



Chapter - I

Executive Summary

I.1 Introduction

Border Road Organisation (BRO) – Project Sewak in state of Manipur and Nagaland has been entrusted Consultant for preparation of Feasibility Study (FS) and Detailed Project Report (DPR) on EPC mode for widening/improvement of existing road from Km 0.00 to Km 15.00 to NHDL Specifications and from Km 15.00 to Km 135.00 (As per CA) to Intermediate Carriageway (IW specifications) of road Mahadev – Toloi - Pfutsero (total length 135.00 Km) in Ukhrul & Senapati Dist. of Manipur State and Phek Dist. of Nagaland State under Project Sewak.

The Detailed Project Report thus prepared shall contain the scheme and layout of the development of the highway and the project facilities, preliminary design, costing and financial viability based on present and future traffic. The Detailed Project Report would thus provide all technical details, based on which comprehensive bid document can be prepared so that realistic bids are received from prospective bidders.

In order to fulfil the traffic needs and road safety requirement, Border Road Organisation (BRO) has appointed the **LN Malviya Infra Projects Pvt.Ltd., Bhopal (M.P.)** as Consultant for preparation of Feasibility Study (FS) and Detailed Project Report (DPR) on EPC mode for widening/improvement of existing road from Km 0.00 to Km 15.00 to NHDL Specifications and from Km 15.00 to Km 135.00 to Intermediate Carriageway (IW specifications) of road Mahadev – Toloi - Pfutsero (total length 135.00 Km) in Ukhrul & Senapati Dist. of Manipur State and Phek Dist. of Nagaland State under Project Sewak. *The assignment for letter no. 85001/EPC/64/E8/Date- 21 Jun 2019.*

I.2 Scope of Study

Reports shall be submitted in four stages as brought out below.

- Stage 1: Inception Report
- Stage 2: Feasibility Report
- Stage 3: LA and Clearance I Report
- Stage 4: Detailed Project Report (DPR)
- Stage 5: Technical Schedules
- Stage 6: LA and Clearance II Report

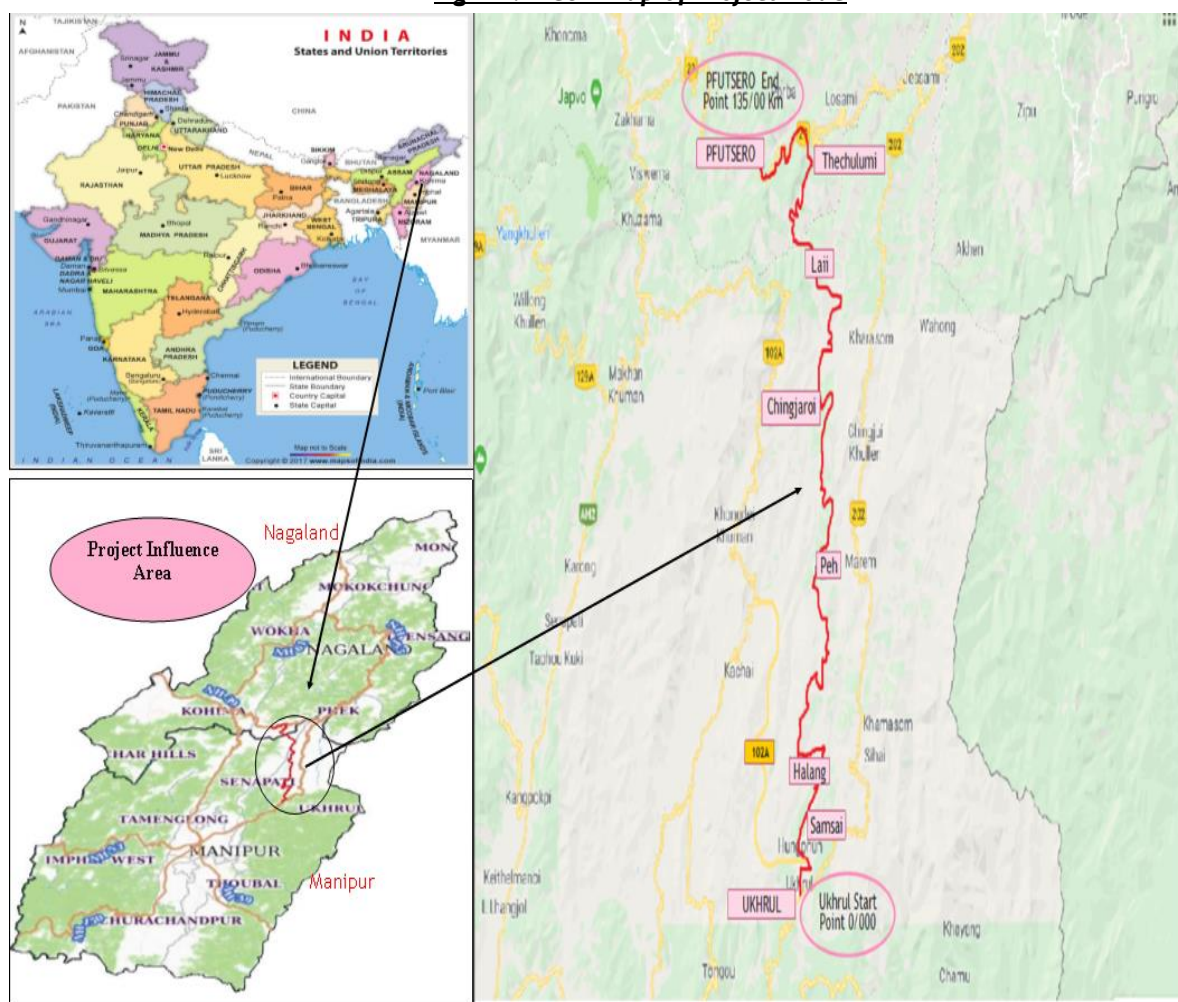
I.3 Socio - Economic Profile

The **Mahadev- Pfutsero Road** is located in the district of **Ukhrul, Senapati & Phek District**, which in turn is located in the State of Manipur and Nagaland. Manipur has a total surface area of (22,327) sq. km. forming 0.7% of the total land surface of the Indian Union. It is situated between the parallels (23o50'N)-(25o41'N) and the meridians (92o59'E) - (94o45'E). Administrative Map. It has a border of 854 km of which 352 is international border with Burma on the East. The remaining 502 km long border separates her from the neighboring states of Nagaland on the North, Assam on the West and Mizoram on the South and the South West. Physiographically the land is divisible into a central valley and the surrounding mountains. Physiographic Map. The plain or the valley is approximately (2238 sq. km.) accounting to 10% of the total area. Out of this an area of 550 sq. km. is occupied by lakes, wetlands, barren uplands and hillocks. The valley is oval shape with a NNW-SSE orientation and has a gentle slope towards the South measuring 798 m above m.s.l. at the extreme North and 746 m above m.s.l. at the Southern end. The Imphal city stands at an altitude of 790 m above m.s.l. Two river systems viz. the Barak-Bramhaputra System and the Chindwin-Irrawaddi System drained the entire State. The Barak River and its tributaries form the sub-system in the western hills and join the earlier system. Important tributaries under this sub-system are the Dzuko, the Leimatak, the Irang, the Makru and the Tuivai flowing in a NE-NW orientation. The Imphal or Manipur River meanders



through the Manipur valley in a NW-SE direction. Its important tributaries are the Kongba, the Iril, the Thoubal, the Heirolk Sekmai, the Khuga and the Chakpi rivers. The Manipur River passes through a gorge flow out of the state to join the Chindwin River in Myanmar. Nagaland is nearly all hilly, the highest peak being Saramati (3841 metres) in the district of Kiphire that borders Myanmar. Many rivers cut through this mountainous terrain. The main ones are Dhansiri, Doyang, Dikhu, Milak, Tizu and Zunki. It has on its long eastern strip the neighboring country Myanmar. The north is bounded by Arunachal Pradesh, while on its west lies the state of Assam. Manipur borders it on its south. Rains are heavy in Nagaland. The average rainfall is between 175 cm and 250 cm. Most of the heavy rainfall is during the 4 months from June to September. The rains during April to May is low. Strong winds blow from the North West in February and March. The climate is pleasant. The terrain is hilly, rugged and mountainous. The highest peak is Saramati in the Twensang district, which is 3840 meters above sea level. The average height of the peaks is between 900 and 1200 metres. The hillsides are covered with green forests. In the Angami region the terraced fields are a feast to the eyes.

Fig-I-1: Index Map of Project Road



1.4 Project Description

1.4.1 Location

The project road takes off Distt. Hospital, Ukhrul town located at Dungrei village locality and following green field alignment from starting point (outside of the Ukhrul Town) to near about 84 RCC. Then following existing road upto Ukhrul- jessami road junction (NH-150), then again following green field alignment upto Langdhang river (samsai river), then meet to Halang village junction by following green field alignment, then following existing road which is already being constructed by state Govt. under PMGSY from Talui village junction to peh village, then following green field alignment outside of the peh village. Then following existing alignment road from peh village to mother reach of Hill. Then following green field alignment along the Laini Lok river from Bailey Bridge and Bypass the chingjaroi C.V., chingjaroi Khullen and also Laii & New Laii Village



and the road to reach the Manipur-Nagaland border i.e. Zerry Lok river upto thechulumi junction, then follows existing road to end point of the project road i.e. Chizami Village (upto NH-150).



Start point at Ukhul Town (Dist. Hospital) CH-0+000



End Point at Chizami village (NH-150) CH-116+955

1.4.2 Climate

Manipur -The climate of Manipur is largely influenced by the topography of this hilly region. Lying 790 meters above sea level, Manipur is wedged among hills on all sides. This north eastern corner of India enjoys a generally amiable climate, though the winters can be chilly. The maximum temperature in the summer months is 32 °C (90 °F). The coldest month is January, and the warmest July.

Nagaland - Nagaland has a largely monsoon climate with high humidity levels. Annual rainfall averages around 1,800–2,500 millimetres (70–100 in), concentrated in the months of May to September. Temperatures range from 21 to 40 °C (70 to 104 °F). In winter, temperatures do not generally drop below 4 °C (39 °F), but frost is common at high elevations. The state enjoys a healthy, pleasant climate. Summer is the shortest season in the state that lasts for only a few months. The temperature during the summer season remains between 16 to 31 °C (61 to 88 °F). Winter makes an early arrival and bitter cold and dry weather strikes certain regions of the state. The maximum average temperature recorded in the winter season is 24 °C (75 °F). Strong northwest winds blow across the state during the months of February and March.

1.4.3 Pavement Condition -

The project road has a combination of NH Overlapping- 21.55 km, PMGSY road – 28.31 km, Old British road- 28.04 km, Earthen+ Foot Track – 12.55 km, Green field alignment – 30.73 km from Km 0+000 to Km 32+450 with 51.110 km bituminous surface and 81.390 km Earthen surface, existing 51.110 km bituminous carriageway width is 3.50 m and condition of the pavement is varying from very poor to fair along the road and condition



of shoulders is also very poor. The existing alignment mostly passing through the steep rolling & mountainous terrain and the existing hill slope vary from 10° to 85°.

The Condition of the pavement is usually very poor defects like, cracking, ravelling, potholes and worn-out BT surface at Project Road. Average travel speed obtained is around 15-30 km/hr due to Very poor condition of project road. Table containing details about Pavement Condition and Road inventory for this road may be seen Appendix-IV to feasibility report.



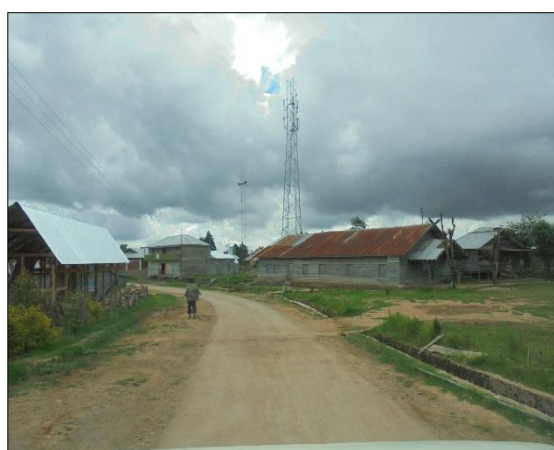
Photo:- Pavement Existing Condition

I.4.4 Connectivity (Village Details)

There are total 09 villages which are connected by the project road, Ukhrul Town, Hungphun, Samsai, Halang, Phungcham, Paorei, Peh, PehSomdharlo, Chizami. Table containing details about the village details for this road are enclosed at Appendix-III.



Ukhrul Town



Paorei Village

Table I.1 List of Town and Villages

Sr. No.	Location		Length (m)	Name of Village/Town
	From	To		
I	II	III	IV	V
1	0+000	7+700	7700	Ukhrul Town
2	7+700	9+700	2000	Hungphun
3	9+700	13+900	4200	Samsai
4	26+100	29+000	2900	Halang
5	39+400	40+300	900	Phungcham
6	41+700	43+900	2200	Paorei



Sr. No.	Location		Length (m)	Name of Village/Town
	From	To		
I	II	III	IV	V
7	48+300	50+900	2600	Peh
8	52+100	53+300	1200	Peh Somdharlo
9	116+600	116+955	355	Chizami

1.4.5 Geometrics

The horizontal alignment is passing through Hilly terrain in its entire length. There are many acute curves & hair pin curves with inadequate sight distance are present on the project road especially before urban area and approaches of structures. The vertical alignment is not smooth as it's having Hilly topography in its most of length.



Photo:- Horizontal alignment along the project road.

1.4.6 Road Junctions

In this various cross roads also join the project road at different locations. Project road encountered with 14 Minor intersections and 07 Major intersections. List of intersections is given in Table 1.2 below. Table containing details about the junction details for this road are enclosed at Appendix-III



Minor Junction at 2+550



Minor Junction at 29+150



Table 1.2: List of Junctions

Sr. No.	Location (Km)	Destinations of Cross Road	Type of Intersection	Type of Junction	Road Side
I	II	III	IV	V	VI
1	0+000	L/S - Ukhrul town, R/S - Imphal	Major Junction	X- Junction	BHS
2	1+720	Nungshong Khunou	Minor Junction	T- Junction	RHS
3	2+550	Ukhrul Town	Minor Junction	Y- Junction	LHS
4	3+900	Seven Finance Quarters	Minor Junction	Y- Junction	LHS
5	4+400	RCC 84 Camp	Minor Junction	Y- Junction	LHS
6	5+000	Jessami	Major Junction	T- Junction	RHS
7	11+100	Assam Rifles	Minor Junction	Y- Junction	LHS
8	25+850	L/S - Ukhrul town, R/S - Halang Basti	Major Junction	X- Junction	BHS
9	28+950	L/S - Tushar Phungthar, R/S - Halang Basti	Major Junction	X- Junction	BHS
10	31+300	Toloi	Major Junction	T-Junction	LHS
11	38+220	Village Road	Minor Junction	Y- Junction	LHS
12	39+800	L/S - Village Road R/S - Phungcham	Minor Junction	X-Junction	RHS
13	41+300	Village Road	Minor Junction	Y-Junction	LHS
14	48+300	Peh Basti	Minor Junction	Y-Junction	LHS
15	51+000	Peh Basti	Minor Junction	Y-Junction	LHS
16	64+000	L/S - Hoomi R/S - Chingjaroi C.V.	Major Junction	X-Junction	LHS
17	83+100	Laii & New Laii	Minor Junction	T-Junction	LHS
18	86+800	Laii & New Laii	Minor Junction	Y-Junction	LHS
19	94+500	Laii & New Laii	Minor Junction	T-Junction	LHS
20	112+700	L/S - Tsupfume R/S - Thechulumi	Minor Junction	X-Junction	RHS
21	116+955	L/S - Pfutsero R/S - Jessami	Major Junction (NH-150 E)	X-Junction	BHS

1.4.7 Bridge & Cross Drainage Structures

There are 01 Minor Bridge and 96 culverts presents along the project road. There is some culvert which is in poor condition and does not fulfil the requirement as a culvert is needed to be reconstructed. The summary of structure details is given in table no. 1.3 and list of Minor Bridges and Culverts are presented in Table 1.4 and 1.5 respectively. Table containing details about the structure details for this road are enclosed at Appendix-V.

Table 1.3: Summary of Existing Bridges and Culverts

Section		Type of Structure			
		Major Bridges	Minor Bridges	Slab /HPC Culvert	VCW/FCW
I	II	III	IV	V	VI
Mahadev-Toloi-Pfutsero	Existing Structure 97 Nos.	0	01	96	0



Existing Ch. 84+800 (Laii Bridge)



Existing Ch. 41+010

Existing Ch. 120+560

Table I.4: Details of Major/Minor Bridges

Sr. No.	Location	Details of Existing Structures				
		Type of Existing Structure	No. of Span x Length of Span	Width of Structure	Condition of Structure	Type of Bridge Steel/PCC
I	II	III	IV	V	VI	VII
I	84+800	MNB	2 X 12.5 & 2 X 15	8.40	Good	R.C.C Bridge

Table I.5: - Details of Existing Slab /HPC/ Pipe Culverts

Sr. No.	Location	Details of Existing Structures				Sr. No.	Location	Details of Existing Structures			
		Type of Existing Structure	Pipe x dia.	Width of Structure	Condition of Structure			Type of Existing Structure	Pipe x dia.	Width of Structure	Condition of Structure
I	II	III	IV	V	VI	2	27+250	HPC	Chocked	6.9	Poor
I	27+075	HPC	1 X 1000	6.9	Poor	3	27+450	HPC	1 X 1000	6.9	Poor



Sr. No	Location	Details of Existing Structures				Sr. No	Location	Details of Existing Structures			
		Type of Existing Structure	Pipe x dia.	Width of Structure	Condition of Structure			Type of Existing Structure	Pipe x dia.	Width of Structure	Condition of Structure
4	27+810	HPC	1 X 1000	6.9	Poor	42	69+550	HPC	1 X 1000	6.9	Poor
5	27+925	HPC	1 X 1000	8.4	Poor	43	69+920	HPC	1 X 1000	6.9	Poor
6	28+220	HPC	1 X 1000	8.4	Poor	44	70+320	HPC	Chocked	6.9	Fair
7	28+400	HPC	1 X 1000	8.4	Poor	45	120+560	SLAB	1 X 5.0	6.4	Poor
8	28+710	HPC	1 X 1000	6.9	Poor	46	121+060	SLAB	1 X 1.0	6.4	Poor
9	28+910	HPC	1 X 1000	6.4	Poor	47	121+160	HPC	1 X 1000	6.4	Poor
10	29+150	HPC	Chocked	6.9	Poor	48	121+180	HPC	1 X 1000	6.4	Poor
11	29+320	HPC	1 X 1000	6.9	Fair	49	121+330	HPC	1 X 1000	6.9	Poor
12	29+385	HPC	1 X 1000	6.9	Poor	50	121+565	HPC	1 X 1000	6.9	Poor
13	29+400	HPC	1 X 1000	6.9	Poor	51	122+350	HPC	Chocked	6.9	Poor
14	29+520	HPC	1 X 1000	5.9	Poor	52	123+490	HPC	Chocked	6.1	Poor
15	29+720	HPC	1 X 1000	5.9	Poor	53	123+690	HPC	Chocked	6.1	Poor
16	29+830	HPC	1 X 1000	5.9	Poor	54	123+940	HPC	Chocked	5.9	Poor
17	29+850	HPC	1 X 1000	5.9	Poor	55	124+840	HPC	Chocked	5.9	Poor
18	30+190	HPC	1 X 1000	5.9	Poor	56	124+990	HPC	Chocked	5.9	Poor
19	30+800	HPC	Chocked	5.9	Poor	57	125+190	HPC	Chocked	5.9	Poor
20	33+285	HPC	1 X 1000	5.9	Poor	58	125+290	SLAB	1 X 3.0	6.4	Poor
21	37+110	HPC	1 X 1000	5.9	Poor	59	125+525	HPC	1 X 900	6.4	Poor
22	37+400	SLAB	1 X 4.0	5.6	Fair	60	125+800	HPC	Chocked	6.4	Poor
23	39+660	HPC	1 X 1000	5.6	Fair	61	126+175	HPC	Chocked	6.4	Poor
24	40+265	HPC	1 X 1000	5.6	Poor	62	126+220	HPC	1 X 900	6.4	Poor
25	40+480	HPC	Chocked	5.9	Poor	63	126+350	SLAB	1 X 1.5	6.4	Poor
26	40+715	HPC	1 X 1000	7.4	Poor	64	126+560	SLAB	1 X 1.5	6.4	Poor
27	41+010	HPC	1 X 1000	7.4	Fair	65	126+685	HPC	1 X 900	6.4	Poor
28	42+650	HPC	1 X 1000	5.6	Fair	66	126+820	HPC	1 X 1000	6.4	Poor
29	43+150	HPC	1 X 1000	5.9	Poor	67	127+010	SLAB	1 X 3.0	6.4	Poor
30	43+400	HPC	1 X 1000	5.9	Poor	68	127+140	HPC	1 X 900	6.4	Poor
31	43+710	HPC	1 X 1000	5.9	Poor	69	127+250	HPC	1 X 900	6.4	Poor
32	45+950	HPC	1 X 1000	5.6	Poor	70	127+500	HPC	1 X 900	6.4	Poor
33	47+425	HPC	1 X 1000	5.6	Poor	71	127+600	HPC	1 X 900	6.9	Poor
34	47+980	HPC	1 X 1000	5.4	Fair	72	127+860	HPC	Chocked	6.9	Poor
35	50+810	PIPE	1 X 1000	5.4	Poor	73	128+065	HPC	Chocked	6.9	Poor
36	51+135	PIPE	1 X 1000	5.4	Poor	74	128+265	HPC	Chocked	6.9	Poor
37	67+950	SLAB	1 X 1.0	8	Fair	75	128+350	HPC	Chocked	-	Poor
38	68+050	SLAB	1 X 1.0	8	Fair	76	128+500	HPC	Chocked	6.9	Poor
39	68+580	HPC	1 X 1000	8	Poor	77	128+910	HPC	Chocked	6.9	Poor
40	68+985	HPC	1 X 1000	6.9	Fair	78	129+130	HPC	1 X 900	6.9	Poor
41	69+225	HPC	1 X 1000	6.9	Fair	79	129+360	HPC	1 X 900	6.9	Poor



Sr. No	Location	Details of Existing Structures				Sr. No	Location	Details of Existing Structures			
		Type of Existing Structure	Pipe x dia.	Width of Structure	Condition of Structure			Type of Existing Structure	Pipe x dia.	Width of Structure	Condition of Structure
80	129+520	HPC	1 X 900	6.9	Poor	89	130+625	HPC	1 X 900	6.9	Poor
81	129+560	HPC	1 X 900	6.9	Poor	90	130+700	SLAB	1 X 2.0	6.9	Poor
82	129+775	HPC	1 X 900	6.9	Poor	91	130+800	SLAB	1 X 2.0	6.9	Poor
83	129+910	HPC	1 X 900	6.9	Poor	92	131+200	HPC	Chocked	6.9	Poor
84	130+000	HPC	1 X 900	6.9	Poor	93	131+465	HPC	1 X 600	6.9	Poor
85	130+080	HPC	1 X 900	6.9	Poor	94	131+880	SLAB	1 X 1.0	9.4	Poor
86	130+300	HPC	1 X 900	6.9	Poor	95	132+180	SLAB	1 X 3.0	6.4	Poor
87	130+410	HPC	1 X 900	6.9	Poor	96	132+450	SLAB	1 X 1.0	6.4	Poor
88	130+525	HPC	Chocked	6.9	Poor						

1.5 Traffic Survey Analysis and Forecast

To establish the traffic flow characteristics and travel pattern of the project corridor between Mahadev -Toloi-Pfutserso section the following traffic surveys were carried out:

- Classified Traffic Volume Count Survey
- Intersection Turning Movement Survey
- Axle Load Survey
- Origin Destination Survey

1.5.1 Classified Continuous Volume Count Survey

The objective of classified traffic volume count survey is to estimate traffic intensity on the project road. The classified volume count surveys have been carried out for 7 days, 24 hours. The traffic is counted in number of vehicles by vehicle category-wise in each direction over 24 Hrs a day for 7 Days. The counts were recorded in the formats as per IRC specifications. Classified volume count survey has been carried out on third locations the details.

Reconnaissance survey was conducted on the Project Road for selection of locations for various traffic surveys. While selecting the traffic volume survey location, considered the aspect of Private sector participation in this road development and accordingly, the locations were selected The first location has been selected Near Ukhrul Village at Ch-5+000, The Second location has been selected Near Phungcham village at 39+800 & the Third CTVC location has been selected near Pfutserso at Ch-116+955.

Table 1.6 Traffic Volume Surveys

S.No.	Chainage (km)	Location	Survey Dates
I	II	III	IV
1	5+000	Near Ukhrul	25.02.20 to 02.03.20
2	39+800	Near Phungcham	25.02.20 to 02.03.20
3	116+955	Near Pfutserso	25.02.20 to 02.03.20



At Ch-5+000 (TVC-1)



At Ch-39+800 (TVC-2)

1.5.2 Traffic Characteristics on Project Road

The summary of all data collected from traffic volume survey for the 3 locations on the section is presented in table 1.11 Average Daily Traffic (ADT) for the month of February 2020 is summarized in this table.

Table 1.7 Traffic Volume at Three Locations of the Project Road (ADT)

Type of Vehicles	Survey Location		
	(km5+000)	(km39+800)	(km116+955)
I	II	III	IV
2-Wheeler	85	102	96
3-Seater	1	0	0
Car/Vans/Jeeps(Taxi)	305	23	23
Mini Bus	0	0	0
Buses	0	0	0
LCVs	78	10	8
2-Axle Trucks	38	7	6
3-Axle Trucks	0	0	0
Multi Axle Trucks	0	0	0
Tractor	5	0	0
Tractor with Tailor	8	0	0
Cycle	0	0	0
Cycle Rickshaw	0	0	0
Army Car	14	10	13
Army Bus	1	0	0
Army Truck	8	7	12
Others	0	0	0
Total	545	159	159

A. Near RCC 84 at Km. 5+000

Survey was carried out at Km 5+000 Near Ukhrul village. Selected location lies between Mahadev-Toloi-Pfutsero is away from urban section to avoid influence of local traffic.



ADT recorded at this station is 545 nos. / 667 PCU. Fast moving vehicles were recorded as 100 % of the total traffic (in PCU). Peak hour traffic flow of 69 nos. formed around 12.66% of the total traffic. Peak hour is identified during 10 AM to 11 AM.

B. Near Phungcham village at Km. 39+800

Survey was carried out at Km 39+800 Phungcham village. Selected location lies between Mahadev-Toloi-Pfutsero is away from urban section to avoid influence of local traffic.

ADT recorded at this station is 159 nos. / 141 PCU. Fast moving vehicles were recorded as 100% of the total traffic (in PCU). Peak hour traffic flow of 23 nos. formed around 14.46% of the total traffic. Peak hour is identified during 07.00-8.00 AM.

C. Near Chizami village at Km. 116+955

Survey was carried out at Km 116+955 Pfutsero village. Selected location lies between Mahadev-Toloi-Pfutsero is away from urban section to avoid influence of local traffic.

ADT recorded at this station is 159 nos. / 153 PCU. Fast moving vehicles were recorded as 100% of the total traffic (in PCU). Peak hour traffic flow of 18 nos. formed around 11.32% of the total traffic. Peak hour is identified during 06.00-7.00 AM.

Table-1.8: Average Daily Traffic

Survey Location	Average Daily Traffic	Average daily PCUs
Near UKhrul	545	667
Near Phungcham	159	141
Near Chizami	159	153

Table 1.9: Summary of ADT

AVERAGE DAILY TRAFFIC SURVEY OF MAHADEV-TOLOI -PFUTSERO ROAD (Date:25.02.2020 to 02.03.2020)																		
Section :	MAHADEV-TOLOI-PFUTSERO ROAD																	
Direction :	Bothways														Average of all 3 locations			
Location	Motorised Traffic														Non Motorised		Grand Total	
	Passenger Vehicles					Goods Vehicles			Agricultural		Army Vehicles			Passenger				
	Two Wheeler	Three Wheeler	Car/Jeep	Mini Bus	Bus	Tempo / LCV	Ord. Trucks			Tractor with Trailer	Tractor	Army Car	Army Bus	Army Truck	Cycle Rickshaw	Hand Cart	ADT	PCU
							2 Axle	3 Axle	M Axle									
PCU Factor	0.5	1.0	1.0	1.5	3.0	1.5	3.0	3.0	4.5	4.5	1.5	1.0	3.0	3.0	2.0	3.0		
KM 5+000	85	1	305	0	0	78	38	0	0	8	5	14	1	8	0	0	545	667
KM 39+800	102	0	23	0	0	10	7	0	0	0	0	10	0	7	0	0	159	141
KM 116+955	96	0	23	0	0	8	6	0	0	0	0	13	0	12	0	0	159	153
AVG OF ALL LOCATIONS	94	0	117	0	0	32	17	0	0	3	2	13	0	9	0	0	288	320



1.5.3 Turning Movement Count

The objective of turning movement count survey is to estimate the direction-wise movement of the traffic at all intersections on these section and thus to arriving at the contribution and diversion of the traffic from adjacent road network.

1.5.4 Origin Destination

Survey to capture the productions and attractions of passenger and goods movement, from the respective zones, OD survey was carried. Roadside Interview method, as detailed in IRC: 102-1988, was used for O-D survey. The survey was carried out for both passenger and goods vehicles for 24 hours (in both directions) and trip data was collected at the volume count locations by trained enumerators under the supervision of Transportation Engineers. From the O-D survey, travel characteristics like origin and destination, occupancy, trip purpose and length of trip by mode type are captured. For goods modes, the survey elicited characteristics like origin and destination, commodity type, trip frequency and length of trip. A reasonable sample size (about 10%) of vehicles was collected. Travel patterns for were established on the basis of these surveys.

1.5.5 Axle Load Survey

The vehicle damage factor is a multiplier for converting the number of commercial vehicles of different axle loads to the number of standard axle load repetitions. Design of new pavement for additional lane or strengthening of existing pavement is based upon the cumulative number of 80 KN (IRC-37-2018 clause no. 4.4.2) equivalent standard axles (ESA) that will pass over during the 15-year design period. The classes of traffic which lead to significant axle loads (or damage) to the pavement and accordingly considered for design are: LCVs, two / three axle and multi axle trucks. Cumulative standard axles (CSA) are calculated in accordance with the guidelines provided in IRC: 37 – 2018 and IRC: 81 - 1997. The overloaded vehicles have serious adverse impact on performance of pavement. It has been ascertained that the damaging effect of axles on flexible pavement is approximately proportional to the fourth power of the axle load (IRC-37-2018 clause no. 4.4.3).

The equivalent single axle loads (ESALs) have been calculated assuming that the project road will be opened to traffic in the year 2022.



At Ch-5+000 (Axel Load Survey-1)



At Ch-31+300 (Axel Load Survey-2)

Table 7.5: Summary of VDF

LOCATION	DIRECTION	Commercial Vehicle			
		LCV	2AXLE	3 AXLE	MAV
I	II	III	IV	V	VI
KM 5+000	Ukhrul to Chizami	0.0411	1.8200	0.0000	0.0000
	Chizami to Ukhrul	0.1181	1.4741	0.0000	0.0000



Adopted Maximum VDF		0.1181	1.8200	0.0000	0.0000
KM 31+300	Ukhrul to Chizami	0.0044	1.9012	0.0000	0.0000
	Chizami to Ukhrul	0.0060	2.4221	0.0000	0.0000
Adopted Maximum VDF		0.0060	2.4221	0.0000	0.0000
KM 116+955	Ukhrul to Chizami	0.0143	1.7527	0.0000	0.0000
	Chizami to Ukhrul	0.0015	2.2663	0.0000	0.0000
Adopted Maximum VDF		0.0143	2.2663	0.0000	0.0000

Table 1.11: Summary of MSA

Name of the road	MSA for 15 th (5+000)	MSA for 15 th (31+300)	MSA for 15 th (116+955)	Adopted Design MSA
Mahadev-Toloi-Pfutserso	0.84	0.29	0.35	5

Reference: Details have been given in Appendix to Main Report.

1.5.6 Homogeneous Section

The entire Project Road is considering as one homogeneous sections based on traffic volume and its characteristics.

Table 1.12: Homogeneous Section

Part	Homogenous Section	Section	Length (km)
I	Mahadev -Toloi- Pfutserso	0+000 to 116+955	116.955

1.5.7 Growth Rate

Adopted growth rate is 5% Ref. IRC-37, 2018 Page 14 clause 4.2.2 for commercial vehicles along the Section. The growth of remain traffic moving vehicles is taken as 5% "Reference: Ministry of Shipping, Road Transport & Highways, (18th January, 2008 reference no. RW/NH-3701 I/57/2006-PIC)5% traffic growth rate." Summary of projected traffic based on adopted growth rate is provided in Table given below:

Table 1.13: Projected Traffic Volume, Veh/day and PCU/day

Project Road	Year 2020	Year 2023	Year 2028	Year 2033	Year 2038
I	II	III	IV	V	VI
Projection of ADT					
Total Fast Moving Vehicle (Motorised Traffic)	288	365	466	594	758
Slow Moving Vehicle (Non-Motorised Traffic)	0	0	0	0	0
Traffic (Number)	288	365	466	594	758
Projection (PCUs/day)	(320)	(406)	(518)	(662)	(844)

Note: Values in bracket indicate PCUs/day

1.6 Capacity Analysis

Capacity analysis for Section has been carried out in order to define the Level of Service (LOS) offered by road sections under the prevailing roadway and traffic conditions.

Capacity and design service volumes for various lane configurations specified by IRC: 64 – 1990: 'Capacity of Roads in Rural Areas' has been adopted for determining the Level of Service offered by the road sections during design period.



Standards for lane width of National Highways and roads developed under Central sector schemes in Hilly and Mountainous terrains in circular no. NH-150/28/2018-P&M Dated, 23rd March 2018.

1.7 Results of Engineering Surveys and Investigations

1.7.1 Pavement Condition

The project road has a combination of NH Overlapping- 21.55 km, PMGSY road – 28.31 km, Old British road- 28.04 km, Earthen+ Foot Track – 12.55 km, Green field alignment – 30.73 km from Km 0+000 to Km 32+450 with 51.110 km bituminous surface and 81.390 km Earthen surface, existing 51.110 km bituminous carriageway width is 3.50 m and condition of the pavement is varying from very poor to fair along the road and condition of shoulders is also very poor.



Condition of existing pavement

1.8 Improvement Proposals

The improvement proposals for proposed widening include the provisions for the following major items:

- Proposed Pavement Design
- Rearrangement of Junctions
- Traffic Control and Safety Measures
- Bridge and Cross Drainage Structures

1.8.1 Reconstruction Proposal

In order to meet future traffic requirement, the existing carriageway is proposed to upgrade and proposal of new alignment to achieve high speed of travel with comfort and safety. Tables given below shows relation between existing and proposed chainage.

Table 1.7: Existing – Proposed Chainage

Sr.No.	Section	Existing Chainage	Proposed Chainage
I	Mahadev -Toloi- Pfutsero	0+000 to 132+450	0+000 to 116+955

1.8.2 Pavement Design

The flexible pavement is adopted for proposed carriageway reconstruction & new construction. Flexible Pavement design period of 15 years. That has been designed as per **IRC 37:2018**

The proposed pavement design standard is presented in Table given below: Table containing details about the tentative pavement proposal for this road are enclosed at Appendix-II.



Table 1.8: Flexible Pavement Design

Homogeneous Section	Mahadev -Toloi -Pfutserso road
Design Period	15 Year
MSA	5
Design CBR (%)	7
Design CBR (%) for Hard Shoulder	10
BC (mm)	30
DBM (mm)	50
WMM(mm)	250
Granular Sub-base (mm)	150

1.8.3 Junction Improvement

Simplicity and uniformity is the guiding principle for intersection design to ensure safe passage manoeuvres. The primary factors considered while proposing improvement to the geometry of the existing junctions are smooth turning of vehicles, reduction of conflicts, provision of corner sight distance and safety. The geometric design of junctions is based on IRC: SP 41: Guidelines for the Design of at grade Intersections in Rural & Urban Areas.

1.8.4 Geometric Improvement

In order to upgrade the road to the geometric requirements commensurate with the design speed, improvement has been proposed for the Project Road. The alignment passes through 09 villages which are scattered built-up sections.

In order to utilize the existing carriageway to the maximum extent, the proposed centre line has been aligned within the existing carriageway with necessary correction to geometry.

Properly designed horizontal curves have been provided commensurate with design speed. All super-elevated curves have been provided with designed transition lengths. The existing geometry (both horizontal and vertical) is found to be inadequate. The alignments of the curves in these locations have been suitably corrected as per IRC standards. At the location of structures and back-to-back occurrence of summit and valley curves, correction of vertical profile is also carried out keeping in view the available and adequate sight distances.

Classifi cation	As per IRC:SP:48-1998 and IRC:52- 2001								As per IRC:SP:73-2015 & IRC:SP:84-2014	
	Mountainous terrain				Steep terrain				Mountainous and Steep	
	Area not affected by snow		Snow Bound Areas		Area not affected by snow		Snow Bound Areas			
	Ruling Minimum	Absolute Minimum	Ruling Minimum	Absolute Minimum	Ruling Minimum	Absolute Minimum	Ruling Minimum	Absolute Minimum	Desirable Minimum Radius	Absolute Minimum Radius
National Highway and State Highways	80	50	90	60	50	30	60	33	150	75

1.8.5 Road Marking & Traffic Signs

Appropriate road markings are provided with stop signs, give-way signs, traffic merging and diverging signs, lane closure signs, compulsory keep left/right signs or any other signs as per IRC-67. Advance cautionary signs are proposed for sharp curves along with chevron signs at the outer edge of the curves with appropriate delineators.



1.8.6 Major Bridge/ Minor Bridge & Cross Drainage Structures

We are propose 01 Major Bridge & 08 Minor bridges along with 398 numbers of culverts. As per proposed alignment option from Km 0.00 to Km 116.955, the Summary of cross drainage structures details is given in table no. 1.9 and is given in Appendix- V & VI (A&B) of main Report.

Table 1.9: Summary of cross drainage structures

Summary of Improvement					
New Proposals					
S.No	Type of Structure	Existing Nos. (Reconstruction & Rehabilitation)	New Proposed	Total	Remark
1	Major Bridge	-	01	01	01 New Proposed MJB at Manipur-Nagaland State Border
2	Minor Bridge	01	07	08	07 New Proposed MNB & 1 MNB Rehabilitation (Laii RCC Bridge)
3	Hume pipe culvert	33	-	33	33 Hume pipe culverts & 01 Slab Culvert are upgrade to BOX Culverts & 364 BOX Culvert are New Proposed
4	Slab/Box Culverts	1	364	365	
Total Structures				407	

1.9 Cost Estimate

Cost estimate for the project section is finalised based on the preliminary improvement proposals.

1.10 Significance Of New Proposed Road To Existing Road And Highways

- The objective of the project is to provide improve connectivity to the Manipur and Nagaland via interior villages of both states as well as to provide a shortest possible route and to enable to exploration of rich agriculture/horticulture/forest and natural produces as well.
- The proposed alignment starts at NH-202 near District Hospital at Ukhrul Town.
- The proposed alignment connects Manipur and Nagaland states and ends at NH-29 (Kohima-Jessami) in the state of Nagaland.
- The proposed alignment connects NH-102A (Imphal-Kohima) via Toloi-Halang road and Laii TT road, Somsai (Assam Rifles unit), NH-202 (Ukhrul-Jessami) via Shirui, Chingjui Khullen, Razai Khunau, Kharasom, Jessami.



I.11 NH-29 Kohima-Jessami Road (Interstate Connectivity Road)

NH-29 runs across the Indian states of Assam, Nagaland and Manipur. This national highway is 338.5 km (210.3 mi) long.

...

National Highway 29 (India)

National Highway 29

Location

States

Assam, Nagaland, Manipur

Highway system

Roads in India Expressways National State ← NH 27 NH 202 →

National Highway 29 (NH 29) is a primary National Highway in India. This highway was previously part of old national highways 36, 39 and 150. Due to rationalisation of national highway numbers of India by Gazette notification on 5 March 2010, it was renumbered as National Highway 29. NH-29 runs across the Indian states of Assam, Nagaland and Manipur. This national highway is 338.5 km (210.3 mi) long, after the highway was cut off, a large number of heavy vehicles, including trucks carrying essential goods to Manipur, were stranded on both sides of the affected area.

I.12 Conclusions and Recommendations

As per contract agreement the current stage of the section comprises preparation of DPR for upgrading and new alignment of project road to NHDL Specification from Km 0/00 to Km 15/00 & Intermediate Carriageway (IW specifications) from Km 15/00 to Km 116/96.

The project section formation width varies from 6 m. to 12 m. at existing PMGSY road from km 29/15 to 52/56, therefore land acquisition is required for widening, improving black spots of this PMGSY project section and Greenfield alignment require complete land acquisition/forest clearance. Hence the project will have minor social impact in terms of loss of livelihood or shelter, which will have to be studied and a suitable mitigation plan prepared.