank, confirm that the Bank, hereby, unconditionally and irrevocably guarantee to pay the Employer the full amount in the sum of **Rs.55,51,19,461/- (Rupees fifty five crore fifty one lakh nineteen thousand four hundred sixty one only)** as above stated.

2. The Bank undertakes to immediately pay on presentation of demand by the Employer any amount up to and including aforementioned full amount without any demur, reservation or recourse. Any such demand made by the Employer on the Bank shall be final, conclusive and binding, absolute and unequivocal notwithstanding any disputes raised/ pending before any Court, Tribunal, Arbitration or any Authority or any threatened litigation by the Employer of Bank.

3. On payment of any amount less than aforementioned full amount, as per demand of the Employer, the guarantee shall remain valid for the balance amount i.e. the aforementioned full amount less the payment made to the Employer.

4. The Bank shall pay the amount as demanded immediately on presentation of the demand by Employer without any reference to the contractor and without the Employer being required to show grounds or give reasons for its demand or the amount demanded.

5. The Bank Guarantee shall be unconditional and irrevocable.

6. The guarantee hereinbefore shall not be affected by any change in the constitution of the Bank or in the constitution of the Contractor.

7. The Bank agrees that no change, addition, modifications to the terms of the Contract Agreement or to any documents, which have been or may be made between the Employer and the Contractor, will in any way release us from the liability under this guarantee; and the Bank, hereby, waives any requirement for notice of any such change, addition or modification to the Bank.

Contd....3.

28 JUL 2020 कृते भारतीय स्टेट बैंक
For STATE BANK OF INDIA

उप प्रबंधक (वि.एव.)
Deputy Manager (C.S.)
वाणिज्यिक ग्राहक समूह शाखा, हैदराबाद
Commercial Clients Group Br.-13039, Hyd.

A. JAYANTI
Deputy Manager
SS. No.J-3478
SBI, CCG Br.-13039, Hyd.

:3: 13039 20BG 0000412

BG No.:
Date: 28 JUL 2020
Amount: **Rs.55,51,19,461/-**
Validity up to: **22.10.2025**
Claim validity up to: **22.10.2026**

8. This guarantee is valid and effective from the date of its issue, which is 28 JUL 2020 **[insert date of issue]**. The guarantee and our obligations under it will expire on **22.10.2025.** All demands for payment under the guarantee must be received by us on or before that date i.e., **22.10.2026.**

9. The Bank agrees that the Employers right to demand payment of aforementioned full amount in one instance or demand payments in parts totaling up to the aforementioned full amount in several instances will be valid until either the aforementioned full amount is paid to the Employer or the guarantee is released by Employer before the Expiry date i.e., **22.10.2025.**

10. The Bank agrees that its obligation to pay any amount demanded by the Employer before the expiry of this guarantee will continue until the amount demanded has been paid in full.

11. The expressions Bank and Employer herein before used shall include their respective successors and assigns.

12. The Bank hereby undertakes not to revoke the guarantee during its currency, except with the previous consent in writing of the employer. This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No.758.

13. The Guarantee shall be in addition to and without prejudice to any other security Guarantee(s) of the contractor in favour of the Employer available with the Employer. The Bank, under this Guarantee, shall be deemed as Principal Debtor of the Employer.

NOTWITHSTANDING ANYTHING CONTAINED HEREIN ABOVE:

1. Our liability under this Bank Guarantee shall not exceed **Rs.55,51,19,461/- (Rupees fifty five crore fifty one lakh nineteen thousand four hundred sixty one only).**
2. This Bank Guarantee shall be valid up to and till **22.10.2025** only being the date of expiry of the Guarantee and
3. The beneficiary's right as well the Bank's liability under this Guarantee shall stand extinguished unless a written claim or demand is made under this Guarantee on or before **22.10.2026.**

Place: Hyderabad
Date: 28 JUL 2020

कृते भारतीय स्टेट बैंक
For STATE BANK OF INDIA

उप प्रबंधक (वा.ग्रा.)
Deputy Manager (C.S.)
वाणिज्यिक ग्राहक समूह शाखा, हैदराबाद
Commercial Clients Group Br-13039, Hyd.

A. JAYANTI
Deputy Manager
SS. No.J-3478
SBI, CCG Br.-13039, Hyd.

SWIFT

Main Reference NO:	1303920BG0000412	Transaction Reference NO:	1303920BG0000412
Unit Code:	13039	Operator:	5853230
Module Name:	BGIF	Function Name:	Inland_Issue_Bank_Guarantee
Transaction Date:	28-07-2020	Transaction Time:	17:02:39
Event Time:	1		

MT760COV ackFlag : notifyFlag :

B1: **Outgoing SWIFT Header 1**

F01SBIN0013039500000000000

B2: **Receiver's BIC Code**

I760PUNB0198800N

7020: **Transaction Referance Number (Issuing Bank Guarantee Number)**

1303920BG0000412

7024: **Type of Bank Guarantee : Performance, Financial, Others**

PERFORMANCE

7025: **Amount of Guarantee Currency Code Amount**

INR55119461,

7026: **Guarantee Validity Guarantee From Date Guarantee To Date**

20200728 20251022

7027: **Guarantee Effective Date**

20200728

7029: **End date for lodgement of claim**

20261022

7030: **Place of lodgement of claim**

STATE BANK OF INDIA

7031: **Issuing Branch IFSC**

SBIN0013039

7032: **Issuing branch name and address**

STATE BANK OF INDIA
SBI,DOOR NO.8
ANAND BANJARA COLONY
HYDERABAD

7033: **Name of applicant and his details**

MEGHA ENGG AND INFRASTRUCTURES LTD
S 2 TIE
BALANAGAR
HYDERABAD

A. JAYANTI
Deputy Manager
SS. No.J-3478
SBI, CCG Br.-13039, Hyd.

7034: **Name of Beneficiary and his details**

THE CHAIRMAN AND MANAGING DIRECTOR
RAIL VIKAS NIGAM LIMITED, 1ST
FLOOR, AUGUST KRANTI BHAWAN,
BHIKAJI CAMA PLACE, R K PURAM, NEW
DELHI 500034

7035: **Beneficiary IFSC**

PUNB0198800

7036: **Beneficiary branch name and address**

PUNJAB NATIONAL BANK
BHIKHAIJI CAMA PLACE, NEW DELH
7, BHIKHAIJI CAMA PLACE, NEW D
DELHI

7037: **Sender to Receiver Information**

HY-5336753

7038: **Purpose of Guarantee**

PERFORMANCE SECURITY BANK GUARANTEE

7040: **Stamp Duty Electronically Paid (Y/N)**

N

7046: **Date of Payment**

20200728

7047: **Place of Payment**

COMMERCIAL CLIENT GROUP BRANCH

7048: **e-Bank Guarantee to be held in Demat Form(Y/N)**

N

20Z: **Transaction Reference Number**

NON-REGULAR

A. JAYANTI
Deputy Manager
SS. No.J-3478
SBI, CCG Br.-13039, Hyd.

SAYMI NARAYANA
S.V.L.NO. 62/2006
K.R.G.6-3-392,R.L.NO.
BEHIND PUNJAGUTTA POLICE STATION
HYDERABAD
LICENCE NO. 12/2006

भारत
INDIA

5BU1U
189829
Govt.
JUL 24 2020
16:48
Rs.0000500
PB5553
NON JUDICIAL STAMP DUTY
TELANGANA

CONTRACT PERFORMANCE SECURITY BANK GUARANTEE

From:
Union Bank of India
(Erstwhile Andhra Bank)
Balanagar Branch
S-1, Technocrat Industrial Estate
Balanagar, Hyderabad – 500 037

To	BG No.: 0057201GPER0127
The Chairman and Managing Director Rail Vikas Nigam Limited 1st Floor, August Kranti Bhawan Bhikaji Cama Place, R.K. Puram New Delhi – 110 066	Date: 27-07-2020 BG Amount: **Rs.20,50,00,000/-** Valid up to: **22.10.2025**

WHEREAS, **Rail Vikas Nigam Limited,** (hereinafter called "the Employer") acting through The Chairman and Managing Director, Rail Vikas Nigam Limited, 1st Floor, August Kranti Bhawan, Bhikaji Cama Place, R.K. Puram, New Delhi – 110 066 has accepted the bid of **M/s. Megha Engineering and Infrastructures Limited,** having its Registered Office at S-2, Technocrat Industrial Estate, Balanagar, Hyderabad – 500 037 (hereinafter called "the Contractor") for the work of **"CONSTRUCTION OF TUNNELS, BRIDGES AND FORMATION WORKS FROM CHAINAGE 91+228 to 101+339 (FLS) UNDER PACKAGE-7B IN CONNECTION WITH NEW BG LINE BETWEEN RISHIKESH AND KARANPRAYAG (125KM) IN STATE OF UTTARAKHAND, INDIA**, vide Notification of Award No. E-office File No.-2020_RVNL_CORP-PROJ_TUNNEL/CONST/TENDER/RKSH-KNPG/PK-7B/Pt-3, Dated: **09.07.2020.**

AND

WHEREAS, the contractor is required to furnish Performance Security for the sum of **Rs.20,50,00,000/- (Rupees twenty crore fifty lakh only)** in the form of bank guarantee, being a condition precedent to the signing of the contract agreement.

WHEREAS, **Union Bank of India** (Erstwhile Andhra Bank), with its Branch at S-1, Technocrat Industrial Estate, Balanagar, Hyderabad – 500 037 having our registered / head office at # 239, Vidhan Bhawan, Nariman Point, Mumbai – 400 021 (hereinafter called "the Bank"), acting through Meher Prasad.R, Asst Manager
K. Aruna Savitha, Manager [**Insert Name and Designation(s) of the authorised person of the Bank**] have, at the request of the Contractor, agreed to give guarantee for performance security and additional performance security as hereinafter contained:

"यूनियन बैंक ऑफ इंडिया"
"Now UNION BANK OF INDIA"

Contd....2.

कृते आन्ध्र बैंक / For ANDHRA BANK
MEHER PRASAD. R. M-908
सहायक प्रबन्धक / Asst. Manager
बालानगर शाखा, हैद. / Balanagar Br., Hydecabad.

कृते आन्ध्र बैंक / For ANDHRA BANK
K. ARUNA SAVITHA A-431
सहायक महा प्रबन्धक / Asst. General Manager
बालानगर शाखा, हैद. / Balanagar Br., Hyderabad.

-2-

BG No.: 005720IGPER0127
Date: 27-07-2020.
Amount: **Rs.20,50,00,000/-**
Validity up to: **22.10.2025**

1. KNOW ALL MEN by these present that I/We the undersigned Mehr Prasad.R Asst Manager, K.Aruna Savitha Manager, **[Insert name(s) of authorized representatives of the Bank]**, being fully authorized to sign and incur obligations for and on behalf of the Bank, confirm that the Bank, hereby, unconditionally and irrevocably guarantee to pay the Employer the full amount in the sum of **Rs.20,50,00,000/- (Rupees twenty crore fifty lakh only)** as above stated.

2. The Bank undertakes to immediately pay on presentation of demand by the Employer any amount up to and including aforementioned full amount without any demur, reservation or recourse. Any such demand made by the Employer on the Bank shall be final, conclusive and binding, absolute and unequivocal notwithstanding any disputes raised / pending before any Court, Tribunal, Arbitration or any Authority or any threatened litigation by the Employer of Bank.

3. On payment of any amount less than aforementioned full amount, as per demand of the Employer, the guarantee shall remain valid for the balance amount i.e., the aforementioned full amount less the payment made to the Employer.

4. The Bank shall pay the amount as demanded immediately on presentation of the demand by Employer without any reference to the contractor and without the Employer being required to show grounds or give reasons for its demand or the amount demanded.

5. The Bank Guarantee shall be unconditional and irrevocable.

6. The guarantee hereinbefore shall not be affected by any change in the constitution of the Bank or in the constitution of the Contractor.

7. The Bank agrees that no change, addition, modifications to the terms of the Contract Agreement or to any documents, which have been or may be made between the Employer and the Contractor, will in any way release us from the liability under this guarantee; and the Bank, hereby, waives any requirement for notice of any such change, addition or modification to the Bank.

8. This guarantee is valid and effective from the date of its issue, which is 27-07-2020. **[insert date of issue]**. The guarantee and our obligations under it will expire on **22.10.2025.** All demands for payment under the guarantee must be received by us on or before that date i.e., **22.10.2025.**

9. The Bank agrees that the Employers right to demand payment of aforementioned full amount in one instance or demand payments in parts totaling up to the aforementioned full amount in several instances will be valid until either the aforementioned full amount is paid to the Employer or the guarantee is released by Employer before the Expiry date i.e., **22.10.2025.**

कृते आन्ध्रा बैंक / For ANDHRA BANK

Contd....3.

MEHER PRASAD.R. M-516
सहायक प्रबन्धक / Asst. Manager
बालानगर शाखा, हैद. / Balanagar Br., Hyderabad

K. ARUNA SAVITHA A-431
सहायक प्रबन्धक / Asst. General Manager
बालानगर शाखा, हैद. / Balanagar Br., Hyderabad.

: 3 :

BG No.: 0057201GPER0127
Date: 27-07-2020.
Amount: **Rs.20,50,00,000/-**
Validity up to: **22.10.2025**

10. The Bank agrees that its obligation to pay any amount demanded by the Employer before the expiry of this guarantee will continue until the amount demanded has been paid in full.

11. The expressions Bank and Employer herein before used shall include their respective successors and assigns.

12. The Bank hereby undertakes not to revoke the guarantee during its currency, except with the previous consent in writing of the employer. This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No.758.

13. The Guarantee shall be in addition to and without prejudice to any other security Guarantee(s) of the contractor in favour of the Employer available with the Employer. The Bank, under this Guarantee, shall be deemed as Principal Debtor of the Employer.

NOTWITHSTANDING ANYTHING CONTAINED HEREIN ABOVE:

1. Our liability under this Bank Guarantee shall not exceed **Rs.20,50,00,000/- (Rupees twenty crore fifty lakh only).**
2. The Bank Guarantee shall be valid up to **22.10.2025.**
3. We are liable to pay the guaranteed amount or any part thereof under this bank guarantee only and only if you serve upon us a written claim or demand on or before **22.10.2025.**

Place: Hyderabad
Date: 27-07-2020.

कृते आन्ध्रा बैंक / For ANDHRA BANK

ARUNA SAVITHA A-431
सहा.महाप्रबन्धक / Asst. General Manager
बालानगर शाखा, हैद. / Balanagar Br., Hyderabad.

"यूनियन बैंक ऑफ इंडिया"
"Now UNION BANK OF INDIA"

Note: The confirmation / genuineness of this Guarantee may be verified by the beneficiary in their own interest, by enclosing a Xerox copy of the guarantee from our controlling office, whose address is mentioned here below:

Address of Controlling Office:

Union Bank of India, Regional Office – Secunderabad, First Floor, Bungalow No. 109, New No. 1-7-252 to 254, Oxford Street, Sarojini Devi Road, Secunderabad–500003;
e-mail id: zosec@andhrabank.co.in

कृते आन्ध्रा बैंक / For ANDHRA BANK

ARUNA SAVITHA A-431
सहा.महाप्रबन्धक / Asst. General Manager
बालानगर शाखा, हैद. / Balanagar Br., Hyderabad.

P. Sandhya Rani

P SANDHYA RANI
S.V.L.NO. 1/2007
H.NO. 8-3-677/1/2
YELLAREDDYGUDA
HYDERABAD - 500073
LICENSE NO: 06/2007

भारत
INDIA

88508 Quantity
131954 JUL 24 2020
12:32
Rs.0000500 PB5932
NON JUDICIAL Stamp Duty
TELANGANA

CONTRACT PERFORMANCE SECURITY BANK GUARANTEE

BG No - 0432711200000022
BG Amount – Rs 17,50,00,000/-
BG Expiry date - 22.10.2025
BG Validity upto - 22.10.2026
Date : 24.07.2020

From:
Indian Overseas Bank
Rashtrapati Road Branch
Door No. # 4-2-25 to 28 & 32,
Kasuva Complex, 1st Floor
R. P. Road, Secunderabad – 500 003

To	BG No.:
The Chairman and Managing Director Rail Vikas Nigam Limited 1st Floor, August Kranti Bhawan Bhikaji Cama Place, R.K. Puram New Delhi – 110 066	Date: BG Amount: **Rs.17,50,00,000/-** Valid up to: **22.10.2025** Claim validity up to: **22.10.2026**

WHEREAS, **M/s. Rail Vikas Nigam Limited,** (hereinafter called the "**Employer**") acting through the Chairman and Managing Director, Rail Vikas Nigam Limited, 1st Floor, August Kranti Bhawan, Bhikaji Cama Place, R.K. Puram, New Delhi – 110 066 has accepted the bid of **M/s. Megha Engineering and Infrastructures Limited,** having its Registered Office at S-2, Technocrat Industrial Estate, Balanagar, Hyderabad – 500 037, (hereinafter called "the Contractor") for the work of **"CONSTRUCTION OF TUNNELS, BRIDGES AND FORMATION WORKS FROM CHAINAGE 91+228 to 101+339 (FLS) UNDER PACKAGE-7B IN CONNECTION WITH NEW BG LINE BETWEEN RISHIKESH AND KARANPRAYAG (125KM) IN STATE OF UTTARAKHAND, INDIA,** vide Notification of Award No. **E-office File No.-2020_RVNL_CORP-PROJ_TUNNEL/CONST/TENDER/RKSH-KNPG/ PK-7B /Pt-3, Dated: 09.07.2020.**

AND

WHEREAS, the contractor is required to furnish Performance Security for the sum of **Rs.17,50,00,000/- (Rupees seventeen crore fifty lakh only)** in the form of bank guarantee, being a condition precedent to the signing of the contract agreement.

WHEREAS, **Indian Overseas Bank,** with its Branch, at Rashtrapati Road Branch, # 4-2-25 to 28 & 32, Kasuva Complex, 1st Floor, R. P. Road, Secunderabad – 500 003 having our head office at Anna Salai, Chennai "hereinafter called the **Bank**", acting through Mr K. Velayatham (Assistant General Manager) & Mr Vivek Salwa (Assistant Manager) **[Insert Name and Designation(s) of the authorised person of the Bank]**, have, at the request of the Contractor, agreed to give guarantee for performance security and additional performance security as hereinafter contained:

For Indian Overseas Bank

Authorised Signatory
Designation
Branch
R.S. No. V-1033

Contd...2

:2:

BG No: 3432 71/20000021
Date: 24.07.2020
Amount: **Rs.17,50,00,000/-**
Validity up to: **22.10.2025**
Claim validity up to: **22.10.2026**

1. KNOW ALL MEN by these present that I/We the undersigned Mr K. Velayutham (Assistant General Manager) & Mr Vivek Salve (Asst Manager) ..... **[Insert name(s) of authorized representatives of the Bank]**, being fully authorized to sign and incur obligations for and on behalf of the Bank, confirm that the Bank, hereby, unconditionally and irrevocably guarantee to pay the Employer the full amount in the sum of **Rs.17,50,00,000/- (Rupees seventeen crore fifty lakh only)** as above stated.

2. The Bank undertakes to immediately pay on presentation of demand by the Employer any amount up to and including aforementioned full amount without any demur, reservation or recourse. Any such demand made by the Employer on the Bank shall be final, conclusive and binding, absolute and unequivocal notwithstanding any disputes raised/ pending before any Court, Tribunal, Arbitration or any Authority or any threatened litigation by the Employer of Bank.

3. On payment of any amount less than aforementioned full amount, as per demand of the Employer, the guarantee shall remain valid for the balance amount i.e., the aforementioned full amount less the payment made to the Employer.

4. The Bank shall pay the amount as demanded immediately on presentation of the demand by Employer without any reference to the contractor and without the Employer being required to show grounds or give reasons for its demand or the amount demanded.

5. The Bank Guarantee shall be unconditional and irrevocable.

6. The guarantee hereinbefore shall not be affected by any change in the constitution of the Bank or in the constitution of the Contractor.

7. The Bank agrees that no change, addition, modifications to the terms of the Contract Agreement or to any documents, which have been or may be made between the Employer and the Contractor, will in any way release us from the liability under this guarantee; and the Bank, hereby, waives any requirement for notice of any such change, addition or modification to the Bank.

8. This guarantee is valid and effective from the date of its issue, which is 24/07/2020 **[insert date of issue]**. The guarantee and our obligations under it will expire on **22.10.2025.** All demands for payment under the guarantee must be received by us on or before that date. **i.e., 22.10.2026.**

Contd....3.

For Indian Overseas Bank

Asst. Manager / Asst. General Manager
Rashtrapathi Road / Rashtrapathi Road
Secunderabad / Secunderabad
S.S. No. V-1033 V0213

:3:

BG No.: 0432711200000022
Date: 24.07.2020
Amount: **Rs.17,50,00,000/-**
Validity up to: **22.10.2025**
Claim validity up to: **22.10.2026**

9. The Bank agrees that the Employers right to demand payment of aforementioned full amount in one instance or demand payments in parts totaling up to the afore mentioned full amount in several instances will be valid until either the aforementioned full amount is paid to the Employer or the guarantee is released by Employer before the Expiry date **i.e., 22.10.2025.**

10. The Bank agrees that its obligation to pay any amount demanded by the Employer before the expiry of this guarantee will continue until the amount demanded has been paid in full.

11. The expressions Bank and Employer herein before used shall include their respective successors and assigns.

12. The Bank hereby undertakes not to revoke the guarantee during its currency, except with the previous consent in writing of the employer. This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No.758.

13. The Guarantee shall be in addition to and without prejudice to any other security Guarantee(s) of the contractor in favour of the Employer available with the Employer. The Bank, under this Guarantee, shall be deemed as Principal Debtor of the Employer.

Notwithstanding anything to the contrary contained hereinabove:

1. Our liabilty under this Bank Guarantee shall not exceed **Rs.17,50,00,000/- (Rupees seventeen crore fifty lakh only).**
2. This Bank Guarantee shall be valid up to and till **22.10.2025** only being the date of expiry of the guarantee and
3. We are liable to pay up to the guaranteed amount only and only if we receive from you a written claim period not later than 12 months from said expiry date relating to default that happened during the guarantee period and all your rights under the Bank Guarantee shall stand discharged unless such written claim or demand is received by us from you on or before **22.10.2026.**

Place: Secunderabad
Date: 24.07.2020

कृते इण्डियन ओवरसीज बैंक
For Indian Overseas Bank

सहायक प्रबंधक / Asst. Manager
S.S. No. V-1033

कृते इण्डियन ओवरसीज बैंक
For Indian Overseas Bank

Asst. General Manager
V 0033

Letter of Acceptance (LOA)

meil

Megha Engineering & Infrastructures Ltd.

An ISO 9001-2015 Company

S-2, Technocrat Indl Estate, Balanagar, Hyderabad-500037, Telangana, INDIA
Tel: +91-40-44336700 Fax: +91-40-44336800
E-mail: info@meil.in Visit us: www.meil.in U45202TG2006PLC050271

Lr. No.: MEIL/HO-PROJECTS/RVNL/RSKH-KNPG/PK-7B/20-21/01
Date: 13.07.2020

To,
The Executive Director/P/RKSH-KNPG,
Rail Vikas Nigam Limited,
August Kranti Bhawan,
Bhikaji Cama Place, R. K. Puram,
New Delhi - 110 066
E-mail: bhanu.dyce@gmail.com

(Kind Attn: Sh. Bhanu Prakash, Executive Director/P/RKSH-KNPG)

Dear Sir,

Sub: "CONSTRUCTION OF TUNNELS, BRIDGES AND FORMATION WORKS **FROM CHAINAGE 91+228 TO 101+339 (FLS) UNDER PACKAGE-7B IN CONNECTION WITH NEW BG LINE BETWEEN RISHIKESH AND KARANPRAYAG (125KM)** IN STATE OF UTTARAKHAND, INDIA - **Submission of LOA Acknowledgement - Reg.**

Ref: LOA No. 2020_RVNL_CORP_PROJ_TUNNEL/CONST/TENDER/RKSH-KNPG/PK-7B/PT.3 Dated: 09.07.2020

*****

With reference to the above cited subject, we thank you for issuing us the Letter of Acceptance (LOA) for the above subject project. We are herewith enclosing the duplicate copy of LOA duly signed and stamped on all pages as an acknowledgement and token of our unconditional acceptance, in compliance with Point No. 9 of LOA.

Thanking you,

Yours faithfully,
For Megha Engineering & Infrastructures Ltd

J. Srinivas Kumar
Authorized Signatory

Encl: As above

रेल विकास निगम लिमिटेड
Rail Vikas Nigam Limited
गुणवत्ता, गति एवं पारदर्शिता
(A Government of India Enterprise)
CIN: L74899DL2003GOI118633

E-office File No.-2020 RVNL CORP-PROJ_TUNNEL/CONST/TENDER/RKSH-KNPG/ PK 7B/ Pt-3 Dated: 09.07.2020

Letter of Acceptance

M/s Megha Engineering & Infrastructures Limited
S-2, Technocrat Industrial Estate, Balanagar,
Hydrabad-500037, Telangana, India
Tel.: 91 40 44336700
Fax: 91 40 44336800
Email: srinivaskumar@meilgroup.in

(Kind Attn: Mr. J. Srinivas Kumar, Authorized Signatory)

Sub: - Letter of Acceptance in c/w "CONSTRUCTION OF TUNNELS, BRIDGES AND FORMATION WORKS FROM CHAINAGE 91+228 TO 101+339 (FLS) UNDER PACKAGE–7B IN CONNECTION WITH NEW BG LINE BETWEEN RISHIKESH AND KARANPRAYAG (125KM) IN STATE OF UTTARAKHAND, INDIA."

Ref: (a) IFB NO. RVNL/RKSH-KNPG/TENDER/TUNNELS/PK7B Dated: 30.09.2019
(b) Your Technical Bid opened on 18.02.2020 and Price Bid opened on 02.06.2020.

This is to notify that your bid submitted on 18.02.2020 with reference to IFB No. RVNL/RKSH-KNPG/Tender/Tunnels/PK7B Dated: 30.09.2019 for "Construction of Tunnels, Bridges and Formation works from chainage 91+228 to 101+339 (FLS) under Package–7B in connection with new BG Line between Rishikesh and Karanprayg (125KM) in state of Uttarakhand, India" for the contract amount of **Rs. 17,45,55,63,272/- including GST (Rupees Seventeen Hundred and Forty-Five Crores Fifty-Five Lakhs Sixty-Three Thousand Two Hundred and Seventy-Two only including GST)** is accepted by the competent authority of RVNL.

1. The summary of the accepted schedule wise contract price is as here under:

Bill No.	Description of Schedule	BOQ Value (In Rs)	Accepted Percentage	Accepted Amount
1	Earthwork in Formation	34,03,05,038.00	18.00% above	40,15,59,944.84
2A	Bridge work (Other than Steel works)	4,92,64,500.00	18.50% above	5,83,78,432.50
2B	Bridge Work (Steel items involving Fabrication and Erection)	2,68,76,911.00	20.25% above	3,23,19,485.48

LOA Received & Accepted

रेल विकास निगम लिमिटेड
Rail Vikas Nigam Limited
(A Government of India Enterprise)

CIN: L74999DL2003GOI118633

Bill No.	Description of Schedule	BOQ Value (in Rs)	Accepted Percentage	Accepted Amount
2C	Bridge Work (Supply of Steel items)	2,50,48,484.00	18.50% above	2,96,82,453.54
9	Site Facilities	5,96,38,828.00	16.00% above	6,91,81,040.48
A	Underground Excavation	3,21,32,67,940.00	13.45% above	3,64,54,52,477.93
B1	Support System: Rock Bolts and Other Steel Supports etc	4,15,64,27,840.00	13.45% above	4,71,54,67,384.48
B2	Support System: Shoccrete and Concrete Works	4,56,73,65,061.00	13.45% above	5,18,16,75,661.70
B3	Supply of Steel Material	1,02,96,83,736.00	15.00% above	1,18,41,36,296.40
C	Drainage and Miscellaneous Work	1,01,38,09,522.00	15.00% above	1,16,58,80,950.30
D1	Ancillary Work	9,01,46,904.00	14.00% above	10,27,67,470.56
D2	Supply of Grouting Material	40,30,87,323.00	17.00% above	47,16,12,167.91
E2	Supply of fibres for Tunnel	19,30,49,780.00	18.00% above	22,77,98,740.40
F	Monitoring of excavations/ construction	6,35,31,433.00	18.50% above	7,52,84,748.11
H	Approach Road for Tunnel and Muck Dumping Site	7,36,55,500.00	17.50% above	8,65,45,212.50
J	Environment Management Plan	68,0,700.00	15.00% above	78,20,805.00
Total Estimated Cost including GST		**15,31,19,59,500.00**	**14.76% above**	**17,45,55,63,272.13**

LOA Received & Accepted

रेल विकास निगम लिमिटेड
Rail Vikas Nigam Limited
भुगतता, गति एव परवर्तिता
(A Government of India Enterprise)
CIN: L74999DL2003GOI118633

NOTE:

(i) Rates of Schedule-2B (Bridge Work (Steel items involving Fabrication and Erection) considered on higher side are banned for future estimation and comparison purpose.

2. You are requested to furnish performance security as under:

(a) The Performance Security shall be for an amount of 10% (Ten percent) of the Accepted Contract Amount excluding GST i.e. **INR 155,85,32,435/-** and in the same currency(ies) of the Accepted Contract Amount in the prescribed form for the stated amount valid for a period of 28 days beyond issue of performance certificate. The contractor shall have the following options:

(i) To submit full Performance Security for an amount equal to **10% of** Accepted Contract Amount excluding GST i.e. **INR 155,85,32,435/-.**

Or

(ii) To submit part Performance Security for an amount equal to **6%** of the accepted contract price excluding GST i.e. **INR 93,51,19,461/-** and the **balance Performance Security i.e. INR 62,34,12,974/-** shall be recovered from interim payment certificates @ 8% of the bill amount starting from 1st bill till it reaches full Performance Security. The contractor shall not be entitled to any interest on the amounts so recovered. However, the contractor shall be entitled for release of recovered amount of performance security against submission of bank guarantee of an equivalent amount, maximum three times during the contract.

3. The work is to be completed within 54 months plus 6 months of Defect Notification Period of actual date of commencement. The date of commencement is within Forty-Two (42) days from the date contractor receives Letter of Acceptance.

4. You shall furnish the Bonds, Guarantees, Evidence of insurances, Undertakings and Warrantees as stipulated in the Tender Documents as per the Contract Forms.

5. You shall ensure full compliance with tax laws of India with regard to this Contract and shall be solely responsible for the same. You shall submit copies of acknowledgements evidencing filing of returns every year and shall keep the Employer fully indemnified against your liability of tax, interest, penalty etc. in respect thereof, which may arise.

6. You shall also undertake not to use information gained during Construction period of the works for any purpose without obtaining the prior approval of RVNL and shall not make any public announcement or divulge any material relating to the project either in India or overseas without the prior written consent of RVNL.

7. You are requested to contact Executive Director/P/RKSH-KNPG, Rail Vikas Nigam Limited, August Kranti Bhawan, Bhikaji Cama Place, R. K. Puram, New Delhi-110066 for signing of the Contract Agreement and CPM/Rishikesh/RVNL for execution of work and for necessary mobilization of men and materials.

LOA Received & Accepted

रेल विकास निगम लिमिटेड
Rail Vikas Nigam Limited
गुणवत्ता, गति एवं परस्परसिद्धि
(A Government of India Enterprise)
CIN: L74999DL2003GOI118633

8. Until a formal agreement is signed, this Letter of Acceptance will constitute a binding contract between you and RVNL.

9. This Letter of Acceptance is sent to you in duplicate. You are required to return one copy duly signed and stamped on all pages including your unconditional acceptance thereof so as to reach the undersigned within **seven days** of issuance of this letter, as a token of your acknowledgement.

DA - (i) COF/3 – Form of Contract Performance Security.

Yours Faithfully

BHANU PRAKASH

(Bhanu Prakash)
Executive Director/RKSH-KNPG
For and on behalf of RVNL

Copy to.-

1) Secretary to CMD/RVNL New Delhi - for kind information of CMD.
2) Director (Projects), Director (Operation), Director (Finance), New Delhi- for kind information please.
3) CPM/Rishikesh/RVNL for information and necessary action please.
4) ED/P/MD, GGM/F (NSP)/RVNL- for information and necessary action please.
5) ED/S&T/CO and ED/Elec/CO for information and necessary action please.
6) AGM/P/Tender Cell of Corporate Office/RVNL, New Delhi - for information and record.
7) JGM, PP&D for information and uploading the LOA on the website.

BHANU PRAKASH

(Bhanu Prakash)
Executive Director/P/RKSH-KNPG
For and on behalf of RVNL

LOA Received & Accepted.

LETTER OF TECHNICAL BID

&

TECHNICAL PROPOSAL

meil

Megha Engineering & Infrastructures Ltd.

An ISO 9001-2015 Company

S-2, Technocrat Ind. Estate, Balanagar, Hyderabad-500037, Telangana, INDIA
Tel: +91 40 44336700 Fax: +91-40-44336800
E-mail: info@meil.in Visit us: www.meil.in U45202TG2006PLC050271

Form: PS 1

Letter of Technical Bid

Date: 17.02.2020

Invitation for Bid No.: RVNL/RKSH-KNPG/TENDER/TUNNELS/PK7B Date: 30.09.2019

To:
The Chief Project Manager,
Rail Vikas Nigam Limited,
Block No. 4, Rishilok, GMVN,
Muni Ki Reti, Rishikesh 249137, Uttarakhand

We, the undersigned, declare that:

(a) We have examined and have no reservations to the Bidding Documents, including Addenda issued in accordance with Instructions to Bidders (ITB) 8;

(b) We offer to execute the Works in conformity with the Bidding Documents;

(c) Our bid shall be valid for a period of 120 days from the date fixed for the bid submission deadline in accordance with the Bidding Documents, and it shall remain binding upon us and may be accepted at any time before the expiration of that period;

(d) If our bid is accepted, we commit to obtain a performance security in accordance with the Bidding Documents;

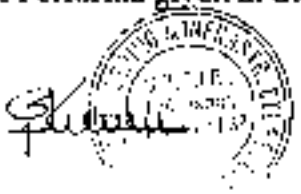
(e) If our bid is accepted, we commit to deploy key equipment and key personnel consistent with the requirements stipulated in Section 5: Works Requirements;

(f) If our bid is accepted, we commit to submit work method statements for all major activities and get these approved from the engineer prior to commencing work on such activities. We also understand that the work shall be executed as per the approved method statements without any deviations;

(g) We, including any subcontractors or suppliers for any part of the contract, do not have any conflict of interest in accordance with ITB 4.3;

(h) We are not participating, as a Bidder or as a subcontractor, in more than one bid in this bidding process in accordance with ITB 4.3, other than alternative offers submitted in accordance with ITB 13;

(i) We declare that we are not liable to be disqualified in Accordance with ITB 4.4, and we are enclosing the affidavit for the same as per the Performa given in the bid document.



meil

(j) We understand that this bid, together with your written acceptance thereof included in your notification of award, shall constitute a binding contract between us, until a formal contract is prepared and executed; and

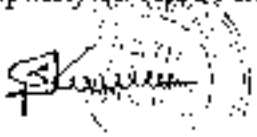
(k) We have not made any deviations from the requirement of the bidding document and we have also not made any tampering or changes in the bidding documents on which the bid is being submitted and if any tampering or changes are detected at any stage, we understand the bid will invite summary rejection and forfeiture of bid security/the contract will be liable to be terminated along with forfeiture of performance security, even if LOA has been issued.

(l) If our bid is accepted, we opt to take payment into the bank account, nominated by us.

(m) We declare that the submission of this bid confirms that no agent, middleman or any intermediary has been, or will be engaged to provide any services or any other item of work related to the award and performance of this contract. We further confirm and declare that no agency commission or any payment which may be construed as an agency commission has been, or will be, paid and that the bid price does not include any such amount. We acknowledge the right of the Employer, if he finds to the contrary, to declare our bid to be noncompliant and if the contract has been awarded to declare the contract null and void.

(n) We understand that you are not bound to accept the lowest evaluated bid or any other bid that you may receive.

Name: J. Srinivas Kumar
In the capacity of: Asst. Manager

Signed: 

Duly authorized to sign the Bid for and on behalf of M/s Megha Engineering & Infrastructures Limited.

Date: 17.02.2020

भारतीय गैर न्यायिक

एक सौ रुपये Rs. 100

रु. 100 ONE HUNDRED RUPEES

भारत INDIA

INDIA NON JUDICIAL

తెలంగాణ तेलंगाना TELANGANA

S.No 543 Date 04/02/2020 Rs. 100/-

SOLD TO: M. Raju S/o. M. Yesu, R/o. Hyd.

FOR WHOM: M/s. Megha Engineering & Infrastructures Ltd, Hyd

071916

CH. SHASHI REKHA
LICENCED STAMP VENDOR
L.No:15-23-009/2011, RL.No. 15-23-53/2020
H.No: 6-10-II/302, Vinayak Nagar, Balanagar
Medchal-Malkajgiri Dist. Cell: 9848470731

Form: PS 3

FORMAT FOR AFFIDAVIT TO BE SUBMITTED BY BIDDER ALONG WITH THE BID

I **J. Srinivas Kumar, Asst. Manager,** appointed as the attorney/authorized signatory of the bidder (including its constituents), **M/s. Megha Engineering & Infrastructures Limited** (hereinafter called the bidder) for the purpose of the Bid for the work of **"Construction of Tunnels, Bridges and Formation works from Chainage 91+228 to 101+339 under Package-7B in Connection with New BG Line between Rishikesh and Karanprayag (125km) in State of Uttarakhand, India"** as per the bid No. RVNL/RKSH-KNPG/TENDER/TUNNELS/PK7B Date: 30.09.2019 of RVNL, do hereby solemnly affirm and state on behalf of the bidder including its constituents as under:

1. That the bidder or any of its constituents has not been Blacklisted/ banned for business dealings for all Government Departments or by Ministry of Railways or by RVNL at any time and/or no such blacklisting is in force as on the deadline for submission of bids.

2. That none of the previous contracts of the bidder or any of its constituents had been terminated/rescinded for Contractor's failure or part terminated for its failure as a

M. SADA SIVA KUMAR (RES.) NOTARY Regn. No. SAPTHAGIRI ENCLAVE, KUKATPALLY, HYDERABAD

JV partner with forfeiture of its full Performance Security, by Rail Vikas Nigam Ltd. during the period of last 3 years before the deadline for submission of bids.

3. The bidder or any of its constituents has not been imposed liquidated damages of 5% or more of contract value by RVNL due to delay in the implementation of any previous contract (either in the capacity of a single entity or as constituent of any other JV) within the period of last 2 years before the deadline for submission of bid [2 years shall be reckoned from the date on which imposed L.D. has exceeded 5% of the contract price] and there are no such accrued delay damages which has not been fully recovered before the deadline for submission of bids on account of contractor's request for deferring recovery to maintain cash flow and RVNL has acceded to the same in the interest of the project and the work under the previous contract in question has been completed before the deadline for submission of bid, unless imposition of such delay damages has been set aside by the Competent Authority.

4. That the Bidder or any of its constituents:

   (i) Has not suffered bankruptcy/insolvency or

   (ii) has no ongoing case of insolvency before the NCLT/any Court where Interim Resolution Professional (IRP) has been appointed or is at any later stage of the insolvency process on the deadline of submission of bids or thereafter till finalization of bids.

5. That the name of the Bidder or any of its constituents is not on the list of "Poor Performer" of RVNL as on the deadline for submission of bid.

6. We declare that the bidder or any of its constituents have not either changed their name or created a new business entity as covered by the definition of "Allied Firm" under para 1102 (iii) of chapter XI of Vigilance manual of Indian Railways with latest amendments and corrections (available on website of Indian Railways), consequent to having been banned business dealings for specified period which is not over or suspended business dealings or having been declared as poor performer.

7. We declare and certify that balance sheets for last three financial years including that for the latest concluded financial year are being submitted.

8. We certify that services offered by us meet the minimum local content requirement (in terms of revised Public Procurement (Preference to Make in India) Order 2017) as specified in the bidding document. We understand that in case of any false certification in this regard shall be a breach of the Code of Integrity under Rule 175(1) (i) (h) of the General Financial Rules (GFR) for which we or our successors

M. SADA SIVA KUMAR, NOTARY, Regn No 195

can be debarred for up to two years as rule 151 (iii) of GFR along with such other actions as may be permissible under law.

9. We declare and certify that we have not made any misleading or false representation in the forms, statements and attachments in proof of the qualification requirements.

10. We declare that the information and documents submitted along with the tender by us are correct and we are fully responsible for the correctness of the information and documents, submitted by us.

11. We understand that in case we cease to fulfill the requirements of qualifying and eligibility criteria at any time after opening of bids and till finalization of bids, it will be our bounden duty to inform the Employer of our changed status immediately and in case of our failure to do so, our bid shall be rejected and bid security shall be forfeited. In case such failure comes to the notice of Employer at any time after award of the contract, it will lead to termination of the contract and forfeiture of Bid or Performance Security. We shall also be liable for Banning of Business dealings upto a period of five years.

12. We understand that if the contents of the affidavit are found to be false at any stage during bid evaluation, it will lead to rejection of our bid and forfeiture of the bid security. Further, we **M/s Megha Engineering & Infrastructures Limited** and all our constituents understand that we shall be liable for banning of business dealings upto a period of five years.

13. We also understand that if the contents of the affidavit are found to be false at any time after the award of the contract it will lead to termination of the contract, forfeiture of Bid or Performance Security and Banning of Business dealings of the Bidder and all its constituents for a period of upto five years.

SEAL AND SIGNATURE OF THE BIDDER

Verification:

Verified on 15th day of February, 2020 at Hyderabad that the contents of the above mentioned affidavit are true and correct and nothing material has been concealed there from.

SEAL AND SIGNATURE OF THE BIDDER

M. SADA SIVA KUMARA SWATHI ENVOY, B.Com, B.L. NOTARY Regn No. 198 KUKATPALLY

ATTESTED 15.2.2020

M. SADA SIVA KUMARA SWATHI ENVOY, B.Com, B.L.
ADVOCATE & NOTARY
Appointed by Govt. of A.P., India
G.O.Ms No 198, Rev (Regn-II), dt. 11.04.2000
102, Saraswathi Enclave, Bhagyanagar Colony,
Kukatpally, Hyderabad. (Ph. 98480 44348)

LETTER OF PRICE BID

(LPB)

Megha Engineering & Infrastructures Ltd.

An ISO 9001-2015 Company

S-2, Technocrat nut, Esloto, Balanagar, Hyderabad-500037, Telangana, INDIA
Tel -91-40-44336700 Fax +91-40-44336800
E-mail: info@meil.in Visit us: www.meil.in U45202TG2006PLC050271

3

Form: PS 2

Letter of Price Bid

Date: 17.02.2020

Invitation for Bid No.: RVNL/RKSH-KNPG/TENDER/TUNNELS/PK7B Date: 30.09.2019

To:

The Chief Project Manager,
Rail Vikas Nigam Limited,
Block No. 4, Rishilok, GMVN,
Muni Ki Reti, Rishikesh 249137, Uttarakhand

We, the undersigned, declare that:

(a) We have examined and have no reservations to the Bidding Documents, including Addenda issued in accordance with Instructions to Bidders (ITB) 8;

(b) We offer to execute the Works in conformity with the Bidding Documents;

(c) The total price of our Bid, is as indicated in the summary of the Bill of Quantities.

(d) We understand that this bid, together with your written acceptance thereof included in your notification of award, shall constitute a binding contract between us, until a formal contract is prepared and executed; and

(e) We have not made any deviations from the requirement of the bidding document and we have also not made any tampering or changes in the bidding documents on which the bid is being submitted and if any tampering or changes are detected at any stage, we understand the bid will invite summary rejection and forfeiture of bid security/the contract will be liable to be terminated along with forfeiture of performance security, even if LOA has been issued.

(f) We understand that you are not bound to accept the lowest evaluated bid or any other bid that you may receive.

Name: J. Srinivas Kumar
In the capacity of: Asst. Manager

Signed:

Duly authorized to sign the Bid for and on behalf of M/s Megha Engineering & Infrastructures Limited.

Date: 17.02.2020

POWER OF ATTORNEY (POA)

meil

Megha Engineering & Infrastructures Ltd.

An ISO 9001-2008 Company

S-2, Technocrat Indl. Estate, Balanagar, Hyderabad-500037, TS, INDIA
Tel: +91-40-44336700 Fax: +91-40-44336800
E-mail: info@meil.in Visit us: www.meil.in U45202TG2006PLC050271

Lr. No: MEIL/RVNL/RKSH-KNPG/PKG-7B/2020-21/08 Dt. 10-08-2020

To
The Executive Director (RKSH-KNPG),
Regd. Office: 1st Floor,
August KrantiBhawan,
BhikajiCama Place,
R.K Puram,
New Delhi-110066
Tel.: +91-11-26738299
Fax: +91-11-26182957,
Email: Info@rvnl.org,

Kind Attn: Sh. Bhanu Prakash (Executive Director/P/RKSH-KNPG

Dear Sir,

Sub: "CONSTRUCTION OF TUNNELS, BRIDGES AND FORMATION WORKS FROM CHAINAGE 91+228 TO 101+339 (FLS) UNDER **PACKAGE-7B IN CONNECTION WITH NEW BG LINE BETWEEN RISHIKESH AND KARANPRAYAG** (125KM) IN STATE OF UTTARAKHAND, INDIA." – **Submission of Power of Attorney** – Reg.

Ref: 1) LOA No. 2020_RVNL_CORP_PROJ_TUNNEL/CONST/TENDER/RKSH-KNPG/PK-7B/PT.3 Dated: 09.07.2020

With reference to the above cited subject project, we are herewith submitting the copy of "POWER OF ATTORNEY" for your reference and future correspondence.

Thanking you and assuring the best of our services all times.

Yours faithfully,
For M/s. Megha Engineering & Infrastructures Ltd.,

N.Akhilesh Reddy
Authorised Signatory

Encl: As above

Copy to: 1) The Chief Project Manager/RKSH for Kind information.

रेल विकास निगम लिमिटेड
Rail Vikas Nigam Limited
गुणवत्ता, गति एवं पारदर्शिता
(A Government of India Enterprise)

मुख्य परियोजना प्रबंधक कार्यालय
(ऋषिकेश-कर्णप्रयाग नई रेल लाईन परियोजना)
Office of Chief Project Manager
(Rishikesh-Karanprayag New BG Rail Line Project)
RVNL Office Building, Opp. GST Bhavan, Next to GMVN, Shyampur Bypass, Road, Rishikesh- 249201
Email: rvnlrksh1@gmail.com, Tel: +91-135-2442008

RVNL/RKSH/CIV/1/2020/CIVIL/RKSH/793 **Dated: 13.08.2020**

M/s Megha Engineering & Infrastructures Limited
S-2, Technocrat Industrial Estate, Balanagar,
Hydrabad-500037, Telangana, India
Tel: 91 40 44336700
Fax: 91 40 44336800
Email: jsrinivaskumar@meilgroup.in

(Kind Attn: Mr. J. Srinivas Kumar, Authorized Signatory)

Sub: **"CONSTRUCTION OF TUNNELS, BRIDGES AND FORMATION WORKS FROM CHAINAGE 91+228 TO 101+339 (FLS) UNDER PACKAGE–7B IN CONNECTION WITH NEW BG LINE BETWEEN RISHIKESH AND KARANPRAYAG (125KM) IN STATE OF UTTARAKHAND, INDIA."**

Reg: **Regarding observation in the submitted Specific Power of Attorney.**

Ref: **(i) LOA No.** 2020_RVNL_CORP_PROJ_TUNNEL/CONST/TENDER/RKSH-KNPG/PK-7B/PT.3, Dated: 09.07.2020
(ii) MEIL/RVNL/RKSH-KNPG/PKG-7B/2020-21/08, Dated: 10.08.2020.

Sir,

1.0 Above vide ref. (ii), You have submitted Specific Power of Attorney in favour of Sh. N. Akhilesh Reddy. There are following observation, which are as follows:

i. At the time of Tendering, Power of Attorney had been given to Sh. J. Srinivas Kumar. However, in the revised Power of Attorney, Dissolution of Power given to Mr. J. Srinivas Kumar has not been mentioned. Therefore, dissolution of Power given to Mr. J. Srinivas Kumar may be clearly mentioned in the Specific Power of Attorney.

ii. Letter of Power of Attorney (vide ref. ii) has been signed by Sh. M. Akhilesh Reddy. However, letter should be signed by Mr. J. Srinivas Kumar duly citing the cancellation of power of attorney earlier given to him and informing about the new authorized signatory i.e. Sh. N. Akhilesh Reddy.

iii. Power of Attorney in favour of Sh. N. Akhilesh Reddy has been issued by Sh. P.V. Krishna Reddy (Managing Director) on behalf of Megha Engineering and Infrastructure Limited. However, it is not clear that Sh. P.V. Krishna Reddy has been given authorization to issue power of Attorney in favour or Sh. N. Akhilesh Reddy. Therefore, Board Resolution may be submitted.

2.0 It is requested to kindly submit the compliance of above mentioned observation at earliest.

Thanking You,

Your sincerely,

Surendra Kumar
Digitally signed by Surendra Kumar
Date: 2020.08.13 14:15:01 +05'30'

Addl. General Manager/P-2
RVNL, Rishikesh Uttarakhand
सुरेन्द्र कुमार/SURENDRA KUMAR
अपर महाप्रबंधक परियोजना / AGM Project-2
रेल विकास निगम लि. / Rail Vikas Nigam Ltd.
(भारत सरकार का उद्यम)/ A Govt. of India Enterprises
रेल मंत्रालय/ Ministry of Railways
ऋषिकेश (उत्तराखण्ड) 249201/ Rishikesh (U.K.) 249201

Corporate Office: 1st Floor, Ashoka Bhawan, Ashoka Marg, Rama Place, R.K.Puram, New Delhi-110066
Tel.: +91-11-26738299 Fax: +91-11-26182957, Web: www.rvnl.org

meil

Megha Engineering & Infrastructures Ltd.

An ISO 9001-2015 Company

S-2, Technocrat Indl. Estate, Balanagar, Hyderabad-500037, Telangana, INDIA
Tel +91-40-44336700 Fax: +91-40-44336800
E-mail: info@meil.in Visit us: www.meil.in U45202TG2006PLC050271

Lr. No: MEIL/RVNL/RKSH-KNPG/PKG-7B/2020-21/08A Dt. 14-08-2020

To
The Additional General Manager/P-2
Rail Vikas Nigam Limited, Rishikesh PIU,
RVNL Office Building, Opp. GST Bhavan,
Next to GMVN, Shyampur Bypass, Road,
Rishikesh- 249201.
Email ID: arya06suren@gmail.com

Kind Attn: Sh. Surendra Kumar, Additional General Manager/Projects-2

Dear Sir,

Sub: "CONSTRUCTION OF TUNNELS, BRIDGES AND FORMATION WORKS FROM CHAINAGE 91+228 TO 101+339 (FLS) UNDER **PACKAGE-7B IN CONNECTION WITH NEW BG LINE BETWEEN RISHIKESH AND KARANPRAYAG** (125KM) IN STATE OF UTTARAKHAND, INDIA." – **Submission of Replies/compliance to the Observations in the submitted Specific Power of Attorney** - Reg.

Ref: 1) LOA No. 2020_RVNL_CORP_PROJ_TUNNEL/CONST/TENDER/RKSH-KNPG/PK-7B/PT.3 Dated: 09.07.2020
2) Our Letter No. MEIL/RVNL/RKSH-KNPG/PKG-7B/2020-21/08, Dt:10.08.2020
3) Your Letter No. RVNL/RKSH/CIV/1/2020/CIVIL/RKSH/793 Dt: 13.08.2020

With reference to the above cited subject project and your letter under reference 3rd cited, we hereby submitting the following for your kind consideration.

1. The Power of Attorney of Mr. J. Srinivas Kumar submitted along with tender is a General Power of Attorney with powers of signing & submission of tenders for various departments across the country and until signing of contract agreement if successful.

2. As per our company procedures in general, after awarding of a project a specific power of attorney will be issued in favour of the person who is related to the execution of that particular project. Therefore a Specific Power of Attorney is issued in favour of Mr. N. Akhilesh Reddy for signing of Contract Agreement & for future correspondences related to the subject work of **RKSH-KNPG Package-7B.** Further Mr. J. Srinivas Kumar will not be communicating in future for this subject project and any future correspondences will be signed by Mr. N. Akhilesh Reddy only. Therefore the dissolution of Power of Attorney of Mr. J. Srinivas Kumar is not mentioned in the SPOA of Mr. N. Akhilesh Reddy as it is not possible.

Megha Engineering & Infrastructures Ltd. S-2, T E Balanagar, Hyderabad-37

3. A separate letter signed by Mr. J. Srinivas Kumar duly informing about the new authorized signatory i.e. Mr. N. Akhilesh Reddy is enclosed for your kind information.

4. The Power of Attoney in favour of Mr. N. Akhilesh Reddy has been issued by Sh. P.V. Krishna Reddy (Managing Director) and the Board vide its resolution dated 03.09.2011 has authorized Sh. P. V. Krishna Reddy (Managing Director) to issue such Specific Power of Attorneys. The copy of Board Resolution is enclosed for your ready reference.

We hope the above replies/compliances are in line with the requirement and we are ready to provide any future clarifications in this regard.

Thanking you and assuring the best of our services all times.

Yours faithfully,
For M/s. Megha Engineering & Infrastructures Ltd.,

J. Srinivas Kumar
Authorised Signatory

Encl: As above

Copy to: 1) The Chief Project Manager/RKSH for Kind information.

meil

Megha Engineering & Infrastructures Ltd.

An ISO 9001-2015 Company

S-2, Technocrat Indl Estate, Balanagar, Hyderabad-500037, Telangana, INDIA
Tel. +91-40-44336700 Fax: +91-40-44336800
E-mail: info@meil.in Visit us: www.meil.in U45202TG2008PLC059271

Lr. No: MEIL/RVNL/RKSH-KNPG/PKG-7B/2020-21/089 Dt. 14-08-2020

To
The Executive Director (RKSH-KNPG),
1st Floor, August Kranti Bhawan,
Bhikaji Cama Place,
R.K Puram,
New Delhi-110066
Tel.: +91-11-26738299
Fax: +91-11-26182957,
Email: bhanu.dvce@gmail.com

Kind Attn: Sh. Bhanu Prakash (Executive Director/P/RKSH-KNPG

Dear Sir,

Sub: "CONSTRUCTION OF TUNNELS, BRIDGES AND FORMATION WORKS FROM CHAINAGE 91+228 TO 101+339 (FLS) UNDER **PACKAGE-7B IN CONNECTION WITH NEW BG LINE BETWEEN RISHIKESH AND KARANPRAYAG** (125KM) IN STATE OF UTTARAKHAND, INDIA." - **Submission of Power of Attorney** – Reg.

Ref: 1) LOA No. 2020_RVNL_CORP_PROJ_TUNNEL/CONST/TENDER/RKSH-KNPG/PK-7B/PT.3 Dated: 09.07.2020

With reference to the above cited subject project, we are herewith submitting the copy of "Specific Power of Attorney along with Board Resolution of Sh. P. V. Krishna Reddy (Managing Director)" issued in favour of Sh. N. Akhilesh Reddy for the subject work for signing of Contract Agreement & to make future correspondence related to the subject project.

This is for your kind information.

Thanking you and assuring the best of our services all times.

Yours faithfully,
For M/s. Megha Engineering & Infrastructures Ltd.,

J. Srinivas Kumar
Authorised Signatory

Encl: As above

Copy to: 1) The Chief Project Manager/RKSH for Kind information.
2) The Addl. General Manager/P-2, RVNL, Rishikesh for kind information.

भारतीय गैर न्यायिक

एक सौ रुपये

Rs. 100

रु. 100

ONE HUNDRED RUPEES

सत्यमेव जयते

भारत INDIA

INDIA NON JUDICIAL

18 JUL 2020

తెలంగాణ तेलंगाना TELANGANA

Y 740688

Sl. No. 3206 Date. 18-07-2020, Rs. 100/-

Name: G. BABU
S/o. G. NARSIMHA, R/o. Secbad
For Whom: Megha Engineering & Infrastructures Ltd, Hyd.

A. RAGHUNATH
LICENSED STAMP VENDOR
License No.16-09-001/2014
Renewal No.16-09-005/2020
Shop No.5, Bhagyarekha Apt.
Hanumanji Co-Op. Housing Society,
Tadbund, Secunderabad.

SPECIFIC POWER OF ATTORNEY

Know all men by these presents that we, **M/s. Megha Engineering & Infrastructures Limited**, a company incorporated under the provisions of the Companies Act, 1956, having its registered office at # S-2, Technocrats Industrial Estate, Balanagar, Hyderabad – 500037, Telangana, India, hereby executes this Power of Attorney.

Our Company is awarded with contract by Rail Vikas Nigam Limited ('RVNL') for construction of project namely "Construction of Tunnels, Bridges and Formation Works from Chainage 91+228 to 101-339 (FLS) under Package-7B in connection with new BG Line between Rishikesh and Karanprayag (125 KM) in State of Uttarakhand, India" vide Letter of Acceptance No. 2020-RVNL-CORP-PROJ-TUNNEL/CONST/TENDER/RKSH-KNPG/PK-7B/Pt-3, Dt. 9-7-2020. In terms of said LoA our company is required to enter into Contract Agreement and execute the works. Therefore we do hereby authorize, appoint and nominate below named person

Contd...(2)

:: 2 ::

Mr. N. AKHILESH REDDY,
S/o. Sri N. Amarnath Reddy, Age: 35 Years,
(Designation: Associate Vice President)
R/o. 265/P, Road No.10, Jubilee Hills,
Hyderabad – 500033 (Aadhar No.4045 0334 1515)

as our authorised representative and authorised signatory to exercise the following powers and/ or authority and to do and/or execute the acts deeds, matters and things:

1. To represent on our behalf, to attend all meetings, enter into correspondence with RVNL and other authorities concerned.

2. To conclude, sign/execute Contract Agreement, Supplementary Agreements, Addendums, amendments, undertakings, assurances etc. with RVNL; to submit bank guarantees and fulfil all other formalities in relation to contract agreement.

3. To purchase required stamp papers/ pay stamp duty in the name of our company, to engraft the agreement on the stamp papers, if require, to attend registration office for the purpose of registration of contract agreement.

4. To prepare and submit plans, reports, designs and drawings for approval of RVNL;

5. To apply for and obtain all approvals, consents, licenses, no objections, clearances etc. from all government authorities in the stretch of railway line required for shifting utilities, RoW and to take up excavation/quarrying operations; to procure metal, gravel and other material; to get approvals/ consents for dumping of material, blasting, tree cutting, road cutting, laying approach roads, environmental clearances etc. as required under applicable laws and by RVNL.

6. To accept and sign on the measurement books, field records and such other records in token of acceptance of measurements as required during the execution of Project.

7. To sign and submit the periodically Running Account Bills, final Bill and such other related documents; to receive cheques / D.Ds / Pay orders; to receive all the payments and advances in the name of the company.

Contd...(3)

8. To perform / fulfil all the contractual obligations; to deal with all authorities of RVNL and all connected government authorities in all stages of project execution; procure insurance policies, set up, taking lease of required land for establishing facilities/ stores/ stock yards etc.; and to deal with all concerned government authorities in respect of all matters under or arising out of or relating to execution and completion of Project.

9. To ask for, demand, recover, receive and collect all amounts due and payable to our company in respect of Project from any person or persons including any Government or semi Government concerns and such other authority as may be constituted by the government in relation to Project.

10. To authorize any person(s) working for the project and to sub-delegate all or any of above powers bestowed on him as he may thinks fit and proper, for operational convenience and for smooth execution of the Project.

All the acts and deeds lawfully done by the attorney shall be deemed as the acts and deeds done by the Company and we do hereby undertake to ratify and confirm all lawful acts, deeds and things done by aforesaid attorney by virtue of this Specific Power of Attorney.

This Power of Attorney is valid and in force till completion of project in all respects and our company is fully discharged by RVNL from all contractual obligations.

This Power of Attorney is executed by the undersigned on behalf of Company on this 29th day of July, 2020 at Hyderabad.

for and on behalf of
M/s. Megha Engineering & Infrastructures Ltd.

(P. V. Krishna Reddy)
Managing Director

WITNESSES:

1. (D. CHAITANYA)

2. (K. Rata Ravindra Babu)

Signature of the Attorney in token of his acceptance.
Name: N. Akhilesh Reddy,
Designation: Associate Vice President.

ATTESTED

M. SADA SIVA KUMAR REDDY, B.Com., B.L.,
ADVOCATE & NOTARY
Appointed by Govt., India
G.O. Ms. No. 168, Rev (Regl-III), dt. 11.04.2000
[illegible] Enclave, Bhagyanagar Colony,
Kukatpally, Hyderabad, T.G., India. (Ph. [illegible])

meil

Megha Engineering & Infrastructures Ltd.

An ISO 9001-2000 Company

S-2, Technocrat Indl. Estate, Balanagar, Hyderabad-500037, A.P., INDIA
Tel: +91-40-44336700 Fax: +91-40-44336800
E-mail: info@meil.in Visit us: www.meil.in

EXTRACT OF THE MINUTES OF THE MEETING OF THE BOARD OF DIRECTORS OF M/S. MEGHA ENGINEERING & INFRASTRUCTURES LIMITED HELD ON 03.09.2011 AT 11.30 A.M AT S-2, T.I.E., BALANAGAR, HYDERABAD – 500 037.

At the request of Smt. P. Rama, Director, for convenience and day to day operations of the Company the board need to delegate some powers to Chairman & Managing Director. The Board considered the same and decided to delegate powers and passed the following resolutions:

Delegation of Powers to Chairman & Managing Director:

"**RESOLVED THAT** in supersession of all earlier resolutions the Board be and hereby authorized Sri P. P. Reddy, Chairman and Sri P.V. Krishna Reddy, Managing Director severally to sign the following documents on behalf of the company :

i. Raising of loans from Banks and Financial Institutions.
ii. Opening / Operating / Closing of Bank Accounts.
iii. Renewal and enhancement of working capital limits.
iv. To sign and execute all agreements, undertakings, applications, returns, papers, receipts, all documents and receive notices and respond thereon to Department of Industry, Office of the Director General of Foreign Trade, Customs and Central Excise authorities, Foreign Investment Promotion Board, Reserve Bank of India, Sales Tax authorities, Shops and Establishment authorities, Municipal authorities, Bharat Sanchar Nigam Limited (BSNL) and all other Government and semi Government Department(s) on behalf of the Company and to do all or any of the acts, deeds, matters, alterations and things as may be considered expedient and necessary on behalf of the Company.
v. Entering in to contracts with Government, Semi Government, Public Sector and Private Sector Organisations.
vi. Entering into Joint Venture Agreements and Memorandum of Understandings.
vii. Issuing of General / Special Power of Attorneys for Specific Projects and such other matters.
viii. To authorize any employee of the organization to sign for any specific purposes.

"**RESOLVED FURTHER THAT** Sri P. P. Reddy, Chairman and Sri P.V. Krishna Reddy, Managing Director shall have powers severally to authorise any employee of the Company to sign any documents related to the matters stated as above".

//Certified true Copy//

M.S.K. CHAKRAVARTHY
ACS No. 22955
Company Secretary
Megha Engineering & Infrastructures Limited
S-2, TIE, Balanagar, Hyderabad-500 037

Form ELI – 1: Bidder's Information Sheet

Bidder's Information	
Bidder's Legal name	M/s Megha Engineering & Infrastructures Limited
Bidder's Country of Constitution	India
Bidder's year of Constitution	2006
Bidder's legal address in Country of Constitution	S-2, Technocrat Industrial Estate, Balanagar, Hyderabad - 500 037, Telangana, India
Bidder's authorized representative	Name: J. Srinivas Kumar Address: S 2, TIE, Balanagar, Hyderabad 500 037, Telangana, India Telephone: 91 40 44336700 Fax: 91 40 44336800 Email: jsrinivaskumar@meilgroup.in

The bidder shall attach copies of the following original documents with the form:

1. In case of single entity, articles of incorporation or constitution of the legal entity named above, in accordance with ITB 4.1 and 4.2.
2. Authorization to represent the firm or JV named in above, in accordance with ITB 20.2.
3. In case of JV, MOU to form JV or JV agreement, in accordance with ITB 4.1.

MEGHA ENGINEERING & INFRASTRUCTURES LTD. S-2, T.I.E., Balanagar, Hyderabad-37

Signature of Bidder

CERTIFIED TRUE COPY
For Megha Engineering & Infrastructures Limited

N. CHANDRA KALA
Company Secretary
ACS No: 32377

सत्यमेव जयते

Form 1
Certificate of Incorporation

Corporate Identity Number : U45202AP2006PLC050271 2006 - 2007

I hereby certify that MEGHA ENGINEERING & INFRASTRUCTURES LIMITED is this day incorporated under the Companies Act, 1956 (No. 1 of 1956) and that the company is limited.

Given under my hand at Hyderabad this SEVENTH day of JUNE TWO THOUSAND SIX.

Registrar of Companies
Andhra Pradesh

CERTIFIED TRUE COPY

For Megha Engineering & Infrastructures Limited

N. CHANDRA KALA
Company Secretary
ACS No: 32317

Certificate for Commencement of Business

Pursuant of Section 149(3) of the Companies Act, 1956

Corporate Identity Number : U45202AP2006PLC050281

I hereby certify that the MEGHA ENGINEERING & INFRASTRUCTURES LIMITED which was incorporated under the Companies Act, 1956(No. 1 of 1956) on the SEVENTH day of JUNE TWO THOUSAND SIX, and which has this day filed a duly verified declaration in the prescribed form that the conditions of the Section 149(2)(a) to (c) of the said act, have been complied with and is entitled to commence business.

Given under my hand at Hyderabad this TWENTY THIRD day of JUNE TWO THOUSAND SIX.

Registrar of Companies
Andhra Pradesh

ADDENDUM

&

CORRIGENDUM

ADDENDUM & CORRIGENDUM No. 6

RVNL/RKSH-KNPG/TENDER/TUNNELS/PK-7B **Dated:21.01.2020**

Bid Notification No.	**RVNL/RKSH-KNPG/TENDER/TUNNELS/PK-7B Dated:30.09.2019**
Name of the Work	**"CONSTRUCTION OF TUNNELS, BRIDGES AND FORMATION WORKS FROM CHAINAGE 91+228 to 101+339 (FLS) UNDER PACKAGE–7B IN CONNECTION WITH NEW BG LINE BETWEEN RISHIKESH AND KARANPRAYAG (125KM) IN STATE OF UTTARAKHAND, INDIA."**

The following changes are to be incorporated at the appropriate place in the Bid Document, A&C-01 & A&C-03.

SN.	Clause	Page No.	Existing	To be read as
1.	Clause 12 of IFB of Bid Document	As per A&C-03	Date of Receipt and opening of Bids: The completed Bids must be submitted through e-tendering portal https://rvnl.euniwizarde.com/ before 11.00 hrs. on 31/01/2020 and the same shall be opened at 11.30 hrs on same day.	Date of Receipt and opening of Bids: The completed Bids must be submitted through e-tendering portal https://rvnl.euniwizarde.com/ before 11.00 hrs. on 18/02/2020 and the same shall be opened at 11.30 hrs.on same day.
2.	ITB-19.2 (Bid Data Sheet)(Section-2) of the bid document	As per A&C-03	The bid security shall be valid up to 11/07/2020.The original Bank Guarantee should be submitted to Chief Project Manager, Rail Vikas Nigam Limited, Floor/Room No.: Block No. 4, Street Address: Rishilok, GMVN City: Muni Ki Reti, Rishikesh,Pin Code: 249137 Country: Indian Republic Tel. No.: Tel 0135-2442008, Fax: 2442008 Mail :himansu.badoni@rvnl.org	The bid security shall be valid up to 29/07/2020.The original Bank Guarantee should be submitted to Chief Project Manager, Rail Vikas Nigam Limited, Floor/Room No.: Block No. 4, Street Address: Rishilok, GMVN City:Muni Ki Reti, Rishikesh. Pin Code: 249137 Country: Indian Republic Tel. No.: Tel 0135-2442008 Fax: 2442008 Mail :himansu.badoni@rvnl.org
3.	Clause 22.1 ITB (Bid Data Sheet)(Section-2) of the Bid	As per A&C-03	For bid submission purposes address is: https://www.rvnl.euniwizarde.com The deadline for bid submission is: Date: 31/01/2020. Time: 11:00 hrs.	For bid submission purposes address is: https://www.rvnl.euniwizarde.com The deadline for bid submission is: Date: 18/02/2020. Time: 11:00 hrs.

<table>
<tr><th>SN.</th><th>Clause</th><th>Page No.</th><th>Existing</th><th>To be read as</th></tr>
<tr><td></td><td>Document</td><td></td><td></td><td></td></tr>
<tr><td>4.</td><td>Clause 25.1 ITB (Bid Data Sheet)(Section-2) of the Bid Document</td><td>As per A&C-03</td><td>The online bid opening shall take place at e-tendering portal
of RVNL https://www.rvnl.euniwizarde.com:
Bid Opening:
Date: 31/01/2020
Time: 11:30 hrs.</td><td>The online bid opening shall take place at e-tendering portalof RVNL https://www.rvnl.euniwizarde.com:
Bid Opening:
Date: 18/02/2020
Time: 11:30 hrs.</td></tr>
<tr><td>5.</td><td>Clause 2.2.3of EQCSection -3</td><td>Page 26 of 85 of A&C-01</td><td>
2.2.3: Net worth
<table>
<tr><th>Requirement</th><th>Single Entity</th><th>All Partners Combined</th><th>Each Partner</th><th>Lead Partner</th><th>Documents Submission Requirements</th></tr>
<tr><td>Minimum average Net-Worth (Total Assets – Total Liabilities) should not be less than INR 306.24 Crores during the last three financial years (refer note below the table).</td><td>Must meet requirement</td><td>Must meet requirement</td><td>Must meet At least 25% of the requirement</td><td>Must meet At least 70% of the requirement</td><td>Form FIN – 1</td></tr>
</table>
</td><td>
2.2.3: Net worth
<table>
<tr><th>Requirement</th><th>Single Entity</th><th>All Partners Combined</th><th>Each Partner</th><th>Lead Partner</th><th>Documents Submission Requirements</th></tr>
<tr><td>Minimum average Net-Worth (Total Assets – Total Liabilities) should not be less than INR 306.24 Crores during the last three financial years (refer note below the table).</td><td>Must meet requirement</td><td>Must meet requirement</td><td>Must meet At least 25% of the requirement</td><td>Must meet At least 50% of the requirement</td><td>Form FIN – 1</td></tr>
</table>
</td></tr>
</table>

SN.	Clause	Page No.	Existing	To be read as
6.	Clause18.4 of Section-6 GCC	463 of 541 of Bid Document	The Contractor shall effect and maintain insurance against liability for claims, damages, losses and expenses (including legal fees and expenses) arising from injury, sickness, disease or death of any person employed by the Contractor or any other of the Contractor's Personnel. The Employer and the Engineer shall also be indemnified under the policy of insurance, except that this insurance may exclude losses and claims to the extent that they arise from any act or neglect of the Employer or of the Employer's Personnel. The insurance shall be maintained in full force and effect during the whole time that these personnel are assisting in the execution of the Works. For a Subcontractor's employees, the insurance may be effected by the Subcontractor, but the Contractor shall be responsible for compliance with this Clause.	The Contractor shall abide by the provisions of ESIC Act, 1948 (extended from time to time) to take care of insurance against liability for claims, damages, losses and expenses (including legal fees and expenses) arising from injury, sickness or disease. In addition the contractor shall also maintain insurance against liability for claim of death of any person employed by the Contractor or any other of the Contractor's Personnel. The Employer and the Engineer shall also be indemnified under the policy of insurance, except that this insurance may exclude losses and claims to the extent that they arise from any act or neglect of the Employer or of the Employer's Personnel. The insurance shall be maintained in full force and effect during the whole time that these personnel are assisting in the execution of the Works. For a Subcontractor's employees, the insurance may be effected by the Subcontractor, but the Contractor shall be responsible for compliance with this Clause.

SN.	Clause	Page No.	Existing	To be read as
7.	Salient features of some major labour laws applicable to establishment engaged in Building and other Construction Work of Section-6 of GCC.	Page 469 of 541 of the Bid Document	Salient features of some major labour laws applicable to establishment engaged in Building and other Construction Work (The laws as current on the date of Bid opening will apply) a) **Workmen Compensation Act 1923:** The Act provides for compensation in case of injury by accident arising out of and during the course of employment. b) **Payment of Gratuity Act 1972:** Gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed 5 years service or more or on death the rate of 15 days wages for every completed year of service. The Act is applicable to all establishments employing 10 or more employees. c) **Employees P.F. and Miscellaneous Provision Act 1952 (since amended):** The Act Providesfor monthly contributions by the employer plus workers @ 10% or 8.33%. The benefits payable under the Act are : (i) Pension or family pension on retirement or death, as the case may be. (ii) Deposit linked insurance on the death in harness of the worker. (iii) payment of P.F. accumulation on	**Appendix-1** Salient features of some major labour laws applicable to establishment engaged in Building and other Construction Work (The laws as current on the date of Bid opening will apply) a) **Workmen Compensation Act 1923**: The Act provides for compensation in case of injury by accident arising out of and during the course of employment. b) **Payment of Gratuity Act 1972**: Gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed 5 years service or more or on death the rate of 15 days wages for every completed year of service. The Act is applicable to all establishments employing 10 or more employees. c) **Employees P.F. and Miscellaneous Provision Act 1952 (since amended):** The Act Provides for monthly contributions by the employer plus workers @ 10% or 8.33%. The benefits payable under the Act are: (i) Pension or family pension on retirement or death, as the case may be. (ii) Deposit linked insurance on the death in harness of the worker. (iii) payment of P.F. accumulation on retirement/death etc.

SN.	Clause	Page No.	Existing	To be read as
			retirement/death etc. d) **Maternity Benefit Act 1951:** The Act provides for leave and some other benefits to women employees in case of confinement or miscarriage etc. e) **Contract Labour (Regulation & Abolition) Act 1970:** The Act provides for certain welfare measures to be provided by the Contractor to contract labour and in case the Contractor fails to provide, the same are required to be provided, by the Principal Employer by Law. The Principal Employer is required to take Certificate of Registration and the Contractor is required to take license from the designated Officer. The Act is applicable to the establishments or Contractor of Principal Employer if they employ 20 or more contract labour. f) **Minimum Wages Act 1948:** The Employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment. Construction of Buildings, Roads, Runways are scheduled employments. g) **Payment of Wages Act 1936:** It lays down as to by what date the wages are to be paid, when it will be paid and what deductions can be made from the wages of the workers.	d) **Maternity Benefit Act 1951**: The Act provides for leave and some other benefits to women employees in case of confinement or miscarriage etc. e) **Contract Labour (Regulation & Abolition) Act 1970**: The Act provides for certain welfare measures to be provided by the Contractor to contract labour and in case the Contractor fails to provide, the same are required to be provided, by the Principal Employer by Law. The Principal Employer is required to take Certificate of Registration and the Contractor is required to take license from the designated Officer. The Act is applicable to the establishments or Contractor of Principal Employer if they employ 20 or more contract labour. f) **Minimum Wages Act 1948**: The Employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment. Construction of Buildings, Roads, Runways are scheduled employments. g) **Payment of Wages Act 1936**: It lays down as to by what date the wages are to be paid, when it will be paid and what deductions can be made from the wages of the workers. h) **Equal Remuneration Act 1979**: The Act provides for payment of equal wages for work of equal

SN.	Clause	Page No.	Existing	To be read as
			h) **Equal Remuneration Act 1979:** The Act provides for payment of equal wages for work of equal nature to Male and Female workers and for not making discrimination against Female employees in the matters of transfers, training and promotions etc. i) **Payment of Bonus Act 1965:** The Act is applicable to all establishments employing 20 or more employees. The Act provides for payments of annual bonus subject to a minimum of 8.33% of wages and maximum of 20% of wages to employees drawing Rs.3500/-per month or less. The bonus to be paid to employees getting Rs.2500/- per month or above upto Rs.3500/- per month shall be worked out by taking wages as Rs.2500/-per month only. The Act does not apply to certain establishments. The newly set-up establishments are exempted for five years in certain circumstances. Some of the State Governments have reduced the employment size from 20 to 10 for the purpose of applicability of this Act. j) **Industrial Disputes Act 1947:** The Act lays down the machinery and procedure for resolution of Industrial disputes, in what situations a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment.	nature to Male and Female workers and for not making discrimination against Female employees in the matters of transfers, training and promotions etc. i) **Payment of Bonus Act 1965**: The Act is applicable to all establishments employing 20 or more employees. The Act provides for payments of annual bonus subject to a minimum of 8.33% of wages and maximum of 20% of wages to employees drawing Rs.3500/-per month or less. The bonus to be paid to employees getting Rs.2500/- per month or above upto Rs.3500/- per month shall be worked out by taking wages as Rs.2500/-per month only. The Act does not apply to certain establishments. The newly set-up establishments are exempted for five years in certain circumstances. Some of the State Governments have reduced the employment size from 20 to 10 for the purpose of applicability of this Act. j) **Industrial Disputes Act 1947**: The Act lays down the machinery and procedure for resolution of Industrial disputes, in what situations a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment. k) **Industrial Employment (Standing Orders) Act 1946**: It is applicable to all establishments employing 100 or more workmen (employment size reduced by some of the States and Central Government to

SN.	Clause	Page No.	Existing	To be read as
			k) **Industrial Employment (Standing Orders) Act 1946:** It is applicable to all establishments employing 100 or more workmen (employment size reduced by some of the States and Central Government to 50). The Act provides for laying down rules governing the conditions of employment by the Employer on matters provided in the Act and get the same certified by the designated Authority. l) **Trade Unions Act 1926:** The Act lays down the procedure for registration of trade unions of workmen and employers. The Trade Unions registered under the Act have been given certain immunities from civil and criminal liabilities. m) **Child Labour (Prohibition & Regulation) Act 1986:**The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of Child Labour is prohibited in Building and Construction Industry. n) **Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979:** The Act is applicable to an establishment which employs 5 or more inter-state migrant workmen through	50). The Act provides for laying down rules governing the conditions of employment by the Employer on matters provided in the Act and get the same certified by the designated Authority. l) **Trade Unions Act 1926**: The Act lays down the procedure for registration of trade unions of workmen and employers. The Trade Unions registered under the Act have been given certain immunities from civil and criminal liabilities. m) **Child Labour (Prohibition & Regulation) Act 1986**:The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of Child Labour is prohibited in Building and Construction Industry. n) **Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979:** The Act is applicable to an establishment which employs 5 or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The Inter-State migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, travelling expenses from home upto the establishment and back, etc.

SN.	Clause	Page No.	Existing	To be read as
			an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The Inter-State migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, travelling expenses from home upto the establishment and back, etc. o) **The Building and Other Construction workers (Regulation of Employment and Conditions of Service) Act 1996 and the Cess Act of 1996:** All the establishments who carry on any building or other construction work and employs 10 or more workers are covered under this Act. All such establishments are required to pay cess at the rate not exceeding 2% of the cost of construction as may be modified by the Government. The Employer of the establishment is required to provide safety measures at the Building or construction work and other welfare measures, such as Canteens, First-Aid facilities, Ambulance, Housing accommodations for workers near the work place etc. The Employer to whom the Act applies has to obtain a registration certificate from the Registering Officer appointed by the Government. As per Central Government's Notification No.S.O.2899 dated 26.09.1996 under this act, the cess shall be levied @1% of cost of	o) **The Building and Other Construction workers (Regulation of Employment and Conditions of Service) Act 1996 and the Cess Act of 1996:** All the establishments who carry on any building or other construction work and employs 10 or more workers are covered under this Act. All such establishments are required to pay cess at the rate not exceeding 2% of the cost of construction as may be modified by the Government. The Employer of the establishment is required to provide safety measures at the Building or construction work and other welfare measures, such as Canteens, First-Aid facilities, Ambulance, Housing accommodations for workers near the work place etc. The Employer to whom the Act applies has to obtain a registration certificate from the Registering Officer appointed by the Government. As per Central Government's Notification No.S.O.2899 dated 26.09.1996 under this act, the cess shall be levied @1% of cost of construction works which shall be deducted from each bill of the payment due to the contractor. p) **Factories Act 1948**: The Act lays down the procedure for approval at plans before setting up a factory, health and safety provisions, welfare provisions, working hours, annual earned leave and rendering information regarding accidents or dangerous occurrences to designated authorities. It is applicable to premises employing 10 persons

SN.	Clause	Page No.	Existing	To be read as
			construction works which shall be deducted from each bill of the payment due to the contractor.	or more with aid of power or 20 or more persons without the aid of power engaged in manufacturing process.
			p) **Factories Act 1948:** The Act lays down the procedure for approval at plans before setting up a factory, health and safety provisions, welfare provisions, working hours, annual earned leave and rendering information regarding accidents or dangerous occurrences to designated authorities. It is applicable to premises employing 10 persons or more with aid of power or 20 or more persons without the aid of power engaged in manufacturing process.	q) **The Employees State Insurance Act, 1948 (Act No. 34 of 1948) (Provisions as extended from time to time):**An Act to provide for certain benefits to employees in case of sickness, maternity and 'employment injury' and to make provision for certain other matters in relation thereto.
8.	COF/3 Form of Contract Performance Security (Bank Guarantee) of section-8 of Contract Forms	Page 523 of 541 of the Bid Docu emnt	COF/3:- FORM OF CONTRACTPERFORMANCE SECURITY (BANK GUARANTEE) stands replaced with Annexure-A of A&C-06.	

21/01/2020

ED/RKSH

Page **9** of **12**

Annexure-A

COF/3

FORM OF CONTRACTPERFORMANCE SECURITY
(BANK GUARANTEE)

[*Refer Clause 41 of Instructions to Bidders]*

(*On non-judicial stamp paper of the appropriate value in accordance with stamp Act. The stamp paper to be in the name of Executing Bank).*

From:
Name and Address of the Bank…..
……..
To:
The Chairman and Managing Director,
Rail Vikas Nigam Limited,
1st Floor, August Kranti Bhawan,
Bhikaji Cama Place, R. K. Puram,
New Delhi-110 066.

WHEREAS**,** Rail Vikas Nigam Limited, hereinafter called the **Employer,** acting through ***[Insert Designation and address of the Employer's Representative]***, has accepted the bid of ***[Insert Name and address of the Contractor]***, hereinafter called the **Contractor,** for the work of ***[Insert Name of Work]***, vide Notification of Award No.***[Insert Notification of Award No.]***.

AND

WHEREAS, the contractor is required to furnish Performance Security for the sum of ***[Insert Value of Performance Security required]***, in the form of bank guarantee, being a condition precedent to the signing of the contract agreement.

WHEREAS, ***[Insert Name of the Bank]***, with its Branch ***[Address]*** having its Headquarters office at ***[Address]***, hereinafter called the **Bank,** acting through ***[Designation(s) of the authorised person of the Bank]***, have, at the request of the *[Insert name of the JV partner]* , a JV partner on behalf of the contractor, agreed to give guarantee for performance security and additional performance security as hereinafter contained:

1 KNOW ALL MEN by these present that I/We the undersigned ***[Insert name(s) of authorized representatives of the Bank],***being fully authorized to sign and incur obligations for and on behalf of the Bank**,** confirm that the Bank, hereby, unconditionally and irrevocably guarantee to pay the Employer the full amount in the sum of ***[Insert Value of Performance Security required]*** as above stated.

2 The Bank undertakes to immediately pay on presentation of demand by the Employer any amount up to and including aforementioned full amount without any demur, reservation or recourse. Any such demand made by the Employer on the Bank shall be final, conclusive and binding, absolute and unequivocal notwithstanding any

disputes raised/ pending before any Court, Tribunal, Arbitration or any Authority or any threatened litigation by the Employer of Bank..

3 On payment of any amount less than aforementioned full amount, as per demand of the Employer, the guarantee shall remain valid for the balance amount i.e. the aforementioned full amount less the payment made to the Employer.

4 The Bank shall pay the amount as demanded immediately on presentation of the demand by Employer without any reference to the contractor and without the Employer being required to show grounds or give reasons for its demand or the amount demanded.

5. The Bank Guarantee shall be unconditional and irrevocable.

6 The guarantee hereinbefore shall not be affected by any change in the constitution of the Bank or in the constitution of the Contractor.

7 The Bank agrees that no change, addition, modifications to the terms of the Contract Agreement or to any documents, which have been or may be made between the Employer and the Contractor, will in any way release us from the liability under this guarantee; and the Bank, hereby, waives any requirement for notice of any such change, addition or modification to the Bank.

8 This guarantee is valid and effective from the date of its issue, which is ***[insert date of issue]***. The guarantee and our obligations under it will expire on ***[Insert the date twenty eight days after the expected end of defect liability period]***. All demands for payment under the guarantee must be received by us on or before that date.

9 The Bank agrees that the Employers right to demand payment of aforementioned full amount in one instance or demand payments in parts totaling up to the aforementioned full amount in several instances will be valid until either the aforementioned full amount is paid to the Employer or the guarantee is released by Employer before the Expiry date.

10 The Bank agrees that its obligation to pay any amount demanded by the Employer before the expiry of this guarantee will continue until the amount demanded has been paid in full.

11 The expressions Bank and Employer herein before used shall include their respective successors and assigns.

12 The Bank hereby undertakes not to revoke the guarantee during its currency, except with the previous consent in writing of the employer. This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 758.

13 The Guarantee shall be in addition to and without prejudice to any other security Guarantee (s) of the contractor in favour of the Employer available with the Employer.

The Bank, under this Guarantee, shall be deemed as Principal Debtor of the Employer.

Date ……. ……
Place……. [*Signature of Authorised person of Bank]*

……..
[Name in Block letters]

……..
[Designation]

……
[P/Attorney] No.

……..
Bank's Seal

[P/Attorney] No.……

Witness:

1. *Signature*
   Name & Address & Seal

2. *Signature*
   Name & address & Seal

Note :

1 *All italicized text is for guidance on how to prepare this bank guarantee and shall be deleted from the final document.*

2 *In case the guarantee is issued by a foreign Bank, which does not have operations in India, the said bank shall have to provide a counter-guarantee by State Bank of India.*

3 *In case the Contractor is a JV, the Performance Security is required to be furnished on behalf of the JV in favour of the Employer by the JV Partners in proportion of their respective percentage share specified in the JV Agreement. The percentage share of M/s [**Insert Name of the JV Partner**] in the JV is [**Fill share % in the JV**] percent. All the Bank Guarantee of JV Partners are liable to be encashed cumulatively.*

ADDENDUM & CORRIGENDUM No. 05

173

RVNL/RKSH-KNPG/TENDER/TUNNELS/PK7B **Dated: 08.01.2020**

Bid Notification No.	**RVNL/RKSH-KNPG/TENDER/TUNNELS/PK7B Dated:30.09.2019**
Name of the Work	"CONSTRUCTION OF TUNNELS, BRIDGES AND FORMATION WORKS FROM CHAINAGE 91+228 to 101+339 (FLS) UNDER PACKAGE–7B IN CONNECTION WITH NEW BG LINE BETWEEN RISHIKESH AND KARANPRAYAG (125KM) IN STATE OF UTTARAKHAND, INDIA."

The following changes are to be incorporated at the appropriate place in the Bid Document & A&C-1&-03.

SN	Clause	Page No.	Existing	To be read as
1.	Clause 12 of IFB of Bid Document	As per A&C-03	Date of Receipt and opening of Bids: The completed Bids must be submitted through e-tendering portal https://rvnl.euniwizarde.com/ before 11.00 hrs. on 17/01/2019 and the same shall be opened at 11.30 hrs on same day.	Date of Receipt and opening of Bids: The completed Bids must be submitted through e-tendering portal https://rvnl.euniwizarde.com/ before 11.00 hrs. on 31/01/2020 and the same shall be opened at 11.30 hrs. on same day.
2.	ITB-19.2 (Bid Data Sheet)(Section-2) of the bid document	As per A&C-03	The bid security shall be valid up to 27/06/2020. The original Bank Guarantee should be submitted to Chief Project Manager, Rail Vikas Nigam Limited, Floor/Room No.:Block No. 4, Street Address: Rishilok, GMVN City:Muni Ki Reti, Rishikesh,Pin Code: 249137 Country: Indian Republic Tel. No.: Tel 0135-2442008, Fax: 2442008 Mail :himansu.badoni@rvnl.org	The bid security shall be valid up to 11/07/2020.The original Bank Guarantee should be submitted to Chief Project Manager, Rail Vikas Nigam Limited, Floor/Room No.:Block No. 4, Street Address: Rishilok, GMVN City:Muni Ki Reti, Rishikesh. Pin Code: 249137 Country: Indian Republic Tel. No.: Tel 0135-2442008 Fax: 2442008 Mail :himansu.badoni@rvnl.org

3.	Clause 22.1 ITB (Bid Data Sheet)(Section-2) of the Bid Document	As per A&C-03	For bid submission purposes address is: https://www.rvnl.euniwizarde.com The deadline for bid submission is: Date: 17/01/2020. Time: 11:00 hrs.	For bid submission purposes address is: https://www.rvnl.euniwizarde.com The deadline for bid submission is: Date: 31/01/2020. Time: 11:00 hrs.
4.	Clause 25.1 ITB (Bid Data Sheet)(Section-2) of the Bid Document	As per A&C-03	The online bid opening shall take place at e-tendering portal of RVNL https://www.rvnl.euniwizarde.com: Bid Opening: Date: 17/01/2020 Time: 11:30 hrs.	The online bid opening shall take place at e-tendering portal of RVNL https://www.rvnl.euniwizarde.com: Bid Opening: Date: 31/01/2020 Time: 11:30 hrs.
5.	Clause 13, Sub – Clause 13.8: Adjustment for changes in cost, of Annexure-17 to Section-7B	Page no 50/85 of A&C-01 and page no. 507/541 of bid document	Add a note below the Table in Annexure-17 to Section-7B pertaining to "Clause 13, Sub Clause 13.8 Adjustment for Changes in Cost" as under: **Note:** For Bill no. B1 & Bill no. B3 formulae-I & formulae-III will be applicable respectively for adjustment of steel component under item-(iii) of clause 13.8(C) GCC.	

08/01/2020

ED/P/RKSH-KNPG

ADDENDUM & CORRIGENDUM No. 4

RVNL/RKSH-KNPG/TENDER/TUNNELS/PK-7B **Dated: 27.12.2019**

Bid Notification No.	**RVNL/RKSH-KNPG/TENDER/TUNNELS/PK-7B Dated:30.09.2019**
Name of the Work	"CONSTRUCTION OF TUNNELS, BRIDGES AND FORMATION WORKS FROM CHAINAGE 91+228 to 101+339 (FLS) UNDER PACKAGE–7B IN CONNECTION WITH NEW BG LINE BETWEEN RISHIKESH AND KARANPRAYAG (125KM) IN STATE OF UTTARAKHAND, INDIA."

The following changes are to be incorporated at the appropriate place in the Bid Document.

<table>
<tr><th>S N</th><th>Clause</th><th>Page No.</th><th>Existing</th><th>To be read as</th></tr>
<tr><td>1.</td><td>Clause 4.1 (e) of Section - 1 Instruction To Bidders; S. No. 6 & 7 of the table as per A&C-3</td><td>Page no. 2/8; S. No. 5 of A&C-3.</td><td>
<table>
<tr><th colspan="4">LIST OF PACKAGES INVOLVING TUNNELS</th></tr>
<tr><th>S. No</th><th>Works Package</th><th>Major Works included</th><th>Estimated Cost</th></tr>
<tr><td>6</td><td>Tunnel Package -7A (83+899 to 101+339)</td><td>Tunnel No. 12 (7080m), Bridge No. 12 (Narkota),</td><td>Rs. 1354 Crores (with NATM method)</td></tr>
<tr><td>7</td><td>Tunnel Package-7B</td><td>Tunnel No. 13 (9420m), Tilani Station Part Yard</td><td>Rs. 1583 Crores</td></tr>
</table>
</td><td>
<table>
<tr><th colspan="4">LIST OF PACKAGES INVOLVING TUNNELS</th></tr>
<tr><th>S. No</th><th>Works Package</th><th>Major Works included</th><th>Estimated Cost</th></tr>
<tr><td>6</td><td>Tunnel Package -7A (83+899 to 101+339)</td><td>Tunnel No. 12 (7080m), Bridge No. 12 (Narkota),</td><td>Rs. 1040 Crores (with NATM method)</td></tr>
<tr><td>7</td><td>Tunnel Package-7B</td><td>Tunnel No. 13 (9420m), Tilani Station Part Yard</td><td>Rs. 1531 Crores</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>S N</th><th>Clause</th><th>Page No.</th><th>Existing</th><th>To be read as</th></tr>
<tr><td></td><td></td><td></td><td>(83+899 to 101+339) (700m) and Minor Bridge-1 No. (with NATM method)</td><td>(91+228 to 101+339) (700m) and Minor Bridge-1 No. (with NATM method)</td></tr>
<tr><td>2.</td><td>Clause 5.1 of chapter-5 Section-5 Works Requirement-</td><td>Page 150 of 541</td><td colspan="2">Existing clause 5.1 stands replaced as under:-
5.1 The Bidder shall deploy, as per agreed programme, the minimum number of personnel for the key positions with requisite qualification and experience as mentioned hereunder: -
<table>
<tr><th>S. No.</th><th>Positions</th><th>Minimum No. of Personnel</th><th>Minimum Qualification</th><th>Minimum Experience in Similar Work</th></tr>
<tr><td>1</td><td>Project Manager/ Team Leader</td><td>1</td><td>Graduate in Civil /Mining Engineering</td><td>25 year experience in tunneling projects out of which at least 15 years should of tunneling with NATM concept, and should have executed at least two tunneling projects in the capacity of Project-in-Charge.</td></tr>
<tr><td>2</td><td>Technical / Design Manager</td><td>1</td><td>Graduate in Civil/ Mining engineering</td><td>15 year experience in tunnelling with 5 years design experience with NATM concept.</td></tr>
<tr><td>3</td><td>Tunnel Construction Manager</td><td>3</td><td>Graduate/ Diploma in Civil/ Mining Engineering/ Engineering</td><td>7/10 years of experience in tunnelling with NATM concept..</td></tr>
</table></td></tr>
</table>

S N	Clause	Page No.	Existing				To be read as
						Geology	
			4	**Head Foreman (NATM) (Expat)**	1	Diploma in Civil/ Mining Engineering/ Engineering Geology	10 years of experience in on-site construction supervision of NATM tunnel construction. Expat Head foreman must supervise all Head Foreman National. He must have experience in various position such as nozzleman, pit boss, machine operator etc.
			5	**Foreman (Tunnel) (National)**	6	-	5 years of experience in on-site construction supervision of tunnel construction with NATM concept. Foreman must effectively lead the tunnel site crew in a shift.
			6	**Nozzle men**	12	-	3 years of experience in Shotcrete application in tunnels. Nozzle men will be qualified based on the shotcrete test panels witnessed by the Engineer whose "no objection" will be obtained before deployment of nozzle man at work.
			7	**Jumbo Operator**	14	-	3 years of experience in operation of drilling jumbo. He should be able to prepare, operate, perform routine maintenance and troubleshooting of

S N	Clause	Page No.	Existing				To be read as
							jumbo. Jumbo Operator shall be certified by OEM and shall undergo simulation training program from OEM for Automatic Jumbos.
			8	**Senior Geologist**	1	Postgraduate/ Graduate in Geology/ Engineering Geology	10/15 year experience in tunnelling with drill and blast.
			9	**Senior Surveyor**	1	Graduate/Diploma in Civil Engineering	7/10 years of experience in surveying work with experience of DGPS surveying and surveying inside tunnels.
			10	**Material Procurement Manager**	1	Graduate	10 year experience as Material Procurement Manager on infrastructural Projects. He will be responsible for placing orders for procurement of material, Machinery and consumables according to requirement to maintain critical levels of buffer stocks at all times.
			11	**Material Stock Manager**	1	Graduate	5 years of experience of material stocking on infrastructural projects He will be responsible for updating the material stocks to maintain upto date position of material stocks and

S N	Clause	Page No.	Existing				To be read as
							consumables.
			12	**Safety Manager**	2	Graduate/ Diploma in any discipline and Diploma in Safety, Health or environment Management or Construction Management	2/3 year experience in Safety Management in tunneling projects
			13	**Surveyor**	6	12th	Preferably 1 years of experience in Total Station Surveying
			14	**Grouting Engineer**	2	Graduate/ Diploma in Engineering	3/5 year experience in Grout application in underground / Dam works. The Grouting engineer shall have know how of handling the grouting machine and had training from OEM before the machine deployment.
			15	**Civil Engineers (Tunnel)**	6	Graduate/ Diploma in Civil Engineering	2/3 years of experience preferably in tunneling field

S N	Clause	Page No.	Existing				To be read as
			16	**Geologist**	6	Postgraduate/ Graduate in Geology/ Engineering Geology	5/7 year experience in tunnelling with drill and blast.
			17	**Quality Assurance and Quality Control Engineer**	4 (Lab + Field)	Graduate /Diploma in Civil Engineering	2/3 years of experience in quality control and/or quality assurance in underground works.
			18	**Project Platform Coordinator**	1	Graduate in engineering	5 year experience in handling IT software relating to Project Management Information System (PMIS). He will coordinate the use and operation of the platform and fulfil the deadline of providing the data required by the client on a regular basis.
			19	**Scheduler**	2	Degree in Civil Engineering. Course certification in proposed scheduling software	2 years of experience in Scheduling of underground works
			Note: The requirement and schedule of deployment may be altered by Project Director in consultation with the contractor to suit the site condition and progress.				

<table>
<tr><th>SN</th><th>Clause</th><th>Page No.</th><th>Existing</th><th>To be read as</th></tr>
<tr><td>3.</td><td>Item No C.1.3 of Bill No-C (Drainage and Miscellaneous Work) of A&C-01</td><td>Page 73 of 85 of revised Vol-II as per A&C-01</td><td>
<table>
<tr><td>S. No.</td><td>Item No.</td><td>Unit</td></tr>
<tr><td>3</td><td>C1.3.1</td><td>SQM</td></tr>
<tr><td></td><td>C1.3.2</td><td>SQM</td></tr>
<tr><td></td><td>C1.3.3</td><td>SQM</td></tr>
</table>
</td><td>
<table>
<tr><td>S. No.</td><td>Item No.</td><td>Unit</td></tr>
<tr><td>3</td><td>C1.3.1</td><td>Meter</td></tr>
<tr><td></td><td>C1.3.2</td><td>Meter</td></tr>
<tr><td></td><td>C1.3.2</td><td>Meter</td></tr>
</table>
</td></tr>
</table>

27/12/19

ED/P/RKSH-KNPG

ADDENDUM & CORRIGENDUM No. 3

RVNL/RKSH-KNPG/TENDER/TUNNELS/PK-7B **Dated:20.12.2019**

Bid Notification No.	RVNL/RKSH-KNPG/TENDER/TUNNELS/PK-7B Dated:30.09.2019
Name of the Work	"CONSTRUCTION OF TUNNELS, BRIDGES AND FORMATION WORKS FROM CHAINAGE 91+228 to 101+339 (FLS) UNDER PACKAGE–7B IN CONNECTION WITH NEW BG LINE BETWEEN RISHIKESH AND KARANPRAYAG (125KM) IN STATE OF UTTARAKHAND, INDIA."

The following changes are to be incorporated at the appropriate place in the Bid Document.

SN.	Clause	Page No.	Existing	To be read as
1.	Clause 12 of IFB of Bid Document	As per A&C-01	Date of Receipt and opening of Bids: The completed Bids must be submitted through e-tendering portal https://rvnl.euniwizarde.com/ before 11.00 hrs. on 02/01/2019 and the same shall be opened at 11.30 hrs on same day.	Date of Receipt and opening of Bids: The completed Bids must be submitted through e-tendering portal https://rvnl.euniwizarde.com/ before 11.00 hrs. on 17/01/2020 and the same shall be opened at 11.30 hrs. on same day.
2.	ITB-19.2 (Bid Data Sheet)(Section-2) of the bid document	As per A&C-01	The bid security shall be valid up to 12/06/2020. The original Bank Guarantee should be submitted to Chief Project Manager, Rail Vikas Nigam Limited, Floor/Room No.:Block No. 4, Street Address: Rishilok, GMVN City:Muni Ki Reti, Rishikesh,Pin Code: 249137 Country: Indian Republic Tel. No.: Tel 0135-2442008, Fax: 2442008 Mail :himansu.badoni@rvnl.org	The bid security shall be valid up to 27/06/2020.The original Bank Guarantee should be submitted to Chief Project Manager, Rail Vikas Nigam Limited, Floor/Room No.:Block No. 4, Street Address: Rishilok, GMVN City:Muni Ki Reti, Rishikesh. Pin Code: 249137 Country: Indian Republic Tel. No.: Tel 0135-2442008 Fax: 2442008 Mail :himansu.badoni@rvnl.org

<table>
<tr><th>SN.</th><th>Clause</th><th>Page No.</th><th>Existing</th><th>To be read as</th></tr>
<tr><td>3.</td><td>Clause 22.1 ITB (Bid Data Sheet)(Section-2) of the Bid Document</td><td>As per A&C-01</td><td>For bid submission purposes address is:
https://www.rvnl.euniwizarde.com
The deadline for bid submission is:
Date: 02/01/2020.
Time: 11:00 hrs.</td><td>For bid submission purposes address is:
https://www.rvnl.euniwizarde.com
The deadline for bid submission is:
Date: 17/01/2020.
Time: 11:00 hrs.</td></tr>
<tr><td>4.</td><td>Clause 25.1 ITB (Bid Data Sheet)(Section-2) of the Bid Document</td><td>As per A&C-01</td><td>The online bid opening shall take place at e-tendering portal of RVNL https://www.rvnl.euniwizarde.com:
Bid Opening:
Date: 02/01/2020
Time: 11:30 hrs.</td><td>The online bid opening shall take place at e-tendering portal of RVNL https://www.rvnl.euniwizarde.com:
Bid Opening:
Date: 17/01/2020
Time: 11:30 hrs.</td></tr>
<tr><td>5.</td><td>Clause 4.1 (e) of Section -1 Instruction To Bidders</td><td>22/541 of Bid document.</td><td>Total eleven works contract packages involving tunnels on this project are planned. Package PK-3A involving three small tunnels T-4 (2.3km), T-6(200mtr) & T-7(1.23km) shall be finalized independently. The remaining ten packages are detailed below:
<table>
<tr><th colspan="4">LIST OF PACKAGES INVOLVING TUNNELS</th></tr>
<tr><th>S.No</th><th>Works Package</th><th>Major Works included</th><th>Estimated Cost</th></tr>
<tr><td>1</td><td>Tunnel Package-1 (6+015 to 18+444)</td><td>Embankment between Br-1 & T1 (785m),Bridg</td><td>Rs. 1563 Crores (with NATM</td></tr>
</table></td><td>Total eleven works contract packages involving tunnels on this project are planned. Package PK-3A involving three small tunnels [T-4 (2.3km), T-6(200mtr) & T-7(1.23km)] was planned to be finalized independently, however, tender was discharged as the only bidder was found non-responsive. The package-3A has been now included in Package-3B and renamed as package-3. Package PK-4 involving embankment in Devprayag Station (240m), one minor Bridge, Tunnel No. 8 (15100m) and embankment at Janasu end (300m) from chainage 47+360 to 63+117 to be done with TBM/NATM method, shall be finalized independently. The remaining nine packages whose estimated cost has been reviewed and revised are detailed below:</td></tr>
</table>

SN.	Clause	Page No.	Existing	To be read as

Existing

		e No.2 (Shivpuri), Tunnel No.1 (10850m), Embankment Shivpuri Station Part Yard (794m), Minor bridges - 3 Nos.	method)
2	Tunnel Package-2 18+601 to 33+097	Tunnel No.2 (6460m), Bridge No. 3 (Guller), Embankment At Guller (600m), Tunnel No.3 (6720m), Minor Bridges 2 Nos, and Emb. Byasi Station Part Yard (450m)	Rs. 1686 Crores (with NATM method)

To be read as

LIST OF PACKAGES INVOLVING TUNNELS

S. No	Works Package	Major Works included	Estimated Cost
1	Tunnel Package -1 (6+015 to 18+444)	Embankment between Br-1 & T1 (785m), Bridge No.2 (Shivpuri), Tunnel No.1 (10850m), Embankment Shivpuri Station Part Yard (794m), Minor bridges - 3 Nos.	Rs. 1978 Crores (with NATM method)
2	Tunnel Package -2 18+601 to 33+097	Tunnel No.2 (6460m), Bridge No. 3 (Guller), Embankment At Guller (600m), Tunnel No.3 (6720m), Minor Bridges 2 Nos, and Emb. Byasi Station Part	Rs. 1686 Crores (with NATM method)

SN.	Clause	Page No.	Existing				To be read as			
			3	Tunnel Package-3B (33+097 to 47+360)	Tunnel No. 5 (9760m), Bridge No. 6 (Ganga Nala)	Rs. 1100 Crores (with NATM method)			Yard (450m)	
			4	Tunnel Package-4 (47+360 to 63+117)	Embankment Devprayag Station Part Yard (240m), Minor Bridge-1 No., Tunnel No. 8 (15100m), Embankment At Janasu (300m).	(with TBM and NATM method)	3	Tunnel Package -3 (33+097 to 47+360)	T-4 (2.3km), Tunnel No. 5 (9760m), T-6 (200mtr), T-7 (1.23km), Bridge 4,5 6 (Ganga) & 7	Rs. 1835 Crores (with NATM method)
			5	Tunnel Package-5 (63+414 to 73+001)	Tunnel No. 9 (2800m), Emb. Maletha station Yard (860m), Minor Bridge-2 Nos., Tunnel No. 10 (4140m), Embankment	Rs. 750 Crores (with NATM method)	4	Tunnel Package -5 (63+414 to 73+001)	Tunnel No. 9 (2800m), Emb. Maletha station Yard (860m), Minor Bridge-2 Nos., Tunnel No. 10 (4140m), Embankment Srinagar Station Yard (1650m), Minor Bridge-3 Nos.	Rs. 750 Crores (with NATM method)
							5	Tunnel Package -6 (73+489 to	Tunnel No. 11 (9000m), Bridge No. 10 (Dhaari In), Embankment	Rs. 1446 Crores (with NATM

SN.	Clause	Page No.	Existing				To be read as			
					Srinagar Station Yard (1650m), Minor Bridge-3 Nos.			83+899)	Dhaari Station Yard (750m), Minor Bridge-1 No., Bridge No. 11 (Dhaari Out)	method)
			6	Tunnel Package-6 (73+489 to 83+899)	Tunnel No. 11 (9000m), Bridge No. 10 (Dhaari In), Embankment Dhaari Station Yard (750m), Minor Bridge-1 No., Bridge No. 11 (Dhaari Out)	Rs. 1218 Crores (with NATM method)	6	Tunnel Package -7A (83+899 to 101+339)	Tunnel No. 12 (7080m), Bridge No. 12 (Narkota),	Rs. 1354 Crores (with NATM method)
			7	Tunnel Package-7A (83+899 to 101+339)	Tunnel No. 12 (7080m), Bridge No. 12 (Narkota),	Rs. 700 Crores (with NATM method)	7	Tunnel Package -7B (83+899 to 101+339)	Tunnel No. 13 (9420m), Tilani Station Part Yard (700m) and Minor Bridge-1 No.	Rs. 1583 Crores (with NATM method)
			8	Tunnel Package-7B	Tunnel No. 13 (9420m), Tilani Station	Rs. 1000 Crores (with	8	Tunnel Package -8 (101+339 to 116+911)	Bridge No. 13 (Tilani Out), Bridge No. 14 (Gholtir In), Tunnel No. 14 (6460m), Tunnel No. 15 (7160m) Embankment	Rs. 2700 Crores (with NATM method)

SN.	Clause	Page No.	Existing				To be read as			
				(83+899 to 101+339)	Part Yard (700m) and Minor Bridge-1 No.	NATM method)			Gholtir Station Yard (550m), Minor Bridge-1 No., 9Emb. Gaucher Station Yard (1100m), Minor Bridge-2 Nos.	
			9	Tunnel Package-8 (101+339 to 116+911)	Bridge No. 13 (Tilani Out), Bridge No. 14 (Gholtir In), Tunnel No. 14 (6460m), Tunnel No. 15 (7160m)Embankment Gholtir Station Yard (550m), Minor Bridge-1 No., 9Emb. Gaucher Station Yard (1100m), Minor Bridge-2 Nos.	Rs.1442 Crores (with NATM method)	9	Tunnel Package-9 (117+365 to 125+200)	Bridge No. 16 (Sivai Nala),Tunnel No. 16 (6400m), Embankment Sivai Station Yard (950m), Tunnel 16A (480m)	Rs. 1307 Crores (with NATM method)
			10	Tunnel Package-9 (117+365	Bridge No. 16 (Sivai Nala),Tunnel No. 16	Rs. 740 Crores (with NATM	The nine packages as detailed in table above will be finalized subject to the conditions stipulated below: (i) The scope of work and cost of above packages is tentative and may undergo changes. (ii) All the above packages are planned to be invited before 31.3.2020. (iii) Not more than two works packages out of above nine packages shall be awarded to any one firm participating		

SN.	Clause	Page No.	Existing	To be read as
			<table><tr><td></td><td>to 125+200)</td><td>(6400m), Embankment Sivai Station Yard (950m), Tunnel 16A (480m)</td><td>method)</td></tr></table> The ten packages as detailed in table above will be finalized subject to the conditions stipulated below: (i) The scope of work and cost of above packages is tentative and may undergo changes. (ii) All the above packages are planned to be invited before 31.3.2020. (iii) Not more than two works packages out of above ten packages shall be awarded to any one firm participating either in the capacity of single entity or as a constituent of a JV. (iv)The Technical Proposal of firms who have been already awarded two packages out of ten packages shall not be evaluated. (v)Technical bids of each RFP shall be evaluated as per EQC clause 1.2 of section 3 of RFP.	either in the capacity of single entity or as a constituent of a JV. (iv) The Technical Proposal of firms who have been already awarded two packages out of nine packages shall not be evaluated. (v) Technical bids of each RFP shall be evaluated as per EQC of section 3 of RFP.

SN.	Clause	Page No.	Existing	To be read as
6.	Clause 6.2.5 of Section -5 Works Requirements	156/541 of Bid Document	**Wheel Loaders** having minimum 3.00 cum (Rock Bucket) Tramming /Hauling load capacity.	**Wheel Loaders** having minimum 3.00 cum (Rock Bucket) Tramming /Hauling load with side tipping bucket facility.
7.	Clause 6.2.7 of Section -5 Works Requirements	156/541 of Bid Document	**Dumpers** should be having load capacity of 25-40 Tonne.	**Dumpers** should be having load capacity of 25Ton or more.
8.	Clause 6.2.12 of Section -5 Works Requirements	157/541 of Bid Document	**Continuous loader** of suitable capacity.	**Continuous loader** of 3.5 cum/min capacity or more.

20/12/19

ED/P/RKSH-KNPG

ADDENDUM & CORRIGENDUM –02

Name of Work: "Construction of tunnels, bridges and formation works from chainage 91+228 to 101+310 (Fls) under package-7B in connection with new bg line between Rishikesh and Karanprayag (125km) in state of Uttarakhand, India."

Bid Notification No. RVNL/RKSH-KNPG/TENDER/TUNNELS/PK7B Dated:30.09.2019

SN	Existing	Amendment
1.	Request Tender Document Till: 01.01.2020 at 17:00 Hrs	Request Tender Document Till: 02.01.2020 at 10:59 Hrs

11/12/19
CPM/RKSH

Scanned by CamScanner

ADDENDUM & CORRIGENDUM No. 1

RVNL/RKSH-KNPG/TENDER/TUNNELS/PK7B Dated: 22.11.2019

Bid Notification No.	RFP No. RVNL/RKSH-KNPG/TENDER/TUNNELS/PK7B Dated:30.09.2019
Name of the Work	**"**CONSTRUCTION OF TUNNELS, BRIDGES AND FORMATION WORKS FROM CHAINAGE 91+228 to 101+339 (FLS) UNDER PACKAGE–7B IN CONNECTION WITH NEW BG LINE BETWEEN RISHIKESH AND KARANPRAYAG (125KM) IN STATE OF UTTARAKHAND, INDIA.**"**

The following changes are to be incorporated at the appropriate place in the Bid Document.

<table>
<tr><th>SN</th><th>Clause</th><th>Page No.</th><th>Existing</th><th>To be read as</th></tr>
<tr><td>1.</td><td>Name of Work</td><td colspan="3">Name of the work is stands replaced and should be read as following, wherever stated in Vol-I, Vol-II & Vol-III of the Bid Document.
"Construction of tunnels, bridges and formation works from Chainage km 91+228 to km 101+310 (FLS) under package–7B in connection with new BG line between Rishikesh and Karanprayag (125Km) in the state of Uttarakhand, India.**"**</td></tr>
<tr><td>2.</td><td>Clause 2 of IFB of Bid Document</td><td>9/541
Vol-I</td><td>
<table>
<tr><th>Sl. No.</th><th>Approx. Estimated Cost of Project</th><th>Bid Security</th><th>Period of Completion</th></tr>
<tr><td>1</td><td>Rs. 1583.51 Crores (Rupees One Thousand Five Hundred</td><td>Rs 2 Crores</td><td>54 Months</td></tr>
</table>
</td><td>
<table>
<tr><th>Sl. No.</th><th>Approx. Estimated Cost of Project</th><th>Bid Security</th><th>Period of Completion</th></tr>
<tr><td>1</td><td>Rs. 1531.20 Crores (Rupees One Thousand Five</td><td>Rs 2 Crores</td><td>54 Months</td></tr>
</table>
</td></tr>
</table>

SN	Clause	Page No.	Existing	To be read as
			Eighty Three Point Five One Crore only)	**Hundred Thirty-One Point Two Zero Crore only)**
3.	Clause 12 of IFB of Bid Document	12/541 Vol-I	Date of Receipt and opening of Bids: The completed Bids must be submitted through e-tendering portal https://rvnl.euniwizarde.com/ before 11.00 hrs. on 06/12/2019 and the same shall be opened at 11.30 hrs on same day.	**Date of Receipt and opening of Bids:** The completed Bids must be submitted through e-tendering portal https://rvnl.euniwizarde.com/ before 11.00 hrs. on **02/01/2020** and the same shall be opened at 11.30 hrs on same day.
4.	ITB-19.2 (Bid Data Sheet)(Section-2) of the bid document	46/541 Vol-II	The bid security shall be valid up to 16/05/2020.The original Bank Guarantee should be submitted to Chief Project Manager, Rail Vikas Nigam Limited, Floor/Room No.: Block No. 4,Street Address: Rishilok, GMVN City: Muni Ki Reti, Rishikesh ,Pin Code: 249137 Country: Indian Republic Tel. No.: Tel 0135-2442008, Fax: 2442008 Mail :himansu.badoni@rvnl.org	The bid security shall be valid up to **12/06/2020**.The original Bank Guarantee should be submitted to Chief Project Manager, Rail Vikas Nigam Limited, Floor/Room No.: Block No. 4, Street Address: Rishilok, GMVN City: Muni Ki Reti, Rishikesh, Pin Code: 249137 Country: Indian Republic Tel. No.: Tel 0135-2442008 Fax: 2442008 Mail :himansu.badoni@rvnl.org
5.	Clause 22.1 ITB (Bid Data Sheet) (Section-2) of the Bid Document	47/541 Vol-I	For bid submission purposes address is: https://www.rvnl.euniwizarde.com The deadline for bid submission is: Date: **06/12/2019**. Time: 11:00 hrs.	For bid submission purposes address is: https://www.rvnl.euniwizarde.com The deadline for bid submission is: Date: **02/01/2020**. Time: 11:00 hrs.

SN	Clause	Page No.	Existing	To be read as
6.	Clause 25.1 ITB (Bid Data Sheet) (Section-2) of the Bid Document	47/541 Vol-I	The online bid opening shall take place at e-tendering portal of RVNL https://www.rvnl.euniwizarde.com: **Bid Opening:** Date: **06/12/2019** Time: 11:30 hrs.	The online bid opening shall take place at e-tendering portal of RVNL https://www.rvnl.euniwizarde.com: **Bid Opening:** Date: **02/01/2020** Time: 11:30 hrs.
7.	Section-03 Eligibility & Qualification Criteria (EQC)	55/541 Vol-I	Existing Section 3: EQC stands replaced with Annexure-A of A&C-01.	
8.	Para-4 of Bidding Form PS-3,Section-4	70/541 Vol-I	Existing Biding Form PS-3 stands replaced as Annexure-B of this A&C-6.	
9.	Biding Form MET-3 of Setion-4 of the Bid Document	108/541 Vol-I	Revised Bidding Form MET-3, stands replaced with attached as Annexure-C of the A&C-01.	
10.	Clause 2.2.1(2) of Chapter-2 of Section 5 of Bid Document	121/514 Vol-I	Construction of two box culverts are involved in the Tilani Station Yard at Km 101+150, Km 101+185.	Construction of two box culvert/subway are involved in the Tilani Station Yard at Km 101+150, Km 101+185 and one Road Over Bridge of 1x30 m.

<table>
<tr><th>SN</th><th>Clause</th><th>Page No.</th><th>Existing</th><th>To be read as</th></tr>
<tr><td>11.</td><td>Clause 2.2.1(2) of Chapter-2 of Section 5 of Bid Document</td><td>122/514 Vol-I</td><td>Salient features of the works in this tender are as under:
<table>
<tr><th>S.N.</th><th>Description</th><th>Narkota Nala Bridge to Tilani Part Yard</th></tr>
<tr><td>1</td><td>Length of Section</td><td>10.160kms (91+228 Kmto 101+388 km)</td></tr>
<tr><td>2</td><td>Ruling Gradient</td><td>1 in 80 (C)</td></tr>
<tr><td>3</td><td>Degree of curvature</td><td>2.5 Degree Maximum</td></tr>
<tr><td>4</td><td>Major Bridges</td><td>Nil</td></tr>
<tr><td>5</td><td>Box Culvert</td><td>02Nos.</td></tr>
<tr><td>6</td><td>Stations</td><td>Part Tilani Yard</td></tr>
<tr><td>7</td><td>No. of Junction Station</td><td>NIL</td></tr>
<tr><td>8</td><td>Level Crossings</td><td>NIL</td></tr>
<tr><td>9</td><td>Loading Standard</td><td>25 Tonnes axle load of 2008</td></tr>
</table></td><td>Salient features of the works in this tender are as under:
<table>
<tr><th>S.N.</th><th>Description</th><th>Narkota Nala Bridge to Tilani Part Yard</th></tr>
<tr><td>1</td><td>Length of Section</td><td>10.160kms (91+228 Kmto 101+388 km)</td></tr>
<tr><td>2</td><td>Ruling Gradient</td><td>1 in 80 (C)</td></tr>
<tr><td>3</td><td>Degree of curvature</td><td>2.5 Degree Maximum</td></tr>
<tr><td>4</td><td>Major Bridges</td><td>Nil</td></tr>
<tr><td>5</td><td>Box Culvert/subway & ROB</td><td>03Nos.</td></tr>
<tr><td>6</td><td>Stations</td><td>Part Tilani Yard</td></tr>
<tr><td>7</td><td>No. of Junction Station</td><td>NIL</td></tr>
<tr><td>8</td><td>Level Crossings</td><td>NIL</td></tr>
<tr><td>9</td><td>Loading Standard</td><td>25 Tonnes axle load of</td></tr>
</table></td></tr>
</table>

SN	Clause	Page No.	Existing	To be read as
				2008
12.	Clause 2.3 (B) of Chapter-2 of Section 5 of Bid Document	122/514 Vol-I	There is only Two box culverts are involved in the Tilani Station Yard at Km 101+150, Km 101+185.	There is only Two box culvert/Subway at Km 101+150, Km 101+185 and one ROB are involved in the Tilani Station Yard.
13.	Clause 2.3(C)(f) of Chapter-2 of Section 5 of Bid Document	124/541 Vol-I	Portal T13P1: Portal-1 of T-13 are well connected to NH. Railway Alignment is crossing the existing NH-58 alignment at Narkota Nala location, which will require temporary NH diversion at this location. NH PWD is constructing permanent NH diversion at separate location. To start the construction work of Bridge-12, existing NH bridge (span approx. 20m with RCC abutment) shall be dismantled. Therefore, one temporary NH diversion shall be constructed to regulate the regular traffic. Temporary diversion will require suitable Hume pipe temporary bridge.	Portal T13P1: Portal-1 of T-13 are well connected to NH. Railway Alignment is crossing the existing NH-58 alignment at Narkota Nala location, which will require temporary NH diversion at this location. NH PWD is constructing permanent NH diversion at separate location. To start the construction work of Tunnel-13, P-1, existing NH bridge (span approx. 20m with RCC abutment) shall be dismantled. Therefore, one temporary NH diversion shall be constructed to regulate the regular traffic. Dismantling of Existing NH Bridge & Construction of Temporary NH diversion shall be paid as per relevant BOQ Items.

<table>
<tr><th>SN</th><th>Clause</th><th>Page No.</th><th>Existing</th><th>To be read as</th></tr>
<tr><td>14.</td><td>Clause 2.3(E) of Chapter-2 of Section 5 of Bid Document</td><td>125/541 Vol-I</td><td>
<table>
<tr><th>Ground ID</th><th>Available Muck dumping capacity</th><th>Muck Dumping Location</th><th>Suitable for</th><th>Distance (Kms)</th></tr>
<tr><td>D27 (NH)</td><td>3,52,000.00 cum.</td><td>At Narkota Village</td><td>T13-P-1</td><td>At Tunnel-13 Portal-1 location</td></tr>
<tr><td>D27 (NH)</td><td>3,52,000.00 cum.</td><td>At Narkota Village</td><td>Adit-7 Portal</td><td>At 8 km from adit portal Portal location.</td></tr>
<tr><td>D-28* (NH)</td><td>7,69,280.00 cum</td><td>Nearby Tilani Yard</td><td>T-13-P-2</td><td>At Portal Location Only.</td></tr>
</table>
This dumping ground would be shared between T13 and T14.
</td><td>
<table>
<tr><th>Ground ID</th><th>Available Muck dumping capacity</th><th>Muck Dumping Location</th><th>Suitable for</th><th>Distance (Kms)</th></tr>
<tr><td>D27 (NH)</td><td>Approx.3,52,000.00 cum.</td><td>At Narkota Village</td><td>T13-P-1 & T-12, P-2</td><td>At Tunnel-13 Portal-1 location</td></tr>
<tr><td>D27 (NH)</td><td>Approx. 3,52,000.00 cum.</td><td>At Narkota Village</td><td>Adit-7 Portal</td><td>Approx. 5 km from adit Portal location.</td></tr>
<tr><td>D-28 (NH)</td><td>Approx. 7,69,280.00 cum</td><td>Nearby Tilani Yard</td><td>T-13-P-2 & T-14, P-1</td><td>At Portal Location Only.</td></tr>
</table>
Note: D27 & D28 muck dumping areas will be used for dumping muck from multiple tunnels i.e. T12 & T13 and T13 & T14
</td></tr>
</table>

SN	Clause	Page No.	Existing	To be read as
				respectively. The muck area shall be developed and used by the contractor jointly (without obstructing or creating any impediment in each other's work) in consultation with Engineer/Employer.
15.	Clause 2.3(E) of Chapter-2 of Section 5 of Bid Document	125/541 Vol-1	**Details of access Roads for Muck Dumping Zone D-27 are as follows:** Muck Dumping Yard (D-27) is located at Narkota Location. This dumping yard is accessible through NH-58. No additional approach road is required to access this dumping zone. At Adit-7 portal location, there is space for muck dumping, muck generated from this adit portal shall be dumped in this dumping yard only. **Details of access Roads for Muck Dumping Zone D-28 are as follows:** Muck Dumping Yard (D-28) is located nearby Tilani Yard station. This dumping yard is accessible through NH-58. No additional approach road is required to access this dumping zone.	**Details of access Roads for Muck Dumping Zone D-27 are as follows:** Muck Dumping Yard (D-27) is located at Narkota Location. This dumping yard is accessible through NH-58. No additional approach road is required to access this dumping zone. **Details of access Roads for Muck Dumping Zone D-28 are as follows:** Muck Dumping Yard (D-28) is located nearby Tilani Yard station. This dumping yard is accessible through NH-58. No additional approach road is required to access this dumping zone.
16.	Clause 2.6.3 of Chapter-2 of Section 5 of Bid Document	127/541 Vol-1	Railway land, if available and spareable, shall be provided for the purpose of stacking of material and setting up of concrete batching plant, etc. However, the Contractor shall be responsible for arranging any such requirement of land and arranging/developing any required approach to site of work, etc.at his own	Deleted.

<table>
<tr><th>S N</th><th>Clause</th><th>Page No.</th><th>Existing</th><th>To be read as</th></tr>
<tr><td></td><td></td><td></td><td>cost.</td><td></td></tr>
<tr><td>17.</td><td>Clause 2.14 of Chapter-2 of Section 5 of Bid Document</td><td>129/541 Vol-I</td><td colspan="2">Revised Clause 2.14 of chapter-2 of section-05 stands replaced with attached as Annexure-D of A&C-1.</td></tr>
<tr><td>18.</td><td>Clause 2.17 (a) of Chapter-2 of Section 5 of Bid Document</td><td>131/541 Vol-1</td><td>Entire works are located in Rudraprayag districts in the state of Uttarakhand in vicinity of National highway 58. NH58 has been recently upgraded and widened to accommodate high traffic volume. The work area is in close vicinity to tourist attraction spots and care to environment is of paramount importance.</td><td>Entire works are located in Rudraprayag districts in the state of Uttarakhand in vicinity of National highway 58. NH58 is being recently upgraded and widened to accommodate high traffic volume. The work area is in close vicinity to tourist attraction spots and care to environment is of paramount importance.</td></tr>
<tr><td>19.</td><td>Clause 2.18.7 (a) of Chapter-2 of Section 5 of Bid Document</td><td>135/541 Vol-1</td><td>For Tunnel No.-12, excavation shall be done concurrently at least from Portal 1 direction and in one directions from Adit A6A Junction and from Portal 2.</td><td>For Tunnel No.-13, excavation shall be done concurrently at least from Portal 1 direction and in one directions from Adit A7 Junction and from Portal 2.</td></tr>
<tr><td>20.</td><td>Clause 3.4.3 of Chapter-3 of Section 5 of Bid Document</td><td>146/541 Vol-I</td><td>The Contractor shall provide the following type of vehicles as per requirement indicated by the Project Director within one month of the date of commencement.
<table>
<tr><th>Type</th><th>Numbers</th></tr>
<tr><td>INOVA, MAHINDRA XUV500 or similar</td><td>3 (Three)</td></tr>
</table></td><td>The Contractor shall provide the following type of vehicles as per requirement indicated by the Project Director within one month of the date of commencement.
<table>
<tr><th>Type</th><th>Numbers</th></tr>
<tr><td>INOVA, MAHINDRA XUV500 or similar</td><td>3 (Three)</td></tr>
<tr><td>BOLERO/SCORPIO/ER</td><td>10 (Ten)</td></tr>
</table></td></tr>
</table>

SN	Clause	Page No.	Existing		To be read as	
			BOLERO/SCORPIO/ER TIGA/MARAZZO orsimilar	10 (Ten)	TIGA/MARAZZO orsimilar	
			Motor Bike 150CC or more, Bajaj Pulsar/Honda CB Hornet 160R/ Hero Xtreme Sorts/ SuzukiGixxer or Similar	10 (Ten)	Motor Bike 150CC or more, Bajaj Pulsar/Honda CB Hornet 160R/ Hero Xtreme Sorts/ Suzuki Gixxer or Similar	5 (Five)
21.	Clause 3.6 of Chapter-3 of Section 5 of Bid Document	147/541 Vol-I	Laptop rugged – two Nos.	With minimum specification of Intel Core i5, 8th Generation, upto 3.4 GHz, 6 MB Cache, 8 GB DDR4 2666MHz RAM, 1TB 5400 RPM Hard Disk Drive, 14" color display, 2xUSB-3.0, Standard keyboard. Weight - not more than 2.5 kg, Battery backup - minimum 4 hrs Operating System - Windows 10 or higher preloaded with media and documentation and certificate of authenticity and Microsoft Security Essentials preloaded antivirus software.	Laptop rugged – 10 Nos.	With minimum specification of Intel Core i5, 8th Generation, upto 3.4 GHz, 6 MB Cache, 8 GB DDR4 2666MHz RAM, 1TB 5400 RPM Hard Disk Drive, 14" color display, 2xUSB-3.0, Standard keyboard. Weight - not more than 2.5 kg, Battery backup - minimum 4 hrs Operating System - Windows 10 or higher preloaded with media and documentation and certificate of authenticity and Microsoft Security Essentials preloaded antivirus software. A laptop bag and Adapter/Battery charger shall

<table>
<tr><th>SN</th><th>Clause</th><th>Page No.</th><th>Existing</th><th>To be read as</th></tr>
<tr><td></td><td></td><td></td><td><table>
<tr><td></td><td>A laptop bag and Adapter/Battery charger shall also be provided with the laptop.</td></tr>
<tr><td>Printers – 2 nos. (A4 size – 1 No. and A3 size – 1 No.)</td><td>The A4 size printer shall be all in one office jet having features of Fax, Scanner and Printer, A3 size printer shall be Colour Office jet with a print speed of up to 8 pages at 800 dpi or More.</td></tr>
<tr><td>50 MBPS Wi</td><td>Fi Hotspot/USB Dongle with 4 GB data connection and minimum monthly download limit of 50 GB for use with laptops – two nos.</td></tr>
</table></td><td><table>
<tr><td></td><td>also be provided with the laptop.</td></tr>
<tr><td>Printers – 8 nos. (A4 size – 4 No. and A3 size – 4 No.)</td><td>The A4 size colour printer shall be all in one office jet having features of Fax, Scanner and Printer, A3 size printer shall be Colour Office jet with a print speed of up to 8 pages at 800 dpi or More.</td></tr>
<tr><td>50 MBPS Wi Fi Hotspot</td><td>Wi Fi Hotspot/USB Dongle with 4 GB data connection and minimum monthly download limit of 50 GB for use with laptops –10 nos.</td></tr>
</table></td></tr>
<tr><td>22.</td><td>Clause 6.1 of Chapter-6 of Seciont-5 Work Requirements- 1st para</td><td>155/541 Vol-I</td><td>It is mandatory to deploy machineries of suitable make, capacities and number as mentioned below as per agreed programme on a minimum basis. Adequate number of spares equipments should be deployed in addition to this.</td><td>The contractor shall deploy, as per agreed programme, minimum number of machines of suitable make, specification, capacities and number as mentioned below. Notwithstanding the above, adequate number of equipments may have to be deployed in addition to this to achieve the desired progress and also to cater breakdown and servicing requirements.</td></tr>
<tr><td>23.</td><td>Clause 6.8 of Chapter-6 of</td><td>158/541 Vol-I</td><td>For the initial period as declared in Letter of comfort or 9 months whichever is</td><td>In case delivery period for the above mentioned critical equipments as declared</td></tr>
</table>

SN	Clause	Page No.	Existing	To be read as
	Seciont-5 Work Requirements		earlier from date of commencement in case of above mentioned critical equipment, execution may be allowed with available equipment generally used and available for such operations for commencement of work, subject to condition that the equipment is not more than 5-year-old and further that the contractor submits a copy of purchase order of the New critical equipment. This shall in no way absolve contractor of the responsibility and obligations to perform under the contract. No time extension shall be allowed on account of delayed mobilization due to any reason and the contractor will be required to make up the progress (by increased numbers of machines) due to delayed deployment to finish the work's within stipulated time.	in Letter of Comfort (Form P&M-2 of Section-4) is beyond the date of mobilization as per agreed programme, commencement of work will be allowed with available equipments generally used for such operations up to the date of delivery period of critical equipment at site, subject to the condition that the equipment is in good working condition and further that the contractor submits a copy of purchase order of the New critical equipment under procurement. This shall in no way absolve the contractor of the responsibility and obligations to perform under the contract. No time extension shall be allowed on account of delayed mobilization due to any reason and the contractor will be required to make up the progress (by increased numbers of machines) due to delayed deployment to finish the works within stipulated time.
24.	Clause 6.10.2 of Chapter-6 of Seciont-5 Work Requirements	158/541 Vol-I	Add Clause 6.11 below Clause 6.10.2 as under: 6.11 On completion/likely completion of activities concerned to particular equipment, demobilization of that equipment shall be requested by the Contractor at least 7 days in advance and demobilization shall be done with the approval of Engineer/Employer only. In case demobilization is done without approval of Engineer/Employer, the penalty mentioned above, as relevant, shall be imposed for each day of absence of the equipment.	

SN	Clause	Page No.	Existing	To be read as
25.	Clause 1.1.4 of sub-Chapter-1 of Seciont-5 Work Requirements	162/541 Vol-I	Obtaining necessary clearance/ permission that are needed for construction, from various state/ central authorities for the equipments, water, power, sanitory and explosives shall rest with the contractor.	Obtaining necessary clearance/ permission that are needed for construction, from various state/ central authorities for the equipment, water, power, sanitary and explosives shall rest with the contractor. The Employer will render assistance for initiating necessary request(s) to the concerned authorities for obtaining such permissions if the same become necessary. However, any follow up required for obtaining the permissions will continue to be the responsibility of the Contractor.
26.	Clause 3.5.1 (iii) of sub-Chapter-3 of Seciont-5 Work Requirements	187/541 Vol-I	The Contractor shall make his own arrangements of aggregate crushing plants etc. for crushing of aggregates from stones extracted from approved quarries or obtained after excavation from underground or other works of the project. Railway land if available can be used for setting up of aggregate crushing plants etc.	The Contractor shall make his own arrangements of aggregates including aggregate crushing plant if any. Rock spoils such as stones, boulder, pebbles, gravels etc. available from surface/underground excavation, if are found suitable for use in works as per required specifications, will be available for use free of cost in the project to the extent possible subject to payment of royalty to the concerned authority as specified in GCC. Railway land if available surplus can be allowed to be used for setting up of aggregate crushing plants required to produce aggregates for use in the project. In case excavated material found suitable for use in works is surplus in a particular

SN	Clause	Page No.	Existing	To be read as
				contract/section, such surplus material can be allowed by the Employer, to be used by another agency in the project, free of cost subject to payment of royalty by the user agency to the concerned authority as specified in GCC. **Note:** Lead beyond 2km, on account of leading of free of cost material to the contractor's crushing plant if any, from underground/surface excavation shall not be payable.
	Clause 4.4.3 (xi) of sub-Chapter-4 of Seciont-5 Work Requirements	203/541 Vol-I	**Materials** a. The lateral drainage pipes shall consist of circumferentially slotted, PVC pipes with a minimum diameter of 200 mm as shown on the drawings. The slots shall be within the corrugated area. The width of slots shall not exceed 1.0 mm. The total area of the slots for water intake shall be more than 100 cm2 per metre length of pipe. b. The main collector pipe in the main and escape tunnels shall be virgin HDPE pipes as per design drawings. The HDPE pipe shall be confirming to I.S. 4984/ 4151 / 12786/ 13488 with necessary jointing material li ke mechanical connectors i.e. thread / insert joint / quick release coupler joint	**Materials** a. The lateral drainage pipes shall consist of circumferentially slotted pipes, wrapped with geotextile membrane as shown in the drawings. The slots shall be within the corrugated area. The width of slots shall not exceed 1.0 mm, total area of the slots for water intake shall be more than 100 cm2 per metre length of pipe or as directed by the Engineer. b. The central collector pipe in the main and escape tunnels shall consist of virgin HDPE pipes with diameter as per design drawings. The HDPE pipe shall be confirming to I.S. 14333 with necessary jointing material. c. The transversal connection pipes and cleaning access pipes shall be PVC pipes with diameter as per design drawings.

SN	Clause	Page No.	Existing	To be read as
			/ compression fitting joint or flanged joint c. The transversal connection pipes shall be PVC pipes with a minimum diameter of 150 mm. d. The cleaning access pipes shall be PVC pipes with a minimum diameter of 150 mm. e. No-fines porous concrete shall be used for embedment of the lateral drainage pipes and of the invert drainage pipe. No-fines porous concrete shall also be installed at the bottom of Regular Tunnel Cross Section Type as shown on the respective drawing. No-fines porous concrete shall be composed of ordinary Portland cement and single-sized aggregate of nominal size of 40 mm according to IS 383 (with a maximum grain size of 40 mm). The ratio of aggregate to cement shall be 8:1 by volume or 10:1 by mass. f. Maintenance manholes as well as the drainage gutters shall be made of concrete grade M30 according to IS 456: 2000. (Reaffirmed 2011) g. Inspection shafts that will be installed in the balastless track of the Main	d. Deleted. d. No-fines porous concrete shall be used for embedment of the lateral drainage pipes and of the invert drainage pipe. No-fines porous concrete shall also be installed at the bottom of Regular Tunnel Cross Section Type as shown in the respective drawings. No-fines porous concrete shall be composed of ordinary Portland cement and single sized aggregate of nominal size of 40 mm according to IS 383 (with a maximum grain size of 40 mm). The ratio of aggregate to cement shall be 8:1 by volume or 10:1 by mass. e. Maintenance manholes, drainage gutters and inspection shafts shall be made of concrete grade M30 according to IS 456: 2000. (Reaffirmed 2011) f. Inspection shafts that will be installed in the ballastless track (BLT) of the Main Tunnel and shall be constructed in accordance to the requirements of the BLT design and approved by the Engineer. g. The Contractor shall procure the pipes of the specified quality from leading manufacturers i.e. Supreme, Astral, Alom, Jain Irrigation. Other brands will not be used without approval of the Engineer. h. Geotextile membrane specifications: Synthetic nonwoven

SN	Clause	Page No.	Existing	To be read as
			Tunnel shall be constructed in accordance to the requirements of the BLT design and approved by the BLT engineer.	fabric of needle punched geotextile having following properties: 1) Material: Polyester Fibre 2) Colour: White 3) Thickness: 2.5 mm Minimum 4) Weight / Unit area: 230 gsm Minimum 5) Tensile Strength: a) Machine Direction: 20 Kgf / 5 cm Minimum b) Cross Direction: 35 Kgf / 5 cm Minimum 6) Permeability: 50 litre / m^2/sec (at 50 mm WH) 7) Opening sizes: 60 µm to 120 µm.
27.	Clause 5.1.2 of Chapter-5 of Section-5 Work Requirements	208/541 Vol-I	Contractor may obtain license from statutory authority for procuring, transporting, storing and using explosives. The same may also be arranged through existing approved suppliers/license holders in the project area. The Contractor may also have his own magazine for the storage of explosive etc. In either case, no claim of contractor will be admissible on account of any delay in obtaining any mandatory permissions or in arranging the same for progress of the work.	Contractor may obtain license from statutory authority for procuring, transporting, storing and using explosives. The same may also be arranged through existing approved suppliers/license holders in the project area. The Contractor may also have his own magazine for the storage of explosive etc. If the contractor chooses to have his own magazine, the land for the same shall also be arranged by the contractor at his cost. Employer shall not permit the use of Railway land for the magazine. In either case, no claim of contractor will be admissible on account of any delay in obtaining any mandatory permissions or in

SN	Clause	Page No.	Existing	To be read as
				arranging the same for progress of the work.
28.	Clause 7.10.1 (P) of sub-chapter-7 of section-5 Work Requirements	242/541 Vol-I	All taxes duties excluding royalties.	All taxes duties including royalties.
29.	Clause 7.10.5 (i) of sub-chapter-7 of section-5 Work Requirements	243/541 Vol-I	Royalties Soil or rock spoils such as stones, boulder, pebbles, gravels etc. available from excavation, if are found suitable for use in works as per required specifications, can be used free of cost but the legally payable royalty and taxes are to be paid by contractor to the concerned authorities.	Deleted.
30.	Clause 8.12.1(III)(vi) of sub-chapter-8 of section-5 Work Requirements	257/541 Vol-I	After each blast, support section required shall be decided by the Engineer and Contractor on the basis of recorded observations. Geological face mapping sheet and Geo-mechanical classification of the excavation which face shall be elaborated by the Contractor and validated by the Engineer. Required Excavation and Support Sheet (RESS) shall be used as detailed in Annexure to	After each blast, support section required shall be decided by the Engineer and Contractor on the basis of recorded observations. Geological face mapping sheet and Geo-mechanical classification of the excavation which face shall be elaborated by the Contractor and validated by the Engineer. Required Excavation and Support Sheet (RESS) shall be used as detailed in Annexure to Sub-Chapter 6:

SN	Clause	Page No.	Existing	To be read as
			Sub- Chapter 6: Instrumentation	Instrumentation. In case of disagreement, decision of the Engineer will be final.
31.	Clause 8.22.3(iii)of Sub-Chapter-8 of Annexure-A of Section-5 Work Requirements	267/541 Vol-I	In stretches where the performance of additional excavation requires removal and reinstallation of previously installed support system, only the payment for reinstallation will be made as per quoted rate for the relevant item. Previously installed support recovered shall not be re-used and will be disposed by the contractor at his own cost.	In stretches where the performance of additional excavation requires removal and reinstallation of previously installed support system, no payment will be made for dismantling the existing construction support material. Payment for reinstallation will be made as per quoted rate for the relevant item. Previously installed support material recovered shall not be re-used and will be disposed by the contractor at his own cost.
32.	GCC Clause 14.2.1 & 14.2.2 of PCC, Part-A of Section-7A of the Bid Document	476/541 Vol-I	At the rate of **9.05%**, simple interest per annum on reducing balances.	At the rate of **8.95%,** simple interest per annum on reducing balances.
33.	Clause 14.5 (b) of PCC of Part-A of Section-7A of the bid document	476/541 Vol-I	Not applicable.	Plant and materials when shipped to India from foreign country: 1. Waterproofing Membrane, 2. Geotextile, 3. Water inflatable Bolt (Swellex or similar), 4. Fibre Glass Bolt,
34.	Clause 14.5 (c) of PCC of	476/541 Vol-1	Plant and materials when delivered at site are:	Plant and materials when delivered at site are:

SN	Clause	Page No.	Existing	To be read as
	Part-A of Section-7A of the bid document		1.Cement 2. Reinforcement steel 3. Bridge bearings 4. Pre-stressed cables (High Tensile steel)	1.Cement, Colloidal Silica, PU Grout 2.Reinforcement steel, Structural Steel, Rock Bolts, Pipe Roofing, Wire Mesh, 3. Bridge bearings 4. Pre-stressed cables (High tensile steel) 5. Poly Fibre, Waterproofing Membrane, Geotextile.
35.	Clause 1.5 of PCC of Part-B of Section-7 of the bid document	484/541 Vol-I	The documents forming the Contract are to be taken as mutually explanatory of one another. For the purposes of interpretation, the priority of the documents shall be in accordance with the following sequence: (a) the Contract Agreement (if any), (b) the Letter of Acceptance, (c) the Letter of bid, (d) The Addenda/ Corrigenda/ Correspondence with bidder. (e) Special Conditions of Contract: (i) Part A – Contract Data (ii) Part B - Specific Provisions (f) the General Conditions of Contract (g) Geotechnical Baseline report (h) the Schedules (including Priced Bill of Quantities),	The documents forming the Contract are to be taken as mutually explanatory of one another. For the purposes of interpretation, the priority of the documents shall be in accordance with the following sequence: (a) the Contract Agreement (if any), (b) the Letter of Acceptance, (c) the Letter of bid, (d) The Addenda/ Corrigenda/ Correspondence with bidder. (e) Special Conditions of Contract: (i) Part A – Contract Data (ii) Part B - Specific Provisions (f) the Schedules (including Priced Bill of Quantities) (g) Geotechnical Baseline report (h) the General Conditions of Contract,

SN	Clause	Page No.	Existing	To be read as
			(i) Specification, (j) the Drawings, (k) Works Requirements, (i) Employers Requirements (ii) Safety Requirements, and (l) Bidding forms submitted by Bidder. (m) any other documents forming part of the Contract. If an ambiguity or discrepancy is found in the documents, the Engineer shall issue any necessary clarification or instruction.	(i) Specification, (j) the Drawings, (k) Works Requirements, (i) Employers Requirements (ii) Safety Requirements, and (l) Bidding forms submitted by Bidder. (m) any other documents forming part of the Contract. If an ambiguity or discrepancy is found in the documents, the Engineer shall issue any necessary clarification or instruction.
36.	Clause-7.8 Annexure-10- Royalties of PPC Part-B, Section-7	500/541 Vol-I	Unless otherwise stated in the Specification, the Contractor shall pay all royalties, rents and other payments for: (a) natural Materials obtained from outside as well as inside the Site and (b) the disposal of material from demolitions and excavations and of other surplus material (whether natural or man-made), except to the extent that disposal areas within the Site are specified in the Contract. The contractor will be responsible for keeping record of movement of material sourced from within and outside railway land and produce whenever required by	Unless otherwise stated in the Specification, works requirement, Bill of quantities the Contractor shall pay all royalties, rents and other payments for: (a) natural Materials obtained from outside the Site and, (b) the disposal of material from demolitions and excavations and of other surplus material (whether natural or man-made), except to the extent that disposal areas within the Site are specified in the Contract. The contractor will be responsible for keeping record of movement of material sourced from within and outside railway land and produce whenever required by the

SN	Clause	Page No.	Existing	To be read as
			the authorities.	authorities.
37.	Annexure-17 of PCC part-2,Section-7B of the Bid Document	507/541 Vol-1	Annecure-17- Adjustments for changes in cost, Percentages governing Price Adjustment stands replaced with Annexure-E as per A&C-01.	
38.	Vol-II of Bid Document		Existing Vol-II of Bid Document is replaced and attached as Annexure-F as enclosed. Bid submission shall be based on Revised Vol-II (Revision-1) of the Bid Document.	
39.	Excel Summary sheet (for E Tendering)	Separate Excel File	Existing Summary sheet (for E Tendering) is replaced and attached as separate excel file as Summary sheet (for E Tendering). Bid submission shall be based on Revised Vol-II (Revision-1) of the Bid Document.	
40.	Vol-III Bid Drawings		Existing Vol-III (Bid Drawings) of the Bid Document stands replaced and attached as Annexure-G as enclosed. Bid submission shall be based on Revised Vol-III (Revision 1).	

22/11/19

ED/P/RKSH-KNPG

Annexure-A

Table of Criteria

1. Evaluation 2
1.1. Adequacy of Technical Bid 2
1.2. Multiple Contracts 2
1.3. Completion Time 2
1.4. Technical Alternatives 2
1.5. Margin of Preference 2
1.5.1. Purchase Preference to Central Public Sector Enterprises (CPSUs)2
1.5.2. Preference to Make in india 2
2. Qualification..... 3
2.1 Eligibility..... 3
2.2 Financial Status 3
2.3 Experience..... 4
2.3.1 Specific Construction Experience 5
2.4 Personnel 7
2.5 Equipment..... 7
2.6 Specialist sub- contractor 7
2.7 Works Programme.....8
2.8 Familiarization.....8

1. Evaluation

In addition to the criteria listed in ITB 35.2 (a)-(e), the following criteria shall apply:

1.1. Adequacy of Technical Bid

Evaluation of the Bidder's commitment to mobilize key equipment and personnel for the contract consistent with the requirements stipulated in Section 5: Works Requirements regarding work methods, scheduling, and material sourcing.

1.2. Single Contracts

The qualification of the bidder shall be checked if the bidder has submitted the substantially responsive proposal, subject to the condition that if any bidder has already been awarded two contract packages out of the contract packages listed in para 4.1(e) of Section-1 (ITB) of the bidding document his bid shall not be evaluated further.

After the evaluation of technical proposals as above, the financial offers shall be opened for those specific bidders who have submitted substantially responsive proposals and who have been determined to meet the qualification requirements.

The offers of bidders which have been rejected on the grounds of being substantially nonresponsive to the requirements of the bidding document and which have been determined as being not qualified as a result of evaluation of technical proposal, the price proposal of such bidders shall not be opened and returned unopened.

The bidder whose bid results into lowest evaluated bid shall be considered for award of work.

Multiple Contracts

Multiple Contracts are not envisaged.

1.3. Completion Time

Alternative Completion Time is not permitted.

1.4. Technical Alternatives

Technical alternatives are not permitted

1.5. Margin of Preference

1.6. Purchase Preference to Central Public Sector Enterprises (CPSEs)

Purchase Perference to CPSEs shall not apply.

1.7. Preference to Make in India

Preference as defined in ITB clause 43 shall be applicable.

2. Qualification

2.1 Eligibility

Criteria	Compliance Requirements				Documents Submission Requirements
	Single Entity	Joint Venture			
		All Partners Combined	Each Partner	Lead Partner	
2.1.1 Conflict of Interest					
No Conflict of interest in accordance with ITB Sub-Clause 4.3	Must meet requirement	Existing or intended JV must meet requirement	Must meet requirement	Must meet requirement	Letter of Technical Bid (Form PS-1)
2.1.2 Share of partners					
The share of partners shall not be less than the specified percentage.	N. A.	100%	25%	60%	MoU or JV Agreement Form JV 4 Or JV 5
2.1.3 Disqualification of Bidder					
Not Disqualified under Clause 4.4 of ITB.	Must Meet Requirement	Existing or intended JV must meet requirement	Must meet requirement	Must meet requirement	Letter of Technical Bid (Form PS-1) & Affidavit (Form PS-3)

2.2 Financial Status

Criteria	Compliance Requirements				Documents Submission Requirements
Requirement	Single Entity	Joint Venture			
		All Partners Combined	Each Partner	Lead Partner	
2.2.1 Historical Financial Performance					
Submission of audited balance sheets for the last five financial years (refer note below the table) to demonstrate the current soundness of the Bidders financial position. As a minimum criterion, Profit Before Tax (PBT) should be positive for two financial years out of last five financial years.	Must meet requirement	Not applicable	Must meet requirement	Must meet requirement	Form FIN – 1 with attachments
2.2.2 Average Annual Construction Turnover:					

Minimum average annual construction turnover in equivalent **INR 680.53** Crores Calculated as total certified payments received for contracts in progress or completed, within the last **three** financial years (refer note below the table).	Must meet requirement	Must meet requirement	Must meet At least 25% of the requirement	Must meet At least 70% of the requirement	Form FIN – 2
2.2.3 Net –Worth					
Minimum average Net-Worth (Total Assets – Total Liabilities) should not be less than **INR 306.24 Crores** during the last three financial years (refer note below the table).	Must meet requirement	Must meet requirement	Must meet At least 25% of the requirement	Must meet At least 70% of the requirement	Form FIN – 1
2.2.4 Bid Capacity					
Available Bid capacity = **(A x N x 2.0 - 0.16 x N x B)**, should be more than the total Estimated price where, A = Maximum	Must meet requirement	Must meet requirement	Must meet At least 25% of the requirement	Must meet At least 70% of the requirement	Form FIN – 2 & 3

value of works executed in any one year during the last 5 years which will take into account the completed as well as works in progress (total contract receipts). B = Total value of existing commitments irrespective of the completion period of those works (in case bidder or partner of JV has existing commitment through another JV, then the commitment will be taken in proportion to the share of the Bidder in the JV) and N = Number of years prescribed for completion of works in the present bid.					

Note: In the event that the audited accounts for the latest concluded Financial Year are not available, the Bidder shall furnish information pertaining to the last five financial years after ignoring the latest concluded financial year. In case, the bidder submits audited financial information for the last

six or more years, only the figures for the latest five years shall be considered for evaluation.

2.3 Experience

Criteria	Compliance Requirements				Documents Submission Requirements
Requirement	Single Entity	Joint Venture			
		All Partners Combined	Each Partner	Lead Partner	
2.3.1 Specific Construction Experience					
2.3.1 (a) Contracts of Similar Size and Nature. (i) Execution as contractor, or subcontractor, at least one contract with a value of at least **INR *612.48 Cr.*** that has been successfully or is substantially completed within the last ten years before the deadline for submission of the bids, and that is similar to the proposed work. The similar work here shall be that which includes key activities mentioned below: "Execution of excavation of	must meet requirement of either (I) or (II)	must meet requirement of either (I) or (II)	not applicable	must meet requirement of either (I) or (II)	Form EXP - 2(a)

Criteria	Compliance Requirements				Documents Submission Requirements
Requirement	Single Entity	Joint Venture			
		All Partners Combined	Each Partner	Lead Partner	
Rail/ Road/ Metro/ Hydro/Irrigation Tunnel having finished cross sectional area of minimum 24 sqm through single tunnel of minimum **3.20 km** length or through two tunnels of minimum cumulative length of **4.80 km** by Drill & Blast method. (Tunnels constructed with TBM and Cut & Cover shall not be considered) **OR** (ii) Execution as contractor, or subcontractor, at least two contracts, each with a value of at least **INR 382.8 *Cr.*** that has been successfully or is substantially completed within the last ten years before the deadline for submission of the bids, and that is similar to the proposed work. Each contract should have at least similar work which includes key activities mentioned					

Criteria	Compliance Requirements				Documents Submission Requirements
Requirement	Single Entity	Joint Venture			
		All Partners Combined	Each Partner	Lead Partner	
below: "Execution of excavation of Rail/ Road/Metro/Hydro/Irrigation Tunnel having finished cross sectional area of minimum 24 sqm through single tunnel of minimum **1.60 km** length or through two tunnels of minimum cumulative length of **2.40 km** by Drill & Blast method. (Tunnels constructed with TBM and Cut & Cover shall not be considered)					

Criteria	Compliance Requirements				Documents Submission Requirements
Requirement	Single Entity	Joint Venture			
		All Partners Combined	Each Partner	Lead Partner	
2.3.1 (b) Construction Experience in Key Activities (Executed during the last Ten years prior to the applications submission deadline)					
For the contracts as per 2.3.1 (a) above and/or other contracts a minimum construction experience in the following key activities: Excavation of minimum **3.34 kms** length, of rail/road/hydro/metro/Irrigation tunnels having finished cross section area of minimum 18sqmby Drill & Blast and/or TBM method, in one year as per Note (6) below. (Tunnels constructed with Cut & Cover shall not be considered)	must meet all requirements	must meet all requirements	Must Meet requirement of at least 25%length of the Key activity	Must Meet requirement of at least 70% length of the Key activity	Form EXP - 2(b)

Note:-

(1) (a) For the purpose of value of work for the past experience of a firm in a JV in sub clause 2.3.1(a) credit shall be given in proportion of the percentage share of the firm in that JVF. For past experience of key activities in sub clause 2.3.1(a)) & (b) credit shall be given for execution of the quantity of that specific activity executed by the firm as part of a JV, duly certified by the Employer. If the Employer's Certificate does not indicate the specific quantity of key activity/activities executed by each partner, in such a case credit for quantity of each key activity shall be given as per following provisions in order of priority :

i) As per details given in JV agreement forming part of the relevant Contract Agreement.

ii) If JV agreement does not provide such details, then credit shall be given in proportion of the percentage share of the firm in that JV.

(b) In case a JV quoting for the tender has executed similar work specified in 2.3.1(a) and construction experience in key activities specified under 2.3.1(b), with the same constitution of JV, the requirement specified to be met under sub clause 2.3.1(a) & (b) shall be considered to have been met treating the JV as a single entity for this purpose

(2) Deleted.

(3) For Sub-clause 2.2.2 Average Annual Construction Turnover, the Bidder should submit actual construction turnover figures for the specified financial years. For Evaluation purposes the figures of previous years shall be updated @ 5% per year compounded annually based on Rupee value to bring them to the level of the last Financial Year specified in sub-clause. If the figure for turnover in an individual year is in a currency other than INR, then the same shall first be converted to INR based on the exchange rates published by Reserve Bank of India/International Monetary Fund (in that order) as on last day of that year and then the figures in INR shall be updated as mentioned above.

(4) For Sub-clause 2.3.1 Specific Construction Experience, the Bidder should submit actual Value of Work completed/ substantially completed. Value of Work for Evaluation purposes shall be updated based on Rupee value to bring them to the price level of date of deadline for submission of bids as per formula given below:-

A = B [1+ (5÷36500) x N]

Where

A = updated value of work on dead line for submission of bids.

B = value of work on the date of completion/substantial completion as indicated in the Employer's certificate.

N = Number of days between date of completion and dead line for submission of bids.

The base date for updating purpose shall be considered as the date of completion of work as certified by the Engineer-in Charge.

In case value of the work is mentioned in a currency other than INR, then the same shall first be converted to INR based on the exchange rates published by Reserve Bank of India/International Monetary Fund (in that order) as on the date of completion/substantial completion of the work and then the figures in INR shall be updated as mentioned above.

(5) The phrase "substantial completion" used in clause 2.3.1 (a) shall mean where the employer has certified:
Ongoing works where required value of the work as well as required quantity of key activity has been physically completed. The same should be supported by Employer's certificate issued within six months prior to the deadline for Bid submission.

(6) Evaluation of item 2.3.1(b) shall be done to assess the execution of quantity of each activity in a period of any one year. In cases, where year-wise quantities (For identical Period) of a particular key activity are indicated in the employer's certificate(s) of single or multiple works, the same will be considered to arrive at the total quantity of the particular key activity executed in a single year through single/multiple contract. In all other cases, assessment of execution of quantity of the key activity in a period of any one year will be made in the following manner:

(i) If the criteria is being met through a single contract (as per statement submitted by the bidder as required vide Para (vi) below), then the quantity executed shall be divided by the number of months from start of execution of activity up to the end of execution of activity and multiplied by 12 to arrive at the quantity executed in a year (if the period of execution is less than 12 months, the same will be taken as 12 months for calculation purposes) to establish whether the criteria is being met.

(ii) If the criteria is being met through multiple contracts (as per statement submitted by the bidder as required vide Para (vi) below), then the quantities executed through these contracts will be added and the sum shall be divided by number of months for the period starting from earliest month of start of execution of the activity in any of the contracts and ending with the latest month of execution of the activity in any of the contracts, as per employer's certification. In case the period between the earliest start month and latest finish month is less than 12 months, it will be taken as 12 months for calculation purpose. This average will then be multiplied by 12 to arrive at quantity executed in a year to establish whether the criteria is being met.

(iii) In case employer's certificate does not indicate start/end month of execution of the key activity then start/end month of contract shall be considered as the start/end month of execution of the key activity.

(iv) Twin tubes/ parallel tunnels shall be considered as separate tunnels.

(v) For the contracts starting more than Ten years prior to the deadline for submission of bids and where employer's certificate does not clearly indicate quantity of a particular key activity executed during last Ten years prior to the deadline for the submission of bids, in such a case, quantity considered to be executed during the period of the such contract falling within last Ten years shall be worked out on proportionate basis [i.e. by applying ratio of period of contract falling in last Ten years to total period of the contract or period of execution of key activity falling in last Ten years to total period of execution of the key activity as given in employer's certificate as the case may be]. Provisions of note (i) above shall also apply to cases where period falling within last Ten years is less than 12 months.

(vi) Bidder should submit a statement indicating as to how criteria specified under item 2.3.1(b) is being met duly referring to the relevant employer's certificates enclosed with the bid.

(7) Deleted.

(8) Deleted.

(9) Deleted.

(10) For Sub-clause 2.3.1(a) Evaluation of qualifying length in case of Single Tunnel/Two Tunnel (As the case may be) shall be the total length of excavation in individual tunnel irrespective of working faces from adits and/or shafts, meeting the specified technical

criterion.(This shall exclude length of any excavation in cross passages, shafts, adits, cut and cover.).

2.4 Personnel

The Bidder must give an undertaking, as per EQC Form No.3 in Section 4 of Bidding documents, to provide at least the personnel for the key position as given in Section 5: Works Requirement, if he is awarded the contract.

2.5 Equipment

The Bidder must give an undertaking as per EQC Form No.3 in Section 4 of Bidding documents) to provide minimum key equipment for execution of the work as given in section5: Works Requirement, if he is awarded the contract: The bidder must also provide bidding forms P&M-1consistent with the requirements stipulated in Chapter 6: Section 5: Works Requirements.

2.6 Specialist sub-contractor:

The Bidder must give a separate undertaking (EQC Form No.3 in Section 4 of Bidding documents) for each key activity mentioned below that either he is having minimum requisite experience mentioned below against each activity himself or he will be deploying specialist subcontractor not exceeding one for each activity, each subcontractor having such experience (in proportion of the quantity proposed to be assigned to him), if he is awarded the contract:

Sl No.	**Key Activity**	**Minimum Experience Requirement (executed during the last Seven years prior to the applications submission deadline) for the Bidder or the specialist subcontractor for execution of following Key activities:**
1	Bridge construction	Execution as contractor or subcontractor, at least One contract that has been successfully or is substantially completed within the last Seven years which includes Fabrication, erection and launching of steel/Composite Girders of 18.30m or longer spans in bridge super structures. Rail bridges (including Viaducts).

Note:-

(1) If the contract is awarded to the bidder and he himself does not have requisite experience as above, he is required to enter into legally enforceable agreement with the specialist sub-contractor at least one month prior to scheduled starting of Key activity as per program submitted by him as contractor and agreed by the engineer. The agreement must specify the specific role and responsibility of the subcontractor.

(2) Experience requirement of each key activity under the Clause shall be adjudged in the same manner as described in Note (6) under Clause 2.3 above.

2.7 Works Programme:

The Bidder must give an undertaking (EQC Form No.3 in Section 4 of Bidding documents) to execute work according to work's programme submitted by him in his bid within stipulated completion period, if he is awarded the contract. The bidder must also submit Bidding forms MET-3 completely filled for Bidder's commitment to complete the contract within stipulated period, consistent with the requirements stipulated in Chapter 2: Section 5: Works Requirements.

2.8 Familiarization:

The Bidder must give a certificate (EQC Form No. 4 in Section 4 of Bidding documents) to declare having visited the site of work and familiarized themselves with working conditions of the project area.

IMPORTANT NOTE FOR SPECIAL ATTENTION OF BIDDERS:

Each bidder should submit details/references as to how the eligibility criteria is being met by the bidder against each item of EQC. this should be prepared and submitted in the Performa "EQC Form No.1" enclosed in section 4.

The bidder must submit checklist (EQC Form No.2) for clauses pertaining to SUMMARY REJECTION of bid.

The bidder must submit checklist (EQC Form No 5 section 4 of bidding documents) for clauses pertaining to compliance to requirements for personnel, machinery and work's programme. The bidder shall ensure compatibility between his proposed work's programme, proposed strength of personnel and equipment.

Annexure-B

Form: PS 3

FORMAT FOR AFFIDAVIT TO BE SUBMITTED BY BIDDER ALONGWITH THE BID

*(To be executed in presence of Public Notary on non-judicial stamp paper of the appropriate value in accordance with relevant stamp Act. The stamp paper has to be in the name of the bidder)***

I ***…… (Name and designation)*****…….** appointed as the attorney/authorized signatory of the bidder (including its constituents), M/s. _____ (hereinafter called the bidder) for the purpose of the Bid for the work of _____ as per the bid No._____ of RVNL, do hereby solemnly affirm and state on behalf of the bidder including its constituents as under:

*1. That the bidder or any of its constituents has not been Blacklisted/ banned for business dealings for all Government Departments or by Ministry of Railways or by RVNL at any time and/or no such blacklisting is in force as on the deadline for submission of bids.

*2. That none of the previous contracts of the bidder or any of its constituents had been terminated/rescinded for Contractor's failure or part terminated for its failure as a JV partner with forfeiture of its full Performance Security, by Rail Vikas Nigam Ltd. during the period of last 3 years before the deadline for submission of bids.

(Add Proviso of Clause 4.4(b) (ITB) suitably, if any Contract was so terminated).

*3. The bidder or any of its constituents has not been imposed liquidated damages of 5% or more of contract value by RVNL due to delay in the implementation of any previous contract (either in the capacity of a single entity or as constituent of any other JV) within the period of last 2 years before the deadline for submission of bid [*2 years shall be reckoned from the date on which imposed L.D. has exceeded 5% of the contract price]*and there are no such accrued delay damages which has not been fully recovered before the deadline for submission of bids on account of contractor's request for deferring

recovery to maintain cash flow and RVNL has acceded to the same in the interest of the project and the work under the previous contract in question has been completed before the deadline for submission of bid, unless imposition of such delay damages has been set aside by the Competent Authority.

4. That the bidder or any of its constituents:

(i) Has not suffered bankruptcy/insolvency or

(ii) has no any ongoing case of insolvency before the NCLT/any Court where Interim Resolution Professional (IRP) has been appointed or is at any later stage of the insolvency process

On the deadline of submission of bids or thereafter till finalization of bids.

*5. That the name of the Bidder or any of its constituents is not on the list of "Poor Performer" of RVNL as on the deadline for submission of bid.

6. We declare that the bidder or any of its constituents have not either changed their name or created a new business entity as covered by the definition of "Allied Firm" under para 1102 (iii) of chapter XI of Vigilance manual of Indian Railways with latest amendments and corrections (available on website of Indian Railways), consequent to having been banned business dealings for specified period which is not over or suspended business dealings or having been declared as poor performer.

7.# We declare and certify that balance sheets for last three financial years including that for the latest concluded financial year are being submitted.

OR

We declare and certify that balance sheet for the latest concluded financial year has not been finalized till date and that is why we are furnishing financial data for last three financial years ignoring the latest concluded financial year.

*(# - Delete whichever is not applicable)***.

8. We certify that services offered by us meet the minimum local content requirement (in terms of revised Public Procurement (Preference to Make in India) Order 2017) as specified in the bidding document. We understand that in case of any false certification in this regard shall be a breach of the Code of Integrity under Rule 175(1)(i)(h) of the General Financial Rules (GFR) for which we or our successors can be debarred for up to two years as rule 151 (iii) of GFR along with such other actions as may be permissible under law.

OR

We certify that services offered by us do not meet the minimum local content requirement as specified in the bidding document.

(Delete whichever is not applicable)

9. We declare and certify that we have not made any misleading or false representation in the forms, statements and attachments in proof of the qualification requirements.

10. We declare that the information and documents submitted along with the tender by us are correct and we are fully responsible for the correctness of the information and documents, submitted by us.

11. We understand that in case we cease to fulfill the requirements of qualifying and eligibility criteria at any time after opening of bids and till finalization of bids, it will be our bounden duty to inform the Employer of our changed status immediately and in case of our failure to do so, our bid shall be rejected and bid security shall be forfeited. In case such failure comes to the notice of Employer at any time after award of the contract, it will lead to termination of the contract and forfeiture of Bid or Performance Security. We shall also be liable for Banning of Business dealings upto a period of five years.

12. We understand that if the contents of the affidavit are found to be false at any stage during bid evaluation, it will lead to rejection of our bid and forfeiture of the bid security. Further, we ***[insert name of the bidder]*****_____ and all our constituents understand

that we shall be liable for banning of business dealings up to a period of five years.

13. We also understand that if the contents of the affidavit are found to be false at any time after the award of the contract it will lead to termination of the contract, forfeiture of Bid or Performance Security and Banning of Business dealings of the Bidder and all its constituents for a period of up to five years.

SEAL AND SIGNATURE OF THE BIDDER

Verification:

Verified on _____ day of _____ at _____ that the contents of the above mentioned affidavit are true and correct and nothing material has been concealed there from.

SEAL AND SIGNATURE OF THE BIDDER

**Modify the contents wherever necessary, in terms of sub-clause 4.4 ITB.*

*** The contents in Italics are only for guidance purpose and details as appropriate, are to be filled in suitably by Bidder.*

Attestation before Magistrate/Public Notary

ANNEXURE-C

Form MET-3

WORKS PROGRAMME IN LINE WITH MILESTONES

Completion period of Work has been divided into one Section as defined in the Section 7A: Contract Data. The Milestones (ML) and their Key Dates for each section are given in the Table Below along with respective sub activities. Bidder can modify the sub activities (KD), but the Milestones and their Key Dates defined in table below shall not be violated while framing the programme. Tentative scheduling for guidance is given in Clause 2.14 of Section 5: Work's requirement.

Contractor is required to work out the key dates and submit this form according to his proposed works program without violating the milestones or the completion period of Individual Sections. Functional requirements for execution of works is detailed in Clause 8.0 of Section 7B: Special conditions of contract, which needs to be considered while framing the work's programme.

Abbreviations:

T13 = Tunnel 13	A7= Adit-7	P1 = Portal 1	MT = Main Tunnel	EM = Electromechanical contractor
		P2 = Portal 2	ET = Escape Tunnel	
KD= Sub Activities	**ML= Milestone**	P=Portal		BLT = Ballastless contractor.

SECTION: 1 (Completion Period 54 Months)				
Activity ID	**Stage**	**Key Dates** (Month ending from date of commencement)	**Length (m)**	**Period (Months)**
ML01	**Excavation for Tunnel 13**	**43**	**9381**	
	Excavation from T13P1			
KD01-A	Slope stabilization and T13P1 completed and ET excavation begins from T13P1 towards A7			

SECTION: 1 (Completion Period 54 Months)				
Activity ID	**Stage**	**Key Dates** (Month ending from date of commencement)	**Length (m)**	**Period (Months)**
KD01-B	Slope stabilization and T13P1completed and MT excavation from T13P1 towards A7 begins			
KD01-C	Breakthrough in ET from T13P1 direction			
KD01-D	Breakthrough in MT from T13P1 direction			
	Excavation from A7			
KD01-E	ET excavation begins from A7 towards T13P2			
KD01-F	MT excavation begins fromA7 towards T13P2			
KD01-G	Breakthrough in ET towards T13P2 direction			
KD01-H	Breakthrough in MT towards T13P2 direction			
	Excavation from T13P2			
KD01-I	Slope stabilization and T13P2 completed and ET excavation begins from T13P2 towardsA7			
KD01-J	Slope stabilization and T13P2 completed and MT excavation from T3P2 towards A7 begins			
KD01-K	Breakthrough in ET from T13P2 direction			
KD01-L	Breakthrough in MT from			

SECTION: 1 (Completion Period 54 Months)				
Activity ID	**Stage**	**Key Dates** (Month ending from date of commencement)	**Length (m)**	**Period (Months)**
	T13P2 direction			
ML02	**Final Lining of Tunnel-13 and Adit-7**	**54**	**9381**	
KD02-A	MT lining complete			
KD02-B	ET lining complete			
KD02-C	MT and ET invert structure complete			
KD02-D	Handing over of MT to BLT			
KD02-E	Handing over of ET and Technical rooms to EM			
KD02-F	Adit 7 Lining and under-structure complete			
ML03	**Completion of Embankment up to Formation Level including slope stabilization**	**30**		
KD04	From Km 100+640 to Km 101+388			

Form MET-3 (Contd.)

NOTES:

1. The key dates define the ending of activity (unless explicitly defined in description of the activity).
2. Contractor shall prepare and submit (in CD) detailed works programme, in Microsoft Project or equivalent, with deployment schedule for various critical equipments (Form MET-4) and Key Personnel (Form MET-5). List of Minimum critical equipments and Key Personnel is detailed in the Section 5: Work's Requirement.

3. It is to be noted that shifts will be exchanged at tunnel face and underground excavation cycle times shall not be affected by shift changes. The cycle time has to be matched accordingly by the bidder according to advance rates for 2 line and 3-line section.
4. Submission of above works programme shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

5. Distribution for various Support Section Types is Rock Support Type given in Geotechnical Baseline Report. Details of support installation for each Support Section Type is provided in the Tender drawings. Bidder shall support his assumption of daily/weekly advance rates with calculations detailed in proposed Cycle Time Calculation in Form MET-2. **The advance rates proposed by bidder shall be computed considering the Support Section Type at maximum foreseen excavation drive length from any Tunnel portal according to work's programme proposed by bidder, so that the same is maintainable throughout the tunnel during it's construction. The monthly advance rates should include scheduled rests of 2 days per month.**

	Summary of Advance Rates proposed by bidder							
	Effective Cycle Time	**Round Length**	**Daily (m/day)**		**Weekly (m/week)**		**Monthly (m/month)**	
Support Class	(in Hrs)	(in Meters)	MT	ET	MT	ET	MT	ET
B1								
B2								
C1								
C2								
C3								
P								

SEAL AND SIGNATURE OF THE BIDDER

ANNEXURE-D

Clause-2.14 (Tentative Scheduling of Major Works)

Completion period of Work has been divided into one **Section** as defined in the Section 7A: Contract Data. The Milestones and their Key Dates for each Section are given in the Table Below along with respective sub activities. The contractor during submission of bid or subsequently during execution shall adhere to the Milestones and their Key Dates defined in Table below. The contractor shall mobilize adequate resources to meet these milestone and completion periods of the **Section**.

Abbreviations:

T13 = Tunnel 13	A7= Adit-7	P1 = Portal 1	MT = Main Tunnel	EM = Electromechanical contractor
		P2 = Portal 2	ET = Escape Tunnel	
KD= Sub Activities	**ML= Milestone**	P=Portal		BLT = Ballastless contractor.

SECTION: 1 (Completion Period 54 Months)				
Activity ID	**Stage**	**Key Dates** (Month ending from date of commencement)	**Length (m)**	**Period (Months)**
ML01	**Excavation for Tunnel 13**	**43**	**9381**	
	Excavation from T13P1			
KD01-A	Slope stabilization and T13P1 completed and ET excavation begins from T13P1 towards A7	6		
KD01-B	Slope stabilization and T13P1completed and MT excavation from T13P1 towards A7 begins	11		
KD01-C	Breakthrough in ET from T13P1 direction	25		
KD01-D	Breakthrough in MT from T13P1 direction	38		

SECTION: 1 (Completion Period 54 Months)				
Activity ID	**Stage**	**Key Dates** (Month ending from date of commencement)	**Length (m)**	**Period (Months)**
	Excavation from A7			
KD01-E	ET excavation begins from A7 towards T13P2	6		
KD01-F	MT excavation begins fromA7 towards T13P2	7		
KD01-G	Breakthrough in ET towards T13P2 direction	33		
KD01-H	Breakthrough in MT towards T13P2 direction	43		
	Excavation from T13P2			
KD01-I	Slope stabilization and T13P2 completed and ET excavation begins from T13P2 towardsA7	6		
KD01-J	Slope stabilization and T13P2 completed and MT excavation from T3P2 towards A7 begins	6		
KD01-K	Breakthrough in ET from T13P2 direction	33		
KD01-L	Breakthrough in MT from T13P2 direction	43		
ML02	**Final Lining of Tunnel-13 and Adit-7**	**54**	**9381**	
KD02-A	MT lining complete	51		
KD02-B	ET lining complete	42		
KD02-C	MT and ET invert structure complete	53		

SECTION: 1 (Completion Period 54 Months)				
Activity ID	**Stage**	**Key Dates** (Month ending from date of commencement)	**Length (m)**	**Period (Months)**
KD02-D	Handing over of MT to BLT	54		
KD02-E	Handing over of ET and Technical rooms to EM	45		
KD02-F	Adit 7 Lining and under-structure complete	46		
ML03	**Completion of Embankment up to Formation Level including slope stabilization**	**30**		
KD04	From Km 101+640 to Km 101+388	30		

(Note: The key dates define the ending of activity (unless explicitly defined in description of the activity).
The monthly advance rates at maximum foreseen excavation drive lengths from any Tunnel portal according to tentative work's programme are as given below: -

Average Advance Rates required for tentative work's schedule		
	Monthly advance (in meters)	
Support Class	**MT**	**ET**
B1	250	390
B2	162	235
C1	143	214
C2	70	112
C3	40	66
P	32	43

The above time presents the required monthly advance considering all support measures required to be installed according to tunnel drawings. The monthly rates also include scheduled rests of 2 days per month.

Above scheduling has been prepared considering two shifts in a day. The advance rates for 2 line and 3-line section are assumed after applying reducing factor of 2 and 3 to MT advance rates.

ANNEXURE-E

Annexure 17 – Adjustments for changes in cost, Percentages governing Price Adjustment

Clause 13, Sub – Clause 13.8: Adjustment for changes in cost

Percentages governing Price adjustment

Coefficients governing the adjustment of changes in cost

S. No	Cost Element	Symbol	Bill of Quantity wise % component							
			Bill No. 1, A, D1, F, H, J	**Bill No. 2A, B2**	**Bill No. 2C, B3**	**Bill No. 9, 10**	**Bill No. 2B, B1**	**Bill D2**	**Bill No. E2**	**Bill No. C**
1	Fixed	Px	15	15	15	15	15	15	15	15
2	Labour	Pl	15	10	5	25	15	5	5	20
3	Steel	Ps	0	0	75	20	50	0	0	5
4	Cement	Pc	0	30	0	15	0	75	0	5
5	Plant Machinery & Spares	Pp	20	15	0	0	10	0	0	5
6	Fuel and Lubricants	Pf	35	20	5	10	5	5	5	5
7	Other materials	Pm	15	10	0	15	5	0	75	45
8	Other Non-Ferrous Metals	Pcp	0	0	0	0	0	0	0	0
	Total		**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Bill No.1: Earthwork in Formation.

Bill No.2: Bridges and Protection Works

2 A: Other than Steel works

2 B: Steel Items involving fabrication and Erection

2 C: Supply of Steel Items

Bill No.3: Ballast Supply

Bill No.4: Permanent Way: Supply

4 A: Other than Steel Items

4 B: Steel Items

Bill No.5: Permanent Way Linking

5 A: Installation Work

5 B: Supply & Installation Work

Bill No.6: Buildings

Bill No.7: Platform, Passenger Amenities & Miscellaneous Works

7 A: Other than steel items

7 B: Steel items

Bill No 8: Supply of Cement

Bill No 9: Site Facilities

Bill No.10: Other Item of works not covered in Bill No. 1 to 9

Tunnelling:

Bill No. A: Underground Excavation

Bill No. B1: Support System: Rock Bolts and Other Steel Supports etc

Bill No. B2: Support System: Shotcrete and Concrete Works

Bill No. B3: Supply of Steel Material

Bill No. C: Drainage and Miscellaneous Work

Bill No. D1: Ancillary Work

Bill No. D2: Supply of Grouting Material

Bill No. E2: Supply of fibres for Tunnel

Bill No. F: Monitoring of excavations/ construction

Bill No. H: Approach Roads for Tunnel & Muck Dumping Site

Bill No. J: Environment Management Plan

ANNEXURE-F

Revised

Volume-II

रेल विकास निगम लिमिटेड
Rail Vikas Nigam Limited
गुणवत्ता, गति एवं पारदर्शिता
(A Government of India Enterprise)

Block No. 4, Rishilok, GMVN,

Muni Ki Reti, Rishikesh-249137, Uttarakhand, India

Telefax: 0135-2442008 e-mail: himansu.badoni@rvnl.org

BIDDING DOCUMENT

(Through e-tendering Mode)

FOR

"CONSTRUCTION OF TUNNELS, BRIDGES AND FORMATION WORKS FROM CHAINAGE Km 91+228 to Km 101+310(FLS) UNDER PACKAGE–7B IN CONNECTION WITH NEW BG LINE BETWEEN RISHIKESH AND KARANPRAYAG (125KM) IN STATE OF UTTARAKHAND, INDIA."

September 2019

Corporate Office

RAIL VIKAS NIGAM LIMITED

1ST Floor, August Kranti Bhawan, Bhikaji Cama Place

New Delhi-110066

Tel: +91-11-26738502, Fax: +91-11-26738592, Web: www.rvnl.org

रेल विकास निगम लिमिटेड
Rail Vikas Nigam Limited
गुणवत्ता, गति एवं पारदर्शिता
(A Government of India Enterprise)

Block No. 4, Rishilok, GMVN,

Muni Ki Reti, Rishikesh-249137, Uttarakhand, India

Telefax -01352442008 e-mail: himansu.badoni@rvnl.org

Revised

Volume-II

(Financial Proposal)

(Revision-1)

For

"CONSTRUCTION OF TUNNELS, BRIDGES AND FORMATION WORKS FROM CHAINAGE Km 91+228 to Km 101+310(FLS) UNDER PACKAGE–7B IN CONNECTION WITH NEW BG LINE BETWEEN RISHIKESH AND KARANPRAYAG (125KM) IN STATE OF UTTARAKHAND, INDIA."

IFB No: RVNL/RKSH-KNPG/TENDER/TUNNELS/PK7B Date: 30.09.2019

September 2019

Corporate Office

RAIL VIKAS NIGAM LIMITED
First floor, August Kranti Bhavan,
Bhikaji Cama Place, New Delhi – 110 066
Tele : + 91-11-26738195 , Fax : + 91-11-26182957, web : www.rvnl.org

Bill of Quantities

PREAMBLE

1. The Bill of Quantities shall be read in conjunction with the Instructions to Bidders, General Conditions, Particular Conditions of Contract, Works Requirement (Technical Specifications, and Drawings).

2. The quantities given in the Bill of Quantities are estimated and provisional and are given to provide a common basis for bidding. The basis of payment will be the actual quantities of work ordered and carried out including spares to be handed over to Railway, as measured by the Contractor and verified by the Engineer and valued at the rates and prices tendered in the priced Bill of Quantities, where applicable, and otherwise at such rates and prices as the Engineer may fix within the terms of the Contract. **If any quantities which have been supplied by the contractor and paid by RVNL are determined to be surplus by the Engineer (except those quantities which become surplus due to change in planning/scheme by Railway/RVNL) during the progress of the work or at the completion of the work, shall be taken back by the contractor, and the payment made for such materials shall be recovered from the pending claims. The materials which have become surplus due to change in planning/scheme by Railways/RVNL and are still in usable condition shall be taken over by RVNL and any part payment still to be made shall be released to the contractor.**

3. In the Bill of Quantities, quantity and unit rates and thereby the amount against each item have been indicated. From this, the estimated price of each bill has been worked out and indicated in the summary sheet in BOQ. The Bidder shall quote rates as percentage above/below/at par for each Bill in the summary sheet of E-Tendering Portal. If no percentage as above, below or at par is indicated for any particular bill, the same will be considered as percentage at par.

4. The rates for each bill shall be indicated in figures, while clearly indicating whether the percentage quoted is above/below/at par over the estimated rate in the respective columns.

5. General directions and descriptions of work and materials are not necessarily repeated or detailed in the Bill of Quantities. References to the relevant specifications and sections of the contract documentation should be made before quoting rates in the Bill of Quantities.

6. The rates and prices Bid in the priced Bill of Quantities shall, except as otherwise provided under the Contract, include all construction equipment, plant, labour, supervision, materials, erection, maintenance, insurance, profit, royalty, octroi, taxes and duties, together with all general risks, liabilities and obligations set out or implied in the Contract.

7. The rates are deemed to be inclusive of all lead (except as otherwise specifically provided in the description of the particular item), lifts, ascend, descend, handling, rehandling crossing of nallah/streams/tracks any other obstructions.

8. All enabling works for executing the work e.g. approach road to site (unless specifically mentioned), launching arrangements, procuring right of way, arrangement of water and electricity etc is to be arranged by the contractor at his own cost and deemed to be included in the quoted rates.

9. Storage of Material: All the material at site will have to be properly stacked & stored so as to facilitate inspection. The material should be properly protected from the detrimental effects of nature and fire, theft etc. The contractor shall be responsible for watch & ward and any loss or deterioration on account of above shall lead to rejection of material and contractor has to replace the same at his own cost.

10. The method of measurement of completed work for payment shall be in accordance with provisions in Works Requirements (Specifications) except as otherwise specifically provided in the description of item or particular bill of quantities or explanatory notes to the particular bill of quantities.

11. (a) In items of Bill No. 6: (Building and related items) and Bill No.9: (Site facilities), the rates are inclusive of cost of all materials including cement, steel, etc. required to deliver the final product.

(b) In items of bill No.2: (Bridges), Bill No.5: (track linking), and Bill No.7: (Platforms, passenger amenities and Misc works) where ever reinforcement steel and HTS wire (strands) are required to be consumed in the item, the rates are exclusive of cost of these materials and the same shall be paid separately under relevant items for supply of these materials.

(c) In items of Bill No.4: (P.Way supply) the rates are inclusive of all materials including cement, steel and HTS wire (strands). Rails required for manufacture of item under Bill No.4 shall be issued free of cost by RVNL.

(d) Bill No. A to J pertains to Tunneling and associated works.

12. NOTES SPECIFIC TO EACH BILL OF QUANTITIES.

12.1. BILL NO.1 FOR EARTH WORK IN FORMATION

12.1.1. The earth work in formation and blanketing has to be executed as per latest RDSO guidelines for earthwork in railway projects with upto date correction slips. If naturally available material in the project area is not suitable for using as blanketing material directly then the blanketing material conforming to RDSO specification has to be produced by blending various naturally available materials in required proportion in a pug mill.

12.1.2. Obtaining prior permission for felling of trees including payment of royalty and taxes etc. shall be contractor's responsibility and deemed to be included in the rates unless otherwise stated in the BOQ item.

12.1.3. Joining of new formation with existing embankment has to be done with benching of 30 cm (V), 60 cm (H) in the existing bank slope. The rate of earthwork includes the cost of benching.

12.1.4. Locations where blasting is warranted, prior permission of the employer must be obtained to ascertain whether blasting is permitted or prohibited. Rate of rock cutting includes the cost of all precautionary measures necessary for safety during blasting of rock.

12.2. **BILL NO.2: BRIDGES AND BILL NO.7: PLATFORM, PASSENGER AMENITIES AND MISCELLANEOUS WORK FOR CC, RCC AND PSC ITEMS.**

12.2.1. All material, equipment, labour, casting beds, stress frames, form work, staging, scaffolding, etc is to be arranged by the contractor within the quoted rates.

12.2.2. 1:4:8, 1:3:6 and 1:2:4 indicates concrete prepared using volumetric mix in proportion of cement: coarse sand: stone aggregate of specified size, respectively.

12.2.3. All design mix concrete shall be machine batched with automatic weigh batcher, machine mixed and machine vibrated or Ready Mix Concrete prepared in depot and transported by transit mixer to the site of work.

12.2.4. Prior to demolishing of any structure measurements have to be taken, scheme of dismantling has to be got approved from the Engineer.

12.2.5. Item 2059: The rate under this item is for steel of grade E-250 as per IRS B1-2001.

12.2.6. For entire Bill 2A: All Concrete works include cost of cement, aggregates or any admixtures including Super plasticizers/accelerators/ curing agents/releasing agents etc. or other additives like silica fume etc. **For Reinforced cement concrete M25 and above, minimum cementitious content shall not be less than 350 Kg/cum. For reinforced cement concrete of lesser grades minimum cementitious content shall not be less than 300 kg/cum. For Plain cement concrete minimum cementitious content shall not be less than 250 Kg/cum. For super structure concrete, preferably, OPC 53 shall be used to ensure early gain of strength.**

12.3. **Bill No. A: (Underground Excavation).**

12.3.1. Item A1: The rates include cost of Tunnel excavation (including Cross Passages and Transformer Halls) in full face or sequential excavation or

Multi Drifting (Top heading, Benching, invert and temporary invert) as per site requirement. The rate includes installation and maintenance of pumps and pipes along the excavation for water inflows up to 50 l/sec from the Tunnel heading. The rates also include dismantling of Temporary invert/Tunnel wall in case of Heading benching/Multi drifting. Nothing extra shall be paid for installation of temporary false portal. The rates also include one additional re-handling of muck if required due to site constraints.

12.3.2. Item A2: Nothing extra will be paid for dismantling and disposal of already installed supports.

12.3.3. Item A3: The rate includes extra cost for excavation including installation and maintenance of pumps and pipes along the excavation time for water inflows more than 50 l/sec from the Tunnel heading.

12.3.4. Item A4: Volume of muck for measurement and payment will be the solid In-Situ volumes and not loose.

13. **Bill No. B1: (Support System: Rock Bolts and Other Steel Supports etc.)**

13.1. All items are inclusive of all materials, labor, consumables, accessories, tools, plants and equipments including all lead and lifts, loading and unloading complete.

13.2. B1.1 (Rock Bolts/Anchors & Micropiles): Threaded portion of 200 mm of bolt shall be measured towards the length of bolt considered for payment. Rate include providing MWD drilling data while carrying drilling of holes for rock bolts with Automatic/Semi-Automatic Jumbos.

13.3. B1.2 (Pipe Roof Umbrella) & B1.3 (Light Forepoling): Size of perforations will depend upon strata and will be as decided by Engineer. Nothing extra shall be for using perforated pipes.

13.4. B1.4 (Arches/Steel Ribs/Lattice Girders): For Steel Ribs and Lattice Girders, cost of supply of structural steel and reinforcing steel shall be paid separately under Bill No. B3.

13.5. B1.5 (Reinforcement and Misc.): The size of wiremesh (150x150x6 or 100x100x4) and type of Lining stress controllers (Corrugated plate or Cylindrical tube type) will be as decided by engineer and nothing extra shall be paid for using either sizes or types.

14. **Bill No. B2 (Support System: Shotcrete and Concrete Works):**

14.1. B2.1 (Shotcrete Works): All shotcrete works include cost of Cement, aggregates, micro-silica/Silica Fumes, accelerator, admixtures/additives etc. **For M30 grade, Minimum 385 kg/cum of OPC 53/53S and 15 Kg of Micro Silica/Silica Fumes shall be used in design mix**.

14.2. **Deleted**

14.3. B2.2 (Concrete Works): All Concrete works include cost of cement, aggregates or any admixtures including Super plasticizers/accelerators/ curing agents/releasing agents etc. or other additives like silica fume etc. **For Reinforced cement concrete M25 and above, minimum OPC 53 content shall not be less than 350 Kg/cum. For reinforced cement concrete of lesser grades minimum OPC 53 content shall not be less than 300 kg/cum. For Plain cement concrete minimum OPC 53 content shall not be less than 250 Kg/cum.**

15. **Bill No. B3 (Supply of Steel Material):** Payment for supply shall only be made after the quantity is consumed in the work.

15.1. Item B3.1 will be operated for all reinforcement works for Secondary concrete lining or any other underground works.

15.2. Item B3.2 will be operated for supply of Reinforcement steel for Lattice Girders and Item B3.3 will be operated for supply of Structural steel for Steel Ribs.

16. **Bill No. C, D2, E2 and F:** Payment for supply shall only be made after the quantity is consumed in the work.

16.1. Item C2.3.3: This item will not be operated for pumping of water from underground tunnel stretches which are having favorable and self-draining slopes and such cost is deemed to be included in item for underground excavation.

16.2. Item C5.9: Supply of anchor bars will be paid separately under Item B3.2.

16.3. Bill No. D2: Payment for supply shall be made only after the quantity is consumed in the work. Measurement will be done from automatic data logger on the grouting Rig or as instructed by Engineer.

16.4. Bill No. F: Rates of all items include supply, fixing, maintenance and upkeep of instruments. Charges towards monitoring, interpretation and record keeping will be deemed to be covered by permanent posting of Instrumentation Engineer.

17. Bill No. H: Cost for construction and maintenance of Access routes for access to Tunnel/Adit portals/Bridges or muck dumping grounds defined in Section: 5 (Work's requirement) Clause 2.3 C(f) and 2.3 E shall be paid under relevant items of this Bill.

18. Rates shall always include for testing where specified except where testing is scheduled separately for payment.

19. Technical Specification reference mentioned in BOQ is for guidance only, as there are references to the item under various clauses and the work are to be executed as per the requirement of the various clauses in the Technical Specification.

20. While quoting the rates, Bidder is required to take into account the cost of deployment of minimum machinery and manpower fulfilling requirements specified in Section 5: Work's requirements. Idling charges for manpower and machinery will not be payable to the bidder on any account.

Rail Vikas Nigam Limited

Name of Work: "CONSTRUCTION OF TUNNELS, BRIDGES AND FORMATION WORKS FROM CHAINAGE Km 91+228 to Km 101+310 (FLS) UNDER PACKAGE–7B IN CONNECTION WITH NEW BG LINE BETWEEN RISHIKESH AND KARANPRAYAG (125KM) IN STATE OF UTTARAKHAND, INDIA."

Summary of Bill

Bill No.	Description of Schedule	Estimated Cost in Rs.
1	2	3
1	Earthwork in Formation	34,03,05,038.00
2A	Bridge work (Other than Steel works)	4,92,64,500.00
2B	Bridge Work (Steel items involving Fabrication and Eraction)	2,68,76,911.00
2C	Bridge Work (Supply of Steel items)	2,50,48,484.00
9	Site Facilities	5,96,38,828.00
A	UnderGround Excavation	3,21,32,67,940.00
B1	Support System: Rock Bolts and Other Steel Supports etc	4,15,64,27,840.00
B2	Support System: Shotcrete and Concrete Works	4,56,73,65,061.00
B3	Supply of Steel Material	1,02,96,83,736.00
C	Drainage and Miscellaneous Work	1,01,38,09,522.00
D1	Ancillary Work	9,01,46,904.00
D2	Supply of Grouting Material	40,30,87,323.00
E2	Supply of fibres for Tunnel	19,30,49,780.00
F	Monitoring of excavations/ construction	6,35,31,433.00
H	Approach Road for Tunnel and Muck Dumping Site	7,36,55,500.00
J	Environment Management Plan	68,00,700.00
	Total Estimated Price	**15,31,19,59,500.00**

Bill No. 1: Earthwork in Formation							
S. No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
1	1002	Earthwork in excavation by mechanical means (Hydraulic excavator) in cutting, in formation, trolley refuges, side drains, yard drains, catch water drains, etc. including leading usable cut spoils up to 200 M and making formation in filling using the cut spoils, site clearances, setting out and demarcation, disposing off surplus unusable cut spoils as per directions of the engineer, and top and side dressing and compaction of cutting formation to provide final formation as per designed profile. The rate shall include compaction of cutting formation and initial compaction of sub-soil where cut-spoils are used in filling. The rate shall not include cutting of trees with girth above 30 cm and compaction of cut spoils in filling, which shall be paid separately. Note- (1) Rock spoils such as stones, boulders, pebbles, gravels etc available from excavation, if are found suitable for use in works as per required specifications even after modifications etc., can be used free of cost but the legally payable royalty and taxes are to be paid by the contractor to the concerned authorities. (2) Payment for earthwork in excavation for pucca drains shall not be payable under this item and the same shall be paid under NS-6 of Bill-1.					7.1, 7.4, 7.5, 7.6, 7.7
	1002a	Soil excluding rock.	Cum	125549.00	174.00	21845526.00	7.3.2, 7.10
	1002b	Rock not requiring blasting.	Cum	818693.00	271.00	221865803.00	7.3.3, 7.10
	1002 c	Hard Rock requiring blasting.	Cum	5000.00	461.00	2305000.00	7.3.4, 7.10
	1002 d	Hard Rock requiring blasting, but blasting not permitted hence to be excavated by chiselling.	Cum	5000.00	833.00	4165000.00	7.3.5, 7.10
2	1003	Incremental rate for every Km or part thereof over item 1002 for leading cut spoils beyond 200 M for making formation in filing.	Cum-Km	356193.00	14.20	5057941.00	7.10.1 D
3	1006	Mechanical Compaction of Earth and Blanket materials in layers of about 30 CM (or more or less) in loose state using vibratory compactor (of adequate capacity) so as to achieve compaction as per RDSO Guidelines and Specification for Design of Formation for Heavy Axle Load – Nov 2009. Minimum EV2 Criteria as mentioned in the guidelines is not applicable. Note: The payment for compaction shall be based on the computed quantity of earth work/blanket work from the cross sections. The payment, however, will be restricted only to the approved design profiles furnished by the Engineer; or the actual quantity executed whichever is less.	Cum	100000.00	27.60	2760000.00	
4	1007	Turfing / planting, including all lead and lift, and watering as required until properly rooted, with. Note - Initially payment of only 40% will be made. Balance 60% will be paid only after 3 months of maintenance period if the turfing is properly rooted.					
	a	Turfing with sods, 10cm thick and 20 cm square closely laid	Sqm	625	74.65	46656.00	
	b	Turfing with planted doob grass	Sqm	625	71.50	44688.00	
5	1008	Providing and laying Jute Geo-Textile (JGT) in slopes of Railway embankment in accordance with RDSO's guidelines for application of Jute Geotextile in Railway embankments and hill slopes no. RDSO/2007/GE:G-0008 or its subsequent versions, including incidental earthwork and fixing arrangements (Rate does not include planting of grass)					
	(a)	With GJ - Type 1	Sqm	400	46.60	18640.00	
6	NS-1	(Dry Stone pitching) Providing and laying Pitching with stone boulders weighing not less than 35 kg each with the voids filled with spalls on slopes laid over prepared filter media including boulder apron laid dry in front of toe of embankment complete as per drawing and Technical specification	cum	6960	1516.80	10556928.00	
7	NS-2	(Stone pitching in 1:4) Providing and laying Pitching with stone boulders weighing not less than 35 kg each with the voids filled with cement sand mortar 1:4 on slopes laid over prepared filter media including boulder apron laid dry in front of toe of embankment complete as per drawing and technical specification (rates are inclusive of cement)	cum	6960	3440.00	23942400.00	

Bill No. 1: Earthwork in Formation							
S. No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
8	NS-3	Supplying and placing of mechanical woven double twisted hexagonal shaped wire mesh Gabion boxes of required sizes mesh type 10cmx12cm, Zn and PVC coated mesh wire dia 2.7/3.7mm (ID/OD), edges of meshes meschnically edged/selvedged with heavy coating of galvanisation as per EN-10223-3/ASTM A 975 with partions at every 1 Mtr intervel and proprly packed with approx 150 mm boulders including transportation and placing at indicated places as per direction of Engineer -in-charge including contractor tools, plants, labours royalty charges etc. complete in all respect and stitching with lacing wire of dia 2.2/3.2mm (ID/OD) @ 5% by weight of Gabion boxes carrying the material by head lead from nearest approcah with all safety precautions and all leads and lifts.	cum	3000.00	3700.00	11100000.00	
9	NS-4	Earthwork in filling in Embankment Fill and Prepared Sub-grade of formation including guide bunds, around buried type abutments, bridge approaches, trolley refuges etc using Railway's earth/ Muck generated from excavation of Underground & other works and dumped at the location of the bank or nearby, of approved quality as per RDSO guidelines for design /Construction of formation on Indian Railway track issued vide RDSO specification RDSO/2018/GE:IRS-0004 (D) Part-IV dated July 2019, procured from railway land including site clearances, setting out and demarcation, benching, initial compaction of subsoil after leveling the surface after site clearance, spreading loose earth in layers of maximum 30 cm thickness using grader up to extra width of 0.5 m beyond designed profile, compaction using vibratory compactors, top and side dressing and removal of extra earth from sides to provide final formation as per designed profile as per RDSO Guidelines. The rate shall include cutting of trees with girth upto 30 cm, making good the pockets and depressions left in soil during clearing and uprooting of jungle/trees at site and initial compaction of sub-soil thereafter. The rate shall not include cutting of trees of girth beyond 30 cm and compaction (excluding initial compaction of sub-soil mentioned above), which shall be paid separately. The minimum Ev2 Criteria as mentioned in the guidelines of 2009 is not applicable. The rate shall include cost of all field and laboratory tests including those required for subsoil but excluding CBR tests which will be paid vide separate BOQ item. The rates include segregation of Boulders from the Tunnel Muck. However, the mechanical compaction in layers shall be paid separately under relevant item. Note: 1. Lead for the muck generated from excavation of Underground and other works is included in the BOQ item A1 & A4 of Bill no. A. 2. Lead for railway's earth includes up to 200 m. 3. Royalty on Railway's earth/Muck (being used for formation filling), if applicable will be borne by RVNL.	Cum	103149.00	89.09	9189544.00	
10	NS-5	Providing and laying blanketing materials of specifications as per RDSO guidelines for design /Construction of formation on Indian Railway track issued vide RDSO specification RDSO/2018/GE:IRS-0004 (D) Part-IV dated July 2019, using graders and compaction using vibratory compactors, top and side dressing to provide final formation as per designed profile. The rate shall not include compaction, which shall be paid separately. NOTE:1) If naturally available materials do not meet the laid down specifications, the blanket material has to be produced by mechanical process using mechanical crushing or mechanical blending method or combination of these two methods as given in the Appendix-C of RDSO Guidelines and Specifications for Design of Formation for Heavy Axle Load -2009. The rate for this item is inclusive of the production of material by mechanical process as per above mentioned RDSO guidelines and in case such mechanical process is not required to be used in providing and laying of blanketing material due to availability of natural blanketing material conforming to laid down specifications, the rate of this item shall be reduced by Rs. 250/- per cum. 2) The filter criteria and minimum EV2 Criteria as mentioned in the guidelines of 2009 is not applicable. 3) The rate shall include cost of all field and laboratory tests except CBR tests which will be paid vide separate BOQ item. 4) The Latest guidelines for Design / Construction of formation on Indian Railway track, issued vide RDSO specification RDSO/2018/GE:IRS-0004 (D) Part-IV dated July 2019 shall be adopted for this item. The basic instructions (other than those contained in the latest guidelines dated July 2019) detailed in GE: G-1 of 2003 and GE:0014 of 2009 shall continue to apply.	Cum	18728.00	1179.00	22080312.00	
11	NS-6	**Earth work in cutting** in foundation, trenches, pucca drains in station area/block section etc in all kinds of soil including dressing of sides, ramming of bottoms, back filling of trenches, getting out the excavated soil and disposal of surplus excavated soil with all lead and lift as directed by the Engineer.					
	NS-6 a	In all kinds of soil	Cum	5000.00	172	860000.00	
	NS-6 b	In ordinary rock	Cum	4000.00	278	1112000.00	
	NS-6 c	Hard Rock (requiring blasting)	Cum	3400.00	499	1696600.00	
	NS-6 d	Hard Rock (blasting prohibited)	Cum	2200.00	647	1423400.00	
	NS-6 e	Extra over item NS-6 c for cutting in rock requiring controlled blasting	Cum	3400.00	69	234600.00	
					Sub Total Amount	**34,03,05,038.00**	

Bill No. 2A: Bridge Work (Other than Steel items)							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
1	2001	Earth work in excavation in foundation of bridges to desired profile including backfilling, compaction of back fill, and disposal of surplus earth as per directions of the Engineer.					
	2001 a	Soil excluding rock.	Cum	4000.0	302.00	1208000.00	
2	NS-2003	Providing and laying M 10 cement concrete in foundation and floor using well graded stone aggregate of 40 MM nominal size. ***(Rates are inclusive of Cement)***	Cum	194.00	5262.00	1020828.00	
3	NS-2005	Providing and laying Design mix control concrete M25/M30/M35/M40 in cast-in-situ RCC works of raft, pile cap, pier, abutment, well steining, RCC well kerb, well cap, pier cap, Jacketing, dirt wall, return wall, wing wall, fly wing wall, retaining wall, approach slab, foot path slab, wearing course, ballast retainers, RCC railing, inspection platform, pedestal, boxes and other miscellaneous works using well graded stone aggregate of 20 MM nominal size. ***(Rates are inclusive of Cement)*** Note: Extra @ 32% of the rate for concreting done for the jacketing work under this item shall be payable and shall deem to include cost of surface preparation, drilling of holes, insertion of dowel bars and grouting of holes etc. required for the work but exclude cost of dowel bars which shall be payable separately under relevant BOQ item.	Cum	2876.00	8947.00	25731572.00	
4	2015	Providing and laying dry stone backing behind abutments, wing walls, return walls, RCC boxes with stones not less than 15 CM in any direction and not less than 15 KG (except smaller boulders required for filling voids) in weight.	cum	1500.00	1119.00	1678500.00	
5	2016	Providing and laying backfill material behind boulder filling of abutments, wing walls, return walls consisting of granular materials of GW, GP, SW groups as per IS 1498-1970 in required profile .	Cum	1400.00	414.00	579600.00	
6	2017	Providing and laying 300 MM thick dry stone pitching in flooring, exposed slopes, etc. with boulders of not less than 30 KG each in weight, hand packed with surface levelled off to the correct section with hammer dressing as necessary including filling the gaps with quarry spalls.	Cum	2000.00	1125.00	2250000.00	
7	2032	Providing and fixing of 75 MM dia PVC pipe for weep holes in abutments, wing walls, return walls, face wall, retaining wall etc at suitable intervals as directed by the Engineer-in-charge.	Meter	2500.00	220.00	550000.00	
8	NS-1	Dismantling of existing structures like culverts, bridges, retaining walls and other structure comprising of masonry, cement concrete, wood work, steel work, including T&P and scaffolding wherever necessary, sorting the dismantled material, disposal of unserviceable material and stacking the serviceable material with all lifts and lead of 1000 metres of Prestressed / Reinforced cement concrete grade M-20 & above by Mechanical means.	Cum	2000.00	1073	2146000.00	
9	NS-2	Providing and erection of specified grade precast RCC facia panels of thickness 180 mm made with M-35 grade concrete batching plant transit mixer, concrete pump and vibrator for retaining earth with all elements and accessories including reinforcing elements complete as per approved drawing and clause 3100 of MoRT&H specifications including all material, labor, machinery etc and Providing, placing and compacting to desired approved density, backfill material in layers as per approved methodology including testing for reinforced fill portion and random fill portion in the approaches between the reinforcement soil (RS) wall panels as per approved drawings as per clause 3103 of MoRT&H specification. The soil should be pre dominately coarse grained not more than 10% particle should pass 75 micron sieve. The item shall be measured and paid to the finished surface area (Scope of work includes casting in yard, curing, storing, transporting, lifting, placing in position, errection with all necessary fasteners etc. complete in all respect.).The rate shall include cost of material, labour, plant, royalties, handling, storage and transportation lead & lift expenses, cost of bed block, leveling pad, facia elements, capping beam,connectors, reinforcing elements, scaffolding, supply of the specified filter media material,supply of soil fill for the reinforced as well as unreinforced zone of the quality specified in the contract, placing, spreading and compaction through mechanical means.	Sqm	1000.00	14100	14100000.00	
					Sub Total Amount	**4,92,64,500.00**	

Bill No. 2B: Bridge Work (Steel items involving Fabrication and Eraction)							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
2	2059	Providing steel girders duly launched in position on piers/abutments as per drawing with contractor's steel of grade & quality as per IRS: B1-2001 along with up to date A&Cs, duly tested including fabrication, assembly, erection, launching etc. as per QAP approved by RDSO. Rate shall include all activities for delivering the end product except bearings, stud shear connectors, galvanising and painting of girder components including surface preparation, charpy test, steel channel/ H beam sleepers, chequered plate pathways, and railings, which shall be paid separately under relevant items. **Note: (i)Payment to be made in stages as per RVNL standard specifications Vol I, Part: A- Chapter 3 "Bridges" (h) Steel Works Clause 8.2, para 8.2.2 along with up to date A&Cs.**	MT	53.00	147361.00	**7810133.00**	
3	2067	Supplying and testing of nominal headed stud shear connectors of 25 mm dia and 200 mm length (finished size) conforming to SD1 type material of ISO 13918 along with ferrules and including fitting,fixing & welding with studs guns etc to top flange of Girder for deck slab as per RDSO guidelines contained in report NO.BS 115 (Revision 1) April 2016 for RDSO drawings for composite construction. Note : In case stud shear connector of any other size is required to be provided then payment shall be made on the pro-rata basis in proportion of the weight of the stud shear connectors.	NO'S	1082.00	329.00	**355978.00**	
4	NS-1	Extra over Item 2059 for providing steel conforming to Higher Grade of E-350-C with copper bearing.	MT	40.00	5371.00	**214840.00**	
5	NS-2	Design, Manufacturing, supplying, testing and installation as per RDSO specification and guidelines including anchor plates, all type bolts etc for complete set in all respect including transportation to the site, painting with approved paint as directed by engineer. The load data will be supplied by RVNL. The rates shall also include preparation of Drawings, securing approval from project engineers and assist in proof check from nominated consultant by RVNL, preparation of maintenance manual, replacement procedure etc for the spherical bearing supplied, and all taxes, duties etc. complete. **For Set consisting of four bearings for 24.4 m span (Composite Girder)**	set	4.00	4557000.00	**18228000.00**	
6	NS-3	Supplying and fixing of High strength friction Grip bolts 10.9 Gradefinish Zinc phosphate as per IS 3757:1985 and IS:4000:1992 including HSFG Nuts as per IS 6623 : 2004 and washers to IS 6649:1985 s per drawings, specifications and as directed by Engineer-in-charge a) 24 mm dia of bolts (L=200mm)	NO'S	1320.00	203.00	**267960.00**	
					Sub Total Amount	**2,68,76,911.00**	

Bill No. 2C: Bridge Work (Supply of Steel items)							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
1	2076	**Supplying TMT Fe-500/Fe-500D* reinforcement steel** conforming to IS:1786-1985 including decoiling, straightening, cutting, bending, placing in position, binding with 1MM dia GI binding wire. **Note :** 1. Reinforcement, shall be measured in length for different diameters used in the works and then paid as per standard weights as per IS 1732. Wastages, overlaps, coupling, welded joints, space bars, chairs and binding wire shall not be measured and cost of these items shall be deemed to be included in the rates. 2. * For seismic zone III, IV & V, only TMT Fe-500D steel shall be used.	MT	302.00	82942.00	25048484.00	
					Sub Total Amount	**25048484.00**	

Bill No. 9: Site Facility							
S.No.	**Item No.**	**Description of item**	**Unit**	**Quantity**	**Rate (In Rs.)**	**Amount (In Rs.)**	**Reference to Work Requirement (Section-5)**
1	9001	**Providing site offices for Employer** with Contractor's material, Labour, Tools and Plant, Equipment etc. including provision of Water Supply, Drainage, Power arrangements, office maintenance as per the details mentioned in clauses 3.1 to 3.2.8 & 3.5 to 3.5.2 of Chapter 3 (Site Facilities for the Employer and the Engineer) of Section 5 (Work's Requirement) of Tender Documents. Note 1: This item is provided with the contention that new site offices will be constructed for this purpose and 75% payment of the accepted rates will be made after making available functional office, balance 15% payment shall be made at the end of the completion period and the remaining 10% will be paid after clearance of site by the contractor. Note 2: Alternatively if suitable accommodation is available on hire basis at suitable location acceptable to the employer, the contractor can arrange the same under the item but in such a case the payment shall be regulated as below. (a) 10% payment shall be made on completion of one month from the date of making available the office fit for functioning. b) Remaining 90% payment shall be paid in equal monthly instalments that is (0.9xQuoted rate) / (Stipulated Completion period in months + defect liability period in months). Note 3: In case stipulated period gets extended, payment on monthly basis, under this item, in such extended period, shall be made as under; (i) in case of new construction @ [(54% of Quoted rate) / (Stipulated Completion period in months + defect liability period in months)] per Sq.m. of Plinth area. (ii) in case of accommodation on hire @ [(90% of Quoted rate) / (Stipulated Completion period in months + defect liability period in months)] per Sq.m. of Plinth area.	Sq.m. of Plinth area	292.00	17997.00	5255124.00	3.2, 3.5
2	9002	Providing Furniture as given under clauses 3.3, 3.3.1 of Chapter 3 (Site Facilities for the Employer) of Section 5 (work's Requirement) of Tender Documents. Note: Payment shall be made @ 75% of the accepted rate after making available the furniture items in functional office, balance 15% payment shall be made at the end of the completion period and the remaining 10% will be paid after clearance of site by the contractor.	L S Per Site Office	1.00	1397828	1397828.00	3.3
3	9003	Providing Road Vehicle mentioned below for the use of Engineer/Employer as per the Conditions mentioned in Clause 3.4.3, i.e 3.4.3.1 to 3.4.3.3 of Chapter 3 (Site Facilities for the Employer and the Engineer) of Section 5 Work's Requirement) of Tender Documents.					3.4
	9003a	INNOVA, MAHINDRA XUV500 or similar	Vehicle months	162.00	75133.00	12171546.00	3.4.3
	9003b	BOLERO, SCORPIO, ERTIGA, MARAZZO or similar	Vehicle months	540.00	64649.00	34910460.00	3.4.3
	9003c	Extra for running and maintenance of every additional km over and above 4000 kms as specified in item 9003 (a)	Per km	50000.00	17.50	875000.00	3.4.3
	9003d	Extra for running and maintenance of every additional km over and above 4000 kms as specified in item 9003 (b)	Per Km	50000.00	14.00	700000.00	3.4.3
4	9004	Providing computers with software, printers and other office equipment as given under Clause 3.6 of Chapter.3 (Site facilities For the Employer)of Section-5 (Work's requirement) Of bidding documents: NOTE: i) Payment shall be made @ 85% of the rate after making available the office equipment in functional condition. ii) Next 10% of the rate shall be paid at the end of the completion period. iii) The remaining 5% of the rate shall be paid after the eqipment is taken back by the contractor and the site is cleared by the contractor.	LS per site office	1.00	1248970.00	1248970.00	3.6
5	9005	Providing 36 inch large format colour Plotter – Model HP T830 Designjet Multifunction plotter or similar/better. Note: (i) Payment shall be made @ 85% of the rate after making available the equipment in functional condition, (ii) Next 10% of the rate shall be paid at the end of the completion period. (iii) The remaining 5% of the rate shall be paid after the equipment is taken back by the contractor and the site is cleared by the contractor.	Each	1.00	248900	248900.00	
6	9006	Providing 150CC or higher Motor Bike Bajaj Pulsar/HondaCB Hornet 160R/ Hero Xtreme Sorts/Suzuki Gixxer or Similar for the use of Engineer/Employer as per the Conditions mentioned in Clause 3.4.2 & 3.4.3, of Chapter 3 (Site Facilities for the Employer and the Engineer) of Section 5 Work's Requirement) of Tender Documents.	Bike Months	270.00	10400.00	2808000.00	3.4.2.1
	9006 a	Extra for running and maintenance of Motor Bike for every additional km over and above 2500 kms as covered under item 9006	Per km	10000.00	2.3	23000.00	3.4.2.1
					Sub Total Amount	**5,96,38,828.00**	

Bill No. A: UnderGround Excavation							
S.No.	**Item No.**	**Description of item**	**Unit**	**Quantity**	**Rate (In Rs.)**	**Amount (In Rs.)**	**Reference to Work Requirement (Section-5)**
1	A1	Underground excavation (Full Face, Top Heading, Bench, Invert Arch) for the Main Tunnel, Escape tunnels & Cross Passages, including temporary provision at the portal for the start of tunnel excavation like canopy structure (false portal) etc, Laybys, Cross passage and Transfromer halls and for the connection of remaning part of Adit tunnel (Approx. 50m) with the Main Tunnel including drilling, blasting, or other means of excavation including widening of top heading footings, breaking of shotcrete, lining in temporary invert, provision of surface drainage, construction ventilation, lighting arrangement during construction, temporary backfilling for traffic in tunnel, profiling / reprofiling of tunnel as per approved cross sections, removal and disposal of excavated material including temporary backfill to dumping site with all lifts and leads up to 2 kms from portals / shaft head as per approved drawings and specifications or as directed by Engineer. (Ö-Norm-2203)					Chapter 8.0 of Annexure-A
	A1.1	Excavation in Support Section Type **B1**	Cum	190537.00	1952.00	371928224.00	8.12.1, 8.22
	A1.2	Excavation in Support Section Type **B2**	Cum	343248.00	2416.00	829287168.00	8.12.1, 8.22
	A1.3	Excavation in Support Section Type **C1**	Cum	171491.00	2566.00	440045906.00	8.12.1, 8.22
	A1.4	Excavation in Support Section Type **C2**	Cum	112256.00	2566.00	288048896.00	8.12.1, 8.22
	A1.5	Excavation in Support Section Type **C3**,**C4**	Cum	200362.00	3988.00	799043656.00	8.12.1, 8.22
	A1.6	Excavation in Support Section Type **P**	Cum	25984.00	3988.00	103624192.00	8.12.1, 8.22
2	A2	Additional Excavation for niches in all class categories (Except Laybys, Cross passages and Transformer halls/technical rooms)	Cum	22311.00	3443.00	76816773.00	8.9, 8.22.3
3	A3	Extra for tunnel excavation due to excessive water inflow of more than 50 l/sec	Cum	9964.00	371.00	3696644.00	8.22.6.i
4	A4	Extra for transportation of spoils over 2 km to 10 km from the portal / shaft head	Cum-km	855443.00	32.00	27374176.00	8.22.1.ii.T
5	A5	Removal of muck resulting from Geological overbreak (Measurements will be taken with Tunnel laser scanner or as decided by engineer). Rate to include all associated costs including ventilation and transport and disposal of material lead upto 2 km from tunnel portal.	Cum	10439.00	991.00	10345049.00	8.22.2.ii
6	A6	Extra over item A1 for excavation using Fully and Semi Automatic Jumbo defined in works requirement inside tunnel in lieu of Manual 2 boom Jumbo:					
	A6.1	Jumbo (Type-1) Automatic	Cum	521939.00	274.00	143011286.00	
	A6.2	Jumbo (Type-2) Semi-Automatic	Cum	521939.00	56.00	29228584.00	
7	A7	Extra over item A1 for loading muck using Wheel loader and continuous loader defined in works requirement in lieu of Hydraulic excavator:					
	A7.1	Wheel loader	Cum	521939.00	44.00	22965316.00	
	A7.2	Continuous loader	Cum	521939.00	130.00	67852070.00	
					Sub Total Amount	**3,21,32,67,940.00**	

Bill No. B1: Support System: Rock Bolts and Other Steel Supports etc.							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)- Annexure-A
B1.1 - ROCK BOLTS/ANCHORS & MICROPILES							
1	B1.1.1	SN Bolts: Supply, drilling, installation and grouting of **SN type** rockbolts of the specified length, Yield strength ≥500 MPa (slopes, tunnel support & face bolts) as per approved drawings and Specifications or as directed by Engineer, with contractors men, material, consumables, plants, equipments, machineries, including all lead & lifts loading , unloading etc required for the complete job.					10.8, 10.15.2, 10.15.5
	B1.1.1.1	Φ25 SN Bolts: Cement Grouted	Meter	793309.00	837.00	663999633.00	
	B1.1.1.2	Φ32 SN Bolts: Cement Grouted	Meter	22747.00	1349.00	30685703.00	
2	B1.1.2	SDA Bolts: Supply, drilling, installation and grouting of Φ32 Self-drilling anchor (SDA) bolts of the specified length, Yield load ≥230 KN (Slope, Tunnel Support and Face Bolts) as per approved drawings and Specifications or as directed by Engineer, with contractors men, material, consumables, plants, equipments, machineries, including all lead & lifts loading , unloading etc required for the complete job.	Meter	1069395.00	1898.00	2029711710.00	10.10, 10.13, 10.15.2, 10.15.5
3	B1..1.3	Fiber glass bolts: Supply, transporting to site, drilling, installation, testing and grouting of Fiber glass bolts of the specified length, 32/15, Yield load ≥ 500 KN (For Face Bolting) as per approved drawings and Specifications or as directed by Engineer, with contractors men, material, consumables, plants, equipments, machineries, including all lead & lifts loading , unloading etc required for the complete job.	Meter	55534.00	1524.00	84633816.00	10.14, 10.15.2
4	B1.1.4	Water Inflatable bolts Swellex or similar: Supply, drilling and installation of **Water Inflatable bolts Swellex or similar** rockbolts of the specified length, Fy≥ 150 KN (tunnel support) with contractor's men, material, consumables, tools & plants, equipments, machineries, including all lead & lifts, loading, unloading.	meter	213220	2679.00	571216380.00	10.9.1,10.9.2,10.9.3,10.5.2.iv
B1.2 - PIPE ROOF UMBRELLA							
5	B1.2.1	Supply, drilling hole, installation and grouting of pre-support elements (Pipe roofing) up to 139.7mm OD and up to 15m long with conventional drilling techniques at a shallow look out angle from the tunnel axis with specialised drill bit and casing systems providing direction control and installation accuracy as per approved drawings and Specifications or as directed by Engineer, with contractors men, material, consumables including grout coupling, plants, equipments, machineries, including all lead & lifts loading , unloading etc required for the complete job.					10.13.4, 10.15
	B1.2.1.1	Seamless pipe, OD Φ114.3mm, 6.3mm thick, Yield load ≥ 1200KN	Meter	10424.00	12032.00	125421568.00	
B1.3 - LIGHT FOREPOLING							
6	B1.3.1	Supply, drilling hole, installation and grouting of Light Forepoling elements with contractor's men, material, consumables (including grout coupling where required), tools & plants, equipments, machineries, including all lead & lifts, loading, unloading.					10.13.3, 10.15
	B1.3.1.1	Self-drilling Bolts, OD Φ32mm, Yield Load ≥ 230KN	Meter	124826.00	2096.00	261635296.00	
	B1.3.1.2	Reinforcement bars, dia. **Φ32mm**, Fy=500MPa	Meter	11096.00	958.00	10629968.00	

Bill No. B1: Support System: Rock Bolts and Other Steel Supports etc.							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)- Annexure-A
B1.4 - ARCHES/Steel Ribs/Lattice Girders							
7	B1.4.1	**Steel Ribs:** Fabrication and erection in position permanent tunnel steel ribs including of variable geometry and or member size as per design/assembly, using structural steel Grade A, Yield stress ≥250MPa with all accessories such as bolt/nuts, washers, plates, tie rods etc., including cutting, drilling, cold bending, welding, threading, leveling, aligning and fixing in position of all rods, gusset/ wall plates, pre-stressing by blocking against rock-surface etc. as per approved drawings and Specifications or as directed by Engineer with contractor's men, material, consumables, tools and plants, equipments, machineries, including all lead and lift, loading, unloading. Rate to cover supports & scaffoldings required during the course of erection etc. complete. Note: Payment for supply of structural steel shall be paid as per approved drawing (excluding all wastages) seperately as per item B3.3.	MT	299.0	34757.00	10392343.00	9.4.2, 9.4.3, 9.6.1
8	B1.4.2	**Lattice Girders:** Fabrication and erection of lattice girders using high strength reinforcing steel Fe-500D with all accessories such as bolt/nuts, washers, plates, tie rods etc, including all lead, lift, wastage, storing, drilling holes, fixing in phases etc. and installation of accessories for joining the Lattice girder segments and fixing into place as per approved drawings and Specifications or as directed by Engineer. The rate shall include costs of all materials except as noted below, labour, equipment, welding, etc for the complete job including additional cost for enlargement of top heading footing. (Payment for supply of reinforcement steel (excluding all wastages) will be made separately as per item B3.2.	MT	1684.00	31126.00	52416184.00	9.4.5, 9.6.2
B1.5 - REINFORCEMENT and Misc.							
9	B1.5.1	Wire Mesh: Supply, cutting, placing and fixing into position with appropriate anchors of 150x150x6 mm or 100x100x4 mm welded wire fabric of Yield stress ≥ 480 MPa as reinforcement in primary lining & inner lining with contractors men,material, cost of pins, hooks, consumables , tools & plants, equipments, machnieries, including all lead & lifts, loading , unloading, handling, wastage. Note: Measurement for payment for welded wire mesh provided shall be for the net area (without overlaps) actually installed.	MT	1476.00	104564.00	154336464.00	10.12.2, 10.15.4
10	B1.5.2	**Lining Stress controlers:** Providing and fixing lining stress Controllers (LSC) as per approved drawings and as per technical specification with contractor's men, material, consumables, tools & plants, equipments, machineries, including all lead & lifts, loading, unloading and as directed by Engineer-in-Charge, etc complete.	MT	1475.00	109389.00	161348775.00	9.4.6, 9.5.13, 9.6.4
					Sub Total Amount	**4,15,64,27,840.00**	

Bill No. B2: Support System: Shotcrete and Concrete Works							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
B2.1 - SHOTCRETE WORKS							
1	B2.1.1	M30 Shotcrete : Shotcreting with wiremesh/fibers as per design mix Shotcrete grade M30 as per approved drawings and Specifications or as directed by Engineer, in following works with contractors men, material, consumables (including additives), tools & plants, equipments , machineries, including all lead & lifts, loading, unloading, wastages, rebound, curing etc - Note : i) **Rates are inclusive of Cement.** Nothing extra will be paid for rebound. Note : ii) Payment for Supply of wiremesh / fibers will be done separately.					8.5.2, 8.5.3, 11.11, 11.13
	B2.1.1.1	Primary lining: Theoretical volume of primary (outer) lining of Tunnel & Niches as defined on the drawing and theoretical quantity computed for fixed thickness of 75mm at "A" Line as compensation for filling of irregular excavated profile.	Cum	122612.00	15748.00	1930893776.00	
	B2.1.1.2	**Secondary lining:** Shotcrete for Secondary (inner) lining of Tunnel & Niches. Measurement will be done for theoretical volume of secondary lining as defined on the drawing and volume corresponding to part of deformation not taking place. **Note: i) The rate includes cost of levelling, smoothening and finishing of exposed surfaces, curing etc.**	Cum	2530.00	16591.00	41975230.00	
	B2.1.1.3	Face ceiling, Filling of cavities, filling of GOB (Beyond "A" Line), filling shotcrete incase of pipe roof, widening of top heading footing, temporary shotcrete in multi drifting in tunnel as a complete job as per drawings and specifications and as directed by Engineer-in-Charge.	Cum	10439.00	15748.00	164393372.00	
	B2.1.1.4	100 mm/ 150mm thick sprayed concrete with grade M30 in slope stabilization with 100 mm/150mm (minimum) thickness as a complete job as per specifications and as directed by Engineer-in-Charge.	Cum	3452.00	15748.00	54362096.00	
	B2.1.1.5	30 mm average thickness of M30 shotcrete as smoothing layer and support of the waterproofing membrane, complying the requirement in planarity.	Sqm	354960.00	472.00	167541120.00	4.4.3(ix)A(b)
2	B2.1.2	Extra over item B2.1.1 for using Robo arm PLC controlled shotcrete with Low Pulsation S-Valve equipment as defined in works requirement in lieu of Non-PLC Old generation shotcrete equipment.	Cum	146748.00	832.00	122094336.00	
B2.2- CONCRETE WORKS							
3	B2.2.1	M30 & M25 Concrete: Design mix cement concrete as per approved drawings and Specifications or as directed by Engineer, in following works including machine mixed, machine batched, machine vibrated with contractor's men, material, consumables (including additives), tools & plants, equipments, machineries, all lead & lifts, loading, unloading, wastages etc complete. The rate includes cost of form work, shuttering, centering, scaffolding, fixing and removing thereof, levelling, finishing of exposed surfaces, curing etc. Note : a) **Rates are inclusive of Cement.** Note : b) Payment for fabrication and supply of reinforcement steel / fibers (excluding all wastages) shall be paid as per approved drawing separately.					15.3, 15.10, 15.20.1
	B2.2.1.1	M30 RCC for **Final** (Inner) lining of main tunnel & niches with Movable Shutter with hydraulic moving and adjustment facilities.	Cum	119549.00	11469.00	1371107481.00	
	B2.2.1.2	M30 RCC for **Final** (Inner) lining of main tunnel & niches (Invert slab , foundation beams)	Cum	22526.00	10481.00	236095006.00	
	B2.2.1.3	M30 RCC for small cast in place or precast, lightly reinforced concrete structures such as: manholes, drainage channels or gutters, cable troughts, concrete covers etc. Price includes supply and installation of cement mortar bed for levelling of precast elements.	Cum	11689.00	7835.00	91583315.00	
	B2.2.1.4	M25 concrete for **Primary** (outer) lining of Tunnel or Niches, temporary invert or back fill concrete or in lieu of shotcrete where shotcrete can not be applied because conditions in the tunnels will not allow it. The rate includes cost of form work, shuttering, centering, scaffolding, fixing and removing thereof, levelling, finishing of exposed surfaces, curing etc.	Cum	17375.00	7484.00	130034500.00	

Bill No. B2: Support System: Shotcrete and Concrete Works							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
4	B2.2.2	**M20 Concrete**: Design mix cement concrete M20 as per approved drawings and Specifications or as directed by Engineer, in following works including machine mixed, machine batched, machine vibrated with contractor's men, material, consumables (including additives) , tools & plants, equipments, machineries, all lead & lifts, loading, unloading, wastages etc complete. The rate includes cost of form work, shuttering, centering, scaffolding, fixing and removing thereof, levelling, finishing of exposed surfaces, curing etc. Note: a) **Rates are inclusive of Cement.** Note: b) Payment for supply of reinforcement steel shall be paid as per approved drawing (excluding all wastages)seperately.					15.3, 15.10, 15.20.1
	B2.2.2.1	Concrete above invert slab between foundation beams and walls of tunnel & niches up to the designated level.	Cum	32485.00	5795.00	188250575.00	
	B2.2.2.2	Encasing concrete: concrete placed around cable conduits, precast drains or cable trenches for encasement, below precast units for leveling etc.	Cum	9290.00	5795.00	53835550.00	
5	B2.2.3	Supplying and fixing footpath slabs in reinforced cement concrete in M-20 mix as per approved drawings and Specifications or as directed by Engineer (as drain covers in tunnels), with contractors 20mm approved graded stone aggregates and sand of approved quality, with contractors men, material,consumables,tools and plants, equipments, machnieries, including all lead and lift, loading , unloading etc. complete .The rate includes cost of form work, shuttering, centering, fixing and removing thereof,curing, levelling, finishing of exposed surfaces, mixing of concrete in mechanical mixer, compaction with mechanical/ electrical vibrators etc. Note: a) **Rates are inclusive of Cement.** Note: b) Payment for supply of reinforcement steel if any , shall be paid separately.	Cum	1710.00	5676.00	9705960.00	15.3, 15.10, 15.20.1
6	B2.2.4	M15 Concrete: Design Mix cement concrete M15 as per approved drawings and Specifications or as directed by Engineer,in following PCC works including mechanically mixed, machine batched, machine vibrated with contractors men, material, consumables (including additives), tools & plants, equipments, machineries, all lead & lifts, loading , unloading, wastages etc complete. The rate includes cost of form work, shuttering, centering, scaffolding, fixing and removing thereof, levelling, finishing of exposed surfaces, curing etc. **Note: Rates are inclusive of Cement.**					15.3, 15.10, 15.20.1
	B2.2.4.1	Fill concrete in tunnel.	Cum	5.00	7808.00	39040.00	
	B2.2.4.2	Blinding concrete in tunnel, lean concrete etc	Cum	3.00	7808.00	23424.00	
7	B2.2.5	No-fines porous concrete in tunnel. **Note: Rates are inclusive of Cement.**	Cum	516.00	7086.00	3656376.00	
8	B2.2.6	Cement concrete M-10 mix laid in situ by approved mechanical means by concrete pump, placer or similar equipment in back filling the gap between concrete lagging and excavated line for side walls, roof of tunnel and man refuges, etc. with 20mm graded stone aggregates and sand of approved quality with contractors men, material, consumables,tools and plants, equipments, machnieries, including all lead and lift, loading , unloading as directed by Engineer-in-Charge etc. complete.The rate includes cost of form work, shuttering, centering, scaffolding, fixing and removing thereof,curing, levelling, mixing of concrete in mechanical mixer, compaction with mechanical/ electrical vibrators etc. Note : **Rates are inclusive of Cement.**	Cum	250.00	6946.00	1736500.00	15.3, 15.10, 15.20.1
9	B2.2.7	Supplying and fixing 50 mm or 75 mm thickness precast RCC lagging of M 20 grade Mix, as per approved drawing over permanent tunnel supports continously placed and closed spaced with 20 mm graded stone aggregates and sand of approved quality with contractors men, material,consumables,tools and plants, equipments, machnieries, including all lead and lift, loading , unloading etc. complete .The rate includes cost of form work, shuttering, centering, fixing and removing thereof,curing, levelling, finishing of exposed surfaces, mixing of concrete in mechanical mixer, compaction with mechanical/ electrical vibrators etc. Note:- a) **Rates are inclusive of Cement** Note: b) Payment for supply of reinforcement steel shall be paid seperatly	Cum	6.00	6234.00	37404.00	9.4.4, 9.6.3
					Sub Total Amount	**4,56,73,65,061.00**	

Bill No. B3: Supply of Steel Material							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
1	B3.1	**Supplying TMT Fe-500D reinforcement steel** conforming to IS:1786-1985 including decoiling, straightening, cutting, bending, placing in position, binding with 1mm dia GI binding wire. **Note :** 1. Reinforcement, shall be measured in length for different diameters used in the works and then paid as per standard weights as per IS 1732. Wastages, overlaps, coupling, welded joints, space bars, chairs and binding wire shall not be measured and cost of these items shall be deemed to be included in the rates.	MT	11007.00	82942.00	912942594.00	12.1, 12.9, 3.8 & 3.11
2	B3.2	Supplying TMT Fe-500D reinforcement steel conforming to IS:1786-1985 including all lead lift, labour, loading unloading, ascent, descent, crossings, royalty, taxes, transport (contractor's own), tools and plant complete.	MT	1684.00	58548.00	98594832.00	3.8 & 3.11
3	B3.3	Supply of structural steel of various sections confirming IS 2062 of Grade-A from approved manufacturers at various sites including all transportation and freight charges and all taxes, duties etc. with contractors men, material, tools & plants, equipments, machineries, testing, all lead & lifts, loading , unloading , etc complete	MT	299.00	60690.00	18146310.00	3.8 & 3.11
					Sub Total Amount	**1,02,96,83,736.00**	

Bill No. C: Drainage and Miscellaneous Work							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
C1 - PERMANENT DRAINAGE							
1	C1.1	Drainage pipe: Providing and laying of HDPE pipe of following diameters in Tunnel as main collector pipe, connection pipes, cleaning access pipes, pipe sleeves and all fittings e.g. elbows, Tee's etc, including the cost of all materials, labour, equipments etc required for the completion of job as per approved drawings as a complete job as per IS : 14333 (Pressure Rating of PN-2.5) and as directed by Engineer-in-Charge					
	C1.1.1	400 mm dia pipe (main collector pipe)	Meter	9410.00	4,939.00	46475990.00	
	C1.1.2	315 mm dia pipe (main collector)	Meter	9410.00	3,059.00	28785190.00	
	C1.1.3	200 mm dia pipe	Meter	374.00	2,039.00	762586.00	
	C1.1.4	160mm dia pipe (connection pipes, cleaning access pipes)	Meter	409.00	1,530.00	625770.00	
2	C1.2	Perforated drainage pipe: Providing and laying of perforated (slotted) PVC pipe wrapped with geotextile, of following diameters in tunnel as lateral drainage pipes along the sidewalls and C&C with all fittings e.g. sleeves, Tee's etc, including the cost of all materials, labour, equipments etc. as per required for the completion of job as per approved drawings as a complete job as per IS 16098 Part-2 with perforation as per IS 9271 and as directed by Engineer-in-Charge.					
	C1.2.1	150 mm dia pipe (lateral drainage pipe)	Meter	38456.00	418.00	16074608.00	
	C1.2.2	200 mm dia pipe (lateral drainage pipes)	Meter	1000.00	744.00	744000.00	
	C1.2.3	250 mm dia pipe (lateral drainage pipes)	Meter	1000.00	1285.00	1285000.00	
3	C1.3	Providing and installing PVC pipes of following diameters in the tunnel including the cost of all materials, labour, equipments etc required for the completion of job as per approved drawings as a complete job as per IS Code 13592 and as directed by Engineer-in-Charge.					
	C1.3.1	75 mm internal diameter PVC pipe	Sqm	1000.00	71.00	71000.00	
	C1.3.2	110 mm internal diameter PVC pipe	Sqm	1000.00	119.00	119000.00	
	C1.3.3	160 mm internal diameter PVC pipe	Sqm	1000.00	153.00	153000.00	
3	C1.4	Providing and installing of perforated PVC pipes in drill holes in the tunnel protected by geotextile membrane, of following diameters including the cost of all materials, labour, equipments etc required for the completion of job as per approved drawings as a complete job as per IS 12818 (Plain/Casing Pipes) and as directed by Engineer-in-Charge.					
	C1.4.1	50 mm internal diameter PVC pipe	Meter	10000.00	142.00	1420000.00	
	C1.4.2	80mm internal diameter PVC pipe	Meter	4000.00	213.00	852000.00	
	C1.4.3	100 mm internal diameter PVC pipe	Meter	4000.00	285.00	1140000.00	
4	C1.8	Drilling of 40mm dia holes in shotcrete lining as weep holes/relief holes of required length in any direction of following length as per approved drawings as a complete job as per specifications and as directed by engineer in charge					
	C1.8.1	In underground, L=0.7m, 4 holes every approx 2m	Meter	18000.00	225.00	4050000.00	
	C1.8.2	In Open excavation, L =1.0m, every approx. 4sqm	Meter	1000.00	320.00	320000.00	
	C1.9	Drainage holes upto 35m length, 10m overlap for followings as per approved drawings as a complete job as per specifications and as directed by Engineer in charge					
	C1.9.1	Horizontal/ Sub horizontal in all kinds of rocks, diameter 50 to 90mm	Meter	4000.00	1258.00	5032000.00	

Bill No. C: Drainage and Miscellaneous Work							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
5	C1.9.2	Horizontal/ Sub horizontal in all kinds of soft ground, diameter 50 to 90mm	Meter	3000.00	2364.00	7092000.00	
	C1.9.3	Horizontal/ Sub horizontal in all kinds of rocks, diameter greater than 90mm	Meter	300.00	2172.00	651600.00	
	C1.9.4	Horizontal/ Sub horizontal in all kinds of soft ground, diameter greater than 90mm	Meter	200.00	4079.00	815800.00	
C2 - WATERPROOFING							
6	C2.1	**Geotextile**: Providing, laying and fixing of protective felt (geotextile) as per approved drawings and Specifications or as directed by Engineer,with a minimum weight of 500 g/m2 for protection of the waterproofing membranes & drainage on the finished outer lining surface including the cost of all materials, labour, equipments, etc required for the completion of job	Sqm	354960.00	455.00	161506800.00	4.4.3 (viii), 4.4.3 (ix)
7	C2.2	Membrane: Providing, placing, welding of 2mm thick PVC Water Proofing membrane with 20mm thick HDPE dimple sheet as per approved drawings and Specifications or as directed by Engineer including the cost of all materials, labour, equipments, etc. required for the completion of job.	Sqm	354960.00	1779.00	631473840.00	4.4.3 (viii), 4.4.3 (ix)
8	C2.3	Waterstops: Supply and installation of PVC waterbars and Hydrophilic waterstops with all accessories and special junctions for splicing, securing into place and protecting during concreting works , including the cost of all materials and junction pieces, labour, equipments, etc required for the completion of job.					
	C2.3.1	Construction Joints: PVC waterstop serrated with central bulb (240 mm wide, 8-11mm thick)	Meter	37401.00	672.00	25133472.00	
	C2.3.2	Power consumed for Pumping of Water as per the requirements and as per specificationd and as directed by the Engineer.(Payment will be made only for actual power consumed for Dewatering as per specifications and as per the certfied Log Book by the Engineer.) Note: Cost of Furnishing, Transporting, Installing the equipments and system including Pneumatic Pumps and its maintainance is covered under item A1 and A3.	kWh	1000000.00	25.00	25000000.00	4.6.1 (ii)
C3 - EARTHING							
9	C3.1	Earthing					
	C3.1.1	Longitudinal earthing flat bar, 40 x 4mm Galvanized iron, both sides of the Tunnel.	Meter	37640.00	202.00	7603280.00	
	C3.1.2	Transversal earthing flat bar, 40 x 4 mm, Galvanized Iron, incl. Extensions, Every 250m.	Meter	726.00	202.00	146652.00	
	C3.1.3	Connection bolts M8 with correspondent nuts and washers, made of brass.	Each	50.00	133.00	6650.00	
C4 - ELECTRICAL CABLE CONDUITS							
10	C4.1	Cable Ducts: Providing, laying and encasing in concrete PVC main longitudinal pipe and cross pipe of following diameters as electrical conduits with all fittings e.g. couplers, elbows etc, including the cost of all materials, labour, equipments etc. The cost of encasing concrete, concrete junction boxes, inspection pits or cable pull boxes will be covered separately as per relevent Indian Standard					
	C4.1.1	Cable Ducts diam. 50 mm pipe	Meter	21,643	133	2878519.00	
	C4.1.2	Cable Ducts diam. 70 mm pipe	Meter	18,820	190	3575800.00	
	C4.1.3	Cable Ducts diam. 100 mm pipe	Meter	18820.00	235.00	4422700.00	
	C4.1.4	Cable Ducts diam. 120 mm pipe	Meter	9410.00	282.00	2653620.00	
	C4.1.5	Cable Ducts diam. 160mm pipe	Meter	18820.00	385.00	7245700.00	
C5 - TUNNEL HAZARD WORKS							
11	C5.1	Placing in position of sand bags including supplying sand and filling the same in empty bags and tying with contractors binding wire, leading to tunnel site with contractors men, material, consumables, tools and plants, equipments, machIneries, including all lead and lift, loading, unloading etc. complete.	No.	9411.00	50.00	470550.00	

Bill No. C: Drainage and Miscellaneous Work							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
12	C5.2	Removal of sand bags, when not required and disposal thereof with contractors men, material, consumables, tools and plants, equipments, machineries, including all lead and lift, loading, unloading etc. complete	No.□	9411.00	13.00	122343.00	
13	C5.3	Supply ,manufacture and erection in position of temporary supports/ struts in hazardous position. Payment for supply of steel shall be paid as per approved drawing (excluding all wastages) seperately.	MT□	17.00	40819.00	693923.00	
14	C5.4	Dismantlling of existing permanent/ temporary supports and leading the cut supports to contractor's store/ depot etc with contractor's men,material, consumables, tools & plants, equipments, machineries, including all lead & lifts, loading, unloading, etc complete. Note: 1) Released material will be the property of contractor 2) Recovery of Rs 17500/MT will be recovered for the released structural steel	MT□	13.00	13182.00	171366.00	
15	C5.5	Cavity concreting through bores/pipes (Bores/pipes to be paid separately as specified below) with concrete of grade M10 or any approved mix using 10mm size aggregate with contractors men, material, consumables,tools and plants,equipments, machineries , including all lead and lift, loading , unloading etc. complete. Payment for supply of cement will be made separately as per actual consumption or approved mix proportions (nominal / design), which ever is lower.	Cum□	4484.00	3631.00	16281404.00	
16	C5.6	Drilling of bores 100 to 150mm dia. for cavity concreting through all types of soil/rock etc. with contractors men, material, consumables,tools and plants,equipments, machnieries , including all lead and lift, loading , unloading etc. complete(LS)	RMT□	2.00	3716.00	7432.00	
17	C5.7	Drilling holes upto 38mm dia. and upto 4000mm deep inside concrete or shotcrete or rock for contact or pressure grouting etc. with contractors men, material, consumables,tools and plants,equipments, machnieries , including all lead and lift, loading , unloading etc. complete.	RMT□	3.00	446.00	1338.00	
18	C5.8	Supplying and fixing of 100 to 150mm dia. MS pipe ('C' class) in bore holes for cavity concreting/ fixing with contractors men, material, consumables,tools and plants,equipments, machnieries , including all lead and lift, loading , unloading etc. complete.	RMT□	5.00	4706.00	23530.00	
19	C5.9	Fixing of anchor bars with contractors men, material, consumables,tools and plants,equipments, machnieries , including all lead and lift, loading , unloading etc. complete.	RMT□	15.00	557.00	8355.00	
20	C5.10	Forepoling with suitable structural steel (MS angles, Joist, rods etc.) including cutting to the required length, welding & driving in position with contractors men, material, consumables,tools and plants,equipments, machineries , including all lead and lift, loading,unloading etc complete. Note: 1. Payment for supply of reinforcement steel shall be paid separately. Note 2:-Payment for supply of structural steel shall be paid as per approved drawing (excluding all wastages) seperately.	MT□	10.00	21145.00	211450.00	
C6 - MISCELLENEOUS ITEMS							
21	C6.2	Providing & fixing Porta cabin of approved make (20ft x 10ft) with furnishing & toilet block facility at the designated places including the cost of all materials, labour, equipments, etc required for the completion of job. Note:- The contractor shall arrange for preperation of plinth for proper placement of these porta cabins.	Nos	3.00	508993.00	1526979.00	

Bill No. C: Drainage and Miscellaneous Work							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
22	C6.3	Providing and Fixing of safety fencing with 3 m high pre-coated GI corrugated sheet 0.50 mm, (+0.05%) total coated thickness, with 3.5 m high builtup tabular section as approved by Engineer in Charge placed every 1.8 m c/c founded in 1:2:4 grade concrete of size 60cm X 60cm X 60cm and buttress of same section at 5.4m c/c, similarly founded as verticals, with horizontal runners @ 600 mm c/c complete in all respect including all leads, lifts, ascents, descents etc. Cost of all materials and its maintenance till completion of work is deemed to be included in the rates. Item used as specified in DSR April 2019. **Note- Rates include posting charges of look out men (Minimum 02 men per shift per work site)on National Highway on either side of the work location.**	Sqm	3000.00	1894.00	5682000.00	
C7 - DISMANTLING, CLEANING REPAIR AND RESTORATION							
23	C7.1	Dismantling/ breaking Reinforced cement concrete including clearing of site and leading of broken concrete to disposal site with contractors men,material,consumables, tools & plants, equipments, machinaries, including all lead & lifts, loading , unload etc. complete.	Cum	25.00	9688.00	242200.00	
24	C7.2	Dismantling cement concrete including clearing of site and leading of broken concrete to disposal site with contractors men,material,consumables, tools & plants, equipments, machinaries, including all lead & lifts, loading , unloading , etc. complete	Cum	25.00	9688.00	242200.00	
25	C7.3	Dismantling stone work including clearing of site and stacking of the dismantled material with contractors men, material, consumables, tools & plants, equipments, machineries, all lead & lifts, loading, unloading etc. complete.	Cum	25.00	315.00	7875.00	
					Sub Total Amount	1,01,38,09,522.00	

Bill No. D-1: Ancillary Work							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
1	D1.1	Percussion Drilling of Holes for Probe/Grout Holes (Dia. 50-65mm).	RM	84194.00	836.00	70386184.00	14.10,14.13.2.ii
2	D1.2	Placing of Grout for consolidation grouting. Note: Grout material pumped inside hole will be paid separately.	Each Hole meter	2612.00	115.00	300380.00	14.10,14.12,14.13.3
3	D1.5	Carrying out Tunnel Seismic Prediction (TPS) Survey/ Measurement in tunnel with data processing, evaluation and Report submission in 3 copies (Hard and Soft) inculding all preparatory works and mobilization of requisite machineries, equipment, manpower, expert personnel and other field expenses, if any, including all lead and lift, taxes etc. complete.	Each Job	20.00	973017.00	19460340.00	8.13.1, 8.13.8
					Sub Total Amount	**9,01,46,904.00**	

Bill No. D-2: Supply of Grouting Material							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
1	D2.1	Supply of 53 grade cement OPC conforming to IS: 12269 with latest amendments and using the same in the work as per RVNL's approved mix design as per RVNL's prescribed rates of consumption including all lead lift, labour, loading unloading, ascent, descent, crossing of Railway lines(s), royalty, taxes, transport (contractor's own), tools and plant complete.	MT	4234.00	8920.00	37767280.00	14.7.3, 14.13.3.iii.A,3.7, 14.7.3, 14.13.3.iii.A
2	D2.2	Additional for Supply of 53 S Grade Cement OPC conforming to IS: 12269 with latest amendments over and above item D2.1	MT	2381.00	100.00	238100.00	11.6.2, 3.7, 11.6.2, 14.7.3 &14.13.3.iii.A
3	D2.3	Supply of Micro Fine Cement (D95<15 Microns)	MT	731.00	78993.00	57743883.00	14.7.4,14.13.3.iii .A
4	D2.4	Supply of Ultra Fine Cement (D95<12 Microns)	MT	400.00	97389.00	38955600.00	14.7.5,14.13.3.III .A
5	D2.5	Supply of Colloidal Silica MastreRoc MP 320 or Normet 400CS or similar	MT	230.00	153658.00	35341340.00	14.7.6,14.13.3.III .A
6	D2.6	Supply of two component PU grout like MastreRoc 364 Flex or TamPur 116T or similar (More than 35 Mpa compressive strength)	MT	160.00	509669.00	81547040.00	14.7.9,14.13.3.III .A
7	D2.7	Supply of two component PU grout (upto 40 times expansion)	MT	160.00	946838.00	151494080.00	14.7.9,14.13.3.III .A
					Sub Total Amount	**40,30,87,323.00**	

Bill No. E2: Supply of fibres for Tunnel							
S.No.		Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
1	E2.1	Poly fibers: Supply, weighing and mixing in shotcrete of PP Fiber- Class II (EN 14889-2), 45-55 mm long, Aspect Ratio ≥ 64, tensile strength ≥ 550 Mpa and Modulus of Elasticity ≥ 5GPa. Note: Supply of fibers shall be paid as per approved design mix for the volume of Primary / Secondary Lining measured for payment and Nothing will be paid for rebound or any wastage.	MT	190.00	562280.00	106833200.00	11.6.4, 11.9.3
2	E2.2	Poly fibers: Supply, weighing and mixing in final lining of PP Fiber- Class Ia (EN 14889-2), mono filament length 5-7mm, diameter < 20 microns, Melting point ≤ 165c. Supply of fibers shall be paid as per approved design mix for the volume of Lining measured for payment and Nothing will be paid for any wastage.	MT	180.00	478981.00	86216580.00	15.4.5
					Sub Total Amount	**19,30,49,780.00**	

Bill No. F: Monitoring of excavations/construction							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
1	F101	Bi-Reflex Paper target points along with break off point & 500 mm long 3D	Each	3998.00	3188.00	12745624.00	6.8.5.v,6.11
2	F102	Topographical markers/Survey Points	Each	200.00	2053.00	410600.00	6.7.3,6.11
3	F103	Vibrating wire type Load Cells Measuring Range: 30 T Over Range Limit: 150% with 20m cable	Each	445.00	23949.00	10657305.00	6.8.2,6.11
4	F104	Measuring Tape Extensometer Measuring Range: 30 m	Each	134.00	88953.00	11919702.00	6.8.4,6.11
5	F105	Tape Convergence Points	Each	800.00	616.00	492800.00	6.8.5,6.11
6	F106	Multiple point borehole extensometer 4 points (2m, 5m, 10m, 20m) Measuring Range: 50 mm	Each	60.00	71162.00	4269720.00	6.8.6,6.11
7	F107	Portable read out units for vibrating wire type instruments	Each	4.00	102638.00	410552.00	6.9,6.11
8	F108	Automatic weathering station with wind speed, air temperature, rainfall, relative humidity	Nos.	2.00	478975.00	957950.00	6.7.5,6.11
9	F109	Charges for permanent posting of Instrumentation Engineer	Month	54.00	205275.00	11084850.00	6.11.2
10	F110	Multi core cables					
	F110.1	12 core jelly filled armoured cable	RM	20000.00	226.00	4520000.00	6.7.6, 6.11
11	F111	Cable splicing kit	Each	400.00	547.00	218800.00	6.7.7, 6.11
12	F112	10 Channel Junction Box	Each	70.00	15054.00	1053780.00	6.7.8, 6.11
13	F113	Seepage Discharge measuring device	Each	70.00	68425.00	4789750.00	6.7.4, 6.11
					Sub Total Amount	**6,35,31,433.00**	

Bill No H: Approach Road for Tunnel and Muck Dumping Site							
S.No.	Item No	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
1	H1	**Construction of Embankment with materials deposited from Roadway/Hill side cutting:** Construction of embankment with approved/suitable materials deposited at site i.e. obtained from road way & hill cutting and excavation from drain and foundation of other structures, graded and compacted to meet requirement of table No.300-2 of MORT&H including all leads and lifts all complete as per drawings and Technical Specifications Clause 305 of MORT&H. (Materials as obtained from excavation and hill cutting will be used for construction of embankment on approval of Engineer in Charge).	Cum	12000	150.30	18,03,600.00	
2	H2	**Stone masonry work in cement mortar (1:3)** in substructure, retaining walls, breast walls and parapets, culverts etc all complete as per drawing and Technical Specifications section 1400 & 2706 of MORT&H including providing weep hole of size 110mmx80mm or 110 mm diameter. (Rate is inclusive of cement and form work as required)					
	H2.1	Random Rubble Masonry	Cum	4000	4357.00	1,74,28,000.00	
3	H3	Providing **PCC 1:3:6** nominal mix cement concrete in levelling course or foundation of retaining wall, wing wall, breast wall, drain, culvert, etc. with crushed stone aggregates 40 mm nominal size mechanically mixed, placed in foundation or any other place and compacted by vibration including curing for 14 days and centering & shuttering all complete as per drawing and Technical Specificationss Sections 1500 & 1700. (Rate is inclusive of cement).	Cum	600	5286.00	31,71,600.00	
4	H4	Providing **Plain/Reinforced** cement concrete in open foundation, coping of walls, retaining wall, wing wall, breast wall, drain, culvert, etc. with crushed stone aggregates 40 mm nominal size mechanically mixed, placed in foundation or any other place and compacted by vibration including curing for 14 days and centering & shuttering all complete as per drawing and Technical Specifications Sections 1500 & 1700. (Rate is inclusive of cement).				-	
	H4.1	PCC Grade M15	Cum	500	6119.00	30,59,500.00	
5	H5	**Laying Reinforced Cement Concrete Pipe NP4/ prestressed concrete pipe on first class bedding in Single row:-** Laying Reinforced Cement Concrete Pipe NP4 (IS-456) / prestressed concrete pipe for culverts on first class bedding of granular material in single row including fixing collar with cement mortar 1:2 but excluding excavation, protection works, backfilling, concrete and masonry works in head walls and parapets all complete as per drawings and Technical Specificationss Sections 2900 of MORT&H).				-	
	H5.1	1000 mm dia	Meter	800	7478.00	59,82,400.00	
6	H6	**Granular Sub-Base with Coarse Graded Material (Table: 400-2):-** Construction of granular sub base by providing coarse graded material, spreading in uniform layers with motor grader on prepared surface, mixing by mix in place method with rotavator at OMC, and compacting with vibratory roller to achieve the desired density, complete as per Technical specifications clause 401 and Grading Table:400-1 of MORT&H as decided by Engineer in Charge.				-	
7	H6.1	For grading-I material	Cum	800.00	2458.00	19,66,400.00	
	H6.2	For grading-III material	Cum	300.00	2550.00	7,65,000.00	

Bill No H: Approach Road for Tunnel and Muck Dumping Site							
S.No.	Item No	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
8	H7	**Water Bound Macadem:-** Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with vibratory roller 8-10 tonnes in stages to proper grade and camber, applying and brooming requisite type of screening/binding materials to fill up the interstices of coarse aggregate, watering and compacting to the required density all complete as per Technical Specifications clause No.406 of MORT&H. By Mechanical means Grading-I (Using Screening Crushable type such as Moorum or Gravel) Using Screening Type-A (13.2mm Agg.)	Cum	800.00	2872.00	22,97,600.00	
9	H8	Dense Graded Bituminous Macadam:- Providing and laying dense bituminous macadam with 100-120 TPH batch type HMP producing an average output of 75 tonnes per hour using crushed aggregates of specified grading, premixed with bituminous binder @ 4.0 to 4.5% by weight of total mix of mix and filler, tranporting the hot mix to work site, laying with a hydrostatic paver finisher with sensor control to the required grade, level and alignment, rolling with smooth wheeled, vibratory and tandem rollers to achieve the desire compaction as per MORT&H specification clause No.507 complete in all resect.				-	
	H8.1	For grading II (19 mm nominal size)	Cum	700	9618.00	67,32,600.00	
10	H9	**Prime Coat:** Providing and applying primer coat with bitumen emulsion on prepared surfaces of granular base including clearing of road surfaces and spraying primer at the rate of 0.60 Kg/Sqm using mechanical means all complete as per Technical Specifications Clause 502 of MORT&H.	Sqm	4000	27.78	1,11,120.00	
	H10	**Tack Coat:** Providing and applying tack coat with bitumen emulsion using emulsion pressure distributor at the rate of 0.20 Kg per Sqm on the prepared bituminous/granular surface cleaned with mechanical broom all complete as per Technical specification Clause 503 of MORT&H.	Sqm	4000	10.19	40,760.00	
11	H11	**Open-Graded Premix Surfacing:** Providing, laying and rolling of open-graded premix surfacing of 20 mm thickness composed of 13.2 mm to 5.6 mm aggregates either using penetration grade bitumen or cut back or emulsion to required line, grade and level to serve as wearing course on a previously prepared base, including mixing in a suitable plant, laying and rolling with a smooth wheeled roller 8-10 tonne capacity, finished to required level and grades all complete as per Technical Specifications clause 510 of MORT&H.				-	
	H11.1	Mechanical method using Penetration grade Bitumen and HMP of appropriate capacity not less than 75 tonnes/hour.	Sqm	4000	155.34	6,21,360.00	
12	H12	**Seal Coat:** Providing and laying seal coat sealing the voids in bituminous surface laid to the specified levels, grade and cross fall using Type A and B seal coats all complete as per Technical Specificaions clause 511 of MORT&H.				-	
	H12.1	Seal Coat - Type A	Sqm	4000	69.22	2,76,880.00	
13	H13	Maintanence of Tunnel invert Road surface and all approach roads from the NH-58 to work sites i.e.portals, Bridges, Muck Dumping Sites in good motorable condition in all respects and at all times to the satisfaction of the Engineer. This shall include scheduled maintanence with grader for removal of undulations, potholes etc. of all such roads atleast twice in a month. Cost of all material will be paid separately under schedule H	Maintanence Months	54	544420.00	2,93,98,680.00	
					Sub Total Amount	**7,36,55,500.00**	

Bill No. J: Environment Management Plan							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
1	J1	Monitoring of Environmental Attributes during Construction Activity					
	J1.1	Air Quality (Ambient Air Quality monitoring, as per NAAQM guide lines) and assess parameters such as Sulphur Dioxide (SO2), Oxides of Nitrogen (NOX), Carbon Monoxide (CO), Hydro-Carbons (HC), Suspended Particulate Matter (SPM), Respirable Particulate Matter (RPM), Ammonia (NH3), Ozone (O3), Lead (Pb), Benzo (a) pyrene (BaP), Arsenic (As) and Nickel (Ni)).					
	J1.1.1	Monitoring of Air Quality	Each Sample	300.00	8501.00	2550300.00	1.1,1.3.14,1.4.2
2	J1.2	Noise Levels (Noise level monitoring for monitoring Noise level on db (A) scale as per CPCB standard specifications)					
	J1.2.1	Monitoring of Noise Levels at Equipment Yards	Each Sample	300.00	5667.00	1700100.00	1.4.2
3	J1.3	Water Quality (Water Quality (As per IS 10500 and IS 2296) for parameters such as pH, BOD, COD, TDS, Pb, Oil & Grease and detergents for surface water, Water pH, TDS, Total hardness, Sulphate, Chloride, Fe and Pb).	Each Sample	300.00	8501.00	2550300.00	1.4.2
					Sub Total Amount	**68,00,700.00**	

ANNEXURE-G

Revised Vol -III

Revised Volume III of Bidding Documents can be downloaded free of cost from RVNL website www.rvnl.org . The Tenderer can also have a soft copy (CD) of Volume III from the RVNL office with address mentioned below:

Chief Project Manager,
Rail Vikas Nigam Limited,
Block No. 4, Rishilok, GMVN, Muni Ki Reti,
Rishikesh 249137, Uttarakhand Telefax:
0135-2442008
E-mail: himansu.badoni@rvnl.org

SPECIAL/PARTICULAR CONDITION OF CONTRACT

Section 7

Special Conditions of Contract

Part A: Contract Data

Section 7

Special/Particular Conditions of Contract

Part A: Contract Data

Section 7 - Special Conditions of Contract

The following Special Conditions of Contract (SCC) shall supplement the General Conditions of Contract (GCC). Whenever there is a conflict, the provisions herein shall prevail over those in the GCC

Part A - Contract Data

Conditions	Reference to GCC	Data		
Employer's name and address	1.1.2.2 & 1.3	Rail Vikas Nigam Limited (A Government of India Enterprise) 1St Floor, August Kranti Bhavan, Bhikaji Cama Place, R K Puram New Delhi -110 066 Tele: 91-11-26182963/69/70/72 Fax: 91-11-26182957		
Employer's Representative	1.1.2.6	Chief Project Manager, Rail Vikas Nigam Ltd. Block No. 4, Rishilok, GMVN, Muni Ki Reti, Rishikesh 249137, Uttarakhand Telefax: 0135-2442008 E-mail: himansu.badoni@rvnl.org		
Engineer's name and address	1.1.2.4 & 1.3 (b)	*Will be notified later*		
Defects Notification Period	1.1.3.7	180 days.		
Sections	1.1.5.6; 1.1.3.3 8.2, **8.7 & 8.13**	**Project Sections Name/Description** (Sub-Clause 1.1.5.6**)**	**Time for Completion** (Sub-Clause1.1.3.3 & 8.2**)**	**Percentage (for calculation of contract price under consideration under clause 8.7, 8.13)**
		CHAINAGE 91+228 to 101+339(FLS) (Tunnel No.13, Adit- 7 and all intermediate connecting embankments)	54 Months	**100%**
		ENTIRE WORKS	**54 Months**	**100%**
Electronic transmission systems	1.3 (a)	Not permitted		
Address for Communication to Employer	1.3 (b)	Chief Project Manager, Rail Vikas Nigam Limited, Block No. 4, Rishilok, GMVN, Muni Ki Reti, Rishikesh 249137, Uttarakhand Telefax: 0135-2442008 E-mail: himansu.badoni@rvnl.org		
Governing Law	1.4	The Laws of Republic of India		
Ruling language	1.4	English		
Language for communications	1.4	English		
Time for access to Site (after the date of commencement)	2.1	Starting from the date of commencement, contractor will be handed over access to entire work site except Adit-7 Construction work at Adit-7 is under progress by separate agency and access to Adit-7 will be made available to contractor within **6 months** from date of commencement.		

Conditions	Reference to GCC	Data
Performance Security	4.2 & 11.9	(a) The Performance Security shall be for an amount of 10% (Ten percent) of the Accepted Contract Amount excluding GST and in the same currency(ies) of the Accepted Contract amount in the prescribed form for the stated amount valid for a period of 28 days beyond issue of performance certificate. The contractor shall have the following options; (i) to submit full performance security for an amount equal to 10% of the contract price excluding GST; or (ii) to submit part performance security for an amount equal to 6% of the contract price excluding GST and the balance performance security shall be recovered from interim payment certificates @ 8% of the bill amount starting from 1st bill till it reaches full Performance Security. The contractor shall not be entitled to any interest on the amounts so recovered. However, the contractor shall be entitled for release of recovered amount of performance security against submission of bank guarantee of an equivalent amount, maximum three times during the contract. (b) Additional Performance Security, if any, shall be for an amount as determined by Employer in terms of ITB 35.5 and informed through letter of award and in the same currency(ies) of the Accepted Contract amount in the prescribed form valid for a period of 28 days beyond issue of performance certificate.
Normal working hours	6.5	Round the clock.
Commencement of works	8.1	**Within forty two (42) days from the date, Contractor receives Letter of acceptance.**
Delay damages for the Works	8.7	**1/25000 of the proportionate Accepted Contract Amount per day in the currencies and proportions in which the Contract Price is payable in case delay in completion of a particular section.**
Maximum amount of delay damages	8.7	**5% (Five percent) of the Accepted Contract Amount.**
Amount of bonus for early completion	8.13	**1% of the proportionate Accepted Contract Amount per month (part of the month to be excluded) in the currencies and proportions in which the Contract Price is payable in case early completion of a particular section.**
Maximum limit of bonus	8.13	**5% (Five percent)** of Accepted Contract amount of particular section.
State Capital Applicable	13.8 (c)(v)	*Dehradun*
Mobilization advance payment	14.2.1	Comprises of the percentage of Contract Amount payable in the currencies and proportions in which the Contract Amount is payable and in installments as mentioned below; **Mobilisation Advance** | **Installments** As per request of the Contractor subject to a maximum of 5%. | Two Equal of 2.5% each

Conditions	Reference to GCC	Data
Timing of Mobilization Advance Payment	14.2.1	First Installment within 21 (Twenty-one) days from the date of receipt of guarantee acceptable to Employer. Second Installment shall be released only when the contractor submits statement of having utilized the First Installment of mobilization Advance and the Employer is satisfied that the utilization has been done in purposeful manner. This shall be released within 21 days from the date of receipt of guarantee acceptable to the Employer.
Advance Payment against Plant and Machinery	14.2.2	The total advance for Plant and Machinery shall be limited to **15%** of the Contract price. Each time advance shall be paid within 21 days from the date of receipt of guarantee acceptable to the Employer subject to the fulfillment of other conditions of the sub-clause.
Interest on Advance Payment	14.2.1 & 14.2.2	At the rate of **9.05%,** simple interest per annum on reducing balances.
Repayment rate of Advance payment	14.2.4	13.5% (Thirteen and half percent) of the amount of each payment if the advance taken is 10%. 20% (Twenty percent) of the amount of each payment if the advance taken is 15%. If the total advance taken is less, the rate of recovery shall be proportionate. In case further advance is taken under sub-clause 14.2.1 and/or 14.2.2, after repayment has already been started, the Repayment Rate (R%) shall be revised in the next payment certificate as per following formula; **R = Ax100/(80 - % financial progress till previous payment certificate)** Where 'A' is total outstanding Advance as a percentage of Contract Price. If the Contractor returns part of the advance amount on his own or on the instructions of the Employer or in the event that the Contractor has failed to deposit the advance amount as per demand of the Employer and the Employer has subsequently encashed the Bank Guarantee(s), then the rate of recovery shall be suitably reworked considering the balance amount of advance due to be recovered and to ensure that the complete recovery of advance and accrued interest is made within 80% of the financial progress.
Percentage of Retention Money	14.3	**Deleted.**
Limit of Retention Money	14.3	**Deleted.**
Plant and Materials	14.5 (b) (i)	Not applicable
	14.5(c) (i)	Plant and materials when delivered at site are : 1.Cement 2. Reinforcement steel 3. Bridge bearings 4. Pre-stressed cables (High Tensile steel)

Conditions	Reference to GCC	Data
Employers' Bank details for LC **(a) Nodal Branch** **(b) Issuance/ reimbursing branch for LC**	14.7.1	(a) Punjab National Bank, Delhi IFSC Code. PUNB0198800 (b) Punjab National Bank, Rishikesh IFSC Code. PUNB0371400
Maximum Total Liability of the Contractor	17.6	Accepted Contract Amount
Periods for submission of insurance: **a) evidence of insurance** **b) relevant policies**	18.1	a) 14 days b) 28 days
Maximum amount of deductibles for insurance of Employer's risks.	18.2 (d)	NIL
Minimum amount of insurance by the Contractor for Works and Contractor's Plant and Materials including loss or damage to equipment.	18.2	100 (hundred) percent of Contract price
Minimum amount of insurance by the Contractor for Third party insurance including damage to Other Property and personal injury or death insurance for: a) for other people, and b) for Contractor's Employees.	18.3	Rs.2 (two) crores per occurrence without any limit for number of occurrences.
Jurisdiction of Courts	21	*Delhi*

Section 7

Special Conditions of Contract

Part B: Specific Provisions

Section 7

Special/Particular Conditions of Contract

Part B: Specific Provisions

SECTION – 7
PART B

PARTICULAR CONDITIONS OF CONTRACT

Whenever there is a conflict or inconsistency between the provisions of the Particular Conditions of Contract–Section 7 PART B and the General Conditions of Contract–Section 6, the provisions stipulated in Particular Conditions of Contract–Section 7 PART B shall prevail and supersede those appearing in the General Conditions of Contract–Section 6.

Section 7 – PART B - Particular Conditions of Contract

The following Particular Conditions of Contract (PCC) Section 7-Part B shall supplement the General Conditions of Contract (GCC) Section 6. Whenever there is a conflict, the provisions herein shall prevail over those in the GCC Section 6.

Table of Clauses

Reference to Sub Clause	Subject	Page No.	Remarks
1.5	Annexure 1- Priority of Documents	4	Replaced
3.3	Annexure-2- Instructions of the Engineer	5	Replaced
4.1	Annexure 3- Contractor's General Obligations	6-7	Replaced
4.2	Annexure 4- Performance Security	8-10	Replaced
4.4	Annexure 5- Sub-contractors	11-12	Replaced
4.8	Annexure 6- Safety Procedures	13-16	Amended
4.9	Annexure 7- Quality Assurance	17	Replaced
4.12	Annexure 8- Unforeseeable Physical Conditions	18	Replaced
4.21	Annexure 9- Progress reports	19	Replaced
7.8	Annexure 10- Royalties	20	Replaced
8.2	Annexure 11-Time for Completion	21	Replaced
8.3	Annexure 12-Programme	22	Replaced
8.4	Annexure 13- Extension of Time for Completion	23	Replaced
8.6	Annexure 14- Rate of Progress	24	Replaced
8.7	Annexure 15- Extension of Time for Completion with Delay Damages	25	Replaced
9.5	Annecure 16- Contractor's obligations	26	Replaced
13.8	Annexure 17 – Adjustments for changes in cost, Percentages governing Price Adjustment	27-28	Replaced
14.7	Annexure 18 - Payment	29	Replaced
15.1	Annexure 19 – Notice to Correct	30-31	Replaced
20.2	Annexure 20: Procedure for Amicable Settlement in Contracts	32-33	Replaced
20.3.12	Annexure 21 – Fee Structure for Arbitrators/ Reconciliators	34-36	

Annexure 1 to Section 7

1.5	**Priority of Documents**	The documents forming the Contract are to be taken as mutually explanatory of one another. For the purposes of interpretation, the priority of the documents shall be in accordance with the following sequence: (a) the Contract Agreement (if any), (b) the Letter of Acceptance, (c) the Letter of bid, (d) **The Addenda/ Corrigenda/ Correspondence with bidder.** (e) Special Conditions of Contract: (i) Part A – Contract Data (ii) Part B - Specific Provisions (f) the General Conditions of Contract (g) the Schedules (including Priced Bill of Quantities), (h) Specification, (i) the Drawings, (j) Works Requirements, (i) Employers Requirements (ii) Safety Requirements, and (k) **Bidding forms submitted by Bidder.** (l) any other documents forming part of the Contract. If an ambiguity or discrepancy is found in the documents, the Engineer shall issue any necessary clarification or instruction.

Annexure 2 to section 7B

3.3 Instructions of the Engineer	The Engineer may issue to the Contractor (at any time) instructions and additional or modified Drawings which may be necessary for the execution of the Works and the remedying of any defects, all in accordance with the Contract. The Contractor shall only take instructions from the Engineer, or from an assistant to whom the appropriate authority has been delegated under this Clause. If an instruction constitutes a Variation, Clause 13 [Variations and Adjustments] shall apply. The Contractor shall comply with the instructions given by the Engineer or delegated assistant, on any matter related to the Contract. Whenever practicable, their instructions shall be given in writing. If the Engineer or a delegated assistant, (a) gives an oral instruction and (b) receives a written confirmation of the instruction, from (or on behalf of) the Contractor, within two working days after giving the instruction, and (c) does not reply by issuing a written rejection and/or instruction within two working days after receiving the confirmation, (d) then the confirmation shall constitute the written instruction of the Engineer or delegated assistant (as the case may be). Site inspection register will be maintained by the Engineer or his representative in which the Contractor or his agent will be bound to sign day to day entries made by the Engineer or his representative. The Contractor is required to take note of the instruction given to him in site inspection register and should comply within a reasonable time. The Contractor will also arrange to receive all the letters etc. issued to him at the site of work.

Annexure 3 to section 7B

4.1 Contractor's General Obligations	The Contractor shall design (to the extent specified in the Contract), execute and complete the Works in accordance with the Contract and with the Engineer's instructions, and shall remedy any defects in the Works. The Contractor shall provide the Plant and Contractor's Documents specified in the Contract, and all Contractor's Personnel, Goods, consumables and other things and services, whether of a temporary or permanent nature, required in and for this design, execution, completion and remedying of defects. All equipment, and material, to be incorporated in or required for the Works shall be procured from approved sources as stipulated in the Contract. The Contractor shall be responsible for the adequacy, stability and safety of all Site operations and of all methods of construction. Except to the extent specified in the Contract, the Contractor (i) shall be responsible for all Contractor's Documents, Temporary Works, and such design of each item of Plant and Materials as is required for the item to be in accordance with the Contract, and (ii) shall not otherwise be responsible for the design or specification of the Permanent Works. The Contractor shall, whenever required by the Engineer, submit details of the arrangements and methods which the Contractor proposes to adopt for the execution of the Works. No significant alteration to these arrangements and methods shall be made without this having previously been notified to the Engineer. On completion of the works, the contractor shall arrange to furnish to the Employer three (3) bound sets as well as in editable format of all "As Built" drawings for every component of the Works at his own cost, as approved by the Engineer or his Representative. The Taking – over Certificate of the Works, as per the provisions of Clause 10.1 herein, shall not be issued by the Engineer in the event of the Contractor's failure to furnish the aforesaid "As Built" drawings for the entire works. If the Contract specifies that the Contractor shall design any part of the Permanent Works, then unless otherwise stated in the Special Conditions of Contract: the Contractor shall submit to the Engineer the Contractor's Documents for this part in accordance with the procedures specified in the Contract; these Contractor's Documents shall be in accordance with the Specification and Drawings, shall be written in the language for communications defined in Sub-Clause 1.4 [Law and Language], and shall include additional information required by the Engineer to add to the Drawings for co-ordination of each Party's designs; the Contractor shall be responsible for this part and it shall, when the Works are completed, be fit for such purposes for which the part is intended as are specified in the Contract; and prior to the commencement of the Tests on Completion, the Contractor shall submit to the Engineer the "as-built" documents and operation and maintenance manuals in accordance with the Specification and in sufficient detail for the Employer to operate, maintain, dismantle, reassemble, adjust and repair this part of the Works. Such part shall not be considered to be

	completed for the purposes of taking-over under Sub-Clause 10.1 [Taking Over of the Works and Sections] until these documents and manuals have been submitted to the Engineer. *Some of the documents for tunnelling work but not limited to, listed below are to be submitted by contractor in the required format : -* *a) Geological logs of face.* *b) Actual Rock classification & Support installed.* *c) Details of Instrumentation and 3D monitoring records.* *d) Record on final lining (class thickness, invert, reinforcement)* *e) Tunnel profiles of finished underground structures.* f) *Any other document required for future reference.*

4.2 Performance Security	The Contractor shall obtain (at his cost) a Performance Security and an additional Performance Security, if any in terms of ITB 35.5, for proper performance of the contract, for the amount, currencies and validity period for Performance Security stated in the Contract Data. If an amount is not stated in the Contract Data, this Sub-Clause shall not apply. The Contractor shall deliver the Performance Security and additional Performance Security, if any, to the Employer within 28 days after receiving the Letter of Acceptance, and shall send a copy to the Engineer. The Performance Security/additional Performance Security shall be issued by an entity and from within a country (or other jurisdiction) approved by the Employer, and shall be in the form as given in Section 8 (Contract Forms) or in another form specifically approved by the Employer. The Performance Security/additional Performance Security shall be, at the Contractor's option, in any of the following forms: An unconditional Bank guarantee in the prescribed format; or A Cashier's or Banker's certified cheque drawn on a Scheduled / Nationalized Bank in India in favour of "Rail Vikas Nigam Ltd" payable at New Delhi, The bank guarantee shall be from a bank having minimum net-worth of over INR 500 million from the specified banks as under: (i) a Schedule Bank in India, or (ii) a Foreign Bank having their operations in India, or (iii) a Foreign Bank which does not have operations in India is required to provide a counter-guarantee by State Bank of India, In case the contractor is a JV, the Performance Security and additional Performance Security, if any in terms of ITB 35.5, shall be submitted by each JV Partner separately on behalf of the JV in favour of RVNL in proportion of their respective percentage share specified in the JV Agreement. However, Submission of Performance Guarantee Security by individual partners on behalf of the JV shall in no way dilute their Joint & Several responsibilities. The Employer shall be entitled to recover the amount of Bank Guarantees individually and all the Partners jointly at its discretion." The Contractor shall ensure that the Performance Security/additional Performance Security is valid and enforceable until the Contractor has executed and completed the Works and remedied defects, if any. If the contractor does not complete the work for any reasons whatsoever, the terms of the Performance Security/ additional Performance Security specify its expiry date, and the Contractor has not become entitled to receive the Performance Certificate by the date 28 days prior to the expiry date, the Contractor shall be bound to extend the validity of the Performance Security/additional Performance Security until the Works have been completed and any defects have been remedied. The Guarantees shall be unconditional and irrevocable. The Employer shall return the Performance Security to the Contractor within 21 days after receiving a copy of the Performance Certificate or passing of the Final

	Payment Certificate whichever is later. However, on completion of specified section(s) and successful passage of defect liability period for such section(s) along with execution of any leftover works at the time of completion of such section(s), the contractor shall be entitled for release of 90% of the proportionate Performance Security calculated as specified in Contract Data subject to the condition that Engineer certifies that no recoveries are pending in the contract. In case Engineer points out amount to be recovered then the contractor shall be entitled for release of 90% of the proportionate Performance Security calculated as specified in Contract Data minus the amount to be recovered. The Employer shall return additional Performance Security submitted in terms of ITB 35.5 as per the following; (a) If the contractor submits an application stating that all the works against the particular schedule(s)/bill(s) for which additional Performance Security was submitted in terms of ITB 35.5 have been completed in all respect, then the Employer, on being satisfied with the claim of the contractor, shall return the full additional Performance Security against the particular schedule(s). Decision of the Employer regarding completion of works against a particular schedule/bill shall be final and binding on the contractor. (b) If the contractor submits an application stating that majority of the works (physical progress being not less than 90%) against the particular schedule(s)/bill(s) for which additional Performance Security was submitted in terms of ITB 35.5 have been completed and execution of balance works is held up for reasons not attributable to the Contractor, then the Employer, on being satisfied with the claim of the contractor, shall return 75% of the amount of additional Performance Security against the particular schedule(s). The balance amount of additional Performance Security shall however be returned only after completion of the works against the particular schedule(s)/bill(s) for which additional Performance Security was submitted in terms of ITB 35.5, in all respects to the satisfaction of the Employer. Decision of the Employer regarding completion of works against a particular schedule/bill shall be final and binding on the contractor. Without limitation to the provisions of the rest of this Sub-Clause, whenever the Engineer determines an addition or a reduction to the Contract Price as a result of a change in cost and/or legislation or as a result of a Variation amounting to more than 25 percent of the portion of the Contract Price payable in a specific currency, the Contractor shall at the Engineer's request promptly increase, or may decrease, as the case may be, the value of the Performance Security in that currency by an equal percentage Guarantee. Wherever the contract is terminated under Clause 15.2, the Performance Guarantee shall be encashed by the Employer: i) in full including additional performance guarantee amount, if any, taken in terms of sub clause 35.5 of ITB and not due for release on the date of issue of termination letter in terms of this clause, in case of termination of the contract as a whole; Or ii) at the discretion of the Employer it may be encashed in part/parts proportionate to the Contract price of the bill/schedule to which the terminated part of work belongs i.e. P=(A x B)÷C where

	P=Proportionate Bank Guarantee Amount. A=Contract price (excluding GST) of the particular bill/schedule to which the terminated part of work belongs. B=Performance Guarantee amount in terms of GCC sub clause 4.2. C=Total Contract price excluding GST. Plus additional performance Guarantee amount, if any, taken in terms of sub clause 35.5 of ITB and not due for release on the date of issue of termination letter in terms of this clause against this particular bill/schedule to which the terminated part of the work belongs, in case of termination in part/parts. The balance work should be got done separately, and independently by RVNL without risk and cost of the original contractor. The original contractor shall be debarred from participating in the tender for executing the balance work. If the failed contractor is a JV or a partnership firm, then every member/partner of such a firm would be debarred from participating in the tender for the balance work either in his/her individual capacity or as a partner of any other JV/partnership firm. In case the contractor fails to perform the contract or any JV partner fails to perform its obligations under the JV agreement, which is a part of this agreement, the Employer may issue notice of such default to the said JV partner or the JV (depending upon reasons of default) and declare the said JV partner or the JV as Poor Performer. The issue of such notice shall automatically debar the JV partner or JV, as the case may be, from participating in any RVNL tender from the date of issue of notice of default. The relevant performance security including additional performance security, if any, in terms of sub clauses 35.5 of ITB submitted by the Contractor or submitted on behalf of JV partner to the extent not due for release at the time of contemplation of such action shall be encashed and forfeited either fully or in proportion of the percentage share of that partner in the JV agreement, as the case may be.

4.4 Sub-contractors	The Contractor shall not subcontract the whole of the Works. The Contractor shall be responsible for the acts or defaults of any Subcontractor, his agents or employees, as if they were the acts or defaults of the Contractor. Unless otherwise stated in the Special Conditions of Contract: (a) The Contractor shall not be required to obtain consent to suppliers solely of Materials, or to a subcontract for which the Subcontractor is named in the Contract or as specifically provided in the Contract data or value of any sub-contract for Works, or the aggregate value of such sub-contracts with any Subcontractor, does not exceed 5% (five per cent) of the Contract Price provided that such works are not for the key activities in terms of clause 2.6 of section 3 (Evaluation and Qualification Criteria) which are to be executed by specialist subcontractor(s); (b) the prior consent of the Engineer shall be obtained to other proposed Subcontractors and/or suppliers. While submitting his proposal in this regard, the Contractor shall ensure that; *(i)* total value of Works requiring such consent for subcontracting shall not be more than 50% (fifty per cent) of the Contract Price. *No Sub-contracting is proposed to any of the JV Partner.* (ii) the proposed subcontractor must have executed woks of 40% of value of the proposed subcontract through a single contract during last seven years; and (iii) No banning/blacklisting/declaration as poor performer by RVNL is in force on the proposed subcontractor (on the date of grant of consent by the Engineer); (iv) No contract of the proposed subcontractor has been terminated by RVNL during the last two years (to be reckoned from the date of grant of consent by the Engineer); (v) the Contractor shall submit the proposal for subcontracting with the name, particulars and the relevant experience of the proposed subcontractor; (c) the Contractor shall give the Engineer not less than 28 days' notice of the intended date of the commencement of each Subcontractor's work, and of the commencement of such work on the Site; (d) each subcontract shall include provisions which would entitle the Employer to require the subcontract to be assigned to the Employer under Sub-Clause 4.5 [Assignment of Benefit of Subcontract] (if or when applicable) or in the event of termination under Sub-Clause 15.2 [Termination by Employer]; and (e) On getting consent from the Engineer, the Contractor shall provide to the Engineer copy of the agreement entered with such subcontractor. The Contractor shall ensure that the requirements imposed on the Contractor by Sub-Clause 1.12 [Confidential Details] apply equally to each Subcontractor.

	Where practicable, the Contractor shall give fair and reasonable opportunity for contractors from the Country to be appointed as Subcontractors. The Contractor shall endeavour to resolve all matters and payments amicably and speedily with the sub-contractors. The Contractor shall indemnify and hold the Employer harmless against and from any claim of subcontractors or suppliers of the materials. The Contractor shall release payment to the Sub-contractors/Suppliers promptly and shall endeavour to resolve all issues amicably and speedily with the Sub-contractors/Suppliers, so that the execution of work is not affected in any manner whatsoever. In case a Sub-contractor/Supplier represents to the Engineer in writing with supporting documents, stating that he has not received payment due as per the agreement/work or purchase order for the works executed by such Sub-contractor or supplies made by such Supplier, which have been covered in previous Payment Certificates and the Engineer finds such representation having merit, the Engineer, before issuing next Payment Certificate, may forward a copy of the representation to the Contractor requesting the Contractor to supply reasonable evidence that the amount stated to be outstanding by the Sub-contractor/Supplier for the works executed or supplies made, which have been covered in previous Payment Certificates has been paid and if not, why the same is not payable. The Engineer may recommend to make payment to the Sub-contractor/Supplier unless the Contractor submits reasonable evidence to the Engineer: (i) that the amount claimed has been paid, or (ii) satisfying the Engineer in writing that the Contractor is entitled to withhold or that the amount is not payable. On the recommendation of the Engineer, the Employer may (at his sole discretion) directly pay to the Sub-contractor/Supplier the amount due for and on behalf of the Contractor, part or all of such amounts previously certified (less applicable deductions) as are found due to the Sub-contractor/Supplier by the Engineer. The Employer shall adjust the amount paid directly to the Sub-contractor/Supplier from any amount due by it to the Contractor. The Contractor shall repay the amount; in case no amount is found due by the Employer to the Contractor. That the payment by Employer, on behalf of the Contractor to its Sub-contractor/Supplier, shall not alter any terms of agreement between the Employer and the Contractor and nor the same shall result in any privity of contract between the Employer and the Sub-contractor/Supplier.

Annexure 6 to Section 7B

4.8 Safety Provisions

(1) The Contractor shall comply with all the precautions as required for the safety of the workmen by the I.L.O Convention No.62 as far as they are applicable to the Contract. The Contractor shall provide all necessary safety appliances; such as safety goggles, helmets, masks, etc to the workmen and the staff.

(2) Suitable scaffolds shall be provided for workmen for all work that cannot safely be done from the ground, or from solid construction except for such short period work as can be done safely from ladders. When a ladder is used, an extra labourer shall be engaged for holding the ladder and if the ladder is used for carrying materials as well, suitable foot-holds and hand-holds shall be provided on the ladder, which shall be given an inclination not steeper than 1/4 to 1 (1/4 horizontal in 1 vertical)

(3) Scaffolding or staging more than 3.25 metres above the ground or floor, swung or suspended from an overhead support or erected with stationary support, shall have a guard rail properly attached, bolted, braced and otherwise secured at least 1-metre-high above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such openings as maybe necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying in from the support or structure.

(4) Working platforms, gangways and stairways shall be so constructed that they do not sag unduly or unequally, and if the height of any platform or gangway or stairway is more than 3.25 metres above ground level or floor level, it shall have closely spaced boards, have adequate width and be suitably provided with guard rails as described in (3) above.

(5) Every opening in the floor of a structure or in a working platform shall be provided with suitable means to prevent fall of persons or materials by providing suitable fencing or railing with a minimum height of one metre.

(6) Safe means of access and egress shall be provided to all working platforms and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9 metres in length. The width between side rails in a rung ladder shall in no case be less than 30 cm for ladders up to and including 3 metres in length. For longer ladders the width shall be increased at least 6 mm for each additional 30 cm of length. Spacing of steps shall be uniform and shall not exceed 30 cm.

(7) Adequate precautions shall be taken to prevent danger from electrical equipment. Adequate safety measures shall be taken when any work is undertaken near any live highly charged electric wire. Necessary shutdown may be arranged, where and whenever essential. All rules in force in this connection shall be fully complied with. The Contractor shall ensure all precautions to prevent any accidents due to electrocution or otherwise.

(8) No materials on any of the sites shall be so stacked or placed as to cause danger or inconvenience to any person or the public. The Contractor shall provide all necessary fencing and lights to protect the public from accidents and shall be bound to bear the expenses of defending every suit, action or other proceedings at law that may be brought by any person for injury sustained owing to neglect of the above precautions and to pay any damages and costs which may be awarded in any such suit, action or

proceedings to any such person or which may with the consent of the Contractor be paid to compromise any claim by any such person.

(9) Excavation and Trenching: All trenches, 1.5 metres or more in depth, shall at all times be supplied with at least one ladder for each 20 metres in length or fraction thereof, Ladders shall be extended from the bottom of the trench to at least 1 metre above the surface of the ground. The sides of a trench, which is 1.5 metres or more in depth shall be stepped back to provide a suitable slope or be securely held by timber bracing so as to avoid the danger of side collapse. Excavated material shall not be placed within 1.5 metres of the edge of any trench or half the depth of the trench, whichever is more. Excavation shall be made from the top to the bottom. Under no circumstances shall undermining or undercutting be done.

(10) Demolition: Before any demolition work is commenced and also during the process of the work:

(a) All roads and open areas adjacent to the work site shall either be closed or suitably protected.

(b) No electric cable or apparatus, which is liable to be a source of danger other than a cable or apparatus used by operators, shall remain electrically charged:

(c) All practical steps shall be taken to prevent danger to persons employed by the Employer, from risk of fire or explosion, or flooding. No floor, roof or other part of a building shall be so overloaded with debris or materials as to render it unsafe.

(11) All necessary personal safety equipment as considered adequate by the Engineer shall be available for use of persons employed on the site and maintained in a condition suitable for immediate use; and the Contractor shall take adequate steps to ensure proper use of such equipment by those concerned.

(a) Workers employed on mixing asphaltic materials, cement, lime mortars, concrete etc. shall be provided with protective footwear and protective goggles.

(b) Those engaged in handling any material, which is injurious to the eyes, shall be provided with protective goggles.

(c) Those engaged in welding works shall be provided with welder's protective eye-shield.

(d) Stone breakers shall be provided with protective goggles and protective clothing and seated at sufficiently safe intervals.

(e) When workers are employed in sewers and manhole, which are in use, the contractor shall ensure that manhole covers are open and manholes are ventilated at least for an hour before workers are allowed to go into them. Manholes so open shall be cordoned off with suitable railing and provide warning signals or boards to prevent accidents to the public.

(12) The Contractor shall not employ men below the age of 18 years and women, on the work

of painting with products containing lead in any form. Whenever men above the age of 18 years are employed on the work of lead painting, the following precautions shall be taken:

(a) No paint containing lead or lead products shall be used except in the form of paste or readymade paint.

(b) Suitable face masks shall be supplied for use by workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped.

(c) Overalls shall be supplied by the Contractor to workmen and adequate facilities shall be provided to enable workers to wash during and at the close of any day's work.

13) When work is performed near any place where there is risk of drowning all necessary equipment shall be provided and kept ready for use and all necessary steps taken for prompt first aid treatment of all injuries likely to be sustained during the course of the work.

(14) Use of hoisting machines and tackle including their attachments, anchorage and supports shall conform to the following:

(a) (i) These shall be of good mechanical construction, sound material and adequate strength and free from patent defects and shall be kept in good working order, be regularly inspected and properly maintained.

(ii) Every rope used in hoisting or lowering materials or as a means of suspension shall be of durable quality and adequate strength, and free from defects

(b) Every crane driver or hoisting appliance operator shall be properly qualified and no person under the age of 21 shall be in charge of any hoisting machine including scaffold equipment. Only trained men over the age of 21 shall be permitted to give signals to such plant and appliance operators.

(c) For every hoisting machine and every chain hook, shackle, swivel and pulley block used in hoisting, lowering or as means of suspension, safe working load shall be ascertained by adequate means. Every hoisting machine and all gear referred to above shall be plainly marked with safe working load. In case of a hoisting machine or a variable safe working load, each safe working load and conditions under which it is applicable shall be clearly indicated. No part of any machine or any gear referred to in the paragraph above shall be loaded beyond safe working load except for the purpose of testing.

(d) In case of the Employer's machine, safe working load shall be notified by the Engineer or his Representative. As regards Contractor's machines, the Contractor shall notify safe working load of each machine to the Engineer or his Representative, whenever he brings it to the site of work and get it verified by him.

(15) Motors, gearing, transmission, electric wiring and other dangerous parts of hoisting

appliances shall be provided with efficient safeguards; hoisting appliances shall be provided with such means as will reduce the risk of accident during descent of load to the minimum. Adequate precautions shall be taken to reduce to the minimum risk of any part of a suspended load becoming accidentally displaced. When workers are employed on electrical installations, which are already energised, insulating mats, working apparel such as gloves, sleeves and boots, as may be necessary, shall be provided. Workers shall not wear any rings, watches and carry keys or other materials which are good conductor of electricity.

(16) All scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in a safe condition and no scaffold, ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities shall be provided at or near places of work.

(17) These safety provisions shall be brought to the notice of all concerned by displaying on a notice board at a prominent place at the work location. Persons responsible for ensuring compliance with the Safety Code shall be named therein by the Contractor.

(18) To ensure effective enforcement of the rules and regulations relating to safety precautions, arrangements made by the contractor shall be open to inspection by the Engineer or his Representative.

(19) Notwithstanding anything contained in conditions (1) to (17) above, the Contractor shall at its own costs, remain liable to comply with the provisions of all acts, rules, regulations, and bylaws for the time being in force in India and applicable in this matter.

(20) For work carried out in the vicinity of any wharf or quay, the Contractor shall abide by all the provisions of the Dock Workers (Safety, Health and Welfare) Scheme, 1961.

(21) The Contractor shall at his own expense provide protective safety Equipment like gloves and footwear for all labour engaged on concrete mixing work and all other types of working involving the use of tar, cement, etc. to the satisfaction of the Engineer or his Representative, and on his failure to do so, the employer shall be entitled to provide the same and recover the cost from the Contractor.

(22) The Contractor shall be responsible for observance, by the sub-contractors, of the foregoing provisions.

Annexure 7 to Section 7B

4.9 Quality Assurance	The Contractor shall institute a quality assurance system to demonstrate compliance with the requirements of the Contract. The system shall be in accordance with the details stated in the Contract. The Engineer shall be entitled to audit any aspect of the system. Details of all procedures and compliance documents shall be submitted to the Engineer for information before each design and execution stage is commenced. When any document of a technical nature is issued to the Engineer, evidence of the prior approval by the Contractor himself shall be apparent on the document itself. The Contractor shall submit specific Method Statement (MS) for every main activity, based on prescribed design and technical specifications. MS should describe in detail (but not limited to): (i) List of drawings, technical specifications, standards, etc.; (ii) Detailed work schedule (iii) Plant, equipment, material and manpower proposed to deploy; (iv) Pre-Inspection Request Documents (PIRD) and their relevant Inspection Test Plan (ITP) including proposed test frequencies and acceptance criteria. The Method Statements shall be submitted to Engineer for approval before commencement of works. Included in each Method Statement, a Pre-Inspection Request Documents (PIRD) shall be prepared by the Contractor categorized by work, area, activity type, location, contractor, manpower, plant etc. The PIRD will be used to administer construction inspection for every activity performed on site by the Contractor, both for temporary and permanent works. The PIRD forms shall be jointly agreed by both Contractor and the Engineer. Compliance with the quality assurance system shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

Annexure 8 to Section 7B

4.12 Unforeseeable Physical Conditions	In this Sub-Clause, "physical conditions" means natural physical conditions and man-made and other physical obstructions and pollutants, which the Contractor encounters at the Site when executing the Works, including sub-surface and hydrological conditions but excluding climatic conditions. If the Contractor encounters adverse physical conditions which he considers to have been Unforeseeable, the Contractor shall give notice to the Engineer as soon as practicable but not later than 24 hours after it's occurrence. This notice shall describe the physical conditions, so that they can be inspected by the Engineer, and shall set out the reasons why the Contractor considers them to be Unforeseeable. The Contractor shall continue executing the Works, using such proper and reasonable measures as are appropriate for the physical conditions, and shall comply with any instructions which the Engineer may give. If an instruction constitutes a Variation, Clause 13 [Variations and Adjustments] shall apply. If and to the extent that the Contractor encounters physical conditions which are Unforeseeable, gives such a notice, within 24 hours of occurrence, and suffers delay and/or incurs Cost due to these conditions, and within 72 hours of the event or circumstance gives a notice to Engineer of his intention to raise a claim, then the Contractor shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to: (a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and (b) payment of any such Cost, which shall be included in the Contract Price. After receiving such notice and inspecting and/or investigating these physical conditions, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine (i) whether and (if so) to what extent these physical conditions were Unforeseeable, and (ii) the matters described in sub-paragraphs (a) and (b) above related to this extent. However, before additional Cost is finally agreed or determined under sub-paragraph (ii), the Engineer may also review whether other physical conditions in similar parts of the Works (if any) were more favourable than could reasonably have been foreseen when the Contractor submitted the Bid. If and to the extent that these more favourable conditions were encountered, the Engineer may proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine the reductions in Cost which were due to these conditions, which may be included (as deductions) in the Contract Price and Payment Certificates. However, the net effect of all adjustments under sub-paragraph (b) and all these reductions, for all the physical conditions encountered in similar parts of the Works, shall not result in a net reduction in the Contract Price. The Engineer may take account of any evidence of the physical conditions foreseen by the Contractor when submitting the Bid, which may be made available by the Contractor, but shall not be bound by any such evidence.

4.21 Progress reports	"The progress reports of work at specified intervals, in the proforma as decided by the Engineer shall be prepared by the Contractor and submitted to the Engineer in six copies together with soft copy. The first report shall cover the period up to the end of the first calendar month following the commencement date. Reports shall be submitted monthly thereafter on 25th of each month. Reporting shall continue until the Contractor has completed all work which is known to be outstanding at the completion date stated in the Taking-Over Certificate for the Works. Each report shall include: charts and detailed descriptions of progress, including each stage of design (if any), Contractor's Documents, procurement, manufacture, delivery to Site, construction, erection and testing; and including these stages for work by each nominated Subcontractor (as defined in Clause 5 [Nominated Subcontractors]), photographs showing the status of manufacture and of progress on the Site; for the manufacture of each main item of Plant and Materials, the name of the manufacturer, manufacture location, percentage progress, and the actual or expected dates of: (i) commencement of manufacture, (ii) Contractor's inspections, (iii) tests, and (iv) shipment and arrival at the Site; the details described in Sub-Clause 6.10 [Records of Contractor's Personnel and Equipment]; copies of quality assurance documents, test results and certificates of Materials; list of notices given under Sub-Clause 2.5 [Employer's Claims] and notices given under Sub-Clause 20.1 [Contractor's Claims]; safety statistics, including details of any hazardous incidents and activities relating to environmental aspects and public relations; and comparisons of actual and planned progress of all activities, with details of any events or circumstances which may jeopardise the completion in accordance with the Contract, and the measures being (or to be) adopted to overcome delays. *Contractor shall actively cooperate in case a project software platform (web based or otherwise) should be applied on the project as basis for information, monitoring, controlling, management & planning of the project.*

Annexure 10 to section 7B

7.8 Royalties	Unless otherwise stated in the Specification, the Contractor shall pay all royalties, rents and other payments for: (a) natural Materials obtained from outside as well as inside the Site and (b) the disposal of material from demolitions and excavations and of other surplus material (whether natural or man-made), except to the extent that disposal areas within the Site are specified in the Contract. The contractor will be responsible for keeping record of movement of material sourced from within and outside railway land and produce whenever required by the authorities

Annexure 11 to section 7B

8.2 Time for Completion	The Contractor shall complete the whole of the Works, and each Section (if any), within the Time for Completion for the Works or Section (as the case may be), including: (a) achieving the passing of the Tests on Completion, and (b) completing all work which is stated in the Contract as being required for whole of the Works or Section(s) to be considered to be completed for the purposes of taking-over under Sub-Clause 10.1 [Taking Over of the Works and Sections]. (c) DELETED

Annexure 12 to Section 7B

8.3 Programme	The Contractor shall submit a detailed time programme to the Engineer within 28 days after receiving the notice under Sub-Clause 8.1 [Commencement of Works]. The program shall include the physical and Financial Progress vis-à-vis program and forecast cash flow adopting Project Management Software Primavera/Sure Track/MS Project or any linear networking technique as mutually agreed. The program must identify the milestones, interface requirements and program reporting elements. The Contractor shall supply, free of cost one set of authorized software to the Engineer and the soft copy of structured program for the project. This shall be updated every month. The Contractor shall also submit a revised programme whenever the previous programme is inconsistent with actual progress or with the Contractor's obligations. Each programme shall include: (a) the order in which the Contractor intends to carry out the Works, including the anticipated timing of each stage of design (if any), Contractor's Documents, procurement, manufacture of Plant, delivery to Site, construction, erection and testing, (b) each of these stages for work by each nominated Subcontractor (as defined in Clause 5 [Nominated Subcontractors]), (c) the sequence and timing of inspections and tests specified in the Contract, and (d) a supporting report which includes: (i) a general description of the methods which the Contractor intends to adopt, and of the major stages, in the execution of the Works, and (ii) details showing the Contractor's reasonable estimate of the number of each class of Contractor's Personnel and of each type of Contractor's Equipment, required on the Site for each major stage. Unless the Engineer, within 21 days after receiving a programme, gives notice to the Contractor stating the extent to which it does not comply with the Contract, the Contractor shall proceed in accordance with the programme, subject to his other obligations under the Contract. The Employer's Personnel shall be entitled to rely upon the programme when planning their activities. The Contractor shall promptly give notice to the Engineer of specific probable future events or circumstances which may adversely affect the work, increase the Contract Price or delay the execution of the Works. The Engineer may require the Contractor to submit an estimate of the anticipated effect of the future event or circumstances, and/or a proposal under Sub-Clause 13.3 [Variation Procedure]. If, at any time, the Engineer gives notice to the Contractor that a programme fails (to the extent stated) to comply with the Contract or to be consistent with actual progress and the Contractor's stated intentions, the Contractor shall submit a revised programme to the Engineer within 15 days in accordance with this Sub-Clause. *Consent by the Engineer to a Works Programme shall not relieve the Contractor of any of his duties or responsibilities under the Contract, nor in the* event *that a Works Programme indicates that the time for completion under sub-Clause 8.2 has not or will not be met, constitute any form of acknowledgement that the Contractor is or may be entitled to an extension of time.*

Annexure 13 to Section 7B

8.4 Extension of Time for Completion	The Contractor shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to an extension of the Time for Completion if and to the extent that completion for the purposes of Sub-Clause 10.1 [Taking-Over of the Works and Sections] is or will be delayed by any of the following causes: (a) a Variation (unless an adjustment to the Time for Completion has been agreed under Sub-Clause 13.3 [Variation Procedure]) or other substantial change in the quantity of an item of work included in the Contract, (b) a cause of delay giving an entitlement to extension of time under a Sub-Clause of these Conditions, (c) exceptionally adverse climatic conditions, (d) Unforeseeable shortages in the availability of personnel or Goods caused by epidemic or governmental actions, or (e) any delay, impediment or prevention caused by or attributable to the Employer, the Employer's Personnel, or the Employer's other contractors. (f) Any Force Majeure event under GCC clause 19. (g) Adverse Rock Mass conditions encountered than those defined in Geotechnical Baseline Report (GBR). If the Contractor considers himself to be entitled to an extension of the Time for Completion, the Contractor shall give notice to the Engineer in accordance with Sub-Clause 20.1 [Contractor's Claims]. When determining each extension of time under Sub-Clause 20.1, the Engineer shall review previous determinations and may increase, but shall not decrease, the total extension of time.

Annexure 14 to Section 7B

8.6 Rate of Progress	If, at any time: (a) actual progress is too slow to complete within the Time for Completion, and/or (b) progress has fallen (or will fall) behind the current programme under Sub-Clause 8.3 [Programme], other than as a result of a cause listed in Sub-Clause 8.4 [Extension of Time for Completion], then the Engineer may instruct the Contractor to submit, under Sub-Clause 8.3 [Programme], a revised programme and supporting report describing the revised methods which the Contractor proposes to adopt in order to expedite progress and complete within the Time for Completion. Unless the Engineer notifies otherwise, the Contractor shall adopt these revised methods, which may require increases in the working hours and/or in the numbers of Contractor's Personnel and/or Goods, at the risk and cost of the Contractor. If these revised methods cause the Employer to incur additional costs, the Contractor shall subject to Sub-Clause 2.5 [Employer's Claims] pay these costs to the Employer, in addition to delay damages (if any) under Sub-Clause 8.7 below. The number of Personnel and/or equipments shall be augmented by contractor to meet the work schedule as directed by engineer without any additional cost to the employer, to finish the work within agreed time schedule.

Annexure 15 to Section 7B

8.7	**Extension of Time for Completion with Delay Damages**	If the Contractor fails to comply with Sub-Clause 8.2 [Time for Completion for entire work or for specified section wise completion period], and he is not entitled to an extension of time under sub clause 8.4 then the employer may grant extension of time with delay damage in such case, the Contractor shall subject to Sub-Clause 2.5 [Employer's Claims] pay delay damages to the Employer for this default. These delay damages shall be the sum stated in the Contract Data, which shall be paid for every day which shall elapse between the relevant Time for Completion and the date stated in the Taking-Over Certificate. However, the total amount due under this Sub-Clause shall not exceed the maximum amount of delay damages (if any) stated in the Contract Data. Further, if the contractor fails to achieve physical/financial targets as per the agreed programme for a consecutive period of 3 months without any valid reasons, other than attributable to the contractor, a provisional recovery of delay damages shall be made from the next interim payment certificate @ 1/10th of the sum of delay damages stated in the contract data, for the entire period of 3 months. Such recovery shall continue from the further interim payment certificates till the contractor is able to make good the shortfall and achieve the cumulative targets as per agreed programme. On achieving the cumulative progress targets as per agreed programme, the entire amount recovered till that month, shall be refunded to the contractor in the next interim payment certificate. In case the contractor is unable to make good the shortfall and achieve the cumulative targets resulting in delay in completion of the project **or sections**, then the provisional recoveries made shall be adjusted against the delay damages to be finally imposed on the contractor. These delay damages shall be the only damages due from the Contractor for such default, other than in the event of termination under Sub-Clause 15.2 [Termination by Employer] prior to completion of the Works. These damages shall not relieve the Contractor from his obligation to complete the Works, or from any other duties, obligations or responsibilities which he may have under the Contract.

Annexure 16 to section 7B

9.5 Contractor's obligations	Deleted

Annexure 17 to Section 7B

Clause 13, Sub – Clause 13.8: Adjustment for changes in cost

Percentages governing Price adjustment

Coefficients governing the adjustment of changes in cost

S. No	Cost Element	Symbol	Bill of Quantity wise % component						
			Bill No. 1, 3, 5A, 7A, A, D1, F, H, J	**Bill No. 2A, B2**	**Bill No. 2C, 4B, B3**	**Bill No. 6, 9, 10 & 4A, C**	**Bill No. 2B, 5B, 7B, B1**	**Bill No.8, D2**	**Bill No. E2**
1	Fixed	Px	15	15	15	15	15	15	15
2	Labour	Pl	15	10	5	25	15	5	5
3	Steel	P_s	0	0	75	20	50	0	0
4	Cement	P_c	0	30	0	15	0	75	0
5	Plant Machinery & Spares	P_p	20	15	0	0	10	0	0
6	Fuel and Lubricants	P_f	35	20	5	10	5	5	5
7	Other materials	P_m	15	10	0	15	5	0	75
8	Other Non-Ferrous Metals	P_{cp}	0	0	0	0	0	0	0
	Total		**100**	**100**	**100**	**100**	**100**	**100**	**100**

Bill No.1: Earthwork in Formation.

Bill No.2: Bridges and Protection Works

2 A: Other than Steel works

2 B: Steel Items involving fabrication and Erection

2 C: Supply of Steel Items

Bill No.3: Ballast Supply

Bill No.4: Permanent Way: Supply

4 A: Other than Steel Items

4 B: Steel Items

Bill No.5: Permanent Way Linking

5 A: Installation Work

5 B: Supply & Installation Work

Bill No.6: Buildings

Bill No.7: Platform, Passenger Amenities & Miscellaneous Works

7 A: Other than steel items

7 B: Steel items

Bill No 8: Supply of Cement

Bill No 9: Site Facilities

Bill No.10: Other Item of works not covered in Bill No. 1 to 9

Tunnelling:

Bill No. A: Underground Excavation

Bill No. B1: Support System: Rock Bolts and Other Steel Supports etc

Bill No. B2: Support System: Shotcrete and Concrete Works

Bill No. B3: Tunnel Work (Supply of Steel Items)

Bill No. C: Drainage and Miscellaneous Work

Bill No. D1: Ancillary Work

Bill No. D2: Supply of Grout Material

Bill No. E2: Supply of Poly fibres for Tunnel

Bill No. F: Monitoring of excavations/ construction

Bill No. H: Approach Roads

Bill No. J: Environment Impact Assessment Plan

Annexure 18 to Section 7B

14.7 Payment	The Employer shall pay to the Contractor: (a) the first instalment of the advance payment within 42 days after issuing the Letter of Acceptance or within 21 days after receiving the documents in accordance with Sub-Clause 4.2 [Performance Security] and Sub-Clause 14.2 [Advance Payment], whichever is later; (b) (i) After preliminary scrutiny and certifications by the Engineer, payment of 70% of the certified net payment due (after recoveries and deductions), shall be made by the Employer within 10 days of receiving a statement and supporting documents by the Engineer subject to the condition that last interim payment certificate has been settled after detailed check. In the event of the contractor submitting bills based on false measurements, Project Director should issue a written warning to him to the effect that the facility of 70% payment without detailed check will be withdrawn in future. If the contractor repeats the misconduct this facility should be withdrawn. (ii) The amount certified in each Interim Payment Certificate within 42 days after the Engineer receives the Statement and supporting documents. Any discrepancy shall be rectified in the next payment to the Contractor; and (c) the amount certified in the Final Payment Certificate within 42 days after the Employer receives this Payment Certificate or, the undisputed amount shown in the Final Statement, within 42 days after the date of notification of the suspension in accordance with Sub-Clause 16.2. Payment of the amount due, unless specified in the Contract Data, shall be made in INR into the bank account, nominated by the Contractor except for the Contract where the Contractor has opted for payment through Letter of Credit (LC) arrangement. In such a case, the procedure for payment shall be as prescribed in clause 14.7.1 below. However, in case of JV, direct payment to individual JV partners shall be made on joint certification (about the net amounts payable to individual partners) by the authorized representative of the JV and concerned respective authorized representative of individual JV partners, after making requisite recoveries/deductions from the gross payment. In case of any dispute regarding the net amounts payable to individual partners, the Engineer shall decide the same on the basis of percentage share indicated in the JV agreement. Payment to individual JV partners shall be treated as payment made to the JV. The said payment shall not alter any obligation of the JV and its individual Partners under the Agreement and their obligations under the agreement shall remain joint and several. However, on specific request of the JV, the payment shall be made in the account of JV. A foreign company (either single entity or JV partner), shall have to submit proof of having opened their project office in India before any payment (including advance payment) is released to such a company. The required proof here shall be a copy of the report containing information as per format prescribed by Reserve Bank of India submitted to the Director General of Police (DGP) of the state concerned in which project office has been established.

Annexure 19 to Section 7B

15.1 Notice to Correct	If the Contractor fails to carry out any obligation under the Contract as mentioned below, but not limited to, the Engineer/ Employer may serve the contractor with a 45 days' notice in writing calling upon the contractor to make good the failure and to remedy it. If the contractor; (a) fails to comply with Sub-Clause 4.2 [Performance Security], (b) abandons the Works or otherwise plainly demonstrates the intention not to continue performance of his obligations under the Contract, (c) without reasonable excuse fails to: (i) proceed with the Works in accordance with Clause 8 [Commencement, Delays and Suspension], or (ii) comply with a notice issued under Sub-Clause 7.5 [Rejection] or Sub-Clause 7.6 [Remedial Work], within 28 days after receiving it, or (iii) adhere to the agreed programme of work / activity on the critical path, by a margin of 10% of the stipulated period, or (iv) take steps to deploy competent and adequate number of personnel, and equipment to achieve progress as per agreed programme or (v) adhere to the instructions of Engineers/Employer persistently or (vi) comply any provision of the contract or (vii) provide the Engineer/Employer or their representative proper facilities for inspecting the works or any part thereof as required, under Clause 7.3 (Inspection) and 7.4 (Testing). (d) subcontracts the whole or major part of the Works or assigns the Contract without prior written consent of the Employer., If the contractor does not, within 45 days of receipt of notice under this sub-clause, proceed to make good his default in so far as the same is capable of being made good and carry on the work of complying with such direction as contained in the notice under sub clause 15.1, to the entire satisfaction of the Engineer/Employer, the Employer shall be entitled to take action under sub-clause 15.1.2 or 15.2 below.
15.1.1	**DELETED**

15.1.2	In case the contractor's failure is limited to only some of the works, and in response to Notice to Correct under Clause 15.1 of GCC, the contractor approaches the Employer that such works may be offloaded from him and got executed through another agency and additional cost incurred, if any, should be recovered from his dues, the Employer, on being convinced that the anticipated additional cost for such works will not be substantial and can be recovered from the dues of the contractor and that such offloading will help in improving the overall progress of the project, may agree to such offloading without any repercussion on the performance security and/or additional bank guarantees, if any, submitted by the contractor. However, the Employer will not be under any compulsion to agree to such a request. The Contractor shall be informed of the LOA issued to other agency(ies) for such works. In case the contractor does not approach the employer for offloading but the Employer is convinced that: (i) offloading of some works will help in improving the progress of the project; (ii) termination/part termination of the contract at this stage will not be in the interest of the project; (iii) the anticipated additional cost for such works will not be substantial and can be recovered from the dues of the contractor; The Employer may issue 7 days' notice to the Contractor stating the resources required to be deployed against each work. If the contractor fails to deploy the required resources as indicated in the notice, the employer shall offload such works and proceed with getting the works executed through other agency(ies). The Contractor shall be informed of the LOA issued to other agency(ies) for such works. Offloading under the sub clause 15.1.2 shall be without any repercussion on the performance security and/or additional bank guarantees, if any, submitted by the contractor. The Contractor would have no future claim on this account and the extra expenditure so incurred, if any, by the Employer in getting the offloaded work done, shall be recovered from subsequent payment certificates or any other dues of the contractor.

Annexure 20 to Section 7B

(Referance Clause 20.2 of Section 6: GCC - Amicable Settlement)

Rail Vikas Nigam Limited
(A Govt. of India Undertaking)
Corporate Office: 1st Floor, 'B' Block, August Kranti Bhawan, Bhikaji Cama Place, New Delhi– 110066.
Tel: +91 11 26738553, Fax +91 11 26182957; pramodkumar.sharma@rvnl.org

No. C/Policy/Arbitration/2007-08 Dated: 26.12.2018

All EDs(Projects)/CPMs/GGMs/GMs,
RVNL

Sub: Procedure for Amicable Settlement in contracts

Based on the recommendations of the Committee constituted for revision of bidding documents duly accepted by CMD/RVNL, the following procedure is issued for amicable settlement in contracts.

1. Amicable Settlement Committee at senior management level shall make an attempt to resolve the issues/disputes within 90 days of request by the contractor.

2. The committee shall comprise of the following:-
   (i) ED(P)/ED/PED (in the same order) directly in-charge of the project
   (ii) Concerned finance officer (one level higher than the officer who has dealt the case at PIU level) and
   (iii) ED/PED (in the same order) directly in-charge of the project of other discipline(s) in case the issues involve other discipline(s) of the engineering

3. Whenever the contractor submits a request for amicable settlement, CPM In-charge of the project should forward the same to ED(P)/ED/PED (in the same order) directly in-charge of the project. ED(P)/ED/PED on receipt of the same shall issue a note to the concerned finance officer and concerned ED/PED of other discipline in case the issues involved other discipline(s) of engineering, about the request for amicable settlement to be dealt by them and fix a date in consultation with them for a hearing. The date should then be communicated to the CPM, GM/GGM of other department (if the issues involved their department) and contractor for presenting their case before the Amicable Settlement Committee.

4. This being an additional workload like arbitration, the Committee members shall be paid fee by RVNL at the rates payable to the Arbitrators of RVNL.

Page 1 of 2

5. In this connection, para 22 of SOP is also being modified.

28.12.18

(P. K. Sharma)
Group General Manager/Projects-II

Copy to:

1) Secy to CMD –for kind information of CMD please.
2) DP, DO, DPE & CFO – for kind information please.
3) All PEDs & EDs in Corporate Office – for kind information please.
4) All GMs/DGMs(Finance) – for information please
5) AM/PP&D/Delhi – for information please

RVNL

Page 2 of 2

Annexure 21 to Section 7B

Rail Vikas Nigam Limited
(A Govt. of India Undertaking)
Corporate Office: 1st Floor, 'B' Block, August Kranti Bhawan, Bhikaji Cama Place, New Delhi– 110066.
Tel: +91 11 26738553, Fax +91 11 26738573; pramodkumar.sharma@rvnl.org

No. C/Policy/Arbitration/2007-08 Dated 19.11.2018

All ED(Projects), GGMs, CPMs, GMs & AGMs,
RVNL

Sub: Fee Structure for Arbitrators/Conciliators
Ref: This office letters of even no. dated 14.12.2015 & 15.12.2015

In supersession of letters under reference, fee structure for Arbitration/Conciliation cases shall be as indicated below;

(a) In case of Retired/Officers other than working in RVNL:

S. No.	Particulars	Maximum amount payable per Arbitrator/Conciliator, per case
1	Arbitrator/Conciliator's Fee	Rs. 40,000/- per day or Rs. 20,000/- per half day subject to a maximum of Rs.20 lakh per case. **Note:** (1) The assessment of work shall be on the following basis: (i) 'A day' means more than 2½ hours continuous work on any date; (ii) 'A half day' means work of 2½ hours or less on any date. (iii) If two or more hearings of more than 2½ hours continuous duration are held on any date, then the work shall be treated as equal to 2 days. (2) **The above fee is for hearings and includes a maximum of 3 internal meetings held at RVNL office by the Arbitral Tribunal for finalization of award without the presence of the parties involved.**
2	Studying of documents	Rs.25,000/-
3	Secretarial Assistance & Incidental Charges (telephone, fax, postage etc.)	Rs.30,000/-

S. No.	Particulars	Maximum amount payable per Arbitrator/Conciliator, per case
4	Charges for publishing/ declaration of Award/Settlement Agreement	Maximum Rs. 30,000/- to be fixed by Arbitrator.
5	Other expenses (actuals against bills subject to the prescribed ceiling) applicable for the days of hearing only :	
	i) Travelling Expenses	Economy Class (by air), first class AC (by train) and AC Car (By Road)
	ii) Lodging and Boarding	a) Rs.10,000/-+ GST per day (In Metro cities) b) Rs.7,500/- + GST per day (in other cities) c) Rs.3,000/- +GST per day, if any Arbitrator does not stay in the hotel as mentioned a) and b) above **NOTE :** **1. Lodging, Boarding and travelling expenses shall be allowed for those members who are residing 100 Km away from place of meeting.** **2. Delhi, Mumbai, Chennai, Kolkata, Bangalore and Hyderabad shall be considered as Metro cities.**
6	Local Travel	Rs.2,000/- per day
7	Registration Fee	NA
8	Providing Facilities of hearing rooms, for arbitration hearings and secretarial assistance etc.	NA

(b) In case of Departmental Officers of RVNL:

S. No.	Particulars	Maximum amount payable per Arbitrator/Conciliator, per case
1	Arbitrator/Conciliator's Fee	Rs.25,000/- per day or Rs. 12,500/- per half day subject to a maximum of Rs.12 lakh per case. **Note:** (1) The assessment of work shall be on the following basis: (i) 'A day' means more than 2½ hours continuous work on any date; (ii) 'A half day' means work of 2½ hours or less on any date. (iii) If two or more hearings of more than 2½ hours continuous duration are held on any

		date, then the work shall be treated as equal to 2 days. (2) **The above fee is for hearings and includes a maximum of 3 internal meetings held at RVNL office by the Arbitral Tribunal for finalization of award without the presence of the parties involved.**
2	Studying of documents	Rs.15,000/-
3	Secretarial Assistance	Rs.18,000/-
4	Charges for publishing Arbitral Award	Maximum Rs.18,000/- to be fixed by Arbitrator.

The fee is to be shared equally between RVNL and the other party to the dispute.

This issues with the approval of CMD/RVNL and shall be effective from the date of issue of this letter.

19.11.18

(P. K. Sharma)
GGM/P-II

Copy:

1. Secy to CMD – for kind information of CMD
2. DP, DO, DPE & CFO – for kind information please
3. All PEDs and EDs in Corporate Office - for kind information please

GENERAL CONDITION OF CONTRACT

(GCC)

Section 6

General Conditions of Contract (GCC)

Table of Clauses

1. General Provisions 5
1.1 Definitions 5
1.2 Interpretation 9
1.3 Communications 10
1.4 Law and Language 10
1.5 Priority of Documents 10
1.6 Contract Agreement 11
1.7 Assignment 11
1.8 Care and Supply of Documents 11
1.9 Delayed Drawings or Instructions 11
1.10 Employer's Use of Contractor's Documents 12
1.11 Contractor's Use of Employer's Documents 12
1.12 Confidential Details 12
1.13 Compliance with Laws 12
1.14 Joint and Several Liability 13
1.15 Inspections by the Employer 14
2. The Employer 14
2.1 Right of Access to the Site 14
2.2 Permits, Licences or Approvals 15
2.3 Employer's Personnel 15
2.4 Employer's Financial Arrangements 15
2.5 Employer's Claims 15
3. The Engineer 16
3.1 Engineer's Duties and Authority 16
3.2 Delegation by the Engineer 17
3.3 Instructions of the Engineer 17
3.4 Replacement of the Engineer 17
3.5 Determinations 18
4. The Contractor 18
4.1 Contractor's General Obligations 18
4.2 Performance Security 19
4.3 Contractor's Representative 21
4.4 Subcontractors 22
4.5 Assignment of Benefit of Subcontract 24
4.6 Co-operation 24
4.7 Setting Out 25
4.8 Safety Procedures 25
4.9 Quality Assurance 26
4.10 Site Data 26
4.11 Sufficiency of the Accepted Contract Amount 26
4.12 Unforeseeable Physical Conditions 27
4.13 Rights of Way and Facilities 27
4.14 Avoidance of Interference 28
4.15 Access Route 28
4.16 Transport of Goods 28
4.17 **Contractor's Equipment** 27
4.18 Protection of the Environment 30
4.19 Electricity, Water and Gas 30
4.20 Employer's Equipment and free issue material 30
4.21 Progress Report 30

4.22 Security of the Site 31
4.23 Contractor's Operations on Site 31
4.24 Fossils 31

5. Nominated Subcontractors 33
5.1 Definition of "nominated Subcontractor" 33
5.2 Objection to Nomination 33
5.3 Payments to nominated Subcontractors 33
5.4 Evidence of Payments 33

6. Staff and Labour 34
6.1 Engagement of Staff and Labour 34
6.2 Rates of Wages and Conditions of Labour 34
6.3 Persons in the Service of Employer 34
6.4 Labour Laws 35
6.5 Working Hours 35
6.6 Facilities for Staff and Labour 36
6.7 Health and Safety 36
6.8 Contractor's Superintendence 37
6.9 Contractor's Personnel 37
6.10 Records of Contractor's Personnel and Equipment 38
6.11 Disorderly Conduct 38
6.12 Foreign Personnel 38
6.13 Supply of Foodstuffs 38
6.14 Supply of Water 38
6.15 Measures against Insect and Pest Nuisance 38
6.16 Alcoholic Liquor or Drugs 39
6.17 Arms and Ammunition 39
6.18 Festivals and Religious Customs 39
6.19 Funeral Arrangements 39
6.20 Prohibition of Forced or Compulsory Labour 38
6.21 Prohibition of Harmful Child Labour 38
6.22 Employment Records of Workers 38

7. Plant, Materials and Workmanship 40
7.1 Manner of Execution 40
7.2 Samples 40
7.3 Inspection 41
7.4 Testing 41
7.5 Rejection 42
7.6 Remedial Work 42
7.7 Ownership of Plant and Materials 40
7.8 Royalties 41

8. Commencement, Delays and Suspension 41
8.1 Commencement of Works 41
8.2 Time for Completion 41
8.3 Programme 41
8.4 Extension of Time for Completion 44
8.5 Delays Caused by Authorities 44
8.6 Rate of Progress 45
8.7 Delay Damages 45
8.8 Suspension of Work 46

8.9 Consequences of Suspension 46
8.10 Payment for Plant and Materials in Event of Suspension 46
8.11 Prolonged Suspension 46
8.12 Resumption of Work 46
8.13 Bonus for early completion 45

9. Tests on Completion 47
9.1 Contractor's Obligations 47
9.2 Delayed Tests 47
9.3 Retesting 47
9.4 Failure to Pass Tests on Completion 47
9.5 Contractor's obligation 46

10. Employer's Taking Over 48
10.1 Taking Over of the Works and Sections 48
10.2 Taking Over of Parts of the Works 49
10.3 Interference with Tests on Completion 50
10.4 Surfaces requiring Reinstatement 48

11. Defects Liability 50
11.1 Completion of Outstanding Work and Remedying Defects 50
11.2 Cost of Remedying Defects 51
11.3 Extension of Defects Notification Period 51
11.4 Failure to Remedy Defects 51
11.5 Removal of Defective Work 52
11.6 Further Tests 52
11.7 Right of Access 52
11.8 Contractor to Search 52
11.9 Performance Certificate 50
11.10 Unfulfilled Obligations 50
11.11 Clearance of Site 51

12. Measurement and Evaluation 51
12.1 Works to be Measured 51
12.2 Method of Measurement 51
12.3 Evaluation 51
12.4 Omissions 56

13. Variations and Adjustments 56
13.1 Right to Vary 56
13.2 Value Engineering 56
13.3 Variation Procedure 57
13.4 Payment in Applicable Currencies 55
13.5 Provisional Sums 55
13.6 Day work 58
13.7 Adjustments for Changes in Legislation 59
13.8 Adjustments for Changes in Cost 57

14. Contract Price and Payment 75
14.1 The Contract Price 75
14.2 Advance Payment 76
14.3 Application for Interim Payment Certificates 78
14.4 Schedule of Payments 79
14.5 Plant and Materials intended for the Works 80

14.6 Issue of Interim Payment Certificates 81
14.7 Payment....81
14.8 Delayed Payment....84
14.9 Payment of Retention Money....84
14.10 Statement at Completion....85
14.11 Application for Final Payment Certificate 85
14.12 Discharge....86
14.13 Issue of Final Payment Certificate....86
14.14 Cessation of Employer's Liability 86
14.15 Currencies of Payment....86

15. Termination by Employer 82
15.1 Notice to Correct....82
15.2 Termination by Employer 83
15.3 Valuation at Date of Termination……..**Error! Bookmark not defined.**...83
15.4 Payment after Termination 89
15.5 Employer's Entitlement to Termination for Convenience....90
15.6 Corrupt or Fraudulent Practices....90

16. Suspension and Termination by Contractor 91
16.1 Contractor's Entitlement to Suspend Work 91
16.2 Termination by Contractor 91
16.3 Cessation of Work and Removal of Contractor's Equipment....92
16.4 Payment on Termination 92

17. Risk and Responsibility....92
17.1 Indemnities....92
17.2 Contractor's Care of the Works....93
17.3 Employer's Risks....93
17.4 Consequences of Employer's Risks....94
17.5 Intellectual and Industrial Property Rights....94
17.6 Limitation of Liability....95
17.7 Use of Employer's Accomodation/Facilities 95
18. Insurance 955
18.1 General Requirements for Insurances....955
18.2 Insurance for Works and Contractor's Equipment 96
18.3 Insurance against Injury to Persons and Damage to Property……..98
18.4 Insurance for Contractor's Personnel 998
19. Force Majeure....98
19.1 Payment and release in case of Optional Termination……..……....98
20. Claims, Disputes and Arbitration 1009
20.1 Contractor's Claims....1009
20.2 Amicable Settlement....100
20.3 .....Arbitration…… 102
21. Jurisdiction of Courts……..… 103
Appendix 1…….……...104

General Conditions

1. General Provisions

1.1 Definitions In the Conditions of Contract ("these Conditions"), which include Special Conditions of Contract, Parts A and B, and these General Conditions, the following words and expressions shall have the meanings stated. Words indicating persons or parties include corporations and other legal entities, except where the context requires otherwise.

1.1.1 The Contract

1.1.1.1 "**Contract**" means the Contract Agreement, the Letter of Acceptance, the Letter of Bid, these Conditions, the Specification, the Drawings, the Schedules, and the further documents (if any) which are listed in the Contract Agreement or in the Letter of Acceptance.

1.1.1.2 "**Contract Agreement"** means the contract agreement (*if any*) **referred** to in Sub-Clause 1.6 [Contract Agreement].

1.1.1.3 **"Letter of Acceptance**" means the letter of formal acceptance, signed by the Employer, of the Letter of Bid, including any annexed memoranda comprising agreements between and signed by both Parties. If there is no such letter of acceptance, the expression "Letter of Acceptance" means the Contract Agreement and the date of issuing or receiving the Letter of Acceptance means the date of signing the Contract Agreement.

1.1.1.4 **"Letter of Bid"** means the document entitled letter of bid, which was completed by the Contractor and includes the signed offer to the Employer for the Works.

1.1.1.5 **"Specification**" means the document entitled specification, as included in the Contract, and any additions and modifications to the specification in accordance with the Contract. Such document specifies the Works.

1.1.1.6 **"Drawings"** means the drawings of the Works, as included in the **Contract**, and any additional and modified drawings issued by (or on behalf of) the Employer in accordance with the Contract.

1.1.1.7 **"Schedules"** means the document(s) entitled schedules, completed by the Contractor and submitted with the Letter of Bid, as included in the Contract. Such document may include the Bill of Quantities, data, lists, and schedules of rates and/or prices.

1.1.1.8 **"Bid/Tender"** means the Letter of Technical Bid **and** Letter of Price Bid and all other documents which the Contractor submitted with the Letter of Technical Bid and Letter of Price Bid , as included in the Contract.

1.1.1.9 **"Bill of Quantities"** and **"Daywork Schedule**" and "Schedule of Payment Currencies" mean the documents so named (if any) which are comprised in the Schedules.

1.1.1.10 **"Contract Data"** means the pages completed by the Employer entitled contract data which constitute Part A of the Special

Conditions of Contract.

1.1.1.11 **"Employer's Requirements"** means the document entitled 'Employer's Requirements' as part of Works Requirements and as included in the Contract, and any additions and modifications to such document in accordance with the Contract. Such document specifies the purpose, scope, and/or design and/or other technical criteria, for the works.

1.1.2 Parties and Persons

1.1.2.1 **"Party"** means the Employer or the Contractor, as the context requires.

1.1.2.2 **"Employer"** means the person named as employer in the Contract Data and the legal successors in title to this person.

1.1.2.3 **"Contractor"** means the person(s) named as contractor in the Letter of Bid accepted by the Employer and the legal successors in title to this person(s).

1.1.2.4 **"Engineer"** means the person nominated by the Employer to act as the Engineer for the purposes of the Contract and named in the Contract Data, or other person appointed from time to time by the Employer and notified to the Contractor under Sub-Clause 3.4 [Replacement of the Engineer]. The person nominated to act as an engineer may be an employee of Rail Vikas Nigam Ltd (RVNL) or an employee of a Project Management Consultancy firm engaged by RVNL for project management as per the discretion of the Employer.

1.1.2.5 **"**Contractor's **Representative"** means the person named by the Contractor in the Contract or appointed from time to time by the Contractor under Sub-Clause 4.3 [Contractor's Representative], who acts on behalf of the Contractor.

1.1.2.6 "Employer's **Representative"** means the person named by the Employer in the Contract or appointed from time to time by the Employer who acts on behalf of the Employer.

1.1.2.7 **"Employer's Personnel"** means the Engineer, the assistants referred to in Sub-Clause 3.2 [Delegation by the Engineer] and all other staff, labour and other employees of the Engineer and of the Employer; and any other personnel notified to the Contractor, by the Employer or the Engineer, as Employer's Personnel.

1.1.2.8 **"Contractor's Personnel"** means the Contractor's Representative and all personnel whom the Contractor utilises on Site, who may include the staff, labour and other employees of the Contractor and of each Subcontractor; and any other personnel assisting the Contractor in the execution of the Works.

1.1.2.9 **"**Subcontractor**"** means any person named in the Contract as a subcontractor, or any person appointed as a subcontractor, for a part of the Works; and the legal successors in title to each of these persons.

1.1.3 Dates, Tests, Periods and Completion

1.1.3.1 **"Base Date"** means the date 28 days prior to the deadline for submission of bids.

1.1.3.2 **"**Commencement **Date**" means the date notified under Sub-Clause 8.1 [Commencement of Works].

1.1.3.3 **"Time for Completion"** means the time for completing the Works or a Section (as the case may be) under Sub-Clause 8.2 [Time for Completion], as stated in the Contract Data (with any extension under Sub-Clause 8.4 [Extension of Time for Completion]), calculated from the Commencement Date.

1.1.3.4 **"Tests on Completion"** means the tests which are specified in the Contract or agreed by both Parties or instructed as a Variation, and which are carried out under Clause 9 [Tests on Completion] before the Works or a Section (as the case may be) are taken over by the Employer.

1.1.3.5 **"Taking-Over Certificate"** means a certificate issued under Clause 10 [Employer's Taking Over].

1.1.3.6 **"Tests after Completion"** means the tests (if any) which are specified in the Contract and which are carried out in accordance with the Specification after the Works or a Section (as the case may be) are taken over by the Employer.

1.1.3.7 **"Defects Notification Period"** means the period for notifying defects in the Works or a Section (as the case may be) under Sub-Clause 11.1 [Completion of Outstanding Work and Remedying Defects], as stated in the Contract Data (with any extension under Sub-Clause 11.3 [Extension of Defects Notification Period]), calculated from the date on which the Works or Section is completed as certified under Sub-Clause 10.1 [Taking Over of the Works and Sections].

1.1.3.8 **"Performance Certificate"** means the certificate issued under Sub-Clause 11.9 [Performance Certificate].

1.1.3.9 "**Day"** means any (working or non-working) calendar day from 00:00 hrs. to 24:00 hrs.

1.1.3.10 **"Months"** means any calendar month of the Gregorian calendar year.

1.1.3.11 **"Year"** means 365 days

1.1.3.12 "**Time** Periods" Any reference to time period commencing "from" the specified day or date "till" or "until" a specified day shall include both such days.

1.1.3.13 Any reference to **"Time"** shall be according to Indian Standard Time (IST).

1.1.4 Money and Payments

1.1.4.1 "**Accepted Contract Amount"** means the amount accepted in the Letter of Acceptance for the execution and completion of the Works and the remedying of any defects. In the Letter of Acceptance, the Accepted Contract Amount shall have two components i.e. (i) the base amount excluding GST (ii) GST component (calculated at the rate for works contract service as per GST Laws).

1.1.4.2 **"Contract Price"** means the price defined in Sub-Clause 14.1 [The Contract Price], and includes adjustments in accordance

with the Contract.

1.1.4.3 **"Cost"** means all expenditure reasonably incurred (or to be incurred) by the Contractor, whether on or off the Site, including overhead and similar charges, but does not include profit.

1.1.4.4 **"Final** Payment **Certificate"** means the payment certificate issued under Sub-Clause 14.13 [Issue of Final Payment Certificate].

1.1.4.5 **"Final Statement"** means the statement defined in Sub-Clause 14.11 [Application for Final Payment Certificate].

1.1.4.6 **"Foreign Currency"** means a currency in which part (or all) of the Contract Price is payable, but not the Local Currency.

1.1.4.7 **"Interim Payment Certificate**" means a payment certificate issued under Clause 14 [Contract Price and Payment], other than the Final Payment Certificate.

1.1.4.8 **"Local Currency"** means the currency in Indian Rupees.

1.1.4.9 **"Payment Certificate"** means a payment certificate issued under Clause 14 [Contract Price and Payment].

1.1.4.10 **"Provisional Sum"** means a sum (if any) which is specified in the Contract as a provisional sum, for the execution of any part of the Works or for the supply of Plant, Materials or services under Sub-Clause 13.5 [Provisional Sums].

1.1.4.11 **"Retention Money"** means the accumulated retention moneys which the Employer retains under Sub-Clause 14.3 [Application for Interim Payment Certificates] and pays under Sub-Clause 14.9 [Payment of Retention Money].

1.1.4.12 **"Statement"** means a statement submitted by the Contractor as part of an application, under Clause 14 [Contract Price and Payment], for a payment certificate.

1.1.5 Works and Goods

1.1.5.1 **"Contractor's Equipment**" means all apparatus, machinery, vehicles and other things required for the execution and completion of the Works and the remedying of any defects. However, Contractor's Equipment excludes Temporary Works, Employer's Equipment (if any), Plant, Materials and any other things intended to form or forming part of the Permanent Works.

1.1.5.2 **"Goods"** means Contractor's Equipment, Materials, Plant and Temporary Works, or any of them as appropriate.

1.1.5.3 **"Materials"** means things of all kinds (other than Plant) intended to form or forming part of the Permanent Works, including the supply-only materials (if any) to be supplied by the Contractor under the Contract.

1.1.5.4 **"Permanent Works"** means the permanent works to be executed by the Contractor under the Contract.

1.1.5.5 **"Plant"** means the apparatus, machinery and vehicles intended to form or forming part of the Permanent Works.

1.1.5.6 **"Section**" means a part of the Works specified in the Contract Data as a Section (if any).

1.1.5.7 **"Temporary Works"** means all temporary works of every kind

(other than Contractor's Equipment) required on Site for the execution and completion of the Permanent Works and the remedying of any defects.

1.1.5.8 **"Works"** mean the Permanent Works and the Temporary Works, or either of them as appropriate.

1.1.6 Other Definitions

1.1.6.1 **"Contractor's** Documents" means the calculations, computer programs and other software, drawings, manuals, models and other documents of a technical nature (if any) supplied by the Contractor under the Contract.

1.1.6.2 **"Country**" means India, the country in which the Site (or most of it) is located, where the Permanent Works are to be executed.

1.1.6.3 **"Employer's Equipment**" means the apparatus, machinery and vehicles (if any) made available by the Employer for the use of the Contractor in the execution of the Works, as stated in the Specification; but does not include Plant which has not been taken over by the Employer.

1.1.6.4 **"Force Majeure**" is defined in Clause 19 [Force Majeure].

1.1.6.5 **"Laws"** means all national (or state) legislation, statutes, ordinances and other laws, and regulations and by-laws of any legally constituted public authority.

1.1.6.6 **"Performance Security**" means the security (or securities, if any) under Sub-Clause 4.2 [Performance Security].

1.1.6.7 **"Site"** means the places where the Permanent Works are to be executed and to which Plant and Materials are to be delivered, and any other places as may be specified in the Contract as forming part of the Site.

1.1.6.8 **"Unforeseeable**" means not reasonably foreseeable and against which adequate preventive precautions could not reasonably be taken by an experienced contractor by the date for submission of the Bid.

1.1.6.9 **"Variation**" means any change to the Works, which is instructed or approved as a variation under Clause 13 [Variations and Adjustments].

1.1.6.10 **"Railway"** means a railway, or any portion of a railway for public carriage of passengers and goods as defined in the Railways ACT 1989. Any reference to railway means the Indian Railways and the respective Zonal Railway

1.2 Interpretation

In the Contract, except where the context requires otherwise:

(a) words indicating one gender include all genders;

(b) words indicating the singular also include the plural and words indicating the plural also include the singular;

(c) provisions including the word "agree," "agreed" or "agreement" require the agreement to be recorded in writing;

(d) "written" or "in writing" means hand-written, type-written, printed or electronically made, and resulting in a permanent record; and

(e) the word "tender" is synonymous with "bid", and "tenderer" with "bidder"

and the words “tender documents” with “bidding documents”

The marginal words and other headings shall not be taken into consideration in the interpretation of these Conditions.

In these Conditions, provisions including the expression "Cost plus profit" require this profit to be one twentieth (5%) of this Cost unless otherwise indicated in the Contract Data.

1.3 Communications

Wherever these Conditions provide for the giving or issuing of approvals, certificates, consents, determinations, notices, requests and discharges, these communications shall be:

(a) in writing and delivered by hand (against receipt), sent by mail or courier, or transmitted using any of the agreed systems of electronic transmission as stated in the Contract Data; and

(b) delivered, sent or transmitted to the address for the recipient’s communications as stated in the Contract Data. However:

(i) if the recipient gives notice of another address, communications shall thereafter be delivered accordingly; and

(ii) if the recipient has not stated otherwise when requesting an approval or consent, it may be sent to the address from which the request was issued.

Approvals, certificates, consents and determinations shall not be unreasonably withheld or delayed. When a certificate is issued to a Party, the certifier shall send a copy to the other Party. When a notice is issued to a Party, by the other Party or the Engineer, a copy shall be sent to the Engineer or the other Party, as the case may be.

1.4 Law and Language

The Contract shall be governed by the law of the country or other jurisdiction stated in the Contract Data.

The ruling language of the Contract shall be that stated in the Contract Data.

The language for communications shall be that stated in the Contract Data. If no language is stated there, the language for communications shall be the ruling language of the Contract.

1.5 Priority of Documents

The documents forming the Contract are to be taken as mutually explanatory of one another. For the purposes of interpretation, the priority of the documents shall be in accordance with the following sequence:

(a) the Contract Agreement (if any),

(b) the Letter of Acceptance,

(c) the Letter of bid,

(d) Special Conditions of Contract:

(i) Part A – Contract Data

(ii) Part B - Specific Provisions

(e) the General Conditions of Contract

(f) the Schedules (including Priced Bill of Quantities),

(g) Specification,

(h) the Drawings,

(i) Works Requirements,

(i) Employers Requirements

(ii) Safety Requirements, and

(j) any other documents forming part of the Contract.

If an ambiguity or discrepancy is found in the documents, the Engineer shall issue any necessary clarification or instruction.

1.6 Contract Agreement

The Parties shall enter into a Contract Agreement within 28 days after the Contractor receives the Letter of Acceptance, unless they agree otherwise. The Contract Agreement shall be based upon the form annexed to the Special Conditions of Contract. The costs of stamp duties and similar charges (if any) imposed by law in connection with entry into the Contract Agreement shall be borne by the Employer.

1.7 Assignment

Neither Party shall assign the whole or any part of the Contract or any benefit or interest in or under the Contract. However, either Party:

(a) may assign the whole or any part with the prior agreement of the other Party, at the sole discretion of such other Party, and

(b) may, as security in favour of a bank or financial institution, assign its right to any moneys due, or to become due, under the Contract.

1.8 Care and Supply of Documents

The Specification and Drawings shall be in the custody and care of the Employer. Unless otherwise stated in the Contract, two copies of the Contract and of each subsequent Drawing shall be supplied to the Contractor, who may make or request further copies at the cost of the Contractor.

Each of the Contractor's Documents shall be in the custody and care of the Contractor, unless and until taken over by the Employer. Unless otherwise stated in the Contract, the Contractor shall supply to the Engineer six copies of each of the Contractor's Documents.

The Contractor shall keep, on the Site, a copy of the Contract, publications named in the Specification, the Contractor's Documents (if any), the Drawings and Variations and other communications given under the Contract. The Employer's Personnel shall have the right of access to all these documents at all reasonable times.

If a Party becomes aware of an error or defect in a document which was prepared for use in executing the Works, the Party shall promptly give notice to the other Party of such error or defect.

1.9 Delayed Drawings or Instructions

The Contractor shall give notice to the Engineer whenever the Works are likely to be delayed or disrupted if any necessary drawing or instruction is not issued to the Contractor within a particular time, which shall be reasonable. The notice shall include details of the necessary drawing or instruction, details of why and by when it should be issued, and details of the nature and amount of the delay or disruption likely to be suffered if it is late.

If the Contractor suffers delay and/or incurs Cost as a result of a failure of the Engineer to issue the notified drawing or instruction within a time which is reasonable and is specified in the notice with supporting details, the Contractor shall give a further notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be

delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost , which shall be included in the Contract Price.

After receiving this further notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

However, if and to the extent that the Engineer's failure was caused by any error or delay by the Contractor, including an error in, or delay in the submission of, any of the Contractor's Documents, the Contractor shall not be entitled to such extension of time, Cost or profit

1.10 Employer's Use of Contractor's Documents

As between the Parties, the Contractor shall retain the copyright and other intellectual property rights in the Contractor's Documents and other design documents made by (or on behalf of) the Contractor.

The Contractor shall be deemed (by signing the Contract) to give to the Employer a non-terminable transferable non-exclusive royalty-free licence to copy, use and communicate the Contractor's Documents, including making and using modifications of them. This licence shall:

(a) apply throughout the actual or intended working life (whichever is longer) of the relevant parts of the Works,

(b) entitle any person in proper possession of the relevant part of the Works to copy, use and communicate the Contractor's Documents for the purposes of completing, operating, maintaining, altering, adjusting, repairing and demolishing the Works, and

(c) in the case of Contractor's Documents which are in the form of computer programs and other software, permit their use on any computer on the Site and other places as envisaged by the Contract, including replacements of any computers supplied by the Contractor.

The Contractor's Documents and other design documents made by (or on behalf of) the Contractor shall not, without the Contractor's consent, be used, copied or communicated to a third party by (or on behalf of) the Employer for purposes other than those permitted under this Sub-Clause.

1.11 Contractor's Use of Employer's Documents

As between the Parties, the Employer shall retain the copyright and other intellectual property rights in the Specification, the Drawings and other documents made by (or on behalf of) the Employer. The Contractor may, at his cost, copy, use, and obtain communication of these documents for the purposes of the Contract. They shall not, without the Employer's consent, be copied, used or communicated to a third party by the Contractor, except as necessary for the purposes of the Contract.

1.12 Confidential Details

The Contractor shall disclose all such confidential and other information as the Engineer may reasonably require in order to verify the Contractor's compliance with the Contract.

The Contractor shall treat the details of the Contract as private and confidential, except to the extent necessary to carry out the Contractor's obligations under the Contract or to comply with applicable Laws. The Contractor shall not publish or disclose any particulars of the Works without the previous agreement of the Employer. However, the Contractor shall be permitted to disclose any publicly available information, or information otherwise required to establish his qualifications to compete for other projects.

1.13 Compliance with The Contractor shall, in performing the Contract, comply with applicable Laws.

Laws

Unless otherwise stated in the Special Conditions of Contract:

(a) the Employer shall have obtained (or shall obtain) the planning, zoning or similar permission for the Permanent Works, and any other permissions described in the Specification as having been (or being) obtained by the Employer; and the Employer shall indemnify and hold the Contractor harmless against and from the consequences of any failure to do so; and

(b) the Contractor shall give all notices, pay all taxes, duties and fees, and obtain all permits, licences and approvals, as required by the Laws in relation to the execution and completion of the Works and the remedying of any defects; and the Contractor shall indemnify and hold the Employer harmless against and from the consequences of any failure to do so.

1.14 Joint and Several Liability

If the Contractor constitutes (under applicable Laws) a joint venture of two or more persons/firms:

(a) these persons shall be deemed to be jointly and severally liable to the Employer for the performance of the Contract;

(b) these persons shall notify the Employer of their leader who shall have authority to bind the Contractor and each of these persons; and

(c) the Contractor shall not alter its composition or legal status without the prior consent of the Employer.

(d) In the event of default by any partner of joint venture, on or after achieving 25% of the financial progress (excluding advance if any) the lead partner or remaining partner(s), in case the defaulting partner is the lead partner, shall notify the Employer within twenty eight (28) days of the occurrence and within Fifty six (56) days of the said notification, the lead partner or remaining partner(s), who are not the defaulting partner, shall assign the works of the defaulting partner, to equally competent party with prior consent of the Employer. For this purpose the term “equally competent party” shall mean as under:

> “The new JV partner replacing the defaulting partner should meet the EQC requirement of package/combination of packages which was met by the defaulting partner on the basis of which the original tender was awarded.”

The replacement of any defaulting partner, with the new partner shall be subject to the condition that the new partner has to submit additional performance security equal to 10% of balance cost of work of the JV partner being replaced. The performance security submitted by the defaulting partner shall also continue with RVNL till satisfactory completion of the work.

(e) Notwithstanding the consent of the Employer for change in composition or legal status of the joint venture the partners shall continue to be jointly and severally liable to the Employer.

(f) The joint venture shall enter into a joint venture

agreement incorporating the provisions of sub-paras (a) to (e) based upon the form annexed to the Conditions of Contract. The JV agreement shall indicate precisely the specific role of all members of the JV in respect of planning, design, construction equipment, key personnel, work execution, and financing of the project. The authority to sign the agreement shall be evidenced by approved legal instruments.

Notwithstanding the contents of the sub-clauses above, if the performance of any JV partner is not found satisfactory by the Employer, in respect of the responsibilities assigned to him as per JV agreement which is a part of this agreement, the Employer may issue notice of such default to the said JV partner or the JV (depending upon reasons of default) and declare the said JV partner or the JV as Poor Performer. The issue of such notice shall automatically debar the JV partner or JV as the case may be from participating in any RVNL tender from the date of issue of notice of default.

1.15 Inspections by the Employer

The Contractor shall permit the Employer and/or persons appointed by the Employer to inspect the Site and/or the Contractor's records relating to the performance of the Contract.

2. The Employer

2.1 Right of Access to the Site

The Employer shall give the Contractor right of access to, and possession of, all parts of the Site within the time (or times) stated in the Contract Data. The right and possession may not be exclusive to the Contractor. If, under the Contract, the Employer is required to give (to the Contractor) possession of any foundation, structure, plant or means of access, the Employer shall do so in the time and manner stated in the Specification. However, the Employer may withhold any such right or possession until the Performance Security has been received.

If no such time is stated in the Contract Data, the Employer shall give the Contractor right of access to, and possession of, the Site within such times as may be required to enable the Contractor to proceed in accordance with the programme submitted under Sub-Clause 8.3 [Programme].

If the Contractor suffers delay as a result of a failure by the Employer to give any such right or possession within such time, the Contractor shall give notice to the Engineer and shall be entitled to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) new rates in terms of clause 12.3.1 (c) .

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

However, if and to the extent that the Employer's failure was caused by any error or delay by the Contractor, including an error in, or delay in the submission of, any of the Contractor's Documents, the Contractor shall not be entitled to such extension of time or new rates.

2.2 Permits, Licenses or Approvals

The Employer shall (where he is in a position to do so) provide reasonable assistance to the Contractor at the request of the Contractor:

(a) by obtaining copies of the Laws of the Country which are relevant to the Contract but are not readily available, and

(b) for the Contractor's applications for any permits, licences or approvals required by the Laws of the Country:

(i) which the Contractor is required to obtain under Sub-Clause 1.13 [Compliance with Laws],

(ii) for the delivery of Goods, including clearance through customs, and

(iii) for the export of Contractor's Equipment when it is removed from the Site.

2.3 Employer's Personnel

The Employer shall be responsible for ensuring that the Employer's Personnel and the Employer's other contractors on the Site:

(a) co-operate with the Contractor's efforts under Sub-Clause 4.6 [Co-operation], and

(b) take actions similar to those which the Contractor is required to take under sub-paragraphs (a), (b) and (c) of Sub-Clause 4.8 [Safety Procedures] and under Sub-Clause 4.18 [Protection of the Environment].

2.4 Employer's Financial Arrange-ments

The Employer has sourced the funds to finance the project.

2.5 Employer's Claims

If the Employer considers himself to be entitled to any payment under any Clause of these Conditions or otherwise in connection with the Contract, and/or to any extension of the Defects Notification Period, the Employer or the Engineer shall give notice and particulars to the Contractor. However, notice is not required for payments due under Sub-Clause 4.19 [Electricity, Water and Gas], under Sub-Clause 4.20 [Employer's Equipment and Free-Issue Material], or for other services requested by the Contractor.

The notice shall be given as soon as practicable after the Employer became aware, or should have become aware, of the event or circumstances giving rise to the claim. A notice relating to any extension of the Defects Notification Period shall be given before the expiry of such period.

The particulars shall specify the Clause or other basis of the claim, and shall include substantiation of the amount and/or extension to which the Employer considers himself to be entitled in connection with the Contract. The Engineer shall then proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine (i) the amount (if any) which the Employer is entitled to be paid by the Contractor, and/or (ii) the extension (if any) of the Defects Notification Period in accordance with Sub-Clause 11.3 [Extension of Defects Notification Period].

This amount may be included as a deduction in the Contract Price and Payment Certificates. The Employer shall only be entitled to set off against or make any deduction from an amount certified in a Payment Certificate, or to otherwise claim against the Contractor, in accordance with this Sub-Clause.

3. The Engineer

3.1 Engineer's Duties and Authority

The Employer shall appoint the Engineer who shall carry out the duties assigned to him in the Contract. The Engineer's staff shall include suitably qualified engineers and other professionals who are competent to carry out these duties.

The Engineer shall have no authority to amend the Contract.

The Engineer may exercise the authority attributable to the Engineer as specified in or necessarily to be implied from the Contract.

However, the Engineer shall obtain the specific approval of the Employer before taking action under the-following Sub-Clauses of these Conditions:

(a) Sub-Clause 4.12-Unforeseeable Physical Conditions: Agreeing o determining an extension of time and/or additional cost.

(b) Sub-Clause 8.4-Extension of Time for Completion: Agreeing o determining extension of time.

(c) Sub-Clause 11.9-Performance Certificate: Issue of Performance Certificate.

(d) Sub-Clause 13.1-Instructing a Variation: Except,

i) in an emergency situation as determined by the Engineer and as amplified in sub-paras (h) and (i) below, or

ii) for other situations, if the variation in quantity of any item does not exceed 25% of the stipulated quantity in the agreement, the variation in quantity in such item does not result in increase in excess of 0.1% of contract price and variation in quantity in such item does not result in cumulative variation in contract price in excess of 2%.

(e) Sub-Clause 13.3-Variation Procedure: Approving a proposal for Variation submitted by the Contractor in accordance with Sub Clause 13.1 or 13.2.

(f) Sub-Clause 13.4-Payment in applicable Currencies: Specifying the amount payable in each of the applicable currencies for a Variation.

(g) Clause 20.1: Contractor Claims for extension of time and/or additional payment.

(h) Notwithstanding the obligation, as set out above, to obtain approval, if, in the opinion of the Engineer, an emergency occurs affecting the safety of life or of the Works or of adjoining property, he may, without relieving the Contractor of any of his duties and responsibility under the Contract, instruct the Contractor to execute all such work or to do all such things as may, in the opinion of the Engineer, be necessary to abate or reduce the risk. The Contractor shall forthwith comply, despite the absence of approval of the Employer, with any such instruction of the Engineer. The Engineer shall determine an addition to the Contract Price, in respect of such instruction, in accordance with Clause 13 and shall notify the Contractor accordingly, with a copy to the Employer.

(i) In case the emergency mentioned in above Sub-paras occurs on account of failure of Contractor, by way of not adhering to the approved scheme of work or not taking adequate safety precautions or by any other reason attributable to the contractor, then no additional amounts shall be paid to the Contractor for attending to such emergencies and the Contractor shall

be liable for Employer's claims.

(j) Sub-clause 4.4 regarding deployment of Sub-Contractors.

3.2 Delegation by the Engineer

The Engineer may from time to time assign duties and delegate authority to assistants, and may also revoke such assignment or delegation. These assistants may include a resident engineer, and/or independent inspectors appointed to inspect and/or test items of Plant and/or Materials. The assignment, delegation or revocation shall be in writing and shall not take effect until copies have been received by both Parties.

However, unless otherwise agreed by both Parties, the Engineer shall not delegate the authority to determine any matter in accordance with Sub-Clause 3.5 [Determinations].

Assistants shall be suitably qualified persons, who are competent to carry out these duties and exercise this authority, and who are fluent in the language for communications defined in Sub-Clause 1.4 [Law and Language].

Each assistant, to whom duties have been assigned or authority has been delegated, shall only be authorised to issue instructions to the Contractor to the extent defined by the delegation. Any approval, check, certificate, consent, examination, inspection, instruction, notice, proposal, request, test, or similar act by an assistant, in accordance with the delegation, shall have the same effect as though the act had been an act of the Engineer. However:

(a) any failure to disapprove any work, Plant or Materials shall not constitute approval, and shall therefore not prejudice the right of the Engineer to reject the work, Plant or Materials;

(b) if the Contractor questions any determination or instruction of an assistant, the Contractor may refer the matter to the Engineer, who shall promptly confirm, reverse or vary the determination or instruction.

3.3 Instructions of the Engineer

The Engineer may issue to the Contractor (at any time) instructions and additional or modified Drawings which may be necessary for the execution of the Works and the remedying of any defects, all in accordance with the Contract. The Contractor shall only take instructions from the Engineer, or from an assistant to whom the appropriate authority has been delegated under this Clause. If an instruction constitutes a Variation, Clause 13 [Variations and Adjustments] shall apply.

The Contractor shall comply with the instructions given by the Engineer or delegated assistant, on any matter related to the Contract. Whenever practicable, their instructions shall be given in writing. If the Engineer or a delegated assistant,

(a) gives an oral instruction and

(b) receives a written confirmation of the instruction, from (or on behalf of) the Contractor, within two working days after giving the instruction, and

(c) does not reply by issuing a written rejection and/or instruction within two working days after receiving the confirmation,

(d) then the confirmation shall constitute the written instruction of the Engineer or delegated assistant (as the case may be).

3.4 Replacement of

Notwithstanding Sub-Clause 3.1, if the Employer intends to replace the Engineer, the Employer shall, not less than 21 days before the intended date of

the Engineer replacement, give notice to the Contractor of the name, address and relevant experience of the replacement Engineer.

3.5 Determina-tions Whenever these Conditions provide that the Engineer shall proceed in accordance with this Sub-Clause 3.5 to agree or determine any matter, the Engineer shall consult with each Party in an endeavour to reach agreement. If agreement is not achieved, the Engineer shall make a fair determination in accordance with the Contract, taking due regard of all relevant circumstances.

The Engineer shall give notice to both Parties of each agreement or determination, with supporting particulars. Each Party shall give effect to each agreement or determination unless and until revised under Clause 20 [Claims, Disputes and Arbitration].

4. The Contractor

4.1 Contractor's General Obligations

The Contractor shall design (to the extent specified in the Contract), execute and complete the Works in accordance with the Contract and with the Engineer's instructions, and shall remedy any defects in the Works.

The Contractor shall provide the Plant and Contractor's Documents specified in the Contract, and all Contractor's Personnel, Goods, consumables and other things and services, whether of a temporary or permanent nature, required in and for this design, execution, completion and remedying of defects.

All equipment, and material, to be incorporated in or required for the Works shall be procured from approved sources as stipulated in the Contract.

The Contractor shall be responsible for the adequacy, stability and safety of all Site operations and of all methods of construction. Except to the extent specified in the Contract, the Contractor (i) shall be responsible for all Contractor's Documents, Temporary Works, and such design of each item of Plant and Materials as is required for the item to be in accordance with the Contract, and (ii) shall not otherwise be responsible for the design or specification of the Permanent Works.

The Contractor shall, whenever required by the Engineer, submit details of the arrangements and methods which the Contractor proposes to adopt for the execution of the Works. No significant alteration to these arrangements and methods shall be made without this having previously been notified to the Engineer.

On completion of the works, the contractor shall arrange to furnish to the Employer two (2) bound sets of all "As Built" drawings for every component of the Works at his own cost, all such copies being on Polyester film of quality to be approved by the Engineer or his Representative. The Taking – over Certificate of the Works, as per the provisions of Clause 10.1 herein, shall not be issued by the Engineer in the event of the Contractor's failure to furnish the aforesaid "As Built" drawings for the entire works.

If the Contract specifies that the Contractor shall design any part of the Permanent Works, then unless otherwise stated in the Special Conditions of Contract:

(a) the Contractor shall submit to the Engineer the Contractor's Documents for this part in accordance with the procedures specified in the Contract;

(b) these Contractor's Documents shall be in accordance with the Specification and Drawings, shall be written in the language for communications defined in Sub-Clause 1.4 [Law and Language], and

shall include additional information required by the Engineer to add to the Drawings for co-ordination of each Party's designs;

(c) the Contractor shall be responsible for this part and it shall, when the Works are completed, be fit for such purposes for which the part is intended as are specified in the Contract; and

(d) prior to the commencement of the Tests on Completion, the Contractor shall submit to the Engineer the "as-built" documents and operation and maintenance manuals in accordance with the Specification and in sufficient detail for the Employer to operate, maintain, dismantle, reassemble, adjust and repair this part of the Works. Such part shall not be considered to be completed for the purposes of taking-over under Sub-Clause 10.1 [Taking Over of the Works and Sections] until these documents and manuals have been submitted to the Engineer.

4.2 Performance Security

The Contractor shall obtain (at his cost) a Performance Security and an additional Performance Security, if any in terms of ITB 35.5, for proper performance of the contract, for the amount, currencies and validity period for Performance Security stated in the Contract Data. If an amount is not stated in the Contract Data, this Sub-Clause shall not apply.

The Contractor shall deliver the Performance Security and additional Performance Security, if any, to the Employer within 28 days after receiving the Letter of Acceptance, and shall send a copy to the Engineer. The Performance Security/additional Performance Security shall be issued by an entity and from within a country (or other jurisdiction) approved by the Employer, and shall be in the form as given in Section 8 (Contract Forms) or in another form specifically approved by the Employer.

The Performance Security/additional Performance Security shall be, at the Contractor's option, in any of the following forms: An unconditional Bank guarantee in the prescribed format; or

A Cashier's or Banker's certified cheque drawn on a Scheduled / Nationalized Bank in India in favour of "Rail Vikas Nigam Ltd" payable at New Delhi,

The bank guarantee shall be from a bank having minimum net-worth of over INR 500 million from the specified banks as under:

(i) a Schedule Bank in India, or

(ii) a Foreign Bank having their operations in India, or

(iii) a Foreign Bank which does not have operations in India is required to provide a counter-guarantee by State Bank of India,

In case the contractor is a JV, the Performance Security/additional Performance Security, if any in terms of ITB 35.5, shall be submitted by each JV Partner separately on behalf of the JV in favour of RVNL in proportion of their respective percentage share specified in the JV Agreement. The additional Performance Security shall be submitted by the partner(s) responsible for execution of schedule(s) (as per JV agreement) against which additional Performance Security is required to

be submitted in terms of ITB 35.5. However, Submission of Performance Guarantee Security by individual partners on behalf of the JV shall in no way dilute their Joint & Several responsibility. The Employer shall be entitled to recover the amount of Bank Guarantees individually and all the Partners jointly at its discretion."

The Contractor shall ensure that the Performance Security/additional Performance Security is valid and enforceable until the Contractor has executed and completed the Works and remedied defects, if any. If the contractor does not complete the work for any reasons whatsoever, the terms of the Performance Security/ additional Performance Security specify its expiry date, and the Contractor has not become entitled to receive the Performance Certificate by the date 28 days prior to the expiry date, the Contractor shall be bound to extend the validity of the Performance Security/additional Performance Security until the Works have been completed and any defects have been remedied.

The Guarantees shall be unconditional and irrevocable. The Employer shall return the Performance Security to the Contractor within 21 days after receiving a copy of the Performance Certificate or passing of the Final Payment Certificate whichever is later. However, on completion of specified section(s) and successful passage of defect liability period for such section(s) along with execution of any leftover works at the time of completion of such section(s), the contractor shall be entitled for release of 90% of the proportionate Performance Security calculated as specified in Contract Data subject to the condition that Engineer certifies that no recoveries are pending in the contract. In case Engineer points out amount to be recovered then the contractor shall be entitled for release of 90% of the proportionate Performance Security calculated as specified in Contract Data minus the amount to be recovered.

The Employer shall return additional Performance Security submitted in terms of ITB 35.5 as per the following;

(a) If the contractor submits an application stating that all the works against the particular schedule(s)/bill(s) for which additional Performance Security was submitted in terms of ITB 35.5 have been completed in all respect, then the Employer, on being satisfied with the claim of the contractor, shall return the full additional Performance Security against the particular schedule(s). Decision of the Employer regarding completion of works against a particular schedule/bill shall be final and binding on the contractor.

(b) If the contractor submits an application stating that majority of the works (physical progress being not less than 90%) against the particular schedule(s)/bill(s) for which additional Performance Security was submitted in terms of ITB 35.5 have been completed and execution of balance works is held up for reasons not attributable to the Contractor, then the Employer, on being satisfied with the claim of the contractor, shall return 75% of the amount of additional Performance Security against the particular schedule(s). The balance amount of additional Performance Security shall however be returned only after completion of the works against the particular schedule(s)/bill(s) for which additional Performance

Security was submitted in terms of ITB 35.5, in all respects to the satisfaction of the Employer. Decision of the Employer regarding completion of works against a particular schedule/bill shall be final and binding on the contractor.

Without limitation to the provisions of the rest of this Sub-Clause, whenever the Engineer determines an addition or a reduction to the Contract Price as a result of a change in cost and/or legislation or as a result of a Variation amounting to more than 25 percent of the portion of the Contract Price payable in a specific currency, the Contractor shall at the Engineer's request promptly increase, or may decrease, as the case may be, the value of the Performance Security in that currency by an equal percentage Guarantee.

Wherever the contract is terminated under Clause 15.2, the Performance Guarantee shall be encashed by the Employer:

i) in full including additional performance guarantee amount, if any, taken in terms of sub clause 35.5 of ITB and not due for release on the date of issue of termination letter in terms of this clause, in case of termination of the contract as a whole; Or

ii) at the discretion of the Employer it may be encashed in part/parts proportionate to the Contract price of the bill/schedule to which the terminated part of work belongs i.e. P=(A x B)÷C where

P=Proportionate Bank Guarantee Amount.

A=Contract price (excluding GST) of the particular bill/schedule to which the terminated part of work belongs.

B=Performance Guarantee amount in terms of GCC sub clause 4.2

C=Total Contract price excluding GST.

Plus additional performance Guarantee amount, if any, taken in terms of sub clause 35.5 of ITB and not due for release on the date of issue of termination letter in terms of this clause against this particular bill/schedule to which the terminated part of the work belongs, in case of termination in part/parts.

The balance work should be got done separately, and independently by RVNL without risk and cost of the original contractor. The original contractor shall be debarred from participating in the tender for executing the balance work. If the failed contractor is a JV or a partnership firm, then every member/partner of such a firm would be debarred from participating in the tender for the balance work either in his/her individual capacity or as a partner of any other JV/partnership firm.

In case the contractor fails to perform the contract or any JV partner fails to perform its obligations under the JV agreement, which is a part of this agreement, the Employer may issue notice of such default to the said JV partner or the JV (depending upon reasons of default) and declare the said JV partner or the JV as Poor Performer. The issue of such notice shall automatically debar the JV partner or JV, as the case may be, from participating in any

RVNL tender from the date of issue of notice of default. The relevant performance security including additional performance security, if any, in terms of sub clauses 35.5 of ITB submitted by the Contractor or submitted on behalf of JV partner to the extent not due for release at the time of contemplation of such action shall be encashed and forfeited either fully or in proportion of the percentage share of that partner in the JV agreement, as the case may be.

4.3 Contractor's Representative

The Contractor shall appoint the Contractor's Representative and shall give him all authority necessary, including financial powers, to act on the Contractor's behalf under the Contract.

Unless the Contractor's Representative is named in the Contract, the Contractor shall, prior to the Commencement Date, submit to the Engineer for consent the name and particulars of the person the Contractor proposes to appoint as Contractor's Representative. If consent is withheld or subsequently revoked, or if the appointed person fails to act as Contractor's Representative, the Contractor shall similarly submit the name and particulars of another suitable person for such appointment.

The Contractor shall not, without the prior consent of the Engineer, revoke the appointment of the Contractor's Representative or appoint a replacement.

The whole time of the Contractor's Representative shall be given to directing the Contractor's performance of the Contract. If the Contractor's Representative is to be temporarily absent from the Site during the execution of the Works, a suitable replacement person shall be appointed, subject to the Engineer's prior consent, and the Engineer shall be notified accordingly.

The Contractor's Representative shall, on behalf of the Contractor, receive instructions under Sub-Clause 3.3 [Instructions of the Engineer].

The Contractor's Representative may delegate any powers, functions and authority to any competent person, and may at any time revoke the delegation. Any delegation or revocation shall not take effect until the Engineer has received prior notice signed by the Contractor's Representative, naming the person and specifying the powers, functions and authority being delegated or revoked.

The Contractor's Representative shall be fluent in the language for communications defined in Sub-Clause 1.4 [Law and Language]. If the Contractor's Representative's delegates are not fluent in the said language, the Contractor shall make competent interpreters available during all working hours in a number deemed sufficient by the Engineer.

The Contractor shall depute his Representative to attend all the review meetings notified by the Engineer

4.4 Sub-contractors

The Contractor shall not subcontract the whole of the Works. The Contractor shall be responsible for the acts or defaults of any Subcontractor, his agents or employees, as if they were the acts or defaults of the Contractor.

Unless otherwise stated in the Special Conditions of Contract:

(a) the Contractor shall not be required to obtain consent to suppliers solely of Materials, or to a subcontract for which the Subcontractor is named in the Contract or as specifically provided in the Contract data

or value of any sub-contract for Works, or the aggregate value of such sub-contracts with any Subcontractor, does not exceed 5% (five per cent) of the Contract Price provided that such works are not for the key activities in terms of clause 2.6 of section 3 (Evaluation and Qualification Criteria) which are to be executed by specialist subcontractor(s);

(b) the prior consent of the Engineer shall be obtained to other proposed Subcontractors and/or suppliers. While submitting his proposal in this regard, the Contractor shall ensure that;

(i) total value of Works requiring such consent for subcontracting shall not be more than 70% (seventy per cent) of the Contract Price;

(ii) the proposed subcontractor must have executed woks of 40% of value of the proposed subcontract through a single contract during last seven years; and

(iii) No banning/blacklisting/declaration as poor performer by RVNL is in force on the proposed subcontractor (on the date of grant of consent by the Engineer);

(iv) No contract of the proposed subcontractor has been terminated by RVNL during the last two years (to be reckoned from the date of grant of consent by the Engineer);

(v) the Contractor shall submit the proposal for subcontracting with the name, particulars and the relevant experience of the proposed subcontractor;

(c) the Contractor shall give the Engineer not less than 28 days' notice of the intended date of the commencement of each Subcontractor's work, and of the commencement of such work on the Site;

(d) each subcontract shall include provisions which would entitle the Employer to require the subcontract to be assigned to the Employer under Sub-Clause 4.5 [Assignment of Benefit of Subcontract] (if or when applicable) or in the event of termination under Sub-Clause 15.2 [Termination by Employer]; and

(e) On getting consent from the Engineer, the Contractor shall provide to the Engineer copy of the agreement entered with such subcontractor.

The Contractor shall ensure that the requirements imposed on the Contractor by Sub-Clause 1.12 [Confidential Details] apply equally to each Subcontractor.

Where practicable, the Contractor shall give fair and reasonable opportunity for contractors from the Country to be appointed as Subcontractors.

The Contractor shall endeavour to resolve all matters and payments amicably and speedily with the sub-contractors.

The Contractor shall indemnify and hold the Employer harmless against and from any claim of subcontractors or suppliers of the materials.

The Contractor shall release payment to the Sub-contractors/Suppliers promptly and shall endeavour to resolve all issues amicably and speedily with the Sub-contractors/Suppliers, so that the execution of work is not affected in any

manner whatsoever.

In case a Sub-contractor/Supplier represents to the Engineer in writing with supporting documents, stating that he has not received payment due as per the agreement/work or purchase order for the works executed by such Sub-contractor or supplies made by such Supplier, which have been covered in previous Payment Certificates and the Engineer finds such representation having merit, the Engineer, before issuing next Payment Certificate, may forward a copy of the representation to the Contractor requesting the Contractor to supply reasonable evidence that the amount stated to be outstanding by the Sub-contractor/Supplier for the works executed or supplies made, which have been covered in previous Payment Certificates has been paid and if not, why the same is not payable. The Engineer may recommend to make payment to the Sub-contractor/Supplier unless the Contractor submits reasonable evidence to the Engineer:

(i) that the amount claimed has been paid, or

(ii) satisfying the Engineer in writing that the Contractor is entitled to withhold or that the amount is not payable.

On the recommendation of the Engineer, the Employer may (at his sole discretion) directly pay to the Sub-contractor/Supplier the amount due for and on behalf of the Contractor, part or all of such amounts previously certified (less applicable deductions) as are found due to the Sub-contractor/Supplier by the Engineer. The Employer shall adjust the amount paid directly to the Sub-contractor/Supplier from any amount due by it to the Contractor. The Contractor shall repay the amount, in case no amount is found due by the Employer to the Contractor.

That the payment by Employer, on behalf of the Contractor to its Sub-contractor/Supplier, shall not alter any terms of agreement between the Employer and the Contractor and nor the same shall result in any privity of contract between the Employer and the Sub-contractor/Supplier.

4.5 Assignment of Benefit of Subcontract

If a Subcontractor's obligations extend beyond the expiry date of the relevant Defects Notification Period and the Engineer, prior to this date, instructs the Contractor to assign the benefit of such obligations to the Employer, then the Contractor shall do so. Unless otherwise stated in the assignment, the Contractor shall have no liability to the Employer for the work carried out by the Subcontractor after the assignment takes effect.

4.6 Co-operation

The Contractor shall, as specified in the Contract or as instructed by the Engineer, allow appropriate opportunities for carrying out work to:

(a) the Employer's Personnel,

(b) any other contractors employed by the Employer, and

(c) the personnel of any legally constituted public authorities,

who may be employed in the execution on or near the Site of any work not included in the Contract.

Any such instruction shall constitute a Variation if and to the extent that it causes the Contractor to incur Unforeseeable Cost. Services for these personnel and other contractors may include the use of Contractor's Equipment,

Temporary Works or access arrangements which are the responsibility of the Contractor.

If, under the Contract, the Employer is required to give to the Contractor possession of any foundation, structure, plant or means of access in accordance with Contractor's Documents, the Contractor shall submit such documents to the Engineer in the time and manner stated in the Specification.

4.7 Setting Out

The Contractor shall set out the Works in relation to original points, lines and levels ofreference specified in the Contract or notified by the Engineer. The Contractor shall be responsible for the correct positioning of all parts of the Works, and shall rectify any error in the positions, levels, dimensions or alignment of the works, notifying the Engineer within 28 days of the date of commencement

In the event of such discrepancy arising during the course of the work, for which Employer's documents are handed over after the date of commencement, the contractor shall seek clarifications within 14 days of receipt of such documents

The Employer shall be responsible for any errors in these specified or notified items of reference, but the Contractor shall use reasonable efforts to verify their accuracy before they are used.

Contractor shall promptly notify the Employer and the Engineer of any error, omission, fault, or any other defect in the design, drawing or specifications for the works, which he discovers when reviewing the Contract Documents, and in the process of execution of the Works. The contractor shall be responsible to ensure correlation in various drawings and bill of quantities, before commencement and execution of work. In case of any discrepancy the contractor shall bring it to notice of the Engineer for clarification within 28 days of the issue of Letter of Acceptance. In the event of such discrepancy arising during the course of the work, for which drawings are given after the date of issue of Letter of Acceptance, the contractor shall seek clarifications within 14 days of receipt of such drawings.

4.8 Safety Procedures

The Contractor shall follow the provisions laid down in Annexure 1 to Section 7 (Special Conditions of Contract), Chapter 1. (Safety and Security) of Section 5 (Works/Employers Requirements) and shall:

(a) comply with all applicable safety regulations,

(b) take care for the safety of all persons entitled to be on the Site,

(c) use reasonable efforts to keep the Site and Works clear of unnecessary obstruction so as to avoid danger to these persons,

(d) provide fencing, lighting, guarding and watching of the Works until completion and taking over under Clause 10 [Employer's Taking Over], and

(e) provide any Temporary Works (including roadways, footways, guards and fences) which may be necessary, because of the execution of the Works, for the use and protection of the public and of owners and occupiers of adjacent land.

4.8.1 Notwithstanding with any other provision, the Contractor shall have to pay penalty for damage to Railway cable in terms of clause C 15 of the JPO as

given in para 1.2 of Chapter 1. (Safety and Security) of Section 5 (Works/Employers Requirements) and shall also indemnify the Employer against any losses, damages to property or life in terms of para 1.11 and 1.12 of the chapter 1. (Safety and Security) of Section 5 (Works/Employers Requirements).

4.9 Quality Assurance

The Contractor shall institute a quality assurance system to demonstrate compliance with the requirements of the Contract. The system shall be in accordance with the details stated in the Contract. The Engineer shall be entitled to audit any aspect of the system.

Details of all procedures and compliance documents shall be submitted to the Engineer for information before each design and execution stage is commenced. When any document of a technical nature is issued to the Engineer, evidence of the prior approval by the Contractor himself shall be apparent on the document itself.

Compliance with the quality assurance system shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

4.10 Site Data

The Employer shall have made available to the Contractor for his information, prior to the Base Date, all relevant data in the Employer's possession on sub-surface and hydrological conditions at the Site, including environmental aspects. The Employer shall similarly make available to the Contractor all such data which come into the Employer's possession after the Base Date. The Contractor shall be responsible for interpreting all such data.

To the extent which was practicable (taking account of cost and time), the Contractor shall be deemed to have obtained all necessary information as to risks, contingencies and other circumstances which may influence or affect the Bid or Works. To the same extent, the Contractor shall be deemed to have inspected and examined the Site, its surroundings, the above data and other available information, and to have been satisfied before submitting the Bid as to all relevant matters, including (without limitation):

(a) the form and nature of the Site, including sub-surface conditions,

(b) the hydrological and climatic conditions,

(c) the extent and nature of the work and Goods necessary for the execution and completion of the Works and the remedying of any defects,

(d) the Laws, procedures and labour practices of the Country, and

(e) the Contractor's requirements for access, accommodation, facilities, personnel, power, transport, water and other services.

(f) Data made available by the Employer in accordance with the preceding paragraph shall be deemed to include data listed elsewhere in the contract as open for inspection at the address stipulated in the Contract.

4.11 Sufficiency of the Accepted Contract Amount

The Contractor shall be deemed to:

(a) have satisfied himself as to the correctness and sufficiency of the Accepted Contract Amount, and

(b) have based the Accepted Contract Amount on the data, interpretations, necessary information, inspections, examinations and satisfaction as to all relevant matters referred to in Sub-Clause 4.10 [Site Data].

Unless otherwise stated in the Contract, the Accepted Contract Amount covers all the Contractor's obligations under the Contract (including those under

Provisional Sums, if any) and all things necessary for the proper execution and completion of the Works and the remedying of any defects.

4.12 Unforeseeable Physical Conditions

In this Sub-Clause, "physical conditions" means natural physical conditions and man-made and other physical obstructions and pollutants, which the Contractor encounters at the Site when executing the Works, including sub-surface and hydrological conditions but excluding climatic conditions.

If the Contractor encounters adverse physical conditions which he considers to have been Unforeseeable, the Contractor shall give notice to the Engineer as soon as practicable.

This notice shall describe the physical conditions, so that they can be inspected by the Engineer, and shall set out the reasons why the Contractor considers them to be Unforeseeable. The Contractor shall continue executing the Works, using such proper and reasonable measures as are appropriate for the physical conditions, and shall comply with any instructions which the Engineer may give. If an instruction constitutes a Variation, Clause 13 [Variations and Adjustments] shall apply.

If and to the extent that the Contractor encounters physical conditions which are Unforeseeable, gives such a notice, and suffers delay and/or incurs Cost due to these conditions, the Contractor shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost, which shall be included in the Contract Price.

After receiving such notice and inspecting and/or investigating these physical conditions, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine (i) whether and (if so) to what extent these physical conditions were Unforeseeable, and (ii) the matters described in sub-paragraphs (a) and (b) above related to this extent.

However, before additional Cost is finally agreed or determined under sub-paragraph (ii), the Engineer may also review whether other physical conditions in similar parts of the Works (if any) were more favourable than could reasonably have been foreseen when the Contractor submitted the Bid. If and to the extent that these more favourable conditions were encountered, the Engineer may proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine the reductions in Cost which were due to these conditions, which may be included (as deductions) in the Contract Price and Payment Certificates. However, the net effect of all adjustments under sub-paragraph (b) and all these reductions, for all the physical conditions encountered in similar parts of the Works, shall not result in a net reduction in the Contract Price.

The Engineer may take account of any evidence of the physical conditions foreseen by the Contractor when submitting the Bid, which may be made available by the Contractor, but shall not be bound by any such evidence.

4.13 Rights of Way and Facilities

The Contractor shall bear all costs and charges for special and/or temporary rights-of-way which he may require, including those for access to the Site. The Contractor shall also obtain, at his risk and cost, any additional facilities outside the Site which he may require for the purposes of the Works.

In case any operation connected with traffic necessitates diversion, obstruction or closure of any road, railway or any other right of way, the approval of the Engineer and the concerned authorities shall be obtained well in advance by

the Contractor.

Provided that if it is found necessary for the Contractor to move one or more loads of heavy constructional plants and equipment, materials or Pre-constructed units or parts of units of work over roads, highways, bridges on which such oversized and overweight items that are not normally to be moved, the contractor shall obtain prior permission from the concerned authorities.

Payments for complying with the requirements, if any, for protection or strengthening of the roads, highways or bridges shall be made by the contractor and such expenses shall be deemed to be included in his quoted contract price.

4.14 Avoidance of Interference

The Contractor shall not interfere unnecessarily or improperly with:

(a) the convenience of the public, or

(b) the access to and use and occupation of all roads and footpaths, irrespective of whether they are public or in the possession of the Employer or of others or

(c) Passenger amenities at stations and station platforms.

The Contractor shall indemnify and hold the Employer harmless against and from all damages, losses and expenses (including legal fees and expenses) resulting from any such unnecessary or improper interference.

4.15 Access Route

The Contractor shall be deemed to have been satisfied as to the suitability and availability of access routes to the Site. The Contractor shall use reasonable efforts to prevent any road or bridge from being damaged by the Contractor's traffic or by the Contractor's Personnel. These efforts shall include the proper use of appropriate vehicles and routes.

Except as otherwise stated in these Conditions:

(a) the Contractor shall (as between the Parties) be responsible for any maintenance which may be required for his use of access routes;

(b) the Contractor shall provide all necessary signs or directions along access routes, and shall obtain any permission which may be required from the relevant authorities for his use of routes, signs and directions;

(c) the Employer shall not be responsible for any claims which may arise from the use or otherwise of any access route;

(d) the Employer does not guarantee the suitability or availability of particular access routes; and

(e) Costs due to non-suitability or non-availability, for the use required by the Contractor, of access routes shall be borne by the Contractor.

4.16 Transport of Goods

Unless otherwise stated in the Special Conditions of Contract:

(a) the Contractor shall give the Engineer not less than 21 days' notice of the date on which any Plant or a major item of other Goods will be delivered to the Site;

(b) the Contractor shall be responsible for packing, loading, transporting, receiving, unloading, storing and protecting all Goods and other things required for the Works; and

(c) the Contractor shall indemnify and hold the Employer harmless against

and from all damages, losses and expenses (including legal fees and expenses) resulting from the transport of Goods, and shall negotiate and pay all claims arising from their transport.

4.17 Contractor's Equipment

The Contractor shall be responsible for all Contractors' Equipment. When brought on to the Site, Contractor's Equipment shall be deemed to be exclusively intended for the execution of the Works. The Contractor shall not remove from the Site any major items of Contractor's Equipment without the consent of the Engineer. However, consent shall not be required for vehicles transporting Goods or Contractor's Personnel off Site.

In the event of Contractor imports any equipment the following shall apply" :

(a) Custom Clearance: The Employer will assist the contractor, when required by furnishing letters of recommendation for obtaining expeditious clearance through customs of constructional plants, material and other things required for the works and then for re-export, if any. The following publications, may be referred to by the contractor for guidance about custom regulations etc :

(i) Import & export policy, together with amendments, if any, published by Govt. of India, Ministry of Commerce..

(j) Hand Book of Procedures, together with amendments, if any, Volume 1 and 2 published by Ministry of Commerce.

(iii) Customs Tariff, together with amendments, if any published by Central Customs.

The Contractor shall be responsible to follow the latest rules and regulations without any liability of the Employer.

(b) Re-export of contractors equipment: The contractor shall obtain all the relevant information regarding procedure for the import and subsequent re-export of his equipment and materials from the Chief Controller of Imports and Exports, New Delhi, and shall inform himself and keep himself informed on the details of custom charges and draw-back regulations as applicable to the items of Constructional plant. The contractor shall provide the necessary guarantee/bonds where these are required by the customs notwithstanding that import licenses may be granted in the name of Employer.

(c) Notwithstanding the provisions mentioned above, Contractor's Equipment, including essential spare parts therefore, imported by the Contractor for the sole purpose of executing the Contract shall be temporarily exempt from the payment of import duties and taxes upon initial importation, provided the Contractor shall post with the customs authorities at the port of entry an approved export bond or bank guarantee, valid until the Time for Completion plus six months, in an amount equal to the full import duties and taxes which would be payable on the assessed imported value of such Contractor's Equipment and spare parts, and **callable** in the event the Contractor's Equipment is not exported from the Country on completion of the Contract. A copy of the **bond** or bank guarantee endorsed by the custom authorities shall be provided by the Contractor to the Employer upon the importation of individual items of Contractor's Equipment and spare parts. Upon export of individual items of Contractor's Equipment or spare parts, or upon the completion of the Contract, Contractor shall prepare for approval by the customs authority the authorities, an assessment of the residual value of the Contractor's Equipment and spare parts to be exported based on the

depreciation scale(s) and other criteria used by the customs authorities for such purposes under the provisions of the applicable Laws. Import duties and taxes shall be due and payable to the customs authorities by the Contractor on (a) the difference between the initial imported value and the residual value of the contractor's equipment and spare parts to be exported and (b) on the initial imported value that contractor's equipments and spare parts remaining in the Country after completion of the Contract. Upon payment of such dues within 28 days of being invoiced, the bond or bank guarantee shall be reduced or released accordingly; otherwise the security shall be called in the full amount remaining in the Country.

(d) **Conditions of hire of the contractor's equipment:** A certified copy of the agreement in respect of any item of Equipment held by contractor under any agreement for hire or hire purchase thereof, shall be supplied to the Engineer/Employer."

4.18 Protection of the Environment

The Contractor shall take all reasonable steps to protect the environment (both on and off the Site) and to limit damage and nuisance to people and property resulting from pollution, noise and other results of his operations.

The Contractor shall ensure that emissions, surface discharges and effluent from the Contractor's activities shall not exceed the values stated in the Specification or prescribed by applicable Laws.

4.19 Electricity, Water and Gas

The Contractor shall, except as stated below, be responsible for the provision of all power, water and other services he may require.

The Contractor shall be entitled to use for the purposes of the Works such supplies of electricity, water, gas and other services as may be available on the Site and of which details and prices are given in the Specification. The Contractor shall, at his risk and cost, provide any apparatus necessary for his use of these services and for measuring the quantities consumed.

The quantities consumed and the amounts due (at these prices) for such services shall be agreed or determined by the Engineer in accordance with Sub-Clause 2.5 [Employer's Claims] and Sub-Clause 3.5 [Determinations]. The Contractor shall pay these amounts to the Employer.

4.20 Employer's Equipment and Free-Issue Material

The Employer shall make the Employer's Equipment (if any) available for the use of the Contractor in the execution of the Works in accordance with the details, arrangements and prices stated in the Specification. Unless otherwise stated in the Specification:

(a) the Employer shall be responsible for the Employer's Equipment, except that

(b) the Contractor shall be responsible for each item of Employer's Equipment whilst any of the Contractor's Personnel is operating it, driving it, directing it or in possession or control of it.

The appropriate quantities and the amounts due (at such stated prices) for the use of Employer's Equipment shall be agreed or determined by the Engineer in accordance with Sub-Clause 2.5 [Employer's Claims] and Sub-Clause 3.5 [Determinations]. The Contractor shall pay these amounts to the Employer.

The Employer shall supply, free of charge, the "free-issue materials" (if any) in accordance with the details stated in the Contract data. The Employer shall, at his risk and cost, provide these materials at the time and place specified in the Contract. The Contractor shall then visually inspect them, and shall promptly give notice to the Engineer of any shortage, defect or default in these materials. Unless otherwise agreed by both Parties, the Employer shall immediately rectify the notified shortage, defect or default.

In case materials are handed over, in accordance with the procedure prescribed by the Engineer, after proper measurement and accounted for, the contractor shall be solely liable for any shortage, damage, defect or default in such material, and shall indemnify the Employer until the final accountal of materials is made by the Contractor on completion of the work.

4.21 Progress Reports

Unless otherwise stated in the Special Conditions of Contract, monthly progress reports shall be prepared by the Contractor and submitted to the Engineer in six copies. The first report shall cover the period up to the end of the first calendar month following the Commencement Date. Reports shall be submitted monthly thereafter, each within 7 days after the last day of the period to which it relates.

Reporting shall continue until the Contractor has completed all work which is known to be outstanding at the completion date stated in the Taking-Over Certificate for the Works.

Each report shall include:

- charts and detailed descriptions of progress, including each stage of design (if any), Contractor's Documents, procurement, manufacture, delivery to Site, construction, erection and testing; and including these stages for work by each nominated Subcontractor (as defined in Clause 5 [Nominated Subcontractors]),
- photographs showing the status of manufacture and of progress on the Site;
- for the manufacture of each main item of Plant and Materials, the name of the manufacturer, manufacture location, percentage progress, and the actual or expected dates of:

  (i) commencement of manufacture,

  (ii) Contractor's inspections,

(iii) tests, and

(iv) shipment and arrival at the Site;

- the details described in Sub-Clause 6.10 [Records of Contractor's Personnel and Equipment];
- copies of quality assurance documents, test results and certificates of Materials;
- list of notices given under Sub-Clause 2.5 [Employer's Claims] and notices given under Sub-Clause 20.1 [Contractor's Claims];
- safety statistics, including details of any hazardous incidents and activities relating to environmental aspects and public relations; and
- comparisons of actual and planned progress of all activities, with details of any events or circumstances which may jeopardise the completion in accordance with the Contract, and the measures being (or to be) adopted to overcome delays.

Unless otherwise stated in the Special Conditions of Contract:

4.22 Security of the Site

(a) the Contractor shall be responsible for keeping unauthorised persons off the Site, and

(b) authorised persons shall be limited to the Contractor's Personnel and the Employer's Personnel; and to any other personnel notified to the Contractor, by the Employer or the Engineer, as authorised personnel of the Employer's other contractors on the Site.

4.23 Contractor's Operations on Site

The Contractor shall confine his operations to the Site, and to any additional areas which may be obtained by the Contractor and agreed by the Engineer as working areas. The Contractor shall take all necessary precautions to keep Contractor's Equipment and Contractor's Personnel within the Site and these additional areas, and to keep them off adjacent land.

During the execution of the Works, the Contractor shall keep the Site free from all unnecessary obstruction, and shall store or dispose of any Contractor's Equipment or surplus materials. The Contractor shall clear away and remove from the Site any wreckage, rubbish and Temporary Works which are no longer required.

Upon the issue of a Taking-Over Certificate, the Contractor shall clear away and remove, from that part of the Site and Works to which the Taking-Over Certificate refers, all Contractor's Equipment, surplus material, wreckage, rubbish and Temporary Works. The Contractor shall leave that part of the Site and the Works in a clean and safe condition. However, the Contractor may retain on Site, during the Defects Notification Period, such Goods as are required for the Contractor to fulfill obligations under the Contract.

4.24 Fossils

All fossils, coins, articles of value or antiquity, and structures and other remains or items of geological or archaeological interest found on the Site shall be placed under the care and authority of the Employer. The Contractor shall take reasonable precautions to prevent Contractor's Personnel or other persons from removing or damaging any of these findings.

The Contractor shall, upon discovery of any such finding, promptly give notice

to the Engineer, who shall issue instructions for dealing with it. If the Contractor suffers delay and/or incurs Cost from complying with the instructions, the Contractor shall give a further notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost, which shall be included in the Contract Price.

After receiving this further notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

5. Nominated Subcontractors

5.1 Definition of nominated Subcontractor

In the Contract, "nominated Subcontractor" means a Subcontractor:

(a) who is stated in the Contract as being a nominated Subcontractor, or

(b) whom the Engineer, under Clause 13 [Variations and Adjustments], instructs the Contractor to employ as a Subcontractor.

5.2 Objection to Nomination

The Contractor shall not be under any obligation to employ a nominated Subcontractor against whom the Contractor raises reasonable objection by notice to the Engineer as soon as practicable, with supporting particulars. An objection shall be deemed reasonable if it arises from (among other things) any of the following matters, unless the Employer agrees to indemnify the Contractor against and from the consequences of the matter:

(a) there are reasons to believe that the Subcontractor does not have sufficient competence, resources or financial strength;

(b) the subcontract does not specify that the nominated Subcontractor shall indemnify the Contractor against and from any negligence or misuse of Goods by the nominated Subcontractor, his agents and employees; or

(c) the subcontract does not specify that, for the subcontracted work (including design, if any), the nominated Subcontractor shall:

(i) undertake to the Contractor such obligations and liabilities as will enable the Contractor to discharge his obligations and liabilities under the Contract, and

(ii) indemnify the Contractor against and from all obligations and liabilities arising under or in connection with the Contract and from the consequences of any failure by the Subcontractor to perform these obligations or to fulfil these liabilities.

5.3 Payments to nominated Subcontractors

The Contractor shall pay to the nominated Subcontractor the amounts which the Engineer certifies to be due in accordance with the subcontract. These amounts plus other charges shall be included in the Contract Price in accordance with sub-paragraph (b) of Sub-Clause 13.5 [Provisional Sums], except as stated in Sub-Clause 5.4 [Evidence of Payments].

5.4 Evidence of Payments

Before issuing a Payment Certificate which includes an amount payable to a nominated Subcontractor, the Engineer may request the Contractor to supply reasonable evidence that the nominated Subcontractor has received (Within 7 days of receipt of previous payment by the contractor) all amounts due in accordance with previous Payment Certificates, less applicable deductions for retention or otherwise. Unless the Contractor:

(a) submits this reasonable evidence to the Engineer, or

(b)

(i) satisfies the Engineer in writing that the Contractor is reasonably entitled to withhold or refuse to pay these amounts, and

(ii) submits to the Engineer reasonable evidence that the nominated Subcontractor has been notified of the Contractor's entitlement,

then the Employer may (at his sole discretion) pay, direct to the nominated Subcontractor, part or all of such amounts previously certified (less applicable deductions) as are due to the nominated Subcontractor and for which the Contractor has failed to submit the evidence described in sub-paragraphs (a) or (b) above. The Contractor shall then repay, to the Employer, the amount which the nominated Subcontractor was directly paid by the Employer.

6. Staff and Labour

6.1 Engagement of Staff and Labour

Except as otherwise stated in the Specification, the Contractor shall make arrangements for the engagement of all staff and labour, local or otherwise, and for their payment, housing, feeding and transport.

The Contractor is encouraged, to the extent practicable and reasonable, to employ staff and labor with appropriate qualifications and experience from sources within the Country.

6.2 Rates of Wages and Conditions of Labour

The Contractor shall pay rates of wages, and observe conditions of labour, which are not lower than those established for the trade or industry where the work is carried out. If no established rates or conditions are applicable, the Contractor shall pay rates of wages and observe conditions which are not lower than the general level of wages and conditions observed locally by employers whose trade or industry is similar to that of the Contractor.

If the Employer is obliged to provide amenities or arrange payment of wages to contract labour employed by the contractor either directly or through sub contractor under the contract on account of failures on the part the contractor to provide the amenities and / or arrange payment of wages to the contract labour as required of him under the provision of the said act / rules made there under, the Engineer/Employer shall be at liberty without prejudice to the rights of Engineer/Employer under Section 20(2) and 21(4) of the contract labour (Regulation and Abolition) Act 1970 to recover the whole or part of the expenditure so incurred on the wages so paid by the Engineer/Employer/Railway from the security deposit and/or from any sum or sums due to the contractor whether under this contract or any other contract.

The Contractor shall inform the Contractor's Personnel about their liability to pay personal income taxes in the Country in respect of such of their salaries, wages, allowances, and any benefits as are subject to taxes under the Laws of the Country for the time being in force, and the Contractor shall perform such duties in regard to such deductions thereof as may be imposed on him by such Laws.

The Contractor shall keep the Employer indemnified in case any action is taken against the Employer by the competent authority on account of contravention of any of the provisions of any Act or rules made there-under, regulation or notifications including amendment. If the Employer is caused to pay or

reimburse, such amounts as may be necessary to cause or observe, or for non-observance of the provisions stipulated in the notifications/bye laws/Acts/Rules/ regulations including amendments, if any, on the part of the Contractor, the Engineer/Employer shall have the right to deduct any money due to the contractor including his amount of performance security. The Employer/Engineer shall also have right to recover from the Contractor any sum required or estimated to be required for making good the loss or damage suffered by the Employer.

The employees of the Contractor and the Sub-Contractor in no case shall be treated as the employees of the Employer at any point of time.

The Contractor shall duly comply with the provisions of the Apprentices Act 1961 (III of 1961), the rules made there under and the orders that may be issued from time to time under the said Act and the said Rules and on his failure or neglect to do so he shall be subject to all liabilities provide by the said Act and said Rules.

The Contractor and his Sub Contractors shall comply with all applicable Labour Laws, and should not employ Child Labour for construction and maintenance activities. The Contractor shall provide appropriate facilities for children in Construction Camp sites.

The Contractors shall not differentiate wages between men and women for work of equal value.

6.3 Persons in the Service of Employer The Contractor shall not recruit, or attempt to recruit, staff and labour from amongst persons in the service of the Employer or the Engineer.

6.4 Labour Laws **The Contractor shall comply with all the relevant labour Laws applicable to the Contractor's Personnel, including Laws relating to their employment, health, safety, welfare, immigration, and emigration, and shall allow them all their legal rights.** The contractor and his sub-contractors shall be responsible to ensure at his own cost, compliance to all laws, bye-laws, rules and regulations for the time being in force pertaining to the employment of local or imported labour and shall take all necessary precautions to ensure and preserve the health and safety of all staff employed directly or through sub-contractors or petty contractors on the works, which shall include all the acts listed in Appendix – 1 but not limited to the same.

The Contractor shall require his employees to obey all applicable Laws, including those concerning safety at work.

During continuance of the Contract, the Contractor and his Sub-Contractors shall abide at all times by all existing labour enactments and rules made there under, regulations, notifications and bye laws of the State or Central government or local authority and any other labour laws (including rules), regulations, bye laws that may be passed or notification that may be issued under any labour law in future either by the State or the Central Government or the local authority. Salient features of some of the major labour laws that are applicable to construction industry are given in Appendix 1 to these Conditions of Contract.

6.5 Working Hours No work shall be carried out on the Site on locally recognised days of rest, or outside the normal working hours stated in the Contract Data, unless:

(a) otherwise stated in the Contract,

(b) the Engineer gives consent, or

(c) the work is unavoidable, or necessary for the protection of life or property or for the safety of the Works, in which case the Contractor shall immediately advise the Engineer.

6.6 Facilities for Staff and Labour

Except as otherwise stated in the Specification, the Contractor shall provide and maintain all necessary accommodation and welfare facilities for the Contractor's Personnel. The Contractor shall also provide facilities for the Employer's Personnel as stated in the Specification.

The Contractor shall not permit any of the Contractor's Personnel to maintain any temporary or permanent living quarters within the structures forming part of the Permanent Works.

6.7 Health and Safety

The Contractor shall at all times take all reasonable precautions to maintain the health and safety of the Contractor's Personnel. In collaboration with local health authorities, the Contractor shall ensure that medical staff, first aid facilities, sick bay and a standing arrangement for ambulance service are available at a phone call at all times at the Site and at any accommodation for Contractor's and Employer's Personnel, and that suitable arrangements are made for all necessary welfare and hygiene requirements and for the prevention of epidemics.

In the event of any outbreak of illness of an epidemic nature, the Contractor shall comply with and carry out such regulations, orders and requirements as may be made by the Government or the local medical or sanitary authorities, for the purpose of dealing with and overcoming the same. The Contractor shall appoint an accident prevention officer at the Site, responsible for maintaining safety and protection against accidents. This person shall be qualified for this responsibility, and shall have the authority to issue instructions and take protective measures to prevent accidents. Throughout the execution of the Works, the Contractor shall provide whatever is required by this person to exercise this responsibility and authority.

The Contractor shall send, to the Engineer, details of any accident as soon as practicable after its occurrence.

HIV-AIDS Prevention. The Contractor shall conduct an HIV-AIDS awareness programme via an approved service provider, and shall undertake such other measures as are specified in this Contract to reduce the risk of the transfer of the HIV virus between and among the Contractor's Personnel and the local community, to promote early diagnosis and to assist affected individuals.

Epidemics

In the event of any outbreak of illness of an epidemic nature, the Contractor shall comply with and carry out such regulations, orders and requirements as may be made by the Government or the local medical or sanitary authorities, for the purpose of dealing with and overcoming the same.

Records of Safety and Health

The Contractor shall maintain such records and make such reports concerning safety, health and welfare of persons and damage to property as the Engineer may from time to time prescribe.

Submission of Returns: :

The contractor shall be responsible for timely submission of all returns and statements to the concerned authorities in full compliance of all rules, bye-laws

and regulations for the time being in force.

The Contractor shall throughout the contract (including the Defects Notification Period): (i) conduct Information, Education and Consultation Communication (IEC) campaigns, at least every other month, addressed to all the Site staff and labor (including all the Contractor's employees, all Sub-Contractors and Consultants' employees, and all truck drivers and crew making deliveries to Site for construction activities) and to the immediate local communities, concerning the risks, dangers and impact, and appropriate avoidance behavior with respect to of Sexually Transmitted Diseases (STD)—or Sexually Transmitted Infections (STI) in general and HIV/AIDS in particular; (ii) provide male or female condoms for all Site staff and labor as appropriate; and (iii) provide for STI and HIV/AIDS screening, diagnosis, counseling and referral to a dedicated national STI and HIV/AIDS program, (unless otherwise agreed) of all Site staff and labor.

The Contractor shall include in the program to be submitted for the execution of the Works under Sub-Clause 8.3 an alleviation program for Site staff and labour and their families in respect of Sexually Transmitted Infections (STI) and Sexually Transmitted Diseases (STD) including HIV/AIDS. The STI, STD and HIV/AIDS alleviation program shall indicate when, how and at what cost the Contractor plans to satisfy the requirements of this Sub-Clause and the related specification. For each component, the program shall detail the resources to be provided or utilized and any related sub-contracting proposed. The program shall also include provision of a detailed cost estimate with supporting documentation. Payment to the Contractor for preparation and implementation this program shall not exceed the Provisional Sum dedicated for this purpose.

6.8 Contractor's Superintendence

Throughout the execution of the Works, and as long thereafter as is necessary to fulfil the Contractor's obligations, the Contractor shall provide all necessary superintendence to plan, arrange, direct, manage, inspect and test the work.

Superintendence shall be given by a sufficient number of persons having adequate knowledge of the language for communications (defined in Sub-Clause 1.4 [Law and Language]) and of the operations to be carried out (including the methods and techniques required, the hazards likely to be encountered and methods of preventing accidents), for the satisfactory and safe execution of the Works.

The Contractor shall employ the key personnel named in the Schedule of Personnel as referred to in the Contract Data to carry out the functions stated in the Schedule or other personnel approved by the Engineer. The Engineer will approve any proposed replacement of key personnel only if their qualifications, abilities and relevant experience are substantially equal to or better than those of the personnel listed in the Schedule.

The Contractor shall not employ any retired government Gazetted officer, who has either not completed one year after the date of retirement, or has not obtained permission to employment with the Contractor.

6.9 Contractor's Personnel

The Contractor's Personnel shall be appropriately qualified, skilled and experienced in their respective trades or occupations. The Engineer may require the Contractor to remove (or cause to be removed) any person employed on the Site or Works, including the Contractor's Representative if applicable, who:

(a) persists in any misconduct or lack of care,

(b) carries out duties incompetently or negligently,

(c) fails to conform with any provisions of the Contract, or

(d) persists in any conduct which is prejudicial to safety, health, or the protection of the environment.

If the Engineer asks the Contractor to remove a person who is a member of the Contractor's staff or his work force stating the reasons, the Contractor shall ensure that the person leaves the Site within seven (7) days and has no further connection with the work in the Contract. The replacement person shall be appointed within fourteen (14) days of the notification by the Engineer.

A reasonable proportion of the Contractor's Superintending Staff shall have a working knowledge of the English language or the Contractor shall have available on site at all times a sufficient number of competent interpreters to ensure the proper transmission of instructions and information. If appropriate, the Contractor shall then appoint (or cause to be appointed) a suitable replacement person.

6.10 Records of Contractor's Personnel and Equipment

The Contractor shall submit, to the Engineer, details showing the number of each class of Contractor's Personnel and of each type of Contractor's Equipment on the Site. Details shall be submitted each calendar month, in a form approved by the Engineer, until the Contractor has completed all work which is known to be outstanding at the completion date stated in the Taking-Over Certificate for the Works.

6.11 Disorderly Conduct

The Contractor shall at all times take all reasonable precautions to prevent any unlawful, riotous or disorderly conduct by or amongst the Contractor's Personnel, and to preserve peace and protection of persons and property on and near the Site.

6.12 Foreign Personnel

The Contractor may bring in to the country any foreign personnel who are necessary for the execution of the Works to the extent allowed by the applicable Laws. The Contractor shall ensure that these personnel are provided with the required residence visas and work permits. The Employer will, without any financial liability, if requested by the Contractor, use his best endeavours in a timely and expeditious manner to assist the Contractor in obtaining any local, state, national, or government permission required for bringing in the Contractor's personnel.

The Contractor shall be responsible for the return of these personnel to the place where they were recruited or to their domicile. In the event of the death in the Country of any of these personnel or members of their families, the Contractor shall similarly be responsible for making the appropriate arrangements for their return or burial. Contractor shall also be responsible for any legal liabilities during their stay.

6.13 Supply of Foodstuffs

The Contractor shall arrange for the provision of a sufficient supply of suitable food as may be stated in the Specification at reasonable prices for the Contractor's Personnel for the purposes of or in connection with the Contract.

6.14 Supply of Water

The Contractor shall, having regard to local conditions, provide on the Site an adequate supply of drinking and other water for the use of the Contractor's Personnel.

6.15 Measures against Insect

The Contractor shall at all times take the necessary precautions to protect the Contractor's Personnel employed on the Site from insect and pest nuisance,

and Pest Nuisance

and to reduce their danger to health. The Contractor shall comply with all the regulations of the local health authorities, including use of appropriate insecticide.

The Contractor shall provide his staff and labour with suitable prophylactics for the prevention of malaria, and take steps to prevent the formation of stagnant pools of water. He shall comply with all the regulations of the local health authorities in these respects and shall in particular arrange to spray thoroughly with approved insecticides all buildings erected on the site such treatment shall be carried out at least once a year or as instructed by the Engineer. The Contractor shall warn his staff and labour of the dangers of diseases like Malaria, Filaria and other contagious diseases etc. and also Scorpions, Snakes, Wild animals etc. and preventive actions required to be taken by the labour and staff.

6.16 Alcoholic Liquor or Drugs

The Contractor shall not, otherwise than in accordance with the Laws of the Country, import, sell, give barter or otherwise dispose of any alcoholic liquor or drugs, or permit or allow importation, sale, gift barter or disposal thereto by Contractor's Personnel.

6.17 Arms and Ammunition

The Contractor shall not give, barter, or otherwise dispose of, to any person, any arms or ammunition of any kind, or allow Contractor's Personnel to do so.

6.18 Festivals and Religious Customs

The Contractor shall respect the Country's recognized festivals, days of rest and religious or other customs.

6.19 Funeral Arrange-ments

The Contractor shall be responsible, to the extent required by local regulations, for making any funeral arrangements for any of his local employees who may die while engaged upon the Works.

6.20 Prohibition of Forced or Compulsory Labour

The contractor shall not employ "forced or compulsory labour" in any form. "Forced or compulsory labour" consists of all work or service, not voluntarily performed, that is extracted from an individual under threat of force or penalty.

6.21 Prohibition of Harmful Child Labour

The Contractor shall not employ any child to perform any work that is economically exploitative, or is likely to be hazardous to, or to interfere with, the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral, or social development.

6.22 Employment Records of Workers

The Contractor shall keep complete and accurate records of the employment of labour at the Site. The records shall include the names, ages, genders, hours worked and wages paid to all workers. These records shall be summarized on a monthly basis and shall be available for inspection by the Engineer during normal working hours. These records shall be included in the details to be submitted by the Contractor under Sub-Clause 6.10 [Records of Contractor's Personnel and Equipment].

(i) In addition to the above, the Contractor shall register his firm/company etc. on website 'www.shramikkalyan.indianrailways.gov.in' and upload requisite details of labour and their payment in this portal. These details shall be

available in public domain. The Registration/ updation on Portal shall be done as under:

(a) Contractor shall apply for onetime registration of his company/firm etc. in the Shramikkalyan portal with requisite details subsequent to issue of Letter of Acceptance. Employer/Engineer shall approve the contractor's registration in the portal within 7 days of receipt of such request.

(b) Contractor once approved by any Employer/Engineer, can create password with login ID (PAN No.) for subsequent use of portal for all LoAs issued in his favour.

(c) The contractor once registered on the portal, shall provide details of his Letter of Acceptances (LoA) / Contract Agreements on shramikkalyan portal within 15 days of issue of any LoA for approval of concerned Employer/Engineer. Employer/Engineer shall update (if required) and approve the details of LoA filled by contractor within 7 days of receipt of such request.

(d) After approval of LoA by Employer/Engineer, contractor shall fill the salient details of contract labours engaged in the contract and ensure updating of each wage payment to them on shramikkalyan portal on monthly basis.

(e) It shall be mandatory upon the contractor to ensure correct and prompt uploading of all salient details of engaged contractual labour & payments made thereof after each wage period.

(ii) While processing payment of any 'Interim Payment Certificate' or 'Final Payment Certificate' or release of 'Advances' or 'Performance Guarantee / Security deposit', contractor shall submit a certificate to the Engineer or Engineer's representatives that "I have uploaded the correct details of contract labours engaged in connection with this contract and payments made to them during the wage period in Railway's Shramikkalyan portal at 'www.shramikkalyan.indianrailways.gov.in' till ____Month, ____Year."

7. Plant, Materials and Workmanship

7.1 Manner of Execution

The Contractor shall carry out the manufacture of Plant, the production and manufacture of Materials, and all other execution of the Works:

(a) in the manner (if any) specified in the Contract,

(b) in a proper workmanlike and careful manner, in accordance with recognised good practice, and

(c) with properly equipped facilities and non-hazardous Materials, except as otherwise specified in the Contract.

7.2 Samples

The Contractor shall submit the following samples of Materials, and relevant information, to the Engineer for consent prior to using the Materials in or for the Works:

(a) manufacturer's standard samples of Materials and samples specified in

the Contract, all at the Contractor's cost, and

(b) additional samples instructed by the Engineer as a Variation.

Each sample shall be labelled as to origin and intended use in the Works.

7.3 Inspection

The Employer's Personnel shall at all reasonable times:

(a) have full access to all parts of the Site and to all places from which natural Materials are being obtained, and

(b) during production, manufacture and construction (at the Site and elsewhere), be entitled to examine, inspect, measure and test the materials and workmanship, and to check the progress of manufacture of Plant and production and manufacture of Materials.

The Contractor shall give the Employer's Personnel full opportunity to carry out these activities, including providing access, facilities, permissions and safety equipment. No such activity shall relieve the Contractor from any obligation or responsibility.

The Contractor shall give notice to the Engineer whenever any work is ready and before it is covered up, put out of sight, or packaged for storage or transport. The Engineer shall then either carry out the examination, inspection, measurement or testing without unreasonable delay, or promptly give notice to the Contractor that the Engineer does not require to do so. If the Contractor fails to give the notice, he shall, if and when required by the Engineer, uncover the work and thereafter reinstate and make good, all at the Contractor's cost.

7.4 Testing

This Sub-Clause shall apply to all tests specified in the Contract, other than the Tests after Completion (if any).

The Contractor shall provide all apparatus, assistance, documents and other information, electricity, equipment, fuel, consumables, instruments, labour, materials, and suitably qualified and experienced staff, as are necessary to carry out the specified tests efficiently. The Contractor shall agree, with the Engineer, the time and place for the specified testing of any Plant, Materials and other parts of the Works.

The Engineer may, under Clause 13 [Variations and Adjustments], vary the location or details of specified tests, or instruct the Contractor to carry out additional tests. If these varied or additional tests show that the tested Plant, Materials or workmanship is not in accordance with the Contract, the cost of carrying out this Variation shall be borne by the Contractor, notwithstanding other provisions of the Contract.

The Engineer shall give the Contractor not less than 24 hours' notice of the Engineer's intention to attend the tests. If the Engineer does not attend at the time and place agreed, the Contractor may proceed with the tests, unless otherwise instructed by the Engineer, and the tests shall then be deemed to have been made in the Engineer's presence.

If the Contractor suffers delay and/or incurs Cost from complying with these instructions or as a result of a delay for which the Employer is responsible, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost , which shall be included in the Contract Price.

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

The Contractor shall promptly forward to the Engineer duly certified reports of the tests. When the specified tests have been passed, the Engineer shall endorse the Contractor's test certificate, or issue a certificate to him, to that effect. If the Engineer has not attended the tests, he shall be deemed to have accepted the readings as accurate.

7.5 Rejection

If, as a result of an examination, inspection, measurement or testing, any Plant, Materials or workmanship is found to be defective or otherwise not in accordance with the Contract, the Engineer may reject the Plant, Materials or workmanship by giving notice to the Contractor, with reasons. The Contractor shall then promptly make good the defect and ensure that the rejected item complies with the Contract.

If the Engineer requires this Plant, Materials or workmanship to be retested, the tests shall be repeated under the same terms and conditions. If the rejection and retesting cause the Employer to incur additional costs, the Contractor shall subject to Sub-Clause 2.5 [Employer's Claims] pay these costs to the Employer.

7.6 Remedial Work

Notwithstanding any previous test or certification, the Engineer may instruct the Contractor to:

(a) remove from the Site and replace any Plant or Materials which is not in accordance with the Contract,

(b) remove and re-execute any other work which is not in accordance with the Contract, and

(c) execute any work which is urgently required for the safety of the Works, whether because of an accident, unforeseeable event or otherwise.

The Contractor shall comply with the instruction within a reasonable time, which shall be the time (if any) specified in the instruction, or immediately if urgency is specified under sub-paragraph (c).

If the Contractor fails to comply with the instruction, the Employer shall be entitled to employ and pay other persons to carry out the work. Except to the extent that the Contractor would have been entitled to payment for the work, the Contractor shall subject to Sub-Clause 2.5 [Employer's Claims] pay to the Employer all costs arising from this failure.

7.7 Ownership of Plant and Materials

Each item of Plant and Materials shall, to the extent consistent with the Laws of the Country, become the property of the Employer at whichever is the earlier of the following times, free from liens and other encumbrances:

(a) when it is delivered to the Site;

(b) when the Contractor is entitled to payment of the value of the Plant and Materials under Sub-Clause 8.10 [Payment for Plant and Materials in Event of Suspension].

7.8 Royalties

Unless otherwise stated in the Specification, the Contractor shall pay all royalties, rents and other payments for:

(a) natural Materials obtained from outside the Site, and

(b) the disposal of material from demolitions and excavations and of other surplus material (whether natural or man-made), except to the extent that

disposal areas within the Site are specified in the Contract.

8. Commencement, Delays and Suspension

8.1 Commencement of Works

The Engineer shall give the Contractor not less than 7 days' notice of the Commencement Date. Unless otherwise stated in the Special Conditions of Contract, the Commencement Date shall be within the number of days after the Contractor receives the Letter of Acceptance as specified in Contract Data.

The Contractor shall commence the execution of the Works as soon as is reasonably practicable after the Commencement Date, and shall then proceed with the Works with due expedition and without delay.

8.2 Time for Completion

The Contractor shall complete the whole of the Works, and each Section (if any), within the Time for Completion for the Works or Section (as the case may be), including:

(a) achieving the passing of the Tests on Completion, and

(b) completing all work which is stated in the Contract as being required for whole of the Works or Section(s) to be considered to be completed for the purposes of taking-over under Sub-Clause 10.1 [Taking Over of the Works and Sections].

(c) The date of completion for works described in this sub-clause, shall be the earliest of the following :

(i) The date CRS recommends opening of the Section(s) for public carriage of passengers to Central Government, for speeds of not less than 75% of the designed operating speeds or,

(ii) The date CRS authorises the Railway Administration for opening of Section(s), subject to sanction of the Central Government for speeds of not less than 75% of the designed operating speeds, or,

(iii) The date CRS authorizes/sanctions opening of Section(s) without inspection.

8.3 Programme

The Contractor shall submit a detailed time programme to the Engineer within 28 days after receiving the notice under Sub-Clause 8.1 *[Commencement of Works].* The program shall include the physical and Financial Progress vis-à-vis program and forecast cash flow adopting Project Management Software Primavera/Sure Track/MS Project or as mutually agreed. The program must identify the milestones, interface requirements and program reporting elements. The Contractor shall supply, free of cost one set of authorized software to the Engineer and the soft copy of structured program for the project. This shall be updated every month. The Contractor shall also submit a revised programme whenever the previous programme is inconsistent with actual progress or with the Contractor's obligations. Each programme shall include:

(a) the order in which the Contractor intends to carry out the Works, including the anticipated timing of each stage of design (if any), Contractor's Documents, procurement, manufacture of Plant, delivery to Site, construction, erection and testing,

(b) each of these stages for work by each nominated Subcontractor (as defined in Clause 5 [Nominated Subcontractors]),

(c) the sequence and timing of inspections and tests specified in the

Contract, and

(d) a supporting report which includes:

(i) a general description of the methods which the Contractor intends to adopt, and of the major stages, in the execution of the Works, and

(ii) details showing the Contractor's reasonable estimate of the number of each class of Contractor's Personnel and of each type of Contractor's Equipment, required on the Site for each major stage.

Unless the Engineer, within 21 days after receiving a programme, gives notice to the Contractor stating the extent to which it does not comply with the Contract, the Contractor shall proceed in accordance with the programme, subject to his other obligations under the Contract. The Employer's Personnel shall be entitled to rely upon the programme when planning their activities.

The Contractor shall promptly give notice to the Engineer of specific probable future events or circumstances which may adversely affect the work, increase the Contract Price or delay the execution of the Works. The Engineer may require the Contractor to submit an estimate of the anticipated effect of the future event or circumstances, and/or a proposal under Sub-Clause 13.3 [Variation Procedure].

If, at any time, the Engineer gives notice to the Contractor that a programme fails (to the extent stated) to comply with the Contract or to be consistent with actual progress and the Contractor's stated intentions, the Contractor shall submit a revised programme to the Engineer within 15 days in accordance with this Sub-Clause.

8.4 Extension of Time for Completion

The Contractor shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to an extension of the Time for Completion if and to the extent that completion for the purposes of Sub-Clause 10.1 [Taking-Over of the Works and Sections] is or will be delayed by any of the following causes:

(a) a Variation (unless an adjustment to the Time for Completion has been agreed under Sub-Clause 13.3 [Variation Procedure]) or other substantial change in the quantity of an item of work included in the Contract,

(b) a cause of delay giving an entitlement to extension of time under a Sub-Clause of these Conditions,

(c) exceptionally adverse climatic conditions,

(d) Unforeseeable shortages in the availability of personnel or Goods caused by epidemic or governmental actions, or

(e) any delay, impediment or prevention caused by or attributable to the Employer, the Employer's Personnel, or the Employer's other contractors.

If the Contractor considers himself to be entitled to an extension of the Time for Completion, the Contractor shall give notice to the Engineer in accordance with Sub-Clause 20.1 [Contractor's Claims]. When determining each extension of time under Sub-Clause 20.1, the Engineer shall review previous determinations and may increase, but shall not decrease, the total extension of time.

8.5 Delays Caused by Authorities

If the following conditions apply, namely:

(a) the Contractor has diligently followed the procedures laid down by the relevant legally constituted public authorities in the Country,

(b) these authorities delay or disrupt the Contractor's work, and

(c) the delay or disruption was Unforeseeable,

then this delay or disruption will be considered as a cause of delay under sub-paragraph (b) of Sub-Clause 8.4 [Extension of Time for Completion].

8.6 Rate of Progress

If, at any time:

(a) actual progress is too slow to complete within the Time for Completion, and/or

(b) progress has fallen (or will fall) behind the current programme under Sub-Clause 8.3 [Programme],

other than as a result of a cause listed in Sub-Clause 8.4 [Extension of Time for Completion], then the Engineer may instruct the Contractor to submit, under Sub-Clause 8.3 [Programme], a revised programme and supporting report describing the revised methods which the Contractor proposes to adopt in order to expedite progress and complete within the Time for Completion.

Unless the Engineer notifies otherwise, the Contractor shall adopt these revised methods, which may require increases in the working hours and/or in the numbers of Contractor's Personnel and/or Goods, at the risk and cost of the Contractor. If these revised methods cause the Employer to incur additional costs, the Contractor shall subject to Sub-Clause 2.5 [Employer's Claims] pay these costs to the Employer, in addition to delay damages (if any) under Sub-Clause 8.7 below.

8.7 Extension of Time for Completion with Delay Damages

If the Contractor fails to comply with Sub-Clause 8.2 [Time for Completion for entire work or for specified section wise completion period], and he is not entitled to an extension of time under sub clause 8.4 then the employer may grant extension of time with delay damage in such case, the Contractor shall subject to Sub-Clause 2.5 [Employer's Claims] pay delay damages to the Employer for this default. These delay damages shall be the sum stated in the Contract Data, which shall be paid for every day which shall elapse between the relevant Time for Completion and the date stated in the Taking-Over Certificate. However, the total amount due under this Sub-Clause shall not exceed the maximum amount of delay damages (if any) stated in the Contract Data.

Further, if the contractor fails to achieve physical/financial targets as per the agreed programme for a consecutive period of 3 months without any valid reasons, other than attributable to the contractor, a provisional recovery of delay damages shall be made from the next interim payment certificate @ 1/10th of the sum of delay damages stated in the contract data, for the entire period of 3 months. Such recovery shall continue from the further interim payment certificates till the contractor is able to make good the shortfall and achieve the cumulative targets as per agreed programme. On achieving the cumulative progress targets as per agreed programme, the entire amount recovered till that month, shall be refunded to the contractor in the next interim payment certificate. In case the contractor is unable to make good the shortfall and achieve the cumulative targets resulting in delay in completion of the project, then the provisional recoveries made shall be adjusted against the delay damages to be finally imposed on the contractor.

These delay damages shall be the only damages due from the Contractor for such default, other than in the event of termination under Sub-Clause 15.2 [Termination by Employer] prior to completion of the Works. These damages shall not relieve the Contractor from his obligation to complete the Works, or from any other duties, obligations or responsibilities which he may have under

the Contract.

8.8 Suspension of Work

The Engineer may at any time instruct the Contractor to suspend progress of part or all of the Works. During such suspension, the Contractor shall protect, store and secure such part or the Works against any deterioration, loss or damage.

The Engineer may also notify the cause for the suspension. If and to the extent that the cause is notified and is the responsibility of the Contractor, the following Sub-Clauses 8.9, 8.10 and 8.11 shall not apply.

8.9 Consequences of Suspension

If the Contractor suffers delay and/or incurs Cost from complying with the Engineer's instructions under Sub-Clause 8.8 [Suspension of Work] and/or from resuming the work, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost, which shall be included in the Contract Price.

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

The Contractor shall not be entitled to an extension of time for, or to payment of the Cost incurred in, making good the consequences of the Contractor's faulty design, workmanship or materials, or of the Contractor's failure to protect, store or secure in accordance with Sub-Clause 8.8 [Suspension of Work].

8.10 Payment for Plant and Materials in Event of Suspension

The Contractor shall be entitled to payment of the value (as at the date of suspension)of Plant and/or Materials, if:

(a) the work on Plant or delivery of Plant and/or Materials has been suspended for more than 28 days,

(b) the Contractor has marked the Plant and/or Materials as the Employer's property in accordance with the Engineer's instructions, and

(c) Such materials or plant is received at site.

8.11 Prolonged Suspension

If the suspension under Sub-Clause 8.8 [Suspension of Work] has continued for more than 84 days, the Contractor may request the Engineer's permission to proceed. If the Engineer does not give permission within 28 days after being requested to do so, the Contractor may, by giving notice to the Engineer, treat the suspension as an omission under Clause 13 [Variations and Adjustments] of the affected part of the Works. If the suspension affects the whole of the Works, the Contractor may give notice of termination under Sub-Clause 16.2 [Termination by Contractor].

8.12 Resumption of Work

After the permission or instruction to proceed is given, the Contractor and the Engineer shall jointly examine the Works and the Plant and Materials affected by the suspension. The Contractor shall make good any deterioration or defect in or loss of the Works or Plant or Materials, which has occurred during the suspension.

8.13 Bonus for early completion:

If the Contractor achieves completion of the whole of the Works or any section(s) prior to the intended Completion Date prescribed in Contract data (Extension of time pursuant to Clause 8.4 or any other clause of these conditions will not be considered), the Employer shall pay to the Contractor a sum stated in the Contract data as bonus for early completion, for every

calendar month which shall elapse between the date of completion of all items of works as stipulated in the contract, including variations ordered by the Engineer and the time prescribed in Clause 8.2.

For the purpose of calculating bonus payments, the time given in the Bid for completion of the whole works or any section(s) is fixed and unless otherwise agreed, no adjustment of the time by reasons of granting an extension of time pursuant to clause 8.4 or any other clause of these conditions will be allowed. Any period falling short of completed month shall be ignored for the purpose of computing the period relevant for the payment of bonus.

9. Tests on Completion

9.1 Contractor's Obligations

The Contractor shall carry out the Tests on Completion in accordance with this Clause and Sub-Clause 7.4 [Testing], after providing the documents in accordance with sub-paragraph (d) of Sub-Clause 4.1 [Contractor's General Obligations].

The Contractor shall give to the Engineer not less than 21 days' notice of the date after which the Contractor will be ready to carry out each of the Tests on Completion. Unless otherwise agreed, Tests on Completion shall be carried out within 14 days after this date, on such day or days as the Engineer shall instruct.

In considering the results of the Tests on Completion, the Engineer shall make allowances for the effect of any use of the Works by the Employer on the performance or other characteristics of the Works. As soon as the Works, or a Section, have passed any Tests on Completion, the Contractor shall submit a certified report of the results of these Tests to the Engineer.

9.2 Delayed Tests

If the Tests on Completion are being unduly delayed by the Employer, Sub-Clause 7.4 [Testing] (fifth paragraph) and/or Sub-Clause 10.3 [Interference with Tests on Completion] shall be applicable.

If the Tests on Completion are being unduly delayed by the Contractor, the Engineer may by notice require the Contractor to carry out the Tests within 21 days after receiving the notice. The Contractor shall carry out the Tests on such day or days within that period as the Contractor may fix and of which he shall give notice to the Engineer.

If the Contractor fails to carry out the Tests on Completion within the period of 21 days, the Employer's Personnel may proceed with the Tests at the risk and cost of the Contractor. The Tests on Completion shall then be deemed to have been carried out in the presence of the Contractor and the results of the Tests shall be accepted as accurate.

9.3 Retesting

If the Works, or a Section, fail to pass the Tests on Completion, Sub-Clause 7.5 [Rejection] shall apply, and the Engineer or the Contractor may require the failed Tests, and Tests on Completion on any related work, to be repeated under the same terms and conditions.

9.4 Failure to Pass Tests on Completion

If the Works, or a Section, fail to pass the Tests on Completion repeated under Sub-Clause 9.3 [Retesting], the Engineer shall be entitled to:

(a) order further repetition of Tests on Completion under Sub-Clause 9.3;

(b) if the failure deprives the Employer of substantially the whole benefit of the Works or Section, reject the Works or Section (as the case may be), in which event the Employer shall have the same remedies as are

provided in sub-paragraph (c) of Sub-Clause 11.4 [Failure to Remedy Defects]; or

(c) issue a Taking-Over Certificate, if the Employer so requests.

In the event of sub-paragraph (c), the Contractor shall proceed in accordance with all other obligations under the Contract, and the Contract Price shall be reduced by such amount as shall be appropriate to cover the reduced value to the Employer as a result of this failure. Unless the relevant reduction for this failure is stated (or its method of calculation is defined) in the Contract, the Employer may require the reduction to be (i) agreed by both Parties (in full satisfaction of this failure only) and paid before this Taking-Over Certificate is issued, or (ii) determined and paid under Sub-Clause 2.5 [Employer's Claims] and Sub-Clause 3.5 [Determinations].

9.5 Contractor's obligations

Notwithstanding the provisions of sub-clauses 4.1, 9.1 to 9.4 the provisions in subsequent sub-clauses shall apply for works of Permanent Way, signaling and telecommunication and railway electrification excluding General Electrical Services.

(a) The Contractor shall be responsible for the execution of temporary and/or permanent works which may require the prior sanction/approval of Commissioner of Railway Safety (CRS) in accordance with extant rules for " The Railways opening for Public Carriage of Passengers" was amended from time to time. And applicable as and when the works are undertaken. The Contractor shall initiate the process for approval at least **63** (sixty three) days prior to undertaking such works which require the approval of Commissioner of Railway Safety (CRS) and furnish draft documentation to the Engineer.

(b) The Contractor shall ensure that existing services and operations for public carriage of passengers or goods, are not affected except those, which are essentially required to be regulated for execution of works. Such items of works shall be planned and coordinated through the Engineer.

(c) Prior to the commencement of commercial operations of passenger traffic :

(i) The Contractor may have to operate locomotives, track machines and any other rolling stock for track tamping, trial runs, etc. for which track, signaling or OHE works must comply with the specifications.

(ii) The Employer may permit freight train operations to Railway after certification by the authorized person of Zonal Railway

(iii) The Contractor shall be responsible for maintaining the facilities ensuring safety of operations under (i) & (ii) above as per specifications.

10. Employer's Taking Over

10.1 Taking Over of the Works and Sections

Except as stated in Sub-Clause 9.4 [Failure to Pass Tests on Completion], the Works shall be taken over by the Employer/Railwaywhen (i) the Works have been completed in accordance with the Contract, including the matters described in Sub-Clause 8.2 [Time for Completion] and except as allowed in sub-paragraph (a) below, and (ii) a Taking-Over Certificate for the Works has been issued, or is deemed to have been issued in accordance with this Sub-Clause.

The Contractor may apply by notice to the Engineer for a Taking-Over Certificate not earlier than 14 days before the Works will, in the Contractor's opinion, be complete and ready for taking over. If the Works are divided into Sections, the Contractor may similarly apply for a Taking-Over Certificate for each Section.

In case the works are to be taken over in accordance with sub-clause 9.5, the completed works shall be taken over by the Zonal Railway with the procedure specified by the Engineer.

The Engineer shall, within 28 days after receiving the Contractor's application:

(a) issue the Taking-Over Certificate to the Contractor, stating the date on which the Works or Section were completed in accordance with the Contract, except for any minor outstanding work and defects which will not substantially affect the use of the Works or Section for their intended purpose (either until or whilst this work is completed and these defects are remedied); or

(b) reject the application, giving reasons and specifying the work required to be done by the Contractor to enable the Taking-Over Certificate to be issued. The Contractor shall then complete this work before issuing a further notice under this Sub-Clause.

If the Engineer fails either to issue the Taking-Over Certificate or to reject the Contractor's application within the period of 28 days, and if the Works or Section (as the case may be) are substantially in accordance with the Contract, the Taking-Over Certificate shall be deemed to have been issued on the last day of that period.

10.2 Taking Over of Parts of the Works

The Engineer may, at the sole discretion of the Employer, issue a Taking-Over Certificate for any part of the Permanent Works.

The Employer shall not use any part of the Works (other than as a temporary measure which is either specified in the Contract or agreed by both Parties) unless and until the Engineer has issued a Taking-Over Certificate for this part. However, if the Employer does use any part of the Works before the Taking-Over Certificate is issued:

(a) the part which is used shall be deemed to have been taken over as from the date on which it is used,

(b) the Contractor shall cease to be liable for the care of such part as from this date, when responsibility shall pass to the Employer, and

(c) if requested by the Contractor, the Engineer shall issue a Taking-Over Certificate for this part.

After the Engineer has issued a Taking-Over Certificate for a part of the Works, the Contractor shall be given the earliest opportunity to take such steps as may be necessary to carry out any outstanding Tests on Completion. The Contractor shall carry out these Tests on Completion as soon as practicable before the expiry date of the relevant Defects Notification Period.

If the Contractor incurs Cost as a result of the Employer taking over and/or using a part of the Works, other than such use as is specified in the Contract or agreed by the Contractor, the Contractor shall (i) give notice to the Engineer and (ii) be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to payment of any such Cost, which shall be included in the Contract Price. After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine this Cost and profit.

If a Taking-Over Certificate has been issued for a part of the Works (other than a Section), the delay damages thereafter for completion of the remainder of the Works shall be reduced. Similarly, the delay damages for the remainder of the Section (if any) in which this part is included shall also be reduced. For any period of delay after the date stated in this Taking-Over Certificate, the proportional reduction in these delay damages shall be calculated as the proportion which the value of the part so certified bears to the value of the Works or Section (as the case may be) as a whole. The Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these proportions. The provisions of this paragraph shall only apply to the daily rate of delay damages under Sub-Clause 8.7 [Delay Damages], and shall not affect the maximum amount of these damages.

10.3 Interference with Tests on Completion

If the Contractor is prevented, for more than 14 days, from carrying out the Tests on Completion by a cause for which the Employer/Engineer/other Contractors of the Employer,

are responsible, the Employer shall be deemed to have taken over the Works or Section (as the case may be) on the date when the Tests on Completion would otherwise have been completed.

The Engineer shall then issue a Taking-Over Certificate accordingly, and the Contractor shall carry out the Tests on Completion as soon as practicable, before the expiry date of the Defects Notification Period. The Engineer shall require the Tests on Completion to be carried out by giving 14 days' notice and in accordance with the relevant provisions of the Contract.

If the Contractor suffers delay and/or incurs Cost as a result of this delay in carrying out the Tests on Completion, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost, which shall be included in the Contract Price.

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

10.4 Surfaces Requiring Reinstatement

Except as otherwise stated in a Taking-Over Certificate, a certificate for a Section orpart of the Works shall not be deemed to certify completion of any ground or other surfaces requiring reinstatement.

11. Defects Liability

11.1 Completion of Outstanding Work and Remedying Defects

In order that the Works and Contractor's Documents, and each Section, shall be in the condition required by the Contract (fair wear and tear excepted) by the expiry date of the relevant Defects Notification Period or as soon as practicable thereafter, the Contractor shall:

(a) complete any work which is outstanding on the date stated in a Taking-Over Certificate, within such reasonable time as is instructed by the Engineer, and

(b) execute all work required to remedy defects or damage, as may be notified by (or on behalf of) the Employer on or before the expiry date of

the Defects Notification Period for the Works or Section (as the case may be).

If a defect appears or damage occurs, the Contractor shall be notified accordingly, by (or on behalf of) the Employer.

11.2 Cost of Remedying Defects

All work referred to in sub-paragraph (b) of Sub-Clause 11.1 [Completion of Outstanding Work and Remedying Defects] shall be executed at the risk and cost of the Contractor, if and to the extent that the work is attributable to:

(a) any design for which the Contractor is responsible,

(b) Plant, Materials or workmanship not being in accordance with the Contract, or

(c) failure by the Contractor to comply with any other obligation.

If and to the extent that such work is attributable to any other cause, the Contractor shall be notified promptly by (or on behalf of) the Employer, and Sub-Clause 13.3 [Variation Procedure] shall apply.

11.3 Extension of Defects Notification Period

The Employer shall be entitled subject to Sub-Clause 2.5 [Employer's Claims] to an extension of the Defects Notification Period for the Works or a Section if and to the extent that the Works, Section or a major item of Plant (as the case may be, and after taking over) cannot be used for the purposes for which they are intended by reason of a defect or damage. However, a Defects Notification Period shall not be extended by more than two years.

If delivery and/or erection of Plant and/or Materials was suspended under Sub-Clause 8.8 [Suspension of Work] or Sub-Clause 16.1 [Contractor's Entitlement to Suspend Work], the Contractor's obligations under this Clause shall not apply to any defects or damage occurring more than two years after the Defects Notification Period for the Plant and/or Materials would otherwise have expired.

11.4 Failure to Remedy Defects

If the Contractor fails to remedy any defect or damage within a reasonable time, a date may be fixed by (or on behalf of) the Employer, on or by which the defect or damage is to be remedied. The Contractor shall be given reasonable notice of this date.

If the Contractor fails to remedy the defect or damage by this notified date and this remedial work was to be executed at the cost of the Contractor under Sub-Clause 11.2 [Cost of Remedying Defects], the Employer may (at his option):

(a) Carry out the work himself or by others, in a reasonable manner and at the Contractor's cost, but the Contractor shall have no responsibility for this work; and the Contractor shall subject to Sub-Clause 2.5 [Employer's Claims] pay to the Employer the costs reasonably incurred by the Employer in remedying the defect or damage;

(b) require the Engineer to agree or determine a reasonable reduction in the Contract Price in accordance with Sub-Clause 3.5 [Determinations]; or

(c) if the defect or damage deprives the Employer of substantially the whole benefit of the Works or any major part of the Works, terminate the Contract as a whole, or in respect of such major part which cannot be put to the intended use. Without prejudice to any other rights, under the Contract or otherwise, the Employer shall then be entitled to recover all sums paid for the Works or for such part (as the case may be), plus financing costs and the cost of dismantling the same, clearing the Site

and returning Plant and Materials to the Contractor.

11.5 Removal of Defective Work If the defect or damage cannot be remedied expeditiously on the Site and the Employer gives consent, the Contractor may remove from the Site for the purposes of repair such items of Plant as are defective or damaged. This consent may require the Contractor to increase the amount of the Performance Security by the full replacement cost of these items, or to provide other appropriate security.

11.6 Further Tests If the work of remedying of any defect or damage may affect the performance of the Works, the Engineer may require the repetition of any of the tests described in the Contract. The requirement shall be made by notice within 28 days after the defect or damage is remedied.

These tests shall be carried out in accordance with the terms applicable to the previous tests, except that they shall be carried out at the risk and cost of the Party liable, under Sub-Clause 11.2 [Cost of Remedying Defects], for the cost of the remedial work.

11.7 Right of Access Until the Performance Certificate has been issued, the Contractor shall have such right of access to the Works as is reasonably required in order to comply with this Clause, except as may be inconsistent with the Employer's reasonable security restrictions.

11.8 Contractor to Search The Contractor shall, if required by the Engineer, search for the cause of any defect, under the direction of the Engineer. Unless the defect is to be remedied at the cost of the Contractor under Sub-Clause 11.2 [Cost of Remedying Defects], the Cost of the search shall be agreed or determined by the Engineer in accordance with Sub-Clause 3.5 [Determinations] and shall be included in the Contract Price.

11.9 Performance Certificate Performance of the Contractor's obligations shall not be considered to have been completed until the Employer has issued the Performance Certificate to the Contractor, stating the date on which the Contractor completed his obligations under the Contract.

The Employer shall issue the Performance Certificate within 28 days after the latest of the expiry dates of the Defects Notification Periods, or as soon thereafter as the Contractor has supplied all the Contractor's Documents and completed and tested all the Works, including remedying any defects.

Only the Performance Certificate shall be deemed to constitute acceptance of the Works.

11.10 Unfulfilled Obligations After the Performance Certificate has been issued, each Party shall remain liable for the fulfilment of any obligation which remains unperformed at that time. For the purposes of determining the nature and extent of unperformed obligations, the Contract shall be deemed to remain in force.

11.11 Clearance of Site Upon receiving the Performance Certificate, the Contractor shall remove any remaining Contractor's Equipment, surplus material, wreckage, rubbish and Temporary Works from the Site.

If all these items have not been removed within 28 days after the Employer receives a copy of the Performance Certificate, the Employer may sell or otherwise dispose of any remaining items. The Employer shall be entitled to be paid the costs incurred in connection with, or attributable to, such sale or disposal and restoring the Site.

Any balance of the moneys from the sale shall be paid to the Contractor. If these moneys are less than the Employer's costs, the Contractor shall pay the outstanding balance to the Employer.

12. Measurement and Evaluation

12.1 Works to be Measured

The Works shall be measured, and valued for payment, in accordance with this Clause.

Whenever the Engineer requires any part of the Works to be measured, reasonable notice shall be given to the Contractor's Representative, who shall:

(a) promptly either attend or send another qualified representative to assist the Engineer in making the measurement, and

(b) supply any particulars requested by the Engineer.

If the Contractor fails to attend or send a representative, the measurement made by (or on behalf of) the Engineer shall be accepted as accurate.

Except as otherwise stated in the Contract, wherever any Permanent Works are to be measured from records, these shall be prepared by the Engineer. The Contractor shall, as and when requested, attend to examine and agree the records with the Engineer, and shall sign the same when agreed. If the Contractor does not attend, the records shall be accepted as accurate.

If the Contractor examines and disagrees the records, and/or does not sign them as agreed, then the Contractor shall give notice to the Engineer of the respects in which the records are asserted to be inaccurate. After receiving this notice, the Engineer shall review the records and either confirm or vary them. If the Contractor does not so give notice to the Engineer within 14 days after being requested to examine the records, they shall be accepted as accurate.

12.2 Method of Measurement

Except as otherwise stated in the Contract and notwithstanding local practice:

(a) measurement shall be made of the net actual quantity of each item of the Permanent Works, and

(b) the method of measurement shall be in accordance with the Bill of Quantities or other applicable Schedules.

12.3 Evaluation

Except as otherwise stated in the contract, the Engineer shall proceed in accordance with sub clause 3.5 (Determinations) to agree or determine the contract price by evaluating each item of work, applying the measurement agreed or determined in accordance with the above sub clause 12.1 and 12.2 and the appropriate rate or price for the item.

For each item of work, the appropriate rate or price for the item shall be the rate or price specified for such item in the contract or, if there is no such item, specified for similar work.

12.3.1

However, a new rate or price shall be appropriate for an item of work if :

(a) all the following conditions are met for existing item of the contract:

(i) the measured quantity of the item is increased by more than 50%

from the quantity of this item in the Bill of Quantities or the Schedule,

(ii) this increase in quantity multiplied by specified rate for this item in the Bill of Quantities or the Schedule, exceeds 0.25% of the Accepted Contract Amount,

(iii) this item is not specified in the contract as a "fixed rate item".

Note: New rates in case of increase in quantity of the agreement items shall be applicable to the increase in quantities beyond the quantities required to meet conditions specified under 12.3.1 (a) (i) & (ii) above.

OR

(b) (i) the work is instructed under clause 13[Variations and Adjustments],

(ii) no rate or price is specified in the contract for this item, and

(iii) no specified rate or price is appropriate because the item of work is not of similar character, or is not executed under similar conditions, as any item in the contract.

OR

(c) On passage of original completion period stipulated in the contract, if site in some stretches has not been handed over for execution of the work due to any of the reasons mentioned below:

(i) non acquisition of land,

(ii) non availability of forest/wild life clearances,

(iii) non removal of encroachments, delay in shifting of utilities (to be shifted by other agencies) and

(iv) non handing over of the sites by other agencies/authorities

and the contractor otherwise has been executing the works satisfactorily on other sites, as certified by the Engineer, the contractor shall be entitled for new rates for the items and quantities of work which could not be executed in the stretches still to be handed over. In case the progress is not satisfactory, the contractor shall not be entitled for new rates and the Employer shall have the option either to continue the work in these stretches through the same agency or get it executed through other means.

In case of entitlement for new rates, if the contractor is not willing to take up the work in these stretches, he will have the option to say so in writing or if no agreement is reached on new rates, the remaining works of such stretches shall be excluded from the scope of the contract through a variation statement. In such a case the contractor shall not be

entitled for any claim or compensation on this account. The employer shall get the remaining works on these stretches executed through other means.

12.3.2

(i) Each new rate or price for item(s) as described in sub paragraph 12.3.1 (a) & (c) above shall be derived from an assessment of the reasonable cost of executing the work with an additional element of 15% towards overheads and profit of the Contractor.

(ii) Each new rate or price for item(s) as described in sub paragraph 12.3.1 (b) above shall be derived from an assessment of the reasonable cost of executing the work with an additional element of 15% towards overheads and profit of the Contractor, subject to the condition that such item(s) as described in sub paragraph 12.3.1 (b) above is/are not available in the "Standard Bill of Quantities of RVNL".

(iii) In case item(s) as described in sub paragraph 12.3.1 (b) above is/are available in the "Standard Bill of Quantities of RVNL (updated upto 28 days prior to deadline for submission of bids)", new rate or price for such items shall be the rate as available in the "Standard Bill of Quantities of RVNL (updated upto 28 days prior to deadline for submission of bids)", modified by the percentage above/below accepted in this contract for the respective schedule and also price variation shall be applicable in the same manner as applicable to items specified in the contract.

(iv) The assessment of reasonable cost of executing the work (except over heads and profit which shall be 15%) shall be arrived at based on the prevailing rates and by taking guidance from the following documents. The priority of the documents shall be in accordance with the following sequence:

a) Analysis of Unified SOR of Indian Railway;

b) Analysis issued by MORTH;

c) Analysis of Delhi Schedule of Rates issued by CPWD;

d) Market analysis.

(v) If the final rate decided by the competent authority as per RVNL SOP is not acceptable to the contractor, the contractor will be bound to execute the work at the rates as decided by the competent authority of RVNL but he may refer the dispute in rate for settlement as per provisions of clause 20 of General Conditions of Contract.Until such time as an appropriate rate or price is agreed or determined, the Engineer shall make the Interim payment at the rate of 80% of the rate proposed by him and accepted by the Project Director (concerned CPM/GM in charge of the project).

12.3.3

Until such time as an appropriate rate or price is agreed or determined, the Engineer shall make the Interim payment at the rate of 80% of the rate proposed by him and accepted by the Project Director (concerned CPM/GM in

charge of the project).

12.4 Omissions Whenever the omission of any work forms part (or all) of a Variation, the value of which has not been agreed, if:

(a) the Contractor will incur (or has incurred) cost which, if the work had not been omitted, would have been deemed to be covered by a sum forming part of the Accepted Contract Amount;

(b) the omission of the work will result (or has resulted) in this sum not forming part of the Contract Price; and

(c) this cost is not deemed to be included in the evaluation of any substituted work;

then the Contractor shall give notice to the Engineer accordingly, with supporting particulars. Upon receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine this cost, which shall be included in the Contract Price.

13. Variations and Adjustments

13.1 Right to Vary Variations may be initiated by the Employer at any time prior to issuing the Taking-Over Certificate for the Works, either by an instruction or by making a request to the Contractor to submit a proposal.

The Contractor shall execute and be bound by each Variation till the price does not exceed 50% of the agreemental value as specified in letter of acceptance / original agreement. For variation beyond the above the contractor shall be bound to execute, unless the Contractor promptly gives notice to the Engineer stating (with supporting particulars) that the Contractor cannot readily obtain the Goods required for the Variation. Upon receiving this notice, the Engineer shall cancel, confirm or vary the instruction.

Each Variation may include:

(a) changes to the quantities of any item of work included in the Contract,

(b) changes to the quality and other characteristics of any item of work,

(c) changes to the levels, positions and/or dimensions of any part of the Works,

(d) omission of any work unless it is to be carried out by others,

(e) any additional work, Plant, Materials or services necessary for the Permanent Works, including any associated Tests on Completion, boreholes and other testing and exploratory work, or

(f) changes to the sequence or timing of the execution of the Works.

The Contractor shall not make any alteration and/or modification of the Permanent Works, unless and until the Engineer instructs or approves a Variation.

13.2 Value Engineering The Contractor may, at any time, submit to the Engineer a written proposal which (in the Contractor's opinion) will, if adopted, (i) accelerate completion, (ii) reduce the cost to the Employer of executing, maintaining or operating the Works, (iii) improve the efficiency or value to the Employer of the completed Works, or (iv) otherwise be of benefit to the Employer.

The proposal shall be prepared at the cost of the Contractor and shall include

the items listed in Sub-Clause 13.3 [Variation Procedure].

If a proposal, which is approved by the Engineer, includes a change in the design of part of the Permanent Works, then unless otherwise agreed by both Parties:

(a) the Contractor shall design this part,

(b) sub-paragraphs (a) to (d) of Sub-Clause 4.1 [Contractor's General Obligations] shall apply, and

(c) if this change results in a reduction in the contract value of this part, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine a fee, which shall be included in the Contract Price. This fee shall be half (50%) of the difference between the following amounts:

(i) such reduction in contract value, resulting from the change, excluding adjustments under Sub-Clause 13.7 [Adjustments for Changes in Legislation] and Sub-Clause 13.8 [Adjustments for Changes in Cost],and

(ii) the reduction (if any) in the value to the Employer of the varied works, taking account of any reductions in quality, anticipated life or operational efficiencies.

However, if amount (i) is less than amount (ii), there shall not be a fee.

13.3 Variation Procedure

If the Engineer requests a proposal, prior to instructing a Variation, the Contractor shall respond in writing as soon as practicable, either by giving reasons why he cannot comply (if this is the case) or by submitting:

(a) a description of the proposed work to be performed and a programme for its execution,

(b) the Contractor's proposal for any necessary modifications to the programme according to Sub-Clause 8.3 [Programme] and to the Time for Completion, and

(c) the evaluation of the Variation shall be as specified in Clause 12.3 Evaluation.

The Engineer shall, as soon as practicable after receiving such proposal (under Sub-Clause 13.2 [Value Engineering] or otherwise), respond with approval, disapproval or comments. The Contractor shall not delay any work whilst awaiting a response.

Each instruction to execute a Variation, with any requirements for the recording of Costs, shall be issued by the Engineer to the Contractor, who shall acknowledge receipt.

Each Variation shall be evaluated in accordance with Clause 12 [Measurement and Evaluation], unless the Engineer instructs or approves otherwise in accordance with this Clause.

13.4 Payment in Applicable Currencies

If the Contract provides for payment of the Contract Price in more than one currency, then whenever an adjustment is agreed, approved or determined as stated above, the amount payable in each of the applicable currencies shall be specified. For this purpose, reference shall be made to the actual or expected currency proportions of the Cost of the varied work, and to the proportions of various currencies specified for payment of the Contract Price.

13.5 Provisional Sums

Each Provisional Sum shall only be used, in whole or in part, in accordance with the Engineer's instructions, and the Contract Price shall be adjusted accordingly. The total sum paid to the Contractor shall include only such amounts, for the work, supplies or services to which the Provisional Sum relates, as the Engineer shall have instructed. For each Provisional Sum, the Engineer may instruct:

(a) work to be executed (including Plant, Materials or services to be supplied) by the Contractor and valued under Sub-Clause 13.3 [Variation Procedure]; and/or

(b) Plant, Materials or services to be purchased by the Contractor, from a nominated Subcontractor (as defined in Clause 5 [Nominated Subcontractors]) or otherwise; and for which these shall be included in the Contract Price:

(i) the actual amounts paid (or due to be paid) by the Contractor, and

(ii) a sum for overhead charges and profit, calculated as a percentage of these actual amounts by applying the relevant percentage rate (if any) stated in the appropriate Schedule. If there is no such rate, the percentage rate stated in the Contract Data shall be applied.

The Contractor shall, when required by the Engineer, produce quotations, invoices, vouchers and accounts or receipts in substantiation.

13.6 Day work

For work of a minor or incidental nature, the Engineer may instruct that a Variation shall be executed on a daywork basis. The work shall then be valued in accordance with the Daywork Schedule included in the Contract, and the following procedure shall apply. If a Daywork Schedule is not included in the Contract, this Sub-Clause shall not apply.

Before ordering Goods for the work, the Contractor shall submit quotations to the Engineer. When applying for payment, the Contractor shall submit invoices, vouchers and accounts or receipts for any Goods.

Except for any items for which the Daywork Schedule specifies that payment is not due, the Contractor shall deliver each day to the Engineer accurate statements in duplicate which shall include the following details of the resources used in executing the previous day's work:

(a) the names, occupations and time of Contractor's Personnel,

(b) the identification, type and time of Contractor's Equipment and Temporary Works, and

(c) the quantities and types of Plant and Materials used.

One copy of each statement will, if correct, or when agreed, be signed by the Engineer and returned to the Contractor. The Contractor shall then submit priced statements of these resources to the Engineer, prior to their inclusion in the next Statement under Sub-Clause 14.3 [Application for Interim Payment Certificates].

13.7 Adjustments for Changes in Legislation

The Contract Price shall be adjusted to take account of any increase or decrease in Cost resulting from a change in the Laws of the Country (including the introduction of new Laws and the repeal or modification of existing Laws) or in the judicial or official governmental interpretation of such Laws, made after the Base Date, which affect the Contractor in the performance of obligations under the Contract.

If the Contractor suffers (or will suffer) delay and/or incurs (or will incur) additional Cost as a result of these changes in the Laws or in such interpretations, made after the Base Date, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost, which shall be included in the Contract Price.

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

In case there is a decrease in cost as a result of changes of Law by Legislation after the Base Date, the Engineer shall proceed in accordance with Sub Clause 3.5 (determination) to agree or determine these matters without waiting for Contractor's / Employer's Notice.

Notwithstanding the foregoing, the Contractor shall not be entitled to such an extension of time if the same shall already have been taken into account in determining an extension and such Cost shall not be separately paid if the same shall already have been taken into account in the indexing of any inputs to the table of adjustment data in accordance with the provisions of Sub-Clause 13.8.

RVNL

13.8 Adjustment for changes in cost.

(A) PRICE ADJUSTMENT

The amounts payable to the Contractor and valued at base rates and prices pursuant to Sub-Clause 14.3 (a) hereof shall be adjusted in respect of the rise or fall in the indexed costs for labour, Contractor's Equipment and plant, materials and other inputs to the Works, by the addition or subtraction of the amounts determined by the formulae prescribed in this clause.

(B) OTHER CHANGES IN COST

To the extent that full compensation for any rise or fall in the costs to the Contractor is not covered by the provisions of this or other Clauses in the Contract, the unit rates and prices included in the Contract shall be deemed to include amounts to cover the contingency of such other rise or fall in costs.

(C): ADJUSTMENT FORMULAE

Contract price shall be adjusted for increase or decrease in rates and price of labour, materials fuels and lubricants in accordance with the following principles and procedures as per formulae given below. The

amount certified in each payment certificate is adjusted by applying respective price adjustment factor to the payment amounts due in each currency:

a. Price adjustment shall apply only for work carried out within the stipulated time or extensions granted by the Employer and shall not apply to work carried out beyond the stipulated time: price adjustment for extensions for reasons attributable to the Contractor, shall be paid in accordance with sub-clause 13.8 (H)

b. Price adjustment shall be calculated for the local and foreign components of the payment for the work done as per formulae given below; and

c. Following expressions and meanings are assigned to the work done during each month:

R = Total value of work done during the month. It would include the value of materials on which secured advance has been granted, if any during the month less the value of materials in respect of which the secured advance has been recovered, if any, during the month. This excludes the cost of work on items for which rates were fixed under variations clause (12 and 13) for which the escalation will be regulated as mutually agreed at the time of fixation of rate.

R_I = Portion of 'R' as payable in Indian Rupees

R_f = Portion of 'R' as payable in Foreign currency (at fixed exchange rates)

$R = R_I + R_F$

(i) Adjustment for Labour Component

Price adjustment for increase or decrease in the cost due to labour shall be paid in accordance with the following formula:

$V_L = P_I / 100 \times R_I \times (L_1 - L_0) / L_0$

V_L = Increase or decrease in the cost of work during the month under consideration due to changes in labour cost.

L_0 = Consumer price index Number for industrial workers All India – published in RBI (Reserve Bank of India) Bulletin in the month on the day 28 days prior to the closing date of submission of Bids.

L_1= Consumer price index Number for industrial workers All india- Published in RBI (Reserve Bank of india) Bulletin in the month on the day 28 days prior to the last day of the period to which a particular interim payment certificate is related.

P_I= Percentage of Labour component of the work.

(ii) Adjustment for Cement Component

Price adjustment for increase or decrease in the cost of

cement procured by the contractor shall be paid in accordance with the following formula:

$V_c = P_c / 100 \times R_I \times (C_1-C_0) / C_0$

V_c = Increase or decrease in the cost of work during the month under consideration due to changes in the rates for cement.

C_0 = The index Number of Wholesale Prices in India by Groups and Sub Groups (Averages) for 'Manufacture of cement, lime and plaster'– published in RBI (Reserve Bank of India) Bulletin in the month on the day 28 days prior to the closing date of submission of Bids.

C_1 = The index Number of Wholesale Prices in India by Groups and Sub Groups (Averages) for 'Manufacture of cement, lime and plaster' – published in RBI (Reserve Bank of India) Bulletin in the month on the day 28 days prior to the last day of the period to which a particular interim payment certificate is related.

P_c = Percentage of Cement component of the work.

(iii) **Adjustment for Steel Component**

Price adjustment for increase or decrease in the cost of Steel procured by the contractor under different schedules of BOQ shall be paid in accordance with the following formula:

Formulae-I (for all schedules of BOQ except bill/schedule-2 B & 2 C):

$V_s = P_s / 100 \times R_I \times (S_1-S_0) / S_0$

V_s = Increase or decrease in the cost of work on the date under consideration due to changes in the rates for Steel.

S_0 = The weighted average of index Numbers of Wholesale Prices in India by Groups and Sub Groups (Averages) for

(i) MS Bright Bars under Mild Steel -Long Products sub-group (weight=1)

(ii) Angles, Channels, Sections, steel (coated/not) under Mild Steel -Long Products sub-group (weight=2)

(iii) Mild Steel - Flat products sub-group (weight=1)

published in RBI (Reserve Bank of India) Bulletin / website of the office of the Economic Adviser in the month on the day 28 days prior to the closing date of submission of Bids.

S_1 = The weighted average of index Numbers of Wholesale Prices in India by Groups and Sub Groups (Averages) for

(i) MS Bright Bars under Mild Steel - Long Products sub-group (weight=1)

(ii) Angles, Channels, Sections, steel (coated/not) under Mild Steel - Long Products sub-group (weight=2)

(iii) Mild Steel - Flat products sub-group (weight=1)

published in RBI (Reserve Bank of India) Bulletin / website of the office of the Economic Adviser in the month on the day 28 days prior to the last day of the period to which a particular interim payment certificate is related.

P_s = Percentage of Steel component of the work.

Formulae-II (for schedule-2 B of BOQ):

$V_s = P_s / 100 \times R_I \times (S_1 - S_0) / S_0$

V_s = Increase or decrease in the cost of work on the date under consideration due to changes in the rates for Steel.

S_0 = The index Number of Wholesale Prices in India by Groups and Sub Groups (Averages) for 'Mild Steel - Flat products sub-group'– published in RBI (Reserve Bank of India) Bulletin / website of the office of the Economic Adviser in the month on the day 28 days prior to the closing date of submission of Bids.

S_1 = The index Number of Wholesale Prices in India by Groups and Sub Groups (Averages) for 'Mild Steel - Flat products sub-group'– published in RBI (Reserve Bank of India) Bulletin / website of the office of the Economic Adviser in the month on the day 28 days prior to the last day of the period to which a particular interim payment certificate is related.

P_s = Percentage of Steel component of the work.

Formulae-III (for bill/schedule-2 C of BOQ):

$V_s = P_s / 100 \times R_I \times (S_1 - S_0) / S_0$

V_s = Increase or decrease in the cost of work on the date under consideration due to changes in the rates for Steel.

S_0 = The index Number of Wholesale Prices in India by Groups and Sub Groups (Averages) for 'MS Bright Bars under Mild Steel - Long Products sub-group'– published in RBI (Reserve Bank of India) Bulletin / website of the office of the Economic Adviser in the month on the day 28 days prior to the closing date of

submission of Bids.

S_1 = The index Number of Wholesale Prices in India by Groups and Sub Groups (Averages) for 'MS Bright Bars under Mild Steel - Long Products sub-group'– published in RBI (Reserve Bank of India) Bulletin/ website of the office of the Economic Adviser in the month on the day 28 days prior to the last day of the period to which a particular interim payment certificate is related.

P_s = Percentage of Steel component of the work.

(iv) Adjustment for Plant and Machinery and Spares Component

Price adjustment for increase or decrease in the cost of Plant and Machinery spares procured by the contractor shall be paid in accordance with the following formula:

$V_p = P_p / 100 \times R_I \times (P_1 - P_0) / P_0$

V_p = Increase or decrease in the cost of work during the month under consideration due to changes in the rates for Plant and Machinery spares.

P_0 = The index Number of Wholesale Prices in India by Groups and Sub Groups (Averages) for 'Manufacture of machinery for mining, quarrying and construction'– published in RBI (Reserve Bank of India) Bulletin in the month on the day 28 days prior to the closing date of submission of Bids.

P_1 = The index Number of Wholesale Prices in India by Groups and Sub Groups (Averages) for 'Manufacture of machinery for mining, quarrying and construction' – published in RBI (Reserve Bank of India) Bulletin in the month on the day 28 days prior to the last day of the period to which a particular interim payment certificate is related.

P_p = Percentage of Plant and Machinery spares component of the work.

(v) Adjustment for Fuel and Lubricants

Price adjustment for increase or decrease in the cost of POL(fuel and lubricants) shall be paid in accordance with the following formula:

$V_f = P_f / 100 \times R_I \times (F_1 - F_0) / F_0$

V_f = Increase or decrease in the cost of work on the date under consideration due to changes in the rates for Fuel and lubricants.

F_0 = The average of official prices of Diesel available on

the official website of Indian Oil Corporation Ltd for Delhi, Kolkata, Mumbai & Chennai, applicable on the day 28 days prior to the closing date of submission of Bids.

F_1 = The average of official price of Diesel available on the official website of Indian Oil Corporation Ltd for Delhi, Kolkata, Mumbai & Chennai, applicable on the day 28 days prior to the last day of the period to which a particular interim payment certificate is related.

P_f = Percentage of Fuel and Lubricants component of the work.

(vi) Adjustment for Other Non Ferrous Component

Price adjustment for increase or decrease in the cost of Other Non Ferrous metal procured by the contractor shall be paid in accordance with the following formula:

$V_{NF} = P_{NF} / 100 \times R_I \times (NF_1 - NF_0) / NF_0$

V_{NF} = Increase or decrease in the cost of work during the month under consideration due to changes in the rates for Other Non Ferrous metal.

NF_0 = The index Number of Wholesale Prices in India by Groups and Sub Groups (Averages) for 'Manufacture of non-ferrous metals incl. precious metals' – published in RBI (Reserve Bank of India) Bulletin in the month on the day 28 days prior to the closing date of submission of Bids.

NF_1 = The index Number of Wholesale Prices in India by Groups and Sub Groups (Averages) for 'Manufacture of non-ferrous metals incl. precious metals' – published in RBI (Reserve Bank of India) Bulletin in the month on the day 28 days prior to the last day of the period to which a particular interim payment certificate is related.

P_{NF} = Percentage of Other Non Ferrous metal component of the work.

N

(vii) Adjustment for Other local Materials

Price adjustment for increase or decrease in the cost of local materials other than Cement and Steel, Plant Machinery &Spares, POL and Other Non Ferrous Metals procured by the contractor shall be paid in accordance with the following formula:

$V_m = P_m / 100 \times R_i \times (M_1 - M_0) / M_0$

V_m = Increase or decrease in the cost of work during the month under consideration due to changes in the rates for local material other than cement, steel, plant spares and POL.

M_0 = The index Number of Wholesale Prices in India by Groups and Sub Groups (Averages) for All-Commodities-published in RBI (Reserve Bank of India) Bulletin in the month on the day 28 days prior to the closing date of submission of Bids.

M_1 = The index Number of Wholesale Prices in India by Groups and Sub Groups (Averages) for All -Commodities published in RBI (Reserve Bank of India) Bulletin in the month on the day 28 days prior to the last day of the period to which a particular interim payment certificate is related

Pm = Percentage of local material component (other than cement, steel, plant, spares and POL) of the work.

(viii) Price Variation Clause for Contact and Catenary Wires

The Price payable shall be subject to adjustment, up or down, in accordance with the following formula:

$P_1 = Po + (L_2 - L_1)$

Po = Quoted ex-works price of contact/catenary wire.

L_1 = Average LME cash settlement quotation for Copper Grade A, 60 days prior to the date of opening of the tender.

L_2 = L_2 will be minimum of (i) & (ii) given below:-

(i) LME rates prevailing on 90 days prior to the date of offering for inspection of each lot.

(ii) Invoiced rate in invoice of actual imports.

Notes:

1. For prevailing LME rates, certified copy of LME rate downloaded from official LME website will be accepted as documentary evidence.
2. LME rate in L_1 & L_2 will be converted to Indian Rupees at SBI's

Selling Bills rate of exchange on the date 30 days prior to the date of opening of tender and date of delivery respectively.

3. In case index/price data are not available for particular date due to any reason then the index/price data shall be calculated by drawing a graph of Ist working day before and Ist working day after that particular date. As per graphic line price data arrived at on that particular date may be taken. .

(ix) Adjustment for Fabricated and Galvanized Steel Structures:

(Item Nos. as specified in special conditions). The price adjustment of these items shall be paid as follows:

Price Variation Clause for Fabricated and Galvanized Steel Structures for Railway Electrification Works

The Price payable shall be subject to adjustment, up or down, in accordance with the following formula:

$$P = \frac{P_o}{100}\left[11 + 57\frac{SBLR}{SBLR_o} + 09\frac{Zn}{Zn_o} + 23\frac{W}{W_o}\right]$$

P = Price payable as adjusted in accordance with the above formula.

P_o = Price quoted

$SBLR_o$ = Price of Steel Blooms - Retail (refer notes)

This price is as applicable on the 1st working day of the month, one month prior to the deadline for submission of bids.

Zn_o = Price of electrolytic high grade zinc (refer notes).

This price is as applicable on the 1st working day of the month, one month prior to the deadline for submission of bids.

W_o = All India average consumer price index number for industrial workers, as published by the Labour Bureau, Ministry of Labour, Government of India (Base : 2001=100) (Refer notes). This index number is as applicable on the first working day of the month, three months prior to the deadline for submission of bids.

(For example, if date of tendering falls in May 2014, the applicable prices of Steel Blooms - Retail ($SBLR_o$) and electrolytic high grade zinc (Zn_o) should be for the month of April 2014 and all India average consumer price index number (W_o) should be for the month of February 2014.

The above prices and indices are as published by IEEMA vide circular reference number IEEMA (PVC)/TLT/2014 one month

prior to the deadline for submission of bids.*)*

SBLR = Price of Steel Blooms-Retail (refer notes).

This price is as applicable on the 1st working day of the month, two months prior to the date of delivery.

Zn = Prices of electrolytic high grade zinc (refer notes).

This price is as applicable on the first working day of the month, two months prior to the date of delivery.

W = All India average consumer price index number for industrial workers, as published by the Labour Bureau, Ministry of Labour, Govt of India. (Base 2001=100) (refer notes).

This Index number is as applicable on the first working day of the month, four month prior to the date of delivery.

(For example, if date of delivery falls in December 2014, the applicable prices of steel bloom – Retail (SBLR) and Zinc (Zn) should be for the month of October 2014 and all India average consumer price index number (W) should be for the month of August 2014.

The date of delivery is the date on which transmission line towers are notified as being ready for inspection/dispatch (in the absence of such notification, the date of manufacturer's dispatch note is to be considered as the date of delivery) or the contracted delivery date (including any agreed extension thereto), whichever is earlier.)

Notes:

(a) All prices of raw materials are exclusive of GST and any other taxes, duties, levies etc

(b) All prices are as on first working day of the month.

(c) The details of prices are as under:

1) The prices of Steel Blooms are the average Retail price of Blooms of size 150mm x 150mm of all cities in Rs/MT as published by Joint Plant Committee (JPC), Kolkata.

2) The price of electrolytic high grade zinc (in Rs/MT) is ex-works price as quoted by the primary producer.

3) Cost weight age of re-rolling / conversion charges is included in labor weightage (W)

(x) Price Variation Clause for Traction Power Transformer complete with all accessories and components

The Price payable shall be subject to adjustment, up or down, in

accordance with the following formula:

$$P = \frac{P_o}{100}\left[10 + 29\frac{C}{C_o} + 27\frac{ES}{ES_o} + 7\frac{IS}{IS_o} + 5\frac{IM}{IM_o} + 7\frac{TO}{TO_o} + 15\frac{W}{W_o}\right]$$

P = Price payable as adjusted in accordance with the above formula

P_o = Price quoted/Confirmed

C_o = Average LME settlement price of copper wire bars (refer notes)

This price is as applicable for the month, ONE month prior to the date of bid opening.

ES_o = Price of CRGO Electrical Steel Lamination (refer notes)

This price is as applicable on the 1st working day of the month, ONE month prior to the dead line for submission of bids.

IS_o = Average price of steel plates 10 mm thick (refer notes).

This price is as applicable on the 1st working day of the month, ONE month prior to the dead line for submission of bids.

IM_o = Price of Insulating Materials (refer notes).

This price is as applicable on the 1st working day of the month, one month prior to the dead line for submission of bids.

TO_o = Price of Transformer Oil (Refer notes)

This price is as applicable on the 1st working day of the month, ONE month prior to the dead line for submission of bids.

W_o = All India average Consumer price index Number for industrial workers, as published by the labour bureau, ministry of labour, Govt. of India (base 2001 =100)

This index number is as applicable on the 1st working day of the month THREE months prior to the dead line for submission of bids.

(For example, if date of bid opening falls in June 2015, applicable prices of Copper Wire Bars (C_o), Transformer Oil (TO_o), Steel Plates 10 mm thick (IS_o), CRGO Electrical Steel Laminations (ES_o) and Insulating material (IM_o) should be as on 1st May 2015 and all India average consumer price index no. (W_o) should be for the month of March 2015.

The above prices and indices are as published by IEEMA vide circular reference number IEEMA (PVC)/PWR_TRF/-/- ONE month prior to dead line for submission of bids.

C = Average LME settlement price of copper wire bars (refer notes).

This price is as applicable for the month, TWO months prior to the date of delivery.

ES= Price of CRGO Electrical Steel Lamination (refer notes).

This price is as applicable on the 1st working day for the month, TWO months prior to the date of delivery

IS = Average price of steel plates 10 mm thick (refer notes).

This price is as applicable on the 1st working day of the month, ONE month prior to the date of delivery.

IM= Price of Insulating Materials (refer notes).

This price is as applicable on the 1st working day of the month, TWO months prior to the date of delivery.

TO = Price of transformer oil (Refer notes)

This price is as applicable on the 1st working day of the month, ONE month prior to the date of delivery

W = All India average Consumer price index Number for industrial workers, as published by the labour bureau, ministry of labour, Govt. of India (base 2001 =100)

This index number is as applicable on the 1st working day of the month THREE months prior to the date of delivery.

(For example, if date of delivery in terms of clause given below falls in December 2015, applicable prices of Copper Wire Bars (C), Insulating Material (IM), CRGO Electrical Steel Lamination (ES) should be as on 1st October 2015 and Transformer Oil (TO), Plates 10 mm thick (IS) should be 1st November 2015 and All India average Consumer price index Number (W) should be for the month of September 2015.

The date of delivery is the date on which the transformer is notified as being ready for inspection/dispatch (in the absence of such notification, the date of manufacturer's dispatch note is to be considered as the date of delivery) or the contracted delivery date (including any agreed extension thereto), whichever is earlier.

Notes:

(a) All prices of raw materials are exclusive of GST and any other taxes, duties, levies etc. Transformers manufacturers import major raw materials like copper, CRGO steel sheets and Plates etc. The

landed cost of these imported raw materials includes applicable custom duty but exclusive of GST and any other taxes, duties, levies.

(b) All prices are as on first working day of the month.

(c) The details of prices are as under:

1) The LME price of Copper Wire Bars (in Rs/MT) is the LME average settlement price of Copper Wire Bars converted into Indian Rupees with applicable average exchange rate of SBI of the month. This price is the landed cost, inclusive of applicable customs duty only but exclusive of countervailing duty.

2) The price of CRGO is the price of CRGO Electrical Steel Lamination in Rs./MT suitable for transformers of ratings above 10MVA or Voltage above 33KV up to 400 KV.

3) The price of steel is the average retail price of steel plates 10 mm thick as published by Joint Plant Committee (JPC) in Rs./MT as on 1st working day of the month.

4) The price of Insulating materials (in Rs./Kg) of pre-compressed pressboards of size 10 mm thick, 3200 mm x 4100 mm is the average C&F price in free currency per MT converted into Indian Rupees with applicable exchange rates prevailing as on 1st working day of the month as quoted by primary suppliers. This price is the landed cost, inclusive of applicable customs duty only but exclusive of countervailing duty.

5) The price of Transformer Oil (in Rs./K.Ltr.) is the average price on ex-refinery basis as quoted by primary producers for supply in drums.

(xi) PRICE VARIATION CLAUSE FOR SIGNALING CABLE

The price payable for signaling cables is variable as per Price Variation Formula given below:

For Signaling Copper Cables:
P= Po+CuF (Cu-Cuo) + CCFcu(CC-CCo) + FeF (Fe-Feo)

For Aluminum Power Cables:
P= Po+AlF (Al-Alo) + CCFAl(CC-CCo) + FeF (Fe-Feo)

Where,

P = Price payable per KM as adjusted in accordance with Price variation clause.

Po = Price per KM of cable as per Purchase order.

CuF = Variation factor for Copper

Cuo = Price of copper Rod in Rs. Per MT

CCFCu = Variation factor for PVC Compound for Copper Signaling cable

CCo = Price of PVC Compound in Rs. Per MT

AlF = Variation factor for Aluminum

Alo = Price of EC grade LME Aluminum rods (Properzi rods) in Rs. Per MT.

CCFAl = Variation factor for PVC Compound for Aluminum power cable

FeF = Variation factor for Steel

Feo = Price of Steel for Armour (Flat strip 4 mm. x 0.8mm/ Round 1.4mm dia) in Rs. Per MT

(Prices per MT for Cuo, CCo, Feo, Alo as applicable on the 1st working day of the month, one month prior to the deadline for submission of bids. The above prices and indices are as published by IEEMA vide circular reference no. IEEMA (PVC) /CABLE --/--/-- one month prior to the deadline for submission of bids.)

Cu = Price of Copper Rod in Rs. Per MT.

CC = Price of PVC Compound in Rs. Per MT.

Fe = Price of Steel for Armouring (Flat strip 4mm x 0.8 mm/ Round 1.4mm dia) in Rs. Per MT.

Al = Price of EC grade LME Aluminum rods (Properzi rods) in Rs. Per MT.

(Prices per MT for Cu, CC, Fe, Al as prevailing on 1st working day of the calendar month covering the date One month prior to the date of inspection call letter will be applicable for the calculation of updated price. The above prices and indices are as published by IEEMA vide circular reference no. IEEMA (PVC) /CABLE --/--/-- one month prior to the date of inspection.)

The value of variation factors for copper, steel and PVC Compound are different for different sizes of signaling cables. Accordingly, the PVC formula for some of the types of signaling cable is as given under:-

Underground Railway Signaling Cable unscreened and armoured copper conductor

(i) Size 30 C x 1.5 sq.mm.
P=Po+0.391(Cu-Cuo)+0.557(CC-CCo)+0.425(Fe-Feo)

For armouring, price of steel flat strip of size 4mmx0.8mm is to be taken into consideration.

(ii) Size 24C x 1.5 sq.mm
P= Po+0.313(Cu-Cuo)+ 0.481 (CC-CCo)+0.398(Fe-Feo)

For armouring, value of steel flat strip of size 4mmx0.8mm is to be taken into consideration.

(iii) Size 19C x 1.5 sq.mm
P= Po+0.248(Cu-Cuo) + 0.395(CC-CCo)+0.343(Fe-Feo)

For armouring, value of steel flat strip of size 4mmx0.8mm is to be taken into consideration.

(iv) Size 12C x 1.5 sq.mm
P=Po+0.157(Cu-Cuo) + 0.277(CC-CCu)+0.289(Fe-Feo)

For armouring, value of steel wire size 1.4mm dia is to be taken into consideration.

(v) Size 9C x 1.5 sq.mm
P= Po+0.117(Cu-Cuo)+0.241(CC-CCu)+0.383(Fe-Feo)

For armouring, value of steel wire size 1.4mm dia is to be taken into consideration.

(vi) Size 6Cx 1.5 sq.mm
P= Po+0.078(Cu-Cuo)+0.199(CC-CCu)+0.329(Fe-Feo)

For armouring, value of steel wire size 1.4mm dia is to be taken into consideration.

(vii) Size 4Cx1.5 sq.mm
P=Po+0.052(Cu-Cuo)+0.152(CC-CCo)+0.277(Fe-Feo)

For armouring, value of steel wire size 1.4mm dia is to be taken into consideration.

(viii) Size 2C x 4 sq.mm(multistrand)
P= Po+0.073(Cu-Cuo)+0.156(CC-CCo)+0.3(Fe-Feo)

For armouring, value of steel wire size 1.4mm dia is to be taken into consideration.

(ix) Size 12C x 2.5 sq.mm
P= Po+0.282 (Cu-Cuo)+0.371 (CC-CCo)+0.342 (Fe-Feo)

RVNL

For armouring, value of steel flat strip of size 4mmx0.8mm is to be taken into consideration.

(x) Size 2C x 2.5 sq.mm

P= Po+0.047 (Cu-Cuo)+0.139 (CC-CCo)+0.277 (Fe-Feo)

For armouring, value of steel wire size 1.4 mm dia is to be taken into consideration.

(xi) Size 2C x 25 sq.mm PVC insulated, armoured, Aluminum power cable

P= Po+0.146 (Al-Alo)+0.303 (CC-CCo)+0.306 (Fe-Feo)

For armouring, value of steel flat strip of size 4mmx0.8mm is to be taken into consideration.

For the remaining varieties of signaling cables, the formula shall be the same as in use on Indian railways.

RVNL

(xii) Adjustment for Foreign Currency Component

(for each of the foreign currencies in which the contract price is payable)

a. The foreign currency component of each payment which is convertible into foreign currency at fixed exchange rate shall be adjusted in accordance with the following formula:

$VF_c = 0.85 \times R_f \times (Fe_1-Fe_0) / Fe_0$

VF_c = Increase or decrease in the cost of work payable due to changes in the cost of foreign input.

Fe_0 = the index applicable for the foreign input(plant, material, engineer's salary etc. as the case may be) on the day 28 days prior to the date of submission of Bids, as published in the country of origin.

Fe_1 = corresponding index on the day 28 days prior to the last day of the period to which a particular interim payment certificate is related (average index in case indices are published at lesser intervals).

a. The bidder shall, in his tender, indicate the foreign input, (plant, material, engineer's salary etc.) and appropriate index, the source of which shall be a Government or

Public Organization. The bidder shall also attach specimens of the publications of the last 12 months for information of the Employer. If this index is not acceptable to the Employer, then he will specify as alternative index and the source of publishing of that index.

b. If the bidder has requested payment in more than one foreign currency, R_f shall be suitably broken up and the formula applied separately to each currency component by taking into account and corresponding indices(index and currency belonging to the same country).

c. The currency of foreign exchange payment and the index shall belong to the same country.

(D) If the contractor changes the country of origin of the source of supply of any input to the works, he shall immediately notify the Engineer who shall modify the price adjustment provisions subsequent to such change to reflect the relevant cost index from the actual country of origin of the input.

(E) If the currency in which the Contract price is expressed is different from the currencies of the sources of the relevant indices, the Engineer shall determine the correction to be applied in calculating the Price Adjustment Factor formula viii(a) in order to avoid distortions in the amount of price adjustment. Such correction shall be applied to the increment of price fluctuation in the base costs of the respective inputs and shall correspond to the ratio of the exchange rates between the respective currencies of the date of base indices and the date of current indices as defined in sub-clause viii(a).

(F) SOURCES OF INDICES

The sources of Indices for the foreign currency portion of the Contract (R_F) not stated in Sub-Clause 13.8 (C) shall be those as listed in the Contract Data, as approved by the Employer.

(G) BASE, CURRENT AND PROVISIONAL INDICES:

BASE, CURRENT AND PROVISIONAL INDICES, THE BASE COST INDICES OR PRICES SHALL BE THOSE PREVAILING ON THE DAY 28 DAYS PRIOR TO THE CLOSING DATE FOR SUBMISSION OF BIDS. CURRENT INDICES OR PRICES SHALL BE THOSE PREVAILING ON THE DAY 28 DAYS PRIOR TO LAST DAY OF THE PERIOD TO WHICH A PARTICULAR INTERIM PAYMENT CERTIFICATE IS RELATED. IF AT ANY TIME THE CURRENT INDICES

ARE NOT AVAILABLE, PROVISIONAL INDICES AS DETERMINED BY THE ENGINEER WILL BE USED, SUBJECT TO SUBSEQUENT CORRECTION OF THE AMOUNTS PAID TO THE CONTRACTOR WHEN THE CURRENT INDICES BECOME AVAILABLE. THE INDEX NUMBERS OF VARIOUS GROUPS AND SUB GROUPS AS PUBLISHED BY RESERVE BANK OF INDIA IN THE RBI BULLETIN WILL BE CONSIDERED FOR THIS PURPOSE.

(H) LIMIT OF PRICE ADJUSTMENT

Provided that, in determining all such price adjustment in accordance with the aforesaid Sub-Clauses:

a. No account will be taken of any amount by which any cost incurred by the Contractor has been increased by default or negligence of the Contractor.

If the Contractor fails to complete the work within time for completion prescribed under Clause 8.2, the adjustment of prices thereafter until the completion of the works shall be made using either the indices or prices, whichever is more favourable to the Employer, provided that if an extension of time is granted pursuant to Sub-Clause 8.4, the above position shall apply to the adjustments made after expiry of such extension of time.

(I) Percentages governing adjustments for change in cost

The percentages governing the price adjustment for the local currency portion (R_i) of the contract for various works is given in **Annexure 2.**

(J) Indices to be used in case of Interim Payment Certificate for a period more than a month

As per provisions of contract (Clause 14.3 of GCC) interim payments certificates are to be submitted by the contractor on monthly basis for the works/supply of items pertaining to a particular month. In such cases the monthly indices will be applied for the month on the day 28 days prior to the last day of the period to which a particular interim payment certificate is related. However, in case a bill is submitted for a period pertaining to more than a calendar month the average indices for those months on the day 28 days prior to last day of the period to which bill pertains and previous month(s) shall be used for calculation purpose.

14. Contract Price and Payment

14.1 The Contract Price

Unless otherwise stated in the Special Conditions of Contract:

(a) the Contract Price shall be agreed or determined under Sub-Clause 12.3 [Evaluation] and be subject to adjustments in accordance with the Contract;

(b) the Contractor shall pay all taxes, duties and fees required to be paid by him under the Contract, and the Contract Price shall not be adjusted for any of these costs except as stated in Sub-Clause 13.7 [Adjustments for

Changes in Legislation];

(c) any quantities which may be set out in the Bill of Quantities or other Schedule are estimated quantities and are not to be taken as the actual and final quantities:

(i) of the Works which the Contractor is required to execute, or

(ii) for the purposes of Clause 12 [Measurement and Evaluation]; and

(d) the Contractor shall submit to the Engineer, within 28 days after the Commencement Date, a proposed breakdown of each lump sum price in the Schedules, if applicable. The Engineer may take account of the breakdown when preparing Payment Certificates, but shall not be bound by it.

(e) It may be noted that in the event of the Contractor not making the due payments stated in sub-clause (b) above, and the concerned party puts up a claim with the Employer / Engineer, then the Employer / Engineer may make such payments and deduct the same from the sums due to the Contractor.

RVNL

14.2 Advance Payment

14.2.1 Mobilization Advance

The Employer shall make payment, as an Interest bearing advance for mobilization, when the Contractor submits a guarantee in accordance with this Sub-Clause. The total advance payment, the number and timing of instalments (if more than one), and the applicable currencies and proportions, shall be as stated in the Contract Data.

Unless and until the Employer receives this guarantee, or if the total advance payment is not stated in the Contract Data, this Sub-Clause shall not apply.

The Engineer shall issue an interim payment certificate for the first installment of mobilisation advance after receiving an application for advance payment (under sub clause 14.3 [Application for Interim Payment Certificates]) and after the Employer receives (i) the Performance Security in accordance with Sub-Clause 4.2 [Performance Security] and (ii) a guarantee in amounts and currencies equal to the advance payment plus 10%. The next installment shall be released only when the contractor submits statement of having utilized the previous installment of mobilization advance and the Employer is satisfied that the utilization has been done in purposeful manner.

14.2.2 Advance against Plant and Machinery

Interest bearing advance against plant and machinery, is payable for procurement of plant, equipment and machinery to be utilized specifically for the subject works, provided the same have reached the site along with purchase order and the invoices against a guarantee in amounts and currencies equal to the advance payment plus 10%. The total advance payment under this sub-clause, including the applicable currencies and proportions, shall be as stated in

the Contract Data.

All such plant, equipment and machinery shall be used only for executing the works under this Contract. No such plant, equipment and machinery shall be removed from the site, unless advance equivalent to the advance against such machinery has been fully repaid and prior permission of the Engineer has been obtained.

The Engineer shall decide whether a particular plant, equipment or machinery is actually required to execute the work. No advance is payable against items identified as unnecessary. The plant and machinery admissible for advance payment and its valuation shall be done by the Engineer on following considerations;

a. New items: 80% of purchase price
b. Used or Second hand items: Not to be considered

New Items valued at less than Rs. 10,00,000 each: Not to be considered.

14.2.3 Guarantees

Advances as mentioned in sub-clauses 14.2.1 & 14.2.2 above, shall be payable against acceptable Bank Guarantees from banks as specified in clause 4.2. The guarantees shall be in the form as given in Section 8 (Contract Forms) or in another form approved by the Employer. The Contractor shall ensure that the guarantees are valid and enforceable until the advance amount paid as has been repaid, but its amount may be progressively reduced by the amount repaid by the Contractor as indicated in the Payment Certificates. If the terms of the guarantee specify its expiry date, and the advance payment has not been repaid by the date 28 days prior to the expiry date, the Contractor shall extend the validity of the guarantee until the advance payment has been repaid.

14.2.4 Recovery of Advances

Unless stated otherwise in the Contract Data, the advance payment shall be repaid through percentage deductions from the interim payments determined by the Engineer in accordance with Sub-Clause 14.6 [Issue of Interim Payment Certificates], as follows:

a) deductions shall commence in the next interim Payment Certificate following that in which the total of all certified interim payments (excluding the advance payment) exceeds 5 percent of the Accepted Contract Amount less Provisional Sums or passage of six months from the date of release of first advance payment, whichever is earlier; and

b) deductions shall be made for accrued interest on the advance up to the month and advance at the rate stated in the Contract Data of the amount of each Interim Payment Certificate (excluding the advance payment and deductions and repayments of retention) in the currencies and proportions of the advance payment until such time as the advance payment and accrued interest has been repaid; provided that the advance payment and accrued interest shall be completely repaid prior to the time when 80 percent of the Accepted Contract Amount has been certified for payment. If the amount of interim payment certificate is not sufficient for recovery of accrued interest or in the opinion of the Employer satisfactory progress is not being achieved by the contractor,

then the contractor will have to deposit the accrued interest and return the mobilisation advance in part or in full as demanded by the Employer, failing which Employer shall have the right to encash the Bank Guarantee(s)

The contractor shall always have the option to start repayment earlier and/or to complete the repayment earlier than the due date.

If the advance payment has not been repaid prior to the issue of the Taking-Over Certificate for the Works or prior to termination under Clause 15 [Termination by Employer], Clause 16 [Suspension and Termination by Contractor] or Clause 19 [Force Majeure] (as the case may be), the whole of the balance then outstanding shall immediately become due and payable by the Contractor to the Employer.

14.2.5 Advances to be Used only for This Work

The advances shall be used by the Contractor strictly for the purpose of the Contract, and for the purpose for which they are paid. Under no circumstances, shall the advances be diverted for other purposes. Any such diversion shall be construed as a breach of the Contract and the Contractor shall be asked to return the advance at once and pay interest at 15% per annum till the advance is recovered back from him. The Contractor shall return the advance and pay the interest in one go without demur.

Employer retains the right for any other remedy prescribed for breach of Contract in this regard.

The Contractor, if required by the Engineer shall provide the details of utilisation of Mobilisation advance.

14.3 Application for Interim Payment Certificates

The Contractor shall submit a Statement in six copies to the Engineer in accordance with the payment procedure specified by the Engineer, after the end of each month, in a form approved by the Engineer, showing in detail the amounts to which the Contractor considers himself to be entitled, together with supporting documents which shall include the report on the progress during this month in accordance with Sub-Clause 4.21 [Progress Reports] and Record Measurement Sheets.

The Statement shall include the following items, as applicable, which shall be expressed in the various currencies in which the Contract Price is payable, in the sequence listed:

(a) the estimated contract value of the Works executed and the Contractor's Documents produced up to the end of the month (including Variations but excluding items described in sub-paragraphs (b) to (g) below);

(b) any amounts to be added and deducted for changes in legislation and changes in cost, in accordance with Sub-Clause 13.7 [Adjustments for Changes in Legislation] and Sub-Clause 13.8 [Adjustments for Changes in Cost];

(c) any amount to be deducted for retention, calculated by applying the percentage of retention stated in the Contract Data to the total of the above amounts, until the amount so retained by the Employer reaches the limit of Retention Money (if any) stated in the Contract Data;

(d) Any amounts to be added and deducted for the advance payments and repayments in accordance with sub clause 14.2 [Advance Payment];

(e) any amounts to be added and deducted for Plant and Materials in accordance with Sub-Clause 14.5 [Plant and Materials intended for the Works];

(f) any other additions or deductions which may have become due under the Contract or otherwise, including those under Clause 20 [Claims, Disputes and Arbitration]; and

(g) the deduction of amounts certified in all previous Payment Certificates.

(h) for invoicing as per GST Laws, the estimated contract value of the Works executed in terms of (a) above and any amounts added or deducted as per (b), (e) to (g) above is to be broken up in two components i.e. (i) the base amount excluding GST (ii) GST component (calculated at the rate for works contract service as per GST Laws).

(i) Statement of interim payments certificates should be submitted by the Contractor to the Engineer by the 7th day of each month for the work executed upto the end of the previous month.

(j) An amount to be deducted for the payments to be made to different Departments towards payments liable to be made by the Contractor.

14.4 Schedule of Payments

If the Contract includes a schedule of payments specifying the instalments in which the Contract Price will be paid, then unless otherwise stated in this schedule:

(a) the instalments quoted in this schedule of payments shall be the estimated contract values for the purposes of sub-paragraph (a) of Sub-Clause 14.3 [Application for Interim Payment Certificates];

(b) Sub-Clause 14.5 [Plant and Materials intended for the Works] shall not apply; and

(c) if these instalments are not defined by reference to the actual progress achieved in executing the Works, and if actual progress is found to be less than that on which this schedule of payments was based, then the Engineer may proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine revised instalments, which shall take account of the extent to which progress is less than that on which the instalments were previously based.

If the Contract does not include a schedule of payments, the Contractor shall submit non-binding estimates of the payments which he expects to become due during each quarterly period. The first estimate shall be submitted within 42 days after the Commencement Date. Revised estimates shall be submitted at quarterly intervals, until the Taking-Over Certificate has been issued for the Works.

14.5 Plant and Materials intended for the Works

If this Sub-Clause applies, Interim Payment Certificates shall include, under sub-paragraph (e) of Sub-Clause 14.3:

(k) an amount for Plant and Materials which have been sent to the Site for incorporation in the Permanent Works, and

(ii) a reduction when the contract value of such Plant and Materials is included as part of the Permanent Works under sub-paragraph (a) of Sub-Clause 14.3 [Application for Interim Payment Certificates].

If the lists referred to in sub-paragraphs (b)(i) or (c)(i) below are not included in the Contract Data, this Sub-Clause shall not apply.

The Engineer shall determine and certify each addition if the following conditions are satisfied:

(a) the Contractor has:

(i) kept satisfactory records (including the orders, receipts, Costs and use of Plant and Materials) which are available for inspection, and

(ii) submitted a statement of the Cost of acquiring and delivering the Plant and Materials to the Site, supported by satisfactory evidence;

and either:

(b) the relevant Plant and Materials:

(i) are those listed in the Schedules for payment when shipped,

(ii) have been shipped to the Country, en route to the Site, in accordance with the Contract; and

(iii) are described in a clean shipped bill of lading or other evidence of shipment, which has been submitted to the Engineer together with evidence of payment of freight and insurance, any other documents reasonably required, and a bank guarantee in a form and issued by an entity approved by the Employer in amounts and currencies equal to the amount due under this Sub-Clause: this guarantee may be in a similar form to the form referred to in Sub-Clause 14.2 [Advance Payment] and shall be valid until the Plant and Materials are properly stored on Site and protected against loss, damage or deterioration;

or

(c) the relevant Plant and Materials:

(i) are those listed in the Schedules for payment when delivered to the Site,

(ii) the original 'Invoice' and the original 'Inspection Certificate' by the approved Inspection agency marked 'for payment' is furnished with the Application for IPC [sub-Clause 14.3].

(iii) have been delivered to and are properly stored on the Site, are protected against loss, damage or deterioration, and appear to be in accordance with the Contract.

The additional amount to be certified shall be the equivalent of eighty percent of the Engineer's determination of the cost of the Plant and Materials (including delivery to Site), taking account of the

documents mentioned in this Sub-Clause and of the contract value of the Plant and Materials. The amount shall be certified on receipt of an Indemnity Bond for the stated amount in the Form approved by the Employer.

The currencies for this additional amount shall be the same as those in which payment will become due when the contract value is included under sub-paragraph (a) of Sub-Clause 14.3 [Application for Interim Payment Certificates]. At that time, the Payment Certificate shall include the applicable reduction which shall be equivalent to, and in the same currencies and proportions as, this additional amount for the relevant Plant and Materials.

14.6 Issue of Interim Payment Certificates

No amount will be certified or paid until the employer has received and approved the performance security. Thereafter, the Engineer shall within two days after receiving a statement and supporting documents (including Contractor's certificate in terms of Sub-Clause 6.22 (ii)), issue to the Employer a provisional interim payment certificate which shall state the amount which the Engineer determines to be due after preliminary check as per RVNL's procedure order. After this the Engineer shall, within 28 days after receiving a statement and supporting documents, issue to the employer an Interim Payment Certificate which shall state the amount which the Engineer fairly determines to be due, with supporting particulars.

However, prior to issuing the Taking-Over Certificate for the Works, the Engineer shall not be bound to issue the Interim Payment Certificate in an amount which would (after retention and other deductions) be less than the minimum amount of Interim Payment Certificates (if any) stated in the Contract Data. In this event, the Engineer shall give notice to the Contractor accordingly.

An Interim Payment Certificate shall not be withheld for any other reason, although:

(a) if anything supplied or work done by the Contractor is not in accordance with the Contract, the cost of rectification or replacement may be withheld until rectification or replacement has been completed; and/or

(b) if the Contractor was or is failing to perform any work or obligation in accordance with the Contract, and had been so notified by the Engineer, the value of this work or obligation may be withheld until the work or obligation has been performed.

The Engineer may in any Payment Certificate make any correction or modification that should properly be made to any previous Payment Certificate. A Payment Certificate shall not be deemed to indicate the Engineer's acceptance, approval, consent or satisfaction.

14.7 Payment

The Employer shall pay to the Contractor:

(a) the first instalment of the advance payment within 42 days after issuing the Letter of Acceptance or within 21 days after receiving the documents in accordance with Sub-Clause 4.2 [Performance Security] and Sub-Clause 14.2 [Advance Payment], whichever is later;

(b) (i) After preliminary scrutiny and certifications by the Engineer, payment

of 70% of the certified net payment due (after recoveries and deductions), shall be made by the Employer within 10 days of receiving a statement and supporting documents by the Engineer subject to the condition that last interim payment certificate has been settled after detailed check. In the event of the contractor submitting bills based on false measurements, Project Director should issue a written warning to him to the effect that the facility of 70% payment without detailed check will be withdrawn in future. If the contractor repeats the misconduct this facility should be withdrawn.

(ii) The amount certified in each Interim Payment Certificate within 56 days after the Engineer receives the Statement and supporting documents. Any discrepancy shall be rectified in the next payment to the Contractor; and

(c) the amount certified in the Final Payment Certificate within 56 days after the Employer receives this Payment Certificate or, the undisputed amount shown in the Final Statement, within 56 days after the date of notification of the suspension in accordance with Sub-Clause 16.2.

Payment of the amount due, unless specified in the Contract Data, shall be made in INR into the bank account, nominated by the Contractor except for the Contract where the Contractor has opted for payment through Letter of Credit (LC) arrangement. In such a case, the procedure for payment shall be as prescribed in clause 14.7.1 below.

However, in case of JV, direct payment to individual JV partners shall be made on joint certification (about the net amounts payable to individual partners) by the authorized representative of the JV and concerned respective authorized representative of individual JV partners, after making requisite recoveries/deductions from the gross payment. In case of any dispute regarding the net amounts payable to individual partners, the Engineer shall decide the same on the basis of the execution of items of works under Schedules/Bills indicated in the JV agreement as the responsibility of execution of each JV partner. Payment to individual JV partners shall be treated as payment made to the JV. The said payment shall not alter any obligation of the JV and its individual Partners under the Agreement and their obligations under the agreement shall remain joint and several.

A foreign company (either single entity or JV partner), shall have to submit proof of having opened their project office in India before any payment (including advance payment) is released to such a company. The required proof here shall be a copy of the report containing information as per format prescribed by Reserve Bank of India submitted to the Director General of Police (DGP) of the state concerned in which project office has been established.

14.7.1 **Procedure for payment through LC:**

(i) The LC shall be a sight LC.

(ii) The contractor shall select his Advising/Negotiating bank for LC. The incidental cost towards issue of LC and its operation thereof shall be borne by the contractor.

(iii) The Employer's Bank and its nodal branch for issue of LCs based on requests received from Employer Accounts Units shall be as indicated in the Contract Data . The Branch office of the Employer's Bank, where the Employer Accounts Office has its Account, as indicated in the Contract Data, will be the issuance/reimbursing branch for LC issued under this arrangement. The Bank shall remain same for this tender till completion of contract. The present incidental cost @ 0.15% per annum of LC value or any increase/decrease by the banks for issue of LC and operation thereof shall be borne by the contractor and shall be recovered from his Interim Payment Certificates.

(iv) The LC shall be opened initially for duration of 180 to 365 days in consultation with contractor. The LC shall be extended time to time as per the progress of the contract, on the request of the contractor. The value of LC to be opened initially as well as extended thereafter shall be finalized by the engineer in consultation with the contractor on the basis of expected progress of work.

(v) The LC terms and conditions shall inter-alia indemnify and save harmless the Employer from and against all losses, claims and demands of every nature and description brought or recovered against the Employer by reason of any act or omission of the contractor, his agents or employees, in relation to the Letter of Credit (LC). All sums payable/borne by Employer on this account shall be considered as reasonable compensation and paid by contractor.

(vi) The LC terms and conditions shall inter-alia provide that Employer will issue a Document of Authorisation (in the format decided in consultation with the Employer's Bank) after passing the Interim Payment Certificate for completed work, to enable contractor to claim the authorized amount from their bank.

(vii) The acceptable, agreed upon document for payments to be released under the LC shall be the Document of Authorisation.

(viii) The Document of Authorisation shall be issued by Employer Accounts Office against each Interim Payment Certificate passed by Employers.

(ix) On issuance of document of Authorisation, a copy of Document of Authorization shall be sent to the contractor. A copy of Document of Authorisation shall also be sent by Employer Accounts Office to Employer's bank.

(x) On receipt of Document of Authorization, the contractor shall present his claim to his bank (advising Bank) for necessary payments as per LC terms and conditions. The claim shall comprise of copy of Document of Authorization, Bill of Exchange and Payment Certificate.

(xi) The payment against LC shall be subject to verification from Employer's Bank .

(xii) The contractor's bank (advising bank) shall submit the documents to the Employer's Bank .

(xiii) The Employer's bank (Issuing Bank) shall, after verifying the claim so received w.r.t. the Document of Authorisation received from Employer Accounts Office release the payment to contractor's bank (advising bank) for crediting the same to contractor's account.

(xiv) Any number of Interim Payment Certificates can be dealt within one LC, provided the sum total of payments to contractor is within the amount for which LC has been opened.

(xv) The LC shall be closed after the release of Final Payment certificate including PVC amount, if any, to the contractor.

(xvi) In case of JV, LC shall be opened in the name of JV and option of direct payment to individual JV partners through LC shall not be permissible.

RVNL

14.8 Delayed Payment

If the Contractor does not receive payment in accordance with Sub-Clause 14.7 [Payment], the Contractor shall be entitled to receive interest compounded monthly on the amount unpaid during the period of delay. This period shall be deemed to commence on the date for payment specified in Sub-Clause 14.7 [Payment], irrespective (in the case of its sub-paragraph (b)) of the date on which any Interim Payment Certificate is issued.

Unless otherwise stated in the Special Conditions of Contract, the interest amount be calculated at the annual rate of seven percent.

The Contractor shall be entitled to this payment without formal notice or certification, and without prejudice to any other right or remedy.

14.9 Payment of Retention Money

The Retention Money shall be certified and paid with the final payment certificate or bank guarantee against retention money shall be released, after making required adjustments for recovery for shortage/excess materials, if any **(except those quantities which become surplus due to change in planning/scheme by Railway/RVNL) in case the recovery for surplus/excess materials is still balance after adjusting the amount payable in the final payment certificate.**

The contractor shall be entitled to substitute a bank guarantee in the form approved by the Employer with the retention money amount recovered upto the date of request. Such substitution shall be permissible maximum upto 3 times. The Bank Guarantee shall be valid upto end of Defect Liability Period. In case of extension of date of completion of contract, the Contractor shall extend the validity of the Bank Guarantee(s) until the revised end of Defect Liability Period.

Wherever the contract is terminated under Clause 15.2, the Retention Money shall be forfeited and the balance work should be got done separately.

14.10 Statement at Completion

Within 84 days after receiving the Taking-Over Certificate for the Works, the Contractor shall submit to the Engineer six copies of a Statement at completion with supporting documents, in accordance with Sub-Clause 14.3 [Application for Interim Payment Certificates], showing:

(a) the value of all work done in accordance with the Contract up to the date stated in the Taking-Over Certificate for the Works,

(b) any further sums which the Contractor considers to be due, and

(c) an estimate of any other amounts which the Contractor considers will become due to him under the Contract. Estimated amounts shall be shown separately in this Statement at completion.

The Engineer shall then certify in accordance with Sub-Clause 14.6 [Issue of Interim Payment Certificates].

Within 56 days after receiving the Performance Certificate, the Contractor shall submit, to the Engineer, six copies of a draft final statement as per procedure prescribed by the Engineer, with supporting documents showing in detail in a form approved by the Engineer:

14.11 Application for Final Payment Certificate

Within 56 days after receiving the Performance Certificate, the Contractor shall submit, to the Engineer, six copies of a draft final statement as per procedure prescribed by the Engineer, with supporting documents (including Contractor's certificate in terms of Sub-Clause 6.22 (ii)) showing in detail in a form approved by the Engineer:

(a) the value of all work done in accordance with the Contract, and

(b) any further sums which the Contractor considers to be due to him under the Contract or otherwise.

If the Engineer disagrees with or cannot verify any part of the draft final statement, as per procedure prescribed by the Engineer the Contractor shall submit such further information as the Engineer may reasonably require and shall make such changes in the draft as may be agreed between them. The Contractor shall then prepare and submit to the Engineer the final statement as agreed. This agreed statement is referred to in these Conditions as the "Final Statement".

However if, following discussions between the Engineer and the Contractor and any changes to the draft final statement which are agreed, it becomes evident

that a dispute exists, the Engineer shall deliver to the Employer (with a copy to the Contractor) an Interim Payment Certificate for the agreed parts of the draft final statement. Thereafter, if the dispute is finally resolved under Sub-Clause 20.3 [Obtaining Dispute Board's Decision] or Sub-Clause 20.2 [Amicable Settlement], the Contractor shall then prepare and submit to the Employer (with a copy to the Engineer) a Final Statement.

14.12 Discharge

When submitting the Final Statement, the Contractor shall submit a discharge which confirms that the total of the Final Statement represents full and final settlement of all moneys due to the Contractor under or in connection with the Contract. This discharge may state that it becomes effective when the Contractor has received the Performance Security and the outstanding balance of this total, in which event the discharge shall be effective on such date.

14.13 Issue of Final Payment Certificate

Within 28 days after receiving the Final Statement and discharge in accordance with Sub-Clause 14.11 [Application for Final Payment Certificate] and Sub-Clause 14.12 [Discharge], the Engineer shall issue, to the Employer, the Final Payment Certificate which shall state:

(a) the amount which he fairly determines is finally due, and

(b) after giving credit to the Employer for all amounts previously paid by the Employer and for all sums to which the Employer is entitled, the balance (if any) due from the Employer to the Contractor or from the Contractor to the Employer, as the case may be.

If the Contractor has not applied for a Final Payment Certificate in accordance with Sub-Clause 14.11 [Application for Final Payment Certificate] and Sub-Clause 14.12 [Discharge], the Engineer shall request the Contractor to do so. If the Contractor fails to submit an application within a period of 28 days, the Engineer shall issue the Final Payment Certificate for such amount as he fairly determines to be due.

14.14 Cessation of Employer's Liability

The Employer shall not be liable to the Contractor for any matter or thing under or inconnection with the Contract or execution of the Works, except to the extent that the Contractor shall have included an amount expressly for it:

(a) in the Final Statement and also

(b) (except for matters or things arising after the issue of the Taking-Over Certificate for the Works) in the Statement at completion described in Sub-Clause 14.10 [Statement at Completion].

However, this Sub-Clause shall not limit the Employer's liability under his indemnification obligations, or the Employer's liability in any case of fraud, deliberate default or reckless misconduct by the Employer.

14.15 Currencies of Payment

The Contract Price shall be paid in Indian Rupees (INR).

15. Termination by Employer

15.1 Notice to Correct

If the Contractor fails to carry out any obligation under the Contract as mentioned below, but not limited to, the Engineer/ Employer may serve the

contractor with a 14 days notice in writing calling upon the contractor to make good the failure and to remedy it. If the contractor;

(a) fails to comply with Sub-Clause 4.2 [Performance Security],

(b) abandons the Works or otherwise plainly demonstrates the intention not to continue performance of his obligations under the Contract,

(c) without reasonable excuse fails to:

(i) proceed with the Works in accordance with Clause 8 [Commencement, Delays and Suspension], or

(ii) comply with a notice issued under Sub-Clause 7.5 [Rejection] or Sub-Clause 7.6 [Remedial Work], within 28 days after receiving it, or

(iii) adhere to the agreed programme of work / activity on the critical path, by a margin of 10% of the stipulated period, or

(iv) take steps to deploy competent and adequate number of personnel, and equipment to achieve progress as per agreed programme or

(v) adhere to the instructions of Engineers/Employer persistently or

(vi) comply any provision of the contract or

(vii) provide the Engineer/Employer or their representative proper facilities for inspecting the works or any part thereof as required, under Clause 7.3 (Inspection) and 7.4 (Testing).

(d) subcontracts the whole or major part of the Works or assigns the Contract without prior written consent of the Employer.,

If the contractor does not, within 14 days of receipt of notice under this sub-clause, proceed to make good his default in so far as the same is capable of being made good and carry on the work of complying with such direction as contained in the notice under sub clause 15.1, to the entire satisfaction of the Engineer/Employer, the Employer shall be entitled to take action under sub-clause 15.1.1 or 15.1.2 or 15.2 below.

15.1.1 In case of contractor's repeated failure to adhere to the agreed program, and whereas the contractor has been served with a Notice to Correct under Clause 15.1 of GCC, if the contractor approaches RVNL with a revised program with specific monthly physical and financial targets along with the proposal to deploy matching inputs in the form of manpower and other resources to the satisfaction of the Employer, then the Employer may consider whether to proceed with termination of the contract under Clause 15.2 of GCC or to continue with the contract. However, the request to continue with the contract shall only be considered if the contractor supports his earnestness to adhere to the revised program by submitting additional Performance Security in the form of Bank Guarantee(s) of specified number and value as decided by the Employer (total value of which will not exceed 10% of the contract price). The encashment of these additional Bank Guarantee(s) shall be linked with the non achievement of agreed physical/financial targets agreed upon by the Contractor and the Employer.

15.1.2 In case the contractor's failure is limited to only some of the works, and in response to Notice to Correct under Clause 15.1 of GCC, the contractor approaches the Employer that such works may be offloaded from him and got executed through another agency and additional cost incurred, if any, should be recovered from his dues, the Employer, on being convinced that the anticipated additional cost for such works will not be substantial and can be recovered from the dues of the contractor and that such offloading will help in improving the overall progress of the project, may agree to such offloading without any repercussion on the performance security and/or additional bank guarantees, if any, submitted by the contractor. However, the Employer will not be under any compulsion to agree to such a request. The Contractor shall be informed of the LOA issued to other agency(ies) for such works.

In case the contractor does not approach the employer for offloading but the Employer is convinced that:

(i) offloading of some works will help in improving the progress of the project;

(ii) termination/part termination of the contract at this stage will not be in the interest of the project;

(iii) the anticipated additional cost for such works will not be substantial and can be recovered from the dues of the contractor;

The Employer may issue 7 days notice to the Contractor stating the resources required to be deployed against each work. If the contractor fails to deploy the required resources as indicated in the notice, the employer shall offload such works and proceed with getting the works executed through other agency(ies). The Contractor shall be informed of the LOA issued to other agency(ies) for such works.

Offloading under the sub clause 15.1.2 shall be without any repercussion on the performance security and/or additional bank guarantees, if any, submitted by the contractor. The Contractor would have no future claim on this account and the extra expenditure so incurred, if any, by the Employer in getting the offloaded work done, shall be recovered from subsequent payment certificates or any other dues of the contractor.

15.2 Termination by Employer The Employer shall be entitled to terminate the Contract as a whole or any part or parts (as may be specified in the Notice of Termination under any of the above Sub-Clause issue) if the Contractor:

(a) fails to comply with the directions contained in the notice under Sub-Clause 15.1 [Notice to Correct],

(b) becomes bankrupt or insolvent, goes into liquidation, has a receiving or administration order made against it by Court or Statutory Authority him, compounds with his creditors, or carries on business under a receiver, trustee or manager for the benefit of his creditors, or if any act is done or event

occurs which (under applicable Laws) has a similar effect to any of these acts or events, or

(c) gives or offers to give (directly or indirectly) to any person any bribe, gift, gratuity, commission or other thing of value, as an inducement or reward:

(i) for doing or forbearing to do any action in relation to the Contract, or

(ii) for showing or forbearing to show favour or disfavour to any person in relation to the Contract,

or if any of the Contractor's Personnel, agents or Subcontractors gives or offers to give (directly or indirectly) to any person any such inducement or reward as is described in this sub-paragraph (c). However, lawful inducements and rewards to Contractor's Personnel shall not entitle termination

In any of these events or circumstances, the Employer may, by Notice Terminate the contract with immediate effect.

The Employer's election to terminate the Contract shall not prejudice any other rights of the Employer, under the Contract or otherwise.

The Contractor shall remove all his plants and machinery from the site then leave the Site and deliver any required Goods, all Contractors' Documents, and other design documents made by or for him, to the Engineer within 7 days from the issue of Notice of Termination, failing which Delay Damages as prescribed for delay in completion of works shall be imposed as per provision of clause 8.7. However, the Contractor shall use his best efforts to comply immediately with any reasonable instructions included in the notice of Termination (i) for the assignment of any subcontract, and (ii) for the protection of life or property or for the safety of the Works.

After termination, the Employer may complete the Works and/or arrange for any other entities to do so. The Employer and these entities may then use any Goods, Contractor's Documents and other design documents made by or on behalf of the Contractor for completing the work.

15.3 Valuation at Date of Termination

As soon as practicable after a notice of termination under Sub-Clause 15.2 [Termination by Employer] has taken effect, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine the value of the Works, Goods and Contractor's Documents, and any other sums due to the Contractor for work executed in accordance with the Contract. For this purpose, the contractor shall be notified the date for witnessing of measurements and handing over of the materials for which contractor has already been paid. In case the contractor fails to attend or send a representative even after such notice, the Engineer shall ex parte proceed with measurements of the works executed and taking over of plants and materials etc. for which payment has already been made to the contractor, which shall be treated as final.

15.4 Payment after Termination

After a notice of termination under Sub-Clause 15.2 [Termination by Employer] has taken effect, the Employer may:

(a) proceed in accordance with Sub-Clause 2.5 [Employer's Claims],

(b) encash the Performance Guarantee and forfeit the Performance

Security:

i) In full including additional Performance Guarantee amount if any taken in

terms of sub clause 35.5 of ITB and not due for release on the date of issue of termination letter, in case of termination of the contract as a whole; Or

ii) in part/parts proportionate to the contract price of the bill/schedule to which the terminated part of work belongs i.e.

P = (A x B) ÷ C where,

P = Proportionate Bank Guarantee Amount

A = Contract Price of the particular bill/schedule to which the terminated part of work belongs

B = Performance Guarantee amount in terms of GCC sub clause 4.2

C = Total Contract Price

Plus additional Performance Guarantee amount if any taken in terms of sub clause 35.5 of ITB and not due for release on the date of issue of termination letter against that particular bill/Schedule to which the terminated part of the work belongs in case of termination in part/parts.

(c) release any payment due to the contractor for works executed prior to termination and evaluation under clause 15.3 (valuation at date of termination, however, if by this time the Contractor has failed to make a payment due to the Employer, the same will be deducted from the payment due and any balance remaining shall then be paid to the Contractor.).

15.5 Employer's Entitlement to Termination for Convenience

The Employer shall be entitled to terminate the Contract, at any time for the Employer's convenience, by giving notice of such termination to the Contractor. The termination shall take effect 28 days after the later of the dates on which the Contractor receives this notice or the Employer returns the Performance Security. The Employer shall not terminate the Contract under this Sub-Clause in order to execute the Works himself or to arrange for the Works to be executed by another contractor or to avoid a termination of the Contract by the Contractor under Clause 16.2 [Termination by Contractor].

After this termination, the Contractor shall proceed in accordance with Sub-Clause 16.3 [Cessation of Work and Removal of Contractor's Equipment] and shall be paid in accordance with Sub-Clause 19.1 [Payment and Release in case of Optional Termination].

15.6 Corrupt or Fraudulent Practices

If the Employer determines that the Contractor has engaged in corrupt, fraudulent, collusive or coercive practices, in competing for or in executing the Contract, then the Employer may, after giving 14 days notice to the Contractor, terminate the Contractor's employment under the Contract and expel him from the Site, and the provisions of Clause 15 shall apply as if such expulsion had been made under Sub-Clause 15.2.

For the purposes of this Sub-Clause:

(a) *"corrupt practice" means the offering, giving, receiving of soliciting of any thing of "value to influence the action of a public official in the procurement process or in the Contract execution.*

(b) *"fraudulent practice" means a misrepresentation of facts in order to influence a procurement process or the execution of the Contract to the detriment of the Employer, and includes collusive practice among Bidders (prior to or after bid submission) designed to establish bid prices at artificial non-competitive levels and to deprive the Employer of the benefits of free and open competition.*

(c) *"collusive practice" means a scheme or arrangement between two or*

more bidders, with or without the knowledge of the Employer, designed to establish bid prices at artificial, noncompetitive levels.

(d) *"coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the procurement process or affect the execution of a contract.*

16. Suspension and Termination by Contractor

16.1 Contractor's Entitlement to Suspend Work

If the Engineer fails to certify in accordance with Sub-Clause 14.6 [Issue of Interim Payment Certificates] or the Employer fails to comply with Sub-Clause 2.4 [Employer's Financial Arrangements] or Sub-Clause 14.7 [Payment], the Contractor may, after giving not less than 21 days' notice to the Employer, suspend work (or reduce the rate of work) unless and until the Contractor has received the Payment Certificate, reasonable evidence or payment, as the case may be and as described in the notice.

The Contractor's action shall not prejudice his entitlements to interest under Sub-Clause 14.8 [Delayed Payment] and to termination under Sub-Clause 16.2 [Termination by Contractor].

If the Contractor subsequently receives such Payment Certificate, evidence or payment (as described in the relevant Sub-Clause and in the above notice) before giving a notice of termination, the Contractor shall resume normal working as soon as is reasonably practicable.

If the Contractor suffers delay and/or incurs Cost as a result of suspending work (or reducing the rate of work) in accordance with this Sub-Clause, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost plus profit, which shall be included in the Contract Price.

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

16.2 Termination by Contractor

The Contractor shall be entitled to terminate the Contract if:

(a) the Contractor does not receive the reasonable evidence within 42 days after giving notice under Sub-Clause 16.1 [Contractor's Entitlement to Suspend Work] in respect of a failure to comply with Sub-Clause 2.4 [Employer's Financial Arrangements],

(b) the Engineer fails, within 56 days after receiving a Statement and supporting documents, to issue the relevant Payment Certificate,

(c) the Contractor does not receive the amount due under an Interim Payment Certificate within 42 days after the expiry of the time stated in Sub-Clause 14.7 [Payment] within which payment is to be made (except for deductions in accordance with Sub-Clause 2.5 [Employer's Claims]),

(d) a prolonged suspension affects the whole of the Works as described in Sub-Clause 8.11 [Prolonged Suspension], or

(e) the Employer becomes bankrupt or insolvent, goes into liquidation, has a receiving or administration order made against him, compounds with his creditors, or carries on business under a receiver, trustee or manager for the benefit of his creditors, or if any act is done or event occurs which

(under applicable Laws) has a similar effect to any of these acts or events.

In any of these events or circumstances, the Contractor may, upon giving 14 days' notice to the Employer, terminate the Contract. However, in the case of sub-paragraph (d) or (e), the Contractor may by notice terminate the Contract immediately.

The Contractor's election to terminate the Contract shall not prejudice any other rights of the Contractor, under the Contract or otherwise.

16.3 Cessation of Work and Removal of Contractor's Equipment

After a notice of termination under Sub-Clause 15.5 [Employer's Entitlement to Termination], Sub-Clause 16.2 [Termination by Contractor] or Sub-Clause 19.1 [Optional Termination, Payment and Release] has taken effect, the Contractor shall promptly:

(a) cease all further work, except for such work as may have been instructed by the Engineer for the protection of life or property or for the safety of the Works,

(b) hand over Contractor's Documents, Plant, Materials and other work, for which the Contractor has received payment, and

(c) remove all other Goods from the Site, except as necessary for safety, and leave the Site.

16.4 Payment on Termination

After a notice of termination under Sub-Clause 16.2 [Termination by Contractor] has taken effect, the Employer shall promptly:

(a) return the Performance Security to the Contractor,

(b) pay the Contractor in accordance with Sub-Clause 19.1 [Optional Termination, Payment and Release], and

(c) should the contract be terminated under sub-clause 15.5 of this clause and the contractor claims payment for expenditure incurred by him in the expectation of completing the whole of the work, the Employer shall admit and consider such claims as are deemed reasonable and are supported by vouchers to the satisfaction of the Engineer. The Employer's decision on the necessity and propriety of such expenditure shall be final and conclusive.

(d) The Contractor shall have no claim to any payment of compensation or otherwise, howsoever on account of any profit or advantage which he might have derived from the execution of the work in full but which he did not derive in consequence of termination of contract.

17. Risk and Responsibility

17.1 Indemnities

The Contractor shall indemnify and hold harmless the Employer, the Employer's Personnel, and their respective agents, against and from all claims, damages, losses and expenses (including legal fees and expenses) in respect of:

(a) bodily injury, sickness, disease or death, of any person including railway user whatsoever arising out of or in the course of or by reason of the Contractor's design (if any), the execution and completion of the Works and the remedying of any defects, unless attributable to any negligence, wilful act or breach of the Contract by the Employer, the Employer's Personnel, or any of their respective agents, and

(b) damage to or loss of any property, real or personal (other than the Works), to the extent that such damage or loss arises out of or in the course of or by reason of the Contractor's design (if any), the execution and completion of the Works and the remedying of any defects, unless and to the extent that any such damage or loss is attributable to any negligence, wilful act or breach of the Contract by the Employer, the Employer's Personnel,, their respective agents, or anyone directly or indirectly employed by any of them.

The Employer shall indemnify and hold harmless the Contractor, the Contractor's Personnel, and their respective agents, against and from all claims, damages, losses and expenses (including legal fees and expenses) in respect of (1) bodily injury, sickness, disease or death, which is attributable to any negligence, wilful act or breach of the Contract by the Employer, the Employer's Personnel, or any of their respective agents, and (2) the matters for which liability may be excluded from insurance cover, as described in sub-paragraphs (d)(i), (ii) and (iii) of Sub-Clause 18.3 [Insurance Against Injury to Persons and Damage to Property].

17.2 Contractor's Care of the Works

The Contractor shall take full responsibility for the care of the Works and Goods from the Commencement Date until the Taking-Over Certificate is issued (or is deemed to be issued under Sub-Clause 10.1 [Taking Over of the Works and Sections]) for the Works, when responsibility for the care of the Works shall pass to the Employer. If a Taking-Over Certificate is issued (or is so deemed to be issued) for any Section or part of the Works, responsibility for the care of the Section or part shall then pass to the Employer.

After responsibility has accordingly passed to the Employer, the Contractor shall take responsibility for the care of any work which is outstanding on the date stated in a Taking-Over Certificate, until this outstanding work has been completed.

If any loss or damage happens to the Works, Goods or Contractor's Documents during the period when the Contractor is responsible for their care, from any cause not listed in Sub-Clause 17.3 [Employer's Risks], the Contractor shall rectify the loss or damage at the Contractor's risk and cost, so that the Works, Goods and Contractor's Documents conform with the Contract.

The Contractor shall be liable for any loss or damage caused by any actions performed by the Contractor after a Taking-Over Certificate has been issued. The Contractor shall also be liable for any loss or damage which occurs after a Taking-Over Certificate has been issued and which arose from a previous event for which the Contractor was liable.

17.3 Employer's Risks

The risks referred to in Sub-Clause 17.4 below, insofar as they directly affect the execution of the works in the Country, are:

(a) war, hostilities (whether war be declared or not), invasion, act of foreign enemies,

(b) rebellion, terrorism, sabotage by persons other than the Contractor's Personnel, revolution, insurrection, military or usurped power, or civil war, within the Country,

(c) riot, commotion or disorder within the Country by persons other than the Contractor's Personnel,

(d) munitions of war, explosive materials, ionising radiation or contamination by radio-activity, within the Country, except as may be attributable to the Contractor's use of such munitions, explosives, radiation or radio-activity,

(e) pressure waves caused by aircraft or other aerial devices travelling at sonic or supersonic speeds,

(f) use or occupation by the Employer of any part of the Permanent Works, except as may be specified in the Contract,

(g) design of any part of the Works by the Employer's Personnel or by others for whom the Employer is responsible, and

(h) any operation of the forces of nature which is Unforeseeable or against which an experienced contractor could not reasonably have been expected to have taken adequate preventative precautions.

17.4 Consequences of Employer's Risks

If and to the extent that any of the risks listed in Sub-Clause 17.3 above results in loss or damage to the Works, Goods or Contractor's Documents, the Contractor shall promptly give notice to the Engineer and shall rectify this loss or damage to the extent required by the Engineer.

If the Contractor suffers delay and/or incurs Cost from rectifying this loss or damage, the Contractor shall give a further notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost, which shall be included in the Contract Price. In the case of sub-paragraphs (f) and (g) of Sub-Clause 17.3 [Employer's Risks], Cost shall be payable.

After receiving this further notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

17.5 Intellectual and Industrial Property Rights

In this Sub-Clause, "infringement" means an infringement (or alleged infringement) of any patent, registered design, copyright, trade mark, trade name, trade secret or other intellectual or industrial property right relating to the Works; and "claim" means a claim (or proceedings pursuing a claim) alleging an infringement.

Whenever a Party does not give notice to the other Party of any claim within 28 days of receiving the claim, the first Party shall be deemed to have waived any right to indemnity under this Sub-Clause.

The Employer shall indemnify and hold the Contractor harmless against and from any claim alleging an infringement which is or was:

(a) an unavoidable result of the Contractor's compliance with the Contract, or

(b) a result of any Works being used by the Employer:

(i) for a purpose other than that indicated by, or reasonably to be inferred from, the Contract, or

(ii) in conjunction with any thing not supplied by the Contractor, unless such use was disclosed to the Contractor prior to the Base Date or is stated in the Contract.

The Contractor shall indemnify and hold the Employer harmless against and from any other claim which arises out of or in relation to (i) the manufacture, use, sale or import of any Goods, or (ii) any design for which the Contractor is responsible.

If a Party is entitled to be indemnified under this Sub-Clause, the indemnifying

Party may (at its cost) conduct negotiations for the settlement of the claim, and any litigation or arbitration which may arise from it. The other Party shall, at the request and cost of the indemnifying Party, assist in contesting the claim. This other Party (and its Personnel) shall not make any admission which might be prejudicial to the indemnifying Party, unless the indemnifying Party failed to take over the conduct of any negotiations, litigation or arbitration upon being requested to do so by such other Party.

17.6 Limitation of Liability

Neither Party shall be liable to the other Party for loss of use of any Works, loss of profit, loss of any contract or for any indirect or consequential loss or damage which may be suffered by the other Party in connection with the Contract, provided that this exclusion shall not apply to any obligation of the Contractor to pay Delay Damages to the Employer under Sub-Clause 8.7 [Delay Damages].

The total liability of the Contractor to the Employer, under or in connection with the Contract other than under Sub-Clause 4.19 [Electricity, Water and Gas], Sub-Clause 4.20 [Employer's Equipment and Free-Issue Material], Sub-Clause 17.1 [Indemnities] and Sub-Clause 17.5 [Intellectual and Industrial Property Rights], shall not exceed the sum as specified in the Contract Data or if nothing is specified in the Contract Data, the accepted Contract Amount.

This Sub-Clause shall not limit liability in any case of fraud, deliberate default or reckless misconduct by the defaulting Party.

17.7 Use of Employer's Accommodation / Facilities

The Contractor shall take full responsibility for the care of the Employer provided accommodation and facilities, if any, as detailed in the Specification, from the respective dates of hand-over to the Contractor until cessation of occupation(where hand-over or cessation of occupation may take place after the date stated in the Taking-Over Certificate for the Works).

If any loss or damage happens to any of the above items while the Contractor is responsible for their care arising from any cause whatsoever other than those for which the Employer is liable, the Contractor shall, at his own cost, rectify the loss or damage to the satisfaction of the Engineer.

18. Insurance

18.1 General Requirements for Insurances

In this Clause, "insuring Party" means, for each type of insurance, the Party responsible for effecting and maintaining the insurance specified in the relevant Sub-Clause.

Wherever the Contractor is the insuring Party, each insurance shall be effected with insurers and in terms approved by the Employer. These terms shall be consistent with any terms agreed by both Parties before the date of the Letter of Acceptance. This agreement of terms shall take precedence over the provisions of this Clause.

Wherever the Employer is the insuring Party, each insurance shall be effected with insurers and in terms consistent with the details annexed to the Special Conditions of Contract.

If a policy is required to indemnify joint insured, the cover shall apply separately

to each insured as though a separate policy had been issued for each of the joint insured. If a policy indemnifies additional joint insured, namely in addition to the insured specified in this Clause, (i) the Contractor shall act under the policy on behalf of these additional joint insured except that the Employer shall act for Employer's Personnel, (ii) additional joint insured shall not be entitled to receive payments directly from the insurer or to have any other direct dealings with the insurer, and (iii) the insuring Party shall require all additional joint insured to comply with the conditions stipulated in the policy.

Each policy insuring against loss or damage shall provide for payments to be made in the currencies required to rectify the loss or damage. Payments received from insurers shall be used for the rectification of the loss or damage.

The relevant insuring Party shall, within the respective periods stated in the Contract Data (calculated from the Commencement Date), submit to the other Party:

(a) evidence that the insurances described in this Clause have been effected, and

(b) copies of the policies for the insurances described in Sub-Clause 18.2 [Insurance for Works and Contractor's Equipment] and Sub-Clause 18.3 [Insurance against Injury to Persons and Damage to Property].

When each premium is paid, the insuring Party shall submit evidence of payment to the other Party. Whenever evidence or policies are submitted, the insuring Party shall also give notice to the Engineer.

Each Party shall comply with the conditions stipulated in each of the insurance policies. The insuring Party shall keep the insurers informed of any relevant changes to the execution of the Works and ensure that insurance is maintained in accordance with this Clause.

Neither Party shall make any material alteration to the terms of any insurance without the prior approval of the other Party. If an insurer makes (or attempts to make) any alteration, the Party first notified by the insurer shall promptly give notice to the other Party.

If the insuring Party fails to effect and keep in force any of the insurances it is required to effect and maintain under the Contract, or fails to provide satisfactory evidence and copies of policies in accordance with this Sub-Clause, the other Party may (at its option and without prejudice to any other right or remedy) effect insurance for the relevant coverage and pay the premiums due. The insuring Party shall pay the amount of these premiums to the other Party, and the Contract Price shall be adjusted accordingly.

Nothing in this Clause limits the obligations, liabilities or responsibilities of the Contractor or the Employer, under the other terms of the Contract or otherwise. Any amounts not insured or not recovered from the insurers shall be borne by the Contractor and/or the Employer in accordance with these obligations, liabilities or responsibilities. However, if the insuring Party fails to effect and keep in force an insurance which is available and which it is required to effect and maintain under the Contract, and the other Party neither approves the omission nor effects insurance for the coverage relevant to this default, any moneys which should have been recoverable under this insurance shall be paid by the insuring Party.

Payments by one Party to the other Party shall be subject to Sub-Clause 2.5 [Employer's Claims] or Sub-Clause 20.1 [Contractor's Claims], as applicable.

The Contractor shall be entitled to place all insurance relating to the Contract

(including, but not limited to the insurance referred to Clause 18) with insurers from any eligible source country.

18.2 Insurance for Works and Contractor's Equipment

The Contractor shall insure the Works, Plant, Materials, including those issued by the Employer and Contractor's Documents for not less than the full reinstatement cost including the costs of demolition, removal of debris and professional fees and profit, subject to a maximum value indicated in Contract Data**.**. This insurance shall be effective from the date by which the evidence is to be submitted under sub-paragraph (a) of Sub-Clause 18.1 [General Requirements for Insurances], until the date of issue of the Taking-Over Certificate for the Works.

The insuring Party shall maintain this insurance to provide cover until the date of issue of the Performance Certificate, for loss or damage for which the Contractor is liable arising from a cause occurring prior to the issue of the Taking-Over Certificate, and for loss or damage caused by the Contractor in the course of any other operations (including those under Clause 11 [Defects Liability]).

The insuring Party shall insure the Contractor's Equipment for not less than the full replacement value, including delivery to Site. For each item of Contractor's Equipment, the insurance shall be effective while it is being transported to the Site and until it is no longer required as Contractor's Equipment.

Unless otherwise stated in the Special Conditions of Contract, insurances under this Sub-Clause:

(a) shall be effected and maintained by the Contractor as insuring Party,

(b) shall be in the joint names of the Parties, who shall be jointly entitled to receive payments from the insurers, payments being held or allocated between the Parties for the sole purpose of rectifying the loss or damage,

(c) shall cover all loss and damage from any cause not listed in Sub-Clause 17.3 [Employer's Risks],

(d) shall also cover loss or damage to a part of the Works which is attributable to the use or occupation by the Employer of another part of the Works, and loss or damage from the risks listed in sub-paragraphs (c), (g) and (h) of Sub-Clause 17.3 [Employer's Risks], excluding (in each case) risks which are not insurable at commercially reasonable terms, with deductibles per occurrence of not more than the amount stated in the Contract Data (if an amount is not so stated, this sub-paragraph (d) shall not apply), and

(e) may however exclude loss of, damage to, and reinstatement of:

i) part of the Works which is in a defective condition due to a defect in its design, materials or workmanship (but cover shall include any other parts which are lost or damaged as a direct result of this defective condition and not as described in sub-paragraph (ii) below),

ii) a part of the Works which is lost or damaged in order to reinstate any other part of the Works if this other part is in a defective condition due to a defect in its design, materials or workmanship,

iii) a part of the Works which has been taken over by the Employer, except to the extent that the Contractor is liable for the loss or damage, and

iv) Goods while they are not in the Country, subject to Sub-Clause 14.5 [Plant and Materials intended for the Works].

If, more than one year after the Base Date, the cover described in sub-paragraph (d) above ceases to be available at commercially reasonable terms, the Contractor shall (as insuring Party) give notice to the Employer, with supporting particulars. The Employer shall then (i) be entitled subject to Sub-Clause 2.5 [Employer's Claims] to payment of an amount equivalent to such commercially reasonable terms as the Contractor should have expected to have paid for such cover, and (ii) be deemed, unless he obtains the cover at commercially reasonable terms, to have approved the omission under Sub-Clause 18.1 [General Requirements for Insurances].

18.3 Insurance against Injury to Persons and Damage to Property

The insuring Party shall insure against each Party's liability for any loss, damage, death or bodily injury which may occur to any physical property (except things insured under Sub-Clause 18.2 [Insurance for Works and Contractor's Equipment]) or to any person (except persons insured under Sub-Clause 18.4 [Insurance for Contractor's Personnel]), which may arise out of the Contractor's performance of the Contract and occurring before the issue of the Performance Certificate.

This insurance shall be for a limit per occurrence of not less than the amount stated in the Contract Data, with no limit on the number of occurrences. If an amount is not stated in the Contract Data, this Sub-Clause shall not apply.

Unless otherwise stated in the Special Conditions of Contract, the insurances specified in this Sub-Clause:

(a) shall be effected and maintained by the Contractor as insuring Party,

(b) shall be in the joint names of the Parties,

(c) shall be extended to cover liability for all loss and damage to the Employer's property including Railways Property (except things insured under Sub-Clause 18.2) arising out of the Contractor's performance of the Contract, and

(d) may however exclude liability to the extent that it arises from:

(i) the Employer's right to have the Permanent Works executed on, over, under, in or through any land, and to occupy this land for the Permanent Works,

(ii) damage which is an unavoidable result of the Contractor's obligations to execute the Works and remedy any defects, and

(iii) a cause listed in Sub-Clause 17.3 [Employer's Risks], except to the extent that cover is available at commercially reasonable terms.

18.4 Insurance for Contractor's Personnel

The Contractor shall effect and maintain insurance against liability for claims, damages, losses and expenses (including legal fees and expenses) arising from injury, sickness, disease or death of any person employed by the Contractor or any other of the Contractor's Personnel.

The Employer and the Engineer shall also be indemnified under the policy of insurance, except that this insurance may exclude losses and claims to the extent that they arise from any act or neglect of the Employer or of the Employer's Personnel.

The insurance shall be maintained in full force and effect during the whole time that these personnel are assisting in the execution of the Works. For a Subcontractor's employees, the insurance may be effected by the Subcontractor, but the Contractor shall be responsible for compliance with this Clause.

19. Force Majeure

If at any time, during the continuance of this contract, the performance in whole or in part by either party of any obligation under this contract shall be prevented or delayed by reason of any war, hostility, acts of public enemy, civil commotion, sabotage, serious loss or damage by fire, explosions, epidemics, strikes, lockouts or acts of God (hereinafter referred to 'events') provided, notice of the happening of any such event is given by either party to the other within 14 days from the date of occurrence thereof, neither party shall by reason of such event, be entitled to terminate this contract nor shall either party have any claim for damages against the other in respect of such non-performance of delay in performance, and works under the contract shall be resumed as soon as practicable after such event has come to an end or ceased to exist, and decision of the Engineer as to whether the works have been so resumed or not shall be final and conclusive, PROVIDED FURTHER that if the performance in whole or in part of any obligation under this contract is prevented or delayed by reason of any such event for a continuous period exceeding 84 days, either party may at its option terminate the contract by giving notice to the other party.

19.1 Payment and Release in case of Optional Termination

Upon such termination, the Engineer shall determine the value of the work done and issue a Payment Certificate which shall include :

(a) The amounts payable for any work carried out for which a price is stated in the contract;

(b) The Cost of Plant and Materials ordered for the Works which have been delivered to the Contractor, or of which the contractor is liable to accept delivery; this Plant and materials shall become the property of (and be at the risk of) the Employer when paid for by the Employer, the Contractor shall place the same at the Employer's disposal;

(c) Other Costs or liabilities supported by necessary documentary evidence which in the circumstances were reasonably and necessarily incurred by the Contractor in the expectation of completing the Works as per mutually agreed programme.

(d) the Cost of removal of Temporary Works and Contractor's Equipment from the Site and the return of these items to the Contractor's works in his country (or to any other destination at no greater cost).

20. Claims, Disputes and Arbitration

20.1 Contractor's Claims

If the Contractor considers himself to be entitled to any extension of the Time for Completion and/or any additional payment, under any Clause of these Conditions or otherwise in connection with the Contract, the Contractor shall give notice to the Engineer, describing the event or circumstance giving rise to the claim. The notice shall be given as soon as practicable, and not later than 28 days after the Contractor became aware, or should have become aware, of the event or circumstance.

If the Contractor fails to give notice of a claim within such period of 28 days, the Time for Completion shall not be extended, the Contractor shall not be entitled to additional payment, and the Employer shall be discharged from all liability in connection with the claim. Otherwise, the following provisions of this Sub-Clause shall apply.

The Contractor shall also submit any other notices which are required by the Contract, and supporting particulars for the claim, all as relevant to such event or circumstance.

The Contractor shall keep such contemporary records as may be necessary to substantiate any claim, either on the Site or at another location acceptable to the Engineer. Without admitting the Employer's liability, the Engineer may, after receiving any notice under this Sub-Clause, monitor the record-keeping and/or instruct the Contractor to keep further contemporary records. The Contractor shall permit the Engineer to inspect all these records, and shall (if instructed) submit copies to the Engineer.

Within 42 days after the Contractor became aware (or should have become aware) of the event or circumstance giving rise to the claim, or within such other period as may be proposed by the Contractor and approved by the Engineer, the Contractor shall send to the Engineer a fully detailed claim which includes full supporting particulars of the basis of the claim and of the extension of time and/or additional payment claimed. If the event or circumstance giving rise to the claim has a continuing effect:

(a) this fully detailed claim shall be considered as interim;

(b) the Contractor shall send further interim claims at monthly intervals, giving the accumulated delay and/or amount claimed, and such further particulars as the Engineer may reasonably require; and

(c) the Contractor shall send a final claim within 28 days after the end of the effects resulting from the event or circumstance, or within such other period as may be proposed by the Contractor and approved by the Engineer.

Within 42 days after receiving a claim or any further particulars supporting a previous claim, or within such other period as may be proposed by the Engineer and approved by the Contractor, the Engineer shall respond with approval, or with disapproval and detailed comments. He may also request any necessary further particulars, but shall nevertheless give his response on the principles of the claim within such time.

Each Payment Certificate shall include such amounts for any claim as have

been reasonably substantiated as due under the relevant provision of the Contract. Unless and until the particulars supplied are sufficient to substantiate the whole of the claim, the Contractor shall only be entitled to payment for such part of the claim as he has been able to substantiate.

The Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine (i) the extension (if any) of the Time for Completion (before or after its expiry) in accordance with Sub-Clause 8.4 [Extension of Time for Completion], and/or (ii) the additional payment (if any) to which the Contractor is entitled under the Contract.

The requirements of this Sub-Clause are in addition to those of any other Sub-Clause which may apply to a claim. If the Contractor fails to comply with this or another Sub-Clause in relation to any claim, any extension of time and/or additional payment shall take account of the extent (if any) to which the failure has prevented or prejudiced proper investigation of the claim, unless the claim is excluded under the second paragraph of this Sub-Clause.

20.2 Amicable Settlement

In case any dispute between the Engineer and the Contractor for which claim has already been made by the contractor, remains unresolved, the Contractor shall, then, give notice of dissatisfaction and intention to commence arbitration to the Employer duly specifying the subject of the dispute or difference as also the amount of claim item wise. The Parties shall make attempts to settle the dispute amicably before the commencement of arbitration as per procedure laid down in policy letter no. C/Policy/Arbitration/2007-08 dated 26.12.2018 or any modification issued at a later date (circular enclosed in Section 7 Part B (PCC)). However, unless both Parties agree otherwise, demand for arbitration may be made by the contractor after ninety days from the day on which a notice of dissatisfaction and intention to commence arbitration was given, even if no attempt at amicable settlement has been made.

20.3 Arbitration

Any dispute, in respect of which amicable settlement has not been reached, arising between the Employer and the Domestic or Foreign Contractor related to any matter arising out of or connected with this contract, then the contractor shall be entitled to demand in writing that the dispute or difference be referred to arbitration.

Only such dispute(s) or difference(s) in respect of which the demand had been made for amicable settlement under GCC 20.2 but could not be settled, shall be referred to arbitration subject to the condition that cumulative amount of claims in the contract is not exceeding 20% of the contract price. In case the cumulative amount of claims exceeds 20% of the contract price, arbitration clause will not be applicable.

The Arbitration proceedings shall commence from the day, a written and duly quantified demand for arbitration is received by Chairman and Managing Director, Rail Vikas Nigam Limited, New Delhi (CMD/RVNL).

The disputes so referred to arbitration shall be settled in accordance with the Indian Arbitration & Conciliation Act, 1996 and any statutory modification or re-enactment thereof.

Further, it is agreed between the parties as under:

20.3.1 **Number of Arbitrators:** The arbitral tribunal shall consist of three arbitrators.

20.3.2 **Procedure for Appointment of Arbitrators:** The arbitrators shall be appointed as per following procedure:

(a) The Contractor, while invoking demand for arbitration, shall submit to CMD/RVNL, claims duly quantified along with name and contact details of his nominee arbitrator. Thereafter, he Employer will nominate his nominee arbitrator within a period of 30 days from receipt of such demand from the Contractor and will issue letter of appointment to both the arbitrators appointed by the parties with a copy to the Contractor.

(b) The third Arbitrator shall be chosen by the two Arbitrators so appointed by the parties and shall act as Presiding Arbitrator. In case of failure of the two Arbitrators appointed by the parties to reach upon consensus within a period of 30 days from the appointment of the Arbitrators subsequently appointed, then, upon the request of either or both parties, the Presiding Arbitrator shall be appointed by the Chairman and Managing Director, Rail Vikas Nigam Limited, New Delhi.

(c) If one or more of the arbitrators appointed as above refuses to act as arbitrator, withdraws from his office as arbitrator, or vacates his/their office/offices or is/are unable or unwilling to perform his functions as arbitrator for any reason whatsoever or dies or in the opinion of the CMD/RVNL fails to act without undue delay, the CMD/RVNL shall appoint new arbitrator/arbitrators to act in his/their place except in case of new Presiding Arbitrator who shall be chosen following the same procedure as mentioned in para (b) above. Such re-constituted Tribunal may, at its discretion, proceed with the reference from the stage at which it was left by the previous arbitrator(s).

20.3.3 **Qualification and Experience of Arbitrators (to be appointed as per sub-clause 20.3.2 above):** The contract being of specialized nature requiring knowledge and experience of dealing with construction contracts, the arbitrators to be appointed shall have minimum qualification and experience as under:

Arbitrator shall be;

a working/retired officer (not below E-9 grade and above in a PSU with which RVNL has no business relationship) of any discipline of Engineering or Accounts/Finance department, having experience in Contract Management of construction contracts; or

a retired officer (retired not below the HAG level) of any Engineering/Accounts Services of Central Government, having experience in Contract Management of construction contracts; or a retired officer who should have retired more than 3 years previously from the date of appointment as Arbitrator (retired not below E-9 grade in RVNL or a PSU with which RVNL has a business relationship) of

any Engineering discipline or Accounts department, having experience in Contract Management of construction contracts.

No person other than the persons appointed as per above procedure and having above qualification and experience shall act as Arbitrator. In case any person having the qualification and experience other than that mentioned above is nominated as arbitrator, the arbitration clause shall cease to exist and shall not be applicable.

20.3.4 No new claim, except as otherwise mutually agreed by the Parties, shall be added during proceedings by either party. However, a party may amend or supplement the original claim or defence thereof during the course of arbitration proceedings subject to acceptance by Tribunal having due regard to the delay in making it.

20.3.5 Neither party shall be limited in the proceedings before such arbitrators to the evidence nor did arguments previously put before during amicable settlement.

20.3.6 The reference to arbitration may proceed, notwithstanding that the Works shall not then be or be alleged to be complete, provided always that the obligations of the Employer, the Engineer and the Contractor shall not be altered by the reason of the arbitration being conducted during the progress of the Works. Neither party shall be entitled to suspend the Works, nor shall payment to the Contractor be withheld on account of such proceedings

20.3.7 If the contractor(s) does/do not prefer his/their specific and final claims in writing, within a period of 90 days of receiving the intimation from the Employer/Engineer that the final bill is ready for signature of the contractor(s), he/they will be deemed to have waived his/their claim(s) and the Employer shall be discharged and released of all liabilities under the contract in respect of these claims.

20.3.8 Arbitration proceedings shall be held at New Delhi, India or at a place where CPM/RVNL's (dealing the contract) office is located, and the language of the arbitration proceedings and that of all documents and communications between the parties shall be in English.

20.3.9 The Arbitral Tribunal should record day to day proceedings. The proceedings shall normally be conducted on the basis of documents and written statements.

All arbitration awards shall be in writing and shall state item wise, the sum and detailed reasons upon which it is based.

20.3.10 Any ruling on award shall be made by a majority of members of Tribunal. In the absence of such a majority, the views of the Presiding Arbitrator shall prevail.

A party may apply for correction of any computational errors, any typographical or clerical errors or any other error of similar nature occurring in the award of a tribunal and interpretation of specific point of award to tribunal within 60 days of the receipt of award.

A party may apply to tribunal within 60 days of receipt of award to make an additional award as to claims presented in the arbitral proceedings but omitted

20.3.11 from the arbitral award.

Where the Arbitral award is for the payment of money, no interest shall be payable on whole or any part of the money for any period till the date on which the award is made.

20.3.12

The fees and other charges of the conciliator/arbitrators shall be as per the fee structure fixed by the employer (enclosed as Annexure 3 to section 7) and as amended from time to time irrespective of the fact whether the Arbitrator(s) is/are appointed by the parties or by the Court of law unless specifically directed by Hon'ble Court otherwise on the matter, and shall be shared equally by the Employer and the Contractor. However, the expenses incurred by each party in connection with the preparation, presentation will be borne by itself.

21. Jurisdiction of courts

The Contract Agreement shall be subject to exclusive jurisdiction of Courts as indicated in the Contract Data.

RVNL

APPENDIX 1

SALIENT FEATURES OF SOME MAJOR LABOUR LAWS APPLICABLE TO ESTABLISHMENTS ENGAGED IN BUILDING AND OTHER CONSTRUCTION WORK

(The laws as current on the date of bid opening will apply)

a) **Workmen Compensation Act 1923**: The Act provides for compensation in case of injury by accident arising out of and during the course of employment.

b) **Payment of Gratuity Act 1972**: Gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed 5 years service or more or on death the rate of 15 days wages for every completed year of service. The Act is applicable to all establishments employing 10 or more employees.

c) **Employees P.F. and Miscellaneous Provision Act 1952 (since amended):** The Act Provides for monthly contributions by the employer plus workers @ 10% or 8.33%. The benefits payable under the Act are :

   (i) Pension or family pension on retirement or death, as the case may be.

   (ii) Deposit linked insurance on the death in harness of the worker.

   (iii) payment of P.F. accumulation on retirement/death etc.

d) **Maternity Benefit Act 1951**: The Act provides for leave and some other benefits to women employees in case of confinement or miscarriage etc.

e) **Contract Labour (Regulation & Abolition) Act 1970**: The Act provides for certain welfare measures to be provided by the Contractor to contract labour and in case the Contractor fails to provide, the same are required to be provided, by the Principal Employer by Law. The Principal Employer is required to take Certificate of Registration and the Contractor is required to take license from the designated Officer. The Act is applicable to the establishments or Contractor of Principal Employer if they employ 20 or more contract labour.

f) **Minimum Wages Act 1948**: The Employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment. Construction of Buildings, Roads, Runways are scheduled employments.

g) **Payment of Wages Act 1936:** It lays down as to by what date the wages are to be paid, when it will be paid and what deductions can be made from the wages of the workers.

h) **Equal Remuneration Act 1979**: The Act provides for payment of equal wages for work of equal nature to Male and Female workers and for not making discrimination against Female employees in the matters of transfers, training and promotions etc.

i) **Payment of Bonus Act 1965**: The Act is applicable to all establishments employing 20 or more employees. The Act provides for payments of annual bonus subject to a minimum of 8.33% of wages and maximum of 20% of wages to employees drawing Rs.3500/-per month or less. The bonus to be paid to employees getting Rs.2500/- per month or above upto Rs.3500/- per month shall be worked out by taking wages as Rs.2500/-per month only. The Act does not apply to certain establishments. The newly set-up establishments are exempted for five years in certain circumstances. Some of

the State Governments have reduced the employment size from 20 to 10 for the purpose of applicability of this Act.

j) **Industrial Disputes Act 1947**: The Act lays down the machinery and procedure for resolution of Industrial disputes, in what situations a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment.

k) **Industrial Employment (Standing Orders) Act 1946**: It is applicable to all establishments employing 100 or more workmen (employment size reduced by some of the States and Central Government to 50). The Act provides for laying down rules governing the conditions of employment by the Employer on matters provided in the Act and get the same certified by the designated Authority.

l) **Trade Unions Act 1926:** The Act lays down the procedure for registration of trade unions of workmen and employers. The Trade Unions registered under the Act have been given certain immunities from civil and criminal liabilities.

m) **Child Labour (Prohibition & Regulation) Act 1986**:The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of Child Labour is prohibited in Building and Construction Industry.

n) **Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979:** The Act is applicable to an establishment which employs 5 or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The Inter-State migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, travelling expenses from home upto the establishment and back, etc.

o) **The Building and Other Construction workers (Regulation of Employment and Conditions of Service) Act 1996 and the Cess Act of 1996:** All the establishments who carry on any building or other construction work and employs 10 or more workers are covered under this Act. All such establishments are required to pay cess at the rate not exceeding 2% of the cost of construction as may be modified by the Government. The Employer of the establishment is required to provide safety measures at the Building or construction work and other welfare measures, such as Canteens, First-Aid facilities, Ambulance, Housing accommodations for workers near the work place etc. The Employer to whom the Act applies has to obtain a registration certificate from the Registering Officer appointed by the Government.

As per Central Government's Notification No.S.O.2899 dated 26.09.1996 under this act, the cess shall be levied @1% of cost of construction works which shall be deducted from each bill of the payment due to the contractor.

p) **Factories Act 1948**: The Act lays down the procedure for approval at plans before setting up a factory, health and safety provisions, welfare provisions, working hours, annual earned leave and rendering information regarding accidents or dangerous occurrences to designated authorities. It is applicable to premises employing 10 persons or more with aid of power or 20 or more persons without the aid of power engaged in manufacturing process.

WORKS/EMPLOYER's REQUIREMENTS

Section 5

Works Requirements

Section 5 – Works/Employers Requirements

This Section contains the Specification, the Drawings, and supplementary information that describe the Work to be procured.

I N D E X

S. No.	Description	Pages
1	Safety and Security	002-004
2	General Information and Scope of work	005-021
3	Site Facilities for the Employer and the Engineer	022-032
4	Specifications	033
5	Personnel	034-038
6	Equipment	039-042
7	Bid Drawings	043
8	Geological and Geotechnical data of project	44
9	Annexure-A (Technical Specifications for Tunneling)	045-233
10	Annexure-B (General Methodology and Decision-Making Flowchart for Probe Drilling and Pre-Injection Grouting)	234-243
11	Annexure-C (Geotechnical Baseline Report)	244

Chapter – 1

1.0 Safety and Security

1.1 The works included in this contract are to be carried out close to the running traffic and public utilities, therefore, safety of road traffic and the public is paramount. Therefore, all activities undertaken by the Contractor / his Sub-contractors shall ensure safety at all times. The contractor shall comply with the instructions issued by the Railway / Engineer / Employer from time to time to ensure safety while carrying out works in close vicinity of the various work sites. **The rates quoted by the Contractor shall be deemed to include all expenditure incurred in compliance with the same.**

1.2 Safety for works:

1.2.1 Before starting any excavation work adjacent to existing private/public infrastructure, the contractor shall take necessary permissions from the authorities and required precautions shall be taken.

1.2.2 The Contractor shall be responsible to take all precautions to ensure the safety of the public whether on public or Railway property as may in the opinion of the Engineer be required to comply with regulations pertaining to the work.

1.2.3 The Contractor shall provide safety fencing around foundation pits, trenches, erection sites, demolition sites, blasting sites, storage sites of explosives etc., to prevent accidents and injuries to the public.

1.2.4 The Contractor shall maintain the safety fencing in good working condition the period till the work in a given stretch is completed. He can remove the fencing after getting the approval of Engineer. The fencing material will be the property of the Contractor. Serviceable materials obtained from the released fencing can be re-used for providing fencing in subsequent stretches.

1.2.5 **The Contractor will not be paid separately for installation of such fencing, and cost is deemed to be included in the quoted rates of BOQ,** whenever required to be installed for work locations.

1.3 Damage to Railway Property or Life or Private Property

1.3.1 Contractor shall be responsible for all risks to the works and for the trespass and shall make good at his own expense all loss or damage whether to the works themselves or to any other property of the Railway or the lives of persons or property of others from whatsoever cause in connection with the works until they are taken over by the Employer and this although all reasonable and proper precautions may have been taken by the Contractor.

1.3.2 In case the Railway/Employer/Engineer shall be called upon to make good any costs, loss or damages, or to pay any compensation, including that payable under the provisions of Workmen's compensation act or any statutory amendments thereof to any person or persons sustaining damages as aforesaid, by reason of any act, or any negligence or any omissions on the part of the contractor, the amount of any costs or charges including costs and charges in connection with legal proceedings, which the Railway/Employer/Engineer may incur in reference thereto, shall be charged to the contractor.

1.3.3 The Railway / Employer / Engineer shall have the power and right to pay or to defend or compromise any claim of threatened legal proceedings or in anticipation of legal proceedings being instituted consequent on the action or default of the contractor, to take such steps as may be considered necessary or desirable to ward off or mitigate the effect of such proceedings, charging to Contractor, as aforesaid, any sum or sums of money which may be paid and any expenses whether for reinstatement or otherwise which may be incurred and the propriety of any such payment, defence or compromise, and the incurring of any such expense **shall not be called in question by the Contractor**.

1.4 Reporting of Accidents

1.4.1 The Contractor shall report to the Engineer details of any accidents as soon as possible after its occurrence. In the case of any fatality or serious accident, the Contractor shall in addition, notify the Engineer and the Employer immediately by the quickest available means.

1.5 Life-saving Appliances and First-aid Equipment

1.5.1 The Contractor shall provide and maintain upon the Works sufficient, proper and efficient life-saving appliances and first-aid equipment to the approval of the Engineer and in accordance with the requirements of ILO Convention No. 62. The appliances and equipment shall be available for use at all time.

1.6 Security Measures

1.6.1 Security arrangements for the work shall be in accordance with general requirements and the contractor shall conform to such requirements and shall be held responsible for the action or inaction on the part of his staff, employees and the staff and employees of his subcontractors.

1.6.2 Contractor's employee as well as his Sub Contractor's employees and representatives shall wear identification Badges (cards), uniforms, helmets, gum boots and other safety / protection gadgets / accessories provided by the Contractor. Badges shall identify the Contractor and show the employee's name and number and shall be worn at all times while at site.

1.6.3 All vehicles used by the contractor or his subcontractor shall be clearly marked with the Contractor's name or identification mark.

1.6.4 The contractor shall be responsible for security of works for the duration of the contract and shall provide and maintain continuously adequate security personnel to fulfill these obligations. The requirements of security measures shall include, but not be limited to, maintenance of Law and Order at site, provision of all lighting, guard, flagmen, and all other measures necessary for protection of works within the colonies, camps and elsewhere at site, all materials delivered to the site and all persons employed in connection with the works continuously through-out working and non-working periods including nights, Sundays and holidays, for the duration of the contract.

1.6.5 Deleted

1.7 Safety Fencing for running road traffic

1.7.1 Before commencing any work close to the running traffic, the Contractor shall bring to the notice of the Engineer the details of his proposed date of commencement of the work. If so, required by the Engineer, the Contractor shall provide safety fencing and obtain the specific advance permission of Engineer to commence the work.

1.7.2 The fencing shall be decided by engineer suiting local conditions of traffic.

1.7.3 The Contractor shall maintain the safety fencing in good working condition the period till the work in a given stretch is completed. He can remove the fencing after getting the approval of Engineer. The fencing material will be the property of the Contractor. Serviceable materials obtained from the released fencing can be re-used for providing fencing in subsequent stretches.

1.7.4 Fencing shall bear Details of the work like name of executing agency, contractor and work etc. painted as per employer's requirements.

1.7.5 The Contractor shall post look out men (**Minimum 02 men per shift per work site)**on National Highway on either side of the work location.

1.7.6 The Contractor will be paid separately for installation of fencing under this clause as per the relevant items in RVNL/USSOR/ CPWD/ DSR/ MoRTH SOR.

1.8 Protection of Environment

1.8.1 During execution of works, the Contractor, his sub-contractors and petty contractors shall abide at all times by all existing enactments on environmental protection and rules made there under, regulations, notifications and bye-laws of the State or Central Government or local authorities and any other law, bye-law, regulation that may be issued in this respect in

future by the State or Central Government or local authority. Some of the most relevant laws that are currently in force and are applicable in the subject contract are listed below: -

1.8.1.1 The Forest Act 1927;
1.8.1.2 The Forest (Conservation) Act 1980;
1.8.1.3 The Wildlife (Protection) Act 1972;
1.8.1.4 National Wildlife Action Plan 1983;
1.8.1.5 National Conservation Strategy 1992;
1.8.1.6 National Forest Policy, 1988;
1.8.1.7 The Water (Prevention and Control of Pollution) Act, 1974;
1.8.1.8 The Air (Prevention and Control of Pollution) Act, 1981;
1.8.1.9 The Environment (Protection) Act, 1986;
1.8.1.10 The Public Liability Insurance Act, 1991.

1.8.2 The last-named Act provides for public liability insurance for the purpose of providing immediate relief to persons affected by accidents occurring while handling hazardous substances and for matters connected therewith or incidental thereto. Hazardous substance means any substance or preparation which is defined as hazardous substance under the Environment (Protection) Act, 1986, and exceeding such quantity as may be specified by notification by the Central Government.

1.8.3 Protection of Trees: The Contractor must organize his work in such a way that the ecology of the area is not affected. The work area is located mostly in forest land. The Contractor and his men are prohibited from cutting any trees. Contractor shall provide assistance to the forest official in cutting of trees. Unauthorized felling of trees will result in legal action being taken under the relevant laws for which the Contractor shall be responsible.

1.8.4 Environmental Impact Assessment (EIA) and Environment Management Plan (EMP): Provision has been made in the subject contract for continuous monitoring and assessment of the impact of the project on the local ecology. For implementation of EIA Monitoring Plan, **items have been included in the Bill of quantities for execution by the Contractor**.

1.9 Safety and Environmental Protection in Tunnel Works

1.9.1 Tunneling being a hazardous operation, observance of safety precautions and compliance with the concerned safety codes and legal provisions are essential. The detailed provisions in this regardare detailed in the concerned Indian Standard Safety Codes, Codes of Practices and Acts of the Central Government. The Contractor shall carry out the tunneling operations with strict compliance to the provisions therein.

1.9.2 The various operations involved in tunneling works, such as drilling, blasting, excavating, mucking, other movements of heavy construction machinery etc. could also cause heavy damage to the environment. The damage could be to air, sub-soil water, natural streams and to flora and fauna, due to causes such as production of dust, fumes, vapors, gases, fibers, and due to noise pollution. Contractor shall ensure to take appropriate preventive measures to keep environmental damages to the minimum.

1.10 Indemnity by Contractor

1.10.1 The Contractor shall indemnify and save harmless the Railway / Employer / Engineer from and against all actions, suit proceedings, losses, costs, damages, claims, and demands of every nature and description brought or recovered against the Railways / Employer / Engineer by reason of any act or omission of the contractor, his agents or employees, in the execution of the works or in his guarding the same. All sums payable by way of compensation under any of these conditions shall be considered as reasonable compensation to be applied to the actual loss or damage sustained, and whether or not any damage shall have been sustained.

Chapter – 2

General Information and Scope of work

2.0 SCOPE OF WORK

2.1 Introduction

This work is part of 125 km new Broad Gauge (BG) railway line between Rishikesh and Karnprayag and pertains to Construction of Tunnels , Bridges and Formation Works fromchainage91+228to 101+339 (FLS)under Package–7Ain State of Uttarakhand, India.

The new Broad Gauge (BG) Railway line between Rishikesh and Karnprayag is a very important development project undertaken by Ministry of Railway. The purpose of providing Rail link between Rishikesh and Karnprayag is for facilitating easy access to pilgrimage centre situated in the state of Uttarakhand, connecting new trade centre, development of backward areas and to serve the population living in the area. The entire length of the new line falls in Garhwal Himalayan range. The proposed alignment from Rishikesh to Karnprayag lies between Longitude $78^0$15'E to $79^0$15'E and Latitude $30^0$05'N to $30^0$20'N and passes through 5 districts i.e. Dehradun, Tehri Garhwal, Garhwal, Rudraprayag and Chamoli in the state of Uttarakhand. The railway line traverses very rugged Himalayan terrain, with the alignment oriented across and sometimes sub parallel to the major thrust zones of Himalaya with complex geological conditions.

Total length of the new Single BG electrified line is 125kms and comprises of 17 tunnels, 16 Major Railway bridges and 12 new stations. National highway NH-58 connecting Ghaziabad in Uttar Pradesh to Mana in Uttarakhand runs along the proposed project meeting at important places like Shivpuri, Guller,Byasi, Kaudiyala, Lachmoli, Maletha, Srinagar, Dhari Devi, Tilani, Gholtir, Gaucher and Karanprayag.

2.2 Scope of Present Tender

2.2.1 The scope of this tender comprises of following components:

(1) Construction of Tunnels T-13Main (Finished area approx. 45sqm.) and Parallel Escape (Finished area approx. 18 sqm.) Tunnels each(9381.00m Long from 91+259 to 100+640) part of loop lines inside tunnels In yards, with NATM Methodology.

(2) Construction of two box culverts are involved in the Tilani Station Yard at Km 101+150, Km 101+185.

(3) Earthwork in formation (cutting and filling) in all kinds of soils/rocks between Km 100+640 to 101+388 in Tilani Station Yard.

(4) Slope Stabilization and Slope Protection as per site requirement.

(5) Construction of 50m Adit at junction of Main and Escape Tunnel with Adit7.

(6) Construction of Final lining of Adit-7(which is under construction by separate agency).

(7) Construction of Niches, layby, Technical rooms connecting MT and ET.

(8) Construction and maintenance of the access roads to Tunnel Portals and work sites.

(9) Construction of Site office Facilities including Furnishing items for use of RVNL and Consultant.

(10) Delivery and use of web-based Project Management Information System.

(11) Any other incidental/ancillary works required for completion for work as directed by Engineer-in-charge.

2.2.2 Salient features of the works in this tender are as under:

S.N.	Description	Narkota Nala Bridge to Tilani Part Yard
1	Length of Section	10.160kms (91+228 Kmto 101+388 km)
2	Ruling Gradient	1 in 80 (C)
3	Degree of curvature	2.5 Degree Maximum
4	Major Bridges	Nil
5	Box Culvert	02Nos.
6	Stations	Part Tilani Yard
7	No. of Junction Station	NIL
8	Level Crossings	NIL
9	Loading Standard	25 Tonnes axle load of 2008

2.3 Project Components:

A. Formation

Earthwork in formation in embankments and cuttings, laying of a blanket layer as per RDSO guidelines. The top width of formation in embankment and cutting shall normally be 7.85m in straight and 8.00m on curves. Side slope in embankment will be 2(H):1(V) and in cutting will be as under (or as determined according to slope stability calculations):

	H: V
(i) Hard rock	¼: 1
(ii) Soft rock	¼: 1
(iii) Moorum/Hard soil/Ordinary soil	1: 1

Mainly muck from underground excavation will be used in filling of embankments. Before filling of muck, ground surface with steep slopes shall be suitably benched to ensure proper compaction in layers. Segregation of huge size boulders/Rock more than 30 cm in size will be required to be done and generally not used in embankment. On top part of embankment filling, suitable sub-grade and Blanket layer shall be provided and compacted. Embankment filling and preparation upto formation will be done in accordance with RDSO Guidelines for Earthwork in Railway Projects (GE:G–1, July 2003) and RDSO Guidelines and Specification for Rationalisation of formation layer thickness on Indian Railway Track RDSO/2018/GE:IRS-0004 (D) Part-IV dated July 2019 with upto date correction slips.

B. BRIDGES

There is only Two box culverts are involved in the Tilani Station Yard at Km 101+150, Km 101+185.

C. TUNNELS

a) **Shape:** All Tunnels are of Horseshoe shape. Main Tunnel has finished Cross Section area of approx.45 sqm and Escape Tunnel of approx. 18 sq. Detail Design and PMC Consultant is in place and Detailed Design and Drawings will be provided by RVNL. The Tender drawings attached are only for guidance and RVNL may change the cross section, shape and size to suit actual site conditions and functional requirements. In this tunnel there is single track line. Drawings of tunnel dimensions and layout are made available **in Vol-III.**

b) **Geology:** Detailed Geological, Geophysical studies and Geo-technical investigation have been carried along the proposed alignment. The area is essentially of metavolcanics quartzite with subordinate purple phyllite and basic metavolcanics rocks comprising of Nagnithank of Garhwal Group, at Tunnel T-13.

Detailed Geotechnical Baseline report is attached in Vol III.

c) **Methods:** Drill and Blast with Observation methodology (NATM) shall be adopted for tunnel construction through instrumentation& 3D monitoring. The Details of underground excavation and support classification is given in Sub-chapter 8 of Annexure-A (Technical Specification for Tunneling)of Work Requirements of the bid document. Excavation sequence shall be cyclic with immediate installation of support according to ground classification.

d) **Adit Tunnels**: One separate Adit tunnel of Horseshoe shape having finished dimension of 7m carriageway (Excluding Drains) and 7m clear height are under construction upto 50m short of Junction with the Main Tunnel. Tunnel T-13 has one 680m long adit connecting at 94+445 km. Adit is being developed to support two-way traffic of Tunnel machineries for execution of this work. Drawings of adit tunnel dimensions and layout is made available **in Vol-III.** Salient details of adits are as under:

Adit No.	Length (Meters	Start location	Chainage at Junction	Level at Junction	Approximate slope
A-7	680	On NH-58 at Jawari bypass nearby Rudraprayag (640 AMSL)	94+445.380	670.148	1:23 (Self–Draining towards exit)

Adit No.	Length (Meters)	FROM (UTM 44N, AMSL in m)			TO (UTM 44N, AMSL in m)		
		X	Y	Z	X	Y	Z
A-7	680	303887	3350780	640	304280	3350235	670.148

e) **Main and Escape Tunnels**: The Main and Escape Tunnel are parallel with Centre to Centre distance of approx. 25m interconnected with Cross passages spaced at every approx. 350m.The profile and longitudinal sections of the tunnels is made available **in Vol-III.** Details of main tunnels is as under:

Tunnel No.	Length (Meters)	From		To	
		Project Chainage	Level (AMSL)	Project Chainage	Level (AMSL)
13	9381.00	91+259	693.53	100+640	708

Tunnel No.	Length (Meters)	FROM (UTM 44N, AMSL in m)			TO (UTM 44N, AMSL in m)		
		X	Y	Z	X	Y	Z
13	9381	301308	3349248	693.53	309597	3353400	708

f) Access Roads to sites:

Details of access Roads for Tunnel 13are as follows:

Portal T13P1: Portal-1 of T-13 are well connected to NH. Railway Alignment is crossing the existing NH-58 alignment at Narkota Nala location, which will require temporary NH diversion at this location. NH PWD is constructing permanent NH diversion at separate location. To start the construction work of Bridge-12, existing NH bridge (span approx. 20m with RCC abutment) shall be dismantled. Therefore, one temporary NH diversion shall be constructed to regulate the regular traffic. Temporary diversion will require suitable Hume pipe temporary bridge.

Adit-7 of T-13: Approach road of approx. length 100 m to portal of adit-6A is being constructed by the separate agency. Road shall be bituminous road.

Portal T13P2: Portal-2 of Tunnel-13 opens at Tilani Station Yard, which is just beside the NH-58. It will require constructing approx. 100 m road to enter the right of way of Railway Land.

Total length of road required be constructing and maintaining for Tunnel 13 portal-1&2and Adit-07 will be 200m approximately.

D. Stations

There is one Stations yard, part of which is in the scope of this work.

S.N.	Station Yards	Length (Meters)	From		Rail Level(m)
			Starting Chainage	End Chainage	
1	Tilani	1223	100+485	101+650	708

Part portion of Tilani Yard is outside Tunnels. In this part portion Cutting and Filling of existing ground will be done as per detailed Construction Drawings for Development of Yard and Station Areas.

Part portion of Tilani Yard is inside Tunnel – 13 (Portal -2) and Tunnel – 14 (Portal – 1) respectively and size of tunnels will vary depending upon number of yard tracks inside tunnel as well as depending on geological condition. Approximately 128 m of tilani yard is inside Tunnel - 13 at Portal – 2 and approximately 155 m of tilani yard is inside Tunnel – 14. However, **part yard in tunnel-14 is not in this scope of work.** This scope of work also includes formation work which required cutting and filling to achieve the desired formation level. Cross section area and excavation area of tunnels will be enlarged at these locations to accommodate the yard as well as turnouts also. Cross sections details of Portals shall be provided before the start of construction work activities. Tentative tunnel cross sections and yard plans are available in **Vol. III**.

E. Muck Dumping Locations

Employer has already acquired land required for dumping of muck to be generated from tunnel excavation at suitable locations. All sites are located within 10km lead of the tunnel Portals. Site maps for all muck dumping grounds are shown in bid drawings in **Vol. III**. Brief details are as follows: -

Ground ID	Available Muck dumping capacity	Muck Dumping Location	Suitable for	Distance (Kms)
D27 (NH)	3,52,000.00 cum.	At Narkota Village	T13-P-1	At Tunnel-13 Portal-1 location
D27 (NH)	3,52,000.00 cum.	At Narkota Village	Adit-7 Portal	At 8 km fromadit portalPortal location.
D-28* (NH)	7,69,280.00 cum	Nearby Tilani Yard	T-13-P-2	At Portal Location Only.

*This dumping ground would be shared between T13 and T14.

Details of access Roads for Muck Dumping Zone D-27 are as follows:

Muck Dumping Yard (D-27) is located at Narkota Location. This dumping yard is accessible through NH-58. No additional approach road is required to access this dumping zone. At Adit-7 portal location, there is space for muck dumping, muck generated from this adit portal shall be dumped in this dumping yard only.

Details of access Roads for Muck Dumping Zone D-28 are as follows:

Muck Dumping Yard (D-28) is located nearby Tilani Yard station.This dumping yard is accessible through NH-58. No additional approach road is required to access this dumping zone.

F. Records

a) Photo records of construction work:

1) The Contractor is required to take and supply to the Engineer coloured photographs on construction activities. The digital photographs shall be taken by the Contractor of all the construction activities pertaining to the work at regular intervals as directed by the Engineer. All photos shall be provided to the Engineer in digital forms. Three sets 5” X 3” prints of each snap shall be supplied. The quantum shall involve a minimum of 300 snaps. Out of the above the Contractor shall be required to supply as directed by the Engineer, blow up size coloured prints of upto 36” X 24” size of 30 photographs. The soft copy of all the photographs taken shall also be supplied to the Engineer. The Contractor shall show extreme promptness in taking and supplying the photographs on the action of the Engineer.
2) The Contractor shall keep a record of the construction activities on the site(s) by having DVD/VCD. This shall be having script approved by the Engineer and shall have suitable editing, background music and with special effects so as to have a final 45 minutes to 60 minutes (or as directed by the Engineer) version of the CD giving the details of the construction activities right from the beginning to the end for construction site. Employer shall be supplied the master copy of the above documentary.

3) All the cost of reels & CD, taking and recording, developing and printing extra shall be deemed to have been included in rates quoted against various items and nothing extra shall be paid for the item of work under this Clause as above.
4) Employer shall have full ownership and copyright of all the photographs, Video, CD and the Contractor shall indemnify Employer against any claim of any sort.

b) Time records for all underground excavation activities: The Contractor shall depute dedicated staff on each tunnel excavation face/portal to log time for various activities in each cycle. The record shall be mutually signed by both contractor and Engineer after completion of each shift. Contractor shall digitize all time logs so generated and deliver the same on a weekly basis to the employer in soft and hard formats (Signed).

2.4 The contemplated works as a part of this tender consists of --

(a) Construction of MainTunnel, Escape Tunnel and AditTunnels and other associated structures including construction of permanent lining, portals etc as per approved drawings.

(b) Muck dumping site management.

(c) Construction of Minor Bridges/Box Culvert& ROB.

(d) Providing and maintaining office accommodation and vehicles for use of Employer and their Assistants and Staff.

(e) Survey for fixing the working alignment and establishment of working bench marks for works.

(f) Earth Work in formation in banks with suitable filling / blanketing material.

(g) Protection and Drainage works for all bridges and open area in cutting and filling.

(h) Setting of batching plant for production of controlled concrete.

(i) Setting out alignments and levels and marking of locations for works.

(j) Making and supply of ‘As Built” drawings of all the assets created.

(k) Construction and Maintenance of the approach roads to the works.

(l) Providing all temporary ventilation, lighting, pumping of water etc during construction in tunnels

(m) Developing web-based Project Management Information System

(n) Provision and maintenance of quality control laboratory at site near office accommodation.

(o) Environment and pollution management works including monitoring.

2.5 The **Nature of work:**

The works to be executed is mainly civil works pertaining to construction of tunnels, bridges, formations and associated works.

2.6 Some Special stipulations/features:

Civil Work

2.6.1 While planning for the work of transportation of Tunnel/bridge construction materials to the site., the finished formation of earth work in banks and cuttings with or without blanket layer should not be generally used for plying of trucks or other vehicles used for transportation. This restriction has specially been imposed to save the top surface of the formed formation from forming pits and ruts, which later are likely to accumulate water and pose problems for maintenance.

2.6.2 The mechanical means required to meet the stipulations mentioned in the above sub Para should be arranged by the Contractor.

2.6.3 Railway land, if available and spareable, shall be provided for the purpose ofstacking of material and setting up of concrete batching plant, etc. However, the Contractor shall be responsible for arranging any such requirement of land and arranging/developing any required approach to site of work, etc.**at his own cost**.

2.6.4 The Contractor shall be required to mobilize resources for taking up work at a number of locations simultaneously. A tentative scheduling of major activities is given in Form MET-3 of Section-4 Bidding Forms. The planning of resources has to be done to meetthese requirements.

2.6.5 If Suitable/preferred type of soil for embankment is not available in close proximity of the proposed new line, thenthe bidder may ascertain availability and lead/lift involved before quoting his rates.

Track Laying & Linking

2.6.6 No track linking works are contemplated through subject work.

S & T Work

2.6.7 No S & T works are contemplated through subject work. However, making provision and installation of fixtures as per approved drawings and civil works related to S & T Works will be in scope of subject work.

OHE work

2.6.8 No OHE & General Electrification works are contemplated through subject work. However, making provision and installation of fixtures and civil works related to OHE/E&M/General Electric and other systems will be in scope of subject work.

2.7 Codes & Specifications

2.7.1 General

Wherever reference is made in the Contract to specific standards and codes to be met by the goods and materials to be furnished and work performed or tested the provisions of the **latest current edition or revision of the relevant standards and codes in effect shall apply,** unless otherwise expressly stated in the Contract. Where such standards and codes are national or relate to a particular country or region, other authoritative standards, which ensure an equal or higher quality than the standards, and codes specified will be accepted subject to the Engineer's prior review and written approval. Differences between the

standards specified and the proposed alternative standards must be fully described in writing by the Contractor and submitted to the Engineer at least 28 days prior to the date when the Contractor desires the Engineer's approval. In the event the Engineer determines that such proposed deviations do not ensure equal or higher quality, the Contractor shall comply with the standards specified in the documents.

All goods and materials to be incorporated in the goods be new, unused, and of the most recent or current models, and that they incorporate all recent improvements in design and materials unless provided for otherwise in the contract.

(a) The specifications mentioned in these specifications shall be prime governing.

(b) Where there is conflict between provision in IRS & IS specifications, provisions in IRS specifications shall prevail.

(c) Where there is no provision of specifications in IRS, provisions in IS specifications should be adopted. Where there are no provisions in IRS and IS Specifications, provisions in IRC Specifications should be followed.

(d) For items not covered in IRS/IS/IRC specifications, BS-5400 Part 1 to 10 may also be considered.

(e) Where applicable CEB/FIP recommendations and codes of practices shall be used if specific recommendation does not exist in IRS/IRC/BS specifications.

(f) The decision of Engineer shall be final and binding in the interpretation of the clause of the codes of practice and specifications of this tender and no claim whatsoever shall be entertained on this account from the Contractor.

2.8 Survey and fixing working Benchmarks and alignment markers.

2.8.1 The work of conducting survey and fixing benchmarks and alignment markers before the start of any work on this tender is included in the scope of works covered by the present Tender.

2.9 <u>Benchmarks and Alignment Marker:</u>

2.9.1 All along the length of the proposed New Line benchmarks have been set up by the Employer at intervals of about 5 kilometers. The details of these benchmarks along with their reduced levels have been marked on the design drawings indicating the plan and 'L' section which form a part of the tender. The contractor along with the Engineer should verify the details of these benchmarks in the first instance, soon after taking possession of the site. If any mistakes are detected in these details of these bench marks the same should be indicated to the Engineer. The mistakes detected should be corrected in consultation with the Engineer. These corrections should be got approved by the Engineer before starting of any other work.

2.9.2 The contractor shall then in presence of the Engineer establish working benchmarks at short intervals, adequately connecting them to the reference benchmarks set up by the Employer in the Project length. The working benchmark levels should be got approved from the Engineer. An up to date record of all benchmarks including approved corrections if any, shall be maintained by the contractor and also the Engineer.

2.9.3 All levels taken for making out the longitudinal section and cross section should be related only to these working benchmarks.

2.9.4 While doing the above-mentioned work, the fact that similar work will have to be done once again on the completed earth work in formation, Tunnels and Bridges for fixing up the longitudinal levels of the installed P. Way should be kept in view.

2.9.5 After the formation and bridges have been constructed, the centre line of alignment of both in Block Sections at either end should be refixed taking guidance from already set up alignment references. Similarly, the rail levels of track both in the block sections and the yards should also be fixed with reference markers. These will be used for installation of track by another agency.

2.9.6 Before start of any construction work at site, the contractor shall mark on ground with permanent pillars the alignment of the Station yards in presence of the Engineer. The markings shall also be checked by team of contractor and engineer of adjoining package. Employer will allow start of work after mutual agreement of contractor and engineer of both adjoining packages concerned to a particular yard.

2.10 DELETED

2.11 Responsibility for establishing and maintaining working benchmarks and alignment markers

2.11.1 The Engineer when necessary will provide the contractor with the data necessary for setting out of the centerline. All dimensions and levels shown on the drawing or mentioned in the documents forming part of or issued under the contract shall be verified by the contractor on the site; he shall immediately inform the Engineer of any apparent errors or discrepancies **noticed in such dimensions or levels. In consultation with the Engineer, the noticed mistakes** should be corrected. These corrections should have the approval of the Engineer.

2.11.2 The contractor will be entirely responsible for accurate setting out of the works and safeguarding all survey monuments, benchmarks, alignment references etc. The work of setting out shall be deemed to be a part of the general works preparatory to the execution of work and no separate payment shall be made for the same.

2.11.3 The above-mentioned points have been repeated in the respective sections dealing with specifications for different works for laying emphasis on these items.

2.12 Deleted

2.13 Damages to property:

The contractor shall organize all his activities so as not to cause any damage to the property of Railway or that of other agencies or any third party. In spite of taking all precautions, in the unfortunate event of any damage to the property, then the contractor shall not only indemnify the Employer of the claims made by the affected parties but also settle the matters with the affected parties as per law. If the nature of damage is one of that affecting the road traffic movements or causing a safety hazard to the public, then the situation will be treated as an emergency and the Engineer reserves the right to take all necessary steps as deemed necessary to restore train operations or to remove the hazardous situation or to mitigate the damage, at the risk and cost of the contractor.

2.14 Tentative scheduling of major works:

Completion period of Work has been divided into one**Section** as defined in the Section 7A:Contract Data.The Milestones and their Key Dates for each Sectionare given in the Table Below along with respective sub activities. The contractor during submission of bid or subsequently during execution shall adhere tothe Milestones and their Key Datesdefined in

Table below. The contractorshallmobilize adequate resources to meet these milestone and completion periods of the **Section**.

Abbreviations:

T13 = Tunnel 13	A7= Adit-7	P1 = Portal 1 P2 = Portal 2	MT = Main Tunnel ET = Escape Tunnel	EM = Electromechanical contractor. BLT = Ballastless contractor.
KD= Sub Activities	**ML= Milestone**	P=Portal		

SECTION: 1 (Completion Period 54 Months)				
Activity ID	**Stage**	**Key Dates** (Month ending from date of commencement)	**Length (m)**	**Period (Months)**
ML01	**Excavation for Tunnel 13**	**43**	**9381**	
	Excavation from T13P1			
KD01-A	Slope stabilization and T13P1completed and ET excavation begins from T13P1 towardsA7	5		
KD01-B	Slope stabilization and T13P1completed and MT excavationfrom T13P1 towards A7 begins	6		
KD01-C	Breakthrough in ET from T13P1 direction	23		
KD01-D	Breakthrough in MT from T13P1 direction	17		
	Excavation from A7			
KD01-E	ET excavation begins fromA7 towards T13P2	6		
KD01-F	MT excavation begins fromA7 towards T13P2	7		
KD01-G	Breakthrough in ET towards T13P2 direction	23		
KD01-H	Breakthrough in MT towards T13P2 direction	35		
	Excavation from T13P2			
KD01-I	Slope stabilization and T13P2completed and ET excavation begins from T13P2 towardsA7	6		
KD01-J	Slope stabilization and T13P2completed and MT excavationfrom T3P2 towardsA7 begins	7		
KD01-K	Breakthrough in ET from T13P2 direction	24		
KD01-L	Breakthrough in ET from T13P2 direction	36		
ML02	**Final Lining of Tunnel-13 and Adit-7**	**54**	**9381**	
KD02-A	MT and ET lining complete	50		
KD02-B	MT and ET invert structure complete	52		
KD02-C	Handing over of MT to BLT	53		
KD02-D	Handing over of ET and Technical rooms to EM	54		
KD02-E	Adit 7 Lining and under-structure complete	55		
ML03	**Completion of Embankment upto Formation Level including slope stabilisation**	**18**		
KD04	From Km 101+640 to Km 101+388	18		

(Note: The key dates define the ending of activity (unless explicitly defined in description of the activity).

The monthly advance rates at maximum foreseen excavation drive lengths from any Tunnel portal according to tentative work's programme are as given below: -

Average Advance Rates required for tentative work's schedule		
	Monthly advance (in meters)	
Support Class	MT	ET
B1	250	390
B2	162	235
C1	143	214
C2	70	112
C3	40	66
P	32	43

The above time presents the required monthly advance considering all support measures required to be installed according to tunnel drawings. The monthly rates also include scheduled rests of 2 days per month. Above scheduling has been prepared considering two shifts in a day. The advance rates for 2 line and 3-line section are assumed after applying reducing factor of 2 and 3 to MT advance rates.

2.15 Survey Equipment

All survey shall be done with DGPS/Total Stations and high precision Auto levels. Inside tunnels, Tunnel cross section shall be measured with Tunnel laser profiler. The contractor should provide adequate number of survey equipment and other accessories as per the instructions of the Engineer as and when required. He should also provide all necessary help as required by the Engineer for checking the works, whenever required. He must also arrange for periodical calibrations. If he fails to do so within prescribed time, the equipment may be purchased by RVNL and cost recovered from Running bills. At regular interval (once every Kilometre of Tunnel) he shall get the tunnel alignment cross checked using precision equipment with gyro featureforwhich nothing extra shall be paid and deemed to be included in the quoted rates of BOQ.

2.16 Deleted.

2.17 Specific Aspects of the project

a) Entire works are located inRudraprayag districts in the state of Uttarakhand in vicinity of National highway 58. NH58 has been recently upgraded and widened to accommodate high traffic volume. The work area is in close vicinity to tourist attraction spots and care to environment is of paramount importance.

b) The portals of Tunnel T-13 are located betweenNarkotaNala and tilaniyard respectively. Adit7portalis located on National Highway 58 at Jawari bypass nearby Rudraprayag, between NarkotaNala and tilani yard . The chainage of tunnel works starts at km91+259 at tunnel portal-1 of Tunnel-13 and endsatkm100+640.

c) The area falls in seismic zone-IV of Indian standard seismic zoning map of the country. Climatic conditions from tropical to the sub-polar type prevail in the region. The area is influenced by the south-west monsoon. The monsoon commences early July and continues up to early September. Three months viz. April, May and June are the hottest months with average temperature of

28^0 C and highest temperature touching 40^0 C. December, January, February are the coldest months with average temperature of 13^0 C and minimum temperature touching 2-3^0 C. As per annual 5 years (2009 to 2013) average rainfall, as sourced from IMD, downpour in Dehradun is 1693 mm, Chamoli is 1102mm, Pauri Garhwal is 1068mm and Tehri Garhwal is 846 mm. High relative humidity occurs during the monsoon season and the maximum relative humidity is observed during July and August (95.5–99.2%).

d) Vehicles carrying material and machinery for construction of works will pass through Rishikesh, which has severe capacity constraints and will become a bottleneck when entire project is in full swing. Traffic movement may be restricted during daytime through Rishikesh city.

e) Every year during the months of June to August, heavy tourist rush is observed. During monsoon period, every year from July to September, traffic movement gets restricted due to temporary blockage of NH-58 on account of landslides. Therefore, contractors are advised to maintain higher reserves of critical materials during this period.

f) Mining of aggregates from river beds is banned every year generally around 1st July to 1st September in entire state of Uttarakhand. Contractor shall maintain and evidence buffer stock for all types of aggregates required in works for these 3 months every year on 15th June as per contractor's work program.

2.18 Other Provision:

2.18.1 Land:

a) Employer has acquired land required for construction of permanent works and Muck dumping zones. Necessary forest clearances and possession of entire land (Government, forest and Private) has been obtained. Contractor will be made available entire acquired land for construction of permanent works. All acquired area are shown in drawings included Vol. III.

b) Land made available to contractor is to be concurrently used for dumping of muck from open or underground excavations and is therefore limited. Any additional land required by contractor for sitting labour camps, site offices and workshop/laboratory etc. at work site shall be arranged by Contractor/s at his/their own cost and the contractor shall have no claim on this account.

c) Acquired land at **Tunnel T-13,P-1** is limited and can't be used for material storage or for major site installation or parking huge number of Tunneling equipments. Acquired land at tunnel portal-2 at tilani yard is also limited. Whole tilani yard is in cutting to get desired formation level and land is required to be developed by cutting and slope stabilization. Contractor is advised to visit site and explore the possibility of land for major site installation and parking of heavy vehicle nearby portals locations. Land if available at railway land will be made available to the contractor for establishment of site installations as per time for access to site given in Contract Data (GCC 2.1).

d) Contractor should factor in above mentioned limitations while programming his work during bid submission and subsequently also during execution. No

claim on account of non-availability of adequate land for installation of site facilities will be entertained during execution of works.

e) Precautions to be taken while working near the forest Area:

(i) No labour camps should be established in Forest Land outside right of way.
(ii) Alternative fuel other than firewood should be provided by Contractor to his labour engaged during construction.
(iii) It should be ensured that no damage is caused to wildlife.
(iv) Forest land shall not be used for any other purposed other than authorized.
(v) No tress shall be cut anywhere without proper authority.
(vi) No littering or throwing garbage should be done in forest area.
(vii) If any unauthorized persons are noticed, the same may be informed to the concerned authority.
(viii) During embankment, the roots if any uprooted should be stacked and handed over to the forest dept.
(ix) All the labour should be counselled about the precautions to be taken while working in forest land.

2.18.2 Water supply

Water for drinking and for the construction of works may be scarce in the project area. The Contractor shall make reliable arrangements for suitable water supply at his own cost.

2.18.3 Treatment of Tunnel effluents

The water collected at portals of Main Tunnel, Escape tunnel or Adits must be treated before discharge into the river/stream in accordance with Environmental regulations and norms of State pollution control board etc.
The available areas for positioning water treatment tanks is limited at the portal-1&2 of Tunnel-13 & Adit-7. For this reason, the Contractor shall also realize small tanks at portal areas and appropriate pumping system (chosen by the contractor and approved by the Engineer) in order to transfer the water to the water treatment tanks that will be placed at suitable areas. Nothing extra shall be paid for construction of these temporary treatment plants or for pumping of Tunnel effluents from Tunnel portals to such plants.

2.18.4 Power supply

The Contractor shall make his own arrangements for all electric power supply requirements for the work at his own cost and the rates quoted shall deemed to include the cost of providing such electric supply arrangements required for the works and offices/accommodations etc. All diesel generating sets shall conform to environmental norms and related noise and emission reduction according to local pollution board norms.

Whenever excavation proceeds more than 2 kms from any portal then contractor will be required to install booster ventilation fans to enhance ventilation capacity and install LT lines to reduce transmission loss over long lengths if other methods are not effective, for which nothing extra shall be paid.

2.18.5 Material Stocks:

a) Contractor is required to maintain and stock not less than one-month buffer stock of critical materials like all types of aggregates, cements, Rock bolts, Rebars, Steel sections etc which are critical to tunneling activity. The **critical levels** of buffer stocks shall be decided by the Engineer according to work's program submitted by contractor. Over and above this minimum buffer stock, adequate working stock shall be maintained at site for smooth execution of works.

b) The contractor shall inform the Engineer the expected lead times for all materials required for permanent works to arrive at site from the placement of purchase order.

c) Contractor will maintain and inform to the engineer, stock levels of critical materials available at site on a weekly basis and evidence the placement of purchase order at direction of engineer, as soon as buffer stock at site falls below required critical levels.

d) **For imported materials and equipment**: The contractor shall inform the Engineer the list of all imported materials and equipment being procured by him, before placing such purchase orders.

e) Conditions of this clause shall not be applicable when the work is towards closure.

2.18.6 Access Roads:

a) The Contractor has to construct and maintain all access roads for access to Tunnel/Adit portals/Bridges or muck dumping grounds, which may require up-gradation, strengthening, execution of protection works. Upon completion of work, part of developed access roads which will become part of permanent works may require finishing with black topping and reinstated in good road-worthy-condition with proper drainage, cross drainage, protection works & parapet wall including proper road sign etc wherever required/directed by the Engineer. Land for construction of all access roads has been acquired by Employer. Contractor is obliged to construct these roads through the Right of way only. Detail diagram is available in the Bid document in Vol.III.

b) **Scope of works for maintenance**:

(i) Contractor should maintain the existing and newly constructed access roads as required above, including pot holes filling, regularly grading with grader in required profile, watering, rolling, compacting, maintaining the grade and profile of the roads with contractor's labour, tools, plants, material, all lead and lift, loading, unloading, transportation of materials, complete as per directions of Engineer-in-charge for smooth movement of Inspection vehicles and also construction equipment & heavily loaded trucks and trailers carrying equipment and materials.

(ii) Regular sprinkling of water by mechanical means to ensure dust free, movement of vehicles to meet the requirement of safety & environmental norms shall be the responsibility of Tunnel Contractor.

(iii) Maintenance and cleaning of roadside drains is also covered in the scope of Tunnel contractor at their own cost.

(iv) **Apart from any urgent maintenance of road surface, scheduled maintenance will be done atleast twice every month and witnessed by Engineer.**

c) **Payment of constructing and maintaining access roads:**

Contractor shall be paid separately as per relevant item of BOQ for construction and maintenance of all access roads required to be developed for access to Tunnel/Adit portals/Bridges or muck dumping grounds till completion of works.

Contractor shall be responsible for construction and maintenance of any other internal or access roads apart from the access roads specifically defined in Chapter 2 of Section:5 Works Requirement(Clause 2.3 C(f) &2.3(E)), for which nothing extra shall be payable to contractor.

2.18.7 Functional requirements:

a) For Tunnel No.-12, excavation shall be done concurrently atleast from Portal 1 direction and in one directions from Adit A6A Junction and from Portal 2.

b) In addition to other special conditions and specifications, the minimum functional requirements to meet the schedule are:-

(i) The proposed selection of Equipment, like tunneling excavators, loaders etc shall meet the required high-performance rates. Proven machine types and models with rock cutting/handling capacity as per the tunnel cross section and drive lengths only shall be deployed.

(ii) Considering the requirement of high progress and shorter cycle time, special tunnelling excavators are considered essential. These shall be equipped with quick-change devices for fast switch over of various attachments i.e ripping bucket, normal bucket, rock breaker and working platform etc.

(iii) Properly designed transportation logistics for heavy requirements of muck removal, feeding of lattice girders, shotcrete, concrete and other construction material at tunnel excavation and lining locations.

(iv) Movements of heavy excavation equipment, boomer, shotcrete robots etc. as a part of overall logistics.

(v) In weak geology, Excavation of cross passages shall not be done without approval of Engineer and till ground movement stabilises. All cross passages and Niches required to be constructed are detailed in Tunnel Schematic plan attached as tender drawings. Actual location may vary depending upon ground conditions. Any additional niche required for logistics may be constructed at appropriate locations approved by the Engineer. **These will be paid over and above prescribed scope of work under relevant items of BOQ according to class of support installation and numbers of such niches will be mutually decided in agreement with the Engineer.** However, the contractor shall have no claim upon rejection of his request.

(vi) Lining work along Main Tunnel has to be carried out concurrently with excavation of Main Tunnel and finished as per the milestones mentioned above. Proper logistics for enabling these activities like properly designed formwork and movable gantry permitting vehicular movement, Invert

Bridge etc will be required. Contractor shall prepare and submit design and drawings of Movable gantry for final lining works to engineer for approval.

(vii) Cross passages and Escape Tunnel may be preferably kept unlined until excavation works of Main tunnel are completed, to enable movement of vehicles from Main Tunnel to Escape Tunnel and vice versa as Main Tunnel may have access restriction during execution of Lining or other works.

(viii) Ventilation ducts may require shifting through cross passage to escape tunnel and vice versa in the portion of Main Tunnel due to space restriction during execution of Lining or other works.

2.18.8 Project Management Information System (PMIS)

The Contractor shall be required to develop, deliver and use a web-based GIS and real-time Data Management Project Platform. The cost of this is deemed to be included in quoted rates in BOQ. The web-based GIS and real-time Data Management Project Platform shall be tailored to cover the following aspects of construction progress at site at Contractor's cost:

- Cloud-based DMS (Document Management System) for uploading and sharing all kind of documents, deliverables, photos and videos
- GIS (Geographic Information System) platform to present online and georeferenced the main performed works and all collected information
- Day-by-day information flow
- Drawing management (incl. approval workflow and versioning)
- Correspondence management of Contractor/Engineer/Owner
- Schedule controlling, including the time-location diagram covering all project works (with comparison of planned vs. real)
- Cost controlling (BOQ item wise)
- Progress of works, quantities & performances (as-built data management)
- QA/QC reporting, includingNon Conformities Report
- Instrumentation / 3D Monitoring data management
- Geological and investigation data management
- Excavation data management
- Advanced site data processing facilities
- Interface and deliverables organized according to the WBS of the package
- Any other deliverable as desired by the Engineer

a) The Project Platform must provide integrated processing, numerical and graphical representation features for all data mentioned above.

b) The Contractor shall include in his cost, the cost of such software (i.e., **One-time fee** for providing RVNL Project Platform which includes licenses, implementation, installation, setup, training courses and **Annual fee** for use, maintenance and support of the RVNL Project Platform during Contract duration) able to handle 50 online users (for Client, Consultants, Site Supervisors, , Geologists and other project stakeholders), and the cost of all related hardware and services.

c) The Contractor shall be required to deliver Project Platform within 3 months from the date of issue of LOA. The Contractor shall give certificate from the Owner of the project for the

such software platform having being used or presently in use in tunnel construction projects successfully.

d) The Contractor shall also include the cost of a Project Platform Coordinator (graduate with 5-year experience in handling IT software), who will coordinate the use and operation of the Platform and fulfill the deadline of providing the data required by the Client on a regular basis. The primary information input shall be provided by tunnel engineer / surveyors/ supervisors / foremen/ geologist / etc of the Contractor under the coordination of the Project Platform Coordinator. On behalf of the Employer there will be a General Coordinator for all THE Contracts if required.

The contractor of different tunnel packages may propose different web-based GIS and real-time Data management project platform. However, the platform should have capability for comprehensive use for individual package as well as for entire project. Server shall be maintained at Rishikesh or in Delhi/NCR. Each contractor will have to purchase and install all necessary licenses of the web-based GIS and real-time Data management project platform and will tailor it to suit the above scheduling, monitoring and reporting requirements. All data and deliverables will be uploaded onto the RVNL Project Platform in timely manner in agreement with and as per direction of General Coordinator/RVNL and thus make available data online to every authorized user.

Chapter – 3

3.0 Site Facilities for the Employer and the Engineer

3.1 GENERAL

The Contractor shall provide for the use of the Employer / Engineer office accommodation, equipment, communication & drawing facilities throughout the course of the work and for such period of time during the defects liability period as the employer & Engineer may require, The details of the accommodation & the other facilities are detailed below: All the facilities under this chapter will continue to be maintained by the Contractor free of cost till the defect liability period is over. Thereafter the Contractor shall dismantle the building and take away all the materials, office furniture, & equipment etc. which will be the property of the Contractor. The provision of such facilities as included in para 3.2 to para 3.7 and its sub para's shall be paid for separately as per the rates in the agreement under the relevant BOQ

3.1.1 ORGANIZATION OF THE ENGINEER:

The Detailed Design and Project Management Consultant has already been appointed for control of the works.

During construction following personnel of PMC shall be posted at site:
Key Personnel (Expats): Project Manager, Foreman - Tunnel Construction, Resident Geotechnical Engineer, Resident Alignment & 3D Monitoring Engineer, Resident E&M Engineer, Resident Geologist.

Key Personnel (National): Resident Engineer (Civil)-Tunnel, Resident Engineer (Civil)-Bridges, Expert - Safety, Health & Environment, Expert - Contract Management.

Supervisors (National): Supervisor – Civil Engineer (Tunnel Construction)(6), Supervisor – Civil Engineer (Bridge)(2), Supervisor – Geologist(3), Supervisor - Surveyor cum 3D Monitoring(3), Supervisor - Civil Engineer (Quantity Surveyor), Supervisor - Material/ Laboratory, Supervisor - Electrical (E&M), Supervisor – Electrical (OHE).

Office staff (National): Computer Operator cum Stenographer (2), Clerk cum Record cum Storekeeper (2), Draftsman (Civil)(2), Accountant, Office Attendant(3)

In addition to this, Engineer's personnel responsible for detailed design will also visit the site intermittently.

3.2 SITE OFFICES

3.2.1 Accommodation for the Employer / Engineer shall consist of one site office to be constructed by the Contractor at a place decided by the Employer, within Two months from the date of commencement of the works. In case of delay beyond Two months in provision of the accommodation either through construction or hire, penalty @ Rs 10000/- Per week or part thereof will be imposed."

3.2.2 The site office should remain open for 24 hours a day and 7 days a week i.e. round the clock till the defect liability period is over.

3.2.3 Each Site Office will provide for the following rooms:

SITE OFFICE for Engineer/Employer to be constructed by Contractor	Area required (Sq. m)
Project Director of RVNL	12
Other Officers of RVNL @5 sqmt each (2no)	10
Team Leader (Project Manager)	12
Key Personnel (EXPATS)@ 8 sqmt each (6no.)	48
Key Personnel (National) @ 6 sqmt each (5no)	30
Non-Key personnel @ 4sqmt each (22no.)	88
Conference/ Visitor Room	25
Computer/ Drawing Office	12
Pantry & Kitchen area	8
File and Documents & Instruments Storage	10
Toilets	10
Total "A"	265 M^2
Common Area/Verandah @10% of "A" above	27 M^2
GRAND TOTAL	**292 M^2**

Note: PD may increase or decrease the area of accommodation to be provided at one or more number of locations and payment will be made as per actual measurement of plinth area. Nothing extra shall be paid if Verandah area more than 10% as detailed above is required.
Suitable parking with paver blocks for 50% of the number of vehicles shall be constructed and maintain next to site office. The area of parking will be over and above that mentioned in table above, for which nothing extra shall be paid.

3.2.4 Materials used for the construction of the offices shall be new and of good quality. Materials shall be chosen such that the buildings when erected shall give good ventilation, heat and sound insulation.

3.2.5 All buildings shall be supplied with continuous (24 hour) running potable cold water to the kitchens and washrooms. The toilets may use raw water for flushing. The Contractor shall also arrange for the constant and hygienic disposal of all effluent, sewage and rubbish from the buildings.

3.2.6 All buildings shall be supplied with electricity, AC 240 Voltage 50 Hz that shall be distributed to each room in accordance with the Regulations. Lighting and electrical power points shall be provided in each room. The disposition and location of light and power points will be as directed by the Engineer. 24 hours power supply is to be arranged by contractor to meet full power load. Fans and coolers etc. will be provided in all rooms except in Rooms for (i) Project Director of Employer (ii) Key Personnel of Consultant (iii) Conference/Visitor Room which shall be provided with Air Conditioners of appropriate capacity.

3.2.7 **Deleted**

3.2.8 Fire-fighting equipment shall be provided in accordance with the local recommendations.

3.2.9 **Deleted**

3.2.10 ***Scope of Work***:

The work consists of construction of temporary site office using precast cement concrete including Ferro-cement components or superior material.

I. Superstructure of Brick wall panels and roof panels (of I/C section) and R.C.C. columns /Steel Column and joists as per enclosed plans and drawing.
II. Construction of open foundation using plum concrete as per specifications and drawings (including excavation).
III. Suitable anchorage between superstructure and foundation, between roof panels and columns/joists.
IV. Provision of PVC water storage tanks one each on ground and overhead on erected supports with suitable pipeline connections, electric motor etc. (as per specifications).
V. Sanitary installations as per specifications.
VI. Electrical installations as per specifications.
VII. Assembling of various pre-cast components at site in case of pre-cast construction and finishing work including various fixtures as per specifications.
VIII. Provision of ferro-cement /FRP septic tanks underground with suitable connection to the building and drainage.
IX. The safe design of structure as whole and its individual components will be solely the responsibility of contractor. Contractor may suitably modify the drawing in case considered necessary with the approval of Engineer-in-charge.
X. Providing and fixing fixed wire mesh and M.S. grills on windows, ventilators as directed by Engineer-in-charge.
XI. Providing water and electricity to site offices during currency of the contract including defect liability period.

3.2.10.1 General Requirement for the Temporary Office Building Materials required for the works shall be arranged by the contractor himself including wire mesh /Chicken mesh /Binding wire/G.I. wire and other chemicals required for Ferro-cement work/Brick work as per specifications. All materials arranged by contractor will be tested at contractor's cost, if required by Engineer-in-charge.

3.2.10.2 **Specification for Prefabricated Elements**

Constituents

i) **Foundation and Plinth:** - Cast-in-situ plum concrete work of Nominal Mix concrete all along the periphery up to 300 mm deep below ground level and 450mm deep at column locations. However, depth may vary depending upon site conditions. Rise from ground level to Plinth shall be provided by two steps of concrete of 1:3:6, mix and properly finished or prefabricated as approved by Engineer-in-charge.

ii) **Wall:** - This will consist of R.C.C. precast columns/Steel column and Ferro cement panels of size 1500 mm x 300 mm (thickness 25mm)/Brick wall 230 mm thick in 1:6 Cement Mortar with1:5 CM plaster on both side. The columns shall be anchored to foundation to hold the structure to foundation resulting in a rigid structure which shall be dust and waterproof when assembled completely.

iii) **Roofing:**- Precast ferrocement roofing channels /Steel section of I/C Section as per drawing or corrugated galvanised iron sheet over tubular trusses and purlin or any

better material approved by Engineer in charge as required for the Dead load, live load, wind load and snow load etc.

iv) **Flooring:** - Precast, hydraulically pressed square or as directed by Engineer-in-charge, tile flooring over a bed of crusher stone dust mixed with nominal cement in the ratio of 1:16 Cement & crusher stone dust.

v) **Finishes:** -All interior shall be fine finished with Plaster of Paris and oil bound distemper in two coats, of quality and shade as approved by Engineer-in-charge, including priming coat of whiting to give an even shade. The outer face (excluded roof) shall be finished with two coats of cement paint of approved make. The roof should give concrete finish steel sheet coated with 2 coat of synthetic enamel paint over one coat of primer.

vi) **Water supply:**- One storage tank of 500 lit. capacity, of approved make, shall be erected overhead whereas one storage tank of 2000 lit. capacity, of approved make, shall be fixed on ground over a platform made of 6 solid concrete blocks on levelled ground. The storage tanks shall conform to provision of IS specifications. Suitable arrangement in the form of an electrical motor of 0.5 Hp with proper electric connection shall be made to lift water from ground tank to overhead tank. Water tank shall be coated inside, with suitable chemical solution (approved by Engineer-in-charge) in order to make storage potable. The location for ground and overhead tanks shall be as given by Engineer at site. Overhead tank shall be erected on a suitable raised support, independent of the main structure and shall be connected to ground tank as well as other sanitary installations of the main structure so as to give adequate water pressure at various aps etc.

vii) **Electrical Installation**: - All electric wiring shall be with 3/22 copper wire for light/fan points (5 AMP) and 7/22 copper wire for power points (15 AMP). The electrical wiring shall be concealed in covered plastic battens which shall be securely fitted with the main concrete structure. The electric boxes, of approved make, at various locations to be provided duly covered with by hylum sheet of suitable size in which the sockets and switches will be fitted.

viii) **Following electrical fittings** should be provided at various locations in each unit as below: -

(a) Verandah (1 No) - One tube light and 15 W CFL with holder.
(b) Office (1 No.) - One tube light, one CFL 15 W with holder, one ceiling fan, three pin socket (15AMP) 1 No. each.
(c) Hall (1 No.) - Two tube Light, 15 W CFL with holder, 5 AMP Socket–2 No., `15 AMP Socket – 2No., Ceiling fans – 2 Nos.
(d) Lab Room (1 No.) - CFL with holder, tube light – 1 No., 15 AMP Socket, Ceiling fan.
(e) Toilets (2 Nos.) - CFL with holder, tube light, 15 AMP Socket exhaust fan (suitable size) 1 No. each in each toilet.
(f) Store (1 No.) - CFL with holder, 5 AMP Socket 1 No. each.

The contractor shall be responsible for internal fittings wirings starting from the main switch board and the main switch board will be provided with suitable MCB as per requirement. Electrical installation shall be of standard make as approved by Engineer-in-charge. Electrical motor of 0.5 hp shall be installed at approved location to lift water from ground tank to overhead tank. This arrangement shall be provided with 15A three pin socket and switch and copper wiring of 7/22. Arrangement shall be made be made by contractor in such a way that main switch board with MCB can be connected to main supply at a later date.

ix) **Sanitary Installation: -** Following sanitary fittings shall be provided in each unit separately with cistern.

TOILETS (2 Nos.):- While vitreous glazed W.C. pan with cistern of approved brand (western style) and 'S' trap etc. complete. Wash basin (white vitreous) with water pipe etc. complete. Looking glass in PVC frame fixed over wash basin, CP brass bib cock (2 Nos.), CP brass pillar cock (1 No.), single valves (2 Nos.), with suitable connecting pipes to cistern and wash basin complete, floor trap jail ofCP brass (2Nos.) and one no. 20 litre geyser for hot water shall also be provided in each toilet with all its accessories.

Pantry: - White vitreous glazed sink of size 60cm x 45cm x 25cm suitably supported on brackets or stainless-steel kitchen sink of approved quality etc. to be provided with PVC water pipe, floor trap jail, CP brass bib cock etc. complete. Sanitary installation as mentioned above shall be provided as complete job and shall be of standard make as approved by Engineer at site. The description of ancillary fittings is not exhaustive, and contractor shall perform all other jobs in this connection as directed by Engineer-in-charge/Engineer at site. All sanitary installations shall be connected to main supply line overhead storage tank, with G.I. pipes (15mm dia) and G.I. fittings and clamps.

3.2.10.3 **Material Specifications**

(i) **Foundation and plinth**: - cast in situ plum concrete of nominal mix 1:3:6 Crusher aggregate shall be used with maximum size of aggregate 20mm.

(ii) **R.C.C. Columns**: - 100mm x 100mm size R.C.C. columns using concrete mix of 1:2:4 with suitable grooves to house wall panels to be used. M.S. channels to be used as shuttering. To be cast with power vibrators or vibrating table. In place of RCC column steel column of suitable section may also be used.

(iii) **Wall Panels** :- Ferrocement wall panels having thickness of 25 mm/Brick wall 230 mm thick, to be cast with power vibrators or vibrating table concrete mix of 1:15:15 (1 part of cement with 1.5 parts of coarse sand 4.75mm nominal size and 1.5 parts of 5mm downsize zeera) to be used with water cement ratio of 0.3 to 0.4 depending upon weather conditions and to be decided by engineer at site. The coarse sand shall consist of 4mm longitudinal and transverse mild steel wires and 26-gauge wire mesh on both faces (to be placed symmetrically on the two faces0. The steel shuttering will have smooth, properly machined surface so as to give smooth finish. In place of Z/C section I channels section may also be used over that CGI sheet of 1 mm thick may also be used for roofing or any better material approved by Engineer in charge.

False Ceiling with 8 mm thick plywood shall be provided with prime coat and 2 coat of synthetic enamel paint of required colour as directed by Engineer in charge or any better material approved by Engineer in charge.

(iv) **Horizontal Joists:** - Size 100mm x 100mm, it shall be designed with proper joint fastening arrangement with columns and channels as per drawing 8mm dia reinforcement bars at corners shall be fastened with 4mm dia. shear stirrups at 225mm c/c spacing. MS channels shall be used as shuttering.

(v) **Z/C-Section Roofing channels:** - Masonry moulds shall be used reinforcement details are shown in the drawing. Double layer of 22-gauge wire mesh shall be symmetrically place on both faces 1:2 mix of cement and sand will be used. Suitable water proofing chemicals such as cecopidlite shall be used as approved by Engineer-in-charge. 28 days compressive strength of a 70 mm cube shall not be less than 25 N/mm2.

(vi) **Joinery:** - Door and window frames shall be of precise RCC/ferrocement, conforming to IS 6523-1983 specifications. The doors and windows shall be suitably fixed to the frames with suitable hinges. Doors shutters shall be made up of 22-gauge pressed steel of the approved pattern and design as approved by engineer-in-charge. Door frames shall be 125 x 75mm in size 1.5 x 0.9m, made of steel with steel shutter and suitable locking arrangement, handle and glass panes, suitable fixed with shutter. Door shutters shall be, provided with two coats of ready mixed red oxide primer and two coats of enamel paint of approved quality and shade as approved by Engineer-in-charge. Curtain rods (metallic) of required length with proper support brackets

(wooden/metallic) shall be provided for each door and window in the manner as approved by Engineer-in-charge.
(vii) **Flooring:** - Cement concrete flooring (approx. 25mm thick) shall be provided.
viii) **Steps:** - Proper steps of suitable size and length to be provided between GL and plinth as approved by Engineer-in-charge.

3.2.10.4 **Specification for Ferro Cement Work:**

(i) Adequate care should be taken to ensure proper clear cover on both faces of ferrocement component any component having exposed chicken mesh will not be allowed to be used.
(ii) Power Vibrators / Vibrating Table shall be used to achieve uniform compaction finish and texture.
(iii) Special care shall be taken while casting Z/C-Section roofing elements. The male type mould shall be made of brick masonry with clay filling and plastered with cement mortar on the top. Wire mesh shall be cut to a length equal to twice the length of profile of element plus an overlap of 50mm and longitudinal direction shall be about 100mm.
(iv) Low alkali cement shall be used.
(v) Constituent material for the mix shall be mixed dry in mortar mixer, water shall then be added in small quantities until the mix attains stiff consistency. Water quantity should be such as it should not lead to segregation of particles as well as it should not lead to shrinkage cracks due to excess water.
(vi) Before placing of mix, a thin coating of rich cement slurry shall be applied to reinforced cage with a brush.
(vii) Finished elements shall be cured properly by full covering with wet gunny bags.
(viii) All members should be mould finished and no repair with cement mortar shall be allowed afterwards.
Note - Any better material approved by Engineer in charge. In case the tenderer/s uses any better material than mentioned above, this will be permitted with approval Engineer-in-charge.

3.3 FURNITURE AND OTHER OFFICE EQUIPMENT

3.3.1 The Contractor shall supply and maintain the following new furniture and equipment to the Engineer's offices within two months of the date of commencement of the works until the defect liability period is over:

Description of Item	Nos.
Conference table (4000mm x 1500mm)	1
Conference chairs	16
Glass-fronted lockable bookcase	4
1500mm x 900mm double pedestal desk	2
1200mm x 900mm single pedestal desks	8
Swivel office chair with armrests	12
Swivel office chair without armrests	4
Typist chair	2
Visitors chair	16
4-drawer filing cabinet	4

Plan chest (A 0 size)	1
1500mm x 900mm tables	15
Steel lockable cupboard 6ft high with internal shelves	4
Heavy Duty Paper Shredders	1
Tele-facsimile transmission/reception facility connected to a dedicated line with STD facility	1 set
Telephone switchboard connected to 2 external Lines at each office including the handsets along with the required facilities for the exchange, with STD facility, and with independent Internal communication Facilities with conference facilities.	15 phones lines
First aid kits for up to 36 persons	2 (All kits shall be regularly recouped)
Industrial Safety Helmets along with Cap mounted Earmuffs (with NRR 21 dB), LED Cap Torch and Safety goggles	40 sets (every 12 months)
Gum Boots and Safety Toe shoes	40 sets (every 12 months)
Reflective Safety Jackets (As per IS: 15809) and Safety gloves suitable for Tunneling operations.	40 sets (every 12 months)
Face mask (NIOS Approved N95)	1000 Pieces every 6 months
RO water Purifier	1
2 L kettles	20
Potable water dispenser with hot/cold Taps	1
Cups and plates	20
Fire extinguisher	(As required confirming to the stipulations of Local authorities).
Silent DG set of minimum power of 10 KVA	1

Note: In case of failure to provide the equipment's within Two months, penalty @ Rs 5000/- Per week or part thereof will be imposed.*(On mutual agreement, PD may substitute above items with equivalent/suitable items if the same are not easily available in the market or not required in his opinion.)*

3.4 TRANSPORT

3.4.1 General

The Contractor shall provide road transport (for the use of the Employer and the Engineer within one month from the date of commencement of the works) and the Payment for the same shall be covered in relevant schedule of the BOQ

3.4.2 Road Transport

a) The vehicles shall be new and delivered and maintained by the Contractor in good roadworthy condition including daily cleaning. The vehicle shall be replaced with a new vehicle after a maximum run of 75000 Km or three years whichever is earlier.

b) The Contractor shall employ and make available competent drivers fully licensed to operate the vehicles as and when required by the Engineer/Employer. The Contractor shall replace drivers at the request of the Engineer/Employer.

c) The vehicles shall be commercially licensed and insured for use on the public highway and shall have comprehensive insurance cover for any qualified driver authorised by the Engineer together with any authorised passengers and the carriage of goods or samples.

d) The Contractor shall provide fuel, oil for running of each vehicle for 4000 kms monthly and ensure maintenance in conformity with the vehicle manufacturer's recommendations and all relevant toll and parking charges incurred in connection with the Works. The vehicle shall be provided day and night as required by the Engineer/Employer. If any vehicle is allowed, with the prior approval of Project Director, to run beyond 4000 Kms in a month the charges for running of the additional Kilometers shall be paid separately under item 9003(c), 9003(d) of schedule.

e) A suitable replacement shall be provided by the contractor for any vehicle out of service for more than 24 hours. If the contractor at any time fails to provide vehicle(s) or substitute vehicle(s) as specified, an amount of Rs.1500 per day for each vehicle (that the Contractor failed to provide) shall be recovered from the Contractor.

3.4.2.1 Motor Bike

The Motor Bike shall be new and delivered and maintained by the Contractor in good roadworthy condition. A new helmet shall also be provided along with the bike. The motor bike shall be washed and cleaned once in a month. The bike shall be replaced with a new Motor Bike after a maximum run of 90000 Kms or three years whichever is earlier.

(b) The Motor Bike shall be registered and insured for use on the public roads and shall have comprehensive insurance cover for any rider having valid driving license and authorised by the Engineer.

(c) The Contractor shall provide fuel, lubricants and other oils for running of the Motor Bike for 2500 Kms monthly and ensure maintenance in conformity with the vehicle manufacturer's recommendations and all relevant toll and parking charges incurred in connection with the works shall be borne by the Contractor. The motor bike shall be provided day and night as required by the Engineer/Employer. If any motor bike is allowed to run beyond 2500 Kms in a month, the charges for running of the additional kilometres shall be paid separately under item 9006 (a).

A suitable replacement shall be provided by the contractor for any motor bike out of service for more than 24 hours. If the contractor at any time fails to provide motor bike as specified, an amount of Rs.400 per day for each motor bike (that the Contractor failed to provide) shall be recovered from the Contractor.

3.4.3 **Number of Vehicles**

3.4.3.1 The Contractor shall provide the following type of vehicles as per requirement indicated by the Project Director within one month of the date of commencement.

Type	Numbers
INOVA, MAHINDRA XUV500 or similar	*3 (Three)*
BOLERO/SCORPIO/ERTIGA/MARAZZO or similar	*10 (Ten)*
Motor Bike 150CC or more, Bajaj Pulsar/HondaCB Hornet 160R/ Hero Xtreme Sorts/ Suzuki Gixxer or Similar	10 (Ten)

3.4.3.2 The vehicle requirement given in para 3.4.3.1 above is the maximum requirement of the vehicles at a time. However, requirement in a particular period will be intimated by the project director to the contractor on programme basis at least 7 days before the actual date of requirement after approval of the distribution by the Project Director.The Contractor shall withdraw particular vehicle(s) if the same is not further required by the Engineer/Employer if so, directed by the Project Director. In such cases the instructions shall be given in writing 7 days in advance.The requirement during the Defect Liability Period will be quite less than the maximum requirement mentioned above.

3.4.3.3 **Duration of Transport Requirements**

Transport for the Engineer / Employer shall be provided so as to cover the entire completion period(s) and defect liability period(s). The transport so provided, as per Para 3.4.3, shall continue to be the property of the Contractor.

3.5 OFFICE MAINTENANCE

3.5.1 The contractor is required to maintain the offices throughout the contract period and provide the following, but not limited to:

i. Pay all electricity charges.
ii. Reimburse telephone bills for the use of telephone, upto Rs 3000/- per month for each external landline connection
iii. Pay all water charges.
iv. Carry out necessary repairs to office and equipment as and when required.
v. Day - to - Day cleaning and maintenance and watch & ward etc.

3.5.2 The contractor shall provide within Two months from the Date of Commencement following personnel in the office as required for watch and ward of the site office.

Watchmen / Security(3 shifts of 2 men in a shift, till the defectLiability period is over)

Note: In case of delay beyond Two-month, penalty @ Rs 5000/- Per week or part thereof will be imposed.

3.6 EQUIPMENT FOR USE OF THE ENGINEER.

The Contractor shall provide new equipment and software as listed below and maintain them for the exclusive use of the Employer and the Engineer. The Contractor shall provide and maintain the following equipment for the use of the Engineer and the Employer within two month from the date of commencement of the works until the defect liability period is over. **The payment for the same shall be made separately under relevant BOQ item.** On completion of defect liability period, the equipment shall be property of the Contractor.

(a)	Desktop Computer Eight nos.	With minimum specification of Intel Core i5, 8th Generation, Upto 4.0 GHz, 9 MB Cache, 8 GB DDR4 2666MHz RAM, 1 TB 7200 RPM Hard Disk Drive, DVD Writer, 20-inch colour TFT monitor, 10/100 LAN Card, Modem Card., 10/100 LAN Card, Modem Card, Operating System - Windows 10 or higher preloaded with media and documentation and certificate of authenticity and Microsoft Security Essentials preloaded antivirus software.
(b)	Laptop rugged – two Nos.	With minimum specification of Intel Core i5, 8th Generation, upto 3.4 GHz, 6 MB Cache, 8 GB DDR4 2666MHz RAM, 1TB 5400 RPM Hard Disk Drive, 14" color display, 2xUSB-3.0, Standard keyboard. Weight - not more than 2.5 kg, Battery backup - minimum 4 hrs Operating System - Windows 10 or higher preloaded with media and documentation and certificate of authenticity and Microsoft Security Essentials preloaded antivirus software. A laptop bag and Adapter/Battery charger shall also be provided with the laptop.
(c)	Printers – 2 nos. (A4 size – 1 No. and A3 size – 1 No.)	The A4 size printer shall be all in one officejet having features of Fax, Scanner and Printer, A3 size printer shall be Colour Officejet with a print speed of up to 8 pages at 800 dpi or More.
(d)	LARGE FORMAT PLOTTER - ONE NO.	36-inchcolor plotter: Model -HP T830 Designjet Multifunction plotter or similar/ better
(e)	Application software* (on all desktop and laptop with one-year license)	(i) Microsoft office latest release. (ii) AUTOCAD 3D latest release. (iii) M S Project/Primavera latest release. (iv) PDF Converter/Professional
(f)	Colour scanner- 1 no.	A3 size
(g)	Xerox Machine- 1 No. for coloured prints capable of reduction and copying A3 & A4 size paper with automatic document feeder capability and sorter. (Canon IR 2530 or similar/ better)	
(h)	UPS system with sufficient power backup (with minimum backup time of 30	

	minute) to meet the sufficient power load in case of power disruption.
(i)	Surge Protection Devices (one for each computer and printer as given above)
(j)	Power supply for the systems is to be AC 240 volts, 50 Hz from normal building wiring circuit mains, power regulator, stabilizer or transformer should be supplied by the Contractor for the computer systems such that the systems can function efficiently.
(k)	2 MBPS internet connection with Wi-Fi facility so that multiple devices can be connected.
(l)	50 MBPS Wi-FiHotspot/USB Dongle with 4 GB data connection and minimum monthly download limit of 50 GB for use with laptops – two nos.

Note: In case of failure to provide the equipment including original software & internet connectivity within two month, penalty @ Rs 5000/- Per week or part thereof will be imposed.

***Cost of license renewal of application software beyond first year will be borne by Employer.**

3.7 Documentation

A complete set of documentation will be supplied with each System. The documentation should be self-tutorial in nature and be readily understood by non-computer personnel. The following manuals will be supplied with the system:

(a) Manual on how to operate the equipment; and

(b) Manual on how to use the facilities and software provided by the supplier (including languages and utilities).

Chapter-4

4.0 SPECIFICATIONS

4.1 Standard Specifications for Materials and Works of Rail Vikas Nigam Ltd.

Separate priced booklet containing Rail Vikas Nigam Ltd.'s Standard Specifications for Materials and Works in Volume-1(Civil) and Volume – II (Electrical) are available in the office of Rail Vikas Nigam Ltd. and bidders may obtain the same. The booklet is also available on RVNL's "ebsite HYPERLINK "h"tp://www.rvnl.org"www.rvnl.org.

It is presumed that bidders have gone through Rail Vikas Nigam Ltd.'s Standard Specifications for Materials and works (Civil, Electrical and Signalling and Telecommunication) including latest correction slips issued up to the date 28 days prior to the deadline for submission of bids before quoting the rates.

Works are to be executed as per above referred specifications except for Tunnel work for which detailed specifications are given in Annexure-A of Section-5: Works Requirement.

Chapter – 5

5.0 Personnel

5.1 The Bidder shall deploy, as per agreed programme, the minimum number of personnel for the key positions with requisite qualification and experience as mentioned hereunder: -

S. No.	Positions	Minimum No. of Personnel	Minimum Qualification	Minimum Experience in Similar Work
1	**Project Manager/Team Leader**	1	Graduate in Civil /Mining Engineering	25 year experience in tunneling projects out of which atleast 15 years should be in NATM tunneling and have executed at least two tunneling projects in the capacity of project in charge.
2	**Technical / Design manager**	1	Graduate in Civil/Mining engineering	20 year experience in tunneling, out of which at least 15 years and a minimum of 2 projects should be in observational method / NATM.
3	**Tunnel construction Manager**	1 (One per Tunnel)	Graduate/ Diploma in Civil/ Mining Engineering/ Engineering Geology	The Tunnel construction Manager shall have a minimum of 10/15 years of experience with NATM construction The Tunnel construction Manager shall have a minimum of five/Seven years experience as incharge or one level below incharge on a NATM construction project and worked on a minimum of one project involving soft ground tunnelling.
4	**Head Foreman (NATM) (EXPAT)**	1	Diploma in Civil/ Mining Engineering/ Engineering Geology	Head Foremen shall have 8 years of experience in on-site construction supervision of NATM tunnel construction. Expat Head foreman must supervise all Head Foreman National. He must have experience in various position such as nozzleman, pit boss, machine operator etc.
5	**Head Foreman (NATM) (National)**	6 (1 per shift per tunnel excavation direction)	Diploma in Civil/ Mining Engineering/ Engineering Geology	Head Foremen shall have 5 years of experience in on-site construction supervision of NATM tunnel construction. Head foreman must effectively lead the tunnel site crew in a shift. He must have experience in various position such as nozzleman, pit boss, machine operator etc.

S. No.	Positions	Minimum No. of Personnel	Minimum Qualification	Minimum Experience in Similar Work
6	**Nozzle men**	12 (1 per shift per machine)	-	5 years of experience in Shotcrete application out of which 2 years should with Robo Arm Shotcrete Machine. Nozzle men shall possess adequate experience and will be qualified by the contractor based on the shotcrete test panels prepared as per IS code and other international guideline for shotcrete such as Austrian guidelines 1998. The testing procedure shall be witnessed by the engineer whose "no objection" will be obtained before deployment of nozzle man at work.
7	**Jumbo Operator**	14 (1 per shift per machine)	-	10 years of experience in operation of drilling jumbo. He should be able to prepare, operate, perform routine maintenance and troubleshooting of jumbo. Jumbo Operator shall be certified by OEM and shall possess adequate experience and shall undergo simulation training program from OEM for Automatic Jumbos.
8	**Senior Geologist**	1	Postgraduate in Geology/ geotechnical Engg/ rock mechanics	15 year experience in tunneling out of which at least 5 years should be in NATM tunneling
9	**Senior Surveyor**	1	Graduate in Civil Engineering/ Qualified survey certificate holder	10 years of experience in surveying work with atleast 3 years experience in underground/tunnel survey
10	**Material Procurement Manager**	1	Graduate	10 year experience as Material Procurement manager on infrastructural Projects. He will be responsible for placing orders for procurement of material, Machinery and consumables according to requirement placed by Tunnel and Bridge superintendents to maintain critical levels of buffer stocks at all times.

S. No.	Positions	Minimum No. of Personnel	Minimum Qualification	Minimum Experience in Similar Work
11	**Material Stock Engineer**	2 (1 per shift)	Graduate / Diploma in Any discipline	3/5 years of experience of material stocking on infrastructural projects for Graduate / Diploma He will be responsible for updating the material stocks and work in close liaison with Tunnel superintendents to maintain upto date position of material stocks and consumables.
12	**Safety Manager**	2 (One per shift per Tunnel)	Graduate in any discipline and Diploma in Safety, Health or environment Management or Construction Management	5 year experience in Safety Management in tunneling projects
13	**Junior Surveyor**	6 (One per excavation direction)	Diploma in survey	2 years of experience in surveying in tunneling /Railway/ Highway/ Pipeline project
14	**Grouting Engineer**	1 (One per Tunnel)	Graduate/Diploma in Engineering	5/7 year experience in Grout application in underground / Dam works. The Grouting engineer shall have knowhow of handling the grouting machine and had training from OEM before machine deployment.
15	**Civil Engineers (Tunnel)**	6 (One per excavation direction per shift) and2(Embankment/Muck Dumping site)	Graduate/ Diploma in Civil Engineering	3/5 years of experience in tunneling projects for Diploma/ Graduate
16	**Geologist**	2 (Two per tunnel)	Post-Graduate in Geology/ geotechnical Engg/ rock mechanics	5 year experience in tunnel works
17	**Quality Assurance and Quality Control Engineer**	–4 (Two per Shift - One at Lab and one at construction site for sample collection)	Graduate /Diploma in Civil Engineering	5/8 years of experience in quality control and/or quality assurance in underground works for Degree/Diploma.

S. No.	Positions	Minimum No. of Personnel	Minimum Qualification	Minimum Experience in Similar Work
18	**Project Platform Coordinator**	1	Graduate in Engineering in any discipline.	5-year experience in handling IT Software. He will coordinate the use and operation of the Platform and fulfill the deadline of providing the data required by the Client on a regular basis.

Note: The requirement and schedule of deployment may be altered by Project Director in consultation with the contractor to suit the site condition and progress.

5.2 The contractor shall supplement the additional manpower as per the works requirement and agreed works programme in addition to minimum requirement mentioned above.

5.3 Highly skilled Operators in the category of Drilling jumbo operators, shall possess adequate experience and undergo requisite certification program (witnessed by Engineer if required)from OEM to operate these machineries to the required work specifications. At least two spare Jumbo operators shall be available at site as leave reserve or for replacements on any account.

Tunnel nozzle men and Grouting Engineer should undergo hands on training at work site conducted by OEM.

Employer/Engineer reserve the right to interview the personnel before deployment. If the personnel/operator is found to be lacking in skill to operate machinery to its optimum potential at any stage, then the operator shall be got replaced by the contractor at a notice of 30 days from the engineer.

5.4 The contractor shall submit in his bid the complete organization chart along with CV's and the brief job descriptions of key positions for Project Manager, Design Manager, Senior Geologist, Senior Surveyor, Tunnel **construction** Manager, Bridge **construction** Manager and Expat Foreman and for the remaining not later then 21 days of the award of the Contract. Employer shall have the right to reject, at any time, and ask for replacements to incumbents, due to their lack of requisite competence.

5.5 ***DELETED.***

5.6 Approval/No objection by Engineer to the Contractor's organization, shall not absolve the contractor of his responsibility, in any way, under the contract.

5.7 The **Project Manager** shall be responsible for the following duties:

i. Be located on-site full time for at least one shift per day for a minimum of 6 days per week, when construction is taking place.
ii. Shall coordinate and cooperate with Engineer and be responsible for all obligations under the contract.

The **Design Manager** shall be responsible for the following duties:

i. Provide technical supervision of excavation to help maintain safety of construction at the tunnel heading.
ii. Coordinate preventative and remedial measures when ground loss at tunnel heading or instability of the tunnel occurs or appears likely.

iii. Consult with Engineer (PMC's Construction Manager) or Employer's representative regarding ground conditions encountered, data from probing ahead of the face.
iv. Arrange and maintain daily written interpretation of instrumentation measurement readings during construction.
v. Coordinate and provide to the Engineer all detailed design and calculations of parts of the works under the Contractor's responsibility.
vi. Actively coordinate the decision flow regarding NATM application and related adjustments of the Support Classes.
vii. Responsible for preparation of construction / as built drawings.

5.8 Note:

5.8.1 Contractor should plan for additional men to cover leave/rest/sick etc.

5.8.2 Project Manager is to be deployed within 30 days of issue of Letter of Acceptance. The programme for deployment of other personnel shall be conveyed by PMC/Employer and personnel shall be deployed within 30 days of the stated requirement. In case of failure to deploy any personnel within 30 days of the stated requirement, a penalty shall be imposed for each day of delay as under:

5.8.2.1 Rs. 15,000 per person per day of delay for Head Foreman (NATM) EXPAT.
5.8.2.2 Rs 10,000 per person per day of delay for Project Manager, Tunnel and Bridge Manager, Technical / Design Manager, Material procurement Manager, Head foreman, Senior Geologist and Senior Surveyor.
5.8.2.3 Rs 5,000 per person per day for QA & QC engineers, Safety Managers, Grouting Engineers, Geologists and Material Stock Engineers.
5.8.2.4 Rs 3,000 per person per day for other personnel.

5.8.3 On completion/likely completion of activities concerned to particular personnel, demobilization of that personnel shall be requested by the Contractor at least 30 days in advance and demobilization shall be done with the approval of PMC/Employer only. In case demobilization is done without approval of PMC/Employer, the penaltymentioned above, as relevant, shall be imposed for each day of absence of the personnel.

Chapter – 6

6.0 Equipment

The Bidder shall deploy, as per agreed works programme, sufficient number of suitable equipments for execution of the work. The number, type, capacities and condition of machineries shall be such so as to carry out the scope of work successfully within the specified completion period and to the required specifications mentioned in the document. The number of equipments shall be augmented by contractor to meet the work schedule as directed by engineer without any additional cost to the employer, to finish the work within agreed time schedule.

6.1 **It is mandatory to deploy** machineries of suitable make, capacities and number **as mentioned below** as per agreed programme **on a minimum basis.** Adequate number of spares equipments should be deployed in addition to this.

S. No	Equipment	**Minimum No. of equipment for Entire Work**
1	Jumbo (Type-1) Automatic	3 nos.
2	Jumbo (Type-2) Semi-Automatic	4 nos.
3	Shotcrete equipment	6 nos.
4	Truck mounted complete grouting equipment system	2 No.
5	Wheel Loaders	4 nos.
6	Hydraulic Excavators equipped with breaker for scaling operation	08 nos.
7	Dumpers	Compatible withcycle time to maintain continuous mucking operation at the furthest drive face.
8	Total Station	3 nos.
9	Total Station with onboard Tunnel Profiler	6 No.
10	Electrical Submersible Dewatering/sludge pump	6 Nos. (All pumps should have adequate capacity to handle water inflow of 50 L/sec or more)
11	Scissor platform	06 nos.
12	Fully computerized automatic batching plant	04 (03 for Shotcrete and Augmented by additional 01 before start of lining works)
13	Suitable Genset with catalytic converter	All DG sets should have 100% power back up. Details of minimum power requirement at each location is given below table.
14	Continuous Loader	3 nos.
15	Transit Mixers	According to proposed time cycle to maintain continuous mix supply at the furthest drive face.

6.2 Specifications and minimum capacities of the above equipment is detailed under:

For usage Inside Tunnel

6.2.1 Jumbo (Type-1) having minimum two boom (Each boom with minimum 14ft feed length) with height coverage of atleast 8m, one working platform with FOPS Air-conditioned cabin. The Jumbo should be automated computer controlled with fully automatic drilling system. It should have automatic rod adding and handling system on atleast two booms for drilling upto 18m deep holes (for Probe and grouting hole drilling). Jumbo should have capability of Total station navigation, Logging and reporting of Jumbo Operation and Measurements While Drilling (MWD) data on all booms.

The MWD data shall be interpreted by on-board software.

Contractor will provide (free of cost) one licensed software copy of OEM's Jumbo automation software to engineer for analysis of data.

6.2.2 **Jumbo (Type-2)** having minimum two boom (Each boom with minimum 14ft feed length) with height coverage of atleast 08m, one working platform with FOPS Air-conditioned cabin. The machine shall have capability for semi-automatic drilling, Laser navigation, Logging and reporting of Jumbo Operation and Measurements While Drilling (MWD) data on all booms.

Contractor will provide (free of cost) one licensed software copy of OEM's Jumbo automation software to engineer for analysis of data.

6.2.3 **Shotcrete equipment** shall comprise of robo-arm with radio remote control spray (having maximum vertical reach of 12m) and mounted on chassis with on board Air compressor (Minimum 10.5 cum/min capacity at 7bar).The equipment shall deliver practical shotcrete output of minimum 20 cum/hr. with S-Valve pump for Low pulsation. The machine should be capable of keeping accelerator dosage within ±2% limits of actual dosage required by PLC controlled circuit at all times during its operation.

Contractor will provide (free of cost) one licensed software copy of OEM's Shotcrete job analysis software to engineer for analysis of data.

6.2.4 **Truck mounted complete grouting equipment system** for grouting shall be deployed with all elements included [2 Hoppers mounted with bag breakers, 01 High shear colloidal type mixer (Atleast 200 lit capacity and RPM 1500), agitator of atleast 400 lit capacity and 2-double acting piston pump for grouting 4 holes simultaneously] including a PLC control of batching with the mix design ratios pre-stored and controlled through a RECORDER PC in its memory. Automatic weigh batching facility will be mandatory. There should also be display screen for continuous monitoring of key parameters (Pressure, Flow and volume in the format desired). Onboard Data loggers for all grouting operations shall be mandatory to record the grout volume, pressure etc. data for all the grout lines.

Contractor will provide (free of cost) one licensed software copy of OEM's Grouting rig job analysis software to engineer for analysis of data.

6.2.5 **Wheel Loaders** having minimum 3.00 cum (Rock Bucket) Tramming/Hauling load capacity.

6.2.6 **Hydraulic Excavators** of minimum 1.10 cum (Rock bucket) equipped with breaker for scaling operation.

6.2.7 **Dumpers** should be having load capacity of 25-40 Tonne.

6.2.8 **Survey** equipment: Total Station (Accuracy ≤ 1sec), Auto level,.Calibration certificates of every equipment should be submitted according to manufacturer's instructions

6.2.9 **Dewatering**/sludge pump with suitable pipeline network. Pumps should be new and kept in good condition.Contractor shall provision for standby pump having 100% capacity at each pumping stage.

6.2.10 **Total Station with onboard Tunnel Profiler** for rapid recording of Tunnel wall periphery. (Trimble S7 or similar)

6.2.11 **Suitable Scissorplatform**with telescopic elevation equipment.

6.2.12 **Continuous loader** of suitable capacity.

For usage Outside Tunnel

6.2.13 Fully computerized **automatic batching plant** (Silo based) having minimum capacity of 45 cum/hr.

6.2.14 **Genset** with catalytic converter to control emissions.

For the construction operation, the following minimum power generation supply,unless supported by power demand computations compatible with works programme, should be provided by the Contractor at each site:

Tunnel 13 Portal 1: 750 kVa, Adit 7: 1000 kVa, Tunnel 13 Portal 2: 750 kVa

One spare DG set upto 250 kVa shall be available over and above the final proposed arrangement confirmed by power demand computations.

For Drilling jumbo, shotcrete and grouting rig equipment:

6.2.15 The machines/equipment shall be from a manufacturer who has established 100% spare parts back-up near project area preferably at Rishikesh.

6.2.16 The machine deployed should have a service agreement between contractor and the manufacturer.Service agreement shall mandate permanent presence of manufacturer's service engineer/s for the entire duration of work. Manufacturer in their service agreement with contractor shall ensure minimum equipment availability of 85% for the first two years and 80% thereafter.

6.2.17 After mobilization and prior to seeking Engineer’s approval, contractor shall submit Machine Health check report / condition certificate from OEM at work site and maintenance schedules (Both preventive and need based) which shall be specified in the service agreements signed with OEM. Scheduled maintenance/ health check will be got done from OEM as per stipulated service agreement.

6.3 Spare equipments mentioned above will be used in case of breakdowns of dedicated machines. Contractor shall not use the spare machine on a regular basis.

6.4 Catalytic converter device to control exhaust emissions shall be mandatory for all diesel operations on the project.

6.5 **DELETED.**

6.6 For safety reasons, all diesel dump trucks, loaders, carriers etc. shall be equipped with positive brakes (deadman brakes), HID/LED lighting (Use of Halogens shall not be permitted) and a Rotating beacon light of amber/suitable color, which shall be kept in switch on position during machine movement.

6.7 **All Critical equipment/ plants to be deployed i.e. Drilling Jumbo, Shotcrete machine, Grouting Rigs, Continuous loader and Wheel Loader should be new or less than 2 years old. For each Critical equipment deployed, an annual certificate shall be submitted by the equipment manufacturer attesting the compliance of the performed maintenance plan. After a total of 5 years working life the above mentioned equipmentcan be continued for further duration, if in opinion of engineer, the equipment is performing all functions without affecting work cycles.**

6.8 **For theinitial period as declared in Letter of comfort or 9 months whichever is earlier from date of commencement in case of above mentioned critical equipment, execution may be allowed with available equipment generally used and available for such operations for commencement of work, subject to condition that the equipment is not more than 5 year old and further that the contractor submits a copy of purchase order of the New critical equipment. This shall in no way absolve contractor of the responsibility and obligations to perform under the contract. No time extension shall be allowed on account of delayed mobilization due to any reason and the contractor will be required to make up the progress (by increased numbers of machines) due to delayed deployment to finish the work's within stipulated time.**

6.9 **All other equipment (other than critical equipment) as mentioned above shall be less than 5 years old and shall be replaced upon completion of 5-year service life. However,subject to performance of the equipment, Engineer may relax such replacements. This shall in no way absolve contractor of the responsibility and obligations to perform under the contract.**

6.10 In addition, the contractor shall maintain a fully equipped soil, rock, aggregate and concrete testing laboratory at any one location. ***Contractor shall maintain testing facilities required for testing the fiber reinforced shotcrete at site.***

6.10.1 Failure to deploy the above equipment as per mutually agreed programme shall attract penalty. of Rs. 25,000/- per day (per equipment) of delay for each equipment category at S.No. 6.1 (1) above, Rs.15,000/- per day (per equipment) of delay for each equipment category at S.No. 6.1 (2, 3, 4, 14) above and Rs. 10,000/- per day for each other equipment mentioned in S.No. 6.1.

6.10.2 The type of equipment specified can be changed by the Engineer depending upon suitability of the equipment as per site conditions with the approval of CPM concerned subject to the following;

6.10.2.1 The total rate of production/output of proposed number and type of equipment should be equal to or more than that of the number and type of equipment stipulated in the contract agreement and quality of work is not compromised in any way;

6.10.2.2 Eligibility and Qualification Criteria (EQC) in the bid document did not include any past experience criteria of execution of a key activity with the use of particular type of equipment proposed to be changed;

6.10.2.3 Higher rates for works were not justified in the estimate or BOQ on account of use of particular type of equipment proposed to be changed;

6.10.2.4 Financial implications due to change in type and number of equipment shall be prepared and signed by both the parties and placed on record. If any financial benefit is found to accrue to the contractor, the same shall be recoverable from the contractor’s bills.

6.10.2.5 If the equipment proposed to be changed is covered under penalty. clause specified in note above, then the applicable rate of penalty per equipment shall be modified in proportion to increase/decrease in number of equipment.

Chapter – 7

7.0 BID DRAWINGS

7.1 Following drawings, reports and information etcare available in**Volume III** of the Bid Document

(i) Alignment and Longitudinal Section
(ii) Geotechnical Baseline Report
(iii) Borehole Data (Available in RVNL office for reference)
(iv) Tunnel Portals and other Underground structures.
(v) Approach roads.
(vi) Adit 7
(vii) Muck Dumping Areas
(viii) Station Yard Plan

7.2 The information contained in the tender drawings given in Vol-III are indicative and for guidance only. The contractor shall execute the works as per the approved construction drawings and specifications or as approved by the Engineer.

Chapter – 8

8.0 Geological and Geotechnical data of project

8.1 Geological and Geotechnical data of project is given in Geotechnical Baseline Report.

8.2 Geotechnical Baseline Report (GBR)

a) Geotechnical Baseline Report (GBR) is available as Annexure-C in Section: 5 Work's Requirement and presents the subsurface conditions anticipated during excavation of underground works while carrying out construction with specified means and methods. This report takes precedence over any other Geological or Geotechnical information, references or interpretations available in the tender documents or otherwise but is not to be treated as a warranty and actual conditions may vary from those anticipated in the report. For each category of subsurface condition observed during underground excavation, contractor will be obligated to perform at offered advance rates committed during submission of bid, based on specified construction means and methods defined in the tender drawings.

b) If at any time, the observed subsurface conditions varies substantially than those predicted and in opinion of contractor, requires an extension of time (for the milestone under consideration) as calculated from contractor's offered advance rates committed during submission of bid; then the contractor shall give such notice to the Engineer for extension of time for the associated works or part of the works, showing such calculations in table below (or any other suitable format as decided by the Engineer) for each concurrent excavation drive of underground excavation affecting that milestone.

Section type	Predicted Length according to GBR	Offered Advance rates	Offered excavation time	Anticipated Length according to actual excavation and unexcavated portion as per GBR	Offered Advance rates	Actual excavation time	Time Loss or Gain
1	2	3	4 = 2/3	5	6	7 = 5/6	8 = 7-4
…							
…							
Total			…			…	…

Note: Time loss for executing underground portions of work where the contractor has not followed approved methods of construction or engineer's instructions shall not be considered in table above.

ANNEXURE-A

(**TECHNICAL SPECIFICATION FOR TUNNELLING**)

Sub-Chapter	Description
1	SITE INSTALLATIONS AND SERVICES
2	SURVEYING
3	MATERIALS FOR CONSTRUCTION
4	DEWATERING, DRAINAGE AND PUMPING
5	EXPLOSIVE AND BLASTING
6	INSTRUMENTATION
7	OPEN EXCAVATION
8	UNDERGROUND EXCAVATION
9	STRUCTURAL STEEL SUPPORT
10	ROCK BOLTS AND WIREMESH
11	SHOTCRETE
12	STEEL FOR REINFORCEMENT
13	FORMWORK
14	DRILLING AND GROUTING
15	CEMENT CONCRETE

SUB CHAPTER-1

1.0 SITE INSTALLATIONS AND SERVICES

1.1 SCOPE OF WORK

1.1.1 Site installations, site clearance (including removal), services shall be carried out in accordance with the provisions of the Technical Specifications for Tunneling. The contractor shall include all the costs for such temporary works into the relevant unit prices unless specifically provided in the conditions, for the whole execution works on tunnel construction and for the whole period of construction.

1.1.2 The Contractor shall be responsible for providing plant, equipment, materials and labour for the provision of all necessary Temporary Works and services adequate for the execution of the Work under this contract.

1.1.3 The Contractor shall design, furnish, install, maintain and operate on the Site Constructional Plants as specified in this Chapter, including camps, workshops: warehouses, storage and assembly areas, all equipment, machinery, vehicles. Scaffolding, water and power supply etc.

1.1.4 Obtaining necessary clearance/ permission that are needed for construction, from various state/ central authorities for the equipments, water, power, sanitory and explosives shall rest with the contractor.

1.1.5 Temporary Works and services carried out by the Contractor shall conform to the applicable Indian Standard / Codes / laws, regulations and statutory requirements including compliance to railways codes/manuals/guidelines etc. stipulated for such purpose In-case no National Standard is available, International Standards are to be applied as approved by the Engineer.

1.1.6 The design, construction, operation and maintenance of the Contractor's Temporary Works and services shall be subject to inspection and approval by the Engineer.

1.1.7 The rights or customs of adjacent property occupiers for access shall not be infringed by the Contractor.

1.2 SUBMITTALS

1.2.1 Within 28 days from the commencement date, the Contractor shall submit to the Engineer, updated layout plans showing, to an adequate scale, the locations and arrangement of all enabling and temporary Works and facilities. These plans shall be consistent with the plans submitted by the Contractor with his bid as well as with any amendments and additions subsequently agreed to by the Engineer and the Contractor and shall include.

- **i.** Site offices, storages, parking areas, warehouses, materials yard, storage areas
- **ii.** Concrete and material processing plants," including cement storage.
- **iii.** Temporary road & bridge works, including public road diversions.
- **iv.** Communication System.
- **v.** Service vehicles.
- **vi.** Camps for Contractor’s Employees.
- **vii.** Commercial Establishments.
- **viii.** Medical facilities.
- **ix.** Power supply and illumination, telephone services (radio and cable).
- **x.** Maintenance of Traffic.
- **xi.** Ventilation of Underground System.
- **xii.** Air-cooling in underground works.
- **xiii.** Control of dust, silica and noxious gases in underground works.
- **xiv.** Water supply.

xv. Sanitation & sewerage, sewage treatment and disposal,
xvi. Waste & garbage disposal.
xvii. Security and safety arrangements.
xviii. Field laboratory along with list of equipments as required under Quality Assurance Programme.
xix. Equipment tools and mechanical workshops.
xx. Dumping areas, borrow, quarry and stockpile areas with development plans.
xxi. Explosive magazines.
xxii. Adequate back up power system.
xxiii. Measures to comply with environmental norms and various conditions.
xxiv. Muck disposal management.
xxv. Site Signage.
xxvi. Drainage plan during construction.
xxvii. Contractor Quality Plan
xxviii. Emergency Plan.

1.2.2 Within 42days from the commencement date, the Contractor shall submit to the Engineer the following:

i. Detailed drawings to a scale ranging from 1:100 to 1:500 showing the camp layout, buildings, roads, recreation areas, all utilities etc. and drawings to a scale of 1: 50 to 1: 1 00 showing typical building construction details.
ii. Drawings and Specification for the establishment of primary first aid stations dispensary and ambulances.
iii. Detailed design for industrial and potable water supply to the camps and working area as well as sewerage system, sewerage treatment and disposal with an estimate of number of people to be supplied with water. All the system shall comply with the environmental and pollution control norms as applicable.
iv. Detailed layout drawings for electrical installations and distribution systems on the site, showing voltages, outlets and routing of power lines. The system should include necessary power back up arrangements for uninterrupted construction work.
v. Detailed design and drawings including manufacturer's drawings for concrete and materials processing plants, including details of equipments for transportation and placement of concrete in accordance with the requirements of the pertinent Chapters of these Specifications.
vi. Details of the excavation, drilling and grouting equipment in accordance with the requirements set out in the relevant Chapter of these Specifications.
vii. Details of the underground ventilation system, which shall include all calculations of fresh air supply volume, type of ventilation scheme, duct diameters. Materials, equipment, position of ventilators and dust arresters. Description of the working cycle including number of persons employed, number and capacity of diesel-powered equipment working at each heading face shall also be included.
viii. Details of the dewatering system.
ix. Details of Field laboratory to be set up at site by the contractor.
x. Details of muck disposal and protection measures for compliance with Environmental Management Plan of the work specifications.
xi. The designs shall be consistent with the proposal submitted by the Contractor with his bid as well as with any subsequent amendments and additions agreed to by the Engineer and the Contractor. (The Engineer reserves the right to require any additional information deemed necessary to be included in the submitted

documents.)

1.3 DETAILS OF INSTALLATIONS AND SERVICES

1.3.1 The installations and services to be provided by the Contractor for the execution of Works under this Contract Shall include, but not limited to, the following:

1.3.2 CAMPS FOR CONTRACTOR'S EMPLOYEES

i. The Contractor shall design, construct, provide furnishings, maintain and operate construction camps at the suitable locations. The construction camps shall provide for the housing, feeding and recreation of the Contractor's employees and those of his subcontractors. Kitchens with provision of LPG facility for cooking (Fire wood not to be used), dining rooms, outdoor and indoor recreation facilities, family dwellings, dormitories, sanitary facilities, medical service, places of worship, roadways, drainage, fire control, commercial centers and all utility services (potable water, power, lighting, heating ventilating, sewerage treatment and disposal, cleaning and sanitation, garbage collection and disposal, etc.) shall be provided. The camps shall be large enough to accommodate the anticipated peak work force.The construction labour camp should be as per BOCWA / BOCWR. The contractor has to provide bio-toilets (separate for male and female) at Camp site as well as at all the construction sites. The user ratio shall not be more than that specified in point (iv) below.

ii. Camp area shall be provided by employer subject to availability of land after accommodating all plants, materials, employer's office etc. at site. No camp construction shall commence until the Contractor's drawings and Specifications have been approved by the Engineer.

iii. All camp building shall be of sound construction and connected to all utility services.

iv. Fixtures in the sanitary facilities shall be based on the following user ratios

A. 1 toilet for not more than 6 users

B. 1 tap for not more than 6 users

C. 1 washbasin for not more than 6 users.

The sewerage from the labour camps, work sites is to be properly treated before discharge by providing septic tanks, soak pits etc. or any other treatment as per norms recommended by the concerned authority.

v. Canteen facilities shall be provided by the Contractor in properly equipped canteen buildings for all his and his subcontractor's employees, if it is considered expedient.

vi. The Contractor shall be responsible for keeping the camps and buildings within it, in good hygienic conditions. The standards regulations presently in force in the project area with regard towater treatment, sanitary conditions, and fire and accident prevention shall be duly taken into account.

1.3.3 Site Offices, Stores, Warehouses, Materials Yards

i. The Contractor shall provide and equip, for his own and his subcontractors' use, main and secondary offices, warehouses, materials stock areas, fuel storage areas and explosive magazines, all of which shall be maintained in good condition until the completion of Works.

ii. The buildings, shops and warehouses expected to be constructed and equipped by the Contractor for use in the execution of the Works under this Contract, in addition to the facilities explicitly specified elsewhere in these Specifications shall be, but not limited to, the following:

A. Mechanical repair shop

B. Electrical repair shop
C. Metalwork fabrication and carpentry shop
D. Main warehouse and parts store
E. Bulk cement silo/cement store
F. Spare parts store.

iii. No dangerous goods, explosives, chemicals, fuels or similar items shall be brought onto the Site unless the Contractor has advised the Engineer of the intention to do so and has complied with all statutory requirements for its safe storage and security.

iv. The Contractor shall minimize the use of the Site for the storage of fuels, explosives and other dangerous goods as may be required for the construction of the works and shall not use the site or allow access for any purpose not connected to the Contract.

v. Dangerous Goods are only to be stored in nominated and approved storage areas and facilities which must comply with the Indian regulations governing such facilities.

vi. The contractor has to make appropriate provision for material storage sheds and tarpaulin sheets for loose construction material.

vii. The contractor has to make appropriate provision for dustbins and corresponding disposal of waste at labour campsite and at each work site.

1.3.4 Concrete and Materials Processing Plants

i. The Contractor shall install and erect all necessary material processing plants of sufficient capacity to meet the planned peak requirements during construction. The plants shall be subject to approval by the Engineer and shall be well designed and fabricated and kept in good running order to ensure compliance with the materials quality Specifications. All control and measuring equipment shall be regularly serviced and calibrated.

ii. The plants required to be assembled/erected by the Contractor shall be but not limited to the following:

A. Concrete aggregates processing plant ***(crushing and screening)*****.** The aggregate crushing plant should be provided with cyclone separator for dust suppression.
B. Concrete plant (batching and mixing)
C. Concrete cooling plant (refrigeration and ice plant), if required.
D. Grouting plant.

iii. Concrete & material processing plants shall meet all environment guidelines, conditions imposed for construction of project by MOEF/ Government bodies/ State pollution control boards and other statutory bodies at no extra cost to The Employer.

1.3.5 Temporary Roads and Bridges.

i. The contractor shall construct temporary roads / hauls roads, bridges & culverts to various facilities with corresponding retaining walls and breast walls. Contractor shall develop detailed drawings for the above and accordingly construct the same after approval of Engineer.

1.3.6 COMMUNICATION SYSTEM

i. Outside / Site Communication

ii. The Contractor shall install his communication system in the project area for national/ international voice and data communication. These facilities can be availed from the existing network of tele-communication or the contractor shall

make arrangement for providing these facilities through existing telecom operators.

iii. Communication System in Underground Works

A. Communication systems for underground space shall comprise of telephone/radio systems (walkie-talkie).

B. The Contractor shall install and maintain in operating condition, communication system by telephone or preferably an underground radio system approved by the Engineer between each heading face and entrance to the concerned tunnel / caverns. All the employer's site offices shall be well connected with the above communication system.

C. In case of telephone system, an intermediate Intercom station shall be located atleast every 250m or less along the tunnel.

D. **Deleted**.

E. All Communication system shall have sources of energy independent of the main energy supply for Underground works.

F. The availability of the communication from inside to outside the tunnel shall be ensured at all times throughout the duration of the underground construction.

1.3.7 Check In/Check Out Procedure for all persons entering any underground space:

i. The contractor must maintain an approved check-in/check-out procedure (in form of Name tag boards and RFID/Biometrics) to ensure that above ground personnel maintain an accurate accounting of the number of persons underground and to prevent unauthorized persons from gaining access to the site.

ii. **At any time when underground operations are underway, at least one designated person must be on duty above ground.** This person is responsible for calling for immediate assistance and keeping an accurate count of employees who remain underground in the event of an emergency.

iii. In addition to establishing a check-in/check-out procedure, the contractor must ensure safe access to and egress from all workstations at the construction site to protect employees from potential hazards, such as being struck by excavators, haulage machines, or other moving equipment.

iv. To help control access, all unused openings, including chutes and man ways, must be tightly covered, bulk headed, barricaded, or fenced off, and posted with warning signs that read, "Keep Out" or similar language.

v. RFID system/Bio-metric system for entry record into tunnel for all staff of contractor, employer and employer's representatives. Contractor shall submit record of entry and exit of all staff (Name, Personnel Type, Age, Gender and Agency) along with date and time every 1st and 15th date of month to the employer. The system should be able to transmit all recorded data between the desired dates through USB drive etc. Further the system should be able to generate fresh **RFID tags/Bio-Metric** entries when required for entry of new personnel previously not registered with the system.

1.3.8 Entry/Exit records for all vehicles (Employer, contractor, consultant etc.) including tunneling machineries entering any underground space:

i. The contractor must maintain an approved Entry/Exit record (in form of RFID TAG system) to ensure that above ground personnel maintain an accurate record of time of Entry/Exit and prevent unauthorized vehicles from gaining access to the site.

ii. **At any time when underground operations are underway, at least one designated person must be on duty above ground.** This person is responsible

for calling for immediate assistance and keeping an accurate count of the number and type of vehicles in the event of an emergency.

iii. RFID TAG System for record of entry/exit time for all vehicles: Contractor shall submit time record of entry and exit of all vehicles (Registration number, Vehicle Type and Agency) along with date and time every 1st and 15th date of month to the employer. The system should be able to transmit all recorded data between the desired dates through USB drive etc. Further the system should be able to generate fresh RFID tags when required for entry of new vehicles previously not registered with RFID system.

1.3.9 SERVICE VEHICLES

i. The Contractor shall furnish, operate and maintain sufficient service vehicles for use by his own staff and employees in the management, supervision and performance of the Work.

1.3.10 COMMERCIAL ESTABLISHMENTS

i. Market and shopping complexes are available at nearby towns of the project site, which caters to the local population of the area. The Contractor may establish, with the prior permission of the authorities of Government commercial place(s) in his camps for use by his employees.

1.3.11 MEDICAL FACILITIES

i. Indoor medical facilities are available near Rishikesh.

ii. In addition to above, the Contractor shall construct, equip and maintain on the Site, the following medical facilities:

A. One clinic with ambulance and driver at his main camp.

B. One first aid station at each work site.

iii. The contractor shall comply with laws and health standards in force in the project area. In the event of an epidemic breaking out, the Contractor shall carry out and comply with all or arrangements or regulations, which may be issued by Government or local authorities.

iv. These facilities shall be fully equipped and staffed to meet requirements of the maximum anticipated workload and labour force, taking into consideration the nature of the Works, its occupational hazards, location and accessibility. These establishments shall be available and fully operational within 60 days after the date of issue the Letter of Acceptance.

v. Medical services in the clinics shall be under the direction of qualified doctor on a 24 hours basis throughout duration of the construction and shall be available free of charge persons engaged in the Works and their families or dependents on the Site.

vi. Treatment facilities and care of seriously ill or injured persons shall be on an emergency basis until their transfer to an established hospital.

vii. All the labors to be engaged for construction work shall be thoroughly examined by health personnel and adequately treated before issuing them work permit by contractor.

viii. **Throughout the project duration, the contractor must maintain one 5-person rescue team within 30 minutes travel time from the job site.** Rescue team members must be trained in rescue procedures, the use and limitations of breathing apparatus, and the use of firefighting equipment with qualifications reviewed annually. When flammable or noxious gases are anticipated at a jobsite, rescue teams must practice using self-contained breathing apparatus once a month. The rescue teams must be available through the duration of a construction

project.

1.3.12 POWER SUPPLY AND ILLUMINATION

i. General.

A. Contractor has to make his arrangements at his own cost for entire construction power including any standby power requirements. Equipments/ transmission lines required for distribution and utilization of energy at Construction site for Power, light etc. shall be installed by the contractor on their own.

B. Power to be used by Contractor for their Labour and Staff Colony shall be arranged by contractor on their own and at their own cost.

C. Contractor shall arrange DG sets of adequate capacity at his cost to meet back up and emergency power supply requirement including lighting, dewatering & ventilation.

D. Contractor shall indicate in his proposal of the phase wise requirement of Construction power (HT) at above-mentioned locations.

ii. Power supply and Illumination provided by the Contractor

A. The Contractor shall install, operate and maintain electrical distribution system, which shall include transformers, circuit breakers, disconnection and safety switches, voltage regulators, lines, poles, pole hardware, conductors, meters and other equipment necessary for power distribution throughout the Site and temporary facilities.

B. An alternative source of emergency lighting system shall be provided every 50m at key points underground to allow emergency securing operations and evacuation safely in the event of a primary power failure.

C. The Contractor shall ensure adequate illumination for all his operations on the Site and at the Camps, including illumination of the streets. The contractor shall maintain equipments and arrange device to measure light intensities for illumination as follows:

	Area of Operation.	**Luminous Intensity**
(a)	Excavation and dumping areas and outdoor access ways	35 Lux
(b)	General construction areas, concrete placement, excavation and waste areas, access ways, active storage areas, loading platforms, refueling, and field maintenance areas.	50 Lux
(c)	Indoors: warehouses, corridors, hallways, and exit ways.	50 Lux
(d)	Tunnel and general Underground Work areas	50 Lux
(e)	Tunnel headings during drilling, mucking and scaling	100 Lux
(f)	General construction plant and shops, e.g. batching plants, mechanical and carpentry shops, active storerooms, barracks or living quarters, mess halls and indoor toilets	100 Lux
(g)	First aid stations, infirmaries and offices.	350 Lux
(h)	Welding	300 Lux

D. The vaults along the entire length of the tunnel shall be illuminated with electrical light throughout the duration of, construction works. The lamps shall be provided in two rows with each row lamp spacing of 10 m in unlined stretches and 20 m in lined stretches. Contractor shall suitably modify the spacing and capacity of lights to meet the illumination requirements mentioned above.

E. Electrical cables shall be well insulated, protected and firmly fixed to the walls of

the tunnel by means of adequate insulators; lamps shall be well protected against damage.

F. The Contractor shall also provide suitable movable lamps to iIluminate any area in Underground Works including areas for instrumentation and where the Engineer may wish to carry out inspection and rock mechanics tests or instrumentation.

G. No energized electrical cable shall be permitted nearer than 70 m to the heading face while charging explosives. Accordingly, suitable high-powered light arrangement shall be made to have adequate illumination at the tunnel face.

H. Lighting illumination by flame is expressly forbidden in the Underground Works.

I. Whenever more than one agency is working in the same area, the Contractor, who has already provided lighting I Power supply arrangements, shall extend the facilities to the other Contractor, who shall pay for such facility of utility at mutually agreed rates. In case of disputes, the matter shall be decided by the Engineer, whose decision shall be final.

iii. Earthing of Wet work Areas, Control of Electric Discharges

A. All equipment and appliances, which are exposed to lightning, shall be earthed electrically, and the Contractor's specialized personnel shall periodically check the effectiveness or such earthing.

B. Personnel standing in water shall operate no equipment electrically powered by more than 24 Volts.

C. Only air, battery-powered or hydraulic tools shall be permitted in the wet areas.

D. Where electrical blasting is used, equipment shall be installed to control possible electric discharge in the ground due to storms, electric motors, etc. As soon as such discharges are noted, electrical blasting operations shall be suspended, or the detonator type changed.

1.3.13 MAINTENANCE OF TRAFFIC

i. The Contractor shall be responsible for the safety along the roads related to the Site. Where the work is carried out on the Site of, or close to an existing road, the Contractor shall maintain the vehicular and pedestrian traffic safe at all times. If his operations can cause traffic hazards, he shall repair or fence or take such other measures for ensuring safety that are satisfactory to the Engineer.

ii. The Contractor shall submit his activity, schedule and the locations of his work along the existing public roads to the authorities concerned and obtain all necessary approval prior to the commencement of the respective work.

iii. At the road crossings or in heavy traffic locations, the Contractor shall carry out the Work within the working hours as directed by the Engineer, and after the completion of the work he shall immediately make the necessary backfill and pavement at the crossings.

iv. The Contractor shall provide temporary passes and badges to give an access to the existing village houses, etc., to the satisfaction of the Engineer and the authorities concerned whenever he disturbs such existing way during the execution of works.

1.3.14 VENTILATION OF UNDERGROUND WORKS

i. General

A. The Contractor shall design, install and operate ventilation system for the Underground Works and provide an underground atmosphere monitoring system.

B. All parts of the Works shall be maintained in a state, which will not be injurious to the health or the personnel. The air in underground works shall contain no less than **20% oxygen** (by volume) and shall not contain concentration of gases, vapors or dust greater than is prescribed in the safety standards for the health or workmen.

C. If required, the ventilating system shall be kept in operation also after break-through in tunnels in order to maintain the fresh air-volume requirements stated hereinafter.

D. Intermediate fans attached to the main duel line shall be provided as required to ensure satisfactory removal of contaminated air. All ventilation ducts shall be maintained in a good condition to prevent any leakage.

E. Ventilation ducts shall be firmly fixed to the vaults in such position that a minimum clearance of 30 cm remains between the duct and the extremities of vehicular traffic employed in the Underground Works.

F. The Contractor shall ensure the required quantity of fresh air at the heading face. The check of the airtightness of joints and control of the air ducts for leaks shall be performed periodically. The Contractor shall immediately repair any deficiency discovered or reported by the Engineer.

G. If the volume and quality of fresh air at the heading face is less than that specified, then the whole duct system shall be pressure and volume tested in portions not exceeding a few hundred meters. Measuring stations shall be located not closer than 10 times the duct diameter from any fan or other flow disturbance within the Main Line.

H. No work shall be permitted to be carried out unless the ventilation is provided to the satisfaction of the Engineer. Indoor Air Quality standards as described in EPA,1986 (with latest amendments) be adhered to.

ii. Ventilation System for Tunnel excavation

A. DELETED

B. The ventilating system shall be of such efficiency that the **average air velo**city in the largest excavated profile is not less than **0.3 meters per second**. In case the presence of methane gas is detected or suspected, this value shall be increased to 0.5 meters per second.

C. The main ventilation system shall ensure that both following minimum fresh air volume requirements are satisfied at all times

(a) 5.70 m^3 per minute for each person employed in the Underground Works at one time.

(b) A minimum of 2.00 m^3 of air per minute shall be supplied additionally for each metric horsepower of diesel-powered equipment deployed in the underground works alone time.

These fresh air volumes shall be cumulative, and the Contractor shall allow, in his design calculations, for the maximum number of persons and diesel-powered equipment deployed in the Underground Works at any one time. Any estimated losses, e.g. due to the leaks in the ducts, shall be added to the figures stated above.

D. DELETED

E. The secondary ventilation equipment of the forced type shall be installed to provide an adequate ventilation of the area between the heading face and the air intake/outlet of the main system. This system shall be switched on prior to the blasting and shall remain operative until the main system has been put into exhaust mode of operation. The air intake shall be located at a sufficient

distance from the heading face to ensure that blasting fumes do not permeate into this area and cause a recycling of blasting fumes. The outlet of thisduct shall be located so close to the heading face that the driving of the blasting fumes and dust away from the face into main system is ensured. The minimum capacity shall be at least 70% of the main system's capacity. The end diameter of the duct shall be such that the air discharge velocity is not less than 20 meters per second.

F. Re-entry into the heading face and resuming of the work shall not be permitted until all blasting fumes have been ejected out.

G. Subject to meeting the minimum functional and safety requirements of ventilation the engineer may allow other systems of ventilation also as proposed by contractor. This shall in no way absolve contractor from his obligation to meet the necessary requirements of ventilation at any time during work.

H. All equipment and ventilation duct shall always be maintained in sound working order. Any damage to ventilation duct shall be repaired within 12 hours of the damage.

I. Ventilation ducts must be maintained in straights alignments as much as possible and with plain cross sections avoiding unnecessary curves, reduction and rotations of the cross sections and always without any damage of the ducts.

J. Ventilation ducts must follow the advance of the tunnel excavation, being the extremity of the duct no more distant from the front face than 20m. In any case this distance shall be reduced if the quality of the air in the front face does not follow health and safety specifications.

K. Whenever excavation proceeds more than 2 kms from any portal then contractor will be required to install booster ventilation fans to enhance ventilation capacity and install LT lines to reduce transmission loss over long lengthsif other methods are not effective, for which nothing extra shall be paid.

1.3.15 AIR COOLING IN UNDERGROUND WORKS

i. The Contractor shall make suitable arrangements for cooling of air so as to maintain the temperature in the underground construction sites below 30^0 Centigrade under all conditions.

ii. The temperature shall be measured by the Contractor daily. Temperature measurements shall be taken during normal working conditions with the specified degree of ventilation.

iii. The maintenance of construction progress and control of temperature shall be entirely the responsibility of the Contractor under all conditions. No claim or extension of time for the completion of Works shall be allowed on this basis of high / low temperatures experienced in the course of the work for any reasons, whatsoever. However, Geo-thermal conditions are not anticipated by employer, Temperature meter for measurement of temperature shall be supplied and or installed & maintained at required location by contractor at his own cost.

1.3.16 CONTROL OF DUST, SILICA AND NOXIOUS GASES IN UNDERGROUND WORKS

i. The Contractor shall install and operate equipment for the monitoring and Control of dust, silica and noxious gases in Underground Works as described here under.

ii. Dust and Silica

A. To reduce the amount of dust, only wet drilling will be allowed and during mucking, muck piles shall be kept constantly damp by sprinkling with water. The

use of high-pressure water jets for this purpose will not be permitted.

B. The Contractor shall measure and monitor the concentration of fine dust and content of silicon dioxide. ($Si0_2$) in all dust producing underground operations by a method to be approved by the Engineer.

C. Air Samples shall be taken within 10 days of commencing underground excavation, at 30 days intervals thereafter and within 20 days following major changes in tunnel excavation operation, or whenever required by the Engineer. Samples shall be taken from actual working areas. A qualified person in laboratory to be proposed by the Contractor and approved by the Engineer shall perform the sampling and testing. A copy of the test results shall be submitted to the Engineer within 2 weeks of the sampling date.

D. The concentration of fine dust (diameter less than 0.005 mm) may not, in general exceed the value of 8.0 mg/m^3 of air and this value will be further reduced depending upon the extent of SiO_2 content in rock as detailed in the table below:

Content of SiO_2 in fine dust in percent by weight.	**Concentration of fine dust in milligrams per cum of air.**
1-15 %	8.0 mg / M^3
20 %	6.0 mg / M^3
30 %	4.0 mg / M^3
60 %	2.0 mg / M^3
80 %	1.5 mg / M^3
100 %	1.3 mg / M^3

E. Should the concentration of the fine dust exceed the limits stated above, the Contractor shall undertake such necessary measures and install such additional equipment which will ensure that the dust concentrations are within the specified safe hygienic limits.

F. All staff entering underground work site shall be equipped with PPE including respirators suited for the work.

iii. Noxious Gases

A. Use of internal combustion engines, other than approved mobile diesel-powered equipment will not be permitted in underground construction Sites.

B. The Contractor shall provide and maintain equipment for measuring and monitoring the content of noxious gases and oxygen at each heading face throughout the duration of excavation works. Tests for determining concentrations of carbon monoxide, carbon dioxide, nitrogen dioxide, methane, other inflammable gases, and oxygen Shall be made by qualified personnel before and after each blasting and at the beginning of each shift. A record of reading shall be maintained and be made available to the Engineer as and when asked for.

C. Gas concentrations in underground sites will not exceed the following limits:

0.005 %	50 ppm of carbon monoxide.
0.5 %	5000 ppm of carbon dioxide.
0.0005 %	5 ppm of nitrogen dioxide.
0.001 %	10 ppm of hydrogen sulphide.
0.1 %	1000 ppm of methane.
0.01 %	Milligrams per litre of nitrous oxide.

D. After each blast, before entering the blast area, the concentration of toxic

gases will be checked to ascertain the efficacy of ventilation system. The engineer in addition may direct the contractor to measure the concentration of toxic gases during other operations also. Contractor will always keep all measuring instruments in a ready state . All such records shall be signed jointly by both parties immediately after measurement.

E. Concentrations of other inflammable gases shall not exceed 40 % of the lower explosive limit at the heading face and 20 % of the lower explosive limit elsewhere in the tunnel.

F. If concentrations of noxious gases or other inflammable gases exceedthe permissible limits set forth above, all operations shall be interrupted immediately, and personnel shall be removed to a safe area. All sources of ignition shall be extinguished or removed. All equipment with the exception of ventilation equipment shall be shut down.

G. The required measures will be mutually determined and agreed to by the Engineer and the Contractor. In case of need, the Contractor shall engage the services of an independent Consultant experienced in gaseous tunneling. Re-entry and resuming of the Work shall be prohibited until the Engineer has authorized re-entry.

1.3.17 WATER SUPPLY

i. The Contractor shall design, Install, operate and maintain two separate water supply systems on the Sites

A. **Industrial Water:** For general construction use, treated to the extent necessary to meet specified requirements of Works.

B. **Potable water:** For supply to all buildings and plants requiring high quality water meeting requirements for drinking water supply.

ii. Water shall be, supplied by the Contractor from any suitable sources. The water being supplied shall be free of contamination and unaffected by the Site construction Work.

iii. The Contractor shall furnish, install, operate and maintain all pumps, pipelines, fittings, valves, storage tanks purification plant and chlorination for the Water supply and distribution systems, adequate in quantity and pressure. Industrial water shall be used for construction purposes only. There shall be no cross connections of any kind between the industrial and potable water supply systems. Only potable water shall be piped into buildings.

iv. The Contractor shall provide adequate water treatment facilities so as to ensure that the treated water is supplied for drinking purposes to all the camps and construction places.

v. Ample number of drinking points of potable water shall be provided by the Contractor for the use of personnel in all working areas.

1.3.18 SANITATION AND SEWERAGE

i. Toilets shall be provided and maintained by the Contractor for the use of all personnel at all work locations, which are remote from the fixed sanitary facilities. The Contractor shall arrange for all chemical toilets to be attended to daily for proper sanitary disposal.

ii. All offices, workshops, laboratory and other occupied work buildings shall be provided with toilets connected to property constructed and regularly maintained septic tanks approved by the Engineer.

iii. The camp sites shall be provided with a complete, properly maintained and operated sewerage system, including septic tanks, sewage treatment and disposal

facilities. Facilities for washing clothes shall also be provided and linked to the sewerage system.

iv. Sanitation,seweragesystem and contaminated water from the tunnel excavation shall meet all environment guidelines conditions imposed for construction of project by MOEF / Government Bodies at no extra cost to the Employer.

1.3.19 DUMPING AREAS, WITHDEVELOPMENT PLANS

i. Dumping areas lands acquired by employer near the tunnel portal will be made available for muck disposal purposes. Tender drawings show the available land demarcated and reserved for muck dumping under the scope of works. The technical specifications for developing and rehabilitating the muck disposal sites shall be as submitted by contractor and agreed by the Engineer.

ii. The contractor shall make necessary arrangements for the management of muck disposal so that it meets all the environment guidelines / conditions imposed for the construction of project by MOEF / Govt. bodies / State Pollution control board and/or other statutory bodies.

1.3.20 WASTE AND GARBAGE DISPOSAL

i. The Contractor shall daily collect waste material and garbage from camps, offices and workshops and transport it to an area approved by the Engineer, where it shall be incinerated and buried or disposed off as approved by the Engineer.

ii. The site shall be kept clean and free of refuse at all times. No waste shall be dumped in areas other than those approved by the Engineer for waste disposal. No waste of any kind shall be deposited in any watercourses.

iii. Waste and Garbage disposal system shall meet all environment guidelines and conditions imposed for construction of project by MOEF/ Govt. bodies at no extra cost to The Employer.

iv. The contractor has to make appropriate provision for Oil / Grease interceptor at refueling stations and at fuel storage locations.

1.3.21 SETTING UP OF FIELD LABORATORY

i. The Contractor shall establish a field laboratory for ensuring quality control measures for the Works, as detailed under Quality Assurance Programme described elsewhere in the tender documents.

ii. Prior to setting up of laboratory, Contractor shall submit detailed building plan with exhaustive equipment-list clearly showing the different area for equipment with sizes of the equipment and circulating area, and CV's of qualified personnel identified for laboratory work to the Engineer for approval. The laboratory shall be headed by an experienced graduate civil engineer. All the equipment shall be confirming to either the relevant IS or international standards.

iii. Upon receipt of Engineer's approval, the Contractor shall construct, maintain and operate an integrated laboratory which provides sufficient rooms and equipment to test aggregates, concrete samples, plain shotcrete and SFRS samples, soil and rock samples, rock bolts capacity tests, nuclear gauge tests to control the density of the compacted layers for earthworks, etc. **The laboratory shall be established as early as possible as but not later than three months from the date of issue of Letter of Acceptance.**

iv. The Contractor shall collect the samples, carry out the relevant tests, prepare the complete reports and submit them to the Engineer.

v. All tests will be made according to approved standards, and the testing equipment shall comply with the same standards. All relevant standards shall be made available in the laboratory by the Contractor.

vi. The laboratory shall be provided with light, ventilation, water supply, tank for curing, toilet, office for operators and responsible for laboratory, archive etc. and be spacious enough in order to store indoor the test samples

1.3.22 LAND REQUIREMENT

i. Employer has acquired the required land for permanent components of the project work, approach roads to various project components and muck dumping sites, which shall be handed over to the contractor on as is where is basis. Tender drawings show the available land acquired and major permanent structures required to be constructed. The contractor shall organizethe installation site in a way that his temporary buildings, plants, equipment etc will not hinder the final/permanent works. The land shall be used primarily for execution of work of the project and muck disposal. If contractor requires to use land required for development of station areas/ muck dumping, the contractor will sequence his activities to avoid re-shifting of plants and machinery once installed.The contractor will seek approval of the Engineer for setting up of site facilities on land acquired for the project. Nothing additional will be paid for re-shifting of any plants and machinery to the contractor. Extra land if needed by the contractor for setting up of any of his facilities, such cost of land will be borne by the contractor.

ii. Contractor shall submit his scheme of land utilization including muck disposal and subsequently construct the same after obtaining due approval of the Engineer.

iii. Muck generated in the works may be used by contractor for constructing his facilities / filling works etc. free of cost. The royalty payment and/or any cess leviable by the statutory authority shall however be payable by the contractor by such usage. Unusable muck shall be placed in muck disposal area.

iv. Any Government duties, cessetc. levied by the statutory authority for land use outside railway land shall be borne by the contractor at no extra cost to the Employer.

v. Before demobilization, the contractor shall remove all his temporary facilities which were installed for execution of the work and restore the land to its original state for all such land used as in (i) above.

vi. Unless it is unfeasible, the contractor shall segregate the topsoil and store it separately, so as to dump it back in the permanent works at the appropriate locations.

1.3.23 FENCING AND SITE SECURITY

i. The Contractor's offices, workshops and storage compounds, campsites and all construction areas, where exclusion of unauthorized personnel is necessary for safety and security, shall be adequately fenced, gated and guarded. A central guardhouse shall be established at each main entrance to the Site.

ii. The Contractor shall employ adequate force of properly trained security guards at the worksite and at the construction camps on 24 hours duty including Sundays and holidays. Storage areas shall be fenced, lighted and regularly patrolled by security guards. Warehouse buildings and explosive magazines shall be kept locked and keys accounted for at all times.

iii. All employees engaged in the execution and maintenance of the Works shall wear identification badges when at the worksite.

iv. The Contractor shall be entirely responsible for the losses occurring in his installations and those of the Engineer, resulting from carelessness on the Contractor's part.

v. The contractor has to make appropriate provision for LED Lights on top of the

barricading and provision of the noise enclosures over the tunnel portals.

1.3.24 SITE SIGNAGE

i. Prior to the commencement of work at the Site, the Contractor, at the direction of the Engineer, shall supply and erect reflector site sign at all work sites for the information of the public at all entrances to the Site, containing the following information, clearly visible and legible (In English and Hindi language) to passersby intended for the information of those affected by the Contract Works, for the guidance of those making deliveries and for general public safety:

A. Name of Project;

B. Name of Employer;

C. Name of Contractor;

D. Restrictions on access and appropriate safety warnings.

ii. The Contractor shall also maintain such signs throughout the contract period with up to date information and free from disfigurement.

iii. The Contractor shall also supply, erect and maintain appropriate reflector site signage and safety warning signs as are appropriate for the nature of the work being undertaken. No other signage or advertising materials shall be permitted on the Site, except with the specific consent of the Engineer.

1.3.25 MOBILIZATION

i. Contractor shall furnish all the labour, materials, equipment and shall perform all work required for mobilization to the Project Site.

ii. Mobilization shall include, but not be limited to moving personnel, plant, and equipment to the Site; arranging for necessary Site utilities; establishing camps, shops, offices and administrative facilities; and obtaining all required permits, licenses, and other regulatory authorizations required for the construction of the Project.

1.3.26 DEMOBILIZATION / FINAL CLEAN UP

i. Upon the Completion of Works, or when any plant has completed its functions, the Contractor shall dismantle and demobilize all temporary facilities and remove all refuse, debris objectionable material to areas approved by Engineer, and fill, grade and dress all excavated areas in a clean and proper condition acceptable to the Engineer. All such areas as far as possible shall conform to the natural appearance of the landscape. No extra payment shall be made on this account.

ii. Contractor shall furnish all the labour, materials, equipment and shall perform all work required for demobilization from the Project Site.

iii. Demobilization shall include, but shall not be limited to: removing all plant, equipment, and temporary facilities from the Site; disconnecting temporary utilities; relocating personnel from the Site; cleaning-up and restoring all areas occupied by the Contractor; closing out permits, licenses, and other regulatory authorizations; and disposal of all waste materials and excess construction materials which are not the property of the Employer.

iv. No demobilization or removal of temporary facilities and equipment shall be made without the prior approval of the Engineer.

1.3.27 INSPECTION BY ENGINEER

i. The Engineer shall have the right at any time, to inspect any part of the Contractor's temporary facilities without advance notification and to require immediate rectification of any contravention of the specified requirements.

1.4 PAYMENT FOR SITE INSTALLATIONS AND SERVICES

1.4.1 The Contractor's initial mobilization costs such as purchase and transport of Constructional Plant and materials to the Site, planning, designing, installing, operating, maintaining and removal of all Temporary Works, Site installations, Services and facilities, making submittals to the Engineer, recruiting and transferring staff, obtaining rights of way, providing and maintaining temporary site roads, providing power at working area, offices, worker's colony, generating standby power for construction purposes, clearing and, grading areas for temporary facilities, and any other costs involved in preparation to carry out the Permanent Works or items mentioned under this sub-chapter, **shall not be paid separately** (Except where mentioned specifically), but shall be deemed to be included in the rates quoted by the contractor for all the items of works. Charges if leviable for use of water or any other charges imposed by state/local authority for any of the site installation and services to be developed by contractor, the same shall be borne by contractor.

1.4.2 Equipment required for measuring Gases, fumes, lighting and ventilation: Contractor shall maintain all measuring equipments required to satisfy condition mentioned in this sub-chapter in satisfactory and running condition and shall regularly calibrate them in case of any discrepancy noticed or as advised by engineer. Further necessary record keeping shall also be done and submitted to employer regularly. **No separate payment will be made to the contractor on this account.**

1.4.3 Payment for monitoring of following environmental attributes during construction outside tunnel shall be paid separately as per relevant items of the BOQ:

- **i.** Air Quality (Ambient Air Quality monitoring, as per NAAQM guide lines) and assess parameters such as Sulphur Dioxide (SO2), Oxides of Nitrogen (NOX), Carbon Monoxide (CO), Hydro-Carbons (HC), Suspended Particulate Matter (SPM), Respirable Particulate Matter (RPM), Ammonia (NH3), Ozone (O3), Lead (Pb), Benzo (a) pyrene (BaP), Arsenic (As) and Nickel (Ni)).
- **ii.** Noise Levels (Noise level monitoring for monitoring Noise level on dB (A) scale as per CPCB standard specifications).
- **iii.** Water Quality (Water Quality (As per IS 10500 and IS 2296) for parameters such as pH, BOD, COD, TDS, Pb, Oil & Grease and detergents for surface water, Water pH, TDS, Total hardness, Sulphate, Chloride, Fe and Pb).

1.4.4 No extra payment shall be made separately for monitoring of above-mentioned environmental attributes during construction inside tunnel.

1.4.5 Payment for developing and rehabilitating the muck disposal sites as agreed by the Engineer shall be paid separately under relevant item of Bill of quantities or through additional items.

SUB CHAPTER -2

2.0 SURVEYING

2.1 SCOPE OF WORK

2.1.1 Theemployer has already established certain benchmarks and alignment references. These benchmarks and alignment markers are required to be validated by the contractor. Any error found in these benchmarks and alignment markers shall be rectified by the contractor with the approval of the Engineer. The contractor is also required to maintain these benchmarks provided by the employer throughout the period of construction. The survey to be done by the contractor shall be done by establishing the control points along the proposed railway alignment through the use of DGPS. All these control points will then be connected to the nearest GTS Benchmark using the Total Station.

2.1.2 These services cover in general transfer of control points to working area, the establishment of axis, centerlines, alignments of project structures and features, the setting out for construction thereof; the accompanying control surveys for correct locations, dimensions and elevations as well as the necessary surveys for measurement to permit quantity calculations for billing.

2.1.3 Such surveys shall be based on and/or referred to existing basic grid of datum points, triangulation points and benchmarks extended adjacent to the Work in the project area. This grid shall be the sole basis of reference for all survey work and measurement.

2.1.4 High precision direction measurement of the alignment shall be done at every approx. one km of excavation or as decided by the ENGINEER by use of surveying gyroscopesi.e. Gyromat or similar, at the cost of the contractor.

2.1.5 Contractor has to make the survey of the excavated profile and control the tunnel sections after mucking, after installation of the primary support, prior to the installation of the felt for the protection of the water proofing membrane and after the lining works all along the length of the tunnels to control alignment, envelopes, excavated areas, primary support thickness and the position of the work-forms and final lining geometry, thickness and areas. The quality plan to be submitted by the contractor to the engineer should give a detailed methodology duly indicating the schedule required to cover all the aforesaid survey items that the contractor has to deliver to Engineer and also has to include when the topographical survey of the tunnels and portals has to be carried out.

2.1.6 Responsibility of carrying out the work to correct line and level shall, however, continue to devolve on the contractor notwithstanding the fact that approval for any benchmark and/or alignment marker may inadvertently have been accorded by the Engineer. Consequently, any expenditure incurred by the contractor for rectification of the permanent and/or temporary works constructed to wrong line/level shall not be payable by the Employer.

2.2 SUBMITTAL

2.2.1 Within 28 days from the commencement date, the Contractor shall submit to the Engineer for his approval a proposal of the sequence of the survey works to be performed, the biodata of the key personnel & in-charge of survey works, the list of survey equipment and instruments the Contractor will have available at the site, and a brief outline on methodologies of survey works to be applied for the various types of survey.

2.2.2 At least 7 days prior to the commencement of any survey work, the Contractor shall inform the Engineer of his intention to perform the survey work. The Contractor shall

indicate the purpose of the survey, the area to be surveyed, the structure or facilities involved, the methods to be applied and the survey period.

2.3 MATERIAL AND INSTRUMENTS

2.3.1 The Contractor shall provide, maintain and operate suitable and appropriate equipment, instruments, materials and auxiliary equipment, commensurate with various tasks and precision requirements of the survey works.

2.3.2 Type and accuracy of the survey equipment to be used by the Contractor shall correspond to the nature of the construction, erection works and the construction technique.

2.3.3 All equipment, instruments, materials and auxiliary equipment shall be in perfect operating condition. Prior to the start of survey activities, equipment, instruments, etc., shall be checked as to their proper functioning and accuracy.

2.3.4 During the construction period, the survey instruments shall be checked and adjusted / calibrated at regular time intervals.

2.3.5 Instruments and equipment which have suffered from use, damage or accidents to the extent that they are unfit for further use at the site, shall be removed from the site and replaced immediately.

2.3.6 The contractor should ensure availability of sufficient quantity and quality of survey instruments including provision of professional staff, to avoid any delay in the construction.

2.4 EXECUTION

2.4.1 General

i. For the execution of the survey work the Contractor shall employ and provide experienced professionals and auxiliary staff. All survey and measurement work shall be recorded and filed thoroughly.

ii. The Contractor shall provide, maintain, adjust when necessary and operate the required survey and auxiliary equipment for the performance of the Work.

iii. All survey and measurement activities shall be recorded in maps and field books as directed/approved by the engineer. Where required, the production of drawings and maps shall be deemed to be part of the work.

iv. The Engineer shall have the right to check work performance, accuracy stations, etc., and all survey results, measurements and calculations as well as conformity with plans and drawings.

v. The Contractor shall keep and maintain professional records of all field surveys and measurements, the related computations and calculations, manuscripts, plans, drawings and maps, and shall make them available to the Engineer whenever requested.

vi. If in the opinion of the Engineer, deficiencies and/or inaccuracies in field and office work have been found, such work shall be repeated and made good to the satisfaction of the Engineer at the Contractor's expense. The Contractor shall be solely responsible for accuracy of Survey maps and drawings prepared out of the surveys.

2.4.2 Preparatory Works

i. Prior to starting survey works, the Contractor shall inform his surveyors of the general construction procedure, survey requirements and time limits. The

surveyors shall make adequate terrain investigations with respect to sightings, vegetation to be removed, placement of datum points, reference monuments and benchmarks, taking into consideration future construction work which may affect the survey. Based on these investigations, a survey plan shall be developed comprising existing basic data, the survey grid to be developed, the equipments required for the particular survey task. Staff and time requirements arrangement in a way to warrant smooth progress of construction works.The plan shall be submitted to Engineer in charge for approval.

ii. All survey work shall be done within greatest care and precision.

2.4.3 Verification of Survey Grid

i. The contractor shall verify the basic survey grid.

ii. All coordinates and elevations as shown on the Drawings are based on the basic survey grid. If after having executed the verification, the basic survey grid reveals inconsistencies, which may affect the location, alignment and elevation or structures of the works, the Engineer shall be forthwith informed of these inconsistencies by the Contractor.

iii. The Contractor shall record all calculations, control surveys, setting out and check surveying in a suitable permanent form for verification, which shall be available to the Engineer on request at all times.

2.4.4 Augmentation of Basic Survey Grid

i. Existing datum points and benchmark located very near to the permanent structures may be endangered by construction activities. The Contractor shall therefore in due time establish additional datum points at safe locations and elevations to augment or extend the basic grid.

ii. The new datum points shall be of permanent nature and shall be constructed as, directed by the Engineer.

iii. The Contractor shall also establish reference monuments for center lines and line control of structures, which need frequent and extended control surveys for tunnel alignment and connected works.

iv. New datum points, reference monuments and benchmarks shall be protected and maintained in the same way as the original grid points.

2.4.5 Survey of Ground Profiles

i. Original Ground Profiles.

The Contractor shall inform the Engineer in writing, at least 14 days before commencing such work, of his intentions to perform any work which will result in a change to the topography of the existing site for the permanent works and or for temporary works. Thereupon, before commencing any work, the contractor shall survey the original topography with the approval of the Engineer over the entire area to be occupied or disturbed. Such survey may again be required after removal, of vegetation, topsoil or other overburden. The Contractor and the Engineer shall record the information so obtained. The contractor shall then provide the Engineer with a reproducible copy of each drawing to serve as a permanent record of the purpose of determining the quantities of excavation or earth works carried out in the construction of the permanent structures,Such records will also be required to ascertainthe extent to which Temporary works shall be removed or temporary excavations shall be refilled upon completion of the works.

ii. The Contractor shall also survey all excavated and final surfaces for the purpose of recording as constructed details, and for the measurement of quantities.Such survey shall be required at the following two stages:
A. On completions of excavation and prior to placing concrete or other work.
B. On completion of works.

2.4.6 Setting Out Works

i. The contractor shall perform all setting out and check surveying of the Works in accordance with methods approved by the Engineer. The methods and programme of checking shall be such as to ensure the construction of every part of the Work to the correct line and level. The Engineer may at any time ask the contractor to submit proof that his own setting out has been satisfactorily checked.
ii. The number of points required for setting out as well as the spacing between these points shall be determined by the Contractor in accordance with the type of work. The Engineer may require that some or all of the given points and datum levels be clearly marked during construction in such a way that the marks can be retained after completion of construction.

2.4.7 Setting Out Checks

i. Contractor should carry out the Net Survey (Close traverse) regularly at least once in two months while executing the work of underground excavation and will submit the results to the Engineer to ensure that progress of excavation is correct as per design alignment.
ii. The Contractor is expected to liaise with the Engineer to program the check survey to be carried out during non-production periods or in parallel to construction activities such that the minimum delay or inconvenience is caused to production works, wherever and whenever possible. The Contractor shall afford the Engineer, every cooperation and assistance in this regard including but not being limited to the provision of survey equipment, drainage, lighting, ventilation and the removal of Contractor's equipment and other obstructions such that they do not interfere with the setting out checks.

2.4.8 Tunnel Alignment and Gradients

i. The Contractor shall establish and maintain at suitable distances from tunnel portal at least three (03) reference monuments and benchmarks on the extended tunnel axis/alignment, to warrant that control surveys during tunnel construction can always be referred to such reference monuments. They shall be secured by auxiliary fixed points permitting the reconstruction of the reference monuments in case these have suffered any damage during tunnel excavation periods.
ii. Establishment and control surveys of the tunnel alignment and the gradient shall always be referred to such reference monuments.
iii. Underground alignment and level survey and control thereof shall be performed by the use of suitable precision instruments preferably of the pulsed laser type of equivalent instruments, and auxiliary equipment. Underground survey equipment and methodology shall be subject to the approval of the Engineer.
iv. In addition to the regular survey, carried out by the contractor, if required an independent survey organization engaged by Engineer at his own cost, will perform confirmatory survey of Tunnel alignments. The first confirmatory survey is likely to be performed after the 1st 100 m of tunnel has been excavated, following confirmatory survey will be carried out after every 200m of excavation or as

decided by Engineer. The contractor shall be notified in advance about the date of such confirmatory surveys. The contractor shall cooperate with such surveyor and provide any assistance as required (including stoppage of work, if required) at no extra cost to employer.In this regard, the contractor may please note the contents of clause no. 2.4 of chapter 2 under section 5 of the bid document

v. Contractor should carry out precision gyroscopic measurements (GYROMAT equipment or equivalent) at regular intervals at least every 1 (one) Km progress of the main tunnel and escape tunnel, for accurate high-precision azimuth determination, by specialized agency. A detailed report should be submitted to the Engineer after every gyroscopic verification with the obtained results.

2.4.9 Accuracies and tolerances

i. Accuracies

Accuracy of survey works shall be within the following tolerances:

Triangulation	
Allowable error of closure • Average not to exceed • Maximum not to exceed	 5 Seconds 10 Seconds
Traversing	
Allowable error of closure Allowable error of distance	10 mm per Kilometer
Leveling	
Allowable error for each 1 km measured forward and backward Allowable error of closure	 10 mm 10 √S mm

(Where S is the total distance of leveling expressed in km)

ii. Tolerances

A. The tolerance given below shall be the maximum permissible deviations from the specified dimensions, levels, alignments, positions etc. as shown on the Drawings of the structures of structural elements.

B. In addition, at the interfaces with mechanical components, concrete surface be finished flush and shall also meet any additional tolerances required by the mechanical designs or works respectively.

C. Where the tolerances overlap, the severer tolerance shall apply. Determination of centerlines for alignment of tunnels, access tunnels, galleries, caverns and shafts etc. shall meet the following criteria.

Plan positions of central line	±30 mm
Elevation	±10 mm

2.4.10 Subsidiary Monuments and Benchmarks

i. The Contractor shall erect and establish all necessary additional survey monuments, fix points, benchmarks etc. required for setting out of the work and construction control including determination of coordinates and elevations.

2.4.11 Handing over of Basic Survey Data

i. **General Requirements**

A. Prior to the commencement of the survey works, the Engineer shall hand over to the contractor all information and data of the verified basic survey gird and benchmarks to which the contractor's survey work shall refer. Upon handing

over, the ontractor shall review this information and data and shall verify the existence of the datum points and benchmarks by field checks. Furthermore, the contractor shall take responsibility for maintenance and protection of these basic datum points and benchmarks.

B. Should field checks reveal that points and benchmarks have been damaged, displaced or destroyed, the contractor shall inform the Engineer of this facts, and the Engineer shall give instructions regarding the re-establishment of such datum points and benchmarks.

C. Should it become necessary that basic datum point and benchmarks be removed because of foreseeable construction works, the contractor shall inform the Engineer of the need thereof and obtain approval and instruction for the establishment of new basic datum points and benchmarks and/or auxiliary points.

D. If, within 2 months upon handing over, inconsistencies within the basic grid or related datum points and benchmarks are detected by the contractor, he shall inform the Engineer immediately thereof and produce the evidence. The Engineer shall subsequently inform and instruct the contractor on remedial measures to be taken. Any survey work, setting out or measurement already taken or performed prior to the detection of such inconsistency shall be rechecked and corrected by the contractor.

E. Additional basic datum points and benchmarks established by the contractor for the convenience of this work shall have at least the same quality and durability as those of the existing points and meets the accuracy requirements.

ii. Data and Documentation Available

A. Existing topographical maps based on the surveys, covering the area of the works can be made available to the Contractor upon request to the Engineer.

B. Topo mapping of areas for temporary facilities like the Contractor's camp, constructional buildings, construction plant, etc., shall be prepared by the Contractor prior to the construction of such facilities. The Contractor shall also perform surveys works for construction roads and bridgesincluding preparation of maps.

iii. Survey Records and Documentation

A. The Contractor shall keep records of all survey activities such as sketches, field books, calculations, etc., for the duration of the entire construction period. The Contractor shall upon request of the Engineer put at his disposal all records and documentation or provide copies thereofin format agreed by Engineer. On a monthly basis, the Contractor should submit along with the monthly progress report, a detailed report focused on the performed survey work (excavation profiles, tunnel alignment, traversing, etc) and relevant results. After every round, the Contractor shall submit to the Engineer the excavation profile obtained through Tunnel profiler.

2.5 MEASUREMENT AND PAYMENT

2.5.1 No item of survey work shall be measured for the purpose of payment. No separate payment shall be made for survey work and related auxiliary services, as the cost thereof is deemed to have been included in the rates quoted for various items of works.

2.5.2 The survey work shall include, but not be limited to, the following activities:

i. All survey work, in particular fieldwork, office work, including preparation of survey maps/drawings/sketches, investigations, provision of skilled personnel, provision and maintenance of survey instruments and accessories, supply of all materials required for survey and associated purposes, provision of suitable labour, protection of survey points etc.
ii. Shifting machinery and temporary plant out of the required sightlines.
iii. Stopping all machinery, drilling, blasting, driving and other work causing vibrations, dust, gas, etc.
iv. Restricting or stopping traffic of persons and vehicles near instruments or in sightlines during instrument observations.
v. Providing adequate lighting or cutting of sources of light, which interface with setting out or survey.
vi. Providing adequate ventilation to ensure the necessary view and to enable personnel to stay in underground work areas.
vii. Removing all obstructive accumulation of water.
viii. Taking all necessary safety precautions.
ix. Clearing sightlines by removal of bushes and scrub with the prior approval of the Engineer.

SUB CHAPTER -3

3.0 MATERIALS FOR CONSTRUCTION

3.1 SCOPE OF WORK

3.1.1 The specification described herein under relate to the Work, which includes all labour, materials, equipment and service required to arrange materials for construction of various works under this Contract.

3.1.2 Test reports of materials for the concrete shall be, submitted by the Contractor to the Engineer at the Trial Mix Stage as set out in Section "Cement Concrete".

3.1.3 The specifications of some of the major construction materials are given hereinafter for planning purpose, however the contractor shall abide by all codes/regulations/ specifications as are deemed necessary for the satisfactory completion of work.The use of excavation material for construction purpose (concrete /shotcrete, aggregates, fill etc.) shall be investigated and proposed to the Engineer for approval.

3.1.4 **Minimumbuffer stock for one-month quantity as per agreed work's programmeof following items shall be maintained at site for Cement, Reinforcement bars, Aggregates for Shotcrete/Concrete.**

However, towards work closure, the contractor may use these quantities with prior approval of Engineer. Materials which have a defined shelf life will be regularly consumed and recouped with fresh stock at suitable time intervals.

In case of aggregates 3 months stock according to work's program shall be maintained by contractor on 15th June every year due to ban on mining activities during monsoon period coupled with excessive traffic during pilgrimage season during this period, except when work is towards completion.

3.2 SUBMITTAL

3.2.1 The Contractor shall, specify in his bid and subsequently also, if required by the Engineer,' the source(s) from which all construction materials will be obtained. In case the specified sources(s) is not acceptable to the engineer, the contactor shall be required to substitute the source by an acceptable source. Additional suppliers and change of suppliers shall be subject to the approval of the Engineer.

3.2.2 At least 28 days prior to procuring, or dispatch of the materials to site, the Contractor shall submit, to the Engineer, the following:

- **i.** Certified quality test reports from manufacturers in respect of cement, steel, and other materials. This will also be necessary whenever the source is changedor when the sub-standard materials are received on the Site.
- **ii.** If the materials are to be arranged from several sources, the estimated quantity to be procured from each source and the proposed Schedule of supply.

3.2.3 The layout of the stockpiles and the method of drawing aggregates from them shall be submitted to the Engineer, at least 28 days prior to the commencement of stockpiling of aggregates.

3.2.4 The details relating to the source, method of delivery and storage of water to be used during construction shall be submitted by the Contractor to the Engineer for approval, at least 56 days prior to the commencement of the Work.

3.2.5 The Engineer reserves the right to require any additional information deemed necessary to be included in the submitted documents.

3.3 STANDARDS

3.3.1 The specifications, production, sampling, testing and storage of construction materials shall conform to the following latest Indian Standards or where not covered by these Standards, to the equivalent International Standards. The list is for guidance purpose

only. The contractor shall abide by all codes/regulations/ specifications as are deemed necessary for the satisfactory completion of work.

i. Aggregates and water

IS 456	Code of practice for Plain & Reinforced concrete.
IS 383	Specification for Coarse & Fine Aggregates from natural source for concrete.
IS 2386 (All parts)	Method of test for Aggregate of concrete
IS 516	Method of test for Strength of concrete.
IS 460	Code of Test Sieves
IS 1607	Methods of Test sieving

ii. Cement.

IS 269	Specification for Portland cement.
IS 1489	Specification for Portland Pozzolana cement.
IS 12269	Specification for 53 grade ordinary Portland cement.
IS 12330	Specification for Sulphate Resisting Portland cement.
IS 455	Specification for Portland slag cement.

iii. Steel for Reinforcement

IS 432 (Part-I)	Specification for mild steel & Medium tensile Steel bars and hard drawn steel wire for concrete reinforcement.
IS 1566	Specification for Hard drawn steel wire fabric for concrete reinforcement.
IS 1786	Specification for High strength deformed steel bars & wire for concrete reinforcement.

iv. Structural Steel

IS 2062	Steel for General structural purpose.
IS 808	Dimensions for Rolled steel Beam, Channel & Angle Section.
IS 8500	Structural steel- Micro-alloyed (Medium and High Strength Qualities).
IS 800	Code of Practice for General construction in steel.

v. Steel for Pipes

IS 6286	Seamless and welded steel pipes for sub-zone temperature service.
IS 3589	Steel pipes for Water & Sewerage.
IS 1536	Centrifugally cast (spun) iron pressure pipes for water, gas & sewerage.
IS 6631	Specification for steel pipes for hydraulic purpose.
IS 1161	Steel Tubes for structural purpose.

vi. Welding Electrodes

IS 814	Covered electrodes for manual metal arc welding of carbon and carbon manganese steel.
IS 816	Code of Practice for use of metal arc welding for general construction in mild steel.

For all the materials latest IS-Codes shall be followed.

3.3.2 In case or conflict between the above Standards (or specified by Engineer)and the Specifications given herein, the Specification shall take precedence.

3.4 STONE

3.4.1 All stones used on the Works shall be of sound, hard, durable and tough quality approved by the Engineer.

3.4.2 The stones shall be fine or medium grained; hard, bright in color, breaking with a clean fracture and such as make a ringing sound when struck with a hammer.

3.4.3 It shall be free from decay, vesicles, holes, flaws, cracks and other defects and must have, as far as possible, uniform color and texture. Porous stone absorbing water more than 1 (one) % of its dry weight after 24 hours' immersion, shall be rejected. No stones shattered or cracked by blasting operations or having any skin or earthy cover shall be used.

3.4.4 In case the stone is not considered to be free from dust, or dirt etc. by the Engineer. The Contractor shall get the stone screened washed and/or treated as directed by the Engineer.

3.4.5 Samples of stone that the Contractor intends to use shall be submitted for approval of the Engineer not later than 45 days prior to the date of use.

3.4.6 Relevant codes and specifications and tests shall be followed by the contractor.

3.5 AGGREGATES

3.5.1 General

i. All aggregates shall comply with provisions of IS:383 and shall be tested in accordance with IS:2386. Slag and crushed over burnt brick or tile shall not be approved for usage on the project in any form.

ii. Use of aggregates (coarse and fine) containing excessive amount of zeolites, secondary minerals and such other components, which cause alkali reactivity of the aggregates and consequent reduction in durability of the concrete is prohibited. The Engineer may however, allow the use of such material either in part or in full, with suitable remedial measures, keeping in view the extent of reactivity, the location, the nature of exposure and the structure, if the Engineer considers necessary, he may ask the contractor to carry out mineralogical tests to ascertain the absence of harmful minerals in the stones.

iii. The Contractor shall make his own arrangements of aggregate crushing plants etc. for crushing of aggregates from stones extracted from approved quarries or obtained after excavation from underground or other works of the project. Railway land if available can be used for setting up of aggregate crushing plants etc.

iv. The Contractor shall take all permissions, licenses etc in this regard from the concerned Authorities. Till the time permission is obtained, contractor is required to procure material from alternate sources without affecting schedule of works. No claims on account of delays in grant of permission by authorities or delay in installation of the crusher plants will be admissible. The contractor's aggregate crushing plants shall meet all Environment guidelines and conditions imposed by MoEF&CC, Central /State Pollution Control Board and other statutory bodies, at no extra cost to the Employer.

v. The quality of all aggregates used in the works, as also processing such as washing, classifying, screening, rescreening, crushing and blending necessary to meet the required Specifications, shall be subject to the approval of the Engineer.

vi. The aggregates shall be supplied from supplier after obtaining approval of Engineer. The Contractor shall carry out the required tests and submit the reports to the Engineer for establishing the acceptability of the quality of material and also for ascertaining the quantity of material in the sources.

vii. The aggregates shall be sampled and tested by the contractor in the presence of Engineer in accordance with the Indian Standards. *Gradation, abrasion and water absorption tests on all different types of aggregates procured from approved sources shall be performed at a frequency of 1 test per 200 cum of supply or part thereof.*

viii. The tests shall be made on samples that are representative of the grading that will be used in concrete and the aggregates shall be processed by the equipment proposed for the works.

ix. The Engineer shall at all times, have access to and association with sampling and testing of aggregates and shall be entitled to discuss with the contractor, the results and proposals for grading of aggregates.

x. Coarse and fine aggregates shall be stocked and batched separately.

xi. All in Aggregates is not to be used without prior approval of Engineer.

3.5.2 Coarse Aggregates

i. The term coarse aggregates apply to pieces of natural or crushed rock ranging in sizes from 4.75 mm to 150 mm.

ii. The aggregates shall be composed of clean, hard, strong, durable pieces of stone, angular or rounded in shape obtained naturally or by crushing from suitable stones approved by the Engineer. Coarse aggregates shall not contain more than 15 % elongated or flat particles. An elongated particle is defined as a particle having a maximum length of more than 5 times its maximum width. A flat particle is defined as particle in which its maximum width or length is more than 5 times its maximum thickness.

iii. Coarse aggregates delivered to the batching plant shall have uniform and stable moisture content.

iv. The coarse aggregates shall be free from objectionable materials such as wood or other deleterious substances, the percentage of which in any size of coarse aggregates shall conform to the relevant Standards except that the coarse aggregates shall contain no more than 0.30 % by weight of deleterious (reactive) iron sulphides. The sum of the percentage of all deleterious substances in any size shall not exceed 3 % by weight. Coarse aggregates having a specific gravity (saturated surface dry basis) less than 2.60 shall be rejected.

v. The aggregates shall be resistant to deleterious substance, chemical or physical change such as cracking, swelling softening, leaching or chemical alterations after its incorporation in concrete.

vi. When subject to sodium sulphate soundness test, coarse aggregates shall not suffer more than 12 % loss of weight after five cycles.

vii. The aggregates shall be crushed in approved type of stone crushers and different sizes of the coarse aggregate shall be separated into nominal sizes by screening over vibrating screens as under:

Designation of size	Nominal size range
20 mm aggregate	4.75 mm to 20mm
40 mm aggregate	20 mm to 40mm
80 mm aggregate	40mm to 80mm
150 mm aggregate	80 mm to 150 mm

viii. The grain size distribution of the coarse aggregate for the various maximum sizes of aggregates shall be as set out in the relevant Standards. These may be altered with the approval of the Engineer from time to time if necessary, on the basis of actual tests carried out regularly in the laboratory so as to get the best possible coarse aggregate grading.

ix. Aggregate Impact and abrasion value shall not exceed 30%.

x. The percentage of weight of all the significant under-sizes shall be less than 5 % when tested on the designated test screens having opening 0.5 times the normal minimum size of the material. No oversize (i.e. material that would retain on the

designated test screens having opening 1.5 times the normal sizes of the material) shall be permitted

3.5.3 Fine Aggregates (Sand)

i. General

A. Sand or fine aggregates shall be used for mortar in stone masonry, in grouting and as fine aggregates in concrete work. It shall be either natural river sand or manufactured sand crushed from rock/stones or mixture of both in specified proportions. The sand shall be composed of hard, clean and gritty pieces of stone and of a quality approved by the Engineer. It shall be free from injurious amount of clay, soft and flaky particles, vegetable or organic matter, loam, mica and other deleterious substances and shall not contain any salts.

B. Varying amount of moisture in fine aggregates contributes to lack of uniformity in concrete consistency. The fine aggregates shall therefore have uniform and stable moisture contents. Dry sand shall be preferred. Hence sand stockpiles shall be protected from rainfall.

C. The percentage of deleterious substances in the fine aggregates shall conform to relevant Standards except that the fine aggregates shall contain no more than 0.10 % by weight of deleterious (reactive) ferrous sulphides. The total percentage of deleterious substances must not exceed 5 % of the weight in natural uncrushed fine aggregates and must not exceed 2% of the weight in case of crushed fine aggregate.

D. Fine aggregates having a specified gravity of less than 2.60 are liable to be rejected. Fine aggregates when subjected to a soundness test with a solution of sodium sulphate, after 5 cycles of tests, shall not suffer a loss of weight in excess of 10 %.

E. The sand shall be well graded and, when tested by standard sieves, shall conform to the prescribed limits of gradation. The best gradation shall be determined by the Contractor after experiments and tests and shall be followed after approval of the Engineer.

F. The sand, as delivered to the batching plant shall have a fineness modulus of 2.6 to 3. The grading of fine aggregates shall be so controlled that the fineness modulus of at least 9 out of 10 samples of fine aggregates delivered to the batching plant shall not vary more than 0.20 from the average of 10 samples tested. All classifying, batching or other operations on the fine aggregates shall be done by the Contractor and the cost thereof shall be included in unit rate for the concrete, shotcrete or masonry item as the case may be.

G. The contractor shall provide complete facility at site for determining grading of aggregates by sieve as per IS: 383, IS:460, IS:1607 and IS:2386. The grading of fine aggregates when determined as described in IS:2386 Part-1, shall be within the grading zone I,II,III.

ii. Natural Sand

A. Contractor shall seek approval of source from engineer before using natural sand.No sand affected by salty water shall be used. The sand shall be screened and thoroughly washed, preferably in flowing water so as to remove all earthy impurities and very small fine unless otherwise permitted by the Engineer.

B. Natural sand shall be free from laterite and other softer grains and all sources of sand showing appreciable percentage of these impurities shall be rejected.

C. The presence of mica in the fine aggregate has been found to reduce considerably the compressive strength of concrete. It is advisable, therefore, to

investigate the mica content of the fine aggregates and make suitable allowances for possible reduction in strength of concrete or mortar. The decision of the Engineer whether to use such sand and if so, what allowances to be made, shall be final and binding on the Contractor.

D. The contents of the organic matter shall conform to relevant Standards.

iii. Manufactured Sand

A. Whenever natural sand conforming to the required Specifications is not available recourse shall be taken to manufacture sand of desired quality by crushing of stones. The contractor shall comply with the directions of the Engineer in this behalf. The stone that will be used in crushing for getting tine aggregates shall conform in all respects to the stone / coarse aggregates specified under relevant Paras hereof.

B. In case the natural sand or the manufactured/crushed sand is not considered to be as per Specifications, the same may be rejected outright by the Engineer or the sand may be allowed after processing, provided the sand conforms to the requirements after such treatment.

C. For improving workability of pump able concrete mixes, the Contractor may consider a combination of natural and manufactured sands. Proposed proportions shall be submitted for approval of the Engineer.

D. No additional payment shall be made for producing manufactured sand.

3.5.4 Storage of Aggregates

i. Storage areas for aggregates have to be covered, protected against any kind of contamination, avoid the possibility of mix among aggregates and protected also against any water inflow. The floor of the storage for aggregates has to be in concrete and has to be drained. Storage areas for different size of aggregates have to be independent to avoid any possibility of mix.

ii. During rainy and cold weather periods, the aggregates shall be stored undercover for at least 48 hours before being used and kept sufficiently dry.

iii. The stockpiling of the processed aggregate and drawl there from shall be such as to ensure that the variation in the free moisture in the aggregate during anyone shift of working, does not exceed 1 percent.

iv. The coarse aggregates shall, be stored as per the procedure of relevant IS: codes.

v. Care shall be taken in screening and stocking of the coarse aggregates so as to avoid intermixture of different gauge materials and inclusion of any foreign materials.

vi. The stockpiles shall be built up in horizontal or gently sloping layers.

vii. Trucks and bulldozers shall be kept off the stockpiles to prevent breakage and impairing the cleanliness of aggregate.

viii. A hard base shall be provided to prevent contamination from underlying materials in storage areas in continuous use.

ix. Overlap of different sizes of materials shall be prevented with suitable walls or by ample distance between storage piles.

x. Arrangement shall be made to store natural and manufactured sand in a way that shall protect it from being contaminated with dust, organic matter or other deleterious substances.

3.6 WATER

3.6.1 It may not be practical to arrange water from river at all locations. Contractor shall be responsible to arrange water from river, natural streams, etc. as convenient to him.

Necessary permissions from the local authorities if required shall be obtained by the contractor at no extra cost to the employer.

3.6.2 Adequate water storage facilities shall be provided by the Contractor at the batching and mixing plant and other Work Sites so that various operations of works do not suffer due to temporary breakdown in the main supply system.

3.6.3 The Contractor shall supply test reports of water samples from the intended sources to the Engineer for approval.

3.6.4 The Contractor shall establish the suitability of water to be used for construction purposes and submit for approval of Engineer

3.6.5 Water for washing of aggregates, mixing mortar, concrete or grout shall be clean and free from earth, vegetable or organic matter, injurious amount of oils, acids, sugar, salt and alkaline substances in solution or in suspension and shall conform to relevant Standards. The maximum allowable contents of sulphates (SO_4) shall be 250 parts per million (ppm) and those of chlorides (Cl) shall be 200 mg per litre for plain concrete works and 100 mg per litre for reinforced concrete works. Turbidity shall be within 2000 ppm (or 0.2 % by weight) and preferably as low as possible.

3.6.6 Water used for curing shall be clean and free from contamination and from excess amounts of acids or alkalis or other matter combining chemically with and thus, disfiguring the concrete surface. Water shall not contain organic matter causing stink.

3.6.7 Average 28 days compressive strength of at least three 15 cm concrete cubes prepared with water proposed to be used shall not be less than 90 % of the average of strength of three similar concrete cubes prepared with distilled water. The cubes shall be prepared, cured and tested in accordance with the requirements set out in section of "Cement Concrete".

3.6.8 The Contractor shall bring to the notice of the Engineer the occurrence of hot water during underground excavation. He shall supply test reports of such water to the Engineer. Suitable measures shall be taken in case such testing reveals deleterious effect on concrete.

3.7 CEMENT

3.7.1 General

i. The Contractor shall procure the cement of the specified quality from Ultratech, Ambuja, ACC, Birla Gold. Other brand cements will not be used without approval of the engineer. For this purpose, engineer shall approve at least two sources/plants out to those intimated by the Contractor so that there is a standby for taking care of any eventualities.

ii. Cement to be used for various works shall be of different types such as Ordinary Portland Cement or Portland Pozzolana (fly ash based) Cement as approved by the Engineer and shall conform to the relevant Standards at the time of its use.

iii. OPC 53/ 53S grade shall be used for shotcrete/grouting/underground concrete works and Portland Pozzolana Cement for other concreting and masonry works or as per direction of Engineer.

iv. The Contractor shall deliver with each lot of supply of cement a certificate from the manufactures/suppliers by which the cement is guaranteed to comply with the requirement of the specifications. Engineer shall have the right to check or get the cement tested at any stage of its manufacture or delivery and these test reports shall supersede the test report given in the manufacturer's certificate.

v. The contractor shall perform alkali aggregate reactivity test including accelerated mortar bed test to verify and negate the possibility of alkali silica and alkali

carbonate reactive tendencyand the cement to be used shall not have alkali contents exceeding 0.6% by weight of cement.

vi. The cement shall be sampled and tested by the Contractor in the presence of Engineer for strength and physical properties and chemical analysis will be carried out as set out in relevant Standards.

vii. The Cement samples for testing at the source/plant shall be obtained by the Contractor as the bins are being filled. Tests for false set shall be made on samples taken at the latest time prior to shipment.

3.7.2 Transportation

i. Cement shall be transported to site in bulk/bags in bulk containers / trucks approved by the Engineer.

ii. All bulk containers / carriers shall be clean and dry prior to filling / loading with cement and equipped with weatherproof closures on all openings.

3.7.3 Storage

i. Sufficient storage facilities shall be provided at the batching plant to enable each new shipment of cement to be stored separately from the cement stored from earlier shipments.

ii. Cement shall be stored above ground adequately protected against rain sun and moisture. Bulk storage bins and silos shall be emptied complete and cleaned of all cement accumulation after every 3 months.

iii. Arrangement shall be made such that stock of approved cement are adequate to meet the programme of work at all times. The programme shall allow time for testing and approval of each shipment before such cement is incorporated in the works.

iv. Cement shall be used in the order in which it is received at Site. Cement of different brands, if received on Site, shall not be combined in the same mix and structure. Such cement shall be used in different structures as approved by the Engineer.

v. Handling and storage facilities shall be such that no cement is stored before use for more than 90 days. Should any cement be unavoidably kept in storage longer than 90 days, it shall be tested and if found failing the specifications required to be met, shall be rejected for use on the Project.

3.8 STEEL FOR REINFORCEMENT

3.8.1 General

i. High strength deformed steel bars and wires for reinforcing bar used in the works shall be deformed TMT Fe-500D conforming to IS:1786 manufactured by primary steel producers such as SAIL/TISCO/JINDAL/RINL/IISCO only.

ii. Manufactures test certificate shall be supplied for each lot.

iii. Steel shall be free from loose mill scale, rust, oil, grease, dirt, paint or other deleterious matter, when examined immediately before concrete is being placed.

iv. Upto 10mm dia, one sample per 25MT and beyond 10mm dia one sample per 40 MT or part thereof shall be tested for various physical tests as per IS:226, IS:1608, IS:1559 and IS:1387.

v. Wire for tying reinforcement steel shall be black annealed iron wire or acceptable equivalent, with a suitable diameter and shall have an ultimate strength of 5.68 tonne/cm2 and yield strength of not less than 8.8 tonne/cm^2.

vi. After material passing done by engineer, the reinforcement rods shall then be treated in accordance with IS: 9077.

vii. No extra payment for re-bar treatment shall be made and is deemed to be included in the quoted rates.

3.8.2 Transportation and Storage

i. Transportation shall be undertaken in such a manner that no damage is done to the steel.

ii. Reinforcement steel shall be stored off the ground in separate groups according to size and length. Reinforcement steel, which has been cut and bent according to the schedules provided by the contractor, shall be marked with bar number, as shown in the schedule, by using weather proof tag or by placing in marked bins and shall be stored in such a manner as to be readily accessible when required and to facilitate inspection.

3.9 STRUCTURAL STEEL

3.9.1 General

i. Structural steel used in the works shall conform to IS:2062 manufactured by primary steel producers such as SAIL/TISCO/JINDAL/RINL/IISCO only. Other brand steel shall not be used without prior approval of the engineer.

ii. All structural steel shall be of new/unused stock, clean and straight, free from excessive rust or scale and without any sharp kinks, bends or other objectionable defects.

iii. All structural steel including steel plates and steel to be used for Supports for tunnel and cavities as also for bolts, nuts and washers etc. for steel support shall conform to relevant Standards. Manufactures test certificate shall be supplied for each lot.

iv. The material used in splices shall conform to the Specifications of the material being spliced.

3.9.2 Transportation and Storage

i. Structural steel shall be transported, handled and stored in such a manner that no damage is done to the materials or the structure.

ii. All timber to be used for support accessories shall be stored in separate secure locations.

3.10 SAMPLING, TESTING & QUALITY ASSURANCE

3.10.1 For sampling, testing and Quality Assurance Programme will be submitted by the contractor for approval of engineer.

3.11 MEASUREMENT AND PAYMENT

3.11.1 No separate Measurement & Payment shall be made for supplying, including transportation and storage of material until and unless specifically included in the technical specification/BOQ. The cost of the materials and testing (including the royalties, if any) used in works shall be deemed to be included in the quoted rate for the relevant items of works.

SUB CHAPTER -4

4.0 DEWATERING, DRAINAGE AND PUMPING

4.1 SCOPE OF WORK

4.1.1 The specifications described herein under relate to the work of dewatering, drainage and pumping and installation of water proofing membrane to be carried out by the Contractor, which shall include supply of all labour, construction plant and materials and performance of all services required to remove service water and natural surface flow or ground water seepage under all conditions including rain and flood water from the working areas on the surface as well as from the underground sites for the construction of various structures covered under the contract.

4.1.2 The Contractor shall design, furnish, build, install, operate, maintain and remove all the temporary dewatering facilities as specified herein or as required by the Engineer.

4.1.3 Minimum buffer stock of one month is required to keep at site for all water proofing membranes, Geo-textiles and other water proofing structures as per agreed works program.

4.2 SUBMITTALS

4.2.1 Within 28 day from the commencement date, the Contractor shall submit, to the Engineer, the detailed design of dewatering system.

4.2.2 This design shall be consistent with the outline description submitted by the Contractor with his bid and shall include the following:

- **i.** Design assumptions and calculations.
- **ii.** Layouts of drainage facilities.
- **iii.** Layout and capacity of pumps and pipes, sumps, drains both open and covered, well points etc. and details of standby dewatering arrangements.
- **iv.** Any other arrangements or installation, the contractor may propose for dewatering of the working areas both in open and underground Construction sites.
- **v.** The dewatering design should include standby emergency pumping arrangement to deal with any kind of water inflow as mentioned in the Geological Baseline Report.

4.2.3 At least 28 days prior to the scheduled construction of the particular work, the Contractor shall submit, to the Engineer, full details of the equipment to be installed and all necessary construction details required for dewatering purpose.

4.2.4 The Engineer reserves the right to require any additional information deemed necessary to be included in the submitted documents.

4.2.5 At least 56 days prior to the scheduled installation of water proofing membrane, the contractor shall submit, to the engineer, full details of:

- **i.** Certificates of compliance attesting that the materials meet specification requirements.
- **ii.** Manufacturer's instructions for installation of felt backing and water- proofing membrane, including procedures for preparation, fixing, welding and splicing, flashing etc.
- **iii.** Manufacturer's and installer's qualifications to include evidence of experience of the manufacturer and the installers, as well as resume of lining installation supervisors.
- **iv.** Samples as listed hereafter:
  - **A.** Membrane: One square meter of each type membrane (3 Nos.).
  - **B.** Protective felt: One square meter of each type of felt (3 Nos.).
  - **C.** Welded splice: 1 m of welded membrane splice for each type of membrane. (3 Nos.).

D. Fixings and fittings: 10 samples from different lots of rondels and nails, 2 samples of sealing flanges for projections passing through the membrane.

v. Shop drawings showing all necessary installation details for felt and waterproofing membrane, including installation sequence, position of joints, treatment of projections, connection to water stops, connection to waterproofing of structures in open cut, local reinforcements etc.

4.3 GENERAL

4.3.1 Dewatering of the surface as well as the underground Construction sites shall be undertaken by gravity, wherever possible. Where, however, dewatering by gravity is not practical, pumping shall be resorted to after this mode has been approved by the Engineer.

4.3.2 Where, in the opinion of the Engineer, water inflows or potential water inflows into the excavation are to be reduced or controlled by grouting, the Engineer may direct that these inflows be grouted in advance, in accordance with the provisions set out under Section of "Drilling and Grouting".

4.3.3 Whenever more than one agency is working in the same or adjacent areas, the Contractor, who has already provided the drainage facility, shall extend this facility to the other agencies also, who shall pay for such facility at mutually agreed rates. In case of dispute, the apportioning of such expenditure shall be decided by the Engineer, whose decision shall be final. In no case shall any Contractor be permitted to stop the drainage system.

4.3.4 In case there is flow of water passing through the sites of two or more agencies, the drainage shall be attended to the extent directed by the Engineer by the agency in whose site the origin of the water is located. Out of the sites of both the agencies, the agency working on the upstream side of the flow shall attend to the drainage as directed.

4.3.5 The pumped water carried in pipes or flumes shall be discharged at point sufficiently away from the edge of foundation excavation as directed by the Engineer. Care shall be taken to ensure that there is no seepage and flow of water back to the pit working area.

4.3.6 Power for operating the dewatering system shall be arranged by the Contractor from the Employer power pooling points at his own cost. Employer does not, however guarantee an un-interrupted power supply and the Contractor shall not be entitled to any claim or compensation due to failure or interruption in the power supply. The Contractor shall make his own arrangements to ensure sufficient standby power at his cost to carry on the Works during any interruption of power.

4.3.7 **Water proofing membrane**

i. Shall be provided to prevent leakage of groundwater into the tunnel and to protect the final concrete lining against deleterious chemical influences. Waterproofing shall be applied to crown and sidewalls above footing or invert arch level. The waterproofing membrane shall always be located between primary shotcrete lining and the final concrete lining. No membrane waterproofing will be provided for tunnel inverts.

ii. The waterproofing system shall consist of two layers: the first shall consist of a protective felt fastened to the shotcrete surface; the second layer shall be the actual waterproofing membrane properly fixed by special means as recommended by the manufacturer.

iii. While the sealing function shall be provided by the membrane, the layer of felt is required to protect the waterproofing membrane against damage from contact with

the shotcrete surface, to prevent interlocking between concrete and shotcrete in case of differential movements of primary shotcrete lining and final lining, and to provide a drainage layer allowing to drain off groundwater into the longitudinal lateral drainage pipes, thus preventing a build-up of hydrostatic pressure on the tunnel lining.

4.4 DEWATERING OF UNDERGROUND CONSTRUCTION SITES

4.4.1 General

i. The contractor shall perform all works necessary to collect and drain service and infiltrating ground water and flood water entered into the underground construction sites (if any), convey it to main HS/Conduits and lead it out from underground works such as tunnels, shafts, caverns or adits. Water pumped or drained out of tunnels shall pass through oil skimmer or other oil separator, then through sedimentation basin or by other means as approved by engineer designed for the maximum expected flow before disposal into natural drain / river to ensure clear water discharge. Construction fencing of 1.8m minimum height or other effective protection shall be installed to prohibit unauthorized persons from trespassing into the area of the sedimentation pond.

ii. The work shall include, but not be limited to, the following,
   - A. Design and construction of pits and trenches, flood protection walls at the entrance/exit portals of tunnels/adits.
   - B. Design, furnishing, operation and maintenance of dewatering equipments.
   - C. Design, furnishing, operation and maintenance of dewatering equipments for dewatering under geo-thermal conditions when the water temperature is higher than 50^0C.
   - D. Relocation of dewatering facilities required for the performance of other underground works.
   - E. All auxiliary works required for the safe and continuous dewatering of the underground sites.

iii. Probe holes, as specified in Section of "Underground Excavation and Grouting" shall be drilled to provide information on the inflow of water into the tunnel or cavern as the excavation proceeds. Where the indications are that flows are likely to be large, grouting to seal off the water flows and drilling of drainage holes may be ordered by the Engineer.

iv. The Treatment tank shall have arrangement to segregate the PP fibers from water before disposal into natural drain / River to ensure minimum damage to environment. All such fibers so collected shall not be used back on the project and shall be disposed off safely according to manufacturer's recommendations and engineer's approval.

4.4.2 Requirements and Design

i. The Contractor shall design and provide a complete dewatering system for all underground construction sites.

ii. All excavated areas shall be drained off all service and ground water. In order to keep the construction areas free from water, the dewatering systems shall be able to operate at any time during the whole construction period in any part of the works at the required design capacity.

iii. The contractor shall provide adequate pumping capacity, including a sufficient number of standby pumping units, to handle all water entering including sudden gush of water / flowing ground water condition/ flood water into any portion of Underground works. These units shall be connected to the dewatering systems in such a way that proper and uninterrupted drainage is guaranteed throughout the entire construction period.

iv. The contractor shall make arrangement for sufficient stand-by power at his own cost to carry on the works during any interruption of power. The standby power supply shall undergo weekly trial runs lasting at least 30 minutes. No claims shall be entertained, and contractor shall be answerable for lack of progress on this account.

v. All components of the system shall always be maintained in ready for service condition and all access to pumps and other equipment shall be kept in good condition under the most adverse conditions.

vi. The Contractor shall ensure that all drainage water is disposed off without causing interference to his own or other Contractor's operations elsewhere on the site, and that no drainage water runs into adjacent works.

vii. The dewatering system shall be designed and installed in such a way that modifications and extensions to the system are possible while they are in full operation.

viii. All the components of the dewatering system shall be installed and operated in accordance with the approved method and the construction time schedule, or approved modification thereof.

ix. The approval by the Engineer of the dewatering system shall not relieve the Contractor from being fully responsible for the design, construction, operation, maintenance, safety and removal of the facilities provided for the dewatering system and he shall be liable for any damage or delays caused by its failure. The contractor shall indemnify the “Employer” against claims arising out of any such failure made by a third party.

4.4.3 Materials and Execution.

i. The Contractor shall construct the drainage trench in the access adit (s) and invert of the tunnel as required at site and approved by the Engineer.

ii. After the excavated profile has been checked, the ground water which runs or drips into the excavated space shall be diverted into the drainage trench by means of water collectors and pipes for collecting the seepage water from rock surfaces or laggings. Damp surfaces or seepage areas with low volume inflows can be sealed off with a quick setting-sealing compound.

iii. Special care shall be exercised where excavation passes through material, which is liable to soften or swell when it comes in contact with water. In such locations, water entering the excavated space shall be collected as soon as possible and conveyed away / disposed off in such a way that the water does not come in contact with such material. Should the contractor neglect to observe this requirement and a deterioration of the excavated surface of tunnel invert results from water being allowed to flow over or stand upon the sensitive or swelling material, the Engineer may order the removal of the material from affected surface and its replacement with concrete. The Engineer may order installation of additional rock supports in connection with such remedial work at the cost of the Contractor.

iv. If any water from another portion of the underground works flows into a lower section where concreting is being done, which is likely to be affected by water, all such water shall be diverted past this area in such a way that no damage occurs to the concrete. The length of the affected sections over which water has to be diverted shall be ordered by the Engineer.

v. The contractor shall perform regular checking and cleaning of the drawing trench and all dewatering equipment and accessories during the construction period.

vi. The dewatering facilities shall be kept in operation according to the approved schedule, which shall be related to the progress of the work. No pumps shall be stopped, no pipes, ducts, trenches, etc. shall be taken out of service without the permission of the Engineer.

vii. Any openings such as pipes, boreholes, ducts, pumps, sumps etc. used for temporary drainage purposes. In any part of the work shall be completely sealed by filling with grout, mortar or concrete when no longer required, unless otherwise directed by the Engineer in writing. The Contractor shall notify the Engineer in writing before any such openings are permanently closed.

viii. Water proofing membrane (Material)

A. Protective Felt

a. The protective felt shall be a continuous filament non-woven poly-propylene geotextile of uniform thickness and surface texture meeting the requirements listed below.

Property	Specified Value	Standard
Unit weight	500g/m^2 min	DIN 854
Thickness at 0.02 bar	3.9 mm min	DIN 53855/3
Thickness at 2.0 bar	1.9 mm min	DIN 53855/3
Tensile strength	1000 N/cm^2 min	DIN 53857/2
Extension at break	70 % min	DIN 53857/2
Extension at 30% of Tensile Strength	20 % min	DIN 53857/2
Permeability in plane at 0.02 bar	$5x10^{-1}$ cm/s min	*
Permeability in plane at 2.00 bar	$5x10^{-2}$ cm/s min	*
Resistance against acid and alkaline solutions (pH 2-13)	Loss of strength 10% max	DIN 53857/2
Resistance to Punching	2000 N	DIN 54307

B. Waterproofing Membrane

a. The waterproofing membrane shall be Polyvinyl Chloride (PVC).

b. The membrane shall be supplied with a signal layer, i.e. a thin sheeting of different color, bonded to oneside, which is intended to facilitate the detection of damages.

c. PVC Waterproofing Membrane (poly-vinyl-chloride) will satisfy following specifications:

d. Accessories: Fixing material, flashing, reinforcement for expansion joints, sealing flanges and preparation of corners and intersections shall be made as recommended by the manufacturer of the membrane.

Property	SpecifiedValue	Standard

Thickness(mm)	≥2.0	EN1894-2
Tensilestrengthatbreak(N/mm^2) Elongationatbreak(%)	≥17 ≥300%	EN12311-2
Resistancetotearing(N/mm)	≥100	EN12310-2
Puncturestatictest(kN)	≥2.5	ENISO12236
Watertightness(Bmethod–24hoursat0.5N/mm^2)	Watertight	EN1982
Change ofdimensioningafterheatingat+70°Cfor2 hours	Stable	EN1110
Coldbending(°C)	≥-35	EN495/5
Resistancetoacidicandalkalineat28days	20%maximum elongation.	DIN16726
Resistanceofjoints(N/mm^2)	≥10.5	EN12317-2
Firereactionclassification	ClassE	EN13501-1

ix. Waterproofing Membrane (Installation)

A. Surface Preparation

a. All surfaces to which waterproofing is to be applied shall be sufficiently clean, smooth and free from deleterious materials and projections.

b. The following treatment of surfaces shall be performed prior to the installation of waterproofing:

1. For the fixing of the protective felt and the waterproofing membrane, a minimum shotcrete cover of 50 mm to rock is required.
2. Irregularities of the shotcrete lining surface shall be eliminated by means of additional shotcrete. The ratio of the diameter to depth of irregularities shall be not less than 5:1. Rounding at rock bolts (where applicable), etc. shall have a min. radius “ra” of 0.3 m. Details are given in Figurebelow.
3. Transitions and intersections of tunnel profiles shall be rounded off with a minimum radius of 500 mm.
4. Protruding steel bars, wires, spacers, pipes etc. shall be cut off unless treated with additional shotcrete cover.
5. Exposed steel parts such as rock bolts, if not intended to remain accessible, shall be covered with shotcrete.
6. If required, as per the instruction of the Engineer shotcrete surface shall be smoothened with fine-graded shotcrete (rounded aggregates, grain size 0 - 4 mm), applied in a layer of 30 mm average thickness.

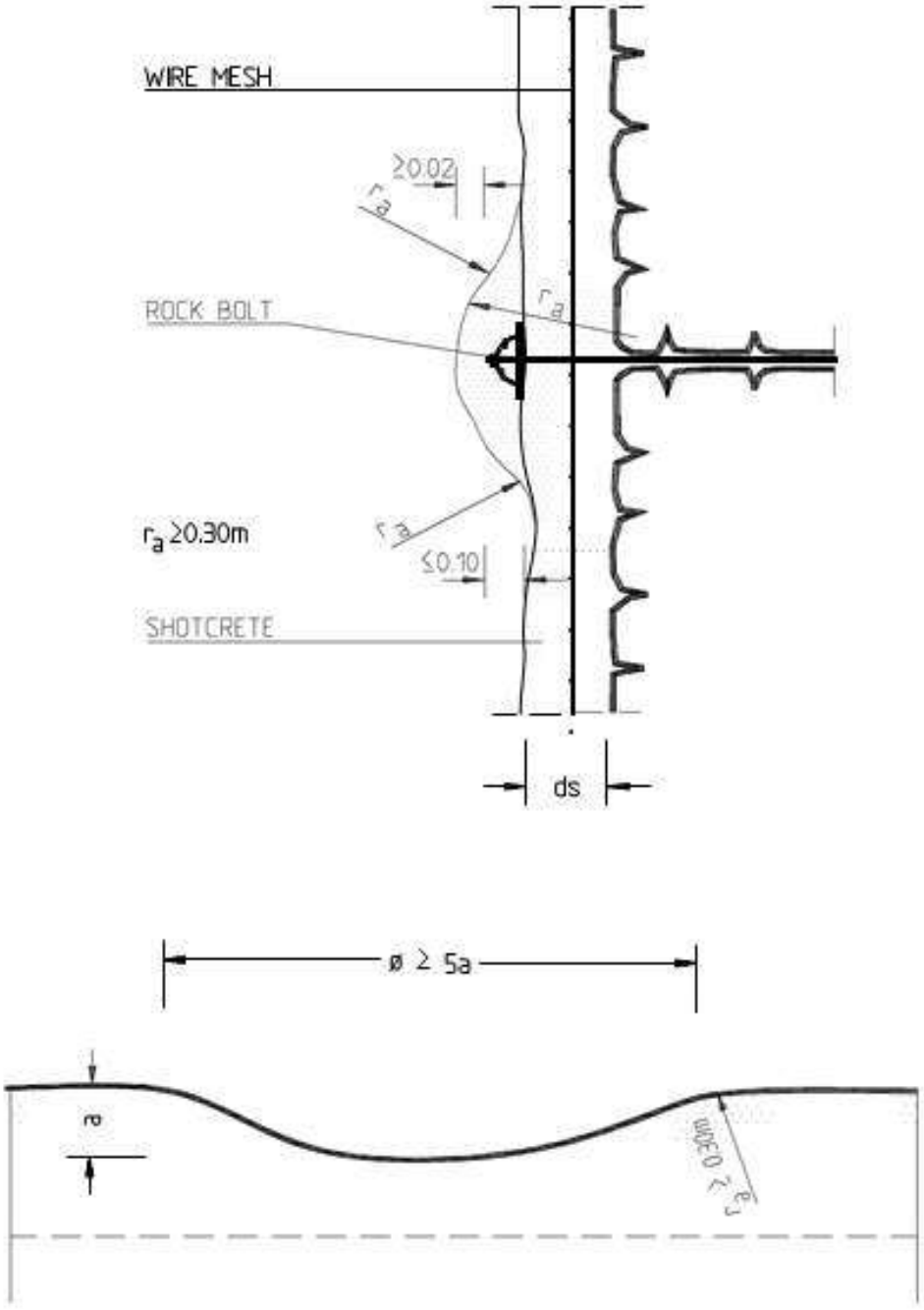


Figure 1: Requirements on surface irregularities of shotcrete

B. Application

a. General: Prior to the application of the waterproofing, all surfaces to which it shall be applied, shall be inspected and approved by the ENGINEER. The application shall follow the written instructions of the manufacturer. Special preparations will be required for waterproofing at tunnel intersections and for projections passing through the membrane. They shall be carried out according to the manufacturer's recommendation.

b. Fixing of Felt: The protective felt shall be attached to the shotcrete surface using suitable fixings specified by the manufacturer. Depending on the location 2 to 4 nos. fixing elements shall be used per square meter. The felt

shall be laid with enough slack to avoid overstress during concreting. Adjacent sections of felt shall be overlapped by 100 mm and joined by point welding or similar suitable method. Along the bottom of the tunnel side walls the felt shall extend sufficiently to cover the lateral drainages as shown on the drawings.

c. Fixing of Waterproofing Membrane: The waterproofing membrane shall be installed to cover the felt and shall be attached to the felt fixings and to each other and to the washers by means of thermal welding. No perforation of the membrane shall be allowed for installation purposes. The waterproofing membrane shall be laid with the signal layer towards the inside and with enough slack to prevent overstressing during concreting. Adjacent sheets of waterproofing shall be joined by a double weld. Along the bottom of the tunnel side walls the membrane shall extend sufficiently to cover the lateral drainages as shown on the drawings. Connections to waterstops and to the waterproofing of structures in open cuts shall be carried out according to drawings to be furnished by the supplier.

C. Testing of seams

a. General: All seams shall be tested, and records of these tests shall be submitted by the CONTRACTOR to the ENGINEER.

b. Seam Test with Compressed Air: For seams between adjacent sheets of waterproofing membrane the testing for tightness shall be carried out by means of compressed air pumped into the test channel which is formed by the double welded joint. Initial test pressure shall be 2 bar for a test period of 5 minutes or 1.5 bar for a test period of 10 minutes. The joint shall be considered waterproof if the loss of air pressure is in both cases not more than 20%.

c. Seam Test with Vacuum Equipment: For the testing of areas of membrane of limited size such as special con- figurations of joints or local repairs with patches, vacuum equipment shall be employed, as instructed by the ENGINEER. This equipment consists of a vacuum bell which, after being fitted tightly over the area to be tested, is evacuated by pumping in order to detect leaks in the membrane.

d. Protective Measures: Every care shall be taken not to damage the waterproofing membrane during or after installation. Any damages occurred shall be repaired and tested before the casting of the final concrete lining.

x. WATER STOPPER

A. Polyvinyl Chloride (PVC)/ rubber water stops shall be furnished and installed for watertight construction at various locations of concrete structures / components covered under these specifications. In order to ensure proper alignment and fixing of water stops in correct position / place, the same shall be rigidly secured to the form work or reinforcement steel as direct/approved by the ENGINEER.

Number of joints in PVC/rubber water stops, when installed in place shall be the barest minimum and joints, thus made, shall be suitably vulcanized/welded using best method/Engineering practice satisfactory to the ENGINEER.

B. All types of water stops shall be tested in a recognized laboratory prior to transport to the site. Test specimens shall be furnished by the manufacturer and the tests shall be carried out at the manufacturer's place.

C. Water stops shall be tested as to their tensile strength, elongation, duration, water absorption, specific gravity, effect of alkali and impact resistance. The PVC Water stops shall meet the following requirements:

D. The CONTRACTORs shall submit to the ENGINEER for approval the test results from recognized institution showing that the material supplied meets the requirements specified. The ENGINEER may carry out the additional tests, for which the CONTRACTOR shall supply specimens from the same material to be used in the work. Test specimens, if required shall be of the shape and dimensions as required in the individual test methods.

Requirement	Method of Test
Tensile strength using die “C” not less than 150 kgf/cm2	ASTM D-412
Ultimate elongation using die “C” not less than 330%	ASTM D-412
Stiffness in flexure, 6 mm span: not less than 28 kgf/cm2	ASTM D-747
Tear resistance: not less than 30 kgf/cm2	ASTM D-624
Specific Gravity: not less than 1.20	ASTM D-792
Shore Hardness: 60A to 80A	
Water Absorption: not more than 5% in a 7 days test	

E. Precautions for Water stopper:

a. PVC water stops will be provided according to drawings in transversal and longitudinal positions at all along the lining tunnel extension. These bands must be welded (heat or vulcanization) among them at the intersection points. For the fault areas, an Omega PVC band will be affixed to the waterproofing membrane. The geometry and type of these water stop bands and Omega band are defined in specific project drawings. To weld the ends of the water, stop bands in transversal joints or in the intersections between transversal and longitudinal water stops bands the parts that must be vulcanized have to be prepared. It is responsibility of the contractor the preparation and the vulcanization of the waterstops unions.

b. When delivered to site, the waterstop products must be unloaded carefully and inspected immediately for completeness and integrity, including form and dimensions. Before installation the waterstops must be kept in a sheltered place on boards or some other firm base (e.g. pallets, concrete surfaces) and protected from contamination or damage.

c. Waterstops must be protected from direct sunlight, especially in summer, e.g. by covering. In high outside temperatures waterstops must be taken to the point of installation and laid out under no tension.

d. Waterstops should be kept in covered storage if possible and then be put in heated rooms for at least one full day prior to their installation, to make their handling and installation easier and less prone to damage (thermoplastic material).

F. Installation of water stopper

a. Fixing Internal Waterstops:Internalwaterstops are anchored to the reinforcement. The waterstops are fixed to the edge anchors with the special waterstop clip or, in the case of waterstops with steel plates (FMS, FS) to the edge perforation of the steel plates at maximum intervals of 25 cm.

b. Spacing Between Joints in the waterstops Themselves: The spacing between two joins in the waterstops themselves should be 0.50 m minimum. In every

configuration the length of the free waterstop ends should be1.00 m minimum so that these connection joints can be formed easily andcorrectly on site.

c. Embedding of External Waterstops:Waterstops must be free from contamination and ice when casted in. If necessary, they should be cleaned before concreting (e.g. removal of any accumulated site debris such as sawdust, sand, concrete residues, cement laitance, oil, grease, snow, ice etc.). This is particularly important for external waterstops in the base of a structure.

d. Clearance between Poker Vibrators and Waterstops:The poker vibrators must never touch the waterstop or its fixings (minimum clearance ≥10 cm). It is usually preferable to compact around external waterstops with external vibrators, which will also give better compaction around stop end anchors.

e. Protection of Exposed WaterstopsonSite: Thewaterstops should be protected from damage until they are fully casted in.

xi. Permanent Groundwater Drainage

A. General

a) This Chapter applies to the installation of the permanent groundwater drainage system in the tunnel.

b) This Chapter covers the requirements for the permanent groundwater drainage system inside the tunnel.

c) The drained groundwater will flow from the highpoint of the tunnel alignment to both Main tunnel and Adit portals.

d) The permanent groundwater drainage of the tunnel shall consist of a main collector pipe along the entire length tunnel and lateral drainage pipe(perforated) with transversal connection pipes to the main collector pipe at regular interval along tunnel sections where major water inflow occurs. The decision of the groundwater drainage system to be installed along a certain tunnel section will be made by the ENGINEER.

e) Drainage gutters shall be located along the entire length of the tunnel at the bottom of either tunnel side wall for collecting groundwater possibly entering through the tunnel lining. The water shall be diverted into the main collector pipe by means of transversal connection pipes.

f) Along tunnel sections with lateral drainage pipes and without invert arch, perforated pipe will be installed at the bottom of the tunnel as invert drainage.

g) At the intersections of the main collector pipe with the transversal connection pipes, maintenance manholes shall be installed. Manholes shall also be installed for the maintenance of the invert drainage.

B. Materials

a) The lateral drainage pipes shall consist of circumferentially slotted, PVC pipes with a minimum diameter of 200 mm as shown on the drawings. The slots shall be within the corrugated area. The width of slots shall not exceed 1.0 mm. The total area of the slots for water intake shall be more than 100 cm2 per metre length of pipe.

b) The main collector pipe in the main and escape tunnels shall be virgin HDPE pipes as per design drawings. The HDPE pipe shall be confirming to I.S. 4984/ 4151 / 12786/

13488 with necessary jointing material like mechanical connectors i.e. thread / insert joint / quick release coupler joint / compression fitting joint or flanged joint

c) The transversal connection pipes shall be PVC pipes with a minimum diameter of 150 mm.

d) The cleaning access pipes shall be PVC pipes with a minimum diameter of 150 mm.

e) No-fines porous concrete shall be used for embedment of the lateral drainage pipes and of the invert drainage pipe. No-fines porous concrete shall also be installed at the bottom of Regular Tunnel Cross Section Type as shown on the respective drawing. No-fines porous concrete shall be composed of ordinary Portland cement and single-sized aggregate of nominal size of 40 mm according to IS 383 (with a maximum grain size of 40 mm). The ratio of aggregate to cement shall be 8:1 by volume or 10:1 by mass.

f) Maintenance manholes as well as the drainage gutters shall be made of concrete grade M30 according to IS 456: 2000. (Reaffirmed 2011)

g) Inspection shafts that will be installed in the balastless track of the Main Tunnel shall be constructed in accordance to the requirements of the BLT design and approved by the BLT engineer.

C. Execution

a) The water appearing and/or collected during construction behind the waterproofing membrane shall be diverted permanently into the lateral drainage pipes installed at the bottom of each sidewall of the tunnel.

b) The lateral drainage pipes shall be covered and protected by no-fines porous concrete.

c) Inspection chamber shall be installed in the inner concrete lining for permanent maintenance (flushing) of the lateral drainage pipes as shown on the drawings.

d) The CONTRACTOR shall ensure that the permanent ground water drainage system is used only for the control of groundwater. Throughout the construction regular inspection and servicing shall be provided.

e) The CONTRACTOR shall protect and maintain the permanent ground water drainage system during construction phase so as not to compromise the effectiveness of the system during operation.

f) All pipes for control of the ground water shall be installed to line and grade as shown on the drawings.

g) No-fines porous concrete shall be mixed by machine or by hand to a uniform colour and consistency before placing. The quantity of water used shall not exceed that required to coat all of the aggregate particles without forming excess grout. The no-fines porous concrete shall be compacted by hand only.

D. Measurement and Payment

The quantities to be paid for shall be measured by the unit of running length of installed drainage pipes. The finished length shall be measured after the fixing and finishing of the work and shall not include connections and any wastage etc. The accepted quantity measured shall be paid for at the unit rates shown in the bill of quantities. The payment shall include all materials and work required to carry out the work in accordance to specifications and shown on the drawings or as instructed by the ENGINEER.

4.5 DEWATERING OF SURFACE CONSTRUCTION SITES

4.5.1 General

i. The Contractor shall perform all works necessary to drain the surface construction sites of rain, flood water, ground water and service water. The Work shall include, but not be limited to the following:
   a. Design and construction of drainage, ditches, pits, dykes/bunds and pump sumps.
   b. Design, furnishing, operation and maintenance of dewatering equipment.
   c. Relocation of dewatering facilities required for the performance of other Works.
   d. All auxiliary Works required for safe and continuous dewatering of the construction sites.

ii. Dewatering of surface construction Sites located near and above a river/stream shall be done up to the existing water level in the river / stream by gravity as directed by the Engineer. Suitable drainage shall be made joining the course downstream of the construction Site to provide required gradient to facilitate proper and efficient dewatering. Below the water level of the stream, dewatering shall be done by pumping water collected in the sumps and discharging the same into course of the river/stream downstream of the construction Site.

4.5.2 Requirements and Design

i. The Contractor shall design and install complete facilities at the surface construction Sites.

ii. The surface water dewatering systems shall be designed to accommodate, without undue disruption to the work, any rainfall event and considering the extent of the Sites to be dewatered and the dewatering arrangements proposed.

iii. Claims for extension of time due to delays caused by unfavorable weather conditions will not be considered.

iv. The contractor shall provide adequate pumping capacity, including standby units, to handle all water entering any of surface construction Sites. In addition, he shall provide sumps and pumps and or well points in the immediate vicinity of the structure foundations using such water conductors as are necessary to conduct the water away from the excavation and concrete placement operations in an approved manner, so that such operation shall be kept free from standing or running water.

v. Power for operating the dewatering system shall be arranged by the contractor from existing poling points. The contractor shall also make his own arrangement for enough standby power at his own cost to carry out the works during any interruption of power.

vi. The Contractor shall ensure that all drainage water is disposed off without causing interference to his own or other Contractors' operations elsewhere on the Site and that no drainage water runs into adjacent Works.

vii. The dewatering systems shall be designed and installed in such a way that modifications and extensions to the systems are possible while they are in full operation.

viii. All the components of the dewatering systems shall be installed and operated in accordance with the approved method and the construction time schedule, or approved modification thereof.

ix. The approval by the Engineer of the dewatering system shall not relieve the Contractor from being fully responsible for the design, construction, operation, maintenance, safety and removal of the facilities provided for the dewatering system and he shall be liable for any damage or delays caused by its failure. The Contractor shall indemnify the Employer against claims arising out of any such, failure made by a third party.

4.5.3 Materials and Execution

i. Drainage ditches shall be excavated along the top of excavated slopes and on the berms. Such ditches shall be kept well back from the excavation edges in order to prevent saturating the upper part of the slopes. The ditches shall be regularly cleaned out of all accumulated silt and other matter so that water may always flow freely.

ii. Where excavation is to be made below the ground water table, the Contractor shall lower the water table sufficiently below any working surface by means of properly screened wells and/or ditches to ensure that the foundation surfaces remain free of standing water and undamaged by the passage of construction traffic. All ditches shall be outside the foundation areas. The water shall be collected and removed by pumping, if no outflow by gravity is possible.

iii. Where concrete is to be placed, the water table shall be maintained below the lowest part of the finished excavation for minimum one day following the raising of structure above the natural ground water table, and for such additional time as may be necessary to preclude damages to structure foundation.

iv. In trenches and foundations, the dewatering shall always enable to carry out the excavation Work in dry, and in a manner that will prevent loss of fines from the foundation.

v. Upon completion of dewatering, temporary pipes and pump sumps beneath permanent structures shall be closed off and filled with grout, mortar or concrete as required by the Engineer.

4.6 MEASUREMENT AND PAYMENT

4.6.1 Dewatering of Surface and Underground Construction Sites

i. **Surface Construction:** Payment for all dewatering activities for surface construction sites shall be included in the rate of excavation itself. No additional payment shall be payable on this account including pumping required from sump, pits, wells etc. as the case may be.

ii. **Underground Construction:** The capacity of pumping plant installed and maintained at each heading face shall be at least two times the expected volume of water inflow. Contractor shall provide and maintain at each face standby pumps and pipe work of capacity at least equal to the normal inflow of water. The standby pumps and pipe work shall be ready for immediate installation as extra capacity to cope with any sudden large inflows that may occur. For downward drives, payment for dewatering the underground construction sites will be made for power consumed for dewatering as per relevant item of BOQ. Nothing extra s**hall be paid for furnishi**ng, **transportati**on and installation/reinstallation of any equipment required for such purposes. The pumps shall be new at the time of initial installation.

The contractor shall install tamper proof electric energy meter at various pumping stages inside the tunnelfor registering the pumping being done.The measurement of the pumping power consumed for dewatering the tunnel will be recorded jointly in Log books in time slots ofevery6 hours or as mutually agreedfor each stage of

pumping. Each stage shall have a separate water line for pumping water from that stage till out of the Tunnel portal.Paymentofpower consumption shall not be done for astage of pumping for particulartimeslot (of 6 hours or as mutually agreed), if engineer records leakage anywhere in pipe network.

iii. Payment for drainage control (Water proofing membrane):

A. The quantities of the protective felt and waterproofing membrane to be paid for shall be measured as theoretical surface area at the intrados of the Primary lining as per Design drawings and shall not include overlaps, folding, welding seams and any wastage etc. The quantity shall be paid for at the unit rates shown in the bill of quantities. The payment shall include all materials and work required to carry out the work in accordance to specifications and shown on the drawings or as instructed by the ENGINEER.

B. The quantities of the water stops to be paid for shall be measured by the unit of running meters installed. The finished length shall be measured after the fixing and finishing of the work and shall not include overlaps or any wastage etc. The accepted quantity measured shall be paid for at the unit rates shown in the bill of quantities. The payment shall include all materials and work required to carry out the work in accordance to specifications and shown on the drawings or as instructed by the ENGINEER.

iv. Measurement for payment and payment for dewatering the underground construction sitesshall also include, but not be limited to, the following:

A. Design of all dewatering system.

B. Excavation of drainage trenches and sumps, construction of dykes/bunds and flood protection walls etc.

C. All costs of furnishing, transportation, installation, running and removal of all pumps including pneumatic pumps, sumps etc.

D. Furnishing installation and removal of pipelines and all other accessories.

E. Moving of the pumps and pipes as necessary between different locations.

F. Operation and maintenance of the dewatering system and disposal of all water up to the disposal points specified by the Engineer.

G. Provision of catch drains, nallah diversions etc. to avoid flow of water to working area.

H. Diverting and discharging water during any concreting operations.

I. Any work or materials required as a result of Contractor's non-observance of the requirements concerning sensitive or swelling ground when the excavated surface have been allowed to become unsuitable due to the action of ground or service water.

J. Any other dewatering done by pumping by the Contractor in contravention of the instruction of the Engineer.

SUB CHAPTER -5

5.0 EXPLOSIVE AND BLASTING

5.1 SCOPE OF WORK

5.1.1 The Specifications described herein under relate to supply transportation, handling, storage and use of explosives. All operations shall be carried out by the Contractor as per Indian Explosive Act, statutory requirements and regulations as applicable in India.

5.1.2 Contractor may obtain license from statutory authority for procuring, transporting, storing and using explosives. The same may also be arranged through existing approved suppliers/license holders in the project area. The Contractor may also have his own magazine for the storage of explosive etc. **In either case, no claim of contractor will be admissible on account of any delay in obtaining any mandatory permissions or in arranging the same for progress of the work.**

5.1.3 The contractor will be required to draw the explosives, transport to the site and keep it safely as per safety guidelines of Indian Explosive Act. He shall acquaint himself with all applicable latest laws and regulations concerning storing handling, safety and use of explosives. The Engineer may issue modifications, if required and the Contractor shall comply with the same without these being made a cause for claim whatsoever, against "EMPLOYER".

5.1.4 Word "Explosives" would also mean the accessories related / similar substances for the purpose of safety unless otherwise specified.

5.2 SUBMITTALS

5.2.1 At least 56 days prior to the commencement of the excavation works, the Contractor shall submit to the Engineer for approval, the details relating to transportation, storage and use of materials such as explosives, detonators, Detonating / safety fuse coils, Blasting Cables, Exploders, Loading Poles and tamping materials etc.

5.2.2 The Engineer reserves the right to require any additional information deemed necessary to be included in the submitted documents.

5.3 STANDARDS

5.3.1 Transportation, handling, storage and use of explosives shall be carried out under Indian explosive regulation, 1984 in a safe and efficient manner and shall also conform to the following Indian Standards or where not covered by these Standards, to equivalent International Standards.

Indian Explosive Act 1883 and Explosives regulations 1984 (Amended 2005)

IS 4081	Safety code for blasting and related drilling operation underground excavation in rock.
IS 6609	Methods of test for commercial blasting explosives and accessories.
IS 10081	Terms relating to commercial explosives, Pyrotechnics and blasting practices.
IS 15447(Part-I)	Commercial blasting explosives specification- Nitroglycerin based.
IS 4863	Glossary of mining terms (drilling and blasting)
IS 7526	Detonating fumes.
IS 7632	detonators.
IS 5878(Part-II/Sec.I)	Code of Practice for construction of tunnels

5.3.2 In case of conflict between the above standards and the Specifications given herein the specifications shall take precedence.

5.4 SUPERVISION

5.4.1 Before taking up blasting operation, contractor/Explosive manufacturer shall submit face wise blast pattern covering blasting pattern, minimum safe charge, vibration control / monitoring etc. for various class of rock mass likely to encounter during excavation to be approved by Engineer/institute of repute as approved by Engineer. Such study report shall have to be got updated improved periodically during the excavation period.

5.4.2 Design and excavation by blasting shall be permitted only under the supervision of competent and trained workmen who are fully experienced in the work and who have received adequate instructions. The Contractor shall make sure that his blasting crew is fully conversant with the rules and regulations concerning storing handling and use of explosives. **The contractor shall submit blasting and monitoring design to engineer for approval. Engineer may arrange for proof checking of blasting design and vibration monitoring results at employer's cost from institution of repute like CIMFR/IIT Dhanbad/NIRM.**

5.4.3 Blasting specifications should include detailed description of state-of-the-art detonators, explosives and blasting patterns as well as blasting expert services including training of actual site personnel to be provided on site at the start of the project.

5.5 TRANSPORTATION AND HANDLING

5.5.1 Explosive shall not be transported to the Site of operation except in suitable cases or containers, which are so made as to prevent any spillage of explosives during conveyance. No explosive shall be removed from such cases or containers except when it is to be used forthwith for the purpose of the work.

5.5.2 Suitable Explosive Vans, duly approved by the Engineer, shall be used for transportation of explosives and detonators. The following rules shall be observed for use of Explosive Van:

i. Vehicles shall have springs under the body. Tyre pressures shall be as per Indian Explosives Regulations.

ii. Detonators and igniters shall not be carried in the same vehicle with explosives.

iii. Beside the driver, only one helper shall be accommodated in the Explosive Van. The vehicle carrying the explosives shall not be used to transport workmen or other materials to workshops although there may be enough space for men or materials.

iv. Driver shall not leave the vehicle unattended while transporting explosives.

v. All vehicles transporting explosives shall be marked or placarded on both sides and with the word "EXPLOSIVES" in bold letters. All explosive boxes shall bear explosive's Batch details, Mfg. Date and specifications etc. clearly on them.

vi. A motor vehicle carrying explosive shall not be refueled except in emergencies and that too only when motor is stopped, and other precautions taken to prevent accidents. Such vehicles shall invariably have at least two fire extinguishers placed at convenient points.

vii. Use of Mobile phones shall be restricted while carrying detonators or while refueling takes place

viii..Explosives Vehicle should have the seat belt for driver and the use shall be mandatory for the driver.

ix. Vehicles transporting explosives shall never be taken into a garage, repair shop parked in congested areas, or in a public garage or similar building.

x. Explosives shall not be transported on a public highway during hours of darkness except in extreme emergency and that too only with the written approval of the Engineer.

xi. Explosives shall not be transported in any form of trailer, nor shall any trailer be attached to a motor truck or vehicle hauling explosives.

xii. No transfer of explosives from one vehicle to another shall be made on any highway except in case of emergency.

xiii. Persons employed in the transport or handling of explosives shall not carry with them or in the vehicles, matches, loaded firearms, petrol or any flame-producing devices.

xiv. All explosives shall be adequately protected against theft.

.

xv. Smoking shall be prohibited during handling, transportation and use of explosives. The places of Explosives storage shall be clearly marked as "No Smoking".

xvi. The speed of the vehicle shall not exceed 25 km per hour on rough roads and 40 km per hour elsewhere.

xvii. The interior of the body of the vehicle shall not have any exposed metal parts except those of copper, brass and other non-Sparking metals and shall be preferably lined with wood.

5.5.3 Motor vehicles used for transporting shall be carefully inspected daily to ensure that:

i. No petrol driven vehicle shall be used.

ii. Filled and serviceable extinguished are in position.

iii. The electric wiring is well insulated and firmly secured.

iv. Chassis, engine and body are clean and free from surplus oil and grease.

v. Fuel tank and feed lines are not leakingLights, brakes and steering mechanism are in good working order

vi. Vehicle is in proper condition in all respects for the safe transportation of explosives

vii. Two nos of red flags shall be present at the left and right top front ends of the vehicle

viii. Condition of Van doors and locking arrangement shall be checked to ensure that rainwater or moisture doesn't damage the explosives case.

5.5.4 Boxes or explosives shall not be handled roughly or allowed to fall.

5.5.5 Containers of explosives shall be opened only by means of non-sparking tools or instruments.

5.5.6 After the loading of a blast is completed, all excess explosives and detonators shall be removed to a safe location or returned at once to the storage magazine, observing the same rules as when being conveyed to the blasting areas.

5.5.7 Containers for detonators shall always be used for storing detonators only.

5.5.8 Explosives and detonators shall be carried in separate containers and by separate persons to the loading face. Only non-electric detonators shall be used.

5.5.9 The drivers of the vehicle carrying explosives shall be trained in use of fire extinguishers on his vehicle.

5.5.10 If any fire occurs on a vehicle carrying explosives the driver shall take all practicable steps to ensure that all other traffic is stopped at least 300 m from the vehicle and that all persons in the vicinity are warned of the danger.

5.5.11 Loadings, unloading and handling of explosives shall, be supervised by qualified personnel. At the time of loading or unloading of explosives no electric switch shall be operated.

5.5.12 Explosives shall not be placed where these may be exposed to flame, excessive heat sparks or impact or hazards of similar nature.

5.5.13 The covers of the explosives cases or packages shall be replaced every time after taking out part of the contents as long as any explosives are left in them.

5.5.14 Explosives shall not be carried in any way other than as specified in The Explosives Act &the Explosives Rules.

5.5.15 Contractor shall ensure no misuse or mishandling of explosives such as carrying the explosives material in the pockets or folds of clothing etc. by any person.

5.5.16 Primers shall not be made up in advance. Priming shall be carried out only when charging of the face starts except emergency for which written approval from Engineer shall be required.

5.5.17 Nothing shall be inserted in the open end of a blasting cap except fuses.

5.5.18 No person shall strike, tamper with, or attempt to remove or investigate the contents of a blasting cap or an electric blasting cap or attempt to pullout the crimped safety fuse out of a blasting cap.

5.5.19 No attempt shall be made to soften / harden explosives by any specific treatment such as heating over a fire or by rolling the explosive on the ground.

5.5.20 The blasting powder, explosives, detonators, fuses, etc. shall be in good condition and not damaged due to damp moisture or any other cause. They shall be inspected before use and damaged articles shall be discarded totally and removed immediately.

5.5.21 No attempt shall be made to reclaim or use fuses, blasting caps, electric blasting caps or any other explosives, which have been water, soaked, even if these have been dried out. The manufacturers shall be consulted for this.

5.5.22 The Contractor shall make all necessary arrangements for the security of the explosives during transportation. However, the Engineer, upon a request by the Contractor, may arrange protection by the Govt. security forces for large quantities of explosives, and the corresponding cost shall be borne by the Contractor.

5.6 STORAGE

5.6.1 The Contractor may either obtain necessary licenses and consents and provide secure storage facilities for all explosives and equipment in accordance with Indian explosive act and requirements of local administration and engineer or may arrange explosives from nay existing explosive supplier in the region. In either case, the contractor shall take approval of engineer and keep him initiated of the source of explosives. **No claims on account of any delays will be admissible in this regard.**

5.6.2 If the Contractor has arranged the required licenses and decided to establish his own magazine for the storage of explosive etc. then: -

i. The contractor will be required to draw the explosives, transport to the site and keep it safety as per safety guidelines of Indian Explosive Act and the Explosive Rules. The magazine shall always , be kept scrupulously clean.

ii. All the explosives like dynamite shall be stored in a dry clean, well ventilated and fireproof building' constructed in accordance with Indian Explosives Act, on an isolated Site. The area around the magazine for 8 m shall be kept clear of all vegetation and combustible matter.

iii. There shall be a barbed wire fencing and security lights around the magazine and security guards shall be posted around for 24 hours to prevent loss or theft of explosives.

iv. Explosives, detonators and fuse coils shall be stored separately.

v. The Contractor shall maintain a record of storage and withdrawal of all explosives. This record shall be made available to the Engineer on request. The Engineer shall be promptly notified of any loss or theft of explosives.

vi. Explosives shall be stored and used chronologically to ensure that the ones received earlier are used first. There shall be enough space between the stacks.

vii. A “preparation area" shall be identified close to the charging face prior to every blast for preparatory work by experienced men as required for the work. All safety measures shall be ensured in the "preparation area".

viii. Unauthorized persons shall not be allowed at any time to enter the magazine.

ix. The person-in-Charge of the magazine shall, always, ensure that the magazine is securely locked.

x. Explosives shall be handled and used only by the Contractor’s duly authorized personnel. The names and qualifications of such personnel shall be submitted to the Engineer in writing in advance of any possible use of explosives.

xi. The magazine on no account is to be opened during or on the approach of a thunderstorm and no person shall remain in the vicinity of the magazine during such storm. Enough lightning conductors shall be provided on top of the magazine.

xii. Magazine shoes, without nails, shall always be kept in the magazine, and a wood tub or cement trough, about 30 cms high and 45 cms in diameter filled with water shall be fixed near the doors of the magazine.

xiii. Persons entering the magazine shall put on the magazine shoes provided for the purpose and be careful not to allow the magazine shoes to touch the ground outside the clean floor.

xiv. Persons with bare feet shall before entering the magazine, dip their feet in water, and then step direct from the tub over the barrier (if there is one) on to the clean floor.

xv. A brush or broom shall be kept in the lobby of the magazine for cleaning the magazine on each occasion it is opened for the receipt, delivery or inspection of explosives.

xvi. No matches shall be allowed in a magazine.

xvii. No person having articles of steel or iron on him shall be allowed to enter a magazine.

xviii. Oily cotton rags, cotton waste and articles liable to spontaneous ignition, shall not be taken into a magazine.

xix. No tools or implements other than those of copper, brass, gun metal or wood shall be allowed inside the magazine. Tools shall only be used with great gentleness and care.

xx. Boxes of explosives shall not be thrown down or dragged along the floor and shall be stacked on wooden trestles. Where there are white ants, the legs of the trestles shall rest in shallow, copper, lead or brass bowls, containing water.

xxi. Package containing explosives shall not be allowed to remain in the sun.

xxii. Empty boxes shall not be stored in the magazine nor let any packing material lie loose

xxiii. Blasting caps and electric blasting caps shall never be stored in the same box, magazine or building with other explosives.

xxiv. The following shall be hung in the lobby of the magazine:

A. A copy of these rules;

B. Display of Magazine License No and the capacity

C. A statement showing the stock in the magazine and

D. Certificate showing the last date of testing of the conductor

xxv. Adequate firefighting equipment shall be provided in the magazine.

xxvi. Signboards reading “DANGER HIGH EXPLOSIVES” “PROTECTED AREA” “NO SMOKING etc. shall be conspicuously displayed in front of the magazine.

xxvii. No explosives shall be stored in the tunnel and adit except for the purpose of charging for an immediate blast. Such storage shall be close to the face and for the quantity limited to the immediate blast requirement. Primed cartridges shall be seated by even steady pressure only.

5.7 DISPOSAL OF DETERIORATED EXPLOSIVES

5.7.1 All deteriorated explosives shall be disposed off in an approved manner as per Explosive Regulation- 1984, The quantity of deteriorated explosives to be disposed off, shall be intimated to the Engineer prior to its disposal.

5.8 DRILLING

5.8.1 **Preferably, Boomer automation software shall be used to finalize drill pattern, hole orientation, termination depth, sequence etc. The boomer shall be total station navigated before drilling holes. All holes should end at same depth. Manual mode shall not be resorted to. A report of the drill hole data (Measured while drilling) along with drilling report shall be generated and handed over to engineer after the drilling. Without affecting drilling quality, Engineer may allow other methods to finalize and execute drill pattern with permission of employer.**

5.8.2 **The holes shall be drilled in automatic mode preferably, so that drilling accuracy is guaranteed. Drill pattern and drilling sequence created on PC through supported software shall be transferred to the drilling rig for this purpose. Without affecting drilling quality, Engineer may allow other methods for drilling of holes with permission of employer.**

5.8.3 Preferably parallel cut drilling pattern shall be adopted. The perimeter holes shall be located within 0.10m deviation from approved blasting plan and never within the design line of excavation. Lookout angle for perimeter holes shall not exceed 2^{o} and drilling deviation of shall not exceed 5% of the borehole depth to a maximum of 250mm at the end of hole. **Engineer, with permission of employer, may allow other type of cuts which do not increase the blast damage zone compared to specified type of cut.**

5.8.4 All holes shall be of greater diameter than the diameter of the cartridges of explosives used.

5.8.5 Perimeter boreholes shall not be more than 0.6m apart. Distance between perimeter and next row of boreholes shall not be more than 0.9m, unless adoption of greater distance does not harm the rock outside design perimeter.

5.8.6 Loading and drilling shall not be carried out with Electric detonators in the same tunnel simultaneously.

5.8.7 Under no circumstances shall any holes be charged until completion of all drilling operations at the face.

5.8.8 A drill or pole shall not be inserted in sockets of old holes even its examination fails to disclose explosives.

5.8.9 Drilling shall not be resumed after-blasts had been fired until a thorough examination has been made to make sure that there are no misfires and sockets with explosives which the drills may strike.

5.8.10 Drilling shall not be started until all remaining sockets of old holes are examined for unexploded charges.

5.8.11 Drilling crew shall be provided with approved respirators in siliceous dusty atmosphere arising out of drilling operations.

5.8.12 Blast design should cater to the changes in geology and/or geotechnical parameters for each face and shall be decided face wise on ground

5.9 LOADING AND CHARGING

5.9.1 The holes shall be cleared of all debris before a cartridge is inserted.

5.9.2 In loading the holes, tamping, if required shall be done with a wooden mallet having no exposed metal parts.

5.9.3 Primed cartridges shall be first inserted and shall be seated by even steady pressure only.

5.9.4 All loaded holes or charges shall be checked and located before firing.

5.9.5 When holes are sprung ample time shall be left between spring shots for the hole to cool, and between the last springing shot and the loading of the main charge.

5.9.6 When practicable, no more cartridges shall be primed those are required for a round of blasting.

5.9.7 Detonators shall be inserted at the end of the primary cartridge facing the end of the drill hole, which is prepared specially for the purpose.

5.9.8 Holes in cartridges for inserting the detonator shall be made with a sharpened wooden stick.

5.9.9 When blasting on the surface the entire area to be blasted must be covered with blasting mats, in locations where surface structures are to be protected, from damage by flying rock fragments.

5.9.10 Detonating cord shall be cut from supply reel before attaching to explosive or tamping in hole. Use of the short pieces of fuse shall be prohibited for detonation purposes.

5.9.11 No welding shall be done inside the tunnel / cavity at the time or loading or charging of the face, till the blast has been taken.

5.9.12 Naked flames and lamps shall be kept away at the time of the loading of holes.

5.9.13 Before starting the charging/loading of holes all electrical lines must be disconnected.

5.9.14 Contractor shall arrange visits of Explosive manufacturer's technical team to design and execute the blast, train the blasting crew and supervise the blasting crew as per the direction of the Engineer.

5.9.15 A team from explosive manufacturer shall be arranged by contractor to remain at site until the definitive drilling patterns/blast plans are defined for each support class.

5.10 TYPE OF EXPLOSIVES & ACCESSORIES

5.10.1 Explosives

i. **For enhancing safety of operations, saving in time and better control of blast quality, bulk type explosives shall be preferable**. However, packaged explosives may also be used.

ii. Explosives shall meet following criterion: -

SN	Parameter	Packages Explosive	Bulk Explosive
1.	Density of explosive	1.15±0.05 g/cc	0.6-1.1 g/cc
2.	Relative weight strength	110 -120 %	90 -110 %
3.	Relative bulk strength	155 -165 %	110 -160 %
4.	Velocity of Detonation	4000±500 m/s	3000 – 6000 m/s

These parameters shall be met before seeking Engineer's approval Additionally, Engineer may collect random samples during any charging cycle, in case of any suspicion.

iii. Explosive as approved by competent statutory authorities shall only be used. These explosives shall be of safe to handle and use, exhibit excellent water resistance and liberate low volumes of noxious gases.

iv. Manual Mixing of chemicals to form any explosives shall not take place and such explosives shall not be used.

v. Any Explosives having shelf life less than 6 months shall not be used.

vi. Explosives being used shall be capable of performing in low temperatures.

5.10.2 Detonators

i. Priming of the explosives shall be done only with Non - Electric detonators with shock tube containing fine spray of around 13-16 mg/m HMX/AL powder

ii. The detonators shall be truly Non-electric in nature.

iii. The shock lube shall be of the nature that the color of the tube gets changed post blast and can be located easily for misfires etc.

iv. Identification tag and J - hook shall be placed at the end of the tube for identification and easy connectivity respectively.

v. Ultrasonic seal shall be provided at the end of the tube to make it waterproof.

vi. Shelf life of the detonators shall be one year.

vii. Non - Electric detonators shall be safe against stray currents, static Electricity, Radio-frequency Energies and accidental initiation by impact, shock, friction and time as per the standards fixed by the appropriate authority.

viii. The delay range of detonators should comprise of a minimum 0 - 15 delays firing completely in not less than 8000 ms for long period detonators.

ix. Short delay series shall contain a nominal delay interval of 25 milli second (ms).

x. Electric detonators shall not be used except for the initiation of Detonating Fuse.

xi. Strict control over delay intervals will be required to control the blasting damage in first 50m of each tunnel portal or underground areas within 25m distance (Vertical/Horizontal) to ground surface/pre-existing underground structures. In such cases contractor shall use electronic detonators if required in opinion of Engineer in Charge. Payment shall be made to the contractor through extra items depending on type and specification of the required electronic detonator after subtracting cost of Nonelectric detonators.

5.10.3 Detonating Fuse / Safety Fuse

i. Detonating Fuse shall be used for connecting Non-Electric detonators.

ii. Nominal Weight of PETN shall be 10 gm/m in detonating fuses (DF).

iii. Detonating Fuses shall be able to get initiated by No.6 electric detonators.

iv. Water resistance shall be excellent.

v. Detonating fuse shall be used only to initiate the plain detonators.

5.11 WIRING

5.11.1 All detonators in a single blast shall be of the manufacture.

5.11.2 Each electric blasting cap used for initiation of shot shall be tested with an approved galvanometer (circuit Tester) to determine whether it will carry the current. All testing shall be done away from the heading face. Testing of a single detonator at any time shall be avoided.

5.11.3 After testing the leg wires of electric blasting caps, they shall be short circuited by twisting the 'bare ends together and shall remain so twisted until ready to be connected into the circuit prior to connection to the firing line.

5.11.4 Unless, the power supply is heavy it is recommended that all electric blasting caps shall be wired in series and the firing line shall not be smaller than No; 14B and S-gauge copper wire.

5.11.5 The number of electric blasting caps used in a circuit shall not exceed, the tested capacity of the blasting machine.

5.11.6 The circuit including all caps shall be tested with a circuit tester or galvanometer, operating accurately before being connected to the firing line.

5.11.7 In surface blasting the cartridges shall not be primed nor a hole during the approach of a thunderstorm or while it is in progress. If a charge has been primed or holes loaded, every person shall be ordered to a safe distance until the storm is over.

5.11.8 Blasting circuit wires and/or detonators leg wires shall never touch other wires carrying electric current.

5.11.9 Blasting operation control shall consist of two switches; a safety switch and a firing switch located at least 2 meters apart, the connection between the switches to be made by a “plug-in” jumper, which may be permanently attached to the safety switch. The plug-in jumper Is so made that it cannot be plugged into or connected to the firing switch until the firing switch is unlocked, and the jumper must be disconnected from the firing switch before the firing switch can be locked.

5.11.10 Both the safety switch and the firing switch shall be of the locking, double pole, double throw type which, when opened and locked in downward position short circuit and ground the leading wires.

5.11.11 Both the safety switch shall be locked immediately after firing the shot and before any person can return to the area. Keys to the switches shall always remain in the possession of the starter.

5.12 FUSE BLASTING will not be allowed.

5.13 FIRING

5.13.1 Shots shall, so far as practicable is fired electrically and only apparatus especially designed for the purpose shall be used. Power lines shall not be tapped for the purpose. No shot shall, be fired except by a licentiate blaster authorized by the Engineer.

5.13.2 The charge shall be fired successively and not simultaneously.

5.13.3 Prior to the firing of a shot all persons in the blasting area shall be warned of the blast through audible warning and ordered to a safe distance from the area.

5.13.4 Competent flagmen; equipped with red flags and whistles shall be posted to stop traffic at access points on each possible route of travel to the vicinity of the blasting area.

5.13.5 Blasting shall be done at fixed hours approved by the Engineer and the blasting times shall be displayed on a Notice Board.

5.13.6 Order to fire shall be given only by the Supervisor-in-Charge of the work after giving three warning signals to enable all the workmen to reach safe shelters.

5.13.7 Blast shall not be fired until it is certain that every person has retreated to a safe distance.

5.13.8 The person-in-Charge of blasting shall be the first one to leave the area to be blasted.

5.13.9 A bugle or an electric buzzer with a distinctive note shall be used to give warning signals. This bugle shall not be used for any other purpose. All the labour shall be made acquainted with the sound of the bugle buzzer and shall be strictly warned to leave their Site of Work immediately for safe shelters at the first warning signal and not to leave the shelters till all clear signal has been given.

5.13.10 An all-clear signal shall be given when the blasting is over.

5.13.11 Definite places of shelter, natural or artificially constructed, shall be assigned to the crew. Workers shall be made to go to these shelters rather than trust each other's judgment about a safe place.

5.13.12 In special cases suitable extra precautions shall be taken. The Engineer may, however, permit blasting for underground excavation without restriction of fixed time provided he is satisfied those proper precautions are being taken and that the work of other agencies on the site is not unduly hampered.

5.13.13 Only Supervisor-in-Charge shall be responsible for the safe custody of the firing apparatus.

5.13.14 For blasts in series, only detonators of the same brand and same electrical resistance shall be used. All detonators shall be checked before use.

5.13.15 The firing cables shall be with a proper insulating cover to avoid short-circuiting due to encountering water, metallic parts or rock.

5.13.16 Use of earth, as a return line shall not be permitted.

5.13.17 The firing cable shall be connected to the source of current only when nobody is in the area of blasting.

5.13.18 Mats or rubber tyres tied together will rope shall be used as protection from flying debris to cover the charges where blasting may expose persons or Properly to injury or damage.

5.13.19 Blasting shall be permitted only after adequate provisions have been made for the protection of persons, the works, and public and private property. The Engineer's approval of any of the Contractor's blasting operations shall not relieve the Contractor of his sale responsibility for the safety of persons and property. Any damage done to the works or property by blasting shall be repaired by the Contractor.

5.14 INSPECTION AFTER BLASTING (Misfire drill)

5.14.1 Immediately after a blast has been fired, the firing line shall be disconnected from the blasting or other source of power.

5.14.2 After each blasting operation the tunnel drive shall be sufficiently ventilated to remove any nitrous gases and the atmospheric conditions shall be constantly checked prior to personnel accessing the excavated face. No persons can enter the blasted area before 20 minutes after firing.

5.14.3 After a blast has been fired, a careful inspection shall be made by the blaster to determine if all charges have been exploded. The blaster shall count the number of the exploding shots in blasting. Misfires in fuse blasting shall not be examined for a enough time after its failure to explode. Electric blasting misfires shall not be examined for at least 15 minutes after failure to explode. Other persons shall not be allowed to return to the area of blast until an “All Clear" signal is given.

5.14.4 The shot-firer must keep a record of the number of shots fired, their time of firing, type and weights of explosives used per delay and total explosives used in the round and the type and number of detonators used, together with a record of the post-blast situation for each and every location. A copy of the record shall be available to the Engineer at the end of every shift on which shots are fired.

5.14.5 All wires shall be carefully traced, and search made for any unexploded cartridges by the person-in-Charge of the blasting operation.

5.14.6 Loose pieces of rock and other debris shall be scaled down from the sides of the face of excavation and the area made safe before proceeding with the work.

5.15 MISFIRES

5.15.1 Misfired holes shall be placed in the charge of a competent person.

5.15.2 If broken wires, faulty connections, or short circuits are determined as the cause of a misfire, proper repairs shall be made, the firing line reconnected; and the charge fired. This shall be done, however only after a careful inspection "has been made of burdens remaining in such' holes and no hole shall be fired when the burden has been dangerously weakened by other shots.

5.15.3 The charge of explosives from a misfired hole shall not be drilled, bored or picked out.

5.15.4 Misfired charges, tamped with solid material shall be detonated by the following method:

- **i.** Float out the stemming by use of a water or air jet from hose until hole has been opened to within 60 cm of charge;
- **ii.** Water shall be siphoned off or pumped out;
- **iii.** New charge shall be placed and detonated.
- **iv.** Whenever this method is not practicable; then a new parallel hole, not nearer than 60 cms, shall be drilled, loaded and detonated. A careful search shall be made of unexploded material in the debris of the second stage.

5.15.5 If misfire has been found to be due to defective detonators or dynamite, whole quantity or box from which the defective article was taken must be withdrawn from the works site for return to the manufacturer or destruction as decided by the Engineer.

5.15.6 The Contractor shall report, in writing, to the Engineer, all cases of misfire, causes of the same and steps taken in connection therewith.

5.16 BLASTING FOR UNDERGROUND TUNNEL/ CAVERN WORK

5.16.1 General

- **i.** Blasting in tunnels and cavities shall be carried out with Non-Electric detonators only except for the cord initiation by electric detonators.
- **ii.** A separate circuit, independent of power and light circuits, shall be used for blasting.
- **iii.** No electrically energized circuit shall be installed on the same side of the tunnel, or cavity with the blasting circuits.
- **iv.** All electric lights or other energized circuits shall be disconnected for at least 70 meter from the point of loading.
- **v.** All tracks, airlines & vent pipes shall be kept properly grounded.
- **vi.** For loading purposes, the employees shall be equipped with permissible battery lamps.
- **vii.** The safety switch and the firing switch shall be placed on opposite sides of the tunnel / cavity.
- **viii.** Only explosives, which produce less than 0.005 m^3 of poisonous gas (carbon monoxide and hydrogen sulphide) per 1.25” X 8” (3.15 cm X 20 cm) cartridge shall be used for Underground Work.
- **ix.** No fire, flame, smoking or open lights shall be allowed within 6 meters from any explosive except for the purpose of firing a charge.
- **x.** Adequate warning notices shall be given to air persons employed indicating the period, or danger at the time or firing and it shall be the duty of the Contractor to provide adequate shelters or screens for protection of workers exposed to risk of injury from the explosion or from flying material.
- **xi.** After the blast takes place in Underground Works the workmen shall not be allowed to go to the face till all the toxic gases are evacuated from the face.
- **xii.** Under water Blasting
  - **A.** Only water-resistant blasting caps and detonating cord shall be used in underwater blasting operations.

B. Loading tubes and casings of dissimilar metals shall not be permitted because of possible electrical transient current from galvanic action.

C. When more than one charge is placed underwater a float device shall be attached to an element of each charge in such manner that it shall be released by the firing.

D. No drilling, digging or excavating shall be permitted until all misfires have detonated or the explosives are removed from the missed holes.

5.17 MONITORING OF BLAST

5.17.1 General

i. The Contractor shall supply and operate at least four approved Engineering Seismometer (Triaxial) or Seismograph to measure 3-components of ground vibration and air blast overpressure. The equipment shall have enough memory space to store at least 300 events and shall be equipped to measure wide range of ground vibration and air blast overpressure. It also shall be equipped with a microphone attachment, permanent paper trace output with built in strip chart printer, LCD display and PC retrieval attachment for data to be used as and where directed by ENGINEER" to monitor blasting work.

ii. Unless otherwise agreed in. writing by "ENGINEER" trial blasts, initial blasting in general, and initial blasts in new areas and blasts adjacent to complete concrete structures and sensitive areas shall be monitored. For structures in the proximity of blasting the peak particle velocity shall be' measured at the locations immediately adjacent to the structure nearest to the face being stated or another location where it is necessary to limit vibration as instructed by engineer. Apart from monitoring on its own the Contractor must provide supports for measurement to other agencies appointed by "EMPLOYER" in tunnel excavation, monitoring shall specially be undertaken with change in rock mass. in shallow cover zone and or as directed by Engineer.

iii. The measured vibration results shall be transmitted to "ENGINEER" together with all the useful information concerning the completed information (cut of the face / slope of the cutting face; particle size distribution of the excavated material etc.; drill marks; vibration wave form in three directions-radial, transverse & vertical; air overpressure waveform; print out of Peak Particle Velocity (PPV) and associated predominant frequency in each direction).

iv. Assistance shall be taken from blasting consultants / experts as specified in Quality Manual document.

v. In case the defined thresholds be exceeded, blasting operations shall be stopped in order to finalize the new blasting pattern or the choice of another methods of proceeding with the excavations.

vi. In general, the methods, parameters to be measured and equipment for measurement of vibration shall be in accordance with IS 14881 unless otherwise specified.

5.17.2 Restriction of Blasting

i. All blasting works shall be completed before pouring the first structural concrete, unless otherwise specifically agreed by "ENGINEER" in writing. When excavation is carried out using explosives the Contractor shall arrange his excavation and concrete placing programmed so that as far as practicable it shall not be necessary to use explosives close to permanent construction. The Contractor shall be responsible for avoiding damage to adjacent structures from fly rock by erecting

barricades and/or the use of blast mats or other means by installing shielding device acceptable to “ENGINEER”. The maximum allowable limit of noise overpressure in blasting shall not exceed 110 dB (beyond 100m in any direction from blast) In surface blasts: It must be measured close to the structure to be protected from blasting. Ground vibration induced by blasting shall be measured in terms of the Maximum or Peak Particle Velocity (PPV) in mm/s and predominant frequency of the ground vibration.

ii. The measurement of peak particle velocity shall be obtained from instruments capable of measuring along three orthogonal axes, one of which shall be aligned parallel to the center line of the excavation and another shall be vertical. The Contractor is to provide supports for the measuring instrument if so, required by the manufacturer’s instructions.

iii. The measurements of the particle velocities (PPV) shall be the responsibility of the Contractor. Copies of the readings in an agreed form shall be supplied to the Engineer.

iv. The following limit on peak particle velocity are given as a guide and may be modified by “ENGINEER” based on seismograph records and observations during the progress of works.

A. PPV shall not exceed 30mm/sec at 20m distance from the tunnel face.

B. For existing surface structures adjacent to excavation areas, including structures of following types.

- Not forming part of the contract,
- Belonging to Employer and
- Not belonging to Employer,

The frequency and peak particle velocity dependent safety criteria as per Director General of Mines Safety (DGMS) criteria shall be followed for protection of nearby structures in surface blasts.

v. Where circumstances dictate, such as when blasting adjacent to partially cured concrete, the peak particle velocity permitted may be reduced by “ENGINEER”

vi. For specific structures and if requested by “ENGINEER” the Contractor shall fulfill the following criteria:

A. At a 20 m radius of the blast, the interstitial velocity, for frequencies inferior to 100 Hertz, shall be limited to 4 cm per sec. (40 mm/sec.)

B. After blasting and scaling of blasted surface, 60% of the half bore holes (barrels) must be visible,

C. Smooth/control blasting is mandatory, in case of “Smooth blasting the spacing of perimeter holes should not exceed 40 cm c/c and the distance between perimeter row of holes and the buffer row of holes should not exceed 0.7 m.

D. Bores holes space is 45 cm maximum.

vii. If necessary, “EMPLOYER” may require the Contractor to restore at his own expense any building, structure, masonry and equipment damaged by blasting, through direct or indirect effects.

5.17.3 Recording blasting operations

i. The Contractor shall keep records of all blasting carried out showing the time and location of each blast, the type and amount of explosive used, together with any other relevant data in an agreed format approved by “ENGINEER”.

ii. During the site works, as mentioned before each blasting pattern shall be submitted to “ENGINEER” for approval at least 24 hours before the blasting operation is due to begin. This shall be in the form of a presentation sheet setting out all the information concerning:

A. The type(s) of explosives to be used.
B. The x, y, z coordinates of each firing hole and the firing polygonal,
C. The diameter, depth, charge and the packing of each hole,
D. The method of ignition and the type of detonator for each charge,
E. If using a sequential exploder, the connection of the different lines and a plan showing the effective delays of the charges,

iii. The total quantity explosives for the firing of the round: always, “ENGINEER” can interrupt the explosive operation or request the Contractor to modify to the blasting patterns and the cost on this account shall be borne by the Contractor.

5.18 MEASUREMENT AND PAYMENT

5.18.1 No separate measurement & payment shall be made for furnishing safe blast reports & their time to time updating from reputed institution as approved by Engineer, supply of blasting material, its safe storage, drilling of holes, loading of blasting material, all blasting operations including monitoring etc. This is deemed to be included in the quoted rate of excavation, provision of support system & concrete lining etc., for different classes of rock mass in all open and underground works.

SUB CHAPTER -6

6.0 INSTRUMENTATION

6.1 SCOPE OF WORK

6.1.1 This section specifies the requirements for the geotechnical measurements in the tunnels and at the surface above the tunnel designed according to the NATM for the purpose of observing and recording deformations, settlements, and load variations on supporting elements and in the adjacent rock.

6.1.2 As part of safety concept 3-dimensional (3-D) deformations of the tunnel lining shall be monitored by means of optical methods. The points to be observed are marked by targets or reflectors mounted on standard convergency bolts.

6.1.3 Measurement shall be carried out with a free-station high precision Total Station. The flow of data shall be fully automatic. The software shall allow determination of displacements in an absolute coordinate system with an accuracy of =/- 1 mm in minimum.

6.1.4 The work of geotechnical measurements includes the installation of geotechnical instrumentation and devices.

6.1.5 Necessary conclusion shall be drawn from the geotechnical measurements, from their magnitude, alterations and tendencies about stability of the primary lining and surrounding rock, performance of the initial support applied and utilizationof the support elements.

6.1.6 The location and spacing between geotechnical measurement sections depends geological conditions, frequency of geologicalalterations, rock mechanical behaviour, length of tunnels, primary stress conditions, size of tunnels. The location of measurement sections shall be decided during tunneling according to the local local geological conditions and the experience gained during tunnel driving and as required by the Designer or Engineer.

6.1.7 Reading of instruments, interpretation and evaluation of monitoring results as well as geological mapping during excavation will be carried out by the Designer/Engineer.

6.1.8 The Contractor shall supply, install, calibrate, test, survey and maintain instrumentation in the Tunnels, Chambers and shafts etc. as specified in this Section or as directed by the Engineer.**Minimum instrument stock for 3 months shall be maintained at site as per approved instrumentation program.** The Contractor shall supply and install all ancillary measuring equipment, read out units and construct terminal structures, protective surrounds for instruments, excavate pits and trenches, backfilling, drill holes, install pipes and fittings, and cast concrete where required. Contractor shall get approved instrumentation plan prior to installation of any instrument. All the instruments to be installed by the contractor in all the structures shall be procured from very reputed manufacturers who have supplied such instruments at other similar projects also and have good credentials of having satisfactory working of those instruments. The specifications and the source of instruments shall be got approved by the contractor from Engineer before procuring them.

6.1.9 The extent, type and location of the individual instruments as shown on the Construction Drawings, the number and location of the instruments may be altered by the Engineer during the construction period, according to the requirements.

6.1.10 The Contract Documents give only the numbers, general type, and general arrangement of the instruments to be supplied and installed by the Contractor.

6.1.11 Instruments shall be preferably vibrating wire type. All instrumentation operating on electrical or hydraulic systems shall be accompanied by individual test certificates andshall be tested in the presence of the Engineer prior to installation, unless specifically stated otherwise.

6.1.12 All instruments shall be installed to the lines and elevations shown on the Construction Drawings or as established by the Engineer as the work progresses during construction.

6.1.13 The installation of instruments may interfere with the overall construction progress. The Contractor shall make provision for any such interference in his construction planning. He will not be entitled to any compensation or extension of the Time for Completion by reason of any such delays, including repair and -replacement of damaged instruments.

6.1.14 No instruments or any of their components shall be purchased prior to Engineer's approval. However, approval by the Engineer of the Contractor's proposals and drawings or data shall not relieve the Contractor from his sole responsibility to meet all the requirements under this Contract.

6.1.15 All instruments shall be guaranteed against defect in installation / manufacturing till completion of Defect Liability Period. The contractor at no cost to “Employer” shall replace all defective instruments during the period of guarantee. However, the buried defective instruments shall not be returned to the contractor.

6.1.16 All the instruments shall be supplied with at least 3 copies of instruction manuals explaining installation procedures, guidelines, necessary protection measures and necessary maintenance requirements etc. complete in all respects.

6.1.17 The measuring devices to be provided shall be manufactured by a reputed manufacturer with proven record and acceptable to the Engineer.

6.1.18 The contractor shall take utmost care in the recording and analysis of the readings and prevent mixing of readings from different instruments.

6.1.19 During execution of the works, the contractor shall observe, record and submit readings of all the instruments in specified format along with analysis of observed data and at specified frequency / period to the Engineer.

6.2 SUBMITTALS

6.2.1 Within 56 days from the commencement date, the contractor shall submit details of the instruments proposed for the installation. These shall be consistent with the general information on the instrumentation submitted by the contractor with his tender as well as with any modifications subsequently agreed to by the Engineer and the Contractor and shall include:

- **i.** Detailed description of all instrumentation, cabling and accessories including any ancillary measuring equipment he proposes to install.
- **ii.** Evidence of successful performance of the instrumentation proposed for installation.
- **iii.** Manufacturer’s instruction for the installation, testing and operation of the instruments.
- **iv.** Schedule of monitoring of instruments.

6.2.2 All the instruments for monitoring load on supportand tunnel deformation shall be installed as soon as possible after the blast and as near as possible to the tunnel face as possible but in any case, before blasting the next round. This is an essential requirement of the proposed method of tunnel excavation,

6.2.3 The monitoring instruments must include

i. Instrumented bolts in place of anchor load cells,
ii. Magnetic Ring extensometer (5-point MPBX),
iii. Piezometer if water seepage is observed,
iv. Paper targets for measuring deformation using Total Station.
v. an optical borehole TV Camera for inspection of discontinuities in the borehole rock.

6.2.4 During the execution of the works, the contractor shall submit any further details regarding the instrumentation required by the Engineer. The contractor shall prepare surveys and furnish “AS BUILT” drawings for all the installed instruments.

6.3 SKILLED PERSONNEL

6.3.1 The whole of the instrumentation work shall be carried out under the direct supervision of a senior supervisor, approved by the Engineer, and employed by the contractor who is well experienced in all types of instrumentation and installation work and who understands the purpose and function of all instruments being installed.

6.3.2 Installation and calibration of instruments shall be carried out by skilled technicians, well experienced in the installation of instruments and who have a thorough understanding of the purpose and function of the instruments being installed, acceptable to the Engineer.

6.4 INSTALLATION

6.4.1 The contractor shall install and calibrate all instrumentation conforming to the supplier’s instructions and shall, where necessary, expose all partially installed instruments, cables and tubes to continue their installation, including carrying out all survey work required to locate such instruments. A representative of instrument’s manufacturer shall be present during the entire process of installation. The contractor shall submit a certificate issued by the manufacturer regarding the installation of instruments as per the instrument’s manual, to the Engineer. The contractor shall tag all cables and tubes with identification tags approved by the Engineer at intervals of 15 m or at such closer intervals as necessary to provide continuous identification.

6.4.2 Instrumentation shall be installed and calibrated in the presence of the Engineer, and when he considers it desirable, instruments shall be installed preferably during daylight hours. At all times, the contractor shall ensure that adequate lighting is available, whether by natural or artificial means, to ensure proper execution of the work.

6.4.3 Cables and tubes shall be installed in the maximum lengths practicable. Splicing and coupling, if essential, shall be performed in accordance with the manufacturer’s recommendations. Calibration readings shall be taken prior to and immediately after splicing. Open ends of all incomplete lines of tubing and casing shall be kept plugged or sealed and the contractor shall always during installation keep the insides of casings and tubes free from foreign matter. Cables and tubes shall be protected from mechanical damage.

6.5 CARE OF INSTRUMENTATION

6.5.1 No traffic or equipment shall be allowed to pass over any part of any instruments or connections unless suitably protected as recommended by the instrument supplier and approved by the Engineer. The backfill material shall be carefully compacted in

such a way that the density of backfills will become equivalent to the surrounding materials to the satisfaction of the Engineer.

6.5.2 The Contractor shall protect all instruments and connections from damage and displacement during the progress of the work. If damage or displacement of the instruments or connections occurs during the progress of the work, they shall be repaired or replaced immediately by the contractor.

6.5.3 The Contractor shall be fully responsible for the maintenance and repair of all instrumentation during the contract period.

6.5.4 The Contractor shall recalibrate instruments at the frequency / period as specified by manufacturer as approved by Engineer.

6.6 READING OF THE INSTRUMENTS

6.6.1 Calibration of all the instruments shall be done by the contractor and all the facilities for the same shall be arranged by him. An initial set of readings on all instruments installed at any elevation will be taken immediately after their installation, and the contractor shall not place concrete over the instruments or tubes or cables at this location until these readings have been taken.

6.6.2 The contractor, after consultation with Engineer, shall program his work and make all necessary arrangements to record the reading of instruments as soon as possible after their installation. Such arrangements shall include, where necessary, the provision of temporary read out points.

6.6.3 During the construction, the contractor shall read the instruments once a day till the tunnel is advanced at least 8 to10 D distance from a monitoring location (D is the maximum dimension of excavated tunnel), and thereafter once a week till the deformations are stabilized or as directed by the Engineer. The contractor shall inform the Engineer when reading of the instruments will take place.

6.7 INSTRUMENTATION AND MONITORING FOR STRUCTURES

6.7.1 The contractor shall supply and install the measuring devices, carry out additional excavation, drilling, construct concrete or mortar pads, backfilling with concrete, perform the measurement, and record the readings at frequency / period specified by Engineer for the following instruments

i. Topographical markers / survey points
ii. Seepage Measuring Devices (Measuring Weir)
iii. Automatic Weather Station
iv. Cables
v. Cable splicing kit.
vi. Junction Boxes
vii. Readout units.
viii. Tiltmeter

6.7.2 The instruments shall be supplied, installed and monitored by the contractor as directed by Engineer in order to assess the behavior of the structure and other structures during the Construction of the work.

6.7.3 Topographical Markers.

i. The contractor shall supply, install and survey studs, base plates, observation pillars and survey targets along with accessories, as shown on the drawings for precision surveying. Base plates and leveling studs shall be used to measure the vertical movements of the structure top or parapet wall & other concrete structures. Survey targets and observation pillars shall be used for measuring horizontal movement or deflection. Observation pillars shall be installed on the downstream side banks and targets mounted on the structure at various elevations as shown on the drawings.

ii. Observation pillar shall be of size 600 mm X 600 mm X 900 mm (projecting 300 mm above ground), RCC of M30 Grade having 4 nos 10 mm longitudinal reinforcement bar with 4 nos 6 mm reinforcement bar stirrups. Observation pillar shall be of size 600 mm X 600 mm X 900 mm (projecting 300 mm above ground), RCC of M30 Grade having 4 nos 10 mm longitudinal reinforcement bar with 4 nos 6 mm reinforcement bar stirrups.

iii. Survey studs shall be of stainless steel of 15 mm Ø and 250 mm long and of the shape and size as shown on the drawings.

iv. Leveling studs/ base plates shall be installed as soon as possible after placement of concrete at the locations where required. The base plate shall be 100 X 100 X 3 mm stainless steel plates or brass plate with 4 MS spikes (hold fasts) about 5 mm Ø X 70 mm long to hold the plate in concrete. The top surface of the plate shall be a perfect plane.

v. Survey targets shall be made of solid brass or stainless steel of about 35 mm Ø on top and 75 mm long. Its top there will be an engraved cross mark 1 mm thick and 1 mm deep. The contractor may suggest some different type of targets also for approval of the Engineer.

vi. Immediately after installation of any studs / base plates, its position and level shall be precisely surveyed. The level and coordinates shall be computed and submitted in writing to the Engineer within 24 hours of installation.

vii. Thereafter, the contractor shall read the targets once a day till the tunnel is advanced at least 8 to10 D distance from a monitoring location (D is the maximum dimension of excavated tunnel), and thereafter once a week till the deformations are stabilized or as directed by the Engineer. The contractor shall inform the Engineer when reading of the instruments will take place.

6.7.4 Seepage Measuring Devices (Measuring Weir)

i. Measuring Weir shall be installed at appropriate locations as shown in the drawing or as directed by Engineer to measure the amount of seepage with the help of V-notch steel plate weir.

ii. Water level variations shall be accurately sensed by vibrating wire sensors. These gauges shall measure the buoyancy (Uplift Pressure) force acting on buoys within protecting cylinders at various depth of submergence. It shall consist of attached data logger to record time data of flow. It shall be capable of providing alarm signals also at predetermined excessive flow rate.

iii. Seepage measuring device shall consist of liquid level indicator (float), vibrating wire transmitter and an indicator. Liquid level indicator shall consist of a V-notch

weir and a sensing element. The sensing element shall consist of a pair of cylinders, each having a vibrating wire type transducer as specified earlier. The scope of supply shall include liquid level float, vibrating wire transducer protection box, datalogger, and all other accessories. The measuring range of the weir shall be upto 30 litre / sec.

6.7.5 Automatic Weather Station

i. Contractor shall supply and install weather station (automatic type) and take observations during construction period and hand over to the Employer at the end of the construction period.

A. The Automatic Weather Station (AWS) must permit to record automatically and continuously the following meteorological data:

a. Wind speed
b. Air temperature
c. Rainfall
d. Relative humidity

B. The Sensors of the AWS shall meet the following requirements:

a. Wind speed Sensor

Range	:	0.5 to 100 m/s
Resolution	:	0.5 m/s

b. Air temperature Sensor

Range	:	-10^0 C to $+60^0$ C
Resolution	:	0.1^0 C

c. Rainfall Sensor

Maximum Range	:	10 mm /min
Resolution	:	0.02 mm

d. Relative humidity Sensor

Range	:	5% to 99%
Resolution	:	0.1%

C. The sampling interval shall be adjustable from 1 to 3 hours.

D. All the sensors must be operated with solar cells with provision for power module.

E. DELETED

F. The data storing unit of the AWS shall have the facility to store all data for a period of at least 6 month and shall permit instant display/USB transfer of data.

G. The Contractor shall supply and install a complete AWS including all instrument shelters within one month from the date of commencement.

6.7.6 Cables

i. Cables connected to instruments shall be laid as per the detailed cable routes submitted by the contractor and approved by the Engineer.

ii. Cables shall be generally be of following types.

A. 12 core cable: it shall have 7 / 0.25 mm ATC PE insulated, with six twisted pair (12 core), color coded, screened with water blocking aluminum foil or jelly filled, polyester taped, inner polythene sheeted, 0.3 mm galvanized iron wire braid armored with 50 % coverage, overall polythene sheathed and overall diameter of around 14 mm.

iii. Special cables, where required, for various gauges shall be of standard market quality, as approved by the Engineer.

6.7.7 Cable Splicing Kit

i. It is required for joining two cable ends of four-core cable. It shall be suitable to make a water resistance sealed joint and shall have requisite amount of cable jointing compound like epoxy and silicon grease. The splicer shall be made of stainless steel and shall be able to withstand a pressure of 30 kg / cm^2 and a tensile force of 12 KN.

6.7.8 Junction Box

i. The junction box shall be mounted at appropriate locations as shown on the drawings or as directed by Engineer. The junction box shall be a device to provide connection between core cables leading from the different instruments and multi-core cables leading to the multiplexer unit. The junction box should have a connector socket for the fly leads from the portable read out unit and a rotary switch to select individual instruments.

ii. All switchable junction boxes shall be double ended. This is essential to remove the possibility of one rogue instrument interfering with the performance of the others. The junction box shall have an arrangement for connecting minimum 20 instruments. The wires and terminals within the junction box shall be fitted with entrance hubs to protect them against danger of water penetration.

iii. The junction box shall be of drip tight sheet steel and shall be provided with stuffing box for special measuring cables and connecting cables and shall have built in terminals and socket strips. The junction box shall be provided with an arrangement for protection against over voltage. The sheet steel metal construction of the distribution box shall be properly treated and coated with corrosion resistant paint. The junction box shall also be provided with an arrangement for earthing and shall be supplied along with its accessories. The specifications for the junction box given herein indicate broad requirements only.

6.7.9 Tiltmeter:

i. Tiltmeters shall be installed at appropriate locations on structures to measure small changes of the inclination due to tunnel construction.

ii. Position of the tilt meter should be determined immediately after installation and parallel to the zero measurement.

6.8 INSTRUMENTATION AND MONITORING FOR UNDER-GROUND WORKS

6.8.1 General

i. The contractor shall supply and install the measuring devices as shown in the drawings of various underground works or as directed by the Engineer to carry out additional excavation, drilling, construct concrete or mortar pads, backfilling with concrete, perform the measurement, and record the readings at frequency / period specified by Engineer for the following.

A. Topographical markers/ survey points.
B. Load cells
C. Measuring tape
D. Tape convergence points
E. Single and multiple point borehole extensometers
F. Readout units.
G. Bi-Reflex Targets and Electronic Total Station

ii. The measuring devices to be provided shall be manufactured by a reputed manufacturer with proven record and acceptable to the Engineer.

iii. The contractor shall take utmost care in the recording and analysis of the readings and prevent mixing of readings from different instruments.

iv. During execution of the works, the contractor shall observe, record and submit readings of all the instruments in specified format as approved by engineeralong with analysis of observed data and at specified frequency / period to the Engineer.

6.8.2 Load Cells

i. Only vibrating wire-based Load cells shall be installed to monitor the behavior of steel ribs/Lattice girder supports installed.

ii. The load cells shall have the following characteristics:

A. Capacity	:	300 kN
B. Overload Capacity	:	150 % of Full scale.
C. Accuracy	:	0.5 % of Full scale
D. Material of Element	:	Stainless Steel.

E. Remote electrical read out unit.

iii. Each load cell shall be supplied with a cable of 20 m length.

iv. At the beginning, the readings shall be taken daily. Later, weekly readings shall be taken till the cessation of any movement or until the Engineer permits termination.

6.8.3 V.W wire based instrumented bolt (Rock bolt load measurement)

i. It shall be 4-point VW type instrument installed at every 100m or as directed by engineer and shall measure load at 3-4 places along the same rock bolt.

ii. It is required to measure load on rock bolt at various depths after installation.

iii. It shall have capacity to measure load upto 300 KN with 0.5% accuracy.

6.8.4 Tape extensometer

i. It is required for measuring distance for “Convergence measuring points”. It shall have following characteristics.

A. It shall be temperature resistant, water resistant and tear resistant Tape.

B. The tape shall be not less than 30 m length.

6.8.5 Convergence Measurement

i. Convergence measurement shall be performed in underground excavation works to determine the relative displacement of opposite measuring points placed around the excavation perimeter.

ii. The measuring points shall consist of the convergence bolts made of stainless-steel pins molded on a short reinforcing bar grouted into predrilled hole.

iii. The distance changes between the opposite convergence bolts shall be measured by means of tape extensometer connected to the bolts and tensioned between them. Change of length shall be read on a digital gauge. Reproducibility of measurement shall be ±0.5 mm.

iv. The distance changes between the opposite convergence bolts may be measured by means of Total station also.

v. The convergence bolts shall be installed within the heading zone after the installation of supports. At the beginning, the measurement shall be carried out daily. Later weekly readings shall be taken for several months up to the cessation of any movement by latest when the placing of the concrete lining commences.The convergence measuring tape extensometer and the digital gauge shall be calibrated on their corresponding calibration devices before and after each measurement. Digital readout shall be in metric unit.Whenever instructed by

engineer, the same shall be replaced by reflector type paper target points which can be remotely spotted for convergence measurements. Removable bi-reflex optical targets shall be installed as near as possible from the face along with protection caps to prevent damage during blast.

6.8.6 Vibrating Wire type Multipoint Bore-Hole Extensometers to accommodate in 45-50 mm dia holes)

i. These extensometers shall be installed in underground excavation to measure displacements in the rock mass surrounding the excavation.

ii. The extensometers shall be installed in the boreholes drilled radially on a plane perpendicular to the centerline of the underground structure. The exact location of each measuring section will be determined by the Engineer.

iii. The borehole diameter shall be less than 50 mm or as recommended by the supplier of the extensometers. The measuring heads shall be installed in recesses excavated around the collar prior to the drilling of the hole and shall be protected from damage by a cover plate.

iv. Extensometers will have a typical rod length of 2,5,10 and 20.

v. Reading of the extensometers shall be done with a readout unit. At the beginning, the readings shall be taken daily. Later, weekly readings shall be taken till the cessation of any movement or until the Engineer permits termination but latest when the placing of the concrete lining commences. The readings so taken along with report (comprising of data observed, analysis of data etc.,) shall be reported to the Engineer.

6.8.7 Electronic Total Station

The electronic total station shall have the minimum precision:

i. Horizontal angle measurement : +/-1” (0.3 mgon)

ii. Vertical angle measurement : +/-1” (0.3 mgon).

iii. Distance measurement : +/- (1 mm+ 1.5 ppm).

6.8.8 Absolute 3D Displacement Monitoring

i. Absolute monitoring shall be performed in underground excavation works to determine the spatial position of measuring points placed around the excavation perimeter.

ii. The measuring points shall consist of the targets mounted on special bolts.

iii. The targets should be installed immediately behind the face on the last round and zero reading should be taken. Construction sequence (top heading- bench excavation etc.) should be recorded simultaneously with absolute displacement monitoring.

6.9 Readout Unit for Electrical Instruments

6.9.1 The contractor shall supply a readout unit for load cells and Extensometers.

6.9.2 The read-out unit shall be portable, battery operated, designed to read vibrating wire gauge/ resistance gauges / thermistors. The LCD display shall present maximum information including output signal period, linear or frequency reading, gauges temperature, thermistor’s Ohm value gauge factor and type. The unit shall be able to log data having minimum 500 channels and 2000 readings. Power supply shall be through rechargeable battery.

6.10 DELETED

6.11 MEASUREMENT AND PAYMENT

6.11.1 The payment for supplying and installing all the instrumentation shall be made as per the rates quoted for various items of works in the schedule of item rates. Unless otherwise specified, the scope of instrumentation shall include the following:

- **i.** Supply, installation, calibration, testing, surveying, repairing and maintaining of all instruments, ancillary and read out equipment, including protective steel covers, tubes and tube protections, required to perform the specified measurements.
- **ii.** Forming all necessary recesses in concrete, all necessary trench and pit excavation, foundation preparation, temporary and permanent protection of instruments and ancillary equipment by surrounding with selected material or by other approved method and maintaining easy access to all readout points. No deduction will be made for the volume occupied by the instruments and instrument protection when measuring the embankment material for payment.
- **iii.** Entire cost of supply and installation, testing, taking measurements and readings and submitting installation protocols and results to the Engineer.

6.11.2 Payment for posting of Instrumentation&MonitoringEngineer(of a reputed instrument manufacturer whose instrument is being procured by the contractoror having suitable experience.)shall be made separately as per rates entered in the schedule. The Instrumentation & MonitoringEngineer shall possess minimum 5 years working experience of field installation, maintenance and taking readings of the instruments.The Instrumentation &MonitoringEngineershall be mandatory forinstallation, Regular reading of the instruments / equipment, and interpretation andsubmission of reportson formats approved bytheEngineerduring construction and the handing over of all data up to the time of completion along with and the instruments and readout units, with all accessories, in proper working order as required by the Engineer.The Contractor shall deployInstrumentation& Monitoring Engineers according to man month mentioned in BOQ in 2 shift per day.

6.12 Monitoring Recording and The Control Process of Underground works Is mentioned in Annexure to Sub- Chapter 6: Instrumentation.

ANNEXURE TO SUB- CHAPTER 6: INSTRUMENTATION

MONITORING RECORDING AND THE CONTROL PROCESS OF UNDERGROUND WORKS

1. GENERAL

a) The Contractor shall submit to the Engineer for agreement a detailed method statement for instrumentation and monitoring, including instrumentation layout, trigger, design and allowable values and procedures for evaluating the monitored data.

b) The Contractor shall appoint within his site team an experienced Instrumentation & Monitoring Engineer who shall lead the Contractor's monitoring team. The Instrumentation & Monitoring Engineer shall present the results of the previous day's monitoring in the daily monitoring meeting with the Engineer where they shall be presented to the Engineer by the Instrumentation & Monitoring Engineer.

c) The frequency of such review meeting may be increased if requested by the Engineer.

d) The Contractor' Tunnel Construction Manager shall attend monitoring review meetings if requested by the Engineer.

e) The accuracy and precision of the measurement required will depend on the purpose of the monitoring.

f) Assessments shall be carried out to establish the zone of influence due to tunneling works and to determine the likely damage that will occur to existing above ground and subsurface infrastructure.

g) The outcome of the assessments shall determine the type and amount of monitoring that will be required.

h) Early preconstruction instrumentation requirements shall be determined so that baseline measurements can be taken for an appropriate period, to establish the stability of the monitoring system and any possible effects of any underlying environmental trends that could be attributed to the Works.

2. Ground Monitoring

a) Unless otherwise provided for in the contract, the Contractor shall monitor the effects of tunnel construction at the surface including all ground movements and the effects on all structures, including the Works. Where specifically requested, the subsurface effects, including movements of the water table, shall also be monitored.

b) Unless otherwise provided for in the contract, monitoring equipment and instruments shall be provided by the Contractor to enable the response of structures to be determined, Equipment and instruments shall be installed to the manufacturer's instructions and shall be calibrated and tested as appropriate. Monitoring pins and devices shall be securely fixed in position. Due regard shall be given to the construction of the structure to be monitored and the layout of its primary support.

c) Monitoring shall be referenced to stable survey stations located outside the zone of influence of the Works and not subject to ground movement. Such benchmarks and coordinated stations shall be established and agreed with the Engineer before any ground is excavated and before any ground treatment or dewatering takes place. They shall be checked at intervals during the duration of the Works.

d) The Contractor shall observe, record and analyze the readings to establish trends in movement and reconcile movements measured with those predicted. He shall provide a copy of all recorded results to the Engineer. He shall make available results to the Engineer in accordance with an agreed programme: however, movement greater than predicted shall be reported to the Engineer immediately.

e) Prior to Construction Works commencing, a defect survey shall be carried out of all structures within the zone of influence and a schedule of defects shall be prepared. This

schedule shall be agreed by the Contractor and the owner of the structure, or his representative, prior to the start of construction. Existing pipelines, tunnels and services shall be regarded as structures.

f) During the execution of the Works, defects which have been scheduled shall be inspected and monitored as necessary. Defects which arise during the course of the works shall be recorded. The Contractor shall keep records of such inspections and a copy shall be available to the Engineer.

g) Monitoring of settlement, scheduled defects and defects arising during the course of the works shall continue at agreed intervals for a period of at least 6 months after completion.

3. Monitoring of Tunnel Excavation

a) The Contractor shall survey, monitor and record tunnel and shaft construction as it proceeds, to form a record of the work. Monitoring shall generally be per unit of advance and include line, level, cross-sectional accuracy, shift advance, total advance.

b) Where grouting is carried out, the type, volume and pressure of grout shall be recorded.

c) All information recorded by the Contractor shall be provided to the Engineer on a daily basis unless another interval has been agreed.

d) Where the Contractor considers that any corrective actions he may take will exceed the tolerance in the contract he shall so inform the Engineer and obtain his agreement.

e) The strata exposed in the tunnel face shall be mapped and recorded where possible and the nature of the excavated material shall be noted in all cases.

f) All significant groundwater ingress shall be recorded and monitored.

g) All atmosphere testing shall be recorded and monitoring for all gases carried out in accordance with relevant code.

h) The Contractor shall keep copies of all recent face records at the workface for the information of supervisory personnel.

4. Daily Review Meeting (DRM)

a) The monitoring instrumentation shall be read on a regular basis- as per Drawings and monitoring plan and the record made available for a Daily Review Meeting (DRM) attended by the Senior members of the Contractor's and the Engineer's staff. Input into the meeting shall also include current Geotechnical Investigations, Measurement While Drilling (MWD) report, face logs, and any recent non-conformance reports relating to the tunnel construction.

b) This DRM shall be held daily during the excavation of the tunnels unless otherwise agreed by the Contractor and the Engineer.

c) At the meeting the Contractor shall present the current results of monitoring of the tunnels, together with records on these results and comparison with the deformation predicted by the calculations.

d) The outcome of the meeting shall be a report Required Excavation and Support Sheet (RESS) agreed by the Contractor and Engineer, which states that tunneling may continue as proposed or gives the requirements for modification to the tunneling (e.g. shorter advances, smaller heading).

e) If no agreed report is available by a specified time each day then the tunnel shall be made safe and tunneling be stopped.

f) All records from these meetings including face logging and monitoring results shall be kept and be available for inspection until the termination of the contract.

5. Key Performance Indicator (KPI)

a) A Key Performance Indicator (KPI) system shall be developed for monitoring movements so that action can be taken in a timely manner, thereby ensuring that damage to existing buildings and subsurface infrastructure is within calculated predictions.
b) The KPIs to be used to guide construction shall relate to specific monitoring activities.
   i. In-tunnel convergence monitoring (SCL)
   ii. Ground movement monitoring
   iii. Monitoring of adjacent and overlying structures.

c) The KPI values specified in the design documentation shall be used to indicate whether or not there is cause for concern during tunnel construction. To ensure that the response is appropriate for any specific concern, certain procedures shall be implemented when a KPI is exceeded. These are summarized below:

   i. A full review of the lining performance shall be conducted for the relevant tunnel section and checked against the KPI values. This includes checks on the ground/soil conditions, the quality of construction and the monitoring results provided by the Contractor.
   ii. A comprehensive review of the trends for monitoring data specific to the area of concern shall be carried out by the Contractor and the Engineer.
   iii. The Contractor shall assess the extent to which the deformations comply with the SCL serviceability and extreme limit conditions.
   iv. Together with the Engineer, the Contractor shall decide whether changes in the SCL excavation sequences are required. This is an interactive process that will determine whether it is safe to proceed with construction or, if there is reasonable cause for concern, the extent to which it is necessary to implement additional measures or emergency procedures. These measures will be included in a new RESS.
   v. The Contractor and Engineer shall implement the Action Plan, the emergency response to implement contingency measures. If there is reasonable cause for concern, it is emphasized that the response must be rapid.
   vi. The performance of the tunnel is kept under continuous review until the monitoring data indicate that KPI trends show a stable condition.

d) At least three trigger values shall be established: a green, amber and red limit. The green limit marks the boundary of normal behaviors. The amber marks the boundary of serviceability while the red trigger should be set below the ultimate capacity of the lining. The Contractor's Action Plan should include pre-planned contingency measures that can be taken if a trigger value is exceeded.
e) If a trigger value is reached, first the site team should check that the reading is correct and consistent with the readings from other instruments. If the rigger has really been breached, then contingency measures will be investigated in accordance with a predefined Action Plan and as directed in the DRM. The contingency measures are designed to correct any anomalous behavior.

6. RESS- Required Excavation and Support Sheet

a) Based on the design and the evaluation of the result of monitoring, a RESS will be issued at the outcome of the Daily Review Meeting (DRM). In the absence of any approved changes the RESS will reflect exactly what is shown on the relevant design drawings.
b) The RESS shall be prepared and endorsed by the Contractor's Tunnel Construction Manager responsible for the tunneling works, the Designer (for specific issues) and the Engineer on site. Unless all the three signatures are obtained, the proposals indicated on the RESS shall not be implemented.
c) The RESS shall address, but not necessary be limited to the following matters:

i. The tunnel section (chainages) to which the RESS is applicable
ii. The support to be installed
iii. The excavation sequence
iv. The method of working related to ground support including staging of application of sprayed-concrete layers and lapping of reinforcement.
v. Monitoring to be installed in the tunnel section in question
vi. Measures to be taken during stoppage of works
vii. Other instruction relevant to the tunnel section in question
viii. Reference to relevant Design Drawings

d) A copy of the RESS will be given to the Head Foreman in charge of the work in the tunnel and shall be kept at the working face.
e) A RESS is required for every metre of the length of the tunnels.
f) If for any reason the approved design method of working is changed, then this will be reviewed prior to the DRM and subject to acceptance by the Engineer a new RESS will be issued.

7. Contingencies measures and Emergencies procedures

a) The Contractor shall determine contingency measures to deal with potential hazards that may affect the Works. The Contractor shall submit for approval to the Engineer an action plan which shall detail the actions, procedures and contingency measures to be followed in the event that the monitoring system shows unacceptable levels of deformation movement if potential hazards occur.

b) Hazards to be addressed include
i. changing ground condition
ii. excessive movement of the linings
iii. Excessive ground movement
iv. Excessive settlement of the existing structures
v. Unplanned stoppages
vi. Mechanical excavation plant failure
vii. Insufficient labour resources
viii. Failure of services to underground work (air, light, power etc.)
ix. Incidents within underground works
x. Delay in supply of sprayed concrete (SCL)

c) In underground construction works, changes tend to be progressive with evidence of structure or ground behavior becoming apparent before failure occurs. For this situation a system of hierarchical trigger levels will be appropriate. This allows proportionate response to adverse indications from monitoring.
d) Trigger levels will be based on the results of assessments of at-risk infrastructure. If the assessment indicates that the at-risk infrastructure is unlikely to be able to tolerate the change due to the Works, then triggers will be set based on the levels of change that will be tolerable.
e) There may be some situations where change is less progressive and monitoring may simply be required to give a yes/no response. In these cases reporting is simple and systems of triggers are not appropriate.

SUB CHAPTER -7

7.0 OPEN EXCAVATION

7.1 SCOPE OF WORK

7.1.1 The specifications described herein under relate to the work of open excavation for various structures and shall include all labour, tools, plants, Constructional Plant and services, necessary to carry out the excavation of different type of materials, geological mapping of excavated surfaces, dewatering, temporary slope stabilization measures required to facilitate excavation, transportation and stockpiling / disposal of all excavated materials into stockpiles / dumping areas as shown on the drawings or as approved by the Engineer.

7.1.2 Excavation shall be made to the lines, grades and dimensions shown on the drawings or as otherwise directed by the Engineer, which shall be required to be backfilled with acceptable material and compacted by contractor in a manner acceptable to the engineer.

7.1.3 The Contractor shall maintain the excavated slopes, drainage and trenches and prepare foundations as shown on the drawings or as required by the Engineer.The Contractor must ensure slope protection measures for riverbank and non-dumping station areas ensuring environmental mitigation measures as per the approved environmental mitigation plan.

7.1.4 The area of open excavation shall, where, in the opinion of the Engineer, clearing is necessary, be cleared of all trees, bushes, rubbish and other objectionable matter and the materials so removed, shall be disposed off suitably or as directed by the Engineer

7.1.5 When additional excavation outside the lines and grades shown on the drawings is required by the Contractor for his own convenience, such additional excavation shall be required to be backfilled with acceptable material and compacted by the Contractor in a manner satisfactory to the Engineer. The contractor shall submit his plans for such proposed work in writing for Engineer's acceptance prior to the commencement of the work.

7.1.6 The removal of mud and slush resulting from heavy rains or flooding of the sites, when necessary to ensure the safe and effective performance of the work, shall be performed by the Contractor.For this purpose, Perimetric drains will also be required to be provided at a suitable distance from the edge of the cutting around the slopes to ensure the safe drainage of superficial water, avoiding slope erosion.

7.1.7 At all times during construction, the Contractor shall adopt such excavation procedures that at no time the stability of any slope be impaired. For the excavation in intake area special care shall be exercised and the contractor shall adopt modern controlled blasting techniques.

7.1.8 The approval given by the Engineer to the contractor's methods and equipment shall not relieve the Contractor of his full responsibility for a proper and safe execution of excavation, or of liability for injuries to, or death of person(s), or any obligations under this Contract.

7.1.9 The contractor shall comply with all safety procedures and requirements as stipulated elsewhere in the tender documents.

7.2 SUBMITTALS

7.2.1 At least 4 (four) weeks prior to the commencement of excavation, the Contractor shall submit details of his excavation methods and sequences for all open excavation Works including the schedule of deploying equipments.

7.2.2 The description of drilling and blasting procedures shall include the following:

- **i.** Diameter, spacing, depth, pattern and orientation of blast holes
- **ii.** Type, strength, amount and distribution of explosives to be used, per hole.
- **iii.** Description and purpose of any special method to be adopted by the Contractor.
- **iv.** Sequence of various activities of the excavation work with an indication of corresponding time requirements.

7.2.3 At least 4 (Four) weeks prior to dumping or stockpiling of any excavated material, the Contractor shall submit the layout of the spoil and stockpile area. All data pertinent to working methods and provisions for the security, stability and temporary and permanent drainage of the work areas shall be included along with details of volumes, material types, heights and grade provided. To prevent spillage of muck, R. R. masonry/ Gabion retaining walls with adequate arrangement shall be provided in disposal area.

7.2.4 To enable the Engineer to verify all necessary setting out and elevations carried out by the Contractor, the latter shall notify the Engineer in writing, giving at least 1(one) week notice of his intention to start excavation.

7.2.5 The Engineer reserves the right to require any additional information deemed necessary to be included in the submitted documents

7.3 CLASSIFICATION OF EXCAVATION

7.3.1 Open excavation shall comprise of the following types of excavation:

7.3.2 Soil excluding Rock (Seismic velocity Vp<1000 m/s)

- **i.** Loose excavation shall include all types of soil and such other material, which can be excavated manually by ordinary pick and shovel or barring and wedging or by mechanical equipment such as dozer blade, Ripper, power shovel and dragline but without resorting to blasting. It shall also include embedded boulder not bigger than 1-meter size in anyone direction.

7.3.3 Rock not requiring blasting (Seismic velocity> 1200 m/s to 2000 m/s)

- **i.** This shall include excavation of all rock, which can be excavated by mechanical equipment such as dozer blade, Ripper, power shovel and dragline but without resorting to blasting to loosen the same.
- **ii.** This shall also include boulders and detached rock blocks of size larger than one meter in any direction. It shall also include the removal of softer materials, lying between layers of rock.

7.3.4 Hard Rock requiring blasting (Seismic velocity >2000 m/s)

- **i.** This shall include excavation of all rock, which cannot be excavated without prior blasting to loosen the same.
- **ii.** The term rock shall include boulders and detached rock blocks of size larger than one meter in any direction which requires blasting for removal. It shall also include the removal of softer materials, lying between layers of rock.

7.3.5 Hard Rock requiring blasting but blasting not permitted

- **i.** This shall include excavation of all hard rock, which cannot be excavated without blasting but due to restriction imposed at site by employer, the same is required to be excavated by chiseling Or Rock breaker, vibratory rock rippers, rotary drum cutters. Alternatively, propellants (non-detonating silent explosives for ex. NONEX, ROYAX).

ii. The term rock shall include boulders and detached rock blocks of size larger than one meter in any direction which requires blasting for removal. It shall also include the removal of softer materials, lying between layers of rock.

7.3.6 Removal of Slip

i. Unavoidable slips, which may occur in the excavated slopes, shall be removed by loading, hauling, dumping of the material and the surface cleaned.

7.3.7 Deleted

7.4 REMOVING BLUFFS AND LOOSE ROCK

7.4.1 All loose boulders, semi-detached rocks (along with the earthy stuff which might move therewith) not directly in excavation but so close to the area to .be excavated as to be liable in the opinion of the Engineer, to fall or otherwise endanger the workmen, equipment of the Work, shall be stripped and removed from the areas of excavation. The methods used shall be such as not to shatter or render unstable or unsafe any rock that was originally sound and safe. Any material not requiring removal as contemplated in the Work but which, in the opinion of the Engineer is likely to become loosened or unstable later on shall also be promptly and satisfactorily removed as directed by the Engineer.

7.5 EXCAVATION IN OPEN CUTS

7.5.1 The side slopes of the excavation shall be as shown on the drawings or as directed by the Engineer.

7.5.2 Any changes in the slopes as shown on the drawings on account of site conditions shall be subject to the approval of the Engineer.

7.5.3 Every precaution shall be taken to prevent slips. In case slips occur, the slipped material shall be removed to the designed / modified slope.

7.5.4 Suitable berms shall be left at appropriate places with necessary approach, ramps and sump pits for installation of dewatering pumps or other purpose, as required by the Engineer. All excavation shall be carried out finished to lines and grades shown on the drawings and to the satisfaction of the Engineer.

7.5.5 In case of loose excavation where the surface is left as excavated or is to be covered by pitching formation of rain cuts and gullies shall be avoided by proper drainages. Any gullies formed shall be "made good" by properly packing excavated rock spoil in them. All holes left by removing boulders shall also tie filled in with rock spoil.

7.5.6 Where plain surfaces are required, such faces of excavation shall be formed in such a manner that would least shatter the rock mass. Only light blasting or ream holes or similar methods shall be allowed in areas adjacent to such faces.

7.5.7 In special locations (only in rock) where specifically indicated or ordered by the Engineer, the use of explosives shall be discarded and excavation completed by the drilling, wedging or barring or other suitable method approved by the Engineer.

7.5.8 All excavations, done beyond the lines and dimensions shown on the drawings, which are to be covered by concrete shall be filled back with the concrete of the same grade and quality or as directed by the Engineer.

7.5.9 Blasting within 30m of concrete works or grouted area shall be permitted preferably after concrete or grout is 7 days old and only after the submission by the Contractor and approval by the Engineer of a plan showing the relative positions of structures or grouted area and the areas to be blasted, Contractor's proposed drilling and blasting plan together with an outline of precautions to be taken.

7.5.10 All concrete works and other completed works within 30m of blasting shall be protected by limiting the charges / size of blasts to ensure that the maximum displacement velocity of particles at nearby structures is not more than 50mm per second. For concrete or grout less than seven days old, this velocity shall not be more than 10 mm per second.

7.5.11 No blasting shall be permitted within 15 m radius of concrete works or grouted area.

7.5.12 The open cut excavation shall be done by benching with individual bench height not exceeding 2m.

7.5.13 The Contractor shall carry out the excavation of open cut rock slopes utilizing the controlled blasting techniques as per relevant clause of “Underground Excavation”.

7.5.14 Where depth of open rock excavation is more than 10m, the excavation shall be carried out in a descending way, from horizontal berms, by benching.

7.5.15 Immediately after excavation and scaling to the satisfaction of Engineer and prior to the excavation of next bench, the Contractor shall install rock bolts, provide wiremesh, shotcrete and temporary relief holes if considered necessary, as shown on the drawings or as required by the Engineer.

7.5.16 All blasted rock shall be removed from the bench toe before undertaking further work.

7.5.17 All other specifications pertaining to blasting and scaling etc. relevant to open excavation shall be as per stipulations of Section of Explosive and Blasting.

7.6 EXCAVATION FOR FOUNDATIONS OF STRUCTURE

7.6.1 While carrying out excavation for the foundations of the structure, if it is considered necessary for a Work and if approved by the Engineer, the sides of the loose excavation shall be shored and strutted to the satisfaction of the Engineer.

7.6.2 After completion of the loose excavation, the rock excavation in foundations of the Structures shall be carried out to the depths as shown on the drawings. At all stages of excavation, precautions shall be taken to preserve the rock beyond the lines of required excavation. The quantity and strength of explosives used in the foundation excavation in rock in various locations shall be such as will neither damage nor crack the rock outside the limits of excavations.

7.6.3 As the excavation approaches its final lines and is within 300 mm to 600 mm of the specified foundation levels, the depth of the holes and the strength and quantity of explosives shall be progressively and suitably reduced so as to ensure that the rock profile beyond the lines and levels specified on the drawings shall remain undisturbed. If so, directed by the Engineer, this excavation shall be carried out by the line drilling.

7.6.4 Final excavated surface shall have no abrupt changes in slope and sharp projection greater than 500 mm. Projections in excess of 500 mm shall be treated where necessary by supplementary excavation as determined by the Engineer to produce the desired surface of contact between concrete and rock.

7.6.5 All excavations done beyond the lines and the dimensions shown on the drawings shall be back filled with concrete of the same grade and quality as that of the foundation or as directed by the Engineer.

7.6.6 Acceptance criteria for important foundations: Important structures shall be founded on sound and competent rock and suitable for taking up the load of the super structure without undergoing deformation beyond the acceptable limits as per the directions of Engineer. After excavation up to fresh rock level, further excavation shall be done up to one meter by wedging and barring to remove all the loose and soft, weathered rock, sheared material etc. All sheared portion shall be excavated to a desired depth and

filled with concrete with steel reinforcements as per approved design and drawings. Concreting shall be taken up only after getting written approval of the Engineer.

7.6.7 Stable slopes shall be provided in open excavations along with berms of specified width as per approved design & drawings.

7.6.8 All permanent rock slopes shall be stabilized by suitable treatments such as shotcrete with chain link mesh, rock anchors, spot rock bolts, perforated drainage pipes, berms with drains etc., as per approved design and drawings. The width of berms shall not be less than 4 m. The slope to be provided in various types of rock as per weathering conditionshall depend upon slope stability calculations and preferably shall be as below.

i.	Fresh rock	0.20-0.25(H): 1 (V).
ii.	Moderately weathered rock	0.33-0.50 (H): 1 (V).
iii.	Highly weathered rock	0.67-1.00(H): 1 (V).
iv.	Overburden	1.25 (H): 1 (V) to 1.50 (H): 1 (V).

7.6.9 The cut slopes in overburden shall be treated with dry rock stone masonry with horizontal and vertical bunds of course rubble masonry in cement mortar 1:4 of 1 m. width as per approved design & drawings.

7.6.10 Surface Preparation of Foundations

i. After completion of excavation of foundations, trimming for the final removal of all dummy rock or loosened mass, shall be done by chiseling, barring and wedging as directed by the Engineer.

ii. Any weathered or decomposed rock remaining shall be removed. Open fissures joints; crevices and any other doubtful areas shall be cleaned to a suitable depth up to firm rock and backfill with the concrete/mortar of the same grade as that of the main structure and contact grouting as specified.

iii. Consolidation grouting of the foundation rock shall be carried out upto the specified depth before the placement of concrete.

iv. Contractor shall wash all rock surfaces of the excavations. This washing shall be carried out initially for inspections when required by the Engineer.

v. Final washing of any section of the work prior to concreting or application of shotcrete shall be carried out only when the blasting for the excavation and removal of projections inside the neat lines has been completed.

vi. Final washing prior to concreting shall be done by directing a stream of water at a pressure of about 8 to 10 bars on the rock surfaces from a distance of 1.5meter through a nozzle of 18 mm diameter so as to remove all loose rock, fragments, dust and debris from the surfaces.

7.7 DISPOSAL OF EXCAVATED MATERIALS

7.7.1 The excavated materials suitable for construction shall be stockpiled at locations approved by the Engineer, if the immediate placement in the final location in Permanent Works is not possible.

7.7.2 Excavated materials which are not suitable for construction and those in excess of the requirement for construction shall be disposed off in the waste disposal area. Surfaces of material so disposed off shall be trimmed to regular lines and grades satisfactory to the Engineer. Disposal of all material shall be such that it will not interfere with natural drainage and is as per the regulations for environmental protection or with Engineer's acceptance.The Contractor must ensure muck management as per the approved environmental mitigation plan with proper turfing and plantation at dumping sites.

Nothing extra shall be paid for it and the contractor must include the same in his quoted price.

7.7.3 The contractor shall ensure that no excavated materials are disposed off in the streams or at locations, where these are liable to be washed away by the floods or may block the water way of streams.

7.7.4 The plan of muck dump yard fill, berms and provision of retaining walls, slope of fill etc. will be as per site requirements and the same shall be got approved by contractor from ENGINEER before start of such works.

7.8 DRAINAGE

7.8.1 Seepage water from springs or rainwater shall be suitably collected and drained away from work area by gravity, wherever it is possible to do so. Where, however, drainage by gravity is not feasible, pumping could be resorted to all stipulations laid down in Section of "Dewatering, Drainage and Pumping" shall be followed.

7.9 Backfill

7.9.1 Backfill shall consist of materials as approved by the ENGINEER and shall be placed in locations as directed by the ENGINEER.

7.9.2 Only suitable materials obtained from excavation, if practicable, shall be used for backfilling.

7.9.3 Material to be used in backfill shall be free drainage type.

7.10 MEASUREMENT AND PAYMENTS

7.10.1 General

i. Payment for open excavation shall be made as per Bill of Quantities.

ii. The contractor is assumed to have included the entire cost but not limited to the following:

A. Provision of all labour, equipment and materials required for open excavation in various locations including drilling holes for blasting, developing and Improving controlled blasting methods, performance of blasting, cleaning, washing protection and maintaining excavated surfaces in satisfactory conditions' and additional excavations if any, required by the Contractor for his construction methods.

B. Geological mapping of the excavated area and the temporary stabilization measures adopted for facilitating the open excavation work.

C. Provision for loading, handling and dumping the excavated material on stockpiles, dumping area or point of incorporation into permanent work up to a lead of 200m from exit point of various structures to entry point of disposal area, shaping and trimming of the excavated materials in the dumping area, cleaning of the stockpile area, formation and maintenance of stockpiles, rehandling of suitable materials including segregating; grading, draining and drying of materials suitable for use in embankment construction or as backfill.

D. In case, the dumping of excavated material is required to be made in the areas beyond 200m of initial lead or incase due to any reason beyond contractor's control, then extra payment shall be made for additional lead as per relevant item of the Bill of Quantities and no other claim what-so-ever shall be admissible to the contractor.

E. Deleted.

F. Complying with all requirements of statutory laws and regulations relating to the works and any restrictions resulting there from obtaining all necessary permits and licenses for the purchase, use storage and transport of explosives and other materials.

G. Surveying, setting out, checking of excavated profile, layouts and any subsequent rectification works resulting from unable or incorrect surveys, provision of suitable equipment for and delays due to carrying out this work.

H. Furnishing, installation, operation, maintenance and removal of Communication and illumination systems and observing safety precautions.

I. Recording and preparation of reports related to excavation progress and procedures.

J. All work involved with and any partial or short interruptions or inconveniences caused by the check surveys, performance of the rock mechanics tests, installation and monitoring of instruments and geological mapping, for which no separate payment is provided elsewhere in these specifications.

K. Seepage water or rainwater suitably collected and drained away by gravity including provision of catch drains, diversion of nallah etc.

L. Dewatering by pumping in the open excavation area due to any reason whatsoever.

M. The compensation for removal of mud and slush resulting from heavy rains/flooding of the sites if necessary, to ensure the safe and effective performance of the work shall be deemed to be included in the quoted rate of excavation.

N. The payment towards the preparation of disposal area shall 'be deemed to be included in the quoted rates of excavation".

O. Excavation for drainage trenches will neither be measured nor be paid for.

P. All taxes duties excluding royalties.

Q. Clearing of all trees, bushes, rubbish and any other objectionable materials and their removal and disposal.

R. Over excavation beyond the excavation lines shown on the drawings, removal of material or backfilling with acceptable material where and when as required by the Engineer.

S. Replacement of survey points fixed by the Engineer, which are damaged by Contractor's negligence, and fixing of additional survey points near working area.

T. Methods adopted for specially controlled excavation at foundation level or near the faces where plain surfaces are required.

U. Formation of berms or ramps sump pits for installation of dewatering pumps at places, which fall beyond the specified excavation lines.

V. Replacement or repair of concrete or other works damaged by bIasting.

W. Over-excavation required for contractor's convenience. The concrete required to fill such excavation shall also be at the contractor's expense.

X. Draining, shaping and trimming of the dumped materials in waste disposal area to the lines and grades as directed or approved by the Engineer.

Y. Provision of catch drain, nallah diversions etc. to avoid flow of water to working area.

7.10.2 Open Excavation

i. Measurement for payment of excavation will be of the in-situ volume defined by the excavation lines as shown on the drawings, and shall be worked out on the

basis of solid volume, worked out from the initial, intermediate, and final ground cross sections recorded or as per direction by the Engineer.

ii. Cross sections will be taken normal to the center line at as close intervals as practicable but, in any case, not more than 5 meters and 3 meters apart in loose excavation and rock respectively, prior to the starting of excavation in each class of material, unless some other method is acceptable to the Engineer in any particular location of the work.

iii. Payment will be made at the appropriate Unit Rate per cubic meteras entered in the Schedule of Item Rate, which shall include the entire cost of

A. Drilling holes for blasting

B. Developing and improving controlled blasting methods

C. Blasting tests, explosives and performance of blasting

iv. Payment for removal of bluffs and loose rock close to the areas to be excavated shall be deemed to have been included in the quoted rate for item of open excavation for various structures.

v. Payment for removal of unavoidable slips, which may occur in the excavated slopes, will be deemed to have been included in the quoted rate for the item of open excavation for various structures.

7.10.3 Shoring and Strutting

i. The rates for shoring and strutting shall be included in the rates of excavation itself.

7.10.4 Deleted

7.10.5 Royalties

i. Soil or rock spoils such as stones, boulder, pebbles, gravels etc. available from excavation, if are found suitable for use in works as per required specifications, can be used free of cost but the legally payable royalty and taxes are to be paid by contractor to the concerned authorities.

SUB CHAPTER -8

8.0 UNDERGROUND EXCAVATION

8.1 SCOPE OF WORK

8.1.1 The specifications described herein under relate to the excavation work for the underground structures and shall include all labour, materials, equipment all drilling and blasting, loading, transporting and disposal of materials in spoil or stockpile areas as well as the removal ofall loose material and cleaning of excavated surfaces, to be carried out by the Contractor under this contract. In general, the excavation work shall be done by mechanical equipments or drill and blast (DBM) and in exceptional cases, by manual means.

8.1.2 Excavation shall be made to the lines, grades and dimensions shown on the drawings or as otherwise directed by the Engineer, which shall be required to be backfilled with acceptable material and compacted by contractor in a manner acceptable to the engineer.

8.1.3 Structural supports, structural steel support, rock bolts, shotcrete, grouting,concretelininganddewateringworks are covered in other chapters of technical specifications.

8.1.4 The contractor shall be required to perform surface exploratory drilling during excavation of the tunnel whenever required.

8.1.5 Advance probing and maintaining specified water tightness (as detailed in the respective sub-chapters) is mandatory and can't be relaxed without approval of engineer.

8.1.6 Fore probing shall be done through MWD capable drill jumbos and data so acquired will be used for decision making regarding the probable nature of the ground ahead and its water-bearing capacity.

8.1.7 The approval given by the Engineer to the Contractor's methods and equipment shall not relieve the Contractor of his full responsibility for proper and safe execution of underground excavations, or liability of injuries to or death of person or any obligations under this contract.

8.1.8 The Contractor shall comply with all safety procedure and requirements as stipulated elsewhere in the tender documents.

8.1.9 All excavations done inside ground with overlying material left in place shall be treated as underground excavation.

8.1.10 **STANDARDS:**

The specifications, production, working etc. shall conform to the following latest Indian Standards or where not coveredby these Standards, to the equivalent International Standards. The list is forguidance purpose only. The contractor shall abide by all codes/regulations/specifications as are deemed necessary for the satisfactory completion of work.

i. IS: 4756: - 1978 – Safety Code for Tunnelling work
ii. IS: 3764 –1966 – Safety Code for Excavation work
iii. IS: 4081-1967 – Safety Code for Blasting and Related drilling operations
iv. IS: 4138-1977 – Safety Code for Working on Compressed Air
v. IS: 7293-1974 – Safety Code for Working with Construction Machinery
vi. IS: 5878 (Various parts) – Codes of practices relating to tunnelling and underground excavations
vii. Indian Explosive Act -1988

viii. Indian Explosive Rules -1983
ix. IS: 823 -1964 – Code of procedure for manual metal Arc welding of mild steel
x. IS: 816-1969 – Code of practice for use of Metal Arc welding for General Construction in Mild steel.

8.2 SUBMITTALS

8.2.1 At least 28 days prior to the commencement of underground excavation, the contractor shall submit details of his excavating methods and sequences for all underground works and portal excavation, including equipment, ventilation air cooling equipment, rock support, details of methods for drilling probe holes, grouting and safety measures. Contractor shall get approval for excavation and sequences from the Engineer.

8.2.2 The description of drilling and blasting procedures shall include the following:

i. Diameter, spacing, depth, pattern and orientation of blast holes.
ii. Pattern of delays to be used per blast.
iii. Sequence of various activities of the excavation works in different. Heading faces with indication of corresponding time requirements.
iv. Excavation methodology shall include proposed exaction cycle time for each class of rock mass along with advance rock stabilization measures.
v. The details to be backed up by supporting calculations & details of trials.

8.2.3 At least 28 days prior to dumping or stockpiling of any material, the Contractor shall submit the layout of the spoil and stockpile areas. All pertinent data of working methods and provision for the security, stability, temporary and permanent drainage of the area shall be Included and details of volumes, material types heights and grades provided. To prevent spillage of muck, R.R. Masonry/ Gabion retaining walls with adequate arrangement shall be provided in disposal area.

8.2.4 To enable the Engineer to verify all necessary setting out and elevations carried out by the Contractor, the latter, shall notify the Engineer in writing, giving at least 1 (One) week notice, of his intention to start excavation.

8.2.5 During the advance of underground excavations, the Contractor shall record and submit weekly to the Engineer, 3 copies of the following:

i. Advance of each heading face and chainage of heading face before the blasting of each round.
ii. Amount, location, spacing, and type of steel support/Lagging installation in various zones, as defined hereafter.
iii. Surface area of shotcrete installed in various zones.
iv. Number, length, and type of rock bolts installed in various zones.
v. Occurrence of gas, if any.
vi. Water inflows at the heading face including its temperature.
vii. Personnel employed during various stages of the operation and their qualification.
viii. Unusual occurrences, all delays and the reason of delays.
ix. Type and number of drill holes, and length of each round.
x. Pattern of drill holes their diameter and length.

8.2.6 The Engineer reserves the right to require any additional information deemed necessary to be included in the submitted documents.

8.2.7 For geological overbreak and adverse geological occurrence Contractor shall be responsible for preparing geological plans and survey plot cross section at required intervals by tunnel profiler to allow for reasonably accurate assessment of the volumes

and taking video / still photographs of overbreak in the presence of the representative of Engineer and providing copies of the same to "ENGINEER". The exact locations and / or chainage shall also be included therein. Such incidences shall be reported immediately to the ENGINEER. Detailed report on adverse geological occurrences shall also be prepared along with probable reasons and submitted to engineer as soon as possible.All cavity and voids formed due to geological overbreak shall be measured in situ, quantified and proposed by contractor for immediate approval of Engineer, If possible, before the excavation of the subsequent blast.

8.2.8 The drilling parameters retrieved from the Jumbo machine will be submitted to the Engineer before every blast.

8.3 DEFINITIONS

8.3.1 Conventional Excavation

i. Excavation performed underground by conventional methods using mechanical means (except TBM) or drilling and blasting and in exceptional cases, by manual means.

8.3.2 Tunneling Face

i. The advance end of a tunnel at which the work is progressing.

8.3.3 Heading Zone

i. Heading zone refer to tunnels (upstream and downstream headings) excavated by conventional method and is defined as a zone between the newly established face and 7m or equal to the excavated diameter of the tunnel behind the face, measured along the tunnel centerline.

8.3.4 Rear Zone

i. Rear Zone is the whole length of tunnel between the heading zone and the portal.

8.3.5 Excavation Rate per working day

i. The daily excavation rate is the average of daily rates calculated over a period of 1 month.

8.3.6 Working Days (WD)

i. Working days are calendar days on which work is performed. When working days are mentioned in writing, they must be indicated with additional indices such as WD1, WD2 or WD3 in order to show whether on the day in question 1, 2 or 3 shifts will be working.

8.3.7 Crown

i. Crown is the top arch of the tunnel above the spring line.

8.3.8 Spring Line

i. The level at which overt and vertical / wall of the tunnel meet is called Spring level and horizontal line passing through the junction points of tunnel is called Springing Line.

8.3.9 Round length (Pull): Maximum distance (along tunnel axis) between any two points on two successive tunneling faces by which the excavation is advanced from previous face to next face by conventional drill and blast or any other method in one go.

8.4 General

8.4.1 The Contractor shall always be responsible for the safety and security of excavations during the execution of the Contract.

8.4.2 Mechanized techniques for excavation shall be used.

8.4.3 **Advance probing and attaining specified water tightness in underground excavation is mandatory and can't be relaxed without approval of the Engineer.**

8.4.4 **Excavation shall generally be full face, headingandbenchingor multi-drift (weak strata or larger tunnels in yard areas)as defined in the construction drawings.**

8.4.5 **Deleted.**

8.4.6 The Contractor shall provide details of his proposed methods for excavation support and spoil removal to the Engineer for agreement. No excavation shall take place until the Engineer's agreement has been obtained. Such agreement shall not relieve the Contractor of any of his obligations under the Contract.

8.4.7 Excavation shall be carried out in a uniform and controlled manner and over-cutting shall be kept to a minimum consistent with the need to maintain the necessary clearance for construction of the Works.

8.4.8 The invert of the tunnel shall be protected against damage and deterioration which may be caused by construction traffic. Any other surfaces which deteriorate or are damaged shall be made good to a standard agreed with the Engineer. After invert casting, tunneling muck will be filled, levelled and compacted over concrete invert.

8.4.9 Excavation shall be carried out in sections limited to such lengths, depths and widths as may be safely executed having regard to all the circumstances and as appropriate to the ground conditions and the equipment and method of construction being used.

8.4.10 In water-bearing strata the Contractor shall use such methods and take such steps as are necessary to control flows and maintain the stability of the excavation.

8.4.11 Where necessary to ensure the safety and security of the Works, excavation shall be continuous by day and night.

8.4.12 Weekends, general holidays and enforced stoppages will require the Works to be made safe and inspected by the Contractor at intervals agreed with the Engineer.

8.4.13 Any voids formed during the excavation process by machine overcut slips, falls of material, overbreak and temporary works shall be filled either completely or partially in agreement with engineer, with grout, concrete, sprayed concrete or other approved durable material.

8.4.14 Where the Contract specifies limits to surface settlement and/or protection in respect of existing services or structures, the Contractor shall provide calculations demonstrating that the method of excavation will result in compliance with those requirements. Details of the monitoring arrangements which are proposed for the recording of movements and the verification of the degree of any settlement or damage to services or structures shall be in accordance with the specified limits.

8.4.15 Where agreed or required by the Engineer, temporary support shall be left in the Works. Generally, untreated timber shall not be left permanently in the Works.

8.4.16 The volume of excavated material shall be measured and recorded as the Works proceed. The Contractor shall present to the Engineer after every 50m of advance, a Chainage wise reconciliation of volumetric advance of tunnel against volume of materials excavated and quantum of support installed (Bolts/Shotcrete), concrete placed, length of drilling of holes and grout injected.

8.4.17 All excavation shall be carried out to a profile as close as possible to the specified minimum excavation line.

8.4.18 The Contractor shall be constantly aware of the possibility of slips and ground movement which may be caused by his method or order of excavation. He shall maintain on-site material, and equipment, for use in ensuring the stability of the face.

8.4.19 The proximity of other tunnels and excavations shall be considered when determining the method of excavation.

8.4.20 Enlargement of tunnel cross section or excavation of bypass tunnel shall also be done as wherever required as per instruction of Engineer.

8.5 EXCAVATION LINES AND TOLERANCES

8.5.1 Definitions:

i. Theoretical excavation line: The excavation profiles as shown on the cross section drawings refer to the theoretical excavation lines.

ii. "A"Line" – Depending on the quality of the rock, an appropriate enlargement of the theoretical excavation profile shall be made in order to provide enough space for the anticipated radial deformations. The "A" Line takes into consideration the anticipated radial deformations above the theoretical excavation line.

iii. "B" Line – Line within which neither rock bolts nor sprayed concrete or any part of the primary support shall intersect except for bolt end hardware.

iv. "C" Line – A Line within which the final lining shall not protrude and be constructed within -0/+50mm radially (Negative value radially inward). The Contractor shall accommodate all his construction tolerances for excavation and support installation within this given allowance.

v. "Z" Line–The "Z" Line is a line which is beyond and parallel to the "Pay" Line. The distance between Pay Line and "Z" Line is 300mm.

vi. "Pay" Line – "Pay" Line is a line which is 150mm beyond and parallel to the "A" Line to provide for construction tolerance and excavation undulations. A Line within which payment of excavation will be made, even if the actual excavation profile is between the minimum excavation line and the pay line. "Pay" Line will be same as "A" Line for all excavation profiles at invert.

vii. "No Pay Zone" – Region between "Z" Line and "Pay" Line is defined as "No Pay Zone" . No payment will be admissible for excavation and filling of "No Pay Zone" except of the case of Geological Overbreak (GOB).

viii. "Overbreak" – "Overbreak" consists of the volume of rock removed during excavation operation outside the "Pay" Line irrespective of its extent. The Contractor shall make all reasonable effort to maintain the excavated profile within "Pay" Line, by exercising careful control of drilling and by varying the various elements of smooth blasting suiting various categories of excavation classes, so as not to create any overbreak. Occurring "Overbreak" may be caused by improper workmanship and careless working techniques (avoidable Overbreak) and/or by reasons which cannot be influenced by the Contractor (unavoidable Overbreak). Unavoidable Overbreak is "Overbreak" caused by unfavourable geological conditions.

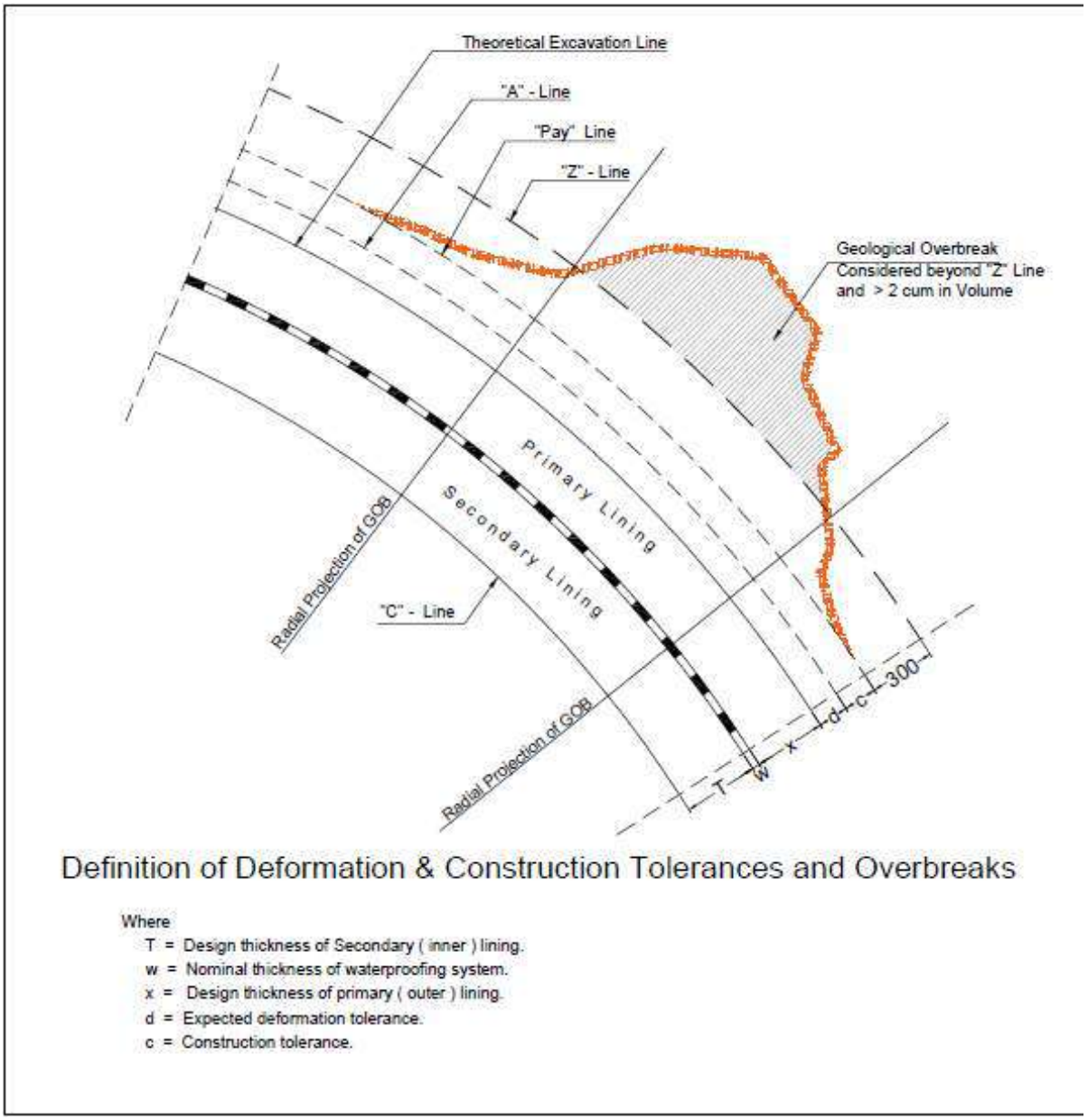


Figure:8.5.1: Definition

ix. "Geological Overbreak" (GOB)–"Geological Overbreak"consist of that portion of over break, the occurrence of which is an unavoidable result of adverse geological conditions due to concealed joints, faults and other structural defect in rock and not due to negligence or lack of reasonable care and skill in excavation operations.

"Overbreak" shall be termed as "Geological Overbreak" if all the following conditions are met: -

A. Part of any" overbreak" which is beyond "Z" Line and exceeds 2 (two)Cumin volume. Volume of GOB for that part will be calculated by multiplying it's area measured beyond "Z" line at such cross section recorded as per clause 8.6.4 below.

B. The "overbreak" occurs above the Invert level of the tunnel.

C. The excavation profile is free from drilling impression.
D. "Over break" is not caused by spalling of the well-known foliation or combination of regular family joints.
E. "Over break" caused due to contractor's not probing ground ahead at locations either mentioned in Geotechnical baseline reports or instructed by engineer otherwise shall not be considered as Geological Overbreak.
F. Approved round length and method of excavation i.e. Drill & Blast or mechanical excavationhave been applied and executed drilling pattern of blast holes and relief holes against approved pattern is shared with the Engineer before taking blast.
G. The Engineer is immediately informed in writing and given an opportunity for inspection while both the cause and the extent of the "overbreak" are clearly visible.
H. When it is decided by the Engineer that "over break" occurreddue to unforeseeable geological conditions beyond the control of the Contractor and not due to Contractor's using improper or improperly applied working methods / bad blasting or negligence and could not have been prevented by prompt and appropriate installation of supports.
I. In case of any dispute regarding the "geological overbreak". The decision of the Engineer shall be final and binding.

For the approval of a "geological overbreak", according to the above described criteria, the Contractor should submit following elements:

a) Detailed geological report including photographic record of the encountered geological conditions.
b) Tunnel excavation profile.
c) Interpretation of Measure While Drilling (MWD) data from Jumbo if any.
d) Daily record of the blast design with information regarding explosives used (quantity, powder factor, etc)

Typical cross section, minimum excavation lines and dimensions of excavations will vary for different Support Section Types required to be installed.Radial Deformation tolerances (δ) as mentioned in drawings shall be adjusted by the engineer to suit actual deformations as experience is gradually gained during excavation. The "A" Line shall accordingly be modified, and the contractor shall be bound by all such adjustments.

8.5.2 Regulation for installation of Primary and Secondary Lining Support

I. Primary Lining Support: After scaling, entire excavated profile will be measured in situ with tunnel Profiler.

For the support classes with shotcrete and bolts only, the design thickness shall be applied directly on the excavated profile. Payment shall be made for the theoretical quantity increased by a thickness of 75mm only, based on the design drawings.

For the support classes with lattice girders/steel ribs the excavated profile shall be placed with Shotcrete upto the "A Line". Thereafter, Design thickness of shotcrete and other supports shall be applied below "A Line", as indicated in the drawings. Payment shall be made for the theoretical quantity increased by a thickness of 75mm only, according to the design drawings.

For the case of the support types with Steel Ribs or Lattice Girders, the application of the shotcrete should respect the design thickness after the A line and reach to the corresponding B Line. In between the steel ribs or lattice girders, the shotcrete application less than the B line can be allowed, upon approval by the Engineer, respecting the following two criteria:

A. Satisfy the shotcrete design thickness as per approved drawings
B. Satisfy the waterproofing membrane waviness criteria

The finished profile of shotcrete shall be checked with tunnel Profiler and shall meet the tolerance for surface finish requirements for installation of water proofing membrane (Sub Chapter 4.4.3 ix). Smoothening layer of shotcrete shall be applied as per drawings or as instructed by engineer.

II. **Secondary Lining Support:** Before application of water proofing membrane, Profile of existing shotcrete surface shall be recorded with tunnel Profiler to establish actual deformation occurred. Any eventual space between the shotcrete surface and "C" Line shall be filled with the inner lining concrete. This eventual space comprises of concrete volumes required on account of portion of radial deformation (δ) which did not occur, added to the volume of theoretical lining thickness.

The actual occurred deformations before the installation of the Final lining will be measured with the convergence target at the closest monitoring cross-section of each support class.

8.5.3 The drilling jumbo should be positioned as per precise survey reference points/lines and shall preferably be laser/total station navigated before it's usage in drilling etc.

8.5.4 The Contractor shall measure the excavated profile by means of a 3 D laser tunnel profiler after each round or as per direction of Engineer.

8.5.5 Excavation not shown on drawings, but which the Contractor considers necessary for his own purposes such as excavation from mucking pits, pump sumps, niche for vehicle parking/turning, drain ditches other than those shown on the drawings and specifications etc. for supply facilities shall only be carried out with the approval of the Engineer.

8.5.6 Excavation of adits other than those shown on the drawings, by the contractor for his convenience, shall be subject to the prior approval of Engineer. Such adit, when no longer be required shall be plugged, as directed by Engineer.

8.5.7 In case of pipe roof umbrella, the excess of excavation below the steel pipes will be filled with Shotcrete/ final lining concrete as instructed by Engineer.

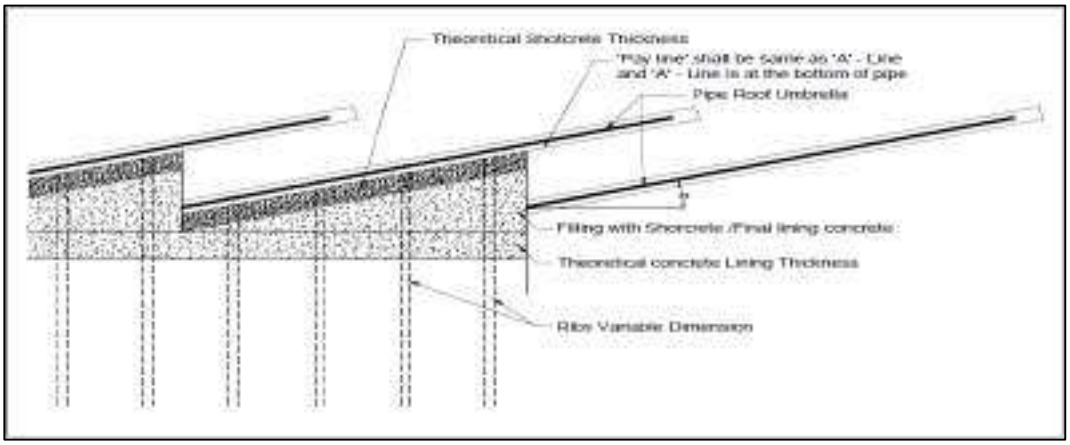


Figure 8.5.7

8.5.8 Tolerances for Lining:

i. Secondary Lining: Finished surface of Secondary Lining shall not protrude “C” Line and be constructed within tolerance of -0/+50mm radially (Negative value radially inward).

ii. No reduction of the theoretical thickness of the inner lining is permitted unless approved by the Engineer. To achieve this requirement, no support elements such as primary shotcrete, rock bolts and steel ribs etc. shall penetrate the theoretical outer boundary of the inner lining.

iii. In the area of the invert and the foundation beams, no rock parts or rock peaks shall protrude into the theoretical excavation line.

8.5.9 Tolerance for Excavation level on invert:

i. For tunnel sections with no concreted invert arch the Contractor shall excavate the bottom level of the invert with an accuracy of -0 to +100(Negative value radially inward) mm related to the theoretical excavation line of the invert.

ii. If the bottom excavation level, after cleaning loose materials etc. is more than 100 mm below the designed theoretical excavation line, the Contractor shall backfill such areas up to the designed, theoretical level by means of sub-base material or as directed and approved by the Engineer.

iii. For tunnel sections with a concrete invert arch no reduction of the designed, theoretical thickness of the concrete structure is permitted. Over excavation must be compensated with structural concrete/ shotcrete for the invert arch as specified. The inside face of a concrete invert arch may deviate not more than +/-50 mm in elevation from the theoretical cross section

8.6 PROFILE CONTROL

8.6.1 Scope

i. The Contractor is required to perform a careful and systematic checking of the final clearance of the primary tunnel lining in order to accommodate the designed nominal thickness of the secondary (inner) lining without interfering with the clearance requirements of the underground structure.

8.6.2 Method of Profile Control

i. For profile control for the shotcrete lining see Clause 8.5.2 (I).

ii. It is the Contractor’s responsibility to ensure that the minimum clearance for the final (inner) lining as shown on the drawings is provided. On approval, the Engineer will issue instructions regarding the systematic checking of the geometry of the template during profiling operations.

iii. The Contractor may prefer to use advance surveying techniques and data processing to establish the final clearance profile. In which case he shall define a method of marking out areas of deviation from the theoretical profile to be approved by the Engineer.

8.6.3 Execution

i. The checking of the final clearance shall not proceed before thegeotechnical measurements show that the radial displacements at anyposition of the tunnel have, in the opinion of the Engineer, largely stopped.

ii. The final clearance profile after the completion of support works of thetunnel and after deformation as per this Clause shall conform to theminimum clearance profile

as indicated on the drawings. Final control isrequired before water proofing system is applied.

iii. In case of an existing under profile, the Contractor shall submit a proposalfor the remedial works to the Engineer for approval.

iv. No reshaping (re-profiling) of the tunnel support shall be carried out withoutthe approval of the Engineer.

v. Geotechnical measurements before, during and after the respective reshaping measures shall be carried out in compliance with the relevant design. The measurement points such as convergence bolts and/or extensometers shall be retained or substituted well in advance in order to establish "transfer - zero - readings".

vi. Geotechnical measurement stations shall not be removed and abandoned without the approval of the Engineer.

8.6.4 Records

i. Records shall be kept for each stage of the remedial measures executed.

ii. The clearance profile i.e cross-sections of excavated profile shall be recorded at every meter of tunnel Chainage in longitudinal direction and at multiple points, 0.5 mtr apart along the periphery of the tunnel or as instructed by the Engineer. The clearance profile shall be recorded by non-contact method (by manually or automatically) i.e by means of a “Tunnel profiler”. The checking of the clearance profile shall be done in presence of the Engineer.

iii. For the shotcrete lining, the final checking of the clearance profile after completion of re-profiling and surface preparation in compliance with this Specification shall be done in presence of the Engineer.

8.7 EXCAVATION UNDER GEO-THERMAL CONDITION

8.7.1 When temperatures above 50°c are encountered it shall be considered as Geo-thermal condition. Temperature of seepage water shall be the criteria for considering the Geo-thermal condition in various reaches. Where there is no Seepage of hot water, temperature of rock mass at the face, inside the tunnel shall be measured.

8.7.2 In case of such occurrence the contractor shall provide additional adequate ventilating / cooling measures so that ambient air temperature below 35° C is maintained inside the tunnel.

8.7.3 In addition to above, provision of ice jackets to workers, ice blocks near working area and other measures may also be required for congenial working atmosphere.

8.8 ADVERSE GEOLOGICAL OCCURRENCE (A.G.O)

8.8.1 Geological occurrence is called adverse if its occurrence is unexpected and there is no possibility of further advance by conventional excavation, including fore poling or pre excavation grouting provided for and priced quoted by the Contractor in his bid, even by using the best qualified tunneling crew.

8.8.2 In the case of such occurrence, the contractor may adopt alternate method with the approval of the Engineer for which he will be compensated as per relevant item of BOQ. (This completion period is subject to time extension given on account of A.G.O.)

8.8.3 In absence of any mutually signed records of Advance probing for the stretch where AGO has occurred, contractor will rectify the situation on its own without any additional cost to the employer. Time loss on this account shall be attributable to the contractor and no claim shall be entertained.

8.9 ADDITIONAL EXCAVATION

8.9.1 The Contractor may be directed by the Engineer to enlarge or change the section or carry out excavation beyond the minimum excavation line in parts of the underground works where excavation has already been completed or carry out excavation for making niches. Such excavation shall be defined as additional excavation and the payment of shall be regulated as per tender clause.

8.9.2 Additional excavation may be carried out for, but not be limited to the following purposes.

- **i.** To enable efficient machinery movement.
- **ii.** To enable the Engineer to carry out rock mechanics tests if any.
- **iii.** To accommodate the increased thickness of the tunnel lining for structural reasons.
- **iv.** Authorized excavation for electrical facility, dewatering, crossovers etc.
- **v.** Authorized excavation on account of unexpected squeezing ground conditions.

8.10 DELETED

8.11 SUPPORT FOR UNDERGROUND EXCAVATION

8.11.1 The provisional and permanent supports for the underground excavation shall principally consist of spot or pattern rock bolts and *I* or shotcrete and/or Structural steel and final concrete liningsupports as approved by the Engineer.

8.11.2 The Contractor shall install the support system as shown on the drawings or as directed by the Engineer in any part of the underground excavation based on rock conditions encountered during the work.

8.11.3 The contractor shall employ a team of qualified geologists, who have adequate working experience in rock supporting work to act as support supervisor(s). The support supervisor(s) shall examine the rock conditions after each excavation advance and shall verify that the rock support system is installed as directed. The support supervisor(s) shall take necessary steps in consultation with Engineer in order to install additional supports or to stop further advance if, in his opinion, the conditions are unsafe. However, he shall have no right to cancel type or amount of rock supports previously directed by the Engineer. The support supervisor(s) shall be present at each heading face throughout the duration of underground excavation work.

8.11.4 The required supports shall be installed concurrently without delay during the process of excavation within the heading zones. In the rear zones additional supports shall be installed immediately after it is observed by monitoring that the supporting system previously installed is not enough to prevent further loosening of the material surrounding the excavation.

8.11.5 Shotcrete shall be applied, in accordance with the provision of Clause 8.5.2, 8.6.3 and relevant Sub Chapter of “Shotcrete”. The Contractor shall consider in his construction planning, that placing of shotcrete protection will be required immediately after blasting a round in conventional method of drill and blast.

8.11.6 DELETED

8.11.7 The use of timber will not be permitted for tunnel supports in any form. However, the Engineer, in exceptional circumstances may permit use of timber for providing temporary supports, which shall be removed as early as practicable.

8.11.8 The Contractor shall keep on the site all necessary construction plant and equipment for installing rock bolts and shotcrete, ready for operation in the excavation heading zones during the entire excavation period.

8.11.9 The contractor shall bear the whole responsibility for the proper and safe excavation. With the prior approval of Engineer, extra supports and special protection for the personnel when the conditions so require can be provided.

8.12 CLASSIFICATION OF UNDERGROUND EXCAVATION

8.12.1 Excavation

i. This section covers the description of rock mass types and rock classes relevant to the underground excavation with respect to the geotechnical properties of rock encountered and its behavior under the influence of tunnel construction. The terminology “rock” in this context shall also include soil conditions. The rock (ground) classes are derived not only from the rock parameters, but also from considerations of a number of external factors such as overburden, size of excavated section and length of round, driving sequence, ground water, water infiltration, results from geotechnical measurements, etc. which can essentially influence the classification.

According to Ö-NORM 2203 Classification, rock masses are divided into 3 main types which are A, B and C:

- A (Stable to over breaking): Stresses acting on rock mass do not cause major failures
- B (Friable): Disintegration due to structural weakness and/or lack of interlocking
- C (Squeezing): Strength of rock mass is exceeded to great depth; this type also includes rock bursts and swelling rock.

Type of support section required shall be based on based upon behavior of rock masses under load and monitoring the performance of underground excavations during construction.

ii. Rock (ground) classes are determined on the grounds of the appearance of the rock at the excavation face of the tunnel before the commencement of the respective excavation sequence. The results of geotechnical measurements under similar rock conditions shall be considered for prediction of deformations and for the determination of rock classes. The aforesaid classifications may not be applicable for a situation requiring multi drift excavation or locations encountering unexpected geological conditions requiring extra measures, for which the support system would be decided by the engineer depending upon the judgement of the rock type being encountered. In case of a drive subdivided into top heading - bench - invert excavation, the rock conditions of the top heading drive shall govern the classification. Following are the various types of Rock mass types and relevant rock mass behaviors.

Rock Mass Types	Rock Mass Behavior
A1 (Stable)	Minor deformations that decline rapidly, no spalling
A2 (Over breaking)	Minor deformations that decline rapidly; some spalling at the crown due to discontinuities

Rock Mass Types	Rock Mass Behavior
B1 (Friable)	Minor deformations that decline rapidly; structural weakness and blasting operations lead to loosening and the separation of blocks in the crown and upper wall
B2 (Very Friable)	Deformations decline rapidly; poor structural strength, little interlocking, high mobility of rock mass and blasting operations lead to rapid and deep loosening where unsupported
B3 (Rolling)	Excavation even in small cross sections leads to inflow of rock material; lack of cohesion and interlocking are responsible for insufficient stability
C1 (Rock Bursting)	Sudden release of energy leads to explosive rock failure
C2 (Squeezing)	Pronounced deformations that take long to decline; development of failure zones and plastic zones in plastic, cohesive rock mass
C3 (Heavily Squeezing)	Large deformations, rapid at the beginning, taking long to decline; development of deep reaching failure zones and plastic zones
C4 (Flowing)	Very low cohesion, low friction, soft and plastic consistency of rock mass; material will flow into the tunnel even through very small unsupported areas
C5 (Swelling)	Rock mass with mineral content that increases in volume by absorbing water, e.g. swelling clay-minerals, salts, anhydrite

iii. SUPPORT SECTION TYPE

A. The Support Section Type classes are the Rock Support Type classes given in the Geotechnical Baseline Report (GBR) attached as Annexure-C to Section-5: Works Requirements.

B. The selection of Support Section Typeanditsadjustment shall be according to NATM or any otherControlled Convergence Method with observational feedback through3D instrumentation and monitoring.

C. The defined Support Section Type classes reflect the excavation system, the roundlengths of each advance and the support requirements under considerationof the behavior of the rock mass.

D. The defined Support Section Type classes are derived not only from the rockparameters, but also from considerations of a number of external factorssuch as overburden, size of excavated section and length of round, drivingsequence, ground water, results from geotechnical measurements, etc.which can essentially influence the classification.

E. The Support Section Type to be applied must be determined on site through TunnelFace Mapping, 3-D Geo-logging at the excavation face of the tunnelbefore/prior the commencement of the excavation sequence.

F. The Support Section Type at the face for each round shall be jointly agreedbetween the Contractor and the Engineer. In case of disagreement, thedecision of the Engineer is binding.

G. The results of geotechnical measurements and monitoring during tunnelconstruction shall be considered for prediction of deformations andfor the determination of Support Section Type to be applied for future excavations.

H. The behavior of the rock in a newly exposed round is time dependent, i.e.rock mass quality will decrease with the free span if no support is installedwithin a

reasonable time. Accordingly, the maximum length of a roundwhich can be excavated and supported in time is a criterion for the rockclassification.

I. Advance probing shall be carried out during tunnel excavation as and whenrequired, as per instruction of Engineer. During advance probing, jointmeasurements& collection of data with contractor and Engineer shall becarried out.

J. The selection of the Support Section Type shall be done jointly by Contractor and the Engineer in writing on agreedform-sheets. The classification record is a collection of all classificationsheets, which shall be kept accessible for consultation and modificationwhenever excavation works are under progress/post construction phase. In case of disagreement, decision of the Engineer shall be binding.

K. Notwithstanding the duties of the Engineer, theContractor is solely responsible for the safety of the works underconstruction.

iv. The contractor will adopt the round length for each blast as instructed by engineer. The engineer's decision to adopt a round length will depend on the behavior of rock mass in previous few rounds and the Support Section Type required to be installed in the round under consideration.Range of non-overlapping round lengths for various Support Section Types are mentioned in tender drawings.

v. **Variability for Each Support Section Type:**The defined Support Section Type includes some parameters variability (Round length, Support installationsand locations) that should be managed during excavation using the parameters like Q Value, RMR Value and Behavior in last few rounds.During execution, the Round length, Support installations and locations may vary on upside or downside from the given values, however only the net effect of all such variations shall be considered.

vi. **After each blast, support section required shall be decided by the Engineer and Contractor on the basis of recorded observations. Geological face mapping sheet and Geo-mechanical classification of the excavation which face shall be elaborated by** the Contractor and validated by the Engineer. Required Excavation and Support Sheet (RESS) shall be used as detailed in Annexure to Sub- Chapter 6: Instrumentation

vii. Pull for next round will not be taken unless already excavated tunnel section in previous round has been supported to the satisfaction of Engineer.

viii. After each blast, fumes shall be ventilated immediately within 15 minutes and scaling shall be done subsequently to remove loose or hanging rock pieces. Contractor's geologist at the time of scaling shall prepare a tunnel geological map registering joint sets, foliation, joint, infill materials, weak zones etc.

ix. After completion of mucking, a period of 30 minutes and a man lift platform (Employer's half hour) shall be kept ready by the contractor at the excavated face for engineer to check for any loose scaling, visually inspection and checking of rock classification carried out by Contractor and to come to a mutual agreement of the support section to be adopted. In case of any dispute, decision of Engineer shall be final.

x. Immediately after decision on support section, supports shall be installed. The behavior of the rock in a newly exposed round will be time dependent, i.e. rock mass quality will decrease with the free span if no support is installed within a reasonable time.Therefore, contractor is required to respect the cycle time for timely support installation.

xi. The contractor shall document time taken for various activities, blast pattern adopted, charging of holes, blast sequence, geological mapping, scanning of tunnel profile before and after installation of support, actual support installed etc. in any excavation cycle on a shift basis and the record shall be got approved from engineer.

xii. Additional excavation tolerance has already been inbuilt which shall be further established through a system of well documented monitoring observations, during excavation.

xiii. The assignment of an individual support class shall always apply to the whole of the round length.

xiv. For mixed face conditions, applicable support system shall be guided by the conditions representative of more than 50% of the mixed face. Engineer may direct to adopt a different support class also in such conditions. In case of any dispute, decision of Engineer shall be final.

8.12.2 Support System for Tunnels

i. The contractor shall understand and recognizethe technical and design concepts of the NATM for the mined tunnels and shall appreciate the function and merits of each component of the tunnel support.

ii. The type and amount of tunnel support to be installed immediately after excavation is directly related to the rock classification as established. The initial support system associated with the established Rock mass types and relevant rock mass behaviors classification is shown ontheBid Drawings for reference. However, as a consequence of variations from the anticipated rock conditions the initial support system as shown on the drawing for each rock mass type may require modifications and adjustment during construction as per agreement between the representative of the Engineer and Contractor. Decision of the Engineer shall be final.

iii. The contractor shall ensure that support elements will be installed or applied is such a manner and sequence as to prevent disintegration and loosening of the rock mass in front and aroundof the excavated tunnel.

iv. Advance probing and Pre-injection grouting will be mandatory to control water ingress to limits defined in Annexure-B (General Methodology andDecision-MakingFlowchart For Probe Drilling And Injection) and to strengthen the ground by filling dry joints and cavities and can't be relaxed without approval of engineer.

v. In the event of more than expected squeezing of the ground the excavated section shall be restored to its theoretical dimensions and the special supporting measures shall be resorted to with the approval of engineer.

vi. Additional support types like pipe roof, face bolting etc. will be provided at the discretion of engineer in charge.

vii. DELETED

8.12.3 DELETED.

8.13 PROBE HOLES IN TUNNELS

8.13.1 Probing is to be carried out simultaneously with any other activity (For E.g. Installation of support or drilling holes for subsequent charging) except that no probing will be undertaken during charging of drill holes for blasting. Probing shall be carried out for a minimum 18m length ahead of face in such a way that at all times during further excavation, 6 m of probed ground ahead of the face is maintained to allow modification of the method of working ahead of any change in ground conditions and

shall be governed by the ground conditions and the degree of uncertainty with distance. **Requirement of probing may be reduced by engineer based on results from additional geophysical tests like TSP etc.**

8.13.2 Probe positions in the face and angles with respect to the tunnel drive shall be governed by the actual ground conditions encountered and the machinery in use. Preferably 4 probe lengths will be drilled from each position whenever carrying out probing and each shall have diameter of holes not less than 51 mm.

8.13.3 A trial shall be carried out in advance of tunneling activities in order to identify the optimum drill bit, drill diameter, flush and percussion rate. These parameters shall be kept constant during drilling to allow direct comparison between probe holes.

8.13.4 An accurate and systematic record of probe hole positions (positions in the face and angles with respect to tunnel drives), drill penetration rate, drill parameters (percussion, torque, thrust), flush (color, percentage return), drilling sounds (loud, quiet, intermittent), water strikes and interpretation of the nature of the ground ahead shall be noted at the time the holes are bored and a copy provided to the Engineer.

8.13.5 Based on the probe hole information, the Contractor shall, without delay, provide in writing, proposal for modification of method of working if any required, for agreement of Engineer.

8.13.6 Should the probe hole indicate the presence of excessive water, high pressure water or geothermal conditions ahead of the excavation face, the Contractor shall take appropriate precautions such a necessary to facilitate excavation. Similarly, the contractor shall adopt suitable measures to deal with *any* gases or zones or weakened rock, which may be encountered. All measures deemed necessary by the contractor shall be subject to approval by the Engineer.

8.13.7 Full facilities shall be provided for the Engineer to inspect probing work in progress.

8.13.8 3D seismic reflection survey (TSP) shall be carried out by the contractor at short notice whenever required by engineer. The data obtained by the contractor from 3D seismic reflection survey will also be used for the design optimizationof tunnel supports. Seismicreflection surveys shall be conducted on a regular basis for surveillance reasons, however, a minimum one week notice shall be given to contactor for carrying out these tests.The data obtained bythe contractor from 3D reflection survey shall be givento the Engineer immediately after carrying out the test. Depending on the geology, measurement intervals shall be 100 meters or more. A detailed result report shall be provided within 24 hours or within an arranged deadline showing relevant faults and geological discontinuities together with corresponding changes in the rock mechanical properties (e.g. Static&dynamic Young's Modulus, Density, Shear Modulus, Bulk Modulus and Poisson's ratio) ahead of the face. Result presented in numerical and graphical 2-D and 3-D outputs must be referred to the geometrical co- ordinate system of the tunnel axis.

8.14 EXECUTION

8.14.1 General

i. Prior to commencement of excavation, Tunnel portal, Tunnels, junction of tunnels with adits, caverns and chambers shall be strengthened as per construction drawings or as directed by Engineer.

ii. All rock material projecting inside the minimum excavation line shall be removed.

iii. All loose rock shall be removed from the underground construction sites and disposed off in the approved dump areas.

iv. The contractor shall constantly check the progress of excavation by means of Laser survey in order to avoid any substantial rectification of the already opened profile and eventual rearranging of the installed rock supports.

v. Where excessive inflows of water occur at the heading face, the contractor shall take all appropriate measures to execute the excavation work safely and properly including provision of extra supports and protection of workmen and any special equipment necessary for working in waterlogged conditions.

vi. When deemed necessary and ordered by the Engineer, the Contractor shall carry out long exploratory drilling >18 m (other than probe holes) with core recovery as described in Section of "Drilling and Grouting".

vii. The Geological Report, as a part of these documents, contains the results of Geological studies carried out on this component of the Project.

viii. The orientation of the tunnel as indicated on the drawings is subject to modification. It may be necessary to introduce slight shifting of the axes of the tunnel after additional information is available. The drawing showing the final orientation will be prepared by the Contractor prior to start of work and he shall be required to execute the Work as per drawings or as directed by the Engineer.

ix. Sheared or shattered rock zones, foliation shears, thick joints with gouge or other thick discontinuities may be encountered during excavation. Whenever shear zones and poor rock bands are encountered along the tunnel, Additional provisions of fore-poling, pipe roof, face bolting, etc. will be undertaken at once by the Contractor to avoid any cavity formation as shown on the drawings or as directed by the Engineer.

8.14.2 Method of Excavation

i. The Contractor shall establish by trial blast and use drilling and blasting techniques, which will produce a smooth final profile a minimum of Overbreak and a minimum of fracturing of the rock beyond the minimum excavation lines. The techniques used shall always be subject to the Engineer's approval, who may direct several blasting tests to be undertaken by the Contractor to substantiate his proposed blast design.

ii. Only controlled blasting techniques shall be used. It shall be performed as described below:

A. Presplitting: Consists of drilling a single row of closely spaced holes along the final excavation perimeter. These holes are Lightly charged and simultaneously detonated before the main blast to produce a presplit crack, which limits the propagation of crack from the subsequent main blast, and in such a way, reduces damage in the rock beyond it. The blasting of the main excavation zone requires a reduced explosive charge in the line of hole nearest to the presplit line and a limit on the distance between the presplit line and the nearest line of main blast holes. The presplit holes shall be drilled deeper than the depth of the pull.

B. Smooth Blasting: Consist of drilling several closely spaced holes along the final excavation perimeter, placing light charges in the holes and detonating the charges simultaneously after the main blast. The outer line of drill holes for the main blast is set at an approved distance inside the final perimeter leaving an annulus of rock to be peeled off the damaged final excavation perimeter by the smooth blast The smooth blast holes are drilled, charged and blasted in the same tunneling cycle as the main blast.

C. Cushion Blasting: As special case blasting in which considerable air space of stemming surrounds charges in the holes and serves to reduce undesired blast effect on the final excavation perimeter.

iii. During the progress of excavation the drilling and blasting pattern specifically the number and depth of holes, quantity, quality and distribution of explosives, shall be varied as necessary to suit the rock conditions encountered taking into consideration the information obtained from the probe/exploratory holes, the actual drilling work (velocity, color of rinsing water, etc.,) as well as the previous blasting results.

iv. Only wet drilling will be permitted in order to reduce dust in the underground excavations.

v. Perimeter drill holes shall be placed such that the over excavation beyond the minimum excavation line is minimized. The Contractor shall pay utmost attention to obtain a smooth and uniform excavated surface.

vi. Should the entire length of most of the perimeter drill holes not be visible after each round of blasting, the contractor shall make an adequate adoption in the blasting pattern used and submit it to the Engineer for approval.

vii. The depth of a new round shall never exceed that which was determined and approved prior to commencement of basting. The Engineer may order reduction of the adopted round depth if the actual rock condition requires it.

viii. Blasting of new round will not be permitted if no, or insufficient, personnel are available to perform the mucking and subsequent support work afterwards. This applies to Work before holidays, non-working weekends etc.

ix. Blasting that may damage the rock beyond the required excavation lines or the tunnel installations will not be permitted. Any damage to, or displacement of the supports and any damage to, any part of the Works caused by blasting or any other of the Contractor's operations shall be repaired by the Contractor in a manner satisfactorily to the Engineer.

x. No new round shall be blasted until the supports required within the heading zone have been installed.

xi. All loosened material that is likely to fall shall be removed immediately following blasting, at frequent intervals during the progress of the Wonk, and finally during the clean-up prior to placing the final tunnel lining.

xii. After excavating, the Contractor shall adequately protect the tunnel invert, surface from damage caused by the construction traffic, should small grain or broken excavation material be used for such protection, it shall be removed prior to placing the final tunnel lining. No vehicular traffic will be permitted over tunnel invert after removal of the protective material.

8.14.3 Excavation of Shaft

i. The excavation for shaft if required shall be carried out by using raise borer or raise climber by using drilling and blasting method. Initially a pilot shaft of suitable size but not less than 4 Sq.m in cross section, shall be excavated and then the shaft shall be enlarged to the required size from top to bottom.

8.14.4 Excavation of Caverns/Chamber

i. Excavation for caverns/chamber if required shall be carried out in stage sequence by adopting drilling and blasting method of excavation. Stage sequence and supporting measures shall be carried by the contractor based on the numerical analysis carried out by the Employer. Rock bolts, cable anchors and shotcrete shall be used for supporting the excavation as per the Employer’s design.

8.14.5 Cleaning of Excavation Surfaces

i. Even prior to the removal of the bulk of the material loosened by blasting, the contractor shall undertake scaling activities to clean the newly exposed rock surface from loose rock fragments, dust and debris to permit if required, the application of the first lay of shotcrete.

ii. Cleaning shall be done by directing a jet of water or air at the rock face. Compact washable rock shall be cleaned with compressed air water jets. Rock, which is prone to quick disintegration, swelling, heaving or is interspersed with clay filled fissures, shall be cleaned with compressed air only. The cleaning shall be done to the satisfaction of the Engineer.

iii. The cleaning is separate from the cleanup of excavated surface required immediately prior to placing of the final lining described in Section of "Cement Concrete".

8.14.6 Tunnel Maintenance

The Contractor shall be responsible for maintaining the completed underground works throughout the construction and contract period. As part of this maintenance, remedial work shall be carried out when repairs are required to the structural or other systems or when grouting is required to stop water inflow.

i. The Contractor shall monitor the tunnel support systems and record any damage to the support systems. If necessary, remedial action shall be taken with temporary propping, including evacuating the area and posting warning signs accordingly.

ii. The Contractor shall, in addition to monitoring the support system, carry out regular maintenance of the underground works, including but not limited to bench marks, 3D monitoring, drainage and pumping systems, light bulb replacement, cleaning, water removal, water pipe maintenance, ventilation system signalling system, communication system, toilets, containers and emergency equipment, and all cabling, transformers and pipes for different purposes and its maintenance, and cable maintenance. Maintenance shall include all repair work required to maintain all equipment in working order.

iii. All these maintenance activities are deemed to be included in the rates quoted for the items of the BOQ and nothing extra shall be payable.

iv. Maintenance of invert level will be paid separately according to relevant item of the BOQ.

8.14.7 Site Traffic on Final excavation levels

i. (Formation level) for pavement construction shall be protected against any wear or deterioration of rock properties following site traffic by backfilling with rock material excavated in the tunnel or similar, to a minimum thickness of 0.5 meters. The access to the main drainage control shafts shall be possible at any time. These must be protected and marked on the side wall for later recovery.

ii. Pounding water and traffic through pounding water for vehicles or pedestrians shall not be allowed.

iii. Any deteriorated material shall be removed and replaced prior to pavement works as directed by the Engineer.

iv. The backfill material used for protection purposes shall be removed in the main tunnel only until immediately prior to pavement construction works

8.14.8 Site Traffic on Invert Support

i. To avoid damage to the Invert structures, these should be duly protected by giving a course constituted of excavated material and having an approximate average thickness of 0.5m. No site traffic shall be allowed to run on unprotected invert

structures. Boulders larger than 100mm dia should not normally be used for this purpose.

8.15 DISPOSAL OF EXCAVATED MATERIALS

8.15.1 All materials from underground excavation suitable for use as fill concrete aggregates or for other purposes shall be stockpiled on the Site as directed or approved by the Engineer, if the immediate placement in the final location in permanent works is not possible.

8.15.2 Excavated materials, which are not suitable or are in excess of the permanent construction requirements, shall be disposed off in the waste disposal areas shown in the drawings or in areas designated as such by Engineer in the course of the work.

8.15.3 The Contractor shall shape and trim the dumping areas and stockpiles to the lines and grades as directed or approved by the Engineer and shall provide for adequate diversion of existing water courses. The area over which the excavated material is to be a disposed shall be stripped of all vegetation. If the area is steeply dipping, precautions shall be taken to ensure stability of the material in the area, including base drainage and surface protection against erosion and providing retaining wall / gabions ate wherever required. The material dumped shall be compacted, by movement of the dumping vehicles and grading as necessary, in layers not exceeding 0.5m in depth. It shall be the responsibility of the Contractor to remove any material from any slide that may occur in the disposal dump or its base and redispose the removed material properly to the satisfaction of the Engineer at his own cost. Prior to the commencement of excavation work the Contractor shall have prepared the disposal area to the satisfaction of the Engineer and the methods proposed for disposal shall also have received approval of the Engineer.

8.15.4 The Contractor shall be liable for any damage to Temporary or Permanent Works or to the property of third parties caused by poor drainage in the waste disposal or stockpile areas.

8.15.5 If additional areas are required for disposal of the excavated material, the contractor shall propose, such area for approval of the Engineer.

8.15.6 The Contractor shall ensure that no excavated materials are disposed off in the stream or at locations, where in the opinion of the Engineer these are liable to be washed away by the floods.

8.15.7 The disposal of the excavated material in the dumping area shall not damage the environment and will be regulated as per the norms of Government of India. In spite muck disposal area shall be suitably covered off with retaining structures. Before taking up such works the contractor shall propose the construction methodology of retaining wall with RR Masonry/ gabions approved from the engineer.

8.16 EVACUATION OF WATER

8.16.1 The Contractor shall carry out all Works required to capture and drain service and infiltrated groundwater during the construction as stipulated in Section of "Dewatering Drainage and Pumping".

8.17 ILLUMINATION

8.17.1 The Contractor shall install an adequate illumination system in the Underground works as stipulated in Section of “Site Installations and Services."

8.18 VENTILATION & AIR COOLING

8.18.1 The Contractor shall install and operate equipment and carry out all works required for the ventilation and air-cooling as stipulated in Section of“Site Installation and Services". **Wherever due to dimensions of tunneling machinery, available space is less for installation of non-rigid ventilation ducts; contractor will be required to install wire reinforced/Solid/other type of ventilation ducts, for which nothing extra shall be paid.**

8.19 CONTROL OF DUST, SILICA AND NOXIOUS GASES IN UNDER-GROUNDWORK.

8.19.1 The Contractor shall install and operate equipment for the control and monitoring of dust, silica and noxious gases in Underground Works as stipulated in Section of "Site Installations and Services".

8.20 COMMUNICATION SYSTEM

8.20.1 The contractor shall install and operate the communication system between each heading face and entrance to the tunnel, shaft or cavern/chamber as stipulated in Section of “Site Installations and Services".

8.21 GEOLOGICAL MAPPING

8.21.1 The purpose of engineering geological mapping and follow-up is the documentation of rock and rock mass conditions as encountered during excavation. The documentation shall enable the verification of the suitability of the designed support and excavation measures, the prediction of rock mass conditions ahead as well as the interpretation of results of the geotechnical monitoring concerning ground deformations. After each blast, Mucking and scaling shall be done. After completion of scaling, a period of 30 minutes (Employer’s half hour) shall be kept by the contractor for engineer to visually inspect and check the rock classification carried out by Contractor and to come to a mutual agreement. In case of any dispute, decision of Engineer shall be final.

8.21.2 If stand up time of unsupported tunnel is very less, then the mutual agreement on rock classification may be required to be arrived at during mucking and scaling activities for early installation of the required support.

8.21.3 ENGINEER shall use mapping and related information along with the rock mechanics test and instrumentation monitoring results shall be used to optimize design of the final lining and rock reinforcement for the tunnel (s), shaft, cavern and chambers.

8.21.4 The Contractor always shall provide adequate lighting, proper ventilation, reasonable access, cleaning and washing of the walls and crowns for checking correctness of mapping by “ENGINEER” representative.

8.21.5 Documentation:

i. The mapping and documentation of encountered geological conditions during the excavation shall be based on uniform legend and terminology for Rock Types / Rock Mass Types, Discontinuities, Jointing, Water seepage, Weathering, Rock Strength, Behavior of Rock Mass and other features which are needed to be described for complete record.

ii. The documentation of the tunnels shall be based on the mapping of the face and the full periphery mapping method. The full periphery mapping method shall be

applied for the permanent walls only. The frequency shall be adjusted to the variability of the encountered ground conditions. In case ground conditions are frequently changing within one round length each round shall be mapped. Each drive which is under construction shall be checked at least once a day.Support types will also be checked during periphery mapping studies.

iii. Face mapping sheets: In general, the mapping shall be performed in a scale 1:100 and shall have a grid of 1 x 1 m for easier drafting, marked with "+". If necessary, details shall be mapped at other suitable scales. Using the uniform terminology, remarks can be stated directly on the mapping sheet or can be referred to the data sheet.

iv. Data Sheets: The data sheet format shall be got pre-approved and shall consist of details like Tunnel, Location, Chainage, Excavation method, Name of mapping geologist, Date and Time, Rock Mass/Types, Discontinuities, Jointing, water, weathering, Behavior, General remarks etc.

v. Vertical and Horizontal Sections: Based on the follow-up of mapping and data sheets, a vertical as well as a horizontal cross section shall be drawn, where the actual mapping results are incorporated continuously daily. The vertical section shall be located along the axis of the tunnel. The horizontal section must be fixed according to the chosen excavation cross section (full face, top heading - bench etc.). In case the tunnel is excavated by top heading - bench excavation the horizontal cross section shall be drawn on the level of the invert of the top heading. Horizontal and vertical scale shall be the same.

vi. The position of the laser beams on the face as well as the steel rib connections may be marked as drafting guides.

vii. Remarks can be stated directly on the mapping sheet or can be referred to the Face Mapping Sheet.

8.22 MEASUREMENT AND PAYMENT

8.22.1 General

i. Measurement of tunnels, shafts, caverns and chambers excavation shall be made on the basis of in-situ theoretical volume (Cum) enclosed within the “Pay” line defined in Clause 8.5.1 and shown on the drawings according to Support Section Type installed as determined for the top heading and shall be paid as per relevant item in the Bill of Quantities(BOQ). For bench and invert excavation, same unit rates as for top heading shall apply.

Excavation occurring due to overbreak beyond “Pay” line except in case of “Geological Overbreak” shall not be paid and will be deemed to be included in the rates quoted by the contractor in the BOQ.

ii. Unit Rates, if not specifically stipulated otherwise, shall be deemed to include the entire cost of, but not be limited to the following:

A. The installation of pumps and pipes as well as their maintenance along the excavation for water inflows up to 50 l/sec.In upward tunnel drives, the measurement of the water inflow shall be carried out 25 m behind the tunnel face. In downward tunnel drives, measurement shall be performed for the water inflow occurring within the last 5 m behind the tunnel face. Power consumption shall be paid separately.

B. Provision of all labour equipment and materials required for the Underground excavation including drilling holes for blasting;

C. Developing and improving controlled blasting methods, blasting tests and performance of blasting.

D. Cleaning, washing, protection and maintaining excavated surfaces in satisfactory conditions and protection of tunnel invert until concrete lining is placed,

E. All enlargements and additional excavations or any temporary supports required by the Contractor for his construction methods,

F. In case of shafts, the entire cost of following items shall also be deemed to be included in the quoted unit rates:

- **a.** Supply, transport, assembly and removal of equipment including hoisting equipment.
- **b.** Use, Operation and Maintenance of Special equipments (such as raise climber etc.).
- **c.** Drilling of pilot holes/ driving of pilot tunnels/ shafts.
- **d.** Reaming.
- **e.** Slashing.

G. Loading, hauling and dumping the excavated material on stockpiles, dumping area or points of incorporation into Permanent Works up to a specified lead as mentioned below, shaping and trimming of the excavated materials in the dumping areas as specified, clearing of the stockpile areas, formation and maintenance of stockpiles, rehandling of suitable materials including segregating, grading, draining and drying of materials suitable for use in embankment construction or as backfill.

H. All delays during excavation work resulting from installation of rock supports and instrumentation measures as advised by engineer required by the Geo-technical conditions of the material encountered, irrespective of the distance from the heading face.

I. Complying with all requirements of statutory laws and regulations relating to underground works and any restrictions resulting therefore obtaining all necessary permits and licenses for the purchase use storage and transport of explosives and other materials.

J. Surveying, setting out, checking of excavated profile, alignment and any subsequent rectification works resulting from undue or incorrect surveys provision of suitable equipment for and delays due to carrying out his work.

K. Furnishing, installation, operation, maintenance and removal of communication, illumination and ventilation system, observing safety precautions and measurement / monitoring of dust silica and noxious and Inflammable gases.

L. Recording and preparation of reports related to excavation progress and procedures. No separate remuneration shall be paid for geological mapping during tunnel excavation.

M. All works Involved with and any partial or short interruptions or inconvenience caused by the check surveys, performance of the rock mechanic test, installation and monitoring of instruments and geological mapping, for which no separate payment is provided elsewhere in these specifications.

N. Seepage/ingress of water suitably collected and drained away by gravity.

O. For Support Section Type where Forepoling is required, pay line will be as per figure 8.5.1 remain fixed throughout the length of the Forepoles. No separate remuneration for excavation beyond “Pay” line will be made except of the case

of Geological Overbreak (GOB), and shall deemed to be included in the rates of Items for excavation.

P. For Support Section Type where Pipe roof is required, "Pay line" will be same as "A" line and situated at Bottom of Pipe roof as shown in Figure under Para 8.5.7. Remuneration for excavation will be made within "A" Line shall be made as per Relevant Item of BOQ. Remuneration of Overbreak between the Pipe roof shall deemed to be included in the rates of Items for excavation.

Q. The payment towards the preparation of Muck disposal plan shall be deemed to be included in the quoted rates of excavation.

R. No separate compensation for the provisions for the start of tunnel excavation from the pre-cut is envisaged. The quoted rate for underground excavation shall include all costs required for the construction of the canopy structure (false portal), if required.

S. No extra Payment will be made for hauling the excavated material for a lead upto 2.0 Km measured from the portal of the tunnels/adits to entry point of disposal area or entry point of permanent works where excavated materials are to be incorporated.

T. In case, the dumping of excavated material is required to be made in the areas beyond 2.0 Km of initial lead, then, extra payment for additional lead shall be made as per relevant item of the Bill of Quantities and no other claim what-so-ever shall be admissible to the contractor.

U. No separate payment shall be made for multiple drifting.No separate remuneration shall be paid for the removal of temporary support installed at the tunnel face or at the top heading invert.

V. All delays during excavation work resulting from fore probing and grouting activities required to achieve the specified water tightness on the project.

W. In case of adverse geological occurrence could not be predicted through advance probing or exploratory holes, the engineer shall determine the rates involved in tackling such occurrence as per relevant clause of conditions of contract.

8.22.2 Overbreak

i. No payment shall be made for excavation occurring due to overbreak except in case of "Geological Overbreak".

ii. In case of "Geological Overbreak", in- situ Cavity or void of the "Geological Overbreak" and theoretical volume in "No Pay Zone" bound within the radial projection of GOB profile, shall be measured, quantified and approved by the Engineer. Payment shall be made as per relevant item relating to Geological Overbreak (GOB) in the Bill of Quantities (BOQ).

8.22.3 Additional Excavation

i. Measurement for payment for additional volumes of excavation in tunnels / shafts /caverns / chambers (required due to enlargement of already excavated sections) as directed by the Engineer will be of the in-situ volume of rock mass excavated.

ii. Payment will be made at the Unit Rate per cubic meter entered in the Schedule of Item Rates for respective class of excavation.

iii. In stretches where the performance of additional excavation requires removal and reinstallation of previously installed support system, only the payment for reinstallation will be made as per quoted rate for the relevant item. Previously installed support recovered shall not be re-used and will be disposed by the contractor at his own cost.

8.22.4 DELETED

8.22.5 Excavation under Geo-thermal conditions.

i. For Excavation under Geo-thermal conditions for the stretches where the geothermal condition prevails, no extra payment shall be made on account of providing and running ventilation / cooling measures and the cost of the same shall be deemed to be included in the rates of the underground excavation.

ii. Payment shall be made at the Unit Rate per M^3 entered in the Schedule of Item Rate for underground excavation.

iii. However, separate measurement and payment shall be made for providing and running ventilation / cooling measures under geothermal conditions beyond temperature of 70^0c and a flow rate of 20 lit / sec as per the rates quoted for this item in the schedule of item rates. Measurement for this item shall be made in units of r.m (tunnel length) x ^{0}c (increase in temperature beyond 70^0c). The tunnel length shall be that length where geothermal conditions beyond temperature of 70^0c have prevailed during excavation.

8.22.6 Exclusions

i. Additional costs for tunnel excavation due to water inflow exceeding 50l/sec in upward and downward drives shall be compensated for by separate items as shown in the Bill of Quantities, independent of the encountered Support Section Type. In upward tunnel drives, the measurement of the water inflow shall be carried out 25 m behind the tunnel face. In downward tunnel drives, measurement shall be performed for the water inflow occurring within the last 5 m behind the tunnel face. Power consumption for pumping of water shall be paid separately.

ii. All costs for exploratory drilling, probe holes and grouting will be covered by the applicable Unit Rates as specified in the Section of, "Drilling and Grouting"

iii. All costs for supply and installation of rock support for tunnels and shaft will be covered by the applicable Unit Rates as specified in Section-of "Structural Steel Supports", "Rockbolts and Wiremesh" and "Shotcrete" respectively.

iv. Rock supports required due to the Contractor not observing approved drilling and blasting techniques will not be included for payment.

v. No extra measurement for payment or payment will be made for

A. Geological mapping as described in this chapter or performed at site.

B. Overbreaks not attributed to geology.

C. Any rectification Works resulting from incorrect surveys and / orblasting.

D. Over excavation including the works mentioned in section “Excavation Lines and Tolerances” above, required for Contractor's convenience. The concrete and grout required to fill such excavation shall also be at the Contractors expense.

E. Extra work or material required for repairing any damage to the tunnel invert caused by construction equipment.

F. Draining, shaping and trimming of the dumped material to the lines and grades as directed or approved by the Engineer.

G. Excavation of tunnels, other than those shown on the drawings carried out by the, Contractor for his convenience and plugging thereof.

SUB CHAPTER -9

9.0 STRUCTURAL STEEL SUPPORT

9.1 SCOPE OF WORK

9.1.1 The specifications described herein under relate to the work which includes all labour, materials, equipment and services required for the supply, handling, fabrication and installation of structural steel supports consisting of steel ribs and lagging, Lattice girders and Lining stress controllers to be carried out by Contractor in the underground excavation to the shape and dimensions as shown on the drawings.

9.1.2 Structural steel supports shall be installed either as complementary measure to the previously installed rockbolts and shotcrete when those prove to be insufficient to stabilize the excavation profile, or as immediate supports after excavation in the heading zone when the material encountered in the process of excavation requires such measures.

9.1.3 Steel ribs shall be furnished complete with bracing, bolts, nuts, washers, plates, tie rods, and other accessories necessary for installation of the supports. Horizontal or bent bracing in the invert may be required in some reaches.

9.1.4 Precast RCC or steel lagging shall be furnished separately for steel ribs.

9.1.5 The Contractor, if he considers necessary, may install temporary supports for his convenience and safety of his workmen / equipment during execution.

9.1.6 The supports shall be bent to the required shape by cold bending process only.

9.1.7 Minimum buffer stock for one-month quantity as per agreed work's programme of Re-Bars for (size decided by engineer) Steel ribs and lattice girders.However, towards work closure, the contractor may use these quantities with prior approval of Engineer.

9.2 SUBMITTALS

9.2.1 Within 4 (four) weeks from the commencement date but before procuring the equipment or mobilization to the site, the contractor shall submit to the Engineer, the description and drawings showing enough details of the layout, type and capacity of the equipment proposed for the fabrication of steel ribs.

9.2.2 At least 8 (eight) weeks in advance of the excavation of underground works being carried out on the site, the Contactor shall submit to the Engineer the schedule for fabrication of ribs and the method statement for erection to the engineer for agreement.

9.2.3 The Engineer reserves the right to require any additional information deemed necessary to be included in the submitted documents.

9.3 STANDARDS

9.3.1 The fabrication and installation of structural steel support shall conform to the following latest Indian Standard or where not covered by these Standard to the equivalent International Standards:

i. IS: 5878 Code of practice for construction of tunnels conveying (Part-IV) water

ii. IS: 800 Code of Practice for general construction in steel.

iii. IS: 814 Covered electrodes for manual metal arc welding of carbon and carbon manganese steel.

iv. IS: 816 Code of practice for use of metal arc welding for general construction in mild steel.

v. IS: 1786 Specification for High strength deformed steel base and wire for concrete reinforcement.

vi. IS 2062 Hot Rolled Medium and High Tensile Structural Steel

vii. IS: 2502 Code of Practice for Bending and Fixing of Bars for concrete Reinforcement.

viii. IS: 2751 Code of Practice for welding of mild steel Plain & Deformed Bars for Reinforced concrete construction.

9.3.2 In case of conflict between the above standards and the specifications given herein, the specifications shall take precedence.

9.4 NECESSITY & DETAILS OF STRUCTURAL STEEL SUPPORTS

9.4.1 GENERAL

i. Steel support shall be installed to support crown and wall of underground excavation in all areas where, in the opinion of Engineer, alternative methods of rock supports like rock bolts and Shotcrete shall not provide adequate support either for construction safety or for permanent stability.

ii. The exact requirement for steel supports in any area shall depend on actual conditions encountered as excavation progresses.

iii. The design and details of the steel supports and steel supports accessories, precast RCC or steel lagging, including size, weight, spacing and method of installing in all parts of the excavation shall be subject to review / revision by the Engineer depending upon the rock conditions encountered.

9.4.2 STEEL RIBS

i. The steel ribs shall comprise of I-beam or built up sections as shown on the drawings.

ii. Rib splices shall be welded or made of bolted plates in such a manner as not to reduce the section moment of resistance.

iii. Preferably one section size of steel rib profile shall be used for each portion of the Underground Works and the structural requirements due to rock conditions encountered shall be met by varying the spacing of the ribs as directed by the Engineer.

9.4.3 STEEL RIB ACCESSORIES

i. Steel support accessories shall include, but not be limited to, collar braces, tie rods, spreaders, liner plates, cribbing, blocking wedges, foot blocks, sills and invert struts which are fabricated from steel plates or sections or other steel products. Steel support accessories shall be used exclusively in conjunction with the steel ribs in the underground excavations and shall be used elsewhere when required by the Engineer.

9.4.4 LAGGING

i. Laggings are the longitudinal supporting members placed behind the steel ribs where necessary to support the walls and crown of the underground excavation as indicated on the drawings.

ii. The precast RCC lagging shall generally be used. The RCC lagging shall be of grade M-20and 150mm X 75mm section and of length to suit the spacing of the steel ribs as indicated in the drawing or as directed by the Engineer. The steel reinforcement in the R.C.C. lagging shall be provided as per drawings. Cutting,

welding, placement and binding of the reinforcement steel shall conform to the relevant Indian Standards.

iii. Deleted.

9.4.5 Lattice girders

i. The lattice girders shall be installed in a similar manner as steel ribs. Lattice girder segments shall have butt plates and the method of installation shall ensure tight connection of all elements. The accessories of lattice girders like plates, bolts, nuts and washers etc. shall be like steel rib accessories. Lattice girders shall be fully encased in shotcrete. Under no circumstance shall lattice girders be installed under unsupported ground.

9.4.6 Lining stress controllers

i. Lining Stress Controllers (LSC) are support elements which are applied in the shotcrete lining in squeezing rock conditions to increase the deformability of the shotcrete lining in a controlled manner by yielding of the deformation elements and thus prevent damages due to high lining stresses resulting from large rock deformations.

ii. Components:

A. The LSC are manufactured of steel plates and/or steel tubes and reinforcement bars in compliance with the required geometry as instructed by the ENGINEER.

B. The LSC shall consist of 2 steel plates (top and bottom) for load transmission and connection to the shotcrete lining. Top and bottom steel plates are connected by deformation elements, which are oriented rectangular to the base plates and welded to them.

C. For the deformation elements two types shall be considered:

a. Type A: The deformation element is formed by a corrugated steel plate, which is bended several times by 90 degrees and has several rectangular horizontal slots. Thickness and actual shape of the corrugated steel plate and the imperfections (slots) will be adjusted during construction on basis of actual displacements of the tunnel.

b. Type B: The deformation element is formed by a cylindrical steel tube, with triangular slots located close to the base plates. Thickness and actual shape of the steel tube and the imperfections (slots) will be adjusted during construction on basis of actual displacements of the tunnel.

D. Actual type of deformation element to be applied in the works shall be instructed by the ENGINEER.

E. To achieve satisfactory connection to the shotcrete lining, U-shaped reinforcing steel bars shall be welded to the top and bottom steel plate of the LSC as shown on the drawings.

F. In case of fabrication on site, the CONTRACTOR shall submit a detailed method statement for approval to the ENGINEER.

G. The CONTRACTOR shall submit related detailed drawings of the LSC, to be approved by the ENGINEER.

9.5 EXECUTION

9.5.1 Steel ribs shall be cold bent with an allowance of one percent to the shape as shown on the drawings. Re-shaping of the bent ribs at the place of installation may only be undertaken with Engineer’s consent and only if the material properties would not be impaired.

9.5.2 Excavation of the underground works shall be completed true to the lines shown on the drawings before installation of steel ribs. The steel ribs shall be placed at the minimum excavation line and at spacing as shown on the drawings or as determined by the Engineer.

9.5.3 Concrete blocks or steel profiles shall be provided as footing for the steel ribs. Use of timber, as foot blocks shall be strictly prohibited. The footplates shall be of enough size and rigidity. If required, the legs of the ribs shall be anchored to the rock by the rockbolts. Where invert bracing is required, it shall be fixed securely to the lower legs of the rib in such a way that buckling is not induced in the steel rib by the presence of such bracing.In case of invert overbreak, the void between the rock and the lattice girder footing shall be filled with pre-cast concrete slabs / blocks.

9.5.4 Steel sections and plates shall be cut, welded, bolted or otherwise provided to the shapes and dimensions indicated on the drawing or as directed by the Engineer.

9.5.5 Immediately after placing the ribs in a correct position, they shall be interconnected and braced by mean of steel bars or beams in order to prevent any displacement and to maintain spacing. Use of timber spreaders shall be strictly prohibited.

9.5.6 Immediately prior to concreting, casting or spraying, the arches, ties and struts shall be rendered clean and free from deleterious matter.

9.5.7 The space remaining between the outer flange of the steel rib and the rock surface shall be backfilled immediately, after the rib has been placed, with concrete or shotcrete over the entire circumference of the steel rib in order to provide uniform load distribution. In over excavation, the bulk of the void space may be filled with concrete / shotcrete.

9.5.8 The Contractor shall duly record the position of all steel ribs installed in order to facilitate drilling operations later on for grouting/drainage purposes etc. Their position shall be marked on the finished concrete lining surface.

9.5.9 Blocking and wedges used to set the steel may be steel, or concrete blocks.

9.5.10 Structural steel supports be maintained in position by the Contractor after installation. Any steel ribs installed improperly or damaged by the Contractor's operations shall be adjusted, repaired or replaced as appropriate by the Contractor without delay after notification by the Engineer.

9.5.11 In case of poor strata, Lagging shall be placed behind the steel ribs where necessary to support the crown and the sides of underground excavations. Where conditions require, it may, supported on the last steel rib, by pushed/pressing and/or hammering into the ground ahead to provide temporary overhead protection while installing the next rib. The space between the rock surface and the lagging shall be backfilled with M15 concrete.Backfilling between rock and lagging with rock spalls, bracing with timber and timber lagging shall be strictly prohibited.

9.5.12 During work the contractor shall maintain a sufficient reserve of steel ribs complete with all accessories on each work site.

9.5.13 Lining stress controllers:

- **i.** LSC shall be installed at locations indicated in approved drawings and shall conform to the excavated shape and design of shotcrete lining.
- **ii.** Slight adjustments may be permitted with ENGINEER's approval during installation.
- **iii.** The length of LSC shall be adjusted to the round length and fixed between lattice girders/other supports.
- **iv.** Lattice girders/ other supports at level of LSC shall be covered during spraying of shotcrete lining to prevent filling of deformation slots with shotcrete. A continuous

deformation slot in the shotcrete lining shall be achieved at installation location of LSC.

v. Installation shall provide required bonding between the top and bottom steel plates and the shotcrete, to form a composite structure in the sense of a continuous reinforced shotcrete lining.

vi. The permanent closure of deformation slots shall be done (by shotcrete and grouting as appropriate) only after the deformation velocity has decreased sufficiently and as instructed by the ENGINEER.

9.6 MEASUREMENT AND PAYMENT

9.6.1 STEEL RIBS

i. Measurement for payment for supply, handling, fabrication and installation of the steel ribs will be of the weight of steel ribs (in MT) installed and approved by the Engineer. Payment for the same shall be made in tunnels, shafts, chambers etc., based on schedule of item rates. The rate for steel ribs as above shall include the entire cost of:

A. Supply, handling, fabrication, transportation to the place of installation and installation of steel ribs,Connection plates, all foot plates, foot blocks, tie rods, bolts nuts cross bracing and all other accessories

B. Surveying and marking the position of ribs on the finished concrete surfaces.

ii. For the measurement and payment purposes, the weight of the steel ribs will be based on the unit weight of the steel profile per linear meter (without any accessories) as per relevant IS Code required to be installed according to drawing.

9.6.2 Lattice Girders

i. Measurement for payment for supply, handling, fabrication and installation of the Lattice Girders will be of the weight of Lattice Girders (in MT) actually installed and approved by the Engineer. Payment for the same shall be made in tunnels, shafts, chambers etc., on the basis of schedule of item rates. The rate for Lattice Girders as above shall include the entire cost of:

A. Supply, handling, fabrication, transportation to the place of installation and installation of Lattice Girders, Connection plates, all foot plates, foot blocks, tie rods, bolts nuts cross bracing and all other accessories

B. Surveying and marking the position of Lattice Girders on the finished concrete surfaces.

ii. For the measurement and payment purposes, the weight of the Lattice Girders will be based on the unit weight of the steel profile per linear meter (without any accessories) as per relevant IS Code required to be installed according to drawing.

9.6.3 LAGGING

i. DELETED.

ii. PRECAST RCC LAGGING

A. The measurement for payment for precast RCC laggings, will be made at the Unit Rate per $M^3$of RCC Lagging(including cost of providing, fabrication and installation but excluding any steel reinforcement) entered in the Bill of quantities. Steel reinforcement used shall be paid separately according to relevant item of bill of quantities.

9.6.4 LINING STRESS CONTROLLERS

i. Measurement for payment for supply, handling, fabrication and installation of the Lining stress controllers will be of the weight of Lining stress controllers (in MT) actually installed and approved by the Engineer. Payment for the same shall be made in tunnels, shafts, chambers etc., on the basis of schedule of item rates. The rate for Lining stress controllers as above shall include the entire cost of:
   A. Supply, handling, fabrication, transportation to the place of installation and installation of Lining stress controllers, complete with all accessories.
   B. Surveying and marking the position of Lining stress controllers before installation.
   C. Protecting Lining stress controllers from filling with shotcrete during initial lining shotcrete spray.

ii. For the measurement and payment purposes, the weight of the Lining stress controllers will be based on the unit weight of the steel profile per linear meter (without any accessories) as per relevant IS Code.

9.6.5 EXCLUSIONS

i. Anchor bolts installed to hold the installed steel ribs in position shall not be measured and paid and its cost is deemed to be included in the unit rate of steel ribs/lattice girders quoted in Schedule of Item Rate.

ii. DELETED

iii. No extra measurement for payment will be made for the following:
   A. Structural steel supports, which have to be replaced, repaired or re-erected as a result of Contractor's negligent operation. The contractor shall rectify or replace such steel ribs and lagging at his own expense.
   B. Structural steel supports which have to be installed as a consequence of the Contractor's non-compliance with the approved drilling and blasting methods as set out in the Contract.
   C. Weight difference in case the contractor prefers installation of heavier or stronger supports or for additional ribs due to closer spacing than those approved by the Engineer.
   D. Temporary supports installed by the Contractor for his convenience and safety of his workmen/equipment during execution.

iv. The cost of testing of materials specified in this chapter shall be deemed to be included in the quoted rate for the relevant item of work.

SUB CHAPTER -10

10.0 ROCK BOLTS AND WIREMESH

10.1 SCOPE OF WORK

10.1.1 The specifications described herein under relate to the Work which includes all labour, material, equipment and services required for the supply, installation, testing and monitoring of rockbolts, pipe-roofs etc.and also the supply and installation of wire mesh and mesh anchors as specified herein or as shown on the drawings.

10.1.2 Rockbolts, pipe roofs etc. shall be furnished complete with all accessories and other materials necessary for their installation, stressing and grouting.

10.1.3 If directed or approved by the Engineer, the Contractor shall supply and install flat steel plates or rolled steel sections to connect together two or more rockbolts.

10.1.4 The contractor shall maintain on site or have immediately available atleast one month buffer stock as per agreed work programme of any of the support element s i.e. Wiremesh, Self-Drilling bolts, Fiber glass bolts or any other specialised bolts required according to the rock mass classifications and as per drawings. However, towards work closure, the contractor may use these quantities with prior approval of Engineer.

10.1.5 STANDARDS:

The specifications, production, working etc. shall conform to the following latest Indian Standards or where not covered by these Standards, to the equivalent International Standards. The list is for guidance purpose only. The contractor shall abide by all codes/regulations/ specifications as are deemed necessary for the satisfactory completion of work.

i. Indian Standards:

A. IS: 1786 – 1985 (Reaffirmed 2000), Specification for high strength deformed steel bars and wires for concrete reinforcement

ii. American Society for Testing and Materials (ASTM):

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel

B. ASTM C150 - Standard Specification for Portland Cement

C. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete

D. ISRM - Doc.2, Part 1 "Suggested Method for Rock-bolt Testing".

10.2 SUBMITTALS.

10.2.1 At least 8 (eight) weeks prior to the commencement of excavation works, the contractor shall submit, to the Engineer, the details of equipment to be used for testing and installation of Rockbolts / Piperoofs / wiremesh etc.

10.2.2 The Engineer reserves the right to require any additional information deemed necessary to be included in the submitted documents.

10.2.3 Test reports of tensile strength tests and pull out tests, routine pullout tests (IS:11309) shall be submitted immediately within 3 hours after the test is carried out.

10.3 GENERAL

10.3.1 For the sake of convenience, the terms used in the Chapter are defined as follows:

i. Reinforcement Element is a general term of rockbolts, pipe roofs, wiremesh etc.

ii. Rockbolt is a stressed (or tensioned) reinforcement element consisting of a rod, grouted anchorage, and plate and a nut for stressing by giving torque to the nut or for retaining tension applied by direct pull. It is synonymous with “active rock anchor”.

iii. Individual rock bolting refers to the installation of reinforcement elements in localized area of in stability or weakness as determined during excavation. It is synonymous with spot bolting.

iv. Pattern Rock bolting refers to the installation of reinforcement elements in a regular pattern over the excavation surface.

v. Water expandable bolts: High-pressure water shall be injected into the steel tube, which causes the steel tube to expand and to form it to the irregularities in the drilled hole.

vi. The reinforcing bar steel used shall be from sources as indicated in the Section – Material for construction. Corroded steel bars shall not be used.

10.3.2 The following types of reinforcing elements are proposed to be used:

i. SN Bolts: Resin-grouted and cement grouted.

ii. Water expandable bolts.

iii. Self-Drilling anchors as Rock bolts or Fore Poles.

iv. Pipe roofing umbrella.

10.3.3 The type, length, diameter, inclination and pattern of the rockbolts shall be as shown on the drawings or as approved by the Engineer. The Contractor shall provide manufacturer's test certificate for all batches of rockbolts supplied. At least 5 samples shall have been tested for tensile strength until failure from each individual batch of rock bolts which is marked with the same manufacturer's identification number. All the results of the tensile test shall comply with the specified data of the manufacturer.

10.3.4 Bearing plates shall conform to IS 2062 and be flat or dished steel plates having minimum dimensions suitable to carry take full load for Rock bolt is installed (Atleast 1 plate of 200x200x12 for 32mm dia bolts and 1 plate of 150x150x10mm for 25mm dia bolts). The washers to be used shall be bevel or hemispherical.

10.3.5 DELETED.

10.3.6 All surfaces of the bearing plates, nuts, washers and wedges, and threads on the projecting ends of rockbolts shall be protected and lubricated with rust preventive compound.

10.3.7 DELETED**.**

10.3.8 Corroded bolts or steel or other elements shall not be used.

10.3.9 When rockbolts are used in conjunction with wire mesh, the mesh shall be connected firmly to the bolts by means of extra steel plates and nuts.

10.3.10 Wire mesh shall not be placed between rock and the bearing plate of the rockbolts. Additional plates shall be provided for this purpose.

10.3.11 Couplers may be required for the bolts. When coupler is used, the threading in the bar shall not reduce the effective diameter of bar. Coupler itself should be able to transfer at least 125 % of the yield load of the bar.Couplers shall not be permitted for rock bolts less than 4m in length.

10.3.12 Minimum one PVC centralizer per rock bolt shall be provided. In long rock bolts, one centralizer at every 6m shall be provided along the length of the bolt.

10.4 TESTING AND MONITORING OF ROCKBOLTS / ROCK ANCHORS.

10.4.1 The contractor shall furnish atleast two sets of testing equipment including hydraulic jacks, fixing device, hydraulic pump with pressure gauge / manometer, extensometer and all necessary accessories. The testing equipment shall be capable of stressing the largest diameter rockbolt to the yield stress of the bolt.

10.4.2 **Proof Tests**

i. A detailed test program set up on basis of above-mentioned document shall be approved by the Engineer prior to all testing work.

ii. Specific deviations from the ISRM suggested method shall be approved by the Engineer.

iii. A test report shall be issued immediately after completion of the tests. It shall be submitted for approval to the Engineer.

iv. For each type of rock bolt submitted information shall comprise:
   A. type of bolts
   B. testing equipment
   C. location and installation records
   D. Applied testing loads and records of deformation
   E. Otherwise the evaluation of test results as specified in ISRM's document
   F. Interpretation and suggested action for failed pull-out tests

v. Proof tests shall be carried out for all types of bolts to be used for this project prior to the commencement of tunnelling to demonstrate the effect and the A service capacity of the bolts in the field.

vi. The tests shall be performed in similar geological ground conditions as expected during tunnel drive. The location of the bolts to be tested shall be selected by the Engineer.

vii. A minimum of five bolts of each type shall be tested. Depending on the testing procedure and the test results the Engineer may require further bolts to be tested.

viii. Adequate testing equipment, as specified in the above mentioned ISRM document shall be provided to record bolt elongation, movement of the bolts and tension forces.

ix. The maximum load to be applied shall be the bolt´s yield load or as otherwise approved by the Engineer.

10.4.3 DELETED

10.4.4 DELETED

10.4.5 DELETED

10.4.6 **Testing during Tunnel Driving**:

The Engineer will select rock bolts for testing of production bolts. For each type of rock bolts five bolts will be selected from the first 100 bolts placed in the tunnel. From the remaining bolts five per 500 bolts will be selected for testing purpose. The testing force to be applied shall be equal to 80% of the rock bolt yield load.

i. Bolts which fail the tests, or which are pulled out shall be replaced.

ii. For each failure, the Engineer shall require further bolts to be tested inthe vicinity.

iii. Otherwise as Clause (i) to (ix) in clause above.

10.4.7 ***Grout mortar:***Prior to acceptance tests of rock bolts, tests with available cements and sands shall be carried out to determine an appropriate mix design to achieve the specified strength and a proper workability in association with the grouting equipment used. Additives will be used to improve workability. The grout mortar shall be tested on cubes 5x5x5 cm. The cubes shall be cured in water. Five numbers of cubes shall be prepared for each compressive strength test. The resultant strength is the average evaluated from the three remaining values after elimination of the highest and the lowest. During construction, cube sample shall be taken weekly at each five bolts drivage from the grouting hose at the nozzle. Preparation and evaluation shall follow the procedure as described above.

10.4.8 If any rockbolt fails due to improper workmanship or defect in materials or due to any reason whatsoever, the Engineer may order a test on all adjacent rockbolts and all rockbolts so failing shall be rejected, replaced and retested.

10.4.9 The bolts and anchors shall be checked for their straightness Tolerance with $\pm$ 1 mm.

10.4.10 The pullout trials shall be conducted in conformity with IS: 11309.

10.4.11 Further sampling and testing for quality control will be got done as directed by engineer at contractor’s cost.

10.5 DRILLING HOLES & PREPARATION FOR INSTALLATION

10.5.1 Holes for rockbolts shall be drilled as specified herein and in accordance with the provisions set out in Section of “Drilling and Grouting”

10.5.2 The minimum diameter of each hole shall be as specified below or as directed by engineer:

i. Rock Bolt of 25mm dia: Hole dia 45mm with coupler and 38mm without coupler

ii. Rock Bolt of 32mm dia: Hole dia 64mm with coupler and 50mm without coupler

10.5.3 The length of drill hole shall be such as to receive the specified rockbolt and to provide for its satisfactory anchorage.

10.5.4 After drilling, each hole in compact, washable rock shall be washed out with clean water and cleaned by blowing out all drill cuttings and debris with compressed air. The holes in rock, which tend to swell or are interspersed with clay filled fissure shall be cleaned with compressed air only. The compressed air shall not contain any oil or other material preventing the bond.

10.5.5 Prior to installing the rock bolts, which will be stressed, the rock surface adjacent to the hole shall be prepared for the bearing plate. Only bevel washers shall be used which shall be placed between the bearing plate and the nut, or dished bearing plate and hemispherical washer used to ensure uniform bearing.

10.5.6 If a rock bolt is not installed immediately after drilling the hole, the hole shall be washed and cleaned as stipulated above, immediately prior to installing the rockbolt.

10.5.7 Fresh holes, as directed by the Engineer, shall be drilled by the contractor at his expense to substitute such holes as have been drilled out of place or alignment.

10.5.8 The rock surface around the drilled holes to receive the bearing plate shall be chipped smooth or be covered with a smooth quickset cement pad.

10.5.9 All bolts within 10 m of a blasting operation shall be retightened to the specified torque within 4 hours after each blast. If it is found that any bolt does not take the required torque without anchorage slip, a new bolt shall be installed in the immediate vicinity of the unsatisfactory bolt.

10.6 Installation Records

Comprehensive records about details of the installation of rock bolts during drivage, such as grout consistency, drilling depth, length and type of rock bolts, deviations from the theoretical position, type and time of grouting, time of tightening, special observations, etc. shall be kept for each round by the Contractor and countersigned by the Engineer’s supervisory personnel. Copies of these records shall be submitted to the Engineer.

10.7 ROCK BOLT RESIN-GROUTED (SN Bolt)

10.7.1 Rockbolts shall consist of deformed steel bar of 25 mm or 32 mm Ø (Grade Fe-500D conforming to IS 1786). Each bolt shall have one end chamfered and the other end threaded with a coarse thread over a length of 200 mm.

10.7.2 After the hole is drilled and cleaned, fast setting resin cartridges shall be placed in the fixed length of the drill hole at bottom as determined by the pull-out tests and slow setting resin cartridge in remaining length of drill hole. These cartridges shall be tamped with the bolt for proper packing. The rock bolt shall then be advanced and rotated steadily through the capsules at the rate recommended by the manufacturer by means of a pneumatic tool and a coupling attached to the threaded end of the bolt. The rotation shall be continued after the bolt has been fully inserted for a further 30 seconds. Bolt shall be stressed by torqueing/jacking, by means of an approved and regularly calibrated stressing device to the level as directed by Engineer. The bolt shall be stressed before setting time of slow setting resin cartridges as suggested by

manufacturer. The Contractor shall demonstrate the resin cartridges used satisfy the specified strength requirements of the bolts to the satisfaction of Engineer, before use.

10.7.3 Bolts shall be thoroughly cleaned before being placed in the drill hole.

10.7.4 The minimum capsule diameter should be proposed for each drill bit dimension, considering that the hole must be fully filled with resin. The drill bit diameter should be defined by the manufacturer, however, as guidance, for a 32 mm resin capsule diameter, the drilling should not be more than 38 mm.

10.8 ROCK BOLTS CEMENT GROUTED (SN Bolt)

10.8.1 Rockbolts shall consist of deformed steel bar of 25 mm or 32 mm Ø (Grade Fe-500D conforming to IS 1786). Each bolt shall have one end threaded with a coarse thread over a length of 200 mm.

10.8.2 Anchor bars/anchor bolts shall be thoroughly cleaned before being placed in the drill hole. The hole shall be filled with grout constituting 1:1 cement/sand mix with low water cement ratio, by inserting the grout hose to the full depth of the hole and withdrawing as the grout is pumped in. The nozzle shall be kept buried in the grout as the pipe is withdrawn so that air is displaced as the hole is filled. The bolt is then pushed into the hole. Admixtures for fast setting and low shrinkage may also be required.

10.8.3 In case of coupled rock bolts, partly collapsed boreholes, or major water- flow from the borehole, grouting may be done after installation of the bolt (post-grouting). The hole is then grouted by a special attachment which allows the mouth of the borehole to be sealed whilst the grout is pumped in. Air is displaced from the hole via a tube which is attached to the full length of the rock bolt as it is installed. Grout is then pumped in and the hole can be seen to be full, when grout escapes from the end of the tube.

10.8.4 The nut of the grouted rock bolts shall be tightened not later than 12 hours after installation to achieve a force at the anchor plate of approx. 20 KN. This force shall be applied by a calibrated torque wrench.

10.9 WATER INFLATABLE BOLTS (Swellex or Similar)

10.9.1 Water Inflatable rock bolts shall be manufactured from a mechanically reshaped steel tube with bushing pressed onto the ends, sealed through welding. The bolt shall have an expansion pressure rating of 300 bar and wall thickness of minimum 3mm. The bolt shall have separate protective coating (zinc epoxy/bitumen/plastic/polymer) that isolates and actively protects the steel. The lower bushing shall have a flange to hold a face plate in place. High-pressure water (about 300 bars) shall be injected into the steel tube through a hole in the lower bushing. This causes the steel tube to expand and to form it to the irregularities in the drilled hole. A 200 mm long sleeve tube made of steel prevents the bar from swelling at the drill hole mount. As the swelling process occurs, the lower part of the steel tube shortens, pulling the face plate firmly against the rockface. The water pressure is released after installation and the water allowed draining out of the expanded steel tube. The drill hole diameter has to be adjusted to suit the size of rock bolt according to the Manufacture's recommendations. The water inflatable rock bolts shall have characteristic minimum breaking load of more than 200 KN and shall undergo upto 10% minimum elongation before failure.

10.9.2 All face plates, washers and other accessories used shall be from original manufacturer of the bolt. Face plates shall be spherical dome type.

10.9.3 The bolts shall be supplied, installed and tested as per recommended procedure of the manufacturer. Standard pull testing shall be done with pull tester along with it's

otherparts as manufactured by OEM. Additional bolt material testing, if required, shall becarried out as determined by Engineer in charge depending on site conditions.

10.10 SELF DRILLING ROCK BOLTS

10.10.1 This is a high-grade (Yield load more than equal to 230KN) hollow core seamlesssteel bar with continuous threaded surface for mechanical coupling. In addition to hollow core seamlesssteel bar, other parts of the assembly consists of Hexagonal nut, bearing plate, extension couplings and sacrificial drill bit. Before and during installation, thread ends will be kept cleaned to allow hex nut and coupler threadability. Construction and drilling shall be as per manufacturers guidelines.

10.10.2 SDA Bolts shall have outer dia of minimum 32mm and inner diameter less than equal to 18mm. Length of rod to be procured shall be decided in agreement with engineer.

10.10.3 Bearing plates shall allow articulation of 5 to 7 degrees in all directions.

10.10.4 Drill bit to be used shall be selected according to installed length of bolt, geology and size of bolt.

10.10.5 Couplers and Nuts shall exceed the tensile strength of bars by minimum 20%.

10.10.6 The bolt shall be grouted according to manufacturer's guideline (to a minimum pressure of 6 bars) with manufacturer's grout material supplied along with bolt. Alternatively, grout mix (M-35 grade) may be prepared using OPC 53 cement and sand having maximum particle size of less than 0.3mm. Grout mix shall have a water cement ratio less than 0.4 and shall contain PC based super plasticizer (Minimum 2%) and expanding plasticizer (allowing upto 3.5% expansion in neat cement) from reputed manufacturer. Admixtures containing chlorides and alkali shall not be used.Face of the Bolts shall be sealed off with GP2 or Similar rapid setting grout to prevent grout leakage during build-up of pressure.

10.10.7 These bolts may also be used as forepoles.

10.10.8 All accessories of self-drilling rock bolts shall be suited to the main anchor rod type and shall be procured from original manufacturer of the bolt.

10.11 DELETED

10.12 WIRE MESH AND MESH ANCHORS

10.12.1 Deleted.

10.12.2 WELDED WIRE MESH

i. Welded wire mesh shall be installed in surface and underground excavation as reinforcement for shotcrete, usually in combination with rockbolts. It may also be used with steel ribs, when it shall be laid over the outer flange of the rib and pinned or fixed to the excavated surface between the ribs where necessary.

ii. Welded wire mesh shall conform to the requirements of IS: 1566. The fabric shall have a minimum square mesh of 150x150x6 or 100x100x4, made of wires having a strength not less than 480 Mpa and diameter 3 to 5 mm or as directed by engineer.

iii. Where possible, the welded wire mesh shall be placed at the same time as rockbolts are installed. It shall not be placed between the rock surfaces and bearing plates of rockbolts but shall be placed over the heads of rockbolts and fastened to them by separate plates and nuts. Sufficient intermediate mesh anchors, or if directed by the Engineer, additional rockbolts, shall be placed to ensure that the mesh is drawn close to the excavated surface so that when shotcrete is applied subsequently, the mesh neither sags nor vibrates excessively and impairs the effectiveness of the shotcrete.

iv. In case the welded wire mesh is placed at such locations where rockbolts have not been provided, wire mesh anchors of a type acceptable to the Engineer shall be used to secure the edges of wire mesh tight to the rock surface to provide anchorage at overlaps and to provide intermediate support. The wire mesh anchors shall have a minimum length of 450 mm.

v. The use of wooden pegs and pins for fastening the wire mesh to the rock surface will not be permitted.

vi. Welded wire mesh shall be firmly stretched between the rockbolts. Care shall be taken to ensure that air pockets are not formed behind the wire mesh, when used as reinforcement for shotcrete. Overlaps in the wire mesh shall not be less than 300mm.

10.13 PRE-EXCAVATION SUPPORT MEASURES

10.13.1 In general, all poor reaches shall be supported by regular supporting measures (Rock reinforcement, shotcrete, Steel Ribs, Lattice Girders, pre-injection grouting etc.) as specified in drawings. However, certain ground conditions may require tunnel support ahead of face before it's excavation. For such situations, **after completion of Pre-Excavation grouting ahead of face**, the advance support measures as described below shall be implemented if required at site as per direction of Engineer.

10.13.2 Grouting of pre-excavation support measures (Forepoles, Piperoof and Fiber glass bolts):

i. OPC 53 / 53Scement shall be used for grouting.

ii. Cement grout shall attain minimum M20 strength.

iii. DELETED.

iv. Viscosity of grout shall be such that it shall not leak down from vertical holes in the bolt/plate and adheres immediately to rock.

v. Water cement ratio of cement grout shall be in the range 0.50 to 0.75 as decided by Engineer and 1.5% PC admixture shall be used to increase flowability of grout..

vi. Admixture shall be added to achieve the workability required for the operation and prolong the initial set to minimum 1 hour.

vii. Starting pressure for grouting of cement grouted bolt and forepoles shall be 10 bars and grouting shall be continued till sufficientgrout take has been accomplished throughout its length.

viii. Face of the Bolts/forepoles/pipes shall be sealed off with GP2 or similar grout to prevent grout leakage during build-up of pressure..

ix. Sufficient numbers of grouting packers shall be available at site to grout same stage of 6m in multiple pipe roofs. Packers will not be disturbed before final setting time of grout.

10.13.3 **FOREPOLING:** Fore poles shall be 25/32 mm diameter self-drilling anchor bars or SN bolts or pipes having outer dia less than 48mm of this sub chapter having length of 6 meters or more. The fore poles shall be placed along periphery of the tunnel inclined at angle and pipe spacing (mentioned in drawings), at the heading face and cement grouted in place as directed by the Engineer.

10.13.4 **PIPE ROOFING:**When ground conditions are such that face cannot be supported by forepoling, then pipe roofing shall be required to be implemented. Pipe roofing consists of high tensile seamless steel pipes(Having a minimum outer diameter of 76mm and a minimum yield load of 1200 KN) conforming to IS: 1611 (Maximum 24 m long) placed along periphery of the tunnel in one or two layers, each layer inclined at angle and pipe spacing (mentioned in drawings) at the heading face or as directed by the Engineer. Engineer may require use of Self drilling 76mm dia pipes. Other pipes of

larger diashall be connected to each other by nipple coupling or squeezed connection or seamless butt-welded producing a leak proof connection. Standard threaded connection shall not be permitted. The cement (OPC 53 or other) grouting of pipes shall be done. In case of perforated pipes grouting shall take place in stages using packer in each stage and starting at deepest location first. Sacrificial ring bits should be used. AT-casing system (or similar) shall be used and orientation of drilling shall be guided by means of equipment installed on the jumbo boom.

10.14 FIBRE GLASS BOLTS

10.14.1 Fibre glass bolts shall be 32/15 configuration with load carrying capacity of more than 300 KN and shall be grouted immediately after installation.

10.14.2 Fibre glass bolts of other configuration or strength may be used by contractor with approval of engineer.

10.15 MEASUREMENT AND PAYMENTS

10.15.1 General

i. The unit Rates entered in the Schedule of Item Rate shall be applied regardless of the work being performed on the surface or underground. The unit rate shall be deemed to include supply of material, labour, equipment and placing of anchors / bolts / wire mesh in position etc. Payment for rock bolt, Self-drilling anchors, forepoles, pipe roofs, fibre glass bolts and wiremesh in all works shall be made on the basis of item rate quoted in schedule of items. The rate shall include the cost of nuts, bearing plates, bearing heads, couplers, centralizers, color coded end caps including required excavation and concrete works (in case of cable anchors) and other accessories. The rates shall also include all other costs associated with carrying the job in full as described in this sub-chapter including all possible delays in the excavation of the tunnel because of installation of rock bolts, whether delays are because of geological conditions, water inflow or other conditions in the tunnel.

ii. Rock bolts required according to design spacing and length or as instructed by engineer only shall be installed and paid. Nothing extra shall be paid in case of over excavation or over break which was unnecessary/due to contractor's fault or need.

iii. In case of geologically accepted overbreak, the payment for rock bolts shall be made as per actuals according to support measures as instructed by engineer.

iv. The cost of testing of materials specified in this chapter shall be deemed to be included in the quoted rate for the relevant item of work.

10.15.2 Rockbolts

i. Testing and Monitoring

A. Payment shall be made for the supply and installation of all rockbolts used in pullout test provided that the rockbolt tested comply with these specifications. Measurement for payment will be as for rockbolts used for the permanent works. Rockbolts failed before reaching yield point due to improper workmanship or defect in material shall be rejected. No measurement for payment & payment for such bolts shall be made. The rate of rock bolts includes drilling of holes.

B. No extra measurement for payment or payment will be made for the testing equipment and carrying out test and the cost thereof shall be included in the Unit Rates Provided in Schedule of Item Rate. **Minimum two testing equipments per tunnel shall be maintained by contractor, out of which one shall be kept for stand- by.**

ii. Deleted.

iii. Cement/Resin Grouted Rockbolts (SN Bolt)

A. Measurement for payment for cement/resin grouted type bolts (SN Bolt) installed shall be of the total length of bolts (including threaded portion) of the same bar diameter installed and approved by the Engineer.

B. Payment will be made separately for each bolt dia at the Unit Rate per linear meter entered in the Schedule of Item Rate, which shall include the entire cost of:

a. Furnishing and installation of quickset resin cartridges.
b. Furnishing and filling the hole with slow set resin.
c. Furnishing and installation of reinforcing steel bars and bearing plates and all other accessories.
d. Centralizers, couplers and all accessories.
e. Stressing of bolt.
f. Load/pull out testing.

C. The drilling of holes shall not be paid for separately.

iv. Water Inflatable bolts (Swellex or Similar)

A.Measurement for payment for water Inflatable rock bolts installed shall be ofthe total length of the bars of the same diameter installed and approved by theEngineer.

B. Payment will be made at the unit rate per meter entered in the Schedule of ItemRate, which shall include the entire cost of:

a. Drilling of the holes.
b. Washing and cleaning of the holes.
c. Supplying and installing water expandable rock bolts with all accessories as Recommended by the manufacturer.
d. Load / pull out testing.

C. Nothing extra shall be paid to complete the item according to specification mentioned in this sub-chapter or to specification of the manufacturer.

v. Self-Drilling Rock Bolts

A. Measurement for payment for self-drilling bolts installed shall be of the total length of the Bolts (including threaded portion) of the same diameter installed and approved by the Engineer.

B. Payment will be made at the unit rate per meter entered in the Schedule of Item Rate, which shall include the entire cost of:

a. Drilling of the holes.
b. Supply and installing self-drilling rock bolts with all accessories including bearing plates, nuts, bolts, Couplers etc.as recommended by the manufacturer.
c. Grouting of rock bolts.
d. Load / pull out testing.

C. Nothing extra shall be paid to complete the item according to specification mentioned in this sub-chapter or to specification of the manufacturer.

vi. No extra payment will be made for the following:

A. Loose and rejected rockbolts which fall out during trimming, excavation and rock bolts which are otherwise damaged, or displaced as a result of contractor's operations. The contractor shall replace such rockbolts at his own expense. If the rock conditions in the underground excavation require an immediate installation of the rockbolts in the heading face, which will be destroyed later as the excavation advances, deviation from this rule may be granted after a mutual agreement between the Engineer and the Contractor.

B. Rockbolts which have to be installed as a consequence of the contractor's non-compliance with the approved drilling and blasting as specified in Section of "Underground Excavation".

C. Length of rock bolt projecting outside the tunnel wall shall not be paid.

vii. Fibre glass bolts

A. Measurement for payment for fibre glass bolts installed shall be of the total length of the bolts installed and approved by the Engineer.

B. Payment will be made at the unit rate per meter entered in the Schedule of Item Rate, which shall include the entire cost of:

a. Drilling of the holes.

b. Washing and cleaning of the holes.

c. Supplying and installing fibre glass bolts with all accessories as recommended by the manufacturer.

d. Load / pull out testing.

10.15.3 Pipe roofs

i. Measurement and payment for pipe roofing will be made for supply and installation at rates quoted in the schedule for different diameters.

ii. Measurement for payment includes supply and installation (Excluding length projected outside the rock mass). The rates deemed to include the entire cost of handling, storage cutting, drilling, grouting of pipe, coupler and other accessories, installation of pipes including its supply.

iii. Nothing extra shall be paid to complete the item according to specification mentioned in this sub-chapter or to specification of the manufacturer.

10.15.4 Wire Mesh

i. Deleted.

ii. Welded Wire Mesh: Measurement for payment for welded wire mesh provided shall be for the net area (without overlaps) actually installed. The weight will be computed using unit weight per square meter as specified in the relevant IS code.

iii. Payment will be made at the Unit Rate per metric tonne entered in the Schedule of Item Rate, which shall include the entire cost of supply and installation of welded wire mesh, including overlaps, and the provision of all necessary accessories for fixing, such as steel pins / mesh anchors and extra plates and nuts for fastening to rock bolts.

10.15.5 Fore Poles

i. Payment for drilling hole and installation and grouting of fore poles will be made at unit rates quoted for self-drilling bolts or end anchored bolts whichever is used.

ii. Measurement for payment of installation of forepoles will be of the total length of forepoles installed (Excluding length projected outside the rock mass).

10.15.6 Miscellaneous steel pieces

i. Measurement for payment for miscellaneous steel pieces such as small steel ties, beams, plates, cables, angles, channels will be the weight of steel actually installed. The weight of standard structural sections will be computed using the nominal unit weight per meter or area as indicated in relevant IS Codes.

ii. Wherever embedded of metal piece in concrete/shotcrete is required.

iii. Payment will be made at unit rate per metric ton entered in the BOQ, which shall include the entire cost of supply and installations.

SUB CHAPTER -11

11.0 SHOTCRETE

11.1 SCOPE OF WORK

11.1.1 The specifications described herein under related to the work, which includes all labour, materials, equipment and services required for the shotcrete work (plain and fiber reinforced) to be carried out by the contractor under this Contract.

11.1.2 All shotcrete work shall be carried out in accordance with guidelines specified in this section.The shotcrete work shall be performed to the dimensionsas shown on the drawings or as otherwise directed by the Engineer.

11.1.3 ***Compressive strength of shotcrete shall be met by compression testing of cylindrical cores extracted from Tunnel wall. The sample prepared for testing shall have a 100mm length and 100mm diameter (Equivalent of a cube).***

11.1.4 The approval given by the Engineer to the Contractor's equipment of their operation or of any construction methods shall not relieve the contractor of his full responsibility for the proper and safe execution of Shotcrete work or any obligations under this Contract.

11.2 SUBMITTALS

11.2.1 Within 28 days from the commencement date, but before procuring or mobilizing to the site, the equipment, the Contractor shall submit to the Engineer, updated and detailed plans and descriptions, of the following:

- **i.** Batching and Mixing Equipment
  - **A.** Description and details of the equipment, which the Contractor intends to use to determine and control the quantity of shotcrete ingredients and mixing thereof into uniform mixture. This shall also include automatic dosing equipment for various admixtures and fibers. All equipments shall be capable of monitoring and recording the dosage during production process.
- **ii.** Placing Equipment
  - **A.** Full details, of the equipment to be used for placement of shotcrete (Robotic Shotcrete machine) and details of standby equipment.
- **iii.** Details of methods and equipment which the Contractor proposes to use to control the temperature of aggregates and water during extreme hot and cold weather conditions.

11.2.2 At least 28 days in advance of any shotcrete work being carried out on the site, the contractor shall submit, to the Engineer the following:

- **i.** Notifications of any admixture and Pozzolana, which the contractor proposes to use, manufacturers thereof and information about the chemical names of the principal ingredients and the effect of under or over dosage.
- **ii.** Description and details of methods which the contractor proposes to adopt for Shotcrete.

11.2.3 The Engineer reserves the right to require any additional information deemed necessary to be included in the submitted documents.

11.3 STANDARDS

11.3.1 The Shotcrete materials, production, methods of application, testing and admixtures shall conform to the following latest Indian Standard or, where not covered by these standards, to the equivalent International Standards.

11.3.2 Indian Standards

- **i.** IS: 456 Code of Practice for Plain & Reinforced concrete.
- **ii.** IS: 269 Specification for ordinary Portland cement.

iii. IS: 383 Specification for coarse and fine Aggregates from natural source for concrete.
iv. IS: 516 Method of test for Strength of concrete.
v. IS: 9012 Recommended practice for Shotcrete.
vi. IS: 2645 Specification for Integral cement water proofing compound.
vii. IS: 9103 Concrete Admixtures.
viii. IS: 12269 Specification for 53-grade ordinary Portland cement.
ix. IS: 15388 Silica-Fumes.
x. IS:7861 Code of practice of extreme weather concreting.
xi. IS: 1199 Methods of Sampling and Analysis of Concrete.
xii. IS: 5878 Code of Practice for Construction of Tunnels.

11.3.3 International Standards have been mentioned at relevant locations in the section.

11.3.4 In case of conflict between the above standards and the specifications given herein, the specifications shall take precedence.

11.4 General

11.4.1 Shotcrete shall be applied by either the wet or dry process as appropriate to the circumstances. All aspects of the application of shotcrete shall be subject to the agreement of the Engineer. Particular emphasis shall be placed on the provision of adequate ventilation.

11.4.2 The Contractor shall develop a shotcrete mix and a plan for its production and application. Specifications of constituent materials shall comply with those listed in this. Admixtures shall be compatible with each other and the mix.

11.4.3 The shotcrete mix design shall, unless otherwise stated, comply with the characteristic strengths specified by the Designer for early-age and long-term loading.

11.4.4 Contractor's shotcrete expert should be on site at all times to check that the materials and workmanship are consistent with the design intent, and to ensure that ground and groundwater conditions are in accordance with design assumptions. The Contractor shall establish a procedure to respond effectively to changes in ground and groundwater conditions from the design assumptions.

11.4.5 The Contractor shall establish and maintain the instrumentation and monitoring required by the design. The Contractor shall establish a procedure that will enable prompt and regular review and effective response to the results from the instrumentation and monitoring. The Engineer shall be included in the monitoring review procedure.

11.5 DEFINITIONS

11.5.1 **Shotcrete:** Shotcrete for the purpose of this work is defined as wet mix of cement concrete (plain) or fiber reinforced (SFR) applied from a spray nozzle by mean of compressed air. The Engineer may, in exceptional cases, allow use of dry mix for plain shotcrete. Shotcrete shall contain approved additives like Accelerator, Superplasticizer, retarder, stabilizer, Pumpability improving additive or curing agents suitable to attain desired properties as mentioned in these specifications and site conditions.

11.5.2 DELETED

11.5.3 Rebound: Rebound is defined as the portion of shotcrete mix or any of its constituents, which bounces away from a surface against which it is being projected.

11.6 MATERIAL FOR SHOTCRETE

11.6.1 Material for shotcrete shall comprise cement, aggregates, fiber, water and approved admixtures, micro-silica/silica fume as specified herein.

11.6.2 Cement:

i. Cement used shall be ordinary Portland cement of 53/53S grade.

ii. ***For M30 Grade Shotcrete: Minimum OPC 53/53S content will not be less than 385 Kg/cum.Minimum 15 Kg/cum Micro-silica/silica fumewill be added to enhance mix durability and reduce life cycle cost of shotcrete.***

iii. Preferably cement fineness shall not be less than 275 m^2/kg for OPC 53 and 370 m^2/kg for OPC 53S.

iv. Maximum temperature of the cement in the mixing plant silos should be limited to 70°C and it should not exceed 50°C at the time of mixing. Cement should be preferably purchased in bulk and fresh cement shall be stored in a suitable silo.

11.6.3 Aggregates:

i. All fine and coarse aggregates to be used shall be supplied from approved sources, which shall not be changed without permission in writing from the ENGINEER Aggregates shall conform to the requirements of IS:383.

ii. The aggregate shall be checked for chemical reactions, such as alkali–aggregate reaction, with latent hydraulic binders and admixtures, especially accelerators.

iii. The aggregates size for shotcrete **shall not exceed 10 mm**. The proportion of aggregate larger than 8mm in size should not exceed 10%. The aggregate shall be well graded, and no fraction shall constitute more than 25 % of the total. The contents of the crushed and non-cubical material under 0.1mm shall not exceed 8 %.

iv. Acceptance of source by Engineer shall not be construed as constituting the acceptance of all aggregates to be taken from that source or grading of aggregates to be in conformance with contract.

v. It is the responsibility of the CONTRACTOR to choose the most suitable grading for the process and materials available from the range given in table below. The grain size distribution of aggregates shall be within ±2% for each sieve size as shown below:

Standard Sieve	Sieve Size [mm]	Passing in %
IS	10.0	100
IS	8.0	90-100
IS	4.0	73-100
IS	2.0	55-90
IS	1.0	37-72
IS	0.50	22-50
IS	0.25	11-26
IS	0.125	4-12

11.6.4 Fibers: Macro Synthetic fibers shall be used which shall conform to specifications mentioned below.

i. Deleted.

ii. The macro-synthetic fibers shall be in accordance with BS EN 14889-2. Fibers shall be dry and free from oil, grease and chlorides and shall be provided with arrangements to deliver anchorage properties. The fibers shall satisfy the following parameters:

Class	Class-II (EN 14889-2)
Length of fibers	45-55 mm.
Type of handling	Mulchable paper bags.
Geometric shape	Regular cross section (More than 0.30mm of equivalent

	Diameter) fully embossed.
Tolerances and sampling	In accordance with EN 14889-2.
Aspect Ratio (Length / Diameter)	≥64
Tensile strength	≥550 MPa, when tested in accordance with EN 10002-1.
Modulus of Elasticity	≥5 GPa.
Quantity of fibers	Maximum 5 Kg/ M^3 (E700) Maximum 7 Kg/M^3 (E1000) (Subject to mix design/field trials)

iii. Mixing procedure adopted by the contractor should be such that there is no fiber balling.

iv. Storage: Fibers shall be stored, handled and dosed in accordance with the manufacturer's recommendations. Generally, this will require them to be stored in dry, sealed containers until ready for use and shall be free from oil, grease, chlorides and deleterious materials which may reduce the efficiency of mixing or spraying processes, or which may reduce bond between the fibers and the shotcrete.

11.6.5 Air used for spraying shotcrete shall be clean and free of oil.

11.6.6 Water used for mixing shall comply with IS-456. Water to cement ratio shall be less than 0.43.

11.6.7 Admixtures: Admixtures conforming to IS:9103 shall be used to develop quick set and high early strength, to ensure good workability, low pumping pressure, adequate slump retention and low rebound as approved by the Engineer, conforming to the requirements of the relevant standards. The proportion of admixtures shall be kept less than 10-12% of the weight of cement or as determined by testing prior to any shotcrete work.

i. General

A. Technical criteria, approved documentation, test reports and test certificates shall be furnished to the ENGINEER for approval.

B. Admixtures shall be stored under the conditions specified and recommended by the manufacturers. The related storage Specifications and recommendations shall be presented to the ENGINEER before approval of such admixtures.

C. The manufacturer's safety instructions shall be observed Admixtures shall be free of chlorides such that the percentage of chlorides shall not exceed 0.1% by weight.

D. The required characteristic values and consistency of delivery to the site shall be agreed in writing with the manufacturer of each admixture before commencement of concrete spraying.

E. Written confirmation of the stability of admixtures with the mix water shall be provided prior to commencement of site trials.

F. The content of SO3 shall not exceed 4.8% by weight of total binder content.

ii. Accelerators

A. Accelerators are used to produce a fast set and to get sufficient early strength development. Accelerating admixtures shall be compatible with the cement used. The compatibility shall be tested in the laboratory by the Manufacturer and verified by the CONTRACTOR in field suitability tests to achieve the required properties for early and final strength.

B. The accelerator must mix with the concrete in the nozzle and begin the hardening immediately after the concrete hits the rock.

C. Only liquid alkali-free accelerators (pH 2.0 to 8.0 and having alkali content less than 1% by weight Na_2O equivalent) shall be used. Additives based on Lingo sulphates (P agents) shall not be used due to retarding and reduced early strength.

D. The accelerators shall be added at the nozzle and only the minimum quantity of accelerator necessary shall be permitted in normal concrete spraying operations. The quantity shall be determined by site trials, subject to maximum dosage of 7% by weight of cementitious materials. Higher dosages of upto 8% accelerator can be considered subject to establishing the effect of the dosage rate on the medium and long-term strength development on the in-situ concrete. At no stage in the strength development should the strength of the accelerated mix drop below 0.7 times the strength of the unaccelerated concrete mix.

E. Testing of accelerators and the base mix with respect to acceleration of setting, early strength and decrease of strength at a later age (28 days), shall take place in due time before commencement of concrete spraying.

F. Laboratory testing of the selected type(s) of accelerator shall be carried out at dosages as recommended by the manufacturer, to establish the variability of the above properties with dosage. Accelerators showing excessive variability with dosage will not be permitted.

G. Accelerators shall be selected so that, at the dosage chosen for use in the Works, the characteristic compressive strength of any shotcrete at an age of 28 days can be achieved. Compliance with this clause shall be demonstrated by site trials.

H. Accelerators delivered to site shall be tested at least once every two months for their reaction with the Portland cement used, with particular reference to the setting behavior and strength decrease after 28 days. The stability of accelerators during storage shall be visually inspected at similar intervals. Storage times and working temperature ranges shall be in accordance with the manufacturer's recommendations. The manufacturer's safety instructions shall be observed.

iii. Super Plasticizers and retarders

A. Used to reduce the quantity of the mixing water and to improve the pumpability of the concrete. The effects and optimum dosages shall be determined by site trials.

B. The above-mentioned desired properties shall only be attained through superplasticizers.

C. Shall be added at the batching plant to keep the shotcrete mix workable during transportation and to ensure good pumpability to an acceptable low water cement ratio.

D. The influence of the superplasticizers and retarders within the concrete mix shall be checked regularly for setting time, water reduction, and development of strength. These values shall be compared with the results from the pre-commencement trials.

E. Compatibility of superplasticizers and retarders with Portland cements, latent hydraulic binders and accelerators shall be verified by observation and site trials. Traditional retarders shall not be allowed.

iv. Hydration control admixtures

A. Hydration control admixtures may be used to control the hydration of the mix as appropriate to expedite construction of the Works. The effects and optimum dosages of hydration control admixtures shall be determined by site trials.

B. Compatibility of hydration control admixtures with Portland cements, latent hydraulic binders and accelerators shall be verified by observation and site trials. Hydration control admixtures shall be used in accordance with the manufacturer's instructions.

11.6.8 Additives: Micro-silica or silica fume

i. Micro-Silica or Silica fume shall conform to ASTM C1240 / IS-15388. Contractor shall submit MTC from original manufacturer. Manufacturer shall furnish evidence of factory production control systems.

ii. The performance of the shotcrete mix with optimum dosage of additives shall be determined by field suitability tests. Testing of Silica fume shall be carried out by contractor before or anytime during its usage at discretion of engineer.

iii. Micro Silica/ Silica fumes shall have a bulk density between 600-700 kg/m3. Micro Silica/ Silica fumes shall be added in the mix at the batching plant facilitating the mixing and distribution of fibers to reduce fiber rebound and improve bond between cement matrix and fibers. Dosage of Micro Silica/ Silica fumes shall be as per Mix design subject to minimum 15 Kg per cum of shotcrete mix.

11.6.9 Curing agents

i. External curing agents and internal curing admixtures shall be allowed to maximize hydration of the cement by reducing uncontrolled water evaporation.

ii. The curing agent selected should not affect the bond of further layers/coatings or be easy to remove. Solvent based curing agents should be avoided

iii. External curing agents are sprayed onto the surface of the shotcrete shortly after it has been applied. When set accelerators are used, an external curing agent should be applied within 15 minutes after the end of spraying. When no accelerators are used it should be applied within 30 minutes.

iv. Internal curing admixtures are special admixtures added to the mix (see 4.6). Compatibility of curing agents with cements, hydraulic binders, accelerators and other admixtures should be verified in site trials. Particular care must be taken to ensure adequate mixing when used in the dry-mix process.

11.7 MIX DESIGN AND PROPORTIONING

11.7.1 The type of shotcrete to be used in a particular location shall be as per drawings and as directed by the Engineer.

11.7.2 The mix proportions of cement, aggregates, and permitted admixtures in each class shall be determined by the Contractor satisfying the requirements given in Table no. 1 below and shall be subject to the approval of the Engineer. The mixes shall be such as to permit placement without excessive rebound and segregation.

Table-1

28-day Characteristic compressive strength of Cylindrical cores (after applying a factor of 0.85 for In-	**Aggregate size/grading**	**Cementations content, (C) kg/M^3**	**Water cement ratio**

Situ coring effects)			
30 MPa (Average of 4 consecutive non-overlapping tests)	Size grading: $D_{max} \leqslant 10$ mm, Aggregate flattening coefficient ⩽20.	Refer para 11.6.2	⩽0.43

11.7.3 The water content of the mixes shall be limited to prevent sloughing. The water: cement ratio of fresh shotcrete in place shall be less than 0.43.

11.7.4 Slump of mix shall be kept less than 200mm, as high value of slump will affect fiber distribution in the shotcrete.

11.7.5 The Mixes shall be such that aggregate gradation and cement content after placing are as those obtained from samples taken from test panels produced from approved trial mixes. All constituents shall be uniformly dispersed throughout the mix.

11.7.6 Proportioning of aggregates and cement shall be only by weigh batching.

11.7.7 Moisture content of the combined aggregate at the time of mixing with cement shall not exceed 6 % (Six percent) by weight of the over dry aggregate.

11.7.8 Mixed material shall be used within 90 minutes after addition of water to cement. This period may be extended by the use of hydration control admixtures, subject to the approval of engineer.

11.7.9 The addition of fibers shall be at a stage in the mixing suitable for the sprayed concreting equipment. Fibers shall be added and mixed in a manner to avoid clumping and bending of fibers. Any fiber clumps in the mix shall be diverted and removed by means of a screen placed over the shotcrete hopper. Fibers shall be uniformly distributed throughout the mortar matrix without isolated concentrations.

11.7.10 Approved mix proportions may have to be varied, during execution stage, to obtain required strength of shotcrete, to maintain rebound to the minimum and to meet other requirements of Contract. The Contractor shall notify to the Engineer of all variations to the mixes.

11.7.11 The Contractor shall carry out all field tests before hand and then propose mix design for shotcrete to meet the requirements of the specifications for prior approval of the Engineer. The quantities of super plasticizers may be adjusted to compensate the slump loss because of fiber. The mix design shall provide the following details for one cubic meter of Shotcrete.

- **A.** Ordinary Portland Cement Kg
- **B.** Microsilica Kg
- **C.** W/C Ratio
- **D.** Aggregate
  - **a.** Natural fine aggregate Size Kg
  - **b.** Natural coarse aggregate Size Kg
  - **c.** Crushed fine aggregate Size Kg
  - **d.** Crushed coarse aggregate Size Kg
- **E.** Super Plasticizer Agent Kg
- **F.** Retarder or Stabiiser Kg
- **G.** Internal curing Kg
- **H.** Pumpability iimprover Kg
- **I.** Alkali free Accelerator Kg
- **J.** Fibre (Aspec Ratio/Length) Kg
- **K.** Slump mm
- **L.** Density (Wet) Kg/cum

11.8 Equipment

11.8.1 Details of all equipment to be used shall be made available to the Engineer prior to commencement of site trials.

11.8.2 The equipment selected and approved by the Engineer will be capable of maintaining the ratio of concrete and accelerator as selected from the trials and approved by the Engineer. The actual ratio of accelerator to concrete selected shall be identified at the nozzle andtake into account the filling efficiency of the equipment and the efficiency of the accelerator dosage equipment to overcome the air and concrete pressure at the nozzle while spraying at typical outputs and air flows. ***Contractor shall provide shotcrete machine data in digital formatafter every cycle whenever required by Engineer.***

11.8.3 Equipment shall be thoroughly cleaned at least once per shift. The spray nozzle shall be checked for wear and where necessary replaced.

11.8.4 Transport pipes consisting of hoses and pipes shall be designed to convey the concrete efficiently and without leakage or blockage. The transport pipes shall have uniform diameter appropriate to the mix characteristics determined by site trials and be free of any dents or kinks between the shotcrete machine and the nozzle.

11.8.5 Working area for sprayed concreting shall be well illuminated and ventilated. Dust pollution shall be minimized by choice of appropriate equipment and by means of additional ventilation, water sprays, and by maintaining equipment in good order. Protective clothing and dust masks shall be provided for and used by all persons present during spraying.

11.8.6 The equipment shall allow for air and water in any combination to be available for preparation of surfaces and/or cleaning of finished work.

11.8.7 **Recipe of mix shall be entered into PLC control prior to spraying.**

11.8.8 A boom mounting or similar device shall be provided for the spray nozzle unless it can be demonstrated to the Engineer that the use of such equipment is impractical.

11.8.9 In particular, the spray nozzle shall be kept as perpendicular as possible to the surface and care shall be taken to achieve a regular properly compacted coating of the correct thickness.

11.8.10 The shotcrete shall emerge from the nozzle in a steady uninterrupted flow. Should the flow become intermittent for any cause, the nozzleman shall direct it away from the work until it again becomes constant.

11.8.11 The thickness and position of the shotcrete shall be defined by screed boards, lattice arches, guide wires, depth pins, lasers or other means.

11.8.12 The site trials shall employ the equipment which will be used in the Works and the constituent materials shall be fully representative of those to be used in the Works. A clean, dry mixer shall be used, and the first batch discarded.

11.8.13 The equipment proposed for the application of concrete in the Works shall be used for the trial. The trial will establish whether the selected equipment is capable of efficiently mixing concrete, accelerator and air at the nozzle, and be capable of positioning the nozzle at a suitable distance and orientation to the surface geometry of the structure to which the concrete is to be applied.

11.8.14 During the trials the Contractor will establish the volume of air required to give adequate compaction of the material using the nozzle and conveyance lines selected for the Works. If the delivery equipment or nozzles are to be changed during the course of the works, the volume of air required will need to be verified again. The equipment will be maintained adequately, to ensure that the required volume of air can be maintained while spraying. Air pressure can only be used as a control if the air delivery system is not altered from the original verification trial. No additional taps or

restrictions will be permitted to be added into the system without repeating the verification trials.

11.8.15 The static compressed air capacity measured at the shotcrete pump shall be according to the manufacturer's recommendations and generally as per EFNARC guidelines G 8.3.2 for wet process and G 8.3.3 for dry process.

11.9 QUAITY CONTROL AND TESTING

11.9.1 The Contractor shall enable the Engineer access to the shotcrete Works at all times and shall allow the Engineer access to inspect the excavated ground surface prior to spraying if requested.

11.9.2 The quality control and testing of shotcrete (Plain and SFR) shall be carried out by the contractor in the presence of Engineer. Tests for Field suitability (to determine mix design) and In-situ suitability (to control quality) shall be carried out separately. Field suitability tests shall be carried out on minimum three test panels for initial establishment of suitable range of accelerator/superplasticizer dosage (All types of Shotcrete), and fibre content of hardened concrete and Energy absorption class (SFR) for the required strength of shotcrete mix. The pressure at which the shotcrete shall be applied to the test panels shall be the same as will be used in actual works at the place of application. Mechanical rebound hammers shall not be used to obtain indirect compressive strength of shotcrete.

A. Control of Fresh shotcrete:

a. Water/Cement ratio: Daily by calculation or test method.

b. Aggregate gradation: Weekly by standard sieving.

c. Accelerator/Superplasticizer: Daily through record of quantity added.

d. Slump: For Each batch separately, measured any time during application, at the pump and should conform within 25mm of the target slump range established earlier and approved by engineer.

e. Fibre content: For fresh shotcrete, one test every 100cum or 500m^2 (Whichever achieved first) of shotcrete applied in accordance with EN 14488-7. For hardened shotcrete, testing shall be done when testing energy abortion capacity.

f. Early (0-24hrs) strength development: Strength results shall conform to Class J2 as per EN-144887-1 unless specified otherwise in the design drawings. In-situ test shall be carried out every 250m^2 of shotcrete applied subject to minimum 2 test per month in accordance with EN 14488-2 (Strength up to 1.0 N/mm^2 shall be determined by Penetrometer and in the range between 1.0 and 16 N/mm^2shall be determined using the HILTI shot bolt method).

B. Control of hardened shotcrete:

a. In-situ strength shall be carried out on shotcrete applied at the tunnel face and shall be determined by crushing of cylindrical shotcrete specimens. Samples shall be collected with core drilling equipment from In-situ shotcrete applied on tunnel wall/or from test panels as the case may be, after lapse of 1 day. Cores for strength testing shall be obtained from random locations. The cores will be visually inspected and the dimensions and comments regarding the quality of the cores will be recorded. The cores will be free from lamination. No sets of cores to be tested at any given age shall come from the same panel/In-situ location. Sets of cores to be tested at different age may come from the same panel/In-situ location. For each test at least one spare specimen shall be provided. The cores for determination of strength

shall be cured in temperature-controlled water until 3 days before further testing. The specimens shall have a diameter of 100mm and be cut to a height of 100mm. Where the nominal required shotcrete thickness is less than 100 mm, the cores for the compressive strength testing shall be taken from areas where the actual thickness is greater than 100 mm. Alternatively additional shotcrete thickness shall be applied in selected areas agreed by the Engineer for subsequent coring of test specimens.

b. Further (1-7days) Strength Development: Average strength of 3 cores tested at 3 days and 7 days each shall exceed 12.5MPa and 70% of 28-day strength requirements respectively. The ENGINEER may also require the drilling of cores from the test panels perpendicular to the spraying direction.

c. Final strength: 3 cores shall be further tested at 28th day and at completion of 6 month each and the 28-day strength obtained shall exceed 28-day strength requirementsmentioned in Table-1 at 11.7.2. Strength results at 6 months shall not be less than 28-day results.

d. Energy absorption class for Fibre Reinforced Shotcrete: Field suitability tests shall be conducted to ascertain the fiber content required for different energy absorption classes. One test every 100cum or 500m^2 (Whichever achieved first) of shotcrete applied in accordance with EN 14488-5. Two classes are required to be designed i.e. E700 and E1000. The design shall be considered satisfactory when each test result exceeds the required energy absorption value by a margin of 5% or more. Fibre content of hardened concrete shall also be measured in accordance with EN 14488-7. ***These tests shall be performed on site in contractor's field laboratory setup for this purpose.*** No extra cost on account of testing shall be payable to the contractor.

C. Shotcrete thickness: In addition to recording tunnel wall profile before and after shotcrete by tunnel profiler etc., the contractor will be required to undertake confirmatory shotcrete thickness testing of the in-situ tunnel lining. The basic test shall consist of 4 nos. drill holes drilled on a 1m^2 pattern. The average thickness of the 4 holes shall exceed the specified design thickness. If not, the ENGINEER shall propose remedial measures and/or further drill testing. All such drill holes shall be subsequently filled back by Non shrink mortar. Nothing extra shall be paid on this account.

D. Bond Strength

Bond strength of shotcrete shall be tested every 1250m^2 (in case of Ground strengthening) or min 3 tests (in other cases) of the shotcrete applied in accordance to EN 14488-4. Bond strength between plain shotcrete and fiber reinforced shotcrete shall also be established.

E. Contractor shall keep at site various testing tools like Penetrometer, HILTI shot bolt, Shotcrete core cutter, Test panels etc. along with all spares required as per standards and specification mentioned above. The frequency of testing, test type or the testing method will not be altered without approval of Engineer. Shotcrete from both the field suitability test panels and the In-situ quality control shall be tested by the Contractor in the presence of Engineer. Engineer may ask contractor to undertake further tests for examination purposes.

11.9.3 Dimension, tolerances and sampling of fibers shall be in accordance with EN 14889-2. Criterion for Tensile strength, Ductility and Modulus of Elasticity have been specified earlier. Furnishing evidence of manufacturer's factory production control system meeting requirements of EN 14889-2 and EN ISO 9000 shall be mandatory and sufficient for QC of fiber, however the contractor shall be ready to demonstrate the

same by carrying out initial type tests (EN 14889-2) in approved laboratories as required by engineer before or anytime during usage. No payments for conducting these tests shall be made by the employer.

11.9.4 The Contractor shall propose to and agree with the Engineer trial mixes for the works at least 56 days before their commencement. Tunneling shall not be permitted to start until the Field suitability tests have been approved by the Engineer.

11.9.5 The site trials shall be repeated if the source or quality of any of the materials, mix proportions or placing equipment is to be changed during the course of the Works.

11.9.6 Where shotcrete does not comply with the required strength, the Contractor shall execute remedial work which may involve additional shotcrete or replacement in sections where it is safe to do so. The Contractor shall take into account any limits placed on the tunnel profile dimensions resulting from the Specification. The Contractor shall submit to the Engineer for agreement, a method statement, specification and calculations for remedial work. The Engineer shall, in the event of repeated failure in Quality Control, require the Contractor to adjust the mix to achieve the required strength.

11.9.7 The Contractor shall keep a record in a form to be agreed with the Engineer of all tests on shotcrete, which shall be kept on site identifying the tests with the section of work to which they relate.

11.10 PROFICIENCY OF WORKMEN

11.10.1 Nozzle men shall have had sufficient previous experience in the application of shotcrete or shall work under the immediate supervision of foreman or instructor having such experience.

11.10.2 Each crew shall demonstrate acceptable proficiency in the application of shotcrete to trial areas before being employed on the Works to the agreement of the Engineer.

11.10.3 Subject to the Engineer's agreement, tests for proficiency may be combined with trial mix tests.

11.10.4 **Contractor shall be bound to arrange 2 visits (First visit within a month of start of shotcrete work and second visit after next 6 months) of an expert nozzlemen who has successfully completed EFNARC Nozzleman Certification course in last 5 years at no extra cost to the employer.Each visit shall be arranged for atleast 3-4 days giving prior intimation to the engineer. The EFNARC certified personnel will check the application of shotcrete and it's quality according to EFNARC guidelines and guide the existing nozzlemen for required improvements to the satisfaction of Engineer.**

11.11 PLACING OF SHOTCRETE

11.11.1 Rock or previously applied shotcrete surfaces to be shotcrete shall be carefully cleaned of all loose material, scale and other contaminations. It may be necessary to use compressed air and a water jet. The surface to receive shotcrete shall be damp but shall not exhibit free water.

11.11.2 Where groundwater flow could interfere with the application of shotcrete or cause reduction in the quality of shotcrete the Contractor shall take all action necessary to control groundwater. Such action shall include the channeling of water by means of pipes and chases.

11.11.3 The optimum distance between nozzle and surface of application is 1.5 to 2.0 meter. The nozzle shall be positioned at right angles to the surface of application.

11.11.4 For vertical and near-vertical surfaces application shall commence at the bottom and the leading edge of the work shall be maintained at a slope. Downward spraying shall be avoided where possible. The nozzle may be inclined sufficiently to ensure reinforcement is properly embedded.

11.11.5 If the design thickness must be applied in more than one layer, then the previous layer must have developed sufficient strength to support the additional layer(s). Lattice girders, roof ties, wire mesh and other reinforcement shall be embedded in shotcrete as shown on the drawings. The minimum cover of wire mesh and re-bars applied at the inner side of a tunnel lining shall be 2 cm or as shown on the drawings.

11.11.6 Prior to continuation of spraying from a joint or leading-edge position or in any other circumstances where shotcrete has hardened beyond its initial set, loose material shall be removed by jetting with a compressed air lance. Any laitance which has been allowed to take final set shall be removed and cleaned by jetting with air and water.

11.11.7 If more than one layer of reinforcement is used, the second layer shall not be positioned before the first one is embedded and covered with shotcrete. Exemptions are to be approved by the ENGINEER.

11.11.8 The temperature of the mix before placing shall not be below 15^0C and shall not exceed 35^0C unless special provisions are made. Spraying shall not be undertaken when ambient temperature is below 15^0C unless special measures can be taken to provide protection against frost until the shotcrete has developed a compressive strength of at least 5 MPa.

11.11.9 A system of delivery notes shall be maintained to record the date, the time of mixing, mix design number, quantity, delivery point, time of delivery and completion of placing. The delivery notes shall be available to the ENGINEER for inspection.

11.11.10 **Deleted.**

11.11.11 Rebound shall be removed immediately after finishing of each shotcrete application. In particular at horizontal shotcrete connections due to separate excavation sequences and at all construction joints the rebound shall be removed, if necessary, by pneumatic hammers, prior to further application of shotcrete.

11.11.12 Under no circumstances rebound material shall be worked back into the construction. The work shall be continuously kept free of rebound material.

11.11.13 Measures to establish the thickness of shotcrete shall be set up by the CONTRACTOR and approved by the ENGINEER. These may include visual guides installed prior to shotcrete, holes drilled after completion of shotcrete or a full control by laser scanning.

11.11.14 Shotcrete shall be left in its natural finish without further working except as required to trim excess thickness where the shotcrete shall be allowed to stiffen sufficiently before being trimmed with an approved cutting screed.

11.11.15 If deemed necessary by the ENGINEER, curing of the shotcrete shall be performed by water spraying or other appropriate measures subject to the approval of the ENGINEER in the first 48 hours after application.

11.11.16 Major ground water seepages shall be drained off or sealed off by grouting prior to spraying or after application of a first sealing layer.

11.11.17 Nozzle men shall be trained in the correct application of shotcrete.

11.11.18 Full personal protection equipment to protect the nozzle man from eye and skin contact and inhalation of shotcrete and/or admixtures shall be provided. The admixture manufacturer's precautions and actions for accidental contact shall be provided and adhered to.

11.11.19 Construction joints or stop joints shall be provided, as directed by the Engineer and shall be sloped at 45^0 to the adjacent shotcrete surface in a clean, regular edge.

Before placing the adjoining work, the sloped portion and adjacent shotcrete shall be prepared as specified in clauses above.

11.11.20 Before a succeeding layer of shotcrete is placed, the preceding layer shall be checked for defects. Areas of work shall be properly compacted and bonded and free from honeycombing, laminations, dry or sandy patches, voids, sagged or slumped material, rebound, excessive cracking and overspray.

11.11.21 Where defects occur, the Contractor shall agree with the Engineer proposals for the removal of the defective material and replacement by material without defect and the area to be replaced shall in any event be not less than 300mmx300mm at such locations.

11.11.22 Gloves and necessary protective clothing shall be worn to protect against dermatitis.

11.12 DELETED

11.13 MEASUREMENT AND PAYMENT

11.13.1 FOR SURFACE WORKS (SLOPES):

Measurement for payment for shotcrete shall be made for the theoretical volume in cum of the shotcrete placed as indicated in drawing or as directed by the Engineer and shall be paid as per relevant item in the Bill of Quantities (BOQ).

11.13.2 FOR THE PRIMARY LINING OF THE TUNNEL:

The installation of Primary Shotcrete lining shall be regulated as per clause 8.5.2.

The cavity or void created due to excavation including overbreak shall be filled by placing of shotcrete of the theoretical thickness or upto the intrados of the primary shotcrete lining as shown on the drawings according to Support Section Type as described in the following:

A. **In case of Geological Overbreak only**: Shotcrete / Concrete / Grout installation for volume of void or cavity beyond “A” Line resulting from Geological overbreak will be paid at full rates of relevant item of BOQ as per section 11.13.3 below.

B. **In case of support classes with shotcrete and bolts only (no lattice girders and/or steel ribs)** the theoretical thickness shall be applied directly on the excavated profile irrespective of the “A” line. Payment of shotcrete to be done for the theoretical quantity only, according to the design drawings. Additional fixed quantity of Shotcrete shall be paid as compensation for filling of the undulating excavated profile. This fixed quantity will be computed by multiplying the theoretical surface area at “A” Line by 75mm. Shotcrete applied for Primary Lining including above compensations shall be paid under primary lining item in the Bill of Quantities (BOQ).

C. **In case of rock support classes with Lattice girders and/or steel ribs**, the measurement and payment for shotcrete installed within “A” line only shall be done at full rates for volume computed according to design thickness multiplied by the “A” line surface area as specified in drawings. Additional fixed quantity of Shotcrete shall be paid as compensation for filling of the undulating

excavated profile. This fixed quantity will be computed by multiplying the theoretical surface area at "A" Line by 75mm. Shotcrete applied for Primary Lining including above compensations shall be paid under primary lining item in the Bill of Quantities (BOQ).

D. **In case of any rock support classes with Pipe Roofing:** For measurement and payment refer to the Clause 11.13.5

For face sealing and for widening of top heading footings, the quantities of shotcrete shall be measured by the unit of cubic meters of shotcrete placed as shown on the drawings or as directed by the Engineer and paid in accordance with the Unit Rate quoted in the Bill of Quantities.

The excavated profile and finished profile of shotcrete shall be checked with tunnel Profilers. The profiling sections shall be performed at the locations of the steel ribs and lattice girders in the case of the corresponding rock support classes or as directed by the Engineer

11.13.3 GEOLOGICAL OVERBREAK:

The cavity or void formed by Geological Overbreak shall be measured in-situ and shall be quantified and approved by the Engineer. Payment shall be made for the filling of Geological Overbreak with shotcrete/ Concrete/Grout in accordance with the Unit Rate quoted in the Bill of Quantities.

The theoretical volume of shotcrete/concrete/grout filled in between 'A Line" and "Z Line" bound within the radial projection of GOB profile and as approved by the Engineer, will also be measured and paid

11.13.4 Pay line in case of forepoles will be as defined in Para 8.22.1(ii)(O). Where forepoling is required, no payment for the additional shotcrete placed in the overbreak will be made, i.e. the costs for the additional shotcrete shall deemed to be included in the primary shotcrete lining rates quoted by the contractor.

11.13.5 For Support Section Type where Pipe roof is required, "Pay" line will be as defined in Para 8.22.1(ii)(P). Remuneration for excavation and Backfill below "A" Line shall be made as per Relevant Item of BOQ for excavation and Support installation. The measurement and payment will be made in theoretical quantities only according to design drawings, without the additional compensation of 75 mm.

Remuneration for filling of triangular void between two successive rounds of Pipe Roofing with Shotcrete/ Concrete as per the design drawings and /or as per the instructions of the Engineer shall be made as per Relevant Item of BOQ. Remuneration of Over Break and it's backfill between the Pipe roof shall be included in the rates of Items for excavation and Support installation.

11.13.6 Payment will be made at the Unit Rates quoted in the Schedule of Item Rate, which shall include the entire cost of but not be limited to the following:

i. Volume of shotcrete as defined in Clause 11.13.1, 11.13.2,11.13.3, 11.13.4 & 11.13.5 above.

ii. All labour, plant and material (**includingcement, aggregates, micro-silica/silica fume, accelerator, admixtures/additives etc**.) along with all the associated

material testing to the required specifications. The quantity of materials shall be as per approved Mix design subject to minimum requirements given in the specifications.

iii. Storage, batching and mixing of all materials, water supply, preparation and cleaning of surfaces.

iv. Placing of plug gauges for control of layer's thickness.

v. Placing of shotcrete and removal of rebound.

vi. Temporary protection and curing.

vii. Making test panels and conducting tests (including equipment cost) required for design and quality assurances.

11.13.7 DELETED.

11.13.8 Payment for **wiremesh, fibers** shall be done separately as per respective BOQ items. Nothing extra shall be paid for Accelerators, super plasticizers, Silica fume/Micro silica or any other additive other material used in mix design.

11.13.9 Exclusions

i. No extra measurement for payment or payment will be made for the following:

A. Removing the defective shotcrete, carrying out surface preparation and reapplication of shotcrete in the area where the shotcrete has been found to be faulty by the Engineer.

B. Any replacement or repair or shotcrete damaged by blasting carried out by the contractor.

C. Taking out of cores from the finished shotcrete and filling the core holes with dry pack mortar.

D. Shotcrete placed by the Contractor in excess of the thickness shown on the drawings or at locations other than those shown on the drawings.

E. Additional shotcrete required for correction of Irregularities of the shotcrete lining surface as per the requirements of the water proofing membrane installation given in clause 4.4.3 (ix) (A).

SUB CHAPTER -12

12.0 STEEL FOR REINFORCEMENT

12.1 SCOPE OF WORK

12.1.1 The specifications described hereunder relate to the work which includes all labour, materials, equipment and services required for the supply, handling storing, cutting, bending, cleaning, placing and fastening into position all reinforcing steel, as shown on the drawings, to be carried out by the Contractor under the Contract.

12.2 SUBMITTALS

12.2.1 Within 4 (four) weeks from the commencement date but before procuring or mobilization to site, the equipment, the contractor shall submit to the Engineer, the description and drawings showing sufficient details of the layout type and capacity of the equipment proposed for the fabrication of reinforcing steel.

12.2.2 At least 4 (four) weeks in advance of the reinforced concrete works being carried out on the site, the contractor shall submit to the Engineer for approval, detailed bar list and bending diagrams showing the number, size, length and bending of all bars required for various parts of the work on the basis of the reinforcement drawings issued by the Engineer from time to time during the progress of works.

12.2.3 The Engineer reserves the right to require any additional information deemed necessary to be included in the submitted documents.

12.3 STANDARDS

12.3.1 The cutting, welding, placement and binding of reinforcing steel shall conform to following latest Indian Standards or, where not covered by these Standards, to their equivalent International Standards.

- **i.** IS: 456 Code of Practice for Plain & Reinforced concrete.
- **ii.** IS: 1786 Specification for High strength deformed steel bars and wire for concrete reinforcement.
- **iii.** IS: 2502 Code of Practice for Bending and Fixing of Bars for concrete Reinforcement.
- **iv.** IS: 2751 Code of Practice for welding of mild steel Plain & Deformed Bars for Reinforced concrete construction.
- **v.** IS: 9417 Recommendation for welding cold worked bars for Reinforced concrete construction.

12.3.2 In case of conflict between the above Standards and the Specifications given herein, the Specifications shall take precedence.

12.4 GENERAL

12.4.1 Steel for reinforcement shall conform to the Standards and requirement outlined in Section of ‘Materials for Construction’ of these documents.

12.4.2 Cutting, bending, cleaning, placing and fastening in position of the reinforcement steel shall conform to the requirements of requirements of relevant Indian Standards and as shown on the drawings.

12.4.3 Transportation and storage of reinforcing steel shall conform to the requirements of Section of ‘Materials for Construction’ of these documents.

12.5 FABRICATION

12.5.1 All bars shall be cut and bent in accordance with the bar bending schedules approved by the Engineer.

12.5.2 Reinforcing steel bars shall be cut and bent on the Site of the Works.

12.5.3 Reinforcing steel shall not be straightened or re-bent in a manner that will damage the materials. Bars with kinks or bends other than those indicated on the drawings and schedules shall not be used.

12.5.4 Shorter length of steel shall not be used in place where continuous lengths are required as per the drawings without the approval of the Engineer. Shorter bars, if approved for use, shall be lapped or spliced to achieve continuity in accordance with the requirements of relevant Indian Standards or as approved by the Engineer.

12.5.5 Bars shall be bent cold to the shape and dimensions shown on the drawings using a bar bender operated by hand or power to attain the proper radii of bends.

12.5.6 A hook at the end of the MS bar, if used, shall have an inner diameter not less than four times the diameter of the bar and shall have length of straight part beyond the curve of the least four times the diameter of the bar, Hooks shall be used only where shown on drawings or as required by the Engineer.

12.5.7 Heating of reinforcement bars to facilitate bending shall not be permitted.

12.5.8 The reinforcement available from rejected reinforced concrete shall not be used without prior approval of the Engineer.

12.5.9 The radii of bends for stirrups and ties shall not be less than twice the diameter of the bar.

12.6 PLACING

12.6.1 Before being placed in position, the reinforcing steel shall be thoroughly cleaned of loose mill scale and rust, grease, paint, or other coatings that would reduce bond. All splashed concrete, which has dried on reinforcing steel, shall be removed.

12.6.2 Reinforcing steel to be incorporated in the works shall be placed accurately in positions as shown on the drawings and shall be held firmly in place during the placing and setting of the concrete.

12.6.3 Reinforcing steel shall be so placed that there will be a clear distance of at least 50 mm between the reinforcing steel and anchor bolts or embedded metal work.

12.6.4 Reinforcing steel shall be maintained in position by the use of small concrete blocks, steel chairs, steel spacer, steel hangers and other steel supports and ties, acceptable to the Engineer at sufficiently close intervals so that they do not either sag between supports or be displaced during placing of concrete or by any operation on the work. Wood supports or spreaders shall not be used. All intersection shall be securely tied except that where the bar spacing is less than 300 mm in each direction, only alternate intersections need be tied.

12.6.5 Binding wire and steel chairs shall not be carried to permanently exposed surface and shall be subject to the same requirements with regard to concrete cover as for the reinforcing steel.

12.6.6 Special care shall be exercised to prevent any disturbances of the reinforcement in concrete that has already been placed. The reinforcement after being placed in position shall be maintained in a clean condition until it is completely embedded in concrete.

12.6.7 The longitudinal bars shall be straight and fixed parallel to each other and to the sides of the form as shown on the drawings. The ties, links and stirrups connected to the bars shall be lightly fixed so that the bars are properly braced. The inside of their curved part shall be in actual contact with the bars around which they are fixed, and their position shall be exact as shown on the drawings.

12.6.8 Wire for tying reinforcement shall be black annealed iron wire. The diameter of wire shall be adequate and shall an ultimate strength of 5.63 tonne/cm^2 and yield point of not less than 3.87 tones/cm^2.

12.6.9 Reinforcement for lining in underground cavities and other locations may be fixed by means of anchor rod or supporting and hanger rods as approved by the Engineer. In difficult locations, tack welding of bars at isolated spots may be permitted to keep these bars in position provided that diameter of the bars is not reduced adjacent to the weld.

12.6.10 The steel bars shall be joined by providing lap joints in accordance with the requirements of the relevant Indian Standards or as approved by the Engineer. “Bar-Grip” type joints may also be adopted by the Contractor for deformed bars of 25 mm diameter and above, subject to the approval of the Engineer. Splices at points of maximum stress shall, however, be avoided. Splices in adjacent bars shall be staggered as directed by the Engineer. Lap length of bars shall be as shown on the drawings. This length may be changed by the Engineer in special locations.

12.6.11 Sufficient concrete cover, as indicated on the drawings shall be provided to protect reinforcement from corrosion. All protruding bars from concrete to which other bars are to be attached and which shall be exposed to action of the weather for long period shall be protected from rusting by thin coat of neat cement grout. Accurate record shall be kept at all the times of the number, sizes, and lengths and weights of bars placed in position different parts of the work.

12.6.12 Where reinforcement bars are bent aside at construction joints and afterwards bent back into their original positions, care shall be taken to ensure that at no time is the radius of the bend less than 4 bar diameter for plain mild steel or 6 bardiameters for deformed bars. Care shall also be taken when bending back bars, to ensure that the concrete around the bar is not damaged.

12.7 WELDING FOR REINFORCEMENT

12.7.1 Lap splices shall not be used for bars larger than 36 mm Ø, which may be welded with the approval of the Engineer. In case where welding is not practicable, lapping of bars larger than 36 mm may be permitted, in which case, additional spirals shall be provided around the lapped bars. Where welding is approved, the Contractor shall prepare at least three samples of butt welds as directed by the Engineer may allow welding in place of lap joints. The decision of the Engineer in this regard shall be final. The joints shall be butt welded by the electric arc method. Cleaning of all loose scale, rust, grease, or other foreign materials and all welding shall conform to the relevant Standard Specifications for welding of reinforcement bars used in reinforced concrete construction or as directed by the Engineer.

12.7.2 A weld shall be considered unsatisfactory if it fails to sustain a tensile stress of at least 90 % of the tensile strength of the bar in which the weld has been made.

12.8 TOLERANCE FOR PLACING REINFORCING STEEL

12.8.1 Unless otherwise required by the Engineer, reinforcement shall be placed within the following tolerances.

i. For effective depth of 200 mm or less (±) 10 mm

ii. For effective depth more than 200 mm (±) 15 mm

12.8.2 The cover shall, in no case, be reduced by more than ⅓ specified cover or 5 mm whichever is less.

12.9 MEASUREMENT AND PAYMENT

12.9.1 Measurement for reinforcing bars will be of the weight of reinforcement steel including hooks and bends actually installed and approved by the Engineer. Actual lengths of reinforcement bars including permissible hooks, bends and splices will be measured. The weight of reinforcing bars will then be calculated for each size of bar from the Unit weights as specified in the relevant IS: 1732 (No payment on account of weight variation shall be made).

Wastages, overlaps (splice), coupling, welded joints, space bars, chairs and binding wire shall not be measured and cost of these items shall be deemed to be included in the rates.

12.9.2 Before starting concreting, the contractor shall make sure that the measurements of reinforcing bars placed in position have been recorded and that the Engineer has certified the correctness of the reinforcement used.

12.9.3 Payment shall include the entire cost of supply, handling, storage, cutting, bending, placing, wire clips, ties, separators and any other fastening devices.

12.9.4 Payment for steel reinforcement in all RCC works shall be paid at the unit price per MT as per schedule of item rates.

12.9.5 DELETED

12.9.6 No extra measurement for payment will be made for the following:

i. Wire for tying reinforcement.

ii. Any additional reinforcement or splices required when Contractor's casting sequences differ from construction joints shown on the drawings.

iii. Any reinforcing steel placed by the contractor for his own convenience in addition to this shown on the drawings.

iv. Devices like steel chairs, hanger, spacers, small concrete blocks, other supports, ties and anchor rods etc. used to keep reinforcing steel in position.

v. Any reinforcing steel delivered for testing including the cost of testing.

vi. Carrying out tests for checking butt welds to replace lapping / splicing of reinforcing bars.

SUB CHAPTER -13

13.0 FORMWORK

13.1 SCOPE OF WORK

13.1.1 The specification described herein under relate to the Formwork. This Work shall include all labour, plant and materials, and services related to the design, fabrication, supply, erection, maintenance and removal of formwork and false work to be carried out by the Contractor under this Contract.

13.1.2 The formwork shall be fabricated and erected to the dimensions of finished surfaces of concrete as shown on the drawings or as otherwise directed by the Engineer.

13.2 SUBMITTALS

13.2.1 At least 4 (four) weeks prior to the construction of telescopic steel formwork for the tunnel lining as also the formwork for other concrete works, the Contractor shall submit, to the Engineer, the following:

- **i.** Shop drawings, details and structural computation of the formwork construction.
- **ii.** Details of materials, which the contractor intends to use for the fabrication of formwork.
- **iii.** Type of Release agent and method of application.

13.2.2 The Engineer reserves the right to require any additional information deemed necessary to be included in the submitted documents.

13.3 GENERAL

13.3.1 Forma of formwork shall mean the mould into which concrete is placed.

13.3.2 Falsework or shoring shall mean the structural supports and bracing for forms used in any part of the Works.

13.3.3 All exposed concrete surfaces having slopes of 1.5:1 or steeper shall be formed unless otherwise directed.

13.3.4 Where the character of the natural material cut in, to receive concrete is such that it can be trimmed to the prescribed lines. The use of forms shall not be required.

13.3.5 Release agents shall be selected and applied in such a way that they are not harmful to concrete, reinforcing steel, or formwork and in such a way that they have no detrimental effects on the environment.

13.3.6 Unless specifically intended, release agents shall have no detrimental effect on the surface quality, its color, or specified subsequent coatings.

13.3.7 Release agents shall be applied according to the product specification or provisions valid at the construction site.

13.4 DELETED

13.5 MATERIALS

13.5.1 Forms shall be of timber; steel or other approved material, except that the sheeting for all exposed surfaces, where form lining is not specified shall, be of tongue and groove timber of uniform width unless otherwise by the Engineer.

13.5.2 All materials used in formwork construction shall be of adequate strength and quality for their intended purpose and shall be satisfactory to the Engineer.

13.5.3 Timber shall be sound, straight, free from warp, decay and loose knots, and shall be dressed smooth.

13.5.4 Where plywood is used, it shall be non-wrinkling and manufactured with special waterproof glues. Plywood sheets shall be of uniform width and length.

13.5.5 The surface of steel or steel lined forms shall be smooth. Forms with dents, buckled areas or other surface irregularities shall not be used.

13.5.6 Reuse of forms and form lumber shall be allowed only if they are thoroughly cleaned and repaired and capable of producing the finish required for the concrete. Timber or plywood forms required with metal patches shall not be used unless permitted by the Engineer.

13.5.7 Damaged forms or forms which have deteriorated through usage shall not be used.

13.5.8 Form oil used on surfaces of timber or plywood forms shall be a straight, paraffin base refined, pale, mineral oil. The oil used on the surface of steel forms shall be specially compounded petroleum oil and other oils of animal or vegetable origin and gums or resins which are heavier in body and frequently darker than straight petroleum oils shall be used in the case of steel lining forms. The Contractor may use any other material also for coating of the formwork with the approval of the Engineer.

13.5.9 Forms of like character shall be used for similar exposed surface in order to produce a uniform appearance.

13.5.10 The type, size, shape, quality and strength of all materials from which forms are made shall be the sole responsibility of the Contractor but subject to the approval of the Engineer.

13.5.11 In general, forms for permanently exposed surface shall consist of or shall be lined with matched or dressed edge grain timber of appropriate thickness, free from loose or cracked knots.

13.5.12 Metal forms or metal lined forms shall be permitted for permanently exposed surfaces only when as entire surface is to be built completely with such forms.

13.6 DESIGN, FABRICATION, ERECTION & MAINTENANCE OF FORMWORK

13.6.1 Forms for various classes and false work shall be designed, fabricated, erected and removed in accordance with the applicable provision of the recommended practice for concrete formwork of IS: 456-2000 as required by the Engineer and as specified herein.

13.6.2 All false work shall be designed to withstand safely all live and dead load, necessary pressure, ramming and vibrations without significant deflection from the prescribed lines, which might be applied to the false work during all stages of construction, service and removal.

13.6.3 Formwork design should be submitted by contractor for approval of the Engineer. The submitted design shall comprise of technical report, computations and drawings (general drawings and details) of all proposed formworks (Main Tunnel, Escape Tunnel, lay-by, junctions and niches). The drawings should depict plan view of formwork and traveller (showing position of windows, vibrators, hydraulic jacks), and cross section in every possible position (closed/moving and open/fixed). Details of fixing elements (buttress, anchors rods, etc) should also be submitted for approval.

13.6.4 Detailed drawings of shoring and false work shall be prepared by the contractor. The calculations and drawings shall show the size and specification of the false work, including the type and grade of all materials used in the construction, design load on false work supports, horizontal forces imposed on the Falsework and used for design purpose, and details of splices and connections including nails, spikes and other

fasteners. If mechanical equipment such as concrete buggies, screening machines etc., are to be used, this information shall be shown of the drawings.

13.6.5 False work shall be constructed only after the false work drawings have been approved by the Engineer.

13.6.6 The approval by the Engineer of Contractor's drawings shall not relieve the Contractor of his responsibility for the adequacy of form and false work, or for the successful completion of the work.

13.6.7 The contractor shall construct the false work strictly in accordance with the approved false work drawings, one set of which shall be kept on the site at all times, and no changes shall be allowed without prior written acceptance of such changes by the Engineer.

13.6.8 Forms shall be designed to permit the concrete to be deposited, as nearly as is practicable, directly in its final position, and to allow inspection, checking and cleanup of the formwork and reinforcement to be completed without delay.

13.6.9 Formwork and false work shall be designed, constructed, erected and maintained such as to confine the concrete without loss of mortar and produce finished surface, which are within the tolerances specified.

13.6.10 Forms for concrete against which backfill is to be placed or which shall not be exposed to view may be constructed of smooth tight boards not less than 25 mm nominal thickness.

13.6.11 Forms for concrete exposed to flow of water or exposed to view shall be constructed of steel or plywood, which is smooth and free from defects with matched and sanded joints to give a symmetrical pattern over the entire area. Chamfer strips, 40 mm by 40 mm. shall be used on all exposed comers, unless otherwise specified or required by the Engineer.

13.6.12 Form ties, supports, anchors, braces, spreaders and other similar devices, which, shall be embedded in the concrete for holding the forms shall incorporate, threaded metal bars to facilitate removal of forms. Wood spreaders shall not be left in the forms. Any metal remaining embedded in the concrete shall be at least 50 mm form the surface of concrete. Holes left in the concrete by removal of parts of form ties or similar devices shall be well filled with cement mortar and neatly finished to match the adjacent concrete.

13.6.13 Form inserts or other similar permanently embedded items shall be accurately located and securely fastened in place. The number and location of form ties and bolts shall be such as to ensure that forms fit tightly against the concrete previously placed and remain in tight contact during operations.

13.6.14 Forms shall be set and maintained within the specified tolerance limits such that the complete concrete surfaces are within these limits.

13.6.15 All form surfaces shall be thoroughly cleaned before erection and shall be lubricated with a non-staining mineral oil. All excess oil shall be wiped off the forms prior to placement of concrete. Oil shall not be allowed to come into contact with reinforcing steel or other embedded items. For use of timber forms, the oil shall be capable of penetrating the timber and keeping it sufficiently oily to eliminate sticking and preventing absorption of water and consequent warping.

13.6.16 The oils shall be applied by brush, spray or swab and the forms shall be covered fully and evenly without excess or drip. Care shall be taken to prevent oil from getting in the surface of construction joints.

13.6.17 Immediately before concrete is placed, all forms shall be inspected to ensure that they are properly placed, sufficiently rigid, clean, tight and properly surface treated and free from encrustations of mortar, grout or other foreign materials. No concrete shall be

placed unit formwork has been inspected and accepted by the Engineer. Where forms of Continuous surfaces are placed in successive units, the form shall fit tightly over the surface so as to prevent leakage of mortar from the concrete and to maintain accurate alignment of the surface.

13.6.18 The formwork for the gate groove areas shall be accurately drilled to be held with first stage anchor couplings / plates to be embedded in primary concrete, Both shall be fixed through formwork into the first stage anchor couplings/plates to ensure that the couplings/plates remain flush with primary concrete face and the couplings do not get plugged.

13.6.19 Where timber forms are used, the laying shall be in the direction which will blend architecturally into lines of the structures, as decided by the Engineer.

13.6.20 Curved and special forms shall be such that these will result in smooth concrete surfaces. They shall be designed and constructed so that they will not warp or spring up during erection or placing concrete.

13.6.21 When metal sheets are used for lining forms, the sheets shall be placed and maintained on the form with the minimum number of wrinkles, humps or other imperfections. The use of sheet metal to cover imperfections in the lining, of timber-faced forms for surfaces that shall be permanently exposed to view, shall not be permitted.

13.6.22 Where plywood or hardboard is used for form lining, the joints between the sheets shall be smooth and as perfect as practicable and no patching of the plywood or hardboard shall be permitted for permanently exposed surfaces. Minor imperfections in the plywood may be corrected by the use of plastic wood secured firmly in place and sand papered smooth.

13.6.23 Wire ties shall be permitted for the forms when specially approved by the Engineer and shall be cut off flush with the surface of concrete, after the forms are removed. Wire ties shall not be used when permanently exposed finished surfaces are required.

13.6.24 Forms shall be so constructed that the finished concrete surfaces shall be of uniform texture in accordance with the type of finish specified for concrete surfaces in these specifications.

13.6.25 The erection of formwork in position shall be rapid enough, rigid and strong to withstand concreting operations and maintain the alignment. Panels of similar shape shall be identical and interchangeable.

13.6.26 For special section / shapes, timber / steel form shall be used, as approved by the Engineer.

13.6.27 The contractor shall strengthen or modify the formwork, whenever required by the Engineer.

13.6.28 Unless authorized, suitable moldings shall be placed to level all exposed edges, at construction joints, and any other edges shown on the drawings, or as required by the Engineer. The final detailed drawings shall show any formed recesses, slots, blackouts and similar construction details, which have to be kept into account in fixing the formwork.

13.6.29 Forms shall be maintained, at all times, in good condition, particularly as to size, shape, strength, rigidity, tightness and smoothness of surface.

13.6.30 The Engineer will, at any time, have the right to reject formwork, which he considers to be no longer fit for use.

13.7 SPECIAL FORMWORK FOR TUNNEL AND CAVERNS

13.7.1 Formwork for final concrete of overt portion of the tunnel and such portion of the underground caverns shall, in general, consist of an approved movable type of telescopic and or collapsible steel shuttering of robust design manufactured in adequate lengths.

13.7.2 Forms to be used for sides of caverns shall be of a design approved by the Engineer consistent with these specifications and surface finish etc. The forms shall be capable of easy manipulation (hydraulic or mechanical) and of accurate setting and shall be made in suitable segments. The segments shall be properly shaped and stiffened of ensure proper matching with adjacent segments.

13.7.3 The forms shall be fitted with ample windows at appropriate spacing and locations to allow the introduction of vibrators and to carry out inspections and any other work needed behind the form.

13.7.4 The formwork shall be of rigid construction, non-deformable due to working loads imposed upon it. Once installed in the position, the form shall remain in position without displacement during concrete placement.

13.7.5 The formwork shall be constructed in such a way that no abrupt irregularities arise at vertical construction joints. The joint in formwork shall overlap the vertical construction joint by at least 50 cm.

13.7.6 The windows shall be provided in each side about the mid height at the tunnel and the crown on alternate sides of the centerline. The windows shall be at least 60 cm in the least dimension and shall be spaced at a distance not exceeding 2.5 m.

13.7.7 The form work shall be designed to allow passage of tunneling machinery beneath the formwork and ventilation ducts through top part of formwork.

13.7.8 At least one of the formworks for the final lining of the Main Tunnel shall be extendable so as to be able to adjust to the increased section at the locations of the home signal, firefighting points etc. as per design drawings. Alternatively, the Contractor shall make provisions for supplementary formwork sections to be appropriately added and installed on the existing gantry for the aforementioned locations only. The Contractor's selected solution shall be approved by the Engineer and upon approval, formwork drawings shall be produced.

13.8 REMOVAL OF FORMWORK

13.8.1 Form shall not be removed until the concrete has hardened and has attained a crushing strength of at least twice the stress, which the concrete may be subjected to at the time of removal of forms.

13.8.2 Duration for which the forms shall remain in place shall, be decided by the Engineer, with reference to weather condition, shape, and position of the structure or structural members and the nature and magnitude of dead and live loads. The forms shall not be removed without the permission of the Engineer.

13.8.3 The following minimum intervals of time shall generally, be allowed between completion of placing of concrete and removal of forms but the period shall be increased in case of wet or cold weather and also at the option of the Engineer.

13.8.4 Structure - Period in days with normal Portland cement

i.	Beam sides, walls columns (Unloaded)	3
ii.	Slabs and arches (Props left under)	4
iii.	Props to slabs and arches	10
iv.	Beam soffits (Props left under)	8
v.	Props to beams	21

vi. Mass concrete 2
vii. Tunnel lining ½

13.8.5 The above minimum periods are only recommendatory. The Contractor, may, where he so desires, extend the above to longer intervals. This shall not, however, constitute any reason for any claim for extension of time or damage to concrete etc.

13.8.6 If the contractor desires to remove the forms early than the period stated above by addition of cement and / or suitable admixtures in the concrete, so as to gain early strength without affecting long term strengths, the matter shall be examined by the Engineer in each case and his decision in the matter shall be final and binding.

13.8.7 Heavy live loads shall not be permitted until after the concrete has reached its design strength.

13.8.8 The forms shall be removed with great caution and without damaging the structure or throwing heavy forms upon the floor. In order to achieve this end, wedges and clamps shall be used whenever practicable instead of nails.

13.8.9 In order to avoid excessive stress in the concrete that might result from swelling of the forms, wood forms for wall opening shall be loosened as soon as this can be accomplished without damage to the concrete. Forms for the opening shall be constructed so as to facilitate such loosening.

13.8.10 The contractor shall be solely responsible for any damage that may be caused by negligence, lack of proper precautions or hastiness etc. in the; matter of removal of forms and shall make the same good to the satisfaction of the Engineer.

13.9 MEASUREMENT AND PAYMENT

13.9.1 Payment for formwork for concrete works shall be deemed to have been included in the cost quoted for all concrete works.

13.9.2 Plain and curved formwork shall include

i. The entire cost of supplying and providing, maintenance, oiling, erection, all necessary ties and fixing, access scaffoldings, forming of chamfers up to 500 mm either internal or external and edges up to 50 mm width including removal of the same.
ii. Any kind of construction joints.
iii. Steel formwork of formwork used for manufacturing of precast concrete units.
iv. Additional cement and/or admixture which contractor adds to concrete to gain early strength to facilitate removal of formwork earlier then the specified period.
v. Any damage caused by contractor's negligence during removal of formwork.

SUB CHAPTER -14

14.0 DRILLING AND GROUTING

14.1 SCOPE OF WORK

14.1.1 The specifications described herein under relate to the Work of drilling and grouting, which includes all labour, materials, equipment, accessories and operations and required for the performance of drilling probe holes, grout holes, exploratory holes, drainage holes, holes for rock bolts/anchors and instrumentation, washing and water pressure testing of grout holes and supplying, transporting, storing, mixing and injecting grout materials and additives for consolidation and curtain grouting including void filling/contact grouting within the underground constriction sites and from surface, at locations shown on the drawings or where directed by the Engineer.

14.1.2 Grouting operations shall include the following:

- **i.** Contact grouting: To fill voids between final concrete lining and primary support system applied to rock surface.
- **ii.** Consolidation grouting, of the rock surrounding the excavated hollow space, which shall commence after placing of the concrete lining/shotcrete and completion of contact Grouting.
- **iii.** Consolidation grouting in the heading zone during excavation to consolidate the heading face before further advance in zones of sheared and disturbed material and/or in zones of high-water inflow.
- **iv.** Fill grouting, ofkarstic cavities, drainage trench, conduits and sump pits, and of exploratory drill holes and drain holes.
- **v.** Crack grouting, to seal open cracks and joints in the structural concrete lining.
- **vi.** Chemical grouting in zones of fine sand and soils, and to control the water inflow and increase the stability and strength of the formations that are too tight to be grouted with a cement grout.
- **vii.** Compensation grouting: Pre-injection of grouting at a controlled pressure prior to tunneling permeate the area to avoid deformations due to tunneling activities

14.1.3 The final number, length, location and inclination of the drill holes, as well as the composition and consistency of the grout mixes, grouting pressures pumping rates and sequence in which the holes are to be drilled and grouted shall be governed by actual conditions encountered on site and shall be at all times subject to approval by the Engineer.

14.1.4 **Contractor shall follow the grouting strategy as approved by Engineer.**

14.1.5 **Contractor shall maintain one-month buffer stock of grout materials as per agreed programme or as directed by Engineer.**

14.2 SUBMITTALS

14.2.1 At least 14 days prior to the start of grouting works, The Contractor shall provide a grouting method statement for the Engineer's agreement. The proposals shall include details and location of the mixing plant and grout pump, mix design and constituents, pumping rates and pressures, injection points, methods of monitoring, recording and controlling the sequence, preventing grout leakage and reconciling the volume of grout placed with the theoretical volume required, including specifications of all equipment, tools and all grouting materials to be used, and qualification and experience of the proposed personnel.

14.2.2 Grouting shall be carried out by operatives skilled in the work and notified in advance to the Engineer. They shall produce evidence of satisfactory performance on projects where the purpose of the work and extent was comparable. The skilled operatives shall further undergo training from OEM whose equipment is being proposed to be used at site.

14.2.3 An overall drilling and grouting Program shall be drawn up jointly between the Contractor and the Engineer. Grouting mixes, pressures, pumping rates, and sequencing will be selected, subject to modifications, to meet local conditions encountered during the performance of the work. Grouting works shall be planned in such a manner that they can be carried out according to the approved plan concurrently with other activities.

14.2.4 The Contractor shall decide and consult with the Engineer details of the proposed grouting scheme including:

- **i.** Information and case records to support the grouting proposed in respect of its ability to penetrate the strata and its ground enhancement effect.
- **ii.** Specific criteria to measure the adequacy, sufficiency or completeness of the ground treatment.
- **iii.** Details of the treatment zone and grout injection patterns with respect to the Works and adjacent structures.
- **iv.** Details of plant proposed.
- **v.** Method statement and programme including arrangements for storage of materials, mixing grout, Quality Control of grout, recording grouting pressures and grout take and tests to prove the efficacy of the grout in the ground, health aspects associated with the materials and grout proposed at all stages of the process and during excavation of treated ground, and means of protecting persons from any adverse effects
- **vi.** An assessment of the environmental impact of the materials and methods proposed.
- **vii.** An occupational health risk assessment, including methods of risk reduction on all aspects of the grouting operation.

14.2.5 **Contractor shall record grouting pressures and flows and produce ongoing assessments of the grout performance in relation to the requirements of grouting objectives.**

14.2.6 During the performance of the grouting works the contractor shall keep complete daily records of all grouting operation which shall include the following:

- **i.** Number and location of the drill holes.
- **ii.** Results of water pressure tests.
- **iii.** Grouting method.
- **iv.** Date and time of commencement and of each change in grouting operations.
- **v.** Rate of pumping.
- **vi.** Grouting pressures and gauge reference number.
- **vii.** Water-cement ratio and its variations.
- **viii.** Quantities of cement, sand, bentonite, fly ash, admixtures and chemicals used.
- **ix.** Connections, if any, with other holes and cracks, as well as any surface leakage of water or grout. Location, how caulked and the success of caulking shall be described.
- **x.** Number of holes and depth of holes left for re-drilling.
- **xi.** Time of completion.
- **xii.** Name of the Foreman in-charge.

14.2.7 Grouting reports in an approved form shall be compiled from these records and submitted to the Engineer for approval. Results of water pressure tests and grout intakes shall be presented graphically. The above reports shall also cover the interpretation of the test results and the actions proposed to be taken by the Contractor for improving the quality of grouting pattern.

14.2.8 The Engineer reserves the right to require any additional information deemed necessary to be included in the submitted documents.

14.3 STANDARDS

14.3.1 Materials for grouting and performance of grouting works shall conform to the following Indian Standards or where not covered by these standards, to the equivalent International Standards:

i.	IS: 12269	Specification for 53 grade ordinary Portland cement.
ii.	IS: 383	Specification for coarse and fine Aggregates form natural source for concrete.
iii.	IS: 5529(Part-II)	Code of practice for in-situ permeability tests.
iv.	IS: 5878 (Part-VII)	Code of practice for construction of tunnels conveying water: Grouting
v.	IS: 9103	Concrete Admixtures: Specification
vi.	IS: 6066	Recommendations for pressure grouting of rock foundations in river valley projects.
vii.	IS:10874	Portland Micro-Fine Cement Specification
viii.	IS:14343	Choice of grouting materials for alluvial grouting

14.3.2 In cases of conflict between the above standards and the specifications given herein, the Specifications shall take precedence.

14.4 DEFINITIONS

14.4.1 Cement grout

i. Cement grout is defined as a mixture of cement and water with the addition of admixtures (sand and bentonite, if directed by engineer), which is forced under pressure into prepared holes or pipes in order to fill voids or consolidate the rock mass as a whole.

ii. Cement grouts are subdivided into stable and unstable mixtures:

A. Unstable mixtures are simple suspensions of cement in water. These suspensions are homogeneous as long as they are in movement and the sedimentations starts as soon as the movement is stopped.

B. Stable mixtures are colloidal suspension dissolved in water of which grain size is so small that no appreciable sedimentation occurs during the grouting operation. These suspensions are obtained by high speed mixing of cement with addition of bentonite.

14.4.2 Chemical Grout is defined as mixture of two or more solutions which combine chemically and form a gel or a solid matter, the solutions may react either prior to pumping into, or within the void. The chemicals may be used in combination with cement or other grout as determined by testing and approved by the Engineer.

14.4.3 Single-Stage Grouting is carried out by introducing the grout at either the collar of the hole through a nipple or by means of a grout supply pipe at the bottom of the hole. The entire length of the hole is grouted in one operation.

14.4.4 Multiple Stage Grouting

i. Multiple stage grouting is carried out by introducing the grout into a predetermined section of the hole, which is blocked off by a packer. The grouting of the entire

length of hole is performed in successive stages either in ascending or descending arrangement.

ii. The terms ascending or descending arrangement mean the sequence of the grouting stages, either from bottom to the collar of the hole or in reverse, irrespective of the effective direction of inclination of the hole.

iii. When grouting is done in ascending arrangement, the hole is drilled to its full depth, washed out, and the packer is set at the top of the deepest section to be grouted at the required pressure through the grout supply pipe. The packer is allowed to remain in place until there is no backpressure and then withdrawn to the top of the next section to be grouted. The water pressure testing and grouting is repeated successively, section by section, until the entire length of the hole is filled with grout.

iv. When grouting is done in descending arrangement, the work is accomplished in section from the collar of the hole. The hole is drilled to a limited depth, washed out and the packer is set just above the section to be grouted. The section is then water-pressure tested and grouted at the required pressure. The grout within the hole is removed before it takes a hard set while the grout surrounding the hole is allowed to obtain its initial set, before the holes is drilled to an additional depth. Repeating thus successively drilling, water-pressure testing, and grouting at various depths until the entire length of hole is completely drilled and grouted.

14.4.5 Split spacing Grouting means the system of locating an additional grout hole approximately mid-way between two previously drilled and grouted holes.

14.4.6 Water Cement Ratio is the proportion by weight of water to cement in a water-cement mixture.

14.5 GENERAL

14.5.1 During drilling, grouting, washing and pressure testing operations, the Contractor shall keep concrete and rock surfaces free and clean of oil, grease, drill cuttings, grout, cement, excess of water or any kind of waste. At all times during the progress of Work pertaining to this item, contractor shall protect all open drill holes from becoming plugged or filled with oil, grease, drill cuttings, grout or waste. The contractor shall clean up and remove all waste in each area on completion of the work.

14.5.2 Before starting the grouting, the contractor shall give due notice thereof to the Engineer, to enable him to be present during the grouting operations, which shall always be done in his presence.

14.5.3 The grout mix that might flow out or otherwise get spilled on the concrete lined surface shall be removed expeditiously without allowing any time for the grout to set on the concrete surface.

14.5.4 After finishing of grouting, each grout hole shall be re-drilled to ⅔rd of theoretical lining thickness and fitted with dry pack mortar.

14.6 SAMPLING AND TESTING

14.6.1 The Contractor shall provide samples of materials and prepare trial mixes as directed by the Engineer and test in the presence of Engineer at least 30 days before the commencement of any grouting. The materials for use in grout mixes shall be tested with applicable requirements stipulated in these specifications.

14.6.2 The Contractor shall carry out the following tests:

i. Laboratory Tests

A. Grain size distribution and moisture content of sand and bentonite, including aerometer analysis.
B. Atterberg limits.
C. Chemical analysis of water and solids.
D. Compressive strength.
E. Viscosity (by fan-viscosimeter and Marsh cone).
F. Density.
G. Decantation and setting time (by Vicat needle).
H. Shrinkage of grout.

ii. Field Tests.
A. Density by hydrometer or mud balance.
B. Viscosity by marsh cone.

14.6.3 All Chemical grouts shall be tested in NABL approved laboratory under conditions identical to those to which they will be subjected in the field, in order to determine the suitability of various chemicals and proportion of the ingredients to satisfactorily complete the work.

14.6.4 During the actual grouting operations, contractor in the presence of the Engineer will carry out tests on grout mixes at the same time as grouting, and will plot values of viscosity, sedimentation limits, compressive strength, and maximum viscosity possible for the grouting on a diagram. The frequency of testing will be once for each grouting jobsite or until acceptance criteria have been met. However, if a significant change in the cement source occurs, sampling and testing shall be repeated.

14.6.5 Further sampling, testing and quality assurance will be as per approved 'Quality Assurance programme submitted by the contractor.

14.7 GROUTING MATERIALS

14.7.1 All grouting materials shall require approval of engineer before their application. Contractor shall arrange to carry out all testing required to the satisfaction of engineer before seeking any approvals.

14.7.2 General

i. The following kinds of grout mixes shall be used:
A. Cement grouts (OPC 53/53S and OPC based Micro/ultrafine cements).
B. Mineral grouts (Colloidal silica or Polyurethane).
C. Combination grouts: Combination of any of the above-mentioned grouts.
D. Admixtures (like super plasticizer, accelerators, Micro silica/Silica fume etc.) shall be added in dosage required to achieve its benefits.
E. Only PC based super plasticizers and alkali free liquid accelerators shall be used with OPC 53/53S, MFC, UFC etc.

ii. All cement based grouts shall use required dosage of super plasticizers (PC based and minimum 1.5% of cement weight), accelerators (1-2% if required), Micro silica/Silica fume (1-2% if required) and other additives and shall be tested on site to achieve following properties. The tests shall be performed both initially (for design approval) and subsequently just after preparing grout for injecting into strata (Once for each type of grout mix per shift):
A. Marsh cone time of less than 35 seconds. (IS: 14343 Annex-A)
B. Bleeding of less than 2% till 2 hours. (IS: 10874 Annex-C)
C. Initial setting time of more than 120 minutes. (IS: 4031 (Part-5))
D. Final setting time of less than 240 minutes. (IS: 4031 (Part-5))

iii. At few locations engineer may direct the contractor to adopt lesser setting times also. This will be achieved by increasing the dosage of accelerator.

iv. The use of toxic chemicals such as acrylamide/Poly-acrylates shall not be permitted for use in the works. Pre-blended cements shall not be permitted.

v. Cement (OPC 53/53S, MFC, UFC) shall not be older than 3 months/Manufacturer's specified shelf life at the time of usage.

14.7.3 OPC 53/53S grade Cement

i. The cement shall conform to requirements of Section of "Materials for Construction" and relevant standards and shall be free from lumps. Any cement containing lumps and foreign matter detrimental to the results of grouting shall be rejected by the Engineer.

ii. Additionally, OPC 53 and OPC 53S used for grouting shall have Blaine value not less than 275 m^2/kg and 370 m^2/kg respectively.

14.7.4 Micro Fine Cement (MFC) shall conform to IS:10874, additionally;

i. Micro fine cement should have specific surface (BET method IS: 15388) more than 600 m^2/kg and D_{95}< 15µ. Original MTC to be submitted for approval of engineer before usage. Contractor at his own cost shall get the same tested from 3rd party at direction of engineer.

14.7.5 Ultra-Fine Cement (UFC) shall conform to IS:10874, additionally;

Ultra-Fine Cement should have specific surface (BET method IS: 15388) more than 900 m^2/kg and D_{95}< 12µ. Original MTC to be submitted for approval of engineer before usage. Contractor at his own cost shall get the same tested from 3rd party at direction of engineer.

14.7.6 Colloidal Silica (CS):

i. Colloidal silica shall be environment friendly, highly stable and having ultralow viscosity of less than 6 mPA.s at 25^{o}c.

ii. Gel time of Colloidal silica shall be adjustable from 60 minutes to 10 minutes by increasing the accelerator dosage.

14.7.7 Water

i. Water shall not contain more than 2 parts per thousand of suspended colloidal solids and no particles larger in size than the cement particles. It shall not be aggressive. The chloride content shall be less than 50 mg per liter and the sulphate content less than 100 mg per liter.

ii. The temperature of water used for the preparation of grout shall not exceed 25^{0}c.

14.7.8 Admixtures

i. Admixtures shall be added to grout mixes to optimize the strength, viscosity, density, decantation, setting time and shrinkage.

ii. Only admixtures proved by testing prior to the start for grouting shall be used. Manufacturer's certificates or guarantees will not be accepted as relieving the contractor of his responsibility for the suitability of any admixture. Admixtures shall conform to the relevant IS code.

iii. Liquid accelerators shall be alkali free and if required shall be added only through dedicated nozzle into the grout line at the face (1-2% by weight of cement).

iv. Super plasticizers shall be PC based only (minimum 1.5% by weight of cement).

v. Micro silica/Silica fume shall be added 1-2% by weight of cement if required.

14.7.9 Polyurethane (PU)

i. The products used in chemical grouting should be non-toxic, solvent free, eco-friendly and present low viscosity. Polyurethane foam resins, polyurethane resins and silicate foam resins can be used depending on the purpose and aim of the grouting.

ii. Polyurethane (combined systems) shall be used for consolidation of the sheared or disturbed rock, loose material, or for making the ground impermeable against water inflow even under high pressure. PU is two component system having high fire resistance, low flammability and extremely fast curing. The system should be capable of being designed to behave as foaming or non-foaming in the presence or absence of water.

iii. For consolidation grouting: A polyurethane resin with low viscosity, a large penetration factor and high compressive strength should be used. Foam factor should be less than 4 (4 times its original size).

iv. For waterproofing and control of high ingress of groundwater: A polyurethane foam resin with low viscosity and a large foam factor (approx. 40) with a fast reaction in contact with water should be used.

v. Accelerators should be used. The ratio accelerator/resin should be tested and calibrated in a trial test to optimize the penetration rate according to the needed depth of the treatment.

vi. It is advised to test the optimized mix for a situation where a weak sheared/fault zone is bearing high inflow and a quick stoppage of the water is required at the same time that a consolidation of the rock. A high foam factor reacts rapidly with the water but reduces compressive strength and decreases penetration capacity. Thus, a trial test should be carried out to define the best combination for each situation.

vii. The results of these tests should be confirmed with core drillings to evaluate the penetration capacity of the resins.

14.7.10 Other Chemicals

i. When other chemicals are required or proposed, they shall be accompanied by the manufacturer's certificates that they have been commercially used with satisfactory service in the similar type of work. The storage, handling and usage shall be strictly with the manufacture's printed instructions.

14.8 GROUT MIXTURES

14.8.1 The type of grout and proportions of various constituents in the grout mixtures shall be as directed by Engineer and shall be constantly adapted to the conditions on the site as the Engineer may direct.

14.8.2 Any grout mixture not used within one hour after mixing shall be rejected.

14.9 DRILLING AND GROUTING EQUIPMENT

14.9.1 General

i. Only modern, properly operating drilling and grouting equipment approved by the Engineer and operated by trained and experienced crew shall be used for the performance of the work.

ii. Drilling equipment of the rotary or percussion type shall be used to perform the drilling as specified herein and as required by the Engineer.

iii. Percussion type drilling equipment shall be equipped for continuous washing of holes during drilling.

iv. All Drill booms on jumbo shall be equipped with sensors to record measurements while drilling (MWD) to record the drilling data.

v. The washing and water pressure testing plant shall include pumps, gauges, valves and all other accessories necessary to complete the works as specified. The pumps shall be of the gear, centrifugal or other acceptable types and shall be capable of maintaining constant pressure. The contractor shall supply water storage tanks sufficient for the pumps in addition to flow meters and pressure gauges for calibration and checking purposes.The arrangement of injection equipment must include a return circuit, conveniently designed so that the grout or mortar can circulate continuously along the pipe, in order to avoid clogging and concurrently allowing an accurate pressure control into the hole. During grouting process, grout should always remain agitated. The distance between the injection pump and the injection hole should not be more than 50 meters. All the grout or mortar dosing and injection equipment must always be kept in optimal operating conditions and calibrated periodically. The entire circuit should be prepared to be washed in case of clogging by means of “T” fittings and water connections.

vi. Grouting equipment shall consist of grout pumps, weighing scale for additives and cement, grout mixers water meters, agitator sumps, pressure gauges, packers, pipelines and fittings, and miscellaneous tools, and shall be specifically designed for grouting purposes.

vii. Grouting equipment shall be capable of effectively mixing and stirring the grout and forcing it into the grout holes or grout convections in a continuous, uninterrupted flow at any specified pressure up to maximum of 100 bar, accurately measuring the grout intake, and maintaining the specified pressure for at least 5 minutes after the hole refuses to accept further grout. The equipment shall be capable of accurately controlling grout flows and pressures and shall be suitable for neat cement, cement sand, and chemical grouts.

viii. Spare gauges, valves and fittings shall be kept available on the Site, and a two-way communication system between the mixing plant and place of grouting shall be provided if the distance exceeds 60 m.

ix. Standby equipment, which can be activated immediately, shall be furnished to ensure continuity of work in the event of main equipment breakdown. The standby equipment shall be able to operate at pressures up to 100 bar.

x. Prior to commencement of the work, during the work as specified or as requested by the Engineer, and at the end of the work, all pressure gauges, recorders and discharge meters shall be checked and calibrated.

xi. The grouting equipment shall be maintained to the satisfaction of the Engineer in order to guarantee continued and efficient performance during grouting work.

14.9.2 Deleted.

14.9.3 Recording of data for grouting

i. Recording of data shall be automatic through an electronic data logger (a PC), which shall have facility to actively control the entire process.

ii. Control parameters such as maximum allowed injection pressure, maximum and minimum flow rate and maximum quantity of grout per injected hole shall be entered into the PC.

iii. PC shall then record the process automatically, and also stop the pump when any of the stop criteria have been reached. When injecting on several holes simultaneously (with one pump per line) this equipment is a great help in keeping

things under control and receiving accurate recordings, without the need for more staff.

iv. It should be possible to see the cumulative grout volumes and grout material weights injected inside the hole under grouting operation.

v. Pressure transducer and an inductive flow meter shall be coupled into the grouting line.

vi. Print out of grouting rig log shall me submitted with grouting reports after each grouting operation.

14.9.4 Grout Mixers and Agitator sumps

i. Grout mixers for mixing the stable mixtures shall be of the mechanically operated, high speed colloidal type of sufficient size, and operating at 1500 to 2000 rpm with electric or pneumatic drive to ensure complete dispersion and activation of the mix.

ii. Hand powered mixers or concrete mixers shall not be permitted for preparation of grout mixtures.

iii. Mix shall be weighing batched and mixers shall be provided with equipment for measuring weight and volume of mix components with an accuracy of 2 % and a water meter calibrated in liters with a reset switch for zeroing after each delivery.

iv. After mixing, the grout shall be discharged through a 5 mm mesh screen into an agitator sump equipped with stirring paddle to prevent settling and to remove any air bubbles from the mix. The stirring paddle shall be of such arrangement to guarantee a complete circulation of the entire sump content. The agitator sump shall have double the capacity as of the mixer so that one batch of grout can be pumped while the next batch is being mixed.

v. Grouting rig shall be equipped with computerized controls and automatic logging of entire grouting operations (volume of different recipies injected in each hole, pressure at which the injection took place, pressure build up/loss as the grout is run, start and stop time for different mixtures).

14.9.5 Grout Pump

i. Grout pump should be able to inject grout at upto 80 bars steady pumping pressure for upto 20 L/min of constant flow, simultaneously into 2 holes at the same time.

ii. Pumps shall be of the duplex double acting piston type. The pump body shall be of high wear and shock resistant material. The plunger unit shall be of stainless steel, highly resistant to abrasion.

iii. The pump shall have hydraulic drive.

iv. The pumps shall be equipped with precise pressure and capacity control valves, which allow the setting of both, the maximum pressure and the flow independently. The pump shall automatically stop whenever the preset pressure is reached and shall maintain the pressure without fluctuation.

v. For works requiring a small volume of grout such as crack grouting or rock bolts grouting, the contractor may use hand operated grout pumps approved by the Engineer. These pumps shall be able to achieve a pressure of up to 25 bar.

14.9.6 Pressure Gauges

i. The Contractor shall provide pressure gauges for both low and high-pressure ranges (0- 20 bar and 20 -100 bar). Two gauges of the appropriate range shall be provided in each grout line, one at the pump for the use of the pump operator, the other at the hook up connection directly at the collar of the hole. The required

pressure for each particular hole shall be measured on the hook up pressure gauge, not at the pump.

ii. Pressure gauges shall have an accuracy of 3%. A minimum of two standardized pressure gauges for each range shall be calibrated and certified by an independent laboratory prior to the commencement of grouting works. One gauge for each range shall remain at the disposal of the Engineer, and the other shall be, used by the contractor for checking and calibration of working gauges. Working gauges shall be used for no longer than 2 shifts before being cleaned and recalibrated. All working gauges shall have reference number for identification, which shall be quoted in the grouting reports to be submitted to the Engineer.

14.9.7 Connections to Grout Holes and Packers

i. Supply and return lines equipped with quick release couplings shall be able to withstand an internal pressure greater than the maximum produced by the pump. The internal diameter of the lines shall be such that no appreciable settlement of grout takes place when pumping at the minimum discharge capacity of the pump.

ii. Valves shall be provided at the pump, in supply line and at the collar of the hole being, grouted. Suitable screens shall be incorporated in the supply line for removing oversize particles and foreign matter before injection into the grout hole.

iii. Packers shall be the same as used for water pressure testing and shall be of the mechanical rubbing ring or pneumatically expandable rubber types. These shall be capable of sealing holes without leakage. These packers shall be capable of being used either single or double. Double packers shall be separated by up to 3 m of perforated pipe. The diameter of pipes used for separating and placing the packers in holes shall be the maximum possible for the size of the holes.

14.9.8 Embedded Pipes and Fittings for Grouting

i. Whenever pipes are required to be installed, Standard mild steel pipes and fittings for grouting shall be set in the rock and concrete as directed by the Engineer. The pipes and fittings embedded in concrete shall be cleaned thoroughly of all dirt, grease, grout and mortar immediately before embedment and shall be firmly held in position and protected from damage of displacement while the concrete is being placed. The size of the pipes embedded in concrete lining for drilling holes for grouting shall be of a suitable internal diameter. A standard coupling and nipple wrapped to facilitate eventual removal shall be attached to the grout pipe where embedded in concrete. No portion of the pipe shall be allowed to remain within 50 mm of the concrete surface and the resulting recess, after removal of the pipe or fitting, shall be filled with dry pack mortar.

ii. Care shall be taken to avoid premature blockage of pipes. Any pipe that becomes blocked before completion of operations shall be cleaned in a satisfactory manner or replaced by the contractor

14.9.9 Maintenance routine

i. Thorough cleanup must be performed to prevent cement from hardening in production apparatus and in the grouting rig. Such maintenance must be facilitated by ensuring that a high-pressure washer and a work bench are available in the vicinity of the grouting rig. Following is the advisory schedule which may be followed: -

Component	Maintenance frequency	Comments
Hoppers	Feed screws should be checked regularly and cleaned when necessary. Hoppers must be emptied in	The screw can be checked when the hopper is run to empty.

	the event a prolonged stoppage.	
High-speed mixer	Cleaning after each round of grouting. Impeller/paddles should be replaced every other year.	Thorough cleaning is vital. Inadequate cleaning may result in set cement falling into the cement being mixed and causing operating problems during grouting. Impeller/paddles/knives will become worn and gradually give poorer mixing results. They should be replaced when they no longer give the same shear force in the mixing process.
Stirrer (agitator)	After each round of grouting.	Thorough cleaning will prevent a buildup of cement, also at the top of the mixer. All surfaces must be checked.
Grouting pump	After each round of grouting.	Must be dismantled, cleaned and lubricated internally with acid-free vaseline.
	After each round of grouting.	Check of wear on connecting pieces, threads and split pins.
	After each round of grouting.	Check for wear and damage. Damaged hoses must be replaced.
Grouting rods	After each hole.	Thorough cleaning and lubrication of threads.
Packers	Check the packers that are going to be used before each round of grouting.	Check there are no production faults in the locking mechanism.
Taps/Ball valves	After each hole and during grouting. When grout takes are large, functionality should be checked by opening the tap.	Important to check functionality, particularly of pressure relief valves.
Grouting rig	Regular cleaning/lubrication, at a minimum after each round of grouting.	Anti-seize oil should be applied after rig has been washed. It is advantageous if the rig is equipped with a high-pressure washer for continuous cleaning during the grouting process.
Scales	Every other month, or after 200 tonne.	Measuring cells should be checked.

14.10 DRILLING OF HOLES

14.10.1 General

i. The number of holes to be drilled, their location, sequence, orientation, inclination and the depth shall be as per approved methodology.

ii. All holes shall be established within 0.10 m of the specified location. Maximum deviation for holes shall be 2^0 (degree) from the proposed values.

iii. If for any reason, the drill hole deviates in inclination or orientation in such a way that it does not satisfy the purpose for which it was intended, the contractor shall correct the deviation or shall drill another hole to the satisfaction of the Engineer.

iv. Hole size for probing and consolidation grouting holes (Drilled in the face) shall be kept same.

14.10.2 Drilling of Holes for Probing/Grouting

i. The Contractor shall drill holes around the periphery of the excavation for draining the surrounding rock. The minimum diameter of holes shall be 57 mm or as directed by the Engineer. The contractor shall also submit interpretation of MWD data.
ii. When so required according to approved methodology or as directed by the Engineer, these holes (along with additional holes if required) shall be used for consolidation grouting of the surrounding rock.

14.10.3 Drilling of Holes for Rock bolts, Exploration and Instrumentation and other than Grouting, etc.

i. The minimum diameter of holes shall be 38 mm or as directed by the Engineer.
ii. Holes shall be drilled either directly into the rock or through the concrete lining and then into rock as directed by the Engineer.
iii. The holes shall be drilled in a direction normal/inclined to the surface of the underground excavation / concrete lining as the case may be or as directed by the Engineer.
iv. While drilling the holes, utmost care shall be taken to ensure that the reinforcement or structural ribs, if any, in the concrete lining, shall not be cut through. The position of steel ribs shall be recorded and marked on the finished concrete lining. If the reinforcement or steel ribs are encountered during drilling of any holes in concrete, drilling shall be discontinued immediately, and a new hole shall be drilled nearby. The holes so abandoned shall be backfilled with concrete as direct by the Engineer and the surface of concrete shall be repaired.
v. Each hole shall be protected from becoming clogged or obstructed by a grout connection pipe fixed suitable into the holes and the holes shall be suitably capped or otherwise protected until these are grouted. Any hole that becomes obstructed before being grouted shall be cleaned out in a satisfactory manner.
vi. The use of rod dope, grease or other lubricants on drill rods shall not be permitted and no drilling water additives of any kind shall be used without the approval of the Engineer.
vii. Whenever the drilled water is lost or artesian flow is encountered, drilling operations shall be stopped, and the hole shall be grouted before drilling operations are resumed. The Contractor shall record the location, flow and the pressure of any artesian conditions encountered in any drill hole.

14.11 FLUSHING OF HOLES

14.11.1 On completion of drilling, all holes shall be thoroughly flushed to remove any accumulation of fines, sludge, or foreign materials. Holes shall be flushed out by water at pressure of 10 bar, combined with some compressed air injected through a stiff plastic hose starting at the bottom of the holes. Contractor shall continue flushing for two minutes after the return water becomes clear.

14.11.2 For grout holes, flushing will also be required immediately before water testing/high pressure grouting. A custom designed diesel-powered piece of equipment shall be used to provide a water jet pressure of upto 100 bar. The high-pressure water hose shall have nozzle arrangement so that some water jets pointing 45° back along the hose and others at 90° radially. With this configuration, the nozzle is self-propelled forward into the hole and can be removed by just pulling the flexible hose.

14.11.3 If there are zones in the borehole that may collapse if soaked in water, or will be excavated by the flushing jet, or if the water yield from the hole is more than 10 l/min, the flushing may be omitted.

14.11.4 Flushing of boreholes for grouting should be done as specified as a routine matter and any necessary deviations should be decided on and recorded by the supervisor, based on the borehole records.

14.12 GROUTING OPERATIONS

14.12.1 General

- **i.** All pressure grouting operations shall be performed in the presence of the Engineer.
- **ii.** In the underground works, the grouting works, and other operations shall be carried out as per approved working methodology or directed by the Engineer.
  - **A.** Consolidation grouting and impermeabilization of the rock ahead and around the heading face as needed before further advance.
  - **B.** Fill grouting of exploratory and drain holes, which may be required during underground excavation, prior to placing of concrete lining.
  - **C.** Contact grouting in the crown of the tunnel and cavern after placing of concrete lining.
  - **D.** Fill grouting of drainage conduits and sump pits.
  - **E.** Depending on the rock conditions, the Engineer may direct to carry out Consolidation grouting.
  - **F.** Control grouting.
  - **G.** Installation of one-way checks valves.
  - **H.** Crack grouting as directed.
- **iii.** The above sequence is not exhaustive, and the Contractor shall plan his operations in such a way that he is flexible to adapt to the conditions encountered.
- **iv.** The utmost care and precautions shall be taken to ensure that the concrete does not get damaged during the grouting operations.
- **v.** If the Engineer considers necessary to carry out an additional grouting in any section of the works, the contractor shall reinstall the necessary equipment and perform the grouting to the satisfaction of the Engineer.

14.12.2 Contact Grouting between Concrete and Rock where concrete lining is required to be installed

- **i.** Low pressure contact grouting shall be carried out between concrete and rock over the entire length of the tunnel to fill voids between the rock surface and the following:
  a. Structural concrete in the crown of the tunnel and cavern and in the concrete plug in the tunnels.
  b. Concrete in any other zones within the underground works where conditions so require and as the Engineer may direct.
- **ii.** Contact grouting shall normally be performed from holes drilled in the crown of the tunnel, shaft and cavern and shall be carried out in advance of consolidation grouting operation.
- **iii.** Contact grouting in the completed concrete plug in access and it shall be performed through the pipe system cast into the body of the plug as specified in Section of “Cement Concrete”.
- **iv.** Water pressure testing will not be required prior to contact grouting.
- **v.** In any section of the underground structure, the concrete lining within 100 m of that section shall have been in place for at least 21 days before grouting commences.

vi. Contact grouting shall be carried out at low pressure (not exceeding 5 kg/sq.cm) using a cement-sand grout and shall continue until all voids are filled. Vent pipes for the release of air and water during grouting shall be provided in locations as shown in the drawings, as directed or approved by the Engineer.

vii. After the grouting of any hole is completed, the pressure shall be maintained, by means of stopcock or other suitable device, until the grout has set.

viii. Control grouting shall be carried out, where directed by the Engineer, to verify that voids have been completely filled with grout. Grouting will be regarded as being satisfactory if the pressure can be maintained for at least 5 minutes without grout intake.

14.12.3 Fill Grouting

i. Fill grouting of exploratory and drain holes shall be carried out before placing of the concrete lining.

ii. After completion of contact grouting, the entire system of temporary invert drains and sump pits in the tunnel and cavern shall be filled by grouting with a cement sand grout at a pressure up to 3 kg/sq.cms.

iii. The Contractor shall use a systematic procedure for fill grouting of the invert drains and sump pits to ensure displacement of water and complete filling of the drains and pits.

14.12.4 Consolidation Grouting

i. General methodology and decision-making flowchart for probe drilling and injection is attached separately as Annexure-B.

ii. **The contractor shall follow grouting method in line with Annexure-B or as directed by Engineer and shall be according to specifications of materials, equipments, and measurement and payment terms detailed in this section. Suitable modifications required to tackle special underground situations anticipated shall be followed whenever directed by Engineer.**

iii. Consolidation grouting of the rock surrounding the excavated hollow space shall be carried out in sections of the underground structure as directed by the Engineer. Consolidation grouting may also be directed by the Engineer during the excavation works in order to consolidate the heading face or seal off the inflow of ground water.

iv. Consolidation grouting shall normally be performed in a single stage through a nipple or packer installed at the collar of the hole within the concrete lining but if geological conditions so dictate, multiple stage grouting either in ascending or descending arrangement shall be performed in particular holes.

v. Immediately before grouting, the grout holes shall, rock characteristics permitting, be thoroughly washed out under pressure, until the returning water is clear, and then as the Engineer may approve, pressure tested.

vi. Grouting with cement-based grouts shall be performed at approved W/C= ratio (Admixtures or accelerators as required) which shall be reviewed based on pressure build up criterion adopted as per site conditions.

vii. Grouting will be stopped based on criterion of maximum Grout intake at the hole or achievement of the required pressure. The values will be decided on the basis of performance of the grout as per sire conditions.

viii. After completion of grouting, the packers shall remain in the hole and the pressure shall be maintained until the grout has attained its initial set.

ix. The results of water pressure testing and all information obtained during the performance of grouting will be used for the determination whether the grouting, in each section of the works under considerations is completed in a satisfactory

manner, or whether additional grouting in separate drill holes is required. The termination of grouting work in any sequence in any section of the works will be decided by the Engineer.

14.12.5 Closure of Holes and Clean-up

i. Upon completion of grouting work, each hole shall be filled with thick grout and connections not embedded in the concrete shall be removed. The drilled holes in the concrete lining shall be reamed or redrilled to a depth corresponding to the ⅔ rd of theoretical concrete lining thickness and filled with dry pack mortar, as stipulated in Section of "Cement concrete", flush with the concrete surface.

14.12.6 Crack Grouting

i. Crack grouting shall be performed to seal the cold joints, construction joints, shrinkage cracks, honeycombs, poorly closed grout holes etc., in the structural concrete lining of underground structure as directed by the Engineer and as stipulated in Section of "Cement Concrete".

ii. Crack grouting shall consist of injecting a stable, cement water mix with admixture through holes specially drilled into cracks or joints.

iii. Preventive measures shall be taken by plugging the joint with wooden wedges, cardboard; cement-gypsum mortar or other suitable mean to prevent the grout from flowing out of the crack.

14.12.7 Curtain Grouting

i. Curtain grouting shall not be started until consolidation grouting has been completed within 60 m radius around the curtain holes to be grouted.

ii. Drill holes for curtain grouting shall be drilled and grouted in three stages consisting of Primary, Secondary and Tertiary holes. Primary holes shall be drilled, washed, subjected to water pressure testing, when required by the Engineer, and grouted before proceeding to execute the secondary holes. The depth of holes and spacing between them shall be as shown on the drawings or as approved by the Engineer.

iii. Unless otherwise specified by the Engineer, curtain grouting shall be done in stages of 5 m each.

iv. If grout absorption in any 5-meter stage, which is not caused by leakage at the surface, is found to be excessive in adjacent primary and secondary holes, the Engineer may require the contractor to drill and grout additional holes (tertiary holes) between the primary and secondary holes.

14.12.8 Water Pressure Testing

i. Water pressure tests with double packer apparatus having a perforated pipe not less than 1.5 m shall be carried out on the grout holes when directed by the Engineer. The actual spacing will be determined by the Engineer. Water pressure shall than be applied to the test section for a minimum period of 5 minutes.

ii. The maximum pressure for water testing shall correspond to the pressure specified for grouting. Water loss shall be measured in liters.

iii. Based on the results of the water pressure tests, the Engineer may require additional grouting. Such grouting shall be, carried out by the contractor at the pressure specified by the Engineer.

14.13 MEASURMENT AND PAYMENT

14.13.1 General:

i. The provision for grouting given in this specification shall be considered as merely a guide on which the contractor is to prepare his bid and not as an accurate indication of the quantity of the work.
ii. The quantities of each item may vary as per the actual site conditions disclosed during the course of the work.
iii. The Unit Rates for drilling holes shall include, but not be limited to, the entire cost of labour, equipment, materials and washing and cleaning of holes.
iv. Cost of performing one water pressure testing at per 10m Tunnel length to be Grouted or part thereof, shall be deemed to be included in unit rate of drilling entered in the Schedule of Item Rates.
v. Unit Rates for grouting schedule shall include, but not be limited to the entire cost of labour, Packers, equipment, processing, mixing, testing, hooking up to the hole, injecting grout, hole closures and clearing up, data processing, recording and presenting.
vi. Unit rates for grouting shall also include the cost of furnishing samples of grouting materials and providing assistance for sampling required in connection with the tests to be performed by the ENGINEER.
vii. Grout materials such as OPC, micro fine cement, ultra-fine cement, Colloidal silica and PU grout shall be made separately on basis of actual consumption. Cost of admixture like plasticizers and accelerators is deemed to be included in the rates for grout materials.

14.13.2 Percussion Drilling of Holes

i. Drilling of holes having diameter less than 50mm
   A. Measurement and payment will be made at the unit rates per linear length (meter) entered in the Schedule of Item Rates. Separate measurement and payment will be made for supply & laying of PVC perforated pipe and filing with gravel if required.
ii. Drilling of holes for having diameter between 50 – 65 mm
   A. Measurement and payment will be made at the unit rates per linear length (meter) entered in the Schedule of Item Rates.

14.13.3 Placing Grout

i. Consolidation grouting
   A. Payment for consolidation grouting include preparation and placing of the grout materials at the unit rate quoted for the item in schedule of item rate on basis of automatic log generated by the grouting rig. Grout material like OPC, Micro fine cement, ultra-fine cement, colloidal silica and PU shall be made separately under supply rate of such items.
ii. Other than consolidation grouting
   A. Contact Grouting
      a. The payment for contact grouting shall be deemed to have been included in the rate quoted for concrete for various works.
   B. Fill Grouting / Grouting of temporary drainage holes.
      a. The payment for fill grouting / grouting of temporary drainage holes shall be deemed to have been included in the rate quoted for concrete for various works.
   C. Curtain Grouting
      a. Payment for curtain grouting including supply and placing of the materials such as cement, sand, bentonite, admixtures etc. shall be made on the basis of cement consumed by weight only at the unit rate quoted for the item in schedule of item rate.

D. Crack Grouting
   a. No extra payment will be made for crack grouting in concrete and the cost thereof shall be deemed to be included in the Unit Rates per m^3 of concrete for various works.

E. Jet Grouting
   a. Payment for Jet grouting including supply and placing of the materials such as cement, sand, bentonite, admixtures etc. shall be made on the basis of cement consumed by weight only at the unit rate quoted for the item in schedule of item rate.

iii. Supply of grout materials
   A. Grout material consumed during grouting (OPC, Micro fine cement, ultra-fine cement, colloidal silica and PU) shall be made separately under supply rate of such items. The measurement for payment in this regard will be the grout placed inside holes only.
   B. Payment for sand or bentonite if used shall be paid separately.

iv. Embedded Pipes and Fittings for Grouting
   A. No separate payment will be made for embedded PVC/steel pipes and fittings or any packers or other consumables in rock and concrete for grouting and the cost of the same shall be deemed to be included in the works of grouting. It shall include the entire cost of supply installation, and protection against blockage of pipes and fittings.

v. Exclusions
   A. All costs for grouting of the rock bolts are excluded from this chapter and will be in accordance with the provision of Section of “Rockbolts and Wire mesh”.
   B. **Time costs on account of grouting activities shall not be paid and such time costs are assumed to be included in the quoted rates of excavation and included in the cycle time while calculating such rates.**
   C. No extra measurement for payment or payment will be made for the following.
      a. Preparation of trial mixes.
      b. Grouting materials used in mixture which has been prepared more than one hour prior to injecting or which have been lost due to improper handling or rejected due to improper mixing
      c. Supply and injection of water.
      d. Plugging and caulking leaks during grouting.
      e. Grouting/Packing of probe or grout holes with mortar when no grouting is required.
      f. Protection of drainage system, if any, during grouting.
      g. Communication facilities required during grouting.
      h. Closure of the holes as specified and clean up.
      i. Preparation and submission of records and reports on grouting operations.
      j. Drilling and backfilling of such holes, which have to be abandoned due to improper drilling by the Contractor.
      k. Re-cleaning or redrilling of holes, which are not protected by the contractor before grouting.
      l. Repair of concrete damaged during grouting.
      m. Use of micro silica/silica fumes or accelerators upto 2% in the grout mix.

SUB CHAPTER -15

15.0 CEMENT CONCRETE

15.1 SCOPE OF WORK

15.1.1 The Specifications described herein under cover all labour, materials, equipment and services related to the concrete work to be carried out by the Contractor under the Contact.

15.1.2 The concrete work shall be performed to the dimensions as shown on the drawings or as otherwise directed by the Engineer.

15.1.3 The Contractor shall cooperate with all other Contractors and organizations related to the construction of Permanent Works where the materials or equipment is to be fixed to, or embedded in, the concrete structures.

15.2 The approval given by the Engineer to the Contractor's plants and equipment or their operation, or of any construction methods shall not relieve the Contractor of his full responsibility for the proper and safe execution of concrete work or any obligations under the Contract. Submittals

15.2.1 Within 4 (four) weeks from the commencement date, but before procuring or mobilizing to the Site, the equipment, the Contractor shall submit to the Engineer, updated and detailed plans and descriptions, consistent with those submitted with his bid and any subsequent amendments and additions agreed to by the Engineer and the Contractor, of the following:

i. Aggregate Processing Plant

Description, flow diagrams and drawingsinsufficient details to indicate layout, type and capacity of crushing, screening, washing, conveying and other aggregate processing and handling equipment.

ii. Batching and Mixing Plant

Description, flow diagrams and drawings of the plants, and details of the equipment, the Contractor intends to use to determine and control the amount of each separate concrete ingredient and mixing thereof into uniform mixture.

iii. Concrete Cooling Plant

Details of refrigeration and ice plants and method, which the contractor proposes to use to comply with concrete temperature requirements.

iv. Heating Facility

Details of methods and equipment, which the Contractor proposes to use for cold weather concreting to comply with, concrete temperature requirements and protection from damage by freezing.

v. Transport and Placing of Concrete

Full details of the equipment and method for transporting the concrete from the concrete plant to the final point of placing, including, numbers, type and capacity of transport vehicles, Concrete pumps, and details of standby plant to be installed:

15.2.2 At least 8 (eight) weeks in advance of any concrete work being carried out on the Site, the Contractor shall submit to the Engineer, following information:

i. Details of any admixture and Pozzolana, which the Contractor proposes to use, name of manufactures thereof, and information about the chemical names of the principal ingredients and the likely effect of under or over dosage. Should the Contractor intend to use an accelerator in any concrete work for his own convenience, he shall give full details of the type, dosage, influence on construction, and the cost saving involved.

ii. Details of surface finish, treatment of construction joints, and construction, techniques, which the Contractor proposes to use in order to achieve the required concrete surfaces and allowable tolerances.

iii. System, methods, and equipment for prestressing steel and grouting of cables in prestressed concrete elements.

15.2.3 At least 4 (four) weeks prior to procuring or dispatch to the site of the particular item of work to which the submittal relates the Contractor shall submit to the Engineer, the following:

i. Details covering the properties and performance, including the certified copies of reports of all tests made by the manufacturers of water stops, expansion joint fillers, and joint sealing compounds along with samples of the products.

ii. Details of curing compounds.

iii. Details of epoxy mortar for concrete repair.

15.2.4 Drawings showing the location of construction joints proposed by the Contractor which differ from the approved drawings, including formwork and reinforcement details, shall be submitted to the Engineer for approval at least 4 (four) weeks prior to the commencement of work on that particular structure.

15.2.5 During the performance of the concrete work, the Contractor shall keep a diary where he shall record the construction procedures relatedto concreting. This diary shall be made available to the Engineer upon request. The records shall contain at least the following:

i. Commencement and termination of concreting of various parts of the structures.

ii. Quantities and quality of aggregates and cement provided and the storage from which they were drawn.

iii. Temperature of air, water, cement, aggregates and concrete.

iv. Meteorological conditions and humidity of air.

v. Personnel employed during various stages of the concreting operation and name of the responsible inspector or foreman.

vi. Equipment used.

vii. Directives received from the Engineer.

viii. Any special material or procedures employed.

15.2.6 The Engineer reserves the right to require any additional information deemed necessary to be included in the submitted documents.

15.3 STANDARDS

15.3.1 Mix design as per IS 456 / SP23.

15.3.2 The concrete materials, production, methods, testing and admixtures shall conform to the following Indian Standards (latest editions) or where not covered by these Standards, to the equivalent International Standards:

i. IS 456 Code of practice for Plain & Reinforce concrete.

ii. IS 5878 (Part-V) Code of Practice for construction tunnels conveying water concrete lining.

iii. IS 516 Method for Test for strength of concrete.

iv. IS 1199 Method of sampling and analysis for concrete

v. IS 457 Code of practice for general construction of Plain & reinforced concrete for dams and other massive structures.

vi. IS 9103 Concrete Admixtures

vii. IS 7861 (Part-I) Code of practice of weather concreting Recommended practice for hot weather concreting.

viii. IS 7861 (Part-2) Recommended Practice for Cold weather concreting.

ix. IS 2505 Concrete Vibrators-Immersion, Type General Requirements.

15.3.3 In cases of conflict between the above Standards and the Specifications given herein, the specifications shall take precedence.

15.4 QUALITY CONTROL AND TESTING

15.4.1 General

i. The quality control and testing of concrete and admixture will be carried out by the Contractor, in accordance with requirements specified elsewhere in tender documents.

ii. The contractor shall perform the 'testing of materials, propose the composition of concrete mixes and prepare trial mix of each of the proposed concrete class. The Contractor will prepare the trial mixes using the cement, water aggregates and admixtures intended for the Work. Such materials shall be arranged by the Contractor, which shall conform to the requirements specified in Section of "Material for Construction".

iii. This preliminary test programme will include the determination of the following parameters:

A. Cement properties.
B. Characteristics of aggregates.
C. Mix water properties.
D. Admixture properties.
E. Proportion of aggregate ranges in the mix.
F. Proportion of uncrushed to crushed aggregates.
G. Cement dosage.
H. Water cement ratio (W/C).
I. Workability of concrete mixes.
J. Compressive and Tensile strength.
K. **Deleted.**
L. Density.
M. Water tightness.

iv. These tests will be carried out until the concrete mixes show appropriate strength, workability, density, and water tightness without the use of excessive cement.

v. The mixes for different grades of concrete shall be proposed by Contractor to the Engineer for approval. **For Reinforced cement concrete M25 and above, minimum cement content shall not be less than 350 Kg/cum. For reinforced cement concrete of lesser grades minimum cement content shall not be less than 300 kg/cum. For Plain cement concrete minimum cement content shall not be less than 250 Kg/cum.**

vi. During the progress of the work, the mixes may be changed whenever, in the opinion of the Contractor with the approval of the Engineer, such change is necessary or desirable to obtain the required strength, workability, Water tightness, density, economy or to limit shrinkage.

15.4.2 Cement, Aggregate and Water

i. Cement, aggregates and water will be sampled and tested as set out in Section of "Materials for Construction".

15.4.3 Admixtures

i. Admixtures to be used will be tested for their suitability with the cement and materials to be used on the works and under proposed construction conditions. The contractor may use the following admixtures when required with the approval of Engineer.

A. Water reducing, set controlling admixtures so as to improve workability without reducing the strength or durability of the mix.

B. **Deleted.**

C. Accelerating agent in the concrete, mortar or grout to increase the rate of hydration, shorter the setting time or increase the rate of hardening or strength development.

D. Plasticizers to increase the workability of concrete for tunnel lining and for pumped concrete in general.

E. Micro silica (as per latest ASTM code) to produce high strength concrete.

ii. Admixtures will be sampled and tested as set out in IS: 9103 - 1979 (Reaffirmed 1990) and in case of lack of corresponding IS, with the ASTM specification C494 and C260.

iii. Admixtures shall be stored and handled so as to avoid contamination or damage to their properties by temperature or moisture changes or other influences.

iv. The quantity of admixture used, and the method of mixing shall be strictly in accordance with the manufacture's printed instructions, or as required to produce specified results and approved by the Engineer.

v. The contractor shall be held liable for any damages and difficulties resulting from the selection and use of admixtures such as delay in concrete placing or damage to concrete during forms removal and shall not be entitled to any time extension or claims resulting there from.

15.4.4 Concrete

i. Concrete test cubes shall be prepared and cured in accordance with IS: 456-2000. Six test cubes shall be made from each mix proposed for the different classes of concrete. Compressive strength of concrete will be tested at 7 and 28 days.

ii. The consistency of the proposed mixes will be tested by means of slump test. Specimen for slump tests will be taken from each batch of concrete used to match the test cubes.

iii. Air content will be determined in accordance with IS: 9103-1979 (Reaffirmed 1990).

iv. Prior to the execution of large-scale concreting work at the site, test will be performed to determine the temperature development due to hydration within the concrete with various types of cement. The temperature rise will be recorded, and corresponding diagrams established.

15.4.5 Polypropylene Fibers

PP Fibers shall conform to relevant International/National Standards or as instructed by Engineer.

Micro Synthetic fibres may be required to be added to concrete to enhance structural durability and desired structural performance in case of fire. When such fibers are required, contractor shall ensure that: -

(i) Micro synthetic fibers shall be CE certified (with Declaration of Performance certificate) in conformance to EN 14889-2.

(ii) Fibers shall be dry and free from oil, grease and chlorides and shall be provided with arrangements to deliver anchorage properties. The fibers shall satisfy the following parameters:

(a) Storage: Fibers shall be stored, handled and dosed in accordance with the manufacturer's recommendations. Generally, this will require them to be stored in dry, sealed containers until ready for use and shall be free from oil, grease, chlorides and

deleterious materials which may reduce the efficiency of mixing or spraying processes, or which may reduce bond between the fibers and the concrete.

(b) Fibers shall be dosed by automatic dosing system. Mixing procedure adopted by the contractor should be such that there is no fiber balling.

15.4.6 Tests During Execution of Works

i. Samples from the concrete being used for the permanent works, taken either at the batching and mixing plant or the placing point shall be cured and tested as per IS:456.

ii. In addition to the seven, twenty-eight days strength tests, the Engineer, may require contractor to undertake, ninety days strength test and also at other ages.

iii. Concrete for test specimens for compressive strengths will be collected at random as it comes out of the mixer or at placing point once every shift or more often as the Engineer may require, and in quantity sufficient to prepare necessary number of test pieces from each sample. The concrete so collected shall be a representative sample.

iv. In addition to the strength tests carried out as above, it is contemplated that tests on actual cores from the concrete laid in position may also be required as per directions of Engineer, and results thereof shall be in conformity with those obtained in cube cast at the batching and mixing plant or at the placing point. For this purpose, it may be necessary to establish relationship between concrete strength versus age, as it may be possible to test control cubes and cores of the same age taken from the hardened concrete in the structure. If the cores taken out show unreasonably low results, the work is liable to be rejected and may be required to be dismantled and redone with all consequences to the Contractor.

v. The Contractor shall fill the test holes left by the removal of the cores with concrete of the required strength to the satisfaction of the Engineer.

vi. Contractor will get Sampling, testing and quality assurance program approved from the Engineer.

15.5 PROPORTIONING OF CONCRETE

15.5.1 The Contractor shall get the proportioning of various grades of concrete done as per the latest standards and shall get the same approved from the Engineer.

15.5.2 **Deleted**.

15.5.3 To achieve the characteristic strength, water reducing super plasticizer or fluidizing agent shall have to be used, which shall be included in the quoted rate of concrete.

15.5.4 DELETED

15.5.5 **Deleted.**

15.5.6 Based on the analysis and tests made from time to time during the progress of Work on the samples of various ingredients of concrete e.g. cement, aggregates and admixtures, and the resulting concrete the Contractor shall propose to Engineer for approval about the quantity of each ingredient to be used in the concrete mix.

15.6 HANDLING OF AGGREGATES

15.6.1 The coarse aggregates shall be stacked in three stockpiles, designated 80 mm, 40 mm to 20 mm and 20 mm to 4.75 mm nominal size aggregates. A separate stockpile shall however be made for 150 mm nominal size aggregate.

15.6.2 If tests reveal that separation of the 10 mm and lower sizes is required, a separate pile shall be made for this aggregate.

15.6.3 The fine aggregate, having the required grading, shall ordinarily be stacked in two piles, one of which is washed and drained and other freshly washed, to minimize the variation in the moisture content.

15.6.4 Where crushed fine aggregate replaces a part of natural fine aggregate, the two shall be stacked in independent stockpiles.

15.6.5 It may be necessary to have two or three piles, by sizes, in case of natural fine aggregate to get the required grading.

15.7 BATCHING AND MIXING

15.7.1 Batching and Mixing Equipment

i. All aggregates shall be batched by weight.

ii. The batching and Mixing Plant shall be of the requisite capacity to maintain the required progress on different items of work.

iii. The Plant shall be capable of determining accurately, by direct weighing, the prescribed amount of the various ingredient including water, cement, and admixtures etc. and each individual size of aggregate entering the concrete and combining them to give a uniform mix within the prescribed time and discharging the mix without segregation.

15.7.2 Calibration of Measuring Devices

i. The Contractor shall provide standard test weights and other auxiliary equipment required for checking the operating performance of each scale and other measuring device and shall make periodic tests over the ranges of measurements involved in the batching operation.

ii. The tests shall be made in the presence of a representative, of the Engineer and shall be adequate to prove the accuracy of the measuring devices.

iii. The frequency of such tests will be determined by the Engineer. Unless otherwise directed, tests shall be made once in two weeks at random without any notice in the case of cement and water scales and once a month in the case of all other scales.

iv. The Contractor shall make such adjustments, repairs or replacements as may be necessary to meet the specified requirements for accuracy of measurement.

15.7.3 Mixing

i. All concrete shall be thoroughly mixed in the Batching and Mixing Plants / tilt batch mixer of an approved type, size and design as to positively ensure uniform distribution of the components throughout the mass during the mixing operations.

ii. Mixing shall be continued until there is a uniform distribution of the materials and the mass is uniform in color and consistency. If there is segregation after unloading from the mixer, the concrete shall be remixed. Unless otherwise authorized by the Engineer for mixers of one cubic meter capacity or less, the mixing of each batch shall continue for 1.5 to 2 minutes as specified in IS 456 after all materials, except the required amount of water, are in the mixer. For mixer of larger capacity, the minimum mixing time shall be increased by fifteen seconds for each additional 0.5 m3.

iii. The mixing time shall be increased when, in the opinion of the Engineer, the charging and mixing operation fail to result in the uniformity of composition and consistency within the batch and from batch to batch.

iv. Separation of coarse aggregate from mortar shall be avoided by proper arrangement of the discharge so that the concrete falls vertically and not diagonally into whatever container is to receive it.

v. Should the last fraction of the batch contain an excessive amount of coarse aggregate, this portion shall be retained and mixed with the succeeding batch.

vi. Discharge pipes of all water batches shall be of such a size and so, arranged that the flow into the mixer be completed within the first 25 % of the mixing time and delivered well inside the mixer where it is mixed quickly with the entire batch.

vii. Over mixing requiring additions of water to preserve the required consistency shall not be permitted.

viii. On no account shall any addition be made to any component of a concrete batch once that batch has been mixed and discharged from the mixer, whether for the purpose of re-tempering or any other reason, without the prior approval of the Engineer.

15.8 TEMPERATURE OF CONCRETE

15.8.1 Placing temperature of concrete for underground and open works shall be maintained between 10^0 C - 25^0 C and 10^0 C - 20^0 C respectively. In cold weather, the placing temperature of concrete for open works shall not be less than 10^0 C or as specified here under. The measures to maintain these temperatures shall, but not be limited to, the following:

15.8.2 During hot weather Conditions.

i. Pre-cooling coarse aggregate with refrigerated water or with cold air blasts.

ii. Using cold mixing water by adding ice. Ice, if used, shall preferably be batched by weight, separately from the water. In short time mixing when aggregates are pre-cooled substantially, the ice may not completely melt in the mixer. In such a case, additional mixing time may be required, or the amount of ice limited to about 30 % of the mixing water.

iii. Using cement having low heat of hydration.

iv. Insulating water supply lines and tanks or at least painting exposed portions white.

v. Insulating mixer drums or cooling them with sprays.

vi. Shading the batching, mixing and conveying equipment.

vii. Working only at night.

viii. Keeping mixing time and the time required to convey to the point of placement to a minimum.

ix. Spraying forms and reinforcement with water when they are exposed to direct sun light.

x. Placing concrete in accordance with the procedure set out in IS: 7861 (Part I)

xi. Protecting all freshly placed concrete from exposure to direct sunlight.

xii. Employing continuous moist curing.

15.8.3 During cold weather Conditions.

i. Pre-heating coarse aggregates as per provisions of IS:7861..

ii. Using hot water for mixing of concrete.

iii. Using calcium chloride in concrete about one percent by weight of cement. Calcium chloride shall, however, not be used in concrete which shall be subjected to Sulphate attack or where galvanized metal parts are embedded.

iv. Placing concrete in accordance with the procedure set out in IS: 7861 (part-II).

v. The temperature of concrete when being placed in cold weather shall be as follows:

A. Mass concrete, not less than 7° C

B. Structural concrete not less than 10° C.

C. Structures thinner than 300 mm, not less than 13° C

vi. Cold weather condition will be considered to be in effect when the mean daily temperature drops below 5° C for more than 3 successive days

vii. When the temperature above, 10° C occurs during more than half of any 24-hour periods, the concrete should no longer be considered as cold weather concreting & normal concreting practice shall apply.

15.9 CONVEYING

15.9.1 Concrete shall be conveyed from mixer to forms as rapidly as practicable by methods, which shall prevent segregation and / or loss of ingredients. In case such separation occurs, concrete shall be remixed before being laid in place.

15.9.2 The distance between the mixer and the place of concreting as also the mode of transport of concrete shall be subject to the prior approval of the Engineer.

15.9.3 Concrete shall be deposited in the final position as early as practicable but always within a period of 60 minutes or initial setting time after mixing. This limit may be modified by the Engineer to suit working or weather conditions.

15.9.4 Plants, such as buckets, cars, conveyors and pumping equipment which may be used for conveying concrete shall be of such size design and condition as to ensure an even and adequate supply of concrete at the placement area.

15.9.5 Particular attention shall be paid to prevent segregation at the ends of chutes, at hopper gates and at all other points of discharge.

15.9.6 Methods of conveying concrete to any part of the structure wherein the concrete is loaded into chutes, belt conveyor or other similar equipment and carried in a thin continuously exposed flow to the forms shall not be permitted except for very limited or isolated sections of the work, and only when approved in writing by the Engineer.

15.9.7 Where chutes are used, they shall be so constructed and arranged as to permit continuous flow of the concrete without separation of the ingredients. Chutes shall not have a slope steeper than 1 V: 2 H.

15.9.8 There shall be no vertical drop greater than 1.5 m except where equipment satisfactory to the Engineer is used to confine and control the falling concrete.

15.9.9 Concrete may be dropped through flexible elephant trunk chutes, provided some method is used at the lower end to retard the, speed of the falling concrete and prevent it from segregating.

15.9.10 Buckets for transporting concrete shall be manufactured as low slump concrete buckets.

15.9.11 The conveying plant shall be kept free from hardened concrete and foreign materials and shall be cleaned at frequent intervals.

15.9.12 During hot or cold weather, concrete shall be transported in deep containers, on account of their lower ratio of areas to mass, reduce the rate of loss of water by evaporation during hot weather and loss of heat in cold weather.

15.9.13 All conveying plant shall be supported independently of the forms, except as specifically permitted by the Engineer.

15.10 PLACING OF CONCRETE

15.10.1 General

i. No mortar or concrete shall be placed except in the presence of the Engineer or his authorized representative.

ii. The Contractor shall provide Engineer with a weekly placing schedule giving the detailed location of the pours, the approximate extent of pours and the date on which the concrete shall be placed.

iii. Concrete shall be placed only in locations where authorized and no concrete or mortar shall be placed until formwork, installation of reinforcing steel, steel ribs, piping and other embedded parts preparation of surface and necessary cleanup

have been done and checked and certified by the Engineer as being in conformity with Specifications and drawings.

iv. Concrete placed without prior knowledge and approval of the Engineer may be required to be removed and replaced.

v. Earth foundations on which concrete is to be laid shall be firm drained soil, free from any soft mud or other objectionable material.

vi. Whenever concrete is to be placed on earth, a layer of lean concrete shall first be placed before placing concrete of the specified grade. The thickness of such layer of lean concrete shall be as shown on the drawings or as directed by the Engineer.

vii. No concrete shall be placed in running water. Water shall generally, not be allowed to flow over freshly poured concrete until final set been achieved.

viii. Immediately, before placing concrete, all such surfaces upon which concrete is to be placed shall be thoroughly cleaned by the use of high velocity air and water jets or sand blasting, steel brooms, picks or other effective means, satisfactory to the Engineer.

ix. All pools of water from the surface on which concrete is to be placed shall be cleaned to ensure proper bonding of fresh concrete with the rock surface. The method of disposal of water in working site shall be subject to the approval of the Engineer.

x. Sufficient mixing and placing capacity shall be provided so that the work may be kept alive and free from cold joints. Formed concrete shall be placed in horizontal layers, avoiding inclined layers and construction joints.

xi. To get a monolithic placement, it is important that each layer be shallow enough so that the previous layer is still soft, and the two layers are vibrated together.

xii. Concrete shall not be allowed or caused to flow horizontally or on slopes in the forms.

xiii. Concrete placing on slope shall begin at the lower end of the slope and progress upward, thereby increasing compaction of concrete.

xiv. In order to reduce bleeding, slump shall not be more than necessary to achieve proper placement and consolidation.

xv. All care shall be taken to avoid separation of coarse aggregate from the concrete. Obvious groups and clusters of separated coarse aggregates shall not be permitted. They shall be removed before the concrete is placed over them, otherwise they may cause serious imperfections in the finished work. Hence particular attention shall be paid to the tendency for objectionable separation to occur at the points of discharge so that uniformity and homogeneity of concrete in placement and good workmanship is assured.

xvi. The concrete shall drop vertically into the center of whatever container receives it. To protect the rods, spacers and embedded features from damage and to prevent displacement of reinforcement, concrete falling in forms shall be confined in a suitable drop chute.

xvii. In pneumatic placement of concrete, usual high velocity discharge shall be reduced to a point where no separation and scattering of the concrete occurs.

15.10.2 Preparation for Placing of Concrete.

i. All surfaces on which or against which concrete is to be placed, including surface of construction joints between successive concrete placement, reinforcing steel and embedded parts, shall be thoroughly cleaned of dirts, mud, debris, grease, oil dried mortar or grout, laitance, loose particles or other deleterious matter.

ii. Surface seepage and other water shall be so controlled, to the satisfaction of the Engineer, that at no time during the placement or hardening of the concrete will it wash, mix with, or seep into the concrete.

15.10.3 Concrete Placement

i. The method and equipment used for placing concrete shall be such as shall permit the delivery of concrete of the required consistency into the Work without objectionable delay, segregation, porosity or loss of workability.

ii. All surfaces of forms and metal work including reinforcement bars that has become encrusted with dried mortar or grout from concrete previously placed, shall be cleaned of all such matter or grout before the surrounding or adjacent concrete is placed.

iii. Concrete shall be placed in lifts as shown on the drawings or as directed by the Engineer.

iv. In reinforced concrete work, which has congested parts, care shall be taken to see that all the bars are properly embedded and that no voids are left. On flat, horizontal surfaces, where the congestion of steel near the forms makes placing difficult, a mortar of the same cement sand ratio as is used in the concrete shall be first deposited to cover the forms.

v. After the surface has been prepared, all approximately horizontal surfaces or rock and construction joints shall be coated with cement slurry of water cement ratio approximately of 0.60 by weight or as directed by the Engineer. It shall then be covered with layers of mortar approximately 50 mm to 75 mm thick for rock surface and approximately 15 mm thick for construction joints. The mortar shall have the same proportion as that of concrete mix unless otherwise prescribed by the Engineer. The consistency shall be suitable for placing and working in the manner hereafter specified. The mortar shall be spread uniformly and thoroughly with stiff brooms into all irregularities of the surfaces. Concrete shall then be immediately laid upon the fresh mortar.

vi. No concrete shall be placed in running water or during rain, high winds, dust storms, excessive heat or cold and similar conditions without prior approval of the Engineer.

vii. In all cases, concrete shall be deposited as nearly as practicable directly in its final position and shall not be caused to flow by vibrators or otherwise in a manner which shall permit or cause segregation.

viii. The maximum time interval between placing successive layers within a lift shall not exceed 30 minutes. However, depending upon job requirements and climatic conditions, the Engineer can allow increasing this time interval using appropriate methods of vibration / agitation.

ix. Concrete shall not be piled up in the forms in a manner that causes movement of the unconsolidated concrete or permit mortar to escape from the coarse aggregate.

15.10.4 Rate of Placing of Concrete.

i. Concreting shall be done as a continuous operation until the structure or section is completed or until a satisfactory construction joint can be made. The Contractor shall make all arrangement necessary to maintain continuity of concrete placing in any particular pour during meal periods shift changes or any other such interruptions.

ii. Concrete shall not be placed faster than the placing crew can compact it properly.

iii. In placing thin members and columns, precaution shall be taken against too rapid placement, which may result in movement or failure of the form due to excessive

lateral pressure. An interval of atleast 24 hours, unless otherwise approved or directed by the Engineer, shall elapse between the completion of columns and walls and the placing of slabs, beams or girders supported by them.

iv. The rate of placing shall be such as to have no objectionable effect on placement of concrete, particularly near forms and in and around embedded equipment where the rate shall not exceed the limit placed by the Engineer.

15.10.5 Consolidation of Concrete.

i. Consolidation of newly placed concrete shall ordinarily be done with internal vibrators of approved design. The equipment for vibration shall have adequate power and shall be of high frequency, rugged and reliable.

ii. Operators of vibrators shall be experienced, competent in handling these devices.

iii. Ample stand by units and parts as well as systematic servicing shall be provided.

iv. Vibrators shall not be used to, cause concrete to move more than a short distance laterally, otherwise fine wet material may run ahead and separate from the coarse aggregate.

v. Inadvertent or unintended re-vibration of concrete is beneficial provided the concrete becomes momentarily plastic again during re-vibration. Re-vibration shall be resorted to only after specific instructions are given by the Engineer.

vi. Where vibration is used to full advantage for consolidation of newly placed concrete, no supplementary roding or other working of the concrete is necessary.

vii. Concrete shall be compacted and worked into all corners and angles of forms, obstructions, blockouts, and locations with congested reinforcement and around embedded items. Special care shall be taken to attend to these places with ample, properly applied additional vibration or roding as the case may be, without permitting the concrete materials to segregate.

viii. Internal vibrators of approved weight and frequency 7000 to 9000 rpm to secure maximum consolidation shall be used,

ix. External i.e. form vibrators of an approved type shall be used only in inaccessible locations and where it is impracticable to use immersion type vibrators after their use has been specifically authorized by the Engineer. The form vibrators shall be designed to receive vibrations without losing shape and causing leakage of mortar.

x. The immersion type mechanical vibrators, complying with IS 2505 electric, air driven or diesel, shall generally be inserted vertically and the vibrating head shall be allowed to penetrate under the action of its own weight. In very shallow concrete, some consolidation can be obtained by using vibrators in horizontal position.

xi. Internal vibrators, when used, shall be inserted at regular intervals and vibration, with the vibrator fully into the layer being compacted, shall be continued till acceptable degree of compaction has been achieved taking care to avoid excessive paste and laitance.

xii. The entire depth of new layer of concrete shall be vibrated and ordinarily the vibrators should penetrate the layer below (which has not yet become rigid) for several millimeters to ensure thorough bond between the layers.

xiii. Under ordinary job conditions, there is little likelihood of damage from direct re-vibration of lower layer or by vibration transmitted by embedded steel provided the disturbed concrete still is or again becomes plastic. Vibrators shall not, however, be inserted into lower courses that have commenced final set nor shall they be directly applied to or allowed to disturb reinforcement extending into hardened or partially hardened concrete.

xiv. Systematic spacing of points of vibrators shall be established to ensure that no portions of the concrete are missed. It shall be ensured that zones of influence overlap and the concrete is properly consolidated.

xv. In compacting the surface of a concrete lift, the coarser particles of the aggregate in the surface shall be embedded while the concrete is being vibrated, but the surface left with the desired degree of roughness.

xvi. Disturbance of the surface concrete at construction joints during early stage of hardening shall be on timber walkways constructed so as not to cause injury to the concrete.

xvii. When smooth surfaces are required, for all surfaces, which shall be permanently exposed to the weather, and for all surfaces next to embedded metal work around which it is desired to prevent leakage, the adjacent concrete shall be properly vibrated, spaded or tamped.

xviii. To ensure even and dense surfaces which are free from aggregate pockets, honey combing or air holes, it may be necessary to supplement internal vibration with hand spading or tamping all along the boundaries of the concrete and around embedded parts, while the concrete is plastic under vibrating action.

15.11 CONCRETING IN UNDERGROUND AND OPEN WORKS

15.11.1 Tunnel/Chambers Concrete Lining

i. Wherever required as per approved design and drawings, Concrete to be used for the tunnel /Chambers concrete lining shall be of the grade as specified on the drawings or as directed by the Engineer.

ii. **DELETED**

iii. The contractor's proposed method of concrete placement is subject to the approval of the Engineer.

iv. Invert concreting of the tunnel shall be carried out before the sides and arch are concreted. The contractor may, however, propose an alternative sequence, which can be adopted, if approved by the Engineer.

v. The tunnel lining shall either be poured in sections or by continuous pouring. If the contractor wishes to use the latter method, then he shall first satisfy the Engineer that the concrete production, transport and placing equipment to be used has sufficient capacity to produce and handle the quantity of concrete necessary for continuous pouring of the lining sections. In addition, the Contractor shall submit details of the steps to be taken in the event of an interruption in the concrete supply.

vi. Where the Overbreak in excavation beyond the theoretical lines and grades exceeds acceptable limits, as determined by the Engineer, the Contractor shall fill up with plain concrete if shotcrete placement is not feasible or as directed by The Engineer.

vii. Openings for the drainage trench (where executed) shall be left in the concrete lining to serve as cleaning andcontrol pits at intervals as shown in the drawing, or where directed by the Engineer. After fill grouting of the entire system of temporary invert drains, these openings shall be filled with concrete of specified grade containing a non-shrink agent.

15.11.2 Concrete in RCC Frames / Walls / Slabs /Floors/ Foundations

i. The specification given hereunder shall be applicable for Concrete in RCC Frames / Walls /Slabs/Floors/ Foundations in all structures underground / open area including tunnel portals.

ii. Concrete shall be placed in lifts of heights as shown on the drawings or as directed by the Engineer. Within each lift, concrete shall be deposited in

approximately horizontal layers about 40 cm in thickness unless otherwise directed by the Engineer.

iii. At locations where lift heights are not shown on the drawings, the Contractor shall submit to the Engineer for approval, details of the placing procedure he proposes. No concrete shall be placed at such locations without the prior approval of the Engineer.

iv. At locations where lift heights are not shown on the drawings, the Contractor shall submit to the Engineer for approval, details of the placing procedure he proposes. No concrete shall be placed at such locations without the prior approval of the Engineer.

v. In walls, lifts shall terminate at such levels as will conform to the structural requirements.

vi. The placement of concrete shall be carried out at such rate and in such a manner that the formation of cold joints is prevented.

vii. Where slabs and beams are placed continuously with walls and columns, the concrete in walls and columns shall have been in place for at least 2 hours or for a longer period when so directed by the Engineer before placing concrete in the slabs and beams.

15.11.3 Concrete Deposited in Water.

i. Concrete shall be deposited in water only with the prior approval of the Engineer.

ii. Concrete placed underwater shall be deposited by tremie or by a valved tremie.

iii. The methods and equipment used shall be subject to the prior approval of the Engineer.

iv. Concrete buckets shall not be permitted for underwater placement of concrete.

v. The tremie seal shall be affected in a manner, which will not produce undue turbulence in water around the pipe. The discharge end shall be kept submerged continuously in the concrete and the concrete pumped in without interruption until the concrete has been brought to the required height. The tremie shall not be moved horizontally during the placing operation and a sufficient number of tremies shall be provided so that concrete does not have to flow horizontally, a distance of more than 3 meters.

15.11.4 Plugging of Niches

i. When no longer required, for turning / parking of the equipment, the niches shall be filled with concrete of grade M-15.

15.12 CHIPPING AND ROUGHENING OF CONCRETE SURFACES

15.12.1 Surface upon or against which additional concrete is to be placed shall be chipped and roughened to a depth of not greater than 25 mm.

15.12.2 The roughening shall be performed by chipping, sand blasting or other satisfactory methods and in such manner as not to loosen, crack or shatter any part of concrete beyond the roughened surface.

15.12.3 After being roughened, the surface of the concrete shall be cleaned thoroughly of the loose fragments, dirt and other objectionable substances and shall be sound and hard in such condition as to assure good mechanical bond between old and new concrete.

15.12.4 All concrete, which is not hard, dense and durable shall be removed to the depth required to secure a satisfactory surface.

15.12.5 Prior to placement of new concrete against the old concrete surfaces and the concrete surfaces over which flood has passed shall be chipped and roughened to a depth of not greater than 25 mm or sand blasted to make them clean and free from loose materials / laitance, grease, etc. so as to develop good bond between the old concrete and new concrete.

15.12.6 Just before placement of concrete, the rock / concrete surface shall be cleaned by high velocity water jet (about 5 kg/cm3 at the nozzle) followed by careful blowing of high pressure air jet as to make the surface free from dirt, mud, debris, grease, oil, laitance, grout, loose particles and other deleterious matter Contractor shall also use picks, wire brushes, if necessary for cleaning. All pools of water shall be removed from depressions.

15.13 DEFECTIVE AND DAMAGED CONCRETE

15.13.1 Concrete which is damaged from any cause and which is not manufactured, placed and compacted in accordance with these specifications and is found to have lower strength, density etc. than specified, as determined from test samples or core samples, shall be removed and replaced by the Contractor.

15.14 FINISHING OF CONCRETE

15.14.1 Finishing of Formed Surfaces

Except as otherwise specified or directed, all permanently exposed concrete surfaces and other waterway surfaces requiring durability under water shall be finished in the following manner:

i. Any damage to finished concrete resulting from the action of removing formwork or from any other cause shall be repaired to the satisfaction of the Engineer. Immediately on removal of the form, the surface shall be examined, and all porous honeycombed or defective concrete removed and repaired as specified herein.

ii. All imperfections or ridges due to joints in the formwork, shall be removed by light chipping-or grinding down if necessary, to produce a smoother surface.

iii. When the treatment of a surface has been completed, the surface shall be cured.

iv. All patches and mortar filled pits on exposed surfaces shall be neat and have the same color and texture as the adjoining concrete.

v. The finished surfaces of concrete shall be true, sound, smooth and free from fins, offsets, pits, depressions, voids, blemishes and other defective concrete and surface irregularities and shall be in accordance with the requirements for the particular class of finish specified herein or as shown on the drawings.

vi. Finishing work shall be done only by skilled workman in the presence of the Engineer and shall be performed within 4 weeks of placing.

vii. Before final acceptance of the work, Contractor shall clean all exposed concrete surfaces of all encrustations of cement, mortar or grout, to the satisfaction of the Engineer. Concrete shall not be considered finished until all required repair work and finishing have been completed.

15.14.2 Finishing of Unformed Surfaces.

Unformed surfaces shall be, finished by one or more methods of screeding, floating and troweling and working of the surfaces shall be done at the proper time, employing experienced men and shall be just sufficient to produce the desired finish.

i. Screeding
   A. It gives the surface its approximate shape by striking off surplus concrete immediately after completion and shall be accomplished by moving a straight edge or template with a swing motion across wood or metal strips, which have been established as guides.
   B. Where the surface is curved, a special screed shall be used.

ii. Floating.
   A. Shortly after the concrete is screeded, the surface shall be brought true to form and grade by working it sparingly with a wooden float. If a coarse textured finish is specified or if the surface is to be steel troweled, a second or final floating shall be performed after some stiffening has occurred and the surface moisture film or shine has disappeared.

iii. Troweling
   A. If a smooth dense finish is desired, floating shall be followed by steel troweling after moisture film or shine has disappeared from the floated surface and when the concrete has hardened sufficiently to prevent fine material and water from being brought up to the surface. Excessive troweling at an early stage as would tend to produce cracking or result in surface that is too hard to finish properly shall be avoided.
   B. Troweling shall, therefore, be done at the appropriate time and shall have the surface smooth, even and free of trowel marks and ripples. A fine textured surface that is not slick shall be obtained by troweling lightly over the surface with a circular motion keeping the trowel flat on the surface of the concrete. Where a hard steel troweled finish is required, troweling shall be continued until it no longer produces noticeable compaction and the surface has a glossy appearance, troweling pressure being increased gradually as the operation progress.
   C. The use of any finishing tool in areas where water has accumulated shall be prohibited. Operation on such areas shall be delayed until the water has been absorbed or has evaporated or has been removed by draining, mopping or other means.
   D. All joints and edges on unformed surface, that shall be exposed to view, shall be finished with suitable moulding tools with rounded, beveled or filleted edge, as directed by the Engineer. Unless the use of other slopes or level surface is indicated on the drawings as directed, narrow surfaces such as top of wall or tunnel portals shall be sloped approximately 9 mm per 300 mm of width. Broader surfaces as walls, roadways platforms and decks shall be slopped approximately 6mm per 300 mm.
   E. Where separate floor finish is specified or directed, the concrete shall be stuck of sufficiently below grade to allow for the subsequent placing of a finished floor. The surface of such concrete shall be left rough.
   F. As soon as the condition of the base permits and before it has hardened fully all dirt, laitance and loose aggregate shall be removed from the surface, by means of water jets and wire brooms leaving the coarse aggregate slightly exposed and the surface made suitable for taking further concrete.

15.15 CURING AND PROTECTION OF CONCRETE

15.15.1 Plant and material required for curing and protection of concrete shall be available at the location of each concrete placement before concrete placement is started and the water used for curing shall meet the requirements set out in Section of “Materials for Construction” of these documents.

15.15.2 All concrete shall be protected against injury until final acceptance.

15.15.3 Exposed finished surfaces of concrete shall be protected from the direct rays of the sun for at least 72 hours after placement.

15.15.4 Fresh exposed concrete shall also be protected from the action of the rains, flowing water and mechanical injury.

15.15.5 No fire shall be permitted in direct contact with concrete at any time.

15.15.6 Concrete in which standard Portland cement is used shall be kept continuously moist for not less than 14 days, for normal concrete and 21 days for concrete containing Pozzolana, by covering with water saturated materials or a system of perforated pipes, mechanical sprinklers or porous hose or any other approved method. Curing period where special cement may be used shall be specified by the Engineer.

15.15.7 Construction joints shall be cured in the same manner as the other concrete and shall also, if practicable, be kept moist for at least 72 hours prior to the placing of additional concrete upon the join.

15.15.8 Horizontal surfaces shall be cured by sprinkling water or by covering with damp sand or may be cured by the use of wet quilts or mats which will satisfactory supply the required curing water. If damp sand or quilt is used for curing, it shall later be completely removed. The time of applying damp sand shall be specified by the Engineer before which curing shall be, carried out by other approved methods.

15.15.9 The method of keeping formed concrete surface moist shall be continuous sprinkling or spraying of water as may be necessary to prevent any portion of the surface from drying during the specified period.

15.15.10 The water and other methods of curing shall be so handled as not to stain concrete surfaces, which shall be exposed.

15.15.11 The actual method of curing adopted shall be subject to the approval of the Engineer.

15.15.12 The Contractor shall have on hand and ready to install before actual, concrete placement is started, all equipment needed for adequate curing and protection at all locations of concrete placement.

15.15.13 In limited areas and for special purposes, the use of an approved and properly applied compound may be permitted at the discretion of the Engineer to restrict the evaporation of the mixing water. Such curing compound shall be of the surface membrane type, which will thoroughly seal the surface. Curing compounded shall not be used on joints where bonding is required.

15.15.14 Curing compounds shall be applied according to the manufacture's recommendations to provide a continuous uniform membrane over all area. Curing compounds shall be applied only after moist curing has been carried out for at least 24 hours.

15.15.15 A curing compound shall not be used on any unformed surface, where, in the opinion of Engineer, the irregularities in that surface would prevent the membrane forming an effective seal, on any surface which has a temperature lower than manufacturer's recommended application temperature, or any surface where a bond is required for additional concrete, or where a curing compound is placed on a surface where a bond is required, it shall be removed by sand blasting or by other means satisfactory to the Engineer.

15.15.16 Curing membranes shall be protected from damage at all times.

15.15.17 Care shall be taken not to disturb the steel reinforcement projecting from any placement for at least 24 hours after the completion of such placement.

15.15.18 Finished concrete surface shall be protected from stains or abrasion and surface or edges likely to be injured during the construction period shall be kept properly projected by leaving forms in place or erecting protective covering satisfactory to the Engineer.

15.15.19 In case, the curing operations are inadequate or unsatisfactory, the Engineer shall be entitled to take such steps as he may deem necessary to make good the deficiencies and defects.

15.16 REPAIR OF CONCRETE

15.16.1 General.

i. Repair of concrete shall be performed by skilled workmen and in the presence of the Engineer.

ii. No repair work shall be carried out until the Engineer, has inspected the location of the proposed repair and accepted the method of repair.

iii. The Contractor shall correct all imperfections on the concrete surfaces as necessary to produce surfaces that shall conform to the required standards.

iv. All materials procedures and operations used in the repair of concrete shall be subject to approval by the Engineer.

v. Surface of concrete finished against forms shall be smooth and free from projections. Immediately upon the removal of forms and within 24 hours thereof, wherever practicable, all unsightly ridges or fines shall be removed and any local bulging on exposed surfaces shall be remedied by tooling and rubbing. All holes left by the removal 6f fasteners from the tie rods shall, after being reamed with a toothed reamer, be neatly filled with dry pack mortar.

vi. All honeycombed, porous, fracture or otherwise defective concrete and surface concrete in which, in the opinion of the Engineer, additions are required to bring it to the prescribed lines, shall be removed by chipping concrete.

vii. The chipped openings shall be sharp edged and keyed and shall be filled to the required lines with fresh concrete or as found suitable. Where concrete is used for filling, the chipped openings shall be not less than 100 mm in depth and the fresh concrete shall be reinforced and dowelled to the surface of the openings as directed by the Engineer.

viii. Dry pack mortar shall consist of one part of cement to two parts of sand by volume and just enough water so that the mortar as used sticks together on being moulded into a ball by slight pressure of the hands and does not free water when so pressed but leaves the hands damp. The mortar shall be fresh when placed and any mortar that is not used within 30 minutes, after preparation shall be wasted with all consequences to the Contractor

ix. The mortar shall be placed in layers not more than 25 mm thickness after being compacted and each layer shall be thoroughly tamped to the satisfaction of the Engineer. Each layer except the last shall be roughened thoroughly to provide effective bond with the succeeding layers. The last or finishing layer shall be smoothened to form a surface continuous with the surroundings concrete. Dry pack mortar shall be used for filing behind reinforcement or for filling holes that extend completely through a concrete section. Shotcrete shall be used for holes too wide for dry pack mortar filing and too shallow for concrete filling and no deeper than the far side of the reinforcement that is nearest to the surfaces.

x. All patches shall be bonded thoroughly to the surface of the chipped opening and shall be sound and free from shrinkage cracks and trummy areas.

xi. Concrete surfaces where high velocity flows may occur and as required by the Engineer, repair to the surfaces having F3 and U3 finishes shall be bonded with an epoxy adhesive acceptable to the Engineer.

xii. All repairs to the surface of concrete for flowing water shall be ground smooth to meet the tolerances set out in clause 14.3 of these specifications.

15.16.2 Sealing works in Structural Concrete

i. The Contractor shall carry out sealing work to reduce water inflow and water losses through, and to guarantee the normal water tightness of the concrete according to criteria stated hereafter and as requested by the Engineer.

ii. The sealing work shall be carried out when the following phenomena are encountered:

A. Cracks or joints of width greater than 0.20 mm regardless whether they are dry or wet.

B. Areas of porous concrete (e.g. Due to poor vibration) of which depth is obviously deeper than superficial.

C. Grout holes filled only with cement I water mix.

iii. The sealed work shall be excavated as under:

A. Crack or joint 0.20-0.6 mm wide shall be repaired as stipulated in Section of “Drilling and Grouting"

B. Crack or joint wider than 0.6mm shall be repaired as under (a) above, followed by cutting a groove 25 mm X 25 mm along the joint or crack and subsequent filling with an epoxy mortar

C. Areas of porous concrete shall be grouted under high pressure (30 kg/sq.cm) with cement group mix W/C = 0.7, by weight containing a water reducing admixture. Grout holes shall be drilled at 50cm spacing up to the rock. After grouting the area shall be repaired with epoxy mortar.

D. Grout holes filled only with water I cement mix shall be redrilled up to ⅔ rd of the theoretical lining thickness and filled with dry pack mortar.

15.17 CONSTRUCTION JOINTS

15.17.1 Concrete surfaces, which become so rigid, by reason of limitations in the rate of placing of concrete imposed by these specifications or by reason of delay in construction progress, that in the opinion of the Engineer, the new concrete cannot be integrally incorporated with that previously placed, shall be defined as construction joints.

15.17.2 Construction joints shall be located in the positions shown on the drawings or as directed by the Engineer and the Contractor shall not be permitted to make any additional joints or deviate from the joints indicated on the drawings without the written authorization of the Engineer.

15.17.3 Joints as exposed surfaces of concrete shall be straight and continuous as shown on the drawings or otherwise directed.

15.17.4 The concrete of the earlier pour shall be hacked to produce a rough, surface or green cut with air-water jet or by sand blasting after the concrete has hardened sufficiently as directed by the Engineer. Before placing new concrete, the surface shall be restored to the condition existing immediately after hacking or green cutting by means of another washing with air-water jet, vigorous brushing, sand blasting etc.

15.17.5 All the points shall be cleaned by, the Contractor to the satisfaction of the Engineer. All intersections of construction joints with concrete faces, which will be exposed to view, shall be made straight, level and in plumb.

15.17.6 All exposed construction joints shall conform to the requirement of aesthetics and their pattern shall be subject to the approval of the Engineer. Surfaces of the construction joints, which have been permitted to dry by reasons of the succeeding layer not placed within the specified moist curing period, shall be kept moist for at least 72 hours prior to placing the succeeding layers.

15.17.7 Horizontal construction joints shall be arranged wherever possible to coincide with joints in the formwork.

15.17.8 To prevent feather edges, the construction joints at the tops of horizontal lifts near sloping exposed concrete surface shall be inclined near the exposed surface so that the angle between such inclined surface and the exposed concrete surface shall not be less than 50 degrees Celsius.

15.17.9 When the work has to be resumed on a surface, which has hardened, such surfaces shall be roughened, and new concrete placed after taking all measures mentioned.

15.17.10 The use of a retarder shall not relieve the Contractor of the responsibility of producing surfaces at construction joints as specified and to the satisfaction of the Engineer.

15.17.11 Disturbance of surface concrete at the joints shall be avoided during the early hardening period. Before placing the succeeding layer, the surface of the construction joint shall be thoroughly cleaned and loose, defective concrete shall be removed satisfactorily.

15.18 EXPANSION AND CONTRACTION JOINTS

15.18.1 Expansion and contraction joints shall be constructed at such points and of such dimensions as indicated on the drawings or as required by the Engineer. The method and material used shall be subject to the approval of Engineer.

15.18.2 Standard bitumen sheets, impregnated with saw dust or any other filler material and sealing compounds, required to be, placed in the expansion joints, shall be fixed in position as shown on the drawing or as directed by the Engineer.

15.19 EMBEDMENT IN CONCRETE / ROCK

15.19.1 Anchor Bars.

i. Wherever indicated on the drawings or directed by the Engineer, holes shall be drilled into rock to receive bars for anchoring to the rock, concrete or masonry structures or parts thereof.

ii. The type and dimensions of the anchor bars, locations, diameter and depths of anchor bar holes shall be as shown on the drawings or as directed.

iii. Anchor rods shall be thoroughly cleaned. Before being placed in the drill hole. The hole shall be filled with grout. The grout shall be workable 1:1 sand: cement mix with low water cement ratio. Admixtures for fast setting low shrinkage may also be required.

iv. Wherever practicable, anchors shall be installed before the concrete is placed, except when otherwise provided or permitted.

v. Drilling for the installation of anchors in the concrete shall not be carried out except with the prior approval of the Engineer.

vi. Where the installation of anchors prior to placing of the concrete, is not practicable, satisfactory formed openings shall be provided for holes drilled for the purpose and the anchors grouted in the openings at some late date.

vii. In the case of reinforced concrete foundations, anchor bolts for machinery may be placed in approved pipe sleeves to facilitate machinery installation and the sleeve

shall be completely filled with grout or mortar as directed by the Engineer. The exact method adopted shall be subject to the prior approval of the Engineer.

viii. The anchors shall be protected against disturbance for minimum of 48 hours after installation or more as required by the Engineer.

15.19.2 Embedded Parts.

i. Before placing concrete, care shall be taken to ensure that all embedded parts are firmly and accurately fastened in place as indicated on the drawings or as directed.

ii. All embedded parts shall be thoroughly cleaned, free from all foreign matter such as scale, rust, oil etc.

iii. The Contractor shall not place concrete on embedded parts unless these are checked and approved by the Engineer.

iv. If concrete is placed by, the Contractor without correctly placing in position the necessary embedded parts, concrete shall have to be removed and replaced by him to enable such embedded parts to be installed in position without any extra payment to him.

v. Care shall be taken not to disturb or displace embedded parts during concrete placement.

15.20 MEASUREMENT AND PAYMENT

15.20.1 CONCRETE

i. Measurement for payment for concrete, unless specified otherwise hereafter, will be of the volume (per cum) placed within the lines, grades, and pay limits shown on the drawings or as established on the site by the Engineer.

ii. Unless otherwise stated, no payment will be made for concrete placed outside these limits, other than in additional excavation as directed by the Engineer and for filling of Geological overbreak.

iii. The unit rates quoted in the Schedule of item rates shall include the entire cost of material including cement, aggregates, admixtures including Super plasticizers /accelerators/ curing agents/ releasing agents etc. or other additives like Micro Silica/ silica fume etc. The quantity of materials shall be as per approved Mix design subject to minimum requirements given in the specifications.

iv. The payment of concrete shall be made at the unit rate quoted for respective items of concrete as specified in the Schedule of item rates, which shall include, but not be limited to, the following:

A. Excavation, loading, transportation, screening, crushing, washing, blending and storage' of aggregates.

B. Batching, supply of mixing water, supply of materials like cement & admixture & additives, mixing, transportation, placing and compacting the concrete.

C. Labour, tools and equipment for cleaning and preparing surfaces prior to concreting.

D. Concrete, pumping of the concrete, including furnishing and mixing the necessry admixtures/additives.

E. Forming and treatment of construction joints including furnishing and spreading of mortar layers before concrete placing.

F. Surface finishing.

G. Attaining the concrete temperature as specified and following hot and/or cold weather precautions.

H. Protection and Curing of Concrete.

I. Repair of defective concrete and scaling of joints.

J. Communication system connecting the points of placing concrete with the relevant mixing plant or delivery equipment.

K. Chipping and roughening of concrete surface.

L. Sampling, testing & Quality arrangements of material, i.e. Cement, Course & Fine Aggregate, Water, Admixtures and also the samples of Mortar, fresh concrete, hardened concrete etc., and providing assistance.

M. Design, furnishing, maintenance, erection, and removal of formwork.

N. Embedding fixtures, other installations, electrical, communication conduits etc.

O. Pre-cast concrete RCC units damaged by improper storing, handling transportation.

P. For repairing of concrete as mentioned in Clause 15.16.

15.20.2 Tunnel Lining Concrete (Inner Lining):

i. Measurement for payment of the inner lining in-situ concrete in the tunnel will be of the theoretical volume of the inner lining as defined on the design drawings, increased by the volume corresponding to the difference between the applied deformation tolerance (as approved by the ENGINEER, (SEE Fig. 8.5.1) and the measured average radial deformation at the closest monitoring cross-section of the same rock support class (e.g. if applied deformation tolerance is 150 mm and measured average radial deformation are 90 mm, the theoretical thickness of the concrete lining will be increased by 60 mm for the payment).

ii. The unit rates for the inner lining concrete shall include, in addition to the works described above under 15.20.1 (iv), the entire cost of the following:

a) Design, furnishing, maintenance, erection and removal of steel formwork.
b) Pumping of the concrete, including furnishing and mixing the necessary plasticizer.
c) Installation of ducts (recesses)
d) Sealing of cracks, cold joints etc, where directed by the ENGINEER
e) Contact grouting

15.20.3 Backfill Concrete in Underground Excavation.

i. No separate payment for backfill concrete shall be made. However, Measurement of the cavity or void formed by Geological Overbreak as well as volume in between "A Line" and "Z Line" bound within the radial projection of GOB profile shall be measured in-situ and shall be quantified and approved by the Engineer. Payment for filling with shotcrete / concrete / grout shall be made in accordance with the Unit Rate quoted in the Bill of Quantities.

15.20.4 Backfill Concrete in Open Excavation.

i. No separate payment for backfill concrete shall be made. However, where backfilling with concrete is directed by the Engineer, payment will be made for concrete placed as backfill in geologically accepted over-break, and in additional excavation directed by the Engineer at Unit Rate(s) for the relevant grade of concrete.

15.20.5 Concrete in RCC Frames / Walls / Slabs /Floors/ Foundations

i. Payment for concrete in the Frames / Walls / Slabs / Floors/ Foundations shall be made as per the quoted Unit Rate(s) for the relevant grade of concrete per cubic meter in Schedule of Item Rates.

ii. The cost of concrete in RCC Frames / Walls / Slabs / Floors/ Foundations shall include, in addition to the works described under clause 15.20.1, the entire cost of the following:

A. Sealing of cracks, cold joints etc. where directed by the Engineer.

15.20.6 Grouting of Equipment Bearing Plates and Anchors

i. Grouting of the equipment bearing plates and anchors will not be measured and paid separately and the cost thereof, including materials, shall be included in the Unit Rate / cost for concrete in the structure with which it is associated.

15.20.7 Water Stops

i. Payment for water stops in all structures shall be done as per relevant BOQ items. Following items shall be deemed to have been included in the rate quoted for water stops.

A. Water stop provided including cost of furnishing, fixing in place, lapping / vulcanizing and jointing.

B. Payment for providing bitumen sheets or any other filler material for expansion and contraction joints, fixing and placing them in position.

C. Joint sealing compound.

D. Painting of surfaces of expansion and contraction joints with the bituminous paints.

E. All joints in concrete structure for convenience of the work as directed / approved by the Engineer.

15.20.8 Embedment in Concrete / Rock

i. Deleted

ii. Embedded Parts

A. Parts of gates, gate hoists, valves, operating machines, turbine, generators and other control equipment as also the anchor bolts, structural shape plates and bearings required in connection with the installation of these parts will be procured separately by the Contractor, along with those gates and hoists etc. and the payment for the same shall be made as per the rates of relevant items in schedule of item rates for HM works.

B. The above parts shall be installed / embedded in concrete / rock by the contractor and cost for the same shall be deemed to have been included in the rates quoted for relevant items of HM works.

iii. Pressure Relief Valves

A. Payment for the supply and installation of these valves all items, accessories required for embedment shall be deemed to have been included in the rate quoted for the works.

15.20.9 Concrete Core

i. The payment for drilling of holes in concrete for taking out cores for testing purpose shall be deemed to have been included in rate quoted for concrete works.

15.20.10 Admixtures.

i. No separate measurement and payment shall be made for air-entraining and water reducing / superplasticizers / retarders / accelerators/ non-shrink agents and antifreeze admixtures or any other approved admixture / additives and the rate quoted for concrete works shall include cost of all admixtures including compensation towards any variation during the mix design stage / execution stage.. The rate quoted shall include cost of supply, transportation, handling and mixing etc.

15.20.11 Second Stage Concrete, Concrete in Blockouts for Embedding of Equipments.

i. Payment of second stage concrete and concrete in blockouts shall be made as per the rate quoted for relevant items of specified grade of concrete.

ii. The cost of second stage concrete & concrete in blockouts for embedding of equipments shall include, in addition to the works included under clause 20.1, the entire cost of preparation of contact surfaces with parent concrete, furnishing of non-shrink agent where directed and any other related works.

15.20.12 Expansion & Contraction Joints.

i. Payment for Expansion & Contraction joints including joint filler materials, joint sealing compound, bituminous compound shall be deemed to have been included in the rate quoted for concrete works.

15.20.13 Exclusion

i. No extra measurement for payment or payment will be made for the following:

A. Any rounded or beveled edges, fillets, scoring, chamfers, or any deduction made for voids or embedded items which are either less than 0.10 M^3 in volume or 0.05 M^2 in cross-section. No allowance will be for approved temporary openings, drains, embedded pipes, or recesses created by the Contractor for his own convenience during construction provided they are filled as directed.

B. Collecting of seepage water or water inflow from rock surfaces and diverting it into the drainage systems as specified in Section of "Dewatering, Drainage and Pumping".

C. Any defective and wasted concrete, concrete which has to be removed and replaced due to Contractor's noncompliance with the Specifications or Engineer's directions and all related cost shall be at the Contractor's expense.

D. Any concrete which the contractor places or uses for his own installation or for his own convenience.

E. Developing alternative sources of aggregates by the contractor and the resulting additional material testing.

F. Pumping of the concrete and plasticizer.

G. Any replacement or repair of concrete damaged during blasting carried out by the contractor.

H. Making stockpiles for coarse and fine aggregate.

I. Removal and replacement of any concrete placed without the prior knowledge and agreement of the Engineer.

J. Removal and replacement of concrete not manufactured, placed and compacted in accordance with these specifications.

K. Curing compound and all operations involved in use.

L. Forming expansion and contraction joints including making drainage and other holes where such joints occur.

M. Filling of holes left by the removal of concrete cores with the concrete of the same grade.

N. The cost of testing of materials used for concrete and test on concrete shall be deemed to be included in the quoted rate for the relevant item of work.

ANNEXURE-B
(GENERAL METHODOLOGY AND DECISION-MAKING FLOWCHART FOR PROBE DRILLING AND PRE-INJECTION GROUTING)

1.0 General methodology: Probe drilling and Pre-Injection grouting works shall be executed on basis of observations made for Water Ingress/Loss while drilling holes in the face, Grout intake volume/pressure values while grouting and checking water discharge at every 100m of in any excavated underground portion. The values and methodology detailed in following paras will be adopted as decided by Engineer on basis of observations made during execution of these works. Contractor is to carry out these works to achieve the specified water tightness within shortest possible time.

1.1 Water inflow criterion

1.1.1 Water ingress shall preferably not exceed **30 lit/min/100m** in any underground excavated portion.

1.1.2 Inflow will be measured by installing dam at invert on any one side of the tunnel at every 100 meters (carefully prepared and sealed to avoid the wrong results by water bypassing the dam) equipped with an automatic recording overflow V-notch (90^o). The reading shall be taken at frequencies decided by engineer through an automated V-notch recording process.

1.1.3 Water ingress criterion shall not be relaxed without specific approval of employer.

1.1.4 The engineer at critical locations may impose a more stringent criterion over a stretch of excavated or to be excavated tunnel, based on functional, environmental or any other site constraints.

1.2 Drilling of holes:

1.2.1 Drilling of probe holes/grouting holes will be done with multi-boom drilling jumbo equipped with sensors for MWD data capture and automatic rod handling system integrated with automatic drilling control system.

1.2.2 Measure while drilling data indicated below and recorded automatically by sensors equipped on boom will be presented in approved format by the drilling supervisor/ operator.

i. Feed pressure.
ii. Rotational pressure.
iii. Rate of penetration.
iv. Drilling problems.
v. Loss of flushing water.
vi. Water inrush.

1.2.3 The MWD data shall be calibrated (with Schmidt hammer) and interpreted by on board software and the results shall provide valuable information about variations in hardness, rock type variations, degree of jointing and water conditions. This shall also allow for adjustment of grout curtain, adaptation of the rod lengths and determination of limits for grouting pressure and choice of suitable grout. Contractor shall keep minimum two Schmidt hammers per face in a calibrated condition at all times.

1.2.4 Drill bit equipped with rods and couplers which fit the drill bit selected shall be deployed. Wear limits whenever mentioned in the work specifications will be followed.

1.2.5 Hole No. and measured inflow shall be written directly on face next to hole with spray paints.

1.2.6 Together with the measured water yield/loss from the drilled holes, this record shall form the basis for the action to be taken, e.g. choice between injection or no injection, and if injection is chosen, how many additional holes, what length, type of grout/pressure etc.

1.3 Flushing of boreholes for injection

1.3.1 Good water flushing during the drilling of the hole shall be ensured. The water pressure used should be at the maximum specified by the drilling equipment manufacturer, (not less than 10 bar) which is ensured by a special pressure booster pump on the drilling jumbo.

1.3.2 Flushing by water and compressed air shall be done using a stiff plastic hose using water at 10 bar pressure, combined with some compressed air. Push the hose to the bottom of the hole, open for water and air, and withdraw the hose while flushing is turned on. If there are zones in the borehole that may collapse if soaked in water, or will be excavated by the flushing jet, or if the water yield from the hole is more than 10 l / min, the engineer may direct to omit flushing of holes.

1.3.3 Further cleaning of the injection holes must be by combining water and compressed air for high pressure water (at not less than 100 bars) cleaning as described in section "Drilling and grouting".

1.3.4 Flushing of boreholes for grouting should be done as specified as a routine matter and any prior approval of engineer shall be obtained for necessary deviations and recorded by the supervisor, based on the borehole records.

1.4 Probing, Grouting and check Holes (Length, Number and direction)

1.4.1 The inclination of drill holes for probing, grouting, interval between holes and the depth of drilling as mentioned in the specifications are for initial guidance. The number of holes, depth, location and inclination of holes shall depend on water inflow conditions and inflow distribution at the face where grouting is performed.

1.4.2 Holes shall be drilled to ascertain the risk of unforeseen water inrush and to detect areas where pre-injection must be carried out to meet ingress limitations or to strengthen the ground or to seal the areas above ground water level where water loss is being observed during drilling of holes.

1.4.3 Probing, Pre-Excavation grouting and check hole drilling shall be generally done in various stages till the requirements/objectives of water tightness are not met. Holes in successive stages will be located by split spacing principle. Grouting of Primary/Secondary holes shall normally be done with OPC (with or without addition of MFC/UFC/CS), however tertiary holes shall be grouted preferably with MFC/UFC/CS or their combination. Depending on water ingress from particular area of tunnel face, Engineer may direct to locate more holes preferably towards that area. Various grouting stages will be as follows: -

i. First stage: Probing with primary holes and checking water ingress.

ii. Second stage: Drilling secondary holes, grouting through Primary + secondary holes and checking water ingress criterion through tertiary holes.

iii. Third stage: Grouting through tertiary holes and checking water ingress criterion with additional holes.

More details on number of holes to be drilled are covered in decision making flowchart.

1.4.4 Generally, 8-20 holes each having upto 18m or more length and dia 54 - 57mm, will be drilled from the tunnel face very close to the tunnel contour, using a look-out angle of between 7º to 10º, creating a cone pattern with the top cut off (the face being the cut-off plane). There may also be situations with very dominating joint orientation where engineer may direct to adapt a preferential borehole direction.

1.4.5 There shall be a minimum 5m overlap between two successive rounds of probe hole drilling. Drilling of holes shall be done within a deviation 2º from the planned layout.

1.4.6 MWD reading shall be recorded whenever hole drilling is carried out. After drilling and flushing; water flow/pressure shall be measured invariably for each hole.

1.5 Placement of packers

1.5.1 For single step grouting, the packer shall be placed at around 3.0m depth from the drill hole opening and the hole shall be injected over its entire length in one single step.

1.5.2 For multiple step grouting, depending on actual conditions encountered, engineer may direct to adopt a different packer placement upto maximum 15m depths in ascending or descending fashion also.

1.5.3 It shall be ensured that packers cannot be ejected from the holes when pumping at high pressure by stretching a chain between various packers and anchor rods into the tunnel wall/floor.

1.5.4 In case of High ground water pressure and very poor rock, grouting operation will provoke a face failure if the packer is placed too close to the tunnel face and under such cases the packer shall be placed at around 5m depth from the borehole.

1.5.5 If any water channel causes water and grout backflow to the face, the packer must be placed at a depth larger than the depth of the intersection between the borehole and this channel.

1.5.6 If the channel is located at depth greater than 15m then, a short length grouting of upto 15m shall be carried out and face shall be advanced by two-three rounds to bring the face close to such problematic zones but keeping a minimum buffer distance of 5m.

1.5.7 In principle, there shall be an overlap of tight rock (a buffer either from the sound rock or grouted rock from the previous injection round) of approximately 5.0m in front of the face. The packer placement shall be in this zone unless there are reasons to do it differently.

1.5.8 At few locations where due to contractor's fault grouted rock from previous injection round is not tight/sound and not able to take pressure of packer, and there are incidences of grout leakage then contractor shall install resin grouted steel standpipes into the probe holes. After installation, drilling of probe hole for further depth shall be done through this standpipe and further attachment of grouting hose shall be done directly on this standpipe. No payment on this account shall be made to the contractor.

1.6 Injection

1.6.1 General

i. The decision criteria for pre-excavation grouting to be undertaken will depend on the target maximum water ingress into the tunnel. The injection will be initiated if a single hole yields more than 5 l/min, or if any combination of probe holes yields a total of more than 15 l/min or drilling water loss of more than 50% in any hole. These limits will be altered by engineer if the required water inflow criterion per 100m of tunnel as mentioned in the beginning of this section is not achieved.

ii. Grout proportions shall be used in accordance with the purpose of the grouting and shall depend on the Grout take / Pressure built up while grouting, but the mixture shall generally have a water / cement ratio value between 0.50 to 1.00 for the entire grouting duration at a particular location. Micro silica/Silica Fume shall be added to control Bleeding and shrinkage at high W/C ratios.

iii. Admixtures: Required type of grout material (OPC, MFC, UFC, CS or combination) shall be mixed with water and other admixtures to maximize strength, plasticity and density and minimize bleeding, setting time and shrinkage. Type of admixture shall be based on compatibility trials in the mixture intended for grouting before grouting starts and shall be approved by the engineer.

iv. Ratio of substances in chemical grout shall be in accordance with the manufacturer's instructions. Chemical grout shall not be used without prior attempt to grout rock with cement-based grout.

v. If there are reasons for deviation from the above given parameters or material choice, this must be made by the injection supervisor, preferably in consultation with the material supplier and approval of engineer shall be taken in all such cases.

1.6.2 Mixing procedure

i. The cement mixer must be a state-of-the-art colloidal mixer with an impeller speed of no less than 1500 rpm. The mixer must also be kept in good maintenance to work efficiently with micro cement.

ii. Add all the water for one batch into the mixer.

iii. Add the corresponding required quantity of cement.

iv. Add the water reducing and dispersing admixture.

v. Mixing time as specified by manufacturer shall not be exceeded, as the intensive high shear mixing will generate heat and increase the temperature of the mix. If the temperature becomes too high, the open time of the batch could be substantially shortened, and in hot climates this could particularly cause practical problems. Likewise, mixing time shall not be cut short, otherwise the flocculated clusters will not be broken up by the mixer. Sufficient mixing time and the use of water reducing, and dispersing admixture is required in order to break up the clusters.

vi. Immediately transfer the batch to the agitated holding tank and keep the grout in slow agitation at all times. Monitor the quantity of grout in the agitator and never start mixing a new batch if the agitator holds a lot of material and the grout pump is delivering at a slow rate and at high pressure. The batches in the agitator should always be kept as fresh as possible.

1.6.3 Use of accelerator in the grout

i. In situations when unexpected backflow occurs through the face or even further back in the tunnel and indicates drill hole connection with extremely large channels with a lot of high-pressure water, then accelerator shall be added to the grout at the packer through a non-return valve. In both situations it can be beneficial to accelerate the cement setting, hardening and gaining early strength to withstand the forces from pressurized water.

ii. Accelerators used in sprayed concrete may be used after establishment of effect on the open time, setting time and hardening time with the equipment, type of cement and the w/c-ratio used on site, site temperature etc. It shall be ensured that addition of accelerator shall not lead to flocculation or thickening at the time of addition, and the reaction shall influence the grout after a certain time to avoid early setting and risk of premature blocking of the holes. The dosage of accelerators shall be adjustable to give the effect needed.

iii. The separate pump for accelerators can be a diaphragm pump or a hydrostatic pump, giving maximum pressure higher than the grout injection pressure. The output shall be adjustable, and because of the high-pressure capacity, it shall not be influenced by any variation in pressure in the grout line. The accelerator pump shall be linked to the grout pump in a way that ensures the same dosage of accelerator even if the output and the pressure change on the grout pump.

iv. Output of the accelerator pump shall be controlled by frequency or by using the hydraulic system. Based on pre-testing of the dosage and calibration of the pump, the dosage of accelerators shall be started at any time needed and shall be

increased in steps until the targeted effect has been achieved. At any stage, the dosage of the accelerator can be stopped, and injection may continue with normal grout, keeping the injection connection open. The system for measuring accelerator dosage entering the grout line should be in place before using accelerators.

1.6.4 Injection pressure

i. Maximum permissible Injection pressure shall be kept at 20 bars plus measured highest water pressure in any of the drilled holes. However, the contractor shall evaluate the maximum pressure on a running basis and check it against local conditions in the tunnel. Maximum pressure will be limited in very poor rock conditions in the face area, high hydrostatic water head and existing backflow. Decision of engineer shall be final.

ii. Grout pump shall continuously measure grout take, pump pressure and total consumption of grout that has been injected into the holes. The pressure shall preferably be measured through valves connected to feeder line of the hole.

iii. The pump shall be equipped with adjustment valves for pressure and output that are connected to computer control system where either a limiting maximum pressure or flow rate or some other criterion may be fixed to stop grouting.

iv. Packers shall be of adequate length and diameter and shall withstand upto 60 bar pressure. Contractor shall keep sufficient number of packers at site (re-usable or single use) for grouting operations.

v. In pre-injection the water cement ratio shall be adopted in such a way that the below mentioned stop criteria are met early. Injection of grout in each hole shall start at maximum allowable pressure and not be stopped until one of the following criteria is met with: -

A. Injection pressure of 50 bars is reached in any hole regardless of grout take OR,

B. Cumulative Grout take of 150 Kg/meter is reached in any hole regardless of pressure.

C. The stop criteria mentioned above shall be adjusted to suit local conditions in order to achieve the desired water tightness.

vi. As soon as any of the above stop criterion is about to be reached the accelerator dosage shall be increased till grout inflow volume reduces to 1 L/min (shall be maintained at below 1 L/min for 5 minutes at maximum pressure).

vii. The choice should be made depending on whichever event happens first. With this approach the quantity of grout that can be placed will be pumped in the shortest possible time period and by working at the highest possible/allowed pressure from the start of the process. This will provide a maximum penetration of fine cracks and joints.

viii. In pressure sensitive/weak ground situations it must also be recognized that the danger of damage being caused by lifting, splitting or other deformations is also linked to the product of pressure and grout quantity, and not to pressure alone. High pressure exerted on the borehole walls (quantity just sufficient to fill the borehole) cannot possibly cause any damage anywhere else than the first few centimeters or so around the borehole itself. This potential damage zone would increase both with increased pressure and grout volume pumped.

1.6.5 Injection procedure

i. Start the injection of the lowest hole in the face and work upwards from both sides. Alternatively, the holes with the largest water inflow to the tunnel may also be grouted first.

ii. A hole is finished when any of the stop criteria is reached.

iii. If backflow of grout and water into the tunnel is detected, this shall be minimized by reducing the pump output, and accelerator shall be increased to create a blockage of the backflow.

iv. If during the injection process two or more holes become interconnected as demonstrated by grout backflow through the placed packers, close the packer valves in the connected holes and continue grouting on the current hole. The maximum grout takes stop criterion before stopping should be multiplied by the number of connected holes. If the maximum pressure is reached before the maximum quantity, the connected holes should be injected too if they take any grout.

v. After grouting each hole, the packer shall be left in the hole closed with the final pressure until grout has set and there is no reflux of grout upon packer removal.

vi. Check holes will be drilled invariably after any stage of grouting to check the efficacy of the grouting cycle.

1.6.6 Injection records

i. Records of the injection data must be taken routinely through computerized recording and the system is to be suitably equipped. The person responsible for record keeping must also be clearly defined.

ii. Within 24 hours of grouting cycle, the contractor shall submit a grouting report on approved format, which must include: -

A. Date and time of start and end of grouting cycle.

B. Number of holes grouted in each stage, Tunnel Chainage, direction and hole depth, hole layout diagram.

C. Grouting mix type, grout take and pressure for each hole.

D. Interconnection with other holes.

E. Leaking of water/grout behind the tunnel face.

F. Date and time of drilling of final check holes after which grouting is stopped.

iii. The following information is also to be recorded:

A. General data such as tunnel location, date, time and shift, person who does the recording, identification and location of holes, measured water flow from the holes.

B. Per hole: Packer placement location, length of hole, grout mix design, start and end pressure, start and end time, flow rate development, total grout quantity, start and end pressure, any backflow and/or connections to other holes.

1.6.7 Grout setting and time until next activity

i. Grout shall be so designed so as to behave as a thixotropic grout and to give initial and final setting a short time after the end of injection. Its purpose is to allow tunneling work to proceed without breaks. At moderate ground water head (approx. less than 15 bar) and if water bearing channels are limited in size (e.g. maximum opening less than 10 mm), this should be possible without any risk.

ii. When the pressure increases, the risk of grout material failure and wash out will increase rapidly, especially if the channel dimensions increase at the same time. Therefore, the consequences of failure, time allowed for grout setting, and the water pressure and channel size in the ground have to be considered.

iii. If an accelerator has been used to shorten setting time, one must be aware that this will be a good help for the accelerated grout, but in many cases part of the grout injected has been accelerated. Caution must be taken if the consequences of failure are serious.

iv. If the next planned activity is the drilling of boreholes for control of injection result or for a next round of grout holes, drilling should preferably be started in the area where the previous injection was first completed (giving the maximum undisturbed setting time).

1.6.8 Drilling of control holes

i. The efficiency of a stage of injection must be checked by new boreholes. These holes will be evaluated using the same decision criteria as used for the probe holes in regard to injection or no injection. Control holes should be drilled on both sides of all holes that yielded water flow above the limit for injection. Next stage grouting shall then be initialized with more fine grout materials as required by the ground.

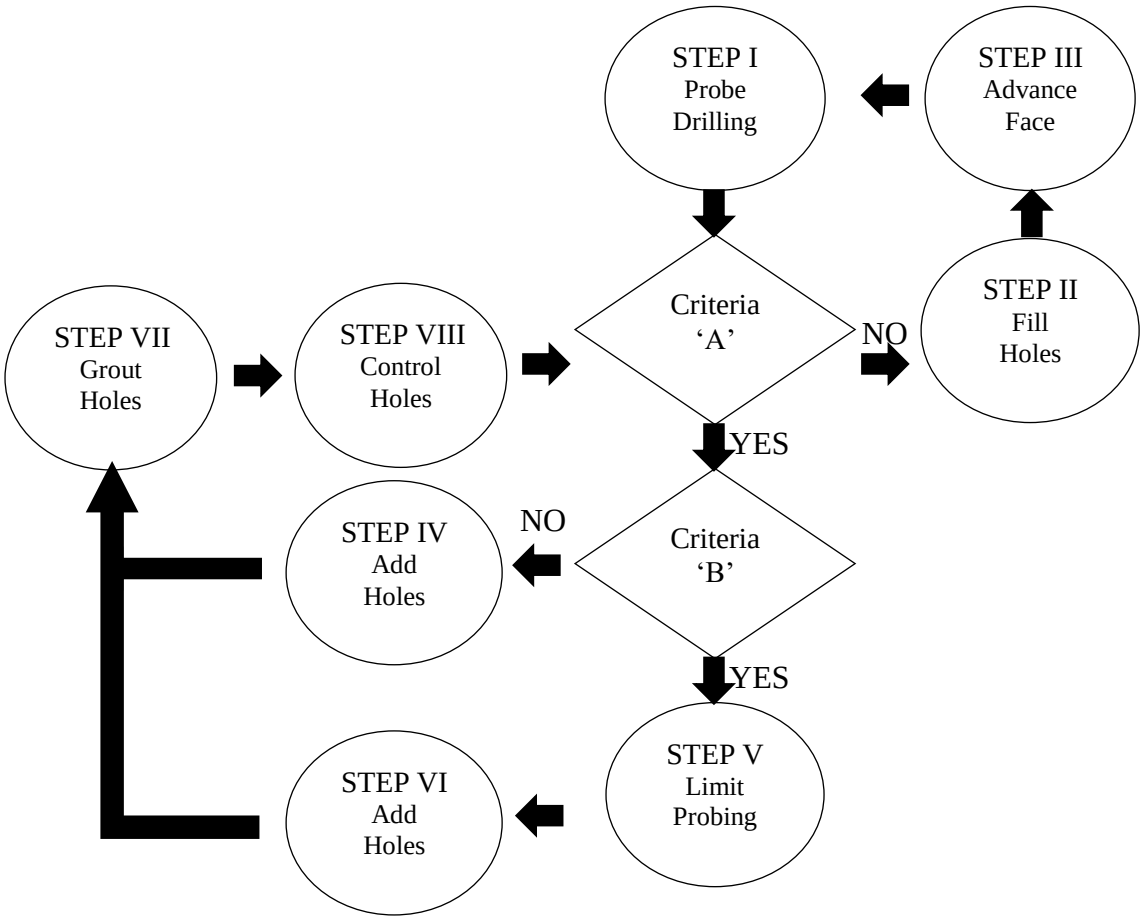
ii. Holes that are tight should be filled by stable cement grout. If no injection is necessary, this should take place for all holes. It can be done with rock bolting mortar if preferred, to avoid starting up and cleaning all the injection equipment only to backfill the holes.

1.6.9 Measurement of water ingress in excavated parts of the tunnel

i. Control of achieved tightness in the tunnel behind the face is the only way to confirm the result of carried out injection. After a certain length of tunnel excavation, the average water ingress over this length of tunnel must be checked. By installing sealed dams in the tunnel invert with V-shaped overflow, the ingress over this defined tunnel section can be measured. To have accurate assessment, it shall be necessary to rely on measurements taken at a time when disturbance from other activities that use water in the tunnel is minimum.

ii. If the required maximum rate of ingress has been exceeded, post-grouting of the remaining leakage spots must be carried out, starting with the largest ones. Furthermore, engineer shall undertake evaluation of the pre-grouting procedure and criteria and direct to adopt any adjustments needed so that the requirements can be met for the coming tunnel sections.

2.0 Decision making flowchart for probe drilling and injection



2.1 Step I: Probing ahead with Primary holes.

2.1.1 Standard number of holes is four in clock positions 6, 9, 12 and 3. Holes shall be drilled upto 18m lengthor more. Use percussive drilling with water flushing at 10 bars. Do high-pressure water cleaning. Start holes at tunnel contour, angle out 7° to 10°. Overlap with end of the last drilling is minimum 5 meters and maximum 10 meters depending on ground class.

2.1.2 Recordings to make during probe hole drilling:

- **i.** Indications of any weak zones (depth and length), higher drilling rate, voids.
- **ii.** Loss of drilling water.
- **iii.** Depth of detectable and substantial water ingress.
- **iv.** After drilling of a hole, drill string removed: Measure initial water ingress rate in l/min.

2.1.3 Apply maximum flushing with water and compressed air when pulling out the drill string at the end of drilling to facilitate efficient cleaning of the hole.

2.1.4 Grouting criteria, A:

i. Initial ingress from any single probe hole > 5 l / min.
ii. Total initial ingress from all holes > 15 l / min.
iii. Loss of more than 50% of the drilling water (approximate) in any single hole.

Check Criterion B if any of the following criteria are met.

2.1.5 **Distance criteria, B**: If all or a major part of the recorded ingress or loss of flushing water locations occur deeper than 15 m into the holes, then the face should be advanced to a minimum distance of 5 m from these features. (Step V)

2.2 Step II: Grout filling of probe holes/Secondary/Tertiary grout holes.

2.2.1 Place a packer at required depth and inject grout for to fill the hole. Holes can alternatively be filled by anchoring mortar through an open plastic hose from the bottom upwards.

2.3 Step III: Advance the face.

2.3.1 Advance the face until a minimum of 5 meters of probing overlap is reached. Execute next stage of probe drilling.

2.4 Step IV: Add boreholes for grouting.

2.4.1 Add further boreholes with split spacing principle with two additional holes near the area of most water ingress or flushing water loss.

2.5 Step V: Limit the probing depth and advance the face.

2.5.1 Limit the probing depth andAdvance the face to a minimum distance of 5 meters from the features that initiated the grouting decision.

2.6 Step VI: Add boreholes for grouting.

2.6.1 Add further boreholes with split spacing principle with two additional holes near the area of most water ingress or drilling water loss. The length of the added holes should be adjusted to end at the same depth as the previous holes.

2.7 Step VII: Pressure grouting.

2.7.1 After packer placement at required depth, start grouting in the lower part of face and work upwards. All holes should be grouted till stop criterion is met.

2.8 Step VIII: Control holes.

2.8.1 Drill control holes according to split spacing (after careful evaluation of the required minimum time for cement hydration), and go to grouting criteria A of Step I.

ANNEXURE-C

GEOTECHNICAL BASELINE REPORT

(Please refer Vol. -III)

GEOTECHNICAL BASELINE REPORT

Geotechnical Baseline Report

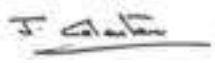
Project: DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+152 to 101+310 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.)

Client: Rail Vikas Nigam Limited (RVNL)

Document Number: 60598728 -ACM-P7B-RP-002-02

Aug 19, 2019

Quality information

Prepared by	Checked by	Verified by	Approved by
			
Om Dixit	Sami Kucuk	Sami Kucuk	Dr. John Celentano

Revision History

Revision	Revision date	Details	Authorized	Name	Position
02	19/08/2019	Revised after RVNL comments	Yes	JC	TD

Prepared for:

Rail Vikas Nigam Limited for Implementation of new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

Prepared by:

AECOM India Private Limited
3rd Floor
Tower A
Buiding No. 8
DLF Cyber City
DLF Phase II
Gurgaon 122002
Haryana
India

CIN: U74210KA2005PTC037770

T: +91 124 4871400
aecom.com

© 2018 AECOM India Private Limited. All Rights Reserved.

This document has been prepared by AECOM India Private Limited (“AECOM”) for sole use of our client (the “Client”) in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client. Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.

Table of Contents

1. Introduction 1
1.1 General 1
1.2 Project 1
2. Purpose and Objective of the Report 2
2.1 Limitation 2
3. Available information 2
4. Regional Geology 3
4.1 Structure and Tectonics 5
4.2 Seismicity 6
4.3 In-Situ Stress 9
4.4 Geology along the Tunnel Alignments 10
4.5 Major Lithological Types along the Tunnels Alignment 19
5. Discontinuity Analysis Along the Tunnel 20
5.1 Tunnel-13 20
6. Geological/ Geotechnical Works for Tunnels 24
6.1 Geological and Geotechnical Investigations 24
6.2 Existing Borehole Data 25
6.3 Existing Geophysical Data 27
6.4 Field Test 27
6.5 Lab test 28
7. Field and Laboratory Test Results 29
7.1 Field test results 29
7.2 Lab Test Results Summary 33
8. Geotechnical Appraisal along the Tunnel Alignment 38
8.1 Tunnel-13 38
9. Ground characterization 42
9.1 Ground Type 42
10. Tunnel Design consideration 54
10.1 Rock Mass classification 54
10.2 Rock Mass classification and support system 70
10.3 Rock support system 71
11. Geotechnical Risks and Potential Hazard Identification 73
12. Hydrological condition along tunnel alignment 74
12.1 Methodology and Basis 75
12.2 Conceptual Hydrogeological Model 75
12.3 Regional Hydrological data and Analysis 77
12.4 Hydrological studies at Bridges location 78

Appendix-1–Geological Plan and Longitudinal Section
Appendix-2 – Behaviour Type Calculations
Appendix-3 – Graphs and Roclab Results
Appendix-4 –Roclab Results

Figures

Figure 1: Package-7B Alignment View (Source: Google Earth Image) 1
Figure 2: Regional geologic map of the Himalayan orogen (Yin. 2006) 4
Figure 3: Regional Geological map of Garhwal and Kumau Himalayas showing the project location in red box. ... 5

Figure 4: Location of Project area and its Distances from the Major seismo-genic Thrust 6
Figure 5:Seismic zonation map of India showing boxed Project location 7
Figure 6: World Stress Map (WSM), 2008; the project zone (Red squaring) 10
Figure 7: Location of Tunnel 13 Portal-1 11
Figure 8: Location and rock outcrops (mainly metabasic) 12
Figure 9: Highly weathered/ crushed Quartzite bands at the fault zone (92+000 approx.) 13
Figure 10: Fractured metabasic rocks 14
Figure 11: Alternate bands of Metabasic and quartzite rocks 15
Figure 12: Quartzite along the tunnel alignment (discontinuities marked with red) 15
Figure 13: Contact between Metabasic and Quartzite type rocks 16
Figure 14: Quartzite outcrops along the tunnel alignment 16
Figure 15: Quartzite outcrops along the tunnel alignment (discontinuities marked with red) 17
Figure 16: Fault along the Nalla (Ch: 97+600 approx). with landsides 18
Figure 17: Highly fractured quartzites 18
Figure 18: Location of T13 Portal-2, Dolomites outcrops on the tunnel portal 19
Figure 19: Plot of 31 poles of discontinuities in the upper hemisphere of equal area projection recorded along the Portal 1 area of Tunnel-13 21
Figure 20: Plot of 38 poles of discontinuities in the upper hemisphere of equal area projection recorded along the Middle reaches of Tunnel-13 22
Figure 21: Plot of 30 poles of discontinuities in the upper hemisphere of equal area projection recorded along the Portal 2 area of Tunnel-13 23
Figure 22: Rosette Plot of 29 poles of foliations recorded along Tunnel-13 24
Figure 23: RQD vs Depth for Tunnel-13 29
Figure 24: Variation of RQD along the Tunnel-13 Alignment 30
Figure 25: RQD along the Tunnel-13 30
Figure 26: Percentage Fractures based on BHTV Results for Tunnel-13 32
Figure 27: UCS vs Depth for Tunnel-13 35
Figure 28: Variation of UCS for Tunnel-13 35
Figure 29: Modulus of Elasticity vs Depth for Tunnel-13 36
Figure 30: Variation of Modulus of Elasticity for Tunnel-13 36
Figure 31 Pie chart of of different Ground types along the Tunnel-13 alignment 52
Figure 33: Annual PET (cm) over India (Source: IMD) 78

Tables

Table 1: Regional stratigraphy along the project area (source GSI) 5
Table 2: Summary of Location and Characteristics of the Seismo-genic Sources near Project Area 6
Table 3: Geotechnical Parameters of the Discontinuities Recorded at Portal- 1 area of Tunnel-13 21
Table 4: Geotechnical Parameters of the Discontinuities Recorded along the Middle Area of Tunnel-13 22
Table 5: Geotechnical Parameters of the Discontinuities Recorded at Portal- 2 Area of Tunnel-13 23
Table 6: Summary of Existing Boreholes Soil Tech 25
Table 7: Summary of Existing Boreholes by SMC 25
Table 8: Summary of geological description from Borehole Investigations for Tunnel-13 26
Table 9: Summary of existing geophysical surveys along T13 tunnel 27
Table 10: Summary of dilatometer testing 31
Table 11: Summary of BHTV fracture classification 31
Table 12: Index of structures 32
Table 13: Summary of Soil test Results 33
Table 14: Summary of Rock test Results 34
Table 15: Summary of Underground water test Results 37
Table 16: Ground Water Conditions 37
Table 17: Summary of packer permeability testing 37
Table 18: Lugeon values and the corresponding rock conditions 38
Table 19: Summary of permeability test results 38
Table 20 summary of Ground types along Tunnel-13 53
Table 21: Designation of a stress deformation behaviour of a tunnel section as a function of the index of elastic behaviour 57
Table 22: General categories of different Ground Behaviours (Change by ÖNORM B) 59

Table 23 Summary of Ground types and its behaviour along Tunnel-13 68
Table 24 Rock classification (RMR) for Tunnel-13 70
Table 25 water table encountered in the Borehole 76
Table 26: Total Long term water seepage drained by the Tunnel -13 77
Table 27: District Rainfall (mm) for last four Years for Pauri Garhwal district 78

1. Introduction

1.1 General

The new broad gauge (BG) Railway Line between Rishikesh and Karanprayag is a very important project in India. The line is proposed to be extended further to connect with Badrinath and Kedarnath (through future development). When completed, this project will improve connectivity in Ganga/Alaknanda valley and boost the economy and tourism in Uttarakhand state.

Rail Vikas Nigam Ltd (RVNL), a public sector undertaking under the ministry of railways, has been entrusted with the work of detailed construction survey, design, engineering and construction of new line as a part of Northern Railway (NR). The proposed alignment connecting Rishikesh and Karanprayag and passing through Ganga and Alaknanda river valley, is 125 km long with a significant part in tunnels and bridges spanning deep gorges and valleys.

RVNL the "**client**" has appointed **AECOM** to carry out the Detailed Design and Project Management Consultancy for Construction of tunnel, yard and formation works from Chainage 91+152 to 101+310 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

1.2 Project

The new proposed BG rail line located between the Rishikesh and Karanprayag in the state of Uttarakhand in North part of the India. The project alignment passes through the rugged, mountainous and steep terrain. In the complete package-7B alignment, there is tunnel T13 and Tilani Station Yard.

Figure 1: Package-7B Alignment View (Source: Google Earth Image)

2. Purpose and Objective of the Report

This Geotechnical Baseline Report (GBR) is prepared as a part of the pre-final design for the construction of the tunnels. This report is prepared based on the evaluation and interpretation of geological and geotechnical data obtained from the subsurface investigation done during various stage of Final Location Survey (FLS).

The objectives of the GBR are as follow:

- Provide a summary of the ground conditions, ground behaviour, ground water and ground obstruction in order to facilitate an understanding of the geotechnical features and ground behaviours.
- Establish baselines for the anticipated geotechnical conditions and basic tunnel ground behaviour.
- This Geotechnical Baseline Report (GBR) summarizes the geotechnical basis for the design of the T-13 tunnel and presents a baseline of the ground conditions to be encountered during the tunnel construction. It comprises the interpretations of the geological and geotechnical data obtained from the geotechnical investigations consisting of engineering geological mapping, boreholes, in-situ tests, laboratory tests and a summary of anticipated ground and groundwater conditions prevailing along the tunnels.

2.1 Limitation

This Geotechnical Baseline Report (GBR) is limited with the subsurface constructions where suggested guidelines issued by ASCE are followed in preparing this particular report. For the bridge design and station design, the geotechnical parameters will be mentioned in the respective design reports. The ground conditions anticipated along the tunnel as per the results of the actual geotechnical investigations may vary in the excavation which requires modification of support types and mitigation measures stated in the report.

3. Available information

During the course of GBR preparation following geological and geotechnical data have been utilized in preparing the Geotechnical Baseline Report for Package 7A. The soil investigation reports provided by RVNL are termed as Geotechnical Data Reports (GDR) and were further reviewed to its accuracy and usage and used for preparation the GBR.

Apart from this additional data was also collected during the geological mapping carried out by AECOM in the month of February 2019 along the Tunnel alignment of T-13. This report is organized based on the data received till date from RVNL, in case there are any changes in the alignment or tunnel location, the details regarding the same shall be incorporated in the next revision of the report.

- Geotechnical investigation work at bridges, tunnels and other specified locations on the railway alignment in Srinagar – Tilani section (73.235-91.740Km) of 125 Km new BG rail link between Rishikesh and Karanprayag in the state of Uttrakhand, India_ Geotechnical Investigation Package-4 by Soiltech (India) private limited, ground engineers and consultants.
- Geotechnical investigation work at bridges, tunnels and other specified locations on the railway alignment in Dhari-Gholtir section (91.740-108.550 Km) of 125 Km new BG rail link between Rishikesh and Karanprayag in the state of Uttrakhand, India_Geotechnical Investigation Package-5 by S.M. Consultants.

- Geological Plan and L-section for package -7B done by Geodata.
- Geomechanical Hazard Analysis done by Geodata
- Geophysical investigation report (ERT and SRT) done by Geodata
- Hydrological Studies done by Geodata.
- Hydrological Model study done by National Institute of Hydrology (NIH) Roorkee.
- Site specific Design Earthquake parameters for Tilani (Out) bridge site done by department of Earthquake Engineering, IIT-Roorkee.
- VS-30/MASW reports of Tilani (out) bridge site.

4. Regional Geology

Project lies in the Garhwal group which forms the major part of the Garhwal Lesser Himalaya and is represented by thick sequence of low-grade med sediments consisting of quartzite with pen contemporaneous mafic meta volcanic and carbonate rocks extending from Nepal through Kali River in the east to the tons valley in the west and continues in to Himachal Pradesh and beyond. It is limited in the north by the Main central Thrust and in the south by the Main boundary Fault.

The Lesser Himalayan belt is one of the most structurally complex litho tectonic units of Himalaya. Pioneering works of Valdiya (1983) and Srivastava et al. (1994) provide insight about the general stratigraphy and tectonics of this region. Many of the previous researches have been rectified by modern approaches but the basic geological framework remains unchanged. The tectonic block of Lesser Himalaya is bounded by the MBT in the south and the MCT in the north.

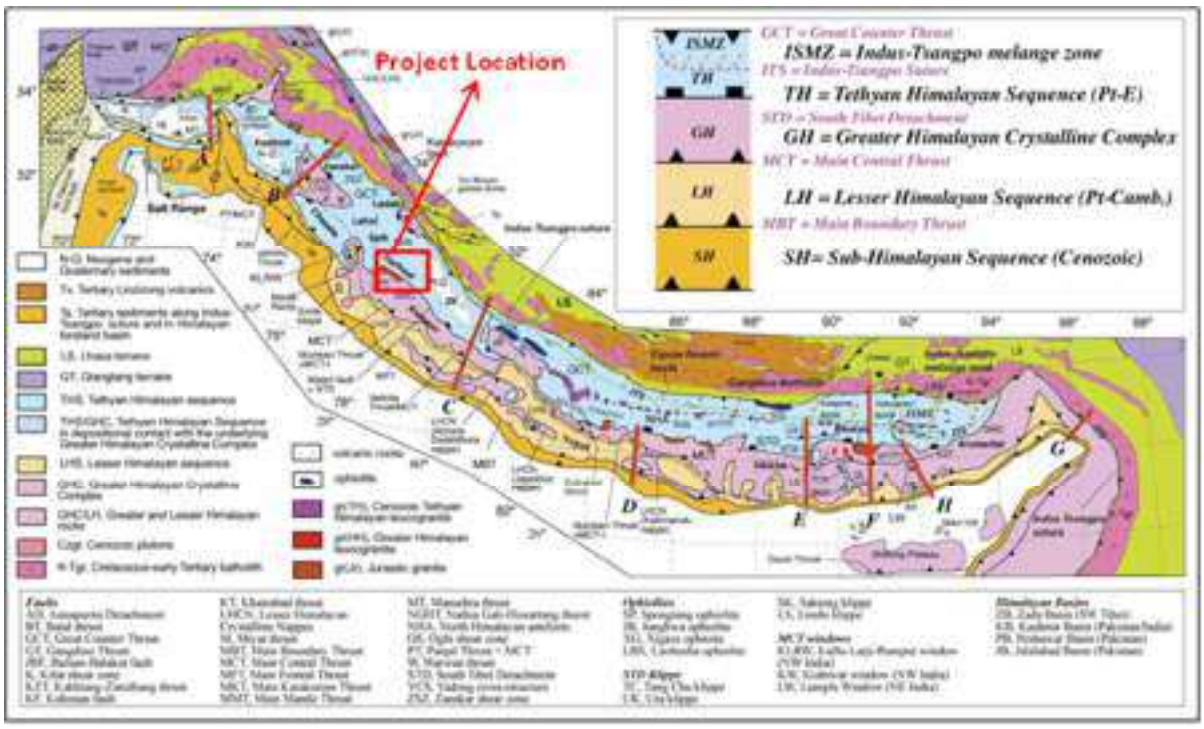


Figure 2: Regional geologic map of the Himalayan orogen (Yin. 2006).

The Garhwal Group, that comprises rocks of Meso-Proterozoic age, is exposed from Srinagar to Karanprayag and over-thrusts the Jaunsar Group by The North Almora Thrust. The Garhwal Group comprises Agastmuni, Rautgara, Pithoragarh, Nagnithak and Berinag Formations. Dolomite with slate is the dominant lithology of Pithoragarh Formation while Rautgara, Berinag and Nagnithak Formations have meta volcanic with basic intrusive and quartzite as the dominant lithologies. The metamorphosed sequence of schist, schistose quartzites and thin bands of dolomite, mainly exposed in the Mandakini valley, is grouped in the Agastmuni Formation and is considered as the base of the Garhwal Group.

In the Garhwal Group numerous bodies and lenses of Epidiorite, Amphibolite and Metavolcanic are present.

1. The Berinag Formation:comprises thickly bedded, fine to medium grained and occasionally gritty, sericitic and chloritic quartzite; dark grey to brown phyllite, occasionally chloritic, graphitic and carbonaceous; sericitic quartz schist and chloritic schist; dark green chlorite schist, horneblende-albite-zoisite schist.
2. The Nagnithank Formation (Pt2gn) is similar to Berinag being mainly constituted by quartzite with subordinate purple phyllite and basic metavolcanics.
3. The Pithoragarh Formation [=Lameri Formation = Deboan Formation] and dolomitic-limestone lenses: represent the carbonaceous sedimentation and comprises of dolomitic limestone, phyllite and carbonaceous slate and quartzite.
4. The Rautgara Formation (=Uttarkashi Formation): consists of massive, cream coloured purplish and brownish fine grained quartzite inter-bedded with purple green mottled slate-shale and calcareous phyllite, with lenses of limestones and metavolcanics.
5. The Agastmuni Formation: is represented by quartz mica-schist, gritty/schistose quartzite, chlorite schist, and greyish white to dark grey, coarse to fine grain, schistose arenites with intrusion of basic rocks.

Table 1: Regional stratigraphy along the project area (source GSI)

Structural Domain	Group	Formation	Age
INNER LESSER HIMALAYA	Garhwal	Epidiorite, Anphibolite and Metavolcanic	Meso-Proterozoic
		Berinag	
		Nagnithank	
		Pithoragarh (= Lameri = Deboan)	

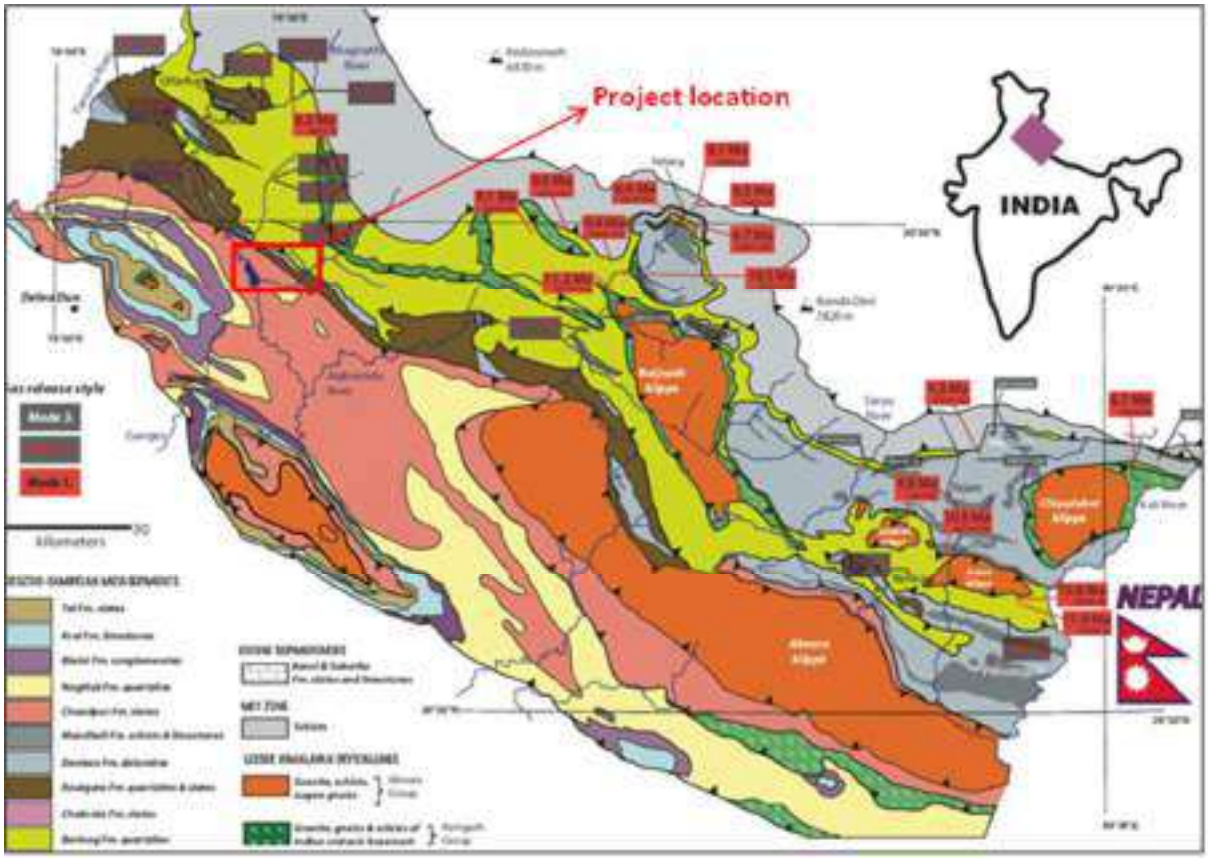


Figure 3: Regional Geological map of Garhwal and Kumau Himalayas showing the project location in red box.

4.1 Structure and Tectonics

4.1.1 Major Structure

The seismo-genic sources nearest to the Project area are North Almora thrust, Main boundary Fault and the Main central thrust. The project area is seismically active lies in the zone IV/V as several earthquakes were reported from this region.

The summarized details of the location and characteristic of these seismo-genic sources nearest to the project area are described below.

Table 2: Summary of Location and Characteristics of the Seismo-genic Sources near Project Area

Major Thrust	Trend	Distance	Maximum observed earthquake (MCE scale)
North Almora Thrust (NAT)	NW-SE	Lies in the Project area (Alignment chainage 81+500 at Tunnel-11)	6.5
Main Boundary Thrust (MBT)	NW	47(approx.) Km south to South-west	7.0
Main Central Thrust (MCT	NW-SE	71 Km (approx.) North to North- East	7.5

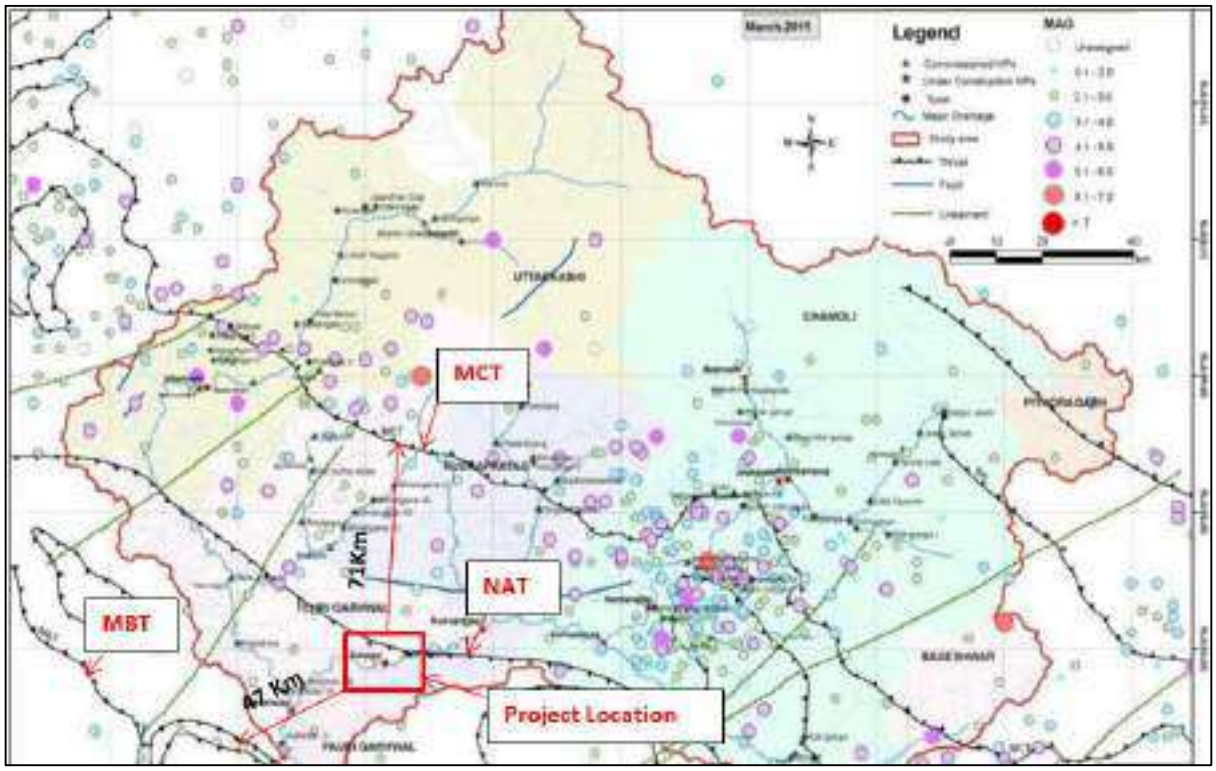


Figure 4: Location of Project area and its Distances from the Major seismo-genic Thrust

4.2 Seismicity

Project lies in the Garhwal Himalayas where several thrust sheet are traversed. The main siemo-tectonic feature of the project area is North Almora Thrust. The Garhwal Himalaya is located at the western side of a Seismic Gap, where a great earthquake is overdue atleast since 200 years. This seismic gap (Central Seismic Gap: CSG) has been defined as the region for future great earthquake with 52% probability, is located between the rupture zones of two significant/great earthquakes, viz. the 1905 Kangra earthquake of M 7.8 and the 1934 Bihar-Nepal earthquake of M 8.0; and the most recent one, the 2015 Gorkha earthquake of M 7.8 is in the eastern side of this seismic gap (CSG). The Garhwal Himalaya is one of the locations in the Himalaya where all the major Himalayan structures and the Himalayan Seimsicity Belt (HSB) can ably be described and studied. The prevailing stress has been identified as compressional towards NNE-SSW which is the direction of relative plate motion between the India and Eurasia continental plates. The low friction coefficient suggests the presence of fluids around the

chamoli region. Although the epicentral locations of these earthquakes are located near the Main Central Thrust Zone, the earthquakes are indeed related to the detachment/Main Himalayan Thrust.

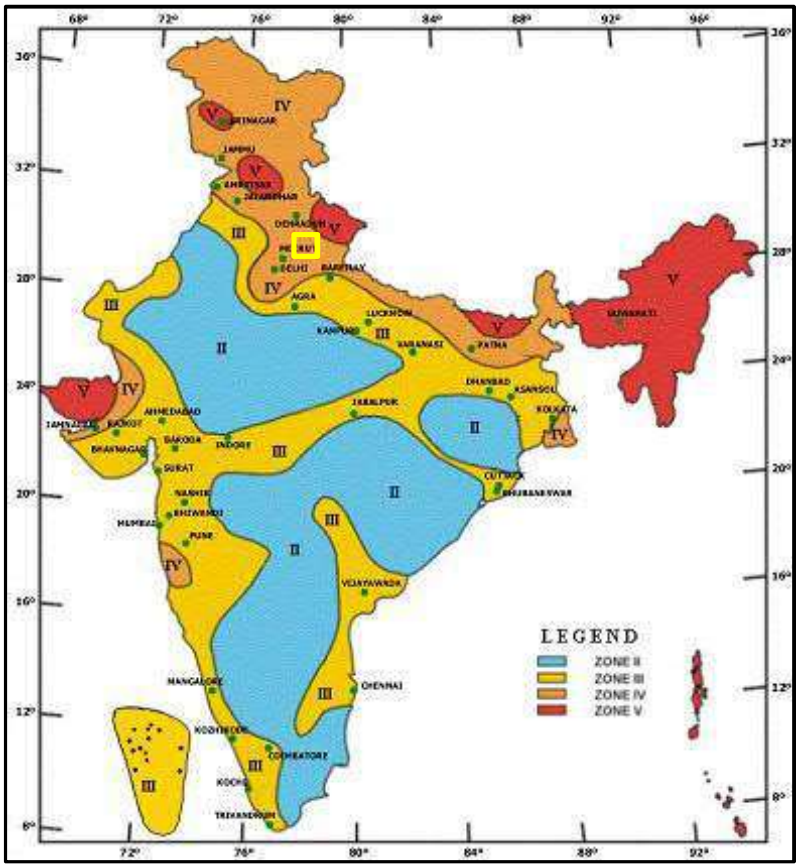


Figure 5:Seismic zonation map of India showing boxed Project location

According to IS 1893:2002, the site is located in seismic Zone IV area, the zone factor (Z), is 0.24. Pseudo-static method is chosen for the tunnel design in the project.

4.2.1 Site specific Earthquake studies

The site-specific seismic hazard assessment studies for seismic design of the bridges have been performed by Department of Earthquake Engineering, Indian Institute of Technology, Roorkee. The recommendations for the site-specific seismic hazard for the location falls in package 7B are based on the studies carried out related to the regional geology, local geology around the site, earthquake occurrences in the region around the site, seismo tectonic setup of the area, and the geotechnical investigations at the site. The Probabilistic Seismic Hazard Analysis (PSHA) has been conducted and Uniform Hazard Spectra (UHS) have been estimated for return periods of 475 and 2475 years, at rock outcrop and soil surface considering the corresponding shear wave velocities available from the geotechnical investigations. Design response spectra for two different return periods (475 and 2475 years) have been developed from the results of the PSHA and ASCE 7 (2016). Design response spectra at brides location falls in Package-7B is summarized below:

4.2.1.1 Tilani (out) Bridge location

- **Design spectra for rock outcrop**

The corresponding equations for design response spectrum at rock outcrop are as follows:

For 475 Years	For 2475 Years
Sa (g) =0.292(1+15T) 0.00s ≤T ≤0.10s Sa (g) =0.731 0.10s ≤T ≤0.290s Sa (g) =0.212 / T 0.290s ≤T ≤4.00s	Sa (g) =0.501(1+15T) 0.00s ≤T ≤0.10s Sa (g) =1.253 0.10s ≤T ≤0.318s Sa (g) =0.398 / T 0.318s ≤T ≤4.00s
• Shear wave velocity for the bed rock has been assumed as 760 m/s.	

- **Design spectra for soil**

The corresponding equations for design response spectrum at soil are as follows:

For 475 Years	For 2475 Years
Sa (g) =0.355(1+15T) 0.00s ≤T ≤0.10s Sa (g) =0.888 0.10s ≤T ≤0.519s Sa (g) =0.461/ T 0.519s ≤T ≤4.00s	Sa (g) =0.550(1+15T) 0.00s ≤T ≤0.10s Sa (g) =1.375 0.10s ≤T ≤0.647s Sa (g) =0.890 / T 0.647s ≤T ≤4.00s

The site-specific design spectra have been estimated based on Probabilistic Seismic Hazard Assessment carried out for the region as well as ASCE 7 (2016) methodology. The design spectra at rock outcrop as well as soil strata for bridge site have been provided for the 475 years and 2475 years return period.

The envelope presented shall be used with appropriate values of Importance Factor, I and Response Reduction Factor, R, as per the relevant standards and codes.

The vertical response spectrum can be considered as 2/3rd of the corresponding horizontal response spectrum.

The design earthquake parameters recommended for 2475 years return period shall be used in place of Z × Sa/g, with load factor for earthquake load being taken as unity.

The forces obtained shall be compared with those obtained from Cl. 9 .4, of IRS code for Earthquake Resistant Design of Railway Bridges (2017). The structure shall not be designed for forces less than those obtained from IRS code for Earthquake Resistant Design of Railway Bridges (2017). For design of structures/components using working stress method, the response spectra given in this report should be reduced by a factor of 1.5.

4.2.2 Shear waves velocity studies

MASW experiment using multiple geophone and shot array was performed at bridges site fall in package -7B close to the pier location. At Borehole locations experiment related to ambient micro tremor recording system for H/V analysis was done. The obtained data used to calculate shear wave velocity structure at pier location using H/V technique. Details of shear wave analysis done at bridges location are summarized below:-

4.2.2.1 Shear wave analysis at Tilani (Out)

- **At BHBR10A-1 location:**

Depth at the bottom of the layer [m]	Thickness [m]	Vs [m/s]
7.5	7.5	195
30	22.5	227

- **At BHBR10A-2 location:**

Depth at the bottom of the layer [m]	Thickness [m]	Vs [m/s]
7.5	7.5	285
30	22.5	401

4.3 In-Situ Stress

Considering the available data coming from the World Stress Map (WSM) (a global compilation of information on the present-day stress field of the Earth's crust with 42,750 stress data records in its current WSM database release 2016, the project zone falls very near the border between the Asian and Indian plate. The available stress indicators are Earthquake Focal Mechanisms, most of them indicating a compressive field with principal tensor NNE-SSW oriented (i.e. the direction of maximum horizontal compressive stress is almost parallel to the direction of plate motion). At belt scales under thrusting of the Indian plate below the Eurasian plate thrust faults are propagating to the foreland side of the Himalaya indicating southernmost front as a most active zone.

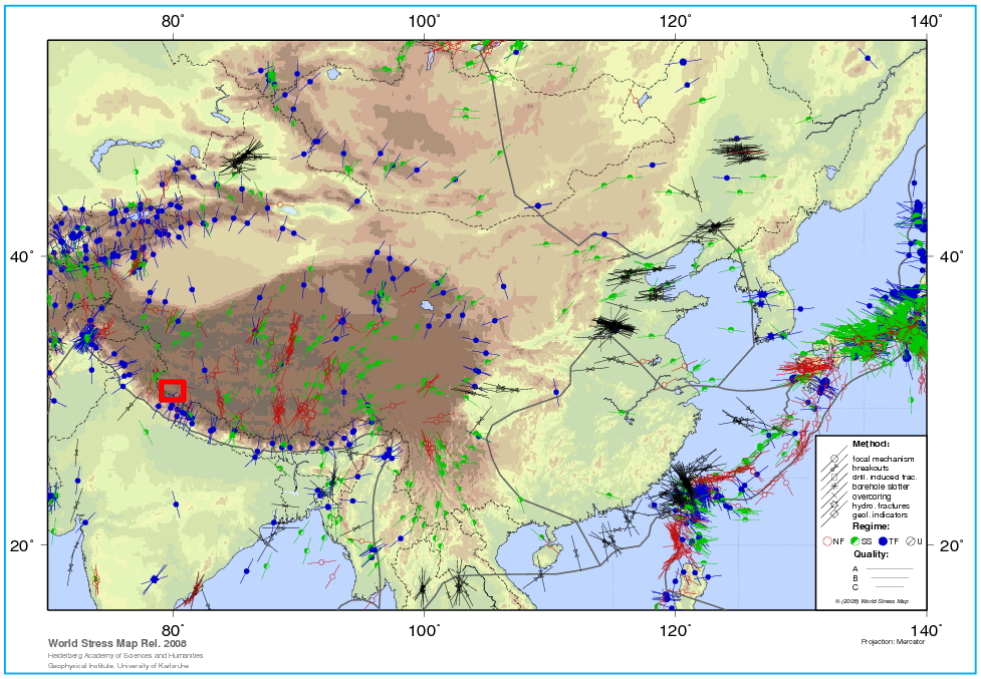


Figure 6: World Stress Map (WSM), 2008; the project zone (Red squaring)

This is also shown by focal mechanism solution of a moderate to large earthquakes that are mainly thrust type events. However, there are some events along the transverse fault indicating strike-slip motion.

Following the above described regional geological context seems to be reasonable to take into account a value of k (ratio between horizontal and vertical stresses) bigger than 1.0, with principal tensor NNE-SSW oriented.

4.4 Geology along the Tunnel Alignments

The geological map and report provided by RVNL, which was initially prepared by Geodata was reviewed prior to the site visit. During the site visit the geological features including rock types, geological mapping of discontinuities reported by Geodata were cross verified and checked. The geological descriptions of these observed geological features are presented below along the alignment.

Most of the Tunnel alignment of Tunnel-13 crosses through the Nagnithak formation of Garhwal group of rock except at the Tilani (Portal -2) area where Pithoragarh group of rock has exposed. In Nagnithak formation Intercepted bedrock is Quartzites with subordinates' phyllites observed along with metabasic rock. Dolomite rock is exposed at the Tilani location at Portal-2 which is a part of the Pithoragarh formation.

Km: 91+190 to 93+500

The Tunnel-13 Portal-1 starts after the major bridge located at Narkota. Thereafter alignment runs alongside of Alaknanda River, more or less parallel to the existing road. At the Narkota portal (P1) of Tunnel-13 bedrock underlain by the debris material consisting of angular to sub-angular rock fragments intermixed with heterogeneous matrix exposures has been visible near by the portal location which is the Meta basic rock also confirmed in the boreholes drilled at the portal location. These Metabasic rocks has overlain the Quartzite of Nagnithak formation.

Figure 7: Location of Tunnel 13 Portal-1

Figure 8: Location and rock outcrops (mainly metabasic)

The tunnel alignment and vicinity is covered with shallow overburden except at some locations where deep overburden has been foreseen, comprises of slope wash materials mixed with silty matrix and thick vegetation. The bed rock outcrops are exposed at in and around portals and intermittently along the tunnel alignment has been used for projecting the geology along the tunnel alignment. The tunnel alignment is mostly normal to the general trend of the rock foliation, which is a fair to favourable condition for tunnelling. It is interpreted from the geological mapping that the tunnel is expected to pass within the Quartzite and metabasics rocks of the Nagnithak and Pithauragarh formation of the Garhwal Group. Most of the Tunnel alignment of Tunnel-13 crosses through the Nagnithak formation of Garhwal group of rock.

Figure 9: Highly weathered/ crushed Quartzite bands at the fault zone (92+000 approx.)

Fault zone was observed at Ch: 92+00 (approx.) along the alignment where the rock is crushed and highly fractured.

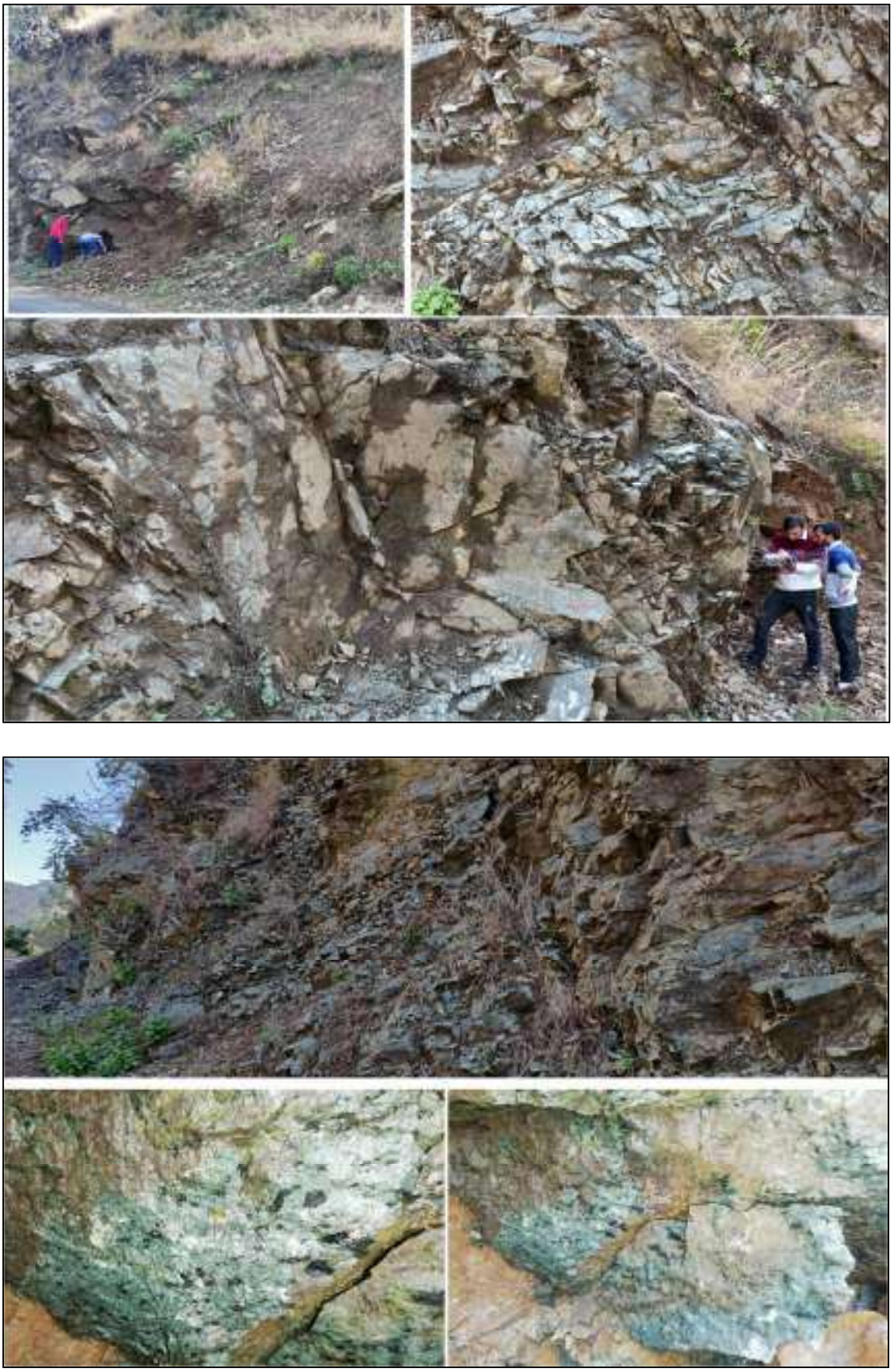


Figure 10: Fractured metabasic rocks

Figure 11: Alternate bands of Metabasic and quartzite rocks

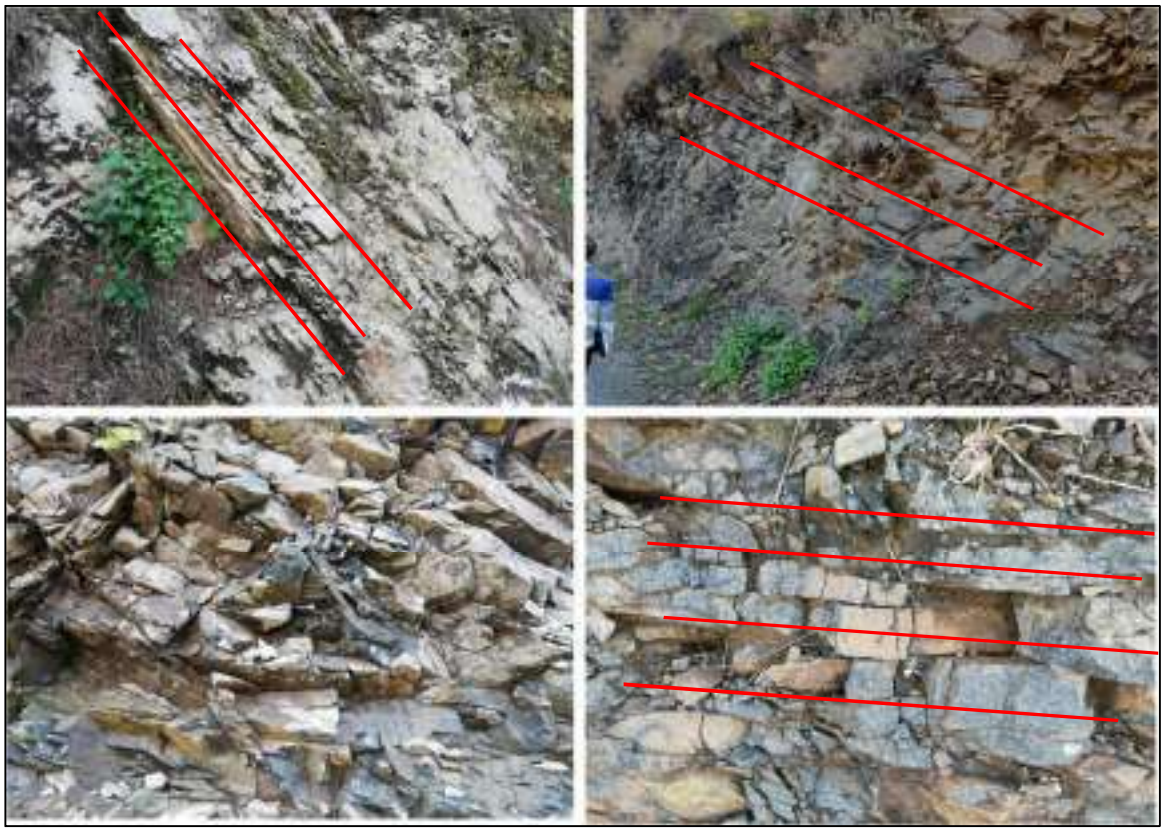


Figure 12: Quartzite along the tunnel alignment (discontinuities marked with red)

Figure 13: Contact between Metabasic and Quartzite type rocks

Km: 93+500 to 96+400

Figure 14: Quartzite outcrops along the tunnel alignment

Km: 96+400 to 97+ 500

The rock at these locations belongs to Nagthank Formation. The outcrops observed in this section are mostly Quartzites. Fault zone was observed at the tunnel alignment at Ch: 97+600 approx. The nature of rock in this zone is crushed and highly fractured. Cause of this landslide is ENE-WSW trending fault which is vertical to sub vertical and transverse in nature.

Figure 15: Quartzite outcrops along the tunnel alignment (discontinuities marked with red)

Figure 16: Fault along the Nalla (Ch: 97+600 approx). with landsides

Figure 17: Highly fractured quartzites

Km: 100+500 to 100+630

At the Tilani (Tunnel-13, Portal -2) area where Pithauragarh group of rock has foreseen. Dolomite rock intercepted at this location which is a part of the Pithauragarh formation. The general trend of discontinuities mapped at this location is fair to favourable, which suits the tunnel alignment.

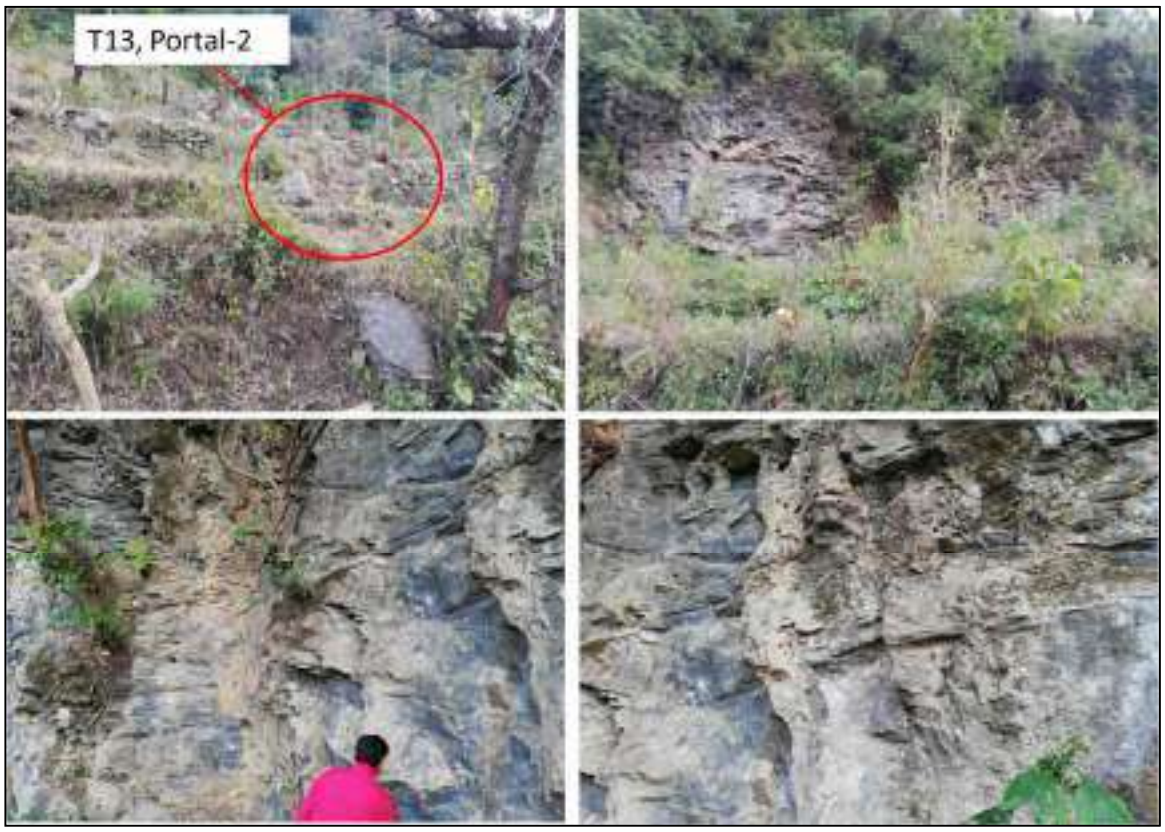


Figure 18: Location of T13 Portal-2, Dolomites outcrops on the tunnel portal

4.5 Major Lithological Types along the Tunnels Alignment

4.5.1 Tunnel-13

A. **Quartzite:** - It is medium to fine grained greyish, pinkish to whitish coloured with intercalation of subordinate purple coloured Phyllite.

A. **Metabasic: -** The metabasic are medium to fine grained and commonly exhibit abundance of greenish pyroxenes, amphibole and white grains of plagioclase. The foliated type of metabasic show hornblende, chlorite and actinolite towards marginal part.

B. **Dolomites: -** Dark coloured Dolomites of the Pithoragarh formation has been observed at Portal-2 area. Karastic action of water foreseen at this location.

C. **Quaternary Deposition:** Colluvial and alluvial deposits of quaternary age were observed during the geological survey at the Portal-1 location at Narkota. The quaternary deposits are generally covered by dense forest cover. Big boulders resting over the scree or slide deposits and in the valley side slopes, probably of glacial origin are found here and there. Colluvial fans and scree materials are forming the

repose slopes and formed due to gravitational forces or fluvial action covering a major portion of the bed rocks. Such types of terraces are good sites for the settlement and agriculture. The area comprises different categories of slope, relative relief and latitudinal variations. This area has moderate to steep slopes.

Percentage distribution of the rock types to be encountered in tunnel 13 is as follows:-

Lithology	Distribution along the Tunnel Alignment (In %)
Quartzites	69.16%
Metabasic	8.12%
Dolomites	15.38%
Quaternary deposits	0.68 %
Sheared/Faulted rock mass	6.66%

The rock types observed along the Tunnel-13 are highly jointed and weak due to the presence of high overburden, thickly vegetated surface and highly varying geology with the presence of numerous small and big shear zones, faults and thrust. Due to these reasons, various tunnelling problems may arise during the execution viz. crown failure, squeezing condition, rock bursting etc. To minimize these risks associated with the varying and mixed geology advance probe hole planning, drilling and monitoring shall be followed seriously to reduce the geological surprises.

5. Discontinuity Analysis Along the Tunnel

5.1 Tunnel-13

The discontinuities data recorded along the proposed Tunnel-13 located between the chainage Km 91+190 to km 100+630 have been subdivided in to three sectors, viz.,Portal-1,Portal-2 and along the tunnel alignment. The data collected will be used to prepare the geological sections more accurately and to evaluate the RMR Values. The geotechnical parameters and attitude of different discontinuities recorded on surface during the geological mapping along the alignment will be further detailed in the Geotechnical Baseline Report. Sector wise description of the discontinuities for the Tunnel-13 has been described below.

Geological mapping along the tunnel alignment has been carried out during the site visit Portal-1 of Tunnel-13 is located in the Narkota just after the minor bridge. At this location bedrock underlain by the debris material consisting of angular to sub-angular rock fragments intermixed with heterogeneous matrix. However, few intermittent bedrock exposures have been visible near by the portal location which is mainly the metabasic rock, which are further confirmed by the boreholes drilled at the portal location. These Metabasic rocks had overlain the Quarzite of Nagnithak formation. Whitish to pinkish quartzite and basic metavolcanics are the most common rock types observed in Portal-1 areas (in between sector-91+190 to 92+200) of T-13 alignment. The Metavolcanics Formation consists of Epidiorite, Amphibolite & Prasinite.

The discontinuities recorded from the bed rock outcrops exposed between portal 1 and middle parts will be used to develop geological sections in the Geotechnical Base Line Reports. Bed rock in this area is traversed by three sets of discontinuities (S1, S2, S3,) along with some random joints.

The average strike of the foliation (S1) planes is N70˚E – S70˚E with 54˚dip towards S20˚E. The average strike of S2 joint planes is N31˚W–S31˚E with 54˚ dip towards N59˚E, and S3 joint planes exhibit average strike as N51˚E – S51˚W with 66˚ dip towards N39˚W.

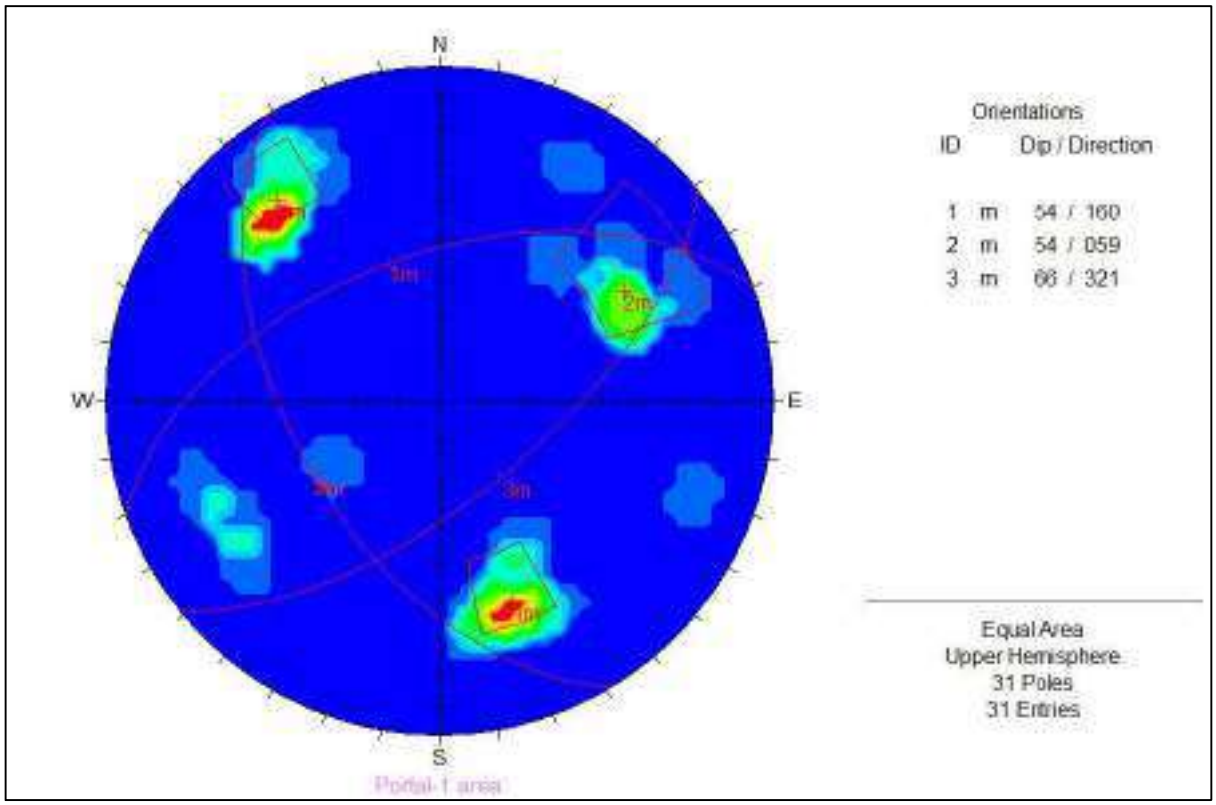


Figure 19: Plot of 31 poles of discontinuities in the upper hemisphere of equal area projection recorded along the Portal 1 area of Tunnel-13

Geotechnical parameters and the variation in the attitudes of the discontinuities recorded along the portal area are tabulated below:

Table 3: Geotechnical Parameters of the Discontinuities Recorded at Portal- 1 area of Tunnel-13

Portal-1 of Tunnel-13 (Ch.91+190 to 92+200)			
Discontinuity	**S_1**	**S_2**	**S_3**
Dip/Direction	$40\text{-}60^0\text{-}25^0/150^0\text{-}170^0$	$45^0\text{-}75^0/40^0\text{-}70^0$	$60^0\text{-}80^0/315^0\text{-}330^0$
Roughness	RP-SP	RU-RP	RU-RP
Spacing	Closely spaced (5cm-50cm)	Close to wide (15cm-200cm)	Close to wide (20cm-200cm)
Aperture	T-open(5mm-1cm)	T-open(2mm-5mm)	T-open(2mm-5mm)
Filling	Clay to none	None to clay	Clay to none
Persistence	>10m	>3m	>2m

Major part of the middle reaches of Tunnel-13 (The area between sector Ch. 92+200 to Ch. 98+600) is inaccessible due to steep cliffs and thick vegetation. However we have carried the walk over survey in the approachable areas and performed the geological mapping and verified the geological features along the tunnel alignment. Whitish to pale green quartzite and basic metavolcanics are the most common rock types observed along the middle reaches of T-13 alignment .White to pale green coloured quartzite largely outcrops and the Metavolcanics formation consists of epidiorite, amphibolite, prasinite. Purple coloured subordinate Phyllites outcrops were observed at some location.

The average strike of the foliation (S1) planes recorded in middle reaches of the tunnel is N57˚E – S57˚E with 41˚dip towards S33˚E. The average strike of S2 joint planes is N43˚W–S43˚E with 65˚ dip towards N47˚W, and S3 joint planes exhibit average strike as N68˚E – S68˚W with 56˚ dip towards N22˚W.

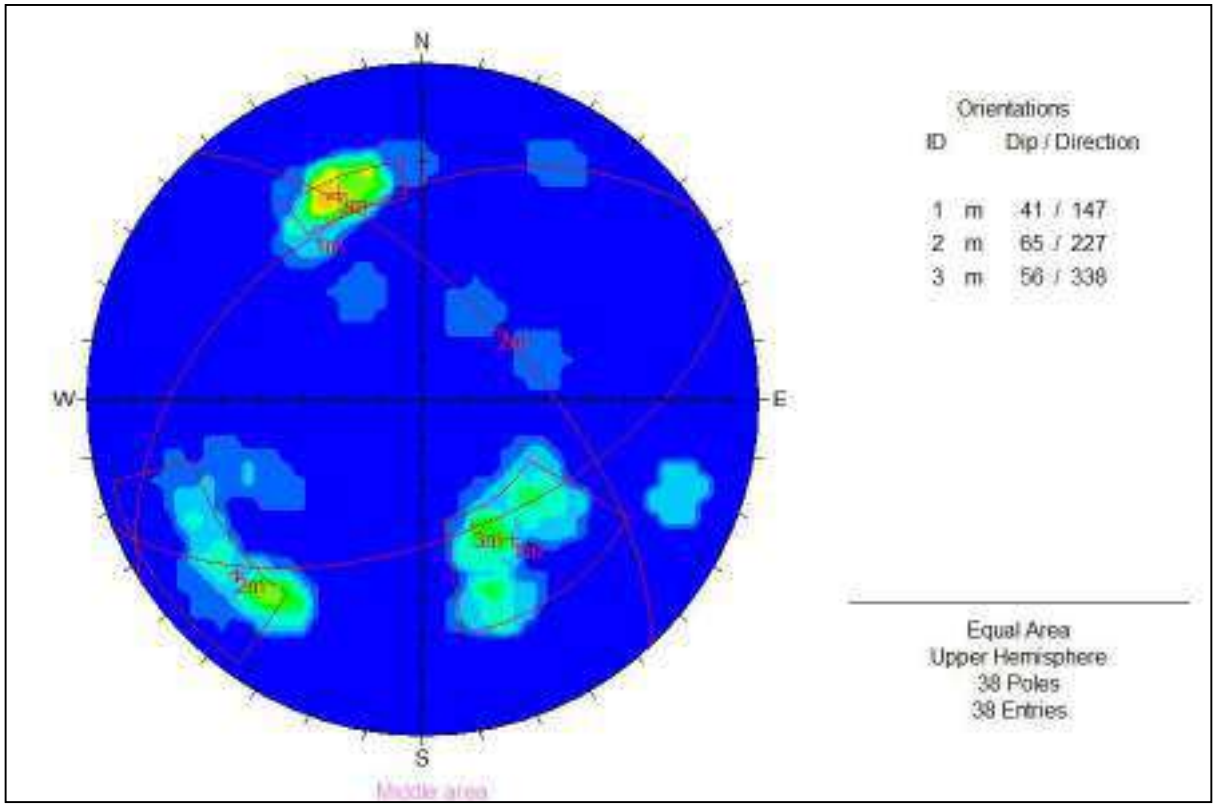


Figure 20: Plot of 38 poles of discontinuities in the upper hemisphere of equal area projection recorded along the Middle reaches of Tunnel-13

The discontinuities data has been recorded along this region which is tabulated below.

Table 4: Geotechnical Parameters of the Discontinuities Recorded along the Middle Area of Tunnel-13

Tunnel-13 (Ch.92+200 to 98+600)			
Discontinuity	**S_1**	**S_2**	**S_3**
Dip/Direction	30^0-60^0/120^0-170^0	50^0-70^0/215^0-255^0	70^0-75^0/325^0-355^0
Roughness	RP-SP	RU-RP	RU-RP
Spacing	Closely spaced (5cm-35cm)	Close to wide (30cm-200cm)	Close to wide (10cm-200cm)
Aperture	T-open(5mm-1cm)	T-open(2mm-5mm)	T-open(2mm-5mm)
Filling	Clay to none	Clay to None	Clay to None
Persistence	>10m	>5m	>3m

Portal-2 of Tunnel-13 is located at Tilani at the chainage 100+630. Exposed rock has been observed and it comprises of grey to dark grey coloured Dolomites of Pithauragarh formation. Natural slope measured at this location is steep. The discontinuities recorded from the bed rock outcrops exposed between portal 2 and middle parts. Bed rock in this area is traversed by three sets of discontinuities (S1, S2, S3,) along with some random joints. A plot of 28 poles of joint planes in the upper hemisphere of the stereogram corroborates the field observations.

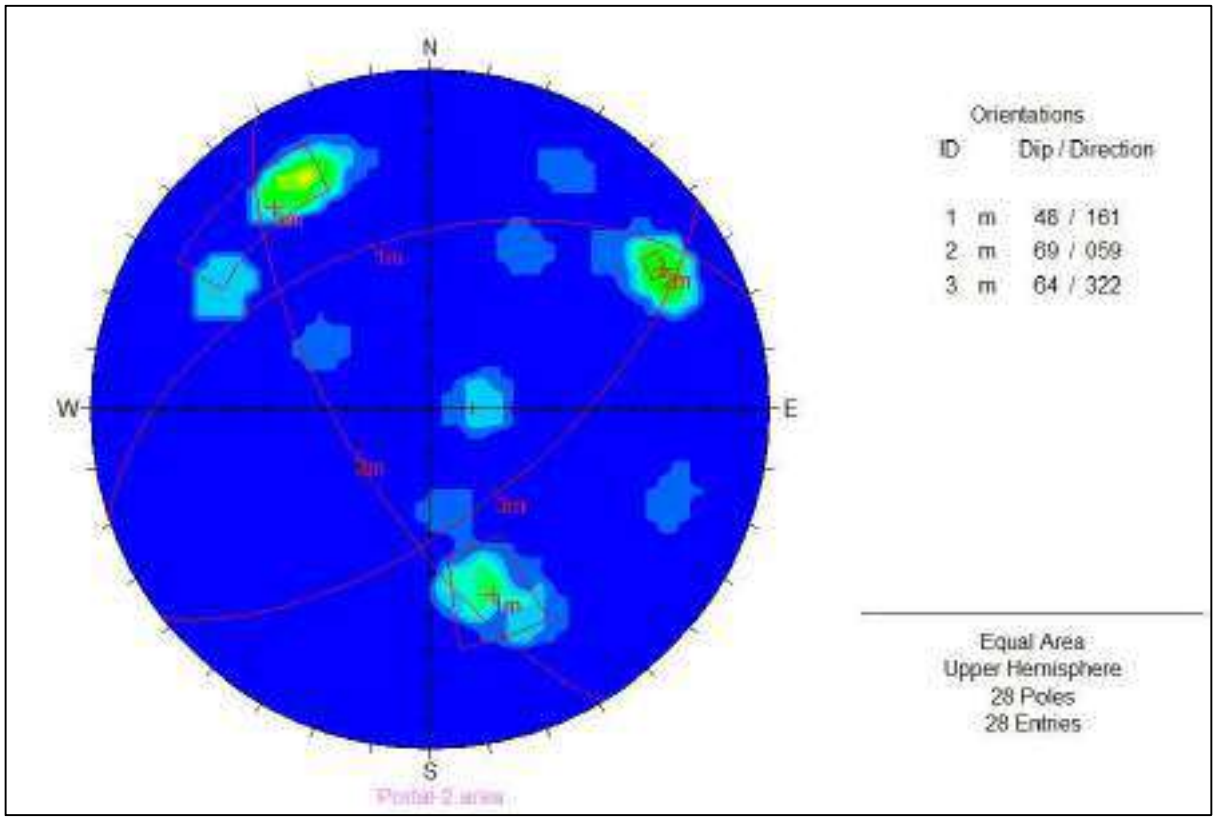


Figure 21: Plot of 30 poles of discontinuities in the upper hemisphere of equal area projection recorded along the Portal 2 area of Tunnel-13

Geotechnical parameters and the variation in the attitudes of the discontinuities recorded along the portal area are tabulated below:

Table 5: Geotechnical Parameters of the Discontinuities Recorded at Portal- 2 Area of Tunnel-13

Portal- 2 of Tunnel-13 (Ch.98+600 to 100+630)			
Discontinuity	**S_1**	**S_2**	**S_3**
Dip/Direction	$10\text{-}55^0/85^0\text{-}170^0$	$55^0\text{-}60^0/65^0\text{-}70^0$	$60^0\text{-}75^0/300^0\text{-}335^0$
Roughness	RP-SP	RU-RP	RU-RP
Spacing	Closely spaced (5cm-40cm)	Close to wide (25cm-200cm)	Close to wide (15cm-200cm)
Aperture	T-open(5mm-1cm)	T-open(2mm-5mm)	T-open(2mm-5mm)
Filling	None to clay	None to clay	Clay to None
Persistence	>5m	>2m	>2m

The major Strike of foliation plane varies along Tunnel 13 is from N57°E to N71°E and S57°W to S71°W with 41° to 54° dip in the south- easterly direction. Variation in the attitude of the joint sets may be expected locally around the area due to local folding/faulting.

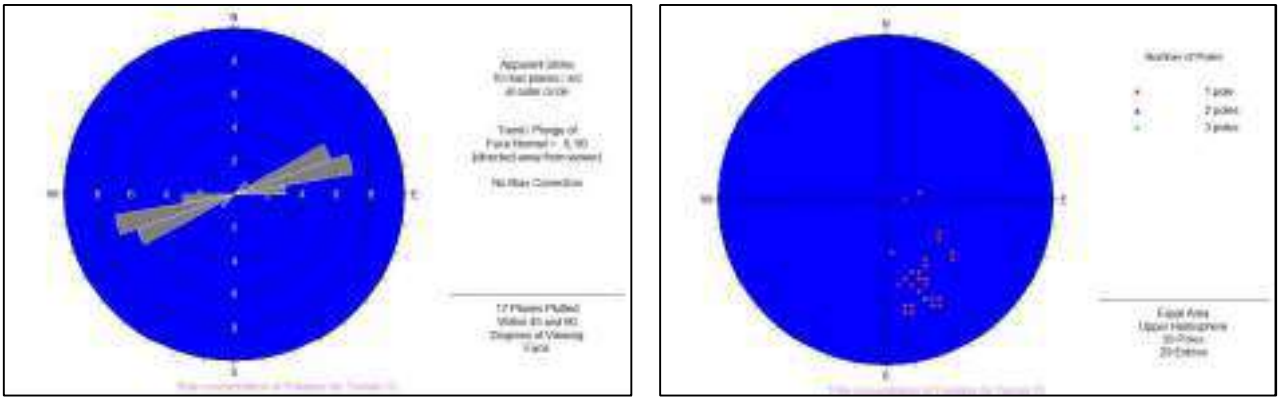


Figure 22: Rosette Plot of 29 poles of foliations recorded along Tunnel-13

6. Geological/ Geotechnical Works for Tunnels

Comprehensive geological and geotechnical study of data has been performed which consists of the following items:

- Detail geological engineering mapping,
- Rock mass classification and relevant support categories,
- Assessment of landslide areas and relevant mitigation measures,
- Finalization of tunnel longitudinal profile,
- Design shape of tunnels and relevant cross sections,
- Detailed designs of surface and underground structures in terms of geology and geotechnics.

Site investigation works concerning the project area will be executed in the following order:

- Review and interpretation of the available geological and geotechnical data,
- Review and interpretation of the available geophysical data,
- Conducting a preliminary site visit to verify major lithologies on portal locations, station areas and minor bridge locations to decide any supplementary site investigations.
- Additional ground investigations proposed at Inception stage will be executed with consent of RVNL.
- The landslide areas affecting the portal areas and tunnel route unfavourably will be investigated in detail and necessary mitigation measures will be recommended.

6.1 Geological and Geotechnical Investigations

A site investigation program was executed to investigate the soil and rock conditions and the landslide areas existing along the project route by Rail Vikas Nigam Ltd. (RVNL) within the project of the execution works of the Rishikesh – Karnaprayag Proposed Alignment. The site investigation works mainly include engineering geological mapping, soil and core drilling, geophysical survey, in situ tests and laboratory tests. Lithological contacts of the units, joints, faults, springs, seepages and the landslides will be presented in detail in the geological map.

6.2 Existing Borehole Data

A Total of 11 boreholes are completed along the tunnel T13 alignment, Details of these borehole are summarized below..

The Geotechnical investigations are executed along the tunnel and station areas by SM Consultant and Soil tech (India) Pvt. Ltd. during the year 2016 - 2018 for determining the engineering properties of the soil and rock units in the project site and to determine the groundwater level in accordance with the relevant technical specifications in order to determine the site characteristics of the units during the drilling works. The soil – rock boundary in some of the borehole logs is revised considering the field observations, laboratory test results and geophysical survey. The locations, depth of BH are given in the Table 6 and Table 7.

In reviewing the existing data, it is noted that boring could not be executed in some areas most probably due to higher overburden, accessibility and performance of existing drill rigs. It is believed that lower values of both TCR and RQD are closely related to the drilling technology.

Table 6: Summary of Existing Boreholes Soil Tech

BH Description	Chainage	Coordinate (m)		BH Depth (m)	Location of BH	Remarks
		X	Y			
BH-119	91+254	301347.000	3349291.000	35	T13 Portal	

Table 7: Summary of Existing Boreholes by SMC

BH Description	Chainage	Coordinate (m)		BH Depth (m)	Location of BH	Remarks
		X	Y			
BH-120	92+020	302039.000	3349569.000	325	Tunnel 13	
BH-121	93+425	303422.000	3349813.000	106.50	Tunnel 13	
BH-122	93+690	303683.000	3349895.000	138	Tunnel 13	
BH-123	96+304	305948.000	3351189.000	40	Tunnel 13	
BH-124	96+836	306410.000	3351453.000	140	Tunnel 13	
BH-125	97+730	307188.000	3351894.000	280	Tunnel 13	
BH-126	99+140	308408.000	3352599.000	250	Tunnel 13	
BH-127	99+920	309078.000	3352999.000	110	Tunnel 13	
BH-128	100+335	309404.000	3353255.000	130	Tunnel 13	
BH-129	100+610	309619.000	3353417.000	45	Tunnel 13 Portal	
BH-130	101+823	309800.000	3353542.000	35	Tilani Station	
BH-131	101+020	309965.000	3353649.000	30	Tilani Station	
BH-132	101+295	310222.000	3353748.000	45	Bridge	

Table 8: Summary of geological description from Borehole Investigations for Tunnel-13

Chainage	Structure	Borehole	Geological Description	In-Situ and Laboratory Tests
91+254	Alignment (T-13)	BH- 119	0.00m – 1.5m, overburden followed by bedrock 1.5m – 13.50m, medium to fine grained, boulders of Quartzite/Metabasic. 13.50m – 55.00m, medium to fine grained, Metabasic recovered	1 - BHTV Test, 4 - Petrographic Analysis, 12 - Rock mechanics lab test, 4 - Chemical Analysis of Water, 8 - Soil mechanics lab test,
92+020	T- 13	BH-120	30.75m – 325.00m, Metabasic Rock recovered	1- BHTV Test, 2 - Dilatometer Test, 3 - Rock mechanics lab test, 9 - Soil mechanics lab test, 6 - Chemical Analysis of Water, Hydro-fracture test
96+304	T- 13	BH- 123	0.00m – 9.75m, overburden followed by bedrock 9.75m – 40.00m, medium to fine grained, strong, Quartzite recovered	1 - BHTV Test, 14 - Rock mechanics lab test, 3 - Packer test, 6 - Chemical Analysis of Water,
99+140	T- 13	BH- 126	0.00m – 10.50m, overburden followed by bedrock 10.50m – 250m, Carbonaceous Phyllite rock	1 - BHTV Test, 14 - Rock mechanics lab test, 3 - Packer test Hydro-fracture test
99+920	T- 13	BH-127	0.00m – 4.50m, overburden 4.50m – 22.50m, River Borne Material 22.50m – 110.00m, Phyllite rock recovered	10 - Rock mechanics lab test, 1 - Permeability test
100+335	T- 13	BH- 128	0.00m – 28.50m, overburden 28.50m – 130.00m, Carbonaceous Phyllite rock recovered	-
100+610	T-13 (Portal)	BH- 129	0.00m – 21.00m, overburden 21.00m – 45.00m, Carbonaceous Phyllite rock recovered	1 - BHTV Test, 2 - Dilatometer Test, 13 - Rock mechanics lab test, 2 - Permeability test, 6 - Chemical Analysis of Water,
100+823		BH- 130	0.00m – 35.00 overburden (Boulders & Gravels of Metabasic and Quartzite)	9 - Soil mechanics lab test, 3 - Permeability test

Chainage	Structure	Borehole	Geological Description	In-Situ and Laboratory Tests
101+020	Tilani station	BH- 131	0.00m – 30.00m, overburden	13 - Soil mechanics lab test, 2 - Permeability test

6.3 Existing Geophysical Data

The geophysical survey has been conducted along the tunnel locations formed of unconsolidated units such as terrace deposits and landslide material overlying the bedrock. The main purpose of the geophysical investigations is to determine the thickness and elastic parameters of the unconsolidated material (Table 9).

Geophysical methods are considered as one of the most feasible techniques for geological modelling the sites with different dynamic conditions. However, some geological conditions encountered during geophysical applications may lead to different interpretations of the obtained results. In this context, the existing geological conditions can be defined more accurately in case the geophysical applications are performed together with other Geological and Geotechnical studies (geological mapping, trial pits, boreholes, in-situ tests, groundwater level measurement, etc.).

The available Geotechnical and Geophysical investigation s are under review by AECOM for better co-relations of Geology, Geophysical and Geotechnical investigations data for design purpose.

Table 9: Summary of existing geophysical surveys along T13 tunnel

Chainage	Structure	Geophysical Survey
CH95+600 to CH96+800	Tunnel 13	3 SR Profile
CH100+600 to CH100+800	Tunnel 13	1 ER Profile

6.4 Field Test

The following tests were carried out in the field to obtain other relevant properties of the sub-surface formation in accordance with the relevant technical specifications.

- Standard penetration test (SPT) : IS code-2131
- Rock Sampling (Rock Quality Designation)
- Dilatometer test:
- Permeability test in both overburden and rocks: IS code-5529 (Part-1 & 2) 2006
- Geophysical survey
- Borehole tele viewer logging (BHTV)

- Hydro fracture Test

6.5 Lab test

The following laboratory tests are being carried out on rock samples & undisturbed and disturbed soil samples for identification and classification purposes and to obtain other relevant properties of the sub-surface formation.

Soil Samples:

(a) Moisture content (BS 1377 Part 3),

(b) Dry density (BS 1377 Part 3),

(c) Organic content (BS 1377 Part 3),

(d) Atterberg limits (IS 2720 Part 5),

(e) Specific gravity (IS 2720 Part 3),

(f) Consolidation test (IS 2720 Part 15),

(g) Grain size Analysis including Hydrometer test (IS 2720 Part 4),

(h) Undrained unconsolidated Tri-axial test (UUT) (IS 2720 Part 11),

(i) Sulphate content (IS 2720 Part 27),

(j) Chloride content (BS 1377 Part 3),

(k) pH value (IS 2720 Part 26).

Rock Samples

Dry density (IS 13030),

(a) Tensile strength (Brazilian) test (IS 10062),

(b) Uniaxial compressive strength test (IS 9143),

(c) Modulus of elasticity and Poisson's Ratio (IS 9221),

(d) Point load strength index (IS 8764),

(e) Specific gravity (IS 1122),

(f) Direct shear test along discontinuities (IS 2720 Part 13),

(g) Tri-axial compression test (IS 13047).

Additionally, chemical analysis of groundwater samples to estimate the suitability for concreting and aggressiveness related to the attack on concrete/reinforcement including the determination of pH value as given in the following;

(a) Sulphate content (IS 3025 Part 11),

(b) Chloride content (IS 3025 Part 32),

(c) pH value (IS 3025 Part 24).

7. Field and Laboratory Test Results

A laboratory and field test was performed to characterize the on-site rock, soil, water in boreholes, and to permit development of geotechnical parameters for engineering analysis and design. The tests were performed in accordance with the Indian standard code.

7.1 Field test results

7.1.1 Rock Quality Designation (RQD)

RQD's from the borings are presented in the GDRs. The logs indicate that RQD generally correlates with the degree of weathering, rock type, and amount of fracturing within the various bedrock units. Figures below indicates the RQD values for Tunnel-13.

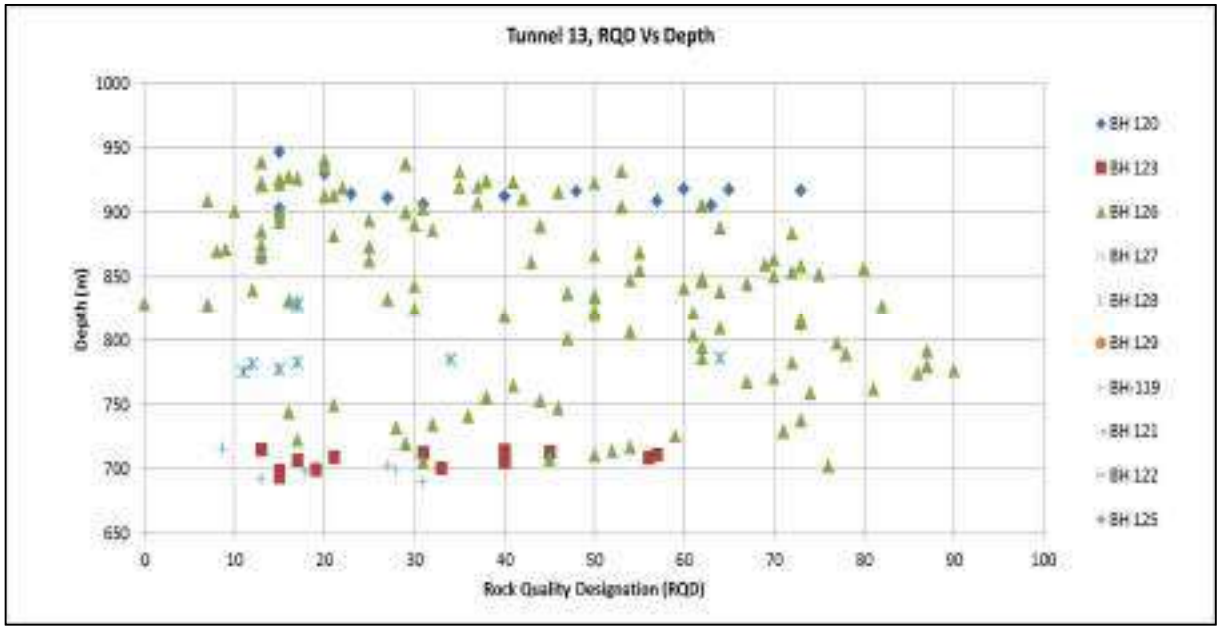


Figure 23: RQD vs Depth for Tunnel-13

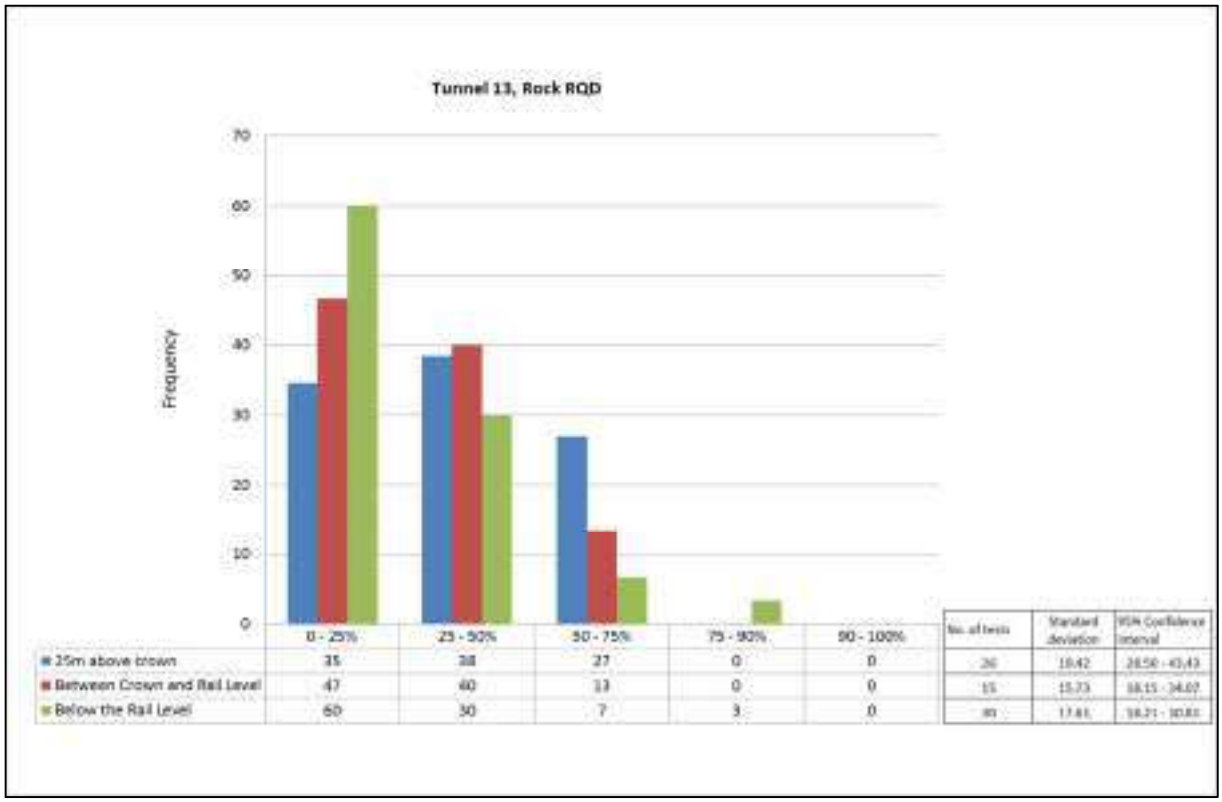


Figure 24: Variation of RQD along the Tunnel-13 Alignment

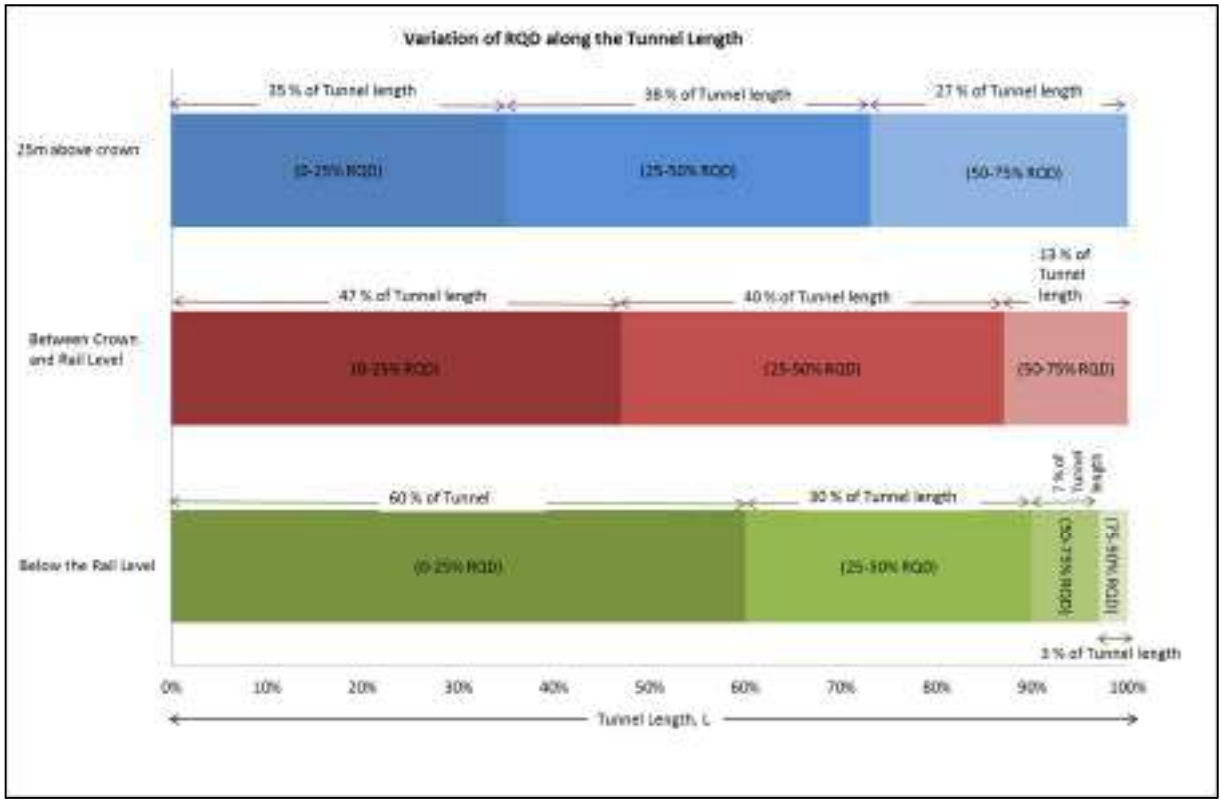


Figure 25: RQD along the Tunnel-13

7.1.2 Dilatometer test

The deformability characteristics of the rock masses can be interpreted due to in-situ determination of the deformation modulus (modulus of elasticity, E) and shear modulus (G) of the rock strata by taking into consideration the dilatometer test results which are represented below in Table.

Table 10: Summary of dilatometer testing

Location	Borehole ID	Test depth (m)	Poisson's ratio	Elastic Modulus (Gpa)	Shear Modulus (Gpa)	Lithology
Tunnel 13	BH 120	92	0.25	11.30	4.52	Amphibolite
		98	0.25	19.87	7.94	Amphibolite
	BH129	23.5	0.25	2.59	1.03	SW to CW ,S to M sheared, fine to medium, grained, foliated strong, black, shale /slate
		42	0.25	1.54	0.61	SW to CW ,S to M sheared, fine to medium, grained, foliated

7.1.3 Borehole Televiewer Logging

The resulted images of the borehole televiewer logging are the acoustic pictures of the borehole wall in which the quantitative properties and the orientations of the fractures can be determined (Zemanek, 1969). The summary of the BHTV logging carried out at project site is represented in Table below.

Table 11: Summary of BHTV fracture classification

Structure	Borehole ID	Fracture classification			
		25m above crown level	Between Tunnel crown and Rail depth	5m below Rail depth	10m below Rail depth
Tunnel 13	BH 123	Broken Zone/ Undifferentiated; Major Open Joint/ Fracture; Minor Open Joint / Fracture	Broken Zone/ Undifferentiated ; Major Open Joint/ Fracture; Minor Open Joint / Fracture; Partially Open Joint /	Major Open Joint/ Fracture; Partially Open Joint / Fracture	-

Structure	Borehole ID	Fracture classification			
		25m above crown level	Between Tunnel crown and Rail depth	5m below Rail depth	10m below Rail depth
			Fracture		
	BH 126	Major Open Joint/ Fracture; Minor Open Joint / Fracture; Partially Open Joint / Fracture	Minor Open Joint / Fracture; Partially Open Joint / Fracture	Minor Open Joint / Fracture; Partially Open Joint / Fracture	-
					Minor Open Joint / Fracture; Partially Open Joint / Fracture

Table 12: Index of structures

Code	Description
0	Broken Zone/ Undifferentiated
1	Major Open Joint/ Fracture
2	Minor Open Joint / Fracture
3	Partially Open Joint / Fracture
4	Filled Fracture / Joint
5	Bedding / Banding / Foliation

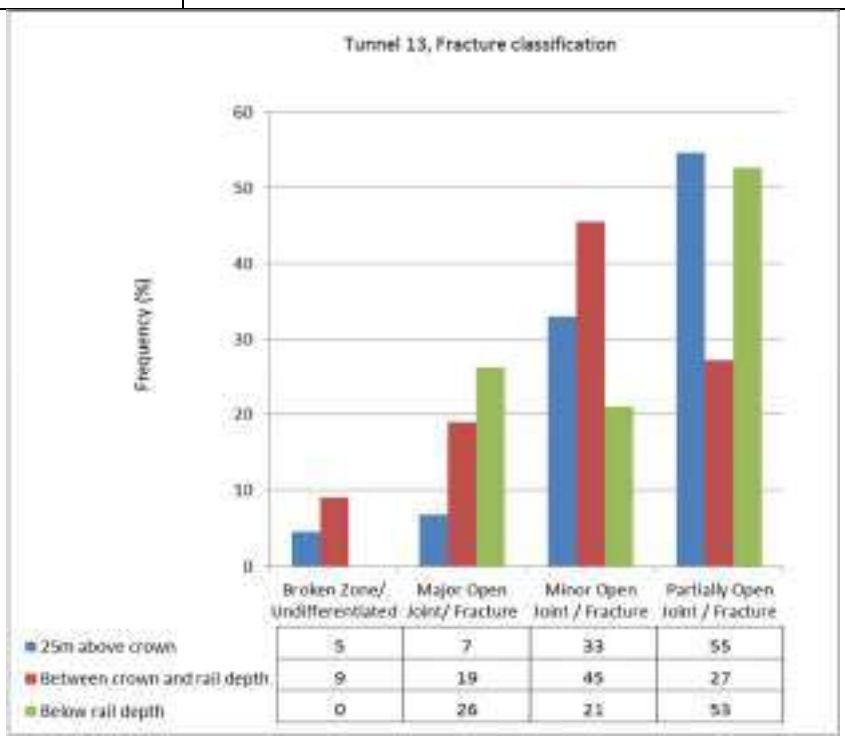


Figure 26: Percentage Fractures based on BHTV Results for Tunnel-13

7.1.4 Hydro fracture test

Hydro fracture test has been done for finding out the average K (ratio between horizontal and vertical stresses) value Vs Depth in the respective borehole no. BH-120, BH-125 & BH-126 at different depth along the Tunnel-13 and results are summarized below

Table 13 Average values of σH, σh, and K vs Depth

Sr. No	BH	Depth (m)	Vertical stress σv Mpa	Major Principal Horizontal Stress σH (MPa)	Major Principal Horizontal Stress σh (MPa)	Stress Ratio = K = {[σH +σh]/2} /σv
1.	**BH-120**	73	1.971	5.30	2.67	2.02
2.		92.5	2.498	7.55	4.45	2.40
3.		103	2.781	10.25	5.90	2.85
4.		127	3.429	10.25	5.75	2.33
5.		143	3.861	6.6	3.5	1.30
6		153	4.131	101.10	5.325	1.86
7	**BH-125**	90.5	2.44	4.95	3.38	1.70
8		120.5	3.35	8.02	4.12	1.86
9		172.5	4.65	15.36	7.87	2.49
10		191.5	5.17	16.07	8.08	2.33
11		203.5	5.46	15.64	8.00	2.16
12		264.0	7.12	11.86	6.70	1.30
13	**BH-126**	108.5	2.93	5.75	3.70	1.61
14		126.5	3.41	3.96	3.40	1.07
		154.5	4.17	6.96	4.31	1.35
		180.5	5.41	11.74	7.26	1.75
		200.5	4.87	4.49	3.85	0.85

7.2 Lab Test Results Summary

Summary of test results on soil and rock samples is tabulated below:

Table 14: Summary of Soil test Results

S.No.	Tests Conducted	Units	Tunnel 13		
			Minimum	Maximum	Average
1.	Moisture content	%	8.9	13.91	10.69
2.	Organic Content	%	1.1	2.35	1.30
3.	Liquid limit	%	17	25	18.77
4.	Plastic limit	%	-	-	-

5.	Plasticity index	%	-	-	-
6.	Specific gravity		2.65	2.68	2.67
7.	PH		6.8	8.1	7.3
8.	Sulphate So_4	%	0.0016	0.0032	0.0025
	So_3	%			
9.	Chloride	%	0.02	0.08	0.05

Table 15: Summary of Rock test Results

S.No.	Tests Conducted		Units	Tunnel 13		
				Minimum	Maximum	Average
1.	Bulk Density		KN/m^3	25.5	28.96	26.22
2.	Swelling Index		%	0.10	0.82	0.32
3.	Tensile Strength		Mpa	3.00	31.21	11.79
4.	UCS (intact)		Mpa	21.67	78.6	51.8
5.	Poisson's Ratio			0.01	0.41	0.20
6.	Modulus of Elasticity		Gpa	14.70	89	45.74
7.	Water Absorption		%	0.14	1.30	0.46
8.	Porosity		%	0.22	2.05	0.75
9.	Point load index		Mpa	2.12	15.85	10.16
10.	Specific Gravity			2.60	2.99	2.70
11.	Direct Shear Test	C	-	0.16	0.06	0.06
		Φ	-	45	26.57	26.57
12.	Tri-axial Compressive Test	C	-	15.1	9.86	9.86
		Φ	-	64.24	49.31	49.31
13.	Hardness			9.69	186.2	90.9
14.	Abrasiveness			1.53	4.27	2.43

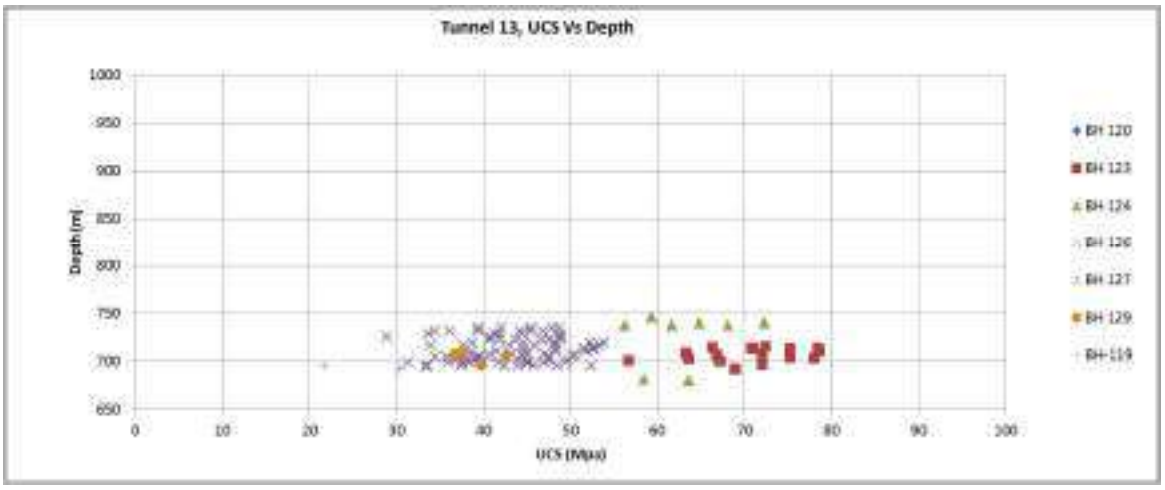


Figure 27: UCS vs Depth for Tunnel-13

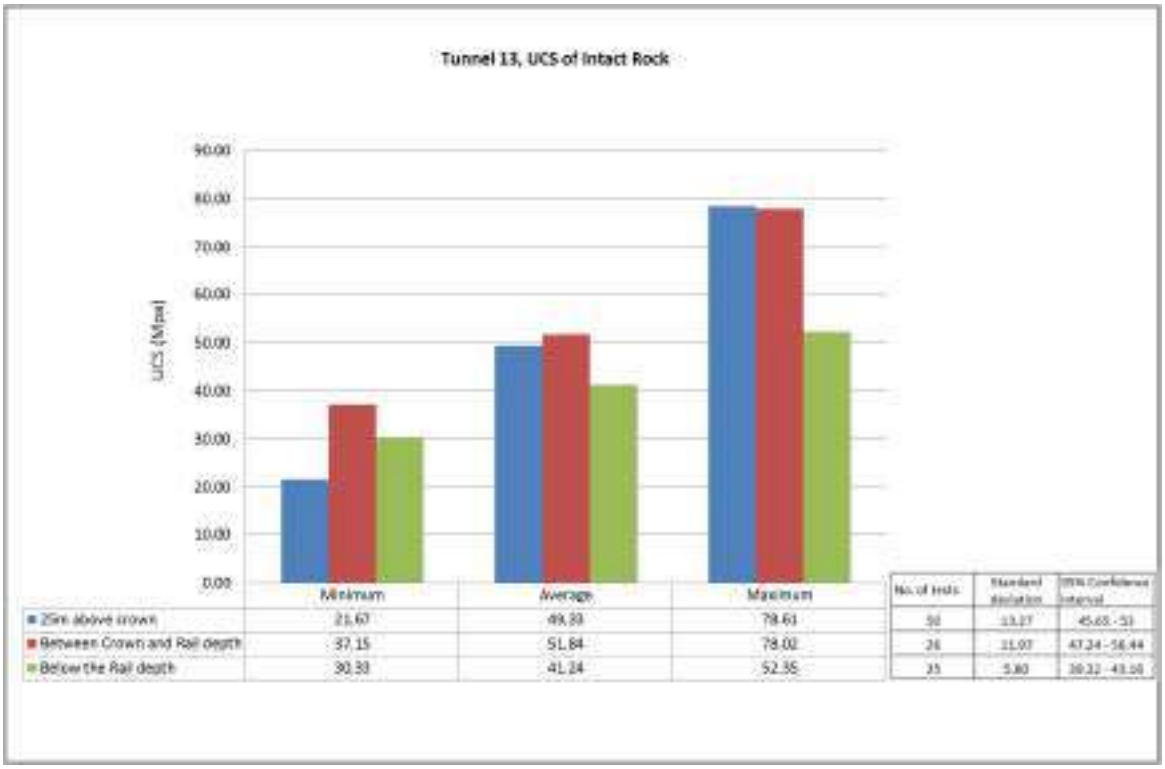


Figure 28: Variation of UCS for Tunnel-13

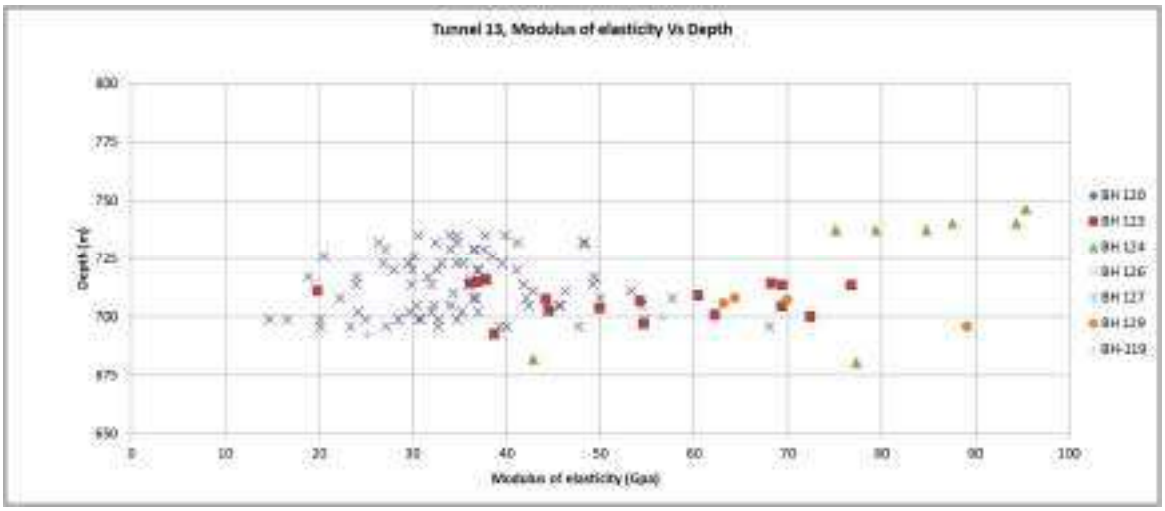


Figure 29: Modulus of Elasticity vs Depth for Tunnel-13

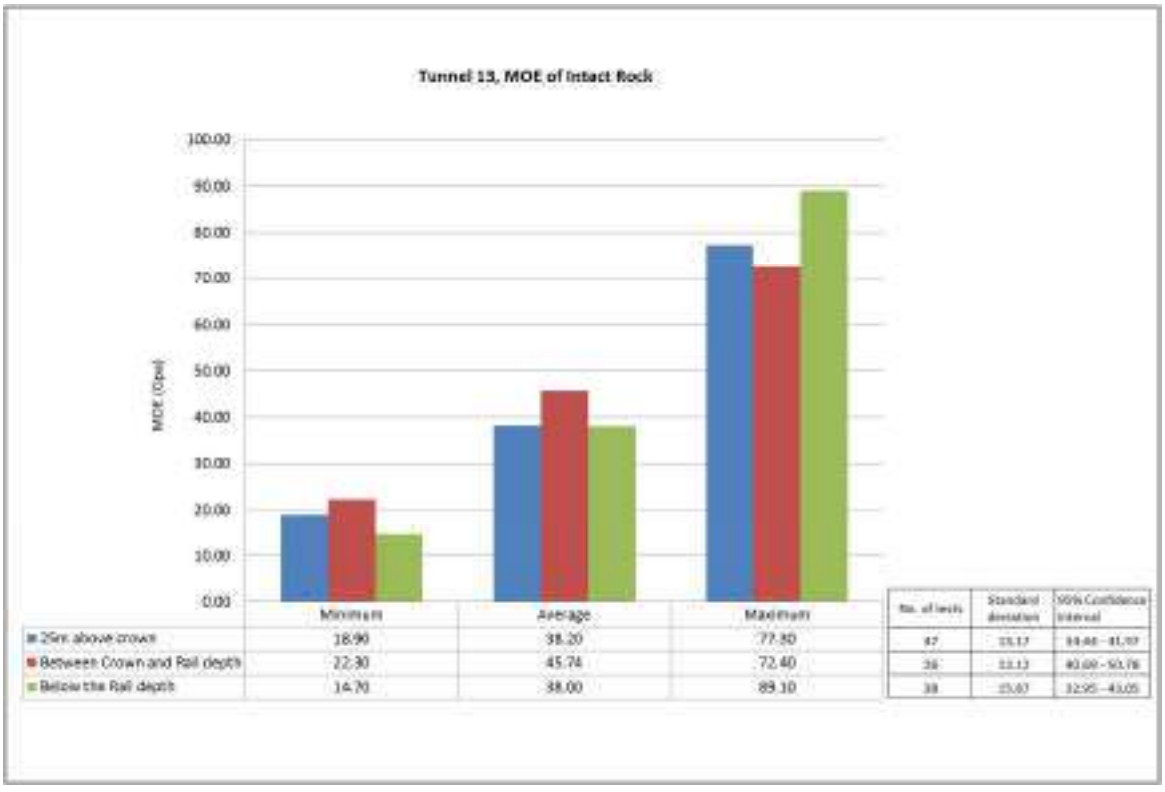


Figure 30: Variation of Modulus of Elasticity for Tunnel-13

Table 16: Summary of Underground water test Results

S.No.	Tests Conducted		Units	Tunnel 13		
				Minimum	Maximum	Average
1.	PH			6.5	7.6	6.92
2.	Chloride		Mg/lit	20	32.5	25.51
3.	Sulphates	So_4	Mg/lit	7.5	14.9	11.46
		So_3	Mg/lit			
4.	TDS		Mg/lit	380	520	436.21
5.	Magnesium		Mg/lit	5.1	18.6	7.61
6.	Carbonates		Mg/lit	37	52	47.41

7.2.1 Ground water conditions

Groundwater is generally affected by discontinuities and lithology of the tunnel ground. The summary of groundwater data is represented in the table below.

Table 17: Ground Water Conditions

Structure	Borehole ID	Depth of water table from ground level	Borehole Ground level	Water table level
Tunnel 13	BH 119	28.5m	742.65m	714.15m
	BH 120	26m	979.593m	953.593m
	BH 123	1.7m	730.025m	728.325m
	BH 126	21m	946.278m	925.278m
	BH 127	10.50m	845.898m	835.398m
	BH 128	15.5m	835.52m	820.02m
	BH 129	21m	732.809m	711.809m

7.2.2 Permeability

The in-situ rock masses have relatively higher permeability in regard to the presence of fractures and joints. These discontinuities provide the flow of water and so that they influence the hydraulic conductivity of the rock mass. Therefore, the lugeon value obtained by packer permeability test represents both the conductivity and the rock joint conditions. The results of packer permeability testing are given in table below.

Table 18: Summary of packer permeability testing

Location	Borehole ID	Depth (m)		Lugeon	Conductivity Classification	Rock Discontinuity Condition	Lithology
		from	to				
Tunnel 13	BH 123	19.5	21	5.9	Moderate	Few partly open	-
		27.5	29	2.08	Low	Tight	-
		38.25	39.75	2.17	Low	Tight	-

Location	Borehole ID	Depth (m)		Lugeon	Conductivity Classification	Rock Discontinuity Condition	Lithology
		from	to				
	BH 126	239.5	242.5	0.30	Very Low	Very tight	-
		229.5	232.5	0.09	Very Low	Very tight	-
		219.5	222.5	0.35	Very Low	Very tight	-

Table 19: Lugeon values and the corresponding rock conditions

Lugeon	Classification	Hydraulic conductivity (cm/sec)	Rock Discontinuity condition
<1	Very low	< 1 x 10^{-5}	Very tight
1 – 5	Low	1 x 10^{-5} - 6 x 10^{-5}	Tight
5 – 15	Moderate	6 x 10^{-5} - 2 x 10^{-4}	Few partly open
15 – 50	Medium	2 x 10^{-4} - 6 x 10^{-4}	Some open
50 – 100	High	6 x 10^{-4} - 1 x 10^{-3}	Many open
>100	Very high	> 1 x 10^{-3}	Open closely spaced or voids

Soils are comprised of particles in varying sizes having interconnected pores. This condition provides water flow through the soil and the permeable structure. The degree of permeability is defined by the permeability co-efficient (k) and depends on the soil type, grain size distribution, soil stress history, etc. The results of permeability testing are given in table below.

Table 20: Summary of permeability test results

Location	Borehole ID	Test Depth (m)	Permeability (cm/sec)
Tunnel 13	BH 127	19.75	2.781 x 10^{-3}
	BH129	6.8	0.050 x 10^{-3}
		17.3	0.043 x 10^{-3}

8. Geotechnical Appraisal along the Tunnel Alignment

Based on the geotechnical parameters recorded during the geological mapping and geotechnical investigation done along the Tunnel alignment. Geological section has been prepared along the Tunnel 13. which is elaborated below:

8.1 Tunnel-13

Ch: 91+180 Tunnel-13 Portal-1:- At this chainage (Km 91+180) portal-1 of tunnel-13 shall be located. The slope of the portal site is mild to sub vertical with overburden of 12.30m.Portal-1 of Tunnel-13 lies in the slope debris/ slided material followed by the bedrock of metabasic rock. The slope debris constituting of angular to sub angular rock fragments of metabasic and Quartzites intermixed with matrix of soil and silt. One borehole (BH-119) drilled to optimize the portal location. Due execution care and stiff support is required in a view of the heterogeneous slope debris. The interpreted geotechnical parameters have been indicated in the geological L-section.

Ch. 91+180 to Ch. 91+300:- The initial 120m length of the Tunnel-13 shall be housed in the medium strong to strong, slightly to moderately fractured, slightly weathered Metabasic rocks. This stretch of tunnel shall be passes through the low to medium cover area with cover ranges between 12.30-88m expected to encounter poor to mix ground condition with ingress of water at portal location. Detail ground types with associated behaviour types have is mentioned in the geological L-section.

Ch. 91+300 to Ch. 91+400:-Between this stretch Tunnel shall be passes through the poor ground condition due to presence of the sheared and faulted rock mass. Shear zone comprises of crushed and fractured rock mass of highly weathered metabasic rock. Damp to dripping water inflow is expected in this area. Due execution care with advance probing is required to pass through this poor ground condition.

Ch. 91+400 to Ch. 91+700: This 300m stretch represents comparatively good ground condition, composed of strong, fresh to slightly weathered metabasic rocks. Medium stress condition with possibilities of over break due to local wedge failure expected in this area. Details of the ground types and its corresponding behaviour types are incorporated in geological L-section.

Ch. 91+700 to Ch. 92+200: Between this stretch Tunnel shall be passes through the poor ground condition due to presence of the sheared and faulted rock mass. Shear zone comprises of crushed and fractured rock mass of highly weathered metabasic rock. Damp to dripping water inflow is expected in this area. One borehole BH-120 drilled between this stretches. Due execution care with advance probing is required to pass through this poor ground condition.

Ch. 92+200 to Ch. 92+550: This 300m stretch represents comparatively good ground condition, composed of strong, fresh to slightly weathered metabasic rocks. Medium stress condition with possibilities of over break due to local wedge failure expected in this area. Details of the ground types and its corresponding behaviour types are incorporated in L-section.

Ch. 92+550 to Ch. 92+620: Between this stretch Tunnel shall be passes through the poor ground condition due to presence of the sheared and faulted rock mass. Shear zone comprises of crushed and fractured rock mass of highly weathered metabasic rock and Quartzites. Damp to dripping water inflow is expected in this area. Due execution care with advance probing is required to pass through this poor ground condition.

Ch. 92+620 to Ch. 93+400:- In this stretches tunnel shall be housed in the good ground area composed of medium strong to strong, fresh to slightly weathered, grey to whitish coloured Quartzites. Local gravity controlled wedges may encounter in this stretch. Dry to Damp water inflow is expected in this area. . Details of the ground types and its corresponding behaviour types are incorporated in geological L-section.

Ch. 93+400 to Ch. 93+800:- : Between this stretch Tunnel shall be passes through the poor to mix ground condition due to presence of the sheared and faulted rock mass. Shear zone comprises of crushed and fractured rock mass of highly weathered Quartzites. Damp to dripping water inflow is expected in this area. Two boreholes BH-121 and BH-122 drilled between this stretches. Due execution care with advance probing is required to pass through this ground condition.

Ch. 93+800 to Ch. 94+250:- In this stretches tunnel shall be housed in the good ground area composed of medium strong to strong, fresh to slightly weathered, grey to whitish coloured Quartzites. Local gravity controlled

wedges may encounter in this stretch. Dry to Damp water inflow is expected in this area. Details of the ground types and its corresponding behaviour types are incorporated in L-section.

Ch. 94+250 to Ch. 94+350:- This 100m of stretch tunnel shall be passes through the poor ground condition due the due to presence of the sheared and faulted rock mass. Shear zone comprises of crushed and fractured rock mass of highly weathered Quartzites. Damp to dripping water inflow is expected in this area. Due execution care with advance probing is required to pass through this ground condition.

Ch. 94+350 to Ch. 94+720:- In this stretches tunnel shall be housed in the good ground area composed of medium strong to strong, fresh to slightly weathered, grey to whitish coloured Quartzites. Local gravity controlled wedges may encounter in this stretch. Dry to Damp water inflow is expected in this area.

Ch. 94+720 to Ch. 94+820:- This 100m of stretch tunnel shall be passes through the poor ground condition due the due to presence of the sheared and faulted rock mass. Shear zone comprises of crushed and fractured rock mass of highly weathered Quartzites. Damp to dripping water inflow is expected in this area. Due execution care with advance probing is required to pass through this ground condition.

Ch. 94+820 to Ch. 95+570:- Between this stretch Tunnel shall be passes through the good ground condition constituting of medium strong to strong, fresh to slightly weathered, grey to whitish coloured Quartzites. Local gravity controlled wedges may encounter in this stretch. Dry to Damp water inflow is expected in this area. Details of the ground types and its corresponding behaviour types are incorporated in L-section.

Ch. 95+570 to Ch. 95+870: This 300m of stretch tunnel shall be passes through the poor ground condition due the due to presence of the sheared and faulted rock mass. Shear zone comprises of crushed and fractured rock mass of highly weathered Quartzites. Damp to dripping water inflow is expected in this area. Due execution care with advance probing is required to pass through this ground condition.

Ch. 95+870 to Ch. 96+070:- In this stretch tunnel shall be housed in the mix ground area constituting thinly to intensely foliated and fractured Quartzites due to presence of fault zone nearby. Damp water inflow expected in this area. Details of the ground types and its corresponding behaviour types are incorporated in L-section.

Ch. 96+070 to Ch. 96+450:- This 380m of stretch tunnel shall be passes through the low cover and poor ground condition due the due to presence of the sheared and faulted rock mass. Shear zone comprises of crushed and fractured rock mass of highly weathered Quartzites. High ingress of water inflow is expected in this area due to presence of the surface Nalah. This stretch is optimized by the one borehole BH-123. Due execution care with advance probing is required to pass through this ground condition.

Ch. 96+450 to Ch. 96+650:- In this stretch tunnel shall be housed in the mix ground area constituting thinly to intensely foliated and fractured Quartzites due to presence of fault zone nearby. Damp water inflow expected in this area. Details of the ground types and its corresponding behaviour types are incorporated in geological L-section.

Ch. 96+650 to Ch. 96+750:- This 100m of stretch tunnel shall be passes through the poor ground condition due the due to presence of the sheared and faulted rock mass. Shear zone comprises of crushed and fractured rock mass of highly weathered Quartzites. Damp to dripping water inflow is expected in this area. Due execution care with advance probing is required to pass through this ground condition.

Ch. 96+750 to Ch. 96+980: In this stretch tunnel shall be housed in the mix ground area constituting thinly to intensely foliated and fractured Quartzites due to presence of fault zone nearby. Damp water inflow expected in

this area. Details of the ground types and its corresponding behaviour types are incorporated in geological L-section.

Ch. 96+980 to Ch. 97+080: This 100m of stretch tunnel shall be passes through the poor ground condition due the due to presence of the sheared and faulted rock mass. Shear zone comprises of crushed and fractured rock mass of highly weathered Quartzites. Damp to dripping water inflow is expected in this area. Due execution care with advance probing is required to pass through this ground condition.

Ch. 97+080 to Ch. 97+600: Between this stretch Tunnel shall be passes through the good ground condition constituting of medium strong to strong, fresh to slightly weathered, grey to whitish coloured Quartzites. Local gravity controlled wedges may encounter in this stretch. Dry to Damp water inflow is expected in this area. Details of the ground types and its corresponding behaviour types are incorporated in L-section.

Ch. 97+080 to Ch. 98+020: Between this stretch Tunnel shall be passes through the poor to mix ground condition due to presence of the sheared and faulted rock mass. Shear zone comprises of crushed and fractured rock mass of highly weathered Quartzites. Damp to dripping water inflow is expected in this area. One borehole BH-125 drilled between this stretches. Due execution care with advance probing is required to pass through this ground condition.

Ch. 98+020 to Ch. 99+030: Between this stretch Tunnel shall be passes through the good ground condition constituting of medium strong to strong, fresh to slightly weathered, grey to whitish coloured Quartzites. Local gravity controlled wedges may encounter in this stretch. Dry to Damp water inflow is expected in this area. Details of the ground types and its corresponding behaviour types are incorporated in L-section.

Ch. 99+030 to Ch. 99+150: This 120m of stretch tunnel shall be passes through the poor ground condition due the due to presence of the sheared and faulted rock mass. Shear zone comprises of crushed and fractured rock mass of highly weathered Quartzites and Dolomites. Damp to dripping water inflow is expected in this area. Due execution care with advance probing is required to pass through this ground condition. One borehole BH-126 drilled between this stretch.

Ch. 99+150 to Ch. 100+280: In this stretch tunnel shall be housed in medium strong to strong, thinly bedded, slightly weathered, Grey to dark coloured Dolomites of the Pithoragarh formation. Karastic action of water foreseen between this stretches. Dry to Damp water ground water condition is expected in this area. Due execution care with advance probing is required to pass through this ground condition. One borehole BH-127 drilled between this stretches.

Ch. 100+280 to Ch. 100+320: This 40m of stretch tunnel shall be passes through the poor ground condition due the due to presence of the sheared and faulted rock mass. Shear zone comprises of crushed and fractured rock mass of highly weathered Dolomites. Damp to dripping water inflow is expected in this area. Due execution care with advance probing is required to pass through this ground condition. One inclined borehole BH-128 drilled between this stretch.

Ch. 100+320 to Ch. 100+600: Between this stretch Tunnel shall be passes through the mix ground condition and composed of weak to medium strong Dolomites. This stretch of tunnel shall be passes through the low to medium cover area with cover ranges between 18-107m Damp ground water conditions expected between this stretches. Detail ground types with associated behaviour types have is mentioned in the geological L-section.

Ch: 100+600 Tunnel-13 Portal-2:- At this chainage (Km 100+600) portal-2 of tunnel-13 shall be located. The slope of the portal site is mild with overburden of 18m.Portal-2 of Tunnel-13 lies in the medium strong to strong, thinly bedded, slightly weathered, Grey to dark coloured Dolomites of the Pithoragarh formation. One borehole BH-129 drilled at this location to optimize the portal location.

9. Ground characterization

9.1 Ground Type

A Ground Type is defined as a geotechnical relevant ground volume, including matrix, discontinuities and tectonic structures, which are similar with respect to following properties;

- **For rock:** mechanical properties (intact rock – rock mass), discontinuity characteristics and properties, rock type, rock- and rock mass conditions, hydraulic properties;
- **For soil:** mechanical properties, grain size distribution, density, mineral composition, parameters of the soil components, matrix parameters and water content and hydraulic properties.

Different Ground Types have different characteristic parameters that influence their mechanical behaviour. To determine different ground types relevant key parameters have to be evaluated and defined. Different ground masses with similar combinations of relevant parameters are defined as one Ground Type.

The definition of the Ground Types has to be based on the current knowledge in each project stage, considering their importance for the successful completion of the project. The number of defined Ground Types is project specific and depends on the design phase, as well as on the complexity of the geological conditions in the project area. In general, in early design phases, a rough discrimination will be sufficient, with increased information in subsequent design phases the distinction of the single Ground Types will be, and has to be more precise.

Selected key parameters describe the geotechnical relevant properties for different rock types. Depending on project specific boundary conditions, other or additional parameters may have to be determined. In any case it has to be checked if the selected parameters are sufficient to adequately describe the ground properties.

Different key parameters may be required depending on the type and use of the under-ground structure. The number of parameters used for the definition of the Ground Types and their mode of classification may change is the project progresses. For the determination of ground types the mechanical and hydraulic properties of the ground have to be determined.

For the geotechnical design of Tunnel T-13, the relevant rock mass has been classified into various Ground Types. for Tunnel-13, 8 Ground Types with different geotechnical properties have been identified and assigned along the alignment developed based on the available geological and geotechnical data. The values for the key parameters and the additional parameters of each Ground Type are evaluated from available data from geological and geotechnical site investigation and/or estimated based on experience from other tunnel projects in comparable ground conditions as well as from geotechnical literature.

The rock mass in the project area can be separated into two basic groups, the bedrock and the overlaying debris material.

For the definition of the Ground Types within the bedrock the following key parameters are defined:

- Lithology i.e. Quartzites with subordinate phyllites & Metabasic rocks
- Uniaxial compression strength of the intact rock i.e. Lab and In-situ tests Results.
- Spacing of dominating discontinuity set i.e. spacing of Foliation joint.

Apart of these key parameters the following additional parameters are given for the intact rock and the discontinuities:

- Intact rock parameters (Density, Hoek constant mi, Poisson's ratio, Young's modulus, Lab test results and site observation)
- Discontinuity properties (Joint Roughness Coefficient - JRC)

Based on the site observations and surface geological mapping the following rock mass parameters are determined using Rock data (Software from Rocscience):

- GSI
- Rock mass strength (UCS, cohesion, friction)
- Young's modulus

For the definition of the Ground Types within the debris material the following key parameters are defined:

- Lithology
- Block size
- Grain size of Matrix

Based on the geological mapping the following rock mass parameters for the debris material are determined:

- Block properties (UCS, cohesion, friction, Young's modulus)
- Properties of block contact planes (friction)
- Matrix properties (friction, cohesion, Young's modulus).

Empirical and numerical methods, as well as in situ tests have been used for the de-termination of the properties of the ground. Ground strength, deformation characteristics, hydraulic properties, as well as specific properties low friction of discontinuities, time dependent behaviour, intercalation of other rock types, etc. have also been evaluated and considered.

Following section provides information of identified individual ground types for Tunnel-13 with their specific geotechnical properties.

9.1.1 Ground Types for Tunnel-13

GT-1 Thickly foliated Massive Quartzites

Description: - Grey to whitish colored, strong to very strong , thickly foliated, Quartzites, gentle to slightly dipping, joint surface is rough undulating to rough plannar, fresh(W0 to slightly weathered when exposed to water/air.

Key Parameters:

Lithology	Thickly foliated massive Quartzites
Geological Strength Index (GSI)	45
Average Spacing of main discontinuity set (cm)	20-200

Additional Parameters:

Ground Type	UCS Intact (Mpa)	mi	Hoek & Brown			Deformation Modulus (Mpa)
			mb	s	a	
GT1	65	20	5.7301	0.0117	0.503	15

GT-2 Thinly foliated /fractured Quartzites

Description: - Grey to whitish colored ,thinly(5 to 15cm) foliated, medium strong to strong, moderately to highly fractured Quarzitic rock, gentle dipping with high persistent, highly anisotropic due to dominance of foliation, and joints. Joint surface is smooth planar to rough undulating, slightly weathered (W1) to moderately weathered (W2) when exposed to water and air.

Key parameters

Lithology	Thinly foliated /fractured Quartzites
Average Spacing of main discontinuity set (cm)	5-15cm
Geological Strength Index (GSI)	25

Additional Parameters:

Ground Type	UCS Intact (Mpa)	mi	Hoek & Brown			Deformation Modulus (Mpa)
			mb	s	a	
GT2	50	20	1.403	0.0022	0.508	3.35

GT-3 Intensely fractured and crushed Quartzite

Description: - Grey to whitish colored, thinly (1 to 5m) foliated, weak, highly fractured Quarzitic rock, highly anisotropic due to dominance of foliation and closely spaced joints. Joint surface is smooth planar to smooth undulating, moderately weathered (W2) to highly weathered (W3).

Key parameters

Lithology	Intensely fractured and crushed Quartzite
Geological Strength Index (GSI)	17.5
Average Spacing of main discontinuity set (cm)	1-5cm

Additional Parameters:

Ground Type	UCS Intact (Mpa)	mi	Hoek & Brown			Deformation Modulus (Mpa)
			mb	s	a	
GT3	25	20	1.6417	0.000419	0.522344	1.22075

GT-4 Massive Metabasic rocks

Description: - The metabasics are medium to fine grained, medium strong to very strong and commonly exhibit abundance of greenish pyroxenes, amphibole and white grains of plagioclase. The foliated type of metabasic show hornblende, chlorite and actinolite towards marginal part. These are well exposed along the Thrust zone. Joint surface is rough planar to rough undulating, Fresh to slightly fractured and fresh (W0) to slightly weathered (W1).

Key parameters	
Lithology	**Metabasic rocks**
Geological Strength Index (GSI)	**45**

Additional Parameters:

Ground Type	UCS Intact (Mpa)	mi	Hoek & Brown			Deformation Modulus (Mpa)
			mb	s	a	
GT4	60	26	4.35961	0.003866	0.505734	8.29402

GT-5 Crushed and fractured Metabasic rocks

Description: - The metabasics are medium to fine grained, weak to medium strong and commonly exhibit abundance of greenish pyroxenes, amphibole and white grains of plagioclase. The foliated type of metabasic show hornblende, chlorite and actinolite towards marginal part. These are well exposed along the Thrust zone. Joint surface is rough planar to rough undulating, highly fractured and moderately (W2) to highly weathered (W3).

Key parameters	
Lithology	**Metabasic rocks**
Geological Strength Index (GSI)	**17.5**

Additional Parameters:

Ground Type	UCS Intact (Mpa)	mi	Hoek & Brown			Deformation Modulus (Mpa)
			mb	s	a	
GT5	40	27	2.21629	0.000419	0.522344	1.4649

GT-6 Thinly bedded Dolomites

Description: - Grey to Dark coloured, fine grained Dolomites of the Pithoragarh formation has been observed at Portal-2 area. They are thinly (1 to 5m) bedded, medium strong to strong, highly anisotropic due to dominance of bedding palne and closely spaced joints. Joint surface is smooth planar to smooth undulating, slightly weathered (W1) to moderately weathered (W2). Karastic action of water foreseen at this location.

Key parameters	
Lithology	**Dolomites**
Geological Strength Index (GSI)	**25**
Average Spacing of main discontinuity set (cm)	1-15cm

Additional Parameters:

Ground Type	UCS Intact (Mpa)	mi	Hoek & Brown			Deformation Modulus (Mpa)
			mb	s	a	
GT6	50	9	0.617951	0.00024	0.531267	1.27193

GT-7 Crushed and Faulted rock mass

Description: - Shear zone comprises of highly crushed and fractured rock mass of highly weathered Phyllites. sheared, faulted; very high degree fracturing due to thrusting/faulting/tectonic shearing, spacing of main discontinuities in mm to cm (extremely thinly foliated/sheared), shear planes with slickensided surfaces, occasionally with clay fillings (50mm to 100mm), potential appearance of fault gauge within shearing.

Key parameters	
Lithology	**Crushed and Faulted rock mass**
Geological Strength Index (GSI)	**12.5**
Average Spacing of main discontinuity set (cm)	Crushed & fractured

Additional Parameters:

Ground Type	UCS Intact (Mpa)	mi	Hoek & Brown			Deformation Modulus (Mpa)
			mb	s	a	
GT7	25	7	0.402028	0.000138	0.543721	0.627984

GT-8 Colluvium or surficial materials	
Description: - Slope debris, Superficial overburden, Slided material, comprises of heterogeneous admixture of rock blocks of variable dimensions (dia. of few centimetres to some meters) with soil and silt fraction occupying the inter spaces.	
Key parameters	
Lithology	**Colluvium or surficial materials**

Additional Parameters:

Overburden	Depth (m)	Cohesion (Mpa)	Friction (deg)	UCS Intact (Mpa)	σ_{cm} Rock mass (Mpa)	Deformation Modulus (Mpa)
-	-	0.05-0.1	20-30	-	-	-

Percentages of the Ground types to be encountered along the Tunnel-13 alignment are as follows:-

Ground Type	Lithology	Distribution along the Tunnel Alignment (In %)
GT-1	Thickly foliated Massive Quartzites	28.12%
GT-2	Thinly foliated Quartzites	19.14%
GT-3	Intensely fractured and crushed Quartzite	16.29%
GT-4	Massive Metabasic rocks	7.12%
GT-5	Crushed and fractured Metabasic rocks	6.12%

GT-6	Thinly bedded Dolomites	15.38%
GT-7	Crushed and Faulted rock mass	6.66%
GT-8	Colluvium or surficial materials	0.680%

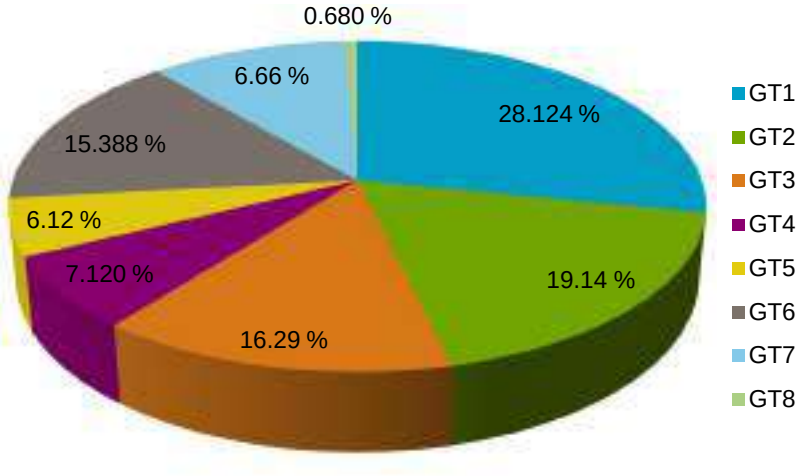


Figure 31 Pie chart of of different Ground types along the Tunnel-13 alignment

According to the defined criteria a total number of eight (8) Ground Types are identified for the tunnel T-13. The summarized details of the ground types observed along the Tunnel-13 alignment is summarized in the below table:

The estimated distribution of ground types along the tunnel 13 has been shown in below tables.

Tunnel-13

Table 21 summary of Ground types along Tunnel-13

S.No.	Chainage (m)		Ground Types (GT)
	From	To	
1	91190	91300	GT-8 & GT-4
2	91300	91400	GT-5 & GT-7
3	91400	91700	GT-4 & GT-5
4	91700	92210	GT-5 & GT-7
5	92210	92540	GT-4
6	92540	92620	GT-3, GT-5 & GT-7
7	92620	93420	GT-1, GT-2 & GT-3
8	93420	93800	GT-2, GT-3 & GT-7
9	93800	94240	GT-1, GT-2 & GT-3
10	94240	94340	GT-3 & GT-7
11	94340	94725	GT-1, GT-2 & GT-3
12	94725	94820	GT-3 & GT-7
13	94820	95575	GT-1 & GT-2
14	95575	95870	GT-3 & GT-7
15	95870	96075	GT-2 & GT-3
16	96075	96460	GT-3 & GT-7
17	96460	96640	GT-2 & GT-3
18	96640	96750	GT-3 & GT-7
19	96750	96975	GT-2 & GT-3
20	96975	97075	GT-3 & GT-7
21	97075	97620	GT-1 & GT-2
22	97620	98010	GT-3 & GT-7
23	98010	90020	GT-1 & GT-2

S.No.	Chainage (m)		Ground Types (GT)
	From	To	
24	99020	99150	GT-3, GT-6 & GT-7
25	99150	100275	GT-6
26	100275	100330	GT-6 & GT-7
27	100330	100600	GT-6 & GT-8

10. Tunnel Design consideration

10.1 Rock Mass classification

10.1.1 RMR System

In order to characterize the lithology, the RMR system (Rock Mass Rating, Bieniawski 1989), shall be used. That system will help in assessing the rock mass parameters for the analysis and design of the excavation. This engineering classification system utilises the following six rock mass parameters:

1. Uniaxial compressive strength of intact rock material.
2. Rock quality designation (RQD).
3. Spacing of discontinuities.
4. Condition of discontinuities,
5. Groundwater conditions.
6. Orientation of discontinuities

All of these are measurable in the field and can also be obtained from borehole data. The rating of each of these parameters are summarised to give a value of RMR.

To apply the RMR classification, the rock mass along a tunnel route is divided into a number of structural regions, i.e. zones in which certain geological feature are more or less uniform. The above six classification parameters are determined for each structural region from measurements in the field.

Each of the parameters give a rating to the rock mass and adding all of them a final number is obtained, which ranges from 0 to 100, This number offers to the engineer a good idea about the rock mass quality

As per the rock mass rating, the rock will be classified as very good, good, fair, poor and very poor rock as per the table below:

ROCK MASS CLASSES DETERMINED FROM TOTAL RATING					
Rating	100-81	80-61	60-41	40-21	<20
Class No.	**I**	**II**	**III**	**IV**	**V**
Description	**VERY GOOD**	**GOOD**	**FAIR**	**POOR**	**VERY POOR**

MEANING OF ROCK MASS CLASSES					
Class No.	I	II	III	IV	V
Average stand-up time					
Cohesion of the rock mass	>400 kPa	300-400 kPa	200-300 kPa	100-200 kPa	<100 kPa
Friction angle of the rock mass	<45°	35-45°	25-35°	15-25°	<15°

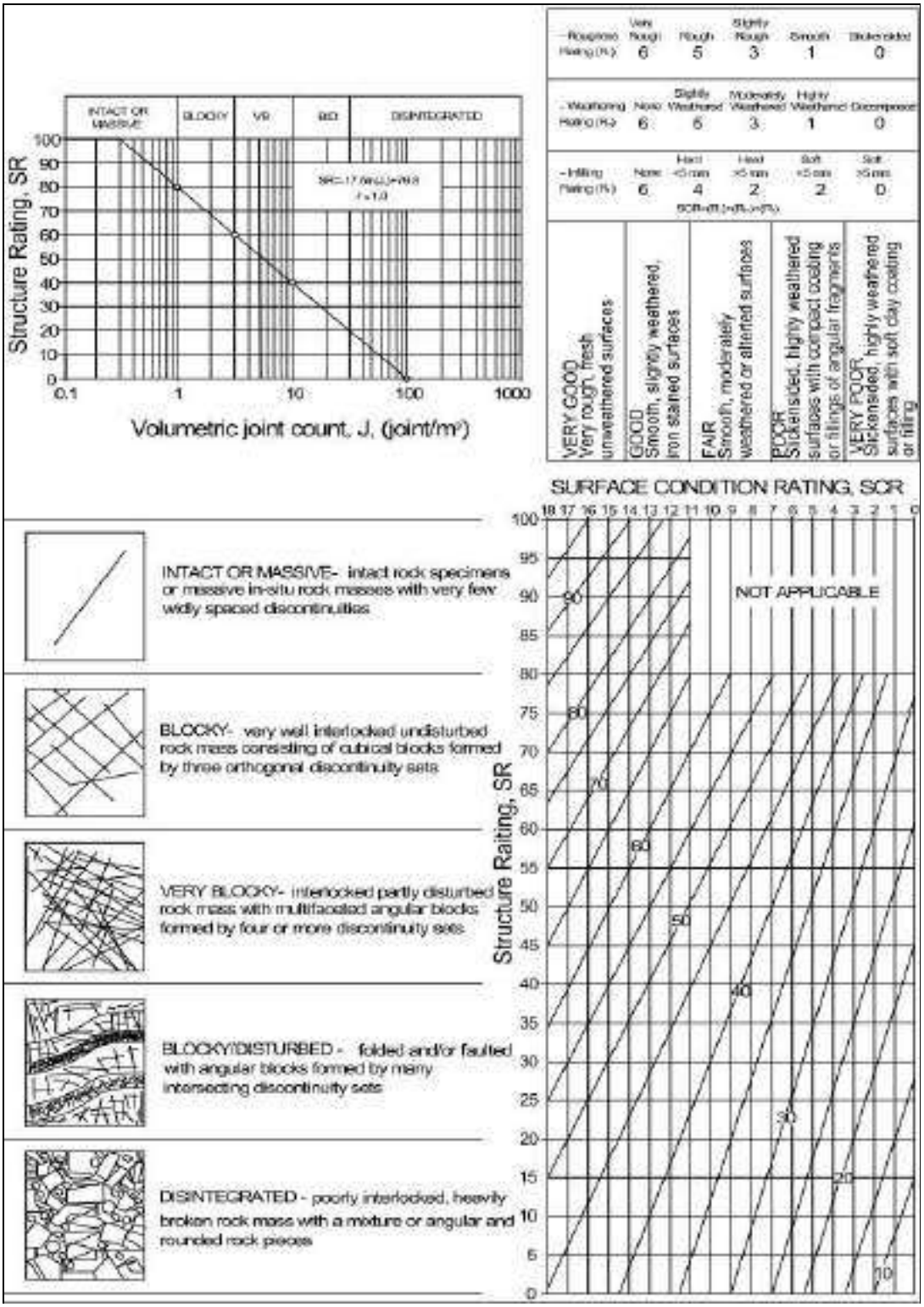
With the calculated value of RMR, some set of supports suitable for the particular lithological unit are suggested by Bieniawski, these supports can be selected from the chart given below and can be used as a preliminary idea to start validation of the actual supports requirements with the help of other analytical and numerical methods.

Rock mass class	Excavation	Support		
		Rock bolts (20 mm diam., fully bonded)	*Shotcrete*	*Steel sets*
1. Very good rock RMR: 81-100	Full face: 3 m advance	Generally no support required except for occasional spot bolting		
2. Good rock RMR: 61-80	Full face: 1.0-1.5 m advance; Complete support 20 m from face	Locally bolts in crown, 3 m long, spaced 2.5 m with occasional wire mesh	50 mm in crown where required	None
3. Fair rock RMR: 41-60	Top heading and bench: 1.5-3 m advance in top heading; Commence support after each blast; Commence support 10 m from face	Systematic bolts 4 m long, spaced 1.5-2 m in crown and walls with wire mesh in crown	50-100 mm in crown, and 30 mm in sides	None
4. Poor rock RMR: 21-40	Top heading and bench: 1.0-1.5 m advance in top heading; Install support concurrently with excavation - 10 m from face	Systematic bolts 4-5 m long, spaced 1-1.5 m in crown and walls with wire mesh	100-150 mm in crown and 100 mm in sides	Light ribs spaced 1.5 m where required
5. Very poor rock RMR < 21	Multiple drifts: 0.5-1.5 m advance in top heading; Install support concurrently with excavation; shotcrete as soon as possible after blasting	Systematic bolts 5-6 m long, spaced 1-1.5 m in crown and walls with wire mesh. Bolt invert	150-200 mm in crown, 150 mm in sides, and 50 mm on face	Medium to heavy ribs spaced 0.75 m with steel lagging and forepoling if required. Close invert

10.1.2 GSI classification System

Similar to the RMR, there exists another rock mass classification system called the GSI (Geological Strength Index 1995) which descripts the rock mass with two factors; rock mass structure and block surface conditions.

The GSI values range from 0 to 100 and it also used for the estimation of the rock mass strength and the rock mass deformation modulus. The rock mass can be classified as per the table shown below:



10.1.3 Stress Strength Ratio

The second aspect to understand the ground behaviour after excavating a tunnel is to determine the ratio between the stresses that the ground in going to impose to the excavation boundary and the strength available strength the rock can mobilize. (Ref: Celada)

On the basis of the estimated parameters, the rock can be classified on the basis of stress deformational behaviour by calculating the Index of Elastic Behaviour (ICE) which mathematical expression is as follows:

$$ICE = \frac{3704.\sigma.e^{(RMR-100)/24}}{(3-Ko).H}.F \qquad \text{(For } K_o \leq 1\text{)}$$

$$ICE = \frac{3704.\sigma.e^{(RMR-100)/24}}{(3Ko-1).H}.F \qquad \text{(For } K_o \geq 1\text{)}$$

On the basis of the value of ICE ,the possibility of plasticization or yielding of a particular type of rock under given amount of stress can be estimated. Table given below lists the elastic behaviour of rock for a given value of ICE.

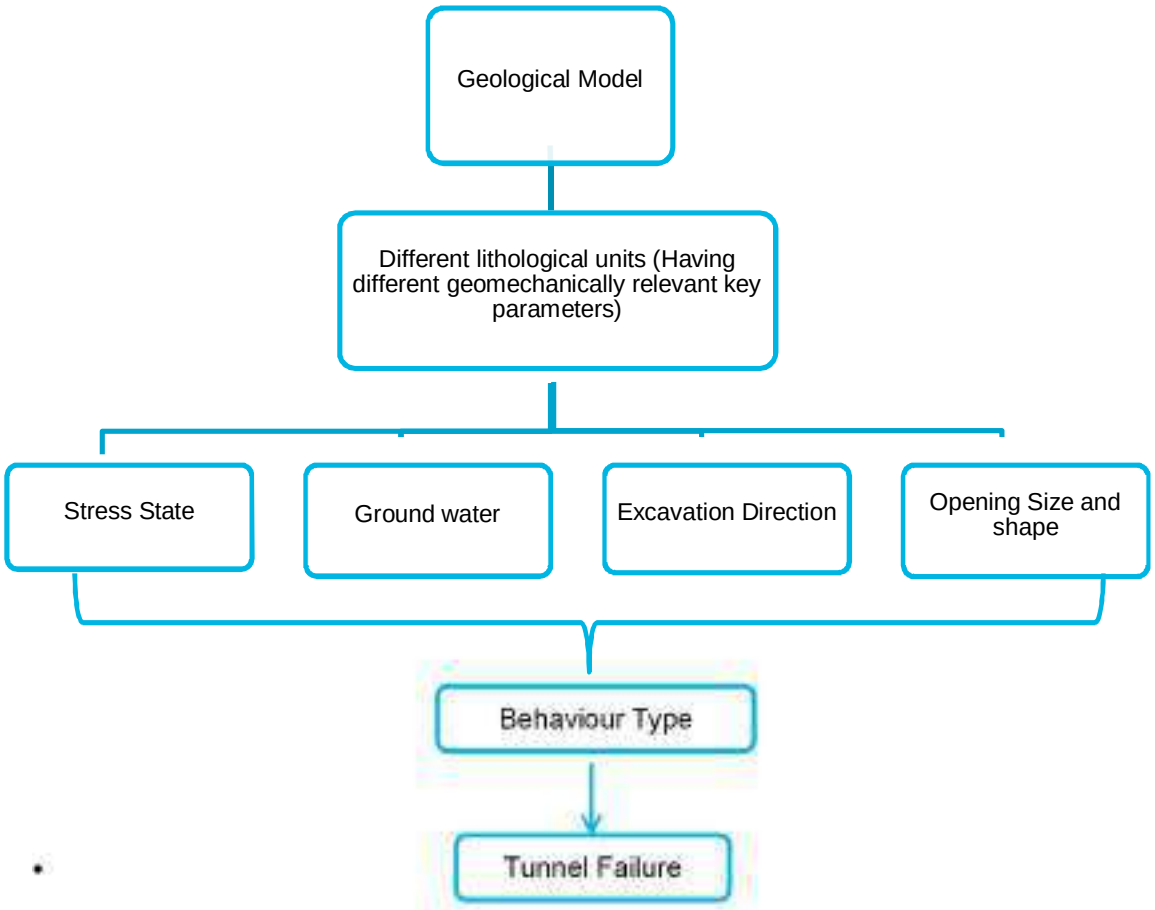
The value of ICE shall be calculated for the different rock types occurring along the whole tunnel alignment of this project, and weak zones where yielding is expected to occur shall be estimated.

Table 22: Designation of a stress deformation behaviour of a tunnel section as a function of the index of elastic behaviour

Designation of a Stress deformation behaviour of a tunnel section as a function of the index of elastic behaviour (ICE)

ICE	Stress Deformation Behaviour
>130	Completely Elastic
70-130	Elastic with Incipient Yielding
40-69	Moderate Yielding
15-39	Intensive yielding
<15	Mostly yielding

After the Lithological units are defined and the geomechanical parameters are estimated for each unit, the elastic behaviour of the lithological units are re studied with the help of ICE parameter. Using the inputs of the in situ conditions and the size and shape of the opening the ground behaviour and the failure type of the excavation can be assessed .The procedure is depicted in the flow chart shown below:



10.1.4 Behaviour Types

Ground behaviour is defined as the reaction of the ground to the excavation of the tunnel in its full profile without consideration of support or other construction measures.

For defining the behaviour type qualitative approaches like Behaviour type charts of Austrian tunnelling guidelines shall be used.

On the basis of the ground strength parameters (RMR, GSI etc.) and ground elastic behaviour (ICE) the ground types or Lithological units classified above shall be related to behaviour type. This will primarily involve identification of potential hazards, like typical failure mode, magnitude and characteristics of movements during excavation, amount of water inflows and its effects on ground stability which has similar ground properties and influencing factors.

In this project, It is planned to utilize a new classification system, namely, Austrian code ÖNORM B2203/1994 closely related to the New Austrian Tunnelling method, As per this Austrian ÖNORM B2203 of October 1994 which is based on the suggestions by Rabcewicz et al. (1964) the rock mass is classified without a numerical quality rating; but the ground conditions are described qualitatively. The main rock mass classes and behaviour of rock masses for each rock mass group according to the ÖNORM B2203 are given in Table below:

Table 23: General categories of different Ground Behaviours (Change by ÖNORM B)

Rock Mass Class	Behaviour of Rock Mass		Explanations
	ÖNORM B 2203 After October, 1994	**ÖNORM B 2203 Before October, 1994**	
A	A1 Stable	A1 Stable	The rock mass behaves elastically, Deformations are small and decrease rapidly. There is no tendency of over breaking after scaling of the rock portions disturbed by blasting. The rock mass is permanently stable without support.
	A2 Slightly Over breaking	A2 Slightly Over breaking	The rock mass behaves elastically, Deformations are small and decrease rapidly. A slight tendency of small overbreak in the roof and in the upper portions of the sidewalls caused by discontinuities and the dead weight of the rock mass exist.
B	B1 Friable	B1 Friable	Major parts of the rock mass behaves elastically, Deformations are small and decrease rapidly. Low rock mass strength and limited stand-up time related to the prevailing discontinuity pattern yield overbreak and loosening of the rock strata in the tunnel roof and upper sidewalls if no support is installed on time.
	B2 Very Friable	B2 Very Friable	This type of rock mass is characterized by plastic zones extended far into the surrounding rock mass, Immediate installation of the tunnel support, will ensure deformations can be kept small and cease rapidly. In case of a delayed installations or an insufficient quantity of support elements, the low strength of the rock mass yields deep loosening and loading of the initial support. Stand-up time and unsupported length are short. The potential of deep and sudden failure from roof, sidewalls and face is high.
	B3 Rolling		
C	C1 Rock Bursting	C1 Squeezing	C1 is characterized by plastic zones extending far into the surrounding rock mass and failure mechanisms such as spalling, buckling, shearing and rupture of the rock structure, by squeezing behaviour or by tendency rock burst, Subject rock mass shows a moderate, but distinct time depending squeezing behaviour; deformations calm down slowly except in case of rock burst. Magnitude and velocity of the deformations at the cavity boundary are moderate.
	C2 Squeezing		
	C3 Heavily Squeezing	C2 Heavily Squeezing	C2 is characterized by the development of deep failure zones and a rapid and significant movement of the rock mass into the cavity and deformations which decrease very slowly. Support elements may frequently be overstressed.
	C4 Flowing	L1 Short-term-stable with high cohesion	By limitations of the unsupported spans at arch and face, the rock mass remains stable for a limited time.
	C5 Swelling	L2 Short-term-stable with low cohesion	No stand-up time without supports by prior installation of Forepoling and shotcrete scaling of faces simultaneously with excavation. The low cohesion requires a large number of sub-divisions.

Similar to ÖNORM 2203, The Austrian guidelines also give classification of behaviour types into different categories as shown in the table below:

Sr.No.	Basic categories of Behaviour Types (BT)	Description of potential failure modes/mechanisms during excavation of the unsupported ground
1.	Stable	Stable ground with the potential of small local gravity induced falling or sliding of blocks
2.	Potential of discontinuity	Voluminous discontinuity controlled, gravity induced falling

Sr.No.	Basic categories of Behaviour Types (BT)	Description of potential failure modes/mechanisms during excavation of the unsupported ground
	controlled block fall	and sliding of blocks. occasional local shear failure on discontinuities
3.	Shallow failure	Shallow stress induced failure in combination with discontinuity and gravity controlled failure
4.	Voluminous stress induced failure	Stress induced failure involving large ground volumes and large deformation
5.	Rock burst	Sudden and violent failure of the rock mass, caused by highly stressed brittle rocks and the rapid release of accumulated strain energy
6.	Buckling	Buckling of rocks with a narrowly spaced discontinuity set, frequently associated with shear failure
7.	Crown failure	Voluminous over breaks in the crown with progressive shear failure
8.	Ravelling ground	Flow of dry or moist, intensely fractured, poorly interlocked rocks or soil with low cohesion
9.	Flowing ground	Flow of intensely fractured, poorly interlocked rocks or soil with high water content
10.	Swelling ground	Time dependent volume increase of the ground caused by physical-chemical reaction of rock and water in combination with stress relief, leading to inward movement of the tunnel perimeter
11.	Ground with frequently changing deformation characteristics	Combination of several behaviours with strong local variations of stresses and deformations over longer sections due to heterogeneous ground (i.e., in heterogeneous fault zones: block-in-matrix rock, tectonic melanges)

Using the above two behaviour type classification system the behaviour of the lithological units shall be assed and it will be anticipated that how a particular lithological unit is going to behave under a particular stress situation and what is the most probable way of its failure.

Austrian code ÖNORM B2203/1994 also related to the other Austrian guidelines based on the behaviour types. Correlation between these classification system are summarized below

Behaviour of Rock Mass	
ÖNORM B 2203 After October, 1994	Behaviour based on Austrian guidelines
A1 Stable	Stable (BT-1)
A2 Slightly Over breaking	Potential of discontinuity controlled block fall(BT-2)
B1 Friable	Shallow failure (BT-3)
B2 Very Friable	Crown failure (BT-7)

B3 Rolling	Ravelling ground (BT-8)
C1 Rock Bursting	Rock burst (BT-5)
C2 Squeezing	Voluminous stress induced failure (BT-4)
C3 Heavily Squeezing	
C4 Flowing	Flowing ground (BT-9)
C5 Swelling	Swelling ground (BT-10)

10.1.5 Criteria for Behaviour Types

Different failure modes occur under different conditions. To be able to identify the applicable Behaviour Types, criteria need to be established. Considering the geological ground condition, the stress situation, the geometry and size of the opening, and other influencing factors like ground water, the criteria are used to identify different behaviour Types. In the following these criteria, which are used for the identification of different Behaviour Types, are briefly described. Note that combinations of different Behaviour Types can occur, for example stress induced failure of the ground in combination with discontinuity controlled over break.

10.1.5.1 Behaviour Type A1: stable

The rock mass behaves elastically, Deformations are small and decrease rapidly. There is no tendency of over breaking after scaling of the rock portions disturbed by blasting. The rock mass is permanently stable without support.

10.1.5.2 Behaviour Type A2 Slightly Over breaking 2

The rock mass behaves elastically, Deformations are small and decrease rapidly. A slight tendency of small over break in the roof and in the upper portions of the sidewalls caused by discontinuities and the dead weight of the rock mass exist.

10.1.5.3 Behaviour Type B1 Friable

Major parts of the rock mass behaves elastically, Deformations are small and decrease rapidly. Low rock mass strength and limited stand-up time related to the prevailing discontinuity pattern yield over break and loosening of the rock strata in the tunnel roof and upper sidewalls if no support is installed on time.

10.1.5.4 Behaviour Type B2 Very Friable/ B3 Rolling

This type of rock mass is characterized by plastic zones extended far into the surrounding rock mass, immediate installation of the tunnel support, will ensure deformations can be kept small and cease rapidly. In case of a delayed installations or an insufficient quantity of support elements, the low strength of the rock mass yields deep loosening and loading of the initial support. Stand-up time and unsupported length are short. The potential of deep and sudden failure from roof, sidewalls and face is high.

10.1.5.5 Behaviour Type C1 Rock Bursting

C1 is characterized by plastic zones extending far into the surrounding rock mass and failure mechanisms such as spalling, buckling, shearing and rupture of the rock structure, by squeezing behaviour or by tendency rock burst, Subject rock mass shows a moderate, but distinct time depending squeezing behaviour; deformations calm

down slowly except in case of rock burst. Magnitude and velocity of the deformations at the cavity boundary are moderate.

10.1.5.6 Behaviour C2 Squeezing/ C3 Heavily Squeezing

C2 & C3 is characterized by the development of deep failure zones and a rapid and significant movement of the rock mass into the cavity and deformations which decrease very slowly. Support elements may frequently be overstressed.

10.1.5.7 Behaviour Type C4 Flowing

Flow of intensively fractured rocks or soil with high water content". Important factors for the determination of flowing ground conditions are the existence of water in the rock mass, the size and shape of single ground particles as well as the grain size distribution. Additionally, the ground permeability around the excavation affects the potential for failure.

10.1.5.8 Behaviour Type C5 Swelling

Time dependent volume increase of the rock mass caused by physical-chemical reaction of rock and water in combination with stress relief, leading to inward movement of the tunnel perimeter". A swelling potential can be identified, if the rock mass contains a certain percentage of swelling minerals (for example clay minerals) and water is present. An additional condition is a stress release, which is always associated with tunnel excavation.

10.1.6 Expected Behaviour Types

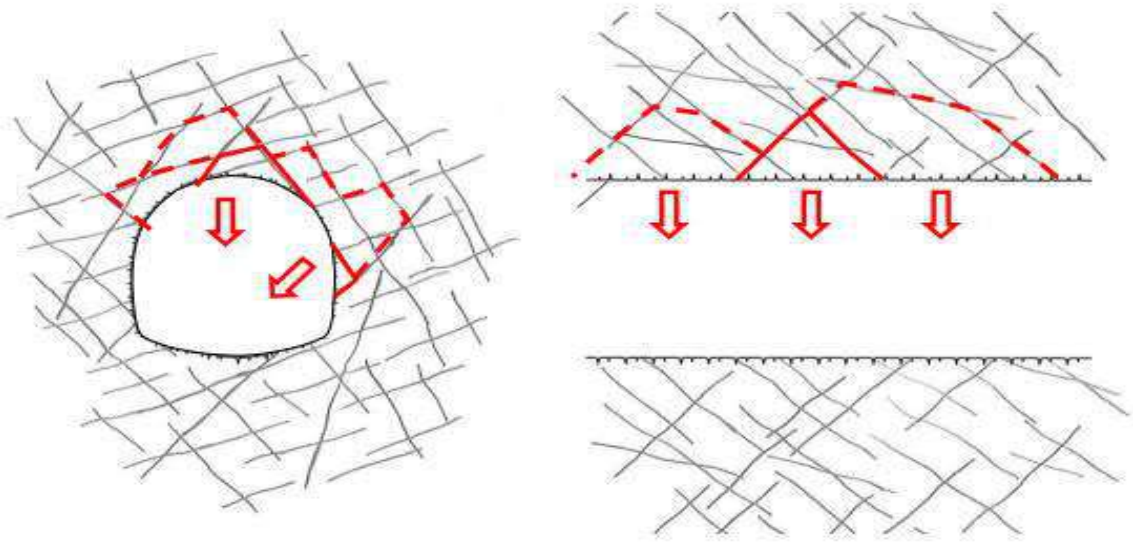
The following influencing factors are considered for the evaluation of the Ground Behaviour within the project:

- Ground Type (GT)
- Virgin stress conditions
- Shape and size of the underground structure (final shape and size)
- Position of underground structure in relation to surface or existing structures
- Relative orientation of the underground structure and discontinuities as a basis For kinematical analyses, and the assessment of the stress redistribution
- Boundaries between different ground types
- Ground water, seepage force, hydraulic head

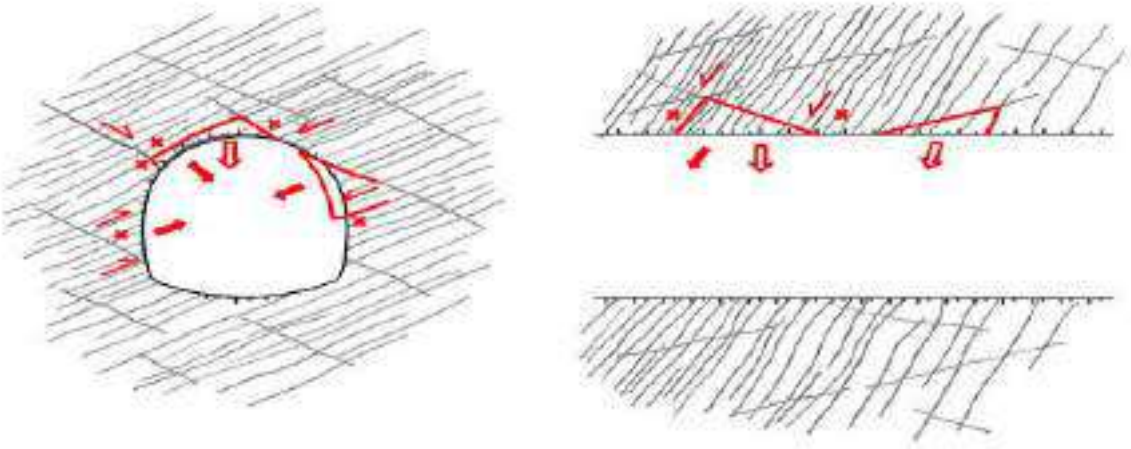
For the determination of the ground behaviour the following evaluations may also be done;

- Kinematics: Kinematical analyses for the determination of discontinuity controlled over break and sliding of wedges
- Methods: Key Block Theory, analyses using stereographic projection
- Ground utilization: evaluation of the ratio between the strength of the ground and the spatial stress situation in the vicinity of the underground opening. Methods: analytical and numerical methods
- Failure mechanisms: possible failure mechanisms of the ground have to be analyzed and described at least qualitatively (for example: spalling, shearing along discontinuities as result of stress release, shear failure, etc.)

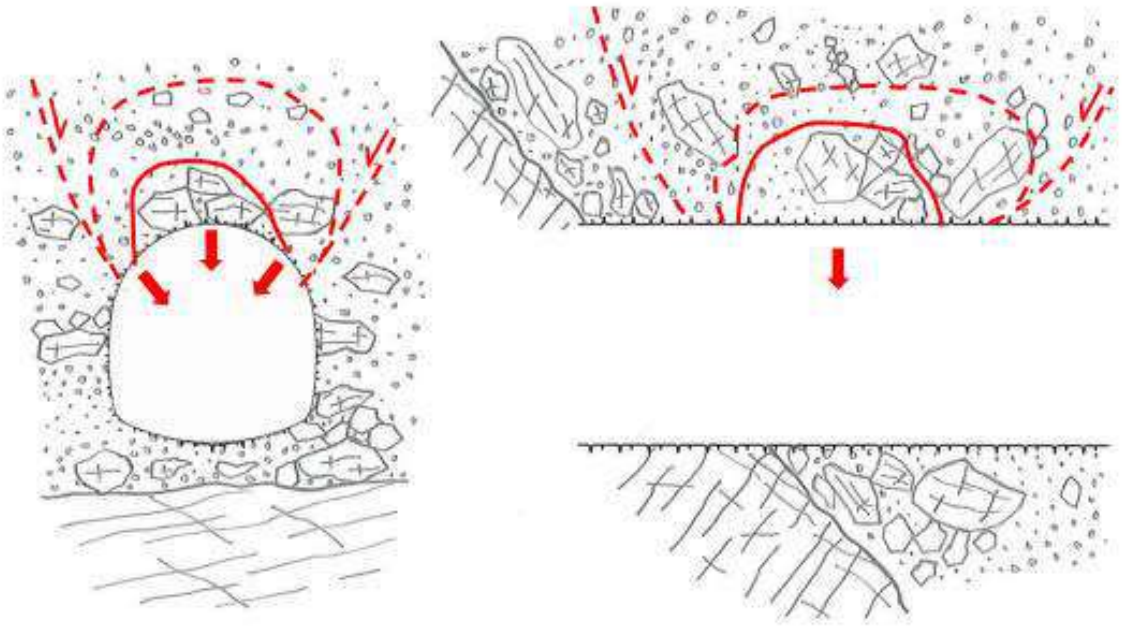
BEHAVIOUR TYPE A2 - Over breaking	
Orientation of main joints	Foliation gentle to moderately inclined, different striking directions (perpendicular to sub parallel to tunnel axis due to varying orientation of tunnel and of foliation) 2-4 moderately to steeply dipping joint-sets (striking sub parallel to obtuse-angled to tunnel axis)
Stress conditions	The stresses are below the rock mass strength. Locally exceeding of shear-strength along discontinuities
Ground water	Predominantly dry conditions with local inflows along major discontinuities (low water pressure)
Rock mass behaviour (failure mechanism and behaviour during failure)	Voluminous discontinuity controlled, gravity induced falling and sliding of blocks from crown and side walls. Occasional local shear failure on discontinuities
Radial displacements	Generally small displacements in the range of millimetres to some centimetres
Face stability	In case of unfavourable orientation of major discontinuities (dipping into excavation) potential of voluminous discontinuity controlled sliding of blocks and wedges.
Example of typical behaviour	



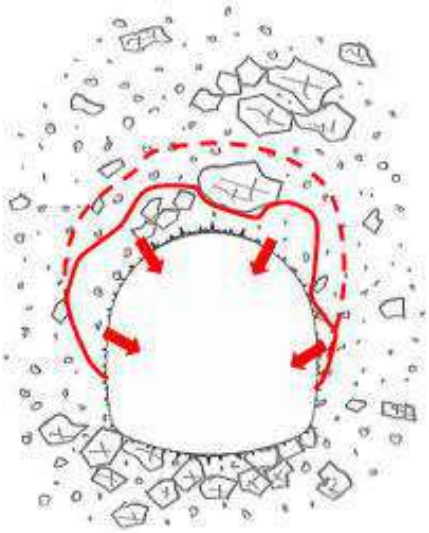
BEHAVIOUR TYPE B1 - FRIABLE	
Orientation of main joints	Foliation moderately to steeply inclined, different striking directions (perpendicular to sub parallel to tunnel axis because of varying orientation of tunnel and of foliation) 2-4 moderately to steeply dipping joint-sets (striking sub parallel to obtuse-angled to tunnel axis)
Stress conditions	The stresses at the tunnel perimeter exceed the rock mass strength.
Ground water	Predominantly dry conditions with local inflows along major discontinuities or fracture zones (low water pressure)
Rock mass behaviour (failure mechanism and behaviour during failure)	Stress induced failure of the rock mass at the tunnel perimeter in terms of brittle failure of the rock or shear failure along discontinuities, resulting in a failure zone of limited depth (up to ¼ of tunnel diameter). Usually combined with discontinuity and gravity controlled falling and sliding of blocks.
Radial displacements	Radial displacements in the range of several centimetres until stabilization.
Face stability	Favourable face stability for foliation dipping into the face, potential for block slides for foliation dipping into the excavation (depending on excavation direction)
Example of typical behaviour	

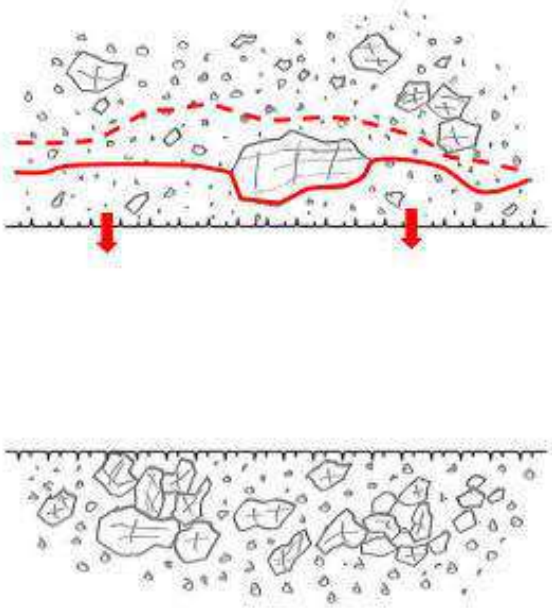


BEHAVIOUR TYPE B2 – VERY FRIABLE	
Orientation of main joints	not relevant
Stress conditions	Low stress level (stresses lower or in the range of rock mass strength) in combination with low horizontal stresses.
Ground water	High ingress of water
Rock mass behaviour (failure mechanism and behaviour during failure)	Voluminous over breaks at crown and progressive shear failure induced by low confining pressure. Excessive over breaks can propagate up to the surface (daylight collapse).
Radial displacements	Failure model will lead to collapse of tunnel.
Face stability	Potential for voluminous overbreaks and progressive shear failure.
Example of typical behaviour	

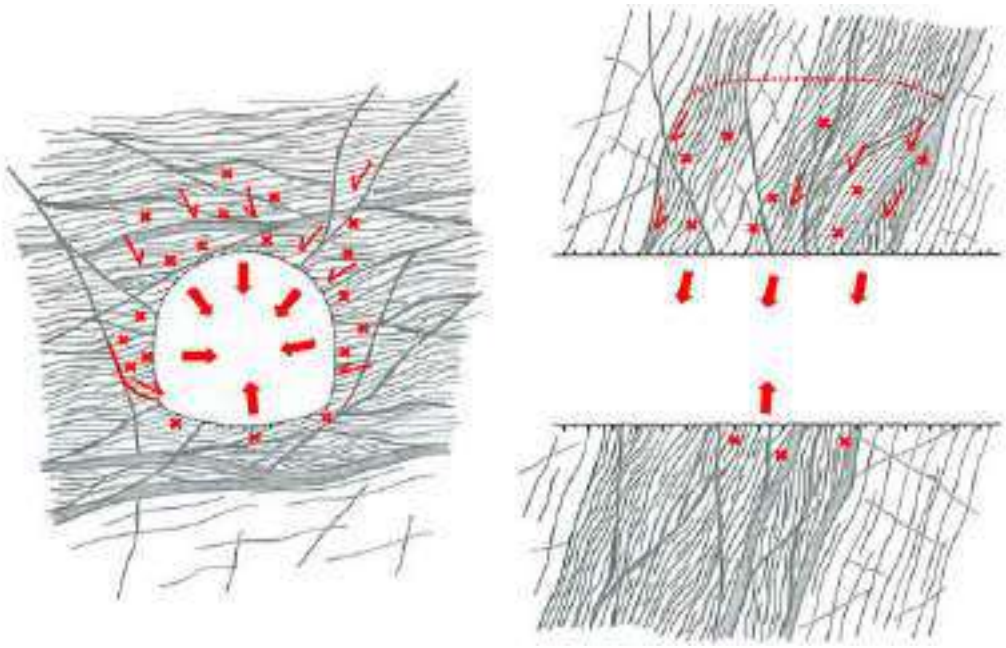


BEHAVIOUR TYPE B3/C4 – Ravelling/flowing	
Orientation of main joints	not relevant
Stress conditions	Low stresses
Ground water	dry to moist
Rock mass behaviour (failure mechanism and behaviour during failure)	Ravelling of ground due to lack of cohesion or interlocking within the rock mass.
Radial displacements	Not relevant, because failure model will lead to collapse of tunnel.
Face stability	Potential for ravelling of ground into the excavation.
Example of typical behaviour	





BEHAVIOUR TYPE C2/C3 - SQUEEZING/HEAVILY SQUEEZING	
Orientation of main joints	Fracture zones, shear zones and faults orientated parallel to foliation respectively steep inclined and obtuse-angled to tunnel axis.
Stress conditions	The stresses exceed the rock mass strength significantly.
Ground water	Predominantly dry. Potentially local inflows along fracture zones of higher permeability (low water pressure).
Rock mass behaviour (failure mechanism and behaviour during failure)	Stress induced, progressive shear failure, involving large ground volumes. Deep reaching failure zone in combination with long lasting stress redistribution and large deformations. Additionally gravity induced failure due to falling or sliding of sheared and heavily fractured rock mass from crown, face and side walls. Potential for deep reaching, voluminous over breaks.
Radial displacements	Long-lasting displacements in the range of decimetres up to collapse of tunnel.
Face stability	Spalling and falling of sheared, fractured rock mass from face and sliding along major shear planes
Example of typical behaviour	



The estimated distribution of ground types and behaviour types along the tunnel 13 has been shown in below tables.

Tunnel-13

Table 24 Summary of Ground types and its behaviour along Tunnel-13

Start	End	Ground Type	Behaviour Type (ONORM)
91190	91200	GT8	B2,B3,C4
91200	91300	GT4	B1
91300	91400	GT5	B1
91400	91640	GT4	B1
91640	91700	GT5	B2
91700	92157	GT5	B2
92157	92210	GT7	C3,C4
92210	92540	GT4	B1
92540	92548	GT5	B2
92548	92588	GT3	C2,C4
92588	92620	GT7	C3,C4
92620	93100	GT1	A2
93100	93340	GT2	B2
93340	93420	GT3	C2,C4
93420	93634	GT2	B2
93634	93748	GT3	C2,C4
93748	93800	GT7	C3,C4
93800	94064	GT1	A2,C1
94064	94196	GT2	B2
94196	94240	GT3	B3,C2
94240	94320	GT3	C2,C4
94320	94340	GT7	C3,C4
94340	94571	GT1	A2,C1
94571	94686.5	GT2	B2
94686.5	94725	GT3	C3,C4
94725	94772.5	GT3	C3,C4
94772.5	94820	GT7	C3,C4
94820	95348.5	GT1	A2,C1
95348.5	95575	GT2	B2
95575	95812	GT3	C2,B3
95812	95870	GT7	C3,C4
95870	96013.5	GT2	B2
96013.5	96075	GT3	B2,C4
96075	96229	GT3	B2,C4
96229	96460	GT7	B2,C4
96460	96604	GT2	B2
96604	96640	GT3	B2,B3

96640	96706	GT3	B2,B3
96706	96750	GT7	B2,C4
96750	96930	GT2	B1
96930	96975	GT3	B2
96975	97060	GT3	C2,C4
97060	97075	GT7	C3,C4
97075	97511	GT1	B1
97511	97620	GT2	B2
97620	97970	GT3	C2,C4
97970	98010	GT7	C3,C4
98010	98717	GT1	A2,C1
98717	99020	GT2	B2
99020	99050	GT3	C3,C4
99050	99120	GT6	C2,C4
99120	99150	GT7	C3,C4
99150	100275	GT6	C3,C4
100275	100330	GT6	B2
100330	100330	GT7	B2
100330	100546	GT6	B2
100546	100600	GT8	B2,B3

10.1.7 Design of Primary Support

For design purpose of primary support the tunnel ground will be grouped into different sections having similar rock type, stress condition and failure type. Each similar section will be provided with same support class.

The design approach will use different available methods for primary support design in conjunction with each other. These methods can be classified into the following broad groups:

- **Purely Empirical methods** suggesting a rock support pressure defined directly from a classification system (viz. Bieniawski (1989) RMR and Barton (1975) Q system.)-This will give a preliminary idea about the support type required for a rock type.
- **Analytical methods** collectively known as “Convergence-Confinement Methods” which account for elasto-plastic ground-support interaction by providing equations for calculating the ground stress-strain curve as well as the stiffness of the lining

  This will give a relation between the ground loads to be supported i.e. the support capacity required and the support capacity provided.
- **Numerical methods**: FEM analysis shall be used to determine the stress –strain state of the ground around the excavation for each tunnel section. It will be based on the constitutive models like Mohr-Coulomb (for soils and highly weathered rock) and Hoek Brown model (for rock).The numerical analysis will also be used to validate the analytical solutions. The numerical analysis shall be done using 2-D FEM software like Phase 2 and STAAD pro.

10.2 Rock Mass classification and support system

The ground types identified along the tunnel alignment of Tunnel- 13 are evaluated on the basis of RMR system and Behaviour types based on Austrian methods for defining the rock mass classification and tunnel support.

Table 25 Rock classification (RMR) for Tunnel-13

Start	End	Rock Type	Ground Type	RMR	Behaviour Type (ONORM)	Supports
91190	91200	Colluvium or surficial materials	GT8		B2,B3,C4	P
91200	91300	Massive metabasic rocks	GT4	55	B1	B1
91300	91400	Metabasic rocks	GT5	35	B1	B1
91400	91640	Massive metabasic rocks	GT4	55	B1	B1
91640	91700	Metabasic rocks	GT5	35	B2	B2
91700	92157	Metabasic rocks	GT5	35	B2	B2
92157	92210	Crushed and faulted rock mass	GT7	25	C3,C4	C3
92210	92540	Massive metabasic rocks	GT4	55	B1	B1
92540	92548	Metabasic rocks	GT5	35	B2	B2
92548	92588	Intensely fractured and crushed quartzites	GT3	35	C2,C4	C2
92588	92620	Crushed and faulted rock mass	GT7	25	C3,C4	C3
92620	93100	Thickly foliated quartzites	GT1	70	A2	B1
93100	93340	Thinly foilated/ fractured Quartzites	GT2	50	B2	B2
93340	93420	Intensely fractured and crushed quartzites	GT3	35	C2,C4	C2
93420	93634	Thinly foilated/ fractured Quartzites	GT2	50	B2	B2
93634	93748	Intensely fractured and crushed quartzites	GT3	35	C2,C4	C2
93748	93800	Crushed and faulted rock mass	GT7	25	C3,C4	C3
93800	94064	Thickly foliated quartzites	GT1	70	A2,C1	C1
94064	94196	Thinly foilated/ fractured Quartzites	GT2	50	B2	B2
94196	94240	Intensely fractured and crushed quartzites	GT3	35	B3,C2	C2
94240	94320	Intensely fractured and crushed quartzites	GT3	35	C2,C4	C2
94320	94340	Crushed and faulted rock mass	GT7	25	C3,C4	C3
94340	94571	Thickly foliated quartzites	GT1	70	A2,C1	C1
94571	94686.5	Thinly foilated/ fractured Quartzites	GT2	50	B2	B2
94686.5	94725	Intensely fractured and crushed quartzites	GT3	35	C3,C4	C3
94725	94772.5	Intensely fractured and crushed quartzites	GT3	35	C3,C4	C3
94772.5	94820	Crushed and faulted rock mass	GT7	25	C3,C4	C3
94820	95348.5	Thickly foliated quartzites	GT1	70	A2,C1	C1
95348.5	95575	Thinly foilated/ fractured Quartzites	GT2	50	B2	B2
95575	95812	Intensely fractured and crushed quartzites	GT3	35	C2,B3	C2
95812	95870	Crushed and faulted rock mass	GT7	25	C3,C4	C3
95870	96013.5	Thinly foilated/ fractured Quartzites	GT2	50	B2	B2
96013.5	96075	Intensely fractured and crushed quartzites	GT3	35	B2,C4	B2

96075	96229	Intensely fractured and crushed quartzites	GT3	35	B2,C4	B2
96229	96460	Crushed and faulted rock mass	GT7	25	B2,C4	B2
96460	96604	Thinly foilated/ fractured Quartzites	GT2	50	B2	B2
96604	96640	Intensely fractured and crushed quartzites	GT3	35	B2,B3	B2
96640	96706	Intensely fractured and crushed quartzites	GT3	35	B2,B3	B2
96706	96750	Crushed and faulted rock mass	GT7	25	B2,C4	B2
96750	96930	Thinly foilated/ fractured Quartzites	GT2	50	B1	B1
96930	96975	Intensely fractured and crushed quartzites	GT3	35	B2	B2
96975	97060	Intensely fractured and crushed quartzites	GT3	35	C2,C4	C2
97060	97075	Crushed and faulted rock mass	GT7	25	C3,C4	C3
97075	97511	Thickly foliated quartzites	GT1	70	B1	B1
97511	97620	Thinly foilated/ fractured Quartzites	GT2	50	B2	B2
97620	97970	Intensely fractured and crushed quartzites	GT3	35	C2,C4	C2
97970	98010	Crushed and faulted rock mass	GT7	25	C3,C4	C3
98010	98717	Thickly foliated quartzites	GT1	70	A2,C1	C1
98717	99020	Thinly foilated/ fractured Quartzites	GT2	50	B2	B2
99020	99050	Intensely fractured and crushed quartzites	GT3	35	C3,C4	C3
99050	99120	Thinly bedded dolomites	GT6	30	C2,C4	C2
99120	99150	Crushed and faulted rock mass	GT7	25	C3,C4	C3
99150	100275	Thinly bedded dolomites	GT6	30	C3,C4	C3
100275	100330	Thinly bedded dolomites	GT6	30	B2	B2
100330	100330	Crushed and faulted rock mass	GT7	25	B2	B2
100330	100546	Thinly bedded dolomites	GT6	30	B2	B2
100546	100600	Colluvium or surficial materials	GT8		B2,B3	P

10.3 Rock support system

Rock type classifications for tunnel 13 have been done based on the site observations and geotechnical investigations in the sections given above. The probable behaviour and failure pattern of a particular rock type under particular stress conditions have been estimated. This method for preliminary support estimate indicates possible ranges of support for a particular behaviour pattern.

Round lengths for each rock class shall be calculated with the help of ground reaction curve (GRC), Longitudinal Displacement profile (LDP) and numerical modelling at the preliminary design stage. Also the specifications of the support systems like diameter of bolt, Lattice girder and steel rib section, Wire mesh size, grade of shotcrete and final lining details will be presented in the preliminary design report along with the calculations.

As per the anticipated ground type and related behaviour type the, tunnel is expected to have six support classes, described in the sections given below:

10.3.1 Support Class A

This support class shall be used for rocks having tendency of minor deformations along with some spalling at the crown due to discontinuities.

10.3.2 Support Class B2

This support class shall be used for rocks showing shallow shear failure, crown failure or ravelling ground condition.

10.3.3 Support Class C1

This support shall be applied if at all the Rock bursting situations are encountered in the tunnel. Rock bursting might happen in case a competent rock is subjected to high stress condition. One such case has been observed in tunnel 13, but the same shall be verified in detailed design stage

10.3.4 Support Class C2

This support system will be used for the mild squeezing areas with grounds in high stress and poor strength conditions.

10.3.5 Support Class C3

This support system shall be used in high squeezing areas.

10.3.6 Support Class P

Support Class P shall be used in portal areas with low cover, where the deformations will be limited by provision of stiff supports like steel ribs.

11. Geotechnical Risks and Potential Hazard Identification

The difficulties during execution of tunnelling in T-13 is mainly influenced by the geological features like thrust/Fault zones, shear zones, folded rock sequence, in-situ stresses, rock cover, ingress of water and the high level of seismicity etc. shall be experienced during the execution of Tunnel-13. The risk and its potential hazard defined in below paragraphs:

Fault zone: - These are the major risk observed along the Tunnel alignment. Many fault/shear zones traversed across the Tunnel-13, these features having a wide affected zone of more than 100m,characterized by highly deformed, water charged, crushed ,brecciated, pulverised rock mass sandwiched between two undeformed litho tectonic blocks. The rock mass conditions within the fault zones usually pose multiple problems while driving tunnels through these sections. Horizontal probe drilling shall be performed in order to investigate ground water and rock conditions ahead of the Tunnel face. In these adverse tectonised zones the tunnels have been driven with utmost care by fore poling, multiple drifting, and controlled blasting followed by instant rock bolting, at times, by self-driving anchors (SDA), reinforced shotcreting (using steel fiber) and provision of drainage holes. Sometimes, steel rib supports at very close interval have also been provided as additional measures.

Faults and sheared zone observed along the Tunnel alignment is summarized below:

- **Along Tunnel-13:**

Chainage		Lithology	Ground Type
From	To		
92157	92210	Crushed and faulted rock mass	GT7
92588	92620	Crushed and faulted rock mass	GT7
93748	93800	Crushed and faulted rock mass	GT7
94320	94340	Crushed and faulted rock mass	GT7
94772.5	94820	Crushed and faulted rock mass	GT7
95812	95870	Crushed and faulted rock mass	GT7
96706	96750	Crushed and faulted rock mass	GT7
97060	97075	Crushed and faulted rock mass	GT7
97970	98010	Crushed and faulted rock mass	GT7
99120	99150	Crushed and faulted rock mass	GT7

Folded Rock Sequence: - Along the Tunnel-13, rock sequences are folded and refolded, regionally and locally, due to polyphase deformations. The rocks are tightly folded due to high compression in the close vicinity of major tectonic features like thrusts. The rock mass present at the closures of synclinal and anticlinal structure behave differently when tunnels are driven through them. In anticlines the rock mass is highly fragmented/jointed at the closure and structurally controlled failures are anticipated at the crown of the tunnels, whereas in the synclinal troughs the rock mass is mostly water charged and at times act as huge water aquifers. The fold axes are usually traversed by numerous shear zones and present difficult ground conditions for tunnelling due to extremely poor rock mass. These problems severely affect the tunneling schedule. Suitable mitigation measures like fore poling, multi drifting and controlled blasting and provision of drainage holes shall be taken.

In-situ Stresses: - In-situ stress along the Tunnel-13 varies from place to place. A major uncertainty lies in forecasting the magnitude of the stresses in different sections of tunnel alignment. In view of the high rock cover maximum of 527m and closer valley side associated with poly phase deformations in tunnel region, the fault

zones and other tectonised zones, high cover reaches are the areas of high in-situ stresses and here the rock masses are heavily stressed. The phenomenon of squeezing and swelling, which cause an inward movement of the tunnel periphery due to dilation or distressing, needs to be accounted to ensure safety of tunnel support. Assessment of the actual geological condition and monitoring of ground deformations, Mitigation measures like probing, additional support shall be taken.

Ingress of Water: - Risk of water ingress will affect the stability and tunnel excavation rates. The risk is higher along the fault zone or low cover area where Nala is flowing and along the Litho contacts.

Tunnelling through rock mass which is highly charged with ground water faces major problems such as:

- Heavy ingress of water in tunnel hampers the construction activities inside.
- The saturated rock mass loses its strength as the shear strength (cohesion and friction) gets reduced due to lubrication, and failure of rock mass occurs from the crown and above spring level. Virtually it is flowing ground condition.
- The high pore water pressure behind the tunnel periphery adversely affects the support system resulting to distress.

Horizontal probe drilling shall be performed in order to investigate the ground water ahead of the tunnel Suitable mitigation measures like grouting; provision of drainages shall be taken.

Low cover areas: - At Ch: 96+150 to Ch: 96+400 the alignment passes through a low cover area under an existing natural Nalla. The minimum ground cover at this location is 44m approximately. The available borehole at these locations shows crushed material composition of which is mainly quartzite. Due to this composition of ground. Preventive measure before advancing tunnel in this area will be considered in design to make sure smooth excavation of the tunnel focusing on minimizing the ground water ingress.

Terrace and slide material at crown level: - At the both portal location of Tunnel-13, slope debris has been observed in Tunnel level which having the heterogeneous nature and loosely bounded which may affects the stability of the tunnel. In view of that portal location is further optimize to avoid this ground.

12. Hydrological condition along tunnel alignment

This section includes the details of the hydrological assessment along the tunnel and the potential impact on construction of the tunnels. This section mainly describes the:

- Interpreted Hydrogeological conditions;
- Estimated discharge of potential groundwater into each tunnel;

Attention has also been paid to information on the ground conditions along the tunnel route and the geo-mechanical properties through means of groundwater inflow control. The drainage designs shall be developed to cater for the highest range of possible ground water discharge for each tunnel, where alternative or additional items or methods may be beneficial to the project, in discussion with the client.

The aim of the hydrogeological assessment for tunnels and adjacent areas is to assess the magnitude of possible inflows to all engineered drained tunnels, the size of drain required for the inflows and to suggest possible methods of drainage system.

12.1 Methodology and Basis

The overall method is to understand the existing groundwater flow configuration for each tunnel based on catchment area, average annual rainfall, including factors for infiltration, surface runoff & evaporation in combination with a geological model of both the wide area as well as the particular tunnel location. The factors for infiltration, evaporation and surface runoff have been considered based on the morphology/topography of area, slopes & climatic conditions through given references. This is then calculated for each tunnel to reproduce current conditions using assumed permeability conditions. The depth to water table is not considered in this method.

Information from the on-going site-specific ground investigation works should be reviewed and incorporated at a later stage. The key limitations of this report relate primarily to uncertainties relating to actual hydrological conditions of all tunnels.

12.2 Conceptual Hydrogeological Model

12.2.1 Sub-regional Model

Ground water in the project occurs in localized, disconnected bodies under favourable geological conditions. Thus there is no homogenous aquifer system having wide aerial extent. Ground Water occurs along the thrust plains, strike slip fault/ normal fault plains, tensile joints, synclinal folds, tensile fractures and at the contact of two different rock formations etc. Further it also occurs in solution cavities, channels etc. in the carbonate rocks. In alluvial formation it occurs in the valley fill deposits, terraces, river terraces and glacial valleys, weathered rock cover and in moraines and glacial deposits. On the hill slope ground water mostly occurs in the form of seepages, springs and gadheras under gravity and favourable geological structures intercepting the topography. The occurrence of springs and seepages is controlled by geological structures and physiography of the area. Most of the springs are originating from higher reaches of the mountains. Two-three springs jointly makes a high discharge gadhera also originating and meeting at higher reaches and flows through contacts of mountains / rocks under gravity. The discharge and temperature of the springs fluctuate throughout the year depending upon its recharge and discharge factor. During the rains the favourable geological structures get recharged and resulting in higher discharge of spring and gadheras after the monsoons. During the post-monsoon period their discharge reduces gradually with time and it is minimum in pre-monsoon period.

The ground water discharge and its temperature of spring/gadheras located in various litho tectonic zones significantly vary. The maximum discharge in the area through spring is observed in litho tectonic zone in the rock formations of Quartzite & Phyllites. In this litho tectonic zone the discharge varies from 1 to 50 lpm in springs and approximately 30 to 1200 lpm in gadheras / gads. The temperature of ground water generally varies from 17 to 22.50C in springs. Mostly the springs in the area are of gravitational type.

The major part of the district is occupied by Lesser Himalaya litho tectonic unit. In Garhwal lithotectonic unit, the discharge of the springs varies 1 lpm to 18 lpm with temperature ranging between 180C and 240C. The springs of this zone are of gravitational type and are of VII to V order of magnitude (after Meinzers Class). In this zone ground water occurs mainly in the secondary structures. Generally, all the cold springs distributed in the different litho tectonic zones are not as deep seated as in the case of hot springs found in the Himalayas. The cold springs are gravitational spring originating from higher altitudes. The meteoric and surface water directly recharge the favourable geological structures controlling the springs. Direct rainfall and snow melt infiltrates through the joints, fissures, fault plains and weathered zones of the rocks and the thin veneer of soil cover. The perennial Rivers viz. Alaknanda and streams also recharge the springs located on the valley side and near

streambeds. The potential recharge areas in the hilly terrain are flat ridges, hills, saddles, spurs, flood plains developed on terraces of major rivers, fault plains, sheared zones along the riverbed etc. The discharge takes places through springs/ gadheras on the hill slops where the structurally weak and saturated zone intercepts the topography.

12.2.2 Hydro-geological Profile

The typical simplified hydrogeological sequences applicable to the tunnel-13 areas are summarised as follows, with each of the units varying in both composition and thickness:

- Superficial deposits (colluvium/fill/Terrace material)
- Weathered bed rock (Quartzites/Metabasic rocks/ Dolomites)
- Interface zone/ litho-contacts/Thrust/Shear zones
- Fresh rock profile (Quartzites/Metabasic rocks/Dolomites)

The continuous observations and monitoring identified the presence of two zones with potential to influence groundwater flows. These consist of a coarse grained and porous highly and completely decomposed layer in the area above rock mass and an interface zone in the upper part of the rock mass, resulting from preferential weathering along sub-horizontal discontinuities and to a smaller extent the sub-verticals.

These zones both have potential for high hydraulic conductivity due to the process of accumulation of water at the soil / rock interface and lateral flow dictated by the underlying, and generally lower permeability, clayey rock mass. The rock mass in which the tunnels will be excavated comprises a fractured crystalline media with an inherently low porosity and hydraulic conductivity. The predominant factor controlling groundwater flow through the rock mass will be the presence of open discontinuities forming networks, in particular those sub-vertical transmissive discontinuities with connectivity to the overlying superficial deposits.

12.2.3 Major Geological structure

Structure at various scales is anticipated to occur within the rock mass in the vicinity of the area. The currently available site observations has identified zones of closely spaced persistent discontinuities These structures may be more permeable than the typical rock mass conditions forming enhanced conduits of flow, although clay infill has been noted in some zones, reducing the significance of such features. Larger structures that have sheared or faulted the rock material are likely to be encountered. Such features often lead to highly variable permeability, and can act as boundaries to flow, however the related enhancement of the weathering profile can further alter conditions locally.

12.2.4 Water table elevation

The water table elevation in relation to rock head profile is important in terms of the impacts of groundwater drawdown or on settlement in the superficial materials. The depth to water table has been confirmed by the boreholes drilled along Tunnel alignment. Details of observed GWT in the boreholes are summarized below:

Table 26 water table encountered in the Borehole

Structure	Borehole ID	Depth of water table from ground level	Borehole Ground level	Water table level

Tunnel 13	BH 119	28.5m	742.65m	714.15m
	BH 120	26m	979.593m	953.593m
	BH 123	1.7m	730.025m	728.325m
	BH 126	21m	946.278m	925.278m
	BH 127	10.50m	845.898m	835.398m
	BH 128	15.5m	835.52m	820.02m
	BH 129	21m	732.809m	711.809m

12.3 Regional Hydrological data and Analysis

12.3.1 Tunnel- T 13

Basic hydrological data along the alignment of the Tunnel T 13 has been obtained from the Indian Meteorological Department (IMD), the local observatory and through other references. The data collected includes rainfall records, estimated evaporation, and surface runoff and calculated catchment area, each of which are together analysed to calculate the approximated quantity of water for each tunnel.

The aquifer regime in the area is through joints which are fed by rains spreading over the whole year with almost no complete dry months and the main wet periods ranging from April to September and peaking in June –Aug

The long term discharge through the tunnel has been estimated and for this an average annual precipitation of 1485 mm is taken. This is from arithmetic mean of 4 year rainfall data provided by India Meteorological Department (IMD) for the area.

- Runoff has been computed by using the formulae

  R=kP (where P is the rainfall and “k” runoff coefficient and is taken as 0 .05 to 0.2 for forest area)
- The annual Potential evapotranspiration (PET) has been taken as 1200mm from the India Meteorological Department data. This has been calculated by using Penman's formula.

These tunnels fall in forest area & for forest area the standard value is taken as 0.05 to 0.2. Keeping in view the topography, the value has been taken between these ranges.

The catchment areas, annual runoff, and calculated long term water drained by tunnel T-13 is given in the below table.

Table 27: Total Long term water seepage drained by the Tunnel -13

S.No.	Tunnel No.	Tunnel length m	Catchment area (m2)	Catchment area (km2)	Annual Precipitation (P) (mm)	Annual PET (mm) taken from IMD Map (E)	* Annual Runoff (mm) R=Kp	Annual Seepage (E-R) mm	Volume of Water Seepage in one year (seepage x area) lt.	Amount of Water Seepage lt/ km/ Hr	* Percentage Drained by Tunnel	lt / Hr	lt/sec/Km of tunnel	Total long term water seepage for the tunnel lt/sec
1	Tunnel-13	9440	42470000	42.470	1485	1200	267.3	17.7	751719000	85813	40%	34325	13	124

Table 28: District Rainfall (mm) for last four Years for Pauri Garhwal district

District : GARHWAL PAURI

Note :(1) The District Rainfall in millimeters (M/F) shown below are the arithmetic averages of Rainfall of Stations under the District.
(2) % Dep. are the Departures of rainfall from the long period averages of rainfall for the District.
(3) Blank Spaces show non-availability of Data

YEAR	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEPT		OCT		NOV		DEC	
	M/F	%DEP	M/F	%DEP	M/F	%DEP	M/F	%DEP	M/F	%DEP	M/F	%DEP	M/F	%DEP	M/F	%DEP	M/F	%DEP	M/F	%DEP	M/F	%DEP	M/F	%DEP
2014	35.3	-19	47.4	104	35.4	0	17.4	-10	17.3	-54	28.3	-77	251.8	-22	257.8	-42	160.7	-32	15.8	-74	0.5	-100	18.4	8
2015	26.3	-39	29.8	-59	61.1	126	24.3	32	31.8	-18	141.9	81	322.4	-61	364.2	-20	89.1	-60	14.8	-76	0.2	-97	4.1	-100
2016	5.1	-88	18.0	-66	17.8	-60	4.0	-69	47.6	84	86.5	-38	485.8	9	342.9	-48	88.6	-67	0.0	-100	0.0	-100	1.6	-98
2017	34.6	-20	1.6	-97	22.0	-96	19.3	-9	50.6	92	108.6	-27	278.3	-28	348.6	-21	168.8	-15	0.0	-100	0.3	-96	16.7	-18

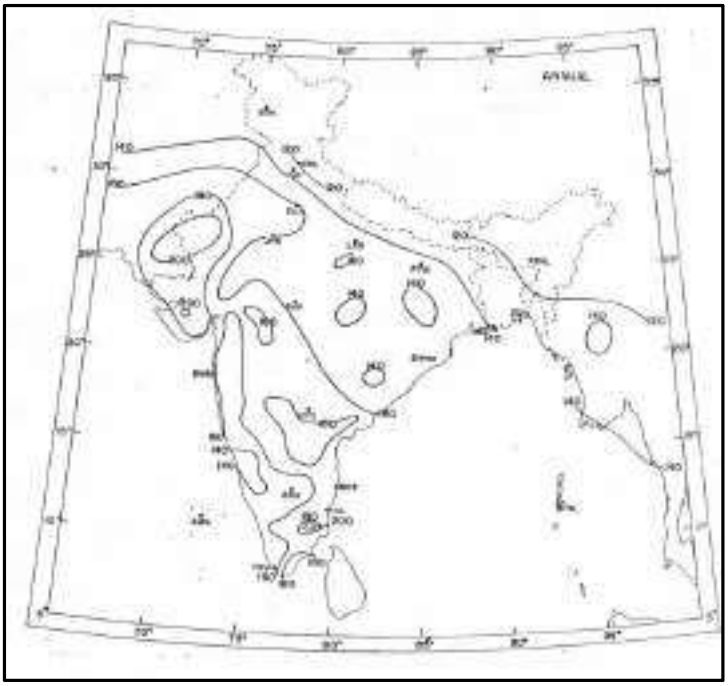


Figure 32: Annual PET (cm) over India (Source: IMD)

Thus the infiltration to the ground after the losses through transpiration etc. is about 267.3mm for Tunnel-13 .The catchment area for Tunnel-13 is 42.47 Km² and as we are intercepting the subsurface flow path by this tunnel and assuming 40% will be discharged in to the tunnel, we can expect a long term maximum discharge of about 124 lt/s for Tunnel-13 and , As these tunnel is being designed as a drained tunnel, lowering of water table is expected in the area.

12.4 Hydrological studies at Bridges location

Apart from the Hydrology study at Tunnel locations. National institute of Hydrology also done the hydrological studies at different bridges location fall in package-7B. The objective of this section is to estimate the Design Flood for deciding the Water Way and the Foundation structure for the bridge location proposed across the Nalah. The summarize details of hydrological studies done at different bridge location as per below:

12.4.1 Tilani (Out) Bridge location

12.4.1.1 Comparison of Peak floods

The peak floods estimated using two methods for 50 year and 100 year return period floods are given in Table below:-

Method	Peak discharge (m3/s)	
	50 year	100 Year
CWC-1994: Flood Estimation Report for Western Himalayan Zone 7 (1994)	171.89	202.22
RFFA-LMT: Regional flood frequency relationship for ungauged catchments.	119.78	140.2
Dicken Formula	48.21	

12.4.1.2 Output of Design floods

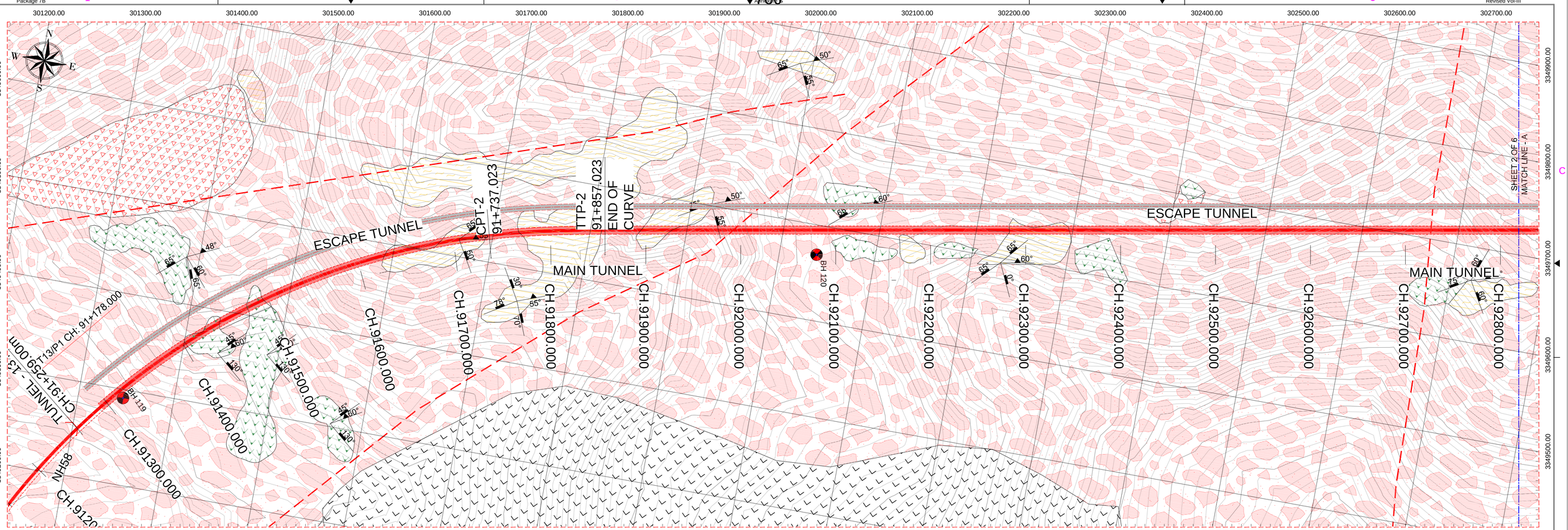
Summary of output at bridge location for various design floods are summarized below:-

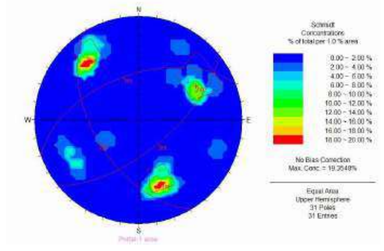
Profile	Water Level	Critical Water Level	Velocity
	m	m	m/s
50 Year	694.48	696.01	11.64
100 Year	694.64	696.29	12.15

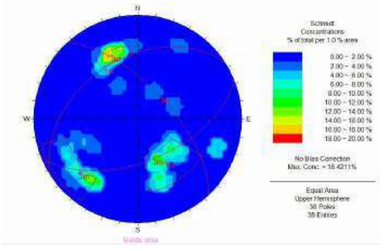
Appendices

Appendix-1

Geological Plan and L-section







NOTE :~

1. THE GEOLOGICAL PLAN HAS BEEN PREPARED BASED ON GEOLOGICAL PLAN FIELD EXCURSION AND GEOLOGICAL MAPPING AND AVAILABLE GEOTECHNICAL INFORMATION.
2. STRUCTURAL FEATURES / LITHOLOGICAL CONTACTS HAVE BEEN REFERRED FROM THE GEOLOGICAL MAPPING COMPLETED DURING FLS.

TENDER DRAWING

LEGENDS :

- Colluvium or surficial material
- Terrace Material
- Nalah Borne material
- Slide material
- Quartzite
- Metabasic rock
- Sheared/Fractured Metabasic rock
- Phyllites
- Dolomites

OTHER SYMBOLS :

- Fault
- Lithological Contact
- Bore Holes

Structural Domain	Group	Formation	Age
Outer lesser Himalaya	Jaunsar	Chandpur formation	Neo-Proterozoic
Inner lesser Himalaya	Garhwal	Epidiorite, Anphibolite and Metavolcanic	Meso-Proterozoic
		Nagnithank formation	

Stratigraphy Along the Project Area (Source GSI)

GT - 1 Thickly Foliated Massive Quartzites

GT - 2 Thinly foliated /fractured Quartzites

GT - 3 Intensely fractured and crushed Quartzite

GT - 4 Massive Metabasic rocks

GT-5 Crushed and fractured Metabasic rocks

GT - 6 Thinly bedded Dolomites

GT-7 Crushed and Faulted rock mass

GT - 8 Colluvium or Surficial Materials

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

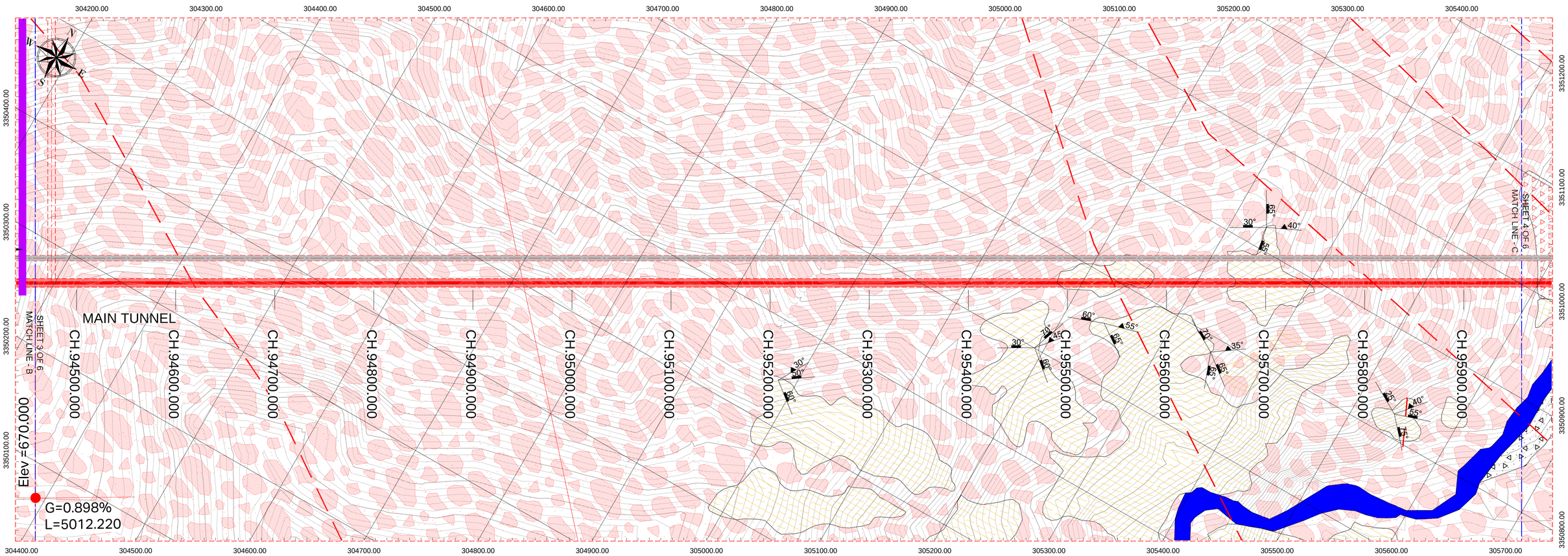
RVNL Rail Vikas Nigam Limited | AECOM

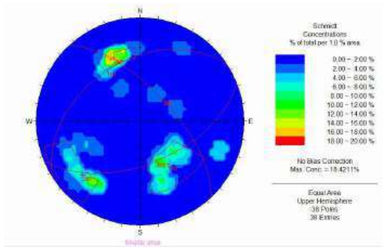
Debasis Bag	Om Dixit	Sami K	John Celentano
Drawn	Designed	Verified	Approved

Title:

TUNNEL-13
GEOLOGICAL PLAN PROFILE
(SHEET 1 OF 6)

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-GT-0041	1:2000	1





NOTE :~

1. THE GEOLOGICAL PLAN HAS BEEN PREPARED BASED ON GEOLOGICAL PLAN FIELD EXCURSION AND GEOLOGICAL MAPPING AND AVAILABLE GEOTECHNICAL INFORMATION.
2. STRUCTURAL FEATURES / LITHOLOGICAL CONTACTS HAVE BEEN REFERRED FROM THE GEOLOGICAL MAPPING COMPLETED DURING FLS.

TENDER DRAWING

LEGENDS :

- Colluvium or surficial material
- Terrace Material
- Nalah Borne material
- Slide material
- Quartzite
- Metabasic rock
- Sheared/Fractured Metabasic rock
- Phyllites
- Dolomites

OTHER SYMBOLS :

- Fault
- Lithological Contact
- Bore Holes

Structural Domain	Group	Formation	Age
Outer lesser Himalaya	Jaunsar	Chandpur formation	Neo-Proterozoic
Inner lesser Himalaya	Garhwal	Epidiorite, Anphibolite and Metavolcanic	Meso-Proterozoic
		Nagnithank formation	

Stratigraphy Along the Project Area (Source GSI)

GT - 1 Thickly Foliated Massive Quartzites

GT - 2 Thinly foliated /fractured Quartzites

GT - 3 Intensely fractured and crushed Quartzite

GT - 4 Massive Metabasic rocks

GT-5 Crushed and fractured Metabasic rocks

GT - 6 Thinly bedded Dolomites

GT-7 Crushed and Faulted rock mass

GT - 8 Colluvium or Surficial Materials

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

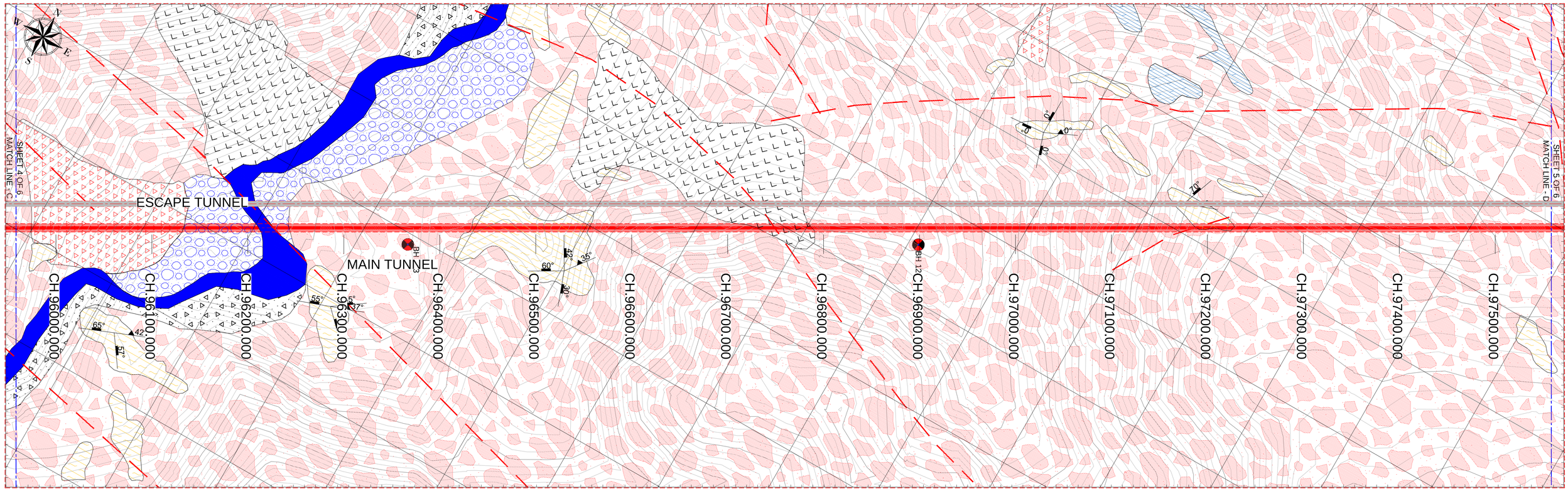
RVNL Rail Vikas Nigam Limited | AECOM

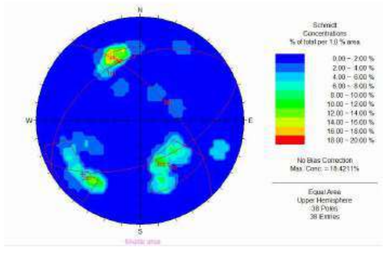
Debasis Bag	Om Dixit	Sami K	John Celentano
Drawn	Designed	Verified	Approved

Title:

TUNNEL-13
GEOLOGICAL PLAN PROFILE
(SHEET 3 OF 6)

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-GT-0043	1:2000	1





NOTE :~

1. THE GEOLOGICAL PLAN HAS BEEN PREPARED BASED ON GEOLOGICAL PLAN FIELD EXCURSION AND GEOLOGICAL MAPPING AND AVAILABLE GEOTECHNICAL INFORMATION.
2. STRUCTURAL FEATURES / LITHOLOGICAL CONTACTS HAVE BEEN REFERRED FROM THE GEOLOGICAL MAPPING COMPLETED DURING FLS.

TENDER DRAWING

LEGENDS :

- Colluvium or surficial material
- Terrace Material
- Nalah Borne material
- Slide material
- Quartzite
- Metabasic rock
- Sheared/Fractured Metabasic rock
- Phyllites
- Dolomites

OTHER SYMBOLS :

- Fault
- Lithological Contact
- Bore Holes

Structural Domain	Group	Formation	Age
Outer lesser Himalaya	Jaunsar	Chandpur formation	Neo-Proterozoic
Inner lesser Himalaya	Garhwal	Epidiorite, Amphibolite and Metavolcanic	Meso-Proterozoic
		Nagnithank formation	

Stratigraphy Along the Project Area (Source GSI)

GT - 1 Thickly Foliated Massive Quartzites

GT - 2 Thinly foliated /fractured Quartzites

GT - 3 Intensely fractured and crushed Quartzite

GT - 4 Massive Metabasic rocks

GT-5 Crushed and fractured Metabasic rocks

GT - 6 Thinly bedded Dolomites

GT-7 Crushed and Faulted rock mass

GT - 8 Colluvium or Surficial Materials

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

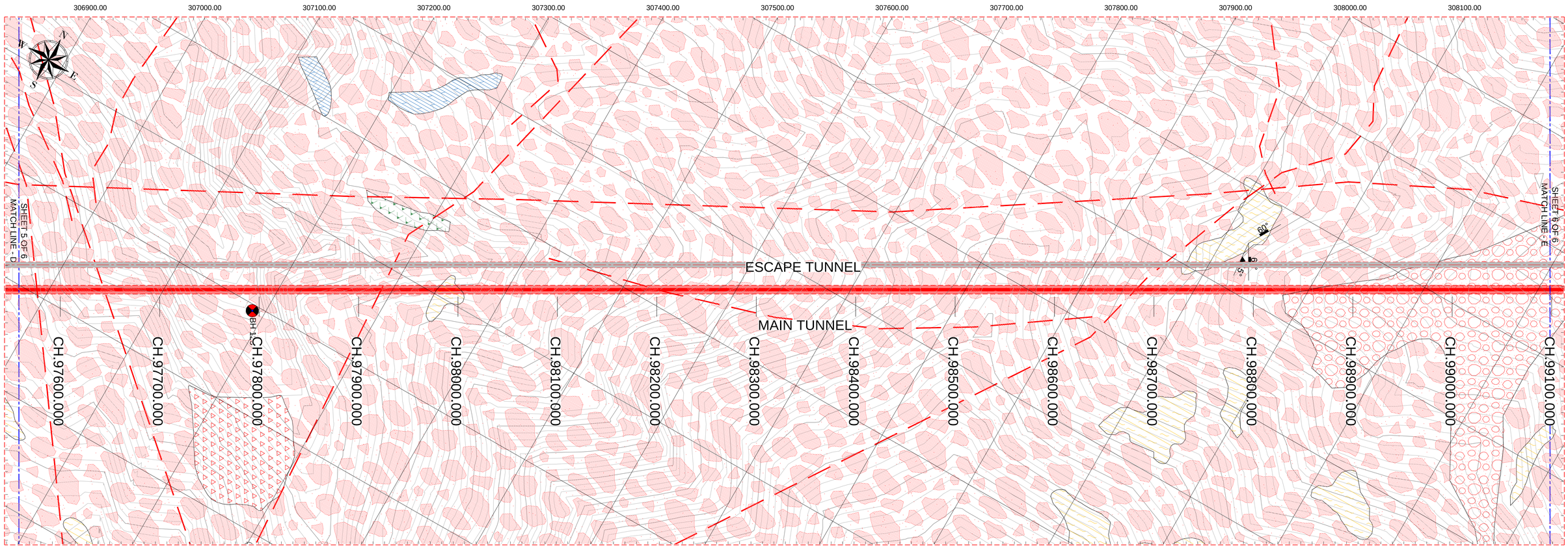
RVNL Rail Vikas Nigam Limited | AECOM

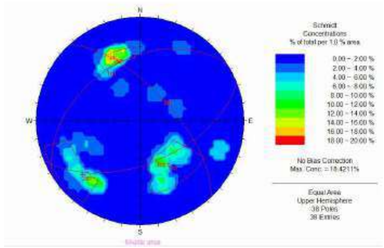
Debasis Bag	Om Dixit	Sami K	John Celentano
Drawn	Designed	Verified	Approved

Title:

TUNNEL-13
GEOLOGICAL PLAN PROFILE
(SHEET 4 OF 6)

Drawing No. ACM-60598728-PKG7B-GT-0044 | Scale 1:2000 | Rev. 1





NOTE :~

1. THE GEOLOGICAL PLAN HAS BEEN PREPARED BASED ON GEOLOGICAL PLAN FIELD EXCURSION AND GEOLOGICAL MAPPING AND AVAILABLE GEOTECHNICAL INFORMATION.
2. STRUCTURAL FEATURES / LITHOLOGICAL CONTACTS HAVE BEEN REFERRED FROM THE GEOLOGICAL MAPPING COMPLETED DURING FLS.

TENDER DRAWING

LEGENDS :

- Colluvium or surficial material
- Terrace Material
- Nalah Borne material
- Slide material
- Quartzite
- Metabasic rock
- Sheared/Fractured Metabasic rock
- Phyllites
- Dolomites

OTHER SYMBOLS :

- Fault
- Lithological Contact
- Bore Holes

Structural Domain	Group	Formation	Age
Outer lesser Himalaya	Jaunsar	Chandpur formation	Neo-Proterozoic
Inner lesser Himalaya	Garhwal	Epidiorite, Amphibolite and Metavolcanic	Meso-Proterozoic
		Nagnithank formation	

Stratigraphy Along the Project Area (Source GSI)

GT - 1 Thickly Foliated Massive Quartzites

GT - 2 Thinly foliated /fractured Quartzites

GT - 3 Intensely fractured and crushed Quartzite

GT - 4 Massive Metabasic rocks

GT-5 Crushed and fractured Metabasic rocks

GT - 6 Thinly bedded Dolomites

GT-7 Crushed and Faulted rock mass

GT - 8 Colluvium or Surficial Materials

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

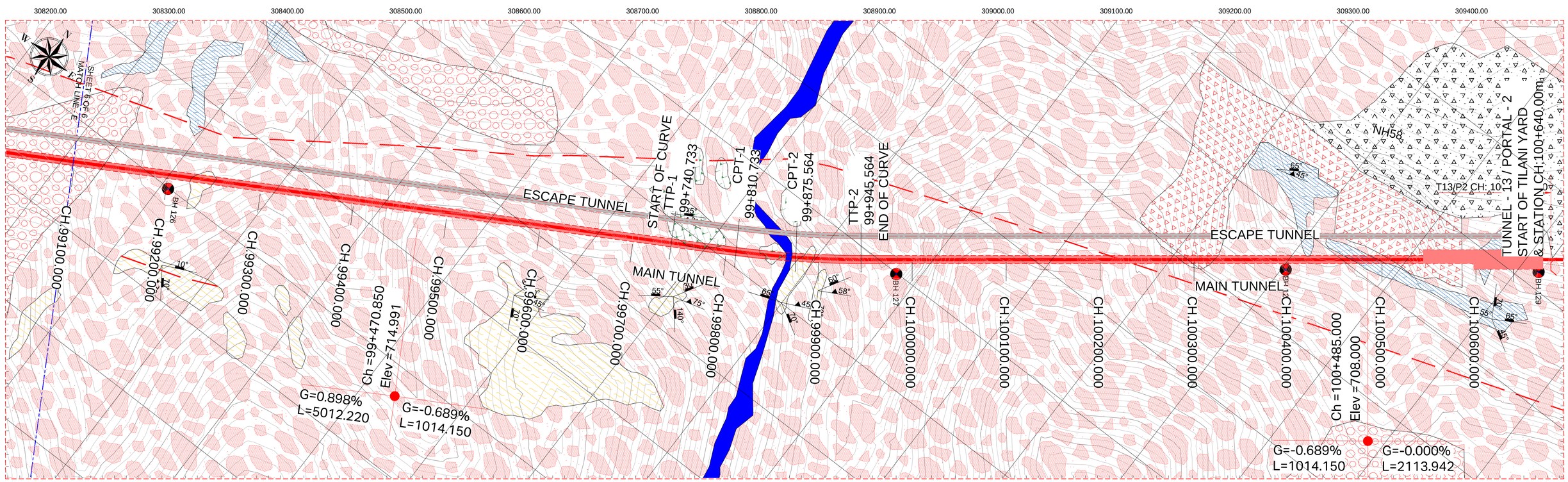
RVNL Rail Vikas Nigam Limited | AECOM

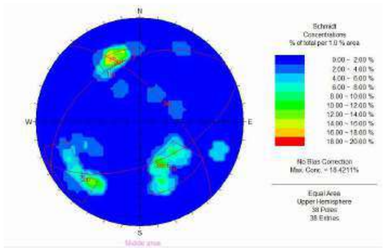
Debasis Bag	Om Dixit	Sami K	John Celentano
Drawn	Designed	Verified	Approved

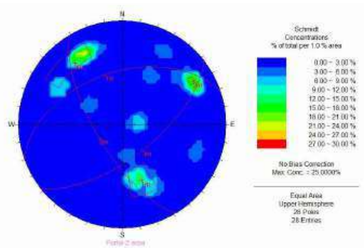
Title:

TUNNEL-13
GEOLOGICAL PLAN PROFILE
(SHEET 5 OF 6)

Drawing No. ACM-60598728-PKG7B-GT-0045 | Scale 1:2000 | Rev. 1







NOTE :~

1. THE GEOLOGICAL PLAN HAS BEEN PREPARED BASED ON GEOLOGICAL PLAN FIELD EXCURSION AND GEOLOGICAL MAPPING AND AVAILABLE GEOTECHNICAL INFORMATION.
2. STRUCTURAL FEATURES / LITHOLOGICAL CONTACTS HAVE BEEN REFERRED FROM THE GEOLOGICAL MAPPING COMPLETED DURING FLS.

TENDER DRAWING

LEGENDS :

- Colluvium or surficial material
- Terrace Material
- Nalah Borne material
- Slide material
- Quartzite
- Metabasic rock
- Sheared/Fractured Metabasic rock
- Phyllites
- Dolomites

OTHER SYMBOLS :

- Fault
- Lithological Contact
- Bore Holes

Structural Domain	Group	Formation	Age
Outer lesser Himalaya	Jaunsar	Chandpur formation	Neo-Proterozoic
Inner lesser Himalaya	Garhwal	Epidiorite, Anphibolite and Metavolcanic	Meso-Proterozoic
		Nagnithank formation	

Stratigraphy Along the Project Area (Source GSI)

GT - 1 Thickly Foliated Massive Quartzites

GT - 2 Thinly foliated /fractured Quartzites

GT - 3 Intensely fractured and crushed Quartzite

GT - 4 Massive Metabasic rocks

GT-5 Crushed and fractured Metabasic rocks

GT - 6 Thinly bedded Dolomites

GT-7 Crushed and Faulted rock mass

GT - 8 Colluvium or Surficial Materials

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

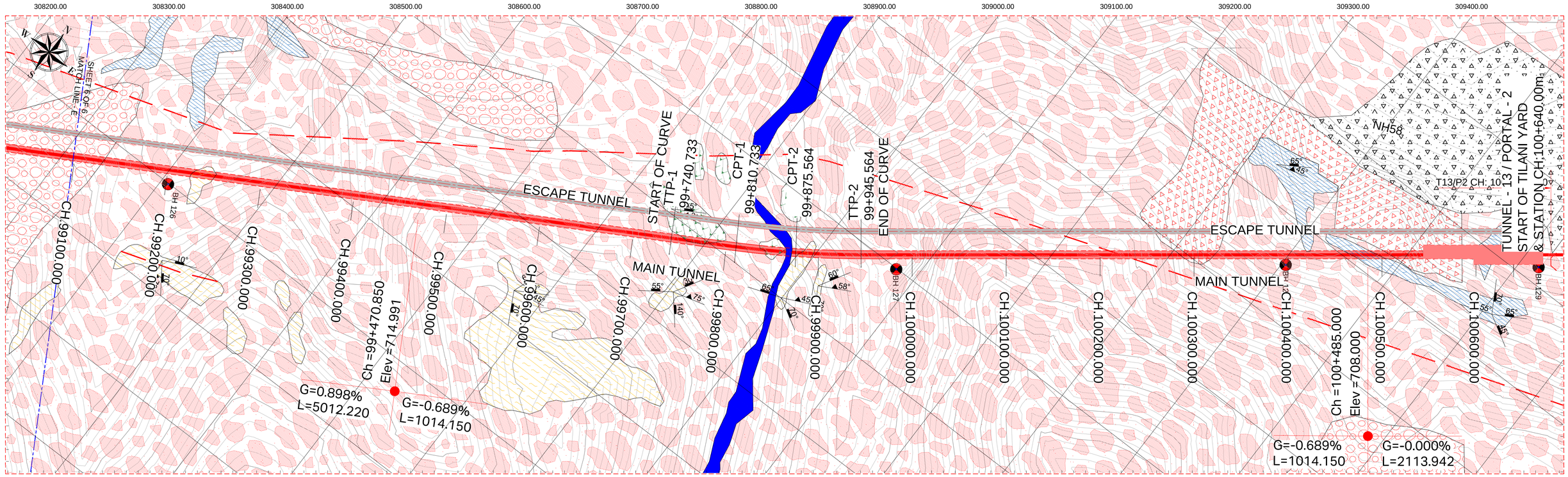
RVNL Rail Vikas Nigam Limited | AECOM

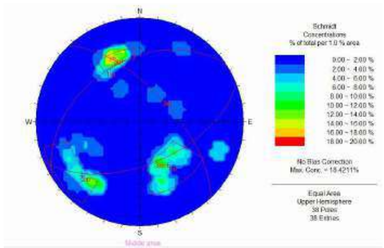
Debasis Bag	Om Dixit	Sami K	John Celentano
Drawn	Designed	Verified	Approved

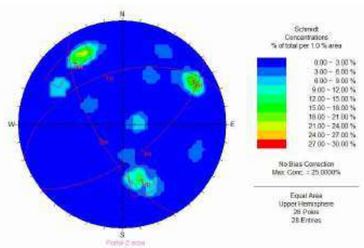
Title:

TUNNEL-13
GEOLOGICAL PLAN PROFILE
(SHEET 6 OF 6)

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-GT-0046	1:2000	1







NOTE :~

1. THE GEOLOGICAL PLAN HAS BEEN PREPARED BASED ON GEOLOGICAL PLAN FIELD EXCURSION AND GEOLOGICAL MAPPING AND AVAILABLE GEOTECHNICAL INFORMATION.
2. STRUCTURAL FEATURES / LITHOLOGICAL CONTACTS HAVE BEEN REFERRED FROM THE GEOLOGICAL MAPPING COMPLETED DURING FLS.

TENDER DRAWING

LEGENDS :

- Colluvium or surficial material
- Terrace Material
- Nalah Borne material
- Slide material
- Quartzite
- Metabasic rock
- Sheared/Fractured Metabasic rock
- Phyllites
- Dolomites

OTHER SYMBOLS :

- Fault
- Lithological Contact
- Bore Holes

Structural Domain	Group	Formation	Age
Outer lesser Himalaya	Jaunsar	Chandpur formation	Neo-Proterozoic
Inner lesser Himalaya	Garhwal	Epidiorite, Amphibolite and Metavolcanic	Meso-Proterozoic
		Nagnithank formation	

Stratigraphy Along the Project Area (Source GSI)

GT - 1 Thickly Foliated Massive Quartzites

GT - 2 Thinly foliated /fractured Quartzites

GT - 3 Intensely fractured and crushed Quartzite

GT - 4 Massive Metabasic rocks

GT-5 Crushed and fractured Metabasic rocks

GT - 6 Thinly bedded Dolomites

GT-7 Crushed and Faulted rock mass

GT - 8 Colluvium or Surficial Materials

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

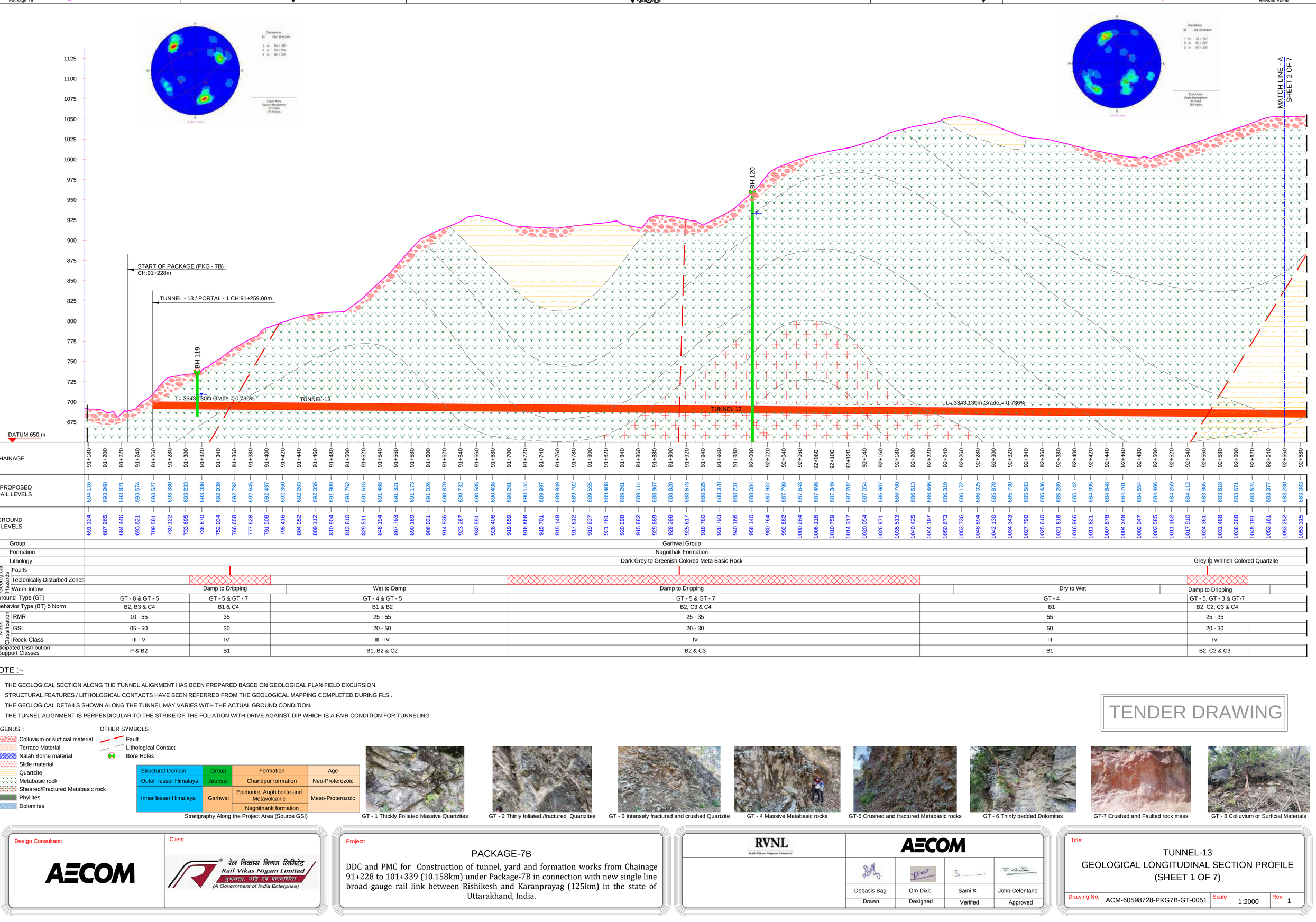
RVNL Rail Vikas Nigam Limited | AECOM

Debasis Bag	Om Dixit	Sami K	John Celentano
Drawn	Designed	Verified	Approved

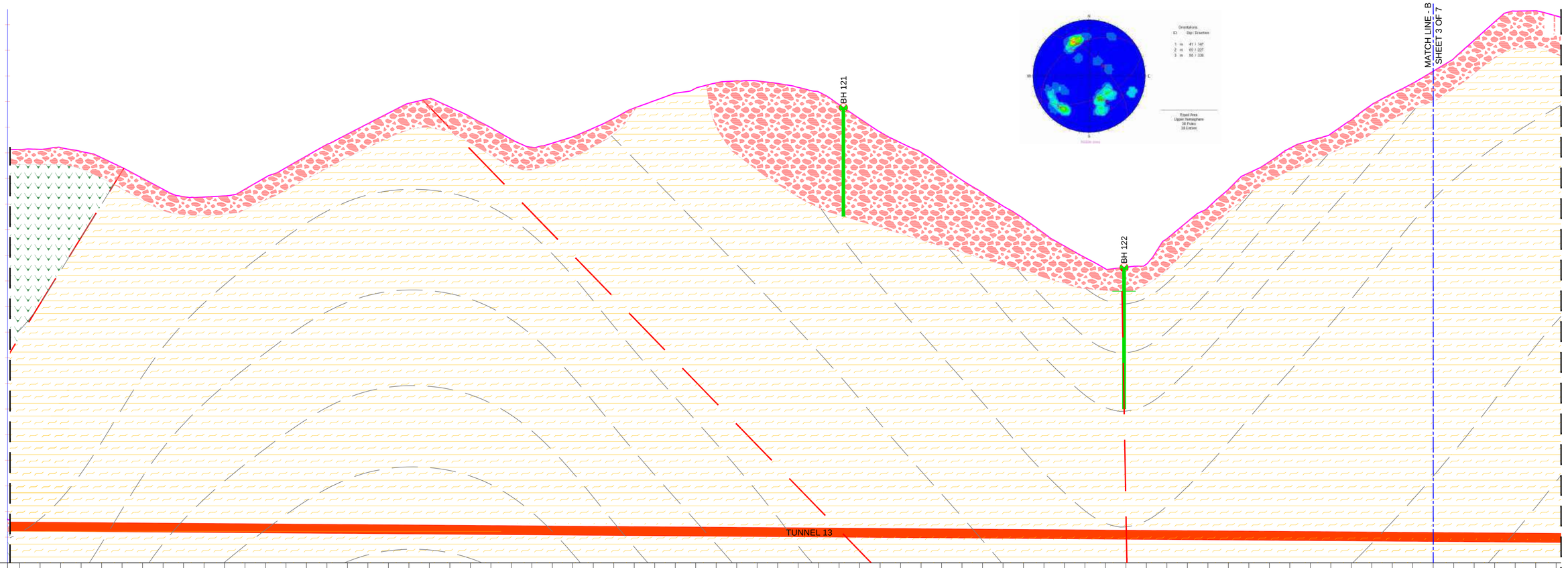
Title:

TUNNEL-13
GEOLOGICAL PLAN PROFILE
(SHEET 6 OF 6)

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-GT-0046	1:2000	1


1125
1100
1075
1050
1025
1000
975
950
925
900
875
850
825
800
775
750
725
700
675
START OF PACKAGE (PKG - 7B)
CH:91+228m
TUNNEL - 13 / PORTAL - 1 CH:91+259.00m
BH 119
BH 120
L= 3343.130m Grade =-0.736%
TUNNEL 13
TUNNEL 13
L= 3343.130m Grade =-0.736%
MATCH LINE - A
SHEET 2 OF 7
DATUM 650 m

| | | |



CHAINAGE	92+680 … 94+180 (every 20 m)	
PROPOSED RAIL LEVELS	683.083 … 672.049	
GROUND LEVELS	1053.315 … 1183.677	
Group	Garhwal Group	
Formation	Nagnithak Formation	
Lithology	Grey to Whitish Colored Quartzite	Grey to Whitish Colored Quartzite
Potential Geological Hazards: Faults		
Potential Geological Hazards: Tectonically Disturbed Zones		
Water Inflow	Dry to Damp	Damp to Dripping / Dry to Damp / Dry to Damp
Ground Type (GT)	GT - 1, GT - 2 & Partially GT-3	GT - 2, GT - 3 & GT-7 / GT - 1, GT - 2 & Partially GT-3 / GT - 1, GT - 2 & Par
Behavior Type (BT) ó Norm	A2, B2, C2 & C4	B2, C2, C3 & C4 / A2, B2, B3, C1 & C2 / A2, B2, B3, C1
Rock Mass Classification: RMR	35 - 70	25 - 50 / 35 - 70 / 35 - 70
Rock Mass Classification: GSI	30 - 65	20 - 45 / 40 - 50 / 40 - 50
Rock Class	II - IV	III - IV / II - IV / II - IV
Anticipated Distribution of Support Classes	B1, B2 & C2	B2, C2 & C3 / B2, C1 & C2 / B2, C1 & C

NOTE :~

1. THE GEOLOGICAL SECTION ALONG THE TUNNEL ALIGNMENT HAS BEEN PREPARED BASED ON GEOLOGICAL PLAN FIELD EXCURSION.
2. FOR ALL OTHERS NOTE REFER DRAWING NO. ACM-60598728-PKG7B-GT-031

LEGENDS :

- Colluvium or surficial material
- Terrace Material
- Nalah Borne material
- Slide material
- Quartzite
- Metabasic rock
- Sheared/Fractured Metabasic rock
- Phyllites
- Dolomites

OTHER SYMBOLS :

- Fault
- Lithological Contact
- Bore Holes

Structural Domain	Group	Formation	Age
Outer lesser Himalaya	Jaunsar	Chandpur formation	Neo-Proterozoic
Inner lesser Himalaya	Garhwal	Epidiorite, Amphibolite and Metavolcanic	Meso-Proterozoic
		Nagnithank formation	

Stratigraphy Along the Project Area (Source GSI)

GT - 1 Thickly Foliated Massive Quartzites

GT - 2 Thinly foliated /fractured Quartzites

GT - 3 Intensely fractured and crushed Quartzite

GT - 4 Massive Metabasic rocks

GT-5 Crushed and fractured Metabasic rocks

GT - 6 Thinly bedded Dolomites

GT-7 Crushed and Faulted rock mass

GT - 8 Colluvium or Surficial Materials

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited सुगमता, गति एवं पारदर्शिता (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

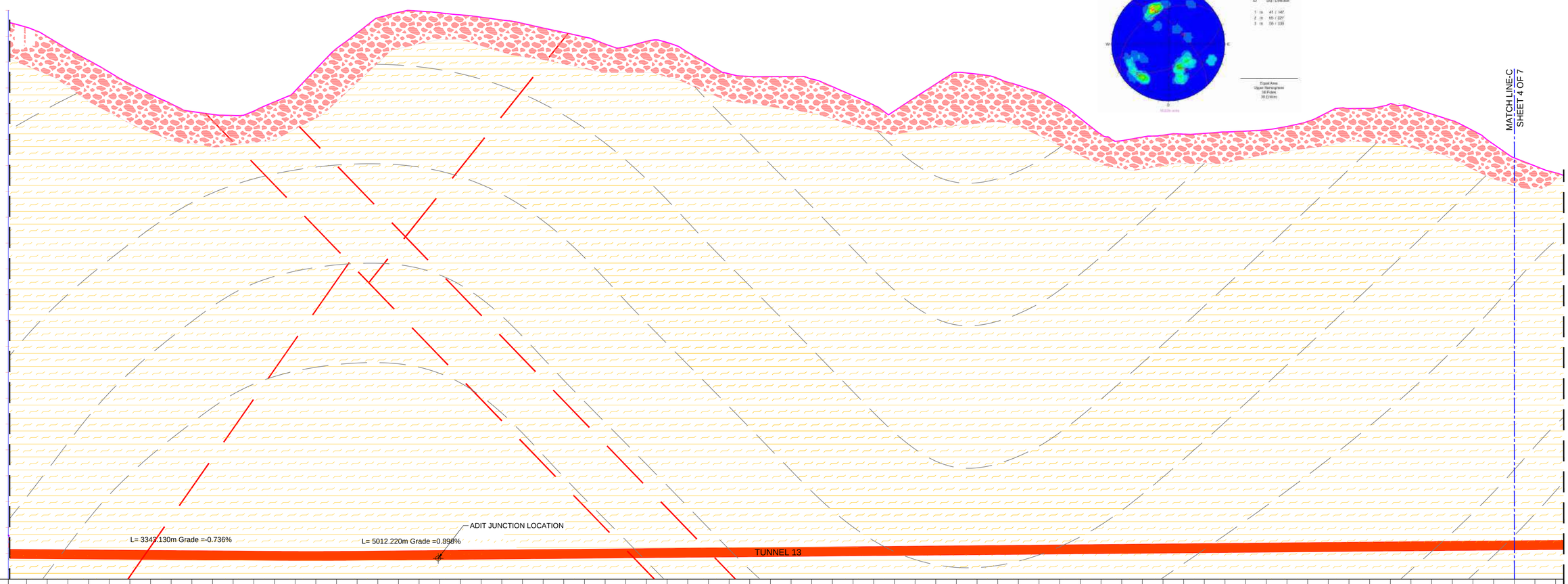
RVNL Rail Vikas Nigam Limited | AECOM

Debasis Bag	Om Dixit	Sami K	John Celentano
Drawn	Designed	Verified	Approved

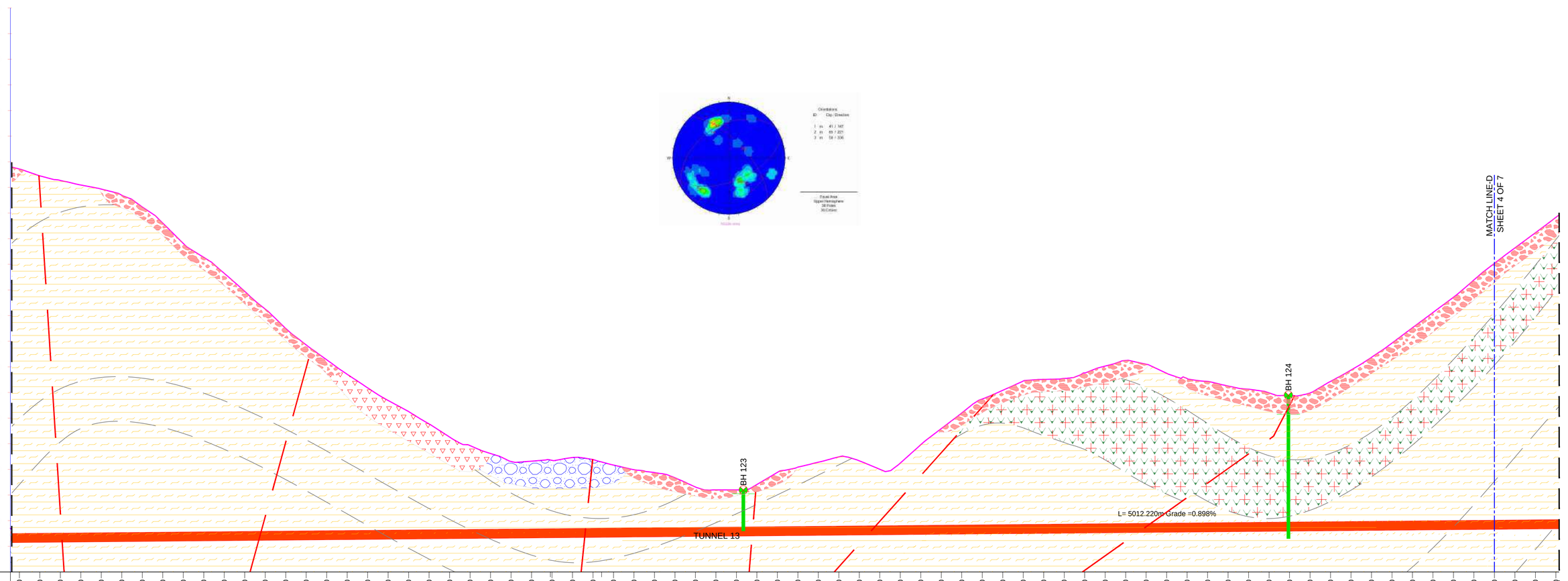
Title:

TUNNEL-13
GEOLOGICAL LONGITUDINAL SECTION PROFILE
(SHEET 2 OF 7)

Drawing No. ACM-60598728-PKG7B-GT-0052 | Scale 1:2000 | Rev. 1


MATCH LINE-C
SHEET 4 OF 7
ADIT JUNCTION LOCATION
L= 3345.130m Grade =-0.736%
L= 5012.220m Grade =0.898%
TUNNEL 13
DATUM 650 m

| | | |



CHAINAGE	95+660 95+680 95+700 95+720 95+740 95+760 95+780 95+800 95+820 95+840 95+860 95+880 95+900 95+920 95+940 95+960 95+980 96+000 96+020 96+040 96+060 96+080 96+100 96+120 96+140 96+160 96+180 96+200 96+220 96+240 96+260 96+280 96+300 96+320 96+340 96+360 96+380 96+400 96+420 96+440 96+460 96+480 96+500 96+520 96+540 96+560 96+580 96+600 96+620 96+640 96+660 96+680 96+700 96+720 96+740 96+760 96+780 96+800 96+820 96+840 96+860 96+880 96+900 96+920 96+940 96+960 96+980 97+000 97+020 97+040 97+060 97+080 97+100 97+120 97+140 97+160
PROPOSED RAIL LEVELS	680.784 680.963 681.143 681.322 681.502 681.681 681.861 682.040 682.220 682.399 682.579 682.759 682.938 683.118 683.297 683.477 683.656 683.836 684.015 684.195 684.374 684.554 684.733 684.913 685.092 685.272 685.451 685.631 685.810 685.990 686.169 686.349 686.529 686.708 686.888 687.067 687.247 687.426 687.606 687.785 687.965 688.144 688.324 688.503 688.683 688.862 689.042 689.221 689.401 689.580 689.760 689.939 690.119 690.299 690.478 690.658 690.837 691.017 691.196 691.376 691.555 691.735 691.914 692.094 692.273 692.453 692.632 692.812 692.991 693.171 693.350 693.530 693.709 693.889 694.069 694.248
GROUND LEVELS	1042.937 1036.252 1031.753 1027.332 1023.359 1017.337 1005.866 990.175 970.346 956.761 941.226 923.604 906.318 887.434 871.418 856.898 842.786 829.519 817.232 806.393 794.304 781.568 773.177 765.485 757.739 758.031 758.821 761.586 759.623 754.209 749.695 746.861 741.830 732.848 730.000 730.000 735.251 747.079 752.180 757.038 762.218 758.344 750.110 756.149 774.068 789.744 805.012 818.605 827.120 836.126 837.745 838.716 844.087 850.728 856.163 852.550 843.708 838.564 835.784 831.314 828.180 824.606 822.428 824.514 835.820 846.842 859.247 873.168 888.118 902.985 917.864 934.737 950.911 965.959 980.736 995.739
Group	Garhwal Group
Formation	Nagnithak Formation
Lithology	Grey to Whitish Colored Quartzite
Potential Geological Hazards — Faults	
Potential Geological Hazards — Tectonically Disturbed Zones	
Water Inflow	Damp to Dripping | Damp | Damp to Dripping | Damp | Damp to Dripping | Dry to Damp | Damp to Dripping | Damp to Dripping
Ground Type (GT)	GT - 3 & GT-7 | GT - 2 & GT - 3 | GT - 3 & GT -7 | GT - 2 & GT - 3 | GT - 3 & GT - 7 | GT - 2 & GT - 3 | GT - 3 & GT - 7
Behavior Type (BT) ὸ Norm	B3, C2, C3 & C4 | B2 & C4 | B2 & C4 | B2 & B3 | B2 & C4 | B1 & B2 | C2, C3 & C4
Rock Mass Classification — RMR	25 - 35 | 35 - 50 | 25 - 35 | 35 - 50 | 25 - 35 | 35 - 50 | 25 - 35
Rock Mass Classification — GSI	20 - 30 | 30 - 45 | 20 - 30 | 30 - 45 | 20 - 30 | 30 - 45 | 20 - 30
Rock Mass Classification — Rock Class	IV | III - IV | IV | III - IV | IV | III - IV | IV
Anticipated Distribution of Support Classes	C2 & C3 | B2 | B2 | B2 | B2 | B1 & B2 | C2 & C3

NOTE :~

1. THE GEOLOGICAL SECTION ALONG THE TUNNEL ALIGNMENT HAS BEEN PREPARED BASED ON GEOLOGICAL PLAN FIELD EXCURSION.
2. FOR ALL OTHERS NOTE REFER DRAWING NO. ACM-60598728-PKG7B-GT-031

LEGENDS :

- Colluvium or surficial material
- Terrace Material
- Nalah Borne material
- Slide material
- Quartzite
- Metabasic rock
- Sheared/Fractured Metabasic rock
- Phyllites
- Dolomites

OTHER SYMBOLS :

- Fault
- Lithological Contact
- Bore Holes

Structural Domain	Group	Formation	Age
Outer lesser Himalaya	Jaunsar	Chandpur formation	Neo-Proterozoic
Inner lesser Himalaya	Garhwal	Epidiorite, Anphibolite and Metavolcanic	Meso-Proterozoic
		Nagnithank formation	

Stratigraphy Along the Project Area (Source GSI)

GT - 1 Thickly Foliated Massive Quartzites

GT - 2 Thinly foliated /fractured Quartzites

GT - 3 Intensely fractured and crushed Quartzite

GT - 4 Massive Metabasic rocks

GT-5 Crushed and fractured Metabasic rocks

GT - 6 Thinly bedded Dolomites

GT-7 Crushed and Faulted rock mass

GT - 8 Colluvium or Surficial Materials

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

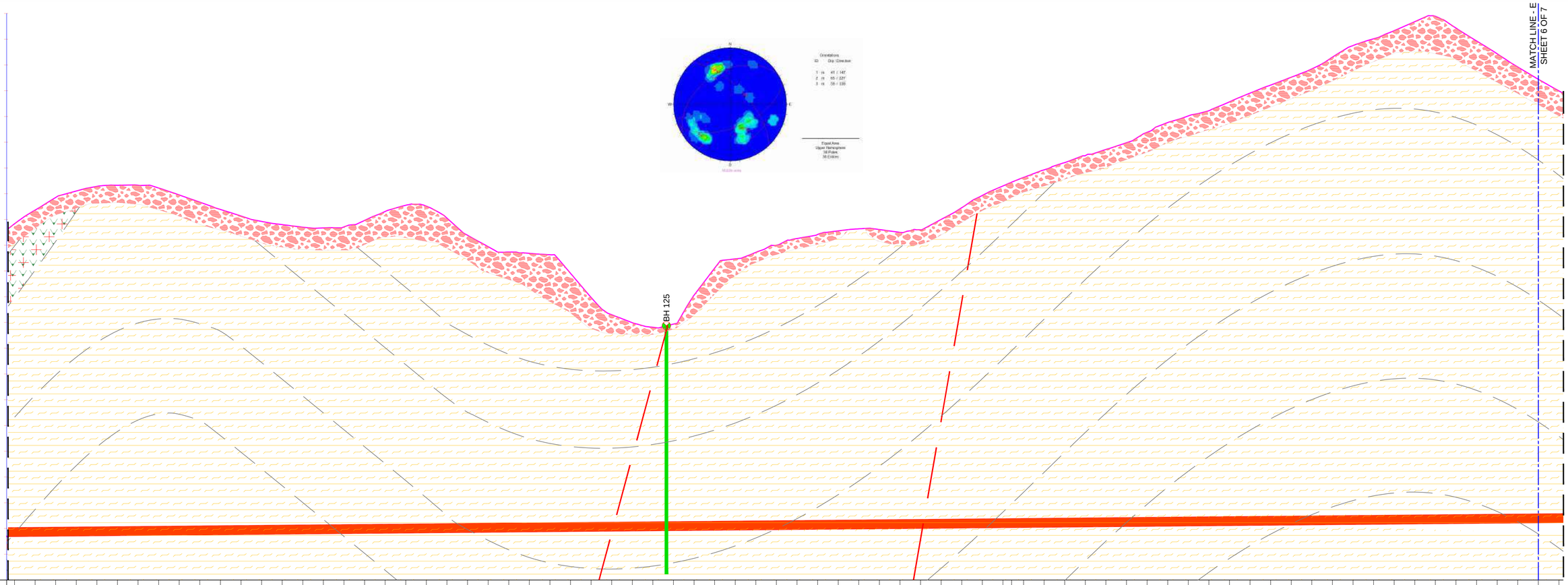
RVNL Rail Vikas Nigam Limited | AECOM

Debasis Bag	Om Dixit	Sami K	John Celentano
Drawn	Designed	Verified	Approved

Title:

TUNNEL-13
GEOLOGICAL LONGITUDINAL SECTION PROFILE
(SHEET 4 OF 7)

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-GT-0054	1:2000	1



CHAINAGE	97+160 … 98+660 (every 20 m)
PROPOSED RAIL LEVELS	694.248, 694.428, 694.607, 694.787, 694.966, 695.146, 695.325, 695.505, 695.684, 695.864, 696.043, 696.223, 696.402, 696.582, 696.761, 696.941, 697.120, 697.300, 697.479, 697.659, 697.839, 698.018, 698.198, 698.377, 698.557, 698.736, 698.916, 699.095, 699.275, 699.454, 699.634, 699.813, 699.993, 700.172, 700.352, 700.531, 700.711, 700.890, 701.070, 701.250, 701.429, 701.609, 701.788, 701.968, 702.147, 702.327, 702.506, 702.686, 702.865, 703.045, 703.224, 703.404, 703.583, 703.763, 703.942, 704.122, 704.301, 704.481, 704.660, 704.840, 705.020, 705.199, 705.379, 705.558, 705.738, 705.917, 706.097, 706.276, 706.456, 706.635, 706.815, 706.994, 707.174, 707.353, 707.533, 707.712
GROUND LEVELS	995.739, 1009.056, 1021.359, 1027.592, 1032.088, 1033.168, 1033.175, 1030.498, 1023.755, 1016.761, 1009.691, 1003.360, 998.090, 994.965, 992.447, 991.796, 992.718, 999.060, 1007.757, 1013.793, 1012.858, 1001.265, 984.609, 973.559, 968.366, 967.098, 965.728, 947.708, 924.217, 907.469, 899.775, 895.319, 898.447, 926.470, 952.750, 961.707, 968.027, 974.980, 981.476, 985.379, 988.893, 990.899, 990.196, 987.429, 990.000, 1000.003, 1011.420, 1023.305, 1032.518, 1040.763, 1048.167, 1055.234, 1062.002, 1067.911, 1074.465, 1084.565, 1094.057, 1100.491, 1105.550, 1114.135, 1122.674, 1130.430, 1138.056, 1146.151, 1157.526, 1168.828, 1175.367, 1183.225, 1192.029, 1197.168, 1185.802, 1173.297, 1160.873, 1148.019, 1136.082, 1124.778
Group	Garhwal Group
Formation	Nagnithak Formation
Lithology	Grey to Whitish Colored Quartzite
Potential Geological Hazards — Faults	
Potential Geological Hazards — Tectonically Disturbed Zones	
Water Inflow	Dry to Damp | Damp to Dripping | Dry to Damp
Ground Type (GT)	GT - 1 & GT - 2 | GT - 3 & GT - 7 | GT - 1 & GT - 2
Behavior Type (BT) ö Norm	B1 & B2 | C2, C3 & C4 | A2, B2 & C1
Rock Mass Classification — RMR	50 - 70 | 25 - 35 | 50 - 70
Rock Mass Classification — GSI	45 - 65 | 20 - 30 | 45 - 65
Rock Mass Classification — Rock Class	II - III | IV | II - III
Anticipated Distribution of Support Classes	B1 & B2 | C2 & C3 | B2 & C1

NOTE :~

1. THE GEOLOGICAL SECTION ALONG THE TUNNEL ALIGNMENT HAS BEEN PREPARED BASED ON GEOLOGICAL PLAN FIELD EXCURSION.
2. FOR ALL OTHERS NOTE REFER DRAWING NO. ACM-60598728-PKG7B-GT-031

LEGENDS :

- Colluvium or surficial material
- Terrace Material
- Nalah Borne material
- Slide material
- Quartzite
- Metabasic rock
- Sheared/Fractured Metabasic rock
- Phyllites
- Dolomites

OTHER SYMBOLS :

- Fault
- Lithological Contact
- Bore Holes

Structural Domain	Group	Formation	Age
Outer lesser Himalaya	Jaunsar	Chandpur formation	Neo-Proterozoic
Inner lesser Himalaya	Garhwal	Epidiorite, Anphibolite and Metavolcanic	Meso-Proterozoic
		Nagnithank formation	

Stratigraphy Along the Project Area (Source GSI)

GT - 1 Thickly Foliated Massive Quartzites

GT - 2 Thinly foliated /fractured Quartzites

GT - 3 Intensely fractured and crushed Quartzite

GT - 4 Massive Metabasic rocks

GT-5 Crushed and fractured Metabasic rocks

GT - 6 Thinly bedded Dolomites

GT-7 Crushed and Faulted rock mass

GT - 8 Colluvium or Surficial Materials

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited गुणवत्ता, गति एवं पारदर्शिता (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

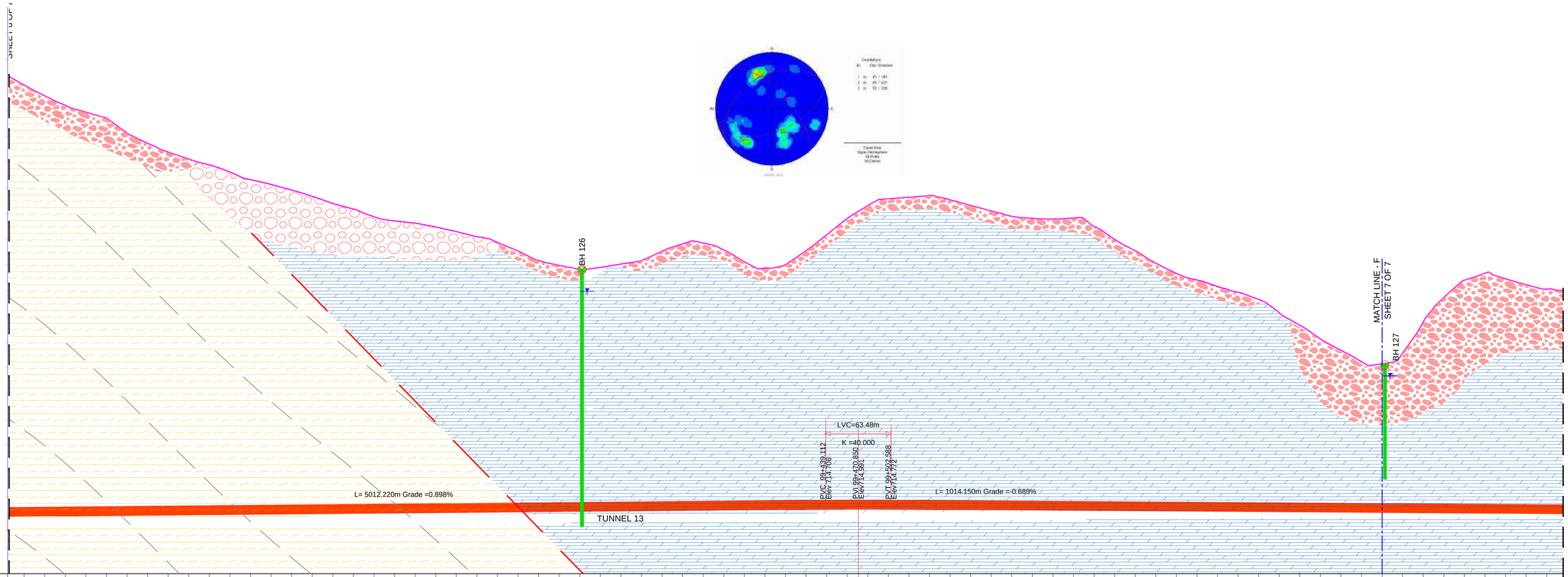
RVNL Rail Vikas Nigam Limited | AECOM

Debasis Bag	Om Dixit	Sami K	John Celentano
Drawn	Designed	Verified	Approved

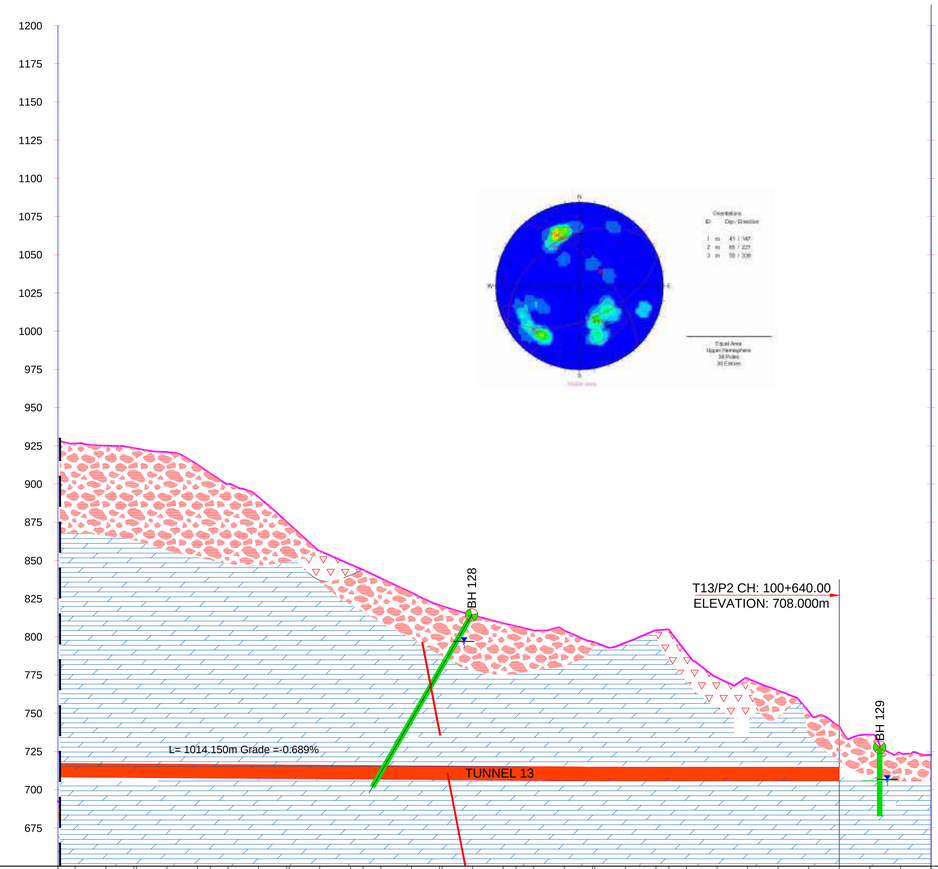
Title:

TUNNEL-13
GEOLOGICAL LONGITUDINAL SECTION PROFILE
(SHEET 5 OF 7)

Drawing No. ACM-60598728-PKG7B-GT-0055 | Scale 1:2000 | Rev. 1


SHEET 5 OF 7
BH 126
BH 127
MATCH LINE - F
SHEET 7 OF 7
LVC=63.48m
K =40.000
PVC 99+439.112
Elev 714.706
PVI 99+470.850
Elev 714.991
PVT 99+502.588
Elev 714.722
L= 5012.220m Grade =0.898%
L= 1014.150m Grade =-0.689%
TUNNEL 13
DATUM 650 m

| | | |



CHAINAGE	100+140	100+160	100+180	100+200	100+220	100+240	100+260	100+280	100+300	100+320	100+340	100+360	100+380	100+400	100+420	100+440	100+460	100+480	100+500	100+520	100+540	100+560	100+580	100+600	100+620	100+640	100+660	100+680	100+700
PROPOSED RAIL LEVELS	710.378	710.240	710.103	709.965	709.827	709.689	709.551	709.413	709.275	709.138	709.000	708.862	708.724	708.586	708.448	708.310	708.173	708.044	708.000	708.000	708.000	708.000	708.000	708.000	708.000	708.000	708.000	708.000	708.000
GROUND LEVELS	926.518	925.071	923.217	920.817	912.737	900.000	891.355	873.835	856.171	847.456	838.317	828.963	820.170	814.194	808.959	804.244	804.174	796.281	796.153	804.241	789.684	773.342	772.682	764.770	751.013	741.052	736.000	723.974	722.639

Group	Garhwal Group			
Formation	Pithoragarh Formation			
Lithology	Grey to Dark Colored Dolomites			
Potential Geological Hazards: Faults				
Potential Geological Hazards: Tectonically Disturbed Zones				
Potential Geological Hazards: Water Inflow		Damp to Dripping	Damp	
Ground Type (GT)		GT - 6 & GT- 7	GT - 6 & GT- 8	
Behavior Type (BT) ŏ Norm		B2	B2 & B3	
Rock Mass Classification: RMR		25 - 30	10 - 30	
Rock Mass Classification: GSI		20 - 25	05 - 25	
Rock Class		IV	IV - V	
Anticipated Distribution of Support Classes		B2	B2 & P	

NOTE :~

1. THE GEOLOGICAL SECTION ALONG THE TUNNEL ALIGNMENT HAS BEEN PREPARED BASED ON GEOLOGICAL PLAN FIELD EXCURSION.
2. FOR ALL OTHERS NOTE REFER DRAWING NO. ACM-60598728-PKG7B-GT-031

LEGENDS :

- Colluvium or surficial material
- Terrace Material
- Nalah Borne material
- Slide material
- Quartzite
- Metabasic rock
- Sheared/Fractured Metabasic rock
- Phyllites
- Dolomites

OTHER SYMBOLS :

- Fault
- Lithological Contact
- Bore Holes

Structural Domain	Group	Formation	Age
Outer lesser Himalaya	Jaunsar	Chandpur formation	Neo-Proterozoic
Inner lesser Himalaya	Garhwal	Epidiorite, Amphibolite and Metavolcanic	Meso-Proterozoic
		Nagnithank formation	

Stratigraphy Along the Project Area (Source GSI)

GT - 1 Thickly Foliated Massive Quartzites

GT - 2 Thinly foliated /fractured Quartzites

GT - 3 Intensely fractured and crushed Quartzite

GT - 4 Massive Metabasic rocks

GT-5 Crushed and fractured Metabasic rocks

GT - 6 Thinly bedded Dolomites

GT-7 Crushed and Faulted rock mass

GT - 8 Colluvium or Surficial Materials

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited गुणवत्ता, गति एवं पारदर्शिता (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited | AECOM

Debasis Bag	Om Dixit	Sami K	John Celentano
Drawn	Designed	Verified	Approved

Title:

TUNNEL-13
GEOLOGICAL LONGITUDINAL SECTION PROFILE
(SHEET 7 OF 7)

Drawing No. ACM-60598728-PKG7B-GT-0057 | Scale 1:2000 | Rev. 1

Appendix-2

Behaviour type calculation

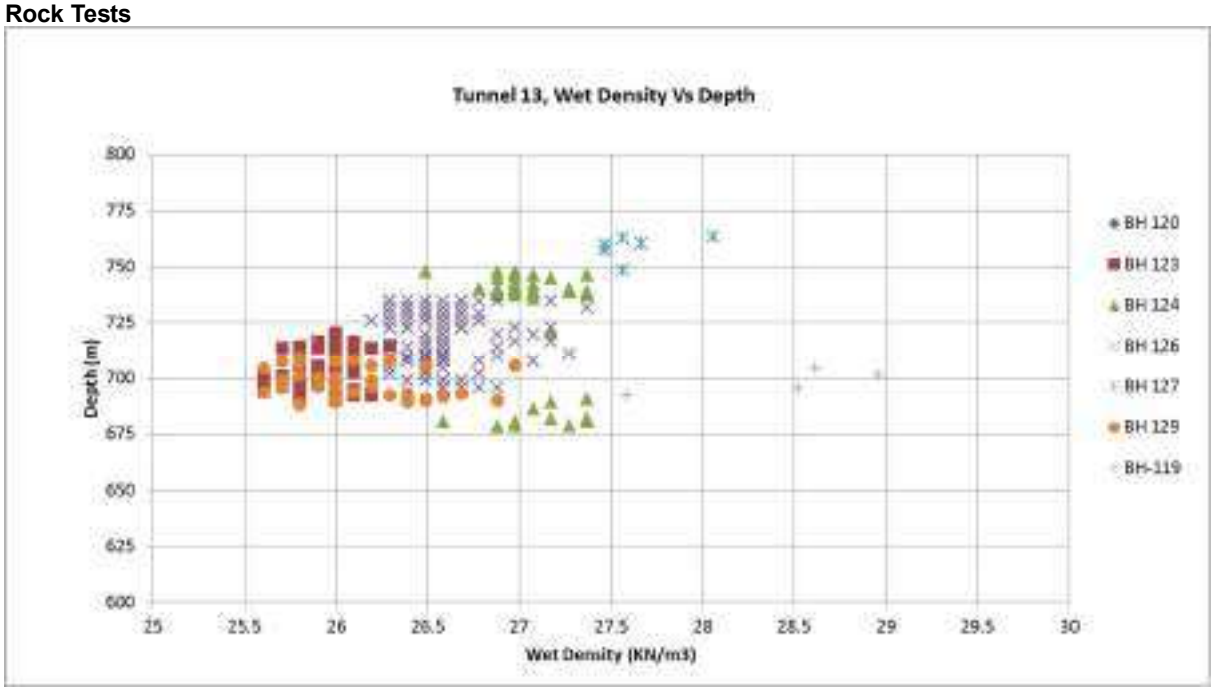
Start	End	Length	Rock Type	Ground Type	Overburden (m)	UCS	ICE	Stress Behaviour	Behaviour Type (ONORM)
				GT		Mpa			
91190	91202	12	Colluvium or surficial materials	GT8	26	0			B2,B3,C4
91202	91302	100	Massive metabasic rocks	GT4	56	60	69.98	MODERATE	B1
91302	91402	100	Metabasic rocks	GT5	112	40	18.81	INTENSIVE	B1
91402	91642	240	Massive metabasic rocks	GT4	228	60	31.90	INTENSIVE	B1
91642	91700	58	Metabasic rocks	GT5	147	40	14.33	MOSTLY YIELDING	B2
91700	92057	357	Metabasic rocks	GT5	249	40	8.46	MOSTLY YIELDING	B2
92057	92210	153	Crushed and faulted rock mass	GT7	359	25	2.42	MOSTLY YIELDING	C3,C4
92210	92540	330	Massive metabasic rocks	GT4	347	60	20.96	INTENSIVE	B1
92540	92548	8	Metabasic rocks	GT5	369	40	5.71	MOSTLY YIELDING	B2
92548	92588	40	Intensely fractured and crushed quartzites	GT3	369	25	3.57	MOSTLY YIELDING	C2,C4
92588	92620	32	Crushed and faulted rock mass	GT7	369	25	2.35	MOSTLY YIELDING	C3,C4
92620	93100	480	Thickly foliated quartzites	GT1	439	65	33.53	INTENSIVE	A2
93100	93340	240	Thinly foilated/ fractured Quartzites	GT2	328	50	15.00	INTENSIVE	B2
93340	93420	80	Intensely fractured and crushed quartzites	GT3	438	25	3.01	MOSTLY YIELDING	C2,C4
93420	93534	114	Thinly foilated/ fractured Quartzites	GT2	296	50	16.62	INTENSIVE	B2
93534	93648	114	Intensely fractured and crushed quartzites	GT3	265	25	4.97	MOSTLY YIELDING	C2,C4
93648	93800	152	Crushed and faulted rock mass	GT7	361	25	2.09	MOSTLY YIELDING	C3,C4
93800	94064	264	Thickly foliated quartzites	GT1	512	65	25.02	INTENSIVE	A2,C1
94064	94196	132	Thinly foilated/ fractured Quartzites	GT2	384	50	11.15	MOSTLY YIELDING	B2
94196	94240	44	Intensely fractured and crushed quartzites	GT3	384	25	2.99	MOSTLY YIELDING	B3,C2
94240	94300	60	Intensely fractured and crushed quartzites	GT3	444	25	2.58	MOSTLY YIELDING	C2,C4
94300	94340	40	Crushed and faulted rock mass	GT7	444	25	1.70	MOSTLY YIELDING	C3,C4
94340	94571	231	Thickly foliated quartzites	GT1	527	65	24.31	INTENSIVE	A2,C1
94571	94686.5	115.5	Thinly foilated/ fractured Quartzites	GT2	527	50	8.13	MOSTLY YIELDING	B2
94686.5	94725	38.5	Intensely fractured and crushed quartzites	GT3	527	25	2.18	MOSTLY YIELDING	C3,C4
94725	94772.5	47.5	Intensely fractured and crushed quartzites	GT3	483	25	2.37	MOSTLY YIELDING	C3,C4
94772.5	94820	47.5	Crushed and faulted rock mass	GT7	483	25	1.56	MOSTLY YIELDING	C3,C4
94820	95348.5	528.5	Thickly foliated quartzites	GT1	467	65	27.44	INTENSIVE	A2,C1
95348.5	95575	226.5	Thinly foilated/ fractured Quartzites	GT2	467	50	9.17	MOSTLY YIELDING	B2
95575	95752	177	Intensely fractured and crushed quartzites	GT3	286	25	4.01	MOSTLY YIELDING	C2,B3
95752	95870	118	Crushed and faulted rock mass	GT7	360	25	2.10	MOSTLY YIELDING	C3,C4
95870	96013.5	143.5	Thinly foilated/ fractured Quartzites	GT2	165	50	25.96	INTENSIVE	B2

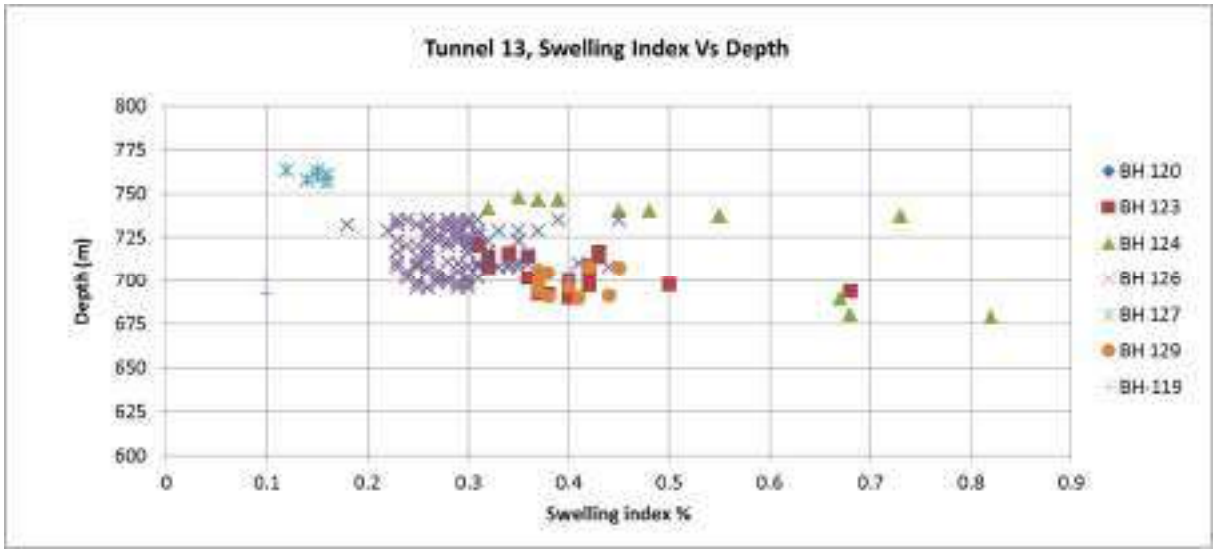
Start	End	Length	Rock Type	Ground Type	Overburden (m)	UCS	ICE	Stress Behaviour	Behaviour Type (ONORM)
				GT		Mpa			
96013.5	96075	61.5	Intensely fractured and crushed quartzites	GT3	83	25	13.81	MOSTLY YIELDING	B2,C4
96075	96229	154	Intensely fractured and crushed quartzites	GT3	81	25	14.15	MOSTLY YIELDING	B2,C4
96229	96460	231	Crushed and faulted rock mass	GT7	81	25	9.33	MOSTLY YIELDING	B2,C4
96460	96604	144	Thinly foilated/ fractured Quartzites	GT2	155	50	27.63	INTENSIVE	B2
96604	96640	36	Intensely fractured and crushed quartzites	GT3	155	25	7.40	MOSTLY YIELDING	B2,B3
96640	96706	66	Intensely fractured and crushed quartzites	GT3	161	25	7.12	MOSTLY YIELDING	B2,B3
96706	96750	44	Crushed and faulted rock mass	GT7	161	25	4.69	MOSTLY YIELDING	B2,C4
96750	96930	180	Thinly foilated/ fractured Quartzites	GT2	141	50	30.38	INTENSIVE	B1
96930	96975	45	Intensely fractured and crushed quartzites	GT3	209	25	5.48	MOSTLY YIELDING	B2
96975	97045	70	Intensely fractured and crushed quartzites	GT3	286	25	4.01	MOSTLY YIELDING	C2,C4
97045	97075	30	Crushed and faulted rock mass	GT7	286	25	2.64	MOSTLY YIELDING	C3,C4
97075	97511	436	Thickly foliated quartzites	GT1	322	65	39.79	INTENSIVE	B1
97511	97620	109	Thinly foilated/ fractured Quartzites	GT2	322	50	13.30	MOSTLY YIELDING	B2
97620	97893	273	Intensely fractured and crushed quartzites	GT3	318	25	3.60	MOSTLY YIELDING	C2,C4
97893	98010	117	Crushed and faulted rock mass	GT7	298	25	2.54	MOSTLY YIELDING	C3,C4
98010	98717	707	Thickly foliated quartzites	GT1	500	65	25.62	INTENSIVE	A2,C1
98717	99020	303	Thinly foilated/ fractured Quartzites	GT2	284	50	15.08	INTENSIVE	B2
99020	99059	39	Intensely fractured and crushed quartzites	GT3	270	25	4.25	MOSTLY YIELDING	C3,C4
99059	99111	52	Thinly bedded dolomites	GT6	270	50	6.89	MOSTLY YIELDING	C2,C4
99111	99150	39	Crushed and faulted rock mass	GT7	270	25	2.80	MOSTLY YIELDING	C3,C4
99150	99849.1	699.1	Thinly bedded dolomites	GT6	415	50	4.49	MOSTLY YIELDING	C3,C4
99849.1	100330	480.9	Thinly bedded dolomites	GT6	110	50	18.89	INTENSIVE	B2
100330	100330	0	Crushed and faulted rock mass	GT7	110	25	7.67	MOSTLY YIELDING	B2
100330	100480	150	Thinly bedded dolomites	GT6	95	50	21.88	INTENSIVE	B2
100480	100600	120	Colluvium or surficial materials	GT8	31	0			B2,B3

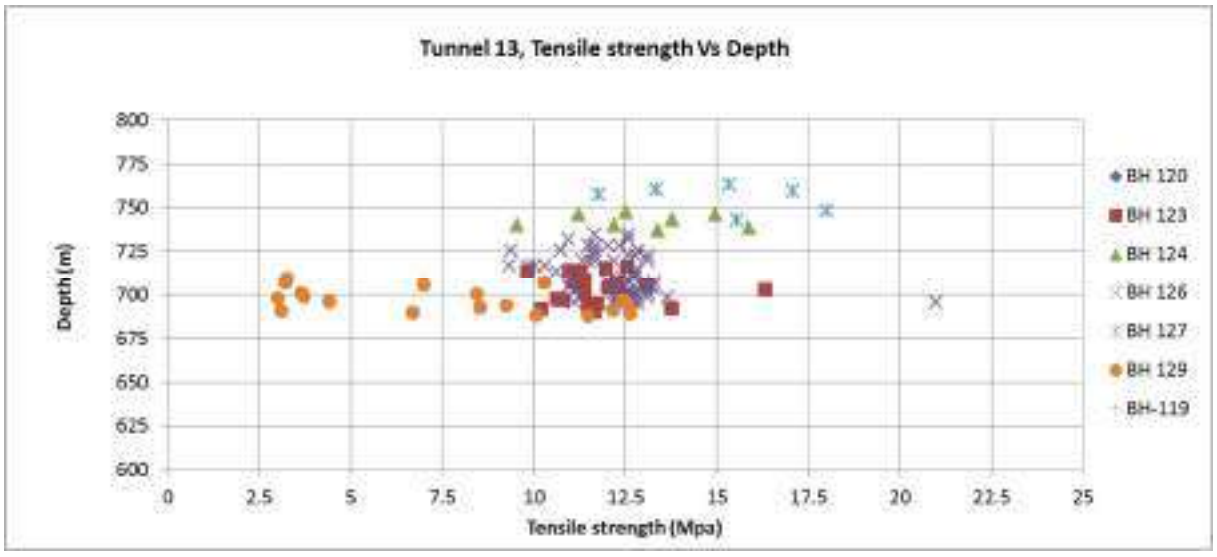
Appendix-3

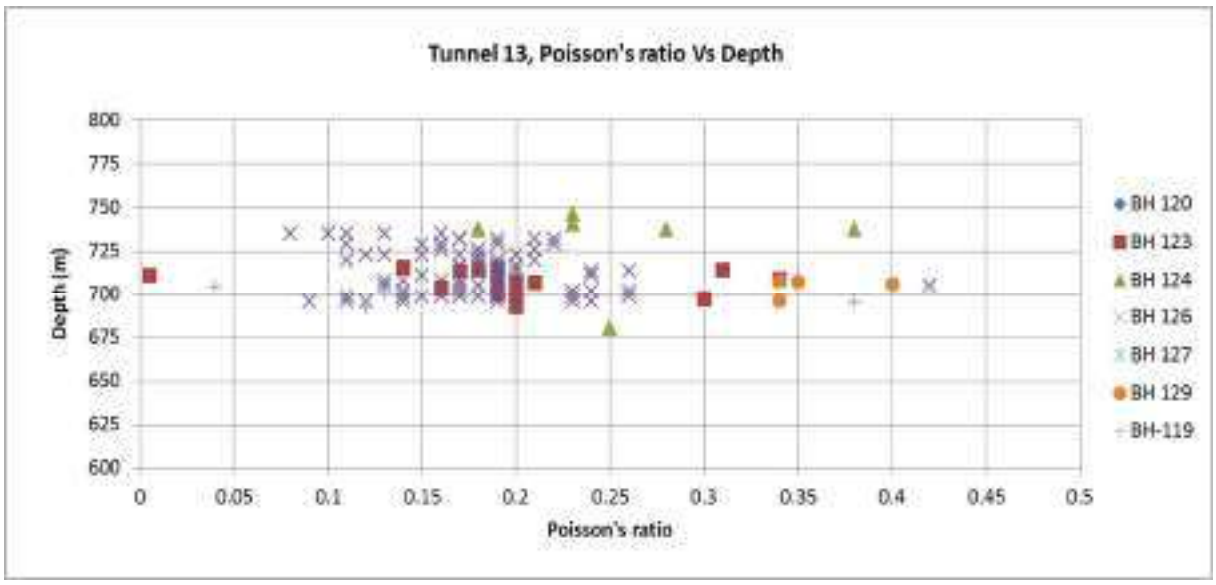
Graphs

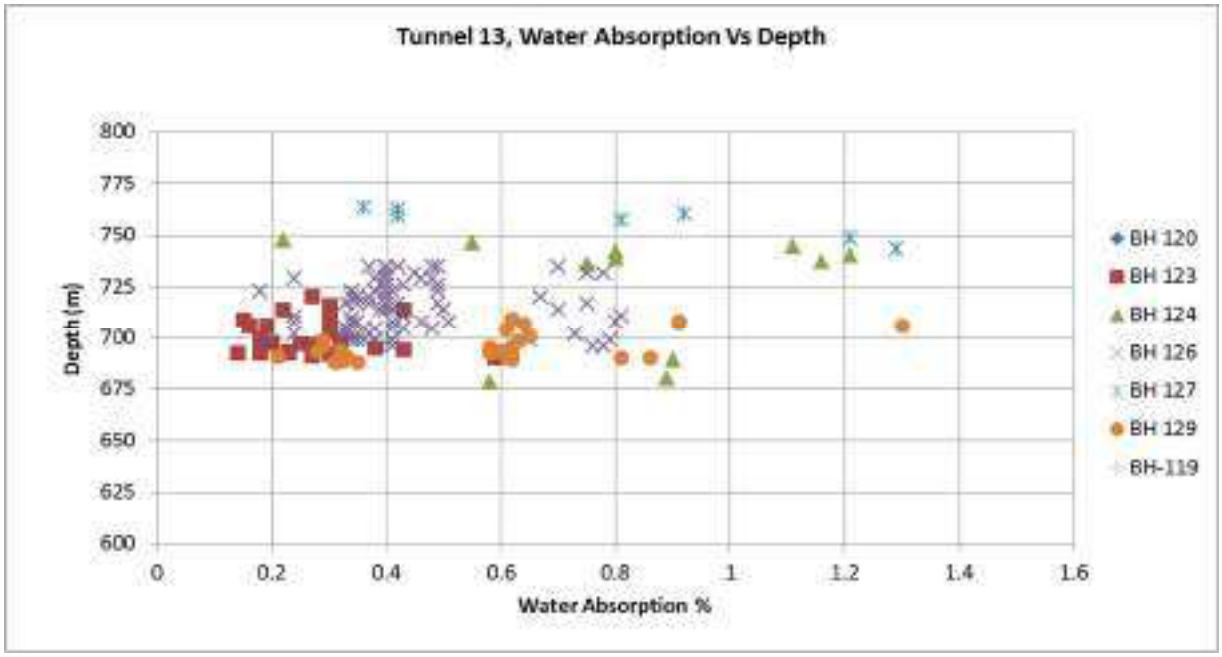
Rock Tests

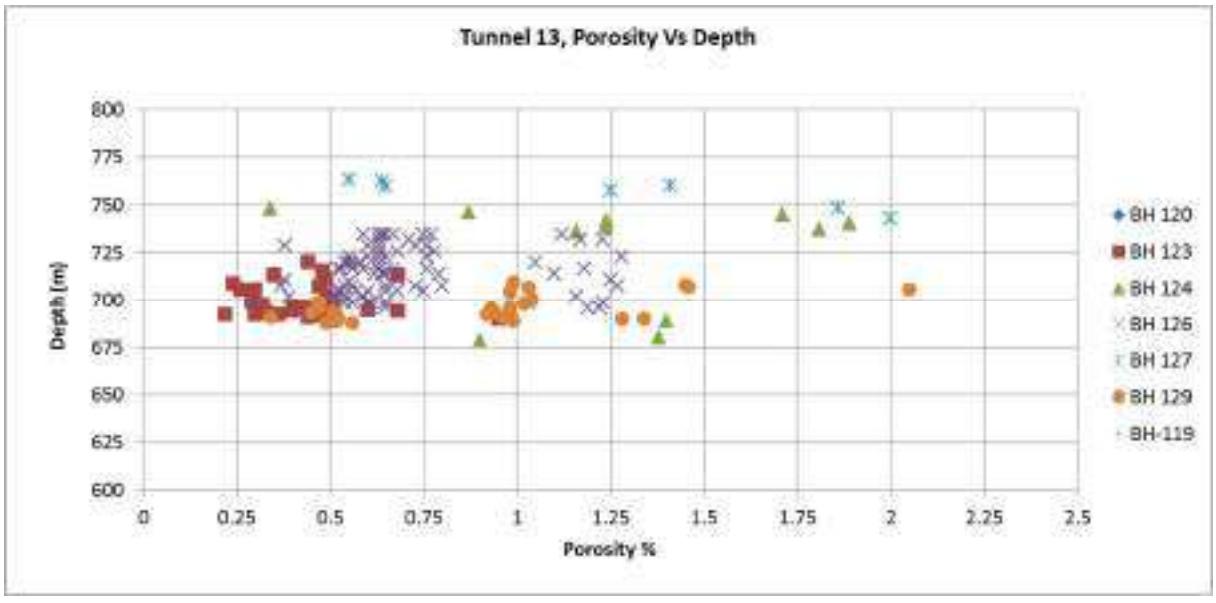

Tunnel 13, Wet Density Vs Depth
Depth (m)
Wet Density (KN/m3)
BH 120
BH 123
BH 124
BH 126
BH 127
BH 129
BH-119

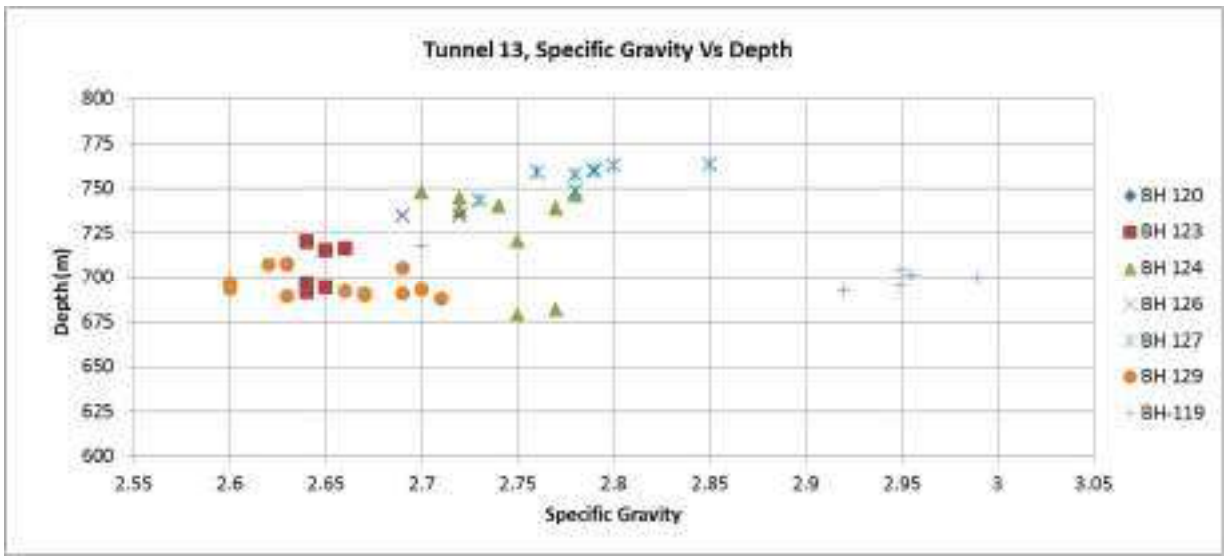

Tunnel 13, Swelling Index Vs Depth
Depth (m)
Swelling index %
BH 120
BH 123
BH 124
BH 126
BH 127
BH 129
BH-119

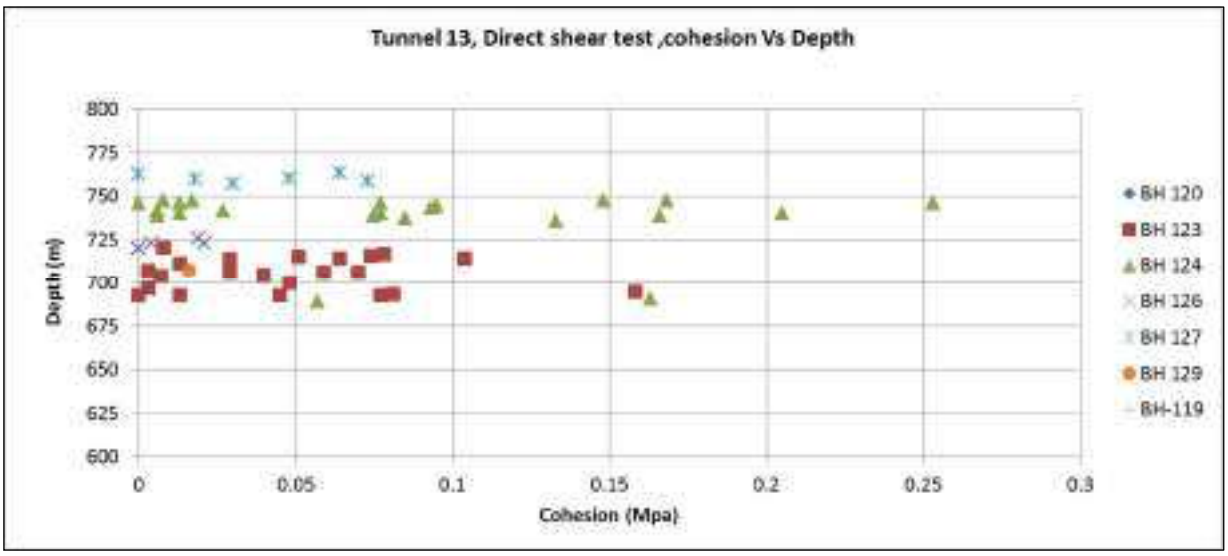

Tunnel 13, Tensile strength Vs Depth
Depth (m)
Tensile strength (Mpa)
BH 120
BH 123
BH 124
BH 126
BH 127
BH 129
BH-119

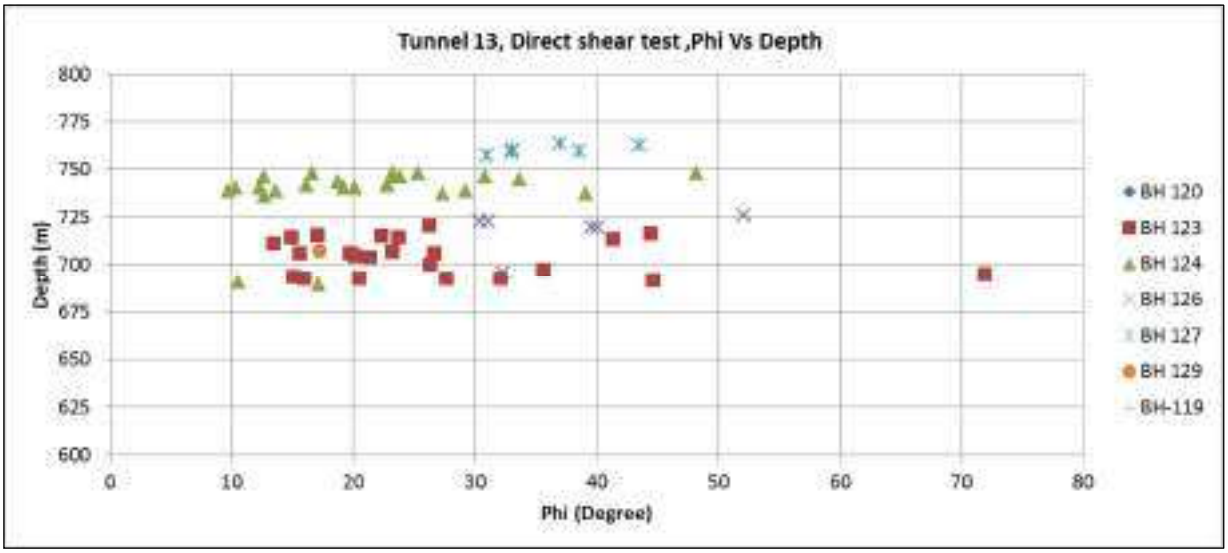

Tunnel 13, Poisson's ratio Vs Depth
Depth (m)
800
775
750
725
700
675
650
625
600
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Poisson's ratio
BH 120
BH 123
BH 124
BH 126
BH 127
BH 129
BH-119

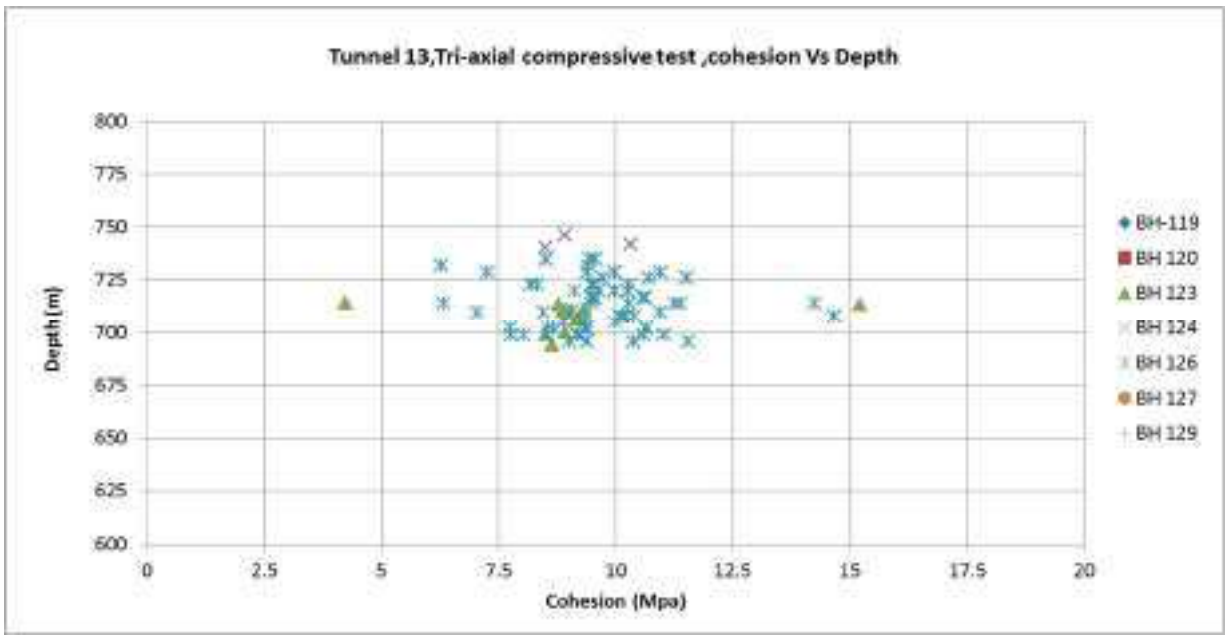

Tunnel 13, Water Absorption Vs Depth
Depth (m)
800
775
750
725
700
675
650
625
600
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
Water Absorption %
BH 120
BH 123
BH 124
BH 126
BH 127
BH 129
BH-119

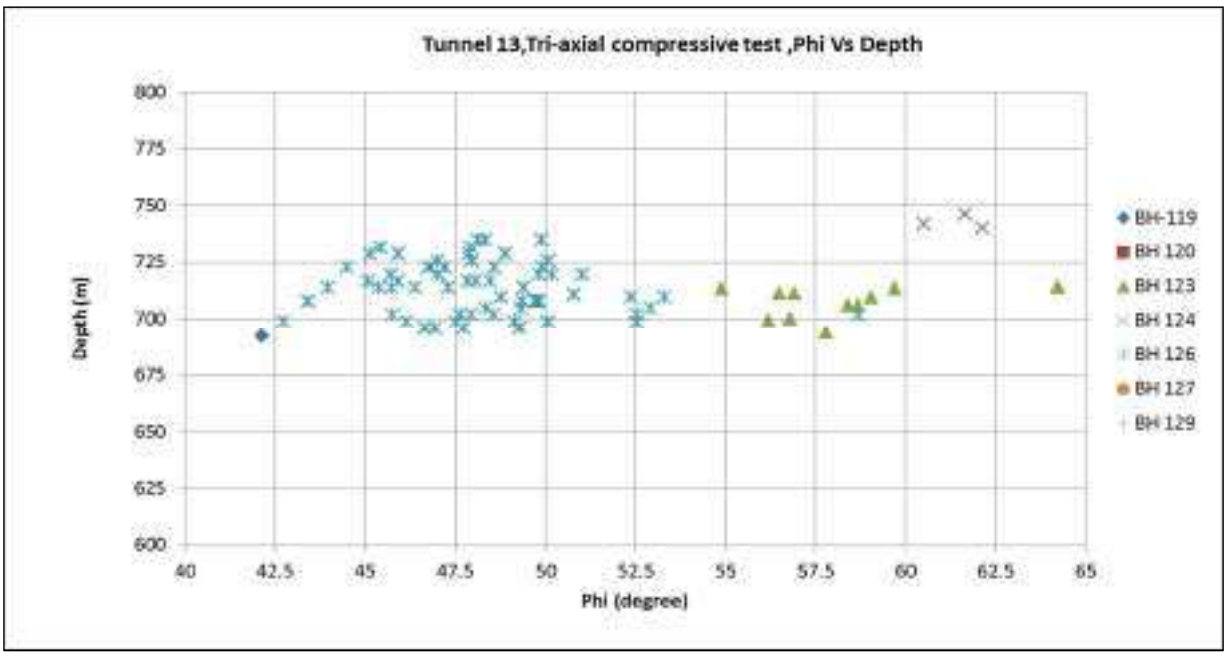

Tunnel 13, Porosity Vs Depth
Depth (m)
800
775
750
725
700
675
650
625
600
0
0.25
0.5
0.75
1
1.25
1.5
1.75
2
2.25
2.5
Porosity %
BH 120
BH 123
BH 124
BH 126
BH 127
BH 129
BH-119

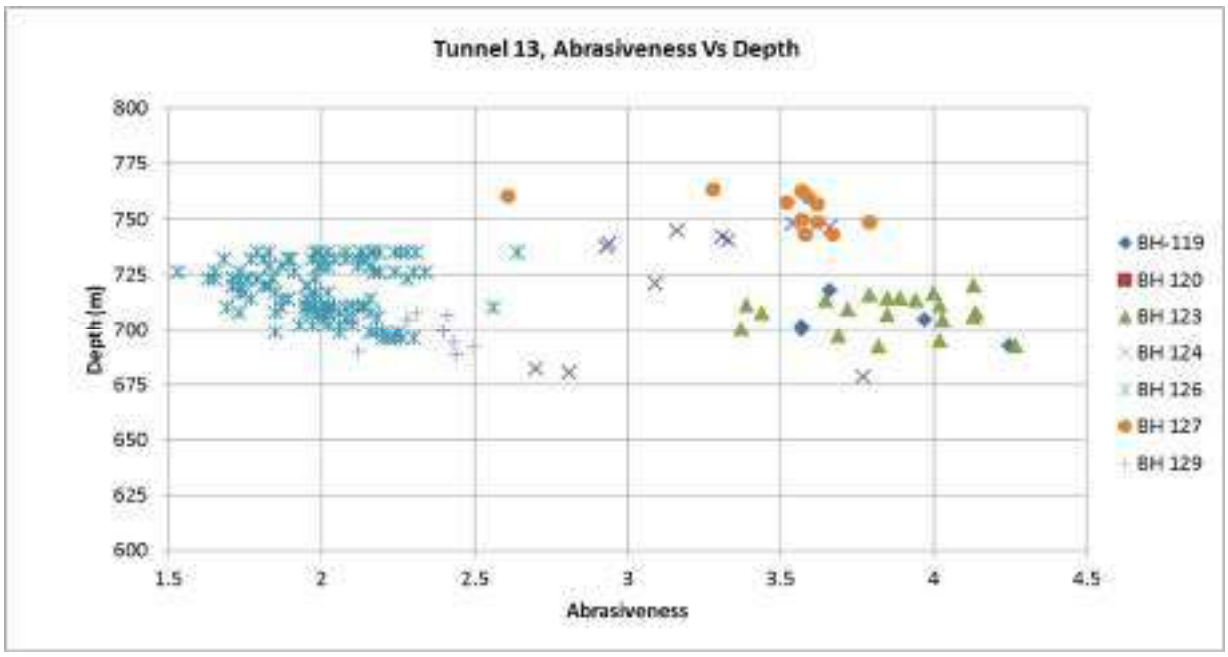

Tunnel 13, Specific Gravity Vs Depth
Depth (m)
800
775
750
725
700
675
650
625
600
2.55
2.6
2.65
2.7
2.75
2.8
2.85
2.9
2.95
3
3.05
Specific Gravity
BH 120
BH 123
BH 124
BH 126
BH 127
BH 129
BH-119

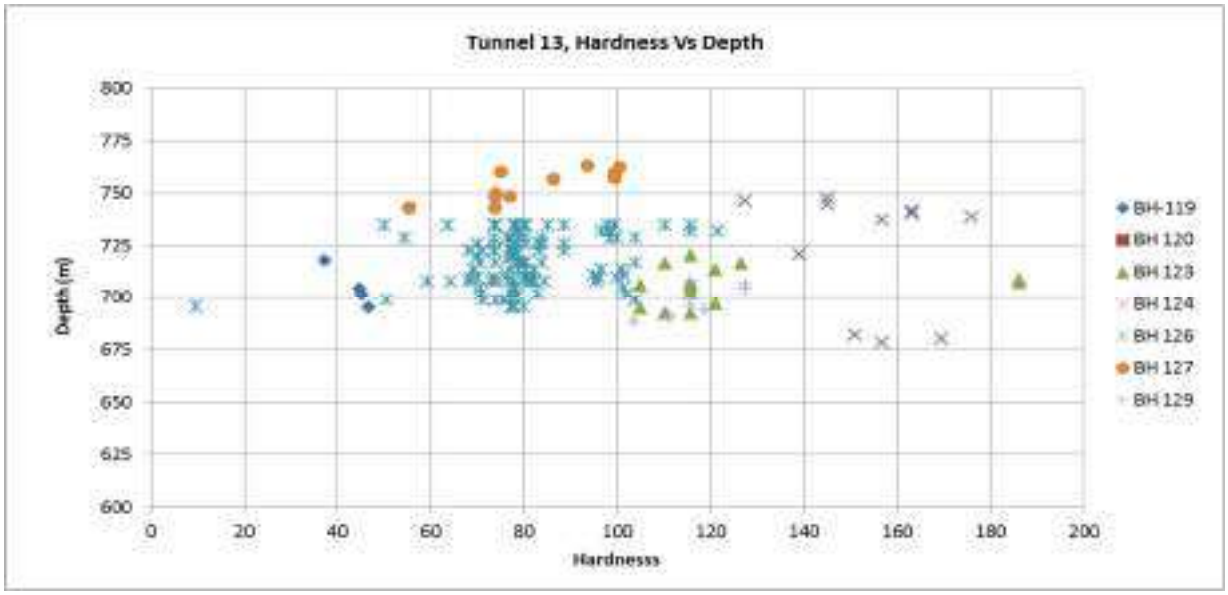

Tunnel 13, Direct shear test ,cohesion Vs Depth
Depth (m)
800
775
750
725
700
675
650
625
600
0
0.05
0.1
0.15
0.2
0.25
0.3
Cohesion (Mpa)
BH 120
BH 123
BH 124
BH 126
BH 127
BH 129
BH-119


Tunnel 13, Direct shear test ,Phi Vs Depth
Depth (m)
800
775
750
725
700
675
650
625
600
0
10
20
30
40
50
60
70
80
Phi (Degree)
BH 120
BH 123
BH 124
BH 126
BH 127
BH 129
BH-119

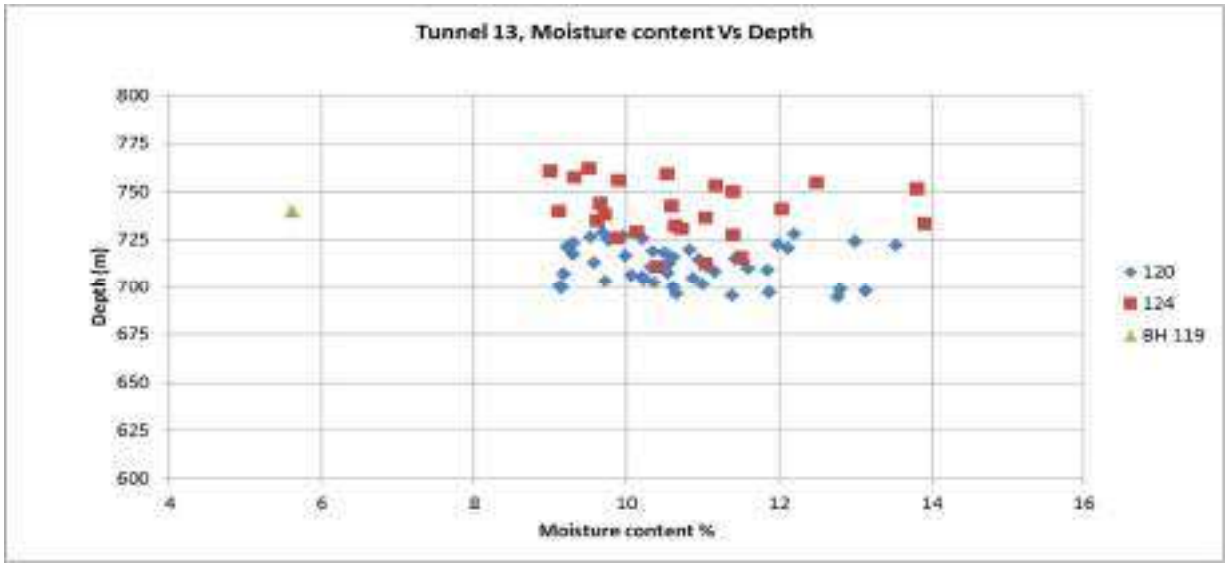

Tunnel 13,Tri-axial compressive test ,cohesion Vs Depth
Depth (m)
800
775
750
725
700
675
650
625
600
0
2.5
5
7.5
10
12.5
15
17.5
20
Cohesion (Mpa)
BH-119
BH 120
BH 123
BH 124
BH 126
BH 127
BH 129

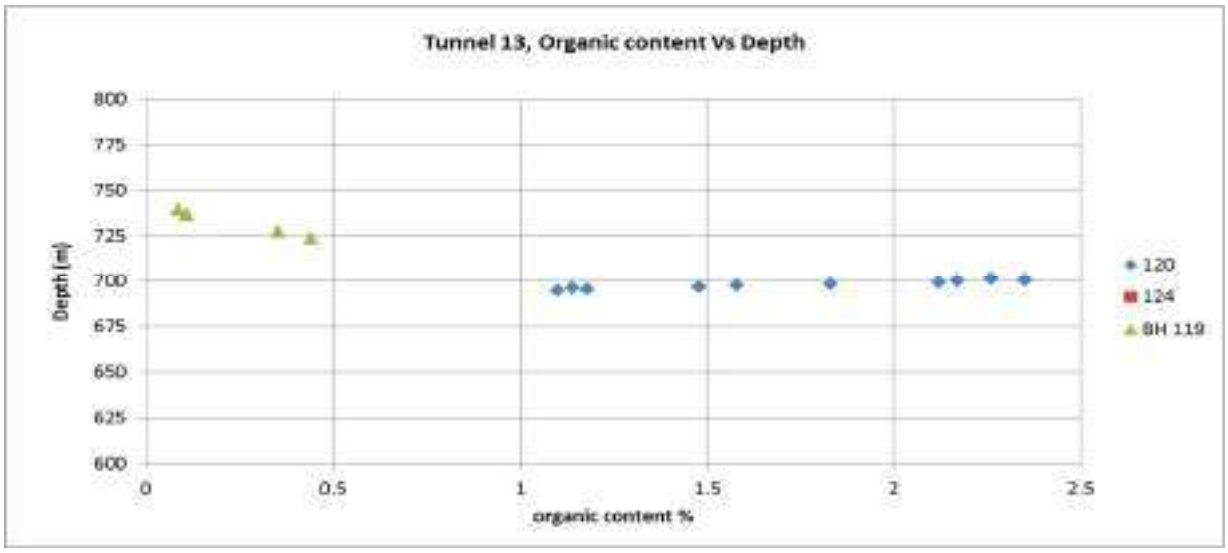

Tunnel 13,Tri-axial compressive test ,Phi Vs Depth
Depth (m)
800
775
750
725
700
675
650
625
600
40
42.5
45
47.5
50
52.5
55
57.5
60
62.5
65
Phi (degree)
BH-119
BH 120
BH 123
BH 124
BH 126
BH 127
BH 129

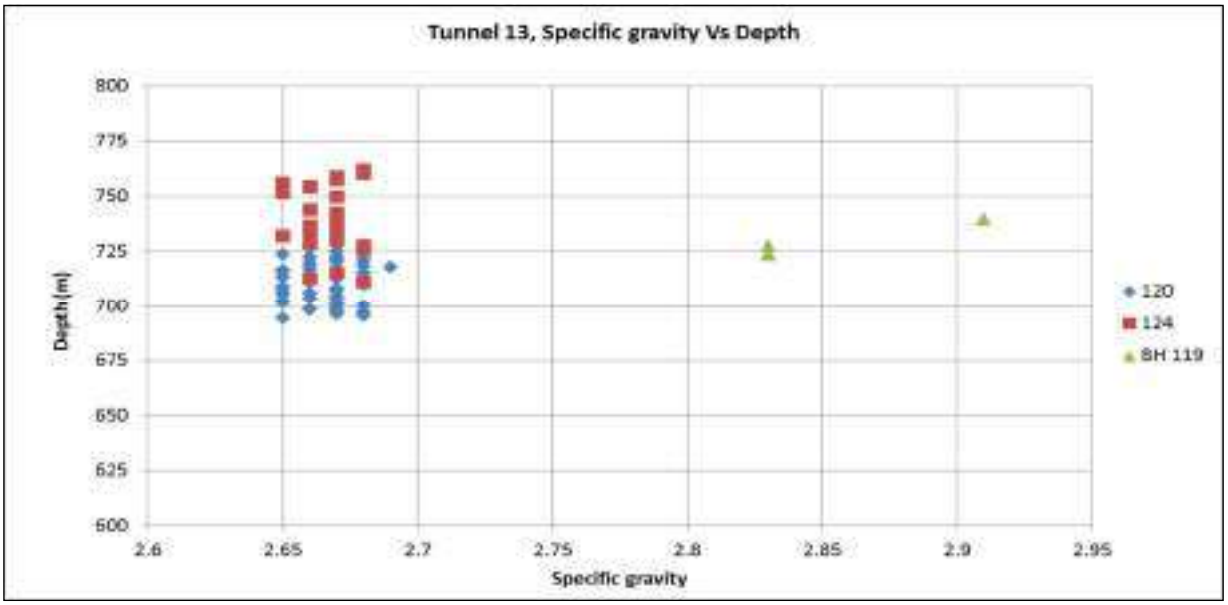

Tunnel 13, Abrasiveness Vs Depth
Depth (m)
800
775
750
725
700
675
650
625
600
1.5
2
2.5
3
3.5
4
4.5
Abrasiveness
BH-119
BH 120
BH 123
BH 124
BH 126
BH 127
BH 129

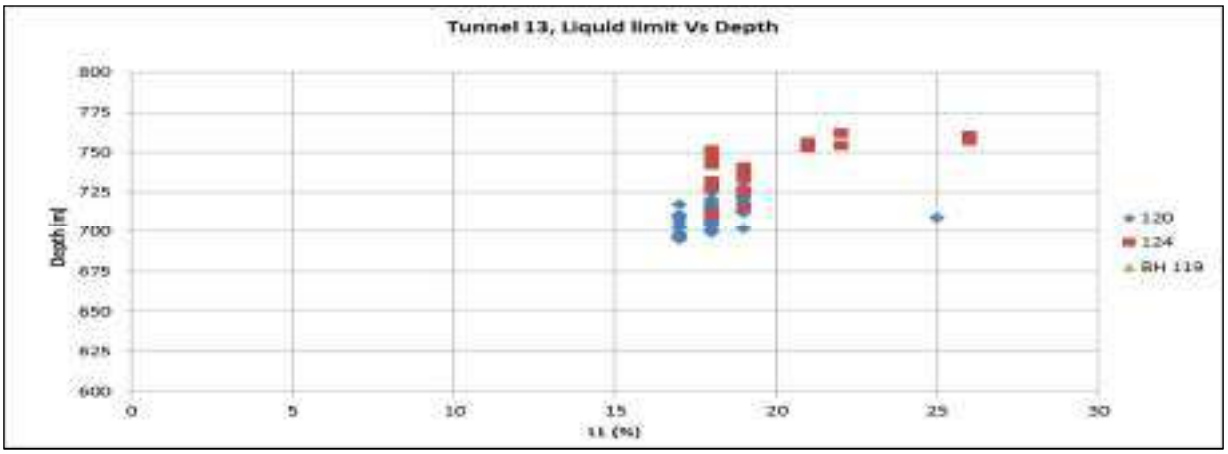

Tunnel 13, Hardness Vs Depth
Depth (m)
800
775
750
725
700
675
650
625
600
0
20
40
60
80
100
120
140
160
180
200
Hardness
BH-119
BH 120
BH 123
BH 124
BH 126
BH 127
BH 129

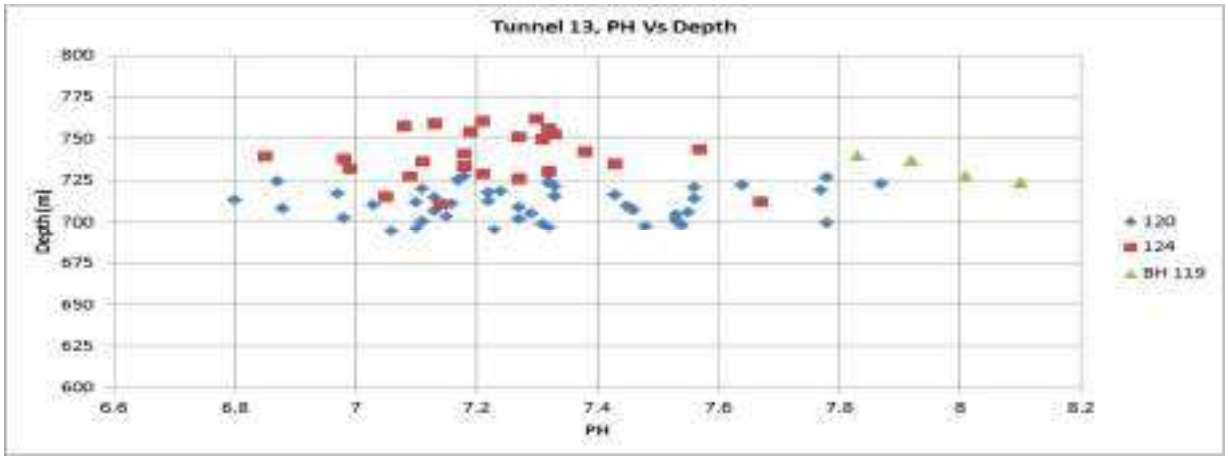
Soil Test Results

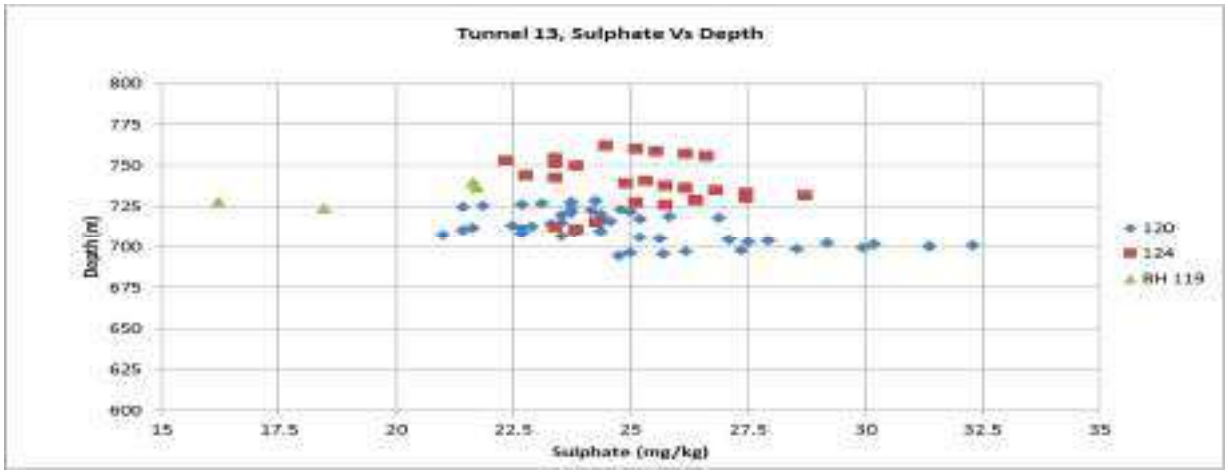




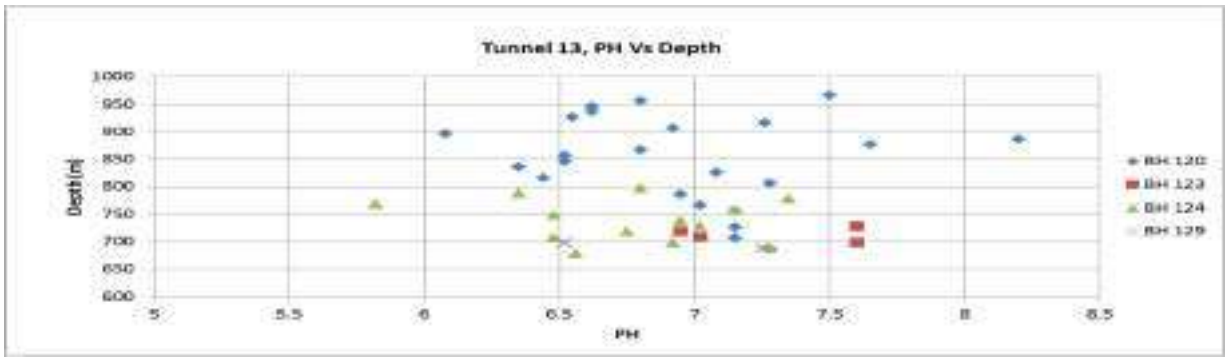


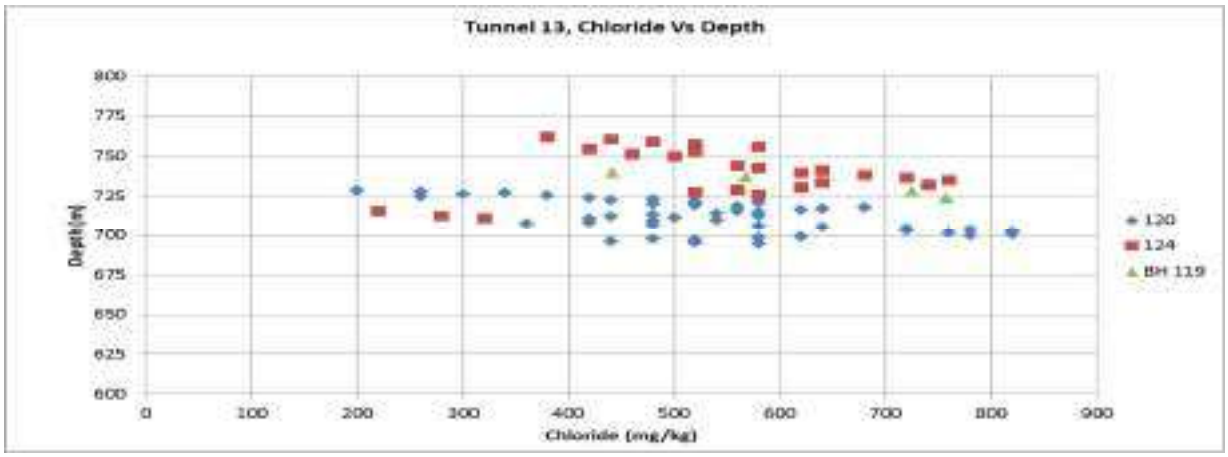

Tunnel 13, Liquid limit Vs Depth
Depth (m)
LL (%)
120
124
BH 119

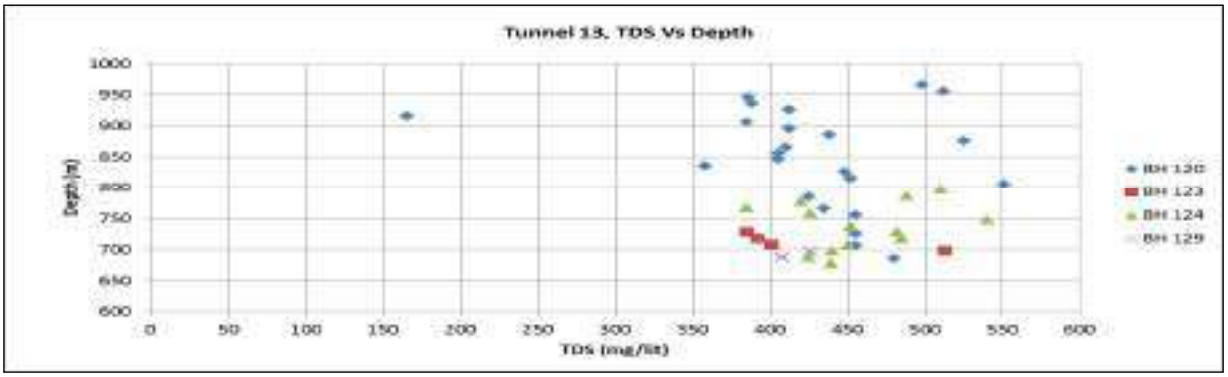

Tunnel 13, PH Vs Depth
Depth (m)
PH
120
124
BH 119

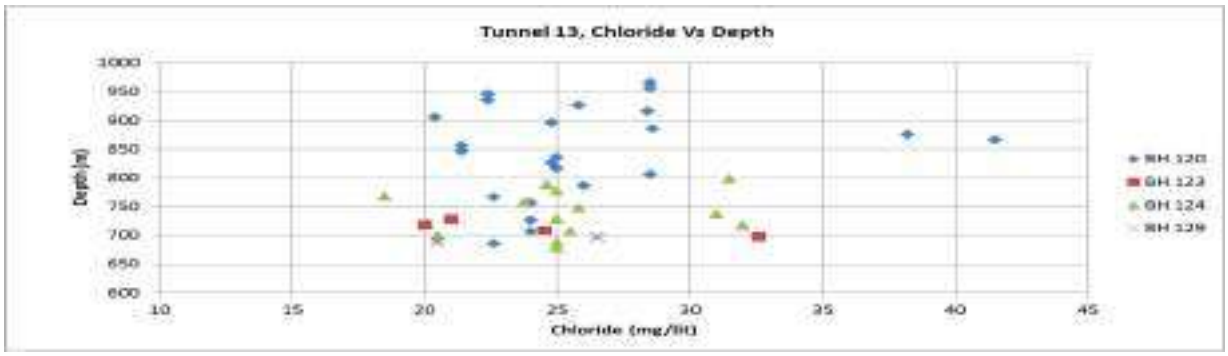

Tunnel 13, Sulphate Vs Depth
Depth (m)
Sulphate (mg/kg)
120
124
BH 119

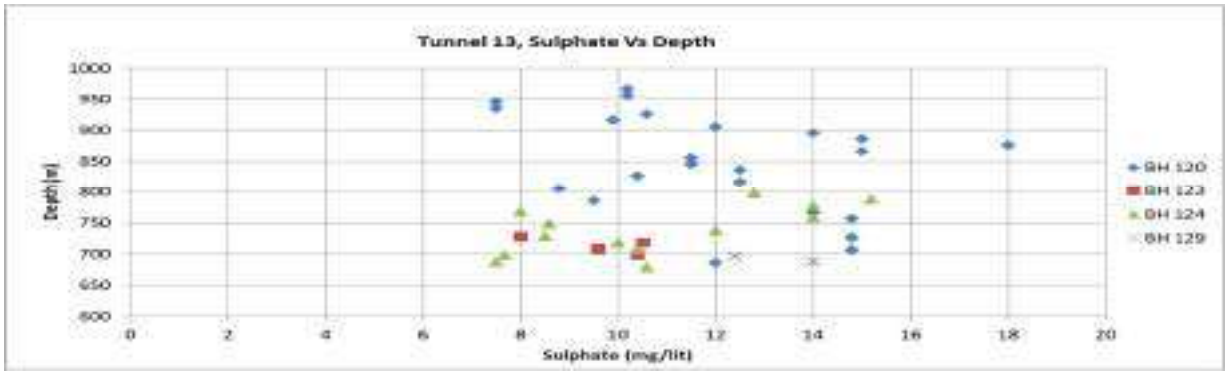
Tests on Water

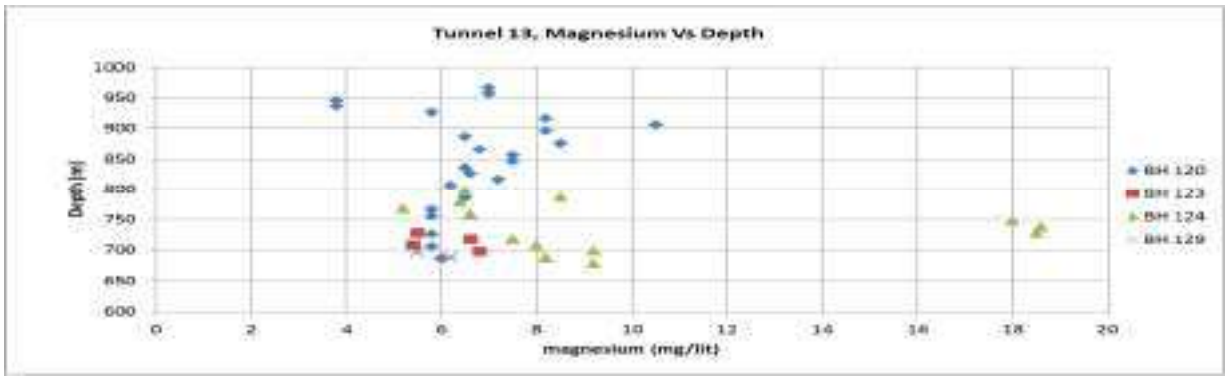


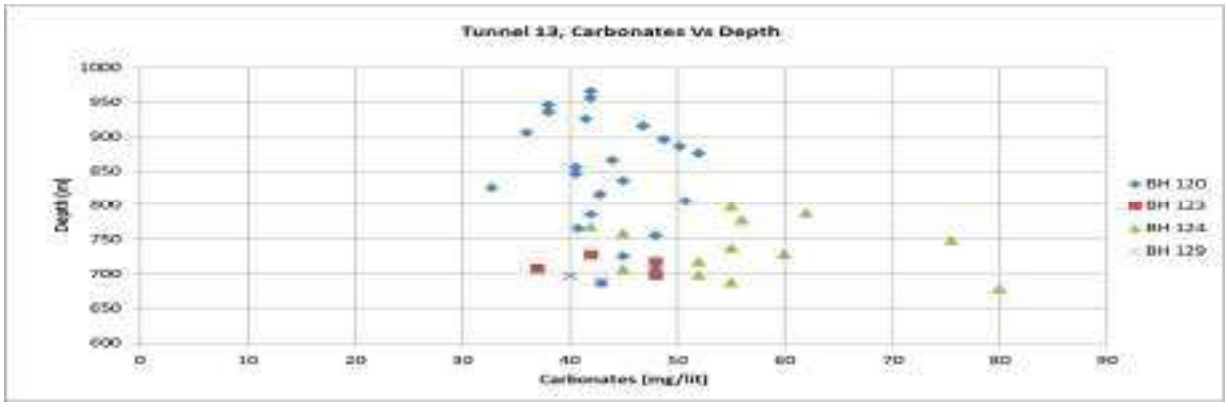







Tunnel 13, Sulphate Vs Depth
Depth (m)
Sulphate (mg/lit)
BH 120
BH 123
BH 124
BH 129


Tunnel 13, Magnesium Vs Depth
Depth (m)
magnesium (mg/lit)
BH 120
BH 123
BH 124
BH 129


Tunnel 13, Carbonates Vs Depth
Depth (m)
Carbonates (mg/lit)
BH 120
BH 123
BH 124
BH 129

Appendix-4

Roclab Results

GT-1		
Hoek Brown Classification		
sigci	65	MPa
GSI	65	
mi	20	
D	0	
Ei	24375	
Hoek Brown Criterion		
mb	5.7301	
s	0.0204681	
a	0.501975	
Rock Mass Parameters		
sigt	-0.232182	MPa
sigc	9.22818	MPa
sigcm	21.6679	MPa
Erm	15398.2	MPa

GT-2		
Hoek Brown Classification		
sigci	50	MPa
GSI	45	
mi	20	
D	0	
Ei	15000	
Hoek Brown Criterion		
mb	2.80512	
s	0.00221808	
a	0.508086	
Rock Mass Parameters		
sigt	-0.0395364	MPa
sigc	2.2413	MPa
sigcm	10.9835	MPa
Erm	3354.75	MPa

GT-3		
Hoek Brown Classification		
sigci	25	MPa
GSI	30	
mi	20	
D	0	
Ei	15000	
Hoek Brown Criterion		
mb	1.6417	
s	0.000418942	
a	0.522344	
Rock Mass Parameters		
sigt	-0.0063797	MPa
sigc	0.430074	MPa
sigcm	3.92126	MPa
Erm	1220.75	MPa

GT-4		
Hoek Brown Classification		
sigci	60	MPa
GSI	50	
mi	26	
D	0	
Ei	27000	
Hoek Brown Criterion		
mb	4.35961	
s	0.00386592	
a	0.505734	
Rock Mass Parameters		
sigt	-0.0532055	MPa
sigc	3.61363	MPa
sigcm	16.6277	MPa
Erm	8294.02	MPa

GT-5		
Hoek Brown Classification		
sigci	40	MPa
GSI	30	
mi	27	
D	0	
Ei	18000	
Hoek Brown Criterion		
mb	2.21629	
s	0.000418942	
a	0.522344	
Rock Mass Parameters		
sigt	-0.00756113	MPa
sigc	0.688118	MPa
sigcm	7.33144	MPa
Erm	1464.9	MPa

GT-6		
Hoek Brown Classification		
sigci	50	MPa
GSI	25	
mi	9	
D	0	
Ei	21250	
Hoek Brown Criterion		
mb	0.617951	
s	0.000240369	
a	0.531267	
Rock Mass Parameters		
sigt	-0.0194489	MPa
sigc	0.597379	MPa
sigcm	4.51096	MPa
Erm	1271.93	MPa

GT-7		
Hoek Brown Classification		
sigci	25	MPa
GSI	20	
mi	7	
D	0	
Ei	13750	
Hoek Brown Criterion		
mb	0.402028	
s	0.000137913	
a	0.543721	
Rock Mass Parameters		
sigt	-0.00857606	MPa
sigc	0.19905	MPa
sigcm	1.67526	MPa
Erm	627.984	MPa

COMPLETED SCHEDULES

INCLUDING

(PRICED BILL OF QUANTITIES)

Megha Engineering & Infrastructures Ltd.

An ISO 9001-2015 Company

S-2, Technocrat nut, Esloto, Balanagar, Hyderabad-500037, Telangana, INDIA
Tel -91-40-44336700 Fax +91-40-44336800
E-mail: info@meil.in Visit us: www.meil.in U45202TG2006PLC050271

3

Form: PS 2

Letter of Price Bid

Date: 17.02.2020

Invitation for Bid No.: RVNL/RKSH-KNPG/TENDER/TUNNELS/PK7B Date: 30.09.2019

To:

The Chief Project Manager,
Rail Vikas Nigam Limited,
Block No. 4, Rishilok, GMVN,
Muni Ki Reti, Rishikesh 249137, Uttarakhand

We, the undersigned, declare that:

(a) We have examined and have no reservations to the Bidding Documents, including Addenda issued in accordance with Instructions to Bidders (ITB) 8;

(b) We offer to execute the Works in conformity with the Bidding Documents;

(c) The total price of our Bid, is as indicated in the summary of the Bill of Quantities.

(d) We understand that this bid, together with your written acceptance thereof included in your notification of award, shall constitute a binding contract between us, until a formal contract is prepared and executed; and

(e) We have not made any deviations from the requirement of the bidding document and we have also not made any tampering or changes in the bidding documents on which the bid is being submitted and if any tampering or changes are detected at any stage, we understand the bid will invite summary rejection and forfeiture of bid security/the contract will be liable to be terminated along with forfeiture of performance security, even if LOA has been issued.

(f) We understand that you are not bound to accept the lowest evaluated bid or any other bid that you may receive.

Name: J. Srinivas Kumar
In the capacity of: Asst. Manager

Signed:

Duly authorized to sign the Bid for and on behalf of M/s Megha Engineering & Infrastructures Limited.

Date: 17.02.2020

Rail Vikas Nigam Limited

Summary Sheet of Bill of Quantities

Etender No	**RVNL/RKSH-KNPG/TENDER/TUNNELS/PK7B Date: 30.09.2019**
Name of Work	**"CONSTRUCTION OF TUNNELS, BRIDGES AND FORMATION WORKS FROM CHAINAGE Km 91+228 to Km 101+310 (FLS) UNDER PACKAGE–7B IN CONNECTION WITH NEW BG LINE BETWEEN RISHIKESH AND KARANPRAYAG (125KM) IN STATE OF UTTARAKHAND, INDIA."**
Name of Bidder	**M/s Megha Engineering and Infrastructures Limited, Hyderabad.**

S. No.	Bill No.	Description of Bills	Estimated Cost in Rs.	Rate quoted by Contractor as percentage above/ below/ at par over the estimated rates		Price in Rs.
				Percentage in Figures	Write whether Percentage quoted in Col. 4 & 5 is above/below/at par over estimated Cost	In Figures
1	2	3	4	5	6	7
1	1	Earthwork in Formation	34,03,05,038.00	18.00%	Above	40,15,59,944.84
2	2A	Bridge work (Other than Steel works)	4,92,64,500.00	18.50%	Above	5,83,78,432.50
3	2B	Bridge Work (Steel items involving Fabrication and Eraction)	2,68,76,911.00	20.25%	Above	3,23,19,485.48
4	2C	Bridge Work (Supply of Steel items)	2,50,48,484.00	18.50%	Above	2,96,82,453.54
5	9	Site Facilities	5,96,38,828.00	16.00%	Above	6,91,81,040.48

6	A	UnderGround Excavation	3,21,32,67,940.00	13.45%	Above	3,64,54,52,477.93
7	B1	Support System: Rock Bolts and Other Steel Supports etc	4,15,64,27,840.00	13.45%	Above	4,71,54,67,384.48
8	B2	Support System: Shotcrete and Concrete Works	4,56,73,65,061.00	13.45%	Above	5,18,16,75,661.70
9	B3	Supply of Steel Material	1,02,96,83,736.00	15.00%	Above	1,18,41,36,296.40
10	C	Drainage and Miscellaneous Work	1,01,38,09,522.00	15.00%	Above	1,16,58,80,950.30
11	D1	Ancillary Work	9,01,46,904.00	14.00%	Above	10,27,67,470.56
12	D2	Supply of Grouting Material	40,30,87,323.00	17.00%	Above	47,16,12,167.91
13	E2	Supply of fibres for Tunnel	19,30,49,780.00	18.00%	Above	22,77,98,740.40
14	F	Monitoring of excavations/ construction	6,35,31,433.00	18.50%	Above	7,52,84,748.11
15	H	Approach Road for Tunnel and Muck Dumping Site	7,36,55,500.00	17.50%	Above	8,65,45,212.50
16	J	Environment Management Plan	68,00,700.00	15.00%	Above	78,20,805.00
		Total Estimated Price	**15,31,19,59,500.00**			17,45,55,63,272.13

Note 1:

(a) Please refer to ITB 14 and 32 while filling the rates in the summary sheet.

(b) Please mention the percentage rate, in figures , for each schedule in columns 5 respectively. Please also mention in column 6 whether the percentage rate mentioned in columns 5 are above or below or at par over the estimated Cost.

(c) The price for each bill shall be calculated and written against each bill, in figures , in columns 7.
(d) The total price, as sum of the price of all the bills/ schedules shall be shown, in figures under columns 7 in the last row of the summary sheet.
(e) Bidder should ensure that the rates are filled with due care and caution so as not to lead to any omission or discrepancy or ambiguity.
Note 2:
(a) The item rates given in each bill are based on all-inclusive taxes prevalent prior to enactment of GST Act i.e. 1st July, 2017.
(b) While quoting their rates, Bidders shall consider the various provisions of The Central Goods and Services Tax Act, 2017(CGST)/ Integrated Goods and Services Tax Act, 2017(IGST)/ Union Territory Goods and Services Tax Act, 2017 (UTGST)/ respective state's State Goods and Services Tax Act (SGST) also, as notified by Central/State Govt & as amended from time to time and all taxes, duties, and levies applicable to the contract. Bidders shall also ensure that full benefit of Input Tax Credit (ITC) likely to be admissible to them is duly considered while quoting rates.
(c) The successful bidder who is liable to be registered under CGST/IGST/UTGST/SGST Act shall submit GSTIN along with other details required under CGST/IGST/UTGST/SGST Act to the Employer within 28 days from the date of the award of contract, without which no payment shall be released to the contractor. The contractor shall be responsible for deposition of applicable GST to the concerned authority. In case the successful bidder is not liable to be registered under CGST/IGST/UTGST/SGST Act, the Employer shall deduct the applicable GST from his/their bills under reverse charge mechanism (RCM) and deposit the same to the concerned authority.

Bill of Quantities

PREAMBLE

1. The Bill of Quantities shall be read in conjunction with the Instructions to Bidders, General Conditions, Particular Conditions of Contract, Works Requirement (Technical Specifications, and Drawings).

2. The quantities given in the Bill of Quantities are estimated and provisional and are given to provide a common basis for bidding. The basis of payment will be the actual quantities of work ordered and carried out including spares to be handed over to Railway, as measured by the Contractor and verified by the Engineer and valued at the rates and prices tendered in the priced Bill of Quantities, where applicable, and otherwise at such rates and prices as the Engineer may fix within the terms of the Contract. **If any quantities which have been supplied by the contractor and paid by RVNL are determined to be surplus by the Engineer (except those quantities which become surplus due to change in planning/scheme by Railway/RVNL) during the progress of the work or at the completion of the work, shall be taken back by the contractor, and the payment made for such materials shall be recovered from the pending claims. The materials which have become surplus due to change in planning/scheme by Railways/RVNL and are still in usable condition shall be taken over by RVNL and any part payment still to be made shall be released to the contractor.**

3. In the Bill of Quantities, quantity and unit rates and thereby the amount against each item have been indicated. From this, the estimated price of each bill has been worked out and indicated in the summary sheet in BOQ. The Bidder shall quote rates as percentage above/below/at par for each Bill in the summary sheet of E-Tendering Portal. If no percentage as above, below or at par is indicated for any particular bill, the same will be considered as percentage at par.

4. The rates for each bill shall be indicated in figures, while clearly indicating whether the percentage quoted is above/below/at par over the estimated rate in the respective columns.

5. General directions and descriptions of work and materials are not necessarily repeated or detailed in the Bill of Quantities. References to the relevant specifications and sections of the contract documentation should be made before quoting rates in the Bill of Quantities.

6. The rates and prices Bid in the priced Bill of Quantities shall, except as otherwise provided under the Contract, include all construction equipment, plant, labour, supervision, materials, erection, maintenance, insurance, profit, royalty, octroi, taxes and duties, together with all general risks, liabilities and obligations set out or implied in the Contract.

7. The rates are deemed to be inclusive of all lead (except as otherwise specifically provided in the description of the particular item), lifts, ascend, descend, handling, rehandling crossing of nallah/streams/tracks any other obstructions.

8. All enabling works for executing the work e.g. approach road to site (unless specifically mentioned), launching arrangements, procuring right of way, arrangement of water and electricity etc is to be arranged by the contractor at his own cost and deemed to be included in the quoted rates.

9. Storage of Material: All the material at site will have to be properly stacked & stored so as to facilitate inspection. The material should be properly protected from the detrimental effects of nature and fire, theft etc. The contractor shall be responsible for watch & ward and any loss or deterioration on account of above shall lead to rejection of material and contractor has to replace the same at his own cost.

10. The method of measurement of completed work for payment shall be in accordance with provisions in Works Requirements (Specifications) except as otherwise specifically provided in the description of item or particular bill of quantities or explanatory notes to the particular bill of quantities.

11. (a) In items of Bill No. 6: (Building and related items) and Bill No.9: (Site facilities), the rates are inclusive of cost of all materials including cement, steel, etc. required to deliver the final product.

(b) In items of bill No.2: (Bridges), Bill No.5: (track linking), and Bill No.7: (Platforms, passenger amenities and Misc works) where ever reinforcement steel and HTS wire (strands) are required to be consumed in the item, the rates are exclusive of cost of these materials and the same shall be paid separately under relevant items for supply of these materials.

(c) In items of Bill No.4: (P.Way supply) the rates are inclusive of all materials including cement, steel and HTS wire (strands). Rails required for manufacture of item under Bill No.4 shall be issued free of cost by RVNL.

(d) Bill No. A to J pertains to Tunneling and associated works.

12. NOTES SPECIFIC TO EACH BILL OF QUANTITIES.

12.1. BILL NO.1 FOR EARTH WORK IN FORMATION

12.1.1. The earth work in formation and blanketing has to be executed as per latest RDSO guidelines for earthwork in railway projects with upto date correction slips. If naturally available material in the project area is not suitable for using as blanketing material directly then the blanketing material conforming to RDSO specification has to be produced by blending various naturally available materials in required proportion in a pug mill.

12.1.2. Obtaining prior permission for felling of trees including payment of royalty and taxes etc. shall be contractor's responsibility and deemed to be included in the rates unless otherwise stated in the BOQ item.

12.1.3. Joining of new formation with existing embankment has to be done with benching of 30 cm (V), 60 cm (H) in the existing bank slope. The rate of earthwork includes the cost of benching.

12.1.4. Locations where blasting is warranted, prior permission of the employer must be obtained to ascertain whether blasting is permitted or prohibited. Rate of rock cutting includes the cost of all precautionary measures necessary for safety during blasting of rock.

12.2. **BILL NO.2: BRIDGES AND BILL NO.7: PLATFORM, PASSENGER AMENITIES AND MISCELLANEOUS WORK FOR CC, RCC AND PSC ITEMS.**

12.2.1. All material, equipment, labour, casting beds, stress frames, form work, staging, scaffolding, etc is to be arranged by the contractor within the quoted rates.

12.2.2. 1:4:8, 1:3:6 and 1:2:4 indicates concrete prepared using volumetric mix in proportion of cement: coarse sand: stone aggregate of specified size, respectively.

12.2.3. All design mix concrete shall be machine batched with automatic weigh batcher, machine mixed and machine vibrated or Ready Mix Concrete prepared in depot and transported by transit mixer to the site of work.

12.2.4. Prior to demolishing of any structure measurements have to be taken, scheme of dismantling has to be got approved from the Engineer.

12.2.5. Item 2059: The rate under this item is for steel of grade E-250 as per IRS B1-2001.

12.2.6. For entire Bill 2A: All Concrete works include cost of cement, aggregates or any admixtures including Super plasticizers/accelerators/ curing agents/releasing agents etc. or other additives like silica fume etc. **For Reinforced cement concrete M25 and above, minimum cementitious content shall not be less than 350 Kg/cum. For reinforced cement concrete of lesser grades minimum cementitious content shall not be less than 300 kg/cum. For Plain cement concrete minimum cementitious content shall not be less than 250 Kg/cum. For super structure concrete, preferably, OPC 53 shall be used to ensure early gain of strength.**

12.3. **Bill No. A: (Underground Excavation).**

12.3.1. Item A1: The rates include cost of Tunnel excavation (including Cross Passages and Transformer Halls) in full face or sequential excavation or

Multi Drifting (Top heading, Benching, invert and temporary invert) as per site requirement. The rate includes installation and maintenance of pumps and pipes along the excavation for water inflows up to 50 l/sec from the Tunnel heading. The rates also include dismantling of Temporary invert/Tunnel wall in case of Heading benching/Multi drifting. Nothing extra shall be paid for installation of temporary false portal. The rates also include one additional re-handling of muck if required due to site constraints.

12.3.2. Item A2: Nothing extra will be paid for dismantling and disposal of already installed supports.

12.3.3. Item A3: The rate includes extra cost for excavation including installation and maintenance of pumps and pipes along the excavation time for water inflows more than 50 l/sec from the Tunnel heading.

12.3.4. Item A4: Volume of muck for measurement and payment will be the solid In-Situ volumes and not loose.

13. **Bill No. B1: (Support System: Rock Bolts and Other Steel Supports etc.)**

13.1. All items are inclusive of all materials, labor, consumables, accessories, tools, plants and equipments including all lead and lifts, loading and unloading complete.

13.2. B1.1 (Rock Bolts/Anchors & Micropiles): Threaded portion of 200 mm of bolt shall be measured towards the length of bolt considered for payment. Rate include providing MWD drilling data while carrying drilling of holes for rock bolts with Automatic/Semi-Automatic Jumbos.

13.3. B1.2 (Pipe Roof Umbrella) & B1.3 (Light Forepoling): Size of perforations will depend upon strata and will be as decided by Engineer. Nothing extra shall be for using perforated pipes.

13.4. B1.4 (Arches/Steel Ribs/Lattice Girders): For Steel Ribs and Lattice Girders, cost of supply of structural steel and reinforcing steel shall be paid separately under Bill No. B3.

13.5. B1.5 (Reinforcement and Misc.): The size of wiremesh (150x150x6 or 100x100x4) and type of Lining stress controllers (Corrugated plate or Cylindrical tube type) will be as decided by engineer and nothing extra shall be paid for using either sizes or types.

14. **Bill No. B2 (Support System: Shotcrete and Concrete Works):**

14.1. B2.1 (Shotcrete Works): All shotcrete works include cost of Cement, aggregates, micro-silica/Silica Fumes, accelerator, admixtures/additives etc. **For M30 grade, Minimum 385 kg/cum of OPC 53/53S and 15 Kg of Micro Silica/Silica Fumes shall be used in design mix**.

14.2. **Deleted**

14.3. B2.2 (Concrete Works): All Concrete works include cost of cement, aggregates or any admixtures including Super plasticizers/accelerators/ curing agents/releasing agents etc. or other additives like silica fume etc. **For Reinforced cement concrete M25 and above, minimum OPC 53 content shall not be less than 350 Kg/cum. For reinforced cement concrete of lesser grades minimum OPC 53 content shall not be less than 300 kg/cum. For Plain cement concrete minimum OPC 53 content shall not be less than 250 Kg/cum.**

15. **Bill No. B3 (Supply of Steel Material):** Payment for supply shall only be made after the quantity is consumed in the work.

15.1. Item B3.1 will be operated for all reinforcement works for Secondary concrete lining or any other underground works.

15.2. Item B3.2 will be operated for supply of Reinforcement steel for Lattice Girders and Item B3.3 will be operated for supply of Structural steel for Steel Ribs.

16. **Bill No. C, D2, E2 and F:** Payment for supply shall only be made after the quantity is consumed in the work.

16.1. Item C2.3.3: This item will not be operated for pumping of water from underground tunnel stretches which are having favorable and self-draining slopes and such cost is deemed to be included in item for underground excavation.

16.2. Item C5.9: Supply of anchor bars will be paid separately under Item B3.2.

16.3. Bill No. D2: Payment for supply shall be made only after the quantity is consumed in the work. Measurement will be done from automatic data logger on the grouting Rig or as instructed by Engineer.

16.4. Bill No. F: Rates of all items include supply, fixing, maintenance and upkeep of instruments. Charges towards monitoring, interpretation and record keeping will be deemed to be covered by permanent posting of Instrumentation Engineer.

17. Bill No. H: Cost for construction and maintenance of Access routes for access to Tunnel/Adit portals/Bridges or muck dumping grounds defined in Section: 5 (Work's requirement) Clause 2.3 C(f) and 2.3 E shall be paid under relevant items of this Bill.

18. Rates shall always include for testing where specified except where testing is scheduled separately for payment.

19. Technical Specification reference mentioned in BOQ is for guidance only, as there are references to the item under various clauses and the work are to be executed as per the requirement of the various clauses in the Technical Specification.

20. While quoting the rates, Bidder is required to take into account the cost of deployment of minimum machinery and manpower fulfilling requirements specified in Section 5: Work's requirements. Idling charges for manpower and machinery will not be payable to the bidder on any account.

Rail Vikas Nigam Limited

Name of Work: "CONSTRUCTION OF TUNNELS, BRIDGES AND FORMATION WORKS FROM CHAINAGE Km 91+228 to Km 101+310 (FLS) UNDER PACKAGE–7B IN CONNECTION WITH NEW BG LINE BETWEEN RISHIKESH AND KARANPRAYAG (125KM) IN STATE OF UTTARAKHAND, INDIA."

Summary of Bill

Bill No.	Description of Schedule	Estimated Cost in Rs.
1	2	3
1	Earthwork in Formation	34,03,05,038.00
2A	Bridge work (Other than Steel works)	4,92,64,500.00
2B	Bridge Work (Steel items involving Fabrication and Eraction)	2,68,76,911.00
2C	Bridge Work (Supply of Steel items)	2,50,48,484.00
9	Site Facilities	5,96,38,828.00
A	UnderGround Excavation	3,21,32,67,940.00
B1	Support System: Rock Bolts and Other Steel Supports etc	4,15,64,27,840.00
B2	Support System: Shotcrete and Concrete Works	4,56,73,65,061.00
B3	Supply of Steel Material	1,02,96,83,736.00
C	Drainage and Miscellaneous Work	1,01,38,09,522.00
D1	Ancillary Work	9,01,46,904.00
D2	Supply of Grouting Material	40,30,87,323.00
E2	Supply of fibres for Tunnel	19,30,49,780.00
F	Monitoring of excavations/ construction	6,35,31,433.00
H	Approach Road for Tunnel and Muck Dumping Site	7,36,55,500.00
J	Environment Management Plan	68,00,700.00
	Total Estimated Price	**15,31,19,59,500.00**

Bill No. 1: Earthwork in Formation							
S. No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
1	1002	Earthwork in excavation by mechanical means (Hydraulic excavator) in cutting, in formation, trolley refuges, side drains, yard drains, catch water drains, etc. including leading usable cut spoils up to 200 M and making formation in filling using the cut spoils, site clearances, setting out and demarcation, disposing off surplus unusable cut spoils as per directions of the engineer, and top and side dressing and compaction of cutting formation to provide final formation as per designed profile. The rate shall include compaction of cutting formation and initial compaction of sub-soil where cut-spoils are used in filling. The rate shall not include cutting of trees with girth above 30 cm and compaction of cut spoils in filling, which shall be paid separately. Note- (1) Rock spoils such as stones, boulders, pebbles, gravels etc available from excavation, if are found suitable for use in works as per required specifications even after modifications etc., can be used free of cost but the legally payable royalty and taxes are to be paid by the contractor to the concerned authorities. (2) Payment for earthwork in excavation for pucca drains shall not be payable under this item and the same shall be paid under NS-6 of Bill-1.					7.1, 7.4, 7.5, 7.6, 7.7
	1002a	Soil excluding rock.	Cum	125549.00	174.00	21845526.00	7.3.2, 7.10
	1002b	Rock not requiring blasting.	Cum	818693.00	271.00	221865803.00	7.3.3, 7.10
	1002 c	Hard Rock requiring blasting.	Cum	5000.00	461.00	2305000.00	7.3.4, 7.10
	1002 d	Hard Rock requiring blasting, but blasting not permitted hence to be excavated by chiselling.	Cum	5000.00	833.00	4165000.00	7.3.5, 7.10
2	1003	Incremental rate for every Km or part thereof over item 1002 for leading cut spoils beyond 200 M for making formation in filing.	Cum-Km	356193.00	14.20	5057941.00	7.10.1 D
3	1006	Mechanical Compaction of Earth and Blanket materials in layers of about 30 CM (or more or less) in loose state using vibratory compactor (of adequate capacity) so as to achieve compaction as per RDSO Guidelines and Specification for Design of Formation for Heavy Axle Load – Nov 2009. Minimum EV2 Criteria as mentioned in the guidelines is not applicable. Note: The payment for compaction shall be based on the computed quantity of earth work/blanket work from the cross sections. The payment, however, will be restricted only to the approved design profiles furnished by the Engineer; or the actual quantity executed whichever is less.	Cum	100000.00	27.60	2760000.00	
4	1007	Turfing / planting, including all lead and lift, and watering as required until properly rooted, with. Note - Initially payment of only 40% will be made. Balance 60% will be paid only after 3 months of maintenance period if the turfing is properly rooted.					
	a	Turfing with sods, 10cm thick and 20 cm square closely laid	Sqm	625	74.65	46656.00	
	b	Turfing with planted doob grass	Sqm	625	71.50	44688.00	
5	1008	Providing and laying Jute Geo-Textile (JGT) in slopes of Railway embankment in accordance with RDSO's guidelines for application of Jute Geotextile in Railway embankments and hill slopes no. RDSO/2007/GE:G-0008 or its subsequent versions, including incidental earthwork and fixing arrangements (Rate does not include planting of grass)					
	(a)	With GJ - Type 1	Sqm	400	46.60	18640.00	
6	NS-1	(Dry Stone pitching) Providing and laying Pitching with stone boulders weighing not less than 35 kg each with the voids filled with spalls on slopes laid over prepared filter media including boulder apron laid dry in front of toe of embankment complete as per drawing and Technical specification	cum	6960	1516.80	10556928.00	
7	NS-2	(Stone pitching in 1:4) Providing and laying Pitching with stone boulders weighing not less than 35 kg each with the voids filled with cement sand mortar 1:4 on slopes laid over prepared filter media including boulder apron laid dry in front of toe of embankment complete as per drawing and technical specification (rates are inclusive of cement)	cum	6960	3440.00	23942400.00	

Bill No. 1: Earthwork in Formation							
S. No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
8	NS-3	Supplying and placing of mechanical woven double twisted hexagonal shaped wire mesh Gabion boxes of required sizes mesh type 10cmx12cm, Zn and PVC coated mesh wire dia 2.7/3.7mm (ID/OD), edges of meshes meschnically edged/selvedged with heavy coating of galvanisation as per EN-10223-3/ASTM A 975 with partions at every 1 Mtr intervel and proprly packed with approx 150 mm boulders including transportation and placing at indicated places as per direction of Engineer -in-charge including contractor tools, plants, labours royalty charges etc. complete in all respect and stitching with lacing wire of dia 2.2/3.2mm (ID/OD) @ 5% by weight of Gabion boxes carrying the material by head lead from nearest approcah with all safety precautions and all leads and lifts.	cum	3000.00	3700.00	11100000.00	
9	NS-4	Earthwork in filling in Embankment Fill and Prepared Sub-grade of formation including guide bunds, around buried type abutments, bridge approaches, trolley refuges etc using Railway's earth/ Muck generated from excavation of Underground & other works and dumped at the location of the bank or nearby, of approved quality as per RDSO guidelines for design /Construction of formation on Indian Railway track issued vide RDSO specification RDSO/2018/GE:IRS-0004 (D) Part-IV dated July 2019, procured from railway land including site clearances, setting out and demarcation, benching, initial compaction of subsoil after leveling the surface after site clearance, spreading loose earth in layers of maximum 30 cm thickness using grader up to extra width of 0.5 m beyond designed profile, compaction using vibratory compactors, top and side dressing and removal of extra earth from sides to provide final formation as per designed profile as per RDSO Guidelines. The rate shall include cutting of trees with girth upto 30 cm, making good the pockets and depressions left in soil during clearing and uprooting of jungle/trees at site and initial compaction of sub-soil thereafter. The rate shall not include cutting of trees of girth beyond 30 cm and compaction (excluding initial compaction of sub-soil mentioned above), which shall be paid separately. The minimum Ev2 Criteria as mentioned in the guidelines of 2009 is not applicable. The rate shall include cost of all field and laboratory tests including those required for subsoil but excluding CBR tests which will be paid vide separate BOQ item. The rates include segregation of Boulders from the Tunnel Muck. However, the mechanical compaction in layers shall be paid separately under relevant item. Note: 1. Lead for the muck generated from excavation of Underground and other works is included in the BOQ item A1 & A4 of Bill no. A. 2. Lead for railway's earth includes up to 200 m. 3. Royalty on Railway's earth/Muck (being used for formation filling), if applicable will be borne by RVNL.	Cum	103149.00	89.09	9189544.00	
10	NS-5	Providing and laying blanketing materials of specifications as per RDSO guidelines for design /Construction of formation on Indian Railway track issued vide RDSO specification RDSO/2018/GE:IRS-0004 (D) Part-IV dated July 2019, using graders and compaction using vibratory compactors, top and side dressing to provide final formation as per designed profile. The rate shall not include compaction, which shall be paid separately. NOTE:1) If naturally available materials do not meet the laid down specifications, the blanket material has to be produced by mechanical process using mechanical crushing or mechanical blending method or combination of these two methods as given in the Appendix-C of RDSO Guidelines and Specifications for Design of Formation for Heavy Axle Load -2009. The rate for this item is inclusive of the production of material by mechanical process as per above mentioned RDSO guidelines and in case such mechanical process is not required to be used in providing and laying of blanketing material due to availability of natural blanketing material conforming to laid down specifications, the rate of this item shall be reduced by Rs. 250/- per cum. 2) The filter criteria and minimum EV2 Criteria as mentioned in the guidelines of 2009 is not applicable. 3) The rate shall include cost of all field and laboratory tests except CBR tests which will be paid vide separate BOQ item. 4) The Latest guidelines for Design / Construction of formation on Indian Railway track, issued vide RDSO specification RDSO/2018/GE:IRS-0004 (D) Part-IV dated July 2019 shall be adopted for this item. The basic instructions (other than those contained in the latest guidelines dated July 2019) detailed in GE: G-1 of 2003 and GE:0014 of 2009 shall continue to apply.	Cum	18728.00	1179.00	22080312.00	
11	NS-6	**Earth work in cutting** in foundation, trenches, pucca drains in station area/block section etc in all kinds of soil including dressing of sides, ramming of bottoms, back filling of trenches, getting out the excavated soil and disposal of surplus excavated soil with all lead and lift as directed by the Engineer.					
	NS-6 a	In all kinds of soil	Cum	5000.00	172	860000.00	
	NS-6 b	In ordinary rock	Cum	4000.00	278	1112000.00	
	NS-6 c	Hard Rock (requiring blasting)	Cum	3400.00	499	1696600.00	
	NS-6 d	Hard Rock (blasting prohibited)	Cum	2200.00	647	1423400.00	
	NS-6 e	Extra over item NS-6 c for cutting in rock requiring controlled blasting	Cum	3400.00	69	234600.00	
					Sub Total Amount	**34,03,05,038.00**	

Bill No. 2A: Bridge Work (Other than Steel items)							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
1	2001	Earth work in excavation in foundation of bridges to desired profile including backfilling, compaction of back fill, and disposal of surplus earth as per directions of the Engineer.					
	2001 a	Soil excluding rock.	Cum	4000.0	302.00	1208000.00	
2	NS-2003	Providing and laying M 10 cement concrete in foundation and floor using well graded stone aggregate of 40 MM nominal size. ***(Rates are inclusive of Cement)***	Cum	194.00	5262.00	1020828.00	
3	NS-2005	Providing and laying Design mix control concrete M25/M30/M35/M40 in cast-in-situ RCC works of raft, pile cap, pier, abutment, well steining, RCC well kerb, well cap, pier cap, Jacketing, dirt wall, return wall, wing wall, fly wing wall, retaining wall, approach slab, foot path slab, wearing course, ballast retainers, RCC railing, inspection platform, pedestal, boxes and other miscellaneous works using well graded stone aggregate of 20 MM nominal size. ***(Rates are inclusive of Cement)*** Note: Extra @ 32% of the rate for concreting done for the jacketing work under this item shall be payable and shall deem to include cost of surface preparation, drilling of holes, insertion of dowel bars and grouting of holes etc. required for the work but exclude cost of dowel bars which shall be payable separately under relevant BOQ item.	Cum	2876.00	8947.00	25731572.00	
4	2015	Providing and laying dry stone backing behind abutments, wing walls, return walls, RCC boxes with stones not less than 15 CM in any direction and not less than 15 KG (except smaller boulders required for filling voids) in weight.	cum	1500.00	1119.00	1678500.00	
5	2016	Providing and laying backfill material behind boulder filling of abutments, wing walls, return walls consisting of granular materials of GW, GP, SW groups as per IS 1498-1970 in required profile .	Cum	1400.00	414.00	579600.00	
6	2017	Providing and laying 300 MM thick dry stone pitching in flooring, exposed slopes, etc. with boulders of not less than 30 KG each in weight, hand packed with surface levelled off to the correct section with hammer dressing as necessary including filling the gaps with quarry spalls.	Cum	2000.00	1125.00	2250000.00	
7	2032	Providing and fixing of 75 MM dia PVC pipe for weep holes in abutments, wing walls, return walls, face wall, retaining wall etc at suitable intervals as directed by the Engineer-in-charge.	Meter	2500.00	220.00	550000.00	
8	NS-1	Dismantling of existing structures like culverts, bridges, retaining walls and other structure comprising of masonry, cement concrete, wood work, steel work, including T&P and scaffolding wherever necessary, sorting the dismantled material, disposal of unserviceable material and stacking the serviceable material with all lifts and lead of 1000 metres of Prestressed / Reinforced cement concrete grade M-20 & above by Mechanical means.	Cum	2000.00	1073	2146000.00	
9	NS-2	Providing and erection of specified grade precast RCC facia panels of thickness 180 mm made with M-35 grade concrete batching plant transit mixer, concrete pump and vibrator for retaining earth with all elements and accessories including reinforcing elements complete as per approved drawing and clause 3100 of MoRT&H specifications including all material, labor, machinery etc and Providing, placing and compacting to desired approved density, backfill material in layers as per approved methodology including testing for reinforced fill portion and random fill portion in the approaches between the reinforcement soil (RS) wall panels as per approved drawings as per clause 3103 of MoRT&H specification. The soil should be pre dominately coarse grained not more than 10% particle should pass 75 micron sieve. The item shall be measured and paid to the finished surface area (Scope of work includes casting in yard, curing, storing, transporting, lifting, placing in position, errection with all necessary fasteners etc. complete in all respect.).The rate shall include cost of material, labour, plant, royalties, handling, storage and transportation lead & lift expenses, cost of bed block, leveling pad, facia elements, capping beam,connectors, reinforcing elements, scaffolding, supply of the specified filter media material,supply of soil fill for the reinforced as well as unreinforced zone of the quality specified in the contract, placing, spreading and compaction through mechanical means.	Sqm	1000.00	14100	14100000.00	
					Sub Total Amount	**4,92,64,500.00**	

Bill No. 2B: Bridge Work (Steel items involving Fabrication and Eraction)							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
2	2059	Providing steel girders duly launched in position on piers/abutments as per drawing with contractor's steel of grade & quality as per IRS: B1-2001 along with up to date A&Cs, duly tested including fabrication, assembly, erection, launching etc. as per QAP approved by RDSO. Rate shall include all activities for delivering the end product except bearings, stud shear connectors, galvanising and painting of girder components including surface preparation, charpy test, steel channel/ H beam sleepers, chequered plate pathways, and railings, which shall be paid separately under relevant items. **Note: (i)Payment to be made in stages as per RVNL standard specifications Vol I, Part: A- Chapter 3 "Bridges" (h) Steel Works Clause 8.2, para 8.2.2 along with up to date A&Cs.**	MT	53.00	147361.00	**7810133.00**	
3	2067	Supplying and testing of nominal headed stud shear connectors of 25 mm dia and 200 mm length (finished size) conforming to SD1 type material of ISO 13918 along with ferrules and including fitting,fixing & welding with studs guns etc to top flange of Girder for deck slab as per RDSO guidelines contained in report NO.BS 115 (Revision 1) April 2016 for RDSO drawings for composite construction. Note : In case stud shear connector of any other size is required to be provided then payment shall be made on the pro-rata basis in proportion of the weight of the stud shear connectors.	NO'S	1082.00	329.00	**355978.00**	
4	NS-1	Extra over Item 2059 for providing steel conforming to Higher Grade of E-350-C with copper bearing.	MT	40.00	5371.00	**214840.00**	
5	NS-2	Design, Manufacturing, supplying, testing and installation as per RDSO specification and guidelines including anchor plates, all type bolts etc for complete set in all respect including transportation to the site, painting with approved paint as directed by engineer. The load data will be supplied by RVNL. The rates shall also include preparation of Drawings, securing approval from project engineers and assist in proof check from nominated consultant by RVNL, preparation of maintenance manual, replacement procedure etc for the spherical bearing supplied, and all taxes, duties etc. complete. **For Set consisting of four bearings for 24.4 m span (Composite Girder)**	set	4.00	4557000.00	**18228000.00**	
6	NS-3	Supplying and fixing of High strength friction Grip bolts 10.9 Gradefinish Zinc phosphate as per IS 3757:1985 and IS:4000:1992 including HSFG Nuts as per IS 6623 : 2004 and washers to IS 6649:1985 s per drawings, specifications and as directed by Engineer-in-charge a) 24 mm dia of bolts (L=200mm)	NO'S	1320.00	203.00	**267960.00**	
					Sub Total Amount	**2,68,76,911.00**	

Bill No. 2C: Bridge Work (Supply of Steel items)							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
1	2076	**Supplying TMT Fe-500/Fe-500D* reinforcement steel** conforming to IS:1786-1985 including decoiling, straightening, cutting, bending, placing in position, binding with 1MM dia GI binding wire. **Note :** 1. Reinforcement, shall be measured in length for different diameters used in the works and then paid as per standard weights as per IS 1732. Wastages, overlaps, coupling, welded joints, space bars, chairs and binding wire shall not be measured and cost of these items shall be deemed to be included in the rates. 2. * For seismic zone III, IV & V, only TMT Fe-500D steel shall be used.	MT	302.00	82942.00	25048484.00	
					Sub Total Amount	**25048484.00**	

Bill No. 9: Site Facility							
S.No.	**Item No.**	**Description of item**	**Unit**	**Quantity**	**Rate (In Rs.)**	**Amount (In Rs.)**	**Reference to Work Requirement (Section-5)**
1	9001	**Providing site offices for Employer** with Contractor's material, Labour, Tools and Plant, Equipment etc. including provision of Water Supply, Drainage, Power arrangements, office maintenance as per the details mentioned in clauses 3.1 to 3.2.8 & 3.5 to 3.5.2 of Chapter 3 (Site Facilities for the Employer and the Engineer) of Section 5 (Work's Requirement) of Tender Documents. Note 1: This item is provided with the contention that new site offices will be constructed for this purpose and 75% payment of the accepted rates will be made after making available functional office, balance 15% payment shall be made at the end of the completion period and the remaining 10% will be paid after clearance of site by the contractor. Note 2: Alternatively if suitable accommodation is available on hire basis at suitable location acceptable to the employer, the contractor can arrange the same under the item but in such a case the payment shall be regulated as below. (a) 10% payment shall be made on completion of one month from the date of making available the office fit for functioning. b) Remaining 90% payment shall be paid in equal monthly instalments that is (0.9xQuoted rate) / (Stipulated Completion period in months + defect liability period in months). Note 3: In case stipulated period gets extended, payment on monthly basis, under this item, in such extended period, shall be made as under; (i) in case of new construction @ [(54% of Quoted rate) / (Stipulated Completion period in months + defect liability period in months)] per Sq.m. of Plinth area. (ii) in case of accommodation on hire @ [(90% of Quoted rate) / (Stipulated Completion period in months + defect liability period in months)] per Sq.m. of Plinth area.	Sq.m. of Plinth area	292.00	17997.00	5255124.00	3.2, 3.5
2	9002	Providing Furniture as given under clauses 3.3, 3.3.1 of Chapter 3 (Site Facilities for the Employer) of Section 5 (work's Requirement) of Tender Documents. Note: Payment shall be made @ 75% of the accepted rate after making available the furniture items in functional office, balance 15% payment shall be made at the end of the completion period and the remaining 10% will be paid after clearance of site by the contractor.	L S Per Site Office	1.00	1397828	1397828.00	3.3
3	9003	Providing Road Vehicle mentioned below for the use of Engineer/Employer as per the Conditions mentioned in Clause 3.4.3, i.e 3.4.3.1 to 3.4.3.3 of Chapter 3 (Site Facilities for the Employer and the Engineer) of Section 5 Work's Requirement) of Tender Documents.					3.4
	9003a	INNOVA, MAHINDRA XUV500 or similar	Vehicle months	162.00	75133.00	12171546.00	3.4.3
	9003b	BOLERO, SCORPIO, ERTIGA, MARAZZO or similar	Vehicle months	540.00	64649.00	34910460.00	3.4.3
	9003c	Extra for running and maintenance of every additional km over and above 4000 kms as specified in item 9003 (a)	Per km	50000.00	17.50	875000.00	3.4.3
	9003d	Extra for running and maintenance of every additional km over and above 4000 kms as specified in item 9003 (b)	Per Km	50000.00	14.00	700000.00	3.4.3
4	9004	Providing computers with software, printers and other office equipment as given under Clause 3.6 of Chapter.3 (Site facilities For the Employer)of Section-5 (Work's requirement) Of bidding documents: NOTE: i) Payment shall be made @ 85% of the rate after making available the office equipment in functional condition. ii) Next 10% of the rate shall be paid at the end of the completion period. iii) The remaining 5% of the rate shall be paid after the eqipment is taken back by the contractor and the site is cleared by the contractor.	LS per site office	1.00	1248970.00	1248970.00	3.6
5	9005	Providing 36 inch large format colour Plotter – Model HP T830 Designjet Multifunction plotter or similar/better. Note: (i) Payment shall be made @ 85% of the rate after making available the equipment in functional condition, (ii) Next 10% of the rate shall be paid at the end of the completion period. (iii) The remaining 5% of the rate shall be paid after the equipment is taken back by the contractor and the site is cleared by the contractor.	Each	1.00	248900	248900.00	
6	9006	Providing 150CC or higher Motor Bike Bajaj Pulsar/HondaCB Hornet 160R/ Hero Xtreme Sorts/Suzuki Gixxer or Similar for the use of Engineer/Employer as per the Conditions mentioned in Clause 3.4.2 & 3.4.3, of Chapter 3 (Site Facilities for the Employer and the Engineer) of Section 5 Work's Requirement) of Tender Documents.	Bike Months	270.00	10400.00	2808000.00	3.4.2.1
	9006 a	Extra for running and maintenance of Motor Bike for every additional km over and above 2500 kms as covered under item 9006	Per km	10000.00	2.3	23000.00	3.4.2.1
					Sub Total Amount	**5,96,38,828.00**	

Bill No. A: UnderGround Excavation							
S.No.	**Item No.**	**Description of item**	**Unit**	**Quantity**	**Rate (In Rs.)**	**Amount (In Rs.)**	**Reference to Work Requirement (Section-5)**
1	A1	Underground excavation (Full Face, Top Heading, Bench, Invert Arch) for the Main Tunnel, Escape tunnels & Cross Passages, including temporary provision at the portal for the start of tunnel excavation like canopy structure (false portal) etc, Laybys, Cross passage and Transfromer halls and for the connection of remaning part of Adit tunnel (Approx. 50m) with the Main Tunnel including drilling, blasting, or other means of excavation including widening of top heading footings, breaking of shotcrete, lining in temporary invert, provision of surface drainage, construction ventilation, lighting arrangement during construction, temporary backfilling for traffic in tunnel, profiling / reprofiling of tunnel as per approved cross sections, removal and disposal of excavated material including temporary backfill to dumping site with all lifts and leads up to 2 kms from portals / shaft head as per approved drawings and specifications or as directed by Engineer. (Ö-Norm-2203)					Chapter 8.0 of Annexure-A
	A1.1	Excavation in Support Section Type **B1**	Cum	190537.00	1952.00	371928224.00	8.12.1, 8.22
	A1.2	Excavation in Support Section Type **B2**	Cum	343248.00	2416.00	829287168.00	8.12.1, 8.22
	A1.3	Excavation in Support Section Type **C1**	Cum	171491.00	2566.00	440045906.00	8.12.1, 8.22
	A1.4	Excavation in Support Section Type **C2**	Cum	112256.00	2566.00	288048896.00	8.12.1, 8.22
	A1.5	Excavation in Support Section Type **C3,C4**	Cum	200362.00	3988.00	799043656.00	8.12.1, 8.22
	A1.6	Excavation in Support Section Type **P**	Cum	25984.00	3988.00	103624192.00	8.12.1, 8.22
2	A2	Additional Excavation for niches in all class categories (Except Laybys, Cross passages and Transformer halls/technical rooms)	Cum	22311.00	3443.00	76816773.00	8.9, 8.22.3
3	A3	Extra for tunnel excavation due to excessive water inflow of more than 50 l/sec	Cum	9964.00	371.00	3696644.00	8.22.6.i
4	A4	Extra for transportation of spoils over 2 km to 10 km from the portal / shaft head	Cum-km	855443.00	32.00	27374176.00	8.22.1.ii.T
5	A5	Removal of muck resulting from Geological overbreak (Measurements will be taken with Tunnel laser scanner or as decided by engineer). Rate to include all associated costs including ventilation and transport and disposal of material lead upto 2 km from tunnel portal.	Cum	10439.00	991.00	10345049.00	8.22.2.ii
6	A6	Extra over item A1 for excavation using Fully and Semi Automatic Jumbo defined in works requirement inside tunnel in lieu of Manual 2 boom Jumbo:					
	A6.1	Jumbo (Type-1) Automatic	Cum	521939.00	274.00	143011286.00	
	A6.2	Jumbo (Type-2) Semi-Automatic	Cum	521939.00	56.00	29228584.00	
7	A7	Extra over item A1 for loading muck using Wheel loader and continuous loader defined in works requirement in lieu of Hydraulic excavator:					
	A7.1	Wheel loader	Cum	521939.00	44.00	22965316.00	
	A7.2	Continuous loader	Cum	521939.00	130.00	67852070.00	
					Sub Total Amount	**3,21,32,67,940.00**	

Bill No. B1: Support System: Rock Bolts and Other Steel Supports etc.							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)- Annexure-A
B1.1 - ROCK BOLTS/ANCHORS & MICROPILES							
1	B1.1.1	SN Bolts: Supply, drilling, installation and grouting of **SN type** rockbolts of the specified length, Yield strength ≥500 MPa (slopes, tunnel support & face bolts) as per approved drawings and Specifications or as directed by Engineer, with contractors men, material, consumables, plants, equipments, machineries, including all lead & lifts loading , unloading etc required for the complete job.					10.8, 10.15.2, 10.15.5
	B1.1.1.1	Φ25 SN Bolts: Cement Grouted	Meter	793309.00	837.00	663999633.00	
	B1.1.1.2	Φ32 SN Bolts: Cement Grouted	Meter	22747.00	1349.00	30685703.00	
2	B1.1.2	SDA Bolts: Supply, drilling, installation and grouting of Φ32 Self-drilling anchor (SDA) bolts of the specified length, Yield load ≥230 KN (Slope, Tunnel Support and Face Bolts) as per approved drawings and Specifications or as directed by Engineer, with contractors men, material, consumables, plants, equipments, machineries, including all lead & lifts loading , unloading etc required for the complete job.	Meter	1069395.00	1898.00	2029711710.00	10.10, 10.13, 10.15.2, 10.15.5
3	B1..1.3	Fiber glass bolts: Supply, transporting to site, drilling, installation, testing and grouting of Fiber glass bolts of the specified length, 32/15, Yield load ≥ 500 KN (For Face Bolting) as per approved drawings and Specifications or as directed by Engineer, with contractors men, material, consumables, plants, equipments, machineries, including all lead & lifts loading , unloading etc required for the complete job.	Meter	55534.00	1524.00	84633816.00	10.14, 10.15.2
4	B1.1.4	Water Inflatable bolts Swellex or similar: Supply, drilling and installation of **Water Inflatable bolts Swellex or similar** rockbolts of the specified length, Fy≥ 150 KN (tunnel support) with contractor's men, material, consumables, tools & plants, equipments, machineries, including all lead & lifts, loading, unloading.	meter	213220	2679.00	571216380.00	10.9.1,10.9.2,10.9.3,10.5.2.iv
B1.2 - PIPE ROOF UMBRELLA							
5	B1.2.1	Supply, drilling hole, installation and grouting of pre-support elements (Pipe roofing) up to 139.7mm OD and up to 15m long with conventional drilling techniques at a shallow look out angle from the tunnel axis with specialised drill bit and casing systems providing direction control and installation accuracy as per approved drawings and Specifications or as directed by Engineer, with contractors men, material, consumables including grout coupling, plants, equipments, machineries, including all lead & lifts loading , unloading etc required for the complete job.					10.13.4, 10.15
	B1.2.1.1	Seamless pipe, OD Φ114.3mm, 6.3mm thick, Yield load ≥ 1200KN	Meter	10424.00	12032.00	125421568.00	
B1.3 - LIGHT FOREPOLING							
6	B1.3.1	Supply, drilling hole, installation and grouting of Light Forepoling elements with contractor's men, material, consumables (including grout coupling where required), tools & plants, equipments, machineries, including all lead & lifts, loading, unloading.					10.13.3, 10.15
	B1.3.1.1	Self-drilling Bolts, OD Φ32mm, Yield Load ≥ 230KN	Meter	124826.00	2096.00	261635296.00	
	B1.3.1.2	Reinforcement bars, dia. **Φ32mm**, Fy=500MPa	Meter	11096.00	958.00	10629968.00	

Bill No. B1: Support System: Rock Bolts and Other Steel Supports etc.							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)- Annexure-A
B1.4 - ARCHES/Steel Ribs/Lattice Girders							
7	B1.4.1	**Steel Ribs:** Fabrication and erection in position permanent tunnel steel ribs including of variable geometry and or member size as per design/assembly, using structural steel Grade A, Yield stress ≥250MPa with all accessories such as bolt/nuts, washers, plates, tie rods etc., including cutting, drilling, cold bending, welding, threading, leveling, aligning and fixing in position of all rods, gusset/ wall plates, pre-stressing by blocking against rock-surface etc. as per approved drawings and Specifications or as directed by Engineer with contractor's men, material, consumables, tools and plants, equipments, machineries, including all lead and lift, loading, unloading. Rate to cover supports & scaffoldings required during the course of erection etc. complete. Note: Payment for supply of structural steel shall be paid as per approved drawing (excluding all wastages) seperately as per item B3.3.	MT	299.0	34757.00	10392343.00	9.4.2, 9.4.3, 9.6.1
8	B1.4.2	**Lattice Girders:** Fabrication and erection of lattice girders using high strength reinforcing steel Fe-500D with all accessories such as bolt/nuts, washers, plates, tie rods etc, including all lead, lift, wastage, storing, drilling holes, fixing in phases etc. and installation of accessories for joining the Lattice girder segments and fixing into place as per approved drawings and Specifications or as directed by Engineer. The rate shall include costs of all materials except as noted below, labour, equipment, welding, etc for the complete job including additional cost for enlargement of top heading footing. (Payment for supply of reinforcement steel (excluding all wastages) will be made separately as per item B3.2.	MT	1684.00	31126.00	52416184.00	9.4.5, 9.6.2
B1.5 - REINFORCEMENT and Misc.							
9	B1.5.1	Wire Mesh: Supply, cutting, placing and fixing into position with appropriate anchors of 150x150x6 mm or 100x100x4 mm welded wire fabric of Yield stress ≥ 480 MPa as reinforcement in primary lining & inner lining with contractors men,material, cost of pins, hooks, consumables , tools & plants, equipments, machnieries, including all lead & lifts, loading , unloading, handling, wastage. Note: Measurement for payment for welded wire mesh provided shall be for the net area (without overlaps) actually installed.	MT	1476.00	104564.00	154336464.00	10.12.2, 10.15.4
10	B1.5.2	**Lining Stress controlers:** Providing and fixing lining stress Controllers (LSC) as per approved drawings and as per technical specification with contractor's men, material, consumables, tools & plants, equipments, machineries, including all lead & lifts, loading, unloading and as directed by Engineer-in-Charge, etc complete.	MT	1475.00	109389.00	161348775.00	9.4.6, 9.5.13, 9.6.4
					Sub Total Amount	**4,15,64,27,840.00**	

Bill No. B2: Support System: Shotcrete and Concrete Works							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
B2.1 - SHOTCRETE WORKS							
1	B2.1.1	M30 Shotcrete : Shotcreting with wiremesh/fibers as per design mix Shotcrete grade M30 as per approved drawings and Specifications or as directed by Engineer, in following works with contractors men, material, consumables (including additives), tools & plants, equipments , machineries, including all lead & lifts, loading, unloading, wastages, rebound, curing etc - Note : i) **Rates are inclusive of Cement.** Nothing extra will be paid for rebound. Note : ii) Payment for Supply of wiremesh / fibers will be done separately.					8.5.2, 8.5.3, 11.11, 11.13
	B2.1.1.1	Primary lining: Theoretical volume of primary (outer) lining of Tunnel & Niches as defined on the drawing and theoretical quantity computed for fixed thickness of 75mm at "A" Line as compensation for filling of irregular excavated profile.	Cum	122612.00	15748.00	1930893776.00	
	B2.1.1.2	**Secondary lining:** Shotcrete for Secondary (inner) lining of Tunnel & Niches. Measurement will be done for theoretical volume of secondary lining as defined on the drawing and volume corresponding to part of deformation not taking place. **Note: i) The rate includes cost of levelling, smoothening and finishing of exposed surfaces, curing etc.**	Cum	2530.00	16591.00	41975230.00	
	B2.1.1.3	Face ceiling, Filling of cavities, filling of GOB (Beyond "A" Line), filling shotcrete incase of pipe roof, widening of top heading footing, temporary shotcrete in multi drifting in tunnel as a complete job as per drawings and specifications and as directed by Engineer-in-Charge.	Cum	10439.00	15748.00	164393372.00	
	B2.1.1.4	100 mm/ 150mm thick sprayed concrete with grade M30 in slope stabilization with 100 mm/150mm (minimum) thickness as a complete job as per specifications and as directed by Engineer-in-Charge.	Cum	3452.00	15748.00	54362096.00	
	B2.1.1.5	30 mm average thickness of M30 shotcrete as smoothing layer and support of the waterproofing membrane, complying the requirement in planarity.	Sqm	354960.00	472.00	167541120.00	4.4.3(ix)A(b)
2	B2.1.2	Extra over item B2.1.1 for using Robo arm PLC controlled shotcrete with Low Pulsation S-Valve equipment as defined in works requirement in lieu of Non-PLC Old generation shotcrete equipment.	Cum	146748.00	832.00	122094336.00	
B2.2- CONCRETE WORKS							
3	B2.2.1	M30 & M25 Concrete: Design mix cement concrete as per approved drawings and Specifications or as directed by Engineer, in following works including machine mixed, machine batched, machine vibrated with contractor's men, material, consumables (including additives), tools & plants, equipments, machineries, all lead & lifts, loading, unloading, wastages etc complete. The rate includes cost of form work, shuttering, centering, scaffolding, fixing and removing thereof, levelling, finishing of exposed surfaces, curing etc. Note : a) **Rates are inclusive of Cement.** Note : b) Payment for fabrication and supply of reinforcement steel / fibers (excluding all wastages) shall be paid as per approved drawing separately.					15.3, 15.10, 15.20.1
	B2.2.1.1	M30 RCC for **Final** (Inner) lining of main tunnel & niches with Movable Shutter with hydraulic moving and adjustment facilities.	Cum	119549.00	11469.00	1371107481.00	
	B2.2.1.2	M30 RCC for **Final** (Inner) lining of main tunnel & niches (Invert slab , foundation beams)	Cum	22526.00	10481.00	236095006.00	
	B2.2.1.3	M30 RCC for small cast in place or precast, lightly reinforced concrete structures such as: manholes, drainage channels or gutters, cable troughts, concrete covers etc. Price includes supply and installation of cement mortar bed for levelling of precast elements.	Cum	11689.00	7835.00	91583315.00	
	B2.2.1.4	M25 concrete for **Primary** (outer) lining of Tunnel or Niches, temporary invert or back fill concrete or in lieu of shotcrete where shotcrete can not be applied because conditions in the tunnels will not allow it. The rate includes cost of form work, shuttering, centering, scaffolding, fixing and removing thereof, levelling, finishing of exposed surfaces, curing etc.	Cum	17375.00	7484.00	130034500.00	

Bill No. B2: Support System: Shotcrete and Concrete Works							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
4	B2.2.2	**M20 Concrete**: Design mix cement concrete M20 as per approved drawings and Specifications or as directed by Engineer, in following works including machine mixed, machine batched, machine vibrated with contractor's men, material, consumables (including additives) , tools & plants, equipments, machineries, all lead & lifts, loading, unloading, wastages etc complete. The rate includes cost of form work, shuttering, centering, scaffolding, fixing and removing thereof, levelling, finishing of exposed surfaces, curing etc. Note: a) **Rates are inclusive of Cement.** Note: b) Payment for supply of reinforcement steel shall be paid as per approved drawing (excluding all wastages)seperately.					15.3, 15.10, 15.20.1
	B2.2.2.1	Concrete above invert slab between foundation beams and walls of tunnel & niches up to the designated level.	Cum	32485.00	5795.00	188250575.00	
	B2.2.2.2	Encasing concrete: concrete placed around cable conduits, precast drains or cable trenches for encasement, below precast units for leveling etc.	Cum	9290.00	5795.00	53835550.00	
5	B2.2.3	Supplying and fixing footpath slabs in reinforced cement concrete in M-20 mix as per approved drawings and Specifications or as directed by Engineer (as drain covers in tunnels), with contractors 20mm approved graded stone aggregates and sand of approved quality, with contractors men, material,consumables,tools and plants, equipments, machnieries, including all lead and lift, loading , unloading etc. complete .The rate includes cost of form work, shuttering, centering, fixing and removing thereof,curing, levelling, finishing of exposed surfaces, mixing of concrete in mechanical mixer, compaction with mechanical/ electrical vibrators etc. Note: a) **Rates are inclusive of Cement.** Note: b) Payment for supply of reinforcement steel if any , shall be paid separately.	Cum	1710.00	5676.00	9705960.00	15.3, 15.10, 15.20.1
6	B2.2.4	M15 Concrete: Design Mix cement concrete M15 as per approved drawings and Specifications or as directed by Engineer,in following PCC works including mechanically mixed, machine batched, machine vibrated with contractors men, material, consumables (including additives), tools & plants, equipments, machineries, all lead & lifts, loading , unloading, wastages etc complete. The rate includes cost of form work, shuttering, centering, scaffolding, fixing and removing thereof, levelling, finishing of exposed surfaces, curing etc. **Note: Rates are inclusive of Cement.**					15.3, 15.10, 15.20.1
	B2.2.4.1	Fill concrete in tunnel.	Cum	5.00	7808.00	39040.00	
	B2.2.4.2	Blinding concrete in tunnel, lean concrete etc	Cum	3.00	7808.00	23424.00	
7	B2.2.5	No-fines porous concrete in tunnel. **Note: Rates are inclusive of Cement.**	Cum	516.00	7086.00	3656376.00	
8	B2.2.6	Cement concrete M-10 mix laid in situ by approved mechanical means by concrete pump, placer or similar equipment in back filling the gap between concrete lagging and excavated line for side walls, roof of tunnel and man refuges, etc. with 20mm graded stone aggregates and sand of approved quality with contractors men, material, consumables,tools and plants, equipments, machnieries, including all lead and lift, loading , unloading as directed by Engineer-in-Charge etc. complete.The rate includes cost of form work, shuttering, centering, scaffolding, fixing and removing thereof,curing, levelling, mixing of concrete in mechanical mixer, compaction with mechanical/ electrical vibrators etc. Note : **Rates are inclusive of Cement.**	Cum	250.00	6946.00	1736500.00	15.3, 15.10, 15.20.1
9	B2.2.7	Supplying and fixing 50 mm or 75 mm thickness precast RCC lagging of M 20 grade Mix, as per approved drawing over permanent tunnel supports continously placed and closed spaced with 20 mm graded stone aggregates and sand of approved quality with contractors men, material,consumables,tools and plants, equipments, machnieries, including all lead and lift, loading , unloading etc. complete .The rate includes cost of form work, shuttering, centering, fixing and removing thereof,curing, levelling, finishing of exposed surfaces, mixing of concrete in mechanical mixer, compaction with mechanical/ electrical vibrators etc. Note:- a) **Rates are inclusive of Cement** Note: b) Payment for supply of reinforcement steel shall be paid seperatly	Cum	6.00	6234.00	37404.00	9.4.4, 9.6.3
					Sub Total Amount	**4,56,73,65,061.00**	

Bill No. B3: Supply of Steel Material							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
1	B3.1	**Supplying TMT Fe-500D reinforcement steel** conforming to IS:1786-1985 including decoiling, straightening, cutting, bending, placing in position, binding with 1mm dia GI binding wire. **Note :** 1. Reinforcement, shall be measured in length for different diameters used in the works and then paid as per standard weights as per IS 1732. Wastages, overlaps, coupling, welded joints, space bars, chairs and binding wire shall not be measured and cost of these items shall be deemed to be included in the rates.	MT	11007.00	82942.00	912942594.00	12.1, 12.9, 3.8 & 3.11
2	B3.2	Supplying TMT Fe-500D reinforcement steel conforming to IS:1786-1985 including all lead lift, labour, loading unloading, ascent, descent, crossings, royalty, taxes, transport (contractor's own), tools and plant complete.	MT	1684.00	58548.00	98594832.00	3.8 & 3.11
3	B3.3	Supply of structural steel of various sections confirming IS 2062 of Grade-A from approved manufacturers at various sites including all transportation and freight charges and all taxes, duties etc. with contractors men, material, tools & plants, equipments, machineries, testing, all lead & lifts, loading , unloading , etc complete	MT	299.00	60690.00	18146310.00	3.8 & 3.11
					Sub Total Amount	**1,02,96,83,736.00**	

Bill No. C: Drainage and Miscellaneous Work							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
C1 - PERMANENT DRAINAGE							
1	C1.1	Drainage pipe: Providing and laying of HDPE pipe of following diameters in Tunnel as main collector pipe, connection pipes, cleaning access pipes, pipe sleeves and all fittings e.g. elbows, Tee's etc, including the cost of all materials, labour, equipments etc required for the completion of job as per approved drawings as a complete job as per IS : 14333 (Pressure Rating of PN-2.5) and as directed by Engineer-in-Charge					
	C1.1.1	400 mm dia pipe (main collector pipe)	Meter	9410.00	4,939.00	46475990.00	
	C1.1.2	315 mm dia pipe (main collector)	Meter	9410.00	3,059.00	28785190.00	
	C1.1.3	200 mm dia pipe	Meter	374.00	2,039.00	762586.00	
	C1.1.4	160mm dia pipe (connection pipes, cleaning access pipes)	Meter	409.00	1,530.00	625770.00	
2	C1.2	Perforated drainage pipe: Providing and laying of perforated (slotted) PVC pipe wrapped with geotextile, of following diameters in tunnel as lateral drainage pipes along the sidewalls and C&C with all fittings e.g. sleeves, Tee's etc, including the cost of all materials, labour, equipments etc. as per required for the completion of job as per approved drawings as a complete job as per IS 16098 Part-2 with perforation as per IS 9271 and as directed by Engineer-in-Charge.					
	C1.2.1	150 mm dia pipe (lateral drainage pipe)	Meter	38456.00	418.00	16074608.00	
	C1.2.2	200 mm dia pipe (lateral drainage pipes)	Meter	1000.00	744.00	744000.00	
	C1.2.3	250 mm dia pipe (lateral drainage pipes)	Meter	1000.00	1285.00	1285000.00	
3	C1.3	Providing and installing PVC pipes of following diameters in the tunnel including the cost of all materials, labour, equipments etc required for the completion of job as per approved drawings as a complete job as per IS Code 13592 and as directed by Engineer-in-Charge.					
	C1.3.1	75 mm internal diameter PVC pipe	Sqm	1000.00	71.00	71000.00	
	C1.3.2	110 mm internal diameter PVC pipe	Sqm	1000.00	119.00	119000.00	
	C1.3.3	160 mm internal diameter PVC pipe	Sqm	1000.00	153.00	153000.00	
3	C1.4	Providing and installing of perforated PVC pipes in drill holes in the tunnel protected by geotextile membrane, of following diameters including the cost of all materials, labour, equipments etc required for the completion of job as per approved drawings as a complete job as per IS 12818 (Plain/Casing Pipes) and as directed by Engineer-in-Charge.					
	C1.4.1	50 mm internal diameter PVC pipe	Meter	10000.00	142.00	1420000.00	
	C1.4.2	80mm internal diameter PVC pipe	Meter	4000.00	213.00	852000.00	
	C1.4.3	100 mm internal diameter PVC pipe	Meter	4000.00	285.00	1140000.00	
4	C1.8	Drilling of 40mm dia holes in shotcrete lining as weep holes/relief holes of required length in any direction of following length as per approved drawings as a complete job as per specifications and as directed by engineer in charge					
	C1.8.1	In underground, L=0.7m, 4 holes every approx 2m	Meter	18000.00	225.00	4050000.00	
	C1.8.2	In Open excavation, L =1.0m, every approx. 4sqm	Meter	1000.00	320.00	320000.00	
	C1.9	Drainage holes upto 35m length, 10m overlap for followings as per approved drawings as a complete job as per specifications and as directed by Engineer in charge					
	C1.9.1	Horizontal/ Sub horizontal in all kinds of rocks, diameter 50 to 90mm	Meter	4000.00	1258.00	5032000.00	

Bill No. C: Drainage and Miscellaneous Work							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
5	C1.9.2	Horizontal/ Sub horizontal in all kinds of soft ground, diameter 50 to 90mm	Meter	3000.00	2364.00	7092000.00	
	C1.9.3	Horizontal/ Sub horizontal in all kinds of rocks, diameter greater than 90mm	Meter	300.00	2172.00	651600.00	
	C1.9.4	Horizontal/ Sub horizontal in all kinds of soft ground, diameter greater than 90mm	Meter	200.00	4079.00	815800.00	
C2 - WATERPROOFING							
6	C2.1	**Geotextile**: Providing, laying and fixing of protective felt (geotextile) as per approved drawings and Specifications or as directed by Engineer,with a minimum weight of 500 g/m2 for protection of the waterproofing membranes & drainage on the finished outer lining surface including the cost of all materials, labour, equipments, etc required for the completion of job	Sqm	354960.00	455.00	161506800.00	4.4.3 (viii), 4.4.3 (ix)
7	C2.2	Membrane: Providing, placing, welding of 2mm thick PVC Water Proofing membrane with 20mm thick HDPE dimple sheet as per approved drawings and Specifications or as directed by Engineer including the cost of all materials, labour, equipments, etc. required for the completion of job.	Sqm	354960.00	1779.00	631473840.00	4.4.3 (viii), 4.4.3 (ix)
8	C2.3	Waterstops: Supply and installation of PVC waterbars and Hydrophilic waterstops with all accessories and special junctions for splicing, securing into place and protecting during concreting works , including the cost of all materials and junction pieces, labour, equipments, etc required for the completion of job.					
	C2.3.1	Construction Joints: PVC waterstop serrated with central bulb (240 mm wide, 8-11mm thick)	Meter	37401.00	672.00	25133472.00	
	C2.3.2	Power consumed for Pumping of Water as per the requirements and as per specificationd and as directed by the Engineer.(Payment will be made only for actual power consumed for Dewatering as per specifications and as per the certfied Log Book by the Engineer.) Note: Cost of Furnishing, Transporting, Installing the equipments and system including Pneumatic Pumps and its maintainance is covered under item A1 and A3.	kWh	1000000.00	25.00	25000000.00	4.6.1 (ii)
C3 - EARTHING							
9	C3.1	Earthing					
	C3.1.1	Longitudinal earthing flat bar, 40 x 4mm Galvanized iron, both sides of the Tunnel.	Meter	37640.00	202.00	7603280.00	
	C3.1.2	Transversal earthing flat bar, 40 x 4 mm, Galvanized Iron, incl. Extensions, Every 250m.	Meter	726.00	202.00	146652.00	
	C3.1.3	Connection bolts M8 with correspondent nuts and washers, made of brass.	Each	50.00	133.00	6650.00	
C4 - ELECTRICAL CABLE CONDUITS							
10	C4.1	Cable Ducts: Providing, laying and encasing in concrete PVC main longitudinal pipe and cross pipe of following diameters as electrical conduits with all fittings e.g. couplers, elbows etc, including the cost of all materials, labour, equipments etc. The cost of encasing concrete, concrete junction boxes, inspection pits or cable pull boxes will be covered separately as per relevent Indian Standard					
	C4.1.1	Cable Ducts diam. 50 mm pipe	Meter	21,643	133	2878519.00	
	C4.1.2	Cable Ducts diam. 70 mm pipe	Meter	18,820	190	3575800.00	
	C4.1.3	Cable Ducts diam. 100 mm pipe	Meter	18820.00	235.00	4422700.00	
	C4.1.4	Cable Ducts diam. 120 mm pipe	Meter	9410.00	282.00	2653620.00	
	C4.1.5	Cable Ducts diam. 160mm pipe	Meter	18820.00	385.00	7245700.00	
C5 - TUNNEL HAZARD WORKS							
11	C5.1	Placing in position of sand bags including supplying sand and filling the same in empty bags and tying with contractors binding wire, leading to tunnel site with contractors men, material, consumables, tools and plants, equipments, machIneries, including all lead and lift, loading, unloading etc. complete.	No.	9411.00	50.00	470550.00	

Bill No. C: Drainage and Miscellaneous Work							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
12	C5.2	Removal of sand bags, when not required and disposal thereof with contractors men, material, consumables, tools and plants, equipments, machineries, including all lead and lift, loading, unloading etc. complete	No.□	9411.00	13.00	122343.00	
13	C5.3	Supply ,manufacture and erection in position of temporary supports/ struts in hazardous position. Payment for supply of steel shall be paid as per approved drawing (excluding all wastages) seperately.	MT□	17.00	40819.00	693923.00	
14	C5.4	Dismantlling of existing permanent/ temporary supports and leading the cut supports to contractor's store/ depot etc with contractor's men,material, consumables, tools & plants, equipments, machineries, including all lead & lifts, loading, unloading, etc complete. Note: 1) Released material will be the property of contractor 2) Recovery of Rs 17500/MT will be recovered for the released structural steel	MT□	13.00	13182.00	171366.00	
15	C5.5	Cavity concreting through bores/pipes (Bores/pipes to be paid separately as specified below) with concrete of grade M10 or any approved mix using 10mm size aggregate with contractors men, material, consumables,tools and plants,equipments, machineries , including all lead and lift, loading , unloading etc. complete. Payment for supply of cement will be made separately as per actual consumption or approved mix proportions (nominal / design), which ever is lower.	Cum□	4484.00	3631.00	16281404.00	
16	C5.6	Drilling of bores 100 to 150mm dia. for cavity concreting through all types of soil/rock etc. with contractors men, material, consumables,tools and plants,equipments, machnieries , including all lead and lift, loading , unloading etc. complete(LS)	RMT□	2.00	3716.00	7432.00	
17	C5.7	Drilling holes upto 38mm dia. and upto 4000mm deep inside concrete or shotcrete or rock for contact or pressure grouting etc. with contractors men, material, consumables,tools and plants,equipments, machnieries , including all lead and lift, loading , unloading etc. complete.	RMT□	3.00	446.00	1338.00	
18	C5.8	Supplying and fixing of 100 to 150mm dia. MS pipe ('C' class) in bore holes for cavity concreting/ fixing with contractors men, material, consumables,tools and plants,equipments, machnieries , including all lead and lift, loading , unloading etc. complete.	RMT□	5.00	4706.00	23530.00	
19	C5.9	Fixing of anchor bars with contractors men, material, consumables,tools and plants,equipments, machnieries , including all lead and lift, loading , unloading etc. complete.	RMT□	15.00	557.00	8355.00	
20	C5.10	Forepoling with suitable structural steel (MS angles, Joist, rods etc.) including cutting to the required length, welding & driving in position with contractors men, material, consumables,tools and plants,equipments, machineries , including all lead and lift, loading,unloading etc complete. Note: 1. Payment for supply of reinforcement steel shall be paid separately. Note 2:-Payment for supply of structural steel shall be paid as per approved drawing (excluding all wastages) seperately.	MT□	10.00	21145.00	211450.00	
C6 - MISCELLENEOUS ITEMS							
21	C6.2	Providing & fixing Porta cabin of approved make (20ft x 10ft) with furnishing & toilet block facility at the designated places including the cost of all materials, labour, equipments, etc required for the completion of job. Note:- The contractor shall arrange for preperation of plinth for proper placement of these porta cabins.	Nos	3.00	508993.00	1526979.00	

Bill No. C: Drainage and Miscellaneous Work							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
22	C6.3	Providing and Fixing of safety fencing with 3 m high pre-coated GI corrugated sheet 0.50 mm, (+0.05%) total coated thickness, with 3.5 m high builtup tabular section as approved by Engineer in Charge placed every 1.8 m c/c founded in 1:2:4 grade concrete of size 60cm X 60cm X 60cm and buttress of same section at 5.4m c/c, similarly founded as verticals, with horizontal runners @ 600 mm c/c complete in all respect including all leads, lifts, ascents, descents etc. Cost of all materials and its maintenance till completion of work is deemed to be included in the rates. Item used as specified in DSR April 2019. **Note- Rates include posting charges of look out men (Minimum 02 men per shift per work site)on National Highway on either side of the work location.**	Sqm	3000.00	1894.00	5682000.00	
C7 - DISMANTLING, CLEANING REPAIR AND RESTORATION							
23	C7.1	Dismantling/ breaking Reinforced cement concrete including clearing of site and leading of broken concrete to disposal site with contractors men,material,consumables, tools & plants, equipments, machinaries, including all lead & lifts, loading , unload etc. complete.	Cum	25.00	9688.00	242200.00	
24	C7.2	Dismantling cement concrete including clearing of site and leading of broken concrete to disposal site with contractors men,material,consumables, tools & plants, equipments, machinaries, including all lead & lifts, loading , unloading , etc. complete	Cum	25.00	9688.00	242200.00	
25	C7.3	Dismantling stone work including clearing of site and stacking of the dismantled material with contractors men, material, consumables, tools & plants, equipments, machineries, all lead & lifts, loading, unloading etc. complete.	Cum	25.00	315.00	7875.00	
					Sub Total Amount	1,01,38,09,522.00	

Bill No. D-1: Ancillary Work							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
1	D1.1	Percussion Drilling of Holes for Probe/Grout Holes (Dia. 50-65mm).	RM	84194.00	836.00	70386184.00	14.10,14.13.2.ii
2	D1.2	Placing of Grout for consolidation grouting. Note: Grout material pumped inside hole will be paid separately.	Each Hole meter	2612.00	115.00	300380.00	14.10,14.12,14.13.3
3	D1.5	Carrying out Tunnel Seismic Prediction (TPS) Survey/ Measurement in tunnel with data processing, evaluation and Report submission in 3 copies (Hard and Soft) inculding all preparatory works and mobilization of requisite machineries, equipment, manpower, expert personnel and other field expenses, if any, including all lead and lift, taxes etc. complete.	Each Job	20.00	973017.00	19460340.00	8.13.1, 8.13.8
					Sub Total Amount	**9,01,46,904.00**	

Bill No. D-2: Supply of Grouting Material							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
1	D2.1	Supply of 53 grade cement OPC conforming to IS: 12269 with latest amendments and using the same in the work as per RVNL's approved mix design as per RVNL's prescribed rates of consumption including all lead lift, labour, loading unloading, ascent, descent, crossing of Railway lines(s), royalty, taxes, transport (contractor's own), tools and plant complete.	MT	4234.00	8920.00	37767280.00	14.7.3, 14.13.3.iii.A,3.7, 14.7.3, 14.13.3.iii.A
2	D2.2	Additional for Supply of 53 S Grade Cement OPC conforming to IS: 12269 with latest amendments over and above item D2.1	MT	2381.00	100.00	238100.00	11.6.2, 3.7, 11.6.2, 14.7.3 &14.13.3.iii.A
3	D2.3	Supply of Micro Fine Cement (D95<15 Microns)	MT	731.00	78993.00	57743883.00	14.7.4,14.13.3.iii .A
4	D2.4	Supply of Ultra Fine Cement (D95<12 Microns)	MT	400.00	97389.00	38955600.00	14.7.5,14.13.3.III .A
5	D2.5	Supply of Colloidal Silica MastreRoc MP 320 or Normet 400CS or similar	MT	230.00	153658.00	35341340.00	14.7.6,14.13.3.III .A
6	D2.6	Supply of two component PU grout like MastreRoc 364 Flex or TamPur 116T or similar (More than 35 Mpa compressive strength)	MT	160.00	509669.00	81547040.00	14.7.9,14.13.3.III .A
7	D2.7	Supply of two component PU grout (upto 40 times expansion)	MT	160.00	946838.00	151494080.00	14.7.9,14.13.3.III .A
					Sub Total Amount	**40,30,87,323.00**	

Bill No. E2: Supply of fibres for Tunnel							
S.No.		Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
1	E2.1	Poly fibers: Supply, weighing and mixing in shotcrete of PP Fiber- Class II (EN 14889-2), 45-55 mm long, Aspect Ratio ≥ 64, tensile strength ≥ 550 Mpa and Modulus of Elasticity ≥ 5GPa. Note: Supply of fibers shall be paid as per approved design mix for the volume of Primary / Secondary Lining measured for payment and Nothing will be paid for rebound or any wastage.	MT	190.00	562280.00	106833200.00	11.6.4, 11.9.3
2	E2.2	Poly fibers: Supply, weighing and mixing in final lining of PP Fiber- Class Ia (EN 14889-2), mono filament length 5-7mm, diameter < 20 microns, Melting point ≤ 165c. Supply of fibers shall be paid as per approved design mix for the volume of Lining measured for payment and Nothing will be paid for any wastage.	MT	180.00	478981.00	86216580.00	15.4.5
					Sub Total Amount	**19,30,49,780.00**	

Bill No. F: Monitoring of excavations/construction							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
1	F101	Bi-Reflex Paper target points along with break off point & 500 mm long 3D	Each	3998.00	3188.00	12745624.00	6.8.5.v,6.11
2	F102	Topographical markers/Survey Points	Each	200.00	2053.00	410600.00	6.7.3,6.11
3	F103	Vibrating wire type Load Cells Measuring Range: 30 T Over Range Limit: 150% with 20m cable	Each	445.00	23949.00	10657305.00	6.8.2,6.11
4	F104	Measuring Tape Extensometer Measuring Range: 30 m	Each	134.00	88953.00	11919702.00	6.8.4,6.11
5	F105	Tape Convergence Points	Each	800.00	616.00	492800.00	6.8.5,6.11
6	F106	Multiple point borehole extensometer 4 points (2m, 5m, 10m, 20m) Measuring Range: 50 mm	Each	60.00	71162.00	4269720.00	6.8.6,6.11
7	F107	Portable read out units for vibrating wire type instruments	Each	4.00	102638.00	410552.00	6.9,6.11
8	F108	Automatic weathering station with wind speed, air temperature, rainfall, relative humidity	Nos.	2.00	478975.00	957950.00	6.7.5,6.11
9	F109	Charges for permanent posting of Instrumentation Engineer	Month	54.00	205275.00	11084850.00	6.11.2
10	F110	Multi core cables					
	F110.1	12 core jelly filled armoured cable	RM	20000.00	226.00	4520000.00	6.7.6, 6.11
11	F111	Cable splicing kit	Each	400.00	547.00	218800.00	6.7.7, 6.11
12	F112	10 Channel Junction Box	Each	70.00	15054.00	1053780.00	6.7.8, 6.11
13	F113	Seepage Discharge measuring device	Each	70.00	68425.00	4789750.00	6.7.4, 6.11
					Sub Total Amount	**6,35,31,433.00**	

Bill No H: Approach Road for Tunnel and Muck Dumping Site							
S.No.	Item No	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
1	H1	**Construction of Embankment with materials deposited from Roadway/Hill side cutting:** Construction of embankment with approved/suitable materials deposited at site i.e. obtained from road way & hill cutting and excavation from drain and foundation of other structures, graded and compacted to meet requirement of table No.300-2 of MORT&H including all leads and lifts all complete as per drawings and Technical Specifications Clause 305 of MORT&H. (Materials as obtained from excavation and hill cutting will be used for construction of embankment on approval of Engineer in Charge).	Cum	12000	150.30	18,03,600.00	
2	H2	**Stone masonry work in cement mortar (1:3)** in substructure, retaining walls, breast walls and parapets, culverts etc all complete as per drawing and Technical Specifications section 1400 & 2706 of MORT&H including providing weep hole of size 110mmx80mm or 110 mm diameter. (Rate is inclusive of cement and form work as required)					
	H2.1	Random Rubble Masonry	Cum	4000	4357.00	1,74,28,000.00	
3	H3	Providing **PCC 1:3:6** nominal mix cement concrete in levelling course or foundation of retaining wall, wing wall, breast wall, drain, culvert, etc. with crushed stone aggregates 40 mm nominal size mechanically mixed, placed in foundation or any other place and compacted by vibration including curing for 14 days and centering & shuttering all complete as per drawing and Technical Specificationss Sections 1500 & 1700. (Rate is inclusive of cement).	Cum	600	5286.00	31,71,600.00	
4	H4	Providing **Plain/Reinforced** cement concrete in open foundation, coping of walls, retaining wall, wing wall, breast wall, drain, culvert, etc. with crushed stone aggregates 40 mm nominal size mechanically mixed, placed in foundation or any other place and compacted by vibration including curing for 14 days and centering & shuttering all complete as per drawing and Technical Specifications Sections 1500 & 1700. (Rate is inclusive of cement).				-	
	H4.1	PCC Grade M15	Cum	500	6119.00	30,59,500.00	
5	H5	**Laying Reinforced Cement Concrete Pipe NP4/ prestressed concrete pipe on first class bedding in Single row:-** Laying Reinforced Cement Concrete Pipe NP4 (IS-456) / prestressed concrete pipe for culverts on first class bedding of granular material in single row including fixing collar with cement mortar 1:2 but excluding excavation, protection works, backfilling, concrete and masonry works in head walls and parapets all complete as per drawings and Technical Specificationss Sections 2900 of MORT&H).				-	
	H5.1	1000 mm dia	Meter	800	7478.00	59,82,400.00	
6	H6	**Granular Sub-Base with Coarse Graded Material (Table: 400-2):-** Construction of granular sub base by providing coarse graded material, spreading in uniform layers with motor grader on prepared surface, mixing by mix in place method with rotavator at OMC, and compacting with vibratory roller to achieve the desired density, complete as per Technical specifications clause 401 and Grading Table:400-1 of MORT&H as decided by Engineer in Charge.				-	
7	H6.1	For grading-I material	Cum	800.00	2458.00	19,66,400.00	
	H6.2	For grading-III material	Cum	300.00	2550.00	7,65,000.00	

Bill No H: Approach Road for Tunnel and Muck Dumping Site							
S.No.	Item No	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
8	H7	**Water Bound Macadem:-** Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with vibratory roller 8-10 tonnes in stages to proper grade and camber, applying and brooming requisite type of screening/binding materials to fill up the interstices of coarse aggregate, watering and compacting to the required density all complete as per Technical Specifications clause No.406 of MORT&H. By Mechanical means Grading-I (Using Screening Crushable type such as Moorum or Gravel) Using Screening Type-A (13.2mm Agg.)	Cum	800.00	2872.00	22,97,600.00	
9	H8	Dense Graded Bituminous Macadam:- Providing and laying dense bituminous macadam with 100-120 TPH batch type HMP producing an average output of 75 tonnes per hour using crushed aggregates of specified grading, premixed with bituminous binder @ 4.0 to 4.5% by weight of total mix of mix and filler, tranporting the hot mix to work site, laying with a hydrostatic paver finisher with sensor control to the required grade, level and alignment, rolling with smooth wheeled, vibratory and tandem rollers to achieve the desire compaction as per MORT&H specification clause No.507 complete in all resect.				-	
	H8.1	For grading II (19 mm nominal size)	Cum	700	9618.00	67,32,600.00	
10	H9	**Prime Coat:** Providing and applying primer coat with bitumen emulsion on prepared surfaces of granular base including clearing of road surfaces and spraying primer at the rate of 0.60 Kg/Sqm using mechanical means all complete as per Technical Specifications Clause 502 of MORT&H.	Sqm	4000	27.78	1,11,120.00	
	H10	**Tack Coat:** Providing and applying tack coat with bitumen emulsion using emulsion pressure distributor at the rate of 0.20 Kg per Sqm on the prepared bituminous/granular surface cleaned with mechanical broom all complete as per Technical specification Clause 503 of MORT&H.	Sqm	4000	10.19	40,760.00	
11	H11	**Open-Graded Premix Surfacing:** Providing, laying and rolling of open-graded premix surfacing of 20 mm thickness composed of 13.2 mm to 5.6 mm aggregates either using penetration grade bitumen or cut back or emulsion to required line, grade and level to serve as wearing course on a previously prepared base, including mixing in a suitable plant, laying and rolling with a smooth wheeled roller 8-10 tonne capacity, finished to required level and grades all complete as per Technical Specifications clause 510 of MORT&H.				-	
	H11.1	Mechanical method using Penetration grade Bitumen and HMP of appropriate capacity not less than 75 tonnes/hour.	Sqm	4000	155.34	6,21,360.00	
12	H12	**Seal Coat:** Providing and laying seal coat sealing the voids in bituminous surface laid to the specified levels, grade and cross fall using Type A and B seal coats all complete as per Technical Specificaions clause 511 of MORT&H.				-	
	H12.1	Seal Coat - Type A	Sqm	4000	69.22	2,76,880.00	
13	H13	Maintanence of Tunnel invert Road surface and all approach roads from the NH-58 to work sites i.e.portals, Bridges, Muck Dumping Sites in good motorable condition in all respects and at all times to the satisfaction of the Engineer. This shall include scheduled maintanence with grader for removal of undulations, potholes etc. of all such roads atleast twice in a month. Cost of all material will be paid separately under schedule H	Maintanence Months	54	544420.00	2,93,98,680.00	
					Sub Total Amount	**7,36,55,500.00**	

Bill No. J: Environment Management Plan							
S.No.	Item No.	Description of item	Unit	Quantity	Rate (In Rs.)	Amount (In Rs.)	Reference to Work Requirement (Section-5)
1	J1	Monitoring of Environmental Attributes during Construction Activity					
	J1.1	Air Quality (Ambient Air Quality monitoring, as per NAAQM guide lines) and assess parameters such as Sulphur Dioxide (SO2), Oxides of Nitrogen (NOX), Carbon Monoxide (CO), Hydro-Carbons (HC), Suspended Particulate Matter (SPM), Respirable Particulate Matter (RPM), Ammonia (NH3), Ozone (O3), Lead (Pb), Benzo (a) pyrene (BaP), Arsenic (As) and Nickel (Ni)).					
	J1.1.1	Monitoring of Air Quality	Each Sample	300.00	8501.00	2550300.00	1.1,1.3.14,1.4.2
2	J1.2	Noise Levels (Noise level monitoring for monitoring Noise level on db (A) scale as per CPCB standard specifications)					
	J1.2.1	Monitoring of Noise Levels at Equipment Yards	Each Sample	300.00	5667.00	1700100.00	1.4.2
3	J1.3	Water Quality (Water Quality (As per IS 10500 and IS 2296) for parameters such as pH, BOD, COD, TDS, Pb, Oil & Grease and detergents for surface water, Water pH, TDS, Total hardness, Sulphate, Chloride, Fe and Pb).	Each Sample	300.00	8501.00	2550300.00	1.4.2
					Sub Total Amount	**68,00,700.00**	

Form KEYP-1, Form KEYP-2, Form P&M-1, Form P&M-2, Form INS-1 & Form INS-2

Form KEYP-1

List of Key Personnel/Engineers
Proposed to be deployed according to Section: 5 Work's Requirement

1. Each Bidder or each member of a JV must fill in this form separately according to their role and responsibilities
2. Proposed Organisation chart and Details of Key Personnel/Engineers having prescribed experience shall be in submitted in Form KEYP-2.

Sl No	Name	Designation	Qualification	Professional Experience in any of the Key Activities	Name of the work and location where working
1	Pedada Syamala Rao	Project Manager/ Team Leader	B. Tech in Civil Engineering	• Total Work Experience is 31.5 Years	Pranahita – Chevella Lift Irrigation Scheme – Link IV – Package XII at Karimnagar, Telangana from past 2.5 years in Tunneling Work with MEIL.
2	Vijay Kumar Singh	Technical / Design manager	B. Tech in Civil Engineering	• Total Work Experience is 23 Years	J. Chokka Rao Devadula Lift Irrigation Scheme Circle – Phase III – Package III at Warnangal, Telangana from past year in Tunneling work with MEIL.
3	Guggulla Sreenatha Reddy	Tunnel construction Manager	Diploma in Civil Engineering	• Total Work Experience is 30 Years	Lift Irrigation Scheme – Veligonda Tunnel I Balance Work at Prakasam District, Andhra Pradesh from Past 6 5 year in Tunneling work with MEIL.
4	Pedada Syamala Rao	Tunnel construction Manager	B. Tech in Civil Engineering	• Total Work Experience is 20 Years	Kaleshwaram Lift Irrigation Project - Annaram at Jayashankar District, Telangana from past 3 years in Tunnel Work with MEIL.

53

Sl No	Name	Designation	Qualification	Professional Experience in any of the Key Activities	Name of the work and location where working
5	K Hari Babu	Tunnel construction Manager	B. E in Civil Engineering	• Total Work Experience is 24 Years	Dr. B. R. Ambedkar Pranahita Chevella Sujala Sravanthi – Package V at Adilabad, Telangana in Tunnel Work with MEIL.
6	PI Ramanathan	Senior Geologist	Masters in Geology	• Total Work Experience of 32 Years	Kaleshwaram Lift Irrigation Project - Annaram at Jayashankar District, Telangana in Tunnel Work with MEIL.
7	Pradeep Makula	Senior Surveyor	Diploma in Civil Engineering	• Experience in surveying in Tunnel Work. • Coordinate with site Engineer & Technical Work. • Day to Day Reporting Work. • Total Experience of 11 Years	Dr. B. R. Ambedkar Pranahita Chevella Sujala Sravanthi – Package V at Adilabad, Telangana from past year in Bridge Work with MEIL.
8	Vanga Narasa Reddy	Material Procurement Manager	Graduate in Computers	Total Work Experience of 21 Years	Working from past 7 years in procurement with MEIL.
9	K. Vijay Kumar	Material Stock Manager	B Tech in EEE	Total Work Experience of 17 Years	Working from past 9 years in Material Management with MEIL.
10	Ajay Kumar Yadav	Safety Manager	Diploma in Safety	• Total Work Experience of 7.5 Years	Pranahita – Chevella Lift Irrigation Scheme – Link IV – Package XII at Karimnagar, Telangana from past 1 years in Safety Management of tunneling Work with MEIL.

Sl No	Name	Designation	Qualification	Professional Experience in any of the Key Activities	Name of the work and location where working
11	Debasis Dash	Safety Manager	Diploma in Safety	• Total Work Experience of 8 Years	Kaleshwaram Lift Irrigation Project - Sundilla at Jayashankar District, Telangana from past 1 years in Safety Management of tunneling Work with MEIL.
12	Gudipudi Pratap	Surveyor	B.Tech in Electronics & Communication Engineering	• Experience in surveying in Tunnel Work. • Coordinate with site Engineer & Technical Work. • Day to Day Reporting Work. • Total Experience of 7 Years.	Dr. B. R. Ambedkar Pranahita Chevella Sujala Sravanthi - Package V at Adilabad, Telangana from past 3 years in Tunneling Work with MEIL.
13	Pujith Kumar Kunamneni	Surveyor	B.Tech in Computer Science Engineering	• Experience in surveying in Tunnel Work. • Coordinate with site Engineer & Technical Work • Day to Day Reporting Work. • Total Experience of 8 Years.	Kaleshwaram Lift Irrigation Project - Annaram at Jayashankar District, Telangana from past 3 years in Tunnel Work with MEIL.
14	Mooli Malli Kharjuna Reddy	Surveyor	Diploma in Civil Engineering	• Experience in surveying in Tunnel Work. • Coordinate with site Engineer & Technical Work • Day to Day Reporting Work. • Total Experience of 9 Years.	Dr. B. R. Ambedkar Pranahita Chevella Sujala Sravanthi - Package V at Adilabad, Telangana from past 2 years in Tunneling Work with MEIL.
15	Naga Venkata Ramana O	Surveyor	M.Sc in Computer Science	• Experience in surveying in Tunnel Work. • Coordinate with site Engineer & Technical Work. • Day to Day Reporting Work. • Total Experience of 8 Years.	Lift Irrigation Scheme - Veligonda Tunnel I Balance Work at Prakasam District, Andhra Pradesh from Past 1 year in Tunneling work with MEIL.

Sl No	Name	Designation	Qualification	Professional Experience in any of the Key Activities	Name of the work and location where working
16	Silambarasan P	Surveyor	B Tech In Civil Engineering	• Experience in surveying in Tunnel Work • Coordinate with site Engineer & Technical Work. • Day to Day Reporting Work • Total Experience of 7 Years	Dr. B. R. Ambedkar Pranahita Chevella Sujala Sravanthi Link II - Package VIII at Karimnagar, Telangana from past 2 years in Tunneling Work with MEIL.
17	Nagaraju Palla	Surveyor	Diploma in Civil Engineering	• Experience in surveying in Tunnel Work. • Coordinate with site Engineer & Technical Work. • Day to Day Reporting Work • Total Experience of 10 Years.	Dr. B. R. Ambedkar Pranahita Chevella Sujala Sravanthi – Package V at Adilabad, Telangana from past 6 years in Tunneling Work with MEIL.
18	Kurra Ananthaiah	Grouting Engineer	B.Tech in Mechanical Engineering	Total work Experience of 6 Years.	LIS Somasila Phase I at Mahabubnagar, Telangana from past 6 years in underground grouting work with MEIL.
19	Arijit Dasadhikari	Civil Engineers (Tunnel)	B.Tech in Civil Engineering	Total work Experience of 9 years	LIS Kaleswaram Annaram at Jayashankar District, Telangana from past 2 years in tunnel work with MEIL.
20	Kuppuri Mallikarjuna Reddy	Civil Engineers (Tunnel)	B.Tech in Civil Engineering	Total work Experience of 4 years	Pranahita – Chevella Lift Irrigation Scheme – Package XI at Karimnagar, Telangana from past 2 years in tunnel work with MEIL.
21	Kolipaka Yoganand	Civil Engineers (Tunnel)	B.Tech in Civil Engineering	Total work Experience of 21 years	Lift Irrigation Scheme – Kondam Cheruvu at Telangana from past 9 years in tunnel work with MEIL.

Sl No	Name	Designation	Qualification	Professional Experience in any of the Key Activities	Name of the work and location where working
22	Madduri Sudhakara Reddy	Civil Engineers (Tunnel)	B.Tech in Civil Engineering	Total Work Experience of 7 years	LIS Kaleswaram Sundilla at Jayashankar District, Telangana from past 3 years in tunnel work with MEIL.
23	Medisetti Pavan Kumar	Civil Engineers (Tunnel)	B.Tech in Civil Engineering	Total Work Experience of 4 years	Pranahuta – Chevella Lift Irrigation Scheme – Package VIII at Karimnagar, Telangana from past 3 years in tunnel work with MEIL.
24	P Ramanjaneya Reddy	Civil Engineers (Tunnel)	B.Tech in Civil Engineering	Total Work Experience of 10 years	Pranahita – Chevella Lift Irrigation Scheme – Package XI at Karimnagar, Telangana from past 8 years in tunnel work with MEIL.
25	Sudhakar Budida	Geologist	MSC in Geotech	Total Work Experience of 13 Years	LIS JCRDLIS Phase III Package III at Warangal, Telangana from past 7 years in Tunneling Work with MEIL.
26	Girinagakanth Sanagapati	Geologist	Masters in Geology	Total Work Experience of 11 Years	PP Lambadug at Himachal Pradesh from past 4 years in Tunneling Work with MEIL.
27	M Anbarasu	Geologist	MSC in Geology	Total Work Experience of 8 Years	PP TTPS at Tamil Nadu from past 2 years in Tunneling Work with MEIL.
28	Chukka Venkatramaiah	Geologist	MSC in Geology	Total Work Experience of 7 Years	Dr. B. R. Ambedkar Pranahita Chevella Sujala Sravanthi – Package V at Adilabad, Telangana from past 2 years in Tunneling Work with MEIL.

542

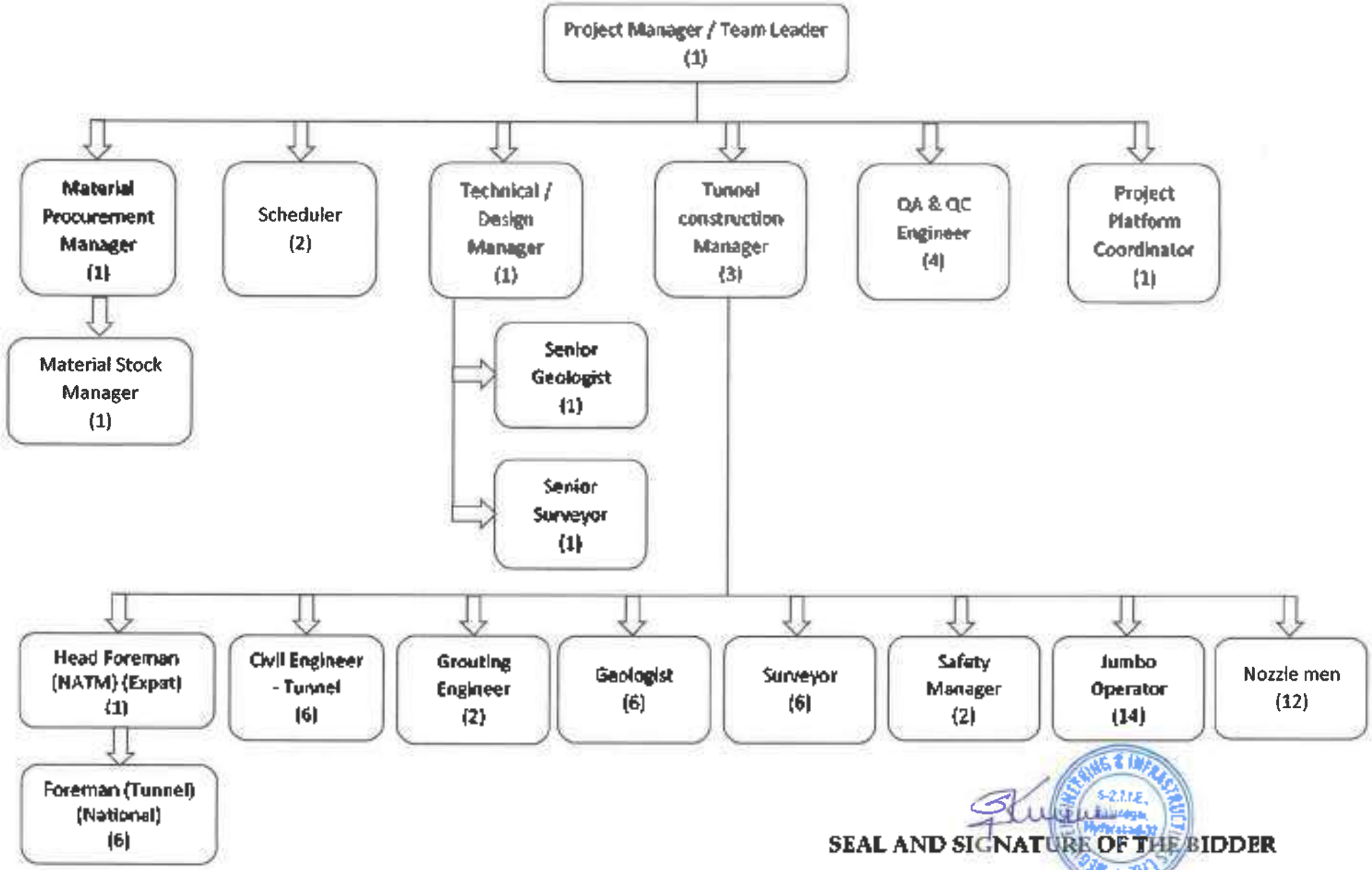
Sl No	Name	Designation	Qualification	Professional Experience In any of the Key Activities	Name of the work and location where working
29	K Man Mohan	Quality Assurance and Quality Control Engineer	B.Tech in Civil Engineering	Total Work Experience of 6.5 Years	Pranahita – Chevella Lift Irrigation Scheme – Package XII at Karimnagar, Telangana from past 8 years in Quality works in underground work with MEIL.
30	M. Ravi	Quality Assurance and Quality Control Engineer	Diploma in Civil Engineer	Total Work Experience of 9 Years	Pranahita – Chevella Lift Irrigation Scheme – Package XII at Karimnagar, Telangana from past 8 years in Quality works in underground work with MEIL
31	Rajesh S	Quality Assurance and Quality Control Engineer	B.E in Civil Engineering	Total Work Experience of 13 Years	Kaleshwaram Lift Irrigation Project - Sundilla, Telangana from past 2 years in Quality works in underground work with MEIL
32	Tejavathu Srinivasarao	Quality Assurance and Quality Control Engineer	B.E in Civil Engineering	Total Work Experience of 16 Years	Lift Irrigation Scheme – Kondam Cheruvu, Telangana from past 1 years in Quality works in underground work with MEIL

Note: Other Key personnel with necessary experience will be recruited after award of work. Submission of above details shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

SEAL AND SIGNATURE OF THE BIDDER

Form KEYP - 2

Proposed Organization Chart



SEAL AND SIGNATURE OF THE BIDDER

Form P & M-1

Details of Critical Plant and Machinery Meeting Requirements of Chapter 6 of Section 5: Works Requirement

Sl No	Type of Plant/Equipment	No. of Plant/ Equipment	Date of Manufacture (in case already owned)	Model/ Make of Plant/ Equipment	Owned/ New Purchase/ Hire
1	Jumbo (Type-1) Automatic	3	New Purchase	EPIROC Model - E2C	New Purchase
2	Jumbo (Type-2) Semi-Automatic	4	New Purchase	EPIROC Model - L2D	New Purchase
3	Shotcrete equipment	6	New Purchase	EPIROC Model – Meyco ME5	New Purchase
4	Truck mounted Complete grouting Equipment system	2	New Purchase	EPIROC Model - Unigrout Smart M2	New Purchase
5	Wheel Loaders	4	New Purchase	JCB Model – JCB 457ZX	New Purchase
6	Hydraulic Excavators equipped with breaker for scaling operation	8	Sep-17 = 04 Dec-17 = 03 July-16 =01	VOLVO Model – EC300DL	Owned
7	Dumpers of 25 Ton load capacity	Compatible with cycle time to maintain continuous mucking operation at the furthest drive face.	June-16 =30	ASHOK LEYLAND Model – N2523	Owned
8	Total Station	3	June-19 = 02 July-19 = 01	HEXAGON Model - TS-07	Owned
9	Total Station with onboard Tunnel Profiler	6	New Purchase	HEXAGON Model - TS-16	New Purchase
10	Electrical Submersible Dewatering / sludge Pump	6 Nos. (All pumps should have adequate capacity to handle water inflow of 50 L/sec or more)	Aug-14 = 6	MODY MAKE Model – G906T, G802T & G702T	Owned
11	Scissor Platform	6	New Purchase	JCB Model- JCB 530-110	New Purchase
12	Fully computerized automatic batching Plant	04 (03 for Shotcrete and Augmented by additional 01 before start of lining works as per required capacity)	60 m³/h – Mar-18 = 01 60 m³/h – Nov-18 = 01 60 m³/h – Dec-18 = 01 205 m³/h – Feb-19 = 01	SCHWING STETTER Model - H1J Model - H1J Model - H1J Model – H6N	Owned

Sl No	Type of Plant/Equipment	No. of Plant/ Equipment	Date of Manufacture (in case already owned)	Model/ Make of Plant/ Equipment	Owned/ New Purchase/ Hire
13	Suitable Genset with catalytic converter	All DG sets should have 100% power back up. Details of minimum power requirement at each location is given below table in Cl. 2.6.14.	250 KVA - Sept-17 = 01 500 KVA - Jan-16 = 01 250 KVA - Dec-16 = 01 62.5 KVA - Feb-16 = 02 82.5 KVA - Feb-16 = 01 125 KVA - Feb-17 = 02	KALA GEN SET POWERICA KALA GEN SET JAKSON	Owned
14	Continuous Loader	3	New Purchase	EPIROC Model - Hagg Loader 10 HRB	New Purchase
15	Transit Mixers	According to proposed time cycle to maintain continuous mix supply at the furthest drive face.	Oct-17 = 08 March-18 = 4 July-17 = 16	SCHWING STETTER Model - AM6SHN2	Owned

Comfort letter from manufactures (EPIROC, HEXAGON and JCB) are enclosed

SEAL AND SIGNATURE OF THE BIDDER

Epiroc

LETTER OF COMFORT

No. LOC/BP/08349

Date: 05.12.2019

To,

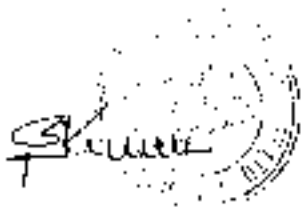
The Chairman and Managing Director,
Rail Vikas Nigam Limited,
1st Floor,August Kranti Bhavan,
Bhikaji Cama Place,
RK Puram New Delhi -110066

Ref: RVNL/RKSHKNPG/TENDER/TUNNELS/PK7B Date: 30.09.2019,
CONSTRUCTION OF TUNNELS, BRIDGES AND FORMATION WORKS FROM CHAINAGE 91+228 to 101+339(FLS) UNDER PACKAGE 7B IN CONNECTION WITH NEW BG LINE BETWEEN RISHIKESH AND KARANPRAYAG (125KM) IN STATE OF UTTARAKHAND, INDIA.

Subject: Comfort Letter for supply of Tunneling Equipment(s).

1 We understand that **M/s Megha Engineering & Infrastructure Limited, Hyderabad** is bidding for the above-mentioned work. We hereby confirm our association with **M/s Megha** Engineering & Infrastructure Limited, Hyderabad for supply of equipment(s) with required specifications and quantities listed in the table below and confirm delivery at Indian Sea Port within a period of six months from the date of placement of purchase order on mutually agreed terms and conditions

No.	Equipment Type and Specification	Quantity Agreed	Model No.	Owned/ Hired/ Fresh Purchase
1.	**Truck mounted complete grouting equipment system**	2	Unigrout Smart M2	Fresh Purchase
2.	**Jumbo (Type-1) Automatic**	3	E2C	Fresh Purchase
3.	**Jumbo (Type-2) Semi-Automatic**	4	L2D	Fresh Purchase
4.	**Shotcrete equipment**	6	Meyco ME5	Fresh Purchase
5.	**Continuous Loader** of 3.5 cum/min capacity or more.	3	Hagg Loader 10HRB	Fresh Purchase



Epiroc

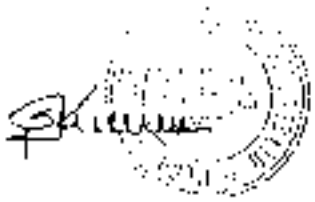
2. We further confirm that the possible delivery periods and costs of the above mentioned equipment|s| along with maintenance related aspects (including any service agreements with OEM if required in accordance with work requirements| have been mutually discussed with **M/s Megha Engineering & Infrastructure Limited, Hyderabad.**

Thanking You,

For Epiroc Mining India Limited

Muniraj Gangarapu
Territory Manager
muniraj.gangarapu@epiroc.com
+91-9172049192

For **Megha Engineering & Infrastructure Limited.,**



JCB INDIA LIMITED

603/2 & 604/2, 6th Floor,
Block-I, White House,
6-3-1192/1/1, Kundan Bagh,
Hyderabad 500 016, Telangana, India.
www.jcb.com/www.jcb.co.uk
Tel: +91 - 40 - 66361123/2341 3173

Form F & M-2
LETTER OF COMFORT

No: JCB/2020/MEIL/7 Dated: March 16, 2020

To
The Chairman and Managing Director,
Rail Vikas Nigam Limited, 1st Floor, August Kranti Bhavan,
Bhikaji Cama Place, RK Puram New Delhi -110066.

Ref: IFB No: RVNL/RKSH-KNPG/TENDER/TUNNELS/PK7B Date: 30.09.2019,
"CONSTRUCTION OF TUNNELS, BRIDGES AND FORMATION WORKS FROM CHAINAGE 91+228 to 101+339 UNDER PACKAGE-7B IN CONNECTION WITH NEW BG LINE BETWEEN RISHIKESH AND KARANPRAYAG (125KM) IN STATE OF UTTARAKHAND, INDIA."

Subject: Comfort Letter for supply of Tunneling Equipment(s).

1. We understand that **M/s Megha Engineering & Infrastructure Limited, Hyderabad** is bidding for the above-mentioned work. We hereby confirm our association with **M/s Megha Engineering & Infrastructure Limited, Hyderabad** for supply of equipment(s) with required specifications and quantities listed in the table below and confirm delivery at Indian Sea Port within a period of Two months from the date of placement of purchase order on mutually agreed terms and conditions.

No	Equipment Type & Specification	Quantity Agreed	Model No.	Owned/Hired/ Fresh Purchase
1	Wheel Loader With 3 Cum Rock Bucket Tramming/ Hauling load with side tipping bucket facility	04	JCB 455ZX	Fresh Purchase

2. We further confirm that the possible delivery periods and costs of the above mentioned equipment(s) along with maintenance related aspects (including any service agreements with OEM if required in accordance with work requirements) have been mutually discussed with **M/s Megha Engineering & Infrastructure Limited, Hyderabad**

Thanking You,
For JCB India Ltd.

Jagan Marapalli
Regional Sales Head – Major Accounts
Mobile No.: 970 464 6622 and Email id: jagan.marapalli@jcb.com

SEAL AND SIGNATURE OF THE BIDDER

normet

551

Form P & M-2

LETTER OF COMFORT

(In case of New purchase/Hire)

(On letter head of Equipment Supplier)

(To be filled only for Drilling Jumbo, Shotcrete Machine, Grouting Rig, Continuous loader and Wheel loader)

No....

Dated:02.01.2020

To
The Chairman and Managing Director,
Rail Vikas Nigam Limited,
1st Floor, August Kranti Bhavan,
Bhikaji Cama Place,
RK Puram New Delhi -110066.

Ref: IFB No: RVNL/RKSH-KNPG/TENDER/TUNNELS/PK7B Date: 30.09.2019, Construction of Tunnels, Bridges and Formation works from Chainage 91+228 to 101+339 under Package-7B in Connection with New BG Line between Rishikesh and Karanprayag (125km) in State of Uttarakhand, India.

Subject: Comfort Letter for supply of Tunneling Equipment(s).

1. We understand that **M/s Megha Engineering & Infrastructure Limited, Hyderabad** is bidding for the above-mentioned work. We hereby confirm our association with **M/s Megha Engineering & Infrastructure Limited, Hyderabad** for supply of equipment(s) with required specifications and quantities listed in the table below and confirm delivery at Indian Sea Port within a period of . months from the date of placement of purchase order on mutually agreed terms and conditions.

No	Equipment Type & Specification	Quantity Agreed	Model No.	Owned/Hired/ Fresh Purchase
1	Shotcrete Spraying Machine	6	5100VC	Fresh Purchase

2. We further confirm that the possible delivery periods and costs of the above mentioned equipment(s) along with maintenance related aspects (including any service agreements with OEM if required in accordance with work requirements) have been mutually discussed with **M/s Megha Engineering & Infrastructure Limited**

Thanking You,

For .....Normet India Pvt Ltd
(Signature)
(Name of Signatory) .....
(Designation of Signatory) .....
(Mobile No. and Email id of signatory)

SEAL AND SIGNATURE OF THE BIDDER

Normet India Private Limited

Corporate Office:
The Corvallium, Tower B
B-31, First Floor, Lobe No.1
Plot A-41, Sector-62
Noida, UP-201307

Registered Office:
Regus Elegance, 2F Elegance
Jasola District Centre
Old Mathura Road
New Delhi-110025

CIN: U29308DL2008PTC242436
T +91 120 450 4500
F +91 120 421 7817
info.india@normet.com

www.normet.com

HEXAGON

Hexagon Geosystems India Pvt. Ltd.
Value Alpha 2nd Floor, Tower-B
Golf Course Road , Sector -53
Gurugram-122002, Haryana, India
T : +91 (124) 643 4501
F : +91 (124) 430 0843
www.hexagon.com
https://leica-geosystems.com/en-in

Form P & M-2

LETTER OF COMFORT

(In case of New purchase/ Hire)

(On letter head of Equipment Supplier)

(To be filled only for Drilling Jumbo, Shotcrete Machine, Grouting Rig, Continuous loader and Wheel loader)

No.HXGN/MP/2019/0001 Dated:02.01.2020

To
The Chairman and Managing Director,
Rail Vikas Nigam Limited,
1st Floor, August Kranti Bhavan,
Bhikaji Cama Place,
RK Puram New Delhi -110066

Ref: IFB No. RVNL/RKSH-KNPG/TENDER/TUNNELS/PK78 Date: 30.09.2019,
Construction of Tunnels, Bridges and Formation works from Chainage 91+228 to 101+339 under Package-78 in Connection with New BG Line between Rishikesh and Karnprayag (125km) in State of Uttarakhand, India

Subject: Comfort Letter for supply of Tunneling Equipment(s)

1. We understand that **M/s Megha Engineering & Infrastructure Limited, Hyderabad** is bidding for the above-mentioned work. We hereby confirm our association with **M/s Megha Engineering & Infrastructure Limited, Hyderabad** for supply of equipment(s) with required specifications and quantities listed in the table below and confirm delivery at **Indian Sea Port** within a period of **01 months** from the date of placement of purchase order on mutually agreed terms and conditions.

No.	Equipment Type & Specification	Quantity Agreed	Model No.	Owned/Hired/ Fresh Purchase
01	Total Station with Onboard Tunnel Profiler	05	15 to	Fresh Purchase

HEXAGON

Hexagon Geosystems India Pvt. Ltd.
Vatika Atrium,2nd Floor, Tower B
Golf Course Road, Sector -53
Gurugram-122002, Haryana, India
T : +91 (124) 843 4531
F : +91 (124) 430 0643
www.hexagon.com
https://hexagon-geosystems.com/en-in

2. We further confirm that the possible delivery periods and costs of the above mentioned equipment(s) along with maintenance related aspects (including any service agreements with OEM if required in accordance with work requirements) have been mutually discussed with M/s.Megha Engineering & Infrastructure Limited

Thanking You,
For Hexagon Geosystems India Pvt Ltd

(Signature)
(Name of Signatory) - M.Prasanna
(Designation of Signatory) - Sr.Sales Coordinator
(Mobile No of signatory) – 9010278734
Email Id of Signatory – Prasanna.mamidelli@hexagon.com

SEAL AND SIGNATURE OF THE BIDDER

JCB

554

603/2 & 604/2, 6th Floor,
Block-I, White House,
6-3-1192/1/1, Kundan Bagh,
Hyderabad 500 016, Telangana, India.
www.jcb.com/www.jcb.co.uk
Tel : +91 - 40 - 66361112/3, 2341397)

Form P & M-2
LETTER OF COMFORT

(To be filled only for Drilling Jumbo, Shotcrete Machine, Grouting Rig, Continuous loader and Wheel loader)

No. JCB/2020/MEIL/3 Dated: 7 January 2020

To
The Chairman and Managing Director,
Rail Vikas Nigam Limited,
1st Floor, August Kranti Bhavan,
Bhikaji Cama Place,
RK Puram New Delhi -110066.

Ref: IFB No: RVNL/RKSI-KNPG/TENDER/TUNNELS/PK7B Date: 30.09.2019,
CONSTRUCTION OF TUNNELS, BRIDGES AND FORMATION WORKS FROM CHAINAGE 91+228 to 101+339 (FLS) UNDER PACKAGE-7B IN CONNECTION WITH NEW BG LINE BETWEEN RISHIKESH AND KARANPRAYAG (125KM) IN STATE OF UTTARAKHAND, INDIA.

Subject: Comfort Letter for supply of Tunneling Equipment(s).

1. We understand that M/s Megha Engineering & Infrastructure Limited, Hyderabad is bidding for the above-mentioned work. We hereby confirm our association with M/s Megha Engineering & Infrastructure Limited, Hyderabad for supply of equipment(s) with required specifications and quantities listed in the table below and confirm delivery at JCB Ballabgarh, Faridabad factory within a period of two (2) months from the date of placement of purchase order on mutually agreed terms and conditions.

No	Equipment Type & Specification	Quantity Agreed	Model No.	Owned/ Hired/ Fresh Purchase
1	Tele Handler (Loadall)	6	JCB 530-110	Fresh Purchase

2. We further confirm that the possible delivery periods and costs of the above mentioned equipment(s) along with maintenance related aspects (including any service agreements with OEM if required in accordance with work requirements) have been mutually discussed with Megha Engineering & Infrastructures Limited, Hyderabad.

Thanking You,
For JCB India Ltd.

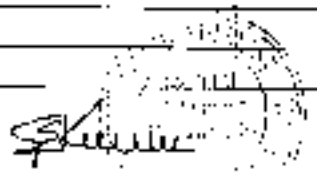
Jagan Marapalli
Regional Head - Major Accounts
Mobile No. 970 464 6622
Email id: jagan.marapalli@jcb.com

SEAL AND SIGNATURE OF THE BIDDER

Form INS-1

List of Survey Instrument/Measuring Equipment meeting Work's Requirements and proposed to be deployed if awarded the work.

S No	Type of Survey Instrument/Measurement Equipment	Number
1	Tunnel Profiler	4
2	Total station	4



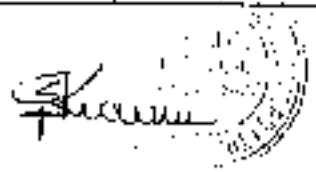
SEAL AND SIGNATURE OF THE BIDDER

Form INS-2

List of laboratory equipment, adequate testing and inspection equipment and facilities for calibration proposed to be deployed if awarded the work.

S.No	Type of Equipment and Specifications	Number
1	Compression Testing Machine	1
2	Cube moulds(150 x150 x 150 mm)	40
3	Cube moulds(100 x100 x 100 mm)	6
4	Cube moulds(7.05 x7.05 x 7.05 mm)	12
5	Flectural moulds (0.7 x 0.15 m)	6
6	Sieve shaker	1
7	Cement mortar cube vibrator	1
8	AIV Machine	1
9	Concrete mixer	1
10	Density bucket	2
11	V-Cat instrument	3
12	Hot plate	1
13	Flakiness Gauge	2
14	Elogmation Gauge	2
15	Electronic digital weigh Balance	1
16	Electronic digital weigh Balance	1
17	Sampling Tray (Enamel)	7
18	Sampling Tray(Enamel)	2
19	pH Meter	1
20	Slump cone with tamping rod	3
21	Soil hydrometer (Glass)	1
22	Pycnometer bottle	4

S.No	Type of Equipment and Specifications	Number
23	IS Sieves For sand 10,4.75,2.36,1.18,0.6,0.3,0.15,.0.9.and pan (mm)	9
24	IS Sieves 63, 40,,20,,10,and pan (mm)	6
25	IS Sieves 63, 40,12.5.20,,10,4.75,2.36 (mm)	5
26	Measuring jars (Glass)	4
27	Hot air oven	2
28	Rebound hammer	1
29	Water bath Machine	1
30	Thermometer	1
31	CBR Testing Machine	2
32	Soil Direct Shear Test Machine	1
33	Concrete Compaction Factor Machine	1
34	Dail Gauge	1
35	Screw Gauge	1
36	GI Tray	1
37	L.L. PL Apparatus	1
38	CBR Hammer	1



SEAL AND SIGNATURE OF THE BIDDER

Form MET-1

To

Form MET-5

Form MET 1

List of Detailed submittals

1. Overall Construction Programme in Microsoft Project or similar, including all main activities within the specified construction time and milestone dates.

2. Tunnel excavation methods: For all the different geological units as described in the Geotechnical Baseline report and shown in the tender drawings the excavation of a tunnel starts with the geotechnical investigation and finalization of designs for the required size of the tunnel. For all the Support section types of tunnel excavation the excavation methods as follows:
   - Preparation of face like marking the excavation line and drilling pattern on the face using Scissor Platform.
   - Geological investigation of the face with probe drilling up to required depth with the MWD mounted on L2D/E2C Drill Jumbo.
   - Drilling the specified with L2D Semi-Automated Drill Jumbo/ E2C Fully Automated Drill Jumbo.
   - Charging the Drilled holes with explosives (Cartridge/Bulk), blasting the required section and after that defuming the fumes with the help of ventilation arrangements like installation of Ventilation fans at Portal.

3. Method of muck disposal from tunnel face with description of machinery and equipment: For main tunnel Muck disposal will be done loading the muck using wheel loader of Approx.5Ton capacity like Volvo L120 Wheel loader/ Ec210 Excavator and muck transportation with 25Ton capacity Dumpers. And for the Escape Tunnel loading with the Ex70 or equivalent type of excavator and muck transportation with 6tyre/10 Ton capacity dumpers.

4. Method statement for execution of permanent lining works, within the time schedule required, including means of achieving the same: Tunnel Lining with the specially designed collapsible shuttering called as lining gantry. Mixing the concrete with the fully computerized concrete batching plant and shifting the concrete in transit mixers up the lining gantry.

5. Ventilation arrangements during tunnel excavation, with details of equipment to be used and of ventilation ducts and their supports, supported by calculations and power installation requirements: Ventilation arrangements using installation of 132Kw/150Kw ventilation fans at each portals and 2 fans at each audit and connecting duct of 1.5 Mts Dia up to the excavation chain age.

6. Dewatering arrangements to handle water ingress into the tunnel during construction including Type and capacity of pumps, supported by calculations: Dewatering inside tunnels using submersible pumps /mud pumps/ monoblock pumps of various capacities as per the requirement of the site and it varies from 5HP to 100 HP capacity.

7. Equipment, materials and procedures for primary support installation.
   - Equipment for primary support: Forepoling, Pipe roofing with L2D/E2C drilling jumbo and Grouting with truck mounted grout pump.
   - Material: SDA anchors, Casing pipe of 76mm to 114mm for pipe roofing, Cement for grouting.

8. Methodology and quality control of Surveying – **Enclosed.**

9. Preliminary plan of site installations – **Enclosed.**

10 Power calculations and List of power supply installations, their capacities, and standby equipment at each working site: Power supply will be taken from the nearby dedicated power supply sources run by the state govt. of other sources.

Sl. No	Location	Required power	Standby equipment
1.	T13P1	7000 KVA	Equivalent capacity DG set
2.	A7	2000 KVA	Equivalent capacity DG set
3.	T13P2	2000 KVA	Equivalent capacity DG set
4.	Camp	1000 KVA	Equivalent capacity DG set

11. Proposed source of Aggregate supply: Aggregate supply from the tunnel muck as well as nearest sources certified by Client.

All the information are to be complete with calculations and supporting data and shall indicate how the bidder intends to perform the works within the time schedule. Submission of above details shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

SEAL AND SIGNATURE OF THE BIDDER

Methodology for Surveying

Aim:

The main aim of the survey is to prepare a map and show the relative positions of the objects of the tunnel

Mobilization:

- We have our own survey team which comprises well qualified surveyors, geologist, survey equipments like DPGS, Total Stations, Gyromat, etc.
- Within 28 days from the letter of acceptance, we will submit to dept. for his approval of the sequence of the survey works to be performed, in-charge of survey works, the list of survey equipment & instruments and a brief outline on methodologies of survey works to be applied for the various types of survey.
- Before commencement of any survey work, we will inform to the dept. mentioning the survey purpose and area to be surveyed.

Methodology:

1. **General**

i. The employer i e. RVNL has already established certain benchmarks and alignment references in the tender documents. These benchmarks and alignment markers will be taken as reference and the same will be validated at site by our survey team. Any error found in these benchmarks and alignment markers will be rectified with the approval of the Engineer.

ii. For the execution of the survey we will deploy experienced professionals. All survey and measurement work shall be recorded and filed thoroughly.

iii. We will provide, maintain, adjust when necessary and operate that are required for survey and performance of the Work.

iv. All survey and measurement activities shall be recorded in field books as approved by the dept.

v. All records of field surveys and measurements, the related computations and calculations, manuscripts, plans, drawings and maps are maintained at site office.

vi. If in the opinion of the dept. found any deficiencies or inaccuracies in field data, such work will be repeated and made good to the satisfaction of engineer-in-charge.

vii. The survey will be done by establishing the control points along the proposed railway alignment through the use of DGPS. All these control points will then be connected to the nearest GTS Benchmark using the Total Station.

2. **Pre Survey Work**

i. Prior to starting the survey work, we will identify and note down the critical activities such as terrain investigations with respect to sightings, vegetation to be removed, placement of datum points, reference monuments and benchmarks etc.

ii. Based on the above, a survey plan will be developed comprising existing basic data, the survey grid to be developed and the equipments required for the particular survey task.

iii. Staff and time requirements arrangement in a way to warrant smooth progress of construction works will be prepared and submitted to the dept. for approval.

iv. After approval of general procedure of survey, we will verify the basic survey grid at site.

v All elevations and coordinates with respect to the basic survey grid will be shown in the maps.

vi. After verification of basic survey grid map, we will set a suitable permanent benchmarks at suitable points, which shall be available to the dept. at all times.

3. **Survey**

i. Original Ground Profiles.
Before commencing of any work, survey will be carried out to find the original topography over the entire area to be occupied or disturbed.

ii. The same survey will be repeated after removal, of vegetation, topsoil or other overburden.

iii. All the survey data will be recorded. The same data in reproducible copy of each drawing to serve as a permanent record for the purpose of determining the quantities of excavation or earth works carried out in the construction of the permanent structures.

iv. All excavated and final surfaces will be surveyed for the purpose of recording as constructed details, and for the measurement of quantities. Same survey data will be used for the following two stages:

A. On completions of excavation and prior to placing concrete or other work.

B. On completion of works.

v. All survey work shall be done within greatest care and precision.

4. **Setting Out Works**

i. Setting out and check surveying of the entire works will be carried as per instructions received by the dept. The methods and programme of checking shall be such as to ensure the construction of every part of the Work to the correct line and level. The entire record of the work will be placed at the office for ready reference at any time.

ii. The number of points required for setting out as well as the spacing between these points will be determined as per site condition in accordance with the type of work.

iii. Every points and datum levels will be clearly marked during construction in such a way that the marks can be retained even after completion of construction.

iv. Close traverse survey will be conducted regularly at least once in two months while executing the work of underground excavation and will submit the results to the dept. to ensure that progress of excavation is correct as per design alignment.

v. Check survey will be carried out during non-production periods or in parallel to construction activities such that the minimum delay or inconvenience is caused to production works, wherever and whenever possible.

5. Alignment and Gradient of Tunnel:

i. Minimum three no of permanent benchmarks or monuments are selected at the every portal for reference. Control surveys during tunnel construction is always be referred from such reference monuments

ii. The reference monuments will be secured by auxiliary fixed points permitting the reconstruction, in case these have suffered any damage during tunnel excavation.

iii. Establishment and proof surveys of the tunnel alignment and the gradient will always be referred from reference monuments only.

iv. Underground alignment and level survey and control thereof will be performed by the use of suitable precision instruments such as pulsed laser type of equivalent instruments, and auxiliary equipment.

v. Methodology for the use of underground survey equivalent shall be submitted and taken approval from the dept.

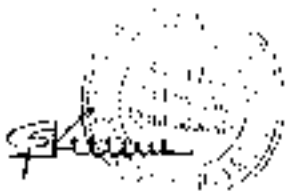
vi. For use of precision gyroscopic measurements (GYROMAT equipment or equivalent) at regular intervals at least every 1 Km progress of the main tunnel and escape tunnel, for accurate high-precision azimuth determination, by specialized agency A detailed report should be submitted to the dept. after every gyroscopic verification with the obtained results.

6. Accuracies and tolerances

i. Accuracies

The following tolerances will be considered for the purpose of accuracy in survey works:

Triangulation	
Allowable error of closure	
• Average not to exceed	±5 Seconds
• Maximum not to exceed	±10 Seconds



Traversing	
Allowable error of closure	±10 mm per Kilometer
Allowable error of distance	±10 mm per Kilometer
Leveling	
Allowable error for each 1 km measured forward and backward	±10 mm
Allowable error of closure	±10 √S mm

(Where S is the total distance of leveling expressed in km)

ii. Tolerances

A. The tolerance mentioned above is the maximum permissible deviations from the specified dimensions, levels, alignments, positions etc. as shown on the Drawings of the structures of structural elements.

B. In addition, at the interfaces with mechanical components, concrete surface be finished flush and shall also meet any additional tolerances required by the mechanical designs or works respectively.

C Where the tolerances overlap, the severer tolerance shall apply. Determination of centerlines for alignment of tunnels, access tunnels, galleries, caverns and shafts etc. shall meet the following criteria.

Plan positions of central line	+30 mm
Elevation	+10 mm

7. Additional Benchmarks

Additional benchmarks will be setting out during survey as and when required.

8. Handing over of Site Survey Data

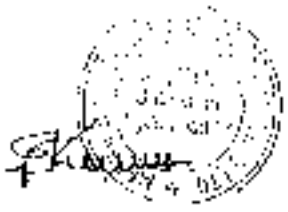
i. General

A. Prior to the commencement of the survey works, data available with the dept. will be verified with basic survey gird and benchmarks.

B. During field check, if any revelation of damage / misplace / destroy to benchmarks, then the same will be informed to the dept. of this facts for taking necessary action.

C. If basic datum point and benchmarks are removed for construction works, then establishment of new basic datum points and benchmarks or auxiliary points will be fixed under the supervision of the dept.

D. Upon handing over of site, inconsistencies within the basic grid or related datum points and benchmarks are detected the same will inform to the dept. Any survey work, setting out or measurement already taken or performed prior to the detection of such inconsistency will be rechecked and corrected.



ii. Survey Records and Documentation

A. Records of all survey activities such as sketches, field books, calculations, etc., for the duration of the entire construction period will be kept and maintained in the field office.

B. The same data will be submitted to the dept. for approval and documentation.

C. On a monthly basis, monthly progress report, a detailed report focused on the performed survey work (excavation profiles, tunnel alignment, traversing, etc) and relevant results will be submitted to dept.

D. After every round, the excavation profile obtained through Tunnel profiler will be submitted.

SITE INSTALLATIONS AND SERVICES

1) CAMPS FOR CONTRACTOR'S EMPLOYEES:

i. Locally available accommodation will be identified near to project site for the Employees & site office purpose.

ii. Local camp offices with pre-fabricated materials will be constructed at site location with provision of LPG facility for cooking, dining rooms, outdoor and indoor recreation facilities, family dwellings, dormitories, sanitary facilities, medical service, places of worship, roadways, drainage, fire control, commercial centers and all utility services (potable water, power, lighting, heating ventilating, sewerage treatment and disposal, cleaning and sanitation, garbage collection and disposal, etc.).

iii. These camps are large enough to accommodate the anticipated peak work force. The construction labour camp should be as per BOCWA / BOCWR.

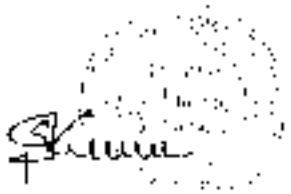
iv. Camp area shall be based on availability of land after accommodating all plants, materials, employer's office etc. at site.

v. Fixtures in the sanitary facilities are based on the following user ratios
   A. 1 toilet for not more than 5 users
   B. 1 tap for not more than 5 users
   C. 1 washbasin for not more than 10 users.

vi. The sewerage from the labour camps, work sites will be properly treated before discharge into septic tanks, soak pits etc.

vii. Canteen facilities are provided in all camp in properly equipped canteen buildings for employees.

viii. These camps and buildings are maintained in hygienic conditions. The standards regulations presently in force in the project area with regard to water treatment, sanitary conditions, and fire and accident prevention shall be duly taken into account.



2) Site Offices, Stores, Warehouses and Materials Yards

i. Main and secondary offices, warehouses, materials stock areas, fuel storage areas and explosive magazines, all of which are maintained in good condition until the completion of Works.

ii. These buildings, shops and warehouses expected to be constructed and equipped for use in the execution of the Works under this Contract.

iii. No dangerous goods, explosives, chemicals, fuels or similar items are brought into site without the prior approval of dept. and duly complying with all statutory requirements for its safe storage and security.

iv. The Site for the storage of fuels, explosives and other dangerous goods as may be required for the construction of the works and shall not use the site or allow access for any purpose not connected to the Contract.

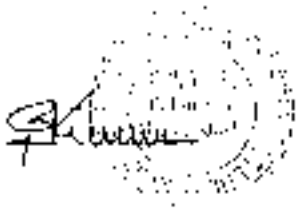
v. Dangerous Goods are only to be stored in nominated and approved storage areas and facilities which must comply with the Indian regulations governing such facilities.

vi. Appropriate provision for material storage sheds and tarpaulin sheets for loose construction material and dustbins for corresponding disposal of waste at labour campsite and at each work site.

3) Material Processing Plants:

i. Material Processing plant of sufficient capacity to meet the planned peak requirements during construction shall be established as per recommendations by the dept. These plants are well designed and fabricated and kept in good running order to ensure compliance with the materials quality Specifications All control and measuring equipment are regularly serviced and calibrated.

ii. The following plants are to be assembled/erected in the site shown by the dept.:



A. Concrete aggregates processing plant (crushing and screening). The aggregate crushing plant will be provided with cyclone separator for dust suppression.
B. Concrete plant (batching and mixing)
C. Concrete cooling plant (refrigeration and ice plant), if required.
D. Grouting plant.

iii. These Concrete & material processing plants will meet all environment guidelines, conditions imposed for construction of project by MOEF/ Government bodies/ State pollution control boards and other statutory bodies.

4) Access to the site facilities:

Temporary roads / hauls roads, bridges & culverts to various facilities with corresponding retaining walls and breast walls are constructed, where ever necessary.

5) Communication System:

i. Site Communication system will be developed in the project area for national/ international voice and data communication. These facilities can be avail from the existing network of tele-communication operators.

ii. Communication System in Underground Works

A. Communication systems for underground space shall comprise of telephone/radio systems (walkie-talkie).
B. Communication system by telephone or preferably an underground radio system will be developed between each heading face and entrance to the concerned tunnel / caverns. All the site offices shall be well connected with the above communication system.
C. In case of telephone system, an intermediate Intercom station shall be located atleast every 250m or less along the tunnel.
D. All Communication system will have sources of energy independent of the main energy supply for Underground works.
E. The availability of the communication from inside to outside the tunnel at all times throughout the duration of the underground construction.

6) Other Procedures:

i. Proper check-in/check-out procedures (in form of Name tag boards and RFID/Biometrics) will be maintained to ensure an accurate accounting of the number of persons going into underground tunnels or caverns and to prevent unauthorized persons from gaining access to the site.

ii. At least one person is maintained all time above ground to monitor the movement of every individual inside the tunnel. This person is responsible for calling for immediate assistance during emergency and keeping an accurate count of employees.

iii. Safe access is provided to all workstations at the construction site to protect employees from potential hazards such as being struck by excavators, haulage machines, or other moving equipment.

iv. All unused openings, including chutes and manways, must be tightly covered, barricaded or fenced off and posted with warning signs.

v. A register is maintained at office in hard and soft form for monitoring the movement of the individuals above and underground activities.

vi. A separate register is maintained for monitoring the movement of the all vehicles and tunneling machinery.

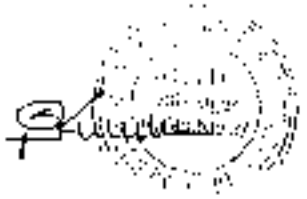
vii. Sufficient service vehicles are maintained at construction site for employees in the management, supervision and performance of the Work.

viii. Medical services are provided in construction site under the direction of qualified doctor on a 24 hours basis and shall be available free of charge to persons engaged in the Works and their families or dependents on the Site.

ix. Local laws and health standards in force are maintained in the project area.

x. All the labors to be engaged for construction work will be thoroughly examined by health personnel and adequately treated before issuing them work permit by contractor.

xi. Sufficient Electricity facilities such as transformers, circuit breakers, disconnection and safety switches, voltage regulators, lines, poles, pole



hardware, conductors and meters will be arranged for temporary site electrification purpose.

xii. Alternatively required DG sets will be provided at site in case local power connection is not available and also during the power cut period.

xiii. Illumination system will be provided throughout the tunnel portion for better lighting and illumination purpose for smooth operation of tunneling work.

xiv. Ventilation system is to be provided for the tunnel portion duly complying the codal procedures

xv. Safe Drinking Water & Sanitation facilities will be provided and maintained at all site locations including labour camps.

xvi. Excavated muck will be dumped at the site identified and provided by the Employer in line with the procedures laid down in the bid document.

xvii. A field laboratory will be established for ensuring quality control measures for the Works, as detailed under Quality Assurance Programme

xviii. Entire labour camp & site camp will be provided with fencing and security system to restrict entry of unauthorized personnel.

xix. Clearly visible and legible reflector site signage and safety warning boards for the information of the public at all entrances to the Site will be maintained throughout the contract period.

Form MET 2

Proposed Cycle Time Calculation

Escape Tunnel for Support Section Type A2 BT

Detailed work cycle for different classes, with a breakdown into different activities and duration of each, in minutes. **Details for cycle time shall be computed considering the Support Section Type at maximum foreseen excavation drive length from any Tunnel portal according to work's programme proposed by bidder. This will become the baseline for computation of contractor's performance at site.**

	Activity	Quantity	Time (min)	Remarks
Excavation	Preparation of new face drilling / Marking of Drill Pattern	As per the Drawing	30	With Scissor Platform/ JCB Load all
	Drilling	As per the Drawing	150	Using L2D Semi-Automatic/T2C fully Automatic Boomer of 5m/min capacity.
	Blasting and Defuming,	As per the Drawing	90	Using Catridge/Bulk explosives and defuming with ventilation fans of 132KV capacity.
Scaling and Mucking		As per the Drawing	135	Scaling with EC210 Excavator and Mucking with a combination of EC210 Excavator and 6 No's of 25Ton capacity Dumpers.
Shortereting		As per the Drawing	60	Using 5100 VC Normet make shotcreting machine of 30 Cum/hr capacity.
Rock bolting		As per the Drawing	30	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
Steel ribs / Lattice griers or others (as applicable)				
Fiberglass elements installation				

Activity	Quantity	Time (min)	Remarks
Forepoling	As per the Drawing,	30	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity
Tunnel face reinforcement			
Downtime (Cleaning up and breakdown)		15	Using Scissor platform/ JCB Load all equipment
Total Time (in Hrs)		9 Hrs	

Support Section Types and their characteristics vis-à-vis tunnelling through them can be inferred from the Geotechnical base line report. All the time calculations for different activities shall be separately worked out with backup calculations for the proposed equipment. All the quantities shall be in relation to the excavation and support drawings for various Support Section Types as per Tender Drawings. The Method statement shall be in accordance with the procedures enumerated above. Submission of above calculation shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

Off Cycle* Time 0.5 hrs (Length of Tunnel considered shall be mentioned and Use separate Sheet if Required)

Cycle Time 9 hrs.

Effective Cycle time 9.5hrs.

Progress per Cycle 3.5 m/Cycle.

Progress per Day 8.84 m/Day.

Progress per Week 57.47 m/Week. (Include 12 hr rest per week)

Progress per Month 247.57 m/Month (Include 48 hr rest per month)

* Time required for off cycle support installation like (Pipe Roof, Forepoles, Face improvement, ground improvement etc.) is to be calculated separately for each Support Section Type.

SEAL AND SIGNATURE OF THE BIDDER

Form MET 2

Proposed Cycle Time Calculation

Main Tunnel for Support Section Type A2 B1

Detailed work cycle for different classes, with a breakdown into different activities and duration of each, in minutes. **Details for cycle time shall be computed considering the Support Section Type at maximum foreseen excavation drive length from any Tunnel portal according to work's programme proposed by bidder. This will become the baseline for computation of contractor's performance at site.**

	Activity	Quantity	Time (min)	Remarks
Excavation	Preparation of new face drilling / Marking of Drill Pattern	As per the Drawing	30	With Scissor Platform/ JCB Load all
	Drilling	As per the Drawing	150	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
	Blasting and Defuming	As per the Drawing	90	Using Catridge/Bulk explosives and defuming with ventilation fans of 132KV capacity.
Scaling and Mucking		As per the Drawing	135	Scaling with EC210 Excavator and Mucking with a combination of EC210 Excavator and 6 No's of 25Ton capacity Dumpers.
Shotcreting		As per the Drawing	60	Using 5100 VC Normet make shotcreting machine of 30 Cum/hr capacity.
Rock bolting		As per the Drawing	30	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
Steel ribs / Lattice griers or others (as applicable)				
Fiberglass elements installation				

Activity	Quantity	Time (min)	Remarks
Forepoling Tunnel face reinforcement	As per the Drawing	30	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity
Downtime (Cleaning up and breakdown)		15	Using Scissor platform/ JCB Load all equipment
Total Time (in Hrs)		9 Hrs	

Support Section Types and their characteristics vis-à-vis tunnelling through them can be inferred from the Geotechnical base line report. All the time calculations for different activities shall be separately worked out with backup calculations for the proposed equipment. All the quantities shall be in relation to the excavation and support drawings for various Support Section Types as per Tender Drawings. The Method statement shall be in accordance with the procedures enumerated above. Submission of above calculation shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

Off Cycle* Time 0.5 hrs (Length of Tunnel considered shall be mentioned and Use separate Sheet if Required)

Cycle Time 9 hrs.

Effective Cycle time 9.5hrs.

Progress per Cycle 3.5 m/Cycle.

Progress per Day 8.84 m/Day

Progress per Week 57.47 m/Week. (Include 12 hr rest per week)

Progress per Month 247.57 m/Month. (Include 48 hr rest per month)

* Time required for off cycle support installation like (Pipe Roof, Forepoles, Face improvement, ground improvement etc.) is to be calculated separately for each Support Section Type

SEAL AND SIGNATURE OF THE BIDDER

Form MET 2

Proposed Cycle Time Calculation

Three Line Cross Section for Support Section Type A2 B1

Detailed work cycle for different classes, with a breakdown into different activities and duration of each, in minutes. **Details for cycle time shall be computed considering the Support Section Type at maximum foreseen excavation drive length from any Tunnel portal according to work's programme proposed by bidder. This will become the baseline for computation of contractor's performance at site.**

	Activity	Quantity	Time (min)	Remarks
Excavation	Preparation of new face drilling / Marking of Drill Pattern	As per the Drawing	60	With Scissor Platform/ JCB Load all
	Drilling	As per the Drawing	180	Using L2D Semi-Automatic/ E2C fully Automatic Boomer of 5m/min capacity.
	Blasting and Defuming	As per the Drawing	60	Using Catridge/ Bulk explosives and defuming with ventilation fans of 132KV capacity.
Scaling and Mucking		As per the Drawing	180	Scaling with EC210 Excavator and Mucking with a combination of EC210 Excavator and 6 No's of 25Ton capacity Dumpers
Shortcreting		As per the Drawing	60	Using 5100 VC Normet make shotcreting machine of 30 Cum/hr capacity.
Rock bolting				
Steel ribs / Lattice griers or others (as applicable)				
Fiberglass elements installation				
Forepoling				
Tunnel face reinforcement				

Activity	Quantity	Time (min)	Remarks
Downtime (Cleaning up and breakdown)		30	Using Scissor platform/ JCB Load all equipment
Total Time (in Hrs)		11.5Hrs	

Support Section Types and their characteristics vis-à-vis tunnelling through them can be inferred from the Geotechnical base line report. All the time calculations for different activities shall be separately worked out with backup calculations for the proposed equipment. All the quantities shall be in relation to the excavation and support drawings for various Support Section Types as per Tender Drawings. The Method statement shall be in accordance with the procedures enumerated above. Submission of above calculation shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

Off Cycle* Time 0.5 hrs (Length of Tunnel considered shall be mentioned and Use separate Sheet if Required)

Cycle Time 11.5 hrs.

Effective Cycle time 12 hrs.

Progress per Cycle 3.5 m/Cycle.

Progress per Day 7 m/Day.

Progress per Week 45.5 m/Week. (Include 12 hr rest per week)

Progress per Month 196 m/Month. (Include 48 hr rest per month)

* Time required for off cycle support installation like (Pipe Roof, Forepoles, face improvement, ground improvement etc.) is to be calculated separately for each Support Section Type.

SEAL AND SIGNATURE OF THE BIDDER

Form MET 2

Proposed Cycle Time Calculation

Two Line Cross Section for Support Section Type A2 B1

Detailed work cycle for different classes, with a breakdown into different activities and duration of each, in minutes. **Details for cycle time shall be computed considering the Support Section Type at maximum foreseen excavation drive length from any Tunnel portal according to work's programme proposed by bidder. This will become the baseline for computation of contractor's performance at site.**

	Activity	Quantity	Time (min)	Remarks
Excavation	Preparation of new face drilling / Marking of Drill Pattern	As per the Drawing	30	With Scissor Platform/ JCB Load all
	Drilling	As per the Drawing	180	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
	Blasting and Defuming	As per the Drawing	60	Using Catridge/Bulk explosives and defuming with ventilation fans of 132KV capacity.
Scaling and Mucking		As per the Drawing	150	Scaling with EC210 Excavator and Mucking with a combination of EC210 Excavator and 6 No's of 25Ton capacity Dumpers.
Shotcreting		As per the Drawing	60	Using 5100 VC Normet make shotcreting machine of 30 Cum/hr capacity.
Rock bolting		As per the Drawing	60	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
Steel ribs / Lattice girders or others (as applicable)				
Fiberglass elements installation				
Forepoling				

Activity	Quantity	Time (min)	Remarks
Tunnel face reinforcement			
Downtime (Cleaning up and breakdown)		60	Using Scissor platform/ JCB Load all equipment
Total Time (in Hrs)		10 Hrs	

Support Section Types and their characteristics vis-à-vis tunnelling through them can be inferred from the Geotechnical base line report. All the time calculations for different activities shall be separately worked out with backup calculations for the proposed equipment. All the quantities shall be in relation to the excavation and support drawings for various Support Section Types as per Tender Drawings. The Method statement shall be in accordance with the procedures enumerated above Submission of above calculation shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

Off Cycle* Time 0.5 hrs (Length of Tunnel considered shall be mentioned and Use separate Sheet if Required)

Cycle Time 10 hrs.

Effective Cycle time 10.5 hrs.

Progress per Cycle 3.5 m/Cycle.

Progress per Day 8 m/Day.

Progress per Week 52 m/Week. (Include 12 hr rest per week)

Progress per Month 224 m/Month. (Include 48 hr rest per month)

* Time required for off cycle support installation like (Pipe Roof, Forepoles, Face improvement, ground improvement etc.) is to be calculated separately for each Support Section Type.

SEAL AND SIGNATURE OF THE BIDDER

Form MET 2

Proposed Cycle Time Calculation

Escape Tunnel for Support Section Type B2

Detailed work cycle for different classes, with a breakdown into different activities and duration of each, in minutes. **Details for cycle time shall be computed considering the Support Section Type at maximum foreseen excavation drive length from any Tunnel portal according to work's programme proposed by bidder. This will become the baseline for computation of contractor's performance at site.**

	Activity	Quantity	Time (min)	Remarks
Excavation	Preparation of new face drilling / Marking of Drill Pattern	As per the Drawing	60	With Scissor Platform/ JCB Load all
	Drilling	As per the Drawing	180	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
	Blasting and Defuming	As per the Drawing	90	Using Catridge/Bulk explosives and defuming with ventilation fans of 132KV capacity.
Scaling and Mucking		As per the Drawing	210	Scaling with EC210 Excavator and Mucking with a combination of EC210 Excavator and 6 No's of 25Ton capacity Dumpers.
Shotcreting		As per the Drawing	60	Using 5100 VC Normet make shotcreting machine of 30 Cum/hr capacity.
Rock bolting		As per the Drawing	60	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
Stell ribs / Lattice griers or others (as applicable)			60	With Scissor Platform/ JCB Load all
Fiberglass elements installation				
Forepoling				

Activity	Quantity	Time (min)	Remarks
Tunnel face reinforcement			
Downtime (Cleaning up and breakdown)			
Total Time (in Hrs)		12 Hrs	

Support Section Types and their characteristics vis-à-vis tunnelling through them can be inferred from the Geotechnical base line report. All the time calculations for different activities shall be separately worked out with backup calculations for the proposed equipment. All the quantities shall be in relation to the excavation and support drawings for various Support Section Types as per Tender Drawings. The Method statement shall be in accordance with the procedures enumerated above. Submission of above calculation shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

Off Cycle* Time 0.5 hrs (Length of Tunnel considered shall be mentioned and Use separate Sheet if Required)

Cycle Time 12 hrs.

Effective Cycle time 12.5 hrs.

Progress per Cycle 3 m/Cycle.

Progress per Day 5.76 m/Day.

Progress per Week 37.44 m/Week. (Include 12 hr rest per week)

Progress per Month 161.28 m/Month. (Include 48 hr rest per month)

* Time required for off cycle support installation like (Pipe Roof, Forepoles, Face improvement, ground improvement etc.) is to be calculated separately for each Support Section Type.

SEAL AND SIGNATURE OF THE BIDDER

Form MET 2

Proposed Cycle Time Calculation

Main Tunnel for Support Section Type B2

Detailed work cycle for different classes, with a breakdown into different activities and duration of each, in minutes. **Details for cycle time shall be computed considering the Support Section Type at maximum foreseen excavation drive length from any Tunnel portal according to work's programme proposed by bidder. This will become the baseline for computation of contractor's performance at site.**

	Activity	Quantity	Time (min)	Remarks
Excavation	Preparation of new face drilling / Marking of Drill Pattern	As per the Drawing	60	With Scissor Platform/ JCB Load all
	Drilling	As per the Drawing	180	Using L2D Semi-Automatic/ E2C fully Automatic Boomer of 5m/min capacity.
	Blasting and Defuming	As per the Drawing	90	Using Catridge/Bulk explosives and defuming with ventilation fans of 132KV capacity
Scaling and Mucking		As per the Drawing	210	Scaling with EC210 Excavator and Mucking with a combination of EC210 Excavator and 6 No's of 25Ton capacity Dumpers.
Shortcreting		As per the Drawing	60	Using 5100 VC Normet make shotcreting machine of 30 Cum/hr capacity.
Rock bolting		As per the Drawing	60	Using L2D Semi-Automatic/ E2C fully Automatic Boomer of 5m/min capacity.
Steel ribs / Lattice griers or others (as applicable)				
Fiberglass elements installation				

Activity	Quantity	Time (min)	Remarks
Forepoling			
Tunnel face reinforcement			
Downtime (Cleaning up and breakdown)			
Total Time (in Hrs)		12 Hrs	

Support Section Types and their characteristics vis-à-vis tunnelling through them can be inferred from the Geotechnical base line report. All the time calculations for different activities shall be separately worked out with backup calculations for the proposed equipment. All the quantities shall be in relation to the excavation and support drawings for various Support Section Types as per Tender Drawings. The Method statement shall be in accordance with the procedures enumerated above. Submission of above calculation shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

Off Cycle* Time 0.5 hrs (Length of Tunnel considered shall be mentioned and Use separate Sheet if Required)

Cycle Time 12 hrs.

Effective Cycle time 12.5 hrs.

Progress per Cycle 3 m/Cycle

Progress per Day 5.76 m/Day.

Progress per Week 37.44 m/Week. (Include 12 hr rest per week)

Progress per Month 161.28 m/Month. (Include 48 hr rest per month)

* Time required for off cycle support installation like (Pipe Roof, Forepoles, Face improvement, ground improvement etc.) is to be calculated separately for each Support Section Type.

SEAL AND SIGNATURE OF THE BIDDER

Form MET 2

Proposed Cycle Time Calculation

Three Line Cross Section for Support Section Type B2

Detailed work cycle for different classes, with a breakdown into different activities and duration of each, in minutes. **Details for cycle time shall be computed considering the Support Section Type at maximum foreseen excavation drive length from any Tunnel portal according to work's programme proposed by bidder. This will become the baseline for computation of contractor's performance at site.**

Activity		Quantity	Time (min)	Remarks
Excavation	Preparation of new face drilling / Marking of Drill Pattern	As per the Drawing	60	With Scissor Platform/ JCB Load all
	Drilling	As per the Drawing	240	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
	Blasting and Defuming	As per the Drawing	120	Using Catridge/Bulk explosives and defuming with ventilation fans of 132KV capacity.
Scaling and Mucking		As per the Drawing	210	Scaling with EC210 Excavator and Mucking with a combination of EC210 Excavator and 6 No's of 25Ton capacity Dumpers.
Shortereting		As per the Drawing	60	Using 5100 VC Normet make shotcreting machine of 30 Cum/hr capacity.
Rock bolting		As per the Drawing	60	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
Stell ribs / Lattice griers or others (as applicable)		As per the Drawing	60	With Scisser Platform/ JCB Load all
Fiberglass elements installation				

Activity	Quantity	Time (min)	Remarks
Forepoling	As per the Drawing	30	Using L2D Semi-Automatic/L2C fully Automatic Boomer of 5m/min capacity.
Tunnel face reinforcement			
Downtime (Cleaning up and breakdown)		30	
Total Time (In Hrs)		14.5 Hrs	

Support Section Types and their characteristics vis-à-vis tunnelling through them can be inferred from the Geotechnical base line report. All the time calculations for different activities shall be separately worked out with backup calculations for the proposed equipment. All the quantities shall be in relation to the excavation and support drawings for various Support Section Types as per Tender Drawings. The Method statement shall be in accordance with the procedures enumerated above. Submission of above calculation shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

Off Cycle* Time 0.5 hrs (Length of Tunnel considered shall be mentioned and Use separate Sheet if Required)

Cycle Time 14.5 hrs.

Effective Cycle time 15 hrs.

Progress per Cycle 3 m/Cycle.

Progress per Day 4.8 m/ Day.

Progress per Week 31.2 m/ Week, (Include 12 hr rest per week)

Progress per Month 134.4m/ Month. (Include 48 hr rest per month)

* Time required for off cycle support installation like (Pipe Roof, Forepoles, Face improvement, ground improvement etc.) is to be calculated separately for each Support Section Type.

SEAL AND SIGNATURE OF THE BIDDER

Form MET 2

Proposed Cycle Time Calculation

Two Line Cross Section for Support Section Type B2

Detailed work cycle for different classes, with a breakdown into different activities and duration of each, in minutes. **Details for cycle time shall be computed considering the Support Section Type at maximum foreseen excavation drive length from any Tunnel portal according to work's programme proposed by bidder. This will become the baseline for computation of contractor's performance at site.**

	Activity	Quantity	Time (min)	Remarks
Excavation	Preparation of new face drilling / Marking of Drill Pattern	As per the Drawing	60	With Scissor Platform/ JCB Load all
	Drilling	As per the Drawing	210	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
	Blasting and Defuming	As per the Drawing	90	Using Catridge/Bulk explosives and defuming with ventilation fans of 132KV capacity.
Scaling and Mucking		As per the Drawing	210	Scaling with EC210 Excavator and Mucking with a combination of EC210 Excavator and 6 No's of 25Ton capacity Dumpers
Shortcreting		As per the Drawing	60	Using 5100 VC Normet make shotcreting machine of 30 Cum/hr capacity.
Rock bolting		As per the Drawing	60	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
Steel ribs / Lattice girders or others (as applicable)		As per the Drawing	60	With Scissor Platform/ JCB Load all
Fiberglass elements installation				

Activity	Quantity	Time (min)	Remarks
Forepoling	As per the Drawing	30	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
Tunnel face reinforcement			
Downtime (Cleaning up and breakdown)		30	
Total Time (in Hrs)		13.5 Hrs	

Support Section Types and their characteristics vis-à-vis tunnelling through them can be inferred from the Geotechnical base line report. All the time calculations for different activities shall be separately worked out with backup calculations for the proposed equipment. All the quantities shall be in relation to the excavation and support drawings for various Support Section Types as per Tender Drawings. The Method statement shall be in accordance with the procedures enumerated above. Submission of above calculation shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

Off Cycle* Time 0.5 hrs (Length of Tunnel considered shall be mentioned and Use separate Sheet if Required)

Cycle Time 13.5 hrs.

Effective Cycle time 14 hrs.

Progress per Cycle 3 m/Cycle.

Progress per Day 5.14 m/Day.

Progress per Week 33.42 m/Week. (Include 12 hr rest per week)

Progress per Month 143.92 m/Month. (Include 48 hr rest per month)

* Time required for off cycle support installation like (Pipe Roof, Forepoles, Face improvement, ground improvement etc.) is to be calculated separately for each Support Section Type.

SEAL AND SIGNATURE OF THE BIDDER

Form MET 2

Proposed Cycle Time Calculation

Main Tunnel for Support Section Type C1 & C2

Detailed work cycle for different classes, with a breakdown into different activities and duration of each, in minutes. **Details for cycle time shall be computed considering the Support Section Type at maximum foreseen excavation drive length from any Tunnel portal according to work's programme proposed by bidder. This will become the baseline for computation of contractor's performance at site.**

Activity		Quantity	Time (min)	Remarks
Excavation	Preparation of new face drilling / Marking of Drill Pattern	As per the Drawing	60	With Scissor Platform/ JCB Load all
	Drilling	As per the Drawing	180	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
	Blasting and Defuming	As per the Drawing	90	Using Catridge/Bulk explosives and defuming with ventilation fans of 132KV capacity.
Scaling and Mucking		As per the Drawing	210	Scaling with EC210 Excavator and Mucking with a combination of EC210 Excavator and 6 No's of 25Ton capacity Dumpers.
Shortcreting		As per the Drawing	60	Using 5100 VC Normet make shotcreting machine of 30 Cum/hr capacity.
Rock bolting		As per the Drawing	60	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
Steel ribs / Lattice griers or others (as applicable)				

Fiberglass elements installation			
Forepoling			
Tunnel face reinforcement			
Downtime (Cleaning up and breakdown)			
Total Time (in Hrs)		12 Hrs	

Support Section Types and their characteristics vis-a-vis tunnelling through them can be inferred from the Geotechnical base line report. All the time calculations for different activities shall be separately worked out with backup calculations for the proposed equipment. All the quantities shall be in relation to the excavation and support drawings for various Support Section Types as per Tender Drawings. The Method statement shall be in accordance with the procedures enumerated above. Submission of above calculation shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

Off Cycle* Time 0.5 hrs (Length of Tunnel considered shall be mentioned and Use separate Sheet if Required)

Cycle Time 12 hrs.

Effective Cycle time 12.5 hrs.

Progress per Cycle 2 m/Cycle.

Progress per Day 3.84 m/Day.

Progress per Week 24.96 m/Week. (Include 12 hr rest per week)

Progress per Month 107.52 m/Month. (Include 48 hr rest per month)

* Time required for off cycle support installation like (Pipe Roof, Forepoles, Face improvement, ground improvement etc.) is to be calculated separately for each Support Section Type.

SEAL AND SIGNATURE OF THE BIDDER

Form MET 2

Proposed Cycle Time Calculation

Escape Tunnel for Support Section Type C1 & C2

Detailed work cycle for different classes, with a breakdown into different activities and duration of each, in minutes. **Details for cycle time shall be computed considering the Support Section Type at maximum foreseen excavation drive length from any Tunnel portal according to work's programme proposed by bidder. This will become the baseline for computation of contractor's performance at site.**

Activity		Quantity	Time (min)	Remarks
Excavation	Preparation of new face drilling / Marking of Drill Pattern	As per the Drawing	60	With Scissor Platform/ JCB Load all
	Drilling	As per the Drawing	180	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
	Blasting and Defuming	As per the Drawing	90	Using Catridge/Bulk explosives and defuming with ventilation fans of 132KV capacity.
Scaling and Mucking		As per the Drawing	210	Scaling with EC210 Excavator and Mucking with a combination of EC210 Excavator and 6 No's of 25Ton capacity Dumpers.
Shotcreting		As per the Drawing	60	Using 5100 VC Normet make shotcreting machine of 30 Cum/hr capacity.
Rock bolting		As per the Drawing	60	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
Steel ribs / Lattice girders or others (as applicable)				

Fiberglass elements installation			
Forepoling			
Tunnel face reinforcement			
Downtime (Cleaning up and breakdown)			
Total Time (in Hrs)		12 Hrs	

Support Section Types and their characteristics vis-à-vis tunnelling through them can be inferred from the Geotechnical base line report. All the time calculations for different activities shall be separately worked out with backup calculations for the proposed equipment. All the quantities shall be in relation to the excavation and support drawings for various Support Section Types as per Tender Drawings. The Method statement shall be in accordance with the procedures enumerated above. Submission of above calculation shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

Off Cycle* Time 0.5 hrs (Length of Tunnel considered shall be mentioned and Use separate Sheet if Required)

Cycle Time 12 hrs.

Effective Cycle time 12.5 hrs.

Progress per Cycle 2 m/Cycle.

Progress per Day 3.84 m/Day.

Progress per Week 24.96 m/Week. (Include 12 hr rest per week)

Progress per Month 107.52 m/Month. (Include 48 hr rest per month)

* Time required for off cycle support installation like (Pipe Roof, Forepoles, Face improvement, ground improvement etc.) is to be calculated separately for each Support Section Type.

SEAL AND SIGNATURE OF THE BIDDER

Form MET 2

Proposed Cycle Time Calculation

Three Line Cross Section for Support Section Type C1 & C2

Detailed work cycle for different classes, with a breakdown into different activities and duration of each, in minutes. **Details for cycle time shall be computed considering the Support Section Type at maximum foreseen excavation drive length from any Tunnel portal according to work's programme proposed by bidder. This will become the baseline for computation of contractor's performance at site.**

	Activity	Quantity	Time (min)	Remarks
Excavation	Preparation of new face drilling / Marking of Drill Pattern	As per the Drawing	60	With Scissor Platform/ JCB Load all
	Drilling	As per the Drawing	240	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
	Blasting and Defuming	As per the Drawing	120	Using Catridge/Bulk explosives and defuming with ventilation fans of 132KV capacity.
Scaling and Mucking		As per the Drawing	210	Scaling with EC210 Excavator and Mucking with a combination of EC210 Excavator and 6 No's of 25Ton capacity Dumpers.
Shotcreting		As per the Drawing	60	Using 5100 VC Normet make shotcreting machine of 30 Cum/hr capacity.
Rock bolting		As per the Drawing	60	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
Steel ribs / Lattice griers or others (as applicable)		As per the Drawing	60	With Scissor Platform/ JCB Load all
Fiberglass elements installation				

Forepoling	As per the Drawing	30	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
Tunnel face reinforcement			
Downtime (Cleaning up and breakdown)		30	
Total Time (in Hrs)		14.5 Hrs	

Support Section Types and their characteristics vis-à-vis tunnelling through them can be inferred from the Geotechnical base line report. All the time calculations for different activities shall be separately worked out with backup calculations for the proposed equipment. All the quantities shall be in relation to the excavation and support drawings for various Support Section Types as per Tender Drawings. The Method statement shall be in accordance with the procedures enumerated above. Submission of above calculation shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

Off Cycle* Time 0.5 hrs (Length of Tunnel considered shall be mentioned and Use separate Sheet if Required)

Cycle Time 14.5 hrs.

Effective Cycle time 15 hrs.

Progress per Cycle 3 m/Cycle.

Progress per Day 4.8 m/Day.

Progress per Week 31.2 m/Week. (Include 12 hr rest per week)

Progress per Month 134.4m/Month. (Include 48 hr rest per month)

* Time required for off cycle support installation like (Pipe Roof, Forepoles, Face improvement, ground improvement etc.) is to be calculated separately for each Support Section Type.

SEAL AND SIGNATURE OF THE BIDDER

Form MET 2

Proposed Cycle Time Calculation

Two Line Cross Section for Support Section Type C1 & C2

Detailed work cycle for different classes, with a breakdown into different activities and duration of each, in minutes. **Details for cycle time shall be computed considering the Support Section Type at maximum foreseen excavation drive length from any Tunnel portal according to work's programme proposed by bidder. This will become the baseline for computation of contractor's performance at site.**

	Activity	Quantity	Time (min)	Remarks
Excavation	Preparation of new face drilling / Marking of Drill Pattern	As per the Drawing	60	With Scissor Platform/ JCB Load all
	Drilling	As per the Drawing	210	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
	Blasting and Defuming	As per the Drawing	90	Using Catridge/Bulk explosives and defuming with ventilation fans of 132KV capacity.
Scaling and Mucking		As per the Drawing	210	Scaling with EC210 Excavator and Mucking with a combination of EC210 Excavator and 6 No's of 25Ton capacity Dumpers.
Shotcreting		As per the Drawing	60	Using 5100 VC Normet make shotcreting machine of 30 Cum/hr capacity.
Rock bolting		As per the Drawing	60	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
Steel ribs / Lattice griers or others (as applicable)		As per the Drawing	60	With Scissor Platform/ JCB Load all
Fiberglass elements installation				

Activity	Quantity	Time (min)	Remarks
Forepoling	As per the Drawing	30	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
Tunnel face reinforcement			
Downtime (Cleaning up and breakdown)		30	
Total Time (in Hrs)		13.5 Hrs	

Support Section Types and their characteristics vis-à-vis tunnelling through them can be inferred from the Geotechnical base line report. All the time calculations for different activities shall be separately worked out with backup calculations for the proposed equipment. All the quantities shall be in relation to the excavation and support drawings for various Support Section Types as per Tender Drawings. The Method statement shall be in accordance with the procedures enumerated above. Submission of above calculation shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

Off Cycle* Time 0.5 hrs (Length of Tunnel considered shall be mentioned and Use separate Sheet if Required)

Cycle Time 13.5 hrs.

Effective Cycle time 14 hrs.

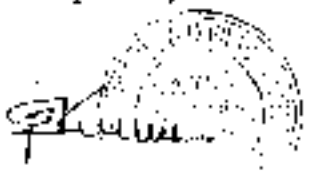
Progress per Cycle 3 m/Cycle.

Progress per Day 5.14 m/Day.

Progress per Week 33.42 m/Week. (Include 12 hr rest per week)

Progress per Month 143.92 m/Month. (Include 48 hr rest per month)

* Time required for off cycle support installation like (Pipe Roof, Forepoles, Face improvement, ground improvement etc.) is to be calculated separately for each Support Section Type.



SEAL AND SIGNATURE OF THE BIDDER

Form MET 2

Proposed Cycle Time Calculation

Escape Tunnel for Support Section Type C3 & C4

Detailed work cycle for different classes, with a breakdown into different activities and duration of each, in minutes. **Details for cycle time shall be computed considering the Support Section Type at maximum foreseen excavation drive length from any Tunnel portal according to work's programme proposed by bidder. This will become the baseline for computation of contractor's performance at site.**

	Activity	Quantity	Time (min)	Remarks
Excavation	Preparation of new face drilling / Marking of Drill Pattern	As per the Drawing	15	With Scissor Platform/ JCB Load all
	Drilling	As per the Drawing	180	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
	Blasting and Defuming	As per the Drawing	90	Using Catridge/Bulk explosives and defuming with ventilation fans of 132KV capacity.
Scaling and Mucking;		As per the Drawing	180	Scaling with EC210 Excavator and Mucking with a combination of EC210 Excavator and 6 No's of 25Ton capacity Dumpers.
Shortcreting		As per the Drawing	120	Using 5100 VC Normet make shotcreting machine of 30 Cum/hr capacity.
Rock bolting		As per the Drawing	60	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity
Steel ribs / Lattice griers or others (as applicable)			90	
Fiberglass elements installation			30	
Forepuling;				

Activity	Quantity	Time (min)	Remarks
Tunnel face reinforcement			
Downtime (Cleaning up and breakdown)		15	
Total Time (in Hrs)		13 Hrs	

Support Section Types and their characteristics vis-à-vis tunnelling through them can be inferred from the Geotechnical base line report. All the time calculations for different activities shall be separately worked out with backup calculations for the proposed equipment. All the quantities shall be in relation to the excavation and support drawings for various Support Section Types as per Tender Drawings. The Method statement shall be in accordance with the procedures enumerated above. Submission of above calculation shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

Off Cycle* Time 0.5 hrs (Length of Tunnel considered shall be mentioned and Use separate Sheet if Required)

Cycle Time 13 hrs.

Effective Cycle time 13.5 hrs.

Progress per Cycle 0.8 m/Cycle.

Progress per Day 1.42 m/Day.

Progress per Week 9.24 m/Week. (Include 12 hr rest per week)

Progress per Month 39.76 m/Month. (Include 48 hr rest per month)

* Time required for off cycle support installation like (Pipe Roof, Forepoles, Face improvement, ground improvement etc.) is to be calculated separately for each Support Section Type.

SEAL AND SIGNATURE OF THE BIDDER

Form MET 2

Proposed Cycle Time Calculation

Main Tunnel for Support Section Type C3 & C4

Detailed work cycle for different classes, with a breakdown into different activities and duration of each, in minutes. **Details for cycle time shall be computed considering the Support Section Type at maximum foreseen excavation drive length from any Tunnel portal according to work's programme proposed by bidder. This will become the baseline for computation of contractor's performance at site.**

	Activity	Quantity	Time (min)	Remarks
Excavation	Preparation of new face drilling / Marking of Drill Pattern	As per the Drawing	15	With Scissor Platform/ JCB Load all
	Drilling	As per the Drawing	180	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
	Blasting and Defuming	As per the Drawing	90	Using Cartridge/Bulk explosives and defuming with ventilation fans of 132KV capacity.
Scaling and Mucking		As per the Drawing	180	Scaling with EC210 Excavator and Mucking with a combination of EC210 Excavator and 6 No's of 25Ton capacity Dumpers.
Shotcreting		As per the Drawing	120	Using 5100 VC Normet make shotcreting machine of 30 Cum/hr capacity.
Rock bolting		As per the Drawing	60	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
Steel ribs / Lattice griers or others (as applicable)			90	
Fiberglass elements installation			30	
Forepoling				

Activity	Quantity	Time (min)	Remarks
Tunnel face reinforcement			
Downtime (Cleaning up and breakdown)		15	
Total Time (In Hrs)		13 Hrs	

Support Section Types and their characteristics vis-à-vis tunnelling through them can be inferred from the Geotechnical base line report. All the time calculations for different activities shall be separately worked out with backup calculations for the proposed equipment. All the quantities shall be in relation to the excavation and support drawings for various Support Section Types as per Tender Drawings. The Method statement shall be in accordance with the procedures enumerated above. Submission of above calculation shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

Off Cycle* Time 0.5 hrs (Length of Tunnel cousidered shall be mentioned and Use separate Sheet if Required)

Cycle Time 13 hrs.

Effective Cycle time 13.5 hrs.

Progress per Cycle 0.8 m/Cycle.

Progress per Day 1.42 m/Day.

Progress per Week 9.24 m/Week. (Include 12 hr rest per week)

Progress per Month 39.76 m/Month. (Include 48 hr rest per month)

* Time required for off cycle support installation like (Pipe Roof, Forepoles, Face improvement, ground improvement etc.) is to be calculated separately for each Support Section Type.

SEAL AND SIGNATURE OF THE BIDDER

Form MET 2

Proposed Cycle Time Calculation

Three Line Cross Section for Support Section Type C3 & C4

Detailed work cycle for different classes, with a breakdown into different activities and duration of each, in minutes. **Details for cycle time shall be computed considering the Support Section Type at maximum foreseen excavation drive length from any Tunnel portal according to work's programme proposed by bidder. This will become the baseline for computation of contractor's performance at site.**

	Activity	Quantity	Time (min)	Remarks
Excavation	Preparation of new face drilling / Marking of Drill Pattern	As per the Drawing	30	With Scissor Platform/ JCB Load all
	Drilling	As per the Drawing	240	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
	Blasting and Defuming	As per the Drawing	90	Using Catridge/Bulk explosives and defuming with ventilation fans of 132KV capacity.
Scaling and Mucking		As per the Drawing	240	Scaling with EC210 Excavator and Mucking with a combination of EC210 Excavator and 6 No's of 25Ton capacity Dumpers.
Shortereting		As per the Drawing	120	Using 5100 VC Normet make shotcreting machine of 30 Cum/hr capacity.
Rock bolting		As per the Drawing	60	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity
Stell ribs / Lattice griers or others (as applicable)		As per the Drawing	90	With Scissor Platform/ JCB Load all

Activity	Quantity	Time (min)	Remarks
Fiberglass elements installation	As per the Drawing	30	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity
Forepoling			
Tunnel face reinforcement			
Downtime (Cleaning up and breakdown)		30	
Total Time (in Hrs)		15.5 Hrs	

Support Section Types and their characteristics vis-à-vis tunnelling through them can be inferred from the Geotechnical base line report. All the time calculations for different activities shall be separately worked out with backup calculations for the proposed equipment. All the quantities shall be in relation to the excavation and support drawings for various Support Section Types as per Tender Drawings. The Method statement shall be in accordance with the procedures enumerated above. Submission of above calculation shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

Off Cycle* Time 0.5 hrs (Length of Tunnel considered shall be mentioned and Use separate Sheet if Required)

Cycle Time 15.5 hrs.

Effective Cycle time 16 hrs.

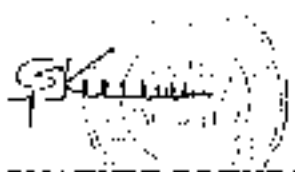
Progress per Cycle 0.8 m/Cycle.

Progress per Day 1.2 m/Day.

Progress per Week 7.8 m/Week. (Include 12 hr rest per week)

Progress per Month 33.6m/Month. (Include 48 hr rest per month)

* Time required for off cycle support installation like (Pipe Roof, Forepoles, Face improvement, ground improvement etc.) is to be calculated separately for each Support Section Type.



SEAL AND SIGNATURE OF THE BIDDER

Form MET 2

Proposed Cycle Time Calculation

Two Line Cross Section for Support Section Type C3 & C4

Detailed work cycle for different classes, with a breakdown into different activities and duration of each, in minutes. **Details for cycle time shall be computed considering the Support Section Type at maximum foreseen excavation drive length from any Tunnel portal according to work's programme proposed by bidder. This will become the baseline for computation of contractor's performance at site.**

	Activity	Quantity	Time (min)	Remarks
Excavation	Preparation of new face drilling / Marking of Drill Pattern	As per the Drawing	30	With Scissor Platform/ JCB Load all
	Drilling	As per the Drawing	210	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
	Blasting and Defuming	As per the Drawing	90	Using Catridge/Bulk explosives and defuming with ventilation fans of 132KV capacity.
Scaling and Mucking		As per the Drawing	210	Scaling with EC210 Excavator and Mucking with a combination of EC210 Excavator and 6 No's of 25Ton capacity Dumpers.
Shortereting		As per the Drawing	120	Using 5100 VC Normet make shotereting machine of 30 Cum/hr capacity.
Rock bolting		As per the Drawing	60	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
Steil ribs / Lattice griers or others (as applicable)		As per the Drawing	90	With Scissor Platform/ JCB Load all
Fiberglass elements installation		As per the Drawing	30	

Activity	Quantity	Time (min)	Remarks
Forepoling		30	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
Tunnel face reinforcement			
Downtime (Cleaning up and breakdown)		30	
Total Time (in Hrs)		13.5 Hrs	

Support Section Types and their characteristics vis-à-vis tunnelling through them can be inferred from the Geotechnical base line report. All the time calculations for different activities shall be separately worked out with backup calculations for the proposed equipment. All the quantities shall be in relation to the excavation and support drawings for various Support Section Types as per Tender Drawings. The Method statement shall be in accordance with the procedures enumerated above. Submission of above calculation shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

Off Cycle* Time 0.5 hrs (Length of Tunnel considered shall be mentioned and Use separate Sheet if Required)

Cycle Time 13.5 hrs.

Effective Cycle time 14 hrs.

Progress per Cycle 3 m/Cycle.

Progress per Day 5.14 m/Day.

Progress per Week 33.42 m/Week (Include 12 hr rest per week)

Progress per Month 143.92 m/Month. (Include 48 hr rest per month)

* Time required for off cycle support installation like (Pipe Roof, Forepoles, Face improvement, ground improvement etc.) is to be calculated separately for each Support Section Type.

SEAL AND SIGNATURE OF THE BIDDER

Form MET 2

Proposed Cycle Time Calculation

Escape Tunnel for Support Section Type P

Detailed work cycle for different classes, with a breakdown into different activities and duration of each, in minutes. **Details for cycle time shall be computed considering the Support Section Type at maximum foreseen excavation drive length from any Tunnel portal according to work's programme proposed by bidder. This will become the baseline for computation of contractor's performance at site.**

	Activity	Quantity	Time (min)	Remarks
Excavation	Preparation of new face drilling / Marking of Drill Pattern	As per the Drawing	15	With Scissor Platform/ JCB Load all
	Drilling	As per the Drawing	120	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
	Blasting and Defuming	As per the Drawing	90	Using Cartridge/Bulk explosives and defuming with ventilation fans of 132KV capacity.
Scaling and Mucking		As per the Drawing	120	Scaling with EC210 Excavator and Mucking with a combination of EC210 Excavator and 6 No's of 25Ton capacity Dumpers.
Shotcreting		As per the Drawing	60	Using 5100 VC Normet make shotcreting machine of 30 Cum/hr capacity.
Rock bolting		As per the Drawing	60	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
Steel ribs / Lattice girders or others (as applicable)		As per the Drawing	90	
Fiberglass elements installation		As per the Drawing	30	

Activity	Quantity	Time (min)	Remarks
Forepoling;			
Tunnel face reinforcement			
Downtime (Cleaning up and breakdown)		15	
Total Time (in Hrs)		9.5 Hrs	

Support Section Types and their characteristics vis-à-vis tunnelling through them can be inferred from the Geotechnical base line report. All the time calculations for different activities shall be separately worked out with backup calculations for the proposed equipment. All the quantities shall be in relation to the excavation and support drawings for various Support Section Types as per Tender Drawings. The Method statement shall be in accordance with the procedures enumerated above. Submission of above calculation shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

Off Cycle* Time 0.5 hrs (Length of Tunnel considered shall be mentioned and Use separate Sheet if Required)

Cycle Time 9.5 hrs.

Effective Cycle time 10 hrs.

Progress per Cycle 1 m/Cycle.

Progress per Day 2.4 m/Day.

Progress per Week 15.6 m/Week. (Include 12 hr rest per week)

Progress per Month 67.2 m/Month. (Include 48 hr rest per month)

* Time required for off cycle support installation like (Pipe Roof, Forepoles, Face improvement, ground improvement etc.) is to be calculated separately for each Support Section Type.

SEAL AND SIGNATURE OF THE BIDDER

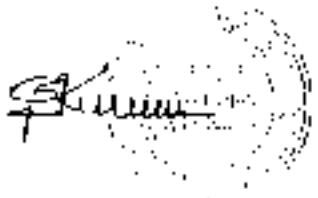
Form MET 2

Proposed Cycle Time Calculation

Main Tunnel for Support Section Type P

Detailed work cycle for different classes, with a breakdown into different activities and duration of each, in minutes. **Details for cycle time shall be computed considering the Support Section Type at maximum foreseen excavation drive length from any Tunnel portal according to work's programme proposed by bidder. This will become the baseline for computation of contractor's performance at site.**

	Activity	Quantity	Time (min)	Remarks
Excavation	Preparation of new face drilling / Marking of Drill Pattern	As per the Drawing	15	With Scissor Platform/ JCB Load all
	Drilling	As per the Drawing	120	Using 1.2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
	Blasting and Defuming	As per the Drawing	90	Using Catridge/Bulk explosives and defuming with ventilation fans of 132KV capacity.
Scaling and Mucking		As per the Drawing	120	Scaling with EC210 Excavator and Mucking with a combination of EC210 Excavator and 6 No's of 25Ton capacity Dumpers.
Shortcreting		As per the Drawing	60	Using 5100 VC Normet make shotcreting machine of 30 Cum/hr capacity.
Rock bolting		As per the Drawing	60	Using 1.2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
Stell ribs / Lattice griers or others (as applicable)		As per the Drawing	90	



Activity	Quantity	Time (min)	Remarks
Fiberglass elements installation	As per the Drawing	30	
Forepoling			
Tunnel face reinforcement			
Downtime (Cleaning up and breakdown)		15	
Total Time (in Hrs)		9.5 Hrs	

Support Section Types and their characteristics vis-à-vis tunnelling through them can be inferred from the Geotechnical base line report. All the time calculations for different activities shall be separately worked out with backup calculations for the proposed equipment. All the quantities shall be in relation to the excavation and support drawings for various Support Section Types as per Tender Drawings. The Method statement shall be in accordance with the procedures enumerated above. Submission of above calculation shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

Off Cycle* Time 0.5 hrs (Length of Tunnel considered shall be mentioned and Use separate Sheet if Required)

Cycle Time 9.5 hrs.

Effective Cycle time 10 hrs.

Progress per Cycle 1 m/Cycle.

Progress per Day 2.4 m/Day.

Progress per Week 15.6 m/Week. (Include 12 hr rest per week)

Progress per Month 67.2 m/Month. (Include 48 hr rest per month)

* Time required for off cycle support installation like (Pipe Roof, Forepoles, Face improvement, ground improvement etc.) is to be calculated separately for each Support Section Type.

SEAL AND SIGNATURE OF THE BIDDER

Form MET 2

Proposed Cycle Time Calculation

Three Line Cross Section for Support Section Type P

Detailed work cycle for different classes, with a breakdown into different activities and duration of each, in minutes. **Details for cycle time shall be computed considering the Support Section Type at maximum foreseen excavation drive length from any Tunnel portal according to work's programme proposed by bidder. This will become the baseline for computation of contractor's performance at site.**

	Activity	Quantity	Time (min)	Remarks
Excavation	Preparation of new face drilling / Marking of Drill Pattern	As per the Drawing	30	With Scissor Platform/ JCB Load all
	Drilling	As per the Drawing	150	Using L2D Semi-Automatic/F2C fully Automatic Boomer of 5m/min capacity.
	Blasting and Defuming	As per the Drawing	90	Using, Catridge/Bulk explosives and defuming with ventilation fans of 132KV capacity.
Scaling and Mucking		As per the Drawing	150	Scaling with EC210 Excavator and Mucking with a combination of EC210 Excavator and 6 No's of 25Ton capacity Dumpers.
Shotcreting		As per the Drawing	90	Using 5100 VC Normet make shotcreting machine of 30 Cum/hr capacity.
Rock bolting		As per the Drawing	90	Using L2D Semi-Automatic/F2C fully Automatic Boomer of 5m/min capacity.
Steel ribs / Lattice girders or others (as applicable)		As per the Drawing	90	With Scissor Platform/ JCB Load all
Fiberglass elements installation				
Forepoling				

Activity	Quantity	Time (min)	Remarks
Tunnel face reinforcement			
Downtime (Cleaning up and breakdown)		30	
Total Time (In Hrs)		12 Hrs	

Support Section Types and their characteristics vis-à-vis tunnelling through them can be inferred from the Geotechnical base line report. All the time calculations for different activities shall be separately worked out with backup calculations for the proposed equipment All the quantities shall be in relation to the excavation and support drawings for various Support Section Types as per Tender Drawings. The Method statement shall be in accordance with the procedures enumerated above. Submission of above calculation shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

Off Cycle* Time 0.5 hrs (Length of Tunnel considered shall be mentioned and Use separate Sheet if Required)

Cycle Time 12 hrs.

Effective Cycle time 12.5 hrs.

Progress per Cycle 1 m/Cycle.

Progress per Day 1.92 m/Day.

Progress per Week 12.48 m/Week. (Include 12 hr rest per week)

Progress per Month 53.76 m/Month. (Include 48 hr rest per month)

* Time required for off cycle support installation like (Pipe Roof, Forepoles, Face improvement, ground improvement etc.) is to be calculated separately for each Support Section Type.

SEAL AND SIGNATURE OF THE BIDDER

Form MET 2

Proposed Cycle Time Calculation

Two Line Cross Section for Support Section Type P

Detailed work cycle for different classes, with a breakdown into different activites and duration of each, in minutes. **Details for cycle time shall be computed considering the Support Section Type at maximum foreseen excavation drive length from any Tunnel portal according to work's programme proposed by bidder. This will become the baseline for computation of contractor's performance at site.**

	Activity	Quantity	Time (min)	Remarks
Excavation	Preparation of new face drilling / Marking of Drill Pattern	As per the Drawing	30	With Scissor Platform/ JCB Load all
	Drilling	As per the Drawing	120	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
	Blasting and Defuming	As per the Drawing	90	Using Catridge/Bulk explosives and defuming with ventilation fans of 132KV capacity.
Scaling and Mucking		As per the Drawing	150	Scaling with EC210 Excavator and Mucking with a combination of EC210 Excavator and 6 No's of 25Ton capacity Dumpers.
Shortcreting		As per the Drawing	90	Using 5100 VC Normet make shotcreting machine of 30 Cum/hr capacity.
Rock bolting		As per the Drawing	60	Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
Steel ribs / Lattice griers or others (as applicable)		As per the Drawing	90	With Scissor Platform/ JCB Load all
Fiberglass elements installation				

Activity	Quantity	Time (min)	Remarks
Forepoling			Using L2D Semi-Automatic/E2C fully Automatic Boomer of 5m/min capacity.
Tunnel face reinforcement			
Downtime (Cleaning up and breakdown)		30	
Total Time (in Hrs)		11 Hrs	

Support Section Types and their characteristics vis-à-vis tunnelling through them can be inferred from the Geotechnical base line report. All the time calculations for different activities shall be separately worked out with backup calculations for the proposed equipment. All the quantities shall be in relation to the excavation and support drawings for various Support Section Types as per Tender Drawings. The Method statement shall be in accordance with the procedures enumerated above. Submission of above calculation shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

Off Cycle* Time 0.5 hrs (Length of Tunnel considered shall be mentioned and Use separate Sheet if Required)

Cycle Time 11 hrs.

Effective Cycle time 11.5 hrs.

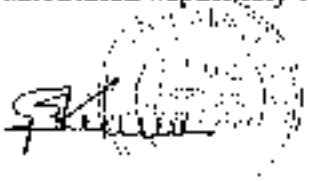
Progress per Cycle 1 m/Cycle.

Progress per Day 2.08 m/Day.

Progress per Week 13.56 m/Week (Include 12 hr rest per week)

Progress per Month 58.24 m/Month. (Include 48 hr rest per month)

* Time required for off cycle support installation like (Pipe Roof, Forepoles, Face improvement, ground improvement etc.) is to be calculated separately for each Support Section Type.



SEAL AND SIGNATURE OF THE BIDDER

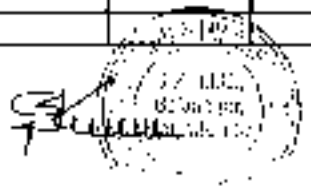
Form MET 3
WORKS PROGRAMME IN LINE WITH MILESTONES

Completion period of Work has been divided into one Sections as defined in the Section 7A: Contract Data. The Milestones (ML) and their Key Dates for each section are given in the Table Below along with respective sub activities. Bidder can modify the sub activities (KD), but the Milestones and their Key Dates defined in table below shall not be violated while framing the programme. Tentative scheduling for guidance is given in Clause 2.24 of Section 5: Work's requirement.

Contractor is required to work out the key dates and submit this form according to his proposed works program without violating the milestones or the completion period of Individual Sections. Functional requirements for execution of works is detailed in Clause 8.0 of Section 7B: Special conditions of contract, which needs to be considered while framing the work's programme.

Abbreviations;
T13 = Tunnel 13 A7 = Adit 7 P1 = Portal 1 P2 = Portal 2 MT = Main Tunnel KD= Sub Activities
EM = Electromechanical contractor. ET = Escape Tunnel ML= Milestone BLT = Ballastless contractor

PACKAGE 7B SECTION: 1 (Completion Period 54 Months)				
ML01	**Excavation for Tunnel 13.**	**43**	**9381**	
	Excavation from T13P1			
KD01-A	Slope stabilization and T13P1completed and ET excavation begins from T13P1 towardsAdit-7	6		6
KD01-B	Slope stabilization and T13P1completed and MT excavation from T13P1 towards Adit-7 begins	11		11
KD01-C	Breakthrough in ET from T13P1 direction	25	3218	19
KD01-D	Breakthrough in MT from T13P1 direction	38	3218	27
	Excavation from A7			
KD01-E	ET excavation begins from A7 towards T13P2	6		6
KD01-F	MT excavation begins from A7 towards T13P2	7		7
KD01-G	Breakthrough in ET towards T13P2 direction	33	3081	27
KD01-H	Breakthrough in MT towards T13P2 direction	43	3081	36
	Excavation from T13P2			
KD01-I	Slope stabilization and T13P2 completed and ET excavation begins from T13P2 towards A7	6		6
KD01-J	Slope stabilization and T13P2 completed and MT excavation begins from T13P2 towards A7	6		6
KD01-K	Breakthrough in ET from T13P2 direction	33	3082	27
KD01-L	Breakthrough in MT from T13P2 direction	43	3082	37
ML02	**Final Lining of Tunnel-13, ET & Adit – 7**	**54**	**9381**	
KD02-A	MT lining complete	51		13
KD02-B	ET lining complete	42		17
KD02-C	MT and ET invert structure complete	53		10
KD02-D	Handing over of MT to BLT	54		1
KD02-E	Handing over of ET and Technical rooms to EM	45		2
KD02-F	Adit 7 Lining and under-structure complete	46		5
ML03	**Completion of Embankment up to Formation Level including slope stabilization**	30		
KD04	From Km 207+640 to Km 208+388	30		30



NOTES:

1. The key dates define the ending of activity (unless explicitly defined in description of the activity).
2. Contractor shall prepare and submit (in CD) detailed works programme, in Microsoft Project or equivalent, with deployment schedule for various critical equipments (Form MET-4) and Key Personnel (Form MET-5). List of Minimum critical equipments and Key Personnel is detailed in the Section 5: Work's Requirement.
3. It is to be noted that shifts will be exchanged at tunnel face and underground excavation cycle times shall not be affected by shift changes. The cycle time has to be matched accordingly by the bidder according to advance rates for 2 line and 3-line section.
4. Submission of above works programme shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.
5. Distribution for various Support Section Types is Rock Support Type given in Geotechnical Baseline Report. Details of support installation for each Support Section Type is provided in the Tender drawings. Bidder shall support his assumption of daily/weekly advance rates with calculations detailed in proposed Cycle Time Calculation in Form MET-2. **The advance rates proposed by bidder shall be computed considering the Support Section Type at maximum foreseen excavation drive length from any Tunnel portal according to work's programme proposed by bidder, so that the same is maintainable throughout the tunnel during it's construction. The monthly advance rates should include scheduled rests of 2 days per month.**

Summary of Advance Rates proposed by bidder					
	Effective Cycle Time	Round Length	Daily (m/day)	Weekly (m/week)	Monthly (m/month)
Support Class	(in Hrs)	(in Meters)	MT/ET	MT/ET	MT/ET
B1	9.5	3.5	8.64	57.47	247.57
B2	12.5	3	5.76	37.44	161.28
C1	12.5	2	3.84	24.96	107.52
C2	12.5	2	3.84	24.96	107.52
C3	13.5	0.6	1.42	9.24	39.76
P	9.5	1	2.4	15.6	67.2

SEAL AND SIGNATURE OF THE BIDDER

FORM MET 4

Month wise Deployment Schedule for Key Equipments in line with Proposed Works Programme (in A3 Format)

Sl. No	Description	Specification/ Brand/ Make	Total Qty	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
1	Jumbo(Type-I) Automatic	Type I SANDVIK/ETHROC	4					1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3	3	3	3	2	1	1	1	1	1	1	1	1
2	Jumbo(Type-II) Semi Automatic	Type2 SANDVIK/ETHROC	4						2	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3	3	2	2	2	2	2	1	1
3	Shotcreting equipment	Whitecap or NORMET	6					4	5	5	5	5	6	6	6	6	6	6	6	6	6	6	5	6	6	6	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	4	4	4	4	4	2	2	2	2
4	Track mounted Complete grouting Equipment system	Type2 Boart EPIROC	2					1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1
5	Wheel Loaders	VOLVO	4					1	2	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
6	Hydraulic Excavator(equipped with breaker for secondary operation	0.2-0.6 CUM-VOLVO	8	2	4	6	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	6	6	6	4	4	4	4	2	2
7	Dumpers	6x4 KOMATSU/VOLVO	Capacity wise to be in accordance with the tunnel cross section and working operation to be finalised by the Engineer-in-charge	10	20	30	40	50	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	50	50	50	50	50	40	40	40	30	30	30	20	20	20	20	15	15	10	10
8	Ventilation	TBA LIEBHERR/SANY	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
9	Twin Shotcrete with robotic Turret Trolley	TBA LIEBHERR/SANY	4			2	2	4	4	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	4	4	4	4	4	4	4	4	4
10	Electrical Submersible Dewatering pump(Single pump	45kW to 90HP	6 Nos (All pumps should have adequate capacity to handle water inflow of 50Lps or more Lps) Optional	2	4	6	6	6	6	6	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
11	Jumbo platform	TATA/ALL/Ashok leyland	3	2	2	4	4	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	4	4	4	4	4	4	4	4	4
12	Fully computerized Automatic batching Plant	30cum/hr Schwingstetter	1 (Over Shotcrete and Augmented by additional volume at the working face as per required capacity)				2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
13	Soil nailing Set with suitable Accessories	12mm dia to 16mm dia	All DC sets should have 100% power back up. Details of the arrangement of power supply to be submitted for approval by the Engineer-in-charge				2	2	4	4	6	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	10	10	10	10	10	6	6	6
14	Continuous Loader	TATA/	2					2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
15	Transit Mixer	10 cum/Schwing/Etc	According to proposed concreting methods and schedule as approved by the Engineer-in-charge				2	4	6	8	10	10	10	10	20	10	10	10	10	10	10	10	10	10	10	20	30	40	50	50	50	50	50	50	50	50	50	50	40	40	40	30	30	30	30	30	20	20	20	10	10	10	10	10				

Note

Bidder shall submit a bar chart for deployment for above mentioned schedule. Spare equipments required in accordance with work programme shall also be shown in the deployment schedule. Substitute or alternative shall not relieve the Contractor of any of the duties, obligation or responsibilities under the Contract.

SEAL AND SIGNATURE OF THE BIDDER

FORM MET 5

Month wise Deployment Schedule for Key Personnel in line with Proposed Works Programme (in A3 Format)

Sl No	Description	Total Qty	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
1	Project Manager/ Team Leader		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	Technical / Design manager	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	Tunnel construction Manager	9					1	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
4	Head Surveyor (NATM) (SAIMA)	1					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5	Head Surveyor (SAIMA) (MACHINE)	4 (1 per shift per tunnel excluding shaft)					4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
6	Muckers	12 (1 per shift per machine)					4	8	8	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
7	Loader Operator	16 (2 per shift per machine)					6	10	12	12	13	13	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
8	Senior Geologist	3	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
9	Senior Surveyor	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
10	Material Procurement Manager	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11	Material Stores Manager	1			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
12	Safety Manager	3	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
13	Surveyor	6	2	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
14	Grouting Engineer	2						1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
15	Civil Engineers (Tunnel)	6					1	3	2	3	4	6	4	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
16	Geologist	6	1	2	2	2	3	4	4	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
17	Quality Assurance and Quality Control Manager	4 (1 each Party)	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
18	Project Platform Coordinator	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
19	Surveyor	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

SEAL AND SIGNATURE OF THE BIDDER

CONTRACT FORMS

Annexure-A

COF/3

FORM OF CONTRACTPERFORMANCE SECURITY
(BANK GUARANTEE)

[*Refer Clause 41 of Instructions to Bidders]*

(*On non-judicial stamp paper of the appropriate value in accordance with stamp Act. The stamp paper to be in the name of Executing Bank).*

From:
Name and Address of the Bank…..
……..
To:
The Chairman and Managing Director,
Rail Vikas Nigam Limited,
1st Floor, August Kranti Bhawan,
Bhikaji Cama Place, R. K. Puram,
New Delhi-110 066.

WHEREAS**,** Rail Vikas Nigam Limited, hereinafter called the **Employer,** acting through ***[Insert Designation and address of the Employer's Representative]***, has accepted the bid of ***[Insert Name and address of the Contractor]***, hereinafter called the **Contractor,** for the work of ***[Insert Name of Work]***, vide Notification of Award No.***[Insert Notification of Award No.]***.

AND

WHEREAS, the contractor is required to furnish Performance Security for the sum of ***[Insert Value of Performance Security required]***, in the form of bank guarantee, being a condition precedent to the signing of the contract agreement.

WHEREAS, ***[Insert Name of the Bank]***, with its Branch ***[Address]*** having its Headquarters office at ***[Address]***, hereinafter called the **Bank,** acting through ***[Designation(s) of the authorised person of the Bank]***, have, at the request of the *[Insert name of the JV partner]* , a JV partner on behalf of the contractor, agreed to give guarantee for performance security and additional performance security as hereinafter contained:

1 KNOW ALL MEN by these present that I/We the undersigned ***[Insert name(s) of authorized representatives of the Bank],***being fully authorized to sign and incur obligations for and on behalf of the Bank**,** confirm that the Bank, hereby, unconditionally and irrevocably guarantee to pay the Employer the full amount in the sum of ***[Insert Value of Performance Security required]*** as above stated.

2 The Bank undertakes to immediately pay on presentation of demand by the Employer any amount up to and including aforementioned full amount without any demur, reservation or recourse. Any such demand made by the Employer on the Bank shall be final, conclusive and binding, absolute and unequivocal notwithstanding any

disputes raised/ pending before any Court, Tribunal, Arbitration or any Authority or any threatened litigation by the Employer of Bank..

3 On payment of any amount less than aforementioned full amount, as per demand of the Employer, the guarantee shall remain valid for the balance amount i.e. the aforementioned full amount less the payment made to the Employer.

4 The Bank shall pay the amount as demanded immediately on presentation of the demand by Employer without any reference to the contractor and without the Employer being required to show grounds or give reasons for its demand or the amount demanded.

5. The Bank Guarantee shall be unconditional and irrevocable.

6 The guarantee hereinbefore shall not be affected by any change in the constitution of the Bank or in the constitution of the Contractor.

7 The Bank agrees that no change, addition, modifications to the terms of the Contract Agreement or to any documents, which have been or may be made between the Employer and the Contractor, will in any way release us from the liability under this guarantee; and the Bank, hereby, waives any requirement for notice of any such change, addition or modification to the Bank.

8 This guarantee is valid and effective from the date of its issue, which is ***[insert date of issue]***. The guarantee and our obligations under it will expire on ***[Insert the date twenty eight days after the expected end of defect liability period]***. All demands for payment under the guarantee must be received by us on or before that date.

9 The Bank agrees that the Employers right to demand payment of aforementioned full amount in one instance or demand payments in parts totaling up to the aforementioned full amount in several instances will be valid until either the aforementioned full amount is paid to the Employer or the guarantee is released by Employer before the Expiry date.

10 The Bank agrees that its obligation to pay any amount demanded by the Employer before the expiry of this guarantee will continue until the amount demanded has been paid in full.

11 The expressions Bank and Employer herein before used shall include their respective successors and assigns.

12 The Bank hereby undertakes not to revoke the guarantee during its currency, except with the previous consent in writing of the employer. This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 758.

13 The Guarantee shall be in addition to and without prejudice to any other security Guarantee (s) of the contractor in favour of the Employer available with the Employer.

The Bank, under this Guarantee, shall be deemed as Principal Debtor of the Employer.

Date ……. ……
Place……. [*Signature of Authorised person of Bank]*

……..
[Name in Block letters]

……..
[Designation]

……
[P/Attorney] No.

……..
Bank's Seal

[P/Attorney] No.……

Witness:

1. *Signature*
   Name & Address & Seal

2. *Signature*
   Name & address & Seal

Note :

1 *All italicized text is for guidance on how to prepare this bank guarantee and shall be deleted from the final document.*

2 *In case the guarantee is issued by a foreign Bank, which does not have operations in India, the said bank shall have to provide a counter-guarantee by State Bank of India.*

3 *In case the Contractor is a JV, the Performance Security is required to be furnished on behalf of the JV in favour of the Employer by the JV Partners in proportion of their respective percentage share specified in the JV Agreement. The percentage share of M/s [**Insert Name of the JV Partner**] in the JV is [**Fill share % in the JV**] percent. All the Bank Guarantee of JV Partners are liable to be encashed cumulatively.*

FORM OF ADDITIONAL PERFORMANCE SECURITY
(BANK GUARANTEE)

[Refer Clause 35.5 of Instructions to Bidders]

(On non-judicial stamp paper of the appropriate value in accordance with stamp Act. The stamp paper to be in the name of Executing Bank)

From:
Name and Address of the Bank…..
…….
To:
The Chairman and Managing Director,
Rail Vikas Nigam Limited,
1st Floor, August Kranti Bhawan,
Bhikaji Cama Place, R. K. Puram,
New Delhi-110 066.

WHEREAS**,** Rail Vikas Nigam Limited, hereinafter called the **Employer,** acting through ***[Insert Designation and address of the Employer's Representative]***, has accepted the bid of ***[Insert Name and address of the Contractor]***, hereinafter called the **Contractor,** for the work of ***[Insert Name of Work]***, vide Notification of Award No.***[Insert Notification of Award No.]***.

AND

WHEREAS, the contractor is required to furnish additional Performance Security for the sum of ***[Insert Value of additional Performance Security required]***, in the form of bank guarantee, being a condition precedent to the signing of the contract agreement.

WHEREAS, ***[Insert Name of the Bank]***, with its Branch ***[Address]*** having its Headquarters office at ***[Address]***, hereinafter called the **Bank,** acting through ***[Designation(s) of the authorised person of the Bank]***, have, at the request of the [Insert name of the JV partner], a JV partner on behalf of the contractor, agreed to give guarantee for additional performance security as hereinafter contained:

1 KNOW ALL MEN by these present that I/We the undersigned ***[Insert name(s) of authorized representatives of the Bank],***being fully authorized to sign and incur obligations for and on behalf of the Bank**,** confirm that the Bank, hereby, unconditionally and irrevocably guarantee to pay the Employer the full amount in the sum of ***[Insert Value of additional Performance Security required]***as above stated.

2 The Bank undertakes to immediately pay on presentation of demand by the Employer any amount up to and including

aforementioned full amount without any demur, reservation or recourse. Any such demand made by the Employer on the Bank shall be final, conclusive and binding, absolute and unequivocal notwithstanding any disputes raised/ pending before any Court, Tribunal, Arbitration or any Authority or any threatened litigation by the Employer of Bank.

3 On payment of any amount less than aforementioned full amount, as per demand of the Employer, the guarantee shall remain valid for the balance amount i.e. the aforementioned full amount less the payment made to the Employer.

4 The Bank shall pay the amount as demanded immediately on presentation of the demand by Employer without any reference to the contractor and without the Employer being required to show grounds or give reasons for its demand or the amount demanded.

5 The Bank Guarantee shall be unconditional and irrevocable.

6 The guarantee hereinbefore shall not be affected by any change in the constitution of the Bank or in the constitution of the Contractor.

7 The Bank agrees that no change, addition, modifications to the terms of the Contract Agreement or to any documents, which have been or may be made between the Employer and the Contractor, will in any way release us from the liability under this guarantee; and the Bank, hereby, waives any requirement for notice of any such change, addition or modification to the Bank.

8 This guarantee is valid and effective from the date of its issue, which is ***[insert date of issue]***. The guarantee and our obligations under it will expire on ***[Insert the date twenty eight days after the expected end of defect liability period]***. All demands for payment under the guarantee must be received by us on or before that date.

9 The Bank agrees that the Employers right to demand payment of aforementioned full amount in one instance or demand payments in parts totaling up to the aforementioned full amount in several instances will be valid until either the aforementioned full amount is paid to the Employer or the guarantee is released by Employer before the Expiry date.

10 The Bank agrees that its obligation to pay any amount demanded by the Employer before the expiry of this guarantee will continue until the amount demanded has been paid in full.

11 The expressions Bank and Employer herein before used shall include their respective successors and assigns.

12 The Bank hereby undertakes not to revoke the guarantee during its currency, except with the previous consent in writing of the

employer. This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 758.

13 The Guarantee shall be in addition to and without prejudice to any other security Guarantee(s) of the contractor in favour of the Employer available with the Employer. The Bank, under this Guarantee, shall be deemed as Principal Debtor of the Employer.

Date .....

.....

Place.....

[Signature of Authorised person of Bank]

.....

[Name in Block letters]

.....

[Designation]

.....

[P/Attorney] No.

.....

Bank's Seal

[P/Attorney] No.....

Witness:

1. *Signature*
   Name & Address & Seal

2. *Signature*
   Name & address & Seal

Note :

1 *All italicized text is for guidance on how to prepare this bank guarantee and shall be deleted from the final document.*

2 *In case the guarantee is issued by a foreign Bank, which does not have operations in India, the said bank shall have to provide a counter-guarantee by State Bank of India.*

3 *The Bank Guarantee should be duly attested by Notary public with notarial stamp of appropriate value affixed thereon.*

4 *In case the Contractor is a JV, the additional Performance Security in term of ITB 35.5 is required to be furnished on behalf of the JV in favour of the Employer by the JV Partner(s) with proportion of their respective percentage share specified in the JV agreement. All the Bank Guarantee of JV Partners are liable to be encashed cumulatively.*

Advance Payment Security
[Refer Clause 14.2 of GCC]

(On non-judicial stamp paper of appropriate value in accordance with stamp Act. The stamp paper to be in the name of Executing Bank)

From
[Name and Address of the Bank]

To
The Chairman and Managing Director,
Rail Vikas Nigam Limited,
1st Floor, August Kranti Bhawan,
BhikajiCama Place, R. K.Puram,
New Delhi – 110 066

Beneficiary: Rail Vikas Nigam Limited.

Guarantee No.: *[…..reference number of the guarantee….]***Dated:** *[…….]*

WHEREAS, Rail Vikas Nigam Limited **(hereinafter called the Employer)** has entered into Contract No. [….*reference number of the Contract….]*dated *[……]* for the execution of *[name of the contract]* **(hereinafter called the Contract)** with*[….name of the Contractor….]***(hereinafter called the Contractor)**.

WHEREAS, according to the Conditions of the Contract, an advance payment is admissible to the contractor against submission of bank guarantee(s).

At the request of the Contractor, we *[….name of the Bank….]* with our branch at*[….address….],*having our Head Office at *[….address….]* ***(*hereinafter called the Bank)** have, at the request of *[……Insert name of the JV partner…..]*, a JV partner on behalf of the Contractor, agreed to give the said guarantee as hereinafter contained:

1. KNOW ALL MEN by these present that I/We the undersigned *[….Insert name(s) of authorized representative(s) of the Bank….]***,** being fully authorized to sign and incur obligations for and on behalf of the Bank**,** confirm that the Bank, hereby, unconditionally and irrevocably guarantees to pay the Employer

the sum of Rs.*[….value in figure….]*(Rupees [….*value in words….] only* **(hereinafter called the Full Amount)**.

2. The Bank undertakes to immediately pay to the Employer, without any demur, reservation or recourse, any amount up to and including aforementioned full amount upon first written demand/demands from the Employer.

3. On payment of any amount less than aforementioned full amount, as per demand of the Employer, the guarantee shall remain valid for the balance amount i.e. the aforementioned full amount less the payment made to the Employer.

4. The Bank shall pay the amount so demanded without any reference to the contractor and without the Employer being required to show grounds or give reasons for its demand or the amount demanded.

5. The guarantee hereinbefore shall not be affected by any change in the constitution of the Bank, the Contractor or the Employer.

6. The Bank agrees that no change, addition, modification to the terms of the Contract Agreement or to any document, which have been or may be made between the Employer and the Contractor, will in any way release us from the liability under this guarantee; and the Bank, hereby, waives any requirement for notice of any such change, addition or modification to the Bank.

7. This guarantee is valid and effective from the date of it's issue, which is *[….date of issue….]*. The guarantee and our obligations under it will expire on dated ……..*[….Please refer note 4 & 5….]*. All demands for payment under the guarantee must be received by us on or before that date.

8. The Bank agrees that the Employer's right to demand payment of aforementioned full amount in one instance or demand payments in parts totaling up to the aforementioned full amount in several instances will continue until either the aforementioned full amount is paid to the Employer or the guarantee validity period expires.

9. The Bank agrees that it's obligation to pay any amount demanded by the Employer before the expiry of this guarantee will continue until the amount demanded has been paid in full.

10. The expressions Bank and Employer herein before used shall include their respective successors and assigns.

11. The Bank hereby undertakes not to revoke the guarantee during its currency, except with the previous consent in writing of the employer. This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 758.

Dated[……]

Place[……]

……
(Signature of the Authorized Person of the Bank)

……
(Name in Block Letters)

……
(Designation)

……
(Bank's Seal)

……
(Authorization No.)

Witness:

……
1. *Signature, Name & Address*

……
2. *Signature, Name & Address*

Note:

1. *All italicized text in brackets [….text….] is for guidance on how to prepare this bank guarantee and shall be deleted from the final document.*

2. *In case the guarantee is issued by a foreign Bank, the said bank shall have operations in India and should be issued by Indian operations branch of the said bank.*

3. *The Bank Guarantee should be duly attested by Notary Public with notarial stamps of appropriate value affixed thereon.*

4. ***Mobilization Advance under GCC 14.2.1****:*

   (a) For Single Entity

   For each Installment of Advance, two Bank Guarantees of equal amounts (each equal to half of the first installment of advance plus

10%) shall be furnished. Each Bank Guarantee shall be valid for the stipulated completion period of the contract.

OR

(b) For JV

For each Installment of Advance, individual JV partner shall furnish Bank Guarantee equal to his share in the installment of Advance plus 10%. Each Bank Guarantee shall be valid for the stipulated completion period of the contract.

5. ***Advance against Plant and Machinery under GCC 14.2.2:***

(a) For Single Entity

For each Installment of Advance, a Bank Guarantee equal to the installment of advance plus 10% shall be furnished. The Bank Guarantee shall be valid for the stipulated completion period of the contract.

OR

(b) For JV

For each Installment of Advance, individual JV partner shall furnish a Bank Guarantee equal to his share in the installment of advance plus 10%. Each Bank Guarantee shall be valid for the stipulated completion period of the contract.

INDEMNITY BOND FOR THE SAFE CUSTODY OF THE PLANT AND MATERIALS SUPPLIED BY THE CONTRACTOR

[Refer Clause 14.5 of GCC]

(To be executed on Non-Judicial Stamp Paper of Appropriate Value and notarised)

THIS INDEMNITY BOND made on this _____ day of _____ 20___ by _____(*insert the name of the Contractor and its registered address*) (hereinafter called "the Contractor") which expression shall where the context do admits or implies be deemed to include its executors, administrators and assigns, in favour of the Rail Vikas Nigam Ltd., August Kranti Bhawan, BhikajiCama Place, R K Puram, New Delhi – 110066 (hereinafter called "RVNL") on the other part.

WHEREAS by an Agreement/Letter of Acceptance No._____dated _____ (hereinafter called "the said agreement"), the Contractor has agreed to execute the _____(*Name of Work*) (hereinafter called "the Works") .

AND WHEREAS the Contractor has submitted to RVNL/ the Engineer for payment on plants &materials procured by him and brought to the site of the Works or his workshop for use in the Works.

AND WHEREAS RVNL/ the Engineer has agreed to make advance/stage payment to the Contractor the total sum of Rs._____ (*in Figures*) [Rupees _____ (*in Words*) in Interim Payment Certificate (IPC) No._____, the quantities and other particulars of which are detailed in this IPC for the said works signed by the Contractor on _____ for the Plant and Materials brought by the Contractor to site of the works or his workshop. Brief details are also mentioned in schedule 1 appended hereto.

NOW THIS INDEMNITY BOND WITNESS that in pursuance of the said agreement and in consideration of the sum of Rs. _____ (*in Figures*) _____ (*in Words*) on or before the execution of these presents to be paid to the Contractor by RVNL so aforesaid, the Contractor doth hereby covenant and agree with RVNL and declare as follows: -

1. That the said sum of Rs. _____ (*In Figures*) _____ (*in Words*) to be paid by RVNL to the Contractor as aforesaid shall be utilized by the Contractor in or towards the execution of the said works and for no other purpose whatsoever.
2. That the Plant and Materials detailed in the said IPC which have been offered to and accepted by RVNL/ the Engineer, are absolutely the Contractor's own property and free from encumbrances of any kind and the Contractor will not make any application for or receive any further payment on the Plant and Materials which are not absolutely his own property and free from encumbrances of any kind, the Contractor indemnifies the RVNL against all claims on any Plant

and Materials in respect of which payment is to be made to him as aforesaid.

3. That the Contractor undertakes that the Plant and Materials shall be used exclusively for the performance / execution of the Contract strictly in accordance with the terms and conditions of the Contract and no part of the Plant and Materials shall be utilized for any other work or purpose whatsoever.

4. That the Contractor is obliged and shall remain absolutely responsible for the safe transit / protection and custody of the Plant and Materials against all risks whatsoever including acts of the God till the Plant and Materials are duly incorporated in the works, commissioned and are taken over by RVNL/Railway (including surplus Plant and Materials, if required as instructed by RVNL/ the Engineer) in accordance with the terms of the Contract. The Contractor undertakes to keep RVNL harmless against any loss or damage that may be caused to the Plant and Materials.

5. That the said Plant and Materials shall not on any account be removed from the site of the works except with the written permission of RVNL/ the Engineer. Further, RVNL/ the Engineer shall always be free at all times to take possession of the materials in whatever form the materials may be in, if in its opinion, the Plant and Materials are likely to be endangered, mis-utilized or converted to uses other than those specified in the Contract, by any acts or omission or commission on the part of the Contractor or any other person or on account of any reason whatsoever and the Contractor binds himself and undertakes to comply with the directions of demand of RVNL to return the Plant and Materials without any demur or reservation.

6. That the said plant and materials shall, at all times, be open to inspection by RVNL/ the Engineer or any authorized representative. In the event of the said material or any part thereof at any time being found to be in lesser quantity than for which payment has been released or the same has been stolen, destroyed or damaged or becoming deteriorated, the Contractor will forthwith replace the same or repair and make good the same as required by RVNL/ the Engineer.

7. That making payment does not mean that Plant and Materials are of required specifications and quality or that whole of the quantity brought to site by Contractor will be used in the work. The Contractor is fully responsible for the materials to conform to required quality and specification and if at any time RVNL/ the Engineer do not find the material satisfactory, the Contractor at his own cost would replace these. RVNL/ the Engineer would be at liberty to recover cost of these from any dues of the Contractor. Also any Plant and Materials which are in excess of what is finally required under the contract would be the Contractor’s property without any liability on RVNL/ the Engineer who would recover the cost of this from the Contractor.

8. That this Indemnity Bond is irrevocable. If at any time, any loss or damage occurs to the Plant and Materials or the same or any part thereof is mis-utilized in any manner whatsoever, then the Contractor hereby agrees that the decision of RVNL/ the Engineer as to assessment of loss or damage to the Plant and Materials shall be final and binding on the Contractor. The Contractor binds itself and undertakes to replace the lost and/or damaged Plant and Materials at its own cost and/or shall pay the amount of loss to RVNL without any demur, reservation or protest. This is without prejudice to any other right or remedy that may be available to RVNL/ the Engineer against the Contractor under the Contract or under this Indemnity Bond.

9. That if the Contractor shall at any time make any default in the performance or observance in any respect of any of the terms and provisions of the said agreement or of those presents, the total amount of the payment shall immediately on the happening of such default be recovered by RVNL/ the Engineer from any dues of Contractor. It is also clearly understood by the Contractor that non-observance of the obligations under this Indemnity Bond by the Contractor shall inter-alia constitute a criminal breach of trust on the part of the Contractor for all intents and purpose including legal / penal consequences.

10. IN WITNESS WHEREOF, the Contractor has hereunto set its hand through its authorized representative, the day, month and year first above mentioned.

11. SCHEDULE 1

Particulars of the Plant and Materials	**Quantity**	**Value of the Plant and Materials**

Signed, Sealed and Delivered by the said Contractor

(Contractor's Name)

Dated: ……. (AUTHORISED SIGNATORY)

Place: ……. SEAL OF COMPANY

IN THE PRESENCE OF:

WITNESS: SIGNATURE _____

NAME: _____

ADDRESS : _____

Note:

The contractor has the option to submit the Indemnity Bond to cover all the items and quantities of Plant and Materials of stage payment or to submit indemnity bond each time the stage payment is to be taken or Plant and Materials advance is to be taken.

FORM OF BANK GUARANTEE FOR RELEASE OF BALANCE RETENTION MONEY

(On non-judicial stamp paper of the appropriate value in accordance with stamp Act. The stamp paper to be in the name of Executing Bank).

From:

……..
…….*Name and Address of the Bank*…..
……..

To:

The Chairman and Managing Director,
Rail Vikas Nigam Limited,
1st Floor, August Kranti Bhawan,
Bhikaji Cama Place, R. K. Puram,
New Delhi-110 066.

a) WHEREAS**,** Rail Vikas Nigam Limited, (hereinafter called the **Employer),** acting through ***[Insert Designation and address of the Employer's Representative]***, has entered into a contract with ***[Insert Name and address of the Contractor's Representative]***,, (hereinafter called the **Contractor),** for the work of ***[Insert Name of Work]***, vide Notification of Award No.***[Insert Notification of Award No.].***

b) WHEREAS as per conditions of contract Employer has deducted an amount of RS____***[Insert Amount deducted as retention money]***towards retention money till date, and WHEREAS now the contractor has requested the Employer for releasing the said amount on submission of a bank guarantee of equivalent amount which has been accepted by the Employer.****

OR

WHEREAS as per conditions of contract Employer has deducted an amount of RS_____***[Insert Amount deducted as retention money]***towards retention money till date, out of a total amount of Rs____ [***Insert total Amount of retention money deductable as specified in the contract]***which is due to be deducted as retention money as per Contract agreement and WHEREAS now the Contractor has requested the Employer to accept a bank guarantee of the equivalent amount of the total retention money due as per contract agreement so that the amount already deducted may be released in favour of the contractor and that no further deduction towards retention money will be made in future which has been accepted by the Employer. ****

c) WHEREAS, ***[Insert Name of the Bank]***, with its Branch ***[Address]*** having its Headquarters office at ***[Address]***, hereinafter called the **Bank,** acting through ***[Designation(s) of the authorised person of the***

Bank], have, at the request of the contractor, agreed to give guarantee as hereinafter contained:

1. KNOW ALL MEN by these present that I/We the undersigned ***[Insert name(s) of authorized representatives of the Bank],***being fully authorized to sign and incur obligations for and on behalf of the Bank**,** confirm that the Bank, hereby, unconditionally and irrevocably guarantee the Employer to pay the full amount in the sum of ***[Insert Value of the Bank Guarantee being submitted]*** as above stated.

2. The Bank undertakes to immediately pay to the Employer any amount up to and including aforementioned full amount upon written order/orders from the Employer without any demur, reservation or recourse.

3. On payment of any amount less than aforementioned full amount, as per demand of the Employer, the guarantee shall remain valid for the balance amount i.e. the aforementioned full amount less the payment made to the Employer.

4. The Bank shall pay the amount so demanded without any reference to the contractor and without the Employer being required to show grounds or give reasons for its demand or the amount demanded.

5. The guarantee hereinbefore shall not be affected by any change in the constitution of the Bank or in the constitution of the Contractor.

6. The Bank agrees that no change, addition, modifications to the terms of the Contract Agreement or to any documents, which have been or may be made between the Employer and the Contractor, will in any way release us from the liability under this guarantee; and the Bank, hereby, waives any requirement for notice of any such change, addition or modification to the Bank.

7. This guarantee is valid and effective from the date of it's issue, which is ***[insert date of issue]***. The guarantee and our obligations under it will expire on ***[Insert the date twenty eight days after the expected end of defect liability period.]***. All demands for payment under the guarantee must be received by us on or before that date.

8. The Bank agrees that the Employers right to demand payment of aforementioned full amount in one instance or demand payments in parts totaling up to the aforementioned full amount in several instances will continue until either the aforementioned full amount is paid to the Employer or the guarantee expires.

9. The Bank agrees that it's obligation to pay any amount demanded by the Employer before the expiry of this guarantee will continue until the amount demanded has been paid in full.

10. The expressions Bank and Employer herein before used shall include their respective successors and assigns.

11. The Bank hereby undertakes not to revoke the guarantee during its currency, except with the previous consent in writing of the employer. This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 758.

Date …… ……

Place……. [*Signature of Authorised person of Bank]*

[Name in Block letters] ……

[Designation] ……

Address ……..

…….

Witness :

1. *Signature*
   Name & Address & Seal
2. *Signature* *Bank's Seal*
   Name & address & Seal *Authorisation No……..*

Note :

1) *All italicized text is for guidance on how to prepare this bank guarantee and shall be deleted from the final document.*
2) *In case the guarantee is issued by a foreign Bank, the said bank shall have operations in India and should be countersigned by Indian operations branch of the said bank.*
3) *The Bank Guarantee should be duly attested by Notary public with notarial stamps of appropriate value affixed thereon.*
4) ***** strike out whichever is not applicable.*

DRAWINGS

Alignment and Longitudinal Section

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.

Legend :

	E&M (Electro mechanical Niche) 375m
WR	Water reserve for fire fighting system
PPG	Pressurization pump for fire fighting system
LB	Escape tunnel layby (every 375m)
TRN	Trolley Refuge (every 100m)
FFCP	Fire Fighting for cross passage
CP	Cross passage
TEC	Technical room
	FFP
	T-13P1 TUNNEL PORTAL-1
	T-13P2 TUNNEL PORTAL-2

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL	AECOM		
	RAJESH K	Eshita / Sourav	GVR. Raju	John Celentano
	Drawn	Designed	Verified	Approved

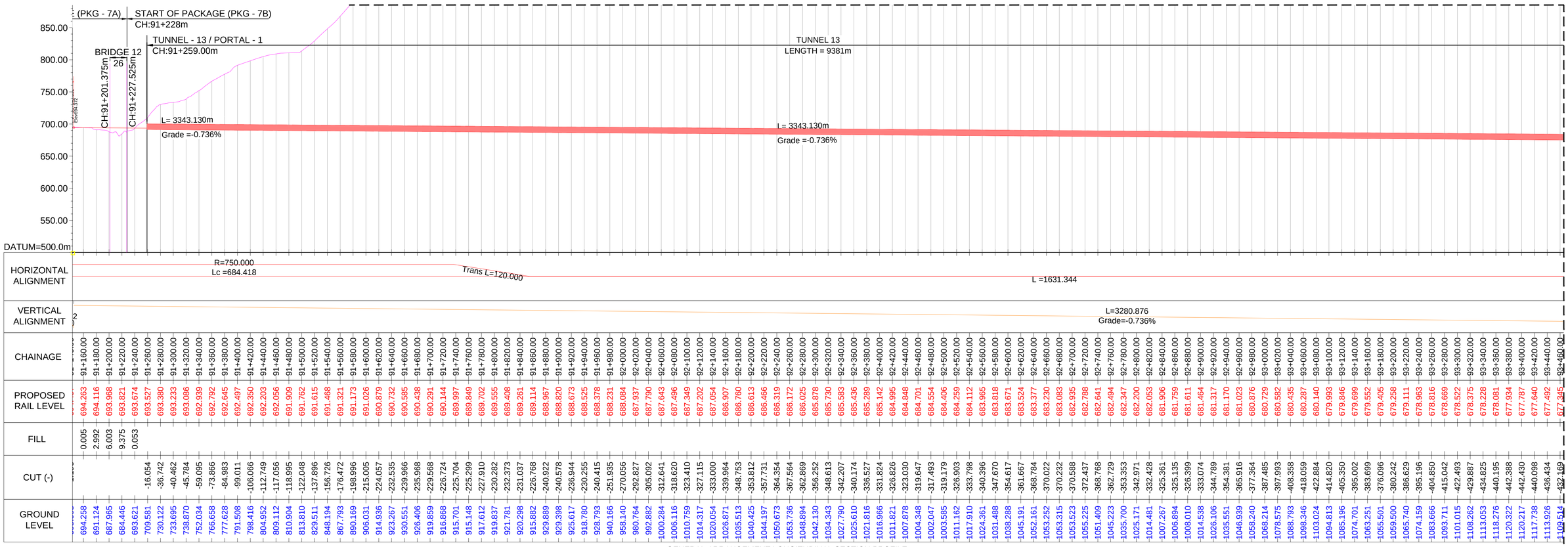
Title:

TUNNEL-13

SCHEMATIC DIAGRAM

Drawing No ACM-60598728-PKG7B-GE-SD-0006 | Scale AS SHOWN | Rev 0

GENERAL ARRANGEMENT ALIGNMENT PLAN PROFILE

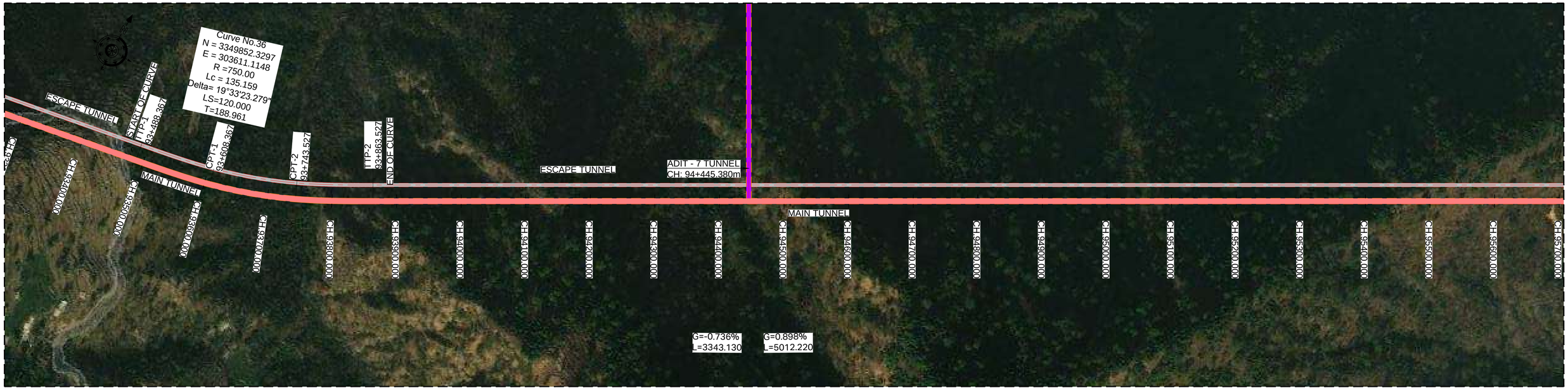


GENERAL ARRANGEMENT LONGITUDINAL SECTION PROFILE

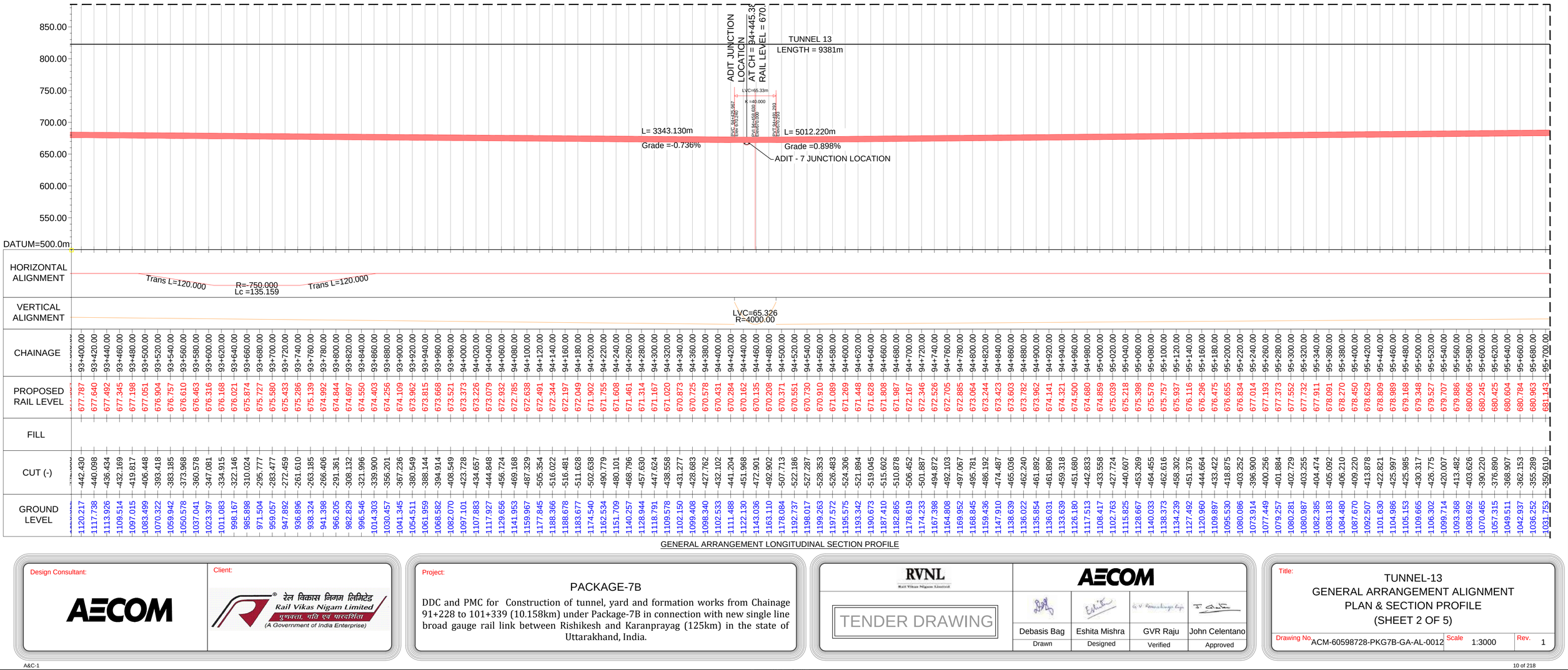
Design Consultant: AECOM	Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)	Project: PACKAGE-7B DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.	RVNL Rail Vikas Nigam Limited TENDER DRAWING AECOM Debasis Bag (Drawn) · Eshita Mishra (Designed) · GVR Raju (Verified) · John Celentano (Approved)

Title: TUNNEL-13
GENERAL ARRANGEMENT ALIGNMENT PLAN & SECTION PROFILE (SHEET 1 OF 5)

Drawing No. ACM-60598728-PKG7B-GA-AL-0011 | Scale 1:3000 | Rev. 1



GENERAL ARRANGEMENT ALIGNMENT PLAN PROFILE



GENERAL ARRANGEMENT LONGITUDINAL SECTION PROFILE

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited

TENDER DRAWING

AECOM

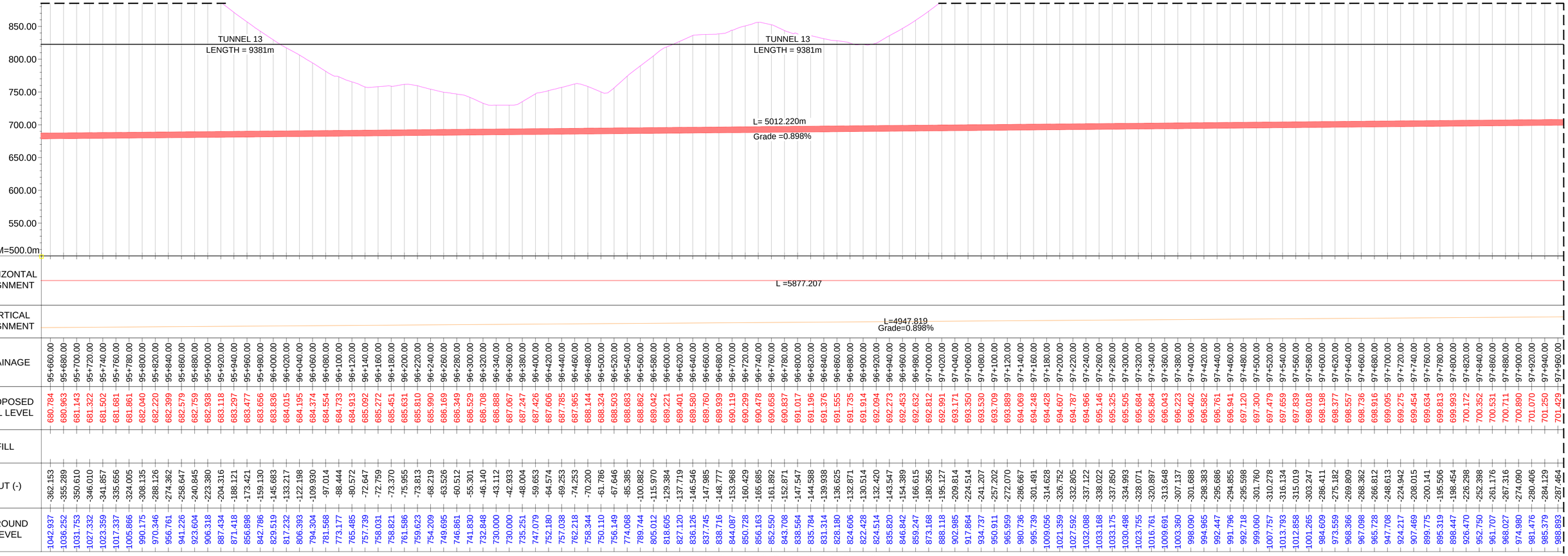
Debasis Bag	Eshita Mishra	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

Title:

TUNNEL-13
GENERAL ARRANGEMENT ALIGNMENT PLAN & SECTION PROFILE
(SHEET 2 OF 5)

Drawing No. ACM-60598728-PKG7B-GA-AL-0012 | Scale 1:3000 | Rev. 1

GENERAL ARRANGEMENT ALIGNMENT PLAN PROFILE



GENERAL ARRANGEMENT LONGITUDINAL SECTION PROFILE

Design Consultant:

AECOM

Client:

रेल विकास निगम लिमिटेड
Rail Vikas Nigam Limited
गुणवत्ता, गति एवं पारदर्शिता
(A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL
Rail Vikas Nigam Limited

TENDER DRAWING

AECOM

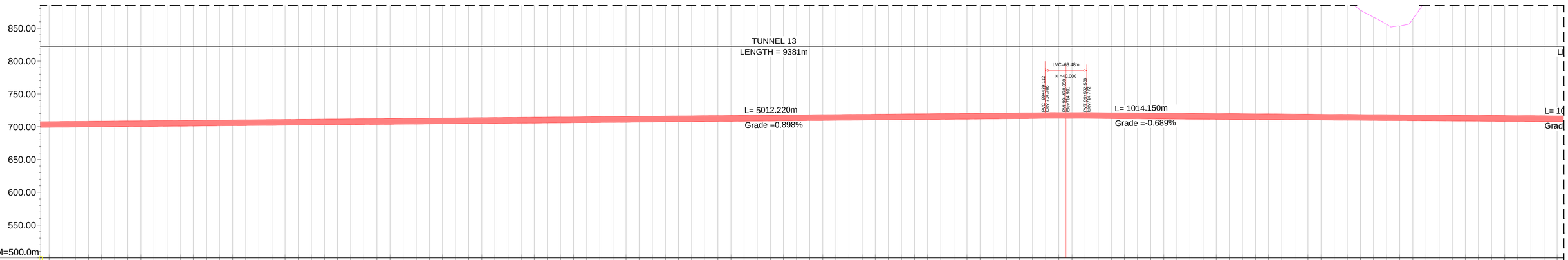
Debasis Bag	Eshita Mishra	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

Title:

TUNNEL-13
GENERAL ARRANGEMENT ALIGNMENT
PLAN & SECTION PROFILE
(SHEET 3 OF 5)

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-GA-AL-0013	1:3000	1

GENERAL ARRANGEMENT ALIGNMENT PLAN PROFILE



CHAINAGE	PROPOSED RAIL LEVEL	FILL	CUT (-)	GROUND LEVEL
97+920.00	701.070		-280.406	981.476
97+940.00	701.250		-284.129	985.379
97+960.00	701.429		-287.464	988.893
97+980.00	701.609		-289.290	990.899
98+000.00	701.788		-288.408	990.196
98+020.00	701.968		-285.461	987.429
98+040.00	702.147		-287.853	990.000
98+060.00	702.327		-297.676	1000.003
98+080.00	702.506		-308.914	1011.420
98+100.00	702.686		-320.619	1023.305
98+120.00	702.865		-329.653	1032.518
98+140.00	703.045		-337.718	1040.763
98+160.00	703.224		-344.943	1048.167
98+180.00	703.404		-351.830	1055.234
98+200.00	703.583		-358.419	1062.002
98+220.00	703.763		-364.148	1067.911
98+240.00	703.942		-370.523	1074.465
98+260.00	704.122		-380.443	1084.565
98+280.00	704.301		-389.756	1094.057
98+300.00	704.481		-396.010	1100.491
98+320.00	704.660		-400.890	1105.550
98+340.00	704.840		-409.295	1114.135
98+360.00	705.020		-417.654	1122.674
98+380.00	705.199		-425.231	1130.430
98+400.00	705.379		-432.677	1138.056
98+420.00	705.558		-440.593	1146.151
98+440.00	705.738		-451.788	1157.526
98+460.00	705.917		-462.911	1168.828
98+480.00	706.097		-469.270	1175.367
98+500.00	706.276		-476.949	1183.225
98+520.00	706.456		-485.573	1192.029
98+540.00	706.635		-490.533	1197.168
98+560.00	706.815		-478.987	1185.802
98+580.00	706.994		-466.303	1173.297
98+600.00	707.174		-453.699	1160.873
98+620.00	707.353		-440.666	1148.019
98+640.00	707.533		-428.549	1136.082
98+660.00	707.712		-417.066	1124.778
98+680.00	707.892		-406.418	1114.310
98+700.00	708.071		-396.970	1105.041
98+720.00	708.251		-390.170	1098.421
98+740.00	708.430		-384.326	1092.756
98+760.00	708.610		-369.533	1078.143
98+780.00	708.790		-359.248	1068.038
98+800.00	708.969		-350.636	1059.605
98+820.00	709.149		-343.749	1052.898
98+840.00	709.328		-337.788	1047.116
98+860.00	709.508		-330.674	1040.182
98+880.00	709.687		-323.163	1032.850
98+900.00	709.867		-318.325	1028.192
98+920.00	710.046		-312.650	1022.696
98+940.00	710.226		-306.351	1016.577
98+960.00	710.405		-299.225	1009.630
98+980.00	710.585		-293.866	1004.251
99+000.00	710.764		-286.025	996.789
99+020.00	710.944		-281.773	992.717
99+040.00	711.123		-279.494	990.617
99+060.00	711.303		-275.538	986.841
99+080.00	711.482		-270.913	982.395
99+100.00	711.662		-265.844	977.506
99+120.00	711.841		-260.040	971.881
99+140.00	712.021		-251.557	963.578
99+160.00	712.200		-242.060	954.260
99+180.00	712.380		-237.258	949.638
99+200.00	712.560		-233.069	945.629
99+220.00	712.739		-234.799	947.538
99+240.00	712.919		-237.899	950.818
99+260.00	713.098		-240.985	954.083
99+280.00	713.278		-249.916	963.194
99+300.00	713.457		-257.003	970.460
99+320.00	713.637		-257.648	971.285
99+340.00	713.816		-250.732	964.548
99+360.00	713.996		-239.161	953.157
99+380.00	714.175		-232.836	947.011
99+400.00	714.355		-235.967	950.322
99+420.00	714.534		-264.530	963.889
99+440.00	714.714		-280.220	979.244
99+460.00	714.839		-292.756	995.059
99+480.00	714.864		-299.449	1007.620
99+500.00	714.789		-301.110	1014.238
99+520.00	714.652		-302.976	1015.762
99+540.00	714.514		-298.905	1017.490
99+560.00	714.376		-293.621	1013.281
99+580.00	714.238		-288.283	1007.859
99+600.00	714.101		-283.255	1002.384
99+620.00	713.963		-281.380	997.218
99+640.00	713.825		-280.937	995.205
99+660.00	713.687		-282.030	994.624
99+680.00	713.549		-280.579	995.579
99+700.00	713.411		-274.090	987.501
99+720.00	713.273		-261.534	974.807
99+740.00	713.136		-250.488	963.624
99+760.00	712.998		-238.752	951.750
99+780.00	712.860		-228.868	941.728
99+800.00	712.722		-222.631	935.353
99+820.00	712.584		-216.461	929.045
99+840.00	712.446		-211.003	923.449
99+860.00	712.308		-204.279	916.587
99+880.00	712.171		-191.275	903.446
99+900.00	712.033		-179.325	891.358
99+920.00	711.895		-166.113	878.008
99+940.00	711.757		-155.251	867.008
99+960.00	711.619		-144.314	855.933
99+980.00	711.481		-141.719	853.200
100+000.00	711.343		-153.053	864.396
100+020.00	711.205		-183.358	894.563
100+040.00	711.068		-207.294	918.362
100+060.00	710.930		-224.168	935.098
100+080.00	710.792		-231.169	941.961
100+100.00	710.654		-225.916	936.570
100+120.00	710.516		-220.235	930.751
100+140.00	710.378		-216.140	926.518
100+160.00	710.240		-214.831	925.071
100+180.00	710.103		-213.114	923.217
100+200.00	709.965		-210.852	920.817
100+220.00	709.827		-202.910	912.737

GENERAL ARRANGEMENT LONGITUDINAL SECTION PROFILE

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited भूगवना, मृदि एव परदर्शिता (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited

TENDER DRAWING

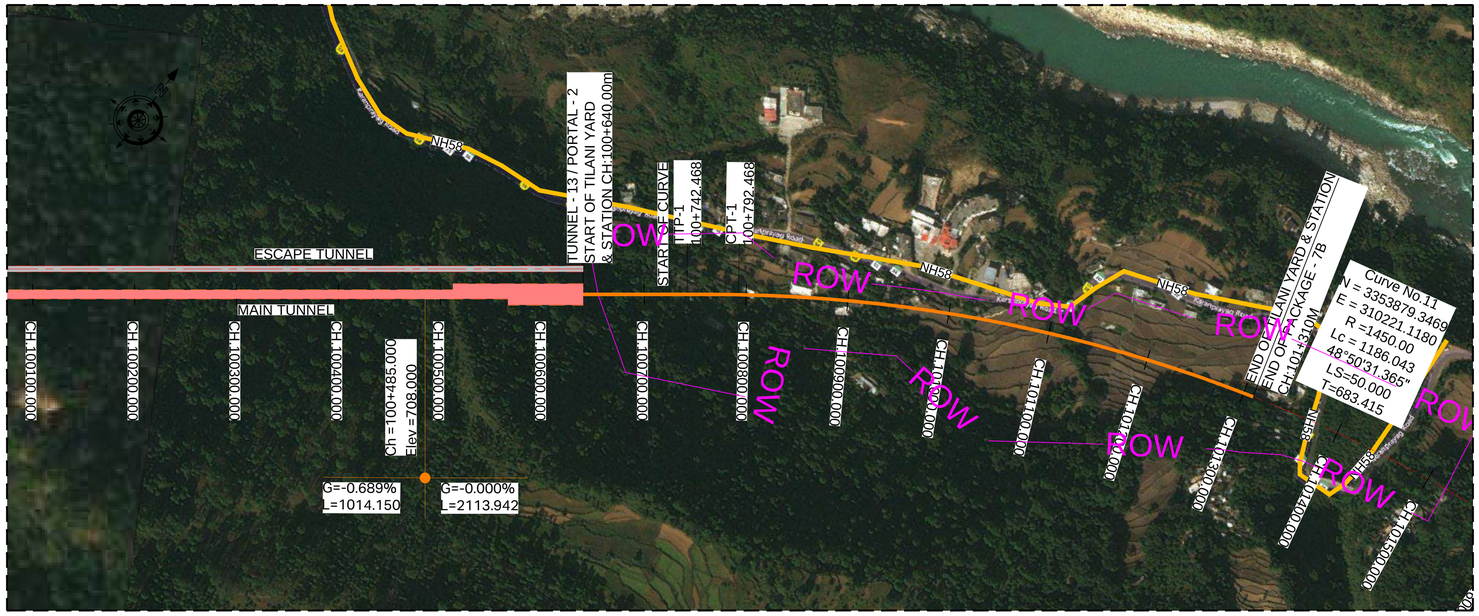
AECOM

Debasis Bag	Eshita Mishra	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

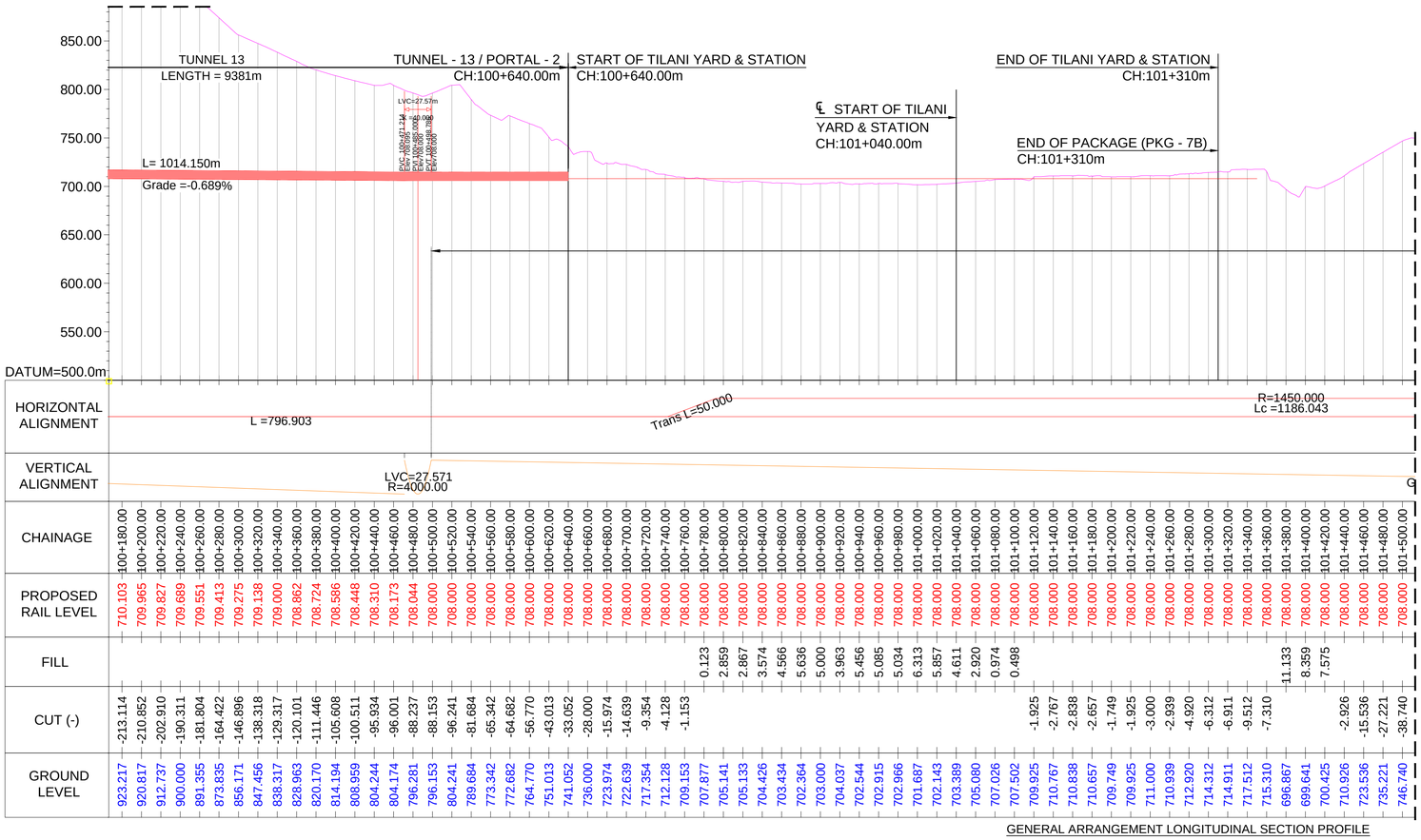
Title:

TUNNEL-13
GENERAL ARRANGEMENT ALIGNMENT
PLAN & SECTION PROFILE
(SHEET 4 OF 5)

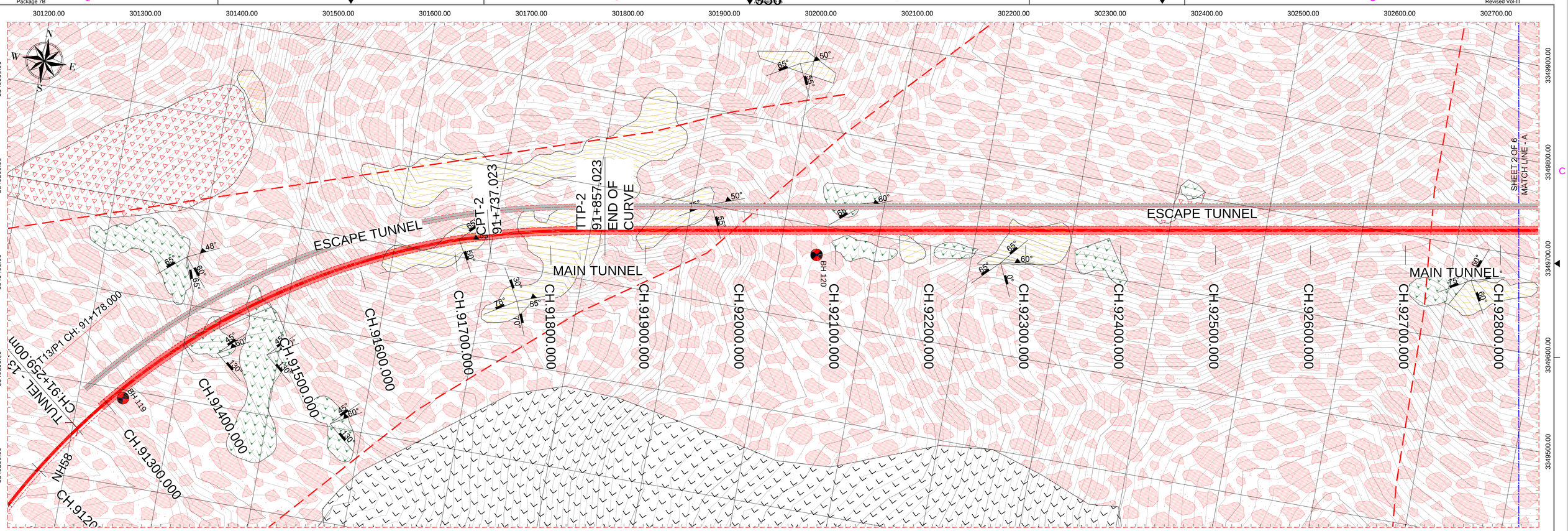
Drawing No. ACM-60598728-PKG7B-GA-AL-0014 | Scale 1:3000 | Rev. 1

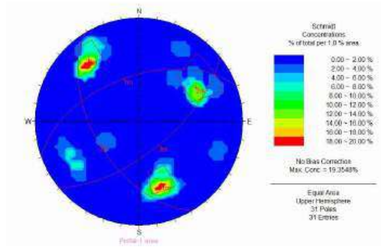


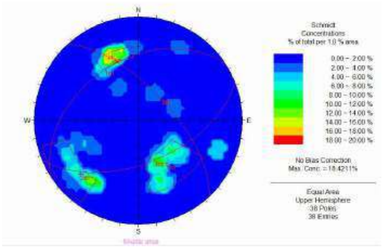
GENERAL ARRANGEMENT ALIGNMENT PLAN PROFILE



| | 100+180.00 | 100+200.00 | 100+220.00 | 100+240.00 | 100+260.00 | 100+280.00 | 100+300.00 | 100+320.00 | 100+340.00 | 100+360.00 | 100+380.00 | 100+400.00 | 100+420.00 | 100+440.00 | 100+460.00 | 100+480.00 | 100+500.00 | 100+520.00 | 100+540.00 | 100+560.00 | 100+580.00 | 100+600.00 | 100+620.00 | 100+640.00 | 100+660.00 | 100+680.00 | 100+700.00 | 100+720.00 | 100+740.00 | 100+760.00 | 100+780.00 | 100+800.00 | 100+820.00 | 100+840.00 | 100+860.00 | 100+880.00 | 100+900.00 | 100+920.00 | 100+940.00 | 100+960.00 | 100+980.00 | 101+000.00 | 101+020.00 | 101+040.00 | 101+060.00 | 101+080.00 | 101+100.00 | 101+120.00 | 101+140.00 | 101+160.00 | 101+180.00 | 101+200.00 | 101+220.00 | 101+240.00 | 101+260.00 | 101+280.00 | 101+300.00 | 101+320.00 | 101+340.00 | 101+360.00 | 101+380.00 | 101+400.00 | 101+420.00 | 101+440.00 | 101+460.00 | 101+480.00 | 101+500.00 |
|---|---|---







NOTE :~

1. THE GEOLOGICAL PLAN HAS BEEN PREPARED BASED ON GEOLOGICAL PLAN FIELD EXCURSION AND GEOLOGICAL MAPPING AND AVAILABLE GEOTECHNICAL INFORMATION.
2. STRUCTURAL FEATURES / LITHOLOGICAL CONTACTS HAVE BEEN REFERRED FROM THE GEOLOGICAL MAPPING COMPLETED DURING FLS.

TENDER DRAWING

LEGENDS :

- Colluvium or surficial material
- Terrace Material
- Nalah Borne material
- Slide material
- Quartzite
- Metabasic rock
- Sheared/Fractured Metabasic rock
- Phyllites
- Dolomites

OTHER SYMBOLS :

- Fault
- Lithological Contact
- Bore Holes

Structural Domain	Group	Formation	Age
Outer lesser Himalaya	Jaunsar	Chandpur formation	Neo-Proterozoic
Inner lesser Himalaya	Garhwal	Epidiorite, Anphibolite and Metavolcanic	Meso-Proterozoic
		Nagnithank formation	

Stratigraphy Along the Project Area (Source GSI)

GT - 1 Thickly Foliated Massive Quartzites

GT - 2 Thinly foliated /fractured Quartzites

GT - 3 Intensely fractured and crushed Quartzite

GT - 4 Massive Metabasic rocks

GT-5 Crushed and fractured Metabasic rocks

GT - 6 Thinly bedded Dolomites

GT-7 Crushed and Faulted rock mass

GT - 8 Colluvium or Surficial Materials

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

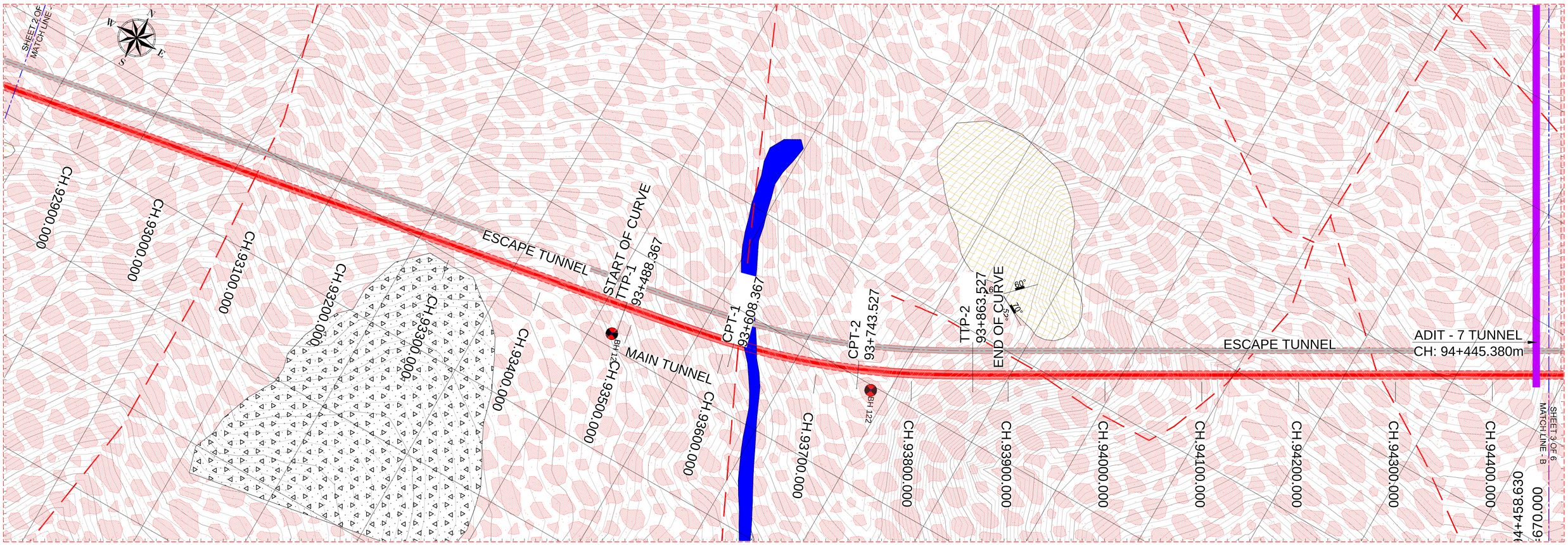
RVNL Rail Vikas Nigam Limited | AECOM

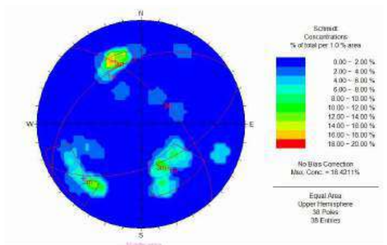
Debasis Bag	Om Dixit	Sami K	John Celentano
Drawn	Designed	Verified	Approved

Title:

TUNNEL-13
GEOLOGICAL PLAN PROFILE
(SHEET 1 OF 6)

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-GT-0041	1:2000	1





NOTE :~

1. THE GEOLOGICAL PLAN HAS BEEN PREPARED BASED ON GEOLOGICAL PLAN FIELD EXCURSION AND GEOLOGICAL MAPPING AND AVAILABLE GEOTECHNICAL INFORMATION.
2. STRUCTURAL FEATURES / LITHOLOGICAL CONTACTS HAVE BEEN REFERRED FROM THE GEOLOGICAL MAPPING COMPLETED DURING FLS.

TENDER DRAWING

LEGENDS :

- Colluvium or surficial material
- Terrace Material
- Nalah Borne material
- Slide material
- Quartzite
- Metabasic rock
- Sheared/Fractured Metabasic rock
- Phyllites
- Dolomites

OTHER SYMBOLS :

- Fault
- Lithological Contact
- Bore Holes

Structural Domain	Group	Formation	Age
Outer lesser Himalaya	Jaunsar	Chandpur formation	Neo-Proterozoic
Inner lesser Himalaya	Garhwal	Epidiorite, Anphibolite and Metavolcanic	Meso-Proterozoic
		Nagnithank formation	

Stratigraphy Along the Project Area (Source GSI)

GT - 1 Thickly Foliated Massive Quartzites

GT - 2 Thinly foliated /fractured Quartzites

GT - 3 Intensely fractured and crushed Quartzite

GT - 4 Massive Metabasic rocks

GT-5 Crushed and fractured Metabasic rocks

GT - 6 Thinly bedded Dolomites

GT-7 Crushed and Faulted rock mass

GT - 8 Colluvium or Surficial Materials

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited गुणवत्ता, गति एवं पारदर्शिता (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

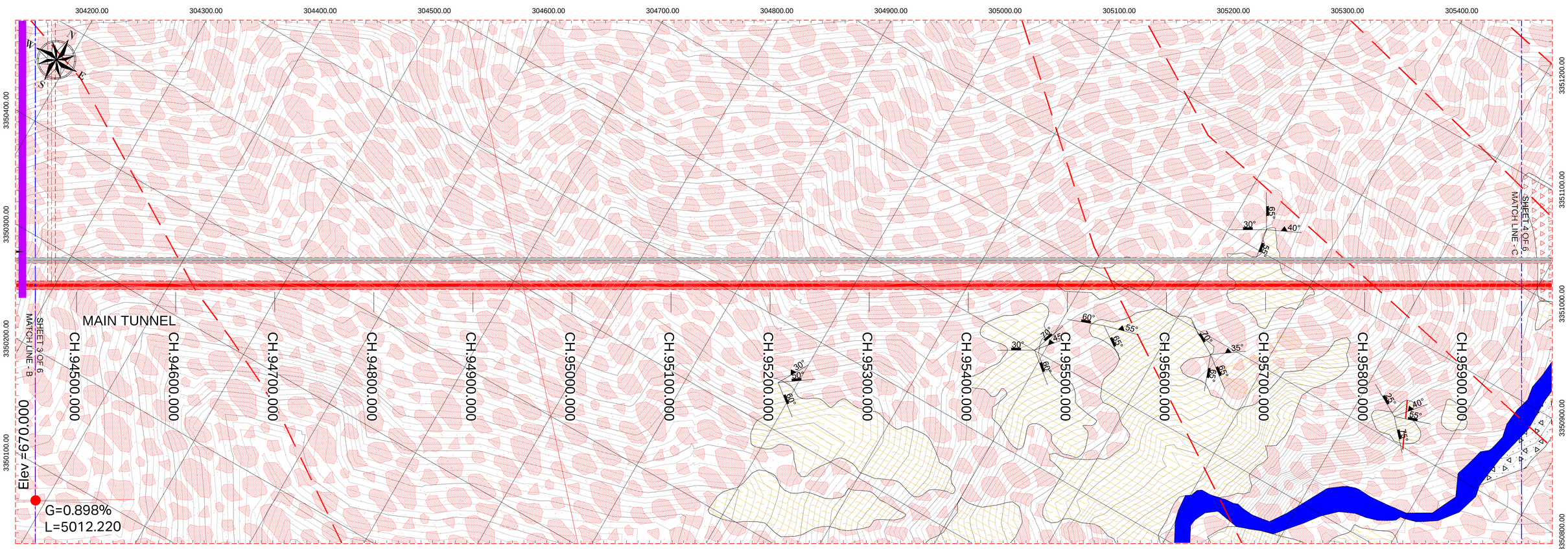
RVNL Rail Vikas Nigam Limited | AECOM

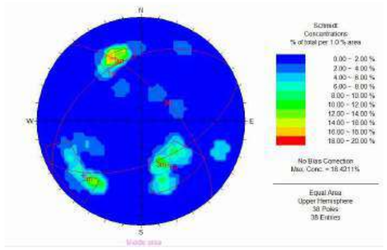
Debasis Bag	Om Dixit	Sami K	John Celentano
Drawn	Designed	Verified	Approved

Title:

TUNNEL-13
GEOLOGICAL PLAN PROFILE
(SHEET 2 OF 6)

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-GT-0042	1:2000	1





NOTE :~

1. THE GEOLOGICAL PLAN HAS BEEN PREPARED BASED ON GEOLOGICAL PLAN FIELD EXCURSION AND GEOLOGICAL MAPPING AND AVAILABLE GEOTECHNICAL INFORMATION.
2. STRUCTURAL FEATURES / LITHOLOGICAL CONTACTS HAVE BEEN REFERRED FROM THE GEOLOGICAL MAPPING COMPLETED DURING FLS.

TENDER DRAWING

LEGENDS :

- Colluvium or surficial material
- Terrace Material
- Nalah Borne material
- Slide material
- Quartzite
- Metabasic rock
- Sheared/Fractured Metabasic rock
- Phyllites
- Dolomites

OTHER SYMBOLS :

- Fault
- Lithological Contact
- Bore Holes

Structural Domain	Group	Formation	Age
Outer lesser Himalaya	Jaunsar	Chandpur formation	Neo-Proterozoic
Inner lesser Himalaya	Garhwal	Epidiorite, Anphibolite and Metavolcanic	Meso-Proterozoic
		Nagnithank formation	

Stratigraphy Along the Project Area (Source GSI)

GT - 1 Thickly Foliated Massive Quartzites

GT - 2 Thinly foliated /fractured Quartzites

GT - 3 Intensely fractured and crushed Quartzite

GT - 4 Massive Metabasic rocks

GT-5 Crushed and fractured Metabasic rocks

GT - 6 Thinly bedded Dolomites

GT-7 Crushed and Faulted rock mass

GT - 8 Colluvium or Surficial Materials

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited

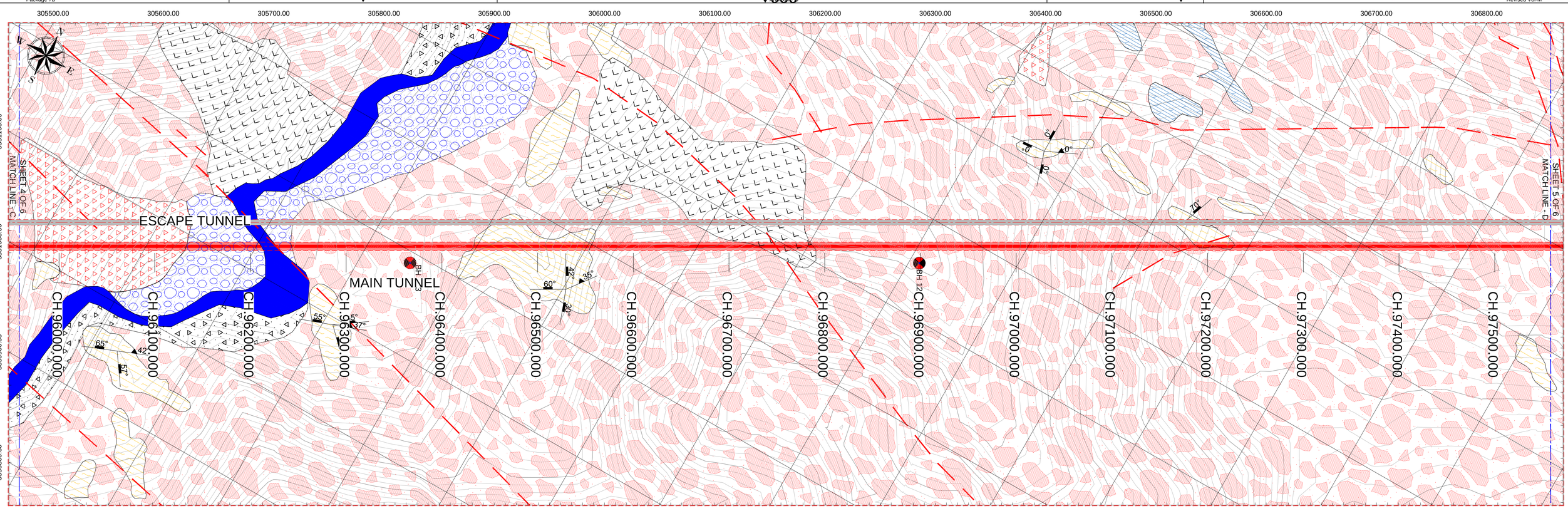
AECOM

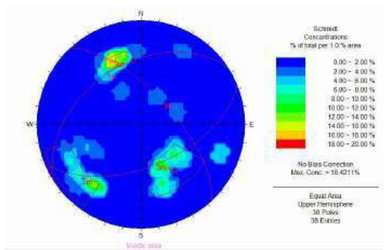
Debasis Bag	Om Dixit	Sami K	John Celentano
Drawn	Designed	Verified	Approved

Title:

TUNNEL-13
GEOLOGICAL PLAN PROFILE
(SHEET 3 OF 6)

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-GT-0043	1:2000	1





NOTE :~

1. THE GEOLOGICAL PLAN HAS BEEN PREPARED BASED ON GEOLOGICAL PLAN FIELD EXCURSION AND GEOLOGICAL MAPPING AND AVAILABLE GEOTECHNICAL INFORMATION.
2. STRUCTURAL FEATURES / LITHOLOGICAL CONTACTS HAVE BEEN REFERRED FROM THE GEOLOGICAL MAPPING COMPLETED DURING FLS.

TENDER DRAWING

LEGENDS :

- Colluvium or surficial material
- Terrace Material
- Nalah Borne material
- Slide material
- Quartzite
- Metabasic rock
- Sheared/Fractured Metabasic rock
- Phyllites
- Dolomites

OTHER SYMBOLS :

- Fault
- Lithological Contact
- Bore Holes

Structural Domain	Group	Formation	Age
Outer lesser Himalaya	Jaunsar	Chandpur formation	Neo-Proterozoic
Inner lesser Himalaya	Garhwal	Epidiorite, Anphibolite and Metavolcanic	Meso-Proterozoic
		Nagnithank formation	

Stratigraphy Along the Project Area (Source GSI)

GT - 1 Thickly Foliated Massive Quartzites

GT - 2 Thinly foliated /fractured Quartzites

GT - 3 Intensely fractured and crushed Quartzite

GT - 4 Massive Metabasic rocks

GT-5 Crushed and fractured Metabasic rocks

GT - 6 Thinly bedded Dolomites

GT-7 Crushed and Faulted rock mass

GT - 8 Colluvium or Surficial Materials

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited गुणवत्ता, गति एवं पारदर्शिता (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

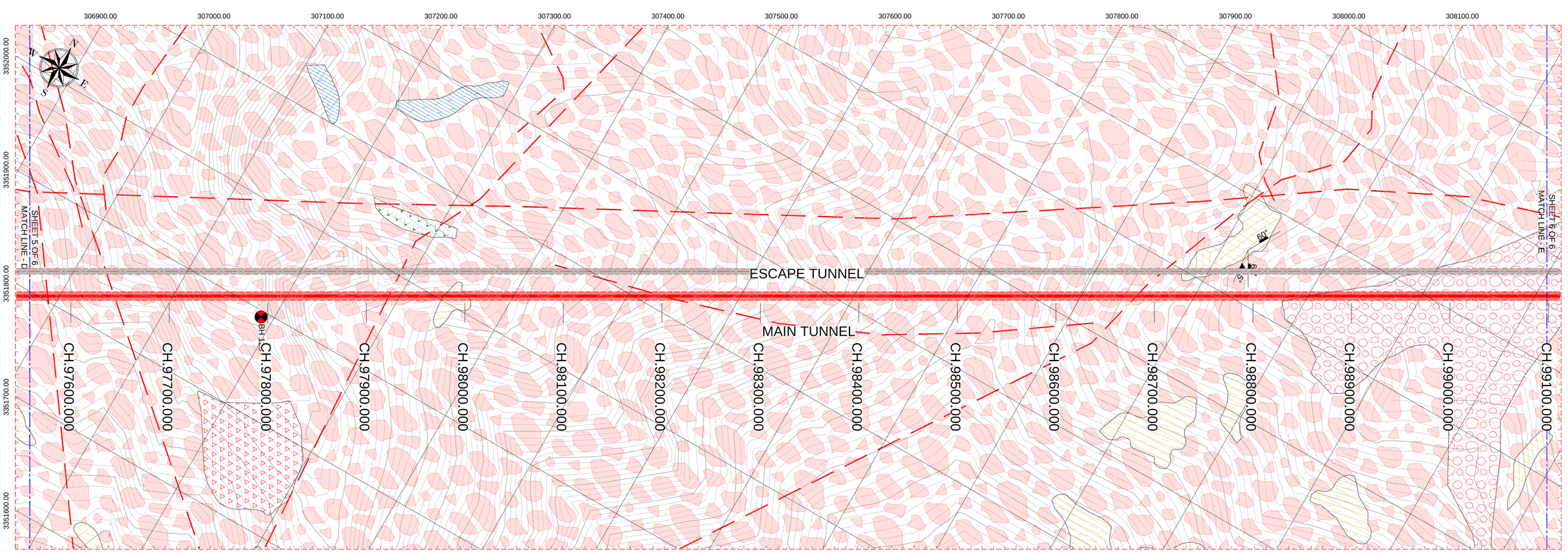
RVNL Rail Vikas Nigam Limited | AECOM

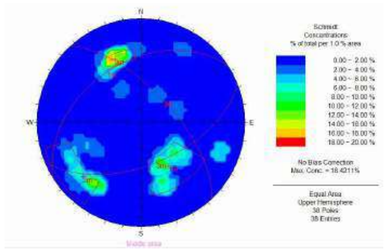
Debasis Bag	Om Dixit	Sami K	John Celentano
Drawn	Designed	Verified	Approved

Title:

TUNNEL-13
GEOLOGICAL PLAN PROFILE
(SHEET 4 OF 6)

Drawing No. ACM-60598728-PKG7B-GT-0044 | Scale 1:2000 | Rev. 1





NOTE :~

1. THE GEOLOGICAL PLAN HAS BEEN PREPARED BASED ON GEOLOGICAL PLAN FIELD EXCURSION AND GEOLOGICAL MAPPING AND AVAILABLE GEOTECHNICAL INFORMATION.
2. STRUCTURAL FEATURES / LITHOLOGICAL CONTACTS HAVE BEEN REFERRED FROM THE GEOLOGICAL MAPPING COMPLETED DURING FLS.

TENDER DRAWING

LEGENDS :

- Colluvium or surficial material
- Terrace Material
- Nalah Borne material
- Slide material
- Quartzite
- Metabasic rock
- Sheared/Fractured Metabasic rock
- Phyllites
- Dolomites

OTHER SYMBOLS :

- Fault
- Lithological Contact
- Bore Holes

Structural Domain	Group	Formation	Age
Outer lesser Himalaya	Jaunsar	Chandpur formation	Neo-Proterozoic
Inner lesser Himalaya	Garhwal	Epidiorite, Amphibolite and Metavolcanic	Meso-Proterozoic
		Nagnithank formation	

Stratigraphy Along the Project Area (Source GSI)

GT - 1 Thickly Foliated Massive Quartzites

GT - 2 Thinly foliated /fractured Quartzites

GT - 3 Intensely fractured and crushed Quartzite

GT - 4 Massive Metabasic rocks

GT-5 Crushed and fractured Metabasic rocks

GT - 6 Thinly bedded Dolomites

GT-7 Crushed and Faulted rock mass

GT - 8 Colluvium or Surficial Materials

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited गुणवत्ता, गति एवं पारदर्शिता (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

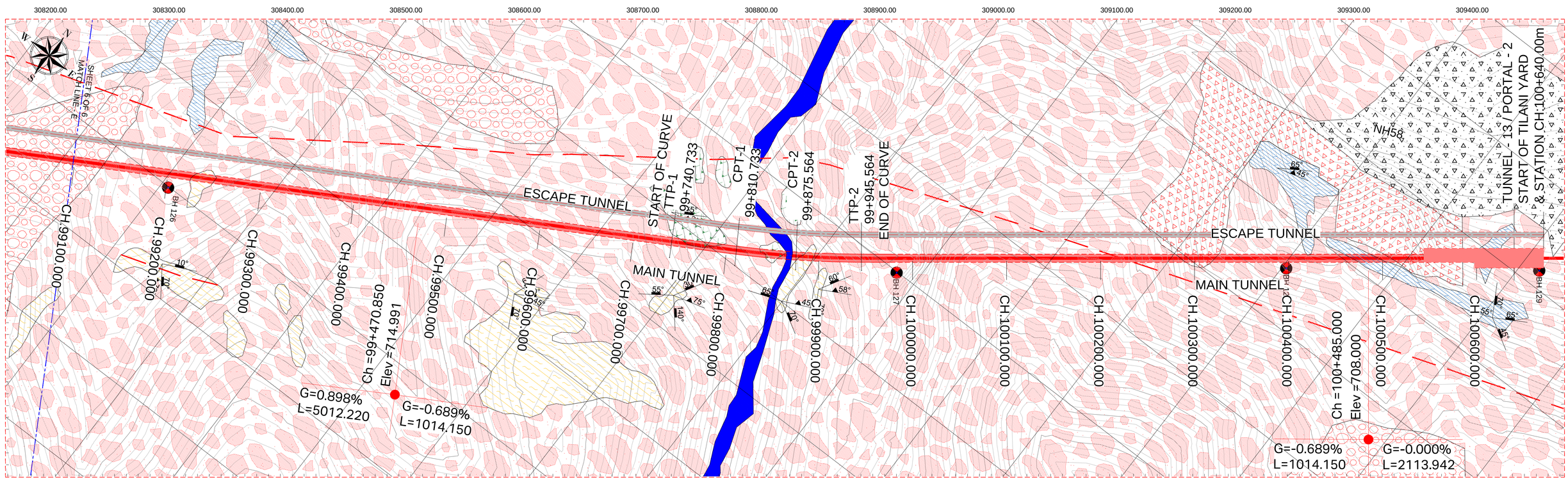
RVNL Rail Vikas Nigam Limited | AECOM

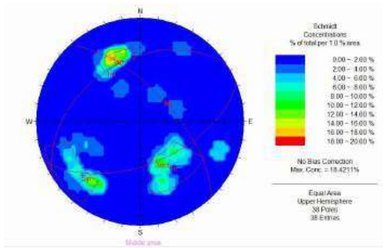
Debasis Bag	Om Dixit	Sami K	John Celentano
Drawn	Designed	Verified	Approved

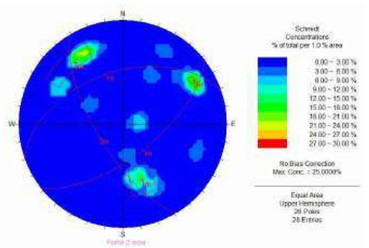
Title:

TUNNEL-13
GEOLOGICAL PLAN PROFILE
(SHEET 5 OF 6)

Drawing No. ACM-60598728-PKG7B-GT-0045 | Scale 1:2000 | Rev. 1







NOTE :~

1. THE GEOLOGICAL PLAN HAS BEEN PREPARED BASED ON GEOLOGICAL PLAN FIELD EXCURSION AND GEOLOGICAL MAPPING AND AVAILABLE GEOTECHNICAL INFORMATION.
2. STRUCTURAL FEATURES / LITHOLOGICAL CONTACTS HAVE BEEN REFERRED FROM THE GEOLOGICAL MAPPING COMPLETED DURING FLS.

TENDER DRAWING

LEGENDS :

- Colluvium or surficial material
- Terrace Material
- Nalah Borne material
- Slide material
- Quartzite
- Metabasic rock
- Sheared/Fractured Metabasic rock
- Phyllites
- Dolomites

OTHER SYMBOLS :

- Fault
- Lithological Contact
- Bore Holes

Structural Domain	Group	Formation	Age
Outer lesser Himalaya	Jaunsar	Chandpur formation	Neo-Proterozoic
Inner lesser Himalaya	Garhwal	Epidiorite, Anphibolite and Metavolcanic	Meso-Proterozoic
		Nagnithank formation	

Stratigraphy Along the Project Area (Source GSI)

GT - 1 Thickly Foliated Massive Quartzites

GT - 2 Thinly foliated /fractured Quartzites

GT - 3 Intensely fractured and crushed Quartzite

GT - 4 Massive Metabasic rocks

GT-5 Crushed and fractured Metabasic rocks

GT - 6 Thinly bedded Dolomites

GT-7 Crushed and Faulted rock mass

GT - 8 Colluvium or Surficial Materials

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited गुणवत्ता, गति एवं पारदर्शिता (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

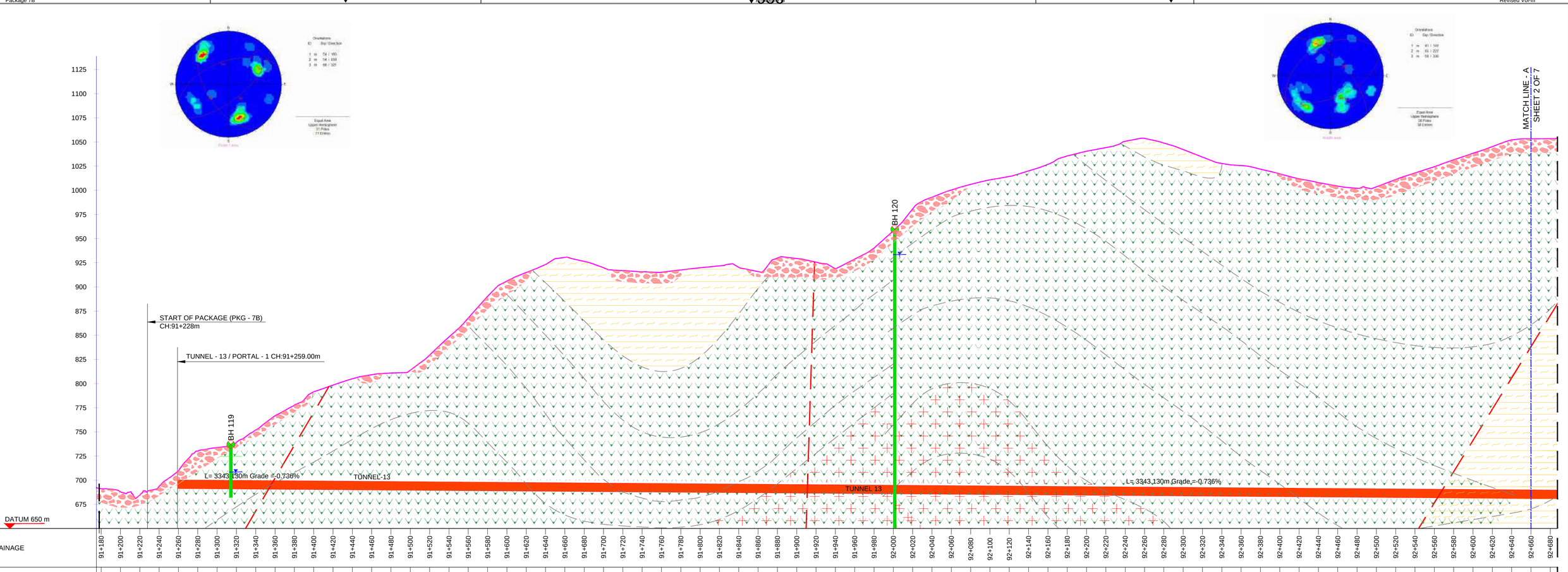
RVNL Rail Vikas Nigam Limited | AECOM

Drawn	Designed	Verified	Approved
Debasis Bag	Om Dixit	Sami K	John Celentano

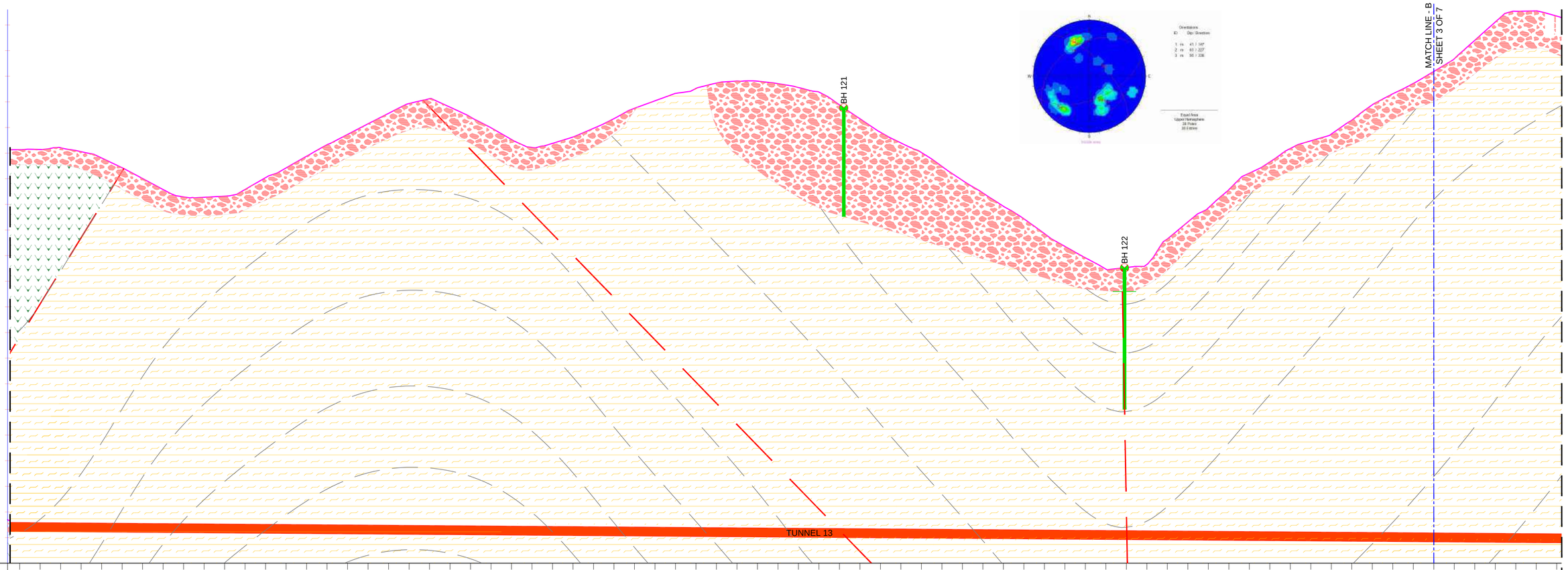
Title:

TUNNEL-13
GEOLOGICAL PLAN PROFILE
(SHEET 6 OF 6)

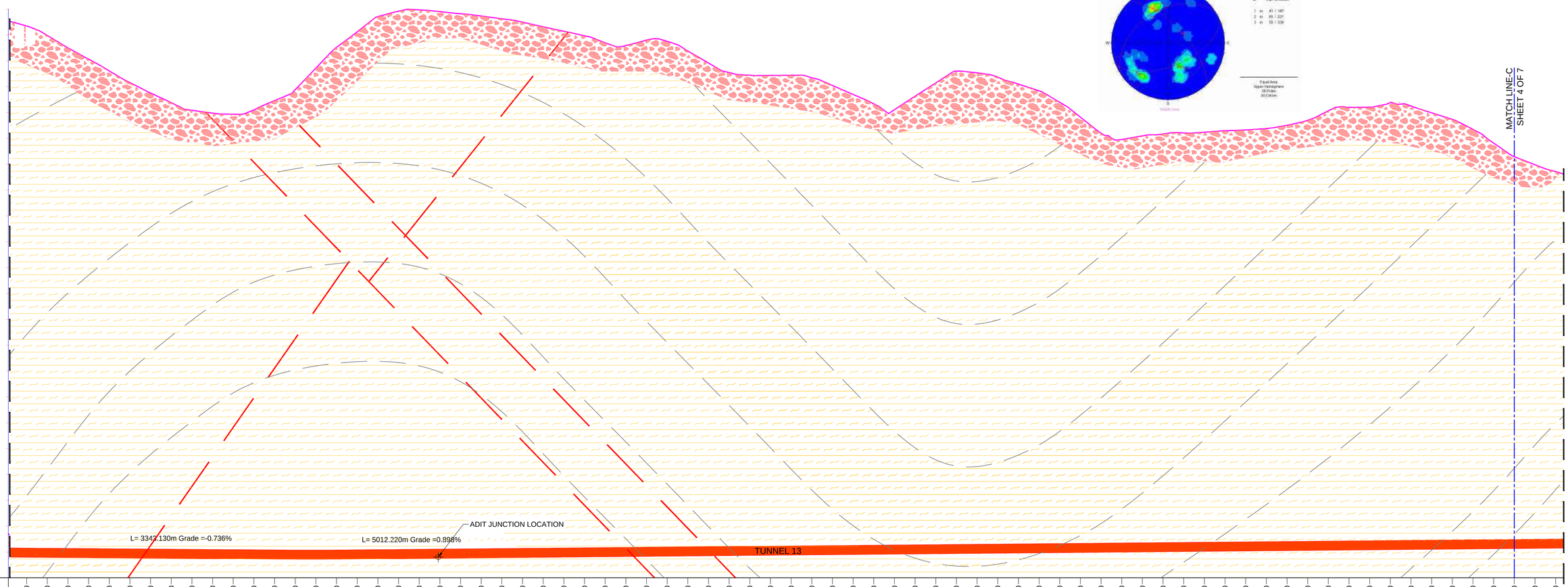
Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-GT-0046	1:2000	1


MATCH LINE - A
SHEET 2 OF 7
START OF PACKAGE (PKG - 7B)
CH:91+228m
TUNNEL - 13 / PORTAL - 1 CH:91+259.00m
BH 119
BH 120
L= 3343.130m Grade =-0.736%
TUNNEL 13
TUNNEL 13
L= 3343.130m Grade =-0.736%
DATUM 650 m
1125
1100
1075
1050
1025
1000
975
950
925
900
875
850
825
800
775
750
725
700
675

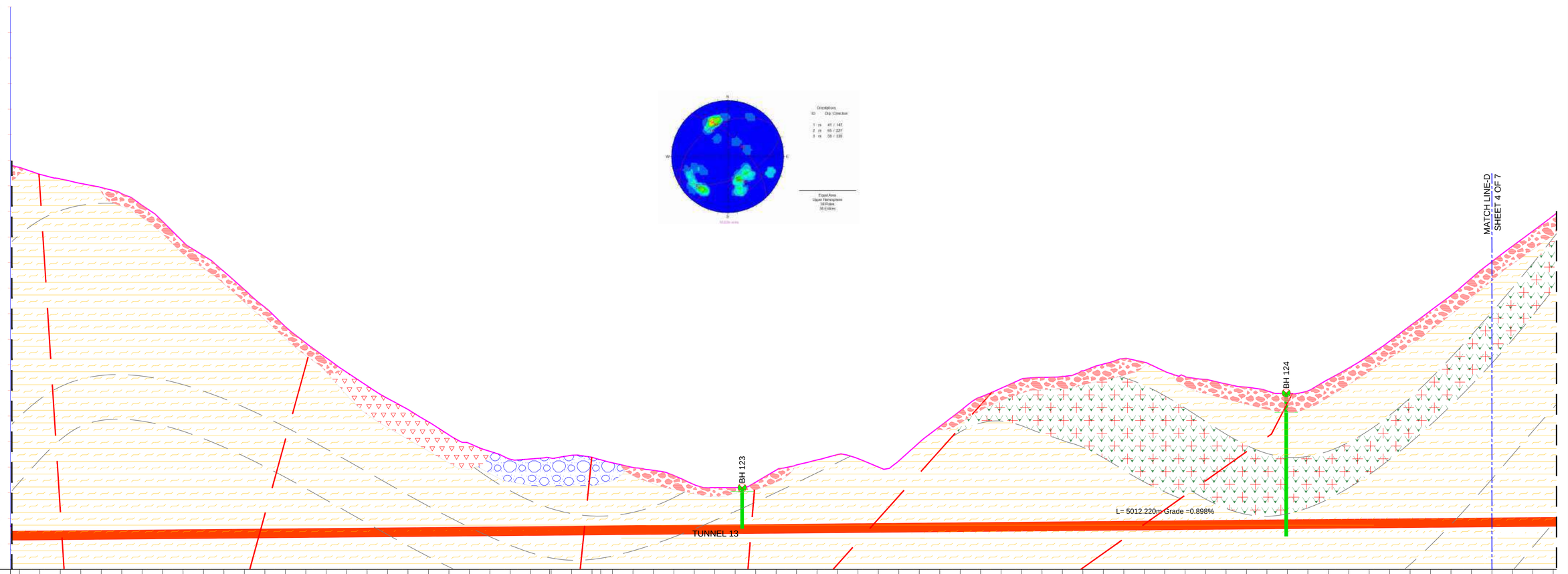
| | | |


MATCH LINE - B
SHEET 3 OF 7
BH 121
BH 122
TUNNEL 13
DATUM 650 m
1175
1150
1125
1100
1075
1050
1025
1000
975
950
925
900
875
850
825
800
775
750
725
700
675

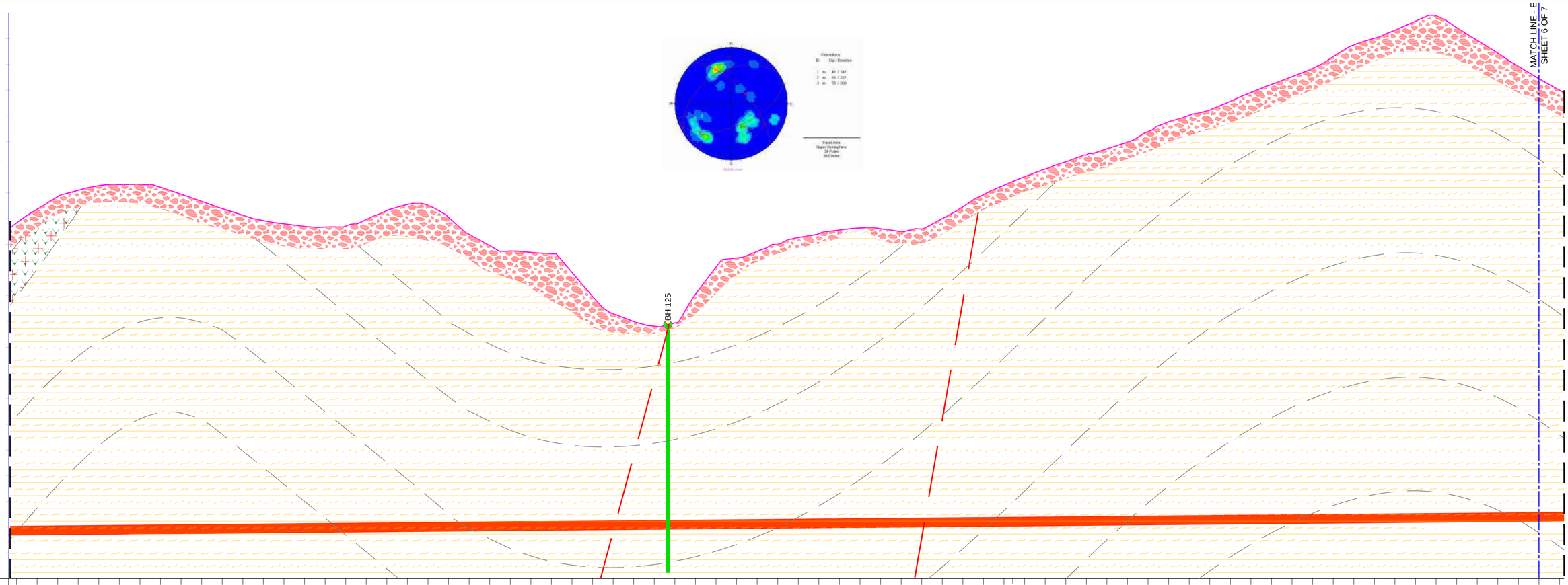
| | | |


MATCH LINE-C
SHEET 4 OF 7
ADIT JUNCTION LOCATION
L= 3345.130m Grade =-0.736%
L= 5012.220m Grade =0.898%
TUNNEL 13
DATUM 650 m

| | | |


1200
1175
1150
1125
1100
1075
1050
1025
1000
975
950
925
900
875
850
825
800
775
750
725
700
675
DATUM 650 m
BH 123
BH 124
TUNNEL 13
L= 5012.220m Grade =0.898%
MATCH LINE-D
SHEET 4 OF 7

| | | |



CHAINAGE	97+160 … 98+660 (every 20 m)	
PROPOSED RAIL LEVELS	694.248 … 707.712	
GROUND LEVELS	995.739 … 1124.278	
Group	Garhwal Group	
Formation	Nagnithak Formation	
Lithology	Grey to Whitish Colored Quartzite	
Potential Geological Hazards – Faults		
Potential Geological Hazards – Tectonically Disturbed Zones		
Potential Geological Hazards – Water Inflow	Dry to Damp	Damp to Dripping / Dry to Damp
Ground Type (GT)	GT - 1 & GT - 2	GT - 3 & GT - 7 / GT - 1 & GT - 2
Behavior Type (BT) ò Norm	B1 & B2	C2, C3 & C4 / A2, B2 & C1
Rock Mass Classification – RMR	50 - 70	25 - 35 / 50 - 70
Rock Mass Classification – GSI	45 - 65	20 - 30 / 45 - 65
Rock Mass Classification – Rock Class	II - III	IV / II - III
Anticipated Distribution of Support Classes	B1 & B2	C2 & C3 / B2 & C1

NOTE :~

1. THE GEOLOGICAL SECTION ALONG THE TUNNEL ALIGNMENT HAS BEEN PREPARED BASED ON GEOLOGICAL PLAN FIELD EXCURSION.
2. FOR ALL OTHERS NOTE REFER DRAWING NO. ACM-60598728-PKG7B-GT-031

LEGENDS :

- Colluvium or surficial material
- Terrace Material
- Nalah Borne material
- Slide material
- Quartzite
- Metabasic rock
- Sheared/Fractured Metabasic rock
- Phyllites
- Dolomites

OTHER SYMBOLS :

- Fault
- Lithological Contact
- Bore Holes

Structural Domain	Group	Formation	Age
Outer lesser Himalaya	Jaunsar	Chandpur formation	Neo-Proterozoic
Inner lesser Himalaya	Garhwal	Epidiorite, Anphibolite and Metavolcanic	Meso-Proterozoic
		Nagnithank formation	

Stratigraphy Along the Project Area (Source GSI)

GT - 1 Thickly Foliated Massive Quartzites

GT - 2 Thinly foliated /fractured Quartzites

GT - 3 Intensely fractured and crushed Quartzite

GT - 4 Massive Metabasic rocks

GT-5 Crushed and fractured Metabasic rocks

GT - 6 Thinly bedded Dolomites

GT-7 Crushed and Faulted rock mass

GT - 8 Colluvium or Surficial Materials

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited | AECOM

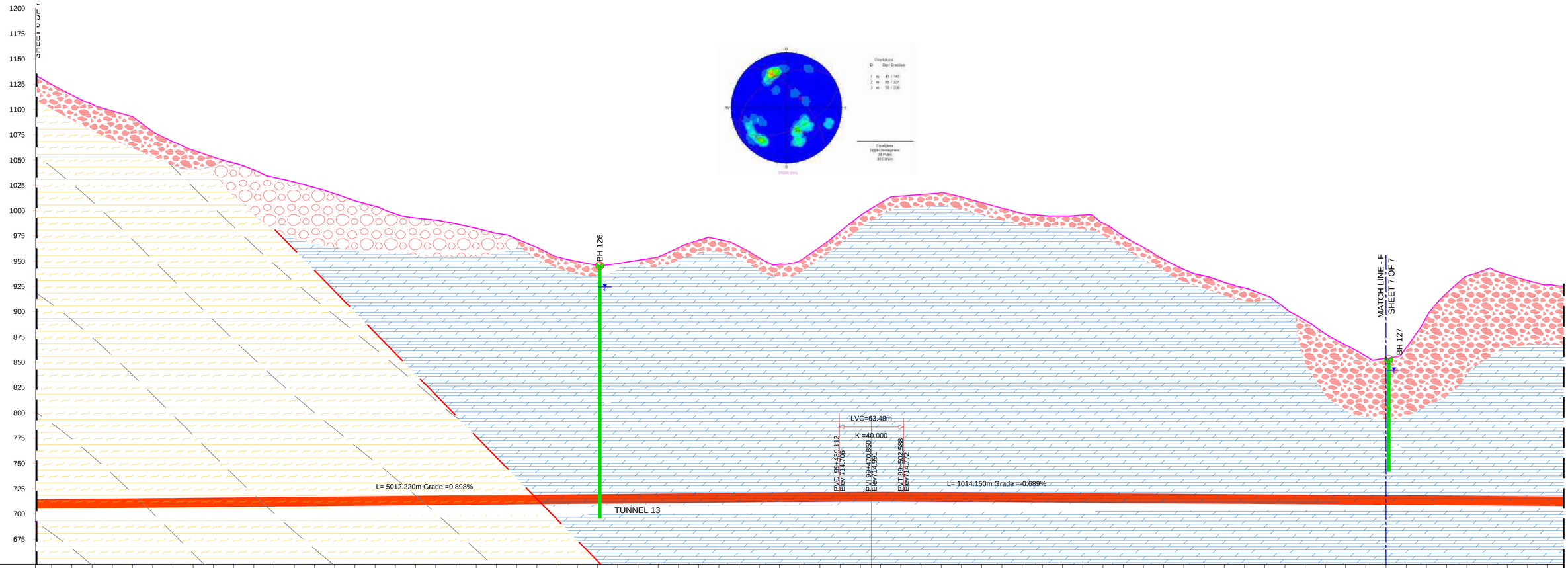
Debasis Bag	Om Dixit	Sami K	John Celentano
Drawn	Designed	Verified	Approved

Title:

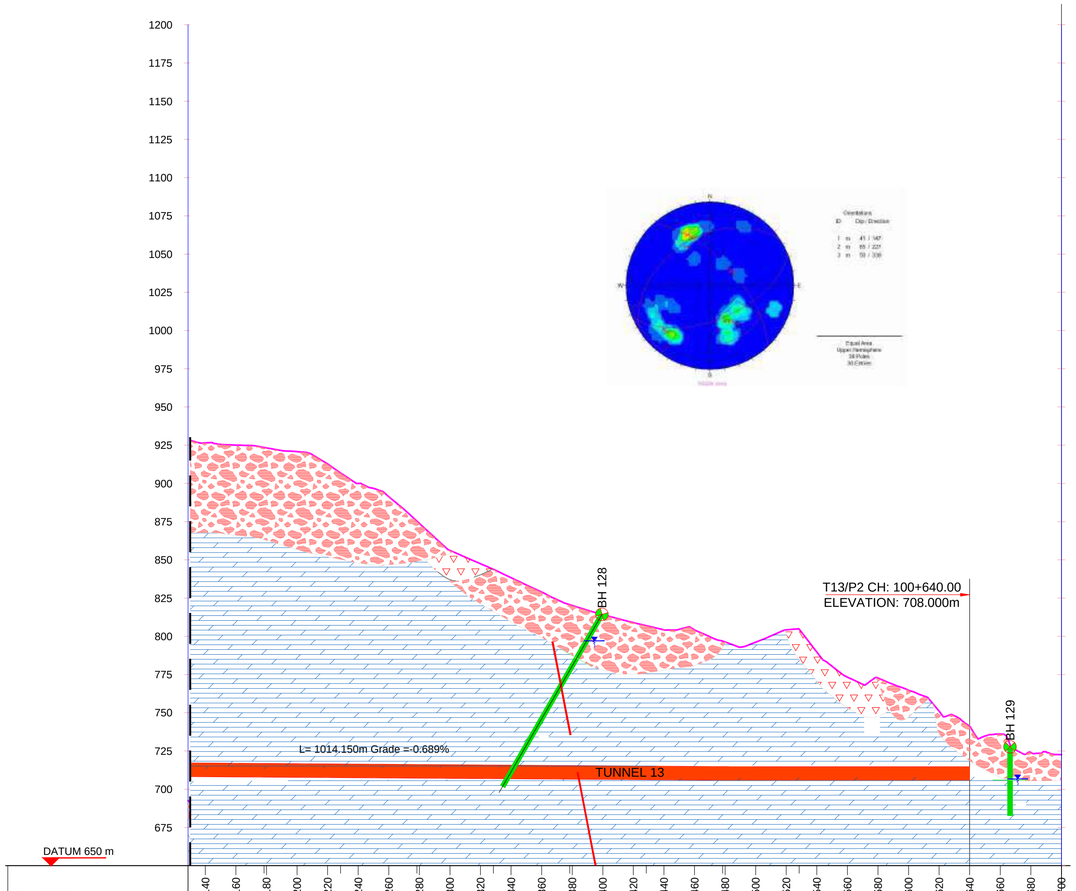
TUNNEL-13

GEOLOGICAL LONGITUDINAL SECTION PROFILE (SHEET 5 OF 7)

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-GT-0055	1:2000	1


SHEET 5 OF 7
BH 126
TUNNEL 13
L= 5012.220m Grade =0.898%
LVC=63.48m
K =40.000
PVC 99+439.112
Elev 714.705
PVI 99+470.850
Elev 714.991
PVT 99+502.588
Elev 714.772
L= 1014.150m Grade =-0.689%
MATCH LINE - F
SHEET 7 OF 7
BH 127
DATUM 650 m

| | | |



CHAINAGE	100+140	100+160	100+180	100+200	100+220	100+240	100+260	100+280	100+300	100+320	100+340	100+360	100+380	100+400	100+420	100+440	100+460	100+480	100+500	100+520	100+540	100+560	100+580	100+600	100+620	100+640	100+660	100+680	100+700
PROPOSED RAIL LEVELS	710.378	710.240	710.103	709.965	709.827	709.689	709.551	709.413	709.275	709.138	709.000	708.862	708.724	708.586	708.448	708.310	708.173	708.044	708.000	708.000	708.000	708.000	708.000	708.000	708.000	708.000	708.000	708.000	708.000
GROUND LEVELS	926.518	925.071	923.217	920.817	912.737	900.000	891.355	873.835	856.171	847.456	838.317	828.963	820.170	814.194	808.959	804.244	804.174	796.281	796.153	804.241	789.684	773.342	772.682	764.770	751.013	741.052	736.000	723.974	722.639

Group	Garhwal Group				
Formation	Pithoragarh Formation				
Lithology	Grey to Dark Colored Dolomites				
Potential Geological Hazards	Faults				
	Tectonically Disturbed Zones				
	Water Inflow		Damp to Dripping	Damp	
Ground Type (GT)			GT - 6 & GT- 7	GT - 6 & GT- 8	
Behavior Type (BT) ŏ Norm			B2	B2 & B3	
Rock Mass Classification	RMR		25 - 30	10 - 30	
	GSI		20 - 25	05 - 25	
	Rock Class		IV	IV - V	
Anticipated Distribution of Support Classes			B2	B2 & P	

NOTE :~

1. THE GEOLOGICAL SECTION ALONG THE TUNNEL ALIGNMENT HAS BEEN PREPARED BASED ON GEOLOGICAL PLAN FIELD EXCURSION.
2. FOR ALL OTHERS NOTE REFER DRAWING NO. ACM-60598728-PKG7B-GT-031

LEGENDS :

- Colluvium or surficial material
- Terrace Material
- Nalah Borne material
- Slide material
- Quartzite
- Metabasic rock
- Sheared/Fractured Metabasic rock
- Phyllites
- Dolomites

OTHER SYMBOLS :

- Fault
- Lithological Contact
- Bore Holes

Structural Domain	Group	Formation	Age
Outer lesser Himalaya	Jaunsar	Chandpur formation	Neo-Proterozoic
Inner lesser Himalaya	Garhwal	Epidiorite, Amphibolite and Metavolcanic	Meso-Proterozoic
		Nagnithank formation	

Stratigraphy Along the Project Area (Source GSI)

GT - 1 Thickly Foliated Massive Quartzites

GT - 2 Thinly foliated /fractured Quartzites

GT - 3 Intensely fractured and crushed Quartzite

GT - 4 Massive Metabasic rocks

GT-5 Crushed and fractured Metabasic rocks

GT - 6 Thinly bedded Dolomites

GT-7 Crushed and Faulted rock mass

GT - 8 Colluvium or Surficial Materials

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited गुणवत्ता, गति एवं पारदर्शिता (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited | AECOM

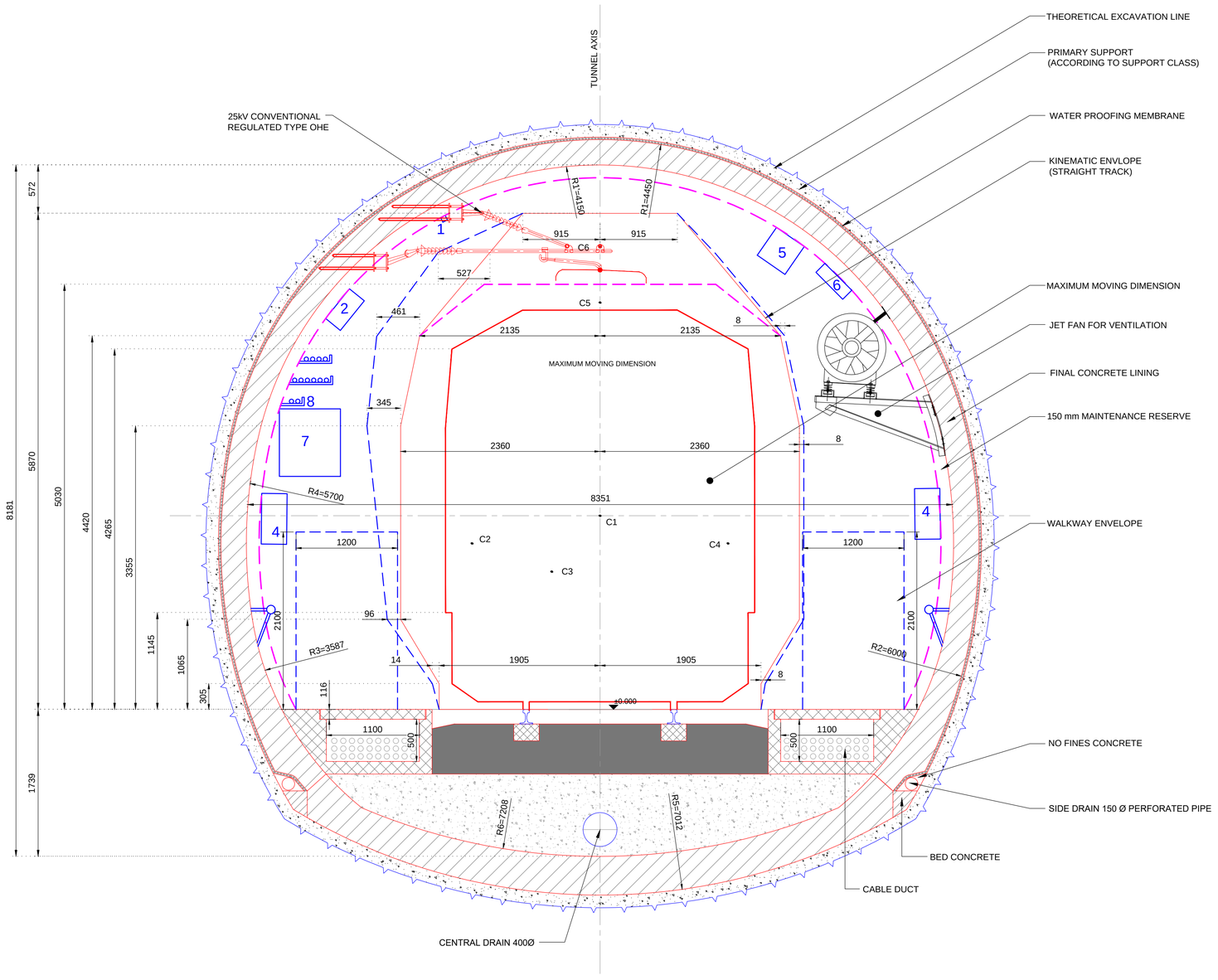
Debasis Bag	Om Dixit	Sami K	John Celentano
Drawn	Designed	Verified	Approved

Title:

TUNNEL-13

GEOLOGICAL LONGITUDINAL SECTION PROFILE (SHEET 7 OF 7)

Drawing No. ACM-60598728-PKG7B-GT-0057 | Scale 1:2000 | Rev. 1



FINSHED AREA = 46.45 m²
EXCAVATED AREA = 70.52m²

MAIN TUNNEL SECTION (WITH INVERT ARCH)

SCALE 1:30

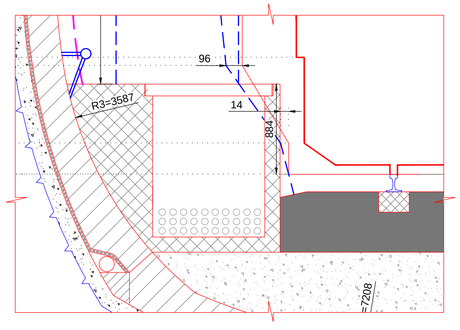
NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. MINIMUM EXCAVATION LINE SHALL INCLUDE CONSTRUCTION & DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.
7. FOR FIREFIGHTING LOCATION THE LEVEL OF THE WALKWAY SHALL BE 884mm HIGHER THAN THE RAIL LEVEL.

CO-ORDINATE OF CENTER		
CENTER	X	Y
C1	0	2292
C2	-1515	1964
C3	-571	1630
C4	1515	1964
C5	0	4815
C6	0	5470

LIST OF EQUIPMENT:

1. SPACE FOR LINEAR HEAT DETECTION CABLE, 60mm x 60mm
2. SPACE FOR CCTV CAMERA FOR TUNNEL MONITORING, 225x450
3. SPACE FOR JET FAN, Ø 900 (OPTIONAL)
4. SPACE FOR LIGHTS, 600mm x 300mm
5. SPACE FOR AIR MONITORING EQUIPMENT, 400mm x 400mm
6. SPACE FOR CABLE TRAY, 450mm x 150mm
7. SPACE FOR ALTERNATING SIGNALLING, 800mm x 800mm
8. CABLE TRAY



DETAIL OF WALKWAY AT FIRE FIGHTING POINT

SCALE 1:30

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

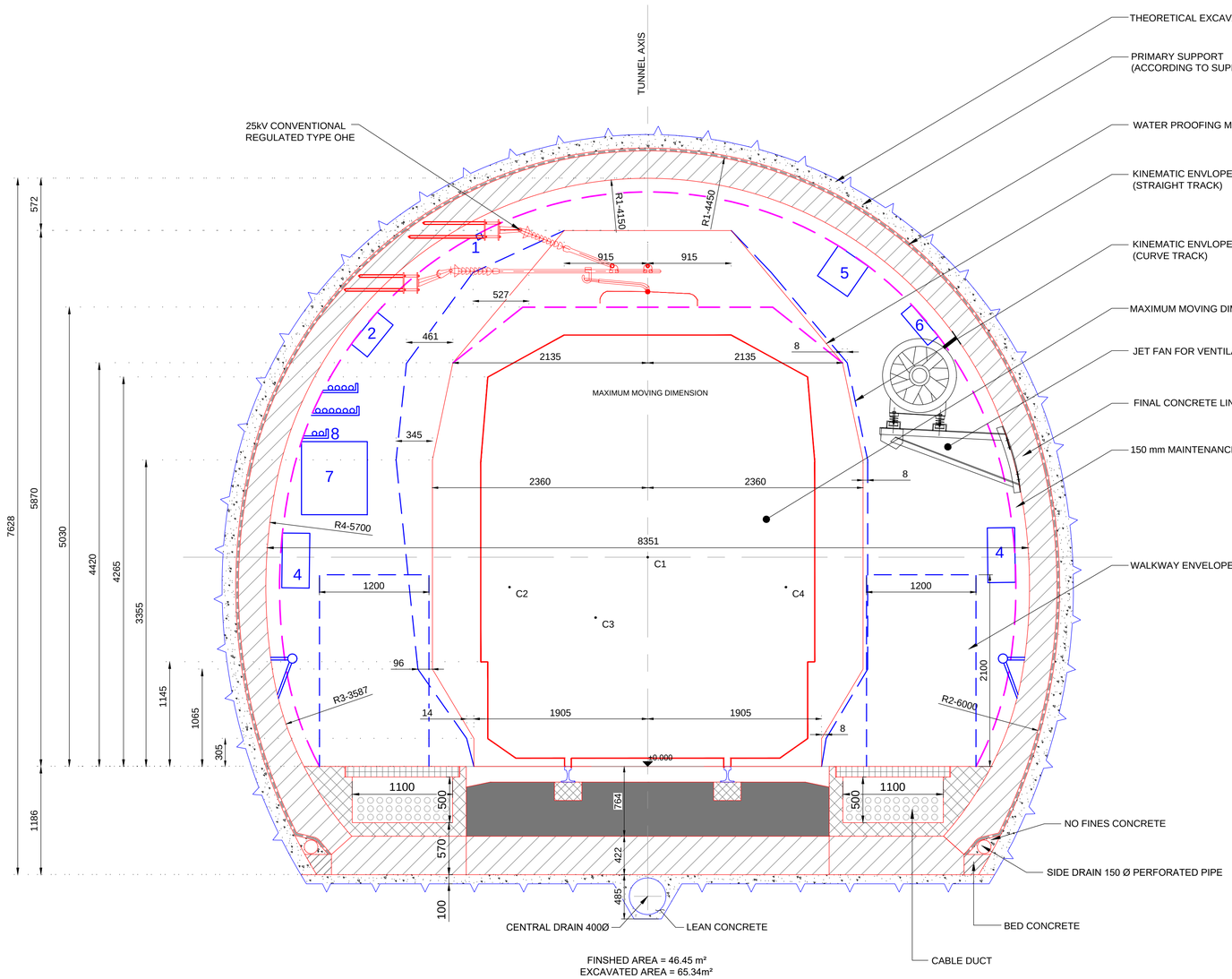
DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited | AECOM

Debasis Bag	Eshita / Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

Title: TUNNEL-13 TYPICAL CROSS SECTION FOR MAIN TUNNEL (WITH INVERT) (SHEET 1 OF 1)

Drawing No. ACM-60598728-PKG7B-MT-CS-0061 | Scale AS SHOWN | Rev. 0



FINSHED AREA = 46.45 m²
EXCAVATED AREA = 65.34m²

MAIN TUNNEL SECTION (WITHOUT INVERT ARCH)

SCALE 1:30

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. MINIMUM EXCAVATION LINE SHALL INCLUDE CONSTRUCTION & DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.

CO-ORDINATE OF CENTER		
CENTER	X	Y
C1	0	2292
C2	-1515	1964
C3	-571	1630
C4	1515	1964

LIST OF EQUIPMENT:

1. SPACE FOR LINEAR HEAT DETECTION CABLE, 60mm x 60mm
2. SPACE FOR CCTV CAMERA FOR TUNNEL MONITORING, 225x450
3. SPACE FOR JET FAN, Ø 900 (OPTIONAL)
4. SPACE FOR LIGHTS, 600mm x 300mm
5. SPACE FOR AIR MONITORING EQUIPMENT, 400mm x 400mm
6. SPACE FOR CABLE TRAY, 450mm x 150mm
7. SPACE FOR ALTERNATING SIGNALLING, 800mm x 800mm
8. CABLE TRAY

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

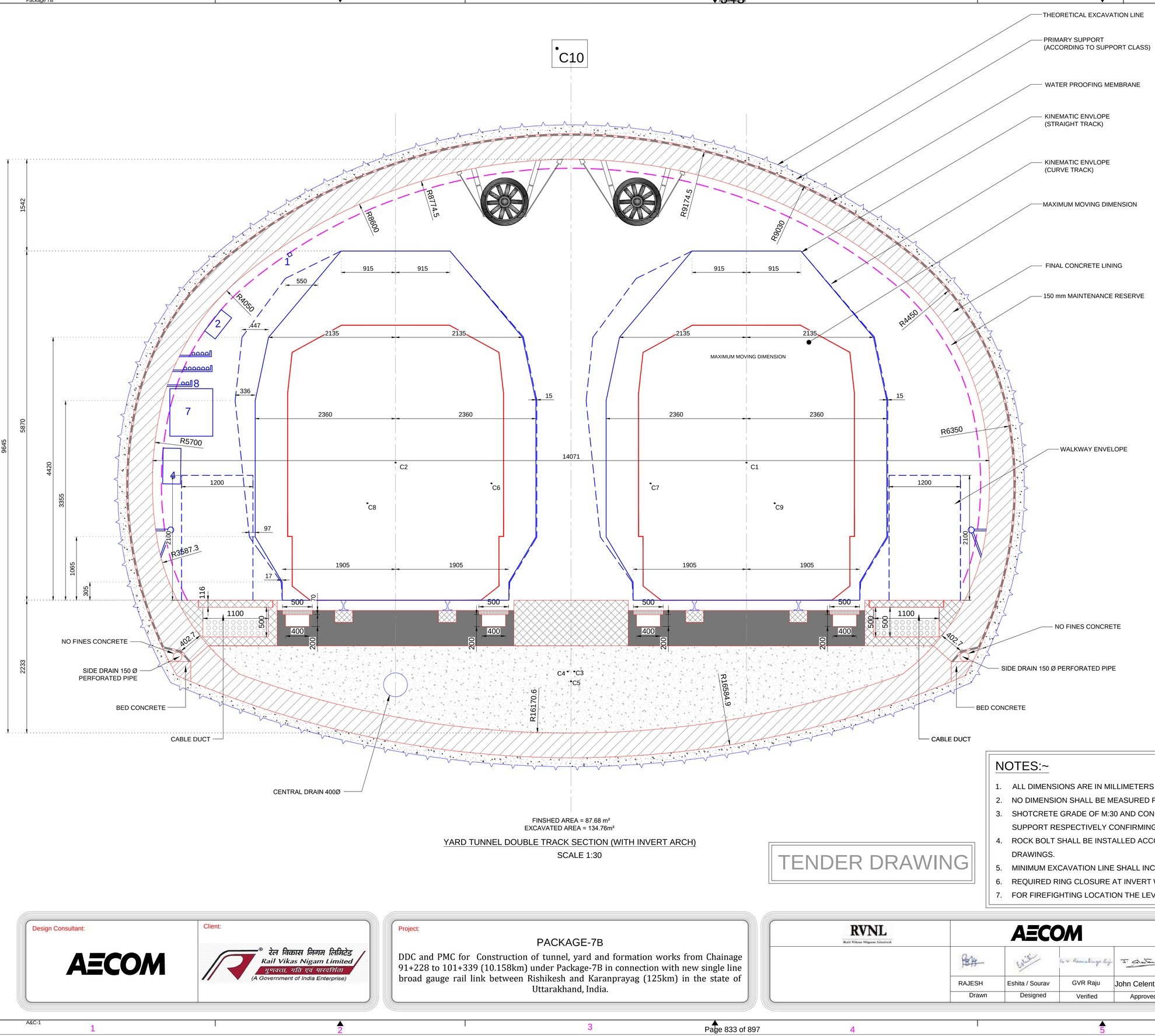
DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited | AECOM

Debasis Bag	Eshita / Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

Title: TUNNEL-13 TYPICAL CROSS SECTION FOR MAIN TUNNEL (WITHOUTINVERT) (SHEET 1 OF 1)

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-MT-CS-0062	AS SHOWN	0



LIST OF EQUIPMENT:

1. SPACE FOR LINEAR HEAT DETECTION CABLE, 60mm x 60mm
2. SPACE FOR CCTV CAMERA FOR TUNNEL MONITORING, 225x450
3. SPACE FOR JET FAN, Ø 900 (OPTIONAL)
4. SPACE FOR LIGHTS, 600mm x 300mm
5. SPACE FOR AIR MONITORING EQUIPMENT, 400mm x 400mm
6. SPACE FOR CABLE TRAY, 450mm x 150mm
7. SPACE FOR ALTERNATING SIGNALLING, 800mm x 800mm
8. CABLE TRAY

CO-ORDINATE OF CENTER		
CENTER	X	Y
C1	2950	2313
C2	-2950	2313
C3	56	-1198
C4	-56	-1198
C5	0	-1363
C6	-1337	1964
C7	1337	1964
C8	-3424	1630
C9	3424	1630
C10	0	13937

FINSHED AREA = 87.68 m²
EXCAVATED AREA = 134.76m²

YARD TUNNEL DOUBLE TRACK SECTION (WITH INVERT ARCH)

SCALE 1:30

TENDER DRAWING

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. MINIMUM EXCAVATION LINE SHALL INCLUDE CONSTRUCTION & DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.
7. FOR FIREFIGHTING LOCATION THE LEVEL OF THE WALKWAY SHALL BE 884mm HIGHER THAN THE RAIL LEVEL.

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

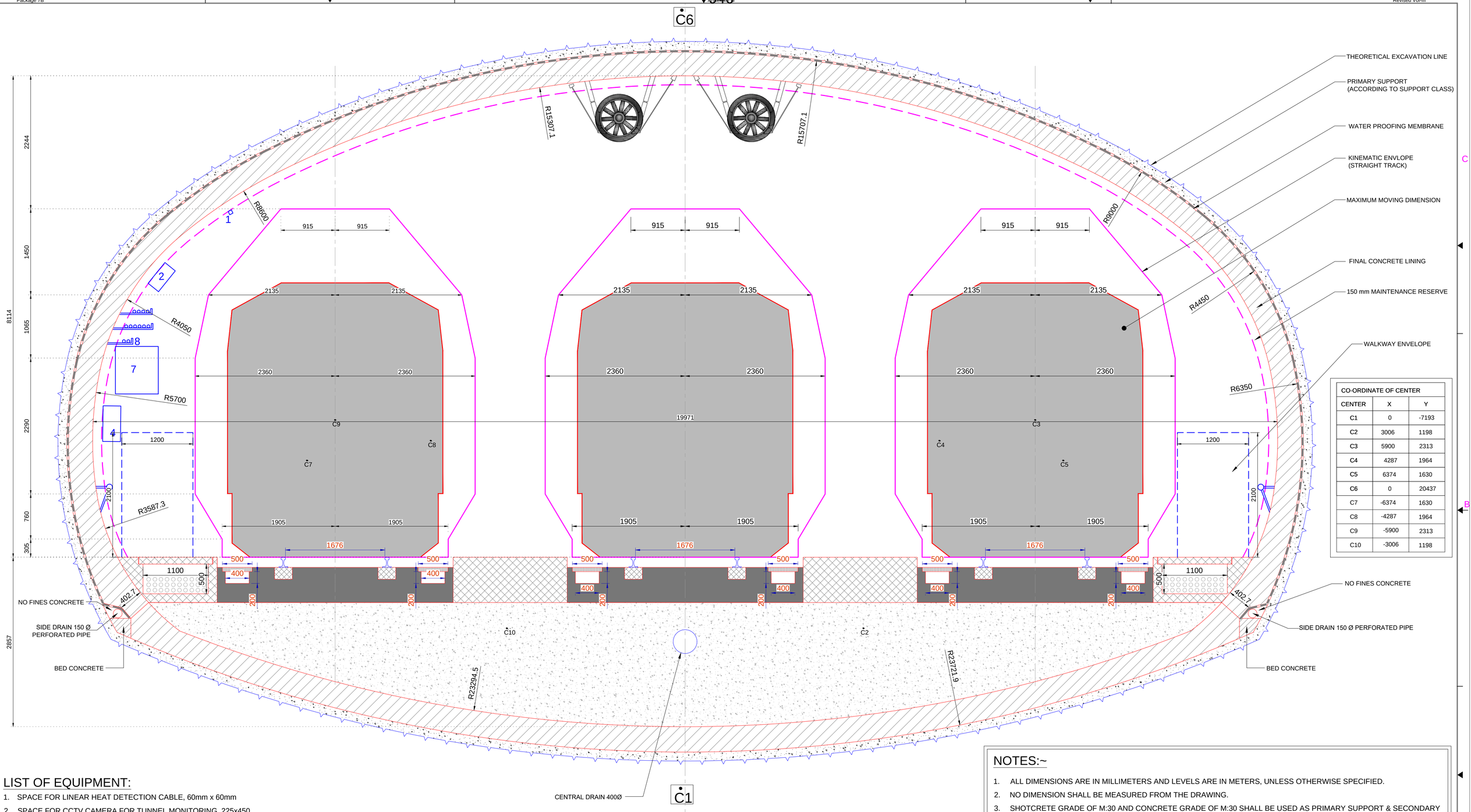
RVNL Rail Vikas Nigam Limited

AECOM

RAJESH	Eshita / Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

Title: TUNNEL-13 TYPICAL CROSS SECTION OF DOUBLE TRACK TUNNEL (SHEET 1 OF 1)

Drawing No.	Scale	Rev.
ACM-60598728-PKG-7B-MT-CS-0063	AS SHOWN	0



CO-ORDINATE OF CENTER		
CENTER	X	Y
C1	0	-7193
C2	3006	1198
C3	5900	2313
C4	4287	1964
C5	6374	1630
C6	0	20437
C7	-6374	1630
C8	-4287	1964
C9	-5900	2313
C10	-3006	1198

LIST OF EQUIPMENT:

1. SPACE FOR LINEAR HEAT DETECTION CABLE, 60mm x 60mm
2. SPACE FOR CCTV CAMERA FOR TUNNEL MONITORING, 225x450
3. SPACE FOR JET FAN, Ø 900 (OPTIONAL)
4. SPACE FOR LIGHTS, 600mm x 300mm
5. SPACE FOR AIR MONITORING EQUIPMENT, 400mm x 400mm
6. SPACE FOR CABLE TRAY, 450mm x 150mm
7. SPACE FOR ALTERNATING SIGNALLING, 800mm x 800mm
8. CABLE TRAY

TENDER DRAWING

FINSHED AREA = 136.24 m²
EXCAVATED AREA = 208.83m²

YARD TUNNEL DOUBLE TRACK SECTION (WITH INVERT ARCH)

SCALE 1:30

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. MINIMUM EXCAVATION LINE SHALL INCLUDE CONSTRUCTION & DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.
7. FOR FIREFIGHTING LOCATION THE LEVEL OF THE WALKWAY SHALL BE 884mm HIGHER THAN THE RAIL LEVEL.

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

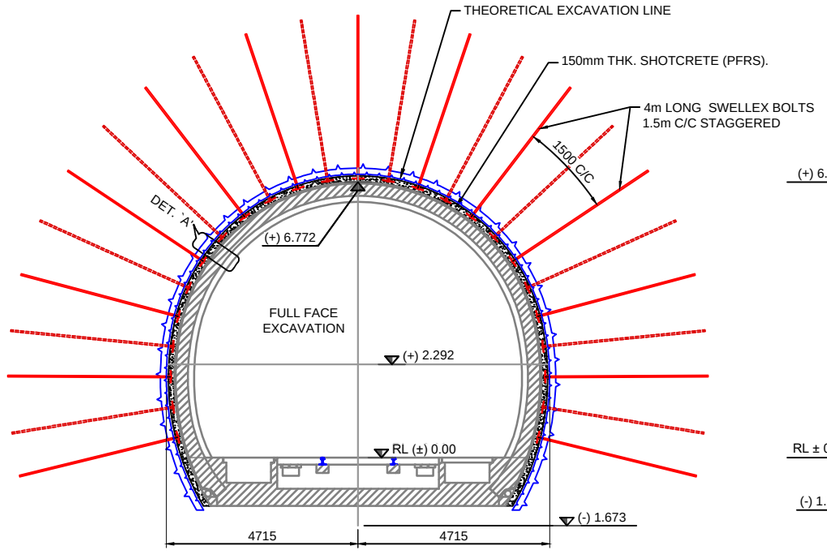
DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited | AECOM

RAJESH	Eshita / Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

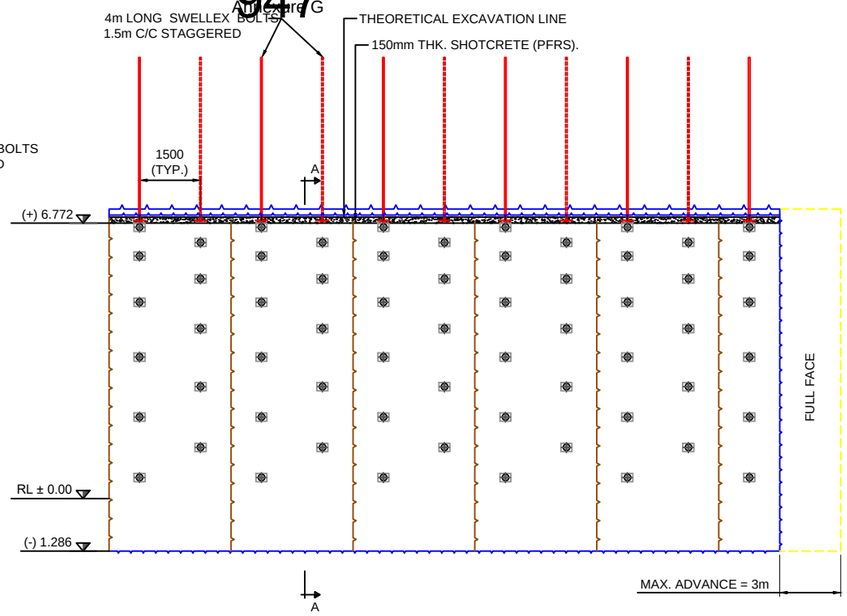
Title: TUNNEL-13 TYPICAL CROSS SECTION OF TRIPLE TRACK TUNNEL (SHEET 1 OF 1)

Drawing No.	Scale	Rev.
ACM-60598728-PKG-7B-MT-CS-0064	AS SHOWN	0



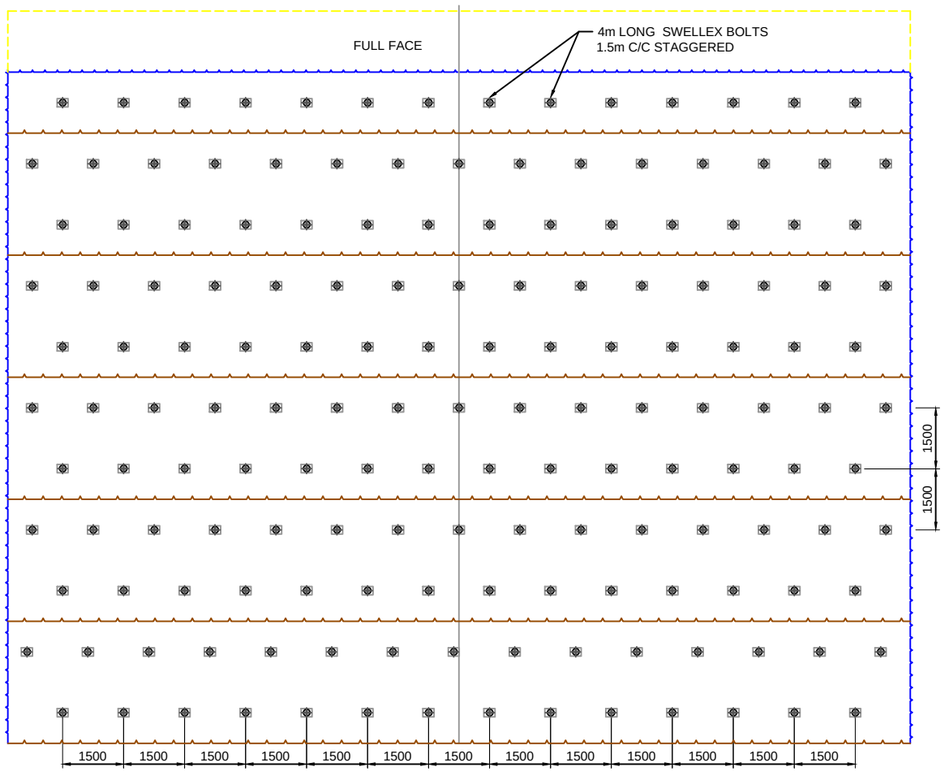
SUPPORT CLASS B1 (SECTION A)

SCALE(A1) 1:75



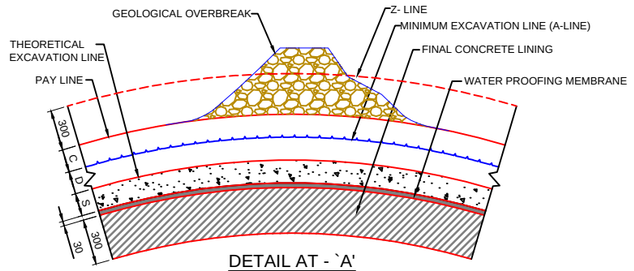
LONGITUDINAL SECTION

SCALE(A1) 1:75



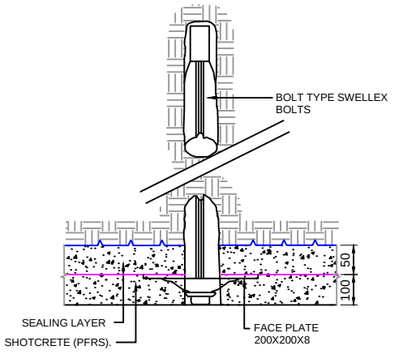
BOLTING PATTERN

SCALE (A1) 1:75



DETAIL AT - `A'

SCALE (A1) 1: 20



DETAIL OF BOLTS

SCALE (A1) N.T.S.

TENDER DRAWING

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. MINIMUM EXCAVATION LINE SHALL INCLUDE DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.
7. FOR OTHER NOTE REFER DWG.NO-ACM-60598728-PKG7B-GE-GA-0003 & 0004[0]
8. DRILLING OF PROBE HOLES SHALL BE MANDATORY AS SPECIFIED IN THE TECHNICAL SPECIFICATION FOR ADOPTION OF SUPPORT SYSTEM SHOWN IN THIS DRAWING.
9. THE CONTRACTOR SHALL DRILL HOLES AROUND THE PERIPHERY OF THE EXCAVATION FOR DRAINING THE SURROUNDING ROCK.THE MINIMUM DIAMETER OF HOLES SHALL BE 57 MM OR AS DIRECTED BY THE ENGINEER. THE NUMBER OF HOLES, DEPTH, LOCATION AND INCLINATION OF HOLES SHALL DEPEND ON WATER INFLOW CONDITIONS AND INFLOW DISTRIBUTION AT THE FACE WHERE GROUTING IS PERFORMED.FOR ANY FURTHER DETAILS REGARDING PROBE DRILLING SECTION 14 & ANNEXURE B OF WORKS REQUIREMENTS SHOULD BE REFFERED.

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited गुणवत्ता, गति एवं पारदर्शिता (A Government of India Enterprise)

A&C-1

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL

AECOM

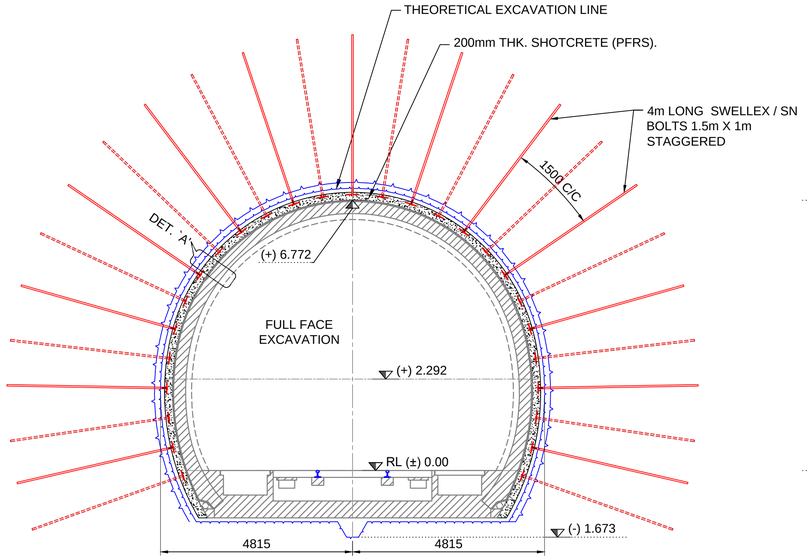
YOGENDRA	Eshita / Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

Title: TUNNEL-13

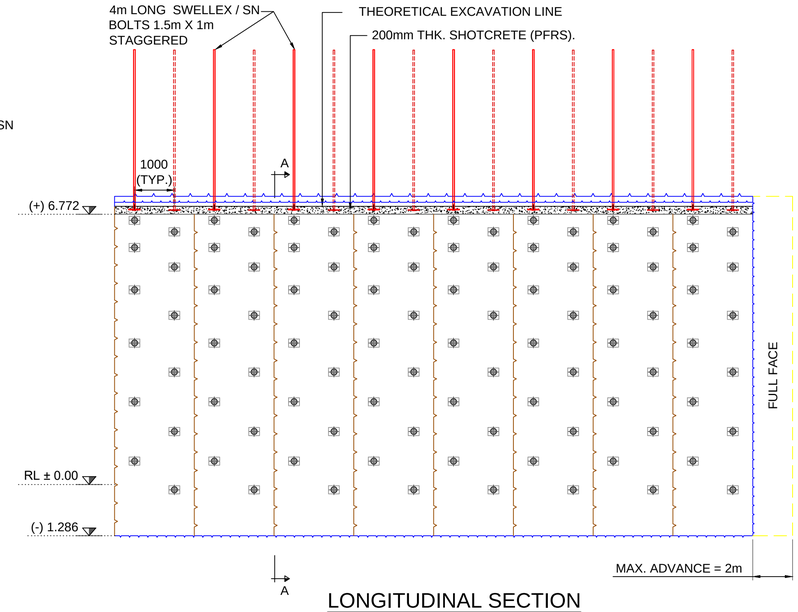
MAIN TUNNEL - ROCK CLASS - B1 (WITHOUT INVERT) TYPICAL SUPPORT DETAILS (SHEET 1 OF 1)

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-MT-ES-0101	AS SHOWN	0

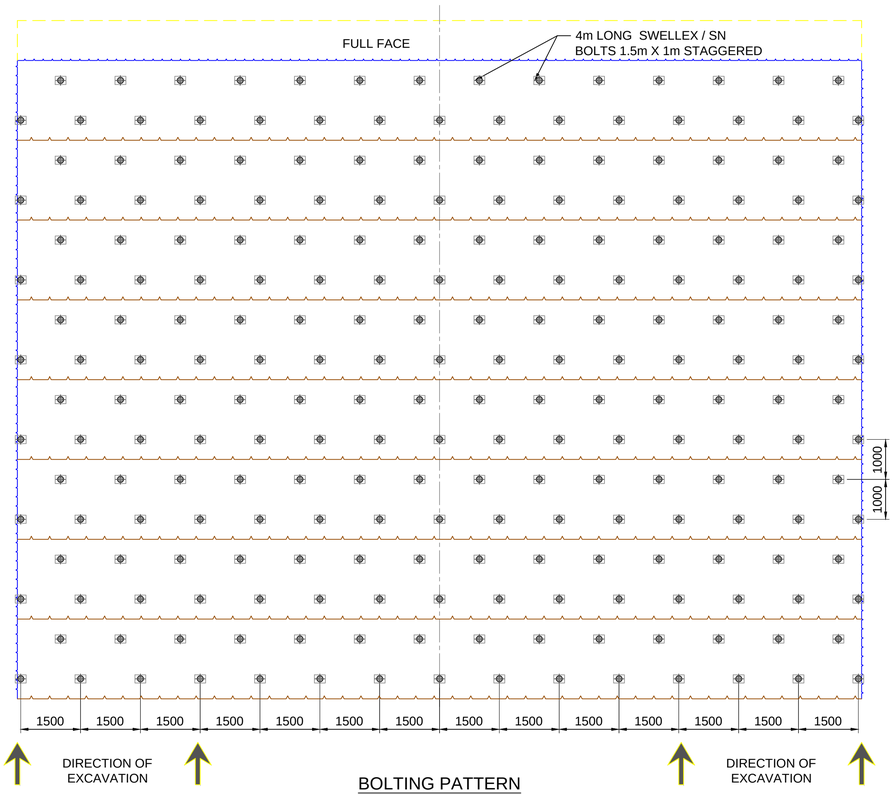
EXCAVATION & SUPPORT QUANTITIES PER METER FOR MAIN TUNNEL SUPPORT CLASS B2				
MAXIMUM DEFORMATION TOLERANCE			D	100 mm
Full FACE EXCAVATION	EXCAVATION	ROUND LENGTH		2 m
		THEORETICAL EXCAVATION VOLUME		68.68 m^3
	SUPPORT	SHOTCRETE (PFRS)	M30, ds=200mm	4.33 m^3
		SWELLEX BOLTS / SN	Fy 200kN 4m 1.5m x 1m	13 Pcs.



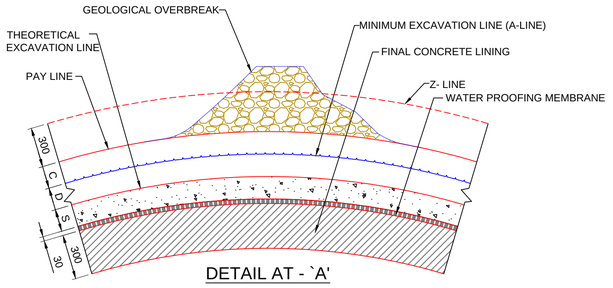
SUPPORT CLASS B2 (SECTION A)
SCALE(A1) 1:75



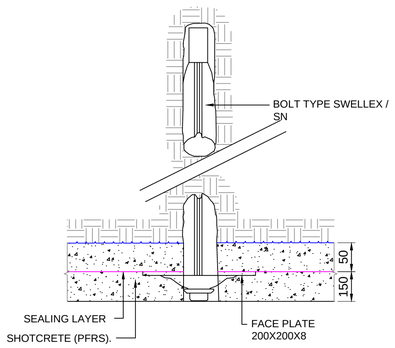
LONGITUDINAL SECTION
SCALE(A1) 1:75



BOLTING PATTERN
SCALE (A1) 1:75



DETAIL AT - `A'
SCALE (A1) 1: 20



DETAIL OF BOLTS
SCALE (A1) N.T.S.

TENDER DRAWING

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. MINIMUM EXCAVATION LINE SHALL INCLUDE DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.
7. FOR OTHER NOTE REFER DWG.NO-ACM-60598728-PKG7B-GE-GA-0003 & 0004[0]
8. DRILLING OF PROBE HOLES SHALL BE MANDATORY AS SPECIFIED IN THE TECHNICAL SPECIFICATION FOR ADOPTION OF SUPPORT SYSTEM SHOWN IN THIS DRAWING.
9. THE CONTRACTOR SHALL DRILL HOLES AROUND THE PERIPHERY OF THE EXCAVATION FOR DRAINING THE SURROUNDING ROCK.THE MINIMUM DIAMETER OF HOLES SHALL BE 57 MM OR AS DIRECTED BY THE ENGINEER. THE NUMBER OF HOLES, DEPTH, LOCATION AND INCLINATION OF HOLES SHALL DEPEND ON WATER INFLOW CONDITIONS AND INFLOW DISTRIBUTION AT THE FACE WHERE GROUTING IS PERFORMED.FOR ANY FURTHER DETAILS REGARDING PROBE DRILLING SECTION 14 & ANNEXURE B OF WORKS REQUIREMENTS SHOULD BE REFFERED.

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

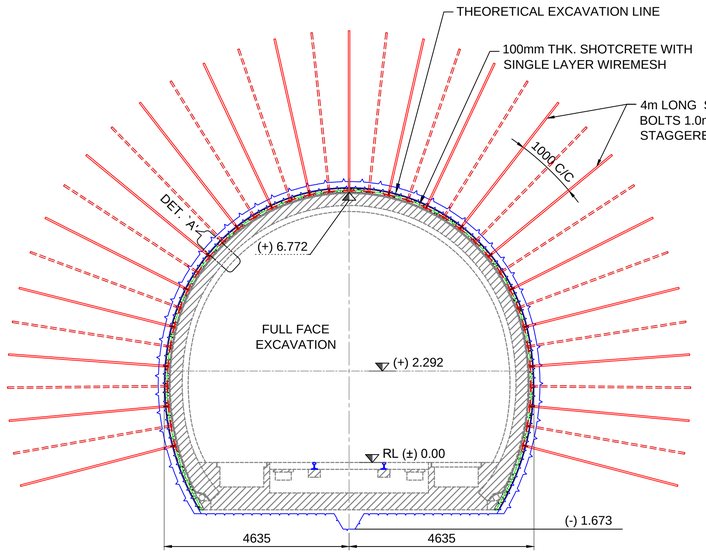
Project:
PACKAGE-7B
DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited | AECOM

YOGENDRA	Eshita / Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

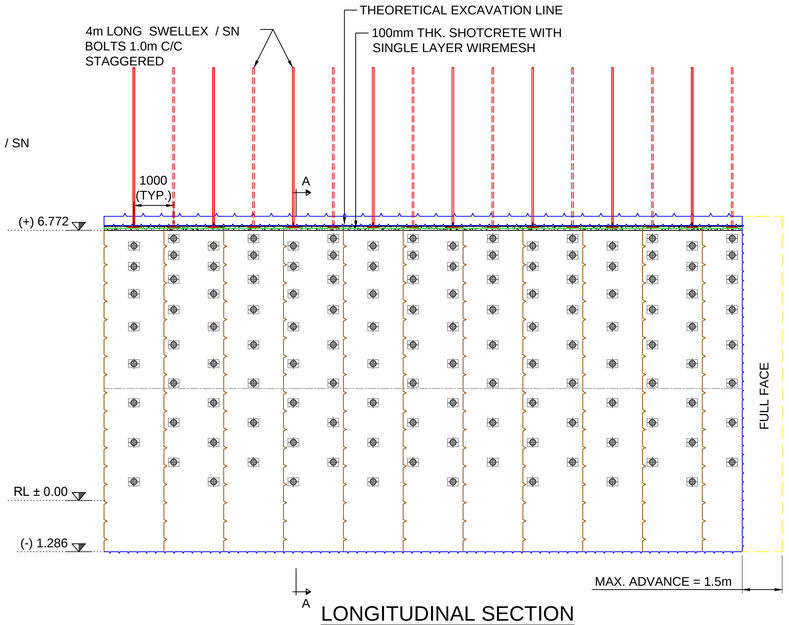
Title:
TUNNEL-13
MAIN TUNNEL - ROCK CLASS - B2 (WITHOUT INVERT)
TYPICAL SUPPORT DETAILS
(SHEET 1 OF 1)

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-MT-ES-0102	AS SHOWN	0



SUPPORT CLASS C1 (SECTION A)

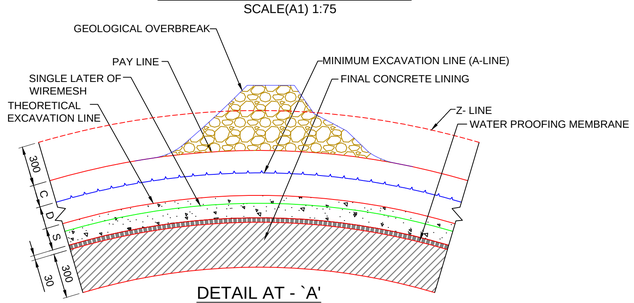
SCALE(A1) 1:75



LONGITUDINAL SECTION

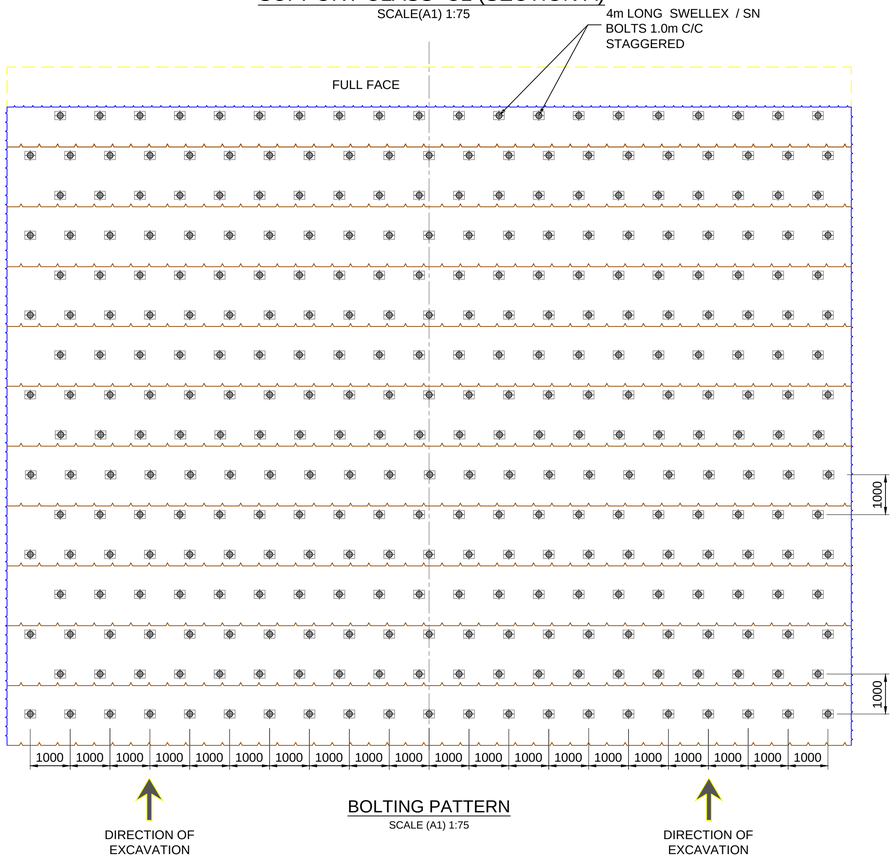
SCALE(A1) 1:75

EXCAVATION & SUPPORT QUANTITIES / METER FOR MAIN TUNNEL SUPPORT CLASS C1				
MAXIMUM DEFORMATION TOLERANCE			20	mm
FULL FACE EXCAVATION	EXCAVATION	ROUND LENGTH	1.5	m
		THEORETICAL EXCAVATION VOLUME	64.68	m^3
	SUPPORT	SHOTCRETE	M30, ds=100mm	2.15	m^3
		WIRE MESH 150/150/6 mm	SINGLE LAYER	21.52	m^2
		SWELLEX BOLTS	Fy 200kN 4m 1m x 1m	19	Pcs



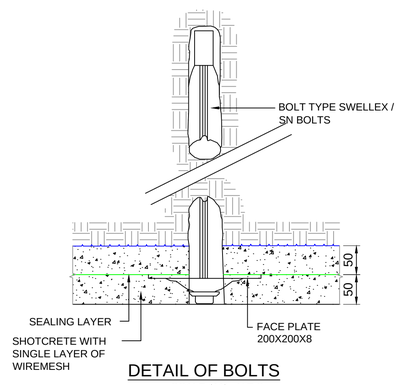
DETAIL AT - `A'

SCALE (A1) 1: 20



BOLTING PATTERN

SCALE (A1) 1:75



DETAIL OF BOLTS

SCALE (A1) N.T.S.

TENDER DRAWING

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. MINIMUM EXCAVATION LINE SHALL INCLUDE DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.
7. FOR OTHER NOTE REFER DWG.NO-ACM-60598728-PKG7B-GE-GA-0003 & 0004[0]
8. DRILLING OF PROBE HOLES SHALL BE MANDATORY AS SPECIFIED IN THE TECHNICAL SPECIFICATION FOR ADOPTION OF SUPPORT SYSTEM SHOWN IN THIS DRAWING.
9. THE CONTRACTOR SHALL DRILL HOLES AROUND THE PERIPHERY OF THE EXCAVATION FOR DRAINING THE SURROUNDING ROCK.THE MINIMUM DIAMETER OF HOLES SHALL BE 57 MM OR AS DIRECTED BY THE ENGINEER. THE NUMBER OF HOLES, DEPTH, LOCATION AND INCLINATION OF HOLES SHALL DEPEND ON WATER INFLOW CONDITIONS AND INFLOW DISTRIBUTION AT THE FACE WHERE GROUTING IS PERFORMED.FOR ANY FURTHER DETAILS REGARDING PROBE DRILLING SECTION 14 & ANNEXURE B OF WORKS REQUIREMENTS SHOULD BE REFFERED.

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

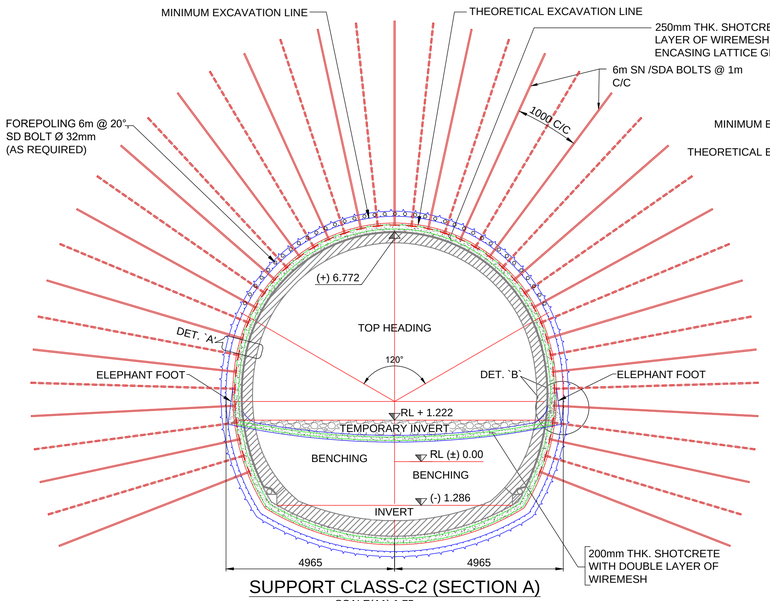
RVNL Rail Vikas Nigam Limited

AECOM

Yogendra	Eshita / Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

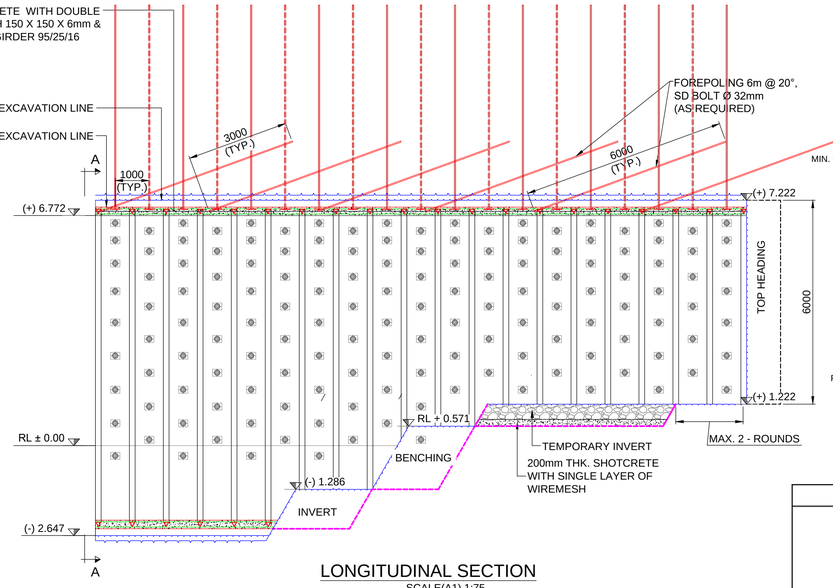
Title: TUNNEL-13
MAIN TUNNEL - ROCK CLASS - C1 (WITHOUT INVERT)
TYPICAL SUPPORT DETAILS
(SHEET 1 OF 1)

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-MT-ES-0103	AS SHOWN	0



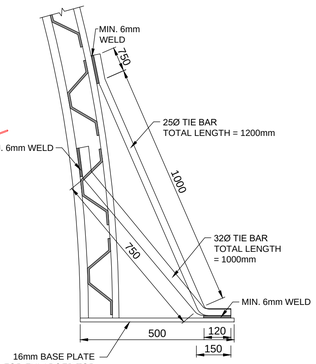
SUPPORT CLASS-C2 (SECTION A)

SCALE(A1) 1:75



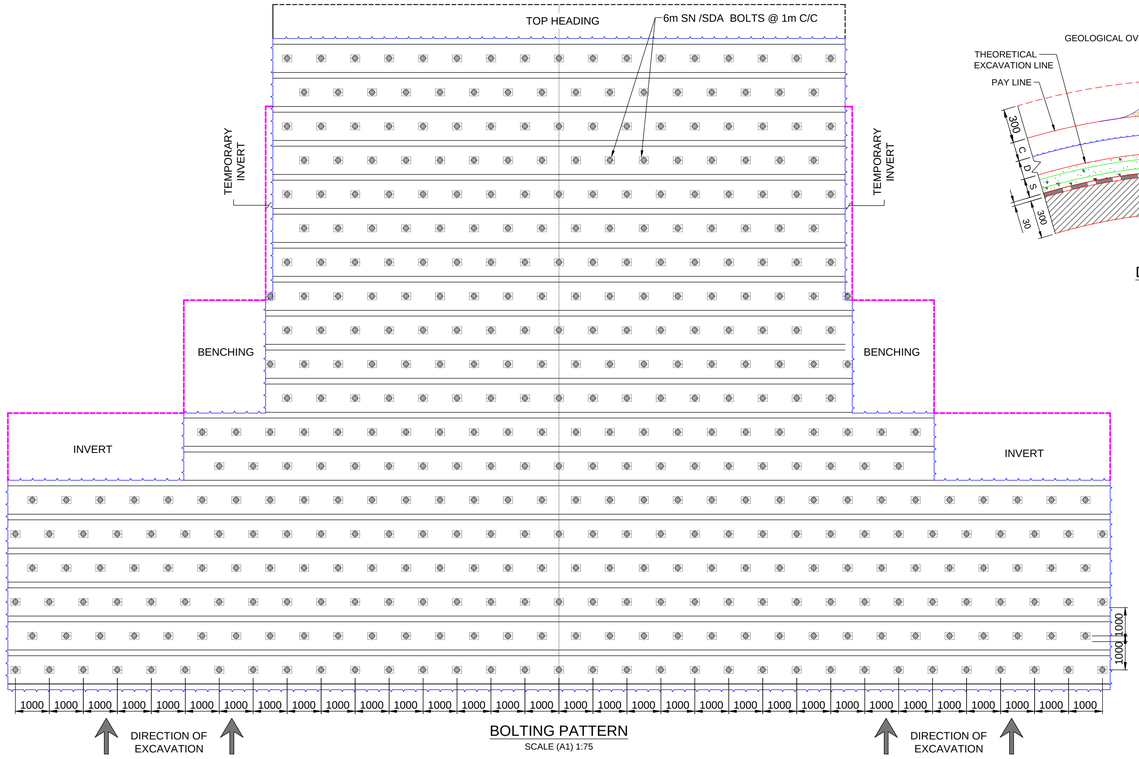
LONGITUDINAL SECTION

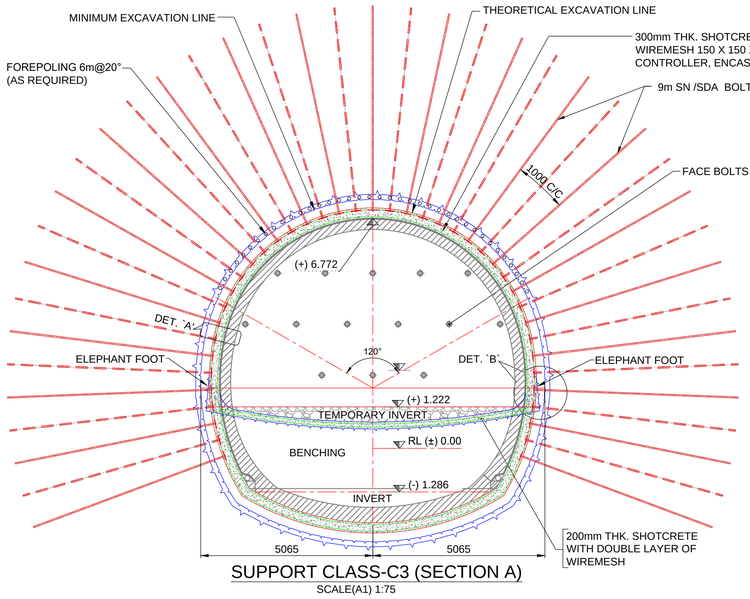
SCALE(A1) 1:75



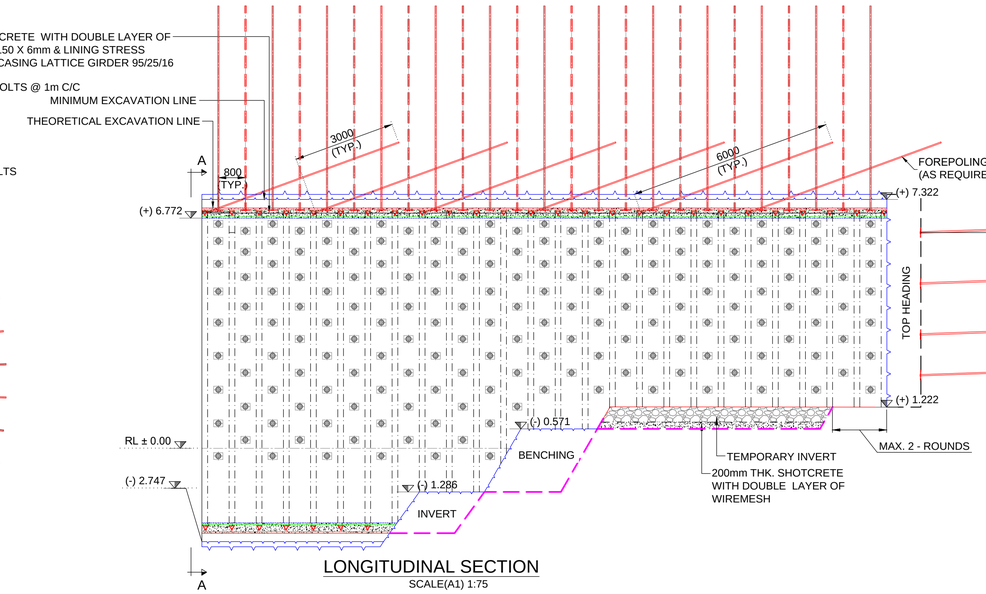
DETAIL AT - `B'

SCALE (A1) 1:10

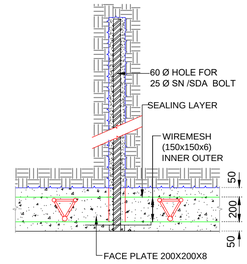

TOP HEADING
6m SN /SDA BOLTS @ 1m C/C
TEMPORARY INVERT
TEMPORARY INVERT
BENCHING
BENCHING
INVERT
INVERT
1000
1000
1000 1000 1000



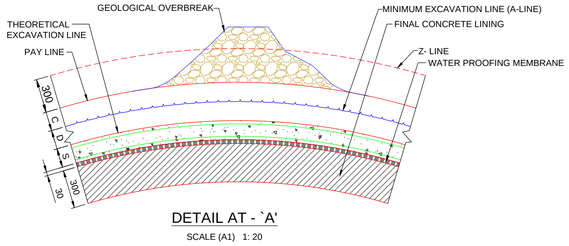
SUPPORT CLASS-C3 (SECTION A)
SCALE(A1) 1:75



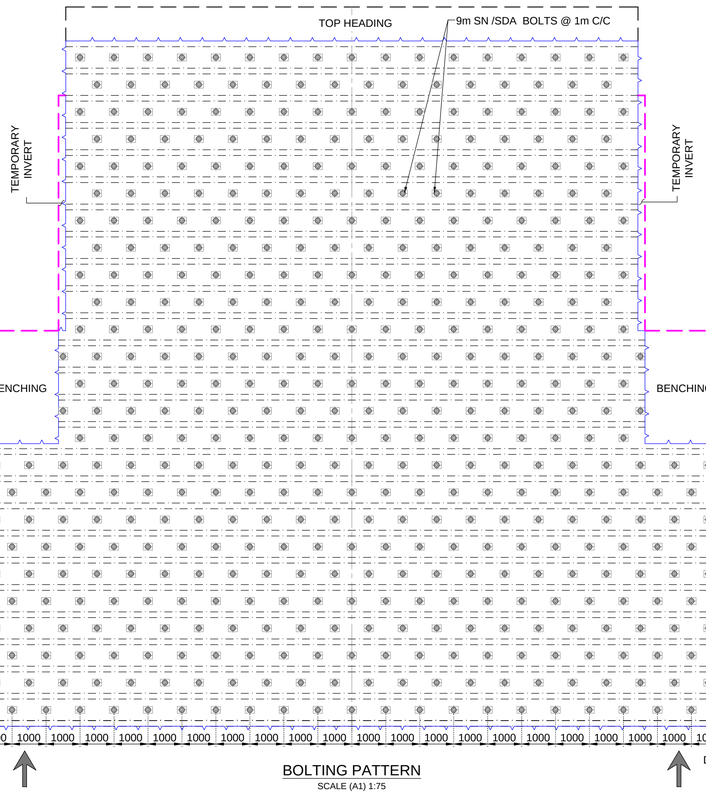
LONGITUDINAL SECTION
SCALE(A1) 1:75



DETAIL OF SN BOLTS
SCALE (A1) N.T.S

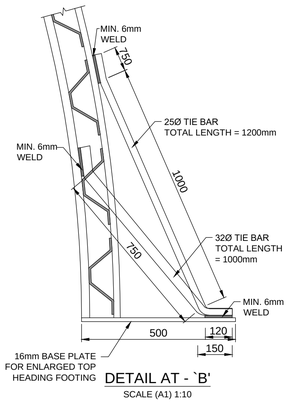


DETAIL AT - `A'
SCALE (A1) 1: 20



BOLTING PATTERN
SCALE (A1) 1:75

EXCAVATION & SUPPORT QUANTITIES / METER FOR MAIN TUNNEL SUPPORT CLASS C3					
MAXIMUM DEFORMATION TOLERANCE			D	250	mm
TOP HEADING	EXCAVATION	ROUND LENGTH		0.8	m
		THEORETICAL EXCAVATION VOLUME		55.25	m^3
	SUPPORT	SHOTCRETE	M30, ds=300mm	5.12	m^2
		WIRE MESH 150/150/6 mm	OUTER / INNER LAYER	34.14	m^2
		SN BOLTS	Fy 200kN 9m, 1m x 1m	21.25	Pcs.
		LATTICE GIRDER	95 / 16 / 25, 1 per round	213.39	Kg
		FOREPOLING (OPTIONAL)	SD BOLTS Ø32, C/C=300, L=6m	39.00	Pcs
		FACE SUPPORT (GLASS FIBER BOLTS) (IF REQUIRED)	Ø32, 12m , 1.5m SPACING	14.00	Pcs
	TEMPORARY INVERT (IF REQUIRED)	SHOTCRETE	M30, ds=200mm	2.51	m^3
		WIRE MESH 150/150/6 mm	OUTER / INNER LAYER	18.56	m^2
BENCHING	EXCAVATION	ROUND LENGTH		0.80	m
		THEORETICAL EXCAVATION VOLUME		16.95	m^3
	SUPPORT	SHOTCRETE	M30, ds=300mm	1.50	m^3
		WIRE MESH 150/150/6 mm	OUTER / INNER LAYER	10.05	m^2
		SN BOLTS	Fy 200kN, 9m	5.0	Pcs
		LATTICE GIRDER	95 / 16 / 25, 1 per round	62.25	Kg
INVERT	EXCAVATION	ROUND LENGTH		0.80	m
		THEORETICAL EXCAVATION VOLUME		6.81	m^3
	SUPPORT	SHOTCRETE	M30, ds=300mm	2.35	m^3
		WIRE MESH 150/150/6 mm	OUTER LAYER	15.66	m^2
		LATTICE GIRDER	95 / 16 / 25, 1 per round	96.53	Kg



DETAIL AT - `B'
SCALE (A1) 1:10

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. MINIMUM EXCAVATION LINE SHALL INCLUDE DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.
7. FOR OTHER NOTE REFER DWG.NO-ACM-60598728-PKG7B-GE-GA-0003 & 0004[0]
8. DRILLING OF PROBE HOLES SHALL BE MANDATORY AS SPECIFIED IN THE TECHNICAL SPECIFICATION FOR ADOPTION OF SUPPORT SYSTEM SHOWN IN THIS DRAWING.
9. THE CONTRACTOR SHALL DRILL HOLES AROUND THE PERIPHERY OF THE EXCAVATION FOR DRAINING THE SURROUNDING ROCK.THE MINIMUM DIAMETER OF HOLES SHALL BE 57 MM OR AS DIRECTED BY THE ENGINEER. THE NUMBER OF HOLES, DEPTH, LOCATION AND INCLINATION OF HOLES SHALL DEPEND ON WATER INFLOW CONDITIONS AND INFLOW DISTRIBUTION AT THE FACE WHERE GROUTING IS PERFORMED.FOR ANY FURTHER DETAILS REGARDING PROBE DRILLING SECTION 14 & ANNEXURE B OF WORKS REQUIREMENTS SHOULD BE REFFERED.

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited गुणवत्ता, गति एवं पारदर्शिता (A Government of India Enterprise)

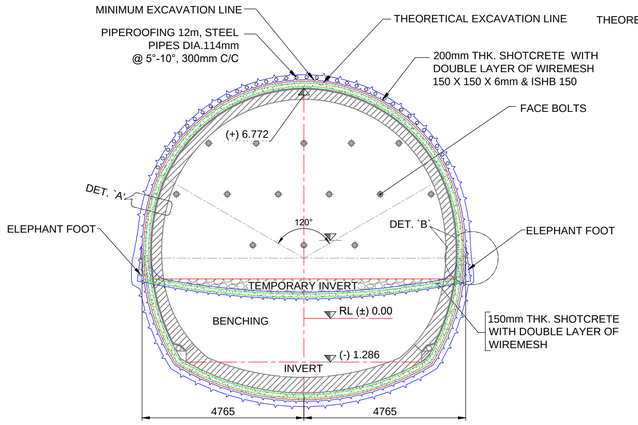
Project:
PACKAGE-7B
DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited | AECOM

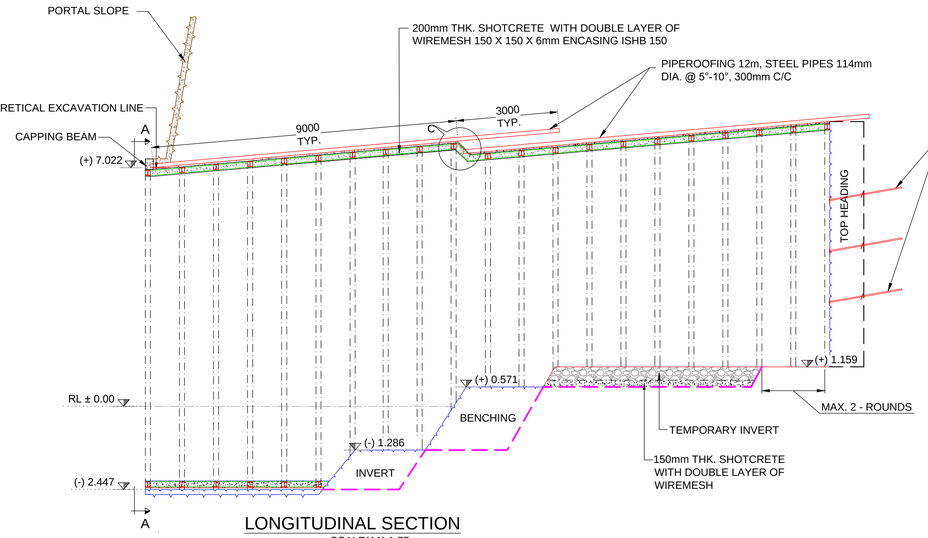
Yogendra	Eshita / Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

Title:
TUNNEL-13
MAIN TUNNEL - ROCK CLASS - C3 (WITH INVERT)
TYPICAL SUPPORT DETAILS
(SHEET 1 OF 1)

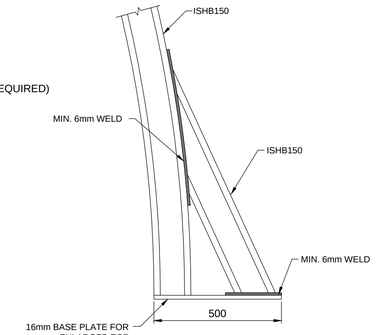
Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-MT-ES-0105	AS SHOWN	0



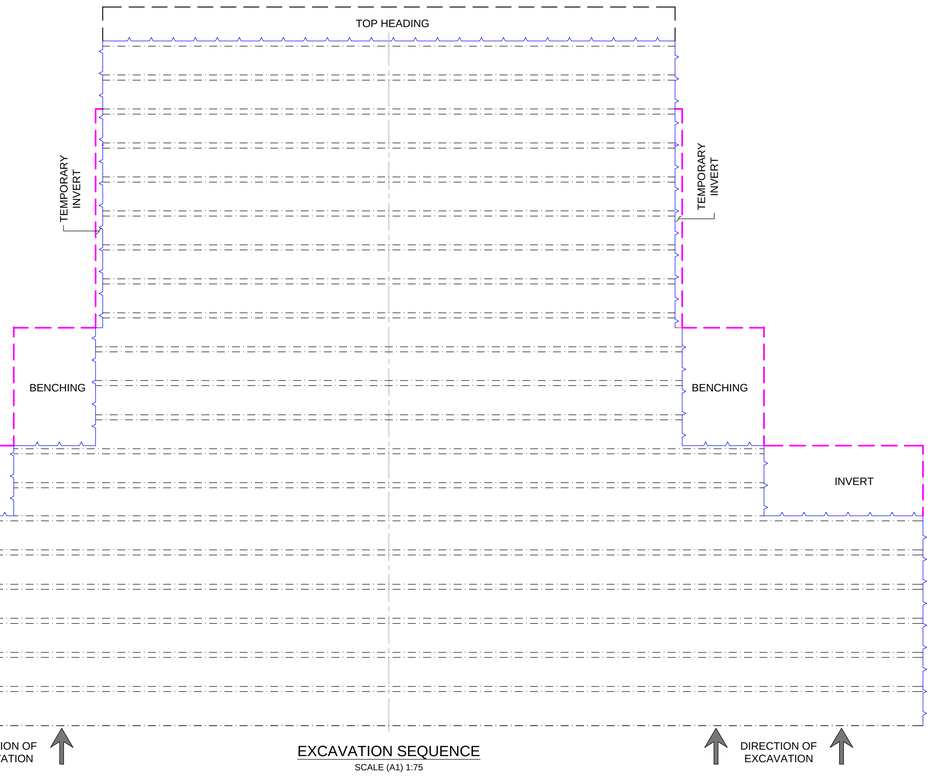
SUPPORT CLASS-P (SECTION A)
SCALE(A1) 1:75



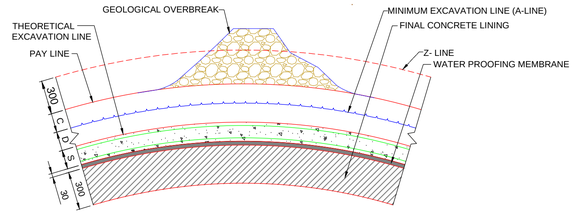
LONGITUDINAL SECTION
SCALE(A1) 1:75



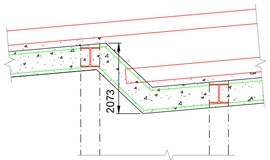
DETAIL AT - `B'
SCALE (A1) N.T.S



EXCAVATION SEQUENCE
SCALE (A1) 1:75



DETAIL AT - `A'
SCALE (A1) 1: 20



DETAIL AT - `C'
SCALE (A1) 1: 20

EXCAVATION & SUPPORT QUANTITIES / METER FOR MAIN TUNNEL SUPPORT CLASS P				
MAXIMUM DEFORMATION TOLERANCE		D	50	mm
TOP HEADING	EXCAVATION	ROUND LENGTH	1	m
		THEORETICAL EXCAVATION VOLUME	49.93	m^3
	SUPPORT	SHOTCRETE M30 ds=200mm	3.39	m^2
		WIRE MESH 150x150/6 mm OUTER / INNER LAYER	33.87	m^2
		STEEL RIB ISHB 150 1m SPACING	585.96	Kg
		PIPE ROOFING (OPTIONAL) Ø114.3 8mm THK., C/C=300, L=12m	38.00	Pcs.
		FACE SUPPORT (GLASS FIBER BOLTS) (IF REQUIRED) Ø32 12m , 1.5m SPACING	14.00	Pcs
	TEMPORARY INVERT (IF REQUIRED)	SHOTCRETE M30 ds=150mm	2.51	m^3
		WIRE MESH 150x150/6 mm OUTER / INNER LAYER	18.35	m^2
BENCHING	EXCAVATION	ROUND LENGTH	1.00	m
		THEORETICAL EXCAVATION VOLUME	17.43	m^3
	SUPPORT	SHOTCRETE M30 ds=200mm	1.00	m^3
		WIRE MESH 150x150/6 mm OUTER / INNER LAYER	10.03	m^2
		STEEL RIB ISHB 150, 1m SPACING	173.22	Kg
INVERT	EXCAVATION	ROUND LENGTH	1.00	m
		THEORETICAL EXCAVATION VOLUME	6.19	m^3
	SUPPORT	SHOTCRETE M30 ds=200mm	1.53	m^3
		WIRE MESH 150x150/6 mm OUTER / INNER LAYER	15.34	m^2
		STEEL RIB ISHB 150, 1m SPACING	265.62	Kg

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. MINIMUM EXCAVATION LINE SHALL INCLUDE DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.
7. FOR OTHER NOTE REFER DWG.NO-ACM-60598728-PKG7B-GE-GA-0003 & 0004[0]
8. DRILLING OF PROBE HOLES SHALL BE MANDATORY AS SPECIFIED IN THE TECHNICAL SPECIFICATION FOR ADOPTION OF SUPPORT SYSTEM SHOWN IN THIS DRAWING.
9. THE CONTRACTOR SHALL DRILL HOLES AROUND THE PERIPHERY OF THE EXCAVATION FOR DRAINING THE SURROUNDING ROCK.THE MINIMUM DIAMETER OF HOLES SHALL BE 57 MM OR AS DIRECTED BY THE ENGINEER. THE NUMBER OF HOLES, DEPTH, LOCATION AND INCLINATION OF HOLES SHALL DEPEND ON WATER INFLOW CONDITIONS AND INFLOW DISTRIBUTION AT THE FACE WHERE GROUTING IS PERFORMED.FOR ANY FURTHER DETAILS REGARDING PROBE DRILLING SECTION 14 & ANNEXURE B OF WORKS REQUIREMENTS SHOULD BE REFFERED.

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited गुणवत्ता, गति एवं पारदर्शिता (A Government of India Enterprise)

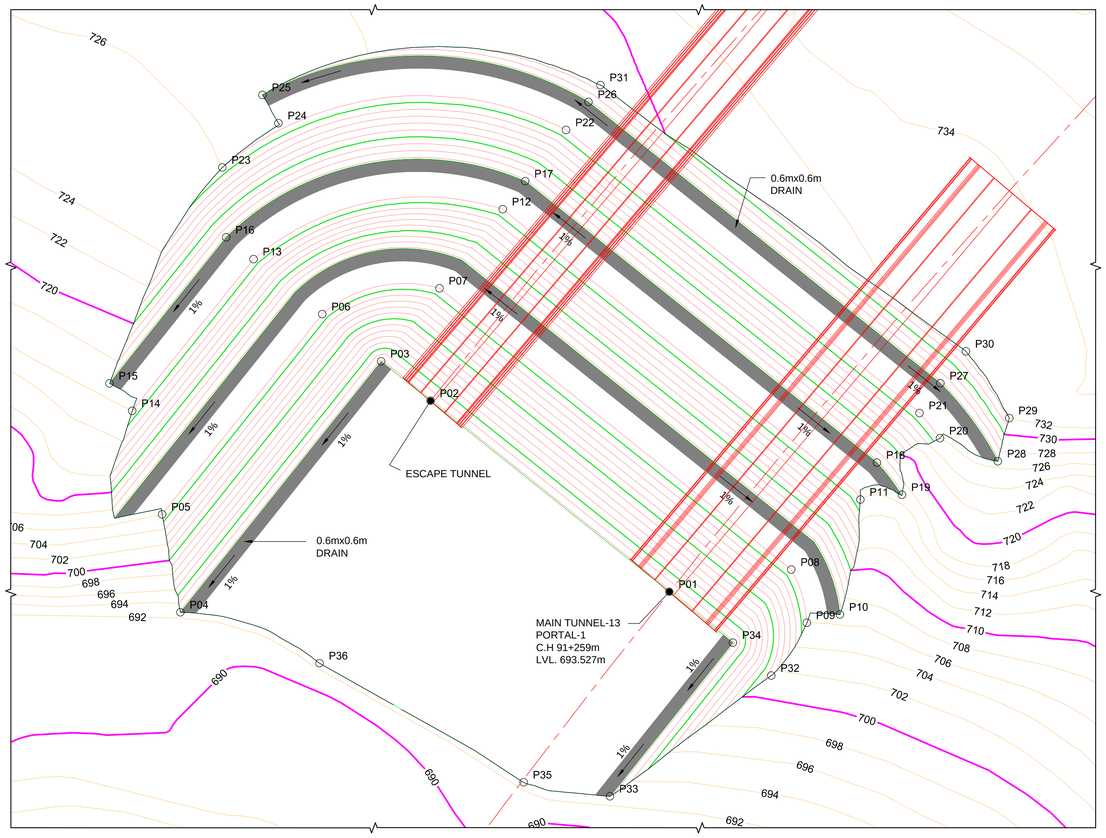
Project:
PACKAGE-7B
DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited | AECOM

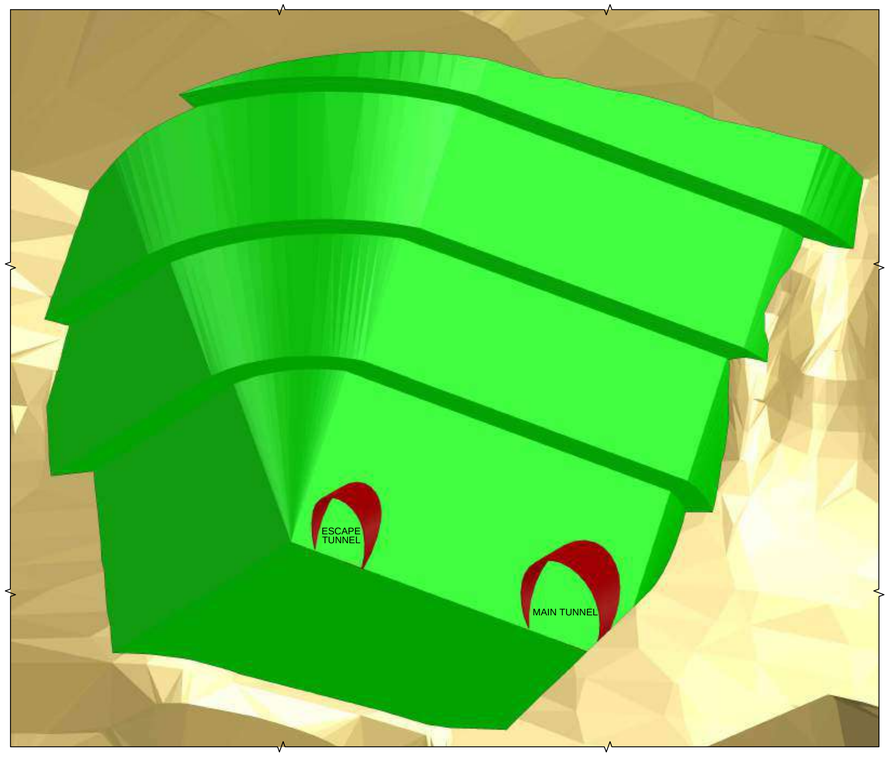
Yogendra	Eshita / Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

Title:
TUNNEL-13
MAIN TUNNEL - ROCK CLASS - P (WITH INVERT)
TYPICAL SUPPORT DETAILS
(SHEET 1 OF 1)

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-MT-ES-0106	AS SHOWN	0

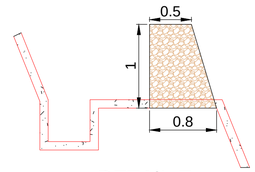


EXCAVATION PLAN
SCALE : 1:250

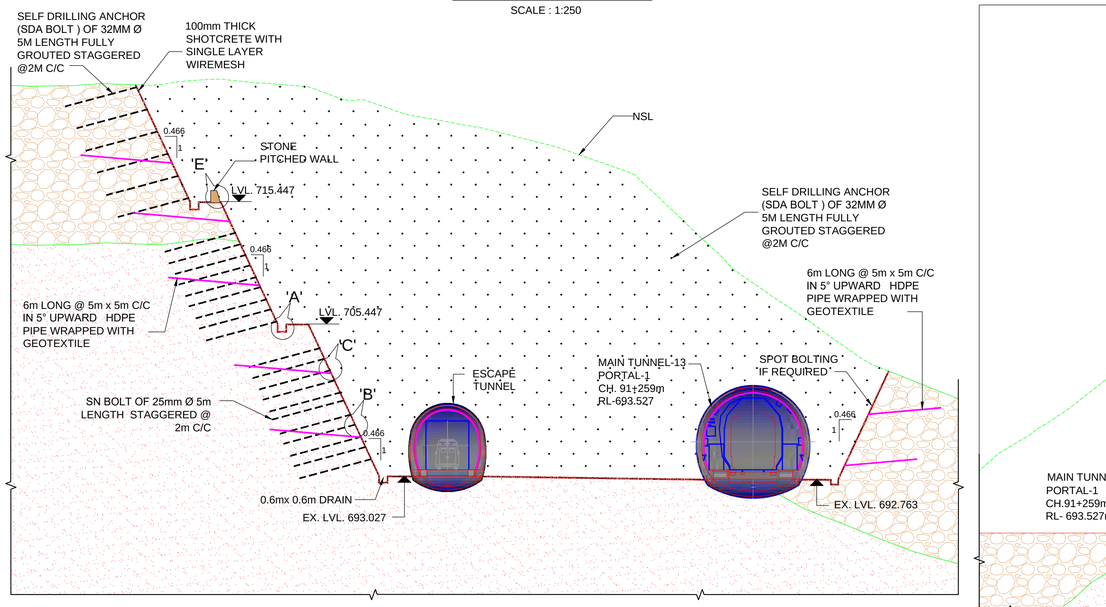


PORTAL-1 - 3D VIEW
SCALE : 1:250

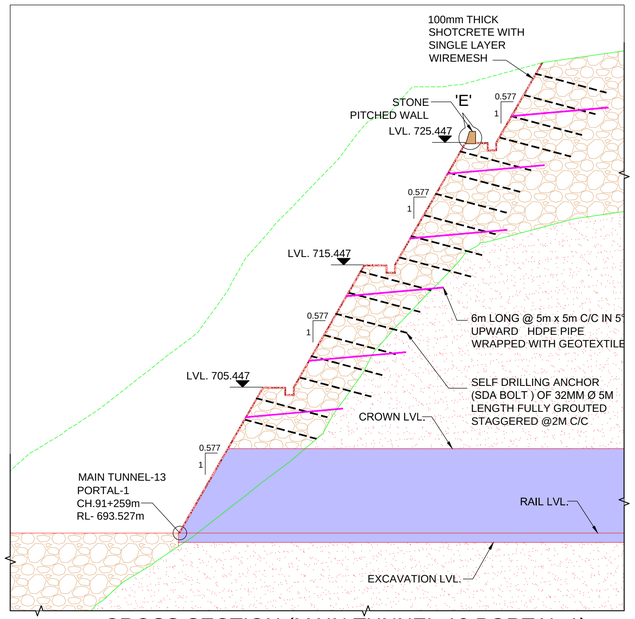
COORDINATES		
POINTS	EASTING	NORTHING
P01	301308.498	3349248.354
P02	301288.972	3349263.968
P03	301284.938	3349267.194
P04	301268.525	3349246.670
P05	301267.032	3349254.679
P06	301280.120	3349271.047
P07	301289.709	3349273.161
P08	301318.474	3349250.159
P09	301319.746	3349245.816
P10	301322.447	3349246.491
P11	301324.116	3349255.888
P12	301294.877	3349279.624
P13	301274.499	3349275.542
P14	301264.581	3349263.139
P15	301262.725	3349265.386
P16	301272.270	3349277.324
P17	301296.710	3349281.915
P18	301325.475	3349258.913
P19	301327.524	3349256.282
P20	301330.630	3349260.904
P21	301328.954	3349262.962
P22	301300.060	3349286.104
P23	301271.950	3349283.037
P24	301276.544	3349286.660
P25	301275.240	3349288.970
P26	301301.893	3349288.398
P27	301330.658	3349265.395
P28	301335.363	3349259.022
P29	301336.291	3349262.550
P30	301332.747	3349268.007
P31	301302.866	3349289.777
P32	301316.833	3349241.498
P33	301303.653	3349231.625
P34	301313.703	3349244.192
P35	301296.585	3349232.771
P36	301279.904	3349242.508



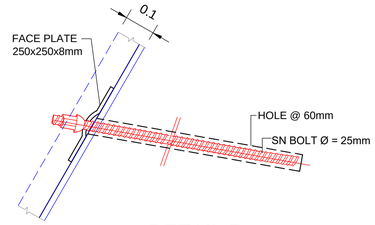
DETAIL E
SCALE : 1:10



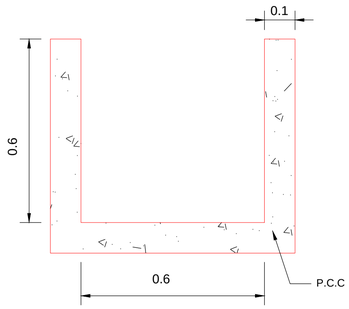
LONGITUDINAL (MAIN TUNNEL-13 PORTAL-1)
SCALE : 1:250



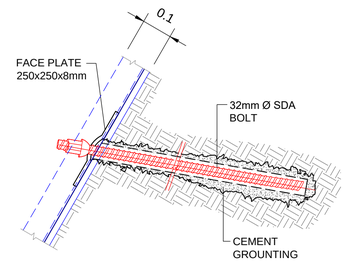
CROSS SECTION (MAIN TUNNEL-13 PORTAL-1)
SCALE : 1:250



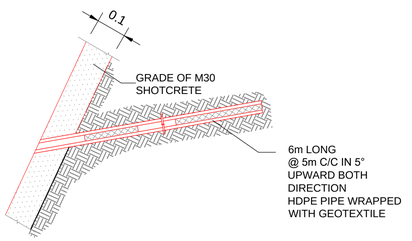
DETAIL B
SCALE : 1:10



DETAIL A
SCALE : 1:10



DETAIL D
SCALE : 1:10



DETAIL C
SCALE : 1:10

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

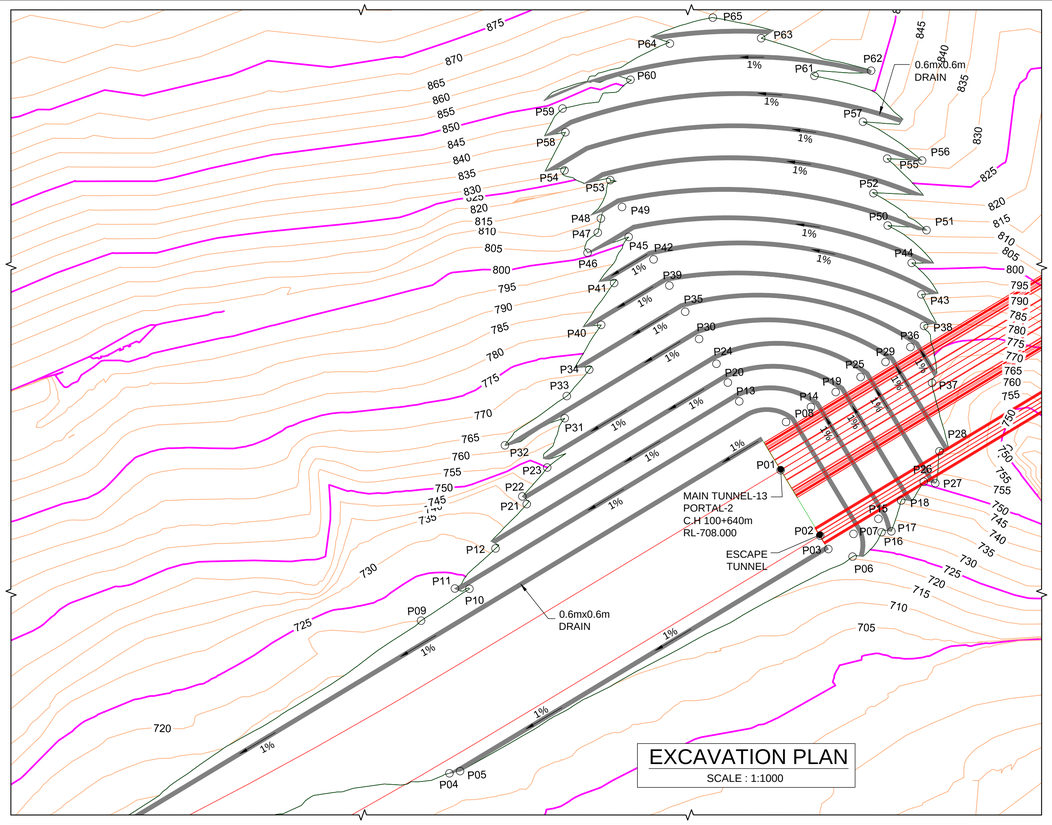
DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL	AECOM		
Yogendra	Eshita / Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

Title:

TUNNEL-13
SUPPORT SYSTEM FOR PORTAL-1

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-MT-PD-0108	AS SHOWN	0

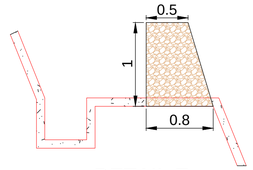


EXCAVATION PLAN
SCALE : 1:1000

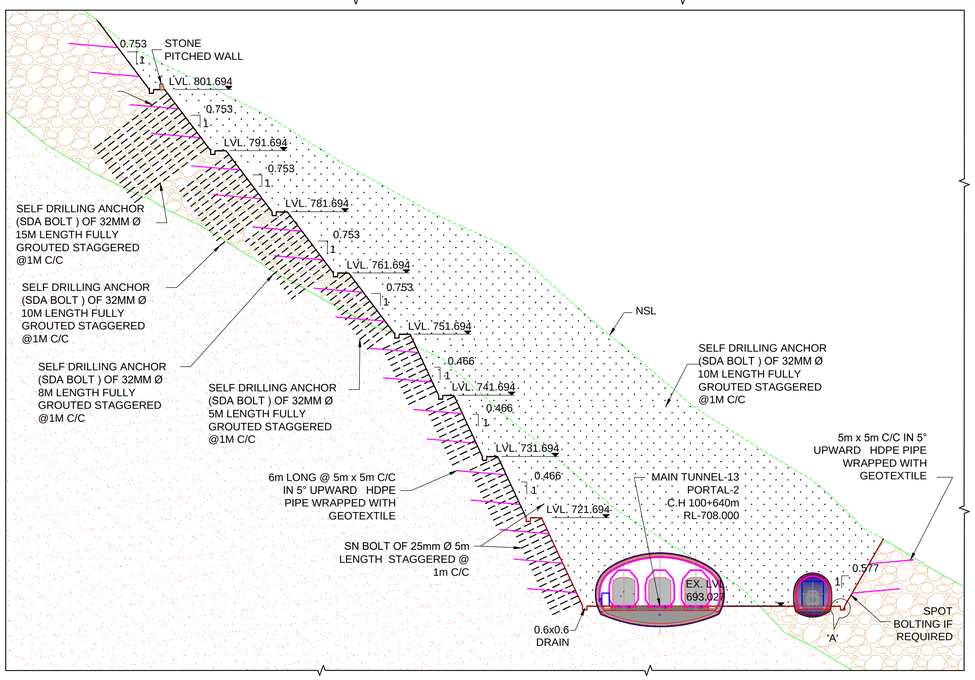
PORTAL-2 - 3D VIEW
SCALE : 1:1000

COORDINATES		
POINTS	EASTING	NORTHING
P01	309597.674	3353400.873
P02	309582.466	3353420.697
P03	309579.319	3353424.796
P04	309694.243	3353511.489
P05	309690.864	3353510.410
P06	309571.127	3353426.367
P07	309571.676	3353418.930
P08	309597.691	3353385.034
P09	309709.056	3353462.944
P10	309694.490	3353450.810
P11	309699.233	3353451.248
P12	309687.520	3353436.745
P13	309613.657	3353380.057
P14	309590.154	3353379.250
P15	309564.140	3353413.146
P16	309562.630	3353417.383
P17	309559.474	3353416.716
P18	309557.376	3353406.358
P19	309582.618	3353373.466
P20	309618.041	3353374.346
P21	309678.979	3353421.167
P22	309680.670	3353418.849
P23	309673.635	3353408.531
P24	309622.424	3353368.634
P25	309575.082	3353367.682
P26	309550.728	3353399.426
P27	309546.924	3353399.468
P28	309546.770	3353388.972
P29	309567.545	3353361.898
P30	309628.970	3353361.254

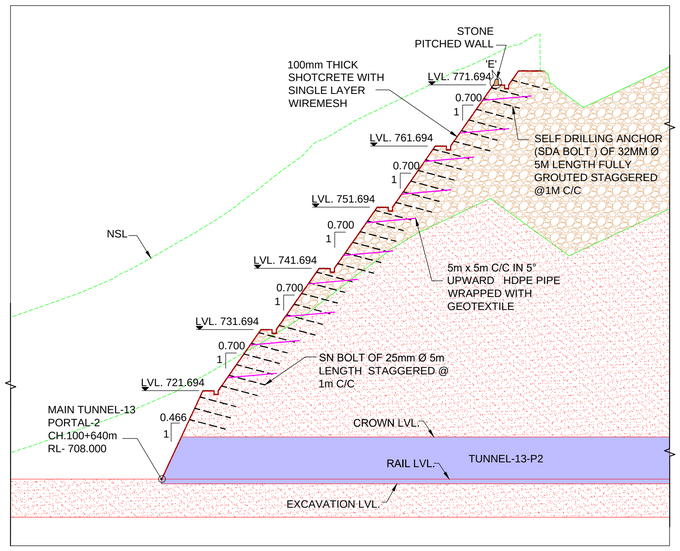
COORDINATES		
POINTS	EASTING	NORTHING
P31	309669.748	3353391.891
P32	309688.181	3353402.887
P33	309669.881	3353384.596
P34	309663.569	3353375.200
P35	309634.505	3353352.893
P36	309560.009	3353356.115
P37	309551.647	3353366.988
P38	309556.364	3353348.750
P39	309640.593	3353344.960
P40	309661.320	3353360.212
P41	309658.639	3353346.117
P42	309646.681	3353337.027
P43	309558.362	3353338.601
P44	309562.670	3353328.734
P45	309655.605	3353330.614
P46	309668.374	3353337.263
P47	309665.794	3353330.375
P48	309665.278	3353325.671
P49	309658.858	3353321.162
P50	309571.824	3353317.483
P51	309559.041	3353317.566
P52	309577.610	3353307.495
P53	309663.640	3353312.829
P54	309678.902	3353311.366
P55	309574.417	3353295.731
P56	309563.016	3353295.116
P57	309583.647	3353284.641
P58	309680.003	3353298.917
P59	309681.757	3353291.325
P60	309660.752	3353279.474
P61	309601.086	3353271.499
P62	309582.849	3353267.745
P63	309619.757	3353261.241
P64	309649.233	3353266.296
P65	309636.269	3353256.279



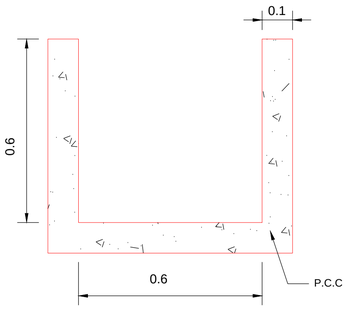
DETAIL E
SCALE : 1:10



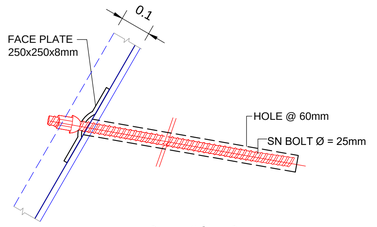
LONGITUDINAL (MAIN TUNNEL-13 PORTAL-2)
SCALE : 1:200



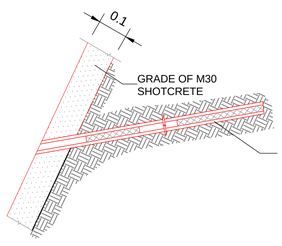
CROSS SECTION (MAIN TUNNEL-13 PORTAL-2)
SCALE : 1:200



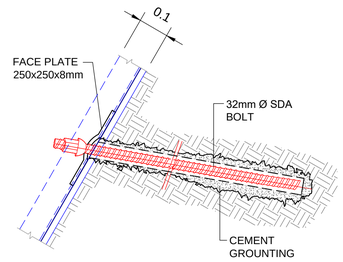
DETAIL A
SCALE : 1:10



DETAIL B
SCALE : 1:10



DETAIL C
SCALE : 1:10



DETAIL D
SCALE : 1:10

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited | AECOM

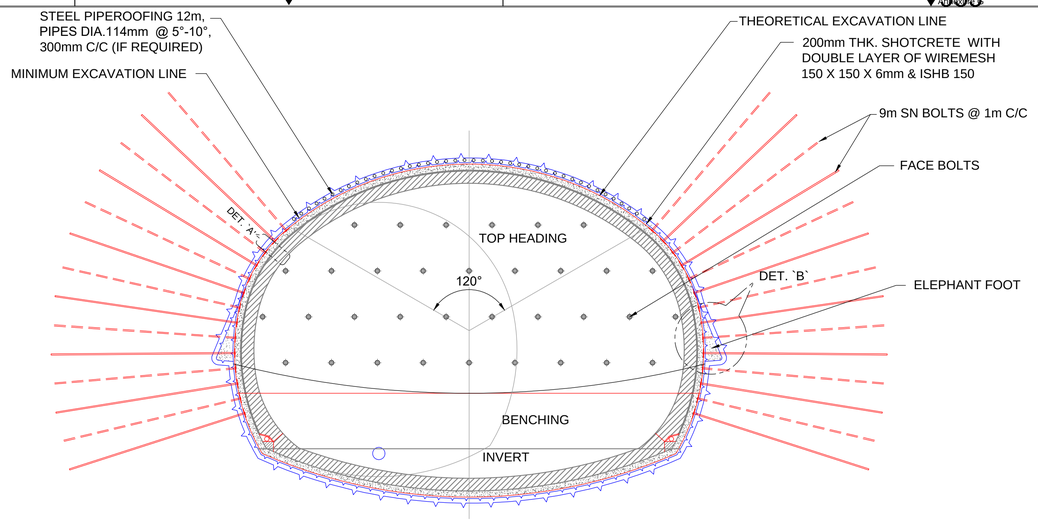
Yogendra	Eshita / Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

Title:

TUNNEL-13

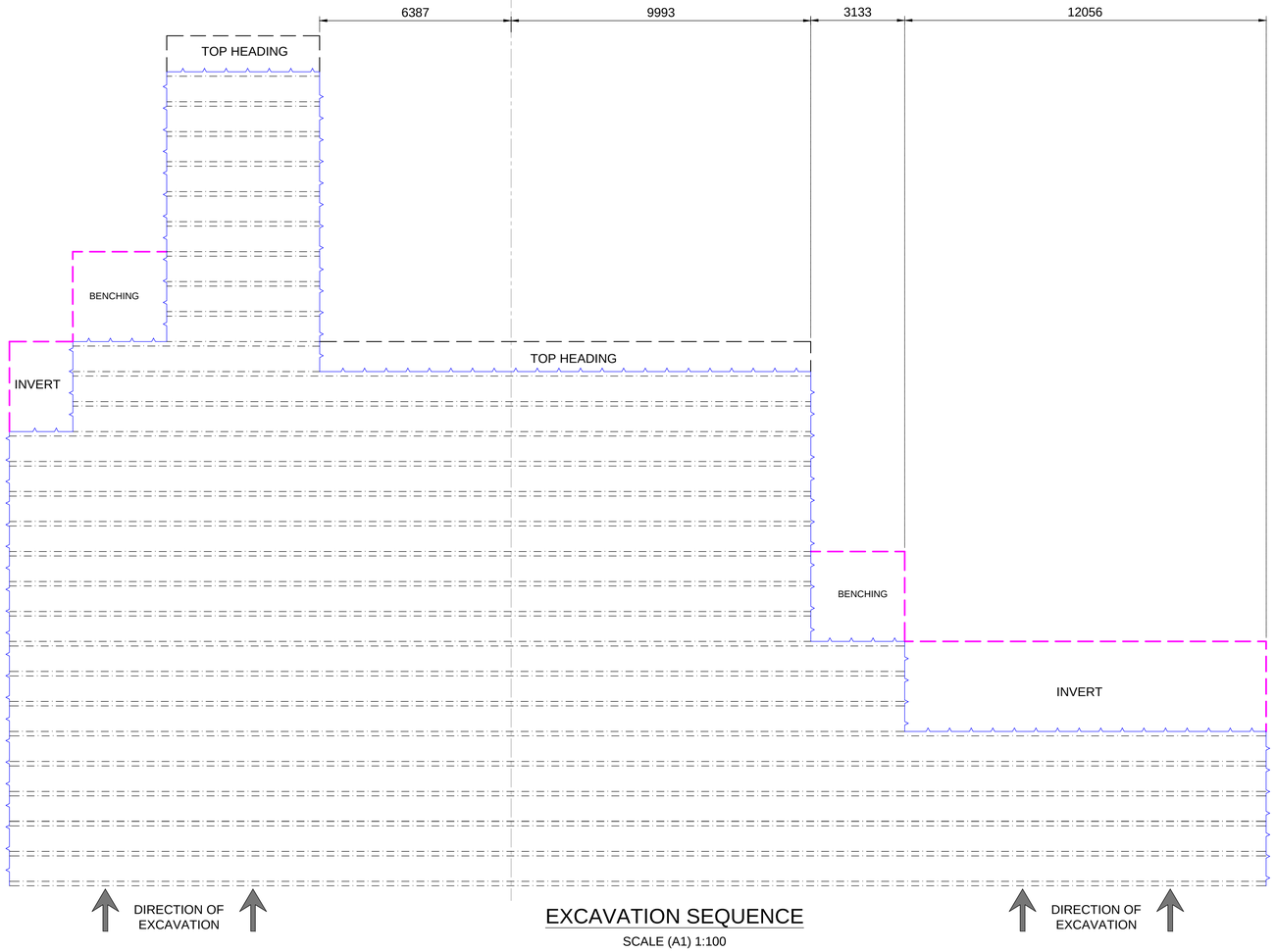
SUPPORT SYSTEM FOR PORTAL-1

Drawing No.	Scale	Rev.
ACM-60603749-PKG6-MT-PD-0109	AS SHOWN	0



SUPPORT CLASS-P (SECTION A)

SCALE(A1) 1:100



EXCAVATION SEQUENCE

SCALE (A1) 1:100

TENDER DRAWING

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. MINIMUM EXCAVATION LINE SHALL INCLUDE DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.
7. FOR OTHER NOTE REFER DWG.NO-ACM-60598728-PKG7B-GE-GA-0003 & 0004[0]
8. DRILLING OF PROBE HOLES SHALL BE MANDATORY AS SPECIFIED IN THE TECHNICAL SPECIFICATION FOR ADOPTION OF SUPPORT SYSTEM SHOWN IN THIS DRAWING.
9. THE CONTRACTOR SHALL DRILL HOLES AROUND THE PERIPHERY OF THE EXCAVATION FOR DRAINING THE SURROUNDING ROCK.THE MINIMUM DIAMETER OF HOLES SHALL BE 57 MM OR AS DIRECTED BY THE ENGINEER. THE NUMBER OF HOLES, DEPTH, LOCATION AND INCLINATION OF HOLES SHALL DEPEND ON WATER INFLOW CONDITIONS AND INFLOW DISTRIBUTION AT THE FACE WHERE GROUTING IS PERFORMED.FOR ANY FURTHER DETAILS REGARDING PROBE DRILLING SECTION 14 & ANNEXURE B OF WORKS REQUIREMENTS SHOULD BE REFFERED.

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited गुणवत्ता, गति एवं पारदर्शिता (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

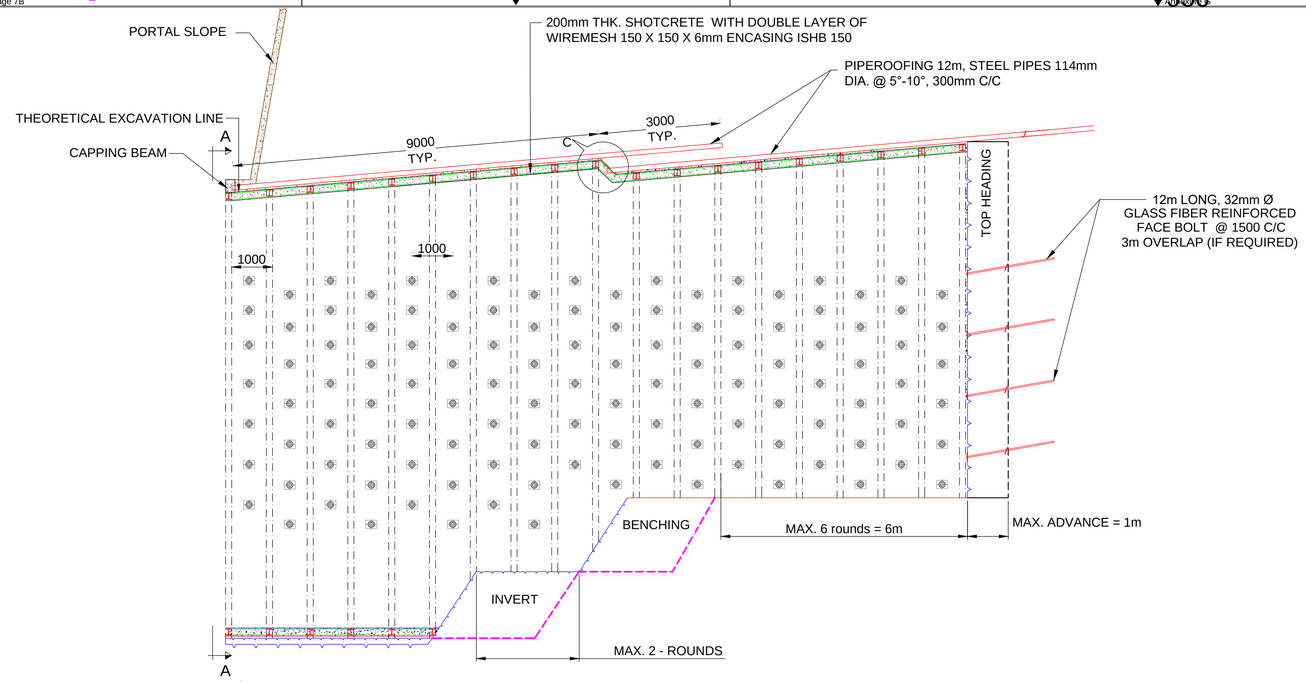
RVNL Rail Vikas Nigam Limited | AECOM

RAJESH	Eshita / Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

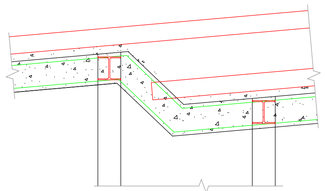
Title:

TUNNEL-13
DOUBLE SECTION - ROCK CLASS - P (WITH INVERT)
TYPICAL SUPPORT DETAILS
(SHEET 1)

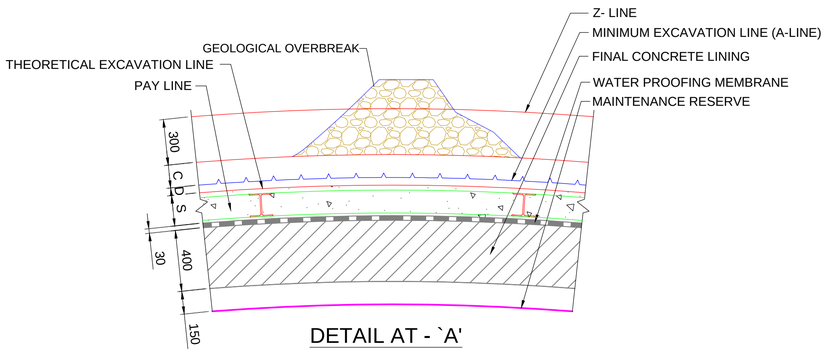
Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-MT-ES-0110	AS SHOWN	0



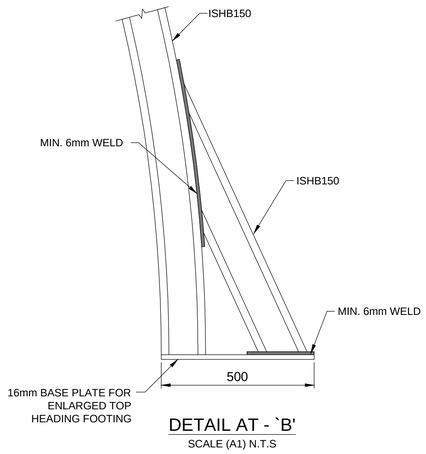
LONGITUDINAL SECTION
SCALE(A1) 1:75



DETAIL AT - `C'
SCALE (A1) 1: 20



DETAIL AT - `A'
SCALE (A1) 1: 20



DETAIL AT - `B'
SCALE (A1) N.T.S

EXCAVATION & SUPPORT QUANTITIES/ METER FOR DOUBLE TRACK TUNNEL SUPPORT CLASS P

				DRIFT-1	DRIFT-2	
MAXIMUM DEFORMATION TOLERANCE			D	50	50	mm
TOP HEADING	EXCAVATION	ROUND LENGTH		1	1	m
		THEORETICAL EXCAVATION VOLUME		49.85	43.06	m^3
	SUPPORT	SHOTCRETE	M30, ds=200mm	5.72	5.02	m^2
		WIRE MESH 150/150/5 mm	OUTER / INNER LAYER	51.85	44.45	m^2
		SN BOLTS	Fy 200kN, 9m 1m x 1m	5	5	
		STEEL RIB	ISHB 150, 1m SPACING	325.63	673.57	Kg
		PIPE ROOFING (OPTIONAL)	Ø114.3, 8mm THK., C/C=300, L=12m	0	42	Pcs.
		FACE SUPPORT (GLASS FIBER BOLTS) (IF REQUIRED)	Ø32, 12m , 1.5m SPACING	20	14	Pcs
BENCHING	EXCAVATION	ROUND LENGTH		1	1	m
		THEORETICAL EXCAVATION VOLUME		18.07	13.18	m^3
	SUPPORT	SHOTCRETE	M30, ds=200mm	2.45	1.73	m^2
		WIRE MESH 150/150/6 mm	OUTER / INNER LAYER	24.49	17.29	m^2
		SN BOLTS	Fy 200kN, 9m 1m x 1m	2	2	
		STEEL RIB	ISHB 150, 1m SPACING	99.51	99.51	Kg
INVERT	EXCAVATION	ROUND LENGTH		1	1	m
		THEORETICAL EXCAVATION VOLUME		6.32	9.50	m^3
	SUPPORT	SHOTCRETE	M30, ds=200mm	1.56	2.14	m^2
		WIRE MESH 150/150/6 mm	OUTER / INNER LAYER	15.70	21.39	m^2
		STEEL RIB	ISHB 150, 1m SPACING	115.82	367.22	Kg

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. MINIMUM EXCAVATION LINE SHALL INCLUDE DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.
7. FOR OTHER NOTE REFER DWG.NO-ACM-60598728-PKG7B-GE-GA-0003 & 0004[0]
8. DRILLING OF PROBE HOLES SHALL BE MANDATORY AS SPECIFIED IN THE TECHNICAL SPECIFICATION FOR ADOPTION OF SUPPORT SYSTEM SHOWN IN THIS DRAWING.
9. THE CONTRACTOR SHALL DRILL HOLES AROUND THE PERIPHERY OF THE EXCAVATION FOR DRAINING THE SURROUNDING ROCK.THE MINIMUM DIAMETER OF HOLES SHALL BE 57 MM OR AS DIRECTED BY THE ENGINEER. THE NUMBER OF HOLES, DEPTH, LOCATION AND INCLINATION OF HOLES SHALL DEPEND ON WATER INFLOW CONDITIONS AND INFLOW DISTRIBUTION AT THE FACE WHERE GROUTING IS PERFORMED.FOR ANY FURTHER DETAILS REGARDING PROBE DRILLING SECTION 14 & ANNEXURE B OF WORKS REQUIREMENTS SHOULD BE REFFERED.

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

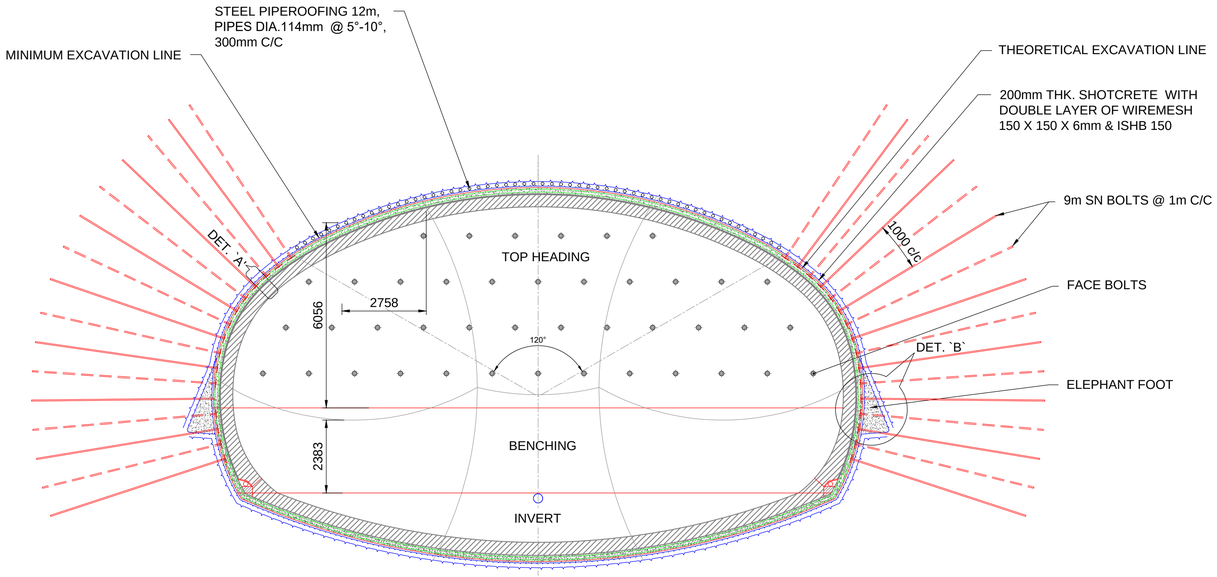
Project:
PACKAGE-7B
DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited | AECOM

RAJESH	Eshita / Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

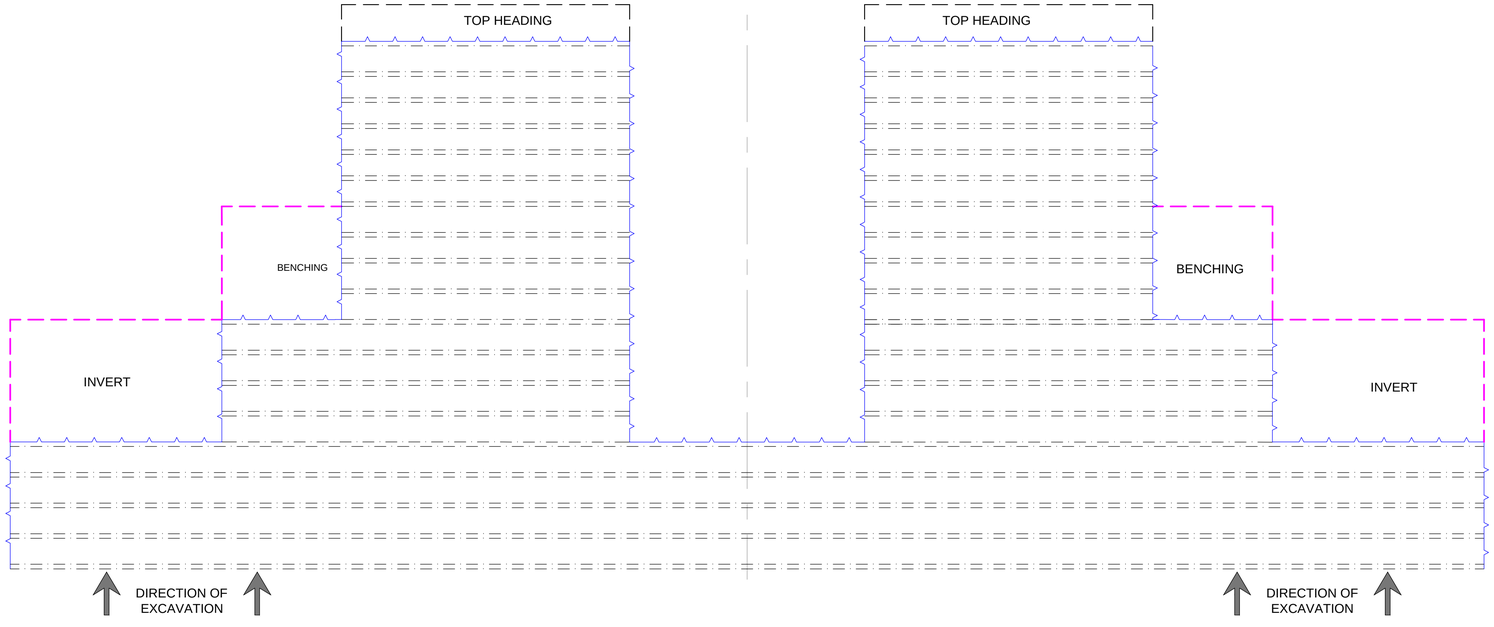
Title:
TUNNEL-13
DOUBLE SECTION - ROCK CLASS - P (WITH INVERT)
TYPICAL SUPPORT DETAILS
(SHEET 2)

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-MT-ES-0111	AS SHOWN	0



SUPPORT CLASS-P (SECTION A)

SCALE(A1) 1:100



EXCAVATION SEQUENCE

SCALE (A1) 1:100

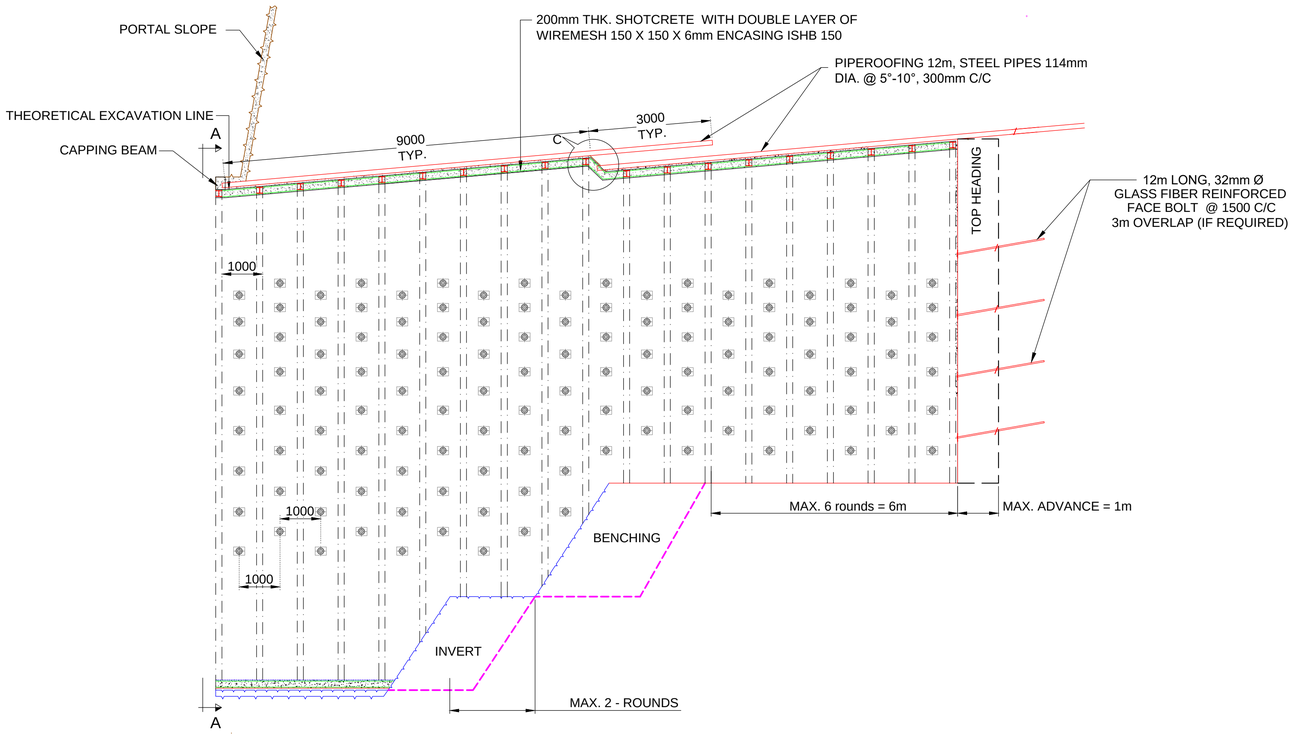
TENDER DRAWING

Design Consultant: AECOM	Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)	Project: PACKAGE-7B — DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.	RVNL Rail Vikas Nigam Limited / AECOM

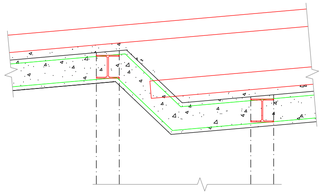
RAJESH	Eshita / Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

Title: TUNNEL-13
TRIPLE SECTION - ROCK CLASS - P (WITH INVERT)
TYPICAL SUPPORT DETAILS
(SHEET 1 OF 2)

Drawing No.	Scale	Rev.
ACM-60598728-PKG-7B-MT-ES-0112	AS SHOWN	0

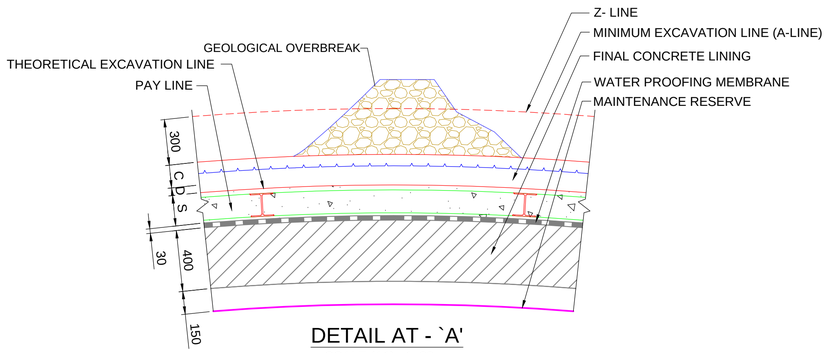


LONGITUDINAL SECTION
SCALE(A1) 1:75

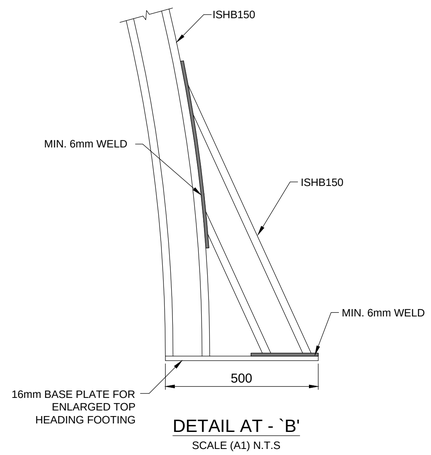


DETAIL AT - `C'
SCALE (A1) 1: 20

EXCAVATION & SUPPORT QUANTITIES / METER FOR TRIPLE TRACK TUNNEL SUPPORT CLASS P							
				LHS DRIFT	CENTRAL DRIFT	RHS DRIFT	
MAXIMUM DEFORMATION TOLERANCE			D	50	50	50	mm
TOP HEADING	EXCAVATION	ROUND LENGTH		1	1	1	m
		THEORETICAL EXCAVATION VOLUME		43.64	34.27	43.64	m^3
	SUPPORT	SHOTCRETE	M30, ds=200mm	4.88	1.51	4.88	m^3
		WIRE MESH 150/150/6 mm	OUTER / INNER LAYER	48.78	15.05	48.78	m^2
		SN BOLTS	Fy 200kN, 9m 1m x 1m	5		5	Pcs
		STEEL RIB	ISHB 150 1m SPACING	330.16	260.36	330.16	Kg
		PIPE ROOFING (OPTIONAL IF REQUIRED)	Ø114.3, 8mm THK , C/C=300, L=12m	15	26	15	Pcs
		FACE SUPPORT (GLASS FIBER BOLTS) (IF REQUIRED)	Ø32, 12m , 1.5m SPACING	15	12	15	Pcs
BENCHING	EXCAVATION	ROUND LENGTH		1	1	1	m
		THEORETICAL EXCAVATION VOLUME		23.69	14.25	23.69	m^3
	SUPPORT	SHOTCRETE	M30, ds=200mm	3.91		3.91	m^3
		WIRE MESH 150/150/6 mm	OUTER / INNER LAYER	28.49		28.49	m^2
		SN BOLTS	Fy 200kN, 9m 1m x 1m	3		3	Pcs
		STEEL RIB	ISHB 150, 1m SPACING	256.35		256.35	Kg
INVERT	EXCAVATION	ROUND LENGTH		1	1	1	m
		THEORETICAL EXCAVATION VOLUME		8.93	12.64	8.93	m^3
	SUPPORT	SHOTCRETE	M30, ds=200mm	1.74	1.32	1.74	m^3
		WIRE MESH 150/150/6 mm	OUTER / INNER LAYER	17.40	13.22	17.40	m^2
		STEEL RIB	ISHB 150, 1m SPACING	233.41	228.67	233.41	Kg



DETAIL AT - `A'
SCALE (A1) 1: 20



DETAIL AT - `B'
SCALE (A1) N.T.S

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. MINIMUM EXCAVATION LINE SHALL INCLUDE DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.
7. FOR OTHER NOTE REFER DWG.NO-ACM-60598728-PKG7B-GE-GA-0003 & 0004[0]
8. DRILLING OF PROBE HOLES SHALL BE MANDATORY AS SPECIFIED IN THE TECHNICAL SPECIFICATION FOR ADOPTION OF SUPPORT SYSTEM SHOWN IN THIS DRAWING.
9. THE CONTRACTOR SHALL DRILL HOLES AROUND THE PERIPHERY OF THE EXCAVATION FOR DRAINING THE SURROUNDING ROCK.THE MINIMUM DIAMETER OF HOLES SHALL BE 57 MM OR AS DIRECTED BY THE ENGINEER. THE NUMBER OF HOLES, DEPTH, LOCATION AND INCLINATION OF HOLES SHALL DEPEND ON WATER INFLOW CONDITIONS AND INFLOW DISTRIBUTION AT THE FACE WHERE GROUTING IS PERFORMED.FOR ANY FURTHER DETAILS REGARDING PROBE DRILLING SECTION 14 & ANNEXURE B OF WORKS REQUIREMENTS SHOULD BE REFFERED.

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

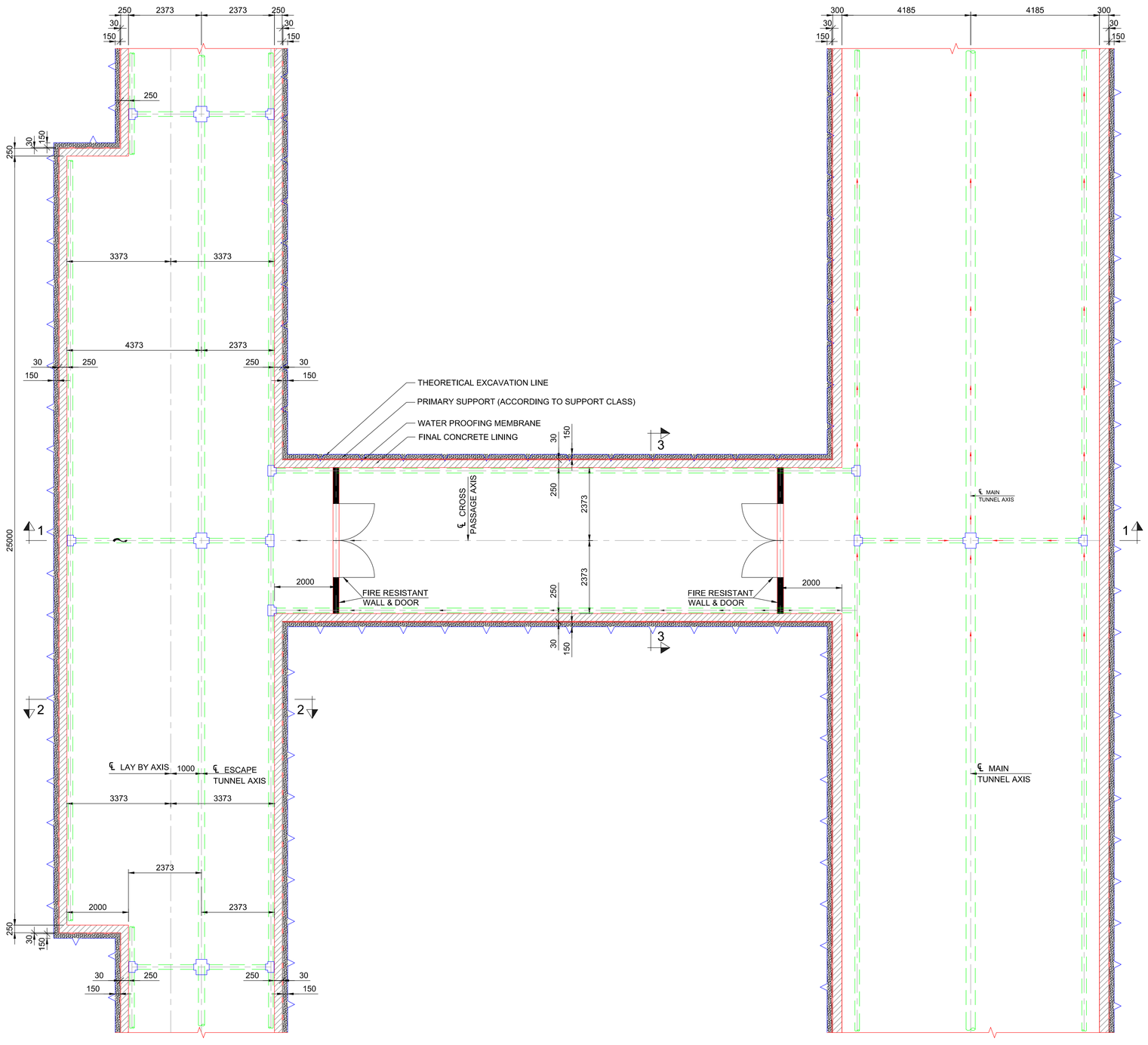
Project:
PACKAGE-7B
DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited | AECOM

RAJESH	Eshita / Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

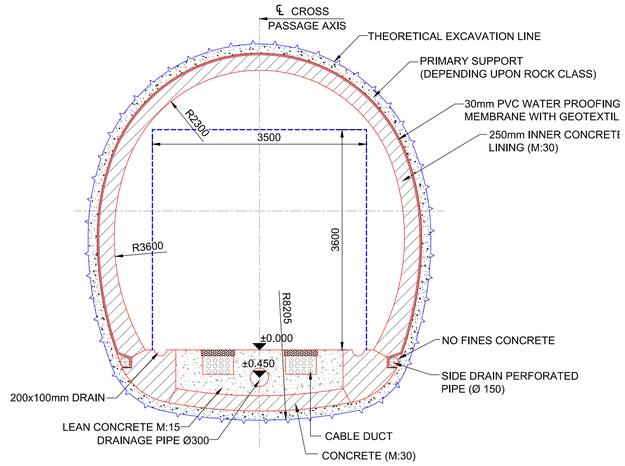
Title:
TUNNEL-13
TRIPLE SECTION - ROCK CLASS - P (WITH INVERT)
TYPICAL SUPPORT DETAILS
(SHEET 1 OF 2)

Drawing No.	Scale	Rev.
ACM-60598728-PKG-7B-MT-ES-0113	AS SHOWN	0



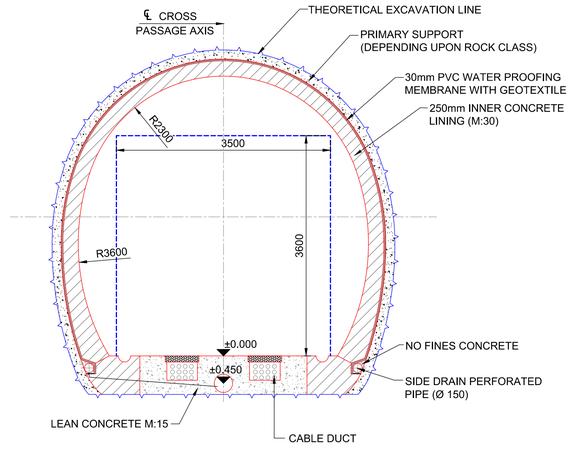
JUNCTION PLAN AT CROSS PASSAGE BETWEEN MAIN TUNNEL & ESCAPE TUNNEL WITH LAY BY

SCALE(A1) 1:75



SECTION 3 - 3
CROSS PASSAGE WITH INVERT

SCALE(A1) 1:50



SECTION 3 - 3
CROSS PASSAGE WITHOUT INVERT

SCALE(A1) 1:50

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. EXCAVATION LINE SHOULD INCLUDE CONSTRUCTION & DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.
7. READ THIS DRAWING TO BE CONJUNCTION WITH DRAWING NO.- ACM-60598728-PKG7B-CP-CS-0182[A]

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

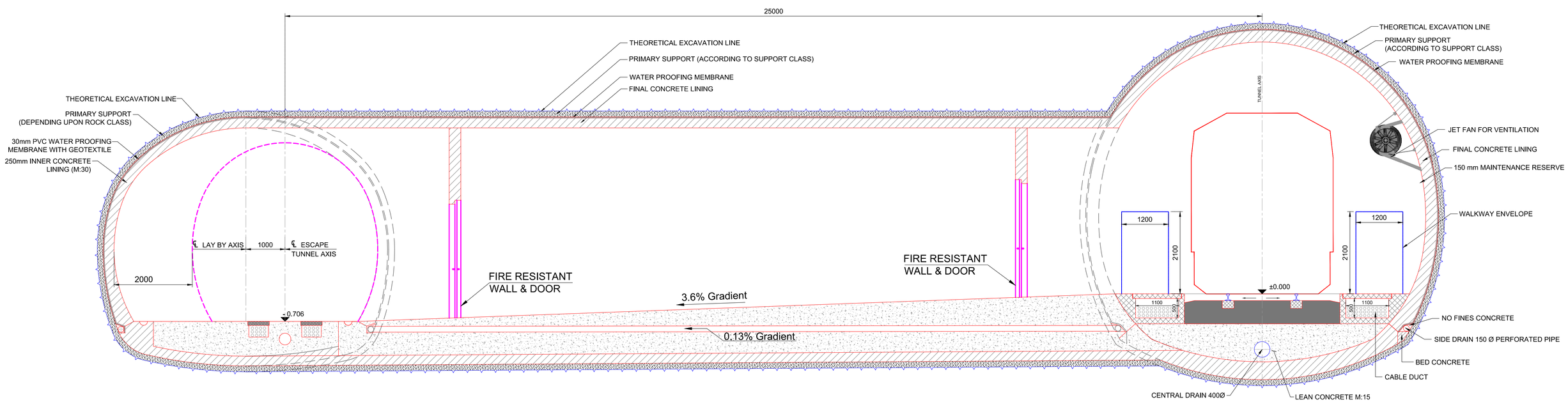
DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited | AECOM

Debasis Bag	Eshita Mishra	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

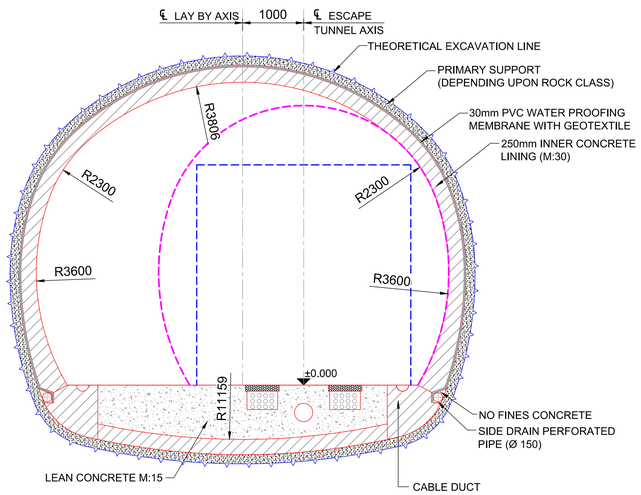
Title: TUNNEL-13 TYPICAL CROSS SECTION & PLAN FOR CROSS PASSAGE WITH TUNNEL (SHEET 1 OF 1)

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-CP-CS-0181	AS SHOWN	0



SECTION 1-1

SCALE(A1) 1:50



SECTION 2 - 2
TYPICAL CROSS SECTION OF LAY BY TUNNEL(WITH INVERT)

SCALE(A1) 1:50

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. EXCAVATION LINE SHOULD INCLUDE CONSTRUCTION & DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.
7. READ THIS DRAWING TO BE CONJUNCTION WITH DRAWING NO.- ACM-60598728-PKG7B-CP-CS-0181[A]

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

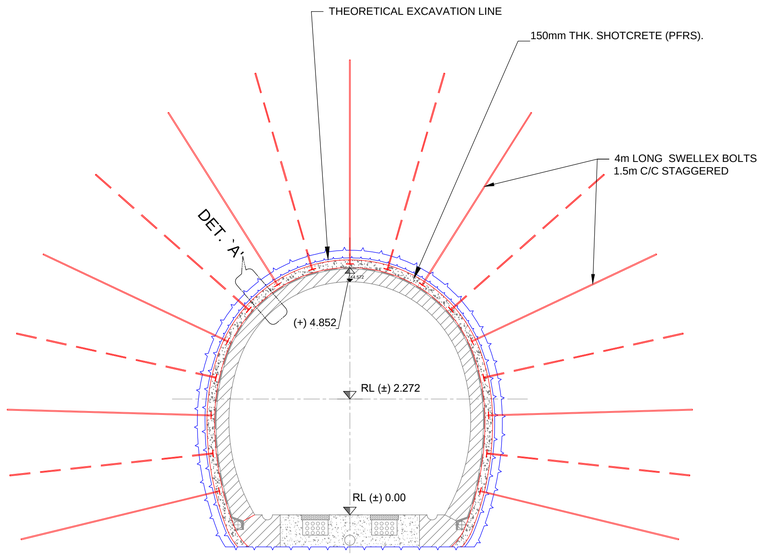
DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited | AECOM

Debasis Bag	Eshita Mishra	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

Title: TUNNEL-13 TYPICAL CROSS SECTION & PLAN FOR CROSS PASSAGE WITH TUNNEL (SHEET 1 OF 1)

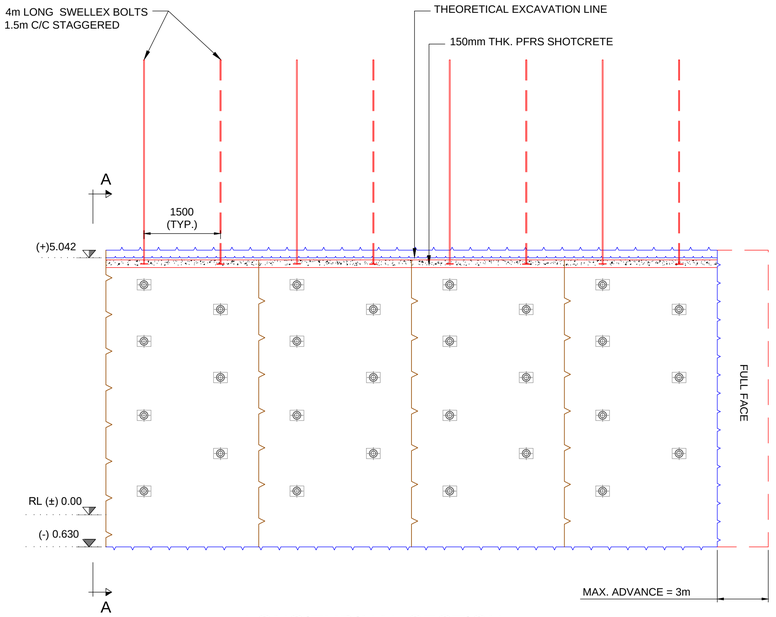
Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-CP-CS-0182	AS SHOWN	0



FINSHED AREA = 18.53 m²
EXCAVATED AREA (WITH SHOTCRETE THICKNESS OF 150MM) = 27.12M²

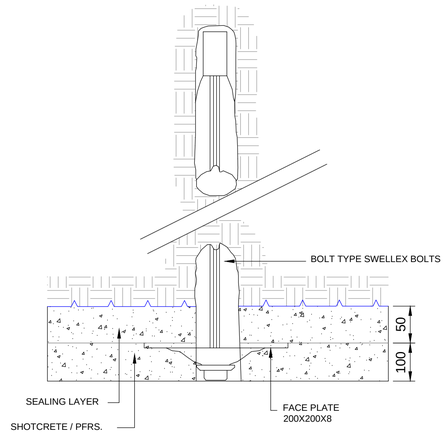
CROSS PASSAGE SECTION (WITH OUT INVERT ARCH) B1 CLASS

SCALE(A1) 1:60

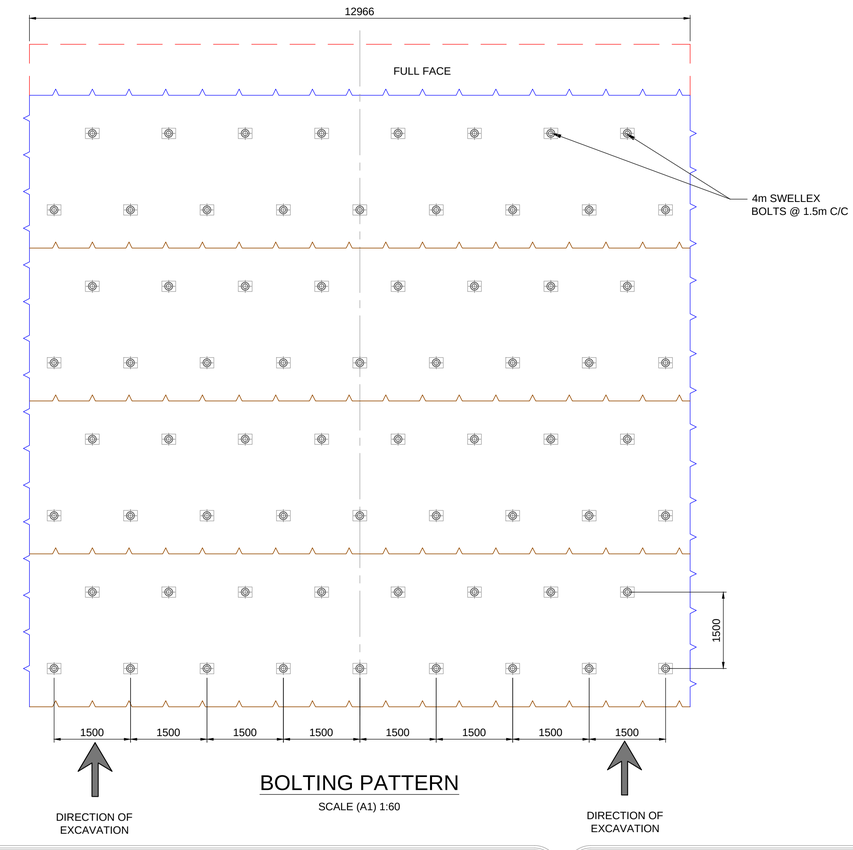


LONGITUDINAL SECTION

SCALE(A1) 1:60

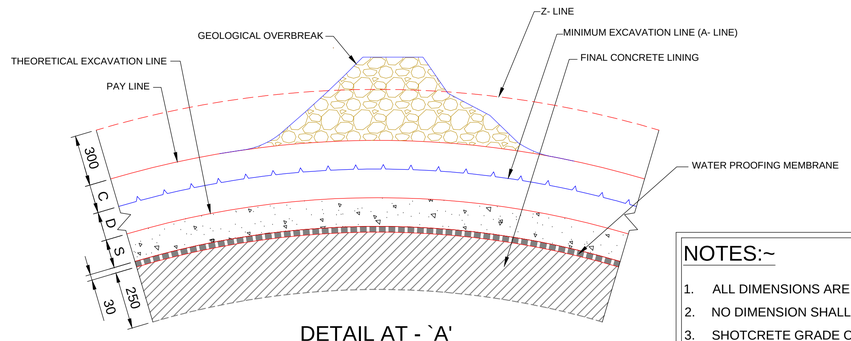


DETAIL OF BOLTS



BOLTING PATTERN

SCALE (A1) 1:60



DETAIL AT - `A'

SCALE (A1) 1: 20

EXCAVATION & SUPPORT QUANTITIES / METER FOR CROSS PASSAGE SUPPORT CLASS B1					
MAXIMUM DEFORMATION TOLERANCE			D	40	mm
FULL FACE EXCAVATION	EXCAVATION	ROUND LENGTH		3	m
		THEORETICAL EXCAVATION VOLUME		27.72	m^3
	SUPPORT	SHOTCRETE (PFRS)	M30, ds=150mm	2.15	m^2
		SWELLEX BOLTS	Fy 200kN, 4m 1.5m x 1.5m	6	Pcs

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. MINIMUM EXCAVATION LINE SHALL INCLUDE DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.
7. FOR OTHER NOTE REFER DWG.NO-ACM-60603749-PKG7B-GE-GA-0003 & 0004[0]
8. DRILLING OF PROBE HOLES SHALL BE MANDATORY AS SPECIFIED IN THE TECHNICAL SPECIFICATION FOR ADOPTION OF SUPPORT SYSTEM SHOWN IN THIS DRAWING.
9. THE CONTRACTOR SHALL DRILL HOLES AROUND THE PERIPHERY OF THE EXCAVATION FOR DRAINING THE SURROUNDING ROCK.THE MINIMUM DIAMETER OF HOLES SHALL BE 57 MM OR AS DIRECTED BY THE ENGINEER. THE NUMBER OF HOLES, DEPTH, LOCATION AND INCLINATION OF HOLES SHALL DEPEND ON WATER INFLOW CONDITIONS AND INFLOW DISTRIBUTION AT THE FACE WHERE GROUTING IS PERFORMED.FOR ANY FURTHER DETAILS REGARDING PROBE DRILLING SECTION 14 & ANNEXURE B OF WORKS REQUIREMENTS SHOULD BE REFFERED.

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

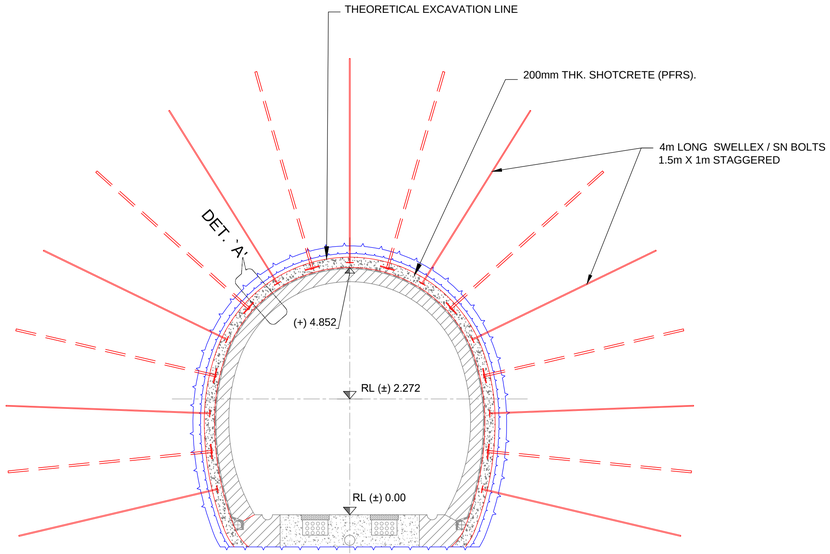
PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL	AECOM			
	RAJESH	Eshita / Sourav	GVR Raju	John Celentano
	Drawn	Designed	Verified	Approved

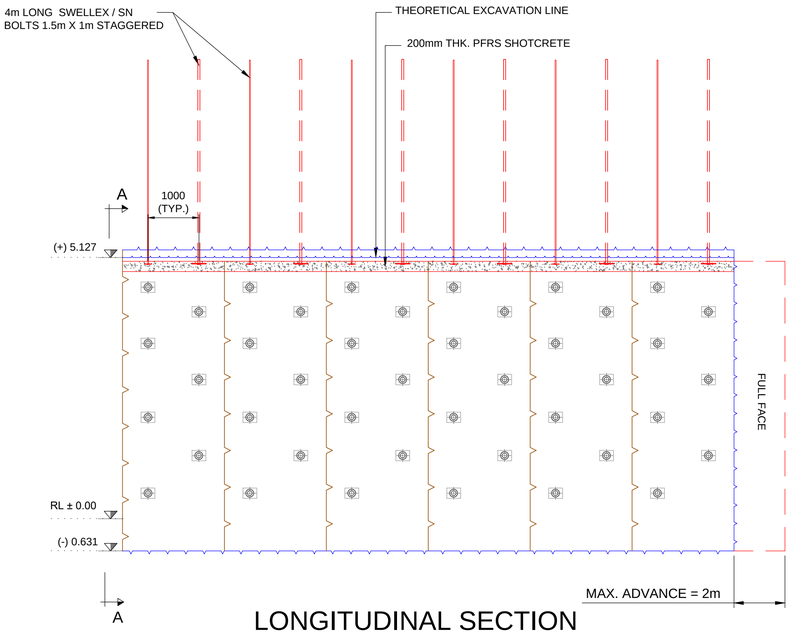
Title: TUNNEL-13
CROSS PASSAGE ROCK CLASS-B1 (WITHOUT INVERT) TYPICAL SUPPORT DETAILS

Drawing No. ACM-60598728-PKG7B-CP-ES-0186 | Scale AS SHOWN | Rev. 0



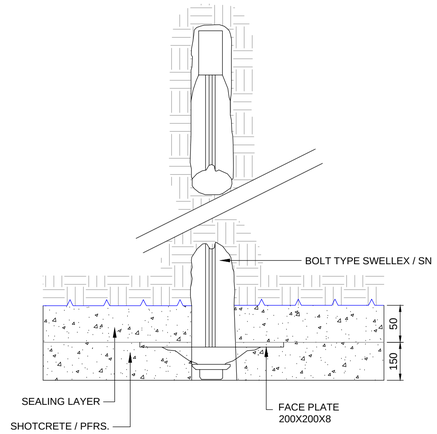
CROSS PASSAGE SECTION (WITH OUT INVERT ARCH) B2 CLASS

SCALE(A1) 1:60



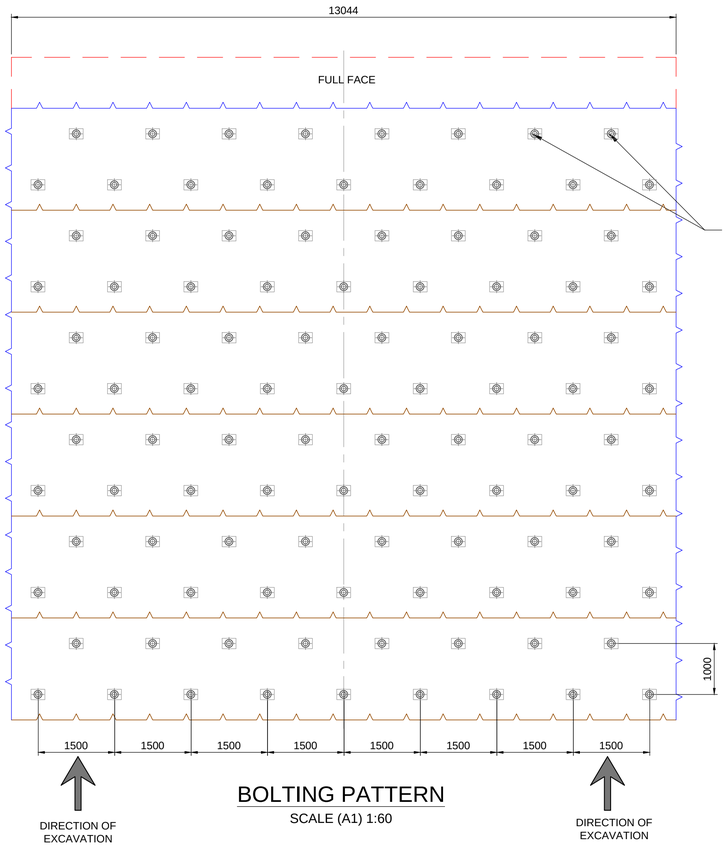
LONGITUDINAL SECTION

SCALE(A1) 1:60



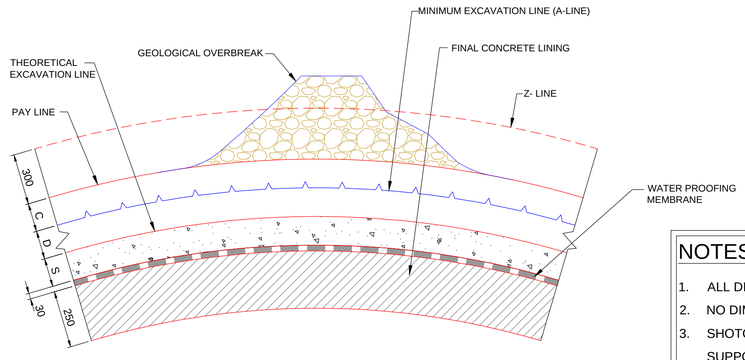
DETAIL OF BOLTS

SCALE (A1) 1:5



BOLTING PATTERN

SCALE (A1) 1:60



DETAIL AT - `A'

SCALE (A1) 1: 20

EXCAVATION & SUPPORT QUANTITIES / METER FOR CROSS PASSAGE SUPPORT CLASS B2				
MAXIMUM DEFORMATION TOLERANCE			D	75 mm
FULL FACE EXCAVATION	EXCAVATION	ROUND LENGTH		2 m
		THEORETICAL EXCAVATION VOLUME		28.98 m^3
	SUPPORT	SHOTCRETE (PFRS)	M30 ds=200mm	2.88 m^2
		SWELLEX BOLTS / SN	Fy 200kN, 4m 1.5m x 1m	9 Pcs

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. MINIMUM EXCAVATION LINE SHALL INCLUDE DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.
7. FOR OTHER NOTE REFER DWG.NO-ACM-60603749-PKG7B-GE-GA-0003 & 0004[0]
8. DRILLING OF PROBE HOLES SHALL BE MANDATORY AS SPECIFIED IN THE TECHNICAL SPECIFICATION FOR ADOPTION OF SUPPORT SYSTEM SHOWN IN THIS DRAWING.
9. THE CONTRACTOR SHALL DRILL HOLES AROUND THE PERIPHERY OF THE EXCAVATION FOR DRAINING THE SURROUNDING ROCK.THE MINIMUM DIAMETER OF HOLES SHALL BE 57 MM OR AS DIRECTED BY THE ENGINEER. THE NUMBER OF HOLES, DEPTH, LOCATION AND INCLINATION OF HOLES SHALL DEPEND ON WATER INFLOW CONDITIONS AND INFLOW DISTRIBUTION AT THE FACE WHERE GROUTING IS PERFORMED.FOR ANY FURTHER DETAILS REGARDING PROBE DRILLING SECTION 14 & ANNEXURE B OF WORKS REQUIREMENTS SHOULD BE REFFERED.

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

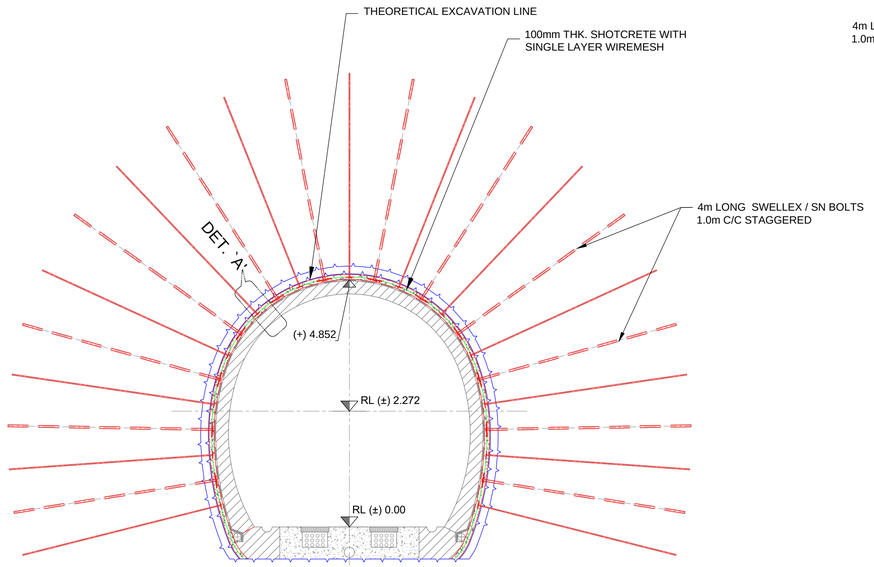
DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited | AECOM

RAJESH	Eshita / Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

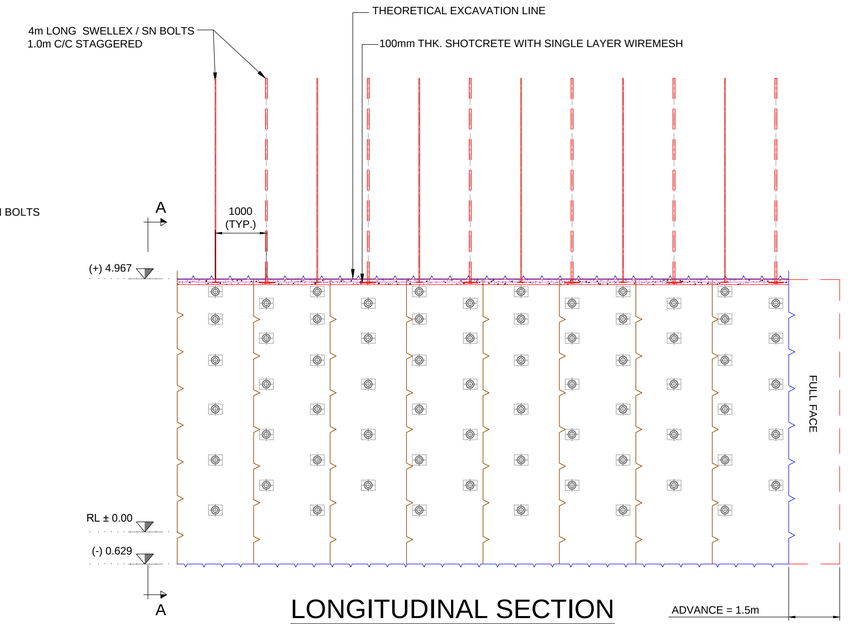
Title: TUNNEL-13
CROSS PASSAGE ROCK CLASS-B2 (WITHOUT INVERT)
TYPICAL SUPPORT DETAILS

Drawing No. ACM-60598728-PKG7B-CP-ES-0187 | Scale AS SHOWN | Rev. 0



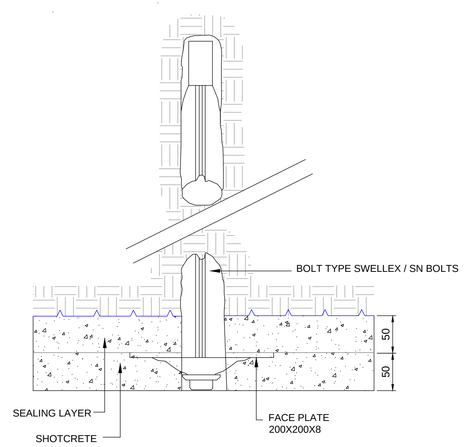
CROSS PASSAGE SECTION (WITH OUT INVERT ARCH) C1 CLASS

SCALE(A1) 1:60



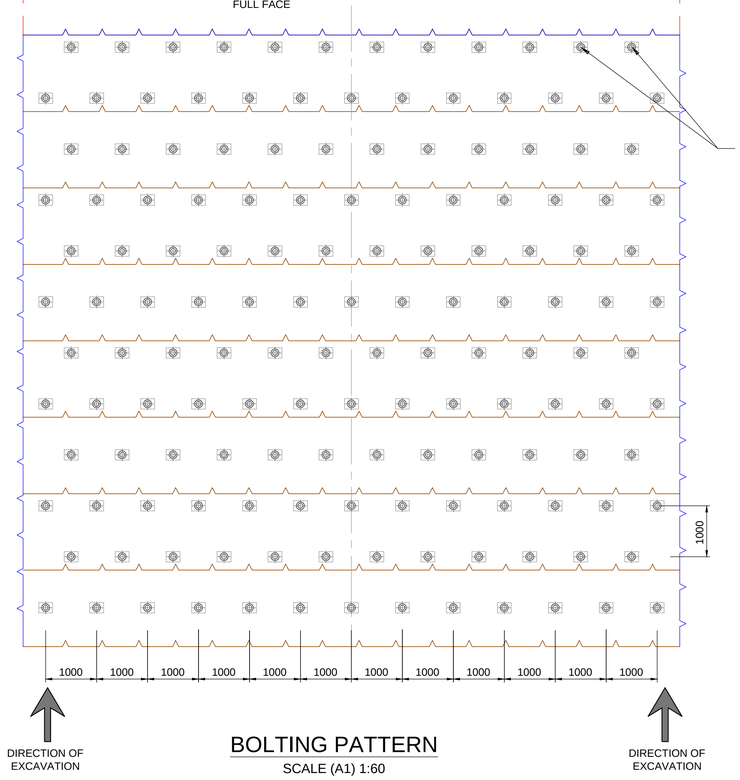
LONGITUDINAL SECTION

SCALE(A1) 1:60



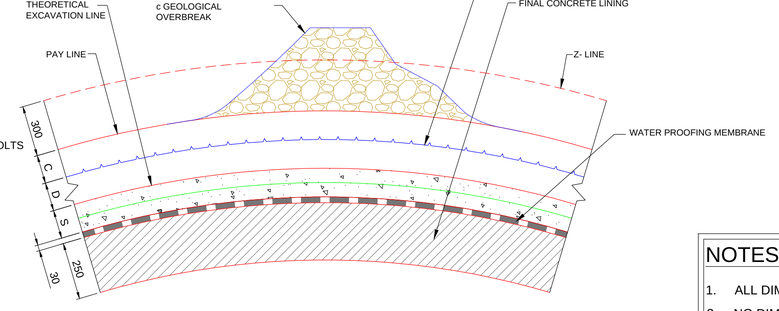
DETAIL OF BOLTS

SCALE (A1) 1:5



BOLTING PATTERN

SCALE (A1) 1:60



DETAIL AT - `A'

SCALE (A1) 1: 20

EXCAVATION & SUPPORT QUANTITIES / METER FOR CROSS PASSAGE SUPPORT CLASS C1				
MAXIMUM DEFORMATION TOLERANCE		D	15	mm
FULL FACE EXCAVATION	EXCAVATION	ROUND LENGTH	1.5	m
		THECRETICAL EXCAVATION VOLUME	26.63	m^3
	SUPPORT	SHOTCRETE	M30, ds=100mm	1.42	m^3
		WIRE MESH 150/150x6 mm	SINGLE LAYER	14.25	m^2
		SWELLEX BOLTS	Fy 200kN, 4m 1m x 1m	13	Pcs

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. MINIMUM EXCAVATION LINE SHALL INCLUDE DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.
7. FOR OTHER NOTE REFER DWG.NO-ACM-60603749-PKG7B-GE-GA-0003 & 0004[0]
8. DRILLING OF PROBE HOLES SHALL BE MANDATORY AS SPECIFIED IN THE TECHNICAL SPECIFICATION FOR ADOPTION OF SUPPORT SYSTEM SHOWN IN THIS DRAWING.
9. THE CONTRACTOR SHALL DRILL HOLES AROUND THE PERIPHERY OF THE EXCAVATION FOR DRAINING THE SURROUNDING ROCK.THE MINIMUM DIAMETER OF HOLES SHALL BE 57 MM OR AS DIRECTED BY THE ENGINEER. THE NUMBER OF HOLES, DEPTH, LOCATION AND INCLINATION OF HOLES SHALL DEPEND ON WATER INFLOW CONDITIONS AND INFLOW DISTRIBUTION AT THE FACE WHERE GROUTING IS PERFORMED.FOR ANY FURTHER DETAILS REGARDING PROBE DRILLING SECTION 14 & ANNEXURE B OF WORKS REQUIREMENTS SHOULD BE REFFERED.

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited गुणवत्ता, गति एवं पारदर्शिता (A Government of India Enterprise)

Project:

PACKAGE-7B

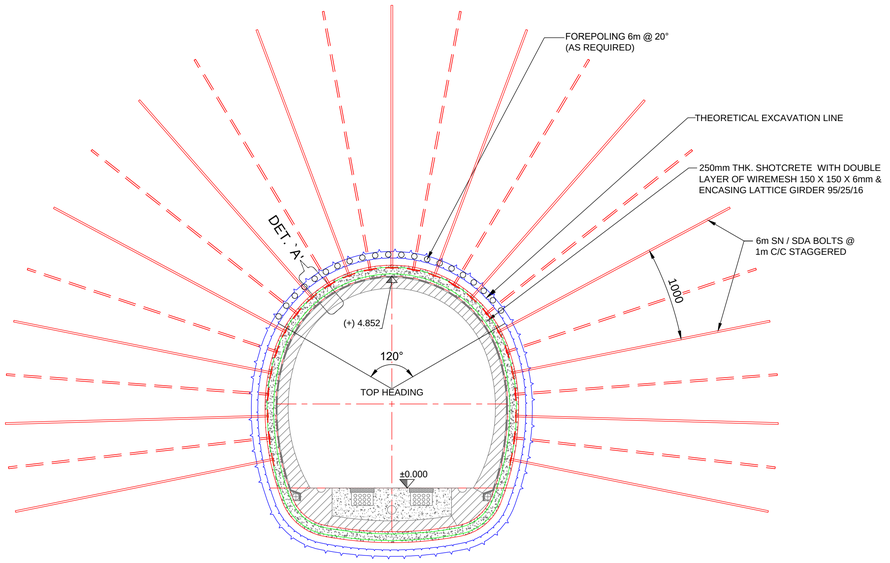
DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited | AECOM

RAJESH	Eshita / Preksha	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

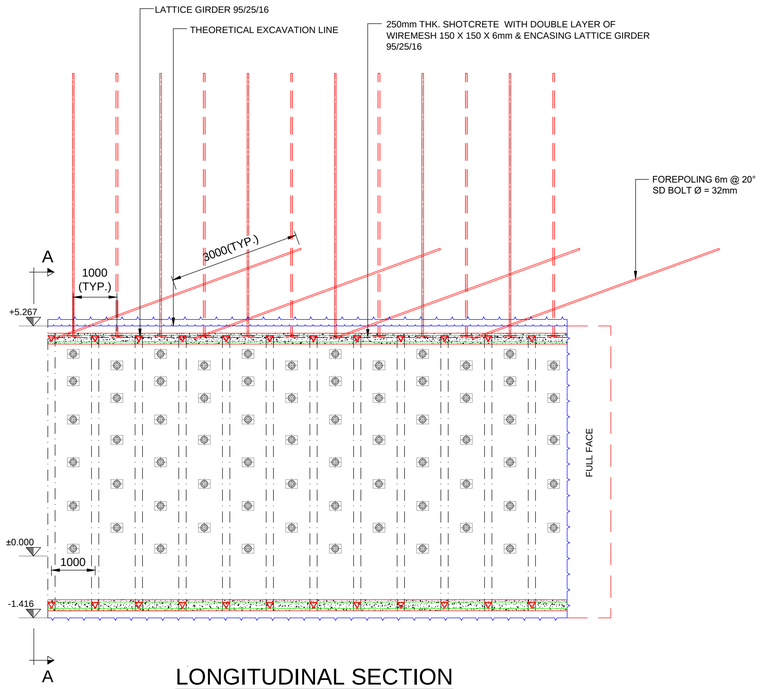
Title: TUNNEL-13 CROSS PASSAGE ROCK CLASS-C1 (WITH OUT INVERT) TYPICAL SUPPORT DETAILS

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-CP-ES-0188	AS SHOWN	0



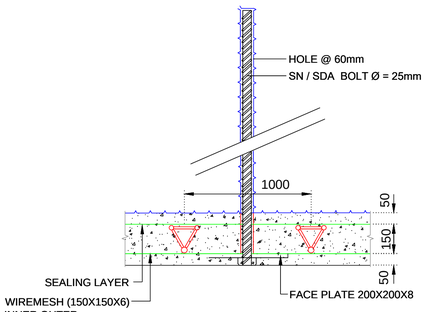
CROSS PASSAGE SECTION (WITH INVERT ARCH) C2 CLASS

SCALE(A1) 1:75



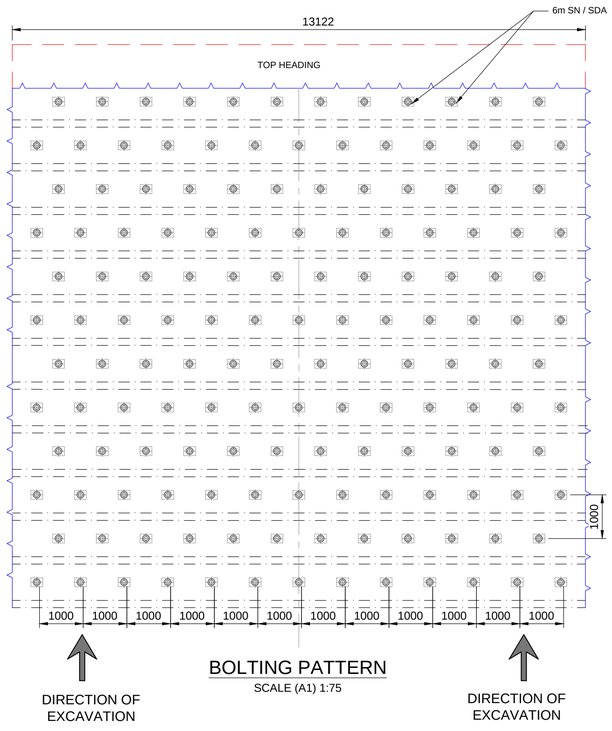
LONGITUDINAL SECTION

SCALE(A1) 1:75



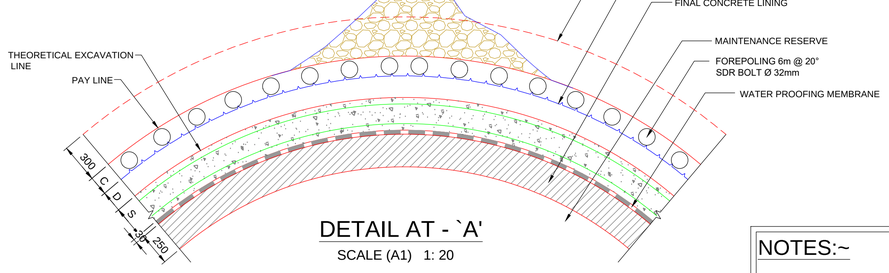
DETAIL OF SN BOLTS

EXCAVATION & SUPPORT QUANTITIES / METER FOR CROSS PASSAGE SUPPORT CLASS C2				
MAXIMUM DEFORMATION TOLERANCE			D	165 mm
FULL FACE EXCAVATION	EXCAVATION	ROUND LENGTH		1 m
		THEORETICAL EXCAVATION VOLUME		34.22 m`
		SHOTCRETE	M30, ds=250mm	4.78 m`
	SUPPORT	WIRE MESH 150X150X6 mm	OUTER / INNER LAYER	38.21 m²
		SN BOLTS	Fy 200kN, 6m 1m x 1m	13.00 Pcs.
		LATTICE GIRDER	95 / 16 / 25 1m spacing	185.78 Kg
		FOREPOLING (OPTIONAL)	SD BOLTS Ø32 C/C=300, L=6m	21.00 Pcs.



BOLTING PATTERN

SCALE (A1) 1:75



DETAIL AT - `A'

SCALE (A1) 1: 20

TENDER DRAWING

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. MINIMUM EXCAVATION LINE SHALL INCLUDE DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.
7. FOR OTHER NOTE REFER DWG.NO-ACM-60603749-PKG7B-GE-GA-0003 & 0004[0]
8. DRILLING OF PROBE HOLES SHALL BE MANDATORY AS SPECIFIED IN THE TECHNICAL SPECIFICATION FOR ADOPTION OF SUPPORT SYSTEM SHOWN IN THIS DRAWING.
9. THE CONTRACTOR SHALL DRILL HOLES AROUND THE PERIPHERY OF THE EXCAVATION FOR DRAINING THE SURROUNDING ROCK.THE MINIMUM DIAMETER OF HOLES SHALL BE 57 MM OR AS DIRECTED BY THE ENGINEER. THE NUMBER OF HOLES, DEPTH, LOCATION AND INCLINATION OF HOLES SHALL DEPEND ON WATER INFLOW CONDITIONS AND INFLOW DISTRIBUTION AT THE FACE WHERE GROUTING IS PERFORMED.FOR ANY FURTHER DETAILS REGARDING PROBE DRILLING SECTION 14 & ANNEXURE B OF WORKS REQUIREMENTS SHOULD BE REFFERED.

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

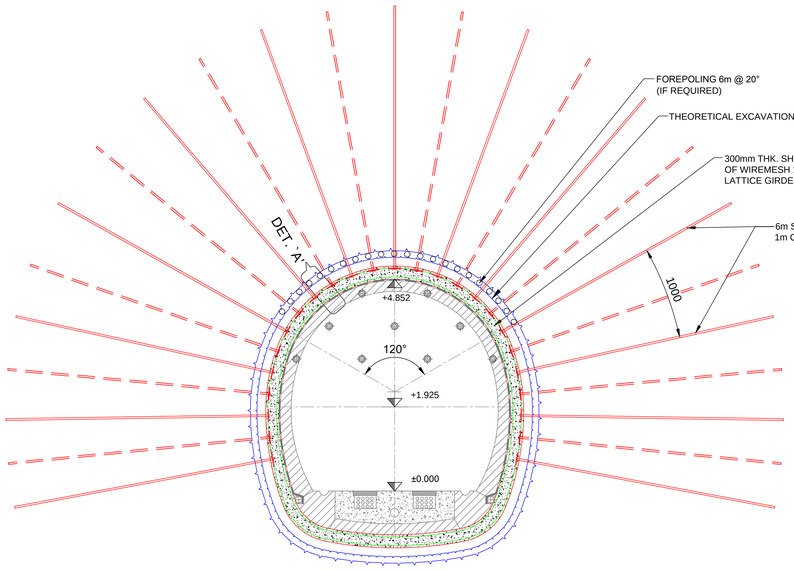
Project:
PACKAGE-7B
DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited | AECOM

Yogendra	Eshita / Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

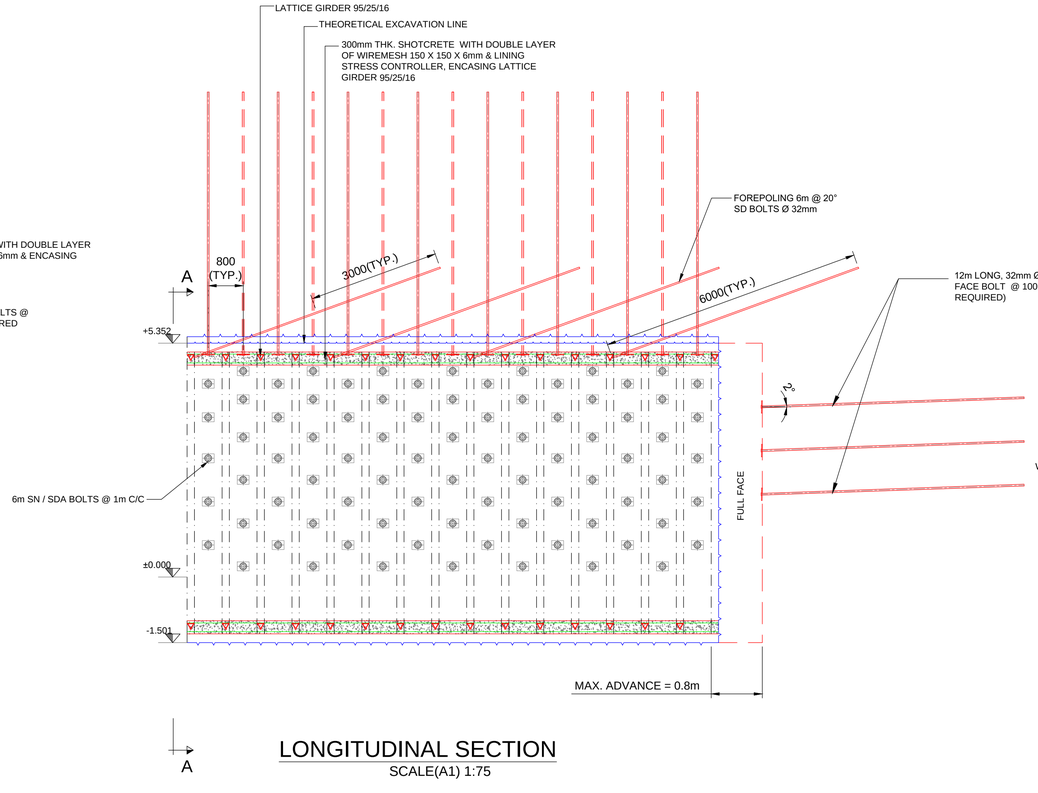
Title:
TUNNEL-13
CROSS PASSAGE ROCK CLASS - C2
(WITH INVERT) TYPICAL SUPPORT DETAILS
(SHEET 1 OF 1)

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-CP-ES-0189	AS SHOWN	0



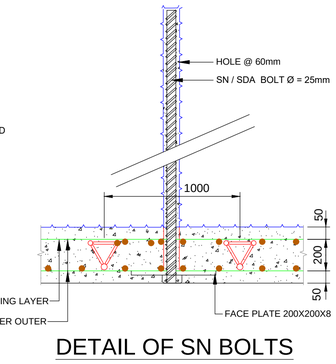
CROSS PASSAGE SECTION (WITH INVERT ARCH) C3 CLASS

SCALE(A1) 1:75

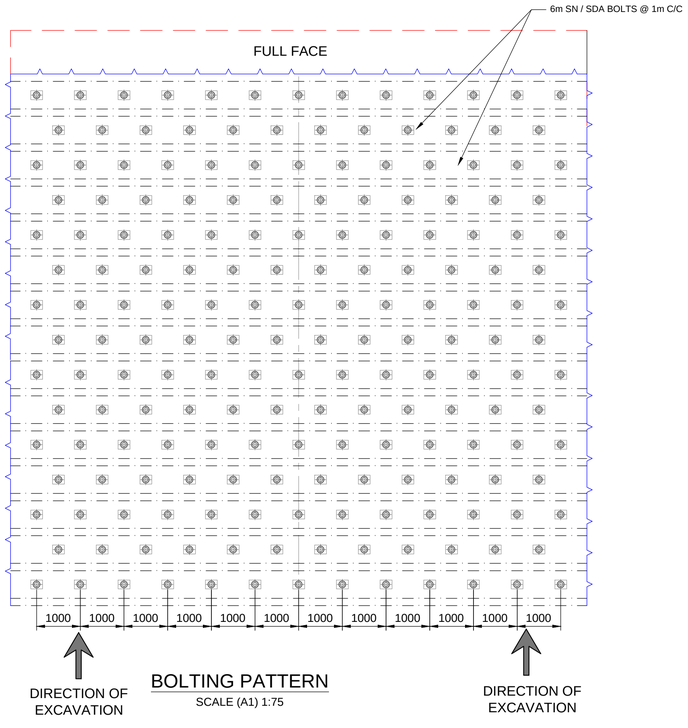


LONGITUDINAL SECTION

SCALE(A1) 1:75

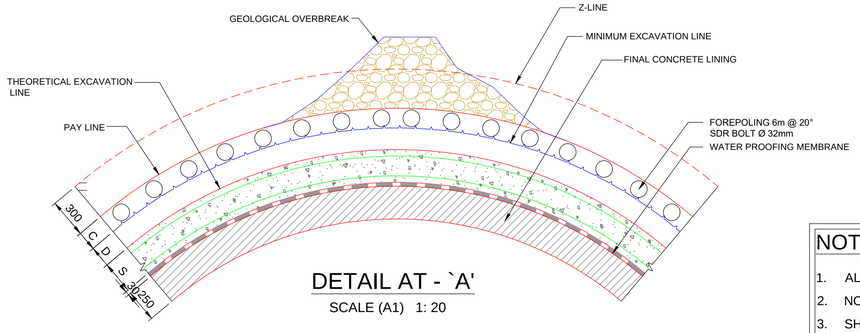


DETAIL OF SN BOLTS



BOLTING PATTERN

SCALE (A1) 1:75



DETAIL AT - `A'

SCALE (A1) 1: 20

EXCAVATION & SUPPORT QUANTITIES / METER FOR CROSS PASSAGE SUPPORT CLASS C3

MAXIMUM DEFORMATION TOLERANCE			D	200 mm
FULL FACE EXCAVATION	EXCAVATION	ROUND LENGTH		0.8 m
		THEORETICAL EXCAVATION VOLUME		36.02 m^3
	SUPPORT	SHOTCRETE	M30, ds=300mm	5.76 m^3
		WIRE MESH 150*150*6 mm	OUTER / INNER LAYER	38.53 m^2
		SN BOLTS	Fy 200kN, 9m, 1m x 1m	16.25 Pcs.
		LATTICE GIRDER	95 / 16 / 25 1 per round	248.66 Kg
		FOREPOLING (OPTIONAL)	SDR BOLTS Ø32, C/C=300, L=6m	22.00 Pcs
		FACE SUPPORT (GLASS FIBER BOLTS) (IF REQUIRED)	Ø32 12m , 1.5m SPACING	9.00 Pcs

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. MINIMUM EXCAVATION LINE SHALL INCLUDE DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.
7. FOR OTHER NOTE REFER DWG.NO-ACM-60603749-PKG7B-GE-GA-0003 & 0004[0]
8. DRILLING OF PROBE HOLES SHALL BE MANDATORY AS SPECIFIED IN THE TECHNICAL SPECIFICATION FOR ADOPTION OF SUPPORT SYSTEM SHOWN IN THIS DRAWING. FOR LENGTH, NUMBER AND DIRECTION OF PROBING, GROUTING AND CHECK HOLES PLEASE SEE "SECTION 14 DRILLING AND GROUTING" AND "ANNEXURE - b" OF "WORKS / EMPLOYERS REQUIREMENTS"

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

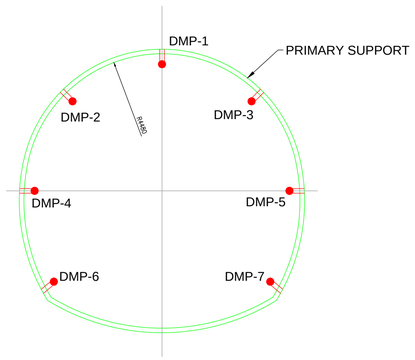
RVNL Rail Vikas Nigam Limited | AECOM

Yogendra	Eshita / Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

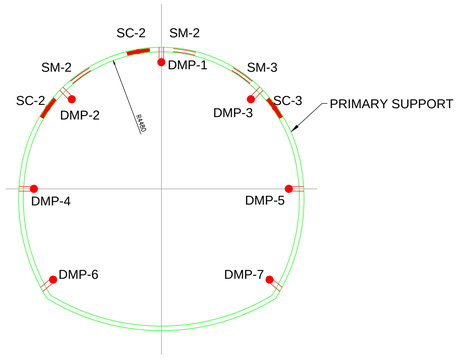
Title: TUNNEL-13
CROSS PASSAGE ROCK CLASS - C3
(WITH INVERT) TYPICAL SUPPORT DETAILS
(SHEET 1 OF 1)

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-CP-ES-0190	AS SHOWN	0

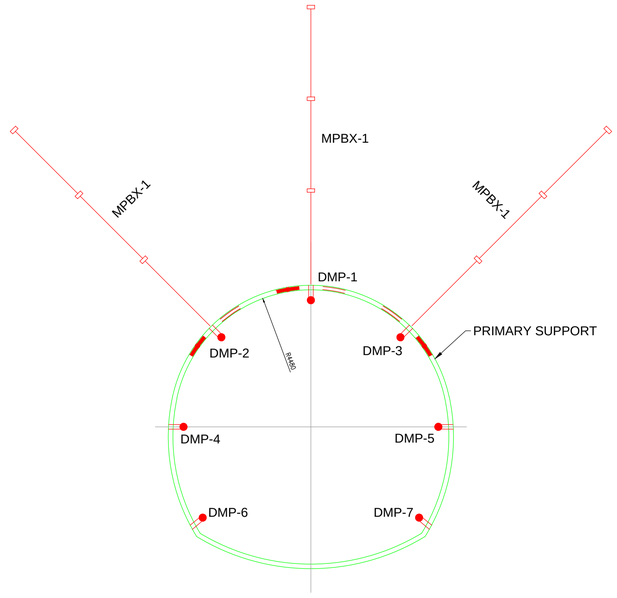
1. SAME NUMBERS AND LOCATIONS OF INSTRUMENTATION ENVISAGED FOR FULL FACE EXCAVATION AND EXCAVATION WITH TOP HEADING AND BENCHING.
2. FOR MAIN MONITORING CROSS SECTIONS, EITHER STRAIN METERS OR STRESS CELLS ARE INSTALLED AT ALTERNATE SECTIONS.
3. THE NUMBERS, LOCATIONS AND FREQUENCY OF INSTRUMENTATION ARE SUBJECT TO CHANGE ACCORDING TO THE ENGINEER'S INSTRUCTIONS ON SITE.



STANDARD MONITORING CROSS SECTION



MAIN MONITORING CROSS SECTION



MAIN MONITORING CROSS SECTION WITH EXTENSOMETERS

FREQUENCY OF MEASUREMENT UPON TUNNEL EXCAVATION:

FREQUENCY OF MEASUREMENT	
WEEK 1	ONCE PER DAY
WEEK 2	TWICE IN A WEEK
WEEKS 3 & 4	ONCE PER WEEK
AFTER WEEK 4	ONCE EVERY TWO MONTHS

INSTRUMENTATION INTERVALS FOR DIFFERENT SUPPORT CLASSES:

SUPPORT CLASS	INTERVALS FOR INSTRUMENTATION		
	STANDARD MONITORING	MAIN MONITORING	MAIN MONITORING WITH EXTENSOMETERS
CLASS B1	50m	150m (OR AS REQUIRED BY ENGINEER)	500m (OR AS REQUIRED BY ENGINEER)
CLASS B2	50m		
CLASS C1	25m		
CLASS C2	20m		
CLASS C3	15m		
CLASS P	10m		

ABBREVIATIONS:

DMP POINTS WITH OPTICAL TARGETS FOR 3D DISPLACEMENT MONITORING

SM STRAIN METER

SC STRESS CELL

MPBX MULTI POINT BOREHOLE EXTENSOMETER (WITH MEASURING POINTS AT 3m , 6m & 9m)

NOTE : ONLY SM OR SC ARE INSTALLED AT EACH ALTERNATE CROSS SECTION

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

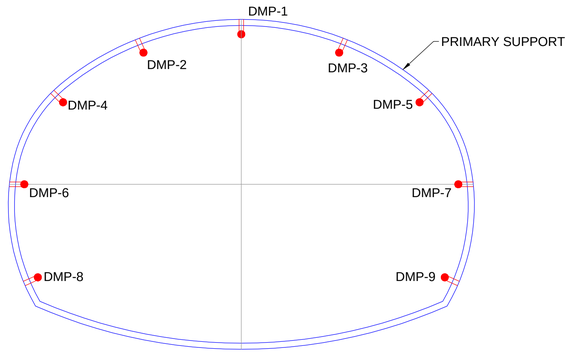
RVNL Rail Vikas Nigam Limited | AECOM

Yogendra	Eshita / Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

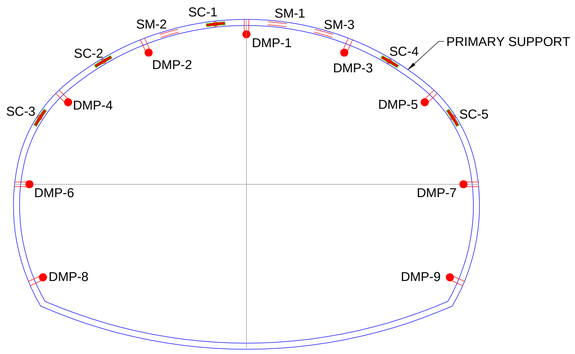
Title:

TUNNEL-13
MAIN TUNNEL
GEOTECHNICAL INSTRUMENTATION & MONITORING
(SHEET 1 OF 1)

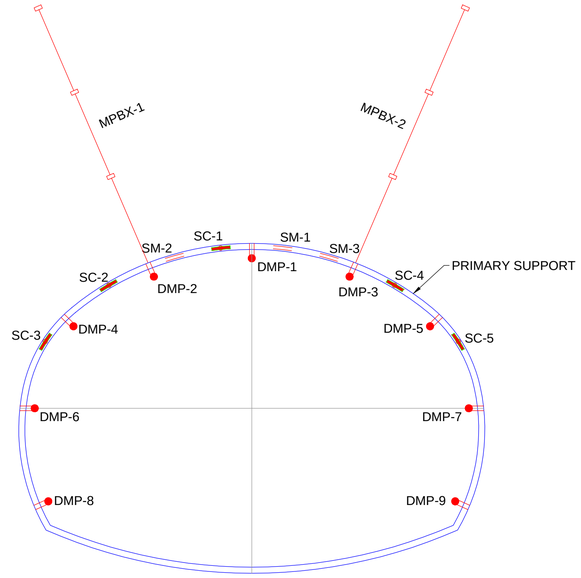
Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-MT-IM-0191	AS SHOWN	1



STANDARD MONITORING CROSS SECTION



MAIN MONITORING CROSS SECTION



MAIN MONITORING CROSS SECTION WITH EXTENSOMETERS

FREQUENCY OF MEASUREMENT UPON TUNNEL EXCAVATION:

FREQUENCY OF MEASUREMENT	
WEEK 1	ONCE PER DAY
WEEK 2	TWICE IN A WEEK
WEEKS 3 & 4	ONCE PER WEEK
AFTER WEEK 4	ONCE EVERY TWO MONTHS

INSTRUMENTATION INTERVALS FOR DIFFERENT SUPPORT CLASSES:

SUPPORT CLASS	INTERVALS FOR INSTRUMENTATION		
	STANDARD MONITORING	MAIN MONITORING	MAIN MONITORING WITH EXTENSOMETERS
CLASS B1	50m	150m (OR AS REQUIRED BY ENGINEER)	500m (OR AS REQUIRED BY ENGINEER)
CLASS B2	50m		
CLASS C1	25m		
CLASS C2	20m		
CLASS C3	15m		
CLASS P	10m		

ABBREVIATIONS:

DMP POINTS WITH OPTICAL TARGETS FOR 3D DISPLACEMENT MONITORING

SM STRAIN METER

SC STRESS CELL

MPBX MULTI POINT BOREHOLE EXTENSOMETER (WITH MEASURING POINTS AT 3m , 6m & 9m)

NOTE : ONLY SM OR SC ARE INSTALLED AT EACH ALTERNATE CROSS SECTION

NOTES :

1. SAME NUMBERS AND LOCATIONS OF INSTRUMENTATION ENVISAGED FOR FULL FACE EXCAVATION AND EXCAVATION WITH TOP HEADING AND BENCHING.
2. FOR MAIN MONITORING CROSS SECTIONS, EITHER STRAIN METERS OR STRESS CELLS ARE INSTALLED AT ALTERNATE SECTIONS.
3. THE NUMBERS, LOCATIONS AND FREQUENCY OF INSTRUMENTATION ARE SUBJECT TO CHANGE ACCORDING TO THE ENGINEER'S INSTRUCTIONS ON SITE.

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

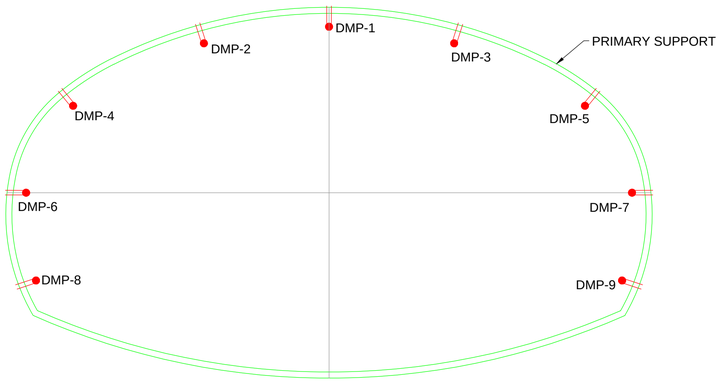
Project:
PACKAGE-7B
DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited | AECOM

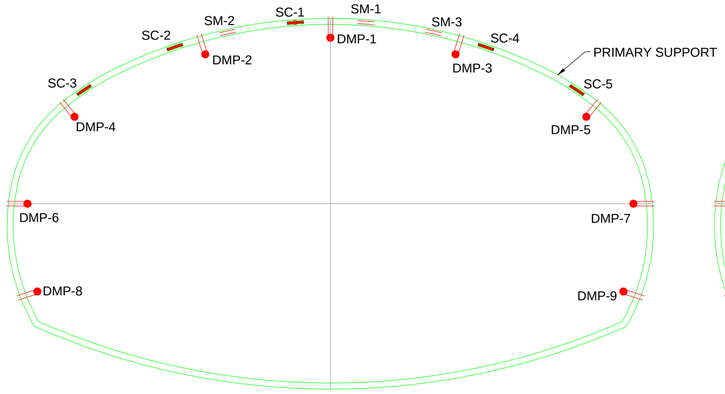
Yogendra	Eshita / Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

Title:
TUNNEL-13
DOUBLE TRACK TUNNEL
GEOTECHNICAL INSTRUMENTATION & MONITORING
(SHEET 1 OF 1)

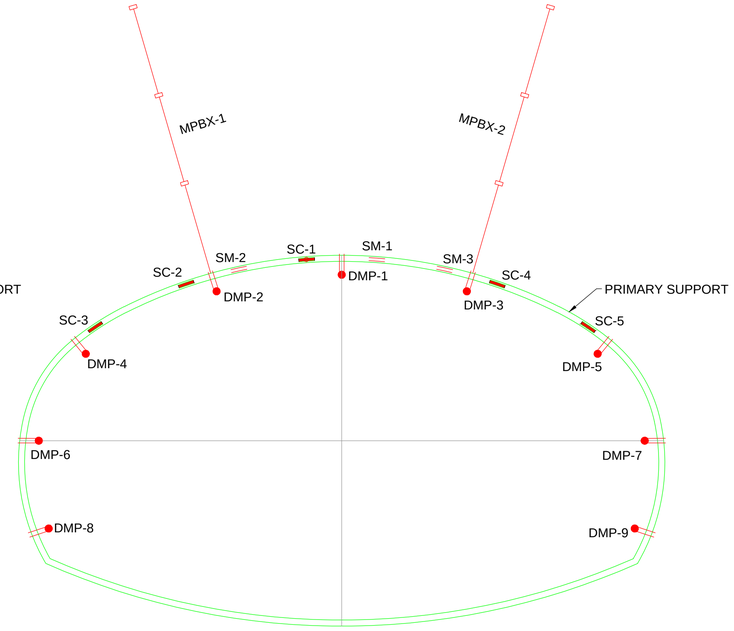
Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-MT-IM-0192	AS SHOWN	0



STANDARD MONITORING CROSS SECTION



MAIN MONITORING CROSS SECTION



MAIN MONITORING CROSS SECTION WITH EXTENSOMETERS

FREQUENCY OF MEASUREMENT UPON TUNNEL EXCAVATION:

FREQUENCY OF MEASUREMENT	
WEEK 1	ONCE PER DAY
WEEK 2	TWICE IN A WEEK
WEEKS 3 & 4	ONCE PER WEEK
AFTER WEEK 4	ONCE EVERY TWO MONTHS

INSTRUMENTATION INTERVALS FOR DIFFERENT SUPPORT CLASSES:

SUPPORT CLASS	INTERVALS FOR INSTRUMENTATION		
	STANDARD MONITORING	MAIN MONITORING	MAIN MONITORING WITH EXTENSOMETERS
CLASS B1	50m	150m (OR AS REQUIRED BY ENGINEER)	500m (OR AS REQUIRED BY ENGINEER)
CLASS B2	50m		
CLASS C1	25m		
CLASS C2	20m		
CLASS C3	15m		
CLASS P	10m		

ABBREVIATIONS:

DMP POINTS WITH OPTICAL TARGETS FOR 3D DISPLACEMENT MONITORING

SM STRAIN METER

SC STRESS CELL

MPBX MULTI POINT BOREHOLE EXTENSOMETER (WITH MEASURING POINTS AT 3m , 6m & 9m)

NOTE : ONLY SM OR SC ARE INSTALLED AT EACH ALTERNATE CROSS SECTION

NOTES :

1. SAME NUMBERS AND LOCATIONS OF INSTRUMENTATION ENVISAGED FOR FULL FACE EXCAVATION AND EXCAVATION WITH TOP HEADING AND BENCHING.
2. FOR MAIN MONITORING CROSS SECTIONS, EITHER STRAIN METERS OR STRESS CELLS ARE INSTALLED AT ALTERNATE SECTIONS.
3. THE NUMBERS, LOCATIONS AND FREQUENCY OF INSTRUMENTATION ARE SUBJECT TO CHANGE ACCORDING TO THE ENGINEER'S INSTRUCTIONS ON SITE.

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

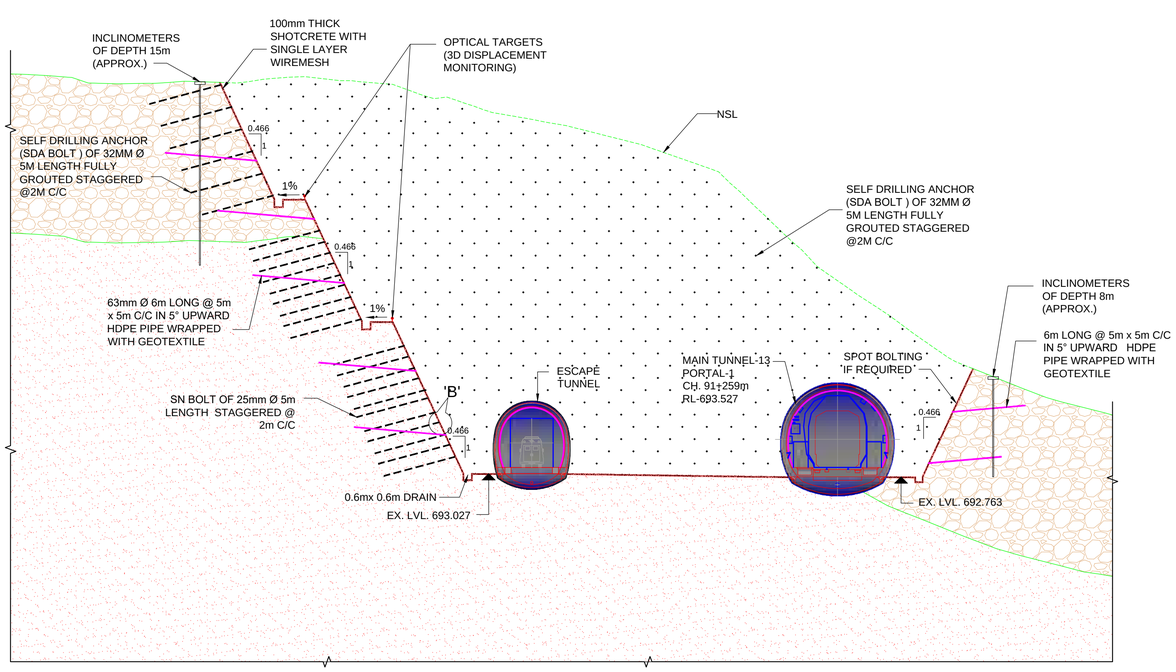
RVNL Rail Vikas Nigam Limited | AECOM

Yogendra	Eshita / Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

Title:

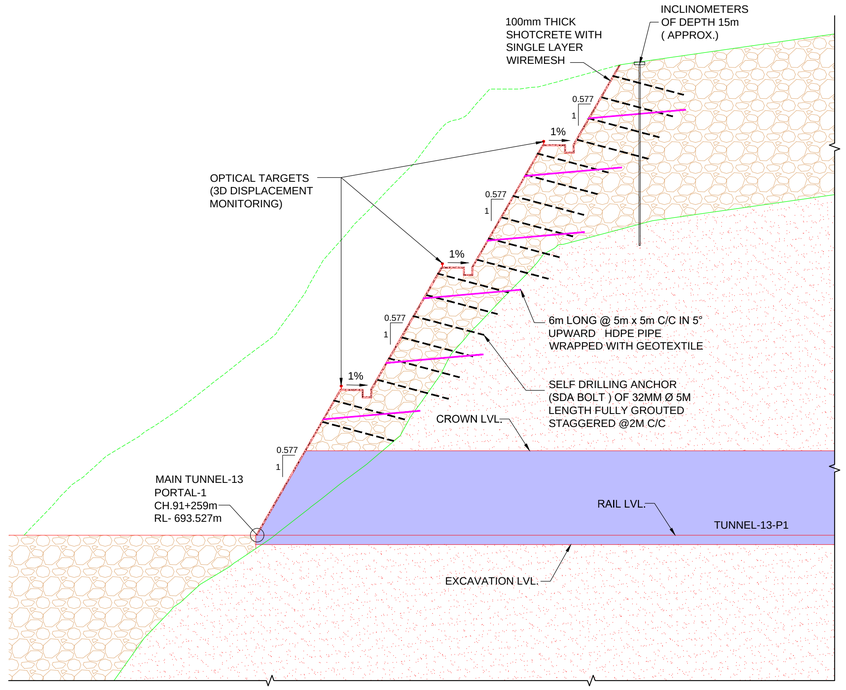
TUNNEL-13
TRIPLE TRACK TUNNEL
GEOTECHNICAL INSTRUMENTATION & MONITORING
(SHEET 1 OF 1)

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-MT-IM-0193	AS SHOWN	0



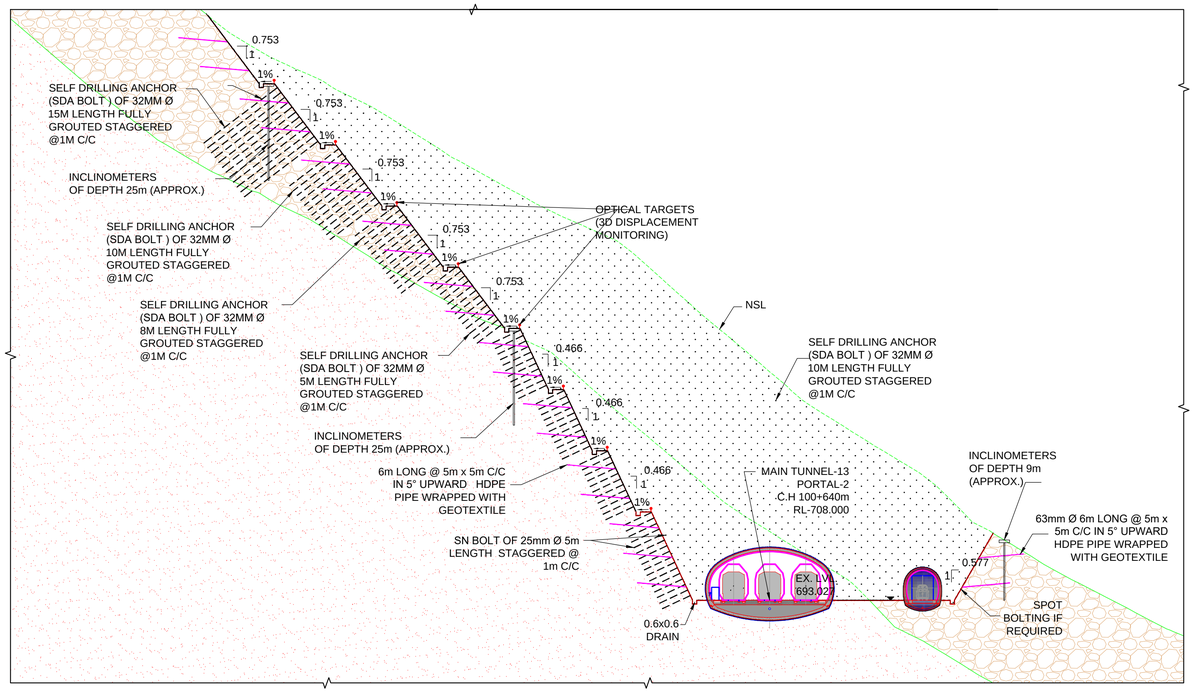
LONGITUDINAL (MAIN TUNNEL-13 PORTAL-1)

SCALE : 1:250



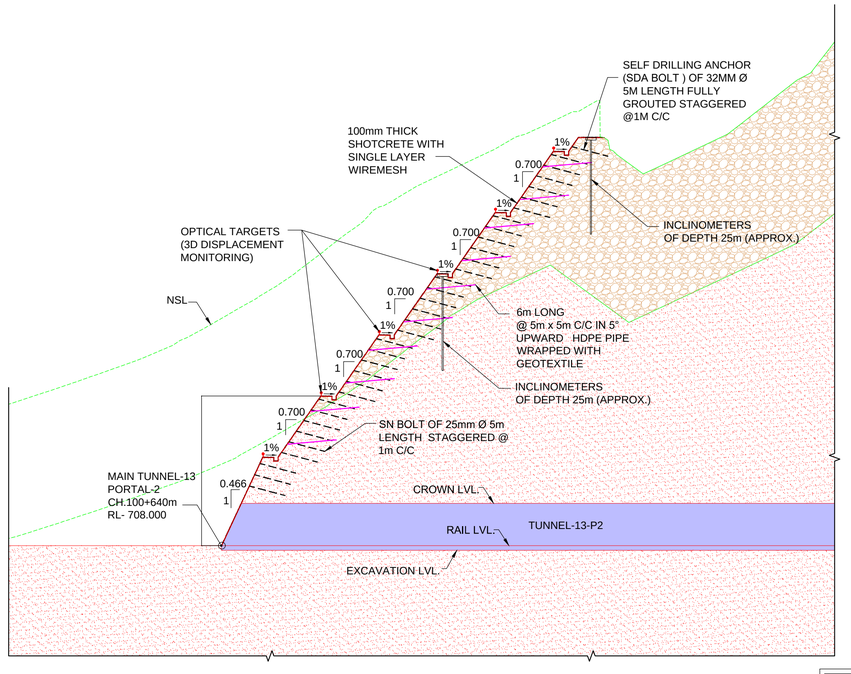
CROSS SECTION (MAIN TUNNEL-13 PORTAL-1)

SCALE : 1:250



LONGITUDINAL (MAIN TUNNEL-13 PORTAL-2)

SCALE : 1:500



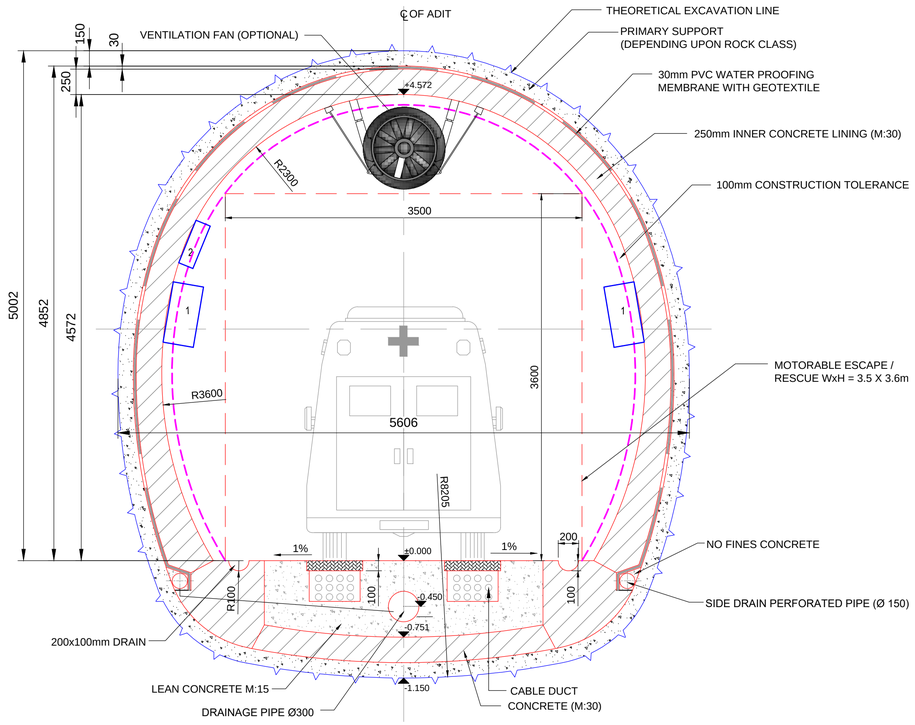
CROSS SECTION (MAIN TUNNEL-13 PORTAL-2)

SCALE : 1:500

TENDER DRAWING

Design Consultant:	Client:	Project:	RVNL	AECOM	Title:
AECOM	रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)	PACKAGE-7B DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.		RAJESH (Drawn) · Eshita / Sourav (Designed) · GVR Raju (Verified) · John Celentano (Approved)	PORTAL-1 & 2, TUNNEL-13 & ESCAPE TUNNEL GEOTECHNICAL INSTRUMENTATION & MONITORING

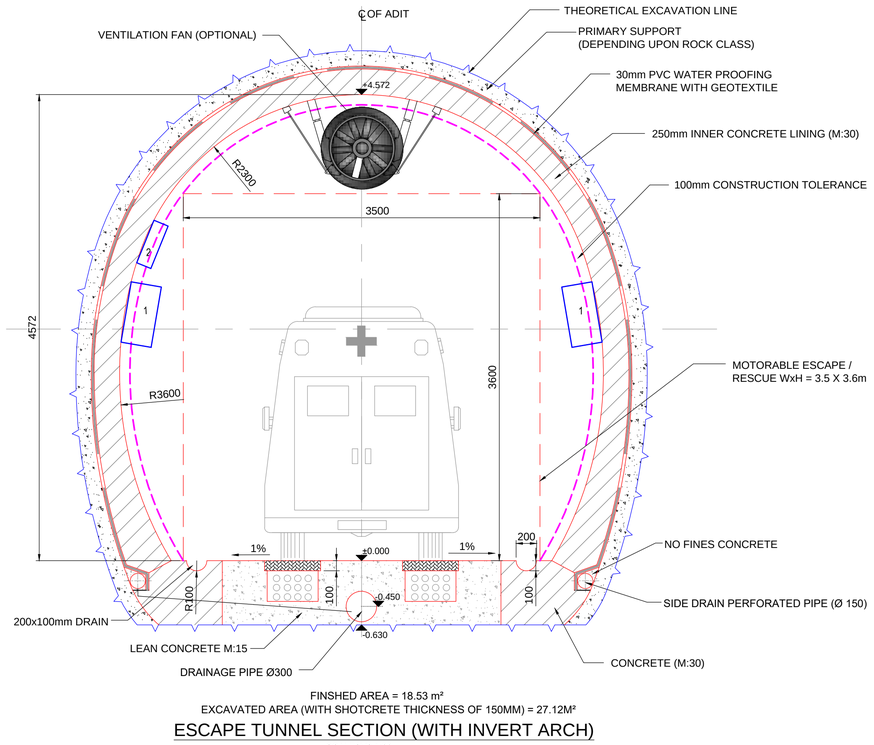
Drawing No. ACM-60598728-PKG7B-MT-PD-0194 | Scale | Rev. 0



FINSHED AREA = 18.53 m²
EXCAVATED AREA (WITH SHOTCRETE THICKNESS OF 150MM) = 28.89m²

ESCAPE TUNNEL SECTION (WITH INVERT ARCH)

SCALE(A1) 1:30



FINSHED AREA = 18.53 m²
EXCAVATED AREA (WITH SHOTCRETE THICKNESS OF 150MM) = 27.12M²

ESCAPE TUNNEL SECTION (WITH INVERT ARCH)

SCALE(A1) 1:30

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. MINIMUM EXCAVATION LINE SHALL INCLUDE CONSTRUCTION & DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited गुणवत्ता, गति एवं पारदर्शिता (A Government of India Enterprise)

Project:

PACKAGE-7B

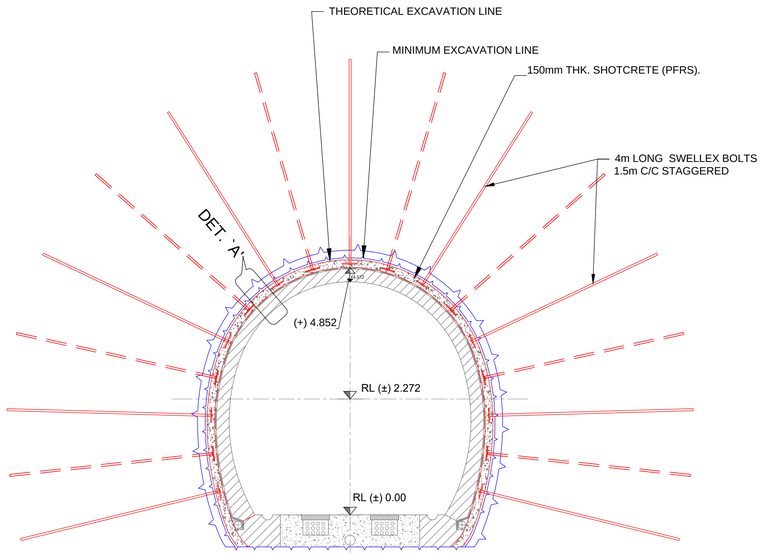
DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited | AECOM

Debasis Bag	Eshita / Preksha	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

Title: TUNNEL-13
TYPICAL CROSS SECTION
FOR ESCAPE TUNNEL
WITH & WITHOUT INVERT (SHEET 1 OF 1)

Drawing No	Scale	Rev.
ACM-60598728-PKG7B-ET-CS-0261	AS SHOWN	0

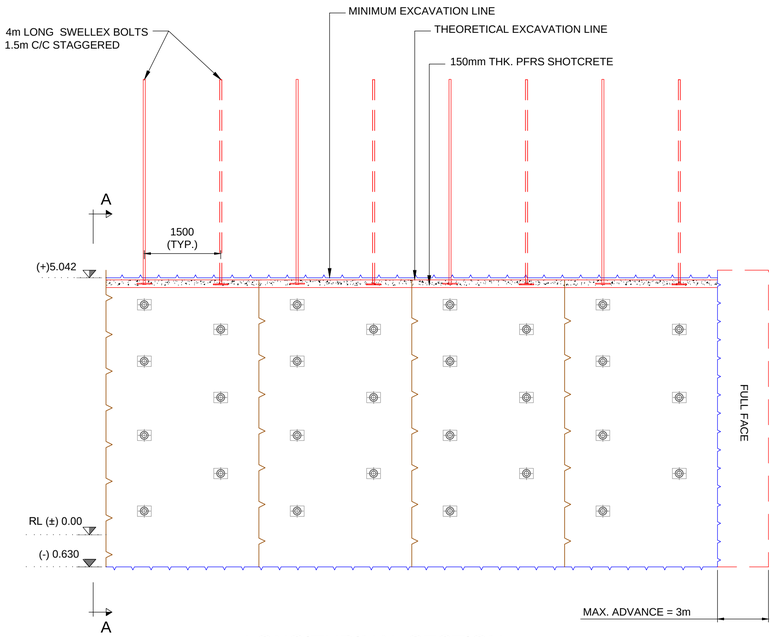


FINSHED AREA = 18.53 m²

EXCAVATED AREA (WITH SHOTCRETE THICKNESS OF 150MM) = 27.12M²

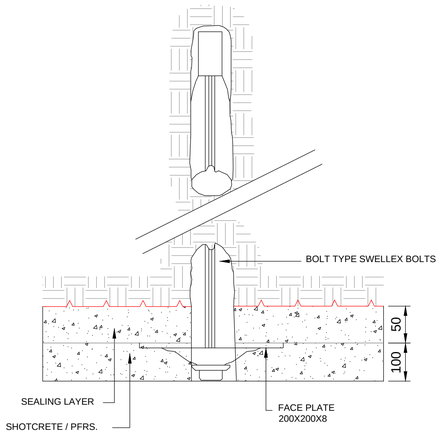
ESCAPE TUNNEL SECTION (WITH OUT INVERT ARCH) B1 CLASS

SCALE(A1) 1:60

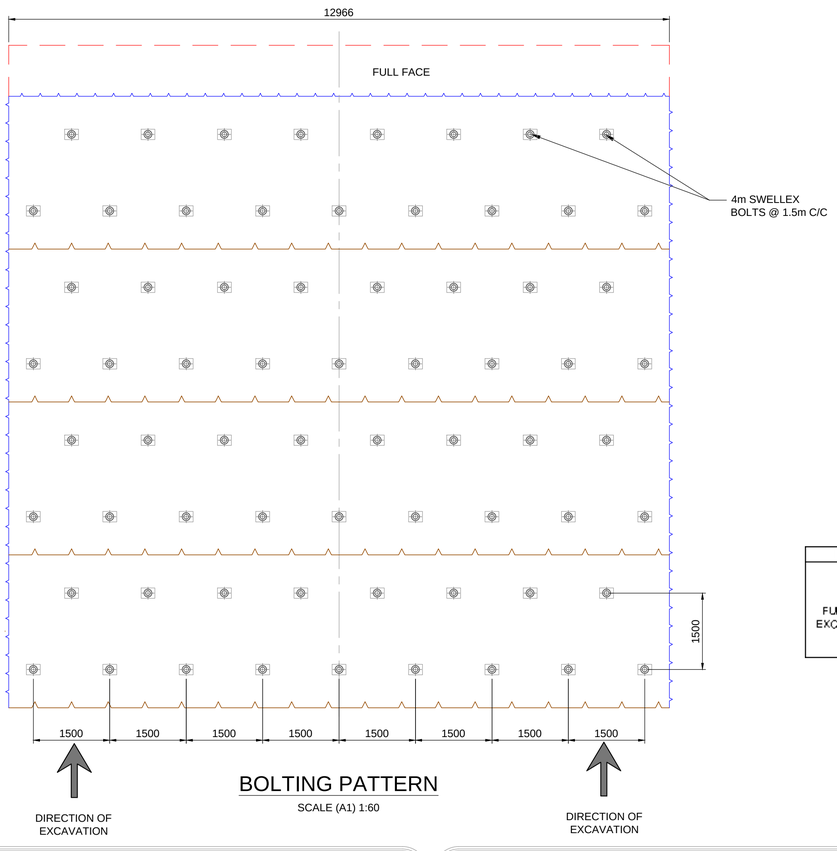


LONGITUDINAL SECTION

SCALE(A1) 1:60

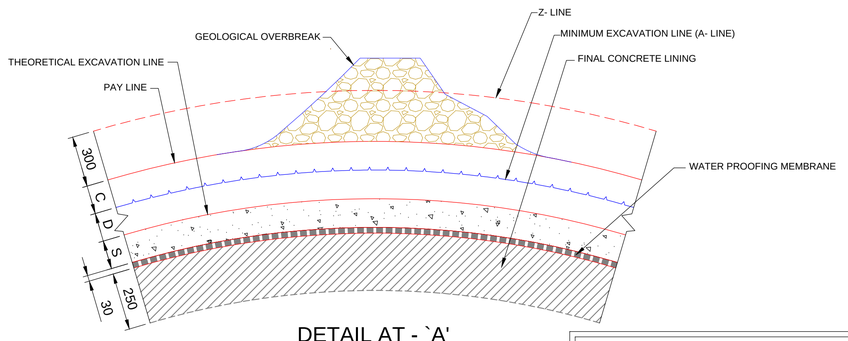


DETAIL OF BOLTS



BOLTING PATTERN

SCALE (A1) 1:60



DETAIL AT - `A'

SCALE (A1) 1: 20

EXCAVATION & SUPPORT QUANTITIES : METER FOR ESCAPE TUNNEL SUPPORT CLASS B1					
FULL FACE EXCAVATION	MAXIMUM DEFORMATION TOLERANCE		D	40	mm
	EXCAVATION:	ROUND LENGTH		3	m
		THEORETICAL EXCAVATION VOLUME		27.72	m^3
	SUPPORT	SHOTCRETE (PFRS)	M30, ds=150mm	2.15	m^3
		SWELLEX BOLTS	Fy 200kN, 4m 1.5m x 1.5m	8	Pcs

TENDER DRAWING

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. MINIMUM EXCAVATION LINE SHALL INCLUDE DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.
7. FOR OTHER NOTE REFER DWG.NO-ACM-60598728-PKG7B-GE-GA-0003 & 0004[0]
8. DRILLING OF PROBE HOLES SHALL BE MANDATORY AS SPECIFIED IN THE TECHNICAL SPECIFICATION FOR ADOPTION OF SUPPORT SYSTEM SHOWN IN THIS DRAWING.
9. THE CONTRACTOR SHALL DRILL HOLES AROUND THE PERIPHERY OF THE EXCAVATION FOR DRAINING THE SURROUNDING ROCK.THE MINIMUM DIAMETER OF HOLES SHALL BE 57 MM OR AS DIRECTED BY THE ENGINEER. THE NUMBER OF HOLES, DEPTH, LOCATION AND INCLINATION OF HOLES SHALL DEPEND ON WATER INFLOW CONDITIONS AND INFLOW DISTRIBUTION AT THE FACE WHERE GROUTING IS PERFORMED.FOR ANY FURTHER DETAILS REGARDING PROBE DRILLING SECTION 14 & ANNEXURE B OF WORKS REQUIREMENTS SHOULD BE REFFERED.

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited

AECOM

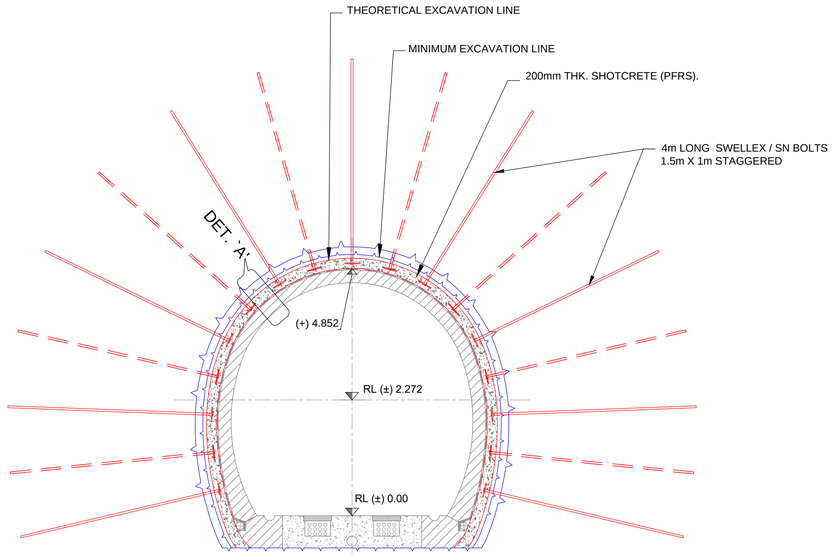
YOGENDRA	Eshita / Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

Title:

TUNNEL-13

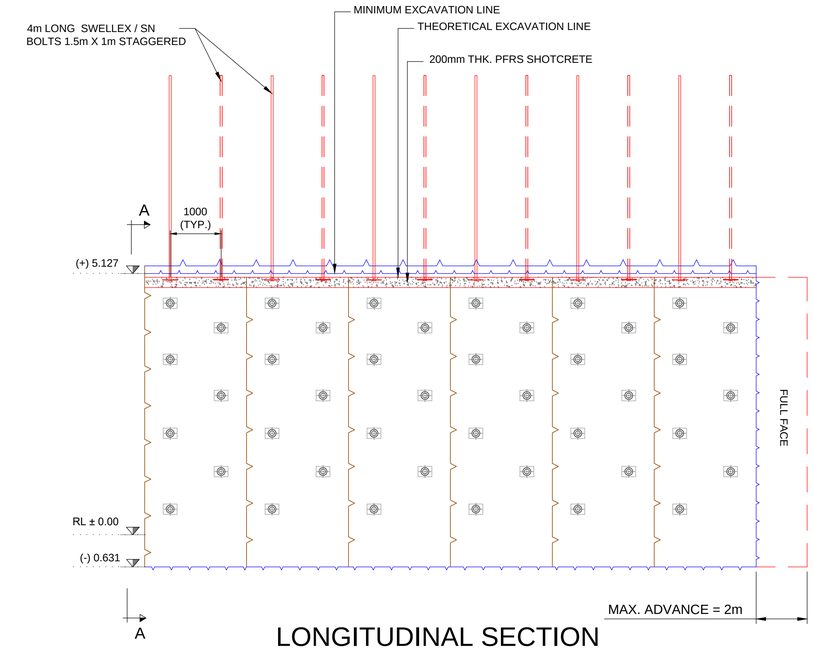
ESCAPE TUNNEL ROCK CLASS-B1 (WITHOUT INVERT) TYPICAL SUPPORT DETAILS

Drawing No. ACM-60598728-PKG7B-ET-ES-0301 | Scale AS SHOWN | Rev. 0



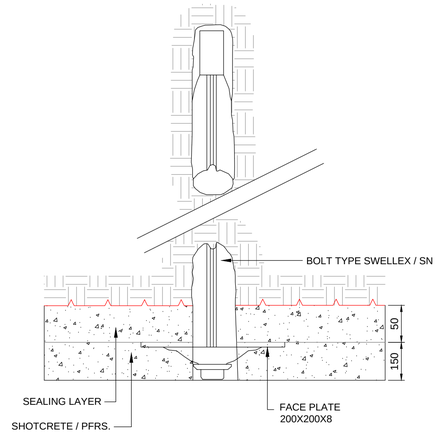
ESCAPE TUNNEL SECTION (WITH OUT INVERT ARCH) B2 CLASS

SCALE(A1) 1:60



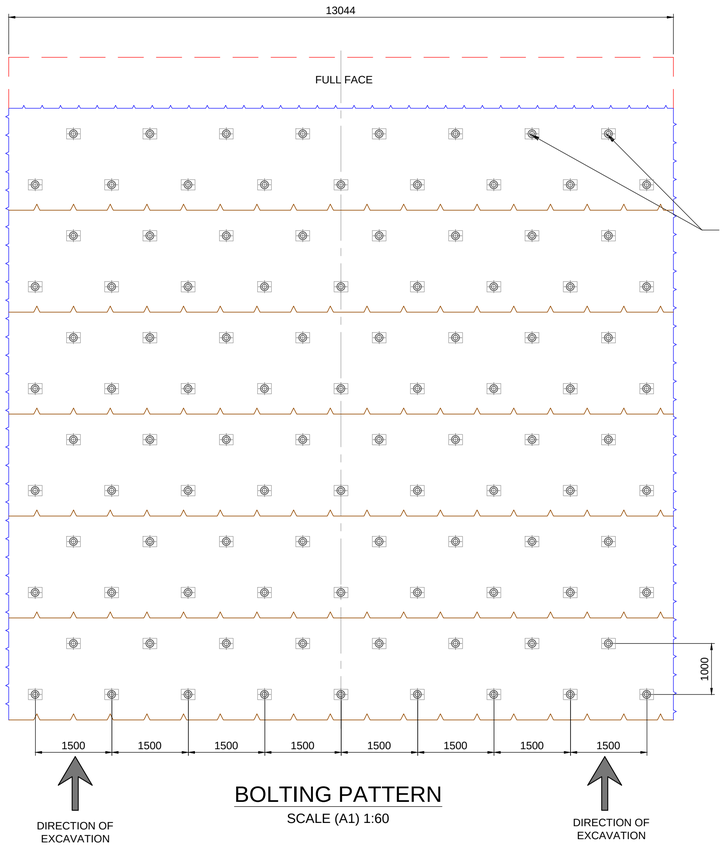
LONGITUDINAL SECTION

SCALE(A1) 1:60



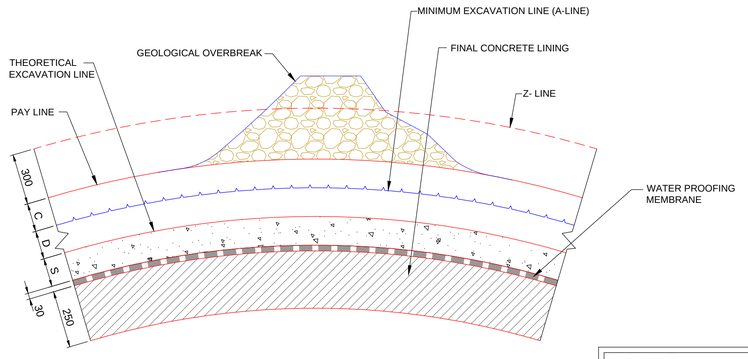
DETAIL OF BOLTS

SCALE (A1) 1:5



BOLTING PATTERN

SCALE (A1) 1:60



DETAIL AT - `A'

SCALE (A1) 1: 20

EXCAVATION & SUPPORT QUANTITIES / METER FOR ESCAPE TUNNEL SUPPORT CLASS B2				
MAXIMUM DEFORMATION TOLERANCE			D	75 mm
FULL FACE EXCAVATION	EXCAVATION	ROUND LENGTH		2 m
		THEORETICAL EXCAVATION VOLUME		28.98 m^3
	SUPPORT	SHOTCRETE (PFRS)	M:30, da=20mm	2.88 m^3
		SWELLEX BOLTS / SN	Fy 200kN, 4m 1.5m x 1m	9 Pcs

TENDER DRAWING

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. MINIMUM EXCAVATION LINE SHALL INCLUDE DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.
7. FOR OTHER NOTE REFER DWG.NO-ACM-60598728-PKG7B-GE-GA-0003 & 0004[0]
8. DRILLING OF PROBE HOLES SHALL BE MANDATORY AS SPECIFIED IN THE TECHNICAL SPECIFICATION FOR ADOPTION OF SUPPORT SYSTEM SHOWN IN THIS DRAWING.
9. THE CONTRACTOR SHALL DRILL HOLES AROUND THE PERIPHERY OF THE EXCAVATION FOR DRAINING THE SURROUNDING ROCK.THE MINIMUM DIAMETER OF HOLES SHALL BE 57 MM OR AS DIRECTED BY THE ENGINEER. THE NUMBER OF HOLES, DEPTH, LOCATION AND INCLINATION OF HOLES SHALL DEPEND ON WATER INFLOW CONDITIONS AND INFLOW DISTRIBUTION AT THE FACE WHERE GROUTING IS PERFORMED.FOR ANY FURTHER DETAILS REGARDING PROBE DRILLING SECTION 14 & ANNEXURE B OF WORKS REQUIREMENTS SHOULD BE REFFERED.

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

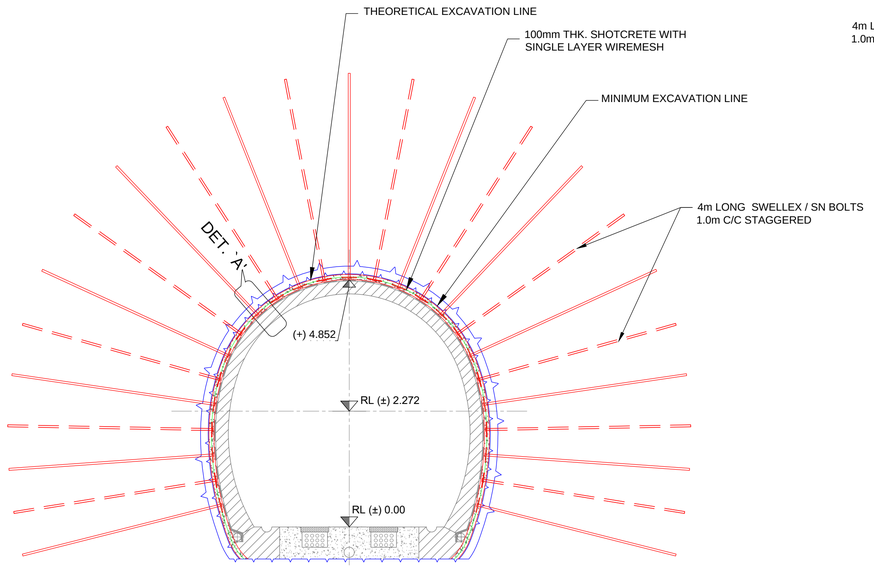
Project:
PACKAGE-7B
DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited | AECOM

YOGENDRA	Eshita / Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

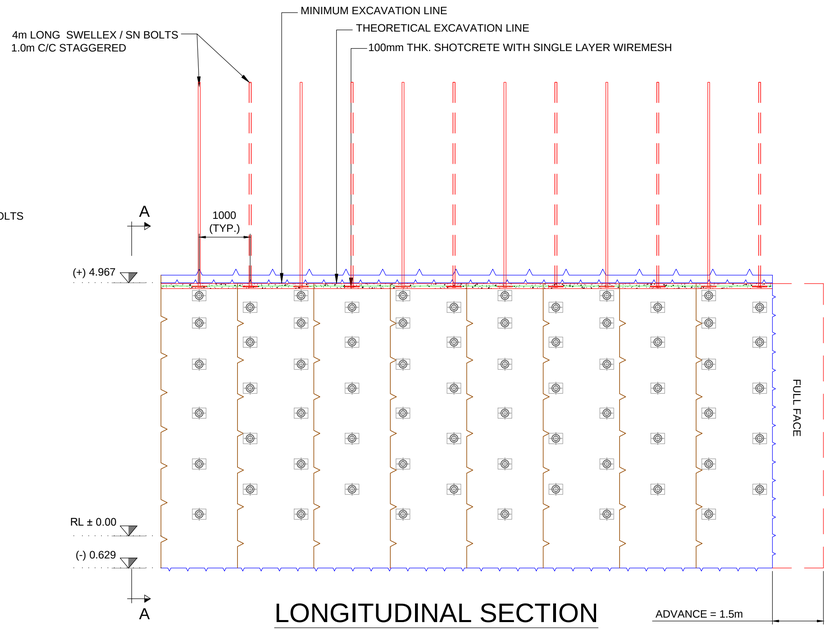
Title:
TUNNEL-13
ESCAPE TUNNEL ROCK CLASS-B2
(WITHOUT INVERT)
TYPICAL SUPPORT DETAILS

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-ET-ES-0302	AS SHOWN	0



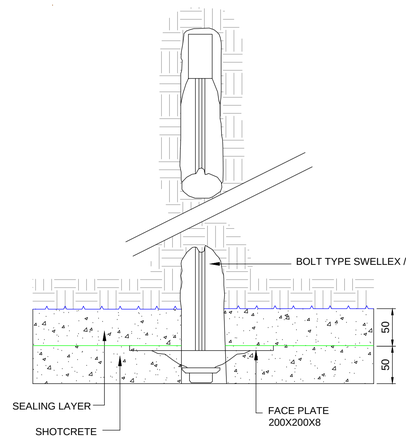
ESCAPE TUNNEL SECTION (WITH OUT INVERT ARCH) C1 CLASS

SCALE(A1) 1:60



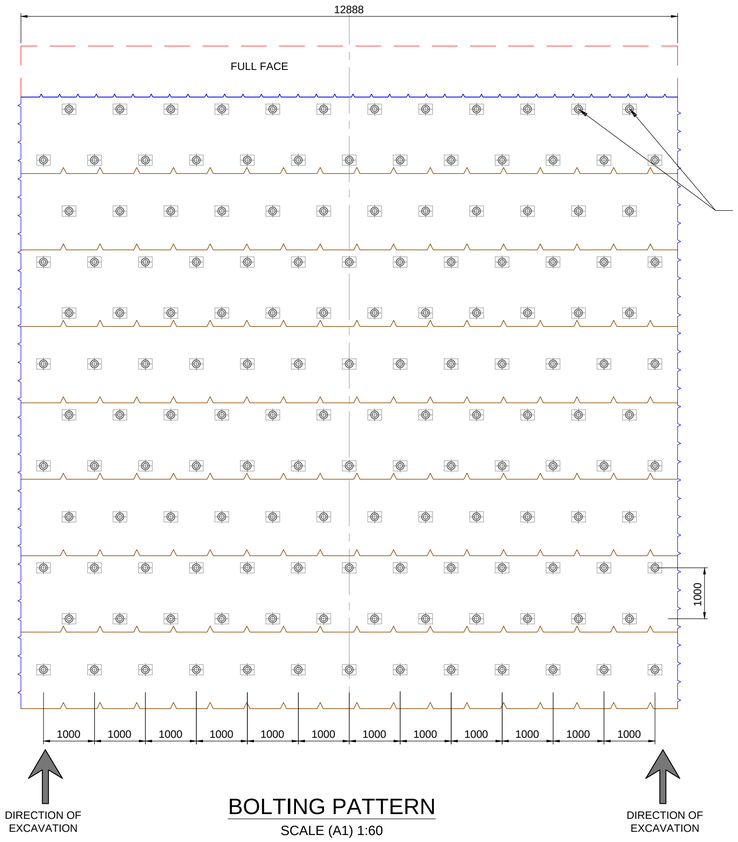
LONGITUDINAL SECTION

SCALE(A1) 1:60



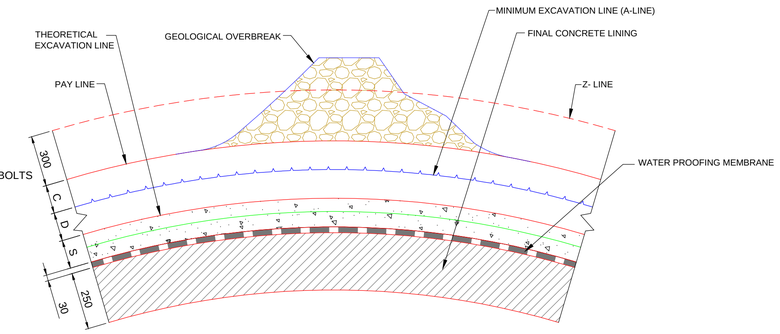
DETAIL OF BOLTS

SCALE (A1) 1:5



BOLTING PATTERN

SCALE (A1) 1:60



DETAIL AT - `A'

SCALE (A1) 1: 20

EXCAVATION & SUPPORT QUANTITIES / METER FOR ESCAPE TUNNEL SUPPORT CLASS C1					
MAXIMUM DEFORMATION TOLERANCE			D	15	mm
FULL FACE EXCAVATION	EXCAVATION	ROUND LENGTH	-	1.5	m
		THEORETICAL EXCAVATION VOLUME	-	28.63	m^3
		SHOTCRETE M30, ds= 100mm	-	1 42	m^3
	SUPPORT	WIRE MESH 150*150/6 mm	SINGLE LAYER	14 25	m^2
		SWELLEX BOLTS	Fy 200kN, 4m 1m x 1m	13	Pcs

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. MINIMUM EXCAVATION LINE SHALL INCLUDE DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.
7. FOR OTHER NOTE REFER DWG.NO-ACM-60598728-PKG7B-GE-GA-0003 & 0004[0]
8. DRILLING OF PROBE HOLES SHALL BE MANDATORY AS SPECIFIED IN THE TECHNICAL SPECIFICATION FOR ADOPTION OF SUPPORT SYSTEM SHOWN IN THIS DRAWING.
9. THE CONTRACTOR SHALL DRILL HOLES AROUND THE PERIPHERY OF THE EXCAVATION FOR DRAINING THE SURROUNDING ROCK.THE MINIMUM DIAMETER OF HOLES SHALL BE 57 MM OR AS DIRECTED BY THE ENGINEER. THE NUMBER OF HOLES, DEPTH, LOCATION AND INCLINATION OF HOLES SHALL DEPEND ON WATER INFLOW CONDITIONS AND INFLOW DISTRIBUTION AT THE FACE WHERE GROUTING IS PERFORMED.FOR ANY FURTHER DETAILS REGARDING PROBE DRILLING SECTION 14 & ANNEXURE B OF WORKS REQUIREMENTS SHOULD BE REFFERED.

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited गुणवत्ता, गति एवं पारदर्शिता (A Government of India Enterprise)

Project:

PACKAGE-7B

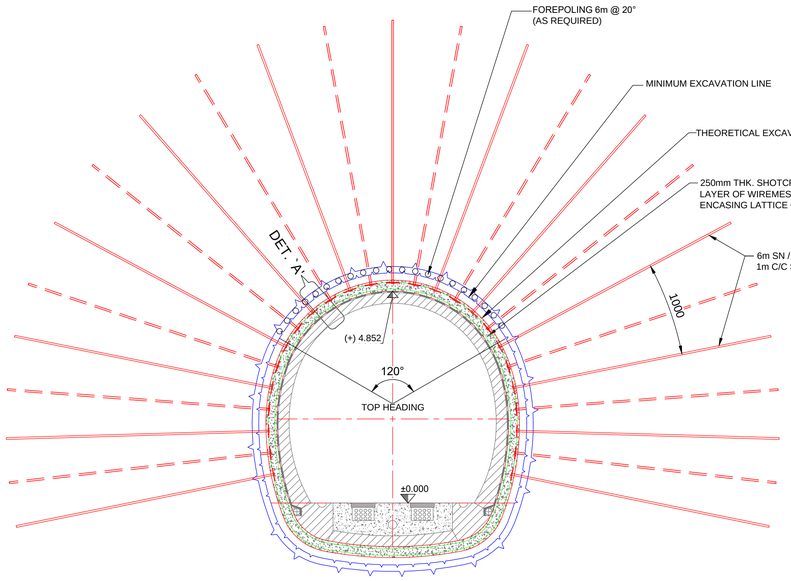
DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited | AECOM

YOGENDRA	Eshita / Preksha	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

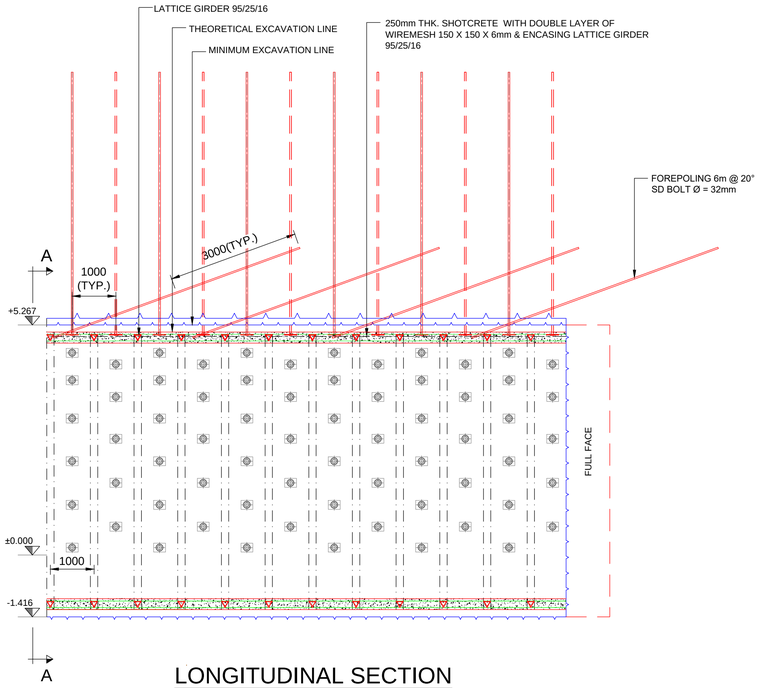
Title: TUNNEL-13 ESCAPE TUNNEL ROCK CLASS-C1 (WITHOUT INVERT) TYPICAL SUPPORT DETAILS

Drawing No. ACM-60598728-PKG7B-ET-ES-0303 | Scale AS SHOWN | Rev. 0



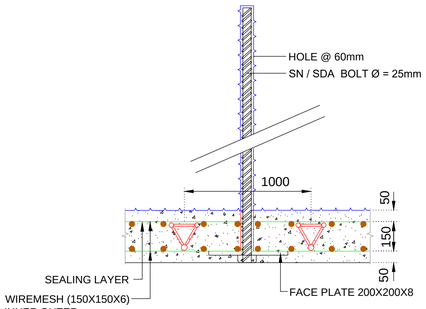
ESCAPE TUNNEL SECTION (WITH INVERT ARCH) C2 CLASS

SCALE(A1) 1:75



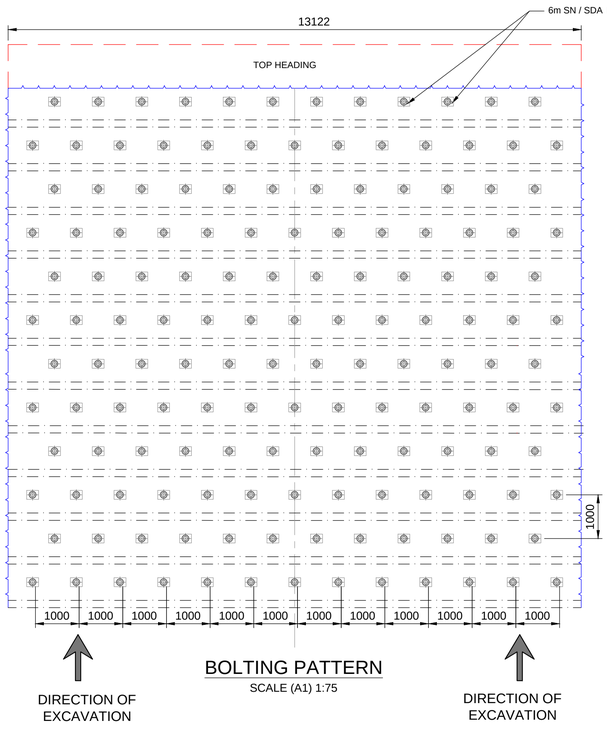
LONGITUDINAL SECTION

SCALE(A1) 1:75



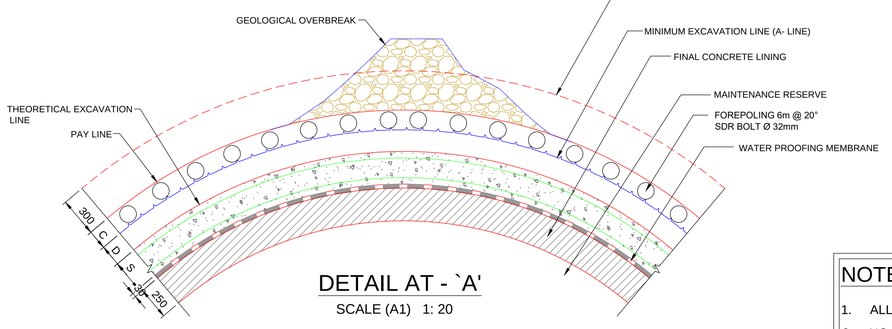
DETAIL OF SN BOLTS

EXCAVATION & SUPPORT QUANTITIES : METER FOR ESCAPE TUNNEL SUPPORT CLASS C2				
FULL FACE EXCAVATION	MAXIMUM DEFORMATION TOLERANCE	D	165	mm
	EXCAVATION — ROUND LENGTH		1	m
	EXCAVATION — THEORETICAL EXCAVATION VOLUME		34.22	m^3
	SUPPORT — SHOTCRETE	M30, ds=250mm	4.78	m^3
	SUPPORT — WIRE MESH 150/150/6 mm	OUTER / INNER LAYER	38.21	m^2
	SUPPORT — SN BOLTS	Fy 210kN, 6m 1m x 1m	13.00	Pcs
	SUPPORT — LATTICE GIRDER	95 / 16 / 25, 1m spacing	195.78	Kg
	SUPPORT — FOREPOLING (OPTIONAL)	SD BOLTS Ø32, C/C=300 L=6m	21.00	Pcs



BOLTING PATTERN

SCALE (A1) 1:75



DETAIL AT - `A'

SCALE (A1) 1: 20

TENDER DRAWING

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. MINIMUM EXCAVATION LINE SHALL INCLUDE DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.
7. FOR OTHER NOTE REFER DWG.NO-ACM-60598728-PKG7B-GE-GA-0003 & 0004[0]
8. DRILLING OF PROBE HOLES SHALL BE MANDATORY AS SPECIFIED IN THE TECHNICAL SPECIFICATION FOR ADOPTION OF SUPPORT SYSTEM SHOWN IN THIS DRAWING.
9. THE CONTRACTOR SHALL DRILL HOLES AROUND THE PERIPHERY OF THE EXCAVATION FOR DRAINING THE SURROUNDING ROCK.THE MINIMUM DIAMETER OF HOLES SHALL BE 57 MM OR AS DIRECTED BY THE ENGINEER. THE NUMBER OF HOLES, DEPTH, LOCATION AND INCLINATION OF HOLES SHALL DEPEND ON WATER INFLOW CONDITIONS AND INFLOW DISTRIBUTION AT THE FACE WHERE GROUTING IS PERFORMED.FOR ANY FURTHER DETAILS REGARDING PROBE DRILLING SECTION 14 & ANNEXURE B OF WORKS REQUIREMENTS SHOULD BE REFFERED.

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

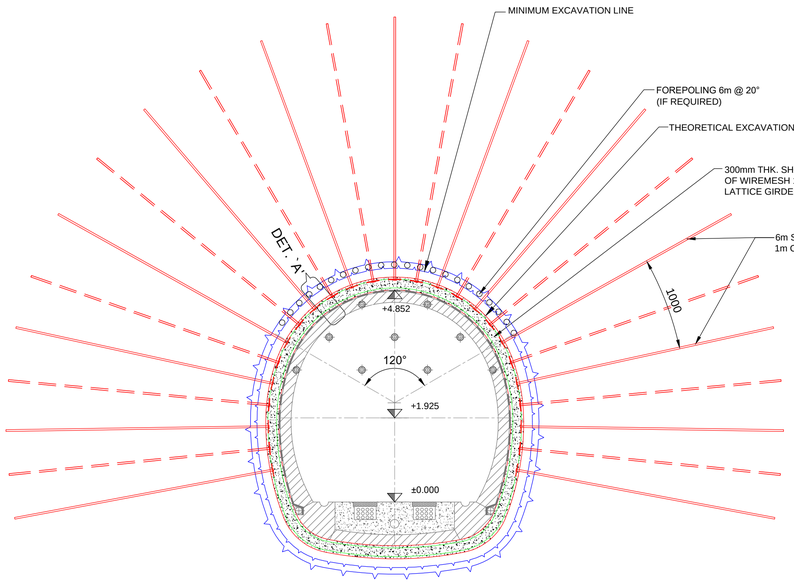
DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited | AECOM

Yogendra	Eshita / Preksha	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

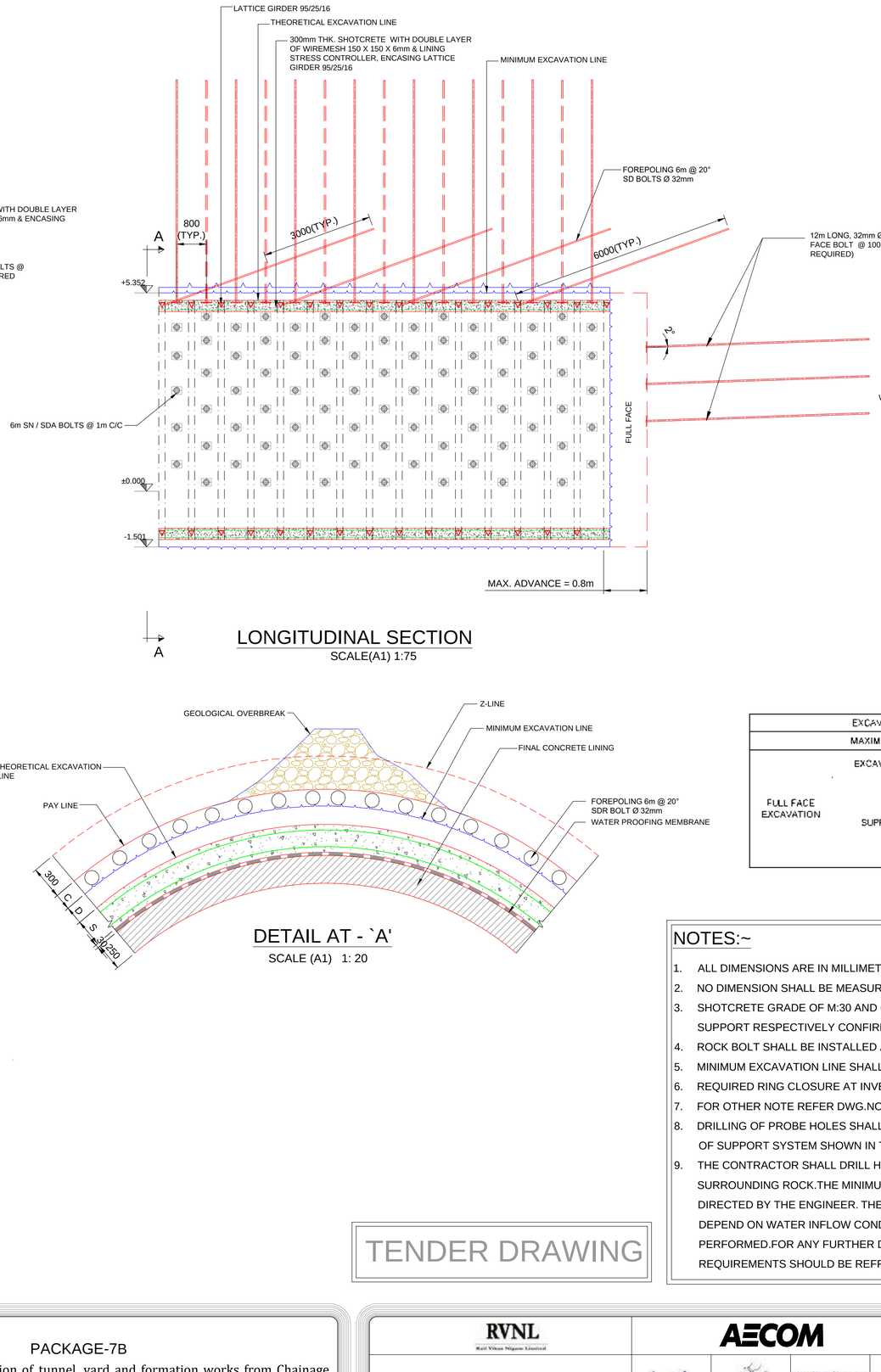
Title: TUNNEL-13 ESCAPE TUNNEL ROCK CLASS - C2 (WITH INVERT) TYPICAL SUPPORT DETAILS (SHEET 1 OF 1)

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-ET-ES-0304	AS SHOWN	0



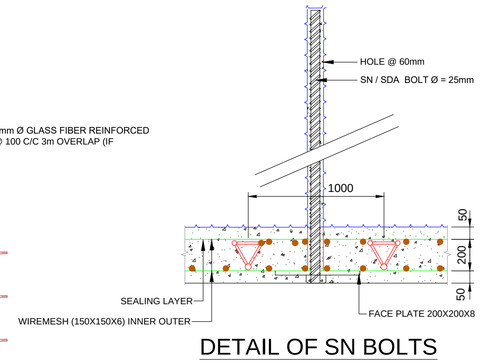
ESCAPE TUNNEL SECTION (WITH INVERT ARCH) C3 CLASS

SCALE(A1) 1:75

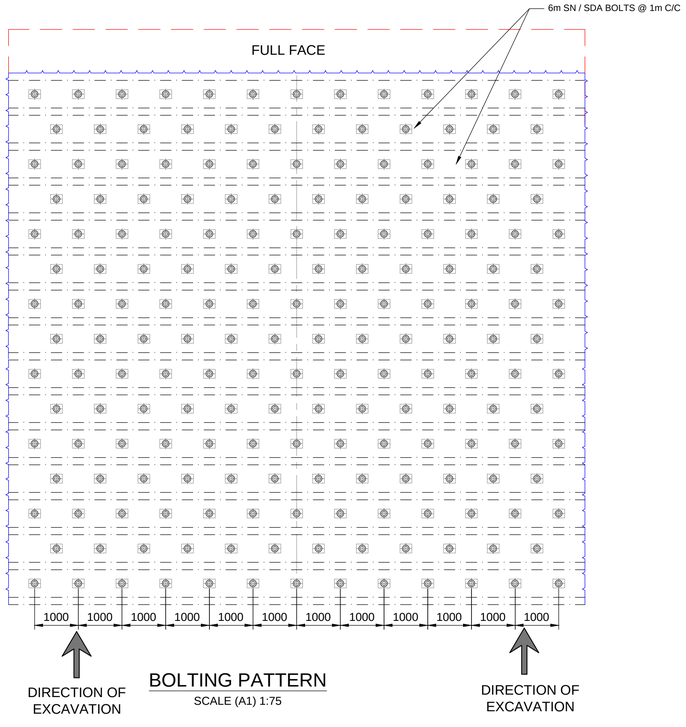


LONGITUDINAL SECTION

SCALE(A1) 1:75



DETAIL OF SN BOLTS



BOLTING PATTERN

SCALE (A1) 1:75

DETAIL AT - `A'

SCALE (A1) 1: 20

EXCAVATION & SUPPORT QUANTITIES / METER FOR ESCAPE TUNNEL SUPPORT CLASS C3				
MAXIMUM DEFORMATION TOLERANCE		D	200	mm
FULL FACE EXCAVATION	EXCAVATION	ROUND LENGTH	0.8	m
		THEORETICAL EXCAVATION VOLUME	36.02	m^3
	SUPPORT	SHOTCRETE M30, ds=300mm	5.78	m^3
		WIRE MESH 150/150/6 mm OUTER / INNER LAYER	38.53	m^2
		SN BOLTS Fy 200kN, 9m, 1m x 1m	15.25	Pcs
		LATTICE GIRDER 95 / 25, 1 per round	248.66	Kg
		FOREPOLING (OPTIONAL) SD BOLTS Ø32, C/C=300, L=6m	22.00	Pcs
		FACE SUPPORT (GLASS FIBER BOLTS) (IF REQUIRED) Ø32, 12m , 1.5m SPACING	9.00	Pcs

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. MINIMUM EXCAVATION LINE SHALL INCLUDE DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.
7. FOR OTHER NOTE REFER DWG.NO-ACM-60598728-PKG7B-GE-GA-0003 & 0004[0]
8. DRILLING OF PROBE HOLES SHALL BE MANDATORY AS SPECIFIED IN THE TECHNICAL SPECIFICATION FOR ADOPTION OF SUPPORT SYSTEM SHOWN IN THIS DRAWING.
9. THE CONTRACTOR SHALL DRILL HOLES AROUND THE PERIPHERY OF THE EXCAVATION FOR DRAINING THE SURROUNDING ROCK.THE MINIMUM DIAMETER OF HOLES SHALL BE 57 MM OR AS DIRECTED BY THE ENGINEER. THE NUMBER OF HOLES, DEPTH, LOCATION AND INCLINATION OF HOLES SHALL DEPEND ON WATER INFLOW CONDITIONS AND INFLOW DISTRIBUTION AT THE FACE WHERE GROUTING IS PERFORMED.FOR ANY FURTHER DETAILS REGARDING PROBE DRILLING SECTION 14 & ANNEXURE B OF WORKS REQUIREMENTS SHOULD BE REFFERED.

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

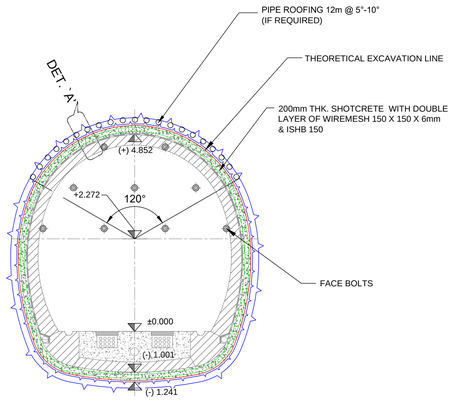
DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited | AECOM

Yogendra	Eshita / Preksha	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

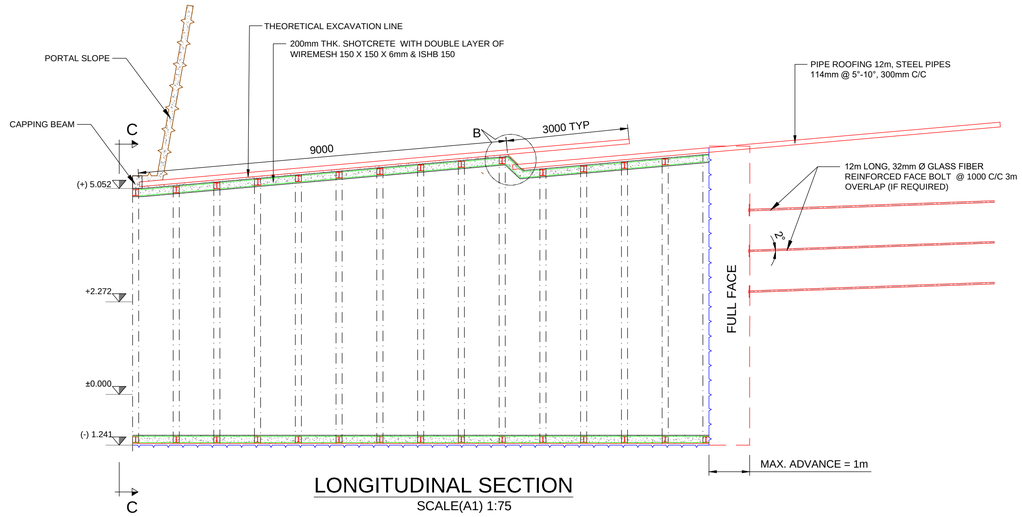
Title: TUNNEL-13
ESCAPE TUNNEL ROCK CLASS - C3
(WITH INVERT) TYPICAL SUPPORT DETAILS
(SHEET 1 OF 1)

Drawing No ACM-60598728-PKG7B-ET-ES-0305 | Scale AS SHOWN | Rev. 0



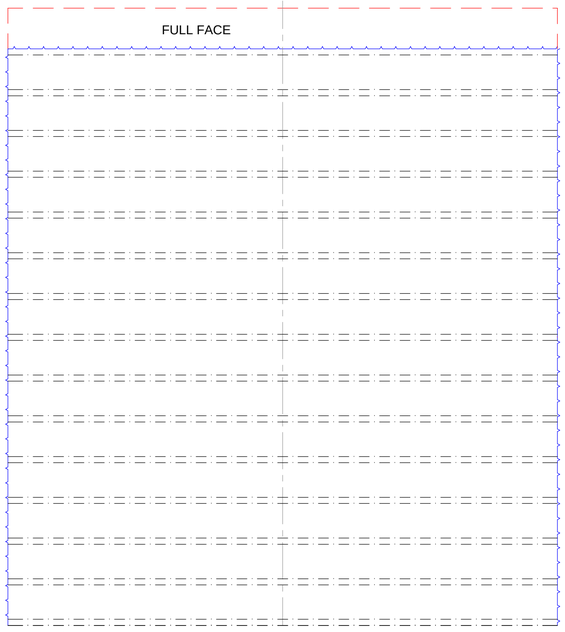
ESCAPE TUNNEL SECTION (WITH INVERT ARCH) P CLASS

SCALE(A1) 1:75



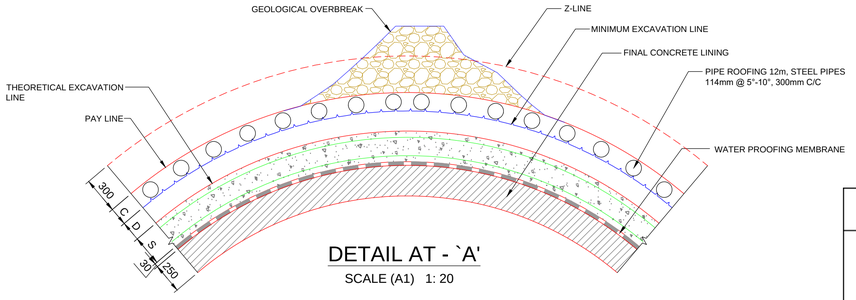
LONGITUDINAL SECTION

SCALE(A1) 1:75



EXCAVATION SEQUENCE

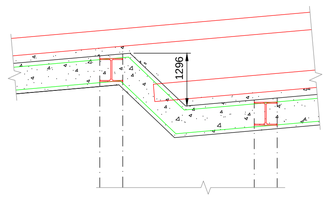
SCALE (A1) 1:75



DETAIL AT - `A'

SCALE (A1) 1: 20

EXCAVATION & SUPPORT QUANTITIES / METER FOR ESCAPE TUNNEL SUPPORT CLASS P				
MAXIMUM DEFORMATION TOLERANCE			D	40 mm
FULL FACE EXCAVATION	EXCAVATION	ROUND LENGTH		1 m
		THEORETICAL EXCAVATION VOLUME		30 65 m^3
	SUPPORT	SHOTCRETE	M30, ds=200mm	3 79 m^3
		WIRE MESH 150/150/6 mm	OUTER / INNER LAYER	37 90 m^2
		STEEL RIB	ISHB 150, 1m SPACING	655 67 Kg
		PIPE ROOFING (OPTIONAL)	Ø114.3, 8mm THK., C/C=300, L=12m	20.00 Pcs.
		FACE SUPPORT (GLASS FIBER BOLTS) (IF REQUIRED)	Ø32, 12m, 1 5m SPACING	9 00 Pcs



DETAIL AT - `B'

SCALE (A1) 1: 20

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. MINIMUM EXCAVATION LINE SHALL INCLUDE DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.
7. FOR OTHER NOTE REFER DWG.NO-ACM-60598728-PKG7B-GE-GA-0003 & 0004[0]
8. DRILLING OF PROBE HOLES SHALL BE MANDATORY AS SPECIFIED IN THE TECHNICAL SPECIFICATION FOR ADOPTION OF SUPPORT SYSTEM SHOWN IN THIS DRAWING.
9. THE CONTRACTOR SHALL DRILL HOLES AROUND THE PERIPHERY OF THE EXCAVATION FOR DRAINING THE SURROUNDING ROCK.THE MINIMUM DIAMETER OF HOLES SHALL BE 57 MM OR AS DIRECTED BY THE ENGINEER. THE NUMBER OF HOLES, DEPTH, LOCATION AND INCLINATION OF HOLES SHALL DEPEND ON WATER INFLOW CONDITIONS AND INFLOW DISTRIBUTION AT THE FACE WHERE GROUTING IS PERFORMED.FOR ANY FURTHER DETAILS REGARDING PROBE DRILLING SECTION 14 & ANNEXURE B OF WORKS REQUIREMENTS SHOULD BE REFFERED.

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited गुणवत्ता, गति एवं पारदर्शिता (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

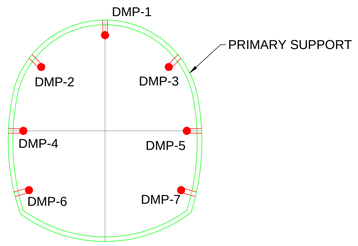
RVNL Rail Vikas Nigam Limited | AECOM

Yogendra	Eshita / Preksha	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

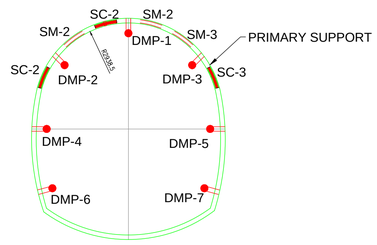
Title: TUNNEL-13 ESCAPE TUNNEL ROCK CLASS - PORTAL (WITH INVERT) TYPICAL SUPPORT DETAILS (SHEET 1 OF 1)

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-ET-ES-0306	AS SHOWN	0

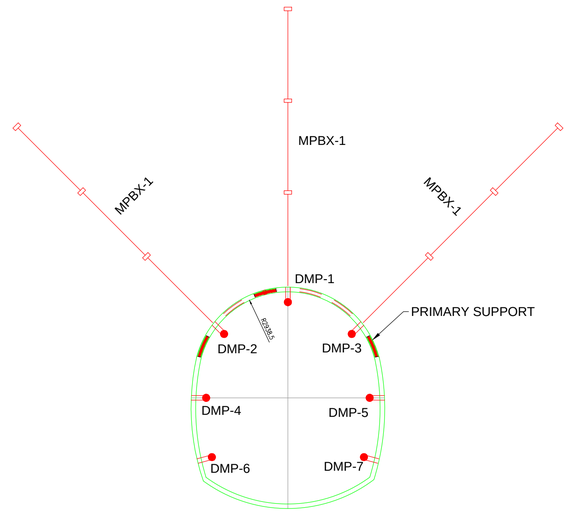
1. SAME NUMBERS AND LOCATIONS OF INSTRUMENTATION ENVISAGED FOR FULL FACE EXCAVATION AND EXCAVATION WITH TOP HEADING AND BENCHING.
2. FOR MAIN MONITORING CROSS SECTIONS, EITHER STRAIN METERS OR STRESS CELLS ARE INSTALLED AT ALTERNATE SECTIONS.
3. THE NUMBERS, LOCATIONS AND FREQUENCY OF INSTRUMENTATION ARE SUBJECT TO CHANGE ACCORDING TO THE ENGINEER'S INSTRUCTIONS ON SITE.



STANDARD MONITORING CROSS SECTION



MAIN MONITORING CROSS SECTION



MAIN MONITORING CROSS SECTION WITH EXTENSOMETERS

FREQUENCY OF MEASUREMENT UPON TUNNEL EXCAVATION:

FREQUENCY OF MEASUREMENT	
WEEK 1	ONCE PER DAY
WEEK 2	TWICE IN A WEEK
WEEKS 3 & 4	ONCE PER WEEK
AFTER WEEK 4	ONCE EVERY TWO MONTHS

ABBREVIATIONS:

DMP POINTS WITH OPTICAL TARGETS FOR 3D DISPLACEMENT MONITORING

SM STRAIN METER

SC STRESS CELL

MPBX MULTI POINT BOREHOLE EXTENSOMETER (WITH MEASURING POINTS AT 3m , 6m & 9m)

INSTRUMENTATION INTERVALS FOR DIFFERENT SUPPORT CLASSES:

SUPPORT CLASS	INTERVALS FOR INSTRUMENTATION		
	STANDARD MONITORING	MAIN MONITORING	MAIN MONITORING WITH EXTENSOMETERS
CLASS B1	50m	150m (OR AS REQUIRED BY ENGINEER)	500m (OR AS REQUIRED BY ENGINEER)
CLASS B2	50m		
CLASS C1	25m		
CLASS C2	20m		
CLASS C3	15m		
CLASS P	10m		

NOTE : ONLY SM OR SC ARE INSTALLED AT EACH ALTERNATE CROSS SECTION

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

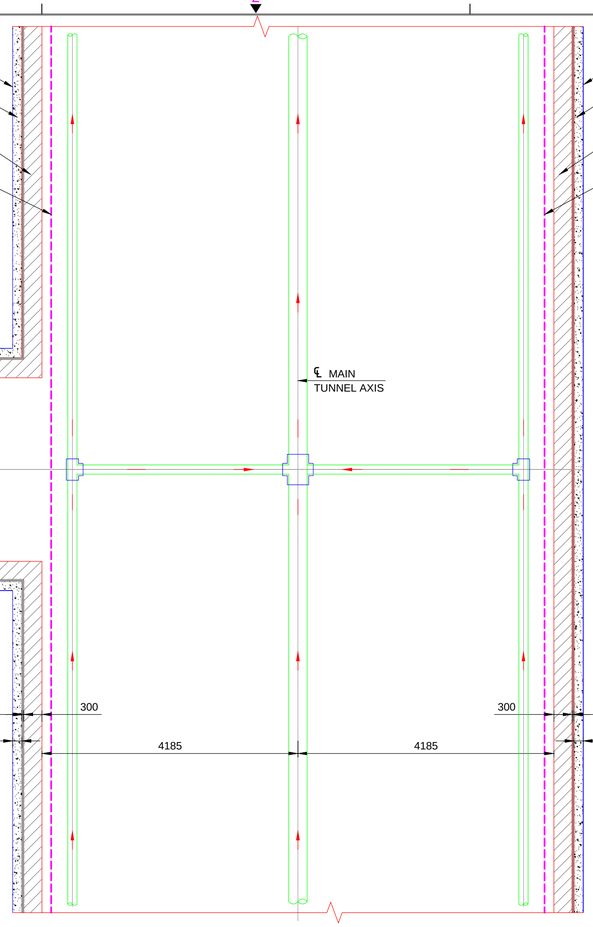
RVNL Rail Vikas Nigam Limited | AECOM

Yogendra	Eshita / Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

Title:

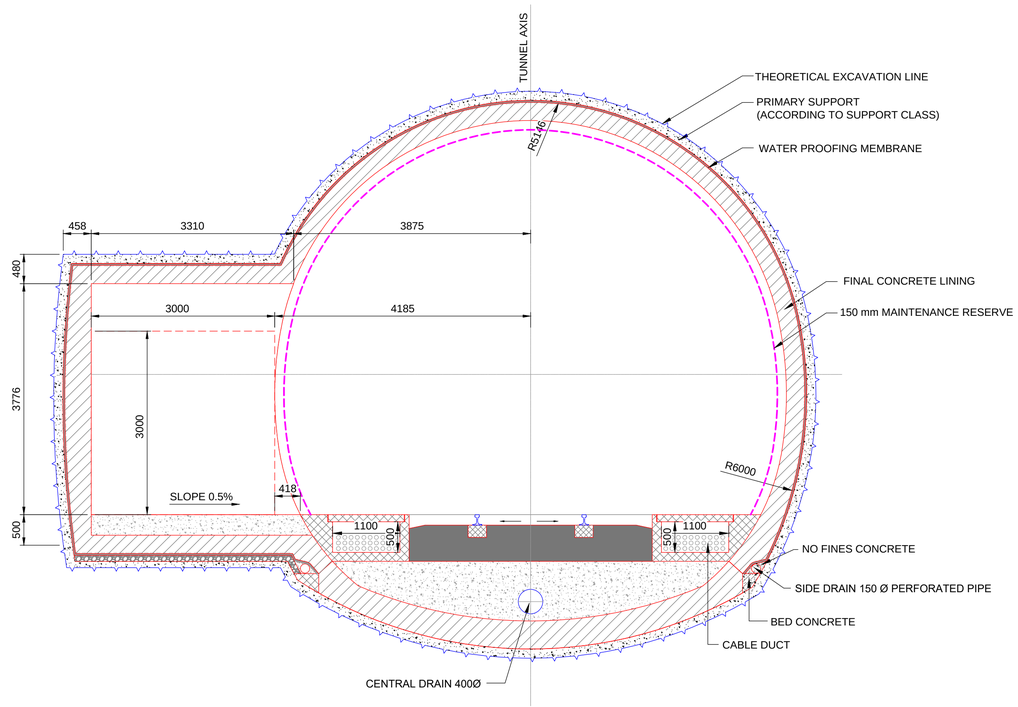
TUNNEL-13
ESCAPE TUNNEL
GEOTECHNICAL INSTRUMENTATION & MONITORING
(SHEET 1 OF 1)

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-MT-IM-0381	AS SHOWN	1



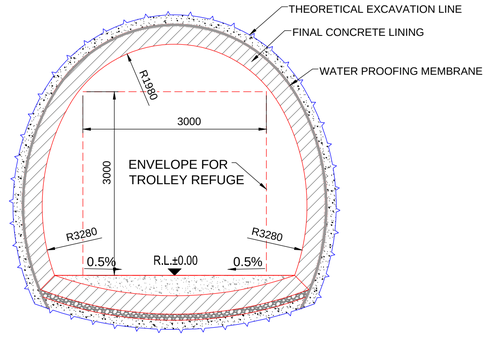
JUNCTION PLAN AT TROLLEY NICHE & MAIN TUNNEL

SCALE 1:50



SECTION 1 - 1

SCALE 1:50



SECTION 2 - 2
CROSS SECTION OF TROLLEY NICHE WITH INVERT

SCALE(A1) 1:50

TENDER DRAWING

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. EXCAVATION LINE SHOULD INCLUDE CONSTRUCTION & DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

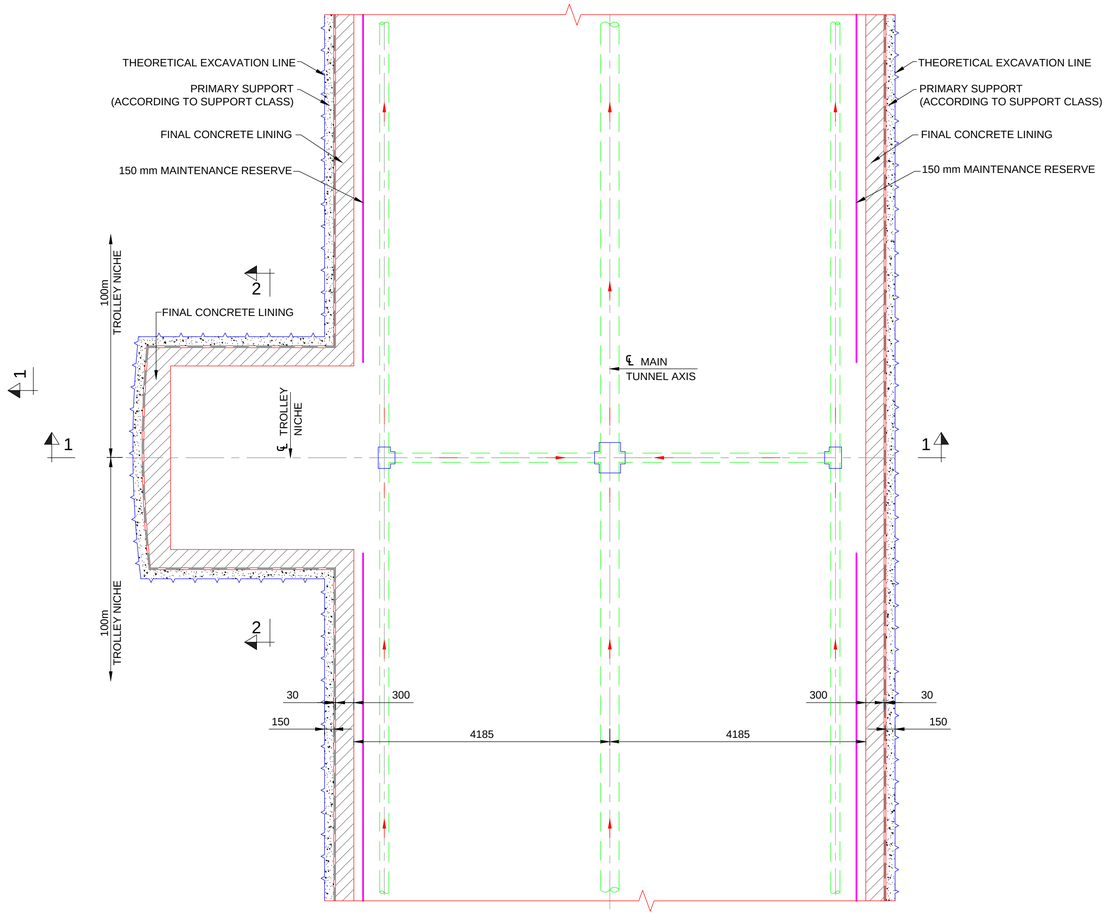
RVNL Rail Vikas Nigam Limited | AECOM

Debasis Bag	Eshita / Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

Title:

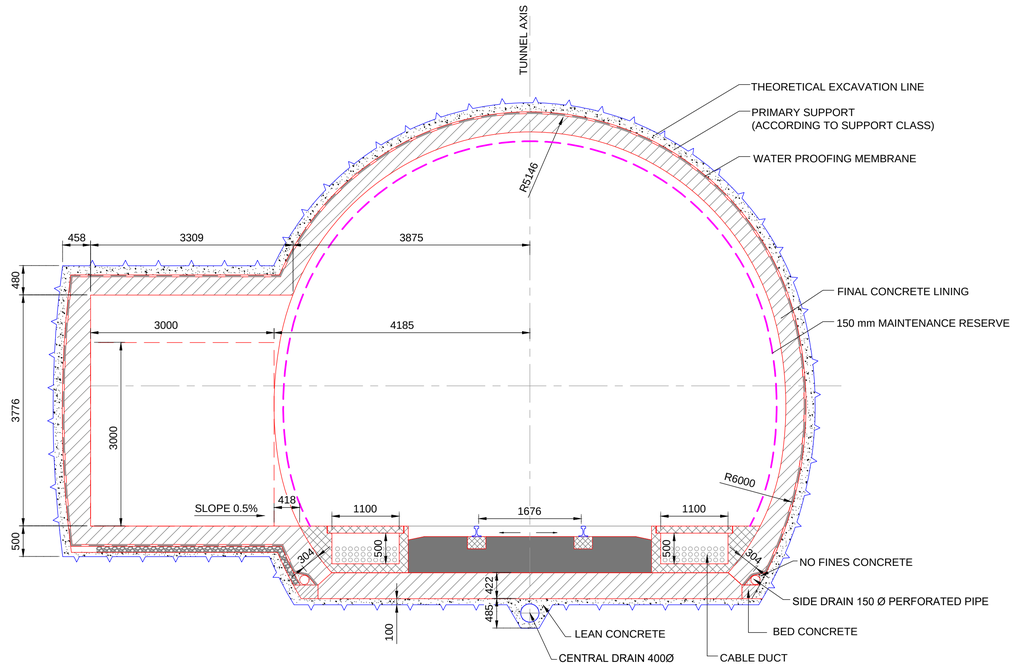
TUNNEL-13
TYPICAL CROSS SECTION
FOR TROLLEY REFUGE NICHE WITH INVERT
(SHEET 1 OF 1)

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-TN-CS-0401	AS SHOWN	0



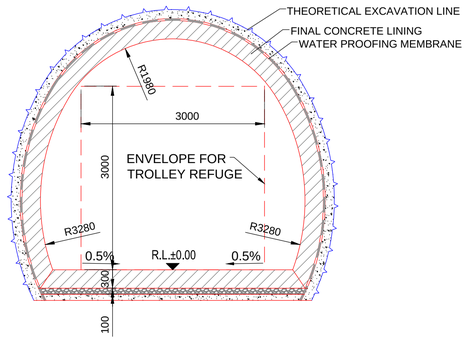
JUNCTION PLAN AT TROLLEY NICHE & MAIN TUNNEL

SCALE 1:50



SECTION 1 - 1

SCALE 1:50



SECTION 2 - 2
CROSS SECTION OF TROLLEY NICHE WITHOUT INVERT

SCALE(A1) 1:50

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. EXCAVATION LINE SHOULD INCLUDE CONSTRUCTION & DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited गुणवत्ता, गति एवं पारदर्शिता (A Government of India Enterprise)

Project:

PACKAGE-7B

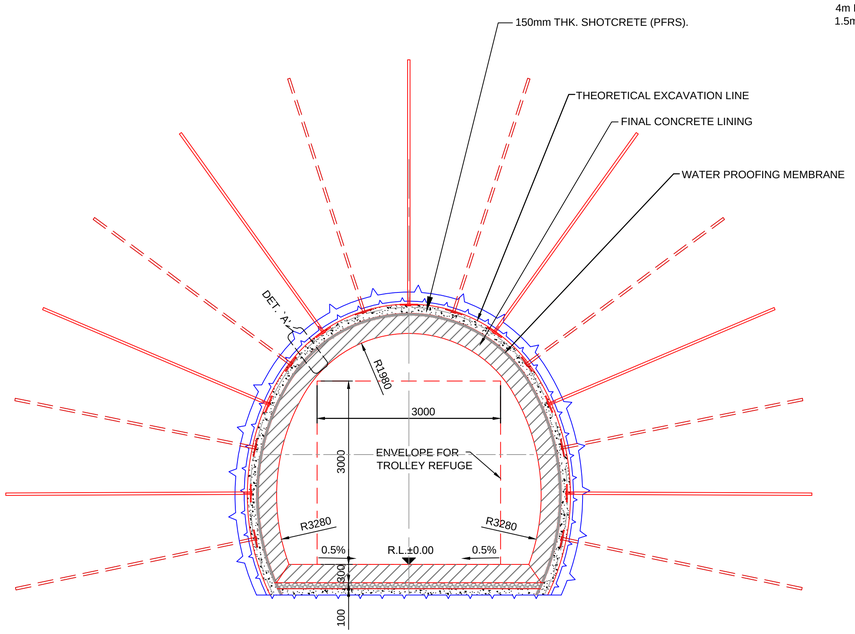
DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited | AECOM

Debasis Bag	Eshita / Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

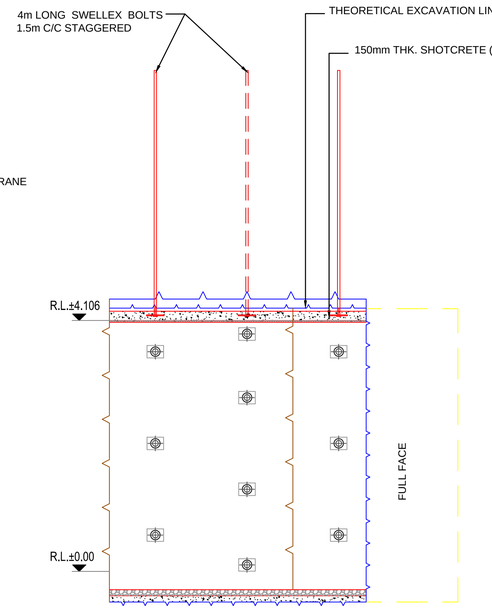
Title: TUNNEL-13
TYPICAL CROSS SECTION
FOR TROLLEY REFUGE NICHE WITHOUT INVERT
(SHEET 1 OF 1)

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-TN-CS-0402	AS SHOWN	0



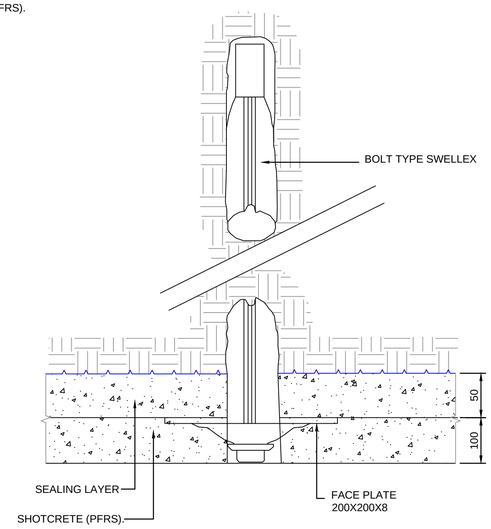
SUPPORT CLASS B1 (SECTION A)

SCALE(A1) 1:50



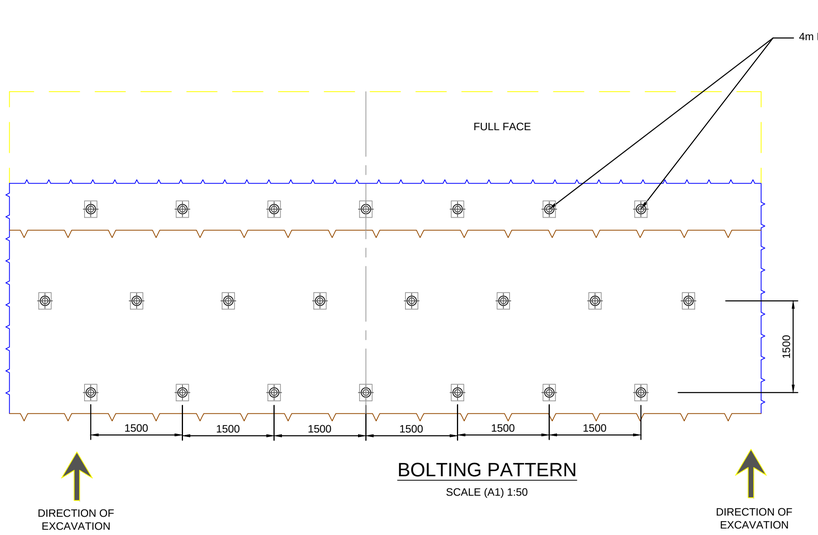
LONGITUDINAL SECTION

SCALE(A1) 1:50



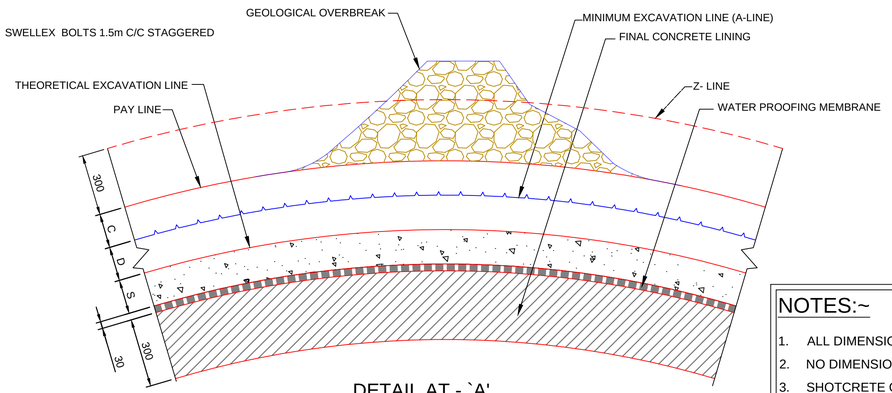
DETAIL OF BOLTS

EXCAVATION & SUPPORT QUANTITIES/ROUND FOR TROLLEY NICHE SUPPORT CLASS -B1				
FULL FACE EXCAVATION	DEFORMATION TOLERANCE		D	50mm
	EXCAVATION	ROUND LENGTH		3m
		THEORETICAL EXCAVATION VOLUME		65.89m³
	SUPPORT	SHOTCRETE (PFRS)		5.32m³
		SWELLEX BOLTS	Fy 200KN, 4m	15 Pcs.



BOLTING PATTERN

SCALE (A1) 1:50



DETAIL AT - `A'

SCALE (A1) 1: 20

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. MINIMUM EXCAVATION LINE SHALL INCLUDE DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.
7. FOR OTHER NOTE REFER DWG.NO-ACM-60603749-PKG7B-GE-GA-0003 & 0004[0]
8. DRILLING OF PROBE HOLES SHALL BE MANDATORY AS SPECIFIED IN THE TECHNICAL SPECIFICATION FOR ADOPTION OF SUPPORT SYSTEM SHOWN IN THIS DRAWING.
9. THE CONTRACTOR SHALL DRILL HOLES AROUND THE PERIPHERY OF THE EXCAVATION FOR DRAINING THE SURROUNDING ROCK.THE MINIMUM DIAMETER OF HOLES SHALL BE 57 MM OR AS DIRECTED BY THE ENGINEER. THE NUMBER OF HOLES, DEPTH, LOCATION AND INCLINATION OF HOLES SHALL DEPEND ON WATER INFLOW CONDITIONS AND INFLOW DISTRIBUTION AT THE FACE WHERE GROUTING IS PERFORMED.FOR ANY FURTHER DETAILS REGARDING PROBE DRILLING SECTION 14 & ANNEXURE B OF WORKS REQUIREMENTS SHOULD BE REFFERED.

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited गुणवत्ता, गति एवं पारदर्शिता (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

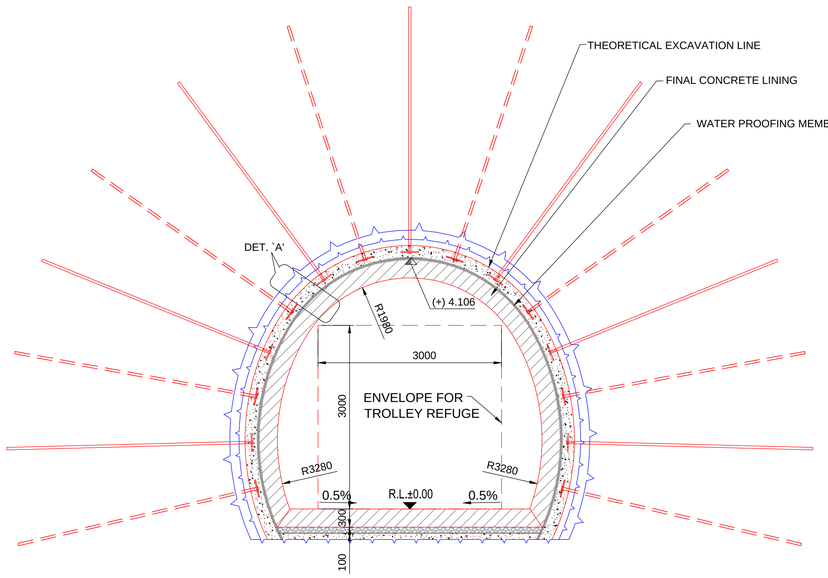
RVNL Rail Vikas Nigam Limited

AECOM

RAJESH K	Eshita / Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

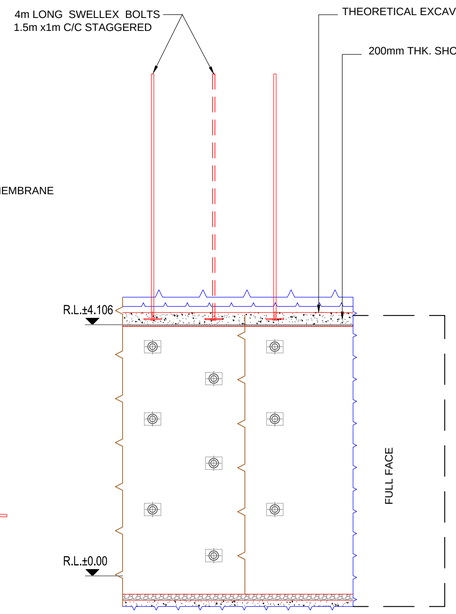
Title: TUNNEL-13
TROLLEY NICHE - ROCK CLASS - B1
(WITH OUT INVERT) TYPICAL SUPPORT DETAILS
(SHEET 1 OF 1)

Drawing No ACM-60603749-PKG7B-TN-ES-0406 | Scale AS SHOWN | Rev. 0



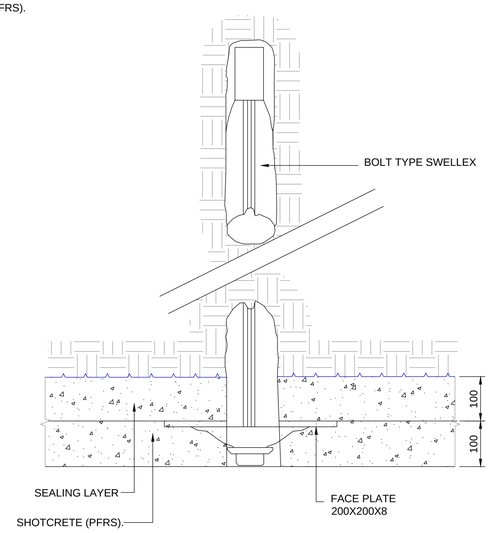
SUPPORT CLASS B2 (SECTION A)

SCALE(A1) 1:50



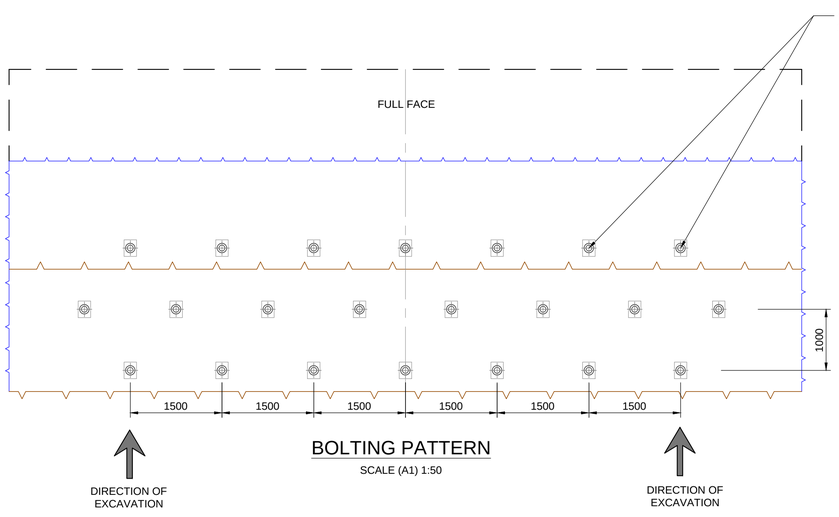
LONGITUDINAL SECTION

SCALE(A1) 1:50



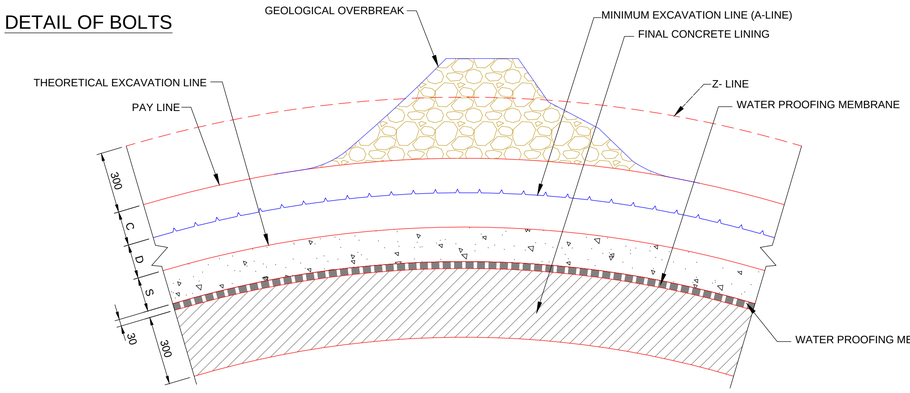
DETAIL OF BOLTS

EXCAVATION & SUPPORT QUANTITIES/ROUND FOR TROLLEY NICHE SUPPORT CLASS -B2				
FULL FACE EXCAVATION	DEFORMATION TOLERANCE		D	100mm
	EXCAVATION	ROUND LENGTH		2m
		THEORETICAL EXCAVATION VOLUME		46.49m³
	SUPPORT	SHOTCRETE (PFRS)	M30, s=200mm	4.76m³
		SWELLEX BOLTS	Fy 200KN, 4m 1.5mx1m	15 Pcs.



BOLTING PATTERN

SCALE (A1) 1:50



DETAIL AT - `A'

SCALE (A1) 1: 20

TENDER DRAWING

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. MINIMUM EXCAVATION LINE SHALL INCLUDE DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.
7. FOR OTHER NOTE REFER DWG.NO-ACM-60598728-PKG7B-GE-GA-0003 & 0004[0]
8. DRILLING OF PROBE HOLES SHALL BE MANDATORY AS SPECIFIED IN THE TECHNICAL SPECIFICATION FOR ADOPTION OF SUPPORT SYSTEM SHOWN IN THIS DRAWING.
9. THE CONTRACTOR SHALL DRILL HOLES AROUND THE PERIPHERY OF THE EXCAVATION FOR DRAINING THE SURROUNDING ROCK.THE MINIMUM DIAMETER OF HOLES SHALL BE 57 MM OR AS DIRECTED BY THE ENGINEER. THE NUMBER OF HOLES, DEPTH, LOCATION AND INCLINATION OF HOLES SHALL DEPEND ON WATER INFLOW CONDITIONS AND INFLOW DISTRIBUTION AT THE FACE WHERE GROUTING IS PERFORMED.FOR ANY FURTHER DETAILS REGARDING PROBE DRILLING SECTION 14 & ANNEXURE B OF WORKS REQUIREMENTS SHOULD BE REFFERED.

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

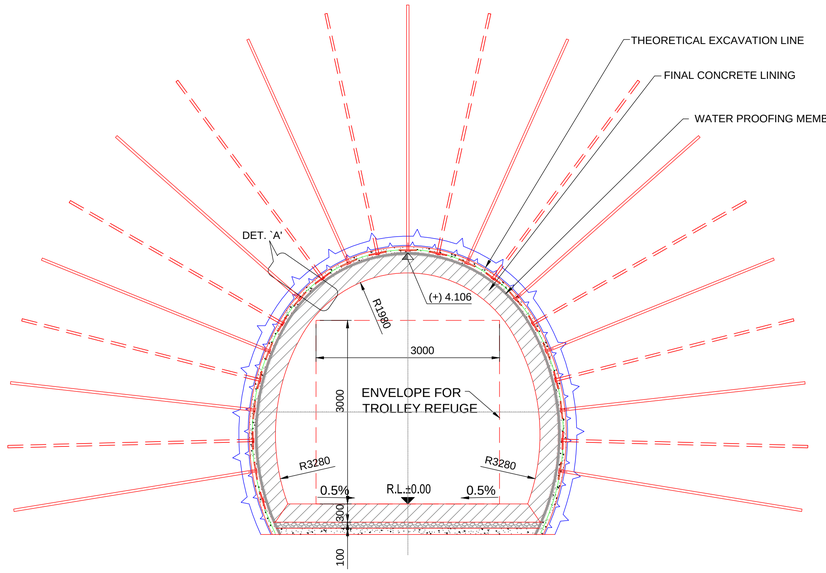
RVNL Rail Vikas Nigam Limited | AECOM

RAJESH K	Eshita / Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

Title: TUNNEL-13
TROLLEY NICHE - ROCK CLASS - B2
(WITH OUT INVERT) TYPICAL SUPPORT DETAILS
(SHEET 1 OF 1)

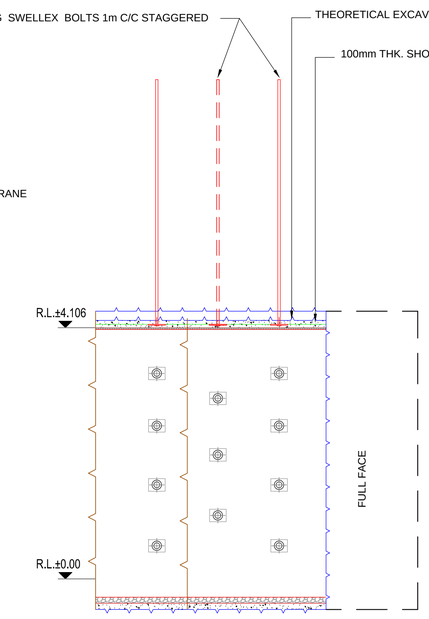
Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-TN-CS-0407	AS SHOWN	0

EXCAVATION & SUPPORT QUANTITIES/ROUND FOR TROLLEY NICHE SUPPORT CLASS -C1				
FULL FACE EXCAVATION	DEFORMATION TOLERANCE		D	20mm
	EXCAVATION	ROUND LENGTH		1.5m
		THEORETICAL EXCAVATION AREA		31.44m³
	SUPPORT	SHOTCRETE		1.75m³
		SWELLEX BOLTS	Fy 200KN, 4m 1 x 1	17 Pcs.
		WIRE MESH	SINGLE LAYER 150/150/6 mm	18.15m²



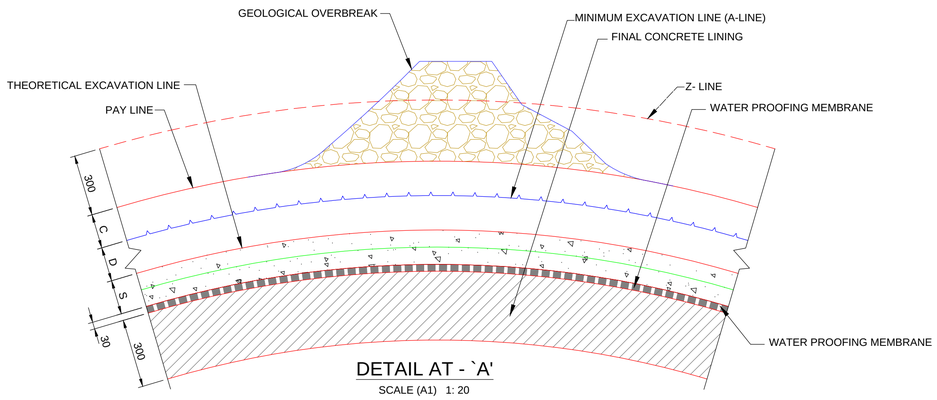
SUPPORT CLASS C1 (SECTION A)

SCALE(A1) 1:50



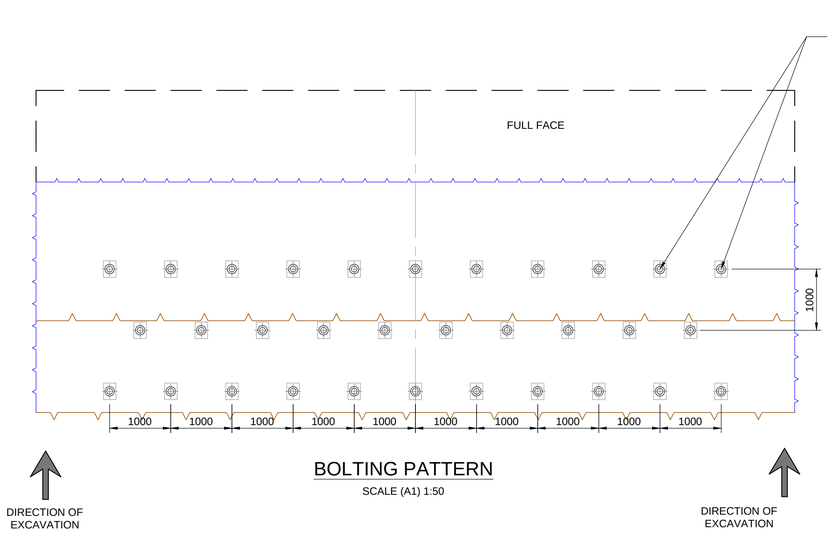
LONGITUDINAL SECTION

SCALE(A1) 1:50



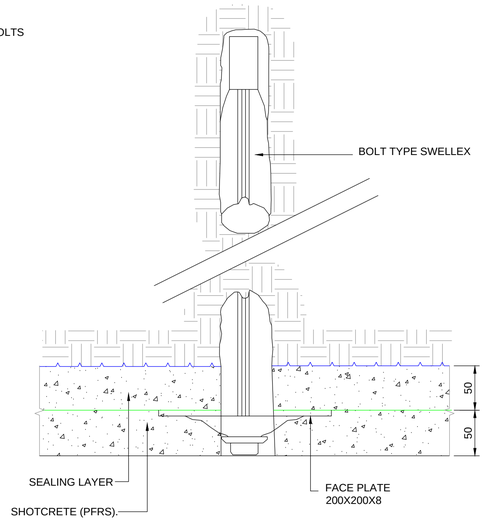
DETAIL AT - `A'

SCALE (A1) 1: 20



BOLTING PATTERN

SCALE (A1) 1:50



DETAIL OF BOLTS

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. MINIMUM EXCAVATION LINE SHALL INCLUDE DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.
7. FOR OTHER NOTE REFER DWG.NO-ACM-60603749-PKG7B-GE-GA-0003 & 0004[0]
8. DRILLING OF PROBE HOLES SHALL BE MANDATORY AS SPECIFIED IN THE TECHNICAL SPECIFICATION FOR ADOPTION OF SUPPORT SYSTEM SHOWN IN THIS DRAWING.
9. THE CONTRACTOR SHALL DRILL HOLES AROUND THE PERIPHERY OF THE EXCAVATION FOR DRAINING THE SURROUNDING ROCK.THE MINIMUM DIAMETER OF HOLES SHALL BE 57 MM OR AS DIRECTED BY THE ENGINEER. THE NUMBER OF HOLES, DEPTH, LOCATION AND INCLINATION OF HOLES SHALL DEPEND ON WATER INFLOW CONDITIONS AND INFLOW DISTRIBUTION AT THE FACE WHERE GROUTING IS PERFORMED.FOR ANY FURTHER DETAILS REGARDING PROBE DRILLING SECTION 14 & ANNEXURE B OF WORKS REQUIREMENTS SHOULD BE REFFERED.

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited

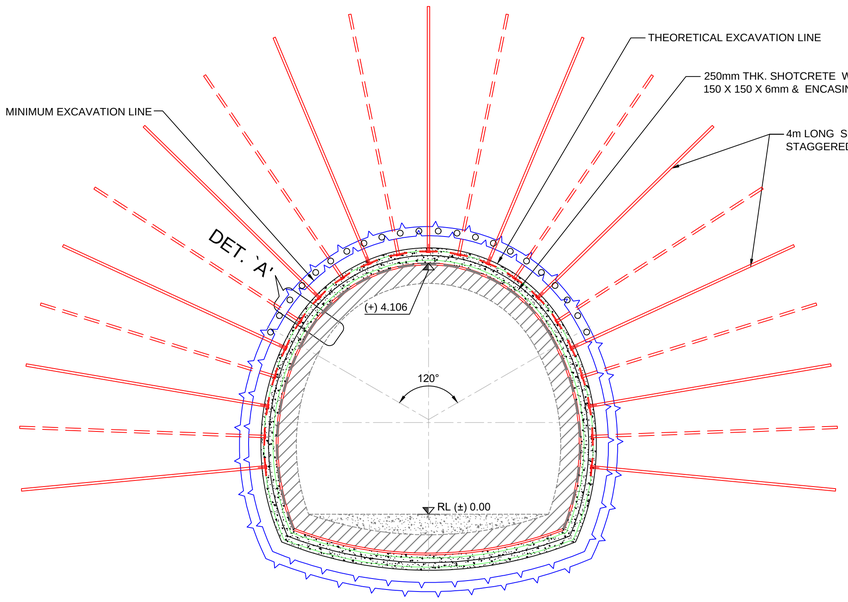
AECOM

RAJESH K	Eshita / Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

Title: TUNNEL-13
TROLLEY NICHE - ROCK CLASS - C1
(WITH OUT INVERT) TYPICAL SUPPORT DETAILS
(SHEET 1 OF 1)

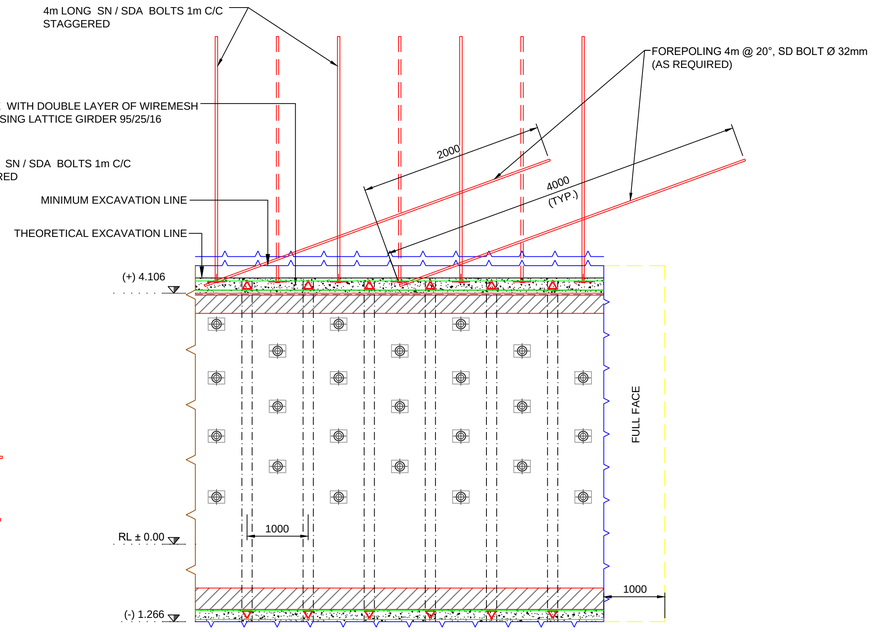
Drawing No ACM-60598728-PKG7B-TN-CS-0408 | Scale AS SHOWN | Rev. 0

EXCAVATION & SUPPORT QUANTITIES/ROUND FOR TROLLEY NICHE SUPPORT CLASS C2				
MAXIMUM DEFORMATION TOLERANCE			D	200 mm
TOF HEADING	EXCAVATION	ROUND LENGTH		1 m
		THEORETICAL EXCAVATION		29.82 m^3
	SUPPORT	SHOTCRETE	M30, ds=250mm	4.16 m^3
		WIRE MESH 150/150/6 mm	OUTER / INNER LAYER	33.25 m^2
		SN BOLTS	Fy 200kN, 6m, 1m x 1m	11.00 Pcs.
		LATTICE GIRDER	95 / 16 / 25, 1m spacing	16.63 Kg
		FOREPOLING (OPTIONAL)	SD BOLTS Ø32, C/C=300, L=4m	20.00 Pcs



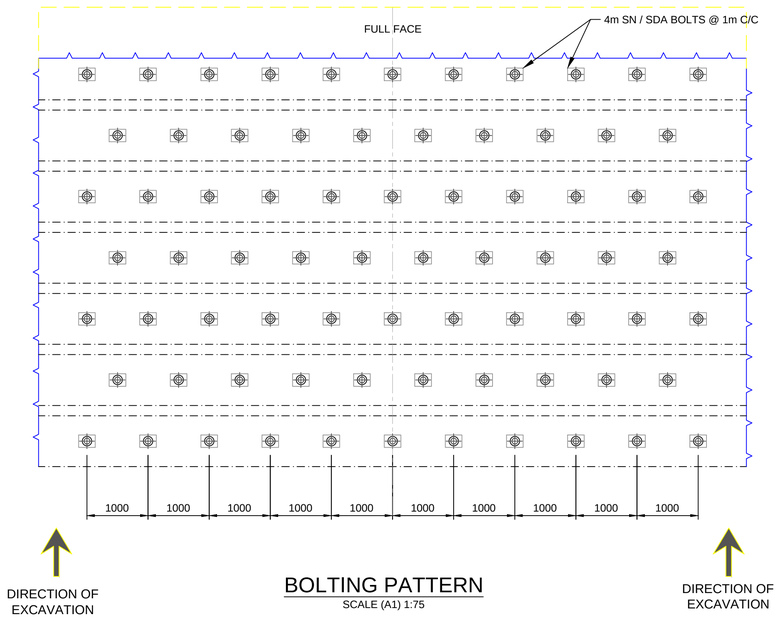
SUPPORT CLASS C2 (SECTION A)

SCALE(A1) 1:50



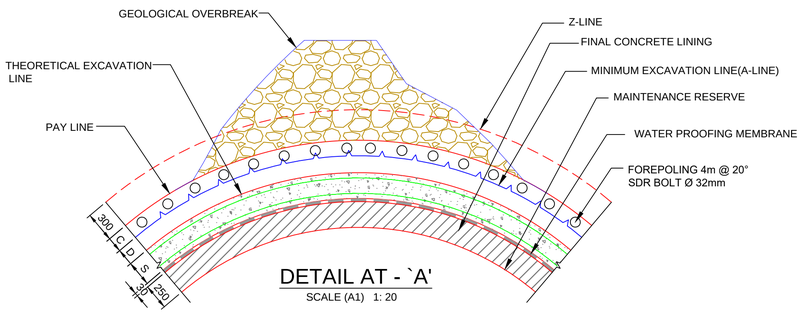
LONGITUDINAL SECTION

SCALE(A1) 1:50



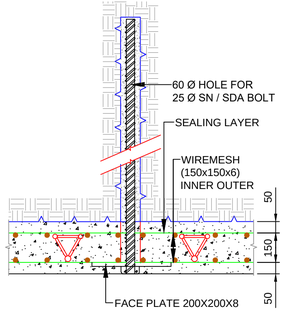
BOLTING PATTERN

SCALE (A1) 1:75



DETAIL AT - `A'

SCALE (A1) 1: 20



DETAIL OF SN BOLTS

SCALE (A1) N.T.S

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. MINIMUM EXCAVATION LINE SHALL INCLUDE DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.
7. FOR OTHER NOTE REFER DWG.NO-ACM-60598728-PKG7B-GE-GA-0003 & 0004[0]
8. DRILLING OF PROBE HOLES SHALL BE MANDATORY AS SPECIFIED IN THE TECHNICAL SPECIFICATION FOR ADOPTION OF SUPPORT SYSTEM SHOWN IN THIS DRAWING.
9. THE CONTRACTOR SHALL DRILL HOLES AROUND THE PERIPHERY OF THE EXCAVATION FOR DRAINING THE SURROUNDING ROCK.THE MINIMUM DIAMETER OF HOLES SHALL BE 57 MM OR AS DIRECTED BY THE ENGINEER. THE NUMBER OF HOLES, DEPTH, LOCATION AND INCLINATION OF HOLES SHALL DEPEND ON WATER INFLOW CONDITIONS AND INFLOW DISTRIBUTION AT THE FACE WHERE GROUTING IS PERFORMED.FOR ANY FURTHER DETAILS REGARDING PROBE DRILLING SECTION 14 & ANNEXURE B OF WORKS REQUIREMENTS SHOULD BE REFFERED.

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited गुणवत्ता, गति एवं पारदर्शिता (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited | AECOM

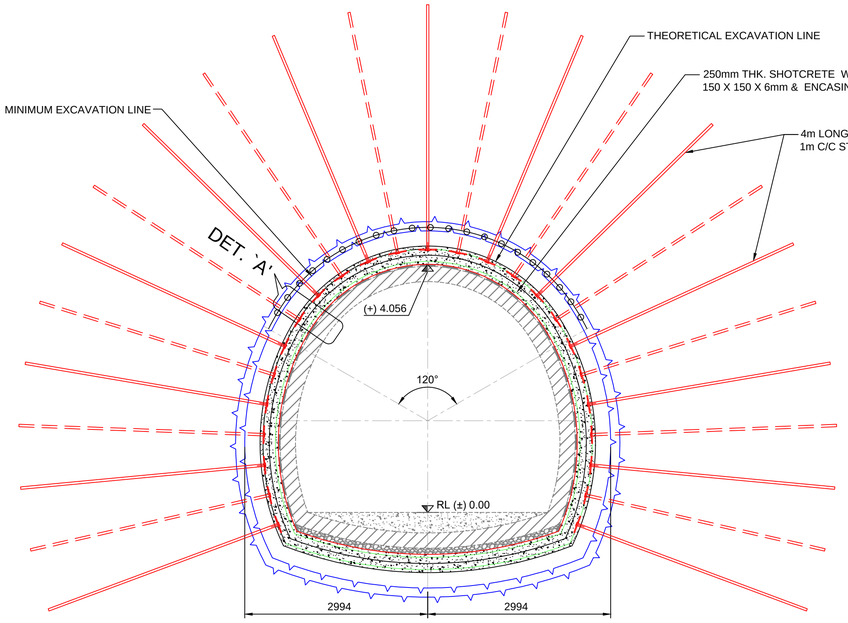
Debasis Bag	Eshita /Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

Title:

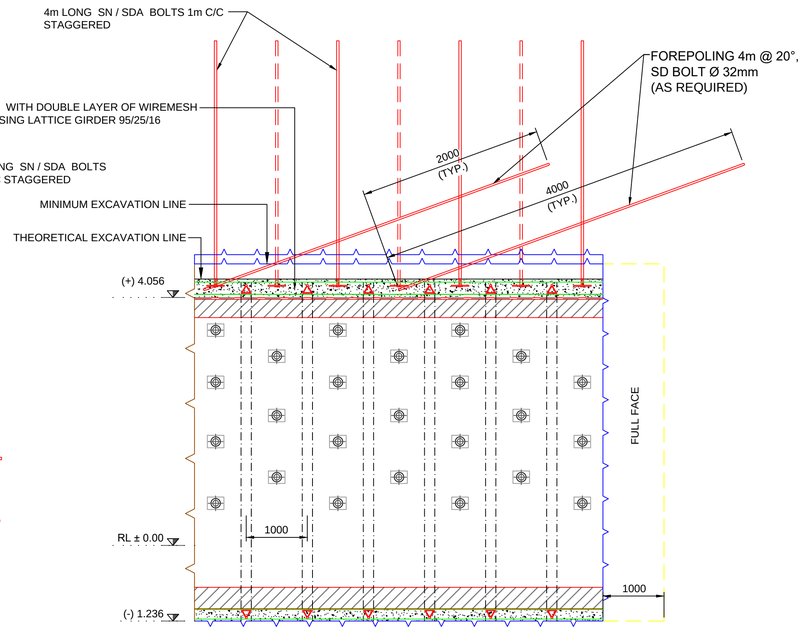
TUNNEL-13
TROLLEY NICHE - ROCK CLASS - C2 (WITH INVERT)
TYPICAL SUPPORT DETAILS
(SHEET 1 OF 1)

Drawing No. ACM-60598728-PKG7B-TN-ES-0409 | Scale AS SHOWN | Rev. 0

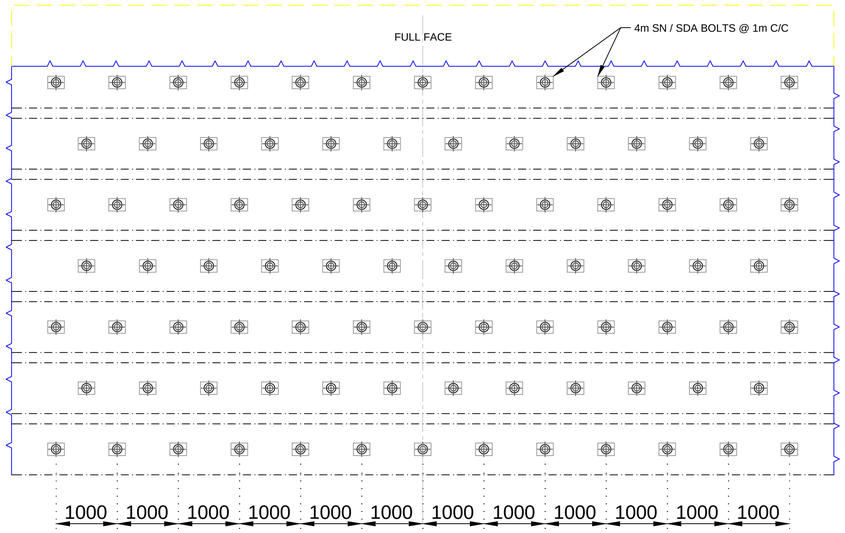
EXCAVATION & SUPPORT QUANTITIES/ROUND FOR TROLLEY NICHE SUPPORT CLASS C3				
MAXIMUM DEFORMATION TOLERANCE			D	250 mm
TOF HEADING	EXCAVATION	ROUND LENGTH		0.8 m
		THEORETICAL EXCAVATION VOLUME		25.46 m³
	SUPPORT	SHOTCRETE	M30 ds=300mm	4.00 m³
		WIRE MESH 150/150/6 mm	OUTER / INNER LAYER	25.80 m²
		SN BOLTS	Fy 200kN. 6m. 1m x 1m	10.40 Pcs.
		LATTICE GIRDER	95 / 16 / 25, 0.5m spacing	13.43 Kg
		FOREPOLING (OPTIONAL)	SD BOLTS Ø32. C/C=300 L=4m	16.80 Pcs



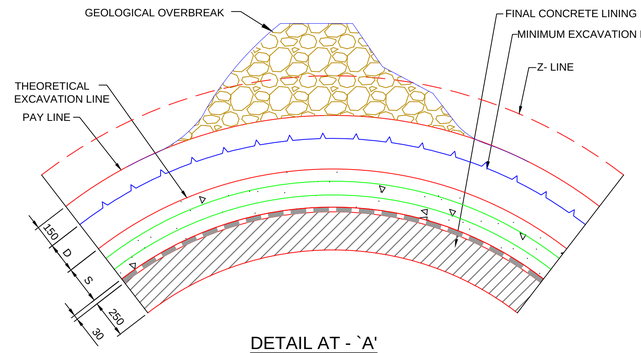
SUPPORT CLASS C3 (SECTION A)
SCALE(A1) 1:50



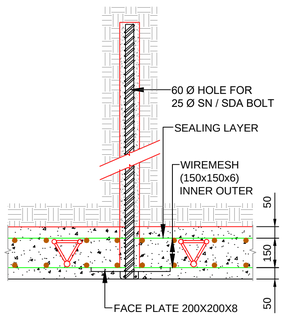
LONGITUDINAL SECTION
SCALE(A1) 1:50



BOLTING PATTERN
SCALE (A1) 1:75



DETAIL AT - `A'
SCALE (A1) 1: 20



DETAIL OF SN BOLTS
SCALE (A1) N.T.S

TENDER DRAWING

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. MINIMUM EXCAVATION LINE SHALL INCLUDE DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.
7. FOR OTHER NOTE REFER DWG.NO-ACM-60598728-PKG7B-GE-GA-0003 & 0004[0]
8. DRILLING OF PROBE HOLES SHALL BE MANDATORY AS SPECIFIED IN THE TECHNICAL SPECIFICATION FOR ADOPTION OF SUPPORT SYSTEM SHOWN IN THIS DRAWING.
9. THE CONTRACTOR SHALL DRILL HOLES AROUND THE PERIPHERY OF THE EXCAVATION FOR DRAINING THE SURROUNDING ROCK.THE MINIMUM DIAMETER OF HOLES SHALL BE 57 MM OR AS DIRECTED BY THE ENGINEER. THE NUMBER OF HOLES, DEPTH, LOCATION AND INCLINATION OF HOLES SHALL DEPEND ON WATER INFLOW CONDITIONS AND INFLOW DISTRIBUTION AT THE FACE WHERE GROUTING IS PERFORMED.FOR ANY FURTHER DETAILS REGARDING PROBE DRILLING SECTION 14 & ANNEXURE B OF WORKS REQUIREMENTS SHOULD BE REFFERED.

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited गुणवत्ता, गति एवं पारदर्शिता (A Government of India Enterprise)

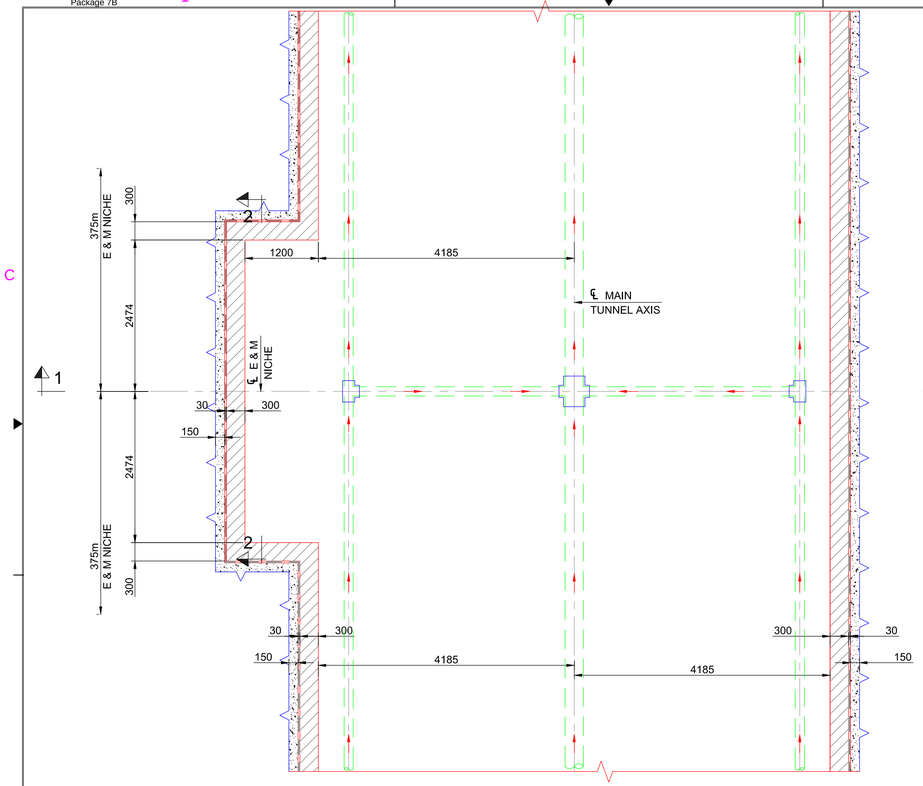
Project:
PACKAGE-7B
DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited | AECOM

Debasis Bag	Eshita /Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

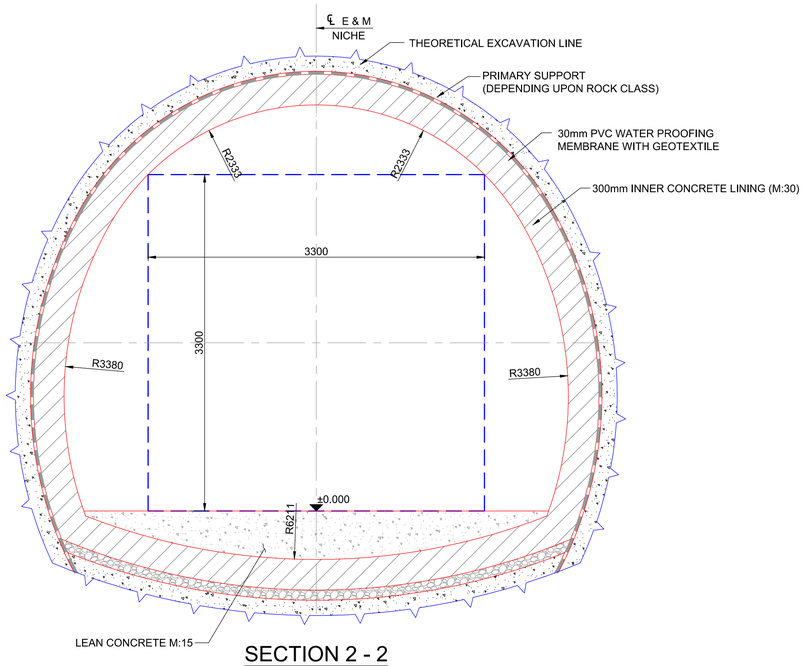
Title:
TUNNEL-13
TROLLEY NICHE - ROCK CLASS - C3 (WITH INVERT)
TYPICAL SUPPORT DETAILS
(SHEET 1 OF 1)

Drawing No.	Scale	Rev.
ACM-60603749-PKG7B-TN-ES-0410	AS SHOWN	0



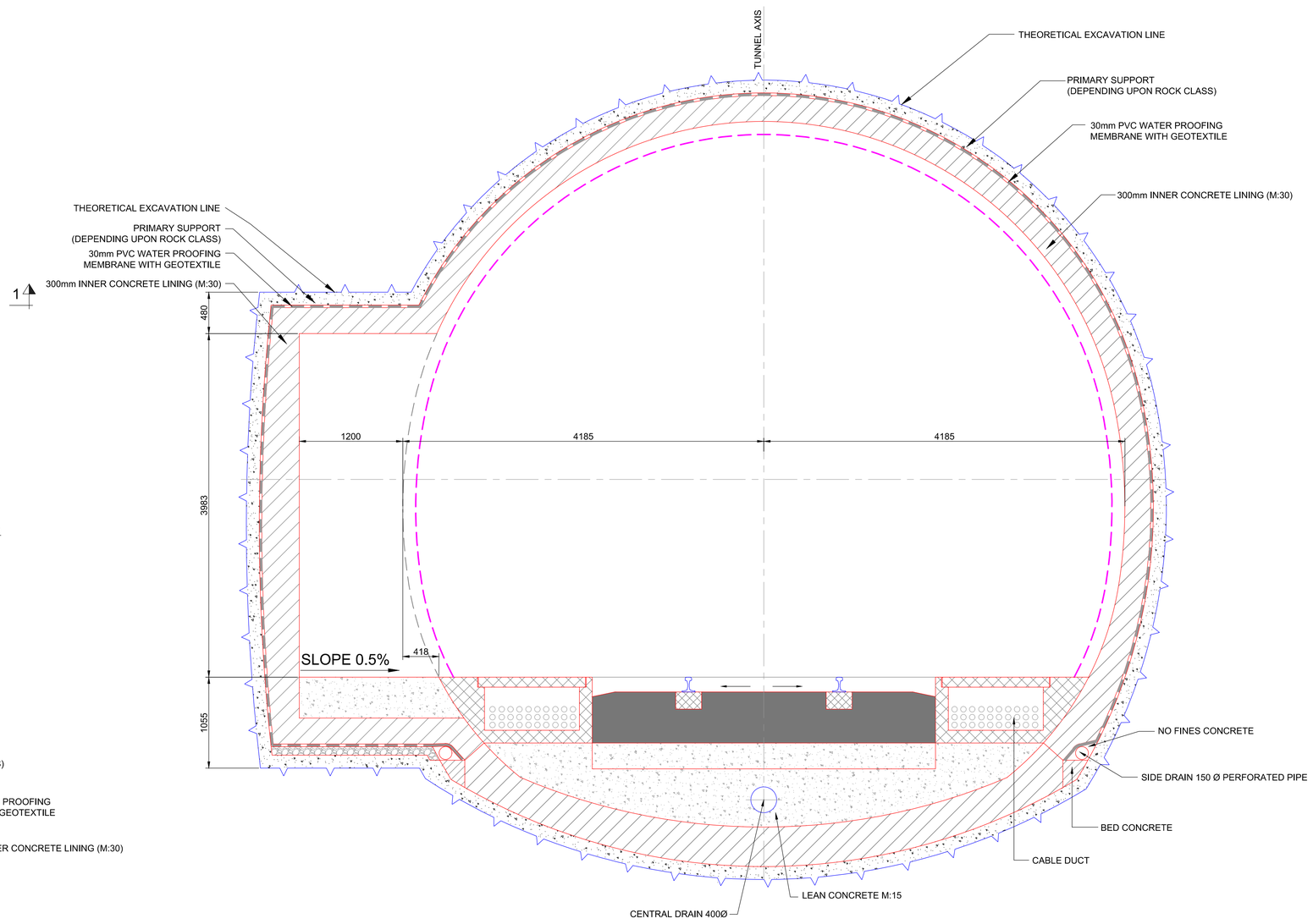
JUNCTION PLAN AT E & M NICHE & MAIN TUNNEL

SCALE(A1) 1:75



SECTION 2 - 2
CROSS SECTION OF E & M NICHE WITH INVERT

SCALE(A1) 1:50



SECTION 1 - 1

SCALE(A1) 1:30

TENDER DRAWING

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. EXCAVATION LINE SHOULD INCLUDE CONSTRUCTION & DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

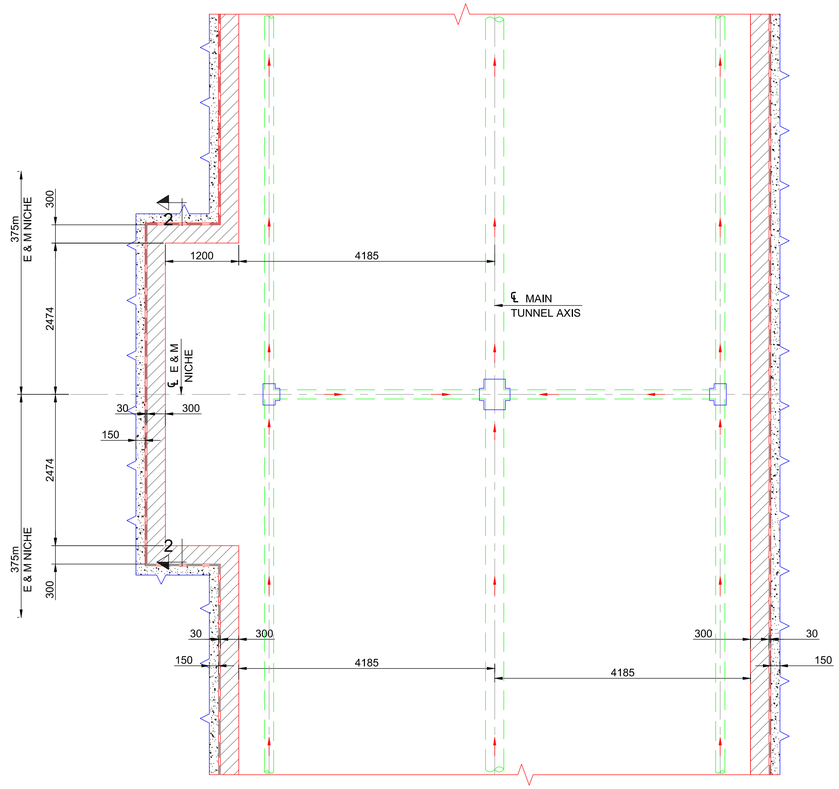
RVNL Rail Vikas Nigam Limited

AECOM

Debasis Bag	Eshita Mishra	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

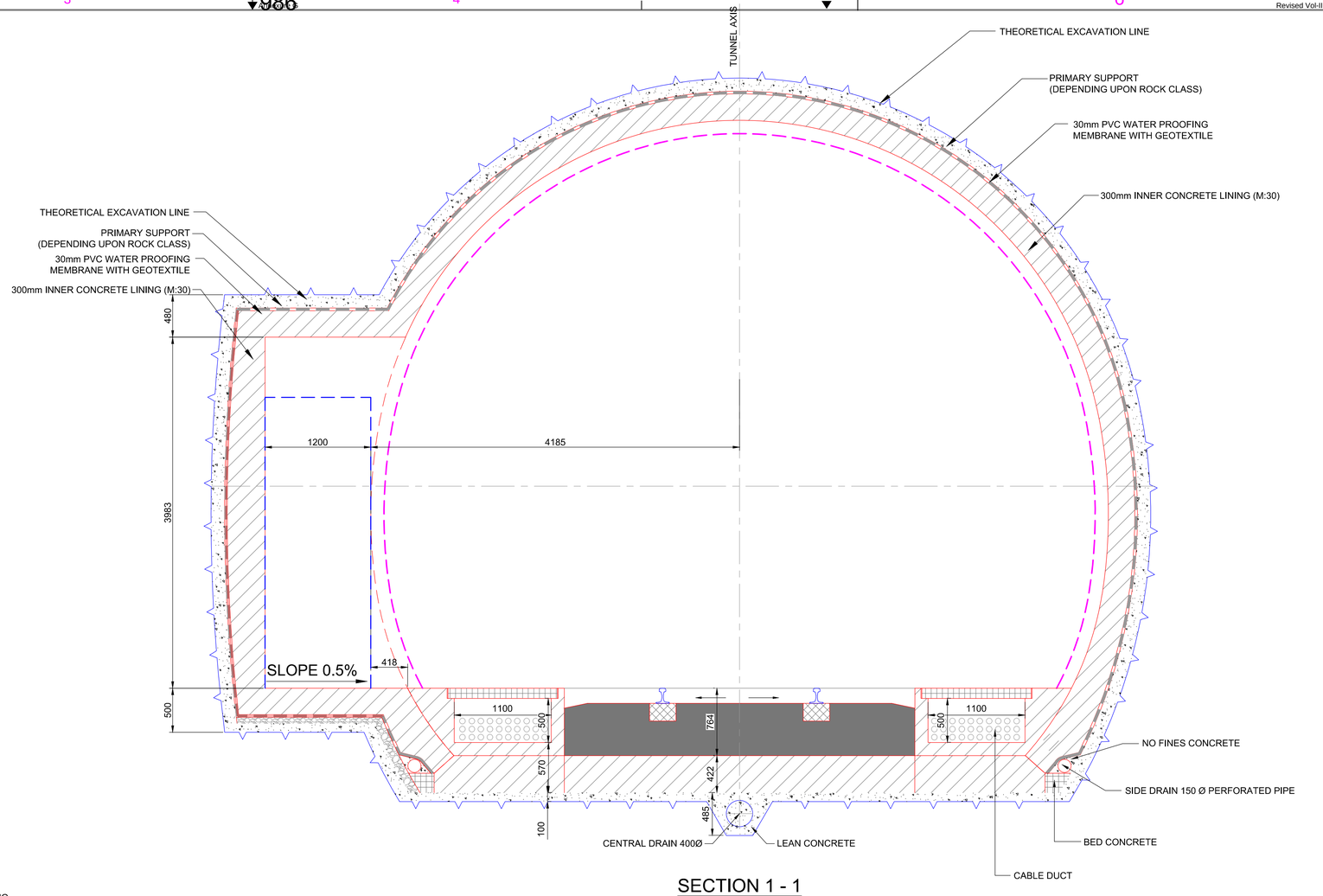
Title: TUNNEL-13 TYPICAL CROSS SECTION & PLAN FOR E&M NICHE WITH INVERT (SHEET 1 OF 1)

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-EMN-CS-0416	AS SHOWN	0



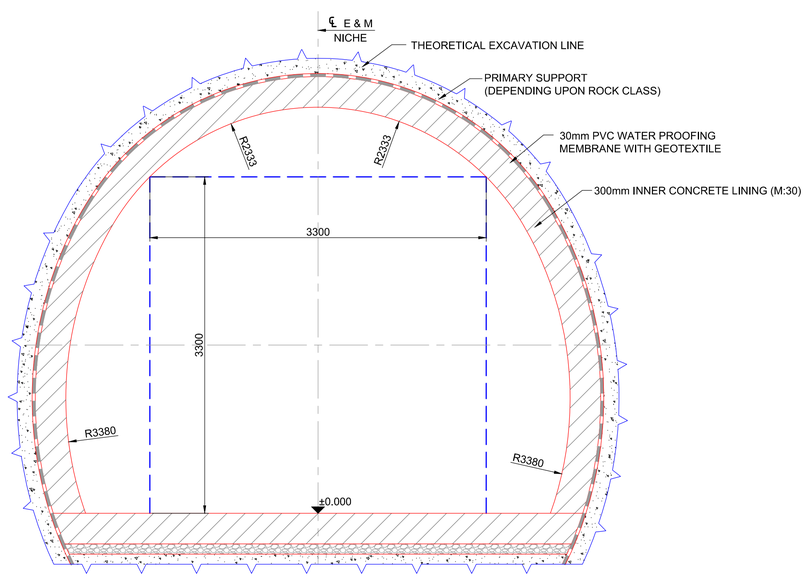
JUNCTION PLAN AT E & M NICHE & MAIN TUNNEL

SCALE(A1) 1:75



SECTION 1 - 1

SCALE(A1) 1:30



SECTION 2 - 2
CROSS SECTION OF E & M NICHE WITHOUT INVERT

TENDER DRAWING

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. EXCAVATION LINE SHOULD INCLUDE CONSTRUCTION & DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

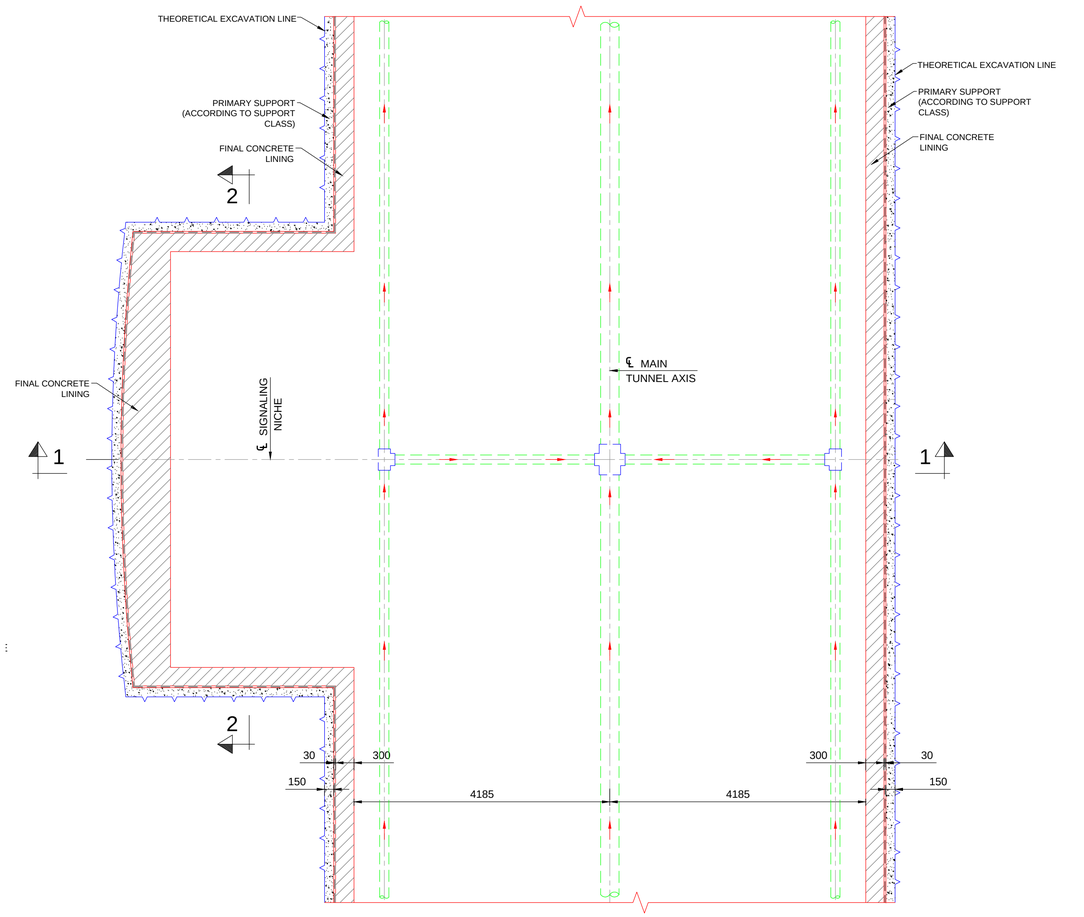
RVNL Rail Vikas Nigam Limited

AECOM

Debasis Bag	Eshita Mishra	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

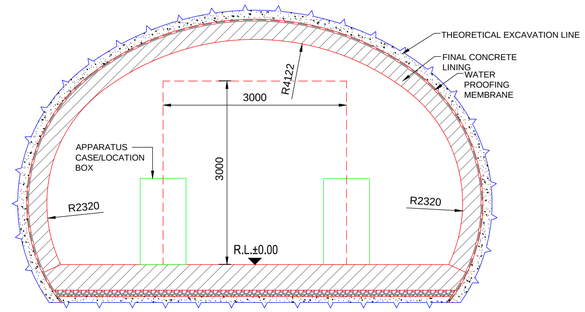
Title: TUNNEL-13 TYPICAL CROSS SECTION & PLAN FOR E&M NICHE WITHOUT INVERT (SHEET 1 OF 1)

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-EMN-CS-0417	AS SHOWN	0



JUNCTION PLAN AT SIGNALING NICHE & MAIN TUNNEL

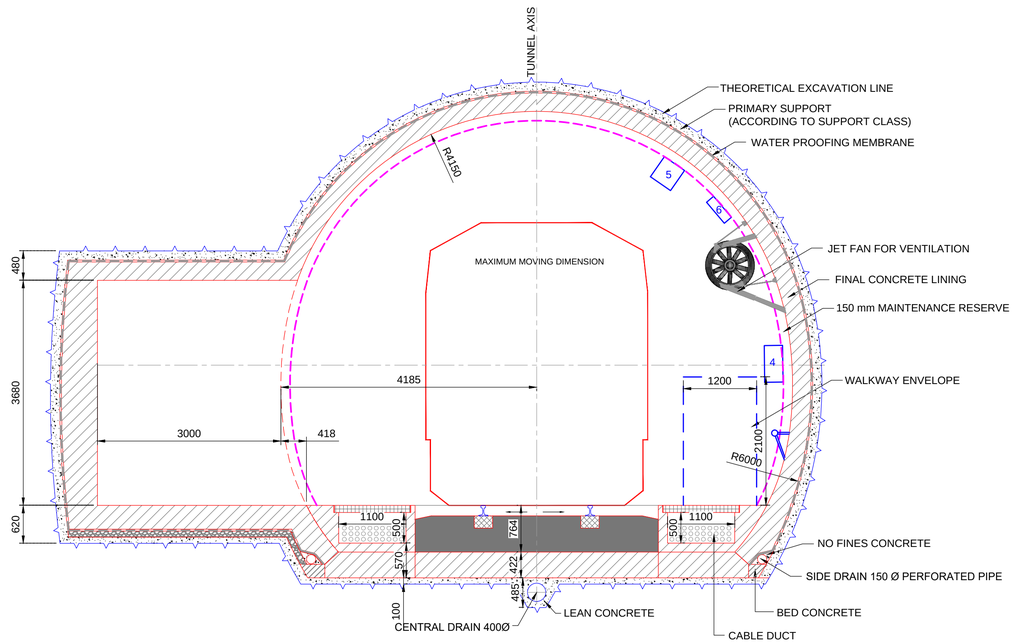
SCALE(A1) 1:50



SECTION 2 - 2

CROSS SECTION OF SIGNALING NICHE WITHOUT INVERT

SCALE(A1) 1:50



SECTION 1 - 1

SCALE(A1) 1:50

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. EXCAVATION LINE SHOULD INCLUDE CONSTRUCTION & DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited गुणवत्ता, गति एवं पारदर्शिता (A Government of India Enterprise)

Project:

PACKAGE-7B

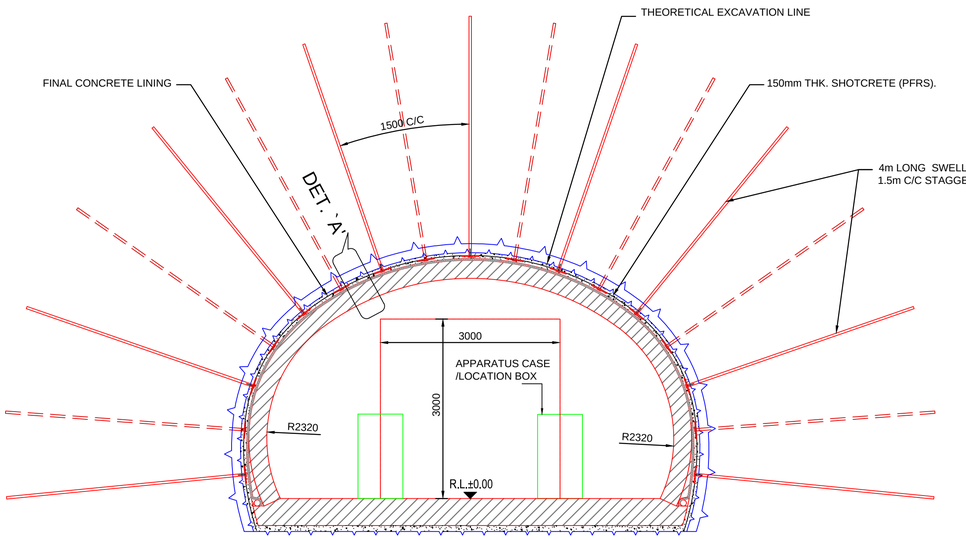
DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

RVNL Rail Vikas Nigam Limited | AECOM

Debasis Bag	Eshita Mishra	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

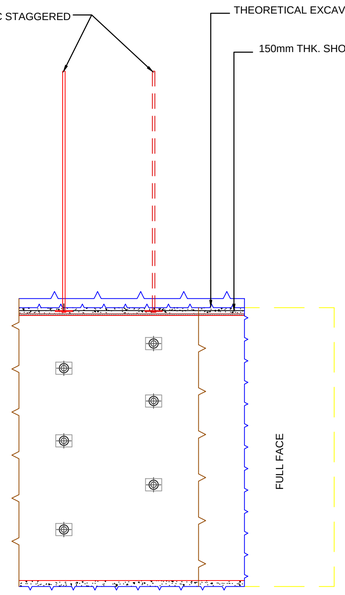
Title: TUNNEL-13 TYPICAL CROSS SECTION FOR SIGNALING NICHE WITHOUT INVERT (SHEET 1 OF 1)

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-SN-CS-0446	AS SHOWN	0



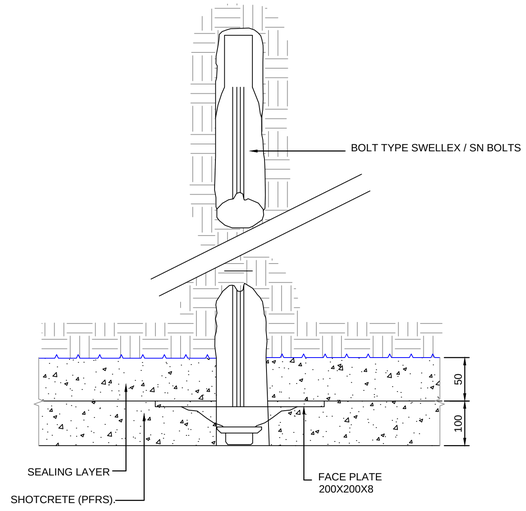
SUPPORT CLASS B1 (SECTION A)

SCALE(A1) 1:75



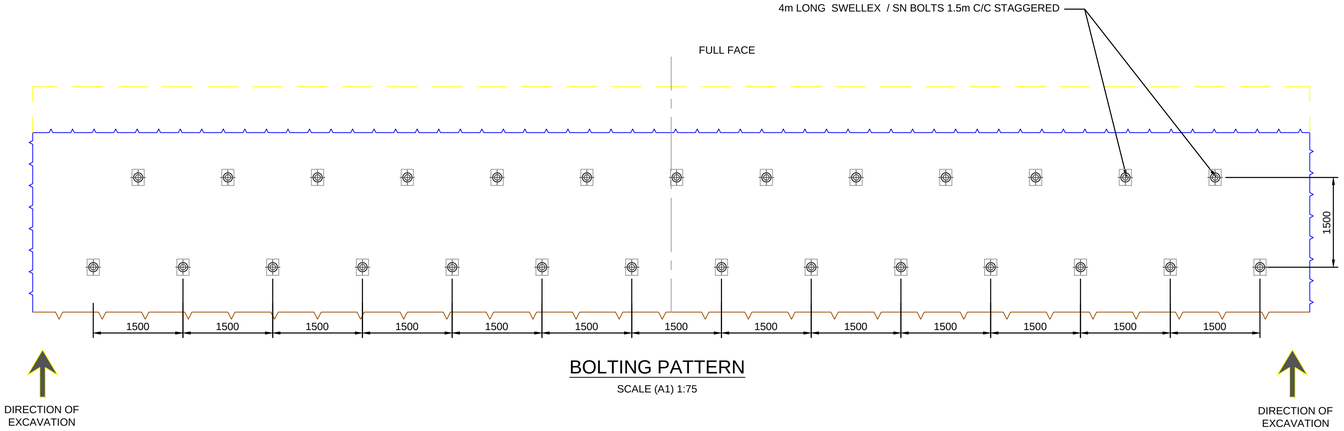
LONGITUDINAL SECTION

SCALE(A1) 1:75



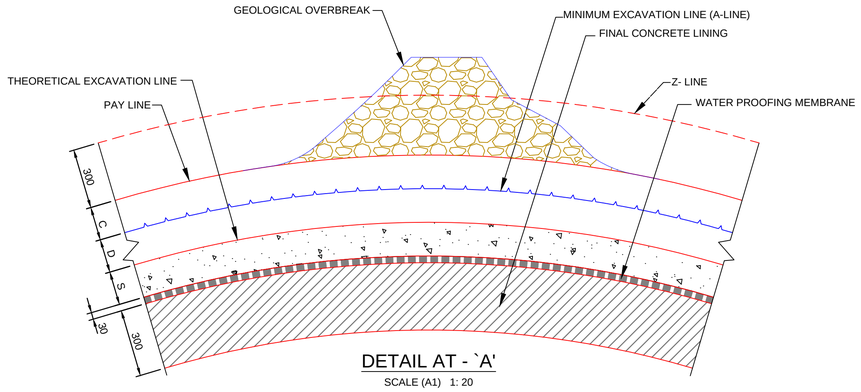
DETAIL OF BOLTS

SCALE (A1) N.T.S.



BOLTING PATTERN

SCALE (A1) 1:75



DETAIL AT - `A'

SCALE (A1) 1: 20

NOTES:~

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING.
3. SHOTCRETE GRADE OF M:30 AND CONCRETE GRADE OF M:30 SHALL BE USED AS PRIMARY SUPPORT & SECONDARY SUPPORT RESPECTIVELY CONFIRMING TO IS456:2000.
4. ROCK BOLT SHALL BE INSTALLED ACCORDING TO THE LENGTHS AND ROCK BOLT PATTERNS SHOWN ON THE DRAWINGS.
5. MINIMUM EXCAVATION LINE SHALL INCLUDE DEFORMATION TOLERANCE.
6. REQUIRED RING CLOSURE AT INVERT WILL BE BASED ON 3D MONITORING RESULT & GEOLOGICAL SITE CONDITIONS.
7. FOR OTHER NOTE REFER DWG.NO-ACM-60598728-PKG7B-GE-GA-0003 & 0004[0]
8. DRILLING OF PROBE HOLES SHALL BE MANDATORY AS SPECIFIED IN THE TECHNICAL SPECIFICATION FOR ADOPTION OF SUPPORT SYSTEM SHOWN IN THIS DRAWING.
9. THE CONTRACTOR SHALL DRILL HOLES AROUND THE PERIPHERY OF THE EXCAVATION FOR DRAINING THE SURROUNDING ROCK.THE MINIMUM DIAMETER OF HOLES SHALL BE 57 MM OR AS DIRECTED BY THE ENGINEER. THE NUMBER OF HOLES, DEPTH, LOCATION AND INCLINATION OF HOLES SHALL DEPEND ON WATER INFLOW CONDITIONS AND INFLOW DISTRIBUTION AT THE FACE WHERE GROUTING IS PERFORMED.FOR ANY FURTHER DETAILS REGARDING PROBE DRILLING SECTION 14 & ANNEXURE B OF WORKS REQUIREMENTS SHOULD BE REFFERED.

TENDER DRAWING

Design Consultant: AECOM

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Project:

PACKAGE-7B

DDC and PMC for Construction of tunnel, yard and formation works from Chainage 91+228 to 101+339 (10.158km) under Package-7B in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in the state of Uttarakhand, India.

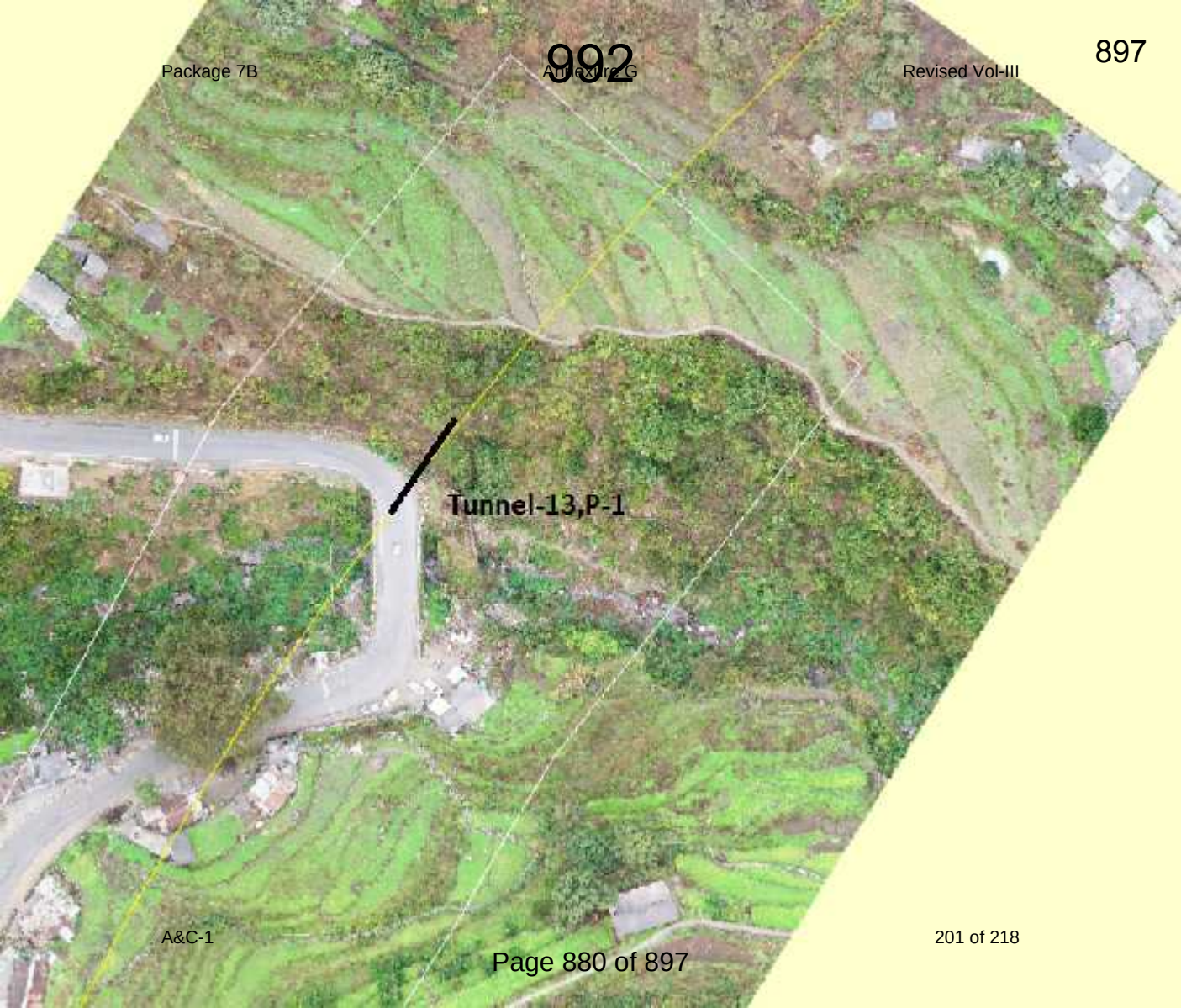
RVNL Rail Vikas Nigam Limited | AECOM

Debasis Bag	Eshita / Sourav	GVR Raju	John Celentano
Drawn	Designed	Verified	Approved

Title: TUNNEL-13 SIGNAL NICHE - ROCK CLASS - B1 (WITH OUT INVERT) TYPICAL SUPPORT DETAILS (SHEET 1 OF 1)

Drawing No.	Scale	Rev.
ACM-60598728-PKG7B-SN-CS-0451	AS SHOWN	0

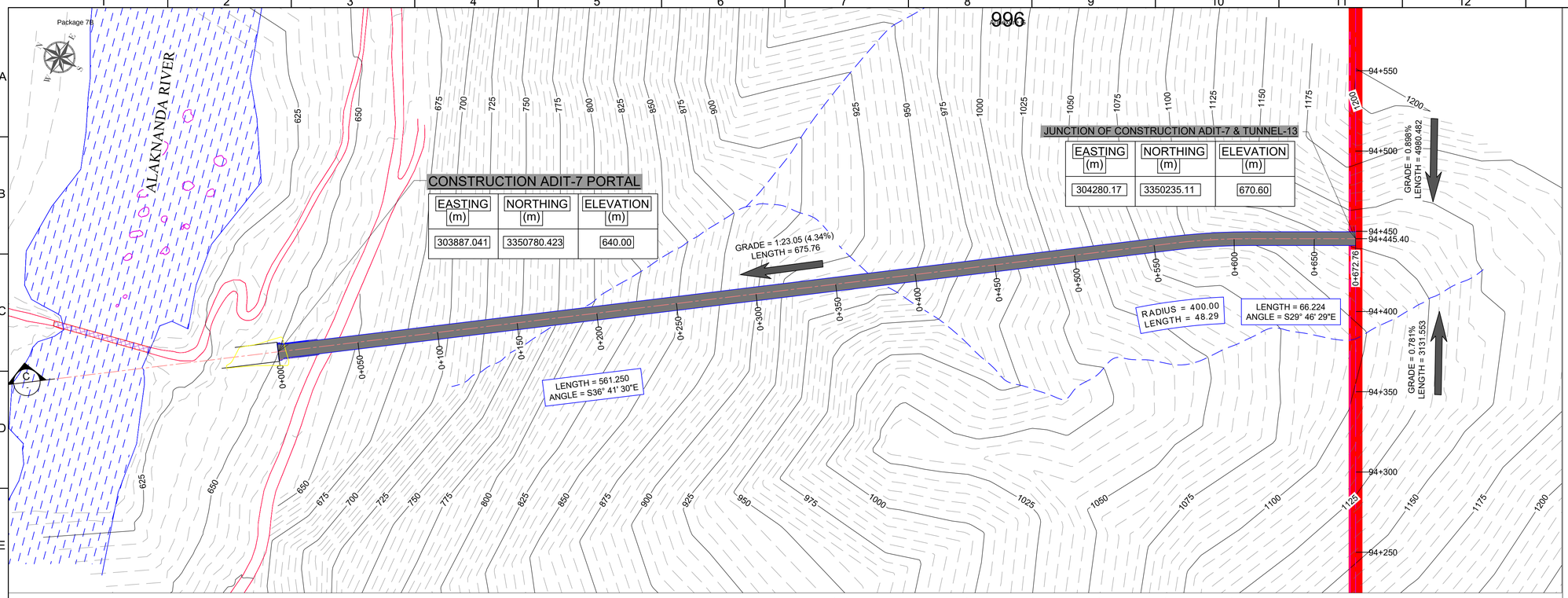
Approach roads

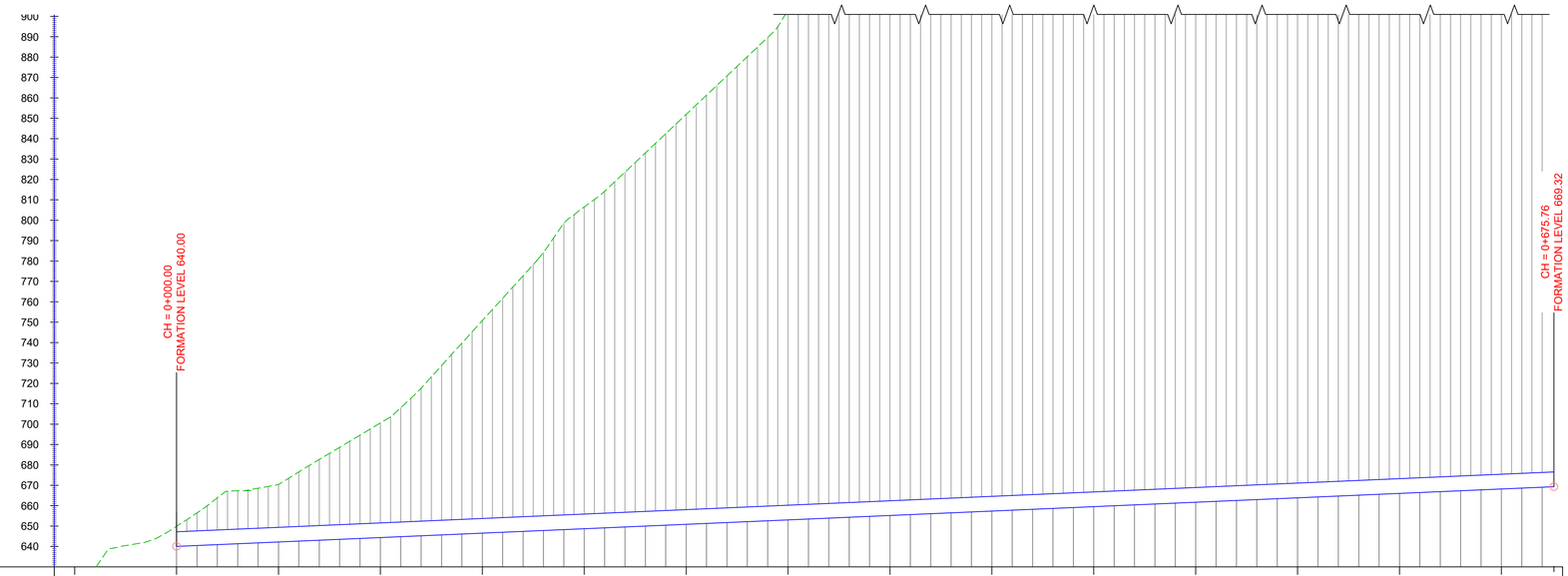

Tunnel-13,P-1

1:3028 UTM (WGS84) - (309738.379, 3353807.759) 30° 18' 03.9432" N, 79° 01' 17.4054" E

Adit 7

Package 7B





CHAINAGE	-0+050	0+000	0+050	0+100	0+150	0+200	0+250	0+300	0+350	0+400	0+450	0+500	0+550	0+600	0+650	0+675.76 / 0+680
GROUND LEVELS	623.76	651.95	670.87	695.75	750.77	806.49	851.90	903.04	935.43	953.32	989.19	1042.06	1084.31	1102.66	1120.47	1131.51
FORMATION LEVELS		640.00	642.17	644.34	646.51	648.68	650.85	653.02	655.19	657.36	659.52	661.69	663.86	666.03	668.20	669.32
VERTICAL GEOMETRY								GRADE = 1:23.05 (4.34%) LENGTH = 675.76								
EASTING		303887.275	303917.150	303947.026	303976.901	304006.776	304036.652	304066.527	304096.402	304126.278	304156.153	304186.028	304215.904	304243.988	304268.864	304280.168
NORTHING		3350780.597	3350740.503	3350700.410	3350660.317	3350620.224	3350580.131	3350540.037	3350499.944	3350459.851	3350419.758	3350379.665	3350339.571	3350298.238	3350254.866	3350235.109

Notes:

1. Dimensions, levels and coordinates shall not be scaled from the drawing.
2. Dimensions, levels and coordinates shall be checked on site prior to execution of the works. Any discrepancies must be brought to the notice of the designer prior to execution of the works.
3. All dimensions are in [millimeter (mm)] except mentioned otherwise.
4. This drawing must be read in conjunction with all relevant drawings, reports, standards and specifications.

Appendent Drawings:

Project:

Detailed Design Consultancy of New BG Railway Project (125Km Long Project) Construction of Rishikesh to Karnapryag

Title:

CONSTRUCTION ADIT-7
GENRAL ARRANGMENT PLAN & PROFILE

Index	Revision	Date	Prepared
F			
E			
D			
C			
B	REVISED AS PER REVISED MAIN TUNNEL ALIGNMENT	05.06.2019	
A	CONSTRUCTION DRAWING	22.02.2019	

Client: रेल विकास निगम लिमिटेड Rail Vikas Nigam Limited (A Government of India Enterprise)

Chief Project Manager

Package In-charge

Designer: TUMAS India Pvt. Ltd.

Reviewer: CSIR-CIMFR

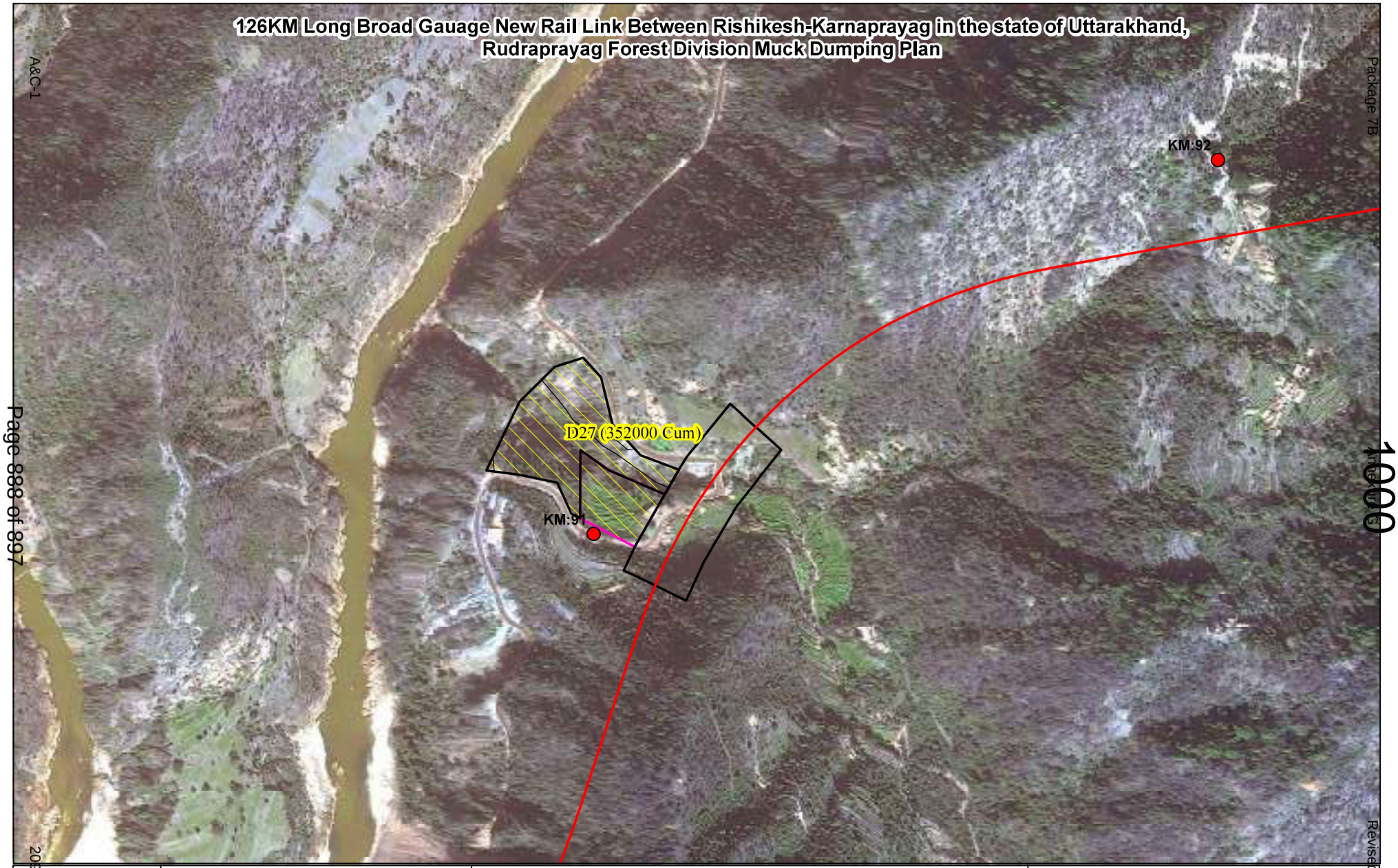
Signature | Signature

Prepared: Date: 05.07.2019	Scale: AS SHOWN	Drawing Code: CA-7-GA-01	Index: C
Approved: Date:	Format: A1		

205 of 218

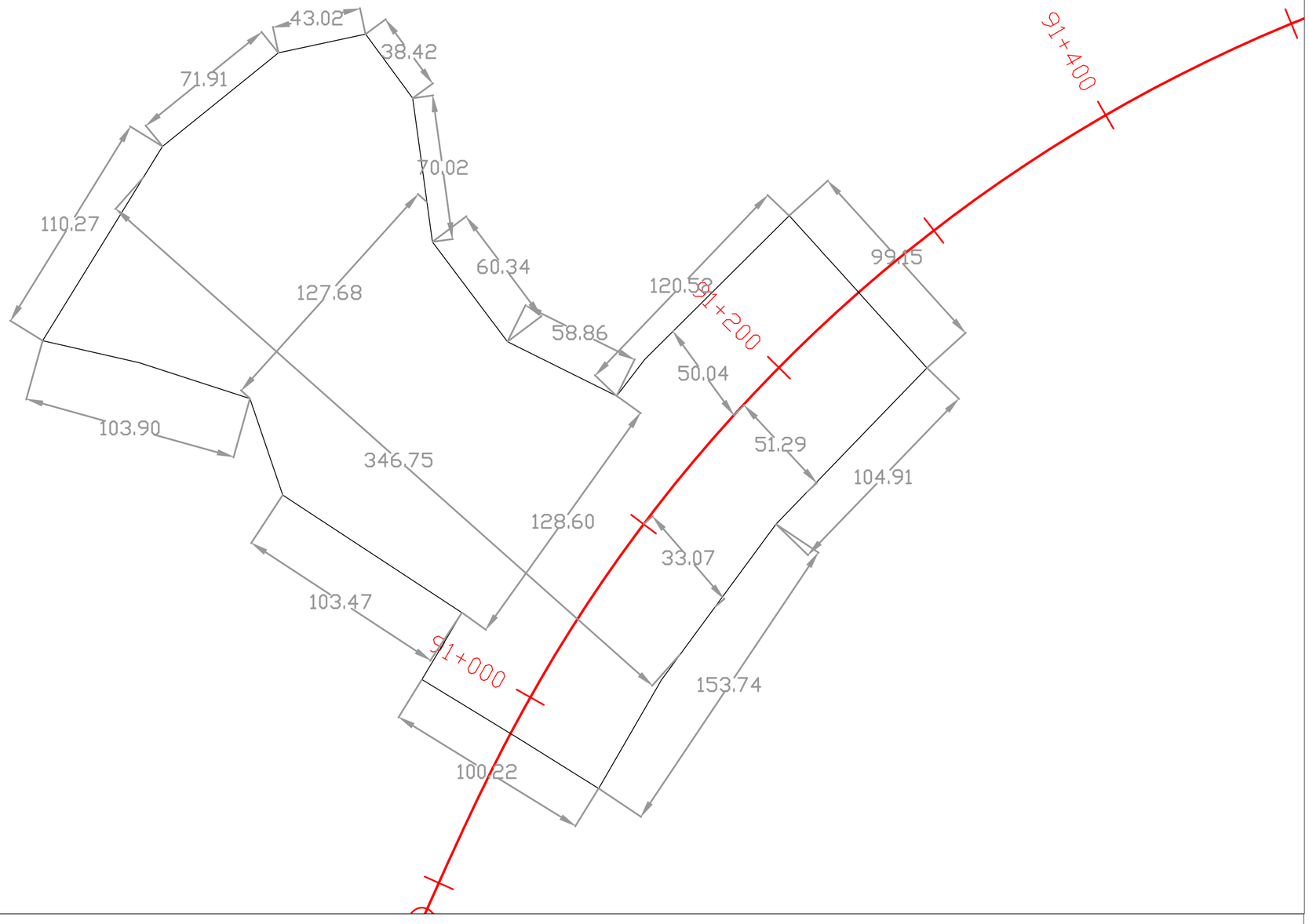
A&C-1

Muck Dumping Areas


126KM Long Broad Gauage New Rail Link Between Rishikesh-Karnaprayag in the state of Uttarakhand,
Rudraprayag Forest Division Muck Dumping Plan
A&C-1
Package 7B
KM:92
D27 (352000 Cum)
KM:91
User Agency:
Indian Railways
Executing Agency:
Rail Vikas Nigam Limited
Legend
Chainage in Km
CL
Reserve Forest
Non Forest
DS
Reserve Forest
Scale 1:5,000
0 0.045 0.09 0.18 Kilometers
SHEET-3

PROJECT NAME :-DEVELOPMENT OF 126 KM LONG BROAD GAUGE NEW RAIL LINK BETWEEN RISHIKESH AND KARANPRYAG VIA DEVPRYAG IN THE STATE OF UTTRAKHUND

मौजा – नर्कोटा, तहसील – रूद्रप्रयाग, पट्टी – बछणस्यूँ, जिला – रूद्रप्रयाग में प्रस्तावित भूमि अर्जन मानचित्र



LEGEND:-

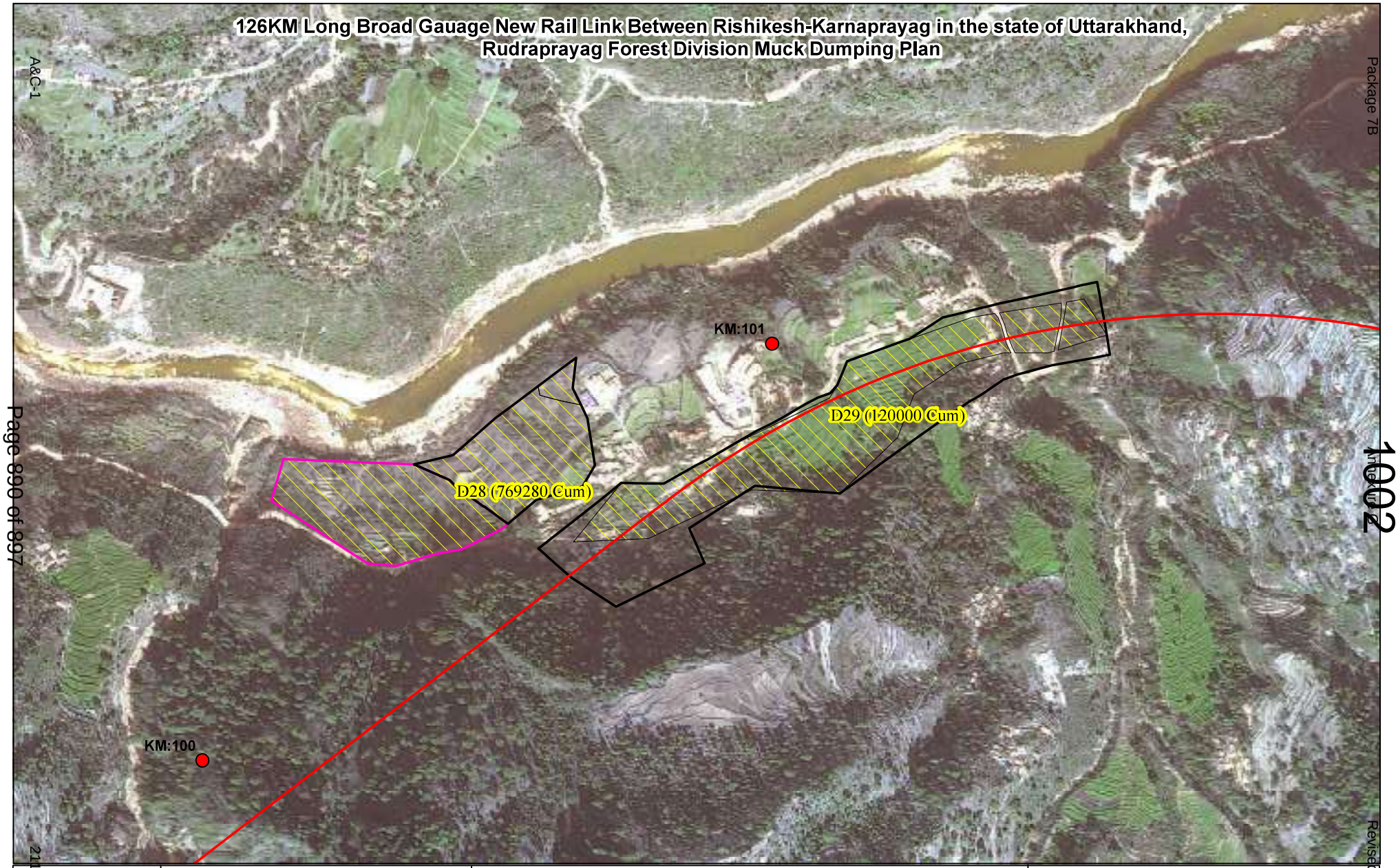
PROP RAILWAY ALIGNMENT

ROW

(S.K BARNWAL)
SR. MANAGER/LAND AQUISITION
RAIL VIKAS NIGAM LIMTED

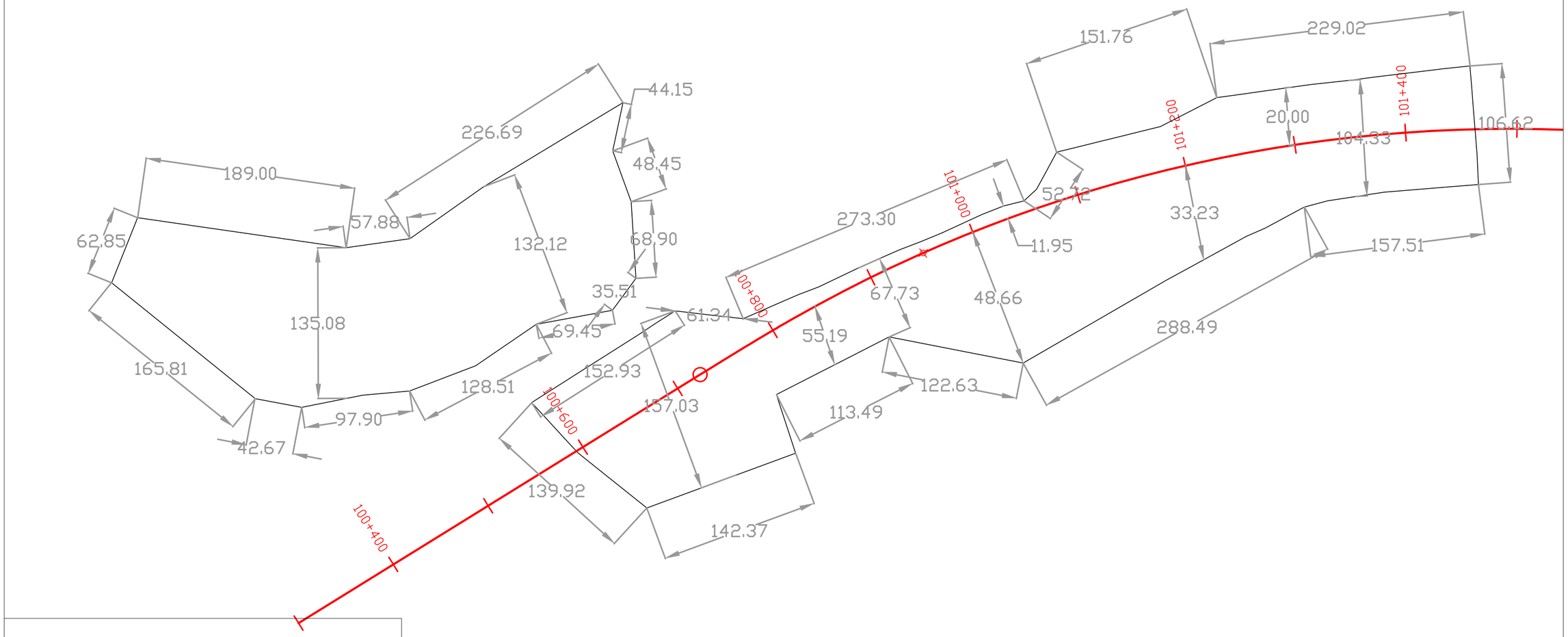
(B.S MASALI)
DY. GENERAL MANAGER/ P-1
RAIL VIKAS NIGAM LIMTED

(BHANU PARKASH)
GENERAL MANAGER/ P-1
RAIL VIKAS NIGAM LIMTED
(ON BEHALF OF INDIAN RAILWAYS)


126KM Long Broad Gauage New Rail Link Between Rishikesh-Karnaprayag in the state of Uttarakhand,
Rudraprayag Forest Division Muck Dumping Plan
A&C-1
Package 7B
KM:101
D29 (120000 Cum)
D28 (769280 Cum)
KM:100
User Agency:
Indian Railways
Executing Agency:
Rail Vikas Nigam Limited
Legend
Chainage in Km
CL
Reserve Forest
Non Forest
DS
Reserve Forest
Scale 1:5,000
0 0.045 0.09 0.18 Kilometers
SHEET-4

PROJECT NAME :-DEVELOPMENT OF 126 KM LONG BROAD GAUGE NEW RAIL LINK BETWEEN RISHIKESH AND KARANPRYAG VIA DEVPRYAG IN THE STATE OF UTTRAKHUND

मौजा – तिलणी, रतूड़ा एवं सुमेरपुर, तहसील – रूद्रप्रयाग, पट्टी – धनपुर, जिला – रूद्रप्रयाग में प्रस्तावित भूमि अर्जन मानचित्र



LEGEND:-

PROP RAILWAY ALIGNMENT

ROW

(S.K BARNWAL)
SR. MANAGER/LAND AQUISITION
RAIL VIKAS NIGAM LIMTED

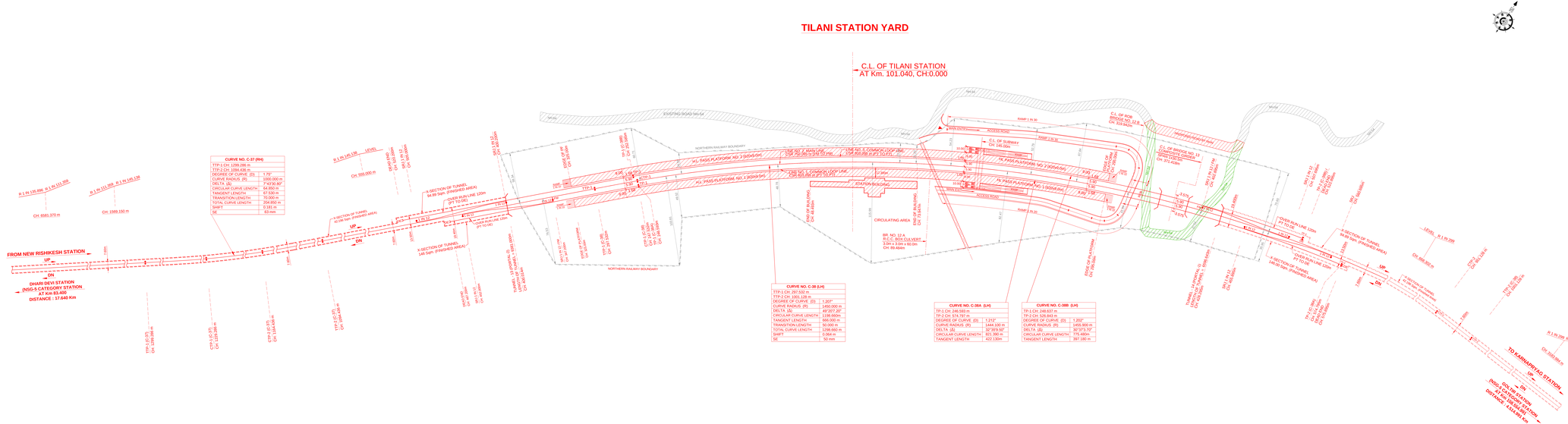
(B.S MASALI)
DY. GENERAL MANAGER/ P-1
RAIL VIKAS NIGAM LIMTED

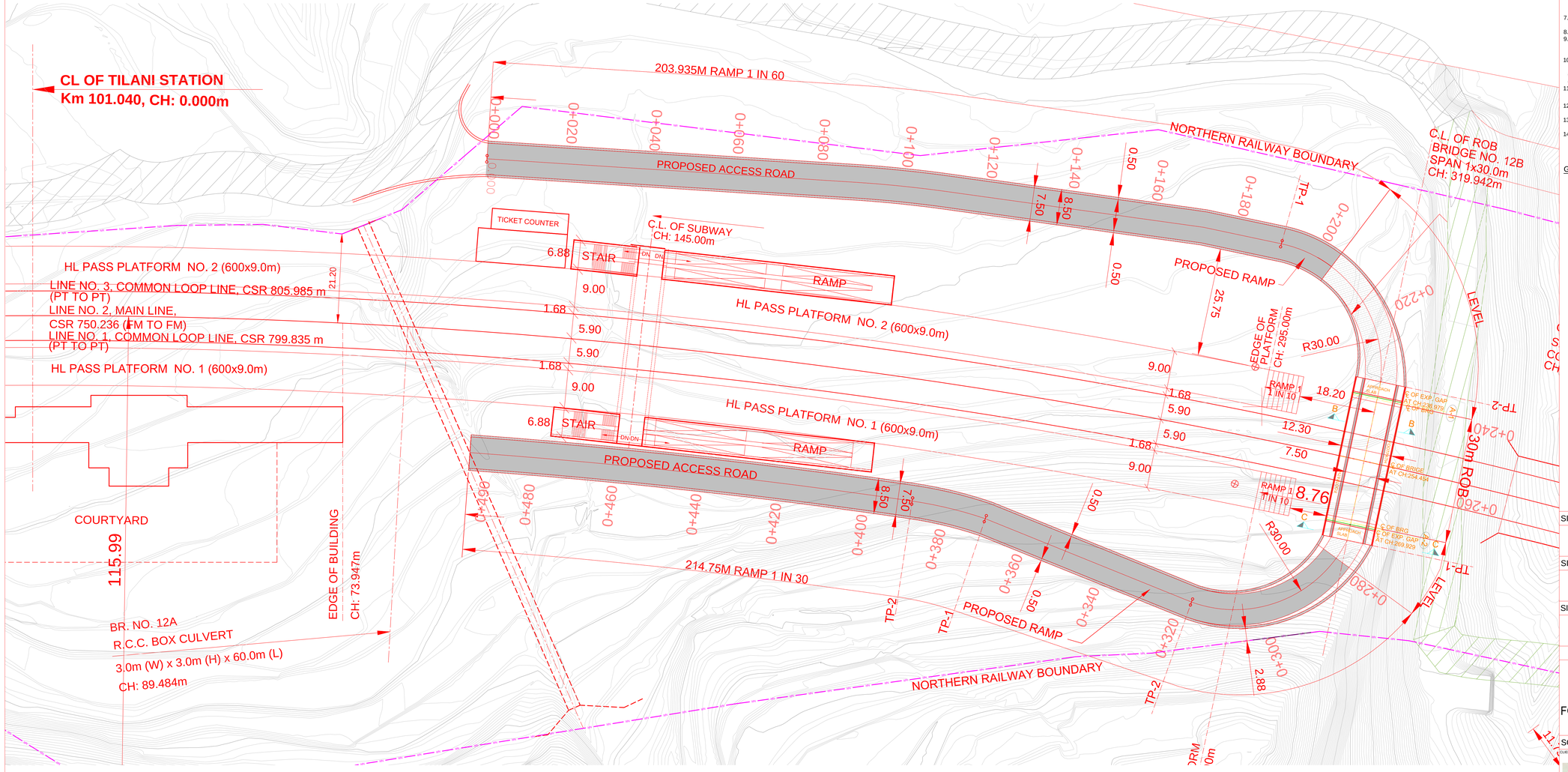
(BHANU PARKASH)
GENERAL MANAGER/ P-1
RAIL VIKAS NIGAM LIMTED
(ON BEHALF OF INDIAN RAILWAYS)

Station Yard Plans & Approach Bridge

TILANI STATION YARD

C.L. OF TILANI STATION AT Km. 101.040, CH.0.000


FROM NEW RISHIKESH STATION
UP
DN
DHARI DEVI STATION
(NSG-5 CATEGORY STATION
AT KM 81.400
DISTANCE : 17.640 Km
EXISTING ROAD NH-94
NORTHERN RAILWAY BOUNDARY
CURVE NO. C-37 (RH)
TTP-1 CH: 1299.288 m
TTP-2 CH: 1994.435 m
DEGREE OF CURVE (D) 1.75°
CURVE RADIUS (R) 1000.000 m
DELTA (Δ) 7°43'30.80"
CIRCULAR CURVE LENGTH 64.850 m
TANGENT LENGTH 67.530 m
TRANSITION LENGTH 70.000 m
TOTAL CURVE LENGTH 204.850 m
SHIFT 0.931 m
SE 63 mm
CURVE NO. C-38 (LH)
TTP-1 CH. 297.532 m
TTP-2 CH. 1951.128 m
DEGREE OF CURVE (D) 1.207°
CURVE RADIUS (R) 1450.000 m
DELTA (Δ) 49°37'07.20"
CIRCULAR CURVE LENGTH 1156.850m
TANGENT LENGTH 666.000 m
TRANSITION LENGTH 50.000 m
TOTAL CURVE LENGTH 1256.850 m
SHIFT 0.064 m
SE 50 mm
CURVE NO. C-38A (LH)
TP-1 CH. 246.593 m
TP-2 CH. 574.787 m
DEGREE OF CURVE (D) 1.21°
CURVE RADIUS (R) 1450.000 m
DELTA (Δ) 10°39'0.00"
CIRCULAR CURVE LENGTH 821.390 m
TANGENT LENGTH 432.130m
CURVE NO. C-38B (LH)
TP-1 CH. 248.637 m
TP-2 CH. 528.843 m
DEGREE OF CURVE (D) 1.205°
CURVE RADIUS (R) 1455.900 m
DELTA (Δ) 10°33'0.70"
CIRCULAR CURVE LENGTH 775.480m
TANGENT LENGTH 397.180 m
R.L 146.138
LEVEL
CH: 555.000 m
R 1.99 135.896
R 1.99 111.309
CH: 6581.370 m
R 1.99 111.309
R 1.99 145.138
CH: 1569.150 m
X-SECTION OF TUNNEL 54.89 Sqm. (SHIELDED AREA)
X-SECTION OF TUNNEL 48.98 Sqm. (SHIELDED AREA)
SEVEN RUN LINE 130m OUT TO DEL
X-SECTION OF TUNNEL 54.89 Sqm. (SHIELDED AREA)
X-SECTION OF TUNNEL 48.98 Sqm. (SHIELDED AREA)
SEVEN RUN LINE 130m OUT TO DEL
UP
DN
1:60
1:60
1:60



NOTES:-

1. ALL DIMENSIONS ARE IN MM AND LEVELS IN METERS, UNLESS OTHERWISE MENTIONED.
2. NO DIMENSION SHALL BE SCALED FROM THE DRAWING. ONLY WRITTEN DIMENSION TO BE FOLLOWED.
3. DETAILED DESIGN SHALL BE PROOF CHECKED AND DRAWINGS SHALL BE FINALIZED IN CONSULTATION WITH RVNL.
4. 100 DIA WEEP HOLES TO BE PROVIDED @1000 C/C HORZ. AND 1000 C/C VERT. ABOVE LOW WATER LEVEL IN ABUTMENT.
5. PROPER CURING OF CONCRETE TO ACQUIRE HARDNESS, STRENGTH AND OTHER PROPERTIES MUST BE ENSURED.
6. THE STRUCTURAL DETAILS OF SUPERSTRUCTURE, SUB STRUCTURE & FOUNDATION ARE TENTATIVE AND LIABLE TO BE CHANGED AFTER DETAILED DESIGN.
7. THE GEO-TECHNICAL PARAMETERS GIVEN BELOW ARE SUBJECT TO BE MODIFIED AS PER DETAILED CONFIRMATORY BOREHOLES PLANNED AT EACH ABUTMENT.
8. OPEN FOUNDATION IS PROPOSED FOR SUBSTRUCTURE
9. GEO-TECHNICAL INVESTIGATIONS AT LOCATION OF EACH ABUTMENT SHALL BE CONDUCTED AND ACCORDINGLY DETAILED DESIGN OF FOUNDATION SHALL BE CARRIED OUT BEFORE START OF WORK.
10. THE EXPOSURE CONDITIONS TO WHICH CONCRETE WILL BE EXPOSED DURING ITS WORKING LIFE IS AS FOLLOWS:
    (i) SUPERSTRUCTURE AND SUB-STRUCTURE - SEVERE
    (ii) FOUNDATION - SEVERE
11. PROPERLY DESIGNED RIVER TRAINING & PROTECTION WORKS SHALL BE PROVIDED AS PER SITE CONDITIONS _
12. PROPER DRAINAGE PLAN ALONG WITH THE LOCATION OF DRAINAGE SPOUTS WILL BE PREPARED SEPARATELY.
13. CRASH BARRIER SHALL BE PROVIDED AS PER BRIDGE PLANS.REMAINING PORTION SHALL BE WITH WBM CRASH BARRIERS ALONG RAMP.
14. FOR SUPERSTRUCTURE DETAILS REFER RDSO DRG.NO:RDSO-B-11774 1 TO 12

GEOMETRICAL PARAMETERS:-

i).SPAN ARRANGEMENT - 1 X30.0m
ii).TOTAL LENGTH OF BRIDGE FROM F/F DIRT WALL=31.0m

SIGNATURE OF NORTHERN RAILWAY HQ OFFICERS			
Dy.CE/BD	CBE		
SIGNATURE OF MORADABAD DIVISION OFFICERS			
SR. DEN - I / MB	SR. DEN-C / MB	DRM / MB	
SIGNATURE OF RVNL OFFICERS			
JGM/P-3/RKSH	CPM/RKSH		

NORTHERN RAILWAY

RISHIKESH-KARANPRAYAG
NEW B.G. RAILWAY LINE PROJECT
GENERAL ARRANGEMENT DRAWING
FOR BRIDGE NO-12B (ROB) AT RAMP SPAN 1X30.0m
AT CH.319.942M (TILANI STATION YARD)

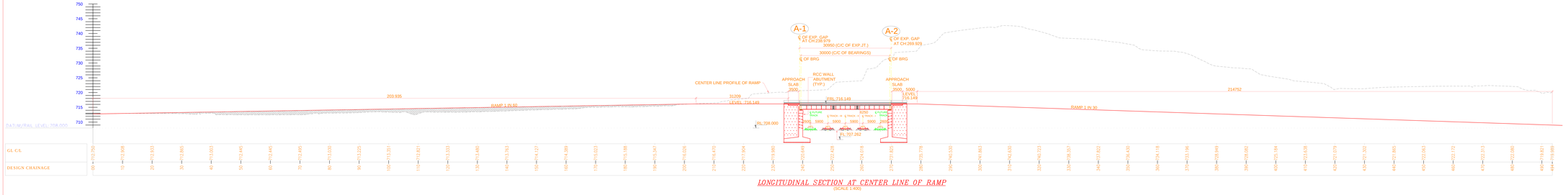
SCALE	ORIGINAL PRINT SIZE = 594mm x 1100mm		
CLIENT : Rail Vikas Nigam Limited	CONTRACTOR'S CONSULTANT : AECOM India Private Limited, 9th FLOOR, INFINITY TOWER-C, DLF CYBER CITY, DLF PHASE-II, GURGAON-122002, HARYANA, INDIA. WWW.AECOM.COM	RVNL DRG. No.	GA-12B
		SHEET No.	01 OF 03
		DATE	30/10/2019
		REV No.	-

DIVL CASE No:	
NRHQE CASE No:	
DIVL PLAN No:	
N. R. H. Q. E. PLAN No:	

FEASIBILITY CERTIFICATE

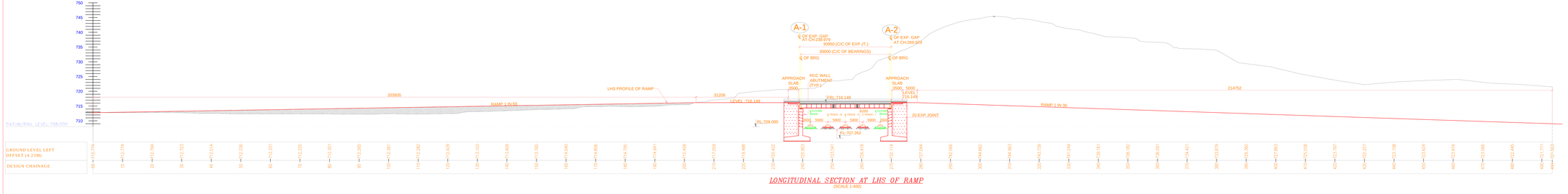
CERTIFIED THAT EXISTING LAYOUT AND PROPOSAL CHECKED AT SITE AND FOUND CORRECT AND FEASIBLE

AM/P/W/RKSH/RVNL	DGM/Pr/SRINAGAR/RVNL	SSE/DRG/MB	SSE/W/HW	SSE/P-WAY/DDN	ADEN/RK



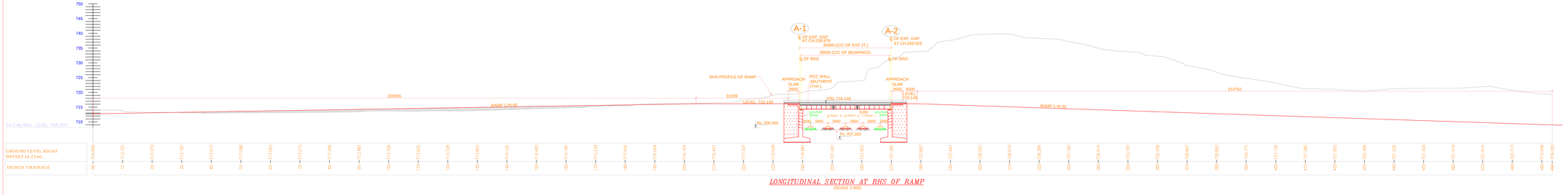
LONGITUDINAL SECTION AT CENTER LINE OF RAMP

(SCALE 1:400)



LONGITUDINAL SECTION AT LHS OF RAMP

(SCALE 1:400)



LONGITUDINAL SECTION AT RHS OF RAMP

(SCALE 1:400)

SIGNATURE OF NORTHERN RAILWAY HQ OFFICERS

Dy.CE/BD	CBE		

SIGNATURE OF MORADABAD DIVISION OFFICERS

SR. DEN - I / MB	SR. DEN-C / MB	DRM / MB

SIGNATURE OF RVNL OFFICERS

JGM/P-3/RKSH	CPM/RKSH	

NORTHERN RAILWAY

RISHIKESH-KARANPRAYAG NEW B.G. RAILWAY LINE PROJECT

GENERAL ARRANGEMENT DRAWING FOR BRIDGE NO-12B (ROB) AT RAMP SPAN 1X30.0m AT CH.319.942M (TILANI STATION YARD)

SCALE	ORIGINAL PRINT SIZE =	594mm x 1500mm
CLIENT	CONTRACTOR'S CONSULTANT	RVNL DRG. No. GA-12B
		SHEET No. 02 OF 03
		DATE 30/10/2019
		REV No. -

AECOM India Private Limited

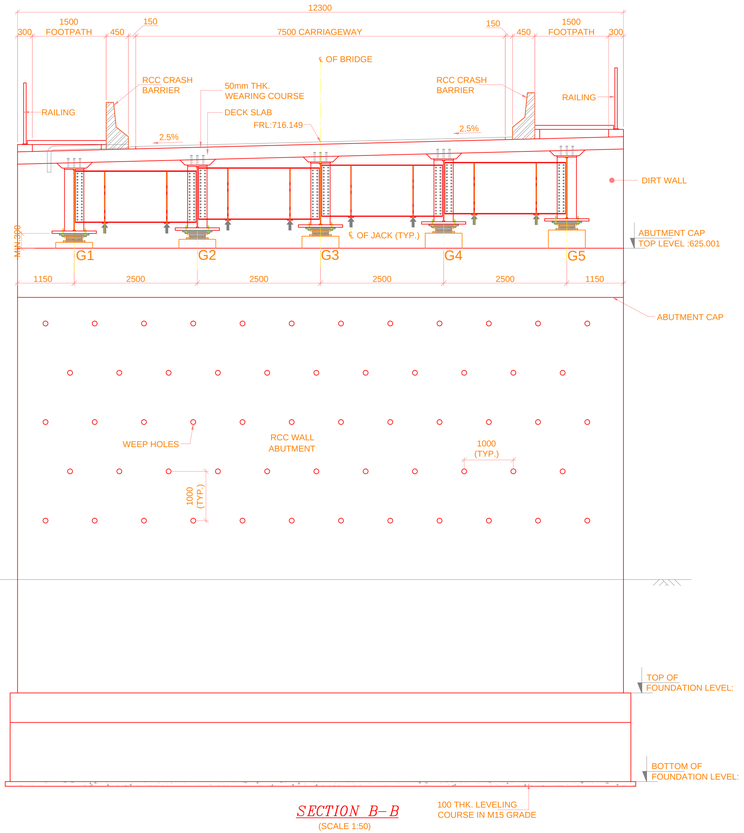
9th FLOOR, INFINITY TOWERS C, DLF CYBER CITY, DLF PHASE-II, GURGAON-122002, HARYANA, INDIA. WWW.AECOM.COM

DIVL CASE No:		
NRHQE CASE No:		
DIVL PLAN No:		
N. R. H. Q. E. PLAN No:		

FEASIBILITY CERTIFICATE

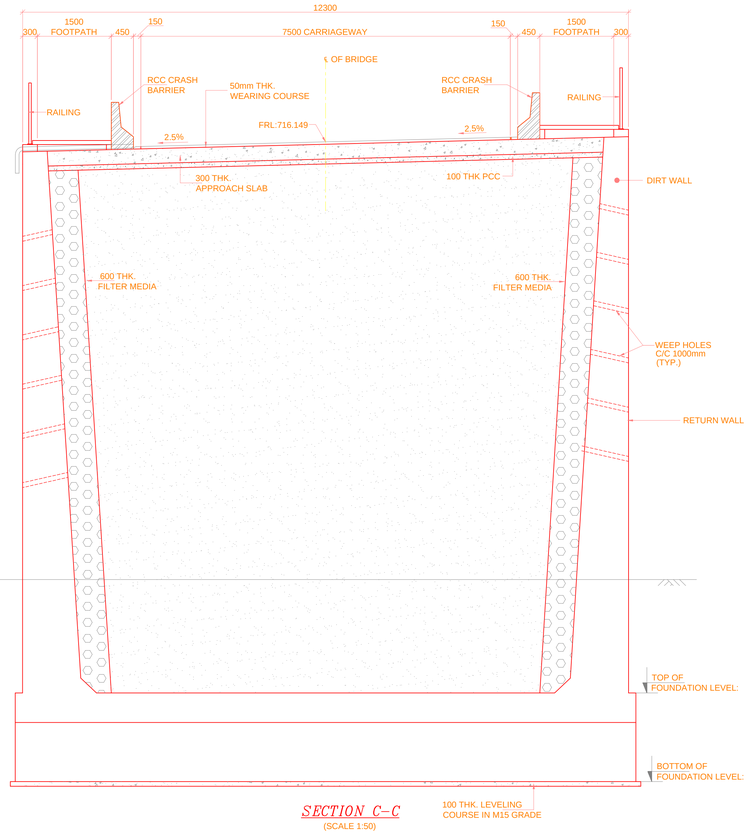
CERTIFIED THAT EXISTING LAYOUT AND PROPOSAL CHECKED AT SITE AND FOUND CORRECT AND FEASIBLE

AM/P/W/RKSH/RVNL	DGM/Pr/SRINAGAR/RVNL	SSE/DRG/MB	SSE/W/HW	SSE/P-WAY/DDN	ADEN/RK



SECTION B–B

(SCALE 1:50)



SECTION C–C

(SCALE 1:50)

SIGNATURE OF NORTHERN RAILWAY HQ OFFICERS			
Dy.CE/BD	CBE		
SIGNATURE OF MORADABAD DIVISION OFFICERS			
SR. DEN - I / MB	SR. DEN-C / MB	DRM / MB	
SIGNATURE OF RVNL OFFICERS			
JGM/P-3/RKSH	CPM/RKSH		

N O R T H E R N R A I L W A Y

R I S H I K E S H - K A R A N P R A Y A G
NEW B.G. RAILWAY LINE PROJECT
GENERAL ARRANGEMENT DRAWING
FOR BRIDGE NO-12B (ROB) AT RAMP SPAN 1X30.0m AT CH.319.942M (TILANI STATION YARD)

SCALE	ORIGINAL PRINT SIZE = 594mm x 1000mm		
CLIENT: Rail Vikas Nigam Limited (A Government of India Enterprise)	CONTRACTOR'S CONSULTANT: AECOM India Private Limited, 9th FLOOR, INFINITY TOWER C, DLF CYBER CITY, DLF PHASE-II, GURGAON-122002, HARYANA, INDIA. WWW.AECOM.COM	RVNL DRG. No.	GA-12B
		SHEET No.	03 OF 03
		DATE	30/10/2019
		REV No.	-

FEASIBILITY CERTIFICATE

CERTIFIED THAT EXISTING LAYOUT AND PROPOSAL CHECKED AT SITE AND FOUND CORRECT AND FEASIBLE

AM/P/W/RKSH/RVNL	DGM/Pr/SRINAGAR/RVNL	SSE/DRG/MB	SSE/W/HW	SSE/P-WAY/DDN	ADEN/RK

DIVL CASE No:

NRHQE CASE No:

DIVL PLAN No:

N. R. H. Q. E. PLAN No:

meil

Megha Engineering & Infrastructures Ltd.

An ISO 9001-2015 Company

S-2, Technocrat Indl. Estate, Balanagar, Hyderabad-500037, Telangana,
INDIA Tel: +91-40-44336700 Fax: +91-40-44336800
E-mail: info@meil.in Visit us: www.meil.in U45202TG2006PLC050271

Lr. No. MEIL/RVNL/RKSH-KNPG/PKG-7B/2021-22/1009 Date: 02/12/2021

To,
The Engineer
AECOM India Pvt. Ltd.,
Site Office –VPO Sumerpur,
Tehsil –Rudraprayag,
Distt –Rudraprayag,
Uttarakhand.
(Kind Attention: Mr. David Lees, Team Leader PMC)

Sub: "CONSTRUCTION OF TUNNELS, BRIDGES AND FORMATION WORKS FROM CHAINAGE 91+228 TO 101+339 (FLS) **UNDER PACKAGE–7B IN CONNECTION WITH NEW BG LINE BETWEEN RISHIKESH AND KARANPRAYAG** (125KM) IN STATE OF UTTARAKHAND, INDIA."

Reg: Non-availability the Muck Disposal Area at Adit 7.

Ref: (i) AECOM/GEO/RVNL/PMC/RKSH-KNPG/PKG-7B/MEIL/656 dated 22.06.2021
(ii) AECOM/GEO/RVNL/PMC/RKSH-KNPG/PKG-7B/MEIL/657 dated 22.06.2021
(iii) AECOM/GEO/RVNL/PMC/RKSH-KNPG/PKG-7B/MEIL/672 dated 24.06.2021
(iv) AECOM/GEO/RVNL/PMC/RKSH-KNPG/PKG-7B/MEIL/692 dated 01.07.2021
(v) AECOM/GEO/RVNL/PMC/RKSH-KNPG/PKG-7B/MEIL/956 dated 10.09.2021
(vi) AECOM/GEO/RVNL/PMC/RKSH-KNPG/PKG-7B/MEIL/1093 dated 20.10.2021
(vii) MEIL/RVNL/RKSH-KNPG/PKG-7B/2020-21/557 dated 12.06.2021
(viii) MEIL/RVNL/RKSH-KNPG/PKG-7B/2020-21/598 dated 23.06.2021
(ix) MEIL/RVNL/RKSH-KNPG/PKG-7B/2020-21/770 dated 04.09.2021
(x) MEIL/RVNL/RKSH-KNPG/PKG-7B/2020-21/886 dated 18.10.2021
(xi) MEIL/RVNL/RKSH-KNPG/PKG-7B/2020-21/913 dated 27.10.2021

Sir,

During last Weekly Progress Review Meeting held on 30.10.2021, Contractor was informed that new dumping site will be given for use after Diwali. However, the same still to be made available to the Contractor.

Due to non-availability of dumping site near Adit 7, Contractor is required to re-handle the muck and cycle time is getting affected.

Availability of Dumping site near Adit 7 is very crucial for timely mucking. Accordingly,

Site office: Megha engineering and Infrastructures Limited, RishikeshKaranprayag BG Rail Link Package-7B, Vill + PO - Sumerpur, Tehsil - Rudraprayag, Dist. - Rudraprayag, Uttarakhand, Pin 246171

Contractor would like to again request you to please allocate dumping area near batching plant at Adit 7/Juari Bypass at the earliest possible so that we can avoid un-necessary re-handling of muck.

Thanking you and assuring you of our best services at all times.

Yours faithfully,
For **Megha Engineering & Infrastructures Limited**

RVNL Tunnel PKG-7B
Vill-Sumerpur Tehsil
Rudraprayag
Distt-Rudraprayag
Pin-246171

ONKAR SINGH CHAUHAN
Authorized signatory
Encl:

Site office: Megha engineering and Infrastructures Limited, RishikeshKaranprayag BG Rail Link Package-7B, Vill + PO - Sumerpur, Tehsil - Rudraprayag, Dist. - Rudraprayag, Uttarakhand, Pin 246171

AECOM India Pvt Ltd.,
9/F, Infinity Tower C,
DLF Cyber City, Phase II,
Gurgaon 122 002
India
www.aecom.com
CIN: U74210HR2008FTC038183

91 124 483 0100 tel
91 124 483 0108 fax

Ref No: AECOM/GEO/RVNL/PMC/RKSH-KNPG/PKG-7B/MEIL/1276 **Date: 28.12.2021**

M/s MEGHA ENGINEERING & INFRASTRUCTURES LTD
S-2,22, T.I.E, Balanagar,
Hyderabad – 500037, Telangana, India
Tel: 91 40 44336700
Fax: 91 40 44336800
Email: jsrinivaskumar@meilgroup.in

(Kind Attention: Mr. Onkar Singh – Project Manager, MEIL, Authorized Signatory)

Subject: "CONSTRUCTION OF TUNNELS & BRIDGES WORKS FROM CHAINAGE 91+228 to 101+339 UNDER PACKAGE–7B IN CONNECTION WITH NEW BG LINE BETWEEN RISHIKESH AND KARANPRAYAG (125KM) IN STATE OF UTTARAKHAND, INDIA."

Reg: **Regarding approval of Dumping Yard for Adit-7 at Jawari Bypass**

Ref: (i) CA No. RVNL/RKSH-KNPG/Tender/Tunnels/PK-7B/52, dated 02.09.2020
(ii) Your office letter no. MEIL/RVNL/RKSH-KNPG/PKG-7B/2021-22/1009, dated 02.12.20221

Dear Sir

This is with respect to the captioned subject and CA under Ref. (i).

The Contractor vide letter under Ref. (ii) has submitted its request for providing the dumping site near Adit-7 and the same was reviewed by the Employer & the Engineer.

The Employer after some negotiation with District Authorities (Forest Department) has now arranged for ***dumping yard for Adit-7 at Jawari Bypass and in principal approval is hereby accorded for the use of said dumping yard***.

The Contractor is therefore required to submit a proposal for protection works for the use of the dump site. After approval of proposal and completion of protection works the Contractor can start dumping the muck from Adit-7. In addition to above, it is pertinent to mention that the Contractor should arrange for a joint measurement for lead and prepare & keep handy the records (maintain a register – a format is already shared) of the same at all times.

It is to be noted that the Engineer during several discussions has asked for maintaining a register/record for the Crusher Plant (a format in this regard is also shared); however, the Contractor to date has not provided the details and also, details/records pertaining to lead distance for dumping of muck from Adit-7 at Portal 2 – Dumping Yard are not provided.

In this regard, the Contractor is required to survey the area and provide the proposal for protection works for dumping yard near Jawari Bypass and to start the works at the earliest. In addition to this, submit the details/records as required and arrange for a joint measurement for lead distance.

Yours sincerely
For AECOM India Pvt. Ltd.

Engineer
Team Leader, PMC

Copy to:

1. Additional General Manager/P3, Rail Vikas Nigam Limited, Rishikesh, PIU, RVNL Office Building, Opp. GST Bhavan, Next to GMVN, Shayampur Bypass Road, Rishikesh, Uttarakhand.
2. Manager Civil/P3, Rail Vikas Nigam Limited, RVNL Office, Srikot, Pauri Gharwal, Uttarakhand.
3. Mr. Chander Shekhar Khokhar, Advisor, Geotechnical, M/s AECOM India Pvt. Ltd., Gurgaon.
4. Mr. Akhil Reddy, M/s Megha Engineering & Infrastructures Limited.

ANNEXURE - 3

उत्तराखण्ड शासन
औद्योगिक विकास (खनन) अनुभाग–1
संख्याः 123 /VII-1/2021/8(16)/19
देहरादून, दिनांकः 19 जनवरी, 2021

अधिसूचना

राज्यपाल, खान और खनिज (विकास और विनियमन) अधिनियम, 1957 (अधिनियम संख्या 67 वर्ष 1957) की धारा 23ग के द्वारा प्रदत्त शक्तियों का प्रयोग करते हुए उत्तराखण्ड खनिज (अवैध खनन, परिवहन एवं भण्डारण का निवारण) नियमावली, 2020 में संशोधन करने की दृष्टि से निम्नलिखित नियमावली बनाते हैं :–

उत्तराखण्ड खनिज (अवैध खनन, परिवहन एवं भण्डारण का निवारण) (संशोधन) नियमावली, 2021

संक्षिप्त नाम और प्रारम्भ

1. (1) इस नियमावली का संक्षिप्त नाम उत्तराखण्ड खनिज (अवैध खनन, परिवहन एवं भण्डारण का निवारण) (संशोधन) नियमावली, 2021 है।

(2) यह तुरन्त प्रवृत्त होगी।

नियम 8 का संशोधन

2. उत्तराखण्ड खनिज (अवैध खनन, परिवहन एवं भण्डारण का निवारण) नियमावली, 2020 (जिसे आगे मूल नियमावली कहा गया है) में नीचे स्तम्भ–1 में दिये गये विद्यमान नियम 8 के स्थान पर स्तम्भ–2 में दिया गया नियम रख दिया जायेगा, अर्थात्–

स्तम्भ–1 विद्यमान नियम	स्तम्भ–2 एतद्द्वारा प्रतिस्थापित नियम
8. (1) इस नियमावली के अन्य उपबन्धों के अधीन रहते हुए, खनिज (आर०बी०एम० एवं बोल्डर को छोड़कर) के रिटेल भण्डारण, ईंट रिटेल भण्डारण, ईंट भट्टा परिसर भण्डारण एवं सोपस्टोन भण्डारण /सोपस्टोन ट्रेडर की अनुज्ञप्ति हेतु आवेदन कोई भी व्यक्ति/ संस्था/फर्म/कम्पनी सम्बन्धित जनपद के जिला खान अधिकारी कार्यालय मे निर्धारित प्रपत्र–"एच" में चार प्रतियों में वांछित अभिलेखों एवं निर्धारित आवेदन शुल्क सहित प्रस्तुत करेगा। आवेदन की एक प्रति पावती के रूप में आवेदक को हस्ताक्षर कर वापस कर दी जायेगी। सम्बन्धित जिला खान अधिकारी द्वारा आवेदन पत्र एवं संलग्नक/अभिलेखों का परीक्षण कर, अपूर्ण अभिलेखों को पूर्ण कराते हुए गठित समिति से स्थलीय निरीक्षण की कार्यवाही हेतु	8. (1) इस नियमावली के अन्य उपबन्धों के अधीन रहते हुए, खनिज (आर०बी०एम० एवं बोल्डर को छोड़कर) के रिटेल भण्डारण, ईंट रिटेल भण्डारण, ईंट भट्टा परिसर भण्डारण एवं सोपस्टोन भण्डारण/ सोपस्टोन ट्रेडर की अनुज्ञप्ति हेतु आवेदन कोई भी व्यक्ति/ संस्था/फर्म/कम्पनी सम्बन्धित जनपद के जिला खान अधिकारी कार्यालय मे निर्धारित प्रपत्र–"एच" में चार प्रतियों में वांछित अभिलेखों एवं निर्धारित आवेदन शुल्क सहित प्रस्तुत करेगा। आवेदन की एक प्रति पावती के रूप में आवेदक को हस्ताक्षर कर वापस कर दी जायेगी। सम्बन्धित जिला खान अधिकारी द्वारा आवेदन पत्र एवं संलग्नक/अभिलेखों का परीक्षण कर, अपूर्ण अभिलेखों को पूर्ण कराते हुए गठित समिति से स्थलीय निरीक्षण की कार्यवाही हेतु

सम्बन्धित जिलाधिकारी को संदर्भित किया जायेगा।"

परन्तु स्टोन क्रेशर, स्क्रीनिग प्लान्ट, मोबाईल स्टोन क्रेशर, मोबाईल स्क्रीनिंग प्लान्ट, हॉट मिक्स प्लान्ट, रेडिमिक्स प्लान्ट एवं पल्वराईजर प्लान्ट परिसर में उपखनिजों के भण्डारण हेतु आवेदन, राज्य सरकार द्वारा उत्तराखण्ड स्टोन क्रेशर, स्क्रीनिंग प्लान्ट, मोबाईल स्टोन क्रेशर, मोबाईल स्कीनिंग प्लान्ट, पल्वराईजर प्लान्ट, हाट मिक्स प्लान्ट, रेडिमिक्स प्लान्ट अनुज्ञा नीति में निर्धारित प्रपत्र क्रमशः अनुसूची–2, अनुसूची–5, अनुसूची–6 एवं अनुसूची–7 में प्रस्तुत किया जायेगा।

(क)(i) रिटेल भण्डारण हेतु पर्वतीय क्षेत्र के लिए न्यूनतम क्षेत्रफल 200 वर्गमीटर तथा मैदानी क्षेत्र हेतु न्यूनतम क्षेत्रफल 500 वर्गमीटर स्थल का होना आवश्यक होगा, तथा भण्डारण स्थल में वाहनों के पार्किंग, आफिस एवं तोल मशीन हेतु अतिरिक्त 200 वर्ग मीटर क्षेत्रफल आरक्षित रखना अनिवार्य होगा।

(ii) ईट रिटेल भण्डारण हेतु पर्वतीय क्षेत्र हेतु न्यूनतम क्षेत्रफल 200 वर्गमीटर तथा मैदानी क्षेत्र हेतु न्यूनतम क्षेत्रफल 500 वर्गमीटर स्थल का होना आवश्यक होगा तथा वाहनों के पार्किन्ग एवं आफिस हेतु अतिरिक्त 200 वर्ग मीटर क्षेत्रफल आरक्षित रखना अनिवार्य होगा।

(ख) वाहन, ऑफिस, तौल मशीन एवं प्लांट के क्षेत्र को छोडकर अवशेष क्षेत्र में खनिज भण्डारण किया

सम्बन्धित जिलाधिकारी को संदर्भित किया जायेगा।"

परन्तु स्टोन क्रेशर, स्क्रीनिग प्लान्ट, मोबाईल स्टोन क्रेशर, मोबाईल स्क्रीनिंग प्लान्ट, हॉट मिक्स प्लान्ट, रेडिमिक्स प्लान्ट एवं पल्वराईजर प्लान्ट परिसर में उपखनिजों के भण्डारण हेतु आवेदन, राज्य सरकार द्वारा उत्तराखण्ड स्टोन क्रेशर, स्क्रीनिंग प्लान्ट, मोबाईल स्टोन क्रेशर, मोबाईल स्कीनिंग प्लान्ट, पल्वराईजर प्लान्ट, हाट मिक्स प्लान्ट, रेडिमिक्स प्लान्ट अनुज्ञा नीति में निर्धारित प्रपत्र क्रमशः अनुसूची–2, अनुसूची–5, अनुसूची–6 एवं अनुसूची–7 में प्रस्तुत किया जायेगा।

(क)(i) रिटेल भण्डारण हेतु पर्वतीय क्षेत्र के लिए न्यूनतम क्षेत्रफल 200 वर्गमीटर तथा मैदानी क्षेत्र हेतु न्यूनतम क्षेत्रफल 500 वर्गमीटर स्थल का होना आवश्यक होगा, तथा भण्डारण स्थल में वाहनों के पार्किंग, आफिस एवं तोल मशीन हेतु अतिरिक्त 200 वर्ग मीटर क्षेत्रफल आरक्षित रखना अनिवार्य होगा।

(ii) ईट रिटेल भण्डारण हेतु पर्वतीय क्षेत्र हेतु न्यूनतम क्षेत्रफल 200 वर्गमीटर तथा मैदानी क्षेत्र हेतु न्यूनतम क्षेत्रफल 500 वर्गमीटर स्थल का होना आवश्यक होगा तथा वाहनों के पार्किन्ग एवं आफिस हेतु अतिरिक्त 200 वर्ग मीटर क्षेत्रफल आरक्षित रखना अनिवार्य होगा।

(ख) वाहन, ऑफिस, तौल मशीन एवं प्लांट के क्षेत्र को छोडकर अवशेष क्षेत्र में खनिज भण्डारण किया

जायेगा, जिसकी अधिकतम ऊंचाई 03 मीटर से अधिक नहीं होगी, परन्तु स्टोन क्रेशर, स्क्रीनिंग प्लान्ट स्वामी प्लान्ट के परिसर में एक समय में औसतन 05 मी० ऊंचाई तक उपखनिज का भण्डारण किया जा सकेगा।

(ग) आवेदक द्वारा खनिज भण्डारण हेतु खनिज प्राप्त किये जाने वाले वैध स्रोत का अनुबन्ध जिला खान अधिकारी से प्रतिहस्ताक्षरित कराकर प्रस्तुत किया जाना होगा।

(2) ऐसे प्रत्येक आवेदन हेतु निम्नानुसार अनुज्ञा शुल्क देय होगा, जो निर्धारित लेखाशीर्षक में जमा कराया जायेगा :–

1. उपखनिज (आर०बी०एम० एवं बोल्डर को छोड़कर) एवं सोपस्टोन ट्रेडर के रिटेल भण्डारण हेतु 50,000 टन क्षमता हेतु अनुज्ञा शुल्क ₹ 25,000.00 (₹ पच्चीस हजार मात्र) देय होगा तथा इससे अधिक क्षमता बढ़ाने पर प्रति टन ₹ 10, अतिरिक्त शुल्क देय होगा।
2. स्टोन क्रेशर/स्क्रीनिंग प्लान्ट / मोबाईल स्टोन केशर/ मोबाईल स्क्रीनिंग प्लांट/ पल्वराइजर/हॉट मिक्स/ रेडिमिक्स प्लांट परिसर में उपखनिज भण्डारण हेतु पृथक से शुल्क देय नहीं होगा।

भण्डारण अनुज्ञा स्वीकृति

जायेगा, जिसकी अधिकतम ऊंचाई 03 मीटर से अधिक नहीं होगी, परन्तु स्टोन क्रेशर, स्क्रीनिंग प्लान्ट स्वामी प्लान्ट के परिसर में एक समय में औसतन 05 मी० ऊंचाई तक उपखनिज का भण्डारण किया जा सकेगा।

(ग) आवेदक द्वारा खनिज भण्डारण हेतु खनिज प्राप्त किये जाने वाले वैध स्रोत का अनुबन्ध जिला खान अधिकारी से प्रतिहस्ताक्षरित कराकर प्रस्तुत किया जाना होगा।

परन्तु, उक्त प्रावधान ऋषिकेश–कर्णप्रयाग रेल लाईन परियोजना की कार्यदायी संस्था रेल विकास परियोजना लिमिटेड/रेल विकास परियोजना लिमिटेड द्वारा अनुबन्धित ठेकेदार पर लागू नहीं होगा।

(2) ऐसे प्रत्येक आवेदन हेतु निम्नानुसार अनुज्ञा शुल्क देय होगा, जो निर्धारित लेखाशीर्षक में जमा कराया जायेगा :–

1. उपखनिज (आर०बी०एम० एवं बोल्डर को छोड़कर) एवं सोपस्टोन ट्रेडर के रिटेल भण्डारण हेतु 50,000 टन क्षमता हेतु अनुज्ञा शुल्क ₹ 25,000.00 (₹ पच्चीस हजार मात्र) देय होगा तथा इससे अधिक क्षमता बढ़ाने पर प्रति टन ₹ 10, अतिरिक्त शुल्क देय होगा।
2. स्टोन क्रेशर/स्क्रीनिंग प्लान्ट / मोबाईल स्टोन केशर/ मोबाईल स्क्रीनिंग प्लांट/ पल्वराइजर/हॉट मिक्स/ रेडिमिक्स प्लांट परिसर में उपखनिज भण्डारण हेतु पृथक से शुल्क देय नहीं होगा।

भण्डारण अनुज्ञा स्वीकृति

हेतु निर्धारित अनुज्ञा शुल्क का 10 प्रतिशत धनराशि आवेदन शुल्क (बिना वापसी के) आवेदन पत्र प्रस्तुत करते समय तथा अवशेष 90 प्रतिशत की धनराशि अनुज्ञा स्वीकृति के उपरान्त चाहरदीवारी बनाने, धर्मकांटा लगाने एवं सी0सी0टी0वी0 लगाने के उपरान्त ई–रवन्ना जारी होने से पूर्व निर्धारित लेखा शीर्षक में जमा किया जाना आवश्यक होगा।

हेतु निर्धारित अनुज्ञा शुल्क का 10 प्रतिशत धनराशि आवेदन शुल्क (बिना वापसी के) आवेदन पत्र प्रस्तुत करते समय तथा अवशेष 90 प्रतिशत की धनराशि अनुज्ञा स्वीकृति के उपरान्त चाहरदीवारी बनाने, धर्मकांटा लगाने एवं सी0सी0टी0वी0 लगाने के उपरान्त ई–रवन्ना जारी होने से पूर्व निर्धारित लेखा शीर्षक में जमा किया जाना आवश्यक होगा।

परन्तु, उक्त प्रावधान ऋषिकेश–कर्णप्रयाग रेल लाईन परियोजना की कार्यदायी संस्था रेल विकास परियोजना लिमिटेड/रेल विकास परियोजना लिमिटेड द्वारा अनुबन्धित ठेकेदार पर लागू नहीं होगा।

(3) भण्डारण अनुज्ञा प्राप्त करने हेतु जिला खान अधिकारी कार्यालय में निर्धारित प्रपत्र पर आवेदन प्रस्तुत करने के 03 दिन के अन्तर्गत आवेदक द्वारा स्थानीय समाचार पत्र में स्वयं के व्यय पर विज्ञप्ति, जिसमें आवेदक का नाम, पता व आवेदित स्थल का पूर्ण विवरण उल्लिखित हो, इस आशय से प्रकाशित की जायेगी कि यदि किसी स्थानीय व्यक्ति/संस्था/विभाग आदि जो निर्धारित दूरी 100 मीटर के अन्तर्गत निवासरत हो तथा खनिज भण्डारण के प्रस्तावित स्थल से प्रभावित हो अथवा उन्हे कोई आपत्ति हो, तो वे अपनी आपत्ति विज्ञप्ति प्रकाशन के 15 दिवस के अन्तर्गत सम्बन्धित जनपद के जिलाधिकारी को प्रस्तुत करेंगे।

प्रकाशित विज्ञप्ति के उपरान्त यदि किसी स्थानीय व्यक्ति/संस्था / विभाग आदि की आपत्ति प्राप्त होती है तो सम्बन्धित

(3) भण्डारण अनुज्ञा प्राप्त करने हेतु जिला खान अधिकारी कार्यालय में निर्धारित प्रपत्र पर आवेदन प्रस्तुत करने के 03 दिन के अन्तर्गत आवेदक द्वारा स्थानीय समाचार पत्र में स्वयं के व्यय पर विज्ञप्ति, जिसमें आवेदक का नाम, पता व आवेदित स्थल का पूर्ण विवरण उल्लिखित हो, इस आशय से प्रकाशित की जायेगी कि यदि किसी स्थानीय व्यक्ति/संस्था/विभाग आदि जो निर्धारित दूरी 100 मीटर के अन्तर्गत निवासरत हो तथा खनिज भण्डारण के प्रस्तावित स्थल से प्रभावित हो अथवा उन्हे कोई आपत्ति हो, तो वे अपनी आपत्ति विज्ञप्ति प्रकाशन के 15 दिवस के अन्तर्गत सम्बन्धित जनपद के जिलाधिकारी को प्रस्तुत करेंगे।

प्रकाशित विज्ञप्ति के उपरान्त यदि किसी स्थानीय व्यक्ति/संस्था/विभाग आदि की आपत्ति प्राप्त होती है तो सम्बन्धित

उपजिलाधिकारी एवं खान अधिकारी द्वारा आपत्तिकर्ता एवं आवेदक को सुनने के उपरान्त युक्तियुक्त निर्णय हेतु जिलाधिकारी को अवगत कराया जायेगा। जिलाधिकारी प्रकरण पर 30 दिन के भीतर निर्णय लेंगे अन्यथा की स्थिति में आपत्ति स्वीकार मानी जायेगी अर्थात् भण्डारण आवेदन निरस्त माना जायेगा।

प्रकाशित विज्ञप्ति में निर्धारित समयावधि के अन्तर्गत यदि किसी स्थानीय व्यक्ति/संस्था/विभाग आदि की आपत्ति प्राप्त नहीं होती है अथवा जिलाधिकारी द्वारा भण्डारण अनुज्ञाधारक के पक्ष में निर्णय लिया जाता है, तो जिलाधिकारी द्वारा ईंट रिटेल भण्डारण एवं ईट भट्टा परिसर भण्डारण हेतु अनुज्ञा स्वीकृति हेतु कार्यवाही की जायेगी। उपखनिज (आर०बी०एम० एवं बोल्डर को छोड़कर) के रिटेल भण्डारण हेतु जिलाधिकारी द्वारा ऐसे आवेदन पत्र को संस्तुति सहित भण्डारण अनुज्ञा स्वीकृति हेतु एक सप्ताह के भीतर मण्डलायुक्त को प्रेषित किया जायेगा तथा सोपस्टोन भण्डारण /सोपस्टोन ट्रेडर की अनुज्ञा स्वीकृति हेतु ऐसे आवेदन पत्र को संस्तुति सहित एक सप्ताह के भीतर निदेशक को संदर्भित किया जायेगा तथा निदेशक द्वारा प्रस्ताव का परीक्षण कर अनुज्ञा स्वीकृति हेतु प्रस्ताव संस्तुति सहित शासन को प्रेषित किया जायेगा।

उपजिलाधिकारी एवं खान अधिकारी द्वारा आपत्तिकर्ता एवं आवेदक को सुनने के उपरान्त युक्तियुक्त निर्णय हेतु जिलाधिकारी को अवगत कराया जायेगा। जिलाधिकारी प्रकरण पर 30 दिन के भीतर निर्णय लेंगे अन्यथा की स्थिति में आपत्ति स्वीकार मानी जायेगी अर्थात् भण्डारण आवेदन निरस्त माना जायेगा।

प्रकाशित विज्ञप्ति में निर्धारित समयावधि के अन्तर्गत यदि किसी स्थानीय व्यक्ति/संस्था/विभाग आदि की आपत्ति प्राप्त नहीं होती है अथवा जिलाधिकारी द्वारा भण्डारण अनुज्ञाधारक के पक्ष में निर्णय लिया जाता है, तो जिलाधिकारी द्वारा ईंट रिटेल भण्डारण एवं ईट भट्टा परिसर भण्डारण हेतु अनुज्ञा स्वीकृति हेतु कार्यवाही की जायेगी। उपखनिज (आर०बी०एम० एवं बोल्डर को छोड़कर) के रिटेल भण्डारण हेतु जिलाधिकारी द्वारा ऐसे आवेदन पत्र को संस्तुति सहित भण्डारण अनुज्ञा स्वीकृति हेतु एक सप्ताह के भीतर मण्डलायुक्त को प्रेषित किया जायेगा तथा सोपस्टोन भण्डारण /सोपस्टोन ट्रेडर की अनुज्ञा स्वीकृति हेतु ऐसे आवेदन पत्र को संस्तुति सहित एक सप्ताह के भीतर निदेशक को संदर्भित किया जायेगा तथा निदेशक द्वारा प्रस्ताव का परीक्षण कर अनुज्ञा स्वीकृति हेतु प्रस्ताव संस्तुति सहित शासन को प्रेषित किया जायेगा।

परन्तु, उक्त प्रावधान ऋषिकेश–कर्णप्रयाग रेल लाईन परियोजना की कार्यदायी संस्था रेल विकास परियोजना लिमिटेड/रेल विकास परियोजना लिमिटेड द्वारा अनुबन्धित ठेकेदार पर लागू नहीं होगा।

(4) आवेदक द्वारा आवेदन पत्र में प्रस्तावित भण्डारण स्थल अनुज्ञा स्वीकृति हेतु समिति द्वारा उपयुक्त न पाये जाने पर संबंधित जिलाधिकारी द्वारा कारणों का उल्लेख करते हुये आवेदनकर्ता को लिखित रूप से सूचित किया जायेगा।

(4) आवेदक द्वारा आवेदन पत्र में प्रस्तावित भण्डारण स्थल अनुज्ञा स्वीकृति हेतु समिति द्वारा उपयुक्त न पाये जाने पर संबंधित जिलाधिकारी द्वारा कारणों का उल्लेख करते हुये आवेदनकर्ता को लिखित रूप से सूचित किया जायेगा।

परन्तु, उक्त प्रावधान ऋषिकेश–कर्णप्रयाग रेल लाईन परियोजना की कार्यदायी संस्था रेल विकास परियोजना लिमिटेड/रेल विकास परियोजना लिमिटेड द्वारा अनुबन्धित ठेकेदार पर लागू नहीं होगा।

(5) उपखनिज (आर०बी०एम० एवं बोल्डर को छोड़कर) के रिटेल भण्डारण, ईट भट्टा परिसर भण्डारण, ईंट रिटेल भण्डारण एवं सोपस्टोन भण्डारण/सोपस्टोन ट्रेडर की अनुज्ञा स्वीकृति हेतु आवेदित स्थल की संयुक्त जांच के लिए निम्नानुसार समिति का गठन किया जाता है:–

1. जिलाधिकारी अथवा उनके द्वारा नामित अपर जिलाधिकारी/ मुख्य विकास अधिकारी – अध्यक्ष।
2. संबंधित उप जिलाधिकारी – सदस्य।
3. जिला खान अधिकारी – सदस्य सचिव।

(5) उपखनिज (आर०बी०एम० एवं बोल्डर को छोड़कर) के रिटेल भण्डारण, ईट भट्टा परिसर भण्डारण, ईंट रिटेल भण्डारण एवं सोपस्टोन भण्डारण/सोपस्टोन ट्रेडर की अनुज्ञा स्वीकृति हेतु आवेदित स्थल की संयुक्त जांच के लिए निम्नानुसार समिति का गठन किया जाता है:–

1. जिलाधिकारी अथवा उनके द्वारा नामित अपर जिलाधिकारी/ मुख्य विकास अधिकारी – अध्यक्ष।
2. संबंधित उप जिलाधिकारी – सदस्य।
3. जिला खान अधिकारी – सदस्य सचिव।

परन्तु, उक्त प्रावधान ऋषिकेश–कर्णप्रयाग रेल लाईन परियोजना की कार्यदायी संस्था रेल विकास परियोजना लिमिटेड/रेल विकास परियोजना लिमिटेड द्वारा अनुबन्धित ठेकेदार पर लागू नहीं होगा।

(6) ऋषिकेश–कर्णप्रयाग रेल लाईन परियोजना की कार्यदायी संस्था रेल विकास परियोजना लिमिटेड/रेल

विकास परियोजना लिमिटेड द्वारा अनुबन्धित ठेकेदार द्वारा ऋषिकेश–कर्णप्रयाग रेल लाईन परियोजना के निर्माण से निकले मक (Muck) के चिन्हित भण्डारण स्थलों पर भण्डारण हेतु प्रपत्र "**एच–1**" में आवेदन, निर्धारित आवेदन शुल्क ₹ 50,000/– (₹ पच्चास हजार) सहित, निदेशक, भूतत्व एवं खनिकर्म इकाई को प्रस्तुत किया जायेगा। उक्त के संबंध में निदेशक, भूतत्व एवं खनिकर्म इकाई द्वारा निम्नानुसार गठित तकनीकी समिति से निर्धारित प्रपत्र "**एच–2**" पर संयुक्त निरीक्षण आख्या प्राप्त की जायेगी :–

i	निदेशक, भूतत्व एवं खनिकर्म इकाई, उत्तराखण्ड द्वारा नामित अपर निदेशक/संयुक्त निदेशक स्तर के अधिकारी	संयोजक
ii	प्रमुख अभियन्ता, लोक निर्माण विभाग, उत्तराखण्ड द्वारा नामित मुख्यालय में पदस्थापित अधीक्षण अभियन्ता स्तर का अधिकारी	सदस्य
iii	प्रमुख मुख्य अभियन्ता, सिंचाई विभाग, उत्तराखण्ड द्वारा नामित मुख्यालय में पदस्थापित अधीक्षण अभियन्ता स्तर का अधिकारी	सदस्य
iv	प्रमुख वन संरक्षक (HOFF), उत्तराखण्ड द्वारा नामित मुख्यालय में पदस्थापित वन	सदस्य

	संरक्षक स्तर का अधिकारी	
v	संबंधित जिलाधिकारी द्वारा नामित अपर जिलाधिकारी	सदस्य
vi	अभियन्ता (सिविल), रेल विकास निगम।	सदस्य
vii	क्षेत्रीय अधिकारी, पर्यावरण संरक्षण एवं प्रदूषण नियंत्रण बोर्ड।	सदस्य

रेल लाईन परियोजना की कार्यदायी संस्था रेल विकास परियोजना लिमिटेड/रेल विकास परियोजना लिमिटेड द्वारा अनुबन्धित ठेकेदार को स्वीकृत अनुज्ञा स्थलों, अन्य स्वीकृत Open Excavation स्थलों एवं रिवर ट्रेनिंग स्थलों से निकासी किये गये उपखनिज के भण्डारण हेतु उपरोक्तानुसार ही आवेदन प्रस्तुत किया जाना होगा;

नियम 9 का संशोधन

3. मूल नियमावली में नीचे स्तम्भ–1 में दिये गये विद्यमान नियम 9 के स्थान पर स्तम्भ–2 में दिया गया नियम रख दिया जायेगा, अर्थात्–

स्तम्भ–1 विद्यमान नियम	स्तम्भ–2 एतद्द्वारा प्रतिस्थापित नियम
9. इस नियमावली के उपबन्धों के अधीन रहते हुये गठित समिति की जॉच आख्या के आधार पर प्रस्तावित भण्डारण स्थल पर एक समय मे रखे जाने वाली कुल खनिज (आर०बी०एम० एवं बोल्डर को छोड़कर) की मात्रा के रिटेल भण्डारण की अनुज्ञा जिलाधिकारी की संस्तुति के उपरान्त मण्डलायुक्त के द्वारा 05 वर्ष की अवधि हेतु स्वीकृत की जायेगी। सोपस्टोन भण्डारण/सोपस्टोन ट्रेडर की अनुज्ञा जिलाधिकारी व निदेशक की संस्तुति के उपरान्त राज्य सरकार द्वारा 05 वर्ष की अवधि हेतु स्वीकृत की जायेगी। ईंट भट्टा परिसर भण्डारण एवं ईंट रिटेल भण्डारण की अनुज्ञा	9. इस नियमावली के उपबन्धों के अधीन रहते हुये गठित समिति की जॉच आख्या के आधार पर प्रस्तावित भण्डारण स्थल पर एक समय मे रखे जाने वाली कुल खनिज (आर०बी०एम० एवं बोल्डर को छोड़कर) की मात्रा के रिटेल भण्डारण की अनुज्ञा जिलाधिकारी की संस्तुति के उपरान्त मण्डलायुक्त के द्वारा 05 वर्ष की अवधि हेतु स्वीकृत की जायेगी। सोपस्टोन भण्डारण/सोपस्टोन ट्रेडर की अनुज्ञा जिलाधिकारी व निदेशक की संस्तुति के उपरान्त राज्य सरकार द्वारा 05 वर्ष की अवधि हेतु स्वीकृत की जायेगी। ईंट भट्टा परिसर भण्डारण एवं ईंट रिटेल भण्डारण की अनुज्ञा

जिलाधिकारी स्तर से 05 वर्ष की अवधि हेतु स्वीकृत की जायेगी।

मोबाईल स्टोन क्रेशर एवं मोबाईल स्क्रीनिंग प्लांट के परिसर में खनिजों के भण्डारण हेतु भण्डारण अनुज्ञप्ति प्रपत्र–"आई" में अधिकतम 02 वर्ष अथवा परियोजना कार्य पूर्ण होने तक, जो भी पहले हो, के लिए जिलाधिकारी द्वारा स्वीकृत की जायेगी।

हाट मिक्स प्लान्ट एवं रेडिमिक्स प्लांट के परिसर में खनिजों के भण्डारण हेतु भण्डारण अनुज्ञप्ति, प्रपत्र–"आई" में 03 वर्ष अथवा परियोजना कार्य पूर्ण होने तक, जो भी पहले हो, के लिए जिलाधिकारी द्वारा स्वीकृत की जायेगी।

अनुज्ञा स्वीकृति के पश्चात् की सभी औपचारिकताएं पूर्ण होने पर, जिला खान अधिकारी का दायित्व होगा कि सभी स्वीकृत अनुज्ञा को ई–पोर्टल से जोड़ा जायेगा।

सभी भण्डारण अनुज्ञाधारक को स्वीकृति से पूर्व जी0एस0टी0 नम्बर लेना अनिवार्य होगा।

जिलाधिकारी स्तर से 05 वर्ष की अवधि हेतु स्वीकृत की जायेगी।

मोबाईल स्टोन क्रेशर एवं मोबाईल स्क्रीनिंग प्लांट के परिसर में खनिजों के भण्डारण हेतु भण्डारण अनुज्ञप्ति प्रपत्र–"आई" में अधिकतम 02 वर्ष अथवा परियोजना कार्य पूर्ण होने तक, जो भी पहले हो, के लिए जिलाधिकारी द्वारा स्वीकृत की जायेगी।

हाट मिक्स प्लान्ट एवं रेडिमिक्स प्लांट के परिसर में खनिजों के भण्डारण हेतु भण्डारण अनुज्ञप्ति, प्रपत्र–"आई" में 03 वर्ष अथवा परियोजना कार्य पूर्ण होने तक, जो भी पहले हो, के लिए जिलाधिकारी द्वारा स्वीकृत की जायेगी।

अनुज्ञा स्वीकृति के पश्चात् की सभी औपचारिकताएं पूर्ण होने पर, जिला खान अधिकारी का दायित्व होगा कि सभी स्वीकृत अनुज्ञा को ई–पोर्टल से जोड़ा जायेगा।

सभी भण्डारण अनुज्ञाधारक को स्वीकृति से पूर्व जी0एस0टी0 नम्बर लेना अनिवार्य होगा।

परन्तु, उक्त प्रावधान ऋषिकेश–कर्णप्रयाग रेल लाईन परियोजना की कार्यदायी संस्था रेल विकास परियोजना लिमिटेड/रेल विकास परियोजना लिमिटेड द्वारा अनुबन्धित ठेकेदार पर लागू नहीं होगा।

नियम 9.क का अतःस्थापन

4. मूल नियमावली के नियम 9 के पश्चात् एक नया नियम 9.क निम्नवत् अंतःस्थापित कर दिया जायेगा, अर्थात्–

9. क ऋषिकेश–कर्णप्रयाग रेल लाईन परियोजना के टनलों के निर्माण कार्य से निकलने वाले मक (Muck) में से उपयोगी उपखनिज (usable material) के उपयोग की अनुमति रायल्टी की दोगुनी धनराशि एवं अन्य देयताओं के भुगतान की शर्त पर निदेशक, भूतत्व एवं खनिकर्म इकाई की संस्तुति पर परियोजना की अवधि अथवा याचित अवधि, जो भी न्यून हो, तक शासन द्वारा स्वीकृत किया जायेगा। अवशेष अनुपयोगी मक को स्वीकृत डम्पिंग साईट पर डम्प किया जायेगा। डम्पिंग साईट पर डम्प खनिज मात्रा के परिमाण को कुल उत्खनित मक की मात्रा से घटाते हुए उपयोगी मक/उपखनिज की गणना की जायेगी।

रेल लाईन परियोजना की कार्यदायी संस्था रेल विकास परियोजना

लिमिटेड/रेल विकास परियोजना लिमिटेड द्वारा अनुबन्धित ठेकेदार को स्वीकृत अनुज्ञा स्थलों, अन्य स्वीकृत Open Excavation स्थलों व रिवर ट्रेनिंग स्थलों से निकासी किये गये उपखनिज के भण्डारण हेतु उपरोक्तानुसार ही स्वीकृति प्रदान की जायेगी।

नियम 11 का संशोधन

5. मूल नियमावली में नीचे स्तम्भ–1 में दिये गये विद्यमान नियम 11 के उपनियम (2) के स्थान पर स्तम्भ–2 में दिया गया नियम रख दिया जायेगा, अर्थात्–

स्तम्भ–1 विद्यमान नियम	स्तम्भ–2 एतद्द्वारा प्रतिस्थापित नियम
11. (2) रिटेल भण्डारण स्थल का सार्वजनिक स्थल, सरकारी वन, रेल मार्ग, नदी आदि से दूरी निम्न प्रकार होगी– (i) पर्वतीय क्षेत्र :– क–धार्मिक स्थल से दूरी–50मी0 ख–शैक्षणिक संस्थान से दूरी –100 मी0 ग–अस्पताल से दूरी– 100 मी0 घ–रेल मार्ग से दूरी–50 मी0 ड.–नदी से दूरी–250 मी० च–सरकारी वन से दूरी–10 मी0 (ii) मैदानी क्षेत्र :– क–धार्मिक स्थल से दूरी– 300 मी0 ख–शैक्षणिक संस्थान से दूरी –300 मी0 ग–अस्पताल से दूरी– 300 मी0 घ–रेल मार्ग से दूरी–50 मी0 ड़–नदी से दूरी–1500 मी० च–सरकारी वन से दूरी– 100 मी0 परन्तु पर्वतीय एवं मैदानी क्षेत्रों मे स्टोन क्रेशर, स्क्रीनिंग प्लांट, मोबाईल स्टोन क्रेशर, मोबाईल स्क्रीनिंग प्लांट, हॉट मिक्स प्लांट, रेडिमिक्स प्लांट व पल्वराईजर प्लांट के परिसर मे खनिजों के भण्डारण हेतु दूरी के मानक वही होंगे, जो इन प्लांटों की स्थापना/संचालन हेतु राज्य सरकार द्वारा जारी स्टोन क्रेशर, स्क्रीनिंग प्लांट, मोबाईल स्टोन क्रेशर, मोबाईल स्क्रीनिंग प्लांट, हॉट मिक्स प्लांट, रेडिमिक्स प्लांट	11 (2) रिटेल भण्डारण स्थल का सार्वजनिक स्थल, सरकारी वन, रेल मार्ग, नदी आदि से दूरी निम्न प्रकार होगी– (i) पर्वतीय क्षेत्र :– क–धार्मिक स्थल से दूरी–50 मी0 ख–शैक्षणिक संस्थान से दूरी– 100 मी0 ग–अस्पताल से दूरी– 100 मी0 घ–रेल मार्ग से दूरी–50 मी0 ड.–नदी से दूरी–250 मी० च–सरकारी वन से दूरी–10 मी0 (ii) मैदानी क्षेत्र :– क–धार्मिक स्थल से दूरी– 300 मी0 ख–शैक्षणिक संस्थान से दूरी –300 मी0 ग–अस्पताल से दूरी– 300 मी0 घ–रेल मार्ग से दूरी–50 मी0 ड़–नदी से दूरी–1500 मी० च–सरकारी वन से दूरी– 100 मी0 परन्तु पर्वतीय एवं मैदानी क्षेत्रों मे स्टोन क्रेशर, स्क्रीनिंग प्लांट, मोबाईल स्टोन क्रेशर, मोबाईल स्क्रीनिंग प्लांट, हॉट मिक्स प्लांट, रेडिमिक्स प्लांट व पल्वराईजर प्लांट के परिसर मे खनिजों के भण्डारण हेतु दूरी के मानक वही होंगे, जो इन प्लांटों की स्थापना/संचालन हेतु राज्य सरकार द्वारा जारी स्टोन क्रेशर, स्क्रीनिंग प्लांट, मोबाईल स्टोन क्रेशर, मोबाईल स्क्रीनिंग प्लांट, हॉट मिक्स प्लांट, रेडिमिक्स प्लांट

	व पल्वराईजर प्लांट नीति के अनुसार होंगे।	व पल्वराईजर प्लांट नीति के अनुसार होंगे। **परन्तु, उक्त प्रावधान ऋषिकेश–कर्णप्रयाग रेल लाईन परियोजना की कार्यदायी संस्था रेल विकास परियोजना लिमिटेड/रेल विकास परियोजना लिमिटेड द्वारा अनुबन्धित ठेकेदार पर लागू नहीं होगा।**
नियम 11 का संशोधन	5. मूल नियमावली में :– (i) नीचे स्तम्भ–1 में दिये गये विद्यमान नियम 11 के उपनियम (7) के स्थान पर स्तम्भ–2 में दिया गया नियम रख दिया जायेगा, अर्थात् :–	
	11. (7) रिटेल अनुज्ञाधारक, खनिज (आर०बी०एम० एवं बोल्डर को छोड़कर) भण्डारण हेतु भण्डारण स्थल में एक समय में अधिकतम 03 मी0 ऊंचाई तक तथा स्टोन क्रेशर, स्क्रीनिंग प्लान्ट स्वामी को प्लान्ट के परिसर में एक समय में औसतन 05 मीटर ऊंचाई तक उपखनिज का भण्डारण कर सकेगा।	11. (7) रिटेल अनुज्ञाधारक, खनिज (आर०बी०एम० एवं बोल्डर को छोड़कर) भण्डारण हेतु भण्डारण स्थल में एक समय में अधिकतम 03 मी0 ऊंचाई तक तथा स्टोन क्रेशर, स्क्रीनिंग प्लान्ट स्वामी को प्लान्ट के परिसर में एक समय में औसतन 05 मीटर ऊंचाई तक उपखनिज का भण्डारण कर सकेगा।
	भण्डारण स्थल में प्रथम वार्षिक खनन सत्र में, एक समय पर भण्डारण क्षमता अधिकतम 50,000 मीट्रिक टन होगी तथा आगामी वार्षिक खनन सत्रों हेतु एक समय में भण्डारण क्षमता वर्षानुवर्ष गत वार्षिक खनन सत्र की विक्रित मात्रा का 40 प्रतिशत होगी।	भण्डारण स्थल में प्रथम वार्षिक खनन सत्र में, एक समय पर भण्डारण क्षमता अधिकतम 50,000 मीट्रिक टन होगी तथा आगामी वार्षिक खनन सत्रों हेतु एक समय में भण्डारण क्षमता वर्षानुवर्ष गत वार्षिक खनन सत्र की विक्रित मात्रा का 40 प्रतिशत होगी।
	स्टोन क्रेशर/स्क्रीनिंग प्लान्ट/ मोबाईल स्टोन क्रेशर एवं मोबाईल स्क्रीनिंग प्लान्ट हेतु क्षमता का निर्धारण निम्नवत् किया जायेगा :– (i) वर्षा ऋतु आदि हेतु खनन चुगान की एक वर्ष में बंदी की अवधि = 90 दिन। वर्षा काल (जुलाई–सितम्बर) की अवधि (90 दिन) हेतु कच्चे माल/आर0बी0एम0 की कुल मात्रा अर्थात् स्टोन केशर/स्कीनिंग प्लान्ट हेतु कच्चे माल की एक समय में	स्टोन क्रेशर/स्क्रीनिंग प्लान्ट/ मोबाईल स्टोन क्रेशर एवं मोबाईल स्क्रीनिंग प्लान्ट हेतु क्षमता का निर्धारण निम्नवत् किया जायेगा :– (i) वर्षा ऋतु आदि हेतु खनन चुगान की एक वर्ष में बंदी की अवधि = 90 दिन। वर्षा काल (जुलाई–सितम्बर) की अवधि (90 दिन) हेतु कच्चे माल/आर0बी0एम0 की कुल मात्रा अर्थात् स्टोन केशर/स्कीनिंग प्लान्ट हेतु कच्चे माल की एक समय में

भण्डारण क्षमता = 90 x टन प्रति घंटा x संचालन अवधि (औसतन 10 घंटा प्रतिदिन) = टन में।

(ii) वर्षा काल से भिन्न अवधि अर्थात अक्टूबर से जून तक की अवधि हेतु कच्चे माल की एक समय में भण्डारण क्षमता 45 x टन प्रति घंटा x संचालन अवधि (औसतन 10 घंटा प्रतिदिन) (टन में)

अनुज्ञाधारक द्वारा उक्त उपनियम की शर्तो का उल्लंघन किये जाने की दशा में, नियम 13 के उपनियम (5) के खण्ड (ग) के अनुसार कार्यवाही की जायेगी।

भण्डारण क्षमता = 90 x टन प्रति घंटा x संचालन अवधि (औसतन 10 घंटा प्रतिदिन) = टन में।

(ii) वर्षा काल से भिन्न अवधि अर्थात अक्टूबर से जून तक की अवधि हेतु कच्चे माल की एक समय में भण्डारण क्षमता 45 x टन प्रति घंटा x संचालन अवधि (औसतन 10 घंटा प्रतिदिन) (टन में)

अनुज्ञाधारक द्वारा उक्त उपनियम की शर्तो का उल्लंघन किये जाने की दशा में, नियम 13 के उपनियम (5) के खण्ड (ग) के अनुसार कार्यवाही की जायेगी।

परन्तु, उक्त प्रावधान ऋषिकेश–कर्णप्रयाग रेल लाईन परियोजना की कार्यदायी संस्था रेल विकास परियोजना लिमिटेड/रेल विकास परियोजना लिमिटेड द्वारा अनुबन्धित ठेकेदार पर लागू नहीं होगा।

(ii) उपनियम (8) के पश्चात् क्रमशः उपनियम (9), उपनियम (10) और उपनियम (11) निम्नवत् अंतःस्थापित कर दिये जायेंगे, अर्थात् :–

(9) तकनीकी दल द्वारा किसी भी टनल से निकासी किये गये उपखनिज (Muck) की कुल मात्रा में से उपयोगार्थ उपखनिज की आगणित/सत्यापित मापन मात्रा, संबंधित टनल निर्माण के उपरान्त स्वीकृत मात्रा से कम अथवा अधिक पाये जाने पर, कम अथवा अधिक पाये जाने वाली मात्रा पर देय रायल्टी का समायोजन/भुगतान किया जायेगा।

स्वीकृत उपखनिज की मात्रा पर आंगणित रॉयल्टी धनराशि एवं अन्य देयों का भुगतान रेल लाईन परियोजना की कार्यदायी संस्था रेल विकास परियोजना लिमिटेड/रेल विकास परियोजना लिमिटेड द्वारा अनुबन्धित ठेकेदार के द्वारा त्रैमासिक किश्तों मे विभागीय लेखा शीर्षक मे अग्रिम जमा किया जायेगा। किश्तों का भुगतान निर्धारित समयान्तर्गत न किये जाने पर 24 प्रतिशत वार्षिक की दर से साधारण व्याज लिया जायेगा।

(10) रेल लाईन परियोजना की कार्यदायी संस्था रेल विकास परियोजना लिमिटेड/रेल विकास परियोजना लिमिटेड द्वारा अनुबन्धित ठेकेदार के द्वारा स्वीकृत स्थल से उपखनिज की निकासी/उपयोग हेतु विभागीय ई–रवन्ना पोर्टल पर पंजीकरण कराया जाना अनिवार्य होगा।

(11) रेल लाईन परियोजना की कार्यदायी संस्था रेल विकास परियोजना लिमिटेड/रेल विकास परियोजना लिमिटेड द्वारा अनुबन्धित ठेकेदार के द्वारा टनल से निकले मक का उपयोग ऋषिकेश–कर्णप्रयाग रेल लाईन परियोजना निर्माण कार्य में ही किया जायेगा। रेलवे विकास निगम लिमिटेड/अधिकृत

कॉन्ट्रेक्टर्स के द्वारा टनल से निकले मक का उपयोग अन्यत्र किये जाने की पुष्टि होने पर नियम 13(5)(ख) के अनुसार कार्यवाही करते हुए ₹ 1.00 करोड़ (₹ एक करोड़) की अतिरिक्त धनराशि वसूल किये जाने के साथ–साथ अनुज्ञा निरस्त करने की नियमानुसार कार्यवाही की जायेगी।

6. मूल नियमावली में इस नियमवली में संलग्न प्रपत्र एच–1 एवं प्रपत्र एच–2 जोड़ दिये जायेंगे।

आज्ञा से,

(डा० मेहरबान सिंह बिष्ट)
अपर सचिव

उत्तराखण्ड शासन
औद्योगिक विकास (खनन) अनुभाग–1
संख्याः 910 /VII-A-1/2021/03(46)/2021
देहरादून, दिनांकः 24 अगस्त, 2021

–कार्यालय ज्ञाप–

उत्तराखण्ड खनिज (अवैध खनन, परिवहन एवं भण्डारण का निवारण) (संशोधित) नियमावली 2021 के के नियम 9क के प्रावधानों के अन्तर्गत निदेशक, भूतत्व एवं खनिकर्म इकाई उत्तराखण्ड के पत्र सं0–643/ खनन/ भू0खनि0ई0/रे0वि0नि0/2021–22, दिनांक 07 जून, 2021 द्वारा उपलब्ध कराये गये प्रस्ताव के क्रम में ऋषिकेश–कर्णप्रयाग रेल लाईन परियोजना के पैकेज–7 बी के टनल–13 पी–2, स्केप टनल टी–13 पी–2 एवं ऐडिट–7 के अन्तर्गत ग्राम तिलणी तहसील व जनपद रूद्रप्रयाग में डम्पिंग यार्ड डी–28 (तिलणी डम्पिंग यार्ड) में भण्डारित होने वाले मक में से 3,06,550 घनमीटर उपयोगी मक अर्थात् छोटे–छोटे पत्थर के टुकड़े/बोल्डर्स आदि, जिसका उपयोग आवेदक द्वारा स्थापित किये जाने वाले स्टोन क्रेशर एवं निर्माण कार्यों में किया जाना है, की निकासी हेतु रेल विकास निगम लि० के अनुबन्धित ठेकेदार मेघा इंजीनियररिंग एंड इंफ्रास्ट्रक्चर्स लि0 ग्राम व पोस्ट सुमेरपुर, जनपद रूद्रप्रयाग के पक्ष में 05 वर्ष अथवा परियोजना अवधि, जो भी न्यून हो, तक की अवधि हेतु, निम्नलिखित शर्तो के अधीन स्वीकृत किये जाने की अनुमति प्रदान की जाती है :–

1. तकनीकी दल द्वारा किसी भी टनल से निकासी किये गये उपखनिज (Muck) की कुल मात्रा में से उपयोगार्थ उपखनिज की आगणित/सत्यापित मापन मात्रा, संबंधित टनल निर्माण के उपरान्त स्वीकृत मात्रा से कम अथवा अधिक पाये जाने पर, कम अथवा अधिक पाये जाने वाली मात्रा पर देय रायल्टी का समायोजन/भुगतान किया जायेगा।
2. रेल विकास निगम लि0 द्वारा अनुबन्धित ठेकेदार/अनुज्ञाधारक मेघा इंजीनियररिंग एंड इंफ्रास्ट्रक्चर्स लि0 ग्राम व पोस्ट सुमेरपुर, जनपद रूद्रप्रयाग द्वारा रायल्टी धनराशि एवं अन्य देयों का त्रैमासिक किश्तों में विभागीय लेखाशीर्षक में अग्रिम जमा कर निकासी की जायेगी। यदि उस त्रैमास में जमा धनराशि से अधिक निकासी करता है, तो आगामी त्रैमास की धनराशि जमा कर निकासी प्राप्त की जा सकती है।
3. अनुज्ञाधारक द्वारा स्वीकृत स्थल से उपखनिज की निकासी/उपयोग हेतु विभागीय ई–रवन्ना पोर्टल पर पंजीकरण कराया जाना अनिवार्य होगा।
4. पैकेज–7 बी के टनल–13 पी–2, स्केप टनल टी–13 पी–2 एवं ऐडिट–7 के विभिन्न संकियाओं से निकलने वाले 3,06,550 घनमीटर उपयोगी मक आवेदक द्वारा स्थापित किये जाने वाले स्टोन क्रेशर एवं अन्य निमार्ण कार्य में उपयोग किया जायेगा। उपयोगी मक की मात्रा में बढोतरी होने की दशा में उपयोगी मक का उपयोग आर0वी0एन0एल0 द्वारा भरान के रूप में उपयोग की जायेगी।
5. अनुज्ञाधारक द्वारा टनल से निकले मक का उपयोग ऋषिकेश–कर्णप्रयाग रेल लाईन परियोजना निर्माण कार्य में ही किया जायेगा तथा उक्त अन्यत्र उपयोग/प्रेषण प्रतिबन्धित रहेगा।
6. अनुज्ञाधारक के द्वारा गठित समिति द्वारा आगणित रॉयल्टी की धनराशि ₹ 11,92,47,950/–(₹ ग्यारह करोड़ बानबे लाख सैंतालीस हजार नौ सौ पचास मात्र) एवं क्षतिपूर्ति–रायल्टी का 15 प्रतिशत ₹ 1,78,87,192.5/– (₹ एक करोड़ अठहत्तर लाख सतासी हजार एक सौ बानबे मात्र) निर्धारित विभागीय लेखाशीर्षक 0853 में, स्टाम्प शुल्क–रायल्टी का 2 प्रतिशत ₹ 23,84,959/– (रू0 तेईस लाख चौरासी हजार नौ सौ उनसठ मात्र) सम्बन्धित लेखाशीर्षक में एवं जिला खनिज फाउन्डेशन में अंशदान–रायल्टी का 25 प्रतिशत ₹ 2,98,11,987.5/– (रू0 दो करोड़ अट्ठानबे लाख ग्यारह हजार नौ सौ

–2

सत्तासी मात्र) जनपद के डी0एम0एफ0 के खाता सं0–72131021000007 (बैंक ऑफ इण्डिया, भानधार रूद्रप्रयाग) में जमा किया जायेगा।

7. उत्तराखण्ड खनिज (अवैध खनन, परिवहन एवं भण्डारण) (संशोधन) नियमावली, 2021 के नियम 11(11) के अनुसार "रेल लाईन परियोजना की कार्यदायी संस्था रेल विकास परियोजना लिमिटेड/रेल विकास परियोजना लिमिटेड द्वारा अनुबन्धित ठेकेदार के द्वारा टनल से निकले मक का उपयोग ऋषिकेश–कर्णप्रयाग रेल लाईन परियोजना निर्माण कार्य में ही किया जायेगा। रेल विकास निगम लिमिटेड/ अधिकृत कॉन्ट्रेक्टर्स के द्वारा टनल से निकले मक का उपयोग अन्यत्र किये जाने की पुष्टि होने पर नियम 13(5)(ख) के अनुसार कार्यवाही करते हुए ₹ 1.00 करोड़ (₹ एक करोड़) की अतिरिक्त धनराशि वसूल किये जाने के साथ–साथ अनुज्ञा निरस्त किये जाने नियमानुसार कार्यवाही की जायेगी"।
8. प्रचलित अधिनियम/नीति/नियमावली एवं समय–समय पर राज्य सरकार एवं केन्द्र सरकार द्वारा निर्गत शासनादेशों का अनुपालन किया जायेगा।
9. मा0 उच्चतम न्यायालय, मा0 उच्च न्यायालय एवं एन0जी0टी0 द्वारा समय–समय पर पारित आदेशों का अनुपालन किया जाना होगा।
10. तकनीकी समिति की संयुक्त निरीक्षण आख्या में उल्लिखित समस्त शर्तों/प्रतिबन्धों का अनुपालन किया जाना होगा।
11. अनुज्ञाधारक द्वारा ई–रवन्ना प्रपत्र सम्बन्धित स्टोन केशर के लिए ही जारी किया जाना अपरिहार्य होगा। अन्यत्र स्थान हेतु जारी ई–रवन्ना प्रपत्र अवैध परिवहन की श्रेणी में आयेगा।
12. डम्पिंग यार्ड की क्षमता एवं उपयोग का मूल्यांकन समय–समय पर जिला प्रशासन, तकनीकी समिति द्वारा किया जायेगा।
13. अनुज्ञाधारक द्वारा अधिकृत किये जाने वाला अधिकार पत्र निदेशक, भूतत्व एवं खनिकर्म इकाई एवं जिला खान अधिकारी, रूद्रप्रयाग को प्रस्तुत किया जाना होगा।

(एन.एस.डुंगरियाल)
संयुक्त सचिव

संख्याः 910 (1)/VII-A-1/2021–03(46)/2021 तद्दिनांकित।

प्रतिलिपि निम्नलिखित को सूचनार्थ एवं आवश्यक कार्यवाही हेतु प्रेषितः–

1. निदेशक, भूतत्व एवं खनिकर्म इकाई, उत्तराखण्ड देहरादून।
2. जिलाधिकारी रूद्रप्रयाग।
3. मैसर्स मेघा इंजीनियरिंग एण्ड इन्फ्रास्ट्रक्चर लिमिटेड, जनपद रूद्रप्रयाग।
4. गार्ड फाईल।

आज्ञा से,

(दिनेश सिंह भण्डारी)
अनु सचिव।

ANNEXURE - 4

प्रपत्र एच–1

रेलवे विकास निगम लिमिटेड हेतु मक/उपखनिज के भण्डारण व निकासी के लिए आवेदन पत्र का प्रारूप

(तीन प्रतियो में प्रस्तुत किया जायेगा)

आवेदन प्राप्ति का दिनांक.....,

सेवा में,

निर्देशक,
भूत्तव एवं खनिकर्म इकाई
उधोग निदेशालय, उत्तराखण्ड,
देहरादून।

महोदय,

मैं/हम निवेदन करता/करती हुँ/करते हैं कि मुझे/हमें उत्तराखण्ड खनिज का (अवैध खनन, परिवहन एवं भण्डारण का निवारण) नियामावली, 2020 के नियम 8 के अनुसार ऋषिकेश–कर्णप्रयाग रेल लाइन परियोजना के टनलो, **Open excavation** व रिवर ट्रेनिंग स्थलों से निकलने वाले मक/उपखनिजो के भण्डारण एवं प्रयोग की अनुमति, परियोजना की अवधि तक दी जायें।

2 उक्त नियमावली के नियम 8 के अधीन प्रार्थना पत्र के सम्बन्ध में निर्धारित शुल्क **₹ 50,000/–** कोषागार चालान संख्या...27.....दिनांक 26/02/21.....के द्वारा निर्धरित लेखाशीर्षक मे जमा कर दिया गया है।

3 अवधि, जिसके लिये अनुमति अपेक्षित है: 20/08/2020 से 25/02/2025

4 आवेदक का पूरा नाम व पता: **ओंकार सिंह चौहान, महाप्रबंधक,**

मेघा इंजीनियरिंग एंड इंफ्रास्ट्रक्चर्स लि. गाँव व डाक : सुमेरपुर, जिला रुद्रप्रयाग,उत्तराखण्ड

5 टनल क्षेत्र: नरकोटा से सुमेरपुर तिलणी उत्तराखण्ड,

6 रेलवे टनल का कमांक: T13 [मुख्य तथा निकास]

7 रेलवे टनल की कटाई की चौड़ाई/माप:– मुख्य [T13] 8.4m व्यास तथा निकास [T13] 5.0m व्यास

8 रेलवे टनल की लम्बाई/माप: T-13 [मुख्य तथा निकास] 9.427 कि0मी0,

9 यदि टनल की अतिरिक्त अन्य स्थान पर खुदाई कर उपखनिज उपयोग किया जाना हो, का विवरण: तिलणी यार्ड।

10 ओपन एक्सवेशन क्षेत्र की स्थिति व माप: तिलणी, 728 मी0।

11 डम्पिंग साईट का विवरण डी0 27 (नरकोटा) 352000 घन मी0 डी0 28 तिलणी 769280 घन मी0 डी 29 21000 घन मी0।

12 बोर होल लोग का विवरण 91.2232+101.332 किमी0 (BH-119 to 132, टनल एलाइनमेंट के उपर नरकोटा से तिलणी के मध्य।

13 रेलवे परियोजना के डी0पी0आर (**Detail Project Report**) के अनुसार टनल से निकलने वाले मक (Muck) की आंगणित मात्रा (घनमीटर में) 10,35,786 घनमी0 व Open excavation से निकलने वाले मे की आंगणित मात्रा (घनमीटर में) 2,74,367 घन मी0

14 रेलवे परियोजना के डी0पी0आर (**Detail Project Report**) के अनुसार टनल से निकलने वाले मक (Muck) की आंगणित कुल मात्रा में उपयोगार्थ (Muck) की मात्रा (घनमीटर में) 414314.00 घनमी0 व ओपन एकस्कवेशन से निकलने वाले की आंगणित मात्रा मक की आंगणित कुल मात्रा में उपयोगार्थ मक की मात्रा (घनमीटर में) 11000.00 घनमी0 है।

15 कोई अन्य विवरण या रेखा–मानचित्र (स्कैच मैप) जो आवेदक प्रस्तुत करना चाहें एलाइनमेंट मैप नरकोटा से तिलणी सुमेरपुर मैं/हम एतद्द्वारा घोषणा करता हूँ/करते हैं कि ऊपर दिये गये समस्त विवरण सही हैं और मैं/हम कोई अन्य विवरण, जो आपके द्वारा अपेक्षिक हों, देने को तैयार हूँ/हैं।

दिनांक 26.02.2021

Engineering & Infra. PVNL Tunnel PKG-75

Chauhan

आवेदक के हस्ताक्षर।

Scanned with CamS

कोषागार प्रपत्र संख्या– 209 A–(राशोधि.)

वित्तीय नियम संग्रह खण्ड–5 भाग–2

प्रपत्र संख्या–43ए (1)

(प्रस्तर 417 एवं 478 देखिए)

धनराशि जमा करने का चालन फार्म

उपकोषागार (नॉन बैंकिंग)/बैंक का नाम व शाखा एस.बी.आई. रुद्रप्रयाग

1. जिस व्यक्ति (पदनाम यदि आवश्यक हो) डी.एफ.ओ. रुद्रप्रयाग
   या संस्था के नाम से धनराशी जमा की
   जा रही है उसका नाम

2. पता गैला इंजीनियरिंग एण्ड इंफ्रास्ट्रक्चर लिमिटेड सोनतीर सोनेरपुर रुद्रप्रयाग

3. पंजीकरण संख्या /पक्ष का नाम वाद संख्या
   (यदि आवश्यक हो)

4. जमा की जा रही धनराशि का पूर्ण विवरण रतनन डानुडा के लिये निर्धारित
   (धनराशि किस हेतु जमा की जा रही है तथा
   किस विभाग के पक्ष में जमा की जा रही है शुल्क

5. चालन की सकल (Gross)राशि 45,000/-

6. चालन की निबल (Net)राशि पैंतालीस हजार रुपये मात्र

7. लेखाशीर्षक का पूर्ण विवरण/लेखाशीर्षक की मोहर

8. लेखाशीर्षक का 13 डिजिट कोड 0853- अलौह खनन धातु क्रम उद्योग
   102- खनिज रियायत शुल्क, किराया और राजस्व

मुख्य लेखाशीर्षक	उप मुख्य शीर्षक	लघु–शीर्षक	उप शीर्षक	ब्यौरेवार–शीर्षक	धनराशि (अंकों में)
0 8 5 3	0 0	1 0 2	0 1	0 0	45,000

धनराशि (शब्दो में) पैंतालीस हजार योग 45,000/-

चालान के लेखाशीर्षक की पुष्टि करने वाले विभागीय अधिकारी के हस्ताक्षर मुहर सहित — प्रभारी अधिकारी जिलाधिकारी रुद्रप्रयाग 26-2-21

जमाकर्ता का नाम व हस्ताक्षर

45,000/-

भारतीय स्टेट बैंक, रुद्रप्रयाग-02463 का0 एफ0 नं0-8575711

26 FEB 2021

Priya

Scanned with CamS

प्रपत्र एच–1

रेलवे विकास निगम लिमिटेड हेतु मक/उपखनिज के भण्डारण व निकासी के लिए आवेदन पत्र का प्रारूप

(तीन प्रतियो में प्रस्तुत किया जायेगा)

आवेदन प्राप्ति का दिनांक 28.06.2021

सेवा में,

निर्देषक,
भूत्तव एवं खनिकर्म इकाई
उधोग निदेषालय, उत्तराखण्ड,
देहरादून।

महोदय,

मैं/हम निवेदन करता/करती हुँ/करते हैं कि मुझे/हमें उत्तराखण्ड खनिज का (अवैध खनन, परिवहन एवं भण्डारण का निवारण) नियामावली, 2020 के नियम 8 के अनुसार ऋशिकेष–कर्णप्रयाग रेल लाइन परियोजना के टनलो, **Open excavation** व रिवर ट्रेनिंग स्थलों से निकलने वाले मक/उपखनिजो के भण्डारण एवं प्रयोग की अनुमति, परियोजना की अवधि तक दी जायें।

2 उक्त नियमावली के नियम 8 के अधीन प्रार्थना पत्र के सम्बन्ध में निर्धारित षुल्क **₹ 50,000/–** कोशागार चालान संख्या 08530621E0362693 दिनांक 28.06.2021 के द्वारा निर्धरित लेखाषीर्शक मे जमा कर दिया गया है।

3 अवधि, जिसके लिये अनुमति अपेक्षित है: **28/06/2021 से 25/02/2025**

4 आवेदक का पूरा नाम व पता **ओंकार सिंह चौहान, महाप्रबंधक,**
मेघा इंजीनियरिंग एंड इंफ्रास्ट्रक्चर्स लि. गाँव व डाक : सुमेरपुर, जिला रुद्रप्रयाग,उत्तराखण्ड

5 टनल क्षेत्ररू **एडिट 7 जवाड़ी बाईपास उत्तराखण्ड,**

6 रेलवे टनल का कमांकरू **मुख्य तथा निकास सुरंग ,**

7 रेलवे टनल की कटाई की चौड़ाई/मापरू– **मुख्य T13, 8.4m ब्यास तथा निकास सुरंग T13, 5.0m ब्यास**

8 रेलवे टनल की लम्बाई/मापरू **T-13 खुख्य तथा निकास, 9.427 कि0मी0ए**

9 यदि टनल की अतिरिक्त अन्य स्थान पर खुदाई कर उपखनिज उपयोग किया जाना हो, का विवरण: **एडिट 7 जवाड़ी**

10 ओपन एक्सवेषन क्षेत्र की स्थिति व माप ।

11 डम्पिंग साईट का विवरण **डी0 27 (नरकोटा) 352000 घन मी0।**

12 बोर होल लोग का विवरण **91.2232+101.332 किमी0 (BH-119 to 132,** टनल एलाइनमेंट के उपर नरकोटा से तिलणी के मध्य।

13 रेलवे परियोजना के **डी0पी0आर (Detail Project Report)** के अनुसार टनल से निकलने वाले मक (डनबा) की आंगणित **मात्रा (घनमीटर में) 10,35,786 घनमी0** व Open excavation से निकलने वाले मे की आंगणित मात्रा **(घनमीटर में) 2,74,367 घन मी0**

14 रेलवे परियोजना के **डी0पी0आर (Detail Project Report)** के अनुसार टनल से निकलने वाले मक (डनबा) की आंगणित कुल मात्रा में उपयोगार्थ (डनबा) की मात्रा (घनमीटर में) **207156.99 घनमी0** व ओपन एकस्कवेषन से निकलने वाले की आंगणित मात्रा मक की आंगणित कुल मात्रा में उपयोगार्थ मक की मात्रा **(घनमीटर में) 30 घनमी0 है।**

15 कोई अन्य विवरण या रेखा–मानचित्र (स्कैच मैप) जो आवेदक प्रस्तुत करना चाहें एलाइनमेंट **मैप नरकोटा से तिलणी सुमेरपुर** मैं/हम एतद्द्वारा धोशणा करता हूँ/करते हैं कि ऊपर दिये गये समस्त विवरण सही हैं और मैं/हम कोई अन्य विवरण, जो आपके द्वारा अपेक्षिक हों, देने को तैयार हूँ/हैं।

दिनांक 28-06-2021

आवेदक के हस्ताक्षर।

29-6-2021
प्रेषण लिपिक
भूतत्व एवं खनिकर्म विभाग
पो0 बडासी, ओपालपाबी,
थानो रोड, रायपुर, देहरादून (उत्तराखण्ड)

Scanned with CamS

IFMS Uttarakhand

E-Challan

Bank Reff. No. - CKQ7207182

Treasury Form-209(1)
Financial Handbook Vol. V, Part- II
Form No. 43A(1)
(See Paragraph 417 and 478)
Challan form for depositing amount

Name of the Treasury/Sub-Treasury/Bank/Bank Branch -State Bank Of India (Payment Gateway)

1	Name of the person (designation if necessary or Organization on whose behalf amount is being paid.	MEGHA ENGINEERING & INFRASTRUCTURES LTD.
2	Address	H.NO.42, SUMERPUR VILLAGE, RUDRAPRAYAG, , RUDRAPRAYAG Uttarakhand 246171
3	Registration Number (if necessary)	
4	Full details of amount to be deposited (for which purpose and in favour of)	mining dept H one form royalty fee
5	Gross value of Challan	50000
6	Net value of Challan	50000
7	Full details of Head of Account	0853 - Non-ferrous mining and metallurgy industry
8	13 Digit code of Head of A/c	As per details below

SL No.	Services	Detail Head	Amount
1	Mineral Concession Fee rent and interest charges.	0853001020100	50000
	Total Challan Amount:-		50000

Amount (in words) - Rs. Fifty Thousand only

Signature of departmental officer with seal

MEGHA ENGINEERING & INFRASTRUCTURES LTD.

Challan No- 08530621E0362693

Amount in Figure(Rs.) - 50000

Date - 28-JUN-2021

Amount in words - Rs. Fifty Thousand only

Received Through

Bank Reff. No. - CKQ7207182

State Bank Of India (Payment Gateway)

Scanned with CamS

प्रपत्र एच–1

रेलवे विकास निगम लिमिटेड हेतु मक/उपखनिज के भण्डारण व निकासी के लिए आवेदन पत्र का प्रारूप

(तीन प्रतियो में प्रस्तुत किया जायेगा)

आवेदन प्राप्ति का दिनांक 28.06.2021

सेवा में,

निर्देषक,
भूत्तव एवं खनिकर्म इकाई
उधोग निदेषालय, उत्तराखण्ड,
देहरादून।

महोदय,

मैं/हम निवेदन करता/करती हुँ/करते हैं कि मुझे/हमें उत्तराखण्ड खनिज का (अवैध खनन, परिवहन एवं भण्डारण का निवारण) नियामावली, 2020 के नियम 8 के अनुसार ऋशिकेष–कर्णप्रयाग रेल लाइन परियोजना के टनलो, **Open excavation** व रिवर ट्रेनिंग स्थलों से निकलने वाले मक/उपखनिजो के भण्डारण एवं प्रयोग की अनुमति, परियोजना की अवधि तक दी जायें।

2 उक्त नियमावली के नियम 8 के अधीन प्रार्थना पत्र के सम्बन्ध में निर्धारित षुल्क **₹ 50,000/–** कोशागार चालान संख्या **08530621E0362665** दिनांक 28.06.2021 के द्वारा निर्धरित लेखाषीर्शक मे जमा कर दिया गया है।

3 अवधि, जिसके लिये अनुमति अपेक्षित है: **28/06/2021 से 25/02/2025**

4 आवेदक का पूरा नाम व पता **ओंकार सिंह चौहान, महाप्रबंधक,**
मेघा इंजीनियरिंग एंड इंफ्रास्ट्रक्चर्स लि. गाँव व डाक : सुमेरपुर, जिला रुद्रप्रयाग,उत्तराखण्ड

5 टनल क्षेत्ररू **नरकोटा से एडिट 7 जवाड़ी उत्तराखण्ड,**

6 रेलवे टनल का क्रमांकरू **T13 P1 मुख्य तथा निकास सुरंग ,**

7 रेलवे टनल की कटाई की चौड़ाई/मापरू– **मुख्य [T13, 8.4m ब्यास तथा निकास सुरंग [T13, 5.0m ब्यास**

8 रेलवे टनल की लम्बाई/मापरू **T-13 ख्मुख्य तथा निकास, 9.427 कि0मी0ए**

9 यदि टनल की अतिरिक्त अन्य स्थान पर खुदाई कर उपखनिज उपयोग किया जाना हो, का विवरण: **नरकोटा P1**

10 ओपन एक्सवेषन क्षेत्र की स्थिति व माप।

11 डम्पिंग साईट का विवरण **डी0 27 (नरकोटा) 352000 घन मी0।**

12 बोर होल लोग का विवरण **91.2232+101.332 किमी0 (BH-119 to 132,** टनल एलाइनमेंट के उपर नरकोटा से तिलणी के मध्य।

13 रेलवे परियोजना के **डी0पी0आर (Detail Project Report)** के अनुसार टनल से निकलने वाले मक (डनबा) की आंगणित **मात्रा (घनमीटर में) 10,35,786 घनमी0** व Open excavation से निकलने वाले मे की आंगणित मात्रा **(घनमीटर में) 2,74,367 घन मी0**

14 रेलवे परियोजना के **डी0पी0आर (Detail Project Report)** के अनुसार टनल से निकलने वाले मक (डनबा) की आंगणित कुल मात्रा में उपयोगार्थ (डनबा) की मात्रा (घनमीटर में) **70275.00 घनमी0** व ओपन एकस्कवेषन से निकलने वाले की आंगणित मात्रा मक की आंगणित कुल मात्रा में उपयोगार्थ मक की मात्रा **(घनमीटर में) 159 घनमी0 है।**

15 कोई अन्य विवरण या रेखा–मानचित्र (स्कैच मैप) जो आवेदक प्रस्तुत करना चाहें एलाइनमेंट **मैप नरकोटा से तिलणी सुमेरपुर** मैं/हम एतद्द्वारा धोशणा करता हूँ/करते हैं कि ऊपर दिये गये समस्त विवरण सही हैं और मैं/हम कोई अन्य विवरण, जो आपके द्वारा अपेक्षिक हों, देने को तैयार हूँ/हैं।

दिनांक 28.06.2021

Chauhan

आवेदक के हस्ताक्षर।

Scanned with CamS

IFMS Uttarakhand

E-Challan

Bank Reff. No. - CKQ7205762

Treasury Form-209(1)
Financial Handbook Vol. V, Part- II
Form No. 43A(1)
(See Paragraph 417 and 478)
Challan form for depositing amount

Name of the Treasury/Sub-Treasury/Bank/Bank Branch -State Bank Of India (Payment Gateway)

1	Name of the person (designation if necessary or Organization on whose behalf amount is being paid.	MEGHA ENGINEERING & INFRASTRUCTURES LTD.
2	Address	H.NO.42, SUMERPUR VILLAGE, RUDRAPRAYAG, , RUDRAPRAYAG Uttarakhand 246171
3	Registration Number (if necessary)	
4	Full details of amount to be deposited (for which purpose and in favour of)	mining dept H one form Royalty Fee
5	Gross value of Challan	50000
6	Net value of Challan	50000
7	Full details of Head of Account	0853 - Non-ferrous mining and metallurgy industry
8	13 Digit code of Head of A/c	As per details below

SL No.	Services	Detail Head	Amount
1	Mineral Concession Fee rent and interest charges.	0853001020100	50000
	Total Challan Amount-		50000

Amount (in words) - Rs. Fifty Thousand only

Signature of departmental officer with seal

MEGHA ENGINEERING & INFRASTRUCTURES LTD.

Challan No- 08530621E0362665 Amount in Figure(Rs.) - 50000

Date - 28-JUN-2021 Amount in words - Rs. Fifty Thousand only

Received Through

Bank Reff. No. - CKQ7205762

State Bank Of India (Payment Gateway)

Scanned with CamS

ANNEXURE - 5

उत्तराखण्ड शासन
औद्योगिक विकास (खनन) अनुभाग–1
संख्याः 123 /VII-1/2021/8(16)/19
देहरादून, दिनांकः 19 जनवरी, 2021

अधिसूचना

राज्यपाल, खान और खनिज (विकास और विनियमन) अधिनियम, 1957 (अधिनियम संख्या 67 वर्ष 1957) की धारा 23ग के द्वारा प्रदत्त शक्तियों का प्रयोग करते हुए उत्तराखण्ड खनिज (अवैध खनन, परिवहन एवं भण्डारण का निवारण) नियमावली, 2020 में संशोधन करने की दृष्टि से निम्नलिखित नियमावली बनाते हैं :–

उत्तराखण्ड खनिज (अवैध खनन, परिवहन एवं भण्डारण का निवारण) (संशोधन) नियमावली, 2021

संक्षिप्त नाम और प्रारम्भ

1. (1) इस नियमावली का संक्षिप्त नाम उत्तराखण्ड खनिज (अवैध खनन, परिवहन एवं भण्डारण का निवारण) (संशोधन) नियमावली, 2021 है।

(2) यह तुरन्त प्रवृत्त होगी।

नियम 8 का संशोधन

2. उत्तराखण्ड खनिज (अवैध खनन, परिवहन एवं भण्डारण का निवारण) नियमावली, 2020 (जिसे आगे मूल नियमावली कहा गया है) में नीचे स्तम्भ–1 में दिये गये विद्यमान नियम 8 के स्थान पर स्तम्भ–2 में दिया गया नियम रख दिया जायेगा, अर्थात्–

स्तम्भ–1 विद्यमान नियम	स्तम्भ–2 एतद्द्वारा प्रतिस्थापित नियम
8. (1) इस नियमावली के अन्य उपबन्धों के अधीन रहते हुए, खनिज (आर०बी०एम० एवं बोल्डर को छोड़कर) के रिटेल भण्डारण, ईंट रिटेल भण्डारण, ईंट भट्टा परिसर भण्डारण एवं सोपस्टोन भण्डारण /सोपस्टोन ट्रेडर की अनुज्ञप्ति हेतु आवेदन कोई भी व्यक्ति/ संस्था/फर्म/कम्पनी सम्बन्धित जनपद के जिला खान अधिकारी कार्यालय मे निर्धारित प्रपत्र–"एच" में चार प्रतियों में वांछित अभिलेखों एवं निर्धारित आवेदन शुल्क सहित प्रस्तुत करेगा। आवेदन की एक प्रति पावती के रूप में आवेदक को हस्ताक्षर कर वापस कर दी जायेगी। सम्बन्धित जिला खान अधिकारी द्वारा आवेदन पत्र एवं संलग्नक/अभिलेखों का परीक्षण कर, अपूर्ण अभिलेखों को पूर्ण कराते हुए गठित समिति से स्थलीय निरीक्षण की कार्यवाही हेतु	8. (1) इस नियमावली के अन्य उपबन्धों के अधीन रहते हुए, खनिज (आर०बी०एम० एवं बोल्डर को छोड़कर) के रिटेल भण्डारण, ईंट रिटेल भण्डारण, ईंट भट्टा परिसर भण्डारण एवं सोपस्टोन भण्डारण/ सोपस्टोन ट्रेडर की अनुज्ञप्ति हेतु आवेदन कोई भी व्यक्ति/ संस्था/फर्म/कम्पनी सम्बन्धित जनपद के जिला खान अधिकारी कार्यालय मे निर्धारित प्रपत्र–"एच" में चार प्रतियों में वांछित अभिलेखों एवं निर्धारित आवेदन शुल्क सहित प्रस्तुत करेगा। आवेदन की एक प्रति पावती के रूप में आवेदक को हस्ताक्षर कर वापस कर दी जायेगी। सम्बन्धित जिला खान अधिकारी द्वारा आवेदन पत्र एवं संलग्नक/अभिलेखों का परीक्षण कर, अपूर्ण अभिलेखों को पूर्ण कराते हुए गठित समिति से स्थलीय निरीक्षण की कार्यवाही हेतु

सम्बन्धित जिलाधिकारी को संदर्भित किया जायेगा।"

परन्तु स्टोन क्रेशर, स्क्रीनिग प्लान्ट, मोबाईल स्टोन क्रेशर, मोबाईल स्क्रीनिंग प्लान्ट, हॉट मिक्स प्लान्ट, रेडिमिक्स प्लान्ट एवं पल्वराईजर प्लान्ट परिसर में उपखनिजों के भण्डारण हेतु आवेदन, राज्य सरकार द्वारा उत्तराखण्ड स्टोन क्रेशर, स्क्रीनिंग प्लान्ट, मोबाईल स्टोन क्रेशर, मोबाईल स्कीनिंग प्लान्ट, पल्वराईजर प्लान्ट, हाट मिक्स प्लान्ट, रेडिमिक्स प्लान्ट अनुज्ञा नीति में निर्धारित प्रपत्र क्रमशः अनुसूची–2, अनुसूची–5, अनुसूची–6 एवं अनुसूची–7 में प्रस्तुत किया जायेगा।

(क)(i) रिटेल भण्डारण हेतु पर्वतीय क्षेत्र के लिए न्यूनतम क्षेत्रफल 200 वर्गमीटर तथा मैदानी क्षेत्र हेतु न्यूनतम क्षेत्रफल 500 वर्गमीटर स्थल का होना आवश्यक होगा, तथा भण्डारण स्थल में वाहनों के पार्किंग, आफिस एवं तोल मशीन हेतु अतिरिक्त 200 वर्ग मीटर क्षेत्रफल आरक्षित रखना अनिवार्य होगा।

(ii) ईट रिटेल भण्डारण हेतु पर्वतीय क्षेत्र हेतु न्यूनतम क्षेत्रफल 200 वर्गमीटर तथा मैदानी क्षेत्र हेतु न्यूनतम क्षेत्रफल 500 वर्गमीटर स्थल का होना आवश्यक होगा तथा वाहनों के पार्किन्ग एवं आफिस हेतु अतिरिक्त 200 वर्ग मीटर क्षेत्रफल आरक्षित रखना अनिवार्य होगा।

(ख) वाहन, ऑफिस, तौल मशीन एवं प्लांट के क्षेत्र को छोडकर अवशेष क्षेत्र में खनिज भण्डारण किया

सम्बन्धित जिलाधिकारी को संदर्भित किया जायेगा।"

परन्तु स्टोन क्रेशर, स्क्रीनिग प्लान्ट, मोबाईल स्टोन क्रेशर, मोबाईल स्क्रीनिंग प्लान्ट, हॉट मिक्स प्लान्ट, रेडिमिक्स प्लान्ट एवं पल्वराईजर प्लान्ट परिसर में उपखनिजों के भण्डारण हेतु आवेदन, राज्य सरकार द्वारा उत्तराखण्ड स्टोन क्रेशर, स्क्रीनिंग प्लान्ट, मोबाईल स्टोन क्रेशर, मोबाईल स्कीनिंग प्लान्ट, पल्वराईजर प्लान्ट, हाट मिक्स प्लान्ट, रेडिमिक्स प्लान्ट अनुज्ञा नीति में निर्धारित प्रपत्र क्रमशः अनुसूची–2, अनुसूची–5, अनुसूची–6 एवं अनुसूची–7 में प्रस्तुत किया जायेगा।

(क)(i) रिटेल भण्डारण हेतु पर्वतीय क्षेत्र के लिए न्यूनतम क्षेत्रफल 200 वर्गमीटर तथा मैदानी क्षेत्र हेतु न्यूनतम क्षेत्रफल 500 वर्गमीटर स्थल का होना आवश्यक होगा, तथा भण्डारण स्थल में वाहनों के पार्किंग, आफिस एवं तोल मशीन हेतु अतिरिक्त 200 वर्ग मीटर क्षेत्रफल आरक्षित रखना अनिवार्य होगा।

(ii) ईट रिटेल भण्डारण हेतु पर्वतीय क्षेत्र हेतु न्यूनतम क्षेत्रफल 200 वर्गमीटर तथा मैदानी क्षेत्र हेतु न्यूनतम क्षेत्रफल 500 वर्गमीटर स्थल का होना आवश्यक होगा तथा वाहनों के पार्किन्ग एवं आफिस हेतु अतिरिक्त 200 वर्ग मीटर क्षेत्रफल आरक्षित रखना अनिवार्य होगा।

(ख) वाहन, ऑफिस, तौल मशीन एवं प्लांट के क्षेत्र को छोडकर अवशेष क्षेत्र में खनिज भण्डारण किया

जायेगा, जिसकी अधिकतम ऊंचाई 03 मीटर से अधिक नहीं होगी, परन्तु स्टोन क्रेशर, स्क्रीनिंग प्लान्ट स्वामी प्लान्ट के परिसर में एक समय में औसतन 05 मी० ऊंचाई तक उपखनिज का भण्डारण किया जा सकेगा।

(ग) आवेदक द्वारा खनिज भण्डारण हेतु खनिज प्राप्त किये जाने वाले वैध स्रोत का अनुबन्ध जिला खान अधिकारी से प्रतिहस्ताक्षरित कराकर प्रस्तुत किया जाना होगा।

(2) ऐसे प्रत्येक आवेदन हेतु निम्नानुसार अनुज्ञा शुल्क देय होगा, जो निर्धारित लेखाशीर्षक में जमा कराया जायेगा :–

1. उपखनिज (आर०बी०एम० एवं बोल्डर को छोड़कर) एवं सोपस्टोन ट्रेडर के रिटेल भण्डारण हेतु 50,000 टन क्षमता हेतु अनुज्ञा शुल्क ₹ 25,000.00 (₹ पच्चीस हजार मात्र) देय होगा तथा इससे अधिक क्षमता बढ़ाने पर प्रति टन ₹ 10, अतिरिक्त शुल्क देय होगा।
2. स्टोन क्रेशर/स्क्रीनिंग प्लान्ट / मोबाईल स्टोन केशर/ मोबाईल स्क्रीनिंग प्लांट/ पल्वराइजर/हॉट मिक्स/ रेडिमिक्स प्लांट परिसर में उपखनिज भण्डारण हेतु पृथक से शुल्क देय नहीं होगा।

भण्डारण अनुज्ञा स्वीकृति

जायेगा, जिसकी अधिकतम ऊंचाई 03 मीटर से अधिक नहीं होगी, परन्तु स्टोन क्रेशर, स्क्रीनिंग प्लान्ट स्वामी प्लान्ट के परिसर में एक समय में औसतन 05 मी० ऊंचाई तक उपखनिज का भण्डारण किया जा सकेगा।

(ग) आवेदक द्वारा खनिज भण्डारण हेतु खनिज प्राप्त किये जाने वाले वैध स्रोत का अनुबन्ध जिला खान अधिकारी से प्रतिहस्ताक्षरित कराकर प्रस्तुत किया जाना होगा।

परन्तु, उक्त प्रावधान ऋषिकेश–कर्णप्रयाग रेल लाईन परियोजना की कार्यदायी संस्था रेल विकास परियोजना लिमिटेड/रेल विकास परियोजना लिमिटेड द्वारा अनुबन्धित ठेकेदार पर लागू नहीं होगा।

(2) ऐसे प्रत्येक आवेदन हेतु निम्नानुसार अनुज्ञा शुल्क देय होगा, जो निर्धारित लेखाशीर्षक में जमा कराया जायेगा :–

1. उपखनिज (आर०बी०एम० एवं बोल्डर को छोड़कर) एवं सोपस्टोन ट्रेडर के रिटेल भण्डारण हेतु 50,000 टन क्षमता हेतु अनुज्ञा शुल्क ₹ 25,000.00 (₹ पच्चीस हजार मात्र) देय होगा तथा इससे अधिक क्षमता बढ़ाने पर प्रति टन ₹ 10, अतिरिक्त शुल्क देय होगा।
2. स्टोन क्रेशर/स्क्रीनिंग प्लान्ट / मोबाईल स्टोन केशर/ मोबाईल स्क्रीनिंग प्लांट/ पल्वराइजर/हॉट मिक्स/ रेडिमिक्स प्लांट परिसर में उपखनिज भण्डारण हेतु पृथक से शुल्क देय नहीं होगा।

भण्डारण अनुज्ञा स्वीकृति

हेतु निर्धारित अनुज्ञा शुल्क का 10 प्रतिशत धनराशि आवेदन शुल्क (बिना वापसी के) आवेदन पत्र प्रस्तुत करते समय तथा अवशेष 90 प्रतिशत की धनराशि अनुज्ञा स्वीकृति के उपरान्त चाहरदीवारी बनाने, धर्मकांटा लगाने एवं सी0सी0टी0वी0 लगाने के उपरान्त ई–रवन्ना जारी होने से पूर्व निर्धारित लेखा शीर्षक में जमा किया जाना आवश्यक होगा।

हेतु निर्धारित अनुज्ञा शुल्क का 10 प्रतिशत धनराशि आवेदन शुल्क (बिना वापसी के) आवेदन पत्र प्रस्तुत करते समय तथा अवशेष 90 प्रतिशत की धनराशि अनुज्ञा स्वीकृति के उपरान्त चाहरदीवारी बनाने, धर्मकांटा लगाने एवं सी0सी0टी0वी0 लगाने के उपरान्त ई–रवन्ना जारी होने से पूर्व निर्धारित लेखा शीर्षक में जमा किया जाना आवश्यक होगा।

परन्तु, उक्त प्रावधान ऋषिकेश–कर्णप्रयाग रेल लाईन परियोजना की कार्यदायी संस्था रेल विकास परियोजना लिमिटेड/रेल विकास परियोजना लिमिटेड द्वारा अनुबन्धित ठेकेदार पर लागू नहीं होगा।

(3) भण्डारण अनुज्ञा प्राप्त करने हेतु जिला खान अधिकारी कार्यालय में निर्धारित प्रपत्र पर आवेदन प्रस्तुत करने के 03 दिन के अन्तर्गत आवेदक द्वारा स्थानीय समाचार पत्र में स्वयं के व्यय पर विज्ञप्ति, जिसमें आवेदक का नाम, पता व आवेदित स्थल का पूर्ण विवरण उल्लिखित हो, इस आशय से प्रकाशित की जायेगी कि यदि किसी स्थानीय व्यक्ति/संस्था/विभाग आदि जो निर्धारित दूरी 100 मीटर के अन्तर्गत निवासरत हो तथा खनिज भण्डारण के प्रस्तावित स्थल से प्रभावित हो अथवा उन्हे कोई आपत्ति हो, तो वे अपनी आपत्ति विज्ञप्ति प्रकाशन के 15 दिवस के अन्तर्गत सम्बन्धित जनपद के जिलाधिकारी को प्रस्तुत करेंगे।

प्रकाशित विज्ञप्ति के उपरान्त यदि किसी स्थानीय व्यक्ति/संस्था / विभाग आदि की आपत्ति प्राप्त होती है तो सम्बन्धित

(3) भण्डारण अनुज्ञा प्राप्त करने हेतु जिला खान अधिकारी कार्यालय में निर्धारित प्रपत्र पर आवेदन प्रस्तुत करने के 03 दिन के अन्तर्गत आवेदक द्वारा स्थानीय समाचार पत्र में स्वयं के व्यय पर विज्ञप्ति, जिसमें आवेदक का नाम, पता व आवेदित स्थल का पूर्ण विवरण उल्लिखित हो, इस आशय से प्रकाशित की जायेगी कि यदि किसी स्थानीय व्यक्ति/संस्था/विभाग आदि जो निर्धारित दूरी 100 मीटर के अन्तर्गत निवासरत हो तथा खनिज भण्डारण के प्रस्तावित स्थल से प्रभावित हो अथवा उन्हे कोई आपत्ति हो, तो वे अपनी आपत्ति विज्ञप्ति प्रकाशन के 15 दिवस के अन्तर्गत सम्बन्धित जनपद के जिलाधिकारी को प्रस्तुत करेंगे।

प्रकाशित विज्ञप्ति के उपरान्त यदि किसी स्थानीय व्यक्ति/संस्था/विभाग आदि की आपत्ति प्राप्त होती है तो सम्बन्धित

उपजिलाधिकारी एवं खान अधिकारी द्वारा आपत्तिकर्ता एवं आवेदक को सुनने के उपरान्त युक्तियुक्त निर्णय हेतु जिलाधिकारी को अवगत कराया जायेगा। जिलाधिकारी प्रकरण पर 30 दिन के भीतर निर्णय लेंगे अन्यथा की स्थिति में आपत्ति स्वीकार मानी जायेगी अर्थात् भण्डारण आवेदन निरस्त माना जायेगा।

प्रकाशित विज्ञप्ति में निर्धारित समयावधि के अन्तर्गत यदि किसी स्थानीय व्यक्ति/संस्था/विभाग आदि की आपत्ति प्राप्त नहीं होती है अथवा जिलाधिकारी द्वारा भण्डारण अनुज्ञाधारक के पक्ष में निर्णय लिया जाता है, तो जिलाधिकारी द्वारा ईंट रिटेल भण्डारण एवं ईट भट्टा परिसर भण्डारण हेतु अनुज्ञा स्वीकृति हेतु कार्यवाही की जायेगी। उपखनिज (आर०बी०एम० एवं बोल्डर को छोड़कर) के रिटेल भण्डारण हेतु जिलाधिकारी द्वारा ऐसे आवेदन पत्र को संस्तुति सहित भण्डारण अनुज्ञा स्वीकृति हेतु एक सप्ताह के भीतर मण्डलायुक्त को प्रेषित किया जायेगा तथा सोपस्टोन भण्डारण /सोपस्टोन ट्रेडर की अनुज्ञा स्वीकृति हेतु ऐसे आवेदन पत्र को संस्तुति सहित एक सप्ताह के भीतर निदेशक को संदर्भित किया जायेगा तथा निदेशक द्वारा प्रस्ताव का परीक्षण कर अनुज्ञा स्वीकृति हेतु प्रस्ताव संस्तुति सहित शासन को प्रेषित किया जायेगा।

उपजिलाधिकारी एवं खान अधिकारी द्वारा आपत्तिकर्ता एवं आवेदक को सुनने के उपरान्त युक्तियुक्त निर्णय हेतु जिलाधिकारी को अवगत कराया जायेगा। जिलाधिकारी प्रकरण पर 30 दिन के भीतर निर्णय लेंगे अन्यथा की स्थिति में आपत्ति स्वीकार मानी जायेगी अर्थात् भण्डारण आवेदन निरस्त माना जायेगा।

प्रकाशित विज्ञप्ति में निर्धारित समयावधि के अन्तर्गत यदि किसी स्थानीय व्यक्ति/संस्था/विभाग आदि की आपत्ति प्राप्त नहीं होती है अथवा जिलाधिकारी द्वारा भण्डारण अनुज्ञाधारक के पक्ष में निर्णय लिया जाता है, तो जिलाधिकारी द्वारा ईंट रिटेल भण्डारण एवं ईट भट्टा परिसर भण्डारण हेतु अनुज्ञा स्वीकृति हेतु कार्यवाही की जायेगी। उपखनिज (आर०बी०एम० एवं बोल्डर को छोड़कर) के रिटेल भण्डारण हेतु जिलाधिकारी द्वारा ऐसे आवेदन पत्र को संस्तुति सहित भण्डारण अनुज्ञा स्वीकृति हेतु एक सप्ताह के भीतर मण्डलायुक्त को प्रेषित किया जायेगा तथा सोपस्टोन भण्डारण /सोपस्टोन ट्रेडर की अनुज्ञा स्वीकृति हेतु ऐसे आवेदन पत्र को संस्तुति सहित एक सप्ताह के भीतर निदेशक को संदर्भित किया जायेगा तथा निदेशक द्वारा प्रस्ताव का परीक्षण कर अनुज्ञा स्वीकृति हेतु प्रस्ताव संस्तुति सहित शासन को प्रेषित किया जायेगा।

परन्तु, उक्त प्रावधान ऋषिकेश–कर्णप्रयाग रेल लाईन परियोजना की कार्यदायी संस्था रेल विकास परियोजना लिमिटेड/रेल विकास परियोजना लिमिटेड द्वारा अनुबन्धित ठेकेदार पर लागू नहीं होगा।

(4) आवेदक द्वारा आवेदन पत्र में प्रस्तावित भण्डारण स्थल अनुज्ञा स्वीकृति हेतु समिति द्वारा उपयुक्त न पाये जाने पर संबंधित जिलाधिकारी द्वारा कारणों का उल्लेख करते हुये आवेदनकर्ता को लिखित रूप से सूचित किया जायेगा।

(4) आवेदक द्वारा आवेदन पत्र में प्रस्तावित भण्डारण स्थल अनुज्ञा स्वीकृति हेतु समिति द्वारा उपयुक्त न पाये जाने पर संबंधित जिलाधिकारी द्वारा कारणों का उल्लेख करते हुये आवेदनकर्ता को लिखित रूप से सूचित किया जायेगा।

परन्तु, उक्त प्रावधान ऋषिकेश–कर्णप्रयाग रेल लाईन परियोजना की कार्यदायी संस्था रेल विकास परियोजना लिमिटेड/रेल विकास परियोजना लिमिटेड द्वारा अनुबन्धित ठेकेदार पर लागू नहीं होगा।

(5) उपखनिज (आर०बी०एम० एवं बोल्डर को छोड़कर) के रिटेल भण्डारण, ईट भट्टा परिसर भण्डारण, ईंट रिटेल भण्डारण एवं सोपस्टोन भण्डारण/सोपस्टोन ट्रेडर की अनुज्ञा स्वीकृति हेतु आवेदित स्थल की संयुक्त जांच के लिए निम्नानुसार समिति का गठन किया जाता है:–

1. जिलाधिकारी अथवा उनके द्वारा नामित अपर जिलाधिकारी/ मुख्य विकास अधिकारी – अध्यक्ष।
2. संबंधित उप जिलाधिकारी – सदस्य।
3. जिला खान अधिकारी – सदस्य सचिव।

(5) उपखनिज (आर०बी०एम० एवं बोल्डर को छोड़कर) के रिटेल भण्डारण, ईट भट्टा परिसर भण्डारण, ईंट रिटेल भण्डारण एवं सोपस्टोन भण्डारण/सोपस्टोन ट्रेडर की अनुज्ञा स्वीकृति हेतु आवेदित स्थल की संयुक्त जांच के लिए निम्नानुसार समिति का गठन किया जाता है:–

1. जिलाधिकारी अथवा उनके द्वारा नामित अपर जिलाधिकारी/ मुख्य विकास अधिकारी – अध्यक्ष।
2. संबंधित उप जिलाधिकारी – सदस्य।
3. जिला खान अधिकारी – सदस्य सचिव।

परन्तु, उक्त प्रावधान ऋषिकेश–कर्णप्रयाग रेल लाईन परियोजना की कार्यदायी संस्था रेल विकास परियोजना लिमिटेड/रेल विकास परियोजना लिमिटेड द्वारा अनुबन्धित ठेकेदार पर लागू नहीं होगा।

(6) ऋषिकेश–कर्णप्रयाग रेल लाईन परियोजना की कार्यदायी संस्था रेल विकास परियोजना लिमिटेड/रेल

विकास परियोजना लिमिटेड द्वारा अनुबन्धित ठेकेदार द्वारा ऋषिकेश–कर्णप्रयाग रेल लाईन परियोजना के निर्माण से निकले मक (Muck) के चिन्हित भण्डारण स्थलों पर भण्डारण हेतु प्रपत्र "**एच–1**" में आवेदन, निर्धारित आवेदन शुल्क ₹ 50,000/– (₹ पच्चास हजार) सहित, निदेशक, भूतत्व एवं खनिकर्म इकाई को प्रस्तुत किया जायेगा। उक्त के संबंध में निदेशक, भूतत्व एवं खनिकर्म इकाई द्वारा निम्नानुसार गठित तकनीकी समिति से निर्धारित प्रपत्र "**एच–2**" पर संयुक्त निरीक्षण आख्या प्राप्त की जायेगी :–

i	निदेशक, भूतत्व एवं खनिकर्म इकाई, उत्तराखण्ड द्वारा नामित अपर निदेशक/संयुक्त निदेशक स्तर के अधिकारी	संयोजक
ii	प्रमुख अभियन्ता, लोक निर्माण विभाग, उत्तराखण्ड द्वारा नामित मुख्यालय में पदस्थापित अधीक्षण अभियन्ता स्तर का अधिकारी	सदस्य
iii	प्रमुख मुख्य अभियन्ता, सिंचाई विभाग, उत्तराखण्ड द्वारा नामित मुख्यालय में पदस्थापित अधीक्षण अभियन्ता स्तर का अधिकारी	सदस्य
iv	प्रमुख वन संरक्षक (HOFF), उत्तराखण्ड द्वारा नामित मुख्यालय में पदस्थापित वन	सदस्य

	संरक्षक स्तर का अधिकारी	
v	संबंधित जिलाधिकारी द्वारा नामित अपर जिलाधिकारी	सदस्य
vi	अभियन्ता (सिविल), रेल विकास निगम।	सदस्य
vii	क्षेत्रीय अधिकारी, पर्यावरण संरक्षण एवं प्रदूषण नियंत्रण बोर्ड।	सदस्य

रेल लाईन परियोजना की कार्यदायी संस्था रेल विकास परियोजना लिमिटेड/रेल विकास परियोजना लिमिटेड द्वारा अनुबन्धित ठेकेदार को स्वीकृत अनुज्ञा स्थलों, अन्य स्वीकृत Open Excavation स्थलों एवं रिवर ट्रेनिंग स्थलों से निकासी किये गये उपखनिज के भण्डारण हेतु उपरोक्तानुसार ही आवेदन प्रस्तुत किया जाना होगा;

नियम 9 का संशोधन

3. मूल नियमावली में नीचे स्तम्भ–1 में दिये गये विद्यमान नियम 9 के स्थान पर स्तम्भ–2 में दिया गया नियम रख दिया जायेगा, अर्थात्–

स्तम्भ–1 विद्यमान नियम	स्तम्भ–2 एतद्द्वारा प्रतिस्थापित नियम
9. इस नियमावली के उपबन्धों के अधीन रहते हुये गठित समिति की जॉच आख्या के आधार पर प्रस्तावित भण्डारण स्थल पर एक समय मे रखे जाने वाली कुल खनिज (आर०बी०एम० एवं बोल्डर को छोड़कर) की मात्रा के रिटेल भण्डारण की अनुज्ञा जिलाधिकारी की संस्तुति के उपरान्त मण्डलायुक्त के द्वारा 05 वर्ष की अवधि हेतु स्वीकृत की जायेगी। सोपस्टोन भण्डारण/सोपस्टोन ट्रेडर की अनुज्ञा जिलाधिकारी व निदेशक की संस्तुति के उपरान्त राज्य सरकार द्वारा 05 वर्ष की अवधि हेतु स्वीकृत की जायेगी। ईंट भट्टा परिसर भण्डारण एवं ईंट रिटेल भण्डारण की अनुज्ञा	9. इस नियमावली के उपबन्धों के अधीन रहते हुये गठित समिति की जॉच आख्या के आधार पर प्रस्तावित भण्डारण स्थल पर एक समय मे रखे जाने वाली कुल खनिज (आर०बी०एम० एवं बोल्डर को छोड़कर) की मात्रा के रिटेल भण्डारण की अनुज्ञा जिलाधिकारी की संस्तुति के उपरान्त मण्डलायुक्त के द्वारा 05 वर्ष की अवधि हेतु स्वीकृत की जायेगी। सोपस्टोन भण्डारण/सोपस्टोन ट्रेडर की अनुज्ञा जिलाधिकारी व निदेशक की संस्तुति के उपरान्त राज्य सरकार द्वारा 05 वर्ष की अवधि हेतु स्वीकृत की जायेगी। ईंट भट्टा परिसर भण्डारण एवं ईंट रिटेल भण्डारण की अनुज्ञा

जिलाधिकारी स्तर से 05 वर्ष की अवधि हेतु स्वीकृत की जायेगी।

मोबाईल स्टोन क्रेशर एवं मोबाईल स्क्रीनिंग प्लांट के परिसर में खनिजों के भण्डारण हेतु भण्डारण अनुज्ञप्ति प्रपत्र–"आई" में अधिकतम 02 वर्ष अथवा परियोजना कार्य पूर्ण होने तक, जो भी पहले हो, के लिए जिलाधिकारी द्वारा स्वीकृत की जायेगी।

हाट मिक्स प्लान्ट एवं रेडिमिक्स प्लांट के परिसर में खनिजों के भण्डारण हेतु भण्डारण अनुज्ञप्ति, प्रपत्र–"आई" में 03 वर्ष अथवा परियोजना कार्य पूर्ण होने तक, जो भी पहले हो, के लिए जिलाधिकारी द्वारा स्वीकृत की जायेगी।

अनुज्ञा स्वीकृति के पश्चात् की सभी औपचारिकताएं पूर्ण होने पर, जिला खान अधिकारी का दायित्व होगा कि सभी स्वीकृत अनुज्ञा को ई–पोर्टल से जोड़ा जायेगा।

सभी भण्डारण अनुज्ञाधारक को स्वीकृति से पूर्व जी0एस0टी0 नम्बर लेना अनिवार्य होगा।

जिलाधिकारी स्तर से 05 वर्ष की अवधि हेतु स्वीकृत की जायेगी।

मोबाईल स्टोन क्रेशर एवं मोबाईल स्क्रीनिंग प्लांट के परिसर में खनिजों के भण्डारण हेतु भण्डारण अनुज्ञप्ति प्रपत्र–"आई" में अधिकतम 02 वर्ष अथवा परियोजना कार्य पूर्ण होने तक, जो भी पहले हो, के लिए जिलाधिकारी द्वारा स्वीकृत की जायेगी।

हाट मिक्स प्लान्ट एवं रेडिमिक्स प्लांट के परिसर में खनिजों के भण्डारण हेतु भण्डारण अनुज्ञप्ति, प्रपत्र–"आई" में 03 वर्ष अथवा परियोजना कार्य पूर्ण होने तक, जो भी पहले हो, के लिए जिलाधिकारी द्वारा स्वीकृत की जायेगी।

अनुज्ञा स्वीकृति के पश्चात् की सभी औपचारिकताएं पूर्ण होने पर, जिला खान अधिकारी का दायित्व होगा कि सभी स्वीकृत अनुज्ञा को ई–पोर्टल से जोड़ा जायेगा।

सभी भण्डारण अनुज्ञाधारक को स्वीकृति से पूर्व जी0एस0टी0 नम्बर लेना अनिवार्य होगा।

परन्तु, उक्त प्रावधान ऋषिकेश–कर्णप्रयाग रेल लाईन परियोजना की कार्यदायी संस्था रेल विकास परियोजना लिमिटेड/रेल विकास परियोजना लिमिटेड द्वारा अनुबन्धित ठेकेदार पर लागू नहीं होगा।

नियम 9.क का अतःस्थापन

4. मूल नियमावली के नियम 9 के पश्चात् एक नया नियम 9.क निम्नवत् अंतःस्थापित कर दिया जायेगा, अर्थात्–

9. क ऋषिकेश–कर्णप्रयाग रेल लाईन परियोजना के टनलों के निर्माण कार्य से निकलने वाले मक (Muck) में से उपयोगी उपखनिज (usable material) के उपयोग की अनुमति रायल्टी की दोगुनी धनराशि एवं अन्य देयताओं के भुगतान की शर्त पर निदेशक, भूतत्व एवं खनिकर्म इकाई की संस्तुति पर परियोजना की अवधि अथवा याचित अवधि, जो भी न्यून हो, तक शासन द्वारा स्वीकृत किया जायेगा। अवशेष अनुपयोगी मक को स्वीकृत डम्पिंग साईट पर डम्प किया जायेगा। डम्पिंग साईट पर डम्प खनिज मात्रा के परिमाण को कुल उत्खनित मक की मात्रा से घटाते हुए उपयोगी मक/उपखनिज की गणना की जायेगी।

रेल लाईन परियोजना की कार्यदायी संस्था रेल विकास परियोजना

लिमिटेड/रेल विकास परियोजना लिमिटेड द्वारा अनुबन्धित ठेकेदार को स्वीकृत अनुज्ञा स्थलों, अन्य स्वीकृत Open Excavation स्थलों व रिवर ट्रेनिंग स्थलों से निकासी किये गये उपखनिज के भण्डारण हेतु उपरोक्तानुसार ही स्वीकृति प्रदान की जायेगी।

नियम 11 का संशोधन

5. मूल नियमावली में नीचे स्तम्भ–1 में दिये गये विद्यमान नियम 11 के उपनियम (2) के स्थान पर स्तम्भ–2 में दिया गया नियम रख दिया जायेगा, अर्थात्–

स्तम्भ–1 विद्यमान नियम	स्तम्भ–2 एतद्द्वारा प्रतिस्थापित नियम
11. (2) रिटेल भण्डारण स्थल का सार्वजनिक स्थल, सरकारी वन, रेल मार्ग, नदी आदि से दूरी निम्न प्रकार होगी– (i) पर्वतीय क्षेत्र :– क–धार्मिक स्थल से दूरी–50मी0 ख–शैक्षणिक संस्थान से दूरी –100 मी0 ग–अस्पताल से दूरी– 100 मी0 घ–रेल मार्ग से दूरी–50 मी0 ड.–नदी से दूरी–250 मी० च–सरकारी वन से दूरी–10 मी0 (ii) मैदानी क्षेत्र :– क–धार्मिक स्थल से दूरी– 300 मी0 ख–शैक्षणिक संस्थान से दूरी –300 मी0 ग–अस्पताल से दूरी– 300 मी0 घ–रेल मार्ग से दूरी–50 मी0 ड़–नदी से दूरी–1500 मी० च–सरकारी वन से दूरी– 100 मी0 परन्तु पर्वतीय एवं मैदानी क्षेत्रों मे स्टोन क्रेशर, स्क्रीनिंग प्लांट, मोबाईल स्टोन क्रेशर, मोबाईल स्क्रीनिंग प्लांट, हॉट मिक्स प्लांट, रेडिमिक्स प्लांट व पल्वराईजर प्लांट के परिसर मे खनिजों के भण्डारण हेतु दूरी के मानक वही होंगे, जो इन प्लांटों की स्थापना/संचालन हेतु राज्य सरकार द्वारा जारी स्टोन क्रेशर, स्क्रीनिंग प्लांट, मोबाईल स्टोन क्रेशर, मोबाईल स्क्रीनिंग प्लांट, हॉट मिक्स प्लांट, रेडिमिक्स प्लांट	11 (2) रिटेल भण्डारण स्थल का सार्वजनिक स्थल, सरकारी वन, रेल मार्ग, नदी आदि से दूरी निम्न प्रकार होगी– (i) पर्वतीय क्षेत्र :– क–धार्मिक स्थल से दूरी–50 मी0 ख–शैक्षणिक संस्थान से दूरी– 100 मी0 ग–अस्पताल से दूरी– 100 मी0 घ–रेल मार्ग से दूरी–50 मी0 ड.–नदी से दूरी–250 मी० च–सरकारी वन से दूरी–10 मी0 (ii) मैदानी क्षेत्र :– क–धार्मिक स्थल से दूरी– 300 मी0 ख–शैक्षणिक संस्थान से दूरी –300 मी0 ग–अस्पताल से दूरी– 300 मी0 घ–रेल मार्ग से दूरी–50 मी0 ड़–नदी से दूरी–1500 मी० च–सरकारी वन से दूरी– 100 मी0 परन्तु पर्वतीय एवं मैदानी क्षेत्रों मे स्टोन क्रेशर, स्क्रीनिंग प्लांट, मोबाईल स्टोन क्रेशर, मोबाईल स्क्रीनिंग प्लांट, हॉट मिक्स प्लांट, रेडिमिक्स प्लांट व पल्वराईजर प्लांट के परिसर मे खनिजों के भण्डारण हेतु दूरी के मानक वही होंगे, जो इन प्लांटों की स्थापना/संचालन हेतु राज्य सरकार द्वारा जारी स्टोन क्रेशर, स्क्रीनिंग प्लांट, मोबाईल स्टोन क्रेशर, मोबाईल स्क्रीनिंग प्लांट, हॉट मिक्स प्लांट, रेडिमिक्स प्लांट

	व पल्वराईजर प्लांट नीति के अनुसार होंगे।	व पल्वराईजर प्लांट नीति के अनुसार होंगे। **परन्तु, उक्त प्रावधान ऋषिकेश–कर्णप्रयाग रेल लाईन परियोजना की कार्यदायी संस्था रेल विकास परियोजना लिमिटेड/रेल विकास परियोजना लिमिटेड द्वारा अनुबन्धित ठेकेदार पर लागू नहीं होगा।**
नियम 11 का संशोधन	5. मूल नियमावली में :– (i) नीचे स्तम्भ–1 में दिये गये विद्यमान नियम 11 के उपनियम (7) के स्थान पर स्तम्भ–2 में दिया गया नियम रख दिया जायेगा, अर्थात् :–	
	11. (7) रिटेल अनुज्ञाधारक, खनिज (आर०बी०एम० एवं बोल्डर को छोड़कर) भण्डारण हेतु भण्डारण स्थल में एक समय में अधिकतम 03 मी0 ऊंचाई तक तथा स्टोन क्रेशर, स्क्रीनिंग प्लान्ट स्वामी को प्लान्ट के परिसर में एक समय में औसतन 05 मीटर ऊंचाई तक उपखनिज का भण्डारण कर सकेगा।	11. (7) रिटेल अनुज्ञाधारक, खनिज (आर०बी०एम० एवं बोल्डर को छोड़कर) भण्डारण हेतु भण्डारण स्थल में एक समय में अधिकतम 03 मी0 ऊंचाई तक तथा स्टोन क्रेशर, स्क्रीनिंग प्लान्ट स्वामी को प्लान्ट के परिसर में एक समय में औसतन 05 मीटर ऊंचाई तक उपखनिज का भण्डारण कर सकेगा।
	भण्डारण स्थल में प्रथम वार्षिक खनन सत्र में, एक समय पर भण्डारण क्षमता अधिकतम 50,000 मीट्रिक टन होगी तथा आगामी वार्षिक खनन सत्रों हेतु एक समय में भण्डारण क्षमता वर्षानुवर्ष गत वार्षिक खनन सत्र की विक्रित मात्रा का 40 प्रतिशत होगी।	भण्डारण स्थल में प्रथम वार्षिक खनन सत्र में, एक समय पर भण्डारण क्षमता अधिकतम 50,000 मीट्रिक टन होगी तथा आगामी वार्षिक खनन सत्रों हेतु एक समय में भण्डारण क्षमता वर्षानुवर्ष गत वार्षिक खनन सत्र की विक्रित मात्रा का 40 प्रतिशत होगी।
	स्टोन क्रेशर/स्क्रीनिंग प्लान्ट/ मोबाईल स्टोन क्रेशर एवं मोबाईल स्क्रीनिंग प्लान्ट हेतु क्षमता का निर्धारण निम्नवत् किया जायेगा :– (i) वर्षा ऋतु आदि हेतु खनन चुगान की एक वर्ष में बंदी की अवधि = 90 दिन। वर्षा काल (जुलाई–सितम्बर) की अवधि (90 दिन) हेतु कच्चे माल/आर0बी0एम0 की कुल मात्रा अर्थात् स्टोन केशर/स्कीनिंग प्लान्ट हेतु कच्चे माल की एक समय में	स्टोन क्रेशर/स्क्रीनिंग प्लान्ट/ मोबाईल स्टोन क्रेशर एवं मोबाईल स्क्रीनिंग प्लान्ट हेतु क्षमता का निर्धारण निम्नवत् किया जायेगा :– (i) वर्षा ऋतु आदि हेतु खनन चुगान की एक वर्ष में बंदी की अवधि = 90 दिन। वर्षा काल (जुलाई–सितम्बर) की अवधि (90 दिन) हेतु कच्चे माल/आर0बी0एम0 की कुल मात्रा अर्थात् स्टोन केशर/स्कीनिंग प्लान्ट हेतु कच्चे माल की एक समय में

भण्डारण क्षमता = 90 x टन प्रति घंटा x संचालन अवधि (औसतन 10 घंटा प्रतिदिन) = टन में।

(ii) वर्षा काल से भिन्न अवधि अर्थात अक्टूबर से जून तक की अवधि हेतु कच्चे माल की एक समय में भण्डारण क्षमता 45 x टन प्रति घंटा x संचालन अवधि (औसतन 10 घंटा प्रतिदिन) (टन में)

अनुज्ञाधारक द्वारा उक्त उपनियम की शर्तो का उल्लंघन किये जाने की दशा में, नियम 13 के उपनियम (5) के खण्ड (ग) के अनुसार कार्यवाही की जायेगी।

भण्डारण क्षमता = 90 x टन प्रति घंटा x संचालन अवधि (औसतन 10 घंटा प्रतिदिन) = टन में।

(ii) वर्षा काल से भिन्न अवधि अर्थात अक्टूबर से जून तक की अवधि हेतु कच्चे माल की एक समय में भण्डारण क्षमता 45 x टन प्रति घंटा x संचालन अवधि (औसतन 10 घंटा प्रतिदिन) (टन में)

अनुज्ञाधारक द्वारा उक्त उपनियम की शर्तो का उल्लंघन किये जाने की दशा में, नियम 13 के उपनियम (5) के खण्ड (ग) के अनुसार कार्यवाही की जायेगी।

परन्तु, उक्त प्रावधान ऋषिकेश–कर्णप्रयाग रेल लाईन परियोजना की कार्यदायी संस्था रेल विकास परियोजना लिमिटेड/रेल विकास परियोजना लिमिटेड द्वारा अनुबन्धित ठेकेदार पर लागू नहीं होगा।

(ii) उपनियम (8) के पश्चात् क्रमशः उपनियम (9), उपनियम (10) और उपनियम (11) निम्नवत् अंतःस्थापित कर दिये जायेंगे, अर्थात् :–

(9) तकनीकी दल द्वारा किसी भी टनल से निकासी किये गये उपखनिज (Muck) की कुल मात्रा में से उपयोगार्थ उपखनिज की आगणित/सत्यापित मापन मात्रा, संबंधित टनल निर्माण के उपरान्त स्वीकृत मात्रा से कम अथवा अधिक पाये जाने पर, कम अथवा अधिक पाये जाने वाली मात्रा पर देय रायल्टी का समायोजन/भुगतान किया जायेगा।

स्वीकृत उपखनिज की मात्रा पर आंगणित रॉयल्टी धनराशि एवं अन्य देयों का भुगतान रेल लाईन परियोजना की कार्यदायी संस्था रेल विकास परियोजना लिमिटेड/रेल विकास परियोजना लिमिटेड द्वारा अनुबन्धित ठेकेदार के द्वारा त्रैमासिक किश्तों मे विभागीय लेखा शीर्षक मे अग्रिम जमा किया जायेगा। किश्तों का भुगतान निर्धारित समयान्तर्गत न किये जाने पर 24 प्रतिशत वार्षिक की दर से साधारण व्याज लिया जायेगा।

(10) रेल लाईन परियोजना की कार्यदायी संस्था रेल विकास परियोजना लिमिटेड/रेल विकास परियोजना लिमिटेड द्वारा अनुबन्धित ठेकेदार के द्वारा स्वीकृत स्थल से उपखनिज की निकासी/उपयोग हेतु विभागीय ई–रवन्ना पोर्टल पर पंजीकरण कराया जाना अनिवार्य होगा।

(11) रेल लाईन परियोजना की कार्यदायी संस्था रेल विकास परियोजना लिमिटेड/रेल विकास परियोजना लिमिटेड द्वारा अनुबन्धित ठेकेदार के द्वारा टनल से निकले मक का उपयोग ऋषिकेश–कर्णप्रयाग रेल लाईन परियोजना निर्माण कार्य में ही किया जायेगा। रेलवे विकास निगम लिमिटेड/अधिकृत

कॉन्ट्रेक्टर्स के द्वारा टनल से निकले मक का उपयोग अन्यत्र किये जाने की पुष्टि होने पर नियम 13(5)(ख) के अनुसार कार्यवाही करते हुए ₹ 1.00 करोड़ (₹ एक करोड़) की अतिरिक्त धनराशि वसूल किये जाने के साथ–साथ अनुज्ञा निरस्त करने की नियमानुसार कार्यवाही की जायेगी।

6. मूल नियमावली में इस नियमवली में संलग्न प्रपत्र एच–1 एवं प्रपत्र एच–2 जोड़ दिये जायेंगे।

आज्ञा से,

(डा० मेहरबान सिंह बिष्ट)
अपर सचिव

उत्तराखण्ड शासन
औद्योगिक विकास (खनन) अनुभाग–1
संख्याः 910 /VII-A-1/2021/03(46)/2021
देहरादून, दिनांकः 24 अगस्त, 2021

–कार्यालय ज्ञाप–

उत्तराखण्ड खनिज (अवैध खनन, परिवहन एवं भण्डारण का निवारण) (संशोधित) नियमावली 2021 के के नियम 9क के प्रावधानों के अन्तर्गत निदेशक, भूतत्व एवं खनिकर्म इकाई उत्तराखण्ड के पत्र सं0–643/ खनन/ भू0खनि0ई0/रे0वि0नि0/2021–22, दिनांक 07 जून, 2021 द्वारा उपलब्ध कराये गये प्रस्ताव के क्रम में ऋषिकेश–कर्णप्रयाग रेल लाईन परियोजना के पैकेज–7 बी के टनल–13 पी–2, स्केप टनल टी–13 पी–2 एवं ऐडिट–7 के अन्तर्गत ग्राम तिलणी तहसील व जनपद रूद्रप्रयाग में डम्पिंग यार्ड डी–28 (तिलणी डम्पिंग यार्ड) में भण्डारित होने वाले मक में से 3,06,550 घनमीटर उपयोगी मक अर्थात् छोटे–छोटे पत्थर के टुकड़े/बोल्डर्स आदि, जिसका उपयोग आवेदक द्वारा स्थापित किये जाने वाले स्टोन क्रेशर एवं निर्माण कार्यों में किया जाना है, की निकासी हेतु रेल विकास निगम लि० के अनुबन्धित ठेकेदार मेघा इंजीनियररिंग एंड इंफ्रास्ट्रक्चर्स लि0 ग्राम व पोस्ट सुमेरपुर, जनपद रूद्रप्रयाग के पक्ष में 05 वर्ष अथवा परियोजना अवधि, जो भी न्यून हो, तक की अवधि हेतु, निम्नलिखित शर्तो के अधीन स्वीकृत किये जाने की अनुमति प्रदान की जाती है :–

1. तकनीकी दल द्वारा किसी भी टनल से निकासी किये गये उपखनिज (Muck) की कुल मात्रा में से उपयोगार्थ उपखनिज की आगणित/सत्यापित मापन मात्रा, संबंधित टनल निर्माण के उपरान्त स्वीकृत मात्रा से कम अथवा अधिक पाये जाने पर, कम अथवा अधिक पाये जाने वाली मात्रा पर देय रायल्टी का समायोजन/भुगतान किया जायेगा।
2. रेल विकास निगम लि0 द्वारा अनुबन्धित ठेकेदार/अनुज्ञाधारक मेघा इंजीनियररिंग एंड इंफ्रास्ट्रक्चर्स लि0 ग्राम व पोस्ट सुमेरपुर, जनपद रूद्रप्रयाग द्वारा रायल्टी धनराशि एवं अन्य देयों का त्रैमासिक किश्तों में विभागीय लेखाशीर्षक में अग्रिम जमा कर निकासी की जायेगी। यदि उस त्रैमास में जमा धनराशि से अधिक निकासी करता है, तो आगामी त्रैमास की धनराशि जमा कर निकासी प्राप्त की जा सकती है।
3. अनुज्ञाधारक द्वारा स्वीकृत स्थल से उपखनिज की निकासी/उपयोग हेतु विभागीय ई–रवन्ना पोर्टल पर पंजीकरण कराया जाना अनिवार्य होगा।
4. पैकेज–7 बी के टनल–13 पी–2, स्केप टनल टी–13 पी–2 एवं ऐडिट–7 के विभिन्न संकियाओं से निकलने वाले 3,06,550 घनमीटर उपयोगी मक आवेदक द्वारा स्थापित किये जाने वाले स्टोन क्रेशर एवं अन्य निमार्ण कार्य में उपयोग किया जायेगा। उपयोगी मक की मात्रा में बढोतरी होने की दशा में उपयोगी मक का उपयोग आर0वी0एन0एल0 द्वारा भरान के रूप में उपयोग की जायेगी।
5. अनुज्ञाधारक द्वारा टनल से निकले मक का उपयोग ऋषिकेश–कर्णप्रयाग रेल लाईन परियोजना निर्माण कार्य में ही किया जायेगा तथा उक्त अन्यत्र उपयोग/प्रेषण प्रतिबन्धित रहेगा।
6. अनुज्ञाधारक के द्वारा गठित समिति द्वारा आगणित रॉयल्टी की धनराशि ₹ 11,92,47,950/–(₹ ग्यारह करोड़ बानबे लाख सैंतालीस हजार नौ सौ पचास मात्र) एवं क्षतिपूर्ति–रायल्टी का 15 प्रतिशत ₹ 1,78,87,192.5/– (₹ एक करोड़ अठहत्तर लाख सतासी हजार एक सौ बानबे मात्र) निर्धारित विभागीय लेखाशीर्षक 0853 में, स्टाम्प शुल्क–रायल्टी का 2 प्रतिशत ₹ 23,84,959/– (रू0 तेईस लाख चौरासी हजार नौ सौ उनसठ मात्र) सम्बन्धित लेखाशीर्षक में एवं जिला खनिज फाउन्डेशन में अंशदान–रायल्टी का 25 प्रतिशत ₹ 2,98,11,987.5/– (रू0 दो करोड़ अट्ठानबे लाख ग्यारह हजार नौ सौ

–2

सत्तासी मात्र) जनपद के डी0एम0एफ0 के खाता सं0–72131021000007 (बैंक ऑफ इण्डिया, भानधार रूद्रप्रयाग) में जमा किया जायेगा।

7. उत्तराखण्ड खनिज (अवैध खनन, परिवहन एवं भण्डारण) (संशोधन) नियमावली, 2021 के नियम 11(11) के अनुसार "रेल लाईन परियोजना की कार्यदायी संस्था रेल विकास परियोजना लिमिटेड/रेल विकास परियोजना लिमिटेड द्वारा अनुबन्धित ठेकेदार के द्वारा टनल से निकले मक का उपयोग ऋषिकेश–कर्णप्रयाग रेल लाईन परियोजना निर्माण कार्य में ही किया जायेगा। रेल विकास निगम लिमिटेड/ अधिकृत कॉन्ट्रेक्टर्स के द्वारा टनल से निकले मक का उपयोग अन्यत्र किये जाने की पुष्टि होने पर नियम 13(5)(ख) के अनुसार कार्यवाही करते हुए ₹ 1.00 करोड़ (₹ एक करोड़) की अतिरिक्त धनराशि वसूल किये जाने के साथ–साथ अनुज्ञा निरस्त किये जाने नियमानुसार कार्यवाही की जायेगी"।
8. प्रचलित अधिनियम/नीति/नियमावली एवं समय–समय पर राज्य सरकार एवं केन्द्र सरकार द्वारा निर्गत शासनादेशों का अनुपालन किया जायेगा।
9. मा0 उच्चतम न्यायालय, मा0 उच्च न्यायालय एवं एन0जी0टी0 द्वारा समय–समय पर पारित आदेशों का अनुपालन किया जाना होगा।
10. तकनीकी समिति की संयुक्त निरीक्षण आख्या में उल्लिखित समस्त शर्तों/प्रतिबन्धों का अनुपालन किया जाना होगा।
11. अनुज्ञाधारक द्वारा ई–रवन्ना प्रपत्र सम्बन्धित स्टोन केशर के लिए ही जारी किया जाना अपरिहार्य होगा। अन्यत्र स्थान हेतु जारी ई–रवन्ना प्रपत्र अवैध परिवहन की श्रेणी में आयेगा।
12. डम्पिंग यार्ड की क्षमता एवं उपयोग का मूल्यांकन समय–समय पर जिला प्रशासन, तकनीकी समिति द्वारा किया जायेगा।
13. अनुज्ञाधारक द्वारा अधिकृत किये जाने वाला अधिकार पत्र निदेशक, भूतत्व एवं खनिकर्म इकाई एवं जिला खान अधिकारी, रूद्रप्रयाग को प्रस्तुत किया जाना होगा।

(एन.एस.डुंगरियाल)
संयुक्त सचिव

संख्याः 910 (1)/VII-A-1/2021–03(46)/2021 तद्दिनांकित।

प्रतिलिपि निम्नलिखित को सूचनार्थ एवं आवश्यक कार्यवाही हेतु प्रेषितः–

1. निदेशक, भूतत्व एवं खनिकर्म इकाई, उत्तराखण्ड देहरादून।
2. जिलाधिकारी रूद्रप्रयाग।
3. मैसर्स मेघा इंजीनियरिंग एण्ड इन्फ्रास्ट्रक्चर लिमिटेड, जनपद रूद्रप्रयाग।
4. गार्ड फाईल।

आज्ञा से,

(दिनेश सिंह भण्डारी)
अनु सचिव।

meil

Megha Engineering & Infrastructures Ltd.

An ISO 9001-2015 Company

S-2, Technocrat Indl. Estate, Balanagar, Hyderabad-500037, Telangana, INDIA
Tel: +91-40-44336700 Fax: +91-40-44336800
E-mail: info@meil.in Visit us: www.meil.in U45202TG2006PLC050271

CERTIFIED TRUE COPY OF RESOLUTION PASSED BY THE BOARD OF DIRECTORS OF MEGHA ENGINEERING & INFRASTRUCTURES LIMITED ("COMPANY") IN THE MEETING HELD ON SATURDAY 26TH MARCH 2022 AT 12.15 P.M. AT S-2, T.I.E, BALA NAGAR, HYDERABAD, TELANGANA -500 037

Chairman informed the Board that the Company is required to appear before courts and tribunals in respect of the cases filed by it and against it; as such a competent person is to be appointed on behalf of Company to perform all these functions. Earlier Board authorised Mr. T. Ashok Reddy to represent the company in all legal matters. He was further apprised that for operational convenience, it was proposed to nominate and appoint Mr.T. Ashok Reddy, Vice president and also Mr.Kalvakolanu Somaraju, General Manager severally for the purpose of signing all the documents required before the court of law and to represent the company in all legal matters on behalf of the Company. Upon deliberations, Board passed the following resolution in this regard.

TO AUTHORIZE MR.T. ASHOK REDDY, VICE PRESIDENT OF THE COMPANY AND MR. KALVAKOLANU SOMARAJU, GENERAL MANAGER OF THE COMPANY AS THE REPRESENTATIVE AND AUTHORIZED SIGNATORY OF THE COMPANY IN ALL LEGAL MATTERS OF THE COMPANY

"RESOLVED THAT Mr.Talasani Ashok Reddy (Aadhar No.6217 2535 2441), Vice President of the Company and Mr.Kalvakolanu Somaraju (Aadhar No. 4385 5927 1523), General Manager of the Company, be and are hereby severally authorized by the Board:

a) to represent the Company in all the legal matters, cases, quasi–judicial, proceedings filed by or against the Company before all Courts, Tribunals (including but not limited to NCLTs, NCLATs, DRTs, NGTs etc.), all appellate Tribunals, Boards, district consumer forums, State Commissions/Forums & National Consumer Disputes Redressal Commission, MSEFCs, all authorities, quasi judicial Authorities, Revenue Authorities and all other forums in India;

b) to file any suit, petitions including Special Leave Petitions, affidavits, appeal, revision, reference, memo's, claims, application including copy applications, written statement and other pleadings, proceedings, documents to the court,

c) to deposit, withdraw and receive documents and any money, moneys from the Court, from the opposite Party either in execution of the decree, otherwise before any court, authority on behalf of the Company,

d) to sign and verify all plaints or petitions, applications, petitions, applications, written statements, counter, memo, vakalat, memo of appearance, any other pleadings on behalf of the Company,

e) to settle, adjust, compromise, compound, withdraw any suit, proceedings, actions, claims, demands or proceedings before any court, quasi-judicial authority, Tribunal and other authority;

Certified True Copy
For Megha Engineering & Infrastructures Limited

N. Chandra Kala
Company Secretary
M.No.A32377

Megha Engineering & Infrastructures Limited HYD.

meil

Megha Engineering & Infrastructures Ltd.

An ISO 9001-2015 Company

S-2, Technocrat Indl. Estate, Balanagar, Hyderabad-500037, Telangana, INDIA
Tel: +91-40-44336700 Fax: +91-40-44336800
E-mail: info@meil.in Visit us: www.meil.in U45202TG2006PLC050271

f) submit to lawful domestic and international arbitration required claims and disputes as per conditions of contracts signed by company; to sign all related documents, to defend the arbitrations on behalf of the company, to settle the disputes and claims under arbitration in the best interest of company, if require.

g) to appear, defend the Company and to adduce evidence on behalf of the Company.

h) to submit necessary letters, applications, memos, petitions and requests etc. relating to legal issues of the company, company's immovable properties to the concerned authorities, local bodies, quasi-judicial authorities; to give replies to all statutory and legal notices and to perform all other related acts and deeds.

i) to sign and present documents for registration, produce documents impounding before judicial, quasi-judicial, tribunal, any authority, to receive the original documents; apply for certified copies.

j) to lodge complaints before police stations, judicial, quasi-judicial, other authorities and to represent in all such matters of the company before police stations and criminal courts.

k) To appoint and remove the legal counsels, advocates in all areas of India, to negotiate and fix their fees and other costs.

l) To authorize competent persons and sub-delegate any of the powers/authorities mentioned above at their discretion.

RESOLVED FURTHER THAT the certified true copy of this resolution duly signed by any of the Director or Company Secretary of the Company be furnished to the concerned authorities for their necessary action and record."

//Certified true copy//

For Megha Engineering & Infrastructures Limited

Engineering & Infrastructures Limited HYD.

Venkata Krishna Reddy Puritipati
Managing Director
DIN-01815061

Certified True Copy
For Megha Engineering & Infrastructures Limited

N. Chandra Kala
Company Secretary
M.No.A32377

IN THE NATIONAL GREEN TRIBUNAL, PRINCIPAL BENCH, NEW DELHI

ORIGINAL APPLICATION NO. 44 OF 2024

IN THE MATTER OF:

Jot Singh Bist ...PETITIONER

versus

State of Uttarakhand & Ors. ...RESPONDENT

KNOW ALL to whom these presents shall come that I/We T. ASHOK REDDY Rep. by Megha Engineering & Infrastructures Ltd, Hyderabad (Resp. 5).

The above name does hereby appoint:

ALPHA LEGAL CONSULTANTS
C-53, JANGPURA EXTENSION, NEW DELHI-110014
CONTACT NO 9988799877, EMAIL: adv.varunchugh@gmail.com

Varun Chugh	**Shagun Shahi Chugh**	**Shreya Mittal**	**Sidhrah Jami**
D/4294/2019	**PH/4181/2019**	**D/3861/2019**	**D/8108/2021**
Vishal Kumar Chandel		**Lovely Singh**	**Ipshita**
UP/00743/2020		**UP/04091/2020**	**UP/ 09606/17**

To be my/our Advocate in the above noted case and authorized him:-
To act, appear and plead in the above-noted case in this Court or in any other Court in which the same may be tried or heard and also in the Appellate Court including High Court subject to payment of fees separately for each Tribunal/ Court by me/ us.
To sign, file verify and present pleadings, appeals cross objections or petitions for execution review, revision, withdrawal, compromise or other petitions or affidavits or other documents as may be deemed necessary or proper for the prosecution of the said case in all its stages.
To file and take back documents to admit and/or deny the documents of opposite party.
To withdraw or compromise the said case or submit to arbitration any differences or disputes that may arise touching or in any manner relating to the said case. To take execution proceedings.
The deposit, draw and receive money, cheques, cash and grant receipts thereof and to do all other acts and things which may be necessary to be done for the progress and in the course of the prosecution of the said case. To appoint and instruct any other Legal Practitioner, authorizing him to exercise the power and authority hereby conferred upon the Advocate whenever he may think it to do so and to sign the Power of Attorney on our behalf.
And I/We the undersigned do hereby agree to ratify and confirm all acts done by the Advocate or his substitute in the matter as my/our own acts, as if done by me/us to all intents and purposes.
And I/We undertake that I / we or my /our duly authorized agent would appear in the Court on all hearings and will inform the Advocates for appearance when the case is called.
And I /we undersigned do hereby agree not to hold the advocate or his substitute responsible for the result of the said case. The adjournment costs whenever ordered by the Court shall be of the Advocate which he shall receive and retain himself.
And I /we the undersigned do hereby agree that in the event of the whole or part of the fee agreed by me/us to be paid to the Advocate remaining unpaid he shall be entitled to withdraw from the prosecution of the said case until the same is paid up. The fee settled is only for the above case and above Court.
I/We hereby agree that once the fee is paid. I /we will not be entitled for the refund of the same in any case whatsoever. If the case lasts for more than three years, the advocate shall be entitled for additional fee equivalent to half of the agreed fee for every addition three years or part thereof.

NOTARY ★ GOVT. OF INDIA ★ RENU AGRAWAL Delhi Regd. No. 17816

Megha Engineering & Infrastructures Ltd.

IN WITNESS WHEREOF I/We do hereunto set my /our hand to these presents contents of which have been understood by me/us on this New Delhi 17 AUG 2024 day of _____ 2024.
Accepted subject to the terms of fees.

Advocate

D/3861/19

UP/00743/20.

UP/09606/17.

NOTARY GOVT. OF INDIA RENU AGARWAL Delhi Regd. No. 17806

17 AUG 2024 ATTESTED NOTARY PUBLIC (INDIA)

Megha Engineering & Infrastructures Ltd. S-2, TIE, Balanagar, Hyderabad-37.

Client