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BEFORE THE NATIONAL GREEN TRIBUNAL SITTING AT PUNE

ORIGINAL APPLICATION NO. 117 OF 2024

(Under Section 18(1) read with Sections 14 and 20 of the National Green Tribunal Act, 2010)

NOTARY SUBHASH KRISHNA KANEKAR SALCETE TALUKA MARGAO-GOA Regd. No. 344/14 Exp. Dt: 28/02/2027 GOVT. OF GOA (INDIA)

Tulshidas Sridhar Naik and Ors) ...Applicants

Versus

State of Goa and Ors) ...Respondents

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BEFORE THE NATIONAL GREEN TRIBUNAL SITTING AT PUNE

ORIGINAL APPLICATION NO. 117 OF 2024

(Under Section 18(1) read with Sections 14 and 20 of the National Green Tribunal Act, 2010)

IN THE MATTER BETWEEN :

Tulshidas Sridhar Naik and Ors) ...Applicants

Versus

State of Goa and Ors) ...Respondents

NOTARY SUBHASH KRISHNA KAMEKAR SALCETE TALUKA MARGAO-GOA Regd. No. 344/14 Exp. Dt. 28/02/2027 GOVT. OF GOA (INDIA)

ADDITIONAL AFFIDAVIT ON BEHALF OF THE APPLICANTS

I, Xavier Fernandes, residing at House No 149, Rassaim, Loutulim, Salcete, Goa, the Applicant No 9 herein, do hereby solemnly affirm and declare as under:

1. I say that I have read the contents of the Application and have understood its contents and am therefore competent to file an affidavit in support of the said Application.

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2. I state that the documents annexed herein are true copies and have been collected by us through RTI applications

3. I say that the Applicants herein have filed Application No. 117 of 2024 seeking directions of this Hon'ble Tribunal to respondent No.1-Chief Secretary, Government of Goa, respondent No.3-Executive Engineer, Works Division XV (NH), Public Works Department, respondent No.4 – Chief Engineer (NH, R&B), Public Works Department and respondent No.5 – Ministry of Road Transport & Highways be directed to reconsider or re-design and selection of the alternative for `proposed construction of High Level New Borim Bridge on NH-17B (NH-566) in the State of Goa, because the present design/alignment of the project fails to identify and consider the presence of CRZ areas, forest areas and environmental preservation and the impact on these eco-sensitive areas and the people dependent on these areas and have further prayed that the Respondent Nos.3 and 4 be directed not to proceed with the project without first obtaining a prior Environment Clearance under the EIA Notification, 2006.

NOTARY SUBHASH KRISHNA KANEKAR SALCETE TALUKA MARGAO-GOA Regd. No. 144/14 Exp. Dt: 28/02/2027 GOVT. OF GOA (INDIA)

4. I say that I am filing the present Additional Affidavit to give sufficient documentary evidence as directed by this Hon'ble

Fernandes

Tribunal to support the claim of the Appellants that the area of the project would exceed 1,50,000 mtrs, and would thus require the Respondents to obtain a prior Environment Clearance under the EIA Notification, 2006.

5. I say that I have already filed an affidavit dated 16.07.2024 producing the requisite documents to show the area of the project would exceed 1,50,000 mtrs. However, I also wish to bring on record the full copy of the inception report prepared by M/s Technogem Consultants Pvt. Ltd, which provides further details about the project. A copy of the entire inception report prepared by M/s Technogem Consultants Pvt. Ltd for the new High Level Borim Bridge project has been annexed hereto and marked as **Exhibit A-1**

6. I say that the Applicants have filed the present affidavit to bring the said Inception Report on record in compliance with the Order passed by this Hon'ble Tribunal on 31.05.2024 in the present Original Application. I say and submit that the aforesaid affidavit is necessary for the Application No. 117 of 2024 may be adjudicated upon by the Hon'ble Tribunal on merits.

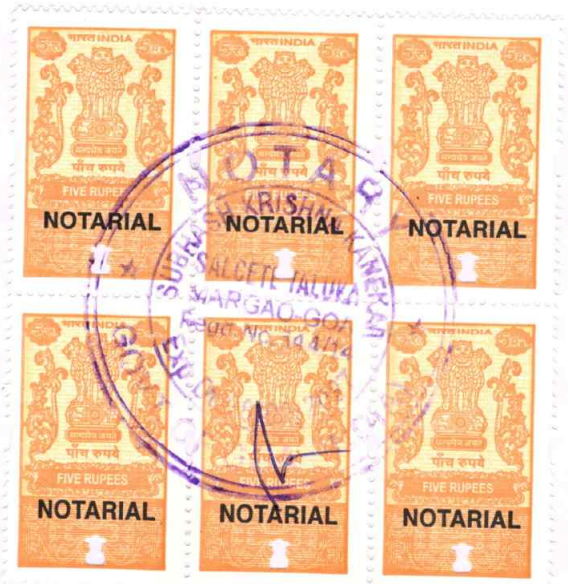
7. I therefore humbly pray that the prayers sought by the Applicants in the Original Application 117/2024 be granted and made absolute.

NOTARY SUBHASH KRISHNA KANEKAR SALCETE TALUKA MARGAO-GOA Regd. No. 344/14 Exp. Dt: 28/02/2027 GOVT. OF GOA (INDIA)

05-08-2024
Margao, Goa

DEPONENT

BEFORE ME



Solemnly affirmed before me by
Shri/Smt. Xavier Fernandes
Who is identified to me by
Shri/Smt. Aadhaar: 6544 9950 8910
Who is personally known to me
this 5th **day of** Aug. **20**24
Reg. No. 1876/2014

05/08/2024

SUBHASH KRISHNA KANEKAR
NOTARY
SALCETE TALUKA
STATE OF GOA (INDIA)

BEFORE THE NATIONAL GREEN TRIBUNAL

SITTING AT PUNE

APPLICATION NO. 117 OF 2024

(Under Section 18(1) read with Sections 14 and 20 of the National Green Tribunal Act, 2010)

Tulshidas Sridhar Naik and Ors …Applicants

Versus

State of Goa and Ors…Respondents

NOTARY SUBHASH KRISHNA KANEKAR SALCETE TALUKA MARGAO-GOA Regd. No. 344/14 Exp.Dt:28/02/2027 GOVT. OF GOA (INDIA)

AFFIDAVIT ON BEHALF OF THE APPLICANTS

Dated this __ of August, 2024

RONITA BHATTACHARYA
Advocate for the Applicants
17,1st Floor,
Rohit Chambers
Janmabhoomi Marg
Fort, Mumbai -400001
Email: ronita.b6@gmail.com
Mobile No. 9920097464
Enrolment No. MAH/2973/2017

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ANNEXURE - A-1

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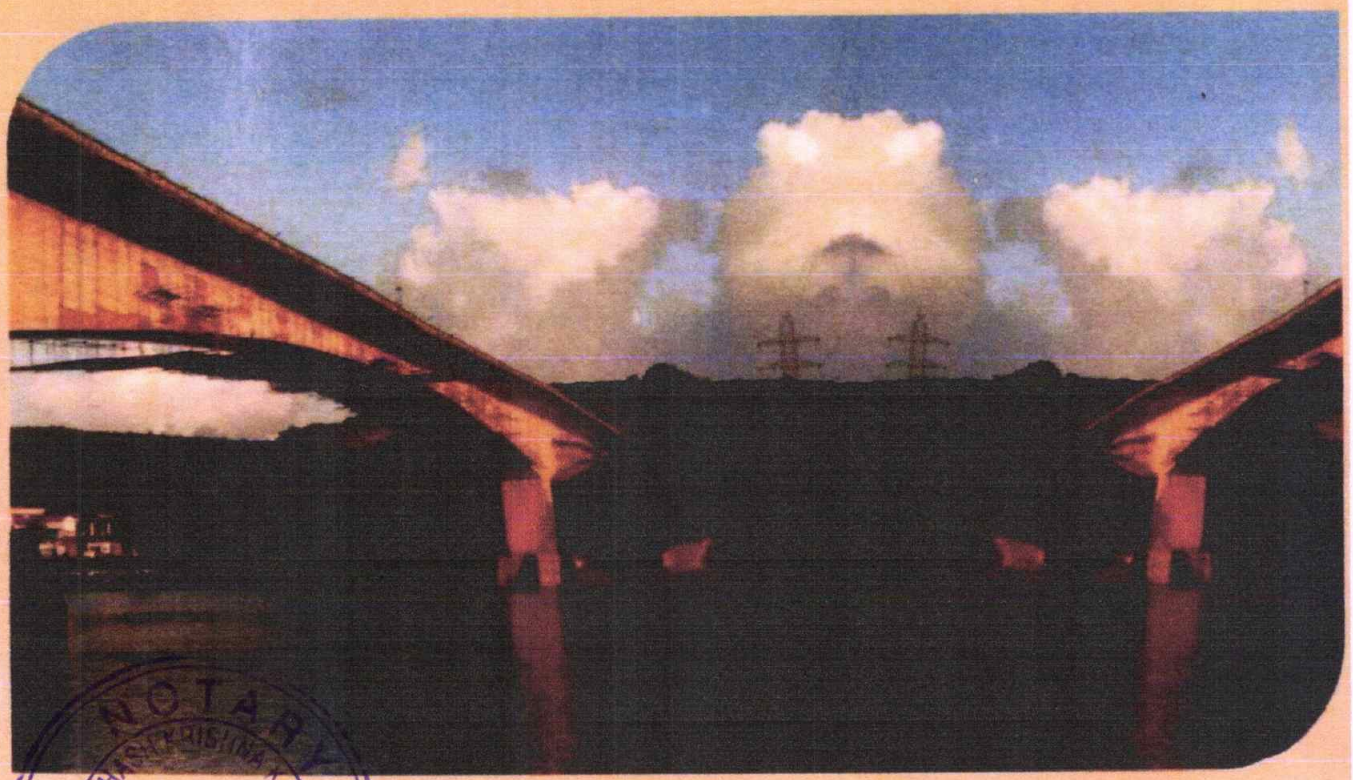
GOVERNMENT OF GOA

PUBLIC WORKS DEPARTMENT

WORK DIVISION XV (NH), P.W.D., PANAJI, GOA

Consultancy Services for the Preparation of Detailed Project Report and Bidding Documents for the "Proposed Construction of High Level New Bridge along with its approaches across River Zuari at Borim on NH – 17B (NH-566) in the State of Goa".



NOTARY SUBHASH KRISHNA KANEKAR SALCETE TALUKA MARGAO-GOA Regd. No. 744/14 Exp. Dt: 28/02/2021 GOVT. OF GOA (INDIA)

INCEPTION REPORT

JANUARY - 2017

TECHNOGEM CONSULTANTS PVT. LTD.

CONSULTING ENGINEERS

101-A/B, Devmilan Building, Opp. Raheja Garden, L.B.S. Marg, Thane (West) - 400 604.

Tel. : 91-22-6799 7145 (3 lines) Fax. : 91-22-2581 4349

Email ID : technogem@rediffmail.com, technogem_thane@yahoo.com

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NOTARY SUBHASH KRISHNA KANEKAR SALCETE TALUKA MARGAO-GOA Regd. No. 544/14 Exp. Dt: 28/02/2021 GOVT. OF GOA (INDIA)

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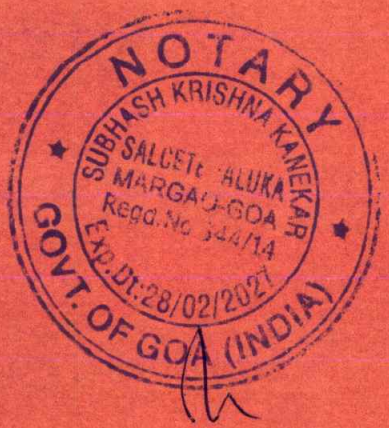
Chapter - 1
Introduction



1.0 INTRODUCTION

1.1 General:

i) The Ministry of Road Transport & Highways (MORT&H) is responsible for the development, maintenance and management of National Highway and for matters connected or incidental thereto. Ministry of Road Transport & Highways intends to construct new bridges on National Highways as per new specification, in place of old, weak and narrow bridges in a phased and in a time bound manner. Accordingly, proposals are invited from eligible consultants for prioritization and preparation of project report for construction of bridge for which state PWD will be the implementing agency.

ii) NH-17B starts at Farmagudi from the junction with NH-4A at Km. 127/400 and proceeding via Borim Village, Verna and terminating at Marmagoa Port. This stretch was declared as National Highway in July 1999. On this National Highway, there is a High level Bridge across River Zuari at Borim having a length of around 431 m. The Bridge is a prestressed balance cantilever concrete bridge with a central navigable span of 122 m. The Bridge was built by M/s Gammon India and was opened to traffic in 1986. There is major commercial traffic along this corridor crossing this bridge. Over the years the traffic on the NH-17B has increased substantially and the existing two lane Bridge is burdened carrying this manifold traffic. Typical problems manifested in the long span cantilever prestressed bridges have plagued the existing Bridge also and inherent corrosion in saline atmospheric conditions have only aggravated the deterioration of the bridge.

iii) The work of preparation of Detailed Project Report and bidding documents for the "Proposed Construction of High Level New Bridge along with its Approaches across River Zuari at Borim on NH-17B (NH-566) in the state of Goa." is entrusted to M/s. Technogem Consultants Pvt. Ltd.

iii) The Letter of Award (LOA) bearing No. PWDD/WDXV(NH)/Accts/8109/2016-17/423 was issued on 29th August, 2016.

iv) Thus, the date of commencement of Consultancy Services is 8th November 2016 and time period for completion of the assignment is 12 months.

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1.2 Site Office:

The consultants have established site office for field work at Madgaon. The distance between Site and Madgaon is about 15 km. Hence, this location will be better for accessibility to the project corridor, to monitor field investigation/ survey activities etc.

The address of site office is as given below:

M/s. Technogem Consultants Pvt. Ltd.
R-5, Living Spaces Castle,
Union Bank Road, Borda,
Madgaon, Goa.

1.3 Mobilization:

We have mobilized a team of key personnel's as well as support staff at site and started the work on 8th November 2016. Initially, Reconnaissance survey has been carried out by the team of engineers.

1.4 Objectives of the Assignment:

- The main objective of the Consultancy Services is to establish an economically and strategically significant link from Ponda to Verna, Vasco and Madgaon by constructing a new bridge across River Zuari at Borim. The link will be useful for the town/ villages along the project corridor.
- To study present traffic pattern & prepare proposal for smooth flow of traffic.
- To establish technical, environmental, social, economical and financial viability of the project and prepare Detailed Project Report and bidding documents for the "Proposed Construction of High Level New Bridge along with its Approaches across River Zuari at Borim on NH-17B (NH-566) in the state of Goa".
- To ensure Detailed Project Preparation incorporating aspects of value engineering, quality audit and safety audit requirements in design and implementation and submit the reports in given time frame.

1.5 Scope of the Services:

The scope of the services involved in Project Report preparation for construction of new bridge, and its long approaches on either side will cover the followings;

- prioritization based on traffic and its financial viability,
- review of all available reports and published information about the project and the project influence area,
- detailed reconnaissance survey

NOTARY SUBHASH KRISHNA KAMEKAR SALCETE TALUKA MARGAO-GOA GOVT OF GOA (INDIA)

- Identification of possible alignments for the new bridge, selection of best suited alignment/ geometrics for the proposed Bridge, the realignment up to minimum 2 km length or greater if the situation demands to create effective traffic movement,
- Inventory and condition survey of existing Bridge/ Culverts and approach roads along the new alignment and connectivity/ accessibility to village traffic,
- topographic surveys using total station as per guidelines of latest IRC SP-19. Fixing of TBM and all reference point in ground during survey and should be clearly shown on detailed survey drawings,
- carrying out detail hydrological study required for completion of Bridge design and project report preparation,
- geotechnical investigation work for proposed Bridges as per guidelines of IRC SP-19 and IRC-78,
- preparation of alignment option study report and GAD for approval of concerned authorities,
- Finalization of GAD of the proposed bridge and submission to the Employer for approval of GAD by concerned authorities,
- to interact with authorities on technical issue during approval of GAD by authority.
- to prepare LA (Land Acquisition) plan and to assist in LA process till completion,
- to obtain the required clearances (if required) such as forest clearance, environmental clearance, CRZ clearance etc.,
- to prepare GAD for construction of proposed bridge, plan & profile of approach road as per guidelines of related latest IRC and IS codes,
- to submit bidding documents as per MORT&H planning commission, to provide required schedules as per EPC/BOT documents,
- to prepare the firm cost estimate as per Ministry's Data Book, based on detailed design and to carry out rate analysis with supported market quotations to calculate Fair Market Rate wherever new or innovative items are included,
- to obtain approval from MORT&H and State Government,
- to provide update Cost Estimate based on current rates and tender document at the time of Bidding if required.

1.6 Reports to be submitted:

The preparation of Detailed Project Report has been split into 4 stages & accordingly following reports are to be submitted to the Employer;

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Table 1.1 Schedule of submission of Reports

Stage No.	Activity	Cumulative Time period in days	No. of copies to be submitted
1	Alignment option and Inception Report.	60	3
2	Selection of the best alignment & geometrics with comparative economics of cost and finances.	90	3
3	Survey/Investigation and preparation of GAD of proposed Bridge approval by concern Authorities. Prepare the LA plan and take clearance of Environment & Forest	240	3
4	GAD and Final Report for Construction of Proposed Bridge along with schedule required as per EPC/BOT document (Final Report)	365	6

1.7 Aspects to be covered in Inception Report as per TOR (As per clause no. 7.1 of TOR)

Following points are covered in the Inception Report;

- proposed Alignment option for construction of new Bridge,
- detailed methodology to meet the requirements of the TOR including number of teams mobilized for deployment, scheduling of various activities to be carried out for completion of different stages of work within the stipulated time schedule,
- task Assignment and Manning Schedule
- work programme,
- proforma for data collection,
- key personal to be employed,
- time frame for submission of various reports

The available alignment options will be worked out on the basis of available maps, topo sheets, reconnaissance survey, etc. The most appropriate alignment option for bridge will be identified on the basis of site conditions and techno-economic considerations. Inception Report along with Alignment report will include the details regarding various alternatives for approval by the employer.

NOTARY SUBHASH KRISHNA KANEKAR SALCETE TALUKA MARGAO-GOA Regd No. 34a/14 Exp. Dt: 28/02/21 GOVT. OF GOA (INDIA)

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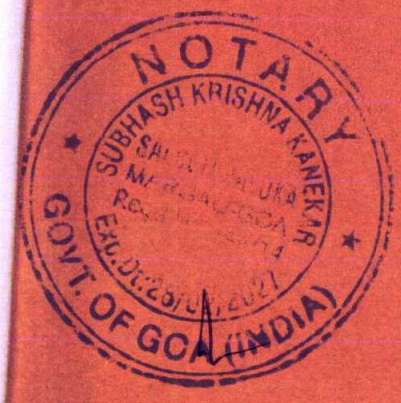
Chapter - 2

Project Appreciation



2.0 PROJECT APPRECIATION

We have carried out detailed Reconnaissance survey and collected the details along the project corridor. The information collected as well as conclusion from Reconnaissance survey is as follows;

2.1 Project Corridor:

The Project road is a section of NH-17B (NH-566). NH-17B which is declared as National Highway in July 1999 originates from intersection with NH-4A at Farmagudi (Ponda), proceeding via. Borim, Loutulim, Verna & terminating at Marmagoa port. There is missing link of this NH between village Loutulim & Verna Industrial Estate.

The Project road under consideration is located between Km. 3/860 to Km. 11/860 of NH-17B i.e. 8 Km. The project corridor located in two districts South Goa & North Goa out of which majority length passes through North Goa district. A key map is enclosed with this report.

2.2 About River Zuari:

- Zuari river is the largest river in the state of Goa (92 Km long).
- Zuari originates at Hemad - Barshem in the western ghat & flush out into the Arabian Sea at Cabo Aguada (near port city Vasco da Gama).
- It is a tidal river (tide affected river at Borim).
- It is backbone of Goa's agricultural industry as well as mining industry.
- In the interior region of Goa, it is referred to as River Khushavati (near Quepem), River Guloli near Netravali) & River Ugem (near Sanguem & Ugem).
- There is Salaulim dam across river Zuari (Guloli) near Sanguem.
- It flows in the southern-western direction & bifurcate the Goa state as South Goa & North Goa.
- It is being used for the navigation for the transportation of iron ore.
- There are following major bridges across river zuari;

  a) on NH-17 near Cortalim

  b) on Konkan Railway near Cortalim – adjoining to NH-17

  c) on NH-17B near Borim

  d) Pipe Line Bridge near Borim – adjoining to NH-17B

  e) on Sanvordem – Dhabadora road near Sanvordem.

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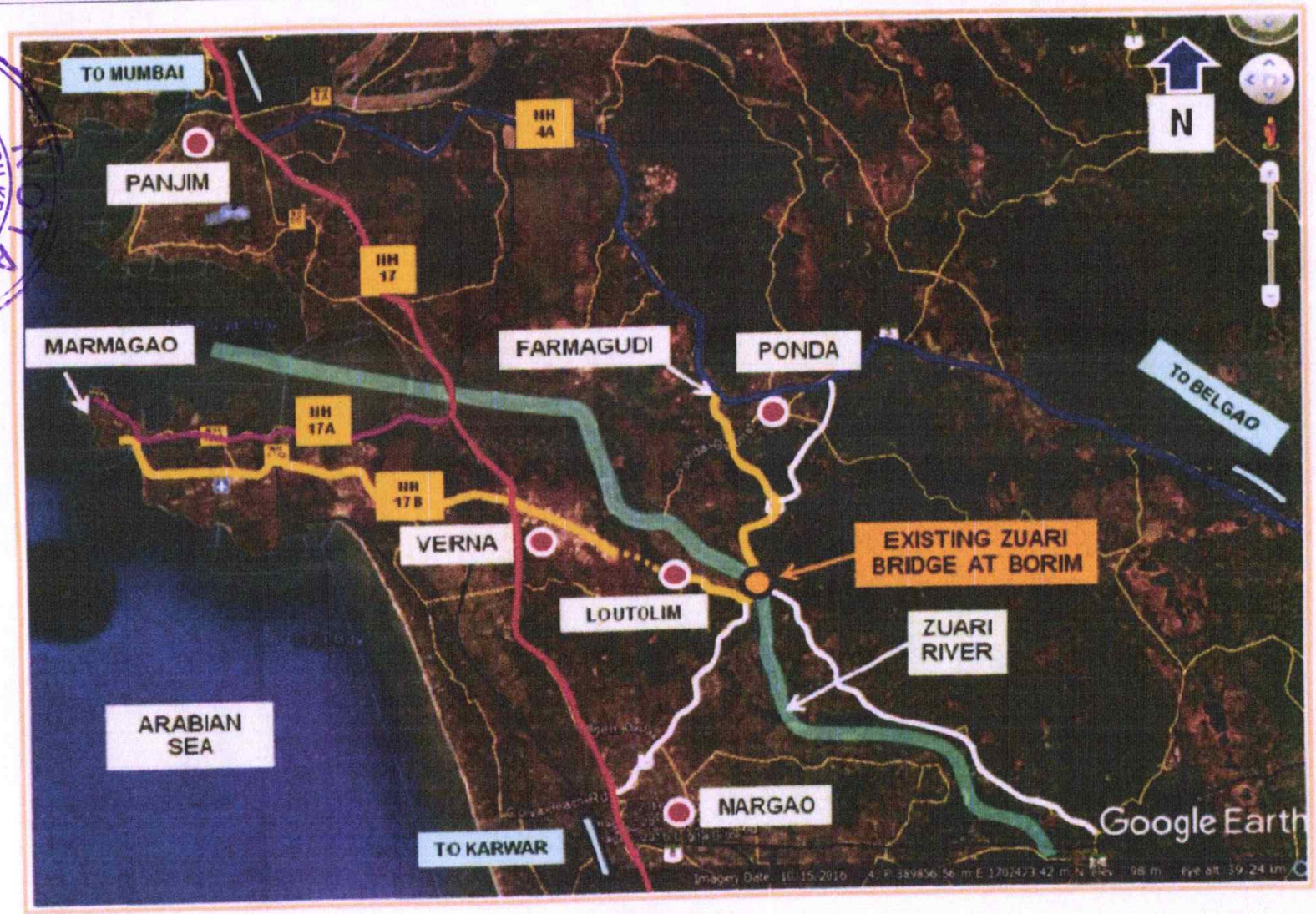
TO MUMBAI
PANJIM
NH 4A
NH 17
MARMAGAO
FARMAGUDI
PONDA
TO BELGAO
NH 17A
NH 17B
VERNA
EXISTING ZUARI BRIDGE AT BORIM
LOUTOLIM
ZUARI RIVER
ARABIAN SEA
MARGAO
TO KARWAR
N
Google Earth

INDEX MAP

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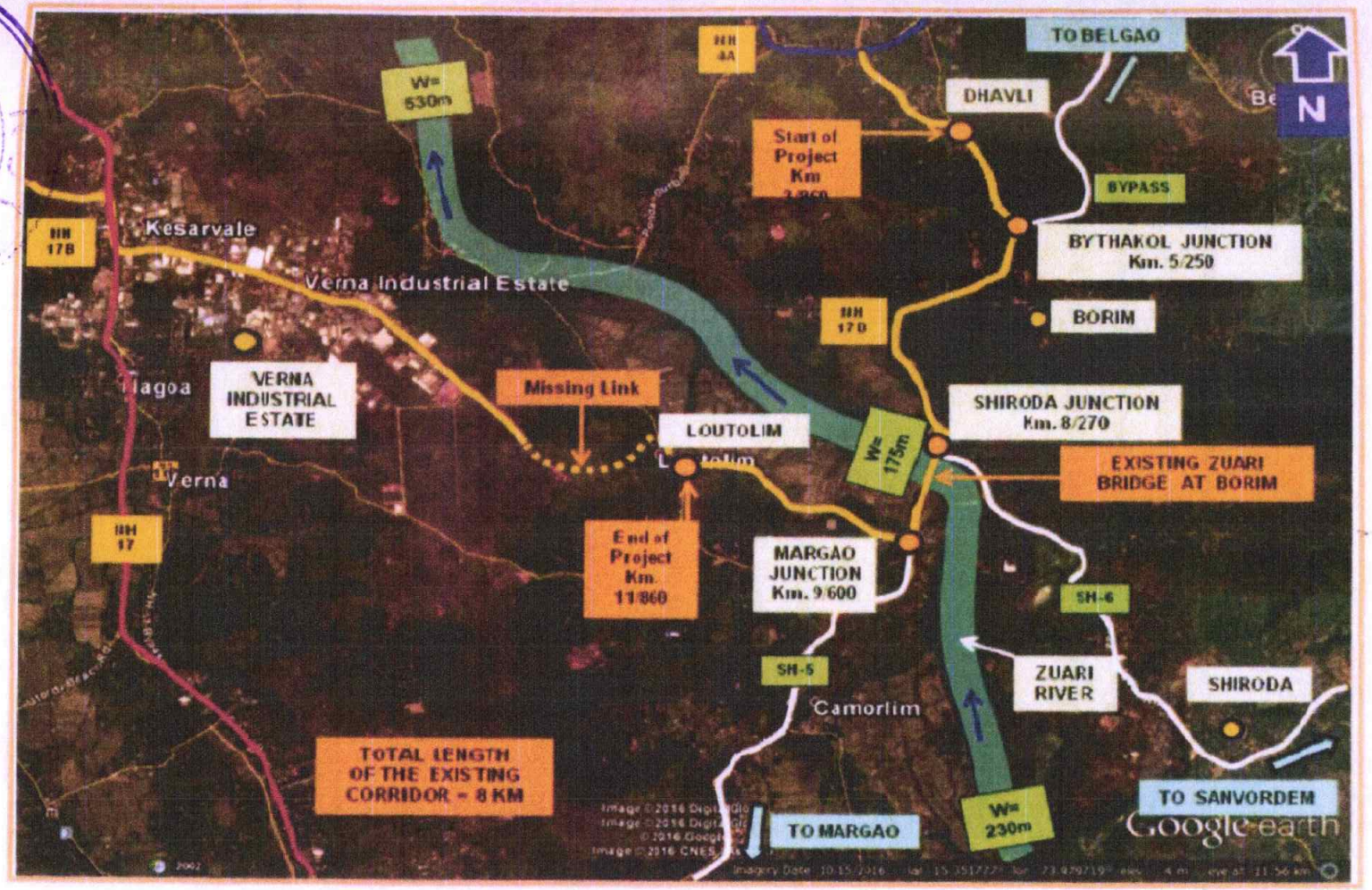

PROJECT CORRIDOR

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2.3 About Existing Bridge Across River Zuari at Borim:

- Existing bridge across River Zuari at Borm was opened to traffic in 1986.
- Existing bridge is 2 lane bridge with footpaths on either side.
- Length of the existing bridge is 431m with additional span of 35m for crossing of SH-6 road.
- There is central navigational span (balance cantilever span) of 122m with navigational channel of 90m and vertical clearance of 13.7m.
- Existing two lane bridge is burdened for carrying present manifold traffic.
- Typical problems manifested in the balance cantilever prestressed span of the bridge.

2.4 Climate:

The temperature in the project corridor being in the tropical zone and located near the Arabian Sea, Goa generally experiences a hot and humid climate all around the year. In Goa, the month of May is considered as the hottest month as it usually carries day temperatures of almost **35°C (95°F)** with high humidity. Goa experiences a short winter season in the mid month of December and February. Usually in the night, the temperature goes down to 21°C (**68°F**) and in the day it rises up to 28°C (84°F). The nights are considered as cool as compared to day. The details of the same are as follows;

During Summer :- Max 35°C and Min 32°C

During Winter :- Max 28°C and Min 21°C

Average annual rainfall in this area is about 3000 mm.

2.5 Terrain:

Project corridor passes through rolling terrain.

2.6 Land use:

In majority length, land use along project road is partially agricultural as well as plantation. At villages/ town locations there are residential/ commercial structures along the existing road. The details of stretch wise land use are as follows;

Table 2.1

From 'Km'	To 'Km'	Side	Land Use	Remarks
3/860	4/260	RHS	Built-up	
3/860	4/250	LHS	Plantation	Hilly portion
4/250	5/450	BOTH	Plantation	Hilly portion
5/450	6/000	BOTH	Built-up	

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6/000	6/850	RHS	Built-up	
6/000	6/850	LHS	Agricultural	Few Built-up sections in scattered location
6/850	8/600	BOTH	Built-up	
8/600	9/450	BOTH	Agricultural	Includes Zuari River channel
9/450	10/450	BOTH	Built-up	
10/450	11/050	BOTH	Agricultural	
11/050	11/860	BOTH	Built-up + Open Land	

2.7 Major Junctions:

Following are the major junctions on the project road.

There three major junctions (junction with SH/ NH) in the project corridor i.e. at Bythakol with NH – 17C. In addition to this there is an important junction at start of project corridor near Dhavli (road leading to Ponda city). Details of major / important junctions are as follows;

Table 2.2

Major/ Important Junctions on Project Road

Sr. No.	Existing Chainage	Location / Identification	Type	Remark
1	3/860	Dhavli	Y	Rotary junction (road leading to Ponda city)
2	5/200	Bythakol	Y	Rotary junction SH - bypass to Ponda city
3	8/200	Shiroda	Y	Rotary junction SH-6 – road leading to Shiroda
4	9/520	Margao	T	SH-5 road leading to Margao

2.8 Villages along the Project Highway:

The following villages / towns are located along the project road

Table 2.3

Villages / Towns on Project Road

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Sr. No.	Name of village / towns	Existing chainage		Habitation on LHS / RHS of road
		From	To	
1	Dhavali	3/860	4/260	RHS
2	Borim	5/450	8/600	LHS & RHS
3	Loutulim	9/500	11/860	LHS & RHS

2.9 Existing Road alignment:

The details of project road are explained at Para 2.1 above. There are acute / substandard horizontal curves in the project stretch where realignment is required.

Table 2.4

Sr. No.	Location		Side on which Improvement is required	Remark
	From 'Km'	To 'Km'		
1	4/760	5/160	LHS & RHS	Series of curves before Bythakol junction
2	6/680	6/860	LHS	Near Durbhat road junction
3	7/160	7/340	LHS	Between Durbhat road junction & Shirdoa junction
4	7/500	7/600	RHS	——— do ———
5	8/240	8/360	RHS	Near Shiroda junction
6	10/220	10/380	LHS	After Margao junction
7	11/200	11/320	LHS	Between Margao junction & Loutulim village junction
	11/460	11/780	LHS	——— do ———

2.10 Existing ROW:

As per the available information and site observations the available ROW of the project road varies from 10m to 12m from Dhavli junction (Km. 3/860) to Margao junction (Km. 9/600). From Margao junction to Loutulim (Km. 11/860) width of ROW is 20m. Additional width of ROW is available at junction locations, at high bank portion of approaches of existing bridge etc.

2.10.1 Existing roadway:

a. Carriageway:

Existing road is having carriageway width of 7.00m (Two lane).

b. Shoulders:

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Soft shoulders of about 1.0 m to 1.5m exist on either side of the carriageway.

Most of the length of existing road is at same/ lower level as that of the adjacent ground level. Longitudinal drains along the existing roads are available in certain stretch along the project length.

2.10.2 Existing Pavement:

Existing road consists of flexible pavement and the same is in fair condition.

2.10.3 Existing structures on the Project Road:

a. Major bridges :

There is only one major bridge across river Zuari along the project corridor. Details of the existing Zuari bridge are as follows;

- It is a high level bridge with central nevigation span of 122m (90m nevigable channel)
- Year of construction 1986.
- Total length of the bridge = 460m (including span of Shiroda underpass)
- Width of carriageway 7.5m & 1.5m footpaths on either side
- Type of foundation – Well foundation
- Type of substructure :-
  a) Piers for navigational span : – RCC hollow piers
  b) Piers for remaining spans : – RCC rectangular piers
  c) Spill through abutments
- Type of superstructure :-
  a) for navigational span & either side span of nevigation channel :- Balance cantilever span with PSC box girder
  b) for remaining span – PSC Box Girders
- Wearing course :- RCC wearing course
- Width of river at existing bridge location = 175m

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Table 2.5

Major Bridges

Sr. No.	Location	Span Arrangement
1	Km. 8/550 (Near Borim)	(1 x 122m) + (2 x 61m) + (4 x 38m) & (1 x 35m viaduct across SH-6)

b. Minor bridges :

There is only one minor bridge in project corridor. The detail of minor bridge is as follows;

Table 2.6

Minor Bridges

Sr. No.	Location	Span Arrangement
1	Km. 6/900 (Near Sakvar bus stop)	1 Span X 6.00m

c. Culverts

In the entire project corridor cross drainage works are observed. Mainly there are Pipe and Slab culverts across the project road. It is also observed that there are some structures which cannot be identified, as they are in buried condition. The total numbers of pipe culverts & Slab culverts are as follows;

Table 2.7

Culverts

Sr. No.	Type of Structure	Nos.
1)	Slab Culvert	15
2)	Pipe Culvert	08
3)	Arch Culvert	01
4)	Unidentified / Buried	05
	Total	**29**

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d. Religious Places in Project Corridor:

Following are the religious places located within ROW/ closer to ROW/ outside ROW;

a) Church within ROW at Km. 5/580 between Petrol pump & UCO bank
b) Saibaba temple close to existing road at Km. 7/450
c) Church closer to ROW at Km. 8/450 near existing Zuari River Bridge

e. Utilities along & across the project corridor:

The utilities such as over head electrical line, underground OFC line, water supply line are located along and across the road in majority length. The major utilities are as follows;

a) High Tension tower electrical line located at D/s of existing bridge
b) Water supply line 600mm dia. located at RHS in partial length & at LHS in partial length
c) Over head electrical line along & across the existing road.

2.10.4 Trees & Mangroves in the Project corridor:

a) Trees :-

There are large numbers of trees located along both side of the existing road in entre length.

b) Mangroves:-

Mangroves located along both side banks of the Zuari River. The width of the mangroves varies from 25m to 125m. Beyond 500m on D/s side of the existing bridge width of mangroves is less (25m to 30m)

2.11 Traffic Pattern:-

a) Existing Traffic Pattern

Present traffic crossing the existing bridge across Zuari near Borim has different patterns depending on various aspects in the vicinity of the project corridor. The following aspects are observed in distinguishing present traffic pattern;

a) Over existing bridge across river Zuari on NH-17 near Cortalim, entry for heavy vehicle is prohibited. Hence, heavy commercial traffic coming from Panjim side and leading towards Verna/ Margao/ Karwar & vice versa is plying on NH-17B presently via. Farmagudi, Borim.
b) There is missing link of NH-17B between Loutulim and Verna Industrial Area. Hence heavy commercial traffic leading towards Verna Industrial Area is plying via. Arlem bypass (bypass to Margao city) by travelling additional length.

Following are the present traffic patterns crossing the existing bridge across river Zuari near Borim;

i) Heavy commercial traffic from Panjim, leading to Verna/ Marmagao port/ Margao via. Farmagudi, Borim & vice versa.
ii) Commercial traffic from Belgaum (Belagavi), leading to Verna/ Marmagao port/ Margao via. Amigo junction, Borim & vice versa.
iii) Local traffic from Ponda to Margao & vice versa
iv) Local traffic from Shiroda to Margao & vice versa

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v) Local traffic from Ponda/ Shiroda, leading to Loutulim, Airport, Marmagao port & vice versa.

b) Future Traffic Pattern

Future traffic crossing the existing bridge across Zuari near Borim will have different patterns depending on various aspects in the vicinity of the project corridor. The following aspects will change present traffic present traffic pattern;

a) As explained above, over existing bridge across river Zuari on NH-17 near Cortalim, entry for heavy vehicle is prohibited. Hence, heavy commercial traffic coming from Panjim side and leading towards Verna/ Margao/ Karwar & vice versa is plying on NH-17B presently via. Farmagudi, Borim. Now, construction of new bridge across River Zuari aon NH-17 is in progress. After completion of this bridge traffic from Panjim & leading towards Margao will get shifted over this new bridge on NH-17.

b) As explained above, there is missing link of NH-17B between Loutulim and Verna Industrial Area. Hence heavy commercial traffic leading towards Verna Industrial Area is plying via. Arlem bypass (bypass to Margao city) by travelling additional length. Now, construction of this missing link is in progress. Hence, in future, the traffic leading to Verna MIDC will follow missing link inplace of Arlem bypass road.

Following will be the future traffic patterns crossing the existing bridge across river Zuari near Borim;

i) Commercial traffic from Belgaum (Belagavi), leading to Verna/ Marmagao port/ via. Amigo junction, Borim, Loutulim & vice versa.

ii) Commercial traffic from Belgaum (Belagavi), leading to Margao/ Karwar via. Amigo junction, Borim, Margao junction & vice versa.

iii) Local traffic from Ponda to Margao & vice versa

iv) Local traffic from Shiroda to Margao & vice versa

v) Local traffic from Ponda/ Shiroda, leading to Loutulim, Airport, Marmagao port & vice versa.

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2.12 Traffic data on Project Road (Data collected from PWD)

Table: 2.7

Date of completion of Survey		Fast / Power Driven Vehicles						Slow Vehicles		Total
		Car/ JeepsTaxies / Van / Three Wheeler (Auto include)	Two Wheeler (Motor Cycle, Scooters etc.)	LCV (Light commercial vehicles Mini Truck)	Bus	Two Axle / truck / Tanker	Multi-axle Truck/ Truck / Trailer / Tanker	Cycle / Rickshaw / Other Human Power	Bullock cart, Horse cart / Other Animal Drawn	
22.02.2013	Vehicle numbers	6635	7504	3630	1245	52	2724	35	6	**21831**
	PCU	*3318*	*7504*	*5445*	*3735*	*156*	*12258*	*18*	*36*	***32470***

Location : Near TopCola, Borim

Source : PWD WDXV(NH), Ponda Goa

Date of completion of Survey		Fast / Power Driven Vehicles						Slow Vehicles		Total
		Car/ JeepsTaxies / Van / Three Wheeler (Auto include)	Two Wheeler (Motor Cycle, Scooters etc.)	LCV (Light commercial vehicles Mini Truck)	Bus	Two Axle / truck / Tanker	Multi-axle Truck/ Truck / Trailer / Tanker	Cycle / Rickshaw / Other Human Power	Bullock cart, Horse cart / Other Animal Drawn	
22.02.2013	Vehicle numbers	2804	2208	415	153	7	535	14	1	**6137**
	PCU	*1402*	*2208*	*623*	*459*	*21*	*2408*	*7*	*6*	***7134***

Location : Near Margao Junction

Source : PWD WDXV(NH), Ponda Goa

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2.13 Conclusion of Reconnaissance survey:

- Existing bridge across River Zuari is weak to carry present traffic hence strengthening of existing bridge is being done by the (NH) PWD, GOA alternatively.
- Existing project road is located in valley portion and there are hilly portion on either side from Dhavli to existing bridge.
- Width of the present available ROW is inadequate i.e. 10m to 20m only.
- In majority length, there are habitations along both sides of the existing road.
- In majority length, existing road is at lower level or at original ground level. As per IRC:SP:84-2014 manual, such stretches shall be raised to bring top of subgrade at least 0.5m above general ground level or to bring subgrade bottom level 1m above the HFL/ high tide level.
- Drainage condition in project corridor is satisfactory.
- River Zuari at existing bridge location is Tidal River.
- From Reconnaissance survey it is revealed that;
  a) Present traffic on the project corridor is substantial. The traffic data collected from concern PWD shows that the corridor is due for minimum 4 lane divided carriageway road.
  b) Partial commercial (Heavy vehicle) traffic coming from Panjim and leading towards Verna/ Margao/ Karwar will get diverted after completion of Bridge across Zuari on NH-17 near Cortalim.
  c) Quantum of multi axle trucks is substantial among all the vehicle categories.
- From the available information/ data, it appears that, there is no forest land along the existing road.
- Large numbers of trees will get affected in improvement/ widening of project road. Quantum of the same will be depending on selection of alternative alignment.
- Mangroves are observed along the both side banks of the River Zuari and shall be taken in to account during preparation of the proposal.

2.14 Improvements / upgrading the existing Project Roads:

a) Roadways:

i) Improvement of existing road envisages rehabilitation / upgrading to 4 /6 lane with paved shoulder configuration. The carriageway configuration will be proposed as given below;

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4/6 Lane Divided Highway Without Service Road & With Raised Median

(Open Country Plain/ Rolling Terrain)

		4 Lane road with Paved shoulders	6 Lane road with Paved shoulders
Median	:	5.00 m	5.00 m
Carriageway	:	2 x 7.00 m	2 X 10.5 m
Paved Shoulder	:	2 x 1.50 m	2 x 1.50 m
Soft Shoulder	:	2 x 2.00 m	2 x 2.00 m
Raised Footpath	:	----	1.75m

Source :- IRC:SP:84-2014 Manual – Fig. 2.4 & IRC:SP:87-2013 Manual – Fig. 2.4

Note:- Width of the median will be reduced to 2.5m (if required) to minimize the width of the proposed ROW.

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4/6 Lane Divided Highway With Service Road & With Raised Median

(Built-up section Plain/ Rolling Terrain

		4 Lane road	6 Lane road
Median	:	2.5 m	2.5 m
Carriageway	:	2 x 7.00 m	2 x 10.50 m
Paved Shoulder	:	2 x 2.00 m	2 x 2.00 m
Raised Footpath	:	2 x 2.00 m	2 x 2.00 m
Service Road	:	2x (7.5 m or 5.5 m)	2x (7.0 m or 5.5 m)
Raised Footpath	:	2 x 1.5 m	2 x 1.5 m

Source :- IRC:SP:84-2014 Manual – Fig. 2.6 & IRC:SP:87-2013 Manual – Fig. 2.8

iii) Geometrical Improvement / realignments:

Major locations which require geometrical improvement / realignments are given at Table No. 2.4 in Para No. 2.8 above. However, for proposed new bridge across river Zuari, alternative alignments which include realignment are studied and discussed in this report separately.

b) Structures:

i) Culverts:

New pipe culverts of NP-4 pipes with adequate diameter will be provided as per site requirements. Existing culverts having poor condition will be proposed for

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reconstruction and culverts with good / fair condition will be widened. The width of all culverts will be proposed as follows;

Width of Culvert - equal to width of roadway

(Source: - IRC:SP:84-2014 – Fig. 7.1A & 7.1B & IRC:SP:87-2013 Manual – Fig. 7.1)

ii) Minor Bridges:

Widening / reconstruction / new construction of minor bridges will be proposed as follows;

		4 Lane road	6 Lane road
Carriageway	:	2 x 8.5 m	2 x 10.50 m
Footpath	:	2 x 1.50 m	2 x 1.50 m
Paved Area	:	---	2 x 1.50 m
Total Width	:	2 x 12.50	2 x 15.20 m

(Source: - IRC:SP:84-2014 – Fig. 7.2A & IRC:SP:87-2013 – Fig. 7.2)

iii) Major Bridge:-

New construction of Major bridges will be proposed as follows;

		4 Lane road	6 Lane road
Carriageway	:	2 x 12 m	2 x 10.50 m
Footpath	:	2 x 1.50 m	2 x 1.50 m
Paved Area	:	---	2 x 1.50 m
Total Width	:	2 x 16.00 m	2 x 15.20 m

(Source: - IRC:SP:84-2014 – Fig. 7.3 & IRC:SP:87-2013 – Fig. 7.2)

2.15 Immediate Repairs to Existing Bridge/ road surface:

- Strengthening of existing bridge across Zuari has been undertaken by the PWD (NH), Goa.
- Existing road is in fair/ good condition and hence no immediate repair work is required except routine maintenance of road and drains.

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Chapter - 3

Approach & Methodology

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3.0 APPROACH AND METHODOLOGY:

3.1 General:

For preparation of D.P.R., different activities in field as well as in Design office are to be carried out. These activities are interrelated and it is very essential to have proper approach and Methodology for all these activities in field and design office to accomplish the job of preparation of DPR qualitatively. Such approach and methodology for carrying out different activities in field and in design office have been developed and given in following paras;

While carrying out the field and design office activities as per TOR, the quality of the resulting product has to be of very high standard. We have therefore prepared Quality Assurance Plan (QAP) to keep control over quality and the same is submitted with this report. This document describes the systems proposed to be adopted for quality assurance of different activities, work procedures, methodology, various formats for collecting and reporting field data. The document also includes details of personnel who shall be responsible for carrying out, preparing and checking / verifying the data collected through various activities.

The methodologies for items of work which are not covered under QAP or the activities requiring more elaboration are given in following paragraphs;

3.2 Traffic Surveys:

3.2.1 Objectives of Traffic study:

The objective of the study will be to appreciate the existing traffic demand and the estimate of the present travel characteristics. Based on the present demand figures and the catchment areas, the traffic projection scenario can be build up which will ultimately help in getting desired inputs for various designs. It is proposed to use the outputs from the traffic study for following design parameters;

i) to finalise demand for the number of lanes based on the section wise forecasted traffic figures
ii) to finalise improvement proposal for major junctions based on the turning movement traffic survey
iii) to design the crust of pavement of proposed road/ approaches
iv) to prepare economic and financial analysis

The details of existing traffic pattern observed during reconnaissance survey have been explained in details in Chapter – 2 at Sr. No. 2.14. In order to fulfill above objectives, we have proposed to undertake various traffic surveys. Methodology of each type of proposed traffic surveys, data collection as well as the data analyses are given in this

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chapter. **The locations of each type of traffic survey had been decided based on the present traffic pattern & the same was discussed with the Employer during meeting cum presentation held on 24th Nov. 2016 in the office of the Superintending Engineer, (NH), PWD, at Panjim Goa**. The locations of various traffic surveys carried out are given below.

3.2.2 Types of Traffic Surveys:

3.2.2.1 Classified Traffic Volume surveys:

The classified traffic volume count survey has been carried out for 7 days.

The vehicle classification system as given in relevant IRC code has been followed. The following generalised classification system is adopted in view of the requirement of traffic demand estimates and economic analysis;

Motorised Traffic			**Non- Motorised Traffic**
2- Wheeler			Bi-Cycle
3- Wheeler			Cycle - Rickshaw
Passenger Car			Animal Drawn Vehicle (ADV)
Utility Vehicle (Jeep, Van etc.,)			Hand Cart
Bus	Mini Bus Standard Bus		Other Non- Motorised Vehicle
LCV	LCV- Passenger LCV- Freight		
Truck	MCV	2-Axle Rigid Chassis	
	HCV	3-Axle Rigid Chassis	
	MAV	Semi-Articulated	
		Articulated	

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3.2.2.2Origin-Destination Surveys:

The Origin and Destination survey along with Commodity Movement Survey has been carried out for 1-day (24 hours, both directions) at the locations mentioned in this report. These will be essentially required to estimate the traffic which will get diverted on another

route in future and traffic which will retain in this corridor. The roadside interviews will be conducted on random sample basis.

3.2.2.3 Turning movement counts:

The turning movement surveys for estimation of peak hour traffic have been carried out at each major junction in the project corridor. The methodology adopted for the surveys is as per IRC: SP:41-1994. The locations of turning movement surveys have been given in this report.

The data derived from the survey will be analysed to identify requirements of suitable remedial measures, such as construction of underpasses, flyovers, interchanges, grade-separated intersections along the project road alignment. Intersections with high traffic volume requiring special treatments either presently or in future will be identified.

3.2.2.4 Speed and Delay surveys:

Highway improvement results in speeding up traffic and reducing congestion. A speed and Delay study on existing facility provides the basis for estimating the causative problems and benefits of the improved facility. The speed and delay surveys will be undertaken by moving car method. With the moving vehicle and the enumerators the distance between the junction points will be noted down along with the time needed to travel the distance. The delays will be noted down if observed along with the reasons for the delay. The average journey speed and running speeds for each section will be derived on the basis of the data collected and the analysis. A separate run will be carried out for each direction.

3.2.3 Methodology for Traffic Surveys:

Traffic study for the project road has been carried out as per the guidelines of IRC: SP-20.

Traffic Survey formats are designed for 24 hours volume count of each type of vehicle as per IRC guidelines. The various formats for traffic surveys are given in QAP. Special teams consisting of Traffic Engineer and enumerators were constituted to carry out the surveys. The activity was included;

- Training of enumerators
- Constitution of survey teams
- Carrying out of surveys

Training of Enumerators:

Enumerators identified for deployment of traffic surveys were trained for identification of various categories of vehicles and appropriately filling up of Proforma /formats before the commencement of surveys.

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Survey Teams

Each team was consist of one supervisor and adequate enumerators, depending upon the traffic volume at the survey location.

3.2.3.1 Classified Volume Count Survey:

Classified Volume Count Survey has been carried out manually and counts were recorded at 15 minutes interval. The survey has been carried out for 7 days for 24 Hrs. (continuous and direction wise). The data collected will be computerized in MS-EXCEL software.

Collection of Secondary Data

The following secondary Data will be collected from various sources:

- Previous traffic count data on the project roads available with PWD.
- Accident data from local traffic police.
- Socio- Economic condition of North & South Goa Districts.
- Vehicle registration data from RTO.
- Monthly Petrol, Diesel consumption for one year near project roads to determine seasonality factor.
- Present land use and development schemes in the project area.

3.2.3.2 Methodology for Origin Destination Survey:

The Origin-Destination Survey as well as Commodity Movement Survey has been carried out adopting roadside interview method as detailed in IRC 102-1988. The survey has been carried out for passenger and commercial vehicles for 24 hours at survey locations.

Trained enumerators under the supervision of Traffic Engineer were deployed to collect the trip characteristics.

The O-D survey will elicit passenger mode characteristics like origin and destination, occupancy, trip purpose and length of trip by mode type. For goods modes, the survey will elicit the characteristics like origin and destination, commodity type and length of trip.

3.2.4 Locations of the Traffic Surveys:

3.2.4.1 Locations of the traffic volume count survey and Origin - Destination surveys:

The entire section of the road under consideration was visited and the locations for the traffic surveys had been identified for the traffic volume and O-D surveys. The traffic volume count and O-D surveys have been carried out the following locations;

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Table No. 3.1

Traffic Survey Locations

Station No.	Name of Location for Traffic Volume Count and O-D Survey
A) Traffic Volume Count Survey	
1	At Ch. 8/500 Km between Shiroda Junction and Existing bridge
B) Origin – Destination Survey	
2	At Ch. 6/900Km near Sakvar Bus stop

3.2.4.2 Locations for Turning Movement Surveys

The turning movement surveys have been carried out at all major junctions (intersection with SH/NH). In this project corridor there are three major junction & other junctions are minor junctions i.e. intersection with village/ town road etc.

The locations of turning movement survey are as given in Table No. 3.2.

Table No. 3.2

Turning Movement Survey Locations

Sr. No.	Name of Junction on Project road	Type of Junction	Remark
1.	At Km. 5/200 at Bythakol Junction	Y	Rotary junction SH - bypass to Ponda city
2.	At Km. 8/200 at Shiroda Junction	Y	Rotary junction SH-6 – road leading to Shiroda
3.	At Km. 9/520 at Loutulim Junction	T	SH-5 road leading to Margao

3.2.5 Analysis of Data:

3.2.5.1 Traffic Volume data analysis:

The analysis of data will include the following:

- Average Daily Traffic (ADT) & its composition.
- Hourly variation of traffic
- Peak hour traffic characteristics
- Directional distribution of traffic
- % Composition of different types of vehicles
- Average Annual Daily Traffic (AADT)
- Truck User Characteristics.

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All results will be presented in tabular and graphical forms. The survey data will be analysed to bring out the hourly and daily variations. The traffic volume count per day will be averaged to show a weekly Average Daily Traffic (ADT) by vehicle type. The Annual Average Daily traffic (AADT) will be worked out by applying seasonal factors.

The relevant traffic volume data from secondary sources will also be collected. The salient features of traffic volume characteristic will be determined and variations if any, from the traffic census carried out by the State PWD will be suitably explained.

Table No. 3.3

Standard PCU Factors

Type of Vehicles	PCU Factor
Two Wheelers	0.5
Auto Rickshaw	0.75
6 Seater	1
Car/Vans/Jeeps Taxi	1
Mini Buses	1.5
Govt. Bus	3
Private Bus	3
Goods Auto	0.75
LCVs	1.5
2-Axle Truck	3
3-Axle Truck	4.5
Multi Axle Truck	4.5
Agricultural Tractors with trailers	4.5
Agricultural Tractors without trailers	1.5
Cycle	0.4
Animal Drawn	6

3.2.5.2 O-D Survey analysis:

Zoning

The entire study area/ region will be divided into major zones and sub zones in such a way that the characteristics of inter-zonal and intra-zonal trips could be clearly analyzed and their influence on the project road will be assessed.

With respect to passenger vehicles, trips will be grouped into seven major purposes of movement. They are:

- Work
- Education
- Business
- Social
- Shopping

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- Recreation / Tourist
- Medical / Hospital
- Return Trips
- Others
- Personal Work

With respect to goods vehicles, the types of goods carried are broadly grouped into 11 categories, plus empty trucks.

The commodity groupings are as follows: -

- Food Grains
- Vegetable / Fruits
- Fertilizers
- Petroleum products – LPG, petrol, Diesel etc
- Building Materials
- Textiles
- Household Goods
- Mineral oils
- Heavy Machinery
- Vehicles Carriers
- Others
- Empty

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Sample Size

The sample size for each category of goods vehicles and passenger vehicles adopted 15% to 20% of the total traffic volume in peak period and 25 to 30% in normal periods.

The trip matrices will be worked out for each vehicle type and information on weight of trucks will be summed up by commodity type and the results tabulated, giving total weight and average weight per truck for the various commodity types. The sample size for each vehicle type will be indicated on the table and also in the graphical representations.

The data derived from surveys will also be analyzed to bring out the lead and load characteristics and desired line diagrams. The data analysis will also bring out the requirement for the construction of bypasses especially for the alignments which are passing through the congested villages/towns along the section. The distribution of lead and load obtained from the surveys will be compared with those derived from the axle load

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studies. The commodity movement data will also be taken into consideration while making the traffic demand estimates.

3.2.5.3 Analysis of turning movement survey data:

The survey has been carried out as per IRC-SP: 41-1994. The analysis of turning movement survey at major junctions will help in identifying the volumes along various sections of the road. The analysis will also lead to need for the at grade intersection improvement such as rotary junction, signalization or grade separators etc.

3.2.5.4 Analysis of Speed and Delay survey data:

This will be carried out by using Moving Car Method for the complete project road. The data will be tabulated and analyzed to assess the time delays occurring at junctions, urban locations and village road sections to identify sections with traffic problem, congestions and to assess need for service roads, grade separated crossings, etc.

Three tests runs of vehicle are considered sufficient for the purpose of arriving journey speeds & running speeds. This will include test runs during morning peak, evening peak and off peak.

3.2.6 Methodology for the traffic forecasts:

The traffic demand estimates will be made and possible traffic growth rates in respect of all categories of vehicles will be established.

The values of elasticity of transport demand will be based on the prevailing practices in the country. The complete background including references for selecting the value of transport demand elasticity will be given.

The traffic demand estimates will be done assuming three scenarios, namely, optimistic, pessimistic and most likely traffic growth. The growth factors will be worked out for five-yearly intervals.

The methodology for traffic estimates described in the preceding paragraphs is for normal traffic only. In addition to the estimates for normal traffic, the estimates for generated, induced and diverted traffic will also be worked out.

Overall traffic forecast thus made will form the basis for the design of the cross sectional elements, and other facilities / ancillary works. The details on the model for traffic forecast to be used for the study in the bid proposal will also be provided. Requirement of the proposed lane width will be with respect to traffic demand. While computing demand forecasts, the provision in TOR will also be kept in view.

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3.2.7 Axle Load Survey:

Axle Load survey has been carried out by using Axle Load Pads for 1 day (24 hours) in both the directions at location mentioned below on the project road on a random sample basis as specified in IRC: 37- 2012.

The Axle load data has been collected axle configuration-wise. The vehicles plying on the road were selectively stopped and weighed by using Axle Pad. Assistance of local Police was taken to stop and weigh the vehicles. The number of standard axles per each type of truck will be calculated on the basis of results obtained. The data collected will be analysed and VDF will be worked out for design of pavement.

The Axle Load survey has been conducted at following location on the Project Highway.

Table No. 3.4

Location of Axle Load Survey

Sr. No.	Location of Axle Load Survey
1	At Ch. 6/900 Km near Sankvar Bus Stop

3.3 SURVEY & INVESTIGATION:

3.3.1 Survey & Investigation covered in QAP:

The detailed methodology for the survey & investigation for following items is already covered under QAP:

i) Topographic survey

ii) Road & Pavement investigation survey.

iii) Investigation for bridges and structures.

iv) Hydraulic & Hydrological investigation surveys.

v) Material Investigation.

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3.3.2 Geotechnical Investigation:

Geotechnical investigation will be carried out as per guide lines specified in IRC:SP:19 (latest) & IRC:78 (latest)

Objectives of investigation are to obtain:

(i) Subsurface profile detailing of different stratum and their variation along the alignment. This will help in deciding the founding levels for the proposed structures.

(ii) To determine engineering properties of the different strata and design parameters for evaluating the bearing capacity of the same.

(iii) To determine the ground water table in order to anticipate the problems during construction.

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(iv) To determine design parameters for high embankment and cut section.

(v) To identify and select suitable borrow and quarry locations in minimum lead for various components of work.

a) Hume pipe Culverts & Slab Culverts:

For these structures having fewer spans, it is suggested to excavate the trial pits for identifying the strata. These trial pits will be taken for shallow depths varying from 1 to 2m depending upon the structure and strata. Recommended size of the pit is 1m × 1m. At least one trial pit will be taken at each culvert location.

b) Low Embankments:

- Soil investigations for low embankments will consist of taking trial pits along the alignment for each type of soil strata. Tests will be conducted on each type of soil. Minimum 3 trial pits for each type of soil strata will be taken.
- Pavement investigation will be carried out for the stretch excluding realignment. Trial pits will be taken at 500m to 1000m interval to ascertain the existing pavement crust, to collect existing subgrade soil sample.

Tests to be performed are in-situ and laboratory tests for assessing the bearing capacity.

For Soil:

Laboratory Tests:

- Gradation Test (IS: 2720 Part IV)
- Atterberg limits (IS: 2720 Part V,VI)
- Modified Proctor Density and optimum moisture content (IS: 2720 Part VIII & IS: 2720 Part II)
- 4 days soaked C.B.R. test for subgrade sample

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c) High Embankments:

The basic objective of investigations in high embankments is for checking stability against slip failures. For safety against excessive settlement, consolidation properties are important. It is also required to ascertain the average shear strength of each strata.

- The Boreholes will be terminated at shallow depths when firm strata or bedrock is encountered.
- The boring will be taken to a depth of at least 1.5 times the height of embankment.

- However, where highly compressible strata are encountered, the boring will be taken deeper.

The test on the soil samples will be conducted as per guidelines specified in IRC:SP:19 (Appendix-10). Following important in-situ and laboratory tests on Soil & Rock will be conducted for evaluating the bearing capacity.

For Soil:

In-situ tests

(i) Standard penetration test at 1.5m interval (IS: 2131)

Laboratory Tests:

- Gradation Test (IS: 2720 Part IV)
- Atterberg Limits (IS: 2720 Part V,VI)
- Free Swel Index (perticularly in case of Black cotton soil)
- Consolidation parameters (IS: 2720 Part XV) (Particularly for cohesive soils)
- Shear strength parameters by triaxial test (IS:2720 Part XI)

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d) Bridges:

The scope of detailed investigation for bridges will be decided in consultation with the Employer based on the final alignment for the proposed bridge and based on the data i.e. type of structure with tentative span arrangement and the location and type of foundation. Thereafter, the extent of exploration, number of boreholes, type of soundings, type of in situ tests, laboratory tests etc. will be decided. Geotechnical investigation for bridges will be carried out in accordance with IRC:78 & IRC:SP:19.

The depth of exploration will extend to about 1.5 times the proposed width of foundation. In case of good sound rock the minimum depth will be 3 meters in the rock having Rock Quality Designation (RQD) greater than 60%.

Samples of soils in all cases will be collected at every 1.5m intervals or change of strata.

e) Borrow area selection:

Investigations for soil material required for construction are to be carried out in respect of the likely sources and availability and suitability. Boreholes or trial pits will be made to find the strata below ground and sample will be tested in accordance with the specifications and shall meet the prescribed criteria.

(i) Moisture content, Specific gravity, Classification tests (IS: 1498)

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(ii) Particle size distribution

(iii) Consolidation test, (IS: 2720 Part V)

(iv) Modified Proctor test, (IS: 2720 Part VII or VIII)

(v) CBR (both 4 days soaked and unsoaked samples). (IS: 2720 Part XVI)

f) Quarry locations:

We propose to take boreholes (if permitted by the owner of the quarry) in the proposed quarries for the metal to ascertain the quantity of rock available below the overburden. The numbers of bore holes will be decided on the basis of area of the quarry. If there will be crusher at quarry location, samples from crusher will be collected for testing & data regarding depth of rock will be collected from the owner of the quarry or crusher. These rock samples will be tested for deciding suitability for construction.

Methodology adopted: Methodology is already given in the QAP.

Bridges are to be designed as per relevant IRC standards.

Current Standard & Specifications:

Ministry of surface transport specifications for Road & bridge work will generally be followed. Following IS/IRC specification shall be followed.

For Material

Ordinary Portland cement	IS 269
Coarse aggregate	IS 383
Fine aggregate	IS 383
Bricks	IS 1077
High strength ordinary Portland cement	IS 8112
High yield deformed bars	IS 1786
High tensile steel Strands	IS 14268
Sheathing	IRC-112
Water	IRC-SP-33 1989 Clause 5.1(ii)
Bitumen	IS 73
Binder for tack coat (Emulsion)	IS 8887

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IRC Codes and Specifications for design of Bridges and Structures:

The Design Standards for Bridges and structures will be evolved for safe structure having good durability confirming to various IRC and MOST Specifications.

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The design of structure shall be as per provisions of following IRC Codes.

LIST OF IRC & IRC – SP CODES FOR BRIDGE WORKS

IRC : 5 - 2015	-	Standard Specifications and Code of Practice for Road Bridges, Section I – General Features of Design (Eighth Revision)
IRC : 6 - 2014	-	Standard Specification and Code of Practice for Road Bridges, Section-II, Loads and Stresses (Revised Edition)
IRC : 22 - 2015	-	Standard Specifications and Code of Practice for Road Bridges, Section VI – Composite Construction (Limit States Design / Third Revision)
IRC : 24 - 2010	-	Standard Specifications and Code of Practice for Road Bridges, Steel Road Bridges (Limit State Method / Third Revision)
IRC : 78 - 2014	-	Standard Specifications and Code of Practice for Road Bridges, Section VII – Foundations & Substructures / Revised Editions)
IRC : 83 -2015 (Part – I)	-	Standard Specifications and Code of Practice for Road Bridges, Section IX Bearings, Part I : Roller & Rocker Bearings (Second Revision)
IRC : 83 -2015 (Part – II)	-	Standard Specifications and Code of Practice for Road Bridges, Section IX Bearings, Part II : Elastomeric Bearings (First Revision)
IRC : 83 -2002 (Part – III)	-	Standard Specifications and Code of Practice for Road Bridges, Section IX Bearings, Part III : POT, POT-CUM-PTFE, PIN and Metallic Guide Bearings.
IRC : 87 - 2011	-	Guidelines for Formwork, False work and Temporary Structures (First Revision)
IRC : 89 - 1997	-	Guidelines for Design and Construction of River Training & Control Works for Road Bridges (First Revision)
IRC : 112 - 2011	-	Code of Practice for Concrete Road Bridges

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IRC : 113 - 2013	-	Guidelines for the Design and Construction of Geosynthetic Reinforcement Embankments on Soft Subsoil.
IRC – SP : 13 – 2004	-	Guidelines for the Design of Small Bridges and Culverts (First Revision)
IRC – SP : 51 - 2015	-	Guidelines for Load Testing of Bridges (First Revision)
IRC – SP : 64 - 2005	-	Guidelines for the Analysis and Design of Cast-in-Place Voided Slab Superstructure
IRC – SP : 65 - 2005	-	Guidelines for Design and Construction of Segmental Bridges.
IRC – SP : 66 - 2005	-	Guidelines for Design of Continuous Bridges
IRC – SP : 67 - 2005	-	Guidelines for Use of External and Unbonded Prestressing Tendons in Bridge Structures
IRC – SP : 69 - 2011	-	Guidelines & Specifications for Expansion Joints (First Revision)
IRC – SP : 90 - 2010	-	Manual for Grade Separators and Elevated Structures
IRC – SP : 102 - 2014	-	Guidelines for Design and Construction of Reinforced Soil Wall
IRC – SP : 104 - 2015	-	Guidelines for Fabrication and Erection of Steel Bridges
IRC – SP : 109 - 2015	-	Guidelines for Design and Construction of Small Diameter Piles for Road Bridges.

When the IRC Codes are silent, relevant BIS Codes or other National Codes shall be followed. In general, sound engineering practice shall be adopted for design and construction.

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LIST OF IRC & IRC – SP CODES FOR ROAD WORKS :-

IRC : 2 - 1968	-	Route Marker Signs for National Highways (First Revision)
IRC : 15 - 2011	-	Standard Specifications and Code of Practice for Construction of Concrete Roads (Fourth Revision)
IRC : 27 - 2009	-	Specifications for Bituminous Macadam (First Revision)
IRC : 35 - 2015	-	Code of Practice for Road Markings (Second Revision)
IRC : 36 - 2010	-	Recommended Practice for Construction of Earth

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		Embankments and Sub-Grade for Road Works (First Revision)
IRC : 37 - 2012	-	Tentative Guidelines for the Design of Flexible Pavements
IRC : 38 - 1988	-	Guidelines for Design of Horizontal Curves for Highways and Design Tables.
IRC : 54 - 1974	-	Lateral and Vertical Clearances at Underpasses for Vehicular Traffic.
IRC : 58 - 2015	-	Guidelines for the Design of Plain Jointed Rigid Pavements for Highways (Fourth Revision)
IRC : 62 - 1976	-	Guidelines for Control of Access of Highways
IRC : 67 - 2012	-	Code of Practice for Road Signs (Third Revision)
IRC : 73 - 1980	-	Geometric Design Standards for Rural (Non-urban) Highways.
IRC : 75 - 2015	-	Guidelines for the Designs of High Embankments (First Revision)
IRC : 80 - 1981	-	Type Designs for Pick-up Bus Stops on Rural (i.e. Non-urban) Highways.
IRC : 81 - 1997	-	Guidelines for Strengthening of Flexible Road Pavements using Benkelman Beam Deflection Technique
IRC : 86 - 1983	-	Geometric Design Standards for Urban Roads in Plains
IRC : 90 - 2010	-	Guidelines for Selection, Operation and Maintenance of Bituminous Hot Mix Plant (First Revision)
IRC : 92 - 1985	-	Guidelines for the Design of Interchanges in Urban Areas
IRC : 93 - 1985	-	Guidelines on Design and Installation of Road Traffic Signals
IRC : 98 - 2011	-	Guidelines on Accommodation of Utility Services on Roads in Urban Area (Second Revision)
IRC : 106 - 1990	-	Guidelines for Capacity of Urban Roads in Plain Areas
IRC : 109 - 2015	-	Guidelines for Wet Mix Macadam (First Revision)
IRC : 110 - 2005	-	Standard specifications and Code of Practice for Design and Construction of Surface Dressing
IRC : 111 - 2009	-	Specifications for Dense Graded Bituminous Mixes
IRC – SP : 11 - 1984	-	Handbook of Quality Control for Construction of Roads and Runways (Second Revision)
IRC – SP : 12 - 2015	-	Guidelines for Parking Facilities in Urban Roads (First Revision)
IRC – SP : 19 - 2001	-	Manual for Survey, Investigation and Preparation of Road Project (Second Revision)

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IRC – SP : 23 - 1983	-	Vertical Curves for Highways
IRC – SP : 50 - 2013	-	Guidelines on Urban Drainage
IRC – SP : 84 - 2014	-	Manual of Specifications & Standards for Four Laning of Highways Through Public Private Partnership
IRC – SP : 87 - 2013	-	Manual of Specifications & Standards for Six Laning of Highways Through Public Private Partnership

Durability Aspects:

The proposed corridor falls under Aggressive Environment and hence the structure on this corridor will be classified under severe condition. The appropriate durability measures shall be taken accordingly. The project road falls in seismic zones III. Accordingly the forces shall be taken into account. Importance factor shall be decided at the time of detailed engineering.

3.4 ENVIRONMENTAL IMPACT ASSESSMENT:

3.4.1 Introduction:

This Inception Report on Environmental Impact Assessment (EIA) provides the Project Team, an opportunity to review the proposed work plan and to make desirable modifications. Interpreting and planning the Environmental Components are given high priority for road projects. As a recent guideline makes clear, the environment evaluation is not a tack on to the job of designing and constructing roads. Rather, it is an integral part of the complete process. The environmental evaluation influences design and project selection. The environmental analysis therefore interacts with the economic evaluation and the design process.

The report presents a detailed methodology the consultant proposes to adopt in the project. The discussion is structured into separate sections: First, a methodology for natural environmental analysis, Second, secondary data needs and proposed field survey; and Third, a preliminary assessment of the natural environmental components utilizing preliminary strip maps and Rapid Assessment Survey.

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3.4.2 Natural Environment:

Roads improvement/development Projects, though intended to enhance the quality of life along the corridors, do generally result in significant impacts on the environmental components. These impacts do have a potential to trigger off impacts thereby impairing the ecology and environment of a larger area than the study area, which may eventually

culminate in certain significant impacts. Some of the major environmental impacts of Bridge Projects include damage to sensitive ecosystems, loss of productive agricultural lands etc.

The objectives of Environmental Impact Assessment (EIA) will be to influence the decision making process, provide a clear assessment of potential impacts, devise a methodology/strategy which assesses and predicts impacts, provides the means for impact prevention and mitigation, enhancement of project benefits and minimization of long term impact and provide a forum for stakeholders consultation to enable their direct impact to the Environmental Management Process (EMP). EIA in essence will optimize the overall performance of the corridor with environmental safe guards. EIA will therefore, effectively address the environmental issues and concerns and propose adequate measures to minimize the potential adverse impacts likely to result from the project.

The natural Environmental Impact Assessment (EIA) ensures that the highway development process will take into account the sensitive environmental features and bottlenecks and incorporate an Environmental Management Strategy (EMS) for effective implementation and monitoring of the measures suggested. EIA will also achieve the internalization of environmental concerns at the planning design and construction stages of the project.

The following sub-sections discuss briefly the methodology to be adopted for the execution of the natural environmental assessment of the Project Corridor. The natural EIA process involves three major components: Initial Environmental Examination (IEE), Environmental Management Plan (EMP) and Monitoring Environmental Compliance during construction and operational phase.

3.4.3 Environmental Impact Analysis:

3.4.3.1 Methodology

The methodology for the Environmental Impact Assessment is given in outline form below:

The environmental study comprises of five primary stages:

- Collection and analysis of secondary data
- Field reconnaissance surveys to assess the corridor and identify the basic environmental attributes
- Field surveys to assess the base line status of environmental attributes on air, water, noise and soil / land
- Environmental Impact Screening and assessment

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- Identification of a suitable method for monitoring the suggested mitigation measures to develop an Environmental Management Plan (EMP) and an Environment Monitoring and Disaster/Accident Management Scheme.

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3.4.3.2.1 Analysis of Alternatives

Various alternatives have been considered of the bridge alignment as discussed in Chapter 6 of this report. The following factors have been considered for various alternatives on environment point of view:

- Length of the alignment and land acquisition and type of land.
- Impact on mangroves existed along the river.
- Tree cutting involved
- Distance from creek and applicability of costal regulation zone clearances.
- Household impacted due to proposed bridge.
- Safety with respect to curves and alignment.
- Connectivity with existing highways.
- Impact on agricultural and other allied activities

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3.4.4 Project Road Influence Area and Study Corridor

- **Project Influence Area**

  These will incorporate the following data:

  - Location
  - Climate
  - Demographic Statistics
  - Forests, Wild life (Natural Parks, Wild life Sanctuaries, other ecological attributes like wetlands etc.)

- **Study Corridor**

  The study corridor covers a sufficiently wide strip on either side of the road alignment.

3.4.5 Secondary Data Collection & Analysis

The objective is to gather information on the regional orientation of the basic elements of environment. For example:

- Topography
- Drainage
- Climate (wind direction. Relative humidity, temperature and rainfall)
- Archaeological places

- Biological wealth, including forests, wetlands, wildlife reserves, sanctuaries, sensitive, critical natural habitats, if any.

3.4.6 Field Reconnaissance Surveys

Field Reconnaissance Surveys has been carried out to assess the corridor. During such visit, locations for setting up ambient air quality monitoring stations, background noise levels, and monitoring and base line water and soil quality status are identified.

Based on the analysis of secondary data collected and site assessment, the preliminary environmental screening process will identify the significant environmental issues. This will pave way for further detailed assessment of the environmental attributes.

3.4.7 Field Surveys

Field surveys for assessment of base line levels will be taken up subsequently.

- **Air Quality**

  Ambient air quality monitoring will be carried out to establish the base line concentrations of various parameters, including:

  - Particular Matter 10
  - Particular Matter 2.5
  - Sulphur Dioxide (SO2)
  - Oxides of Nitrogen (NO)
  - Carbon Monoxide (CO)

  This work will be carried out at residential, commercial, sensitive and industrial areas. Meteorological parameters like wind direction wind speed, relative humidity, temperature and rainfall will be collected during the entire monitoring period.

- **Water Quality**

  Water quality sampling locations will include various ground water and surface water sources along the alignment such as, rivers, lakes, streams and ground water. The samples will be analyzed for various physical, chemical and biological parameters.

- **Noise Level**

  Background noise levels will be monitored for both daytime and night time values at various residential, industrial and sensitive areas. Equivalent sound level values will be computed. Using this data, noise quality models will be developed.

- **Soil/Sediment Quality**

  Soil/sediment data will be collected for agricultural and dry lands, riverbanks and river sediments and will be analyzed for various physical, chemical and biological parameters.

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- **Other Environmental Attributes**

  Field Surveys will also identify:

  - Trees to be removed within the right of way
  - Areas where the right of way is encroached
  - Areas where road widening activities may result in involuntary eviction of people
  - As the proposed improvement is mostly to be confined within the existing right-of-way, detailed air and noise modeling etc are not contemplated by NHAI.

3.4.8 Data Analysis and Interpretation

The generated primary data and collected secondary data will be compiled, collated and analyzed. The data will then be interpreted to define the base line regional environmental status, including features of the right of way.

3.4.9 Environmental Impact and Mitigation Measures

Environmental impacts on each of the attributes will be evaluated, adopting the relevant impact prediction processes and procedures. The assessment will include specifying the source of negative impacts in the context of project location, construction and operation stages.

Feasible mitigation measures will be recommended to minimize / offset the identified negative impacts. Measures for enhancement of the environment such as roadside plantations will be recommended. The norms used by the Asian Development Bank would be integrated with those used by the Government of India in this regard.

3.4.10 Environmental Management Plan (EMP)

An environmental Management Plan (EMP) will be formulated to identify the methods of monitoring implementation of mitigation measures including institutional framework.

3.4.11 Proforma for Data Collection

Following field data collection will be conducted at site.

- Environmental Survey
- Tree Inventory
- Environmental Screening check
- Environmental Scooping check
- Environmental Questionnaire

3.4.12 Time Schedule for Report Submission and Task Completion

- The Environmental Monitoring along with secondary data collection will be carried out within a month after finalization of alignment for the proposed bridge.

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- The Draft EIA will be completed and submitted in stage - II.
- The Final EIA will be submitted within 1 month after incorporating comments, if any on Draft Report.
- The Environmental Clearances / Wild Life Clearances/ CRZ Clearances documents will be submitted in stage - I, if applicable.

3.4.13 Clearances

a) The Consultants will facilitate various clearances such as environmental, forest, wild life, CRZ as applicable from the concerned authorities.

3.5 Cost Estimate:

3.5.1 Rate Analysis:

For preparing bill of quantities rate analysis for different items will be prepared on the basis of standard data book of MORT&H as under:

i) Listing of materials / Labour / machinery for different items.
ii) Preparation of lead charts for material based on material investigation surveys & obtain material rates from Market.
iii) Obtaining labour rates for unskilled / semiskilled / skilled labour from Market / minimum wages act of State Govt.
iv) Obtaining rates for machinery from Market or from P.W.D.
v) Working out the rates of different items using the rates obtained as above based in standard data book of MORT&H.
vi) Compare the rate with common schedule of rate of P.W.D. for Goa region.
vii) Rate analysis by collecting market quotations for new/ innovative items to work out fair rates.

3.5.2 Preliminary Cost:

Preliminary costs of project road for feasibility study will be worked as under:

- Rough cost to be determined for road portions after working out the unit cost per km of various items required for execution in accordance with the proposed cross-section of road for this work,

Lump sum provisions will be made on the basis of past experience for improvement of junctions.

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- Cost of bridges and culverts will be based on the cost per running meter or cost per sq. metre of deck which will be arrived at on updating the cost of previous such structures.
- Provisions will be made for other charges and non civil charges as per standard practice of MoRT&H as follows;

  - Contingency charges @ 2.8% of civil construction cost
  - Supervision Consultancy charges @ 3% of civil construction cost including contingency charges
  - Agency charges @ 3% of civil construction cost including contingency charges
  - Quality Control charges @ 0.25% of civil construction cost including contingency charges
  - Road Safety & Audit charges @ 0.25% of civil construction cost including contingency charges
  - Escalation @ 5% of civil construction cost for 2 years
  - Maintenance Charges @ 2.5% of civil construction cost for 4 years
  - Environmental Impact Mitigation Measures @ 1% of civil cost
  - Relocation of utility services (rough assessment to be ascertained from client departments & to be detailed out in DPR)
  - Land acquisition (rough assessment as per reconnaissance to be detailed out in DPR)
  - An abstract will be prepared for the total preliminary cost of the project.

3.5.3 Final Cost Estimate:

Final cost estimate will be based on the working drawings and specifications using analysis of rates. The cost estimate will consist of following sub-estimates:

- Proposed bridge estimate across River Zuari
- Road/ approaches estimate
  - ✓ Site Clearance & dismantling
  - ✓ Earthwork
  - ✓ Granular Base Course and sub-base
  - ✓ Pavement
- Minor Bridges / Flyover / Subways
- Culverts
- Drainage & protective work

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- Junctions
- Road Furniture
- Way side amenities

Provisions will be made for other charges and non civil charges as per standard practice of MoRT&H as follows;

- Contingency charges @ 2.8% of civil construction cost
- Supervision Consultancy charges @ 3% of civil construction cost including contingency charges
- Agency charges @ 3% of civil construction cost including contingency charges
- Quality Control charges @ 0.25% of civil construction cost including contingency charges
- Road Safety & Audit charges @ 0.25% of civil construction cost including contingency charges
- Escalation @ 5% of civil construction cost for 2 years
- Maintenance Charges @ 2.5% of civil construction cost for 4 years
- Environmental Impact Mitigation Measures – as per estimate
- Relocation of utility services (rough assessment to be ascertained from client departments & to be detailed out in DPR)
- Land acquisition (rough assessment as per reconnaissance to be detailed out in DPR)
- An abstract will be prepared for the total preliminary cost of the project.

3.6 LAND ACQUISITION, UTILITY LOCATION & RELOCATION PLAN:

3.6.1 Land Acquisition Plan:

This will indicate the following on Revenue village maps.

- Final center line of the road.
- R.O.W. limits.
- Buildings / wells / monuments / trees / any other obstruction coming in R.O.W.
- Type of land (e.g. irrigated, wet, dry, barren, hilly, etc.)
- Nature of crops.
- Ownership data of land / structure which will be collected from Revenue department.

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Calculation of area of each survey no. by actual measurement.

3.6.2 Identification of Utility Services which are to be relocated:

- Final center line of road.
- R.O.W. limits.
- Location of utility services such as telegraphic poles, electric poles, water mains, sewer lines and any other obstruction not covered under rehabilitation and resettlement action plan.

3.6.3 Relocation Plans:

Relocation plans of each utility service such as telegraphic poles / electric poles / water mains / sewer lines will be prepared in consultation with PWD (NH) and utility provider is responsible for shifting these services after applying due procedure.

Proper co-ordination will be made with the forest department. Drawings indicating location of trees and their marked numbers will be given through PWD (NH) to concern department with an undertaking that amount of compensation in lieu of felling of trees will be paid by PWD (NH). The time schedule by which the ROW required for project roads is to be made free from encumbrances will be indicated. Similar procedure will be followed for all other utility services.

3.6.4 Clearance required – The clearances required and the authority responsible are as under:

- Removal of trees - Principal Chief Conservator of Forest
- Telegraph poles - Telegraph Department
- Electric poles - State Electricity Distribution Co.
- Water mains - State water supply department / Concerned Local administration
- Encroachments - Local administration
- Environmental clearance - Ministry of Environment & Forest, Govt. of India
- CRZ clearance - Ministry of Environment & Forest, Govt. of India

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3.7 ECONOMIC & FINANCIAL ANALYSIS:

3.7.1 Economic Analysis:

The economic evaluation will be carried out within the broad framework of social cost benefit analysis. The economic analysis will be based on incremental costs and incremental benefits, i.e. comparing the total transport cost in situation "with the project"

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and "without the project", with the costs and benefits expressed in economic terms for avoiding distortions in the input prices of labour, material, equipment and foreign exchange.

The costs and benefits will be computed for each year over the analysis period. The result will be expressed in Economic Internal Rate of Return (EIRR) and Net Present Value (NPV). The economic analysis is proposed to be carried out using World Bank developed "Highway Development and Management Model" (HDM IV). The model generates total transport costs (user plus agency cost) in "with" and without" the project situation. The difference in costs due to road improvement "with the project and also Transport cost without improvement" is considered as the benefit accruing from road improvement.

For appraisal purposes, a comparison between total transport cost for the project road "with the project" and "without the project" situations will be worked out on yearly basis for the entire analysis period which will be taken to be 20 years from opening the improved works. The concept behind the approach is that if the project is implemented, the benefits accrued will decrease operating cost when compared to the cost of alternative foregone i.e. base cost or without project situation. The cost components considered in the analysis will be as follows.

Road Costs	Road user Costs
• Construction cost including design and supervision costs. • Maintenance cost over a period of life of project road.	• Vehicle Operating cost • Other User Costs (like travel time costs) • Accident

Sensitivity of EIRR and NPV will be worked out under different scenarios as follows:

- Base Cost and base benefit.
- Base Cost increased by 15% plus base benefit.
- Base Cost plus base benefit reduced by 15%.
- Base Cost increased by 15% and Base benefit reduced by 15%.

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3.7.2 Financial Analysis:

The objective and methodology of financial analysis is described as given below:

The main objective of financial analysis is to find out the likely returns to the investor. The different options like financing through debt and equity, loan repayment, debt servicing, taxation, depreciation etc. are covered in this. The viability of the project will be evaluated

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on the basis of cash flow analysis, where both costs and revenue have been indexed to take account of inflation.

Financial viability analysis will be done on the basis of a financial model developed by us. The model projects the key financial statements of the investor over the concession period. Financial analysis will be carried out for 20 yrs concession and two years construction period for the project viable on BOT (with or without VGF) as specified in TOR.

All investment costs and capital expenses will be identified in the year in which they are deemed to occur. A 5 % inflation rate per annum will be applied to all cost and revenue items.

The cost of construction is to be financed through both equity and loan. A Debt- Equity ratio of 1.5:1 would be appropriate as most financial institutions hesitate to lend at higher leverages and also in view of the fact that a high gearing invariably subjects projects to substantial financial risks. A 20 year period for construction loan repayment will be assumed. The rate of interest considered will be in line with the prevailing lending rates of financial institutions. The actual financial parameters to be adopted in the analysis will be reviewed after gathering additional data from published sources and finalized in consultation with PWD (NH).

Depreciation of capital items will be calculated by using two methods, viz. the Written Down Value (WDV) Method and the Straight Line Method (SLM). The WDV method favours income shielding and is, therefore, used only to calculate taxes payable by the concessionaire. The rate permitted for a toll road enterprises, viz. 10 percent will be used in the analysis.

A tax holiday (i.e. 100 percent tax exemption on profits) for a block of 5 years and a 30 percent tax relief for the next 5 years will be assumed as per the Government's latest incentives for encouraging investments in the road sector. The 30 percent tax rebate can be availed of by the entrepreneur, provided the money is deposited in a special fund for infrastructure. These tax incentives must be availed within the first 20 assessment years of operation. The corporate tax rate adopted will be based on the latest Finance Bill.

3.8 BID DOCUMENT:

The type of contract whether BOT, annuity or EPC will be proposed after financial analysis. After analysis, if it is found that the work is financially viable on BOT basis, the documents will be prepared accordingly. MoRTH has prepared standard concession agreement, the annexures to this concession agreement will be prepared as per DPR. If

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the proposal is not viable on BOT basis the Annuity / EPC contract document including Bill of Quantities, terms and condition of contract will be prepared as per MoRTH standard bid document for Annuity / EPC. As specified in TOR, Bid documents will be prepared as per MORT&H/ Planning commission.

3.9 DRAWINGS:

After the collection of field data, investigation & survey, the design of components of roads, bridges, structures, drainage and miscellaneous items such as parking area and rest places will be done. Following drawings will be prepared on the basis of the designs.

Roads:

- Index map.
- Road map.
- Technical notes.
- Proposed X-sections indicating the proposal for rehabilitation of existing lanes, design layers for additional lines, central median and drainage.
- Plans indicating the alignment of existing lanes and proposed lanes, geometry of the road, location of structures, details of Longitudinal profile indicating ground level. Finished Road Level, gradient, location of reference to RL bench mark and reference to chainage.
- Details of horizontal curves including super-elevation details, transition lengths.
- Details of vertical curves.
- Details of drainage.
- Details of intersections.
- Details of road signs and their locations.
- Strip plans indicating location / relocation of utility services.
- Strip plans indicating ROW and boundary pillars, requirements of acquisition of land for widening, including form I & XIV extract of land.
- Drawing for toll plazas, bus bays etc.

Bridges & Structures:

- Index map.
- Plan for each bridge indicating name of stream and highway crossing and plan of stream for an adequate length & width on each side which will cover the area beyond the influence of HFL/ HDL.
- Technical Notes
- Flow of water

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- Alignment of road along with angle of crossing
- Position of bridge
- Location of X-sections taken on u/s and d/s
- Bed material characteristics
- Location of BM
- Reference of Chainage
- Any other characteristics of stream
- Location of bore holes, if any

➢ L-section of stream, X-sections of stream & L-sections of approaches BL, LWL, OFL, HFL, LDL, HTL etc., width of stream and formation level at the centerline of the approaches. The reference of BM and reference to Chainage will be indicated on drawing.

➢ Plan for the structure (grade separator) indicating roads depicting all features in plan along with the proposal for additional lanes.

➢ For grade separator, L-section indicating various clearances as per requirements along with grades and levels.

➢ GAD and X-sections for major bridge including important details such as navigational span, minimum vertical clearance, obligatory requirements etc.

➢ GAD and X-sections for minor bridges.

➢ GAD and X-sections for culverts.

➢ Details of foundations, sub-structure and superstructure for each bridge and structure.

➢ Miscellaneous drawings for bearings, expansion joints, wearing course, railing and drainage spouts, approach slab, run-on slab, friction slab etc.

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Chapter - 4

Task Management & Manning Schedule

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4.0 TASK ASSIGNMENT AND MANNING SCHEDULE

4.1 General:

To meet the requirement of the terms of reference, the entire work has been split into various tasks as given in Table 4.1. Assignment of tasks to various professionals is given in Table 4.2. Manning Schedule is attached to the report.

Stages of submission given in TOR have been modified to make proper sequence to complete the project in précised and systematic manner. The modified stages of submission / activities are given in Table No. 4.1 below.

Table 4.1: Task Activities

TASK NO.	DESCRIPTION
	Stage–I : Quality Assurance Plan (QAP) Document & Inception Report (IR)
101	Mobilization
102	Collection and Review of Data and Documents
103	Reconnaissance Survey and Project Appreciation
104	Preparation of Quality Assurance Plan
105	Task Assignment and Manning Schedule
106	Work Programme
107	Design standards and Proposed cross sections
108	Preparation of Various Alternative Alignments
109	Preparation & submission of Inception Report
110	Obtaining approval to the alternative alignment & Inception report
	Stage–II : Selection of the best alignment & geometrics, Survey, Investigation & GAD
201	Inventory and Condition survey of Road, Bridges, culverts & other structures
202	Traffic Surveys and analysis
203	Topographic Survey along selected alignment
204	Road and Pavement Investigations
205	Materials Investigations
206	Hydraulic and Hydrological Investigations
207	Environmental Screening and Preliminary environmental assessment

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TASK NO.	DESCRIPTION
208	Finalization of Design Standards
209	Pavement (Type) Option Study and Preliminary Design of Pavement
210	Preparation of General Arrangement Drawing for the proposed bridges
211	Preparation of Plan & L-Section for the approaches & road stretch
212	Approximate Cost Estimates
213	Obtaining approval to the GAD & other drawings from competent authorities
214	Geotechnical Investigation and Sub-soil exploration in accordance with approved GAD
215	Preparation of socio-economic profile of Project area
216	Initial Social assessment and Preliminary land acquisition / resettlement plan
217	Preparation & submission of proposal for clearances such as environmental, CRZ, forest etc.
218	Shifting of Utility study report
219	Submission of Feasibility Report
220	Obtaining approval to the Feasibility Report
	Stage–III : Final Report , Technical Schedules for EPC / BOT Project and Bid Document
301	Detailed Design of Bridges & Road
302	Preparation of Detailed GAD in accordance with Geotechnical Investigation
303	Detailed Drawings
304	Preparation of Detailed Cost Estimate
305	Updated Economic Analysis and Financial Analysis
306	Technical Specifications
307	Final Environmental Impact Assessment (EIA) Report
308	Final Social Impact Assessment (SIA) Report including Resettlement action plan (RAP)
309	Preparation of Bid Documents including schedules for EPC / BOT Project.
310	Submission of Final Report

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TASK NO.	DESCRIPTION
	Stage–IV : Project Clearances
401	To assist the Employer in Land Acquisition
402	Obtaining Clearance such as Environmental clearance from MoEF, CRZ, forest etc. (if required)

4.2 Team Composition

The team comprises of various key personnels assisted by technical and administrative support staff. The tasks have been assigned to various key personnels, technical support staff and administrative support staff as given in Table 4.2

Table 4.2

Task Assigned to Key Personnels

Sr. No.	Name of Key Personnel	Position	Task Assigned.
1.	Mr. Y. G. Patwardhan	Team Leader cum Bridge Engineer	• Reconnaissance survey and preparation of Inception Report including Finalisation of methodology in consultation with client. • Finalisation of data formats and requirements for field investigation. • Co-ordination with client and other agencies. Finalising alternative alignment and working out Merits and Demerits. • Deciding design standards for the Project. • Scheduling of all field, design and documentation issues. • Collection and compilation of data, development of Data Bank. • Geometric Design of Alignment and Design of pavements of approaches. • Directions to multidisciplinary team to finalise reports, documents and drawings. • Time schedule and management.

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Sr. No.	Name of Key Personnel	Position	Task Assigned.
			• Presentation to client on alternative alignment. • Design finally selected alignment of bridges. • Scheduling of all design and documentation activities. • Preparation of tender documents including 'Schedules' as required. • Identify utility shifting, including overhead towers etc. and processing the same for clearances. • Getting the LA Plan for final alignment prepared and processing the same. • Processing the case for Environmental clearances, Forest clearances etc.
2.	Mr. P. J. Navalakha	Material cum Geo – Tech / Foundation Engineer	• Finalisation of requirements for field studies for sub-soil exploration of bridges, structures and embankment. • Assisting soil investigation, testing and interpretation. • Selection of engineering parameters for design of embankment, foundation of bridge structures etc. • Broad Design of high embankment. • Identification of different material sources. • Deciding suitability, ownership and economic viability of sources.
3.	Mr. M. P. Mina	Highway Engineer	• Deciding highway design standards Geometric design of alignment of finally selected alignment. • Giving requirements for field studies for pavement investigation and periodic inspection during surveys. • Finalisation and adoption of pavement

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Sr. No.	Name of Key Personnel	Position	Task Assigned.
			design standards. • Selection of parameters for pavement design. • Design of pavements for existing roads and additional carriageway, service road etc. • To check adequacy of proposed pavement.
4.	Mr. R. A. Oak	Hydrologist	• To study hydraulic aspects of construction of new bridge including discharge HFL, LWL, Scour, Velocity etc. • To evolve river training measures for reducing high concentration of flow at the bridges if required. • To assess the effect of rise in concentration of flow on the local scours at the piers and to suggest protection measures. • To decide location, orientation, waterway. • To evolve effect of new Bridge on the existing one.
5.	Mr. Jayesh Modi.	Senior Survey Expert	Guiding Survey Team to carry out the following activities; • GPS survey, topographical survey, other structures, service lines, trees, poles, taking spot levels and preparing plans indicating all these details, establishing bench marks. • L. A. plans • Various field surveys such as inventory & condition survey, R&R survey, tree cutting survey etc.
6.	Mr. S. S. Korlekar	Traffic Engineer cum Road Safety Expert	• Collection of existing data of traffic study of traffic pattern. • Finalization of requirements for field studies with respect to traffic volume and other characteristics.

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Sr. No.	Name of Key Personnel	Position	Task Assigned.
			• To guide the team in carrying out various traffic surveys • Analysis of traffic volume and characteristics. • Improvement / upgrading requirements for intersection. • Design of intersections, Traffic control and safety measures. • Establishing probable traffic on the new bridge and rate of growth of the traffic.
7.	Mr. P. B. Sanghani	Financial Analyst	• Review of policies and institutional frame work. • To carry out financial analysis • Obtaining requisite approval from competent authorities.

SUB PROFESSIONAL STAFF:-

SR. No.	Name	Position	Task assigned
1.	Mrs. Smita Shinde	Asst. Bridge Engineer	• To assist the Bridge Engineer to carry out inspection and condition survey of existing bridges and cross drainage works and other structures • To assist the Bridge Engineer to prepare GAD of the proposed Bridges & other structures • To assist the Bridge Engineer to analyze soil data and decide the type of foundation of new bridges in consultation with Material cum Geo – Tech / Foundation Engineer • To assist hydrologist for hydraulic study and analysis • Carry out design of bridges and other structures including preparation of drawing

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SR. No.	Name	Position	Task assigned
			• Assist in the preparation of reports including detailed project report and drawings for the construction of the projects. • Assist in preparation of bid documents.
2.	Mr. Santosh Suryawanshi	Asst. Highway Engineer	• To assist the Highway Engineer to undertake site visits, reconnaissance surveys, examination of possible alignment of bypasses and intersection improvement • Supervise survey and investigation of the roads, bridges and culverts. • Prepare geometric design of the alignment and decide on the land acquisition required • To assist the Highway Engineer in pavement design • Prepare land acquisition proposal • Assist in the preparation of reports including detailed project report and drawings for the construction of the projects. • Assist in preparation of bid documents.

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SR. No.	Name	Position	Task assigned
3.	Mr. Amar Prajapati	Asst. Material Engineer	• Assist Material Engineer to organize Geo-technical investigations and sub-soil exploration for proposed bridges, ROBs / Viaducts / Interchanges etc. and along high embankments and any other location as required for proper design of works. • Assist Pavement Engineer for pavement condition survey, design of pavement. • Organize laboratory and field tests on soil and rock samples. • Obtain available information relating to ground conditions in the vicinity of the project site and prepare desk study. • Assessment of ground investigations required to be carried out. • Interpretation of results of ground investigations. • Organize Material Investigations. • Input and advice to the design engineers while preparing the alternative options and later during detailed designs for the project.
4.	Mr. Karan Shirsat	Asst. Traffic cum Road Safety Engineer	• Assist Traffic Engineer to organize and carry out traffic surveys. • Analysis of traffic volume and characteristics data and forecast of traffic. • Suggest improvements of intersections and junctions. • Work out special treatments by way of grade separators for intersections with high traffic flows. • Identify ancillary road works like traffic signals, road lighting, service roads, toll plazas, parking areas, wayside amenities etc.

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SR. No.	Name	Position	Task assigned
			• Build traffic model. • From traffic model / survey, assist in preparation design of the road. • Assist the Traffic and safety expert in preparing the reports.
5.	Mr. Vinay Aversekar	Survey Engineer	• Assist Sr. Survey Engineer for Initial field surveys (including utilities) • Carrying out topographical survey using Total Station, GPS for development of computer based terrain model of high accuracy for the final design of the proposed upgrading • Detailed surveying for preparation of land acquisition and human re-settlement planning • Carrying out detailed surveys of proposed bypasses, intersections, services roads, approach roads longitudinal and cross sections for proposed bridges and other structures • Carrying out various surveys such as inventory & condition survey, R&R survey, tree cutting survey etc. • Establishment of permanent pillar blocks for transferring new alignments along with R.O.W. • Interaction with the design team during design and preparation of reports
6.	Mr. Akash Lendave	Asst. to Environmental Expert	• Assist environmental specialist to carry out the Environmental Impact Assessment including screening analysis. • Assist during preparation of Environmental Management Plan. • Assist during preparation of designs for

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SR. No.	Name	Position	Task assigned
			environmental mitigation measures. • Assist during preparation of EIA and EMP.
7.	Mr. D. V. Chavan	R & R Expert	• Reconnaissance survey • Study maps and update settlement along / within the ROW of the project roads. • Inventory of the land hold, settlements and properties. • Prepare socio-economic baseline information. • Assist in working out cost of physical properties within ROW including the extent of unauthorized encroachments. • Develop the strip plans showing the existing roadside development. • Assist the government in legal aspects to notify the Project Affected Persons and to ensure further encroachment / settlement after study commencement. • Delineation of R & R plans and policies in highway projects. • Identification of alternative resettlement sites and resettlement budget. • Discuss with Govt. agencies to develop strategies for resettlement action plans, including environmental public hearing and community participation. • Prepare reports on social impact assessment including initial social screening. • Prepare R&R plans.
8.	Mr. Sanjay Pardeshi	Quantity Surveyor	• Assist quantity surveyor, Documentation expert to • Interact with the other professional staff to understand the design output.

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SR. No.	Name	Position	Task assigned
			• Study and review drawings before preparation of bill of quantities. • Review the Schedule of Rates available with the local PWD • Carrying out rate analysis as per Standard Data Book of MoRT&H • Update the Schedule with the prevailing basic rates of items. • Responsible for preparation of preliminary and final cost estimate. • Assist in preparation of Tender documents and schedules.
9.	Mr. V. M. Bagwe	Financial Analyst	• Financial Analysis of project • Funding options • Economical & commercial analysis
10.	Mr. Hamja	CAD Expert	• Development of plans, sections and relevant drawings using computer software packages.

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Chapter - 5

Design Standards

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5.0 DESIGN STANDARDS

5.1 General:

The Geometrics of the Highway is required to be designed to provide optimum efficiency in traffic operation with maximum safety at reasonable cost. It is possible to design the pavement in stages. But improvement to geometrics is very difficult and expensive in stages and hence it is very important to plan and design the geometric features of the alignment in initial stages only, considering this aspect the design standards are prepared for this project.

5.2 Design Standards:

The standards prescribed in IRC / MORT&H / BIS are adopted in general. Where Indian standards are silent or where required under the TOR, the applicable sections of AASHTO / BS / ASTM will be adopted for design.

Considering the physical condition and cost effectiveness, the improvement proposals are conceived and developed under following standards.

i) The desirable standards, which could be adopted as a rule.

ii) The minimum standards, which could be accepted for difficult stretches where application of the desirable standards, would lead to exorbitant costs.

Accordingly, design standards for geometric elements have been proposed under "desirable" and "minimum" categories. These proposed standards are consistent with and fall within the parameters recommended in the related standards of the Indian Roads congress. **Mainly, specifications and standard given in IRC:SP:84-2014 (for 4 lane highway with paved shoulder) & IRC:SP:87-2013 (for 6 lane highway) will be adopted.**

5.3 Geometric Design:

5.3.1 Terrain Classification:

The following terrain classification recommended by IRC is proposed to be adopted:

Table - 5.1

Terrain Classification	Percentage slope of the country
Plain & Rolling	Up to 25
Mountainous & Steep	More than 25

(Source IRC:SP:84-2014 – Table 2.1)

Project road passes through rolling terrain.

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5.3.2 Design Speed:

Design speed is the basic parameter, which determines geometric features of the road. The proposed design speeds for different terrain categories are as follows:

Table - 5.2

Terrain Classification	Design Speed	
	Desirable	Minimum
Plain & Rolling	100	80
Mountainous & Steep	60	40

(Source IRC:SP:84-2014 – Table 2.1)

As far as possible desirable design speed shall be the guiding criteria for designing of different elements. However, where constraints exist the minimum design speed will be adopted. In case for any major constraint where minimum design speed will not be possible, less design speed will be adopted with intimation to the client and the same will be given in concern schedule of bid document.

5.3.3 Cross Sectional Elements:

a. Right of way (R.O.W.):

In the stretches where realignment of existing road for geometrical improvements and where bypasses are proposed, land will have to be acquired. However, width of ROW will be finalized in consultation with PWD (NH).

b. Roadway width:

As per TOR existing road is to be upgraded to min. 4 lanes with paved shoulders. Total roadway width for different elements will be as under.

For 4 Lane road:-

i) For Road ... 26m

ii) Culverts ... Culverts will be widened / constructed to the same width of roadway.

iii) Minor bridges ... 2 x 12.5m (2+2 lanes with foot path on both sides)

iv) Major bridges ... 2 x 12.5m (2+2 lanes with foot path on both sides) for 6 lane future widening ... 2 x 16m (3+3 lanes with foot path on both sides)

v) Grade separators ... 2 x 14.5m (3+3 lanes)

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For 6 lane road:-

i) For Road ... 33m

ii) Culverts ... Culverts will be widened / constructed to the same width of roadway.

iii) Minor bridges ... 2 x 15.20 m (3+3 lanes with foot path on both sides)

iv) Major bridges ... 2 x 15.20 m (3+3 lanes with foot path on both sides)

v) Grade separators ... 2 x 13.40 m (3+3 lanes)

c. Width of carriageway :

4/6 Lane Divided Highway Without Service Road & With Raised Median

(Open Country Plain/ Rolling Terrain)

		4 Lane road with Paved shoulders	6 Lane road with Paved shoulders
Median	:	5.00 m	5.00 m
Carriageway	:	2 x 7.00 m	2 X 10.5 m
Paved Shoulder	:	2 x 1.50 m	2 x 1.50 m
Soft Shoulder	:	2 x 2.00 m	2 x 2.00 m
Raised Footpath	:	----	1.75m

Source :- IRC:SP:84-2014 Manual – Fig. 2.4 & IRC:SP:87-2013 Manual – Fig. 2.4

4/6 Lane Divided Highway With Service Road & With Raised Median

(Built-up section Plain/ Rolling Terrain

		4 Lane road	6 Lane road
Median	:	2.5 m	2.5 m
Carriageway	:	2 x 7.00 m	2 x 10.50 m
Paved Shoulder	:	2 x 2.00 m	2 x 2.00 m
Raised Footpath	:	2 x 2.00 m	2 x 2.00 m
Service Road	:	2x (7.5 m or 5.5 m)	2x (7.0 m or 5.5 m)
Raised Footpath	:	2 x 1.5 m	2 x 1.5 m

Source :- IRC:SP:84-2014 Manual – Fig. 2.6 & IRC:SP:87-2013 Manual – Fig. 2.8

d. Camber:

Camber will be provided to road length on straight reach. The proposed camber will be as under.

(i) Bituminous / Concrete surface - 2.5%

(ii) Concrete surface - 2%

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(iii) Earthen shoulder - 3%

On divided carriageway with median unidirectional cross slope will be provided.

e. Side slopes:

For fill section the following side slopes are proposed.

(i) Fill upto height 6 m - 2H : 1V

(ii) Fill height exceeding 6m - To be designed as high embankment

Cut slopes will be as follows:

(i) Soil / murum - 2H :1V

(ii) Soft disintegrated Rock - 1H : 2V

(iii) Hard Rock - 1H : 4V to near vertical

5.3.4 Sight Distance:

The design of summit curve will correspond to at least stopping sight distance. The values as per IRC recommendations are as follows.

Table - 5.3

Design speed (km /hour)	Safe stopping sight distance (M)
100	180
80	130
65	90
40	45

(Source IRC: SP:84-2014 – Table 2.7)

5.3.5 Horizontal Alignment:

Horizontal curve will consists of a circular portion with spiral transition curve on both ends. While upgrading the road as far as possible the existing features will be maintained. However, where the curves are substandard, the improvement will be done at such locations.

a) Radii of Horizontal curve:-

Minimum radius of curve will be kept as per IRC:38-1988 for corresponding design speed. However, minimum radii of horizontal curves for different terrain will be kept as follows;

Terrain	Desirable Minimum Radius	Absolute Minimum Radius
Plain and Rolling	400 m	250 m
Mountainous & steep	150 m	75 m

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(Source IRC: SP:84-2014 - Table 2.6)

b) Super Elevation:-

The super elevation will be calculated by using following formula;

$e = V^2 / 225 R$

Where,

e - Superelevation in percent

v - Design speed in km/hr

R - Radius in m.

Super elevation will be restricted to 7% max if the radius of curve is less than the desirable minimum. It will be restricted to 5% if the radius of curve is more than desirable minimum.

(Source IRC: SP:84-2014 - Clause 2.9.3)

c) Radii beyond which no super elevation is required:-

Minimum radii beyond which no super elevation for Camber of 2.5% is required will be as per IRC: 38 - 1988 & will be as under:

Table - 5.4

Design speed km/hr	Minimum Radius
100	1800 m
80	1100 m
65	750 m
50	450 m
40	280 m
30	160 m

(Source IRC: 38 – 1988)

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d) Transition curves: -

Transition curves will be provided as stipulated in IRC:38 - 1988 for corresponding speed & type of terrain.

e) Widening of carriageway on curves:-

The minimum radius of horizontal curves will be provided as per IRC: 38 – 1988, also, the paved shoulders are proposed, hence, no widening on curves is proposed. If, however, substandard or sharp curves are required to be provided due to site constraints extra widening on curves will be proposed as per IRC:38 - 1988.

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5.3.6 Vertical Alignment:

The vertical alignment shall be such that it shall provide a smooth vehicle movement on the road for design speed.

a) Gradient :-

The gradients to be adopted will be as under;

Table - 5.5

Terrain	Ruling gradient (Percent)	Limiting gradients (Percent)
Plain or rolling	2.50 (1 in 40)	3.3 (1 in 30)
Mountainous	5.00 (1 in 20)	6.0 (1 in 16.7)
Steep	6.00 (1 in 16.7)	7.00 (1 in 14.3)

(Source IRC: SP-84-2014 – Table 2.8)

b) Vertical curves :-

Vertical curves will be designed for safe stopping sight distance corresponding to the design speed. Valley curves will be designed for head light sight distance. Maximum length of vertical curves will be as per IRC:SP:23 - 1983 as reproduced below.

Table - 5.6

Maximum length of vertical curves

Speed (Km/Hr)	Length of Summit curve for stopping sight distance (m)	Length of valley curve for headlight sight distance(m)	Minimum Length of vertical curve (m)
100	73.6 x A	41.5 x A	60
80	32.6 x A	25.3 x A	50
65	18.4 x A	17.4 x A	40
50	8.2 x A	10.0 x A	30
40	4.6 x A	6.6 x A	20
30	2.0 x A	3.5 x A	15

(Source IRC:SP 23- 1983).

'A' is the algebraic difference in grade expressed as percentage.

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5.3.7 Intersection Design:

There are some major /important junctions with National Highway/ MDR on the project road. The efficiency, safety, speed, cost of operation and capacity of road system depends on design of intersection and hence intersection designs are very important.

The designs will be prepared on the basis of guidelines given in IRC: SP- 41-1994 "Guide lines on Design of at grade intersections in Rural and Urban Area. From turning movement surveys if it is revealed that traffic is heavy and grade separated junction is justified, the grade separated junction will be proposed at such locations.

5.3.8 Pavement Design:

The main aim of the pavement design is to provide structurally stable, durable pavement, with a minimum maintenance cost during post construction period. It will also provide stable and even surface of good riding quality for the traffic with less vehicle operating cost and high comfort level.

A] New Flexible Pavement:

Design of the flexible pavement will be carried out based on procedure given in IRC: 37-2012 and AASHTO. Design parameters will be as under.

i) Traffic:

Initial traffic will be as per traffic survey carried out at site.

ii) Traffic growth rate:

The available data of traffic for previous 5 years will be scrutinized and growth rates will be decided. If, sufficient data is not available then traffic growth rate as given is IRC 37 will be adopted.

iii) Design life:

Design life for flexible pavement will be considered as 15 years as per IRC: 37-2012.

iv) Distribution of commercial traffic over carriageway.

v) Vehicle damage factor:

Vehicle damage factor will be worked out from Axle load survey data.

vi) C.B.R.:

Laboratory C.B.R tests for fill material to be obtained from borrow areas will be carried out. Based on laboratory tests, values of 4 days soaked C.B.R., the flexible pavement will be designed.

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B] Strengthening of existing flexible pavement / overlays:

The design will be based on the analysis of Benkelman Beam Deflection (BBD) test data as described in IRC-81-1997 and stipulations given in TOR. Homogeneous sections will be identified with

(i) Roughness coefficient using bump integrator.

(ii) Pavement condition survey.

The parameters such as Design life, design traffic will be considered as per pavement design for new carriageway for flexible pavement. The other parameters such as subgrade soil classification, temperature, moisture content etc. will be collected at the time of field investigation.

Paved shoulders:-

Paved shoulders will be provided with pavement composition same as that of the main carriageway.

C] New Rigid / CC Pavement:

Design of CC pavement will be carried out based on the procedure given in IRC: 58-2015. The design parameters will be as given below.

i) Traffic:

Initial traffic will be as per traffic survey carried out at site. For, four lane divided carriageway, the design traffic will be 25% traffic of total traffic of the direction under consideration.

ii) Traffic growth rate:

The available data of traffic for previous 5 years will be scrutinized and growth rate will be decided. If, sufficient data is not available then traffic growth rate as given is IRC: 58 will be adopted.

iii) Design life:

Design life for rigid pavement will be considered as 30 years as per IRC: 58-2011.

iv) Expected repeatations of Axle load:

From axle load survey data, the expected repetitions of axle loads, stress ratio, cumulative fatigue life consumed etc. will be calculated as per the procedure given in IRC:58.

vi) C.B.R.:

Laboratory C.B.R tests for fill material to be obtained from borrow areas will be carried out. Based on laboratory test values of 4 days soaked C.B.R., the strength of subgrade (k – subgrade modulus of reaction) will be taken.

vii) Tie bars & Dowel bars:

The design of Tie bars & Dowel bars will be done as per the procedure given in IRC:58.

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5.3.9 Design of High Embankments:

The design of embankment where embankment height is more than 6m will be done as per IRC-75-1979 and MoRT&H Guide lines "Computer aided design system for high embankment".

5.3.10 Design of Drainage:

The requirement of the roadside drainage system and the integration of the same with the proposed cross-drainage system will be worked out for the entire length of the project road section. It consists of draining following road elements. Following types of drains will be proposed.

i) Open drains: - Trapezoidal drains will be proposed between utility corridor and embankment toe in Rural areas.

ii) Hill side – V shaped drains with P.C.C.

iii) Chute drain - Where height of bank is more than 3 m, chute drains at every 25 m will be proposed.

iv) Subgrade drainage – Layer of G.S.B. will be extended for full width of the formation to take care of subsoil drainage.

v) Built up drains: - RCC/ CC drains will be provided in ..

1) built-up sections/ urban areas

2) due to space constraints, the drains located closer to toe of embankment or near structures

3) RCC box type drains will be provided across cross roads leading to the project road.

The drainage systems will be studied in detail as per IRC SP: 42-2014.

5.3.11 Design of Bridges / Structures:

1. Bridges

The methodology for the designs and drawings for the existing and proposed bridge structures is proposed as under:

a. Review of Past Studies, Reports and Data in order to have complete background of the bridges, reports of all past studies will be examined and utilized for project preparation.

Data relevant to bridges will be collected from the PWD and irrigation department. The following data will generally be looked for to the extent available.

- Inventory of existing bridges
- Hydrology and geo-technical reports of the existing bridges.

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- 'As built' drawings of existing bridges along with their design calculations, if available.
- Any plans for remodeling canals and drains crossing the alignment. Proposals, if any, for increasing the railway lines (future tracks) at Level crossings by the Railway Department.
- Details of repair / rehabilitation, if any, carried out for the existing bridges.
- Nature and extent of damage observed during floods to any of the existing bridges.
- Utility services to be carried over the bridges.

Any other engineering data found suitable for the detailed engineering of the proposed bridge structure will also be reviewed.

a) Retention of Existing Bridges

Based on condition survey of the existing bridges, an assessment will be made whether any of the bridges can be retained after carrying out repairs or not. In case any bridge is found to be beyond economical repairs. Then reconstruction of new 3 lane bridge will be proposed at this location.

b) New Bridges

As per TOR, it is proposed to construct a high level bridge on river Zuari is to be constructed, if required 6 lane carriageway with foot paths on either side will be proposed in consultation with PWD (NH).

c) Design Philosophy for New Structures

It will be ensured that the superstructure and substructure proposed for new bridges will be made aesthetically pleasing. The form selected will be innovative and cost effective. Design of proposed structures and preparation of their general arrangement drawing (GAD's) will be as per provisions contained in the following IRC Codes.

A) Standard Specifications and Codes of Practice for Road Bridges

IRC: 5-1998	Standard Specifications and Code of Practice for Road Bridges. Section-I - General Features of Design.
IRC: 6-2014	Standard Specifications and Code of Practice of Road Bridges. Section – II - Loads and Stresses

IRC: 112-2011	Code of Practice for Concrete Bridges.
IRC:22-2015	Composite construction for road bridges. (Section VI – Composite Construction)
IRC: 78-2014	Standard Specifications and Code of Practice for Road Bridges. Section – IV - Foundations and Substructure.
IRC: 83-2015	Standard Specifications and Code of Practice for Road Bridges, Section-IX - Bearings Part – I - Metallic Bearings.
IRC: 83-2015	Standard Specifications and Code of Practice for Road Bridges, Section-IX-Bearings Part – II – Elastomeric Bearings.
IRC: 83-2002	Standard Specifications and Code of Practice for Road Bridges, Section-IX-Bearings Part – III – POT, POT cum PTFE, PIN and Metallic Bearings.
IRC: SP-37-2010	Evaluation of load carrying capacity of bridges.
IRC:40-2002	Standard Specifications and Code of Practice for Road Bridges, Section IV – Brick, Stone and Block Masonry (Second Revision)
IRC-54-1974	Lateral and Vertical Clearances at Underpasses for Vehicular Traffic.
IRC:89-1997	Guidelines for Design and Construction of River Training & Control Works for Road Bridges (First Revision)
IRC:SP:18-1978	Manual for Highway Bridge Maintenance Inspection
IRC:SP:40-1993	Guidelines on Techniques for Strengthening and Rehabilitation of Bridges
IRC:SP:51-2015	Guidelines for Load Testing of Bridges (First Revision)
IRC:SP:64-2005	Guidelines for the Analysis and Design of Cast-in-Place Voided Slab Superstructure
IRC:SP:65-2005	Guidelines for Design and Construction of Segmental Bridges
IRC:SP:66-2005	Guidelines for Design of Continuous Bridges

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IRC:SP:67-2005	Guidelines for Use of External and Unbonded Prestressing Tendons in Bridge Structures
IRC:SP:69-2011	Guidelines & Specifications for Expansion Joints (First Revision)
IRC:SP:71-2006	Guidelines for Design and Construction of Pretensioned Girder of Bridges
IRC:SP-90-2010	Manual for Grade Separators and Elevated Structures
IRC:SP-102-2014	Guidelines for Design and Construction of Reinforced Soil Walls

B) Any I.R.C. standard specifications and codes of practice or criteria for road bridges other than "A" above.

C) For any item not covered by A & B above, specification for Road and Bridge works published by I.R.C. for Ministry of Road Transport & Highways.

D) For items not covered by any of the A, B and C above, standards and specifications, provisions of I.S. Codes of practice.

E) For pre-cast segmental construction 'Guide to good practice' recommendation for segmental construction in pre-stressed concrete published by FIP will be used for aspects other than those covered in A, B, C & D above.

F) For any item not covered by A, B, C, D & E above, the relevant provision from B.S./AASHTO Codes.

G) For items not covered by any of the above Standards and Specifications sound Engineering practice and provisions of relevant Codes of other nation will be referred.

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5.3.12 Traffic Safety Features, Road Furniture and Road Markings:

Suitable traffic safety features and road furniture including traffic signals, signs, markings, overhead sign boards, crash barriers, delineators, cat eyes etc. will be designed and their locations will be given as per the National Highways standards as given in IRC:SP:84-2014.

5.3.13 Arboriculture and Landscaping:

Existing road is lined with trees on both sides in majority of proposed road stretches.

For arboriculture and landscaping following guidelines will be followed:

- Existing plantation shall be retained as far as possible.
- Efforts will be made to continue the same type of plantation as exists on road side. The central median of the four lanes will be provided with dwarf shrubs to avoid the glare of

headlights traveling from the opposite direction. Suitable landscaping will also be proposed at toll plaza, junctions etc.

5.3.14 Bus Bays, Bus Shelters, Parking areas and Rest areas:

The location and number of existing Bus bays, bus shelters, parking areas and rest areas will be ascertained in the entire road network of project influence area and deficiencies in their numbers will be suitably met with by locating extra bus bays, parking areas and rest areas along road side. These provisions will be made as per IRC:SP:84-2014.

5.3.15 Specifications:

Ministry of Road Transport & Highways, "Specifications for Road and Bridge works, (fifth revision) – 2013" will be made applicable for various items of execution. For the items which are not covered in MoRTH, the specifications will be drafted by using relevant codes such as BIS, AASHTO or any good industry practice and incorporated in bid documents suitably after consultation with client. For materials respective I.S. specifications will be followed.

5.3.16 Proposed X – Sections of Roads & Bridges:

As per TOR, it proposed to construct a High Level New Bridge along with its Approaches across River Zuari at Borim on NH-17B (NH-566). Proposed cross sections for the roads as well as for bridges & grade separators are given in drawing volume separately.

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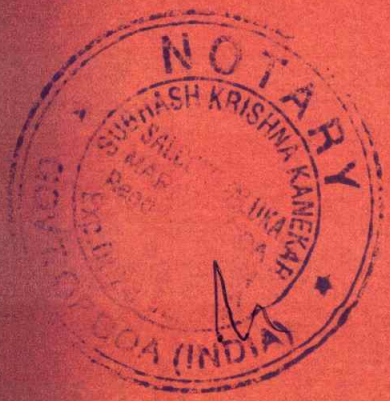
Chapter - 6

Alternative Alignments



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6.0 ALTERNATIVE ALIGNMENTS:

6.1 General:

The scope of work includes identification of alternative alignments for the proposed River Bridge across River Zuari. The realignment minimum up to 2 Km or more, if situation warrants for smooth flow of traffic is included in the scope of work. Accordingly, various alternatives have been studied and explained in this chapter. The emphasis while study of the alternative alignments has been given for the followings;

- the proposed alignment shall be economical,
- smooth flow of traffic shall be ensured,
- to provide best possible geometrics,
- least disturbance to the mangroves located along the banks
- access to the local traffic shall be ensured,
- least numbers of structures shall be affected,
- to ensure minimum adverse impact to the environment,
- to minimize the numbers of tree cutting.

Basically, the alternatives alignments are studied for the proposed new Bridge across River Zuari and its approaches. The stretch between Bythakol junction to Loutulim end is undertaken and covered in this alternative alignments as per demands of each alternative. For the road stretch between Dhavli and Bythakol junction, eccentric widening of existing road to 4/ 6 lane road will be proposed and necessary local realignment/ curve improvement will be proposed as per site situation. The locations of realignments/ curve improvement have been explained in Chapter – 2.

6.2 Constraints:

Followings are the main constraints in the project corridor which are considered during the study of the alternative alignments;

- width of available ROW is inadequate (varies from 10m to 20m),
- there is habitation closer to the existing road in majority length,
- from Dhavli junction to existing bridge location, there is hillock on either side of the existing road,
- large numbers of trees are located in hillock portion as well as along the existing road,
- mangroves located along the banks of River Zuari,
- Margao junction (junction of NH-17B with SH-5) is located at close distance of 720m from the River Bank.

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6.3 Alternative Alignments:

Considering the constraints, 7 alternative alignments have been studied taking in to account the various issues mentioned at sr. no. 6.1. Out of 7 alternatives, 5 alternatives are proposed at D/s of the existing bridge and remaining 2 are proposed at U/s side of the existing bridge. The details of each alternative such as location, merits, de-merits, possible junction improvements etc. are as follows;

6.3.1 Alternative Alignment No. 1:

- **Location:**

  Alternative 1 alignment for the new Zuari Bridge is proposed at a distance of 950m at D/s side of the existing Zuari River Bridge. With this alternative , total length of the NH-17B between Dhavli junction and Loutulim end from existing Km. 3/860 to Km. 11/860 will be 6.25 Km against present 8.00 Km. Refer drawing no. 869-ZB-ALT I-001 of drawing volume for alternative alignment no. 1.

- **Proposed Bridge Location:-**
  - 950m at D/s side of the existing Zuari River Bridge,
  - Width of Zuari River at this location = 430m,
  - the alignment of the proposed bridge in River portion = straight & at right angle to the flow,
  - Width of mangroves along the banks of River Zuari = 20m to 40m.

- **Path:**

  From Bythakol junction to Loutulim end the alignment will be passing as follows;
  - between Bythakol junction & road leading to Borim village, through campus of Topcola company (which is not functional now),
  - from Borim road to Durbhat junction, through agricultural land located at LHS of existing NH-17B road,
  - from Durbhat junction to River Zuari, through agricultural land located at Borim side bank of the River & at RHS of existing NH-17B road
  - from River Zuari to existing NH-17B at Loutulim end, through agricultural land located at Loutulim side bank of the River & will join the existing NH-17B road at a chainage Km. 11/250.

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➢ **Land Use**:

Land use alogn the proposed alignment is as follows;

- between Bythakol junction & road leading to Borim village, through campus of Topcola company – Open land with trees,
- from Borim road to Durbhat junction - agricultural land
- from Durbhat junction to River Zuari - agricultural land (paddy field)
- from River Zuari to existing NH-17B at Loutulim end - agricultural land (paddy field)

➢ **Geometry of the alignment**:

For the alternative 1 alignment, following geometry (horizontal & vertical) is possible;

- the alignment of the proposed bridge will be straight in River portion & at right angle to the flow,
- design speed of 100 Km/Hr for bridge & both side approaches,
- design speed of maximum 80 Km/Hr for realignment stretch between Durbhat junction & Bythakol junction to minimize numbers of affected structures,
- approach on Loutulim side will be in curve (with design speed of 100 Km/Hr) so as to provide grade separated intersection at Loutulim end,
- since, entire alignment will be passing through plain land, for vertical geometry, flatter longitudinal gradients as specified in IRC codes are possible.

➢ **Affected Structures**:.

In this proposed realignment, approximately 09 numbers of existing structures will be affected. The details are as follows;

- 3 abandon structures located in TopCola company campus ,
- 2 small shops of temporary nature located adjoining existing road near Borim road junction,
- 4 shops cum houses of semi-permanent nature at Durbhat road junction.

Grade Separators proposed:

- Flyover along NH-17B at Bythakol junction
- Vehicular underpass at Loutulim end for traffic coming from Margao on NH-17B
- Vehicular underpasses at Borim junction & Durbhat junction

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➢ **Accesses to the local traffic on NH-17B:**

- Up & down ramp from new bridge approach (Borim side) will be provided for local traffic from Shiroda/ Borim & leading to Margao/ Verna & vice versa.
- This local traffic will use proposed vehicular underpasses at Borim & Durbhat junction for right turn to avoid conflict with the traffic of NH-17B.
- Local traffic crossing the Zuari River can use existing bridge till its balance life span.
- After opening of new alignment NH-17B for traffic, existing road can be utilized for local traffic.

➢ **Merits & De-merits:**,

Various merits & demerits of the alternative alignment no.1 are given below.

- Saving in length of the NH-17B will be 1.75 Km.
- Since, majority length will be passing through open/ agricultural land, tree cutting involved will be less.
- Increase in length of traffic from Bythakol to Margao and vice versa direction will be 680m.
- Flatter gradients for vertical geometry can be provided.
- Less area of mangroves will be affected since width of mangroves along the banks of River Zuari is less at this location (between 20m to 40m).
- Grade separated junctions can be provided at major junctions located in realignment stretch.
- Existing available land within the existing ROW can be utilized for a length of 500m.

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ALTERNATIVE ALIGNMENT NO. - 1

6.3.2 Alternative Alignment No. 2:

- **Location:**

  Alternative 2 alignment for the new Zuari Bridge is proposed at a distance of 470m at D/s side of the existing Zuari River Bridge. This realignment is proposed for stretch of NH-17B between Bythakol junction and Margao junction. With this alternative, total length of the NH-17B between Dhavli junction and Loutulim end from existing Km. 3/860 to Km. 11/860 will be 8.22 Km against 8.00 Km. Refer drawing no. 869-ZB-ALT II-001 of drawing volume for alternative alignment no. 2.

- **Proposed Bridge Location:-**
  - 470m at D/s side of the existing Zuari River Bridge,
  - Width of Zuari River at this location = 330m,
  - the alignment of the proposed bridge in River portion = straight & at right angle to the flow,
  - Width of mangroves along the banks of River Zuari = 20m to 40m at Borim side bank & 150m at Loutulim side bank.

- **Path:**

  From Bythakol junction to Loutulim end the alignment will be passing as follows;
  - between Bythakol junction & road leading to Borim village, through campus of Topcola company (which is not functional now),
  - from Borim road to Durbhat junction, through agricultural land located at LHS of existing NH-17B road,
  - from Durbhat junction to River Zuari, through agricultural land located at Borim side bank of the River, just behind the habitation located along the existing road at RHS.
  - from River Zuari onwards, through agricultural land located at Loutulim side bank of the River & will join the existing NH-17B road at a chainage Km. 9/450 near Margaon junction (in front of Chougle shipping industry).
  - from Margaon junction to Loutulim end, existing NH-17B route will be followed.

- **Land Use:**

  Land use alogn the proposed alignment is as follows;
  - between Bythakol junction & road leading to Borim village, through campus of Topcola company – Open land with trees,
  - from Borim road to Durbhat junction - agricultural land
  - from Durbhat junction to River Zuari - agricultural land (paddy field)

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- from River Zuari to existing NH-17B at Loutulim end - agricultural land (paddy field)

➢ **Geometry of the alignment:**

For the alternative 2 alignment, following geometry (horizontal & vertical) is possible;

- the alignment of the proposed bridge will be straight in River portion & at right angle to the flow,
- design speed of maximum 80 Km/Hr for bridge & both side approaches,
- design speed of maximum 80 Km/Hr for realignment stretch between Durbhat junction & Bythakol junction to minimize numbers of affected structures,
- Immediately after the new bridge, the proposed alignment will in curvature (with max. design speed of 80 Km/Hr) for both side approaches.
- For Margao side approach, steeper gradient (more than 1:30) may be required.

➢ **Affected Structures:**,

In this proposed realignment, approximately 16 numbers of existing structures will be affected. The details are as follows;

- 3 abandon structures located in TopCola company campus ,
- 2 small shops of temporary nature located adjoining existing road near Borim road junction,
- 4 shops cum houses of semi-permanent nature at Durbhat road junction.
- 3 shops + 4 houses of semi – permanent to permanent nature at Margaon junction (affected due to proposed at grade junction improvement)

➢ **Grade Separators proposed:**

- Flyover along NH-17B at Bythakol junction
- Vehicular underpasses at Borim junction & Durbhat junction

➢ **Accesses to the local traffic on NH-17B:**

- Up & down ramp from new bridge approach (Borim side) will be provided for local traffic from Shiroda/ Borim & leading to Margao/ Verna & vice versa.
- This local traffic will use proposed vehicular underpasses at Borim & Durbhat junction for right turn to avoid conflict with the traffic of NH-17B.
- Local traffic crossing the Zuari River from Borim side to Margao side can use existing bridge till its balance life span for one way traffic only. Both way traffic will not be possible due to improvement of Margaon at grade junction. Refer drawing no. 869-ZB-JL-002 of drawing volume.

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- After opening of new alignment NH-17B for traffic, existing road can be utilized for local traffic.

➢ **Merits & De-merits:**

Various merits & demerits of the alternative alignment no.2 are given below.

- Increase in length of the NH-17B will be 0.22 Km.
- Since, majority length will be passing through open/ agricultural land, tree cutting involved will be less.
- Length of the stretch for traffic from Bythakol to Margao and vice versa direction will not be changed.
- Since approaches are proposed along the boundary of agricultural land, there will not be bifurcation of this land in 2 parts.
- For Margao side approach, steeper gradient (more than 1:30) may be required.
- Approximately 16 numbers of existing structures will be affected.
- More area of mangroves will be affected since width of mangroves along the Loutulim side bank of River Zuari is more at this location (150m).
- Margao junction can be improved as at-grade junction only. Provision of grade separator along NH-17B will lead to increase in numbers of affected structures.

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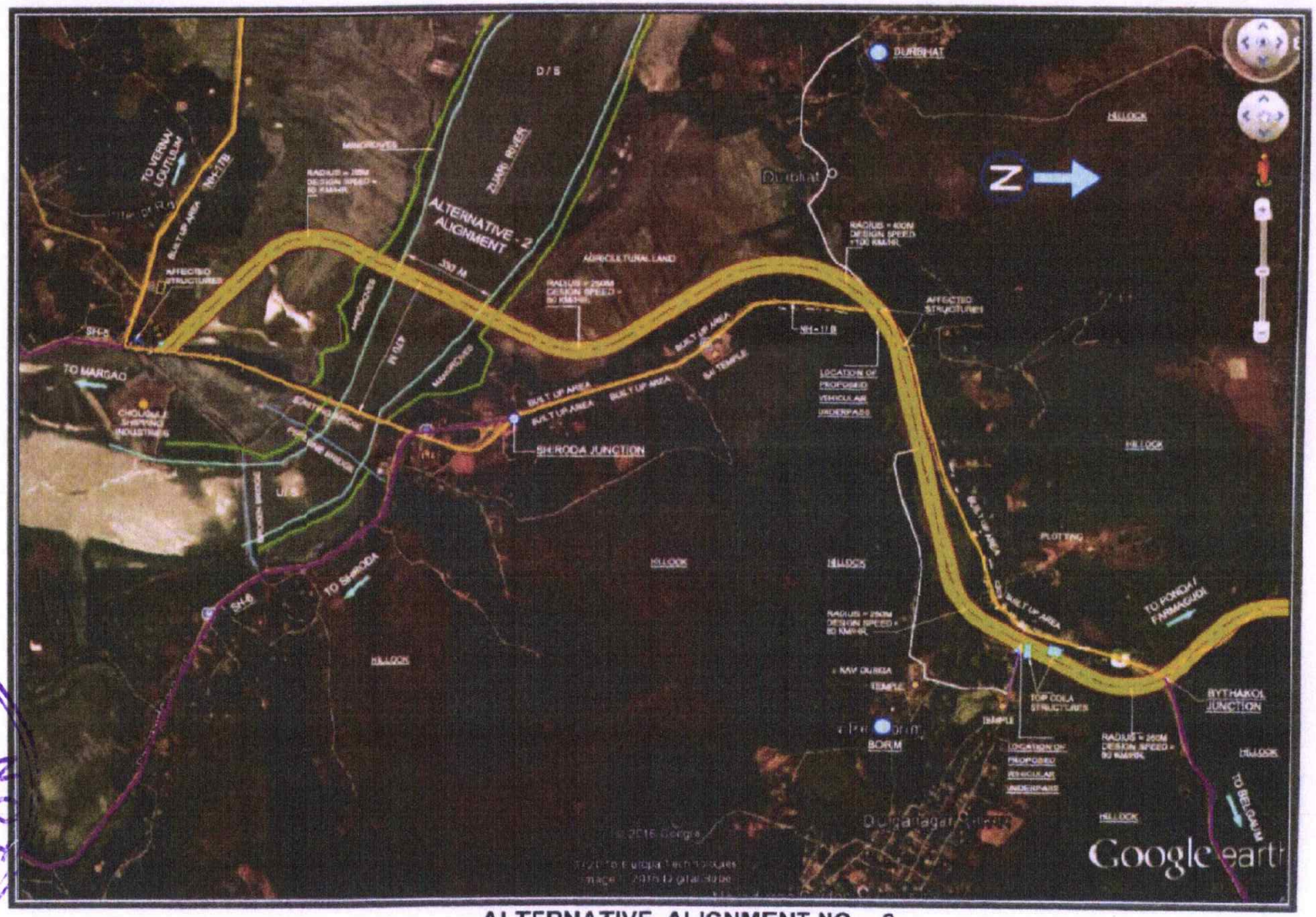

ALTERNATIVE ALIGNMENT NO. - 2

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6.3.3 Alternative Alignment No. 3:

- **Location:**

Alternative 3 alignment for the new Zuari Bridge is proposed at a distance of 950m at D/s side of the existing Zuari River Bridge. With this alternative, total length of the NH-17B between Dhavli junction and Loutulim end from existing Km. 3/860 to Km. 11/860 will be 6.10 Km against 8.00 Km. Refer drawing no. 869-ZB-ALT III-001 of drawing volume for alternative alignment no. 3.

- **Proposed Bridge Location:-**
  - 950m at D/s side of the existing Zuari River Bridge,
  - Width of Zuari River at this location = 430m,
  - the alignment of the proposed bridge in River portion = straight & at right angle to the flow,
  - Width of mangroves along the banks of River Zuari = 20m to 40m.

- **Path:**

From Bythakol junction to Loutulim end the alignment will be passing as follows;

  - between Bythakol junction & Durbhat junction, through hillock located at RHS of existing NH-17B road,
  - at Durbhat junction, for a smaller length of 275m, through open land (having dense trees) located at LHS of existing NH-17B road,
  - from Durbhat junction to River Zuari, through agricultural land located at Borim side bank of the River & at RHS of existing NH-17B road
  - from River Zuari to existing NH-17B at Loutulim end, through agricultural land located at Loutulim side bank of the River & will join the existing NH-17B road at a chainage Km. 11/250 i.e. between Margao junction and Loutulim end.

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- **Land Use:**

Land use alogn the proposed alignment is as follows;

  - between Bythakol junction & Durbhat junction – Open land (hillock) with dense trees in majority length and plotting is being done in a length of 200m,
  - at Durbhat junction (LHS of existing road) – Open land with dense trees & habitation in smaller length,
  - from Durbhat junction to River Zuari - agricultural land (paddy field)
  - from River Zuari to existing NH-17B at Loutulim end - agricultural land (paddy field)

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➢ **Geometry of the alignment:**

For the alternative 3 alignment, following geometry (horizontal & vertical) is possible;

- the alignment of the proposed bridge will be straight in River portion & at right angle to the flow,
- design speed of 100 Km/Hr for bridge & both side approaches,
- design speed of 100 Km/Hr for realignment stretch between Durbhat junction & Bythakol junction except at Durbhat junction for a length of 500m where max. design speed will be restricted to 80 Km/Hr. to minimize numbers of affected structures,
- approach on Loutulim side will be in curve (with design speed of 100 Km/Hr) so as to provide grade separated intersection at Loutulim end,
- since, the alignment between Bythakol junction and Durbhat junction will be passing through hillock portion, for vertical geometry, steeper longitudinal gradient may be involved in this stretch.

➢ **Affected Structures:**,

In this proposed realignment, approximately 06 numbers of existing structures will be affected at Durbhat road junction. The details are as follows;

- 5 shops of semi permanent nature,
- 1 residential structure of semi permanent type,

➢ **Grade Separators proposed:**

- One way flyover at Bythakol junction for traffic from new bridge and leading towards Belgaum.
- Vehicular underpass at Loutulim end for traffic coming from Margao on NH-17B.
- Vehicular underpasses at Durbhat junction.

➢ **Accesses to the local traffic on NH-17B:**

- Up & down ramp from new bridge approach (Borim side) will be provided for local traffic from Shiroda/ Borim & leading to Margao/ Verna & vice versa.
- This local traffic will use proposed vehicular underpasses at Durbhat junction for right turn to avoid conflict with the traffic of NH-17B.
- Local traffic crossing the Zuari River can use existing bridge till its balance life span.
- After opening of new alignment NH-17B for traffic, existing road can be utilized for local traffic.

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➢ **Merits & De-merits:**,

Various merits & demerits of the alternative alignment no.3 are given below.

- Saving in length of the NH-17B will be 1.9 Km.
- Since, for a length of 1.6 Km the proposed alignment will be passing through hillock portion located at RHS of existing road, tree cutting involved will be more.
- Increase in length for traffic from Bythakol to Margao and vice versa direction will be 550m.
- Steeper gradients for vertical geometry for the stretch passing through hillock portion may be involved.
- Deep cutting for a length of 1.6 Km may be required for the stretch passing through hillock portion located at RHS of existing NH-17B road.
- Less area of mangroves will be affected since width of mangroves along the banks of River Zuari is less at this location (between 20m to 40m).
- Grade separated junctions can be provided at major junctions located in realignment stretch.

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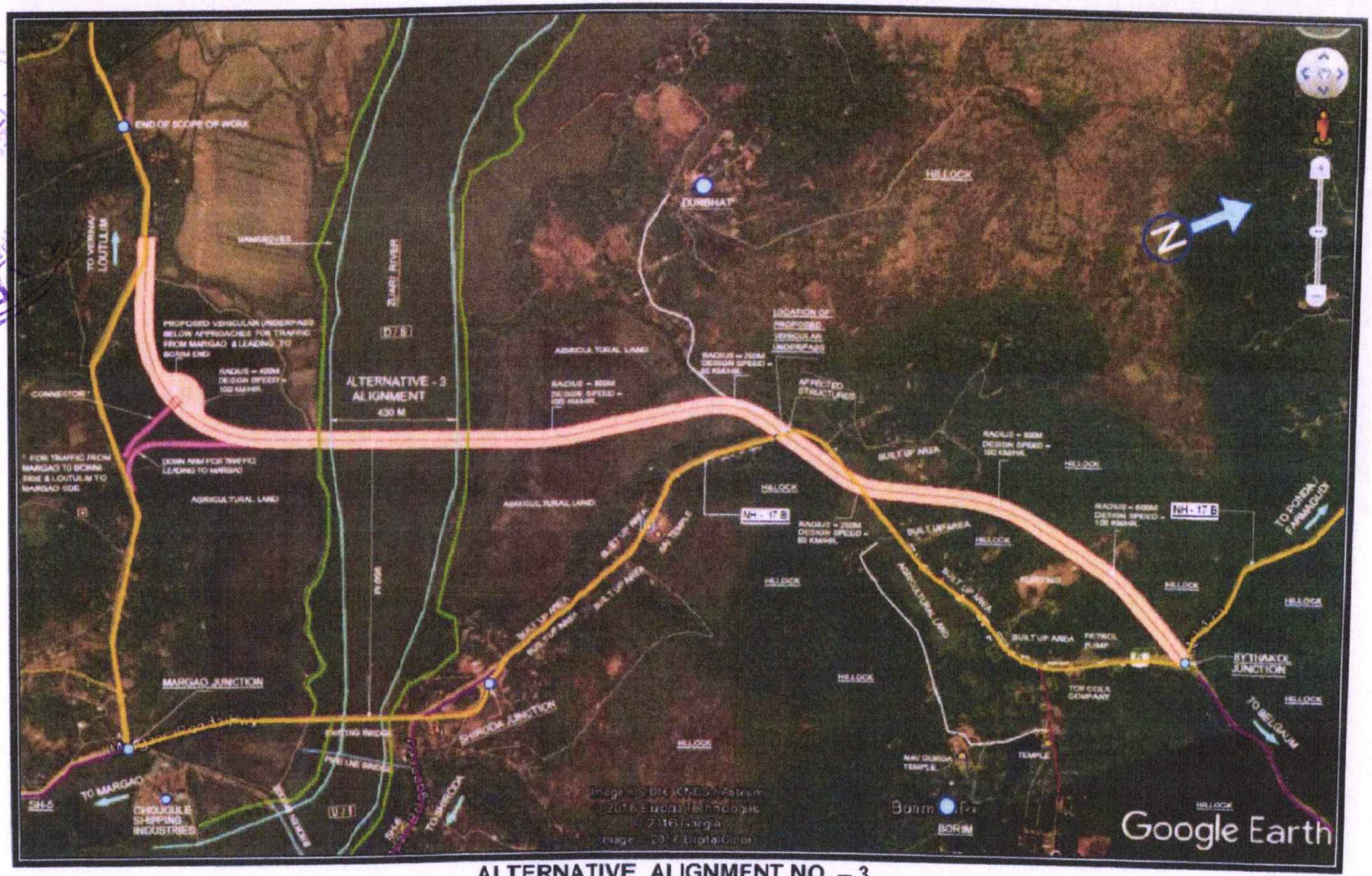

ALTERNATIVE ALIGNMENT NO. – 3

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6.3.4 Alternative Alignment No. 4:

- **Location:**

Alternative 4 alignment for the new Zuari Bridge is proposed at a distance of 470m at D/s side of the existing Zuari River Bridge. This realignment is proposed for stretch of NH-17B between Bythakol junction and Margao junction. With this alternative, total length of the NH-17B between Dhavli junction and Loutulim end from existing Km. 3/860 to Km. 11/860 will be 8.1 Km against 8.00 Km. Refer drawing no. 869-ZB-ALT IV-001 of drawing volume for alternative alignment no. 4.

- **Proposed Bridge Location:-**
  - 470m at D/s side of the existing Zuari River Bridge,
  - Width of Zuari River at this location = 330m,
  - the alignment of the proposed bridge in River portion = straight & at right angle to the flow,
  - Width of mangroves along the banks of River Zuari = 20m to 40m at Borim side bank & 150m at Loutulim side bank.

- **Path:**

From Bythakol junction to Loutulim end the alignment will be passing as follows;

- between Bythakol junction & Durbhat junction, through hillock located at RHS of existing NH-17B road,
- at Durbhat junction, for a smaller length of 275m, through open land (having dense trees) located at LHS of existing NH-17B road,
- from Durbhat junction to River Zuari, through agricultural land located at Borim side bank of the River, just behind the habitation located along the existing road at RHS.
- from River Zuari onwards, through agricultural land located at Loutulim side bank of the River & will join the existing NH-17B road at a chainage Km. 9/450 near Margaon junction (in front of Chougle shipping industry).
- from Margaon junction to Loutulim end, existing NH-17B route will be followed.

Land Use:

Land use alogn the proposed alignment is as follows;

- between Bythakol junction & Durbhat junction – Open land (hillock) with dense trees in majority length and plotting is being done in a length of 200m,
- at Durbhat junction (LHS of existing road) – Open land with dense trees & habitation in smaller length,

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- from Durbhat junction to River Zuari - agricultural land (paddy field)
- from River Zuari to existing NH-17B at Loutulim end - agricultural land (paddy field).

➢ **Geometry of the alignment:**

For the alternative 4 alignment, following geometry (horizontal & vertical) is possible;

- the alignment of the proposed bridge will be straight in River portion & at right angle to the flow,
- design speed of maximum 80 Km/Hr for bridge & both side approaches,
- design speed of maximum 100 Km/Hr for realignment stretch between Durbhat junction & Bythakol junction,
- immediately after the new bridge, the proposed alignment will in curvature (with max. design speed of 80 Km/Hr) for both side approaches,
- for Margao side approach, steeper gradient (more than 1:30) may be required,
- since, the alignment between Bythakol junction and Durbhat junction will be passing through hillock portion, for vertical geometry, steeper longitudinal gradient may be involved in this stretch.

➢ **Affected Structures:**,

In this proposed realignment, approximately 13 numbers of existing structures will be affected. The details are as follows;

- 5 shops of semi permanent nature & 1 residential structure of semi permanent type at Durbhat junction,
- 3 shops + 4 houses of semi – permanent to permanent nature at Margaon junction (affected due to proposed at grade junction improvement).

➢ **Grade Separators proposed:**

- One way flyover at Bythakol junction for traffic from new bridge and leading towards Belgaum.
- Vehicular underpasses at Durbhat junction

➢ **Accesses to the local traffic on NH-17B:**

- Up & down ramp from new bridge approach (Borim side) will be provided for local traffic from Shiroda/ Borim & leading to Margao/ Verna & vice versa.
- This local traffic will use proposed vehicular underpasses at Durbhat junction for right turn to avoid conflict with the traffic of NH-17B.

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- Local traffic crossing the Zuari River from Borim side to Margao side can use existing bridge till its balance life span for one way traffic only. Both way traffic will not be possible due to improvement of Margaon at grade junction. Refer drawing no. 869-ZB-JL-002 of drawing volume.
- After opening of new alignment NH-17B for traffic, existing road can be utilized for local traffic.

➢ **Merits & De-merits:**

Various merits & demerits of the alternative alignment no.4 are given below.

- Increase in length of the NH-17B will be 0.1 Km.
- In the stretch between Bythakol junction & Durbhat junction the proposed alignment will be passing through hillock, tree cutting involved will be more in this stretch.
- Length of the stretch for traffic from Bythakol to Margao and vice versa direction will not be changed.
- Since approaches are proposed along the boundary of agricultural land, there will not be bifurcation of this land in 2 parts.
- For Margao side approach, steeper gradient (more than 1:30) may be required.
- Since, for a length of 1.6 Km the proposed alignment will be passing through hillock portion located at RHS of existing road, tree cutting involved will be more.
- Steeper gradients for vertical geometry for the stretch passing through hillock portion may be involved.
- Deep cutting for a length of 1.6 Km may be required for the stretch passing through hillock portion located at RHS of existing NH-17B road.
- Approximately 13 numbers of existing structures will be affected.
- More area of mangroves will be affected since width of mangroves along the Loutulim side bank of River Zuari is more at this location (150m).
- Margao junction can be improved as at-grade junction only. Provision of grade separator along NH-17B will lead to increase in numbers of affected structures.

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ALTERNATIVE ALIGNMENT NO. – 4

6.3.5 Alternative Alignment No. 5:

- **Location:**

Alternative 5 alignment for the new Zuari Bridge is proposed at a distance of 220m at U/s side of the existing Zuari River Bridge. This realignment is proposed for stretch of NH-17B between Bythakol junction and Margao junction. With this alternative, total length of the NH-17B between Dhavli junction and Loutulim end from existing Km. 3/860 to Km. 11/860 will be 8.1 Km against 8.00 Km. Refer drawing no. 869-ZB-ALT V-001 of drawing volume for alternative alignment no. 5.

- **Proposed Bridge Location:-**
  - 220m at U/s side of the existing Zuari River Bridge,
  - Width of Zuari River at this location = 230m,
  - the alignment of the proposed bridge in River portion = straight & at right angle to the flow,
  - Width of mangroves along the banks of River Zuari = 30m to 40m.

- **Path:**

From Bythakol junction to Loutulim end the alignment will be passing as follows;

  - between Bythakol junction & Durbhat junction, through hillock located at RHS of existing NH-17B road (Behind habitation & petrol pump located at RHS),
  - from Durbhat junction to River Zuari, through hillock located at LHS of existing NH-17B road (Behind habitation & Sai temple located at LHS) & crossing Shiroda road i.e. SH-6.
  - at River location, the alignment of the proposed bridge will be in between existing pipe line bridge & old broken bridge,
  - from River Zuari onwards, through agricultural land located between approach of existing bridge & approach of old broken bridge,
  - further, the alignment will join the existing NH-17B road at a chainage Km. 9/450 near Margaon junction (in front of Chougle shipping industry).
  - from Margaon junction to Loutulim end, existing NH-17B route will be followed.

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- **Land Use:**

Land use along the proposed alignment is as follows;

  - between Bythakol junction & Durbhat junction –open land (hillock) with dense trees in majority length and plotting is being done in a length of 200m,

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- from Durbhat junction to Shiroda road (SH-6) – open land (hillock) with dense trees in entire length (habitation for partial length in hillock portion)
- from SH-6 to River Zuari – habitation along the existing SH-6 on both sides
- from River Zuari to existing NH-17B at Margao junction - agricultural land (paddy field)

➢ **Geometry of the alignment:**

For the alternative 5 alignment, following geometry (horizontal & vertical) is possible;

- the alignment of the proposed bridge will be straight in River portion & at right angle to the flow,
- design speed of maximum 80 Km/Hr for bridge & both side approaches,
- design speed of 80 to 100 Km/Hr for realignment stretch between Bythakol junction & River,
- Immediately after the new bridge, the proposed alignment at Borim side approach will in curvature (with max. design speed of 80 Km/Hr).
- Height of the proposed bridge will be more than the minimum requirement due to topography of the Borim side approach portion (hillock), hence for Margao side approach, steeper gradient (more than 1:30) may be required.
- since, the alignment between Bythakol junction and Durbhat junction will be passing through hillock portion, for vertical geometry, steeper longitudinal gradient may be involved in this stretch.

➢ **Affected Structures:**,

In this proposed realignment, approximately 17 numbers of existing structures will be affected. The details are as follows;

- 10 residential structures of semi permanent to permanent nature at Borim side approach portion from SH-6 to hillock portion,
- 3 shops + 4 houses of semi – permanent to permanent nature at Margaon junction (affected due to proposed at grade junction improvement).

➢ **Grade Separators proposed:**

- One way flyover at Bythakol junction for traffic from new bridge and leading towards Belgaum
- Vehicular underpasses before Durbhat road junction across existing NH-17B
- For SH-6, crossing will be provided below the viaduct of the proposed bridge

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➢ **Accesses to the local traffic on NH-17B:**

- Up & down ramp from new bridge approach (Borim side) will not be feasible for local traffic from Shiroda/ Borim & leading to Margao/ Verna & vice versa.
- Proposed vehicular underpasses before Durbhat junction will be useful for local traffic crossing the new alignment.
- Local traffic from Shiroda/ Borim will have to take U- turn at Bythakol junction to use new bridge for leading towards Margao/ Verna/ Loutulim etc.
- Local traffic crossing the Zuari River from Loutulim side to Borim side can use existing bridge till its balance life span for one way traffic only. Both way traffic will not be possible due to improvement of Margaon at grade junction. Refer drawing no. 869-ZB-JL-003 of drawing volume.
- After opening of new alignment NH-17B for traffic, existing road can be utilized for local traffic.

➢ **Merits & De-merits:**

Various merits & demerits of the alternative alignment no.5 are given below.

- Increase in length of the NH-17B will be 0.1 Km.
- Length of the stretch for traffic from Bythakol to Margao and vice versa direction will increase by 0.1 Km.
- For Margao side approach, steeper gradient (more than 1:30) may be required.
- Since, for a length of 3.3 Km the proposed alignment will be passing through hillock portion, tree cutting involved will be more as compared to all alternatives.
- Steeper gradients for vertical geometry for the stretch passing through hillock portion may be involved.
- Deep cutting for a length of 3.3 Km may be required for the stretch passing through hillock portion (Between Bythakol junction and River).
- Approximately 17 numbers of existing structures will be affected.
- Height of the proposed bridge will be more due to topography at Borim side approach (hillock between SH-6 & Borim village).
- Less area of mangroves will be affected since width of mangroves along the both side banks of River is less at this location (30m to 40m).

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ALTERNATIVE ALIGNMENT NO. – 5

6.3.6 Alternative Alignment No. 6:

- **Location:**

  Alternative 6 alignment for the new Zuari Bridge is proposed at a distance of 220m at U/s side of the existing Zuari River Bridge. This realignment is proposed for stretch of NH-17B between Bythakol junction and Margao junction. With this alternative, total length of the NH-17B between Dhavli junction and Loutulim end from existing Km. 3/860 to Km. 11/860 will be 7.3 Km against 8.00 Km. Refer drawing no. 869-ZB-ALT VI-001 of drawing volume for alternative alignment no. 6.

- **Proposed Bridge Location:-**
  - 220m at U/s side of the existing Zuari River Bridge,
  - Width of Zuari River at this location = 230m,
  - the alignment of the proposed bridge in River portion = straight & at right angle to the flow,
  - Width of mangroves along the banks of River Zuari = 30m to 40m.

- **Path:**

  From Bythakol junction to Loutulim end the alignment will be passing as follows;
  - between Bythakol junction & road leading to Borim village, through campus of Topcola company (which is not functional now),
  - between borim village road & Navdurg temple, through open land as well as through habitation,
  - from Navdurg temple to River Zuari, through hillock located between Borim village & SH-6 i.e. at LHS of existing NH-17B road (Behind habitation & Sai temple located at LHS) **(a tunnel is proposed for this hillock portion between Borim village & SH-6 road)**.
  - at River location, the alignment of the proposed bridge will be in between existing pipe line bridge & old broken bridge,
  - from River Zuari onwards, through agricultural land located between approach of existing bridge & approach of old broken bridge,
  - further, the alignment will join the existing NH-17B road at a chainage Km. 9/450 near Margaon junction (in front of Chougle shipping industry).
  - from Margaon junction to Loutulim end, existing NH-17B route will be followed.

- **Land Use:**

  Land use along the proposed alignment is as follows;

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- between Bythakol junction & road leading to Borim village, through campus of Topcola company – Open land with trees,
- between Borim village road & Navdurg temple – Open land as well as built-up area,
- between Navdurg temple & SH-6 – open land (hillock) with dense trees and habitation in partial length,
- at Shiroda road (SH-6) – Built-up area along both side of SH-6
- from River Zuari to existing NH-17B at Margao junction - agricultural land (paddy field)

➢ **Geometry of the alignment:**

For the alternative 6 alignment, following geometry (horizontal & vertical) is possible;

- the alignment of the proposed bridge will be straight in River portion & at right angle to the flow,
- design speed of maximum 80 Km/Hr for Margao side approach,
- design speed of 100 Km/Hr for realignment stretch between Bythakol junction & River,
- Height of the proposed bridge will be more than the minimum requirement due to topography of the Borim side approach portion (hillock), hence for Margao side approach, steeper gradient (more than 1:30) may be required.
- Due to proposed tunnel between Borim village & SH-6, for the alignment between Bythakol junction and River flatter longitudinal gradient will be possible.

➢ **Affected Structures:**,

In this proposed realignment, approximately 20 numbers of existing structures will be affected. The details are as follows;

- 7 residential structures of semi permanent to permanent nature between Borim village road & start of hillock near Navdurg temple,
- 6 residential structures of semi permanent to permanent nature between SH-6 to hillock portion,
- 3 shops + 4 houses of semi – permanent to permanent nature at Margaon junction (affected due to proposed at grade junction improvement).

➢ **Grade Separators proposed:**

- Flyover along NH-17B at Bythakol junction
- Vehicular underpasses at Borim village road

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- Vehicular underpasses at road crossing near Navdurg temple, Borim
- For SH-6, crossing will be provided below the viaduct of the proposed bridge

➢ **Accesses to the local traffic on NH-17B:**

- Up & down ramp from new bridge approach (Borim side) will not be feasible for local traffic from Shiroda/ Borim & leading to Margao/ Verna & vice versa.
- Proposed vehicular underpasses at Borim village will be useful for local traffic crossing the new alignment.
- Local traffic from Shiroda/ Borim will have to take U- turn at Bythakol junction to use new bridge for leading towards Margao/ Verna/ Loutulim etc.
- Local traffic crossing the Zuari River from Loutulim side to Borim side can use existing bridge till its balance life span for one way traffic only. Both way traffic will not be possible due to improvement of Margaon at grade junction. Refer drawing no. 869-ZB-JL-003 of drawing volume.
- After opening of new alignment NH-17B for traffic, existing road can be utilized for local traffic.

➢ **Merits & De-merits:**

Various merits & demerits of the alternative alignment no.6 are given below;

- Saving in length of the NH-17B will be 0.7 Km.
- Length of the stretch for traffic from Bythakol to Margao and vice versa direction will decrease by 0.7 Km.
- For Margao side approach, steeper gradient (more than 1:30) may be required.
- Height of the proposed bridge will be more due to topography at Borim side approach (hillock between SH-6 & Borim village)
- Approximately 20 numbers of existing structures will be affected.
- Less area of mangroves will be affected since width of mangroves along the both side banks of River is less at this location (30m to 40m).
- From visual inspection & available information, it is observed that a soil strata at hillock location (location of the proposed tunnel) is having soft strata beneath the top soil. Hence, concrete lining may be required for majority length of the tunnel.
- The project cost of this alternative will be more as compared to all other alternatives.
- Access to the local traffic cannot be provided between Bythakol junction & Margao junction.

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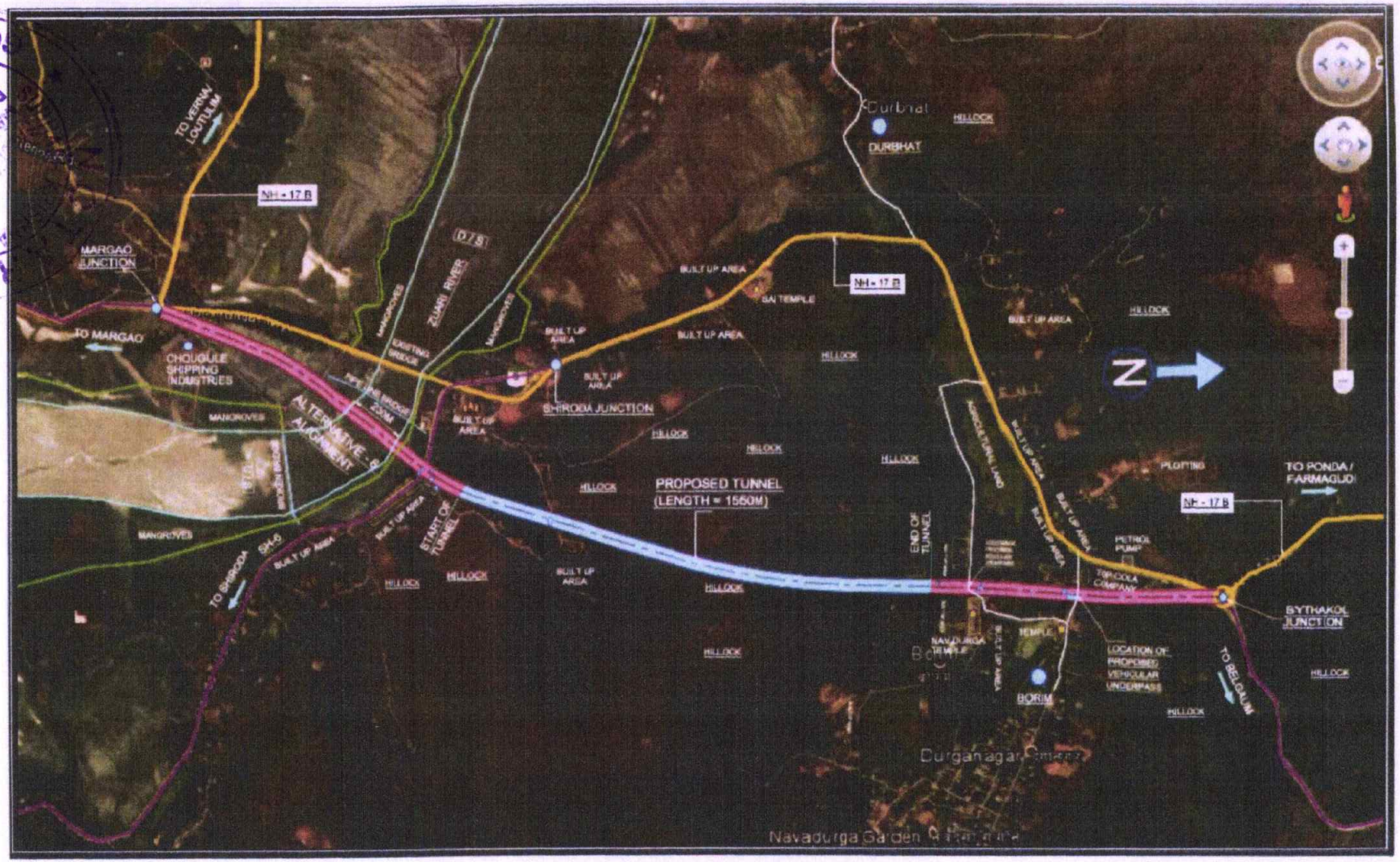

ALTERNATIVE ALIGNMENT NO. – 6

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6.3.7 Alternative Alignment No. 7:

➢ **Location:**

Alternative 7 alignment for the new Zuari Bridge is proposed at a distance of 1780m at D/s side of the existing Zuari River Bridge. With this alternative , total length of the NH-17B between Dhavli junction and Loutulim end from existing Km. 3/860 to Km. 11/860 will be 5.6 Km against 8.00 Km. Refer drawing no. 869-ZB-ALT VII-001 of drawing volume for alternative alignment no. 7.

➢ **Proposed Bridge Location:-**

- 1780m at U/s side of the existing Zuari River Bridge,
- Width of Zuari River at this location = 380m,
- the proposed bridge will be in skew with respect to the flow of the River,
- Width of mangroves along the banks of River Zuari = 30m to 40m.

➢ **Path:**

From Bythakol junction to Loutulim end the alignment will be passing as follows;

- between Bythakol junction & Durbhat junction, through hillock located at RHS of existing NH-17B road,
- at Durbhat junction, for a smaller length of 275m, through open land (having dense trees) located at LHS of existing NH-17B road,
- from Durbhat junction to River Zuari, through agricultural land located at Borim side bank of the River & at LHS of road leading to Durbhat,
- from River Zuari to existing NH-17B at Loutulim end, through agricultural land located at Loutulim side bank of the River & will join the existing NH-17B road at a chainage Km. 12/000 i.e. at start point of missing link project work near Loutulim village.

➢ **Land Use:**

Land use along the proposed alignment is as follows;

- between Bythakol junction & Durbhat junction – Open land (hillock) with dense trees in majority length and plotting is being done in a length of 200m,
- at Durbhat junction (LHS of existing road) – Open land with dense trees & habitation in smaller length,
- from Durbhat junction to River Zuari - agricultural land (paddy field) except for a length of 500m where the alignment will be passing through open land near Durbhat village.

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- from River Zuari to existing NH-17B at Loutulim end - agricultural land (paddy field)

➢ **Geometry of the alignment:**

For the alternative 7 alignment, following geometry (horizontal & vertical) is possible;

- the proposed bridge will be in skew with respect to the flow of river,
- design speed of 100 Km/Hr for bridge & both side approaches,
- design speed of 100 Km/Hr for realignment stretch between Durbhat junction & Bythakol junction,
- approach on Borim side will be in curve (with design speed of 100 Km/Hr) to avoid the habitation located in open land near Durbhat village,
- since, the alignment between Bythakol junction and Durbhat junction will be passing through hillock portion, for vertical geometry, steeper longitudinal gradient may be involved in this stretch.

➢ **Affected Structures:**,

In this proposed realignment, approximately 06 numbers of existing structures will be affected at Durbhat road junction. The details are as follows;

- 5 shops of semi permanent nature,
- 1 residential structure of semi permanent type,

➢ **Grade Separators proposed:**

- One way flyover at Bythakol junction for traffic from new bridge and leading towards Belgaum.
- Vehicular underpasses 2 nos. near Durbhat junction at the crossing of existing NH-17B.
- Vehicular underpass at Loutulim end for traffic coming from Margao on NH-17B.
- In addition to the above, additional vehicular underpass will be required at Loutulim village across the smaller road leading to Verna.
- **Vehicular underpasses 2 nos. proposed above at Loutulim end will be a part of missing link work. Hence, in the ongoing work of missing link, provisions of these underpasses need to be incorporated.**

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➢ **Accesses to the local traffic on NH-17B:**

- Up & down ramp from new bridge approach (Borim side) will be provided for local traffic from Shiroda/ Borim & leading to Margao/ Verna & vice versa.

- This local traffic will use proposed vehicular underpasses at Durbhat junction for right turn to avoid conflict with the traffic of NH-17B.
- Local traffic crossing the Zuari River can use existing bridge till its balance life span.
- After opening of new alignment NH-17B for traffic, existing road can be utilized for local traffic.

➢ **Merits & De-merits:**,

Various merits & demerits of the alternative alignment no.7 are given below.

- Saving in length of the NH-17B will be 2.4 Km.
- Since, for a length of 1.6 Km the proposed alignment will be passing through hillock portion located at RHS of existing road, tree cutting involved will be more in this stretch.
- Increase in length for traffic from Bythakol to Margao and vice versa direction will be 2.3 Km.
- Steeper gradients for vertical geometry for the stretch passing through hillock portion between Bythakol junction & Durbhat junction may be involved.
- Deep cutting for a length of 1.6 Km may be required for the stretch passing through hillock portion located at RHS of existing NH-17B road.
- Less area of mangroves will be affected since width of mangroves along the banks of River Zuari is less at this location (between 20m to 60m).
- Grade separated junctions can be provided at major junctions located in realignment stretch.
- As per guidelines of IRC:SP:84 & IRC:SP:87, it is obligatory to provide grade separator/ vehicular underpass at intersection with NH or SH. At Loutulim end, there will be intersection of new NH-17B with old alignment of NH-17B (which is further connected to SH-5 i.e. road towards Margao). Hence, it is mandatory to provide grade separator/ vehicular underpass at this intersection. The location of this underpass is located in project stretch of missing link for which work is in progress. Hence, for provision of this vehicular underpass, proposal of ongoing missing link work needs to be modified accordingly.

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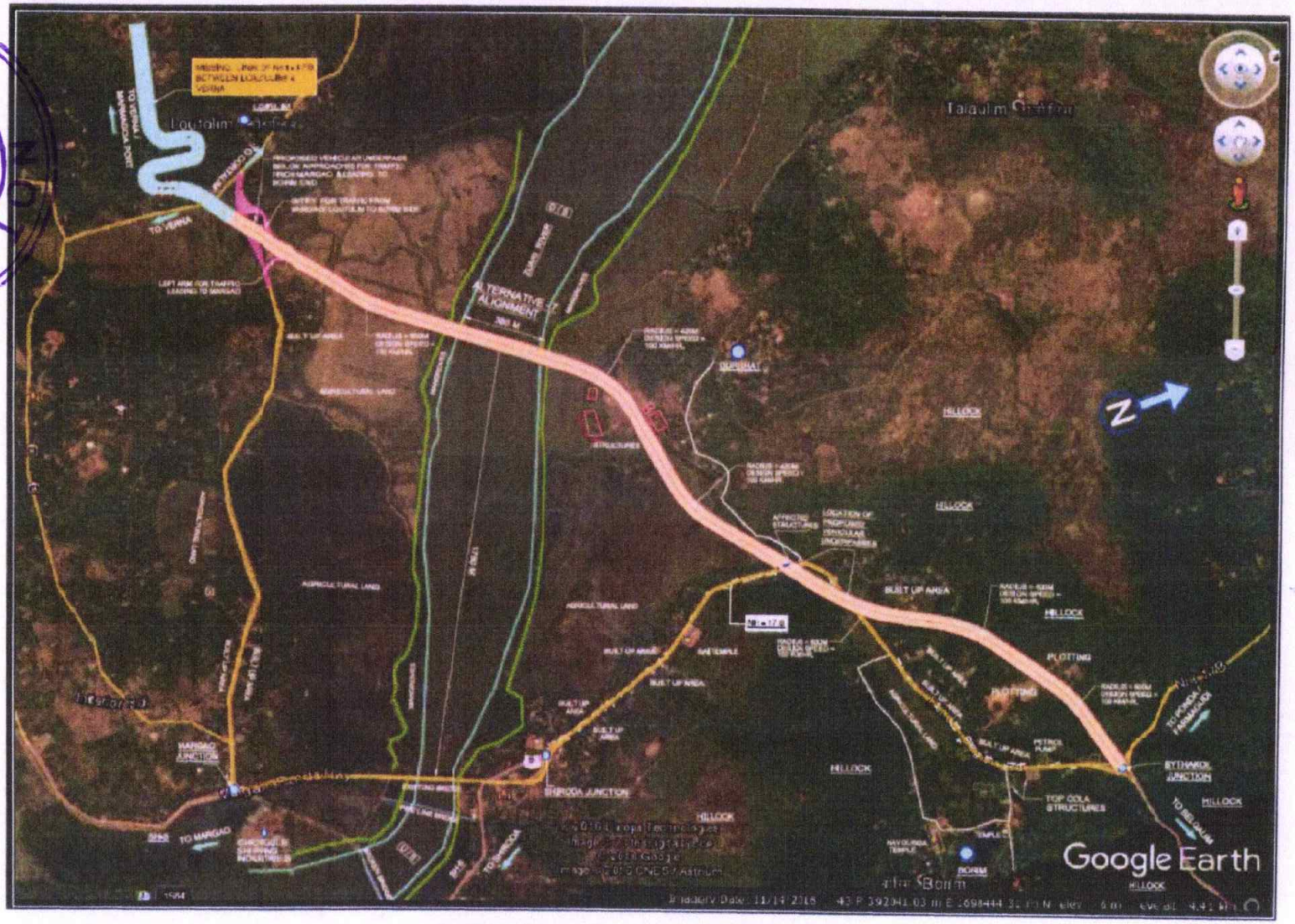

ALTERNATIVE ALIGNMENT NO. – 7

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COMPARISION TABLE FOR MERRTIS & DE-MERRITS OF THE ALTERNATIVE ALIGNMENTS

DESCRIPTION	ALT. 1	ALT. 2	ALT. 3	ALT. 4	ALT. 5	ALT. 6	ALT. 7
+ Increase/ - decrease in length of NH-17B	- 1.75 Km	+ 0.22 Km	- 1.90 Km	+ 0.10 Km	+ 0.10 Km	- 0.7 Km	- 2.4 Km
Increase/ decrease in length for the path of traffic leading to Margao	+ 0.68 Km	0.00 Km	+ 0.55 Km	0.00 km	+ 0.10 Km	- 0.7 Km	+ 2.3 Km
Access to the local traffic within short distance	Possible	Possible	Possible	Possible	Not Possible	Not Possible	Possible
Design speed for the proposed alignment	80 to 100 Km/hr.	80 Km/Hr.	100 Km/Hr.	80 to 100 Km/hr.	80 to 100 Km/hr.	80 to 100 Km/hr.	100 Km/Hr.
Approximate nos. of structures affected in proposed realignment portion	09	16	06	13	17	20	06
provision of grade separator at major junctions	Possible	Not possible at Margao end	Possible	Not possible at Margao end	Not possible at Margao end	Not possible at Margao end	Possible
Extent of Tree cutting involved (Higher to Lower)	3	3	2	2	1	2	2
vertical gradient involved in approaches	Flatter	Flatter	Flatter	Flatter	Steeper at Margao end	Steeper at Margao end	Flatter
vertical gradient involved in rest realignment	Flatter	Flatter	Steeper at hillock	Steeper at hillock	Steeper at hillock	Flatter	Steeper at hillock
Deep cutting involved	No	No	Yes at hillock	Yes at hillock	Yes at hillock	Yes for smaller length	Yes at hillock
Extent of area of mangroves likely to be affected (Higher to Lower)	4	1	4	1	3	3	2
Approximate area of additional land required	38.5 Hect.	45 Hect.	38 Hect.	44.5 Hect.	45 Hect.	40 Hect.	34 Hect.

Note:- 1) For alternative No. 5 & 6 - Height of proposed bridge will be more than the minimum required for the reasons explained at respective sr. no.

2) For provision of grade separator at Loutulim end, proposal of ongoing project of missing link needs to be modified for the reasons explained at respective sr. no.

Revised

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6.4 Consultants Recommendation:

Considering various issues mentioned at sr. no. 6.1. , merits & de-merits of each alternative, we recommend the following sequence;

1st – Alternative No. 1.

2nd – Alternative No. 3

3rd - Alternative No. 7

Alternative Alignment No. 1 is recommended for the proposed new bridge across River Zuari i.e. alignment proposed at 950m at D/s side of the existing Zuari River Bridge & involving realignment from Bythakol junction to River via. agricultural land located at LHS of the existing NH-17B road. Following points have been considered behind recommendation of this alternative;

- the alignment of the proposed bridge in River portion will be straight & at right angle to the flow,
- Width of mangroves along the banks of River Zuari at this location is less i.e. 20m to 40m,
- Design speed of 100 Km/Hr. is possible for entire length except for a smaller length near Topcola campus where design speed is restricted to 80 Km/Hr.
- Entire length of the realignment is passing through plain land only.
- No steeper gradients will be involved in entire realignment.
- Saving in length of the NH-17B will be 1.75 Km.
- No deep cutting will be involved in this alignment.
- Provision of grade separators at all major junctions can be made in this alternative.
- Access to the local traffic from Shiroda, Borim etc. can be given in short distance by providing up & down ramps from the proposed bridge.
- Tree cutting involved in this alternative will be very less as compared to all other alternative
- Traffic from Borim / Bythakol end and leading to Margao is substantial; hence facility for this traffic shall also be given. With this alternative, distance of the path for Margao junction to Bythakol junction will increase by only 0.68 Km.

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- Only 9 no's structures will be affected. Out of these 9 structures, 3 structures are belongs to Topcola company which is not functional now and these are abandoned structures.
- There will not be any effect on ongoing project of missing link. Refer details of alternative 7 in this regard.
- Total area of additional land required is less than 4 alternatives out of 7 alternatives.

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GOVT. OF GOA (INDIA)

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Chapter - 7

Decisions/ Conformations Requested From the Client

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7.0 DECISIONS/ CONFORMATIONS REQUESTED FROM THE CLIENT:

Following approval/ decisions/ conformations are requested from the client;

- Approval to the Inception Report & QAP
- Approval to the one of the alternative alignment among 7 alternatives described in this report
- Traffic survey locations where traffic surveys have been carried out were discussed with the officers of the PWD (NH), Goa during meeting cum presentation held on 24th Nov. 2016 in the office of the Superintending Engineer, (NH), PWD, at Panjim Goa. You are requested to give confirmation for these locations.
- Any specific requirement of the client regarding type of the superstructure of the proposed Bridge across River Zuari such as Cable Stayed, steel or other cost effective structures.
- Vertical clearance for navigation span for the existing Zuari Bridge at Borim is 13.7m. Weather the same clearance is to be adopted or clearance which will be suggested by the M.T.B shall be followed. Decision regarding minimum vertical clearance to be kept for the proposed navigation span is requested.
- Navigational span of the existing Zuari Bridge at Borim is 122m with navigational channel of 90m. Specific requirement, if any, regarding minimum navigational span for the proposed bridge may please be conveyed.
- For the road portion, type of the pavement to be adopted i.e. flexible or rigid will be proposed based on the life cycle cost analysis. However, any specific requirement regarding the type of the pavement to be adopted may please be conveyed.

Note:- <u>Further field work and design work can only be started after receipt of the approval to the alternative alignment.</u>

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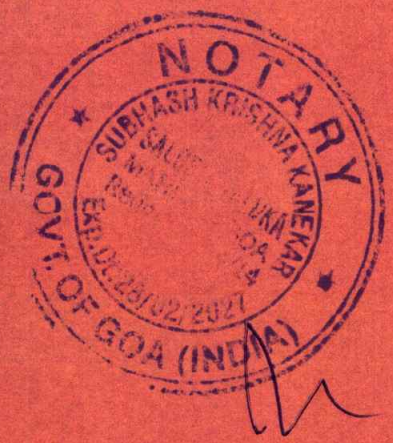
Chapter - 8

Site Photographs



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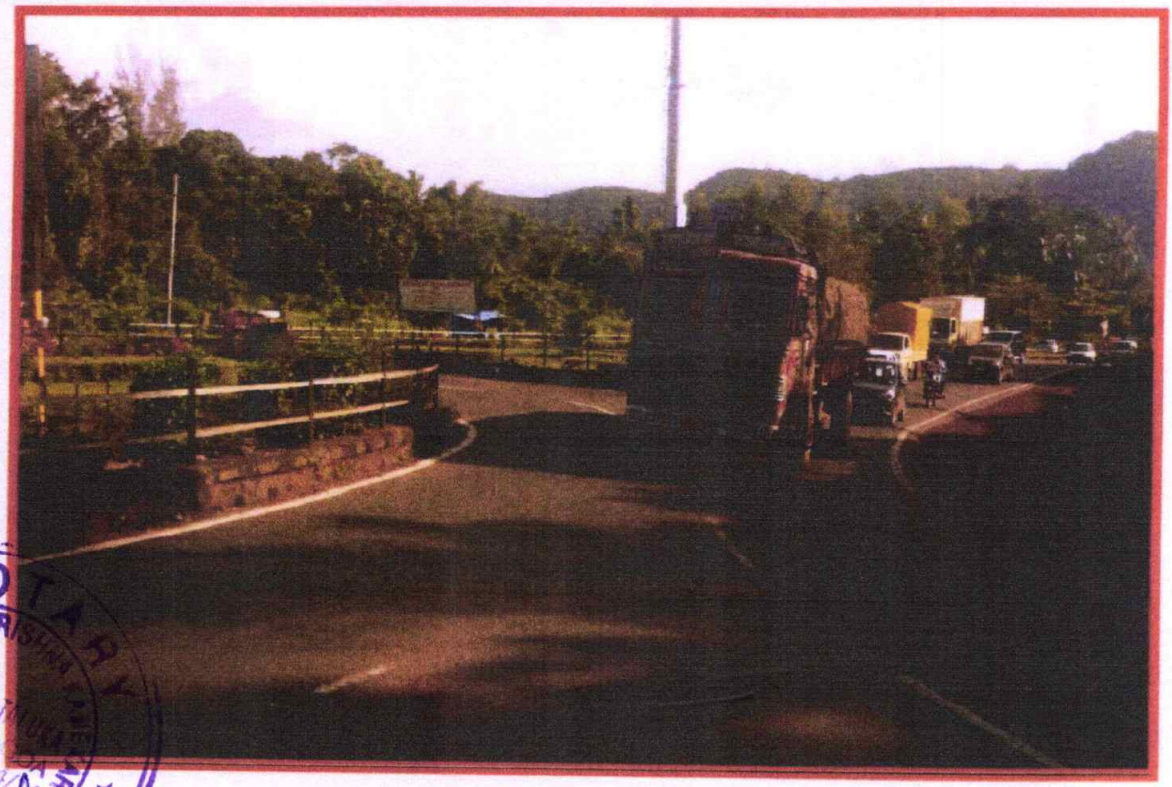
8.0 SITE PHOTOGRAPHS:

START POINT OF THE PROJECT (DHAVALI JUNCTION Km 3/860)



BYTHAKOL JUNCTION Km 5/200

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PROJECT CORRIDOR PASSES THROUGH BUILT-UP AREA NEAR BORIM

SHIRODA JUNCTION Km 8/200

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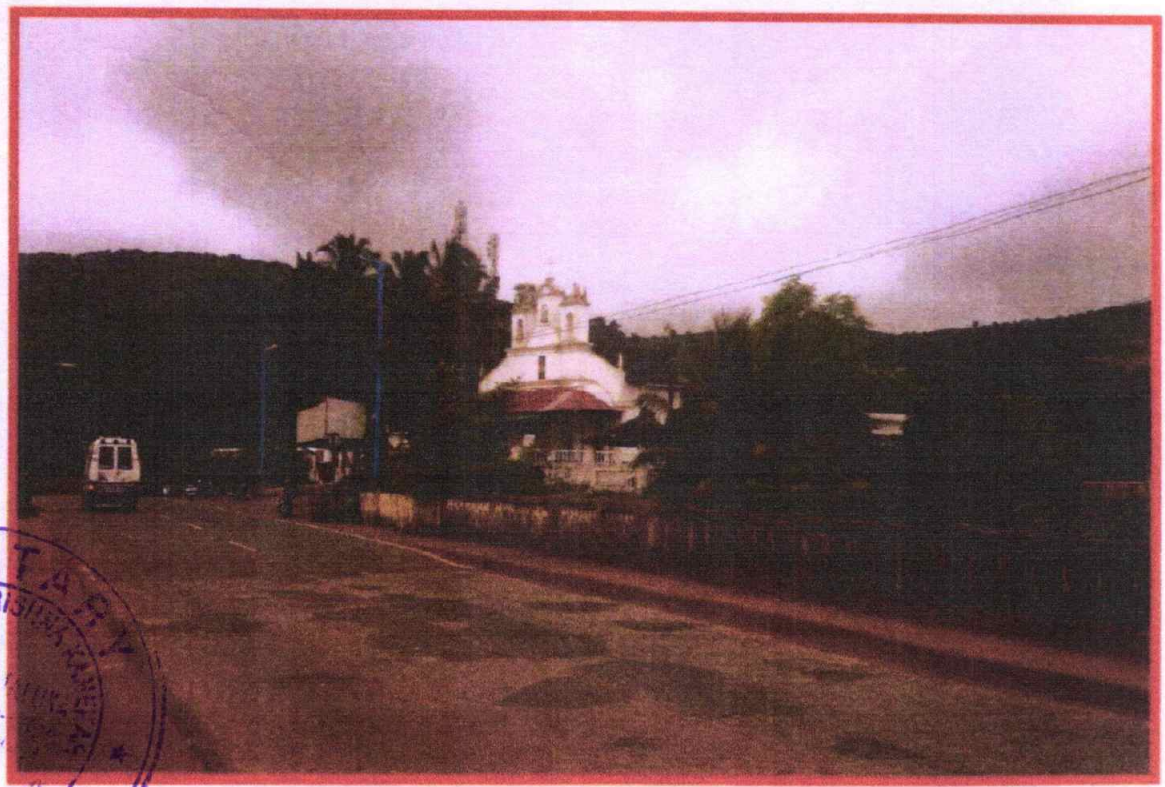
SAI BABA TEMPLE AT BORIM ADJOINING TO EXISTING ROAD AT LHS



CHRUCH BETWEEN SHIRODA JUNCTION AND EXISTING BRIDGE AT LHS

EXISTING VIADUCT ACROSS SH-6 (ROAD LEADING TO SHIRODA)

PIPE LINE BRIDGE ON U/S OF EXISTING ZUARI BRIDGE

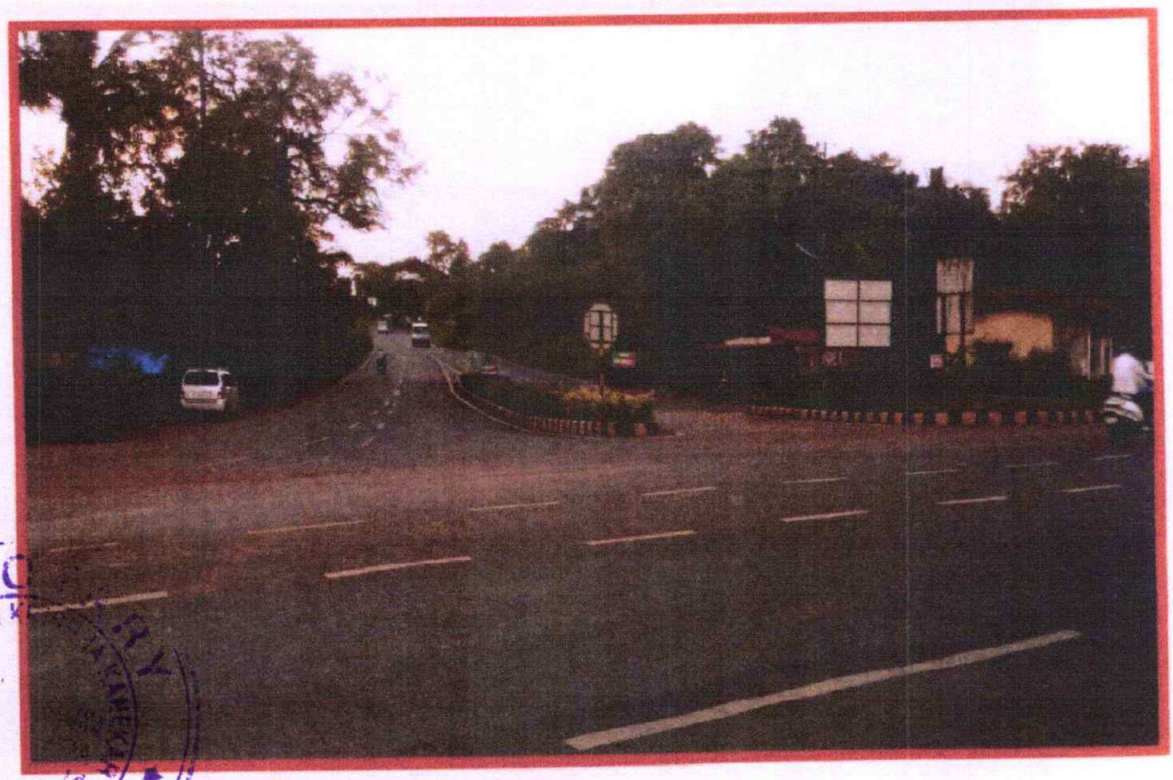
874

NAVIGATIONAL SPAN OF EXISTING ZUARI BRIDGE

CARRIAGEWAY & FOOTPATH OF EXISTING ZUARI BRIDGE

875

MANGROOVES ALONG THE BANKS OF THE ZUARI RIVER



MARGAO JUNCTION AT Km. 9/520

876

EXISTING ROAD BETWEEN MARGAO JUNCTION AND LOUTULIM

LOUTULIM JUNCTION Km 12/270

Chapter - 9

Work Programme and Activity Schedule

Consultancy Services for the Preparation of Detailed Project Report and bidding documents for the "Proposed Construction of High Level New Bridge along with its Approaches Across River Zuari at Borim on NH-17B (NH-566) in the state of Goa."

Work Programme and Activity Schedule

Sr. No.	Item of Work/ Activity	Time Period in Months											
		Stage-I		Stage-II						Stage-III		Stage-IV	
		Inception Report		Selection of the best Alignment & Geometrics, Surveys, Investigation & GAD						Final Report , Technical Schedules for EPC / BOT Project and Bid Document		Project Clearances	
		1	2	3	4	5	6	7	8	9	10	11	12
Stage-I: Alignment Option Along with Inception Report													
1	Mobilization												
2	Collection and Review of Data and Documents												
3	Reconnaissance Survey and Project Appreciation												
4	Topographic Survey of existing corridor												
5	Traffic Surveys												
6	Preparation of Quality Assurance Plan												
7	Design standards and Proposed cross sections												
8	Preparation of Various Alternative Alignments												
9	Preparation & submission of Inception Report												
10	Obtaining approval to the alternative alignment & Inception report												
Stage-II: Selection of the best Alignment & Geometrics, Surveys, Investigation, Preparation of GAD, obtaining approval, Feasibility Report													
11	Inventory and Condition survey of Road, Bridges, culverts & other structures												
12	Analysis of Traffic Surveys												
13	Topographic Survey along selected alignment												
14	Road and Pavement Investigations												
15	Materials Investigations												
16	Hydraulic and Hydrological Investigations												
17	Environmental Screening and Preliminary environmental assessment												
18	Finalization of Design Standards												
19	Pavement (Type) Option Study and Preliminary Design of Pavement												
20	Preparation of General Arrangement Drawing for the proposed bridges												
21	Preparation of Plan & L-Section for the approaches & road stretch												
22	Approximate Cost Estimates												
23	Economic Analysis and Financial Analysis												
24	Obtaining approval to the GAD & other drawings from competent authorities												
25	Geotechnical Investigation and Sub-soil exploration in accordance with approved GAD												
26	Land Acquisition Proposal												
27	Preparation & submission of proposal for clearances such as environmental, CRZ, forest etc.												
28	Shifting of Utility study report												
29	Submission of Feasibility Report												

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M/s. Technogem Consultants Pvt. Ltd.

Sr. No.	Item of Work/ Activity	Time Period in Months											
		Stage-I		Stage-II						Stage-III		Stage-IV	
		Inception Report		Selection of the best Alignment & Geometrics, Surveys, Investigation & GAD						Final Report , Technical Schedules for EPC / BOT Project and Bid Document		Project Clearances	
		1	2	3	4	5	6	7	8	9	10	11	12
Stage-III: Final Report , Technical Schedules for EPC / BOT Project and Bid Document													
30	Approval to the Feasibility Report												
31	Detailed Design of Bridges & Road												
32	Preparation of Detailed GAD in accordance with Geotechnical Investigation												
33	Detailed Drawings												
34	Preparation of Detailed Cost Estimate												
35	Updated Economic Analysis and Financial Analysis												
36	Technical Specifications												
37	Final Environmental Impact Assessment (EIA) Report												
38	Preparation of Bid Documents including schedules for EPC / BOT Project.												
39	Submission of Final Report												
Stage-IV: Project Clearance													
40	To assist the Employer in Land Acquisition												
41	Obtaining Clearance such as Environmental clearance from MoEF, CRZ, forest etc. (if required)												

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Chapter - 10

Task Assignment and Time Schedule for Key personnel

Consultancy Services for the Preparation of Detailed Project Report and bidding documents for the "Proposed Construction of High Level New Bridge along with its Approaches Across River Zuari at Borim on NH-17B (NH-566) in the state of Goa."

TASK ASSIGNMENT AND TIME SCHEDULE FOR KEY PERSONNEL

Sr. No.	Name	Position	Reports / Activities	Man-Month	Time Period in Months
					Stage-I: Inception Report (1–2)
					Stage-II: Selection of the best Alignment & Geometrics, Surveys, Investigation & GAD, Feasibility Report (3–8)
					Stage-III: Final Report , Technical Schedules for EPC / BOT Project and Bid Document (9–10)
					Stage-IV: Project Clearances (11–12)
1	Mr. Y. G. Patwardhan	Team Leader cum Bridge Engineer	QAP Document Inception Report Repair and Rehabilitation Methodology for Bridges Design Report Environmental Impact Assessment Report Draft and Final EIA Reports Social Impact Screening Report Feasibilty Report Final DPR Tender Documents	12	
2	Mr. P. J. Navlakha	Material cum Geo – Tech / Foundation Engineer	Reconnsaionse Survey Sub soil investigation Field & Laboratory Testing Material Report	4	
3	Mr. M. P. Mina	Highway Engineer	Pavement study, design & geometry design	5	
4	Mr. R. A. Oak	Hydrologist	Reconnsaionse Survey Collection of Field Data, Hydraulic study, Recommedation & Finalisation of Favorable location of bridge, Preparation of Hydraulics Report	5	
5	Mr. Jayesh Modi	Senior Survey Expert	Field Survey, LA Report and Plans	5	
6	Mr. S. S. Korlekar	Traffic Engineer cum Road Safety Expert	Traffic study, Survey analysis & Report	5	
7	Mr. P. B. Sanghani	Financial Analyst	Review of policies and institutional frame work, Financial Analysis, Obtaining requisite approval from competent authorities	3	

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