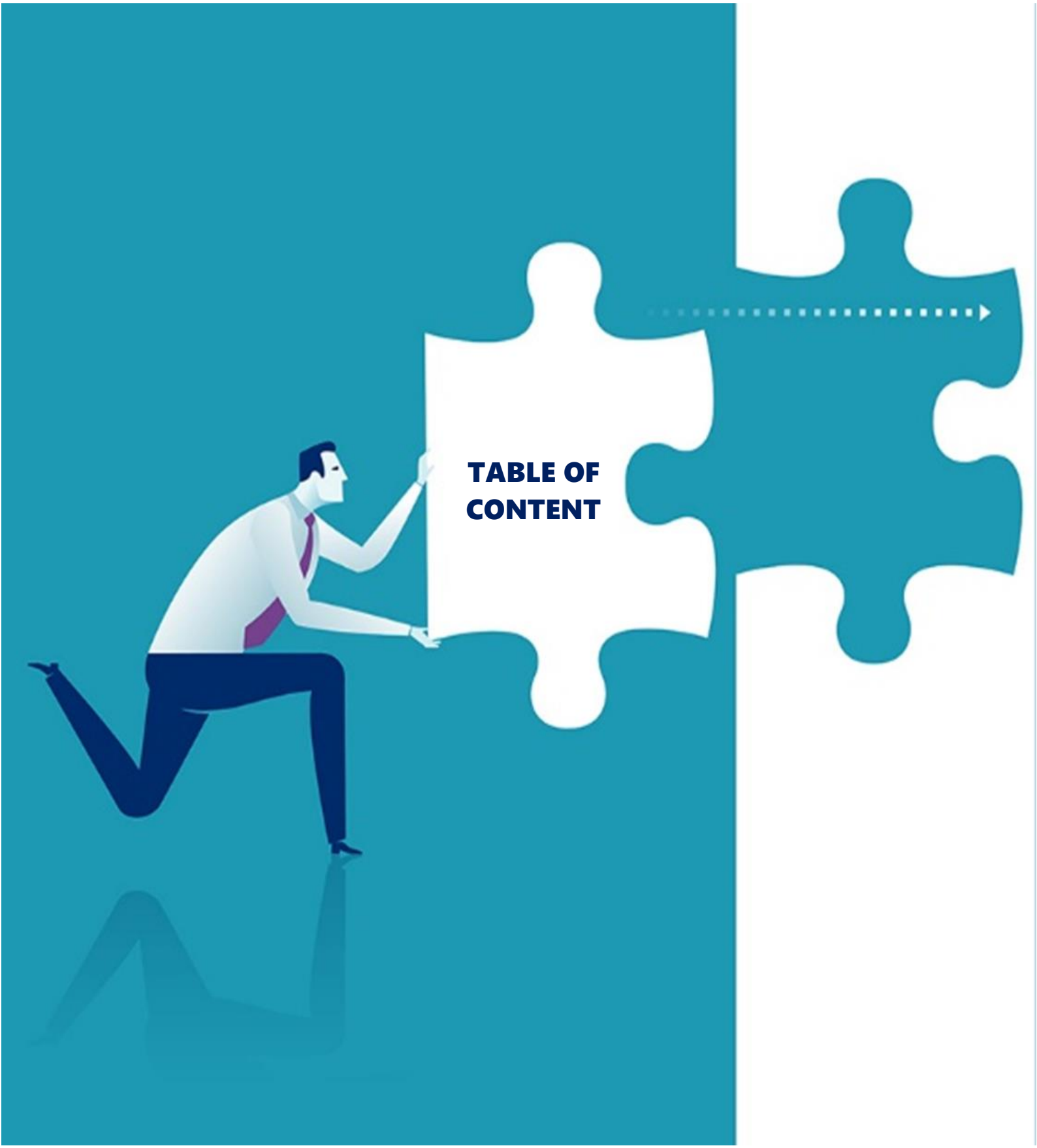
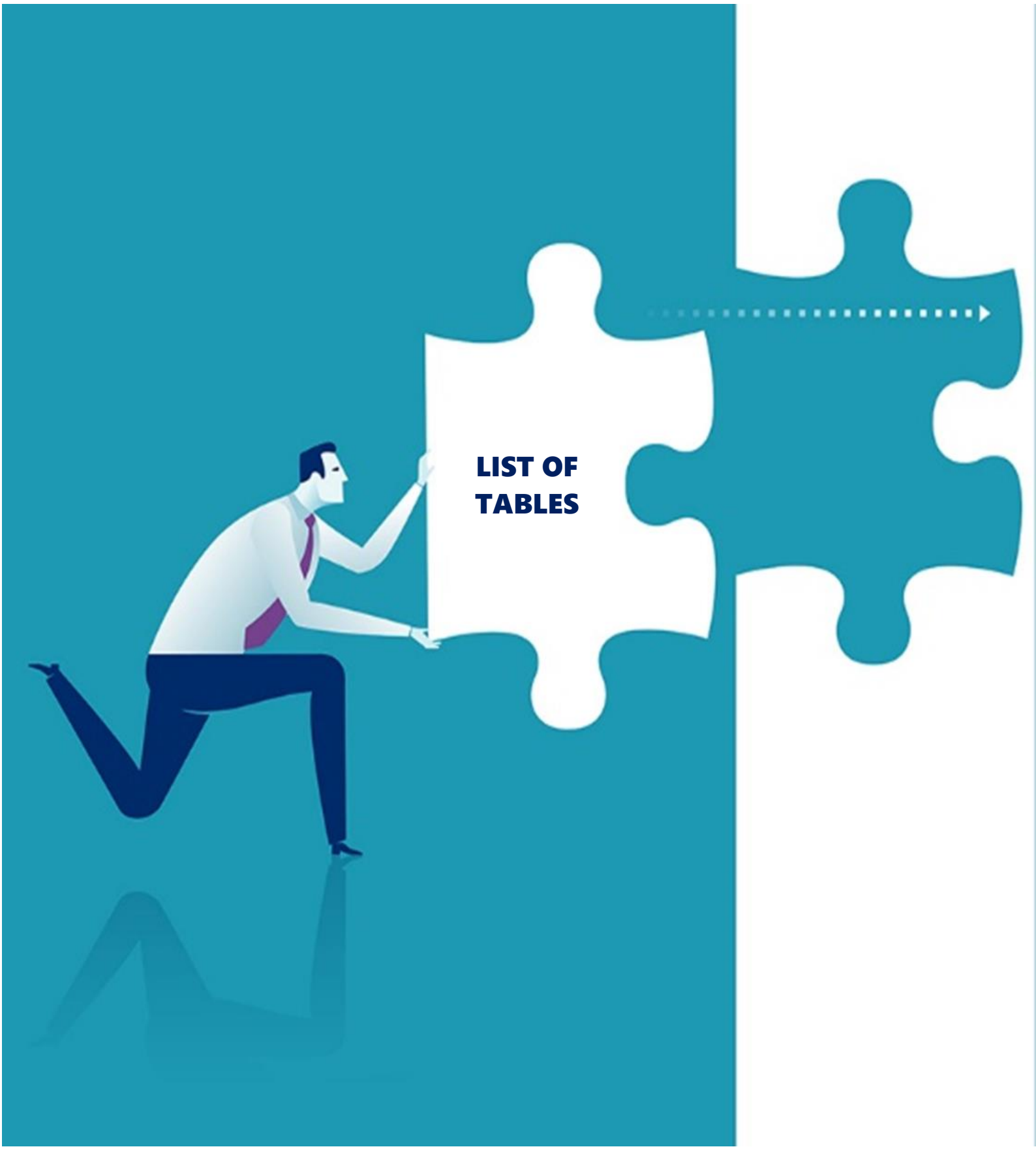


TABLE OF CONTENT

TABLE OF CONTENTS



LIST OF TABLES

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES

ABBREVIATION

ABBREVIATION

NHIDCL: National Highways and Infrastructure Development Corporation Limited

NHAI : National Highway Authority of India

AASHTO: American Association of State Highway and Official

MORTH: Ministry of Road Transport & Highway

MoEF : Ministry of Environment and Forest

IRC : Indian Road Congress

BIS : Bureau of Indian Standards

EPC : Engineering Procurement Contract

PPP : Public Private Partnership

MSA : Million Standard Axle

AADT : Average Annual Daily Traffic

ADT : Annual Daily Traffic

GSDP : Gross State Domestic Product

OMC : Optimum Moisture Content

BBD : Benkelman Beam Deflection

SOR : Schedule of Rates

ROW : Right of Way

RUB : Railway Under Bridge

SPBC : State Pollution Control Board

LWL : Low water Level

HTL : High Tide Level

PAP : Project Affected People

RRP : Resettlement & Rehabilitation Plan

LA : Land Acquisition

FAS : Fully Affected Structures

TPC : Total Project Cost

FY : Financial Year

VGF : Viability Gap Funding

QAP : Quality Assurance Plan

ToR : Term of Reference

LiDAR : Light Detection and Ranging

DBFOT : Design, Build Finance Operate & Transfer

TS : Total Station

DTM : Digital Terrain Model

BMS : Bench Mark Stations

ESAL : Equivalent Standard Axle

GPS : Global Positioning System

VDF : Vehicle Damage Factor

TVC : Total Vehicle Count

OD : Origin-Destination

PCU : Passenger Car Unit

CBR : California Bearing Ratio

DCPT : Direct Cone Penetration Test

BOQ : Bill of Quantities

GAD : General Arrangement Drawing

ROB : Railway Over Bridge

CPBC : Central Pollution Control Board

HFL : High Flood Level

LTL : Low Tide Level

R&R : Resettlement & Rehabilitation

RAP : Resettlement Action Plan

PAS : Partially Affected Structures

CPR : Common Property Resources

IRR : Internal Rate of Return

COD : Commercial Operations Date

WDV : Written Down Value Method

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

0.1 GENERAL

National Highways and Infrastructure Development Corporation Limited (NHIDCL) has decided to take up the development of various National Highways Corridors in the North-eastern state where the intensity of traffic has increased significantly in plain areas and where there is requirement of safe and efficient movement of trafficmainly in hilly terrains.

This project is a part of the above mentioned programme and the project awarded to Consultant is Consultancy Services for carrying out Feasibility Study, Preparation of Detailed Project Report and providing pre-construction services in respect of 2 laning of Yaingangpokpi-Nagaland Border in the state of Manipur.

- Project Stretch: Yaingangpokpi– Finch Corner(30.970 Km).

The NHIDCL has been entrusted with implementation of the development of this corridor from Ministry's Plan Funds.

In order to fulfil the above task, NHIDCL has entrusted the work of preparation of the feasibility study and Detailed Project Report for the above project to M/s S. M. Consultants., vide contract agreement dated 19thJanuary 2017. The Letter of Acceptance was communicated vide letter No NHIDCL/DPR/IM&UJ/Manipur/2016/293.

0.2 OBJECTIVE

The main objectives of the consultancy service will focus on establishing technical, financial viability of the project and prepare detailed project reports for rehabilitation/ upgradation/ construction of the existing road to two lane NH with paved shoulder configuration with the following points to be ensured.

- Ensure Enhanced safety of the traffic, the road users and people living close to the Highway
- Ensure enhanced operational efficiency of the highway
- Ensure fulfilment of the access needs of the local population
- Ensure minimal adverse impact on the road users and the local population due to construction
- Minimal additional acquisition of land
- Formulation of up-gradation to two lane
- Provide technical assistance including designing and cost estimation
- Superior operation and maintenance enabling enhanced operational efficiency of the Project Highway.

0.3 SCOPE OF SERVICES

The study includes all field works and detailed engineering studies for the widening and improvement of the existing road to two lane carriageway. The scope of services as detailed in TOR is as follows:

- As far as possible, the widening/improvement work to two lane with paved shoulders shall be within the existing right of way avoiding land acquisition, except for locations having inadequate width and where provisions of short bypasses, service roads, alignment corrections, improvement of intersections are considered necessary and practicable and cost effective. However bypass proposals should also be considered, wherever in urban areas, improvement to two lane of the existing road is not possible. The Consultant shall furnish land acquisition details as per revenue records/maps for further processing of land acquisition in case we require extra land exceeding RoW. Consultant will also submit 3a, 3A and 3D draft notification for acquisition of land. Scope of services includes all activities up to completion of the Land Acquisition process till 3G Notification as per LA Act of acquisition of land either under NH Act or State Act, as applicable.
- The Consultant shall study the possible locations and design of toll plaza. Wayside amenities required on tolled highway shall also be planned. The local and slow traffic may need segregation from the main traffic and provision of service roads and fencing may be considered, wherever necessary to improve efficiency and safety.
- The general scope of services is given in the sections that follow. However, the entire scope of services would, inter-alia, include the items mentioned in the Letter of Invitation and the TOR. The Consultant will also make suitable proposals for widening/improvement of the existing road to two lane with paved shoulder etc. and strengthening of the carriageways, as required at the appropriate time to maintain the level of service over the design period. The Consultants shall prepare documents for EPC contracts for each DPR assignment.
- All ready to implement 'good for tender drawings and designs' shall be prepared.
- Environmental Impact Assessment, Environmental Management Plan and Rehabilitation and Resettlement Studies shall be carried out by the Consultant meeting the requirements of the lending agencies like ADB/ World Bank/JICA, etc.
- Preparation of the Bid Documents, based on the feasibility report, due to exigency of the project for execution if desired by NHIDCL.
- Consultant shall obtain all types of necessary clearances required for implementation of the project on the ground from the concerned agencies. The client shall provide the necessary supporting letters and any official fees as per the demand note issued by such concerned agencies from whom the clearances are being sought to enable implementation.

- The Consultant shall prepare documents for the chosen mode of implementation on EPC after studying various options like BOT, Annuity and EPC.
- The Consultant shall prepare the bid documents including required schedules as per EPC mode. For that, it is suggested that Consultant should also go through the EPC documents of ministry before bidding the project. The Consultant shall assist the NHIDCL and its Financial Consultant and the Legal Adviser by furnishing clarifications as required for the financial appraisal and legal scrutiny of the project highway and bid documents.

The scope of consultancy service as set out in the TOR includes the following major tasks:

- Traffic surveys and demand assessment
- Engineering surveys and investigations of the project
- Location and layout of toll plaza
- Location and layout of truck lay byes.
- Location and layout of bus bays and bus shelters
- Identification of possible improvements in the existing alignment (horizontal & vertical) and bypassing congested locations with alternatives, evaluation of different alternatives with comparison on techno-economic and other considerations, and recommendations regarding the most appropriate option
- inventory and condition surveys for the road
- Social impact assessment
- Environmental impact assessment
- Inventory and condition surveys for bridges, cross drainage structures and drainage provisions.
- Detailed topographic surveys using total stations
- Pavement investigations
- subgrade, subsoil characteristics and strength;
- Identification of sources of construction materials;
- Preliminary design of road, cross drainage and other structures, bypasses if necessary, preparation of GAD.
- Identification of the type and the design of intersections
- Design of complete drainage system and disposal point for storm water
- Value analysis / value engineering and project costing;
- Economic and financial analysis;
- Contract packaging and implementation schedule;
- Preparation of strip plans indicating the scheme for carriageway widening, location of all existing utility services (both over and underground) and the scheme for their

relocation, trees to be felled and planted and land acquisition requirements including schedule for LA;

- Reports documents and drawings;
- Financial viability of project and financing options like BOT, Annuity, SPV;
- Preparation of Feasibility cum preliminary project report, cost estimate, approved for construction drawings, rate analysis, detailed bill of quantities, bid documents for execution of civil works through budgeting resources on BOT basis.
- Design of toll plaza and identification of their numbers and location and office cum residential complex including working drawings;
- Design of weighing stations, parking areas and rest areas as required;
- Any other user oriented facility enroute toll facility;
- Tie-in of on-going / sanctioned works of MOSRT&H /NHAI/ other agencies;
- Preparation of social plans for the project affected people as per policy of the lending agencies/ Govt. of India R & R Policy.

The Consultant shall be guided in its assignment by the Model Agreement for Engineering, Procurement and Constructions (EPC) and the Manual of Specifications and Standards for two lane of highways through Engineering, Procurement and Constructions (EPC) published by IRC:SP: 73(the "Manuals") along with relevant IRC codes for design of long bridges and other features.

0.4 APPROACH & METHODOLOGY

The consultant's approach towards the project is in accordance to the TOR in lines with the project objectives. The prescribed engineering surveys and investigations have been carried out on the Project Road conforming to MORTH/IRC/BIS Specifications/ Codes as per TOR to generate adequate database for preparing the most appropriate proposal for the rehabilitation and upgrading of the existing National Highway.

0.5 PROJECT DESCRIPTION

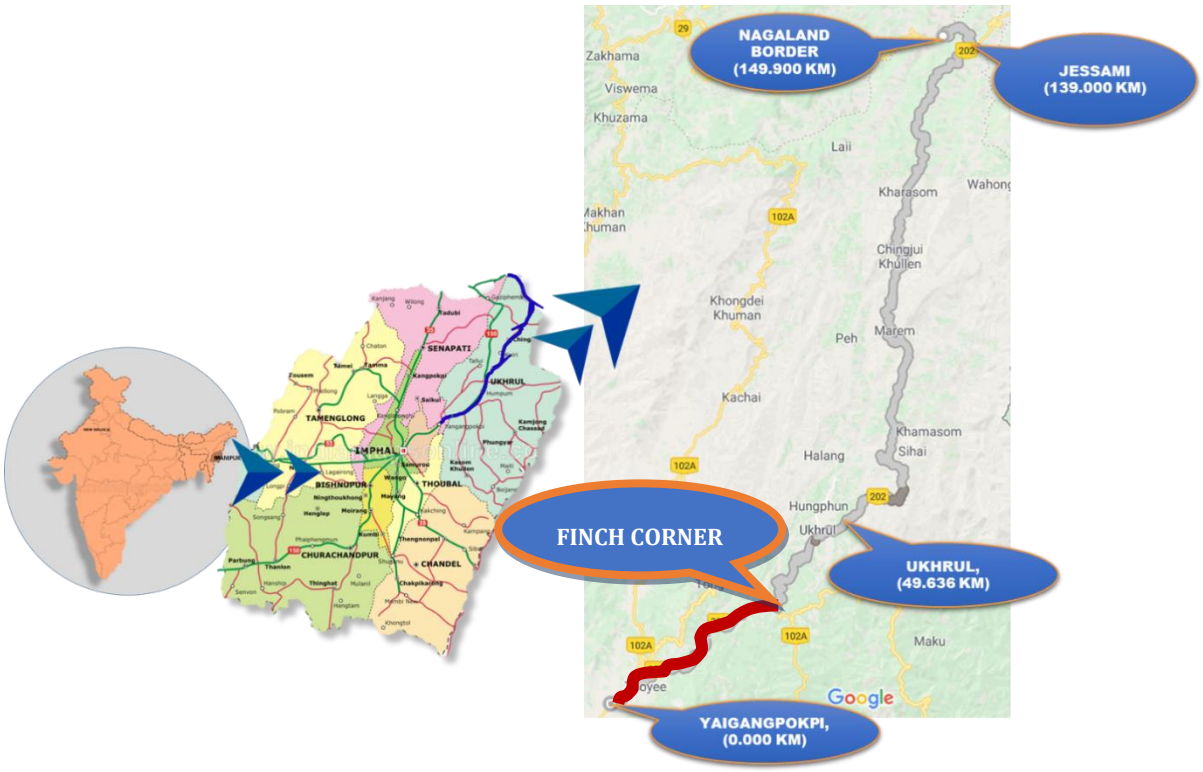
National Highway 202 (NH 202) is a National Highway in India that links Mokokchung to Imphal and runs for a distance of 460 km (290 mi).

The project road starts from Yaingangpokpi on NH 202 and ends at Finch Corner. The road lies in the district of Imphal East, Kamjong and Ukhrul, Manipur. The developed length of the road is 30.970 km. The road passes through the settlements of Laikot, Thawai, Zalenbung, Shangkhai, Lamla Chingphei, Mongkot, Litan Sareikhong, T.M. Kasom, Shakvao and Lambui. The road is in hilly terrain with poor road condition at most of the stretches. The start of the project road of about 1.300 km is in plain stretch and rest continues in hilly stretch The existing project stretch

has configuration of single lane with earthen shoulders throughout the stretch. Most of the stretches are in poor condition due to soil type and frequent occurrence of landslides at those stretches.

The project location map is provided in the figure below.

Figure 1: LOCATION MAP OF PROJECT ROAD



0.5.1 PROJECT LOCATION

The Project Roads under consideration is a part of the National Highway202 of length 460 km, the project highway starts at Yaingangpokpi at proposed chainage of 0/000 km of NH 202 and ends at Finch Corner at 30/970 km connecting Gwaltabi, Laikot, Thawai, Zalenbung, Shangkhai, Lamlai Chingphei, Mongkot, Litan, Leingangching, T.M. Kasom and Shakvao in the state of Manipur. The road passes through Ukhrul, Kamjong and Imphal East district of Manipur.

0.5.2 SETTLEMENTS ALONG HIGHWAY

A part of the total population of the towns is settled on both side of the road or local roads connecting it. At some stretches water logging problem prevails. The land-use pattern in the project road is mainly built-up and cultivation type.

Table 1: DETAILS OF VILLAGES & TOWNS ALONG THE PROJECT ROAD

Sl. No.	Existing Chainage		Villages
	From (km)	To (km)	Name
1	0.000	1.300	Gwaltabi
2	7.900	8.400	New Cannon
3	12.400	14.300	Litan
4	17.300	17.700	Yaolen
5	27.800	28.300	Ramva
6	29.500	30.000	Ramva
7	30.000	31.500	Ramva
8	34.800	35.400	Finch Corner

0.5.3 LANDUSE PATTERN

The land use pattern in Imphal East District is presented in table below:

Table 2: LANDUSE PATTERN IN IMPHAL EAST DISTRICT

SL NO	LAND CLASSIFICATION	AREA	% OF THE TOTAL DISTRICT AREA
1	Settlement	20735.9	39.12
2	Agricultural Land	60616.8	114.37
3	Forest Cover	14673.1	27.69
4	Land with/without Scrub	12486.7	23.56
5	Water Bodies		
	a) Group – A	1629.9	3.08
	b) Group - B	6687	12.62
6	Others	3270.6	6.17

The land use pattern in Ukhrul District is presented in table below:

Table 3: LANDUSE PATTERN IN UKHRUL DISTRICT

Sl. No	Category	Area (Ha)	% to the total District Area
1.	Settlement	6569.1	1.45
2.	Agricultural Land	9675.02	2.13
3.	Forest Cover	288330.98	63.45
4.	Land with /without scrub	148347.82	32.65
5.	Water Bodies		
	(a) Group - A	0	0

Sl. No	Category	Area (Ha)	% to the total District Area
	(b) Group - B	0	0
6.	Others	4077.08	0.9

Table 4: DETAILS OF TERRAIN & LAND USE PATTERN FOR ROAD 1

Sl. No.	Chainage (From)	Chainge (To)	Terrain	Landuse Pattern	Location
1.	0	0.5	Hilly	Built-up	Gwaltabi
2.	0.5	1	Plain	Built-up	
3.	1	1.3	Plain	Built-up	
4.	1.3	2	Plain	L-Valley, R-Hill	
5.	2	2.5	Hilly	L-Valley, R-Hill	
6.	2.5	3	Hilly	L-Valley, R-Hill	
7.	3	3.5	Hilly	L-Valley, R-Hill	
8.	3.5	4	Hilly	L-Valley, R-Hill	
9.	4	4.7	Hilly	L-Valley, R-Hill	
10.	4.7	5	Hilly	R-Valley, L-Hill	
11.	5	5.5	Hilly	R-Valley, L-Hill	
12.	5.5	6	Hilly	R-Valley, L-Hill	
13.	6	6.5	Hilly	R-Valley, L-Hill	
14.	6.5	7	Hilly	R-Valley, L-Hill	
15.	7	7.5	Hilly	R-Valley, L-Hill	
16.	7.5	8	Hilly	R-Valley, L-Hill	
17.	8	8.5	Hilly	R-Valley, L-Hill	New Cannon
18.	8.5	9	Hilly	R-Valley, L-Hill	
19.	9	9.5	Hilly	R-Valley, L-Hill	
20.	9.5	10	Hilly	R-Valley, L-Hill	
21.	10.0	10.5	Hilly	R-Valley, L-Hill	
22.	10.5	11.0	Hilly	R-Valley, L-Hill	
23.	11.0	11.5	Hilly	R-Valley, L-Hill	
24.	11.5	12.0	Hilly	R-Valley, L-Hill	
25.	12.0	12.5	Hilly	R-Valley, L-Hill	
26.	12.5	13.0	Hilly	R-Valley, L-Hill	Litan
27.	13.0	13.5	Plain		Litan
28.	13.5	14.0	Plain		Litan
29.	14.0	14.2	Plain		Litan
30.	14.2	14.5	Hilly	L-Valley, R-Hill	
31.	14.5	15.0	Hilly	L-Valley, R-Hill	
32.	15.0	15.5	Hilly	L-Valley, R-Hill	
33.	15.5	16.0	Hilly	L-Valley, R-Hill	
34.	16.0	16.5	Hilly	L-Valley, R-Hill	
35.	16.5	17.0	Hilly	L-Valley, R-Hill	
36.	17.0	17.5	Hilly	L-Valley, R-Hill	
37.	17.3	17.7	Hilly	L-Valley, R-Hill	Yaolen
38.	17.7	18.0	Hilly	L-Valley, R-Hill	
39.	18.2	18.5	Hilly	L-Valley, R-Hill	
40.	18.7	19.0	Hilly	L-Valley, R-Hill	
41.	19.2	19.5	Hilly	L-Valley, R-Hill	

Sl. No.	Chainage (From)	Chainge (To)	Terrain	Landuse Pattern	Location
42.	19.7	20.0	Hilly	L-Valley, R-Hill	
43.	20.2	20.5	Hilly	L-Valley, R-Hill	
44.	20.7	21.0	Hilly	L-Valley, R-Hill	
45.	21.2	21.5	Hilly	L-Valley, R-Hill	
46.	21.7	22.0	Hilly	L-Valley, R-Hill	
47.	22.2	22.5	Hilly	L-Valley, R-Hill	
48.	22.7	23.0	Hilly	L-Valley, R-Hill	
49.	23.2	23.5	Hilly	L-Valley, R-Hill	
50.	23.7	24.0	Hilly	L-Valley, R-Hill	
51.	24.2	24.5	Hilly	L-Valley, R-Hill	
52.	24.7	25.0	Hilly	L-Valley, R-Hill	
53.	25.2	25.5	Hilly	L-Valley, R-Hill	
54.	25.7	26.0	Hilly	L-Valley, R-Hill	
55.	26.2	26.5	Hilly	L-Valley, R-Hill	
56.	26.7	27.0	Hilly	L-Valley, R-Hill	
57.	27.2	27.5	Hilly	L-Valley, R-Hill	
58.	27.5	27.8	Hilly	L-Valley, R-Hill	
59.	27.8	28.2	Hilly	L-Valley, R-Hill	Ramva
60.	28.2	28.5	Hilly	L-Valley, R-Hill	
61.	28.5	29.0	Hilly	L-Valley, R-Hill	
62.	29.0	29.5	Hilly	L-Valley, R-Hill	Ramva
63.	29.5	30.0	Hilly	L-Valley, R-Hill	
64.	30.0	30.5	Hilly	L-Valley, R-Hill	Ramva
65.	30.5	31.0	Hilly	Both-Valley	
66.	31.0	31.5	Hilly	R-Valley, L-Hill	
67.	31.5	32.0	Hilly	R-Valley, L-Hill	
68.	32.0	32.5	Hilly	R-Valley, L-Hill	
69.	32.5	33.0	Hilly	R-Valley, L-Hill	
70.	33.0	33.5	Hilly	R-Valley, L-Hill	
71.	33.5	34.0	Hilly	R-Valley, L-Hill	
72.	34.0	34.2	Hilly	R-Valley, L-Hill	
73.	34.2	34.5	Hilly	R-Valley, L-Hill	
74.	34.5	35.0	Hilly	R-Valley, L-Hill	
75.	35.0	35.5	Hilly	R-Hill, L- Valley	

0.5.4 JUNCTIONS ALONG HIGHWAY

There are a total of 7+ junctions. Out of these junctions, 1is left side road junctions and 6 are right side road junctions. Other junctions are of less importance leading to jungle or metalled/cart tracks.

Table 5: LIST OF JUNCTIONS

Sl No.	Chainage	Junctions	
	From (km)	Type of Junction	Connecting places
1	0.145	Y (R)	Substation
2	1.350	Y(R)	Thawai
3	4.750	Y(L)	

Sl No.	Chainage	Junctions	
	From (km)	Type of Junction	Connecting places
4	6.920	Y (R)	
5	13.415	Y (R)	
6	28.400	Y (R)	Shakvo
7	34.700	Y (R)	Gamnoum

0.5.5 EXISTING STRUCTURES

The list of existing Highway structures such as major bridge, minor bridge, culverts, vehicular under/overpass, ROB, RUB, grade separators, Flyovers, cattle pass, pedestrian underpass etc. are listed in Tables as below:

Table 6: SUMMARY OF EXISTING STRUCTURES

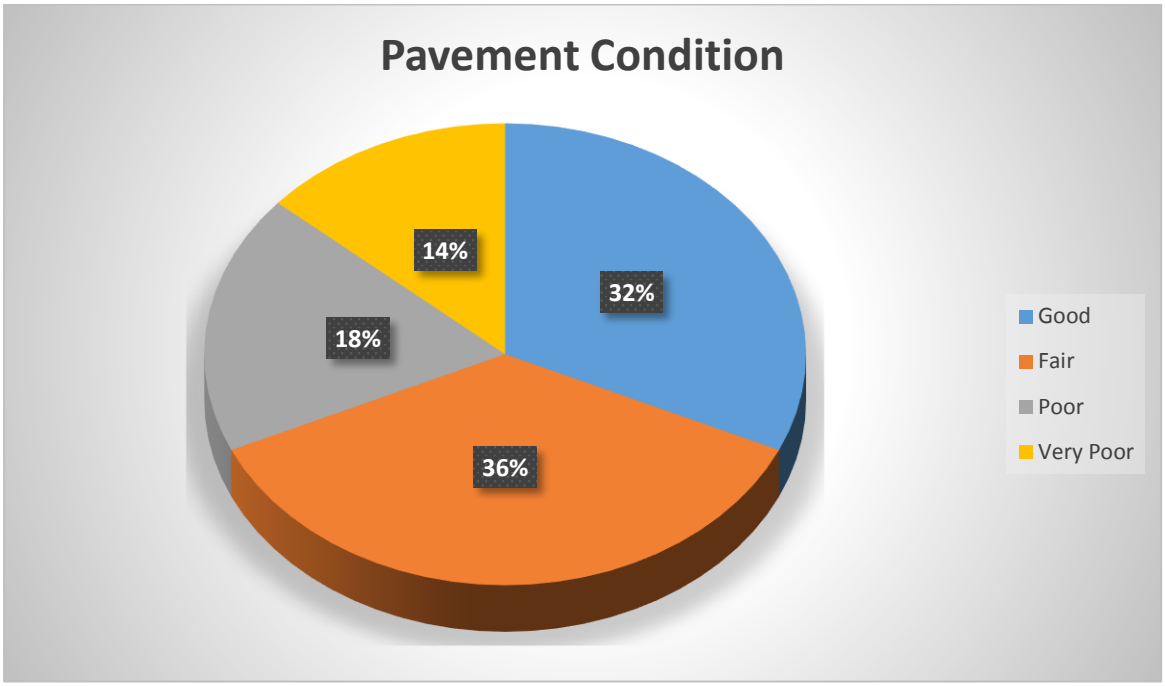
Sl.No.	Features	Description
1	Major Bridge	Nil
2	Minor Bridge	4
3	ROB	Nil
4	RUB	Nil
5	Flyover	Nil
6	Grade Separated Structures	Nil
7	Culverts	158
8	Arch Culverts	Nil
9	Cattle Underpass	Nil
10	Pedestrian Underpass	Nil

0.5.6 EXISTING CARRIAGEWAY AND PAVEMENT

The existing road configuration between Yaingangpokpi and Nagaland Border is uniform single lane carriageway with varying width of earthen shoulders.

The surface of the carriageway is bituminous and the surface of shoulders is unpaved except at few stretch near Litan (Prayer's Moutain) is found to be metalled road. Generally the condition of the pavement is poor. The details of the road condition is shown below in the chart. The detail road condition is shown in the figures below.

Figure 2: ROAD CONDITION



0.5.7 ALIGNMENT

The horizontal alignment between Yaingangpokpi to Finch Corner is complicated with many sharp curves. The said section mainly passes through hilly terrain in most of its length and cater to the design speed of 20km/hr or less. The existing road had 567 approx. nos of curves.

0.5.8 OTHER EXISTING STRUCTURES

The list of other structures like school, colleges, other educational institutions, Petrol Pump, hospital & police station is listed below.

Table 7: LIST OF OTHER IMPROTANT STRUCTURES ALONG THE CORRIDOR

SL NO	CHAINAGE	SIDE	FEATURE
LIST OF SCHOOLS			
1	26/942	RHS	JNV
RELIGIOUS STRUCTURES			
1	4/257	LHS	Mahadev Temple
2	8/120	RHS	Graveyard
3	11/470	LHS	Mongkot Christian Church
4	12/202	RHS	Tangkhul Baptist Church
5	15/300	RHS	Graveyard
POLICE STATION & PETROL PUMP			
1	0/360	RHS	Yaingangpokpi Police Station
3	12/255	RHS	Police Check Gate
4	12/227	RHS	Police Station, Litan

SL NO	CHAINAGE	SIDE	FEATURE
BUS STOP			
1	0/944	LHS	Bus Shelter
2	1/248	RHS	Bus Shelter
3	20/120	LHS	Bus Shelter
4	27/850	LHS	Bus Shelter

0.5.9 RIGHT OF WAY

The existing ROW for the project road was enquired from revenue department and was found to be 8-10 m being common at most places.

As finalized vide MoM dated 29.11.2017,24 m ROW is proposed to be acquired at open area and 20 m in built up area. This is meant to keep sufficient carriageway width, drains, catch pits, structures if any required, bus bays, truck lay byes, parking areas, way side amenities if provided for, arboriculture etc..

0.6 TRAFFIC ANALYSIS & FORECAST

The traffic surveys have been carried out along the corridor to establish base year traffic as well as travel characteristics. The baseline traffic characteristics are very important for the assessment of future traffic and travel pattern. Traffic surveys were conducted during the month of April2017. The survey locations were finalised in consultation with Authority.

The summary of the average daily traffic for the project stretch is given in Table 8. The count was made at 2 locations for the two homogeneous stretches.

Table 8: SUMMARY OF ADT

Vehicle type	HS 1 (At 49/800 km)	HS 2 (At 113/470 km)
Car/Taxies	4049	21
Jeep/Van	315	10
LCV Passenger	76	0
LCV Freight	19	1
Mini Bus	2	0
Bus	30	0
Two Axle	76	20
Three Axle	5	1
Semi Articulated	0	0
Articulated	2	0
ADT TOLLED	4574	53
PCU TOLLED	4851.5	95.5
Two Wheeler	741	13

Vehicle type	HS 1 (At 49/800 km)	HS 2 (At 113/470 km)
Three Wheeler	12	0
Cycle	31	0
Rickshaw	1	0
Animal Cart	0	0
Hand Cart	10	0
Others	2	1
ADT NON TOLLED	797	14
PCU NON TOLLED	424	8.5
ADT Total	5371	67
PCU total	5275.1	103
Percentage non Tolled	17.42%	20.9%

0.6.1 Traffic Projected

The traffic projected for the project stretch with 5% traffic growth rate has been tabulated below.

Table 9: PROJECTED TRAFFIC FOR 15 YEARS

Projected Year	HS 1 (At 49/800 km)		HS 2 (At 113/470 km)	
	Total Vehicles	Total PCU	Total Vehicles	Total PCU
2018	5641	5541	67	103
2019	5924	5819	70	108
2020	6221	6110	74	114
2021	6533	6416	78	120
2022	6860	6737	82	126
2023	7203	7074	87	133
2024	7564	7428	92	140
2025	7943	7800	97	147
2026	8341	8190	102	155
2027	8759	8600	108	163
2028	9197	9030	114	172
2029	9657	9482	120	181
2030	10140	9957	126	191
2031	10647	10455	133	201
2032	11180	10978	140	212

0.7 PAVEMENT COMPOSITION AND PAVEMENT CONDITION SURVEY

Existing pavement composition forms important information, in formulating the rehabilitation designs. From the composition details, it can be seen that the asphalt surface thickness varies from 0 mm to 40 mm. The existing Base layer thickness varies from 130 mm to 240 mm. As sub base layer various combination of different materials have been observed comprising of moorum, sand, old BT and WBM along the project road length.

Pavement condition survey has been carried out on the project corridor by visual observation of basic pavement distress. Predominant distresses like cracking, ravelling and at some stretch metalled road are also seen from Finch corner to Pilgrim Prayer Mountain. Number of potholes for each 100m length has also been noted. Apart from these distresses, Edge breaking as percentage length affected has also been noted for every 100m along the road. Condition of the unpaved shoulders was also assessed in terms of shoulder drop-off and depressions on shoulder. Residual structural strength of the existing pavement was separately assessed by Benkelman Beam deflection measurements for the purpose of Design of Overlay.

The overall condition of the pavement varies from fair to good. The overall riding quality is also fair except for a few stretches. Condition of the unpaved shoulders is fair.

0.8 PROPOSED WIDTH OF CARRIAGEWAY

The paved carriageway configuration shall be 7.0 m wide carriageway with 1.50 m shoulder on both side and 1.00 m of earthen shoulders towards valley side in open section and 1.5 m RCC Covered drain in built-up sections.

0.9PROPOSED CROSS SECTION

Details of cross section are tabulated below.

Table 10: DETAILS OF CROSS SECTION

Sl. No.	Chainage (From)	Chainage (To)	Length	Typical Cross-section
1	9.800	10.800	1000.000	TCS 1
2	11.100	12.900	1800.000	
3	13.350	14.400	1050.000	
4	19.000	21.700	2700.000	
5	22.000	22.300	300.000	
6	23.800	24.500	700.000	
7	28.550	30.800	2250.000	
8	0.000	1.450	1450	TCS 2
9	7.150	7.550	400	
10	13.050	13.350	300	
11	15.750	16.000	250	
12	24.500	24.900	400	
13	26.050	26.400	350	
14	26.800	27.700	900	
15	1.450	1.800	350	TCS 2A
16	3.800	4.780	980	
17	9.500	9.680	180	
18	10.800	11.100	300	
19	15.580	15.750	170	
20	16.800	18.200	1400	
21	27.700	28.550	850	
22	30.800	30.970	170	
23	1.450	1.800	350	TCS 3

Sl. No.	Chainage (From)	Chainage (To)	Length	Typical Cross-section
24	3.800	4.780	980	
25	9.500	9.680	180	
26	10.800	11.100	300	
27	15.580	15.750	170	
28	16.800	18.200	1400	
29	27.700	28.550	850	
30	30.800	30.970	170	
31	16.400	16.800	400	TCS 3A
32	8.600	9.000	400	TCS 4
33	9.68	9.8	120	
34	21.700	22.000	300	TCS 5
35	12.900	13.050	150	TCS 6
36	15.300	15.580	280	
37	18.200	19.000	800	
38	22.300	23.100	800	

Figure B3: TYPICAL CROSS SECTION 1

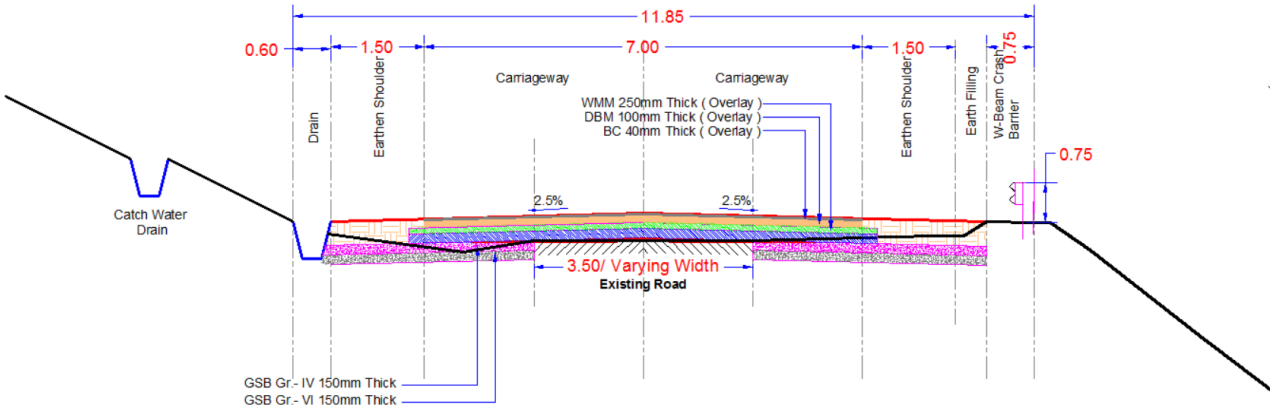


Figure B4: TYPICAL CROSS-SECTION 2

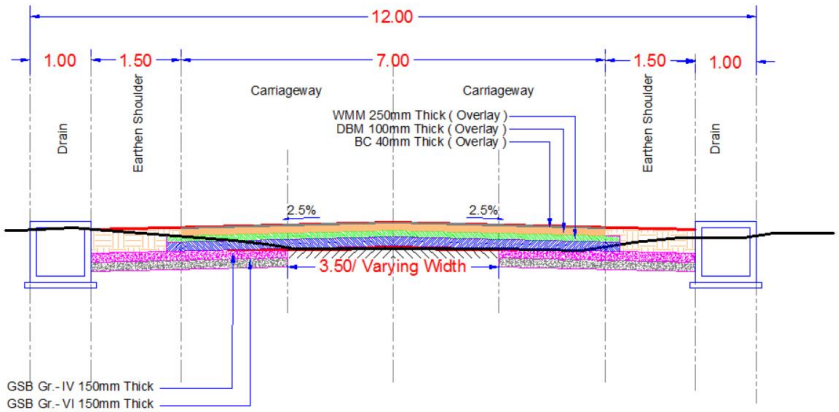
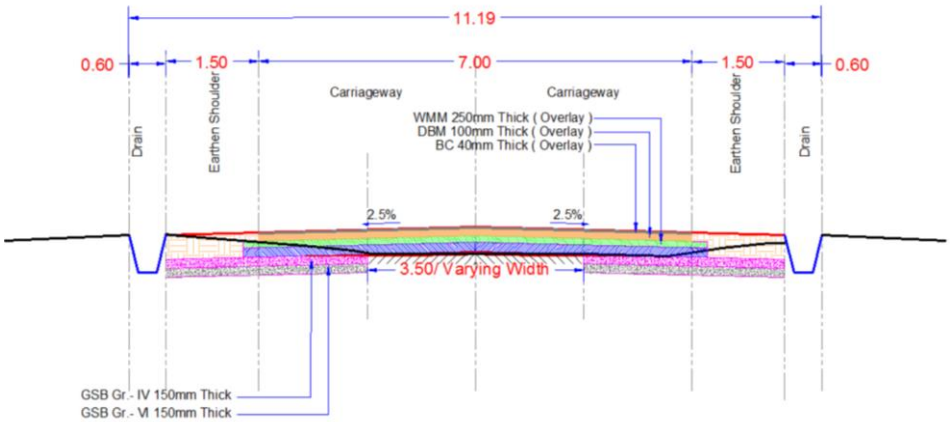


Figure B5: TYPICAL CROSS-SECTION 2A



FigureB 6: Typical Cross-section 3

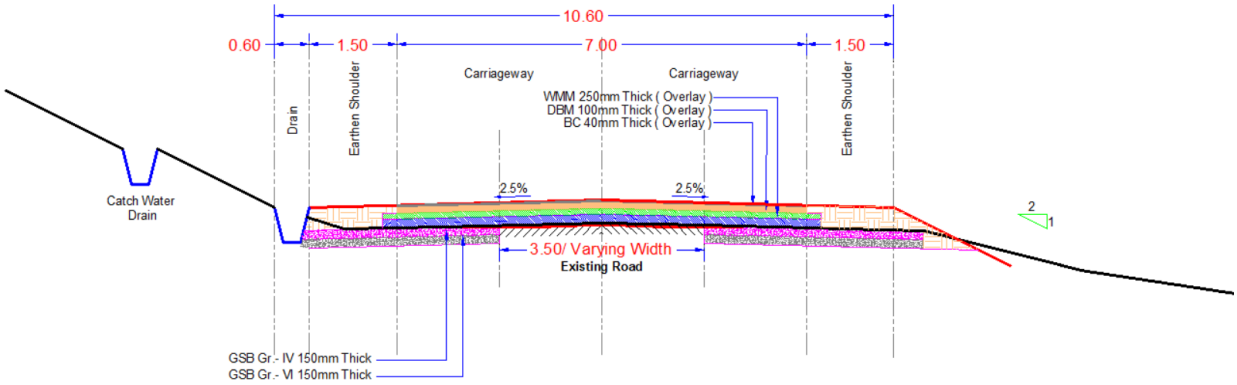


Figure B5: Typical Cross-section 3A

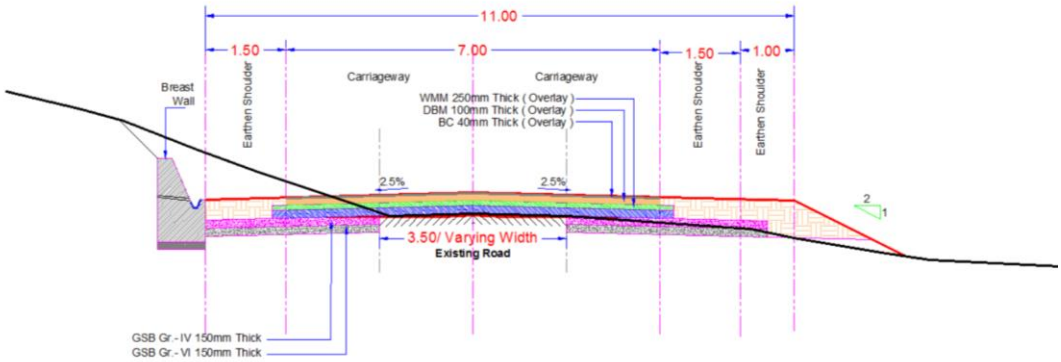


Figure B6: Typical Cross-section 4

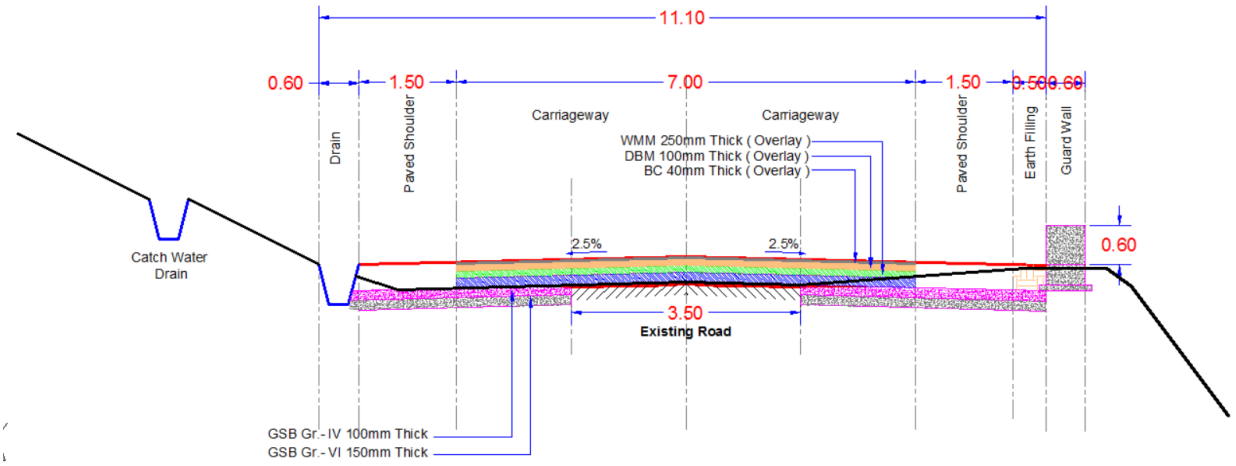


Figure B7: Typical Cross-section 5

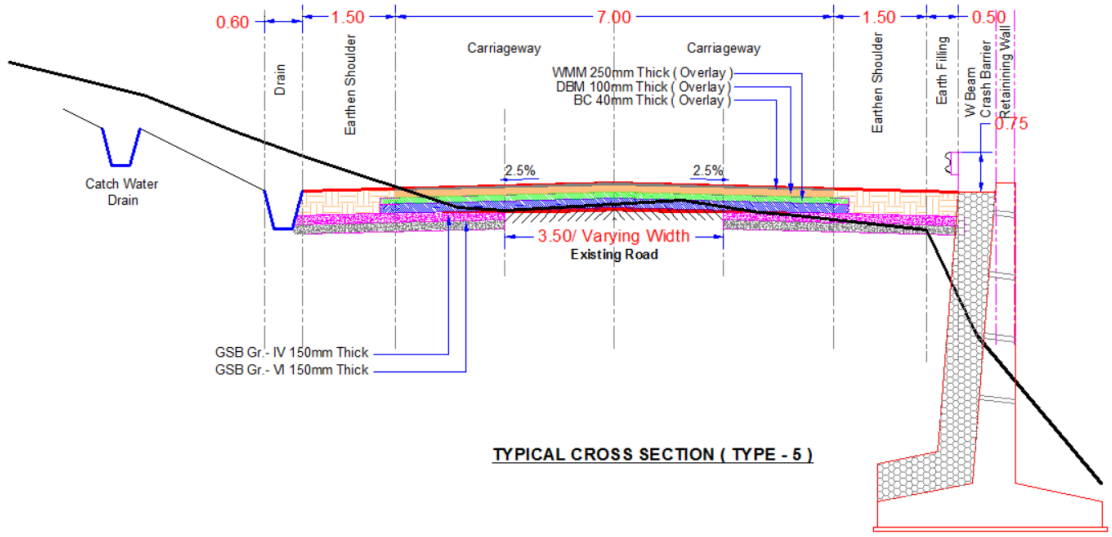
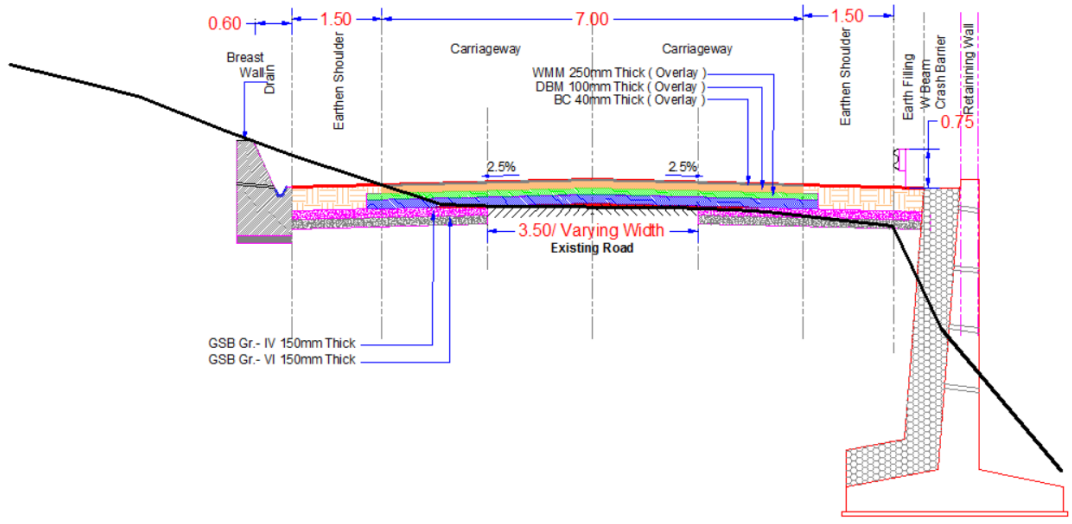


Figure B8: Typical Cross-section 6



0.11 PROPOSED BYPASSES

The option for bypasses it is not feasible as the traffic on the project road is very low. Realignments have been done to improve the existing alignment of single-lane road to the desired design standards. Most of the realignment are done considering the design speed of 40 kmph.

0.12 PROPOSED PAVEMENT COMPOSITION

The total pavement thickness requirements for both the homogenous sections using the design chart of IRC: 37-2012, for the design CBR value of 5.4% and respective 15 years design traffic, pavement composition is given below.

Table 11: PAVEMENT CRUST DETAILS

Chainage From and To	Design traffic (MSA)	CBR of subgrade (%)	Viscosity grade of bitumen	Proposed Pavement Thickness			
				GSB	WMM	DBM	BC
0/000-30/970	20	5.4	VG 10	300	250	100	40

The composition of pavement has been worked out on the basis of:

- Extended thickness combination block has been used to determine the surfacing course thickness;
- Surfacing course is designed for 10-year design life while base and sub-base courses are designed for the full 15-year design life; and, minimum compacted layer thickness for surfacing and base courses.

0.13 DESIGN OVERLAY

The average characteristic deflection values to be used for design purposes have been worked from BBD survey. The thicknesses of different layers of crust are deduced from Fig 9 of IRC 81-1997 in terms of bituminous macadam construction. However to match with the new pavement thickness, overlay thickness proposed are presented in table below.

Table 12: REQUIRED OVERLAY DETAILS

Chainage from and to	Design traffic (MSA)	Characteristic deflection	DBM overlay	Proposed overlay
0/00-30/970	20 MSA	1.2 mm	70 mm	390 mm (WMM-250 mm, DBM-100 mm BC-80 mm)

0.14 PROPOSED IMPROVEMENT FOR JUNCTIONS / INTERSECTIONS (AT GRADE)

Following aspects shall be considered for design of at-grade junctions:

- Adequately designed junction proper turning radius at all intersections for safe and smooth movement of traffic.

0.15 PROPOSALS FOR STRUCTURES

0.15.1 CULVERTS

The Project road from Yaingangpokpi to Finch Corner from Km 0.000 to Km 30.970 (design chainages), includes provision of 199 slab culverts. The condition of most of the culvert is poor and there is insufficient adequacy for waterway. The summary of the culverts are as follows:

Table 13: PROPOSALS FOR CULVERTS

Sl. No.	Type of Structure	Proposal	Numbers
1	Slab	Widening	27
		Reconstruction	4
		New Construction	62
2	Hume Pipe	New Construction	23
		Reconstruction	83

0.15.2 BRIDGES

There are total of 9 minor bridges. Out of 9 minor bridges, 3 requires reconstruction, 5 are newly constructed as the alignment shifts and 1 is retained.

Table 14: DEVELOPMENT PROPOSALS FOR BRIDGES

Sl.	Type of Bridge	Proposal	Numbers
1	Minor Bridges	Retain	1
		New Construction	5
		Reconstruction	3

0.16 PUBLIC UTILITIES

All most all kinds of utility services that can be located like electric pole, transformer, telephone pole, water supply line, optical fibre cables along roads are present at few locations of the project road stretch including crossings these services need to be reallocated. Some services are just located at the edge of the shoulder and some at the toe.

0.16.1 Electric Lines

The electric poles are very close at few locations and generally located on the edge of the right of way. The electric lines are close to project highway in the town/village areas.

0.16.2 Fibre Optic Cable

Fibre Optic Cable is present along the project road at very few locations.

0.16.3 Impact

An important part of the later detailed design will be to fully determine impacts and design, in conjunction with utility companies, the diversions or strengthening or crossing (via pipe crossings to be provided under the roadwork contract) locations and works. It is also very important to note that in "urban" road projects service relocations are an important part of the preplanning, both on the actual work [definition and phasing] and especially on the material procurement side, as in simplistic terms one cannot relocate power lines, telephone lines and waterlines with at least a reasonable amount of cable, pipes and fittings already in stock and immediately available.

It should be noted that there may be additional land requirements identified in the final design as the available ROW is insufficient to accommodate the moving of utility services and the tree planting proposals.

0.17 COST ESTIMATE

The total civil cost of the project is 623.91 crores. The table below shows the civil cost estimate for the project.

Table 15: GENERAL ABSTRACT

SL. NO	TYPE OF WORK	AMOUNT
1	**Road Work**	
i)	Road Proper	₹ 2,49,48,28,333.21
ii)	Curves (Extra Widening)	₹ 4,57,24,814.53
2	**C.D Works**	
i)	PCC Slab Culvert	₹ 29,23,21,594.00
ii)	RCC Slab Culvert	₹ 18,52,448.00
iii)	Minor Bridge	₹ 7,16,65,576.00
3	**Miscellaneous Item**	
i)	Drain	₹ 1,23,33,118.58
ii)	Lined Drain	₹ 4,89,34,710.94
iii)	Breast Wall	₹ 11,07,61,998.19
iv)	W Metal Beam Crash barrier	₹ 2,53,87,836.15
v)	Retaining Wall	₹ 19,86,19,420.00
vi)	Junctions	₹ 9,47,786.95
vi)	Signs & Safety	₹ 1,67,90,554.78

SL. NO	TYPE OF WORK		AMOUNT
vii)	Overhead Signage	₹	7,72,664.49
ix)	Bus Bay	₹	41,10,995.00
x)	Seeding and Mulching	₹	3,31,09,880.00
xi)	Soil Nailing	₹	47,42,080.00
xii)	Gabion Structure	₹	5,15,25,278.00
4	**Toilet Block (4nos @ 15 lakhs)-L.S**	₹	60,00,000.00
5	**Street Lighting (Built-up Section @ Rs 9000- 240 nos)-L.S**	₹	21,60,000.00
	Civil Cost	**₹**	**3,42,25,89,089.00**
	Add GST @12%	₹	41,07,10,691.00
	Total Civil Cost (A+A')	**₹**	**3,83,32,99,780.00**
	Add Contingency @ 2.8% on "A"	₹	9,58,32,494.00
	Total Cost with contingency (EPC Cost = B+B')	**₹**	**3,92,91,32,274.00**
a)	Supervision Charges @ 3% of (A)	₹	10,26,77,673.00
b)	Agency Charges @ 3% of (A)	₹	10,26,77,673.00
c)	Maintenance Charges @ 5% of (A) for 5 years	₹	8,55,64,727.00
d)	Escalation Charges @ 15 % of (A) for 3 years	₹	17,11,29,454.45
	Sum(C+D+E+F+G)	**₹**	**4,39,11,81,802.00**
	Tentative Cost for Preconstruction Activities (LA, Forest Clearance, EIA/EMP cost, Utility Shifting)	**₹**	**52,00,00,000.00**
	SAY Rs.	**₹**	**491.12**
			CRORES


PROJECT
BACKGROUND

PROJECT BACKGROUND

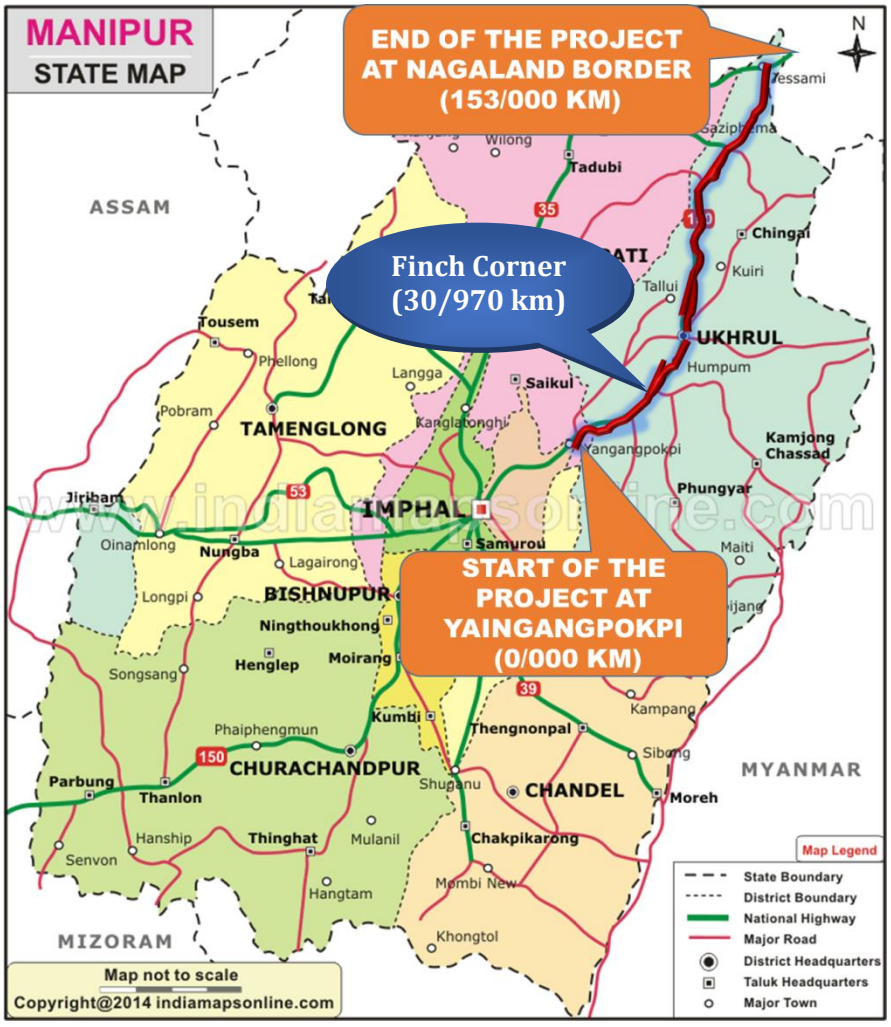
1.1 BACKGROUND

Ministry of Road Transport and Highways (MoRTH) through NHIDCL (the "Authority") intends to develop the national highways in the North-Eastern states. As a part of this endeavour, the Authority has decided to undertake the twolaning of the following road through EPC mode.

The road under consideration for the present submission is Yaingangpokpi-Finch Corner on NH 202 in the state of Manipur. The length of the road is 30.970 km. The starting point is near Gwaltabi near Yaingangpokpi and it traverses through Laikot, Thwai, Zelenbung, Shangkai, LambaiChingphei, Mongkot, Litan, Leingangching and TM Kasom ending at Finch Corner.

In the above backdrop, NHIDCL has entrusted the work of preparation of the feasibility study and Detailed Project Report for the above project to M/s S. M. Consultants, vide contract agreement dated 19th January, 2017.

Figure 7: KEY MAP OF PROJECT ROAD



1.2 PROJECT OBJECTIVE

The main objective of the project is to provide sound and appropriate engineering solutions for the rehabilitation and improvement of the present road deficiencies through conducting comprehensive studies, assessing the importance of the corridor and comprehensive analysis of data collected.

1. The main objective of the consultancy service is to establish the technical, economical, and financial viability of the project and prepare detailed project reports for rehabilitation and upgrading of the existing National Highway to a 2 lane with paved shoulder carriageway configuration
2. The viability of the project designed with regard to rehabilitation, upgrading and improvement based on highway design, pavement design, provision of service roads wherever necessary, type of intersections, rehabilitation and widening of existing and/or construction of new bridges structures and, road safety features, quantities of various items of works and cost estimates vis-à-vis
3. The Detailed Project Report would inter-alia include detailed highway design, design of pavement and overlay with options for flexible or rigid pavements, design of bridges and cross drainage structures, design of service roads, quantities of various items, detailed working drawings, detailed cost estimates, economic and financial viability analyses, environmental and social feasibility, social and environmental action plans as appropriate and documents required for tendering the project on commercial basis for competitive bidding.

1.3 SCOPE OF SERVICES

The study includes all field works and detailed engineering studies for the widening and improvement of the existing road to two lane carriageway. The scope of services as detailed in TOR is as follows:

- As far as possible, the widening/improvement work to two lane with paved shoulders shall be within the existing right of way avoiding land acquisition, except for locations having inadequate width and where provisions of short bypasses, service roads, alignment corrections, improvement of intersections are considered necessary and practicable and cost effective. However bypass proposals should also be considered, wherever in urban areas, improvement to two lane of the existing road is not possible. The Consultant shall furnish land acquisition details as per revenue records/maps for further processing of land acquisition in case we require extra land exceeding RoW. Consultant will also submit 3a, 3A and 3D draft notification for acquisition of land. Scope of services includes all activities up

to completion of the Land Acquisition process till 3G Notification as per LA Act of acquisition of land either under NH Act or State Act, as applicable.

- The Consultant shall study the possible locations and design of toll plaza. Wayside amenities required on tolled highway shall also be planned. The local and slow traffic may need segregation from the main traffic and provision of service roads and fencing may be considered, wherever necessary to improve efficiency and safety.
- The general scope of services is given in the sections that follow. However, the entire scope of services would, inter-alia, include the items mentioned in the Letter of Invitation and the TOR. The Consultant will also make suitable proposals for widening/improvement of the existing road to two lane with paved shoulder etc. and strengthening of the carriageways, as required at the appropriate time to maintain the level of service over the design period. The Consultants shall prepare documents for EPC contracts for each DPR assignment.
- All ready to implement 'good for tender drawings and designs' shall be prepared.
- Environmental Impact Assessment, Environmental Management Plan and Rehabilitation and Resettlement Studies shall be carried out by the Consultant meeting the requirements of the lending agencies like ADB/ World Bank/JICA, etc.
- Preparation of the Bid Documents, based on the feasibility report, due to exigency of the project for execution if desired by NHIDCL.
- Consultant shall obtain all types of necessary clearances required for implementation of the project on the ground from the concerned agencies. The client shall provide the necessary supporting letters and any official fees as per the demand note issued by such concerned agencies from whom the clearances are being sought to enable implementation.
- The Consultant shall prepare documents for the chosen mode of implementation on EPC after studying various options like BOT, Annuity and EPC.
- The Consultant shall prepare the bid documents including required schedules as per EPC mode. For that, it is suggested that Consultant should also go through the EPC documents of ministry before bidding the project. The Consultant shall assist the NHIDCL and its Financial Consultant and the Legal Adviser by furnishing clarifications as required for the financial appraisal and legal scrutiny of the project highway and bid documents.

The scope of consultancy service as set out in the TOR includes the following major tasks:

- Traffic surveys and demand assessment
- Engineering surveys and investigations of the project
- Location and layout of toll plaza
- Location and layout of truck lay byes.
- Location and layout of bus bays and bus shelters

- Identification of possible improvements in the existing alignment (horizontal & vertical) and bypassing congested locations with alternatives, evaluation of different alternatives with comparison on techno-economic and other considerations, and recommendations regarding the most appropriate option
- inventory and condition surveys for the road
- Social impact assessment
- Environmental impact assessment
- Inventory and condition surveys for bridges, cross drainage structures and drainage provisions.
- Detailed topographic surveys using total stations
- Pavement investigations
- subgrade, subsoil characteristics and strength;
- Identification of sources of construction materials;
- Preliminary design of road, cross drainage and other structures, bypasses if necessary, preparation of GAD.
- Identification of the type and the design of intersections
- Design of complete drainage system and disposal point for storm water
- Value analysis / value engineering and project costing;
- Economic and financial analysis;
- Contract packaging and implementation schedule;
- Preparation of strip plans indicating the scheme for carriageway widening, location of all existing utility services (both over and underground) and the scheme for their relocation, trees to be felled and planted and land acquisition requirements including schedule for LA;
- Reports documents and drawings;
- Financial viability of project and financing options like BOT, Annuity, SPV;
- Preparation of Feasibility cum preliminary project report, cost estimate, approved for construction drawings, rate analysis, detailed bill of quantities, bid documents for execution of civil works through budgeting resources on BOT basis.
- Design of toll plaza and identification of their numbers and location and office cum residential complex including working drawings;
- Design of weighing stations, parking areas and rest areas as required;
- Any other user oriented facility enroute toll facility;
- Tie-in of on-going / sanctioned works of MOSRT&H /NHAI/ other agencies;

- Preparation of social plans for the project affected people as per policy of the lending agencies/ Govt. of India R & R Policy.

The Consultant shall be guided in its assignment by the Model Agreement for Engineering, Procurement and Constructions (EPC) and the Manual of Specifications and Standards for two lane of highways through Engineering, Procurement and Constructions (EPC) published by IRC:SP: 73(the "Manuals") along with relevant IRC codes for design of long bridges and other features.

1.4 COMMENCEMENT

The consultancy service has various systematic steps to prepare the detailed project report of Project Highway. In the first step, the Inception Report with Quality Assurance Plan was submitted to provide an overview of the project site, the mobilisation process to take up the work and the quality assurance of the field work to be carried out. The second phase includes the feasibility report which is in two phases- draft feasibility report submission with presentation and submission of final feasibility report after incorporating the comments on draft feasibility report. The last phase requires submitting the detailed project report with the strip maps, schedules, clearances and execution plans with bid documents.

The following reports have been submitted in consonance with the terms of reference:

Table 16: SCHEDULE OF SUBMISSION

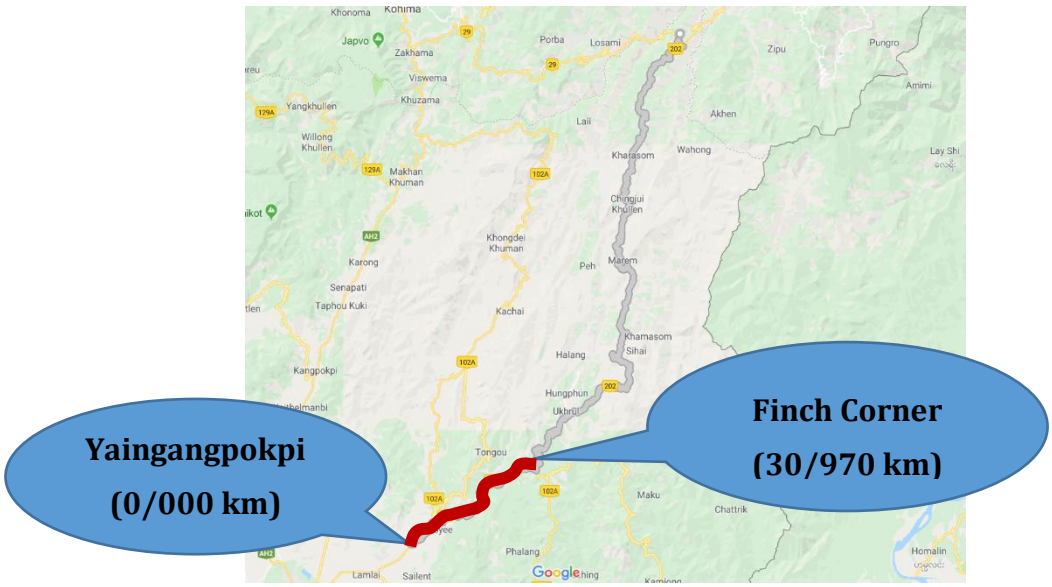
Sl No	Deliverables	Date
1	Inception report and QAP	02.02.2017
3	Alignment Report	10.05.2017
4	Draft Feasibility Report	27.04.2017
5	Final Feasibility Report	29.07.2017
6	Draft Detailed Project Report	29.12.2017
7	Detailed Project Road	10.05.2018

1.5 PROJECT LOCATION

The project highway i.e., Yaingangpokpi-Finch Corner (30.970 km) in the state of Manipur has a great potential to promote the economic development of the state. The development of these roads will also provide scope to local entrepreneurs to explore the growth opportunities by taking up need based ventures as the project road passes through the district headquarter of Ukhrul and is a linking road to the capital city of Manipur. The road has a major inter-district and interstate connectivity. It connects to Mizoram on the southern side.

The project location map is provided in the figure below.

Figure 8: LOCATION MAP OF YAINGANGPOKPI-FINCH CORNERSECTION



1.6 PROJECT DESCRIPTION

The National Highway 202 connecting Yaingangpokpi to Finch Corner Section (30.970kms) in the state of Manipur has a great potential to promote the socio-economic development. Ukhrul is the district head-quarter. Thus development of the road will provide scope to entrepreneurs to explore the growth opportunities. National Highway 202 (NH 202) is a National Highway in India that links Mokokchung to Imphal and runs for a distance of 460 km and 210 km in the state of Manipur.

The stretch under consideration is Yaingangpokpi(0/000 km) till Finch Corner(30/970 km) in the state of Manipur. The road stretch is important as Ukhrul is the district headquarter and the road connects to the capital city of Manipur state. The existing road is single lane in configuration with earthen shoulders. Thus development of these roads will also provide scope to entrepreneurs to explore the growth opportunities.

1.7 STRUCTURE OF THE REPORT

The present submission is the Detailed Project Report.

This report comprises the following volumes:

- Volume I : Main Report;
- Volume VI : Rate of Analysis
- Volume VII : Cost Estimates
- Volume VIII : Bill of Quantities

Volume I: Main Report comprises the following chapters

Chapter 1: Project Background

Chapter 2: Socio-Economic Features

Chapter 3: Engineering Survey & Investigation

Chapter 4: Hydrology Study of Project Road

Chapter 5: Traffic Survey & Analysis

Chapter 6: Improvement Proposals

Chapter7: Design Standards

Chapter 8: Cost Analysis

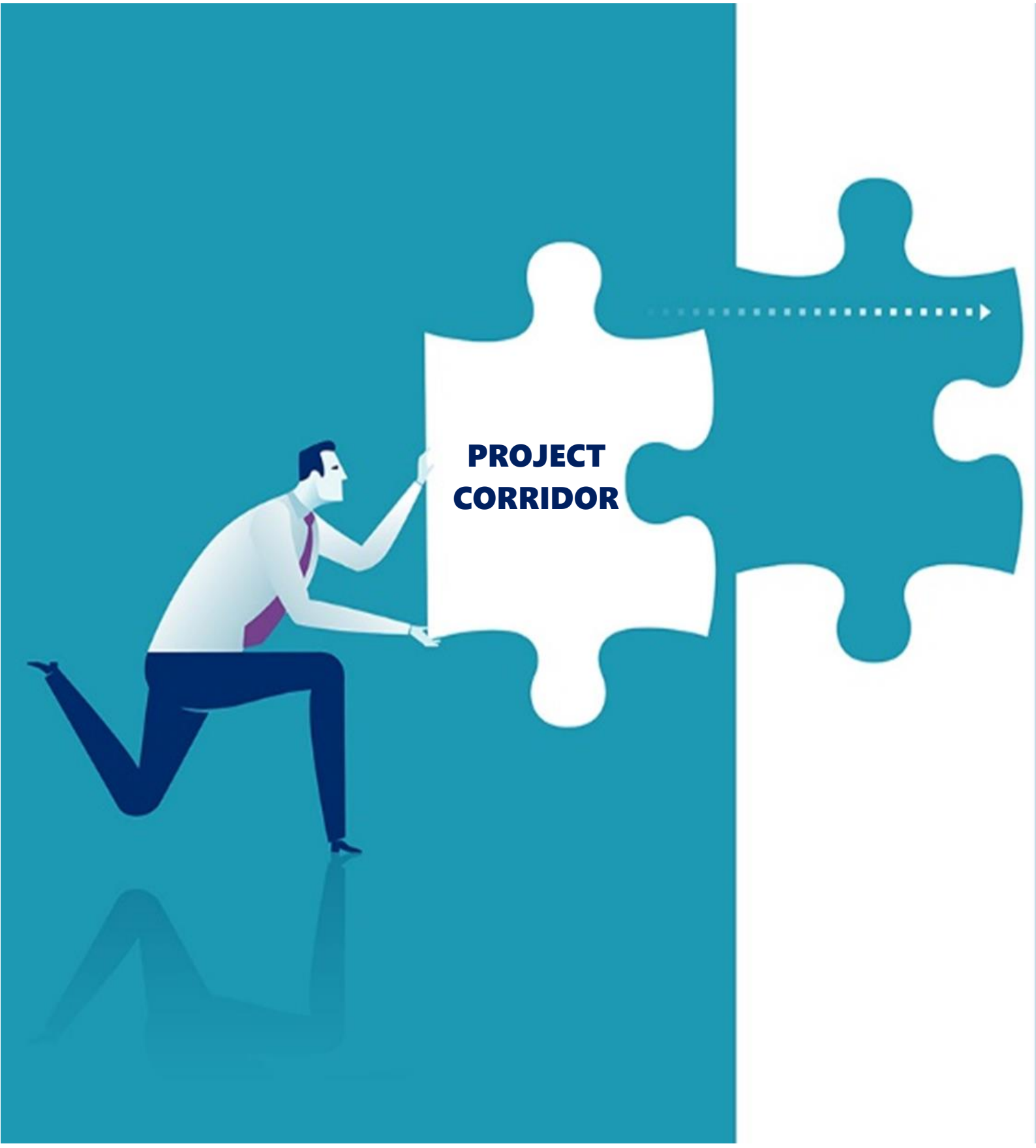
Chapter 9: Economic Analysis

Chapter 10: Financial Analysis

Chapter 11: Environmental Impact Assessment

Chapter 12: Social Impact Assessment & Action Plan

Chapter 13: Traffic Operation & Safety Plan


PROJECT
CORRIDOR

PROJECT CORRIDOR

2.1 General

Manipur is a state in north eastern India, with the city of Imphal as its capital. It is bounded by Nagaland to the north, Mizoram to the south, and Assam to the west, Burma (Myanmar) lies to its east. The state covers an area of 22,327 square kilometres (8,621 sq mi) and has a population of almost 3 million inhabitants.

Manipur is a land that is home to several unique cultures and pristine beauty. Manipur sets it foot in new cultural believes, carrying forward its thriving traditions from thousands of years. When it comes to the tourist attraction, it lags behind because of conflicts within the state and the condition of the roads.

2.2 Economy of Manipur

The 2012–2013 gross state domestic product of Manipur at market prices was about 10,188 crore. Its economy is primarily agriculture, forestry, cottage and trade driven. Manipur acts as India's "Gateway to the East" through Moreh and Tamu towns, the land route for trade between India and Burma and other Southeast Asian countries. Manipur has the highest number of handicrafts units and the highest number of crafts persons in the north eastern region of India.

The project roads come under the influence of Ukhrul and Imphal East districts of Manipur. A brief view of the district and the areas of influence are presented below so that we can overview the effects that the various features of the district are likely to influence the project roads.

2.3 Ukhrul District

Ukhrul is a town in Ukhrul district in the state of Manipur, India. Ukhrul district is the home of the Tangkhul Naga. It is the administrative headquarters of the Ukhrul district. There are also four sub-divisions in the district for administering the villages in and around it.

- **Geography**

Ukhrul district, with a total geographical area of 4544 square kms, lies between 24.28 degree and 25.41 degree north latitudes and 94.45 degree and 94.80 degree east longitudes. The District is bounded by Myanmar in the East, Chandel District in the South, Imphal East and Senapati Districts in the West and Nagaland State in the North. The terrain of the district is hilly with varying heights of 913 m to 3114 m (MSL). The district head quarter Ukhrul is linked with Imphal, the state capital by NH 202.

- **Rivers**

Maklang and Tuyeng are the important rivers for KasomKhullen and Kamjong Sub- division. The Thoubal River starts from the district and running through the Ukhrul North and Ukhrul central sub-divisions. It is the longest and biggest river in the district. Chammu and chingai rivers run through Ukhrul North Sub-division.

- **Climate & Rainfall**

The whole district is having the monsoon type of climate. As the district headquarters lies on the top of the high hills it is very cold throughout the year. It is always covered by the clouds. Regarding weather of the district Headquarter, the sudden changes of the position of cloud are openly seen within a few moments. But in other places outside the district Headquarter, it is hot in summer and very cold in winter. However, the whole district is having a moderate temperature. The hill range that lies in the district Headquarter Ukhrul Central sub-division has got very cold climate in winter while other parts of the vast hilly areas of the district have got moderate climate throughout the year. The coldest months of the district are December and January. During this period, the temperature at the Ukhrul district head-quarter uses to come down to 300C and even 00C. The climate in Ukhrul is warm and temperate. In winter, there is much less rainfall in Ukhrul than in summer. This location is classified as Cwb by Köppen and Geiger. The average temperature in Ukhrul is 15.5 °C. Precipitation here averages 1616 mm.

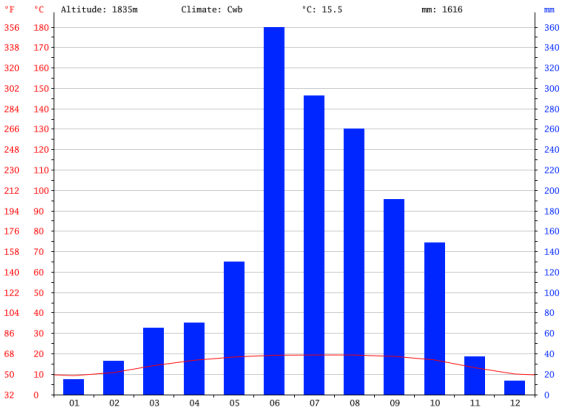


Figure 9: Ukhrul Climate Graph

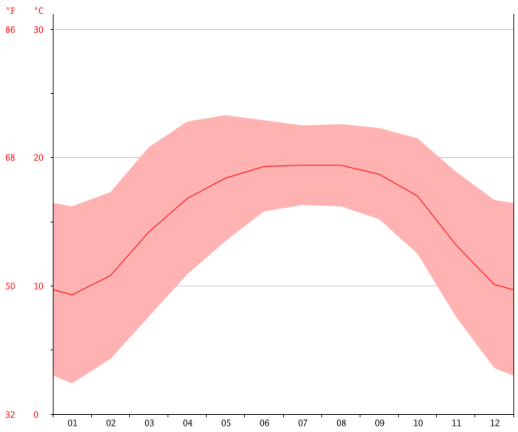


Figure 10: Ukhrul Temperature Graph

- **Industries:**

District Industries Centre, Ukhrul is functioning with its office at Western Block, Mini Secretariat Building, Ukhrul. The General Manager, DIC is the Head of the Office. Department of Commerce & Industries, Govt. of Manipur is setting up one Industrial Estate (IE) in each district of Manipur

under Micro & Small Enterprises-Cluster Development Programme (MSE-CDP) of Ministry of MSME, Govt. of India for the development of Micro & Small Enterprises in the State. There are 3 (three) Handloom Clusters in Ukhrul District. Department of Commerce & Industries, Govt. of Manipur is also setting up one Cold Chain/Value Addition Common Facility Centre at MaaKachuiram, Ukhrul District at an estimated cost of Rs. 3.00 crore.

- **Agriculture:**

Rice, Maize, Pulses and Oil seeds are the important crops cultivated in the district. Among which rice is the main stable food crop covered about 13,659 hectares of land (Terrace and Jhum). Next to rice, maize and pulses are also very important crop for the people of Ukhrul District. Local varieties and H.Y.V are cultivated favourably by the farmers.

- **Workforce**

The workforce distribution of the total population in the district shows that 47.2 percent of the population is in the total workforce, which is higher than the state average for rural areas of 45.4 percent. Again of the total workforce of 47.2 percent, 36.6 percent are main workers and 10.6 percent are marginal workers. Among the total workforce of Ukhrul, the Census 2001 reveals that there are 46005 (69.2 percent) cultivators, 1917 (2.9 percent) agricultural labourers, 2620 (3.9 percent) household industries workers and 15973 (24.0 percent) other workers. The desegregated figures on gender based work participation rate indicate that female work participation rate is lower than the rate of males in the district.

2.4 Kamjong

Kamjong District is a district in Manipur state, India created by splitting Ukhrul district.

The district headquarters is located in Kamjong. Kamjong District is a newly created district on 8th December 2016 and lies between Latitude 24.857044N and longitude 94.513463 E with GPS coordination of 24*51'25.3584" N 94*30'48.4668 E and shares a long international border with Myanmar. It covers approximately an area of 2400 Sq.Km. It is bounded by Myanmar in the east, Senapati in the West, Ukhrul in the North and Chandel in the South. The terrain of the district is hilly with varying heights of 913 m to 3114 m (MSL). The district headquarter is linked with state highway of 120 Km from Imphal.

- **Demographics**

The district is home to about 33 thousand people, among them about 17 thousand (52%) are male and about 16 thousand (48%) are female. 4% of the whole population are from general caste, 0% are from schedule caste and 96% are schedule tribes. Child (aged under 6 years)

population of Kamjong district is 14%, among them 52% are boys and 48% are girls. There are 6300 households in the district and an average 5 persons live in every family.

100% population of Kamjong district live in the Kamjong District rural part.

As of 2011 census there are 929 females per 1000 male in the district. Sex ratio in general caste is 452, in schedule caste is 294 and in schedule tribe is 959. There are 930 girls under 6 years of age per 1000 boys of the same age in the district.

- **Literacy**

Total about 23 thousand people in the district are literate, among them about 13 thousand are male and about 11 thousand are female. Literacy rate (children under 6 are excluded) of Kamjong is 82%. 86% of male and 77% of female population are literate here.

- **Work Force**

Kamjong has 50% (about 17 thousand) population engaged in either main or marginal works. 51% male and 49% female population are working population. 41% of total male population are main (full time) workers and 10% are marginal (part time) workers. For women 37% of total female population are main and 12% are marginal workers.

2.5 Imphal East District

Imphal East district is one of the 16 districts of Manipur state in north-eastern India. As of 2011 it is the second most populous district in the state, after Imphal West.

The start of the project i.e., Yaingangpokpi comes under this district. The interstate and inter district economy of this district is dependent on the project road. So, the studying the economy of the district is important.

- **Demographics**

According to the 2011 census Imphal East district has a population of 452,661, roughly equal to the nation of Malta. This gives it a ranking of 551st in India (out of a total of 640). The district has a population density of 638 inhabitants per square kilometre (1,650/sq mi) . Its population growth rate over the decade 2001-2011 was 14.63%. Imphal East has a sex ratio of 1011 females for every 1000 males, and a literacy rate of 82.81%.

- **Economy**

Agriculture is the main occupation of the people in the district. In the district there are 27,000 and 4,100 hectares of land for H.Y.V. (high yield variety) and improved local paddy field respectively. There are land of 450 hectares for maize, 60 hectares for wheat and 350 hectares

for potato in the district. The main food crops are paddy, potato and vegetables. Among the cash crops are sugar cane, maize, pulse, oil seed and other vegetables etc. The total number of workers engaged in agriculture in the district was 42,473 as per 1991 census of which 28,661 were male and 13,812 were female. Spices like chilli, onion, ginger, turmeric and coriander of very good quality are grown in the district.

Horticulture products have been acquiring popularity with the people in the district. Fruits like pineapple, banana, lemon and papaya grow well in the district. Pineapple grows in plenty at the slope of Ngariyan Hill. There is considerable scope for increasing the area under different horticulture crops. The soil and climate favour for mass plantation of horticulture products in the district.

In the district, there is a dairy farm and a veterinary training center. There are also 5 veterinary Hospitals and 19 Veterinary Dispensaries in the district along with 3 nos. of Aids centers. The following is the population of livestock as per survey report of 1997 census.

2.5 Details of Roads

Table 17: DETAILS OF ROADS

Chainage (Km)		Terrain Type	Location	District
From	**To**			
0/000	**30/970**	Plain, Hilly	Yaingangpokpi to Finch Corner	Imphal East, Ukhrul, Kamjong

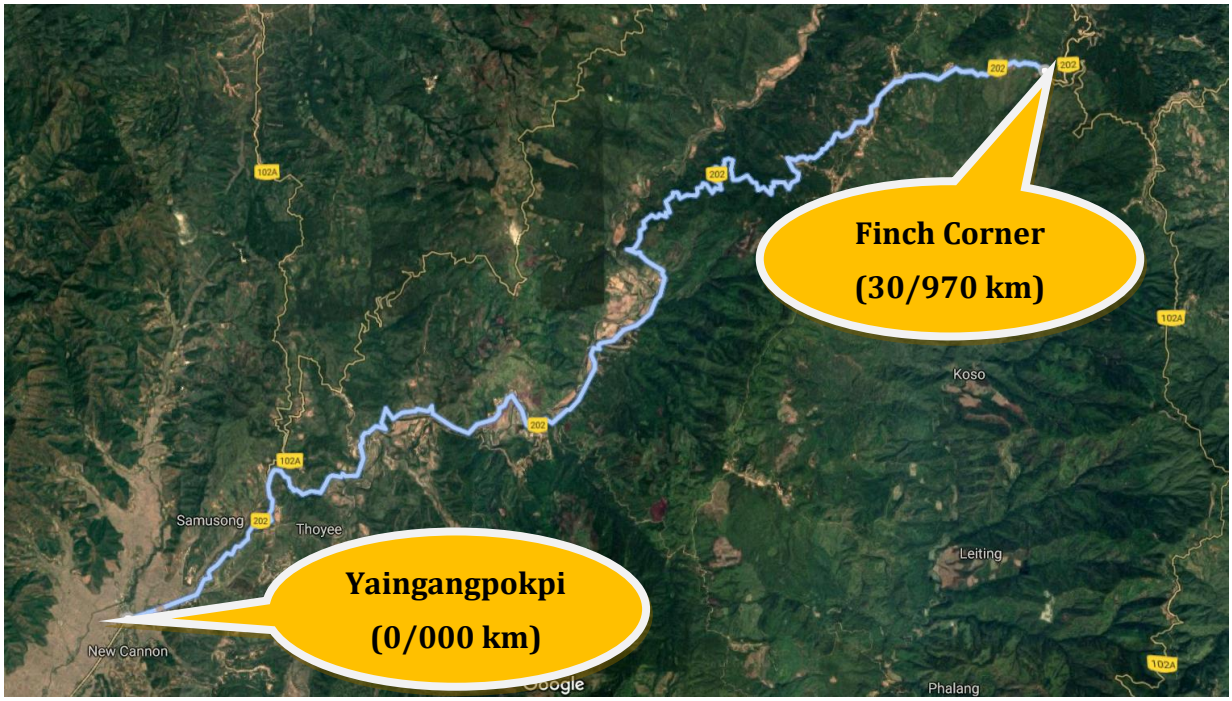


Figure 11: Key Map

2.6 General Overview of Project Highway

The Project Roads is a part of the newly renamed National Highway of 202 of total length 460 km, starting from Yaingangpokpi to Nagaland Border passing through Ukhrul, Shiroi, Lunghar, Nungbi, Marem, Razai, Kharasom,Lazo and Jessami in the state of Manipur. The project highway starts from a junction in Yaingangpokpidesign chainage of 0/000 km NH 202 and ends at Finch Corner 30/970 km of NH 202 in the state of Manipur. This road falls in Ukhrul, Kamjong and Imphal East district with a total length 30.970 kms having a configuration of single lane. The road passes through hilly terrain having a land use pattern mostly of forest and built-up. There are many sharp curves which needs to be corrected. Overtopping is seen at some stretches of the road.

Table 18: EXISTING STRUCTURES/ FEATURES OF THE ROAD

Sl.No.	Features	Description
1	Major Bridge	Nil
2	Minor Bridge	4
3	ROB	Nil
4	RUB	Nil
5	Flyover	Nil
6	Grade Separated Structures	Nil
7	Service Roads	Nil
8	Culverts	158
9	Arch Culvert	Nil
10	Median	Nil
11	Roadside Drains	Approx. 26 km
12	Junctions	7
13	At Grade Railway Crossings	Nil
14	Road Boundary Stones	Nil
15	Road Sign Boards	Inadequate
16	Bus Bays	Nil
17	Truck Lay Bye	Nil
18	Bus Stops	4

2.7 Settlements along Highway

Most of the population of the towns is settled on hill side with some on valley portion of the road. The land-use pattern in the project road is mainly agriculture and forest with few stretches of built-up.

Table 19: DETAILS OF VILLAGES & TOWNS

Sl. No.	Existing Chainage		Villages
	From (km)	To (km)	Name
1	0.000	1.900	Gwaltabi
2	7.900	8.400	New Cannon
3	12.400	14.300	Litan
4	17.300	17.700	Yaolen
5	27.800	28.300	Ramva
6	29.500	30.000	Ramva
7	30.000	31.500	Ramva
8	34.800	35.400	Finch Corner

2.8 Junctions along Highway

There total of 5 junctions. Out of these junctions, 1 are left side road junctions and 4 right side road junctions. Other juctions are of less importance leading to jungle or metalled/cart tracks.

Table 20: DETAILS OF JUNCTIONS

Sl No.	Chainage	Junctions	
	From (km)	Type of Junction	Connecting places
1	0.145	Y (R)	Substation
2	1.350	Y(R)	Thawal
3	4.750	Y(L)	
4	6.920	Y (R)	
5	13.415	Y (R)	
6	28.400	Y (R)	Shakvao
7	34.700	Y (R)	Shangshak Phungdon

2.9 Existing Structures

The list of existing Highway structures such as major bridge, minor bridge, culverts, vehicular under/overpass, ROB, RUB, grade separators, Flyovers, cattle pass, pedestrian underpass etc. are listed in Tables as below:

Table 21: SUMMARY OF EXISTING STRUCTURES

Sl.No.	Features	Description
1	Major Bridge	Nil
2	Minor Bridge	4
3	ROB	Nil
4	RUB	Nil
5	Flyover	Nil

6	Grade Separated Structures	Nil
7	Culverts	158
8	Arch Culverts	Nil
9	Cattle Underpass	Nil
10	Pedestrian Underpass	Nil

Table 22: LOCATION OF EXISTING STRUCTURES

Sl No	Existing Chainage	Existing Type of Structures	Existing Span Arrangement (m)
1.	0.710	Hume pipe	1 x 1.1
2.	0.786	Hume pipe	1 x 1.1
3.	0.980	Hume pipe	1 x 1.1
4.	1.720	Hume pipe	1 x 1.1
5.	1.760	Hume pipe	1 x 1.1
6.	2.050	Hume pipe	1 x 1.1
7.	2.235	Hume pipe	1 x 1.1
8.	2.344	Hume pipe	1 x 1.1
9.	2.635	Hume pipe	1 x 1.1
10.	2.880	Hume pipe	1 x 1.1
11.	2.930	Hume pipe	1 x 1.1
12.	3.125	Hume pipe	1 x 1.1
13.	3.340	Hume pipe	1 x 1.1
14.	3.527	Hume pipe	1 x 1.1
15.	3.780	Hume pipe	1 x 1.1
16.	3.895	Hume pipe	1 x 1.1
17.	3.980	Hume pipe	1 x 1.1
18.	4.240	Hume pipe	1 x 1.1
19.	4.350	Hume pipe	1 x 1.1
20.	4.500	Hume pipe	1 x 1.1
21.	5.300	Hume pipe	1 x 1.1
22.	5.410	Hume pipe	1 x 1.1
23.	5.470	Hume pipe	1 x 1.1
24.	5.530	Hume pipe	1 x 1.1
25.	5.605	Hume pipe	1 x 1.1
26.	6.170	Hume pipe	1 x 1.1
27.	6.275	Hume pipe	1 x 1.1
28.	6.630	Hume pipe	1 x 1.1
29.	6.688	Hume pipe	1 x 1.1
30.	6.945	Hume pipe	1 x 1.1
31.	7.730	Hume pipe	1 x 1.1
32.	8.108	Hume pipe	1 x 1.1
33.	8.180	Hume pipe	1 x 1.1
34.	8.565	Hume pipe	1 x 1.1
35.	8.845	Hume pipe	1 x 1.1
36.	9.200	Hume pipe	1 x 1.1
37.	9.440	Hume pipe	1 x 1.1

Sl No	Existing Chainage	Existing Type of Structures	Existing Span Arrangement (m)
38.	10.125	Hume pipe	1 x 1.1
39.	10.250	Hume pipe	1 x 1.1
40.	10.550	Hume pipe	1 x 1.1
41.	10.645	Hume pipe	1 x 1.1
42.	11.195	Hume pipe	1 x 1.1
43.	11.375	Hume pipe	1 x 1.1
44.	11.450	Hume pipe	1 x 1.1
45.	11.635	Hume pipe	1 x 1.1
46.	11.725	Hume pipe	1 x 1.1
47.	12.160	Hume pipe	1 x 0.9
48.	12.595	Hume pipe	1 x 0.6
49.	12.690	Hume pipe	1 x 1.1
50.	12.810	Hume pipe	1 x 1.1
51.	13.005	Hume pipe	1 x 1.1
52.	14.730	Hume pipe	1 x 0.9
53.	15.080	Hume pipe	1 x 0.9
54.	15.165	Hume pipe	1 x 0.9
55.	15.680	Hume pipe	1 x 0.9
56.	16.150	Hume pipe	1 x 0.9
57.	16.290	Hume pipe	1 x 0.9
58.	16.945	Hume pipe	1 x 0.9
59.	17.185	Hume pipe	1 x 0.9
60.	17.310	Hume pipe	1 x 0.9
61.	17.575	Hume pipe	1 x 0.9
62.	17.795	Hume pipe	1 x 0.7
63.	17.865	Hume pipe	1 x 0.5
64.	17.900	Hume pipe	1 x 0.9
65.	17.965	Hume pipe	1 x 0.5
66.	18.365	Hume pipe	1 x 0.9
67.	18.720	Hume pipe	1 x 0.6
68.	18.920	Hume pipe	1 x 0.3
69.	19.010	Hume pipe	1 x 0.9
70.	19.325	Hume pipe	1 x 0.9
71.	19.620	Hume pipe	1 x 0.9
72.	20.645	Hume pipe	1 x 0.9
73.	20.790	Hume pipe	1 x 0.9
74.	21.760	Hume pipe	1 x 0.9
75.	22.415	Hume pipe	1 x 0.9
76.	23.370	Hume pipe	2 x 0.9
77.	23.335	Hume pipe	1 x 0.9
78.	23.590	Hume pipe	1 x 0.9
79.	23.740	Hume pipe	1 x 1.1
80.	23.930	Hume pipe	1 x 1.1
81.	24.790	Hume pipe	1 x 0.9

Sl No	Existing Chainage	Existing Type of Structures	Existing Span Arrangement (m)
82.	25.050	Hume pipe	1 x 0.9
83.	25.260	Hume pipe	1 x 0.6
84.	25.405	Hume pipe	2 x 0.6
85.	27.110	Hume pipe	1 x 0.9
86.	28.475	Hume pipe	1 x 0.9
87.	28.660	Hume pipe	1 x 0.9
88.	28.900	Hume pipe	1 x 0.9
89.	28.970	Hume pipe	1 x 0.9
90.	29.010	Hume pipe	1 x 0.3
91.	29.335	Hume pipe	1 x 0.9
92.	29.535	Hume pipe	1 x 0.3
93.	30.000	Hume pipe	1 x 0.9
94.	30.115	Hume pipe	1 x 0.9
95.	30.920	Hume pipe	1 x 0.9
96.	32.875	Hume pipe	1 x 0.9
97.	33.100	Hume pipe	1 x 0.9
98.	33.200	Hume pipe	1 x 0.9
99.	33.300	Hume pipe	1 x 0.9
100.	33.405	Hume pipe	1 x 0.9
101.	33.440	Hume pipe	1 x 0.9
102.	33.595	Hume pipe	1 x 0.9
103.	33.675	Hume pipe	1 x 0.9
104.	33.770	Hume pipe	1 x 0.9
105.	33.900	Hume pipe	1 x 0.9
106.	34.490	Hume pipe	1 x 0.9
Sl. No	Existing Chainage	Existing Type of Structures	Existing Span Arrangement (m)
1.	0.640	SLAB	1 X 1.5
2.	1.210	SLAB	1 X 1.5
3.	1.515	SLAB	1 X 1.5
4.	3.485	SLAB	1 X 0.9
5.	5.020	SLAB	1 X 1.0
6.	5.145	SLAB	1 X 1.5
7.	5.170	SLAB	1 X 3.0
8.	5.925	SLAB	1 X 0.9
9.	6.785	SLAB	1 X 0.9
10.	7.050	SLAB	1 X 0.9
11.	7.225	SLAB	1 X 1.2
12.	8.700	SLAB	1 X 1.5
13.	8.730	SLAB	1 X 1.5
14.	10.465	SLAB	1 X 1.85
15.	12.375	SLAB	1 X 2.0
16.	14.265	SLAB	1 X 1.2
17.	14.550	SLAB	1 X 1.1

Sl No	Existing Chainage	Existing Type of Structures	Existing Span Arrangement (m)
18.	15.280	SLAB	1 X 2.8
19.	15.360	SLAB	1 X 2.0
20.	15.975	SLAB	1 X 3.5
21.	16.480	SLAB	1 X 1.5
22.	17.440	SLAB	1 X 1.0
23.	19.185	SLAB	1 X 2.0
24.	19.825	SLAB	1 X 1.5
25.	21.250	SLAB	1 X 1.0
26.	21.320	SLAB	1 X 1.5
27.	21.475	SLAB	1 X 1.0
28.	21.700	SLAB	1 X 1.0
29.	22.100	SLAB	1 X 1.0
30.	22.565	SLAB	1 X 1.0
31.	22.810	SLAB	1 X 1.5
32.	23.220	SLAB	1 X 1.0
33.	23.415	SLAB	1 X 1.0
34.	23.640	SLAB	1 X 1.5
35.	24.170	SLAB	1 X 1.0
36.	24.460	SLAB	1 X 1.0
37.	25.825	SLAB	1 X 1.0
38.	25.945	SLAB	1 X 1.0
39.	26.010	SLAB	1 X 1.5
40.	23.650	SLAB	1 X 4.5
41.	26.545	SLAB	1 X 1.5
42.	26.805	SLAB	1 X 1.0
43.	27.040	SLAB	1 X 1.5
44.	27.320	SLAB	1 X 3.0
45.	27.380	SLAB	1 X 1.0
46.	27.465	SLAB	1 X 1.0
47.	28.425	SLAB	1 X 1.0
48.	28.815	SLAB	1 X 1.5
49.	32.540	SLAB	1 X 1.0
50.	34.300	SLAB	1 X 1.5
51.	34.850	SLAB	1 X 1.5
52.	34.910	SLAB	1 X 1.5
53.	34.965	SLAB	1 X 1.3
54.	35.210	SLAB	1 X 3.0
55.	35.410	SLAB	1 X 1.3
56.	35.685	SLAB	1 X 1.5
57.	35.990	SLAB	1 X 1.5
58.	36.080	SLAB	1 X 1.5
59.	36.350	SLAB	1 X 1.5
60.	36.430	SLAB	1 X 1.5
61.	36.450	SLAB	1 X 1.5
62.	36.595	SLAB	1 X 1.5
63.	36.710	SLAB	1 X 1.5
64.	36.835	SLAB	1 X 1.5

Sl No	Existing Chainage	Existing Type of Structures	Existing Span Arrangement (m)
65.	36.990	SLAB	1 X 1.5
66.	37.520	SLAB	1 X 1.5
67.	37.750	SLAB	1 X 1.5
68.	38.160	SLAB	1 X 1.5
69.	38.300	SLAB	1 X 1.5
70.	38.475	SLAB	1 X 1.5
71.	38.600	SLAB	1 X 4.5
72.	39.015	SLAB	1 X 1.5
73.	39.430	SLAB	1 X 1.3
74.	39.725	SLAB	1 X 1.3
75.	40.045	SLAB	1 X 1.6
76.	40.160	SLAB	1 X 1.5
77.	40.440	SLAB	1 X 1.6
78.	40.615	SLAB	1 X 1.5
79.	40.870	SLAB	1 X 1.6
80.	41.065	SLAB	1 X 1.6
81.	41.345	SLAB	1 X 1.5
82.	41.530	SLAB	1 X 1.5
83.	41.750	SLAB	1 X 1.2
84.	41.990	SLAB	1 X 1.5
85.	42.180	SLAB	1 X 1.5
86.	42.460	SLAB	1 X 1.0
87.	42.640	SLAB	1 X 1.5
88.	42.830	SLAB	1 X 1.5
89.	43.070	SLAB	1 X 2.5
90.	43.250	SLAB	1 X 1.0
91.	43.450	SLAB	1 X 1.5
92.	43.580	SLAB	1 X 1.5
93.	43.725	SLAB	1 X 1.5
94.	43.900	SLAB	1 X 1.5
95.	44.050	SLAB	1 X 1.0
96.	44.120	SLAB	1 X 1.0
97.	44.240	SLAB	1 X 1.2
98.	44.500	SLAB	1 X 1.5
99.	44.635	SLAB	1 X 4.5
100.	44.930	SLAB	1 X 1.5
101.	45.040	SLAB	1 X 3.0
102.	45.200	SLAB	1 X 1.5
103.	45.300	SLAB	1 X 1.5
104.	45.530	SLAB	1 X 1.5
105.	45.705	SLAB	1 X 1.5
106.	45.900	SLAB	1 X 1.5
107.	46.240	SLAB	1 X 1.5
108.	46.480	SLAB	1 X 1.5
109.	46.700	SLAB	1 X 1.2
110.	47.130	SLAB	1 X 1.2
111.	47.525	SLAB	1 X 1.5

Sl No	Existing Chainage	Existing Type of Structures	Existing Span Arrangement (m)
112.	47.945	SLAB	1 X 1.0
113.	48.110	SLAB	1 X 1.5

2.10 Existing Carriageway and Pavement

The existing road configuration between Yaingangpokpi and Finch Corner is having a uniform single lane carriageway with varying width of earthen shoulders.

The surface of the carriageway is bituminous and the surface of shoulders is unpaved. Generally the condition of the pavement is poor at most stretches.

Table 23: ROAD CONDITION AND WIDTH

Sl. No.	Chainage		Carriageway			Shoulder			
	From	To	Type (BT/ CC/ GR/ ER)	Width (m)	Condition (G/ F/ P/VP)	Type (BT/ CC/ GR/ ER)	Width L.H.S (m)	Width R.H.S (m)	Condition (G/ F/ P/VP)
1	0	0.5	BT	4	P	ER	1.5	1.5	F
2	0.5	1	BT	4	P	ER	1.5	1.5	F
3	1	1.5	BT	4	F	ER	1	1.5	F
4	1.5	2	BT	4	F	ER	1	1.5	F
5	2	2.5	BT	3.7	F	ER	1	1	P
6	2.5	3	BT	3.3	P	ER	1	1	P
7	3	3.5	BT	3.5	F	ER	1.5	1.5	P
8	3.5	4	BT	3.5	G	ER	1.5	1.5	P
9	4	4.5	BT	3.5	G	ER	1.5	1.5	P
10	4.5	5	BT	3.5	G	ER	2	1.5	P
11	5	5.5	BT	3.5	G	ER	1.5	1	P
12	5.5	6	BT	3.5	G	ER	1.5	1.5	P
13	6	6.5	BT	3.5	G	ER	2	1	P
14	6.5	7	BT	4	G	ER	2	1	P
15	7	7.5	BT	3.5	F	ER	2.5	1	P
16	7.5	8	BT	3.5-4.0	P	ER	1.5	1.5	P
17	8	8.5	BT	3.5	G	ER	1.5	1	F
18	8.5	9	BT	3.5	G	ER	2	1.5	F
19	9	9.5	BT	3.5	G	ER	1	0.5	P
20	9.5	10	BT	3.5	G	ER	1	0.5	P
21	10	10.5	BT	3.5	G	ER	0.5	1.5	P
22	10.5	11	BT	3.5	G	ER	1	1	P
23	11	11.5	BT	3.5	G	ER	1.5	1	F
24	11.5	12	BT	3.5	G	ER	1.5	0.5	P
25	12	12.5	BT	3	G	ER	1	1	P

Sl. No.	Chainage		Carriageway			Shoulder			
	From	To	Type (BT/ CC/ GR/ ER)	Width (m)	Condition (G/ F/ P/VP)	Type (BT/ CC/ GR/ ER)	Width L.H.S (m)	Width R.H.S (m)	Condition (G/ F/ P/VP)
26	12.5	13	BT	3.5	G	ER	1	1.5	P
27	13	13.5	BT	3.5	G	ER	1.5	1.5	F
28	13.5	14	BT	3.5	G	ER	1.5	1.5	F
29	14	14.1	BT	3.5	G	ER	1.5	1.5	P
30	14.1	14.5	BT	3.5	G	ER	0.5	0.5	F
31	14.5	15	BT	3.5	G	ER	0.5	1	P
32	15	15.5	BT	3.5	F	ER	1.5	1.5	F
33	15.5	16	BT	3.5	F	ER	2	0.2	P
34	16	16.5	BT	3.5	F	ER	2	1	P
35	16.5	17	BT	3.5	P	ER	2	1	P
36	17	17.5	BT	3.5	P	ER	2	1	F
37	17.5	18	BT	3.5	F	ER	2	1	F
38	18	18.5	BT	3.5	F	ER	1.5	1.5	F
39	18.5	19	BT	3.5	G	ER	2	1	F
40	19	19.5	BT	3.5	G	ER	2	1	G
41	19.5	20	BT	3.5	P	ER	2.5	0.5	F
42	20	20.5	BT	3.5	P	ER	2	0.5	P
43	20.5	21	BT	3.5	P	ER	2.5	0	P
44	21	21.5	BT	3	P	ER	1.5	0.5	P
45	21.5	22	BT	3.5	F	ER	1.5	1.5	F
46	22	22.5	BT	3.5	VP	ER	1	0.5	P
47	22.5	23	BT	3.5	P	ER	1.5	0	p
48	23	23.5	BT	3.5	P	ER	1.5	1	P
49	23.5	24	BT	3.5	P	ER	0.5	0	P
50	24	24.5	BT	3.5	VP	ER	2	1	VP
51	24.5	25	BT	3.5	VP	ER	2	0.5	VP
52	25	25.5	BT	3.5	VP	ER	1.5	1	VP
53	25.5	26	BT	3.5	VP	ER	1.5	1	VP
54	26	26.5	BT	3.5	VP	ER	1.5	0	VP
55	26.5	27	BT	3.2	VP	ER	1.5	1.5	F
56	27	27.5	BT	3.2	VP	ER	1.5	1.5	F
57	27.5	27.8	BT	3.2	VP	ER	1.5	1.5	F
58	27.8	28.2	BT	3.2	VP	ER	1.5	1.5	F
59	28.2	28.5	BT	3.5	P	ER	1.5	1.5	F
60	28.5	29	BT	3.5	P	ER	1.5	0	p
61	29	29.2	BT	3.5	P	ER	1.5	0	p
62	29.2	30	BT	3.5	P	ER	1.5	0.5	P
63	30	30.5	BT	3.5	F	ER	2	0.2	P

Sl. No.	Chainage		Carriageway			Shoulder			
	From	To	Type (BT/ CC/ GR/ ER)	Width (m)	Condition (G/ F/ P/VP)	Type (BT/ CC/ GR/ ER)	Width L.H.S (m)	Width R.H.S (m)	Condition (G/ F/ P/VP)
64	30.5	31	BT	3.5	F	ER	2	0.2	P
65	31	31.5	BT	3.5	P	ER	1.8	0.5	P
66	31.5	32	BT	3.5	F	ER	2	0.5	P
67	32	32.5	BT	3.5	F	ER	2	1	F
68	32.5	33	BT	3.5	G	ER	1.5	1.5	F
69	33	33.5	BT	3.5	G	ER	1.5	1.5	F
70	33.5	34	BT	3.5	F	ER	2	1	F
71	34	34.2	BT	3.5	F	ER	0.5	2	F
72	34.2	34.5	BT	3.5	F	ER	0.2	2	F
73	34.5	35	GR	3.5	G	ER	1	1.5	P
74	35	35.5	GR	3.5	G	ER	0.5	2.5	P
75	35.5	36	GR	3.5	G	ER	1	2	P

Figure 12:PAVEMENT CONDITION OF THE PROJECT ROAD

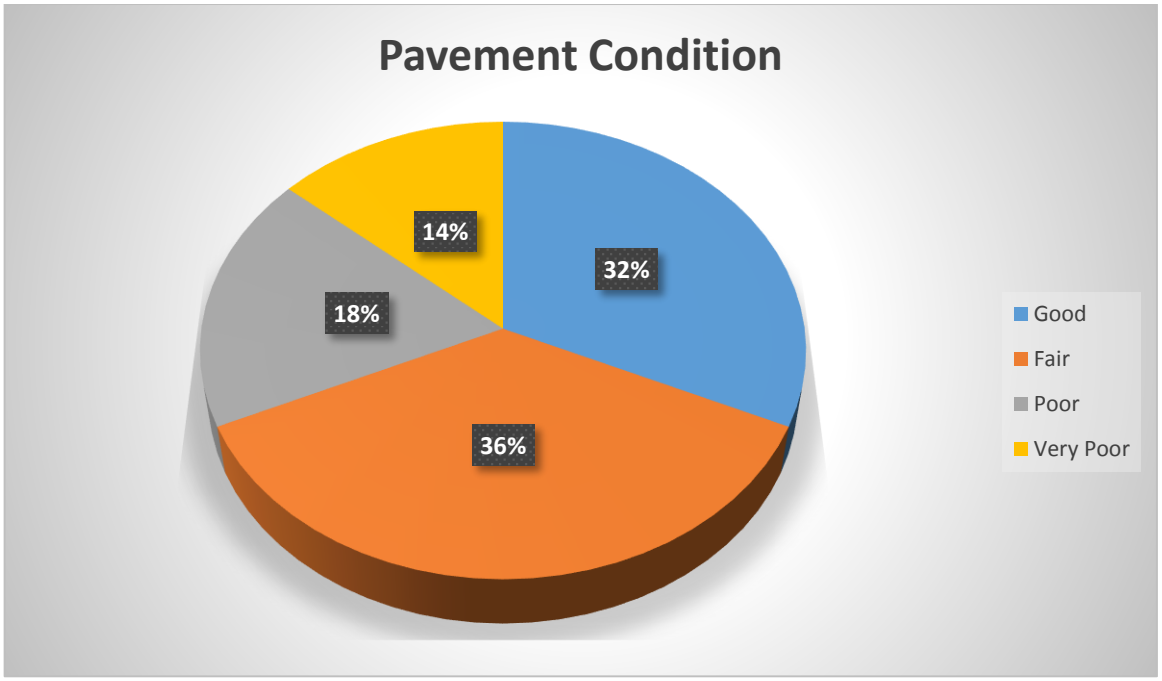


Figure 13: Pavement Condition

2.11 Alignment

The horizontal alignment between Yaingangpokpi to Finch Corner is complicated with many sharp curves. The said section mainly passes through hilly terrain in most of its length and cater to the design speed of 20km/hr or less. The existing road hasmany curves.

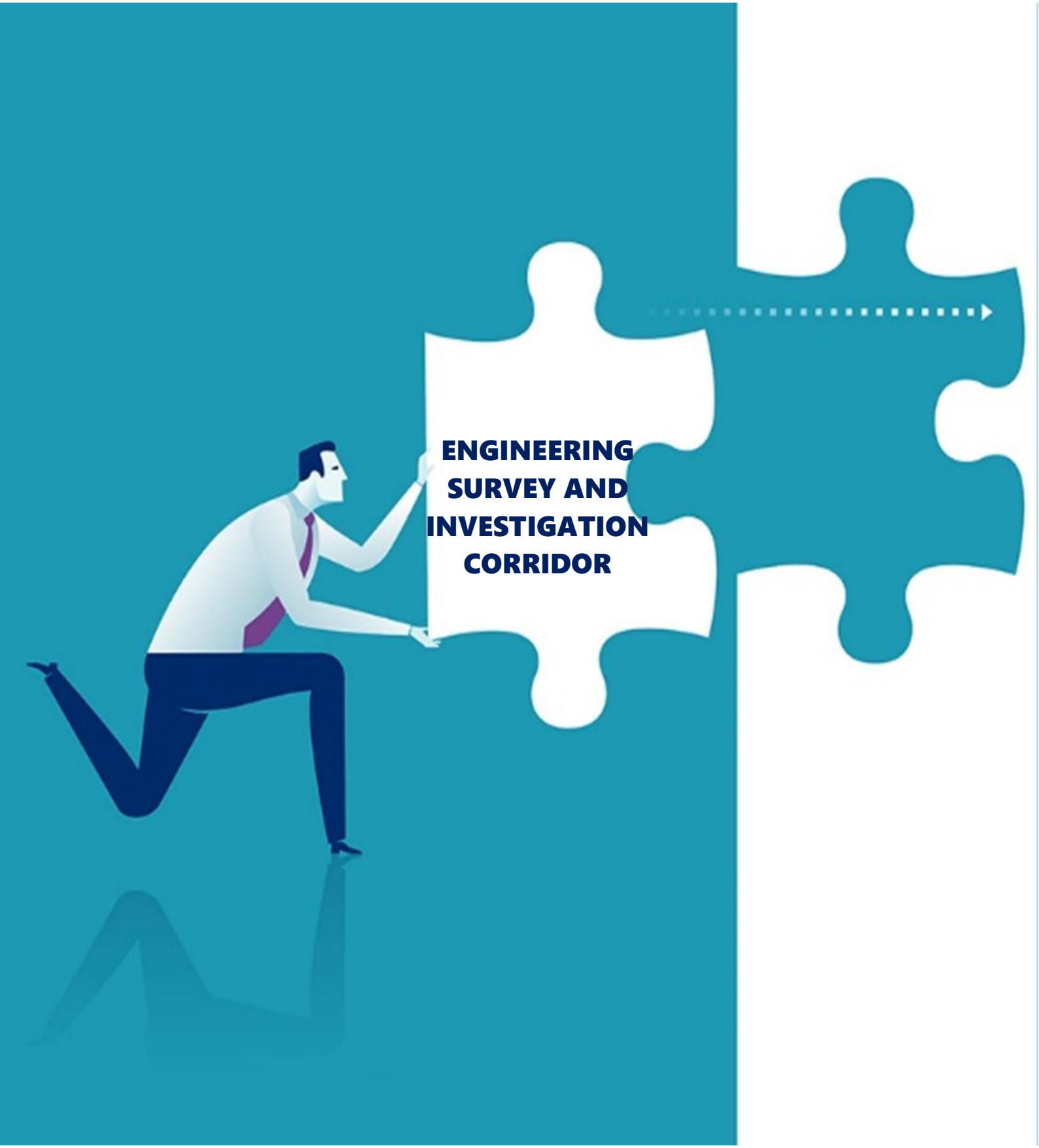
2.12 Other Existing Structures

The list of other structures like school, colleges, other educational institutions, Petrol Pump, hospital & police station is listed below.

Table 24: LIST OF OTHER IMPROTANT STRUCTURES ALONG THE CORRIDOR

SL NO	CHAINAGE	SIDE	FEATURE
LIST OF SCHOOLS			
1	26/942	RHS	JNV
RELIGIOUS STRUCTURES			
1	4/257	LHS	Mahadev Temple
2	8/120	RHS	Graveyard
3	11/470	LHS	Mongkot Christian Church

SL NO	CHAINAGE	SIDE	FEATURE
4	12/202	RHS	Tangkhul Baptist Church
5	15/300	RHS	Graveyard
6	31/650	RHS	Shiv Temple
POLICE STATION & PETROL PUMP			
1	0/360	RHS	Yanpopki Police Station
3	12/255	RHS	Police Check Gate
4	12/227	RHS	Police Station, Litan
BUS STOP			
1	0/944	LHS	Bus Shelter
2	1/248	RHS	Bus Shelter
3	20/120	LHS	Bus Shelter
4	27/850	LHS	Bus Shelter


ENGINEERING
SURVEY AND
INVESTIGATION
CORRIDOR

ENGINEERING SURVEY AND INVESTIGATIONS

3.1 General

Primary consideration for feasibility study of a road is that overall cost of transportation (i.e. the cost of initial construction, traffic operation and maintenance) be minimum without adversely affecting the environment and society. All operations need advance planning of methodology in logical sequence.

The available topographic maps, GT Sheets and photographs are being studied. Detailed reconnaissance surveys have been done to outline the procedure for the detailed investigations to follow. The reconnaissance study identifies:

- Topographic and physical features of the project and surrounding region including environmental features.
- Alignment alternatives, realignment requirements and need for bypasses and grade separators.
- Traffic pattern and homogenous links.
- Locations for conducting diverse traffic surveys.
- Preliminary inventory of pavement, carriageway type, bridges and structures, intersections, urban/congested areas.
- Requirements for conducting supplementary investigations.
- Extent of land available and additional requirements for widening.

3.2 Road Inventory Survey

An inventory of the Project Road (PR) has been carried out with visual observations supplemented with topo-survey. All existing details like terrain, land-use, surfacing type and width, shoulder type & width, subgrade, local soil type, curve details, intersection details, retaining structures details, location of water bodies, height of embankment or depth of cut, cross drainage structures, road side facilities, existing utility services, general drainage conditions etc., were recorded. The road inventory has been referenced to the existing kilometre posts established along the roadside. The data have been collected in sufficient detail, compiled & presented in tabular form. The data have been stored in computer files using utility packages, such as EXCEL etc. A detailed road inventory is presented in the Appendix.

The project road starts from Yaingangpokpi on NH 202 at 0/000 km and ends in Manipur-Nagaland Border at chainage 153/000 km. The project road passes through hilly terrain.

Generally the horizontal alignment of the Project Road is mostly in rural area flared up with barren/ agricultural land use. In the built-up areas both residential/commercial cottages have developed. A detail of the land use pattern along the project road is given in Road Inventory.

The detailed inventory on existing carriageway reveals that the project road stretch comprises of single lane carriageway with 1 to 2 m earthen shoulder. The details of the carriageway have been presented in the inventory. The type of pavement is flexible with very high embankments.

3.2.1 Pavement/ Road Condition

Pavement Condition Survey was done for collecting the basic information of the road structure & based on this the road can be demarcated into (i) sections of more or less equal / uniform performance; (ii) that is classified into similar characteristics or (iii) obtain homogeneous sections. This operation consists primarily of visual operations supplemented by simple measurements for rut depth using a 3-meter straight edge. The criteria for classification of pavement sections has been derived from IRC-81-1997 which also explains that, It is not practical to modify the overlay design at frequent intervals; it will be preferable if the length of each section be kept at a minimum of 1 km except in the case of localized failure or other situations requiring closer examination where minimum length of section may be suitably fixed.

In case the pavement shows severe distress or signs of premature failure further investigation would be necessary to ascertain the causes & design remedial measures.

3.3 Topographical Survey

The topographical survey has been carried out using Total Stations. The five categories of surveys are:

- Establishing of control points at 5 km intervals
- Traverse along the existing road and establishment of bench marks (BMS)
- Cross-sections at 50 m intervals and at critical locations.
- Longitudinal section levels along final centre line at 30 m in straight sections and at 10 m interval in curved sections including fixation of cardinal points with a pair of reference points.
- Collection of details of all features such as structures (Bridges) utilities, existing road etc.
- For topographic surveys extended to a width of 30m beyond either side of the centre line of the proposed divided carriageway or the land boundary whichever is more is surveyed. Where existing road crosses the alignment, the survey extended to minimum 100m either side of the road centre line and will be of sufficient width to allow improvements, including at grade intersections to be designed.

- Longitudinal and cross-sections for major and minor streams over 500 meters on both sides of ROW and 100 meters beyond the abutments.
- Location and type of services and utilities

An open traverse could lead to cumulated errors of angles. Hence, every 5 km the traverse has been closed to limit cumulative errors. The benchmarks have been referenced to GTS BMs of the Survey of India. A separate team has carried out this task. The ground cross-sections and details of features are referred to as the BMs. Separate teams concurrently with the traverse team have carried out these tasks. The levelling of the longitudinal section along the final centre line (FCL) and fixation of cardinal points has been carried out.

The readings from the Total Stations have been registered using data base software and then transferred to the survey model of the MX Road Software to prepare the DTM of the area surveyed. The DTM and the longitudinal profile of the FCL have been computed by MX Road software and drawn using Auto CAD on A3 size sheets showing 1 km sections (1:2500).

For junctions/intersections, additional areas have been surveyed (ground sections, topographical features and utilities) as required. During this Survey, all utilities within the areas surveyed are identified, and noted; complementary data has been collected from the competent bodies to complete the process.

The list of PBM and TBM along the road alignment is as attached in Volume 2 of this report.

Figure 14: TOPOGRAPHIC SURVEY ON YAINGANGPOKPI TO UKHRUL SECTION

3.4 Traffic Surveys

The number and locations of traffic survey stations have been identified after reconnaissance. The traffic Engineer has monitored and trained the surveyors to collect the required data for the traffic calculation. Survey and count sheets are spot checked on a regular basis and data registered in the field office. Data collected includes:

A. Secondary Data Collection

I. Previous Traffic Count Data

II. Statistical Information Economic Indicators

III. Seasonal Variation

IV. Accident Statistics

B. Primary Data Collection

3.4.1 Classified Traffic Volume Count Survey

Direction-wise classified traffic volume count survey are carried out for 24 hours 7 days. The vehicle classification system is basically confined to all vehicular traffic as per Table -1 of IRC: 64 -1990. The primary data collected is analysed to bring out the hourly and daily variations and is presented in tabular form along with a Pie Chart showing composition pattern, classified hourly average traffic and a graphical representation of average hourly variation of the vehicles. Keeping in view the vehicle classification system given in IRC codes the following generalized classification system is used to record the classified volume count.

Table 25: LIST OF VEHICLES FOR CLASSIFIED VOLUME COUNT

Motorized Traffic	Non-Motorized Traffic
2- Wheeler	Bi Cycle
3- Wheeler	Cycle- Rickshaw
Passenger Car	Animal Driven Cart
Utility Vehicle	Hand Cart
Bus	Other Non- Motorized Vehicle
LCV	
Truck – 2 Axle Rigid Chassis	
Truck – 3 Axle Rigid Chassis	
MAV- Semi Articulated	
MAV- Articulated	

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

Table 26: TRAFFIC DATA

Sl.No.	Place of Count	CVD	PCU
1	Ukhrul (49/800 km)	210	5276
2	Kharasom (113/470 km)	22	103

3.4.2 Traffic Demand Estimates

Traffic projections are based on sound and proven forecasting techniques. Traffic demand estimates are such that, it will establish possible traffic growth rates in respect of all categories of vehicles, taking into account the past trends, annual population and real per capita growth rate, elasticity of transport demand in relation to income and estimated annual production increase. The other aspects including socio-economic development plans and the land use patterns of the region having impact on the traffic growth, the projections of vehicle manufacturing industry in the country, development plans for the other modes of transport, commodity movement behaviour is also be taken into account while working out the traffic demand estimates. The traffic demand estimates is done for a further period of 15 years from completion of work.

On Going Traffic Activity Through Videography

3.5 Pavement Investigations

3.5.1 Pavement Composition

In order to ascertain pavement composition trial pits (1mx1m in plan) were dug at every 1km interval (staggered left & right) or at each major change in the pavement condition, whichever is less. For each test pit the following information has been recorded

Pavement Investigation Activities




Table 27: EXISTING CRUST DETAILS

Subsection	Existing Pavement Details			
	G.S.B(Moorum) in mm	W.B.M. in mm	B.T in mm	Average Existing Crust in mm
0/000-1/000	170	160	25	330
1/000-2/000	180	170	25	350
2/000-3/000	200	180	30	380
3/000-4/000	200	185	30	385
4/000-5/000	200	180	30	380
5/000-6/000	205	180	25	385
6/000-7/000	210	185	30	395
7/000-8/000	210	185	30	395
8/000-9/000	200	170	30	370
9/000-10/000	195	170	30	365
10/000-11/000	190	165	25	355
11/000-12/000	190	160	25	350
12/000-13/000	180	155	25	335
13/000-14/000	175	155	25	330

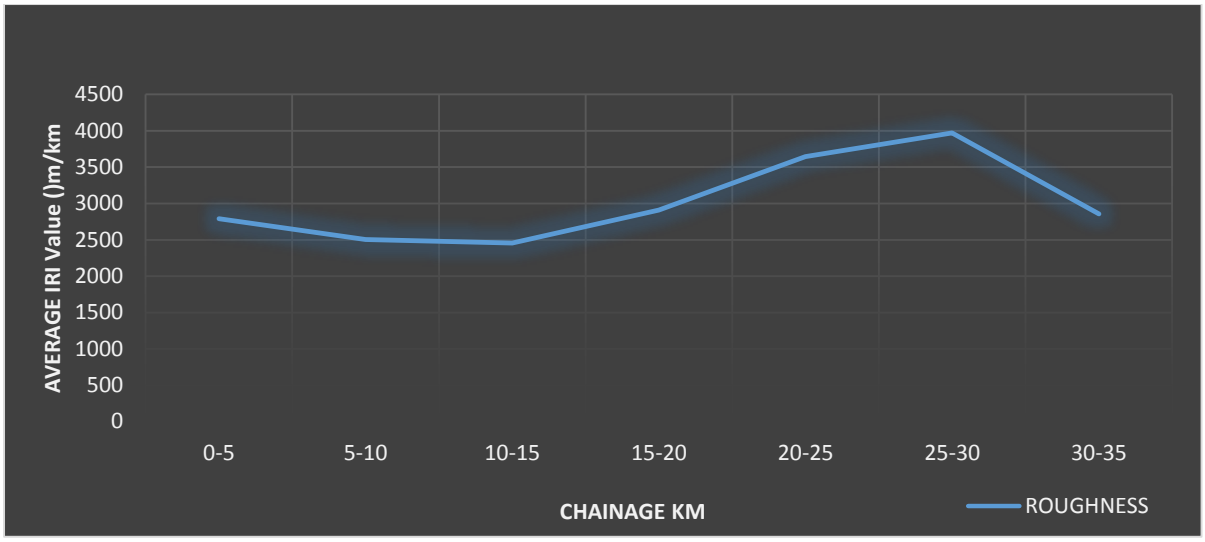
Subsection	Existing Pavement Details			
	G.S.B(Moorum) in mm	W.B.M. in mm	B.T in mm	Average Existing Crust in mm
14/000-15/000	165	150	20	315
15/000-16/000	165	150	20	315
16/000-17/000	160	155	20	315
17/000-18/000	140	160	25	300
18/000-19/000	140	160	30	300
19/000-20/000	130	165	30	295
20/000-21/000	145	155	30	300
21/000-22/000	160	160	25	320
22/000-23/000	165	165	30	330
23/000-24/000	170	165	30	335
24/000-25/000	160	165	30	325
25/000-26/000	150	160	30	310
26/000-27/000	140	160	35	300
27/000-28/000	140	160	40	300
28/000-29/000	145	155	30	300
29/000-30/000	150	155	30	305
30/000-31/000	170	150		320
31/000-32/000	185	150		335
32/000-33/000	185	150		335
33/000-34/000	205	180		385
34/000-35/000	175	155		330
35/000-36/000	165	150		315

3.5.2 Pavement Roughness

The Vehicle Mounted Bump Integrator (VMBI) which is a response-type road unevenness meter mounted in a vehicle to monitor pavement unevenness. It records the displacement of the vehicle chassis relative to the rear axle per unit distance travelled, usually in terms of counts/km or m/km. Since each vehicle responds differently to unevenness due to its own unique springs and shocks, as these changes over time with wear, it is necessary to calibrate each vehicle against a standard unevenness measure.

Two runs, one on each direction of wheel path have been carried out by maintaining a running speed of 30kmph. The Kilometre values of roughness in International Roughness Index (IRI) observed on project road have been tabulated in Table below and graphically presented in Figure 29. Details of the survey results are present in Appendix.

Figure 15: ROUGHNESS VALUE



3.5.3 Benkelman Beam Deflection Survey

Benkelman Beam Deflection Technique is useful in evaluating the strengthening requirements of the existing flexible road pavements. The basic principle of deflection method considers the performance of flexible pavements which is closely related to the elastic deflection/ deformation of pavement under the wheel loads. The amount of pavement deflection under an applied design wheel load or its rebound deflection on removal of this load is a measure of the structural stability of the pavement system. Larger rebound deflection indicates weaker pavement structure indicative of strengthening and/or higher overlay thickness for the pavement.

Structural strength surveys for existing two lane pavements using Benkelman Beam Deflection Technique were carried out in accordance with the procedure given in IRC: 81-1997 "Guidelines for Strengthening of Flexible Road Pavements using Benkelman Beam Deflection Technique". On the Project Highway the BBD test has been conducted in 26 stretches, with each stretch of 1 km length for each set of test.

5.5.3.1 Calculation of Deflections

To get a single value of rebound deflection from three field values (Initial, Intermediate & Final Readings) following steps are followed:

Table 28: DEFLECTION CALCULATION STEPS

Step 1	Double the field observations (readings): D_o, D_i & D_f are doubled values. This is done because the dial gauge is fixed such that distance between probe end and fulcrum of beam is twice the distance between fulcrum and dial gauge.

Step 2	Let Initial Reading be Do (doubled), Intermediate Reading be Di (doubled), &Final Reading be Df (doubled) & XT & YT is rebound deflections in mm in case 1 & 2 respectively.
Case 1	If Df - Di < 0.025mm XT = rebound deflection = 2 (Df - Do) = twice the difference between final and initial readings
Case 2	If Df - Di ≥ 0.025mm YT = rebound deflection = 2 (Df - Do) + 2x2.91 (Df - Di)
Step 3	After this temperature & seasonal corrections were applied to get final (corrected) deflection from which, mean, standard deviation and characteristic deflection are obtained.

5.5.3.2 Characteristic Deflection

The statistical analysis of all the measurements done in the field and corrections applied as required was done as under:

Mean deflection= $X' = \Sigma X/N$

Standard deviation= $\sigma = \sqrt{(\Sigma (X' - X) 2/ (n -1)}$

The characteristic deflection for design purposes has been taken as Characteristic deflection Dc in mm= $X + 2\sigma$ for major arterial roads (like NH & SH)

Dc = $X + \sigma$ could be considered for all other roads but for this project it is not applicable. Here,

X' = Individual deflection in mm

X = Mean deflection in mm

n = Number of deflection measurements

In the formula for standard deviation, division by n-1 and not n follows the established statistical theorems.

In the same km on road, readings were staggered with respect to 25m on either side, Left Hand (LHS) and Right Hand (RHS). The observations of LHS were taken while going and RHS while returning, involving a difference of several days. Hence, calculated characteristic deflection for LHS is bound to be different for RHS in the same km. The representative characteristic deflection for the same km is the maximum of the two and not the average for the obvious reasons.

Based on homogeneous pavement characteristics, the characteristic deflection value in 2 homogeneous sections is as below;

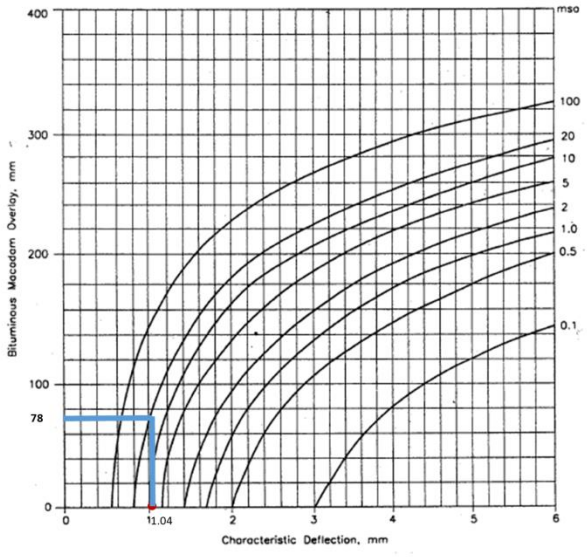
Table 29: DEFLECTION CHARACTERISTICS OF THE PROJECT ROAD

LOCATION OF TEST POINT	MEASURED DEFLECTION(FROM COLUMN 9 TABLE 1 TO 11	TEMP CORRECTION FACTOR IN mm	AFTER CORRECTION FOR TEMPERATURE mm	CORRECTION FOR SEASON	CORRECTED DEFLECTION mm	MEAN DEFLECTION X (mm) (CORRECTED	STANDARD DEVIATION (mm) OF CORRECTED	CHARACTERISTIC DEFLECTION ,mm as per equation(4) (mm)
2	3	4	5	6	7	8	9	10
0/000-1/000	41.682	+ 0.00	41.6818	1.050	43.7659	1.0941	0.1712	1.44
1/000-2/000	22.030	+ 0.00	22.0298	1.060	23.3516	0.5838	0.9322	2.45
2/000-3/000	19.605	+ 0.00	19.6052	1.055	20.6835	0.5171	0.153	0.82
3/000-4/000	15.934	+ 0.00	15.9338	1.055	16.8102	0.4203	0.1502	0.72
4/000-5/000	20.565	+ 0.00	20.5652	1.030	21.1822	0.5296	0.1186	0.77
5/000-6/000	46.629	+ 0.00	46.629	1.045	48.7273	1.2182	0.1938	1.61
6/000-7/000	48.539	+ 0.00	48.5386	1.050	50.9655	1.2741	0.1883	1.65
7/000-8/000	48.726	+ 0.00	48.726	1.170	57.0094	1.4252	0.1995	1.82
8/000-9/000	47.019	+ 0.00	47.0188	1.180	55.4822	1.3871	0.2128	1.81
9/000-10/000	45.664	+ 0.00	45.6642	1.190	54.3404	1.3585	0.2024	1.76
10/000-11/000	21.200	+ 0.00	21.2004	1.191	25.2497	0.6312	0.1623	0.96
11/000-12/000	43.948	+ 0.00	43.9478	1.181	51.9024	1.3308	0.1783	1.69
12/000-13/000	31.695	+ 0.00	31.6952	1.172	37.1468	0.9525	0.1591	1.27
13/000-14/000	39.887	+ 0.00	39.8874	1.170	46.6683	1.1667	0.1955	1.56
14/000-15/000	30.339	+ 0.00	30.3388	1.170	35.7998	0.895	0.2314	1.36
15/000-16/000	40.522	+ 0.00	40.5224	1.199	48.5864	1.2147	0.2412	1.7
16/000-17/000	37.497	+ 0.00	37.4972	1.198	44.9216	1.123	0.1689	1.46
17/000-18/000	42.161	+ 0.00	42.1608	1.181	49.7919	1.2448	0.2042	1.65
18/000-19/000	39.605	+ 0.00	39.6046	1.170	46.3374	1.1584	0.1664	1.49
19/000-20/000	32.390	+ 0.00	32.3898	1.172	37.9608	0.9490	0.1516	1.25
20/000-21/000	33.808	+ 0.00	33.8084	1.170	39.6234	0.9906	0.1849	1.36
21/000-22/000	34.408	+ 0.00	34.4084	1.170	40.2578	1.0064	0.1805	1.37
22/000-23/000	35.523	+ 0.00	35.5232	1.184	41.5621	1.0391	0.1724	1.38
23/000-24/000	35.563	+ 0.00	35.5634	1.045	42.1071	1.0527	0.1514	1.36
24/000-25/000	37.802	+ 0.00	37.802	1.046	39.5409	0.9885	0.1603	1.31
25/000-26/000	38.112	+ 0.00	37.802	1.048	39.5409	0.9885	0.1603	1.31

LOCATION OF TEST POINT	MEASURED DEFLECTION(FROM COLUMN 9 TABLE 1 TO 11	TEMP CORRECTION FACTOR IN mm	AFTER CORRECTION FOR TEMPERATURE mm	CORRECTION FOR SEASON	CORRECTED DEFLECTION mm	MEAN DEFLECTION X (mm) (CORRECTED	STANDARD DEVIATION (mm) OF CORRECTED	CHARACTERISTIC DEFLECTION ,mm as per equation(4) (mm)
26/000-27/000	32.007	+ 0.00	38.1116	1.044	39.941	1.1095	0.1637	1.44
27/000-28/000	36.249	+ 0.09	32.0074	1.045	33.4157	0.8354	0.1798	1.2
28/000-29/000	39.010	+ 0.00	36.2494	1.046	37.8806	1.1141	0.1637	1.44
29/000-30/000	37.732	+ 0.00	39.0096	1.043	40.804	1.0201	0.1425	1.31
30/000-31/000	37.880	+ 0.00	37.7322	1.048	39.3547	0.9839	0.1765	1.34
31/000-32/000	38.262	+ 0.00	37.88	1.079	39.6982	0.9925	0.128	1.25
32/000-33/000	36.078	+ 0.00	38.2622	1.076	41.2849	1.0321	0.157	1.35
33/000-34/000	38.16	+ 0.00	36.0784	1.077	38.8204	0.9705	0.1809	1.33
34/000-35/000	12.8374	+ 0.00	38.16	1.170	41.0983	1.0275	0.1587	1.34
35/000-36/000	20.66	+ 0.00	12.8374	1.170	13.3509	0.3338	0.0477	0.43

The average deflection comes out to 1.04 mm projecting the deflection value in the Deflection graph provided in IRC: 81-1997 we get 78 mm overlay. The flexibility of the project road is very less due to the deterioration of the bituminous layer at most of the stretches. Considering the condition of the road, an overlay of 250 mm with 140 mm BT layer is provided.

Figure 16: OVERLAY CALCULATION



3.5.4 Sub grade Characteristics & Strength

The testing of soils for classification & mechanical characteristics has been as per terms of reference. "Testing of three sub-grade soil samples for each design section or three samples for

each soil type encountered, whichever is more has been done". Thus testing for sub-grade soil at each test pit includes:

In-situ density & moisture content

Field CBR using DCP

Characterization (Grain size &Atterberg's Limits)

Laboratory moisture-density characteristics (modified AASHTO compactions)

Laboratory CBR (uncooked & 4 day soaked compacted at 3 energy levels)

Ongoing Pavement Benkelman Beam Deflection Activities

3.5.5 Investigation of Subgrade

The borrow areas were first identified by visual inspection and enquiries along the project road and adjacent areas. The soil samples from the project corridor were collected, and the required tests as per specification & IRC/BIS codes were done. Grain size analysis was done for particles smaller than 4.75 mm. For particles having size between 4.75 mm and 75 microns, sieve analysis was done (wet sieving) and for particles smaller than 75 microns, Hydrometer analysis was done. CBR test, Atterberg's Limit, DCPT and moisture contents were also determined. Material found satisfactory can be used for construction activity. The result sheet of DCPT is attached in the Appendices.

Table 30: CBR OF SUBGRADE SOIL ALONG THE PROJECT STRETCH

Sl. No.	Soil sample collected at Chainage	Grain size analysis					Atterberg's Limits			Proctor Compaction		California bearing ratio test (Remoulded at FDD & FMC)			DFS in %	Group of soil as per IS 1498 – 1970
		Fine Gravel In % (20mm To 4.75mm)	Coarse Sand In % (4.75mm To 2.00	Medium Sand In % (2.0mm To 0.425mm)	Fine Sand in % (0.425mm To 0.075 mm)	Silt & Clay in % (0.075mm To 0.001mm)	Liquid Limit In %	Plastic Limit In %	Plasticity Index in %	Maximum dry density in gm/cc	Optimum moisture Content in %	C.B.R Un-soaked in %	C.B.R Soaked for 4 days in %	Moisture content after 4 days Soaking in %		

1	0+00 km	11.15	4.16	20.83	12.99	50.87	41	21	20	1.880	13.5	9.2	5.7	16.6	30	CI
2	4+00 km	4.9	2.49	13.22	9.27	70.12	44	23	21	1.850	14.2	9.0	5.2	17.2	34	CI
3	8+00 km	4.86	2.98	12.87	9.57	69.72	43	22	21	1.822	14.4	9.0	5.0	17.5	32	CI
4	12+00 km	15.22	2.72	9.41	6.97	65.68	40	21	19	1.842	13.2	9.6	5.8	18.2	30	CI
5	16+00 km	26.62	10.55	32.59	9.33	20.91	30	18	12	1.988	10.5	12.8	9.6	13.4	20	SC
6	20+00 km	24.56	6.72	26.97	15.78	25.97	33	18	15	1.982	10.8	12.2	9.4	13.4	25	SC
7	24+00 km	24.59	6.44	32.38	15.97	20.62	31	16	15	1.985	10.6	12.3	9.5	13.1	22	SC
7	24+00 km	24.59	6.44	32.38	15.97	20.62	31	16	15	1.985	10.6	12.3	9.5	13.1	22	SC
8	28+00 km	12.86	6.10	24.66	16.97	39.41	30	18	12	1.975	11.0	11.6	8.9	14.7	20	SC
9	32+00 km	5.92	3.85	33.05	24.58	32.60	32	16	16	1.912	11.5	11.2	8.4	13.8	22	SC
10	36+00 km	13.98	5.09	18.24	22.83	39.86	33	18	15	1.978	10.9	11.5	8.4	13.5	25	SC

3.5.6 Investigation of Material for Construction

The investigation of different quarries was conducted from different places where stone aggregates and sand are available. Samples were collected and tests were performed in accordance with IS: 2386 (Part III), IS: 120 (Part I), AASHTOT182, IS: 624-1971, IS: 2380 (Part V). The crushers and other sources are approved by the department.

The borrow areas were identified in and around and along the project road. The suitability of borrow material is established from laboratory testing.

3.5.7 Investigations of Other Construction Materials

Availability and suitability of other construction materials like Fly ash, coarse sand, local sand and bricks were investigated. Samples were collected and required tests performed in the laboratory. Cement, Steel and Bitumen are manufactured items and readily available.

3.5.8 Drainage System

Requirement of roadside drainage system and the integration of the same with proposed cross drainage system have been worked out for the entire length. Improving storm water drainage in built-up areas using vertical drains as per IRC: SP: 50-1990 has been adopted.

3.5.9 Investigations for Structures

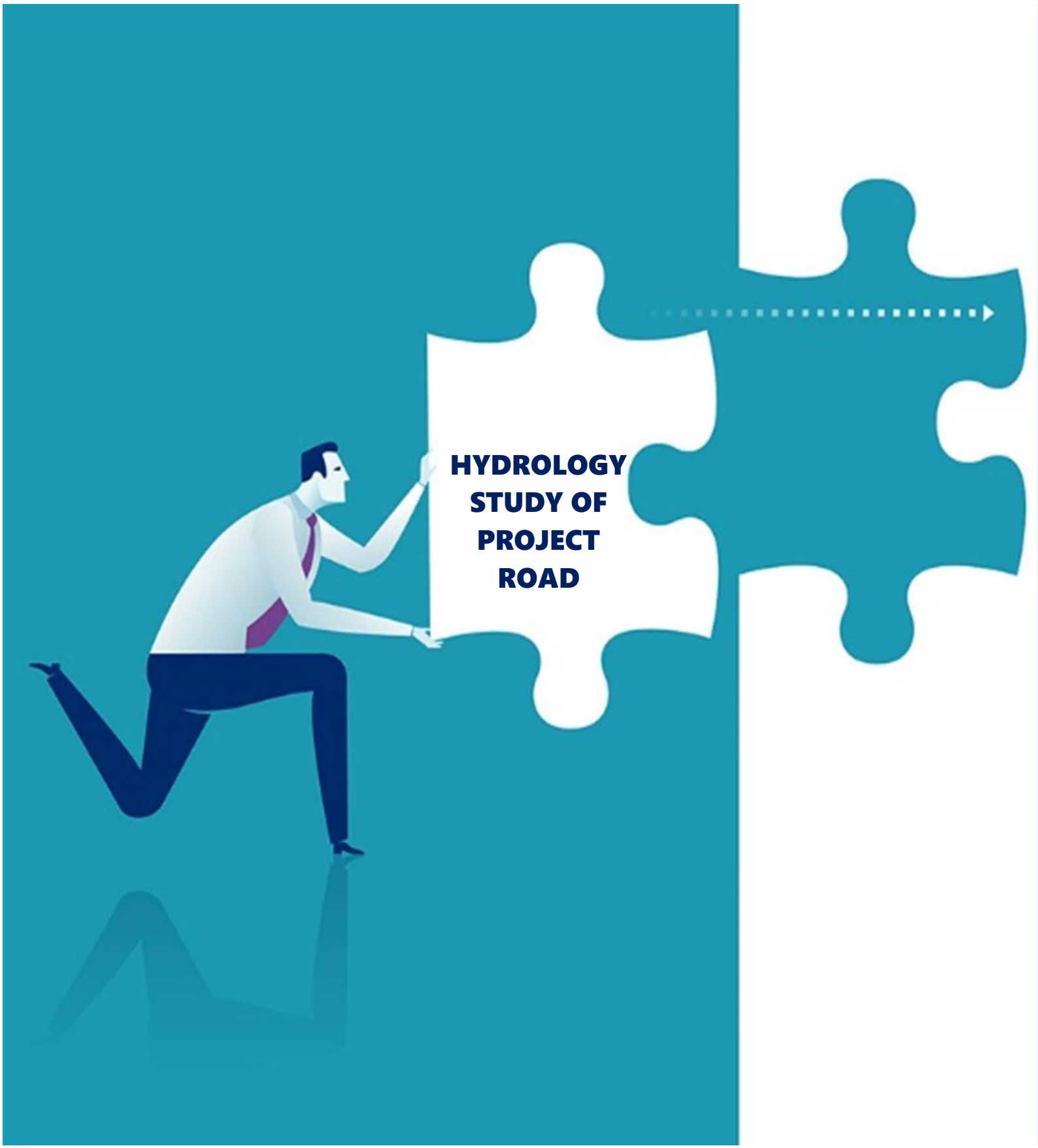
We have made an inventory of all the structures (bridges, viaducts, ROB, culverts, etc.) along the road under the project. The inventory for the bridges, viaducts and ROB's shall include the parameters required as per the guidelines of IRC-SP: 35-1990. The inventory of culverts was presented in a tabular form covering relevant physical and hydraulic parameters.

3.6 Hydraulic and Hydrological Investigations

Special Publication No. 13 ("Guidelines for the Design of Small Bridges and Culverts") and IRC: 5-2015 ("Standard Specifications & Code of Practice for Road Bridges, Section I General Feature of Design"). These investigations were carried out for all existing drainage structures along the road sections under the study. Study on topography (topographic maps), storm duration, rainfall statistics, topsoil characteristics, vegetation cover etc. were done so as to assess the catchments areas and hydraulic parameters for all existing and proposed drainage provisions. The findings of the desk study have been further supplemented and augmented by a reconnaissance along the area. All-important hydrological features were noted during this field reconnaissance. Information on high flood level (HFL), low water levels (LWL), discharge velocity etc. were collected from available past records, local inquiries and visible signs, on the structural components and embankments. Local inquiries were also made with regard to the road sections getting overtopped during heavy rains.

3.6.1 Condition Surveys for Bridges, Culverts and Structures

Thorough inspection of the existing structures done and prepared a report about their condition including all the parameters given in the Inspection pro-forma of IRC-SP: 35-1990. The condition and structural assessment survey of the bridges / culverts / structures was carried out. Summary of inventory of structures has been provided in Chapter 2.


HYDROLOGY
STUDY OF
PROJECT
ROAD

HYDROLOGY STUDY OF PROJECT ROAD

4.1 General

Physiographical the terrain of Manipur is an elevated plain surrounded from all sides by structural hills of disang formation. Flood is a primary natural hazard in the area during the monsoon season damaging the crop and properties of the people. Flash flood occur almost every year during rainy season due to poor drainage condition. The primary causes of flood in Manipur valley are heavy runoff and less infiltration in degraded watersheds in the upper reaches of the river during rainy seasons in the valley.

Manipur Valley is traversed by the major rivers viz., Imphal, Iril, Thoubal, Sekmai, Wangjing, Khuga, Chapki, Nambol etc. which either fall directly into or indirectly connect (through lakes) with Imphal river which later on known as Manipur river. Manipur Valley is drained by three major rivers viz. (i) Imphal River, (ii) Iril River, (iii) Thoubal River Flood in Manipur Valley is primarily due to heavy rainfall in the upper catchment areas. Intensity of rainfalls is higher in the hilly region than in the plain region. Hilly region, surrounding the valley region occupies 4432 sq. km. which is 70% of the total catchment area and area of Manipur Valley is 1900 sq. km. which is 30% only. Thus Manipur Valley has large upper catchment area where rainfall is normally high. These good amounts of rainfall feed many streams and rivers, which finally drain, through Manipur Valley. In the hilly region very steep slope nature occupies the major portion. Besides, degraded land areas occupy 1545 km^2 which is 24 % of total catchment area and 35 % of hilly region, enhancing more erosion and run off. There are many vulnerable points along the riverbanks of the major rivers of Manipur Valley. In these areas; erosion, sliding and slumping of the banks are common; causing breach of riverbanks to these points during rainy season. Proper maintenance of these riverbanks is much necessary and retaining walls are to be constructed. The total catchment area of the Manipur river system is 6332 sq. km.

4.2 Background

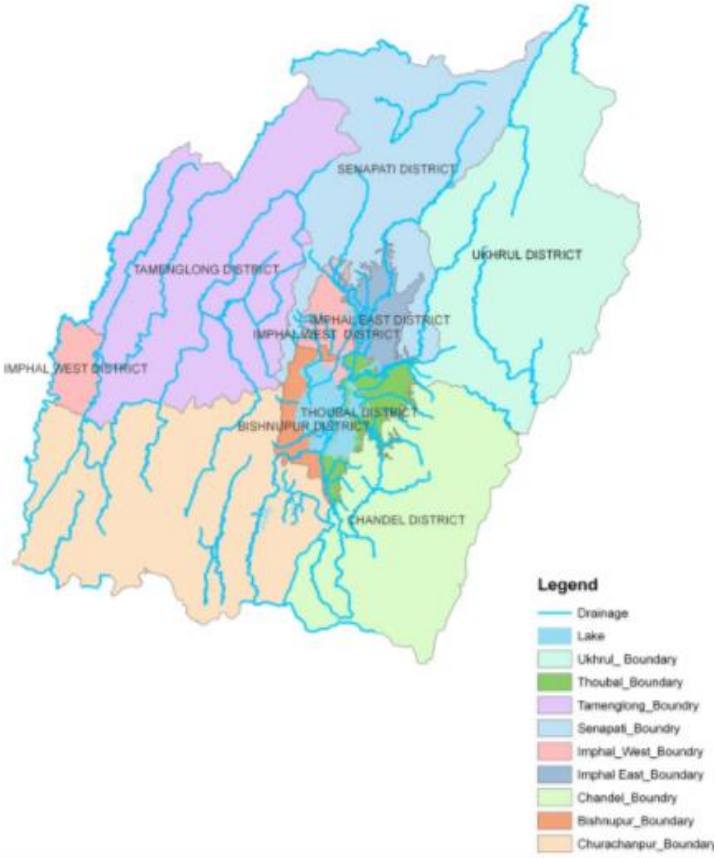
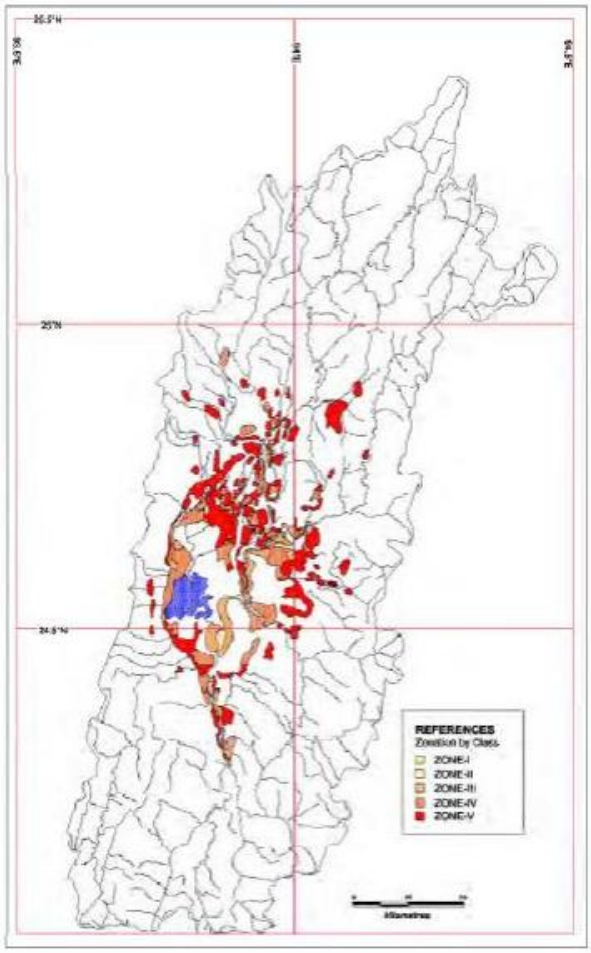


Figure 17: River Channels in Manipur

There are many vulnerable points along the riverbanks of the major rivers of Manipur Valley. In these areas; erosion, sliding and slumping of the banks are common; causing breach of riverbanks to these points during rainy season. Proper maintenance of these riverbanks is much necessary and retaining walls are to be constructed.

Elements at Risk:

The four valley districts in Manipur, namely Imphal East, Imphal West, Thoubal and Bishnupur are most vulnerable to floods.



Flood Zonation Map of Manipur River Basin

Figure 18: Flood Affected Zone of Manipur River Basin

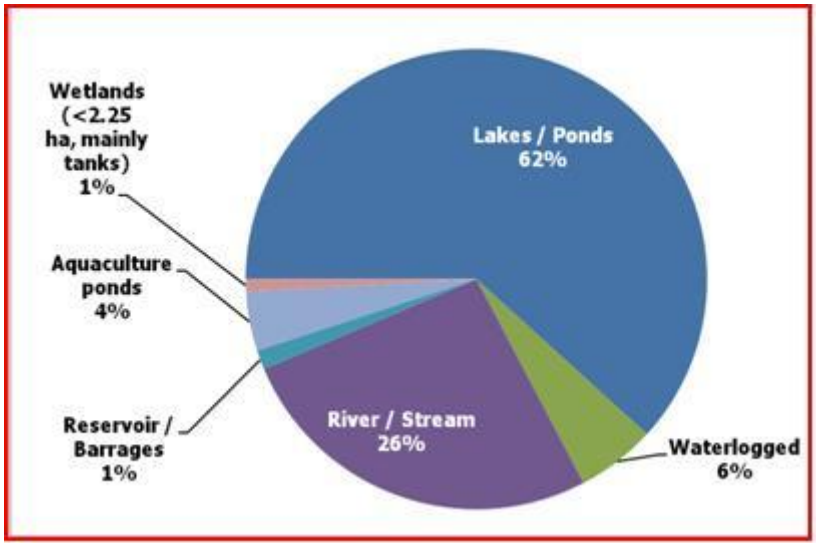
4.3 Project Road River Basin

The project road of Yaingangpokpi-Finch Corner comes under the Manipur River Basin and Liyai River Basin.

The Manipur River basin is in the central Manipur, with a far less discharge capacity of 0.5192 Million ha. Meter in a catchment area of 6332 sq. km. on the other hand, is the most important as it passes through thickly populated areas and covers the whole of Manipur valley consisting of the four valley districts. It also covers most of the habitations of Senapati district, the western portion of Ukhrul and Chandel districts and also the more populated eastern one-third of Churachandpur district.

4.4 Wetlands of Manipur :

The National Wetland Atlas 2010, developed by Space Application Centre has identified 167 wetlands (≥ 2.25 Ha) and 541 wetlands (<2.25 Ha) covering 63,616 ha i.e. 2.85% of total geographic area under different types of wetlands like lake / pond (61.5%), river/steam (26.2%), waterlogged (5.5%) and aquaculture pond. Analysis of wetland status in terms of open water and aquatic vegetation showed that around 71 % of wetland area is under open water category during post monsoon and 62% during pre-monsoon respectively. Aquatic vegetation (floating/emergent) occupies around 26 % of wetland area during post monsoon and 37 % during pre-monsoon respectively.



Source : National Wetland Atlas, 2010, SAC, ISRO

Figure 19: Percentage of wetland area in Manipur during 2010

Out of 9 (nine) districts in Manipur, three districts are rich in wetland viz. Bishnupur (30.7 % of total district of total district geographic area under wetland), Thoubal (30.3% of total district geographical area) and Imphal West (2.6 % of total geographical area under wetland). Chandel district has the lowest area under wetland i.e. 0.44 %. Senapati and Thoubal have observed with very high concentration of small wetlands (< 2.25 ha).

4.5 Underground Water Resources :

Groundwater in the state is mostly exploited through open wells. As per reported by the Central Ground Water Board (CGWB), ground water in the deeper aquifers occurs under sub-artesian and artesian conditions. Granular zones are encountered at a depth of about 150 m in Imphal valley and at about 220 m in Jiribam valley. Tube wells have been installed at various places of the valley areas with the yields ranging from 0.6 to 4 cu.m/hr. On the basis of the monitoring of water level in key/dug wells network stations in the area, an annual recharge of 44 M.cu.m has

been estimated. Considering the clayey nature of formation in the top aquifer, development of this resource is not considered promising on a large scale either in irrigation of water supply. Hydrological study reports reveal that Manipur valley is underlined by a thin veneer of alluvial deposits, which is largely clayey in nature, underlined by rocks of Tertiary age. Ground water occurs under un-confined and confined conditions. Since the upper formations are mainly silty and clayey, open wells have poor yield prospects. However the deeper zone, consisting of sand stones of Tertiary age, forms good aquifers which are under confined conditions, Auto flow conditions are observed in Imphal where the yield of the tube wells vary from 0.5 to 4 m3/hr.

4.6 Hydrology of Ground Water

Dynamic Ground Water Resources	
Annual Replenish able Ground water Resource	0.38 BCM
Net Annual Ground Water Availability	0.34 BCM
Annual Ground Water Draft	0.002 BCM
Stage of Ground Water Development	0.65 %
Ground Water Development & Management	
Over Exploited	NIL
Critical	NIL
Semi- critical	NIL
Ground water user maps	6 districts
Artificial Recharge to Ground Water (AR)	Feasible AR structures: 300 check dams, 500 weirs, 500 gabion structures, 300 rooftop harvesting, 150 development of springs
Ground Water Quality Problems	
Contaminants	**Districts affected (in part)**
Iron (>1.0 mg/l)	Bishnupur, Thoubal

Source: http://cgwb.gov.in/documents/Country%20Resource.pdf

4.7 Sufficiency of CD Structures :

The hydrological study formulae are not, however, strictly applicable to hill areas (especially in the North and North East) and as such, appropriate evaluations by collection of data from ground in each case may have to be resort to.

As per IRC:SP: 48-1998, Clause 8.10.5 (a) culverts are generally provided 5 to 6 per kilometre for efficient drainage and at every small rivulet. The vent should be about 1 m x 1.5 m so as to afford ample space for the maintenance staff to clean them before and after the rainy season.


TRAFFIC
SURVEY AND
ANALYSIS

TRAFFIC SURVEY & ANALYSIS

5.1 General

Traffic is one of the most important components of road project feasibility study. The study of traffic & travel characteristics is conducted to assess the nature and magnitude of traffic problems on the project road. A correct assessment of the existing traffic condition along with past traffic flow trends forms a basis for further analysis of estimation of traffic flow for the horizon years. As the travel is the derived demand due to interaction of numerous socio economic activities, it is also imperative to study the growth of the socio-economic, demographic profiles in the project area influencing the travel demand.

Presently traffic facilities on the project road in terms of pedestrian sidewalk in urban area, access control, road signage and markings are non-existent or at best highly deficient. Certain sections on the road, heavy movement of goods traffic poses serious problems of traffic operation resulting in high degree of traffic congestion. Other problems along the highway are inadequate sight distance, poor road geometrics, kerb side parking, and non-conforming land use activities along the roadside and other encroachments within right of way.

5.2 Background

The project road starts from Yaingangpokpi-Finch Corner at 0/000 km and ends at Finch Corner at chainage 30/970 km passes through the major settlements of Gwaltabi, Shangkai, Litan Sareikhong, Yaolen and Lambui.

5.3 Objective

The primary objective of the traffic survey is:

- To determine the characteristics of the present traffic on the project road
- To assess the future growth during the design life of the pavement
- To determine the impact of the diverted and generated traffic
- To determine the travel pattern as well as types of vehicles plying
- To determine the axle load distribution
- To determine the turning movement of traffic at junctions
- To determine the bottlenecks for the pedestrian and cattle movement
- To determine requirement of design facilities etc
- To assess the toll tax generation
- To determine the viability of the project

The data obtained by traffic surveys and their analysis provides the basic input for the following part of the feasibility study:

- Pavement design
- Intersection design
- Environmental Impact assessment and Investment appraisal
- Development of wayside amenities
- Capacity assessment and recommendation for wider carriageway
- Option study for bypass/ service road
- Design of toll plaza
- Economic, Financial and Sensitivity analysis
- Ultimate viability of the project on BOT basis

For making the proper assessment of traffic volume, base year traffic and its projection, Consultants have carried out the necessary traffic surveys and investigations. The base year traffic data is the primary input for determination of future traffic demand. With a view to estimate the base year traffic volume in respect of goods and passenger carrying vehicles, the Classified Traffic Volume Count (CTVC) surveys, Origin and Destination survey, Intersection volume count and Axle Load surveys were conducted in the month of April 2017. For the purpose of traffic estimation and projections the year 2017-18 has been taken as the base year.

5.4 Identification of Homogeneous Sections

The study area pertains to the National Highway No 202 connecting Imphal to Mockchung. It is a single lane carriageway road with a total length of 153kms. For traffic point of view, the project road has been divided into 2 homogeneous section with respect to variation in traffic volume based on location of major intersection and minor settlements.

The homogeneous sections are given in Table below.

Table 31: HOMOGENEOUS SECTIONS

Homogeneous Section	Location	Length (km)	Remarks
HS-1	0/000-113/470	113.470	Yaingangpokpi to Kharasom
HS-2	113/470-153/000	39.530	Kharasom to Nagaland Border

Based on the homogeneous section proposed above, traffic survey locations have been judiciously selected to carry out the mid-block traffic volume survey as per the requirement of ToR.

The traffic survey has been performed at locations and schedule mentioned in the table below.

Table 32: PROPOSED LOCATION FOR TRAFFIC SURVEY

Sl no	Type of Survey	Duration	Location

1	Classified Volume Count	7 days	At km 49/636 at Ukhrul
		7 days	At km 113/470 at Kharasom
2	Intersection volume count	Peak hours	At km 49/636 at Ukhrul
4	Axle load survey	12 hours	At km 49/636 at Ukhrul

5.5 Analysis Of Traffic Volume Surveys

The data collected through primary and secondary sources has been compiled, collated and analysed. The analysis of traffic volume was recorded on hourly variation sheet and was further accumulated to obtain the daily traffic volume in 24 hours for seven consecutive days of the week. The average daily traffic volume is further derived in vehicles as well as in passenger car units (PCUs). Similarly traffic composition and traffic flow pattern has been arrived at.

PCU:

Inorder to generalize the traffic volume on project road, the standards of passenger car units have been adopted as follows:

Table 33: PCU VALUES

Category of Vehicles	PCU Value
Cars/Jeep/ Taxies/Van	1
Two wheeler (Motor-Cycles/ Scooters)	0.5
Three Wheeler	1
Bus	3
LCV (Light Motor Vehicle) e.g. mini truck	1.5
Two Axle	3
Multi Axle	4.5
Tractor	4.5
Cycle	0.5
Animal cart (Bullock Cart)	8
Others	2

5.6 Classified Traffic Volume count

The Classified traffic volume count is carried out at 2 locations in the 2 homogeneous stretches in the month of April and May 2017. The vehicle classification has been done on the basis of IRC SP 19-1991 and IRC 9-1972.

Figure 20: TRAFFIC COUNT STATIONS

5.7 Classified Traffic Volume count

The Classified traffic volume count is carried out at 1 location in the 1 homogeneous stretches in the month of April 2017. The vehicle classification has been done on the basis of IRC SP 19-1991 and IRC 9-1972. The purpose of the survey is to calculate the Average Daily Traffic (ADT) on all the traffic homogeneous sections and to convert the traffic into PCU, for Capacity Analysis and fixing of concession period. Vehicle classification and PCU factors adopted are presented in Table below.

Table 34: PCU VALUES

Category of Vehicles	PCU Value
Two Wheeler	0.5
Three Wheeler	1
Car/Taxies	1
Jeep/Van	1
Mini Bus	1.5
Bus	3
LCV Passenger	1.5
LCV Freight	1.5
Two Axle	3
Three Axle	3
Semi Articulated	4.5
Articulated	4.5
Cycle	0.5
Rickshaw	2

Category of Vehicles	PCU Value
Animal Cart	8
Hand Cart	2
Others	2

Under the present study, manually 7 days traffic volume counts were carried out at 2 locations for 24 hours in the month of April of 2017. The survey stations have been located away from urban agglomerations and villages to minimize interference of local traffic. The summary of the daily traffic count at all survey locations is presented below.

Table 35: DETAILS OF TRAFFIC SURVEY AT 49/636 km CHAINAGE

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	ADT
Two Wheeler	911	560	775	387	848	952	755	741
Three Wheeler	15	2	6	4	16	25	17	12
Car/Taxies	5227	1613	3974	1603	5371	5512	5041	4049
Jeep/Van	403	86	337	90	472	445	373	315
Mini Bus	5	3	0	0	0	2	1	2
Bus	39	7	28	14	37	41	47	30
LCV Passenger	105	27	80	10	104	119	90	76
LCV Freight	48	5	12	5	31	22	11	19
Two Axle	101	37	83	21	104	109	79	76
Three Axle	2	9	1	0	5	4	11	5
Semi Articulated	0	0	0	0	0	1	2	0
Articulated	0	0	2	0	3	5	1	2
Cycle	38	52	56	14	24	12	23	31
Rickshaw	0	0	0	0	0	0	6	1
Animal Cart	0	0	0	0	0	0	0	0
Hand Cart	17	5	18	1	11	16	3	10
Others	1	1	0	0	7	0	3	2
Total Vehicles	6912	2407	5372	2149	7033	7265	6463	5372
Total PCU	6818.5	2230.5	5251.5	2027	6985	7199.5	6421.5	5276

Table 36: DETAILS OF TOLLABLE and NON-TOLLABLE TRAFFIC

Vehicle type	HS 1
Car/Taxies	4049
Jeep/Van	315
LCV Passenger	76
LCV Freight	19
Mini Bus	2
Bus	30
Two Axle	76
Three Axle	5
Semi Articulated	0
Articulated	2

Vehicle type	HS 1
ADT TOLLED	4574
PCU TOLLED	4851.5
Two Wheeler	741
Three Wheeler	12
Cycle	31
Rickshaw	1
Animal Cart	0
Hand Cart	10
Others	2
ADT NON TOLLED	797
PCU NON TOLLED	424
ADT Total	5371
PCU total	5275.1
Percentage non Tolled	17.42%

Table 37: DETAILS OF TRAFFIC SURVEY AT 49/636 km CHAINAGE

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	ADT
Two Wheeler	15	13	14	7	11	9	21	13
Three Wheeler	0	1	0	0	0	0	0	0
Car/Taxies	13	26	16	15	21	24	29	21
Jeep/Van	7	9	19	11	10	5	11	10
Mini Bus	0	0	2	0	0	0	0	0
Bus	0	0	0	0	0	0	0	0
LCV Passenger	0	0	0	0	0	0	0	0
LCV Freight	0	3	0	1	2	2	0	1
Two Axle	15	18	17	17	31	14	28	20
Three Axle	0	1	0	0	1	0	2	1
Semi Articulated	0	0	0	0	0	0	0	0
Articulated	0	0	0	0	0	0	0	0
Cycle	0	0	0	0	0	0	0	0
Rickshaw	0	0	0	0	0	0	0	0
Animal Cart	0	0	0	0	0	0	0	0
Hand Cart	0	0	0	0	0	0	0	0
Others	0	2	0	0	0	1	2	1
Total Vehicles	50	73	68	51	76	55	93	67
Total PCU	72.5	108	96	82	135.5	80.5	144.5	103

Table 38: DETAILS OF TOLLABLE and NON-TOLLABLE TRAFFIC

Vehicle type	HS 2
Car/Taxies	21
Jeep/Van	10
LCV Passenger	0

Vehicle type	HS 2
LCV Freight	1
Mini Bus	0
Bus	0
Two Axle	20
Three Axle	1
Semi Articulated	0
Articulated	0
ADT TOLLED	53
PCU TOLLED	95.5
Two Wheeler	13
Three Wheeler	0
Cycle	0
Rickshaw	0
Animal Cart	0
Hand Cart	0
Others	1
ADT NON TOLLED	14
PCU NON TOLLED	8.5
ADT Total	67
PCU total	103
Percentage non Tolled	20.9%

The traffic in these area is very low. So, the toll to be recovered from the project will non-viable.

5.7.1 Hourly Variation of Traffic

Average hourly variation of traffic for all three count locations is shown in figure below. It is observed that at all locations traffic flow in day and night has considerable variation in volume. At these locations peak flow happens in morning hours 8.00-10.00 AM and evening hours between 3.00PM to 5.00PM.

Figure 21 : HOURLY VARIATION OF TRAFFIC AT BOTH THE LOCATIONS

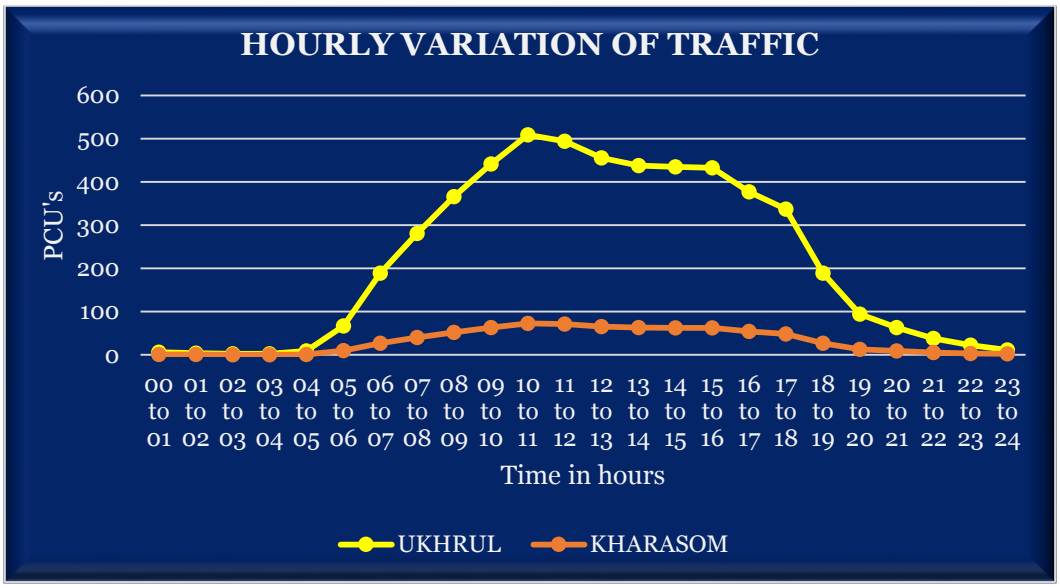
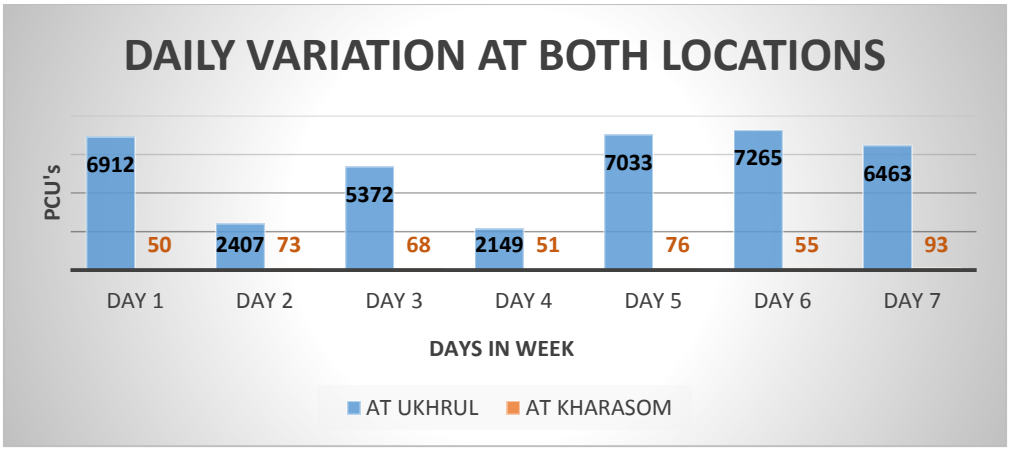


Figure 22: DAILY VARIATION OF TRAFFIC



5.7.2 Composition of Traffic

Seven days average composition of traffic at each count location is presented in the form of pie-charts in Figure 31 & 32. Table 36 shows the average composition of traffic at each location.

Table 39: AVERAGE TRAFFIC COMPOSITION AT COUNT LOCATIONS

Type of Vehicles		Location 1 (49/636 km)		Location 1 (113/470 km)	
		Nos	%	Nos	%
Toll-able vehicles	Car/Taxies	4049	75.386	21	31.34
	Jeep/Van	315	5.8648	10	14.93
	LCV Passenger	76	1.415	0	0
	LCV Freight	19	0.3538	1	1.49
	Mini Bus	2	0.0372	0	0
	Bus	30	0.5586	0	0
	Two Axle	76	1.415	20	29.85

Type of Vehicles		Location 1 (49/636 km)		Location 1 (113/470 km)	
		Nos	%	Nos	%
	Three Axle	5	0.0931	1	1.49
	Semi Articulated	0	0	0	0
	Articulated	2	0.0372	0	0
	ADT TOLLED	4574	82.58	53	79.1
Non toll-able vehicles	Two Wheeler	741	13.796	13	19.4
	Three Wheeler	12	0.22	0	0
	Cycle	31	0.57	0	0
	Rickshaw	1	0.018	0	0
	Animal Cart	0	0	0	0
	Hand Cart	10	0.1862	0	0
	Others	2	0.0372	1	1.49
	ADT NON TOLLED	797	17.42	14	20.9
	ADT Total	5371		67	

Figure 23: VEHICLE COMPOSITION CHART AT UKHRUL (49/636 KM)

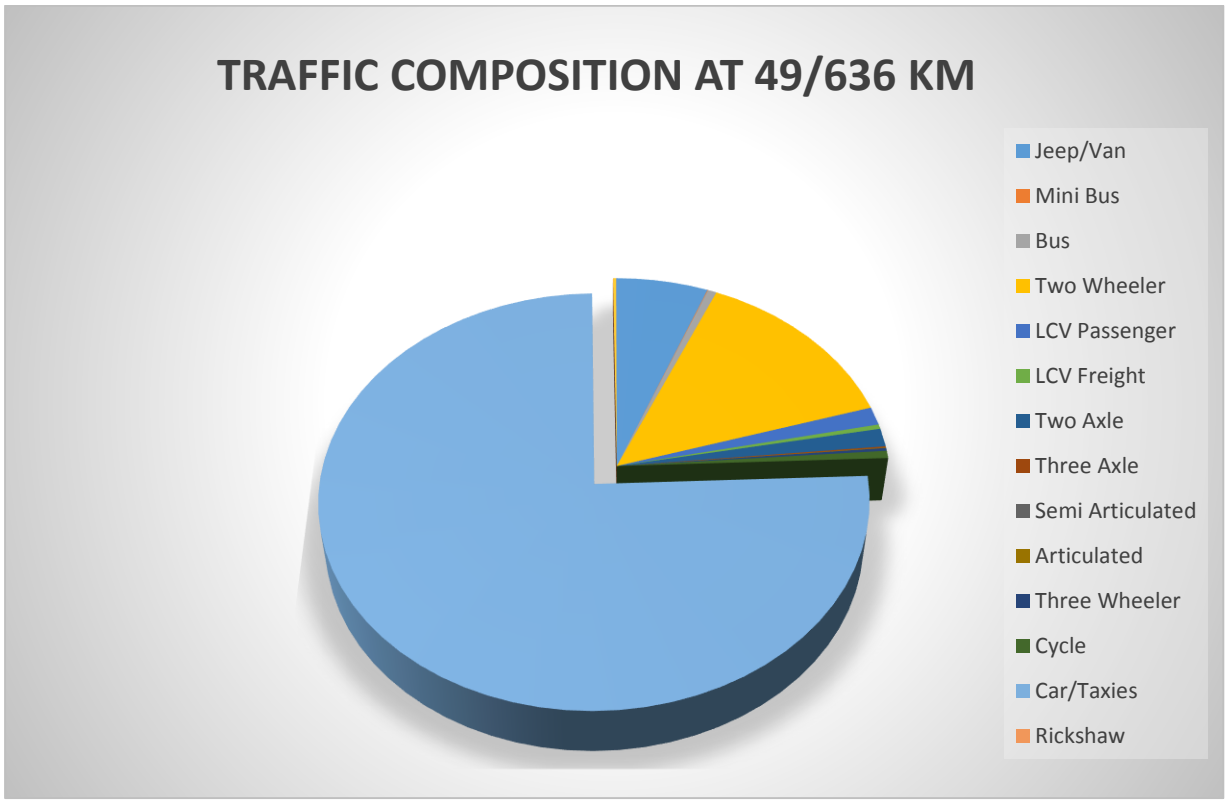


Figure 24: VEHICLE COMPOSITION CHART AT UKHRUL (113/470 KM)

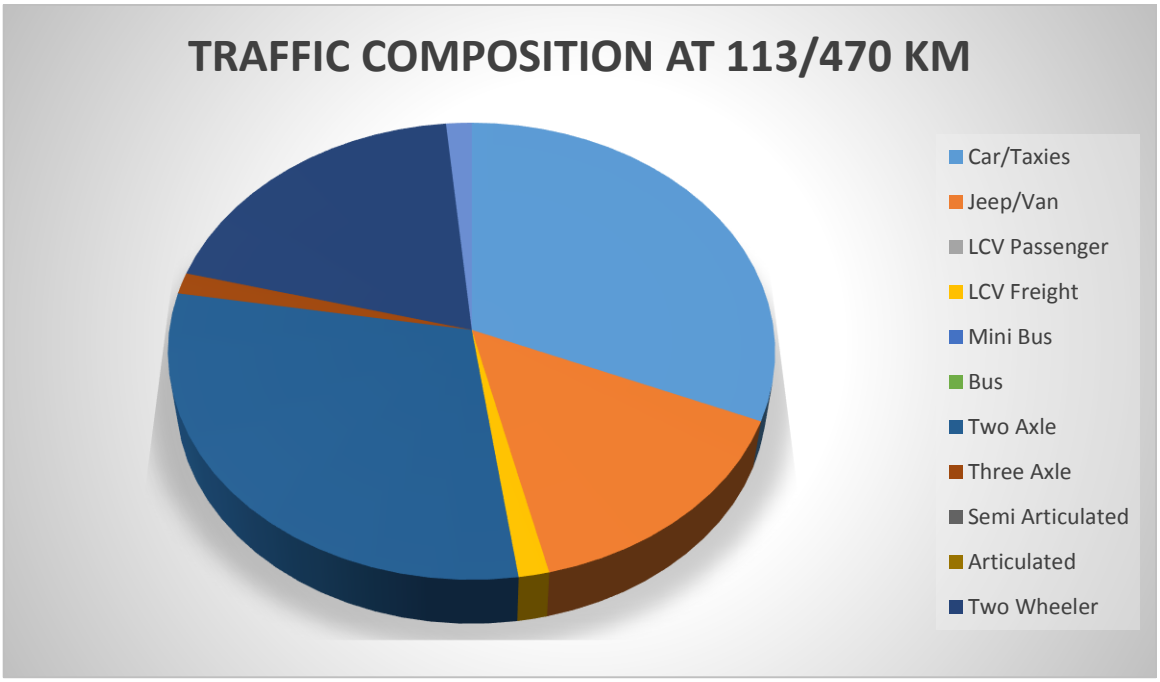
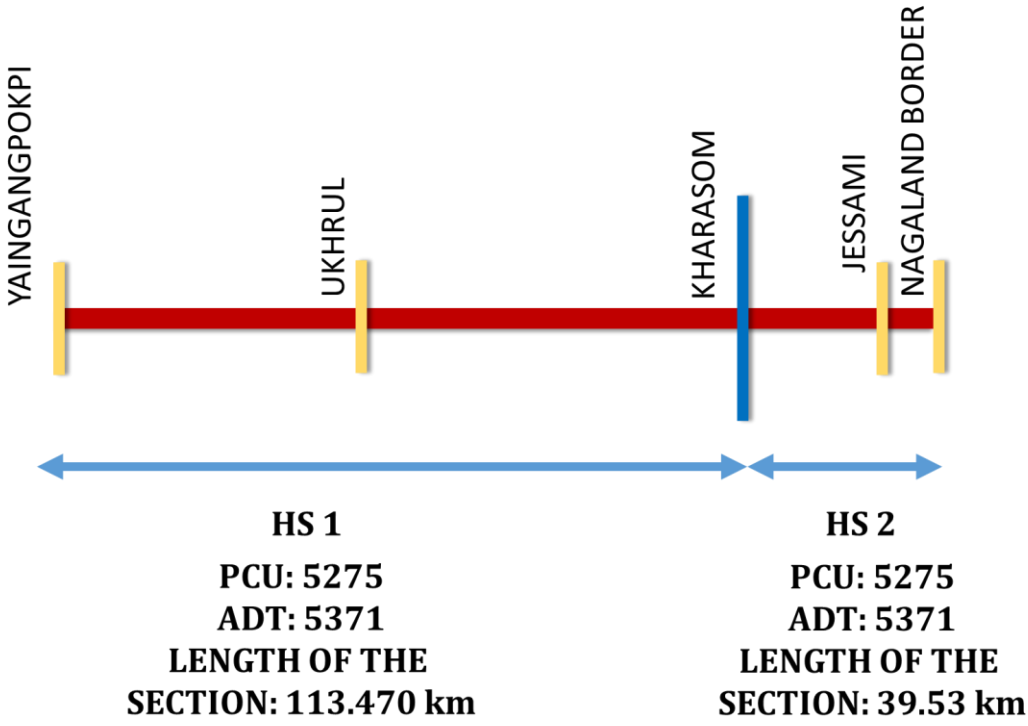


Figure 25: PROJECT ROAD WITH HOMOGENEOUS SECTIONS



5.8. Traffic Forecast and Management

5.8.1 General

Investment priorities are governed by the traffic demand, assessed benefits and cost of the project. Demand plays the important role, governing which type of facility / infrastructure needs to be created. This in turn determines likely benefits and costs to develop the same. A

highway project of this nature calls for significant investment. Prediction of traffic demand becomes an important task and has to be carried out near accurately. Accurate estimation of traffic has direct bearing on the viability of the project. Recognizing this, efforts need to be made to carefully assess all the parameters that help in predicting the traffic demand in future, which necessitates realistic estimation of traffic growth rates. Traffic growth on a road facility is generally estimated on the basis of historical trends. In the present case, traffic growth rates have been estimated using elasticity method as per IRC: 108 – 1996. Demand changes are usually because of shifts in the pattern of economic activities in the surrounding regions. Hence, future traffic estimation necessitates a preview, however imprecise, of the probable pattern of future growth of the economy.

5.8.2. Growth Traffic Projections

The seven days volume counts obtained during the traffic survey work has been analysed both in terms of Vehicle and PCUs. Average daily traffic (ADTV) for the project road has been assessed based on Traffic Survey Counts and other factors. As project is being checked for feasibility on DBFOT pattern, the concession period has to be taken maximum 30 years. Therefore traffic forecast has been made for 30 years period including construction period of the project road.

The projected traffic volume has been presented in the table below. Based on the projected traffic volume, the capacity has been augmented in terms of widening the carriageway as well as improvement of geometrics.

5.8.3. Projection of Tollable Vehicles

The project road has been envisaged to be constructed on BOT basis which anticipates the projection of vehicles that can be charged for using the road facility. Therefore, traffic has been projected mode wise for the project life period. For this purpose, the vehicles of similar dimensions and character have been classified. The vehicles which can be levied toll tax are (i) Car/jeep/taxi, (ii) Standard buses, (iii) LCV and Mini buses, (iv)Standard trucks of 2 Axles, (v) Trucks- 3 Axles, (vi) Multi-axle and Articulated Trucks and (vii) Loaded tractors.

Table 40 : PROJECTED TRAFFIC FOR 30 YEARS AT UKHRUL

PROJECTED TRAFFIC AT 5% GROWTH RATE

	Fast Vehicle												Slow Vehicle						PCU
	2W	3W	Passenger Car	Utility Vehicle (Jeep, vanet c)	Bus		LCV		Truck				Cycle	Rickshaw	Animal Drawn	Hand Cart	Other non-motorised	Total	
					Mini	Full	Passenger	Freight	2 Axle	3 Axle	MAV								
											Semi Artic	Artic							
	0.5	1	1	1	1.5	3	1.5	1.5	3	3	4.5	4.5	0.5	2	8	2	2		
2018	741	12	4049	315	2	30	76	19	76	5	0	2	31	1	0	10	2	5372	5276
2019	779	13	4252	331	3	32	80	20	80	6	0	3	33	2	0	11	3	5641	5541
2020	818	14	4465	348	4	34	84	21	84	7	0	4	35	3	0	12	4	5924	5819
2021	859	15	4689	366	5	36	89	23	89	8	0	5	37	4	0	13	5	6221	6110
2022	902	16	4924	385	6	38	94	25	94	9	0	6	39	5	0	14	6	6533	6416
2023	948	17	5171	405	7	40	99	27	99	10	0	7	41	6	0	15	7	6860	6737
2024	996	18	5430	426	8	42	104	29	104	11	0	8	44	7	0	16	8	7203	7074
2025	1046	19	5702	448	9	45	110	31	110	12	0	9	47	8	0	17	9	7564	7428
2026	1099	20	5988	471	10	48	116	33	116	13	0	10	50	9	0	18	10	7943	7800
2027	1154	21	6288	495	11	51	122	35	122	14	0	11	53	10	0	19	11	8341	8190
2028	1212	23	6603	520	12	54	129	37	129	15	0	12	56	11	0	20	12	8759	8600
2029	1273	25	6934	546	13	57	136	39	136	16	0	13	59	12	0	21	13	9197	9030
2030	1337	27	7281	574	14	60	143	41	143	17	0	14	62	13	0	23	14	9657	9482
2031	1404	29	7646	603	15	63	151	44	151	18	0	15	66	14	0	25	15	10140	9957
2032	1475	31	8029	634	16	67	159	47	159	19	0	16	70	15	0	27	16	10647	10455
2033	1549	33	8431	666	17	71	167	50	167	20	0	17	74	16	0	29	17	11180	10978
2034	1627	35	8853	700	18	75	176	53	176	21	0	18	78	17	0	31	18	11739	11527

2035	1709	37	9296	735	19	79	185	56	185	23	0	19	82	18	0	33	19	12326	12104
2036	1795	39	9761	772	20	83	195	59	195	25	0	20	87	19	0	35	20	12943	12710
2037	1885	41	10250	811	21	88	205	62	205	27	0	21	92	20	0	37	21	13591	13346
2038	1980	44	10763	852	23	93	216	66	216	29	0	23	97	21	0	39	23	14271	14014
2039	2079	47	11302	895	25	98	227	70	227	31	0	25	102	23	0	41	25	14985	14715
2040	2183	50	11868	940	27	103	239	74	239	33	0	27	108	25	0	44	27	15735	15451
2041	2293	53	12462	987	29	109	251	78	251	35	0	29	114	27	0	47	29	16522	16224
2042	2408	56	13086	1037	31	115	264	82	264	37	0	31	120	29	0	50	31	17349	17036
2043	2529	59	13741	1089	33	121	278	87	278	39	0	33	126	31	0	53	33	18217	17888
2044	2656	62	14429	1144	35	128	292	92	292	41	0	35	133	33	0	56	35	19128	18783
2045	2789	66	15151	1202	37	135	307	97	307	44	0	37	140	35	0	59	37	20085	19723
2046	2929	70	15909	1263	39	142	323	102	323	47	0	39	147	37	0	62	39	21090	20710
2047	3076	74	16705	1327	41	150	340	108	340	50	0	41	155	39	0	66	41	22145	21746

Table 41 : PROJECTED TRAFFIC FOR 30 YEARS AT KHARASOM

PROJECTED TRAFFIC AT 5% GROWTH RATE

	Fast Vehicle												Slow Vehicle						PCU
	2W	3W	Passenger Car	Utility Vehicle (Jeep, vanet c)	Bus		LCV		Truck				Cycle	Rickshaw	Animal Drawn	Hand Cart	Other non-motorised	Total	
					Mini	Full	Passenger	Freight	2 Axle	3 Axle	MAV								
											Semi Artic	Artic							
	0.5	1	1	1	1.5	3	1.5	1.5	3	3	4.5	4.5	0.5	2	8	2	2		
2018	13	0	21	10	0	0	0	1	20	1	0	0	0	0	0	0	1	67	103
2019	14	0	23	11	0	0	0	2	21	2	0	0	0	0	0	0	2	70	108
2020	15	0	25	12	0	0	0	3	23	3	0	0	0	0	0	0	3	74	114
2021	16	0	27	13	0	0	0	4	25	4	0	0	0	0	0	0	4	78	120

2022	17	0	29	14	0	0	0	5	27	5	0	0	0	0	0	0	5	82	126
2023	18	0	31	15	0	0	0	6	29	6	0	0	0	0	0	0	6	87	133
2024	19	0	33	16	0	0	0	7	31	7	0	0	0	0	0	0	7	92	140
2025	20	0	35	17	0	0	0	8	33	8	0	0	0	0	0	0	8	97	147
2026	21	0	37	18	0	0	0	9	35	9	0	0	0	0	0	0	9	102	155
2027	23	0	39	19	0	0	0	10	37	10	0	0	0	0	0	0	10	108	163
2028	25	0	41	20	0	0	0	11	39	11	0	0	0	0	0	0	11	114	172
2029	27	0	44	21	0	0	0	12	41	12	0	0	0	0	0	0	12	120	181
2030	29	0	47	23	0	0	0	13	44	13	0	0	0	0	0	0	13	126	191
2031	31	0	50	25	0	0	0	14	47	14	0	0	0	0	0	0	14	133	201
2032	33	0	53	27	0	0	0	15	50	15	0	0	0	0	0	0	15	140	212
2033	35	0	56	29	0	0	0	16	53	16	0	0	0	0	0	0	16	147	223
2034	37	0	59	31	0	0	0	17	56	17	0	0	0	0	0	0	17	155	235
2035	39	0	62	33	0	0	0	18	59	18	0	0	0	0	0	0	18	163	247
2036	41	0	66	35	0	0	0	19	62	19	0	0	0	0	0	0	19	172	260
2037	44	0	70	37	0	0	0	20	66	20	0	0	0	0	0	0	20	181	273
2038	47	0	74	39	0	0	0	21	70	21	0	0	0	0	0	0	21	191	287
2039	50	0	78	41	0	0	0	23	74	23	0	0	0	0	0	0	23	201	302
2040	53	0	82	44	0	0	0	25	78	25	0	0	0	0	0	0	25	212	318
2041	56	0	87	47	0	0	0	27	82	27	0	0	0	0	0	0	27	223	334
2042	59	0	92	50	0	0	0	29	87	29	0	0	0	0	0	0	29	235	351
2043	62	0	97	53	0	0	0	31	92	31	0	0	0	0	0	0	31	247	369
2044	66	0	102	56	0	0	0	33	97	33	0	0	0	0	0	0	33	260	388
2045	70	0	108	59	0	0	0	35	102	35	0	0	0	0	0	0	35	273	408
2046	74	0	114	62	0	0	0	37	108	37	0	0	0	0	0	0	37	287	429
2047	78	0	120	66	0	0	0	39	114	39	0	0	0	0	0	0	39	302	451

5.9 Axle Load Survey

The commercial vehicles specifically more than 3 tons cause severe damage to the road pavement. For this purpose axle load survey has been conducted on three locations identified for the toll plaza installation. The total pavement thickness required to be determined is based on the cumulative million standard axle (msa) and the CBR value of the sub-grade soil. The pavement thickness is derived from the IRC-37 Specification. The commercial vehicles of different axles have been assessed and converted to number of axles and number of vehicles indicating Vehicle Damage Factor (VDF) which will be utilized for assessment of cumulative standard axle load.

Axle load survey was conducted at km 49/636 to estimate vehicle damage factor (VDF). Vehicle Damage Factor (VDF) is required in the design of overlays on existing pavement and new pavement design for Additional Lanes/ Widening/ Realignment/ Reconstruction.

VDF is a multiplier for converting the number of commercial vehicles of different axle loads to the number of standard axle load repetitions. Design of new pavement for Additional Lanes/Widening/New Construction/Reconstruction or strengthening of existing pavement is based upon the cumulative number of 8.16 tonne Equivalent Standard Axles (ESA) that will pass over during the design period. The VDF values are used in calculating the design traffic (in MSA) for pavement design. On Yaingangpokpi-Nagaland Border section, the survey was conducted on 127 number of commercial vehicles weighing more than 3 tonnes having cumulative axle load of 1359.7 T indicating VDF of 2.68.

As per IRC: 37, Para 3.3.4.4, if the number of commercial vehicles is between 150 and 1500, the VDF 3.5 may be considered. Accordingly, million standard axle load (msa) has been considered as 20 msa for the project road.

5.10 Capacity Analysis

The traffic (AADT) at both survey locations is projected to analyses the concession period based on the traffic capacity parameters. Maximum capacity for 2 Lane (7.00m) with earthen shoulder is considered as 18,000 PCUs. The growth rate of 5 % is considered for all types of vehicles.

Table 42: ESTIMATION OF LOS

Year	V/C	A	B	C	D	E	F
		0.6	0.7	0.8	0.85	0.9	1
2017	0.293	✓					
2020	0.339	✓					
2025	0.433	✓					
2030	0.553	✓					

2035	0.706	✓

5.11 Turning Movement Survey

Turning movement surveys were conducted at two major intersections falling on the project corridor to obtain information on directional movement of traffic at these intersections. The survey was conducted for 24 hours one a normal weekday. Each turning movement at the intersection was recorded by deployed enumerators in sufficient numbers at suitable locations. The data on peak hourly directional movements would be used to analyse and design the intersection. Table 40 gives detailed schedule of turning movement surveys conducted.

Table 43: SCHEDULE OF TURNING MOVEMENT SURVEY

Sl No	Location	Name
1	49/636	Ukhrul
2	113/470	Kharasom

Data analysis of turning movements at major junctions reveals that generally peak hours are staggered. The morning peak hour occurs between 08.00 – 10.00 AM hours whereas evening peak is between 4.00 – 5.00 PM hours.

The intersection volume count data is presented in Appendix I.

Table 44: INTERSECTION TRAFFIC PROJETIONS

Sl No	Chainage	Location description	Type of junction	Legs leading to	Peak Hour Volume PCU	Peak Hour
1	49/636	Ukhrul	Cross Road	Imphal Kharasom	648	4-5 PM
2	113/470	Kharasom	Y Junction	Kharasom-Nagaland Border	8	4-5

The 15 years projected traffic being more than 6000 PCU, rotary intersections may be provided for both the intersections. However, due to constraint in space, signalized intersections may be provided at both the locations.

5.12 Million Standard Axles (MSA)

Design method considers traffic in terms of the cumulative number of standard axles (8160 kg) to be carried by the pavement during the design life. The project road has been divided into two homogenous sections with respect to variation in traffic volume based on location of major intersections & major settlements. Design Traffic in MSA for 15 years is tabulated below.

Table 45: MSA DETAILS

Homogeneous	From km to km	Length in kms	15 years msa	Adopted msa

section				
Yaingangpokpi-Kharasom	0/000 km-113/470 km	113.470 kms	3 msa	20 msa
Kharasom-Nagaland Border	113/470 km-153/000 km	39.53 kms	0 msa	

5.13 Tolling Homogeneous Sections

As the project stretch is not feasible on PPP basis as studied in Feasibility stage as the vehicles projected do not meet the desire standard, the proposal for toll plaza was dropped.


IMPROVEMENT
PROPOSAL

IMPROVEMENT PROPOSALS

6.1 Introduction

This chapter is intended to give brief descriptions concerning the various improvement proposals for the up-gradation of existing NH 202 road to two lane carriageway with earthen shoulders from Yaingangpokpi to Manipur-Nagaland Border for a length of 153.000 km project stretch. The improvement proposal is based on the findings from various engineering surveys and investigations carried out on the project road section.

2 lane road carriageway with 1.5 m earthen shoulder on both side is proposed for the project road section. In the built up two lane has not been proposed due to non-availability of space and less traffic. The provisions have been made as per IRC SP 73:2015.

Improvement proposals for a highway essentially consist of two components, viz. Geometric and Structural. Geometric improvement deals with visible dimensions of roadway and is dictated by the traffic and economic considerations. Geometric design involves several design elements such as horizontal and vertical alignments, sight distance considerations, cross sectional elements, lateral and vertical clearances, intersection treatment, control of access, etc. The structural component deals with the pavement and embankment design aspects, i.e. the ability of the highway to adequately carry and support the vehicle / wheel loads over the design period. The improvement proposals for the proposed up gradation & widening to 2-lane with earthen shoulder configuration system includes the provision for the following major items:

- Geometric improvements and realignments
- Pavement
- Road junctions
- Bridges and CD structures
- Safety
- Road Appurtenances

6.2 Geometric design proposals

The proposal for the improvement of the geometric elements of the existing road includes:

- Improvement to the cross sectional elements
- Alignment design

6.2.1 Improvement to the cross sectional elements

Lane width:

The standard lane width of the project highway shall be 3.5 m, hence the two lane shall be 7 m.

Earthen shoulders:

1.5 m earthen shoulders is proposed on both side of the carriageway.

Cross fall:

The cross-fall for the pavement is 2.5% with a crown at the inner edge. The cross-fall for granular shoulder is 3%.

Proposed ROW:

The proposed development shall be within 10-12 m ROW. The proposed ROW for the project road has been proposed as 20 m built-up section and 24 m in open section.

The typical cross sections to be followed in the project stretch are detailed in Volume 2: Drawings

6.2.2 Development scheme

The most important fact in deciding the side of widening is the availability of land. Secondary factors include presence of environmentally; religiously and socially sensitive features such as Heritage Structures, other monument structure and so on. The following criteria have been used with suitable inter-alias weight age in terms of their influence in governing the decision on the side of widening.

- Available ROW from the existing center line;
- Location of utility lines;
- Abutting land use;
- Adjacent cultural properties;
- Geometric improvements necessary;
- Location and type of trees required to be cut;
- Socio Economic affected person;

Improvement of existing alignment has been done in following ways which will have significant beneficial impact in terms of :

- Minimizing Displacement
- Reducing resistance to the project
- Minimize the impact on the existing trees/local environment.
- Maximum benefit in terms of road geometry, pavements, shoulders, embankments etc.
- Uninterrupted flow of through traffic along the Project stretch
- Avoid future possibility of installation of speed breakers by the local administration/public

- Avoid adverse impacts of the crowded areas along the project stretch

The summary of widening scheme proposed is as below:

Table 46: SUMMARY OF WIDENING PROPOSAL

Sl. No.	Chainage (From)	Chainage (To)	Length	Typical Cross-section
1	9.800	10.800	1000.000	TCS 1
2	11.100	12.900	1800.000	
3	13.350	14.400	1050.000	
4	19.000	21.700	2700.000	
5	22.000	22.300	300.000	
6	23.800	24.500	700.000	
7	28.550	30.800	2250.000	
8	0.000	1.450	1450	TCS 2
9	7.150	7.550	400	
10	13.050	13.350	300	
11	15.750	16.000	250	
12	24.500	24.900	400	
13	26.050	26.400	350	
14	26.800	27.700	900	
15	1.450	1.800	350	TCS 2A
16	3.800	4.780	980	
17	9.500	9.680	180	
18	10.800	11.100	300	
19	15.580	15.750	170	
20	16.800	18.200	1400	
21	27.700	28.550	850	
22	30.800	30.970	170	
23	1.450	1.800	350	TCS 3
24	3.800	4.780	980	
25	9.500	9.680	180	
26	10.800	11.100	300	
27	15.580	15.750	170	
28	16.800	18.200	1400	
29	27.700	28.550	850	
30	30.800	30.970	170	
31	16.400	16.800	400	TCS 3A
32	8.600	9.000	400	TCS 4
33	9.68	9.8	120	
34	21.700	22.000	300	TCS 5
35	12.900	13.050	150	TCS 6
36	15.300	15.580	280	
37	18.200	19.000	800	
38	22.300	23.100	800	

Figure 26: TYPICAL CROSS SECTION 1

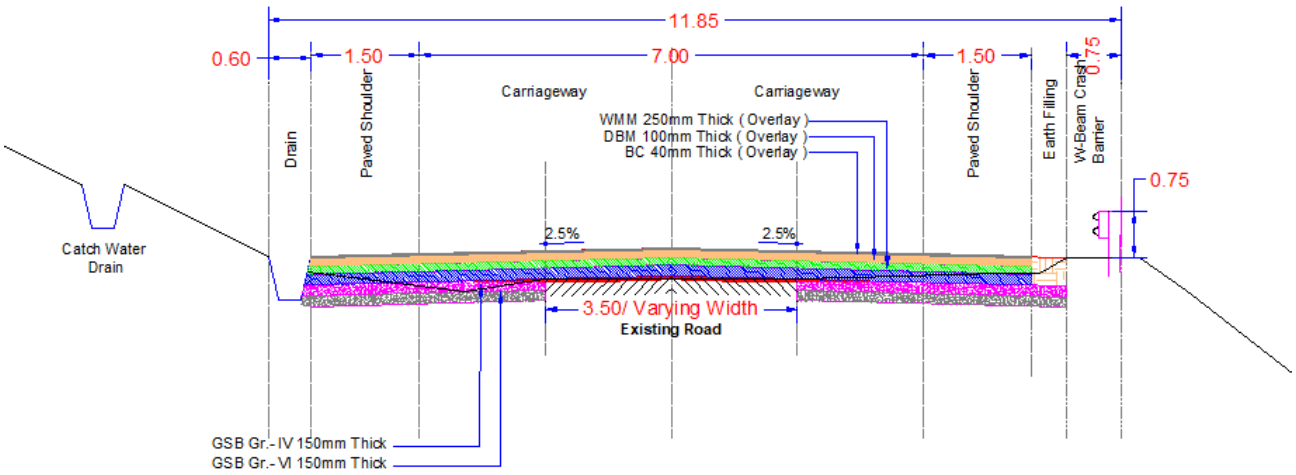


Figure 27: TYPICAL CROSS-SECTION 2

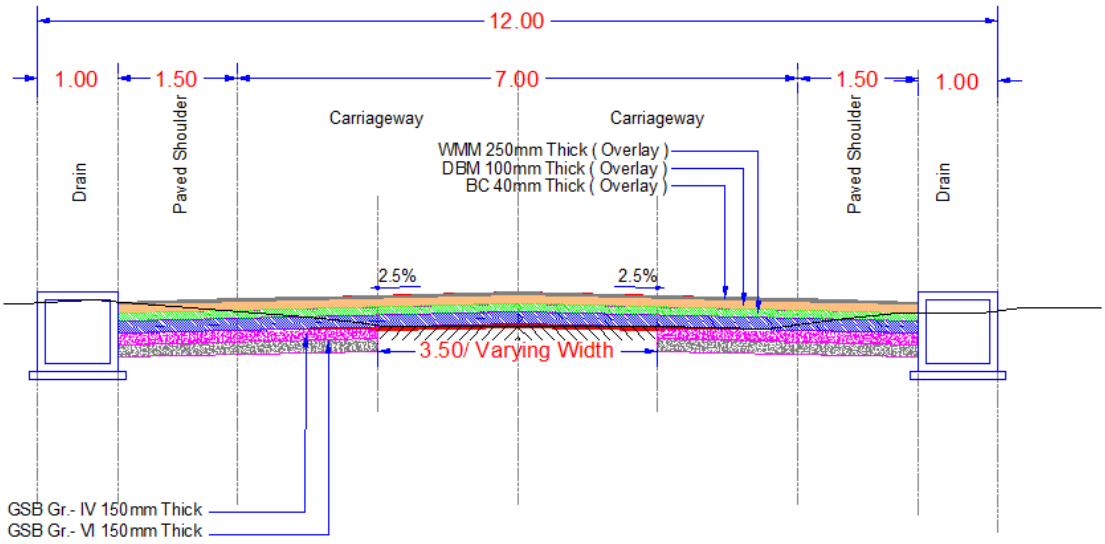


Figure 28: TYPICAL CROSS-SECTION 2A

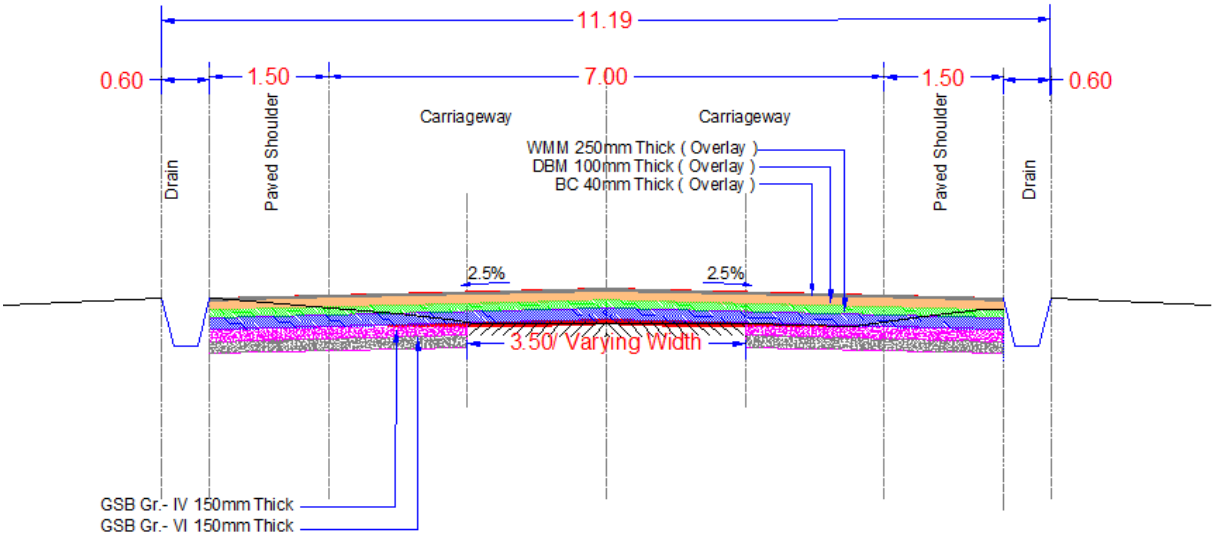


Figure 29: Typical Cross-section 3

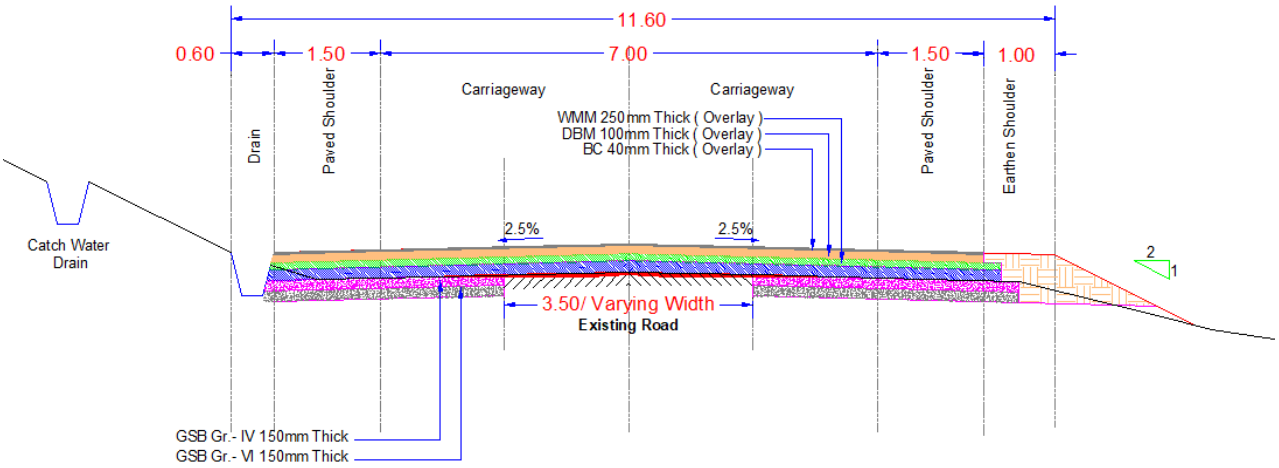


Figure 30: Typical Cross-section 3A

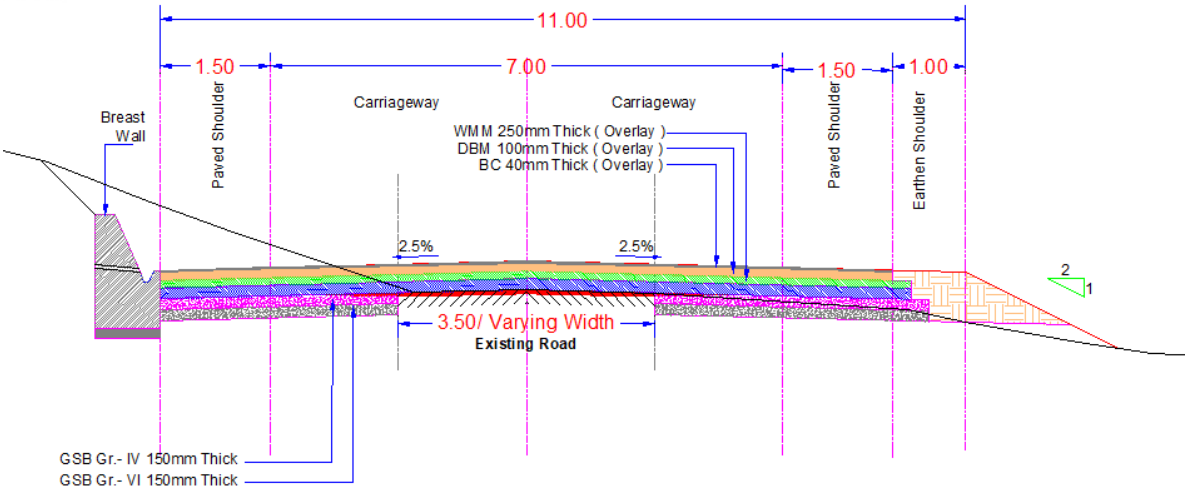


Figure 31: Typical Cross-section 4

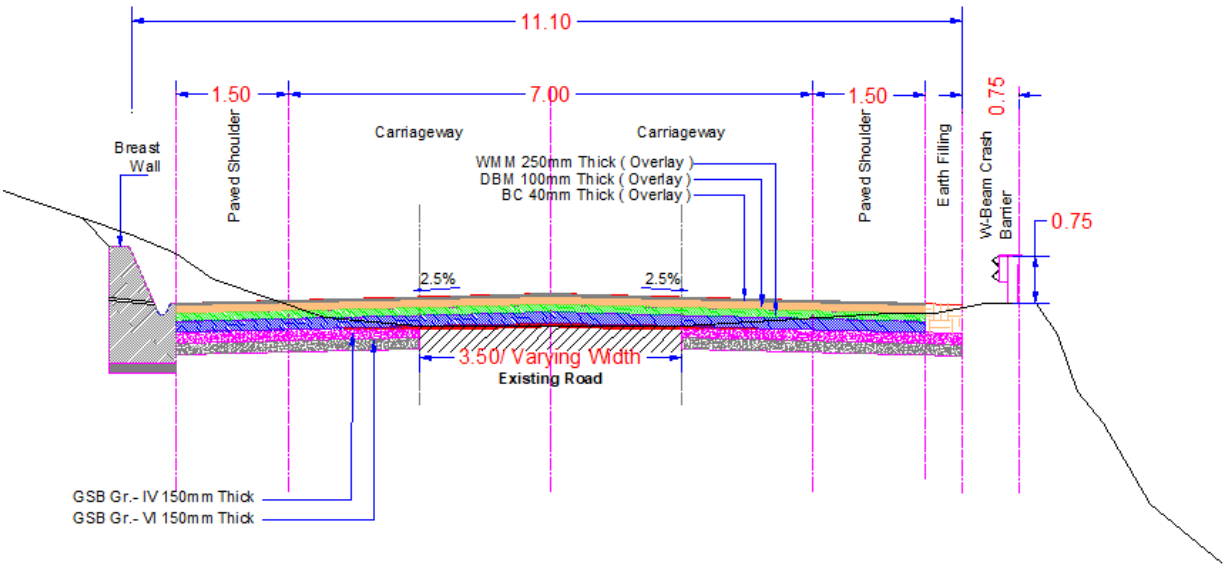


Figure 32: Typical Cross-section 5

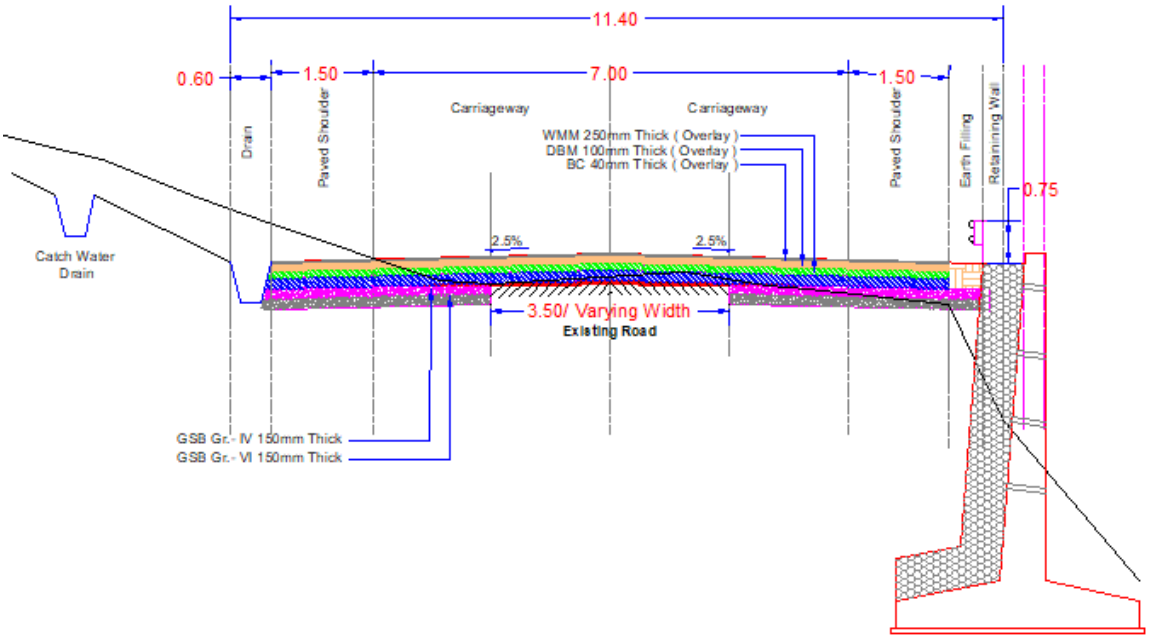
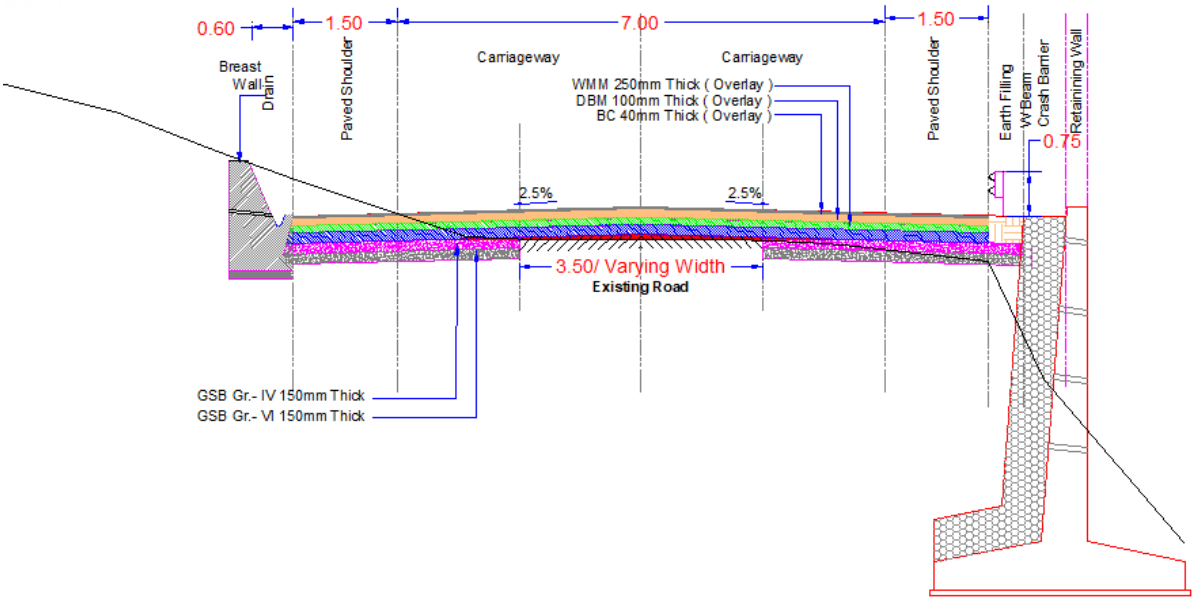


Figure 33: Typical Cross-section 6



6.2.3 Alignment Design

The entire geometric design has been based on the ground modelling by highway MX design software. The design of proposed alignment for 2-lane with earthen shoulder has been carried out based on the widening scheme as discussed above.

6.2.3.1 Horizontal Alignment

The horizontal alignment is designed for 40-50 kmph design speed. The sub-standard curves are proposed with realignments/curve improvements to improve the sub-standard curves as standard curves.

The existing road has as many as 567 curves. This has been improved to 555 number of curves with radius of 15 m minimum. The total road has been designed for minimum speed of 20 kmph.

Table 47: DETAILS OF SHARP CURVES

Sl. No.	Radius (m)	Number of curves
1	0-40	4
2	41-60	20
3	61-100	84
4	101-300	29

Vertical alignment:

Vertical Alignment is designed for minimum criteria of Intermediate Sight Distance (ISD). The existing road profile is reviewed on the basis of cross-sections taken at regular intervals with the help of Digital Terrain Model (DTM). Additional culverts have been proposed depending upon the site specific conditions/profile.

6.2.4 Pavement Options

For the purpose of pavement design the project road is divided into two homogeneous sections as detailed in the traffic chapter.

The purpose of the pavement study is to make analysis of different pavement alternatives to provide a basis for selection of the most advantage solution, considering all costs occurring during the life of the pavement, viz., construction costs, maintenance costs and costs for the road users.

In pavement option study, the following is studied in detail:

- New flexible pavement on the widening part and for full reconstruction stretches
- Flexible overlay over the existing pavement
- Flexible Pavement for partial reconstruction stretches of existing pavement.

The different pavement design methods for above pavement options are studied and applied, which are given in Table below

Table 48: CODE FOR PAVEMENT DESIGN

Pavement option	Option type	Design method
1	New Flexible pavement	IRC 37:2012
2	Flexible Overlay	IRC 81:1997
3	New Rigid Pavement	IRC 58: 2015

The pavement existing thorough out the project length is flexible in nature. The project envisages widening to two lanes with earthen shoulder of the existing single lane carriageway for augmenting the capacity of the project road and significantly extending its service life. Pavement Design includes strengthening of existing single/intermediate lane by providing appropriate bituminous overlay thickness.

The general design procedure for the flexible pavement for the proposed road from Yaingangpokpi to Nagaland Border for widening portion as new construction as well as strengthening of existing carriageway has been followed as per the guidelines of IRC: 37-2012 – "Guidelines for the design of flexible pavements" and IRC: 81-1997- "Guidelines for Strengthening of flexible road pavements using Benkelman Beam Deflection Technique" respectively. For the pavement design, the information is required with regard to the parameters such as volume of traffic, pavement condition; borrow area soil characteristics and

properties of the existing subgrade. Growth rate is required to predict the traffic over the design life and axle load spectrum is necessary to calculate the Vehicle Damage Factor (VDF) for the design traffic calculations.

New pavement design is based on the design traffic (msa) and the subgrade strength, however the overlay design will vary for each homogenous sections based on its structural and functional adequacy.

Flexible overlay is suggested over the existing pavement in order to enhance its structural and functional quality. Bituminous overlay in the form of BC and DBM is recommended as an overlay to support the design traffic of 10 years or 100 msa, whichever is less. BBD testing, test pit investigation, pavement condition survey and testing of the existing subgrade have been carried out to assess the requirements of strengthening. The overlay design is done in accordance with IRC: 81-1997 "Guidelines for Strengthening of flexible road pavements using Benkelman Beam Deflection Technique".

6.2.4.1 Crust and Overlay Design

Based on the traffic MSA of 20 and CBR of 5.4%, the crust of the pavement to be widened is designed and the overlay thickness is decided basing upon the BBD deflection characteristics. The table below shows the adopted thickness of each layer both in widening portion and the overlay portion.

Table 49: CRUST DETAILS

Sl. No.	Chainage (km)		Widening Portion				Overlay Portion		
1	From	To	GSB	WMM	DBM	BC	WMM	DBM	BC
	0/000 km	30/970 km	300	250	100	40	250	100	40

6.2.5 Improvement of Structures

The improvement proposal includes repair, rehabilitation, widening and reconstruction of the culverts and bridges which are in poor condition. The improvement proposals are summarized in the following table.

Table 50: ABSTRACT OF IMPROVEMENT DETAILS ON STRUCTURES IN PROJECT ROAD

Sl. No.	Type of Structure	Proposal	Numbers
1	Slab	Widening	27
		Reconstruction	4
		New Construction	62

Sl. No.	Type of Structure	Proposal	Numbers
2	Hume Pipe	New Construction	23
		Reconstruction	83
3	Minor Bridges	Retain	1
		New Construction	5
		Reconstruction	3

A specialized team having relevant experience and expertise has inspected all the structures. Based on the defects observed, a comprehensive repair and rehabilitation plan is to be prepared for repair and rehabilitation of the distresses bridge components.

6.2.6 Improvement and Upgradation of Road Intersections

The following intersections are proposed for improvement.

Table 51: INTERSECTIONS PROPOSED FOR IMPROVEMENT

Sl No.	Chainage	Junctions	
	From (km)	Type of Junction	Connecting places
1	0.145	Y (R)	Substation
2	1.312	Y(R)	Thawal
3	4.225	Y(L)	
4	6.265	Y (R)	
5	12.100	Y (R)	
6	24.960	Y (R)	Shakvao
7	31.000	Y (R)	Shangshak Phungdon

6.2.7 Longitudinal Drains

RCC covered drain in built-up section has been proposed where enough space is available. To facilitate the drainage along the whole stretch of the project road, lined drains has been provided with catch-pits on the hill side.

Table 52: DRAINAGE PROPOSAL

Sl. No.	Chainage (From)	Chainage (To)	Length	Typical Cross-section	Remarks
1	9.800	10.800	1000.000	TCS 1	Lined Drain on one side
2	11.100	12.900	1800.000		
3	13.350	14.400	1050.000		
4	19.000	21.700	2700.000		

Sl. No.	Chainage (From)	Chainage (To)	Length	Typical Cross-section	Remarks
5	22.000	22.300	300.000		
6	23.800	24.500	700.000		
7	28.550	30.800	2250.000		
8	0.000	1.450	1450	TCS 2	Covered Drain on one side
9	7.150	7.550	400		
10	13.050	13.350	300		
11	15.750	16.000	250		
12	24.500	24.900	400		
13	26.050	26.400	350		
14	26.800	27.700	900		
15	1.450	1.800	350	TCS 2A	Lined Drain on both side
16	3.800	4.780	980		
17	9.500	9.680	180		
18	10.800	11.100	300		
19	15.580	15.750	170		
20	16.800	18.200	1400		
21	27.700	28.550	850		
22	30.800	30.970	170		
23	1.450	1.800	350	TCS 3	Lined Drain on one side
24	3.800	4.780	980		
25	9.500	9.680	180		
26	10.800	11.100	300		
27	15.580	15.750	170		
28	16.800	18.200	1400		
29	27.700	28.550	850		
30	30.800	30.970	170		
34	21.700	22.000	300	TCS 5	Lined Drain on one side

6.2.8 Traffic Safety Measures

Design of proper junctions, foot paths, all other measures such as crash barriers, road signs, road marking, turn lanes etc. have been provided as per road safety standards prescribed by MoSRT&H. These have been shown in the drawing volume.

The Metal Beam Crash barriers are provided at various locations as the embankments are high. The location where guard wall has been proposed is listed below.

Table 53: Chainages of W-Beam Crash Barrier Provision

Sl. No.	Chainage (From)	Chainage (To)	Length	Typical Cross-section
1	9.800	10.800	1000.000	TCS 1
2	11.100	12.900	1800.000	
3	13.350	14.400	1050.000	
4	19.000	21.700	2700.000	
5	22.000	22.300	300.000	
6	23.800	24.500	700.000	

Sl. No.	Chainage (From)	Chainage (To)	Length	Typical Cross-section
7	28.550	30.800	2250.000	
8	8.600	9.000	400	TCS 4
9	9.68	9.8	120	
10	21.700	22.000	300	TCS 5

Retaining Wall

The retaining wall is to be provided at the following chainages which are tabulated below.

Table 54: Chainages of Retaining Wall Provision

Sl. No.	Chainage (From)	Chainage (To)	Length	Typical Cross-section
1	12.900	13.050	150	TCS 6
2	15.300	15.580	280	
3	18.200	19.000	800	
4	22.300	23.100	800	

Breast Wall

The breast wall is to be provided at the following chainages which are tabulated below.

Table 55: Chainages of Breast Wall Provision

Sl. No.	Chainage (From)	Chainage (To)	Length	Height
1	16.400	16.800	400	1 m
2	8.600	9.000	400	2 m
3	9.68	9.8	120	
4	12.900	13.050	150	2.5 m
5	15.300	15.580	280	
6	18.200	19.000	800	
7	22.300	23.100	800	

6.2.9User Facilities

The facilities provided for the project stretch include busbays, toilets, road signages and footpath in the urban sections which facilitate the users as weel as reducing the disruption of traffic flow.

Table 56: LOCATION OF PROPOSED BUS SIDINGS

Sl No	CHAINAGE	LHS/RHS
1	0.600	LHS
2	1.550	RHS
3	7.000	LHS
4	12.900	RHS
5	25.000	RHS
6	28.250	LHS

Table 57: LOCATION OF PROPOSED TOILETS

Sl No	CHAINAGE	LHS/RHS
1	0.600	LHS
2	1.550	RHS
3	7.000	LHS
4	12.900	RHS
5	25.000	RHS
6	28.250	LHS

The footpaths are provided over the drains in the built-up sections to facilitate the pedestrian movements. Proper traffic signages are provided to warn and regulate the flow of traffic. The details of the traffic signs are provided in the Traffic Safety chapter.

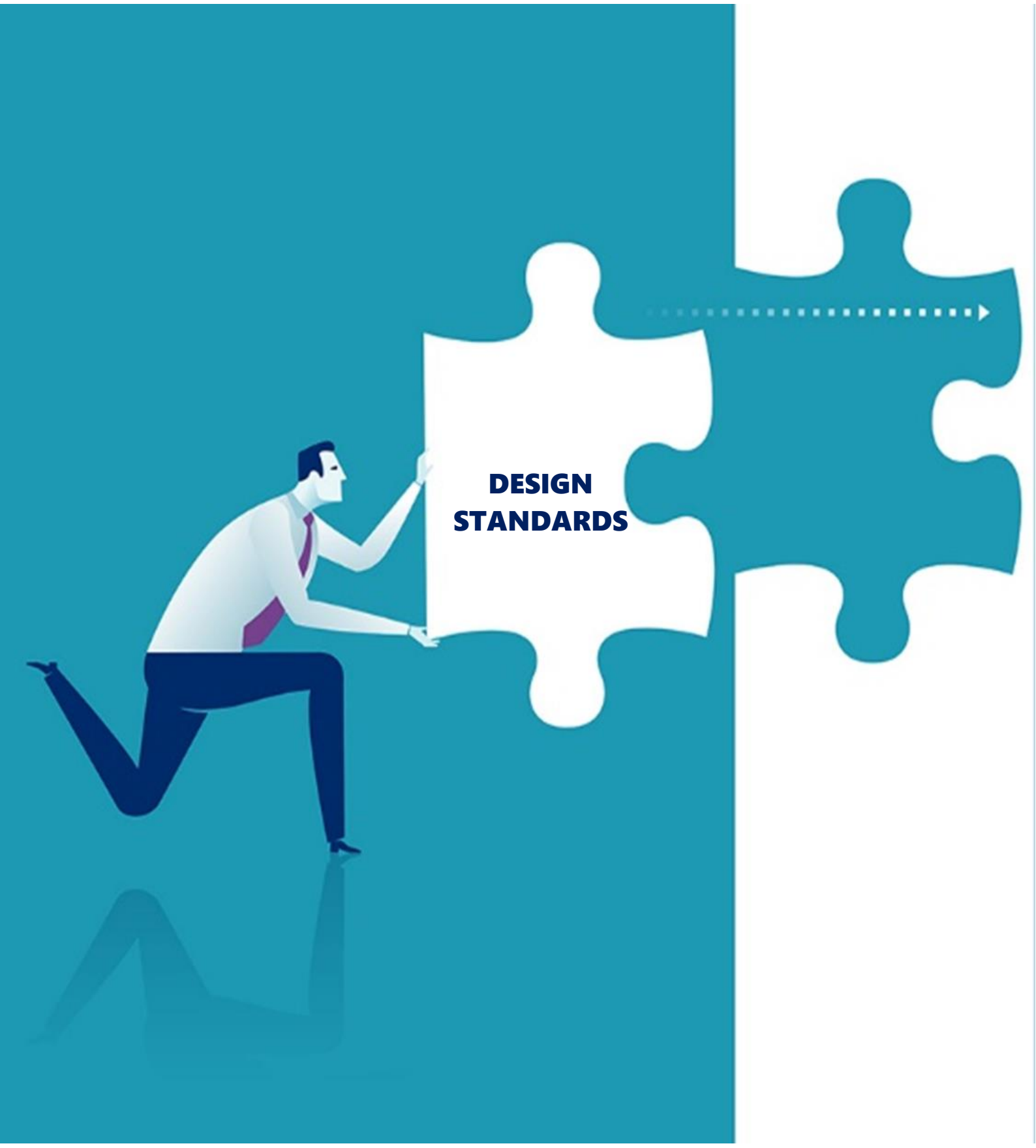
6.2.10 Road Furniture and Other Features

The road furniture, traffic safety features and other facilities included in the design are:

- Bus Shelters
- Road Markings
- Traffic Signs
- Kilometre Stone Details
- 200m Stones and Boundary Stones

Overhead sign boards at the start and end of the project road. The section of the signboard is provided in the drawings volume.

DESIGN STANDARDS



DESIGN STANDARDS

7.1 General

The primary purpose of this assignment is to Study the "Feasibility for Two laning with earthen shoulders configuration of National Highways of Manipur namely NH 202". The scope of Consultancy Service covers all aspects of Project preparation activities of proposed improvements. These improvements will consist of widening and strengthening of pavement with all ancillaries such as the improvements of cross section elements, sight distance consideration, horizontal curvature, gradients, intersection and geometries; widening/ strengthening/reconstruction of culverts and bridges; drainage; location of toll plazas, bypasses, junction improvements etc at reasonable cost to provide optimum efficiency in track operation and maximum safety.

7.2 Goal & Objectives

The aim is to provide maximum safety in the design of the highway geometry, pavement, shoulders, embankments and other pertinent components for an uninterrupted flow of through traffic along the project stretch with the provision of:

1. Bypasses and Realignment where appropriate
2. Road junctions for cross traffic at appropriate locations.

7.3 Highway Design Standards

The formulation of the design standards is required in order to avoid any inconsistency in design from one section to the other and provide desired level of service and safety. For this project, it is proposed to follow design standards given in the IRC codes, guidelines and special publications. IRC SP:73-2015 "Two laning of highways through Public Private Partnership" and IRC SP:48-1998 "Hill Road Manual".

7.4 Approach

While designing improvement works it is aimed at providing maximum safety to the road users. Accordingly, the highway geometrics, carriageway widths, and other pertinent components have been proposed for an uninterrupted and smooth flow of traffic along the project corridor.

7.5 Design Standards

The geometric design standards outlined below have been followed for the horizontal alignment and vertical profile. The design standards of all the elements of a highway corridor can be grouped into the following categories as given in Table below.

Table 58: DESIGN ELEMENTS

Sl no	Category	Design element
1	Design capacity	Design service volume standards Design capacity standards
2	Geometric Design	Design Speed Cross sectional elements Sight distance Horizontal curves Vertical curves
3	Pavement design	CBR, Traffic, Structural strength
4	Grade separators and Cross drainage structures	Underpass Flyover/ ROBs Bridges and culverts
5	Intersections and interchanges	At grade intersections Grade separated intersections Acceleration and deacceleration
6	Slope protection	Side slopes Slope protection
7	Drainage system	Longitudinal, cross drainage
8	Safety measures	Guard rails & safety barriers Traffic signals Road signage & pavement markings Footpaths and sidewalks

7.6 Capacity standards and width of carriageway

The width of carriageway is decided based on the following "Projected Traffic Volume" as on the date of commencement of the Project.

Table 59: Capacity Standards

Sl no	Traffic volume PCUs	Carriageway width (in m)	Maximum Capacity (PCUs per day)
1	Upto 1000	Single lane (3.75 m)	2000
2	1000 – 2500	Intermediate lane (5.50 m)	6000
3	2500 – 7500	Two lane (7 m)	15000
4	Above 7500	Two lane + Paved shoulders (10.0 m)	18000

7.7 Sight Distance

It is necessary that sight distance of sufficient length is available to permit drivers enough time and distance to control their vehicles to avoid accidents for safety on roads.

Two types of sight distances are considered in design of hill roads which are:

- Stopping sight distance which is the clear distance ahead needed by a driver to see, analyse, and react on seeing an obstacle.
- Intermediate sight distance

The values of both sight distances and criteria for measurement are given in tables

Table 60: STOPPING AND INTERMEDIATE SIGHT DISTANCE

SPEED	DESIGN VALUES- METERS	
	STOPPING SIGHT DISTANCE	INTERMEDIATE SIGHT DISTANCE
20	20	40
25	25	50
30	30	60
40	45	90
50	60	120
65	90	180
80	120	240
100	180	360

Table 61: CRITERIA TO MEASURE SIGHT DISTANCE

SL. NO.	SIGHT DISTANCE	DRIVER'S EYE HEIGHT	HEIGHT OF OBJECT
1	Safe Stopping Distance	1.2m	0.15m
2	Intermediate Sight Distance	1.2m	1.2 m

The stopping sight distance is the absolute minimum in case of hill rods and shall be ensured regardless of any considerations while designing the road. However, intermediate sight distance shall be tried to achieve while designing the road geometries. Overtaking sight distance shall be considered for the road stretches in plain terrain and hilly terrain.

7.8 Horizontal Profile

Horizontal alignment in road design consists of straight sections of road, known as tangents, connected by circular horizontal curves. Circular curves are defined by radius (tightness) and deflection angle (extent). The design of a horizontal curve entails the determination of a minimum radius (based on speed limit), curve length, and objects obstructing the view of the driver. The other considerations to finalize the horizontal profile are:

- Radius

- Design Speed
- Side Friction Factor
- Superelevation:
  a) Runoff
  b) Runout

7.9 Vertical Profile

The Profile of the Project Corridor has been finalized on the basis of DTM data collected during the topographic survey. In addition to the standards and guidelines set in this chapter, there are other considerations to finalize the vertical profiles, which are presented below:

- Minimum distance between two PVIs (Point of Vertical Intersection) is 150m.
- Minimum longitudinal gradient is 0.5%, for longitudinal drainage for Kerbed Pavements.
- Minimum length of a vertical curve is 30m.
- Minimum K (rate of change of vertical curvature) value as 75 for the summit curve and 45 for valley curve.

7.10 Cross Sectional Elements

7.10.1 Carriageway

The project road has undivided carriageway of single lane throughout the length of road. Proposal for widening of the carriageway from single lane to two lane with earthen shoulders has to be carried out as per IRC SP 73-2015.

7.10.2 Shoulder

The Project Road has an earthen shoulder of 0.5 to 1 m at different stretches. The proposal for Project Road has earthen shoulder 1.5 m on both side of the carriageway.

7.10.3 Drainage

Requirements for provision of drains as per guidelines of IRC: SP: 50-2013 and IRC: SP: 42-2014 has been checked. The HFL of adjoining ground is below the bottom of Sub grade level due to the hilly terrain. Considering a very high annual average rainfall and the proneness to lanslides due to the soil type, the existing drainage provisions has been found insufficient. Proper drainage plan has been provided to ensure the drainage of rain-water without causing harm to the pavement layers and the hill section.

7.11 Embankment Design

The design and construction of the road in embankment and in cuttings shall be carried out in accordance with Section 300 of MORTH Specifications and the requirements and standards and

specifications given in the section. The height of the embankment has been decided on the basis of final road levels. The following principles shall be kept in view while fixing the road level:

i. No section of the road is overtopped. Top of subgrade shall be at least 0.5 m above the general ground level.

ii. The bottom of sub-grade shall be 1.0 m above the high flood level(HFL)/level of water table.

7.11.1 Materials and Physical Requirements

Sourcing of materials for embankment and subgrade construction, as well as compliance with environmental requirements in respect of excavation and borrow area under the applicable laws. The material to be used in sub-grade shall satisfy the design CBR at the specified density and moisture content. The embankmentand sub-grade shall be compacted to satisfy the minimum compaction requirements given in clause 305 of MORTH Specifications.

4.11.2 Structural Features and Design of Embankment

Embankment with height 6.0 or more above shall be designed in accordance with IRC: 75 taking into account slope stability, bearing capacity, consolidation, settlement and safety considerations based on geotechnical and investigation data.

Side slopes shall not be steeper than 2H: 1V unless soil is retained by suitable soil reatining structures

The side slopes and the earthen shoulders shall be protected against erosion by providing a suitable vegetation cover, kerb channel, chute, stone/ cement concreteblock pitching or any other suitable protection measures depending on the height of the embankment and susceptibility of the soil to erosion.

Embankment has been designed for ensuring the stability of the roadway. High embankments (height 6m or above) in all soils has been designed from stability consideration as per IRC-75, IRC SP-58 & MOSRTH-Guidelines for Design of High Embankments.

7.12 Pavement Design

Designs for new pavement and overlays have been done in accordance with IRC requirements. The preliminary designs are carried out on the basis of sub grade 4 day soaked CBR. The design of new flexible pavement has been carried out as per IRC: 37-2012 and IRC: SP: 73-2015 as per the design requirements for new pavement sections:

i) Flexible pavement shall be dsigned for a minimum design period of 15 years, subjected to the condition that design traffic shall not be less than 20 msa.

ii) Stage construction shall not be permitted.

Flexible overlays have been always as per IRC: 81-1998 for 10 years of design period. The crust component of the earthen shoulder has been kept matching with the main carriageway crust.

The new flexible pavement structure shall comprise of Bituminous Concrete wearing course on bituminous base course of Dense Bituminous Macadam (DBM). Below the bituminous layers, a Granular base with well-graded aggregates in the form of Wet Mix Macadam (WMM) base has been laid on top of GSB layer. All these layers has been constructed to the requirements of MORT&H specifications.

7.13 Cross Drainage structures

Drainage structures basically comprise of Major bridges, Minor bridges and culverts. The sections of the culverts and bridges have been planned as per sections of IRC SP 73:2015 and IRC SP 48: 1988.

i) All structures shall be designed in accordance with the relevant Codes, Standards and Specifications, Special Publications and Guidelines of the IRC. Construction of all culverts, bridges and grade separated structures shall conform to MORTH Specifications for Road and BridgeWorks.

ii) In two lane Sections the culverts, bridges and grade separated structures shall conform to the requirements of IRC: SP: 73. Two lane bridges and grade separated structures wherever provided shall have independent superstructure for each direction of travel unless specified otherwise in Schedule'B'. Culverts may have single or independent superstructure.

iii) All bridges shall be high level bridges.

iv) In built up sections viaduct spans shall be provided in the approaches of the structure. However, embankment/RE wall/Retaining wall may be provided upto 5 m height. For this purpose the height shall be measured from existing road level.

v) In two lane sections the width of median in the culvert and bridge portion shall, as far as possible, be kept same as that in the approaches. In case width of median is different from that of approach section due to site constraints, transition of 1 in 30 shall be provided near approaches for guiding vehicular traffic with adequate road safety signage, well before the start of median transition.

vi) The median in the portion of structures where relevant shall be treated as below:

a) A suitably designed catch pit shall be provided to collect and carry discharge from median drain.

b) The median shall be open to sky. The safety barrier on the median side shall be provided at a clear distance of 0.5 m from the edge of carriageway.

vii) Suitable provision shall be made for retaining the earth in the median portion either by extending the abutment wall or constructing a new retaining wall. The abutment wall shall have provision for taking the discharge from the median. Care shall also be taken to merge the wing wall/return wall and flooring of the old bridge with those of the new bridge.

viii) Any utility service to be carried by the structures shall be specified in Schedule 'B' of the Concession Agreement.

7.14 Intersections

The existing intersections, which are deficient with respect to the minimum requirements shall be improved to the prescribed standards. Additional land, if any, required for improving the existing intersections shall be provided by the Authority. The types and locations of new Intersections, and grade-separated Intersections shall be based on requirements stipulated in IRC: SP: 41, IRC: 5, IRC: 92 and MORTH Specifications for Road and Bridge works.

7.15 Drainage system

For efficient drainage system for the entire Project Highway including structures, directions contained in Clause 309 of MORTH Specifications, IRC: SP: 42, IRC: SP: 50 and IRC: SP: 90 as relevant shall be followed.

Table 62: SLOPE FOR CAMBER

Element	Recommended slope
Lanes and shoulders with Bituminous Concrete Surfacing	2.5%
Lanes and shoulders with Cement Concrete Surfacing	2%
Cross slope in Granular shoulders	3%

7.16 Road and Traffic Signs

7.16.1 Signage Plans

Proper signing and striping (delineation) are very critical for the safety and guidance of a driver. Signage plans showing the guide signs, and regulating signs at all appropriate locations have been developed. Guide signs showing the locations of and distance to all major crossings, towns and villages have been installed at the appropriate locations. Regulatory signs, including the speed limit sign, toll signs and signs for traffic have been installed at appropriate locations. The signs have been reflector type so that they can be seen easily in the dark. Also, the guide signs at

major junctions have been illuminated type and have been mounted on poles so that they can be easily seen. The lettering size used for designing the signs and location of signpost has been based on the proposed design speed and clear visibility. The material specified for manufacturing signs has been based on international standards. Use of reflectors has been made, so that the lanes are clearly visible at nighttime. Different reflectors have been used for the medians striping and the lane striping so that the opposite traffic can be properly guided.

7.16.2 Road Signs

All road signs are proposed to be provided conforming to standards of "Code of Practice for Road Signs" (IRC: 67-2012) and "New Traffic Signs" (IRC: SP: 31-1992) Latest type of reflective and fluorescent sign boards, in appropriate sizes, have been installed. The signs are broadly categorized as below:

(i) Mandatory/Regulatory Signs: These signs are mostly for giving instructions and are mostly circular generally red and blue colors and sign shown in black or white.

(ii) Cautionary/Warning Signs: They are mostly triangular with red border and black sign.

(iii) Informatory Signs: These are mostly rectangular with blue or green background and sign in white. Advance direction sign can be mounted on steel, brass portal frame fixed across the carriageway at a height of 5.5 m above the pavement grade at the center of roadway and visible from a distance for the vehicles approaching.

7.16.3 Florescent Signs

It is proposed to use "Florescent traffic signs" for better working conditions and safety especially at night.

7.17 Utilities

Appropriate provisions are considered for various utilities e.g. Water line, gas pipes, telephone cables, Sewerage line, electric conduits etc. along or across the Highway to prevent the road being cut or dug at later stages, similar provision has been made along the cross-drainage works, bridges and underpasses.

7.18 Design standards for structures

The detailed inventory and condition survey of the existing structure has been conducted. Based on detailed survey the proposal for structural arrangement has been finalised. The methodology and standards to be adopted are illustrated below.

7.18.1 Materials

Concrete Grade:

Grade of concrete in various elements shall be kept as follows for moderate conditions of exposure

Reinforcement:

Only Thermo Mechanically Treated (TMT) Fe-500 bars conforming to IS: 1786-2008 shall be used as reinforcing steel.

Exposure condition:

Moderate exposure conditions will be considered while designing various components of all the structures.

Structural steel:

All structural steel, castings and forgings, fasteners (bolts, nuts, washers and rivets), welding consumables and wire ropes and cables shall conform to the provisions of IRC: 112 – 2011.

Bearings:

Elastomeric bearings has been proposed for simply supported superstructures. These bearings shall be designed and supplied by the approved manufacturers. The loads and forces on the bearings has been calculated to enable the manufacturer to design these bearings and these shall conform to Cl. 2005 of MORTH's Specifications for Road & Bridge Works (5th Revision).

Expansion joints:

The following types of expansion joints shall be adopted:
Compression expansion joints have been proposed for superstructures having movements up to 40 mm. The compression seal type expansion joints shall conform to Cl. 2609 of MORTH's Specifications for Road and Bridge works (5th Revision).

Miscellaneous

- Cement concrete wearing course has been proposed over the deck slab. ·
- Drainage spouts with gratings at the top has been provided on the bridges to ensure proper drainage of surface water. ·
- An approach slab, 3.5m long and 300mm thick, resting on the bracket taken out from the dirt wall has been provided on both sides of the bridge resting on the 150mm thick levelling course. The gap between the approach slab and dirt wall has been filled with bituminous joint filler sealing compound. ·

- Weep holes has been provided behind abutment and wing wall to avoid building up of hydrostatic pressure behind them. Weep holes has been provided 150mm, above the low water level or bed level whichever is higher.

7.19 IRC Codes

The scope of our work is limited to Preliminary Designs only. The GAD of structures based on preliminary designs has been prepared. Following IRC/IS codes used for preliminary designs.

Table 63: DESIGN STANDARDS TO BE FOLLOWED

IRC:5-2015	**Standard Specification & Code of practice for Road Bridges. Section – I General Features of Design (Seventh Revision)**
IRC: 6-2014	Standard Specification & Code of practice for Road Bridges. Section – II Loads & Stresses (Fourth Revision
IRC: 18-2000	Design Criteria for Prestressed Concrete Road Bridges (Post- Tensioned Concrete) (Third Revision)
IRC: 21-2000	Standard Specification & Code of practice for Road Bridges. Section – III Cement Concrete Plain & Reinforced (Second Revision)
IRC: 22-2015	Standard Specification & Code of practice for Road Bridges. Section – VI Composite Construction (First Revision)
IRC: 24-2010	Standard Specification & Code of practice for Road Bridges. Section – V Steel Road Bridges (Second Revision)
IRC: 45-1972	Recommendations for Estimating the Resistance of soil below the maximum Scour Level in the Design of Well Foundations of Bridges.
IRC:73-1980	Geometric Design standards for Rural (Non-Urban) Highways.
IRC:78-2014	Standard Specification & Code of practice for Road Bridges. Section – VII Foundation & Substructure (First Revision)
IRC: 83-1999	Standard Specification & Code of practice for Road Bridges. Section – IX Bearings, Part-I Metallic Bearings (First Revision)
IRC: 83-1987	Standard Specification & Code of practice for Road Bridges. Section – IX Bearings, Part-II Elastomeric Bearings
IRC: 83-2002	Standard Specification & Code of practice for Road Bridges. Section – IX Bearings, Part-III POT, POT-CUM-PTTE, PIN & Metallic guide bearings.
IRC: 89-2010	Guidelines for Design & Construction of River training & control works for road bridges.
IRC: SP:13-2004	Guidelines for the Design of small Bridges and Culverts
IRC: SP:33-1989	Guidelines on supplemental Measures for Design, Detailing & Durability of Important Bridge Structures.

IRC: SP:35-1990	Guidelines for inspection and maintenance of Bridges
IRC: SP:37-2012	Guidelines for evaluation of load carrying capacity of Bridges.
IRC: SP:40-1993	Guidelines on Techniques for strengthening and rehabilitation of Bridges.

For items not covered in the above specifications, provisions of IS codes, Sound Engineering practice, Technical Literatures/Papers & provision of relevant codes of other nations have been considered.

7.20 Project Highway Drawings

7.20.1 Horizontal and Vertical Alignment Drawings

The existing horizontal and vertical profiles of the Project Highway have been shown with proposed design alignment drawings. These drawings are included in Volume II. The geometric standards of the existing road are not confirming with relevant IRC standards and provisions of "Manual of Standards" for 2- lane Highways. The radius of circular curves and the lengths of transition curves have been improved. To obtain optimum and accurate designs, the designs has been developed by using Advance Software like MX-ROAD.

7.20.2 Typical Cross Sections

Depending upon the requirements of improvement in different stretches of the Project Highway the Typical cross sections applicable to particular stretch of the road. The cross sections at every 500m for each homogeneous section and cross sections at start, middle, end for each curve are provided.

7.20.3 General Arrangement Drawings for Structures

The General Arrangement Drawings of the proposed structures to be constructed.

7.20.4 Miscellaneous Drawings

The Miscellaneous Drawings for typical details of road signs, road markings, kilometre stone and hectometre stone, standard junction, bus bay layout, toll booth, Toll Plaza layout, W-Beam crash barrier and Overhead Sign board details, as proposed are included.


COST
ANALYSIS

COST ANALYSIS

8.1 General

The project road starts from Yaingangpokpi on NH 202 at 0/000 km and ends at Finch Corner at 30/970 km in the state of Manipur. The project road is proposed with 2 lane carriageway with earthen shoulder throughout the project corridor.

The proposal has been made to rehabilitate the existing bridges and culverts. The proposals also includes the junction improvement, proposal of toll plazas, longitudinal drains, road furniture, and bus shelters.

8.2 Quantification

The quantification of most of the items which are uniformly occurring are based on the TCS & pavement design for different homogeneous section and are calculated as per Km basis. The quantification of structures is based only on Square meters of widening, re/new construction for each structure and lump sum provision for rehabilitation on square meter basis.

The construction items covered in cost estimates are: site clearance, earthwork in case of widening and raised pavement, Pavement in carriageways and shoulders, bridges and culverts, and miscellaneous items such as side drains, road furniture, intersections, bus shelters, Toll Plazas, and utility relocations etc.

8.3 Unit Rates

The rate analysis for the Construction Items has been done based on standard data book published by MORT&H and the basic rates are taken from Common Standard Schedule of Rates 2016, Govt of Manipur. For items whose rates are not available in the SOR, market rates shall be adapted for its costing.

8.4 Project Costing

8.4.1 Road

The pavement quantities like GSB, WMM & Bituminous items etc. have been worked out based on Typical Cross Sections, pavement design done based on traffic and with subgrade as CBR 5.4%.

Reconstruction in BT stretches considered from existing GSB layer top in poor carriageway stretches and considered from subgrade wherever vertical profile is to be improved.

8.4.2 Bridges and Culverts

The cost of new/Widening of structures has been calculated on detail with volume calculation of each component of structure.

The improvement options have been already discussed in Chapter 6.

8.4.3 Maintenance During Construction Period

Provision has also been made for maintenance of existing road items such as pot hole and Renewal Coat for road maintenance are considered under this bill. It is also assumed that out of the whole existing road approximately 3% length of the road has potholes depending on the road condition and 25 % length of the road for renewal coat.

8.4.4 Land and Structure Acquisition

Provisional land acquisition requirement is assessed based on the typical cross section types to be adopted with additional area for the locations of junctions. No acquisation or minimal acquisation is required to develop the project road.

8.4.5 Miscellaneous Items

The cost for providing major and minor junctions, overhead signs, bus bays, bus shelter, Toilets, Retaining Wall, Breast Wall, Stone Pitching, Crash Barrier, Toe wall etc. have been worked out and included in the total cost estimate.

8.5 Construction Cost

The construction cost of the proposed alignment i.e., Pavement with Flexible Configuration and Pavement has been evaluated and are as provided below.

Table 64: Abstract of Estimated Cost

SL. NO	TYPE OF WORK	AMOUNT
1	**Road Work**	
i)	Road Proper	₹ 2,49,48,28,333.21
ii)	Curves (Extra Widening)	₹ 4,57,24,814.53
2	**C.D Works**	
i)	PCC Slab Culvert	₹ 29,23,21,594.00
ii)	RCC Slab Culvert	₹ 18,52,448.00
iii)	Minor Bridge	₹ 7,16,65,576.00
3	**Miscellaneous Item**	
i)	Drain	₹ 1,23,33,118.58

SL. NO	TYPE OF WORK		AMOUNT
ii)	Lined Drain	₹	4,89,34,710.94
iii)	Breast Wall	₹	11,07,61,998.19
iv)	W Metal Beam Crash barrier	₹	2,53,87,836.15
v)	Retaining Wall	₹	19,86,19,420.00
vi)	Junctions	₹	9,47,786.95
vi)	Signs & Safety	₹	1,67,90,554.78
vii)	Overhead Signage	₹	7,72,664.49
ix)	Bus Bay	₹	41,10,995.00
x)	Seeding and Mulching	₹	3,31,09,880.00
xi)	Soil Nailing	₹	47,42,080.00
xii)	Gabion Structure	₹	5,15,25,278.00
4	**Toilet Block (4nos @ 15 lakhs)-L.S**	₹	60,00,000.00
5	**Street Lighting (Built-up Section @ Rs 9000- 240 nos)-L.S**	₹	21,60,000.00
	Civil Cost	**₹**	**3,42,25,89,089.00**
	Add GST @12%	₹	41,07,10,691.00
	Total Civil Cost (A+A')	**₹**	**3,83,32,99,780.00**
	Add Contingency @ 2.8% on "A"	₹	9,58,32,494.00
	Total Cost with contingency (EPC Cost = B+B')	**₹**	**3,92,91,32,274.00**
a)	Supervision Charges @ 3% of (A)	₹	10,26,77,673.00
b)	Agency Charges @ 3% of (A)	₹	10,26,77,673.00
c)	Maintenance Charges @ 5% of (A) for 5 years	₹	8,55,64,727.00
d)	Escalation Charges @ 15 % of (A) for 3 years	₹	17,11,29,454.45
	Sum(C+D+E+F+G)	**₹**	**4,39,11,81,802.00**
	Tentative Cost for Preconstruction Activities (LA, Forest Clearance, EIA/EMP cost, Utility Shifting)	**₹**	**52,00,00,000.00**
	SAY	**₹**	**491.12**
			CRORES


ECONOMIC
ANALYSIS

ECONOMIC ANALYSIS

9.1 INTRODUCTION

Economic Analysis of an infrastructure project is undertaken to ascertain the importance and benefits of the project to the society at large. The proposed road project has been designed to derive benefits such as meeting the demands of a certain level of traffic, reduction in vehicle operating costs, etc. The project would, in turn, have a negative impact as well, such as construction cost of the project, environmental and social costs, etc. Economic analysis brings the two together on a common platform to afford due comparison. The costs and benefits are weighed to assess the returns on the investment made. The analysis is undertaken from the perspective of the society, i.e. the benefits are the ones which accrue to the people at large in the form of savings in Vehicle Operating Costs (VOC), savings in travel time, etc. Similarly, costs comprise those that are borne by the society.

9.2EVALUATION FRAMEWORK

Generally the framework adopted for the economic analysis is cost-benefit analysis, which sets a monetary value where possible on all financial, economic and social costs and benefits over the lifetime of the project. The underlying principles for this analysis are as follows:

- ✓ The lifetime of a road project for the present analysis is considered as the period for which reliable traffic forecasts can be made. A discount rate is then applied to future economic costs and benefits to arrive at the Net Present Value (NPV) of the project. The Economic Internal Rate of Return (EIRR) of the project is also computed.
- ✓ To analyse the cash flow at constant prices, an allowance is made for relative price inflation
- ✓ The discount rate is expressed in real terms

The concept of economic feasibility is to maximize the returns on investments. This is accomplished by determining the appropriate improvement proposal that leads to minimum total transport cost, which comprises of two basic components shown below.

Road Agency costs:

- Construction
- Maintenance

Road User costs:

- Vehicle Operating Costs
- Other user costs (like travel time costs)
- Accidents

9.3 BASIC PARAMETERS FOR ECONOMIC ANALYSIS

The following basic parameters and assumptions have been considered for the purpose of the present economic analysis:

- Time frame for Construction: 24 months (1st April 2018 to end of 31st March 2020);
- Analysis Period: 15 years (2018 to 2033), i.e. 15 years
- Interest Rate: 11.75 % per annum;
- Costs Considered: Social, Environmental, Utility Relocation Costs, Initial Construction and Maintenance Costs;
- Phasing of Total Costs: 40% and 60% of the total construction costs in the year 2018-19 and 2019-20 respectively; and
- Maintenance Costs: routine maintenance costs every year and periodic maintenance cost as per the triggered overlays.

9.4 APPROACH

The approach to the economic analysis comprises assessment of project benefits for 'Without' and 'With'-Project scenarios. As mentioned earlier, the major benefits would be in the form of VOC and travel time savings due to improved road conditions that would result in improved riding quality and higher travel speeds. The capital costs for the improvement of the project road and the annual costs for routine and periodic maintenance have also been evaluated. Based on the above, the following indicators have been estimated to determine economic viability of the proposed project:

- Equity Internal Rate of Return (EIRR);
- Net Present Value (NPV); and
- Net Present Value to Cost ratio (NPV/C).

The economic analysis for the projects shall be carried with a minimum of 12 % rate of interest using the standard packages. The project with more than 12% of ERR shall be taken as the criteria for the investment purposes.

9.5 RESULTS OF ECONOMIC ANALYSIS

Economic analysis was carried out by giving all relevant inputs like value of time, fuel costs, tire costs, vehicle costs, maintenance of parts, depreciation, crew time, interest, over heads, project cost, traffic data etc. The result of the economic analysis indicate that the EIRR for the project is less than 12%.

But the evaluation has been made considering the present traffic of the road. The traffic will increase manifold after the development of the road as this stretch is an important

connecting link to the areas and an important link connecting Imphal and Nagaland. The traffic using the present state highway shall be diverted to this alignment. The road stretch from Yaingangpokpi to Nagaland Border is a premier connectivity for the tourist attraction i.e., Shiroi Peak.

Hence the project shall be viable at a later date.


FINANCIAL
ANALYSIS

FINANCIAL ANALYSIS

10.1 General

The main objective of financial analysis is to assess the likely returns to the investors under realistic conditions/assumptions. In the present studies the financial viability of the project is assessed, assuming minimum Equity IRR to be >=15%, on the basis of project's financial internal rate of return on investments, which is estimated on the basis of cash flow analysis. The analysis attempts to ascertain the extent to which the investment can be recovered through toll revenue and the gap, if any, be provided through grant. This covers aspects like financing through debt and equity, loan repayment, debt servicing, taxation, depreciation, etc. The viability of the project is evaluated on the basis of Equity IRR. The Equity IRR is estimated on the basis of cash flow analysis, where both costs and revenues have been indexed to take account of inflation.

As per the Terms of Reference (ToR), this report has been prepared documenting the financial evaluation for up gradation and strengthening to 2 lane of highway corridor with earthen shoulder between Ukhrul -Jessami sections in the state of Manipur.

This report provides a financial analysis of the Project based on the key business assumptions based on circulars issued by NHAI and MoRT&H from time to time, civil construction cost & traffic numbers as finalized in consultation with client.

Further, it should be noted that in case of any change in the assumptions / project parameters used for developing the financial analysis, the projected financial parameters are likely to undergo a change that might significantly impact the potential (adversely / favourably) of developing the Project on BOT basis.

Table 65: FEATURES OF EXISTING ROAD

Project Feature	
Length	**153.000 kms**
Total Civil Cost (2016-17)	**Rs 900.0 Crores**
Total Civil Cost as in 1st April 2018, (Escalated by 5%)	**Rs 944.87 Crores**
Base Total Average Traffic in (2020-21) – AADT (First year of Operation) in PCU	**5965**
Base Total Average Traffic in (2048-49) – AADT (Last year of Operation) in PCU	**23405**
Construction Period	**730 days**
Concession Period	**30 years**

10.2 Project Background

NHIDCL is engaged in the development of National Highways and as part of this endeavour, the Authority has decided to undertake development and operation/ maintenance of the Project Road of Yaingangpokpi-Nagaland Border sections in the state of Manipur on Design Build Finance Operate Transfer (DBFOT) Toll Basis.

The Project road has been kept as two tolling homogeneous section.

The physical packaging of the Project is presented in the Table below.

Table 66: PHYSICAL PACKAGING OF THE PROJECT

Project/ Program Ref. No.	National Highway	Stretch	Length (Km)	Total Civil Cost (2017-18) Rs Crores	Total Project Cost (Rs Crores) @ 40% Grant	Total Project Cost (Rs Crores) @ No Grant
	202	0/000-153/000	153	900.02	1054.95	1036.56

The key assumptions used in this analysis have been provided by NHAI through its various circulars issued from time to time. Accordingly, this financial viability report is based on the civil construction cost and other details as provided by NHAI. No independent verification for the same has been carried out.

It has been decided that from COD, user fee for two lane highway would be charged on the following Toll Plazas.

Table 67: DETAILS OF TOLL PLAZA

Toll Plaza	Toll Plaza I
Location	87/300 km
Lane	2-lane
Length of highway stretch in km catering to the relevant toll plaza	153.000

A list of the key assumptions taken for the financial analysis of the Project is included in the chapter. Subsequent sections of this chapter present the detailed financial analysis of the Project.

10.3 Traffic Count

The classified Traffic volume count is carried out at km 0/500 km. Table below presents the traffic count at proposed toll plaza location.

Table 68: TRAFFIC TOLLABLE

	Type of Vehicles	Location 1 (0/150 km)		Location 1 (0/150 km)	
		Nos	%	Nos	%
Toll-able vehicles	**Car/Taxies**	4049	75.386	21	31.34
	Jeep/Van	315	5.8648	10	14.93
	LCV Passenger	76	1.415	0	0
	LCV Freight	19	0.3538	1	1.49
	Mini Bus	2	0.0372	0	0
	Bus	30	0.5586	0	0
	Two Axle	76	1.415	20	29.85
	Three Axle	5	0.0931	1	1.49
	Semi Articulated	0	0	0	0
	Articulated	2	0.0372	0	0
	ADT TOLLED	4574	82.58	53	79.1
Non toll-able vehicles	**Two Wheeler**	741	13.796	13	19.4
	Three Wheeler	12	0.22	0	0
	Cycle	31	0.57	0	0
	Rickshaw	1	0.018	0	0
	Animal Cart	0	0	0	0
	Hand Cart	10	0.1862	0	0
	Others	2	0.0372	1	1.49
	ADT NON TOLLED	797	17.42	14	20.9
	ADT Total	5371		67	

The traffic (AADT) at proposed toll plaza location is projected to analyses the concession period based on the traffic capacity parameters. Maximum capacity for two lane with earthen shoulder is considered as 25,000 PCUs. The details of PCU and projected PCU has been provided in the chapter 6.

Hence maximum concession period of 30 years can be considered for proposing 4 lane divided carriageway with earthen shoulders.

10.4 Concession Period

As desired by NHAI, the Design Capacity of the proposed Project Highway has been considered to be 25,000 PCUs for 2-Lane Section. Concession period for this Project Highway is understood to start from 1st April, 2018 (in FY 2018-19). For the purpose of numbering, FY 2018-19 has been numbered as Year 1.

The base traffic at the various Toll Plazas and the year in which each Toll Plaza crosses the capacity of 25,000 PCUs are provided below:

Table 69: TARRIF OF TOLL PLAZA

Toll Plaza	Base Traffic (Year 2020-21), (Total PCUs)	Year in which the traffic exceeds the design capacity
Toll Plaza I covering two lane section	5965	Not Applicable since road doesn't achieve full capacity even after maximum allowable 30 years as Concession Period. Last year of Operation i.e. **2048-49**, PCU is 23405

Construction period of 24 months/ 730 days has been assumed for this financial feasibility analysis.

10.5 Key Business Assumptions

The key business assumptions used in this financial analysis have been discussed

Table 70: KEY BUSINESS ASSUMPTIONS 2 LANING OF REFERRED PROJECT HIGHWAY

(The figures for two Laning has been assumed as 60% of two lane standards)

Particulars	Assumption	Underlying reasoning
Appointed Date	1st April 2018	Assumption.
Construction Period	730 days from Appointed date	As per DPR.
Capex Phasing for Construction over a 24 Month Period	40%, 60% in the first and second year of construction respectively	As per DPR
Commercial Operations Date (COD)	1st April 2020	Based on the assumed Construction Period.
Concession Period	30 Years	As determined by Design Capacity
Weighted Price Index (WPI)	5.0% p.a.	As per the base documents provided by NHAI (circular no. NHAI/11033/CGM (Finn)/2011 dated 29th April, 2011 provided to us by NHAI).
Key Financing & Tax rate Assumptions		
Debt Equity Ratio	70:30	As per the base documents provided by NHAI (circular no. NHAI/11033/CGM (Finn)/2011 dated 29th April, 2011 provided to us by NHAI).
Term of Debt Drawn	Over 24 months	Based on the assumed Construction Period.
Moratorium & Principal Repayment	Total tenor - 52 quarters (13 years including moratorium period) Moratorium - 10 quarters (including the entire construction Period of 8 quarters)	As per the base documents provided by NHAI (circular no. NHAI/11033/CGM (Finn)/2011 dated 29th April, 2011 provided to us by NHAI).
Tax Depreciation	WDV method Depreciation – 100% of asset	Under the WDV method we have assumed depreciation on 100% of the asset value at a rate of 10% per year.

Particulars	Assumption	Underlying reasoning
Construction & Operation Period		
Interest Rate	11.75% pa	As per the base documents provided by NHAI (circular no. NHAI/11033/CGM (Finn)/2011 dated 29th April, 2011 provided to us by NHAI).
Cost Escalation during construction Periods	5.0% p.a	As per the base documents provided by NHAI (circular no. NHAI/11033/CGM (Finn)/2011 dated 29th April, 2011 provided to us by NHAI).
Pre-Operative expenses during construction Period	1.00% of the sum of civil construction cost and contingencies	As per the base documents provided by NHAI (circular no. NHAI/11033/CGM (Finn)/2011 dated 29th April, 2011 provided to us by NHAI).
Contingency Costs	1%	As per the base documents issued by MORTH provided by NHAI (circular no.RW/NH37011-02/2010/PPP/Vol.III dated 16th November, 2011).
Concession Fee	Re 1 p.a.	As per the Concession Agreement
Routine Maintenance Costs	0.035 crores/Km/Year (Year FY 2011-12)	As per the base documents issued by MORTH provided by NHAI (circular no.RW/NH37011-02/2010/PPP/Vol.III dated 16th November, 2011). For two lane, for two lane 60% of this has been assumed.
Periodic Maintenance Costs	0.35 crores/Km/every 6 Years (Year FY 2011-12)	As per the base documents issued by MORTH provided by NHAI (circular no.RW/NH37011-02/2010/PPP/Vol.III dated 16th November, 2011). For two lane, for two lane 60% of this has been assumed.
Electricity and Patrolling Expenses	0.0125 crores/Km/Year (Year FY 2010-11)	As per the base documents provided by NHAI (circular no. NHAI/11033/CGM (Finn)/2011 dated 29th April, 2011 provided to us by NHAI). For two lane, for two lane 60% of this has been assumed.
Office Expenditure	2.5 crores/Km/Year (Year FY 2010-11)	As per the base documents provided by NHAI (circular no. NHAI/11033/CGM (Finn)/2011 dated 29th April, 2011 provided to us by NHAI). For two lane, for two lane 60% of this has been assumed.
Insurance	0.15% of Total Project Cost (TPC)	As per the base documents provided by NHAI (circular no. NHAI/11033/CGM (Finn)/2011 dated 29th April, 2011 provided to us by NHAI).
Toll Expense	5 crore per Toll Plaza (Year FY 2010-11) for Two Lane (First and Second Toll Plaza) 8 crore per Toll Plaza (Year FY 2010-11) for two Lane (Third Toll Plaza)	As per the base documents provided by NHAI (circular no. NHAI/11033/CGM (Finn)/2011 dated 6th June, 2012 provided to us by NHAI). For two lane, for two lane 60% of this has been assumed.
Viability Gap Funding (VGF)/Grant Assumptions		

Particulars	Assumption	Underlying reasoning
In case of VGF	100% upfront Equity	As per the base documents provided by NHAI (circular no. NHAI/11033/CGM (Finn)/2011 dated 29th April, 2011 provided to us by NHAI).
In case of no VGF	25% upfront Equity and balance in proportion of Debt	As per the base documents provided by NHAI (circular no. NHAI/11033/CGM (Finn)/2011 dated 29th April, 2011 provided to us by NHAI).
Debt Drawdown	After spending the upfront equity	As per the base documents provided by NHAI (circular no. NHAI/11033/CGM (Finn)/2011 dated 29th April, 2011 provided to us by NHAI).
Traffic Assumptions		
Concession Period	30 Years	Two Lane Capacity 25,000 PCU two-Lane Capacity 60,000 PCUs As per the base documents provided by NHAI (circular no. NHAI/11033/CGM (Finn)/2011 dated 29th April, 2011 provided to us by NHAI).
Traffic Growth rate	9.26%	As per the base documents provided by NHAI (circular no. NHAI/11033/CGM (Finn)/2011 dated 29th April, 2011 provided to us by NHAI).
Start of Toll Collection	From Commercial Operation date (COD)	As per the base documents provided by NHAI (circular no. NHAI/11033/CGM (Finn)/2011 dated 29th April, 2011 provided to us by NHAI).
Traffic Leakages (Traffic that will not use highway)	Cars/Jeep/Van @10%, Other Vehicles @5%	As per the base documents issued by MORTH provided by NHAI (circular no.RW/NH37011-02/2010/PPP/Vol.III dated 16th November, 2011).
Exempted Vehicles	Cars/Jeep/Van @3%, Other Vehicles @0%	As per the base documents issued by MORTH provided by NHAI (circular no.RW/NH37011-02/2010/PPP/Vol.III dated 16th November, 2011).

10.6 Key Project Outputs

10.6.1 Total Project Cost

The civil construction cost of the project of the km 102.6 stretch is ₹ 944.87 crores (2017-18 prices). The Total Project Cost (TPC) of the Project based on the civil construction costs, contingencies, financing costs and IDC without any Grant is about ₹ 1054.95 crores. Summary of the TPC is provided in Table below.

Table 71 : PROJECT COST DETAILS (FIGURES IN CRORES) WITHOUT GRANT

Construction Cost (1st April 2018)	944.87	
Contingency	9.449	1.00%

Independent Consultant and Pre-Operative Expenses	9.543	1.00%
Insurance During Construction	1.417	0.15%
Escalation @ 5%	53.203	5%
Finance Cost	14.769	2.00%
Environmental Cost	0.000	
Interest During Construction	78.092	11.75%
Total Project Cost	1054.95	**18.03%**

@ 40% Grant is as below:

Table 72 : PROJECT COST DETAILS (FIGURES IN CRORES) WITH 40% GRANT

Construction Cost (1st April 2018)	944.87	
Contingency	9.449	1.00%
Independent Consultant and Pre-Operative Expenses	9.543	1.00%
Insurance During Construction	1.417	0.15%
Escalation @ 5%	53.203	5%
Finance Cost	8.707	2.00%
Environmental Cost	0.000	
Interest During Construction	65.770	11.75%
Total Project Cost	1036.56	15.05%

Table 73: IDC CALCULATION

Calculation of IDC				
	Without Grant		**With Grant @ 40%**	
	Year1	**Year2**	**Year1**	**Year2**
Opening Balance	0.00	295.38	0.00	228.04
Additions	73.85	110.77	57.01	108.84
Closing Balance	73.85	406.15	57.01	336.88
Interest	1.08	10.30	0.84	8.30
2nd Quarter				
Opening Balance	73.85	406.15	57.01	336.88
Additions	73.85	110.77	57.01	108.84
Closing Balance	147.69	516.92	114.02	445.72
Interest	3.25	13.56	2.51	11.49
3rd Quarter				
Opening Balance	147.69	516.92	114.02	445.72
Additions	73.85	110.77	57.01	108.84
Closing Balance	221.54	627.69	171.03	554.56
Interest	5.42	16.81	4.19	14.69
4th Quarter				
Opening Balance	221.54	627.69	171.03	554.56
Additions	73.85	110.77	57.01	108.84
Closing Balance	295.38	738.46	228.04	663.40
Interest	7.59	20.07	5.86	17.89

Calculation of IDC				
	Without Grant		With Grant @ 40%	
	Year1	Year2	Year1	Year2
Total Interest	17.35	60.74	13.40	52.37
Total IDC	**78.09**		**65.77**	

We are of the opinion that for the purpose of financial analysis of the project, the TPC without any Grant from Government shall be used as the basis.

10.6.2 Means of Finance

Based on the assumptions presented in previous section, the Project cost is proposed to be financed by a mix of debt - equity in the proportion 70:30, which translates into a debt equity ratio of 2.33 times. In case where Grant has been considered, the balance project cost has been funded in the debt equity ratio of 70:30. The funding component for the project is presented in the table below:

Table 74: MEANS OF FINANCE FOR REFERRED PROJECT HIGHWAY

		Grant	
Sl No	**Items**	**Nil Grant**	**40% Grant**
1	**Debt**	**738.46**	**435.36**
2	**Equity**	**316.48**	**186.58**
3	**Grant**	**0.00**	**414.62**
	Total	**1054.95**	**1036.56**

10.7 Traffic Details-Location of Toll Plazas, Traffic Count & Toll Revenue

10.7.1 Toll Location

From COD: Toll Plaza-I: At km 47/500. At this Toll Plaza, traffic is to be tolled for a length of 113 km. The base toll rates for this toll plaza would be for two lane highway.

10.7.2 Traffic figures at Toll Plazas for the year 2017-18 are as under

Table 75: TRAFFIC FIGURES AT TOLL PLAZA

Category of Vehicles	At Toll Plaza-I – at Km 87/300	
	AADT	**PCU Factor**
Car/Jeep/Van	4049	1.0
Mini Bus	2	1.5
LCV/ Mini Bus	95	1.5
Buses	30	3.0
Trucks (2 axle)	76	3.0
MAV (>3 axle)	2	4.5
Motor Cycle	741	0.5
3 Wheeler	12	1.0

Category of Vehicles	At Toll Plaza-I – at Km 87/300	
	AADT	PCU Factor
Trucks 3 Axle	3	3.0
Tractor without Trailer	2	1.5
Tractor with Trailer	3	4.5
Cycle	31	0.5
Rickshaw	1	2.0
Bullock Cart	0	8.0
Others	2	2
Total	5049	-

10.7.3 Traffic Growth Rate

The Growth Rate of all categories of all vehicles have been taken as 5 % annually.

10.7.4 Toll Rates

The rates of fee for use of a two lane section of National Highway for the base year 2007-08 for different categories of vehicles are as under:

Table 76: TOLL RATES

	For 4 lane carriageway	For Bypass (1.5 times of four lane toll)	For 2 lane carriageway
Type of Vehicle	Base rate of fee per km (in rupees)		
Car, Jeep, Van or Light Motor Vehicle	0.65	0.98	0.39
Light Commercial Vehicle, Light Goods Vehicle or Mini Bus	1.05	1.58	0.63
Bus or Truck	2.20	3.30	1.32
3 Excel	2.40	3.60	1.44
Heavy Construction Machinery or Earth Moving Equipment or Multi-Axle Vehicle (three to six axles)	3.45	5.18	2.07
Oversized Vehicles (seven or more axles)	4.20	6.30	2.52

The toll rates presented above have been revised annually as per guidelines under the New Toll Policy 2008 as amended by the gazette notification dated 3rd December 2010 and 12th January 2011 and notifications issued thereafter.

10.8 Toll Revenue

The toll revenue for first five year (in ₹. crores) of operation is as below:

Table 77: TOLL REVENUE

Revenue Through + Daily + Monthly	CP	CP	8.85	9.76	10.76	11.86	13.08
Toll Plaza 1							
Total Revenue (in ₹ crores)	0	0	8.85	9.76	10.76	11.86	13.08

10.9 Operational Expenditure

The operational expenditure for first five year (in ₹ crores) of operation is as below:

Table 78: OPERATIONAL EXPENDITURE FOR FIRST FIVE YEAR

Operating Expenses (2 Lane)	CP	CP					
Management expenses	0	0	3.65	3.84	4.03	4.23	4.44
Routine Maintenance	0	0	3.54	3.71	3.90	4.09	4.30
Toll Expenses	0	0	1.42	1.49	1.56	1.64	1.72
Major Maintenance	0	0	0.00	0.00	0.00	0.00	0.00
Total Outflows	0	0	8.61	9.04	10.78	11.32	11.88

10.10 Financial Analysis

A Concession Period of 30 years has been assumed for analysing the financial feasibility of this project. Based on the civil construction cost, operational cost and other assumptions mentioned in the earlier part of this report and the analysis carried out thereafter, it has been observed that theEquity IRR and Project IRR can't be calculated due to extremely low traffic and higher capital and operational expenses.

The operational expense for first year is ₹. 8.61 Crore and revenue is only ₹. 8.85 crores. Most of the traffic is non-toll-able and revenue generated from the project is not sufficient to make the project viable.

At maximum possible allowable Grant of 40%, Equity IRR and Project IRR can't be calculated. Minimum 15% Equity IRR is required for viable project as per NHAI guidelines. Under this situation/ circumstance the project can be only be considered either on Annuity or Hybrid Annuity Model.

10.11 Cash Flow Statement

Table 79: CASH FLOW

Equity IRR	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28
Promoters Equity	**80.73**	**121.10**	**0.00**							
Inflows to Equity holders										
PAT	0.00	0.00	0.16	(79.19)	(75.43)	(69.33)	(63.14)	(56.86)	(97.85)	(43.93)
Depreciation	0.00	0.00	0.00	24.92	24.92	24.92	24.92	24.92	24.92	24.92
Total Inflows	0.00	0.00	0.16	(54.27)	(50.52)	(44.42)	(38.23)	(31.94)	(72.94)	(19.01)
Outflows from Equity holders										
Debt Repayment	23.55	0.00	0.00	23.55	47.09	47.09	47.09	47.09	47.09	47.09
Total Outflows	**23.55**	**0.00**	**0.00**	**23.55**	**47.09**	**47.09**	**47.09**	**47.09**	**47.09**	**47.09**

FCFE	(104.28)	(121.10)	0.16	(77.82)	(97.61)	(91.51)	(85.32)	(79.03)	(120.03)	(66.10)
Equity IRR	NA									
Project IRR	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28
Outflows										
Capital Expenditure less IDC	258.04	364.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Outflows	258.04	364.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Inflows										
PBDIT	0.00	0.00	0.24	0.72	(0.02)	0.54	1.20	1.96	(44.58)	3.82
Net Pre-Tax Cash Outflows	(258.04)	(364.93)	0.24	0.72	(0.02)	0.54	1.20	1.96	(44.58)	3.82
Taxes										
Net Post-Tax Cash Outflows	(258.04)	(364.93)	0.16	0.72	(0.02)	0.54	1.20	1.96	(44.58)	3.82
IRR Project (Post-tax)	NA									

10.12 Profit Loss Statement

Table 80: PROFIT LOSS

P&L Statement	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28
	100.00%									
Inflows					10.26%	10.28%	10.29%	10.31%	10.33%	10.35%
Revenue from Toll Traffic	0.00	0.00	8.85	9.76	10.76	11.86	13.08	14.43	15.92	17.57
Outflows										
Operating Expenses										
Total Outflows	0.00	0.00	8.61	9.04	10.78	11.32	11.88	12.48	60.50	13.76
Earnings before interest, taxes, depreciation and amortization (EBITDA)	0.00	0.00	0.24	0.72	(0.02)	0.54	1.20	1.96	(44.58)	3.82
Depreciation	0.00	0.00	0.00	24.92	24.92	24.92	24.92	24.92	24.92	24.92
Profit before	0.00	0.00	0.24	(24.20)	(24.94)	(24.37)	(23.72)	(22.96)	(69.49)	(21.10)

Interest and Tax (PBIT)										
Non-Operating Income										
Non-Operating Expenses										
Interest on Term-Loans	0.00	0.00	0.00	54.99	50.49	44.96	39.43	33.89	28.36	22.83
Total Non-operating Expenses	0.00	0.00	0.00	54.99	50.49	44.96	39.43	33.89	28.36	22.83
Profit before Tax (PBT)	0.00	0.00	0.24	(79.19)	(75.43)	(69.33)	(63.14)	(56.86)	(97.85)	(43.93)
Income Tax/Corporate Tax	0.00	0.00	2.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Profit After Tax (PAT)	0.00	0.00	0.16	(79.19)	(75.43)	(69.33)	(63.14)	(56.86)	(97.85)	(43.93)

10.13 CONCLUSION

Based on the project structure and toll analysis it is seen that the project cannot be taken up in the DBFOT model. The 3 reasons for non-viability of the project are:

The road does not achieve 18000 PCU which is required for two laning with earthen shoulder (LOS B) within 150 years with 5% growth in traffic.

The percentage of vehicles which are toll able are very less which will make the project even more non-viable

The operational expenditure cannot be met through the tolls collected.

Hence the project may be considered under EPC mode of execution with some other funding options.

ENVIRONMENTAL IMPACT ASSESSMENT & ENVIRONMENTAL MANAGEMENT PLAN

ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL MANAGEMENT PLAN

10.1 Preliminary Environmental Assessment

- ✓ Ministry of Road Transport and Highways has taken up development of the existing National Highways in the state of Manipur. The National Highways and Infrastructure Development Corporation a fully owned company of MORT&H has been entrusted with implementation of this vital infrastructure development project.
- ✓ The consultancy services for preparation of detailed project report of the road has been assigned to M/s SM Consultants with an aim to establish the technical, economical and financial viability of the project and carryout the rehabilitation and upgrading of the existing road to 2 Lane with earthen shoulder carriageway configuration.
- ✓ The existing road is moderately trafficked during the day time with about 5378 vehicles a day.

10.2 Boundaries for Environmental Assessment

The total length of the existing road under consideration is 30.970 km, which starts from Yaingangpokpi and traverses through towns of Gwaltabi, ShangkaiKuki, Litan, Yaolen, Lambui, and ends at Finch Corner. The project road passes through the district of Ukhrul, Kamjong and Imphal East of Manipur State. The area of direct influence will be confined in a linear fashion along the corridor where the construction activities take place. The road is proposed to be widened into two- lane with earthen shoulder for which ROW supposedly, is available. Therefore, the area of direct influence of 10 meters on either side has been considered.

However, for various other environmental Components, which are likely to have a broader area of influence, a distance of 10 Km on either side of the road (as per the MOEF Notification of Environmental Impact assessment, Government of India, 2006) has been used to define the indirect area of Influence. Thus, the term project influence area referred in this chapter therefore, covers both direct and indirect area of influence.

10.3 Inventory of Environmental Features

10.3.1 Secondary Data

Secondary information on various environmental components such as physiography, soil, geology, drainage, forest, ambient air quality, land-use, demography etc. have been collected from old reports & various published sources to examine the baseline status of the environmental features in the project influence area.

10.3.2 Local Concerns

In addition to the secondary data collected and the inventory information obtained, discussions with the stakeholders including the local people and government officials have been held so as to provide a realistic assessment of any significant/specific socio-environmental concerns due to proposed project. These discussions helped in incorporating the views of the stakeholders.

10.4 Baseline Environmental Assessment

The baseline environmental status of the project influence area is based on the field survey within proposed ROW and within the indirect area of influence, i.e., a radius of 10 km from the centreline of the road by environmental team, as well as data collected from various secondary sources. It will help in assessing the magnitude of potential impacts both beneficial as well as adverse due to the proposed project activities on the environment.

10.4.1 Natural Resource Base

10.4.1.1 Land, its quality and used

The state of Manipur has been divided into two physiographic zones-valley and hills, and Ukhrul is one of the hill districts of Manipur. The climate of the district is subtropical monsoon type. The district has alluvial, lateritic black regur and red ferruginous type of soil. The district is mostly covered by forest and only small percentage of total geographical area is under agricultural use (2.13 percent) and settlement (1.45 percent).

This district falls under the jurisdiction of Manipur East Forest Division. It has about 77.6 percent forest cover of the total geographical area. Forest provides firewood, charcoal, wood and many other forest resources. As per the State of Forest Reports (1999 and 2001), 1210 sq.km areas were under dense forest in 1999, which had decreased to 1111 sq. km in 2001. However open forest area increased from 2346 sq.km in 1999 to 2415 sq.km. in 2001. Likewise, area under scrubs also increased from 1 sq. km in 1999 to 24 sq. km in 2001. Nevertheless, total forest area in the district has gone down in recent years due to excessive practice of shifting cultivation.

Moreover, forest is one of the most important constituents of the resource base of the district. But from 1997-98, revenue generated by forest has gone down. This may be due to Supreme Court's ban on the fell of timber.

Agriculture is the most important source of livelihood for the people of the district. More then 70 per cent of the total population of the district is directly or indirectly depended on agricultural activities. Rice, Maize, Potato, Pulse, Cabbage, Leafy vegetable, chillies, groundnuts etc. are the main agricultural products. Banana, sugarcane, fruits like lemon and orange are also

planted. Plantation of cotton is also done for their domestic consumption. Jhum cultivation is practised in the southern and eastern parts of Ukhrul district. In some cases the shifting cultivation is practiced in small pockets keeping the adjoining area for regeneration. Thus, after 2-3 years they cultivate a fresh piece of land, which was kept under forest for about 8-10 years, which gives better yield.

10.4.1.2 Forestry

The District is gifted with rich flora and fauna. There are varieties of trees, flowering plants, orchids of enumerable hues and kinds, epiphetic ferns, varied species of plants and shrubs. This tropical forest is also the habitat of many valued species of birds and animals. Ukhrul District is best introduced by its beautiful Shirui Lily, grown only on the peak of ShiruiKashung, some 18 Km. east of the district HQ. Ukhrul. The rareness and the uniqueness of this Lily is that, it has seven colours when examined through a microscope. Shirui Lily was declared the State Flower in 1989 on March 21. Native to Tangkhul Hills and grown only on Shirui Peak, it is endemic to the region and considered as the most fabulous wealth of the Tangkhuls.

10.4.2 Geology, Soil

The soil cover can be divided into two broad types, viz. the red ferrogenous soil in the hill area and the alluvium in the valley. The soil generally contains small rock fragments, sand and sandy clay and are of varieties. The top soil on the steep slopes are very thin. In the plain areas, especially flood plains and deltas, the soil is of considerable thickness. Soil on the steep hill slopes is subjected to high erosion resulting into formation of sheets and gullies and barren rock slopes. The normal pH value ranges from 5.4 to 6.8.

10.4.3 Climate

The climate in Ukhrul is warm and temperate. In winter, there is much less rainfall in Ukhrul than in summer. This location is classified as Cwb by Köppen and Geiger. The average temperature in Ukhrul is 15.5 °C. Precipitation here averages 1616 mm. The driest month is December, with 13 mm of rain. With an average of 360 mm, the most precipitation falls in June. July is the warmest month of the year. The temperature in July averages 19.4 °C. January has the lowest average temperature of the year. It is 9.3 °C. There is a difference of 347 mm of precipitation between the driest and wettest months. During the year, the average temperatures vary by 10.1 °C.

10.4.4 Land-Use Pattern

The land-use pattern along the project corridor is mainly agriculture. No industrial belts are found in this stretch. The built-up area mainly composes of residential buildings with small kiosks are situated near to the project stretch.

10.4.5 Water Resources

A number of brine wells occur at Chingai, Challao, Nameri, Luchai-Khullen, Mariem and Kharawam in Ukhrul District. The spring water is locally used in making salt cakes. Ground water is restricted to secondary porosity in joints, fissures, fractures and weathered residuum of consolidated and semi-consolidated rocks and inter-granular pore spaces of alluvial deposits.

10.4.6 Water Quality

The district is totally covered by hills with slopes more than 20%. Since the poor quality ground water is only a localized phenomenon, the block-wise poor quality area has been taken as nil.Water qualities as well as quantity are major concerns in the rural sector of the hill district. Biological contamination of drinking water supply combined with scanty quantity has been a major cause of most of the ill health. Because of the shortage of safe drinking water many people use the available surface water for drinking and domestic purposes from any source. The people illegally break the water pipe and tap inviting another problem of the hazard.

10.4.7 Air Quality

Ambient air quality of the area is moderately polluted as per the discussion with the State Pollution Control Board personnel's owing to the highway passing through hill locks prone to erosion.

10.4.8 Noise Level

Since the traffic volume on the project road is not much and the highway is generally passing through open hills, noise is not a major problem at present. The noise level becomes insignificant near the built-up areas but is in permissible levels.

10.5 Ecological Resources

10.5.1 Trees/Vegetation within corridor of impact

The road alignment passes primarily through rich agricultural fields. Ecological assessment indicates that many trees exist (on both sides of the road) within the R.O.W.

10.5.2 Wildlife

The project highway does not pass through any ecologically sensitive area.

10.6 Assessment of the Impact on the Environment of the Project

10.6.1 Impact on the Topography and the Geology

During the construction it is expected small negative impact on the performance of the preparation works on the location. As there is no land slide zones during the performance of the

excavation, there is no danger of appearance of landslips. The potential of appearance or deepening the erosion processes as a result of the construction and exploitation of the highway can be seen from the analysis of the geo-mechanical characteristics.

10.6.2 Impact on surface water and groundwater

During the preparation of the field for newly aligned roads and establishment of constructional zones around the route of the highway, there can be pollution of the surface waters and groundwater of temporary character in shape of erosion and disposal of sediments and surrounding stream flows. The erosion appears mostly because of the removal of the soil cover. The pollution of the stream flows can occur as a result of leakage of the fuel and oil from the equipment and the vehicles, as well as different waste which is created during these activities.

Typical impacts on the quality of the waters as a consequence of the road drainage are the changed levels of heavy metals, salinity, blurring of the waters and dissolved oxygen. On the other hand, these changes in the water quality, even in regions with high humidity, are often temporary and localized as a consequence of the variations of the water quantity.

10.6.3 Impact on the Air

The emissions in the air during the construction will appear as a result of the exhaust gases from the constructional mechanization. Within these emissions will appear polluters as SOx, NOx, CO, VOC etc. Generally, it is expected less concentrations of these polluters, for which it is expected fast dispersion of the open regions in which the project is performed, and it is also potentially expected jeopardizing small number of people, because of the small number of settlements to which the route is approaching. Dust will appear as a result of the soil works and the activity of the preparation of the field and clearance, excavation, mining in rock etc.

It is expected that the effects from these impacts to be of local and short-term importance. In the operational phase, emissions will appear from vehicles which will run along the highway, i.e. from:

- System of exhale gases;
- The casings of the monitors through the exhaust pipe
- Carburetor, reservoir

On this level of planning it can be assumed that the frequency of the traffic along the highway will be with limited volume. In case of increased frequencies of traffic, (increasing which can mostly by with seasonal character), it is possible to appear necessity of application of appropriate biological measures for protection of air pollution.

10.6.4 Impact on Soil

The activities of construction and setting on the highway directly will damage the soil quality and it will reflect on the change of the specific geological characteristics. The soil works, that will potentially have an impact on the soil characteristics and, accordingly, to the soil quality, are:

- Removal of the surface layer of the soil (humus)
- Smoothening of the surface – Compaction to the necessary density
- Performance of quarries and dumps for removal of the remained excavated soil material

The impact in the construction phase on the soil pollution is assessed as negative with insignificant size and of temporary character. For the operational phase characteristic are impacts connected with the soil quality damage as a result of the emissions of the pollutant from the traffic. Along the route of the highway there is an agricultural land. Certain zone beside the route of the highway will be endangered due to the pollution which will occur because of the traffic.

10.6.5 Impacts Caused by Waste Management

The primary forms of hard waste which will be generated during construction phase will be:

- Excess excavated soil and sand
- Packing waste
- Debris and construction waste
- Waste tires (of constructional mechanisation)
- Waste oils and greases (from construction mechanisation)
- Communal waste of working site camps (construction sites).

For managing excess excavated material, it will be made appropriate disposal sites. Their location is chosen according to the geo-mechanical elaboration and confirmed with this Study, considering that the criteria like avoiding catchment areas of rivers, avoiding areas with sensitive habitats, i.e. valuable areas, are respected. For managing construction waste, it will be done segregation of the inert material and the same will be removed on location determined by the local authorities. In case of creating waste with dangerous character, the same will be given to the licensed company.

It is not expected creating waste during the exploitation due to the fact that resting site or any other construction in the area of the road is not planned.

10.6.6 Impacts Caused by Increased Noise and Vibration

The construction of the highway is connected with a series of activities which cause vibration, like using construction mechanisation and eventual rock mining during performing of the vertical alignment for the parts of the route which lead to excavation. The impacts from the vibration are expected to be insignificant, and to have an impact mainly on a local level. Along the highway it is not expected excessive noise because of the relatively low frequencies of traffic. However, the highway is approaching the some settlements. These locations are potentially endangered due to harmful noise.

10.6.7 Impact on the Area and Visual Effects

The area, in the range of the construction zones, established along the highway will be clearly changed during the construction. Main receptors of the new look of the area in phase of setting the construction will be the local population and the passengers which pass through the local roads. In phase of usage, it is expected the visual effect of the highway to be insignificant.

10.6.8 Impact on Social Elements of Environment

The following positing effects on the population are expected due to this project:

- Possibility for employing qualified and unqualified workers
- Purchase (expropriation) of the land in a private ownership

Taking into consideration in most, the route of the highway passes through many settlements, the construction activities of the same locations of the construction will have direct impacts on the human health. The construction phase will require temporal or permanent expropriation of the farmland and the urbanizing land in private property (residential areas in the suburb of the settlements, weekend houses etc.).

10.7 Measures to Reduce the Negative Impact on the Environment

10.7.1 Measures to reduce the impact on topography and geology

The following measures will be applied to prevent erosion of big volume during remediation of the landfills:

- Careful planning of the construction works with a goal to decrease the negative effects and to provide preventing erosion.
- Decreasing the size of the location, because of the minimizing the land which is under a negative influence, and stopping the erosion and polluting the soil
- Restriction of the movement of the vehicles and usage of mechanisation which put a smaller pressure of the area

- Precise performance of the construction works, avoiding leakage of vehicles. The vehicles should be constantly maintained to prevent leakage.
- Appropriate clearance of the material which is spilled on the spot.
- Minimizing the loss of vegetation along the construction site
- Construction works cannot run in heavy rains,
- Decreasing of the speed and volume of the polluted area drain.
- Implementing preventing measures for landslides, stabilizing the incline if necessary

10.7.2 Measures to Reduce the Impact on Surface Water and Groundwater

The measures for protection of the surface waters and groundwater are reduced to consistent application of good construction practice during the construction works connected with the highway, i.e. preventing erosion, managing sediments, maintaining construction mechanization out of the areas sensitive on releasing the waste waters etc. Protection on surface and ground waters quality, in operational phase will be reached with application of appropriate system of drainage of the washing out waters from the pavement area.

10.7.3 Measures to reduce the impact on Air

For mitigation the impacts on environment in the construction phase, it is suggested performing a strict control on the constructional methods and the used mechanization and other equipment. As an eventual measure during the operational phase it is suggested planting a green belt in the sideways of the road which will prevent wider dispersion on air pollution caused by the traffic along the route of the road.

10.7.4 Measures to Reduce the Impact on the Soil

For reducing the impacts on the soil, there will be taking measures for preventing leakage of polluting materials and oils from constructional mechanization in the surrounding soil, the eroded areas will be rehabilitated and safely stored and the construction materials and construction waste will be removed.

In operational phase, the measures to reduce the impacts are identical with the measures for mitigation of erosion.

10.7.5 Measures to Reduce the Impact Caused by Waste Management

Because of protection of the environment (soil, waters and region), it is predicted application of statutory regulation orders relating to the waste management. Additionally, it is suggested preparation of plans for waste management of the construction locations in order to enable recycling of recyclable materials, and also to separate the dangerous fractions for the purpose of their appropriate collecting, storing and giving to licensed companies which deal with this kind of waste. In order to avoid pollution of the environment with constructional waste and solid

waste during the exploitation of the highway, it will implement a ban for disposal of the same along the route in the road.

10.7.6 Measures to Reduce the Impact Caused by Noise and Vibration

The measures for mitigation of the impacts caused by noise and vibrations in construction phase include: Careful planning on preparation works in order to decrease the noise, avoiding equipment which will emit noise more than 90 dB, control on constructional methods and usage of mechanization and regular maintenance of the equipment because of the possible decrease of the noise, careful planning on time of the works in the settlements (ex: ban on construction in certain period during the day or night, as well as seasonal bans during the mating of certain animal species and/or birds), avoiding loud sound signals in the settlements/decease of the disturbing the peace of the citizens, limiting the speed of the constructional vehicles, especially in the towns etc. The route of the highway approaches many settlements.

10.7.7 Measures to Reduce the Impact on the Area and Visual Effect

The measures for mitigation of the impact on the environment, beside the recommendations for mitigation, reducing the size of the construction site, application of good practises for designing and construction, careful maintenance and appropriate maintenance of the order 25 and cleanness of the construction site, also include fast disposal of the constructional waste of the approved places, filling the holes/quarries made during excavation of sand by the excavated material, repairing the footpaths and roads right after finishing the works with the performance of the highway and re-vegetation of the inclines, careful closing of the construction sites/places for waste disposal/cleaning of the construction site after finishing with the construction works/re-vegetation of the region and completing the construction activities with removal of all obstacles.

10.7.8 Measures to Reduce the Social Impact

Among the measures for reduction of the social impact in the construction phase are the measures for protection of the workers from workplace injuries, measures for compensation of the citizens whose property is expropriated and measures for compensation of the citizens whose property is with reduced value because of the pollution of the surrounding land. In the working phase of the highway, it is expected positive impacts on the population and the human health, especially regarding the improving the communication, the transport of people and goods, so due to that reason, there aren't any measures predicted in this phase.

10.8 Regulatory Clearances

Regulatory Clearances required as per the new alignment

Table 74: LIST OF REGULATORY CLEARANCE REQUIRED

Sl. No	Required Clearances
1	Forest Clearances
2	Utility Clearances
3	Civil designs from Chief Engineer, Central Design Office, I&CAD Department
4	Permission for water extraction from Irrigation & CAD Department

10.9 Policy, Legal And Administrative Framework

The legal framework for addressing the environmental components are governed by National and State legal frame work which are covered under the Environmental (Protection) Act, 1986, and Rules, 1987-2006 (various), The Motor Vehicular Act,1988 and Central Motor Vehicles Rules, State Motor Vehicles Rules, Noise Pollution (Regulation and Control) Rules, 2000. Government of India has prepared various National Policies, Acts, Rules to protect exploitation of natural resources and improve the environment and to safeguard forest and wildlife of the country. Similarly, the legal framework and principles adopted for addressing the resettlement issues in the project have been guided by the existing legislation and policies of the GOI and the Government of Manipur. Prior to the preparation of the compensation Plan, a detailed analysis of the existing National and State policies is very much essential. Brief description of applicable environmental regulations related to the proposed development is given below:

10.9.1 Environment (Protection) Act, 1986

The Environment (Protection) Act is the most comprehensive law on the subject. The law grants power to the Central Government to take all measures necessary to protect and improve the quality of environment and to prevent pollution of the environment. In terms of responsibilities, the Act and the associated Rules requires for obtaining environmental clearances for specific types of new/expansion projects (addressed under Environmental Impact Assessment Notification, 14th September 2006) and for submission of an environmental statement to the State Pollution Control Board annually.

10.9.1.1 Environment (Protection) Rules, 1986

These rules lay down the procedures for setting standards of emission or discharge of environmental pollutants. The rules prescribe the parameters for the Central Government, under which it can issue orders of prohibition and restrictions on the location and operation of industries in different areas. The Rules lay down the procedure for taking samples, serving notice, submitting samples for analysis and laboratory reports. The functions of the laboratories are also described under the Rules along with the qualifications of the concerned analyst.

10.9.1.2 EIA Notification, 2006

As per the Environmental Impact Assessment (EIA) Notification, 14th September 2006 and its amendment up to April 2011, new projects or activities require Prior Environmental Clearance. Projects have been grouped under Category 'A' requiring clearance from Expert Appraisal

Committee (EAC) of MoEF, GoI and Category 'B' requiring clearance from the State Expert Appraisal Committee (SEAC). The concerned Committee (EAC or SEAC) will finalize the ToR on the basis of Form-1, proposed TOR & Pre-Feasibility/ Feasibility Report. Environmental Impact Assessment study is to be carried out as per the ToR provided by the Committee. Public Hearing is required for Category 'A' project. List of projects requiring Prior Environmental Clearance is given in the "SCHEDULE" of EIA Notification.

10.9.2 Forest (Conservation) Act, 1980 and its amendment

This Act provides for the conservation of forests and regulating diversion of forestlands for non-forestry purposes. When projects fall within forestlands, prior clearance is required from relevant authorities under the Forest (Conservation) Act, 1980. State Governments cannot de-reserve any forestland or authorize its use for any non-forest purposes without approval from the Central Government. For diversion of forestland, the project proponent needs to apply to the State Government. Depending on the area required to be diverted, the proposals are cleared by MoEF Regional or Central Offices provided that the cost of compensatory afforestation, cost of rehabilitation of endangered/rare species of flora/fauna, and the net present value of the forest resources are deposited upfront with the state Forest Department.

- If the area of forests to be diverted exceeds 20 Ha (or 10 Ha in hilly area), prior permission of Central Government is required;
- If the area of forest to be diverted is between 5 to 20 Ha, the Regional Office of Chief Conservator of Forests is empowered to approve;
- If the area of forest to be diverted is below or equal to 5 HA, the State Government can give permission; and,
- If the area to be clear-felled has a forest density of more than 40%, permission to undertake any work is needed from the Central Government, irrespective of the area to be cleared.

10.9.3 Wildlife Protection Act, 1972

This Act empowers the Central and State Governments to establish National Parks and Sanctuaries; to formulate rules and designate authorities for the maintenance of National Parks, Sanctuaries and Zoos; to protect and conserve the flora and fauna. Vide Circular No. 11-9/98-FC dated 4-12-1998 issued by the Asst. Inspector General of Forests states that the Ministry of Environment and Forest has taken a decision not to permit development activities inside National Park/Sanctuaries and Tiger reserves areas that are not in consonance of Section 29 of the Wildlife (Protection) Act, 1972.

10.9.4 Biodiversity Act, 2002

The Biological Diversity Act, which came into force in February 2003, aims to promote conservation, sustainable use and equitable sharing of benefits of India's biodiversity resources. It provides for establishment of a National Biodiversity Authority at national level, State Biodiversity Boards at state level and Biodiversity Management Committees at the level of Panchayats and Municipalities. The National Biodiversity Authority shall play a regulatory role with regard to access to biological resources by foreign citizens and grant of intellectual property rights. Itshall play an advisory role in matters relating to the conservation, sustainable use and equitable distribution of biological resources.

10.9.5 The Water (Prevention and Control of Pollution) Act and Rules, 1974-1975

This Act represented India's first attempts to comprehensively deal with environmental issues. The Act prohibits the discharge of pollutants into water bodies beyond a given standard, and lays down penalties for non-compliance. The act was amended in 1988 to conform closely to the provisions of the EPA, 1986. It set up the CPCB (Central Pollution Control Board), which lays down standards for the prevention and control of water pollution. At the state level, the SPCBs (State Pollution Control Board) function under the direction of the CPCB and the state government.

10.9.6 The Air (Prevention and Control of Pollution) Act, Rules and Amendment, 1981, 1982, 1983, 1987

To counter the problems associated with air pollution, ambient air quality standards were established, under the 1981 Act. The Act provides means for the control and abatement of air pollution. The Act seeks to combat air pollution by prohibiting the use of polluting fuels and substances, as well as by regulating appliances that gives rise to air pollution. Under the Act establishing or operating of any industrial plant in the pollution control area requires consent from the state boards. The boards are also expected to test the air in air pollution control areas, inspect pollution control equipment, and manufacturing processes. To empower the Central and State Pollution Boards to meet grave emergencies, the Air (Prevention and Control of Pollution) Amendment Act, 1987, was enacted. National Ambient Air Quality Standards (NAAQS) for major pollutants were notified by the CPCB first time in April 1994 and further notified in 16th November 2009.

10.9.7 Ancient Monuments and Archaeological Sites and Remains Act, 1958

The legal requirement is to obtain from ASI a no-objection certificate if any protected cultural property is within 10km of the project.

10.9.8 The Land Acquisition Act (LA) of 1956

In this Act, unless the context otherwise requires,—

(a) "competent authority" means any person or authority authorised by the Central Government, by notification in the Official Gazette, to perform the functions of the competent authority for such area as may be specified in the notification;

(b) "land" includes benefits to arise out of land and things attached to the earth or permanently fastened to anything attached to the earth.]

Power to acquire land, etc.—

(1) Where the Central Government is satisfied that for a public purpose any land is required for the building, maintenance, management or operation of a national highway or part thereof, it may, by notification in the Official Gazette, declare its intention to acquire such land.

(2) Every notification under sub-section (1) shall give a brief description of the land.

(3) The competent authority shall cause the substance of the notification to be published in two local newspapers, one of which will be in a vernacular language.]

Power to enter for survey, etc.—On the issue of a notification under sub-section of section 3A, it shall be lawful for any person, authorised by the Central Government in this behalf, to—

(a) make any inspection, survey, measurement, valuation or enquiry;

(b) take levels;

(c) dig or bore into sub-soil;

(d) set out boundaries and intended lines of work;

(e) mark such levels, boundaries and lines placing marks and cutting trenches; or

(f) do such other acts or things as may be laid down by rules made in this behalf by that Government.

Hearing of objections.—

(1) Any person interested in the land may, within twenty-one days from the date of publication of the notification under sub-section (1) of section 3A, object to the use of the land for the purpose or purposes mentioned in that sub-section.

(2) Every objection under sub-section (1) shall be made to the competent authority in writing and shall set out the grounds thereof and the competent authority shall give the objector an opportunity of being heard, either in person or by a legal practitioner, and may, after hearing all such objections and after making such further enquiry, if any, as the competent authority thinks

necessary, by order, either allow or disallow the objections. Explanation.—For the purposes of this sub-section, "legal practitioner" has the same meaning as in clause (i) of sub-section (1) of section 2 of the Advocates Act, 1961 (25 of 1961).

(3) Any order made by the competent authority under sub-section (2) shall be final.]

Declaration of acquisition.—

(1) Where no objection under sub-section (1) of section 3C has been made to the competent authority within the period specified therein or where the competent authority has disallowed the objection under sub-section (2) of that section, the competent authority shall, as soon as may be, submit a report accordingly to the Central Government and on receipt of such report, the Central Government shall declare, by notification in the Official Gazette, that the land should be acquired for the purpose or purposes mentioned in sub-section (1) of section 3A.

(2) On the publication of the declaration under sub-section (1), the land shall vest absolutely in the Central Government free from all encumbrances.

(3) Where in respect of any land, a notification has been published under sub-section (1) of section 3A for its acquisition but no declaration under sub-section (1) has been published within a period of one year from the date of publication of that notification, the said notification shall cease to have any effect: Provided that in computing the said period of one year, the period or periods during which any action or proceedings to be taken in pursuance of the notification issued under sub-section (1) of section 3A is stayed by an order of a court shall be excluded.

(4) A declaration made by the Central Government under sub-section (1) shall not be called in question in any court or by any other authority.

Power to take possession.—

(1) Where any land has vested in the Central Government under sub-section (2) of section 3D, and the amount determined by the competent authority under section 3G with respect to such land has been deposited under sub-section (1) of section 3H, with the competent authority by the Central Government, the competent authority may by notice in writing direct the owner as well as any other person who may be in possession of such land to surrender or deliver possession thereof to the competent authority or any person duly authorised by it in this behalf within sixty days of the service of the notice.

(2) If any person refuses or fails to comply with any direction made under sub-section (1), the competent authority shall apply—

(a) in the case of any land situated in any area falling within the metropolitan area, to the Commissioner of Police;

(b) in case of any land situated in any area other than the area referred to in clause (a), to the Collector of a District, and such Commissioner or Collector, as the case may be, shall enforce the surrender of the land, to the competent authority or to the person duly authorised by it.

Right to enter into the land where land has vested in the Central Government.—Where the land has vested in the Central Government under section 3D, it shall be lawful for any person authorised by the Central Government in this behalf, to enter and do other act necessary upon the land for carrying out the building, maintenance, management or operation of a national highway or a part thereof, or any other work connected therewith.

Determination of amount payable as compensation.—

(1) Where any land is acquired under this Act, there shall be paid an amount which shall be determined by an order of the competent authority.

(2) Where the right of user or any right in the nature of an easement on, any land is acquired under this Act, there shall be paid an amount to the owner and any other person whose right of enjoyment in that land has been affected in any manner whatsoever by reason of such acquisition an amount calculated at ten per cent. of the amount determined under sub-section (1), for that land.

(3) Before proceeding to determine the amount under sub-section (1) or sub-section (2), the competent authority shall give a public notice published in two local newspapers, one of which will be in a vernacular language inviting claims from all persons interested in the land to be acquired.

(4) Such notice shall state the particulars of the land and shall require all persons interested in such land to appear in person or by an agent or by a legal practitioner referred to in sub-section (2) of section 3C, before the competent authority, at a time and place and to state the nature of their respective interest in such land.

(5) If the amount determined by the competent authority under sub-section (1) or sub-section (2) is not acceptable to either of the parties, the amount shall, on an application by either of the parties, be determined by the arbitrator to be appointed by the Central Government.

(6) Subject to the provisions of this Act, the provisions of the Arbitration and Conciliation Act, 1996 (26 of 1996) shall apply to every arbitration under this Act.

(7) The competent authority or the arbitrator while determining the amount under sub-section (1) or sub-section (5), as the case may be, shall take into consideration—

(a) the market value of the land on the date of publication of the notification under section 3A;

(b) the damage, if any, sustained by the person interested at the time of taking possession of the land, by reason of the severing of such land from other land;

(c) the damage, if any, sustained by the person interested at the time of taking possession of the land, by reason of the acquisition injuriously affecting his other immovable property in any manner, or his earnings;

(d) if, in consequences of the acquisition of the land, the person interested is compelled to change his residence or place of business, the reasonable expenses, if any, incidental to such change.

10.9.9 National Rehabilitation and Resettlement Policy, 2007

This policy strikes a balance between the need for land for developmental activities & protecting the interests of land owners and others. The benefits under the new policy are available to all Project Affected Persons (PAP) & families whose land, property or livelihood is adversely affected by land acquisition, involuntary displacement due to natural calamities, etc.

10.9.10 National Resettlement and Rehabilitation Policy (Ministry of Rural Development, Department of Land Resources), 2007

In India, compensation for land acquisition (LA) and resettlement assistance for project-affected people is generally governed by the Land Acquisition Act (1894), which has been amended from time to time.

A National Policy on Resettlement and Rehabilitation (NPRR) 2007 was adopted by the Government of India (GOI) to address the issues not addressed in the LA Act and also to cover development induced involuntary resettlement of people.

The policy aims to minimize displacement and promote, as far as possible, non-displacing or least displacing alternatives. The policy also aims to ensure adequate rehabilitation package and expeditious implementation of the rehabilitation process with the active participation of those affected. The policy also recognizes the need for protecting the weaker sections of the society especially members of the Scheduled Castes and Scheduled Tribes. The objectives of the National Rehabilitation and Resettlement Policy are to:

- Minimize displacement and to promote,' as far as possible, non-displacing or least-displacing alternatives;
- Ensure adequate rehabilitation package and expeditious implementation of the rehabilitation process with the active participation of the affected families;
- Ensure that special care is taken for protecting the rights of the weaker sections of society, especially members of the Scheduled Castes and Scheduled Tribes, and to create obligations on the State for their treatment with concern and sensitivity;

- Provide a better standard of living, making concerted efforts for providing sustainable income to the affected families;
- Integrate rehabilitation concerns into the development planning and implementation process; and where displacement is on account of land acquisition, to facilitate harmonious relationship between the requiring body and affected families through mutual cooperation.

10.9.11 National Rehabilitation and Resettlement Policy, 2013

The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 is an Indian Parliament act that regulates land acquisition and laid down rules for granting compensation, rehabilitation and resettlement to the people affected in regions in the absence of any state Act.

Table 75: APPLICABILITY OF ENVIRONMENTAL REGULATIONS

Sl No	Environmental Regulation	Applicability in the Sub-project
1	Environment (Protection) Act, 1986	Not Triggered
2	EIA Notification, 2006 and its amendment up to April 2011	Not Triggered
3	Coastal Regulation Zone Notification (CRZ), 2011	Not Triggered
4	Forest (Conservation) Act, 1980 and its amendment	Triggered
5	Wildlife Protection Act, 1972	Not Triggered
6	Biodiversity Act, 2002	Not Triggered
7	The Water (Prevention and Control of Pollution) Act and Rules, 1974-1975	Not Triggered Due to raising & strengthening of Embankment, there will be no discharge of pollutants into the water bodies located adjacent/ close to the embankment.
8	The Air (Prevention and Control of Pollution) Act, Rules and Amendment, 1981, 1982, 1983, 1987	Not Triggered
9	Ancient Monuments and Archaeological Sites and Remains Act, 1958	Not Triggered As there are no ancient monument and Archaeological site, no ancient monument or building as notified by ASI (Central/ State List)

		will be affected.
10	The Land Acquisition Act (LA) of NH Act 1956	Triggered
11	National Rehabilitation and Resettlement Policy, 2007	Triggered

ENVIRONMENTAL MANAGEMENT PLAN

PRE-CONSTRUCTION STAGE

Sl. No.	Environmental Issue	Management Measures	Reference Document	Responsibility	
				Planning and Execution	Supervision /Monitoring
PRE-CONSTRUCTION STAGE					
Pre-construction activities by Project Implementation Unit					
P.1	Land Acquisition	The acquisition of land and properties (Govt. /private) will be carried out in accordance with the Rehabilitation Action Plan as prescribed by Govt. of Manipur, as per the entitlement framework for the project. MWD has to ascertain that any additional environmental impacts resulting from additional acquisition of land shall be addressed and integrated into the EMP and other relevant contract documents.	LA NH Act 1956 and its Amendments, R&R Policy Manipur Govt. R&R Policy.	EMU of MWD, Revenue Dept., NGOs, Collaborating Agencies	EMU of MWD
P.2	Preservation of Trees	As far as possible maximum efforts to minimize the list of trees proposed to be felled by suitable on the spot adjustment of engineering designs at the time of execution. Tree cutting is to proceed only after all the legal requirements including attaining of In-principle and Formal Clearances from the Forest Dept. / SEIAA / MoEF are completed after which a joint enumeration of the trees to be cut is prepared by the PIU in association with Manipur Forest Development Corporation (MFD), and Forest Department. Subsequent approval orders from the divisional forest officer having jurisdiction over the area are to be issued to fell the trees in compliance with the Manipur Timber and other forest produce transit rules 1980 and Manipur Forest Act. 1972. The felling has to be carried out by the MFDC. In the event of design changes, additional assessments including the possibility to save trees shall be made if necessary separate proposals for felling of such trees submitted to the Divisional Forest officer concerned after joint enumeration to issue tree felling and conversion orders. Systematic corridor level documentation for the trees to be cut and those retained. A separate list will be maintained by the PIU / MWD in a bound register for each contract package of the corridor duly	MoRTH 201.2 Guideline 1(Guidelines for arrangement with Forest Department)	Contractor Agency engaged by EMU of MWD	Supervision Consultants and EMU of MWD

		signed by the site in charge, contractor and designated officer of the FDC ltd., so that no such unmarked trees will be cut or removed from the corridor.			
P.3	Tree Cutting	Trees will be removed from the Corridor of Impact before the actual commencement of the construction work to prevent traffic problems and accidents. No construction activity and tree felling should be simultaneously taken up in any location of the package, which has not been cleared by the regional C.C.F. Vijayawada or the MoEF Govt. of India for any reason what so ever. felling, logging, stacking of fire wood and passing of timber are to be synchronized with the corridor development action plan for each package and removal of the converted materials shall be taken up by the responsible agencies as per tree cutting and removal guidelines of this report subject to any other stipulation that may be prescribed by competent authority of Forest Department.	MoRTH 201.6 Guideline-1 (Guidelines for arrangement with Forest Department)	Contractor Agency engaged by EMU of MWD	Supervision Consultants and **EMU of** MWD
P.4	Relocation of Community Utilities and Common Property Resources	All CPRs (common property resources) such as stand posts, bore wells, wells, ponds, water supply lines, sewage lines, drainage systems, optical fibre cables, telephone and television cables together with electric power supply lines shall have to be removed and relocated outside the corridor before commencement of the road improvement activity. The aim of such precondition is to reduce stress to the local population and to prevent un necessary loss of man-days along with law and order situations, accidents, and pollution and traffic problem. While relocating these essential but hazardous CPRs, care should be taken to prevent accidental fall into bore holes, pits, drains and demolition sites by provision of barricades and covers over such sites whether it is a residential or non-residential area. In case of schools, colleges, hospitals, govt. offices, gram Panchayat market places or weekly market areas extra care has to be taken to ensure construction of the boundary wall and buildings as the case may be, so that no accident occurs. Early completion of the schools and college buildings and boundary walls may be planned for execution during the summer vacation, so that the impact on the day to day activity of such institutions are minimized with total avoidance	RAP document of MSRP.	**EMU of** MWD, Concerned Agencies, Contractor	EMU of MWD

		of freak accidents. In case of hospitals and govt. buildings, staff quarters, weekly markets and kisan markets, extra care has to be taken to prevent unusual hardship to the public on account of demolition and discontinuance of the functioning of such facilities by providing new accommodations /new constructions as the case may be before demolition of the existing structures ahead of the actual road constructions. The relocation sites for CPRs mentioned above shall be in consultation with the respective local administrative authorities, concerned departments in addition to the local gram sava as the case may be and finalized with environmental considerations. In case of any doubt or any problem the views of the site engineer, supervision consultant and the local administration has to be ensured by the contractor executing agency prior to finial execution.			
P.5	Relocation of affected Cultural and Religious Properties	Religious structures, statues, mandaps and boundaries coming within the RoW has to be demolished after alternate sites are selected for relocation of the structures where total replacement is necessary in consultation with the management committee /trustee /Endowment authority and after disbursement of due compensation amount under the active support and cooperation of local administration as these are very sensitive issues warranting special attention. No such structures be destroyed or removed and relocated without the knowledge and consent of interested parties and location decided after the involvement of local civil and police administration. These activities must be completed before commencement of the physical road improvement activity in that part of the package. Any such construction of religious sites other than the boundary walls with site enhancement measures and approach roads should not be taken up by the contractor or PIU since compensation is being paid for all such structures. In case of approach roads and boundary walls detailed designs and action plan has been provided in the drawings enclosed to the environmental management plan in the tables above for each of the components under impact. Care should be taken to ensure the drainage and garbage disposal of such sites very near to the road so as to prevent generation and accumulation of polluting materials which is a normal feature in and around many of these structures. Garbage collection bins and soaks	Annexure (List of CPRs)	EMU of MWD, NGOs, Contractor	Supervision Consultant EMU of MWD

		pits for waste disposal may be provided as an additional measure in consultation with the local managing trustee.		
P.6	Orientation of Implementing of Agency and Contractor	The MWD shall organize orientation sessions and regular training sessions during all stages of the Project. This shall include on-site training (general as well as specific to the context of a sub-project). These sessions shall involve all staffs of the MWD involved in the implementation of EMP, Environmental Specialists of the PIU and the Contractors.		
Pre-construction activities by the Contractor/Environmental Expert of Supervision Consultants (SC)				
P.7	**Field Verification and Modification of the Contract Documents**			
P.7.1	Joint Field Verification	The Environmental Expert of Supervision Consultant and the Contractor will carry out joint field verification with the site engineer to ascertain the possibility to saving trees, environmental and community resources wherever such representations or suggestions in writing have been received and forwarded by the project authority or by the site engineer in accordance with the local situations. In all such cases the interested organization, authority, expert, the executing and supervising agencies together with the local administrative set up, has to under take a joint field verification for assessing the pros and cons of such demands /suggestions to asses the need for any additional features, changes in the design and implementation of the activities, earlier approved by the competent authority. The complaints /suggestions /changes together with the observations and expert opinion of the joint verification team containing the need for additional protection measures, or changes in design /scale/nature of protection measures including the efficacy of enhancement measures suggested in the EMP, shall be reduced to a written document containing all the details with date, time, place and signature of such individuals.	Contractor/Environmental Expert of SC	EMU of MWD

P.7.2	Assessment ofImpacts due toChanges /Revisions /Additions in the Project Work	The Environmental Expert of SC will assess impacts and revise /modify the EMP in consultation with the site engineer in accordance to the recommendation made by the field survey party and the project document/s in the event of changes /revisions (including addition or deletion) in the project's scope of work.		Contractor/Environmental Expert of SC	EMU of MWD
P.7.3	Crushers, hot-mix plants and Batching Plants Location	Hot mix plants and batching plants will be located away from settlements and agricultural operations, commercial establishments to the extent possible taking care to avoid nearby wildlife movement corridors and forest areas in the vicinity. Such plants will be located at least 200 m away from the nearest village /settlement preferably in the downwind direction. The Contractor shall submit a detailed layout plan for all such sites and prior approval of Environmental Expert of SC shall be necessary. Arrangements to minimize dust pollution through provision of windscreens, mist spray units, and dust encapsulation will have to be provided at all such sites. Specifications of crushers, hot mix plants and batching plants should have to comply with the requirements of the relevant current emission control legislations and Consent / NOC for all such plants shall be submitted to the S C and MWD. No such installation by the contractor shall come into operation until and unless all legal clearances are obtained from the competent authority.	MoRTH 111.1 Air Pollution Control Act, and Noise Rules Guideline-2 (Generic Guidelines for environmental friendly construction methodology)	Contractor/ Environmental Expert of S C	EMU of MWD
P.7.4	Other Construction Vehicles,Equipment andMachinery	All vehicles, equipment and machinery to be procured for construction, will confirm to the relevant Bureau of Indian Standard (BIS) norms. The discharge standards promulgated under the Environment Protection Act, 1986, will be strictly adhered to. The most efficient and user friendly equipment confirming to the latest noise and effluent emission control measures available in the market shall be used in the Project. The Contractor shall maintain a record of PUC for all vehicles and machinery used during the contract period, which shall be produced by the contractor or its authorized representative to the Executive officer of MWD for verification whenever required for ensuring the continuity of such use by the contractor at the time of inspection of	Air Pollution Control Act, 1981, and Noise Rules and Motor Vehicle Act, 1988 Guideline-12 (Guidelines for storage handling use and Emergency response for Hazardous Chemicals)	Contractor/ Environmental Expert of Supervision Consultant	EMU of MWD

		statutory authority and environment impact monitoring body.			
P.8	Identification and Selection of Material Sources				
P.8.1	Borrow Areas	Finalizing borrows areas for borrowing earth and all logistic arrangements as well as compliance to environmental requirements, as applicable, will be the sole responsibility of the contractor. Where borrow areas other than the Govt. land is brought under operation by the contractor to meet the additional requirement or for speedy completion of works, legal and fail safe documentary permission from the land owner shall have to be obtained by the contractor prior to activating such borrow areas. An authentic copy of such document shall have to be submitted to the SC and the site engineer along with test reports showing the standard of the material available from the borrow area along with documentary details of the land. Such locations finalized by the contractor shall be reported to the Environmental Expert of Supervision Consultant and who will in turn the report to MWD. Location of selected borrow areas is listed in the location and lead chart of quarries, borrow areas for the project. Most of the haul roads to the designated borrow areas and quarry sites have been provided with WBM or Black Top paved roads except shorter distance from the road to actual site of removal. Except for haulage of sand and earth all other roads are either bituminous or WBM surface roads or murrom topped roads, which will be useable throughout the year by minimum maintenance and repair along with strengthening of pot holes and diversions at construction sites. The kutcha /earthen road requiring strengthening during rains and winter months shall have to be taken up for improvement as and when so required to reduce air and water pollution, logistic problem and generation of dust through frequent sprinkling of water and repairing of the haulage road besides proper coverage of the loaded vehicles by	Guidelines /Criteria for evaluation of borrow areas	Contractor/ Environmental Expert of S C	EMU of MWD

	waterproof tarpaulin. Speed limit should be fixed by the SC and the environment expert for operation of haulage vehicles with record of entry and exit to the quarry area in order to keep track of the movement of vehicles, personnel and timing of movement in shape of a logbook. This has to be maintained by the record keeper placed at the entry & exit points of such haulage roads as a traffic control measure, besides standing instruction regarding slowing down of movement while passing near populated areas, schools, colleges, courts etc. In addition to testing for the quality of borrow materials by the Supervision Consultant, the environmental personnel of the Supervision Consultant will be required to inspect every borrow area location prior to approval.			
	Without the prior consent of the land owner/s no agricultural land or any private property be used as a haulage road by the quarry operator /contractor. In all such cases, where the contractor has to use alternate connecting roads to quarries and borrow areas passing through private land, an agreement as per the terms and conditions agreed to between the land owner and contractor shall have to be executed before competent authority indicating the map and the location of the proposed haul road with survey no.s, khatianno.s and kisam details as per the Govt. Record of Right (ROR). There should be a precondition in all such cases of private land to restore the original condition of the land soon after the use of the said land is dispensed with. The contractor will consult the Environmental Expert of Supervision Consultant before finalizing the haulage network and also take necessary approval from the expert. Supervision Consultant in turn shall have to report all these facts with documentary proofs of quarry site, borrow areas, distance from the project, road location of haulage road with a reference to plot no., khatian no. duration of the activity, area to be operated etc. including pre conditions to be fulfilled at the time of use and at the time of abandoning the sites to the MWD.	Guide lines for use of private property as quarry /borrow site.	Contractor/Environmental Expert of Supervision Consultant	EMU of MWD

P.8.2	Quarry	Contractor will finalize the quarry for procurement of construction materials after assessment of the availability of sufficient materials and other logistic arrangements. In case the contractor decides to use quarries other than recommended by DPR consultants, then it shall be subjected to technical evaluation of quality for conformation of the physical standard fixed by the IRC that has been selected as suitable for use on the specific corridor. The contractor will procure necessary permission for procurement of materials from Directorate of Mines Govt. of Manipur, District Administration and State Pollution Control Boards, written approval from the local Tahesildar to operate, depositing required fees to operate such quarry and shall submit a copy of the approval and the rehabilitation plan to the MWD and Environmental Expert of the Supervision Consultant. No quarry would be selected in and around adjacent to forest boundary, wildlife movement path, breeding and nesting habitats, reserved forest, national parks and sanctuaries etc. Contractor will also work out haul road network and report to Environmental Expert of Supervision Consultant who shall inspect and in turn report to MWD the suitability of such haul roads from biodiversity and environment angles. Before approval of such haul roads other than the existing (under use) the procedure as enumerated for borrow areas has to be followed and documentary evidence with maps showing site details accompanied with copy of revenue records submitted to MWD through the SC.	MoRTH 111.3 Annexure - 3.2	Contractor	Environmental Expert of SC and EMU of MWD
P.8.3	Sand	Quality sand shall be procured from riverbed adjacent to the corridors i.e. from river Godavari in NH-16 at other places up stream free from silt and other impurities. For this, procurement shall be made after declaration of sand quarry sites by the local Tahesildar with the concurrence of the district Collector with due regard to miner minerals concession rules 2004. In case of selection of new sites for sand quarry, the Contractor has to obtain prior approval and concurrence of the quarry site from competent district authority and the Environment expert of the SC keeping in view the objection and convenience of the local population, which may restrain such activities for their own security and safety. This is because many times removal of sand from riverbed results in change of the watercourse endangering embankment and the nearby habitation.	MoRTH 111.3 Annexure - 3.2	All riverbeds recommended for sand extraction for the project.	Environmental Expert of SC and EMU of MWD

		This also impacts the embankment adversely when haulage is through the embankment. All these things are to be looked into by the SC and Environment Expert before agreeing to the proposition of the contractor for new sand quarry sites. Where the supplier of sand is another party other than the contractor, the authentic copy of the lease agreement that has been executed between the local Tahesildar and the supplier has to be submitted to the Executive Engineer of the project before any procurement is made there from. To avoid accidents and caving in of sand banks at quarry sites it should be removed layer by layer and digging dipper than the permissible limit has to be avoided at all costs. Such quarry should be barricaded 10mtr away from the periphery on all sites except the entry point, so as to prevent accidental fall of domestic cattle, wildlife and human beings. The flood embankment on either side of the river should not be used for movement of tippers and loaders, which are very likely to be damage and destroy such structures. Instead the haulage roads should have to be constructed afresh avoiding the embankment for safety and security of the vehicles, road users and the habitation along the banks of the river.			
P.8.4	Arrangement for Construction Water	As far as possible all efforts should be made to ensure avoidance of competitive use of a single water source, that may be depleted on account of the stress caused by drawing of water for road construction activity by the contractor. The contractor should use surface water depending on the availability and quality by developing its own water harvesting units in a river bed, digging up sand to store the percolated river water from where water can be lifted using diesel or electric pump sets. In case of nalas and water scarcity areas sinking of bore wells adjacent to nalas and streams may be made, so that while the water requirement for road construction is solved the structures when abandoned will serve as a ground water recharge through suitable modification of the structures, without impacting the purity and competitive users. If there is any subsequent modification in the relevant acts for use of ground or river water for such activities the contractor shall be bound to pay for the royalty due for use of such water as may be decided by the State Govt. from time to time. Use of ground water facility shall be subject to the local legislation and ground water availability and the competent authority for such	Guideline 11 (Guidelines for quarry material)	Contractor	Environmental Expert of SC and EMU of MWD

		permission as declared by the State Govt. from time to time shall have to be contacted for issue of necessary permission in this regard. Use of any other water source such as irrigation bunds, ponds, water harvesting structures and damming up of river /stream flow which is likely to strain and deplete the inhabitant in and around, as well as downstream should be avoided. For this the contractor has to obtain the express consent of the local gram sava as well as the group of users including the approval from the environment expert of SC and Executive Engineer. The Contractor will provide a list of locations and type of sources from where water for construction will be used.			
P.8.5	Labor Requirements	The contractor preferably shall use unskilled labor drawn from local areas to provide maximum benefit to the local community specially to the SC and ST population along the corridor.	General conditions of Contract Document	Contractor	Environmental Expert of SC and EMU of MWD
P.9	Construction Camp Locations – Selection, Design and Layout	Setting up of the construction camps will be as per the guidelines and details of layout plan. As far as possible construction camps will not be proposed within 500 m from the nearest settlements and 1000m from nearest reserve and protected forest to avoid conflicts and stress over the infrastructure facilities, local community and forest resources. Stock pilling of construction materials and go downs should be sufficiently away from the nearest water source as well as located on higher ground to avoid impact due to flood and pollution of the water source on account of any accidental spillage of stored /stockpiled materials. The waste disposal and sewage treatment shall be such that the environment is not polluted with the waste material, foul odour including the effluents and wastewater generated at the campsite. The designing and setting up of these structures should be as per the site plan of camp site providing for soak pits and carriage of extra sewage by sealed mechanized containers for disposal at designated sites as will be available in the locality with due written permission from the competent local authority. In case of non-receipt of any such permission from the competent authority as stated above the provision of wider safety tanks and storage facility for garbage has to be made at the camp site as an	Guidelines for Locations of Construction Camp General conditions of Contract Document	Contractor	Environmental Expert of SC and EMU of MWD

		additional measure.			
P.10	Arrangements for Temporary Land Requirement	The contractor shall have to carry out negotiations with the landowners for obtaining their consent for temporary use of their lands for haulage roads approach roads, temporary diversions, stockpiling of bulk construction materials, establishment of camps, hot mix and batching plants crusher units under proper agreement detailing the term and conditions agreed to between both the parties involved including the conditions governing activities to be ensured during the operational stage and at the time of decommissioning of the project, where such sites are private property. The copy of such agreements shall have to be submitted to the Supervision Consultant and the Executive officer through the environment expert by the contractor along with the declaration through an affidavit sworn in by the land owner before a legal authority competent in this regard as authentic proof of such arrangement. The agreement and the affidavit must contain the details of the land involved with connected records of ownership.	Contract Document	Contractor	Environmental Expert of SC and EMU of MWD
P.11	Orientation of Implementing Agency and Contractors	The MWD shall organize orientation sessions and regular training sessions during all stages of the project. This shall include on-site training (general as well as in the specific context of a sub-project). These sessions shall involve all staff of Environmental Cells, field level implementation staff of MWD, Environmental Experts of Supervision Consultant and Contractors.	Contract Document	EMU/ EMU of MWD	EMU of MWD

CONSTRUCTION STAGE

Sl. No.	Environmental Issue	Management Measures	Reference Document	Responsibility	
				Planning and Execution	Supervision /Monitoring
CONSTRUCTION STAGE					
Activities to be Carried Out by the Contractor					
C.1	**Site Clearance**				
C.1.1	Clearing and Grubbing	Site clearance including clearance of marked trees for felling and removal has to be carried out much before the actual road construction takes place. While doing so maximum care has to be taken for removal of all the overhead power transmission lines, telephone and cable T.V. connections bore wells, stand posts (water taps) wells in proper manner so as not to pollute the underground water sources and aquifers. In addition to this the structures (cabins, commercial constructions, hoardings, statues and temples etc. should have to be compensated for and removed before tree felling as tree felling is likely to damage all these structures and essential connections used by the public. The contractor, under any circumstances will not cut or damage trees. Trees identified under the project will be cut only after receiving clearance from the Forest Dept. / DoEF / MoEF (as applicable) and after the receipt of MWD's written permission in this regard. The tree felling should have to be under taken after due permission for felling has been obtained from the concerned divisional forest officer and the estimated cost of removal of trees submitted by MFDC ltd. gets approved by the MWD. Vegetation above 30 cm girth will be considered as trees and shall be compensated, in the event of MWD's instruction to undertake tree cutting and all trees below 30cm girth at BH has to be uprooted mechanically with ball of earth intact for relocation and transplanting at various degraded sites, embankment of water body, ponds, temples, market places, schools and road corridors to the extent possible for preventing loss of vegetative cover.	MoRTH 201.2 Guideline-1 (Guidelines for arrangement with Forest Department)	Contractor	EnvironmentalExpert of SC, **EMU of** MWD

C.1.2	Generation of Debris from dismantlings tructures and road surface	Tree cutting should not be carried out simultaneously all along the corridor as this will adversely impact the traffic movement and road safety. It should be carried out on priority basis at locations of diversions, bridge and culvert construction, and such other places where the construction work is scheduled to be started early for various consideration that may be decided by the site engineers the SC and the contractor as per work schedule. All workers involved in the cutting and removal of trees and demolition of structures shall wear safety helmets, gloves, and protective shoes and provided with a batch of emergency medical aid facility for attending to all unforeseen and freak accidents. Records to be maintained on the spot for all trees felled and logs, fire wood, stacks, obtained from such trees in the conversion register, which shall be available for verification by any competent supervising authority of the forest department, MWD, SC and expert of EMP unit. No sooner the trees are felled converted the same has to be kept under watch and ward by the felling agency and steps taken for its authentication by passing carried out at stump site. The passing by any forest officer not below the rank of an ACF of the forest department irrespective of the location of the tree either with in the RoW or the acquisitioned private land and Govt. forest land for quick removal from the RoW to facilitate uprooting of the stumps of such trees. Uprooting of the stumps should start immediately after the logs and firewood are removed from the stump site to speed up the road formation as discussed earlier. As far as possible felling of trees which are located beyond the hard shoulder that is on the slopes of the embankment can be retained for reducing the loss of vegetative cover by careful selection of young and sound trees within 30cm girth and up to 1mtr girth. 🗁 Debris generated due to the dismantling of the existing road will be suitably reused in the proposed construction. The 80% of the sub grade excavated from the road surface excluding the scarify layer of bitumen shall be recycled after improving the soil below the subgrade through addition of sand and suitable cementing material for qualitative up-gradation of the underlying black cotton soil. 🗁 The dismantled scraps of bitumen surface shall be utilized for	Guide lines of Manipur State Pollution Control Board.	Contractor	Environmental Expert of SC, **EMU of** MWD

		the paving the picnic spots or publicrecreation locations along the corridor to prevent erosion soil contamination and loss of vegetative cover on account of accumulation of such materials along the road and water bodies. The contractor will suitably dispose off unutilized non-toxic debris either through filling up of borrows areas located in wasteland or at pre-designated disposal sites, so selected subject to the approval of the Environmental Expert of SC and local competent authority. All arrangements for transportation during construction including provision, maintenance, dismantling and clearing debris, considered incidental to the work, will be planned and implemented by the contractor as approved and directed by the Environmental Expert of SC/ MWD. The pre-designed disposal locations will be a part of Comprehensive Solid Waste Management Plan to be prepared by Contractor in consultation and with approval of Environmental Expert of SC and approval local competent authority. Debris generated from pile driving or other construction activities along the rivers and streams drainage channels shall be carefully disposed in such a manner that it does not flow into the surface water bodies or form puddles in the area. All dumping sites identified by the contractor has to be ratified by the environment expert of SC in consultation with the local competent authority after joint visit of the locations and signing of documents as a proof of such verification and acceptance. For future management of these dumping yards the contractor shall be responsible by providing barricade walls or embankment if necessary to contain the outflow or erosion of such debris from the dumping site.			
C.1.3	Other Construction Wastes Disposal including Fly Ash	The pre-identified disposal locations will be a part of Comprehensive Waste Disposal & Solid Waste Management Plan to be prepared by the Contractor in consultation with& approval of Environmental Expert of SC. Location of disposal sites will be finalized prior to completion of the earthworks on any particular section of the road. The Environmental Expert of SC will approve these disposal sites after conducting a joint inspection on the site with the Contractor. Contractor will ensure that any spoils of material unsuitable for embankment fill will not be disposed off near any water course,	Guide lines of Manipur State Pollution Control Board.	Contractor	EnvironmentalExpert of SC, **EMU of** MWD

		agricultural land, and natural habitat like grass lands or pastures, wet lands, flood plains, eroded slopes, filling up ditches etc. which may pollute the surrounding including water sources. Such spoils from excavation can be used to reclaim borrow pits and shoring up of depression which are not connected to any water source in the locality nor under use by the local people. Non-bituminous wastes other than fly ash may be dumped in borrow pits (preferably located in barren lands) where such borrow pits are not suitable for storage of rainwater to develop pisci-culture or a source of irrigation by development of embankments around. Such borrow pits have to be filled up with non-bitumen wastes and then covered with a minimum 30cm layer of the soil to take up plantation of trees and shrubs to restore the environmental balance. The species suitable for such re-habitation site shall be 18month old seedling of alstonea, casuarinas, zizyphus, bel, peepal, banyon, babool, chirounji etc. No new disposal site shall be created as part of the project, except with prior approval of the Environmental Expert of SC and concurrence of local competent authority on environment. In case of diversions over private land or productive Govt. land it should be the duty and responsibility of the contractor to ensure rehabilitation and restoration of the impugned /sites before abandoning the area in such a manner that the site so released comes into productive use without extra input what so ever.			
C.1.4	Stripping, stocking and preservation of top soil	The topsoil from all sites of cutting/ quarrying/ borrows areas and areas to be permanently covered will be stripped and scraped of to a specified depth of 150 mm and stored separately for reuse as detailed below. A portion of the temporarily acquired area and/or RoW will be earmarked for storing topsoil. The locations for stock piling will be pre-identified in consultation and with approval of Environmental Expert of Supervision Consultant and Site Engineers. The following precautionary measures will be taken to preserve them till they are used: (a) Stockpile will be designed such that the slope does not exceed 1:2 (vertical to horizontal), and height is restricted to 2 m. To retain soil and to allow percolation of water, the edges of the pile will be protected by silt fencing. (b) Stockpiles will not be surcharged or otherwise loaded and	MoRTH: 301.3.2, MoRTH: 301.7, MoRTH: 301.3.3, MoRTH: 305.3 Guidelines – 3 (Guidelines for borrow area management)	Contractor	Environmental Expert of SC,EMU of MWD

		multiple handling kept to a minimum to ensure that no compaction occurs. Such stockpiles shall be covered with empty gunny bags or showing and planting of grasses to prevent erosion during rains. It will be ensured by the contractor that the topsoil will not be unnecessarily trafficked either before stripping or when in stockpiles. Such stockpiled topsoil will be utilized for - ↳ Covering all reclamation sites /disturbed areas including borrow areas (not those in barren areas) ↳ Top dressing of the road embankment and fill slopes ↳ Filling up of tree pits, in the median and ↳ In the agricultural fields of farmers, acquired temporarily. Residual topsoil, if there is any will be utilized for the plantation at median and side of the main carriageway.			
C.1.5	Accessibility	The contractor will provide safe and convenient passage for vehicles, pedestrians and livestock to and from roadsides and property accesses connecting the project road, providing temporary connecting road. The contractor will also ensure that the existing accesses will not be undertaken without providing adequate provisions and to the prior satisfaction of Environmental Expert of Supervision Consultant. The contractor will take care that the cross roads are constructed in such a sequence that construction work over the adjacent cross roads are taken up one after the other, so that traffic movement in any given area does not get affected much.		Contractor	Environmental Expert of S C, EMU of MWD
C.1.6	Planning for Traffic Diversions and Detours	Temporary diversions will be constructed with the approval of the Resident Engineer and Environmental Expert of Supervision Consultant. Detailed Traffic Control Plans will be prepared and submitted to the Environmental Expert of SC for approval, five days prior to commencement of works on any section of road. The traffic control plans shall contain details of temporary diversions, traffic safety arrangements for construction under traffic, details of traffic arrangement after cessation of work each day, safety measures	MoRTH: 112 and its amendments Guidelines 7 (Guideline for traffic management during construction)	Contractor	Environmental Expert of SC, EMU of MWD

		undertaken for transport of hazardous materials and arrangement of flagmen etc. to regulate traffic congestion. The Contractor will provide specific measures for safety of pedestrians and workers at night as a part of traffic control plans. The Contractor will ensure that the diversion/detour is always maintained in running condition, particularly during the monsoon to avoid disruption to traffic flow. The contractor will also inform local community of changes to traffic routes, conditions and pedestrian access arrangements with assistance from SC and MWD. The temporary traffic detours will be kept free of dust by sprinkling of water three times a day or as required under specific conditions (depending on weather conditions construction in the settlement areas and volume of traffic).			
C.2	**Procurement of Construction Material**				
C.2.1	Earth from Borrow Areas for Construction	No borrow area will be opened without permission of the Environmental Expert of Supervision Consultant. The location, shape and size of the designated borrow areas will be as approved by the Environmental Expert of Supervision Consultant and in accordance to the IRC recommended practice for borrow pits for road embankments (IRC 10: 1961). The borrowing operations will be carried out as specified in the guidelines for setting and operation of borrow areas. The unpaved surfaces used for the haulage of borrow materials, if passing through the settlement areas or habitations; will be maintained dust free by the contractor. Sprinkling of water will be carried out thrice a day to control dust along such roads during their period of use. During dry seasons (winter and summer) frequency of water sprinkling will have to be increased according to the site and climatic conditions in the settlement areas and Environmental Expert of SC will decide the numbers of sprinkling depending on the local requirements. Contractor will rehabilitate the borrow areas as soon as borrowing is over from a particular borrow area in accordance with the Guidelines for Redevelopment of Borrow Areas or as suggested by Environmental Expert of Supervision Consultant.	MoRTH: 305.2 Guidelines – 3 (Guidelines for borrow areamanagement)	Contractor	EnvironmentalExpert of SC, EMU of MWD

C.2.2	Quarry Operations	The contractor shall obtain materials for quarries only after the consent letter from the department of mines Govt. of Manipur, and the District Administration is received. The contractor will develop a Comprehensive Quarry Redevelopment plan, as per the Mining Rules of the state and submit a copy to MWD and SC prior to opening of the quarry site. The quarry operations will be undertaken within the rules and regulations in vogue.	MoRTH:111.3	Contractor	EnvironmentalExpert of SC, EMU of MWD
C.2.3	Transporting Construction Materials and Haul Road Management	Contractor will maintain all roads (existing or built for the project), which are used for transporting construction materials, equipment and machineries as précised. All vehicles delivering goods subject to susceptible to be blown by wind during the vehicular movement to avoid spilling and air pollution. It shall be the responsibility of the contractor or his agent, sub-agents, sub-contractors, petty contractor, material suppliers whose vehicles use the highways and other roads for transportation of construction materials, to keep the roads clear from any dust, sand, soil, aggregates fallen from the transport vehicle. Contractor will arrange for regular water sprinkling as necessary for dust suppression on all such roads and surfaces where dust generation is a major problem. The unloading of all materials at construction sites should be limited to day time only for safety and avoiding accidents. Screens of hessian cloth, agro net and such other barricading material are to be erected along all construction, dumping and stockpiling sites under use, so that the generation of the dust in the vicinity of such locations can be minimized to great extent.		Contractor	EnvironmentalExpert of SC, EMU of MWD
C.2.4	Construction Water	Contractor will arrange adequate supply and storage of water for the whole construction period at his own cost. The Contractor will submit a list of such source/s from where water will be used for the project to Supervision Consultant and MWD. Such source of water to meet the requirement on this road should preferentially be ground water collected from river or stream bed with prior permission from the Ground Water Board and the District Administration commensuration with the prevalent water act and rules promulgated by the State Govt. Such use shall be from a source	Guideline 11 (Guidelines for quarry material)	Contractor	EnvironmentalExpert of SC, EMU of MWD

		other than the common source of water that is used by the local population and wildlife etc. as detailed in preconstruction activity. A copy of the permission so obtained from the competent authority shall have to be submitted to Supervision Consultant and MWD prior to initiation of construction activity. The contractor will take all precaution to minimize the wastage of water in the construction process/ operation where ground water and river water is scarce.			
C.3	**Construction Work**				
C.3.1	Disruption to Other Users of Water	While working across or close to any perennial water bodies, contractor will not obstruct/ prevent the flow of water. Construction over and close to the non-perennial streams shall be undertaken in dry season and if such activity is likely to constraint or impact the community water body connected to such streams adequate prior information will be provided to such community for making a suitable arrangement that may lead to peaceful and uninterrupted use of the resource during the time of construction activity. Such water body may be ponds, water harvesting structures (WHS), feeder channels to pond and irrigation bunds etc. In all such cases specific provision of lessening the impact of construction has been elaborated in the design plan of retaining walls, spillways and ghats in Drawing No. MSRP /CEG /SH /ENV /03 Wherever excavation for diverting water flow will is imminent as per the designs available in the DPR the contractor will ensure that such diversion channels have no stepper slopes than 1:2 (vertical: horizontal). Otherwise proper slope protection measures have to be taken as approved by the Environmental Expert of SC and the resident engineer. The contractor will take prior approval of the River Authority or Irrigation Department and SC for any such activity. The MWD will ensure that contractor has served the notice to the downstream users of water well in advance where such diversion of the flow is likely to affect the downstream population subject to the condition that under no circumstances the downstream flow should be stopped putting the wildlife, the aquatic fauna and the shore line settlement under distress. Minimum eco-flow should be maintained in spite of the diversion by ensuring the downstream connectivity to the main	MoRTH:304.3.2	Contractor	EnvironmentalExpert of SC, EMU of MWD

		channel.			
C.3.2	Drainage and Flood Control	Contractor will ensure that no construction materials like earth, stone, ash or appendage disposed off so as not to block the flow of water of any water course and cross drainage channels. In addition to the design requirements the contractor will take all necessary measures to prevent the flooding of the installation well in advance of he rainy season in consultation with the resident engineer and SC by providing cross drainage to manage accumulation of rain water at any construction site. Where necessary adequate mechanical devices to bail out accumulated water from construction sites, camp sites, storage yard, excavation areas are to be pre-settled and arranged well in advance of the rainy season besides cross drainage systems. The contractor will take all adequate precautions to ensure that construction materials and excavated materials are properly located and enclosed in such a manner that sediment laden water through erosion does not affect the runoff and block the natural flow of water in any water course or cross drainage channel, by a proper watch and ward arrangement for monitoring.	MoRTH:305.3.7 MoRTH:306 Annexure 3.3 Annexure 3.4	Contractor	EnvironmentalExpert of SC, EMU of MWD
C.3.3	Siltation of Water Bodies and Degradation of Water Quality	Contractor will construct silt fencing at the base of the embankment construction for the entire perimeter of any water body (including wells) adjacent to the RoW and around the stockpiles at the construction sites close to water bodies. The fencing will be provided prior to commencement of earthwork and continue till the stabilization of the embankment slopes, on the particular sub-section of the road. The contractor will also put up sedimentation cum grease traps at the outer mouth of the drains located in truck lay byes, which are ultimately entering into any surface water bodies / water channels with a fall exceeding 1.5 m. Contractor will ensure that construction materials containing fine particles are stored in an enclosure such that sediment-laden water does not drain into nearby water bodies.	MoRTH: 306 Annexure 3.5 (Silt Fencing)	Contractor	EnvironmentalExpert of SC, EMU of MWD

C.3.4	Slope Protection and Control of Soil Erosion	The contractor will construct slope protection works as per design, or as directed by the Environmental Expert of SC to control soil erosion and sedimentation through use of dykes, sedimentation chambers, basins, fibre mats, mulches, grasses, slope drains and other devices as will be necessitated according to the local conditions. All temporary sedimentation, pollution control works and maintenance thereof will be deemed as incidental to the earth work or other items of work and as such no separate payment will be made for them. Contractor will ensure the following aspects: ↳ After construction activities of road embankment, the side slopes of all cut and fill areas will be graded and covered with stone pitching, grass and shrub as per design specifications. ↳ Turfing works will be taken up as soon as possible, provided the season is favourable for the establishment of grass sods. Other measures of slope stabilization will include mulching, netting and seeding of batters and drains immediately on shrub and bushes at 30cm interval from line to line across the slope and sprinkling of water on such slopes after completion of the earth work. Regular watering through sprinklers shall be provided at such locations much before the pre-monsoon rains as would be required in the field to encourage bio-engineering stabilization of slopes. In all these cases, seeds of road side weeds such as, Banakolthi (Tephrosia spp.), Banachakunda (Cassia tora), Bala (Sida species), Vetiver grass, Pamarosa grass etc. are the best choice. ↳ In borrow pits, the depth shall be regulated so that the sides of the excavation should not be stepper than 1 vertical to 2 horizontal, from the edge of the final section of the bank. ↳ Along sections abutting water bodies, stone pitching as per design specification will protect slopes. All such stone pitching should have a filter layer to prevent scouring and unsettlement of the pitched surface when the water label recedes. ↳ Refer **Guidelines-8** for soil erosion and sedimentation.	MoRTH: 305.2.2.2 MoRTH: 306.2 Guideline 8 (Guideline for soil erosion and sedimentation control)	Contractor	Environmental Expert of SC, EMU of MWD
C.4	**Pollution**				
C.4.1	**Water Pollution**				

C.4.1.1	Water Pollution from Construction Wastes	The Contractor will take all precautionary measures to prevent the waste water generated during construction from entering into streams, water bodies or the irrigation system by providing safe wastewater soak pits away from any aquifers or water body. Contractor will avoid continuation of construction activity close to the streams or water bodies during monsoon. All waste arising from the project is to be disposed off in the manner that is acceptable to the State Pollution Control Board or as directed by Environmental Expert of Supervision Consultant in accordance to the local legislation for such disposal. The Environmental Expert of S C will certify that all liquid wastes disposed off from the sites meets the discharge standards as specified by the CPCB, Govt. of India.	MoRTH: 111.4 MoRTH: 111.1	Contractor	EnvironmentalExpert of SC, EMU of MWD
C.4.1.2	Water Pollution from Fuel and Lubricants	The contractor will ensure that location of parking lots, garages, fuel/lubricants dumps /storage sites, vehicle, machinery and equipment maintenance and refuelling sites are located on high ground at least 500 m from rivers /streams /canal /ponds with proper boundary wall to prevent any accidental leakage or flooding or due to spillage or mishandling. All location and lay-out plans of such sites will be submitted by the Contractor prior to their establishment and will be approved by the Environmental Expert of Supervision Consultant and EMU of MWD, besides the conditions governed by the Central Excise and Explosive substances act etc. Contractor will ensure that all vehicle/machinery and equipment operation, maintenance and refuelling will be carried out in such a fashion that, spillage of fuel and lubricants does not contaminate the ground. Oil interceptors will be provided for vehicle parking, wash down and refuelling areas as per the design provided for such locations by the contractor. In all, fuel storage and refuelling areas, if located on agricultural land or areas supporting vegetation, the top soil will be stripped, stockpiled and returned after cessation of such storage. Contractor will arrange for collection, storage and disposal of spent oil, lubricants, grease and sludge and other waste to collection beans kept separately at maintenance and refuelling yards for recycling and to dispose of the filtered sludge from filter ponds at pre-identified	MoRTH: 111.4 MoRTH: 111.1 Annex 3.6 Petroleum Act and Rules MoEF /CPCB Notifications	Contractor	EnvironmentalExpert of S C, EMU of MWD,

		disposal sites (list to be submitted to SC and MWD) as approved by the Environmental Expert of S C. All spills and collected petroleum products will be disposed off in accordance with MoEF and SPCB guidelines issued from time to time. A certificate to this extent has to be issued by the Environmental Expert of S C in compliance with the guidelines of PCB/ MoEF or any other relevant law in force.			
C.4.2	**Air Pollution**				
C.4.2.1	Dust Pollution	The contractor will take every precaution to reduce the level of dust from crushers /hot mix plants, construction sites involving earthwork by sprinkling of water mist spray, encapsulation of dust source and erection of screen /barriers. All the plants will be located at least 1 km away in the downwind direction of normal wind flow from the nearest human settlement or any other institutions of importance. The contractor will provide necessary certificates to confirm that all crushers used in construction conform to relevant dust emission control legislation from time to time. The suspended particulate matter value at a distance of 40m from a unit located in such a cluster should be less than 500 µg/m^3. The pollution monitoring is to be conducted as per the monitoring plan. Alternatively, operating crushers with valid license from the SPCB shall be used and required certificates and consents of the operator /owner shall be procured and submitted by the contractor to the MWD through Environment expert of the SC. Dust screening vegetation through planting of dwarf bamboos, justacea, vitexnegundo, lawsoniainermis on the edge of the RoW or around the crusher sites for all existing roadside crushers besides provision of dust screens. Hot mix plant and batch mix plant will be fitted with dust extraction units and mist spray to keep down the dust emission levels.	MoRTH:111.1 MoRTH:111.5 MoRTH:111.9 MoRTH:111.10 Contract Agreement	Contractor	EnvironmentalExpert of SC, EMU of MWD

C.4.2.2	Emission from Construction Vehicles, Equipment and Machineries	All machinery and equipment installed or brought under use by the contractor shall have to conform to the latest anti-pollution parameters as specified by the international stand and BSI as the case may be. Contractor will ensure that all vehicles, equipment and machinery used for construction are regularly maintained and confirm to the emission standards specified by the CPCB and certification issued for such contrivances obtained from designated /approved authority from time to time. The Contractor will submit PUC certificates for all vehicles/ equipment/machinery used for the project. Monitoring results will also be submitted to S C and EMU of MWD as per the monitoring plan and specified formats.	Motor Vehicle Act	Contractor	EnvironmentalExpert of S C, EMU of MWD
C.4.3	**Noise Pollution**				
C.4.3.1	Noise Pollution: Noise from Vehicles, Plants and Equipments	The Contractor will confirm the following: All plants and equipment used in construction (including that of MWD, aggregate crushing plant) shall strictly conform to the MoEF/ CPCB noise standards and should have latest noise suppression mountings. All vehicles and equipment used in construction will be fitted with exhaust silencers. Servicing of all construction vehicles and machinery will be done regularly and during routine servicing operations, the effectiveness of exhaust silencers will be checked and if found defective will be replaced. Limits for construction equipment used in the project such as compactors, rollers, front loaders, concrete mixers, cranes (movable), vibrators and saws shall not exceed 75 dB (A) (measured at one meter from the edge of equipment in the free field), as specified in the Environment (Protection) rules, 1986. Maintenance of vehicles, equipment and machinery shall be regular and up to the satisfaction of the Environmental Expert of S C to keep noise levels at the minimum. Construction activity at sites within 100m from habitation, hospitals and 1000mtrs. from forest areas should not be carried out during night.	Noise Rules 2002 Annex – 3.7	Contractor	EnvironmentalExpert of SC, EMU of MWD

		The contractor will not take up any noisy construction activities around educational institutes /health centers, hospitals, silence zones up to a distance of 1000 m from these sensitive receptors at night. Contractor will provide noise mitigation barriers along the sensitive receptors mentioned above including masonry and vegetative screen walls mounted with creepers as per the design drawing No. MSRP /CEG /SH /ENV /04 B at suggested locations. List of such locations for temples, schools, govt. offices. There are 16 temples, 10 schools & colleges, 2 offices, 2 Govt. hospitals. Monitoring shall be carried out at the construction sites as per the monitoring schedule and results will be submitted to SC and MWD. Environmental Expert of SC will be required to inspect regularly such sites to ensure proper compliance of the EMP.		
C.5	**Safety**			
C.5.1	Personal Safety Measures for Labour	Contractor will provide: 🕘 Protective footwear and protective goggles to all workers employed on mixing asphalt materials, cement, mortars, concrete working at welding blasting, crusher and stockpiling locations etc. as per the Factory Act 1948. 🕘 Welder's protective eye-shields to workers engaged in welding works 🕘 Earplugs to workers exposed to loud noise, and at quarries, crushers, compaction, concrete mixing, batch mixing, and drilling, fabricating and heavy machinery operations. 🕘 Hard hat or minors helmets shall be provided to all workers supervising staffs and inspecting officials entering into any construction site quarry, borrow areas, loading and unloading sites for safety and security which should be compulsory, irrespective of the rank and file of such personality. 🕘 The use of nettings and platforms below and on the sides of overhead construction and excavation, scaffolding activity has to be compulsory to be installed by the contractor to prevent accidental fall of workmen and debris, which are a major source of fatality at all construction sites. 🕘 The contractor will comply with all regulations regarding safe	Contractor	EnvironmentalExpert of SC, EMU of MWD

		scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress. The contractor will comply with all the precautions as required for ensuring the safety of the workmen as per the International Labour Organization (ILO) Convention No. 62 as far as those are applicable to this contract. The contractor will make sure that during the construction work all relevant provisions of the Factories Act, 1948 and the Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996 are adhered to. The contractor will not employ any person below the age of 18 years for any work and no woman of productive age will be engaged in the work of painting containing lead in any form. The contractor will also ensure that no paint containing lead or lead products is used except in the form of paste or readymade paint. Contractor will provide facemasks for use by the workers engaged in spray painting or manual painting when lead based compound is one of the constituents of such surface to be scrubbed, cleaned and painted. 🕘 No smoking and other 'high risk' areas are to be provided with statutory signage besides strict enforcement of PPE with zero tolerance limits for the safety and security of installation and equipment. These guidelines will be reflected in the Construction Safety Plan to be prepared by the Contractor during mobilization and same shall be approved by S C and MWD after proper scrutiny		
C.5.2	Traffic and Safety	The contractor will take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signage, markings, flags, indicator lights, reflectors and flagmen as proposed in the Traffic Control Plan/Drawings and as required by the Environmental Expert of S C for the information and protection of road users approaching or passing through the section of any construction site of activity or diversion. The contractor will ensure that all signs, barricades, pavement markings are provided as per the MoRTH specifications. Before taking up of construction on any section of the existing lanes of the highway, a Traffic Control Plan will be devised and implemented to the	Contractor	EnvironmentalExpert of SC, PIU of MWD, EMU ofMWD

		satisfaction of the Environmental Expert of S C together with the local police and administrative authorities.		
C.5.3	Risk from Electrical Equipment (s)	All power transmission lines whether cladded or sufficiently covered are potential hazards at construction sites. The Contractor will take all required precautions to prevent danger from electrical wirings and equipment and ensure that - No material will be so stacked or placed on or installations, which can be a potential danger to affect /inconvenience /fatally injure any road user or workmen so as to cause danger or inconvenience to any person or the public. • All such electrical installation and wirings should be out of reach of the road users, wildlife along with operating vehicle, cranes, excavators and loaders fabricating units. Necessary fencing and proper insulation of the supply lines shall have to be ensured by the contractor with proper illumination of work sites and equipment for safety and security. • Loosely hanging and exposed power supply lines, heavily loaded supply lines are the cause of many accidents and fire hazards, which may endanger the life and property of so many individuals during construction /lay off period. The contractor should ensure proper maintenance of such supply routes and closer of all such electrical operating units before leaving the sit of activity every day or night as the case may be. All machines to be used in the construction shall have conformed to the relevant BIS specification codes. The contractor will ensure that such machinery are free from patent defect, and under good working conditions and maintained in good working order as per the owner's manual supplied by the manufacturer through regular supervision, monitoring, maintenance and repair /replacement from time to time as per the schedule of activity such units in consultation with the SC.	Contractor	Environmental Expert of SC, EMU of MWD
C.5.4	Risk Force Measure	The contractor will take all reasonable precautions to prevent danger of destruction to life and property of public as well as workers on account of flash flood, sudden collapse of structures accidental fire and explosion in and around work sites camps, maintenance unit, quarries,	Contractor	Environmental Expert of SC, EMU of MWD

		and haulage or roads vehicles carrying hazardous materials. The contractor will make required arrangements so that in case of any mishap all necessary steps can be taken for prompt rescue operation along with provision for on this spot first aid and quick removal of injured to nearest hospital for treatment. Fire extinguishers and firefighting equipments, salvaging equipments for recovery of hazardous chemicals on account of accidents or spillage to be kept ready at camping sites or major construction sites to attend such eventualities. Construction Safety Plan prepared by the Contractor in this regard will identify necessary actions in the event of an emergency accordingly and get it approved by the supervision consultant and the executive officer of the MWD as per the standard practice adopted under labour welfare activities and factory act.		
C.5.5	First Aid	The contractor will arrange for - ◴ a readily available first aid unit including adequate supply of sterilized dressing materials and appliances as per the Factories Rules in every work zone with life saving first aid kits. ◴ availability of suitable transport at all times to take injured or sick person(s) to the nearest hospital ◴ Equipment and trained nursing /paramedical staff at construction camps.	Contractor	Environmental Expert of SC, EMU of MWD
C.5.6	Informatory Signs and Hoardings	The contractor will provide, erect and maintain informatory/safety signs, hoardings written in local language and English, for the benefit and information of road users and local inhabitants.	Contractor	Environmental Expert of SC, EMU of MWD
C.6	**Flora and Fauna: Plantation/Preservation/ Conservation Measures**			
C.6.1	Road side Plantation Strategy	The tree planting along the corridor within the RoW shall be taken up by local self-help groups (SHG) or forest department as the case may be depending upon the location of the land on the corridor i.e. near and on forest lands the forest department shall take up the plantation activity and elsewhere these shall be carried out by contractor selected for such activity, which may be local self-help groups. Minimum 80 percent survival rate of the saplings will be acceptable, otherwise the contractor will replace dead plants at his own cost. The contractor will maintain the plantation till they handover the project site to MWD after the 3rd year of planting.	Contractor	Environmental Expert of SC, EMU of MWD

		The Environmental Expert of SC will inspect and monitor regularly the survival rate of all plantations and record his observation in the plantation journal at the time of inspection besides making official correspondence regarding deficiencies or changes improvements, warranted in specific area of activities.		
C.6.2	Flora and Chance found Fauna	The contractor will take reasonable precaution to prevent his workmen or any other persons connected with the contract from removing and damaging any flora (plant/vegetation) and fauna (animal) including fishing in any water body and hunting of any animal in and around the road corridor, whether it is a forest or non-forest land, other than permissive activity of fishing in the local non-forest areas with the consent of local authorities and villagers. If any wild animal is found near the construction site at any point of time, the contractor or his representative will immediately upon discovery thereof acquaint the Environmental Expert of SC and the resident engineer together with the local forest authority for immediate necessary action as will be suggested by them. The Environmental Expert of SC and or the wildlife & forestry expert of EMU will report to the near by forest office (range office or divisional office) and will take appropriate steps/ measures, if required in consultation with the forest officials for rescue or driving out the animal towards the forest.	Contractor	Environmental Expert of SC, EMU of MWD
C.6.3	Chance Found Archaeological Property	All fossils, coins, articles of value of antiquity, structures and other remains or things of geological or archaeological interest discovered on the site shall be the property of the Government and shall be dealt with as per provisions of the relevant legislation. The contractor will take reasonable precautions to prevent his workmen or any other persons from removing and damaging any such article or thing. He will, immediately upon discovery thereof and before removal intimate the Environmental Expert of SC and the EMU of MWD of such discovery and carry out the instructions received from them in dealing with the same while keeping the responsible authority informed of such findings, besides the local police and local administrative authority of the district. The SC will seek direction from EMU of MWD and they from the State Archaeological Department /the district Collector for proceeding in appropriate manner to deal with the chance findings /discovery. Till	Contractor	EnvironmentalExpert of SC, EMU of MWD

		that time the site and the findings shall be under strict watch and ward to prevent any pilferage alteration of the findings by the workmen or locals as the case may be.		
C.7	**Labour Camp Management**			
C.7.1	Accommodation	Contractor will follow all relevant provisions of the Factories Act, 1948 and the Building and the other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 for construction and maintenance of labour camp. The location, layout and basic provision of facilities at each labour camp site will be submitted to SC and EMU of MWD prior to their setting up in the field for approval. The construction of camps will only commence after the written approval from the EMU. In consultation and concurrence of the Environmental Expert and SC. The contractor will maintain necessary living accommodation and ancillary facilities in functional and hygienic manner as per the suggestions and guidance provided by the environment expert and SC.	Contractor	EnvironmentalExpert of SC, EMU of MWD
C.7.2	Potable Water	Provision for supply of potable water to all camp sites in the package will have to be in place in such a manner that the sources are free from pollution and contamination. With proper drainage, platforms, storage facility and sanitation measures in position to see that the surplus and waste water flow does not stagnate or create un healthy atmosphere around camp as well as the surrounding agricultural fields, water sources and habitation. Ground water recharging provision through setting up of soak pits away from such water supply system to discharge the waste water shall have to be made by the contractor at each camp site whether the same is over Govt. or private land. The Contractor will also provide availability of potable water within the precincts of every workplace in a cool and shaded area which is easily accessible as per standards set by the Building and other Construction Workers (Regulation of Employment and Conditions of	Contractor	EnvironmentalExpert of SC, EMU of MWD

Service) Act, 1996.

The contractor will ensure the fulfilment of the following conditions at all work places for the benefit of worker:

a) Adequate supply of potable water (as per IS) in every workplace/labor camp site suitably located on high ground and dry place which is easily accessible and regularly maintained for health and hygiene to prevent contamination and communicable diseases.

b) All such storage facilities of drinking water will be on raised platform for drainage and safe storage above at least 1m ground above ground to facilitate its use..

c) As far as possible shallow well should not be used as potable source of water unless there is any constraint for boring of tube wells. In all such cases of potable water from open wells, irrespective of its location from polluting environment, regular dis-infection of the water source by application of lime, bleaching powder, potassium permanganate solution have to be ensured at weekly /fort nightly interval. However it should be safe to provide water purifier units in such locations to prevent water borne diseases, where power supply and storage water facility is available.

d) All open wells should be covered with a trap door, to facilitate disinfections of water sources while mini hand pumps may be set up to draw water from such wells and prevent accidental contamination /accidental fall into such wells besides avoiding dust and filth from the adjacent road entering the well for which a safe drainage channel encircling the open well should be mandatory to prevent inflow of polluted water from outside.

e) The trap door will be kept locked and opened only for cleaning or inspection, which will be done at least once in a month to be monitored and recorded by the camp in charge at each place.

f) Water quality testing of all potable water sources will be done every month as per parameters prescribed in IS 10500:1991, by sample testing of the water periodically.

Environmental Expert of SC will be required to inspect the labour camp once in a week to ensure health and hygienic of the work force.

C.7.3	Sanitation and Sewage System	The contractor will ensure that - 🕘 the sewage system for the camp are designed, built and operated in such a fashion that no health hazard occurs and no pollution to the air, ground water or adjacent water courses takes place. 🕘 separate toilets /bathrooms /latrines, wherever required, are to be provided for women workers separately with specific signage indicating its exclusive use by them. 🕘 All such facilities must have adequate water supply with proper drainage and disposal facility. 🕘 All toilets in workplaces are to be located with covered screen walls and of dry earth system which are to be maintained, cleaned and disinfected daily using strong disinfectants. The location of such provisions should not be affecting the air surface water and ground water of the locality or the agricultural fields near by either during summer or rains. 🕘 For lavatory purposes the use of portable latrines system are to be brought under use and the night soil so collected has to be disposed of at designated septic latrines, so as to prevent pollution of the workplace and surrounding areas.	Contractor	Environmental Expert of SC, EMU of MWD
C.7.4	Waste Disposal	The contractor will provide garbage bins in the camps and ensure that these are regularly emptied and disposed off in a hygienic manner as per the Comprehensive Solid Waste Management Plan approved by the Environmental Expert of SC. No night soil should be disposed of at any place other than the septic tank constructed for the workers at the camp site by ensuring the use of portable latrines system mounted on wheels and fitted with temporary water sealed containers to store the night soil, which shall be emptied at the nearest septic tank facility of any camp site.		
C.8	**Contractor's Demobilization and Decommissioning of Established Setup**			
C.8.1	Clean-up Operations, Restoration and Rehabilitation	Contractor will prepare site restoration plans, which will be approved by the Environmental Expert of SC. The clean-up and restoration operations are to be implemented by the contractor prior to demobilization. The contractor will clear all temporary structures; dispose all garbage, night soils and POL, as per Comprehensive Waste Management Plan and as approved by SC and accepted by the EMU.	Contractor	Environmental Expert of SC, EMU of MWD

		All disposal pits or trenches will be filled in disinfected and effectively sealed off. Residual topsoil, if any will be distributed or spread evenly on adjoining/ proximate barren land or affected agricultural land adjacent to the RoW that has been impacted on account of accidental spillage, drainage or erosion of the construction materials as will be identified and suggested by Environmental Expert of SC not below the thickness of 75 mm. All construction zones including river-beds, culverts, road-side areas, camps, hot mix plant sites, crushers, batching plant sites and any other area used/affected by the project will be left clean and tidy, at the contractor's expense, to the entire satisfaction of the land owner in case of private land and to the best satisfaction of the Environmental Expert of SC as well as the site engineer.			

OPERATION STAGE

Sl. No.	Environmental Issue	Management Measures	Reference Document	Responsibility	
				Execution/Civil Work	Supervision/Monitoring
OPERATION STAGE					
Activities to be Carried Out by the MWD (EMU)					
O.1	Monitoring Operation Performance	The MWD will monitor the operational performance of the various mitigation/ enhancement measures carried out as a part of the project. The indicators selected for monitoring include the survival rate of trees; utility of enhancement provision for schools, hospitals, water bodies, temples, spur roads, bus stand and sheds at bus stops, sealing of abandoned, bore wells, stand posts, wells, re-sinking of bore wells and noise and dust filter structures at sensitive receptors, site enhancement measures at recreation points, bus and truck lay bye etc. including status of rehabilitation of borrow areas; and utility of		EMU of MWD/PWD The Forest and Biodiversity wing of EMU of MWD	EMU of MWD/PWD

		noise barriers. The completion of wildlife under passes as per design and specifications with approach corridor plantations and its 3 years maintenance schedule for survival and development into a proper wildlife corridor has to be keenly monitored and evaluated. The rehabilitation of degraded sites along with development and functioning of nalas, streams and gullies after soil and water conservation measures has to be inspected, recorded and timely damages repaired for effective functioning and maintenance of such efforts in the field. Monitoring of the wildlife movement along the wildlife under passes provided for in the corridor. Monitoring the function and stability of temporary water holes /water storage tanks provided on either side of the corridor to remove distress of the wildlife during late winter and summer months till the corridor is restocked with necessary avenue plantation and restoration /improvement of degraded /eroded sites.		
O.2	Maintenance of Drainage	MWD will ensure that all drains (side drains, median drain and all cross drainages) are periodically cleared especially before monsoon season to facilitate the quick passage of rainwater and avoid flooding without damaging the spurs and check dams erected to stabilize the course and flow of all such drainage channels. MWD will ensure that all the sediment /oil and grease traps set up at the truck and bus lay bye are cleared once in every 3 months.	EMU of MWD/PWD	EMU of MWD/PWD

0.3	Pollution Monitoring	The periodic monitoring of the ambient air quality, noise level, water (both ground and surface water) quality, soil pollution/contamination are to be continued at pre-designated locations and if necessary at additional locations for comparative study of pre and post-operative data in order to ensure further improvement /modification in the design /methodology MWD may appoint specific pollution monitoring agency for such study or carry it out as per the suggestion /recommendation of the statutory authority, (SPCB).	EMU Environment expertPollution Monitoring Agency	EMU of MWD/PWD
0.3.1	Atmospheric Pollution	Ambient air concentrations of various pollutants shall be monitored as envisaged in the pollution monitoring plan at pre designated locations to compare it with the pre-construction data and ensure further improvement by collection of additional data at additional location as the situation demands. The avenue plantation raised afresh and the old avenue trees retained are to be periodically checked with respect to the plantation register for evaluating the effect and importance of avenues along the road. Site enhancement plantations together with plantation to serve as noise and dust filters, environment up-liftment for aviary and amphibian fauna near water sources by relocation of avenue trees are to be monitored and brought into a register of such activity for study of their growth, utility and impact on the biodiversity as well as environmental parameters.	EMU of MWD Pollution Monitoring Agency	EMU of MWD/PWD
0.3.2	Noise Pollution	Noise pollution will be monitored as per monitoring plan at sensitive locations where pre construction noise quality studies were conducted. The survival and functioning of the noise filter plantations and noise control walls has to be specifically supervised and monitored for further improvement /replication at other affected points if necessary. The plantation of dwarf bamboos at such locations along the road avenue needs special mention in cyclone ravaged	Pollution Monitoring Agency	EMU of MWD /PWD

		corridor to enforce the control programs. Monitoring the effectiveness of the pollution attenuation barriers, if there is any, will be taken up thrice in the operation period. The effectiveness of functioning of the earth cushion provided at wildlife under passes and viaducts near wet land eco system with trap drain structures at different locations will be monitored and evaluated to study the incidents of reduction in death of amphibians and reptiles at such points in comparison with other control points without such structures for further improvement in the corridor to prevent such destruction of biodiversity.		
O.4.	Soil Erosion and Monitoring of Borrow Areas	Visual monitoring and inspection of soil erosion at borrow areas, quarries (if closed and rehabilitated), embankments and other places expected to be affected, will be carried out before monsoon, during monsoon and after winter rains to regularly record and monitor the effectiveness of such structures at monthly intervals for the 1st three years during and after completion of project, so as to evaluate the beneficial effects of each type of activity together with the cost involved for adoption of most effective structures in other areas of road improvement to check soil erosion.	EMU of MWD /PWD	EMU of MWD /PWD
O.5	Changes in Land Use Pattern	EMU of MWD shall take initiative to move and motivate the Govt. as a facilitator in preparing an action plan to encourage balanced congestion free hygienic environment friendly activity on either side of the developed highway during and after completion of the project. This is to avoid irregular, ugly, unhygienic and destructive ribbon development, close to the road corridor which adversely affects agricultural and water harvesting capabilities and drainage system of the area. The department may strive for effective promulgation of some legislation and guidelines, controlling such unbridled activity,	EMU of MWD /PWD, Local Planning Authorities, Revenue Department and Local Civic Bodies EMU of the MWD& Revenue Department, Town planning Authority	EMU of MWD /PWD EMU of MWD /PWD

	which are self-destructive and distress full for the poor farmers and drainage on the State's Economic Resources. A land use-zoning map may be developed, under which up to a particular distance from the RoW of the alignment especially in new bypass stretches, no development will be allowed. Necessary hoardings along the corridor need be provided in shape of permanent structures to warn and advise encroachers against such activity under punitive action such as forfeiture of the structures and belonging without prior notice besides punitive legal action in the court of law barring any stay over such action by the state from any court of law. Budgetary provisions are to be made to control the ribbon development along project road.	

10.10 Social Impact Assessment (SIA)

Social Impact Assessment (SIA) is predicated on the notion that development interventions have social ramifications and it is imperative that decision-makers understand the consequences of their decisions before they act and people affected get the opportunity to participate in designing their future. Social assessment helps to make the project responsive to social development concerns. Developmental initiatives informed by social assessment alleviate poverty, enhance inclusion and build ownership while minimizing and compensating for adverse social impacts on the vulnerable and the poor. Social Impact Assessment can be defined in terms of efforts to assess or estimate, in advance, the social consequences that are likely to follow specific policy actions (including programs and the adoption of new policies), and specific government actions. It is a process that provides a framework for prioritizing, gathering, analysing, and incorporating social information and participation into the design and delivery of developmental interventions. It ensures that development interventions: (i) are informed and take into account the key relevant social issues; and (ii) incorporate a participation strategy for involving a wide range of stakeholders.

10.10.1 Summary of Applicable Acts and Policies

Applicable acts, notifications, and policies relevant in the context of the project are discussed below. The Project Authority will ensure that project activities implemented are consistent with the national, state, local regulatory/legal framework for Social Considerations.

Table 81: Applicable Acts and Policies

No.	Acts, Notifications, Policies	Relevance and Applicability to the Project
1	Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 (LARR 2013)	Provides for enhanced compensation and assistances measures and adopts a more consultative and participatory approach in dealing with the Project Affected Persons (PAPs). The Act took effect in January 2014, however, State of Manipur opposes to the provisions on the ground that being under the Sixth Schedule of the Constitution, land in the State belongs to the individuals and not the Government.
2	National Rehabilitation & Resettlement Policy, 2007 ((NRRP	Provides limited benefits to affected family (an ex-gratia payment of not less than Rs. 20,000/- and in

	2007)	case land-holder becoming landless or small or marginal farmer in such cases other rehabilitation benefits as applicable.
3	The National Tribal Policy, 2006	Provides an environment conducive to the preservation of traditional and customary systems and regime of rights and concessions enjoyed by different ST communities.
4	The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006	Provides for recognition of forest rights to Scheduled Tribes in occupation of the forest land prior to 13.12.2005 and to other traditional forest dwellers who are in occupation of the forest land for at least 3 generations i.e. 75 years, up to maximum of 4 hectares. These rights are heritable but not alienable or transferable.
5	The Right to Information Act, 2005	Provides for setting out the practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, the constitution of a Central Information Commission and State Information Commissions and for matters connected therewith or incidental thereto.
6	World Bank OP 4.12 – Involuntary Resettlement	The project requires additional land area for widening and strengthening, junction improvements, realignments, safety provisions, etc. It will also affect structures mainly used for residences, business units, cattle sheds and livelihood of people. Some of them are without any valid pass/permit. All affected under the project, irrespective of a valid pass/permit shall be supported under the project to improve their quality of life or at least restore to pre-project standards.

7	OP 4.10 – Indigenous Peoples	Over 90% of the population in the State belongs to Tribal community, and almost all affected households belong to ST. While a separate IPP report is not prepared, the issues discussed in RAP takes into account this fact and address issues related to indigenous peoples in the RAP. The project shall ensure broad community support for the project based on free prior and informed consultation.

10.10.1.1 Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act (LARR), 2013

The Act provides for enhanced compensation and assistances measures and adopts a more consultative and participatory approach in dealing with the Project Affected Persons. Enhanced compensation provision for land acquisition provides for 1-2 times the prevailing market rate (as determined by stipulated mechanism, primarily relying on officially recorded/registered rates) in urban areas (as determined by the state) and 2-4 times the prevailing market rate in rural areas. The original law also made provision for need for 'consent', while exempting 13 existing laws (having sections governing land acquisition processes for projects coming under its ambit). Subsequently, in 2015 an amendment bill was brought in the bill and enforced through ordinance by the current central government. Key changes made by this bill vis-à-vis the original law are:

The LARR 2013 exempted 13 laws, including the National Highways Act from its purview. However, the LARR 2013 required that the compensation, rehabilitation, and resettlement provisions of these 13 laws be brought in consonance with the LARR 2013 within a year of its enactment (that is, by January 1, 2015), through a notification. The Bill brings the compensation, rehabilitation, and resettlement provisions of these 13 laws in consonance with the LARR Act, 2013. The Bill creates five special categories of land use: (i) defence, (ii) rural infrastructure, (iii) affordable housing, (iv) industrial corridors, and (v) infrastructure projects including Public Private Partnership (PPP) projects where the central government owns the land. The LARR 2013 requires that the consent of 80% of landowners is obtained for private projects and that the consent of 70% of landowners be obtained for PPP projects. The proposed amendment to the Bill, currently under the parliamentary discussion, exempts the five categories mentioned above from this provision of the Act. Being a rural infrastructure project, the above requirement does not technically apply to this project. As per the proposed amendment, projects that belong to five categories do not require social impact assessment. The amendment has not yet passed,

but regardless the passage of the amendment, the project has sought to obtain support from the affected community as shown in the chapter on consultation in keeping with JICA Guidelines for Environmental and Social Guidelines. Timeline for LARR 2013 amendment process is as follows.

Table 82: Process of Amending LARR 2013

Date	Action
1 January 2014	LARR 2013 comes into existence, repealing the Land Acquisition Act, 1984
31 December 2014	LARR (Amendment) Ordinance, 2014 promulgated
24 February 2015	LARR (Amendment) Bill, 2015 introduced in Lok Sabha
10 March 2015	LARR (Amendment) Bill, 2015 passed in Lok Sabha with amendments but could not be passed by the Rajya Sabha and remains pending
3 April 2015	LARR (Amendment) Ordinance, 2015 incorporating the amendments made by the Lok Sabha promulgated
10 April 2015	Public interest litigation (PIL) filed in Supreme Court to declare LARR (Amendment) Ordinance, 2015 as "unconstitutional" and ultra vires of the Constitution and as a "colourful exercise of power"
13 April 2015	Supreme Court issues notice in the PIL but refuses to stay the LARR (Amendment) Ordinance, 2015.
11 May 2015	LARR (Amendment) Second Bill, 2015 introduced in the Lok Sabha
13 May 2015	LARR (Amendment) Second Bill, 2015 referred to the Joint Committee of Parliament
30 May 2015	LARR (Amendment) Second Ordinance, 2015 promulgated. The ordinance will lapse if it is not passed by Congress within six months.

Other requirements in the LARR 2013 that may be applicable to this project are the following:

- The LARR 2013 required that if the acquired land remains unused for five years, it must be returned to the original owners or the land bank. The Bill states that the period after which unused land will need to be returned will be: (i) five years, or (ii) any period specified at the time of setting up the project, whichever is later.
- The LARR Act, 2013 states that the Land Acquisition Act, 1894 will continue to apply in certain cases, where an award has been made under the 1894 Act. However, if such an award was made five years or more before the enactment of the LARR 2013, and

the physical possession of land has not been taken or compensation has not been paid, the LARR 2013 will apply.

- The LARR 2013 stated that if an offence is committed by the government, the head of the department would be deemed guilty unless he could show that the offence was committed without his knowledge, or that he had exercised due diligence to prevent the commission of the offence. The Bill replaces this provision and states that if an offence is committed by a government official, he cannot be prosecuted without the prior sanction of the government.

10.10.1.2National Rehabilitation & Resettlement Policy, 2007

The policy, prepared by the Department of Land Resources, Ministry of Rural Development, and Government of India, stipulates the minimum benefits to be ensured for persons displaced due to acquisition of land for public purposes. The objectives of the Policy are:

(a) to minimize displacement and to identify the non-displacing or least-displacing alternatives;

(b) to plan the Resettlement and Rehabilitation of project affected families (PAFs), or project affected households (PAHs), including tribal and vulnerable households;

(c) to provide improved standard of living to PAFs or PAHs; and

(d) to facilitate a harmonious relationship between Requiring Body/Competent Authority (CA) and PAFs.

The Policy is applicable to projects displacing 400 or more families en masse in plain areas, or 200 or more families en masse in tribal or hilly areas, Desert Development Program (DDP) blocks, areas mentioned in Schedule V and Schedule VI of the Constitution of India. Some of the highlights of this policy may be noted as follows:

(i) Recognizes apparent need for additional R&R benefits which must be beyond compensation of loss of land or structure;

(ii) SIA as mandatory component where project is likely to impact 400 or more families en masse (in plain areas), or 200 or more families en masse in tribal or hilly areas;

(iii) Detailed R&R planning in case anticipated displacement is more than 400 families in plains (200 families in hilly/tribal areas). The plan to have details such as extent of land to be acquired with names and identification of affected families, village wise list of affected persons, their profile, agricultural labourers as affected persons, people with livelihood affected, list of occupiers, public utilities, comprehensive list of benefits and packages to be provided to affected persons. Other information

include- Resettlement site related details such as location and area, amenities to be provided, schedule for displacement and resettlement;

(iv) Special care to protect rights of weaker sections specifically SC and ST community and affirmative action by way of state obligation for their treatment with concern and sensitivity;

(v) R&R cost (arising out of benefits and packages beyond compensation) will be included as part of project cost;

(vi) Compensation and resettlement activities to be done well in advance of ouster of affected families;

(vii) R&R benefits to be extended to all affected families. Benefits includes possible allotment of house site, one time assistance for house construction to BPL families (quantum aligned with existing house construction schemes by state), Replacement cost basis or land for land approach for PAFs who have become landless or marginal account of project impacts. Stamp duty and other fees to be borne by requiring body. Provisions of assistance for land development, cattle shed, shifting allowance (on actual cost basis), assistance to rural artisans, self-employed for construction of working shed/shop. Conditional provision for employment of those rendered jobless or rehabilitation grant, subsistence allowance for displaced PAFs; and

(viii) Requirement of developing of tribal development plan and recommended consultation with tribal advisory council where project entails displacement of 200 or more ST families.

Consultation with Gram Sabha or Panchayats for land acquisition in scheduled areas.

10.10.1.3 National Tribal Policy 2006

The Scheduled Tribes (STs) have traditionally lived as isolated entities in about 15% of the country's geographical areas, mainly forests, hills, undulating inaccessible terrain in plateau areas, rich in natural resources. The problems and difficulties being faced by the scheduled tribes and tribal areas in the country are to be addressed by the National Tribal Policy, 2006. A periodic review of implementation of various initiatives/measures outlined in the policy is essential to ensure accountability of the different public agencies responsible for implementation and to reveal the practical difficulties in implementation. The objectives of the policy are to:

- Provide an environment conducive to the preservation of traditional and customary systems and regime of rights and concessions enjoyed by different ST communities, and reconciliation of modes of socio-economic development with these.

- Prevent alienation of land owned by STs and restoring possession of wrongfully alienated lands.
- Protect and vesting of rights of STs on forestlands and other forest rights including ownership over minor forest produce (MFP), minerals and water bodies through appropriate legislations and conversion of all forest villages into revenue villages.
- Provide a legislative frame for rehabilitation and resettlement in order to minimize displacement, ensure that affected persons are partners in the growth in the zone of influence, provide for compensation of social and opportunity cost in addition to market value of the land and rights over common property (NPV).
- Empower tribal communities to promote self-governance and self-rule as per the provisions and spirit of the Panchayats (Extension to the Scheduled Areas) Act, 1996.

Protect political rights to ensure greater and active participation of tribal peoples in political bodies at all levels

SOCIAL IMPACT ASSESSMENT & RESETTLEMENT ACTION PLAN

SOCIAL IMPACT ASSESSMENT ANDRESETTLEMENT ACTION PLAN

11.1 INTRODUCTION

The chapter is a summarized version of impact on field due to project road development in form of land acquisition and clearances, it attempts to comprehend the existing socio-economic profile of the project area along with understanding and quantifying the magnitude of impact due to the proposed improvement and up gradation. The impact has been studied with respect to various sensitive groups like the vulnerable population, women, tribes etc. The chapter also outlines the strategy adopted to ensure that the PAPs are able to "regain their previous living standards". Further, the institutional arrangement to be adopted for this project has been outlined with the resettlement and rehabilitation costs at the end.

11.2 OBJECTIVES OF RAP

- Establish the magnitude of adverse social impacts due to the project and propose mitigation measures through the ORRP.
- Involuntary resettlement will be avoided wherever possible or minimized exploring all other project alternatives.
- Analyse results of stakeholders' consultations and incorporate their feedback and opinions in the final design.
- Develop institutional mechanism for implementation of the R & R activities and for monitoring and evaluation of the R & R process.

11.3 POLICY, LEGAL FRAMEWORK AND ENTITLEMENT MATRIX

The RAP document has been prepared in concurrence with applicable State Government, Government of India and ADB policy and legal framework and Land Acquisition Act (2013; amended in 2013). The institutional arrangements provisioned in the Policy are meant to ensure a transparent delivery of rehabilitation assistance. District and State level Compensation Advisory Committee, are the major institutional mechanism which offers consistent support to population adversely affected with involuntary displacement. Institutional arrangements to address grievances of project displaced people and the specific monitoring mechanism are noteworthy features of the Manipur Government. A detailed description of the R&R measures and assistance shall be carried out in the entitlement framework.

11.4 SOCIO-ECONOMIC IMPACTS AND MITIGATION MEASURES

The likely socio-economic impacts after incorporation of design mitigation measures comprise the following tangible impacts:

- Strip land acquisition along the project corridor,
- Partial / full removal of public and private road side structures and
- Relocation of public utilities and amenities

Various intangible impacts include:

- Likely Gender specific impacts,
- Likely impacts related to Child labour,
- Safety risk to pedestrians and slow moving traffic, and
- Increase in instances of transmission of HIV/AIDS to various high-risk groups such as truckers and sex workers.

11.4.1 Loss of Land

Since the existing RoW is not adequately wide, 8-15 m being common at most places the requirement for acquiring new land has greatly increased. The process of land acquisition is under process for this road stretch as the revenue maps are currently not available with the concerned Authority. The details shall be incorporated soon in the next deliverables.

The compensation for land acquisition shall be based on the provisions of Land Acquisition Act 2013. Compensation for diversion of forest lands shall be as per the provisions of Forest Conservation Act 1980 (Amendments Made in 1988) if any.

11.4.2 Impact on Structures

After incorporation of mitigation measures into the design, a total of 160 road side structures are likely to be affected out of the total 8 structures are buildings, 152 are sheds which are likely to be affected during the widening purpose.

The major structures along the road comprise residential, commercial and mixed (residential and commercial) structures. Project affected structures have been distinguished into partly and fully affected structures. Distribution of the project affected structures has been presented in Table 82.

Table 83: PROJECT AFFETED STRUCTURES

Sl.No.	Type	SIDE	NUMBERS
01	BUILDING	LEFT	26
		CENTER	8
		RIGHT	67
02	SHED	LEFT	83
		CENTER	9
		RIGHT	57

11.4.3 Impact on Trees

The road alignment passes primarily through rich agricultural fields. A lot of trees require felling, detail of it is provided in the appendix. Large number of trees/ plants of various species planted along the avenue and median exist within and outside the ROW. The trees cut during the process of widening shall be compensated with planting double the amount of trees cut or pay the price as decided by the government and authorities.

11.4.4 Gender Impacts

Manipur is one of the most economically backward states of North-Eastern region of India bordering with Myanmar. Women constitute about half of the total population and about 40% of the workforce in the state .Unlike other parts of India, Manipuri women face less discrimination .Women are playing multiple role in the economy and society besides their role as mother, wife ,home maker ,and care giver in the household. But their participation in the organised sector as worker is low as majority of them are engaged in the informal or unorganised sector characterized by low productivity, insecurity and vulnerability.

Specific facilities that will be provided for women labourers in the construction camps include:

- Temporary housing;
- Health centre;
- Day crèche facilities;
- Suitable work scheduling for women labourers;
- Necessary education facilities

11.4.5 Child Labour

Children below the age of 14 years will be restricted from getting involved in the constructional activities and wage employment.

11.4.6 Road Safety

During engineering survey few critical locations from road safety point of view were encountered such as junctions with high traffic congestion, deficient curves, major pedestrian crossings near settlements, stretches with significant slow moving traffic and unpredictable road user behaviour. The engineering design deficiencies at these locations have been adequately addressed in the engineering designs.

For road behaviour issues road safety awareness campaigns will be developed to improve the knowledge, attitudes and behaviour of all road users through a combination of formal and non-formal education, adult programs and mass communication activities. Community awareness activities will be carried out by combining a series of programs such as raising general

awareness of the public. The target groups for the public education and awareness campaign are school children, school teachers, senior citizens, roadside dwellers and shop-keepers, drivers of motorized and non-motorized vehicles, paramedical, religious leaders.

11.4.7 Combating HIV/AIDS

Manipur has been placed at the second spot among Indian states with high HIV/AIDS prevalence rate. Moreover, all nine districts of the State are under Category-A of HIV/AIDS prevalence. Around 500 cases are detected every three months resulting to about 2000 cases annually in the State. There are six Integrated Counselling and Testing Centres (ICTC) in Bishnupur, four in Chandel, 10 in Churachandpur, 13 in Imphal East, 15 in Imphal West, seven in Senapati, 10 in Thoubal and eight in Ukhrul district.

An Action Plan has been prepared in view of the location specific issues and measures to combat the same.

The intervention strategy for combating HIV/AIDS in the highway sector includes various measures such as IEC, BCC, creation of enabling environment, social marketing of condoms, care and support.

11.4.8 Utility Relocation

In view of the impact of the proposed project on utilities and to reallocate the same, proper survey and analysis has been carried out. Separate volume of strip plans incorporating the locations of utilities have been provided. The total project include such as Electric Poles, Transformers, Telephone Poles, Water Supply pipes, Water tanks, OFCs etc. The table below represents an abstract of the utilities present along the project road.

Table 84: DETAILS OF AFFECTED UTILITIES

Sl. No	Utility Type	Unit	Number of Units
1	Electricity Poles	Number	136
2	Electricity Transformers	Number	4
4	Water Tank	Number	12
6	Water pipeline (length in Mtr)	Running Meter	Approx. 4200
7	OFC	Number	19

11.5 STAKEHOLDER CONSULTATIONS AND PREFERENCES

Public consultation shall be carried out at various locations along the project corridor. The locations include Gwaltabi, Thawai, Zalenbung, Shangkhai, LamlaiChingphei, Mongkot, Litan Sareikhong, TM Kasom and Shakvao. Consultations shall also be carried out in tribal hamlets and in locations where tribal population are getting affected. Some of the common concerns of the PAPs expressed during the consultation process have been outlined below.

- Compensation package emerged as the major cause of worry for most PAPs. They expressed their doubt whether the compensation amount would meet their expectation and be able to make up for the loss.
- Management of common property resources (CPR) was also viewed as a critical issue as according to common perception the CPRs are seldom rehabilitated as per community opinion. It was suggested that shifting of utilities and CPRs be done after consultation with the local people.
- It was suggested by the villagers that local labour should be hired to provide employment to the villagers for the construction period.

Along the congested settlements, PAPs suggested that concentric widening be so that equal amount of land is acquired from either side of the road.

TRAFFIC OPERATIONS AND SAFETY PLAN

TRAFFIC OPERATION & SAFETY PLANS

12.1 General

For a good and effective safety planning of the road, the safety designer should first know the project corridor properly and then plan a synchronised work plan to be followed throughout the operation process of the road construction.

The Planning of the safety of the road project should be done in three phases during the operation. The first phase should be planned before the constructional operation starts, the second phase of safety design should commence during the construction process and the third phase shall be employed after the construction ends.

Stages of Planning:

- Pre-construction
- During Construction
- Post Construction

12.2 Scope

The Scope of traffic operation and safety Plan includes the safety of:

- Site / Project Workers
- Road Users
- Construction Machineries / Equipment
- Environment
- Project Assets

12.3 Pre Construction Safety Plan

The stage of construction for a safety plan initiates from the pre-construction stage. The stage of pre-construction for a road project involves the personnel to collect the data of the project corridor and interaction with the road users. So, the safety of the Survey personnel along with the road users during the process of surveying should be given priority.

12.3.1 Steps involved during the Pre-Construction Safety Stage

- The personnel involved in the survey investigation should wear reflectorized dress or jackets so, that the road users approaching can view them from far distance and slowdown in the stretch being surveyed
- The vehicle involved in the survey process should be painted with reflecting colour and marked with company name and parked at proper distance away from the traffic without causing any hindrance

- Road Delineators should be used at the site of survey which should be as per the code of IRC: 79
- Proper Safety should be followed during the work near high voltage power lines, bridges and water bodies
- The personnel involved in the process of survey should be dressed properly which does not cause any hindrance or harm to the person.

12.4 During Construction Safety Plan

In construction, typically safety is treated as a discrete and separate function within the contractor's organization. Much of what we do in safety revolves around incidents, accidents, and losses. We use programs and other strategies to help us control their adverse effects. We train our workers in accordance with safety standards. We measure our success in reduced incidents and by comparing our loss data to national statistics.

Our accidents and losses impact our cost of risk and ultimately our very competitiveness in a highly competitive industry. This also may well diminish our ability to market construction services and/or secure work. Accidents usually do not happen due to fate or intent on the worker's part. They happen because of ineffective processes, inadequate procedures, poor planning or lack of foresight. Therefore, we must get away from the predominantly worker-focused interventions common in the industry, and look into areas that the worker has little or no control over but are the underlying contributing causes of incidents and losses.

12.4.1 Guiding Principles

The construction zone creates an environment where the road user is faced with a series of unusual hazards in the form of unfamiliar routes, substandard horizontal and vertical alignment, adverse cambers, construction equipment etc. the safety practices in construction zones should therefore be oriented towards reducing conditions which lead to such hazards and consequent stress where by risk of accident is increased. The guiding principles for safety in road construction zones are to:

i. Warn the road user clearly and sufficiently in advance
ii. Provide safe and clearly marked lanes for guiding road user
iii. Provide safe and clearly marked buffer and work zones, and
iv. Provide adequate measures that control driver behaviour through construction zones

12.4.2 Components of the Construction Zone

Legal Aspects

The policy under these guidelines is to keep the closure of the roads to a minimum and to ensure that traffic is delayed as little as possible by the construction operations. The traffic

management strategies to be used at construction zones should ensure that the traffic safety is an integral and high priority element of the project. This can be ensured by avoiding inconvenience to traffic as far as possible and by guiding the drivers in a clear and positive way. Routine inspections of traffic control elements and traffic operations must be carried out so that care and attention to roadside safety is never slack during the progress of project.

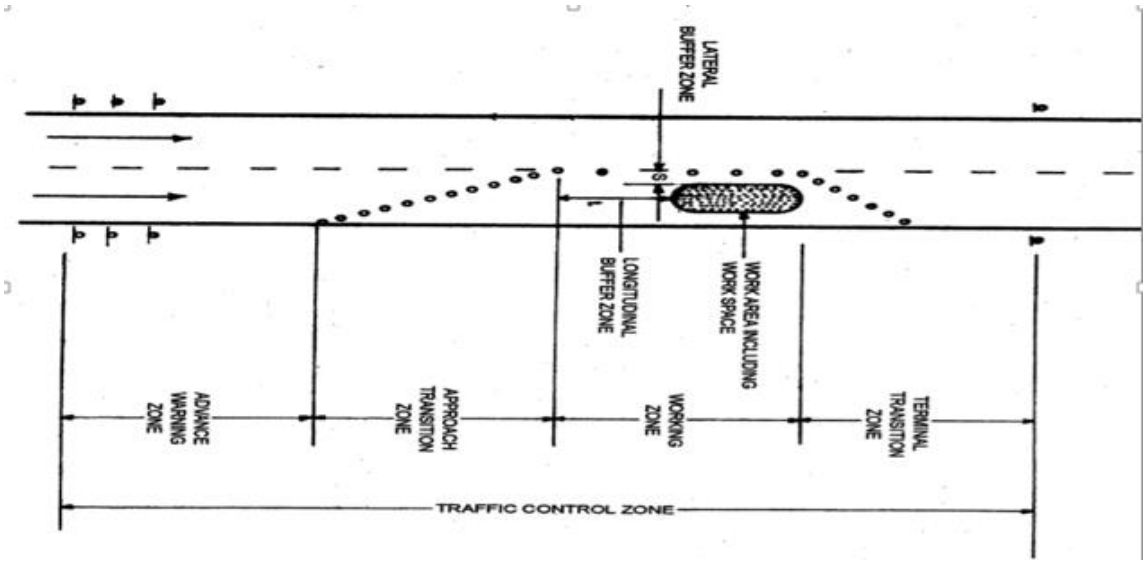
Traffic Control Zone

In rural areas, the problems at many construction zones is accentuated by the availability of only an undivided carriageway, which may involve problems of either the temporary acquisition of ;land for diversions, or the sharing of the limited remaining road space by road users under som4e form of traffic control. In any case it should be ensured that road user is properly segregated from the working zones.

In urban areas where construction zones are likely to be even more constrained, diversions may have to be taken over adjacent sections of the road network in addition to the sharing of road space by road users. The effects of construction zones may, therefore, be felt over a wide area.

The Traffic Control Zone can be divided into three components, that is, the Advance Warning Zone, the Transition Zone, and Working Zone. All construction zones will have a working zone, which is flaked, by a transition zone for each direction of approaching traffic and an advance warning zone will precede these in turn.

Figure 34: ELEMENT OF TRAFFIC CONTROL ZONE



Traffic Control Devices

Traffic control devices individually and collectively perform the following tasks:

i. Warning the road user;
ii. Inform the road user;
iii. Guide the road user;

iv. Modify road user behaviour;

v. Protect the road user and the vehicle;

vi. Ensure safe passage to the road user; and

vii. Provide a safe working area

Figure 35: TRAFFIC SIGNS USED FOR CONSTRUCTION ZONE

Figure 36: PLACEMENTS OF SIGN

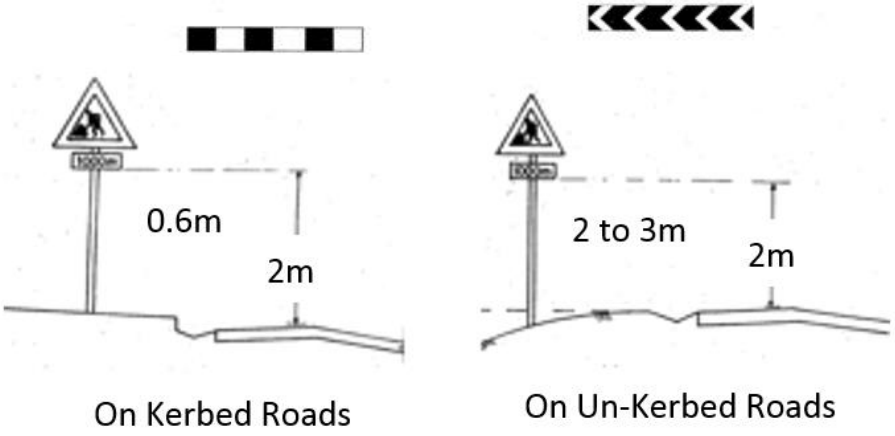


Figure 37: TRAFFIC DEVICES USED IN CONSTRUCTION ZONES

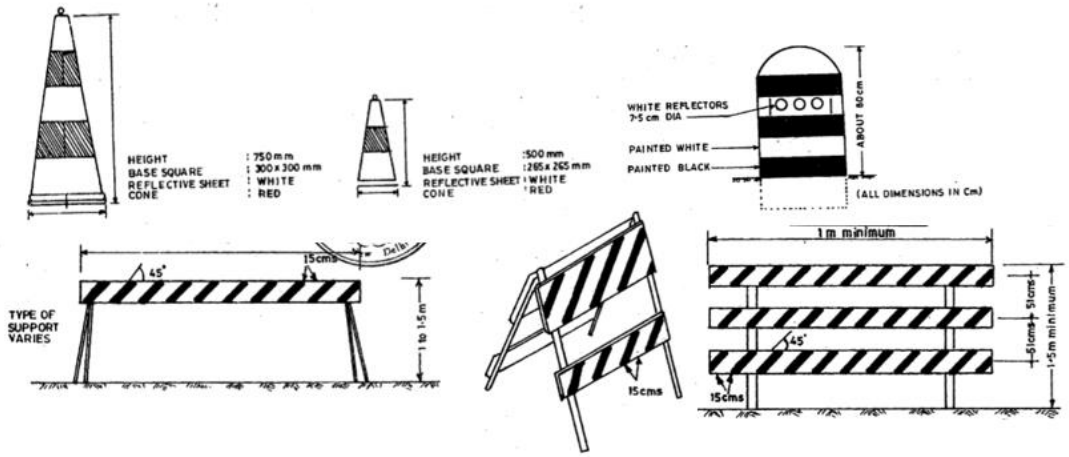


Figure 38: FLAGMEN AT CONSTRUCTION ZONE

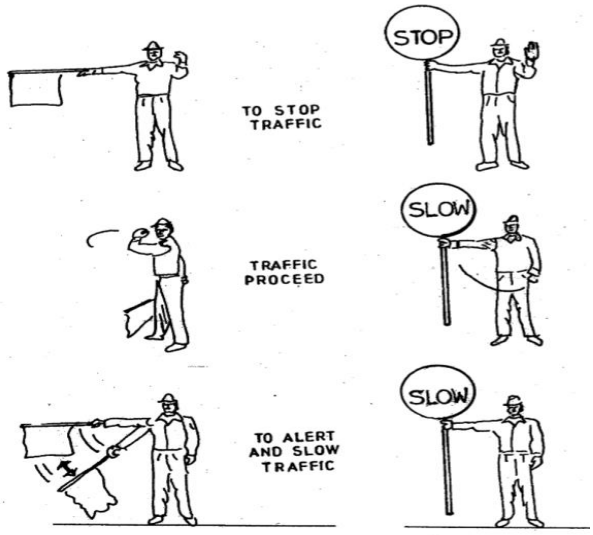


Figure 39: TRAFFIC CONTROL BY STOP/GO BOARDS

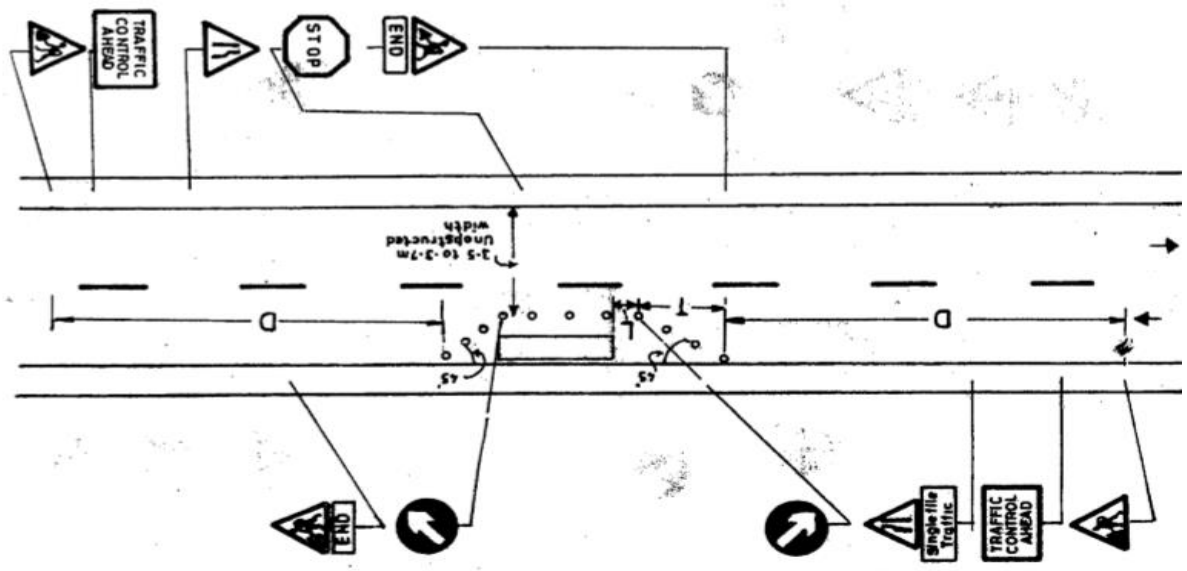
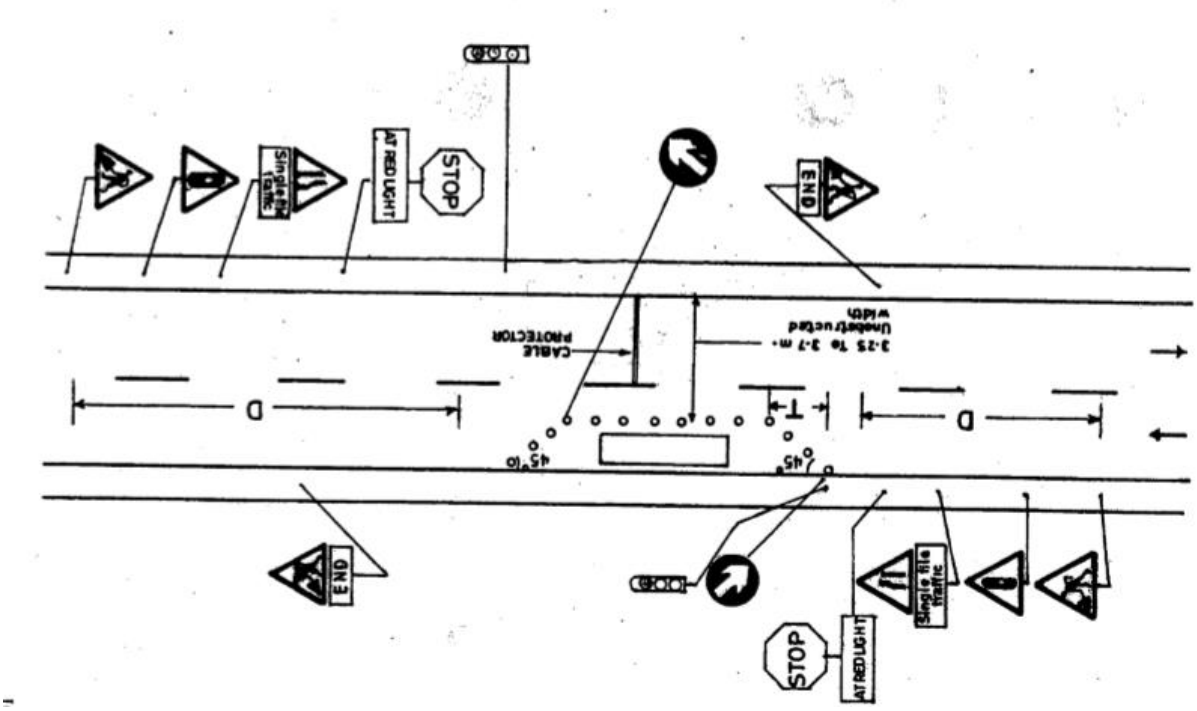


Figure 40: TRAFFIC CONTROL BY PORTABLE TRAFFIC SIGNALS



All works during construction should be followed with safety codes as per provided in the IRC: SP: 55 code. The code provides safety norms to be followed during construction which will directly or indirectly protect the workers and road users during an on-going work.

12.5 After Construction Safety Plan

Even after the construction gets over the risk of accident lurks on the roads. The Engineer must keep an eye on the safety of the road users and in-time make the users aware of the road. The safety of the users can be executed even after the construction is over by providing the project stretch with proper and adequate signs as per codes and other norms.

Traffic signs are the silent speakers on the road. Be it the person behind the wheel or a pedestrian, having a sound knowledge about road safety is absolutely necessary for all before hitting the roads.

12.5.1 Traffic Signs

Traffic signs give information about the road conditions ahead, provide instructions to be followed at the major crossroads or junctions, warn or guide drivers, and ensure proper functioning of road traffic. Being unaware of road signs is akin to throwing caution to the wind. It can lead to loss of life and property. A person is supposed to be familiar (get through a written or oral test) with the traffic signs and symbols before acquiring a driving license in India.

Road safety signs are primarily of three types

1. **Mandatory Signs**: These signs are used to ensure free movement of traffic and make the road users cognisant of certain laws and regulations, restrictions and prohibitions. Violation of these signs is an offence, as per law.
2. **Cautionary Signs**: These signs make the road users conscious of hazardous conditions on the road beforehand. The drivers, accordingly, take necessary actions to handle the situation.
3. **Informatory Signs:** These signs guide the road users about destinations, distance, alternative routes, and prominent locations like food joints, public toilets, nearby hospitals, etc.

12.6 Road Markings

Road markings are used as a means of controlling and guiding traffic. They are highly important on urban roads and intersections as they promote road safety and bring out smooth and harmonious flow of traffic along guided paths of travel. They also supplement the messages conveyed by road signals and signs. In some cases, they are used alone to convey certain regulation, information or warning that cannot otherwise be effectively made known to the road users.

The main functions of the road markings are to guide the safe and smooth flow of traffic in the following ways:

i) Segregation of traffic
ii) Stop and go
iii) Give way instruction
iv) Overtaking or not
v) Two lanes to one lane/ lane traffic
vi) Inter-vehicle distance
vii) Parking zone or no parking
viii) Speed indication
ix) Direction
x) One way
xi) Pedestrian crossing
xii) Type of vehicles allowed

Types of Road Markings Road markings are basically of two types: Carriageway markings and Object markings.

Carriageway Markings

As the name implies, these are the markings applied to the carriageway. Carriageway markings are of the following categories:

i) Centre line
ii) Traffic lane lines
iii) No-overtaking zone markings
iv) Pavement edge line (both sides)
v) Carriageway width reduction transition markings
vi) Obstruction approach markings
vii) Stop lines
viii) Pedestrian crossings
ix) Cyclist crossings
x) Route direction arrows etc.
xi) Word message
xii) Markings at approaches to intersections
xiii) Parking space limits
xiv) Bus stops

Object markings

Object markings are of the following categories:

i) Objects within carriageway
ii) Kerb marking for visibility
iii) Kerb marking for parking restriction
iv) Objects adjacent to the carriageway
v) Median marking

Figure 41: ROAD MARKINGS FOR STOP SIGNS

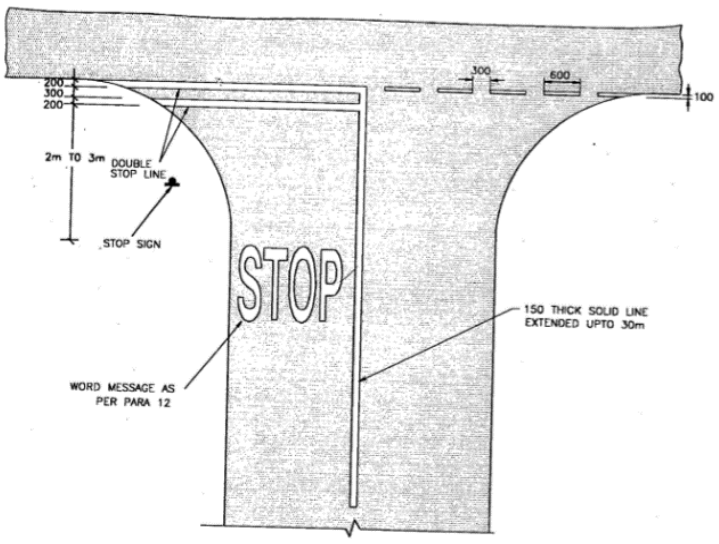
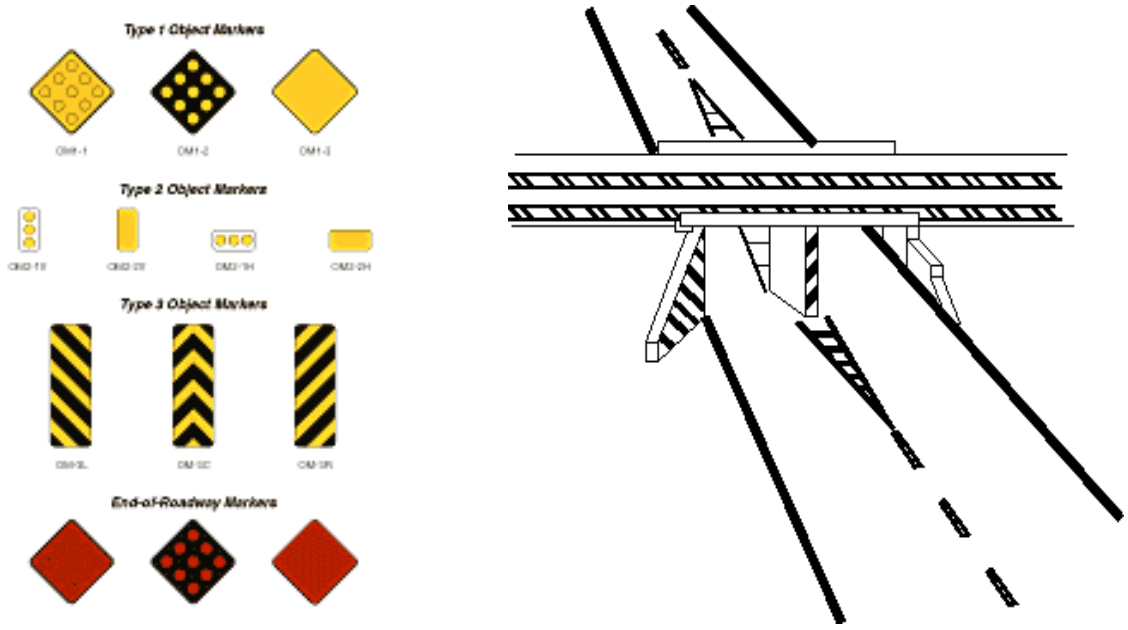


Figure 42: OBJECT MARKINGS TO BE PROVIDED AT PROJECT SITE



Physical obstructions in a carriageway like traffic island or obstructions near carriageway like signal posts, pier etc. cause serious hazard to the flow of traffic and should be adequately marked. They may be marked on the objects adjacent to the carriageway.

Objects within the carriageway

The obstructions within the carriageway such as traffic islands, raised medians, etc. may be marked by not less than five alternate black and yellow stripes. The stripes should slope forward at an angle of 45° with respect to the direction of traffic. These stripes shall be uniform and should not be less than 100 m wide so as to provide sufficient visibility.

Objects adjacent to carriageway

Sometimes objects adjacent to the carriageway may pose some obstructions to the flow of traffic. Objects such as subway piers and abutments, culvert head walls etc. are some examples for such obstructions. They should be marked with alternate black and white stripes at a forward angle of 45◦ with respect to the direction of traffic. Poles close to the carriageway should be painted in alternate black and white up to a height of 1.25 m above the road level. Other objects such as guard stones, drums, guard rails etc. where chances of vehicles hitting them are only when vehicle runs off the carriageway should be painted in solid white. Kerbs of all islands located in the line of traffic flow shall be painted with either alternating black and white stripes of 500 mm wide or chequered black and white stripes of same width.

Our Project Road is a combination of different type of curves, different terrains, open and built-up areas and also some stretches crosses near sanctuary and animal habitats. So, proper signs and markings should be provided to in-advance warn the road users about these variations.

The Road Signs to be installed along the road stretches should be according to IRC: 67 and the road markings shall follow the code of IRC: 35.

12.7 Safety on Project Corridor

The project stretch accompanies various varying feature throughout its corridor. These varying feature calls to wake for safety consideration. The priority of any road project is its users. And with this responsibility to provide a good communication, comes the safety alert for the road users. A project is valued to be good when the project road is helpful in minimizing the fatalities and provide the best communication facilities.

The road is evaluated viewing the safety of the road user and provisions of safety signs and markings are suggested to be followed for well-being of the road user as well as the project road.

12.7.1 Road Signs at the Curves

Cautionary signs which are triangular in shape with red border with the direction of the curve are provided at the curves. This helps in manoeuvring vehicle accordingly and nullifies the possibility of accident due to sudden appearance of turn. The speed limit signs should also be ruled at sharp curves. These signs are places 200m before the start of the curve. The curves with radius less or equal to 100 m are considered to be sharp curve.

The curves where there is sharp bends and the vehicle is restricted to maintain the design speed, should be marked with speed marker signs showing the speed to be maintained at that stretch.

The sharp curves i.e., the curves with radius less than 100 m should be protected with guard posts or crash barriers.

12.7.2 Provision for Road Studs (Reflective Pavement Markers)

Road Studs is provided to improve the visibility in night time and wet weather conditions.Red-White Bi-directional on shoulder side & Yellow-Yellow Bidirectional on Centre line of No overtaking portions and White- White Bidirectional for center line of other reaches.

Road Studs are provided at:

- All sections of Project Highway having horizontal curves
- All sections of Project Highway where overtaking prohibited

- Built-up areas
- All Major/Minor Bridge, ROB and all structures (Interchange/Flyover/VUP)
- All junctions and median openings
- All pedestrian crossings

12.7.3 Protection at the High Embankments

The high embankments are marked as un-protective for the road users as fall from these heights can lead to fatalities. So, the embankments with height above 3 m should be protected at the edges so that the road user is careful about the road profile. These type of embankments should be protected with crash barriers. So, it is recommended to use W-Beam crash barriers at these locations.

Figure 43: W-BEAM CRASH BARRIER

12.7.3 Road Signs at Built-up Areas

The Built-up areas should be marked with informatory signs signifying the identifying the place with speed limit signs, which should be followed by the road user while entering into the built-up area.

The signs to be provided are Informatory signs and Speed limit signs. These signs should be provided at both the side of the carriageway from both the direction at 200 m before the school. So, total of 6 'School Ahead' signs and 6 speed limit signs should be provided.

The school areas should also be provided with safety barricades during the school's arrival and departure time.

12.7.4 Road Signs for Structures

The road user must also be aware of the structures it is approaching to. So, that they can take precautionary measures before riding over it. The structures include culverts, minor and major bridges, ROB, FOB, RUB etc. The objects are too marked with reflectorized paints.

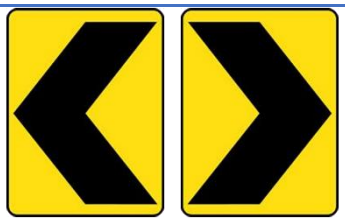
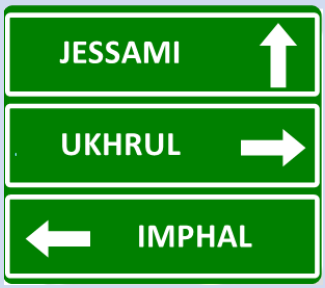
The structures should be indicated as per the markings and devices discussed above. The Object Marking Devices should be provided in one number at every culverts on both the sides of the structure. The minor and major bridges are objectified with two numbers of Object Marking Devices at start of the structure and end of the structure on both the sides of the carriageway.

The following signs are recommended at the specified chainages:

Table 85: LIST SIGNS TO BEPROVIDED ALONG THE PROJECT CORRIDOR

SL NO	SIGNS	CHAINAGE
SP1		This signs are to be provided at each junctions and schools present on or near to the project corridor. 7 nos. of junctions 1 nos. of school Total no. of Sign boards=2x(7+1)=16
SP 2		This signs are to be provided at each junctions and schools present on or near to the project corridor. 7 nos. of junctions Total no. of Sign boards=2x(7)=14
SP 3		This signs are to be provided as per the site location near the sharp curves, schools, built-up areas, junctions etc. 7 nos. of junctions 1 nos. of school 8 nos. of settlement 137 curves Total no. of Sign boards=2x(7+1+8+137)=306
SP 11		This signs are to be provided at each junctions 7 nos. of junctions Total no. of Sign boards=2x(7)=14

SP 15		This signs are to be provided as per the site location near the sharp curves Total no. of Sign boards=75
SP 16		This signs are to be provided as per the site location near the sharp curves Total no. of Sign boards=74
SP 18		This signs are to be provided at settlements Total no. of Sign boards=2x(8)=16
SP 21		This signs are to be provided at schools present on or near to the project corridor. 1 nos. of school Total no. of Sign boards=2x(1)=2
SP 22		To be provided at 20 m behind the start of a structure. As there are 208 structures in our project stretch, 208 X 2=416 number of Object hazard markers are to be provided.

SP 23		This signs are to be provided as per the site location near the curves with less curvature Total no. of Sign boards=137x3=411
SP 24		0/000 km 30/900 km
SP 25		This signs are to be provided at settlements Total no. of Sign boards=2x(8)=16
SP 26		This signs are to be provided at each junctions 5 nos. of junctions Total no. of Sign boards=2x(7)=14
SP 27		This signs are to be provided at each bus shelters 6 nos. of bus shelters Total no. of Sign boards=2x(6)=12

SP 31		At every 5 km interval of the project stretch, 7x2=14 nos. of sign boards are to be provided.
		This signs are to be provided as per the site location near the hairpin curves Total no. of Rolls (Each Roll-3m)=10 Rolls