BUILDING INFRASTRUCTURE - BUILDING THE NATION

NATIONAL HIGHWAYS AND INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED

A GOVT. OF INDIA UNDERTAKING

Consultancy Services for Feasibility Study and Detailed Project Report for Four / Six Laning from Km 38.000 to Km 168.167 of Daboka-Dimapur Section of NH-36 & 39 in the State of Assam & Nagaland under NHDP, Phase – III B, Pkg. No. NHDP – III/DL5/21, Group - G

DIMAPUR BYPASS (ASSAM PART)

REVISED FINAL DETAILED PROJECT REPORT
VOLUME I : MAIN REPORT

Archtech Consultants Pvt. Ltd.
CONSULTANTS & ENGINEERS
11, Shakespeare Sarani, Kolkata-700071

DECEMBER 2016

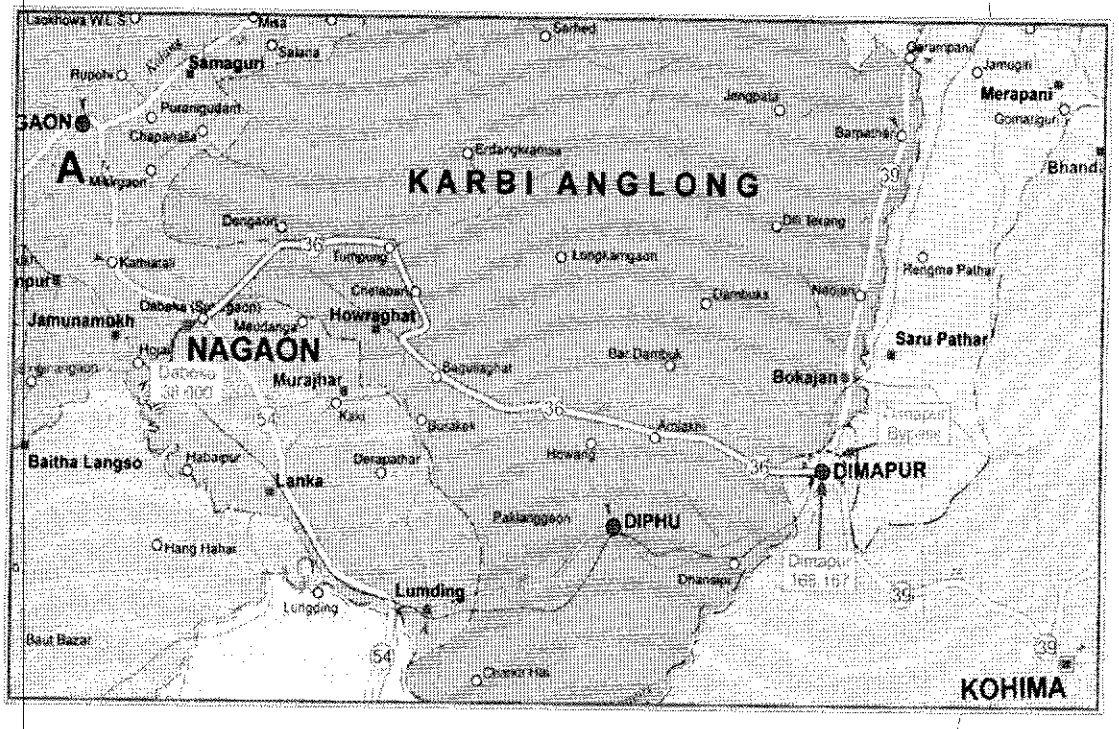
BUILDING INFRASTRUCTURE - BUILDING THE NATION

NATIONAL HIGHWAYS AND INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED

A GOVT. OF INDIA UNDERTAKING

Consultancy Services for Feasibility Study and Detailed Project Report for Four / Six Laning from Km 38.000 to Km 168.167 of Daboka-Dimapur Section of NH-36 & 39 in the State of Assam & Nagaland under NHDP, Phase – III B, Pkg. No. NHDP – III/DL5/21, Group - G

DIMAPUR BYPASS (ASSAM PART)



REVISED FINAL DETAILED PROJECT REPORT

VOLUME I : MAIN REPORT

Archtech Consultants Pvt. Ltd.
CONSULTANTS & ENGINEERS
11, Shakespeare Sarani, Kolkata-700071

DECEMBER 2016

VOLUME – I

MAIN REPORT (DIMAPUR BYPASS - ASSAM PART)

CONTENTS

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY (DIMAPUR BYPASS – ASSAM PART)

0.1 Background

With the rapid socio-economic development in India, there has been a tremendous growth in industrialization of the country. This has resulted in a spurt of freight and passenger transport movement and increase in demand for better quality of road and transport system.

Govt. of India have undertaken a massive program of development and up-gradation of National Highways in India through improvement and widening to 4/6 lane of the existing National Highways through National Highway Development Project (NHDP). Phase I and II of NHDP comprise Golden Quadrilateral linking four Metros viz. Delhi, Mumbai, Chennai and Kolkata and North-South and East-West corridors of NH network connecting Kashmir to Kanyakumari (North-south) and Silchar to Porbandar (East-West). In NHDP Phase III, about 10000 km of National Highways are proposed to be upgraded to 4-lane standard primarily on B.O.T basis. This project is a part of NHDP Phase IIIB.

Architech Consultants Pvt. Ltd. (ACPL), Kolkata have been awarded the work of project preparation for Rehabilitation and Upgradation to 4 Lane divided carriageway configuration of NH-36 & 39 from Km 38.000 to Km 168.167 (Daboka - Dimapur). The project preparation is being carried out in 4 stages including all engineering activities i.e., Inception Report, Draft Feasibility Report and Final DPR with schedules. Later the work was taken over by NHIDCL and hence Final DPR on EPC basis is submitted herewith.

0.2 Overview of NHAI

NHAI has been mandated by the Govt. of India to implement the National Highways Development Project (NHDP). NHDP National Highways comprise less than 2% of India's road network but carry 40% of total traffic.

Golden Quadrilateral: The project envisages widening to 4-lane and improvement of high traffic density corridor along the existing National Highways connecting the four metropolitan cities of Delhi, Kolkata, Chennai and Mumbai. The total length of the project is 5846 km and has been taken up in Phase-I of NHDP.

North South and East West Corridors: The project comprises widening to 4-lane and improvement of the existing National Highways of about 4000km length from Srinagar to Kanyakumari (North-South Corridor) and about 3300km length from Silchar to Porbander (East-West Corridor). Implementation of a part of this project along North South and East West Corridor has been taken up in Phase-I of NHDP along with the Golden Quadrilateral. Implementation of the balance length of NSEW corridor is in different stages of progress.

0.3 Socio Economic Profile of Project Area

Project Area

The Bypass project road stretch passes through one district, viz. Karbi-Anglong in the State of Assam. The project road passes mainly through rolling terrain The land use on both sides of the corridor is mostly agricultural and rural.

Demographic Features

The Bypass project road stretch, passing through KAAC of the State of Assam, has the following demographic features: -

- The average density of population (persons per square km) was 340, as per 2001 census with an average growth rate of about 6.23 percent per year during 1991-2001.
- The average sex ratio i.e ratio of females per 1000 males, as per 2001 census, was 929.
- The average literacy rate, as per 2001 census, was 64.28 per cent.

Economic Characteristics

- The project area is primarily rural. Agriculture is the primary source of income for vast majority of households. The area is economically quite backward. The principal agricultural crops are paddy, wheat, pulses, potato, different vegetables, horticulture and forest products.
- About 31 % population are engaged in full time occupational persuits and marginal workers are about 5%.

0.4 Deficiencies and Issues

Dimapur Bypass (Assam part) is a new alignment ad hence does not attract any deficiency and issue.

0.5 Investigations & Evaluations

This has been done in Draft DPR stages for selection of suitable alignment for 4-laning of Dimapur Bypass road sections based on field data and detail study involving traffic, geo-technical, topographic, pavement and road condition and socio-economic aspects. A few appropriate design applications have been considered for operational efficiency and road safety.

Pavement design options including flexible and rigid pavement structures for new construction have been considered including their life cycle costs using design methods and guidelines of IRC and AASHTO. Rigid pavement is proposed having the following items:

Subgrade	= 500 mm
GSB/Drainage layer	= 150 mm
DLC	= 150 mm
PQC	= 300 mm

Various Bypass alignment options have been developed for the highway sections with all major and minor junctions / intersections.

0.6 Project Description and Alignment proposal

a) **Project Road**

The Bypass project road stretch is starting from existing Chainage km 159.400 of NH-36 at Lahorizan and ending at km 124.200 of NH-39 near Patkoi Bridge. The project road is situated in the Districts of KAAC in the State of Assam & Dimapur in the State of Nagaland.

b) Terrain

The project road in the entire stretch traverses through rolling terrain. Accordingly, geometric standards for rolling terrain are to be adopted as per IRC: 73-1980 & IRC:SP:84-2014.

c) Road Geometrics

i) The pavement will consist of 2x7.00 m width with 4.00 median throughout the length of the project road. This will be

Including shyness Median	– 1x5.00 = 5.00 m
Carriage Way -	2x7.00 =14.00 m
Soft & hard Shoulder	– 2x3.50 = 7.00 m
Total	**=26.00 m**

ii) Horizontal curves are of design speed varying from100 Km/hr to 65 Km/hr.

iii) The gradient along the entire length of the project road is relatively rolling, except for the high embankments in the approaches to major/minor bridges, which are on easy grades excepting a few cases appearing in drawing volume.

d) Existing Pavement

There is no existing pavement as the Bypass will be a new one.

e) Drainage

There is no problem of drainage as the corridor is on rolling terrain. The nos. of culverts provided are:

Box 2x3	10
Slab 2x2	36
Total	**46**

f) Cross-Drainage Structures

There will be new cross-drainage structures. The nos. of major & minor bridges are:-

Major Bridge – 3

Minor Bridge – 6

g) ROW

The ROW will be acquired for 60.00 m width.

h) Land Use

The land adjacent to the proposed road is predominantly agricultural.

i) Relocation of Utilities

Both LT and HT lines run along / across the road at a number of places. At few stretches, telephone lines also exist. Telephone, LT & HT lines will need relocation in consultation with local authorities.

i) Meteorology

The climate is hot and humid in summer and moderate in winter with temperatures varying from 9°C (in winter) to 33°C (in summer).

j) Widening Proposals

One bypass of approximate length 14.325 km have been suggested to avoid the heavily congested Dimapur town connecting NH-36 & NH-39. The Assam part of Bypass will be to the north of Dimapur town.

0.7 Traffic Survey

No extra traffic survey has been done for this stretch.

a) **Traffic Growth Rate**

Traffic growth rates for the project stretch have been assessed on the basis of the average growth rates of vehicles on road or registered vehicles as well as the growth

rates obtained from Regression Analysis. The growth rates obtained are then compared with the growth rates adopted earlier for similar 4-laning projects on other National highways in Assam to arrive at reasonably realistic and rational growth rates of traffic along N.H 36.

Most probable growth of traffic on NH-36 as analyzed up to the year 2036 is given in the Table below:

Type of Vehicle	Final Growth Rate (%)					
	Upto 2011	Upto 2016	Upto 2021	Upto 2026	Upto 2031	Upto 2036
Average for vehicle having axle load>3T	7.00	7.50	7.50	7.50	7.00	7.00

Overall average growth rate for the project road section of NH-36: 5.00 % (as per SP84-2014).

b) Axle Load Survey

As it is a new alignment, no Axle Load Survey has been done.

0.8 Design Standard

a) Terrain

The project road traverses in rolling terrain and, therefore, geometric standards are adopted as per IRC: 73-1980 and IRC:SP:84-2014.

b) Design speed

Ruling speed is varying from 100 Km/hr. to 65 Km/hr. These design speeds will govern the geometric parameters. Vertical profile will have a speed of 50 Km to 65 Km/hr. at places due to proximity of structures.

c) Cross Section

i) 4- Lane carriageway will be 2 x 7.00 m with raised median.

ii) Width of the median is generally proposed as 5.00 m including shyness The Roadway proposed is

Median –	5.00 m x 1 = 5.00 m
Carriageway -	7.00 m x 2 = 14.00 m
Hard Shoulder -	1.50 m x 2 = 3.00 m
Soft Shoulder -	2.00 m x 2 = 4.00 m
Total	**= 26.00 m**

iii) Shoulder width is 3.50 m including 1.50 m paved shoulder on either side.

iv) Cross fall for Rigid carriageway is 2.00% with paved shoulder, 3.00% for unpaved shoulder and 3.50% for median.

d) **Horizontal Curves**

The horizontal curves are proposed as per IRC:73-1980 & IRC:SP:84-2014 and designed in accordance with IRC:38.

e) Gradient

i) Ruling - 3.3% (1 in 30)

ii) Limiting - 5% (1 in 20) to be adopted in exceptional cases, where Ruling gradient will be uneconomical.

f) Bridges and Cross Drainage Structures

New 4-lane bridges & culverts have been designed for two lanes of traffic, as per IRC Standards & MORTH Guidelines and Specifications adopting one lane of Class 70R plus one lane of Class A or two lanes of Class A live load, whichever produces worst effect. All bridges are to be provided with crash barriers.

g) Road Junctions

There is 1 (one) major junction of the Bypass project road with mainly National Highways.

h) Service Road, Footpath and Drains

No Footpath are proposed. Only Service Roads of width 7.00 m are proposed at 4 corners at crossing of NH – 39 and Dimapur Bypass.

i) Underpass

Traffic warrant Underpass for Vehicular & Cattle. There are Underpasses 2 nos Cattle. There is a history of Elephant Corridor and so, one 4.50 m high Underpass has been proposed.

j) ROB/Flyover

There is one R.O.B on the Bypass project road stretch and one Flyovers on NH-39.

0.9 Pavement Structure

Pavement option studies have been carried out for both rigid and flexible pavements based on the design standards of IRC and AASTHO methods. Generally, the rigid pavement option works out to be economical based on the life cycle costing. Rigid pavement has been proposed for the Service Roads due to their very low volume of traffic. Following pavement structures have been proposed for the project stretch:

Rigid pavement for new construction	Subgrade	=	500 mm
	GSB/Drainage layer	=	150 mm

DLC	=	150 mm
PQC	=	300 mm

0.10 Environmental Impact Assessment

The objectives of the Environmental Impact Assessment study are: 1) to establish the existing environmental settings of the project area through generation of primary data and collection of secondary data, 2) to evaluate potential environmental impacts from the project during pre-construction, construction and operational phases and identify appropriate mitigation measures, 3) to prepare an effective Environment Management Plan and to propose an Institutional Framework.

Present report deals with the project "Consultancy Services for Feasibility Study and Detailed Project Report for Rehabilitation & Upgrading to 4/6-lane divided carriageway configuration of East-West corridor", which starts from km 38.00 (Daboka) and terminate at km 168.167 (Dimapur) of National Highway No. 36 in the state of Assam / Nagaland and will have some direct impact on the Environment. A reconnaissance survey was accordingly carried out to study the present environmental set up of the study corridor, which is the corridor for environmental concern, in general and proposed ROW in particular, on the basis of which screening exercises were undertaken to identify the environmentally sensitive issues and areas. The purpose of the PESS (Preliminary Environmental and Social Study) is " to determine any significant economic, social and environmental issues, which could require further analysis (including the analysis of bypass, short realignments, improvement of junctions etc.) to resolve such issues". The social and environmental screening will include, but not be limited to, the analysis of available information (supplemented where appropriate by site assessment) concerning:

- Areas of significance within right-of-way (ROW).
- Sensitive and/or critical natural habitats (e.g., national park, wild life reserves, sanctuaries, social groves, reserve and protected forest, social forest, wetlands etc.).
- Major rivers and waterways.
- Recorded religious and cultural heritage sites.
- And any potentially sensitive areas, based on recent GOI census, official data and information from NGOs and site visit.

Salient Environmental Features:

- The new ROW generally will be 60.00 m wide.
- Bypass Road passes through / side by Lahorijan, Gautam Basti, Khatkhati etc. Possibility of generation of gaseous and particulate pollutants in these urban and semi urban areas is more.

- The main drainage system of the area are deep gorges. Besides, there are numerous tributaries of these drainage systems, which cut across Bypass at different chainages

  from Lahorijan to Patkoi Bridge resulting in 6 nos. of minor Bridges and 4 nos major bridges.
- There are number of plantation trees, mainly, Ahat (Pipal), Caseasima, Segun (Teak), Rubber, Gamari, Sonaru, Mango, Simur, Gulmohar, Sirish, Sesam, Eucalyptus and Acacea. Among the big trees Mango, Jamun, Ahat (Pipal), Kathal and Bargad are more or less common.
- Construction of one bypass for Dimapur town would be required to avoid significant social and environmental impact of 4-laning the road.
- Ditches, submersible reaches and many water bodies exist within the study corridor. Raising the formation level of the new 4-lane road for four laning would be required in several stretches.

The major areas of concern from environmental angle appeared to be as follows, from PESS:

- Dust and sound pollution particularly at sensitive areas during construction of road
- Protections of social plantation forest within and outside the ROW
- Existence of natural water bodies very near to road
- Presence of telephone lines & posts, electric lines & posts, low and high tension posts, transformers, tube wells etc.

Infrastructure improvement associated with road projects invariably provides positive socio-economic benefits. However, the road project can produce complex negative impacts during the construction and operation stages. Since the proposed road works do not involve widening and improving the existing road, the overall environmental and social impacts will be minimal. Impacts during both construction and operation phases are considered. In the EMP specific mitigation measures for the impacts identified are presented along with the organizations that will be responsible for implementing and monitoring the requisite measures. Environmental Management Plan associated with the following four broad categories of activities:

- Construction of road and associated structures
- Construction materials procurement storage and handling
- Construction and operation of project camps/compounds
- Operation phase

Approx. cost of implementation of EMP will be about Rs 154.12 lakhs for Bypass.

With the background of environment screening report in Feasibility stage, detailed Environmental Impact Assessment study is necessary to safeguard the environment impacts. They are broadly outlined below:

- To make an assessment which delineates the significant environmental effects of the project;
- To describe and quantify the magnitude of the effects;
- To determine the feasible mitigation measures for minimizing, eliminating, or offsetting unavoidable adverse effects; and
- To recommend the most appropriate prevention and/or mitigation measures

0.11 Social Screening and Social Assessment

Generally, about one-third of the population along the project area belong to vulnerable groups i.e. SC, ST and OBC. Widening of the existing road to 4-lane is expected to bring about positive social changes by way of reduced travel-time, increased access to markets, jobs and educational institutions, improve community facilities and health care services leading to overall development of the region in general and the project area in particular. Affected people are:

	General	ST	OBC	SC	Total
In Assam					
Family	**41**	**53**	**102**	**16**	**212**
Persons	**255**	**303**	**482**	**111**	**1151**

Social Assessment

A comprehensive social screening and assessment has been carried out for the entire stretch through extensive field visits and public consultations with project-affected persons and some responsible persons from all walks of life in the project area.

Affected properties

Implementation of the project would involve acquisition of some areas of land and structures both pucca and semi-pucca/ kachha. Suitable compensation will have to be paid to the owners of these properties, as per the Govt. policies and regulations. Affected properties are:

Sl. No.	Name of Village	Pucca (P)	Semi Pucca (SP)	Kachha (K)
	In Assam			
1	Belijan 'A' / Khatkhati P.S.	0.00	251.09	965.25
2	Belijan / Khatkhati P.S.	0.00	416.00	517.50
3	Karagaon / Khatkhati P.S.	0.00	164.63	1372.26
4	Gautam Basti / Khatkhati P.S.	107.88	2074.91	3135.20
5	Naharjan / Dilai P.S.	0.00	0.00	1391.31
6	Chotolengrijan / Dilai P.S.	0.00	86.62	877.46
7	Boro Lengri / Dilai P.S.	0.00	896.70	851.33
8	Boro Lengri (ii) / Khatkhati P.S.	0.00	584.63	1640.02

Sl. No.	Name of Village	Pucca (P)	Semi Pucca (SP)	Kachha (K)
9	Purana lahorijan / Khatkhati P.S.	0.00	36.00	230.86
10	Boro Lengri / Khatkhati P.S.	181.84	791.58	915.34
	TOTAL	**289.72**	**5,302.16**	**11,896.53**

Estimated cost for Rehabilitation and Resettlement Program

The tentative cost of acquisition of land and Rehabilitation and Resettlement beyond ROW including those required for construction of 4-lane bypass is estimated as Rs. (173.88 + 1038.27) i. e Rs 1212.15 lakhs, which would form a part of the project cost.

Signages & Road Markings

Adequate provision for signages viz. overhead gantry signs, direction / information boards etc. are proposed as per IRC: 67-2001 for the entire Bypass project reach. Besides, suitable provision is proposed for road markings for centre line, shoulder and median side edge lines for the entire length. Besides, painting of median kerbs and provision of reflective posts/bollards, at the intersections and median openings, have been proposed to ensure road safety.

0.12 Quality Audit & Safety Audit

The entire consultancy services comprising Feasibility Study and Detailed Project preparation are being carried out at every stage adopting the various IRC Codes and Standards, Specifications, Guidelines, Manuals and Circulars of MOSRTH, as well as International Standards and Practices, wherever required to ensure quality of the DPR. Adequate emphasis has been given on the accuracy of field survey, hydraulic and sub-soil investigations and analysis of data to develop a fairly accurate and cost-effective DPR for implementation of the project.

Keeping in view the growing concerns of the client and the road users, adequate provision has been made in the project proposal for provision of minimum number of median openings etc. Besides, suitable provisions are also to be made for ensuring safety during construction by outlining the minimum requirements to be fulfilled by the contractors during implementation of the project and making appropriate provision accordingly in the Estimate and BOQ.

0.13 Conclusions and Recommendations

The following are the major conclusions of the Feasibility Study Report:

- The Bypass project road is proposed to be constructed to four lane standard by new construction in a length of about 14.325 km.
- One 4-lane bypass is proposed for Dimapur town.
- There will be 46 nos R.C. Box culverts in the Bypass alignment.
- There will be 6 Nos Minor Bridges in the Bypass alignment.
- There will be 3 nos Major Bridges in the Bypass in the Bypass alignment.
- There will be 1 No ROB & 1 No Flyover on the Bypass alignment.
- The project is not economically viable. Accordingly, project should be undertaken on EPC contract basis.
- The Bypass project road stretch of about 14.325 km length from Design Chainage Km 118.050 to Km 132.375 (Lahorijan to Assam Border) has been considered as one construction package.

The estimated cost of the proposed new Dimapur Bypass of the project stretch to four lane standard (including centage charges) works out to **Rs. 570.24 *Crores*** *with rigid pavement.* **(Rs. 39.81 cr. / km).**

OVERVIEW OF NHAI'S ORGANIZATION AND ACTIVITIES, NHDP PROGRAMME AND PROJECT FINANCING & COST RECOVERY MECHANISM.

CHAPTER – 1

OVERVIEW OF NHAI's ORGANISATION AND ACTIVITIES, NHDP PROGRAMME AND PROJECT FINANCING AND COST RECOVERY MECHANISM

Introduction

1.1 India is a vast country and has one of the largest road networks in the world. The primary road system covers the National Highways, the secondary road system encompasses the State Highways and Major District Roads (MDR) while the third category includes Other District Roads (ODR) / rural roads. The Ninth Five Year Plan has laid emphasis on a coordinated and balanced road network development throughout the length and breadth of the country. Improvements taken up will give a big boost to rural economy by giving a direct and faster access from hinterland to main marketing centres / metropolitan towns.

1.2 Infrastructure Development is a key indicator of progress of a nation. Surface transport infrastructure forms an integral component of infrastructure development. In our country surface transport infrastructure largely consists of roads and railways while inland water transport and air transport play supportive roles. Today the preferred mode of travel, between road and railways for both goods and people, is the road transport as it caters door to door service etc. and offers movement flexibility.

The share of freight traffic by roads is about 70% as compared to about 30% by rail and that of share of passenger traffic by road is approximately 85% as compared to 15% by rail. A study carried out by World Bank indicates that there will be a saving of about Rs. 8000 crores per year in VOC and fuel consumption after completion of Golden Quadrilateral alone connecting four metro cities.

National Highways Network

1.3 The National Highways have utmost significance in the road transport sector as they link major cities and ports and carry a substantial part of road traffic. The road network in the country is approximately 3.3 million kilometers out of which National Highways constitute a length of 65,569 km. Though the National Highways is only 2% of the total road network, they carry about 70% of the freight traffic and 85% of the passenger traffic. The whole road network is, therefore, seriously capacity constrained which adversely affect traffic movement especially that of goods. The problem is further accentuated due to accelerated growth in vehicle population from 3 lakhs in 1951 to about 500 lakhs in the Year 2000 with substantial increase in axle loads.

1.4 Though the vehicle population has increased manifold from the Year 1951, the growth in length of the National Highways has been very modest as under: -

	Year	Length of NH(Km)
a)	1951	21,440
b)	1971	23,838
c)	1981	31,671
d)	1991	33,650
e)	2001	58,112
f)	2005	65,569

The minimum standards of National Highways should be two lane carriageway. However, about 40% length is still single lane / intermediate lane width carriageway. Only about 5% length of the National Highways is with 4 lane facility. Apart from these the maintenance of highways has been below standards due to availability of only 40% of the required maintenance funds.

1.5 Due to phenomenal rate of increase in vehicular traffic (about 7-10% per year) and heavier axle loads, the National Highways have come under tremendous pressure. Moreover, due to lack of adequate maintenance and upkeep, these highways suffer from a number of inherent deficiencies: -

a) Poor riding quality
b) Structurally inadequate pavement
c) Weak / missing bridges

NHAI Organisation and Role

1.6 In order to give a boost to the economic development of the country, the Govt. of India has taken upon itself to rectify the mismatch in the increase in length of National Highways and the road traffic volume and other existing deficiencies of the road network in the country. Accordingly an autonomous body – The National Highways Authority of India (NHAI) was constituted by an act of Parliament, National Highways Authority of India Act 1988 (Act 68 of 1988) to oversee, to plan, coordinate, finance and implement the massive programme for 4/6 laning of about 13000 km of National Highways since 1999 under National Highways Development Project (NHDP) Phase I and II.

The NHAI broadly composes of :

a) A Chairman
b) Full-time Members (not more than six)
c) Part-time Members (not more than four)

The members of the Board are appointed by the Central Govt. The present position is given below: -

Chairman	-	Full time
Member (Adm.)	-	Full time
Member (Finance)	-	Full time

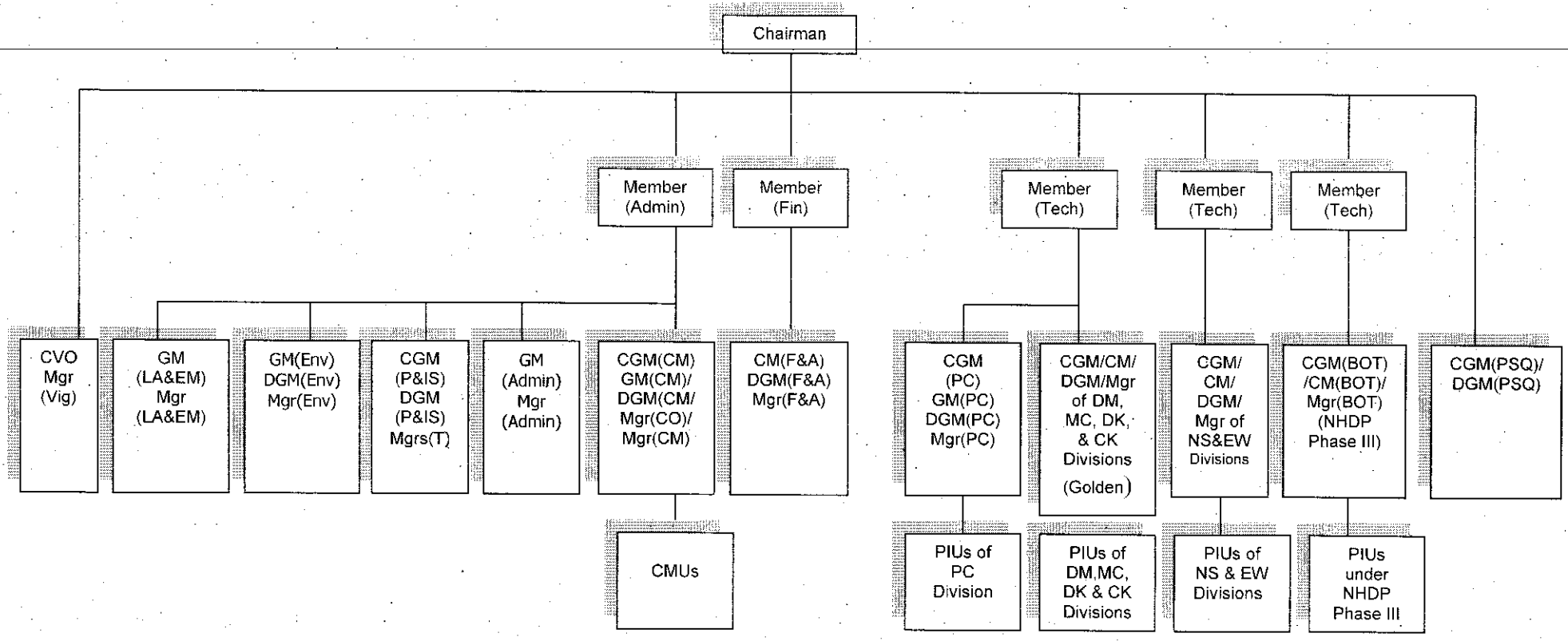
Member (Technical) - 3 Nos.	-	Full time
Secretary, Planning Commission	-	Part time
Secretary (MORT&H)	-	Part time
D.G. Roads & Special Secretary MORT&H	-	Part time
Secretary (Expenditure)	-	Part time

An outline organisation of NHAI is presented in Fig 1

Activities: National Highways Authority of India Act, 1988 stipulates the function and activities of the NHAI very clearly. The main activities of the NHAI are:

- Survey, develop maintain & manage highways.
- Construct offices or workshops and establish, maintain hotels, motels etc. near highways.
- Construct residential buildings, townships for its employees.
- Regulate and control the plying of vehicles on the highways.
- Develop and provide consultancy & construction services in India & abroad and carry on research activities in relation to the development, maintenance & management of highways.
- Provide such facilities amenities for the users of the highways, which are in the opinion of the NHAI necessary for smooth flow of traffic.
- Form one or more companies under the Companies Act, 1956 (Act-I of 1956) to further the efficient discharge of the functions imposed on it by this Act.
- Engage or entrust any of its functions, to any person, on such terms and conditions as may be prescribed.
- Advise the Central Govt. on matters relating to highways.
- Assist, on such terms and conditions as may be mutually agreed upon, any State Govt. in formulation and implementation of scheme for highway development.
- Collect fees on behalf of Central Govt.
- Take all such steps as may be necessary or convenient for or may be incidental to, the exercise of any power or the discharge of any of its functions.

Organisational Structure of the National Highways Authority of India



Abbreviations:

BOT	-	Build Operate & Transfer	-	East –West Corridor	CO	-	Commercial Operations	-	Land Acquisition & Estate Management
CGM	-	Chief General Manager	-	Environment	CVO	-	Chief Vigilance Office	-	Mumbai-Chennai Section of GQ
CK	-	Chennai-Kolkata Section of GQ	-	Finance & Accounts	DGM	-	Deputy General Manager	-	Manager
CM	-	Corridor Management	-	General Manager	DK	-	Delhi-Kolkata Section of GQ	-	Planning and Information Systems
CMU	-	Corridor Management Unit	-	Golden Quadrilateral	DM	-	Delhi-Mumbai Section of GQ	-	Port Connectivity
									Project Implementation Unit
									Planning, Standardization & Quality
									Assurance North-South Corridor

Fig 1

Management Information System

1.7 NHAI has developed an extensive network of computerised information system to monitor progress of works in various projects. Updated progress data, reports, bottlenecks in implementation etc, flow from numerous Project Implementation Unit (PIUs) to the Corporate Head Quarter and vice-verse on a daily basis.

In addition, a study on Corridor Management Information System is in progress for development of a comprehensive data bank on inventory of corridor assets for future development operation and maintenance programmes once the present NHDP is completed.

Corridor Management

1.8 A Corridor Management Unit (CMU) has been set up headed by CGM with support staff for collection of toll, maintenance of the road, incorporating value added services e.g. provision of mobile medical assistance in case of accidents, evacuation of disabled vehicles enhancement of road safety features etc.

Port Connectivity Programme

1.9 NHAI has taken up in addition 4-lanning of about 356kms of roads for providing road connectivity to 12 major ports in the country. The status as in Sep, 2002 is as follows :

- Total length - 356 k.m. approximately.
- 4 / 6 laned - 69 k.m.
- Under construction - 243 k.m.
- Balance under process - 44 k.m.

National Highways Development Programme (NHDP)

1.10 The National Highways Development Project (NHDP) was announced by the Prime Minister on October 24, 1998. The Task Force headed by the Dy. Chairman, Planning Commission constituted on October 30,1998. Under the NHDP, 13000 km length of National highways has been taken up for improvement and widening to 4/6 lane since 1999 and is targeted to be completed by Dec 2007 at an estimated cost of Rs. 54000 crores (at 1999 price level). The programme is being implemented by NHAI. NHDP Phase I and II have the following components: -

a) **Golden Quadrilateral (GQ)** comprising National Highways connecting the four metropolitan cities of Delhi, Mumbai, Chennai, Kolkata. The total length is 5846km and is scheduled for completion by Dec 2005. Out of 5846 kms, 4611 kms have already been completed, 135 kms are under implementation and 84 kms are yet to be awarded (progress as on 28-2-2005).

b) **North-south (NS)** corridor is comprising the National Highways connecting Srinagar to Kanyakumari **and East-West (EW)** corridor is comprising the National Highways connecting Silchar to Porbandar. The NSEW corridor has a total length of about 7300km and is scheduled for completion by Dec 2007. Out of this, 692 kms have already been

completed, 886 kms are under implementation and 5696kms are yet to be awarded (progress as on 28-2-2005).

c) A state-wise details of 4-laning of National Highways is given below:

State-wise National Highways Distribution and NHAI's Laning Programme

Sl. No.	State Name	Length of NHs in State (kms)	Length of 4-Laning by NHAI (in kms)					
			NHDP			Port Connectivity	Others	Total
			GQ	NS	EW			
1.	Andhra Pradesh	4002	1016	753		12	83	1864
2.	Arunachal Pradesh	392						0
3.	Assam	2836			753			753
4.	Bihar	3301	206		517			723
5.	Chandigarh	24						0
6.	Chattisgarh	1810					18	18
7.	Delhi	72	25	34			10	69
8.	Goa	269				18		18
9.	Gujarat	2461	485		654	56		1195
10.	Haryana	1361	152	180			18	350
11.	Himachal Pradesh	1188		14				14
12.	Jammu Kashmir	823		405				405
13.	Jharkhand	1614	192					192
14.	Karnataka	3570	653	125		60		808
15.	Kerala	1440		160		10		170
16.	Madhya Pradesh	4664		524	142			666
17.	Maharashtra	3626	489	232		44	17	782
18.	Manipur	954						0
19.	Meghalaya	717						0
20.	Mizoram	927						0
21.	Nagaland	369						0
22.	Orissa	3301	444			74		518
23.	Pondichery	53						0
24.	Punjab	1553		296				296
25.	Rajasthan	4597	722	32	480			1234
26.	Sikkim	62						0
27.	Tamil Nadu	3758	341	851		57	450	1699
28.	Tripura	400						0

29.	Uttar Pradesh	4941	753	268	548		57	1626
30.	Uttaranchal	1076						0
31.	West Bengal	1951	398		366	53		817
	Total	**58112**	**5846**	**3874**	**3460**	**384**	**653**	**14217**

1.11 NHDP Phase III

In addition to Port Connectivity and other National Highway works mentioned above, NHAI has also been entrusted recently with the task of development of about 10000 Km length of some identified National Highways in various states to 4-lane standards to provide suitable linkage of state capitals and all important National Highways to NHDP corridors. This programme is intended to be implemented through public and private participation on BOT basis. The progress in this regard is as under: -

a) Total length of other NH under improvement - 10000km
b) Completed - -
c) In progress - 30km
d) Yet to be taken up - 9970km

1.12 Other National Highways

Besides the above upgradation works, certain other National Highways are being improved as under: -

a) Total length of other NH under improvement - 777 Km.
b) Completed - 287 Km.
c) In progress - 132 Km.
d) Yet to be taken up - 358 Km.

Project Financing and Recovery Mechanism

1.13 Project financing - NHAI proposes to finance its projects through a host of financing mechanisms for effective and perceptible development of the National Highways network in the country for which a staggering amount of Rs. 1,65,000 crores (at 1999 price level) is needed. The Govt. of India has laid down the following mandate: -

a) A Central Road Fund Act 2000 has been enacted dedicated for development and maintenance of roads. This is a non-lapsable fund and is financed by levying cess on petrol and diesel from time to time. Presently, the accrual would be about Rs. 6000 crores. The expenditure of funds accrued from this source is to be allocated in the following manner: -
   i) 50% of the cess on HSD for development of rural roads
   ii) Balance 50% of the cess on HSD and the entire cess collected from petrol will be apportioned as under: -

- 57.5% for development and maintenance of National Highways
- 12.5% for construction of ROB and safety works at unmanned railway crossings
- Balance 30% for development and maintenance of State roads.

b) Assistance from external multi-lateral agencies such as the World Bank, Asian Development Bank, OECF for improvement of the National Highways. An amount of approximately Rs. 8000 crores has been arranged by NHAI from World Bank and ADB.

c) NHAI has set up its own companies for borrowing funds from the market by issue of infrastructure bonds for financing NHDP projects.

d) Encouraging private sector participation in highway development through Build, Operate and Transfer (BOT) schemes and providing a number of incentives such as exemption of custom duties on import of "State of art" road construction equipment, ten years income tax exemption to be availed within 20 years of commissioning the facility, capital grant upto 40% of project costs to make it viable and toll rates indexed to whole sale price index and permitting development of real estates along the highway. For these projects Govt. has prepared model concession agreement for projects costing less than Rs. 100 crores and those costing more than Rs. 100 crores.

1.14 Cost Recovery Mechanism - The mechanism for recovery of the project cost is by establishing toll check posts and collecting toll tariff from users. Govt. has laid down the rates of tolls for various types of vehicles. A special purpose vehicle ('SPV') will be constituted for individual projects on BOT Basis, which would go to the market for borrowing money and then repay through toll collection. The following are broadly the modes of financing of NHDP: -

a) Project fully financed by NHAI and cost recovery through toll. (EPC Project)
b) Construction by full private participation and collection of toll by private entrepreneur for BOT projects.
c) Grant by NHAI upto 40% to BOT entrepreneurs from NHAI fund to bridge the viability gap for BOT projects.
d) Annuity payment by NHAI to private entrepreneurs implementing the project at their cost (BOT – Annuity projects).

For the instant project of 4/6 laning of NH-36&NH-39 from Daboka to Dimapur NHAI has decided project implementation on BOT basis. NHAI Administrative set-up consists of 1 no. Project Director, NHAI, PIU Nagaon with the support of Managers (Technical), under Chief General Manager, Guwahati (NE) & R.O., Assam

PROJECT DESCRIPTION

CHAPTER– 2
PROJECT DESCRIPTION

2.1 EXISTING SCENARIO:

2.1.1 GENERAL

The project road along N.H 36 in the scope of the Consultancy Services for Feasibility Study and Detailed Project Report (DPR) stretch from Daboka to Dimapur (Km 38.00 to Km 168.167). The road in this entire stretch generally passes through rolling terrain. The Northern Dimapur Bypass takes off at 159.40 Km of NH-36 (Design Ch. Km 118.050 and meets NH-39 at Design Ch. 153.058 Km near Patkoi Bridge. (Existing Chainage of NH-39 is Km 124.200). The Assam part of Dimapur Bypass ends at Design Chainage 132.375 Km.

The Assam side Dimapur Bypass passes through/side of Lahorijan, Belijan, Gautam Basti, Khatkhati Village. The stretch of Bypass extends from Design Chainage 118.050 Km to 132.375 Km in Assam.

2.1.2 TOPOGRAPHY

The project road is in embankment throughout the entire length with average height of embankment varying from 2.00 m to 2.50 m, except for the high embankment of 5.00 m to 7.500 m height near the major bridge / Flyover approaches. Average height of embankment of the Bypass project road stretch is as below:

Height of embankment along Dimapur Bypass (Assam Part)

< 1.00 m	7.375 Km
2.00 m to 2.50 m	2.500 Km
2.50 m to 3.00 m	1.500 Km
> 3.00 m	3.000 Km

There is no case of submergence of any stretch of project corridor in issue.

2.1.3 ENVIRONMENT AND LAND USE

The project is located in the high rainfall area with lots of matured trees and vegetation growth along side of the road. In the Bypass project corridor, the road will pass through new alignment and felling of trees will be minimum. The land use pattern along the project corridor is as below:

Land use along Northern Dimapur Bypass

Type of land	Length
Agricultural	95%
Built up area	2%
Forest (Planted)	3%

2.1.4 RIGHT OF WAY (ROW)

There is no existing ROW. It is, therefore proposed to have 60.00 m ROW throughout the Bypass alignment.

2.1.5 ALIGNMENT

The proposed alignment of Assam part Dimapur Bypass has been proposed to fulfill all stipulations of IRC-73, IRC-37-2012, IRC:SP:84-2014 & IRC-58-2015.

2.1.6 PAVEMENT

There is no existing pavement as the alignment is new. However, the new pavement will comprise of the following thicknesses as also appearing in new pavement of the entire road corridor:

Subgrade	=	500 mm
GSB/Drainage layer	=	250 mm
DLC	=	150 mm
PQC	=	300 mm

2.1.7 ROADWAY DRAINAGE

Site Investigation has revealed that there is no drainage problem on the roadway surface in the Bypass project corridor. It has been ascertained that the project road is not susceptible to inundation. In the rural stretches, the drainage of road surface follows the surrounding topography.

2.1.8 TRAFFIC

The Bypass project road will have practically the same traffic except those entering Dimapur town. The Traffic on the road are mixed in character. It consists of both fast and slow moving vehicles. As per the traffic survey conducted as a part of this Feasibility Study, the total no. of fast moving vehicles per day on the project road stretch with different tables and the total ADT is appended in the table below :

Table – 1: Average Daily Traffic at All the Mid-Block Count Stations

Vehicle Type		MB 1 (On NH-36)		MB 2 (On NH-36)		MB 3 (On NH-36)		MB 4 (On NH-36)	
		No.	PCU	No.	PCU	No.	PCU	No.	PCU
Two Wheeler		319	160	501	250	447	224	76	38
Three Wheeler		281	281	219	219	312	312	69	69
Car/Jeep/Van/Taxi		421	421	329	329	468	468	103	103
Bus	Mini	28	42	23	37	31	47	7	11
	Standard	141	424	114	341	155	465	36	108
Truck	LCV	55	83	77	115	79	119	36	54
	2-Axle	176	529	244	733	253	758	114	342
	3-Axle	20	91	28	126	29	130	13	59
	Semi-artc/ artc.	0	0	0	0	0	0	0	0
Slow moving vehicle		1178	1981	1185	778	1,215	914	102	51
Total		2,619	4,012	2,720	2,928	2,989	3,437	556	835

Source: Primary Traffic Survey March- 2007

Table 2: Representative Traffic – Homogeneous Section wise

Homogeneous Section	Vehicle Type	Two Wheeler	Three Wheeler	Car/Jeep/Van/Taxi	Bus		Truck				Agricultural Tractor		Slow moving vehicle	Total
					Mini	Standard	LCV	2-Axle	3-Axle	Semi-artc/ artc.	With	Without		
Section I	Nos.	423	271	406	27	137	71	224	26	0	0	0	1393	2977
	PCU	211	271	406	41	410	106	673	115	0	0	0	1224	3458
Section II	Nos.	76	69	103	7	36	36	114	13	0	0	0	102	555
	PCU	38	69	103	11	108	54	342	59	0	0	0	51	835

Table 3: Peak Hour Traffic Volume in PCUs

Location	Passenger Traffic Hours	Passenger Traffic Volume	Freight Traffic Hours	Freight Traffic Volume	Total Traffic Hours	Total Traffic Volume
MB 1	8:00 – 9:00	99	18:00 – 19:00	59	16:00 – 17:00	334
MB 2	10:00 – 11:00	105	10:00 – 11:00	81	10:00 – 11:00	215
MB 3	16:00 – 17:00	125	4:00 – 5:00	101	16:00 – 17:00	241
MB 4	8:00 – 9:00	25	8:00 – 9:00	33	8:00 – 9:00	51

Table 4: Final adopted Most Likely growth Rates

VEHICLE CATEGORY	2007-011	2012-16	2017-21	2022-26	2027-31	2032-36
Two Wheeler	10.00	10.50	11.00	11.00	10.50	10.50
Three Wheeler	12.50	13.00	13.50	13.50	13.00	13.00
Car, Taxi, Jeep, Van	9.50	10.00	10.50	10.50	10.00	10.00
Bus	7.00	7.50	7.50	7.50	7.00	7.00
Goods Vehicle	6.50	7.00	7.50	7.50	7.00	7.00
Tractor	2.00	2.00	2.00	2.00	2.00	2.00
Average (FMV)	7.92	8.33	8.67	8.67	8.25	8.25
Slow Moving Vehicle	2.00	2.00	2.00	2.00	2.00	2.00

Table 5: Base Year Peak Season Average Daily Traffic (PSADT) on Project Road

Vehicle Type	PSADT for Section - I		PSADT for Section - II	
	Number	PCU	Number	PCU
2 Wheeler	542	271	97	49
3 Wheeler	347	347	88	88
Car/Jeep/Van/Taxi	520	520	132	132
Mini Bus	35	53	9	14
Full Bus	176	526	46	138
LCV	91	136	46	69
2-Axle Truck	287	863	146	438
3-Axle Truck	33	147	17	76
Semi Artc./Artc.	0	0	0	0
Total Fast Moving Vehicle	2031	2863	581	1004
Slow Moving Vehicles	1393	1224	102	51
Slow and Fast Moving Vehicles Together	3424	4087	683	1055

2.1.9 TOPOGRAPHIC SURVEY

Topographic Survey of the entire road stretch under report has been carried out following the stipulations in the TOR as well as to meet the requirements of the relevant Codes and Manual.

GPS stations were established at suitable locations on the project road, based on which traverse stations were fixed on the roadside embankment to capture Topographic Survey data for developing the geometric features of the existing road. Details of GPS, Traverse stations etc. have been annexed in the Bypass Drawing volume submitted.

2.1.10 BRIDGES AND CROSS DRAINAGE STRUCTURES

2.1.10.1 Existing Bridges

There is no existing bridges as it is on new alignment. But 3 nos Major Bridges and 6 nos Minor Bridges have been proposed.

2.1.10.2 Existing Culverts

There is no existing culvert as the alignment is on new alignment except 14 nos HP Culverts which are to be dismantled and constructed new. Total nos proposed are Box Culverts – 46 nos.

A total list of proposed structures are as under:

LIST OF BRIDGE / FLYOVER / ROB / UNDERPASS ON DIMAPUR BYPASS

Sl. No	*CD. No*	*Proposed Chainage (KM)*	*Type of Structure*	*Proposal (M)*	*Type of Bridge*	*Width of Structure (M)*	*HFL (M)*	*FRL (M)*	*Remarks*
1	119/2	118+227	RCC	1 X 16.00 = 16.00	Minor	27.50	162.300	164.740	
2	119/3	118+390	RCC	1 X 16.00 = 16.00	Minor	27.50	162.700	165.140	
3	122/5	121+875	RCC	2 X 14.00 = 28.00	Minor	27.50	152.256	154.800	
4	123/2	122+535	RCC	1 x 5.0 x 3.0	Cattle Underpass	32.00	-	167.155	
5	125/4	124+938	RCC	2 X 14.00 = 28.00	Minor	27.50	148.525	151.070	
6	128/2	127+190	RCC	1 X 21.00 = 21.00	Minor	27.50	148.292	151.540	
7	128/4	127+648	RCC	2 X 16.00 = 32.00	Minor	27.50	151.102	153.850	
8	129/2	128+545	RCC	1 x 5.0 x 3.0	Cattle Underpass	32.00	-	167.590	
9	130/1	129+381	PSC	1 X 37.00 = 37.00	Flyover	27.50	-	172.600	
10	131/3	130+380	RCC	1x5.00x4.50	Elephant Underpass	32.00	-	154.732	
11	132/1	131+249	PSC	1 X 37.00 = 37.00 + 2 X 18.00 = 36.00	ROB	26.30	-	149.576	
12	132/2	131+559	RCC	4 X 24.00 = 96.00	Major	27.50	136.536	140.380	
13	132/3	131+927	RCC	4 X 24.00 = 96.00	Major	27.50	136.898	140.740	
14	133/1	132+344	RCC	4 X 24.00 = 96.00	Major	27.50	136.898	140.780	

Sl. No	*Proposed CH (Km)*	*CD No*	*Easting*	*Northing*	*Type of Existing Culvert*	*Existing culvert span arrangement (MM)*	*Proposal*	*Type of Proposed Culvert*	*Proposed culvert span arrangement (M)*	*FRL (M)*	*Top of Deck Lvl (M)*	*Invert Lvl (M)*	*Height of Cushion (M)*	*Culvert Width (M)*	*Remarks*
1	118+120	119/1					New	BOX	1/2X2	166.887	166.812	164.462		26.000	
2	118+868	119/4			Pipe	φ1000mm	New	BOX	1/2X2	166.863	166.788	164.438		26.000	
3	119+130	120/1					New	BOX	1/2X2	170.644	170.569	168.219		26.000	
4	119+187	120/2					New	BOX	1/2X2	172.267	172.192	169.842		26.000	
5	119+392	120/3					New	BOX	1/2X2	177.937	177.862	175.512		26.000	
6	119+478	120/4					New	BOX	1/2X2	179.202	179.127	176.777		26.000	
7	119+662	120/5					New	BOX	1/2X2	177.761	177.686	175.336		26.000	
8	119+707	120/6					New	BOX	1/2X2	176.546	176.471	174.121		26.000	
9	119+903	120/7					New	BOX	1/2X2	172.760	172.685	170.335		26.000	
10	120+115	121/1					New	BOX	1/2X2	178.425	178.350	176.000		26.000	
11	120+187	121/2					New	BOX	1/2X2	180.969	180.894	178.544		26.000	
12	120+255	121/3					New	BOX	1/2X2	182.810	182.735	180.385		26.000	
13	120+419	121/4					New	BOX	1/2X2	184.066	183.991	181.641		26.000	
14	120+540	121/5					New	BOX	1/2X2	182.162	182.087	179.737		26.000	
15	120+702	121/6					New	BOX	1/2X2	178.537	178.462	176.112		26.000	
16	120+857	121/7					New	BOX	1/2X2	175.066	174.991	172.641		26.000	
17	121+128	122/1					New	BOX	1/2X2	168.999	168.924	166.574		26.000	
18	121+344	122/2					New	BOX	1/2X2	164.163	164.088	161.738		26.000	

Sl. No	*Proposed CH (Km)*	*CD No*	*Easting*	*Northing*	*Type of Existing Culvert*	*Existing culvert span arrangement (MM)*	*Proposal*	*Type of Proposed Culvert*	*Proposed culvert span arrangement (M)*	*FRL (M)*	*Top of Deck Lvl (M)*	*Invert Lvl (M)*	*Height of Cushion (M)*	*Culvert Width (M)*	*Remarks*
19	121+504	122/3					New	BOX	1/2X2	160.580	160.505	158.155		26.000	
20	121+835	122/4			Pipe	φ1000mm	New	BOX	1/2X2	154.800	154.725	152.375		26.000	
21	122+175	123/1					New	BOX	1/2X3	157.122	157.047	153.677		26.000	
22	122+923	123/3			Pipe	φ600mm	New	BOX	1/2X3	156.037	155.962	152.592		26.000	
23	123+042	124/1			Pipe	φ1000mm	New	BOX	1/2X2	152.784	152.709	150.359		26.000	
24	123+299	124/2			Pipe	φ900mm	New	BOX	1/2X2	156.648	156.573	154.223		26.000	
25	123+345	124/3					New	BOX	1/2X2	158.285	158.210	155.860		26.000	
26	123+659	124/4			Pipe	φ900mm	New	BOX	1/2X3	164.637	164.562	161.192		26.000	
27	123+957	124/5			Pipe	φ900mm	New	BOX	1/2X2	157.363	157.288	151.915	3.023	40.000	Coushion
28	124+137	125/1					New	BOX	1/2X2	158.693	158.618	156.268		26.000	
29	124+325	125/2					New	BOX	1/2X2	158.490	158.415	156.065		26.000	
30	124+813	125/3			Pipe	φ600mm	New	BOX	1/2X2	151.070	150.995	148.645		26.000	
31	125+209	126/1					New	BOX	1/2X2	156.745	156.670	154.320		26.000	
32	125+303	126/2					New	BOX	1/2X2	160.980	160.905	158.555		26.000	
33	125+531	126/3			Pipe	φ600mm	New	BOX	1/2X2	169.406	169.331	166.981		26.000	Cut Portion
34	125+736	126/4			Pipe	φ1000mm	New	BOX	1/2X2	170.615	170.540	168.190		26.000	
35	125+945	126/5					New	BOX	1/2X3	178.459	178.384	175.014		26.000	
36	126+255	127/1					New	BOX	1/2X2	171.595	171.520	165.693	3.478	40.000	Coushion

Sl. No	*Proposed CH (Km)*	*CD No*	*Easting*	*Northing*	*Type of Existing Culvert*	*Existing culvert span arrangement (MM)*	*Proposal*	*Type of Proposed Culvert*	*Proposed culvert span arrangement (M)*	*FRL (M)*	*Top of Deck Lvl (M)*	*Invert Lvl (M)*	*Height of Cushion (M)*	*Culvert Width (M)*	*Remarks*
37	126+640	127/2			Pipe	φ600mm	New	BOX	1/2X3	163.539	163.464	160.094		26.000	
38	126+866	127/3					New	BOX	1/2X2	157.450	157.375	154.005		26.000	
39	127+035	128/1			Pipe	φ600mm	New	BOX	1/2X2	152.911	152.836	150.486		26.000	Cut Portion
40	127+307	128/3			Pipe	φ600mm	New	BOX	1/2X2	151.668	151.593	149.243		26.000	
41	128+115	129/1			Pipe	φ1000mm	New	BOX	1/2X3	151.884	151.809	148.439		26.000	
42	128+920	129/3			Pipe	φ600mm	New	BOX	1/2X3	162.816	162.741	159.371		26.000	
43	130+101	131/1					New	BOX	1/2X2	153.306	153.231	147.121	3.760	40.000	Coushion
44	130+297	131/2					New	BOX	1/2X3	154.131	154.056	144.892	5.814	50.000	Coushion
45	130+465	131/3					New	BOX	1/2X3	154.876	154.801	144.977	6.474	52.000	Coushion
46	130+893	131/4					New	BOX	1/2X3	149.721	149.646	142.423	3.873	42.000	Coushion

2.2 NEW PROPOSAL (BYPASS)

2.2.1 FOUR LANING

In line with the general policy of NHAI and sound engineering practice, the proposed new alignment will be concentric to ROW mostly and as 4-lane.

2.2.2 RAISING OF SUBMERSIBLE REACHES

Local enquiry reveals that there is no such case of inundation of project corridor during monsoon. However, ponding level and HFL have been collected from Govt. agencies and local enquiry.

2.2.3 NEW BRIDGES:

2.2.3.1 Hydrological Consideration

Generally total length each bridge has been planned to be the same or slightly more in length as that of the bank lines, unless hydraulic study and the performance record demand a larger waterway. The Hydrological studies have been done based on the detailed field investigation by the Hydrology Engineer, who had inspected all the streams having major and minor bridges and collected field data for computation of various Hydrologic/Hydraulic parameters. Also, the catchment areas of all the streams are either calculated from Topo Sheets of Survey of India or from local Water Resources Department.

2.2.3.2 Siting

Along bypasses and short realignments, overall deck configuration of 4-lane new bridges for 4-lane carriageway shall match with the overall width of the roadway in the approaches to the bridges, which will dictate the spacing between the two new bridges.

2.2.3.3 Span Arrangement

The span arrangement is mostly single span in 6 minor Bridges. 4 span Bridges are also provided in 3 nos Major Bridges. However, choice of longer span length in multiple of the existing span would depend on the S.B.C. of the proposed founding strata and economy in the cost of foundations of the new bridges.

2.2.4 REPAIR / REHABILITATION OF EXISTING BRIDGES

There is no such case.

2.2.5 PROPOSAL FOR CULVERTS

This Bypass is on new alignment, but there are existing culverts as specified in Cl. 2.1.10.2.

Details of all proposed bridges & culverts in the Bypass project corridor are as under: -

Summary of Proposed Structures for Dimapur Bypass – Assam part

Major Bridge Nos.	Minor Bridge Nos.	ROB Nos	Flyover Nos	Box Culverts Nos
3	6	1	1	46

2.2.6 JUNCTION IMPROVEMENT

The Bypass project road has 1 number of major junction mainly with National Highways. At grade junctions has been proposed at entry locations. Various Major junctions along the project road are given below:

Sl. No.	Place	Design Ch. (Km)	Remarks
1	Lahorijan on NH-36	118.050	3 Leg

2.2.7 DIMAPUR BYPASS / REALIGNMENT PROPOSAL

The project road passes through very congested town at Dimapur with heavy built up areas on both sides of the road. Widening of the existing road to four lane in Dimapur town areas is not economical and practical due to huge financial involvement for high cost of acquisition of land and structures and shifting of utilities. As such, suitable four lane bypass is proposed for this town to the north of Dimapur town in Assam part and Nagaland part has since been submitted.

2.2.8 DIMAPUR BY-PASS EXERCISES

In order to avoid the congested and built up area at the end point of NH-36 at Dimapur in Daboka-Dimapur section construction of a By pass connecting NH-36 with NH-39 is necessary. Accordingly necessary survey has been conducted for 8 alternative alignments in addition to existing alignment of NH-36 connecting NH-39. The recommended one has the approval of NHAI, KAAC & Govt. of Nagaland.

2.2.9 SERVICE ROADS

As this is a new alignment, there is no such case. But at Flyover point where Bypass crosses NH-39, service Roads have been provided at all 4 corners for vehicles who do not want to use Flyover.

2.2.10 FOOTPATH AND COVERED DRAINS

There is no such case.

2.2.11 TRAFFIC ROTARY:

There is no requirement of traffic rotary in the project corridor.

2.2.12 TOLL PLAZA:

There is no such case as the work is on EPC basis.

2.2.13 BUS BAY/TRUCK BAY

There are one such case of Bus Bay at design Ch. 128.682 to 128.782 which have been proposed.

2.2.14 ROAD MARKINGS/SIGNAGES/ROAD FURNITURE

Retro-reflective signages as per IRC standard mounted on post or overhead gantry, required for safety and traffic control will be provided at suitable locations. Thermoplastic road markings, road studs, delineators, crash barriers etc. will be provided at required locations to ensure adequate safety of the road users.

2.3 SOIL AND MATERIAL INVESTIGATION:

2.3.1 Introduction

The Feasibility Study Report includes the report on soil and material survey and investigation work for the proposed Bypass of Dimapur.

The survey & investigation was conducted through site visits, discussions with local PWD officials, collection of representative samples of material, testing of the samples both in the field and laboratory.

The work was done in accordance with the Terms of Reference (TOR) of the project following the guidelines contained in the relevant IRC and BIS Codes. All the field and laboratory tests were conducted by a group of experienced personnel under the guidance of the qualified and experienced Geo-technical and Material engineer.

2.3.2 Purpose and Scope

The purpose and scope of the soil and material investigation are as follows:

(a) To determine the characteristics and strength of the sub grade along the proposed road as well as along the proposed alignment for 4-laning. The following tests were done:

- In-situ density of the sub grade.
- Field moisture content to determine Field Dry Density.
- DCP (Dynamic Cone Penetration) tests as per TRRL (UK) Road No. 8 to correlate the results of penetration data with field CBR.
- Modified Proctor tests to determine maximum dry density and optimum moisture content of the sub grade soil in the laboratory.
- Classification (grain size and Atterberg Limits) of subgrade soil.
- Laboratory CBR (both un soaked and 4-day soaked) at three energy levels.

The laboratory tests conducted to establish the suitability of the borrow areas are as follows:

- Grain size
- Modified proctor test
- Liquid and plastic limits
- CBR at three energy levels

(b) To locate the quarries and testing of stone aggregate as available to evaluate their suitability for use in construction of Pavement, such as GSB/Drainage layer DLC & PQC.

Aggregate Quarry

Sl. No.	Quarry	Location	Material Available
1	Delai	147TH Km of NH-36	Syanalong Store Quarry
2	Dimapur	168TH Km of NH-36	Nichugh & Kukidalong River Quarry

The tests included were as follows:

- Sieve Analysis
- Flakiness and Elongation index
- Specific gravity and water absorption
- Aggregate impact value

(c) **Sand Quarry**

Sl. No.	**Name & Quarry**	**Location**	**Material available**
1	Dimapur Sand Mahal	168TH Km of NH – 36	Sand
2	Nichugh River Quarry	168TH Km of NH – 36	Sand
3	Kukidalong River Quarry	168TH KM of NH – 36	Sand

Testing of available sand in the close proximity of the existing highway were done for use in bituminous mixtures and cement concrete work. The following tests were done to determine the suitability of fine aggregates:

- Sieve analysis
- Fineness Modulus
- Specific gravity
- Deleterious content

Most of the quarries around the project area are closed during monsoon.

The following field and laboratory tests have been conducted:

- Laboratory Tests of sub grade soil
- Laboratory Tests of borrow pit soil
- Field Density and O.M.C
- Grain Size Distribution Curve
- Atterberg Limits
- Modified Proctor Test
- Dynamic Cone Penetration Test
- Laboratory CBR Tests

METHODOLOGY

CHAPTER – 3

METHODOLOGY ADOPTED FOR DETAILED PROJECT REPORT

3.1 Purpose

The basic purpose of Detailed Project Report, is to plan and undertake all the relevant field studies including topographical surveys, traffic surveys, engineering surveys and investigations, interaction with local NGOs/stake holders working in the area and documentation which would provide essential inputs for designing the rehabilitation, and widening of the existing two lane highway into a four lane divided carriageway as a partially controlled facility. It also aims at social screening and preliminary social assessment including preliminary L.A / resettlement plan. An indicative cost of improvement works is also estimated.

3.2 Standards and Codes of Practices

All activities related to field studies, design and documentation as enumerated in the TOR have been undertaken as per the latest guidelines/circulars of MORTH and relevant publications of Indian Roads Congress (IRC) and Bureau of Indian Standards (BIS). For aspects not covered by IRC and BIS, relevant international standards and sound engineering practices should be adopted.

3.3 Methodology

3.3.1 The broad methodology as outlined in Inception Report, prepared on the basis of the Terms of Reference (TOR) has been generally followed with certain additional items considered necessary during the study.

3.3.2 The DPR basically covers all activities relating to collection of data from field and all available documents of the project road, engineering surveys and investigations, design and documentation. While carrying out the field studies, the development plans being implemented or proposed for future by local bodies / Govt. depts. have been considered.

3.3.3 To ensure quality of the study, all the relevant activities have been carried out as under:

3.3.3.1 Collection and analysis of data

a) The collection of ground data as well as various surveys and investigations have been carried out by professionally qualified and experienced staff nominated for various activities.

b) The designated key personnel of the team were responsible for supervision of the task of collecting data and carrying out surveys and investigations pertaining to the areas of specialization as laid down in various standards and codes with `state of the art' instruments and equipment.

c) The data collected from various documents, surveys and investigation have been tabulated in planned formats.

d) Computers and relevant software's have been used for analysis of various data.

The details of the engineering surveys and investigations and basic data obtained from field studies during Feasibility Study are discussed in succeeding paragraphs, in broad outline, as each aspect of surveys / investigations has been discussed in detail in relevant chapter.

3.3.3.2 Review of Data and Documents

Considerable efforts and resources have been utilised for collection of available data on the road project sector e.g.: -

a) Climate of the area

b) Road condition, major rehabilitation / maintenance works done in preceding few years.

c) Road and culverts / bridges inventory.

d) Condition Survey of road and culverts / bridges.

e) Details of sanctioned / ongoing works by MORTH / other agencies.

f) Survey and evaluation of locally available construction materials and their sources.

g) Historical data on classified traffic volume count (past 5 years or more) and other traffic survey data e.g. road accidents.

h) Type and location of all utility services (e.g. telephone line, OFC, electric lines, water main, oil pipeline etc.) with proposal for future proposed location.

i) Environmental setting including details of trees and social base line of the project.

j) Hydraulic and hydrological data of bridges.

3.3.3.3 Reconnaissance and Alignment

A detailed ground reconnaissance was undertaken by all key personnel and other sub-professional staff after study of all available data as discussed above with the objective of planning detailed surveys and investigations based on study mainly of: -

a) Topographical features of the area.

b) Existing alignment and physical features within and astride the ROW i.e. land use.

c) Possible alignment alternatives / widening scheme.

d) Preliminary assessment of bypasses / ROB / Underpasses, service roads.

e) Traffic pattern.

f) Soil and drainage condition.

g) Inventory of road, bridges and other structures.

h) Utility services within the existing and proposed ROW

i) Interactions with NGOs working in the area.

j) Development plans undertaken / proposed in the area

k) Social issues including social screening and preliminary social assessment (L.A. required / resettlement plan) and socio-economic profile of the project areas.

l) Study of road user's preparedness to pay toll,

3.4 Traffic Surveys

All traffic surveys have been done by the Senior Traffic Engineer with a team of trained enumerators as indicated in TOR as per programme submitted in Inception Report and in liaison with local NHAI and police authorities.

3.4.1 Number and location of Survey Stations

The number of count stations for various types of traffic survey were selected in consultation with local NHAI, PIU offices and provision of the TOR. These are indicated against each type of survey in Chapter 6 on Traffic Survey.

3.4.2 Classified Volume Count

a) 4 Count stations at Km 38.700 (Daboka), Km 93.00 (Malancha), Km 130.00 (Manja) & Km 160.00 (Lahorizan) in 2007 as detailed in Chapter 6.

b) Teams of enumerators carried out the survey for 7 days (continuous and direction-wise)

c) Data was collected and tabulated as per vehicle classification of IRC code (IRC:9–1972).

d) The traffic census was analysed and Average Daily Traffic (ADT) and Annual Average Daily Traffic (AADT) were determined.

e) Two such counts was conducted at Gautam Basti & Patkoi later in 2015 to ascertain probable traffic in Dimapur Bypass.

3.4.3 Origin-Destination and Commodity-Movement Survey

Origin-Destination (OD) surveys determine the pattern of traffic flows to trip purpose and commodities carried. The information obtained from the surveys provide a basis for estimates of the growth of future flows to be made. The location of Survey stations and conduct of Survey is given below:

a) Three Count stations at points of classified volume count were selected essentially around congested locality.

b) Roadside interviews, covering four wheeled vehicles, were conducted on a random sample basis for obtaining information on origin and trip destination, commodities carried including total weight of various type of commodity.

c) The data derived from the survey have been analysed to bring out the lead and load characteristics and the need for construction of bypasses.

The origin–destination survey was carried out by roadside interview method at location selected to capture all trip desires in each section. The surveys was carried out on one working day for 24 hours on a random sample basis. All categories of commercial vehicles were surveyed for trip origin, destination, trip purpose, occupancy and weight of commodity carried. The survey crew was organised with sufficient enumerators for each direction flow. These enumerators were fully trained in the use of standard interview sheets before commencement of survey and adequately supervised by experienced personnel. Police help was sought to ensure smooth flow of traffic and stoppage of randomly selected vehicles. A sample size of 20% for different types of vehicles was collected. The details of the traffic survey and analysis is contained in Chapter 6 of the Report.

The Mid-block Count Surveys were done at Gautam Basti & Patkoi for Bypass in 2015 again as required by NHAI.

3.4.4 Turning Movement Survey

Turning movement surveys at 4 Stations for estimation of peak hour traffic for design of 4-legged major intersections have been carried out as per IRC: SP: 41-1994. The location of the major intersections are as under: -

a) Km 63+500 in Docmoka

b) Km 85+200 in Howraghat Tiniali

c) Km 130+000 in Manja

d) Km 147+000 in Delai

The data obtained have been analysed to identify suitable remedial measures e.g. improvement of at-grade intersection and provision of flyovers / underpasses, grade separated Interchanges etc.

3.4.5 Axle Load Surveys

Axle load surveys in both directions were carried out using Axle Load Pads at three count stations at Km 38+700, Km 93+000 & Km 130+000 for one day on a random sample basis for trucks (both empty and loaded) and a few buses. The data collected were tabulated and analysed to bring out Vehicle Damage Factor (VDF) for design of pavement.

3.4.6 Speed-Delay Surveys

Speed delay study on the project road section has been undertaken from Km 38+000 to Km 168+167 up & down by `moving car' method with three runs to determine running speed and journey time as per SP-19 Proforma 3(a). The data collected have been analysed to identify sections with traffic flow problems and congestion and suggest suitable corrective measures. No such survey was carried out in Bypass as this is a new alignment.

3.4.7 Pedestrian / Animal Cross-Traffic Survey

Pedestrian survey was undertaken at 6 locations at Km 65+500, Km 85+200, Km 130+000 & Km 147+000 in major habitations along the highway to determine requirements, if any, for provision of viaduct for pedestrian / animals to improve traffic safety. It was seen that there is no need of any such structure. No such activity was carried out in Bypass.

3.4.8 Accident Data Survey

Data on accidents in the project road section were collected from nine local police stations to identify 'accident prone' areas for suggested improvements. As Dimapur Bypass is a new construction, no such exercise was made.

3.4.9 Accumulation / Way side Amenities Survey

Accumulation of truck Survey was undertaken at Km 40+000 (Daboka) & Km 90+000 (Bahuliaghat) and it was decided to have Truck bays.

3.4.10 Toll Rate Survey

Toll Rate Survey was carried out to assess the willingness of highway users to pay toll for the benefits accruing from the provision of high quality, 4 lane dual carriageway.

The benefits will be in the form of time savings, reduced incidence of accidents, reduced vehicle maintenance and operating costs (e.g. less wear and tear / damages). The off setting payment will be in the form of tolls.

A questionnaire to record stated preference along project route to estimate user fee levels, was framed and data collected by trained staff and the findings are as below.

Willingness to Accepted Toll Rate in respect of 50 Km Travel

Rate	% For Passenger Traffic	% For Commercial Traffic
0/-	43.48	30.77
5/-	21.74	6.92
10/-	15.94	13.85

Rate	% For Passenger Traffic	% For Commercial Traffic
15/-	13.04	23.85
20/-	2.90	15.38
25/-	2.90	8.46
Above 25/-	0.00	0.77

3.4.11 Traffic growth and projections

Traffic growth rates were ascertained on the basis of transport demand elasticity calculated from socio-economic indicators and past trend. The data obtained from traffic surveys was then projected for 15 years design period for flexible pavement and 30 years design period for rigid pavement using the growth rate.

3.5 Topographic Survey

3.5.1 Topographic survey is a very crucial and important aspect of field studies carried out to capture essential ground features along the alignment in order to consider for working out improvements, rehabilitation and upgrading. The survey has been carried out with total stations, auto levels and GPS. The data collected is in X, Y, Z format for use in DTM. Survey has been carried out as under: -

a) The GPS pair-pillars were erected at approximately 5.00 Km. intervals all-through.

b) Fixing of Bench Mark / Reference Pillar of Concrete M20 (15 cm x 15 cm x 45 cm) with a nail fixed flush on top. 30 cm of the pillar was buried in concrete of M-10 and top 15 cm painted yellow and numbered with red point.

c) The Bench Mark pillars were fixed at interval of 250metre.

d) The BMs erected were connected to a GTS Bench Mark.

e) Levels at 25m interval for 'L' section and 50m interval for 'X'-section along the road alignment were recorded in straight stretches and at closer intervals at curves or where required.

f) The topographic survey information was then translated into digitised topographical map with suitable mapping software.

3.6 Road and Bridge Inventory Survey

Inventory surveys of project road, culverts and bridges (both minor and major) have been carried out to collect data which have been tabulated on comprehensively designed proforma, as per IRC: 19-2001.

3.7 Condition Survey for Road and Bridges

3.7.1 Road Condition Survey

Through visual observations, information regarding rut depth, potholes, ravelling, type and area of cracks, edge breaks of the carriageway and shoulders were obtained and recorded on specified proforma. Homogenous segments were thereafter identified by cumulative approach method.

Roughness survey was carried out with Bump Integrator

Benkelman Beam Deflection test was conducted by CGRA method conforming to the recommendation of IRC 81-1997.

No such exercise was made in Bypass as it is a new construction.

3.7.2 Culverts and Bridge Condition Survey

Condition survey of culverts and bridges was done to ascertain the characteristics and condition of existing cross drainage structure to formulate proposals for strengthening and widening. Information regarding distresses in the structure in the form of cracking, spalling, damages to concrete surface, bearings, expansion joints etc. have been computed in appropriate proforma with visual observations.

3.8 Material Investigation

Material investigations were carried out in the field laboratory established at site on samples collected from: -

a) Quarry sites for aggregate characteristics e.g. AIV/LAV, combined flakiness and elongation index, stripping value, moisture absorption etc.

b) Identification of borrow areas for availability of suitable subgrade and embankment material and determination of engineering characteristics e.g. grain size analysis, CBR values, Atterberg's limits, moisture content, field density etc.

c) Laboratory tests to assess suitability of different materials in construction e.g. fly-ash, sand & stone and water.

d) Lead charts for various construction materials are prepared for cost estimate.

3.9 Geotechnical Sub-soil Investigation for Bridges High Embankments

Soil investigation through boreholes are carried out at each new bridge site for lane augmentation. The following tests are carried out: -

a) Standard Penetration Tests.

b) Unconsolidated and Undrained Triaxial Test

c) Undrained consolidated Triaxial Test

d) Consolidation tests

e) Grain size analysis

f) Atterberg's limits

g) Chemical tests

h) Silt factor determination.

Analysis of these test results will be used to determine the shear strength of the various strata below the ground / bed level and S.B.C. of the strata of the proposed founding levels.

3.10 Hydraulic and Hydrological Data for Preliminary Design of Bridges

a) The design discharge for determining the waterway of bridges has been taken as the maximum discharge on record for a period not less than 50 years. Where this data is not available, the design discharge has been estimated by the following methods:

- From the rainfall and other characteristics of the catchments area by use of an empirical formula applicable to that region.
- 'Area Velocity' method with the help of hydraulic characteristics of the channel.
- Unit hydrograph method.

b) The values of discharge worked out by various methods are compared and maximum discharge fixed. The linear waterway of the bridges is determined as per formula given in Cl. 104 of IRC: 5-1998 and compared with that of the existing bridge.

c) The span arrangement of the new bridge is determined on the basis of the requirement of waterway, type of foundation and safe bearing capacity of the founding strata and the span lengths of the existing bridge. The scour depth is calculated as per Cl. 110 of IRC: 5-1998 and vertical clearance as per Cl. 106 of IRC: 5-1998.

3.11 Environmental Survey

Primary and secondary data collections are undertaken for Environmental Impact Assessment. Environment monitoring stations along the project road are to be set up for collection of primary data e.g. air quality, noise level, water quality, soil quality, land use pattern etc., (these parameters are to be collected during non-monsoon season). Secondary data were collected from concerned authorities like Survey of India, Zoological & Botanical survey, State Forest Dept., Geological Survey of India, Census of India etc.

3.12 Initial Social Assessment and Preliminary Land Acquisition / Resettlement Plan

a) Development projects generate adverse social impact in the form of displacement, loss of properties, business and livelihood. In Road Projects, adverse impacts are felt by those who inhabit adjoining the project corridor. Therefore, a preliminary assessment of social impacts including a framework of compensation, mitigation and entitlements have been carried out. Accordingly, preliminary and secondary data

collection and extensive consultations with stakeholders, NGOs and other Govt. Agencies are necessary. A study has been done for the project affected personnel and their properties, socially vulnerable groups and entitlement framework in accordance with the NHAI's rehabilitation and resettlement principles and policy framework and furnished in Chapter 8.

b) The implementation of proposed highway improvement work may entail acquisition of land outside the ROW. Such acquisition has been kept to the minimum possible. Details of such land e.g. type of land (agricultural, barren, forest, hilly etc.) nature of crops / usage, ownership details, affected properties on the land, area of land to be acquired, costs (both land and properties) are collected and a Land Acquisition Plan has been prepared.

3.13 Traffic Safety

Traffic Safety measures have been planned for incorporation in the design of road features. Service roads will be provided in congested areas of towns / villages astride the road. Concrete crash barriers of New Jersey type/Steel beam guardrails will be provided on bridge approaches / sections of road where embankment height is more than 6m. Road signs and markings will be provided as per relevant IRC codes.

3.14 Relocation of Public Utilities

Existing public utilities along the road have been surveyed e.g. telephone lines, electric lines, OFC, gas / oil pipelines etc. and their layout are shown in an utility relocation plan. The details have been collected from the concerned govt. agencies for relocation, cost estimate for shifting and necessary clearances.

3.15 Cost Estimate

Analysis of rates based on Standard Data Book of MORT&H (2003) and schedule of Rates for NH Wing of PWD, Assam 2014 & Nagaland 2016 is carried out for costing. The unit rate for non-scheduled items have been worked out from the market rates by taking appropriate coefficients for labour, material and machinery from the Standard Data Book. Computation of quantities for each road component and bridges and other ancillary items are being carried out for preparing cost estimate alongwith other costs e.g. land acquisition, utility relocation, environmental mitigation, resettlement / rehabilitation costs.

3.16 Financial Analysis

3.16.1 Back Ground

The Project length starts from Daboka at Km 0.000 (Km 38.000 of NH-36) and the Dimapur Bypass (Assam part) starts at Km 159.400 of NH-36.

The total length of the project highway is 153.058 Km (design length) and for Financial Analysis at draft feasibility stage, this has been considered in one package as under: -

Description	**Design Length (Km)**
From Km 38.000 - Km 168.167 on NH – 36	153.058

3.16.2 Approach to Financial Evaluation

The viability of each package depends on the working cash flows available to service the debt and equity. This working cash flow is basically dependent upon the following: -

a) Project Cost
b) Traffic & Traffic Growth
c) Toll Structure
d) Operation and Maintenance expenses
e) Interest on Debt
f) Tax

The main objective of Financial Analysis is to examine the viability of implementing the project.

SOCIOECONOMIC PROFILE OF PROJECT AREA

CHAPTER-4

SOCIO-ECONOMIC PROFILE OF PROJECT AREA (Dimapur Bypass – Assam Part)

Introduction

This Chapter provides a detailed review of Socio-economic profile of states of Assam & Nagaland and the relative status of the project influence area within the state. Traces has been given on population density, the work force, distribution of work force, the changes in sectoral distribution of workers, growth of enterprises, status of non-agricultural workers, distribution of important units, condition of cultivators, condition of household workers, condition of non-workers, condition of manufacturing industry and the related social problems, such as poverty eradication,. Gender issue, etc., of the different region of Assam & Nagaland and other economic variables of the state and the PIA districts (Nagaon, KAAC & Dimapur).

The profile discusses the past performance and the present scenario and also a broad assessment of the perspective growth of the economy and social development of state and PIA Districts (Nagaon, KAAC & Dimapur), as basis for estimating the future growth in transport demand. The influence area of the project road, for the purpose of present study, is defined at the state level. Appropriate major economic characteristics are reviewed for the district as well. The output of this chapter is the economic growth prospects of the PIA with respect to certain selected economic variables and serves as the basis for arriving at a realistic traffic growth rate for different vehicle categories. Secondary data available from the different departments of the State Government have been collected and analyzed for preparation of socio-economic profile.

Project Influence Area:

Though, the district through which the study corridor passes is considered to be the primary project influence area (PIA), the nature of the study corridor, being the National Highway, also facilitates long distance traffic movement and the influence area stretches beyond the district boundaries. Hence the area could extend to the state limits and on occasions could extend into neighboring states. However the influences area of the project corridor, for the purpose of present study, is defined at the state level. It is observed that a substantial part of the total traffic on the project road originates in Assam and terminates in Nagaland. The State of Assam & Nagaland are thus taken as the broad influence area, while Nagaon, KAAC & Dimapur districts are considered as the immediate Project Influence Area (PIA).

Assam

Assam is the rainbow land where the multi-hued Indian Culture has blossomed from times immemorial. Blessed with a variety of geographical land and many cultural diversities, Assam, has been the area of activity of historical heroes. Rich and tranquil expanses of meadows, perennial rivers, dense forests and fertile soil of Assam have contributed numerous golden chapters to the annals of Indian History. Dotted with various holy shrines and pilgrim places, full of joyous festivals, it plays an important role in the politics, education, culture, industry, agriculture and tourism of India.

Garlanded by the Barak and Brahmaputra the two rivers, Assam is surrounded by Nagaland & Manipur in the East, Tripura & Mizoram in the South, West Bengal in the west and Bhutan & Arunachal in the north. Its area of 78,438.08 sq kms lies between latitude 24 deg to 28 deg and longitude 90 deg to 96 deg East.

Assam is endowed with natural wealth in abundance. The diversity of flora and fauna displayed here due to vast area, big and small rivers, varieties of climatic conditions, and different kinds of soil are hard to find elsewhere.

Tropical Deciduous Forests are found in all parts of the plains. The trees are mostly deciduous. Since sun-light reaches the ground in abundance, shrubs and grasses also grow here. Large tracts of these forests have been cleared for cultivation. Important trees are Sal, Palas, Bamboo, Bel, Anjeer etc. Neem, Peepal, Sheesham. Mango, Jamun Babool, Imli (Tamarind) etc. grow along riverbanks and in other moist regions.

Socio –Economic Profile of PIA (District)

Nagaon

It is located between Longitude 92°15′ & 93°30 East and Latitude 25°50′ & 26°40 North. Spread in area of 3973 Sq. Km. It is surrounded by District Sonitpur in North, KAAC in East, Mizoram in West and North Cachar in South. It is well connected by Railways & Roadways.

District Nagaon/KAAC

Item	Units	Year	Value
Geographical Area	Sq. Km.	2011	3973 / 10434

Nagaon/KAAC			
Item	**Units**	**Year**	**Value**
Population			
Male Nagaon / KAAC	**In thousand**	**2011**	**1440.3 / 493.5**
Female Nagaon / KAAC	**In thousand**	**2011**	**1385.7 / 471.8**
Total Nagaon / KAAC	**In thousand**	**2011**	**2826 / 965.3**
Literacy Rate%			
Male Nagaon / KAAC	**In %**	**2011**	**78.19 / 82.12**
Female Nagaon / KAAC	**In %**	**2011**	**69.21 / 64.62**
No. of Village			
No. of habituated Village Nagaon / KAAC	**No.**	**2011**	**1375 / 2633**
Police Station			
Nagaon / KAAC	**No.**	**2011**	**21/16**
Education			
Junior Basic Schools Nagaon / KAAC	**No.**	**2011**	**2348/1772**
Senior Basic Schools Nagaon / KAAC	**No.**	**2011**	**377/225**
Higher Secondary Schools Nagaon / KAAC	**No.**	**2011**	**130/11**
Degree Colleges Nagaon / KAAC	**No.**	**2011**	**3/2**
University Nagaon / KAAC	**No.**	**2011**	**0/0**

Electricity				
Total Villages KAAC	**Electrified** Nagaon /	**No.**	**2010-2011**	**1213/1740**

Social & Economic Growth potential

Due to its rolling terrain there is no visible possibility of reckonable growth in the secondary sector of the economy of Nagaon, KAAC & Dimapur. Migration of workers to these places, seeking jobs in secondary sector has little possibility of happening. On the other hand, evidently the tertiary sector seems to be the engine of economic growth in this town. Most of the activities under the tertiary sector, which is the main constituent of the economic base of these places, are related to small trade and enterprises, hotel business, transport and such other activities. On the other hand tourism has its impact on the tertiary sector of the economy of the places Conservation of built heritage, developing social and cultural tourist attractions, their promotion and marketing, and of course development of infrastructure together would ensure substantial positive impact on the economy and its growth, particularly on the tertiary sector, which is and will remain the dominant economic sector in Nagaon, KAAC & Dimapur Districts. As project corridor is mostly in Assam, details of Assam is given below:

A] National Park & Wild Life Sanctuaries

The Wildlife Act provided for setting up national parks and sanctuaries for Wildlife. The total Wildlife protected areas in Assam is 3925 Sq. Kms. Wildlife protected areas of PIA districts are as below [Source Chief Conservator of Forest (WL), Assam 2007-2008].

Name	**Location (District)**	**Area ins Sq. Kms.**
Nambor WLS	KAAC	37.00
Garampani WLS	KAAC	6.05
East Karbi Anglong WLS	KAAC	221.81
Marat Longri WLS	KAAC	451.00
Laskhowa WLS	Nagaon	70.13
North Karbi Anglong WLS (Proposed)	KAAC	96.00
	TOTAL	**881.99**

B] Area under Forest in PIA districts of Assam (as on 31.03.11)

(Area in Hectare)

Forest D	Reserved Forest	Proposed Reserved Forest	Protected Area	Total Forest (Less unclassed S.F.)
Karbi Anglong East	61995.937	84089.60	34042.00	180127.537
Karbi Anglong West	90949.915	3525.00	451.00	94925.915
Nagaon	33250.006	3573.04	-	36823.046
Nagaon South	64873.521	-	-	64873.521
Nagaon Wild Life	2156.00	-	11417.040	13573.04

(Source: Pr. Chief Conservator of Forest, Assam)

C] Total numbers of Small Scale Industries registered in 2010

District	Unit Registration during the year	Total Registered units	Total Workers
Nagaon	16	3762	1647
Karbi Anglong	2	581	440

(Source: Directorate of Industries & Commerce, Assam)

D] District-wise length of PWD Roads By Type in Assam 2010-11

(In Kms.)

District	Black Topped	Earthen/Gravelled	Total	Remarks
Nagaon	1530	1588	3118	Source P.W.D. Assam
Karbi Anglong	1481	2828	4309	- Do -

E] District-wise Length of Roads (Diff. Classes) under PWD in Assam (2010-2011)

In Km.

District	State Highways	Village Connectivity from Phase I to VI, PMGSY	Major District Roads	Rural Roads	Urban Road	Total
Nagaon	297	492 Villages	327	2407	88	3118

Karbi Anglong	337	170 Villages	561	3341	70	4309

F] District-wise Length of Roads per Lakh of Population 2010-11

District	Road Length	Length per Lakh of population	Length per '00' Sq. Km of Geographical Area
Nagaon	3118	110.34	78.49
Karbi Anglong	4309	446.40	41.30

G] District-wise number of Motor Vehicles in Assam (2010-11)

a) Motor Vehicle registered: In Karbi Anglong - 4,154
In Nagaon - 12,156

b) Motor Vehicle on Road: In Karbi Anglong - 18,787
In Nagaon - 80,044

c) Collection of Revenue by Transport Deptt. in Assam: In Karbi Anglong - 3.54 Crores
In Nagaon - 10.10 Crores

H] Number of Motor Vehicles in Assam districts (PIA) in 2010-11

Type	Karbi Anglong	Nagaon
Multi-Axle Trucks	20	-
Articulated Trucks	-	-
Trucks	1810	1450
LMV Goods	140	750
Bus	256	298
Omni Bus	33	-
Mini Bus	4	-
Taxi	106	1168
Two Wheeler	11325	57940
Car/Jeep/Govt. Car	2370	9857
Auto Ricksaw	2500	3300
Others	63	1340

I] PIA District-wise number of Assam Employment Exchanges & Employment in 2010

District	Exch. General & Special	Registration in 2010	No. in live register	Vacancies notified	No of Placement
Nagaon	4	13319	146607	168	15
Karbi Anglong	5	4578	47311	3	3

J] PIA District-wise Tea & Rubber Plantation details during 2010-2011

District	Tea Plantation		Rubber Plantation			
	Grower	Area in hec.	Area in hec.	Production in MT	Tapping Area in hec.	Employment in Mandays
Nagaon	136	330.74	510.88	156	95.10	12950
Karbi Anglong	451	2524.54	4174.00	3386	2129.61	994600

K] PIA District-wise statistics of Handloom & Textiles in 2010-2011

District	Villages Covered	Weavers Engaged			Extn. Service Unit Production	Handloom Production Centre
		Part Time	Whole Time	Total		
Nagaon	285	42032	5011	47043	2510	185
Karbi-Anglong	135	45364	2700	48064	-	-

4.2.2.16 General Discussion on Assam

Although the literacy rate of the State is 63%, which is much higher than the national average, the State still lacks in skilled manpower. This scenario is slowly changing as large number of Assam youths are going out of the State for higher and technical education. In addition to the ITI centres run by the government, private training institutes, particularly in computer education are also coming up. This requires a major push so as to develop and up-grade the skills of the local people by utilizing the service of reputed training institutions/organizations. Development of managerial capability of local youth shall be taken up through intensive EDPs. The State shall encourage private investors/organizations to set up training Institutions in the State.

The following shall be the thrust areas for Industrial Development: -

a. Food Processing Industries
b. Tourism Industry
c. Agro-based industries
d. Mineral based industries
e. Handloom and Handicrafts
f. Sericulture

g. Floriculture
h. Electronics and IT
i. Pharmaceuticals
j. Petrochemicals
k. Bio-tech Industries

Details of Project Affected Persons (PAP) and Analysis

The Northern Dimapur Bypass through 10 villages in Assam & 10 villages in Nagaland State i.e. 20 Villages affecting 4 Police Stations of KAAC & Dimapur District. The ROW has been taken as 60 m i.e. 30 m on each side of Centre-line of Alignment.

It will appear from the tables placed herein-after that the following structures will be affected and cost involved, total affected PAPs & Families and losses of income of PAPs. (Cost based on Assam P.W.D. schedule of Rates of 2013-14)

		In Assam		**In Assam**	**Total**
1)	Pucca dwelling	289.72 Sqm.	@10,920 /Sqm.	31,63,742/-	31,63,742/-
	Semi Pucca dwelling	5302.16 Sqm.	@9,348 /Sqm.	4,95,64,591/-	4,95,64,591/-
	Kancha Dwelling	11896.53 Sqm.	@9,348 /Sqm.	11,12,08,762/-	11,12,08,762/-
				16,39,37,095/-	**16,39,37,095/-**

		In Assam
2)	Families displaced	210 nos
	Affected PAPs	1247 persons

		In Assam	
3)	Monthly Loss of Business	3,55,000/-	3,55,000/-
	Monthly household income loss	24,78,200/-	24,78,200/-
	Total monthly loss from Business & Household Income		**28,33,200/-**

INDICATIVE DESIGN STANDARDS, METHODOLOGIES AND SPECIFICATIONS – PAVEMENT DESIGN

CHAPTER 5

INDICATIVE DESIGN STANDARDS, METHODOLOGIES, SPECIFICATIONS, AND PAVEMENT DESIGN (DIMAPUR BYPASS – ASSAM PART)

5.1 DESIGN BASIS

The project has been planned as a "partially controlled access highway" and access to highway has been provided at pre-determined locations taking measures to overcome physical and operational constraints, such as, limitation of ROW un-regulated access, inadequate service roads/underpasses, numerous at-grade functions, lack of physical separation between local and through traffic etc. and operational constraints arising out of necessity or possibility of closing a portion of the road for construction and/or diverting the traffic to temporary diversion, thereby reducing the capacity and safety of the existing highway, adopting safety of design, durability as also mitigating disruptive effects of construction.

In attaining proper planning and designing of the road project the following Indian Standards, specifications, codes of practice, Guidelines, etc. have been adopted in the following order of priority :

i) MORT&H Manual for specifications and standards for four laning of National Highways through Public Private Partnership (IRC:SP:84-2014).

ii) Technical circulars issued by MORTH and published by Indian Roads Congress/available on MORTH website in so far as they relate to design and construction.

iii) Specifications for Road and Bridge Works issued by the Ministry of Road Transport & Highways hereinafter referred as MORTH or Ministry's Specifications.

iv) Indian Roads Congress (IRC) Codes and Standards; as below

v) Bureau of Indian Standards (BIS) in the absence of any specific provision / issue in the aforesaid Codes and Specifications as below.

Wherever Indian standards are either not available or if available but not adequate, it shall be permitted to adopt international standards and specifications as followed in United States of America, United Kingdom, European Union, Japan, Germany or Australia.

List of IRC Codes/Standards/Acts for Road/Bridge Works

IRC : 2 – 1968	Route Marker Signs for National Highways (First Revision)
IRC : 3 – 1983	Dimensions and weight of Road Design vehicles (First Revision)

List of IRC Codes/Standards/Acts for Road/Bridge Works

IRC : 5 – 1998	Standard Specification & Code of Practice for Road Bridges, Section I – General Features of Design (7th Revision)
IRC : 6 – 2000	Standard Specifications & Code of Practice for Road Bridges, Section II – Loads and Stresses (Fourth Revision)
IRC : 7 – 1971	Recommended Practice for Numbering Bridges and Culverts (First Revision)
IRC : 8 – 1980	Type Designs for Highway Kilometre Stones (Second Revision)
IRC : 9 – 1972	Traffic Census on non urban roads (First Revision)
IRC : 10 – 1961	Recommended Practice for Borrow pits for Road Embankments Constructed by Manual Operation
IRC : 15 – 2002	Standard Specifications & Code of Practice for Construction of Concrete Roads (Third Revision)
IRC : 16 – 1989	Specification for Priming of Base Course with Bituminous Primers (First Revision)
IRC : 18 – 2000	Design Criteria for Prestressed Concrete Road Bridges (Post-Tensioned Concrete) (Third Revision)
IRC : 21 – 2000	Standard Specifications and Code of Practice for Road Bridges. Section-III Cement Concrete (Plain and reinforced) (Third revision).
IRC : 22 – 1986	Standard Specifications and Code of Practice for Road Bridges. Section-VI Composite Construction (First Revision).
IRC : 24 – 2001	Standard Specifications and Code of Practice for Road Bridges. Section-V Steel Road Bridges (First Revision).
IRC : 26 – 1967	Type Design for 200-Metre Stones
IRC : 30 – 1968	Standard Letters and Numerals of Different Heights for Use on Highway Signs
IRC : 32 – 1969	Standard for Vertical and Horizontal Clearances of Overhead Electric Power and Telecommunication Lines as Related to Roads.
IRC : 33 – 1969	Standard procedure for evaluation and condition surveys of stabilized soil roads.
IRC : 34 – 1970	Recommendations for road construction in waterlogged area.
IRC : 35 – 1997	Code of Practice for Road Markings (with Paints) (First Revision)
IRC : 36 – 1970	Recommended Practice for Construction of Earth Embankments for Road Works
IRC : 37 – 2012	Guidelines for the Design of Flexible Pavements (Second Revision)
IRC : 38 – 1988	Guidelines for Design of Horizontal Curves for Highways and Design Tables (First Revision)
IRC : 40 – 2002	Standard Specifications and Code of Practice for Road Bridges, Section IV – Brick, Stone and Block Masonry (Second Revision)
IRC : 41 – 1997	Type designs for check barriers (First Revision)

List of IRC Codes/Standards/Acts for Road/Bridge Works

IRC : 42 – 1972	Proforma for record of test values of locally available pavement construction materials.
IRC : 45 – 1972	Recommendation for Estimating the Resistance of Soil Below the Maximum Scour Level in the Design of Well Foundations of Bridges.
IRC : 47 – 1972	Tentative specifications for built up spray grout.
IRC : 52 – 2001	Recommendation about the alignment survey and geometric design of hill roads, (Second Revision)
IRC : 54 – 1974	Vertical Clearances at Underpasses for Vehicular Traffic.
IRC : 56 – 1974	Recommended Practice for Treatment of Embankment Slopes for Erosion Control
IRC : 57 – 1974	Recommended Practice for Sealing of Joints in Concrete Pavements
IRC : 58 – 2015	Guidelines for the design of plain jointed Rigid pavements for highways (Fourth Revision)
IRC : 59 – 1976	Tentative Guidelines for the design of gap graded cement concrete mixes for road pavements.
IRC : 61 – 1976	Tentative Guidelines for the construction of Cement Concrete Pavements in Hot Weather.
IRC : 65 – 1976	Recommended practice for traffic rotaries.
IRC : 67 – 2001	Code of Practice for Road Signs (First Revision)
IRC : 69 – 1977	Space Standards for Roads in Urban Areas
IRC : 70 – 1977	Guidelines on regulations and control of mixed traffic in urban areas.
IRC : 71 – 1977	Recommended practice for preparation of notations.
IRC : 73 – 1980	Geometric Design Standards for Rural (Non-Urban) Highways
IRC : 75 – 1979	Guidelines for the Design of High Embankments
IRC : 78 – 2000	Standard Specifications and Code of Practice for Road Bridges. Section-V Foundations & Sub-structure (Second Revisions).
IRC : 79 – 1981	Recommended Practice for Road Delineators
IRC : 80 – 1981	Type Designs for Pick-up Bus Stops on Rural (i.e. Non-Urban) Highways
IRC : 81 – 1997	Tentative Guidelines for Strengthening of Flexible Road Pavement Us Benkelman Beam Deflection Technique (First Revision)
IRC : 83 – 1999	Standard Specifications and Code of Practice for Road Bridges. Section Bearings, Part-I : Metallic Bearings.
IRC : 83 – 1987	Standard Specifications and Code of Practice for Road Bridges, (Part-II) Section-IX Bearings, Part-II : Electrometric Bearings
IRC : 83 – 2002	Standard Specifications and Code of Practice for Road Bridges, (Part-II) Section-IX Bearings, Part-III : POT POT-CUM-PTFE, PIN AND METALLIC GUIDE BEARINGS

List of IRC Codes/Standards/Acts for Road/Bridge Works

IRC : 84 – 1983	Code of Practice for Curing of Cement Concrete Pavement.
IRC : 85 – 1983	Recommended practice for accelerated strength testing and evaluation of concrete for Road and Airfield Constructions.
IRC : 86 – 1983	Geometric Design Standards for Urban Roads in Plains
IRC : 87 – 1984	Guidelines for the design and erection of false work for road bridges.
IRC : 89 – 1997	Guidelines for Design & Construction of River Training & Control Works for Road Bridges (First Revision)
IRC : 91 – 1985	Tentative guidelines for construction of cement concrete pavement in cold weather.
IRC : 92 – 1985	Guidelines for the Design of Interchanges in Urban Areas.
IRC : 93 – 1985	Guidelines on Design and Installation of Road Traffic Signals
IRC : 98 – 1997	Guidelines on Accommodation of Underground Utility Services Along and Across Roads in Urban Area (First Revision).
IRC : 102 – 1988	Traffic studies for planning bypasses around towns.
IRC : 103 – 1988	Guidelines for Pedestrian Facilities.
IRC : 104 – 1988	Guidelines for Environmental impact assessment of Highway projects.
IRC : SP : 4 – 1966	Bridge Loading Round the World
IRC : SP : 11 – 1988	Handbook of Quality Control for Construction of Roads and Runways (Second Revision)
IRC : SP : 13 – 2004	Guidelines for the Design of Small Bridges and Culverts.
IRC : SP : 14 – 1973	A Manual for the Application of the Critical Path Method to Highway Project in India
IRC : SP : 15 – 1996	Ribbon Development Along Highways and its Prevention
IRC : SP : 16 – 2004	Guidelines for surface evenness of Highways Pavements (First Revision)
IRC : SP : 17 – 1977	Recommendations About Overlays on Cement Concrete Pavements
IRC : SP : 18 – 1978	Manual for Highway Bridge Maintenance Inspection
IRC : SP : 19 – 2001	Manual for Survey, Investigation and Preparation of Road Projects (First Revision)
IRC : SP : 21 – 1979	Landscaping of Road
IRC : SP : 22 – 1980	Recommendations for the Sizes for each Type of Road Making Machinery to Cater to the General Demand of Road Works
IRC : SP : 23 – 1983	Vertical Curves for Highways
IRC : SP : 27 – 1984	Report Containing Recommendations of IRC Regional Workshops on Highway Safety

List of IRC Codes/Standards/Acts for Road/Bridge Works

IRC : SP : 32 – 1988	Road Safety for Children (5-12 Years Old)
IRC : SP : 33 – 1989	Guidelines on Supplemental Measures for Design, Detailing & Durability of Important Bridge Structures.
IRC : SP : 34 – 1989	General Guidelines About the Equipment
IRC : SP : 35 – 1990	Inspection and Maintenance of Bridge
IRC : SP : 37 – 1991	Guidelines for Evaluation of Load Carrying Capacity of Bridges
IRC : SP : 39 – 1992	Guidelines on Bulk Bitumen Transportation & Storage Equipment
IRC : SP : 40 – 1993	Guidelines on techniques for strengthening and rehabilitation of bridges
IRC : SP : 41 – 1994	Guidelines on Design of At-Grade Intersections in Rural & Urban Areas
IRC : SP : 42 – 1994	Guidelines on Road Drainage
IRC : SP : 44 – 1994	Highway Safety Code
IRC : SP : 46 – 1997	Steel Fibre Reinforced Concrete For Pavements
IRC : SP : 47 – 1998	Guidelines on Quality System for Road Bridges (Plain, Reinforced, Prestress and Composite Concrete).
IRC : SP : 48 – 1998	Hill Road Manual
IRC : SP : 50 – 1999	Guidelines on Urban Drainage
IRC : SP : 51 – 1999	Guidelines for Load Testing of Bridges
IRC : SP : 52 – 1999	Bridge Inspector's Reference Manual
IRC : SP : 53 – 2002	Guidelines on Use of Polymer and rubber Modified Bitumen in F Construction (First Revision)
IRC : SP : 54 – 1999	Project Preparation Manual for Bridges
IRC : SP : 55 – 2001	Guidelines for Safety in Construction Zones
IRC : SP : 56 – 2000	Guidelines for Steel Pedestrian Bridges
IRC : SP : 57 – 2001	Guidelines for Quality Systems for Road Construction
IRC : SP : 59 – 2002	Guidelines for Use of Geotextiles in Road Pavements and Associated World
IRC : SP : 60 – 2002	An Approach Document for Assessment of Remaining Life of Concrete B.
IRC : SP : 73 - 2007	Manual of standards & specification for two laning of State Highways on B.O.T. basis.
IRC : SP: 84 : 2014	Manual of specification & standards for Four laning of National Highways through Public Private Partnership.

III Ministry of Surface Transport Publications

MORT&H Pocketbook for Bridge Engineers, 2000 (First Revision)

MORT&H Pocketbook for Highway Engineers, 2002 (Second Revision)

MORT&H Specifications for Road and Bridge Works, 2001 (Fourth Revision)

MOST Standard Plans for 3.0 m Span Reinforced Cement Concrete Solid Slab Superstructure with and without Footpaths for Highways, 1991

MOST Standard Plans for Highways Bridges R.C.C. T-Beam & Slab Superstructure – Span from 10 m to 24 m with 12 m width, 1991

MOST Standard Plans for Highway Bridges PSC Girder and RC Slab Composite Superstructure for 30 m Span with and without Footpaths, 35 m Span with Footpaths and 40 m Span without Footpath, 1991

MOST Standard Drawings for Road Bridges – R.C.C Solid Slab Superstructure (15* & 30*SKEW Span 4.0m to 10.0m (with and without Footpaths), 1992

MOST Type Designs for Intersections on National Highways, 1992

MOST Computer Aided Design System for High Embankment Problems, 1993

MOST Addendum to Ministry's Technical Circulars and Directives on National Highways and Centrally Sponsored Road & Bridge Projects (Aug.88 to Dec 92), 1993

MOST Standard Drawing for Road Bridges R.C.C. Solid Slab Superstructure (22.5* SKEW) R.E.Span 4M to 10M (with and without Footpath), 1996

MOST Addendum to Ministry's Technical Circulars and Directives on National Highways and Centrally Sponsored Road & Bridge Projects (Jan.93 to Dec.94), 1996

Standard Plan for Highway Bridges – Prestressed Concrete Beam & RCC Slab Type Superstructure - Volume – II

MOST Addendum to Technical Circulars & Directives on National Highways & Centrally Sponsored Road & Bridge Works Projects (Jan, 1995 to Dec.1997)

MOST Standard Plans for Single, Double and Triple Cell Box Culverts with and without Earth Cushion

Manual for Safety in Road Design

MORT&H Manual for Construction and Supervision of Bituminous Works, 2001

BIS PUBLICATIONS

IS : 1944 (Part-I&II) 1970	Code of Practice for lighting of Public thorough fare: Parts Land 2 For Main and Secondary roads (Group-A and B) (First revision) (Amendments No.1 and 2) (Parts – I and 2 in one volume) (Amendments – 2).
IS:1944 (Part-V) 1981	Code of Practice for Lighting of Public Thoroughfares : Parts 5 Lighting for Grade separated junctions, Bridges and Elevated roads (Group-D).
IS:1944(Part-VI)1981	Code of Practice for lighting of Public thoroughfare : Part-6 Lighting for Towns and city centers and areas of civic Importance (Group-E).
IS : 10748-1995	Hot rolled steel for welded tubes and pipes (First Revision)
NBC	National Building Code.

Part-III, NBC : Development Control rules and general building requirements.

Part-IV, NBC : Fire Protection

Part-VI, NBC : Structural Design

Part-VIII, NBC: Building Services

Part-IX, NBC : Plumbing Services

The design basis for the Project Road has been adopted with the objective of construction of new road to a 4-lane divided carriageway configuration. The following guiding principles have been kept in view during evolving the highway designs:

(a) A uniform application of design standards for any area is essential from the viewpoint of road safety and the smooth flow of traffic. The selection of optimum design standards reduces the possibility of early obsolescence of the facility.

(b) Faulty geometric standards, after construction, are frequently difficult to rectify at a later date and they are always costly. As such, both horizontal and vertical geometry has been accorded due importance at the initial design stage itself and selected standards have, generally, not been compromised except in some compelling site condition.

(c) The design is more or less consistent within any area and the standards proposed for the different elements are compatible with one another. It is sometimes necessary to reduce the selected design speed for economic reasons attempts have been made to avoid any abrupt changes in the design speed.

(d) Efforts have been made to select the design such that it minimises the total transportation cost, including initial construction costs, costs for maintenance of the facility, and the cost borne by the road users.

(e) Safety is built-in into design elements.

(f) "Ruling" standards have been followed as a matter of routine. "Minimum" standards have been followed only where serious restrictions are imposed by technical or economic consideration.

5.2 The design standards enumerated in the Draft Feasibility Report were broad based ones. Those standards have been concretized as per relevant codes and standards matching the ground situation and on assessment of highway conditions during field survey and investigations. The standards adopted are given in succeeding paragraphs. Methodologies have been stated in the Draft Feasibility Report and hence not repeated in detail again.

5.3 DESIGN STANDARDS

5.3.1 Terrain Classification

The project road (NH-36&NH-39) under cover of this report (Km. 0.000 to Km. 168.167 including one Bye-pass and Realignment) lies mostly in rolling terrain having cross-slope more than 25% and passing through Rural (open country) as well as semi-urban areas. As such, the geometric standards relevant to plain terrain as per **IRC:73-1980, IRC:86-1983, IRC:58-2015, IRC:38 and IRC:SP:23** have been adopted. This part deals with new Northern Dimapur Bypass.

5.3.2 Design Speed

Choice of design speed depends on the function of the road as also the terrain conditions. It is the basic parameter, which determines all other geometric design features. Normally **ruling design** speed has been adopted. In sections where site conditions including costs do not permit adoption of ruling design speed, **minimum design** speed has been adopted in consultation with the client in line with the stipulations in **IRC:73-1980 & IRC:58-2015**.

The design speed has been considered as under depending on site condition and other considerations of proximity of structures:

	Ruling	Minimum
Rolling Terrain	**100 km/hr**	**65 km/hr**

If changes in the design speed appear unavoidable, gradual changes have been introduced by providing successive sections of increasing / decreasing design speeds so that road users become progressively conditioned to such changes. Warning signs are to be placed at suitable location where design speed reduction becomes unavoidable.

5.4 CROSS-SECTIONAL ELEMENTS

5.4.1 Right-of-way (ROW)

The existing ROW along the project road varies from locations to locations. Based on approved alignment proposal Land Acquisition has been made based on the guidelines as in IRC:73-1980 & IRC:58-2015.

Generally a 60 metre wide corridor for ROW has been considered for the instant road project.

5.4.2 The guidelines as contained in the aforesaid Codes / Manuals relevant to **rolling terrain** have been followed to finalise various elements of roadway as detailed hereinafter:

i) (a) For **4-lane divided carriageway** – 2 x 7.0m width with 0.50 m width for kerb shyness adjacent to raised median.

ii)(a) The soft **shoulder** for the project road will be kept as **2.0 m** on two ends (outer side) of both carriageways. In open country area **1.5m** adjacent to main carriageway on either side will be **paved** with the same pavement composition as the main carriageway. The remaining **2.0m** portion of shoulder will be earthen except in locations where guard rail has to be used the shoulder width in such locations will be **2.50m.**

iii) The height of embankment shall be based on the final road level. The bottom of subgrade is to be kept at least 1.00 m above HFL.

iv) Embankment side slope should normally be 2 (H): 1(V) but in high embankment the side slope may vary at different levels depending upon the stability of embankment. Erosion of side slopes are to be protected by providing turfing/vegetative cover, stone/C.C. block pitching, geosynthetics etc.

v) Side drain has been provided on both sides of the road in open country areas and cross section is to be designed to cater for effective drainage of estimate peak hour runoff.

5.4.3 Median:

The width of median verge is proposed to be **5.00 metre** including shyness for open country stretches. This is followed throughout the length of the corridor.

5.4.4 Cross - Slope

a) Each carriageway shall have cross-slope of 2.00%, as the pavement is of concrete

b) The paved shoulder shall have the same specification as that of main carriageway and cross-slope of 2.00% matching with main carriageway slope.

c) The earthen shoulders shall have a slope of 3.00%.

In **superelevated sections** the shoulders will have same cross fall as that of the pavement. The shoulders on the high side of the superelevated portion shall be provided with reverse slope from the superelevated carriageway portion.

5.5 HORIZONTAL ALIGNMENT

Uniformity of design standards is one of the essential requirements of any road alignment. In a given section, there must be consistent application of design criteria to avoid creation of unexpected situations for the drivers. As a general rule, the horizontal alignment adopted is fluent and blend well with the surrounding topography. The curves have been designed to have the largest practical radius but in no case less than the ruling value. Hazardous sharp curves at the end of long tangent have been avoided. Curve lengths have been kept sufficiently long with suitable transitions to provide pleasing appearance. Reverse curves

have generally been avoided but for unavoidable situations sufficient length of transition between two curves have been provided. The horizontal alignment has been coordinated carefully with longitudinal profile.

5.5.1 Horizontal Curves

The horizontal curves for this project road have been designed in accordance with the requirements as stipulated in IRC:38-1998. Horizontal curves will normally consist of a circular curve flanked by spiral transition curves at both ends.

The transition curves will facilitate gradual application of super-elevation and will ensure smooth entry of vehicles from straight to the circular curve without causing any discomfort to the driver.

5.5.2 Superelevation

Superelevation to be provided on horizontal curves has been based on the following formula:

$$e = \frac{V^2}{225R}$$

where

e = superelevation (metre/metre)

V = speed (km/hr)

R = radius (metres)

Superelevation obtained from the above expression has been limited to **5% maximum** in **plain** terrain. **No superelevation** is required for radius above **1800m** corresponding to design speed of **100 Km/hr** (for camber of 2.5%).

5.5.3 Radius of Horizontal Curves

a) The radii of horizontal curves have been calculated from the following formula :

$$R = \frac{V^2}{127(e+f)}$$

Where, V = vehicle speed (km/hr)

e = superelevation ratio (metre per metre)

f = coefficient of side friction between vehicle tyres and the pavement (taken as 0.15)

R = radius (metres).

b) The ruling radius is **400m**, which corresponds to the ruling **design speed of 100km/hr.** For new alignment the largest practicable radius in excess of 400m has been adopted. In case of existing curves having radius 400m and above.

5.5.4 Transition Curves

a) Transition curves are necessary for vehicles to progress smoothly from a straight alignment into a circular curve or between curves of different radius. The transition curve also facilitates a gradual application of the superelevation and widening of the carriageway which may be required for the horizontal curves. **Spiral curves** will be used for this purpose.

b) The length of the transition curve has been determined from the following two considerations, i.e. i) rate of change of centrifugal acceleration, ii) rate of change of superelevation. The larger of the two values has been adopted for design :

i) $L_S = \frac{0.0215V^3}{CR}$

where L_S = length of transition in metres

V = speed in km/hr

R = radius of circular curve in metres

$C = \frac{80}{75+V}$ (maximum of 0.8 & minimum of 0.5)

ii) **The rate of change of superelevation** or run-off shall not be steeper than **1 in 150** in **plain terrain.**

For **plain terrain, no transition curve** is provided for radius **above 2000m.**

5.5.5 Widening of Carriageway on Curves

At sharp horizontal curves, it is necessary to widen the carriageway to provide for safe passage of vehicles. The extra width of carriageway provided at horizontal curves for two-lane roads is given in Table 5.1.

Table 5.1

Extra Width of Pavement at Horizontal Curves (IRC:73-1980)

Radius of curve (m)	Upto 20	21 to 40	41 to 60	61 to 100	101 to 300	Above 300
Extra Width (m) for Two-lane Roadway	1.5	1.5	1.2	0.9	0.6	Nil

For multilane roads, the pavement widening is calculated by adding half the widening for two lane roads to each lane.

5.5.6 Set-back Distance at Horizontal Curves

Requisite sight distance is to be available across the inside of horizontal curves. The set-back distance has been calculated from the following equation:

$m = R - (R-n) \cos \theta$

Where $\theta = \frac{S}{2(R-n)}$ radians

m = minimum set-back distance to sight obstruction in meters;

R = radius at centre line of road in metres

n = distance between the centre line of the road and the centre line of the inside lane in metres

S = Sight distance in metres.

Where horizontal and summit vertical curves overlap, the design has been made to provide for required sight distance both in vertical direction along the road and in the horizontal direction on the inside of the curve;

5.6 SIGHT DISTANCE

On consideration of driver's perception time & braking time required to control their vehicles to avoid unwarranted accidents before meeting a stationary object in his path, proper sight distance will be required.

In dual carriageway configuration having central median, the various curves have been designed corresponding to Intermediate Sight Distance unless there are constraints where **minimum Safe Stopping Sight Distance** according to adopted Design Speed as detailed below :

Sight Distance (IRC:73-1980)

Speed in Km/hr	Safe Stopping Sight Distance (metre)	Intermediate Sight Distance (metre)
20	20	40
25	25	50
30	30	60
40	45	90
50	60	120
60	80	160
65	90	180
80	120	240
100	180	360

5.7 VERTICAL ALIGNMENT

5.7.1 Gradient

The vertical alignment has been provided with a smooth longitudinal profile consistent with the terrain through which the road passes. Gradients upto the "**ruling gradient**" has been used as far as possible in the design. Grade **steeper** than the "**ruling gradient**" has been used for a length "**as short as possible**".

Gradients adopted for Roads in Different Terrains

(IRC:73-1980)

Sl. No.	Terrain	Ruling Gradient	Limiting Gradient	Exceptional Gradient
1	Plain or Rolling	3.3% (1 in 30)	5.0% (1 in 20)	6.7% (1 in 15)
2	Mountainous	5.0% (1 in 20)	6.0% (1 in 16)	-

5.7.2 Vertical Curves

Vertical curves have been introduced for smooth transition at grade changes. For satisfactory appearance, the minimum length of vertical curves have been provided based on design speed as detailed below:

Minimum Length of Vertical Curves (IRC:73-1980)

Design Speed (km/hr)	Maximum grade change (per cent) NOT requiring a vertical curve	Minimum length of Vertical Curve (metres)
80	0.6	50
100	0.5	60

In the approaches of the bridges suitable vertical curves have been provided as per provisions of relevant IRC Codes. Decks of small cross-drainage structures (i.e. culverts and minor bridges) have been given the same profile as the flanking road section with no break in the grade line.

Summit curves :

The length of summit curve is governed by the choice of sight distance. The length of summit curve has been calculated for **Intermediate sight distance,** unless there are site constraints when a safe stopping sight distance is provided. Overtaking sight distance has not been considered in dual carriageway.

a) For safe stopping sight distance

Case (i) when L>S

$$L = \frac{NS^2}{4.4}$$

where N = Deviation angle i.e. algebraic difference between two grades.

L = Length of parabolic vertical curve in metres

S= Sight distance in metres

Case (ii) when L<S

$$L = 2S - \frac{4.4}{N}$$

b) For Intermediate Sight Distance

Case (i) when L>S

$$L = \frac{NS^2}{9.6}$$

Case (ii) when L<S

$$L = 2S - \frac{9.6}{N}$$

Valley Curves :

The length of valley curves have been designed such that for night travel, the headlight beam distance is equal to the stopping sight distance.

Case (i) when L>S

$$L = \frac{NS^2}{1.50+0.035S}$$

Case (ii) when L<S

$$L = 2S - \frac{1.50+0.035S}{N}$$

The value of headlight beam distance applicable for design of valley curve is 180m corresponding to ruling design speed of 100 km/hr.

5.8 Pavement Design

5.8.1 Type of Pavement

(i) Unless otherwise specified in Schedule-B, the concessionaire may adopt any type (flexible/rigid) pavement structures for new construction. Hence it is taken as rigid.

(ii) The Concessionaire shall submit proposal with regard to the type of pavement proposed for strengthening of the existing pavement to IE for review and comments and finalize the proposal taking into account comments of IE.

5.8.2 Design Traffic

Rigid Pavement of the main highway has been designed for the cumulative number of standard axles of 8.16 tonnes over the design life of 30 years. Service roads have been designed for repetition of 10 million standard axles. Base year traffic, axles load distribution, and vehicle damage factor for design has been determined on the basis of survey. Investigation to be carried out by the concessionaire in accordance with the Manual. The cumulative axle load for the purpose of design has been done on the basis of the number of standard axles obtained at a rate of growth, determined from secondary socio economic data and elasticity factors subject to a minimum rate of growth of 5% at any point of time.

5.8.3 Design procedures

(i) For widening of the existing flexible pavement to meet the geometric design requirements specific in this Manual, the thickness and composition of layers for widening is the same as that of existing pavement and further deficiencies in thickness shall be made up by overlay on the entire width of the pavement including paved shoulders. If the condition of existing pavement is so deficient that it can not be improved by overlays, it will be scarified and the pavement shall be designed afresh.

(ii) In case the existing cement concrete pavement is to be widened, the widened pavement shall be of the same thickness and specification not inferior to that of the existing pavement. The widened pavement shall be joined with the existing pavement by providing longitudinal joints of the same design and specification as that of the existing pavement. Similarly, the transverse joints with dowel bars of the same design as provided in the existing pavement shall be provided.

(iii) Flexible Pavement

The new flexible pavement has been designed in accordance with IRC:37 and strengthening of the existing flexible pavement in accordance with IRC:81.

(iv) Rigid Pavement

The new rigid pavement has been designed in accordance with IRC:58 - 2015.

5.8.4 Pavement Performance Indicators and Requirements

i) The pavement performance and structural capacity has been measured in terms of objective measurable performance and strength indicators, i.e., roughness, rutting, cracking and deflection.

ii) The new or strengthened flexible pavement surface on completion shall satisfy the following standards:

a)	Roughness		
	In each lane measured by Bump Integrator (BI)	:	Not more than 2000 mm/km for each lane in a km length
b)	Rutting		
	In wheel path measured by 3 m. Straight Edge.	:	No Rutting
c)	Cracking	:	No Cracking
d)	Deflection	:	Not more than 0.5mm characteristic deflection to be determined as per IRC:81
e)	Other distress	:	Nil

iii) The new or strengthened rigid pavement surface on completion shall satisfy the following standards:

a)	Roughness		
	In each lane measured by BI	:	Not more than 2000 mm/km for each lane in a km length
b)	Cracking	:	No Cracks other than shrinkage cracks
c)	Other distresses such as scaling, raveling, spalling at edges	:	Nil

5.9 DESIGN STANDARDS FOR BRIDGES AND STRUCTURES

Design Standards have been clearly identified and enumerated for evolving a comprehensive design philosophy, which has covered all aspects of design for various parts of the bridges and other structures viz. Superstructure, substructure, foundation, protection works and repair and rehabilitation. The design standards are primarily based on relevant IRC codes of practices, MORTH specifications, latest guidelines and circulars of MORTH/NHIDCL and relevant Bureau of Indian Standards (BIS). For aspects not covered by IRC and BIS standards, relevant International Standards & sound engineering practices have been followed. For ROBs and RUBs, the standards / instructions laid down by Ministry of Railways have been taken into consideration. The design philosophy has included but is not limited to the following :

- Width of Carriageway, Span arrangement and Type of Bridges / Structures
- Requirement of footpaths
- Design speed
- Materials – concrete, steel, etc.
- Live loads
- Seismic effect
- Wind effect
- Temperature effect and climatic condition
- Safe bearing capacity and soil parameters
- Differential settlement
- Methodology for Analysis & Design
- Bearings, Expansion joints and wearing coats
- Protection works
- Construction methods
- Repair / Rehabilitation techniques.

5.9.1 RETENTION / REPLACEMENT OF EXISTING BRIDGES:

Decision to retain / replace any bridge has been taken on the basis of its overall structural condition, hydraulic behaviour, adequacy of carriageway and improvement of road alignment etc. There is no such case as Northern Dimapur Bypass is on new & virgin alignment.

5.9.1.1 Structural Condition:

As Dimapur Bypass is on new and virgin alignment, there is no such case.

5.9.1.2 Hydraulic behaviour:

As Dimapur Bypass is on new and virgin alignment, there is no such case. HFL of all channels & bridges has been ascertained from local enquiry.

5.9.1.3 Adequacy of Carriageway:

This is a new carriageway.

5.9.1.4 Improvement of Road Geometrics:

For improvement of Road Geometrics it is not required to replace, any of the existing bridges as the alignment of the approaches to the existing bridges remain unaltered in the present 4-laning programme.

5.9.2 PROPOSAL FOR NEW BRIDGES / STRUCTURES DUE TO 4 LANING:

New proposed bridges / structures are as under:

(i) Where the proposed 4-lane alignment follows the existing alignment with minor modifications, at each of the existing bridge locations a new 2-lane bridge has been proposed on D/S or U/S of the existing bridge for the proposed 4-laning of the road.

(ii) 1 no of R.O.B. have been proposed during preparation of the 4-laning schemes.

(iii) One Flyover on NH-39 crossing has been proposed.

5.9.3 PLANNING OF NEW BRIDGES:

5.9.3.1 Siting:

All the bridge will be on the centre line of the alignment.

5.9.3.2 Median:

Open median is proposed for all the bridges. Width of median from inner face of road Kerb of one bridge to inner face of crash barrier of 2nd bridge have been kept 4.50 m for bridges with open foundation and pile foundation.

5.9.3.3 Span Arrangement:

As all the bridges are new, the span arrangement is in conformity with site condition.

5.9.3.4 Types of superstructure:

Following types of superstructure have been adopted.

i) **For Cross Drainage Structures:**

a) Spans upto 10.50 m span: R.C.C. Solid Slab.

b) Spans more than 10.50 m and upto 24.0 m: R.C.C. T-Beam Slab.

c) Spans more than 24.0 and upto 45.0 m.: PSC girder with R.C.C. deck.

ii) **For R.O.B's :** PSC Girder Slab.

5.9.3.5Type of Substructure:

All abutments in river bridges are of R.C.C. solid wall type earth retaining structures. Abutments for R.O.Bs and flyovers are of wall type or column type without retaining the back earth. The back earth will be retained by R.E. Wall Structures and a small floating span will connect the R.E. Wall Structure and the abutment.

Piers are generally R.C.C. Solid Wall type.

5.9.3.6Type of Foundation:

Based on span arrangements, available information, scour condition of foundation locations and the subsoil parameters at the bridge sites, raft foundation / pile foundation have been proposed in general. Due attention was given for open foundations so that depth of excavation of new foundations do not go below the foundation of existing bridge.

5.9.3.7Carriageway width and deck configuration:

For all proposed bridges carriageway width has been kept 8.50 m plus 0.50 m Shyness on either side (Total 9.50m). 1.50 m at grade footpath on outer side as per SP: 84-2014 has been provided. Two nos. of crash barriers of width 450 mm. each have been provided on either side of carriageway. A railing of 300 mm wide has been provided on the outer side after the footpath. Total width of deck superstructure made as 12.250 m for four lane configuration.

5.9.3.8 Loading:

a) **Carriageway:** Loading on carriageway of all the proposed bridges will be 2-lanes of IRC Class A loading or single lane of IRC Class 70R loading.

b) **Footpath:** Basic intensity of footpath load has been considered as 500 Kg/m^2 as per Cl. No. 209 of IRC: 6-2000.

5.9.3.9 Seismic Force:

As per modified clause 222 of IRC: 6-2000 the project road passes through seismic zone V. Hence all the bridges have been designed for seismic force as per the said clause.

5.10 DESIGN STANDARDS:

Design of various components of bridges are based on the following IRC: Codes of practice.

i) IRC: 5-1998
ii) IRC: 6-2000
iii) IRC: 18-2000
iv) IRC: 21-2000
v) IRC: 22-1986
vi) IRC: 24-2001
vii) IRC: 78-2000
viii) IRC: 83(Part II) – 1987
ix) IRC: 83 (Part III) – 2002.
x) IRC – SP: 13 – 2004
xi) IS: 2911 (Part II) Sec – 3 – 1978
xii) MORTH Circular No RW/NH-34059/1/96 – S&R dated 30.11.2000 regarding expansion joints.
xiii) MOST's standard plans for Highway Bridges – R.C.C. Slab Superstructure.
xiv) MOST's standard plans for Highway Bridges – R.C.C. T-Beam and Slab Superstructure.

Where IRC codes remain silent relevant IS Codes have been followed.

5.11 PRELIMINARY DESIGN OF CULVERTS:

All the culverts will be Box type.

5.12 DETAILS OF PRELIMINARY BRIDGE DESIGN REPORT:

The details of preliminary bridge design. i.e., hydraulic calculations, span scheme, scour calculations and foundation type with depth of foundation have been presented in separate volume.

5.13 GENERAL ARRANGEMENT DRAWINGS:

General arrangement drawings (GAD) of new bridges and structures are submitted in the Drawing volume.

DESIGN OF PAVEMENT (DIMAPUR BYPASS – Assam Part)

1.0 Introduction

There is hardly any carriageway and this will be a new one. There will be concentric construction of four lanes suitably within the right of way (ROW). Pavement design will, therefore, comprise: -

i) New construction: Widening configuration – This will be concentric to ROW.

ii) Service Roads 7.00 m wide and Merge Lanes 3.5m wide have been provided at relevant places and detailed in the Alignment Plan. Also there is one important junction.

1.1 Design of rigid pavement.

1.1.1 In consonance with design standards adopted, the rigid pavement has been designed for 30 years service life. This agrees with Manual of specification and standards for four laning and two laning. Also IRC 58 of 2015 indicates such design.

1.1.2 CBR of Subgrade

The borrow area soil, as revealed from laboratory tests, is mostly of CL or ML-CL classification and SM or SM-SC classification in the end stretch having MDD of 1.8 to 1.83 gm / cm^3 at OMC 10.62% - 13.48% and 4 days soaked CBR of 5.6% to 6.8%. Improvement of borrow soil to attain a minimum CBR of 8% will be attained.

1.1.3 Design Traffic

As recommended by Traffic Analyst the design VDF is 3.50 [Sec I=3.37 & Sec II=3.77]. Traffic Analysis has resorted to the rigorous analysis of regression etc. on the growth rates derived by the elasticity method and the various growth rates are produced in the following table for Traffic Information. However, provisions in clause 5.5 of Manual for specifications and standards for Four Laning of National Highways through Public Private Partnership override and govern the growth rate factors, produced in the following Table. As per IRC:58-2015, the directional distribution factor and lane distribution factor have been taken to be 25% of predominant direction traffic for four lane divided carriageway. The probable cumulative million standard axles have been calculated from the probable date of completion of the project road and opening to traffic in the year 2015 to 30 years design period i.e. year 2045. ESA computations have been done on the basis of different growth rates. The design of pavement has been done considering the highest volume of Bus, 2 Axle Truck & MAV among the count stations.

1.1.4 Homogeneous section

The design CBR value being more or less same throughout, the entire length of the project road has been designed for the highest of the traffic obtained in the count stations as detailed earlier for the package.

1.1.5 Design thickness of flexible pavement layers in new construction.

By IRC : 37-2012

From the pavement thickness design chart of IRC-37 of 2012 and cumulative standard axles of 17.34 msa, i.e. design vol 6.94 msa the pavement thickness is found to be 580 mm for design life of 15 years.

Pavement design as per IRC:37-2012 is based on mechanistic pavement design principle which has evolved from theoretical, laboratory and pavement performance studies on Indian pavement materials and pavements constructed in India. In IRC:37-2012, for analysis, DBM layer with 60/70 bitumen and an annual average pavement temperature (AAPT) of 35°C have been used. The vertical strain between the dual wheels and the horizontal tensile strain at the bottom of the DBM layer below one of the wheels (vide Annexure-1 IRC:37-2012), are assumed to be the design criteria for fatigue and rutting failure of the pavement. Apart from the axle load, the design thickness depends on tyre pressure and the wheel configuration. The standards taken for single wheel load, tyre pressure and wheel configuration are at variance with different codes of practices. IRC:37-2012 adopts 20.5 KN as single wheel load, 310 mm as centre to centre distance between dual wheels and 560 Kpa as tyre pressure whereas shell Pavement Design Manual, London adopts these parameters as 20.0 KN, 315 mm & 600 Kpa and Austroads adopts these parameters as 20.5 KN, 330mm & 550-700 Kpa respectively, as basis of mechanistic pavement design approach.

The bituminous pavement design charts in India are calibrated as per constant AAPT of 35°C throughout the design period. However, pavement design, which takes into account temperatures prevalent in various seasons as well as various regions, would definitely give more reliable results compared to the pavement design that assumes single value of AAPT throughout the whole design period.

1.1.6 Design of Flexible Overlay

Overlay corresponding to 6.94 msa will have the following pavement composition:

40mm BC + 60mm DBM + 250mm WMM over a layer of 230mm GSB for drainage.

- **Pavement Composition for New Paved Shoulder of Carriageway:**

It is proposed that the pavement composition for new paved shoulder shall comprise, as follows:

GSB	:	230 mm
WMM Base Course	:	250 mm
DBM	:	60 mm
BC	:	40 mm
		580 mm

1.2 Flexible pavements for Service Roads / Merge Lanes

There is no such case.

Paved Shoulders:

Flexible pavement of main carriageway will be repeated in paved shoulders on both sides carriageway.

FLEXIBLE PAVEMENT DESIGN DETAILS AS PER IRC: 37-2012

(1) ESTIMATION OF DESIGN ESA

(a) Traffic Information

Adopted Growth Rate as per Traffic Analysis (Feasibility Report)

Traffic Classification	Growth Rate%				
	Upto 2016	2017-2021	2022-2026	2027-2031	2032-2036
Bus	7.50%	7.50%	7.50%	7.00%	7.00%
2 Axle Truck	7.00%	7.50%	7.50%	7.00%	7.00%
MAV	7.00%	7.50%	7.50%	7.50%	7.00%

(a) Vehicle Damage Factors (F): 3.50 for all categories of commercial vehicles (Source: Traffic Analysis – Feasibility Report)

(b) Lane Factor (D): 0.75 x 0.5 = 0.375 (Clause 3.3.5 IRC: 37-2012) adopted 0.40

(c) ESA Computation – Cumulative Equivalent Single Axle under below:-

ESTIMATION OF DESIGN ESA OF DIMAPUR BYPASS ON NH-36 & NH-39 (COUNT STN. FROM PATKOI-GAUTAM BASTI)

(a) Traffic Information (Both direction)

Traffic Classification for Pavement Design	Opening year (2015) AADT	Growth rate, r					
		Year 2015-2019	Year 2020-2024	Year 2025-2029	Year 2030-2034	Year 2035-2039	Year 2040-2044
Bus	244	7.50	7.50	7.50	7.00	7.00	7.00
2-Axle Truck	1887	7.00	7.50	7.50	7.00	7.00	7.00
3-Axle Truck + Multi-Axle Truck	544	7.00	7.50	7.50	7.00	7.00	7.00

Source Feasibility Report

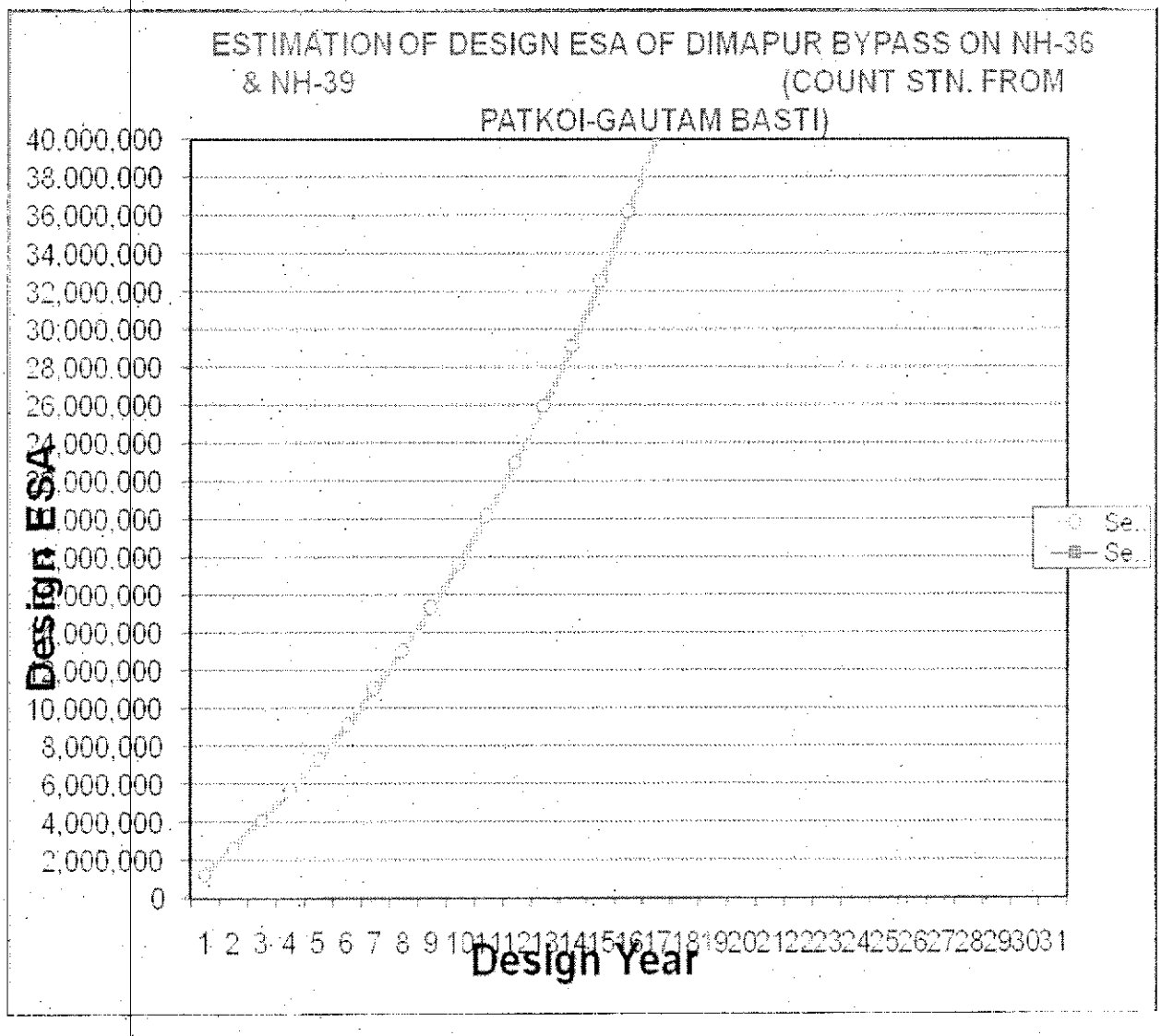
(b) Vehicle Damage Factors : Bus (TF1) = 0.81 2 Axle Truck (TF2) = 3.50 3 - Axle Truck (TF3) = 3.50

(c) Lane Factor : LF = 0.4

(d) ESA Computation :

	Design Period , Yrs	No. of trips at the end of the year in column (1)			Estimated ESA (2 - directions)				(9) Design ESA (8) x LF
		(2) Bus 365 x AADT x (1+r)	(3) Truck 365 x AADT x (1+r)	(4) Truck 365 x AADT x (1+r)	(5) Bus (2) x TF1	(6) Truck (3) x TF2	(7) Truck (4) x TF3	(8) Cumulative ESA	
Op. Year	0	89,060	688,755	198,560	72,139	2,410,643	694,960	3,177,741	1,271,096
Year 2015-2019	1	95,740	736,968	212,459	77,549	2,579,387	743,607	6,578,285	2,631,314
	2	102,920	788,556	227,331	83,365	2,759,945	795,660	10,217,254	4,086,902
	3	110,639	843,754	243,245	89,618	2,953,141	851,356	14,111,368	5,644,547
	4	118,937	902,817	260,272	96,339	3,159,861	910,951	18,278,519	7,311,407
	5	127,857	966,015	278,491	103,564	3,381,051	974,717	22,737,851	9,095,140
Year 2020-2024	6	137,446	1,038,466	299,377	111,332	3,634,630	1,047,821	27,531,633	11,012,653
	7	147,755	1,116,351	321,831	119,681	3,907,227	1,126,408	32,684,950	13,073,980
	8	158,837	1,200,077	345,968	128,658	4,200,269	1,210,888	38,224,764	15,289,906
	9	170,749	1,290,083	371,916	138,307	4,515,289	1,301,705	44,180,065	17,672,026
	10	183,555	1,386,839	399,809	148,680	4,853,936	1,399,333	50,582,014	20,232,805

	11	197,322	1,490,852	429,795	159,831	5,217,981	1,504,283	57,464,108	22,985,643
Year 2025-2029	12	212,121	1,602,666	462,030	171,818	5,609,329	1,617,104	64,862,360	25,944,944
	13	228,030	1,722,865	496,682	184,705	6,030,029	1,738,387	72,815,480	29,126,192
	14	245,133	1,852,080	533,933	198,557	6,482,281	1,868,766	81,365,085	32,546,034
	15	263,518	1,990,986	573,978	213,449	6,968,452	2,008,923	90,555,910	36,222,364
Year 2030-2034	16	281,964	2,130,355	614,157	228,391	7,456,244	2,149,548	100,390,093	40,156,037
	17	301,701	2,279,480	657,147	244,378	7,978,181	2,300,016	110,912,668	44,365,067
	18	322,820	2,439,044	703,148	261,485	8,536,654	2,461,017	122,171,824	48,868,730
	19	345,418	2,609,777	752,368	279,788	9,134,220	2,633,289	134,219,120	53,687,648
	20	369,597	2,792,461	805,034	299,374	9,773,615	2,817,619	147,109,728	58,843,891
Year 2035-2039	21	395,469	2,987,934	861,386	320,330	10,457,768	3,014,852	160,902,678	64,361,071
	22	423,152	3,197,089	921,683	342,753	11,189,812	3,225,892	175,661,134	70,264,454
	23	452,772	3,420,885	986,201	366,746	11,973,099	3,451,704	191,452,683	76,581,073
	24	484,466	3,660,347	1,055,235	392,418	12,811,216	3,693,323	208,349,639	83,339,856
	25	518,379	3,916,572	1,129,102	419,887	13,708,001	3,951,856	226,429,383	90,571,753
Year 2040-2044	26	554,666	4,190,732	1,208,139	449,279	14,667,561	4,228,486	245,774,709	98,309,884
	27	593,492	4,484,083	1,292,709	480,729	15,694,290	4,524,480	266,474,207	106,589,683
	28	635,037	4,797,969	1,383,198	514,380	16,792,890	4,841,194	288,622,671	115,449,068
	29	679,489	5,133,826	1,480,022	550,386	17,968,393	5,180,077	312,321,527	124,928,611
	30	727,053	5,493,194	1,583,624	588,913	19,226,180	5,542,683	337,679,303	135,071,721
	Σ	9,675,095	73,151,878	21,088,830	7,836,827	256,031,572	73,810,904		


ESTIMATION OF DESIGN ESA OF DIMAPUR BYPASS ON NH-36 & NH-39 (COUNT STN. FROM PATKOI-GAUTAM BASTI)
Design ESA
40,000,000
38,000,000
36,000,000
34,000,000
32,000,000
30,000,000
28,000,000
26,000,000
24,000,000
22,000,000
20,000,000
18,000,000
16,000,000
14,000,000
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Design Year
Se
Se

(d) 15 years Axle Load = 17.34 msa

Design ESA = 40% of 17.34 msa = 6.94 msa.

Adopted Cumulative Equivalent Single Axle repetition = 17.34 msa

Referring to Fig-1 & Plate –1, IRC:37-2012 corresponding to 4-day soaked CBR of 7% the recommended pavement layers are –

GSB	-	230 mm
WMM	-	250 mm
DBM	-	60 mm
BC	-	40 mm
		580 mm

Environmental Impacts

Soil Survey consisting of Test Pits and G.T.I Bore holes, carried out at requisite intervals, shows that soil conditions do not vary substantially along the project length. Thus, one pavement cross-section design will serve for the entire project length. The project area experiences high rainfall and the roadbed soil is predominant in clay which is susceptible to swelling. The design considerations will therefore, include the aspect of constructing an efficient drainage system capable of removing excessive moisture in earliest time. As such, drainage layer has been provided upto the slope face of road embankment.

RIGID PAVEMENT DESIGN DETAILS AS PER IRC: 58-2015

FOR ASSAM/NAGALAND PART OF DIMAPUR BYPASS

Design Calculation for Rigid Pavement by IRC 58-2015 Guidelines have been followed for Design of Rigid Pavement. The following inputs have been considered for design.

- Design life = 30 years
- Grade of Paving Concrete = M40
- Flexural strength of cement concrete = 45 kg/Cm^2
- Poisson ratio value for cement concrete = 0.15
- E for concrete = 3.00 x 10^5 kg/cm^2
- Coefficient of thermal expansion of concrete = 10 x 10^{-6} / °C
- Tyre Pressure, q = 8 Kg / Cm^2

- Spacing of contraction joints = 4.5m
- Width of slab = 4.375m

	Traffic					
	With Growth Rate					
	Upto 2016	**Upto 2021**	**Upto 2026**	**Upto 2031**	**Upto 2036**	**Upto 2041**
In 2015 start	7.50%	7.50%	7.50%	7.00%	7.00%	7.00%

Cumulative repetition of Commercial Vehicle = (9.68+73.15+21.09) x 10^6 = 103.92 x 10^6 = 103.92 msa (from enclosed format)

Axle Load Class of NH-36 & NH-39 (Taken on NH-36)								
Name of Road Stretch: Northern Dimapur Bypass								
Area	**Axle Load Class**	**Direction**	**2 Axle Truck**	**3 Axle Truck**		**LCV**	**Bus**	**Remarks**
				Single Axle	**Tandem Axle**			
Daboka	3^T to 7^T	UP	14	5	0	7	19	
		Down	20	4	0	3	19	
	10^T to 13^T	UP	24	0	1	2	1	
		Down	20	5	0	0	1	
	14^T to 15^T	UP	0	3	0	0	0	
		Down	0	0	0	0	0	
	TOTAL		**78**	**17**	**1**	**12**	**40**	
Bokulia	3^T to 7^T	UP	37	4	0	9	48	
		Down	23	1	0	20	30	
	10^T to 13^T	UP	54	1	1	9	4	
		Down	53	1	1	4	2	
	14^T to 15^T	UP	3	3	0	0	0	
		Down	0	1	0	0	0	
	TOTAL		**170**	**11**	**2**	**42**	**84**	

Axle Load Class of NH-36 & NH-39 (Taken on NH-36)								
Name of Road Stretch: Northern Dimapur Bypass								
Area	**Axle Load Class**	**Direction**	**2 Axle Truck**	**3 Axle Truck**		**LCV**	**Bus**	**Remarks**
				Single Axle	**Tandem Axle**			
Manja	3^T to 7^T	UP	37	4	0	9	39	These values have been taken for analysis for being the highest
		Down	39	4	0	11	43	
	10^T to 13^T	UP	54	1	1	9	3	
		Down	54	1	1	9	3	
	14^T to 15^T	UP	3	1	0	0	0	
		Down	3	1	0	0	0	
	TOTAL		**190**	**12**	**2**	**38**	**88**	
	GRAND TOTAL		**438**	**40**	**5**	**92**	**212**	**=787 (Total)**

Adopted Axle Load Class							
Single Axle							**Tandem Axle**
Axle Load Class	**Direction**	**2A**	**3A**	**LCV**	**Bus**	**Total**	
3^T to 7^T	Up	37	4	9	39		0
	Down	39	4	11	43		0
TOTAL		**76**	**8**	**20**	**82**	**186**	**0**
10^T to 13^T	Up	54	1	9	3		1
	Down	54	1	9	3		1
TOTAL		**108**	**2**	**18**	**6**	**134**	**2**
14^T to 15^T	Up	3	1	0	0		0
	Down	3	1	0	0		0
TOTAL		**6**	**2**	**0**	**0**	**8**	0
						328	

% of Axle Load Class of NH-36 & NH-39 (Taken on NH-36)				
Name of Road Stretch: Northern Dimapur Bypass				
Axle Load Class in KN	**No of Axle**	**Equivalency Factor**	**Equivalent Axle**	**%**
Single Axle				
85>	186	1	186.00	18.68
85-95	0	2.3	0.00	0.00
95-105	34	3.27	111.18	11.16
105-115	33	4.48	147.84	14.85
115-125	34	5.98	203.32	20.42
125-135	33	7.80	257.40	25.85
135-145	4	10.00	40.00	4.02
145-155	4	12.5	50.00	5.02
Total			**995.74**	**100.00**

% of Axle Load Class of NH-36 & NH-39 (Taken on NH-36)				
Name of Road Stretch: Northern Dimapur Bypass				
Axle Load Class in KN	**No of Axle**	**Equivalency Factor**	**Equivalent Axle**	**%**
Tandem Axle				
100>	0	0.166	0.00	0.00
100-120	1	0.342	0.342	35.08
120-140	1	0.633	0.633	64.92
Total			**0.975**	**100.00**

Rigid pavement has been designed as per IRC:58-2015

1. Selection of modulus of Subgrade reaction

- Effective CBR of compacted Subgrade = 8%; Modulus of Subgrade reaction = 50.3 MPa/m (Table 2).
- 150 mm thick granular Subbase has been provided.
- A DLC of thickness 150 mm with a minimum 7 day compressive strength of 7 MPa has been provided.
- Effective modulus of Subgrade reaction of combined foundation of Subgrade + Granular Subbase and DLC Subbase (from Table 4 by interpolation) = 285 MPa/m

- A Debonding layer of Polythene sheet of 125 micron thickness between DLC and Concrete Slab is to be provided.

2. Selection of Flexural Strength

- 28-day compressive strength of Cement Concrete = 40 MPa
- 90-day compressive strength of Cement Concrete = 48 MPa
- 28-day Flexural Strength of Cement Concrete = 4.5 MPa
- 90-day Flexural Strength of Cement Concrete = 4.5x1.1 = 4.95 MPa

3. Selection of design traffic for Fatigue Analysis

- Design period =30 years
- Cumulative repetition for all categories of commercial vehicle for 30 years = 103.92×10^6
- Total two-way axle load repetition during design period
  = $103.92 \times 10^6 \times 2.35$ [Average number axle per commercial vehicle – 2.35]
  = 244.212×10^6
- Number of axles in predominant/direction = $244.212 \times 10^6 \times 0.5 = 122.106 \times 10^6$
- Design axle load repetition = $122.106 \times 10^6 \times 0.25 = 30.53 \times 10^6$
- Night time (12 hour) design axle repetition
  = $30.53 \times 10^6 \times 0.6 = 18.32 \times 10^6$ [Night Traffic – 60%]
- Day time (12 hour) design axle repetition = 12.21×10^6
- Day time (6 hour) design axle repetition = $12.21 \times 10^6 \times 0.5 = 6.105 \times 10^6$
- Hence design number of axle repetition for Bottom-Up-Cracking analysis – 6.105×10^6
- Night time (6 hour) axle load repetition = $18.32 \times 10^6 \times 0.5 = 9.16 \times 10^6$

- Percentage of commercial vehicles having the spacing between front (Steering) axle and the first rear axle unit <4.5 m = 55%
- Hence the night time design axle load repetition for Top-Down-Cracking analysis (wheel base <4.5 m) = $9.16 \times 10^6 \times 0.55 = 5.038 \times 10^6$

Axle Category	Proportion of the axle category	Category wise axle load repetition for	
		Bottom-Up-Cracking	Top-Down-Cracking
Front (Steering) Axle	0.45	2.747×10^6	2.267×10^6
Rear Axle	0.15	0.916×10^6	0.756×10^6
Tandem Axle	0.40	2.442×10^6	2.015×10^6

Axle load Spectrum

Table – A/1 – Single Axle (Rear Axle)

Axle load Category KN	ESA	% of each Category	Axle load Repetition	
			Bottom-up-Cracking	Top-Down-Cracking
145-155	50.00	5.02	0.046×10^6	0.038×10^6
135-145	40.00	4.02	0.037×10^6	0.030×10^6
125-135	257.40	25.85	0.237×10^6	0.195×10^6
115-125	203.32	20.42	0.187×10^6	0.155×10^6
105-115	147.84	14.85	0.136×10^6	0.112×10^6
95-105	111.18	11.16	0.103×10^6	0.085×10^6
85-95	0	0	0	0
85>	186.00	18.68	0.171×10^6	0.141×10^6

Table – A/2 – Tandem Axle

Axle load Category KN	ESA	% of each Category	Axle load Repetition	
			Bottom-up-Cracking	Top-Down-Cracking
120-140	0.633	64.92	1.585×10^6	1.308×10^6
100-120	0.342	35.08	0.857×10^6	0.707×10^6
100>	0	0	0	0

4. Cumulative Fatigue Damage analysis for Bottom-Up Cracking (BUC) and Top-Down Cracking (TDC) and Selection of slab thickness

- Effective modulus of Subgrade reaction of foundation, K = 285 MPa/m.
- Elastic modulus of concrete, E = 30000 MPa
- Poisson's ratio of concrete, μ = 0.15
- Unit weight of concrete, Υ = 24 KN/m^3
- Design flexural strength of concrete = 4.95 MPa
- Maximum day-time Temperature Differential in slab (for BUC) = 16.8°c (Assam)
- Night-time Temperature Differential in slab (for TDC) = day-time differential/2+5 = 16.8/2+5 =13.4°c

Case I

Concrete pavement with tied shoulder and with dowel bars across transverse joints

- Trial thickness of slab, h = 300 mm = 0.30 m

Radius of relative stiffness, $l = \sqrt[4]{\frac{Eh^3}{12xKx(1-\mu^2)}}$ =0.701593467 m

I. Maximum tensile stresses at the bottom of the slab (for BUC Case)

Single Axle (Appendix V)

$S= 0.042+3.26x24x0.3^2/(285x0.701593467^2)+1.62xPx0.3/(285+0.701593467^4)+0.0522x16.8$

$= 0.042+0.0502+0.00704xP+0.877 = 0.9692+0.00704xP$..... (1)

Tandem Axle (Appendix V)

$S= -0.210+3.88x24x0.3^2/(285x0.701593467^2)+0.73xPx0.3/285x0.701593467^4)+0.0506x16.8$

$= -0.210+0.05974+0.00317xP+0.85 = 0.7+0.00317xP$..... (2)

Table B – Stresses at bottom of the slab in day time (BUC case) – Midpoint Axle load Class

Single Axle Loads, KN	150	140	130	120	110	100	90	<85
Stresses, MPa	2.0252	1.9548	1.8844	1.8140	1.7436	1.6732	1.6028	1.5324

Tandem Axle Loads, KN	130	110	<100
Stresses, MPa	1.1121	1.0487	0.9853

All stresses are less than 4.95 x 0.45 = 2.2275 MPa

II. Maximum Tensile Stresses at the top of the slab (for TDC Case)

$S=-0.219+1.686xBxPx0.3/(285x0.701593467^4)+168.48x0.3^2/(285x0.701593467^2)$

$+0.1089x13.4$

$=-0.219+0.007325xBxP+0.10809+1.45926$ [B=0.66 for Transverse Joints with dowel bars]

$= 1.34835+0.0048345xP$..... (3)

Table C – Stresses at top of the slab in night time (for TDC Case) – Midpoint of Axle load class

Single Axle Loads, KN	150	140	130	120	110	100	90	<85
Stresses, MPa	2.0735	2.0252	1.9768	1.9285	1.8801	1.8318	1.7835	1.7351

Tandem Axle Loads, KN	130	110	<100
Stresses, MPa	1.6626	1.6142	1.5659

All stresses are less than 2.2275 MPa. Hence 300 mm thick slab is safe in Case I.

Case II

Concrete pavement without tied shoulder and without dowel bars across transverse joints (Extreme Case)

- Thickness of slab – 300 mm = 0.3 m
- Radius of relative stiffness, I=0.701593467 m

I. Maximum tensile stresses at the bottom of the slab (for BUC Case)

Single Axle

$S = -0.238+7.02x24x0.3^2/(285x0.701593467^2)+2.41xPx0.3/(285x0.701593467^4)+0.0585x16.8$

$= -0.238+0.10809+0.01047xP+0.9828 = 0.85289+0.01047xP$ ..... (1)

Tandem Axle

$S = -0.3+9.88x24x0,3^2/(285x0.701593467^2)+0.965xPx0.3/(285x0.701593467^4)+0.0543x16.8$

$= -0.3+0.152123+0.004192xP+0.91224 = 0.764363+0.004192xP$ ..... (2)

Table B – Stresses at bottom of the slab in day time (BUC Case) – Midpoint of Axle load class

Single Axle Loads, KN	150	140	130	120	110	100	90	<85
Stresses, MPa	2.4234	2.3187	2.214	2.1093	2.0046	1.900	1.7952	1.6905

Tandem Axle Loads, KN	130	110	<100
Stresses, MPa	1.3093	1.2255	1.1416

II. Maximum tensile stress at the top of the slab (for TDC Case)

S = 1.34835+0.0066xP..... (3) [B=0.9 for transverse joints without dowel bars]

Table C – Stress at top of the slab in night time (TDC Case) – Midpoint of Axle load class

Single Axle Loads, KN	150	140	130	120	110	100	90	<85
Stresses, MPa	2.3384	2.2724	2.2064	2.1404	2.0744	2.0084	1.9424	1.8764

Tandem Axle Loads, KN	130	110	<100
Stresses, MPa	1.7774	1.7114	1.6454

Table C – Cumulative Fatigue Damage Analysis for Bottom Up-Cracking
(Midpoint of the Axle load class – Ref. Table A/1, A/2 & B)

Bottom-Up Cracking Fatigue Analysis for day-time (6 hour) traffic and positive Temp Diff.									
Rear Single Axles					**Rear Tandem Axles**				
Expected Rep. (ni)	**Flex Stress, MPa**	**Stress Ratio, SR**	**Allowable Rep. (Ni)**	**Fatigue Damage ni/Ni**	**Expected Rep. (ni)**	**Flex Stress, MPa**	**Stress Ratio, SR**	**Allowable Rep. (Ni)**	**Fatigue Damage ni/Ni**
$0.046x10^6$	2.4234	0.490	$1.287x10^6$	0.036	$1.585x10^6$	1.3093	0.265	infinite	0.000
$0.037x10^6$	2.3187	0.468	$6.223x10^6$	0.006	$0.857x10^6$	1.2255	0.248		
$0.0237x10^6$	2.214	0.447	infinite	0.000	0	1.1416	0.231		
$0.187x10^6$	2.1093	0.426							
$0.136x10^6$	2.0046	0.405							
$0.103x10^6$	1.900	0.384							
0	1.7952	0.363							
$0.171x10^6$	1.6905	0.342							
			Σ	**0.042**					

Table D - Cumulative Fatigue Damage Analysis for Top Down-Cracking

(Midpoint of the Axle load class – Ref. Table A/1, A/2 & C)

Top-Down Cracking Fatigue Analysis for night-time (6 hour) traffic and negative Temp Diff.									
Rear Single Axles					**Rear Tandem Axles for 50% of Axle load**				
Expected Rep. (ni)	**Flex Stress, MPa**	**Stress Ratio, SR**	**Allowable Rep. (Ni)**	**Fatigue Damage ni/Ni**	**Expected Rep. (ni)**	**Flex Stress, MPa**	**Stress Ratio, SR**	**Allowable Rep. (Ni)**	**Fatigue Damage ni/Ni**
$0.038x10^6$	2.3384	0.472	$4.39x10^6$	0.009	$1.308x10^6$	1.7774	0.359	infinite	0.000
$0.030x10^6$	2.2724	0.459	$16.18x10^6$	0.002	$0.707x10^6$	1.7114	0.346		
$0.195x10^6$	2.2064	0.446	infinite	0.000	0	1.6454	0.332		
$0.155x10^6$	2.1404	0.432							
$0.112x10^6$	2.0744	0.419							
$0.085x10^6$	2.0084	0.406							
0	1.9424	0.392							
$0.141x10^6$	1.8764	0.379							
			Σ	**0.011**					

Sum of BUC and TDC i.e. CFD = 0.042+0.011 = 0.053<1, Safe 300 mm thick slab is safe for slab without tied shoulder and without dowel bars across transverse joint. But recommended is continuous hard shoulder with 300 mm thickness which will be more safe in Edge Stress.

TRAFFIC SURVEYS AND ANALYSIS

CHAPTER-6

TRAFFIC SURVEY AND ANALYSIS

6.1 Project Corridor (Bypass)

The project corridor comes to an end on NH-39 at Dimapur in Nagaland, thereby catering the traffic for the entire portion of Karbi-Anglong and district head quarter Diphu to the rest part of the state and traffic from other states like Nagaland and Manipur to reach Guwahati, the gateway of NE States. More importantly, it is the shortest connector of NH-39, which is connecting International corridor of India –Myanmar.

Based on physical characteristics and major junctions within the stretch, the corridor can be divided into the following segments:

6.1.1 Delai to Dimapur Town (km 147/000 to km 168/167)

Next to Delai junction, traffic seems to be flowing in leeward side keeping most of the through traffic on road for first 15 km with rolling terrain and forest area of Laharijan both side. And then with the advent of Dimapur town, road encounters the suburb establishments. Out of 21 km, 19 km caters a two-lane carriageway. From Lahorizan Beat Office the Bypass starts and ends at Patkoi Bridge on NH – 39 thereby avoiding entry to Dimapur town.

6.2 Homogeneous Sections

There is no such case.

6.3 Objectives of Traffic Study

The objectives of carrying out various traffic studies are as follows

- Assessment of capacity based on demand forecasting for next 30 years
- Understanding the pattern of Commodity movement
- Identification of spatial influence of the project stretch
- Deriving Growth Factors for Traffic demand forecasting
- Providing inputs for pavement design
- Providing inputs for design of intersections
- Studying the traffic impact of other road development works in the influence area of the project
- Identifying the requirements for service roads
- Planning of truck terminal
- Development of wayside amenities
- Studying possible location of toll plaza and providing inputs for design
- Providing traffic inputs for economic and financial analysis
- Providing traffic inputs for Environmental Impact Assessment

6.4 Traffic Surveys and Analysis

Analysis of primary data obtained from traffic surveys and secondary data obtained from various sources were carried out as per the stipulations of TOR for obtaining the following:

- Average Daily Traffic (ADT)
- Seasonal variation
- Annual Average Daily Traffic (AADT)
- Composition of traffic stream
- Vehicle Damage Factor (VDF) for design of pavement
- Average speed and delay
- O-D and Commodity matrix
- Identification of spatial influence of the project
- Traffic Growth Factors
- Traffic Demand Forecasting for various development scenarios
- Providing inputs required for the estimation of Vehicle Operation Cost (VOC)

Primary traffic surveys carried out are given below

Schedule of Traffic Surveys

➢ As the Bypass is on virgin and new alignment, Traffic Survey is not needed.

The following secondary Informations were collected

- Previous traffic count data -on NH36 for last 5 years
- Statistical Information- up to 2003-04 (where available)
- Seasonal variation- derived from past fuel sale data

6.5 Classified Traffic Volume Counts

This has been given in DFSR – Main Volume and hence not repeated.

6.6 Origin-Destination (O-D) Survey

There is no such case.

6.6.1 Willingness to Pay (WTP)

With a view to understand users' willingness to pay for the upgraded / enhanced facility, WTP surveys were conducted with O-D surveys at all the four locations and submitted in Draft FSR – Main Volume and hence not repeated in Bypass alignment.

ENVIRONMENTAL SCREENING & PRELIMINARY ENVIRONMENTAL ASSESSMENT

CHAPTER 7

ENVIRONMENTAL SCREENING AND PRELIMINARY ENVIRONMENTAL ASSESSMENT (Dimapur Bypass – Assam Part)

7.1 Introduction

Project of 4-laning of NH- 36 from km 38.0 to km 168.167 (Daboka to Dimapur) includes construction of one new bye-pass to Dimapur town covering a total length of 35.004 Km in Assam State, which will have some direct impact on environment. It is necessary to undertake **P**reliminary **E**nvironmental **S**creening and **A**ssessment **S**tudy for the proposed for construction of proposed Bypass to assess the potentially critical impacts on environment for construction of proposed Bypass in order to suggest the mitigative measures or alternate alignment, which are required to be incorporated during the initial planning stages. Besides there are 2 stretches of Planted Forest in Bypass, which will have significant effect on the design of the road.

The present road alignment of Northern Dimapur Bypass of NH-36 passes through plain/rolling terrain. This will be a 4-lane divided carriageway.

The project stretch passes through 2 districts viz. Karbi Anglong in Assam and Dimapur in Nagaland. The district wise semi-urban areas are as follows,

Table 7.1: District-wise semi-urban / urban areas

Sr. No.	District	Urban/Village/Semi-urban area
1	Karbi Anglong	Belijan, Belijan A, Karagaon, Naharjan, Chotolengrijan, Barolengri, Barolengri (ii), Purana, Lahorijan, Gautam Basti, Khatkhati
2	Dimapur	Dimapur, Khusiabil, Saikathemi 'c', Patkoi

The road is in embankment throughout with average height varying from 0.50 m to 2.50 m. There is high embankment of the order of 5.0 m to 6.0 m height near the major bridge/ROB/Flyover approaches. In an around the semi-urban area localities, the embankment height is as low as 0.50 to 1.00 m.

The proposed ROW is generally 30.00 m on either side of the centerline of the Dimapur Bypass carriageway, where it has run through agricultural land.

A reconnaissance survey was carried out to study the present environmental set up of the study corridor, which is the corridor for environmental concern, in general and proposed ROW in particular, on the basis of which screening exercises were undertaken to identify the environmentally sensitive issues and areas.

Detailed studies on each parameters/issues have established exact conditions in respect of assessment of potential negative impacts of the project on the environment.

7.2 Environmental Screening

7.2.1 Purpose of Preliminary Environmental Screening Study

This report provides a Preliminary Screening study of 4-laning of **Northern Dimapur Bypass** in NHDP Phase IIIB. Its preparation has been undertaken as an activity parallel to and to be completed in tandem with the study of other aspects of the project's economic and financial feasibility. As required in Terms of Reference (TOR) for the consulting services, the results of the preliminary environmental screening are submitted as a document of **Final Detailed Project Report on EPC basis** in order to clearly mark out the environmental problems, enhancement of opportunities and locations at which appropriate action can be taken. As stated in the TOR for the work, the purpose of the **Preliminary Environmental Screening Study (PESS)** is "to determine any significant economic, social and environmental issues, which could require further analysis (including the analysis of Bypass, improvement of junctions etc.) and to resolve such issues". The social and environmental screening will include, but not be limited to, the analysis of available information (supplemented where appropriate by site assessment) concerning:

- Areas of significance within right-of-way (ROW).
- Sensitive and/or critical natural habitats (e.g., national park, wild life reserves, sanctuaries, social groves, reserve and protected forest, social forest, wetlands etc.).
- Major rivers and waterways.
- Recorded religious and cultural heritage sites.
- And any potentially sensitive areas, based on recent GOI census, official data and information from NGOs and site visit.

The results of this analysis will be tabulated clearly to identify any conflicts. The recommendations concerning how to resolve them (including recommendations for exclusion analysis of alternatives and/or mitigation) shall be recorded as precursor to preliminary engineering design and for undertaking the required social impact and environmental assessment studies.

7.2.2 Physical Environment

7.2.2.1 Physiography

The area lies within Karbi Anglong & Dimapur District and have a general height 67m to 181 m above MSL. Near Dimapur, a range of hills exist of the alluvium which is about 90m – 182m above MSL. The general slope of the land is towards south. The area is served by two major rivers and 8 minor channels.

7.2.2.2 Drainage

The study area lies within the Assam & Nagaland states and is plain to rolling in nature. The Northern Dimapur Bypass crosscuts the different drainage system at different Chainage.

Most of the drainage system debouch from the sub-Himalaya through segmented piedmont plain and flow in a general southerly direction through narrow conical or linear zones. Over a certain distance, they invariably flow along nearly straight, braided channels on bed of gravel and then follow a meandering path in the flood plain.

The recent flood plain shows a variety of landform elements, viz., meander scroll, channel bar, etc.

7.2.2.3 Geology and Geomorphology

The area under investigation is characterized by the quarternary alluvial deposits. This deposit has been classified into four informal stratigraphic units. Each formation has two facies - a piedmont plain facies and a flood-plain facies. The former is characterized by dominance of gravel and the latter by sand-silt-clay. The road is passing through hills of Nagaland.

There are four-stepped sequences of geomorphic surface present in this area, which can be clearly discernible. The level difference between the successive terraces is the maximum at the hilly front. It decreases gradually towards south. An interesting feature of the area is hillocks made of granitic and gneissic rocks and geologically part of Karbi-Megalaya Plateau. The plateaus are geologically ancient and a part of the Deccan Plateau, while the hills are young and geologically belong to the Himalayan group. Karbi Anglong itself is spread over two separated areas. Its Harem Sub-Dn is a part of the Meghalaya Plain while the Diphu and Bokajan Sub-Dns are located in Karbi Plateau proper. The Harem Sub-Dn. is physiographically a part of the Jayantia hills of the Meghalaya plain and hence it is relatively low.

The Karbi Plateau proper is oval in shape and highly dissected along its margins. The central part is, however, high and has such peaks as chenghehison (Singhason 1359m) and Daubukso (1361m). The plateau gives out many streams to the surrounding low lands of Golaghat & Nagaon districts and there are terraces at places where these rivers emerge to plains. These support tea gardens and Reserve Forests.

7.2.2.4 Geohydrology

Groundwater occurs under phreatic condition in the area. The general slope of the water table is from north to south being more or less concordat with topographic slope. The hydraulic gradient is highest in the piedmont plain on the north and progressively decreases towards south. The shallow and deeper aquifers in the entire area are interconnected. The piedmont plain forms the primary recharge area of the region. The quaternary sediment in

the area gets completely saturated by mid-monsoon. The average seasonal fluctuation of water table in the area is around 3 m. Chemically groundwater from shallow and deeper aquifers in the area are suitable for irrigation, domestic and industrial use.

7.2.2.5 Soil

The soil of the entire stretch is Alluvial in origin. Deposition of alluvium is mainly from the rivers passing through the area. Alluvial soil is generally fertile. Alluvial soil is either older, which contains clay, sand, gravel and pebbles or younger (flood plain deposit), which contains sand, gravel, pebbles, clay and fine classes. Cultivation area is observed in the project stretch. Possibility of release and deposition of pollutants in soil, mainly Lead, generated from vehicular movement is moderate. Characterization of soil through sampling and analysis has been done during detail monitoring.

7.2.2.6 Land Use

This portion of the National Highways (NH-36) passes thorough some densely populated area of Karbi-Anglong district of Assam state. On both side of NH-36 agricultural activity is very much predominant. Orchard and roadside plantation of different species of plants are very dominant type of land use class in the area. A substantial portion of the study area is covered by Planted areas, which lie on both side of the road.

River / tributaries constitute a substantial portion of the land use class in this area.

7.2.2.7 Climate

The area experiences four distinct seasons i.e. winter, summer or pre-monsoon, monsoon and retreating monsoon. The winter lasts from November to February, followed by brief period of summer. The monsoon commences from May and continues up to September and sometimes up to the 2nd week of October. The season of retreating monsoon is brief and is characterized by progressively fair weather and morning fog of short duration. The minimum temperature comes down to 9°C during month of December while the temperature shoots up to 39 °C in the month of July. Though the main monsoon rains begin in May, the pre-monsoon showers start by mid – April and are often accompanied by hailstorms. The average yearly rainfall is quite high 2400 mm throughout the year, but more so in the wet season.

7.2.2.8 Geo-Environmental Hazards

As per the seismic zoning Map of India (IS: 1893-2002), the area under investigation fall under seismic zone V. With reference to the MSK intensity scale used for all engineering design purposes, the region lies in the highest damages risk zone. Therefore, there is always necessity to consider the factor of safety for highest earthquake intensity while formulating any development programme.

7.2.2.9 Ambient Air Quality

There is no past data on ambient air quality in this stretch. Through reconnaissance survey it can be assessed that, since most part of the stretch under rural category and vacant area, possibility of high level of gaseous and particulate pollution is less. In semi-urban to urban area like Dillai, Lahorijan and Dimapur expected level of air pollutants comparatively higher due to commercial activity, residential emission and emission from vehicle. Vehicular traffic is the main source of air pollution in the study area. Monitoring of ambient air quality at different stretches has been assessed to present status of air pollution. It has been found that the levels of pollutants ie., SPM, CO_2, SO_2, Nox and HC are within the prescribed limits of CPCB as shown in **Table 7.10 A**.

7.2.2.10 Water Quality

There is no past data on surface and ground water quality in this stretch. There are 2 major rivers and a few minor channels, few bils and irrigation canals in the study area. Since during construction of bridge and road, surface water quality may be affected, complete of water quality study is necessary. It has been found that Physical, Chemical and bacteriological quality of water source are within the prescribed limits of CPHEEO. This may be because of the fact that there are no industries in the area, as shown in **Table 7.11 A**.

7.2.2.11 Noise Level

Since most part of the stretch is under rural areas, noise generated from use of horn by vehicles at rural stretch is less. But at commercial and residential areas of semi-urban category and turning curve of the road, expected noise level is high. Measurement of ambient noise level at Residential, Commercial and Sensitive areas will give the clear picture before strengthening and upgradation of the project road. Noise levels in these areas are formed to be within limits prescribed by CPCB as shown in **Table 7.12 A**.

7.2.3 Biological Environment

7.2.3.1 Status of Flora

The project road is located in the high rainfall area with number of matured trees and vegetation growth along side of the road. The following are the common plants recorded all along the stretch.

Table 7.3: Tentative Floral checklist

Name of Species	Local Name	Common Name	Family
Dalbergia sisoo	Sisoo	Sesam	Leguminosae
Tectona grandis	Segun	Teak	Verbenaceae
Gmelina arborea	Gamari	Gamar(Hill Teak)	Euphorbiaceae
Trewia nudiflora	Bhelkar	Bhelkar	Euphorbiaceae
Ficus religiosa	Ahat	Pipal	Moraceae
Azardarichta indica	Nim	Neem	Meliaceae
Cassia fistula	Sonaru	Sonaru	Leguminacea
Caesalpinia pulcherrima	Krishnachura	Krishnachura	Leguminosae
	Arccanut		
	Jia		
	Jalpai		
	Poma		
	Koras		
	Simalu		
	Satiyana		
	Sal		
	Sirish		
	Jungle Tree		
Zizyphus jujuba	Bogori	Ber, Kul	Rhamnaceae
Eucalyptus spp.	Eucalyptus	Eucalyptus	Myrtaceae
Accacia spp.	Acacia	Akashmoni	Leguminosae
Artocarpus heterophyllus	Kanthal	Kathal, Jackfruit	Moraceae
Mangifera indica	Aam	Mango	Anacardiaceae
Syzygium cumini	Jamuk	Jam, Black Plum	Myrtaceae
Ficus elastica	Rubber	Rubber	Moraceae
Anthocephalus kadamba	Odam, Kadam	Kadam	Rubiaceae
Bambusha sp.	Bamboo, Bah	Bamboo	Graminieae
Aegle marmelos	Bel	Bel	Rutaceae
Cocos nucifera	Coco	Nariel, Coconut	Palmae
Lagerstroemia flosreginae	Ajar	Queen Crape Myrtle	Lythraceae
Borassus flabellifer	Tal	Tal	Palmae
Albegzea procera	Koroi	Koroi	Mimocea
	Debdaru		
	Titachops		

In some stretches thick plantation of Sesam, Sirish, Eucalyptus, Segun, Acacea and Jigur are noted.

Preliminary estimation trees indicates that total number of affected trees within the ROW is in the tune of 24,734 **(Table 7.8).** There are about 12,099 trees along the left side of the road while there are about 12,635 trees along the right hand side of the road. Most of the trees (62%) are in the girth size <50cm There are also approx. 8446 nos., 995 nos., 20 nos. affected trees of the girth size 50-100 cm, 100-200 cm, >200cm respectively exist within the ROW.

7.2.3.2 Status of Fauna

Road passes through plain agricultural, residential and commercial land. There are 2 Planted areas within the stretch. Only few social forest plantations are noted in the stretch. Therefore existence of wild fauna is not reported. Only domestic animals are present.

7.2.4 Status of Religious & Cultural Heritage Site

Practically there is no cultural heritage site throughout the stretch of the bypass.

7.2.5 Status of Utility Services

As the alignment is new, very less numbers of Utility Services.

7.3 Preparation of Environmental Screening Data Sheet-Environmental Analysis

Environmental screening data sheet (km wise) is given in **Table 7.9.** That indicates Land use within the ROW and just outside the ROW. Also type of natural, plantation and planted forest trees, existence of sensitive area, religious place, market and residential areas are also indicated in screening sheet.

7.4 Salient Environmental Features

- The existing road alignment of Dimapur Bypass passes mostly through plain agricultural land. But in some stretches, the road passes through forestland. The road stretch passes through Karbi Anglong district of the state of Assam and Dimapur district in the state of Nagaland.
- Road passes through the important big villages viz. Khusiabil, Belijan, Kargaon, Naharjan, Saithekema "C", Patkoi, Khatkhati and Gautam Basti. Possibility of generation of gaseous and particulate pollutants in these urban areas is more though not significant.
- There are number of plantation trees, mainly, Caseasima, Segun (Teak), Gamari, Sonaru, Mango, Simur, Gulmohar, Sirish, Sesam, Segun, Eucalyptus and Acacea. Among the big trees Mango, Jamun, Ahat (Pipal), Kathal, Bargad are more or less common.
- Ditch, low lying area, pond and other water body are present within the study corridor.
- Daboka-Dimapur section after road is passing through congested area of Dimapur Town. To avoid significant social and environmental impact, construction of Northern Dimapur bye-pass for this area is needed. Acquisition of agricultural land, few beels are necessary for construction of bye-pass.

7.5 Area of Environmental Concerns and Risks

Seismicity poses another natural environmental problem. Other than these natural environmental hazards, there are some man-made/anthropogenic hazards also.

The major areas of concern from environmental angle appeared to be as follows, from PESS:

- Felling of large numbers of roadside trees/ social plantation trees.
- Gaseous pollution at commercial area, semi urban sections of road
- Dust and sound pollution particularly at sensitive areas during construction of road
- Protections of reserve and social plantation forest within and outside the ROW
- Existence of natural water body very near to road

7.6 Scopes and Necessity of Detail Environmental Assessment

With the background of environment screening report in feasibility stage detail Environmental Impact Assessment study is necessary to safeguard the environment impacts may arise from new construction of Northern Dimapur Bypass by a 4-lane with divided carriageway.

- To make an assessment which delineates the significant environmental effects of the project;
- To describe and quantify the effects;
- To describe feasible mitigation measures for minimizing, eliminating, or offsetting unavoidable adverse effects; and
- To recommend the most appropriate mitigation and/or enhancement measures

The following activities have been taken up for preparation of detail Environment Assessment Report:

- Generation of primary data as follows:
  - **a) Air Quality**: Air quality monitoring has been carried out at five locations spread over the entire stretch. Locations of sampling sites and description of sites given in **Table 7.10.** Monitoring has been carried out for two days for determination of parameters like SPM. RPM, SO_2, NOx, Pb etc.
  - **b) Water quality**: Water quality monitoring has been carried out at 3 locations for determination of common parameters. **Table 7.11.**
  - **c) Noise Level**: Noise level **monitoring** has been carried out in 3 locations covering sensitive area, residential area, and mixed area. **Table 7.12.**
- **Collection of Secondary Data**: Secondary data has been collected from published sources and from concerned authorities in respect to geology, geohydrology, drainage, physiography, soil, flora, fauna, meteorology and regional land use pattern
- Assessment of potential positive and negative impacts associated with strengthening of road on different environmental attributes.

- Suggesting cost effective mitigation measures relevant to project activities
- Preparation of Environment Management Plan (EMP) which contents
  - Monitoring requirements for mitigate measures
  - Institutional arrangement required for the purpose
  - Cost of implementation to mitigate measures and monitoring arrangements

7.7 Possible Environmental Impact and Mitigation measures:

The proposed project would influence the environment in two distinct phases:

- During the construction phase which would be temporary and short term;
- During the operation phase which would have long term effects

Checklists of potential environmental impacts of the project are presented in **Table 7.4** and are discussed in the following sections.

Table 7.4: Environmental Checklist

Actions Affecting Environmental Resources and values (A)	Damages to Environment (B)	Recommended Feasible Protection Measures (C)	IEE (D)				Comments
			No Significant Effect (D1)	Potential Significant Effect			
				Small (D2)	Mod (D3)	Major (D4)	
Problem relating to Project Planning, Design and Construction							
Disruption of surface hydrology resulting in impairment of beneficial water uses	Depends on type of adverse effect	Checking on whether there is any significant effect		√			
Encroachment on precious ecology	Loss of precious ecology (flora and fauna)	Careful planning to minimize and offset losses				√	Judicious environmental design can protect biodiversity
Impairment of fisheries/aquatic ecology and other beneficial uses	Impairment of downstream beneficial water uses	Careful planning to minimize and offset losses		√			
Erosion and Siltation	Excessive soil erosion and impairment of downstream water quality	Careful resurfacing or replanting of exposed area			√		
Environmental aesthetics	Loss of scenic values	Careful planning to minimize and offset losses			√		
Noise and Vibration	Nuisances to travelers and neighbors	Careful planning to minimize and offset losses		√			Joint monitoring by Consultant

Actions Affecting Environmental Resources and values (A)	Damages to Environment (B)	Recommended Feasible Protection Measures (C)	IEE (D)				Comments
			No Significant Effect (D1)	Potential Significant Effect			
				Small (D2)	Mod (D3)	Major (D4)	
Air pollution hazards	Nuisances and health hazards to travelers/workers	Control of motor vehicle and industrial emission			√		Joint monitoring by Consultant
Highway runoff pollution	Serious health/safety hazards to travelers and neighbors	Careful planning and O&M and competent emergency cleanup			√		
Highway spills of hazardous materials	Serious health/safety hazards to travelers and neighbors	Careful planning and O&M and competent emergency cleanup		√			
Impact on utility services	Public inconvenience due to disruption of service	Appropriate planning plus prompt action			√		To the extent feasible existing utilities will be bypassed
Problem During Operation Stage							
Increase in air pollutants during the operation phase; since traffic volume is predicted to be high	With widening of road emission from the vehicles less	Control of motor vehicle emission		√			
Increase in noise level due to the increase in number of vehicles passing through a point per unit time	With widening of road noise generated from the vehicles less	More or less positive impact		√			
Pollution of surface runoff will occur from exhaust emission, pavement and tire wear, petroleum product dripping, corrosion of metal	Serious health/safety hazards to travelers and neighbors	Careful planning and O&M and competent emergency cleanup		√			

Actions Affecting Environmental Resources and values (A)	Damages to Environment (B)	Recommended Feasible Protection Measures (C)	IEE (D)				Comments
			No Significant Effect (D1)	Potential Significant Effect			
				Small (D2)	Mod (D3)	Major (D4)	
The impact of the road improvement on the socio-economic environment	Positive beneficial effect, likely to stimulate the economic growth of the area	Insignificant	√				
Contamination of soil	Deposition of the chemicals from emission of the vehicles as well as spill from the vehicles	Control of emission from the vehicles as well as spill from the vehicles		√			
Changes in the land use pattern	Areas presently under forest area, agricultural land, may be diverted for development and other usages along the roads expected	Development should be as per development control plan			√		

7.7.1 Environmental Impacts

7.7.1.1 Environmental Impacts - Construction Phase

During the construction phase, there would be large impact on ecology (flora and fauna) and comparatively small impact on air, noise and water quality, and management of soil. Also there would be some impact on quality of life due to inconvenience caused to public as a result of construction activities.

Air quality impacts are likely from general construction activities including land clearing, construction of pavement, handling and transportation of construction and demolition materials, and from wind erosion of open sites and stock pile areas.

Noise pollution will occur from operation of construction equipment including earth moving and material handling equipment.

Water quality impacts may occur from runoff and waste generated from construction activities.

Within the Right Of Way (ROW) there are large number of affected trees (Estimated no. 16,325 nos.), would need to be feeling as a result of construction.

7.7.1.2 Environmental Impacts - Operation Phase

During the operation phase the environmental impacts are likely to be mostly positive. However, there could be some adverse impacts due to inadequate operation and maintenance or control.

Increase in air pollutants load is expected during the operation phase; since traffic volume is predicted to be higher. It is essential that appropriate traffic safety measures are included in the project design so that with the increase in traffic volume, movement of animal particularly at forest stretch are not affected by frequent accidents.

Increase in noise level is expected due to the increase in number of vehicles passing through a point per unit time. Widening of the road will result in decrease in noise level due to smooth running of the vehicles and congestion at intersections/junctions as well.

Chronic pollution of surface runoff will occur from exhaust emission, pavement and tyre wear, petroleum product dripping, corrosion of metal. It is envisaged that there is possibility of positive impacts, during operation phase. Generation of dust from vehicle movement will be controlled and the drainage system will be improved to reduce adverse effect of soil erosion.

Contamination of soil is expected due to deposition of the chemicals from emission of the vehicles as well as spill from the vehicles. Also change in the land use pattern due to development along the roads is expected. Pollution risks will increase from transportation of hazardous products during traffic operation.

Changes in the land use pattern i.e. areas presently under Reserved forest area, agricultural land, may be diverted for development and other usages. However the status of the change will be insignificant.

The impact of the road improvement on the socio-economic environment will be significantly beneficial, as it is likely to stimulate the economic growth of the area. The specific benefits of the road improvement will include reduction in travel time, travel cost, reduction in the time to bring the agricultural goods to the markets etc.

7.7.2 Mitigation Measures

7.7.2.1 Mitigation Measures - Construction Phase

Following measures are recommended for mitigating or minimizing the environmental impacts that are likely to be occur during the construction phase of the proposed project. The contractor under supervision and direction of NHIDCL shall implement these mitigation measures.

Prevention of erosion

- Construction will be scheduled so that large areas of soil particularly at low lying area and bridge slopes are not laid bare during the monsoon.
- Ground disturbances will be phased so that it is limited to workable size.
- Exposed surface will be resurfaced and stabilized as soon as possible.
- Stabilizations of soil at bridge approach, high embankment zone through plantation.

Protection of trees

- Number of trees to be cut will keep at the minimum level by modifying alignment. No construction vehicle will be allowed to enter into the forest area. During construction proper care would be exercised to avoid additional loss/cutting of trees. Construction camps will be sited at least 2 km away from the forest area. Trees with girth size 50 cm will be transplanted. To balance the ecological loss compensatory afforestation of at least 49,000 trees will be done as per the arboriculture and landscaping plan.

Prevention of dust nuisance:

- On exposed construction surfaces during dry/windy periods fugitive dust generation will be suppressed by spraying of water or other suitable means.
- Workers working in dust prone areas will be provided with masks and goggles.
- Excavated material and construction materials transported by trucks will be covered and/or wetted to prevent dust nuisance.

Noise and emission from vehicles and construction activities

- All construction vehicles will be properly maintained and will have valid "Pollution Under Control Certificate"
- Noisy construction activities will be carried out only during normal working hours and local residents will be advised of any unusual or unavoidable noise.
- Where feasible sound barrier will be provided in inhabited areas.

Relocation of utility services

There is no such case.

Prevention of dust and noise during material handling operation

- Dust and noise producing activities such as stone crushing, bitumen and cement batching plant etc. will be preferably located downwind and away from habitation settlement wherever practicable.

Prevention of soil, ground and/or surface water contamination

- Alignment susceptible to soil erosion has to be minimized. Only clean fill materials around watercourse, such as quarried rocks containing no fine soil will be used leaving buffer zones of undisturbed vegetation (width increase in proportion to slope) between road sites and bodies of water.
- Flow speed especially near water crossing will be controlled.

- Construction activity will be such as to ensure unhindered flow of watercourse at all times.
- Plant and machinery required for concreting etc. and construction workers camp will be sited away from the watercourse. The water quality will be monitored at regular intervals to monitor the change, if any, during the project implementation

Protection of land environment

- Minimizing the area of ground clearance, excess cut & fill as well borrow pits, avoided contaminated sited.
- Avoiding embankment angles more than natural angle of repose for that soil, replanting disturbed areas with grasses on embankment slopes to effectively limit the surface erosion.

Road safety and traffic management during construction

Contractor will coordinate preparation of a traffic management plan for approval of Assam/Nagaland Government. The plan will include:

- Provision of temporary safe access to school/residence, which will be blocked due to construction.

Health and safety of workforce

- All occupational and health and safety requirements for workforce will be adhered to.
- Periodic health check up of workers will be provided
- A physician's services will be retained to handle emergencies.
- Workers engaged in construction activity will be provided with proper protective equipment.

Environmental health and safety considerations at construction campsites and construction work-sites

- Camps/compounds will be located so that they do not interfere with the existing alignment.
- Camps/compounds will be surrounded with a bund or earth mound with controlled drainage outlet.
- Campsites will have adequate provision of shelter, water supply, excreta and solid waste management.
- Construction work-site will be properly barricaded and have adequate provision of drinking water, toilets and dispensing first aid.
- Appropriate control measures will be taken to prevent insect/vector diseases especially malaria by measures such as spraying and/or preventing creation of stagnant pool of water

7.7.2.2 Mitigation Measures - Operation Phase

Impact on physical and ecological environment and road safety due to increased vehicular traffic following completion of the project are the key aspects of operational phase impacts.

Prevention of Air Quality Impact

- The project implementation will improve the air quality. But increase in traffic volume will bring air quality level to the existing scenario may further deteriorate in the subsequent years, if long term mitigation measures are not taken particularly along rural & semi urban stretches at this stage. Following measure, as part of upgradation project, from air pollution point of view will be considered.
- Along the semi urban areas vegetative cover having canopy at two levels (double storied plantation) as special screens for dust and noise barriers will be provided to wall those areas against air and noise pollution.

Prevention of Noise Level Impact

- Mitigation at the same locations suggested under air quality during operational stage will also contribute in the reduction of noise levels.
- Mitigation of noise at sensitive locations and areas having good habitation will also include the posting of signs prohibiting the use of horns.

Improvement of Road Safety

- Improvement of road intersection
- Provision of speed regulating sign at proper locations to control vehicles speed in urban built up areas and sharp horizontal and vertical curves.
- Provision of guardrails at bridge approaches.
- Provision of safety guard rails physical separation of local traffic in built up portions.
- Development and enforcement of Emergency Response Plan and contingency Plan for accidents.
- Provision of suitable lighting arrangement at intersections in built up area, grade separators, wayside amenities, relief centers, Administration and Maintenance and Base Camp Depots.

Protection of Land Environment

- Construction within ROW should be such as not to cause damage to the environment and the existing regulation should be enforced strictly.
- Plantation of trees, shrubs and bushes as appropriate to soil characteristics and climate condition will be considered.

7.7.3 Monitoring Plan

Effective implementation of the mitigation measures to mitigate or minimize the environmental impacts would require the project to undertake a comprehensive monitoring programme. The objective of the monitoring programme is to ensure that the construction

and operation activities are carried out in an environmentally sensitive and responsible manner, and in accordance with the recommendations of **PESS**. Recommended monitoring activities of the proposed project are presented in **Table 7.5.**

Table 7.5: Summary of Environmental Monitoring Programme

Monitoring Category	Type of Monitoring	Frequency	Performed by
CONSTRUCTION PHASE			
Soils			
Erosion	Monitor proper management of excavated soil	Monthly	Contractor
Surface and Ground Water Quality			
Surface runoff management	Monitor measures taken to prevent surface runoff	Weekly	Contractor/ PCB
Air/Noise Pollution			
Dust emission during site preparation, excavation	Monitor adequacy of dust suppression measures undertaken	Daily	Contractor
Storage and transportation of construction materials, excavated soil and silt	Monitor adequacy of measures undertaken to prevent fugitive dust	Daily	Contractor
Noise and emissions from construction vehicles	Monitor 'Pollution under Control' certificate are current for construction vehicles	Weekly	Contractor/ Pollution Control Board (PCB)
Health and safety of construction workforce			
Health and safety requirements	Monitor adherence to all occupational and safety requirements	Daily to Monthly	Contractor
Health check up of workers	Monitor adequacy of health check up service provided including attendance of the physician retained and the extent to which the workforce is availing this service	Monthly	Contractor/ Govt. Health Dept.
Maintenance of health and safety records of work force	Review and monitor health and safety records to ensure all project related accidents are being properly investigated and reported	Monthly	Contractor/ Govt. Health Dept.
Sanitary conditions of construction campsite	Monitor provision of shelter, water supply, excreta and solid waste management at campsites	Daily to Monthly	Contractor/ Govt. Health Dept
Road Safety and Traffic Management			
Traffic management plan	Obtain approval to traffic management plan from Assam Police		
	Monitor adherence to the traffic management plan	Daily to Monthly	Contractor
Review road safety record	Review and monitor road safety records to ensure all project related road accidents are being properly	Monthly	Contractor/Police Dept.

Monitoring Category	Type of Monitoring	Frequency	Performed by
	investigated and reported		
Community Life and Economic Activities			
Access to community and private properties	Monitoring impact of project activity on dwelling and business in the project area	Monthly	
Damage to public and private property	Monitor construction activities to ensure public and private property is not damaged or proper development of compensation package	Daily to Monthly	Contractor
Public Awareness			
Awareness campaign highlighting the long term benefit of the project and public cooperation to overcome short term construction phase inconveniences	Review and monitor effectiveness of the awareness campaigns	Daily to Monthly	NGO
OPERATION PHASE			
Operation and Maintenance of the System			
Unscheduled maintenance/repairing as result of accidents or damage of the road	Monitor adequacy of implementation of preventive and all unscheduled maintenance work including periodic observation of present road facility, timely completion of work, etc.	Quarterly	
Discharge of Solid Waste and Liquid Waste			
Discharge of solid and liquid waste into the road particularly at semi urban area	Monitor Discharge/Throwing of solid and liquid waste into the road	Ongoing Monthly	NGO

7.8 Public Consultation

The Public consultation started prior to commencement of engineering design. The consultation process established for the project has employed a range of formal and informal discussion, in-depth interviews with key informatics, Focus Group Discussion, on-site consultation and meetings. The enactment of the participation and consultations with the primary stakeholders was done at local or village level in areas where problems were noted. In addition, NGO group undertook an awareness campaign to highlight the benefits that the public would derive from these projects. Issues discussed and community perception about the environment is given hereunder.

Table 7.6: Issues of the Public Consultation

Sr. No.	Key Issues/Demands	Action to be Taken
1	The number of trees going to be affected due to construction should be compensated with new plants, trees at the earliest	As per the requirements of the concerned Divisional Forest Dept. trees will be planted in the ratio of 1:3 whichever is applicable

Sr. No.	Key Issues/Demands	Action to be Taken
2	Increased noise level will cause adverse impact on human health	Stringent control measures will be adopted which includes reduction in speed limit, no horn signage, restricted traffic in night time
3	The water quality and environment should be protected during construction of the road	Proper sanitation and drainage facilities will be provided during construction and operation phase
4	Provision of better road engineering design will minimize noise levels that are particularly severe at semi urban places	Dense plantation and noise barriers will be provided on both sides of the sensitive area
5	Dust due to cru shers should be minimized and steps should be taken by the Government	Carefully controlled and continuously implementing soil wetting will be done
6	Physical relocation should be kept at the minimum level	Community consensus to be evolved
7	Watercourses such as *nala*, ponds, tube wells should not be disturbed	Disturbance to these watercourses will be avoided to the maximum possible extent at design stage
8	Public facilities should be enhanced along the project road	Suitable enhancement measures will have to adopted at certain locations as per EMP

7.9 Environment Management Plan

An environmental management plan has been proposed along with institutional arrangements for effective implementation, monitoring and reporting. It is envisaged that all stake holders i.e. the NHIDCL, Forest Department, the design and supervision consultant, contractor, environmental consultant and public/NGO's will play their role in effective implementation of EMP (Monitoring plan and responsibility discuss in section 6.3). The effort of all agencies will be to bring together by the "Environment Management Unit" proposed to be set up under the Project Implementation Unit of the NHIDCL. This unit will also arrange training of the staff involved in monitoring of the implementation of the EMP besides taking steps to create awareness amongst the public and stakeholders.

Most environmental impacts from the project will arise during construction. Items such as air pollution, surface water pollution, ground water pollution, noise pollution, preservation of ecological resources, respect for cultural and religion sentiments, labour health, accidents and safety will be controlled by making suitable provisions in the BID documents and assigning the responsibility for implementing mitigate measures to the contractor.

During operation phase it is proposed that NHIDCL will monitor periodically air, water, and noise pollution for suitable action as necessary. The primary post construction responsibility of the Forest Dept. is maintenance of compensatory and transplantation trees by watering, manuring and spraying of pesticides and insecticides.

7.10 Planning Consideration:

b) Minimum tree felling through proper selection of alignment and by other means of judicial road designing

c) Provision of underpasses and arrangement of cautionary sign.

d) Provision of good drainage system throughout the stretches

e) Provision of 5.00 m median including shyness at center line of the road (particularly at rural plain land) for protection of few trees

f) Provision of 3-5 m strip of land for road side plantation on both sides of the road

g) Protection of religious places, utility services through proper selection of new alignment

h) Protection of soil of the embankments at river approach

i) Provision of road sign at suitable locations

j) Protection of *nala* and water body near the road alignment

k) Provision of Truck bays and service roads

7.11 Implementation of EMP and Costing

The analysis of existing conditions, potential impacts and mitigation measures suggested above would need effective Environment Management Plan, which is proposed to be submitted separately. EMP will include the organizational and staffing arrangement, environmental training, monitoring procedure and record keeping. A tentative cost for implementation of environment management plan on different items is expected to be **Rs.414.00 lakh.** Details of cost estimate are given in **Table 7.7**

Table 7.7: Tentative Cost of Environment Management

Sr. No.	Items Particular	Assumption	Unit Rate (Rs.)	Total Cost in Rs (lakh)
	I. During Construction Phase			
1	Road side tree plantation and maintenance	39,000	700/- plant including 2 yrs maintenance	273.00
2	Transplantation of the young trees	10,000	700/- plant including 2 yrs maintenance	7.00
3	Flowering shrubs at the median	20000 shrubs	500/- plant including 2 yrs maintenance	10.00
4	Dust suppression	LS (35.00 km)		4.00
5	Aesthetics and landscape	LS (35.00 km)		
6	Erosion control along high embankment	To be included in Engineering Design (tentative estimate)		10.00
7	Air pollution Monitoring	5 sites with the frequency twice in a week for 52 weeks	4000.00 per sample	20.80

Sr. No.	Items Particular	Assumption	Unit Rate (Rs.)	Total Cost in Rs (lakh)
8	Noise Monitoring	6 sites with the frequency twice in a week for 52 weeks	200.00 per observation	1.26
9	Water Quality Monitoring	Once in all the four seasons at 5 locations	5000.00 per sample	1
10	Project level specific mitigation/enhancement			
	a) Noise barriers	LS		2.00
	b) Rehabilitation/enhancement of ponds	LS (approx.)		4.00
	c) Rehabilitation/enhancement of religious place	LS (approx.)		10.00
	d) Market place improvement	LS		50.00
	e) Underpasses for animal movement	LS		4.00
11	Disposal of Sewage effluent and solid waste	2	150000.00	3.00
	Total (I)			**400.06**
			Say	**400.00**
	II. During Operation Phase			
1	Expenditure on Environmental unit in Project Implementation Unit	LS		10.0
2	Air pollution Monitoring	Twice in a week for 4 weeks in three seasons at 3 locations	4000.00	2.88
3	Noise Monitoring	Once in week for four weeks in four seasons at 3 locations	200.00	-10.00
4	Water Quality Monitoring	Once in a season in four seasons at 3 stations	5000.00	0.60
	Total (II)			**13.48**
			Say	**14.00**
	Grand Total (I+II)			**414.00**

Table 7.8

Girth Size (cm)	Number of Trees within ROW in Dimapur Bypass
<50	6,886
50 - 100	4,640
100 – 200	542
> 200	9
Total	**12,077**

Dimapur Bypass Km wise affected of trees

Chainage	No of Trees
Ch. 118.05 to 121.00	2,802
Ch. 121.00 to 124.00	3,740
Ch. 124.00 to 127.00	2,589
Ch. 127.00 to 130.00	2,674
Ch. 130.00 to 133.00	272
Total Trees affected	**12,077**

Girthwise felling of number of affected trees in Dimapur Bypass (Assam Part)

Design Km	Trees in		Girth				
	LHS	RHS	< 50 cm	50 to 100 cm	100 to 200 cm	>200 cm	
118 to 121	1380	1422	1788	987	27	0	
121 to 124	1934	1806	2042	1656	42	0	
124 to 127	1143	1446	1471	877	241	0	
127 to 130	985	1689	1430	1008	227	9	
130 to 133	170	102	155	112	5	0	
Total	**5612**	**6465**	**6886**	**4640**	**542**	**9**	**12077**

Table-7.9: Environment Data Sheet

Km Chainage (From Daboka)	Environmental Features		Remarks
	LHS	***RHS***	
118.00 to 121.00	**Inside ROW:** Ditch, open land, road side trees mainly Ahat, Mango, Gamari, Sirish, Simul **Outside ROW:** Open land, Paddy land, ditch, fallow land; trees present	**Inside ROW:** Ditch, open land, roadside trees mainly Mango, Sesam, Sirish, Simul, paddy field, vacant land. **Outside ROW:** Open land, Paddy land, ditch, fallow land; trees present	Felling of roadside trees may be unavoidable for concentric design.
121.00 to 124.00	**Inside ROW:** Road side natural and plantation trees like Ahat, Simul, Mango, Gamari, Sirish; paddy field, ditch **Outside ROW:** Common trees	**Inside ROW:** Roadside natural and plantation trees like Ahat, Simul, Mango, Casea, Sesam, Gamari, Sirish; paddy field. **Outside ROW:** Common trees	Felling of mature trees may be unavoidable for concentric design.
124.00 to 127.00	**Inside ROW:** Trees mainly Simalu, Sirish, Jamun, Mango, Krishnachura; paddy field **Outside ROW:** Mainly open and tea plantation, village residential and few commercial shops; trees common.	**Inside ROW:** Trees mainly Simalu, Sirish, Sesam, Arjun, Kadam, Jamun, Mango, Krishnachura; paddy field. **Outside ROW:** Mainly open and agricultural paddy land, village residential and few commercial shops; trees common.	Felling of roadside trees may be unavoidable for concentric design.
127.00 to 130.00	**Inside ROW:** Trees mainly Simalu, Sirish, Jamun, Mango, Krishnachura and Bhelu;	**Inside ROW:** Trees mainly Simalu, Sirish, Jamun, Mango, Krishnachura and Bhelu. **Outside ROW:** trees common.	

Km Chainage (From Daboka)	Environmental Features		Remarks
	LHS	*RHS*	
	Outside ROW: Semi urban residential area, few tea plant, thick tree cover.		
130.00 to 133.00	**Inside ROW:** Trees mainly Simalu, Sirish, Jamun, Mango, Krishnachura and Bhelu, Eucalyptus, Sonaru, Kathal, Sesam; ditch, bamboo tree, few residential. **Outside ROW:** Mainly open and agricultural paddy land, village residential and few commercial shops; trees common, bamboo tree.	**Inside ROW:** Trees mainly Simalu, Sirish, Jamun, Mango, Krishnachura and Bhelu, Eucalyptus, Sonaru, Kathal, Sesam; ditch, bamboo tree, few residential area; **Outside ROW:** Mainly open and agricultural paddy land, village residential and few commercial shops; trees common, bamboo tree.	Felling of trees may be unavoidable for concentric design.

Table 7.10 A: Ambient Air Quality Monitoring Data

Sl. No.	Name of Sampling Station	Allotment Level mg/m^3						Remarks
		SPM	RPM	SO_2	NOX	CO	Pb	
1	Dillai	60 (100)	35 (75)	15 (30)	12 (30)	0.5 (2) mg	0.12 (0.75)	Figures in the Bracket indicate permissible limit in respective area for 24 hrs average
2	Belijan	120 (200)	40 (100)	15 (80)	12 (80)	0.6 (4) mg	0.2 (1.0)	
3	Gautam Basti	100 (200)	25 (100)	16 (80)	15 (80)	0.7 (4) mg	0.1 (1.0)	

Table 7.11: Location of Water Sampling Sites (Assam Part)

Sl. No.	Location (km Chainage) from Daboka	Sample Code
Surface Water		
1	River Dhansiri	**SW1**
2	Nala (18 Kmp)	**SW2**
Ground Water		
1	Tube well water at Dilai	**GW1**
2	Tube well water near Gautam Basti	**GW2**

Table 7.11 A: Water Quality of the Study Area (Assam Part)

Sl. No.	Parameter	SW 1	SW 2
1	**Physical Characteristics**		
	Colour (Hazen Unit)	<5	<5
	Odour (TON)	1.0	1.0
	Temperature (°C)	22^0	23^0
	P^H	6.3	7.1
	Electrical Conductivity (Us/Cm)	64	67
	Total suspended solid (mg./l)	4.0	10
	Total Dissolved solid (mg./l)	60	66
2	**Mineralogical and chemical charactories**		
	Chloride (as Cl (mg./l)	4.92	5.62
	Sulphate (as SO_4) (mg./l)	<5	<5
	Total Hardness as $CaCo_3$ (mg./l)	30	32
	Calcium (as Ca) (mg./l)	8	7
	Magnesium (as Mg) (mg.1/l	1.5	1.6
	Nitrates (as No_3) (mg./l)	<5	<5
3	**Nutrients**		
	Total Kieldahl Nitrogen (mg./l)	0.80	0.90
	Ammonia cal Nitrogen (mg.1/l)	0.22	0.22
	Total Phosphate – Phosphorus (as P04, mg./l)	<0.01	<0.01

Sl. No.	Parameter	SW 1	SW 2
4	**Demand Analysis Report**		
	Dissolved Oxygen (mg./l)	4	4
	COD (mg./l)	<10	<10
	BOD (3 days, 27°c (mg./l)	<2	<2
5	**Metallurgical Characteristics**		
	Manganese (as Mn)/ (mg./l)	0.08	0.10
	Iron (as Fe) (mg/l)	0.10	0.13
	Lead (as Pl) (mg./l)	0.05	0.06
6	**Bacteriological Status**		
	Total Coliform (MPN/100 ml)	$5x10^3$	$5x10^3$
	Faecal Coliform (MPN/100 ml)	$2x10^3$	$2x10^3$

Table 7.12: Location of Noise Level Monitoring Sites (Assam Part)

Sl. No.	Location (km Chainage) from Daboka	Distance from the C/L of Road (m)	Description of Monitoring Site
1	Dilai, near starting point of Bypass - N_1	5	Forest area
2	Gautam Basti - N_2	20	Sensitive area

Table 7.12 A: Ambient Noise Quality Data (Assam Part)

Sl. No.	Location (Km Chainage), Zone	Day Time Leq (dBA)	Night Time Leq (dBA)
1	Dilai near starting point of Bypass – Forest Area	30 (50)	20 (40)
2	Gautam Basti – Sensitive Area	25 (50)	20 (40)

Figures in ( ) indicate permissible noise level as per CPCB.

INITIAL SOCIAL ASSESSMENT AND PRELIMINARY LAND ACQUISITION/RESETTLEMENT PLAN

CHAPTER 8

INITIAL SOCIAL ASSESSMENT & PRELIMINARY LAND ACQUISITION / RESETTLEMENT PLAN (ASSAM PART)

8.1. Introduction

8.1.1. The goals of the project are :

a) Socio-economic development through efficient transportation system

b) Improvement capacity and good riding quality of Highway infrastructures

c) Providing adequate transportation infrastructure to the local people for significant impact nurturing their spirit of enterprise.

d) Improvement in quality of life and social status through the implementation of Highway development of the region.

A road net work is an essential requirement for **poverty reduction** as it provides access to markets, integrates markets in different areas, mitigates the risks to which the poor are often more exposed, and improves social welfare resulting from the increased accessibility to basic social services. Better mobility and delivery of services due to improved road, help the people of that region to earn higher wages and diversify their economic activities. Employment generation resulting from road construction and maintenance or from enhanced business opportunities, will increase the economic activity which is very crucial in raising income at the project affected area. The availability of reliable transport to input and output markets, stimulates cash crop farming in isolated areas, and lowers transport costs, which influences access to off-farm employment opportunities. The transition from subsistence farming to a market economy is thus accelerated, so that the poor are better off than merely being self-sufficient.

Better transport links improve economic efficiency, foster trade, facilitate interregional integration, and reduce the cost of trucking. Improved local roads will help and boosts the rural economy by providing the less developed communities better access to regional market centres.

The transport corridor (NH-36) is of strategic importance in the economic development of northeast India and the neighboring countries of Bangladesh, Bhutan and Nepal. This corridor is the major trade route for India's northeastern states.

On completion of our contemplated development of stretch of NH-36, & Dimapur Bypass part of the connectivity road network will open up a wide horizon to the people of other region of the country, which will also accelerate the socio-economic development of the region. Better mobility, less travel time, lower transportation cost, less vehicle operating cost, good riding quality and comfort will have tremendous effect on the quality of the life of the people in that region. More employment generation, scope of setting of subsidy industries even during the period of construction will uplift the economy of the region. Exchange of cultural heritage, educational facilities, and more health care consciousness will be developed on completion of such trunk road.

8.1.2. This chapter deals with matters relating to social viability of the project. The issues being examined herein would include the extent of damages to properties likely to be caused by implementation of the project, how the project affected persons would react, magnitude of resettlement cost, socially acceptable resettlement action plan etc.

8.1.3. Guidelines for the Social Screening:

Some guidelines for the screening Reports are as follows:

(i) **Social groups**: This means any part of the local population that can be grouped together because they share the same interest, such as similar livelihood strategies, socio-economic levels or social status. Social groups can be quickly and easily identified when planning assessment by sitting down with community leaders and asking some key questions to them.

(ii) **Ethnic groups** : Care should be taken to note the names of all ethnic groups living in the core area and to ensure that every group is consulted. In order to get an idea of key resource-use issues for different ethnic groups we should consult with the community leaders. We should also consult with Block and panchayet level officials.

(iii) **C**onsultation with Women should aim to produce a meaningful understanding of how men and women may be involved in different activities within the project affected area.

8.1.4. Development projects in general and road development projects in particular bring about changes in socio-economic and environmental conditions in the project influence area. The development impacts do not, generally, remain confined to the **Immediate Impact Area,** but spread over to a considerably wider area, which may be termed as the zone of influence.

The zone of influence may be categorised into three groups - **Immediate Impact Area, Intermediate Influence Zone** and **Outer Influence Zone.** The number of villages through which the project corridor passes constitutes Immediate Impact Area. The Intermediate Influence Zone comprises of concerned police stations area and is even extended to the administrative boundary of district(s), through which the project corridor is traversing, while the Outer Influence Zone is the concerned state(s), as a whole.

8.1.5. Roads are agents of change. These changes may be positive or negative or both. They are responsible for both benefits and costs to the existing balance between men and environment. On the positive side, it accelerates the process of overall socio-economic development of the region. On the negative side, it may cause damage to eco-systems, more particularly when it is required to uproot trees and greens. Secondly, a good number of people are adversely affected. The affected persons may incur loss of the following types: agricultural land, homestead land, living quarters and other physical infrastructures due to demolition of buildings, commercial and business activities, occupied land (adverse possession or with permission of owner), structures (illegally constructed) for dwelling or business, tenant contract or farming. Moreover, the project road may also cause damage to community facilities and utilities, like, potable water source (e.g. Tube well, well etc), market place, schools, place of worships, community centers or clubs etc. It is worth mentioning that the affected properties, in the case under reference, may be classified into three categories i.e., private, public and places of worship.

8.2 The Project road

The Project Road runs from Daboka in Assam to Dimapur in Nagaland (some part), from 38.00 km to 168.167 km. and includes northern Dimapur Bypass starting at 159.400 (existing Ch.) of NH-36 and ends at 124.200 (existing Ch.) of NH-39.

Nagaland is a hill state located in the far northeastern part of India. It borders the state of Assam to the west, Arunachal Pradesh and part of Assam to the north, Myanmar to the east and Manipur to the south. The state capital is Kohima, and the largest city is Dimapur. With a population of nearly two million people, it has a total area of 16,579 km – making it one of the smallest states of India. The tribe of Nagaland are Angami, Ao, Chakhesang, Chang, Khiamniungan, Konyak, Lotha, Phom, Pochury, Rengma, Sumi, Sangtain, Yimchungru, Zeliang.

There is one Railway Crossing (ROB) on our study corridor. There are 3 Major RCC Bridges & 6 Minor Bridges and 46 Box Culverts of different sizes along our project corridor. All along the Bypass Project Road, ROW to be acquired is 60.00 m.

The economy of Nagaland is predominantly based on agriculture. 68.03 percent of the working populations pursue agriculture and other allied activities as their chief means of livelihood. The per capita income of the State is Rs.13,052 for the year 1997-98. Nagaland ranks 11th in the human resource development index. More than 358138.7 hectares of the total land area of the State is under forests. Nagaland is rich with regard to its mineral wealth. But due to lack of modern industries, proper utilization of these resources have been restricted.

8.3 Objectives of Social Screening

The main objective of conducting social screening is to provide inputs of social concerns to be dovetailed in project design and to avoid or minimize the adverse social impacts with the best possible engineering solutions at minimum cost in close coordination among engineering, environmental and social experts during the entire design process. The instant social screening exercise is intended to assess the negative impacts (direct, indirect or cumulative) and to suggest mitigating measures to avoid or at least minimize the adverse impacts on: nearby communities and natural environment, people and properties falling on the direct path of road development, people indirectly affected by the way of disruption of livelihood, breakage in community linkages, impacts arising from land acquisition and resettlement, impacts on indigenous people (SC, ST, etc), impacts on human safety etc. To minimize and/ or avoid the adverse impacts, necessary modifications are to be made at design stage. But in cases of unavoidable negative impacts, these would be mitigated through suggested appropriate measures to be adopted during construction and operational stages.

8.4 Public Consultation And Participation

Participation is a process through which stakeholders influence and share control over development initiatives and the decisions and resources which affect them. The effectiveness of R&R programs is directly related to the degree of continuing involvement of those affected by the project. Comprehensive planning is required to assure that local government, NGOs, host population and project staffs interact regularly and purposefully in all stages of the project. Participation of persons directly affected by Project is a prerequisite of R&R policy, if its programs are to be suited to the needs of the resettlement population. PAP involvement increases the probability of successful resettlement and rehabilitation. The overall goal of the consultation program is to disseminate project information and to incorporate PAPs views in the R&R policy. The specific aims of the consultations are to:

a) Improve project design and lead to fewer conflicts and delays in implementation
b) Facilitate development of appropriate and acceptable entitlement options.
c) Increase long term project sustainability and ownership
d) Reduce problems of institutional coordination
e) Make the R&R process transparent and reduce leakage.
f) Increase effectiveness of sustainability of income restoration strategies, and improve coping mechanisms.

A state level workshop is to be conducted with participation from key stakeholders including local NGOs, academic institutions, government officials, and others. The purpose of this stake-holder's workshops is to present and discuss the project content, review the policy framework. The discussion includes an elaboration on the approach to social impacts and resettlement, and to reach on agreement on the implementation mechanisms and coordination among different groups and agencies. The project will continue to document how people's views have been taken into consideration in a meaningful way. It will ensure that groups and individuals that are consulted are informed later about the outcome of the decision-making process, and how their views have been incorporated.

8.5 Preliminary Resettlement Plan

This resettlement plan (RP) has been prepared in accordance with National policy of India and other social safeguard policies designed to protect the rights of the affected persons and communities. The primary objectives of the RP are to mitigate the adverse impacts of the project and to assist the affected persons (Aps) in resettlement and restoration of their income and livelihoods.

The Resettlement Plan has been prepared keeping the following broad objectives :

- The negative impact on persons affected by the project would be avoided or minimized.
- Affected people and the beneficiary population will be informed and consulted about the project and its design.
- Where the negative impacts are unavoidable, the project-affected persons will be assisted in improving or regaining their standard of living. Vulnerable groups will be identified and assisted in improving their standard of living.
- People's participation will be undertaken in planning and implementation of the project.

- All information related to resettlement plan and implementation will be disclosed to APs.

The RP is based on the general findings of the census/socio-economic surveys, field visits, and meetings with various project-affected persons in the project area. In view of the human dimension involved the possible social impacts have been integrated into the improved alternative engineering designs to minimize resettlement and displacement. These benefits have been achieved by adopting engineering solutions like underpasses, bypasses, raised pavement, service roads, ROB's and reduced median at congested segments. The RP provides detailed guidance on how to implement provisions in the policy framework, including institutional arrangements and budgets based on enumeration of project affected people with entitlements under the framework. The RP identifies (i) type and extent of loss of assets, including land and houses; (ii) type and extent of loss of livelihood or income opportunities; (iii) collective losses, such as common property resources and social infrastructure; (iv) entitlement matrix and provisions for relocation assistance and restoration of businesses/income; and (v) institutional framework for the implementation of the plan, including monitoring and evaluation. It is expected that the impact on APs, including roadside small business enterprises (SBEs), will be limited due to relocation opportunities close to their existing locations and additional assistance for shifting and resettlement. The RP also addresses other interrelated socio-cultural impacts – for example indigenous/vulnerable groups, issues of road safety, trafficking of women and AIDS/HIV – with road widening and improvements. In sum, the RP has taken an integrated and holistic approach to dealing with project impacts and aims at rebuilding lives and livelihoods of those affected as quickly as possible. It is designed to involve all stakeholders, including roadside communities and other user groups, in the planning and implementation of the project. The RP will be revised and updated by the Project Implementation Unit (PIU), based on the final technical design.

8.6 The National Highways Act

For LA, the Act defines the various steps of the process as follows: (i) section 3A – power to acquire land; (ii) 3B – power to enter for surveys ; (iii) 3C – hearing of objections; (iv) 3D – declaration of acquisition; (v) 3E – power to take possession; (vi) 3F – power to enter into the land where land has vested in the central government; (vii) 3G – determination of amount payable as compensation ; and (viii) 3H – deposit and payment of amount. The Act requires that the processes must be completed within a year from 3A to 3D. The acquisition process is faster due to central government co-ordination and provision for arbitration or power of civil court for trying any LA-related dispute. Although NHAI Act significantly reduces the time frame for acquisition, the rules and principles of compensation are derived from the

LA Act of 1894 amended from time to time. The Act covers only legal title holders and provides for : (i) market value of the land; (ii) a solarium of 30% on the market value for compulsory acquisition; (iii) additional amount for trees, crops, houses or other immovable properties; (iv) damage due to severing of land, residence, place of business; (v) compensation to sharecroppers for loss of earning; and (vi) an interest of 12% on the market value from the date of notification to award.

The LA Act does not address many of the social and economic issues associated with displacement and resettlement of "illegal" or non-titled informal settlers/squatters. However, in many donor-funded projects, NHIDCL assisted affected persons even without any legal title. The impacts of the present project are also on the roadside SBEs/households – people who are "non titled" informal dwellers and encroachers.

8.7 National Policy on Resettlement and Rehabilitation

The Government of India (GOI) in February 2004 approved a Nat Resettlement and Rehabilitation (NPRR). Its recognizes the following essential features :

1. That project affected families (PAF) not only lose their lands, other assets and livelihoods, they also experience adverse psychological social/cultural consequences;

2. The need to minimize large-scale displacement and where displacement and where inevitable, resettlement and rehabilitation has to be handled with care. This is especially necessary for tribal, small and marginal farmers and women;

3. That cash compensation alone is often inadequate to replace agricultural land, homesteads and other resources. Landless labour, forest dwellers, tenants, artisans are not eligible for cash compensation; The need to provide relief especially to the rural poor (with no assets), PE and marginal farmers, SCs/STs and women;

4. The importance of dialogue between PAFs and the administration; responsible for resettlement for smoother implementation of projects R&R.

8.8 R & R Principles and Assistance

In accordance with the resettlement and rehabilitation (R&R) policy of the project, all affected Households/SBEs will be entitled to a combination of compensation measures and resettlement assistance, depending on the nature of ownership rights of lost assets and scope of the impact, including social and economic vulnerability of the affected persons. In general terms, the affected persons in the project will be entitled to four types of compensation and assistance: (i) compensation for loss of land, crops/trees; (ii) compensation for structures (residential/commercial) and other immovable assets; (iii) assistance for loss of business wage income; and (iv) re-building and/or restoration of community resources/facilities. A detailed description of each compensation measures and assistance is provided in the entitlement matrix (Para 8.9).

The R&R activities in the project are guided by the following broad principles:

- Where land acquisition is required, it will be carried out in a way to minimize the adverse impacts and to avoid displacement as much as possible.
- Replacement land/or cash compensation at market value to households affected the loss of agricultural or other kinds of land. Likewise, loss of standing crops and productive trees will be compensated at market Price.
- Cash compensation for structures (residential/commercial) affected by road widening and improvements at replacement cost.
- Provision for (i) relocation of the informal settlers on project-sponsored resettlement sites with civic amenities, and (ii) markets to assist SBEs to assist in the restoration of businesses and incomes.
- Shifting cost to owners of residential structures and informal dwellers/squatters households due to loss of ability to maintain livelihood during relocation / shifting.
- Rehabilitation assistance i.e. compensation for lost businesses and workdays (including employees) due to relocation.
- Special measures and assistance for vulnerable groups e.g., female-headed household, and disabled persons.
- Affected people and the beneficiary population will be informed and consulted about the project and its design. All information related to resettlement preparation will be disclosed to the APs and all concerns.
- Appropriate grievance redress mechanism will be established at the district level to ensure speedy resolution of dispute.

- All activities related to resettlement implementation will be monitored by a suitably qualified independent agency.

These principles are further explained in the entitlement matrix at para 8.9. Compensation and R & R assistance will be paid in according with this policy before taking possession of the acquired land and properties. There would be no/or minimum adverse on host communities, and if occurs would be mitigated appropriately. All activities that related to resettlement planning, implementation and monitoring would ensure involvement of women. Efforts will also be made to ensure that vulnerable groups are included. R&R assistance will be provided to all squatters and disadvantaged vulnerable people as per the entitlement framework. Also the compensation will be paid at the replacement value. All losses, including loss of income, would be compensated within the overall R&R package as per the broad entitlement framework. The unit of entitlement framework will be the households. In case the replacement cost is more than the compensation at market price determined by the difference is to be paid by the project. The entitlement of compensation and assistance will be extended to only those AFs who are so identified on or prior to the cut off date.

8.9 Detailed Entitlement Matrix for National Highway Corridor

The broad entitlement framework for the Resettlement Plan is presented below :-

	Category	Type of Loss	Unit of Entitlement	Entitlement	Details
1A	Private Property	Agricultural land and assets	Titleholder	Compensation at "replacement cost" or "actual market value"	If the replacement cost is more than the compensation at "market price" as determined by the Competent Authority in the policy frame work, then the difference is to be paid by the project in the form of "assistance". APs will be explained the process and their views will be taken into consideration, while determining the market value. If the residual plot(s) is (are) not viable i.e. less than average land holding of the

	Category	Type of Loss	Unit of Entitlement	Entitlement	Details
					district, there are three options to be given to the EP. The EP remains on the plot, and the compensation and assistance paid to the tune of required amount of land to be acquired. Compensation and "assistance" are given for the entire plot including residual plot, if the owner of such land wishes that his residual plot should also be acquired by the project authority provided residual land is quantified less than average land holding of the districts. The project authority will acquire the residual plot so paid. If EP is from vulnerable group, compensation for the entire land is by means of land for land if so wished by EP provided that the land of equal or more productive value is available. Transitional allowance of Rs.2000 per month for 9 months if the residual land is not viable or for 3 months when the residual land is viable. In case of severance of

	Category	Type of Loss	Unit of Entitlement	Entitlement	Details
					agricultural land, an additional grant of 10% of the amount paid for land acquisition. All fees, taxes and other charges, as applicable under the relevant laws, incurred in the relocation and resource establishment, are to be borne by the project. Alternative economic rehabilitation grant for vulnerable groups is Rs.3000 lump sum. Training for up-gradation of the skills for vulnerable groups and linked to employment opportunities is Rs.1500 lump sum. 1. Where there is severance from farmland, an additional grant – 15% of the compensation-will be paid 2. Replacement land must be bought within one year of the compensation payment. 3. Sharecroppers/tenants are to be compensated according to the NHAI Land Acquisition Law.

	Category	Type of Loss	Unit of Entitlement	Entitlement	Details
1B	Private Property	Non-agricultural land	Titleholder/ owner: Residential	Compensation at "replacement cost"	If the asset (part or full) in question is a residential structure, then the replacement cost will be calculated as equivalent to the cost of provision of residential structural of area equivalent to that lost, subject to relevant "quality standards" of BSR as maintained by Government/Local Bodies Authorities. If replacement cost is more than the compensation (at "market price" as determined by the Competent Authority) then the difference is to be paid by the project in the form of "assistance". Transitional assistance of Rs.2500 per month in the form of grant to cover a maximum nine months rental accommodation. A lump sum shifting allowances of Rs.1500 for temporary, Rs.2000 for semi-permanent structures and Rs.5000 for permanent structures. Absentee landlords will receive only the compensation

	Category	Type of Loss	Unit of Entitlement	Entitlement	Details
					at "replacement cost". Right to salvage materials from the demolished structure. Compensation for loss of residential/commercial land at replacement value.
			Titleholder/ Owner: Commercial		If the asset (part or full) in question is a commercial structure, then the replacement cost will be calculated as equivalent to the cost of provision of commercial structure of area equivalent to that lost, subject to relevant "quality standards" of BSR as maintains by Government / Local Bodies Authorities. If the replacement cost is more than the compensation (at "market price" as determined by the competent Authority), then the difference is to be paid by the project in the form of "assistance". Transitional assistance of Rs.2000 per month in the form of grant to cover a maximum nine months rental accommodation. A lump sum shifting allowance of Rs.700 for temporary and

	Category	Type of Loss	Unit of Entitlement	Entitlement	Details
					Rs.2000 for semi-permanent structures and Rs.5000 for permanent structures. Absentee landlords will receive only the compensation at "replacement cost" Right to salvage materials from the demolished structure. Compensation for loss of residential / commercial land at replacement value. Option for commercial plot at wayside amenities planned.
			Tenant : Residential		The tenants will receive the following : The amount of deposit or advance payment paid by the tenant to the landlord or the remaining amount at the time of expropriation (This will be deducted from the payment to the landlord). A sum equal to nine months rental in consideration of disruption caused. Compensation for any structure the tenant has erected on the property (This will be deducted from the payment to the landlord). Shifting allowance of Rs.800 lump sum for shifting.

	Category	Type of Loss	Unit of Entitlement	Entitlement	Details
			Tenant : Commercial		The tenants will receive the following : The amount of deposit or advance payment paid by the tenant to the landlord or the remaining amount at the time of exportation. (This will be deducted from the payment to the landlord). A sum of equal to nine months rental in consideration of disruption caused. Compensation for any structure the tenant has erected on the property (This will be deducted from the payment to the landlord). Shifting allowance of Rs.500 lump sum for shifting.
2.	**Others**		**Agricultural Land being Acquired**		
2A	Livelihood	Wage earning Agriculture and other labourers	Individual	Lump Sum	1. This is valid for persons indirectly affected due to the employer being displaced, on a case-by-case basis after suitably determining the monthly wage. 2. In individual cases, when the Wager will be entitled to Rs.2000 as transitional allowance.

	Category	Type of Loss	Unit of Entitlement	Entitlement	Details
					3. Alternative economic rehabilitation support in the form of training for upgradation of skill.
2B		Non-perennial	Family	Notice to Harvest Standing crops	They are entitled to be given a notice substantially 4 months in advance. Grant towards crop lost before harvest due to forced relocation, equal to market values of crop lost plus cost of replacement of seeds of the next season's harvest.
2C		Perennial crops such as fruit trees	Family	Compensation at "market value"	Compensation for perennial crops and trees, calculated as annual produce value for one season and times 3-5 depending on the nature of crops / trees.
3.	**Illegal Use of the ROW**				
3A	Illegal Use of the ROW	Encroacher	Family	Will receive no compensation for land but they will be compensated for loss of structure for replacement cost.	Encroachers will be notified a time in which to remove their assets (except trees) and harvest their crops. To be assisted on case to case basis by considering relevant facts on family income and existing assets only in the case of person being a member of more

	Category	Type of Loss	Unit of Entitlement	Entitlement	Details
					disadvantage families of the vulnerable group. Compensation for structures at replacement cost to the vulnerable person. Right to salvage materials from the demolished structure.
3B		Squatters	Family	Will receive no compensation for land but will be compensated for loss of structure for replacement costs.	Facilitation / access to training, which includes equivalent income generating assistance. A lump sum shifting allowances of Rs.700 for temporary and Rs.1200 for semi permanent structures and Rs.2200 for permanent structures. Compensated for loss of structure at replacement cost. Right to salvage materials from the demolished structure.
3C	Shifting Business	Mobile ambulatory vendors	Family	They are not eligible for compensation or "assistance"	Ambulatory vendors licensed for fixed locations will be considered as kiosks.

	Category	Type of Loss	Unit of Entitlement	Entitlement	Details
3D		Kiosks	Family	"Assistance" for business disruption	The Assistance will be paid as a flat sum of Rs.2000.
4	Additional support to vulnerable group	Primary source of income	Individual	Additional assistance to training or equivalent	The assistance will be equal to Rs.1500 for income generating or vocational training option for the EP's choice. The training includes starting a suitable production of service activity. Economic rehabilitation support and training and in case the money not spent for training program, the equivalent amount to be paid as per EP's choice.
5A	Community infrastructure, cohesion and amenities	Common property resources	Community	Conservation protection compensatory replacement	Economic replaced resources, such as cultural properties will be conserved (by means of special protection, relocation, replacement, etc.) in consultation with the community. Loss of access to firewood, etc. will be compensated by involving the communities in a social forestry scheme, in co-ordination with the Department of Forests, wherever possible. Adequate safety measures, particularly for pedestrians

	Category	Type of Loss	Unit of Entitlement	Entitlement	Details
					and children; Landscaping of community common areas; improved drainage; roadside rest areas, etc. are all provided in the design of the highways. Employment opportunities in the project, if possible. Loss of trees will be replaced by compensatory a forestation.
5B	Any other impact not yet identified, whether loss of asset or livelihood	Loss of commercial and homestead land			Unforeseen impact will be documented and mitigated based on the principles agreed upon in this policy framework.

8.10 Social Interactions

8.10.1 Initial public consultation in the form of group discussions has been carried out at different locations of the project corridor with a view to minimize adverse impact of the project through creating awareness among the communities on potential benefits of the project. Moreover different meetings were organized with NGOs and officials of various government departments and institutions as detailed hereunder.

Interaction with affected shopkeepers & others

This will be done after approval of total alignment of Bypass.

8.11 Affected Properties

This will be assessed after approval.

8.12 Tentative cost estimate for R R Program

8.12.1 It may be mentioned that all potentially affected properties are situated within the right of way (ROW) of the project corridor. No further land acquisition is required for project itself. Nevertheless, to mitigate and / or minimize the social impact, acquisition of some lands have been considered and the associated costs will be charged to this project.

8.12.2 In this cost estimate, rehabilitation cost in respect of public properties is not included. The estimated rehabilitation cost for the project has been assessed to be approximately 16.68 Crs. as detailed hereunder:-

(a) Cost of demolition in Assam (PAP)	=	16,39,37,095/-
(b) Loss of monthly business in Assam	=	3,55,000/-
(c) Loss of monthly household income in Assam	=	24,78,200/-
Total	**=**	**16,67,70,295/-**

COST ESTIMATE

CHAPTER - 9

COST ESTIMATE (ASSAM PART)

9.1 General

This chapter provides for the proposed estimate of project cost for 4 laning and strengthening of Northern Dimapur Bypass (Assam part) connecting NH–36 & NH-39 in Assam & Nagaland (Consultancy package No. NHDP-III/DL-5/21-Gr.G). The length of the project road is 14.325 km.

9.2 Methodology

The following procedure has been adopted for the preliminary estimate of project corridor:

- Computation of unit rates of the principal work items based on market rates. The latest schedules of rates for Road, Bridge and Culvert works under PWD in the State has also been consulted. The unit rates for non-scheduled items have been worked out from market rates by taking coefficient for labours, material and machinery from MOST Data Book wherever the same is available.
- Computation of cost per km. length for each road component comprising various configurations for widening and new road 4-lane construction.
- Computation of cost of bridges per metre length and cost of culverts from their deck area in respect of Slab/Box culverts and culvert length across the road in respect of H.P. Culverts.
- Computation of per km. costs for each configuration by the application of unit rates.
- Estimation of cost of Land Acquisition, Resettlement and Rehabilitation, Utility Shifting and Environment Mitigation measures as per Preliminary Assessment of their cost.
- Estimation of allowances for quality control, contingencies, Supervision and administration costs as percentage of total costs.

9.3 Unit Rates

The unit rates are based on market rates and Schedule of Rates for Road. Bridge & Culvert works under PWD, Assam effective from 01.04.2013. The rates at sites for stone aggregates, sand from available quarries, which meet specifications and are in use for PWD works for State have been assessed based on lead distance. The rates for labour and carriage of materials have been adopted as per latest Assam PWD Schedule of Rates. The hire charges rates for the Plants and Machinery to be deployed have been worked out on the basis of their current cost and cost of P.O.L. with due consideration of usage rates of Plant & Machinery as per PWD Schedule of Assam.

9.4 Pavement Options:

Following pavement design options have been considered in the estimated cost :

- Flexible pavement for a design life of 15 years.
- Rigid Pavement (for the new 2-lane) for a design life of 30 years.

9.5 Bridges:

There are 9 nos proposed bridges (3 Major + 6 Minor) on the project road of 4-lane.

9.6 Culverts:

There will be 46 nos. of new box culverts. There are existing 14 nos H.P. Culverts, which are to be replaced.

9.7 Underpasses:

There are 2 nos Cattle Underpass and 1 no Elephant Underpass.

9.8 Drainage and Protective Works:

There will be roadside drains and required number of protective works as per site condition.

9.9 Junction:

There is 1 major junction in the project corridor. Lump sum provision for improvement of these junctions per km. length has been made.

9.10 Miscellaneous:

Provisions have been made in the estimated cost for the following miscellaneous items:

- Road appurtenances
- Land acquisition
- Resettlements and Rehabilitation
- Environmental Mitigation
- Shifting of utilities
- Horticulture

9.11 Maintenance during construction:

Provision for maintenance of proposed road during construction has been made.

9.12 Quality Control, Contingencies and Supervision Costs:

Provisions have been made for EPC percentages as detailed below:

COST OF AGENCY CHARGES		Amount (In Lac.)
1	A. Civil Cost	42941.21
2	B. Contingency 2.8% on (A)	1202.35
3	C. Sub Total = (A + B)	44143.57
4	D. Supervision charges 3% on (A)	1288.24
5	E. Agency charges 3% on (C)	1324.31
6	F. Quality Control 0.25% on (C)	110.36
7	G. Road Safety Cell Audit Charges 0.25% on (C)	110.36
8	H. Maintenance for 4 years 5% on (A)	2147.06
9	I. Escalation @5% per year for 3 years on (A)	6441.18
	(II) Total Agency Cost : (2+4+5+6+7+8+9)	**12623.86**
	Total Agency Cost (In Cr.)	126.24
	Agency Cost Per Km (In Cr.)	8.81

9.13 Project Cost :

The preliminary estimated project cost with Rigid Pavement has been worked out as under:

Sl. No.	Estimated Cost (Rs. in Cr.)			Cost per Km. (Rs. in Cr.)
1.	Civil Cost	= 429.41		29.98
2.	Government Cost	= 140.83	(including Cos t of Agency charges)	9.83
3.	**Total Project Cost (Sl. 1+2)**	**= 570.24**		**39.81**

Summary of estimated cost for the same has been presented in Appendix 9.1.

9.14 Maintenance Costs:

For economic analysis routine maintenance costs for shoulder repair, patch repairing, clearing of drains and the like is worked out based on norms of maintenance costs. These costs are not included in the project costs and has been accounted for in the economic analysis only.

ABSTRACT OF COST ESTIMATE

DESIGN ROAD LENGTH IN KM (118.050 Km to132.375 Km) 14.325 Km

STRUCTURES LENGTH IN KM 1.040 Km

NET ROAD LENGTH IN KM 13.285 Km

Bill No	Description	Amount (In Lac.)
1	Site Clearance and Dismantling	76.08
2	Earthwork	5128.38
3	Sub-Base and Base Courses	1562.61
4	Cement Concrete Pavements	11309.40
5	Cross Drainage Works (Culverts)	3886.18
6	Bridges/Underpass/Flyover/Rail Over Bridge	10393.66
7	Reinforced Earth Retaining Wall	7188.85
8	Drainage & Protection Works	2534.58
9	Junctions	52.44
10	Traffic Signs, Markings and Road Appurtenances/ Others & Traffic Amenities	621.59
11	Miscellaneous	187.44
	(I) Total Civil Cost : 1 to 11	**42941.21**
	Total Civil Cost (In Cr.)	429.41
	Civil Cost Per Km (In Cr.)	29.98
COST OF AGENCY CHARGES		**Amount (In Lac.)**
1	A. Civil Cost	42941.21
2	B. Contingency 2.8% on (A)	1202.35
3	C. Sub Total = (A + B)	44143.57
4	D. Supervision charges 3% on (A)	1288.24
5	E. Agency charges 3% on (C)	1324.31
6	F. Quality Control 0.25% on (C)	110.36
7	G. Road Safety Cell Audit Charges 0.25% on (C)	110.36
8	H. Maintenance for 4 years 5% on (A)	2147.06
9	I. Escalation @5% per year for 3 years on (A)	6441.18
	(II) Total Agency Cost : (2+4+5+6+7+8+9)	**12623.86**
	Total Agency Cost (In Cr.)	126.24
	Agency Cost Per Km (In Cr.)	8.81

COST TO THE GOVERNMENT		Amount (In Lac.)
1	Shifting of Utilities	93.06
2	Land Acquisition	173.88
3	Environment Mitigation	154.12
4	Resettlement & Rehabilitation	1038.27
	(III) Total Govt. Cost (1 to 4)	**1459.32**
	Total Govt. Cost (In Cr.)	14.59
	Govt. Cost Per Km (In Cr.)	1.02
	TOTAL PROJECT COST (I+II+III) (In Lacs)	57024.40
	TOTAL PROJECT COST (In Crores)	**570.24**
	PER "KM" COST (In Crores)	**39.81**

FINANCIAL ANALYSIS

CHAPTER 10

FINANCIAL ANALYSIS

10.1 BACKGROUND

The Dimapur Bypass Section is a segment of NH – 36 & NH-39 in the State of Assam and Nagaland. The total length of the Project Highway is 153 km including Dimapur Bypass. For the purpose of Financial Analysis the entire length of 35 km has been considered as one package.

Package	Description	Length (Km)
Package	From Km 118.050 (Design Ch.) to Km 153.058 (Design Ch) on NH – 36 & NH-39	35.008

10.2 APPROACH TO FINANCIAL EVALUATION

The viability of each package depends on the working cash flows available to service the debt and equity. This working cash flow is basically dependent upon the following:-

a. Project Cost
b. Traffic Forecast

10.3 COST OF CIVIL WORKS

The total cost of the project includes cost of civil works including the improvement of existing carriageway. The estimated project cost is considered excluding shifting of utilities, land acquisition, acquisition of structures, rehabilitation and resettlement and environmental mitigation measures which are to be borne by NHAI. Cost of Civil Works at 2013-14 prices is given as under:

For 4 Lane

Description	Cost of Civil Works Rs in crore	Rate per Km In Cr.
From Km 118.050 (Design Ch) to Km 132.37 (Design Ch) on NH – 36 & NH-39 (Dimapur Bypass).	429.41	29.98

10.4 COST ESCALATION

The base costs have been escalated at a rate of 5% per annum to obtain the actual costs in the year of expenditure. This is based on average WPI for the last 5 years.

10.5 INTEREST DURING CONSTRUCTION (IDC)

As it on EPC basis, this is not attracted.

10.6 TOTAL PROJECT COST

The total landed costs for each individual package at the end of the construction period has been estimated by adding Contingencies. The total landed cost at the time of commissioning is thus estimated as under:

For 4 Lane

S. No.	Cost	Cost Rs. in crore
A	**CIVIL COST & CENTAGE COST**	
1	Total Civil Construction cost	429.41
2	Total Agency Cost	126.24
3	**TOTAL**	**555.65**
B	**GOVERNMENT COST**	
1	Land acquisition	1.74
2	Shifting of utilities	0.93
3	Rehabilitation & Resettlement costs	10.38
4	Environmental mitigation measures	1.54
5	**Total GOVERNMENT cost**	**14.59**
6	**Total Project Cost (A+B)**	**570.24**
7	Project Cost per Km	**39.81**

10.7 TRAFFIC

Traffic surveys for seven days volume counts have been carried out at four locations and average has been taken. For Financial Analysis, Average Traffic at all the 4 Locations has been considered. Details are given as under:

S. No.	Description	Traffic at km 38.7	Traffic at km 93	Traffic at km 130	Traffic at km 160	Average
1	Car/Jeep/3 Wheelers	702	548	780	172	551
2	Mini Bus	28	23	31	7	22
3	Bus	141	114	155	36	112
4	LCV	55	77	79	36	62
5	Truck-2 Axle	176	244	253	114	197
6	Multi Axle/HME	0	0	0	0	0
	Total	**1122**	**1034**	**1327**	**378**	**965**
	Total PCU	**1838**	**1856**	**2256**	**726**	**1669**

On the instruction of NHAI additional Traffic Count was done in 2015. The count stations were at Patkoi and Gautam Basti to assess traffic on Dimapur Bypass.
5% Growth rate has been considered for future projections of the traffic.

Insurance Expenses Insurance expenses are estimated as 0.15% of the Project Cost.
Other Overhead Expenses
To meet out the other overhead expenses, provisions of Rs. 100 lacs per annum have been considered.

Concession Fee
Concession Fee is payable Re. 1

10.8 OPERATION AND MAINTENANCE COST

Routine maintenance costs comprise of maintenance of the pavement, collection of litter, traffic management (policing), accident repairs and all ancillary works including beautification.

The periodic maintenance costs include cost of overlay, repair/renovation of road furniture, drains, buildings etc. The periodic maintenance includes periodic renewals at every 5 years.

Routine maintenance/ Periodic maintenance costs have been considered as per the MORT&H guidelines 1997 prices. The details of the maintenance costs and administration charges are given as under:

S. No	Description	Amount (Rs. in Lacs)
1	Routine maintenance in every year cost per km for the four lanes with paved shoulder (Rs Lacs / Km)	3 lac/Km/yr.
2	Periodic maintenance every five years cost per km for the four lanes with paved shoulder (Rs Lacs / Km)	25 lac/Km/5 yrs.
3	Patrolling Expenses (Rs Lacs / Km)	1 lac/Km/yr.
4	Electricity Expenses (Rs Lacs / Km)	

OBSERVATIONS OF NHIDCL ON DPR AND REPLIES

CHAPTER – 11

Four-laning of Dimapur bypass from design chainage Km. 118.050 to Km 132.375 in the state of Assam – Clarifications of points raised by GM(P)/Dimapur/NHIDCL against Final DPR Submitted.

Sl. No.	Observation	Reply
2 a)	Provision for debonding layer of polythene sheet over DLC is not given.	Debonding layer has been shown in the section of Concrete pavement. It also appears in BOQ. Please refer drg. # ACPL/NHIDCL/NH-36/AS/Misc/14B (Sheet 2 of 2) for the same.
2 b)	Confirm that proposed design for pavement is with tied concrete shoulders.	Rigid pavement & Rigid shoulder are to be cast together. This will marginally reduce load stresses at edges.
2 c)	It is found that there is an already existing road overlapping with the proposed bypass. It is requested to provide the details.	The existing road is mostly Kancha and not taken into consideration as the same does not figure in new pavement construction. Hence it is not mentioned. This road is from Ch. 118.000 to Ch. 129.350.
2 d)	Consultant is proposing ruling gradient as 3.3% and limiting gradient as 5%, while as per 4-lane manual (IRC: SP: 84-2014), for plain and rolling terrain ruling gradient is 2.5% and limiting gradient is 3.3%. Please re-concile it.	Cl 2.9.1 (P-13) of SP 84-2014 states that IRC73-1980 shall also be followed. Only in one occasion limiting gradient is not within 5% because of proximity of structures. Please refer Cl. 10.2.2 to Cl 10.2.5 of IRC 73-1980. In two cases it is more than ruling but less than 5%. This is vetted in FDPR presentation on 18/11/16.
2 e)	It is reported by Forest Department that as per history, there is movement of elephant at few locations in the proposed bypass. It is requested to incorporate it, cattle underpass and vertical clearance as per 2.10.2 of IRC:SP:84-2014, whereas vertical clearance is 4.5m for elephant corridor.	One Elephant corridor at Ch.130.380 provided. The place is also confirmed by GM(P)/Dimapur/NHIDCL.
2 f)	As per Clause 6.5 (Drainage layer) of IRC: 58-2015, it is essential to design the drainage layer appropriately in areas having annual rainfall in excess of 1000mm. As the stretch lies in high rainfall area, Consultant should design drainage layer. Please refer example of design of a drainage layer as given in Appendix-VI, Para VI-VIII of IRC: 58-2015.	As the work is on EPC basis, the Contractor will design the drainage layer. Hence it was not designed but qty. is provided in BOQ.
2 g i)	As per para 5.4.3 of Chapter 5, Vol-I, Consultant is proposing median width of 1.5m in forest areas, no such provision found in any of code. Please provide authority.	Median width has been maintained 4.50 m throughout in the corridor.
2 g ii)	As per para 2.14 (Median openings) of manual, all location of median openings shall be mentioned in Schedule 'B' of Contract Agreement. Please provide same.	Locations of Median openings are as under : 118.975 125.654 120.975 127.793 123.125 131.040 This has been shown in drawing and included in Schedule B.
2 g iii)	All median openings shall be provided with additional 3.5m wide shelter lane for waiting of vehicles to take U-turn. Provide same.	In the miscellaneous drawing this has been shown. Please refer drg # ACPL/NHIDCL/NH-36/AS/Misc/02
2 h)	It seems that Consultant has followed IRC: 73-1980 for geometric design, while all the designs should have been as per	Please refer to 2 d) above for clarification.

Sl. No.	Observation	Reply
	4-lane manual (IRC: SP:84-2014).	
2 i)	Consultant has followed old version of codes and not updated one. Consultant is requested to refer latest version of codes and update DPR accordingly.	Specific points of difference may please be stated for clarification. Recent publications have been followed. There may not be any conflict with recent publications.
2 j)	As per KAAC letter no. KAAC/PWD (R&B)/NE-36 & 39/2012-13/07 dated 08/11/2013 and NHAI letter no. NHAI/NGN/Archtech/10100 dated 11/11/2013 client is supposed to construct a single lane road of 7 Km length. Kindly provide specification and details of the same.	As decided in meeting on 18/11/2016 in NHIDCL Office, this is omitted. Hence not needed.
2 k)	A lot of typographical error has been noticed. Please go through report once again and do require correction.	This is being looked into. If the idea is understandable, they may not pose any difficulty.
2 l)	As per Ministry of Environment & Forest notification dated 22/08/2013 (copy attached) Para 2 (b) (ii) Expansion of National Highways greater than 100 km involving additional right of way or land acquisition greater than 40m on existing alignments and 60m on re-alignments or by-passes are exempted from purview of environment clearances, it seems that the proposed Dimapur bypass is exempted from obtaining clearance from Ministry of Environment & Forest. It is requested to clarify the same.	As decided in meeting on 18/11/2016, MOEF Clearance may not be necessary, as the project is considered to be 35.00 km long.
2 m)	It is requested to include the cost of single-lane road in the total project cost and rectify the maintenance charge to 5% for 42 months.	This is deleted in Cost Estimate now. Please refer item 2 j) above.
2 n)	In Schedule H, the contract price is mentioned as 421.50 Crores. It is requested to add further Rs.10 Crores towards construction cost of 7 km single lane road and accordingly modify weightages.	This is complied in Schedule H now. Please refer item 2 j) above.
2 o)	Most of curves have been designed for speed less than 100 kmph, which is ruling speed for 4-lane. Even as per 4-lane manual, minimum speed is 80 kmph. Please explain why curves have been designed for speed less than ruling/minimum speed.	In order to reduce L.A. problem, the existing Kancha Road was followed as far as possible for which the speed limit was reduced. This had the approval of NHAI. The design speed varies between 60 Km/hr and 100 Km/hr. This is vetted in meeting on 18/11/2016 in NHIDCL Hd.Qrs, New Delhi.
2 p)	TCS in cut area requires drain. Please provide same and give X-Section of drain.	Drain has already been provided in cut-area (drg # ACPL/NHIDCL/NH-36/AS/TCS/02 of TCS-1C). Cross section of drain is being shown now in drawing.
2 q)	Space for services has not been mentioned in TCS.	Space for services (2.00 m wide) is being mentioned in TCS drawings towards the end of ROW.
2 r)	For proposed Br.No. 132/2, 132/3 and 133/1, well foundation has been suggested. As sinking of well involves lot of uncertainty, pile foundation may be better choice. Kindly give comparative merits/demerits of well foundation v/s pile foundation. Reconsider proposal of well foundation.	As recommended in soil investigation report, the lateral load carrying capacity of 1200 mm. dia piles in these regions are very small (varying from 8.09 t. to 16.36 t.), whereas considering seismic Zone V, design horizontal forces at bottom of abutment pile cap (R.L. 130.0 m) were found to be very high requiring a large nos. of piles. Moreover in some bridges the pile cut off level is a few metre above the design scour level, which will reduce the lateral capacity. Hence well foundation is suggested for these bridges. The

<table>
<tr><th>Sl. No.</th><th>Observation</th><th>Reply</th></tr>
<tr><td></td><td></td><td>table below will show required nos. of piles in these bridges:-
<table>
<tr><th rowspan="2">Sl. No.</th><th rowspan="2">Bridge No.</th><th rowspan="2">Lateral load capacity of 1200 dia pile (t.) as per soil investigation report</th><th rowspan="2">Bottom of pile cap level (m)</th><th rowspan="2">Design Scour level (Non-Seismic) (m)</th><th colspan="2">Total horizontal force at bottom of pile Cap (t.)</th><th rowspan="2">Nos of 1200 mm dia piles required for non-seismic condition</th></tr>
<tr><th>Non-Seismic</th><th>Seismic</th></tr>
<tr><td>1.</td><td>132/2</td><td>16.36</td><td>130.00</td><td>128.480</td><td>457.95</td><td>1054.85</td><td>28</td></tr>
<tr><td>2.</td><td>132/3</td><td>8.09</td><td>130.00</td><td>130.09</td><td>407.08</td><td>963.14</td><td>50</td></tr>
<tr><td>3.</td><td>133/1</td><td>9.81</td><td>130.00</td><td>124.282</td><td>489.89</td><td>1080.00</td><td>42</td></tr>
</table></td></tr>
<tr><td>2 s)</td><td>Please provide detail calculation of design discharge and scour depth for minor/major bridges. Also provide method to arrive at HFL.</td><td>Design calculation for discharge and scour are enclosed herewith. The H.F.L. was arrived at after detailed site investigation & local enquiry & informations.</td></tr>
<tr><td>2 t)</td><td>All GADs shall be signed by Team Leader and bridge engineer.</td><td>This is being signed while submitting balance DPRs (Revised).</td></tr>
<tr><td>2 u)</td><td>ROB has been approved by Railway. However Rail connection between Dimapur to Dibrugarh is being converted into double track. Please confirm approved ROB is suitable for double track also. Confirm whether vertical clearance is enough for electrification of rail route in future.</td><td>The G.A.D. for ROB has been approved and issued by Railways. It is obvious that they have scrutinised all the points raised in Para (u).</td></tr>
<tr><td>2 v)</td><td>As per 4-lane manual. Roadway is 12.50m and not 12.25 as suggested by you, for cross section of bridge at deck level. Please refer clause 7.3 and 7.4 of manual.</td><td>It is in our knowledge the roadway width for new bridges at deck level with footpath for 4 lane divided Highway will be 12.50 m. each as per Fig. 7.2A of IRC:SP:84-2014. We made the roadway width at deck level as 12.25 m. each due to the reasons stated below:
i) The roadway width at approaches are 2x(7.0+1.50+2.0)+5.0 = 26.0 m. Providing 2 nos bridges of 12.50 m with a clear gap of 3.0 m in between the overall width at bridge portion will be 28.00 m which is 2.0 m. more than the approach embankment. Hence we reduced the overall width at bridge portion as much as practicable as per codal provisions to reduce the cost of approaches.
ii) Width of railing may be made 300 mm. as shown in Fig. 7.5 of IRC:SP:84-2014.
iii) The crash barrier width at base is 450 mm. as per IRC:5-2014. Hence the width of crash barrier & shyness towards footpath becomes (450+500) = 950 mm. against 1000 mm as shown in SP-84-2014.
iv) Hence we reduced the roadway by (200+50) = 250 m. which seems to be well justified matching the roadway.</td></tr>
<tr><td>2 w)</td><td>Minimum CBR for sub grade is 8% and not 7% as mentioned at some places.</td><td>Rigid Pavement has been designed now as per IRC 58-2015 with 8% CBR.</td></tr>
<tr><td>2 x)</td><td>Whole area is in seismic Zone V. Please design bridges as per IRC: 6-2014, clause 219.</td><td>This has been done and confirmed.</td></tr>
<tr><td>2 y)</td><td>Cost estimate has been done as per SoR 2013-14. Please confirm SoR 2013-14 is latest and no further SoR has been published. If so, confirm if escalation has been taken into account while calculating rates.</td><td>It is confirmed that SOR 2103-14 of Assam P.W.D. is the latest published schedule of Rates and considered in Estimate.</td></tr>
</table>

Bridge No 132/2 Dhansiri1 Easting : 185680.8 Northing: 82517.42

Chainage : **131.559Km.**

Calculation for Discharge : -

1. **Dicken's formula** :

Catchment Area = 950 km² RFER TOPO SHEET Nı 83G/9

C = 11.00 (for Guwahati region)

Therefore Discharge (Q) = C x $M^{3/4}$ 11x(950)¾ = **1882.29** m³/s

2. **Rational Formula for Peak Runoff from Catchment**

Catchment Area (A) = 950 km² =	95000	Hectares	95000	0.6
L = Distance from critical point to the Bridge =	75.00	km	95000	0.6
H =The fall in level from critical point to the Bridge site in =	560.00	m		
Nearest rain gauge station is Tezpur Io = Heaviest one hour rainfall =	6.30	cm		
Time of concentration = tc = $(0.87 * L^3/H)^{0.385}$ =	12.144	hr		
Ic = (2*Io)/ 1+ tc =	0.959	cm		
Intensity factor(f) for catchment area of 95000 Hectares =	0.63			
Catchment characteristics is Loam, lightly cultivated and covered. p =	0.5			
Therefore Discharge(Q) = 0.028*A*p*f*Ic =	**796.85**	m³/s		

3. **Conveyence Factor & Slope method**

A) C/S No: 1 Offset : 10m(U/S) HFL (m): 136.536

Sl No.	Offset Distance (m)	Bed level (m)	Segment No	Segment width (m)	Height at start (m)	Height at end (m)	Difference in height (m)	Area of segment (m²)	Wetted perimeter (m)
1	29.000	136.536	-	-	-	-	-	-	-
2	35.000	136.229	1	6.000	0.000	0.307	0.307	0.921	6.008
3	40.000	135.816	2	5.000	0.307	0.720	0.413	2.567	5.017
4	45.000	135.374	3	5.000	0.720	1.162	0.442	4.705	5.019
5	50.000	134.542	4	5.000	1.162	1.994	0.832	7.890	5.069
6	55.000	133.939	5	5.000	1.994	2.597	0.603	11.478	5.036
7	60.000	133.351	6	5.000	2.597	3.185	0.588	14.455	5.034
8	65.000	133.191	7	5.000	3.185	3.345	0.154	16.325	5.002
9	70.000	133.058	8	5.000	3.345	3.690	0.076	17.588	5.001
10	75.000	132.937	9	5.000	3.690	3.599	0.039	18.223	5.000
11	76.861	132.896	10	1.861	3.599	3.640	0.419	6.736	1.908
12	80.000	133.401	11	3.139	3.640	3.135	0.505	10.633	3.179
13	85.000	134.241	12	5.000	3.135	2.295	0.042	13.575	5.000
14	90.000	135.257	13	5.000	2.295	1.279	2.258	8.935	5.486
15	92.887	136.536	14	2.887	1.279	0.000	2.258	1.846	3.665
							Total	**134.030**	**61.760**

Hydraulic mean depth, R = Area/ Perimeter = 2.170

Surface condition : Clean, straight bank, full stage, no rifts or deep pools in fair condition Rugosity Fa 0.0400

Conveyence factor (C1) = (Area x R⅔)/ n = 5631.1057

B) C/S No: 2 Offset : At Alignment HFL (m): 136.536

Sl No.	Offset Distance (m)	Bed level (m)	Segment No	Segment width (m)	Height at start (m)	Height at end (m)	Diff in height (m)	Area of segment (m²)	Wetted perimeter (m)
1	25.000	136.536	-	-	-	-	-	-	-
2	30.000	135.824	1	5.000	0.000	0.712	0.712	1.780	5.050
3	35.000	134.540	2	5.000	0.712	1.996	1.284	6.770	5.162
4	40.000	133.256	3	5.000	1.996	3.280	1.284	13.190	5.162
5	45.000	132.623	4	5.000	3.280	3.913	0.633	17.983	5.040
6	50.000	132.558	5	5.000	3.913	3.978	0.065	19.728	5.000
7	52.488	132.526	6	2.488	3.978	4.010	0.032	9.937	2.488
8	55.000	132.970	7	2.512	4.010	3.566	0.444	9.515	2.551
9	60.000	133.437	8	5.000	3.566	3.099	0.467	16.663	5.022
10	65.000	134.005	9	5.000	3.099	2.531	0.568	14.075	5.032
11	70.000	134.088	10	5.000	2.531	2.448	0.083	12.448	5.001
12	75.000	134.157	11	5.000	2.448	2.379	0.069	12.068	5.000
13	80.000	136.536	12	5.000	2.379	0.000	2.379	5.947	5.537
14	80.000	136.536	13	0.000	0.000	0.000	0.000	0.000	0.000
15	80.000	136.536	14	0.000	0.000	0.000	0.000	0.000	0.000
					Total			140.103	56.047

Hydraulic mean depth, R = Area/ Perimeter = 2.500

Surface condition : Clean, straight bank, full stage, no rifts or deep pools in fair condition Rugosity Fa 0.0400

Conveyence factor (C2) = (Area x R⅔)/ n = 6471.081

C) C/S No: 3 Offset : 100 m D/S HFL (m): 136.036

Sl. No	Offset Dist(m)	Bed Level (m)	Segment No	Segment Width(m)	Height at start(m)	Height at end(m)	Diff. in height(m)	Area of (m^2)	Wetted Perimeter(m)
1	20.000	136.036	-	-	-	-	-	-	-
2	25.000	133.977	1	5.000	0.000	2.059	2.059	5.147	5.407
3	30.000	131.670	2	5.000	2.059	4.366	2.307	16.063	5.507
4	31.956	131.476	3	1.956	4.366	4.560	0.194	8.730	1.966
5	35.000	131.703	4	3.044	4.560	4.333	0.227	13.535	3.052
6	40.000	132.065	5	5.000	4.333	3.971	0.362	20.760	5.013
7	45.000	132.427	6	5.000	3.971	3.609	0.362	18.950	5.013
8	50.000	132.791	7	5.000	3.609	3.245	0.364	17.135	5.013
9	55.000	133.231	8	5.000	3.245	2.805	0.440	15.125	5.019
10	60.000	133.630	9	5.000	2.805	2.406	0.399	13.028	5.016
11	65.000	134.249	10	5.000	2.406	1.787	0.619	10.483	5.038
12	70.000	135.301	11	5.000	1.787	0.735	1.052	6.305	5.109
13	72.000	136.036	12	2.000	0.735	0.000	0.735	0.735	2.131
14	72.000	136.036	13	0.000	0.000	0.000	0.000	0.000	0.000
Total								**145.995**	**53.285**

Hydraulic mean depth, R = Area/ Perimeter = 2.740

Surface condition : Clean, straight bank, full stage, no rifts or deep pools in fair condition Rugosity Fi 0.0400

Conveyence factor (C3) = (Area x $R^{2/3}$)/ n = 7146.589

Mean Conveyence Factor (C_f) = (C1xC2xC3)$^{1/3}$ = 6385.915

Longitudinal Bed Slope, S = 0.0014

Discharge through the channel, Q = C_f x $(S)^{0.5}$ = **241.95** m^3/s

Highest discharge from the three method is = 1882.29 m^3/s

Second highest discharge is = 796.85 m^3/s

Maximum discharge is greater than 1.5 times second highest discharge

Hence Design Discharge is = **1196.00 m^3/s**

Proposed bridge :

Span scheme and type of foundation :

Design discharge = Q = 1196.00 m^3/s

Lacey's waterway = L = 4.8 √Q = 166.00 m.

Provide a 4 span bridge 24.00 m c/c bearings as shown in the G.A.D.

Clear waterway becomes = 94.24 m.

(Centre to centre distance between bearings on piers = 0.6 m.

Thickness of pier shafts was taken as 1.0 m.

Bearing centre at abutment to front face of abutment shaft is 0.280 m.)

Hence clear waterway provided is 57% of Lacey's waterway , o.k.

Calculation for scour depth and depth of foundation.

For calculation of scour design discharge = 1.3x1196 = 1554.80 m^3/s

Clear waterway provided = 94.24 m.

Hence d_b = 1554.8 / 94.24 16.50 m^3/s per metre

Silt factor :

As per soil investigation report , soil below lowest bed is greyish clay,some / trace silt having cohesion 0.15 kg/m^2.

Silt factor as per soil investigation report is 2.57.

Hence considered silt factor as 2.57

Depth of scour = d_{sm} = 1.34 x $(d_b^2/k_{sf})^{1/3}$ 6.34 m. below H.F.L.

Hence depth of normal scour is at R.L. = 130.20 m.

Lowest bed level is at R.L. 132.53 m.

Hence depth of normal scour below H.F.L. is taken as = 6.34 m.

Maxm. Depth of scour at abutment location = 6.34x 1.27 = 8.05 m. below H.F.L.

R.L.of maxm. scour at abutment location = 128.48 m.

Maxm. Depth of scour at pier location = 6.34 x 2.0 = 12.68 m. below H.F.L.

R.L.of maxm. scour at pier location = 123.86 m.

For open foundation , depth of foundation to be taken at least 2.0m. Below maximum scour level .

Hence, founding level for abutment will be not above R.L. 128.48-2.0 = 126.48 m.

And founding level for pier will be not above R.L. 123.86-2.0 = 121.86 m.

Hence depth of abutment foundation becomes 132.526 - 126.48= 6.042 m.below lowest bed ,

And depth of pier foundation becomes 132.526 - 121.86= 10.670 m.below lowest bed ,

which is not practicable Hence deep foundation (Well foundation) is suggested for both piers and abutments .

Provide top of well cap for abutment at about 4.0m below G.L. , ie.,at	133.00	m. R.L.
And top of well cap for pier foundation at lowest bed level , ie. , at	132.53	m. R.L.

Calculation for formation level :-

Highest Flood Level	:	136.536	m.
Vertical clearance	:	1.200	m.
Depth of superstructure (RCC. T-beam slab superstructure)		2.370	m.
Thickness of wearing course	:	0.065	m.
Increase due to inclination	:	0.204	
Required formation level	:	**140.375**	**m.**
Provide formation level at centre of deck as		**140.38**	**m.**

Bridge No 132/3 Dhansiri- 2 Easting : 185680.83 Northing: 82517.42

Chainage : 131.927 Km.

Calculation for Discharge : -

1. **Dicken's formula** :

Catchment Area = 954 km² RFER TOPO SHEET N 83G/9

C = 11.00 (for Guwahati region)

Therefore Discharge (Q) = C x $M^{3/4}$ 11x(954) ¾ = **1888.23** m³/s

2. **Rational Formula for Peak Runoff from Catchment**

Catchment Area (A) = 954 km² =	95400 Hectares	95000	0.6
L = Distance from critical point to the Bridge =	75.50 km	96000	0.6
H =The fall in level from critical point to the Bridge site in =	562.00 m		
Nearest rain gauge station is Tezpur Io = Heaviest one hour rainfall =	6.30 cm		
Time of concentration = tc = $(0.87 * L^3/H)^{0.385}$ =	12.221 hr		
Ic = (2*Io)/ 1+ tc =	0.953 cm		
Intensity factor(f) for catchment area of 95400 Hectares =	0.62		
Catchment characteristics is Loam lightly cultivated or covered p =	0.4		
Therefore Discharge(Q) = 0.028*A*p*f*Ic =	**631.36** m³/s		

3. **Conveyence Factor & Slope method**

A) C/S No: 1 Offset : 100mU/S HFL (m): 136.964

Sl No.	Offset Distance (m)	Bed level (m)	Segment No	Segment width (m)	Height at start (m)	Height at end (m)	Difference in height (m)	Area of segment (m²)	Wetted perimeter (m)
1	24.000	136.964	-	-	-	-	-	-	-
2	30.000	136.578	1	6.00	0.000	0.386	0.386	1.158	6.012
3	40.000	136.628	2	10.00	0.386	0.336	0.050	3.610	10.000
4	50.000	136.425	3	10.00	0.336	0.539	0.203	4.375	10.002
5	60.000	136.032	4	10.00	0.539	0.932	0.393	7.355	10.008
6	70.000	135.613	5	10.00	0.932	1.351	0.419	11.415	10.009
7	80.000	135.082	6	10.00	1.351	1.882	0.531	16.165	10.014
8	87.384	134.588	7	7.38	1.882	2.376	0.494	15.721	7.401
9	95.000	135.492	8	7.62	2.376	1.472	0.904	14.653	7.669
10	105.000	136.679	9	10.00	1.472	0.285	1.187	8.785	10.070
11	107.400	136.964	10	2.40	0.285	0.000	0.285	0.342	2.417
							Total	**83.579**	**83.602**

Hydraulic mean depth, R = Area/ Perimeter = 1.000

Surface condition : Clean, straight bank, full stage, no rifts or deep pools in fair condition Rugosity Fa 0.0300

Conveyence factor (C1) = (Area x R⅔)/ n = 2785.433

B) C/S No: 2 Offset : At Alignment HFL (m): 136.898

Sl No.	Offset Distance (m)	Bed level (m)	Segment No	Segment width (m)	Height at start (m)	Height at end (m)	Diff in height (m)	Area of segment (m²)	Wetted perimeter (m)
1	13.903	136.898	-	-	-	-	-	-	-
2	25.000	135.856	1	11.097	0.000	1.042	1.042	5.782	11.146
3	35.000	135.629	2	10.000	1.042	1.269	0.227	11.555	10.003
4	45.000	135.417	3	10.000	1.269	1.481	0.212	13.750	10.002
5	55.000	135.211	4	10.000	1.481	1.687	0.206	15.840	10.002
6	65.000	135.002	5	10.000	1.687	1.896	0.209	17.915	10.002
7	75.000	134.791	6	10.000	1.896	2.107	0.211	20.015	10.002
8	85.000	134.697	7	10.000	2.107	2.201	0.094	21.540	10.000
9	94.288	134.632	8	9.288	2.201	2.266	0.065	20.745	9.288
10	100.000	136.068	9	5.712	2.266	0.830	1.436	8.842	5.890
11	103.726	136.898	10	3.726	0.830	0.000	0.830	1.546	3.817
							Total	137.530	90.153

Hydraulic mean depth, R = Area/ Perimeter = 1.526

Surface condition : Clean, straight bank, full stage, no rifts or deep pools in fair condition Rugosity Fa 0.0300

Conveyence factor (C2) = (Area x R⅔)/ n = 6083.657

C) C/S No: 3 Offset : 100m.D/S HFL (m): 136.448

Sl No.	Offset Distance (m)	Bed level (m)	Segment No	Segment width (m)	Height at start (m)	Height at end (m)	Diff in height (m)	Area of segment (m²)	Wetted perimeter (m)
1	8.777	136.448	-	-	-	-	-	-	-
2	15.000	135.817	1	6.223	0.000	0.631	0.631	1.963	6.255
3	25.000	135.400	2	10.000	0.631	1.048	0.417	8.395	10.009

4	35.000	135.002	3	10.000	1.048	1.446	0.398	12.470	10.008
5	45.000	134.786	4	10.000	1.446	1.662	0.216	15.540	10.002
6	55.000	134.593	5	10.000	1.662	1.855	0.193	17.585	10.002
7	65.000	134.389	6	10.000	1.855	2.059	0.204	19.570	10.002
8	75.000	134.179	7	10.000	2.059	2.269	0.210	21.640	10.002
9	84.635	133.887	8	9.635	2.269	2.561	0.292	23.269	9.639
10	90.000	134.796	9	5.365	2.561	1.652	0.909	11.301	5.441
11	100.000	136.448	10	10.000	1.652	0.000	1.652	8.260	10.136
							Total	55.953	46.276

Hydraulic mean depth, R = Area/ Perimeter = 1.209

Surface condition : Clean, straight bank, full stage, no rifts or deep pools in fair condition Rugosity Fa 0.0300

Conveyence factor (C3) = (Area x $R^{2/3}$)/ n = 2116.835

Mean Conveyence Factor (C_f) = (C1xC2xC3)$^{1/3}$ = 3297.981

Longitudinal Bed Slope, S = 0.0049

Discharge through the channel, Q = C_f x $(S)^{0.5}$ = **229.86 m³/s**

Highest discharge from the three method is = 1888.23 m³/s

Second highest discharge is = 631.36 m³/s

Maximum discharge is greater than 1.5 times second highest discharge

Hence Design Discharge is = **948.00 m³/s**

Proposed bridge :

Span scheme and type of foundation :

Design discharge = Q = 948.00 m³/s

Lacey's waterway = L = 4.8 √Q = 147.79 m.

Provide a 4 span bridge 24.00 m c/c bearings as shown in the G.A.D.

Clear waterway becomes = 94.24 m.

(Centre to centre distance between bearings on piers = 0.6 m.

Thickness of pier shafts was taken as 1.0 m.

Bearing centre at abutment to front face of abutment shaft is 0.280 m.)

Hence clear waterway provided is 64% of Lacey's waterway , o.k.

Calculation for scour depth and depth of foundation.

For calculation of scour design discharge = 1.3x948 = 1232.40 m³/s

Clear waterway provided = 94.24 m.

Hence d_b = 1232.4 / 94.24 13.08 m³/s per metre

Silt factor :

As per soil investigation report , soil below lowest bed is greyish clay,some / trace silt having cohesion 0.15 kg/m^2.

Silt factor as per soil investigation report is 2.67

Hence considered silt factor as 2.67

Depth of scour = d_{sm} = 1.34 x $(d_b^2/k_{sf})^{1/3}$ 5.36 m. below H.F.L.

Hence depth of normal scour is at R.L. = 131.54 m.

Lowest bed level is at R.L. 134.63 m.

Hence depth of normal scour below H.F.L. is taken as = 5.36 m.

Maxm. Depth of scour at abutment location = 5.36x 1.27 = 6.81 m. below H.F.L.

R.L.of maxm. scour at abutment location = 130.09 m.

Maxm. Depth of scour at pier location = 5.36 x 2.0 = 10.72 m. below H.F.L.

R.L.of maxm. scour at pier location = 126.18 m.

For open foundation , depth of foundation to be taken at least 2.0m. Below maximum scour level .

Hence, founding level for abutment will be not above R.L. 130.09-2.0 = 128.09 m.

And founding level for pier will be not above R.L. 126.18-2.0 124.18 m.

Hence depth of abutment foundation becomes 134.632 - 128.09= 6.543 m.below lowest bed ,

And depth of pier foundation becomes 134.632 - 124.18= 10.457 m.below lowest bed ,

which is not practicable Hence deep foundation (Pile foundation) is suggested for both piers and abutments .

Provide bottom of pile cap for abutment foundation at maxm. scour level 130.09 m. R.L.

And top of pile cap for pier foundation at lowest bed level , ie. , at 134.63 m. R.L.

Using 1200mm dia. piles , depth of pile cap = 1200 x 1.5 = 1800 mm.

Hence bottom of pile cap for piers will be = 134.632-1.8= 132.832 m. R.L.

Free standing height of pier piles are 132.83 - 126.18 = 6.66 m.

Hence top of pile cap for abutments will be = 130.09+1.8= 131.89 m.R.L.

Calculation for formation level :-

Highest Flood Level	:	136.898 m.
Vertical clearance	:	1.200 m.
Depth of superstructure (RCC. T-beam slab superstructure)		2.370 m.
Thickness of wearing course	:	0.075 m.
Increase due to inclination	:	0.194
Required formation level	:	**140.737 m.**
Provide formation level at centre of deck as		**140.74 m.**

Bridge No 133/1 Dhansiri3 Easting : 185680.8 Northing: 82517.42

Chainage : **132.344 Km.**

Calculation for Discharge : -

1. Dicken's formula :

Catchment Area = 960 km² RFER TOPO SHEET ? 83G/9

C = 11.00 (for Guwahati region)

Therefore Discharge (Q) = C x $M^{3/4}$ 11x(960)¾ = **1897.13** m³/s

2. **Rational Formula for Peak Runoff from Catchment**

Catchment Area (A) = 960 km² =	96000	Hectares	96000	0.6
L = Distance from critical point to the Bridge =	76.00	km	96000	0.6
H =The fall in level from critical point to the Bridge site in =	566.00	m		
Nearest rain gauge station is Tezpur Io = Heaviest one hour rainfall =	6.30	cm		
Time of concentration = tc = $(0.87 * L^3/H)^{0.385}$ =	12.281	hr		
Ic = (2*Io)/ 1+ tc =	0.949	cm		
Intensity factor(f) for catchment area of 96000 Hectares =	0.62			
Catchment characteristics is Loam lightly cultivated or covered p =	0.5			
Therefore Discharge(Q) = 0.028*A*p*f*Ic =	**790.58**	m³/s		

3. **Conveyence Factor & Slope method**

A) C/S No: 1 Offset : 100mU/S HFL (m): 136.898

Sl No.	Offset Distance (m)	Bed level (m)	Segment No	Segment width (m)	Height at start (m)	Height at end (m)	Difference in height (m)	Area of segment (m²)	Wetted perimeter (m)
1	-45.891	136.898	-	-	-	-	-	-	-
2	-43.176	135.457	1	2.715	0.000	1.441	1.441	1.956	3.074
3	-36.946	132.151	2	6.230	1.441	4.747	3.306	19.276	7.053
4	-31.616	130.874	3	5.330	4.747	6.024	1.277	28.705	5.481
5	-24.937	129.275	4	6.679	6.024	7.623	1.599	45.574	6.868
6	-16.767	128.087	5	8.170	7.623	8.811	1.188	67.133	8.256
7	-9.647	127.052	6	7.120	8.811	9.846	1.035	66.419	7.195
8	0.000	126.941	7	9.647	9.846	9.957	0.111	95.520	9.648
9	4.407	126.889	8	4.407	9.957	10.009	0.052	43.995	4.407
10	12.284	127.594	9	7.877	10.009	9.304	0.705	76.064	7.908
11	15.662	127.875	10	3.378	9.304	9.023	0.281	30.954	3.390
12	22.080	128.408	11	6.418	9.023	8.490	0.533	56.199	6.440
13	29.435	129.130	12	7.355	8.490	7.768	0.722	59.789	7.390
14	36.306	129.486	13	6.871	7.768	7.412	0.356	52.151	6.880
15	41.004	129.504	14	4.698	7.412	7.394	0.018	34.779	4.698
16	44.512	130.795	15	3.508	7.394	6.103	1.291	23.674	3.738
17	49.317	132.562	16	4.805	6.103	4.336	1.767	25.080	5.120
18	61.108	136.898	17	11.791	4.336	0.000	4.336	25.563	12.563
							Total	**752.830**	**110.108**

Hydraulic mean depth, R = Area/ Perimeter = 6.837

Surface condition : Clean, straight bank, full stage, no rifts or deep pools in fair condition Rugosity F: 0.0400

Conveyence factor (C1) = (Area x $R^{2/3}$)/ n = 68234.63

B) C/S No: 2 Offset : At Alignment HFL (m): 136.898

Sl No.	Offset Distance (m)	Bed level (m)	Segment No	Segment width (m)	Height at start (m)	Height at end (m)	Diff in height (m)	Area of segment (m²)	Wetted perimeter (m)
				-	-	-	-	-	-
1	-38.281	136.898							
2	-34.777	134.152	1	3.504	0.000	2.746	2.746	4.811	4.452
3	-29.018	129.639	2	5.759	2.746	7.259	4.513	28.809	7.317
4	-23.834	128.807	3	5.184	7.259	8.091	0.832	39.787	5.250
5	-12.339	127.864	4	11.495	8.091	9.034	0.943	98.426	11.534
6	-8.413	127.374	5	3.926	9.034	9.524	0.490	36.429	3.956
7	0.000	126.964	6	8.413	9.524	9.934	0.410	81.850	8.423
8	7.347	128.823	7	7.347	9.934	8.075	1.859	66.156	7.579
9	12.731	129.495	8	5.384	8.075	7.403	0.672	41.667	5.426
10	19.040	130.489	9	6.309	7.403	6.409	0.994	43.570	6.387
11	23.868	132.555	10	4.828	6.409	4.343	2.066	25.955	5.251
12	29.024	134.762	11	5.156	4.343	2.136	2.207	16.703	5.608
13	34.016	136.898	12	4.992	2.136	0.000	2.136	5.331	5.430
14	34.016	136.898	13	0.000	0.000	0.000	0.000	0.000	0.000
							Total	**489.495**	**76.613**

Hydraulic mean depth, R = Area/ Perimeter = 6.389
Surface condition : Clean, straight bank, full stage, no rifts or deep pools in fair condition Rugosity F: 0.0400
Conveyence factor (C2) = (Area x $R^{2/3}$)/ n = 42397.335

C) C/S No: 3 Offset : 100mD/S HFL (m): 136.848

Sl. No	Offset Distance (m)	Bed level (m)	Segment No	Segment width (m)	Height at start (m)	Height at end (m)	Diff in height (m)	Area of segment (m^2)	Wetted perimeter (m)
1	-36.400	136.848							
2	-32.506	134.573	1	3.894	0.000	2.275	2.275	4.429	4.510
3	-24.866	130.110	2	7.640	2.275	6.738	4.463	34.430	8.848
4	-20.697	129.610	3	4.169	6.738	7.238	0.500	29.133	4.199
5	-15.000	128.707	4	5.697	7.238	8.141	0.903	43.807	5.768
6	-9.304	128.003	5	5.696	8.141	8.845	0.704	48.376	5.739
7	0.000	126.907	6	9.304	8.845	9.941	1.096	87.392	9.368
8	8.617	127.651	7	8.617	9.941	9.197	0.744	82.456	8.649
9	17.586	128.792	8	8.969	9.197	8.056	1.141	77.371	9.041
10	22.061	130.732	9	4.475	8.056	6.116	1.940	31.710	4.877
11	28.762	132.417	10	6.701	6.116	4.431	1.685	35.338	6.910
12	32.477	134.775	11	3.715	4.431	2.073	2.358	12.081	4.400
13	35.743	136.848	12	3.266	2.073	0.000	2.073	3.385	3.868
							Total	**489.909**	**76.178**

Hydraulic mean depth, R = Area/ Perimeter = 6.431
Surface condition : Clean, straight bank, full stage, no rifts or deep pools in fair condition Rugosity F: 0.0400
Conveyence factor (C3) = (Area x $R^{2/3}$)/ n = 42355.589
Mean Conveyence Factor (C_f) = (C1xC2xC3)$^{1/3}$ = 49668.919
Longitudinal Bed Slope, S = 0.0002
Discharge through the channel, $Q = C_f x (S)^{0.5}$ = **672.42** m^3/s

Highest discharge from the three method is = 1897.13 m^3/s
Second highest discharge is = 790.58 m^3/s
Maximum discharge is greater than 1.5 times second highest discharge
Hence Design Discharge is = **1186.00 m^3/s**

Proposed bridge :

Span scheme and type of foundation :

Design discharge = Q = 1186.00 m^3/s
Lacey's waterway = L = 4.8 √Q = 165.30 m.

Provide a 4 span bridge 24.00 m c/c bearings as shown in the G.A.D.
Clear waterway becomes = 94.24 m.
(Centre to centre distance between bearings on piers = 0.6 m.
Thickness of pier shafts was taken as 1.0 m.
Bearing centre at abutment to front face of abutment shaft i 0.280 m.)
Hence clear waterway provided is 57% of Lacey's waterway , o.k.

Calculation for scour depth and depth of foundation.

For calculation of scour design discharge = 1.3x1186 = 1541.80 m^3/s
Clear waterway provided = 94.24 m.
Hence d_b = 1541.8 / 94.24 16.36 m^3/s per metre
Silt factor :
As per soil investigation report , soil below lowest bed is greyish clay,some / trace silt having cohesion 0.15 kg/m^2.
Silt factor as per soil investigation report is 1.8

Hence considered silt factor as	1.8	
Depth of scour = d_{sm} = 1.34 x $(d_b^2/k_{sf})^{1/3}$	7.10	m. below H.F.L.
Hence depth of normal scour is at R.L. =	129.80	m.
Lowest bed level is at R.L.	126.96	m.
Hence depth of normal scour below H.F.L. is taken as =	9.93	m.
Maxm. Depth of scour at abutment location = 9.93x 1.27 =	12.62	m. below H.F.L.
R.L.of maxm. scour at abutment location =	124.28	m.
Maxm. Depth of scour at pier location = 9.93 x 2.0 =	19.87	m. below H.F.L.
R.L.of maxm. scour at pier location =	117.03	m.

For open foundation , depth of foundation to be taken at least 2.0m. Below maximum scour level .

Hence, founding level for abutment will be not above R.L124.28-2.0 =	122.28	m.
And founding level for pier will be not above R.L. 117.03-2.0	115.03	m.
Hence depth of abutment foundation becomes 126.964 - 122.28=	4.682	m.below lowest bed ,
And depth of pier foundation becomes 126.964 - 115.03=	11.934	m.below lowest bed ,

which is not practicabl Hence deep foundation (Well foundation) is suggested for both piers and abutments .

Provide top of well cap for abutment foundation at R.L.	132.00	m. R.L.
And top of well cap for pier foundation at lowest water level , ie. , at	130.50	m. R.L.

Calculation for formation level :-

Highest Flood Level	:	136.898	m.
Vertical clearance	:	1.200	m.
Depth of superstructure (RCC. T-beam slab superstructure		2.370	m.
Thickness of wearing course	:	0.065	m.
Increase due to inclination	:	0.242	
Required formation level	:	**140.775**	**m.**
Provide formation level at centre of deck as		**140.78**	**m.**

MINUTES OF MEETING ON FINAL DPR PRESENTATION ON 18.11.2016

CHAPTER – 12

MINUTES OF MEETING ON FINAL DPR PRESENTATION ON18.11.2016

No. NHIDCL/DPR/Dimapur Bypass. Dated: 18.11.2016

Minutes of Meeting

Sub: - Detailed Project Report for Assam part of Dimapur bypass from Design Km 118.050 to Km 132.375 of NH-36 & NH-39.

A meeting was convened on 18/11/16 under the chairmanship of Managing Director, NHIDCL for acceptance of final DPR for the above project. M/s Arctech Consultants Pvt. Ltd. was awarded the consultancy for preparation of DPR for the above work. The Consultant has held meetings in NHIDCL in the past and has been getting inputs from these meetings. A presentation on final DPR was given on 18.11.2016. Following persons were present in the meeting:

	NHIDCL	M/s Arctech Consultants Pvt. Ltd.
(i)	Shri Anand Kumar, MD	Mr. A.K. Bhattacharyya
(ii)	Shri V.K. Rajwar, JD-I	Mr. P.S. Mandal
(iv)	Shri Y.C. Srivastava, GM (Tech)	Mr. P. Ghosh
(v)	Shri A.K. Jha, DGM (Tech)	

2. M/s Arctech Consultants Pvt. Ltd. stated that the alignment of the subject stretch has already been approved by NHAI and accordingly final DPR has been prepared. After detailed discussions the reduction of speed below 80 Kmph and extra gradient due to proximity of structures were approved keeping in view the constraints and already approval Alignment. It was observed that there were some discrepancies in the cost estimate, hence the Consultant was asked to modify the submission of Final DPR based on IRC 58: 2015, IRC 84: 2014. It was also emphasized to provide proper slope protection works to avoid rain cuts in the embankment works.

3. In addition, following decisions were also taken:

i) The Forest Department, Dimapur has informed Nagaland GM (P), Dimapur, NHIDCL that there is a history of Elephant corridor on the alignment. Consultant was advised to provide the same at the specified spot of crossing after discussions with DFO Dimapur State Forest Department.

ii) Consultant had proposed a road of 7 Km long for KAAC/Assam Council as part of the project which cannot be accepted. Consultant was asked to delete the proposed 7 Km single lane road from the Draft DPR being 2 to 3 Km away from the proposed bypass.

iii) Consultant was advised to carry out 3 (D) and 3(O) on fast track as this project does not involve any MOEF clearance due to the project length being 35 Km only. It was also emphasized to complete all Land Acquisition proceedings within a period's time enabling NHIDCL to start the bidding process for civil work.

4. The Consultant was finally advised to submit the DPR after incorporating the above observations by 15th December, 2016.

Meeting ended with thanks to chair.

CONCLUSIONS AND RECOMMENDATIONS

CHAPTER – 11

CONCLUSIONS & RECOMMENDATIONS FOR DIMAPUR BYPASS (ASSAM PART)

11.1 Introduction

The Bypass project road in the state of Assam is recommended for new Rigid construction of 4-lane divided carriageway configuration. The stretch of the corridor is new and on virgin land.

11.2 Bridges & Culvert

There are 3 nos of new Major Bridges and 6 nos. new Minor Bridges & 46 nos. of culverts in this stretch of Bypass. There will be one ROB & one Flyover also on bypass to avoid Dimapur town. This has been proposed to the north of Dimapur town.

Total no. of C.D. Structures are:

1)	Major Bridge	-	3
2)	Minor Bridge	-	6
3)	Box Culverts	-	46
4)	Cattle Underpass	-	2
5)	Elephant Underpass	-	1
	Total:		58

11.3 Bypass

11.3.1 Dimapur Bypass (Assam Part):

The existing alignment of the project road crosses through a heavily congested Dimapur town between Km 162 to Km 168.167. This is to be bypassed. Retaining the present alignment calls for a massive demolition of important residential, commercial and public structures like Hospital, College, Schools, Govt. Offices, religious structures, Police Station and Post Office etc. The ROW is also minimum in the Nagaland stretch of NH-36. It is therefore, suggested to have a 4-lane bypass to Dimapur town commencing from existing km 159.400 on NH-36 and terminating at Patkoi Bridge at Km 124.200 of NH-39. The length of the proposed 4-lane bypass would be 35.008 km. The abandoned stretch of NH-36 will be 8.767 Kms and some part of NH-39. The Assam part of Bypass will be 14.325 Kms.

11.4 Design Speed:

The project road is designed for 100 Kmph adhering to the ruling standards for National Highways as prescribed by IRC: 73-1980 & SP84-2014. In jungle areas the design speed is restricted to 65 Km/hr.

11.5 Pavement

Though both flexible and rigid pavement has been discussed, it is proposed to provide Rigid pavement on the Dimapur Bypass alignment. The reasons are:

a) In 30 year cycle, the Rigid Pavement is economical.

b) As it is in a heavy rainfall area, the maintenance cost will be less.

11.6 Junction Improvement

There is one major intersection along the Bypass (Assam side) project road, which have been recommended for improvement at grade. The intersections is 3-legged and they it does not account for any grade separation.

11.7 Packages

The Bypass project stretch has been proposed to be divided into only one package.

The estimated cost of the proposed original construction for the project stretch has been estimated to be as follows:

a) With Rigid pavement civil cost option **Rs. 429.41 Crores**

b) The estimated cost of the proposed new construction of the Bypass project stretch to 4-lane standard (including centage charges) works out to **Rs 570.24 Crores** with Rigid pavement.