



# Government of India

Ministry of Road Transport & Highways

**National Highways Infrastructure Development Corporation Ltd.**

Consultancy Services for preparation of Detailed Project Report for development of NH-54 from Km 0.0 to Km 125.0 in Mizoram to 2-lane Standards Under Phase 'B' of SARDP-NE\_Package-1

## FINAL DETAILED PROJECT REPORT

**VOLUME - I**  
**MAIN REPORT**

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## **Executive Summary**

## EXECUTIVE SUMMARY

### 0.1 Background

MoRT&H has been entrusted with the task of development, maintenance and management of National Highways. The Programme essentially envisages strengthening, widening and upgrading of National Highways.

As a part of this programme, Archtech Consultants Pvt. Ltd. (ACPL) has been awarded by MoRT&H the work of /consultancy Services for preparation of Detailed Project Report for Widening the existing single/intermediate lane road to 2-lane with Paved shoulder configuration from Aizwal to Keitum (NH-54) and strengthening of the existing road. The letter to proceed with the work is RW/GHT/N.54 (I)MZ/2009 dt. 28.05.2009 issued by RO, Guwahati/MoRT&H.

Mizoram, a state of India is unique in character as a border state with two international boundaries on its eastern and western fronts with the neighbouring countries of Myanmar & Bangladesh respectively. Mizoram, as such, enjoys a very special status from the point of view of strategic importance.

NH-54 is the vital road corridor of the State of Mizoram linking its capital Aizwal to Tuipang point. The road was taken over by Border Roads Organisation, when it was a single lane road. It was widened to intermediate/two lane in places in order to cater to the present day needs, improvement of this strategically important road was over due. This route is also very important from the point of view of tourist attractions to the state of Mizoram.

The consultancy job for detailed project preparation is being carried out in four stages as per Terms of Reference (TOR):

- (i) Stage 1 -- QAP & Inception Report
- (ii) Stage 2 -- Preliminary Report (PR)
- (iii) Stage 3 -- Draft Detailed Project Report (DDPR)
- (iv) Stage 4 -- Final Detailed Project Report (FDPR)

Preliminary Project Report, Inception Report and Quality Assurance Plan have been submitted by the Consultant.

This Final Detailed Project has been prepared as per Clause 18.4.1 of the T.O.R covering the following: -

- Executive Summary
- Project Description including possible alternative alignments/bypasses and technical/engineering alternatives

- Indicative Design Standards, Methodology and Specification
- Traffic surveys and analysis
- Environmental Screening, Environmental Assessment & Action Plan
- Initial Social Assessment and summary of Resettlement Plan
- 
- Updated Economic and Financial Analysis
- Conclusions and Recommendations

The Final Detailed Project Report has been compiled as under:

- Volume I - Main Report      Volume IV – Env. Ass. Report, EMP & RAP
- Volume II - Design Report      Volume V – Tech. Specification
- Volume III- Material Report      Volume VI – Rate Analysis
- 
- Volume IX- Drawing Vol.      Volume X - Civil Work Contract Agreement
- Volume XI- Project Clearance

The Chapter contains the Executive Summary of the Final Detailed Project Report.

## 0.2 Project Description & Improvement Proposal

### 0.2.1 Project Corridor

The section of the project road (NH-54) from the starting point at Aizwal (Km 0) to Keitum (Km 125) having a length of 125 Km is in the state of Mizoram. The project corridor lies in Seismic Zone V. Socio-Economic profile of the state of Mizoram along the project corridor is likely to be influenced by the widening of the road to 2-lane standard.

In the meeting on 07.08.2014 taken by Chief Engineer (NER)/MoRT&H in New Delhi, it was requested to carry on the DPR work from 8.000 Km to 125.000 Km. The Final Detailed Project Report, therefore, has been recast accordingly.

### 0.2.2 Terrain & Meteorology

#### a) Terrain

The project road traverses through steep terrain. Accordingly, geometric standards relevant are for hill roads as per IRC: 52-2001 and IRC: SP:48-1998 Hill Road Manual.

#### b) Meteorology

NH-54 passes through the area of high precipitation with occasional cloud bursts. Rainfall in the region generally starts from May & ends in October every year. Maximum rainfall occurs in the months of June to September every year. The average annual rainfall is around 2500 mm.

#### 0.2.3 Topography & Geology

The entire length of the project road passes through hilly terrain. Some length of the road is located in planted forest area. There are some built-up areas like urban/semi-urban/villages spread over the length of the project road and limited stretches of the road also pass through agriculture area. The hillside slopes are generally gentle to steep along most of the length of the road, although flatter slopes are encountered at some locations particularly near the built-up areas. The valley slopes are equally steep.

The project area falls within the parts of the Lusai hills that covers Mizoram.

#### 0.2.4 Geology

The road passes through mountains that are more unstable than other regions of the Himalayas. The strata consist of interbedded slates, phyllites, talcose schists, quartzites, quartzitic phyllite ramified with quartz veins. It is expected that in such rock types and geological environment the strength of rocks may be classified as fair to poor i.e. Class III to Class IV with occasional partings of CI II (good) rock. The rocks have suffered intense folding, faulting and shearing. At the same time the rocks are heavily fractured and jointed with discontinuation, which provide channels for the ingress of perennial ground water and seasonal rain water flow. As a result the rocks are easily weathered turning into a soft and disintegrated material.

The region through which the road passes, therefore, poses some of the most challenging slope instability problem encountered in the Himalayan region.

#### 0.2.5 Right of Way (ROW)

The existing ROW information as received from Mr. Lallan Kumar, EE (C IV), Officer Commanding, BRO vide his number 2033/AL/GEN/294/E2 dt. 05.11.09 is 36.58 m average. Site investigation reflects otherwise. As per site information, it is much less. However, Hill edge and valley edge has been considered to be existing ROW. It has been directed by NH&IDCL that the ROW may be taken as 24 m. It is done accordingly.

#### 0.2.6 Land Use

The land adjacent to the road is predominantly forestland with commercial establishments in built up areas near Aizawl, Zemabawk, Seling, Khumtung, Serchhip and Keitum. Some of the areas along the road are agricultural land.

#### 0.2.7 Deficiencies and Issues of the Existing Project Road

The following major deficiencies have been identified and addressed in terms of traffic operation and safety, road conditions and maintenance. A few other issues which contribute to operational deficiencies and safety concerns and which prevent the optimum utilization of the highway capacity to the desired level of service, e.g. driving discipline and compliance, traffic surveillance, corridor security and management, level of

regular road maintenance, maintenance and its road worthiness etc. are beyond the scope of this study.

a) Operation

- ☐ Road capacity augmentation
- ☐ Congestion and delays through built-up areas
- ☐ Deficient road surface conditions
- ☐ Deficient geometric features
- ☐ No pavement edge markings
- ☐ Uncontrolled roadside developments and encroachments
- ☐ Bridge & culverts requiring rehabilitation, reconstruction & widening

b) Safety

- ☐ Lack of adequate provision of parapets on valley side
- ☐ Exposed roadside hazards
- ☐ No pavement markings
- ☐ Inadequate and unspecified traffic signs
- ☐ Inadequate provision of catch drains
- ☐ Inadequate provision of breast walls/retaining walls

c) Road

- ☐ Poor pavement condition in stretches and structural inadequacy
- ☐ Cross drainage – poor condition and choking of culverts
- ☐ Curve radii less than that required for the Design speed of 40 km/hr in hill roads
- ☐ Deficient curves and reverse curves in roads without transition length for safe reversal of super elevation.

#### 0.2.8 Road Geometrics

##### Curves

At many places, horizontal curves are sub-standard for the design speed as per I. R. C: 52-2001 for steep terrain. Deficient curves are proposed for improvement to minimum standards in the hills as far as possible, keeping in view the site constraints, time and cost involved in execution. There is only one major hairpin bend with the sharpest bend having a radius of 7 m. This has been eased. The radius of curves as per revised design works out as under

CURVES

Radius (M)	Nos.	Remarks
< 30	2	One is 22m & another is 25m
30 – 40	807	-
40 – 50	158	-
50 – 60	61	-
60 – 100	248	-
> 100	89	-
Total	1365	-

Gradient, Ascent & Descent

In this section (Km 0 – Km 125), the existing gradients are mostly within allowable limits except at one location where there is one hair-pin bend.

Improvement of longitudinal gradient of an existing hill road (specially, when there is no other alternative route for communication available), hardly feasible. But significant improvement of grade is proposed while considering widening and strengthening of the existing road to 2-lane standards. There are realignments, which have improved geometrics of alignment. Detailed picture is as under:

AIZAWL – KEITUM ROADWAY (8.000 KM TO 118.263 KM) OF NH-54: TOTAL 110.263 KM (DESIGN LENGTH)

Proposed Design Ch. (Km)		Existing Ch. (Km)		Concentric & Excentric widening (Km)	Realignment (Km)	Bypass (Km)	Remarks
From	To	From	To				
8.000	38.000	8.292	40.810	15.975	14.025	0.000	
38.000	65.000	40.810	69.625	15.875	11.125	0.000	
65.000	89.000	69.625	94.628	7.575	16.425	0.000	
89.000	118.263	94.628	125.272	15.063	14.200	0.000	



Proposed Design Ch. (Km)		Existing Ch. (Km)		Concentric & Excentric widening (Km)	Realignment (Km)	Bypass (Km)	Remarks
From	To	From	To				
Total Road Length (Km)				54.488	55.775	0.000	

#### 0.2.9 Formation & Carriageway

The formation width in the section from Aizawl to Keitum (Km. 0 – 125) varies from 4.80 m to 13.30 m and the carriageway width varies from 3.66 to 7.00 m. the width of shoulders on the valley side is mostly inadequate. In the urban areas, the formation widths are reduced due to encroachments. Widening the existing road even to 2-lane standards would be difficult, specially in congested areas, without removal of encroachments and Structures. The width of carriageway in the section is an under:

From Km 0.00 to Km 6.80	-	2-Lane (7.00 m)
From Km 6.80 to Km 50.00	-	Intermediate lane (5.50 m)
From Km 50.00 to Km 125.00	-	Single lane (3.66 m)

#### 0.2.10 Road Pavement

##### Existing Pavement

The condition of the existing road pavement from Km 8.000 to Km 50.000 is moderate to fair, except in landslide locations, where it is severely damaged. The pavement in the road stretch from Km 50.000 to Km 125.000 is in bad condition with potholes and raveling.

The thickness of the existing pavement varies from 350 mm to 450 mm. Strengthening has been proposed, based on the Condition Survey and BBD tests. This has been elaborately reflected in Chapter – 1 (Project Description). Provision of maintenance of the existing road by pothole filling and renewal coat during the construction stage has been made in the updated cost estimate.

##### New Pavement

Pavement studies have been carried out based on the design standards of IRC & AASHTO methods. Since the existing road is having flexible pavement, widened portion of the existing road will also have flexible pavement matching with the strengthening overlay on the existing pavement. For 2-lane carriageway also, flexible pavement option has been proposed considering the need for frequent repairs to the pavement involved in

the hills due to occurrences of landslides, slips and sinking of pavement caused by toe erosion as well as difficulty in operation of heavy equipments on hill road with steep grades and sharp curves for construction of rigid concrete pavement.

New pavement by Realignment has been proposed for 34.887 Kms and rest as widening & overlay on existing surface treating the existing surface as subgrade.

#### 0.2.11 Widening Proposal

The existing project road NH-54 from Aizawl to Keitum is generally having double/intermediate/single lane carriageway for most of the length. Widening of the existing road to 2-lane NH standard with Paved Shoulder is proposed to be done in one stage, based on the traffic requirement and the intended level of service. As per the traffic projection, the existing road after widening to two lane with hard shoulder on either side will cater to traffic up to year 2030. At present design of pavement is based on traffic of 20 msa as per IRC 37-2012.

The widening of the existing double/intermediate/single lane road to 2 lane road with hard shoulders is proposed mainly on hill side, keeping in view the limited extent of widening required for the carriageway, inadequate shoulder width available on the valley side and consideration of improvement of geometrics. In some stretches, where hill slopes are very steep, widening to two lanes has been proposed within the available road formation with standard cross-section. Earth obtained from excavation will be reutilized and balance earth disposed to Dumping places as detailed below:

Table 1: List of Dumping Ground  
NH- 54 (Mizoram). Aizawl to Keitum Section - 1

Sl. No.	Section	Sta.	Capacity of Spoil Bank
1	S1 – 1	10+600	75,900
2	S1 – 2	13+200	68,250
3	S1 – 3	15+500	24,553
4	S1 – 4	19+000	167,913
5	S1 – 5	21+700	247,680
6	S1 – 6	25+400	66,640
7	S1 – 7	29+500	50,460
8	S1 – 8	33+600	92,810
9	S1 – 9	36+700	47,266
10	S1 – 10	37+600	203,286
11	S1 – 11	38+400	11,090
12	S1 – 12	39+000	120,000
13	S1 – 13	40+200	38,326
14	S1 – 14	42+100	28,120
15	S1 – 15	44+100	60,060

Sl. No.	Section	Sta.	Capacity of Spoil Bank
16	S1 – 16	44+700	26,666
17	S1 – 17	45+600	98,666
18	S1 – 18	46+100	14,186
19	S1 – 19	48+700	53,760
20	S1 – 20	49+400	46,666
21	S1 – 21	50+600	45,013
22	S1 – 22	53+100	8,970
23	S1 – 23	53+600	19,110
24	S1 – 24	59+000	93,620
25	S1 – 25	65+400	73,670
26	S1 – 26	68+900	13,770
27	S1 – 27	73+100	54,370
28	S1 – 28	78+800	84,370
29	S1 – 29	79+600	31,666
30	S1 – 30	81+500	99,750
31	S1 – 31	82+100	43,120
32	S1 – 32	83+300	19,370
33	S1 – 33	83+800	62,500
34	S1 – 34	88+500	18,120
35	S1 – 35	88+900	31,250
36	S1 – 36	90+700	50,000
37	S1 – 37	93+400	23,750
38	S1 – 38	94+300	46,666
39	S1 – 39	97+800	37,500
40	S1 – 40	105+800	17,273
41	S1 – 41	111+000	13,960
	Total in Section 1		2,430,116

#### 0.2.12 Drainage

The existing drainage provision along the project road corridor is generally inadequate. In the built-up areas, covered drains will be proposed, and lined uncovered drains will be provided in the entire balance stretch. Major portion of the hillside drains will be dismantled during widening of the existing road on the hillside and reconstructed after widening of the road.

#### 0.2.13 Bridges

The project stretch comprises of the entire NH-54, from Aizawl (8.00) to Keitum (125.00).

In all, there is one bridge (Tuirial) on the project road, and it is a major bridge. Detailed inventory and condition survey of the existing bridge has been carried out. One Steel Arch Bridge in 75<sup>th</sup> Km has been proposed.

#### Condition of Existing Bridge

In general, the condition of the primary structural members of the existing bridge is satisfactory and no major Distresses have been observed during the Condition Survey. However, damages to wearing coat, handrails/parapet, bearings, expansion joints, drainage spouts etc. have been noticed in the existing bridge, besides spalling of concrete. Adequate provision for repairs to the existing bridge will be made accordingly in the Cost Estimate and BOQ.

#### 0.2.14 Culverts

There are in all 465 nos. existing culverts of following types along the project road:

Slab Culvert	-	38 nos
Hume Pipe Culvert	-	266 nos
Box culvert	-	234 nos
Major Bridge	-	1 no
Causeway	-	2 nos
		<hr/> 541 nos

Total proposed cross drainage structures will be as under:

Hume Pipe Culverts 1.20 m $\phi$	-	692 nos
New Box Culverts	-	10 nos
Renewed/Old Box Culverts	-	Nil
Major Bridge	-	Nil (Existing 1 no)
Major Bridge (Steel Arch Bridge)	-	1 no

All culverts will need complete replacement by new culverts which have been proposed along the entire length of the hill road to provide for adequate cross drainage.

#### 0.2.15 Tunnels & Viaducts

There is no provision of any such structure in the project corridor.

#### 0.2.16 Junction Improvement

There are in all 4 nos important road junctions at NH-150 crossing, Champai, Thenzawl and Khawlailling along the total length of the project road NH-54 from Aizawl to Keitum. These junctions have been proposed be improved to the extent required in accordance with the relevant I.R.C standards for smooth flow of traffic. Also there are 15 nos. unimportant junctions which have been proposed to be developed.

#### 0.2.17 Relocation of Utilities

Overhead Electric lines run along the road at a number of places. At few stretches, telephone lines also exist alongside the road. Both Telephone and Electric lines will need relocation in consultation with local authorities. OFC lines within roadway at few

stretches are also to be realigned. Water pipelines of PHE Deptt. are also required to be shifted in some places for the widening of the road.

#### 0.2.18 Signages & Road Markings

Signages and road markings are grossly inadequate along the project road. In order to ensure road safety, adequate provision for signages viz. overhead gantry signs, cautionary/direction/information boards etc. are proposed as per IRC:67-2001 for the entire project reach. Besides, suitable provision will be made for road markings as per IRC:35-1997. Provision of retro-reflective delineators along curves, posts/bollards, at the intersections and median openings, have also been proposed to ensure road safety.

#### 0.2.19 Landslides & Sinking Zones

There are two locations of landslides/rockslides and sinking zones along the entire length of the project road NH-54 from Aizawl to Keitum. Besides the common causative factors like nature of the hill slope forming materials – rock and slope wash, degree of slope, past tectonic and structural movements making the rocks mechanically degraded, high rainfall along with anthropogenic factors etc. cloud bursts, have made Mizoram landslide prone. Locations of major sinking areas and zig/sinking zones are as below:

- (i) Between 20.086 Km to 20.186 Km
- (ii) Between 63.252 Km to 63.352 Km

It is proposed to arrest these behaviours by Rock Bolting and Rock Anchor.

#### 0.2.20 Slope Protection Measures

The existing breast walls on the hillside have to be dismantled during hill slope cutting for widening the existing road to two lane. New breast walls have been provided at these locations. Besides, breast walls are required on the hillside at selected stretches depending upon the nature of hill slope and the extent of hill cutting involved in widening the existing road. Retaining walls have been proposed at selected locations on the valley side to protect the valley slope, wherever required at site as well as on the hillside in some stretches. Also it is proposed to have Reinforced-Earth Retaining Wall where the edge of the alignment hangs on the valley side

#### 0.2.21 Truck Lay bye, Bus bays & Bus Shelters

Suitable locations of Truck Laybys, Bus bays, View points, have been identified along the project road corridor for providing value added services to the road users, particularly keeping in view the likelihood of levy of toll/user charges after completion of widening. Details are as under:

Bus Bays	=	11 nos
Truck Laybye	=	1 no
View point	=	7 nos

#### 0.2.22 Way Side Amenities

Tourists expect way side amenities like toilets, tea/coffee and snacks bar, drinking water and other articles of emergency needs at every 40 to 50 Km intervals. Suitable locations have been identified for this purpose along the project road at Seling and Serchhip.

#### 0.2.23 Toll Plaza

There is no such case.

#### 0.2.24 Road Safety

Road safety is of paramount importance particularly for hill roads, where sharp curves and steep grades coupled with increase in speed due to road widening pose potential danger to vehicular traffic, as compared to the plain terrain. While all efforts will be made to improve the geometrics of the road to conform to relevant I.R.C standards, certain site constraints and techno-economic feasibility considerations may not permit the desired improvements to the full extent. Adequate road safety measures are, therefore, proposed along the project road to ensure safety of the road users. Typical safety measures to be taken include provision of R. C. C. crash barriers on bridge decks, retro-reflective delineators along the edge of the roadway on the valley sides and cat's eyes along the centre line of the road on the curves. In addition single 'W' type steel crash barriers will be provided along the outer curves at selected locations

### 0.3 Socio Economic Profile of Project Area

#### Project Area

The section of the project road NH-54 from Aizawl to Keitum passes through Aizawl and Serchhip Districts under Bangkawn P.S. and Serchhip P. S. of Mizoram. They constitute the project area for this segment of the project road.

#### Demographic Features

The project area from Aizawl to Keitum (Km 0.00 to Km 125.00) is predominantly rural with urban component being about 10% of the total geographical area coverage. As reported earlier the project corridor has been fixed from Km 8.000 to Km 125.000

#### Population

- (i) The size of population in the project area from Aizawl to Keitum i.e. Km 0 to 125 works out to be 3,79, 537 according to Census 2001. About 28% of the total population, are living in rural areas and 72% in urban settlements whereas the corresponding figures for the state as a whole was about 49.6%
- (ii) The number of villages in the project area was about 14 (2001 census).
- (iii) On an average the number of persons per household of the project area consists of 5 persons per household as against state average of 5 persons.

#### Economic Characteristics

The project area is primarily hilly and agrarian in character.

- Forest constitutes about 7 per cent of the total project area. Major output of forest are charcoal, fuel wood & cocoon.
- Total cropped area is estimated to be about 1,78,346 Hectares.
- The principal agricultural crops are: paddy, pulses, oilseeds and different vegetables. Horticulture products are banana, jackfruit, guava, mango, papaya etc. Moreover, forest products, like, timber, bamboo, broomstick, cane, medicinal herbs and plants and thatch grass generate considerable income in the project area. Bamboo may be a major production.

#### Industries

It has already been mentioned that the project area is predominantly rural. Industrial development in the concerned districts is insignificant. Only a few registered factories were found in the project area.

#### O.4 Investigations & Evaluations

This has been done for selection of suitable alignment for 2-laning of road sections and for optimum upgrading of existing road based on field data and detail study involving traffic, geotechnical, topographic, pavement and road condition and socio-economic aspect.

##### Traffic Survey

Traffic survey have been conducted as per the stipulations contained in the T.O.R. Types of surveys undertaken are: Classified Traffic Volume, Pedestrian Traffic, Turning Movement at intersection, Axle Load, Origin-Destination, Speed-Delay, Parking, Truck Terminal, Survey for willingness to pay Toll etc. The details of Traffic Surveys conducted are given in the Chapter 4 on Traffic Surveys & Analysis with 7.50% growth the cumulative ESA after 20 years (w.e.f. 2010) comes to 24,993,611 i.e.  $25 \times 10^6$  and after 10 yrs comes to  $9 \times 10^6$ . The average VDF is taken as 1.50 as per IRC 37 – 2012

##### Period of Survey

Traffic Surveys have been carried out over a period of three weeks during August 2009.

##### Secondary Data

Secondary Data have been collected from various organisations like Border Roads Organisation, Police Department, Statistical Handbook, Census and other published documents.

#### Utilisation of the Data

The Analysed Classified Traffic Volume data provided information on Average Daily Traffic (ADT), Annual Average Daily Traffic (AADT), Peak Hourly Traffic, Modal Split, Weekly Variation etc.

Forecasting of traffic has been done considering the base year Traffic of 2009.

#### Projected Traffic

Applying growth factor & regression, the projected traffic at five year intervals from 2009 base year are given below in passenger car units (PCU). Past traffic data from Border Roads Organisation indicate an average 6% growth of light vehicular traffic and about 7.25% growth of heavy vehicles along the project corridor. On date, PCU of Average Daily Traffic are:

H.S.-01, is Aizawl to Seling (Km 0.00 to Km 42.00) &

H.S.-02 is Seling to Keitum (Km 42.00 to Km 125.00)

In H.S.-01, it is 5,128 PCU in MB-1 & 2,843 PCU in MB-2

In H.S.-02, it is 2,096 PCU in MB-3 & 1,165 PCU in MB-4

#### Vehicle Damage Factor (VDF)

Vehicle Damage Factor has been derived from the IRC Publication and VDF works out to 1.31. However, as per I.R.C. 37-2012, the recommended VDF for design of flexible pavement in hilly terrain is 1.50.

#### Journey Speed

The average journey speed along the project corridor for the up traffic from Aizawl to Keitum is 40 Km/h and for the down traffic Keitum to Aizawl is 35 km/h.

#### Origin Destination Survey

Origin Destination survey was conducted at Zemabawk (7.10 Km) and Sailam (114.0 Km). The survey was limited to commercial vehicles only. The drivers/occupants of the vehicles were interviewed and information was collected. The sample sizes and other particulars are given below. For OD purpose 19 zones were selected and 19 x 19 matrix was developed.

#### Summary of Origin Destination Matrix

##### SUMMARY OF ORIGIN DESTINATION MATRIX

Chainage (Km)	Location	Direction	Intrastate Traffic (%)	Assam Traffic (%)	Rest of India Traffic (%)
8.600	Zemabawk	Up	41.860	46.512	11.628
8.600	Zemabawk	Down	72.340	19.149	8.511



114.400	Sailam	Up	24.429	64.286	14.286
114.400	Sailam	Down	50.000	33.333	16.667

Intrastate traffic are those traffic whose movements are inside Mizoram only. Assam traffic are those traffic which are either originating from Assam state or moving into Assam state. Rest of India traffic are those traffic which are either coming from anywhere inside India except Mizoram and Assam or moving into anywhere inside India except Mizoram and Assam.

Analyzing up direction traffic at Zemabawk (Chainage 8.600 Km), it is observed that traffic originating from Aizawl and Silchar are 35% and 30% respectively and traffic terminating at Serchhip and Lunglei are 23% and 40% respectively. In the same time down direction traffic gives traffic originating from Lunglei, Serchhip, Champhai and Zemabawk are 23%, 21%, 19% and 17% respectively and traffic terminating at Aizawl and Kolasib are 38% and 32% respectively.

Up direction OD data at Sailam (Chainage 114.400 Km) gives traffic originating from Silchar, Digboi, Shillong and Kolasib are 45%, 12%, 10% and 10% respectively. In the same time down direction traffic gives traffic originating from Lunglei and Saiha are 60% and 24% respectively and traffic terminating at Silchar, Aizawl and Shillong are 24%, 17% and 17% respectively.

OD data at Zemabawk gives 20% traffic is intrastate passenger traffic whereas no passenger traffic is observed at Sailam. There is no interstate passenger traffic observed.

#### Commodity Survey

The Commodity Survey was organised at Zemabawk and Sailam. Commodity Survey data shows 31% of Commercial Vehicles are empty, most of them moving from southern part of Mizoram to northern part of Mizoram and rest of India. Those, which are not empty mostly carrying construction material (17%) followed by Agricultural and food Products (16%)

Sl. No.	Type of commodity	% of trucks carrying the commodity		Average
		Zemabawk	Sailam	
1	Agricultural and Food Products	10.294	21.429	15.861
2	Forest Products	10.526	7.143	8.835
3	Water Tanker	1.471	0.000	0.735
4	Gas Cylinder	2.941	3.571	3.256

Sl. No.	Type of commodity	% of trucks carrying the commodity		Average
		Zemabawk	Sailam	
5	Fish	1.471	0.000	0.735
6	Animal	11.842	9.524	10.683
7	Dress materials	2.941	3.571	3.256
8	Construction materials	20.588	14.286	17.436
9	Electronics and Machinery	2.941	2.381	2.661
10	Oil Tanker	2.941	5.952	4.447
11	Miscellaneous	1.471	0.000	0.735
12	Empty	30.573	32.143	31.358

#### Tourist Traffic Survey

International tourist traffic constitutes about 2% of the total tourist traffic and the balance 98% are domestic tourists.

#### Willingness to pay Toll Survey

No exercise was made as it is not a Toll Road.

#### Need for Future Widening

No such exercise was made.

### 0.5 Design Standards

#### a) Terrain

The project road traverses through hills. Therefore, geometric standards are to be adopted as per IRC:52-2001 Hill Road Code and Hill Roads Design Manual, IRC:SP:48-1998.

#### b) Design Speed

Ruling speed and minimum speed of 40 Km/Hr and 30 Km/Hr respectively relevant for hilly terrain have been adopted. But the existing site constraints may not permit adoption of these design speeds at some locations, where improvement of geometrics of the existing road have been made from techno-economic considerations.

#### c) Cross Section

- i) 2 lane carriage way of 7.00 m width.
- ii) Paved Shoulder 1.50 m width each side.
- iii) Soft Shoulder of 1.10 m width on each side.

- iv) Parapet and drains of 0.450 m width (parapet on valley side and drain on hill side) within Soft Shoulder. Small width between end of Paved Shoulder and Hill side drain will be paved.
  - v) Camber/Cross fall for carriage way is 2.5% & 3% Soft Shoulder.
  - vi) The total Formation Width is proposed to be 12 m and the ROW width has been proposed as 24 m.
- d) Horizontal Curves
- The horizontal curves are proposed as per IRC:52-2001 for hilly terrain by carrying out necessary curve improvements, wherever feasible, keeping in view the site constraints.

#### 0.6 Environmental Impact Assessment

A study of the environmental set up of the project corridor in general and ROW in particular reveals the following salient features:

- The project road of NH-54 from Aizawl to Keitum passes through the hilly terrain and minimum length of the road falls within planted forest area. There are some built-up areas like urban/semi-urban/villages along the road and a limited stretch of the road passes through agricultural area. Major portion of road has hill on one side and deep gorge/valley on other side.
- There is one hairpin bend along the entire length of existing road. This has been bypassed.
- The National Highway (NH-54) from Aizawl to Keitum falls in Seismic Zone-V with high earthquake damage risk.
- The major road junctions (4 nos) along the entire length of the project road, have been taken for improvement. There are 15 nos minor junctions also improved.
- Some industries like, Stone Crusher, Cold Storage, Food Preservation Factory are located outside the ROW.
- Initial investigation indicates that average RPM and SPM concentrations in the ambient air are  $60\mu\text{g}/\text{m}^3$  and  $120\mu\text{g}/\text{m}^3$  respectively in the Homogeneous Section 1 and  $35\mu\text{g}/\text{m}^3$  and  $55\mu\text{g}/\text{m}^3$  respectively in and around the existing road corridor in the Homogeneous Section 2.

Both the concentrations are low and very much within the limit for residential and commercial areas.

- There is one Major River, Namely, Tuirial River in the study corridor.

- There are approx. 16,992 trees within the ROW of NH-54 from Aizawl to Keitum. Most of the trees have their girth size between 50 and 200 cm. Concentration of trees in the stretch Section 1 is the maximum and in Stretch 2 it is much less.
- There are a few temples churches and burial ground just outside the ROW.
- Telephone poles, electric poles and transformers are present at a few locations along the road particularly at urban/semi-urban stretches. Shifting of telephone cables, telephone posts, electric posts etc. have been considered to accommodate widening of the road in the stretch of NH-54.

Enhancement of environmental features has been considered giving due attention to the following aspects:

- Stabilization of slopes/preservation measures
- Proper landscaping at junctions and other suitable areas
- Improving the cultural properties along the highway
- Preservation and improvement of highway side water bodies.
- Restoration of borrow areas located on public land.

Detailed Environment Impact Assessment Report has taken care of:

- Generation of primary data on air quality, noise level, water quality and soil quality
- Collection of secondary data
- Assessment of potential positive and negative impacts on environment both during construction and operation phases of the project activities.
- Suggesting cost effective mitigation measures relevant project activities.
- Suggestion cost effective mitigation measures relevant project activities.
- Preparation of Environment Management Plan (EMP).

#### 0.7 Construction Risks

Risks and hazards always go hand in hand with construction activities. Most of them may be anticipated in advance and taken care of by proper planning and effective implementation. By such risk management, at least fatal accidents can be avoided.

Widening of the existing road will involve substantial cutting of the hills and all necessary precautions need to be taken during blasting. A check list of precautions to be taken, would be prepared and the persons to be earmarked for its implementation would be identified. Local bodies, NGOs would also be involved in this process.

Since the project alignment will generally follow the existing route particularly during widening of the existing road to 2-lane, normal traffic has to be maintained along the existing road without causing any major problem/damage to road users. Necessary arrangement has to be made accordingly with proper signages and cautionary measures.

Disposal of huge debris formed out of hill cutting & blasting during widening, keeping in view the environmental impact, will be one of the major activities to be planned and monitored. The probable places of dumping have been tabled in Chapter 5.

#### 0.8 Social Screening and Social Assessment

A comprehensive social screening and social assessment study has been carried out for the entire project road corridor through extensive field visits, consultations with project affected persons and some responsible agencies of the locality during February & March 2010. A list of affected properties indicating their nature and type viz. house, shop, temple, mosque etc. has been prepared. Besides, the field investigators have also visited the affected locations to record the details of the affected properties and collect the socio-economic data of the affected persons / households.

In the survey, it appears that the total number of structures affected would be in the tune of 834 (Private). The details are as under.

##### Type of Structures Affected

Sl. No.	Type of Private Property	Total
1	Residential	545
2	Commercial	287
4	Other / CPR Structures	2
Total		834

**Source:** Census Survey, NH-54 Project, 2014

No religious structures will be affected for widening proposal.

##### Brief Summary of the Resettlement Impact.

Sl. No.	Impacts	Number
1	Total land acquisition requirements (in hectare)	153.635
2	Total private land acquisition requirements (in hectare)	108.885
3	Total number of land units/plots affected	856
4	Total number of private land units/plots affected	834
5	Total number of private structures affected	834
6	Total number of Household affected	2908
7	Total Number of Informal Dwellers	288
8	Total Number of Vulnerable households affected	757
9	Total number of displaced persons (DPs)	2908
10	Total number of CPRs affected	12

Sl. No.	Impacts	Number

The total stretch will be divided into 4 packages.

DESIGN ROAD LENGTH IN KM (8.000 Km To 118.263Km)	110.263 Km
STRUCTURE LENGTH INCULDING APPROACH SLAB	0.306 Km
NET ROAD LENGTH IN KM	109.958 Km

Broadly, the following provisions have been made in the Estimate:

- √ Land Acquisition
- √ Resettlement & Rehabilitation
- √ Relocation of Utilities
- √ Drainage and Slope Stability Measures
- √ Treatment of land slide and sinking zones
- √ Bridges and Culverts – new construction, widening & strengthening of existing bridges
- √ Improvement of junctions

- √ Roadside amenities including landscaping, Bus bay etc.
- √ Signages, Road marking, Road Safety measures including illumination at junctions etc.
- √ Environment Mitigation Measures including river bank protection
- √ Maintenance of road during construction period

Rates have been assessed as per MORT&H Standard Data Book, June 2003, Mizoram (NH) PWD Current Schedule of Rates of 2014 and in absence of any item therein, by analysis of market rates.

#### 0.10 Economic Analysis

Economic analysis has been carried out to establish the economic viability of the project. The analysis has been done by using HDM IV program, with input data collected from field surveys/investigations as well as preliminary cost estimate etc. worked out for the purpose.

#### 0.11 Summary of Improvement Proposal

The following are the major conclusion of the Final DPR Report for 2-laning of Aizawl to Keitum road NH-54:

##### Alignment and Cross section

- The alignment for 2-laning is proposed mostly eccentric on hillside due to inadequate space on the valley side. Some encroachment in valley side has also been done. Reinforced-Earth Wall has been constructed in such case
- 450 mm wide drain on hillside and 450 wide parapet wall on valley side are proposed.
- The main cross sectional elements of the 2-lane road are proposed as under:

Carriageway = 2x3.50 m	= 7.00 m
Hard Shoulder = 2x1.50 m	= 3.00 m
Soft shoulder including 0.45 parapet & 0.45 m wide drain = 1x2.00	= 2.00 m
TOTAL	= 12.00 m

In a meeting taken by Mr. S. K. Verma, C. E. (N.E.R.)/MORT&H on 07.08.14 in New Delhi it was decided to improve the road from existing chainage Km 8.00 to Km 125.00. It was also decided that the proposal of a Bypass of Aizawl will be taken up as separate project and not within the perview of present project.

##### Pavement & Road Junctions

- Strengthening of the existing intermediate lane pavement are made with bituminous overlay based on the traffic volume and BBD test results. New pavement of designed thickness will compose of granular base and bituminous layers composed of D.B.M. and B.C. for widening of the existing



intermediate/single lane road to 2-lane road and construction of soft shoulder.

They are as under:

Junction Improvement	Overlay on existing pavement	New/Widened pavement	Remarks
GSB = 300 mm WMM = 250 mm DBM = 100 mm BC = 40 mm	GSB = 300 mm WMM = 250 mm DBM = 100 mm BC = 40 mm	GSB = 300 mm WMM = 250 mm DBM = 100 mm BC = 40 mm	Considerations: CBR = 5% Growth = 7.50 % VDF = 1.50 15 Yr. Design ESA = 16 msa 20 yr. Design ESA = 25 msa Present Design ESA = 20 msa Base Year = 2009

- Improvement of junctions with at-grade intersections with the existing road and provision of new road junctions, where applicable.
- As per IRC 37-2012, 20 msa and 5% CBR has been considered for design of pavement.

#### Miscellaneous

- ❖ Provision of slope stability/erosion measures for land slide prone/sinking areas.
- ❖ Provision of signages road markings, crash barriers etc. to ensure road safety.
- ❖ Provision of stone masonry / concrete hillside drains and breast walls and parapet walls on valley side.
- ❖ Provision of bus bay, wayside amenity, view point.
- ❖ Provision made for L. A. and shifting of utilities along the project corridor.
- ❖ Environmental mitigation measures proposed during construction based on EIA Study. Spoil bank has been considered.
- ❖ R & R measures are proposed as per MORT&H / ADB norms.

# **Chapter - 1**

## **Project Description**

## CHAPTER - 1

### PROJECT DESCRIPTION

#### 1.1 EXISTING SCENARIO

##### 1.1.1 GENERAL

The Project Road is under cover of the Consultancy Services for Feasibility Study and Detailed Project Report from Aizawl (Km 0.00) to Keitum (Km 125.00) in the State of Mizoram of NH-54.

The road is being maintained by PWD.

The road is intermediate / single lane and at some places it is even less. Due to rapid growth of tourism industry in Mizoram and insufficient lane width, there is a need for improvement / widening of this road. This is also needed for trade with Myanmar.

The project road falls in the districts of Aizawl & Serchhip in the state of Mizoram. The road is fully in hilly terrain having hills on left. The road has lot of sub-standard curves including hairpin bend. As per the provisions of TOR and Design Standards as adopted, Deficiencies of the existing geometrics and sub-standard curves have been improved to the extent possible to match NH standard specified for hill road relevant to hilly terrain.

##### 1.1.2 TOPOGRAPHY

This stretch of road runs along the foothills of Lusai Mountain, which is quite young and has typical character of varied composition and stability problems of slides and sinking. Major part of the road is situated in the hilly terrain. The entire road runs through the high rainfall region. Because of topography and terrain, innumerable Jhoras have crossed the road at various locations.

The road is located between longitude 92-20° E, and 93°29' E, and latitude 20.20° N and 24.27° N. The existing road is mainly an intermediate / single lane highway having formation width ranging from 6m to 8m and carriageway width varying between 3.66m to 7m with roadside drain on the hillside. At places, the drains on the hillside are not lined. The overall condition of the drains is fair.

##### 1.1.3 ENVIRONMENT AND LAND USE

It lies within the high rainfall areas with lot of trees and vegetation growth along the road. The maximum rainfall takes places during the months from May to September. The configuration of mountains also has an impact on the strong moisture laden monsoon wind and causes variation in rainfall. The average annual rainfall is 2540 mm/year.

The Climate in this region is generally cool and is cold during winter months.

All along the road, lot of matured trees of various girth have been found abutting the road. Many of these trees need to be felled to accommodate the widening scheme of 2 lane carriageway. Environmental screening around the project road has been carried out in details as per norm.

#### 1.1.4 RIGHT OF WAY (ROW), BUILT-UP AREAS & ENCROACHMENT

The ROW from Aizawl (0 Km) to Keitum (Km 125.0) in the state of Mizoram is varying. This information regarding ROW has been verified from BRO, Project Pushloak. They have reported that average ROW is 36.58m. But this is not so ROW recommended is 24.00 m. There are some built-up areas like semi-urban/villages spread over the length of the project road and limited stretches of the road also pass through agriculture area. The important semi-urban/villages in this stretch are listed below.

Sl. No.	Name of urban / semi-urban / villages	Existing Km.
1	Bawangkawn	02-03
2	Thuampui	05
3	Zemabawk	06, 07, 08
4	Tuirail	25
5	Seling	40, 41
6	Thingsulthliah	45, 46
7	Darlawng	57
8	Tlungvel	59, 60
9	Phulmawi	65
10	Khumtung	67
11	Chingchip	81, 82
12	Chhishtlang	99, 100
13	New Serchhip	107, 108
14	Serchhip	110, 111, 112
15	Keitum	125

#### 1.1.5 CARRIAGEWAY & PAVEMENT

The existing road surface was fair to good with places of visible pavement distress. Recently, BRO has taken up the work of new bituminous surfacing. The carriageway width varies between 3.66m and 7.00m with average pavement thickness of 350mm comprising one layer of hill slope materials used as granular sub-base of thickness

250mm, WBM 200mm and bituminous P.C. layer of 25mm thick on top of it. The Road Inventory and Pavement condition Survey have also been carried out as per norms and are furnished Appendix 1.1 & 1.2.

The average CBR of sub-grade soil varies from 5% to 10%. For design of overlay on the existing pavement Benkelman Beam Deflection Technique has been used. The field data and analysis thereof have been used for the purpose of pavement design. The findings are as under:

On Existing Pavement	On Major / Minor Junction	On New / Widened Pavement
Overlay: GSB = 300 mm WMM = 250 mm DBM = 100 mm BC = 40 mm	GSB = 300 mm WMM = 250 mm DBM = 100 mm BC = 40 mm	GSB = 300 mm WMM = 250 mm DBM = 100 mm BC = 40 mm

#### 1.1.6 PROTECTIVE WORK AND ROADWAY DRAINAGE

##### RETAINING WALLS & BREAST WALLS AND REINFORCED-EARTH WALLS

The stretches of the hill by the side of the road consist of soft rock, ordinary soil mixed with boulder. The hill slopes are protected by Breast Walls and Retaining Walls of varying heights on hillside to protect the hill face and ensure stability of hills. On the valley side, protection of the bench is done by the retaining walls of different heights and also to maintain the proper geometrics of the road Provision of Reinforced-Earth Wall has been made. The Inventory and Condition Survey of Breast & Retaining Walls are furnished in Appendix 1.3

##### DRAINAGE

Site reconnaissance and Investigation at the site indicate very little drainage problem of the roadway surface in the rural areas, except in the built-up areas, where the drainage condition is poor. In some of the built up areas, roadside drains have been provided, but their drainage capacity is not adequate. In some of the built-up areas, proper drains have also not been provided causing local drainage problem and associated distress of the pavement surface.

In tune with the topography and terrain, roadside drains as have been provided on the hillside will be dismantled. Provision has been made for construction of new drains on the hillside of the widened roadway. Since drainage is one of the most vital and important components of hill roads, due care has been taken to provide adequate drains with

suitable outlet into the cross-drainage structure including protective works on the valley face, as required. The data regarding Inventory & Condition survey of drains have been included in Appendix 1.4

#### 1.1.7 BRIDGES & CROSS-DRAINAGE STRUCTURES

The project stretch comprises of Aizawl to Keitum (Km 0.00 to Km 125.00). In all, there is one major bridge and there are 541 nos culverts of different size in this stretch. Inventorisation and condition survey of these cross-drainage structures have been done by a team of experienced Bridge Engineer and Hydrologist and the reports have been furnished, in prescribed format in the Appendix 1.5 & 1.6. The conditions of the bridge is, in general, satisfactory and no major distresses in the bridge has been noticed during the condition survey. The structures are as under:

RCC Major Bridge	-	1
Slab Culverts	-	38
Box Culverts	-	234
H. P. Culverts	-	266
Causeway	-	2
		<hr/>
		541

#### 1.1.8 TRAFFIC

Various types of Traffic Surveys as outlined by NHAI in the T.O.R. and indicated / detailed by Consultant in the Quality Assurance Plan have been undertaken during August 2009.

##### TYPES OF SURVEYS:

Classified Traffic Volume, O-D, Axle Load, Speed & Delay, Turning Count, Truck Terminal, Pedestrian Counts etc. have been undertaken and analysed.

##### THE HIGHWAY:

The total project road is from Aizawl to Keitum. For the purpose of homogeneity of development & assessing traffic thereof, the project has been divided into two sections:

- a) Section I - Km. 0.00 to Km. 42.00 - 42 Km
- b) Section II - Km. 42.00 to Km. 125.00 - 83 Km

##### CLASSIFIED TRAFFIC VOLUME:

This mid-block count survey has been undertaken at 4 places as detailed below:

- i) MB-1 Zemabawk (Km. 7.10)
- ii) MB-2 Seling (Km. 40.20)
- iii) MB-3 Serchhip (Km. 109.80)

iv) MB-4 Keitum (Km. 124.30)

For this stretch of Road, results of traffic survey in the Homogeneous Section  
– I & II has been reproduced below:

Mid Block Count

Classified Traffic Volume Count

Classified Average Daily Traffic in Number

Homogenous section	Count station ID	Weightage	Fast Moving Vehicle								Slow Moving Vehicle			Total vehicles	Commercial vehicle per day
			Two wheeler	Three wheeler	Car / Jeep / Van / Taxi	LCV	Bus	Truck	Agri tractor	Total	Cycle	Cart	Total		
HS-01	MB-01	0.500	642.857	3.857	1464.571	341.286	577.000	361.571	0.000	3391.143	0.286	3.571	3.857	3395.000	1279.857
	MB-02	0.500	361.571	311.000	867.429	261.286	71.000	197.429	0.000	2069.714	19.857	92.286	112.143	2181.857	529.714
	Weighted average		502.214	157.429	1166.000	301.286	324.000	279.500	0.000	2730.429	10.071	47.929	58.000	2788.429	904.786
HS-02	MB-03	0.500	244.714	116.571	423.714	186.286	91.429	292.429	0.429	1355.571	1.571	0.000	1.571	1357.143	570.143
	MB-04	0.500	83.000	16.000	271.286	118.429	46.571	133.429	0.000	668.714	2.286	39.000	41.286	710.000	298.429
	Weighted average		163.857	66.286	347.500	152.357	69.000	212.929	0.214	1012.143	1.929	19.500	21.429	1033.571	434.286

Classified Average Daily Traffic in PCU

Homogenous section	Count station ID	Weightage	Fast Moving Vehicle								Slow Moving Vehicle			Total vehicles
			Two Wheeler	Three wheeler	Car / Jeep / Van / Taxi	LCV	Bus	Truck	Agri tractor	Total	Cycle	Cart	Total	
HS-01	MB-01	0.500	321.429	3.857	1464.571	511.929	1731.000	1084.714	0.000	5117.500	0.143	10.714	10.857	5128.357
	MB-02	0.500	180.786	311.000	867.429	391.929	213.000	592.286	0.000	2556.429	9.929	276.857	286.786	2843.214
	Weighted average		251.107	157.429	1166.000	451.929	972.000	838.500	0.000	3836.964	5.036	143.786	148.821	3985.786
HS-02	MB-03	0.500	122.357	116.571	423.714	279.429	274.286	877.286	1.929	2095.571	0.786	0.000	0.786	2096.357
	MB-04	0.500	41.500	16.000	271.286	177.643	139.714	400.286	0.000	1046.429	1.143	117.000	118.143	1164.571
	Weighted average		81.929	66.286	347.500	228.536	207.000	638.786	0.964	1571.000	0.964	58.500	59.464	1630.464

The projected design traffic for flexible pavement after 10 yrs, 15 yrs & 20 yrs are 9.00 msa, 16.00 msa & 25 msa respectively. But for pavement design 20 msa has been considered.

### 1.1.9 GEOMETRIC FEATURES AND DEFICIENCIES

Geometrics of the existing road from Aizawl to Keitum (Km 0.00 to Km 125.00) does not fully match with the NH standard relevant to hill roads. Over the entire stretch of 125 Km of road, the degree of curvature is around 614°/Km. (In HS-01 it is 553°/Km & HS-02 it is 675°/Km.)

The existing road constructed long back was widened to present day width in stages without much improvement of geometrics. As such, the road has several geometric deficiencies with respect to present day NH standards i.e. deficient reversal of superelevation corresponding to minimum design speed of NH specified in IRC:52-2001.

In places of reverse curves, proper space needs to be provided to accommodate reversal of superelevation for safe and comfortable journey. The deficient curves have been corrected as far as possible while finalizing the horizontal alignment for 2-laning. In certain cases some realignments and Bypasses have been proposed for easing deficient curves.

#### 1.1.10 SLIDING/SINKING AREA

Border Roads Organisation (BRO), who are in charge of maintenance and improvement of the instant project road from Aizawl to Keitum, have since then identified two major sinking areas along the project road and have got geological investigations done through the organizations like GSI and CRRI to find out long term solution to the perennial problem of slides. The brief history and causative factors, as identified, are enumerated in subsequent paras:

Sinking / Sliding areas at Km.21<sup>st</sup> & Km.64<sup>th</sup>: Causative factors:

- Adverse Slope Morphology (Slope greater than 60°);
- Weathered and fractured interbonded rocks;
- Decrease in shear strength of the rocks due to ingress of water through cracks & fissures and subsequent change of pore pressure;

#### 1.1.11 UTILITIES, ROAD FURNITURE AND TRAFFIC SIGNS

##### UTILITIES

There are various utilities of different nature all along the project corridor. Those falling within the proposed widened corridor need be shifted / relocated properly, so that the road can be widened without hindrance. The utilities like Electric Posts, Telephone Posts, Light Posts, Optical Fibre Cable and Transformer etc. are required to be shifted. They have been shown in Relocation drawing Appendix 1.7.

##### ROAD FURNITURE

There are bus stops all along the road at the specified points for the buses, which ply regularly from Aizawl to Keitum. Some Bus Bays, View Points and Truck Lay Bys have been proposed in addition.



## SIGNAGES & CAUTIONARY BOARDS

The signages and information/cautionary boards are existing along the project road. These are, however, inadequate considering NH standards and the more need for safety on hill roads. Increased numbers have been provided in BOQ.

### 1.2 WIDENING PROPOSAL

#### 1.2.1 IMPROVEMENT PROPOSAL

The existing project road NH-54 from Aizawl to Keitum is generally having 7.00m/5.50m/3.66m wide carriageway for almost the entire length. Widening of the existing road to 2-lane standard has been done from Km 8.000 to Km 125.000 including Bypasses & realignment. This change of starting point has been effected as decided by Chief Engineer (NER) in a meeting on 07.08.2014

#### 1.2.2 CROSS SECTIONAL FEATURES

Since the project road is situated in hilly terrain, the different elements have been provided giving due consideration to the topography, existing site constraints keeping in view the provisions of IRC:52-2001 applicable for Hill Road :-

(2-lane Road with Soft Shoulders)

i)	Parapet on the valley side	1×0.450	-	0.450mm	(Present width of carriageway)
ii)	Unpaved shoulder adjoining parapet	1×1.100	-	1.100mm	From Km 0.00 to Km 6.80 = 7.00 m From Km 6.80 to Km 50.00 = 5.00 m From Km 50.00 to Km 125.00 = 3.66 m
iii)	Paved shoulder	2×1.500	-	3.000mm	
iv)	Main Carriageway		-	7.000mm	
v)	Hill side drain	1×0.450	-	0.450mm	
	Total Formation Width			12.000mm	

### 1.2.3 BRIDGES AND CROSS DRAINAGE STRUCTURES

In the project length the numbers are as under:

Major Bridge	-	1
Slab Culvert	-	38
Box Culvert	-	234
H.P. Culverts	-	266
Causeway	-	2

#### 1.2.3.1 RECONSTRUCTION OF BRIDGES

There is no such case.

Reconstruction of a bridge on a hill road is a difficult and in some cases an impartial task. Apart from cost involved, the three stages of reconstruction viz. provision of a suitable diversion, dismantling of the existing bridge and finally completing the new construction, will create prolonged disruption of road service. This road being the life-line to Mizoram, maintenance of traffic movement is of paramount importance and must be given due consideration. One steel Arch Major Bridge has been proposed.

#### 1.2.3.2 CULVERTS

There are 538 nos culverts in this Section. All the HP culverts require replacement while the remaining ones have to be dismantled to match with the 2-lane road width.

#### ADDITIONAL MEASURES

It is proposed to provide some additional Box culverts at suitable locations in order to cater to the drainage congestion likely to occur in future. This, along with suitable and adequate drainage facilities, will certainly help in reducing the occurrence of land slides in hill / valley faces and also sinking of the road surface.

### 1.2.4 GEOLOGICAL REPORT ON FEASIBILITY

The folded structure of the Mizoram ranges are at the junction of two moving tectonic plates, (Indian and Burmese Desi Kachar 1974). The folded hilly or mountainous North South belts, with perpendicular faults, comprise sediments of the Surma, Barail, Tipam groups and Aluvium in riverbeds consisting of deposits of argillaceous and arenaceous sandstones, shale, siltstones & mudstones and greywacke. The rock system is weak unstable, weathered and prone to seismic and weather influence producing landslides. The soft, black to grey rock is used locally for building materials and for low trafficked

road construction work. There are no useful minerals of economic significance apart from clays in the River Tlawng beds.

Typical soils are sandy loam, clay loam that have been heavily leached due to the high slopes leaving it porous and lacking in minerals or humus.

A number of oil and gas exploration activities have taken place due the geographical condition with which Mizoram has been formed, leading to the possibilities and high expectation that reserves of oil would be confirmed. France, Russia and Cyprus as well as several Indian companies have already signed a 12% oil and 10% gas royalty arrangement with proceeds going direct to Mizoram state on any production (April 2009).

#### 1.2.5 SOIL AND MATERIAL INVESTIGATIONS

The soil and material investigation work on existing pavement subgrade was performed along the highway from km 0.00 to km 125.00 of NH-54. The investigations were performed by conducting in-situ tests and supplemented by Laboratory tests. Field data for condition survey of Shoulder and Embankment are furnished in Appendix-1.9

The in-situ tests consisted of determination of density of the subgrade soil and the corresponding field CBR values as determined by DCP tests based on TRRL method. The laboratory tests were performed on bulk soil samples as collected from each test pit locations. The tests in the laboratory consisted of determination of particle size distribution and atterberg limits, modified proctor density tests and related CBR values.

In addition to above, borrow materials such as fine and coarse aggregates were tested in the laboratory for evaluation as to their suitability for use in construction of the proposed highway. The locations of the quarries for both coarse and fine aggregates are also shown in Appendix volume of this report.

In general test data reveal that in-situ field dry density at the existing pavement subgrade varies in the range of 1.52 to 1.89 gms/cc and the corresponding CBR values are in the order of 5% to 10% based on field DCP tests, whereas the laboratory CBR values vary in the range of 5% to 10% in 4-days soaked condition. However, 5% CBR value has been adopted.

#### 1.2.6 IMPROVEMENT OF GEOMETRICS

While designing the horizontal alignment due consideration has been made to adopt the design standards already specified elsewhere. Based on the design standards adopted for steep terrain the deficient curves have been improved to NH standard as far as possible. It appears that the existing curvature is high i.e.  $553^0/\text{km}$  in HS-01 &  $675^0/\text{km}$  in HS-02. The project corridor being in hilly terrain, these were improved much and this attracted some hill cutting and some overhang in Valley side.

In a meeting CE/NH/Mizoram on 10.02.10 (in his chamber), the question of a bypass of Aizawl was discussed. The proposal of CE/NH could not be covered in this Agreement. However, in a meeting taken by CE(NER)/MORT&H on 07.08.14 in New Delhi, it was decided that DPR may be done from km 8.000 to km 125.000 to avoid Aizawl Bypass.

#### 1.2.7 JUNCTIONS

There are in all 04 nos. major road junctions and 15 nos minor road junctions along the total length of the project road of NH-54. These junctions will be improved to the extent possible in accordance with the relevant I.R.C. standards for smooth flow of traffic. Appendix 1.8. The major junctions are in the following existing chainages.

a) 38.000 Km - Cutting of NH-150 (y)	b) 40.856 Km – Cutting of Champai
c) 114.209 Km - Thenzawl	d) 124.145 Km - Khawlailung

#### 1.2.8 TOLL PLAZA

There is no such case.

#### 1.2.9 TRUCK LAY BYES

In a hilly terrain due to site constraints as well as on consideration of safety of vehicles parking of heavy vehicles like trucks are not permitted to park anywhere except at specified locations. In the instant package truck lay bye has been proposed near end of Serchhip Bypass at 114<sup>th</sup> existing km.

#### 1.2.10 BUS BAYS

There is no such case. But there will be 11 Bus Bays. Main Bus Bays will be as under:

- i) Existing km 10.000 (Near Zemabawk)
- ii) Existing km 38.250 (Near Seling)
- iii) Existing 97<sup>th</sup> km (Near Serchhip)

#### 1.2.11 RETAINING WALLS & BREAST WALLS

In the existing road, Breast Walls and Retaining Walls have been found to exist at many places. The condition of existing breast walls is generally fair to good. Retaining Walls, wherever existing, are found to be fair. Since the road will be widened on the hill side mainly, many breast walls will have to be dismantled to facilitate hill cutting. In the locations, where breast walls have already been provided, the hill abutting the road was found to consist of soft disintegrated and weathered rock, ordinary soil mixed with boulders.

Suitable breast walls of adequate dimension have been proposed to be erected to protect the hill slope on consideration of stability.

#### 1.2.12 SHIFTING OF UTILITIES

All the electric / telephone poles and lines including underground OFC lines within the existing ROW will be shifted as per guidelines given in IRC: 98-1997. Proper headroom for crossing of HT lines will be kept. The relocation strip plan is prepared for the purpose of submission as per provision of TOR.

#### 1.2.13 ROAD FURNITURE

Traffic safety is the most important part in geometric design. Drivers of all categories as well as other road users must be informed well ahead of time regarding compulsion they have to maintain for their own as well as others' safety, the necessary information to satisfy their query relating to locality, distance covered, distance of important places ahead, distance of destination, directions showing adjacent areas etc.

##### TRAFFIC SIGNS:

Traffic signs of the following categories (i) Mandatory, (ii) Cautionary and (iii) Informatory types have been assessed to meet the site conditions and provision has been made for retro reflective type as per IRC:67 and ISTMI Std E:810 standard in the cost estimate.

##### MARKINGS:

Markings on road is very essential, particularly at night in a hilly terrain. The edge marking with yellow continuous line in thermoplastic paint of specified standard ensures the driver to manoeuvre the vehicle safely while broken white lines along the centre line will ensure smooth flow of disciplined traffic. Provision for such markings has been made.

#### OTHER ROAD APPURTENANCES:

200-metre, Kilometre and 5<sup>th</sup> Kilometre stones are to be provided all along the road as per IRC standard. Boundary stones are to be provided to establish the ROW and this should be incorporated in the as-built drawings for future use.

Road delineators used to provide visual assistance to drivers particularly at night, have been incorporated where necessary.

Concrete crash barriers are essentials required at bridge approaches, near edges of the road and particularly at curves.

Guard rails are essential in built up areas to check pedestrian infiltration and to guide pedestrian crossing at defined locations marked by zebra crossing.

The existing provisions in respect of some of the components of road furniture are totally inadequate and in some cases not existing at all. Necessary provision are being made for adequate numbers with new provisions of missing components.

#### 1.2.14 ROAD SAFETY

The road safety can be ensured and improved through the improvement of road characteristics such as geometric design, surface condition, illumination, road development etc.

DESIGN SPEED: At present the vehicles are not running at a high speed even on intermediate lane of this hill road. Rumbling strips, caution boards are to be fixed to restrict the speed within the limit of design speed.

ROAD GEOMETRICS: The existing horizontal curves have been upgraded as far as possible so that road safety is ensured.

PAVEMENT SURFACE: Care has been taken to improve riding quality of pavement. The existing pavement is bituminous. Overlay will be applied on the existing surface thereby improving the riding quality.

Intersections will be geometrically improved on the basis of traffic data adopting relevant IRC/MORTH standard design.

ROAD SIGNS, CAUTIONARY BOARDS : Proper retro-reflective road signages, cautionary boards have been provided in adequate numbers to ensure road safety.

Guard walls, crash barriers as required will be provided on valley side, on bridges and approaches.

## **Chapter - 2**

### **Summary of EIA/IEE and Action Plan**



## CHAPTER - 2

### SUMMARY OF EIA/IEE AND ACTION PLAN

Widening and Upgradation of road shall have some direct impact on environment. It is necessary to undertake Environmental Impact Assessment study for the proposed project to assess the potentially critical impacts of the project on environment in order to suggest the mitigate measures. The objectives of the present 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.

The existing environmental setting has been assessed from two perspectives, regional and local. The regional environment has been defined as a corridor of 15 km on either side of the proposed project road, while the local setting pertain to the environmental features within and adjacent to the ROW.

The Examination for "EIA/EMP for 2 - laning of NH-54 from Aizawl to Keitum has been carried out.

Road projects are generally undertaken to improve the economic and social welfare of those using the road or served by it. Increased road capacity and improved pavements can reduce travel times and lower the costs of vehicle use. Benefits include increased access to markets, jobs, education and health services, and reduced transport costs for both freight and passengers, reduce fuel consumption and exhaust emissions from the vehicle plying on the road.

The main objective of environmental screening of the proposed project is the early determination of the potential magnitude of environmental impacts due to the proposed widening of the project road.

The section of the project road (NH- 54) from the starting point at Aizawl (Km 0) to Keitum (Km 125) having a length of 125 Km is in the state of Mizoram. The project corridor lies in Seismic Zone V. Socio economic profile of the state of Mizoram along the project corridor is likely to be influenced by the widening of the road to 2 lane standard. In the meeting on 07.08.14 taken by chief Engineer (NER) / MORT&H in New Delhi it was requested to carry on the DPR work from 8.000 Km to 125.000 Km .The Draft Project Report, therefore, has been recast accordingly.

The maximum average temperature in the summer in Mizoram is 30°C, while in the winter the minimum average is around 11°C. The four months between November and February are winter time in Mizoram, which is followed by the spring. The three months from June to September are known as the rainy season. The climate is at its moderate best in the two autumnal months.

Rainy season is from May to September. The average rainfall is 250 cm per year. In September and October, the temperature moves between 19°C to 25°C.

The following environmental features are noteworthy.

- Around 15 Km of the project areas no Protected areas, National Parks, Wild life Sanctuaries Biosphere Reserve Marine Parks are found. No wet lands or catchment areas are noticed. But there is a Planted Forest at 25th km of NH- 54 on either side of River Tuirial. There are also some plantations (both private and Govt.) on either side of the road. Tawi Wild Life Sanctuary (60 Sq.km) is located 62 Km away from the Highway. Presence of wild animals like Tigers, Elephants, Black Bears, Bison, Langurs, Porcupines, Mongoose etc. have been reported in the jungles/sanctuary
- There are no critically polluted areas listed by Central Pollution Control Board.
- No State or International boundaries exist within 15 km of either side of the Highway.
- There are no eco sensitive zones around 15 Km of the project area.
- There is no mangrove vegetation around the site and no endangered species are found.
- The site does not have any history of Industrial pollution and so no question of any penalties levied by the Pollution Control Board.
- There are no fishing Villages around 15 Km of the site.
- There is no salt water intrusion, flooding due to sea level rise and climate change.

In the local settings, monitoring data for air, quality, water quality and noise quality have been recorded.

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 involves mainly widening and improving the existing road, the overall environmental and social impacts will be low. Impacts during both construction and operation phases are considered.

During up gradation of road from single lane to 2 lane standards 16992 trees of different species out of 23,596 trees shall have to be felled. Accordingly 51,000 trees shall have to be planted.

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

Total tentative cost calculated for implementation of EMP is in the tune of Rs. 1382.10 Lakhs including environmental monitoring during construction phase and operational phase. The cost of such programmes may be shared by the MORT&H, Government of India, and Mizoram Pollution Control Boards.

## **Chapter - 3**

### **Summary of Resettlement Plan**

## CHAPTER – 3

### SUMMARY OF RESETTLEMENT PLAN

#### 3.1 The Project

Mizoram is a land of rolling hills, valleys, rivers and lakes. As many as 21 major hills ranges or peaks of different heights run through the length and breadth of the state, with plains scattered here and there. The average heights of the hills to the west of the state are about 1,000 metres (3,300 feet). Mizoram has a mild climate, comfortable in summer 20 to 29 °C (68 to 84 °F) and never freezing during winter, with temperatures from 7 to 21 °C (45 to 70 °F). The region is influenced by monsoons, raining heavily from May to September with little rain in the dry (cold) season. The average state rainfall is 254 cm (100 in) per annum. In the capital Aizawl, rainfall is about 208 centimetres (82 in) and in Lunglei, another major center, about 350 centimetres (140 in). The origin of the Mizo people, like those of many other tribes in the north-eastern India, is shrouded in mystery. Mizo history in the 18th and 19th century is marked by many instances of tribal raids and head hunting led by the village chieftains. The Lushai Hills Autonomous District Council was formed in 1952 and it led to the abolition of chieftainship. The great majority of Mizoram's population consists of several ethnic tribes who are either culturally or linguistically linked. These ethnic groups are collectively known as Mizos (Mi= People, Zo= Hill). One should note that 'Mizo' is a generic term which denotes a particular group of hill people who are closely linked culturally and linguistically. The formalization of the state of Mizoram took place on 20 February 1987. According to 2011 census report, Mizoram has literacy rate of 91.58%, second only to Kerala. It scores approximately 93.4% in sanitation. Mizoram also has the 2nd highest urbanization rate in India with 22 towns included.

The project corridor is located in the state of Mizoram passes through Aizawl district and Serchhip district of Mizoram. The report is based on social screening exercise conducted over the entire length of the project corridor measuring about 125 km. The project road starts from km 0.00 of NH-54 and follow this national highway –54 upto Km 125. The section of road from Aizawl to Phulmawi (Km 65.400) falls under Aizawl District and Phulmawi to Keitum (Km 125.00) falls under Serchhip District. The Project corridor will be segmented in 2 parts i.e. Kms 0.00 to 65.400 km (Aizawl District) & 65.400 to 125.00 Km (Serchhip District).

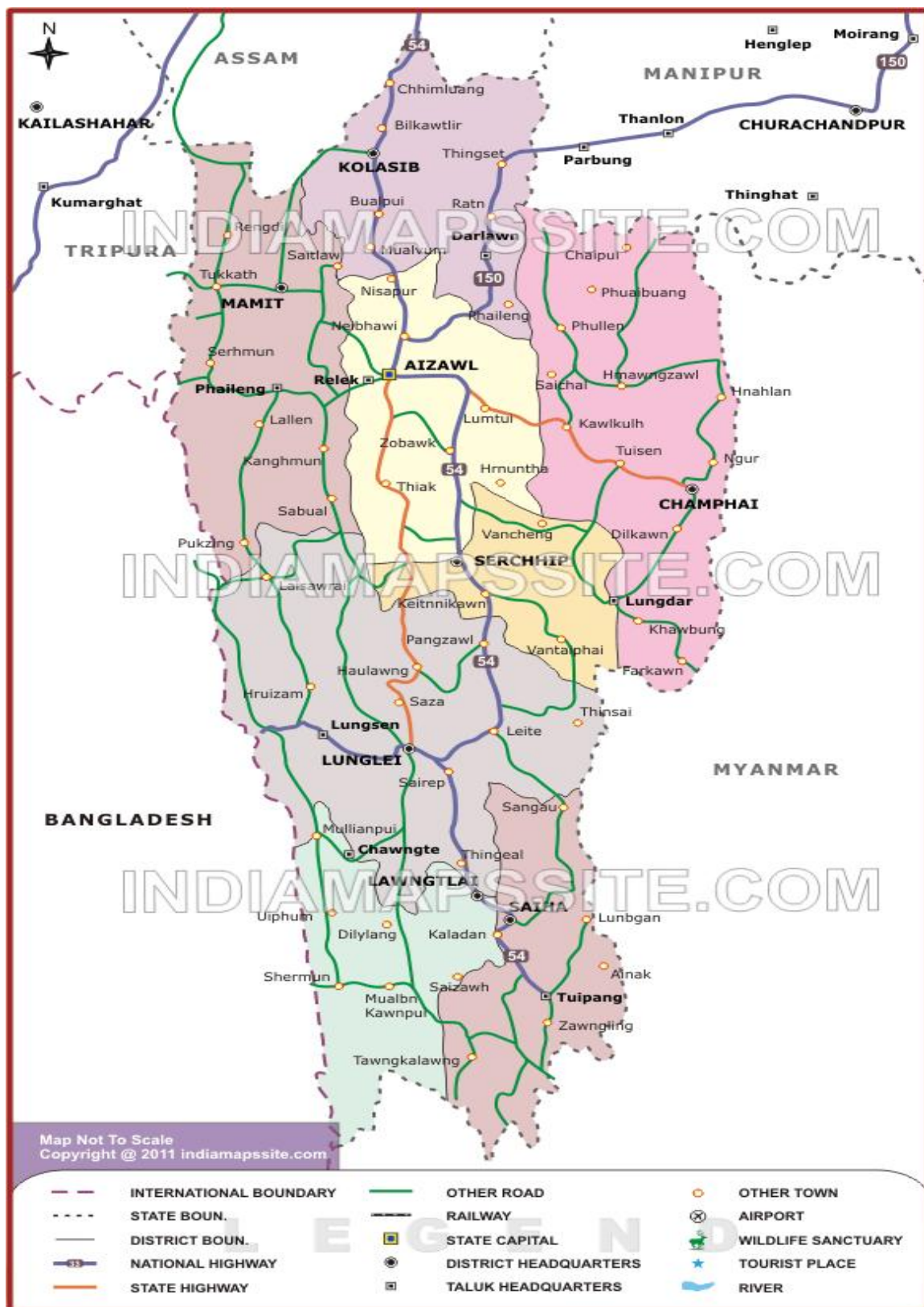
The Project road, as a whole, is located partly in Aizawl District and partly in Serchhip District of Mizoram State. This stretch of the project corridor passes through Aizawl &

Serchhip district of Mizoram and cutting across the built up areas, namely, Aizawl, Zemabawk, Airfield, Tuirialseling, Thingsulthlah, Darlawng, Tlungvel, Phulmawi, Khumtung, Bunkangkawn, Chhingchhip, Chhiautlang, Serchhip, Keitum under nine Police Station.

Adequate attention has been given during the feasibility and detailed project design phases of the project preparation to minimize the adverse impacts on land acquisition and resettlement impacts. However, technical and engineering constraints were one of the major concerns during exploration of various alternative alignments. With the available options, best engineering solution have been adopted to avoid large scale land acquisition and involuntary resettlement impacts.

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Figure 1: Depicting NH-54



This Resettlement Plan (RP) is prepared to mitigate all unavoidable negative impacts caused due to the project, resettle the displaced persons and restore their livelihoods. This Full Resettlement Plan has been prepared on the basis of census survey findings and consultation with various stakeholders. The plan complies with JICA policy for involuntary resettlement and rehabilitation.

### 3.2 Scope of Land Acquisition and Resettlement Impacts

Existing carriageway width generally varies from 3.50m to 7.0m with about 1.0 m to 1.5m unpaved shoulder on either side. Throughout the carriageway is much below the basic width requirement which is also confirmed from the Traffic Analysis. Crossing of wheel loads on unpaved shoulders has been too frequent. The existing ROW varies from 10 m to 15m. Fresh land will have to be acquired, to make up the shortfall, both along the existing NH-54 and along all the Bypasses / Realignment.

As discussed the scope of land acquisition is quite significant in the project because of availability of limited ROW and construction of some new Bypasses. According to the Land Acquisition Plan (LAP) prepared as a part of Detailed Design Report, 153.635 Hectares of land will be acquired for the sub-project. A project census survey was carried out to identify the persons who would be displaced by the project and to make an inventory of their assets that would be lost to the project, which would be the basis of calculation of compensation.

As per requirement of the Resettlement Action Plan a 100% census survey of the likely affected Displaced Persons (DP) have been conducted again in January 2014 of affected land and non-land assets of the project has been taken up. The impacts can be broadly classified as (i) impacts on private land, (ii) impacts on private structures (Encroachers and Squatters), (iii) impacts on livelihoods due to loss of private properties and (iv) loss of common property resources. It was found out that altogether 856 land units/plots including 834 private land units will be affected due to the project work. As per the survey, total 814 household comprising of 2908 DPs will be affected in the sub-project. As per the new study in January 2014 the findings are little different. The total DP of new study is 2908. The details of project impacts as discussed in both the studies have been depicted in the following section and the summary of the project impacts are presented in the (Table 1.1). Table: 1.1: Brief Summary of the Resettlement Impact.

Sl. No.	Impacts	Number
1	Total land acquisition requirements (in hectare)	153.635
2	Total private land acquisition requirements (in hectare)	108.885
3	Total number of land units/plots affected	856



Sl. No.	Impacts	Number
4	Total number of private land units/plots affected	834
5	Total number of private structures affected	834
6	Total number of Household affected	2908
7	Total Number of Informal Dwellers	288
8	Total Number of Vulnerable households affected	757
9	Total number of displaced persons (DPs)	2908
10	Total number of CPRs affected	12

Source: Census Survey on January 2014

### 3.3 Stakeholders Consultation and Participation

Focus Group Consultations with various stakeholders were carried out during various phases of project preparation. Key person and focus group consultations at section of the society were arranged at the stage of project preparation to ensure peoples' participation in the planning phase of this project and to treat public consultation and participation as a continuous two way process. Aiming at promotion of public understanding and fruitful solutions of developmental problems such as local needs and problem and prospects of resettlement, various sections of DPs and other stakeholders were consulted through focus group discussions and individual interviews.

To keep more transparency in planning and for further active involvement of DPs and other stakeholders, the project information will be disseminated through disclosure of resettlement planning documents. This report with the Entitlement Matrix after accepted by the EA and JICA would be available for disclosure on both EA's and JICA's website.

### 3.4 Legal and Policy Framework

The legal framework and principles adopted for addressing resettlement issues in the Project have been guided by the existing legislation and policies of the Government of Mizoram, Government of India, and JICA's guidelines. Prior to the preparation of the Resettlement Plan, a detailed analysis of the existing national and state policies was undertaken and an entitlement matrix has been prepared for the entire program. The section below provides details of the various national and state level legislations studied and their applicability within this framework. This RP is prepared based on the review and analysis of all applicable legal and policy frameworks of the country and JICA policy requirements.

The objectives of the Resettlement Framework as per the policies are as follows:-

- ❖ To minimize displacement and to identify non-displacing or least-displacing alternatives.

- ❖ To plan the resettlement and rehabilitation of Project Affected Families, (PAFs) including special needs of Tribal and vulnerable sections.
- ❖ To provide better standard of living to DPs; and
- ❖ To facilitate harmonious relationship between the Requiring Body and DPs through mutual cooperation.
- ❖ The involuntary resettlement would be avoided wherever possible or minimized as much as possible by exploring project and design alternatives.
- ❖ The Project or all sub-projects under the program will be screened to identify past, present, and future involuntary resettlement impacts and risks.
- ❖ The scope of resettlement planning will be determined through a survey and/or census of displaced persons, including a gender analysis, specifically related to resettlement impacts and risks.
- ❖ Meaningful consultations with affected persons, host communities, and concerned non-government organizations will be carried out and all displaced persons will be informed of their entitlements and resettlement options participation in planning, implementation, and monitoring and reporting of resettlement programs will be ensured.
- ❖ Particular attention will be paid to the needs of vulnerable groups, especially those below the poverty line, the landless, the elderly, women and children, and Indigenous Peoples, and those without legal title to land, and ensure their participation in consultations.
- ❖ An effective grievance redress mechanism will be established to receive and facilitate resolution of the displaced persons' concerns. The social and cultural institutions of displaced persons and their host population will be supported through proper planning. Where involuntary resettlement impacts and risks are highly complex and sensitive, compensation and resettlement decisions should be preceded by a social preparation phase.
- ❖ The livelihoods of all displaced persons will be improved or at least restored through (i) land-based resettlement strategies when affected livelihoods are land based where possible or cash compensation at replacement value for land when the loss of land does not undermine livelihoods, (ii) prompt replacement of assets with access to assets of equal or higher value, (iii) prompt compensation at full replacement cost for assets that cannot be restored, and (iv) additional revenues and services through benefit sharing schemes where possible.

- ❖ Physically and economically displaced persons will be provided with needed assistance, including (i) if there is relocation, secured tenure to relocation land, better housing at resettlement sites with comparable access to employment and production opportunities, integration of resettled persons economically and socially into their host communities, and extension of project benefits to host communities; (ii) transitional support and development assistance, such as land development, credit facilities, training, or employment opportunities; and (iii) civic infrastructure and community services, as required.
- ❖ The standards of living of the displaced poor and other vulnerable groups, including women, will be improved to at least national minimum standards. In rural areas legal and affordable access to land and resources will be provided, and in urban areas appropriate income sources and legal and affordable access to adequate housing will be provided to the displaced poor.
- ❖ If land acquisition is through negotiated settlement, procedures will be developed in a transparent, consistent, and equitable manner to ensure that those people who enter into negotiated settlements will maintain the same or better income and livelihood status. If, however, the negotiated settlement fails, the normal procedure of land acquisition will be followed.
- ❖ Displaced persons without titles to land or any recognizable legal rights to land will be ensured that they are eligible for resettlement assistance and compensation for loss of non-land assets.
- ❖ A resettlement plan will be prepared elaborating on displaced persons' entitlements, the income and livelihood restoration strategy, institutional arrangements, monitoring and reporting framework, budget, and time-bound implementation schedule.
- ❖ The draft resettlement plan, including documentation of the consultation process will be disclosed in a timely manner, before project appraisal, in an accessible place and in a form and language(s) understandable to affected persons and other stakeholders. The final resettlement plan and its updates will also be disclosed to displaced persons and other stakeholders.
- ❖ Involuntary resettlement will be conceived and executed as part of a development project or program. Full costs of resettlement will be included in the presentation of project's costs and benefits. For a project with significant involuntary resettlement impacts, consider implementing the involuntary resettlement component of the project as a stand-alone operation.

- ❖ All compensation will be paid and other resettlement entitlements will be provided before physical or economic displacement. The resettlement plan will be implemented under close supervision throughout project implementation.
- ❖ Resettlement outcomes, their impacts on the standards of living of displaced persons will be monitored; it will be accessed whether the objectives of the resettlement plan have been achieved by taking into account the baseline conditions and the results of resettlement monitoring. Monitoring reports will be disclosed to DPs.
- ❖ Land acquisition for the project would be done as per both Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (Amendment) Ordinance, 2014 and as per guidelines of JICA. To meet the replacement cost of land payment of compensation in revised rate, an additional as registration cost plus solatium will be provided to each land holders.
- ❖ The uneconomic residual land remaining after land acquisition will be acquired as per the provisions of Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013. The owner of such land/property will have the right to seek acquisition of his entire contiguous holding/ property provided the residual land is less than the average land holding of the district.
- ❖ People moving in the project area after the cut-off date will not be entitled to any assistance. In case of land acquisition, the date of publication of preliminary notification for acquisition under Section 4.1 of the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (Amendment) Ordinance, 2014 will be treated as the cut-off date. For non-titleholders the date of project census survey or a similar designated date declared by the executing agency will be considered as cut-off date.
- ❖ All common property resources (CPR) lost due to the project will be replaced or compensated by the project.

The project will recognize three types of displaced persons like (i) persons with formal legal rights to land lost in its entirety or in part; (ii) persons who lost the land they occupy in its entirety or in part who have no formal legal rights to such land, but who have claims to such lands that are recognized or recognizable under national laws; and (iii) persons who lost the land they occupy in its entirety or in part who have neither formal legal rights nor recognized or recognizable claims to such land. The involuntary resettlement requirements apply to all three types of displaced persons.

### 3.5 Entitlements, Assistance and Benefits

The project will have three types of displaced persons i.e., (i) persons with formal legal rights to land lost in its entirety or in part; (ii) persons who lost the land they occupy in its entirety or in part who have no formal legal rights to such land, but who have claims to such lands that are recognized or recognizable under national laws; and (iii) persons who lost the land they occupy in its entirety or in part who have neither formal legal rights nor recognized or recognizable claims to such land. The involuntary resettlement requirements apply to all three types of displaced persons.

Compensation eligibility is limited by a cut-off date as set for this project on the day of the beginning of the census survey which is 15th January 2014. DPs who settle in the affected areas after the cut-off date will not be eligible for compensation. They, however, will be given sufficient advance notice, requested to vacate premises and dismantle affected structures prior to project implementation. Their dismantled structures materials will not be confiscated and they will not pay any fine or suffer any sanction.

Compensation for the lost assets to all displaced persons will be paid on the basis of replacement cost. Resettlement assistance for lost income and livelihoods will be provided to both title holders and non-title holders. Special resettlement and rehabilitation measures will be made available to the "Vulnerable Group" comprises of DPs living below poverty line (BPL), SC, ST, women headed households, the elderly and the disabled. The detail of the assistance and entitlements has been discussed in the following chapters.

### 3.6 Relocation of Housing and Settlements

The EA will provide adequate and appropriate replacement land and structures or cash compensation at full replacement cost for lost land and structures, adequate compensation for partially damaged structures, and relocation assistance, according to the Entitlement Matrix. The EA will compensate to the non-title holders for the loss of assets other than land, such as dwellings, and also for other improvements to the land, at full replacement cost. The entitlements to the non-titleholders will be given only if they occupied the land or structures in the project area prior to the cut-off date.

### 3.7 Income Restoration and Rehabilitation

Due to loss of land and structures, many households shall lose their livelihoods or shall get economically displaced. The DPs losing their livelihoods includes titleholders land, agricultural labourers, agricultural tenants, and sharecroppers, DPs having commercial structures and employees of the affected structures. In the case of economically displaced persons, regardless of whether or not they are physically displaced, the EA will promptly compensate for the loss of income or livelihood sources at full replacement cost. The EA will

also provide assistance such as credit facilities, training, and employment opportunities so that they can improve, or at least restore, their income-earning capacity, production levels, and standards of living to pre-displacement levels.

### 3.8 Resettlement Budget

The resettlement cost estimate for this project includes eligible compensation, resettlement assistance and support cost for RP implementation. The support cost, which includes staffing requirement, monitoring and reporting, involvement of NGO in project implementation and other administrative expenses are part of the overall project cost. The unit cost for land and other assets in this budget has been derived through field survey, consultation with affected families, relevant local authorities and reference from old practices. Contingency provisions have also been made to take into account variations from this estimate.

### 3.9 Institutional Arrangements

For implementation of RP there will be a set of institutions involve at various levels and stages of the project. The Executing Agency (EA) for the Project is MORT&H Government of Mizoram. The existing MORT&H has already set up a Project Management Unit (PMU) headed by a Chief Engineer/PWD/NH/Mizoram. This office will be functional for the whole Project duration. The EA, MORT&H will have overall responsibility for implementation of loan and will also be responsible for the overall coordination among JICA, Government of Mizoram and PIU. For resettlement activities, PMU will do the overall coordination, planning, implementation, and financing. Project Implementation Unit (PIU) will be established at project level for the implementation of sub-projects. An experienced and well-qualified NGO in this field will be engaged to assist the PIUs in the implementation of the RP.

### 3.10 Implementation Schedule

Implementation of RP mainly consists of compensation to be paid for affected structures and rehabilitation and resettlement activities. A composite implementation schedule for R&R activities in the project including various sub tasks and time line matching with civil work schedule is prepared and presented in the following chapters. The cut-off date will be notified formally for titleholder as the date of LA notification and for non titleholders as the date of census survey. However, the sequence had change or delay had occurred due to circumstances beyond the control of the Project and accordingly the time can be adjusted for the implementation of the plan. The present implementation schedule is also being structured through package wise. The entire stretch can be divided in to 4 contract packages and the completion of resettlement implementation for each contract package shall be the pre-condition to start of the civil work at that particular contract package.

### 3.11 Monitoring and Reporting

Monitoring and reporting are critical activities in involuntary resettlement management in order to ameliorate problems faced by the DPs and develop solutions immediately. Monitoring is a periodic assessment of planned activities providing midway inputs. It facilitates change and gives necessary feedback of activities and the directions on which they are going. In other words, monitoring apparatus is crucial mechanism for measuring project performance and fulfilment of the project objectives.

PIU responsible for supervision and implementation of the RP will prepare monthly progress reports on resettlement activities and submit to PMU. PMU will submit quarterly reports to JICA. The Resettlement Expert under Supervision Consultant would be responsible for monitoring of the RP implementation will submit a quarterly review report to determine whether resettlement goals have been achieved, more importantly whether livelihoods and living standards have been restored/ enhanced and suggest suitable recommendations for improvement. All the resettlement monitoring reports will be disclosed to DPs as per procedure followed for disclosure of resettlement documents by the EA. An External Monitor to be engaged to review and monitor the implementation process and time frame of the resettlement and rehabilitation of the DPs. The External Monitor may submit a biannual report on the progress of the implementation of the Resettlement action plan to JICA through the EA.

## **Chapter - 5**

### **Economic Analysis**



## CHAPTER - 5

### Economic Analysis

#### NH-54 Km.8.00 to Km.125.00 (Aizawl – Keitum)

This chapter presents the Economic Analysis of the Project. Financial Analysis to determine commercial viability in absence of the road toll tax may not be necessary.

#### 5.1 ECONOMIC ANALYSIS

##### 5.1.1 Introduction

Economic analysis has been carried out keeping in view the main objective of the present consultancy services i.e. to establish the economic viability of the proposed rehabilitation and upgrading of existing single / 2-lane National Highway No.54 (between km.8.00 and Km.125.00 of Aizawl – Keitum Section) to 2-lane standard carriageway configuration. Economic Analysis has been carried out for making the existing 2-lane road with standard width, geometry and improved flexible pavement. With the inclusion of realignments the existing length of 117.00 km. decreases to 110.263 km. (design chainage).

##### 5.1.2 Scope of Work

Economic analysis has been carried out by making comparative evaluation between the base situation i.e. "Without Project" or "Do Minimum" situation and the improvement options i.e. "With Project" situation. This has been done by taking into consideration net savings of total transportation cost in alternative option. The alternative option considered for the present analysis is as given in Table 5.1.

Table 5.1  
Descriptions of Alternative Options

Alternative Options	Descriptions
1	Upgrading of existing single / 2-lane road to 2-lane road. Existing road is rehabilitated / reconstructed / improved with flexible pavement.

#### 5.1.3.2 Salvage Value

Salvage values have not been taken into account.

#### 5.1.3.3 Road and Pavement characteristics

Geometric and pavement characteristics of existing road are given in Chapter-1. Road and pavement characteristics of the new road (alternative option) are given in the same chapter.

#### 5.1.3.4 Existing and Projected Traffic

Average daily traffic (ADT & PCU) as given in Annexure 5.1.3.4 has been taken on the basis of projected traffic worked out as part of traffic study. Base year traffic has been taken as in year 2009 with modifications made in case of car traffic. Thus, in the volume of car traffic, converted numbers of 2-wheeler and 3-wheeler traffic have been added by taking 2 two-wheeler as equivalent to 1 car and 1 LCV as equivalent to 1.5 car.

Traffic growth rates (in %), as given in traffic study as 7.50% for reasons given in traffic studies. Average daily traffic in terms of PCU has been taken on the basis of 7.5% projection per year and worked out as part of traffic study given and enclosed in Annexure 5.1.4

#### 5.1.3.5 Accident Costs

In order to account for benefits due to reduction in road accidents after upgradation of road i.e. "with project situation", savings in accident cost has been worked out on the basis of road accident data collected from concerned Police Stations on Traffic Studies. Accordingly, estimated annual cost of road accidents has been worked out as Rs.75,35,000.00 (For details see Annexure 5.3). However, since all road accidents are not reported, it can be said that actual economic loss due to accident may be higher than the estimated amount. At the same time, though an improved highway with better provision of safety measures would lead to reduction in accidents, all accidents cannot be eliminated even after proposed improvement. On these considerations, for the purpose of economic analysis it has been assumed that annual saving due to accident would remain the same as the estimated base-year average annual cost of accident, over the period of analysis. This year-wise benefit, has been taken as inputs to the model for the analysis. In order to account for benefits due to reduction in road accidents "with project" scenario, savings in accident cost has

been worked out on the basis of road accident data collected from concerned Police Stations and given in Annexure 5.3. Accordingly, estimated annual cost of road accidents has been worked out to be Rs.0.7535 Cr.

#### 5.1.3.6 Passenger Time Saving Cost

Since passenger travel time savings in a developing country like India are controversial in nature (Ref : IRC SP 30:PP 15) the analysis is prepared without this component especially in Mizoram's socio-economic structure where it would be more realistic to avoid this controversy.

#### 5.1.4 Results of Economic analysis

Detailed economic analysis has been carried out by HDM program taking into account, year-wise streams of economic society cost comprising economic agency cost, road user cost and accident benefits (Annexure 5.1.4).

Savings after road construction:

##### A. V.O.C.

- i) Savings have been taken from Table (SP-30 of IRC) with RF=40, Roughness "Without Project" as 5000 and "With Project" as 2000.

Hence, cost saving is arrived at as follows :

Let RF = 40

Economic Cost Roughness

(Rs./Km.) at 1990 base MM / Km.

Yr.

5.66 5000 (Without Project)

4.72 2000 (With Project)

0.94 say Re.1

With conversion by multiplication factor 267/180

Economic cost saving at current year is

$1 \times 1.50 = 1.50$  Rs./Km./Pcu.

##### ii) Traffic

Volumes of traffic year by year in terms of PCU are taken from Traffic Analysis report.

##### iii) Travel Distance p.a. of Vehicles

From Traffic study the distribution of cars, buses and trucks etc are taken.

Vehicles utilization data for km driven per year is adopted as follows (Annexure 5.1.3.4) :

Taxi/Car/Jeep/Van	...	...	10000 Km.
LCV & Bus	...	...	35000 Km.
Trucks	...	...	47000 Km.

Weighted average of all vehicles p.a. in PCU is estimated as 2703 in base year (Annexure 5.1.3.4).

Hence, fuel saving cost under VOC is calculated per year during the Analysis Period and given in the Economic Analysis Annexure 5.1.4.

#### 5.1.5 Conclusion

Economic Analysis has been carried out taking into account

- i) Economic cost of the project.
- ii) Economic cost of Maintenance derived from financial cost of maintenance items multiplied by 0.9 year by year.
- iii) Without time saving cost but including benefits arising from reduction of VOC and accident costs year by year to derive the stream of net benefits.

Stream of tangible social benefits are low because volume of traffic is low and reduction of accident costs are naturally low. But the Economic cost of the project, which is Rs.1195.17 crore, is too high for low stream of tangible social benefits to yield any significant internal rate of return. The opportunity cost of the capital is not justified by the stream of tangible social benefits but may be justified for the creation of social capital (asset) enhancing the connectivity of the region promoting the social welfare of the people.

Better approach is on the basis of Producer Surplus as given in 6.10 of IRC SP30 which is not provided by Highway Design Software approved by the NH.

Annexure – 5.1.3.4

**Classified ADT in % Number (Number & PCU)**

F.M. Vehicle	% Number	Number	% PCU	PCU
Two-Wheeler	15.850	333	5.025	167
Three-Wheeler	6.413	112	4.065	112
Jeep/Car/Van/Taxi	33.621	756	21.313	756
LCV	14.741	226	14.017	339
Bus	6.676	196	12.696	590
Truck	20.601	246	39.178	738
Agri Tractor	0.021	1	0.059	1
Total	97.923	1870	96.353	2703

**Average Annual Travel by all vehicles**

Description	Km. run/yr.	% Traffic	Total Km. run / yr.
Jeep/Car/Van/Taxi	10000	0.34	3400
LCV	35000	0.15	5250
Bus	35000	0.07	2450
Truck	47000	0.21	9870
			20970

Annexure – 5.1.4

**VOC Savings : Fuel Consumption based for Economic Analysis**

Yr.	Total Annual Traffic in PCU @ 7.5% growth rate	Average Annual Travel by all vehicles (Km.)	In Crores
			VOC Saving @ Rs.1.50 per km./pcu
1	Construction Period		
2			
3			
4	2703	20970	8.50
5	2906	20970	9.14
6	3124	20970	9.83
7	3358	20970	10.56
8	3610	20970	11.36
9	3881	20970	12.21
10	4172	20970	13.12
11	4485	20970	14.11
12	4821	20970	15.16
13	5183	20970	16.30
14	5572	20970	17.53
15	5990	20970	18.84
16	6439	20970	20.25
17	6922	20970	21.77
18	7441	20970	23.41
19	7990	20970	25.13
20	8589	20970	27.02

Annexure – 5.3

**1.9 Road Accident Data**

**1.9.1 Road Accident recorded at Bawngkawn Police Station**

Name of the Police Station : Bawngkawn

District : Aizawl

State : Mizoram

Year	Total (Number)	Type of accident		Type of vehicles involved					Reason of accident			
		Fatal	Non fatal	Two wheeler	Car / Taxi / Van	Bus	Truck	Unknown	Human	Human + Road	Human + Vehicle	Unknown
2005	13	6	7	1	7	1	3	1	4	9	0	0
2006	22	13	9	9	7	2	6	2	0	22	0	2
2007	22	9	13	3	15	1	8	0	7	15	0	0
2008	30	17	13	8	16	4	13	0	7	23	0	0
2009 *	22	10	12	3	17	3	3	1	2	6	0	1

Yearly Cost In Lacs @ 4.93×11 @ 0.76×11  
= 54.23 + 8.36  
= 62.59 Lacs

@ 0.11×13 @ 0.37×3 @ 0.43×7  
= 1.43 + 1.11 + 3.01  
= 5.55 Lacs

∴ Total yearly accident cost (lacs)  
= 62.59 + 5.55 = 68.14 Lacs

Annexure – 5.3

Name of the Police Station : Serchhip

District : Serchhip

State : Mizoram

Year	Total (Number)	Type of accident		Type of vehicles involved					Reason of accident			
		Fatal	Non fatal	Two wheeler	Car / Taxi / Van	Bus	Truck	Unknown	Human	Human + Road	Human + Vehicle	Unknown
2005	2	1	1	0	2	0	0	0	0	2	0	0
2006	2	0	2	0	1	0	1	0	0	2	0	0
2007	1	1	0	0	1	0	0	0	0	1	0	0
2008	3	3	0	0	4	0	0	0	1	2	0	0
2009 *	5	0	5	0	5	0	0	0	0	2	0	0

Yearly Cost In Lacs @ 4.93×1 @ 0.76×2

= 4.93 + 1.52

= 6.45 Lacs

@ 0.11×3 @ 0.37×0 @ 0.43×1

= 0.33 + 0 + 0.43

= 0.76 Lacs

∴ Total yearly accident cost (lacs)

= 6.45 + 0.76 = 7.21 Lacs

## **Chapter - 6**

### **Suggested Methods of Procurement and Packaging**



## CHAPTER - 6

### Suggested Methods of Procurement and Packaging

#### 6.1 Introduction

The project road is in a hilly terrain and as such the working procedure will be difficult as the road will have to be kept open for traffic. So, selection of efficient agency/agencies is required. Again, the project is to be executed on EPC basis under JICA assistance. The design chainage of the road is 110.263 km

#### 6.2 Procurement

At first a Notice Inviting Tender (NIT) is to be floated in website with Request for Proposal (RFP) giving entire details of Terms of Reference (TOR). The submission of tender will be after one month of NIT through E-Tender, Portal (E-arrangement). But one copy of "Technical Proposal" is required to be submitted in hard copy within due date and the "Financial Proposal" shall remain in E-form.

Next a "Pre-bid" meeting is to be called after 15 days of submission and detailed requisites shall appear in "Data Sheet" appearing in RFP. The outcome of the meeting shall form a part of Contract.

Between this period the Technical Proposal shall be evaluated as decided by Client and shall make one panel of bidders who have fulfilled the requirements. The "Financial Bid" of those bidders in the panel will be opened only giving notice of the date & time of opening. The lowest bidder and the 2<sup>nd</sup> lowest bidder will only be considered. The lowest bidder will be requested to submit "Performance Guarantee" within a specified date in the "Letter of Acceptance (LOA)". On compliance, necessary Agreement will be signed and "Letter to Proceed" will be issued by Client.

In case, the lowest bidder fails to submit "Performance Guarantee" the 2<sup>nd</sup> lowest bidder will be called and negotiated, if the Client feels so. Otherwise fresh NIT may be floated.

## 6.3 Packaging

### 6.3.1 Objective:

- (i) To divide the total length of a project road into sub-sections of such length which is manageable for proper planning scheduling, execution, supervision and co-ordinating.

### 6.3.2 Aim:

- (i) To divide the project into a number of package of manageable length and the more or less of similar construction cost of each package based on unit rate of different items of work including cost of loading, unloading and carriage of materials of construction.

### 6.3.3 Methodology:

- (i) To prepare preliminary cost estimate of the total length of the project corridor based on plan & profile of the road, pavement structure, GAD of bridges, no. of culverts, provision of Traffic Signs, Markings and other road Appurtenances, River Training and Protection works, Repair and Rehabilitation and Maintenance of road during construction period of the project road.
- (ii) To divide total project road length into a no. of packages so that the estimated civil cost of each package comes more or less same.  
Considering present cost Index of NH projects manageable length of a package comes to nearly 30 km.
- (iii) After trial division into packages, preliminary cost of each package is estimated. At this stage unit rate of each item of work is determined including cost of loading & unloading and haulage based on trial division of packages and corresponding lead chart.
- (iv) Thereafter, cost of all packages are compared for adjustment of length if there is appreciable variation. If so, revised lead chart is prepared and unit rate of each item of work is calculated based on revised lead of materials. If not the initial lead chart is adopted.
- (v) Thereafter, BOQ for each item of work is prepared and estimated cost of each package is determined.

# **Chapter - 7**

## **Traffic Survey and Analysis**

## CHAPTER 7

### TRAFFIC SURVEY AND ANALYSES

#### 7.1 BACKGROUND

The region between Aizawl to Keitum is principally dependent on:

- a) National Highway 54 section from Aizawl to Lunglei.

In this portion, there are several PWD roads, generally single lane and footways leading to villages on the hills. There are several rural roads looked after by PWD as well Zila Parishad. However, the principal spine of this hilly region is NH-54. At present, NH-54 is gradually becoming inadequate in Aizawl part to cater to the traffic growth because of the following reasons:

- a) Intermediate lane width
- b) Several slide zones totally disconnect the existing National Highway and disrupt the movement of persons and goods to different parts of Mizoram.
- c) Several sharp curves.

The proposal of 2-lane standard of NH-54 from Aizawl to Keitum is, therefore, very necessary. It is also required to examine in which year how many lanes are required so to ensure continuous traffic movement.

#### 7.2 OBJECTIVE

The objectives of traffic survey and analyses are following:

- ◆ To know the present classified traffic characteristics.
- ◆ To arrive at an Average Daily Traffic (ADT) flow in number and passenger car units (PCU).
- ◆ To know the daily variation in traffic flow.
- ◆ To analysis present traffic and find out traffic composition.
- ◆ To know hourly variation.
- ◆ Determine peak hour composition and peak hour factor, and percentage of 24-hour traffic flowing in the peak hour
- ◆ To analyse growth factor.
- ◆ To arrive at Annual Average Daily Traffic (AADT).
- ◆ To calculate yearly projected A.A.D.T for next 30 years
- ◆ To apply Design Service Volume as per I.R.C. norms.
- ◆ To calculate required number of lanes for movement of traffic.
- ◆ To know the Vehicle Damage Factor (VDF) and enable pavement design.
- ◆ To provide classified volume data for economic analysis.
- ◆ Turning movement survey, analysis and future design.
- ◆ To identify the conflict with highway traffic at the intersection from vehicles, pedestrians and suggest remedy.

- ◆ To assist economic analyses in preparation of EIRR / cost benefit and sensitivity analysis. To provide input for HDM – 4 analysis.
- ◆ To assist environmental study.
- ◆ To assist in geometric design.

## 7.3 SURVEY

### 7.3.1 Secondary Survey

To support and assess the requirement of highway widening, secondary data have been collected from various organisations, which include:

- Previous traffic data collected and analysed by local PWD, if any.
- Data from Border Roads Organisation,
- Accident data from Police.
- Vehicles registration data from Mizoram Regional Transport Authority.
- Tourist information from Mizoram Tourism Department.
- Statistical information from Mizoram.
- Seasonal variation has been derived from fuel sales at fuel pump on the Highway.

In view of proposed 2-lane standard, the likely traffic on the highway will also increase.

### 7.3.2 PRIMARY SURVEYS

Detailed traffic study was carried out to establish the requirement and extent of need of 2-lane standard highway as per guidelines of IRC.

#### 7.3.2.1 Homogeneous section of Highway

Alignment and Traffic survey data collected from site shows that entire section of NH-54 from Aizawl to Keitum can be divided into two Homogeneous sections, one from Aizawl to Seling and the other from Seling to Keitum. Dividing the entire section into two stretches also makes operation and phased development easy.

Homogeneous Sections of NH-54 (Aizawl to Keitum)

Homogeneous Section Identity	From		To	
	Location	Chainage (Km)	Location	Chainage (Km)
HS-01	Aizawl	0.000	Seling	42.000
HS-02	Seling	42.000	Keitum	125.000

Cross slopes of country of HS-01 and HS-02 calculated from alignment survey are 63% and 55% respectively. IRC: 73-1980 classify HS-01 as steep whereas HS-02 as mountainous terrain.

Present curvatures of HS-01 and HS-02 calculated from alignment survey are 55.3° per kilometer and 675° per kilometer respectively. IRC: 64-1990 classify both section as High Curvature.

### 7.3.2.2 Organisation of the traffic survey

Traffic Survey was conducted considering the total 125 km stretch. The data has been presented in totality as well as individually for each stretch. Traffic data recorded in July / August 2009 for the two-laning project of Mizoram has also been referred. Data of Border Roads has been collected and referred.

### 7.3.2.3 Traffic Survey

Following are the various types of traffic survey those were carried out during the study:

- Classified Traffic Volume Count Survey – 4 locations
- Turning Movement Survey at intersections – 5 intersections
- Axle load survey – 2 locations
- Origin Destination & Commodity Movement Survey – 2 locations
- Toll Rate Survey – 2 locations

### 7.3.2.4 Schedule of survey

The schedule of various traffic surveys is presented below for ready reference.

#### TRAFFIC SURVEY LOCATIONS & DATES

Serial number	Type of survey	Count station ID	Chainage (km)	Station name	Counting date		Duration
					From	To	
1	Classified traffic volume count	MB-01	7.100	Zemabawk	17/08/2009	23/08/2009	24 Hours x 7 Days at each Location.
		MB-02	40.200	Seling	17/08/2009	23/08/2009	
		MB-03	109.800	Serchhip	17/08/2009	23/08/2009	
		MB-04	124.300	Keitum	17/08/2009	23/08/2009	
2	Turning movement survey	TM-01	3.000	Bawngkawn	11/08/2009		7 AM to 7 PM, Peak Hour data will be analysed & used.
		TM-02	38.020	Seling	11/08/2009		
		TM-03	40.700	Seling	11/08/2009		
		TM-04	114.400	Sailam	13/08/2009		
		TM-05	124.500	Keitum	13/08/2009		
3	Axle load survey	AL-01	8.600	Zemabawk	12/08/2009		24 Hours both Direction (Sample Basis)
		AL-02	114.400	Sailam	14/08/2009		
4	Origin Destination survey	OD-01	8.600	Zemabawk	12/08/2009		
		OD-02	114.400	Sailam	14/08/2009		
5	Commodity survey	CS-01	8.600	Zemabawk	12/08/2009		
		CS-02	114.400	Sailam	14/08/2009		
6	Toll rate survey	TR-01	8.600	Zemabawk	12/08/2009		
		TR-02	114.400	Sailam	14/08/2009		

Following secondary informations were collected over the entire stretch, from Aizawl to Keitum of NH-54.

Serial number	Type of data	Source
1	Past Traffic Data of Border Road	Border Roads Organisation
2	Accident Data	Police station
3	Petrol Sales data	Fuel pump
4	Data on social, economic NSDP, Vehicle Registration, Population etc.	From various Agencies, Departments and publications
5	Misc. any other data	-
6	Overall Road Network System in Mizoram	a) Maps of Tourist Department b) Maps published by various agencies.

#### 7.3.2.5 Field Survey Period

Traffic Surveys were carried out during August 2009. The surveys started on 11.08.2009 onwards and were mostly completed by 23.08.2009.

## 7.4 ANALYSIS

### 7.4.1 Classified Traffic Volume Counts Survey

As prescribed by NHAI, (also by I.R.C) 7-days Classified Traffic Volume Counts were carried out at 4-locations (2 on Section-1 and 2 on Section-2). The location of count stations are indicated in the table. The survey has been done at (a) Zemabawk (b) Selling (c) Serchhip and (d) Keitum.

The analysis has been carried out to derive:

- Weekly traffic summary and weekly variation
- ADT for fast and slow moving vehicles along with ADT composition pattern in numbers and PCU.
- Classified hourly average traffic
- Average hourly variation for each of the count stations.
- Annual Average Daily Traffic (AADT) for capacity analysis and AADT for economic analysis and pavement design.

### 7.4.2 Summary of Classified ADT

#### Section-I (Aizawl to Seling)

In this stretch of hilly and steep gradients, slow moving vehicles do not generally ply on the National Highway and adjoining areas.

YEAR 2009 - AVERAGE DAILY TRAFFIC										
		Two wheelers	Three Wheeler	Car/Jeep/Van/ Taxi	Bus	L.C.V	Trucks (2-Axle)	Agricultural Truckter	Slow Moving Vehicle	Total
ADT	No.	502.214	157.429	1166.0	324.0	301286	279.500	0.000	58.000	2788.429
ADT	P.C.U	251.107	157.429	1168.00	972.0	451.929	838.5	0.000	148.821	3985.786
(Year 2009 – A.A.D.T. by applying Seasonal Variation Factor) Annual Average Daily Traffic										
AADT	No.	592.884	185.851	1376.510	382.495	355.680	329.961	0.000	68.471	3291.853
AADT	P.C.U.	296.442	185.851	1376.511	1147.485	533.520	989.883	0.000	175.690	4705.381
AADT	% of No.	18.011%	5.646%	41.816%	11.619%	10.805%	10.024%	0.000%	2.080%	100%
ADT	% of PCU	6.300%	3.950%	29.254%	24.387%	11.339%	21.037%	0.000%	3.734%	100%

Analysing traffic composition in Section-1, it is observed that 29% traffic are of class car, 24% traffic are of class bus and 21% traffic are of class truck. Slow moving vehicle shares merely 4% of total traffic.

#### Section-II (Seling to Keitum)

Entire stretch is on the hills of Mizoram full of steep gradients and high curvature.

YEAR 2009 – AVERAGE DAILY TRAFFIC (A.D.T)

	Two wheelers	Three Wheeler	Car/Jeep/Van/ Taxi	Bus	L.C.V	Trucks (2-Axle)	Agricultural Truckter	Slow Moving Vehicle	Total
No.	163.857	66.287	347.500	69.000	152.357	212.929	0.214	21.429	1033.571
P.C.U.	81.929	66.286	347.5	207.000	228.536	638.786	0.964	59.464	1630.464

(Year 2009 – A.A.D.T. by applying Seasonal Variation Factor)

No.	211.497	85.558	448.532	89.061	196.653	274.835	0.277	27.659	1334.070
P.C.U.	105.790	85.558	448.532	267.183	294.980	824.505	1.245	76.753	2104.503
% of Number	15.853	6.413	33.621	6.676	14.741	20.601	0.021	2.073	100



% of PCU	5.025	4.865	21.313	12.696	14.017	39.178	0.059	3.647	100
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Analysing traffic composition in section-II, it is observed that 39% traffic are of class truck followed by 21% car followed by 14% LCV followed by 13% bus, slow moving vehicle comprises only 4% of total traffic.

#### 7.4.3 Daily Variation of Traffic Volume

Traffic flow varies throughout the day. Daily variation at Zemabawk count station is presented below. It is seen that usually Sunday has lowest traffic (34% of ADT).

1.	17.08.09	Monday	110% of ADT	5.	21.08.09	Friday	113% of ADT
2.	18.08.09	Tuesday	112% of ADT	6.	22.08.09	Saturday	104% of ADT
3.	19.08.09	Wednesday	118% of ADT	7.	23.08.09	Sunday	34% of ADT
4.	20.08.09	Thursday	110% of ADT				

#### 7.4.4 Hourly variation of Volume in Number

Average hourly variation at Zemabawk count station is presented here.

Hour	Number of vehicle	% of ADT	Hour	Number of vehicle	% of ADT
07.00 – 08.00	219	6.45%	20.00 – 21.00	83	2.45%
08.00 – 09.00	238	7.02%	21.00 – 22.00	83	2.43%
09.00 – 10.00	238	7.02%	22.00 – 23.00	73	2.14%
10.00 – 11.00	221	6.52%	23.00 – 24.00	50	1.47%
11.00 – 12.00	215	6.33%	24.00 – 01.00	28	0.82%
12.00 – 13.00	218	6.42%	01.00 – 02.00	18	0.53%
13.00 – 14.00	222	6.55%	02.00 – 03.00	25	0.74%
14.00 – 15.00	224	6.59%	03.00 – 04.00	23	0.69%
15.00 – 16.00	238	7.01%	04.00 – 05.00	38	1.12%
16.00 – 17.00	224	6.60%	05.00 – 06.00	83	2.45%
17.00 – 18.00	217	6.39%	06.00 – 07.00	135	3.97%
18.00 – 19.00	168	4.94%			
19.00 – 20.00	114	3.35%	Total vehicles	3395	

#### 7.4.5 Abstract of hourly variation at Zemabawk

- a) Peak hour is 8 to 9 AM with 238 vehicles and peak hour volume is 7.1% of 24- hour traffic.
- b) Traffic is low between 01.00 to 02.00 with 18 Vehicles only,
- c) In the 12 hour between – 7 AM and 7 PM out of 24 hours, total of 2643 vehicles flow at Zemabawk, which is 78% of the 24 hour total volume of 3395 vehicles.

#### 7.4.6 Peak Hour Composition

Peak hour depends upon the development of the region. Peak hour is a Multi Dimensional Factor. Peak Hour changes from one location to another location and in the same location from one class of traffic to another class of traffic. There could be more than one peak hour on the same location on same day. From average hourly variation, it is observed that peak hour at Zemabawk is 08:00 to 09:00, peak hour at selling is 15:00 to 16:00, peak hour at Serchhip is 20:00 to 21:00 and peak hour at Keitum is 06:00 to 07:00.

Analysing average hourly variation at Zemabawk, it is observed that Two Wheeler, Three Wheeler, Car, LCV, Bus, Truck and Slow Moving vehicle classes have peak hour at 09:00 to 10:00, 07:00 to 08:00, 15:00 to 16:00, 17:00 to 18:00, 12:00 to 13:00, 06:00 to 07:00 and 11:00 to 12:00 respectively, where as peak hour based on total traffic is 08:00 to 09:00.

Here we are presenting peak hour composition at Zemabawk based on survey conducted between 17.08.2009 to 23.08.2009.

Class	Two Wheeler	Three Wheeler	Car	LCV	Bus	Truck	Slow Moving Vehicle	Total
No.	49.7	0.7	101.0	20.1	47.3	19.0	0.4	238.3
PCU	24.9	0.7	101.0	30.2	141.9	57.0	0.6	356.2

#### 7.4.7 Determination of Vehicle Damage Factor through Axle Load Survey

For Axle Load Survey, a double pad portable weigh bridge, capable of weighing static wheel loads with a capacity of 10,000 Kgs x 10 Kgs increment with  $\pm 1\%$  accuracy was used. The survey was conducted at Zemabawk and Sailam.

Commercial vehicles buses / mini buses, two axle trucks were measured for up and down direction. Simultaneously, an hourly count of the 'Vehicle Population' was also carried out. The information has been used for VDF assessment.

- The Equivalent Standard Axle Load (ESAL) was determined by the IRC: 37 - 2001 equivalency factors.
- VDF for design of flexible pavement was worked out for 2 axles truck, bus and LCV separately.
- The weighted average VDF for both the sections of NH54 are given below:

Highway	Location of Survey Stations	Average VDF	Recommended VDF
NH-54	Zemabawk	0.307	1.50
NH-54	Sailam	0.217	1.50

#### Summary of VDF for Flexible Pavement Design.

Count station ID	Chainage (km)	Location	Direction	Population (24 hours)			Cumulated VDF			Weighted average	Average VDF
				LCV	Two axle truck	Bus	LCV	Two axle truck	Bus		
AL-01	8.600	Zemabawk	Up	171	169	277	0.111	0.961	0.110	0.343	0.307
	8.600	Zemabawk	Down	170	193	300	0.105	0.634	0.133	0.272	
AL-02	114.400	Sailam	Up	103	179	43	0.649	1.167	0.186	0.873	0.717
	114.400	Sailam	Down	84	114	48	1.043	0.393	0.114	0.560	

#### Sample Calculation of Weighted Average VDF

For UP Direction at Sailam Weighted Average VDF for Flexible Pavement  
 $= \{(103 \times 0.649 + 179 \times 1.167 + 43 \times 0.186) / (103 + 179 + 43)\} = 0.873$

RECOMMENDED VDF FOR DESIGN OF FLEXIBLE PAVEMENT IN HILLY TERRAIN AS PER IRC – 37: 2001 = 1.50 (as recommended by Indian Roads Congress).

#### 7.4.8 Origin Destination and Commodity Movement Survey

Origin Destination survey was conducted at Zemabawk (7.10 km) and Sailam (114.40 km). The survey was limited to commercial vehicles only. The drivers/occupants of the vehicles were interviewed and information was collected. The sample sizes and other particulars are given below. For OD purpose 19 zones were selected and 19 x 19 matrix was developed.

#### 7.4.8.1 Summary of Origin Destination Matrix

##### SUMMARY OF ORIGIN-DESTINATION MATRIX

Chainage (km)	Location	Direction	Intrastate traffic (%)	Assam traffic (%)	Rest of India traffic (%)
8.600	Zemabawk	Up	41.860	46.512	11.628
8.600	Zemabawk	Down	72.340	19.149	8.511
114.400	Sailam	Up	21.429	64.286	14.286
114.400	Sailam	Down	50.000	33.333	16.667

Intrastate traffic are those traffic whose movement inside Mizoram only. Assam traffic are those traffic which are either originating from Assam state or moving into Assam state. Rest of India traffic are those traffic which are either coming from anywhere inside India except Mizoram and Assam or moving into anywhere inside India except Mizoram and Assam.

Analyzing up direction traffic at Zemabawk (Chainage 8.600 km), it is observed that traffic originating from Aizawl and Silchar are 35% and 30% respectively and traffic terminating at Serchhip and Lunglei are 23% and 40% respectively. In the same time down direction traffic gives traffic originating from Lunglei, Serchhip, Champhai and Zemabawk are 23%, 21%, 19% and 17% respectively and traffic terminating at Aizawl and Kolasib are 38% and 32% respectively.

Up direction OD data at Sailam (Chainage 114.400 km) gives traffic originating from Silchar, Digboi, Shillong and Kolasib are 45%, 12%, 10% and 10% respectively. In the same time down direction traffic gives traffic originating from Lunglei and Saiha are 60% and 24% respectively and traffic terminating at Silchar, Aizawl and Shillong are 24%, 17% and 17% respectively.

OD data at Zemabawk gives 20% traffic is intrastate passenger traffic whereas no passenger traffic is observed at Sailam. There is no interstate passenger traffic observed.

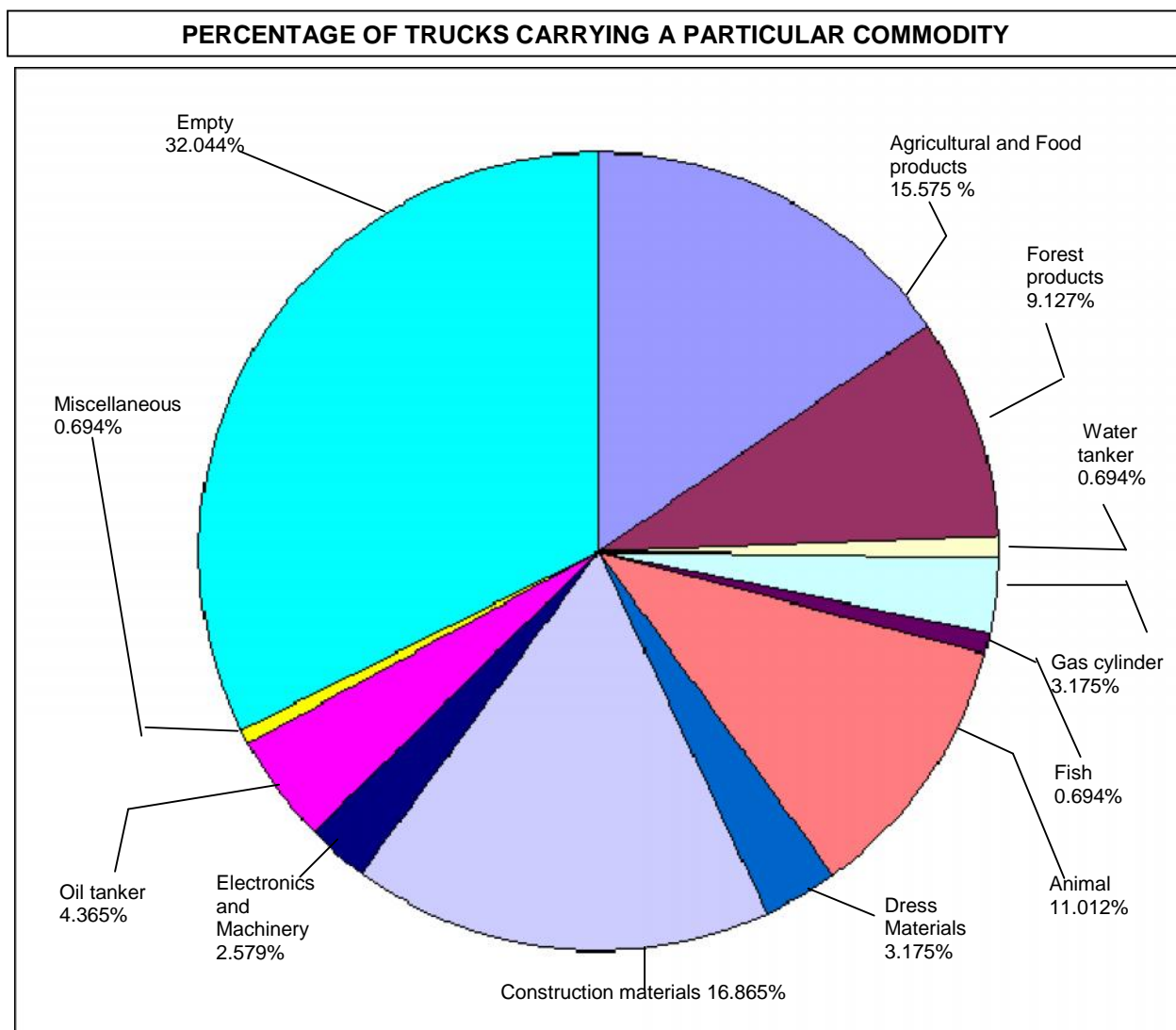
#### 7.4.8.2 Commodity Survey

The Commodity Survey was organized at Zemabawk and Sailam. Commodity Survey data shows 32% of Commercial Vehicles are empty, most of them moving from southern part of Mizoram to northern part of Mizoram and rest of India. Those, which are not empty mostly carrying construction material (17%) followed by Agricultural and Food Products (16%).

##### COMMODITY SURVEY

Sl. No.	Type of Commodity	% of trucks carrying the commodity		Average
		Zemabawk	Sailam	
1	Agricultural and Food products	10.294	21.429	15.861
2	Forest products	10.526	7.143	8.835
3	Water tanker	1.471	0.000	0.735
4	Gas cylinder	2.941	3.571	3.256
5	Fish	1.471	0.000	0.735
6	Animal	11.842	9.524	10.683
7	Dress materials	2.941	3.571	3.256
8	Construction materials	20.588	14.286	17.436

9	Electronics and Machinery	2.941	2.381	2.661
10	Oil tanker	2.941	5.952	4.447
11	Miscellaneous	1.471	0.000	0.735
12	Empty	30.573	32.143	31.358



#### 7.4.9 Truck Terminal

There is no such case.

#### 7.4.10 Long Distance Bus Terminus (Regional)

There is need for a regional bus terminus for about 3 parking spaces outside Aizawl and along or close to NH-54. i.e. in totality at Aizawl, Seling, Serchhip and Keitum.

#### 7.4.11 Diesel / Petrol Filling stations / Pumps

There are four fuel pumps on the stretch from Aizawl to Seling, but there is just one fuel pump on the stretch from Seling to Keitum. It is proposed to add one fuel pump at Chhingchhip (Chainage 81.00).

#### 7.4.12 Highway oriented rescue service and medical facility

One such facility needs to be developed at Seling.

#### 7.4.13 Willingness to pay toll survey

To estimate the realistic return of money from collection of toll tax, as per requirement of NHAI. Survey at Zemabawk and Sailam revealed the following information about acceptability of toll over the stretch:

- 54% proposes toll rate Rs 30.00 for goods vehicle.
- 27% proposes toll rate Rs 20.00 for goods vehicle.
- 11% proposes toll rate Rs 40.00 for goods vehicle.

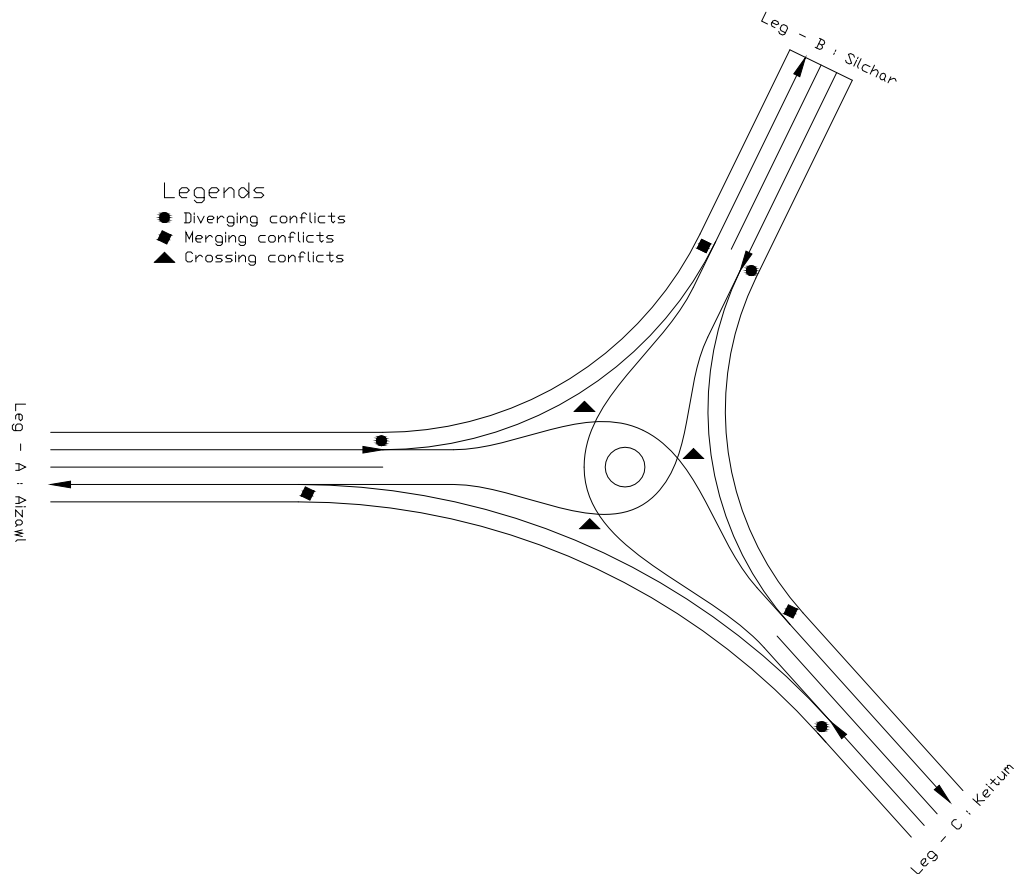
#### 7.4.14 Turning Movement Survey

Five junctions over the stretch have been selected for turning movement survey.

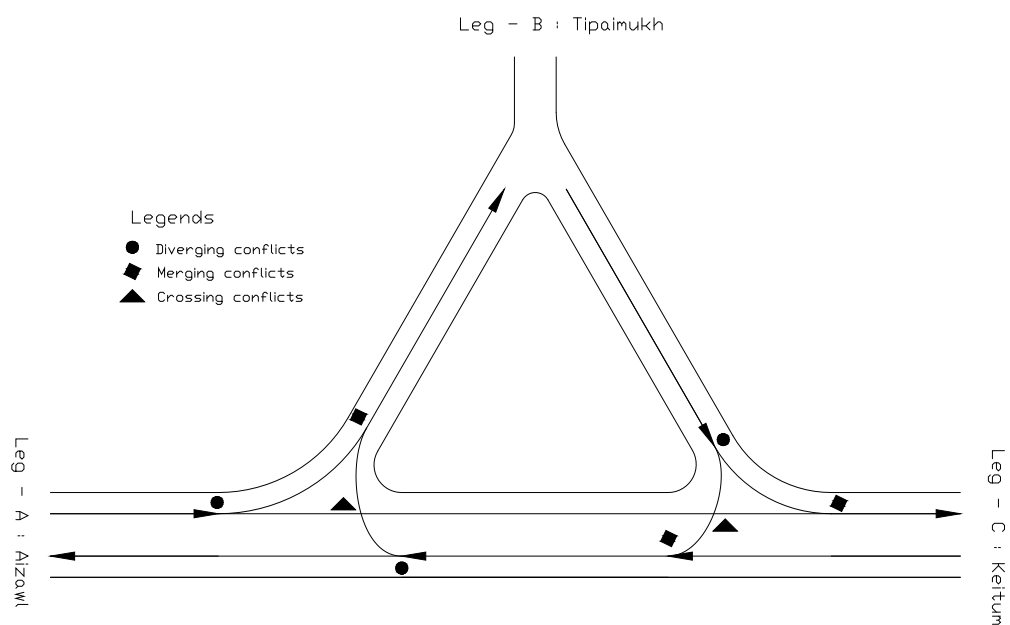
Details of peak hour traffic movements are presented ----- . Conflict points at each intersection are summarized in a table and shown in sketches. Peak hour conflict volumes are presented in a tabular form thereafter.

#### CONFLICT POINTS AT INTERSECTION

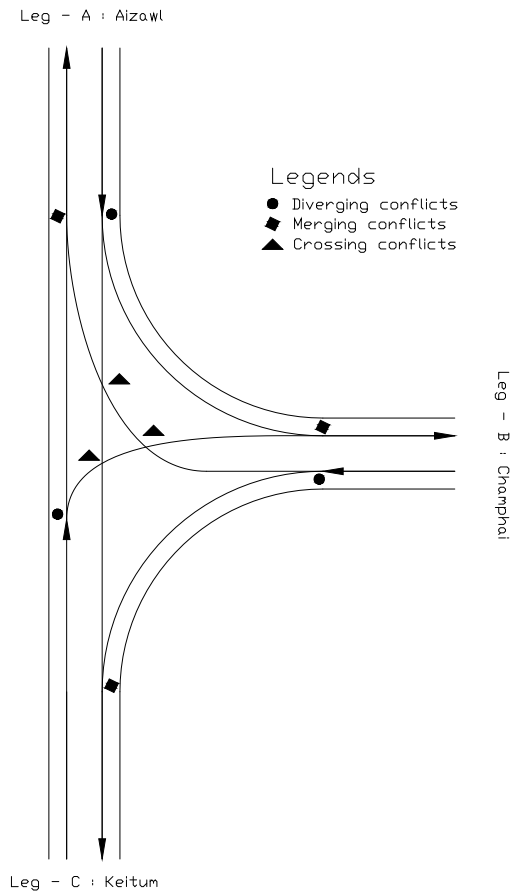
Location	Chainage (KM)	Highest volume on an approach (Number)	Number of Conflict points			
			Diverging	Crossing	Merging	Total
Bawngkawn	3.00	708	3	3	3	9
Seling	38.020	87	3	2	3	8
Seling	40.700	104	3	3	3	9
Sailam	114.400	66	3	2	3	8
Keitum	124.500	43	3	3	3	9



CONFLICT POINTS AT TM-01, BAWNGHAWN, CHAINAGE – 3.00 KM.

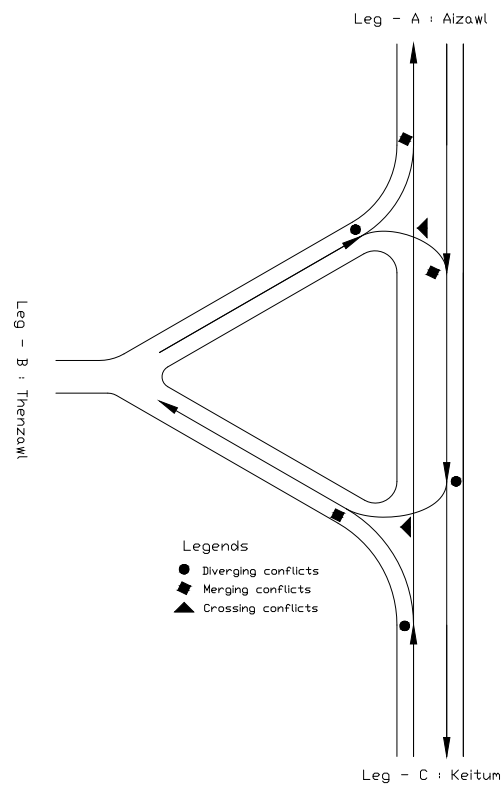


CONFLICT POINTS AT TM-02, SELING, CHAINAGE – 38.020 KM.

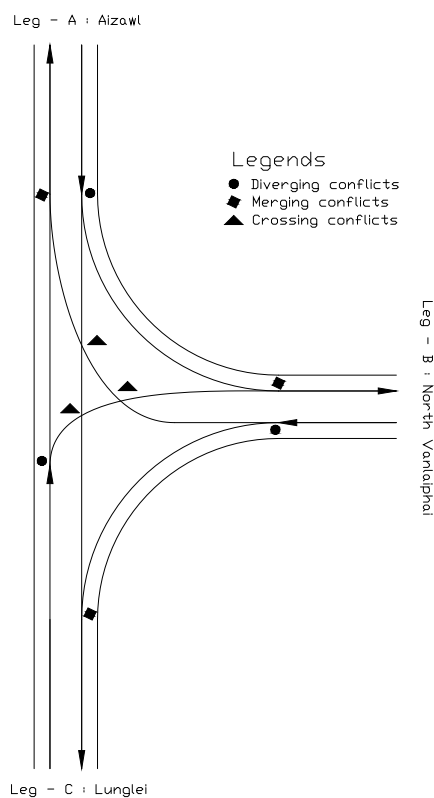


CONFLICT POINTS AT TM-03, SELING, CHAINAGE – 40.700 KM.





CONFLICT POINTS AT TM-04, SAILAM, CHAINAGE – 114.400 KM.



CONFLICT POINTS AT TM-05, KEITUM, CHAINAGE – 124.500 KM.

#### PEAK HOUR CONFLICT VOLUME

Count Station ID	Diverging			Crossing			Merging		
	Leg - A	Leg - B	Leg - C	Leg - A with Leg - B	Leg - B with Leg - C	Leg - C with Leg - A	Leg - A	Leg - B	Leg - C
TM-01	708	514	438	373 with 226	226 with 28	28 with 373	636	363	661
TM-02	65	56	87	65 with 81	-	87 with 65	81	47	80
TM-03	100	104	72	40 with 58	58 with 35	40 with 35	95	95	86
TM-04	43	35	59	-	11 with 42	42 with 10	66	27	11
TM-05	37	24	43	23 with 13	13 with 19	19 with 23	37	33	34

#### 7.4.15 Parking survey

Car and light commercial vehicle parking takes places at several locations along the highway. Usually such parking takes place near restaurants, hotels and abutting shops to serve the tourists and local population. Some tourist buses and medium sized goods carriers unload' goods along the highway. There are some commercial centers, which generate parking.

#### 7.4.16 Tourist Survey

Mizoram is having several hill stations, Mountains with scenic surroundings, Zoological gardens, Museums, Picnic spots, Lakes with boating facilities, Water falls, National parks for conservation of wild life and shopping centers to attract domestic and foreign tourists. Most of these tourist spots are accessible through NH-54

#### Tourist arrival in Mizoram

Serial Number	Year	Domestic Tourist		Foreign Tourist (No)		Growth Rate	
		Number	Days Halted	Number	Days Halted	Domestic	Foreign
1	2001- 2002	27417	51136	197	519	-	-
2	2002- 2003	31454	74821	269	1097	46.318	111.368
3	2003- 2004	37074	74795	266	1375	-0.035	25.342
4	2004- 2005	38226	63848	304	1274	-14.636	-7.345
5	2005- 2006	45999	71026	313	878	11.242	-31.083

6	2006-2007	50244	75257	542	1376	10.181	56.720
7	2007-2008	44226	79382	735	1607	1.438	16.788
Average						9.085	28.631

#### 7.4.17 Accidents

Accident information was obtained from police department and analysed. The summary indicates heavy accidents occur in this stretch of NH-54 due to problem with road alignment and negligence of driver. Number of fatal accidents is more than non-fatal accidents.

#### 7.4.18 Seasonal Variation

Average seasonal index was calculated based on fuel sales data collected from fuel stations on the stretch:

Season	Months		
		HS-01	HS-02
Winter	December-February	1.000	1.000
Summer	March-May	0.789	0.951
Monsoon	June-August	0.677	0.693
Autumn	September-November	0.730	0.933
Average Personal Index		0.799	0.894

#### 7.4.19 Time savings

As traffic is very less, this aspect was not scrutinized.

### 7.5 TRAFFIC PROJECTION

#### 7.5.1 Growth of registered vehicles

Only two years' data were available from statistical Handbook, Mizoram - 2006.

##### NUMBER OF REGISTERED MOTOR VEHICLES IN MIZORAM

Serial number	Type of vehicle	Vehicle on road	
		2004-05	2005-06
1	Two wheeler	16456	19431
2	Three wheeler	946	1189
3	Taxi	2744	3307
4	Maxi cab	612	788
5	Car	7507	8844
6	Bus	593	621
7	Trucks & Lorries	2952	3384

Serial number	Type of vehicle	Vehicle on road	
		2004-05	2005-06
8	Tractor	104	119
9	Trailer	49	53
10	Excavator/Earthmover	82	144
<b>Total</b>		<b>32045</b>	<b>37881</b>

### 7.5.2 Growth rate estimation

Sufficient data were not available for estimation of traffic growth using Econometric Models as per IRC: 108-1996. As per IRC: 37-2001 annual growth rate of 7.5% may be adopted. Therefore, we assume flat 7.5% growth rate for all fast moving vehicles.

### 7.5.3 Additional Traffic

7.5.3.1 Growth rate of 7.5% is assumed considering growth of normal traffic, Diverted traffic and any induced traffic.

No other additional traffic is expected on this stretch (Aizawl to Keitum) of NH – 54.

## 7.6 CAPACITY

For Plains

IRC: 64-1990 stipulates a design service volume of 12,500 to 15,000 PCU / day for a two lane undivided highway with a level of service B and plan terrain, depending on degree of curvature per km. With 1.5 meter paved shoulder the service volume may be enhanced to 14,400 to 17,300. A value of 35,000 PCU can be adopted for four lane divided carriageway in plain terrain, with minimum 3M wide central verge & unpaved shoulder. With paved shoulder of 1.5 M the capacity can be taken as 40,000 PCU.

Rolling & Hilly Terrain

Design service volume for two lanes road in rolling terrain having low curvature is 11000 PCU / day where as having high curvature is 10000 PCU / day as per IRC: 64-1990.

Design service volume for two lanes road in Hilly terrain having low curvature is 7000 PCU/day where as having high curvature is 5000 PCU / day.

These design service volumes are for a road having 7 m wide carriageway with good Earthen shoulder both sides, operating with a Level of Service B and having peak hour traffic in the range 8-10 pavement.

These values can be increased by 15% providing 1.5 m width paved and surfaced shoulders both side.

Design service volumes for multi-lane roads in Rolling and Hilly terrain are not given in IRC: 64-1990. We put an effort to calculate design service volume for dual carriageway four lane and six lane road using “Green Shield's Macroscopic Model” of traffic flow theory. Based on our calculation we use design service volume for four lane road 20000 PCU / day and for six lane road 40000 PCU / day. Detail calculations are given in Traffic report.

## 7.7 LANE REQUIREMENT

### HS – 01 (Aizawl to Seling)

As per TOR, two laning is pre-fixed. The section is having high curvature, which causes accidents and loss of life. As the section is in hilly terrain there is little chance of curvature reduction without help of tunnels and viaducts. Therefore for two laning, we take design service volume of high curvature, where as for four and six laning, we take design service volume of low curvature.

Lane requirement in HS-01

Year	2009	2010	2012	2030
Projected AADT (PCU/day)	4705	5058	5845	20903
Lane Requirement	Two lanes	Two lanes with paved shoulder	Four lanes	Six lanes

Sufficient data was not available for growth estimation using Econometric model as per IRC: 108-1996. Therefore traffic prediction on the section should be verified once sufficient data is available for growth estimation using Econometric model.

### HS-02 (Seling to Keitum)

As per TOR, two laning is pre-fixed on this section of NH-54. Similar as HS-01 this section having high curvature too. but Low Traffic Flow reduced number of accident on the stretch.

Lane Requirement in HS-02

Year	2009	2021	2023
Projected AADT (PCU/day)	2105	5012	5775
Lane Requirement	Two lanes	Two lanes with paved shoulder	Four lanes

## 7.8 RECOMMENDATION

Based on lane requirements following recommendations are made on NH – 54. Aizawl to Keitum section. Recommendations are made four five year's period.

### Recommendation on SH-01 (Aizawl to Seling)

Year	2009	2014	2029
Lane Requirement	Two Lanes	Four Lanes	Four Lanes
Lane Recommendation	Two Lanes with Paved Shoulder	Four Lanes	Six Lanes

### Recommendation on SH-02 (Seling to Keitum)

Year	2009	2019	2024
Lane requirement	Two Lanes	Two Lanes	Four Lanes
Lane Recommendation	Two Lanes	Two Lanes with Paved Shoulder	Four Lanes

## **Chapter - 8**

### **Conclusion & Recommendation**

## CHAPTER – 8

### CONCLUSION & RECOMMENDATION

- 8.0 The project corridor is from Aizawl to Keitum NH-54. The total length of project road passes through hilly terrain. The following are the Conclusion & Recommendations for construction of this Segment of Project Road.
- 8.1 Widening has been proposed in general on hillside for this stretch from single/intermediate lane carriageway to two lane carriageway configuration with 1.50 m wide Paved Shoulder each side. But in order to use cut volume in filling some widening have been in valley side also by R-E Wall.
- 8.2 There are geometric deficiencies in the existing single / intermediate lane road. These deficiencies have been corrected to improve the widened road alignment at least to minimum standard specified in the IRC : 52-2001 for hill road as far as possible.
- 8.3 At few stretches in hill the minimum provision as per codal requirement could not be maintained due to the site constraints so far as it relates transition curves.
- 8.4 There are important junctions. These junctions have been improved keeping in view the traffic data.
- 8.5 One bridge, which conform fully to NH Standard have been proposed to be retained with necessary repairs. One steel Arch Bridge has been proposed in 75<sup>th</sup> Km whose span is 130.0 m.
- 8.6 Out of existing Culverts in the Project Road, all the culverts are to be dismantled and constructed a new to paved shoulder + 2-lane width. Provision of additional culverts have been proposed on the basis of hydrological study.
- 8.7 Between Km 35 to Km 37, there is a Zig with U-turn road on top. This has been realigned and made straight.
- 8.8 Following cross section is proposed for the widening:
- 2-lane carriageway width will be 7 m.
  - Paved shoulder width will be 2×1.50m
  - Soft Shoulder – 2.00m
  - Parapet and drains of 0.45 m wide each are to be provided within soft shoulder.
  - The formation width is proposed as 12.00 m.
  - In between drain & paved shoulder in hillside, soft shoulder is paved.
- 8.9 Strengthening of the existing single / intermediate lane pavement with suitable bituminous overlay based on the traffic volume and BBD test results made. The details of proposed new pavement composition on the basis of pavement design have been



- furnished in Draft DPR. The assessed 10-years traffic is 8.50 msa & 20-years traffic is 25.00 msa. But pavement design has been done considering 20 msa
- 8.10 There are two landslide prone areas in the project stretch. Proper remedial measure like Rock-Anchor have been suggested and the probable cost has been provided in the updated cost estimates.
- 8.11 Adequate provision for signages and markings are proposed and the provision has been made in the overall estimate.
- 8.12 Provision has been made for Crash barrier in bridges/intersections.
- 8.13 Drains have been provided on the hillside of the project road. Catch water drains will be provided where necessary.
- 8.14 Provisions of stone masonry / concrete parapet wall have been made and included in cost estimate.
- 8.15 Provision of adequate length of Breast Walls of matching height and retaining walls have been made and included in cost estimate.
- 8.16 In a meeting taken by Mr. S. K. Verma, CE (NER)/MORT&H on 07.08.2014 in New Delhi it was decided to improve the road from Km 8.000 to Km 125.00(existing chainage). It was also decided that the proposal of a Bypass of Aizawl will be taken up as a separate project and not within the pervue of present project.
- 8.17 Environmental mitigation measures necessary have been adopted during construction based on EIA study. Provision has been made in the estimate.
- 8.18 Preliminary R&R cost has also been included in the DPR estimate.
- 8.20 The work of entire road stretch has been suggested to be divided into 4 (Four) Contract packages to complete the work programme within stipulated period of 36 months.