BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL,

PRINCIPAL BENCH, NEW DELHI

Original Application No. 751/2024

In the Matter of: -

Abhisht Kusum Gupta ... Applicant

Vs.

State of Uttarakhand & Ors. ---Respondents

NDOH: 30.01.2025

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4.	**Annexure C**: Compliance Report by Secretary, Uttarakhand Government, Drinking Water and Sanitation on Dated- 06.12.2024	
5.	**Annexure D**: Compliance Report by the Additional Chief Executive Officer, Kedarnath Development Authority, Rudraprayag on Dated- 10.01.2025	

Filed By

Deepak Bora

Counsel for the State of Uttarakhand

17, New lawyers Chambers,

Setalvad Block, Supreme Court of India,
New Delhi-110001

Email-advdeepakbora@gmail.com

Mobile No. 9971578987

BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL,

PRINCIPAL BENCH, NEW DELHI

Original Application No. 751/2024

In the Matter of: -

Abhisht Kusum Gupta ... Applicant

Vs.

State of Uttarakhand & Ors. ...Respondents

Status Report by the way of an Affidavit on behalf of Respondent No-1 State of Uttarakhand in order dated- 04.10.2024

NOTARIAL NOTARIAL NOTARY Yuvraj Joshi Advocate Notary R.N. -10/07/2022 Basukedar Rudraprayag NOTARIAL NOTARIAL Govt of Uttarakhand

The deponent, Saurabh Gaharwar, presently holding the position of District Magistrate, Rudraprayag, Uttarakhand, do hereby solemnly affirm and state as follows:

1. That the deponent is the District Magistrate of Rudraprayag, Uttarakhand, and in this capacity, he is fully aware of the facts and circumstances of the present case based on official records, and has been authorised by Secretary, Uttarakhand Government, Drinking Water and Sanitation Section-1, Dehradun, vide office letter number-1032/74369/2024 dated 06 December, 2024 to file the affidavit in the Hon'ble Authority on the behalf Respondent No-1 (State of Uttarakhand) within the stipulated time, and as such is competent to depose this affidavit.

Saurabh Gaharwar
District Magistrate
Rudraprayag

2. That this affidavit is being filed in compliance with the directions of the Hon'ble National Green Tribunal, New Delhi, in the order dated 04.10.2024, in Original Application No. 751/2024, titled Abhisht Kusum Gupta vs State of Uttarakhand & Ors.

3. That the Hon'ble Tribunal in its order dated 04.10.2024 directed Respondent No-1 State of Uttarakhand to file an affidavit indicating the timeline for providing proper sewage treatment with on adequate capacity and solid waste management facilities in Kedarnath and for implementing suggestions made by the joint committee and also directed that before the next season, soak pits should be properly maintained and 100% connectivity through sewage system to 600 KLD STP be ensured. It was specifically mentioned in paragraph No. 13 of the said order as follows :-

> *"13. Hence, we direct respondent no.1-State of Uttarakhand to file an affidavit indicating the timeline for providing proper sewage treatment with on adequate capacity and solid waste management facilities in Kedarnath and for implementing suggestions made by the joint committee. We also direct that before the next season, soak pits should be properly maintained and 100% connectivity through sewage system to 600 KLD STP be ensured. Let the affidavit to this effect be filed within a period of six weeks."*

4. That pursuant to the said order, a meeting was called by the Director General, Government of India, Ministry of Jal Shakti, Department of Water Resources, River Development and Ganga Rejuvenation. National Mission for Clean Ganga, New Delhi on 11-11-2024 through hybrid mode, the briefs of the said meeting have been made available by the letter Pr- 12011/17/2017-O/

NOTARY
Yuvraj Joshi
Advocate/Notary
R.N. - 10/07/2022
Basukedar
Rudraprayag
Govt. of Uttarakhand

District Magistrate
Rudraprayag

Dir (T-III) NMCG dated 13.11.2024 of the Director (Technical), NMCG, New Delhi. The copy of same is annexed here with and marked as **Annexure A.**

5. That in pursuance to instructions in Minutes of Meeting of Director General, Government of India, Ministry of Jal Shakti, Department of Water Resources, River Development and Ganga Rejuvenation. NMCG, New Delhi, directions were issued to conduct a field inspection through the concerned departmental representatives through office letter number-640(1)/33-34(2023-24) dated November 18, 2024 and to provide the joint inspection report. The copy of same is annexed here with and marked as **Annexure B.**

6. That Secretary, Uttarakhand Government, Drinking Water and Sanitation Section-1, Dehradun, by office letter number-1032/74369/2024 dated 06 December, 2024, in the original application number-751/2024, has authorized undersigned to coordinate with all the departments related to the case (Urban Development Department, Tourism Department, Public Works Department, Drinking Water Department, Environmental Protection Department, Pollution Control Board, State Clean Ganga Mission (Namami Gange), Indian Institute of Technology, Roorkee (IIT) and National Institute of Urban Affairs) and consolidate the implementation report and file the affidavit in the Hon'ble Authority within the stipulated time. The copy of same is annexed here with and marked as **Annexure C.**

NOTARY
Yuvraj Joshi
Advocate/Notary
R.N. -10/07/2022
Basukedar
Rudraprayag
Govt. of Uttarakhand

District Magistrate
Rudraprayag

7. That the Additional Chief Executive Officer, Kedarnath Development Authority, Rudra Prayag has provided the joint inspection report related to the above case through his office letter number-772/KDA/2024-25 dated January 10, 2025. The copy of same is annexed here with and marked as **Annexure D.**

8. That the concerned departments have ensured timely submission of all relevant reports and compliance documents as directed by the Hon'ble Tribunal and as required by the law, detailing the actions taken and progress made to prevent any further environmental damage.

9. That the contents of this affidavit are true and correct to the best of knowledge, based on official records and personal information. No part of this affidavit is false, and nothing has been concealed.

DEPONENT

NOTARY
Yuvraj Joshi
Advocate/Notary
R.N. -10(07)/2022
Basukedar
Rudraprayag
Govt. of Uttarakhand

Attested By
Yuvraj Joshi 21.1.25
Advocate/Notary
R.N - UK-10(07)/2022
Basukedar
Distt Rudraprayag

District Magistrate
Rudraprayag

District Magistrate
Rudraprayag

VERIFICATION

Verified at Rudraprayag, on this 21th day of January 2025, that the contents of the above affidavit are true and correct to the best of my knowledge and belief, based on the official records maintained by my office and other relevant authorities.

DEPONENT

(Saurabh Gaharwar)
District Magistrate,
Rudraprayag, Uttarakhand

District Magistrate
Rudraprayag

NOTARY
Yuvraj Joshi
Advocate/Notary
R.N. -10(07)/2022
Basukedar
Rudraprayag
Govt. of Uttarakhand

Attested By
21-1-25
Yuvraj Joshi
Advocate/Notary
R.N - UK-10(07)/2022
Basukedar
Distt Rudraprayag

No. Pr-12011/17/2017 - O/o Dir (T-III) NMCG
भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन, नदी विकास एवं गंगा संरक्षण विभाग
राष्ट्रीय स्वच्छ गंगा मिशन
****

पहली मंजिल, मेजर ध्यान चंद नेशनल स्टेडियम,
निकट इंडिया गेट, नई दिल्ली – 110002,

दिनांक: 13.11. 2024

Subject: Record of Discussion (RoD) to discuss the response to the Hon'ble NGT order dated 04.10.2024 in OA No. 751/2024 Abhisht Kusum Gupta V/s State of Uttarakhand held on 11.11.2024 at 11.00 AM on Hybrid mode.

A copy of Record of Discussion (RoD) of the meeting dated 11th November 2024 under the Chairmanship of Director General, NMCG in the Hon'ble NGT matter OA No. 751/2024 - Abhisht Kusum Gupta V/s State of Uttarakhand, is forwarded herewith for information / necessary actions.

2. This issues with the approval of Competent Authority, NMCG.

भवदीय,

13/11/24

(डॉ. प्रवीण कुमार)
निदेशक (तकनीकी), एनएमसीजी

Encl: As above

To,

I. Secretary, Drinking Water Department, Govt of Uttarakhand, New Building, 4th Floor, Uttarakhand Secretariat, 4, Subhash Rd, Dehradun-248001. (secy-dw-ua@nic.in)
II. Secretary, Urban Development Directorate, 31/62, Rajpur Rd, Indra Market, Dehradun, Uttarakhand 248001 (secynkjha@gmail.com)
III. Principal Secretary, Environment & Forest, Govt of Uttarakhand, New Building, 4th Floor, Uttarakhand Secretariat, 4, Subhash Rd, Dehradun-248001. (secy-env-ua@nic.in)
IV. Secretary, Uttarakhand Tourism Development Board. Pt. Deendayal Upadhyay Paryatan Bhawan, Near ONGC Helipad Garhi Cantt, Dehradun-248001(secyoffice.uk2003@gmail.com)
V. Program Director, SPMG Uttarakhand, – 117 Indira Nagar, Dehradun -248001. (spmgngrba.utk01@gmail.com)

जिला अधिकारी कार्यालय रुद्रप्रयाग

VI. District Magistrate Rudraprayag, 8242+8QQ, Chopta Pokhari Road, Rudraprayag, Uttarakhand 246171 (dmrudraprayag@gmail.com)

VII. Member Secretary, Uttarakhand Pollution Control Board (UKPCB) Gaura Devi Paryavaran Bhawan,46 B IT Park, Sehstradhara Road,Dehradun -248001. (msukpcb@yahoo.com)

VIII. Engineer in Chief, Public Works Department, 29, Yamuna Colony Road Yamuna Colony, Yamuna Colony Road, Yamuna Colony, Khurbura Mohalla, Dehradun – 248001 (einc.ukpwd@gmail.com, cepwdua@gmail.com)

For Internal Distribution:

PS to DG/ ED (P)/ED(T), NMCG

Record of Discussion (RoD) held on 11.11.2024 at 11.00 AM under the Chairmanship of DG, NMCG

A meeting was held with the officials of Uttarakhand on 11.11.2024 at 11.00 AM under the Chairmanship of Director General NMCG for discussion regarding the Hon'ble NGT Matter OA No. 751/2024 - Abhishit Kusum Gupta vs. State of Uttarakhand. The list of participants present in the meeting is at ***Annexure I.***

Actionable points discussed in the meeting are as follows: -

1. **Sewage management:**
   a) A detailed assessment of wastewater generation at Kedarnath Island area is required, especially during peak season, to determine whether the 600 KLD STP under construction is adequate especially in view of the number (peak) quoted by joint committee before NGT. The same may also be corroborated by Tourism Department of Uttarakhand.
   b) The report may include the liquid waste management for Tent area (outside Kedarnath Island) also.

[Action: DM, Rudraprayag/ Tourism Dept. UK]

2. **Solid Waste Management:** Similarly, the report should also include solid waste generation at Kedarnath Island area & along trekking route and waste management options being adopted by the State Government including relevant details of the waste management facilities.

[Action: DM, Rudraprayag/ Urban Development Dept. UK]

3. It was decided in the meeting that there is need to deal the solid waste management issue in a more comprehensive manner and hence state may engage the experts from NIUA (National Institute of Urban Affairs) and IIT Roorkee to assess and prepare the comprehensive waste management plan. NMCG may facilitate the joint meeting of state officials, NIUA and IIT Roorkee.

[Action: NMCG]

4. **Construction and Demolition (C&D) Waste:** Details regarding the quantity of C&D waste generated & disposed-off and time lines/agency responsible for disposing remaining debris in Kedarnath should be included in the report to be submitted to the NMCG.

[Action: DM, Rudraprayag/ UKPCB]

5. **Report Submission:** The detailed report may be submitted to NMCG by 2nd December 2024. The State's report may also include other initiatives taken by the State in managing the environmental challenges in Kedarnath.

[Action: DM, Rudraprayag/ Tourism Dept./Urban Development Dept./Environment Dept.]

The meeting ended with thanks to the Chair.

****

Annexure 1

List of Attendees

From NMCG;

S. No.	Name	Designation
1.	Shri Rajeev Kumar Mital	Director General
2.	Shri. Brijendra Swaroop	Executive Director (Projects)
3.	Shri. Anup Kumar Srivastava	Executive Director (Technical)
4.	Dr. Pravin Kumar	Director (Technical)
5.	Shri Narender Kumar Madan	Senior Monitoring Expert
6.	Shri Mahender Singh	Monitoring Expert
7.	Shri Ishwer Singh	Consultant Legal
8.	Shri Vishal Garg	Institutional Associate

From Uttrakhand:

S. No.	Name	Designation
1.	Shri Shailesh Bagauli	Secretary, DW & Sanitation
2.	Shri Nitesh Kumar Jha	Secretary UD
3.	Shri R.K. Sudhanshu	Principal Secretary, Env.& Forest
4.	Shri Sachin Kurve	Secretary, Tourism
5.	Shri Ranvir Singh Chauhan	PD SPMG UK
6.	Dr. Saurabh Gahaewar	DM Rudraprayag
7.	Dr. Parag Madhukar	MS, UKPCB
8.	Shri Deepak Yadav	Engineer in chief, PWD

OC/M.C

No. Pr-12011/17/2017 - O/o Dir (T-III) NMCG

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन, नदी विकास एवं गंगा संरक्षण विभाग
राष्ट्रीय स्वच्छ गंगा मिशन
****

ADM 21.11.2024

पहली मंजिल, मेजर ध्यान चंद नेशनल स्टेडियम,
निकट इंडिया गेट, नई दिल्ली – 110002,

दिनांक: 20.11. 2024
21st

Subject: Record of Discussion (RoD) to the review of the Solid & Liquid Waste Management Plan Implemented at Kedarnath Dham held on 14.11.2024 at 3:30 PM in NMCG office New Delhi on Hybrid mode.

A copy of Record of Discussion (RoD) of the meeting dated 14th November 2024 under the Chairmanship of Executive Director Projects, NMCG for the review of Solid & Liquid Waste Management Plan Implemented at Kedarnath, Uttarakhand, is forwarded herewith for information / necessary actions.

2. This issues with the approval of Competent Authority, NMCG.

भवदीय,

Pravin 21/11/24

Encl: As above

(डॉ. प्रवीण कुमार)
निदेशक (तकनीकी), एनएमसीजी

To,

I. District Magistrate Rudraprayag, 8242+8QQ, Chopta Pokhari Road, Rudraprayag, Uttarakhand 246171 (dmrudraprayag@gmail.com)
II. Program Director, SPMG Uttarakhand, – 117 Indira Nagar, Dehradun -248001. (spmgngrba.utk01@gmail.com)
III. Dr. Absar Ahmad Kazmi, Department of Civil Engineering Indian Institute of Technology, Roorkee - 247 667 (absar.kazmi@ce.iitr.ac.in)
IV. Dr. Victor Rana Shinde, National Institute of Urban Affairs, 1st & 2nd Floor, Core 4B, India Habitat Center, Lodhi Rd, Institutional Area, Lodi Colony, New Delhi, Delhi 110003 (vshinde@niua.org)
V. Engineer in Chief, Public Works Department, 29, Yamuna Colony Road Yamuna Colony, Yamuna Colony Road, Yamuna Colony, Khurbura Mohalla, Dehradun – 248001 (einc.ukpwd@gmail.com, cepwdua@gmail.com)
VI. General Manager, Construction Circle (Ganga), UKPJN, Jagjeetpur, Post-Kankhal, Haridwar-249408(gmgangahw@gmail.com)

For Internal Distribution:
PS to DG/ ED (P)/ED(T), NMCG

कार्यालय जिला अधिकारी रुद्रप्रयाग

Record of Discussion (RoD) held on 14.11.2024 at 3:30 AM under the Chairmanship of Executive Director Projects, NMCG

In compliance to the RoD dated 11.11.2014 **(copy enclosed)**, a meeting was held on 14.11.2024 at 11.00 AM under the Chairmanship of Executive Director Projects, NMCG with the Uttarakhand State officials and Institutional experts of Indian Institute of Technology, Roorkee (IITR), Uttarakhand and National Institute of Urban Affairs (NIUA), New Delhi with regard to liquid and solid waste management plan in Kedarnath Dham. The list of participants present in the meeting is at ***Annexure I.***

Points discussed in the meeting are as follows: -

1. State briefed about the proposed plan for Liquid and Solid Waste Management Plan in Kedarnath Dham to the experts of institutes. The directions of Hon'ble NGT order dated 04.10.2024 in OA No. 751/2024 - Abhisht Kusum Gupta V/s State of Uttarakhand and reports of State were also briefed. Institutes (IIT Roorkee and NIUA) shall review the State's plan, conduct site visits and prepare a comprehensive waste management plan/report. State has to directly connected with the institutes in this regard.

[Action: DM, Rudraprayag / IIT Roorkee/NIUA/ SMCG UK]

2. State administration will share the final vetted comprehensive report with NMCG.

[Action: DM, Rudraprayag/ SMCG UK]

The meeting ended with thanks to the Chair.

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कार्यालय जिला अधिकारी रुद्रप्रयाग

Annexure 1

List of Attendees

From NMCG;

S. No.	Name	Designation
1.	Shri. Brijendra Swaroop	Executive Director (Projects)
2.	Dr. Pravin Kumar	Director (Technical)
3.	Shri Mahender Singh	Monitoring Expert

From Uttrakhand:

S. No.	Name	Designation
1.	Shri Yogender Singh	CEO, Kedarnath Development Authority on behalf of DM, Rudraprayag
2.	Shri Rajesh Sharma	Chief Engineer on behalf of Engineer in Chief, PWD
3.	Shri Ravi Panday	Superintending Engineer, UDD
4.	Dr. Absar Ahmad Kazmi	Prof. Deptt. of Civil Engineering, IIT Roorkee
5.	Dr. Victor Rana Shinde	Head, NIUA New Delhi
6.	Shri Akashy Kumar	Environmental Expert, SMCG UK
7.	Shri R.K Jain	GM, Ganga, UKPJN
8.	Shri Sanjay Singh	Chief Engineer, UKPJN
9.	Shri Manish Semwal	Superintending Engineer, UJS

प्रेषक,

//एन.जी.टी. प्रकरण//

जिलाधिकारी,
रूद्रप्रयाग।

सेवा में,

1– कार्यक्रम निदेशक, राज्य स्वच्छ गंगा मिशन, नमामि गंगे, उत्तराखण्ड–देहरादून।
2– अपर निदेशक, शहरी विकास निदेशालय, उत्तराखण्ड–देहरादून।
3– अपर मुख्य कार्यकारी अधिकारी, केदारनाथ विकास प्राधिकरण, रूद्रप्रयाग।
4– जिला पर्यटन विकास अधिकारी, रूद्रप्रयाग।
5– अधिशासी अधिकारी, निर्माण खण्ड, लो0नि0वि0, गुप्तकाशी।
6– परियोजना प्रबन्धक, निर्माण एवं अनुरक्षण इकाई (गंगा), उत्तराखण्ड पेयजल निगम, श्रीनगर गढ़वाल।
7– अधिशासी अधिकारी, नगर पंचायत, केदारनाथ।

संख्या– 6400/33–34 (2023–24) दिनांक नवम्बर, 18 ,2024

विषयः– मा0 राष्ट्रीय हरित प्राधिकरण, नई दिल्ली में योजित मूल आवेदन संख्या–751/2024 Abhisht Kusum Gupta Vs State of Uttrakhand & Ors. के संबंध में।

महोदय,

कृपया उपरोक्त विषयक मा0 राष्ट्रीय हरित अधिकरण, नई दिल्ली में योजित मूल आवेदन संख्या–751/2024 Abhisht Kusum Gupta Vs State of Uttrakhand & Ors. का संदर्भ ग्रहण करने का कष्ट करें।

मा0 प्राधिकरण द्वारा उक्त मामले में दिनांक 04.10.2024 को पारित आदेश के क्रम में महानिदेशक, भारत सरकार, जल शक्ति मंत्रालय, जल संसाधन, नदी विकास एवं गंगा संरक्षण विभाग, राष्ट्रीय स्वच्छ गंगा मिशन, नई दिल्ली द्वारा दिनांक 11.11.2024 को हाईब्रिड मोड के माध्यम से बैठक आहूत की गयी।

निदेशक (तकनीकी), एनएमसीजी, नई दिल्ली द्वारा पत्र Pr-12011/17/2017 – O/o Dir (T-III) NMCG दिनांक 13.11.2024 के द्वारा बैठक का कार्यवृत्त उपलब्ध कराया गया है।

अतः उपरोक्त बैठक के कार्यवृत्त में दिये गये निर्देशों/बिन्दुओं के संबंध में विभागीय प्रतिनिधि के माध्यम से स्थलीय निरीक्षण करते हुए संयुक्त निरीक्षण आख्या अपर मुख्य कार्यकारी अधिकारी, केदारनाथ विकास प्राधिकरण, रूद्रप्रयाग के माध्यम से अधोहस्ताक्षरी को उपलब्ध कराने का कष्ट करें।

संलग्न–

1)– पत्र Pr-12011/17/2017 – O/o Dir (T-III) NMCG दिनांक 13.11.2024
2)– दिनांक 11.11.2024 को आहूत बैठक का कार्यवृत्त।

भवदीय,

(सौरभ गहरवार)
जिलाधिकारी,
रूद्रप्रयाग।

कार्यालय जिला अधिकारी रूद्रप्रयाग

Sender, // N.G.T. case//

District Magistrate,

Rudraprayag.

To.

1-Program Director, State Clean Ganga Mission, Namami Gange, Uttarakhand-Dehradun.

2-Additional Director, Urban Development Directorate, Uttarakhand-Dehradun.

3-Additional Chief Executive Officer, Kedarnath Development Authority, Rudraprayag.

4-District Tourism Development Officer, Rudraprayag.

5-Executive Officer, Construction Block, PWD, Guptakashi.

6-Project Manager, Construction and Maintenance Unit (Ganga), Uttarakhand Drinking Water Corporation, Srinagar Garhwal.

7-Executive Officer, Nagar Panchayat, Kedarnath.

Number- 640(1)/33-34 (2023-24) Dated- November 18, 2024

Subject- Hon'ble National Green Authority, New Delhi Original Application No.-751/2024 Abhisht Kusum Gupta Vs State of Uttrakhand & Ors. in relation to.

Sir,

Please refer the above subject matter in the context relating to Hon'ble National Green Authority, New Delhi for Original Application No.-751/2024 Abhisht Kusum Gupta Vs State of Uttrakhand & Ors

In continuation of the order passed by the Hon'ble Authority on 04.10.2024 in the said matter, a meeting was called by the Director General, Government of India, Ministry of Jal Shakti, Department of Water Resources, River Development and Ganga Rejuvenation, National Mission for Clean Ganga, New Delhi on 11.11.2024 through hybrid mode.

The minutes of the meeting have been made available by the Director (Technical), NMCG, New Delhi vide letter Pr-12011/17/2017 - O/o Dir (T-III) NMCG dated 13.11.2024.

Therefore, in relation to the instructions / points given in the minutes of the above meeting, please conduct a field inspection through the departmental representative and provide the joint inspection report to the undersigned through the Additional Chief Executive Officer, Kedarnath Development Authority, Rudraprayag.

attached-

1 Letter Pr-12011/17/2017-O/ Dir (T-III) NMCG dated 13.11.2024

2)- Minutes of the meeting convened on 11.11.2024.

Sincerely,

(Saurabh Gaharwar)

District Magistrate,

Rudra Prayag.

Reegd eNo-443/ERK
17 222 24

संख्या 1032/74369/2024

प्रेषक,

शैलेश बगौली,
सचिव,
उत्तराखण्ड शासन।

सेवा में,

जिलाधिकारी,
रूद्रप्रयाग,

oc/mc
ADM
17-12-2024

Index
Department ... Year 2023-24
Reg... No 1003
Reference ... Date 18.12.2024

पेयजल एवं स्वच्छता अनुभाग–1 **देहरादूनः दिनांकः 6 दिसम्बर, 2024**

विषयः– मा0 राष्ट्रीय हरित प्राधिकरण में योजित मूल आवेदन संख्या–751/2024" अभीष्ट कुसुम गुप्ता बनाम राज्य के सम्बन्ध में।

महोदय,

उपर्युक्त विषयक मा0 राष्ट्रीय हरित प्राधिकरण में योजित मूल आवेदन संख्या–751/2024 "अभीष्ट कुसुम गुप्ता बनाम राज्य" में मा0 प्राधिकरण द्वारा पारित आदेश दिनांक 04.10.2024 का सन्दर्भ ग्रहण करने का कष्ट करें। मा0 प्राधिकरण द्वारा दिनांक 04.10.2024 के बिन्दु संख्या–13 एवं 14 में निम्नवत् आदेश पारित किये गये हैः–

13. Hence, we direct respondent no.1-State of Uttarakhand to file an affidavit indicating the timeline for providing proper sewage treatment with on adequate capacity and solid waste management facilities in Kedarnath and for implementing suggestions made by the joint committee. We also direct that before the next season, soak pits should be properly maintained and 100% connectivity through sewage system to 600 KLD STP be ensured. Let the affidavit to this effect be filed within a period of six weeks.

14. Respondent no.3- UKPCB is also directed to place on record the action that is taken/proposed to be taken for violation of environmental norms by the local authorities in the area concerned. Let this affidavit be also filed within six weeks. List on 30.01.2025.

2. अतः इस संबंध में सम्यक् विचारोपरान्त मुझे यह कहने का निदेश हुआ है कि विषयगत योजित मूल आवेदन संख्या–751/2024 में वाद से संबंधित समस्त विभागों (शहरी विकास विभाग, पर्यटन विभाग, लोक निर्माण विभाग, पेयजल विभाग, पर्यावरण संरक्षण विभाग, प्रदूषण नियंत्रण बोर्ड, राज्य स्वच्छ गंगा मिशन(नमामि गंगे), भारतीय प्रौद्योगिकी संस्थान, रूड़की (आई0आई0टी0) तथा National Institute of Urban Affairs) से समन्वय स्थापित कर क्रियान्वयन आख्या समेकित करते हुये प्रतिशपथ पत्र निर्धारित समयान्तर्गत मा0 प्राधिकरण में योजित किये जाने हेतु आपको अधिकृत किया जाता है। इसके अतिरिक्त मूल आवेदन संख्या–751/2024 में विभागीय अधिकारियों से समन्वय स्थापित कर क्रियान्वयन आख्या/प्रतिशपथ पत्र तैयार किये जाने हेतु आपके सहयोगार्थ श्री अक्षय कुमार, पर्यावरण विशेषज्ञ राज्य स्वच्छ गंगा मिशन (नमामि गंगे) देहरादून को वाद समन्वयक (Case Coordinator) नामित किया जाता है।

भवदीय,

Signed by
Shailesh Bagauli
Date: 06-12-2024 10:32:05

(शैलेश बगौली)
सचिव।

संख्या 1032/74369/2024, तद्दिनांकित।

प्रतिलिपि, श्री **अक्षय कुमार** पर्यावरण विशेषज्ञ **को राज्य स्वच्छ गंगा मिशन (नमामि गंगे) देहरादून को सूचनार्थ एवं आवश्यक कार्यवाही हेतु प्रेषित।**

Signed by आज्ञा से,
Dhruve Mohan Singh Rana
Date: 06-12-2024 12:12:24
(डी0एम0एस0राणा)
संयुक्त सचिव।

TRANSLATED COPY

Sender,

Letter Number 1032/74369/2024

Shailesh Bagauli,

secretary,

Uttarakhand Government.

To,

District Magistrate,

Rudraprayag,

Drinking Water and Sanitation Section-1

Dehradun: December 6, 2024

Subject- Original application number-751/2024 filed with Hon'ble National Green Authority" Required in relation to Kusum Gupta vs. State.

Sir,

In the above-mentioned matter, please refer to the order dated 04.10.2024 passed by the Hon'ble Authority in the original application number-751/2024 "Abhisht Kusum Gupta vs State" filed in the Hon'ble National Green Authority. The following orders have been passed by the Hon'ble Authority in point number-13 and 14 dated 04.10.2024-

13. Hence, we direct respondent no.1-State of Uttarakhand to file an affidavit indicating the timeline for providing proper sewage treatment with on adequate capacity and solid waste management facilities in Kedarnath and for implementing suggestions made by the joint committee. We also direct that before the next season, soak pits should be properly maintained and 100% connectivity through sewage system to 600 KLD STP be ensured. Let the affidavit to this effect be filed within a period of six weeks.

14. Respondent no.3- UKPCB is also directed to place on record the action that is taken/proposed to be taken for violation of environmental norms by the local authorities in the area concerned. Let this affidavit be also filed within six weeks. List on 30.01.2025

Therefore, after due consideration in this regard, I am directed to say that in the thematic planned pool application number-751/2024, you are authorized to coordinate with all the concerned departments (Urban Development Department, Tourism Department, Public Works Department, Drinking Water Department, Environmental Protection Department, Pollution Control Board, State Clean Ganga Mission (Namami Gange), Indian Institute of Technology, Roorkee (IIT) and National Institute of Urban Affairs) and consolidate the implementation report and file the affidavit in the No. Authority within the prescribed time. Apart from this, Mr. Akshay Kumar, Environment Expert, State Clean Ganga Mission (Namami Gange), Dehradun is nominated as Case Coordinator for your assistance in preparing the implementation report/affidavit by coordinating with the departmental officers in the original application number-751/2024.

Yours sincerely,

(Shailesh Yagauli) Secretary.

Signed by Shailesh Bagauli

Date: 06-12-2024 10:32:05

So, dated. Copy, sent to Shri Akshay Kumar Environmental Specialist, State Swachh Ganga Mission (Namami Ganga), Dehradun for information and necessary action.

Signed by with permission,

Dhruve Mohan Singh Rana

Date: 06-12-2024 12:12:24

(Dr. M. S. Rana) Joint Secretary

OC/M.C

A.D.M
13-01-2025

प्रेषक,

अपर मुख्य कार्याधिकारी,
केदारनाथ विकास प्राधिकरण,
रूद्रप्रयाग।

सेवा में,

जिलाधिकारी,
रूद्रप्रयाग।

संख्या– 772 /KDA/2024–25 दिनांक जनवरी, 10 ,2025

विषयः– मा0 राष्ट्रीय हरित प्राधिकरण, नई दिल्ली में योजित मूल आवेदन संख्या–751/2024 Abhisht Kusum Gupta Vs State of Uttrakhand & Ors. के संबंध में।

महोदय,

कृपया उपरोक्त विषयक मा0 राष्ट्रीय हरित अधिकरण, नई दिल्ली में योजित मूल आवेदन संख्या–751/2024 Abhisht Kusum Gupta Vs State of Uttrakhand & Ors. से संबंधित मामले में दिनांक 04.10.2024 को पारित आदेश के क्रम में महानिदेशक, भारत सरकार, जल शक्ति मंत्रालय, जल संसाधन, नदी विकास एवं गंगा संरक्षण विभाग, राष्ट्रीय स्वच्छ गंगा मिशन, नई दिल्ली द्वारा दिनांक 11.11.2024 को हाईब्रिड मोड के माध्यम से बैठक आहूत की गयी।

उक्त बैठक के कार्यवृत्त में दिये गये निर्देशों/बिन्दुओं तथा आपके कार्यालय पत्र संख्या–640(1)/33–34 (2023–24) दिनांक 18 नवम्बर, 2024 के क्रम में संबंधित विभागीय प्रतिनिधि द्वारा दिनांक 20.12.2024 को स्थलीय निरीक्षण किया गया।

अतः संयुक्त निरीक्षण आख्या आवश्यक कार्यवाही हेतु संलग्न कर सादर प्रेषित की जा रही है।

संलग्न– संयुक्त निरीक्षण आख्या।

भवदीय,

10/1/25
(श्याम सिंह राणा)
अपर मुख्य कार्याधिकारी,
केदारनाथ विकास प्राधिकरण,
रूद्रप्रयाग।

कार्यालय जिला अधिकारी रूद्रप्रयाग

TRANSLATED COPY

Sender,

Additional Chief Executive Officer,

Kedarnath Development Authority,

Rudra Prayag.

To,

District Magistrate,

Rud Prayag.

Number-772/KDA/2024-25 dated: January, 10 2025

Subject: - Hon'ble National Green Authority, New Delhi in respect of Original Application No.-751/2024 Abhisht Kusum Gupta Vs State of Uttarakhand & Ors.

Sir,

Please note that in continuation of the order dated 04.10.2024 passed in the matter related to the above subject original application number-751/2024 Abhisht Kusum Gupta Vs State of Uttrakhand & Ors., a meeting was called on 11.11.2024 through hybrid mode by the Director General, Government of India, Ministry of Jal Shakti, Department of Water Resources, River Development and Ganga Conservation, National Mission for Clean Ganga, New Delhi.

In accordance with the instructions/points given in the minutes of the said meeting and your office letter No. 640(1)/33-34 (2023-24) dated 18 November 2024, a field inspection was conducted by the concerned departmental representative on 20.12.2024.

This is being done. Therefore, the joint inspection report has been attached and respectfully sent for necessary action.

Joint inspection report attached.

Yours sincerely,

425 (Shyam Singh Rana)

Additional Chief Executive Officer,

Kedarnath Development Authority,

Rudraprayag.

Compliance report in O.A. No. 751/2024 in Abhisht Kusum Gupta Vs State of Uttarakhand

This is in reference to the Hon'ble National Green Tribunal (NGT) order dated 04.10.2024 in O.A. No. 751/2024 Abhisht Kusum Gupta Vs State of Uttarakhand, read with National Mission for Clean Ganga letter No. Er- 12011/17/2017- Office o/dir (T-III) NMCG dt. 13.11.2024, where in detail report was asked from District Magistrate, Rudraprayag, Tourism department, Urban development department and Environment Department. In continuation of the above directions, a committee was constituted for site inspection and discussions with Professor of IIT, Roorkee.

The following committee members inspected the site on dated 20.12.2024 and discussions were held with Proff. Kazmi, IIT Roorkee.

- ACEO, KDA, Rudraprayag.
- Executive Engineer, PWD, Guptkashi
- Environment specialist, SMCG, Dehradun.
- Executive officer, Nagar Panchayat, Kedarnath
- Solid waste management consultant, Urban Development Directorate, Dehradun.
- Assistant engineer, Urban Development Directorate, Dehradun.
- District tourism development officer, Rudraprayag.
- Project manager, Jal Nigam, Srinagar.

A. Hon'ble Tribunal in order dt. 04.10.2024 has stated that

a. **Para 08:** - *The above report clearly indicates that there is no STP in Kedarnath to treat the sewage. One STP of 600 KLD is under construction and annexure C to the report states that 60% of work is over and construction of STP will be completed by December 2024. No timeline has been provided for household connection to the STP. It also needs to be ascertained that 600 KLD of STP is adequate.*

Response: -

i. Under Shri Kedarnath Dham Master plan, 84 buildings (total 862 modules) are being constructed or to be constructed in the temple island area. 04 persons per module cumulates to **3448** Residential/Permanent population. For STP design calculation, Residential/Permanent population was taken as 5000 along with 20,000 floating population. Per capita Water usage/sewage generation was taken as per National Building Code, Part-9 & Central Public Health & Environmental Engineering Organization Manual 1999. Due consideration was also given to cold climatic conditions at the Dham. Sewerage system with STP and DPR was vetted by Jamia Milia Islamia University, Delhi and CSIR-CBRI Roorkee. Copy of the vetted process design is enclosed as **Annexure-I**

ii. In the design plan, there are branching sewerage channels in 3 major regions, along Saraswati edge, Mandakini edge and in the central street

EO, Kedarnath P.M UJVN SDM/DD ADD ACEO E.E PWD

area. Out of these, as the buildings to be constructed in the Master plan are completed or are in near completion along the Mandakini edge, the sewerage channel along this edge measuring 400 meters in length has been installed. As sewerage channel laying work is possible only after development /finalisation of surroundings and plinth level around the buildings, and the building construction works as per Master plan is ongoing on Saraswati edge and in the central street area, therefore the installation work of the sewerage channel is ongoing in these two regions. Post confluence of the sewerage channels from the three regions measuring 575 meters length is near completion (80%). Due to the ineffectiveness of welding in extreme cold climatic condition, cement setting issues and low availability of skilled labours, work progress in the month of December was hampered, however efforts are being made to complete the work in due time.

iii. The construction of 600 KLD STP is 80-85% complete. The remaining works like roof work, flooring work and internal installations which was due by December 2024, have been hampered, due to extreme cold temperature, snowfall, ineffectiveness of welding in extreme cold climatic conditions, cement setting issues and low availability of skilled labours along with other causes. Despite this, efforts are being made & work is in progress in prevailing harsh climate conditions for timely completion of STP so as to complete the STP. ***Annexure-2- Photographs of the site.***

iv. The liquid waste management was designed for a population of 5000 residential and 20,000 floating population at Dham and regarding the higher numbers of pilgrims reported in the joint committee report dated August, 2024, it is to be clarified that higher numbers of pilgrims mentioned was effectively the number of pilgrims moving from Sonprayag to Kedarnath area and not more than the designed population stays at Kedarnath Dham in a given day. Further STPs (4 in number totalling 222 KLD) along with sewerage network and I&D of drains are under construction along the Kedarnath yatra trek/route at Gaurikund.

v. Currently, for pilgrims staying in the camps, 155 nos. of fixed toilets are in place based on soak pit systems. The joint committee highlighted seepage at few locations, however these have been rectified. Professor A.A. Kazmi has advised for installation of Johkasou System for management of sewage in such locations, in continuation of which proposal will be submitted for sanction/approval.

B. Para 09: - *In respect of solid waste management, the committee has found that there is no waste processing plant established in Kedarnath for the management of solid and plastic waste which is estimated to be 1.667 TPD during the season.*

(Read with)

SDM(UKD) AE UDD

जिला अधिकारी रुद्रप्रयाग

Para 10: - *The observations of the committee is that waste management facilities needs to be enhanced.*

Response

i. Currently the total solid waste generation was estimated to be 1.667 TPD and this is being managed with following resource.

1. **Status of Human Resource**
   a. Total number of Paryavaran Mitra - 190
   b. Environment Supervisor - 07
2. **Status of SWM/PWM**
   a. Solid Waste Collection Vehicle - 01 (mini tractor with trolley)
   b. Processing Facility - 01 MRF and 01 (for segregation of dry waste) Bailing machine (Photograph attached -01)
3. **Deposit Refund System (DRS) – New Initiative**
   a. Under this system all the plastic bottles of water or soft drinks are labelled with QR code. Every bottle is charged Rs. 10.00 extra on MRP. Post use the customer can deposit these bottles at multiple kiosks along the track and can get their Rs. 10.00 refunded.
   b. The initiative has engaged the local community and has promoted responsible waste disposal practices and environmental awareness.
   c. DRS Progress Status –
      i. Total QR provided on plastic bottle/tetra pack is 1,72,100.
      ii. Out of above, 1,39,838 Bottles/Tetra Pack (81%) with QR have been returned by the customers for recycling. (Photograph attached-02)

ii. **Prospective Solid Waste Management Action Plan** -

1. Solid Waste Management Action Plan/Detail Project Report costing Rs. 309.46 Lacs has been prepared and submitted to urban development (***Annexure-3)*** that includes: -
   a. For Dry Waste, Executive Officer Nagar Panchayat appraised that 01 TPD capacity Material Recovery Facility centre will be established in collaboration with the Heal Himalaya Foundation with equipments like Plastic Compactor, Shredder, Ballistic Separators, etc.
   b. For Wet waste management an Organic Waste Composter of 500 Kg per day capacity is proposed at the MRF and additional 8 Organic Waste Composters with capacity of 50 kg per day are to

be established at 08 different locations for processing of Wet Waste generated in outer periphery/tent colony. Contour map of Dham area and the plan is annexed in ***Annexure-4***

c. As per suggestions of Dr./Prof. Kazmi, IIT Roorkee verification of the performance of above proposed organic waste composter was needed with reference to low temperature areas and in continuation satisfactory performance reports issued by agencies, where these have been established have been received. ***Annexure-5***

C. Para 11: - *The joint committee during the visit found a lot of construction and demolition waste materials like iron rods/pipes and cemented broken bricks etc., lying in many places due to ongoing construction activities.*

Response: –

i. As mentioned in the 1st para, buildings and other structures are being constructed as per the Master plan in Dham area. Demolition waste materials like Iron rods, pipes and cement blocks and excavated soil are being used for back filling/foundation filling of under construction buildings and also to construct approach.

ii. In the year 2023-24, 10 old buildings were demolished, generating approximately 2400 cum of waste material, which was completely used in backfilling of Sangam Ghat, Arrival plaza and also in the foundation filling of under construction buildings.

iii. The plan of Construction agency (PWD) is to utilise all the demolition waste for backfilling in low lying areas and also to strengthen such locations. As soon as the construction will be completed, the entire C&D waste will be utilised in such locations. ***Annexure-6 (Photographs).***

(Nerraj Kumar)
Executive Officer
Nagar Panchayat,
Kedarnath

(Vinay Jhinkwan)
Executive Engineer
PWD Guptkashi

(Akshay Kumar)
Environment Specialist,
SMCG, Dehradun

(Ravinder Singh)
Project Manager
Jal Nigam
Srinagar

(Digvijay Semwal)
SWM Consultant,
Urban Development
Directorate, Dehradun

(Bharat Singh Rawat)
Assistant Engineer
Urban Development
Directorate, Dehradun

(Rahul Chaubey)
DTDO
Rudraprayag

(Shyam Singh Rana)
ACEO, KDA
Rudraprayag

जिला अधिकारी रुद्रप्रयाग

ANNEXURE-1

KEDARNATH RESTORATION AND REDEVELOPMENT
BASIC ENGINEERING PROCESS
of
SEWAGE TREATMENT PLANT (600 KLD)

CLIENT
GOVT. OF UTTRAKHAND

उत्तराखण्ड राज्य

PROJECT MANAGEMENT CONSULTANT:
INI DESIGN STUDIO

INI DESIGN STUDIO

CONTRACTOR
GAWAR CONSTRUCTIONS LTD.

STP VENDOR
AV ENGINEERING

Dr. Abid ... Khan
Princi... ...ering
Dept. ... ...
Jamia 025
New ...

VETTED BY
DR. ABID ALI KHAN
DEPARTMENT OF CIVIL ENGINEERING
JAMIA MILLIA ISLAMIA (A CENTRAL UNIVERSITY)
NEW DELHI INDIA - 110025

कार्यालय जिला अधिकारी रुद्रप्रयाग

(इं. विनय झिंक्वाण)
अधिशासी अभियन्ता
निर्माण खण्ड, लो.नि.वि.
गुप्तकाशी

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(इं० विनय झिंक्वाण)
अधिशासी अभियन्ता
निर्माण खण्ड, लो०नि०वि.
गुप्तकाशी

कार्यालय जिला अधिकारी रुद्रप्रयाग

Abbreviations

- CPHEEO - Central Public Health & Environmental Engineering Organization.
- FB – Free Board.
- H – Height.
- HFL – High Flood Level.
- HR - Hours
- KLD – Kilo Liters Per Day.
- L – Length.
- LD - Liquid Depth.
- W- Width.

(इं॰ विनोद झिंक्वाण)
अधिशासी अभियन्ता
निर्माण खण्ड, लो॰नि॰वि॰
गुप्तकाशी

SECTION I

DESIGN CHARACTERISTICS

(इं० विनय झिंक्वाण)
अधिशासी अभियन्ता
निर्माण खण्ड, लो०नि०
रुद्रप्रयाग

Verified

Dr. Abid
Princ
D
J
M - 110025

ering

Dehradun

AHMEDABAD

जिला मजिस्ट्रेट
रुद्रप्रयाग

Raw Sewage and Treated Sewage Characteristics of 600 KLD Sewage Treatment Plant at Kedarnath Dham, UK

- **Treatment Capacity:**

The Sewage treatment plant is designed to treat 6,00,000 Litre per day of sewage generated from the site. The treated sewage can be used for agriculture, horticulture or can be discharged to public drain.

- **Characteristics of Raw & Treated Sewage:**

The Sewage characteristics considered for the design purpose of the plant are as mentioned below:-

S. No.	Parameters	Raw Sewage	Treated Sewage	Treated Sewage for Discharge into Inland surface water as per CPHEEO Manual (Table 5.3)
1.	Daily average flow	600 KLD	600 KLD	-
2.	Design temperature	15-25°C	15 -25°C	-
3.	pH	6.5 – 8.5	6.5 – 8.5	5.5 to 9.0
4.	Total suspended solids (TSS)	400 -450 mg/L	< 10 mg/L	10 mg/L
5.	Conductivity	50 µS	-	-
6.	Total BOD	250 – 300 mg/L	< 10 mg/L	10 mg/L
7.	Total COD	400 – 450 mg/L	< 50mg/L	50 mg/L
8.	Oil and grease	<10 mg/Ltr	Nil	NIL
9.	Total ammoniacal nitrogen	<25 mg/L	<5 mg/L	5.0 mg/L
10.	Total Nitrogen	<10 mg/L	<5 mg/L	10 mg/L
11.	Total Phosphorous	5 – 12 mg/L	<2 mg/L	-
12.	Total coliform count	$1x10^6$ MPN/100ml	<100 MPN/100ml	<100 MPN/100ml

- **Design & Peak Flow:**
  - Design Flow : 600 KLD = **30Cum/hr.**
  - Working Hours: **20.**
  - Peak Load Factor: **2**
  - Peak Flow: 30 Cum/hr X 2 = **60Cum/hr.**
- **The Design** of various units are as per CPHEEO manual on Sewerage and Sewage Treatment Systems except Electrocoagulation reactors.

Ganwar Construction Limited Dehradun

M/S DESIGN STUDIO PVT. LTD. AHMEDABAD

विनय झिंक्वाण, अधिशासी अभियन्ता, निर्माण खण्ड, लो.नि.नि. रुद्रप्रयाग

जिला अधिकारी रुद्रप्रयाग

Dr. Abid ... Engineering
Princ...
Deptt. ...
Jamia Mil... 110025
New Delhi - 110025

SECTION II

PROCESS DESCRIPTION

ELECTROCOAGULATION (EC) PROCESS DESCRIPTION

- Water is one of human being's most fundamental needs.
- **Globalization**, uncontrolled growth, and other causes are causing a lack of fresh water, and many countries are concerned about the problem. As a result, it's critical to consider water purifying processes that are both effective and affordable, as well as reusability.

- People are presently aware of a wide range of wastewater treatment options. With recent technological advancements in the **electrochemical** area, a new technique known as electrocoagulation has been introduced into the business.

The Process of Electrocoagulation in Sewage Treatment Plants

Ref. Science journal - Science Direct, Jan 26th 2021

- Here major goal is to focus on **electrocoagulation** process technique and applications!

Introduction of the process

- Filtration, air stripping, ion exchange, chemical precipitation, chemical oxidation, carbon adsorption, ultrafiltration, reverse osmosis, electrodialysis, volatilization, and gas stripping are the traditional physico-chemical treatment techniques utilized for wastewater treatment.
- Oxidation of Biological mass by aeration technique is widely used in treatment of sewage water. Aeration of the sewage generates aerobic bacteria which in turn destroys the disease-causing bacteria in the liquor. But this process is viable at ambient temperature because the growth of aerobic bacteria can only occur at the RT.

- The **electrocoagulation** process is the viable option for such conditions.
- The **electrocoagulation** process is a sophisticated electrochemical technology-based procedure. **Electrocoagulation** (EC), which involves sending an electric current through water to remove pollutants, has shown to be quite successful. Anode and cathode geometries such as plates, balls, fluidized bed spheres, wire mesh, rods, and tubes have been used in electrocoagulation systems for many years.
- Water containing foodstuff wastes, oil wastes, dyes, suspended particles, chemical and mechanical polishing waste, organic matter from landfill leachates, de-fluorination of water, synthetic detergent

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effluents, mine wastes, and heavy metal-containing solution have all been treated with it in recent decades. By decreasing electricity usage and miniaturizing the required power supply, EC has become one of the most cost-effective

- wastewater treatment systems in the world.

Parameters removed by EC

- **EC removes** metals, colloidal solids and particles, and soluble inorganic contaminants.
- EC treats a wide spectrum of waste streams comprising heavy metals, virus, bacteria, pesticides, arsenic, MTBE, cyanide, Biochemical oxygen demand (**BOD**), Total dissolved solids (**TDS**), and Total suspended solids (**TSS**) using a specialized treatment chamber and electricity. It is used to treat wastewater from municipal, industrial, and commercial sources.

Methodology involved

- For breaking stable emulsions and suspensions, EC is a viable alternative to metal salts, polymers, and polyelectrolyte addition.
- An electrolytic cell with one anode and one cathode makes up an EC reactor. The EC system is made up of two parallel pairs of conductive metal plates that operate as monopolar electrodes.

- The criteria for using EC are as follows:
  - A power source that uses direct current
  - Box of Resistance
  - Multimeter

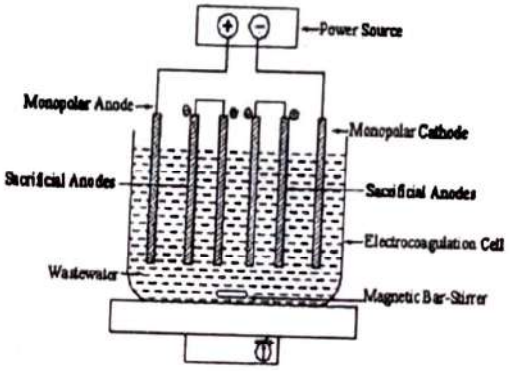

Fig 1: Bench-scale EC reactor with monopolar electrodes in series connection

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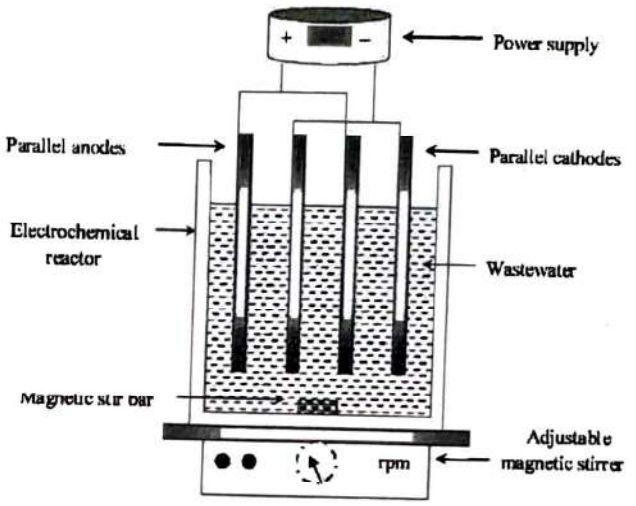

Fig 2: Bench-scale EC reactor with monopolar electrodes in parellel connection

1. "Sacrificial electrodes" is a term used to describe the conductive metal plates. The sacrificial anode decreases the anode's dissolving potential and reduces the cathode's passivation. The materials used for the sacrificial anodes and cathodes might be the same or different.

2. The cells can be connected to monopolar electrodes in a series. or in parallel.
   The cells connected in series have higher resistance, so bigger potential difference is required for a given current to flow in a series cell configuration. The cells connected in parallel have lower resistance, so lesser potential difference is required for a given current to flow in a series cell configuration.

   During electrolysis, anodic reactions occur on the positive side, whereas cathodic reactions occur on the negative side. The coagulation process will begin with released ions neutralizing the charges of the particles.

3. The released ions eliminate undesired impurities by forcing colloidal materials to agglomerate, which can then be removed by flotation. When water containing colloidal particles, oils, or other pollutants passes through an electric field, ionization, electrolysis, hydrolysis, and the generation of free radicals can occur, altering the physical and chemical characteristics of the water and contaminants. Contaminants are liberated from the water and destroyed or rendered less soluble due to the reactive and excited condition.

   Reactions in an EC cell

   At Anode
   $2Al - 6e = 2AL^{3+}$

   At Cathode
   $6H_2O + 6e = 6OH^- + H_2$

   Within the Cell
   $2Al^{3+} + 6OH^- = 2Al(OH)_3$

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Conclusion

- **Electrocoagulation** is capable of treating wide range of wastewaters. It is the technique of using a little amount of electrical current to destabilize suspended, emulsified, or dissolved pollutants in an aqueous media. As a result, the process's extra expenses are reduced.
- When it comes to the advantages, the EC method aids in the elimination of TSS by 95-99%, BOD by 50-99%, and bacteria by 95-99%. This shows that the technology is successful and dependable for a wide range of future uses, providing hope for everyone to have access to clean water.

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SECTION III

UNIT SIZING AND TECHNICAL DESCRIPTION OF VARIOUS UNITS

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3.1 Inlet Chamber

Quantity	1 No.
MOC	Civil
Effective Volume	1.6M3
HRT at normal flow	3 minutes
HRT at peak flow	1 minute, 30 seconds
Dimensions in mm	900(L)X1800(W)X1500(LD)+300(FB)
Use	Holding heavy material such as pebbles, metal lids etc

3.2 Coarse Bar Screen Chamber

Quantity	1 No.
MOC	Civil
Effective Volume	2.3M3
Dimensions in mm	2900(L)X800(W)X1500(LD)+450(FB)
Use	Fixing of Coarse Screen

3.3 Fine Bar Screen Chamber

Quantity	1 No.
MOC	Civil
Effective Volume	2.3M3
Dimensions in mm	2900(L)X800(W)X1500(LD)+600(FB)
Use	Fixing of Fine Screen

3.4 Coarse Screen

Quantity	1 working + 1 standby
MOC	SS 304
Dimensions in mm	800 x 2000
Slit or pore size of screen	10 mm approx.
Angle of Inclination	55° to 60°
Head Loss	150mm
Use	Screening of large particulate from raw sewage

3.5 Fine Screen

Quantity	1 working + 1 standby
MOC	SS 304
Dimensions in mm	800 x 2000
Pore Size of screen	6mm approx.
Angle of Inclination	55° to 60°
Head Loss	150mm
Use	Screening of fine particulate from raw sewage

3.6 Grit Chamber

Quantity	1 No.
MOC	Civil
Effective Volume	1.1M3
HRT at normal flow	120 seconds
HRT at peak flow	60 seconds
Dimensions in mm	900 x 900 x 1500
Use	Collection of particle that skips the fine screen (sand etc)

3.7 Oil & Grease Chamber

Quantity	1 No. (divided into two parts)
MOC	Civil

Verified

Dr. Abid Ali Khan
Principal Investigator
Deptt. of Civil Engineering
Jamia Millia Islamia
New Delhi - 110025

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	Effective Volume	7.5M3
	HRT at normal flow	15 minutes
	HRT at peak flow	7 minutes 30 seconds
	Dimensions in mm	2900 x 1800 x 1500
	Use	Separation of oil and aqueous phase
3.8	**Oil Skimmer**	
	Quantity	1 No.
	MOC	Standard
	Capacity	Capable of extracting 50 lph of oil
	Motor capacity	0.37KW, 3P, Geared motor
	Belt size	1200 mm length and 15 mm width, MOC PP
	Use	Extraction of remaining oil from O & G trap
3.9	**Collection/Equalization Tank**	
	Quantity	1 No.
	MOC	Civil
	Effective Volume	250M3
	HRT for normal flow	8 Hrs and 30 minutes (Aerated thru Blowers)
	HRT with peak load	7 Hrs
	Dimensions in mm	9500 x 6030 x 4350 + 500mm FB
	Use	Collection and equalization of influent raw sewage
3.10	**Twin Lobe Air Blower**	
	Quantity	2 working + 1 standby
	MOC	Standard
	Capacity	110M3/Hr at 0.6 bar pressure
	Motor capacity	5.5KW, 3P
	Make	Everest, Model No. M44 or equiv.
	Use	Complete with MS base, antivibration pads, V belt, pulleys, NRV, pressure gauge, filling oil etc Providing air to collection tank to maintain aseptic conditions, EC reactors, flash mixers, sludge holding tank etc. for agitation
3.11	**Air Grid in Collection Tank**	
	Quantity	1 set
	Pipe MOC	GI and CPVC of varied sizes as required for headers, manifolds and connections to diffusers Coarse diffusers 150 mm dia, EPDM disc type diffusers
	Quantity of diffusers	1 set
3.12	**Raw Sewage Transfer Pumps**	
	Quantity	2 working + 1 standby
	MOC	Standard, submersible cutter pumps
	Capacity	30M3/Hr, 15 M head, with low & high level sensors
	Motor capacity	5.5KW, 3P
	Make	KBL, Model Eterna 5500CW or equiv
	Use	Complete with MS lowering & lifting frame, NRV, pressure gauge, valves etc. Lifting of raw sewage from collection tank to EC reactors at desired flow and height
3.13	**Acid/Alkali Dosing system**	
	Dosing Pumps	

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Quantity	1 working + 1 standby
MOC	Standard, Electronic dosing pumps
Capacity	0-10 lph, 4 M head (Dose Subject to the site condition)
Motor capacity	80 W, 1P
Make	Milton Roy (Asia LMI)
	Complete with PU flexible pipe, inlet & outlet NRV's Dosing

Tanks

Quantity	1 No
MOC	HDPE
Capacity	100 Ltr
Make	Sintex
Mixing	Agitation by air
Use	The dosing system will be used to dose acid or alkali to the sewage to adjust pH to almost neutral if required

3.14 **Electrolyte (NaCl) Dosing system**

Dosing Pumps	
Quantity	1 working + 1 standby
MOC	Standard, Electronic dosing pumps
Capacity	0-10 lph, 4 M head (Dose Subject to the site condition)
Motor capacity	80 W, 1P
Make	Milton Roy (Asia LMI)
	Complete with PU flexible pipe, inlet & outlet NRV's
Dosing Tanks	
Quantity	1 No.
MOC	HDPE
Capacity	100 Ltr
Make	Sintex
Mixing	Agitation by air
Use	The dosing system will be used to dose electrolyte to the sewage to adjust conductivity to approx. 100uS if reqd.

3.15 **Electrocoagulation Reactors**

Quantity	6 Nos, all working
Effective volume	3.6 M3
Dimensions in mm	3000 x 1000 x 1200 + 300 mm weir with EC treated water collection tank, complete with outlet weirs, valves etc
MOC of tanks	MS FRP coated from inside and epoxy coated for outside
HRT for each EC unit	30 minutes minimum
Number of Anodes	26 Nos
MOC of Anodes	Aluminium
Size of Anodes in mm	800 x 700
Number of Cathodes	26 Nos
MOC of Cathodes	Iron
Size of Cathodes in mm	800 x 700
Voltage applied	12 V, DC
Current density at each Electrode	2 mA/cm2
Electrode configuration	Parallel
AC Step down transformer & DC Rectifier	AC Transformer 240 V AC to 12 V AC Rectifier 12V AC to 12V DC, 12 A, 3.5 KW

3.16 **Flash Mixers**

Quantity	3 Nos.

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	MOC	MS EP
	Effective Volume	4.0M3
	HRT	20 minutes (Wastewater Engg, Metcalf & Eddy)
	Dimensions in mm	1000 x 2000 x 2000
	Mixing	Agitation by air
	Use	Mixing of Poly electrolyte for coagulation process

3.17 **Poly Electrolyte Dosing System**

Dosing Pumps	
Quantity	3 working + 3 standby
MOC	Standard, Electronic dosing pumps
Capacity	0-10 lph, 4 M head (Dose Subject to the site condition)
Motor capacity	80 W, 1P
Make	Milton Roy (Asia LMI)
	Complete with PU flexible pipe, inlet & outlet NRV's
Dosing Tanks	
Quantity	1 No.
MOC	HDPE
Capacity	100 Ltr
Make	Sintex
Mixing	Agitation by air
Use	The dosing system will be used to dose polyelectrolyte to the EC treated sewage for floc formation of the sludge toe ease the settling process

3.18 **Tube Settlers**

Quantity	3 Nos.
MOC	MS EP
Length of settler	2062 mm
Width of settler	1300 mm
Total Height of settler	3100 mm
Height of legs	500 mm
Qty of tube deck media(TDM)	2M3
Surface area available In tube deck media	22M2
Angle for installation of TDM	60°
	Dimensions in mm details dimensions in tube settler calculation sheet
Use	Gives the required surface area for settling of sludge

3.19 **Chlorine Dosing System**

Dosing Pumps	
Quantity	1 working + 1 standby
MOC	Standard, Electronic dosing pumps
Capacity	0-10 lph, 4 M head (Dose Subject to the site condition)
Motor capacity	80 W, 1P
Make	Milton Roy (Asia LMI)
	Complete with PU flexible pipe, inlet & outlet NRV's
Dosing Tankss	
Quantity	1 No.
MOC	HDPE
Capacity	100 Ltr
Make	Sintex
Mixing	Agitation by air

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	Use	Dosing of Sodium Hypochlorite in the Filter Feed/Chlorine Contact tank to attain 2ppm of residual free chlorine in treated water
3.20	**Filter Feed/Chlorine Contact Tank**	
	Quantity	1 No.
	MOC	Civil
	Effective Volume	52.4M3
	HRT	95 minutes
	Dimensions in mm	4675 x 2800 x 4000 + 500mm FB
	Mixing	Agitation by air
	Use	This tank collects the treated water & act as a relay tank for water to be fed to the filters. It also acts as chlorine dosing tank.
3.21	**Filter Feed Pumps**	
	Quantity	2 working + 1 standby
	MOC	Standard CI, Horizontal centrifugal pumps
	Capacity	30M3/Hr, 28 M head, with low & high level sensors
	Motor capacity	5.5KW, 3P
	Make	KBL, Model KDS/GMC 844+ or equiv
		Complete with MS base frame, antivibration pads, NRV, pressure gauge, valves etc.
	Use	Feeding of treated sewage to the PSF and ACF at desired flow and pressure
3.22	**Pressure Sand Filter**	
	Quantity	1 No.
	Filtration velocity	10M3/Hr
	MOC	MS EP
	Dimensions in mm	2000 dia x 1800 HOS, both side dish ends, 1manhole and one hand hole
	MS sheet thickness in mm	HOS-6mm, dish ends-8mm, flanges-8mm
	Frontal Piping	MSEP/GI, 65NB,
	Valves	5Nos 63NB butterfly control valves, 1 No 1" air release valve
	Media	Graded sand-3800 Kgs
	Filter vessel	Fabricated
	Valves make	Zoloto
3.23	**Activated Carbon Filter**	
	Quantity	1 No.
	Filtration velocity	10M3/Hr
	MOC	MS EP
	Dimensions in mm	2000 dia x 1800 HOS, both side dish ends, 1 manhole and one hand hole
	MS sheet thickness in mm	HOS-6mm, dish ends-8mm, flanges-8mm
	Frontal Piping	MSEP/GI, 65NB,
	Valves	5Nos 63NB butterfly control valves, 1 No 1" air release valve
	Media	Supporting media pebbles-500 kgs, Granular activated carbon-1600 Kgs
	Filter vessel	Fabricated
	Valves make	Zoloto
3.24	**Filter Backwash Pumps**	
	Quantity	1 working + 1 standby

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	MOC	Standard CI, Submersible centrifugal pumps
	Capacity	45M3/Hr, 15 M head, with low & high level sensors
	Motor capacity	3.3KW, 3P
	Make	KBL, Model KDS/GMC 515+ or equiv
		Complete with MS base frame, anti vibration pads, NRV, pressure gauge, valves etc.
	Use	Back washing of PSF and ACF at desired flow and pressure

3.25 **UV Sterilizer Unit**

Quantity	1 No.
MOC	SS-316
Capacity	for water flow of 30M3/Hr
UV Dose	60,000 uW-sec/cm2
UV Transmission per cm	80%
Voltage	220-240V
Wattage	1370W
Make	Alfa
Model	WL12

3.26 **Filtered Water Tank**

Quantity	1 No.
MOC	Civil
Effective Volume	86M3
HRT	2 hrs and 30 minutes
Dimensions in mm	5200 x 3800 x 4350 + 500mm FB
Use	This tank collects the final treated & filtered to send to drain/re use/ horticulture etc, Chlorine is also dosed in this final water to achieve 2ppm of residual free chlorine in final treated water

3.27 **Sludge Transfer Pump**

Quantity	1 working + 1 standby
MOC	Semi Open impeller pump
Capacity	15M3/Hr, 15 M head, with low & high level sensors
Motor capacity	5.5KW, 3P
Make	KBL, Model SP1H or equiv
	Complete with MS base frame, anti vibration pads, NRV, pressure gauge, valves etc.
Use	Transfer of sludge from settlers to sludge holding tank

3.28 **Sludge Holding Tank**

Quantity	1 No.
MOC	Civil
Effective Volume	31M3
HRT	1 hrs
Dimensions in mm	2750 x 2800 x 4000 + 500mm FB
Mixing	Agitation by air
Use	This tank collects the sludge received from the settlers and is used as sludge thickner also, apart for feed tank to filter press

3.29 **Filter Press Feed Pump**

Quantity	1 working + 1 standby
MOC	CI body, SS 304 shaft, Screw pump
Capacity	5M3/Hr, 50 M head
Motor capacity	3.3KW, 3P

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Make	Roto, Model RLAB541 or equiv Complete with MS base frame, anti vibration pads, NRV, pressure gauge, valves etc.
Use	Screw type pump is suitable for transfer of semi solids, slurries etc and therefore it is used for feeding of sludge from sludge holding tank to filter press

3.30 **Filter Press**

Quantity	1 No.
MOC	CI mounting structure and PP recessed plates/plate frame
Size of plates	24" x 24"
No. of plates and frames	23
Type of operation	Hydraulic
Sludge Holding Capacity	290 Ltrs in one load

Calculation for sludge generation:

BOD	300 mg/L
Sludge generation in BOD x 0.5	
Flow/Day	600 KLD 6,00,000 m3/Day
BOD/Day	300 x 600000 180,0,00,000 mg 180 Kgs
Sludge generated	180 x 0.8 **144 Kgs/Day** Selected Filter press of capacity 290 Kgs per lot

3.31 **Sludge Holding Area**

Quantity	1 No.
MOC	Civil
Dimensions in mm	6000 x2825 x300, open space
Use	This space is meant for storing the wet cake of sludge from filter press till disposal, it can take 16 loads (290Ltr x 16 loads) of sludge output from filter press.

3.32 **Platform for EC Reactors**

Quantity	1 No.
MOC	Civil structure
Dimensions in mm	12975 x 6530 at a height of 4500
Use	Civil structure for placing of EC reactors along with walking and working space

3.33 **Platform for Flash Mixers and Settlers**

Quantity	1 No.
MOC	Civil structure
Dimensions in mm	6000 x 6530 on a platform of 250mm height
Use	Civil structure for placing of flash mixers and settlers along with walking and working space

3.34 **Electro Magnetic Flow Meter**

Quantity	2 Nos.
MOC	Standard, Sensor SS
Pipe connections	80mm, flange type
Bore	Full bore
Power	Battery operated

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	Type	Flow indicator, transmitter, flow totalizer, Backlit display, aluminium frame for glass mounting, factory calibrated
	Make	Micro Flow
3.35	**pH Meter**	
	Quantity	2 Nos.
	MOC	Standard, Sensor glass
	Pipe connections	20mm, threaded
	Power	240 V AC from the electrical control panel
	Type	pH range 0-14, digital LED display, Online installation, factory calibrated
	Make	Aster
3.36	**Pressure Gauges**	
	Quantity	Set
	MOC	SS, glycerine filled
	Dial size	4"
	Range	0 – 7 kgs/cm2
3.37	**Level Sensors/Controllers**	
	Quantity	Set
	MOC	Standard
	Type	Float Type NO/NC circuit
	Range	low and high limits adjustable
3.38	**Pipes, Fittings and Valves**	
	Quantity	Set
	MOC	CPVC, GI and MSEP
	Size	Variable sizes of pipes, fittings and valves will be used in the piping system depending upon the flow and pressure requirements at that point
3.39	**Electrical Control Panel**	
	Quantity	1 Set IP 55 LT panel with all incoming and outgoing feeders as per the capacity of the instruments. All feeders shall have overload, short circuit and phase reversal protection. Required PLC and starters etc will be the part of the panel.Incomer feeders shall multifunctional meters, CT's, push buttons and indicating lamps. Panel shall be supplied as per specifications and requirements for auto operation of the sewage treatment plant with manual over rides. Earthing shall be provided for each electrical instrument with GI strip or GI wire as required at the specific place. All power and control panels (from panel to the individual electrical instrument, termination of cables and cable trays (inside the STP) are considered in this item. All cables wires etc will be wrapped with PP/PU insulation sheets.
3.40	Antifreeze Flexible Heating Cables	Antifreeze flexible heating cables will be installed with the CPVC piping system tied by PP cable ties

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IMI DESIGN STUDIO PVT. LTD. AHMEDABAD

Dr. Abid
Principal
Deptt. of
Jamia Millia
New Delhi - 110025

SECTION IV
DESIGN CALCULATIONS

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4.1 Calculation for Coarse Screen

No. of Bars in bar Screen

Width of Bar Screen	800	mm
Effective Length of bar screen	1300	mm
Bar spacing	10	mm
Bar width	40	mm
Total width used by each bar	50	mm
Total Nos. of bars	16	mm
Available spacing width wise	150	mm
Total area available for water flow	195000 mm2	0.195 m2

Approach Velocity at Bar Screen

A = Flow/Velocity

Peak Flow of water	60	M3/Hr
	0.017	M3/Sec
Min. Reqd Approach velocity	0.3	M/Sec
Cross section reqd for desired approach velocity	0.056	M2
Channel dimensions before bar screen:	1800mm (L) X 200mm (W) x 300 mm(H)	

Length of the channel is less due to space constraint

Head loss thru the screens

$h = .0729(V^2-v^2)$

h	Head loss in metre
V	flow velocity thru the screen in m/s
Factor	0.0729
V	0.3 m/s
V^2	0.09
V	0.017 m/s
v^2	0.000289
V^2-v^2	0.09
H	0.01 m< 150 mm hence Ok

Head Loss taken is 150mm as standard practice as per CPHEEO, Chapter 5, Section 5.6.1.8 &5.6.1.9

4.2 Calculation for Fine Screen

$h = (1/2g)(Q/CA)^2$

Discharge Flow in M/sec Q		0.017	M3/sec
Coefficient of discharge C		0.6	
Effective submerged open area A	0.4M x 0.6M	0.24	M2
Gravity		9.8	M/Sec^2
2g	9.8 x 2	19.6	
1/2g		0.05	
CA		0.144	
Q/CA		0.12	
(Q/CA)2		0.014	
Head Loss H		0.0007	

Head Loss taken is 150mm as standard practice as per CPHEEO, Chapter 5, Section 5.6.1.9

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Principal
Deptt. of ...
Jamia Millia Islamia
New Delhi - 110025

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4.3 Calculation for Grit Chamber

Settling Velocity		
Vs = g (Ss-1) d2		
18 μ		
Gravity g	9.8	
Specific Gravity of grit Ss	2.65	
Particle size of grit d	0.15	mm
	0.00015	M
g/18	0.544444444	
Ss-1	1.65	
d2	2.25E-08	
Viscosity	0.00000114	
d2/μ	0.019736842	
Vs	0.017730263	M/sec
Reynolds Number R = Vs x d/μ	2.332929363	
	2.3>0.5 Hence Stoke law doe not apply	
Applying transition law for 0.5 < R < 103		
Vs = [0.707 x (Ss-1) d1.6 - v-0.6]0.714	0.0168	M/sec 1451.52
Computation of Surface Overflow rate		
Surface overflow rate for 100% removal Efficiency in an ideal Grit Chamber = Settling velocity of minimum size of particle		
Convert Vs to M/day	1451.52	M3/m2/day
Determine actual overflow rate		
n = 1 - {1+nVs/Q/A}-1/n		
Assuming η= 0.75 and n = 1/8 then		
Q = Vsn	959	M3/m2/day
A (1- η)-n -1		
Flow per day	600	KLD
flow per hour/60 minutes Q		
Determine of Dimension of grit chamber	30	M3/Hr
Plan area of grit chamber = Q	0.031282586	M2
Q/A		
Proposed a grit chamber of dimensions	**900mm x 900mm x 1500mm**	
As per CPHEEO manual page No. A-112 critical		

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displacement velocity for above parameters Vc 0.161 m/sec

As per CPHEEO manual Horizontal velocity Vh should < Vc

assuming depth of 900mm Vh 1.20689E-06

Ref: CPHEEO manual appendix 2, page No. A-111 to A-113

4.4 Calculation for Oil & Grease Trap

Flow per day	600	KLD
Effective working Hours	20	HRS
flow per hour/60 minutes	30	M3/HR
Retention time for removal of oil and grease	15	MINUTES
Min. Volume of oil & grease trap required	**7.5**	M3

4.5 Calculation sheet for Equalization/Collection tank

Flow per day	600	KLD
Effective working Hours	20	HRS
flow per hour/60 minutes	30	M3/HR
Peak load flow (2 times of normal flow in M3/Hr)	60	M3/HR
Retention time for collection tank	8	HRS
Min. Volume of collection tank required	240	M3

Ref: Wastewater Engg. Metcalf & Eddy, CPHEEO Manual. 5,Sec. 5.6.3

4.6 Calculations for EC Reactor

Electro Coagulation Calculator by Faradays Law

$m = \frac{E \times i \times t}{96485}$ or $i = \frac{m \times 96485}{E \times t}$ or Watts $W = \frac{m \times 96485 \times \text{Voltage V}}{E \times t}$

	Anode Aluminium		Cathode Iron	
Flow per cell	100	KLD	100	KLD
	100000	LPD	100000	LPD
Working Hrs	20	Hrs	20	Hrs
flow per Hr	5000	LPH	5000	LPH
HRT per cell	30	Minutes	30	Minutes
	1800	Seconds	1800	Seconds
Flow per cell in 30 minutes	2500	LPH	2500	LPH
	2.5	KL	2.5	KL
Equivalent Wt of Anode material	27	Aluminium	56	Iron
Mass of substance dissolved per Ltr	15	mg/Ltr	15	mg/Ltr
Mass of substance dissolved/cell in 30 minute (2500L)	37500	mg	37500	mg
	37.5	gms	37.5	gms
	0.0375	kgs	0.0375	kgs
Mass of substance dissolved/cell in a day (100KL)	1.5	kgs	1.5	kgs
Number of days for replacement of suicidal electrode	120	days	120	days

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	Anode Aluminium		Cathode Iron	
Mass of substance dissolved/cell in above days)	180	kgs	180	kgs
Faraday Number	96485		96485	
Min. Current required for dissolution of anode	0.074	Amp	0.074448	Amp
	74	mA	74	mA
Voltage applied	12	Volts	12	Volts
Min. Power required per cell	0.89	Watts	0.89338	Watts
Electrode Area to Volume ratio, A/V, (100-1000)	156	cm2/Ltr	156	cm2/Ltr
Area of Electrode material required/cell with A/V ratio	29034.84	cm2	29034.84	cm2
	29.03	m2	29.03484	m2
Number of electrodes/cell	52	Pairs	52	Pairs
Area per electrode	0.56	M2	0.558362	M2
	5583.62	cm	5583.623	cm
Thickness of electrode	5	mm	3	mm
	0.00005	M		M
Length of electrode	0.8	M	0.8	M
Width of electrode	0.7	M	0.7	M
Distance between 2 electrodes	2	cm	2	cm
Depth of cell	1.5	M	1.5	M
Free board	300	mm	300	mm
Width of cell	1	M	1	M
Length of cell	3	M	3	M
Specific gravity of Material	2.7	Al	7.87	Fe
Weight per electrode (L x W x Thickness x sp.gravity)	7.56	kgs	13.22	Kgs
Min. Current density required/electrode	2	mA/cm2	2	mA/cm2
Actual current required per cell (parallel connections)	11167.25	mA	11167.25	mA
	11.17	Amp	11.17	Amp
Voltage applied	12	Volts	12	Volts
Power per cell	134.01	Watts	134.01	Watts
	0.13	KW	0.13	KW

4.7 **Calculations for Flash Mixer**

Calculation sheet for Flash mixers

Flow per day	600	kld
No. of Flash mixers in parallal	3	Nos
Flow in each mixer	200	kld
Effective working Hours	20	Hrs
flow per hour/60 minutes	10	M3/Hr
Mixing time required for mixer	20	minutes
Min. Volume of flash mixer required	**3.3**	M3

Ref: Wastewater Engineering, Metcalf & Eddy
CPHEEO, Chapter 5, Section 5.7.3.2

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4.8 Calculation for Tube Settler

Calculation for Tube Settler

Flow per day	200	KLD	
Flow of effluent/Hr.	10	M3/Hr	Q
Settling Velocity of effluent	10	M/Hr	V
Angle of inclination	60	degree	
Area in per M3 of Tube deck	11	M2	
Factor for Tube deck media	19		
M3 of Tube deck media	1.727	M3	
Add 10% extra	1.90	M3	
Tube deck Media required in L			
Ht of Tube deck media	1.00	M	
Length & Width required for fixing Tube deck media			
Width of settler	1.30	M	
Length required	1.46	M	
Size required for fixing tube deck media	1.5 x 1.3 x 1	LWH in M	
Height of settler			
Free port top	500	mm	
Inlet Chamber	800	mm	
Free port bottom	300	mm	
Height of Chamber	1500	mm	
Height of cone	500	mm	
Height of legs	500	mm	
Total Height of Tube settler	**3600**	**mm**	
Difference in ht of Inlet and outlet chamber	300	mm	
Length of components of settler			
Inlet chamber	300	mm	
Outlet chamber	300	mm	
Length of media chamber & cone	1461.54	mm	
Total Length of Settler	**2061.54**	mm	
Width of components of settler			
Inlet chamber	1300	mm	
outlet chamber	1300	mm	
Cone	1300	mm	
Main body	1300	mm	
Total width of settler	**1300**	mm	

Technical Data Sheet for Tube deck media attached in section VIII, 8.11

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4.9 Calculations for DMF and ACF vessels

Calculation sheet for DMF and ACF

Flanged Vessels

	Nos			3.14xDiaxDia/4x250		
Flow Rate in M3/Hr.		30				
Velocity, M/Hr		10				
		3.821656				
Vessel dia.		**1.954906**	Mtr			
Shell Thickness		5	mm			
Shell Height		1.8	m	Media Ht	1000	mm
Shell Wt.		433.6782	Kgs	Shell Vol.	5400	Ltrs
Dish end Dia.		2.736868		Vol of media	3000	
Dish end Thickness		8	mm			
Top Dish End Wt.		369.264	Kgs	Sand Vol.	1950	Ltrs
Bottom Dish End Wt.		369.264	Kgs			
Outer Dia of Flange		2.054906	m	Pebbles Vol.	450	Ltrs
Inner Dia of Flange		1.954906	m	Total sand	2400	Ltrs
Thickness of Flange		8	mm	Wt.of sand & pebbles	4320	Kgs
		208.1676	Kgs	Anthracite Vol.	600	Ltrs
		188.4	Kgs	Wt of Anthracite	300	Kgs
Flanges Wt. Bottom/top	1	39.53514	Kgs			
Thickness of Strainer Plate		8	mm			
Strainer plates Wt. bottom/Top	1	208.1676	Kgs			
Wt. of Manhole	1	75	Kgs			
Wt of handhole	1	25	Kgs			
Wt of Legs	4	80	Kgs			
Wt of Hooks	2	10	Kgs			
Wt of Nozzles & Flanges		30	Kgs			
Wt of Funnel		10	Kgs			
Total Wt. of Vessel		**1649.909**	Kgs			
No of Strainers,Top		0	Nos			
No of Strainers,Bottom		147	Nos			

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SECTION V

ELECTRICAL LOAD, AUTOMATION LOGIC, EQUIPMENT WEIGHTS

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5.1 Electrical Load

Electrical Load Data Sheet

S.No.	Equipment name	Qty in Nos	KW per unit	Total Electrical Load in KW
1	Oil Skimmer	2	0.37	0.74
2	Air Blowers	3	5.5	16.5
3	Sewage Transfer Pumps	3	5.5	16.5
4	Dosing Pump for Acid	2	0.08	0.16
5	Dosing Pump for NaOH	2	0.08	0.16
6	Dosing Pump for NaCl	2	0.08	0.16
7	Electro coagulation unit	6	3.5	21
8	Poly Dosing System	6	0.08	0.48
9	Chlorine Dosing System	2	0.08	0.16
10	Filter Feed Pump	2	5.5	11
11	Filter Backwash Pump	2	3.7	7.4
12	Screw pump	2	2.2	4.40
13	Filter press, Hydraulic	1	3.7	3.7
	Total Connected Electrical Load			**82.36**

5.2 Automation Logic

1. **Collection tank**
   a) The Sewage transfer pumps will stop if the level in the collection tank is low and will restart as soon as the level reaches high.
   b) The blower will continue working even at low level. Needs to be stopped manually

2. **Electrolysis Reactors**
   a) The DC Circuit will trip as soon as the level in the reactor tank gets low and will restart when the level reaches high.
   b) Low level in the reactor tank will also trigger the sewage transfer pump to start if the level in the collection tank is sufficient.
   c) Low level in Reactors will also stop agitation in flash mixers.

3. **Filter Feed Tank**
   a) Filter feed pump will trip if water in the filter feed tank is low and will restart on sensing high level.

4. **Treated Water Tank**
   a) In case level in the Treated Water Tank is sensed high, whole plant will stop including the DC power supply of the Electrolysis reactors and the Dosing system.
   b) The blower will continue working. Plant will restart at low level in Treated water tank.

5. **Manual Overrides**
   a) Manual override will be provided for all the automation. In case the plant is run in manual mode all automation systems will cease to work.
   b) All working and standby equipment have a selector switch to manually switchover to the desired equipment if required.
   c) An emergency switch will be provided in the panel to completely cut off power supply to the complete unit.

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5.3 Mechanical Weights of Equipment

Weights of SS, MS FRP and MS EP Fabricated Instruments

S.No.	Equipment name	Qty	Unit	Wt./unit in Kgs	Total Wt. in Kgs	Total Wt. in Kgs with Water
1	Bar Screen	2	Nos	103	206	206
2	EC Reactors	6	Nos	897	5382	35586
	Wt of Anodes/reactor	1	set	190	1140	
	Wt of cathodes/reactor	1	set	344	2064	
	Wt of water per EC Reactor			4500	27000	
3	Settling tanks	3	Nos	2270	6810	66810
	Wt of water per Settler			20000	60000	
4	Pressure Sand Filter Vessel	1	No	1870	1870	10170
	Wt of media			4800	4800	
	Wt of water in PSF Vessel			3500	3500	
5	Activated Carbon Filter	1	No	1870	1870	8570
	Wt of media			3200	3200	
	Wt of water in ACF Vessel			3500	3500	

Dr. Abid ... Professor
Principal ... Engineering
Deptt. of ... Jamia ...
New Delhi - 110025

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Dr. Abid [illegible]
Principal
Deptt. of [illegible]engineering
Jamia [illegible]
New Delhi - 110025

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SECTION VI

DRAWINGS (ANNEXURE – A)

Verified

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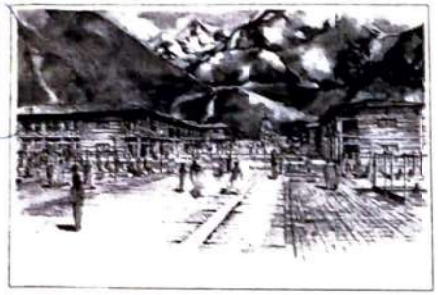

PROJECTS FOR HPCL

STP

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PREPARED FOR

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(VISION, LANDSCAPE & CIVIL INFRASTRUCTURE)

SCHEDULE OF PACKAGES	DATE

DRAWING LIST PACKAGE - 01

04	HPCL	Drawing Date
	SEWAGE TREATMENT PLANT	
KR-STP-G101	COVER SHEET	30-09-2022
KR-STP-C101	LOCATION IN MASTERPLAN	30-09-2022
KR-STP-C102	MARKING PLAN	30-09-2022
KR-STP-C103A	RETAINING WALL SECTION	30-09-2022
KR-STP-C103B	RETAINING WALL ELEVATION	30-09-2022
KR-STP-C104	PCC LAYOUT	30-09-2022
KR-STP-C105	FLOOR PLAN AT -3225MM (-VE)	30-09-2022
KR-STP-C106	FLOOR PLAN AT +225MM (+VE)	30-09-2022
KR-STP-C107	FLOOR PLAN AT +1275MM (+VE)	30-09-2022
KR-STP-C108	FLOOR PLAN AT +4500MM (+VE)	30-09-2022
KR-STP-C109	ROOF PLAN	30-09-2022
KR-STP-C110	SECTION-1	30-09-2022
KR-STP-C111	SECTION-2	30-09-2022
KR-STP-C112	SECTION-3	30-09-2022
KR-STP-C113	FLOOR PLAN AT +1275MM (+VE) RCP - LIGHTING LAYOUT	30-09-2022
KR-STP-C114	FLOOR PLAN AT +4225MM (+VE) RCP - LIGHTING LAYOUT	30-09-2022
KR-STP-C115	FLOOR PLAN AT +4500MM (+VE) RCP - RAFTER GRID	30-09-2022
KR-STP-C116	FLOOR PLAN AT +4500MM (+VE) RCP - FALSE CEILING	30-09-2022

General Notes

GOOD FOR CONSTRUCTION

Key Plan

KEDARNATH RESTORATION AND REDEVELOPMENT

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124200404

STP

COVER SHEET

A2

KR-STP-G101

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गुप्तकाशी

Dr. Abid Ali Khan
Principal Investigator
Deptt. of Civil Engineering
Jamia Millia Islamic
New Delhi - 110025

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Dehradun

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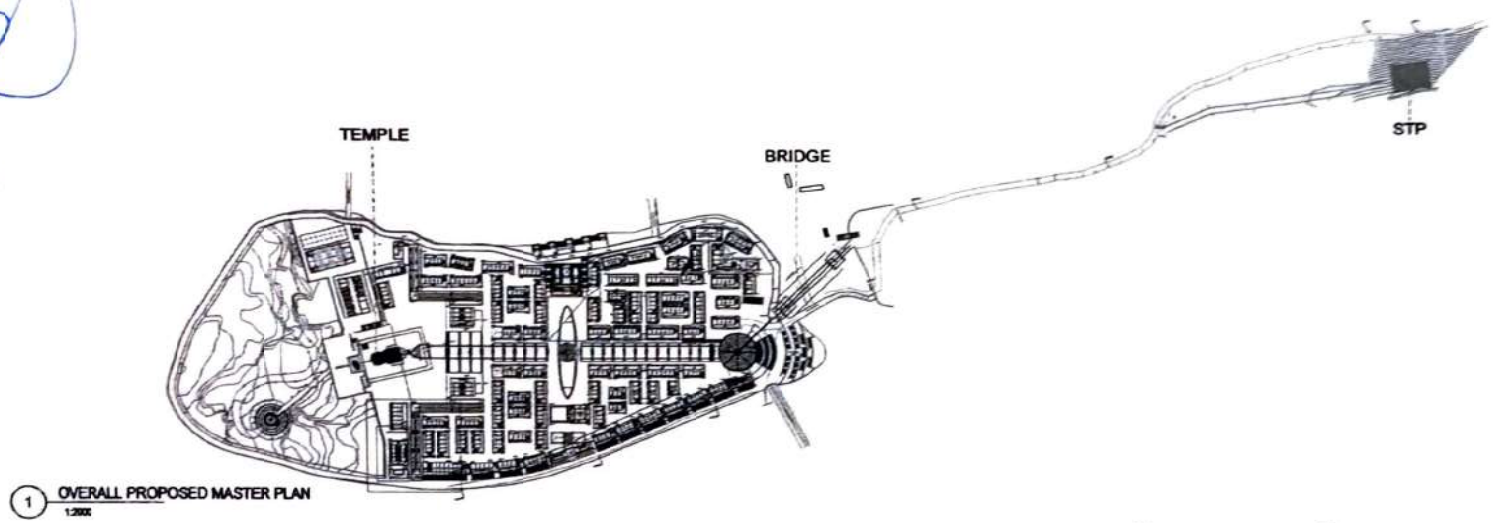
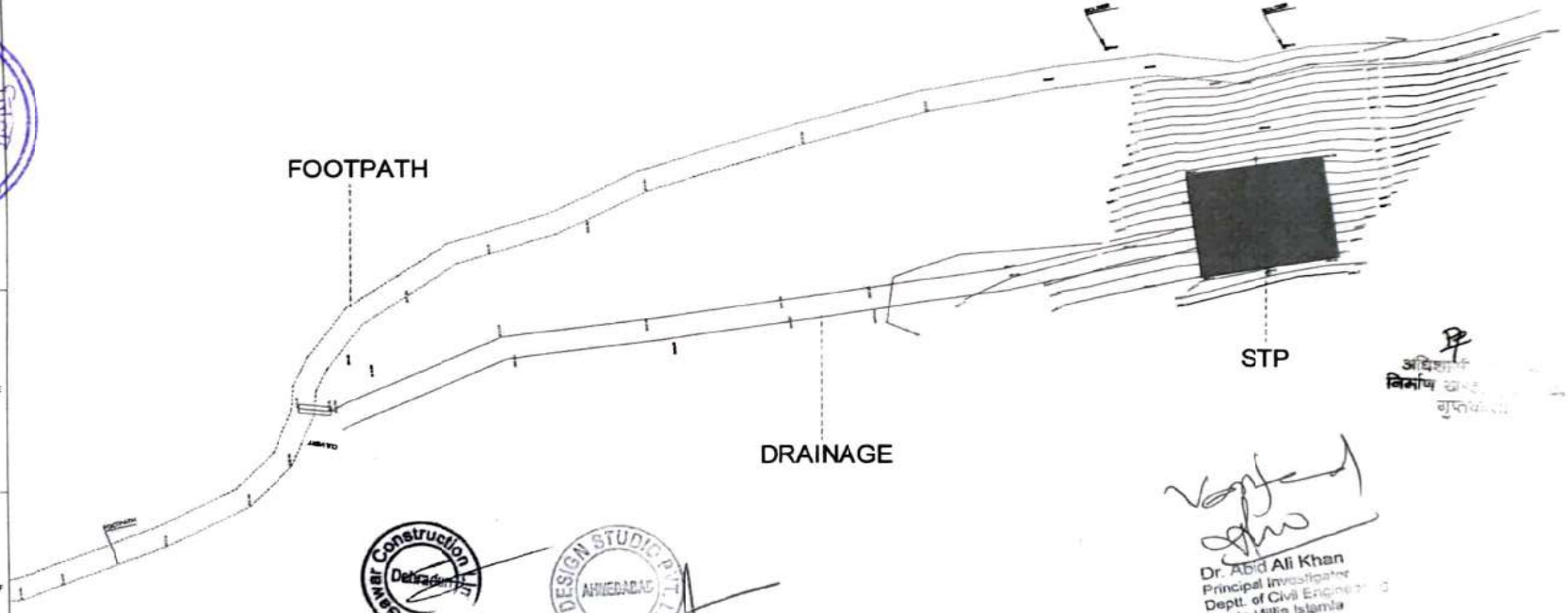


1 OVERALL PROPOSED MASTER PLAN
1:2000



2 STP LOCATION ON MASTERPLAN
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Dr. Abid Ali Khan
Principal Investigator
Deptt. of Civil Engineering
Jamia Millia Islamia
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SEWAGE TREATMENT PLANT
LOCATION IN MASTERPLAN

A2

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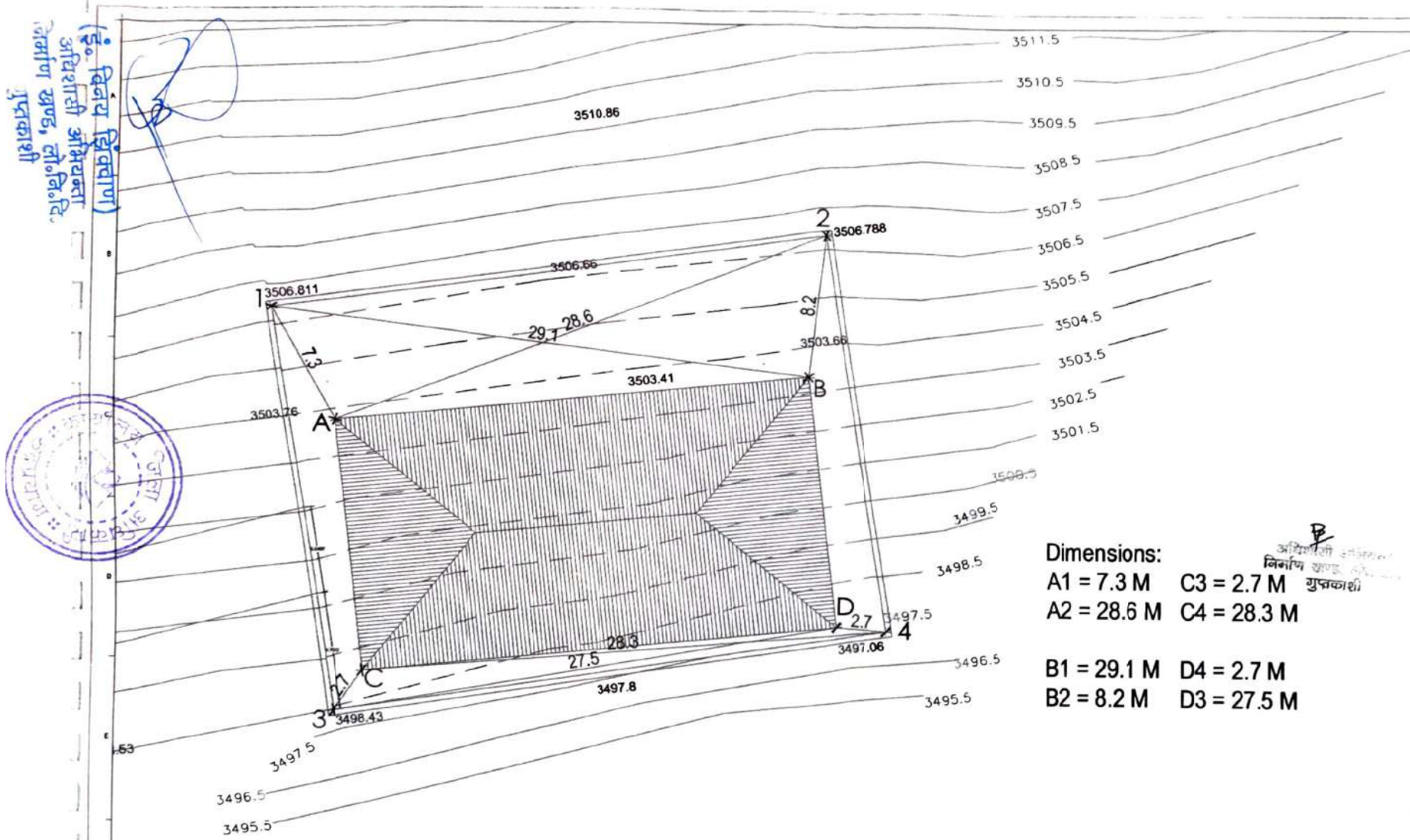

Dimensions:

A1 = 7.3 M C3 = 2.7 M

A2 = 28.6 M C4 = 28.3 M

B1 = 29.1 M D4 = 2.7 M

B2 = 8.2 M D3 = 27.5 M

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SEWAGE TREATMENT PLANT
MARKING PLAN

A2

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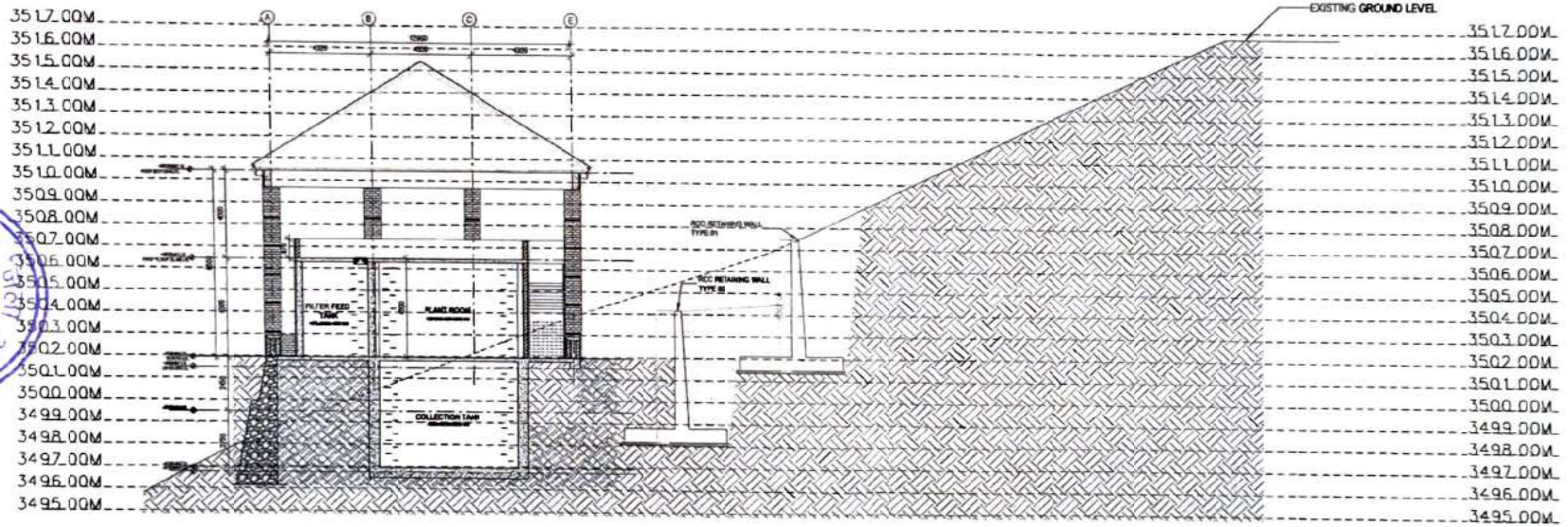

1 SECTION A
1:100

General Notes

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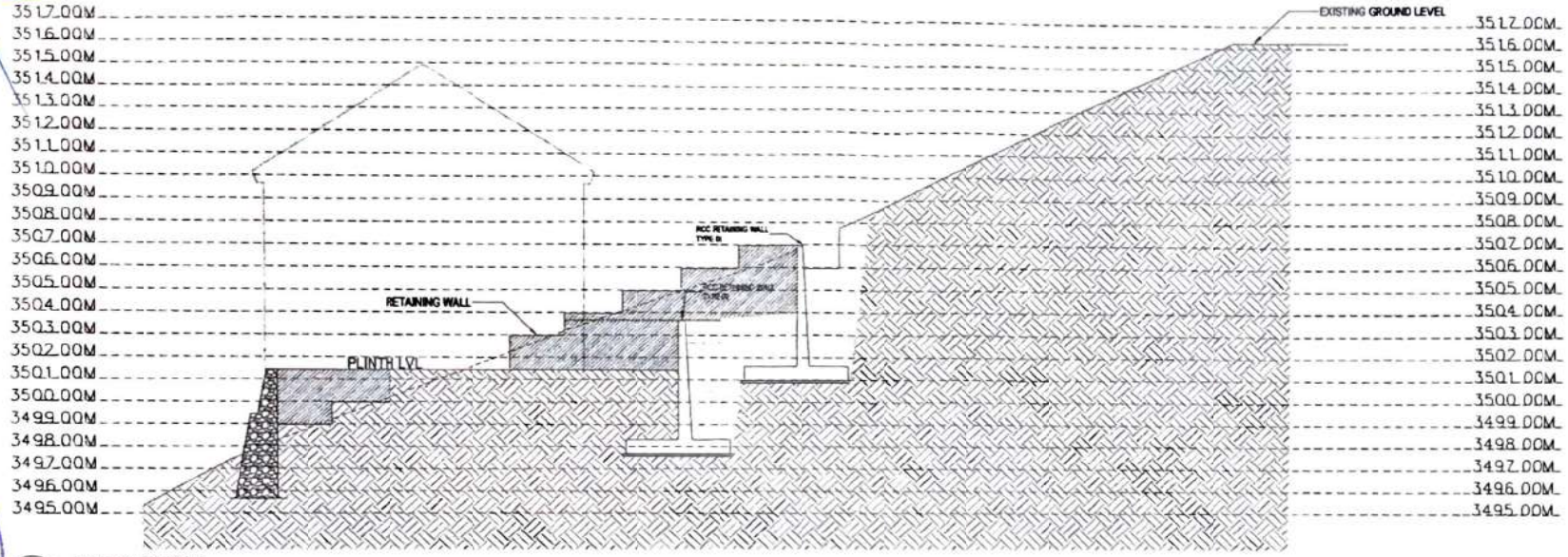
SEWAGE TREATMENT PLAN

SEWAGE TREATMENT PLANT
RETAINING WALL SECTION

A2

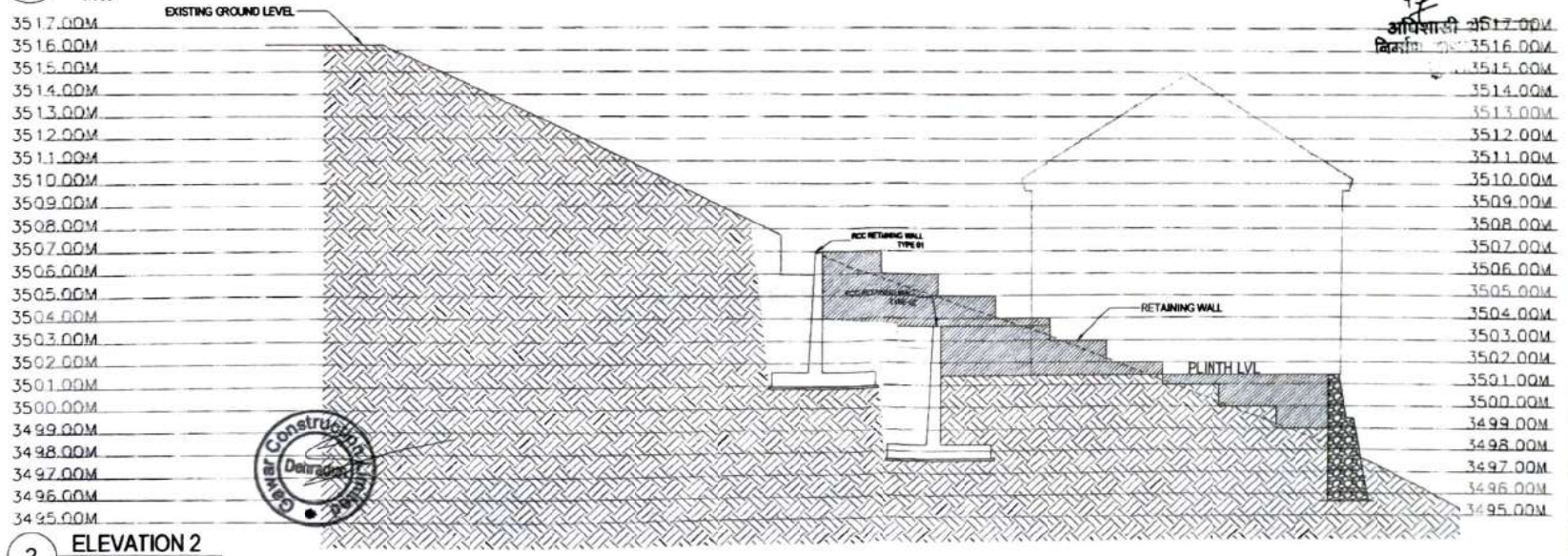
KR-STP-C102A

266



1 ELEVATION 1

1:100



2 ELEVATION 2

1:100

General Notes

GOOD FOR CONSTRUCTION

Key Plan

KEDARNATH RESTORATION AND REDEVELOPMENT

GOVERNMENT OF UTTARAKHAND

GENSTRU CONSULTANTS PVT LTD

124200404

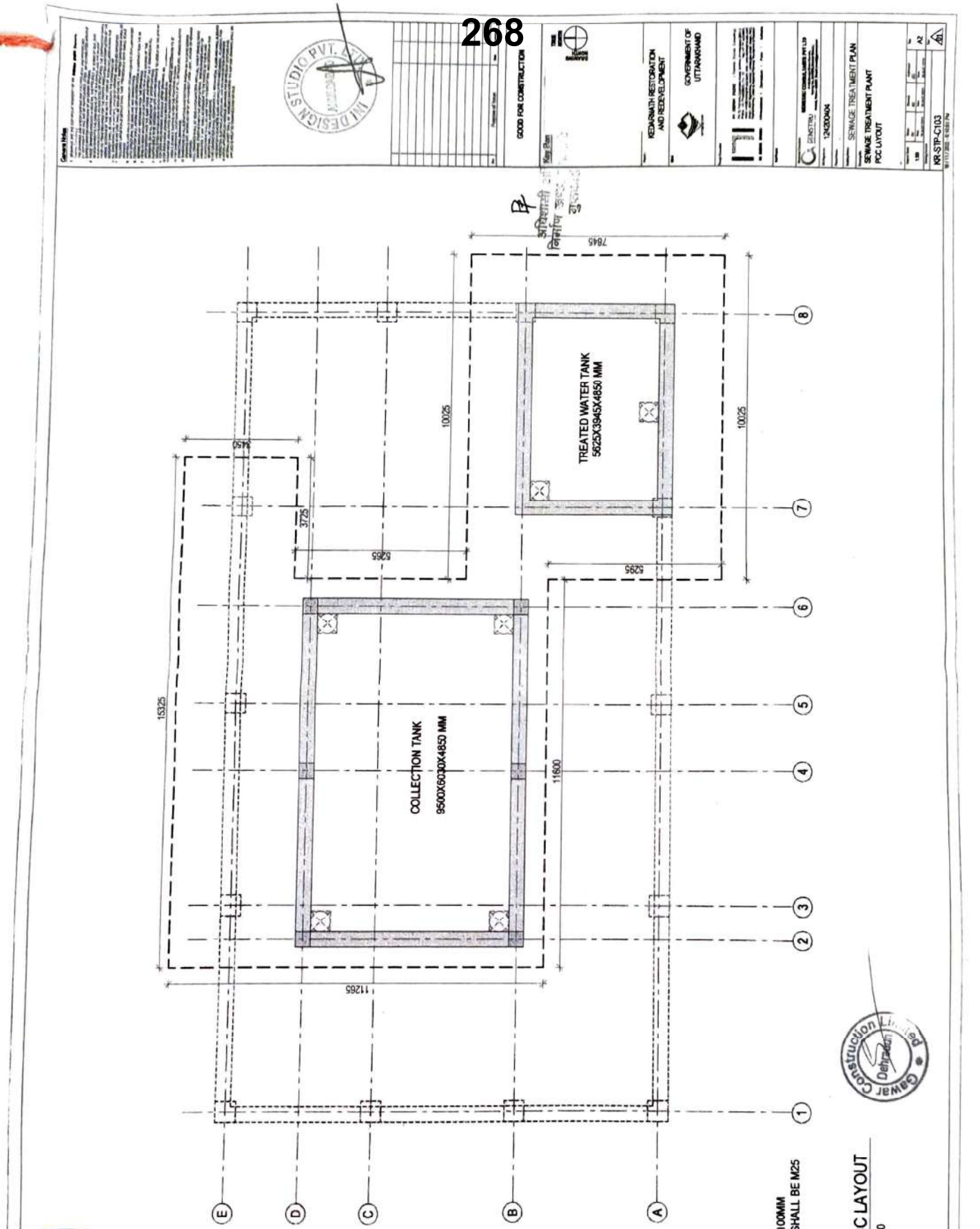
SEWAGE TREATMENT PLAN

SEWAGE TREATMENT PLANT
RETAINING WALL ELEVATIONS

A2

KR-STP-C102B

267



(ई० बिनय झिंक्वाण)
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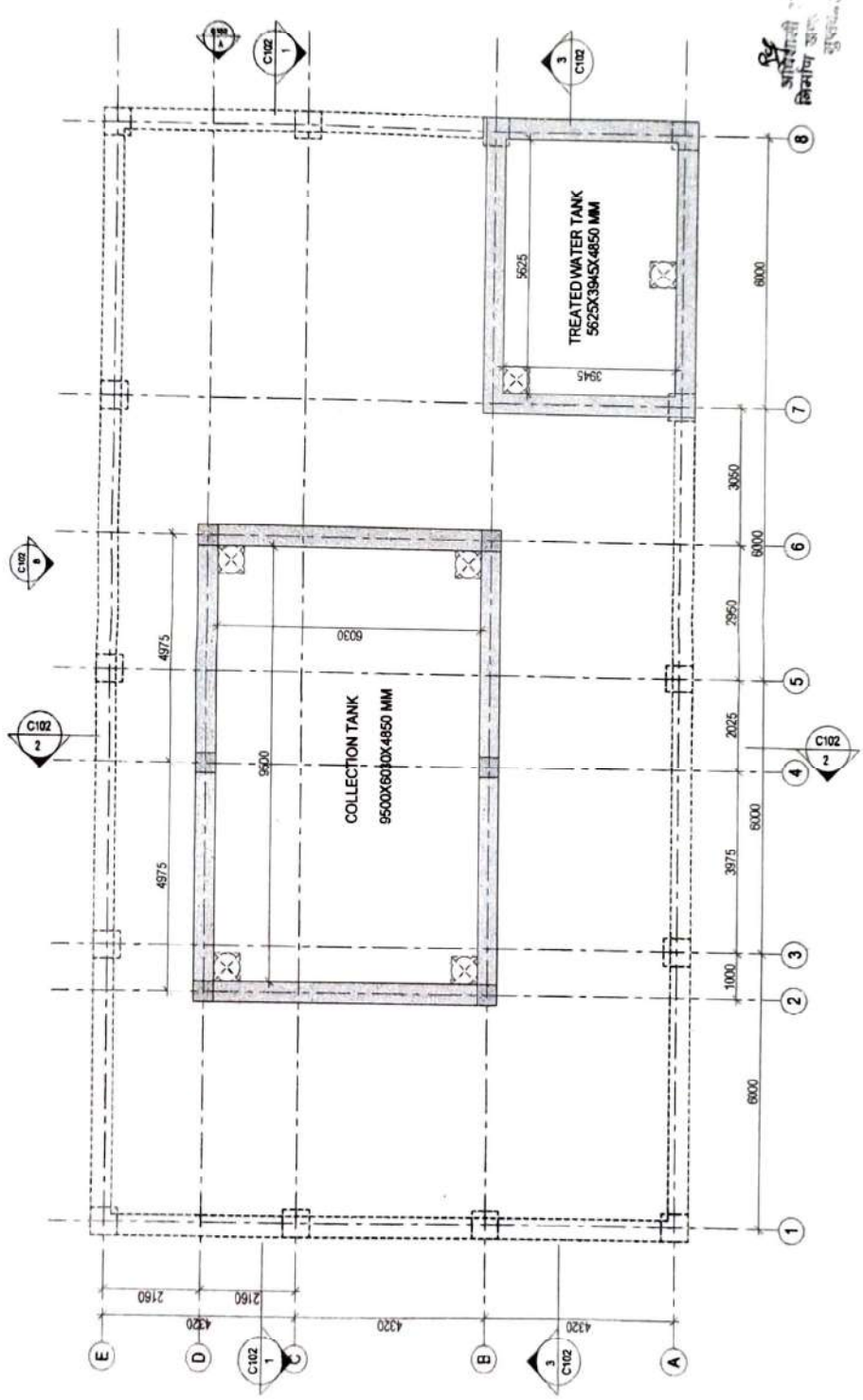
रुद्रप्रयाग



1 PLAN AT -3000MM FROM GROUNDLEVEL
1:50

GOOD FOR CONSTRUCTION

KEDARNATH RESTORATION AND REDEVELOPMENT

GOVERNMENT OF UTTARAKHAND

SEWAGE TREATMENT PLANT

SEWAGE TREATMENT PLANT
FLOOR PLAN
AT -3000 MM LEVEL

NR-STP-C104

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रुद्रप्रयाग

GOOD FOR CONSTRUCTION

Key Plan

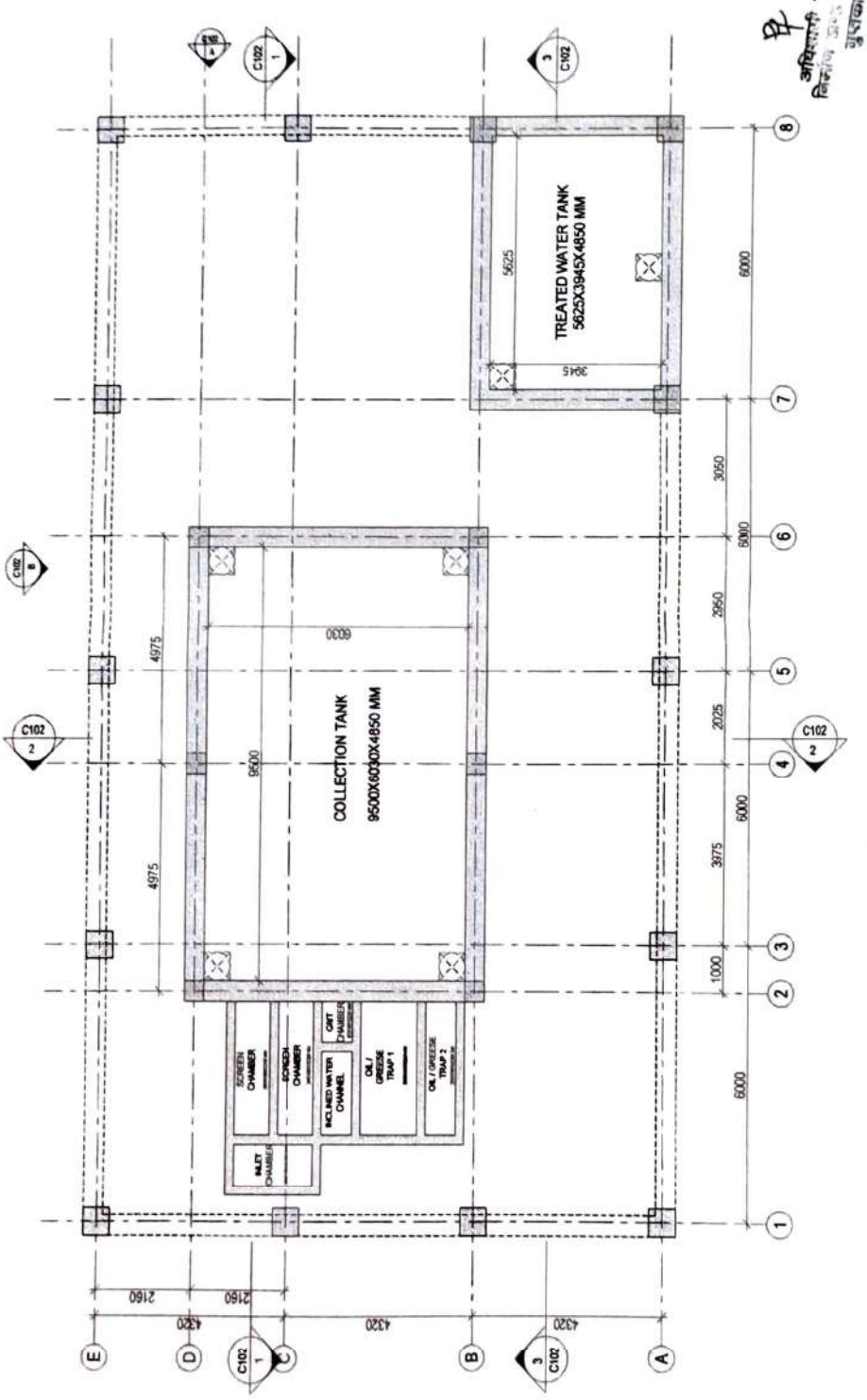
KEDARNATH RESTORATION AND REDEVELOPMENT

GOVERNMENT OF UTTARAKHAND

SEWAGE TREATMENT PLANT

SEWAGE TREATMENT PLANT FLOOR PLAN AT -600 MM LEVEL

KR-STP-C105



1 PLAN AT -600MM FROM GROUND LEVEL
1:50

इं० विनय झिंक्वाण
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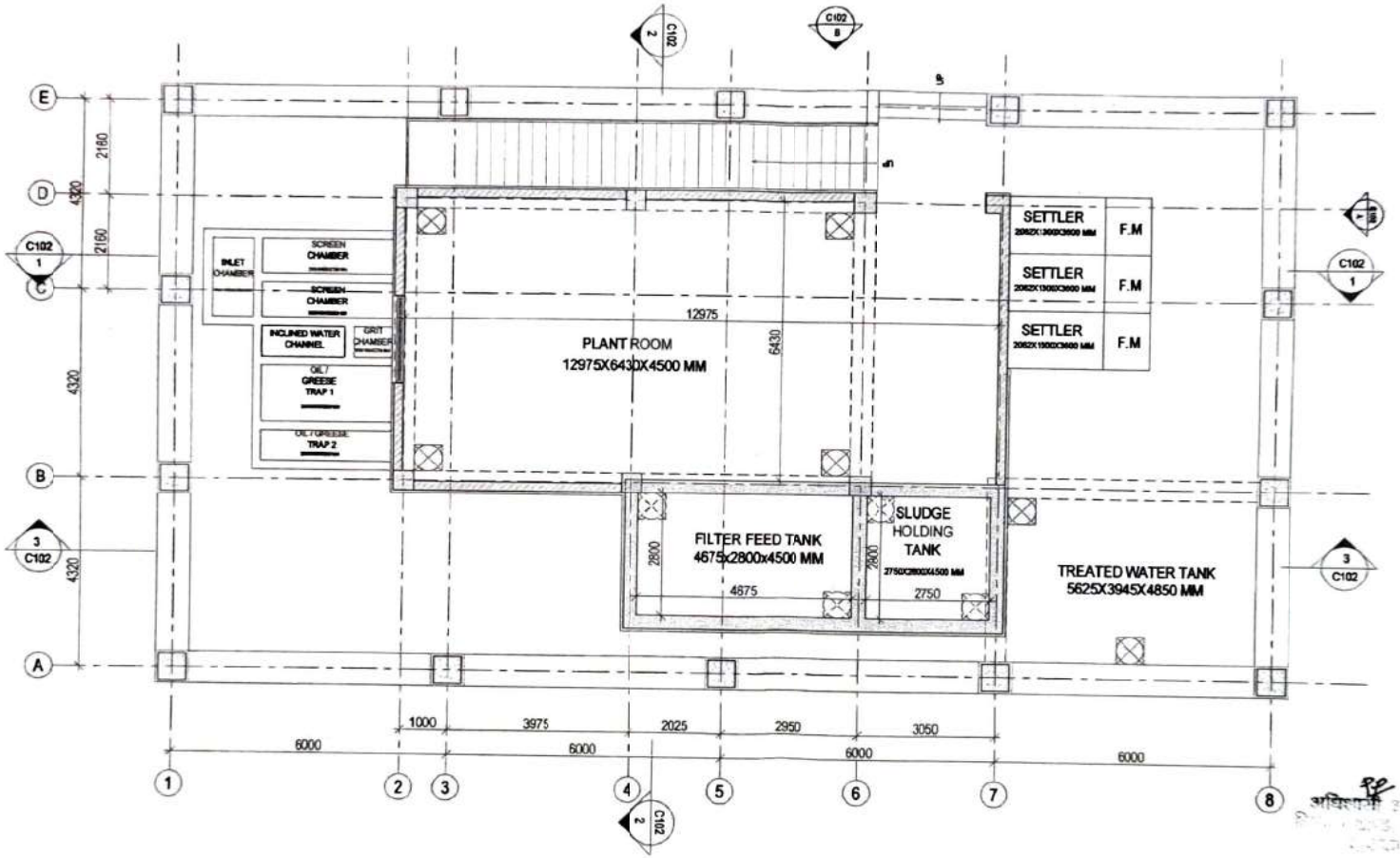
रुद्रप्रयाग



1 PLAN AT +1200MM FROM GROUND LEVEL
1:50

GOOD FOR CONSTRUCTION

Key Plan

KEDARNATH RESTORATION AND REDEVELOPMENT

GOVERNMENT OF UTTARAKHAND

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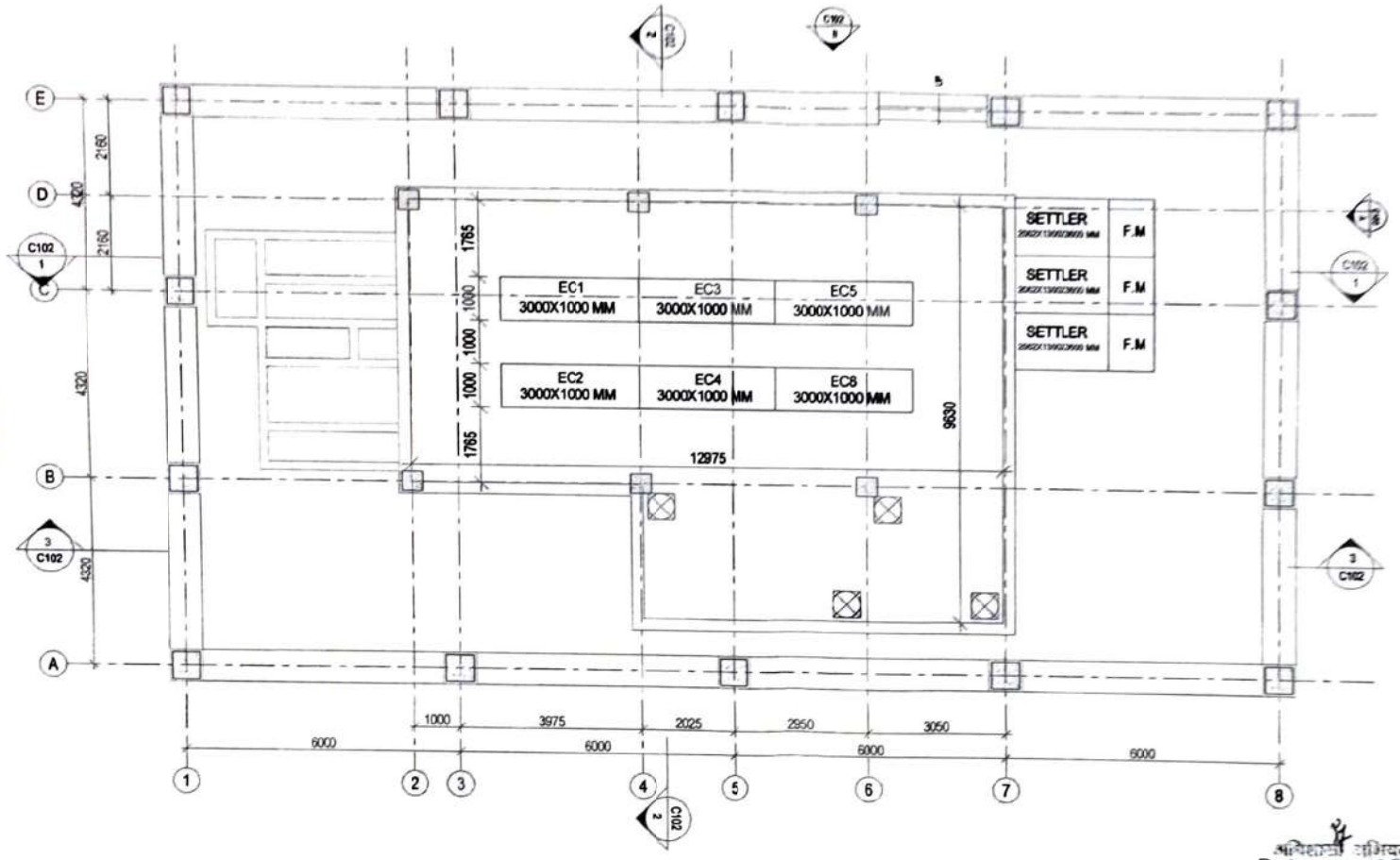
SEWAGE TREATMENT PLAN

SEWAGE TREATMENT PLANT
FLOOR PLAN
AT +1200 MM LEVEL

A2

KR-STP-C106

271



1 PLAN AT +6000MM FROM GROUND LEVEL

1:50

GOOD FOR CONSTRUCTION

KEDARNATH RESTORATION AND REDEVELOPMENT

GOVERNMENT OF UTTARAKHAND

SEWAGE TREATMENT PLANT

SEWAGE TREATMENT PLANT
FLOOR PLAN
AT +6000 MM LEVEL

A2

KR-STP-C107

272

GOOD FOR CONSTRUCTION

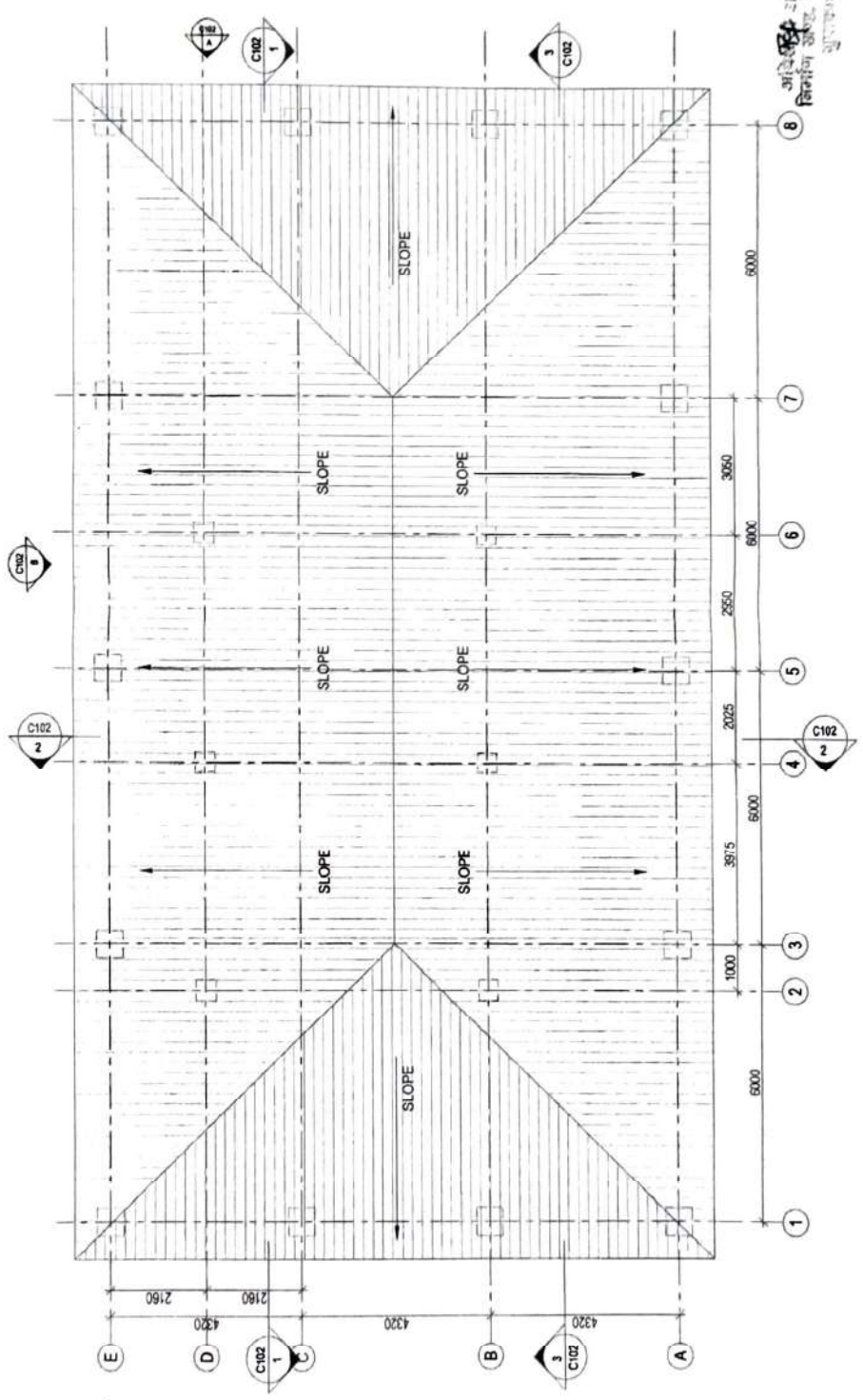
KEDARNATH RESTORATION AND REDEVELOPMENT

GOVERNMENT OF UTTARAKHAND

SEWAGE TREATMENT PLANT

ROOF PLAN

NR-STP-C108



1 ROOF PLAN 1:50

(इं. विनीत झिंक्वाण)
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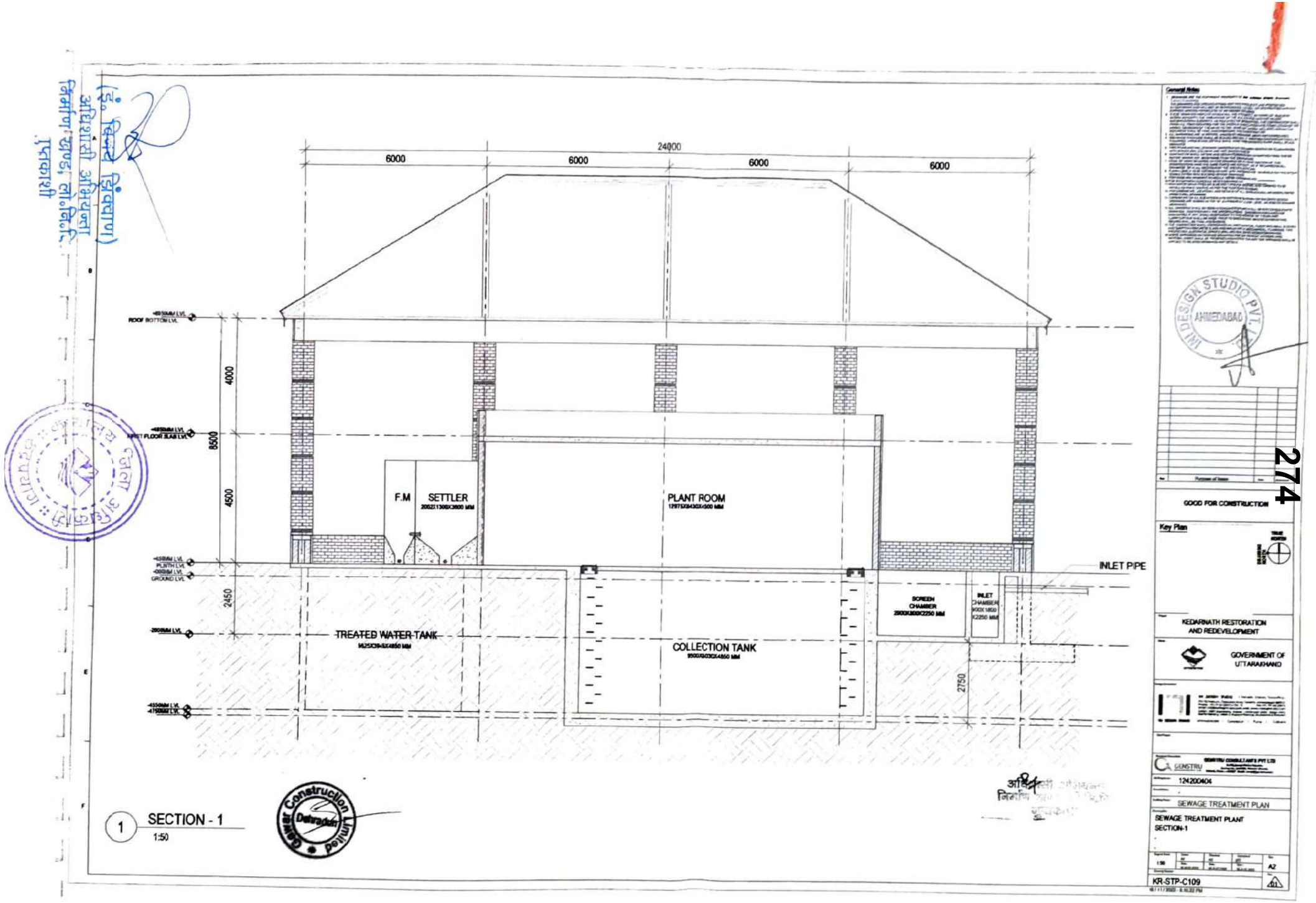
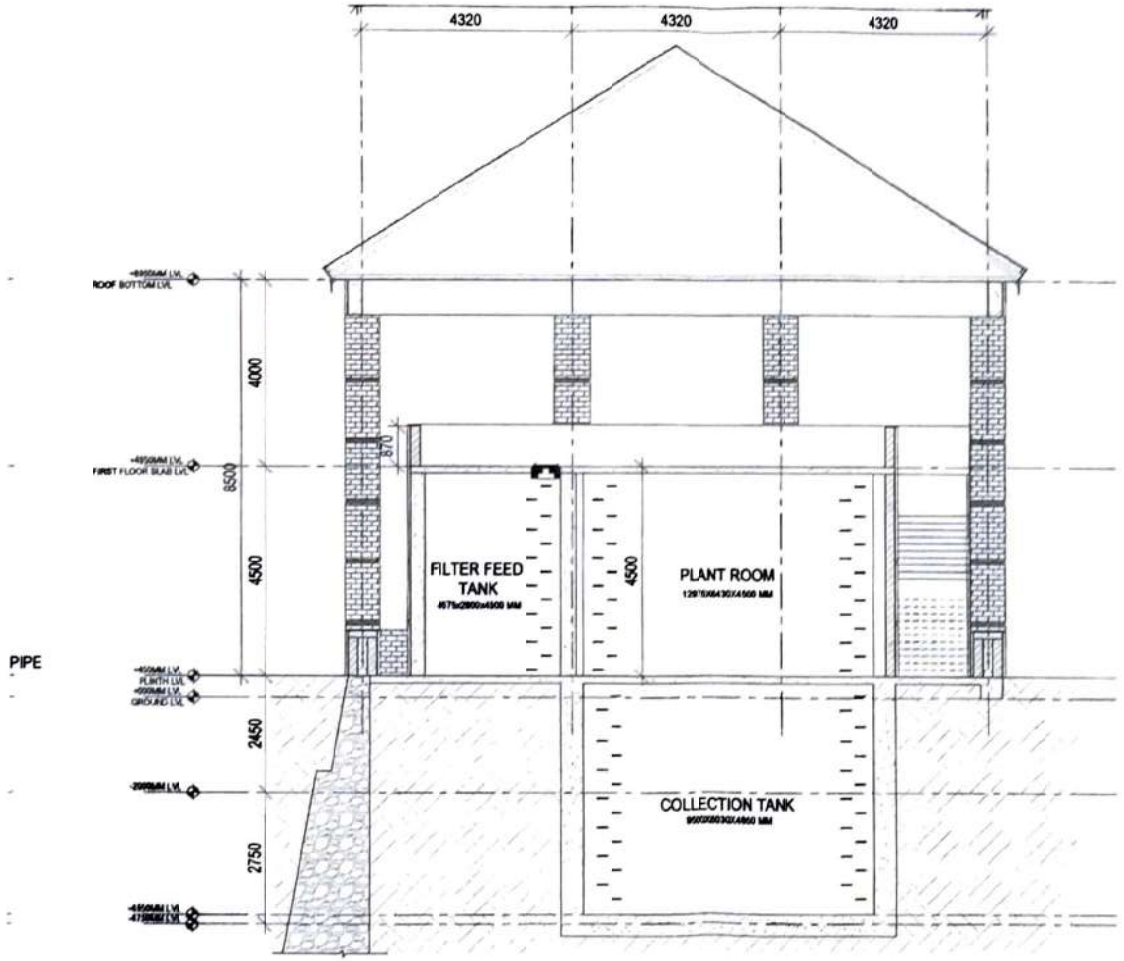
निर्माण खण्ड, लो.नि.नि.
रुद्रप्रयाग

जिला अधिकारी रुद्रप्रयाग


24000
6000
6000
6000
6000
4000
8500
4500
2450
F.M
SETTLER
PLANT ROOM
INLET PIPE
SCREEN CHAMBER
INLET CHAMBER
TREATED WATER TANK
COLLECTION TANK
2750
ROOF BOTTOM LVL
FIRST FLOOR SLAB LVL
PLINTH LVL
GROUND LVL
SECTION - 1
1:50
GOOD FOR CONSTRUCTION
KEDARNATH RESTORATION AND REDEVELOPMENT
GOVERNMENT OF UTTARAKHAND
SEWAGE TREATMENT PLAN
SEWAGE TREATMENT PLANT SECTION-1
KR-STP-C109
A2
274



1 SECTION - 2
1:50

GOOD FOR CONSTRUCTION

KEDARNATH RESTORATION AND REDEVELOPMENT

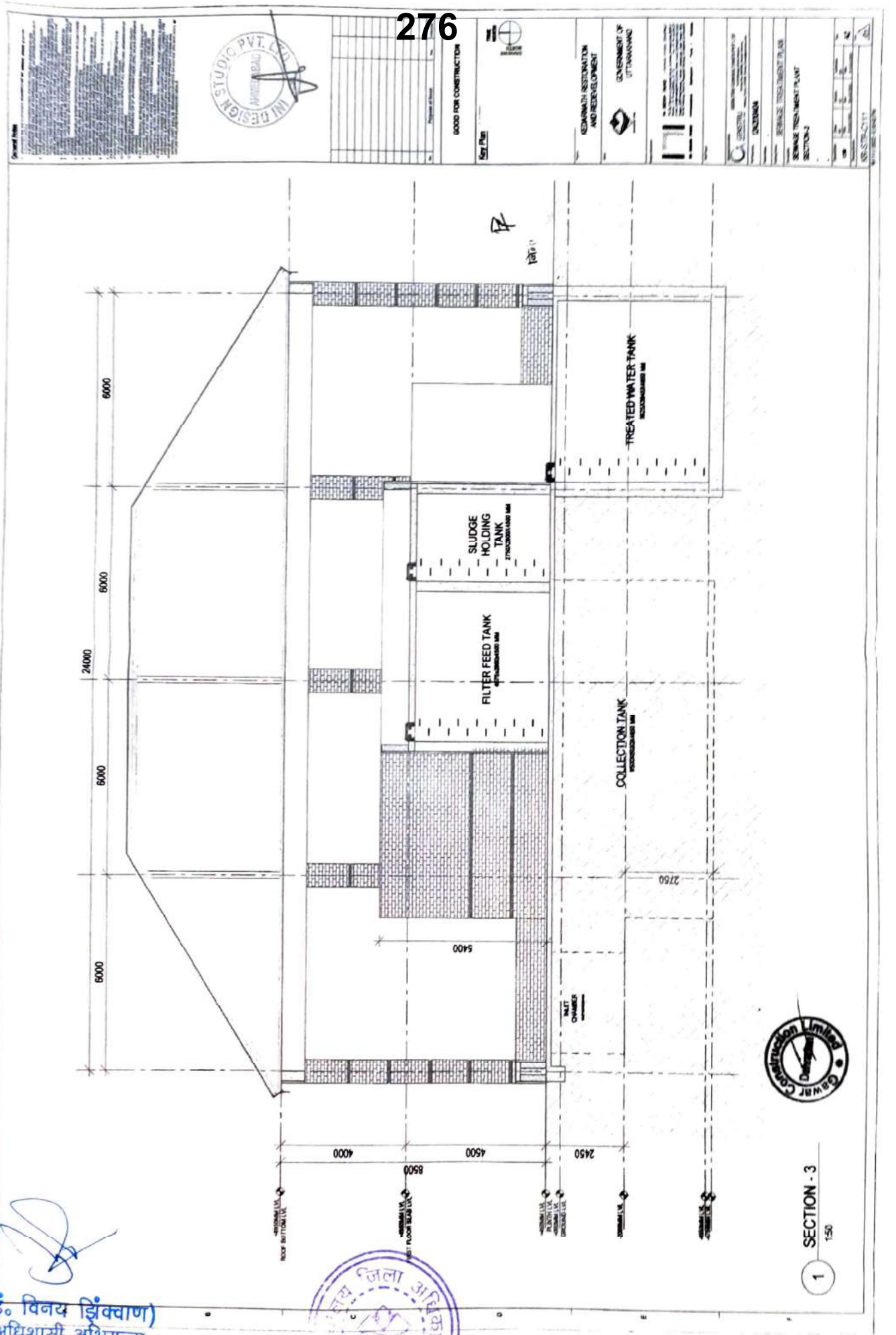
GOVERNMENT OF UTTARAKHAND

SEWAGE TREATMENT PLAN

SEWAGE TREATMENT PLANT
SECTION-2

KR-STP-C110

275



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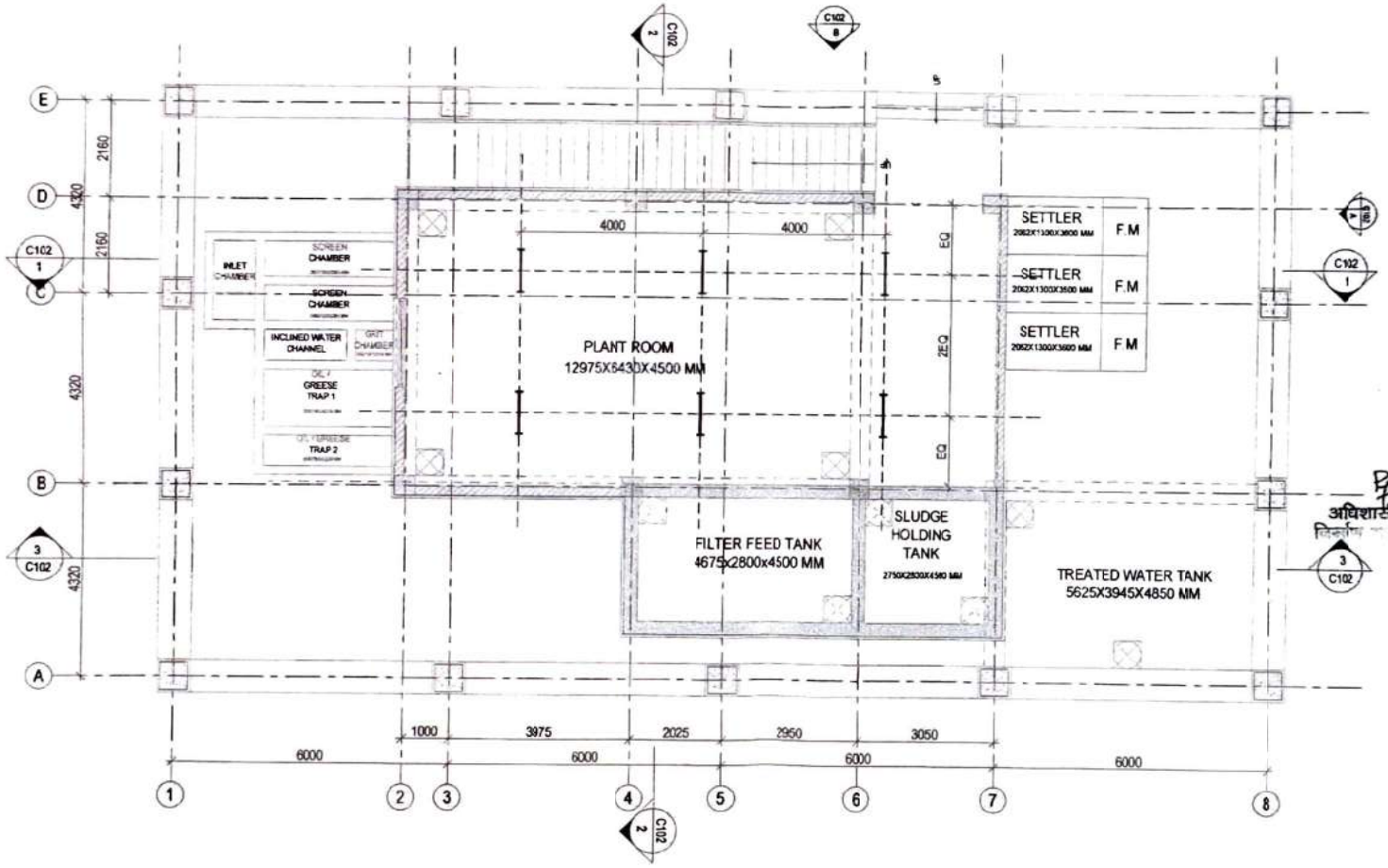

FLOOR PLAN AT +1200 MM LEVEL
REFLECTED CEILING PLAN - LIGHTING INTENT

1

SCALE 1:50

GOOD FOR CONSTRUCTION

Key Plan

KEDARNATH RESTORATION AND REDEVELOPMENT

GOVERNMENT OF UTTARAKHAND

GENSTRU CONSULTANTS PVT LTD

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SEWAGE TREATMENT PLAN

FLOOR PLAN AT +1200 MM LEVEL
REFLECTED CEILING PLAN
LIGHTING INTENT

A2

KR-STP-C112

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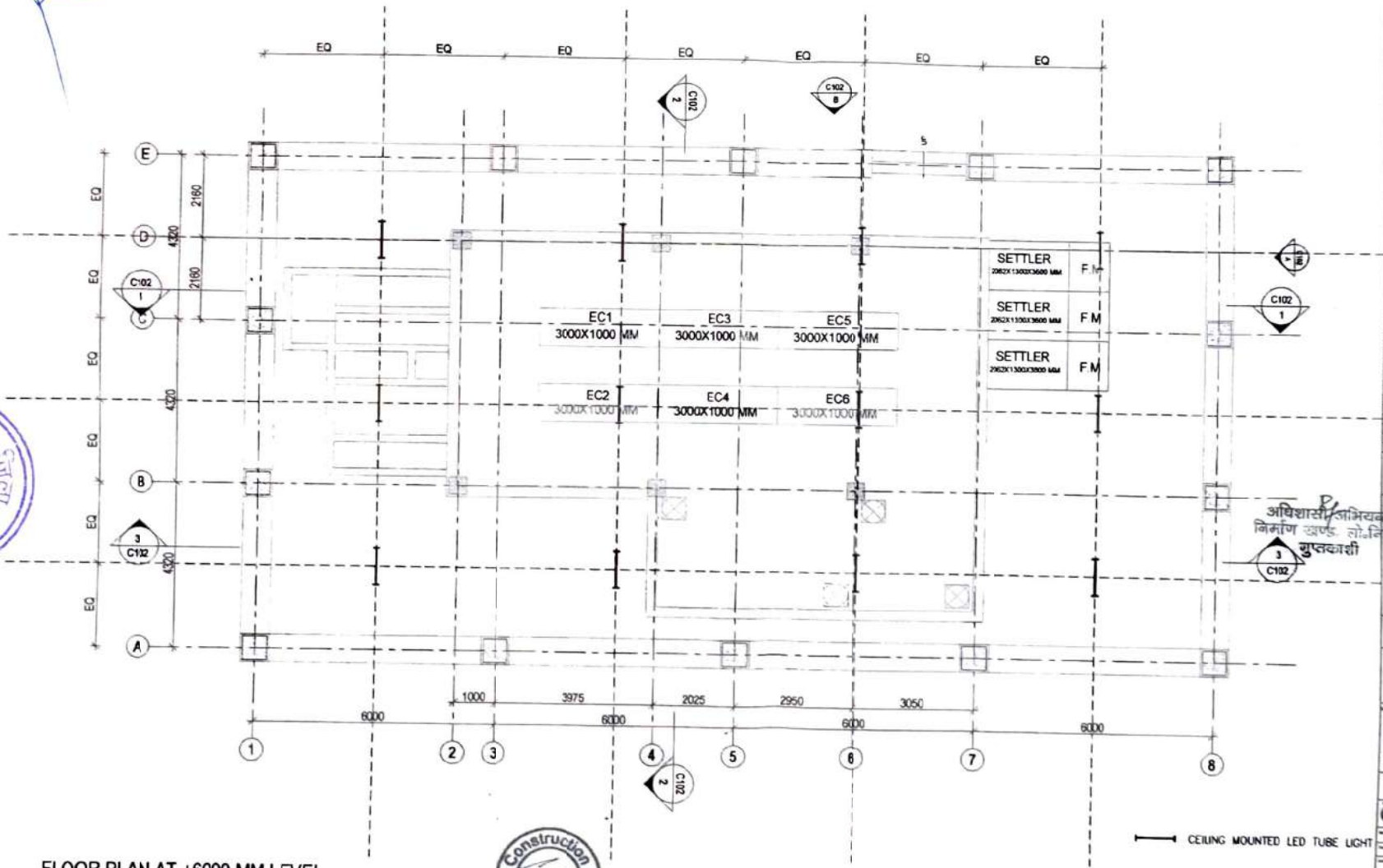
277



FLOOR PLAN AT +6000 MM LEVEL
REFLECTED CEILING PLAN - LIGHTING INTENT

1

SCALE 1:50

GOOD FOR CONSTRUCTION

Key Plan

KEDARNATH RESTORATION AND REDEVELOPMENT

GOVERNMENT OF UTTARAKHAND

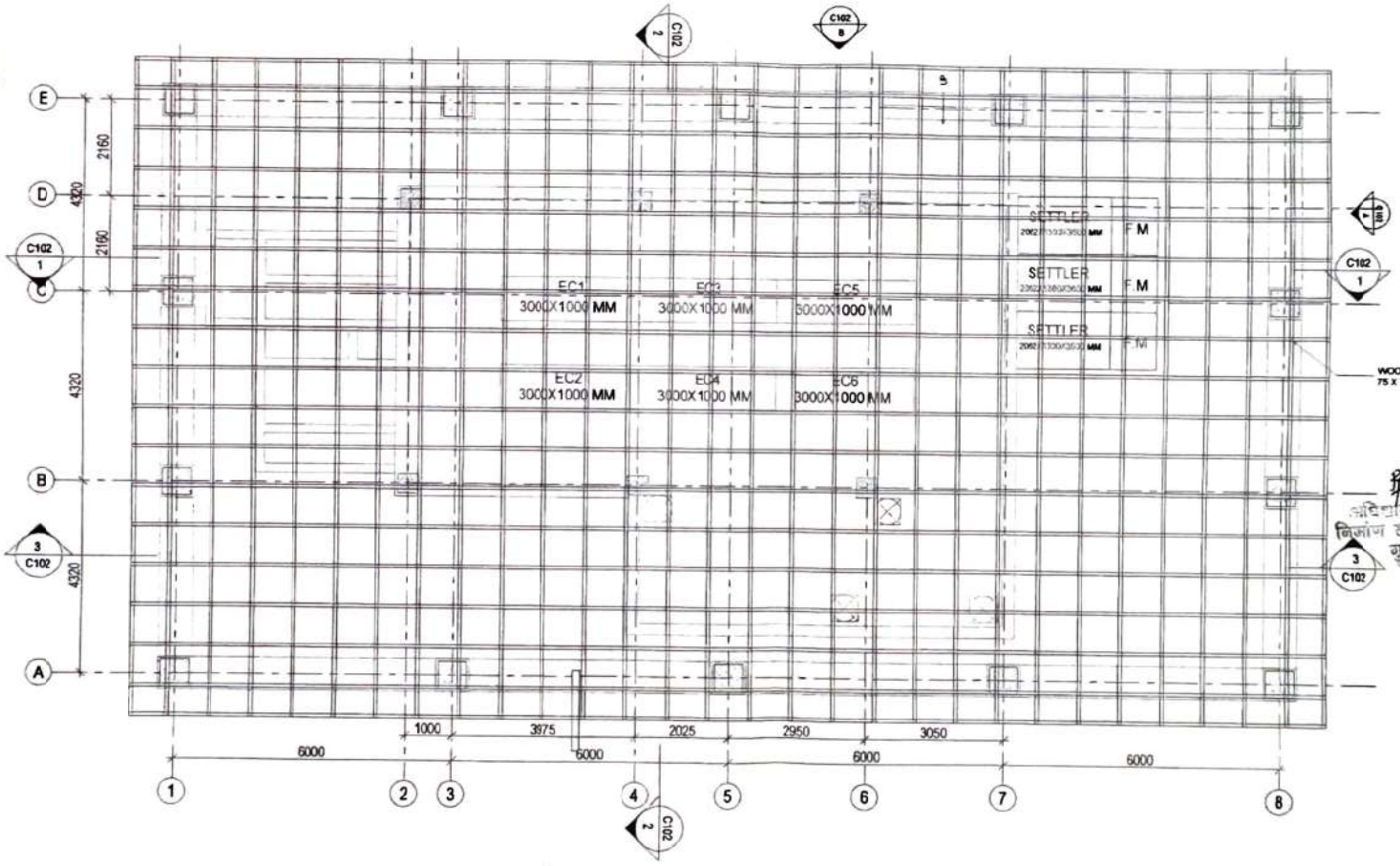
SEWAGE TREATMENT PLAN

FLOOR PLAN AT +6000 MM LEVEL
REFLECTED CEILING PLAN
LIGHTING INTENT

KR-STP-C113

A2

278



FLOOR PLAN AT +6000 MM LEVEL
REFLECTED CEILING PLAN - RAFTER GRID

1

SCALE 1:50

General Notes

GOOD FOR CONSTRUCTION

Key Plan

KEDARNATH RESTORATION AND REDEVELOPMENT

GOVERNMENT OF UTTARAKHAND

GENSTRU

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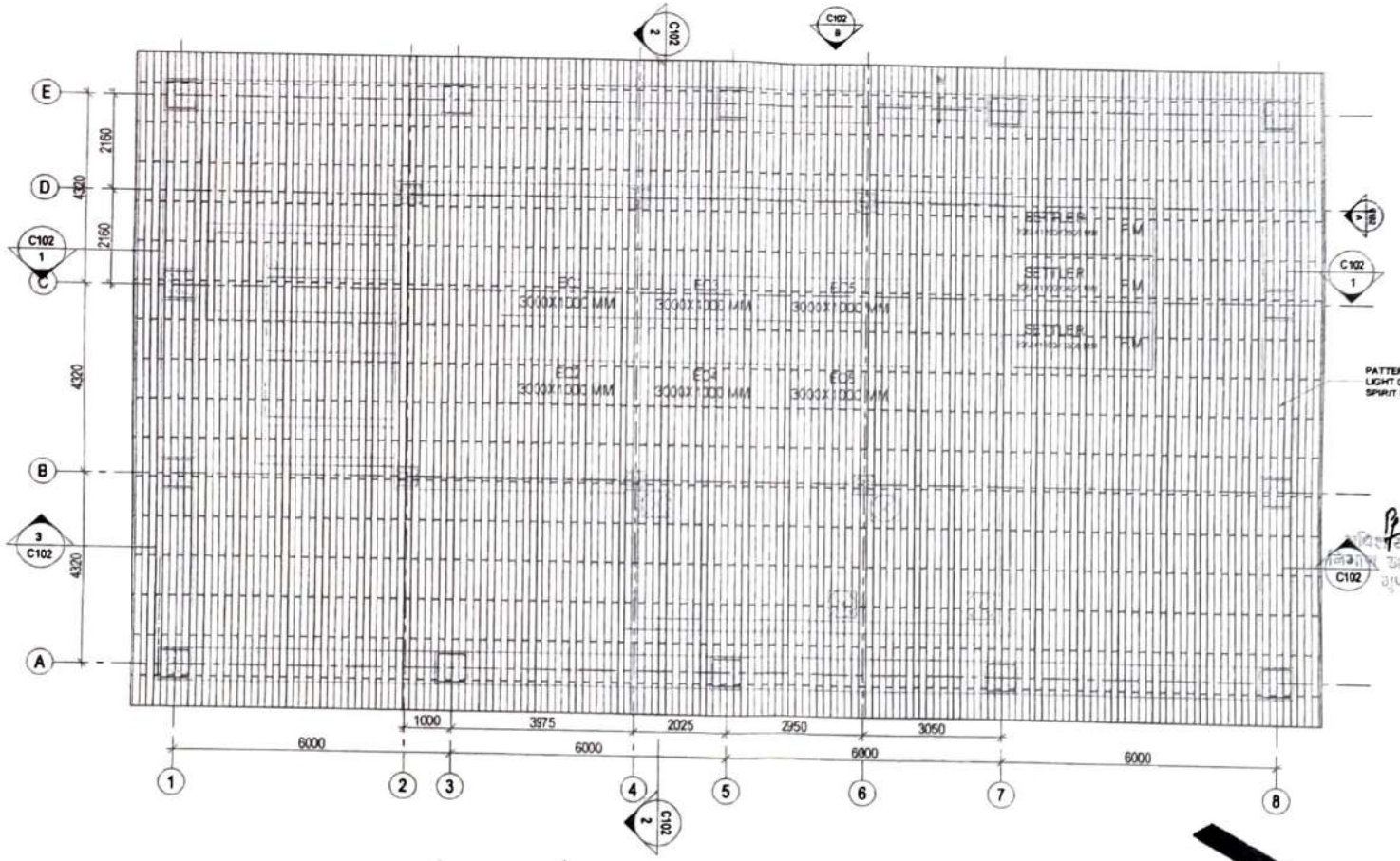
SEWAGE TREATMENT PLAN

FLOOR PLAN AT +6000 MM LEVEL
REFLECTED CEILING PLAN
RAFTER GRID

A2

KR-STP-C114

279



1 FLOOR PLAN AT +6000 MM LEVEL
REFLECTED CEILING PLAN - FALSE CEILING
SCALE 1:50

2 FALSE CEILING
PANEL DETAIL
SCALE 1:30

GOOD FOR CONSTRUCTION

Key Plan

KEDARNATH RESTORATION AND REDEVELOPMENT

GOVERNMENT OF UTTARAKHAND

GENSTRU CONSULTANTS PVT LTD

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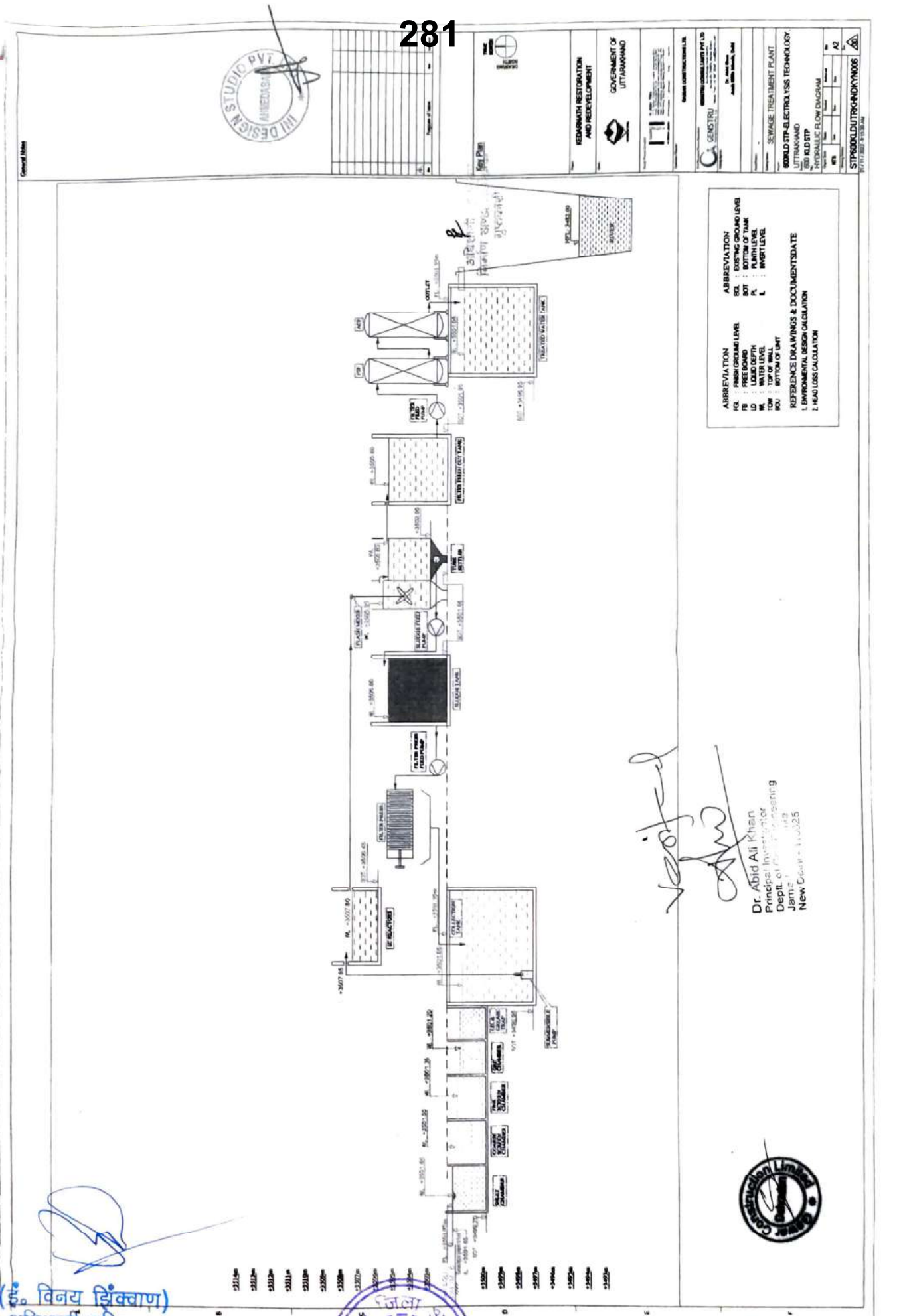
SEWAGE TREATMENT PLAN

FLOOR PLAN AT +6000 MM LEVEL
REFLECTED CEILING PLAN
FALSE CEILING

A2

KR-STP-C115

280



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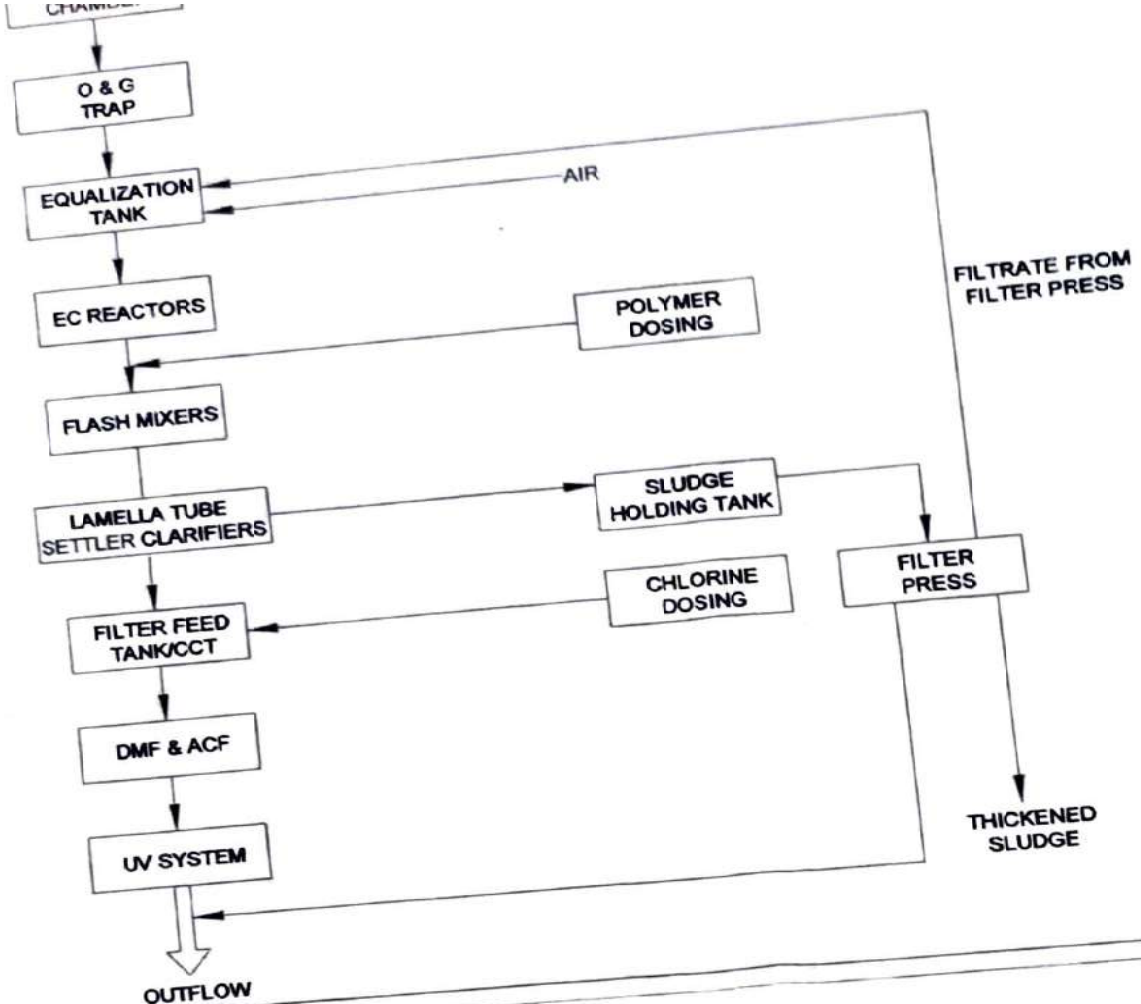

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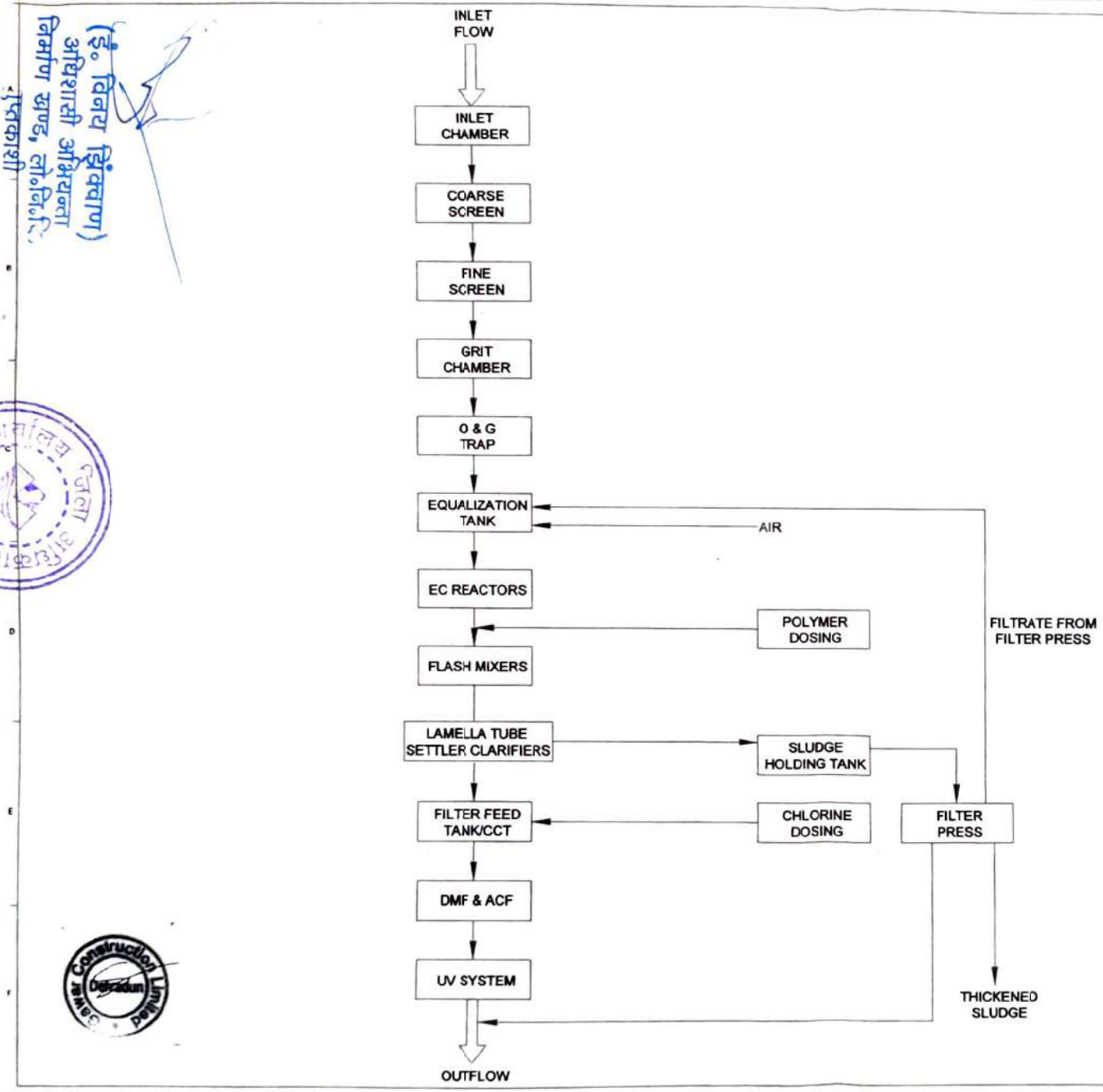
Key Plan



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रुद्रप्रयाग

Dr. Abid Ali Khan
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Jamia Millia Is...
New Delhi - 1...

General Notes

Key Plan

KEDARNATH RESTORATION AND REDEVELOPMENT

GOVERNMENT OF UTTARAKHAND

SEWAGE TREATMENT PLANT

600KLD STP-ELECTROLYSIS TECHNOLOGY, UTTRAKHAND

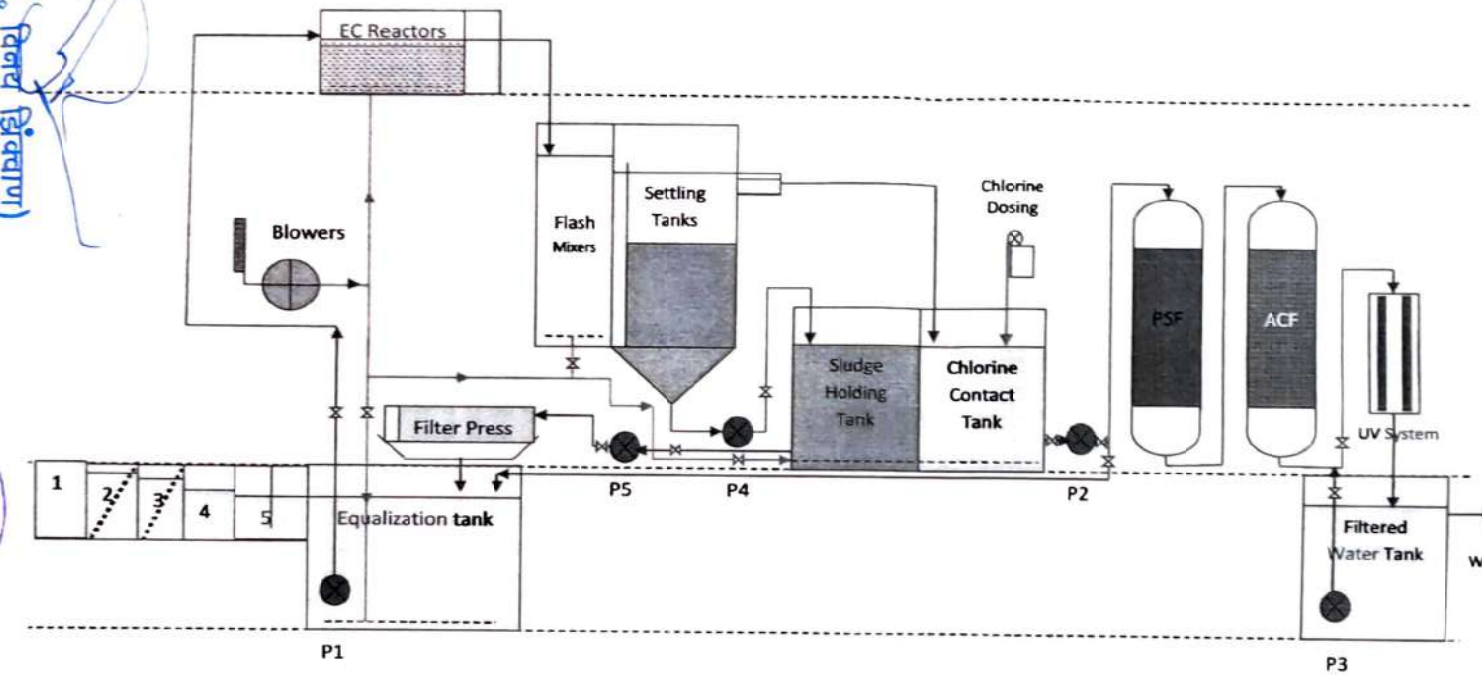
600 KLD STP

PROCESS FLOW DIAGRAM

NTS | A2

STP600KLDUTRKHNDKYN006

283



Legends	Item Name	Description	Qty
1	Inlet Chamber	Civil, Size: 900x1800x1500mm	1 Nos
2	Coarse Screen Chamber	Civil, Size: 2900x800x1500mm	1 Nos
	Coarse Screen	SS, Size 800x2000mm, with frame, 10mm slit/hole size, angle of inclination 60 degree	2 Nos
3	Fine Screen Chamber	Civil, Size: 2900x800x1500mm	1 Nos
	Fine Screen	SS, Size: 800x 2000mm, with frame, 5mm hole size, angle of inclination 60 degree	2 Nos
4	Grit Chamber	Civil, Size: 900x900x1500mm	1 Nos
5	Oil & Grease Chamber	Civil, Size: 900x1800x1500mm	1 Nos
	Equalization Tank	Civil, Size: 9500x6030x4350+500mm FB, HRT	1 Nos
P1	Sewage Transfer Pumps	Submersible cutter Pump, 30M3/Hr, 15M head, 5.5 KW, KBL	3 Nos
	pH Correction System	Dosing purrp, 0 to 10 lph, 4 bar, Dosing tank 100 Ltr, HDPE, Asia LMI	2 Nos
	Electrolyte Dosing System	Dosing purrp, 0 to 10 lph, 4 bar, Dosing tank 100 Ltr, HDPE, Asia LMI	2 Nos
	Electrocoagulation Reactors	M.SFRP inside, M.SEP outside, size: 2000x1000x1800mm, No. of electrodes 52 Nos, 12V, DC	6 Nos
	Flash Mixer	M.SEP, Size: 1000x1000x2000mm, agitation thru air	3 Nos
	Poly Electrolyte Dosing System	Dosing purrp, 0 to 10 lph, 4 bar, Dosing tank 100 Ltr, HDPE, Asia LMI	6 Nos
	Settling Tanks	M.SEP, Size: 2000x2000x1900+1800 slant+500mm FB, Surface Area 16.8M2	3 Nos
	Chlorine Dosing System	Dosing purrp, 0 to 10 lph, 4 bar, Dosing tank 100 Ltr, HDPE, Asia LMI	2 Nos
	Filter Feed/Cl2 Contact Tank	Civil, Size: 4675x2800x4000+500mm FB, HRT 95 minutes	1 Nos
P2	Filter Feed Pumps	Horizontal Centrifugal, 30M3/Hr, 28M head, 5.5KW, KBL	3 Nos
	Pressure Sand Filter	M.SEP, Size, HOS 1800xDia2000mm, Media quantity 3800 Kgs. approx., graded sand	1 Nos
	Activated Carbon Filter	M.SEP, Size, HOS 1800xDia2000mm, Media quantity 1600 Kgs. approx., GAC	1 Nos
P3	Filter Backwash Pumps	Submersible Pump, 45M3/Hr, 15M head, 3.7KW, KBL	2 Nos
	UV sterilizer Unit	SS-316, 30M3/Hr, UV Dose 60000uW-sec/cm2, 200V AC, 1370W	1 Nos
	Filtered Water Tank	Civil, Size: 5625x3925x4350+500mm FB, HRT 2Hrs 30minutes,	1 Nos
P4	Sludge Transfer Pump	Open Impeller Pump, 15M3/Hr, 15M head, 3.7KW, KBL	2 Nos
	Sludge Holding Tank	Civil, Size: 2750x2800x4000+500mm FB, HRT 1 hour	1 Nos
P5	Filter Press Feed Pump	Screw Pump, 5M3/Hr, 50M head, SS shaft, 3.3 KW, ROTO	2 Nos
	Filter Press	PP Recessed plates, 24"x24"x23 Nos, Sludge Holding capacity 290 Ltr, Hydraulic,	1 Nos
	Valves	Varied types, varied sizes depending upon the use, pipe size etc.	1 Nos

Dr. Abid Ali Khan
Principal Investigator
Dept. of Civil Engineering
Jamia Millia Islamia
New Delhi-110025

Power Construction Ltd. Dehradun

KEDARNATH RESTORATION AND REDEVELOPMENT

GOVERNMENT OF UTTARAKHAND

GENSTRU

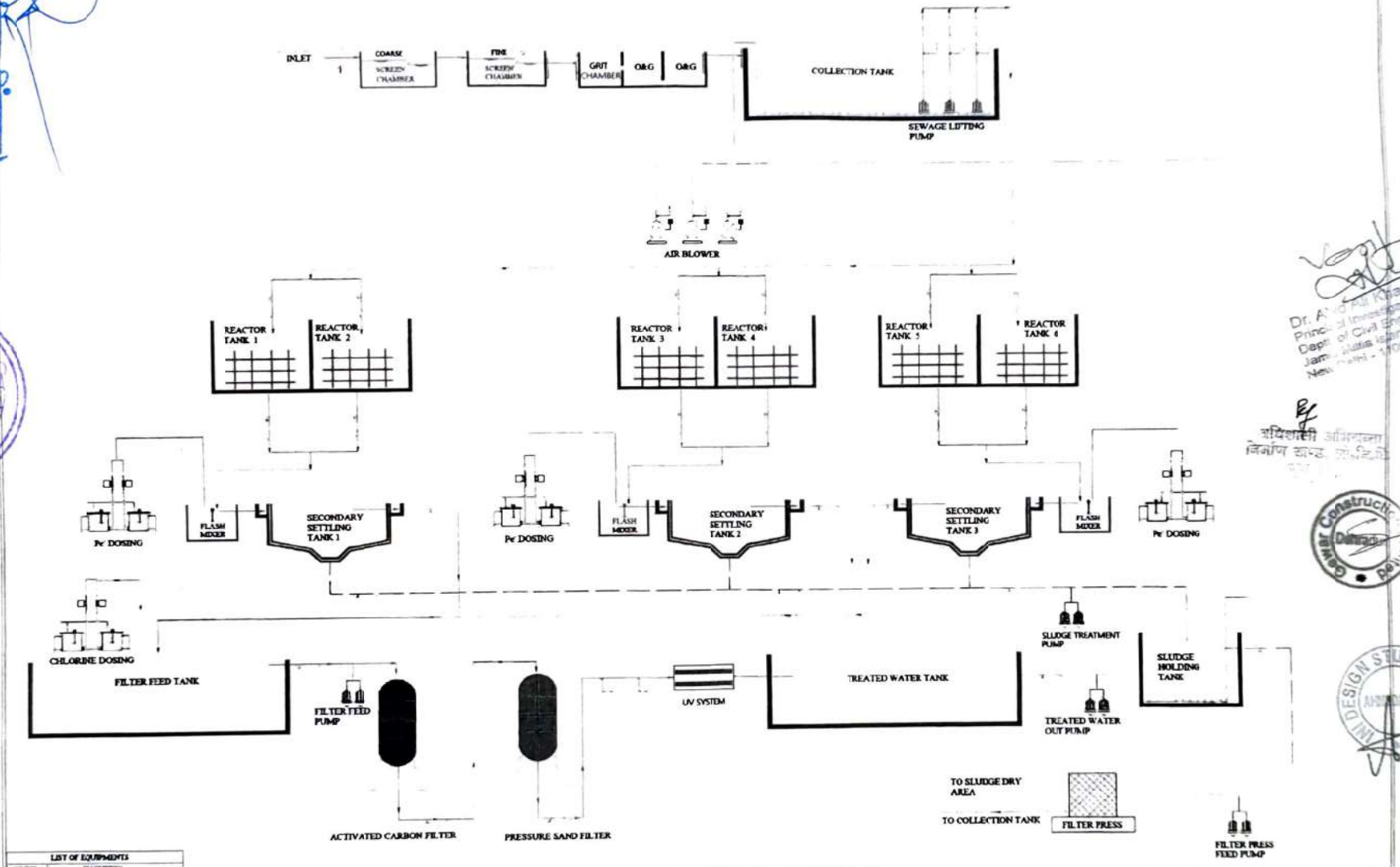
SEWAGE TREATMENT PLANT

500KLD STP-ELECTROLYSIS TECHNOLOGY, UTTRAKHAND
500 KLD STP

PROCESS FLOW DIAGRAM

STP500KLDUTRKHNDKYN006

284



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Dr. Arshad Ali Khan
Principal Investigator
Dept. of Civil Engineer
Jamia Millia Islamia
New Delhi - 110025

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निर्माण खण्ड

Gaur Constructions Limited
Dehradun

AV DESIGN STUDIO PVT. LTD.
AHMEDABAD

285

SECTION VII

CATALOGUES AND BROCHURES

Dr. Abid Ali
Principal Investigator
Deptt. of Civil Engineering
Jamia Millia Islamia
New Delhi - 110025

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(इं० विनय झिंक्वाण)
अधिशासी अभियन्ता
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एतकाशी

कार्यालय जिला अधिकारी रुद्रप्रयाग

7.1 Oil Skimmer

UNIVERSAL TECH TRADE PVT. LTD.

TEST CERTIFICATE

Product	: Oil Skimmer	INVOICE NO. : UTT/0573/21-22
		DATE : 25-09-21
		CLIENT : Meridian Micro Technology
S.NO	Description	
1	Make	Universal
2	Model/Size	UTT-OS100
3	Quantity	1Nos.
4	Size of Belt	4"x 2400 M End Less
5	MOC	Roller in GI & Other Parts in MS.
6	RPM	48
7	Type	Horizontal Type Gear
8	Motor	0.18kw/1450Rpm/Flanged
9	Power Supply	3 Phase/415Volts
10	Motor Make	CG
11	Oil Removal Capacity	50 lph in pure oil
12	Connection Size:	1"

UNIVERSAL TECH TRADE PVT. LTD. Plot No-48 First Floor, Peera Garhi New Delhi-87

Authorised Dealer : wilo Mather&Platt Rota

Deals in : Water Supply Pump, Sewage Pump, Screw Pump, Dosing Pump, Filter Press, Centrifuge, Oil-Skimmer, U.V. System, Bio-Pac Media, Tube Deck Media, Air Diffusers & Agitator etc.

Regd. Office : G-12/6, Laxmi Park, Nangloi, New Delhi - 110041 | Works : G-335, Adhyapak Nagar, Nangloi, New Delhi - 110041

Ph. : 011-65069300 Mob. : 9873173288, 9810572578 E-mail : universaltechtrade@gmail.com www.universaltechtrade.com

Sewer Construction Limited Dehradun

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7.2 Air Blower

ROOTS BLOWERS

AIR COOLED SERIES

EVEREST TWIN LOBE ROTARY AIR COMPRESSORS

A complete range of Standard Blowers is available for flow rates from 25 m3/hr through 7,000 m3/hr in single stage and upto any capacity in parallel configurations, for working pressures upto 1 kg/cm2. They are available as total package units, ready to install or as bare blower units for replacement.

Our technology is so flexible, we can custom manufacture "Special Air Blowers" by altering and cross linking diverse designs to suit individual requirements and impart substitutes.

STANDARD DESIGN AND CONSTRUCTION FEATURES

- 100% oil free air delivery.
- Factory engineered, factory guaranteed, superior product.
- Alloy steel hardened and ground timing gears.
- Anti-friction bearings.
- Rotary oil sealings.
- Rigid one piece CI casing and side plates.
- Horizontal and vertical configurations available.
- Easy rotor timing setting.
- No vanes, valves or rings to wear.
- Large inlet and outlet connections for minimum loss.
- Improved volumetric efficiency and reduced operating temperatures.
- Alloy steel toughened shafts ground to close tolerances.

APPLICATIONS

- ***Water Treatment Plants*** For backwashing of filter/mixed beds.
- ***Effluent Treatment Plants*** For diffused aeration and agitation of effluent.
- ***Cement Plants*** For Blending, Aeration, Fluidization, Conveying.
- ***Aquaculture*** For maintaining the dissolved Oxygen level.
- ***Chemical Plants*** For supplying of process air.
- ***Electroplating Plants*** For Oil Free air agitation of electrolyte.
- ***Paper Plants*** Knife edge coating, Drying, Conveying, Vacuum pickup.
- ***Yarn Drying*** Vacuum/Pressure Drying of Yarn.
- ***Vacuum Moulding*** For creating quick vacuum.
- ***Polyster Chip Conveying & drying*** For transfer of polyster Chips and other similar materials.
- ***Bag Filters*** For reverse cleaning of Filter bags.
- ***Pneumatic Conveying*** Vacuum, Pressure and Combination Conveying of cereals, cement, husk, baggase, granules, powders and other similar material.
- ***Regeneration of Dryers & Molecular Sieves.***

THE EVEREST ADVANTAGE

Retain your advantage with factory genuine replacement parts.

- All parts meet original manufacturing specifications and tolerances for guaranteed fit and function.
- Pre-packaged overall kits with detailed service manuals are available on request.

WE JUST DON'T OFFER BLOWERS, WE OFFER SOLUTIONS!

PRODUCT RANGE

Air Blowers–Water Cooled Blowers–Gas Blowers–Vacuum Booster Pumps–Acoustic Hoods & Enclosures–Dry Vane Pumps

EVEREST Transmission

Gener Construction Limited Dehradun

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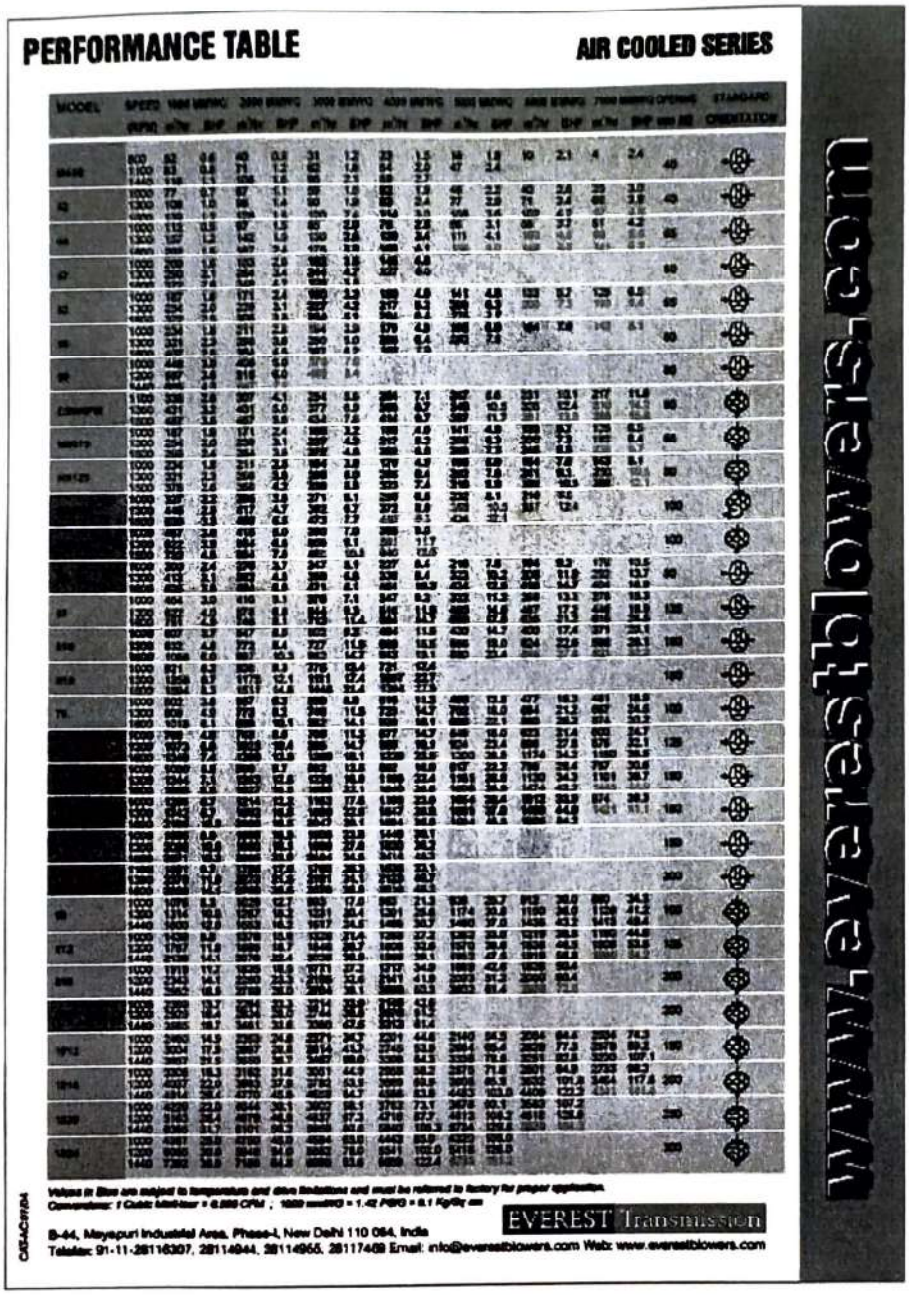
निर्माण खण्ड, लो.नि.नि.
एतवाली

कार्यालय जिला अधिकारी रुद्रप्रयाग



PERFORMANCE TABLE

AIR COOLED SERIES

www.everestblowers.com

Values in Blue are subject to temperature and drive limitations and must be referred to factory for proper application.

Conversions: 1 Cubic Meter/hour = 0.589 CFM ; 1000 mmWG = 1.42 PSIG = 0.1 Kg/Sq cm

EVEREST Transmission

B-44, Mayapuri Industrial Area, Phase-I, New Delhi 110 064, India

Telefax: 91-11-28116307, 28114944, 28114955, 28117469 Email: info@everestblowers.com Web: www.everestblowers.com

CEAC/01/04

Power Construction Limited Dehradun

(इं० विनय डिंक्वाण)
अधिशासी अभियन्ता
निर्माण खण्ड, लो०नि०दि.
एतकाशी

जिला अधिकारी कार्यालय रुद्रप्रयाग

7.3 Sewage Transfer Pump

KIRLOSKAR PUMPS

ETERNA CW

SEWAGE DE-WATERING SUBMERSIBLE PUMPS

TECHNICAL SPECIFICATION

Head Range	: Upto 70 Metres
Discharge Range	: Upto 4800 LPM
Power Rating	: 0.75 to 15 kW (1 to 20 HP)
Voltage Range	: 380 to 440 Volts (Three phase.)
pH Value	: 6.5 to 7.5
Maximum Density	: < 1050 kg/m³
Protection	: IP 68
Consistency of Medium	: < 1.2 x 10³ kg/m³
Maximum Ambient Temperature	: 40 °C
Insulation	: 'B'/ 'E'Class

MATERIAL OF CONSTRUCTION

Impeller	: Cast Iron
Delivery Casing	: Cast Iron
Motor Body	: Cast Iron
Pump Shaft	: Carbon Steel

APPLICATIONS

- Sewage pumping
- Dewatering from basements, multi-storeys, shopping malls, godowns
- Construction site
- Dewatering foundation, trenches and pits
- Flood water handling

FEATURES

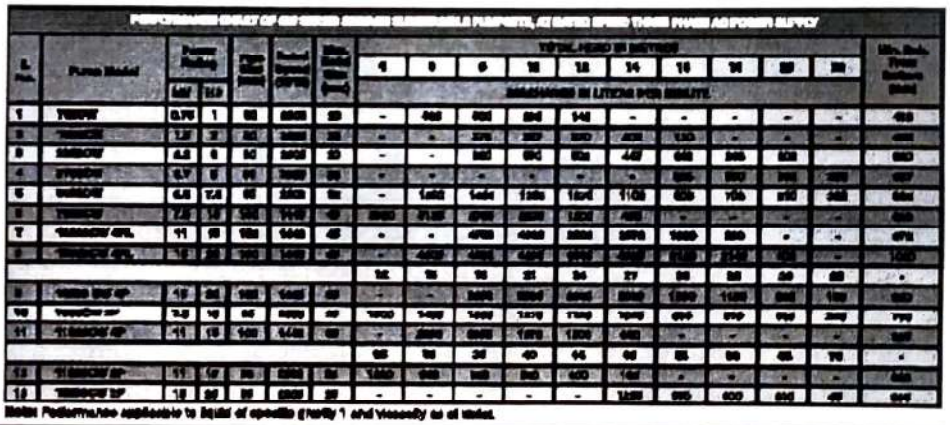
High Efficiency and Energy Saving Design
Innovative design manufactured at state of art plant, delivers optimum efficiency at lower energy consumption resulting in significant cost savings.

Easy Maintainable Designs
Easy maintainable design and better interchangeability of components so that pump can be serviced even at remote locations by semi-skilled technicians.

Robust Construction
Heavy duty construction made from graded cast iron, carbon + alloyed castable mechanical seal makes the pump suitable for sewage and sludge.

Replaceable Wearing Parts
All wearing parts within the pumps are easily accessible and replaceable which facilitates ease of maintenance thereby extending the life of the pump.

Dynamically Balanced Rotating Parts
Minimum vibrations protect components from damages during the operations, thus ensuring consistent performance as consistently is maintained.



Note: Performance applicable to liquid of specific gravity 1 and viscosity as of water.

KIRLOSKAR BROTHERS LIMITED
A Kirloskar Group Company
Established 1888

Service Toll-Free No.
1800 103 4443

Registered Office & Global Headquarters : "Yamuna", Survey No. 98/2(part), Plot No. 3, Baner, Pune 411 045, State Maharashtra, India.
Tel.: +91 (20) 2721 1111 Fax: +91 (20) 27211050 Email: marketing@kirloskar.com Website: www.kirloskarpumps.com CIN No.: L29130PN1920PLC000670

Ganesh Construction Limited
Dehradun

(इं. विनय झिंक्वाण)
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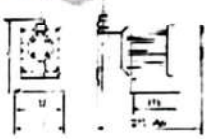
लोक निर्माण विभाग जिला अधिकारी रुद्रप्रयाग

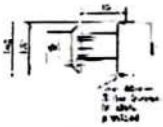
7.4 Dosing Pump

SERIES B

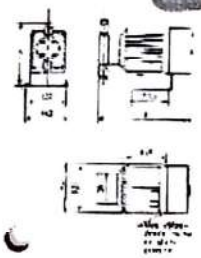


TYPICAL PERFORMANCE

PUMP MODEL	CAPACITY MIN CC/HR	CAPACITY MAX LI'H	MAX. INJ. PRESS KG/CM²	DIAPHRAGM SIZE (Sq.Inch)	DIMENSION DETAILS A	SIZE OF TUBING OD x ID	NET WEIGHT
B-11, B-71, B91	60	6.0	10.0	0.9	210	3/8"X1/4"	Plastic Liquid end 5.5 kg, Metallic Liquid end 6.0 kg
B 12, B 72, B92	95	9.5	7.0	0.9			
B 13, B-73, B93	170	17.0	3.5	1.8	210	1/2" x 3/8	



SERIES D



TYPICAL PERFORMANCE

PUMP MODEL	CAPACITY MIN CC/HR	CAPACITY MAX LPM	MAX. INJ. PRESS KG/CM²	DIAPHRAGM SIZE (Sq.Inch)	DIMENSION DETAILS A	DIMENSION DETAILS B	SIZE OF TUBING OD x ID	NET WEIGHT Plastic	NET WEIGHT Metallic
D-10/D-70/D-90	50	5.0	18.0	0.9	210	278	3/8"x1/4"	8.5 kg	9.0 Kg
D-11/D-71/D-91	100	12.0	9.0	.8					
D 12/D 72/D 92	150	17.0	7.0	1.8			1/2"x3/8		
D-13/D-73/D-93	250	35.0	4.0	3.0					
D-14/D-74/D-94	600	90.0	1.5	6.0	235	295	1/2"x3/8	9.0 kg	10.5 kg

MATERIAL OF CONSTRUCTION

PART	MATERIAL			
HEAD	PP	PVC	PVDI	CPBM
DIAPHRAGM	TEFLON FACED HYPALON	TEFLON FACED HYPALON	TEFLON FACED HYPALON	TEFLON FACED HYPALON
BALL	CERAMIC	CERAMIC	CERAMIC	CERAMIC
RING SEAL	TEFLON	TEFLON	TEFLON	TEFLON
SUCTION / DISCHARGE VALVE	PVC	PVC	PVC	SS - 316
ANTISYPHON VALVE	PVC	PVC	PVC	SS - 316
FOOT VALVE	PVC	PVC	PVC	SS - 316
TUBING	LDPE	LDPE	LDPE	LDPE

Gaur Construction Limited Dehradun

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7.5 Filter Feed Pump

Enriching Lives

KDS+ Three Phase Monobloc Pumps | **KDT+** Monobloc Pumps

Approximate performance of "KDT+/ KDS+/++, 2 Pole, Monobloc Pumps, at rated voltage, 50 Hz, Three Phase A.C. Power Supply

PUMP MODEL	POWER RATING		PIPE SIZE		TOTAL HEAD IN METRES																	RATED VOLTAGE (VOLTS)
					28	32	36	40	44	48	52	56	60	64	68	72	76	80	90	94	98	110
	kW	HP	SUC.	DEL.	CAPACITY IN LITRES PER SECOND																	
KDT-544+	3.7	5.0	65	50	8.8	6.2	5.6	4.8	2.5													400
KDS-550+ +	3.7	5.0	50	40			4.1	3.7	3.3	2.7	2.0											400
KDT-558+	3.7	5.0	80	40			4.3	4.0	3.7	3.4	3.0	2.5	2.0	1.0								400
KDS-644+ +	5.5	7.5	65	65	10.3	9.5	8.4	7.1	4.7													400
KDT-844+	5.5	7.5	80	65	11.5	10.8	10.0	9.0	7.5													400
KDS-882+ +	5.5	7.5	65	50		8.5	8.1	7.5	6.5	5.9	4.5											400
KDT-864+	5.5	7.5	80	50			7.3	7.0	6.5	6.0	5.5	5.0	4.2	2.7								415
KDS-1065+ +	7.5	10.0	65	65	12.5	12.0	11.4	10.7	9.6	8.1	6.0											415
KDT-1080+	7.5	10	80	65	13.6	13.3	12.4	11.5	10.5	9.2	8.5											415
KDS-1085+ +	7.5	10.0	65	50				7.5	7.4	6.5	6.4	5.5	5.1	4.3	3.0							415
KDT-1078+	7.5	10.0	65	50			8.2	8.0	7.8	7.5	7.1	6.7	6.2	5.6	4.9	4.0	2.9					415
KDS-1245+	9.3	12.5	80	65	12.7	12.3	12.0	11.3	11.0	8.3												415
KDS 1260	9.30	13	65	50	12.2	11.9	11.7	11.0	11.0	9.6	8.9											415
KDT-1272+	9.3	12.5	65	65			11.9	11.0	10.5	9.5	9.2	8.0	7.5	7.0	6.0	5.0	2.5					415
KDT-1380+	9.3	12.5	65	50									7.5	6.9	6.5	5.7	5.0	5.4	2.9			415
KDS-1555+	11.0	15.0	80	65		13.2	12.9	12.4	12.0	11.5	12.2											415
KDS 1570+	11	15	65	50		13.0	12.7	12.5	11.7	11.5	10.7	9.7	9.0	8.0	6.5							415
KDS-1575+	11.0	15.0	65	50							8.1	7.7	7.4	6.9	6.4	5.5	4.9					415
KDT-1580+	11.0	15.0	65	65						11.3	10.5	10.1	9.5	9.0	8.3	7.5	7.1	6.3	3.2			415
KDT-1536+	11.0	15.0	65	50												7.5	7.1	6.7	5.7	5.3	4.5	1.75	415
KDS-2050+	15.0	20.0	100	80	20.4	20.0	27	25.0	22.5	19.4	2.0											415
KDT-2070+	15.0	20.0	80	65				20.0	19.0	17.5	16.5	15.1	13.5	12.0	10.0	8.0						415
KDT-2084+	15.0	20.0	65	65											12.0	11.5	10.9	10.2	8.0	7.5	6.5	415
KDS-2560+	18.7	25.0	100	80						24.5	22.0	18.6	13.0									415
KDS-3060+	22.0	30.0	100	80						28.0	26.5	24.5	21.5	17.5	13.0							415

Note: KDT+/A... KDT-568+ ... KDT-844+ ... M...

KDS+/A... KDS-1575+ ... M... A...

P... 1...

04

Gawar Construction Limited Dehradun

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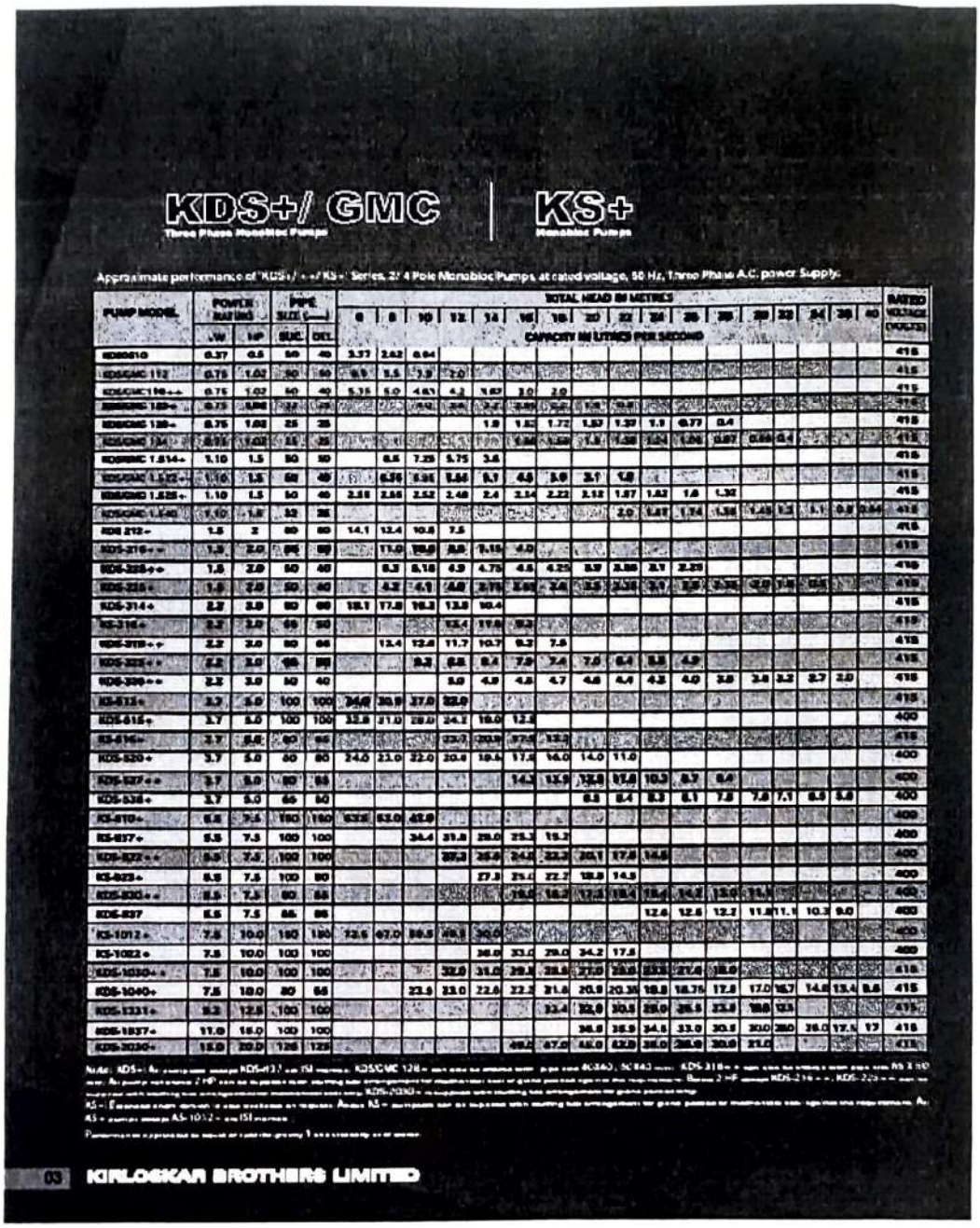
7.6 Filter Backwash Pump



KDS+/ GMC
Three Phase Monobloc Pumps

KS+
Monobloc Pumps

Approximate performance of 'KDS+/ GMC / KS+' Series, 2/ 4 Pole Monobloc Pumps at rated voltage, 50 Hz, Three Phase A.C. power Supply.

PUMP MODEL	POWER RATING		PIPE SIZE (mm)		TOTAL HEAD IN METRES																RATED VOLTAGE (VOLTS)
					6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	40
	kW	HP	SUC.	DEL.	CAPACITY IN LITRES PER SECOND																
KDS0810	0.37	0.5	50	40	3.37	2.62	0.64														415
KDS/GMC 112	0.75	1.02	50	50	6.9	5.5	3.9	2.0													415
KDS/GMC 116-+	0.75	1.02	50	40	5.35	5.0	4.61	4.2	3.87	3.0	2.0										415
KDS/GMC 120+	0.75	1.02	32	25																	415
KDS/GMC 128+	0.75	1.02	25	25					1.9	1.52	1.12	1.57	1.32	1.1	0.77	0.4					415
KDS/GMC 134	0.75	1.02	25	25																	415
KDS/GMC 1.514+	1.10	1.5	50	50		8.5	7.25	5.75	3.6												415
KDS/GMC 1.522+	1.10	1.5	50	40	6.75	6.25	5.85	5.5	4.5	3.9	3.1	1.8									415
KDS/GMC 1.528+	1.10	1.5	50	40	2.55	2.55	2.52	2.48	2.4	2.34	2.22	2.12	1.97	1.82	1.8	1.32					415
KDS/GMC 1.540	1.10	1.5	32	25								2.0	1.87	1.74	1.56	1.45	1.2	1.1	0.8	0.64	415
KDS 212+	1.5	2	80	80	14.1	12.4	10.8	7.5													415
KDS-216+	1.5	2.0	65	50		11.0	10.0	8.0	7.15	6.0											415
KDS-228+	1.5	2.0	50	40		8.3	8.18	6.9	4.75	4.5	4.25	3.9	3.55	2.1	2.25						415
KDS-235+	1.5	2.0	50	40		8.2	6.1	4.8	3.75	3.55	2.6	2.5	2.35	2.1	2.0	1.95	1.8	1.65			415
KDS-314+	2.2	3.0	80	80	18.1	17.2	16.3	13.5	10.4												415
KS-316+	2.2	3.0	65	50				13.4	11.8	9.2											415
KDS-318+	2.2	3.0	80	65		13.4	12.6	11.7	10.7	9.2	7.5										415
KDS-325+	2.2	3.0	65	50			9.2	8.5	8.1	7.0	7.4	7.0	6.4	5.5	4.9						415
KDS-330+	2.2	3.0	50	40				5.0	4.9	4.5	4.7	4.6	4.4	4.3	4.0	3.5	3.4	3.2	2.7	2.0	415
KS-512+	3.7	5.0	100	100	34.0	30.9	27.0	22.0													415
KDS-515+	3.7	5.0	100	100	32.5	31.0	28.0	24.2	18.0	12.5											400
KS-516+	3.7	5.0	80	65				23.0	20.0	17.5	13.2										415
KDS-520+	3.7	5.0	80	80	24.0	23.0	22.0	20.8	19.4	17.8	16.0	14.0	11.0								400
KDS-527+	3.7	5.0	80	65					14.3	13.9	13.5	12.8	11.8	10.3	8.2	6.4					400
KDS-538+	3.7	5.0	65	50								8.3	8.4	8.3	8.1	7.5	7.8	7.1	6.5	5.6	400
KS-810+	5.5	7.5	150	150	53.5	52.0	49.0														400
KS-827+	5.5	7.5	100	100			34.4	31.8	28.0	25.2	19.2										400
KDS-832+	5.5	7.5	100	100				39.3	36.0	34.2	32.0	29.1	27.8	14.5							400
KS-833+	5.5	7.5	100	80					27.3	25.4	22.7	18.8	14.5								400
KDS-835+	5.5	7.5	80	65						19.0	18.2	17.5	16.4	15.4	14.2	13.0	11.5				400
KDS-837	5.5	7.5	65	80										12.6	12.5	12.2	11.8	11.1	10.3	9.0	400
KS-1012+	7.5	10.0	150	150	72.5	67.0	59.5	48.5	36.0												400
KS-1022+	7.5	10.0	100	100					36.0	33.0	29.0	24.2	17.5								400
KDS-1030+	7.5	10.0	100	100				32.0	31.0	29.5	28.5	27.0	25.0	23.5	21.6	19.0					415
KDS-1040+	7.5	10.0	80	65			23.5	23.0	22.0	22.2	21.6	20.9	20.35	19.8	18.76	17.9	17.0	15.7	14.6	13.4	8.6	415
KDS-1331+	9.2	12.5	100	100							32.4	32.0	30.5	28.0	26.5	23.8	19.8	13.5			415
KDS-1837+	11.0	15.0	100	100								36.8	35.5	34.5	33.0	30.5	30.0	28.0	26.0	17.4	17	415
KDS-2030+	15.0	20.0	125	125								48.2	47.0	46.0	42.8	38.0	38.0	30.0	21.0			415

Note: KDS+/ As ... KDS+/ ... KDS/GMC 128+ ... KDS-3130+ ... KDS-2130+ ...

KS+ : Flanged ... KS+ ... KS+ ...

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7.7 Filter Press & Screw Pump

WASTE WATER TREATMENT EQUIPMENT

POLYPROPYLENE FILTER PRESS

(Sizes – 12" – 30" Manual & Hydraulic Type)
MAKE: UNIVERSAL

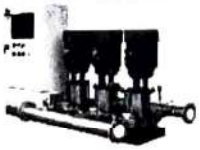
Model	Plate Detail Size	No.	MOC	Cake Holding Cap.	Filtration Area	Operating Pre. Bar	Tightening Mechanism
UTFP-12X12	12"x12"	11	PP	24 Ltrs.	1.62 M2	3.0 - 4.0	Manual/Hydraulic
UTFP-18X18	18"x18"	17	PP	120 Ltrs.	6.20 M2	4.0 - 5.0	Manual/Hydraulic
UTFP- 18X24	18"x18"	23	PP	160 Ltrs.	8.26 M2	4.0 - 5.0	Manual/Hydraulic
UTFP- 24x24	24"x24"	23	PP	290 Ltrs.	15.58 M2	4.0 - 5.0	Manual/Hydraulic
UTFP-30x30	30"x30"	29	PP	530 Ltrs.	31.10 M2	5.0 - 6.0	Manual/Hydraulic

SCREW PUMP

PROGRESSIVE CAVITY (Screw) PUMPS

FLOW RANGE : UP TO 100M3/H
HOUSING : CI (IS 210FG 220)
ROTOR : SS -AISI 316/410
SHAFT : SS -AISI 316/410
STATOR : Nitrile Black
MAKE: Roto

WATER & WASTE WATER PUMPS



Horizontal/Vertical Multistage Pump : MOC – SS 304/SS 316
Flow Range : Up to 180 M3/h
Head : Up to 240 Meter
Sewage/ Drainage Pump :
MOC – CI Impeller/Body & SS Shaft/ Solid – Up to 100MM
MAKE: Wilo / Leo / Kirloskar

UV SYSTEM

APPLICATION : Clear Water & Waste Water Treatment
UV Lamp Type : Low pressure, high-performance quartz lamps
RECOMMENDED UV LAMP LIFE : Up to 8500 Hours.
BALLAST : Matched high frequency electronic ballasts.
INPUT POWER : 230-240V AC, 50-60 Hz.
UV CHAMBER : Electro-polished SS316L
LAMP FAIL ALARM : Audiovisual
MAKE : SUKRUT / UNIVERSAL

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7.8 Electromagnetic Flowmeter

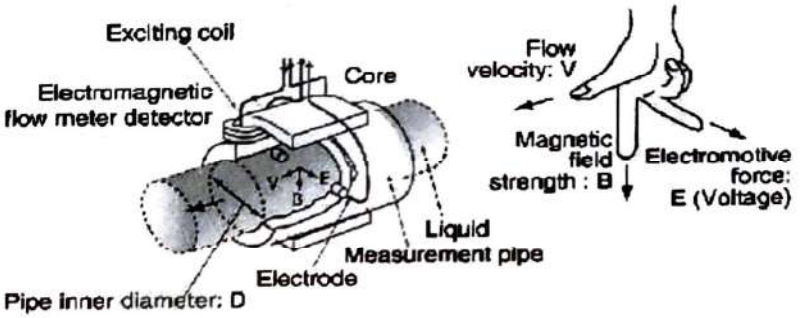
PRINCIPLES

Electromagnetic flow meters detect flow by using Faraday's Law of induction.

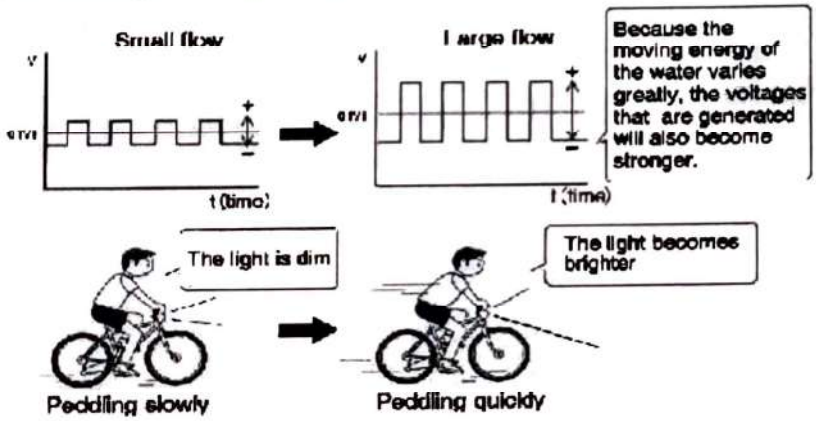
Inside an electromagnetic flow meter, there is an electromagnetic coil that generates a magnetic field, and electrodes that capture electromotive force(voltage).

Due to this, although it may appear as if there is nothing inside the flow pipe of an electromagnetic flow meter, flow can be measured.

Under Faraday's law of induction, moving conductive liquids inside of a magnetic field generates an electromotive force (voltage) in which the pipe inner diameter, magnetic field strength, and average flow velocity are all proportional. In other words, the flow velocity of liquid moving in a magnetic field is converted into electricity. (E is proportional to V × B × D)



As the flow changes, the electromotive force (voltage) captured by the electrodes changes as follows.



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7.9 pH Meter

pH/ORP METER

EMBARK SENSE MEASURE CONTROL

pH is the measure of the hydrogen ion concentration in a liquid. pH measures the acidity or alkalinity of a liquid. The pH scale is logarithmic and runs from 0.0 to 14.0 with 7.0 being neutral. Readings less than 7.0 indicate acidic solutions, while higher readings indicate alkaline or base solutions.

Chlorine and Ozone are the most common disinfectants used in the water and waste water treatment industry. Oxidation-reduction potential (ORP) is the parameter commonly used to measure REDOX reactions and is the only practical method we have to electronically monitor disinfectant effectiveness.

PO 650 pH/ ORP

PO 650 pH/ORP with LCD

WHY CHOOSE THIS METER

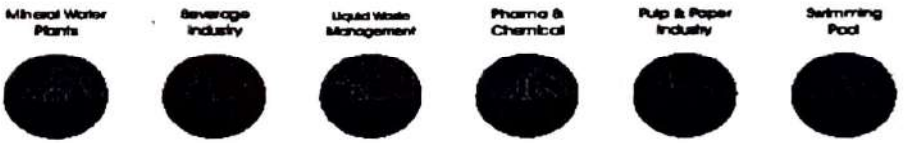
- **TRACEABILITY?** to NABL/ BRL standards
- **PUSH BUTTON FRONT KEYS** for easy set up
- **INDIVIDUAL HIGH & LOW SET POINT RELAY** for alarm or signal to PLC or can be used for proportional acid/alkali dosing
- **PROGRAMMABLE CONTROL DELAY TIME TO PREVENT CHATTERING**
- **HYSTERISIS TO PREVENT RELAY CHATTERING** Hysteisis is the percentage of set point below which relay will reset after getting energized
- **IN-BUILT DIAGNOSTICS** for wrong calibration or sensor error
- **IN-BUILT ALARM ANNUNCIATOR** It's a facility to acknowledge high/low fault condition and reset relays by pressing the acknowledge key
- **MANUAL/AUTOMATIC** relay reset options

ADVANCED OPTIONS AVAILABLE:

- **AUTOMATIC TEMPERATURE COMPENSATION**
- **DUAL LINE BACKLIT LCD** which displays temperature and pH/ORP along with relay status
- **RS 485** for online monitoring/ data logging
- **ISOLATED 4-20 mA OUTPUT** with normal/inverse function and in-built current simulator

APPLICATIONS

Mineral Water Plants | Beverage Industry | Liquid Waste Management | Pharma & Chemical | Pulp & Paper Industry | Swimming Pool



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निर्माण खण्ड, लो.नि.वि.
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7.10 UV Sterilizer

ACE HYGIENE PRODUCTS PVT. LTD.

Alfaa UV Technical Specifications Sheet

Sizing	Model	WL12
	Flow Rate	30.0 m³/hr
	UV Dose	60,000 uW-sec/cm²
	UV Transmission (per cm)	80%
Electrical	Voltage	220-240V / 50-60Hz
	Maximum Power Consumption (W)	1370 W
	Number of Lamps	12
	Max. Lamp Cable Length (meters)	4.5
	Ballast Type	Electronic with Programmed Start
Reactor	MOC	Stainless Steel 316L
	End Connections	3" BSP (M)
	Max. Operating Pressure	80 psi
	Max. Operating Temperature	45 degrees C
	Max. Sanitization Temperature	90 degrees C (lamps turned off)
	Quartz Jacket MOC	High Purity Quartz (UVT > 95%)
Features	Lamp Status Indicator	Yes
	Lamp Running Hour Counter	Yes
	UV Intensity Meter w/ 4-20 mA Output	Optional (UVM710)

1002 A, Peninsula Towers, Peninsula Corporate Park
Lower Parel (W), Mumbai 400013. India.
Tel: +91-22-66612200. E-Mail: info@alfauv.com.

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(इं० विनय झिंक्वाण)
अधिशासी अभियन्ता
निर्माण खण्ड, लोनि
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7.11 Tube Deck Media

TECHNICAL DATA SHEET FOR TUBE SETTLER MEDIA

MODEL	86-T-V
PLAN SETTLING AREA OF MEDIA	12 M²/M² (60° SLOPE)
LAYING ANGLE	60 DEG. FROM HORIZONTAL
STRUCTURE	HEXAGONAL CHEVRON
STARIGHT HEIGHT OF MEDIA	750 MM & 1000 MM
MOC OF MEDIA	PVC
THICKNESS	1.0 MM
FITTING ARRANGEMENT	TONGUE & GROOVE
CROSS SECTIONAL AREA	75 MM X 60 MM
MAX CONTINUOUS OPERATING TEMPERATURE	60° CELSIUS
ACTUAL PLAN AREA OF EACH TUBE SETTLER	68.22 M²
COLOUR	BLACK
SETTLING VELOCITY	6.69 mm/min
SLR	1.79 M³/M²-HR
ANGLE CORRECTION	0.43 M
WIDTH OF INLET LAUNDER	0.30 M
HOPPER SLOPE	60.0 DEGREES
TOTAL NO. OF HOOPERS	4
HOPPER DEPTH	1.86 M
WEIR LOADING RATE	128 MM/M-DAY
TOTAL WEIR LENGTH	16.67 M

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निर्माण खण्ड, लो०नि०वि.
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SECTION VIII

VETTED DOCUMENT OF ELECTROCOAGULATION TECHNOLOGY

STP IN UTTARAKHAND FOR REFERENCE

(ANNEXURE – B)

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(इं० विनय झिंक्वाण)
अधिशासी अभियन्ता
निर्माण खण्ड, लो०नि०वि०
गुप्तकाशी

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भारतीय प्रौद्योगिकी संस्थान दिल्ली
INDIAN INSTITUTE OF TECHNOLOGY DELHI
Centre for Rural Development & Technology
हौज़ खास, नई दिल्ली-११००१६
Hauz Khas, New Delhi-110016
Tel. :+91-11-2659 6581
Fax:+91-11-2659 1121
E-mail : vivekk@iitd.ac.in

Dr. Vivek Kumar
Associate Professor

Ref No: IITD/CRDT/E-18732

03/07/2018

KK Rastogi
General Manager
Office of General Manager, Construction Circle (Ganga)
Uttarakhand Pey Jal Nigam, Haridwar (U.K.)

Dear Sir,

This is with reference to the vetting of 18 EC technology based STPs of Uttarakhand. Earlier we had sent 18 reports excluding the performance of EC Reactor. Now we are ready with 10 days performance analysis report of the pilot plant we had installed at IIT Delhi. Plant performance is now satisfactory and consistent. Find enclosed herewith vetting of Electrocoagulation technology for sewage treatment.

Thanking You,

Sincerely Yours,

Vivek Kumar

Ganar Construction Limited Dehradun

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अधिशासी अभियन्ता
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Introduction

A pilot scale electro-coagulation plant has been installed at the IIT Delhi premises for the purpose of performance analysis and process optimization. 1 m^3/hr plant is installed at micro-model premises near an open unconstructed (Kachha Nala) drain. Drain carries the domestic waste water of Katwaria Sarai village, and IIT Delhi's staff colony. Units of the plant were transported from Coimbatore (M/s Confident Engineering) and installed on a concrete platform. A flowchart of the pilot scale plant shown in fig 1.

The primary focus of the study was to analyze performance of the plant with respect to selected parameters and further optimize the performance as per the targeted values of the selected parameters. Targeted values of the various parameters are shown in table 1. These values are the discharge norms as per the DNIT and Contract.

Table 1: Treated water parameters as per contract

S. No.	Parameter	Values
1.	pH	6.7-7.0
2.	TSS, mg/L	<10
3.	BOD, mg/L	<10
4.	COD, mg/L	<50
5.	Total Kjeldahl Nitrogen (as N) mg/L	<10
6.	Ammonia Nitrogen (as N) mg/L	<5
7.	Total Phosphorous (as PO_4) mg/L	<2
8.	Fecal Coliform Count (MPN)	<100

Before the installation of plant, survey of drain and sampling of wastewater was carried out at various point and time to observe variation in parameters to ease the plant operation. Based on the study it is found that peak flow and pollutant load occur at two times in a day, 8:00-10:00 AM in the morning and 8:00-10:00 PM in the evening. Sampling at Nala was done for 24 hours at the interval of 2 hours. Wastewater parameters were analyzed in CRDT, IIT Delhi following standard methods (table 2). The characteristics of wastewater flowing in the drain is shown in table 3. For the treatment purpose wastewater is being pumped from kaccha Nala, upstream (u/s)

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निर्माण खण्ड, लो०नि०वि०
ऋषिकेश

Dr. Vivek Kumar
Associate Professor
Centre for Rural Development & Technology
Indian Institute of Technology Delhi
Hauz Khas, New Delhi-110016, INDIA

(about 20-30 m from the plant) to 3000 L storage tank by a 1 HP pump having 14 m^3/hr rated capacity and 8 m head. Pump is placed at the bank of the Nala. From the collection tank wastewater flows through the treatment plant by gravity and pump. Finally treated water is being used for gardening purposes. Pilot scale plant is being run at various daytimes on batch basis from morning 6 am to evening 10 pm to study the impact of variation in the flow and pollution load rate on the treatment performance of the plant. The treatment plant based on electrocoagulation technology consisted of EC reactor, followed by online ozone dosing, lamella clarifier, MGF, and ACF. Detailed design parameters of the pilot plant after modification are presented from tables 4a to table 4c.

Table 2: Methods and reference used for wastewater parameters

Parameters	Method	Procedure Reference
pH	Used a Labman scientific instrument	-
COD (mg/L)	Closed Reflux method	5220 B
BOD (mg/L)	Winkler method	5210 B
TSS (mg/L)	Filtration method	2540 D
Total phosphorus (as PO_4)	Colorimetric test	4500-PD
Fecal Coliform (MPN)	-	9221 B-C

Table 4: Analysis of Drain wastewater

Parameters	Range (Average)
pH	6.5-7.2 (6.85)
COD (mg/L)	190-362 (332)
TSS (mg/L)	170-400 (310)
TDS (mg/L)	800-1100 (1030)
EC (µs)	1330-1650 (1200)
Fecal coliform (MPN)	5.60-9.80 x 10^4 (820 x 10^4)

Table 4 (a): Equalization tank

Descriptions	Parameters
Volume of the tank	0.5 m^3
Retention time Actual/design @ 1 m^3/h	30 min
Retention time peak (Assuming peaking factor 3)	10 min
Ozone applied in equalization tank	
Rate of Ozone dosing	3 g/m^3

Dr. Vivek Kumar
Associate Professor
Centre for Rural Development & Technology
Indian Institute of Technology Delhi
Hauz Khas, New Delhi-110016, INDIA

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Table 4 (b): Electro-Coagulation tank detailed description

Description	Value
Design flow	1 m^3/h
Peak flow (Assuming peaking factor 3)	3 m^3/h
Dimension (L*W*d) of the EC tank (meter)	0.465*0.390*0.903
EC tank Volume	0.1637 m^3
One plat Dimensions (L*W*thickness) (meter)	0.6*0.3*0.004
One plate one side surface area	0.18 m^2
Total one plate surface area	0.36 m^2
Total number of electrodes	53 No's
Gaps between two electrodes	5 mm
Total volume occupied by electrodes	0.03816 m^3
EC tank effective volume	0.12554 m^3
Current	6 amp
Optimum power range	300-500 watts
Optimum energy density range	15.72 – 26.20 (watts/total surface area m^2)
Total plats surface area	19.08 m^2
Retention time Design	7.5324 min
Retention time Peak	2.51 min
Maximum electrodes consumption	10 g/ m^3(m^3 of sewage)

Table 4 (c): Other Pilot scale plant unit's capacities

Descriptions	Parameters
Flash Mixer Tank Dimension Volume	0.6*0.54*0.7
Flash Mixer Tank Volume	0.2268 m^3
Lamella Tube settler dimensions	4.18 m^3
Area	3.05 m^2
Angle	55
MGF and ACF Dimensions	1.450 m Height and 0.5 m diameter
Area	0.196 m^2

Methodology:

After initial performance analysis on the basis of COD, SS, and TDA it was found that plant was neither stable nor performing as per the set targets. Further detailed design of the plant was

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अधिशासी अभियन्ता
निर्माण खण्ड, लो०नि०वि.
एकाश्री

Dr. Vivek Kumar
Associate Professor
Centre for Rural Development & Technology
Indian Institute of Technology Delhi
Hauz Khas, New Delhi-110016, INDIA

studied and after discussion with M/s Confident Engineering, process optimization study was carried out to achieve discharge norms and stable performance of the plant. Parameters chosen for, optimization study were Power density, gaps between electrodes, location of ozone treatment, change in the angle of Tube settler media.

Results and Discussion:

Electro coagulation unit was run at 6 Amp constant current using iron electrodes plates with varying power density 13.10-26.20 (watts/ m^2). Tube settler media was adjusted at different angles varying from 45-60°. Angle 55° is found more suitable for proper particle settlement, the same is described in literature also. Location of ozone treatment has a significant impact on pollutant removal efficiency, ozone treatment was tried at two different locations keeping dosing rate constant, (i) after tertiary treatment (MGF and ACF) and (ii) before EC treatment. Ozone treatment before EC reactor has shown significant pollution reduction efficiency, therefore ozone treatment was continued before EC reactor for further work. The gap between two electrodes was varied -4 mm gap (58 No's plates), 5 mm gap (53 No's plates), 6 mm and 10 mm gap (39 No's & 24 No's plates) and uniformity of space electrodes was also maintained. 5 mm gap was found suitable as it enhance contact between wastewater and electrodes, which leads high performance. Lesser gap was not found suitable probably due to the fact that very low gap creates problems in cleaning which leads low performance. Higher gap is not found suitable too, probably it results in poor contact between wastewater and electrodes. After optimization of all the above variables, electrode gap was fixed at 5 mm, Tube settler media at 55°, and Ozone-treatment location at before EC and then optimization of power density was carried out by varying it from 13.10-26.20 (watts/ total surface area m^2) keeping current constant at 6 amp. Range of power density 15.72 – 26.20 watts/total surface area m^2 was found achieving almost similar result. At the optimum conditions outlet parameters were found under target limits. After optimization study plant performance was studied for 10 days continuously and the results are presented in table 5. It is clear from the results that now plant is performing well and achieving treated water quality targets shown in table 1.

Dr. Vivek Kumar
Associate Professor
Centre for Rural Development & Technology
Indian Institute of Technology Delhi
Hauz Khas, New Delhi-110016, INDIA

Sewer Construction Division Dehradun

(इं० विनय झिंक्वाण)
अधिशासी अभियन्ता
निर्माण खण्ड, लो०नि०वि०
एकलाड़ी

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Vivek

Dr. Vivek Kumar
Associate Professor
Centre for Rural Development & Technology
Indian Institute of Technology Delhi
Hauz Khas, New Delhi-110016, INDIA

Gawar Construction Limited Dehradun

(इं० विनय श्रीवास्तव)
अधिशासी अभियन्ता
निर्माण खण्ड, लो०नि०वि०
प्रतापगढ़ी

Table 5: Analyzed parameters of pilot scale EC plant

Parameter	Inlet Range (Average)	Outlet range (Average)
pH	7.15-7.34 (6.85)	7.25-7.39 (7.3)
COD (mg/L)	190-362 (332)	28-48 (36)
BOD (mg/L)	70-270 (240)	8-9.7 (8.6)
TSS (mg/L)	170-360 (290)	7.5-13.5 (9.5)
Total phosphorus (as PO_4)	4.6-5.8	0.9-1.7 (1.5)
Fecal Coliform (MPN)	5.60-9.80 x 10^4 (8.20 x 10^4)	80-95 (84)

Recommendation:

Following are the recommendation for the implementation in all the 18 plants to be installed:

1. Ozone treatment should be done before EC reactor
2. Plate spacing in EC reactors should be kept at 5 mm.
3. EC plants need to be operated at the energy density range from 16-26 Watt/total plate surface area m^2.
4. Angle of the media in lamella clarifier should be kept around 55^o
5. Polishing treatment

Conclusion: The EC based treatment plant in IIT Delhi is performing consistently now. The retention time of EC reactor is much lower than any biological reactor with better plant performance. Therefore the foot print of EC based treatment system will be much lower than conventional treatment system. The treatment system also reduces fecal coliform significantly due to the ozone addition. It is also reported in the literature that ozone is a better option for disinfection as compare to conventional disinfection treatment technologies.

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निर्माण खण्ड, लो०नि०वि०
रुद्रप्रयाग

Dr. Vivek Kumar
Associate Professor
Centre for Rural Development & Technology
Indian Institute of Technology Delhi
Hauz Khas, New Delhi-110016, INDIA

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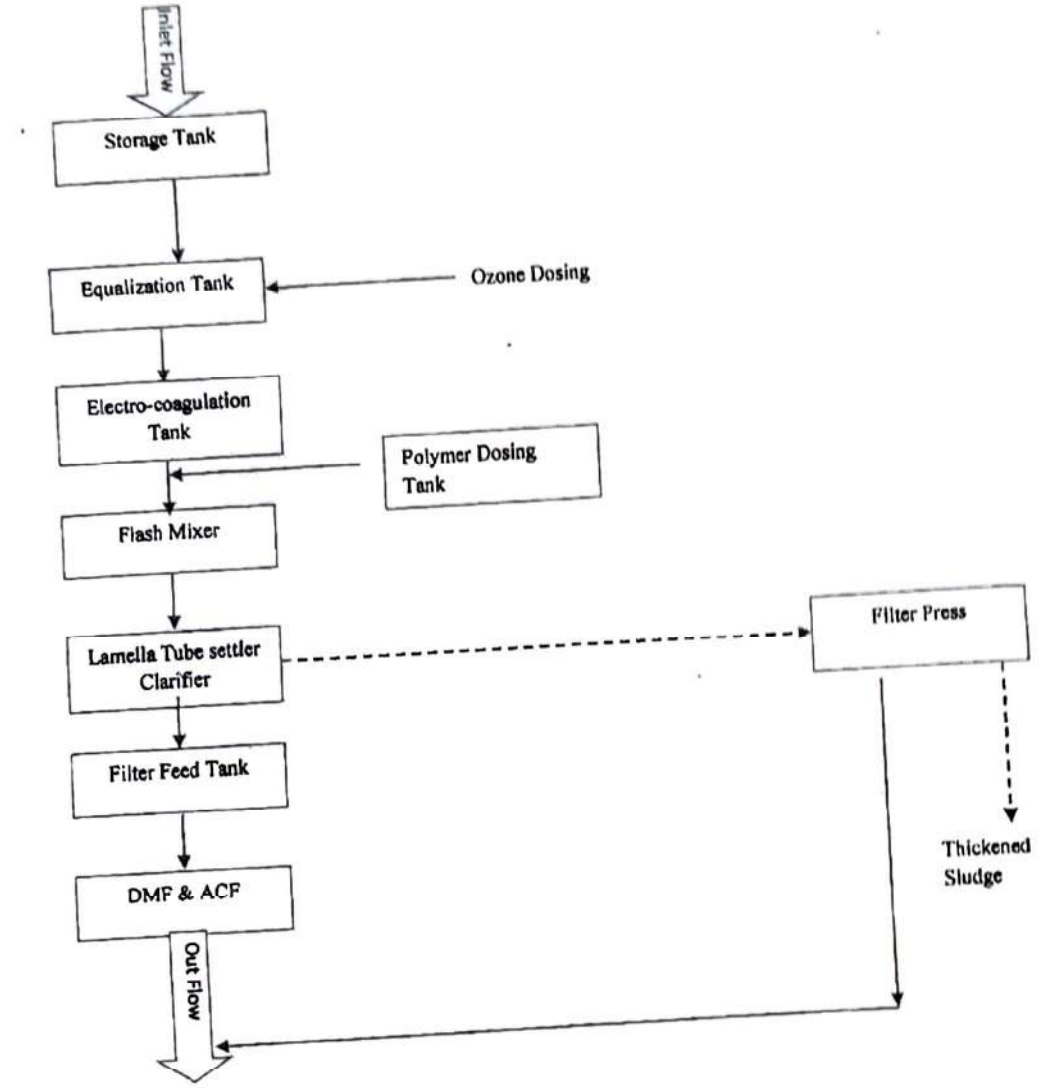

Figure 1: Schematic flow chart of pilot scale sewage treatment plant based on Electro-coagulation in IIT Delhi

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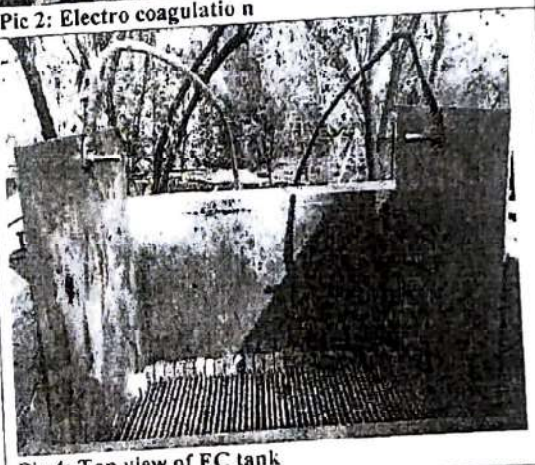
Dr. Vivek Kumar
Associate Professor
Centre for Rural Development & Technology
Indian Institute of Technology Delhi
Hauz Khas, New Delhi-110016, INDIA

Photos and Video of pilot scale plant installed in IIT Delhi

Pic 1: 3000 L Capacity sewage storage tank

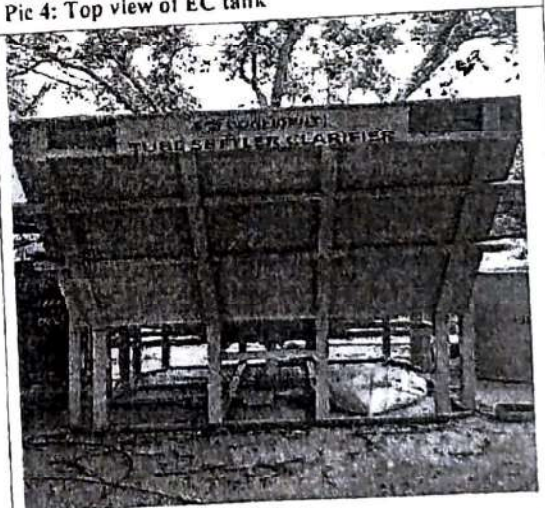
Pic 2: Electro coagulatio n

Pic 3: Flash mixer



Pic 4: Top view of EC tank

Pic 5: Pilot scale plant



Pic 6: Lamella tube settler

Dr. Vivek Kumar
Associate Professor
Centre for Rural Development & Technology
Indian Institute of Technology Delhi
Hauz Khas, New Delhi-110016, INDIA

(इं० विनय डिंक्वाण)
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प्रतापी

Design criteria on

STP-1, 75KLD, ANOOP NEGI SCHOOL, RUDRAPRAYAG,

Distt. - Rudraprayag (Uttarakhand)

SUBMITTED TO:

Project Manager
Uttarakhand Peyjal Nigam
Dehradun

SUBMITTED BY:

TECHNICAL CONSULTANCY SERVICES
14-C, ARAWALI ENCLAVE, GMS ROAD, DEHRADUN
Phone: - (0135) - 2720017, 2720018 (FAX), 9997093344
E-mail: tcsdoon@yahoo.com, tcsdoon@gmail.com

(इं० विनय झिंक्वाण)
अधिशासी अभियन्ता
निर्माण खण्ड, लो०नि०नि०
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जिला अधिकारी रुद्रप्रयाग

1. Introduction:-

This report concerns with the design assumptions considered while designing proposed various STP buildingsin Uttarakhand. This report includes design philosophy and various loadings taken into account while modeling and designing different structural members. The substructure and upto plinth level the building is of RCC and above it the building is of structural steel. For fast construction the contractor has agreed to procure steel tanks for various treatment processes.

2. Design philosophy and modeling:-

The building had been designed as framed structure and modeling hadbeen done using finite element based software ETABS v9.7.4. Column and beam elements had been modeled as frame elements while slab had been modeled as shell element. Foundation had been considered fixed at least 1.2m below stilt for foundation resting on soil and at least 300mm for footing resting on rock. To incorporate the cracked section properties of concrete members the following property modifiers had been considered while modeling:
Column - 0.7; beam - 0.35 and slab - 0.25.

Since the building is in earthquake prone area, ductile detailing as per IS-13920 had been followed.

3. Soil:

Safe bearing capacity of soil has been considered asper the concerned building soil report.

4. Material Properties:

Concrete: M-25; E_c = 25000 N/mm^2; Density = 25 kN/m^3.
Steel: Fe500D; E_s = 2.0E+5 MPa; Density = 78 kN/m^3.
Structural steel – E250 (BR); Bolt grade – 10.9;
Welding electrode (As/ IS 814) – EX41XX with a ultimate stress of 410-510 MPa and a min yield stress of 330 MPa;
Steel deck - 6mm thkchequered plate.

5. Loadings:

This section includes various loading applied on the structure to design various elements.

5.1. Live loads:

STP tank	-	30kN/m^2
Machine area	-	5kN/m^2

5.2 Super imposed dead loads (SIDL):

Decking is of steel chequered plate only painting shall be done to protect from corrosion. Weight of steel deck has been taken while modeling.

5.3 Earthquake loads:

Following parameters has been considered for earthquake loading:

Zone IV; Z = 0.24; Soil type: II; R = 4 (Steel building with ordinary braced frame);

Importance factor = 1.0; Damping (ζ) = 2%.

Calculation of base shear:

$T_a = 0.085*h^{0.75}$;

Percentage of live load considered for seismic weight is 50%.

5.4 Wind loads:

V_b = 47m/s, $V_z = k1*k2*k3*V_b$; Terrain category – 2; Building class - B

Maximum force = C_f*A*Pz.

6. Load combinations:

The following load combinations have been considered for designing structural elements:

A) Limit state of serviceability:
   - DL + LL
   - DL + EQ
   - DL + 0.8 LL + 0.8 EQ

B) Limit state of collapse:
   - 1.5 DL + 1.5 LL
   - 1.5 DL + 1.5 EQ
   - 0.9 DL + 1.5 EQ
   - 1.2 DL + 1.2 LL + 1.2 EQ

Where, DL is dead load, LL is live load and EQ is earthquake loads.

7. Special notes:

- Since the steel structure is not showing any signs of uplift, 16 diameter holing down bolts have been used.
- Bracing shall be provided to at least two adjacent edges of building.

Vetted

&

Rajib Chowdhury

Assistant Professor

Department of Civil Engineering

Indian Institute of Technology Roorkee

Roorkee-247667, Uttarakhand

Tewar Construction Limited Dehradun

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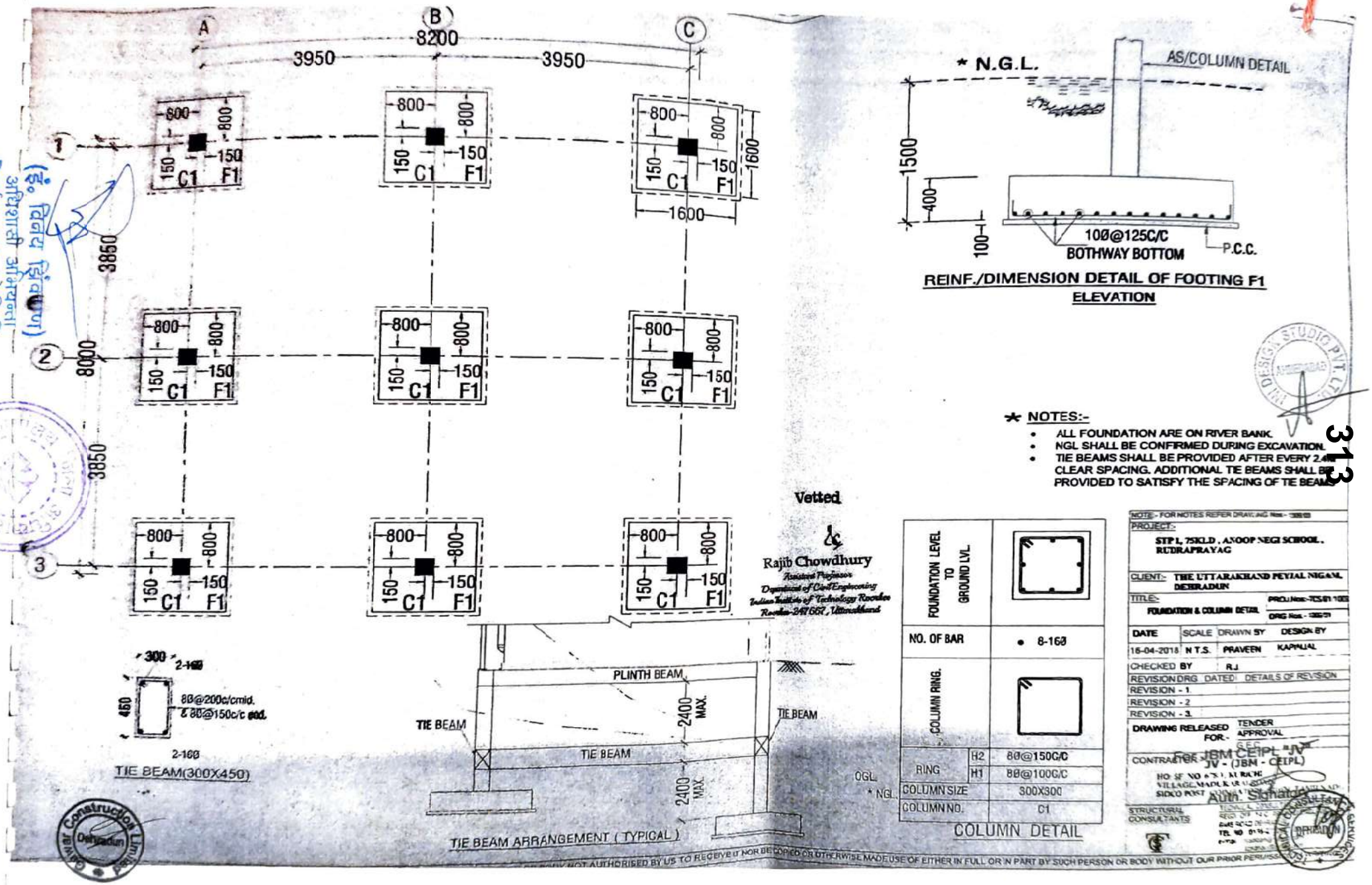
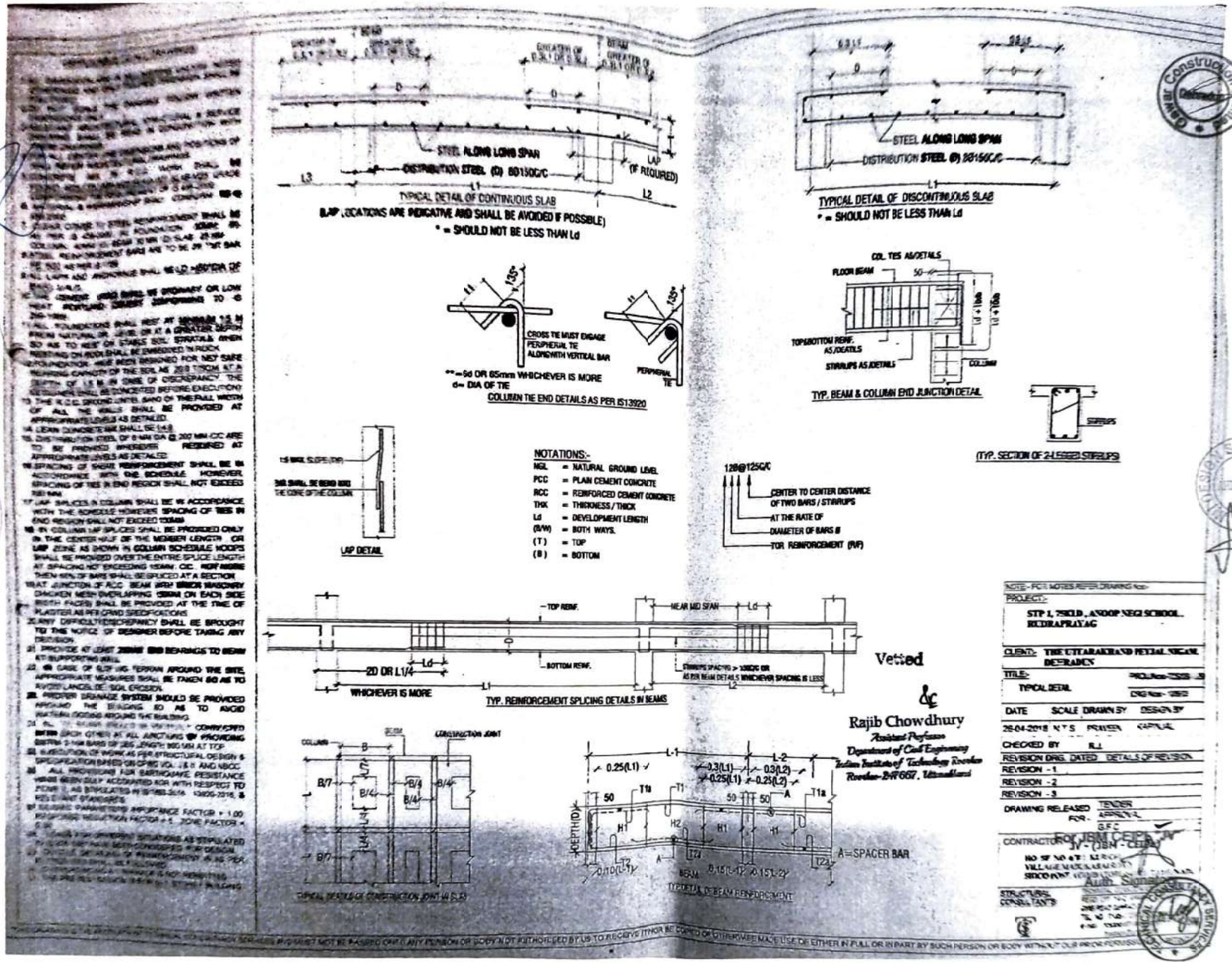
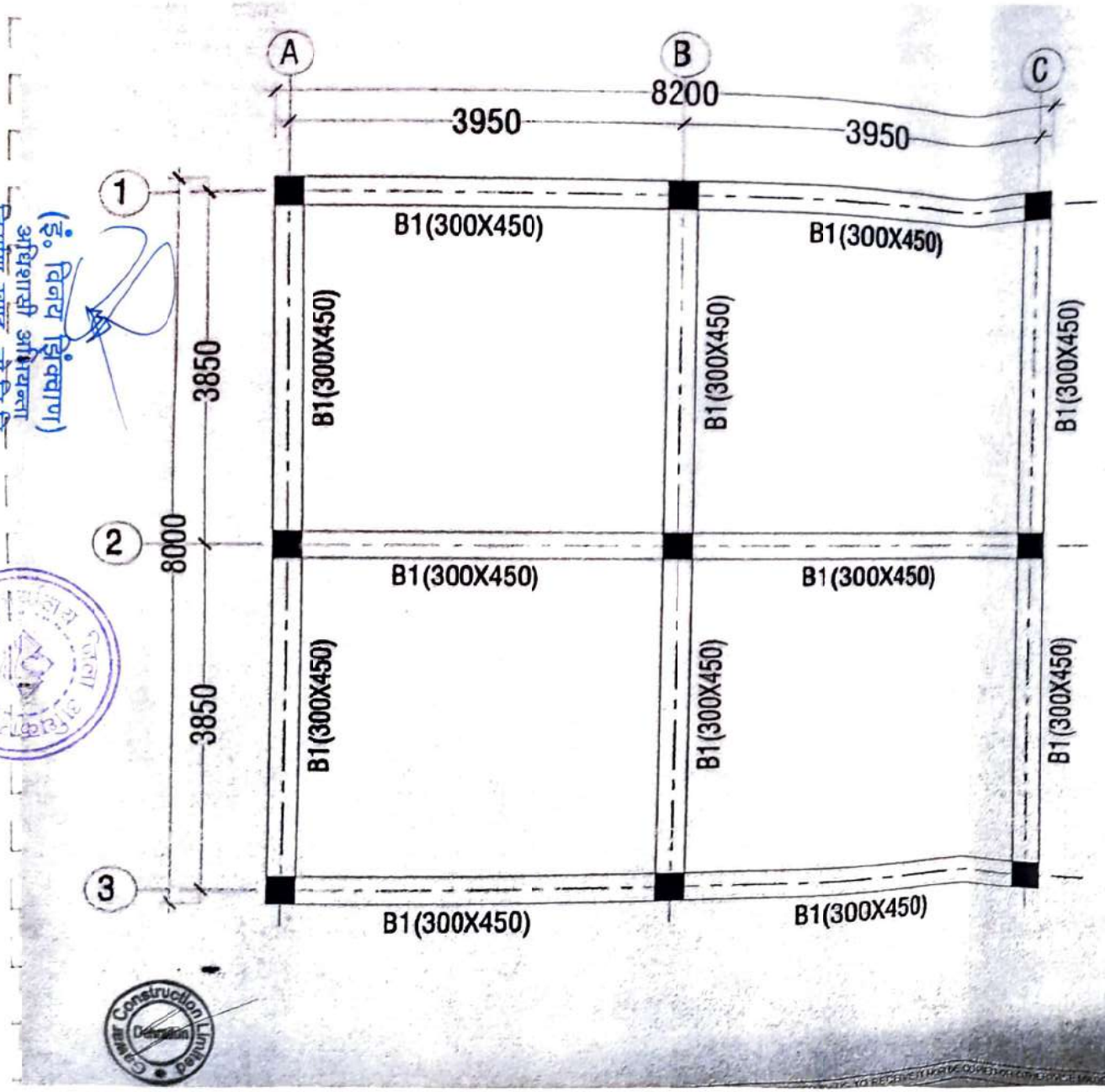
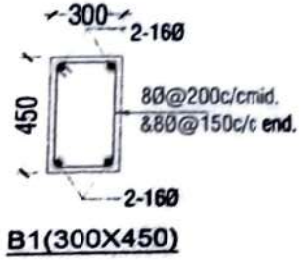

A
B
C
8200
3950
3950
1
2
3
8000
3850
3850
800
150
C1
F1
1600
* N.G.L.
AS/COLUMN DETAIL
1500
400
100
100@125C/C
BOTHWAY BOTTOM
P.C.C.
REINF./DIMENSION DETAIL OF FOOTING F1
ELEVATION
* NOTES:-
ALL FOUNDATION ARE ON RIVER BANK.
NGL SHALL BE CONFIRMED DURING EXCAVATION.
TIE BEAMS SHALL BE PROVIDED AFTER EVERY 2.4m CLEAR SPACING. ADDITIONAL TIE BEAMS SHALL BE PROVIDED TO SATISFY THE SPACING OF TIE BEAMS
Vetted
Rajib Chowdhury
Assistant Professor
Department of Civil Engineering
Indian Institute of Technology Roorkee
Roorkee-247667, Uttarakhand
300
2-16ø
450
8ø@200c/cmid.
& 8ø@150c/c end.
2-16ø
TIE BEAM(300X450)
PLINTH BEAM
TIE BEAM
TIE BEAM
2400 MAX.
2400 MAX.
OGL
* NGL
TIE BEAM ARRANGEMENT (TYPICAL)
FOUNDATION LEVEL TO GROUND LVL.
NO. OF BAR
8-16ø
COLUMN RING.
RING
H2
8ø@150C/C
H1
8ø@100C/C
COLUMN SIZE
300X300
COLUMN NO.
C1
COLUMN DETAIL
NOTE - FOR NOTES REFER DRAWING Nos. - 3850
PROJECT:-
STP I, 75KLD , ASOOP NEGI SCHOOL , RUDRAPRAYAG
CLIENT:- THE UTTARAKHAND PEYJAL NIGAM DEHRADUN
TITLE:- FOUNDATION & COLUMN DETAIL
PROJ.Nos:-TCS/01/103
DRG Nos. - 3857/1
DATE 16-04-2018
SCALE N.T.S.
DRAWN BY PRAVEEN
DESIGN BY KAPIL/AL
CHECKED BY R.J
REVISION DRG DATED DETAILS OF REVISION
REVISION - 1
REVISION - 2
REVISION - 3
DRAWING RELEASED FOR:- TENDER APPROVAL
CONTRACTOR :- For JBM CEIPL "JV" JV - (JBM - CEIPL)
Auth. Signatory
STRUCTURAL CONSULTANTS
DEHRADUN
Garhwal Construction Limited Dehradun
313
(इं० विनय त्रिपाठी)
अधिशासी अभियन्ता
निर्माण खण्ड, लो०नि०नि०
रुद्रप्रयाग



(डॉ० विनय डिंबवाल)
अधिशासी अभियन्ता
लेखा एवं प्रशासन खण्ड, लो०नि०वि०
उत्तराखण्ड





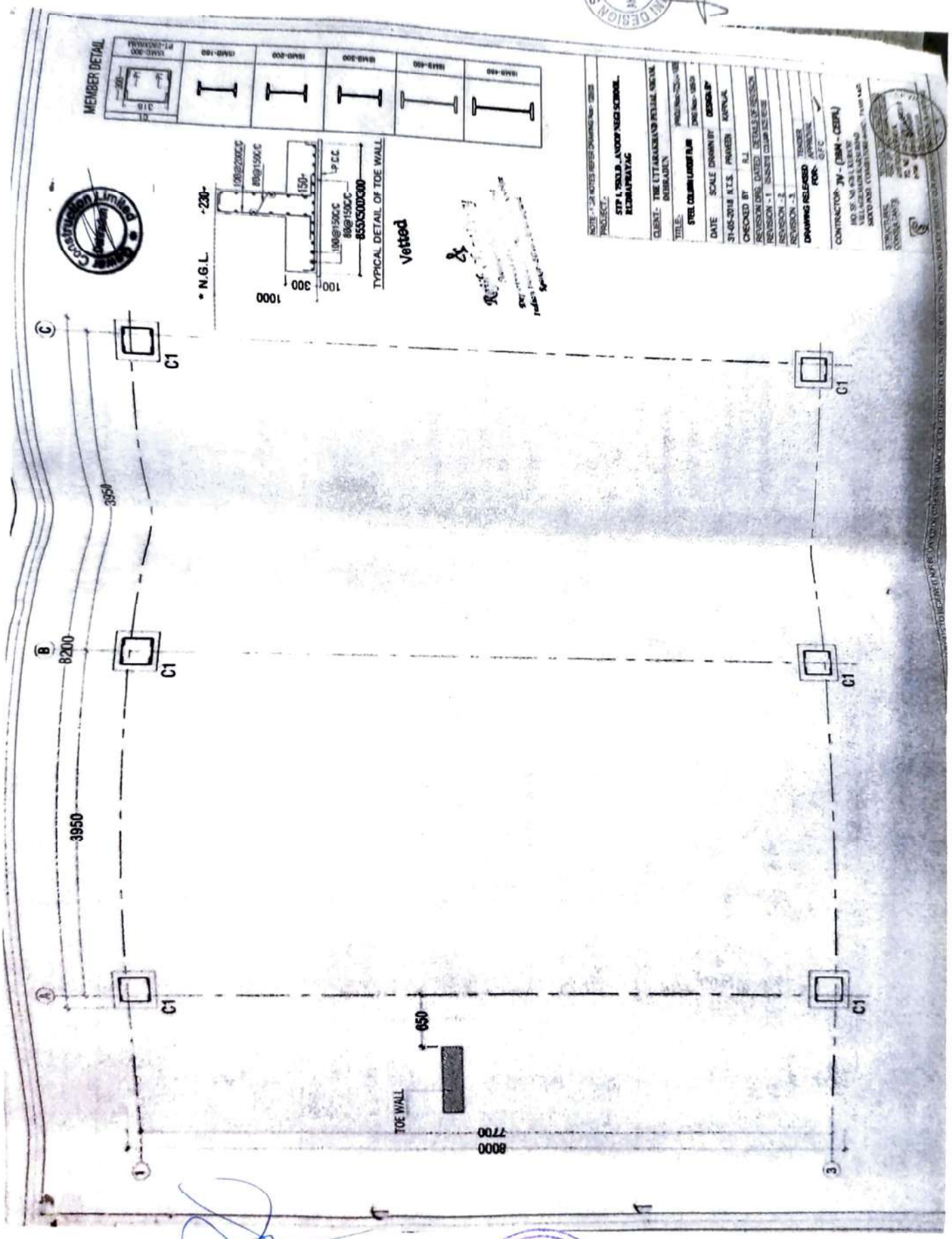
B1(300X450)

(इं० विनय सिंघवाण)
अधिशासी अभियन्ता
निर्माण खण्ड, लो०नि०नि०
रुद्रप्रयाग

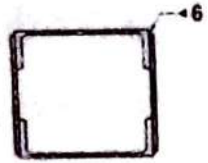
Rajib Chowdhury
Assistant Professor
Department of Civil Engineering
Indian Institute of Technology Roorkee
Roorkee-247667, Uttarakhand

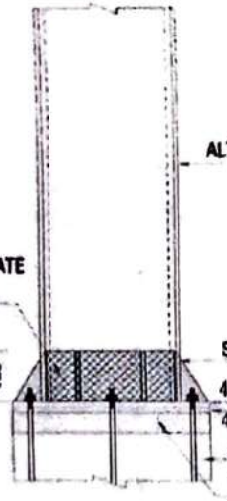
NOTE :- FOR NOTES REFER DRAWING No.			
PROJECT :- STP 1.75KLD , ASOOF NEGI SCHOOL , RUDRAPRAYAG			
CLIENT :- THE UTTARAKHAND PEYJAL NIGAM, DEHRADUN			
TITLE :- PLINTH BEAM DETAIL			PROJ.No:- DRG No:-
DATE	SCALE	DRAWN BY	DESIGN BY
25-04-2018	N.T.S.	PRAVEEN	KAPIL/JAL
CHECKED BY		R.J.	
REVISION DRG.	DATED	DETAILS OF REVISION	
REVISION - 1			
REVISION - 2			
REVISION - 3			
DRAWING RELEASED		TENDER / APPROVAL	
CONTRACTOR :- JV - (JBM - DEPL)			

For JBM DEPL JV

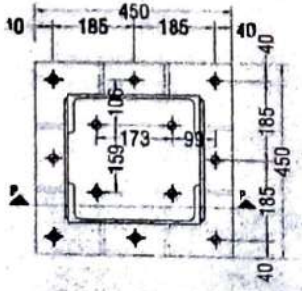


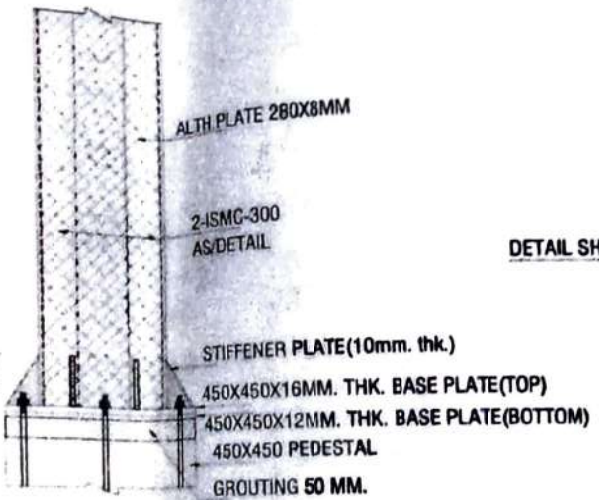
(इं० विनय झिंक्वाण)
अधिशासी अभियन्ता
निर्माण खण्ड, लो०नि०वि०
एप्तकाशी



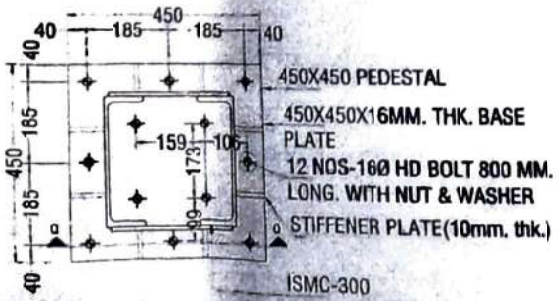


SECTION AT P-P
(ELEVATION)





SECTION AT Q-Q
(ELEVATION)



DETAIL OF BASE PLATE
(TOP PLAN)

DETAIL SHOWING COPING IN STIFFENER

Vetrivel
&
Rajib Chowdhury

NOTE:- FOR NOTES REFER DRAWING No.- 000003

PROJECT:-
STP @ SKLD , STEEL BRIDGE .
RUDRAPRAYAG

CLIENT:- THE UTTARAKHAND PEYJAL NIGAM, DEHRADUN

TITLE:- COLUMN DETAIL

PROJ.No.- TCS/05/1006

DRG No.- 1006/05

DATE	SCALE	DRAWN BY	DESIGN BY
31-05-2018	N.T.S	PRAVEEN	KAPILRAJ

CHECKED BY : R.J.

REVISION DRG.	DATED	DETAILS OF REVISION
REVISION - 1		
REVISION - 2		
REVISION - 3		

DRAWING RELEASED FOR:- TENDER APPROVAL ✓ G F C

CONTRACTOR:- JV - (JBN - CEIPL)
HO: SF NO 476/1 KURICHI
VILLAGE MADUKARAI ROAD
MECO POST, COIMBATORE

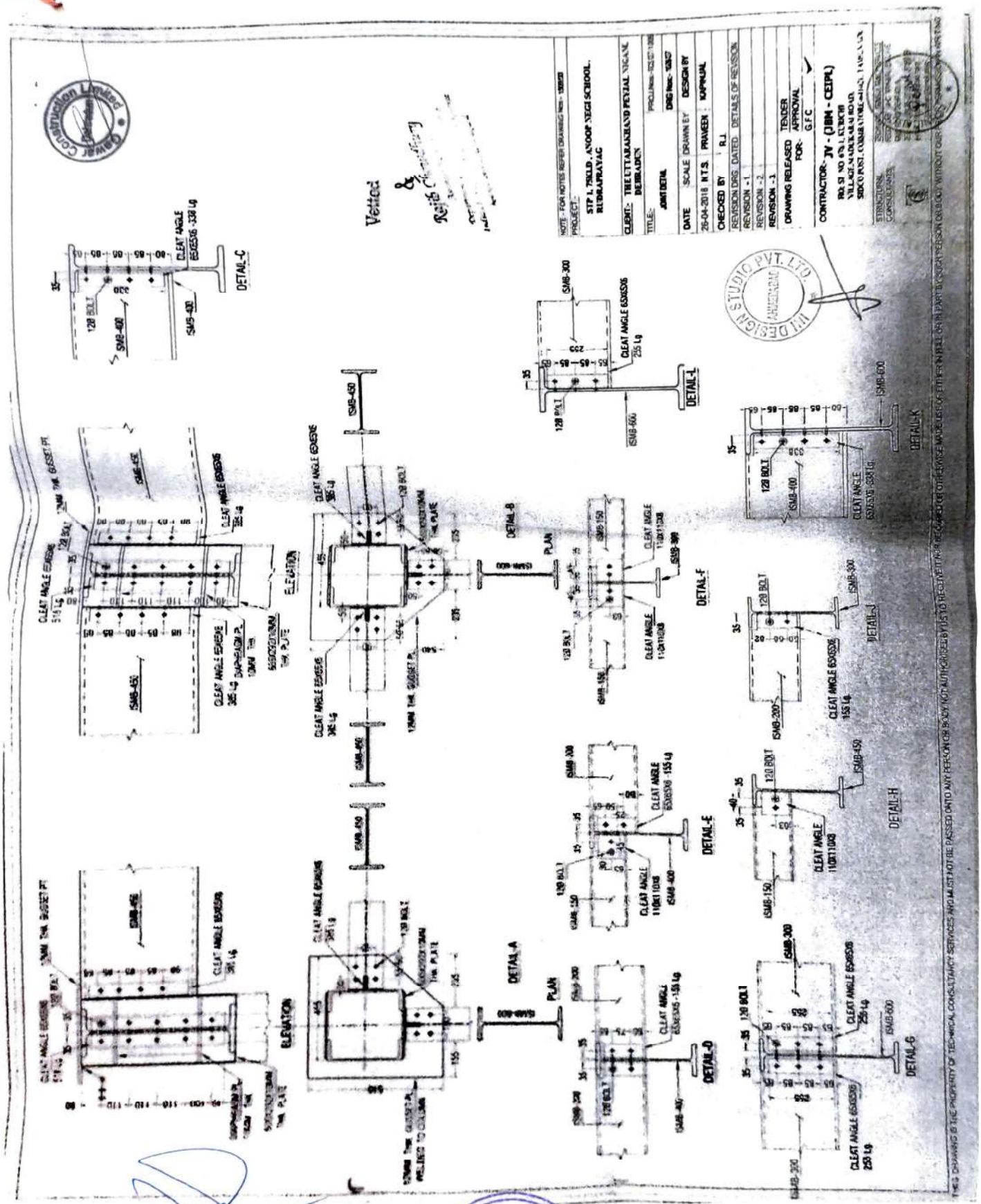
STRUCTURAL CONSULTANTS:

Vetted

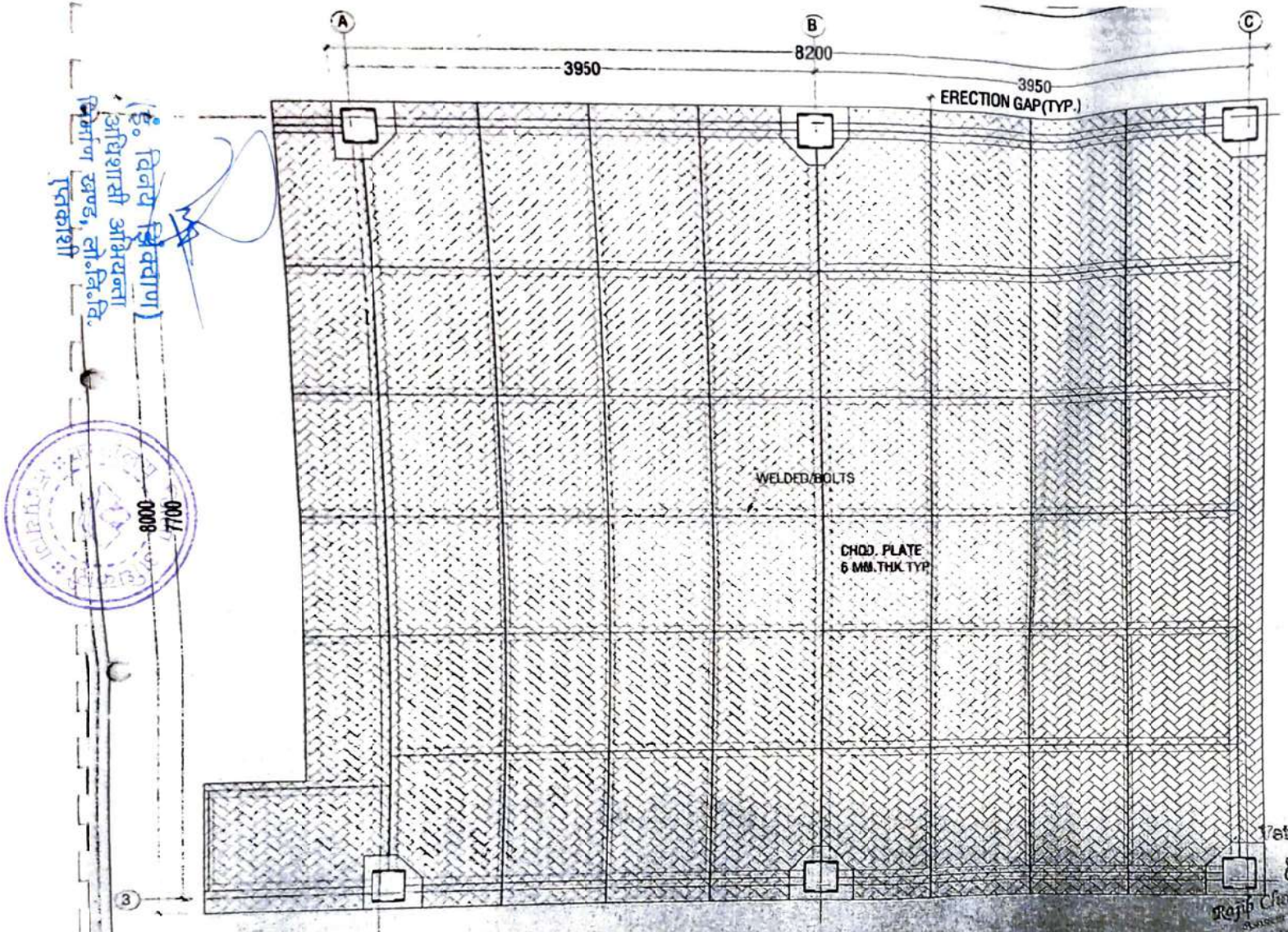
MEMBER DETAIL

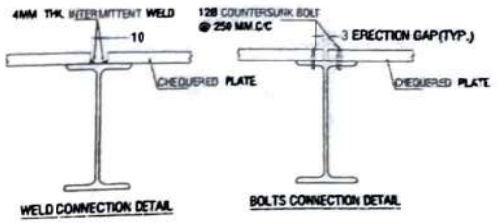
ISMB-450	ISMB-400	ISMB-300	ISMB-200	ISMB-150
I	I	I	I	I

(इं. विनय झिंक्वाण)
अधिशासी अभियन्ता
निर्माण खण्ड, लो.नि.वि.
पुरोला

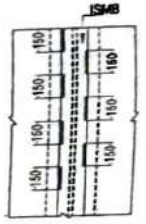


(इं॰ विनय झिंक्वाण)
अधिशासी अभियन्ता
निर्माण खण्ड, लो॰नि॰वि॰
एप्तकाशी





CHEQUERED PLATE JOINT DETAIL
ETHER OF BOLT OR WELDING CAN BE DONE



DETAIL OF INTERMITTENT WELD PLAN

320

(इं० विनय त्रिवेदी)
अधिशासी अभियन्ता
निर्माण खण्ड, लो०नि०वि.
रुद्रप्रयाग

NOTE:- FOR NOTES REFER DRAWING Nos:- 1005/03

PROJECT:-
STP 1, 75KLD , ANOOP NEGI SCHOOL , RUDRAPRAYAG

CLIENT:- THE UTTARAKHAND PEYJAL NIGAM, DEHRADUN

TITLE:- FIRST FLOOR CHEQUERED PLATE PLATFORM PLAN

PROJ Nos:- ITCS/05-1/005

DRG Nos:- 1005/08

DATE	SCALE	DRAWN BY	DESIGN BY
31-05-2018	N.T.S.	PRAVEEN	KAPILIAL
CHECKED BY		R.J.	

REVISION	DRG.	DATED	DETAILS OF REVISION
REVISION - 1.		05-03-2018	COLUMN SIZE REVISE
REVISION - 2			
REVISION - 3			

DRAWING RELEASED FOR: TENDER / APPROVAL / G.F.C. ✓

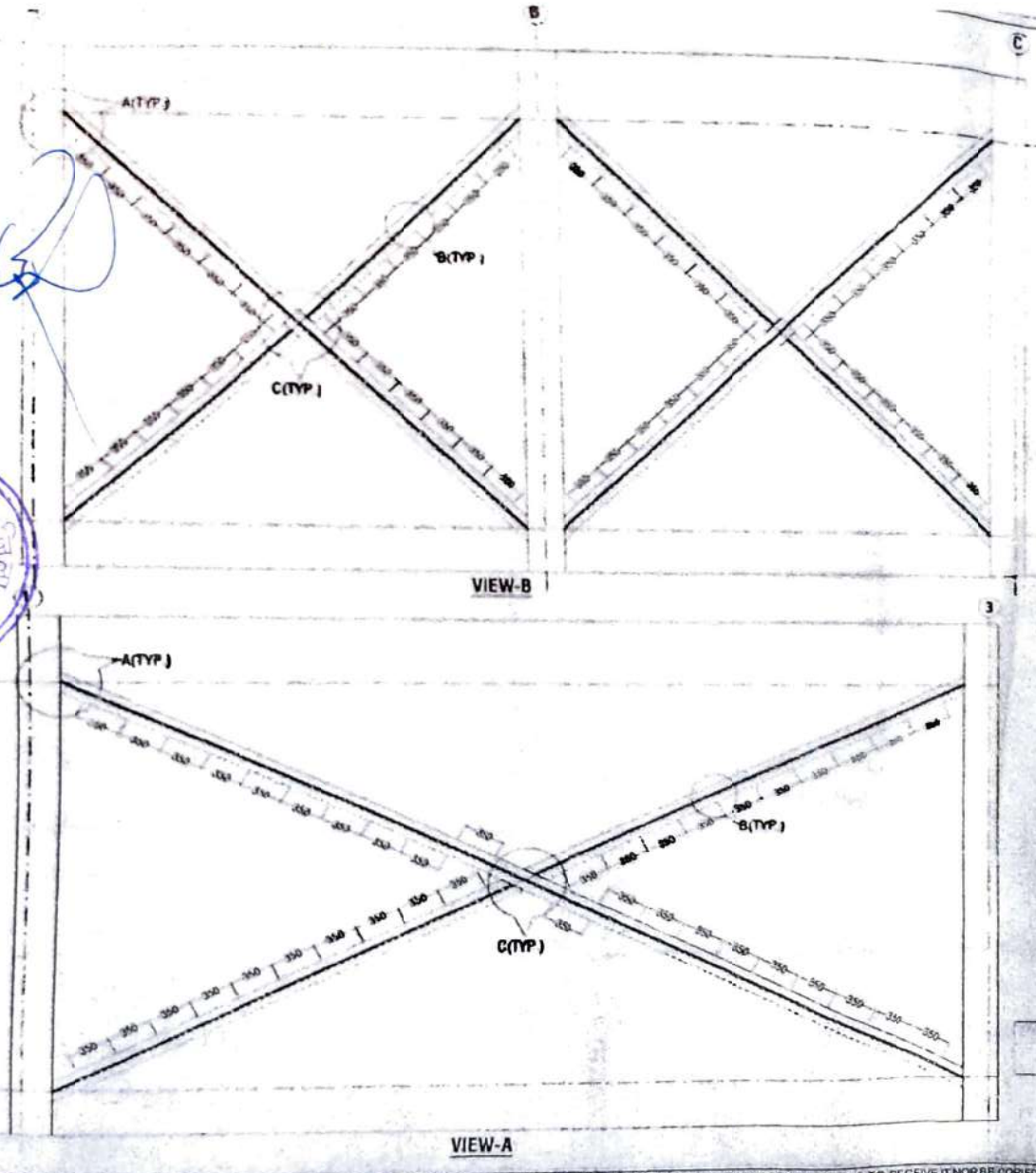
CONTRACTOR:- JV - (JBN - CEIPL)
HOUSE NO. 676 I, SURJETH VILLAGE MADUGRAM ROAD, SIDCO POST, COIMBATORE-641021, TAMIL NADU

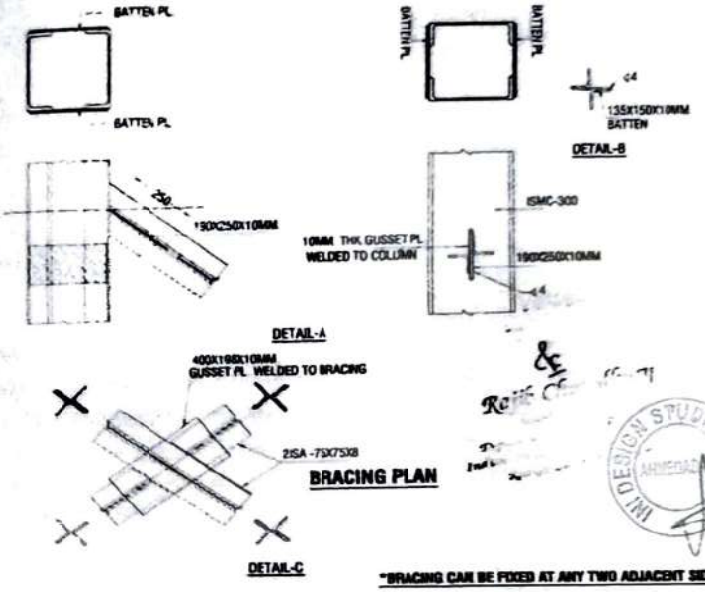
STRUCTURAL CONSULTANTS:-

RR DESIGN STUDIO PVT. LTD. AMRITSAR

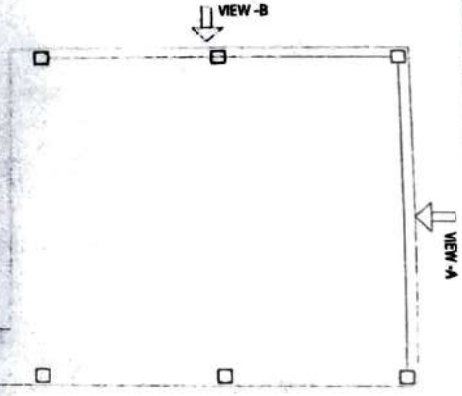
Vetted & Rajib Chowdhury

Geo Linear Construction Limited Dehradun





*BRACING CAN BE FIXED AT ANY TWO ADJACENT SIDES.



NOTE :- FOR NOTES REFER DRAWING Note:- 1005/03

PROJECT:-
STP I, 75MLD , ANOOP NEGI SCHOOL , RUDRAPRAYAG

CLIENT:- THE UTTARAKHAND PEYJAL NIGAM, DEHRADUN

TITLE:- BRACING DETAIL

PROJ Nos:- T_SW 1009

DRG Nos:- 1005/0

DATE	SCALE	DRAWN BY	DESIGN BY
31-05-2018	N.T.S.	PRAVEEN	KAPILLAL

CHECKED BY R.J.

REVISION DRG.	DATED:	DETAILS OF REVISION
REVISION - 1.	05-06-2018	COLUMN SIZE REVISE
REVISION - 2		
REVISION - 3		

DRAWING RELEASED FOR:- TENDER APPROVAL / GFC ✓

CONTRACTOR:- JV - (JBM - CEIPL)
HO SF NO 678 1, KURICHI
VILLAGE,MADUKARAI ROAD
SIDCO POST, COIMBATORE

STRUCTURAL CONSULTANTS

(इं० विनय त्रिपाठी)
अधिशासी अभियन्ता
निर्माण खण्ड, लो०नि०वि०,
रुद्रप्रयाग

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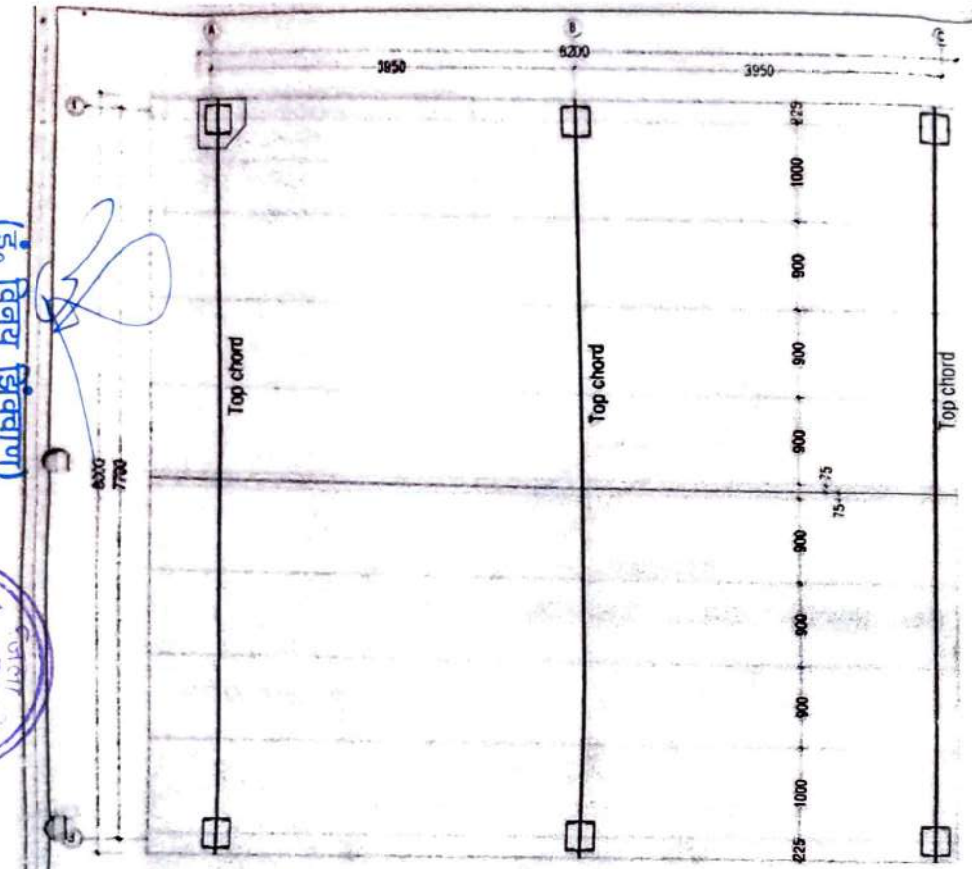
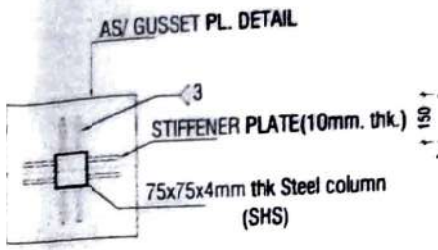


TRUSS PLAN(ROOF)



STEEL COLUMN
(TOP PLAN)

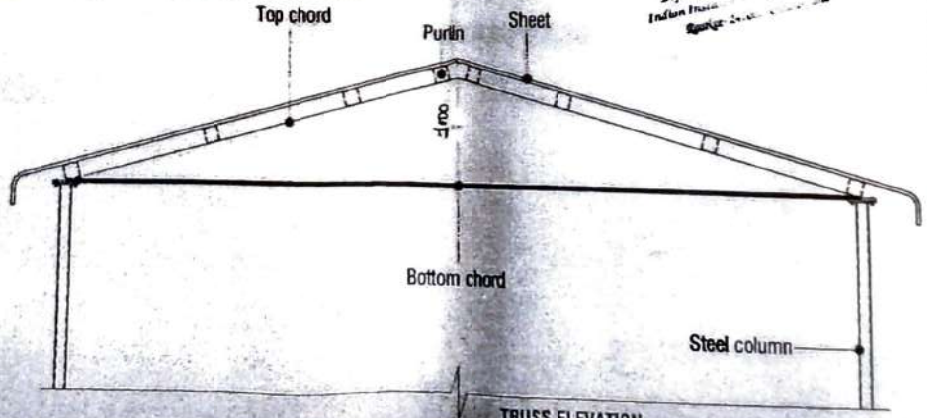
LEGENDS

1. 1 125 x 125 x 4.5 mm SHS BOTTOM CHORD
2. 2 75 x 75 X 4mm SHS STEEL COLUMN
3. 3 100 x 100 x 4 mm SHS TOP CHORD
4. 4 90 x 90 X 4.5mm SHS PURLIN

SHS-Square hollow section

(APPLICABLE TO ALL DRAWINGS)

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS IN METERS
2. DIMENSIONS ARE NOT TO BE SCALED ONLY WRITTEN DIMENSIONS ARE TO BE FOLLOWED
3. STIFFENERS & BRACING - STEEL (GRADE E -250 QUALITY-BR CONFORMING TO IS 2062:2011
4. BOLTS SHALL BE OF GRADE 8.8 .
5. ALL BOLTS AND NUTS SHALL CONFORM TO LATEST VERSIONS OF IS 1363, IS 1364, IS 1367 IS 3640, IS 3757, IS 6623 AND IS 6639AS APPROPRIATE
6. DURING WELDING POSITION OF MEMBERS AND ASSEMBLY SHOULD BE SUCH THAT OVERHEAD WELDING SHALL BE AVOIDED / MINIMIZED
7. ALL ELECTRODES SHALL BE OF DESIGNATION E3412X WITH ULTIMATE STRESS OF 410-513 MPA & MIN YIELD STRESS OF 330 MPA CONFORMING TO IS 814:2004
8. WELDING SHALL BE DONE AT FABRICATION SHOP ONLY SITE WELDING SHALL BE ALLOWED ONLY FOR FIXING OF CHEQUERED PLATE
9. BEFORE FABRICATION WELDING PROCEDURE SHALL BE APPROVED BY THE ENGINEER IN CHARGE
10. ALL FABRICATED MEMBER SHALL BE THOROUGHLY WASHED WITH 1% PHOSPHORUS ACID SOLUTION TO REMOVE ALL LOOSE SCALE AND RUST WITH WIRE BRUSHING AND BUFFING/SAND BLASTING AS REQUIRED
11. WELD THK SHALL BE AS PER DETAILS GIVEN
12. FABRICATION & WELDING SHALL BE DONE AS PER IS 816 & IS: 1024.
13. ALL OBTUSE ANGLE CUTTING SHOULD BE DONE IN PROPER SHAPE AND WITHOUT ANY DAMAGE
14. PAINTING SHALL BE AS PER TENDER SPECIFICATIONS



TRUSS ELEVATION

NOTE:- FOR NOTES REFER DRAWING No:- 1005/03

PROJECT:-
STP 1, 75KLD , ANOOP NEGI SCHOOL , RUDRAPRAYAG

CLIENT:- THE UTTARAKHAND PEYJAL NIGAM, DEHRADUN

TITLE:- TRUSS DETAIL

PROJ.No:- TCS/18/1005

DRG No:- 1005/18

DATE	SCALE	DRAWN BY:	DESIGN BY
31-05-2018	N.T.S.	PRAVEEN	KAPINJAL

CHECKED BY R.J.

REVISION DRG.	DATED	DETAILS OF REVISION
REVISION - 1.	05-06-2018	COLUMN SIZE REVISE
REVISION - 2.		
REVISION - 3.		

DRAWING RELEASED FOR:- TENDER APPROVAL / G.F.C ✓

CONTRACTOR:- JV - (JBM - CEIPL)
HO: SF NO. 67/1, KURICHI
VILLAGE, MADUKARAI ROAD,
SIDCO POST, COIMBATORE-641021, TAMIL NADU

STRUCTURAL CONSULTANTS

(इं० विनय त्रिपाठी)
अधिशासी अभियन्ता
निर्माण खण्ड, लो०नि०नि०,
रुद्रप्रयाग

Gammon Construction Limited Dehradun

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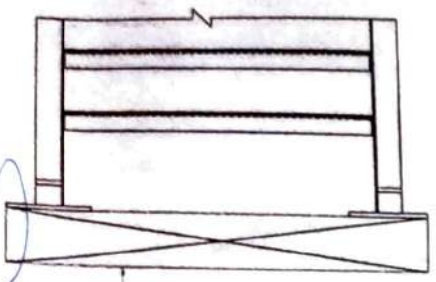
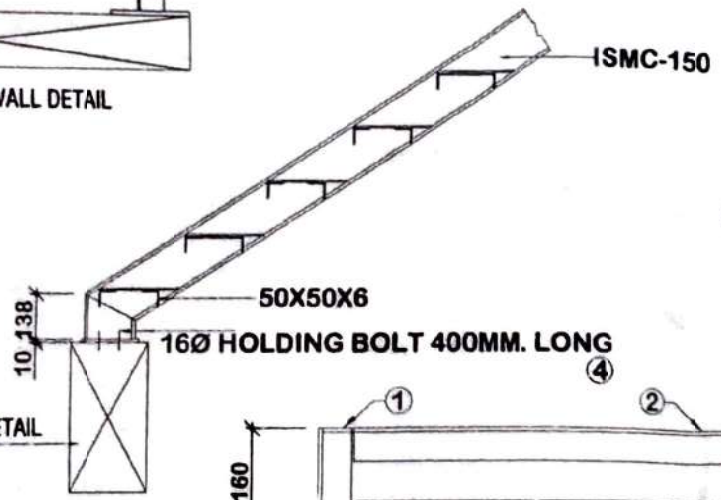
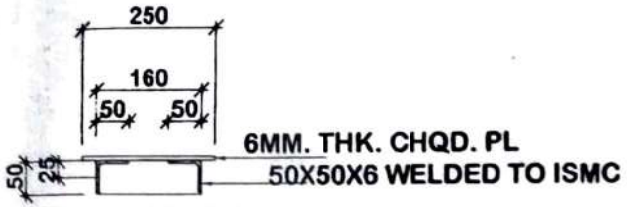
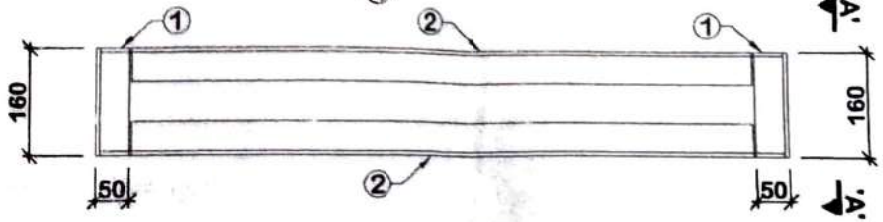


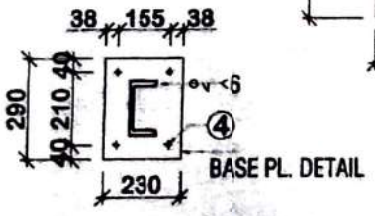




SECTION ON-'A-A'
SLOT HOLES



DETAIL OF STAIR CASE.



Vetted

Rojib Chowdhury

Department of Civil Engineering
Indian Institute of Technology Roorkee
Roorkee-247667, Uttarakhand

NOTE:- FOR NOTES REFER DRAWING No.- 1028/03			
PROJECT:-	STP 1.75KLD., ANOOP NEGI SCHOOL, RUDRAPRAYAG		
CLIENT:-	THE UTTARAKHAND PEYJAL NIGAM, DEHRADUN		
TITLE:-	STAIR CASE DETAIL	PROJ.No.:- TCS/11/1028	
		DRG No.:- 1028/11	
DATE	SCALE	DRAWN BY	DESIGN BY
31-05-2018	N.T.S.	PRAVEEN	KAPINJAL
CHECKED BY	R.J.		
REVISION DRG.	DATED	DETAILS OF REVISION	
REVISION - 1			
REVISION - 2			
REVISION - 3			
DRAWING RELEASED FOR:-	TENDER APPROVAL / G.F.C ✓		
CONTRACTOR:-	JV - (JBM - CEIPL)		
	HO SF NO 67/1, KURICHI, VILLAGE, MADUKARAI ROAD, SIDCO POST, COIMBATORE-641021, TAMIL NADU		
STRUCTURAL CONSULTANTS			

(इं० विजय डिंभराणा)
अधिशासी अभियन्ता
निर्माण खण्ड, लो०नि०वि०
रुद्रप्रयाग

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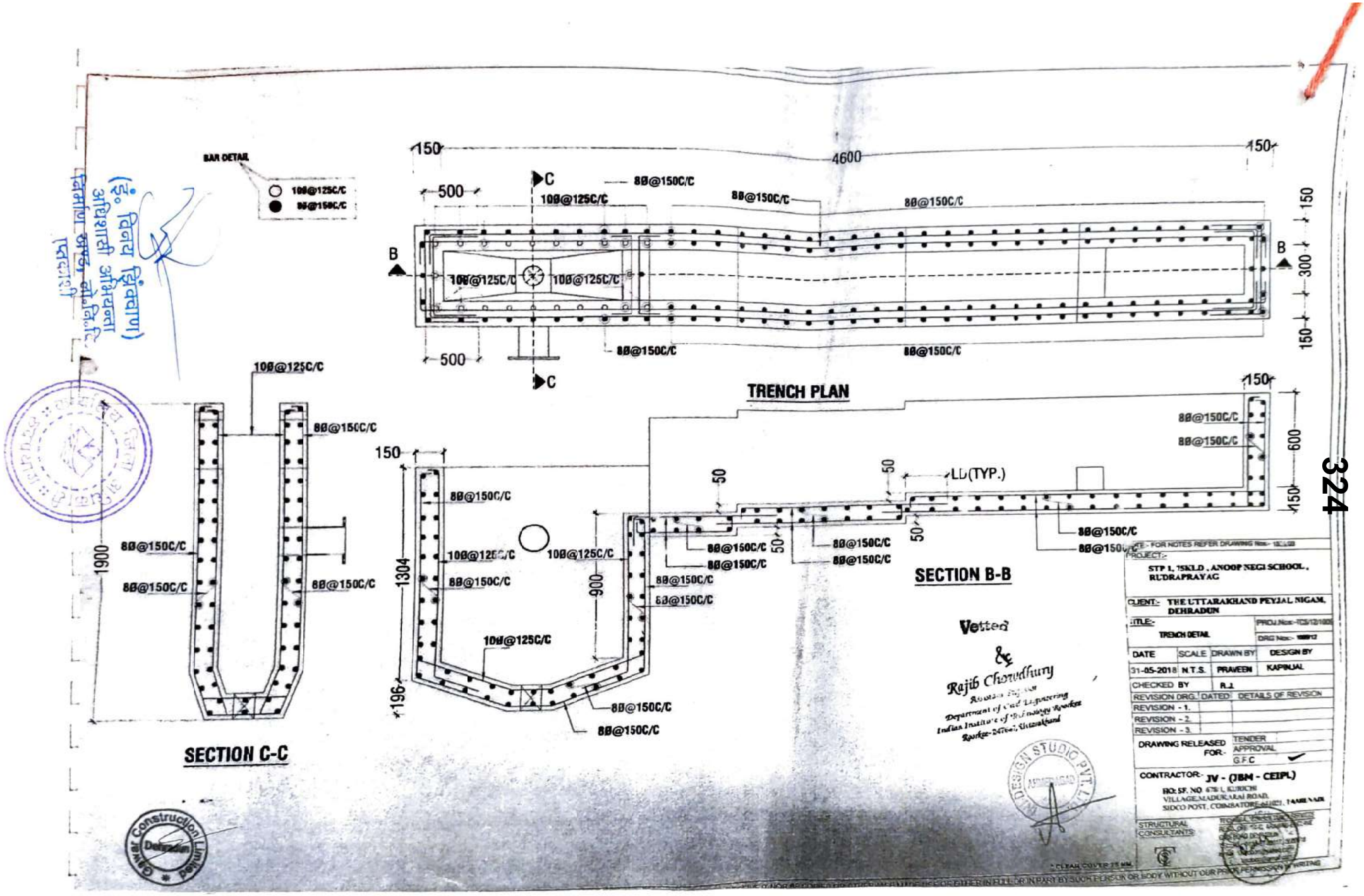
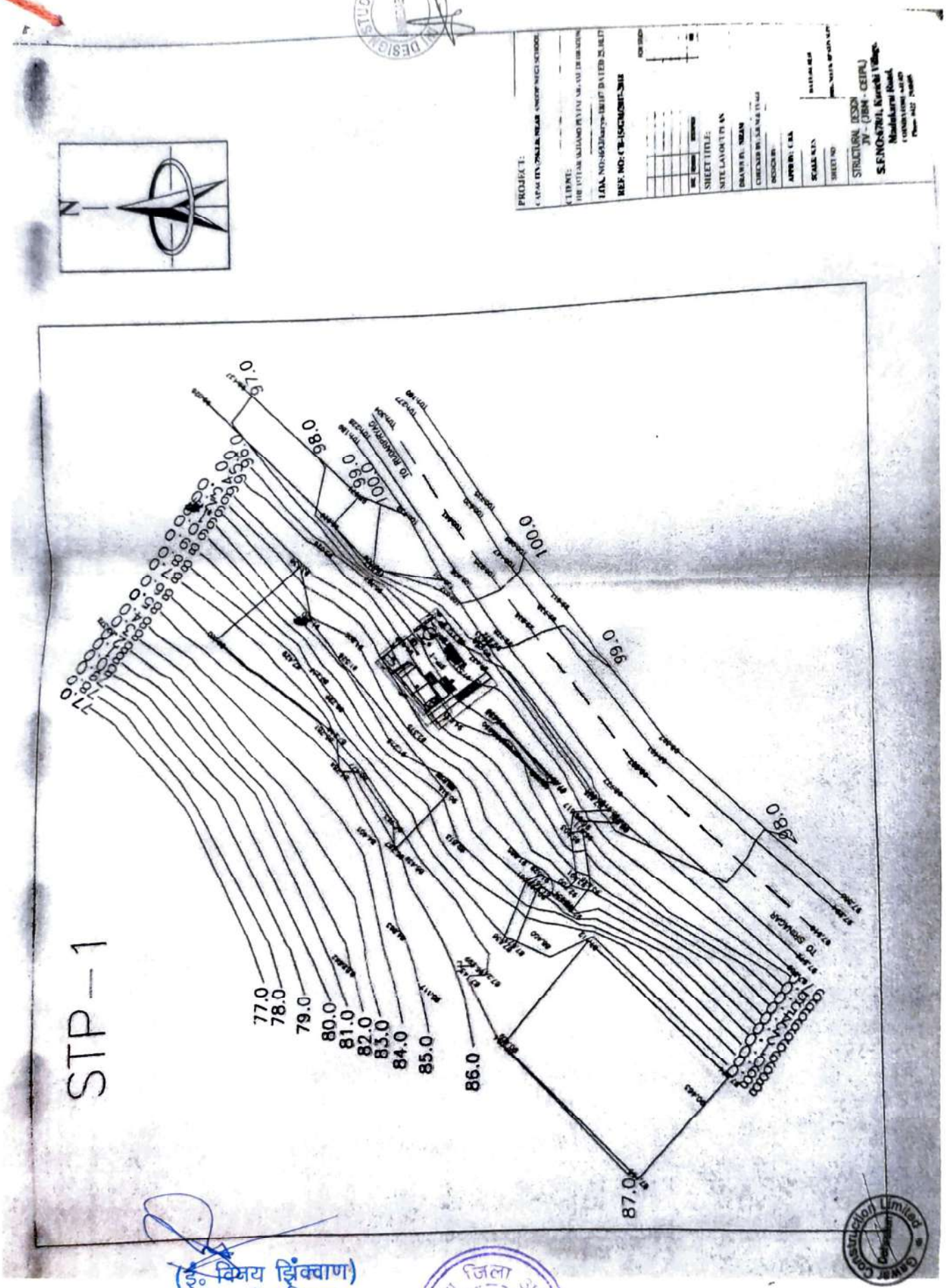
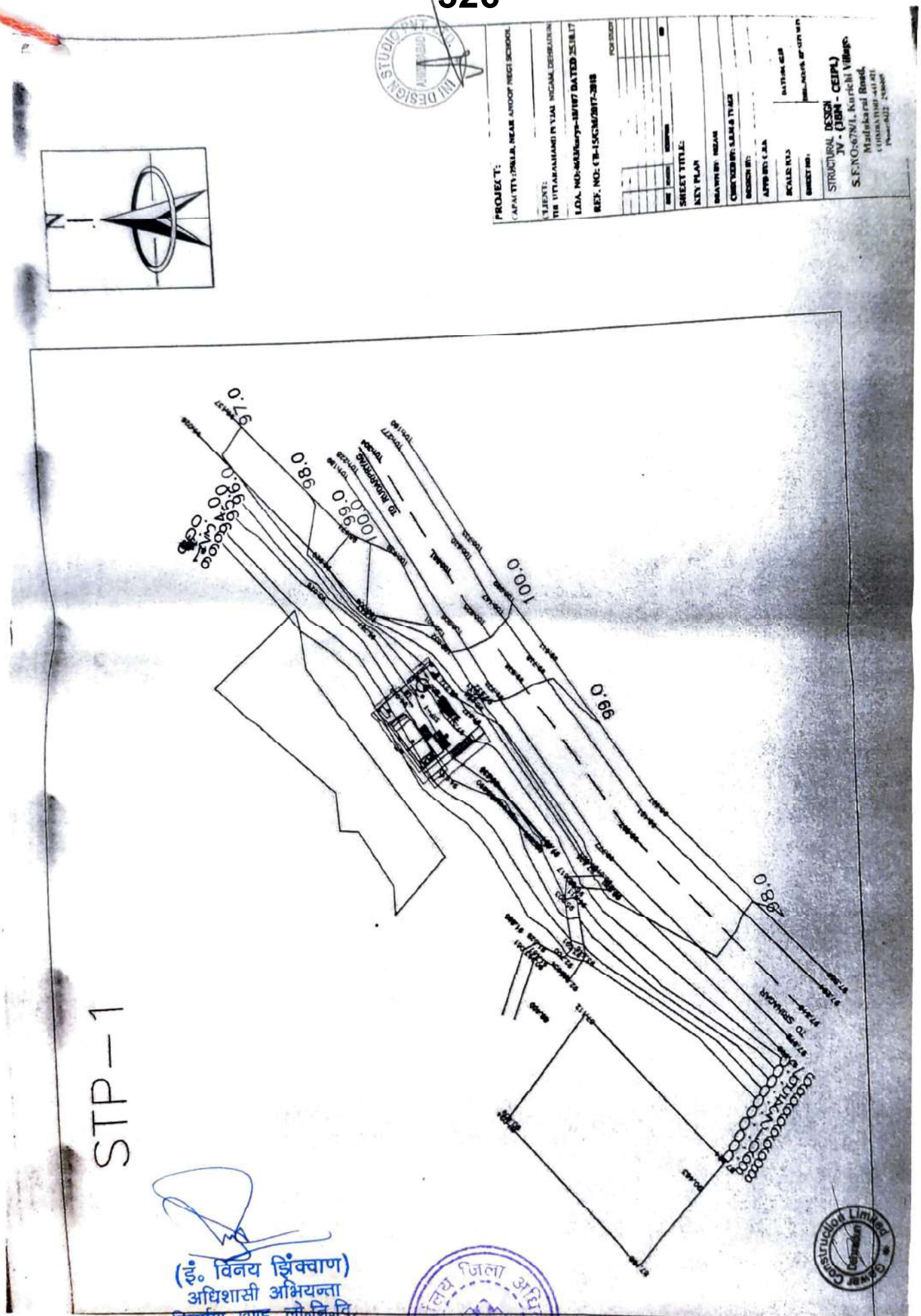

BAR DETAIL
10Ø@125C/C
8Ø@150C/C
150
4600
500
C
8Ø@150C/C
10Ø@125C/C
B
TRENCH PLAN
LD(TYP.)
50
600
300
SECTION B-B
1900
1304
900
196
SECTION C-C
Vetted
&
Rajib Chowdhury
Department of Civil Engineering
Indian Institute of Technology Roorkee
Roorkee-247667, Uttarakhand
STP 1, 75KLD , ANOOP NEGI SCHOOL , RUDRAPRAYAG
CLIENT:- THE UTTARAKHAND PEYJAL NIGAM, DEHRADUN
TITLE:- TRENCH DETAIL
DATE 31-05-2018
SCALE N.T.S.
DRAWN BY PRAVEEN
DESIGN BY KAPILLAL
CHECKED BY R.J.
REVISION - 1.
REVISION - 2.
REVISION - 3.
DRAWING RELEASED FOR:- TENDER / APPROVAL / G.F.C
CONTRACTOR:- JV - (JBM - CEIPL)
STRUCTURAL CONSULTANTS:
CLEAR COVER 25 MM.
324



(इं॰ विनय झिंक्वाण)
अधिशासी अभियन्ता
निर्माण खण्ड, लो॰नि॰वि॰
रुद्रप्रयाग



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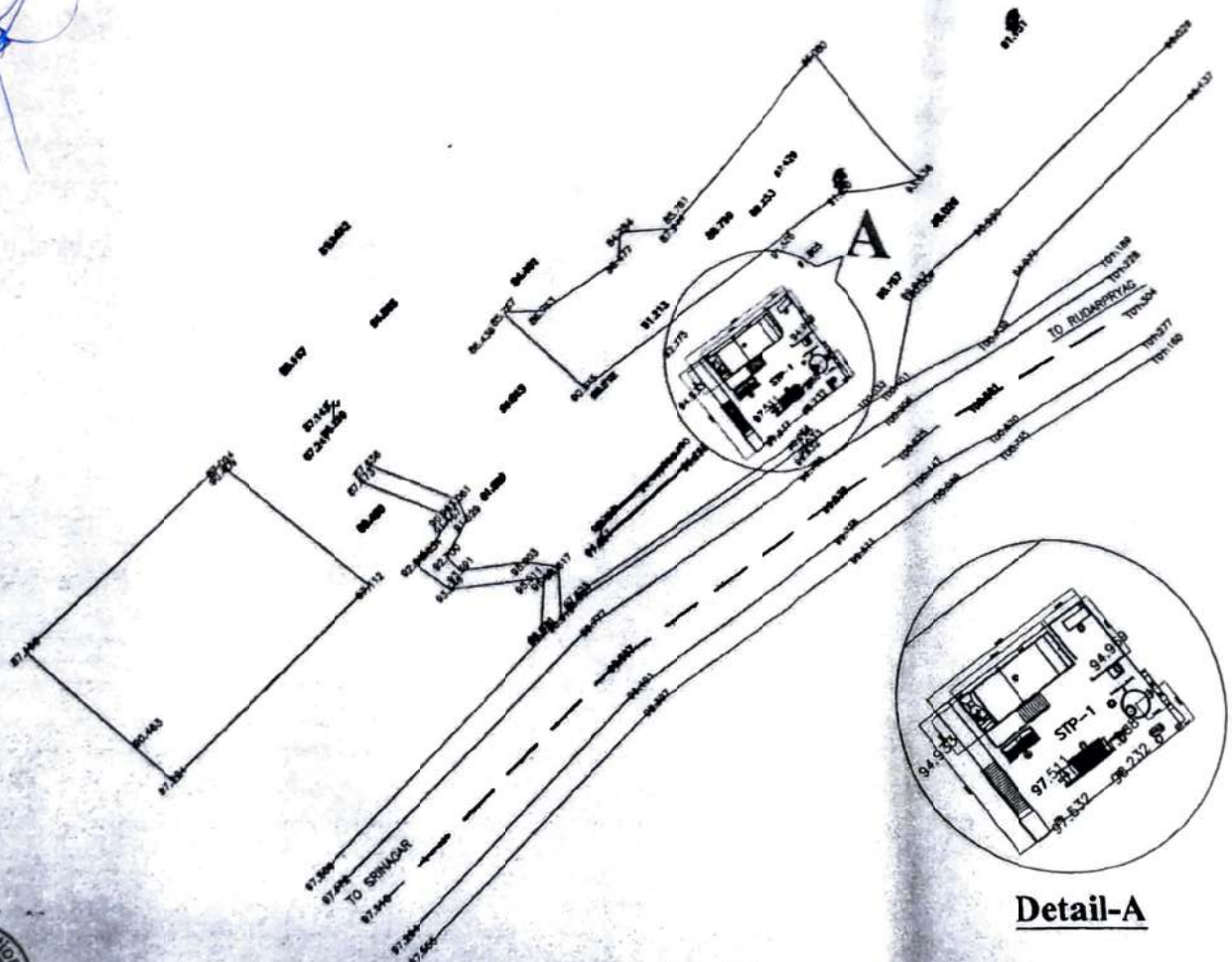
निर्माण खण्ड, लो०नि०वि०
रुद्रप्रयाग

STP – 1



Detail-A

(इं. विवेक सिंकवाण)
अधिशासी अभियन्ता
निर्माण खण्ड, लो.नि.वि.
उदकाशी

PROJECT:

CLIENT:

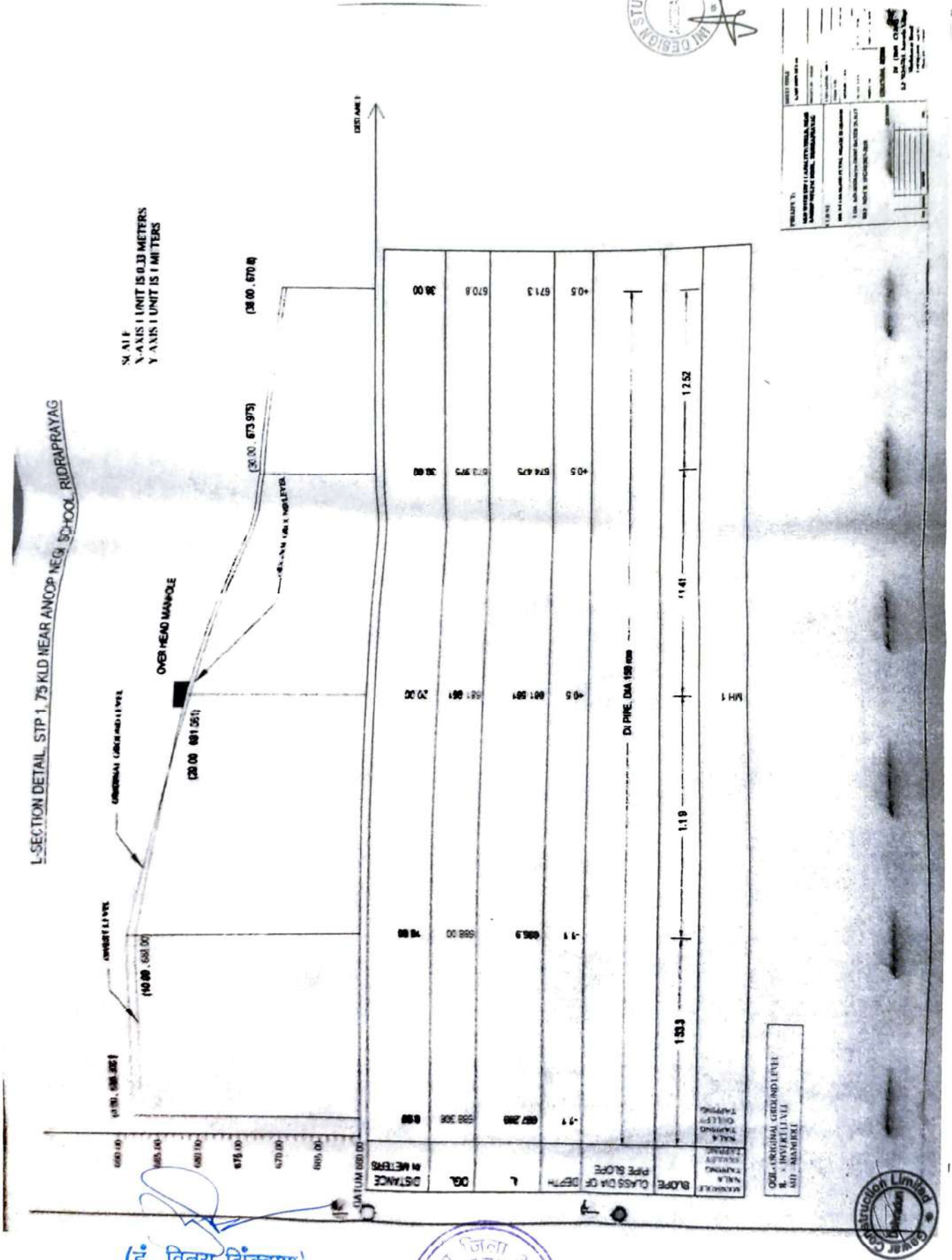
LOA. NO:

REF. NO:

SHEET TITLE:
SITE PLAN

STRUCTURAL DESIGN
JV - (JBM - CEIPL)
S.F.NO:678/1, Karichi Village,
Madukarai Road,

327



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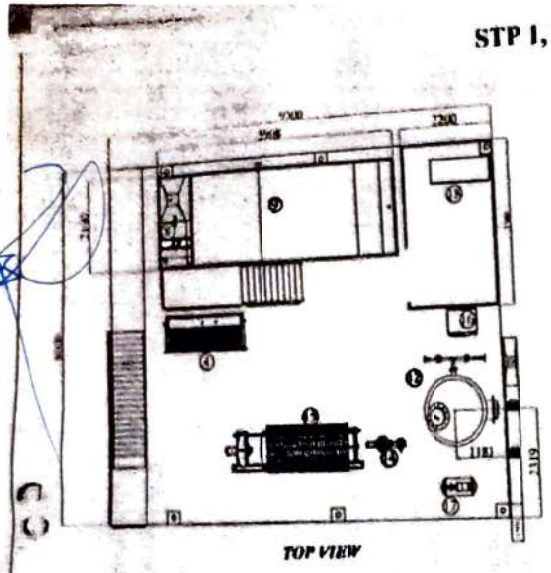
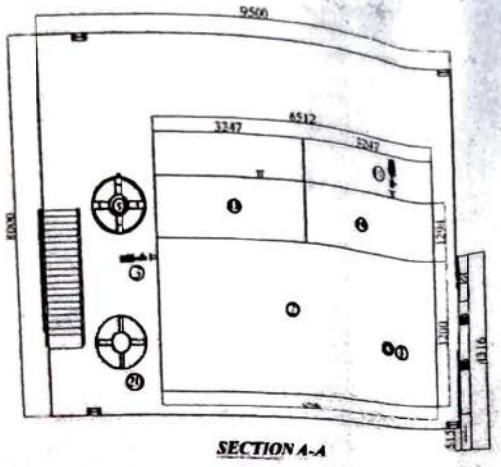
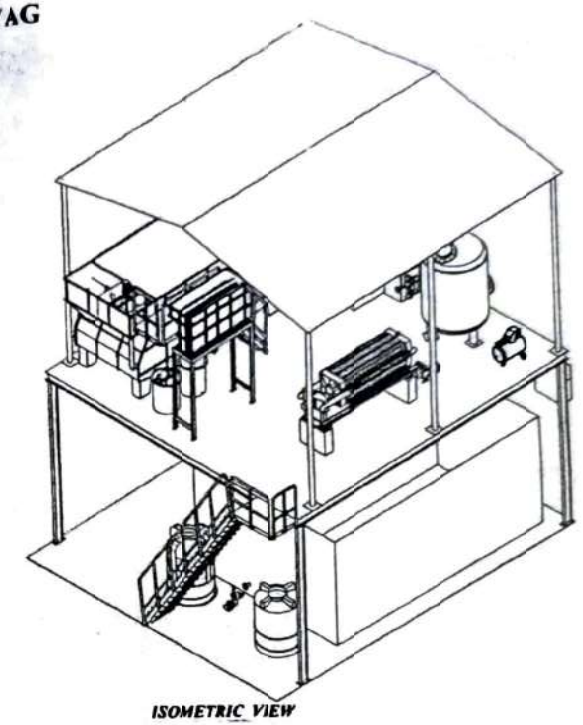
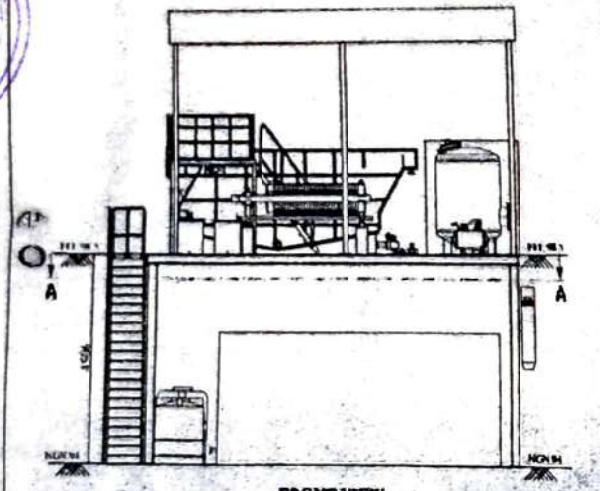
निर्माण खण्ड, लो०नि०नि०
रुद्रप्रयाग

STP I, 75KLD , ANOOP NEGI SCHOOL , RUDRAPRAYAG









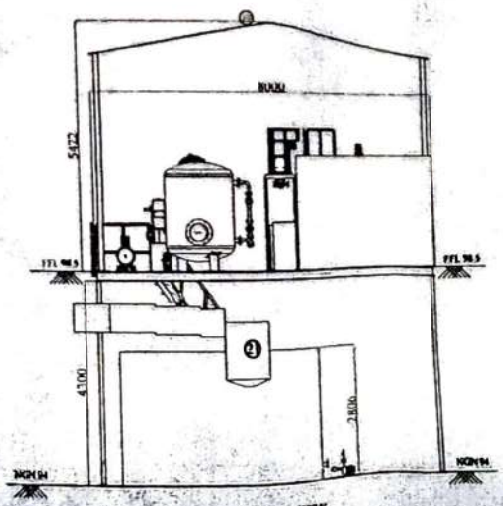


TABLE OF CONTENTS:

S.No	DESCRIPTION	CAPACITY	QTY	LOAD IN kg
1	AIR PUMP/BLOWER			
2	COLLECTION TANK			
3	CI FEED PUMP			
4	MCRD			
5	EQ CLEANING TANK			
6	CHARGE ALUM DOSING SYSTEM			
7	POLYMER DOSING SYSTEM			
8	CI ASH MEDIA			
9	TUBE SETTLER			
10	FILTER FEED TANK			
11	FILTER FEED PUMP			
12	PRESSURE SAND FILTER			
13	BACK WASH FEED TANK			
14	BACK WASH FEED PUMP			
15	FILTER PRESS			
16	CHLORINE DOSING			
17	AIR COMPRESSOR			
18	STP PANEL			
19	MISC			
20	TREATED WATER TANK			
21	BARSEEM SCREEN WITH TROLLEY			

TITLE :	G + 4 DRAWING
LOCATION:	STP I, 75KLD , ANOOP NEGI SCHOOL , RUDRAPRAYAG
CLIENT :	THE UTTARAKHAND PEYJAL NIGAM, DEHRADUN
	JV - (JMM - CEIPL)

NOTE:
TOTAL AREA REQUIRED: 9.5m x 8m = 76 sq.m

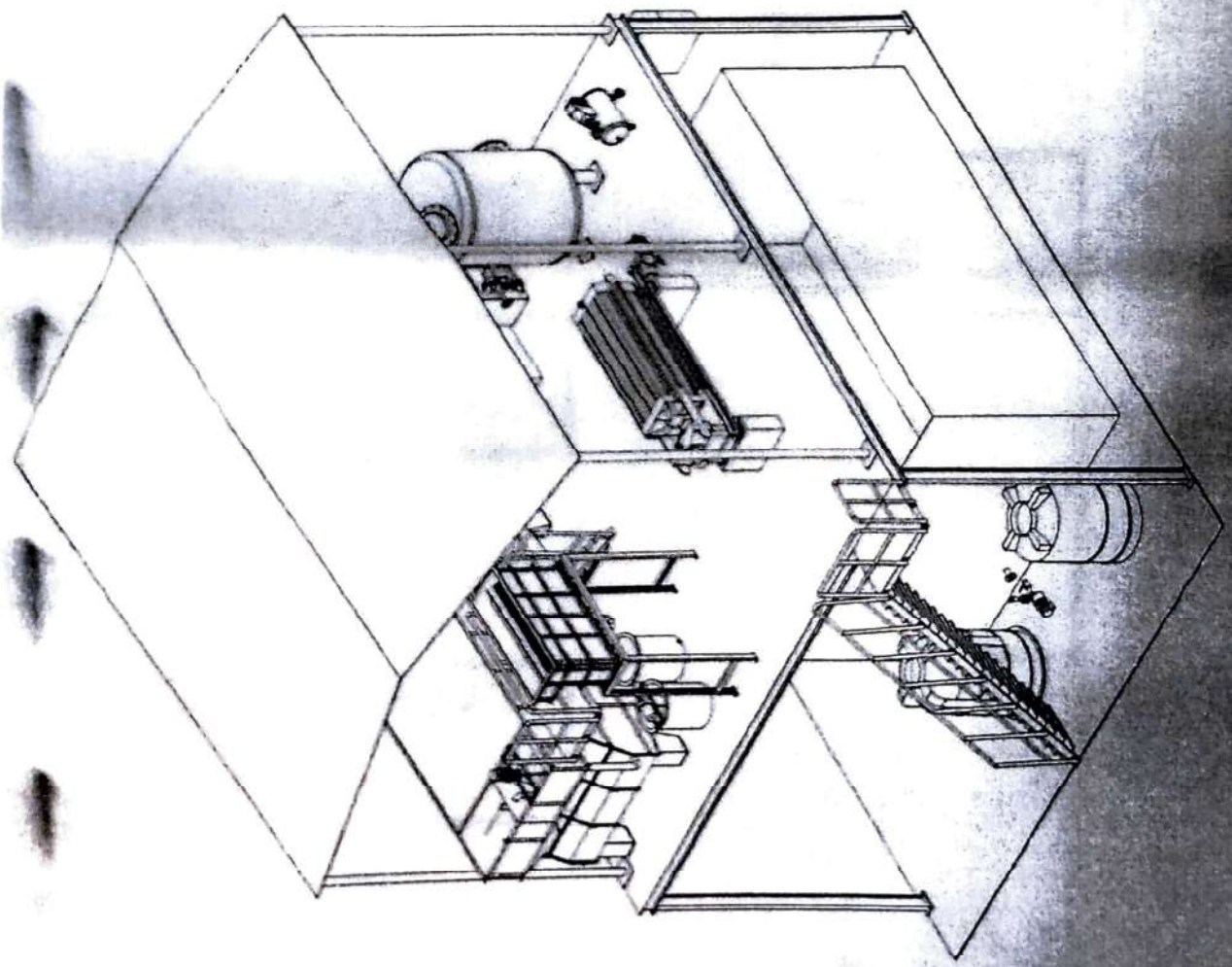
NOTE:
Plant al Fencing work with Barbed wire, chain link(2.4mHt) etc. & M.S Gate

EQUIPMENT AND TANK LOAD DETAILS WITH WATER:
First Floor - 30 TONNES

PROJ	DRAWN BY:	CHECKED BY:	DESIGN BY:	APPROVED BY:
	NIGAM			C.E.O.

DATE - PLACE

329



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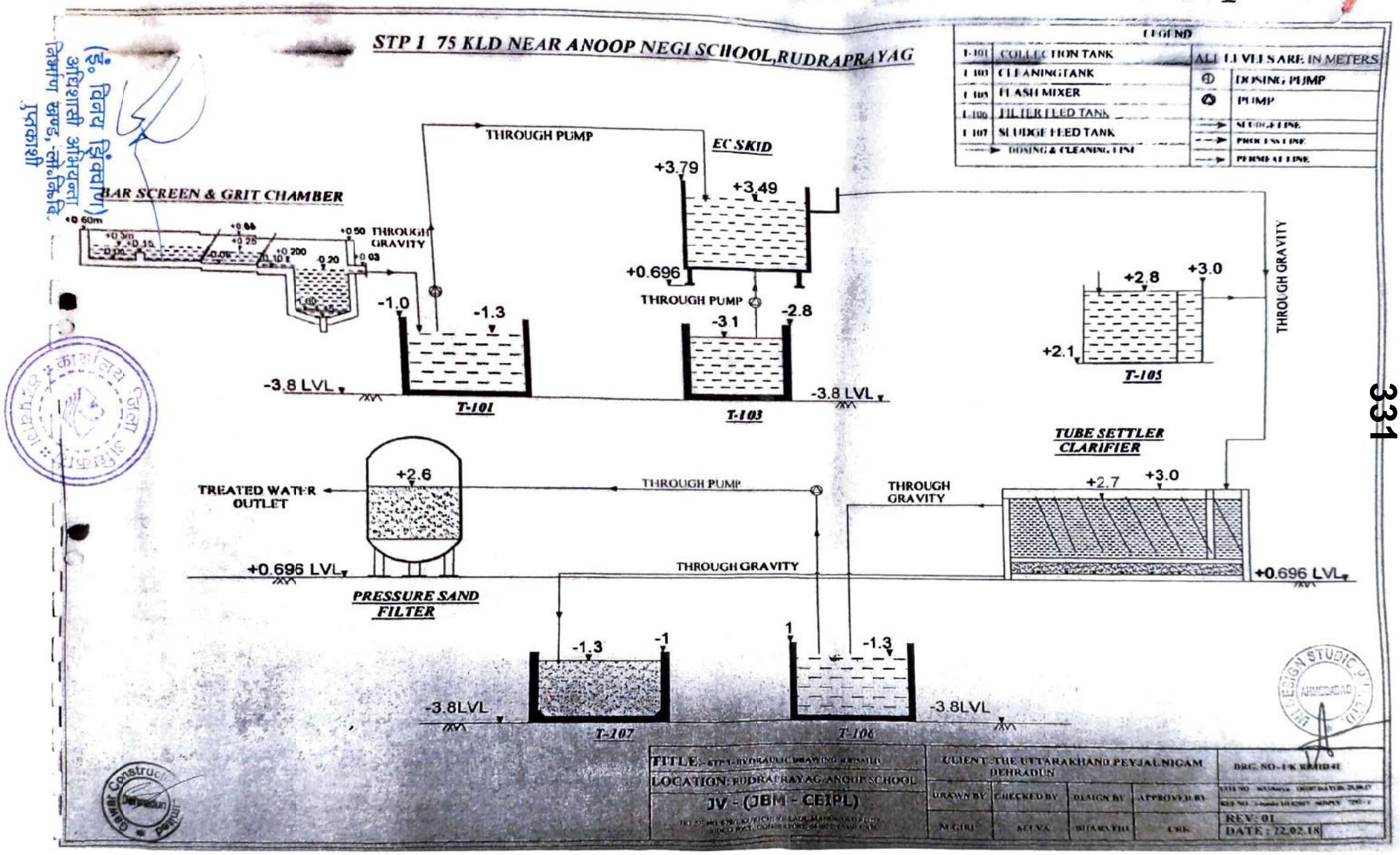
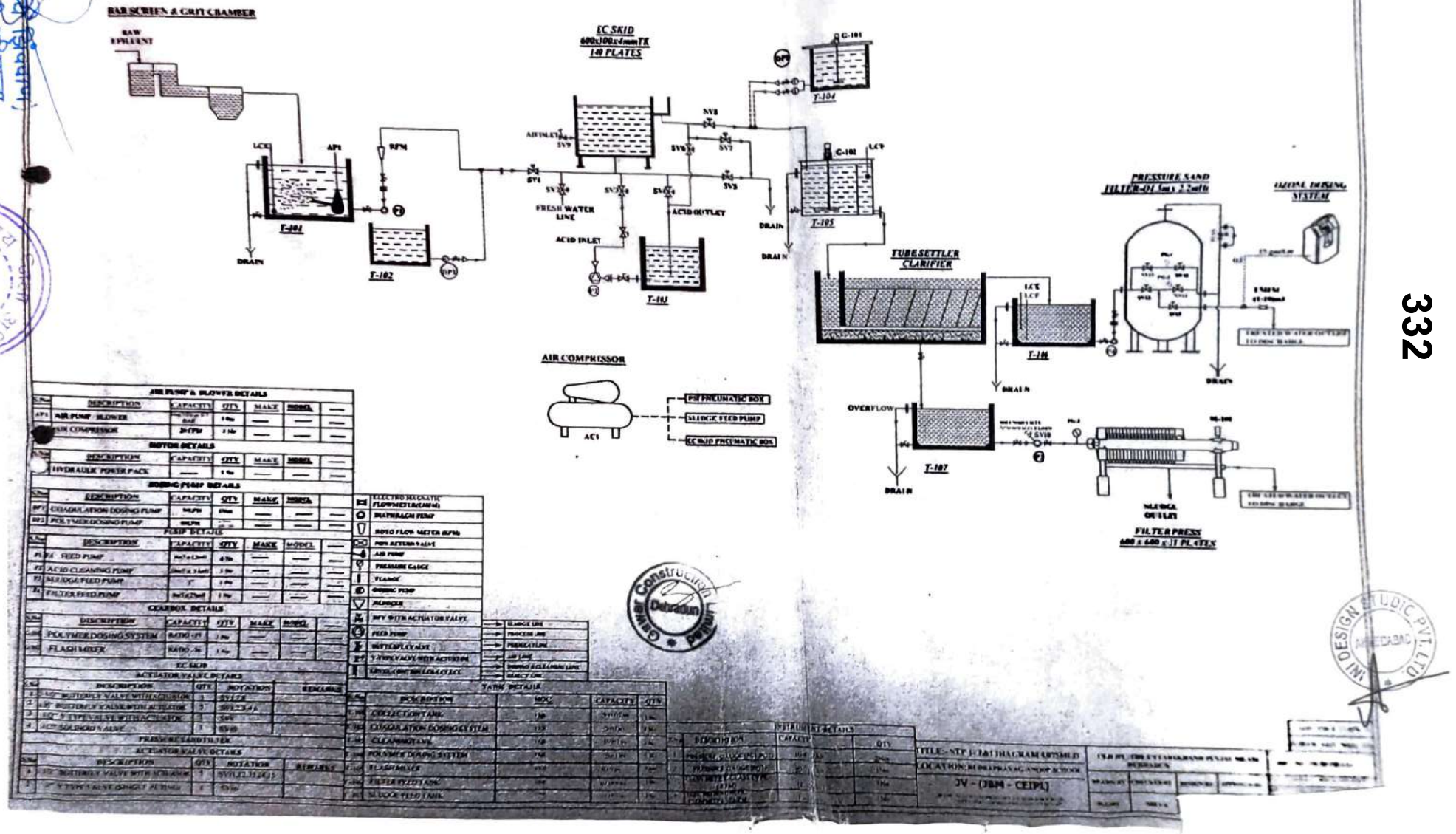
अधिशासी अभियन्ता
निर्माण खण्ड, लो०नि०वि०
रुद्रप्रयाग



(इं. विनय डिंभवाल)
अधिशासी अभियन्ता
पेयजल खण्ड, ऊखीमठ

STP-1 75 KLD NEAR ANOOP NEGI SCHOOL,RUDRAPRAYAG



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निर्माण खण्ड, लो०नि०वि०
रुद्रप्रयाग

332

SECTION IX

REFERENCE OF ELECTROCOAGULATION TECHNOLOGY

(ANNEXURE – C)

Gamwar Construction Limited Dehradun

INI DESIGN STUDIO PVT. LTD. AHMEDABAD

कार्यालय जिला अधिकारी रुद्रप्रयाग

(इं० विनय झिंक्वाण)
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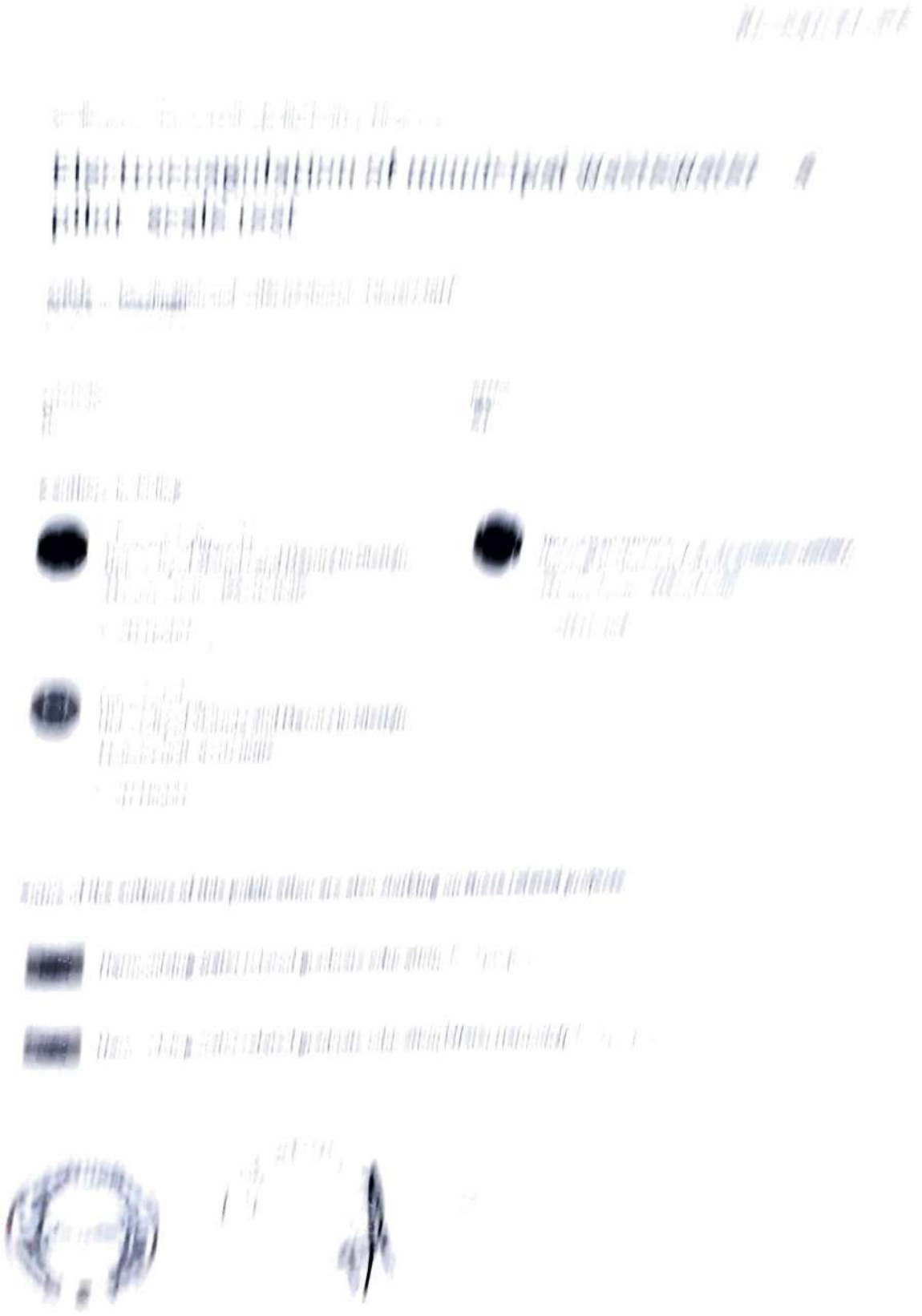
प्रकाशी



Electrocoagulation of municipal wastewater – a pilot-scale test

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Desalination and Water Treatment
www.deswater.com
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72 (2017) 162–168
April

Electrocoagulation of municipal wastewater – a pilot-scale test

Lech Smoczyński[a,*], Sławomir Kalinowski[a], Harsha Ratnaweera[b], Marta Kosobucka[a], Mihaela Trifescu[a], Krystyna Pieczulis-Smoczyńska[a]

[a]*Faculty of Environmental Management and Agriculture, University of Warmia and Mazury in Olsztyn, Poland, Tel. +48 89 5233668, email: lechs@uwm.edu.pl (L. Smoczyński)*
[b]*Department of Mathematical Sciences and Technology, Norwegian University of Life Sciences, Aas, Norway*

Received 17 November 2016; Accepted 4 March 2017

ABSTRACT

In this study, a pilot test of electrocoagulation (EC with aluminium electrodes) of natural municipal wastewater was performed. In view of the obtained results and the unique and innovative nature of the proposed procedures and solutions, EC can be regarded not only as a preliminary purification step, but also as a comprehensive alternative to other wastewater treatment methods. Electrocoagulation was conducted at constant current, and changes in voltage were registered continuously to control and calculate energy consumption. After 2 h (7200 s of EC + 1800 s of additional sludge settling), initial colour (2140–2570 mg/L) was removed in 86–99.5%, turbidity (87.5–149 mg/L) – in 100%, suspended solids (250–340 mg/L) – in 88.5–91%, COD (609–737 mg/L) – in 60.8–63.5%, and phosphorus (10.0–10.7 mg/L) – in 94.5–96%. As expected, a higher electrocoagulant dose at higher energy consumption improved the efficiency of wastewater treatment, but energy consumption was not directly proportional to the treatment efficiencies of electrocoagulated municipal wastewater. The obtained results of sewage purification seem to be promising both economically and technologically. They fulfil Polish standards of effluent quality, except for COD where higher efficiency is required. EC poses a viable alternative to other wastewater treatment methods and should be considered as an initial step in municipal wastewater treatment.

Keywords: Electrocoagulation EC; Al-electrodes; Energy consumption; Sewage

1. Introduction

Biological treatment of wastewater, the most popular sewage treatment method, is characterized by very low efficiency at low temperatures [1–3]. At low temperatures (5–10°C), the efficiency of most biological processes decreases considerably, and the effectiveness of suspended solids, COD and phosphorus removal is reduced significantly. Therefore, a biological purification of wastewater, in cold regions, should be supported such as chemical coagulation or, alternatively, electrocoagulation, which will significantly reduce the loading to biological stages.

*Corresponding author.

Electrocoagulation (EC) is easy to control, which is an important consideration in wastewater treatment systems for single houses and portable water treatment units [4,5]. When aluminium electrodes are used, the formation of the aluminium coagulant can be described with the use of the following equations representing the main electrode reactions:

$$2n\,Al^{0} - 6n\,e = 2n\,Al^{3+} \quad (1)$$

$$6(n-x)H_2O + 6(n-x)e = 6(n-x)OH^{-} + (n-x)H_2(\uparrow) \quad (2)$$

The formation of a positively-charged, colloidal aluminium electro-coagulant is described by the following reaction equation:

$$2n\,Al^{3+} + 6(n-x)OH^- = \left\{Al(OH)_3\right\}_{2(n-x)} + 2x\,Al^{3+} \quad (3)$$

The above reactions are accompanied by minor oxygen polarization of the cathode (the value of n in the above equations is significantly higher than the value of x), which induces a minor increase in the pH of electrocoagulated wastewater:

$$\frac{3}{2}x\,O_2(\text{from water}) + 6x\,e + 3xH_2O = 6x\,OH^- \quad (4)$$

EC poses an alternative to chemical treatment [6,7], in particular with regard to low transportation costs of Al from Al-electrodes which is nearly 10 times lighter than Al from $Al_2(SO_4)_3 \cdot 18H_2O$. The availability of cheap electricity and/or the addition of seawater to wastewater treated by EC could reduce the costs associated with this method [8–10]. Such an approach has already been tested in Norway by Foyn [11]. Surprisingly, Al-Zuhair et al. [12] noted a 10–15% increase in EC efficiency when the temperature of treated wastewater was decreased by 15°C, which may suggest that this method is more suitable for cold climate regions. Similarly to coagulation, the main stages of EC are destabilization and flocculation of the colloidal system [13–15]. Electrochemical treatment of sewage [16–19] and other types of wastewater, such as baker's yeast [20], chips [21], pulp and paper [22,23], has been widely researched. Under these conditions, wastewater disinfection [24] also by chlorine evolution at the anode [10,19] may be an important part of the electrocoagulation process. During laboratory experiments, a variety of practical improvements have been suggested for the EC process to lower the coagulant dose, including: a) wastewater recirculation [25], b) the use of electrodes that are specifically shaped to account for the unique parameters of treated wastewater and c) changes in the direction of current flow [26] for electrode self-cleaning [27].

In this study, selected innovative solutions for sewage EC, which had been previously tested only in a laboratory setting, were analysed in semi-industrial conditions. The following unique solutions were applied in a pilot experiment: a) sewage flow during recirculating EC was enforced by the shape of the electrodes and the electrolyser, and the electrolyser can be easily adapted to process large quantities of wastewater, b) electrode self-cleaning was induced by changes in the direction of current flow on the electrodes, c) the optimized frequency of changes in the direction of current flow on the electrodes (every 256 s) was sufficient for electrode polarization. In view of the unique and innovative nature of the proposed procedures and solutions, EC can be regarded not only as a preliminary purification step, but also as a comprehensive alternative to other wastewater treatment methods.

2. Materials and methods

Sewage from Reszel (Poland, 5000pe) was used in this pilot test. Raw sewage was characterized by the following average parameters: pH = 6.89–6.97; Turbidity TU = 87.5–149 mg/L, Suspended Solids SS = 250–340 mg/L; Chemical Oxygen Demand COD = 609–737 mg/L; Total Phosphorus P = 10.0–10.7 mg/L. A pilot system for EC of municipal wastewater, equipped with Al-electrodes, was designed and constructed specifically for this test. The diagram of a recirculation system for sewage EC is shown in Fig. 1.

550 g NaCl was dissolved in 100 L of sewage to increase its specific conductance κ to $2.2 \cdot 10^{-3}\ \Omega^{-1} \cdot cm^{-1}$. Then, 26 mL of concentrated HCl (36%) was added to decrease pH and dissolve the passive layer of the anode [28]. According to some researchers [10,19,24], disinfectant chlorine can be generated electrochemically under the above conditions. Next, 100 L of sewage was recirculated at 200 L/h between the small electrolyser and the large container for 1 h (Fig. 5) or 2 h (Figs. 3 and 4). Nine Al-electrodes with the width of 46 cm, height of 16 cm and thickness of 0.3 cm each, spaced at 2.3 cm, were installed in the glass chamber. This unique arrangement contributed to maximum contact between the electrodes and wastewater (Fig. 1, "6"). The pH in the container was maintained at 6.0 by adding small amounts (14–19 mL) of concentrated (36%) HCl during the process.

EC was conducted at constant current. Changes in voltage were registered continuously (Fig. 2), and the mean value of U was determined for controlling and calculating energy consumption. Programmable power supply for the electro-coagulator and the microcomputer controlling the system (10 and 11 in Fig. 1) changed the direction of the current on the electrodes every 256 seconds (based on the results of previous laboratory tests [27]) to: a) facilitate "sophisticated" self-cleaning of the cathode which became a soluble anode after every 256 s, b) minimize polarization loss. The electro-coagulant dose was proportional to the time of electrolysis according to Faraday's law,

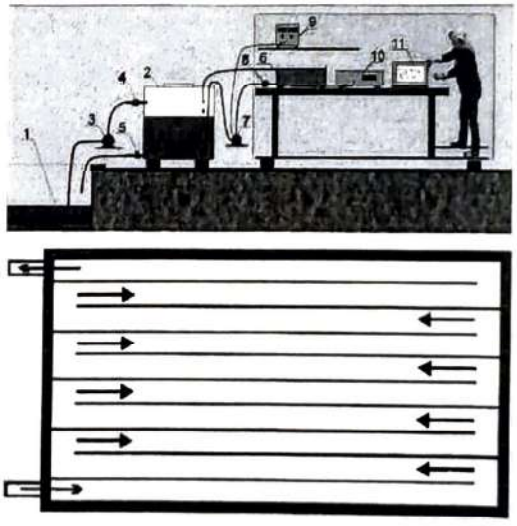

Fig. 1. Diagram of a recirculation system for sewage EC. 1 – wastewater reservoir, 2 – treated sewage tank, 3 – pump for filling the tank, 4 – volume counter, 5 – valve for draining the tank, 6 – electro-coagulator (including the top view), 7 – recirculation pump, 8 – volume counter, 9 – power supply for the recirculation pump, 10 – programmable power supply for the electro-coagulator, 11 – microcomputer controlling the system.

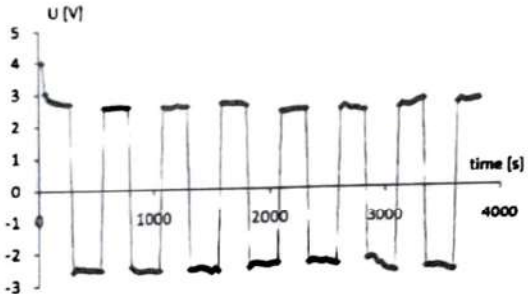

Fig. 2. Example of registration of changes in voltage.

$m = k \cdot i \cdot t$, where the electrochemical equivalent of aluminium is $k = 27/(96500 \cdot 3) = 9.3 \cdot 10^{-5}$ g·A^{-1}·s^{-1}, although previous research [29] demonstrated that it could be higher. Samples for analysis were collected from the supernatant every 10 min. Colour, turbidity (TU), suspended solids (SS), total phosphorus and COD were measured in the DR 2800 HACH-Dr Lange system, and pH was controlled with the Hanna Instruments HI 8424 pH-meter. After EC, treated sewage was sedimented for 30 min, and three final samples were collected from the supernatant for analysis. The mean values of parameters describing treated wastewater are given in Figs. 3–5, and the percent error (± %) of SS, P and COD values is presented in Table 1. In Polish wastewater treatment plants, the maximum concentration of phosphorus in purified wastewater is 5 mg/L. Initial phosphorus concentration in the analysed sewage was close to 10 mg/L. Therefore, the common denominator for comparing the obtained purification results was the removal of 50% P.

3. Results and discussion

The purification of re-circulated sewage treated by EC with Al-electrodes is shown in Figs. 3–6 as the following relationship:

impurity removal [%] = f (time of electrolysis)

The first run of EC was performed at I = 10A during t = 2 h (Fig. 3).

During EC, aluminium ions formed by electrolytic dissolution of the aluminium anode are transferred to wastewater [Eq. (1)]. Positively-charged colloidal [$Al(OH)_3$] in sewage [Eq. (3)] is gradually bound to wastewater impurities (responsible for the values of TU, SS, P and COD). After aggregation, agglomeration, flocculation and sedimentation of the sewage sludge, the liquid phase of treated wastewater is gradually separated from impurities expressed by the values of TU, SS, P and COD. After 2 h of EC, the initial colour (2520) was finally removed in 70.2%, turbidity (148) – in 98%, suspended solids (350) – in 74.3%, and phosphorus (10.0 mg/L) – in 79.1%. The electro-coagulant dose required to achieve the above results was:

$$m = 9.3 \cdot 10^{-5} g \cdot A^{-1} \cdot s^{-1} \cdot 10\ A \cdot 7200\ s = 6.7 g\ Al / 100\ L \quad (5)$$

According to the data in Fig. 3, less Al (approx. 62.5 mg Al/L) was required (t = 6720 s) to meet the Polish sewage treatment standards with regard to (–50%) phosphorus removal. Unfortunately, the final COD of 289 mg/L (up to 60.8%) did not conform to the Polish requirements, i.e. 150 mg/L. The energy consumption associated with the introduction of 6.7 g of Al to 100 L of treated sewage was:

$$E = 2.65V \cdot 10A \cdot 2h = 53Wh / 100L \quad (6)$$
$$= 0.53\ kWh\ per\ tonne\ of\ sewage$$

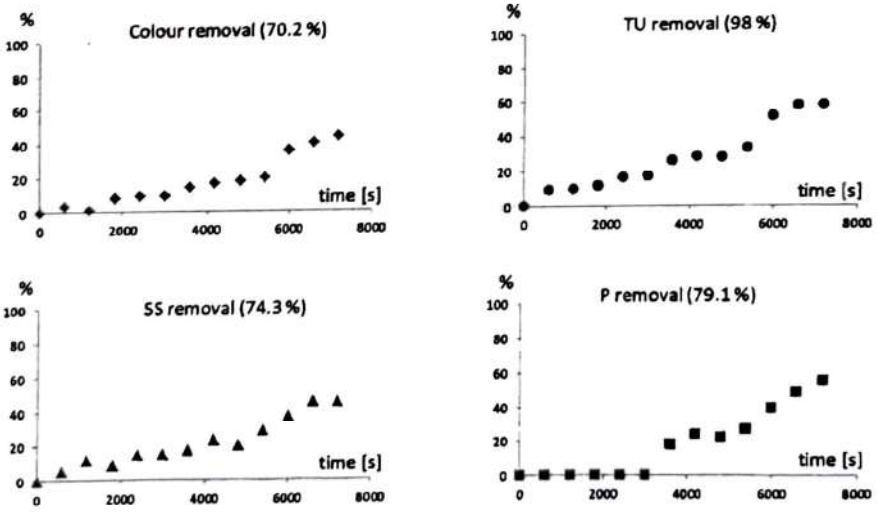

Fig. 3. Purification of sewage treated by EC at I = 10 A, U = 2.65 V, t = 7200 s, pH_o = 6.93 + 15 mL HCl, P_o = 10.0, $Colour_o$ = 2520, TU_o = 148, SS_o = 350, $COD_o \rightarrow COD_f$ = 609 → 326 mg/L (–46.5%).

(इं० विनय झिंक्वाण)
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निर्माण खण्ड, लो०नि०वि०
प्रतापगढ़

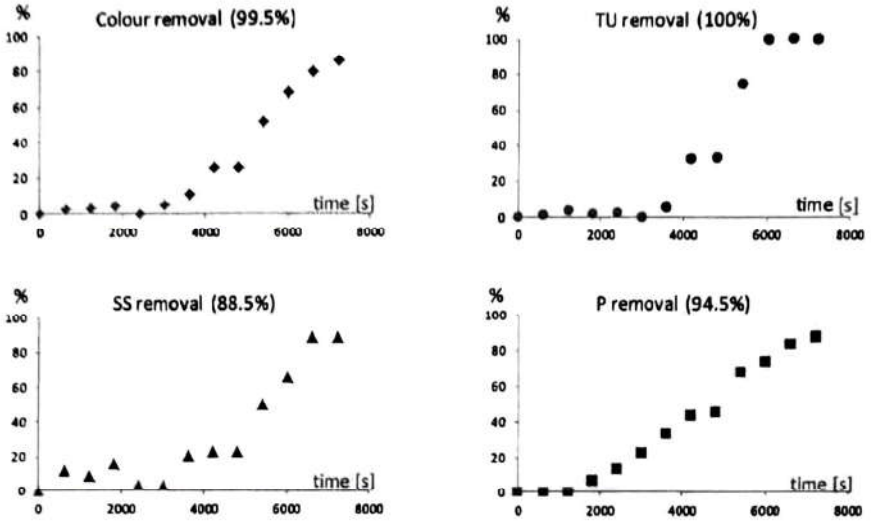

Fig. 4. Purification of sewage treated by EC at I = 13 A, U = 2.8 V, t = 7200 s, pH_o = 6.92 + 14 mL HCl, P_o = 10.7, $Colour_o$ = 2140, TU_o = 87.5, SS_o = 260, $COD_o \rightarrow COD_f$ = 737 → 289 mg/L (–60.8%).

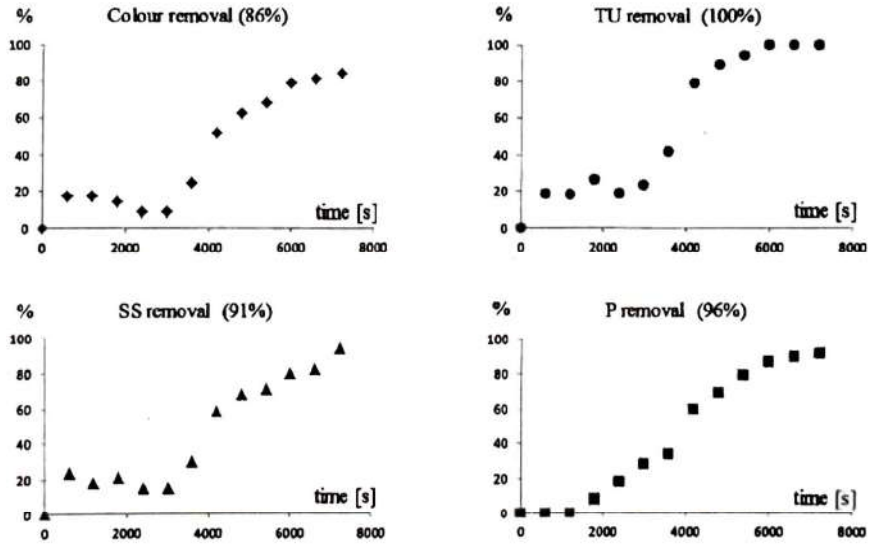

Fig. 5. Purification of sewage treated by EC at I = 15 A, U = 3.2 V, t = 7200 s, pH_o = 6.89 + 15 mL HCl, P_o = 10.7, $Colour_o$ = 2570, TU_o = 149, SS_o = 340, $COD_o \rightarrow COD_f$ = 737 → 269 mg/L (–63.5%).

Table 1
Parameters and results of pilot EC of municipal wastewater

No. of run	Al-dose	Energy consumption	SS	P	COD
	g/tonne	kWh/tonne	[%] removal		
1	67	0.530	74.3 ± 1.2	79.1 ± 4.4	46.5 ± 5.0
2	87	0.728	88.5 ± 1.5	94.5 ± 4.5	60.8 ± 5.5
3	100	0.960	91.0 ± 1.7	96.0 ± 4.3	63.5 ± 1.6

Therefore, energy consumption required to remove 50% of P was 0.49 kWh per tonne of sewage (62.5 mg Al/L was consumed). Al-anode dissolution and energy consumption are the main costs associated with EC maintenance.

The second run of EC was performed at $I = 13$ A during $t = 2$ h (Fig. 4). Those parameters (I and t) were selected based on numerous laboratory experiments and trials [29–31].

After 2 h of EC, the initial colour (2140) was removed in 99.5%, turbidity (87.5) in 100%, suspended solids (250)– in 88.5%, and phosphorus (10.7 mg/L) in 94.5%. The electro-coagulant dose required to achieve the above results was:

$$m = 9.3 \cdot 10^{-5}\, g \cdot A^{-1} \cdot s^{-1} \cdot 13\ A \cdot 7200\ s = 8.7\, g\ Al / 100\ L \quad (7)$$

According to the data in Fig. 4, less Al (approx. 58.6 mg Al/L) was required ($t = 4850$ s) to meet the Polish sewage treatment standards with regard to (–50%) phosphorus removal. Unfortunately, the final COD = 289 mg/L (60.8% removal) did not conform to the requirements, i.e. 150 mg/L. The energy consumption associated with the introduction of 8.7 g of Al to 100 L of treated sewage was:

$$E = 2.8\ V \cdot 13\ A \cdot 2\ h = 72.8\ Wh / 100\ L = 0.728\ kWh\ per\ tonne\ of\ sewage \quad (8)$$

Therefore, energy consumption required to remove 50% of P at 58.6 mg Al/L was 0.49 kWh per tonne of sewage. It means that energy consumption required to remove 50% of P is the same at $I = 13$ A and $I = 10$ A, although less Al was consumed at $I = 13$ A.

In the third run of EC (Fig. 5), current was increased to $I = 15$ A.

After 2 h of EC, the initial colour (2570) was removed in 86%, turbidity (149) – in 100%, suspended solids (340) – in 91%, and phosphorus (10.4 mg/L) – in 96%. Due to higher $I = 15$ A, the electro-coagulant dose required to achieve the above results was:

$$m = 9.3 \cdot 10^{-5}\, g \cdot A^{-1} \cdot s^{-1} \cdot 15\ A \cdot 7200\ s = 10\, g\ Al / 100\ L \quad (9)$$

According to the data in Fig. 5 and according to expectations (Figs. 3 and 4), less Al (approx. 55.5 mg Al/L) was required to meet the sewage treatment standards with regard to (–50%) phosphorus removal. However, the final COD of 269 mg/L (up to 63.5% removal after EC) did not fulfil the Polish requirements. Similar or even worse results were obtained in numerous laboratory experiments and trials [29–31]. The energy consumption associated with the introduction of 10 g of Al to 100 L of treated sewage was:

$$E = 3.2V \cdot 15A \cdot 2h = 96Wh / 100L = 0.96\ kWh\ per\ tonne\ of\ sewage \quad (10)$$

Therefore, energy consumption required to remove 50% of P (at 55.5 mg Al/L) was 0.53 kWh per tonne of sewage. It means that energy consumption required to remove 50% of P at $I = 15$ A was slightly higher than at $I = 10$ A and $I = 13$, but less Al was consumed at $I = 15$ A. Considering the final results of purification (final removal of Colour, TU, SS and P, Fig. 5), a compromise between Al-anode dissolution and energy consumption has to be reached.

As expected, a higher electrocoagulant dose at higher energy consumption improved the efficiency of wastewater purification. The data presented in Table 1 indicate that the improvement in the purification degree of electrocoagulated waste may not be cost-effective in practice. When energy consumption is increased by 45% and aluminium consumption (Al electrodes) is increased by 33%, the corresponding increase in removal efficiency (SS, P and COD) is only around 17%. However, operating costs (consumption of Al electrodes and energy) can be adapted to local needs and requirements. One of the greatest advantages of the proposed EC method is that it is easy to control by changing the current flowing through the electrolyser.

As mentioned in the Introduction, EC and chemical coagulation involve the aggregation, agglomeration and flocculation of impurities with colloidal particles of aluminium hydroxide and other aluminium compounds in the system after the hydrolysis of aluminium cations [32].

The diagram in Fig. 6 presents a simple model for the aggregation and flocculation of phosphates and COD with colloidal $\{Al(OH)_3\}_n$. From the physicochemical point of view, this process involves bridging of positively-charged, colloidal $\{Al(OH)_3\}_n$ adsorbents by negatively-charged sewage impurities, and the adsorption of other wastewater impurities (such as phosphate anions) by colloidal $\{Al(OH)_3\}_n$ adsorbents [30]. In industrial practice, this aggregation mechanism is known as sweep flocculation [15,32]. Sewage impurities are agglomerated in sludge, and sludge is separated to produce treated wastewater.

In the fourth run (Fig. 7), in order to validate the data from purification trials 1, 2 and 3, the duration of the experiment was reduced to 1 h of EC at the current of $I = 15$ A (Fig. 5).

After 1 h of EC, the initial colour (2170) was removed in 63%, turbidity (102) – in 100%, suspended solids (270) – in 71%, and phosphorus (10.7 mg/L) – in 51%. Since the fourth run of EC was twice shorter, the electro-coagulant dose required to achieve the above results was also twofold lower (50 mg Al/L). In such conditions purification results were not satisfactory, except for the final removal of P after 0.5 h of additional sludge settling. Therefore, EC has to last longer under practical conditions.

The results obtained during EC of municipal wastewater indicate that EC can pose a viable alternative to other wastewater treatment methods and can be seriously considered as an initial process of municipal wastewater purification.

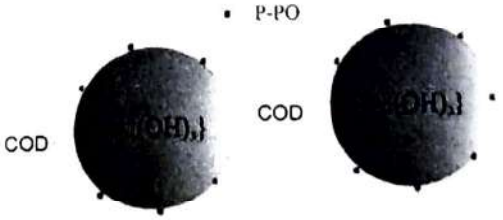

Fig. 6. Aggregation and flocculation of phosphates and COD in wastewater electrocoagulated with Al electrodes.

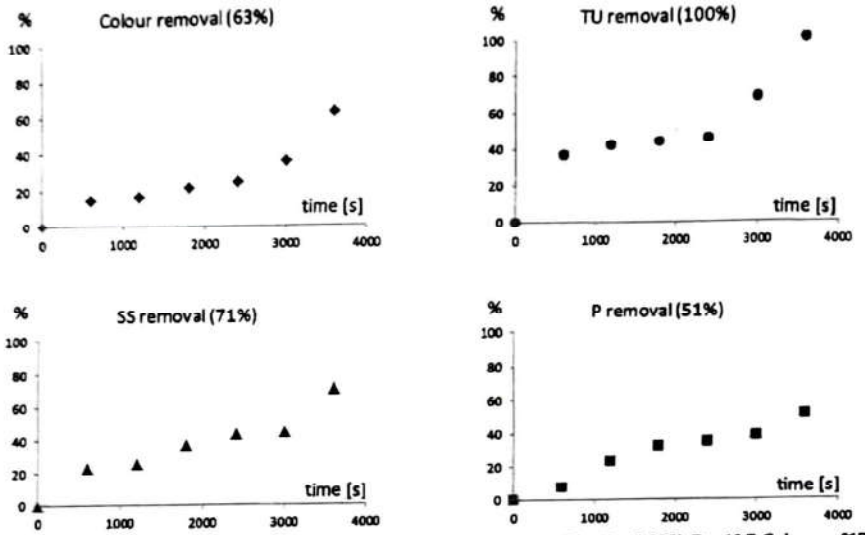

Fig. 7. Purification of sewage treated by *EC* at $I = 15$ A, U = 3.0 V, $t = 3600$ s, $pH_o = 6.97 + 19$ mL HCl, $P_o = 10.7$, $Colour_o = 2170$, $TU_o = 102$, $SS_o = 270$, $COD_o \rightarrow COD_f = 737 \rightarrow 304$ mg/L (–58.7%).

4. Conclusions

Municipal wastewater treated by the pilot electrocoagulation method (*EC*) is purified equally or more effectively than sewage treated in a laboratory. The costs of the main components of the *EC* system are determined by the prices of aluminium and energy. Therefore, a certain compromise has to be reached to match the specific requirements of a wastewater treatment plant. In the described pilot test: a) the maximum energy consumption associated with 55.5 mg Al/L was 0.53 kWh per tonne of sewage and b) the minimum energy consumption associated with 62.5 mg Al/L was 0.49 kWh per tonne of sewage. Sewage purification results seem promising, and they fulfil Polish effluent quality standards, excluding COD where higher efficiency is required, which is caused by the dissolved fractions. Electrocoagulation alone can pose a viable alternative to other wastewater treatment methods in most cases and will be an important initial step, where biological processes are required to remove dissolved COD during municipal wastewater purification.

Acknowledgement

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References

[1] T.M. LaPara, J.E. Alleman, Thermophilic aerobic biological wastewater treatment, Water Res., 33 (1999) 895–908.
[2] F. Morgan-Sagastume, D.G. Allen, Effect of temperature transient conditions on aerobic biological treatment of wastewater, Water Res., 37 (2003) 3590–3601.
[3] D. Mulkerrins, A.D.W. Dobson, Parameters affecting biological phosphate removal from wastewater, Environ. Int., 30 (2004) 249–259.
[4] A.J. Gadgil, Portable water treatment unit. US patent (2002), US 6464884 B1.
[5] R.A. Wiemers, Electrocoagulation apparatus with in-place electrode cleaning. US patent (2013), US8435391 B2.
[6] L. Zaleschi, C. Teodosiu, I. Cretescu, M.A. Rodrigo, A comparative study of electrocoagulation and chemical coagulation processes applied for wastewater treatment, Environ. Eng. Manage. J., 11 (2012) 1517–1525.
[7] M. Yousuf, A. Mollah, R. Schennach, J.R. Parga, D.L. Cocke, Electrocoagulation (EC) – science and applications, J. Hazard. Mater., B64 (2001), 29–41.
[8] T. Öztürk, S. Veli, A. Dimoglo, The effect of seawater conductivity on the treatment of leachate by electrocoagulation, Chem. Biochem. Eng. Q., 27 (2013) 347–354.
[9] N. Daneshvar, A.R. Khataee, A.R.A. Ghadim, M.H. Rasoulifard, Decolorization of C.I. Acid Yellow 23 solution by electrocoagulation process: Investigation of operational parameters and evaluation of specific electrical energy consumption (SEEC), J. Hazard. Mater., 148 (2007) 566–572.
[10] G. Chen, Electrochemical technologies in wastewater treatment, Sep. Purif. Technol., 38 (2004) 11–41.
[11] E.A. Vik, D.A. Carlson, A.S. Eikum, E.T. Gjessing, Electrocoagulation of potable water, Water Res., 18 (1984) 1355–1360.
[12] S. Al-Zuhair, A. Al-Lobaney, S. Makhloud, Assessment of electrocoagulation for the treatment of petroleum refinery wastewater, J. Environ. Manage., 91 (2009) 180–185.
[13] T. Harif, M. Khai, A. Adin, Electrocoagulation versus chemical coagulation: Coagulation/flocculation mechanisms and resulting floc characteristics, Water Res. 46 (2012) 3177–3188.
[14] L. Smoczyński, Z. Bukowski, R. Wardzyńska, B. Załęska-Chróst, K. Dłużyńska, Simulation of coagulation, flocculation and sedimentation, Water Environ. Res., 81 (2009) 348–356(9).

[15] L. Smoczyński, P. Mróz, R. Wardzyńska, B. Załęska-Chróst, K. Dłużyńska, Computer simulation of flocculation of suspended solids, Chem. Eng., J. 152 (2009) 146–150.
[16] M. Al-Shannag, K. Bani-Melhem, Z. Al-Anber, Z. Al-Qodah, Enhancement of COD-nutrients removals and filterability of secondary clarifier municipal wastewater influent using electrocoagulation technique, Sep. Sci. Technol., 48 (2013) 673–680.
[17] M. Nasrullah, L. Singh, Z.A. Wahid, Treatment of sewage by electrocoagulation and the effect of high current density, Energy Environ. Eng. J., 1 (2012) 27–31.
[18] M.A. Rodrigo, P. Canizares, C. Buitron, C. Saez, Electrochemical technologies for the regeneration of urban wastewater, Electrochim. Acta., 55 (2010) 8160–8164.
[19] L. Zaleschi, C. Saez, P. Canizares, I. Cretescu, M.A. Rodrigo., Electrochemical coagulation of treated wastewater for reuse, Desal. Water Treat., 51 (2013) 3381–3388.
[20] M. Al-Shannag, Z. Al-Qodah, K. Alananbeh, N. Bouqellah, E. Assirey, K. Bani-Melhem, COD reduction of baker's yeast wastewater using batch electrocoagulation, Environ. Eng. Manage. J., 13 (2014) 3153–3160.
[21] M. Kobya, H. Hiz, E. Senturk, C. Aydiner, E. Demirbas, Treatment of potato chips manufacturing wastewater by electrocoagulation, Desalination, 190 (2006) 201–211.
[22] P. Asaithambi, Studies on various operating parameters for the removal of COD from pulp and paper industry using electrocoagulation process, Desal. Water Treat., 25 (2016) 11746–11755.
[23] M. Al-Shannag, W. Lafti, K. Bani-Melhem, F. Gharagheer, O. Dhaimat, Reduction of COD and TSS from paper industries wastewater using electrocoagulation and chemical coagulation, Sep. Sci. Technol., (2012) 700–708.
[24] N. Boudjema, N. Drouiche, M. Kherat, N. Mameri, Wastewater disinfection by electrocoagulation process and its interaction with abiotic parameters, Desal. Water Treat., 57 (2016) 28151–28159.
[25] O. Groterud, L. Smoczyński, Removal of phosphorus and residual aluminium by recirculating electrolysis of wastewater, Vatten, 42 (1986) 293–296.
[26] M.M. Emamjomeh, M. Sivakumar, Review of pollutants removed by electrocoagulation and electrocoagulation/flotation processes, J. Environ. Manage., 90 (2009) 1663–1679.
[27] O. Groterud, L. Smoczyński, Phosphorus removal from water by means of electrolysis, Water Res., 20 (1986) 667–669.
[28] G. Mouedhen, M. Feki, M. De Petris Wery, H.F. Ayedi, Behavior of aluminum electrodes in electrocoagulation process, J. Hazard. Mater., 150 (2008) 124–135.
[29] L. Smoczyński, K. Muńska, B. Pierozyński, Electrocoagulation of synthetic wastewater, Water Sci. Technol., 67 (2013) 404–409.
[30] L. Smoczyński, H. Ratnaweera, M. Kosobucka, K. Kvaal, M. Smoczyński, Image analysis of sludge aggregates obtained at preliminary treatment of sewage, Water Sci. Technol., 70 (2014) 1048–1055.
[31] L. Smoczyński, H. Ratnaweera, M. Kosobucka, M. Smoczyński, Image analysis of sludge aggregates, Sep. Purif. Technol., 122 (2014) 412–420.
[32] J. Duan, J. Gregory, Coagulation by hydrolyzing metal salts, Adv. Colloid Interface Sci., 100–102 (2003) 474–502.

(इं० विनय झिंक्वाण)
अधिशासी अभियन्ता
निर्माण खण्ड, लो०नि०नि०
उत्तरकाशी

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Electrocoagulation -A Promising Technology for Sewage Treatment

Shah Kruna A.[1] Prof. M. J. Pandya[2]
[1]M. E. Student, [2]Asso. Professor
[1,2]Department of Environmental Engineering
[1,2]L. D. College of Engineering, Ahemedabad, India

Abstract — Treatment of sewage wastewater has become an absolute necessity because sewage is main point source pollutant on global scale. An innovative, cheap and effective method of purifying and cleaning wastewater before discharging into any other water system is needed. Wide ranges of wastewater treatment techniques are known which include biological process and physicochemical process. Study has been made to replace the biological treatment of sewage by electrochemical process with consideration to achieve desired water quality. Present study was conducted to investigate the applicability of the electro-coagulation technique for the treatment of sewage wastewater. In this study lab-scale electro-coagulation was carried out for the treatment of raw sewage wastewater at different operating time i.e 15min, 20min, 25min, 30min using Aluminum as Cathode and Mild steel as a Anode, with 15mm and 10 mm electrode spacing, supplying 24v and 10amp. It is observed that the batch which is operated at 10Amp for 30 min has maximum removal efficiency of COD & S.S i.e. 95% & 86% respectively at optimum pH 8.3.

Keywords: Sewage, Electro-Coagulation, COD removal

I. INTRODUCTION

Sewage is the main point source pollutant on a global scale [5]. So, direct discharge of raw or improperly treated sewage into the water body is one of the main sources of pollution [5]. Sewage normally consists of biological, chemical and physical constituents which usually high in Bio-chemical Oxygen demand (BOD), Chemical Oxygen Demand (COD) and Suspended Solids (SS). There are two main objectives of wastewater treatment, one is protecting the environment and other is conserving fresh water resources [1].

Nowadays, many treatment plants use the biological process in treating sewage water but there are also disadvantages for that process. Besides, this Conventional biological treatment needs aeration for days and growth of bacteria. To enhance the removal efficiency of Suspended Solids (SS) in conventional treatment, chemical coagulant such as alum, ferric chloride, ferric sulfate and lime are usually used resulting in suspended solid removal efficiency ranging between 80% to 90%. The major disadvantages of chemical precipitation process for the removal of SS and COD are that it involves the addition of chemicals which can be costly and result in the increase of Total Dissolve solids (TDS). Research in the past few decades, have shown that the Electro-Coagulation is a promising treatment method and have potential to treat variety type of wastewater including sewage.

Electro-coagulation treatment offers an alternative to the use of chemical coagulant such as metal salts or polymer for breaking the pollutants because during the Electro-coagulation process, the electrode can generate the metal hydroxides that destabilized and aggregate the suspended particles and precipitates. It is a complex process involving chemical and physical mechanism operating simultaneously to remove the organics from the sewage wastewater. It involves 3 successive stages

1) Formation of coagulants by Electrolytic oxidation of the sacrificial electrode such as mild steel.
2) Destabilization of contaminants, particulate suspension and breaking of emulsion.
3) Aggregation of destabilized phase to floc formation. (Mollah et al., 2014)

Main aim of the study is to investigate the potential of Electro-Coagulation process using Mild Steel electrodes in the removal of COD and SS from Domestic wastewater. The effect of electrolysis time, inter electrode distance for the removal of parameters are discussed.

II. MATERIALS AND METHODS

A. Sewage Water Samples

Raw sewage wastewater samples were collected from the Pirana 106 MLD sewage treatment plant located in Ahmedabad, Gujarat. The composition of sewage wastewater then characterized to identify the pH, SS, COD, TDS.

B. Experimental Set-up

The batch experimental set-up shown in Fig. 1. The Electrochemical unit consists of an Electrocoagulation cell, a DC power supply and the electrodes (4 Aluminum as cathode and 3 Mild Steel as anode). A Monopolar electrode having same dimensions (230mm X 170 mm X 3mm) as an anode and cathode which spacing of 10mm and 15 mm (depending on the experiment) between each other. The total effective area of electrode was 78200 mm2. All the electrodes were washed with dilute HCl before every experiment conducted.

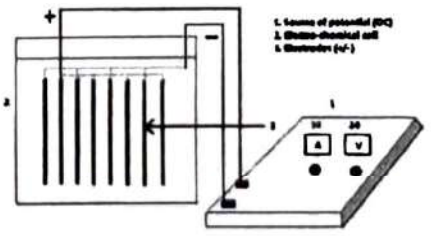

Fig. 1: Schematic diagram of experimental set-up

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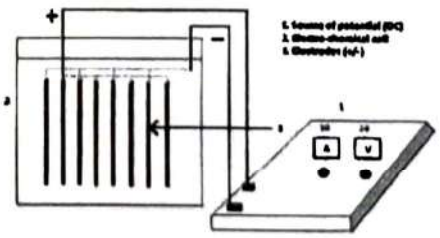

Fig. 1: Schematic diagram of experimental set-up

C. Specifications of lab-scale model

Sr No	Physical Features	Dimensions
1	Reactor Dimensions	380 X 235 X 255 mm^3
2	Liquid Depth	210mm
3	Width of Baffle	50mm
4	Volume of Reactor	22L
5	No of Electrode	4 Al + 3 MS
6	Electrode Dimensions	230mm x 170mm
7	Electrode Area	78200mm^2
8	Thickness of Electrode	3mm
9	Distance between Electrode	15 mm & 10mm

Table 1: SPECIFICATION OF LAB-SCALE REACTOR

D. Electrodes for Lab-scale Model

In the present work Aluminum used as Cathode and Mild steel used as Anode. Electrode design is one of the most important factor that affects the Electro-coagulation process. Electrode design affects the release of coagulants in the solution and the bubble type.

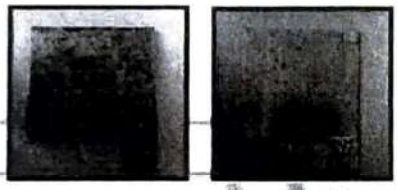

Fig. 2: Electrode Material

E. Experimental procedure

The experiments were carried out in a batch mode. Monopolar electrodes used with electrode distance 15mm and 10 mm. 10 Ampere and 24 volt are fixed in power supply unit. Each run was carried out at time interval of 15min, 20min, 25 min, and 30 min, once the DC power supply was started. Experiments were carried out to Determine the effect of electrode material, Electrocoagulation time, interelectrode distance and initial pH. After the experiment 500ml treated sample was taken from each plate and then kept undistributed for 60 min in order to allow the flocs to settle. Subsequently after settling the sample of supernatant was collected to perform the analysis of TDS, SS and COD.

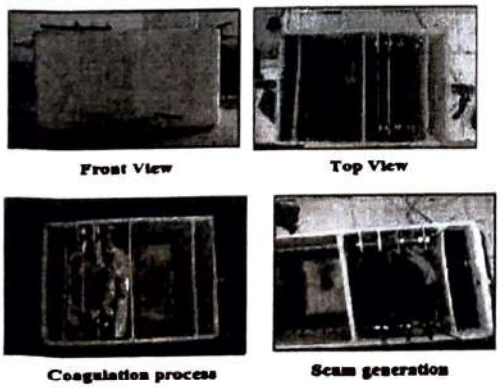

Fig. 3: Electrocoagulation Process

III. RESULTS AND CONCLUSION

A. Characteristics of raw sewage water

Parameter	Avg Value
COD(mg/L)	506
SS(mg/L)	182
TDS(mg/L)	847
pH	7.1

Table 2: Average raw sewage characteristics of 106 MLD, Pirana, Ahmedabad

Parameter	Avg Value
COD(mg/L)	506
SS(mg/L)	182
TDS(mg/L)	847
pH	7.1

B. Effect of electrolysis time

As shown in fig 4 as the time of electrolysis increase comparable changes in the removal efficiency of COD, SS, TDS and pH are observed. Reactive time also influence the treatment efficiency of Electrocoagulation Process because the more time consume the more production rate of hydroxyle and metal ions are produced on the electrodes.

Parameter	Raw	15 min	20min	25min	30min
COD(Mg/L)	457.6	52	31.2	26	20.8
% removal	-	88	93	94	95
SS(Mg/L)	440	120	120	60	60
% removal	-	72	72	86	86
TDS(Mg/L)	790	755	748	742	734
% removal	-	44	53	60	70
pH	7.6	8.0	8.1	8.1	8.3
Energy consumption(kwh/m^3)		6.31	8.42	10.52	12.6

Table 3: Effect of Electrocoagulation time on parameters

C. Effect of interelectrode distance

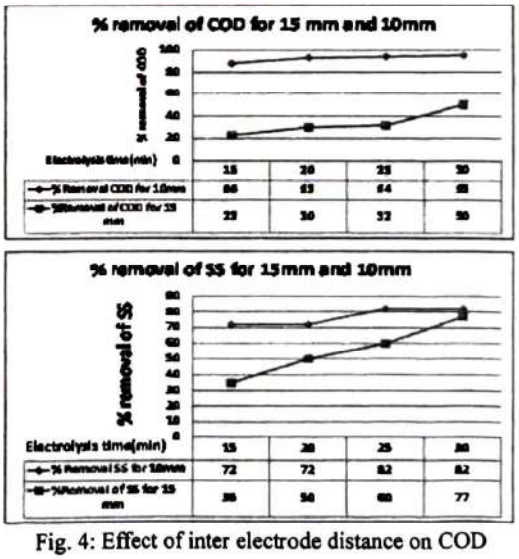

Fig. 4: Effect of inter electrode distance on COD

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and SS removal using MS and Al electrode, current density 42A/m2 and for 15 min, 20min, 25min, 30min Ec time.
The effect of interelectrode distance shows a significant result in this experiment.

Electrolysis time(min)	COD(% removal)		SS(%removal)	
	15mm	10mm	15mm	10mm
15	23	88	35	72
20	30	93	50	72
25	32	94	60	86
30	50	95	77	86

Table 4: Effect of electrolysis time on COD and SS removal

As shown in fig 4, when interelectrode distance increases the efficiency of COD and SS removal decreases slightly because the rate of electron transfer is become slower. Variations of the percentage removal with inter electrode distance is shown in figure below.

IV. CONCLUSION

In this study the EC process was found to be an effective method for the treatment of Domestic wastewater. The effect of operational conditions such as electrolysis time, pH and inter electrode distance on removal of COD and SS was examined. The result showed that the removal of COD and SS increase with increase electrolysis time except for pH and inter electrode distance. The highest removal efficiency of COD by 95%, SS by 82% occurred at 42A/m2 current density, 10mm electrode distance and pH 8.3 in 30min of operating time by Mild Steel electrode.

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REFERENCES

[1] Bukhari, A, A. Investigation of the Electrocoagulation treatment process for the removal of TSS from municipal wastewater, bio resource technology, (2008), 99: 914-21
[2] C.sarala, domestic wastewater treatment by electrocoagulation with Fe-Fe electrodes, International Journal of engineering trends and technology, 31(4): 530-33, ,(2012),
[3] ESSEE 4 4th European summer school of electrochemical engineering.
[4] Gauha CHEN, Electrochemical technologies in wastewater treatment, Eco asia conference, pp 1-30, (29/10/2008)
[5] Gijzen, H, Anaerobic digestion for sustainable development: a natural approach. Water science and technology,vol 45, pp 321-28, (2002),
[6] Guohua Chen,1 Xueming Chen,2 and Po Lock Yue, Electro-coagulation and electro Flotation of Restaurant wastewater, JOURNAL OF ENVIRONMENTAL ENGINEERING, vol 126, pp.858-863, SEPTEMBER (2000)
[7] Kaan yetilmezsoy, decolorization and COD reduction of UASB pretreated poultry manure wastewater by electrocoagulation process: A post treatment study, journal of hazardous material), vol 162: pp 120-32, 2009
[8] Nasrullah et al., energy and environmental engineering journal, vol 1(1): 27-3, (2012)
[9] Nikolai P. Shapkin, Eugene K. Papynov, Irina G. Halchenko, Nellie N. Zhamskaya, Perfection of the Electrochemical Method of Sewage Treatment, J. Water Resource and Protection, pp 739-741, 2010
[10]Niraj S topare, sewage wastewater technologies, vol 1(1), pp18-24, 2011
[11]Polish. J of environmental student, (2011), 20(1): 173-79

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Studying the effectiveness of treating waste water using the electro coagulation process at Sewage Treatment Plants

Stuart Sibanda[1], Bothwell Nyoni[1], Clever Mpofu[1], Bobby Naidoo[2], Haleden Chirariwa[2*]

[1]Department of Applied Chemistry, National University of Science & Technology, P.O Box AC939 Ascot Bulawayo, Zimbabwe.

[2]Biosorption and Water Research Laboratory Department of Chemistry, Vaal University of Technology, Private Bag X021, Vanderbijlpark, 1911, Andries Potgieter Blvd, South Africa.

** Corresponding author*

Abstract

Sewage has become a major point-source pollutant on a global scale. The management and treatment of wastewater is important to ensure that it is processed to a safe quality before re-use or disposal. The purpose of this study is to investigate the effectiveness of the electrocoagulation process in treating wastewater as an alternative to conventional methods to treat sewage. A 2 litre batch electrocoagulation unit was set up consisting of 4 monopolar electrodes connected to a DC power supply and the process was investigated for chemical oxygen demand, ammonia, and phosphates reduction. Iron and aluminium were comparatively used as the treatment electrodes, and effects of operating conditions like applied voltage and treatment time were investigated. Voltage was varied from 5V, 10V and 15V for 30 and 60 minutes treatment duration and aluminium gave better results than iron. The optimum conditions were experimentally determined to be 15V at 30 minutes treatment using aluminium, to give 92% COD removal, 100% phosphate removal and 61% ammonia removal using DC current converted to alternating pulse current by use of a circuit. The experimental results showed electrocoagulation to be a feasible process in the treatment of wastewater.

Keywords: electrocoagulation; wastewater treatment; applied voltage; COD removal; phosphate removal; ammonia removal; monopolar electrodes.

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INTRODUCTION

Sewage is the main point-source pollutant on a global scale [1]. The biological and chemical composition of sewage is usually high in Biological Oxygen Demand (BOD), Suspended Solid (SS) and Chemical Oxygen Demand (COD). So, direct discharge of raw or improper treated sewage into the water body is one of the main sources of pollution on a global scale [1]. Wastewater treatment serves two main objectives, protecting the environment and conserving fresh water resources [2].

Treated municipal wastewater is considered, in many major cities of the world, as a supplementary water source for several uses such as agricultural irrigation, landscaping, industrial activities (cooling and process needs), groundwater recharge, recreational and other uses. The continued dependence on treated municipal wastewater for the previously mentioned uses coupled with emerging stricter policies/guidelines for such uses prompted scientists and researchers to concentrate in improving current treatment technologies and to come up with innovative ideas to treat municipal wastewater in an efficient and cost effective manner [3].

The most common conventional methods of treating sewage include Activated Sludge Process, Aerated Lagoons (Oxidation Ponds), Biological Trickle Filtration systems and Anaerobic Digesters. The major disadvantages of most of the conventional methods is that they consume a lot of space and require long periods to process sewage. Simple and efficient sewage water treatment systems are urgently needed in developing countries [4].

Electrocoagulation is one of a simple method to treat wastewater efficiently [5]. Electrocoagulation (EC) is an emerging technology that combines the functions and advantages of conventional coagulation, flotation, and electrochemistry in water and wastewater treatment [6]. It is a complex process involving chemical and physical mechanisms operating simultaneously to remove pollutants from wastewaters [2]. Therefore the potential of electrocoagulation to treat multiple contaminants must be studied. Wastewater is the main cause for irreversible damages to the environment and also contributes to the reduction of fresh water reserves, creating threats to the next generation [7]. Sewage treatment plants are then setup to manage wastewater disposal from the sewer systems and processing this wastewater to safe quality before re-use or disposal.

The purpose of this study is to investigate the treatment of wastewater using electrocoagulation and study its effectiveness as an alternative treatment system to already existing methods. Eyvaz et al. (2014) states that electrocoagulation (EC) has gained many interest due to providing simple, reliable and cost effective operation for the treatment of wastewaters without and need for additional chemicals, and thus the secondary pollution [8].

Research, in the past few decades, have shown that electrocoagulation is a promising

treatment method and effectively potential to treat variety type of wastewaters including dyes wastewater, tannery wastewater, restaurant wastewater, palm oil mill effluent, food wastewater, potato chip manufacturing wastewater, urban wastewater, and removing heavy metals [9-10]. Hence a multiple contaminant treatment system could prove very beneficial for municipalities and this could lead to advancement in water treatment technology.

METHODS AND MATERIALS

A schematic diagram of the experimental set-up is depicted in Figure 1. The electrochemical circuit unit consists of an electrocoagulation cell, a D.C power supply and the electrodes (aluminum and iron) and is shown in Figure 2. A magnetic stirrer was put in place to keep the composition the sample homogeneous throughout the treatment and set at 100 rpm. All the electrodes were washed with 5% HCl before every experiments conducted. At the beginning of each experiment, 2000 mL of Municipal wastewater was fed into the electrocoagulation cell and current was applied to the circuit for 60 min. The amount of voltage that were applied to the system were 5, 10 and 15 V with maximum treatment time of 60 minutes. Every experiment was performed at room temperature and experimental samples were taken at 5 minute intervals of each run for COD, phosphate and ammonia measurements. Reagent grade of chemicals were used without further purification in every experiment. The pH value was determined by a pH meter (HACH HQ11d). The COD values were measured using a Double Beam UV/VIS Spectrophotometer (PERKIN – ELMER). Conductivity measurements were obtained using a Conductivity meter (Eutech CON 5100). Phosphates and ammonia measurements were obtained using a Single Beam Ultra-Violet Visible Spectrophotometer (HACH-LANGE DR 6000). The system's current was provided by a regulated D.C power with maximum 30V and 3A output volume and current respectively with a 2cm gap between them.

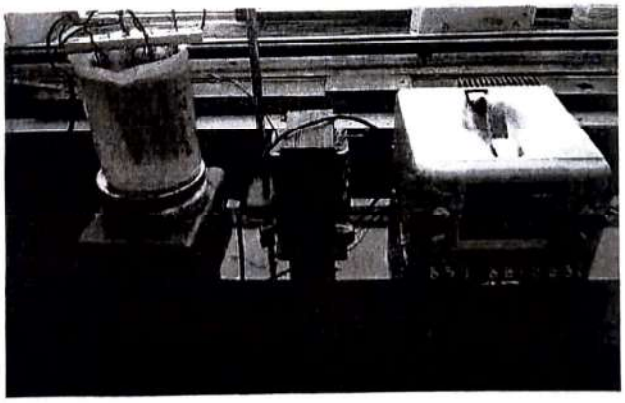

Figure 1: Electrocoagulation unit setup

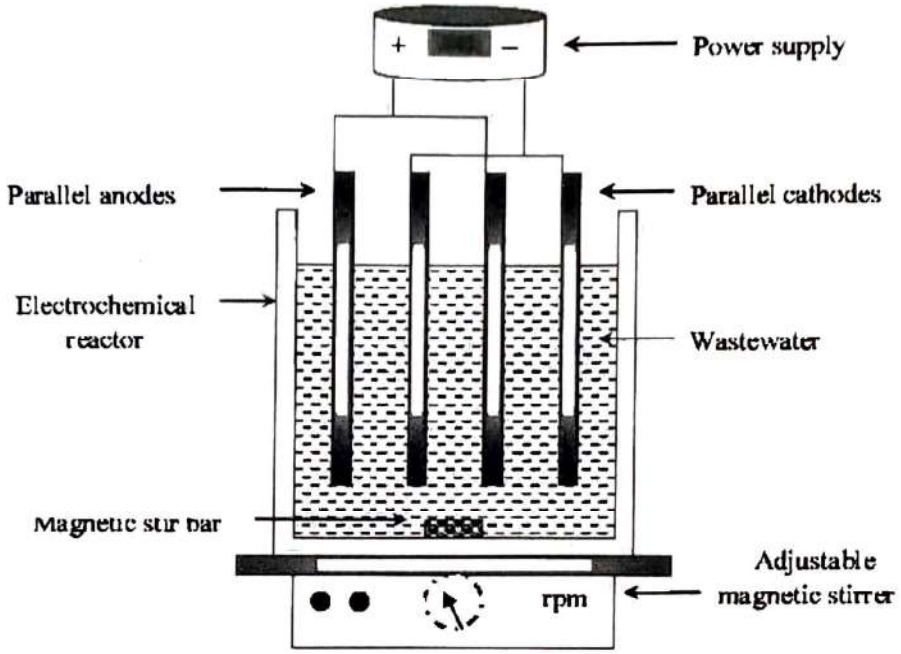

Figure 2: Circuit diagram of electrocoagulation reactor setup

Effect of electrode material

Aluminium and iron were compared for their treatment efficiency. The varied parameters were voltage and treatment time for each electrode.

Effect of Applied Voltage

Voltage was varied from 5V, 10V to 15V. Each voltage was run on a fresh sewage sample. The electrodes were washed with 5% HCl and rinsed with water before and after each treatment in order to remove all dirt from the electrodes [11-12].

Effect of treatment time

50 ml samples were taken after 30 minutes and 60 minutes treatment time. These were filtered and preserved with concentrated H_2SO_4 at 4°C for analysis. The amount of electrode material used up in the treatment was determined using Faraday's Law

$$W = \frac{itM}{zF}$$

RESULTS AND DISCUSSION

pH and conductivity

The effect of pH and conductivity were not subjects of this study, but were analyzed before treatment was carried out to ensure that their values could suffice electrocoagulation. From literature near neutral pH and conductivity in the range >50mS/cm was adequate for electrocoagulation. Domestic wastewater has a fairly good concentration of dissolved salts like NaCl which enable the conduction of current.

Treatment using iron

The EC process was first applied using iron electrodes and the results shown in Table 1.

Table 1: Characteristics of raw and treated wastewater for iron at 5, 10 and 15 volts

5 VOLTS	Pre-Treatment	30-Minutes	60-Minutes
COD (mg/L)	346	242.2	215
Phosphates (mg/L)	10.8	1.3	0.11
Ammonia (mg/L)	56.4	50.1	49.3
10 VOLTS	**Pre-Treatment**	**30-Minutes**	**60-Minutes**
COD (mg/L)	470	222	153
Phosphates (mg/L)	7.51	0.12	0.00
Ammonia (mg/L)	58.6	37.4	30.8
15 VOLTS	**Pre-Treatment**	**30-Minutes**	**60-Minutes**
COD (mg/L)	481	154	96.1
Phosphates (mg/L)	10.33	0.00	0.00
Ammonia (mg/L)	41.7	23.2	19.13

Removal Efficiency was calculated from equation 1:

Taking COD at 5 Volts, Removal efficiency (R %) was calculated from equation 1:

$$R\%\ (30\text{minutes}) = \frac{346-242.2}{346} \times 100 \qquad (1)$$

$$= 30\%$$

(Tables showing Removal efficiencies are in the Appendix)

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Effect of Time :

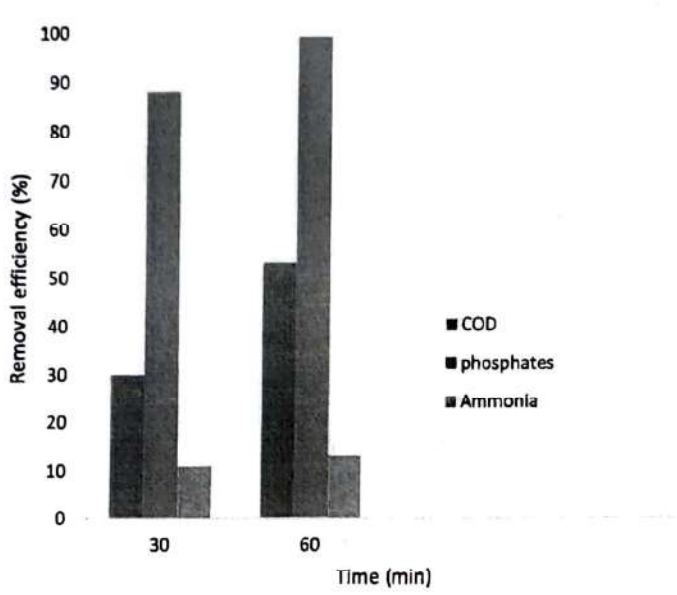

Figure 3: Effect of time at on removal efficiency at 5 volts

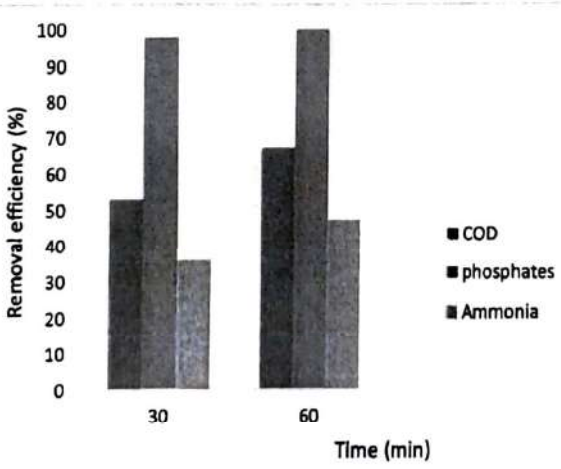

Figure 4: Effect of time on removal efficiency at 10 volts

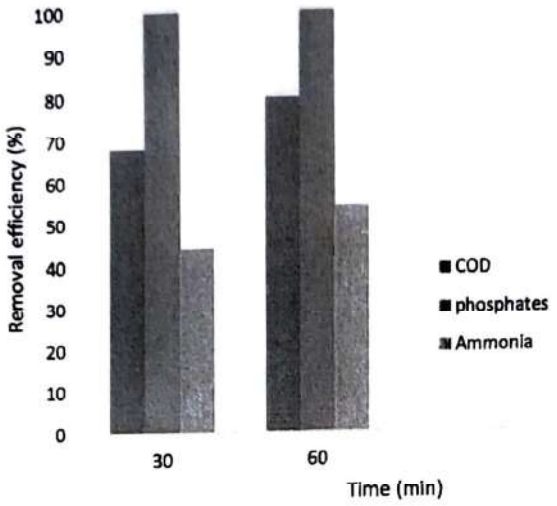

Figure 5: Effect of time on removal efficiency at 15 volts

Effect of Applied Voltage :

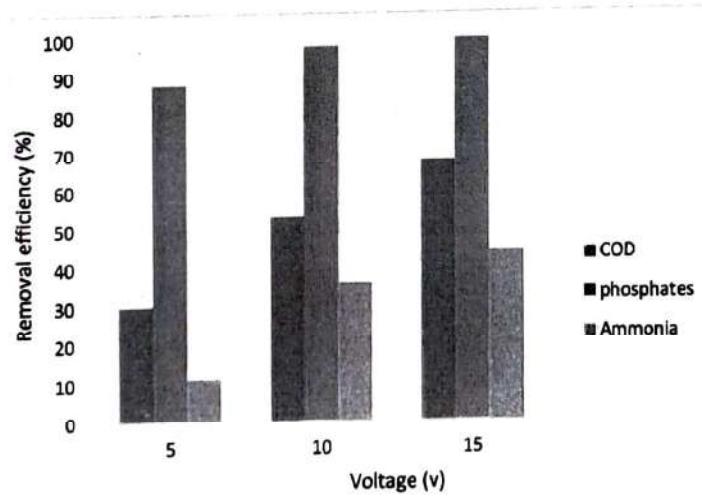

Figure 6: Effect of applied voltage on removal efficiency after 30 minutes treatment

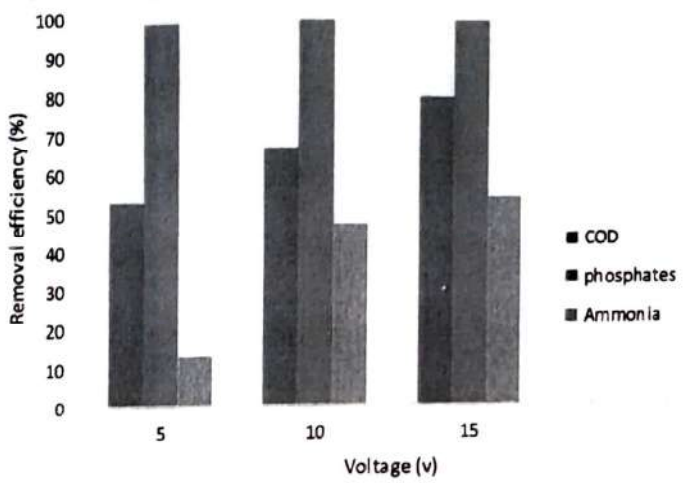

Figure 7: Effect of applied voltage on removal efficiency after 60 minutes treatment

Table 1 shows the results obtained for iron at different voltages and different treatment times. The best result was obtained at 15 volts after 60 minutes treatment. COD, phosphates and ammonia were reduced from 481 mg/L, 10.33 mg/L, and 41.7 mg/L to 96 mg/L, 0.00 mg/L and 19.13 mg/L. Conversely, the lowest result was obtained at 5 volts. Figures 3 to 5 show that increasing treatment time increases removal and Figures 6 and 7 show that increasing voltage had a positive effect on removal efficiency of all pollutants because of the increase in anode dissolution per unit time. 80%, 100% and 54% removal efficiencies were obtained for COD, phosphates and ammonia respectively.

Using iron electrodes, the treating solution began to change into a greenish color after 5 minutes and then switched into brownish color a few minutes later during treatment. These particles are extremely fine and very hard to precipitate, the color was also hard to wash from the vessels. Therefore all subsequent treatments were carried out using aluminum.

TREATMENT USING ALUMINUM

Because of the problems associated with using iron, the results are associated with aluminium

Table 2: Characteristics of raw and treated water at 5 volts

Experiment 1	**Pre-Treatment**	**30-Minutes**	**60-Minutes**
COD (mg/L)	431	243.3	231.7
Phosphates(mg/L)	5.82	0.33	0.01
Ammonia (mg/L)	41.82	32.46	32.10
Experiment 2	**Pre-Treatment**	**30-Minutes**	**60-Minutes**
COD (mg/L)	300	178	162
Phosphates(mg/L)	15.3	0.8	0.01
Ammonia (mg/L)	59.9	48	46
Experiment 3	**Pre-Treatment**	**30-Minutes**	**60-Minutes**
COD (mg/L)	365	207	197
Phosphates(mg/L)	6.71	0.3	0.02
Ammonia (mg/L)	41.34	32.35	31.20

Table 3: Characteristics of raw and treated water at 10 volts

Experiment 1	**Pre-Treatment**	**30-Minutes**	**60-Minutes**
COD (mg/L)	315.1	98.3	52.7
Phosphates(mg/L)	5.65	0.13	0.00
Ammonia (mg/L)	6.37	3.81	2.35
Experiment 2	**Pre-Treatment**	**30-Minutes**	**60-Minutes**
COD (mg/L)	537	197	95.4
Phosphates(mg/L)	10.34	0.00	0.00
Ammonia (mg/L)	3.99	2.47	1.56
COD (mg/L)	481	168.3	60.2
Phosphates(mg/L)	7.6	0.00	0.00
Ammonia (mg/L)	45.7	27.42	20.15

Table 4: Characteristics raw and treated wastewater at 15 volts

Experiment 1	**Pre-Treatment**	**30-Minutes**	**60-Minutes**
COD (mg/L)	360	21.6	2.2
Phosphates(mg/L)	3.70	0.00	0.00
Ammonia(mg/L)	2.75	2.11	1
Experiment 2	**Pre-Treatment**	**30-Minutes**	**60-Minutes**
COD (mg/L)	438	24.6	14.6
Phosphates(mg/L)	8.60	0.00	0.00
Ammonia (mg/L)	38.2	22.50	15.10
Experiment 3	**Pre-Treatment**	**30-Minutes**	**60-Minutes**
COD (mg/L)	273.3	17.3	0.00
Phosphates(mg/L)	13.1	0.00	0.00
Ammonia (mg/L)	11.4	6.56	4.22

The tables show that initial concentration is also an important factor to be considered in electrocoagulation. From Table 2, comparing COD removal, it can be seen that a higher initial COD loading meant a relatively higher COD loading in the final treated

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solution. The same is true with ammonia, which exhibits the same trend as COD. Phosphate conversely did not seem to be affected by this factor. COD was in the blue zone, ammonia red and phosphate blue according after 60 minutes treatment at 15 volts. 30 minutes treatment produced similar results.

Effect of Time:

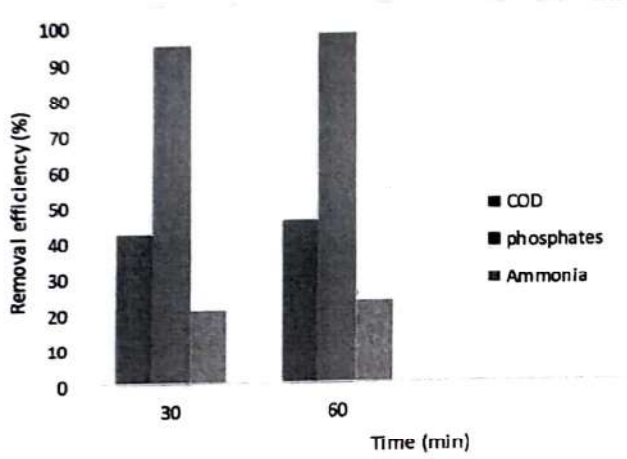

Figure 8: Effect of treatment time on removal efficiency at 5 volts

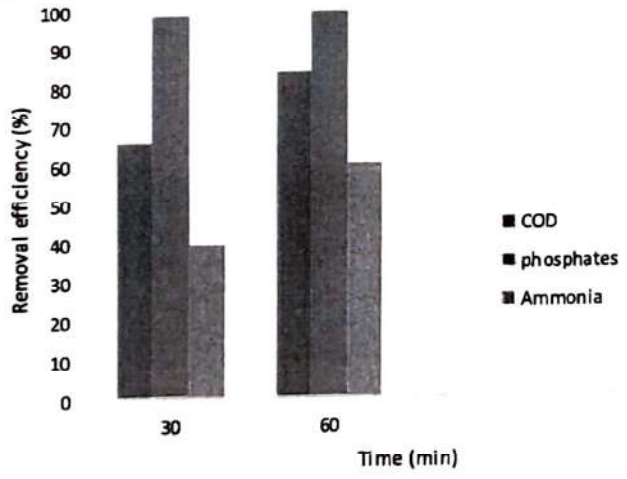

Figure 9: Effect of treatment time on removal efficiency at 10 volts

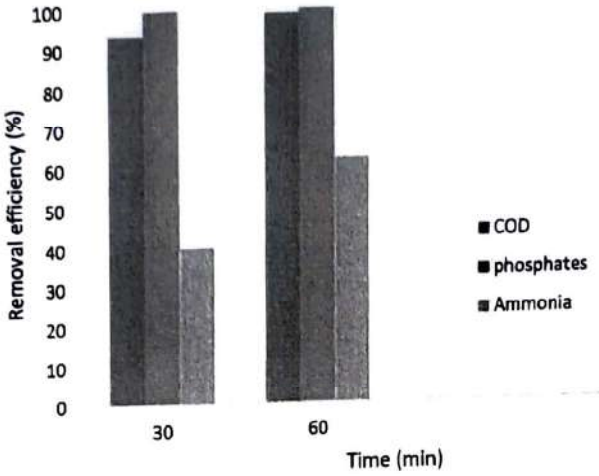

Figure 10: Effect of treatment time on removal efficiency at 15 volts

Figures 8-10 show pollutant reduction to be a function of time. An increase in treatment time results in a subsequent increase in removal efficiency. The best COD reduction was observed after 60 minutes. The same is true with ammonia. 100% phosphate removal efficiency just after 30 minutes at 15 volts, and at all voltages, excellent phosphate removal was observed after 30 minutes.

Effect of Applied Voltage

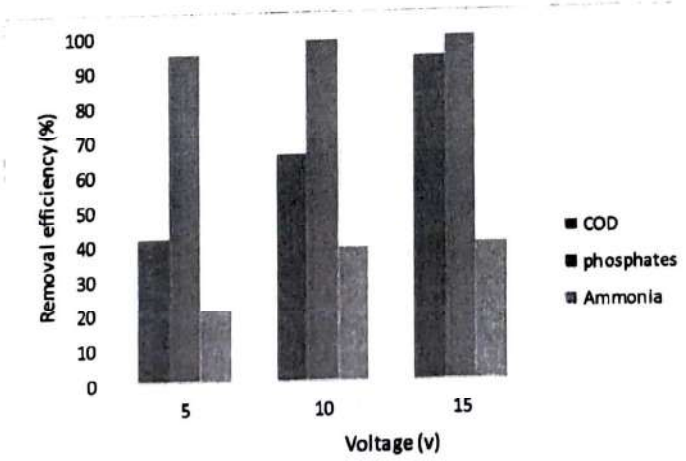

Figure 11: Effect of applied voltage after on removal efficiency 30 minutes treatment

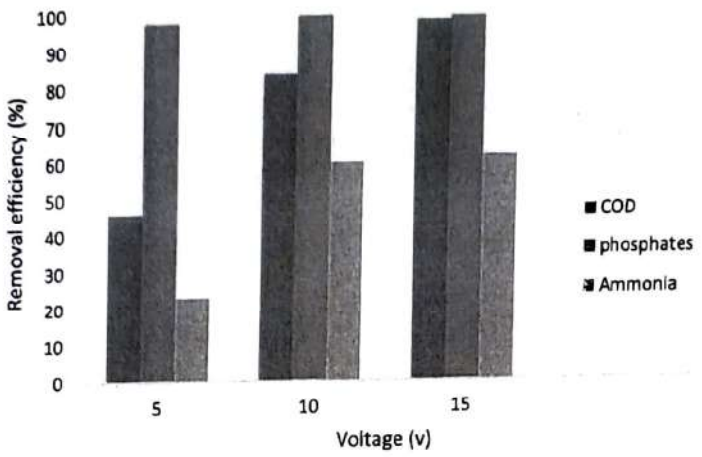

Figure 12: Effect of applied voltage on removal efficiency after 60 minutes treatment

Pollutant removal is observed to also be in accordance with Faraday's law in terms of increase in voltage. Removal efficiencies reached 46%, 84%, 99% for COD at 15 Volts in 60 minutes respectively. High removal efficiency for phosphate was obtained at 5 volts reaching 98% in 60 minutes and 100% at 10 and 15 volts respectively. 23%, 60% and 63% removal efficiencies were obtained for ammonia at 5, 10 and 15 volts.

Effect of passivation

The effects of electrode passivation started developing after the electrodes were used for several different treatments. The effect of the formation of a passive layer was not initially considered but was only noted as after repeating the experiments three or more times.

Table 5: Characteristics of wastewater before and after treatment using passivized aluminium electrodes

5 VOLTS	Pre-Treatment	30-Minutes	60-Minutes
COD (mg/L)	631.7	554.9	534.9
Phosphates(mg/L)	5.72	0.34	0.10
Ammonia (mg/L)	40.5	39.3	36.2
10 VOLTS	**Pre-Treatment**	**30-Minutes**	**60-Minutes**
COD (mg/L)	691	550.9	500.1
Phosphates(mg/L)	5.53	0.13	0.00

Ammonia (mg/L)	39.2	36.5	34.5
15 VOLTS	**Pre-Treatment**	**30-Minutes**	**60-Minutes**
COD (mg/L)	722.7	543.5	466.7
Phosphates(mg/L)	6.82	0.06	0.00
Ammonia (mg/L)	41.3	32.2	31.4

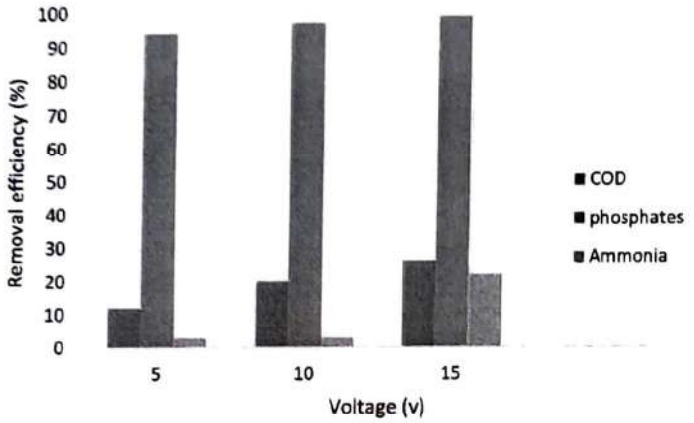

Figure 13: Effect of passivation on removal efficiency after 30 minutes with varying voltage

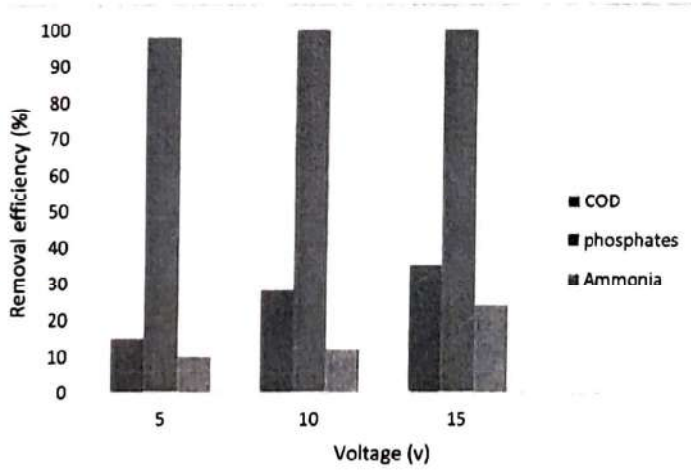

Figure 14: Effect of passivation on removal efficiency after 60 minutes with varying voltage

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A decrease in removal efficiency was observed over time as seen in Table 5 and represents the final results using the passivized electrodes. Figures 13 and 14 show that the lowest removal for COD was 12% at 5 volts after 30 minutes treatment and the highest was 24% after 60 minutes treatment for COD. Ammonia removal reduction was also significantly affected by passivation recording such low removal efficiencies as 22% at 5 volts after 30 minutes and 24% was the highest at 15 volts after 60 minutes. Phosphate removal was unaffected by passivation and high removal of 100% was still maintained.

This passivation phenomenon occurred during the process and impeded the oxidation/reduction reactions. The oxide layer reduced the ionic transfer between the anode and the cathode directly, hindering the metal dissolution and indirectly preventing metal hydroxide formation [8].

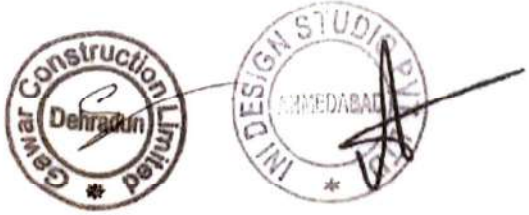
Application of alternating pulse current

Note should be taken that this method of analyzing the effects of passivation is a novel process. Conductivity of the electrodes is decreased by the formation of the oxide layer, which increases the resistance to the flow of current in the cell.

Table 6: Analysis of conductivity of aluminium before and after treatment using an APC system

Before Treatment		After Treatment	
VOLTAGE	CURRENT	VOLTAGE	CURRENT
2	0.01	2	0.1
3	0.03	3	0.3
4	0.04	4	0.4
5	0.05	5	0.5

The notion of application of alternating pulsed current was brought about to reverse the effects of passivation. At first, manual changing of polarity of electrodes was done after 30 minutes of treatment. From literature passivation must decrease the electrodes' current conductivity, and this is observed in Table 6, the electrodes used had lower conductivity before APC was applied to them. They had a little passivation owing to the treatments they had performed. However, after electrocoagulation with APC their conductivity was observed to increase.



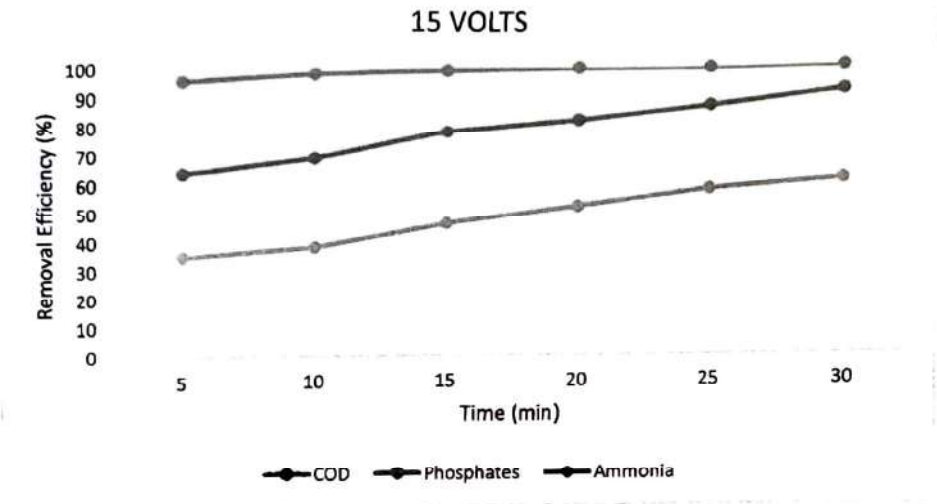


Figure 15: Effect of electrocoagulation on wastewater at 15 volts for 30 minutes using alternating pulse current

According to Figure 15 the rate of pollutant removal is high in the first 5 minutes and the rate decreases as time progresses. As time approaches 30 minutes, rate of pollutant removal decreases and reaches a monotonic state. This may be due to existence of excess colloids for adsorption

CONCLUSION

Electro coagulation was successfully applied for the treatment of municipal wastewater. The study was performed to evaluate the influence of different operational parameters on the reduction of COD, phosphates and ammonia in wastewater. Effects of type of electrode material, treatment time and applied voltage were investigated and the following observations were made:

- Aluminium and Iron were compared and Aluminium gave better results. Aluminium gave 99%, 100% and 62% removal efficiencies for COD, ammonia and phosphates respectively while Iron gave 80%, 100% and 54% removal efficiencies for the same parameters after 60 minutes treatment at 15 volts.
- Applied voltage was varied between 5, 10, 15 Volts. Pollutant removal increased with increasing voltage because of the increased coagulant generation per unit time.15 Volts gave the best results
- Application of alternating pulsed current was effective in reducing the effects

passivation, with the conductivity of the already passivised electrodes increasing after applying alternated pulsed current. This also had the effect of increasing ammonia removal. At 15 volts, 30 minutes without the automated alternating pulsed gave 40% removal while after alternating pulsed current system gave 62% removal at the same time

- Phosphate was the most efficiently reduced pollutant, with 100% reduction being recorded at all voltages, then COD 99% and ammonia 63% at 15 volts.

ACKNOWLEDGEMENTS

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REFERENCES

[1] H Gijzen, Water Science and Technology, 2002, 45, 321-328.

[2] A. A Bukhari, Bioresource Technology, 2008, 99, 914-921

[3] G Tchobanoglous, F. L Burton, H. D Stensel, 2003, 4th Ed. McGraw-Hill Inc.: Metcalf & Eddy.

[4] P Grau, Water Science and Technology, 1996, 33, 39-46.

[5] G. H Chen, X. M Chen, P. L Yue, 2000, Journal of Environmental Engineering, 126 (9), 858–863.

[6] V Kuokkanen, T Kuokkanen, J Rämö, U Lassi, 2013, Green and Sustainable Chemistry, 3, 89-121.

[7] Akanksha, G. B Roopashree, K. S Lokesh, International Journal of Environmental Sciences, 2013, 4 (4), 519-530.

[8] M Eyvaz, E Gürbulak, S Kara, E Yüksel, 2014, Nanotechnology and Nanomaterials "Modern Electrochemical Methods in Nano, Surface and Corrosion Science" edited by Mahmood Aliofkhazraei.

[9] M Nasrullah, L Singh, Z Mohamad, S Norsita, S Krishnan, N Wahida, A.W. Zularisam, 2017, Water Resources and Industry, 17, 7–10.

[10] M Nasrullah, L Singh, Z. A Wahid, 2012, Energy and Environmental Engineering Journal, 1 (1), 27-31.

[11] E Bazrafshan, A. H Mahvi, S Nasseri, M Shaieghi, 2007, Iranian Journal of Environmental, Health, Science and Engineering, 4 (2) 127-132.

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एलकाण्डी

[12] E Bazrafshan, H Moein, F. K Mostafapour, S Nakhaie, 2013, Journal of Chemistry, Volume 2013 (2013), 1-8.

APPENDIX

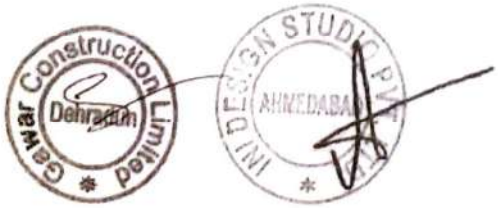
Removal Efficiency Tables:

A1: Removal efficiencies of COD, phosphates and ammonia using Iron at 5, 10, 15 volts

IRON		5 VOLTS	10 VOLTS	15 VOLTS
30 Minutes	COD	30	53	68
	Phosphates	88	98	100
	Ammonia	11	36	44
60 Minutes	COD	53	67	80
	Phosphates	99	100	100
	Ammonia	13	47	54

A2: Removal efficiencies of COD, phosphates and ammonia at 5 volts with varying treatment time

5 VOLTS		Experiment 1	Experiment 2	Experiment 3	Average
30 Minutes	COD	43	41	43	42
	Phosphates	94	95	96	95
	Ammonia	22	20	21	21
60 Minutes	COD	46	46	46	46
	Phosphates	99	95	100	98
	Ammonia	23	23	24	23



A3: Removal efficiencies of COD, phosphates and ammonia at 10 volts with varying treatment time

10 VOLTS		Experiment 1	Experiment 2	Experiment 3	Average
30 Minutes	COD	69	63	65	66
	Phosphates	98	100	100	99
	Ammonia	40	38	40	39
60 Minutes	COD	83	82	87	84
	Phosphates	100	100	100	100
	Ammonia	63	60	56	60

A4: Removal efficiencies of COD, phosphates and ammonia at 15 volts with varying treatment time

15 VOLTS		Experiment 1	Experiment 2	Experiment 3	Average
30 Minutes	COD	94	94	94	94
	Phosphates	100	100	100	100
	Ammonia	38	41	42	40
60 Minutes	COD	99	97	100	99
	Phosphates	100	100	100	100
	Ammonia	63	60	63	62

A5: Removal efficiencies of COD, phosphates and ammonia after treatment using passivized electrodes

		5 VOLTS	10 VOLTS	15 VOLTS
30 Minutes	COD	12	20	26
	Phosphates	94	97	99
	Ammonia	3	3	22
60 Minutes	COD	15	28	35
	Phosphates	98	100	100
	Ammonia	10	12	24

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एलक्वाणी

A6: Removal efficiencies of COD, phosphates and ammonia with varying time during time optimization experiment

	5Minutes	10Minutes	15Minutes	20Minutes	25Minutes	30Minutes
COD	64	69	78	82	87	92
Phosphates	96	98	99	100	100	100
Ammonia	35	38	46	52	58	61

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Annexure - 2

PROJECT: KEDARNATH RESTORATION AND REDEVELOPMENT

DOCUMENT: WATER DEMAND & SEWAGE GENERATION

Sr No.	Description	Total Population	Diversity Factor	Diversitified Population	Water Requirement per person per Day as per NBC (LTR) Floating Population: (NBC PART-9 TABLE-1) Permanennt Population: (NBC PART-9 Clause no. 4.1.1)			Total Water Requirement per Day (KL)			Total Sewage Generation per Day in KLD (80% of Domestic+ Flushing)	STP Capacity (KLD)		Total Recycle water Generation (90%) (KLD)	Solid Waste Generation as per NBC	
					Domestic	Flushing	Total	Domestic	Flushing	Total		Diversity			Solid Waste/ Person/ Day (KG)	Total Solid Waste Generation (Kg/day)
1	Floating Population - Pilgrims	20000	85%	17000	5	10	15	85.00	170.00	255.00	238.00				0.15	2,550.00
2	Permanent Staff including Hospital	5000		5000	60	30	90	300.00	150.00	450.00	390.00				0.30	1,500.00
3	Hospital: Nos of Bed			26	230	110	340	5.98	2.86	6.84	7.64				0.30	7.80
	Total KLD							**390.98**	**322.86**	**713.64**	**635.64**					4,058
	Say. **KLD**							**391**	**323**	**714**	**635**	**95%**	**600**	**540**		4058
1	Summary		Unit													
a	Total Water Demand	714	KLD													
b	Total Domestic Water Demand	391	KLD													
c	Total Flushing Water Demand	323	KLD													
e	Total Waste Water Generation	635	KLD													
F	Total **Solid Waste Generation**	**4,058**	**KG/DAY**													
G	Total Organic **Solid Waste Generation (approximate 40% of Total Solid Waste)**	**1,502**	**KG/DAY**													

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Certified that structural design & Drawing has been checked & found safe Execution/Implementation of the same rests with the client/owner.

Dr. Ajay Chourasia
Senior Principal Scientist
Structural Engineering Division
CSIR-Central Building Research Institute
Roorkee-247667 (Uttarakhand)
ajayc@cbri.res.in

(MANOJ JOSHI)

INDESIGN STUDIO PVT. LTD. AHMEDABAD

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Annexure -2

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पुणेकाशी

(Photograph -01)

MRF (Material Recovery Facility)

Plastic bailing machine, Kedarnath

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(Photograph -02)

DRS project stablished RVM machine in Kedarnath.

Plastic bottle collection at Kedar triples from last year

Tanmayee Tyagi@timesgroup.com

Dehradun: Plastic waste management has continued to plague Char Dham shrines, but officials in Kedarnath have made a significant improvement in PET bottle collection this year compared to 2022. They attributed the success to increased awareness campaigns. The Digital Refund System, initiated last year, allows consumers to claim a Rs 10 refund by scanning a QR code on the wrapper of a plastic bottle.

This system was implemented by the Rudraprayag administration with a Hyderabad-based cleantech startup Recykal.

The campaign was also launched in Chopta in September last year and then in Yamunotri and Gangotri this year. According to data obtained by TOI, the distribution of codes at Kedarnath increased from 3.15 lakh in 2022 to 5.35 lakh this year. The number of bottles collected also rose from 1.63 lakh to 4.1 lakh.

SDM Jitendra Verma said, "When we include the non-DRS bottles, the amount of plastic collected has almost tripled in this one year. We have had tremendous support from the locals along the trek route and the goal is to decentralise the whole process, do away with the need for collection centres and make it a no-waste shrine. In the next phase of the project, we will move on to multi-layered plastics like food wrappers and packets. Local hoteliers and business owners are being engaged to install compacting machines along the yatra route to facilitate responsible waste management. This strategy aims to reduce the need for transportation and preserve resources.

According to data obtained by TOI, the distribution of codes at Kedarnath increased from 3.15 lakh in 2022 to 5.35 lakh this year. The number of bottles collected also rose from 1.63 lakh to 4.1 lakh

Abhay Deshpande, founder and CEO of Recykal, said, "Our goal is to target 100% collection and ensure zero environmental impact while promoting sustainable tourism in the region. The success of DRS and its expansion has been remarkable and made possible with the support of natives, shopkeepers, distributors, and the local administrations."

A company spokesperson mentioned that a total of 16 lakh codes were distributed this year, resulting in the collection of 11.5 lakh bottles across Gangotri, Yamunotri, Kedarnath, and Chopta. The ultimate goal is 100% collection with zero environmental impact, promoting sustainable tourism in the region.

The success of the Digital Refund System and its expansion has been attributed to the support of natives, shopkeepers, distributors, and local administrations. With a record 54.2 lakh pilgrims visiting the Char Dham shrines this year, waste generation has increased significantly, emphasising the need for large-scale initiatives for source segregation of plastic waste.

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Annexure-3

Solid Waste Management Action Plan/ Detailed Project Report of Sri Kedarnath/Nagar Panchayat Kedarnath

Solid Waste Management

Cost of DPR: Rs. ₹ 309.46 Lakhs

27/12/24

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Urban Development Directorate, Uttarakhand

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Introduction:

Waste Management in Kedarnath

Kedarnath, a renowned pilgrimage site nestled in the Himalayan region of Uttarakhand, attracts millions of devotees and tourists annually. With its resident population of 612 (Census 2011) and a floating population averaging 9,334 per day (2024), the town faces significant challenges in managing municipal solid waste. The influx of visitors during peak pilgrimage seasons increases daily waste generation, necessitating robust and sustainable waste management systems.

Currently, the total waste generated in Kedarnath is estimated at 0.147 TPD on average basis while on the basis of highest footfall of 38682 on a single day it may reach upto 1.191 TPD in 2024, projected to rise to 3.049 TPD by 2050 due to population growth and increasing tourist activity. Approximately 60% of the waste is wet (organic), while 40% is dry (recyclables and inert), with varying moisture content impacting processing efficiency.

To address these challenges, a Material Recovery Facility (MRF) has been designed, optimized for the region's limited space and hilly terrain. This facility, spread across 160 m² of ground area incorporates advanced waste segregation and processing systems to handle the wet and dry waste streams effectively. The MRF aims to process wet waste through composting and potential biogas generation, while dry waste is segregated into recyclables like plastics, paper, metals, and glass for further recycling.

This initiative represents a critical step towards sustainable waste management in Kedarnath, promoting environmental conservation and enhancing the town's capacity to handle the demands of its growing population and tourism. The facility's design ensures scalability and integration of innovative waste-to-energy solutions for a cleaner and greener Kedarnath.

General Information

- ULB - Nagar Panchayat - Kedarnath
- Current Population - **612**
- Floating Population - **9334** Per day average (Total **1652076** tourist visited till 03-11-2024 in current tourism session with highest footfall of **38682 on 21-05-2024**)

Status of Human Resource

- Total number of Paryavaran Mitra - 50
- Permanent Paryavaran Mitra - 0 1
- Environment Supervisor - 01

Status of SWM/PWM

- Total processed plastic waste - 8.6 tonne(approx.)
- Total income by selling plastic - Rs. 0.51 Lacs
- Solid Wast Collection Vehicle - 01 (mini tractor with trolly)
- Processing Facility - 01 MRF and 01 Bailing machine

(for segregation of dry waste)

Status of Sanitation/Toilets

- 22 (20 + 02 Smart Toilets Newly Constructed)
- 02 smart toilets (6 female seat and 6 male seat) have been constructed by Kedarnath Development Authority within Nagar Panchayat Kedarnath area.
- Construction work of 20-Seater and 22-seater public toilets is also in progress.

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- Disposal Mechanism- 20 toilets with Soak Pits and 02 Toilets with Soak pit as well as with septic tank.
- Operation and Maintenance- All toilets are maintained by Sulabh International and 04 Paryavarannitra are deployed for thecleaning of all 20 toilets in 04 location/cluster.

Status of New Initiatives Deposit Refund System (DRS)

The town is a famous tourist spot with high footfall every year. The demographic consists of a significant number of tourists and local businesses, making it an ideal location for implementing innovative waste management solutions like the digital DRS.

Focusing on this urban locality, digital DRS aims to address the waste management challenges in a rapidly growing city. It ensures efficient collection and recycling of PET bottles and other recyclable materials. The initiative also engages the local community, promoting responsible waste disposal practices and environmental awareness.

DRS Progress Status –

- Total QR provided on plastic bottle/tetra pack is 172100
- Out of above 139838 Bottles/Tetra Pack (81%) with QR returned for recycling.
-

Population Growth

- Considering Annual Population Growth Rates:
  - Resident Population: 1.2% per year.
  - Floating Population: Estimate not directly available; assumed proportional to user-provided 2024 data (9,334 for 2024, 3% annual growth).

$$P_t = P_0 \times (1+r)^n$$

Where:

P_t: Population in the target year

P_0: Current population

r: Growth rate (decimal)

n: Number of years

Year	Resident Population	Floating Population (Average)
2011	612	~6,774
2024	735	9334
2034	$735\times(1.012)^{10}=687$	$9,334\times(1.03)^{10}=12,556$
2044	$735\times(1.012)^{20}=772$	$9,334\times(1.03)^{20}=16,887$
2050	$735\times(1.012)^{26}=878$	$9,334\times(1.03)^{26}=20,246$

Waste Generation

- Resident: 0.35 kg/person/day in 2024, increasing by 1% annually.
- Tourist: 0.10 kg/person/day in 2024, increasing by 1% annually.

$$W_t = W_0 \times (1+r)^n$$

Where:

W_t : Waste generation rate in the target year

W_0: Current waste generation rate

r : Growth rate (decimal)

n : Number of years

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Year	Resident Waste Generation Rate (kg/person/day)	Tourist Waste Generation Rate (kg/person/day)
2011	0.30	0.05
2024	0.35	0.10
2034	$0.35 \times (1.01)^{10} = 0.386$	$0.10 \times (1.01)^{10} = 0.110$
2044	$0.35 \times (1.01)^{20} = 0.427$	$0.10 \times (1.01)^{20} = 0.122$
2050	$0.35 \times (1.01)^{26} = 0.444$	$0.10 \times (1.01)^{26} = 0.129$

Total Waste Generation

The formula for total waste is:

Total Waste = Population × Waste Generation Rate

Year	Resident Waste (TPD)	Floating Waste (TPD)	Total Waste (TPD)
2011	612×0.30=183.6kg= 0.184TPD	6,774×0.05=1,693.5kg= 0.3387 TPD	0.184+0.3387= **0.5227 TPD**
2024	735×0.35=257.25kg= 0.257TPD	9,334×0.10=2,800.2kg= 0.9334 TPD	0.257+0.9334= **1.1904 TPD**
2034	822×0.386=317.29kg= 0.317TPD	12,556×0.110=4,155.03kg= 1.3811 TPD	0.317+1.3811= **1.6981 TPD**
2044	919×0.427=392.91kg= 0.393TPD	16,887×0.122=6,183.64kg= 2.0602 TPD	0.393+2.0602= **2.4532 TPD**
2050	985×0.444=437.34kg= 0.437TPD	20,246×0.129=7,716.73kg= 2.6117 TPD	0.437+2.6117= **3.0487 TPD**

Final Summary:

Year	Resident Population	Floating Population	Resident Waste (TPD)	Floating Waste (TPD)	Total Waste (TPD)
2011	612	6,774	0.184	0.338	0.522
2024	**735**	**9,334**	**0.257**	**0.934**	**1.191**
2034	822	12,556	0.317	1.381	1.698
2044	919	16,887	0.393	2.060	2.453
2050	985	20,246	0.437	2.612	3.049

Waste Composition:

- Wet Waste: 60% of total waste (kitchen waste, food scraps, etc.).
- Dry Waste: 40% of total waste (plastics, paper, metals, etc.).

Moisture Content:

- Wet Waste: 70% moisture.
- Dry Waste: 10% moisture.

Dry Waste Segregation:

- Plastics: 40%
- Paper/Cardboard: 30%
- Metals: 10%
- Glass: 10%
- Other (Rubber, textiles, etc.): 10%

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Wet and Dry Waste with Moisture Content

Year	Total Waste (TPD)	Wet Waste (60%) (TPD)	Dry Waste (40%) (TPD)	Wet Waste (After Moisture) (TPD)	Dry Waste (After Moisture) (TPD)
2011	0.522	0.313	0.209	0.313×(1−0.7)=0.094	0.209×(1−0.1)= 0.188
2024	**1.191**	**0.715**	**0.476**	0.715×(1−0.7)=0.215	0.476×(1−0.1)=0.429
2034	1.698	1.019	0.679	1.019×(1−0.7)=0.306	0.679×(1−0.1)=0.611
2044	2.453	1.472	0.981	1.472×(1−0.7)=0.442	0.981×(1−0.1)=0.883
2050	3.049	1.829	1.220	1.829×(1−0.7)=0.549	1.220×(1−0.1)=1.098

Dry Waste Partwise Segregation

Year	Total Dry Waste (After Moisture) (TPD)	Plastics (40%)	Paper/Cardboard (30%)	Metals (10%)	Glass (10%)	Other (10%)
2011	0.188	0.188×0.4 =0.075	0.188×0.3=0.056	0.188×0.1 =0.019	0.188×0.1= 0.019	0.188×0.1=0.019
2024	**0.429**	**0.429×0.4 =0.172**	**0.429×0.3=0.129**	**0.429×0.1 =0.043**	**0.429×0.1= 0.043**	**0.429×0.1=0.043**
2034	0.611	0.611×0.4 =0.244	0.611×0.3=0.183	0.611×0.1 =0.061	0.611×0.1= 0.061	0.611×0.1=0.061
2044	0.883	0.883×0.4 =0.353	0.883×0.3=0.265	0.883×0.1 =0.088	0.883×0.1= 0.088	0.883×0.1=0.088
2050	1.098	1.098×0.4 =0.439	1.098×0.3=0.329	1.098×0.1 =0.110	1.098×0.1= 0.110	1.098×0.1=0.110

- Objective: Design a facility capable of handling **1 TPD** (including future scalability).
- Available Area: Total Area 0.30 hectare

Proposed Design

The facility will adopt a compact and efficient layout tailored for hilly terrain with modular machinery.

Wet Waste Processing:

- Organic Waste Composter: Suitable for food and organic waste
  (1 Nos. of 500 Kgs in MRF and 8 Nos. of 50 Kgs in Route to Kedarnath)
- Biogas Generation: Option for future integration.

Dry Waste Processing:

- Segregation: Focus on plastics, paper, metals, glass, and other materials.
- Baling/compactor: Compact packaging for recyclables.
- Magnetic Separator: For metal waste.
- Manual Sorting: For finer segregation where needed.

Dry Waste Segregation Process (Partwise Breakdown)

- Plastics (40%): Recyclable plastics processed, sorted, and sent for baling or direct sale.
- Paper/Cardboard (30%): Sorted, compacted into bales for recycling.
- Metals (10%): Separated using magnetic separators; compacted for sale.
- Glass (10%): Collected separately for recycling, handled with care due to fragility.
- Other (10%): Textiles, rubber, and other recyclable materials sorted and processed accordingly.

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1. Facility Layout

MRF Centre (160 m²)

Section	Nos./ Qty.	Area Allocation (m²)	Description
Receiving Area & Tipping Area	1	20	For unloading and initial segregation of dry waste from collection vehicles.
Sorting/Processing Area	1	90	Manual sorting area with flat sorting conveyor belts Includes OWCs, conveyor belts, ballistic separator, and magnetic separator.
Bale Storage/ Dispatch Area	1	15	For storing compressed bales of recyclables like plastics, paper, and metals. And ready to move for the recycler.
Office with toilet	1	10	Includes supervisor's office, rest area, and hygiene facilities with Separate facilities for male and female workers.
Security Cabin	1	10	Located near the entry for weighing incoming and outgoing waste loads.
Weigh Balance/Machine	1	5	At the main entrance to monitor entry and exit of vehicles.
Miscellaneous Space/ (Pathways and emergency exits)	1	10	For pathways, circulation, and additional storage.

2. Machinery and Equipment

Essential Machinery

Machinery	Specifications	Quantity
Weigh Balance/Machine	1 Ton	1
Ballistic Separator	Capacity: 5–10 TPD, adjustable paddles	1
Magnetic Separator	High-intensity, auto-cleaning	1
Conveyor Belts	Flat type, 7.8 m & 4 m lengths (2 units)	2
Hydraulic Compactor Machine	Vertical, Single Cylinder, 25 Tonne (Jack force)	1
HDPE Wheeled Bins	Capacity: 100 Liters	10
Organic Composter Machine	Capacity: 50 Kg	8
	Capacity: 500 Kg	1
Pallet Truck	Manual, 1 T capacity	1

Proposed Sites (8 Locations) for the Installation of 50 Kg capacity Organic Waste Composter and HDPE Wheeled Bins-

1) Sitapur, 2) Sonprayag, 3) Gaurikund, 4) Jungle chatti, 5) Bhim bali, 6) Choti lincholi, 7) Badi lincholi, 8) Base camp

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3. Operational Plan

Workflow:

1. **Receiving and Sorting**:
   - Waste unloaded into receiving area.
   - Conveyed to sorting conveyor for manual segregation.
2. **Mechanical Processing**:
   - Ballistic separator separates 2D (plastics, paper) and 3D (bottles, cans) materials.
   - Magnetic separator removes ferrous materials.
3. **Baling and Storage**:
   - Sorted materials compressed into bales.
   - Bales stored in basement storage area.
4. **Dispatch**:
   - Processed materials dispatched to recyclers periodically.

Workforce Requirements:

Role	Number	Responsibilities
Supervisor	1	Oversee operations, manage records.
Sorting Workers	6	Manual segregation of waste.
Baler Compactor Operator	1	Operate baling machine.
Security Personnel	2	Monitor entry/exit, manage weighbridge.

Suggested Placement of Equipment:

Weight Balance Machine: Place in the Weighing Area to align with its purpose. This ensures incoming and outgoing materials are properly weighed before or after processing.

Ballistic Separator: Place in the Sorting Area as it is critical for segregating lightweight and heavy materials during sorting.

Magnetic Separator: Place adjacent to the Ballistic Separator in the Sorting/Processing Area to separate ferrous metals efficiently after initial sorting.

Conveyor Belts: 4m Conveyor Belt: Place between the Receiving/Tipping Area and the Sorting Area to transport materials for processing.

8m Conveyor Belt: Place between the Sorting/Processing Area and the Bale Storage/Dispatch Area to move processed materials for storage or dispatch.

Hydraulic Compactor Machine: Place in the Bale Storage/Dispatch Area as it compacts recyclable materials into bales ready for dispatch.

Organic Waste Compactor Machine: Place near the Sorting/Processing Area or along the Pathways, close to where organic waste is sorted, to handle organic material efficiently.

Cost Estimates

Operational Expenditure (OPEX)

S.No.	Component	Annual Cost (₹)
1	Salaries	15,00,000
2	Electricity & Maintenance	5,00,000
3	Water Supply	1,00,000
4	Miscellaneous	3,00,000
	Total	**₹24,00,000/year**

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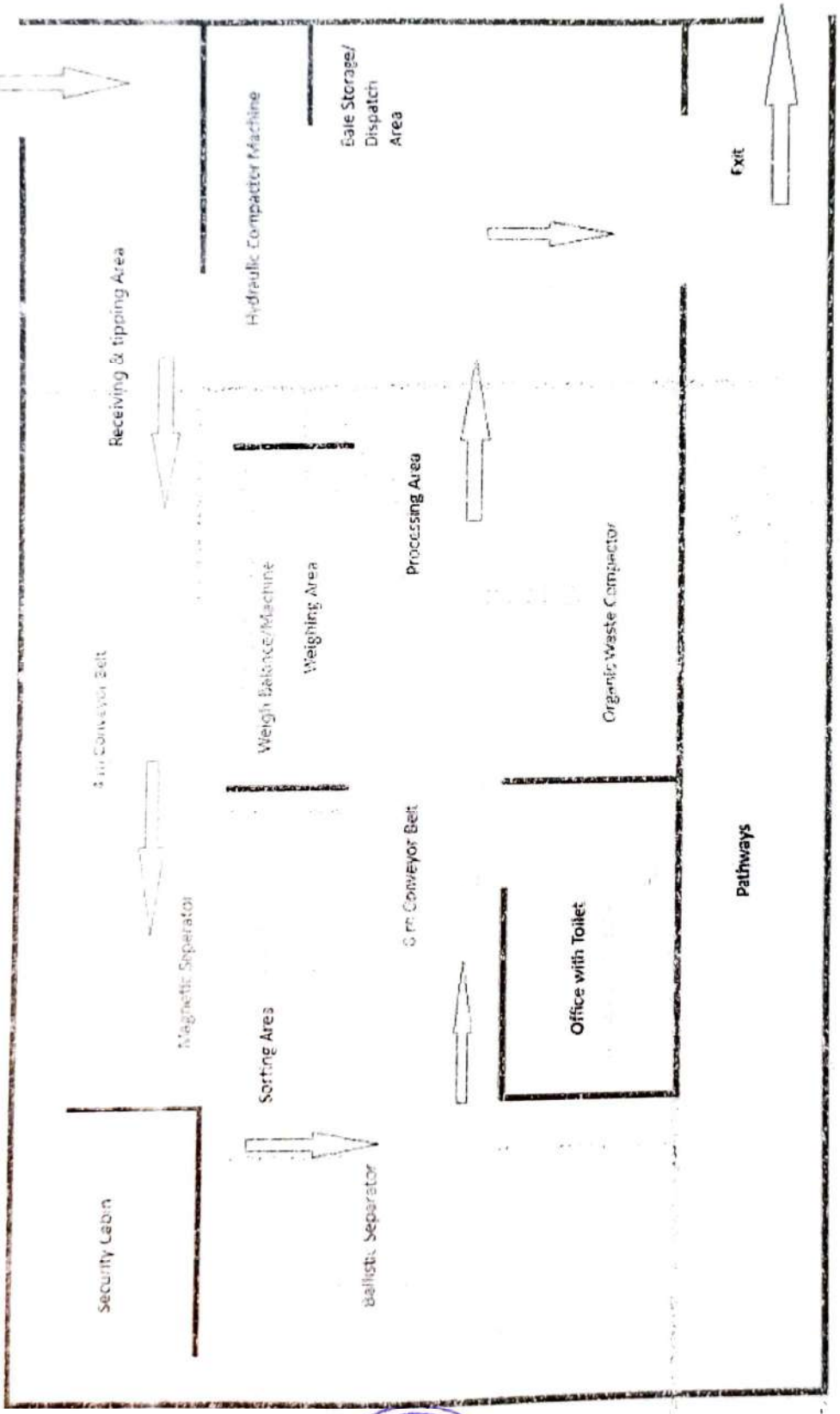

Basic MRF Floor Plan for 10 m * 16 m (160 Sq. M.) Area

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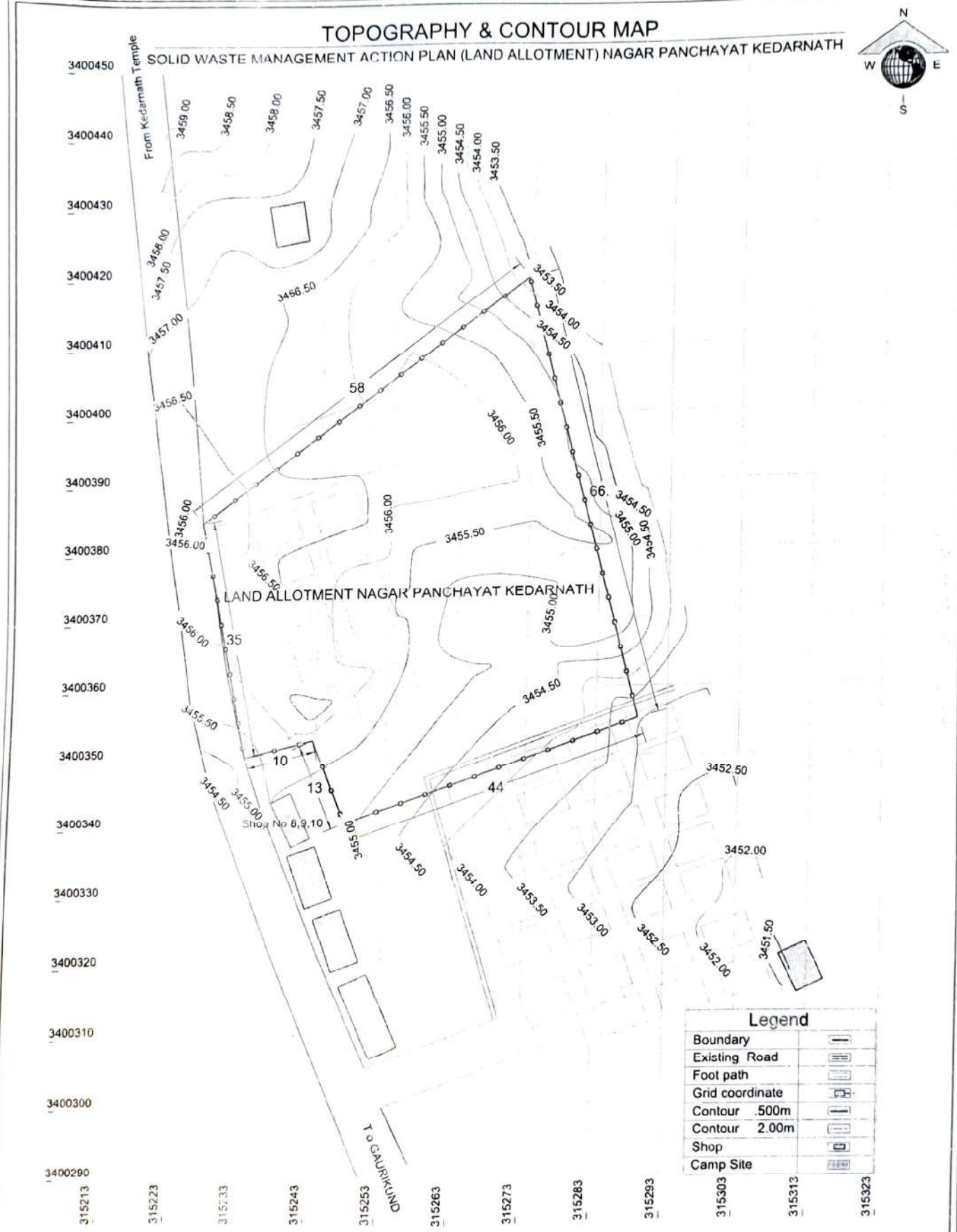
Capital Expenditure (CAPEX)

S.No.	Component	No.	Rate (₹ in lakhs)	Total Cost (₹ in lakhs)	GST %	GST Amount	Total Amount (₹ in lakhs)
1	Cost of MRF Shed	1	72.35	72.35	-	-	72.35
2	Cost of Protection Work & GI Sheet Covering for MRF Centre	1	46.37	46.37	-	-	46.37
	Contingencies on item 1 & 2 @ 5 %			5.94	-	-	5.94
3	Electricity Expenses	1	L.S.	3.00	-	-	3.00
4	Water Supply	1	L.S.	1.5	-	-	1.50
5	Machinery & Equipment						
5.1	Weigh Balance/Machine	1	0.25	0.25	18%	0.045	0.29
5.2	Ballistic Separator	1	15	15	18%	2.7	17.70
5.3	Magnetic Separator	1	1	1	18%	0.18	1.18
5.4	Conveyor Belts 4 m	1	1	1	18%	0.18	1.18
5.5	Conveyor Belts 8 m	1	1.8	1.8	18%	0.324	2.12
5.5	Hydraulic Compactor Machine	1	3.75	3.75	18%	0.675	4.42
5.6	HDPE Wheeled Bins	20	0.02	0.4	18%	0.072	0.47
5.7	Pallet Truck	1	0.15	0.15	18%	0.027	0.17
5.8	Organic Composter Machine (Capacity 50KG/Day)	8	6.75	70.88	12%	8.49	79.37
	Freight & installation Charges	8	0.95	7.6	18%	1.36	8.96
5.9	Organic Composter Machine (Capacity 500KG/Day)	1	33	33	12%	3.96	36.96
	Freight & installation Charges	1	2.1	2.1	18%	0.38	2.48
	Total			₹ 266.09		₹ 18.39	₹ 284.46
6	Transportation/Freight Cost		L.S				₹ 25.00
	Grand Total						₹ 309.46

अधिशासी अधिकारी
नगर पंचायत केदारनाथ

TOPOGRAPHY & CONTOUR MAP

SOLID WASTE MANAGEMENT ACTION PLAN (LAND ALLOTMENT) NAGAR PANCHAYAT KEDARNATH

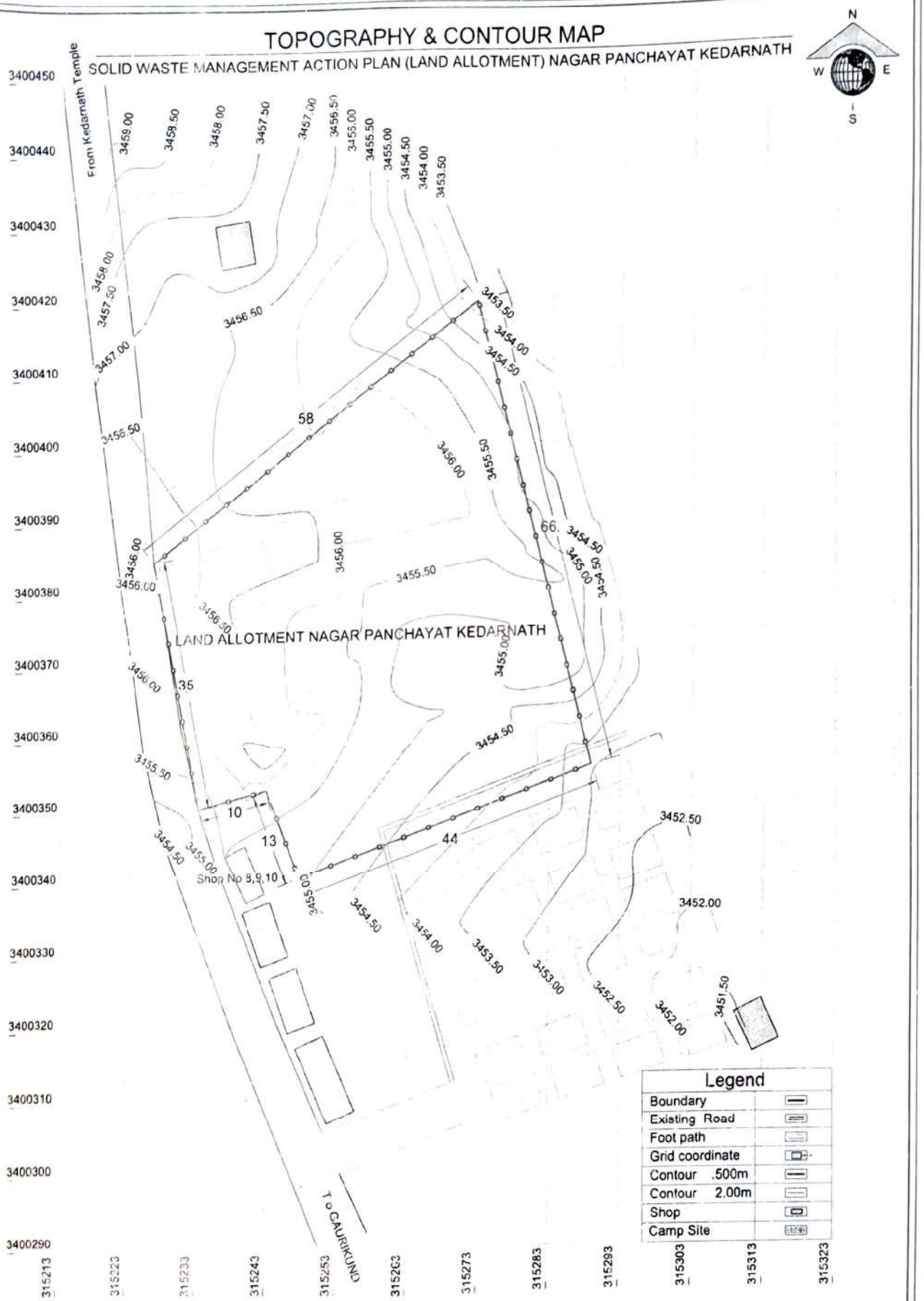


CLIENT:-	PROJECT:	LAND ALLOTMENT	PREPARED BY:-	SCALE:-	SHEET NO:-
NAGAR PANCHAYAT KEDARNATH/ KEDARNATH DHAM RUDRAPRAYAG (U.K.)	SOLID WASTE MANAGEMENT ACTION PLAN NAGAR PANCHAYAT KEDARNATH / KEDARNATH DHAM	Area = 3000 Sqm Area = 0.300 Hect Khasra no = 337& 338	DIGITAL LAND SURVEY & ENGINEERING	1:500	02

अधिशासी अधिकारी
नगर पंचायत केदारनाथ

TOPOGRAPHY & CONTOUR MAP

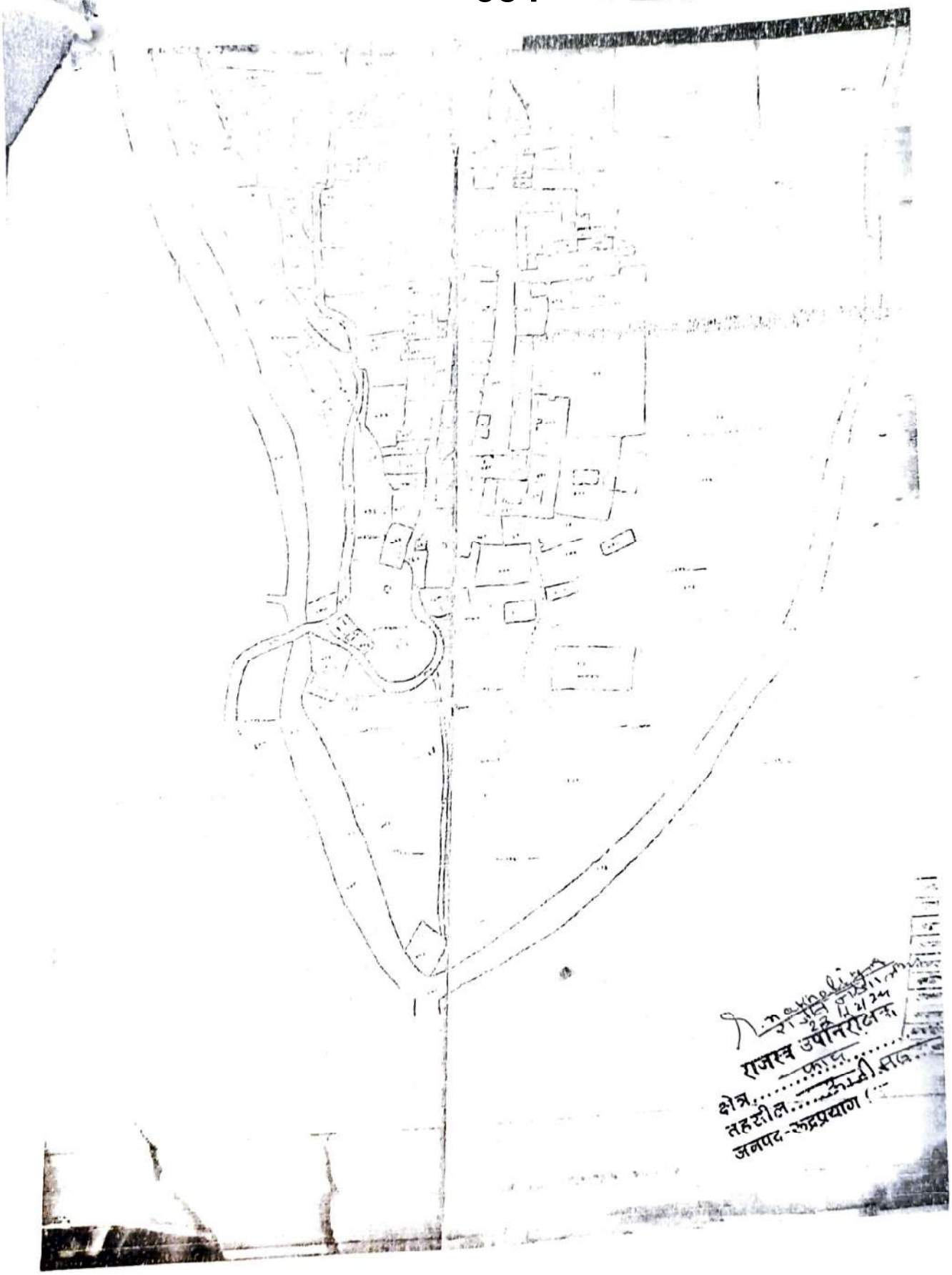
SOLID WASTE MANAGEMENT ACTION PLAN (LAND ALLOTMENT) NAGAR PANCHAYAT KEDARNATH



CLIENT:-	PROJECT:	LAND ALLOTMENT	PREPARED BY:-	SCALE:-	SHEET
NAGAR PANCHAYAT KEDARNATH/ KEDARNATH DHAM RUDRAPRAYAG (U.K.)	SOLID WASTE MANAGEMENT ACTION PLAN NAGAR PANCHAYAT KEDARNATH KEDARNATH DHAM	Area = 3000 Sqm Area = 0.300 Hect Khasra no = 337& 338	DIGITAL LAND SURVEY & ENGINEERING	1:500	NO:- 02

अधिशासी अधिकारी
नगर पंचायत केदारनाथ

अधिशासी अधिकारी
नगर पंचायत केदारनाथ



राजस्व उपनिरीक्षक
क्षेत्र.....फाटा.....
तहसील.....केदारनाथ.....
जनपद-रुद्रप्रयाग

जिला अधिकारी रुद्रप्रयाग

अधिशासी अधिकारी
नगर पंचायत केदारनाथ

चक्शा हायाप्रति

ग्राम : श्री केदारनाथ, ग0 ग0 नि0 के0: फाटा

तहसील : ऊखीमठ, जनपद : रूद्रप्रयाग

पैमाना 3/2" = मीटर

मिलान शीट सं0 - 1

(उ0)

राजस्व उपनिरीक्षक

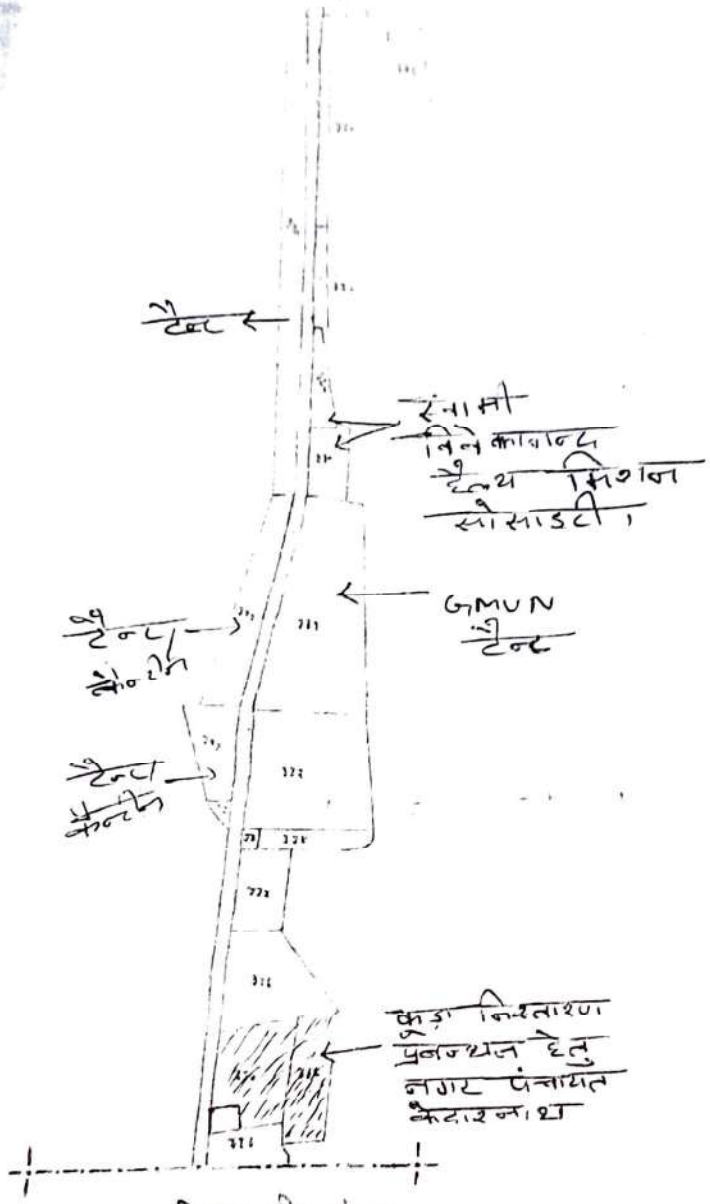
क्षेत्र..... फाटा.....

तहसील..... ऊखीमठ.....

जनपद-रूद्रप्रयाग.....

कार्यालय जिला अधिकारी रूद्रप्रयाग

अधिशासी अधिकारी
नगर पंचायत केदारनाथ



सहायक अभिलेख अधिकारी,
ऊखीमठ।

राजस्व उपनिरीक्षक
क्षेत्र.....
तहसील.....
जनपद-रुद्रप्रयाग।

अधिशासी अधिकारी
नगर पंचायत केदारनाथ

पत्रांश दायां प्रति

(30)

ग्राम : श्री केदारनाथ, श०उ०नि० द्वं० फाटा
तहसील : ऊखीमठ, जनपद : रुद्रप्रयाग

मुलाहजा शीट सं० 2

पैमाना : 32" = 1 मील

टेन्ट/कैंटीन

टेन्ट/कैंटीन

टेन्ट/कैंटीन

टेन्ट/कैंटीन

टेन्ट/कैंटीन

टेन्ट/कैंटीन

(टेन्ट/कैंटीन)

टेन्ट/कैंटीन

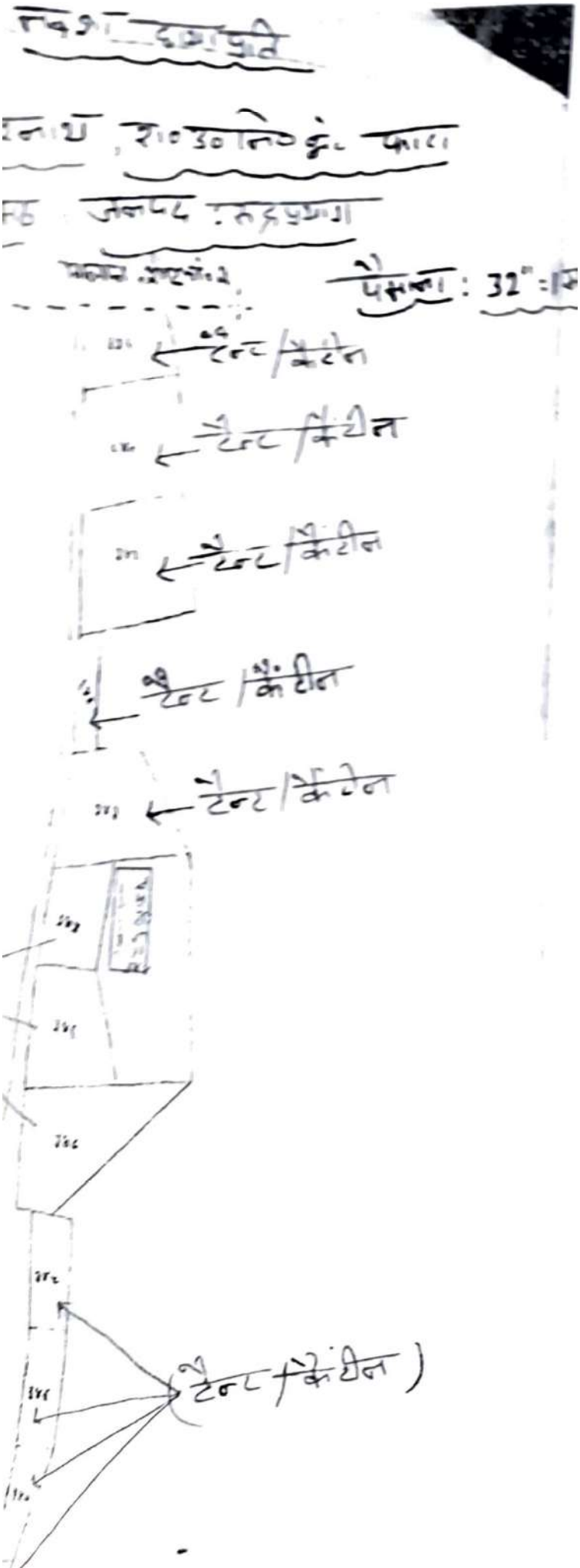
(टेन्ट/कैंटीन)

भू-चित्र
शीट सं० 3
ग्राम – केदारनाथ
परगना – ऊखीमठ
तहसील – ऊखीमठ
जिला – रुद्रप्रयाग
स्केल – 1 फी० मी०= 20 मी०= 1 जरीब
सन् – 2015-2030
रकबा – 1626 फा०

R. Nagendra
23/12/24
राजस्व उपनिरीक्षक।
क्षेत्र.....फाटा.....
तहसील...ऊखीमठ
जनपद-रुद्रप्रयाग

(Rajeev)
अधिशासी अधिकारी
नगर पंचायत केदारनाथ

कार्यालय जिला अधिकारी रुद्रप्रयाग



कब्जा दायर प्रति

(3०)

ग्राम : श्री केदारनाथ, रा०उ०नि० ब्लॉ० फाटा
तहसील : ऊखीमठ, जनपद : रुद्रप्रयाग

मौका : शीट नं० 3, पैमाना : 32" = 1 मील

टैन्ट/कैंटीन
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टैन्ट/कैंटीन

भू-चित्र
शीट नं० 3
ग्राम – केदारनाथ
परगना – ऊखीमठ
तहसील – ऊखीमठ
जिला – रुद्रप्रयाग
साक्षा-१से.मी०=२०मी०=१फर्लांग
सन् – २०१६-२०३०
तह० – १४२६ फ०

23/12/24
राजस्व उपनिरीक्षक
क्षेत्र.....फाटा.....
तहसील.....ऊखीमठ
जनपद-रुद्रप्रयाग

(10129)
अधिशासी अधिकारी
नगर पंचायत केदारनाथ

न्यायालय जिला अधिकारी रुद्रप्रयाग

AnyScanner

राजस्व उपनिरीक्षक
क्षेत्र.....
तहसील.....
जनपद.....

अधिशासी अधिकारी
नगर पंचायत केदारनाथ

Name of work-Construction of Shed,Protection Work and G.I sheet Covering for MRF centre in Kedarnath.

SUMMARY OF COST

S.N	Particular of items	Nos	Cost(in lakh)	Amount
1	Cost of Shed.(16 X 10)m	1	72.35	72.35
2	Proposed Construction of Protection work & G.I sheet Covering for MRF centre in Kedarnath.	1	46.37	46.37
			Total	118.72
	Contigencies@5.00%			5.94
			Grand Total	**124.66**

अधिशासी अधिकारी
नगर पंचायत केदारनाथ

Name of work: Construction of MRF Shed in Kedarnath .

Bill of Quantity

S.N.	Item of work	Quantity	Unit	Rate	Amount
1	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift upto 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.	37.31	cum	737.00	27495.44
2	Providing and laying in position cement concrete 1:4:8 excluding the cost of centering and shuttering i/c all.	23.83	cum	16678.00	397474.27
3	Providing and laying in position specified grade of reinforced cement concrete, excluding the cost of centering, shuttering, finishing and reinforcement -All work up to plinth level: 1 :1.5:3 (1 cement : 1.5 coarse sand (zone-III) derived from natural sources : 3 graded stone aggregate 20 mm nominal size derived from natural sources) i/c all.	29.54	cum	27316.00	806941.96
4	Centering and shuttering including strutting, propping etc. and removal of form for Foundations, footings, bases of columns, etc. for mass concrete i/c all.	79.20	sqm	1572.00	124502.40
5	Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level.	3478.45	kg	179.00	622643.04
6	Steel work in built up tubular (round, square or rectangular hollow tubes etc.) trusses etc., including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer, including welding and bolted with special shaped washers etc. complete.	10695.40	kg	303.00	3240706.20
7	Random Rubble stone masonary laid in 1:6 cement and sand mortar i/c all.	6.18	cum	13056.70	80721.74
8	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 and for all lift.	52.10	cum	580.00	30215.68

अधिशासी अधिकारी
नगर पंचायत केदारनाथ

9	Providing corrugated G.S. sheet roofing including vertical I curved surface fixed with polymer coated J or L hooks, bolts and nuts 8 mm diameter with bitumen and G.I. limpet washers or with G.I. limpet washers filled with white lead, including a coat of approved steel primer and two coats of approved paint on overlapping of sheets complete (up to any pitch in horizontal/ vertical or curved surfaces), excluding the cost of purlins, rafters and trusses and including cutting to size and shape wherever required. 0.63 thick with zinc coating not less than 275 gm/m2	228.42	sqm	1695.00	387165.12
10	Providing ridges or hips of width 60 cm overall width plain G.S. sheet fixed with polymer coated J or L hooks, bolts and nuts 8 mm dia G.I. limpet and bitumen washers complete. 0.80 mm thick with zinc coating not less than 275 gm/m2	16.60	m	1083.30	17982.78
11	Providing and fixing 15 cm wide, 45 cm overall semi-circular plain G.S. sheet gutter with iron brackets 40x3 mm size, bolts, nuts and washers etc., including making necessary connections with rain water pipes complete. 0.80 mm thick with zinc coating not less than 275	33.20	m	1029.65	34184.38
12	Providing and fixing 1 mm thick M.S. sheet door with frame of 40x40x6 mm angle iron and 3 mm M.S. gusset plates at the junctions and corners, all necessary fittings complete, including applying a priming coat of approved steel primer.	12.00	sqm	9937.00	119244.00
13	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level: 1 :2:4 (1 cement : 2 coarse sand (zone-III) derived from natural sources : 4 graded stone aggregate 20 mm nominal size derived from natural sources)	20.13	cum	23368.00	470281.00
14	Providing and fixing of Puf pannel to walls as per required shape and design directed by engineer in charge including material,labour and all fixing.(Rates taken as per Gem portal)	196.00	Sqm	3900.00	764400.00
15	Painting Steel work with Deluxe Multi Surface Paint to give an even shade. Two or more coat applied @ 0.90 ltr/10 sqm over an under coat of primer applied @ 0.80 ltr/10 sqm of approved brand and manufacture i/c all.	238.90	Sqm	255.00	60919.50
				TOTAL=	7184877.51
	Add cartage for item no 10,11 & 14 due to rates are taken from DSR 2023 and Gem portal.			L.S	50000.00
				G. Total	7234877.51
				Says(lakh)	**72.35**

अधिशासी अधिकारी
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कार्यालय जिला अधिकारी रुद्रप्रयाग

9	Providing corrugated G.S. sheet roofing including vertical l curved surface fixed with polymer coated J or L hooks, bolts and nuts 8 mm diameter with bitumen and G.I. limpet washers or with G.I. limpet washers filled with white lead, including a coat of approved steel primer and two coats of approved paint on overlapping of sheets complete (up to any pitch in horizontal/ vertical or curved surfaces), excluding the cost of purlins, rafters and trusses and including cutting to size and shape wherever required. 0.63 thick with zinc coating not less than 275 gm/m2	228.42	sqm	1695.00	387165.12
10	Providing ridges or hips of width 60 cm overall width plain G.S. sheet fixed with polymer coated J or L hooks, bolts and nuts 8 mm dia G.I. limpet and bitumen washers complete. 0.80 mm thick with zinc coating not less than 275 gm/m2	16.60	m	1083.30	17982.78
11	Providing and fixing 15 cm wide, 45 cm overall semi-circular plain G.S. sheet gutter with iron brackets 40x3 mm size, bolts, nuts and washers etc., including making necessary connections with rain water pipes complete. 0.80 mm thick with zinc coating not less than 275	33.20	m	1029.65	34184.38
12	Providing and fixing 1 mm thick M.S. sheet door with frame of 40x40x6 mm angle iron and 3 mm M.S. gusset plates at the junctions and corners, all necessary fittings complete, including applying a priming coat of approved steel primer.	12.00	sqm	9937.00	119244.00
13	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level: 1 :2:4 (1 cement : 2 coarse sand (zone-III) derived from natural sources : 4 graded stone aggregate 20 mm nominal size derived from natural sources)	20.13	cum	23368.00	470281.00
14	Providing and fixing of Puf pannel to walls as per required shape and design directed by engineer in charge including material,labour and all fixing.(Rates taken as per Gem portal)	196.00	Sqm	3900.00	764400.00
15	Painting Steel work with Deluxe Multi Surface Paint to give an even shade. Two or more coat applied @ 0.90 ltr/10 sqm over an under coat of primer applied @ 0.80 ltr/10 sqm of approved brand and manufacture i/c all.	238.90	Sqm	255.00	60919.50
				TOTAL=	7184877.51
	Add cartage for item no 10,11 & 14 due to rates are taken from DSR 2023 and Gem portal.			L.S	50000.00
				G. Total	7234877.51
				Says(lakh)	**72.35**

अधिशासी अधिकारी
नगर पंचायत केदारनाथ

न्यायालय जिला अधिकारी रुद्रप्रयाग

Name of work: Construction of MRF Shed in Kedarnath .

Detail of Measurements

S No.	Item of Work	No.	Length	Width	Height	Quantity	Unit
1	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on						
	Fd.	10	1.45	1.45	1.65	34.69	cum
	Plinth beam Long side	2	16.00	0.60	0.10	1.92	cum
	Plinth beam S.side	2	8.80	0.60	0.10	1.06	cum
	Ded	-10	0.60	0.60	0.10	-0.36	cum
					Total	37.31	cum
2	Providing and laying in position cement concrete 1:4:8 excluding the cost of centering and shuttering i/c all.						
		10	1.45	1.45	0.15	3.15	cum
	Base B/W Long side	2	16.00	0.60	0.10	1.92	cum
	Base B/W S.side	2	8.80	0.60	0.10	1.06	cum
	Ded	-10	0.60	0.60	0.10	-0.36	cum
	Floor	1	16.00	10.00	0.10	16.00	cum
	Apron	1	16.00	0.75	0.10	1.20	cum
	Apron	1	11.50	0.75	0.10	0.86	cum
					Total	23.83	cum
3	Providing and laying in position specified grade of reinforced cement concrete, excluding the cost of centering, shuttering, finishing and reinforcement -All work up to plinth level : 1 :1.5:3 (1 cement : 1.5 coarse sand (zone-III) derived from natural sources : 3 graded stone aggregate 20 mm nominal size derived from natural sources)						
	footing	10	1.35	1.35	0.60	10.94	cum
	fdn.	10	0.90	0.90	0.90	7.29	cum
	Upto Plinth	10	0.60	0.60	0.60	2.16	cum
	Plinth beam Long side	2	16.00	0.60	0.35	6.72	cum
	Plinth beam S.side	2	8.80	0.60	0.35	3.70	cum
	Ded	-10	0.60	0.60	0.35	-1.26	cum
					Total	29.54	cum

अधिशासी अधिकारी
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4	Centering and shuttering including strutting, propping etc. and removal of form for Foundations, footings, bases of columns, etc. for mass concrete i/c all.						
	footing	40	1.35		0.60	32.40	sqm
	fdn.	40	0.90		0.90	32.40	sqm
	Upto Plinth	40	0.60		0.60	14.40	sqm
	Plinth beam Long side	4	16.00		0.35	22.40	sqm
	Plinth beam S.side	2	8.80		0.35	6.16	sqm
					Total	79.20	sqm
5	Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level.						
	Taking 1.50 % of total Qt. of item no 3	0.015	29.541	7850		3478.45275	Kg
						3478.45275	Kg
6	Steel work in built up tubular (round, square or rectangular hollow tubes etc.) trusses etc., including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer, including welding and bolted with						
	M.S Plate (15 mm thick)	10	0.6	0.60	118 kg/sqm	424.8	Kg
	Nuts,bolts,fixtures etc @15% of total wt. of plate	1				63.72	Kg
	Vertical square Pipe (180 mm*180mm*10mm)	10	4.00	@	53 Kg/m	2120	Kg
	Truss base (172 mm*92mm*4.8 mm) E	10	11.5	@	18.71 Kg/m	2151.65	Kg
	Inclined (100 mm*100mm*5 mm) A	20	6.88	@	14.80 Kg/m	2036.48	Kg
	Members (60*60*4) B					0	
	(0.67 + 1.81+1.34+2.13)= 5.95m	20	5.95	@	6.97 Kg/m	829.43	Kg
	Centre Vertical	10	2.00	@	6.97 Kg/m	139.4	Kg
	purlin member(145*82*4.8) C	8	16.00	@	15.92 Kg/m	2037.76	Kg
	Tie runner(60*60*4) D	8	16.00	@	6.97 Kg/m	892.16	Kg
					Total	10695.4	Kg
7	Random Rubble stone masonary laid in 1:6 cement and sand mortar i/c all.						
	Upto Plinth	2	16.00	0.60	0.23	4.42	Cum

अधिशासी अधिकारी
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		2	8.80	0.60	0.23	2.43	Cum
	Ded	-8	0.60	0.60	0.23	-0.66	Cum
					Total	6.18	Cum
8	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 mtd for all lift						
		1	14.8	8.80	0.40	52.10	Cum
					Total	52.10	Cum
9	Providing corrugated G.S. sheet roofing including vertical I curved surface fixed with polymer coated J or L hooks, bolts and nuts 8 mm diameter with bitumen and G.I. limpet washers or with G.I. limpet washers filled with white lead, including a coat of approved steel primer and two coats of approved paint on overlapping of sheets complete (up to any pitch in horizontal/ vertical or curved surfaces), excluding the cost of purlins, rafters and						
		2	16.6	6.9		228.4	sqm
					Total	228.4	Sqm
10	Providing ridges or hips of width 60 cm overall width plain G.S. sheet fixed with polymer coated J or L hooks, bolts and nuts 8 mm dia G.I. limpet and bitumen washers complete. 12.4.1 0.80 mm thick with zinc coating not less than 275 gm/m2						
		1	16.60			16.60	M
					Total	16.6	M
11	Providing and fixing 15 cm wide, 45 cm overall semi-circular plain G.S. sheet gutter with iron brackets 40x3 mm size, bolts, nuts and washers etc., including making necessary connections with rain water pipes complete. 12.7.1 0.80 mm thick with zinc coating not less than 275 gm/m2						
		2	16.60			33.20	M
					Total	33.20	M

Goval
अधिशासी अधिकारी
नगर पंचायत केदारनाथ

कार्यालय जिला अधिकारी रुद्रप्रयाग

12	Providing and fixing 1 mm thick M.S. sheet door with frame of 40x40x6 mm angle iron and 3 mm M.S. gusset plates at the junctions and corners, all necessary fittings complete, including applying a priming coat of						
	Door	1	3.00	4.00		12.00	
					Total	12	sqm
13	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level: 1 :2:4 (1 cement : 2 coarse sand (zone-III) derived from natural sources : 4 graded stone aggregate 20 mm nominal						
	Floor	1	16.00	10.00	0.10	16.00	
	Apron	2	16.00	0.75	0.10	2.40	
	Apron	2	11.50	0.75	0.10	1.73	
					Total	20.13	Cum
14	Providing and fixing of Puf pannel to walls as per required shape and design directed by engineer in charge including material,labour and all fixing.(Rates taken as per Gem portal)						
	walls	2	16.00		4.00	128.00	
		2	10.00		4.00	80.00	
	Ded Door	-1	3.00		4.00	-12.00	
					Total	196.00	sqm
15	Painting Steel work with Deluxe Multi Surface Paint to give an even shade. Two or more coat applied @ 0.90 ltr/10 sqm over an under coat of primer applied @ 0.80 ltr/10 sqm of approved brand and manufacture						
	Vertical square Pipe (180 mm*180mm*10mm)	10	4.00	0.72		28.8	Sqm
	Truss base (172 mm*92mm*4.8 mm) E	10	11.5	0.524		60.26	Sqm
	Inclined (100 mm*100mm*5 mm) A	20	6.88	0.40		55.04	Sqm
	Members (60*60*4) B					0	Sqm
	(0.67 + 1.81+1.34+2.13)= 5.95m	20	5.95	0.24		28.56	Sqm
	Centre Vertical	10	2.00	0.24		4.8	Sqm
	purlin member(145*82*4.8) C	8	16.00	0.24		30.72	Sqm
	Tie runner(60*60*4) D	8	16.00	0.24		30.72	Sqm
					Total	238.90	sqm

अधिशासी अधिकारी
नगर पंचायत केदारनाथ

जिला अधिकारी रुद्रप्रयाग

Name of Work :-Proposed construction of Protection work & G.I sheet covering for MRF centre in Kedarnath.

BILL OF QUANTITY

S.No.	Item of Work	Quantity	UNIT	Rate	AMOUNT
1	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift upto 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.	950.00	Cum	737.00	700150.00
2	Excavation in foundation for retaining, breast walls etc, in all types of soils and rocks including all lead, lift and disposal of surplus material as per direction of engineer - in - charge, as per drawing and technical specifications Clause 305.1 of MORD Specifiction	87.00	Cum	1369.00	119103.00
3	Providing concrete for plain/ reinforced concrete in open foundations complete as per drawings and technical specifications Clause 802, 803, 1202 & 1203	9.75	Cum	29368.00	286338.00
4	Steel work welded in built up sections/ framed work, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer using structural steel etc. as required..	4996.38	KG	303.00	1513903.14
5	Providing corrugated G.S. sheet roofing including vertical / curved surface fixed with polymer coated J or L hooks, bolts and nuts 8 mm diameter with bitumen and G.I. limpet washers or with G.I. limpet	339.00	Sqm	1695.00	574605.00
6	Random rubble stone masonary laid dry by locally available approved stone including supply of all material labour, T&P etc. required for proper completion of work as per detail PWD specification and as per direction of Engineer in charge	31.05	Cum	7215.70	224047.49
7	Random Rubble Stone Masonry laid1:6, in breast walls, retaining walls, etc. including supply of all material, labour, T&P and royaltiies etc. complete as per drawing and technical specifications Clauses 702, 704, 1202 & 1203 of MORD Specifiction	93.33	Cum	13056.70	1218625.33
				Total	**4636771.96**
			SAY(in lakh)		**46.37**

अधिशासी अधिकारी
नगर पंचायत केदारनाथ

Name of Work :-Proposed construction of Protection work & G.I sheet covering for MRF centre in Kedarnath.

DETAIL OF MEASUREMENT

S No.	Item of Work	No.	Length	Width	Height	Quantity	Unit
1	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift upto 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead						
		1	50.00	20.00	0.95	950.00	Cum
					Total	**950.00**	**Cum**
2	Excavation in foundation for retaining, breast walls etc, in all types of soils and rocks including all lead, lift and disposal of surplus material as per direction of engineer - in - charge, as per drawing and technical specifications Clause						
	Column	78	0.50	0.50	0.50	9.75	Cum
		1	50.00	1.27	0.90	57.00	Cum
		1	45.00	0.60	0.75	20.25	Cum
					Total	**87.00**	**Cum**
3	Providing concrete for plain/ reinforced concrete in open foundations complete as per drawings and technical specifications Clause 802, 803, 1202 & 1203						
		78	0.50	0.50	0.50	9.75	Cum
					Total	**9.75**	**Cum**
4	Steel work welded in built up sections/ framed work, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer using structural steel etc. as required..						
	Main Post @ 70x70x5 hollow pipe vertical	78	3		10.11	2365.74	Kg
	horizontal pipe @ 50x25x5 hollow pipe	3	226		3.88	2630.64	Kg
					Total	**4996.38**	**Kg**
5	Providing corrugated G.S. sheet roofing including vertical / curved surface fixed with polymer coated J or L hooks, bolts and nuts 8 mm diameter with bitumen and G.I. limpet washers or with G.I. limpet washers filled with white lead, including a coat of a						
		1	226	1.50		339.00	Sqm
					Total	**339.00**	**Sqm**
6	Random rubble stone masonary laid dry by locally available approved stone including supply of all material labour, T&P etc. required for proper completion of work as per detail PWD specification and as per direction of						
		1	45.00	0.60	1.15	31.05	Cum
					Total	**31.05**	**Cum**

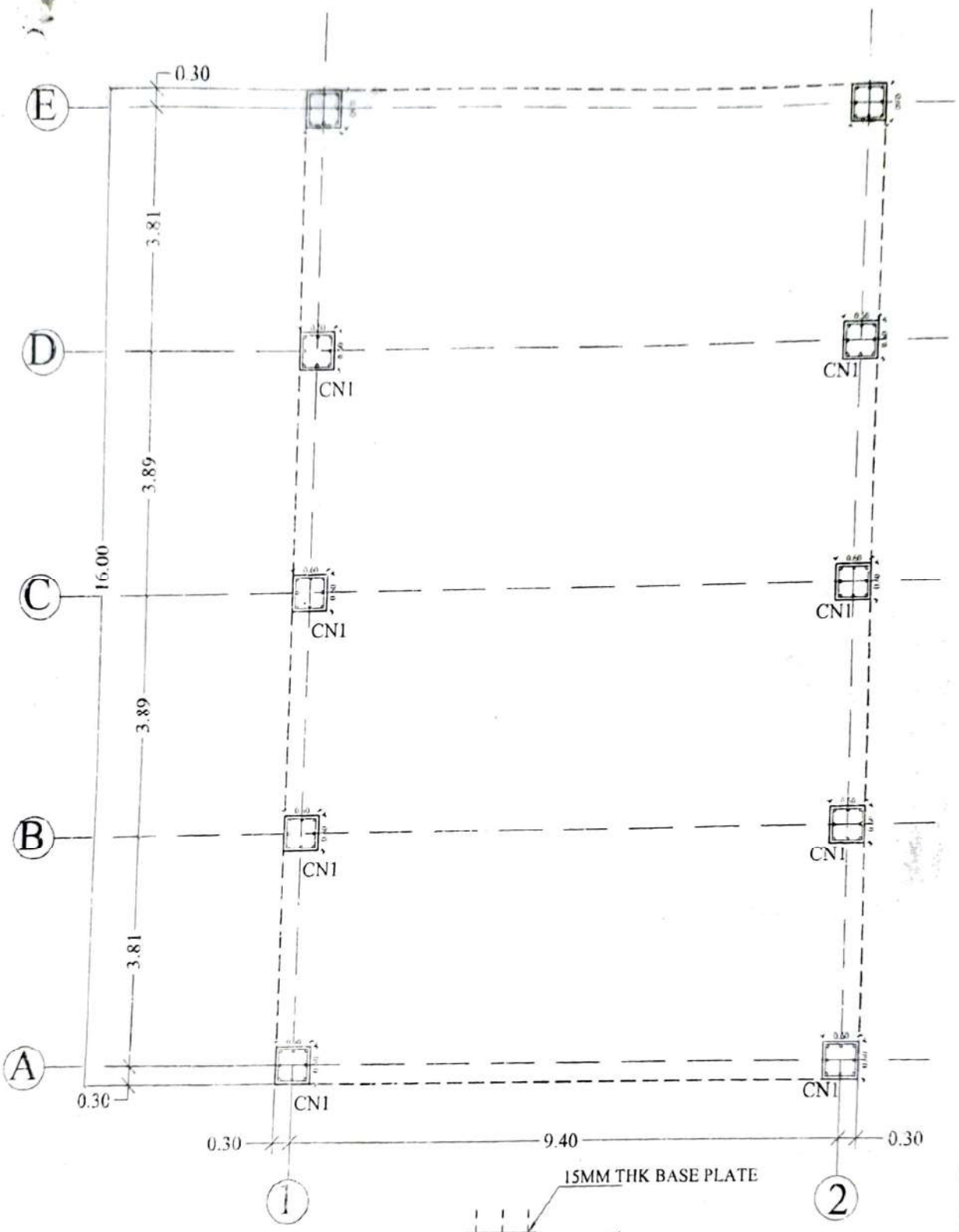
अधिशासी अधिकारी
नगर पंचायत केदारनाथ

कार्यालय जिला अधिकारी रुद्रप्रयाग

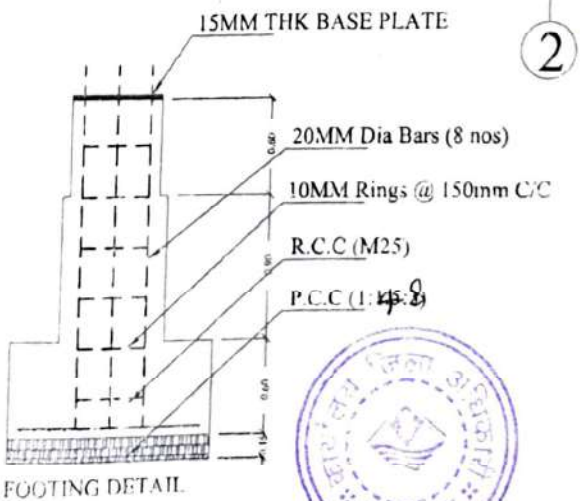
7	Random Rubble Stone Masonry laid1:6, in breast walls, retaining walls, etc. including supply of all material, labour, T&P and royaltiies etc. complete as per drawing and technical specifications Clauses 702, 704, 1202 & 1203 of MORD Specifiction						
		1	50.00	0.93	2.00	93.33	Cum
					Total	**93.33**	**Cum**

अधिशासी अधिकारी
नगर पंचायत केदारनाथ

जिला अधिकारी रुद्रप्रयाग

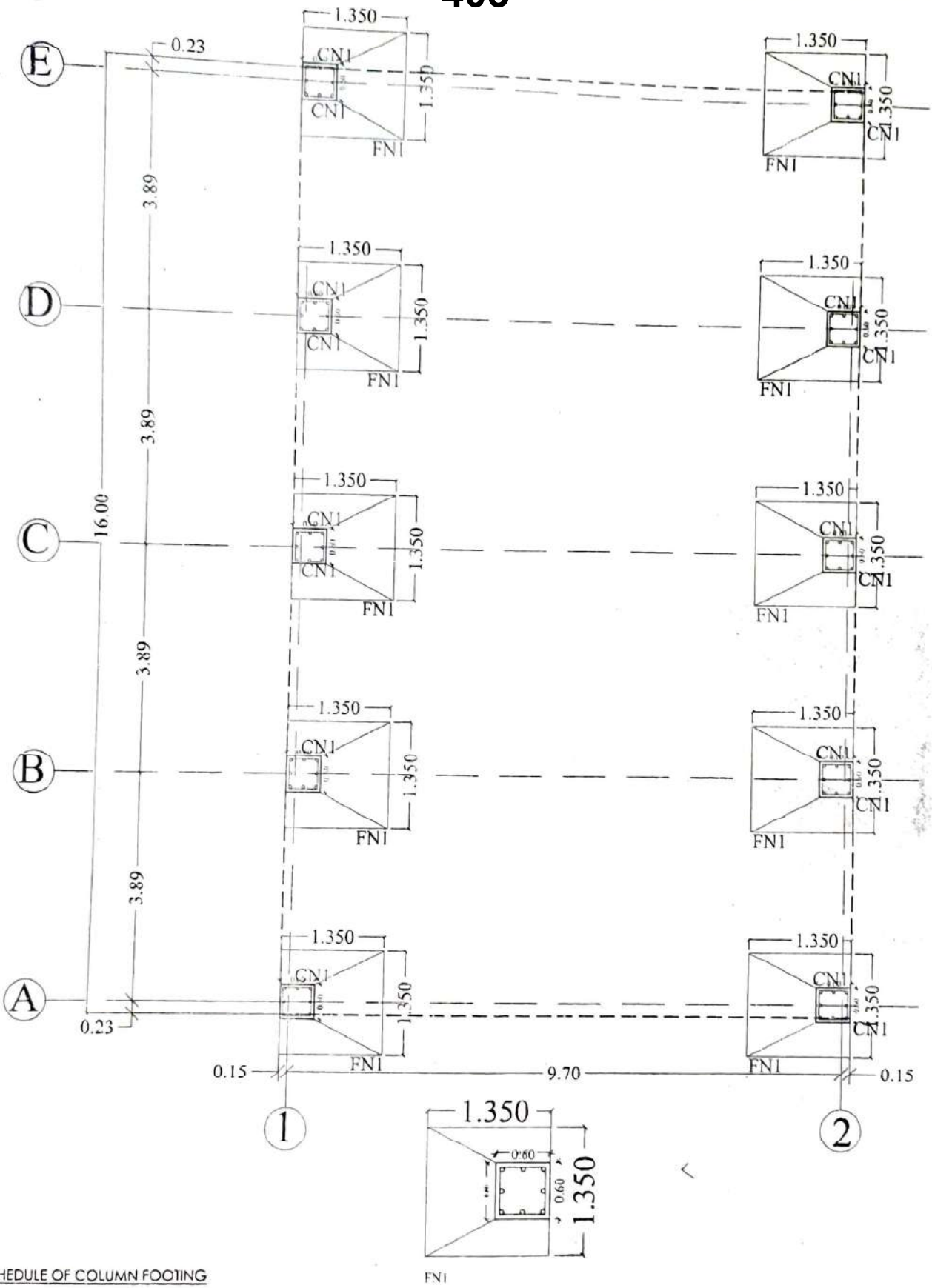


COLUMN LAYTOUT PLAN



FOOTING DETAIL

अधिशासी अधिकारी
नगर पंचायत केदारनाथ

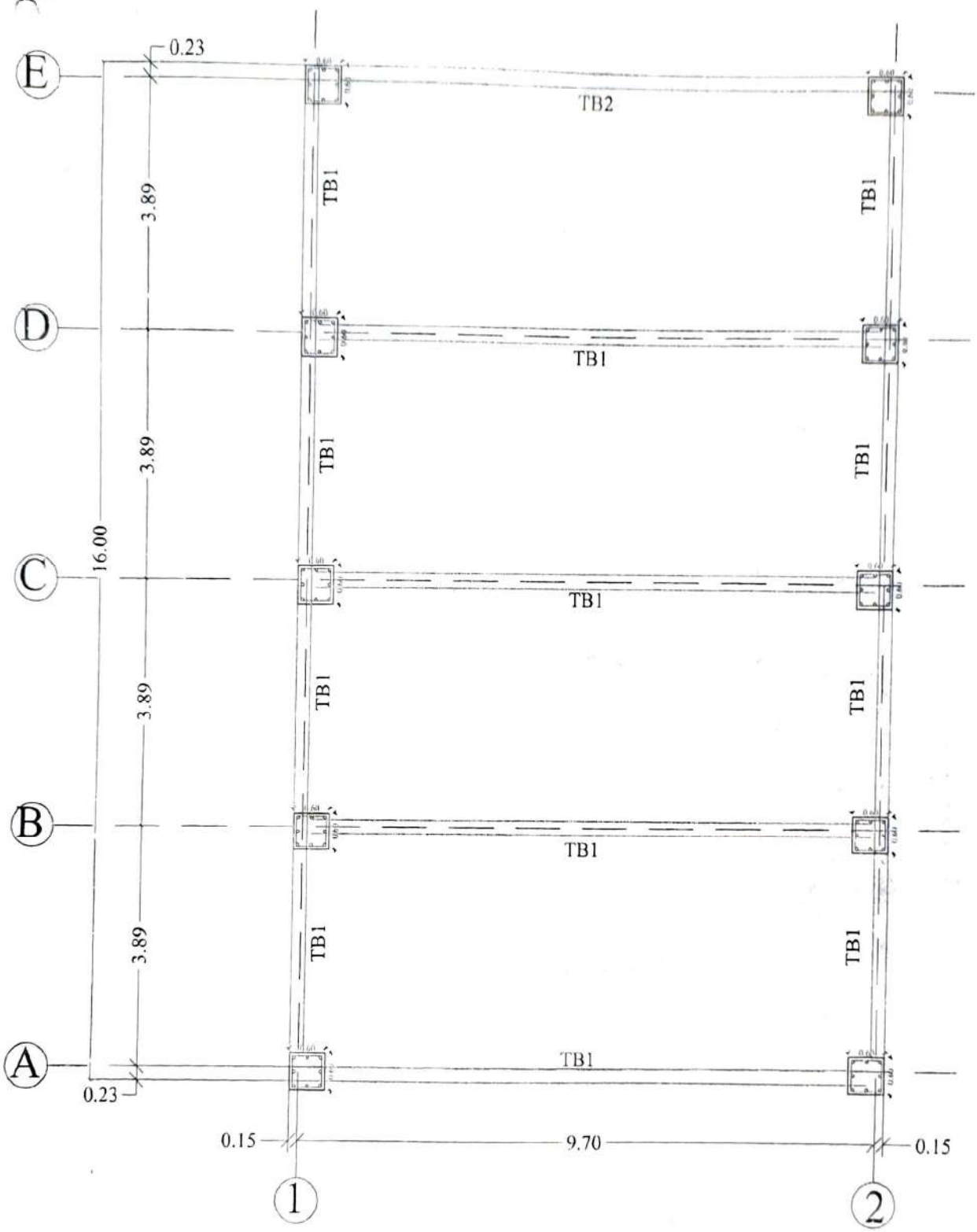


SCHEDULE OF COLUMN FOOTING

Sr. No.	NAME OF FOOTING	TYPE OF FOOTING	SIZE (MM)	DEPTH BELOW THE COLUMN (mm)	DEPTH AT OUTER EDGES (mm)	BOTTOM REIN.		TOP REIN.	
						ALONG SHORT SPAN	ALONG LONG SPAN	ALONG SHORT SPAN	ALONG LONG SPAN
1.	FN1	Isolate Footing	As per Drawing	750		16Ø @ 150 C/C.	16Ø @ 150 C/C.	12Ø @ 175 C/C.	12Ø @ 175 C/C.
USE M-25 GRADE CONCRETE									

FOOTING LAYTOUT PLAN

अधिशासी अधिकारी
नगर पंचायत केदारनाथ



SCHEDULE OF TIE BEAMS

Sr. No.	TYPE OF TIE BEAM	REINFORCEMENT						
		SIZE(MM)		BOTTOM BARS	TOP BARS	STIRRUPS		
		B	D			DIA	NO. OF LEGS	SPACING (MM)
1.	TB1	300	450	3 - 16Ø	3 - 16Ø	8Ø	2	150
2.	TB2	300	450	3 - 20Ø	3 - 16Ø	8Ø	2	150
USE M-25 GRADE CONCRETE								

TIE BEAM LAYTOUT PLAN

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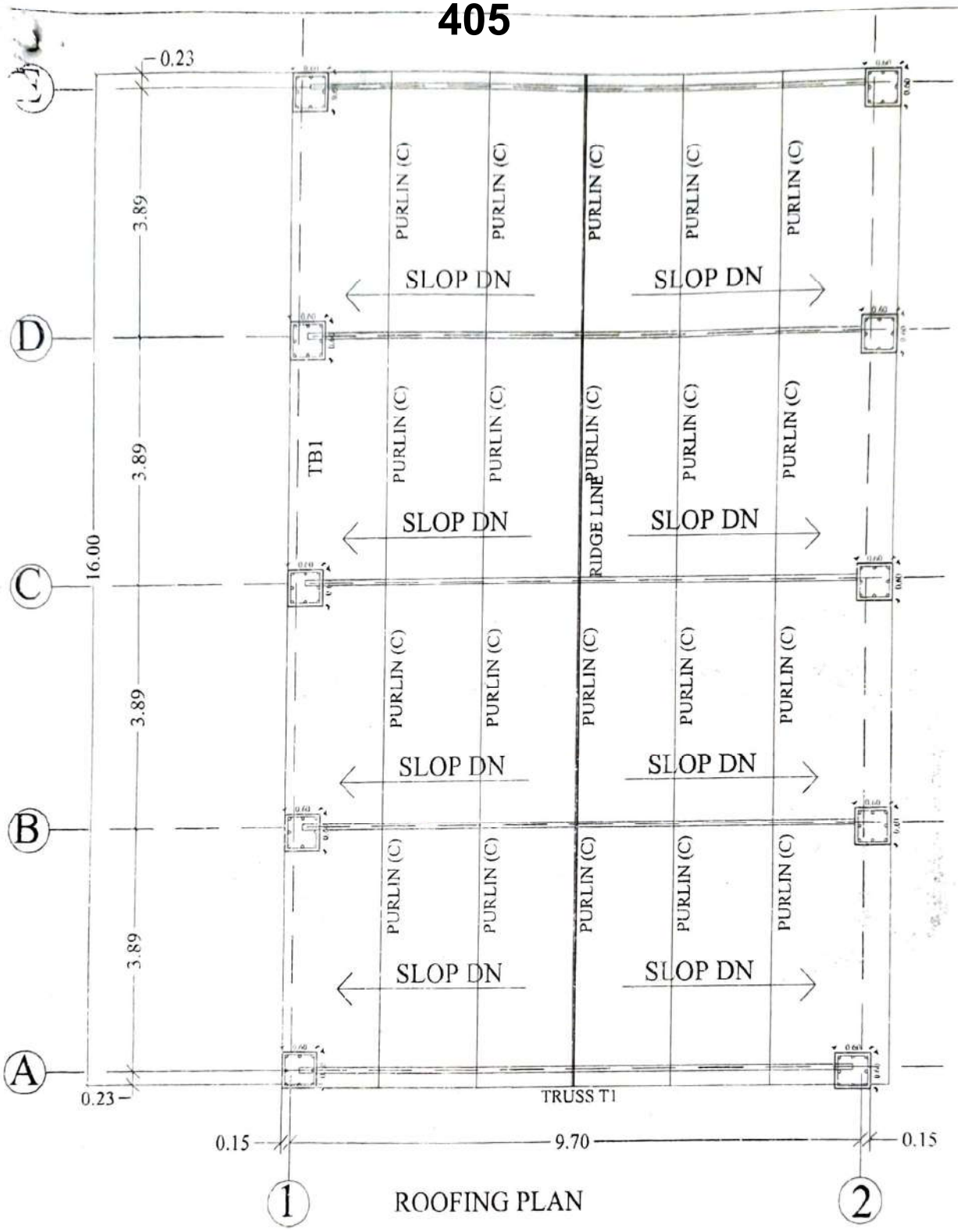
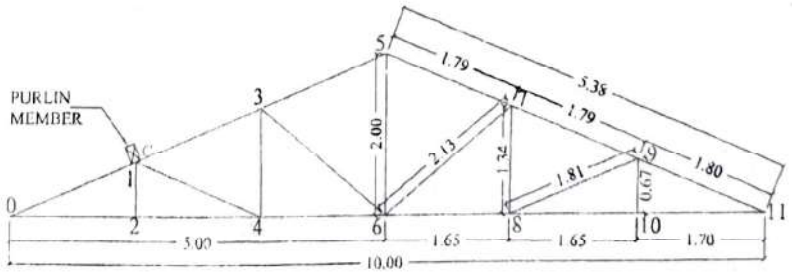
नगर पंचायत केदारनाथ

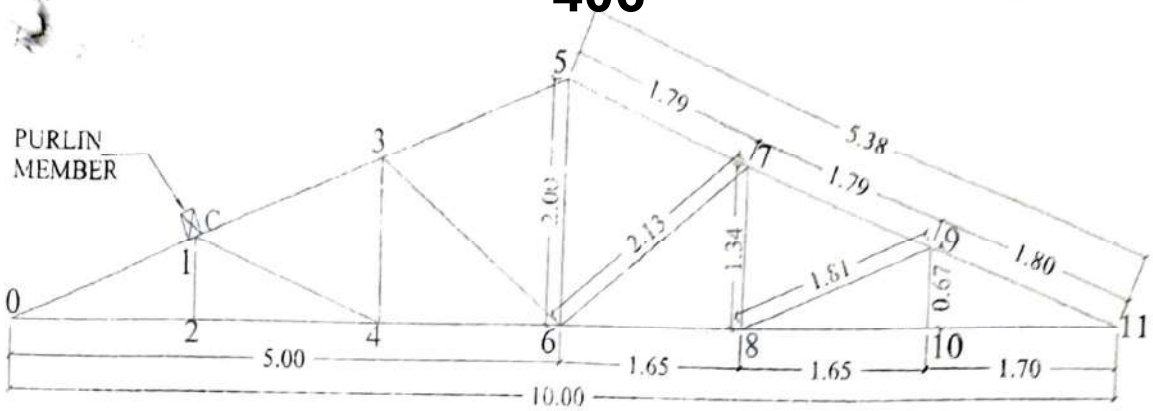


ROOFING PLAN

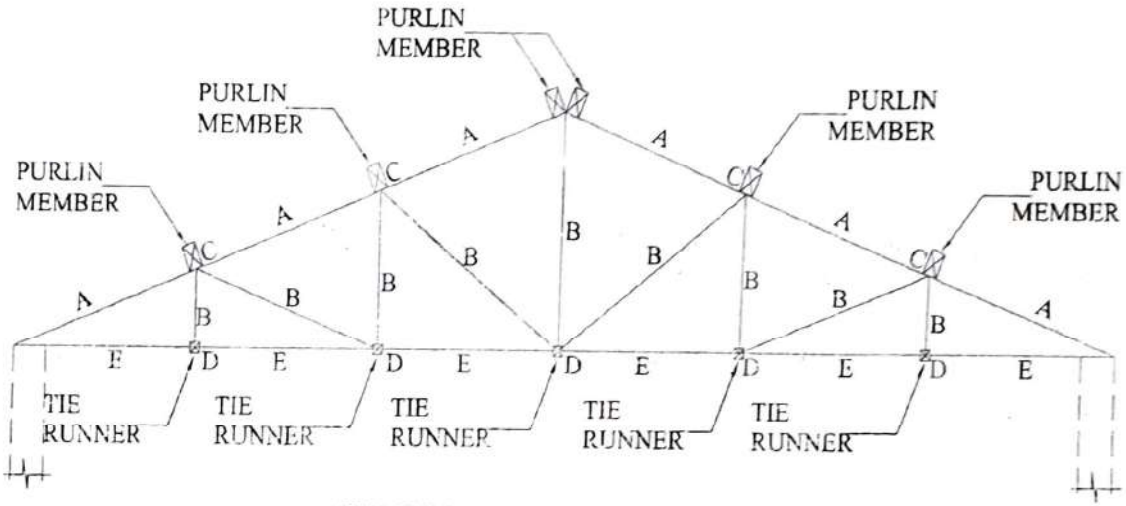


ROOFING - ELEVATION

अधिशासी अधिकारी
नगर पंचायत केदारनाथ

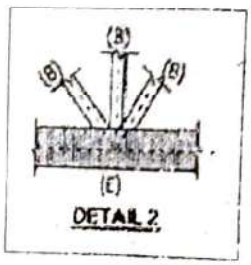


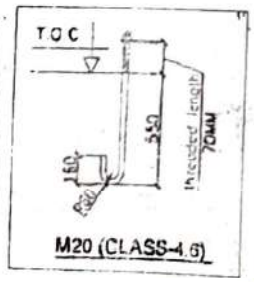
TRUSS SECTION - T1

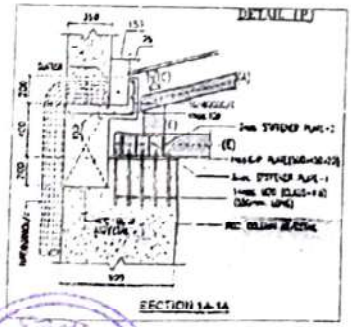


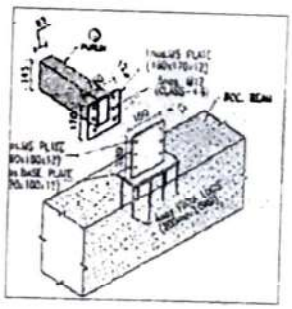
TRUSS SECTION - T1

MEMBER SCHEDULE		
MEMBER NO.	MEMBER SIZE (DXB)	GRADE OF STEEL
(A)	SHS - 100 X 100 X 5	YST 310
(B)	SHS - 60 X 60 X 4	YST 310
(C) (PURLINS)	RHS - 145 X 82 X 4.8	YST 310
(D) (TIE RUNNER)	SHS - 60 X 60 X 4	YST 310
(E)	RHS - 172 X 92 X 4.8	YST 310









अधिशासी अधिकारी
नगर पंचायत केदारनाथ

कार्यालय अधीक्षण अभियन्ता
सप्तम् वृत्त लोक निर्माण विभाग
गोपेश्वर (चमोली)

E-Mail: sepwdgope@rediffmail.com

पत्रांक – 1960/173 सप्तम्-7/2023 दिनांक :– 10/04/2023

सेवा में,

मै0 राज कन्स्ट्रक्शन
ए0 511, पैसफिक हिल्स, राजपुर रोड
देहरादून।

विषयः– श्री केदारनाथ धाम परिक्षेत्रान्तर्गत गतिमान निर्माण कार्यो पर कार्यरत श्रमिकों के विश्राम तथा रात्रि प्रवास की सुविधा हेतु, सरस्वती नदी एंव भैरव मन्दिर मार्ग के मध्य अस्थाई लेबर हट/बंकर नं0–4 का निर्माण कार्य। (साईज 30.00 मी0 X 6.60मी0 क्षमता 200 श्रमिक)।
Tender ID:- 2023_pwd_56478_1

उपरोक्त विषयक श्री केदारनाथ धाम परिक्षेत्रान्तर्गत गतिमान निर्माण कार्यो पर कार्यरत श्रमिकों के विश्राम तथा रात्रि प्रवास की सुविधा हेतु, सरस्वती नदी एंव भैरव मन्दिर मार्ग के मध्य अस्थाई लेबर हट/बंकर नं0–4 का निर्माण कार्य। (साईज 30.00 मी0 X 6.60मी0 क्षमता 200 श्रमिक) हेतु आपके द्वारा दी गयी निविदा दरें उत्तराखण्ड सरकार की ओर से निम्न हस्ताक्षरकर्ता द्वारा रू0 1,59,93,504.96 (एक करोड उन्सठ लाख तिरानब्बे हजार पांच सौ चार रूपये एवं छयानब्बे पैसे) मात्र के लिए स्वीकृत की जाती है।

अतः आपको सूचित किया जाता है कि आप पत्र निर्गत होने की तिथि के 7 दिन के अन्तर्गत उत्तराखण्ड शासन द्वारा जारी शासनादेशों के अनुसार अनुबन्ध हेतु रू0 7,99,675.00 (सात लाख निथानब्बे हजार छः सौ पिचत्तर रूपये) मात्र की परफॉरमेन्स सिक्यूरिटी मात्र, जो कि अधीक्षण अभियन्ता, सप्तम् वृत्त, लो0नि0वि0 गोपेश्वर के नाम बन्धक हो एवं अनुबन्ध पर हस्ताक्षर करने हेतु आप स्वयं अधिशासी अभियन्ता, निर्माण खण्ड, लो0नि0वि0 गुप्तकाशी के कार्यालय में उपस्थित हों एवं इसके अतिरिक्त अनुबन्ध हेतु रू0 100.00 मात्र का नॉन–ज्यूडिशियल स्टॉम्प भी जमा करें।

यदि आप निश्चित समय के अन्दर उपस्थित न हुये तो उक्त स्वीकृति वापस ले ली जायेगी तथा आपके बकाया अवशेषों में से उक्त धरोहर धनराशि काटकर उत्तराखण्ड सरकार के नाम जब्त कर राजस्व खाते में डाल दी जायेगी, तत्पश्चात् आपका कोई विवाद इस सम्बन्ध में मान्य नहीं होगा।

अधीक्षण अभियन्ता
सप्तम् वृत्त, लो0नि0वि0
गोपेश्वर

प्रतिलिपिः–
1. अधिशासी अभियन्ता, निर्माण खण्ड, लो0नि0वि0 गुप्तकाशी को सूचनार्थ एवं आवश्यक कार्यवाही हेतु प्रेषित।
2. अनुबन्ध हेतु।

अधीक्षण अभियन्ता
सप्तम् वृत्त, लो0नि0वि0
गोपेश्वर
10/04/23

अधिशासी अधिकारी
नगर पंचायत केदारनाथ

Office of The Superintending Engineeer, 7th Circle, P.W.D. Gopeshwar

E-mail: sepwdgope@rediffmail.com

No. 200/173 यातात-7/2023 Date: 12/04/2023

To,

M/S Raj Construction
A511, Pacific hills Rajpur road
Dehradun.

Subject: **Construction work of temporary labour hut/bunker no.4 between Saraswati river and Bhairav Mandir road for rest and night stay convenience of labourers working on reconstruction work of Shri Kedarnath Dham.**

Your contract Bond No. 03/SE-7/2023 Dated 12/4/2023 For the above mentioned work has been accepted by the under signed on behalf of Government of Uttarakhand.

Please start the work at once and completed it within 06 months positively.

The date of start and date completion of the work is as following:-

1. Date of Start 12/4/2023
2. Date of Completion 11/10/2023

(Er. Rajesh Chandra Sharma)
Superintending Engineer
7th Circle P.W.D.
Gopeshwar

Copy to the following for information and necessary action :-

1. Executive Engineer, Construction division, PWD Guptkashi, Rudraprayag.
2. Bond Copy.
3. Office Copy.

Superintending Engineer
7th Circle P.W.D.
Gopeshwar
12/4/23

अधिशासी अधिकारी
नगर पंचायत केदारनाथ

जिला अधिकारी रुद्रप्रयाग

CONTRACTOR

7 वां वृत्त लो० नि० वि०
गोपेश्वर (चमोली)

अधीक्षण अभियन्ता, सप्तम वृत्त, लो०नि०वि० गोपेश्वर।

Contract Bond no. 03/SE-7/2023 Date. 12/4/2023

¼ value of work done:-

¼ value of work done:-

¼ value of work done:-

Name of Work- Construction work of temporary labour hut/bunker no.4 between Saraswati river and Bhairav Mandir road for rest and night stay convenience of labourers working on reconstruction work of Shri Kedarnath Dham.(Size 30.00 m X 6.60 M Capicity 200 Labour).

1. Name of Contractor:- M/S Raj Construction, A511, Pacific hills, Dehradun.
2. Estimated Cost:- 1,60,01,958.61
3. Amount of Bond Rs:- 1,39,93,504.96
4. Amount of E.M. Rs. 3,30,000.00

Vide PC→ 41391158735S ₹1,30,000.00
AC- 41763763746 ₹ 1,00,000.00
AIC→ 41762864162 ₹ 1,48,000.00
AIC- 41270435509 ₹ 40,000.00
AIC-) 88080000R00005SI ₹ 39,000.00
Total 5,57,000.00

5. Date of Start:- 12/4/2023
6. Date of Completion:- 11/10/2023
7. Defect of Liability Period:- Acc-41054512772 RS.- 4,00,000.00

S.No of Bill	M.B. No.	Amount of Bill	Stock Machinery	5 % S.D.	2% I.Tax / 2% GST / 1% L. Cess	Royalty	12% GST	By Cheque

Form

CONTRACTOR

अधिशासी अधिकारी
नगर पंचायत केदारनाथ

अधीक्षण अभियन्ता
7 वां वृत्त लो० नि० वि०
गोपेश्वर (चमोली)

E. E.

ePocurement System Government of Uttarakhand
Created By: PRAVEEN KUMAR KATARWAL
Created Date/Time: 05-Apr-2023 12:15 PM

Tender Title: Construction work of temporary labour hut no.4 between Saraswati river and Bhairav Mandir road for rest and night stay convenience of laborers working on reconstruction work of Shri Kedarnath Dham
Tender ID: 2023_pwd_58478_1

Tender Inviting Authority: Superintending Engineer 7th Circle PWD Gopeshwar

Contract No: 1372/173 Yatayat-7/2023 Date 13-03-2023

REVISED SCHEDULE OF WORK / ITEM(S)

				Estimated		Market Rate		Discount Quoted by Contractor (%) / Quoted Rate	
				Rate	Amount	Rate	Amount	Rate	Amount
	Note : GST Including In rates								
3.00	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan) including dressing of sides and ramming of bottoms, lift up to 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m. All Kinds of Soil.	731.25	Cum	737	538931.25	733	536006.25	750	548437.5
4.00	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan) including dressing of sides and ramming of bottoms, lift up to 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m. Ordinary Rock.	354.38	Cum	1369	485146.22	1365	483728.7	1400	496132
5.00	Extra for every additional lift of 1.5 m or part thereof in excavation / banking excavated or stacked materials. All kinds of soil	221.25	Cum	240	53100	240	53100	250	55312.5
6.00	Excavation in foundation for retaining, breast walls etc, in all types of soils and rocks including all lead, lift and disposal of surplus material as per direction of engineer - in - charge, as per drawing and technical specifications Clause 305.1 of MORD Specification.	20.7	Cum	1563.5	32364.45	1563	32354.1	1570	32499
7.00	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc.in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto1.5m.	61.97	Cum	580	35942.6	580	35942.6	590	36562.3
8.00	Providing and Laying of Mechanically Woven Double Twisted Hexagonal shaped Gabions (Zinc plus PVC coated), of size 3mX1mX1m with two diaphragms at 1m interval, having mesh opening 100mmx120 mm, mesh wire diameter 2.7mm/3.7mm, edge/selvedge wire diameter 3.4/4.4 mm and lacing wire diameter 2.2/3.2 mm. (The work includes filling boulders in the gabions).	10	No.	21394.58	213945.8	21300	213000	22000	220000
9.00	Cement plum masonry with 40% plum & 60% 1:3:6 cement concrete including supply of all material, labour, T&P etc. required for proper completion of the work.	203.25	Cum	12804.08	2602449.585	12600	2560950	14950	3038587.5

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10.00	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:4:8 (1 Cement : 4 coarse sand (zone-III) : 8 graded stone aggregate 40 mm nominal size) (Nominal Mix)	18.96	Cum	16678	316214.88	16678	316214.88	17000	322320
11.00	Providing and laying in position specified grade of reinforced cement concrete, excluding the cost of centering, shuttering, finishing and reinforcement - All work up to plinth level : 1:1.5:3 (1 cement : 1.5 coarse sand (zone-III) : 3 graded stone aggregate 20 mm nominal size).	31.01	Cum	27316	847069.16	27315	847069.15	27500	852775
12.00	Centering and shuttering including strutting, propping etc. and removal of form for : Lintels, beams, plinth beams, girders, bressumers and cantilevers	215.46	Sqm	1572	338703.12	1572	338703.12	1600	344736
13.00	Steel reinforcement for R.C.C. work including cutting, bending, placing in position and binding all complete up to plinth level. Thermo-Mechanically Treated bars of grade Fe-500 D or more.	2705.9	Kg	179	484296.1	179	484296.1	180	487062
14.00	Random Rubble Stone Masonry laid Dry, in breast walls, retaining walls, etc. including supply of all material, labour, T&P and royalties etc. complete as per drawing and technical specifications Clauses 702, 704, 1202 & 1203 of MORD Specification.	36.2	Cum	7215.7	261208.34	7215	261183	7220	261364
15.00	Random Rubble Stone Masonry laid in 1:6 cement and sand mortar, in breast walls, retaining walls, parapets, scuppers, etc. including supply of all material, labour, T&P and royalties etc. complete as per drawing and technical specifications Clauses 702, 704, 1202 & 1203 of MORD Specification.	91.1	Cum	13056.7	1189465.37	13056	1189401.6	13100	1193410
16.00	Hand Packed stone filling in back of walls including cost of all materials, royality, T&P etc. Complete as per direction of Engineer-in- charge. (As per PWD Uttarakhand specifications).	86.25	Cum	4075.72	351530.85	4075	351468.75	4100	353625
17.00	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:2:4 (1 cement : 2 coarse sand(zone-III) : 4 graded stone aggregate 20 mm nominal size)	10.45	Cum	23368	244195.6	23368	244195.6	23400	244530
18.00	Steel work in built up tubular (round, square or rectangular hollow tubes etc.)trusses etc., including cutting, hoisting, fixing in position and applying a primingcoat of approved steel primer, including welding and bolted with special shapedwashers etc. complete.Hot finished seamless type tubes	11608.74	Kg	303	3517448.22	303	3517448.22	310	3598709.4
19.00	Providing and fixing 1mm thick M.S. sheet door with frame of 40x40x6 mm angle iron and 3 mm M.S. gusset plates at the junctions and corners, all necessary fittings complete, including applying a priming coat of approved steel primer. Using flats 30x6mm for diagonal braces and central cross piece	7.2	Sqm	9937	71546.4	9937	71546.4	9950	71640

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20.00	Providing and fixing M.S. Tubular frames for doors, windows, ventilators and cupboard with reclangular/ L-Type sections, made of 1.60 mm thick N.S. Sheet, joints mitred, welded and grinded finish, with profiles of required size, including fixing of necessary butt hinges and screws and applying a priming coat of approved steel primer. Fixing with 15x3 mm lugs 10 cm long embeoded in cement concrete block 15x10x10 cm of C.C. 1:3:6 (1 Cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size).	143.12	Kg	295	42220.4	295	42220.4	300	42936
21.00	Providing Corrugated G.S. Sheet Roofing including vertical/curved surface fixed with polymer coated J or L hooks, bolts and nuts 8 mm diameter with bitumen and G.I. [illegible] lead and including a coat of approved steel primer and two coats of approved paint on overlapping of sheets complete upto any pitch in horizontal/ vertical or curved surfaces) excluding the cost of purlins, rafters and trusses and including cutting to size and shape wherever required. 0.80 mm thick with zinc coating not less than 275 gm/m²	283.5	Sqm	1956	554526	1956	554526	1950	552525
22.00	Providing Corrugated G.S. Sheet Roofing including vertical/curved surface fixed with polymer coated J or L hooks, bolts and nuts 8 mm diameter with bitumen and G.I. limpet washers or with G.I. limpet washers filled with white lead and including a coat of approved steel primer and two coats of approved paint on overlapping of sheets complete upto any pitch in horizontal/ vertical or curved surfaces) excluding the cost of purlins, rafters and trusses and including cutting to size and shape wherever required. 0.63 mm thick with zinc coating not less than 275 gm/m²	322.72	Sqm	1695	547010.4	1695	547010.4	1680	542169.6
23.00	Painting Steel work with Deluxe Multi Surface Paint to give an even shade. Two or more coat applied @ 0.90 ltr/ 10 sqm over an under coat of primer applied @ 0.60 ltr/ 10 sqm of approved brand and manufacture	15.6	Sqm	255	3978	255	3978	300	4680
24.00	Providing and fixing 12 mm thick prelaminated particle board flat pressed three layer or graded wood particle board conforming to IS: 12823 Grade I Type II, in panelling fixed in aluminum doors, windows shutters and partition frames with C.P. brass / stainless steel screws etc. complete as per architectural drawings and directions of engineer-in-charge. Pre laminated particle board with decorative lamination on one side and balancing lamination on other side	555.6	Sqm	2146	1192317.6	2145	1192317.6	2150	1194540
25.00	Providing & fixing Translucent white Acrylic Plastic Sheet with putty and glazing clips in steel doors, windows, clerestory windows, all complete with : 3 mm thick translucent white acrylic plastic sheet.	2.8	Sqm	2228	6238.4	2228	6238.4	2250	6300
26.00	Providing and fixing ISI marked oxidised M.S. tower bolt black finish, (Barrel type) with necessary screws etc. complete : 250x10 mm	4	No.	108	432	108	432	110	440

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27.00	Providing and fixing ISI marked oxidised M.S. tower bolt black finish (Barrel type) with necessary screws etc. complete : 150x10 mm.	6	No.	80	640	80	640	90	720
28.00	Providing and fixing ISI marked oxidised M.S. handles conforming to IS:4992 with necessary screws etc. complete : 125 mm	8	No.	54	432	54	432	60	480
29.00	Providing and fixing mild steel round holding down bolts with nuts and washer plates complete.	221.03	Kg	150	33154.5	140	30954.2	150	33274.5
30.00	(6) Septic Tank, Soak Pit etc. Work.				0				
31.00	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including [illegible] part lift upto 1.5 m as directed by Engineer-in-charge. All kinds of soil	54.51	Cum	737	[illegible]	737	[illegible]	740	[illegible]
32.00	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan) including dressing of sides and ramming of bottoms, lift up to 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m. Ordinary Rock.	14.40	Cum	1369	19836.81	1369	19836.81	1375	19921.75
33.00	Extra for every additional lift of 1.5 m or part thereof in excavation / banking excavated or stacked materials. All kinds of soil	11.75	Cum	240	2822.4	240	2822.4	250	2940
34.00	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc.in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto1.5m.	0.24	Cum	580	139.2	580	139.2	590	141.6
35.00	Random Rubble Stone Masonry laid Dry, in breast walls, retaining walls, etc. including supply of all material, labour, T&P and royalties etc. complete as per drawing and technical specifications Clauses 702, 704, 1202 & 1203 of MORD Specification.	6.15	Cum	7215.7	44376.56	7215	44372.25	7250	44587.5
36.00	Random Rubble Stone Masonry laid in 1:6 cement and sand mortar, in breast walls, retaining walls, parapets, scuppers, etc. including supply of all material, labour, T&P and royalties etc. complete as per drawing and technical specifications Clauses 702, 704, 1202 & 1203 of MORD Specification.	19.15	Cum	13056.7	250035.81	13056	250022.4	13200	252780
37.00	Providing and laying in position specified grade of reinforced cement concrete, excluding the cost of centering, shuttering, finishing and reinforcement - All work up to plinth level : 1:1.5:3 (1 cement :1.5 coarse sand (zone-III) : 3 graded stone aggregate 20 mm nominal size).	4.18	Cum	27316	114180.88	27316	114180.88	27350	114323
38.00	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:4:8 (1 Cement : 4 coarse sand (zone-III) : 8 graded stone aggregate 40 mm nominal size) (Nominal Mix)	5.05	Cum	16678	84223.9	16678	84223.9	16700	84335
39.00	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:2:4 (1 cement : 2 coarse sand(zone-III) : 4 graded stone aggregate 20 mm nominal size)	1.05	Cum	23368	24536.4	23368	24536.4	23400	24570

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40.00	**12 mm cement plaster of mix : 1:4 (1 cement: 4 fine sand)**	26	Sqm	749	19474	749	19474	760	19760
41.00	**Providing and laying** Ceremic glazed **floor tiles of size 300x300 mm (thickness to be specified by the manufacturer) of 1st quality conforming to IS : 15622 of approved make in colours such as White, Ivory, Grey, Fume Red Brown, laid on** 20 mm thick cement mortar 1:4 (1 Cement : 4 Coarse sand). Jointing with grey cement **slurry @** 3.3 kg/sqm including pointing the joints with white cement and **matching pigment** etc., complete.	11.67	Sqm	2484	28975.83	2430	28544.1	2450	29081.5
42.00	Centering and shuttering **including** strutting, propping etc. and removal of form for all heights : Suspended floors, roofs, landings, balconies **and access platform** .	15.5	Sqm	1937	30023.5	1936	30008	1950	30225
43.00	Centering and shuttering including strutting, propping etc. and removal of form for : Lintels, beams, plinth beams, girders, staircases and cantilevers	18.36	Sqm	1572	28861.92	1570	28825.2	1580	29008.8
44.00	Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing **in position** and binding all complete up to plinth level. Thermo-Mechanically **Treated bars of** grade Fe-500 D or more.	492.2	Kg	179	88103.8	178	87611.6	185	91057
45.00	**Structural steel work riveted, bolted or welded in built up** sections, trusses and framed work, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer **all complete.**	762.98	Kg	303	231182.94	303	231182.94	310	236523.8
46.00	Providing and fixing 1mm thick M.S. sheet door with frame of 40x40x6 mm angle iron and 3 mm M.S. gusset plates at the junctions and corners, all necessary fittings complete, including applying a priming coat of approved steel primer. Using flats 30x6mm for diagonal braces and central cross piece	16	Sqm	9937	158992	9936	158976	9950	159200
47.00	Providing and fixing M.S. Tubular frames for doors, windows, ventilators and cupboard with rectangular/ L-Type sections, made of 1.60 mm thick M.S. Sheet, joints mitred, welded and grinded finish, with profiles of required size, including fixing of necessary butt hinges and screws and applying a priming coat of approved steel primer. Fixing with 15x3 mm lugs 10 cm long embedded in cement concrete block 15x10x10 cm of C.C. 1:3:6 (1 Cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size).	294.66	Kg	295	86983.7	294	86688.84	300	88458
48.00	Providing Corrugated G.S. Sheet Roofing including vertical/curved surface fixed with polymer coated J or L hooks, bolts and nuts 8 mm diameter with bitumen and G.I. limpet washers or with G.I. limpet washers filed with white lead and including a coat of approved steel primer and two coats of approved paint on overlapping of sheets complete upto any pitch in horizontal/ vertical or curved surfaces) excluding the cost of purlins, rafters and trusses and including cutting to size and shape wherever required. 0.63 mm thick with zinc coating not less than 275 gm/m²	90.84	Sqm	1695	153973.8	1690	153519.6	1700	154428

49.00	Painting Steel work with Deluxe Multi Surface Paint to give an even shade. Two or more coat applied @ 0.90 ltr/ 10 sqm over an under coat of primer applied @ 0.80 ltr/ 10 sqm of approved brand and manufacture	32	Sqm	255	8160	255	8160	280	8960
	[illegible] finish, (Barrel type) with necessary screws etc. complete : 250x10 mm	20	No.	108	2160	108	2160	115	2300
	Providing and fixing ISI marked oxidised M.S. handles conforming to IS:4992 with necessary screws etc. complete : 125 mm	20	No.	54	1080	54	1080	60	1200
52.00	(iii) Water Supply, Sanitary & Plumbing Work				0				
	[illegible] pipes conforming to IS [illegible] Type A including [illegible] with seal ring [illegible] IS : 5382, leaving 10 mm [illegible] for thermal expansion [illegible] jointed pipes. 110 mm diameter	55	Rm	553	22055	363	[illegible]	600	[illegible]
54.0	Providing and fixing on wall face unplasticised - PVC moulded fittings/ accessories for unplasticised Rigid PVC rain water pipes conforming to IS : 13592 Type A including jointing with seal ring conforming to IS :5382 leaving 10 mm gap for thermal expansion. Coupler 110mm	6	No.	241	1446	241	1446	250	1500
55.00	Providing and fixing on wall face unplasticised - PVC moulded fittings/ accessories for unplasticised Rigid PVC rain water pipes conforming to IS : 13592 Type A including jointing with seal ring conforming to IS :5382 leaving 10 mm gap for thermal expansion. Single tee with door 110x110x110 mm	4	No.	387	1548	387	1548	390	1560
56.00	Providing and fixing on wall face unplasticised - PVC moulded fittings/ accessories for unplasticised Rigid PVC rain water pipes conforming to IS : 13592 Type A including jointing with seal ring conforming to IS :5382 leaving 10 mm gap for thermal expansion. Single tee without door 110x110x110 mm	10	No.	369	3690	369	3690	370	3700
57.00	Providing and fixing on wall face unplasticised - PVC moulded fittings/ accessories for unplasticised Rigid PVC rain water pipes conforming to IS : 13592 Type A including jointing with seal ring conforming to IS :5382 leaving 10 mm gap for thermal expansion. Bend 87.5° 110 mm bend	5	No.	294	1470	294	1470	300	1500
58.00	Providing and fixing on wall face unplasticised - PVC moulded fittings/ accessories for unplasticised Rigid PVC rain water pipes conforming to IS : 13592 Type A including jointing with seal ring conforming to IS :5382 leaving 10 mm gap for thermal expansion. Shoe (Plain) 110 mm Shoe	3	No.	273	819	273	819	280	840

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59.00	Providing and fixing water closet squatting pan (Indian type W.C. pan) with 100 mm sand cast iron P or S trap, 10 litre low level white P.V.C. flushing cistern, including Bush pipe, with manually operated device (handle lever) conforming to IS: [illegible] with all fittings complete including [illegible] complete. White Vitreous china Orissa pattern W.C. pan of size 580x41[illegible] mm with integral type foot rests	10	No.	[illegible]	[illegible]	[illegible]	[illegible]	1160	[illegible]
[illegible]	[illegible] wash basin with C.I. brackets, 15 mm dia C.P. brass single hole basin mixer of approved quality and [illegible] including painting of fittings and brackets, cutting and making good the walls wherever required. White Vitreous China Wash basin size 550x400 m m with a 15 m m C.P. Brass single hole basin mixer	2	No.	8843	17686	8843	17686	8850	17700
[illegible]	[illegible] P.V.C. waste pipe [illegible] complete [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	210	[illegible]
[illegible]	[illegible] grating, trap of self cleansing design with screwed down or hinged grating with or without vent arm complete, including cost of cutting and making good the walls and floors. 100 mm inlet and 100 mm outlet Sand cast iron SAS as per IS: 3989.	2	No.	3411	[illegible]	3411	[illegible]	3450	6900
63.00	Providing and fixing Chlorinated Polyvinyl Chloride (CPVC) pipes, having thermal stability for hot & cold water supply, including all CPVC plain & brass threaded fittings, including fixing the pipe with clamps at 1.00 m spacing. This includes jointing of pipes & fittings with one step CPVC solvent cement and testing of joints complete as per direction of Engineer in Charge. : Internal work - Exposed on wall 20 mm nominal outer dia. Pipes	30	Rm	630	18900	630	18900	640	19200
64.00	Providing and fixing uplasticised PVC connection pipe with brass unions : 45 cm length 15 mm nominal bore	5	No.	205	1025	205	1025	210	1050
55.00	Providing and placing on terrace (at all floor levels) polyethylene water storage tank ISI : 12701 marked, with cover and suitable locking arrangement and making necessary holes for inlet, outlet and overflow pipes but without fittings and the base support for tank. Circular tank	2000	Litre	18	36000	18	36000	20	40000
56.00	Providing and fixing C.P. Brass Long Body Bib Cock of approved quality conforming to IS standards and weighing not less than 690 gms. (15 mm nominal bore)	12	No.	784	9408	784	9408	790	9480
67.00	Providing and fixing C.P. brass stop cock (concealed) of standard design and of approved make conforming to IS:8931. 15 mm nominal bore.	2	No.	873	1746	873	1746	890	1780
68.00	Providing and fixing C.P. brass angle valve for basin mixer and geyser points of approved quality conforming to IS:8931 : a) 15 mm nominal bore 15mm nominal bore	10	No.	778	7780	778	7780	780	7800
69.00	Providing and fixing C.P. Brass extension nipple (size 15mmx50mm) of approved make and quality as per direction of Engineer-in-charge.	2	No.	158	316	158	316	160	320

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70.00	Providing and fixing Ball Valve (brass) of approved quality, High or low pressure, with plastic floats complete : 20 mm nominal bore.	4	No.	593	2372	593	2372	600	2400
71.00	(N) Internal Electrification Work								
72.00	Wiring for light point/ fan point/ exhaust fan point/ call bell point with 1.5 sq. mm FRLS PVC insulated copper conductor single core cable in surface / recessed medium class PVC conduit, with modular switch, modular plate, suitable GI box and earthing the point with 1.5 sq. mm FRLS PVC insulated copper conductor single core cable etc. as required	33	Nos.	1850	61050	1850	61050	1880	62040
73.00	Supplying and fixing following modular switch/ socket on the existing modular plate & switch box including connections but excluding modular plate etc. as required				0				
74.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
75.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
76.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	and cover in front on surface or in recess, including providing and fixing 5 pin 5/6 A modular socket outlet and 5/6 A modular switch, connections etc. as required	99	Nos	929	91971	929	91971	950	94050
77.00	Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing 6 pin 5/6 & 15/16 A modular socket outlet and 15/16 A modular switch, connections etc. as required.	12	Nos.	1048	12576	1045	12540	1060	12720
78.00	Supplying and fixing following way, Vertical type three pole and neutral, sheet steel, MCB distribution board, 415 V, on surface/ recess, complete with tinned copper bus bar, neutral bus bar, earth bar, din bar, interconnections, powder painted including earthing etc. as required. (But without MCB/RCCB/Isolator) 8 way (8 + 24), Double door	1	Nos.	20082	20082	20082	20082	20100	20100
79.00	Supplying and fixing 63A rating, four pole, 415 V, MCCB in the existing MCB DB complete with connections, testing and commissioning etc. as required.	1	Nos	10667	10667	10667	10667	10700	10700
80.00	Supplying and fixing Single pole 5 A to 32 A rating, 240/415 V, 10 kA, "C" curve, miniature circuit breaker suitable for inductive load of following poles in the existing MCB DB complete with connections, testing and commissioning etc. as required	20	Nos	433	8660	433	8660	450	9000
81.00	Wiring for circuit/ submain wiring alongwith earth wire with the following sizes of FRLS PVC insulated copper conductor, single core cable in surface/ recessed medium class PVC conduit as required.				0				
82.00	2 X 1.5 sq. mm + 1 X 1.5 sq. mm earth wire	168	Rm	299	50232	299	50232	300	50400
83.00	2 X 4 sq. mm + 1 X 4 sq. mm earth wire	180	Rm	372	66960	372	66960	380	68400
84.00	S/F of ceiling rose 3 pin 5 amp	33	Nos	223	7359	223	7359	250	8250
85.00	Earthing with G.I. earth plate 600 mm X 600 mm X 6 mm thick including accessories, and providing masonry enclosure with cover plate having locking arrangement and watering pipe of 2.7 metre long etc. with charcoal/ coke and salt as required.	1	Nos	23571	23571	23571	23571	24000	24000

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कार्य संचालन केंद्र बालाघाट

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86.00	Providing and laying earth connection from earth electrode of 6 SWG dia G.I. Wire in 15 mm dia G.I. pipe from earth electrode including connection with G.I. thimble excavation and re-filling as required	15	Rm	103	1545	103	1545	110	1650
87.00	Supply/ Fixing of 22 watt LED Tube Light Philips/Crompton/Bajaj	31	Nos	1395	43245	1395	43245	1350	41850
88.00	S/L 3.5 CX 35 Sq mm Al. Ar Cable Polycab/KEI/Havells	25	Mtr	676	16900	676	16900	890	22250
89.00	S/F of 36 watt LED street Light Philips/Havells/Crompton/Bajaj	2	No	6219	12438	6219	12438	6250	12500
					16001938.61		15993642.96		16603107.75

CONTRACTOR

Total in Figures

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प्रथम एवं न्यूनतम निविदादाता मै० राज कन्स्ट्रक्शन राजपुर रोड, देहरादून की निविदा तकनीकि स्वीकृति उपरान्त, पुनरीक्षित गणनाओं, नेगोशिएशन एवं निविदा परामर्श समिति के उपरान्त रु० 1,59,93,504.96 मात्र की स्वीकृति हेतु सादर अग्रसारित।

सहायक अभियन्ता
निर्माण खण्ड लो०नि०वि०
गुप्तकाशी

S.E

अधिशासी अभियंता की संस्तुति के आधार पर न्यूनतम निविदादाता मै० राज कन्स्ट्रक्शन, पसियूण हिल्स, राजपुर रोड, देहरादून द्वारा दाखिल की निविदा रु० 1,59,93,504.96 (एक करोड़ उनसठ लाख तिरानवे हजार पांच सौ चार रुपये 96 पैसे) मात्र की स्वीकृति हेतु संस्तुति पत्र के बाद रुपये दियानवे मात्र की जी०एस०टी० सहित प्रेषित है।

अधिशासी अभियन्ता
निर्माण खण्ड, लो०नि०वि०
गुप्तकाशी

1,59,93,504.96

सादर स्वीकृत।

अधीक्षण अभियन्ता
7वाँ वृत्त लो० नि० वि०
गोपेश्वर (चमोली)

CONTRACTOR

13.3

सं० अ०

418

Seller Details

Sold by:	Resellers
Reseller not verified by OEM	
Catalogue not verified by OEM	
Seller Excellence	4.5 - 5.0

Specifications

Fascia options	PPGI(Prepainted galvanized iron steel) sheet conforming to IS 14246 - 2013
Thickness of fascia sheets	0.5 mm
Density of all polyurethane foam	40 ± 2 kg/cubic meter conforming to IS 11239 part II-1985 as amended upto date
External pattern of panels	As per Buyer's requirement
Foundation for panels	Building of foundation at site

VIEW MORE

MATERIAL

Fascia options	PPGI(Prepainted galvanized iron steel) sheet conforming to IS 14246 - 2013
Thickness of fascia sheets	0.5 mm
Insulation material	Polyurethane foam
Density of all polyurethane foam	40 ± 2 kg/cubic meter conforming to IS 11239 part II-1985 as amended upto date
Insulation core of panel is formed in one piece	Yes

Ask GeMmy

Product Compare Product History 4

अधिशासी अधिकारी
नगर पंचायत केदारनाथ

कार्यालय जिला अधिकारी रुद्रप्रयाग

25-11-2024 11:52

PUF Panel

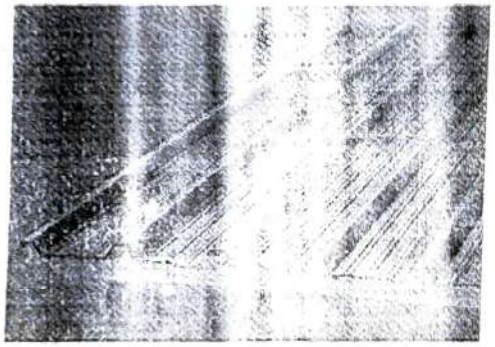
HomeLand and Buildings and Structures and ThoroughfaresPrefabricated buildings and structures

Prefabricated emergency relief buildings and structuresPUF Panel (Q3 Category)

CACTUS PUF Panel use for Wall

CACTUS[R]

(Cactus PUF Panel)



₹ 39.00 99% OFF

Trends

Product Details

Price For :	1 square meter
MRP/Unit:	₹ 3,900.00
Offer Price/Unit:	**₹ 39.00**
Availability:	7000 In Stock
Min. Qty. Per Consignee:	2400
Product id:	5116877-166997910
Country Of Origin:	India
Local Content (Mil):	100%

*Please Note: Local Content value is as declared by reseller since OEM is not registered on GeM

अधिशासी अधिकारी
नगर पंचायत केदारनाथ

Ask GeMmy

Product Compare Product History

Product feature	Consist of an insulating layer of rigid polyurethane foam between two layers of metal sheets
Panels For	Wall
Types of panel	Single groove panels – for general purpose an application in building / shelters
Facility of tongue-n-groove joinery for wall panels	Yes
Fire class	FR grade (fire resistance grade)
External pattern of panels	As per Buyer's requirement
Provision of male-female type groove made with extended wall panel sheets	Yes
Provision of cam lock system	No
Scope of supply(offer price to include all cost component)	Supply of Product only
Transportation / freight charges	Offer prices are on free delivery at consignee site basis
Foundation for panels	Building of foundation at site shall be the responsibility of the consignee and the seller shall install / erect and commission the structure on the foundation constructed up to plinth level by the consignee

DIMENSION

अधिशासी अधिकारी
नगर पंचायत केदारनाथ

कार्यालय जिला अधिकारी रुद्रप्रयाग

Width - Wall panel ± 10 mm	1185 mm
Width - Roof panel ± 5 mm	980 mm
Width - Door panel ± 10 mm	900 mm
Width - Floor panel ± 5 mm	980 mm
Length - Wall panel ± 10 mm	2500 mm
Length - Roof panel ± 10 mm	2000 mm
Length - Door panel	1800 mm
Length - Floor panel	2000 mm
Core thickness of PUF panel	30 mm

COLOUR AND FINISH

Grade of Zinc Coating	120 gms/square meter
Surface finish	With 50 microns thick PVC guard film

PERFORMANCE

अधिशासी अधिकारी
नगर पंचायत केदारनाथ




Product Video

Ballistic Separator Machine For Solid Waste, Electronic

₹ 15,00,000/ Piece Get Latest Price

Usage/Application	Wasto Sorting
Applicable Industry	Waste Management
Power Source	Electronic
Features	Higher throughput rates, Low operating costs,...
Material	Municipal Solid Waste
Automation Grade	Manual

SVM Infraestate Ballistic separators are designed for sorting 2D materials (plastic film, paper, cardboard and fibres) and 3D materials (containers, plastic bottles, cans, stone, wood, etc.). They can also sort fine particles that can be collected separately with the optional variable screen openings.
A ballistic separator is a high load segregating device that separates out wastes of different kinds. It consists of parallel agitating paddles and a deck that oscillates at high speed so as to sort a stream of waste passed through it.

Separates Waste into 3 Fractions - They can also sort fine particles which, with the optional variable screen openings, can be collected separately.

- Lighter material which moves upwards due to eccentric motion supported by a fan which mainly contains plastic papers, wrappers, cloth, papers etc.
- Heavier/3D material – which is heavy in weight and slides down on the paddles to the bottom & gets separated which mainly contains C&D waste, coconut shells, glass, metals, footwear & pet bottles
- Minus material which screens down from the mesh paddling system normally contains earth and other smaller size material

View Less Details

Get Latest Price

SVM Infraestate Private Limited

Noida, Gautam Buddha Nagar, Uttar Pradesh

5/5 ★★★★★ (2)

GST- 09AAPCS3813B1ZE

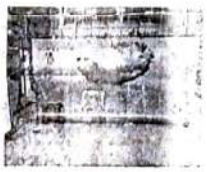
Verified Supplier | Manufacturer

View Mobile Number

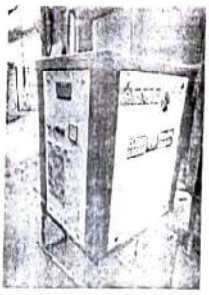
Contact Supplier

Find products similar to Ballistic Separator Machine For Solid Waste, Electronic near Noida


WHEM Is "2o02" Ballistic Separat...


3 Solid Waste Compost Plant,...


Food Waste Composting...


Solid Waste Treatment Plant,...


Treatment Capacity: 30 Tph...


Technoscreen Ballistic Separat...

अधिशासी अधिकारी
नगर पंचायत केदारनाथ

कार्यालय नगर पंचायत केदारनाथ रुद्रप्रयाग

U value (heat transfer coefficient) in watt per square meter Kelvin	0.15
R value (measure of resistance to heat flow through a given thickness of material) British Thermal Units Per Hour Per Square Feet Degrees Fahrenheit	9.8
Thermal conductivity value at 10 degree centigrade (test method ASTM C 518-98)	0.021 w/nk
Compressive strength at 10 % deformation (Kg per square centimetre) (test method ASTM D 1621-94)	2.1
Bending strength (Kg per square centimetre)	4
Tensile strength (Kg per square centimetre) (test method ISO 1926:2005)	3.7
Adhesive strength(Kg per square centimetre) – foam to steel	2.9
Water absorption (volume percent) at 100% RH (test method ISO 2896:2001)	0.2 %
Closed cell content (%)	94
Vapour permeability at 90% (RH) and 38 degree centigrade (gms per Hr[dot] square meter)	0.12

CERTIFICATION

Availability of Test Report from Designated AHSP / NABL / ILAC accredited or Central Government Lab to prove conformity of products to the specification	Yes
Warranty Period in years	1

अधिशासी अधिकारी
नगर पंचायत केदारनाथ

अधिशासी अधिकारी
नगर पंचायत केदारनाथ

कार्यालय जिला अधिकारी रुद्रप्रयाग

IndiaMART > Ba... & Permanent Magnets > Magnetic Separators > Magnetic Drum Separator

MAGNA TRONIX Double Drum Magnetic Separator, Capacity: 1.5 Ton/Hour

₹ 24,000 Get Latest Price

Capacity	1.5 Ton/Hour
Type Of Magnet Used	Ferrite
Type Of Magnetic Separators	Double Drum Magnetic Separator
Brand	MAGNA TRONIX
Applications	Pharmaceutical & Biochemical
Apparatus Weight	300 kg

View All Details

Get Latest Price

Magna Tronix

West Mambalam, Chennai, Tamil Nadu

4.3/5 ★★★★★ (54)

GST- 33AANPM2649A1ZY

TrustSEAL Verified | Leading Supplier

Verified Exporter | Manufacturer

Company Video

View Mobile Number

86% Response Rate

Contact Supplier

Find products similar to MAGNA TRONIX Double Drum Magnetic Separator, Capacity: 1.5 Ton/Hour near Chennai

Magnetic Drum Separator....

Star Trace India

Redhills, Chennai, Tamil Nadu

₹ 1,50,000

View Mobile Number

Get Latest Price

Magnetic Drum Separator....

Star Trace I...

Redhills, Chennai, Tamil Nadu

₹ 1,50,000

View Mobile Number

Get Latest Price

Magnetic Wet Drum Separator....

Vibromag...

Redhills, Chennai, Tamil Nadu

₹ 1,00,000

View Mobile Number

Get Latest Price

Magnetic Drum Separator....

Vibromag...

Redhills, Chennai, Tamil Nadu

₹ 1,00,000

View Mobile Number

Get Latest Price

Magnetic Drum Separator....

Star Trace Privat...

Redhills, Chennai, Tamil Nadu

₹ 85,000

View Mobile Number

Get Latest Price

Magnetic Drum Separator....

Star Trace Solutio...

Redhills, Chennai, Tamil Nadu

₹ 98,000

View Mobile Number

Get Latest Price

View More

Find related categories near Chennai

Magnetic Separators in Chennai Get Quote >

Magnetic Coolant... in Chennai Get Quote >

Suspension Magnet in Chennai Get Quote >

Magnetic Roll Separator in Chennai Get Quote >

Product Gallery Company Details

Product Image

Send enquiry for **Double Drum Magnetic Separator**

Submit Requirement

अधिशासी अधिकारी
नगर पंचायत केदारनाथ

नगर पंचायत केदारनाथ जिला अधिकारी रुद्रप्रयाग

427

High Intensity Roller Type Magnetic Separator

₹ 1,00,000/ Piece Get Latest Price

Roller Diameter	65 mm
Roller/Belt Width	1000 mm
Type Of Material Used	Neodymium
Type Of Magnetic Separators	Double Stage Roll type Magnetic Separator
Applications	Mine And Mineral Industry, Ceramic And...

View All Details

Get Latest Price

Product Brochure

Kumar Magnet Industries

Odhav, Ahmedabad, Gujarat

4.3/5 ★★★★★ (71)

GST: 24BNBPM9953P1Z9

TrustSEAL Verified | Leading Supplier

Verified Exporter | Manufacturer

View Mobile Number

73% Response Rate

Contact Supplier

Find products similar to High Intensity Roller Type Magnetic Separator near Ahmedabad

High Intensity Roller Type...

Shree...

Odh... Ahmedab... Gujarat

₹ 2,00,000/ Piece

View Mobile Number

Get Latest Price

High Intensity Roller Type...

Shree...

Odh... Ahmedab... Gujarat

₹ 4,00,000/ Piece

View Mobile Number

Get Latest Price

Wet High Intensity Magnetic...

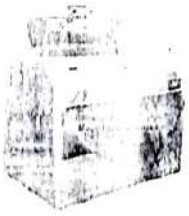
Laxx Magnetics

Kathwada, Ahmedabad, Gujarat

₹ 1,50,000

View Mobile Number

Get Latest Price



MS High Intensity Magnetic Separ...

Aanal Magnetic...

Odhav, Ahmedabad, Gujarat

₹ 2,75,000/ Unit

View Mobile Number

Get Latest Price

Multi Stage Roller Magnetic...

Excel Magnetics

Kathwada, Ahmedabad, Gujarat

₹ 2,00,000/ Piece

View Mobile Number

Get Latest Price

High Intensity Permanent...

Shree Ambica...

Khodiyamagar, Ahmedabad, Gujarat

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Find related categories near Ahmedabad

Magnetic Destoner in Ahmedabad

Get Quote >

Magnetic Drum... in Ahmedabad

Get Quote >

Magnetic Separators in Ahmedabad

Get Quote >

Magnetic Rolls in Ahmedabad

Get Quote >

Magnetic Filters in Ahmedabad

Get Quote >

अधिशासी अधिकारी
नगर पंचायत केदारनाथ

Product Video Product Brochure

VEPL Flat Belt Conveyor, For Material Handling, 100kg

₹ 1,00,000/ Unit Get Latest Price

Usage/Application	Material Handling
Brand	VEPL
Capacity	100kg
Material	Mild Steel
Belt Material	PVC
Belt Width	500-1200mm
Voltage	415V
Belt Speed	0-60mtr/min
Warranty	1 year
Model Name/Number	VEPL-FBC
Country of Origin	Made in India

A conveyor belt is the carrying medium of a belt conveyor system (often shortened to belt conveyor). A belt conveyor system is one of many types of conveyor systems. A belt conveyor system consists of two or more pulleys (sometimes referred to as drums), with a closed loop of carrying medium—the conveyor belt—that rotates about them. One or both of the pulleys are powered, moving the belt and the material on the belt forward. The powered pulley is called the drive pulley while the unpowered pulley is called the idler pulley. There are two main industrial classes of belt conveyors: Those in general material handling such as those moving boxes along inside a factory and bulk material handling such as those used to transport large volumes of resources and agricultural materials, such as grain, salt, coal, ore, sand, overburden and more.

View Less Details

Get Latest Price

Verticon Equipments Private Limited

Chikhali, Pimpri Chinchwad, Pune, Maharashtra

4.8/5 ★★★★★ (40)

GST- 27AAGCV9154P1ZF

TrustSEAL Verified Leading Supplier

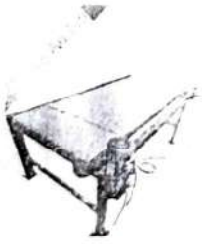
Manufacturer

View Mobile Number

86% Response Rate

Contact Supplier

Find products similar to VEPL Flat Belt Conveyor, For Material Handling, 100kg near Pimpri Chinchwad



Rubber Flat Belt Conveyor, Load...

Rudra Industries

Hanuman ... Tamhane ...

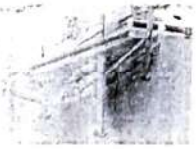
₹ 1,20,000/ Piece

Metal Industrial Flat Belt ...

...Conveyors

... Pimpri Chinchwad

₹ 95,000/ Piece



Rubber Belt Conveyor, Materi...

Verticon ...

... Pimpri Chinchwad

₹ 1,80,000/ Piece

Mild Steel Gravity Roller Conveyor, ...

... Enterprises Chinchwad

₹ 9,000/ Piece

Material Handling Belt Conveyor

Das Systems

Deals In Pimpri Chinchwad

₹ 8,000/ Meter

Flat Belt Conveyor, For Pharma,...

M/S Arise...

Deals In Pimpri Chinchwad

₹ 2,10,000/ Piece

अधिशासी अधिकारी
नगर पंचायत केदारनाथ

429

Multifunction Hand Pal Truck, Capacity: 1ton, 3ton, 4ton, 5ton

₹ 15,000/ Piece Get La Price

Capacity	1ton,2ton,3ton,
Fork Length	1150mm/as pe customer requi
Fork width	550mm /as per customer requi

Item Code: 101

Multifunction Hand Pallet Truck

View All Details

Get Latest Pric

View More Photos

Patel Material Handling Equipment

Naroda, Ahmedabad Gujarat

PATEL 4.2/5 ★★★★★ (

GST- 24AKPPP940

TrustSEAL Verified

Leading Supplier Verified E

Manufacturer Company Vi

View Mobile Number Co Sup

88% Response Rate

Find products similar to Multifunction Hand Pallet Truck, Capacity: 1ton, 2ton, 3ton, 4ton, 5ton near Ahmedabad

Scale Pallet Truck, Capacity: 3 Ton,2...

Stacker's & Movers

Vatva, Ahmedabad, Gujarat

₹ 85,000/ piece

View Mobile Number

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Utkal Hand Pallet Truck, Loading...

Utkal Engineers

Vikram Nagar, Ahmedabad, Gujarat

₹ 15,000/ Piece

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Get Latest Price

Patel Godrej Hand Pallet Truck,...

Patel Material...

Naroda, Ahmedabad, Gujarat

₹ 15,000/ Piece

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Get Latest Price

Annapurana Battery Operated Hydraul...

Maruti Industries

Vatva, Ahmedabad, Gujarat

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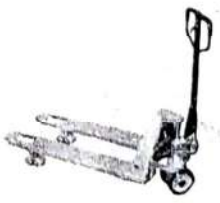

Hydraulic Hand Pallet Truck

Saideep Industries

GIDC Naroda, Ahmedabad, Gujarat

₹ 12,500/ Piece

View Mobile Number

Get Latest Price

1.5 Ton Hand Pallet Truck

Sky Industries

Naroda, Ahmedabad, Gujarat

₹ 25,000/ Piece

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Get Latest Price

View More

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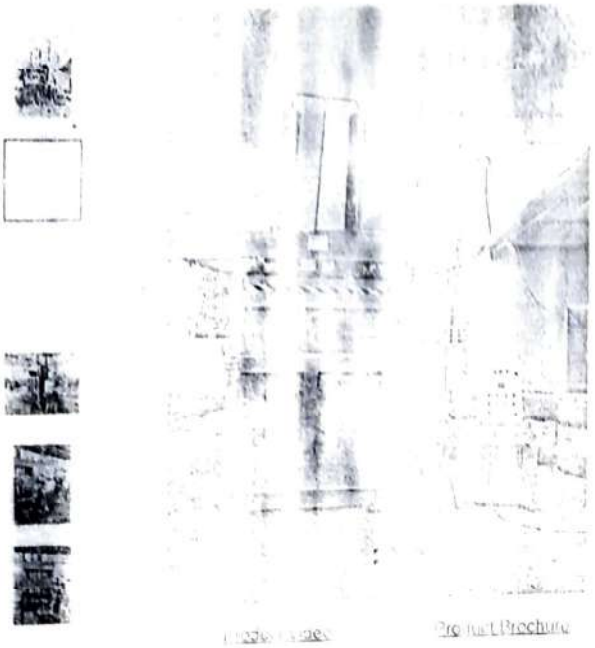
नगर पंचायत केदारनाथ



Mild Steel 30-60 ton Hydraulic Vertical Baler In Manesar, Capacity: 50 Ton, Model Name/Number: Ragnor

₹ 3,75,000 Get Latest Price

Max Force or Load	60-90 ton
Usage/Application	Industrial
Max Load Capacity	... Kg
Material	... STEEL
Model Name/Number	RAGNOR
Capacity	50 TON
Bale Weight	100-150 KGS
Brand	RAGNOR
Automation Grade	Automatic
Minimum Order Quantity	1

Ragnor Hydraulics is located in IMT Manesar, Gurgaon and the working area is 10000 sq. feet. Many years of research & development, vast experience & production capabilities has earned a reputed name in the field of High Technology Quality Products. Our company is equipped with in-house computer aided designing and manufacturing facilities and supplying machines to top ... companies.

A record establishment of Ragnor Hydraulics in 2016 has made a rapid growth in the Indian market. We are engaged in Manufacturing, Suppling & Exporting a wide ... ent of Car Lifts, Dock Leveler, Hydraulic Scissor Lift, Hydraulic Cutting Machine, Hydraulic Power Packs, Hydraulic Cylinders, Container Tilters, Hydraulic Goods Lift, Hydraulic Presses, Industrial Sheds, Baler And Baling Press Machine, Drum Crushers And Compactor, etc.

Our dedicated and highly proficient team of engineers is ... involved in the process of product ... Our in-house production line ... us to undertake orders as per ... the requirements of our esteemed clients. Our products have established a ... recognition in the domestic markets ... owing us as repeated ... At Ragnor Hydraulics, we have a ... quality ... department who ensure that ... machine is tested for quality and performance. We guarantee all our customers that our manufactured hydraulic presses are ... and complete ... intro... Our ... timely after-sale ... are ... ed to fulfill the ... 's ...

... to ... render optimum ... maintenance ... Contract ... and ... Press Job ... Mr. Ravinder ... (CEO) ... has been able to ... maximum ... to our clients.

Ragnor Hydraulics
Manesar, Gurugram, Haryana
4.6/5 ★★★★★ (24)
GST- 06AAUFR4663K1ZA
TrustSEAL Verified ... Star Supplier
Verified Exporter ... Manufacturer
View Mobile Number
85% Response Rate
Contact Supplier

अधिशासी अधिकारी
नगर पंचायत केदारनाथ

431

Bulk Discount

DIGITONE 1000 Kg (1 Ton) Digital Platform Weighing Scales DGP1TON

Visit the DIGITONE Store

POWER BRAND

EMI starts at ₹2805/month. No Cost EMI available. EMI options

AVAILABLE OFFERS View Offers

- Use SAVE1000 & get ₹1000* off. Valid for GST-Registered Users Only. View
- Use SAVE3000 & get ₹3000* off. Valid for GST-Registered Users Only. View
- Use NEW3000 & get ₹3000* off. Only Valid on your first

Request callback Get quote

FEATURES

More Details

Type of Product	Weighing Scales
Dimension	1000x1000
Model No	DGP1TON
Display	Digital

More DIGITONE Analytical Weighing Scale products

Browse Analytical Weighing Scale products

~~₹29,999~~ (Incl. of all taxes)

₹25,423 + 18% GST

MRP ~~₹30,075~~ 3.15% OFF

Quantity

− 1 + Minimum Order Quantity- 1 Piece

Bulk quantity Discounts!!

Select	Quantity	Discounted price per piece(Incl. of all taxes)
○	2	₹28,955.20
○	3	₹28,694.25
○	4	₹28,433.30
○	5-more	₹27,911.40

ADD TO CART BUY NOW

Need Assistance? Connect with a product expert.

Enter phone nt CALL NOW

Average Wait: less than 1 minute

Check Delivery Details

Enter Pincode Check

PREPAID	Available
PART COD	Available
COD	Unavailable
RETURN	Available Return period : 7 days

Warranty as per brand

100% Secure payments

100% Buyer protection

Top Brands

Type of Product	Weighing Scales
Dimension	1000x1000
Model No	DGP1TON
Display	Digital
Product Sub Type	Platform Weighing Scale
Weighing Capacity (kg)	1 Ton
Country of Origin	India
Name of Manufacturer/Packer/Importer	DIGITAL COMPUTER SERVICE

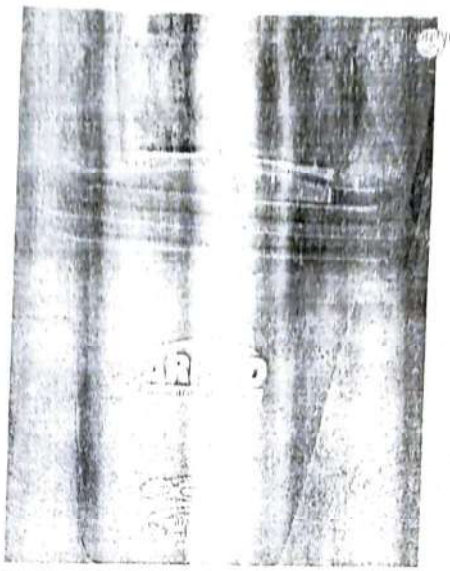
FREQUENTLY BOUGHT TOGETHER

Ships within 24 hrs

Ships within 24 hrs

अधिशासी अधिकारी
नगर पंचायत केदारनाथ

Product Brochure



Aristo Hdpe 90L Wheeled Dustbin

₹ 2,047 Get Latest Price

Capacity	90 L
Color	Black, Blue, Red, Green, Yellow
Usage/Application	Home, Office, I
Brand	Aristo
Structure	Foot Pedal
Material	HDPE
Minimum Order Quantity	10

View All Details

Get Latest Price

View More Photos

Krishna Polymer Industries

Rohini Sector 15, N

4.2/5 ★★★★★ (

GST- 07ARQPG46

TrustSEAL Verified

Leading Supplier | Manufac

View Mobile Number | Co... Sup...

Find products similar to Aristo Hdpe 9... Wheeled Dustbin near New Delhi

120 Liter Wheeled Dustbin

Subhash Sales

New Delhi

₹ 2,050

View Mobile Number

Get Latest ...

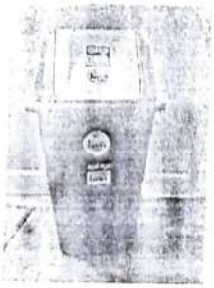
Plastic ... Top ... 240 L ...

Sub...

New De...

₹ 2,85...

View Mobile Number



Plastic 40 Ltr swing Square Dustbin

Prisha Enterprises

...ar, New Delhi

₹ 460

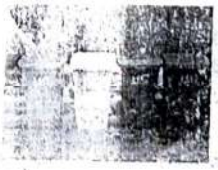
View Mobile Number

Plastic ... Dustbin

Deals in ... Price

₹ 2,500

View Mobile Number



Plastic 2 Wheeled Dustbin 90L

SC Creation

Shakti Vihar, New Delhi

₹ 1,800

View Mobile Number

Get Latest Price

Aristo HDPE Wheeled Garbage...

S S Enterprises

Mayur Vihar Phase 1, New Delhi

₹ 2,050

View Mobile Number

Get Latest Price

View More

Find related categories near New Delhi

- Plastic Dustbin
- ... Medical Waste ...
- Ishkamal Dustbins
- Plastic Bins in Delhi
- Garbage Bin in New Delhi

अधिशासी अधिकारी
नगर पंचायत केदारनाथ

नगर पंचायत केदारनाथ रुद्रप्रयाग

50 kg

BIORAPID

Commercials

	Quantity (Nos)	Unit Rate (Rs.)	GST	Amount (Rs.)
50 kgs / day				
Bio Rapid 75	1	₹ 675,000	12%	₹ 7,56,000
SubTotal				₹ 7,56,000
Freight,Packing & Insurance		₹ 60,000	18%	₹ 70,800
Installation, Commissioning & Training		₹ 35,000	18%	₹ 41,300
Grand Total				₹ 8,68,100

433

Terms and Conditions

- Taxes: GST as applicable
- Freight and Installation to be charged extra. The freight charges is up to the place where road is available. Any other
- Delivery Period: Within 60-70 days from the date
- Payment Terms: 100% Advance prior to dispatch
- Warranty: 12 months from the date of installation or commissioning
- Validity of offer: This offer is valid for acceptance within 30 days

ग्रामपंचायत अधिकारी
कणर पंचायत केदारलोध

500/kg

BIORAPID

Commercials

500 kgs / day	Qty (Nos)	Unit Rate (Rs.)	Rate	GST	Amount (Rs.)
BioRapid 500	2	₹ 1,650,000	₹ 33,00,000	12%	₹ 36,96,000
Sub-Total					₹ 36,96,000
Freight,Packing & Insurance		₹ 150000		18%	₹ 1,77,000
Installation, Commissioning & Training		₹ 60,000		18%	₹ 72,600
Grand Total					**₹ 39,45,600**

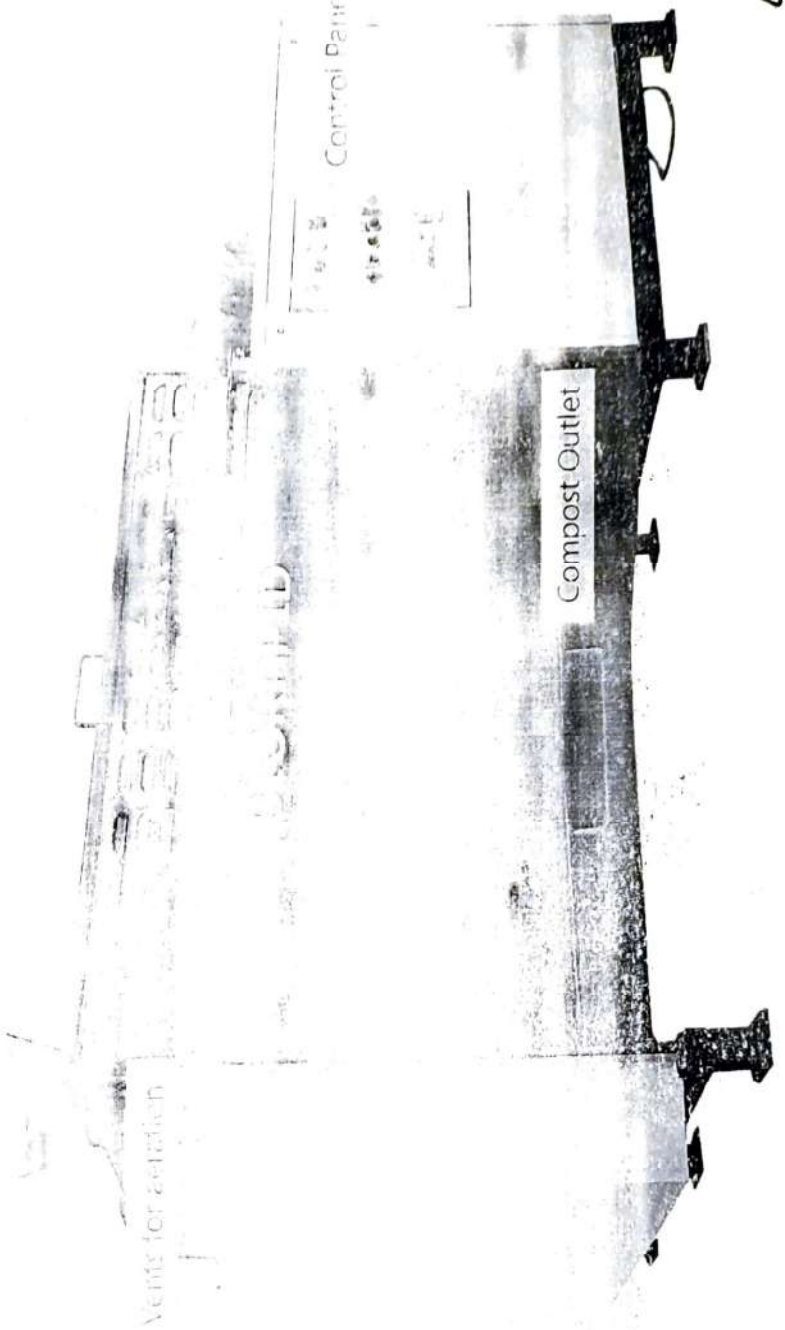
434

Terms and Conditions

- Taxes: GST as applicable
- **Freight and installation** to be charged extra. The freight charges is up to [illegible]. Any other expense for the cartage of machine to the site will be borne by client.
- Delivery Period: Within 60-70 days from the date of P.O & Advance
- Payment Terms: 100% Advance prior to dispatch
- Warranty: 12 months from the date of installation and commissioning
- Validity of offer: This offer is valid for acceptance within 30 days.

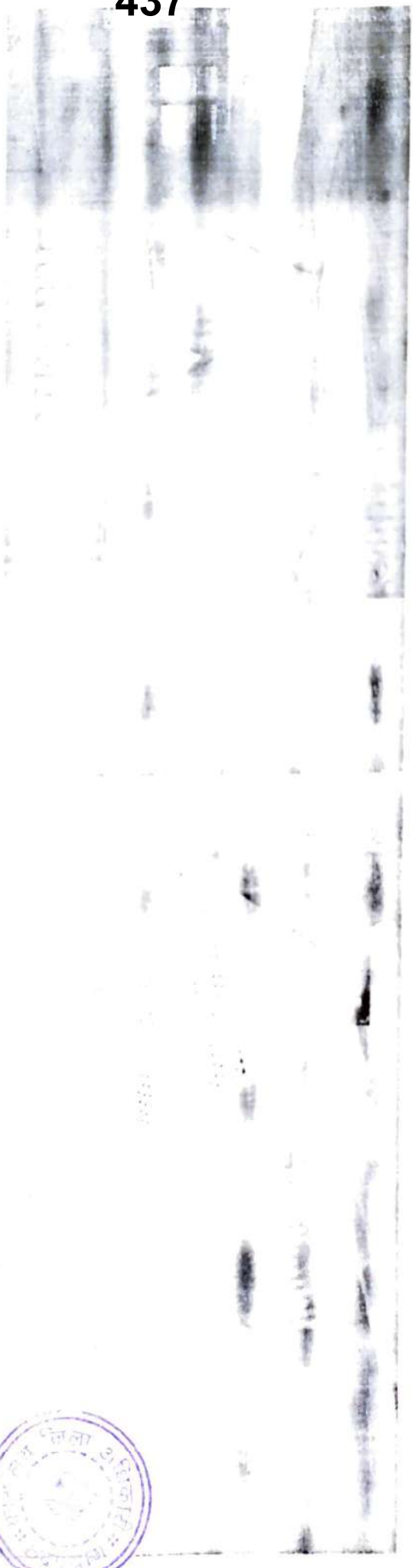
ग्रामपंचायत अधिकारी
कणर पंचायत केंदारनाथ

अधिशासी अधिकारी
नगर पंचायत केदारनाथ



कार्यालय जिला अधिकारी रुद्रप्रयाग

अधिशासी अधिकारी
नगर पंचायत केदारनाथ



अधिशासी अधिकारी
नगर पंचायत केदारनाथ

अधिशासी अधिकारी
नगर पंचायत केदारनाथ

BIORAPID

Specifications

Genral Spec	Capacity (kg/day)	500
	Vessel volume (L)	[illegible]
	MOC of Vessel and Shaft	MS Painted
	MOC of Outer Cover	MS Powder coated
Technical Specs.	Electric Supply	3 Phase, 4 Pole
	Motor (HP)	12.5 HP
	Waste shredder	Single stage
	Shredder Capacity (per hour)	200 kg
	Shredder Motor (HP)	2.0 HP
	Overall dimensions (m)	**3.1 x 2.6 x 2.2**
Other Req.	Space requirement	**175 sq. ft.**
	Electrical consumption (units/day)	25-30
	Machine Weight (kg)	**4105**

439

Commercials

[illegible]	[illegible]	₹ [illegible]	₹ 33,00,000	[illegible]	₹ 38,96,000
Sub Total					₹ 36,96,000
Freight, Packing & Insurance		₹ 150000		18%	₹ 1,77,000
Installation, Commissioning & Training		₹ 60,000		18%	₹ 72,600
Grand Total					**₹ 39,45,600**

Terms **and Conditions**

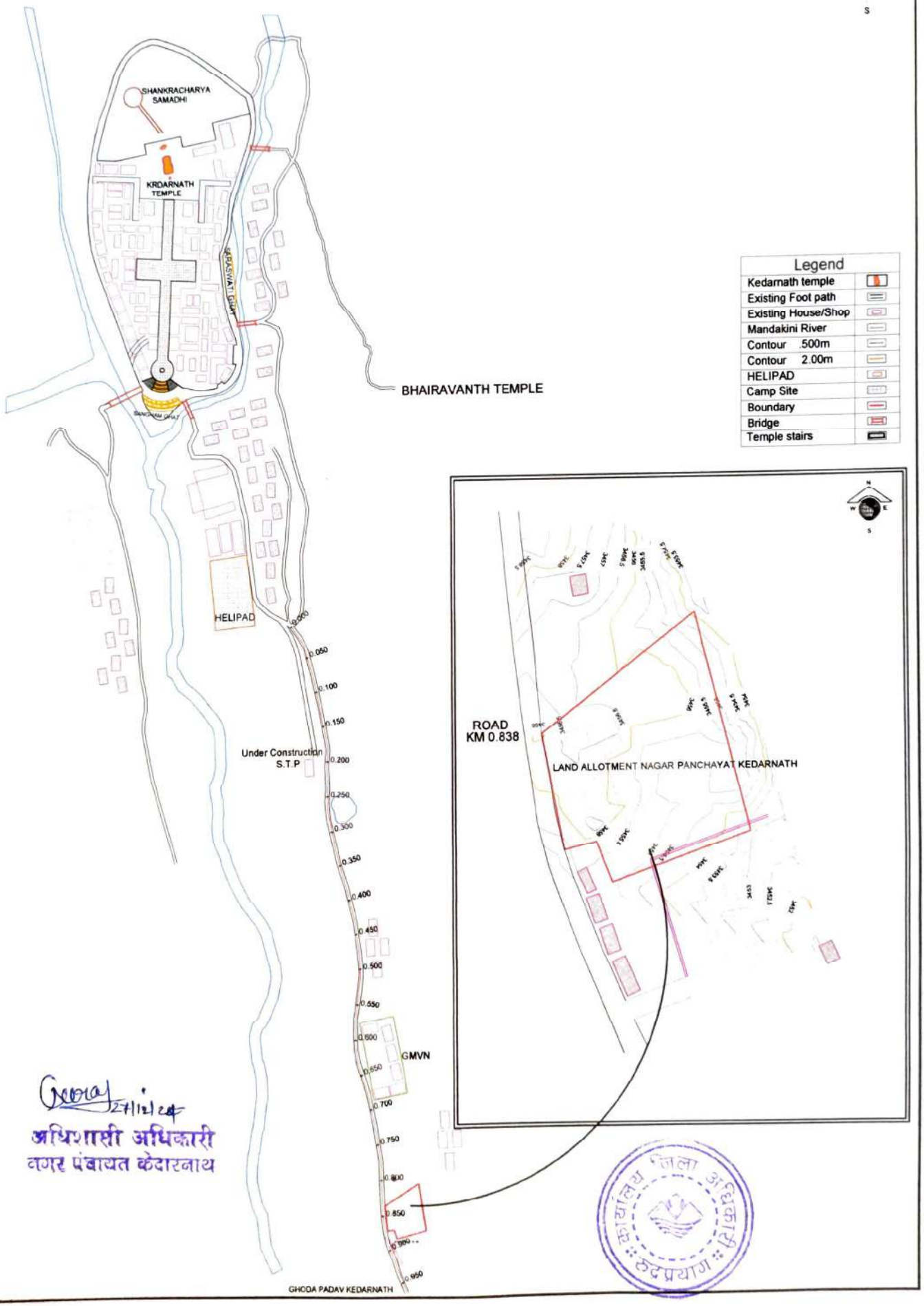
- Taxes: GST as applicable
- Freight and Installation to be charged extra. The Freight charged **is up to the place where road is available.** Any other expense for the cartage of machine to the site will be **borne by Client.**
- Delivery Period: Within 60-70 days from the date of PO & Advance
- Payment Terms: 100% Advance prior to dispatch
- Warranty: 12 months from the date of installation and commissioning
- Validity of offer: This offer is valid for acceptance within 30 days.

440

Annexure-4

KEY PLAN

SOLID WASTE MANAGEMENT ACTION PLAN (LAND ALLOTMENT) NAGAR PANCHAYAT KEDARNATH/KEDARNATHDHAM

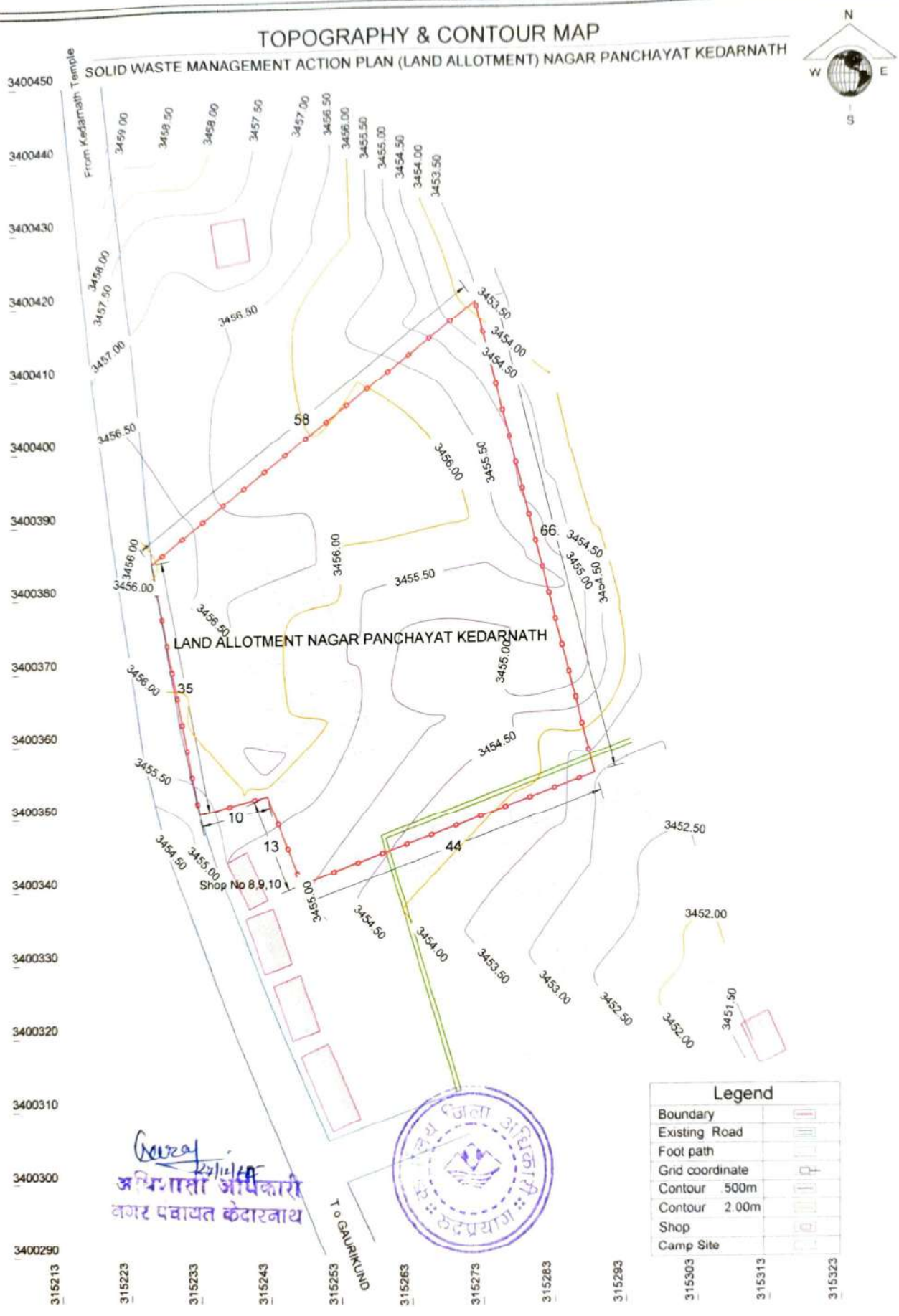


27/12/24
अधिशासी अधिकारी
नगर पंचायत केदारनाथ

कार्यालय जिला अधिकारी रुद्रप्रयाग

TOPOGRAPHY & CONTOUR MAP

SOLID WASTE MANAGEMENT ACTION PLAN (LAND ALLOTMENT) NAGAR PANCHAYAT KEDARNATH



अधिशासी अधिकारी
नगर पंचायत केदारनाथ

CLIENT:-	PROJECT:	LAND ALLOTMENT	PREPARED BY:-	SCALE:-	SHEET
NAGAR PANCHAYAT KEDARNATH/ KEDARNATH DHAM RUDRAPRAYAG (U.K.)	SOLID WASTE MANAGEMENT ACTION PLAN NAGAR PANCHAYAT KEDARNATH / KEDARNATH DHAM	Area = 3000 Sqm Area = 0 300 Hect Khasra no = 337& 338	DIGITAL LAND SURVEY & ENGINEERING	1:500	NO:- 02

Annexure-5

N.P.A./2022- 331
Office of Nagar Panchayat Arki,
Teh. Arki, Distt. Solan (H.P.)

Date: Arki, 11, April,2022

To whom it may concern

This is to certify that, we are using OWC 500 KG per day capacity supplied by M/s. Excel Industries Ltd. for decentralised waste management system in our town, Arki, District Solan, Himachal Pradesh. Around 500 kg wet waste is treated by use of Bioculum and Sanitreat and they are working satisfactory without any operational issues.

The system and use of Bioculum and Sanitreat helping us dispose off the wet waste with reduced composting cycle to 10 days and eliminating foul odour during composting process. We place on record our appreciation for the M/s EXCEL Industries Limited, for making the composting process easier and efficient.

Secretary
Nagar Panchayat Arki.

27/12/24
अधिशासी अधिकारी
नगर पंचायत केदारनाथ

कार्यालय जिला अधिकारी रुद्रप्रयाग

444

N.P.A./2022-321

Office of Nagar Panchayat Arki,

Reh.Arki. Distt. Solan(H.P)

Date: Arki, 16, April,2022

To whom it may concern

This is to certify that, we are using OWC 500 KG per day capacity supplied by M/s. Excel Industries Ltd. for decentralised waste management system in our town, Arki, District Solan, Himachal Pradesh. Around 500 kg waste is treated by use of Bioculum and Sanitreat and they are working satisfactory without any operational issues.

The system and use of Bioculum and Sanitreat helping us dispose off the wet waste with reduced composting cycle to 10 days and eliminating foul odour during composting process. We place on record our appreciation for the M/s Excel Industries Limited, for making the composting process easier and efficient.

हस्ताक्षर अस्पष्ट

Secretary

Nagar Panchayat Arki.

हस्ताक्षर अस्पष्ट

27/12/2024

अधिशासी अधिकारी

नगर पंचायत केदारनाथ

कार्यालय जिला अधिकारी रुद्रप्रयाग

mc/SNA/2022-1802

Dt. 12/4/2022

To whom so ever it may concern

We adopted decentralised waste management system in our town in the year 2021. Around 1000 kg wet waste is treated by use of Excel Industries Ltd's OWC machine along with Bioculum and Sanitreat.

OWC machine shreds, homogenises wet waste with horticulture waste like dry grass, dry leaves. Bioculumis mixedWet Waste to for accelerate the composting process and Sanitreat is used to control foul odour. OWC machine and its shredders are working satisfactorily without any operational issues.

Use of OWC, Bioculum and Sanitreat has brought efficiency in handling wet waste and reduced the composting cycle to 10 days and eliminating foul odour during composting process. We place on record our appreciation for the M/s EXCEL Industries Limited, for making the composting process easier and efficient.

Thanking you,

Yours truly,

Executive Officer

Municipal Council

Sundernagar Distt.Mandi

Himachal Pradseh

27/12/24
अधिशासी अधिकारी
नगर पंचायत केदारनाथ

कार्यालय जिला अधिकारी रुद्रप्रयाग

Annexure -6