MINISTRY OF ROAD TRANSPORT AND HIGHWAYS (GOVERNMENT OF INDIA)

REVISED DETAILED PROJECT REPORT AND VERIFICATION OF EXECUTED QUANTITIES / ITEMS FOR WIDENING TO 2-LANE OF 4 ROADS IN STATE OF NAGALAND UNDER SARDP-NE

Stage 4:Final Detailed Project Report
Volume I : Main Report

September 2016

Submitted By

RITES
THE INFRASTRUCTURE PEOPLE
(A Government of India Enterprise)

Global Contents

For

Final Detailed Project Report under Stage 4, for Revised Detailed Project Report and Verification of Executed Quantities / Items for Widening to 2 Lane for *Merangkong – Tamlu – Mon Road, Changtongya – Longleng Road, Chakabama – Zunheboto Road and Pfutsero – Phek Road in* State of Nagaland under SARDP Phase 1, is prepared and submitted in accordance with Para 18.6 of Terms of Reference. The Detailed Project Report consists of following Volumes:

Volume I:	**Main Report**
Appendix to Volume I:	Primary and Secondary Data
Volume II:	Design Report
Part I:	Road Features
Part II:	Bridges and Cross Drainage Structures
Appendix to Design Report:	Sub Soil Exploration Report
Volume III:	Materials Report
Volume IV:	Technical Specifications
Volume V:	Rate Analysis
Volume VI:	Cost Estimates
Volume VII:	Bill of Quantities
Volume VIII:	Drawings

Volume I: Main Report for captioned project is presented in this Volume and is being submitted along with other, above detailed, Volumes.

Volume I: Main Report

Table of Contents

List of Tables

List of Figures

Chapter 1

Executive Summary

Chapter 1 Executive Summary

1.1 The Consultancy Services

The Ministry of Road Transport and Highways, vide letter number NH-12018/03/2012/NG/SARDP-NE Dated 27th December 2013, has issued Letter of Acceptance to RITES Ltd. The Time Period for completion of activities under Terms of Reference is indicated as 9 months.

The Contract agreement has been signed on 17th April 2014. As sequel to signing of Contract Agreement, the Client officials have issued notice to consultant for proceeding with works on 19th May 2014. Accordingly consultancy works have been commenced and concluded with submission of this report.

1.2 Project Roads

Four Project Roads under present scope of works are

Table 1-1: Project Roads

S. No.	Name of State Road	Length (km) as per ToR	Actual Length at Site	Location (Lat/long) between	
				Start	End
1	Merangkong – Tamlu – Mon Road (M T M Road)	100	98.1	26°36′/94°38′	26°43′/95°02′
2	Changtongya – Longleng Road (C L Road)	35	29.53	26°31′/94°40′	26°29′/94°50′
3	Chakabama – Zunheboto Road (C Z Road)	128	121.2	25°39′/94°11′	26°02′/94°31′
4	Pfutsero – Phek Road (P P Road)	66	65.3	25°34′/94°17′	25°41′/94°27′

During Presentation on submitted Preliminary Report, on 8 Oct 2014, it was communicated by MORT&H Officials that following Roads have been declared as New National Highways in State of Nagaland

- **Changtongya - Longleng** - Longching - Mon - Lapa - Tizit - Assam Border as 'NH 702 New'
- Mokokchung - **Zunheboto** - **Chozuba** - Thaveopheshu - **Phek** - Lanye as 'NH 702 A'.

In view of above, following sections / roads included in preparation of Revised Detailed Project Report would be part of New National Highway System

- **Changtongya** - **Longleng** Road for Complete Length of 30 km (approx.)
- **Chozuba** (near Km 38/200 on Chakabama - Zunheboto Road from Chakabama) - **Zunheboto** Section of Chakabama Zunheboto Road, Length 84 Km (Approx.)
- **Assam Riffle Check Post** (End Point of Pfutsero - Phek Road) to **Phek Village** Junction, Section of Pfutsero Phek Road, Length 3.5 km (Approx.)

The remaining roads and Sections of Roads would be part of State Highways of Nagaland State, and hence are proposed to be designed in accordance with State Highway/MDR/ODR Standards as detailed below:

- **Merangkong - Tamlu - Mon** Road as **State Highway** as existing road section from Km 47/300 to Mon Town (Km 98/065) is part of State Highway.
- **Chakabama - Chozuba** Section of Chakabama - Zunheboto Road as **State Highway** as it would serve as connection/link between New National Highway 702 A and NH 29 thorough Cheteba village and terminating at Chakabama.
- **Pfutsero – Phek village** section of Pfutsero – Phek Road as State Highway as it connections Pfutsero (on NH 29) to Phek (on new NH 702 A) through Porba, Sakarba, Khomi and losami villages.

The Key Plan of all Project roads is presented in Figure 1-1 at end of this Chapter. The Location of project roads is shown figure 1 – 1 and 1 – 2.

1.3 This Submissions

The Present report, **"Volume I: Main Report is part of Final Detailed Project Report".** This is being submitted in accordance with Para 18.6 of Terms of Reference Page 74 of Contract Agreement. Para 18.5 states that Main Report should consist of following

This report will present the project background, social analysis of the project, details of surveys and investigations carried out, analysis and interpretation of survey and investigation data, designs, cost estimation and conclusions. The report shall include Executive Summary giving brief accounts of the findings of the study and recommendations.

The Report shall also include maps, charts and diagrams showing locations and details of existing features and the essential features of improvement and upgrading. The basic data obtained from the field studies and investigations and input data used for the preliminary design shall be submitted in a separate volume as an Appendix to Main Report.

Accordingly, report has been prepared and structured in accordance with stated requirement and is summarized as below.

Chapter 1: Executive Summary
Chapter 2: Project Background
Chapter 3: Summary of Surveys and Investigation
Chapter 4: Improvement Proposals
Chapter 5: Cost Estimate
Chapter 6: Conclusions and Recommendations

Apart from above, **Volume II to Volume VIII** are being submitted along with this. The contents of all volumes are in accordance with scope of works stated in Terms of Reference.

Hence, the Consultant completes and concludes all project activities under present consultancy contract agreement.

1.4 Engineering Surveys and Investigations

Terms of Reference for project works details various Engineering Surveys and Investigations are required to be carried out by the consultant. The details are compiled and progress against each is detailed in following table.

Table 1-2: Engineering Surveys and Investigations

S. No.	Description	ToR Reference (Para)	Merangkong – Tamlu – Mon Road	Changtongya – Longleng Road	Chakabama – Zunheboto Road	Pfutsero – Phek Road
1	Road Inventory	11.4.1	Completed	Completed	Completed	Completed
2	Road and Pavement Condition surveys	11.5.2	Completed	Completed	Completed	Completed
3	Inventory of Bridges Culverts and Structures	11.7.1	Completed	Completed	Completed	Completed
4	Condition Survey for Bridges Culverts and Structures	11.7.1	Completed	Completed	Completed	Completed
5	Topographic Surveys	11.2	Completed	Completed	Completed*	Completed*
6	Geotechnical Investigations and Sub Soil Exploration	11.7.4	Completed	Completed	Completed	Completed
7	Materials Investigation	11.8	Completed	Completed	Completed	Completed
8	Pavement Composition	11.5.1	Completed	Completed	Completed	Completed
9	Strip Plan	11.2.7	Completed	Completed	Completed	Completed

* *Topographic Survey Works suspended from 25.07.2014 to April 2015 due to problems by unsocial local elements. Field Activities completed during May 2015.*

1.5 Submission of Reports and Documents

The Date of Commencement of consultancy Services is reckoned as 19th May 2014. The Schedule for submission of Reports and Documents is stated in Enclosure III to Terms of Reference.

The statement of schedule of submissions completed by the Consultant vis. a vis. stated requirements is presented in table below.

Table 1-3: Schedule for Submission of Reports and Documents

Stage No.	Report	Time in months for submission w.e.f. from Date of Commencement (19 May 2014)	Submission Completed on
1	**Inception Report**	1 (19 June 2014)	24 Mar 2014
2	**Preliminary Project Report**	4 (19 September 2014)	8 Aug 2014
3	**Draft Project Report**	7 (19 December 2014)	
	Volume I : Preliminary Design Report		30 Nov 2015*
	Volume II : Design Report		10 Aug 2015*
	Volume III : Drawings		9 Jan 2015* & 10 Aug 2015*
4	**Detailed Project Report**	9 (19 February 2015)	29 March 2016*
	Verification Report	9 (19 February 2015)	15 June 2016*
*Force Majeure Conditions detailed below forced delays in project progress			

1.5.1. Difficulties and force Majeure Conditions

Disturbance by unsocial elements completely, halted progress of Topographic surveys and Geotechnical Investigations at various locations on Chakabama-Zunheboto Road & Pfutsero-Phek Road during July 2014 to March/April 2015. We were not in position to carry out topographic surveys from Km 65 to 68 (Zulami village) & Km 115 to 122 on Chakabama-Zunheboto Road. Resulting in delay in completion of field activities for Topographic surveys and hence Draft Project Report.

In addition to above, **Adverse climatic, topographic, inadequate logistics and social conditions** in Nagaland have resulted in *delayed mobilization of resources, lesser outputs and slow progress of Major Engineering Surveys and Investigations* viz. Topographic surveys & Geotechnical Investigations, Sub soil Investigation & Construction Material Investigation.

Topographic Surveys have been completed for entire project road lengths in end of May 2015.

1.5.2. Documents and Data required for Verification and Verification Report

- **S. No. 2 of Form-V on Page 236 of Contract Agreement** indicates *the data and documents required to be provided by the Client* and **S. No. 24 on Page 381 of Contract Agreement**, details that "*copies of documents and data available with Employer will be provided*" to consultant for fulfilling objective of Verification. Accordingly, the Consultant has been requesting for essential Document(s)/Data required for carrying out works of verification from the Clients Officials **since inception of project in January 2014 both verbally and in writing**. However, no documents and data have been provided till 31 Jul 2015.

- The Consultant (RITES Ltd.) has provided detailed observations on provided documents by MoRTH Officials (NH-12018/03/2013/NG/SARDP-NE dated 30 July 2015) vide RITES/HW/MORTH-Nagaland/4055-30/2013 dated 12th August 2015 duly stating usefulness / non usefulness of provided documents and data.

- A meeting was held under Chairmanship of the Secretary RT&H on 11 August 2015, wherein Officials from Nagaland PWD were also present, for review of project activities. During the meeting consultant (RITES Ltd.) was instructed by MORTH to collect all documents and data from Nagaland PWD and Nagaland PWD Officials were directed to provide all documents and data.

- Nagaland PWD (NH) officials have provided some of documents and data on 2 September 2015 and Consultant (RITES Ltd.) has gone through provided documents & data, and detailed observations have been submitted vide letter dated 7 October 2015.

In-spite of non-supply of complete documents and data, as stated above, the consultant has complied information on verification and presented in **Chapter 5: Verification Report** of Stage 3 Reports' **Volume I submitted during November 2015.**

- Further to our detailed observations on provided documents and data, MORTH Officials have provided some more documents and data vide letter No. NH-12018/03/2012/NG/SARDP-NE dated 8th February 2016.

  It is important to note here that, documents and data provided by MoRTH vide letter dated 8th February 2016, were not originally available with Nagaland PWD (as stated by Chief Engineer, Nagaland PWD, vide letter dated 2nd September 2015).

  Based on data and documents provided by the Client to the Consultant on three different occasion viz. 30.07.2015, 02.09.2015 and 8 Feb 2016, **a detailed Verification Report has been submitted on 15 June 2016.**

- The Consultant has submitted Detailed Project Report on 29 March 2016 and Verification Report on 15 June 2016.

- The consultant has not received comments on submitted Detailed Project Report, accordingly consultant is submitting this 'Final Detailed Project Report'. ***With this submission consultant concludes all works and submissions in accordance with Terms of reference of Consultancy Contract Agreement.***

1.6 Existing Features on Project Roads

The existing features along all project roads viz. Number of Villages, Built up section stretch on project roads, Junctions, terrain classification, pavement type, available roadway/formation width, landslide locations, road sinking locations, overflow/submergence locations, culverts, bridges, protection works and status w.r.t. ongoing construction works are summarized and presented in table below. The project road wise details are presented in respective chapter of report.

Table 1-4: Summary of Existing Features along Project Roads

S. No.	Description	Merangkong – Tamlu – Mon Road	Changtongya – Longleng Road	Chakabama – Zunheboto Road	Pfutsero – Phek Road
1A	No. of Villages / Towns on Project Roads	10	10	16	8
1B	Length of Built up sections on Project Road (Km)	13.365	6.150	17.730	7.275
2	Junctions w.r.t. Surface Type of Cross Road (No.)				
A	Bituminous	32	6	32	8
B	Gravel	21	13	115	24
C	Concrete	1	-	1	-
D	Earthen	34	11	7	14
	Total	88	30	155	46
3A	3 Legged Junctions (No.)	85	3	5	0
3B	4 Legged Junctions (No.)	3	27	150	46
	Total	88	30	155	46
4	Terrain Classification (in Km)				
A	Mountainous	59.1	18.53	62	46.3
B	Steep	35	11	59.2	19
C	Rolling/Plain	4	-	-	-

S. No.	Description	Merangkong – Tamlu – Mon Road	Changtongya – Longleng Road	Chakabama – Zunheboto Road	Pfutsero – Phek Road
	Total	98.1	29.53	121.2	65.3
5	Existing available Roadway /Formation Width (in Km)				
A	< 4 m	0.00	0.10	0.30	4.55
B	4 – 6 m	8.70	1.50	15.00	26.25
C	6 – 8 m	20.90	5.08	32.25	15.50
D	8 – 10 m	11.30	2.40	13.70	7.15
E	10 – 12 m	7.15	3.15	18.50	4.45
F	> 12 m	50.05	17.30	41.45	7.40
	Total (in Km)	98.1	29.53	121.2	65.3
6	Surface Type of Existing Project Road (in Km)				
A	Bituminous	40.6	0.530	85.7	28.0
B	Gravel	55.9	29	10.6	37.3
C	Earthen	1.6	-		
D	Pavement under Construction	-	-	24.9	
7	Landslide Locations				
A	Numbers	23	12	84	12
B	Affected Length (in m)	4400	2200	4820	1660
8	Locations having Road Sinking Problems				
A	Numbers	-	-	9	7
B	Affected Length	-	-		
9	Hair Pin Bends Locations	19	2	6	-
10	Overflow / Submergence Locations	34	8	5	3
11	Location having Water Seepage / Flow from Hill Side	15	1	26	29
12	Culverts				
A	Pipe	151	68	249	236
B	RCC Slab	138	8	130	10
C	Box	-	-	-	2
	Total	289	76	379	248
13	Bridges				
A	Major	1	-	-	-
B	Minor	5	3	5	-
	Total	6	3	5	-
14	Retaining / Toe Walls (in m)				
	Toe Walls on Hill Side	1237	605	310	790
	Retaining Walls on Valley Side	-	-	2988	521

S. No.	Description	Merangkong – Tamlu – Mon Road	Changtongya – Longleng Road	Chakabama – Zunheboto Road	Pfutsero – Phek Road
	Total	1237	605	3298	1311
15	Ongoing Construction Works status				
	Road Works (in Km)	68.10	24.70	66.53	23.315
	Culverts (No.)	35	36	68	0

1.7 Design Standards

Design Standards for Project Roads have been proposed in accordance with relevant Indian Roads Congress publications and are detailed in relevant Chapter of volume II: Design Report. The summary of proposed and recommended design standards is presented in table below

Table 1-5: Design Standards for Road

S. No.	Description	Detail
1	Design Speed (Absolute minimum)	30 kmph
2	Carriageway Width	7.0 m
3	Paved Shoulder on Hill / Valley Side	1.5 m
4	Camber	2.5%
5	Minimum Radii for Horizontal Curve	33 m
6	Maximum Super elevation (%)	7
7	Minimum Radius of Inner Edge at Hair Pin Bends	14.5 m
8	Grade Compensation at Curves	Not Applied
9	Ruling Gradient	6%
10	Exceptional Gradient	8% for a maximum length of 100 m with easing gradients on both sides
11	Minimum Sight Distance (SSD) for 30 kmph speed	30 m

The Design Standards for Culverts, Bridges and Protection Works are in accordance with respective IRC publications.

1.8 Improvement Proposals

1.8.1. Typical Cross Section

Typical Cross Sections for Project Roads have been proposed keeping in view terrain and built up areas. The nos. of details of cross Sections are;

Table 1-6: Summary of Typical Cross Sections

Type	Carriageway Width (m)	Paved Shoulder	Drain	Valley Side Protection	Hill Side Protection
I (a) : Typical Cross Sections for project road sections in hill locations	7.0	1.5 m on both Sides	Trapezoidal RR Masonry Drain on Hill Side	Parapet Wall	Slope Stability/ Erosion Control
I (b) : Typical Cross Section for Project Road Sections requiring Fill on Valley Side	7.0	1.5 m on both Sides	Trapezoidal RR Masonry Drain on Hill Side	Retaining / Reinforced Earth Wall on Valley Side	Slope Stability/ Erosion Control
II : Typical Cross Section for project	7.0	1.5 m on both Sides	Trapezoidal RR Masonry on both	-	-

Type	Carriageway Width (m)	Paved Shoulder	Drain	Valley Side Protection	Hill Side Protection
road sections in ridge and straight reaches			sides		
III : Typical Cross Section for Project Road Sections through Box Cut Locations	7.0	1.5 m on both Sides	Trapezoidal RR Masonry on both sides	-	Slope Stability/ Erosion Control
IV : Typical Cross Section for Project Road Sections through Town with Hill/Valley combination	7.0	1.5 m on both Sides	RCC Covered Drain on Hill Side	'W' Metal Beam Crash Barrier	Retaining Wall on Hill Side
V : Typical Cross Section for Project Road Section through Town on Ridge	7.0	1.5 m on both Sides	RCC Covered Drain on both Sides	-	-

Table 1-7: Summary of Length of Typical Cross Sections along Project Road (in km)

S. No.	Project Road	Type-I	Type-II	Type-III	Type-IV	Type-V	Bridge	Total
1	Merangkong-Tamlu-Mon Road	75.7	3.8	3.1	0.0	4.1	0.1	86.8
2	Changtongya-Longleng Road	34.9	0.5	2.3	0.7	0.0	0.1	38.5
3	Chakabama Zunheboto Road	105.4	0.8	1.3	3.2	4.6	0.2	115.5
4	Pfutsero-Phek Road	60.0	0.1	0.9	1.5	0.0	0.0	62.6
**Bridges having length more than 50 m (approach to approach) have been defined under Bridge in above table. Minor Bridges and Culverts locations have been taken in type of project road sections (Type I to Type V).*								

1.8.2. Alignment

Alignment Improvement Proposals for Project Roads has been worked out based on design standard requirements keeping in view of terrain and local requirements. The summary of alignment proposals detailing Geometric Improvement (Left, Right, and Concentric), Realignment and No Geometric Improvement is presented below:

Table 1-8: Summary of Alignment Improvement Proposals

Project Road	Widening With Geometric Improvement (km)			Realignment (km)	No Geometric Improvement (km)	Total (km)
	LHS	RHS	Concentric			
Merangkong – Tamlu – Mon Road (M T M Road)	27.8	41.8	2.8	10.4	4.0	86.8
Changtongya – Longleng Road (C L Road)	8.1	2.5	0	27.9	0	38.5
Chakabama – Zunheboto Road (C Z Road)	35.5	66.1	9.8	0	4.1	115.5
Pfutsero – Phek Road (P P Road)	60.9	1.5	0	0.2	0	62.6
Total	132.3	111.9	12.6	38.5	8.1	

1.8.3. Pavement

Pavement layers and thicknesses (in mm), proposed for Project Roads are presented in table below:

Table 1-9: Proposed Pavement Composition

S. No.	Pavement Layer	Layer Thickness (mm)			
		Merangkong – Tamlu – Mon Road	Changtongya – Longleng Road	Chakabama – Zunheboto Road	Pfutsero – Phek Road
1	Wearing Coat (Bituminous Concrete)	30	30	30	30
2	Bituminous Base Layer (Dense Bituminous Macadam)	50	50	50	50
3	Non Bituminous Base Layer (Wet Mix Macadam)	250	250	250	250
4	Granular Sub Base (CBR 30%)	180	180	250* / 210	210
5	Sub Grade (effective CBR % as detailed)	500 (7%)	500 (7%)	500 (5%* / 6%)	500 (8%)
*from km 0 to km 27+500 on C Z Road					

1.8.4. Culverts

Adequate numbers of Culverts have been proposed at various locations replacing existing culverts along proposal of new culverts at required locations. The summary is detailed below.

Table 1-10: Improvement Proposal for Culverts

Project Road	Length, km	Pipe	Box	Total
Merangkong – Tamlu – Mon Road	86.8	283	149	**432**
Changtongya – Longleng Road	38.5	175	28	**203**
Chakabama – Zunheboto Road	115.5	309	340	**649**
Pfutsero – Phek Road	62.6	300	136	**436**
Total	303.4	**1067**	**653**	**1720**

1.8.5. Bridges

Summary of proposed improvement proposal for bridges is

Table 1-11: Improvement Proposal for Bridges

Project Road	Reconstruction	Retained with repairs	New Construction	Total
Merangkong – Tamlu – Mon Road	6	-	-	6
Changtongya – Longleng Road	1	1	2	4
Chakabama – Zunheboto Road	6	1	-	7
Pfutsero – Phek Road	2	-	-	2
Total	15	2	2	19

1.8.6. Slope Stability and Erosion Control

Summary of proposed improvement proposal for slope stability and Erosion Control is

Table 1-12: Improvement Proposal for Slope Stability and Erosion Control

Project Road	Length, km	Geo-synthetic mat with Soil Nailing for stretches prone to Land Slide, Length (in km)	Seeding and Mulching (Polymer Mat), Length (in km)
Merangkong – Tamlu – Mon Road	86.8	7.910	31.620
Changtongya – Longleng Road	38.5	2.395	5.390
Chakabama – Zunheboto Road	115.5	13.490	25.360
Pfutsero – Phek Road	62.6	5.565	33.215
Total	303.4	29.36	95.585

1.8.7. Gabion / Reinforced Earth Wall

Summary of proposed improvement proposal for Gabion / Reinforced Earth Wall for protection of slope is

Table 1-13: Improvement Proposal for Gabion / Reinforced Earth Wall

Project Road	Length, km	Gabion Wall, Length (in km)	Reinforced Earth Wall, Length (in km)
Merangkong – Tamlu – Mon Road	86.8	32.86	1.40
Changtongya – Longleng Road	38.5	24.22	0.41
Chakabama – Zunheboto Road	115.5	23.86	0.19
Pfutsero – Phek Road	62.6	24.22	0.14
Total	303.4	105.16	2.14

1.9 Cost Estimates

The Updated Cost Estimate for implementation of Preliminary Improvement Proposals is summarized as below.

Table 1-14: Abstract of Cost Estimate for Project Roads

Bill No.	Description	M T M Road	C L Road	C Z Road	P P Road
A	**Civil Works**				
1	Site Clearance and Dismantling	1,41,27,661	65,31,709	2,71,49,647	1,53,18,649
2	Earthworks	83,15,31,036	59,21,80,240	2,16,47,19,927	1,23,12,45,505
3	Granular Sub Base and Base Course	1,43,40,95,177	67,53,28,538	2,46,28,24,986	1,31,77,33,700
4	Bituminous Course	85,70,42,688	39,29,40,187	1,27,14,46,928	68,63,33,109
5	Cross Drainage	1,62,55,10,839	69,32,95,778	2,72,83,23,192	1,70,75,62,820
6	Bridge	47,51,53,196	13,19,19,657	27,61,76,075	6,16,38,010

Bill No.	Description	M T M Road	C L Road	C Z Road	P P Road
7	Repair of Existing Bridges	0	0	1,54,320	0
8	Drainage and Protective Works	4,62,27,62,595	2,82,33,05,121	5,79,43,89,633	3,21,18,65,097
9	Traffic Signs, Road Markings and Appurtenances	23,59,19,826	9,54,16,668	35,52,64,745	17,47,90,136
10	Miscellaneous	7,26,39,590	1,54,44,655	16,97,61,090	6,78,61,785
Sub Total for Civil Works (A)		**10,16,87,82,607**	**5,42,63,62,552**	**15,25,02,10,542**	**8,47,43,48,810**
B	Utility Shifting Cost	2,00,00,000	80,00,000	2,50,00,000	1,30,00,000
Sub Total (A+B)		**10,18,87,82,607**	**5,43,43,62,552**	**15,27,52,10,542**	**8,48,73,48,810**
C	Physical Contigencies @5% on (A+B)	50,93,12,887	27,17,18,128	76,37,60,527	42,43,67,441
Grand Total(A+B+C)		**10,69,82,21,738**	**5,70,60,80,679**	**16,03,89,71,069**	**8,91,17,16,251**
Length of the package Road (km)		**86.8**	**38.5**	**115.5**	**62.6**
Cost per km		**12.3**	**14.8**	**13.9**	**14.2**

1.10 Conclusions and Recommendations

- The up-gradation of existing single / intermediate lane road with substandard geometrics to 2-Lane with Paved Shoulders configuration of National/State Highway Standard shall return benefit by
  - Reduction in Travel time
  - Reduction / Savings in vehicles operation cost and
  - Significant reduction in road accidents (by Improving Substandard Geometrics)
  - An Effective National Development work to encourage Road Transport to IRC Standards ensuring safe and smooth journey.

- Project roads are planned to be upgraded to be 2- lane with paved shoulders carriageway configuration facility with National Highways / State Highways Design Standards In spite of much below 'the warrant of design service volume' of traffic values as recommended by Indian Roads Congress.

- Project Road sections are part of road connectivity from National Highway to District Head Quarters via selected villages and route. The existing road width varies from single lane to intermediate lane. Also, there are many substandard curves, makes it difficult for maneuvering of commercial traffic. The improved facility would encourage movement of traffic, resulting in increase in economic activity and hence overall development of project influence area.

- Technically, The project Proposals stand feasible and recommended for implementation

- Four years duration for project implantation has been proposed with a phasing of 20%, 20%, 35% and 25% respectively in each year.

- Total Project Cost of Works is in range of INR 12.3 to 14.8 Crores per km which is attributed to non-availability of construction materials, entire reconstruction of existing roadway formation, pavement structure, extensive cross drainage, longitudinal drainage, Protection & Erosion Control

measures, **high rates** of commercial materials viz. Bitumen, Cement & Steel and **Carriage of materials at Site**.

- Project would be Economically Viable with social economic costs viz. all weather connectivity to population, increase in agricultural productivity due to reduction in wastage, Vehicle Operating Cost and Passenger time Cost but financially not viable.

- Project is to be taken up under EPC for urgent Implementation for Overall Development of Road Network and Socio Economic Development of Project Area.

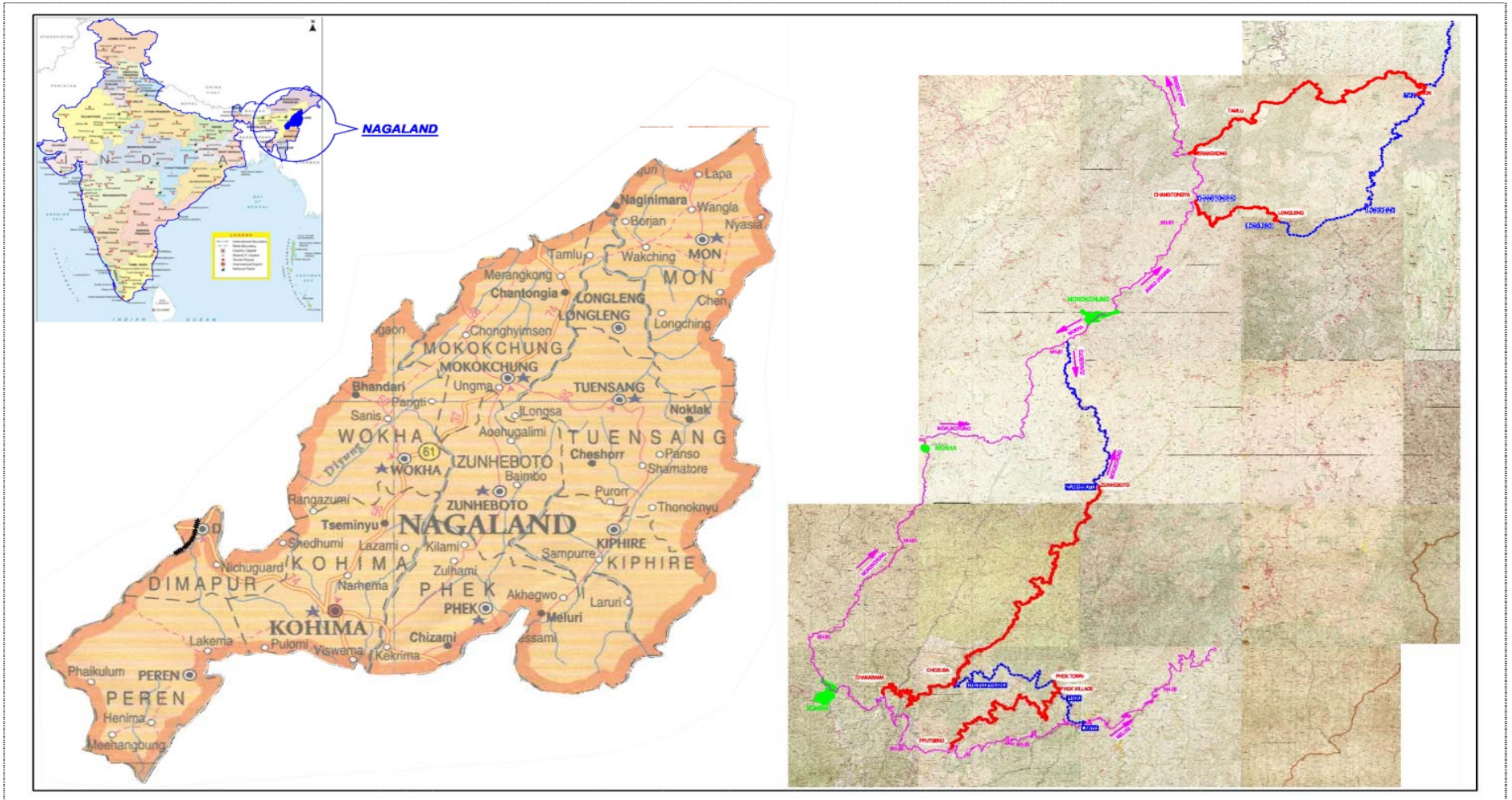

Figure 1-1: Key Plan of Project Roads

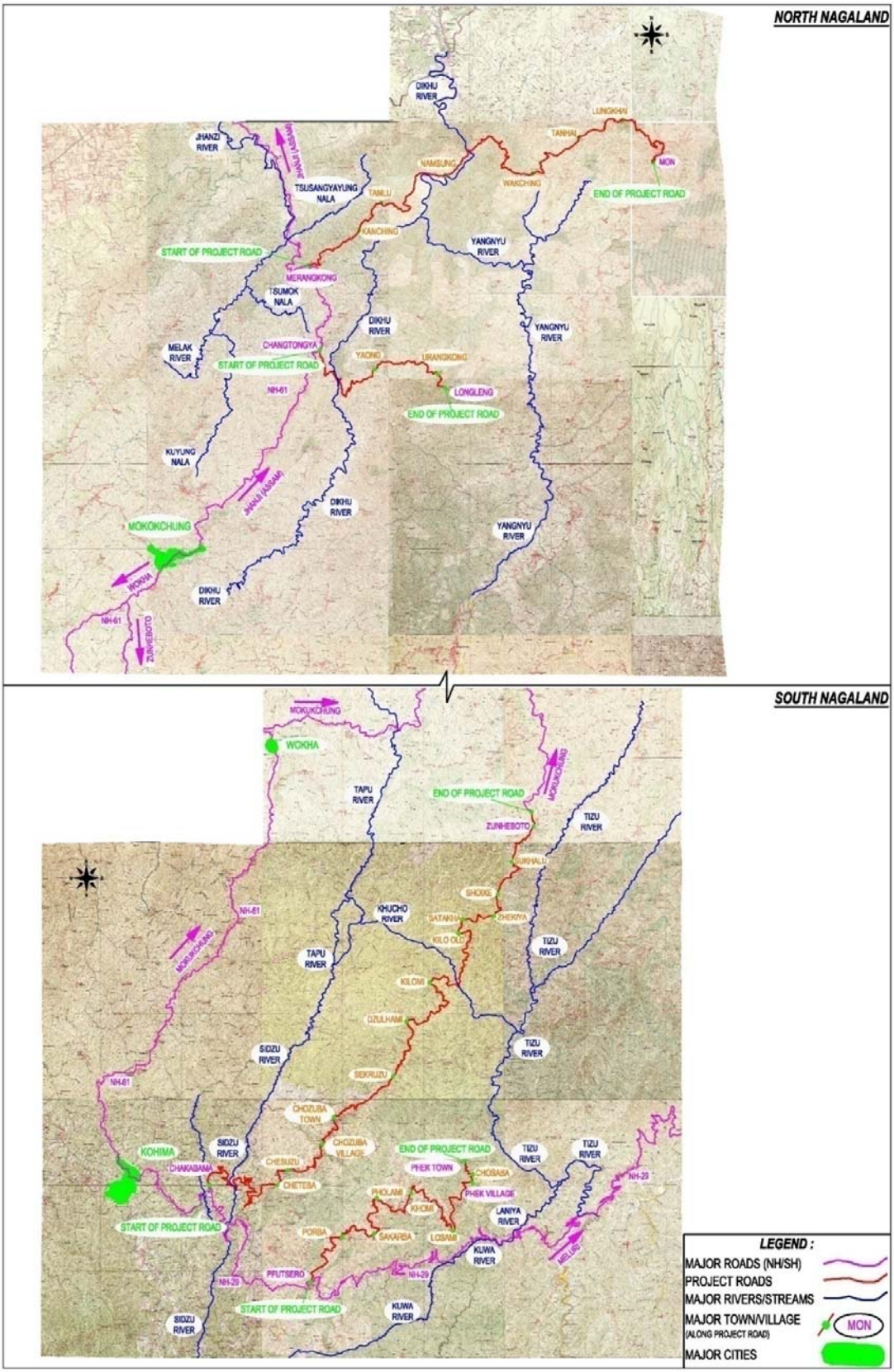

Figure 1-2: Project Roads

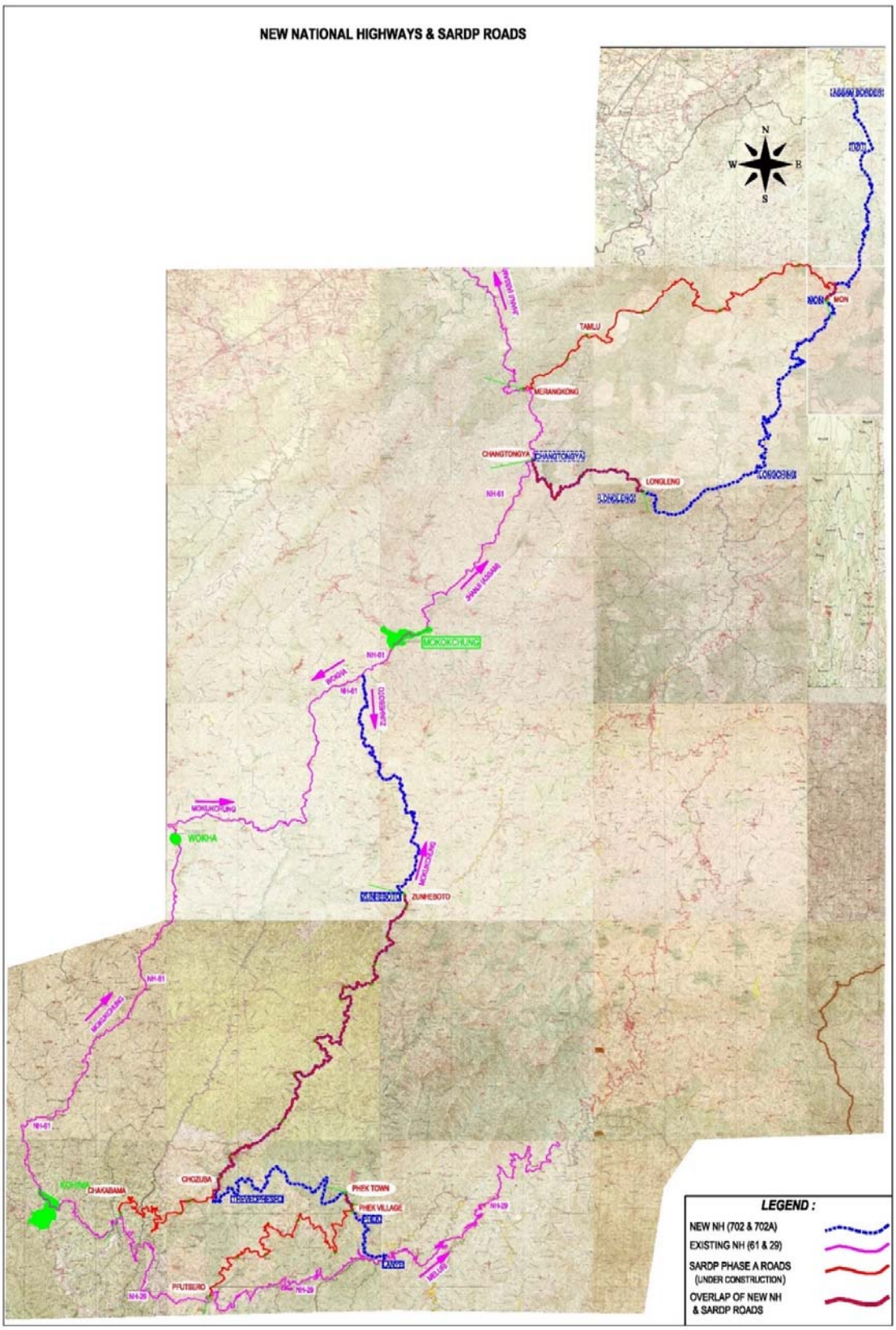

Figure 1-3: New National Highways and SARDP (Phase 1) Project Roads

Chapter 2

Project Background

Chapter 2 Project Background

2.1 Initiative of Ministry of Road Transport and Highways

The Ministry of Road Transport & Highways has initiated mega road development programme in North East with name **Special Accelerated Road Development Programme in North East (SARDP-NE)**.

The scope of the programme has been enlarged from time to time, since September 2005. As on date Government of India has given approval for 2/4 laning of 6418 km of various categories of roads under Phase 'A' and Arunachal Package of SARDP-NE in entire North East at an estimated investment of about Rs. 33,500 crore. Apart from the above Government has also given approval to preparation of detailed project report for 3723 km of roads under Phase 'B' so as to enable Government to plan expenditure on these roads during next 5 years plans.

Apart from SARDP-NE, National Highways Authority of India (NHAI) is implementing the 4 laning of 672 km of East West Corridor from Srirampur (Assam/ W. Bengal border) to Silchar in Assam at an estimated cost of Rs 6000 crore and 2 laning with paved shoulders from Jowai to Rattecherra (104 km) in Meghalaya under NHDP-III.

2.2 Objectives of SARDP-NE

- Upgrade National Highways connecting State Capitals to 2/ 4 lane;
- To provide connectivity of all 88 District Headquarter towns of NER by at least 2- lane road;
- Improve roads of strategic importance in border area;
- Improve connectivity to neighboring countries.

2.3 Project Background

The Department of Road Transport & Highways, Ministry of Road Transport and Highways, Government of India requires **Revised Detailed Project Report and Verification Report of executed items** for widening to 2-lane of following 4 roads in the state of Nagaland under SARDP-NE Phase 'A'.

Table 2-1: Project Roads

S. No.	Name of State Road	Length (km) as per ToR
1	Merangkong – Tamlu – Mon Road	100
2	Changtongya – Longleng Road	35
3	Chakabama – Zunheboto Road	128
4	Pfutsero – Phek Road	66

The total length of these State roads is 329 km. Most of the length passes through hilly terrain. The construction works for 2 – laning of these 4 roads was sanctioned by the Ministry of Road Transport and Highways on 09.12.2010 for Rs. 1296.00 Crore and work awarded by PWD, Nagaland on 04.02.2011. The date of commencement of the construction project was 19.02.2011, and the scheduled date of completion of the work as per Contract Agreement is 18.02.2014.

The Original DPRs for above 4 state Roads were prepared by the State PWD of Nagaland by engaging the Consultant. The sanctioned scope of work is improvement of 4 existing single lane State roads totalling 329 km length to 2-lane standards. The total scope of work as per the original sanction is as below:

- Improvement of 329 km of existing single lane roads to 2-lane standards.
- Construction of 1167 NP4 hume pipe culverts and 105 RCC slab culverts.
- Extension of 79 existing hume pipe culverts.
- Construction of 12 minor and 2 major bridges.
- Construction of 6934.50 m retaining wall and 4887 m breast wall.
- Construction of 328.39 km unlined drains.

- Road safety appurtenance.

The work was awarded at a contract price of Rs. 1130.67 Crore and the up to date physical progress as reported is about 20% with and presently the work is at stand still.

2.4 Objective, Scope of services and Tasks to be performed

Objective

The objective of present consultancy services is to prepare a revised detailed project report covering improvement of the highway to 2-lane standards and verification of executed quantities, items with respect to original DPR, which shall, inter-alia, include bypasses, realignments, construction/reconstruction of bridges and culverts and provision of road safety measures.

The Consultant would also bring out difference between original DPR, executed work at site and balance work proposed to be executed now. The consultant would also submit a report on the work executed by the contractor beyond the project requirement for 2-laning like excess earth work excavation carried out resulting in to infructuous work done as per submission schedule.

Scope of Services

As per Terms of Reference, the scope of works for present consultancy services includes:

- To carryout detailed Topographical survey.
- To carry out sound and optimum design for widening of the existing road to two lane National Highway standards, including bridges, culverts, bypasses etc. and prepare cost estimates.
- To carry out detailed engineering design of the proposed road and bridges.

Task to be performed

As per Terms of Reference for the project works, the consultant is required to carry out following tasks:

- To prepare and take inventory and detailed condition survey of existing road, including bridges, Cross Drainage works etc. and review all available reports and published information aboutthe project road and the project influence area;
- To carry out detailed reconnaissance;
- To identify the possible improvements in the existing alignment and make recommendations regarding most appropriate option;
- To carry out detailed topographic surveys using Total Stations and GPS;
- To carry out necessary investigations for pavement design, sub-grade characteristics and strength, investigation of required sub-grade and sub-soil characteristics and strength for road and embankment design and sub soil investigation;
- To identify the sources of construction materials;
- To carry out detailed design of road, its x-sections, horizontal and vertical alignment and design of embankment of height more than 6m and also in poor soil conditions and where density consideration require, even lesser height embankment. Detailed design of structures, preparation of GAD and construction drawings and cross-drainage structures and underpasses etc.
- To review complete drainage system and suggest improvement , if required;
- To prepare strip plan indicating the scheme for carriageway widening, location of all existing utility services (both over- and underground) and the scheme for their relocation, trees to be felled and planted and land acquisition requirements including schedule for LA: reports documents and drawings arrangement of estimates for cutting of trees and shifting of utilities from the concerned department;
- To prepare revised detailed project report, cost estimate, approved for construction drawings, rate analysis, detailed bill of quantities;
- The consultant shall submit detailed report showing difference between original DPR and revised DPR under all heads like Topographic survey, Design aspect, protection work, quantities of different items of BOQ etc.

2.5 Project Road Sections

Four Project Roads under present scope of works are:

Table 2-2: Project Roads and their Location

S. No.	Name of State Road	Length (km) as per TOR	Actual Length (Km)	Location between (lat./long.)	
				Start	End
1	Merangkong – Tamlu – Mon Road	100	98.1	26°36'/94°38'	26°43'/95°02'
2	Changtongya – Longleng Road	35	29.53	26°31'/94°40'	26°29'/94°50'
3	Chakabama – Zunheboto Road	128	121.2	25°39'/94°11'	26°02'/94°31'
4	Pfutsero – Phek Road	66	65.3	25°34'/94°17'	25°41'/94°27'
	Total	329	314.13		

During Presentation on submitted Preliminary Report, on 8 Oct 2014, it was communicated by MORT&H Officials that following Roads have been declared as New National Highways in State of Nagaland

- Changtongya - Longleng - Longching - Mon - Lapa - Tizit - Assam Border as 'NH 702 New'
- Mokokchung - Zunheboto - Chozuba - Thaveopheshu - Phek - Lanye as 'NH 702 A'.

In view of above, following sections / roads included in preparation of Revised Detailed Project Report would be part of New National Highway System.

- **Changtongya** - **Longleng** Road for Complete Length of 30 km (approx.)
- **Chozuba** (near Km 38/200 on Chakabama - Zunheboto Road from Chakabama) - **Zunheboto** Section of Chakabama Zunheboto Road, Length 84 Km (Approx.)
- **Assam Riffle Check Post** (End Point of Pfutsero - Phek Road) to **Phek Village** Junction, Section of Pfutsero Phek Road, Length 3.5 km (Approx.)

The remaining roads and Sections of Roads would be part of State Highways of Nagaland State, and hence are proposed to be designed in accordance with State Highway/MDR/ODR Standards as detailed below:

- **Merangkong - Tamlu - Mon** Road as **State Highway** as existing road section from Km 47/300 to Mon Town (Km 98/065) is part of State Highway.
- **Chakabama - Chozuba** Section of Chakabama - Zunheboto Road as **State Highway** as it would serve as connection/link between New National Highway 702 A and NH 29 thorough Cheteba village and terminating at Chakabama.
- **Pfutsero – Phek village** section of Pfutsero – Phek Road as State Highway as it connections Pfutsero (on NH 29) to Phek (on new NH 702 A) through Porba, Sakarba, Khomi and Iosami villages.

Project Road Sections and New National Highways have been presented in Figure 2.1.

2.6 Merangkong – Tamlu – Mon (M T M) Road

Project Road starts from Junction with National Highway 61 near Km 209/500 from Kohima in Merangkong Village and terminates at km Stone No. 161 which is start point of Project 'Sewak' of Border Roads Organization (BRO) in Mon District. The Project Road traverses in Mokokchung, Longleng and Mon Districts of Nagaland. The Project Road passes through mountainous to steep terrain.

Start Point (Junction with NH-61) of M T M Road

End Point of M T M Road

2.6.1. Mon District Profile

The District, with the exception of the foothills, is hilly with steep slopes. Low-lying areas with undulating hills characterize the foothills. The District can be divided into two regions topographically, namely the Upper Region comprising Longching, Chen, Mopong and Tobu areas and the Lower Region comprises Mon, Tizit and Naginimora area. The foothills lie adjacent to the plains of Assam i.e. the Tizit and Naginimora areas. The hill ranges extend from the foothills to the slopes of Naga Hills and Patkai Range in the Eastern side of the District. Shawot, the highest peak in the district has an altitude of 2414 meters above sea level.

The Mon District presents picturesque scenes with lusty rich green forest, which provides a natural habitat to different species of flora and fauna. Some of the forests of Mon are Shingphan forest, Wanching forest, Tiru forest, Zangkhum forest, Shawot and Chen forests, Yei, Monyakshu, Pessao, Yongkao and Tobu forests. These forests are rich in timber.

The Mon District is rich in flora and fauna. The rare Blue Vanda, White Orchids, Foxtail, Wild Lilies, Maples etc. are found in the mountainous region of the District. There are varieties of medicinal herbs, edible plants, shrubs, and plants etc., which are of great botanical value.

Elephant, Tigers, Spotted Leopards, Jungle Cats, Mithuns, Hornbills, Partridge fowls, the rare Tragopan, Barking Deer, Mountain Goats, Wild Boars, Bears are found in the forest of the Mon District.

The Mon District has a fairly moderate climate. Days are warm and nights are cool. Rainy season sets in the month of May and lasts till October. From November to April, the District has dry weather with relatively cool nights and bright and sunny days. The average relative humidity is 76 per cent and the average temperature is 24.4°C.

In the higher altitude, summers are pleasantly warm while winter is quite cold. The lower altitude especially those adjoining the plains of Assam experience hot summers but pleasant winters.

The average annual rainfall ranges from 2000mm to 3000mm, mostly occurring between May and October.

The main occupation of the people of this district is agriculture with nearly 90 per cent of the work force engaged in it. The economic condition of the people lags behind when compared to the living conditions of the people of other districts in Nagaland. As it is located in the remotest part of Nagaland, its economic development has not been satisfactory. Mon has great potentialities for economic development if her forest resources, human resources, water resources etc. can be re-generated. Due to ignorance, lack of capital, scientific and technical know-how, infrastructure inadequacies, the Mon District has failed to lift her up to the level of other districts. The recent trend in the District is tea-cultivation by the local people. The gentle slopes of Mon provide ample scope for developing the Mon District for the cultivation with all modern techniques. Though the Government has provided funds but the local people fail to channelise the funds for economic growth and development. If the central agencies like the Indian Council of Agricultural Research (ICAR) can establish demonstration farms to teach the villagers about the modern farming, inclination towards cash crops and horticulture, rearing of

orchids by scientific means can offer ample opportunities to the people of the Mon District for regenerating employment opportunities and for economic development in the District.

The Dikhu is the most important river in the district. It flows through the Mon district, flows past Naginimora and later joins the Brahmaputra river in Assam. There are some minor streams, rivulets and rills all over the district and many of them dry up during lean season but roar in monsoon.

Other important rivers of the Mon District are Yamon, Yityong, Kaimang, Tesang, Maksha, Tapi, Tizit, Teyap, Tekang, Jein, Teggie, Telem, Pongma and Tehok, which provide good fishing grounds, picnic spots and rafting and has a number of fish species like trout etc.

2.7 Changtongya – Longleng (C L) Road

Project Road starts from Junction with National Highway 61 in Changtongya Village near Km 191 from Kohima. It connects Longleng District Head Quarters with National Highway. The Project Road traverses through Mokokchung and Longleng districts of Nagaland. The Locations of Start and End Points are detailed in photographs below

Start Point, Junction with NH-61 in Changtongya

End Point in Longleng

During joint site visit held on 15 May 2014 with Nagaland PWD officials at Mokokchung, the physical end point of the project road was fixed near first traffic point from Changtongya. Length of Project Road is 29.530 Km.

2.7.1. District Profiles

2.7.2.1. Mokokchung District Profile

Mokokchung is the Home of the Ao Naga tribe in Nagaland. It covers an area of 1,615 sq. km. It is bounded by Assam to its north, Wokha to its west, Tuensang to its east, and Zunheboto to its south.

The physiography of the district shows six distinct hill ranges. The ranges are more or less parallel to each other and runs southeast direction.Mokokchung District lies between 93.53 and 94.53° Longitude and 25.56° Latitude.

There are several Ranges that run more or less parallel to each other in North-east or South-west direction. Between the Ranges, there are glens and gorges through which flow the hill streams. There are only two small valleys viz. Changki and Tuli, and both of them are on the western side of the district adjoining the plains of the Sibsagar district of Assam. The entire District of Mokokchung is conveniently sub-divided into Ranges. They are: Tzurangkong, Japukong, Changkikong, Asetkong, Langpangkong and Ongpangkong Range.

Alluvial, Non Laterite Red Soil and Forest Soil are predominant type of Soils found in Mokokchung district. Melak, Dikhu and Tsurang are Major Rivers in Mokokchung district. The summary of Land use of Mokokchung district is

Table 2-3: Project Roads and their Location

S. No.	Category	Area in Hectares (ha)
1	Total Land	1,61,500
2	Forest Department Purchased Land	4,966
3	Under Agriculture	18,039
4	Area occupied by Villages and Town	1,050
5	Under Horticulture	812
6	Area under different development Departments	38,607
7	Degraded Land	98,262

Rice, Tuber, Maize, Naga Dal, Soya Bean, Pea, Mustard are main crops of Mokokchung District. Tea and Orange are major cash crops of district.

2.7.2.2. Longleng District profile

Longleng District is a strip of mountainous territory having no plains and situated in the Northern Nagaland. Longleng District is located between longitude 94°E - 95°E and latitude 26°N - 27°N of the Equator. Longleng District has a total area of 1066.80 sqk.m.

Longleng District have State and 3 District boundaries. On the East it shares boundary with Tuensang and Mon district of Nagaland. On North it has Nagaland's Inter-State boundary with Assam. On the west it shares boundary with Mokokchung District of Nagaland. On the South it shares boundary with Tuensang and Mokokchung district of Nagaland.

Longleng district is the home of the Phom Tribe. The Phomes are hardworking, industrious and laborious and sportive tribe by nature.Though in the past they were fierce headhunters, having rivalry even among the Phomes, but with the advent of Western civilizations like education and Christianity, they have transformed themselves into a refine society and are now rapidly coming up at par with other society of the state, particularly the younger generation.The forefathers of the Phome Tribe practice a ritual to which the early missionaries have term it as Animisms. Today, the Phome tribe is Christian and as such the Church plays an important role in their social setup.

The Phoms have 4 major festivals, the most important of which is Monyu. The others are Moha, Bongvum and Paangmo.As per the report of 2001 Census, literacy rate of Longleng district for male was 89.1%, female literacy rate was 70.7% and total literacy rate was 80.2%.

Longleng District has a number of beautiful sightseeing, trekking, fishing, and picnic spots to attract tourists. It provides serenity, peaceful environment unlike disturbence of busy city life. Some of the populer tourist spots are (a) Pongo Village (b) Bhumnyu Village. The Longleng town itself has good senic beauty. Along the sides of Dikhu river and Yongam River tehre are lots of tourist attraction for fishing and picnicking. There are place which are good for rock inscriptions and of attraction for ornithologists and also for watching Tragopan birds. Some places can be marked for rich educational research work for anthropologists. Traditional architecture and old sculptures provide historical background of the past of Longleng and their culture and tradition.

The place can be a tourist destination in two ways. One by its historical value. Specially the tradition culture and the living lifestyles of Naga people particularly from the remote villages. Secondly, to see the cenic beauty of the Place this is fully surrounded by hills and deep jungle.

Longleng District is also popular for its Handicraft items. Specially Shawls, small items made by bamboo etc. For this quality of the Phom people the District is tagged as "The District of Handicrafts" by the Government.

2.8 Chakabama – Zunheboto (C Z) Road

Chakabama – Zunheboto Road is part of state Highway (approximate 170 km) from Mokokchung – Chakabama, connecting National Highways 61 (in North) and 29 (in South). The state Highway serves as connectivity to state capital, Zunheboto district headquarters and Nagaland University. The Project Road traverses through Phek and Zunheboto District of Nagaland State.

The Project Road starts from Junction with National Highway 29 in Chakabama Village near Km 27 from Kohima. It terminates at Junction after traversing Zunheboto town, near Assam Rifle establishment gate (km 122/250). The Project Road passes through mountainous to steep terrain.

Start Point, Junction with NH-29 in Chakabama

End Point in Zunheboto

2.8.1. District Profiles

2.8.2.1. Phek District Profile

Phek is a district in the South-Eastern part of Nagaland, bounded by Myanmar in the East, Zunheboto and Tuensang districts in the North, Manipur state in the South and Kohima district in the West.Phek is derived from the word "Phekrekedze" meaning watch tower. Earlier a part of Kohima district, it was made a separate district on December 21, 1973. It is inhabited by the Chakhesangs and Pochurys. The word "Chakhesang" an amalgamation of the names of three sub-tribes - "cha" from "Chokri", "khe" from "Khezha (Kuzha)" and "Sang" from "Sangtam (Pochury)". There are atleast three main lingusticgroup in the district, namely, Chokri, Khezha and Pochury.

The medium of communication among the people is mainly Tenyidie and Nagamese. It is a hilly district rich in flora and fanua. There are three important rivers namely Tizu, Lanye and Sedzu and three important lakes called Shilloi, chinda and Dzudu. Summer is moderately warm and winter is cold. Monsoon sets in by the last week of May and retreat by the end of September.

Agriculture is the main occupation with 80.84 % of the population engaged in agriculture. Terrace Rice Cultivation (TRC) is predominant. Besides agriculture people engage in salt making (in Meluri area) weaving, bamboo and wood carving, and in making fruit juice.

Phek is a land rich in culture and festivals. Festivals are held round the year. there are different traditional attires for every occasion. Coupled with their rich cultural heritage, the people in Phek are renowned for their cheerful nature and hospitality.

2.8.2.2. Zunheboto District Profile

Zunheboto is the home of the Semas. They are famous for their colourful war dances and folk songs. Sumis in general in those days had so many traditional festivals in sequence of seasons of the year. Even these days, two main festivals, Tulunih and Ahunah are celebrated with gaity and grandeour by young and old.

The inhabitants of every Semas are living together in harmony without any discriminations or distinction, speaking the one language i.e. Sema. The people are hard workers, the main stay of people's livelihood is shifting cultivation except the people living on the bank of Tizuriver, where 70% practice terrace cultivation. With the advent of Christianity, people have adjured animistic practice 99% of the population are Christians

Satoi and Asuto area are considered as less developed area of the district. The villages like Hokiye, Ikiye, Itoviand Shishimi are not yet connected even by jeepable road. Under Asuto area, there are still some villages like Yeshito, Yevishe, Kathara, Akhakhu,

There are high hills spread over many areas of the district. The hills vary from 1000 to 2500 m and most people live between1500 - 2000 maltitudes. The altitude of the district head quarter (ZBTO) is 1874.22 m above sea level. Most of the population resides in rural areas. Zunheboto Town is the only designated urban area of the district.

Owing to the high altitude, this district enjoys a monsoon climate almost throughout the year. Winters are very cold but summers moderately warm. December and January form the coldest part of the season and at times the temperature comes down to 10˚C. The highest summer temperature is 22˚C. The average rainfall is about 200 cm. It falls for nine months in a year, heaviest contribution being in July and August.

There are alluvial soil, Forest soil (organic) pertaining to moolisol, non-laterite soil and soils of high altitudes belonging to order spodosals.

There are three important rivers in the district viz,

- Tizuriver originating in Tuensang district flows down towards south crossing at the centre of Zunheboto district and join Chindwin.
- Doyangriver originating in Japfu passes through west part of the district and joins Dhansiri in Assam.
- Tsuthariver, originating in North East of Zunheboto drains eastern part of the district and joins Tizu below Nihoshe village, where a Mini Hydel Power project is located.

Most of the area under terrace cultivation on Tizu, Tsutha and Mela a tributary of Tizuriver. Agriculture is the main occupation of the people. The main form of cultivation is Jhum which means, Shifting cultivation. In Jhum field, Paddy, Millet, Maize,Taro or Kuchhu, (colocasea) French bean, potato, pumkin, cucumber, chilly and several varieties of gourd are grown. Terrace cultivation is practiced along the banks of Tizu, Tsutha and Mela, a tributary of Tizuriver. However, terrace cultivation, hardly occupies about 20% of the cultivable land.The yield of paddy per hectare under Jhum cultivation is much lower than the production per hectre under Terrace cultivation. There is however, great scope for increasing the yield per hectare through extending the cultivation to new area, increasing irrigation facilities, use of HYV seeds, fertilisers and through soil and water conservation measures.

2.9 Pfutsero – Phek (P P) Road

Project Road starts from Pfutsero, at junction with National Highway 29 near Km 66/500 from Kohima and Ends in Phek at junction in front of Gate of camp area of 'Assam Rifle'. The Project Road would provide 2-lane connectivity to Phek district Headquarters from NH-29 through interior and remote villages.

Start Point, Junction with NH-29 in Pfutsero

End Point in Phek

2.9.1. Phek District Profile

Phek is a district in the South-Eastern part of Nagaland, bounded by Myanmar in the East, Zunheboto and Tuensang districts in the North, Manipur state in the South and Kohima district in the West. Phek is derived from the word "Phekrekedze" meaning watch tower. Earlier a part of Kohima district, it was made a separate district on December 21, 1973. It is inhabited by the Chakhesangs and Pochurys. The word "Chakhesang" an amalgamation of the names of three sub-tribes - "cha" from "Chokri", "khe" from "Khezha (Kuzha)" and "Sang" from "Sangtam (Pochury)". There are atleast three main lingusticgroup in the district, namely, Chokri, Khezha and Pochury.

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Agriculture is the main occupation with 80.84 % of the population engaged in agriculture. Terrace Rice Cultivation (TRC) is predominant. Besides agriculture people engage in salt making (in Meluri area) weaving, bamboo and wood carving, and in making fruit juice.

Phek is a land rich in culture and festivals. Festivals are held round the year. there are different traditional attires for every occasion. Coupled with their rich cultural heritage, the people in Phek are renowned for their cheerful nature and hospitality.

Chapter 3

Summary of Surveys and Investigations

Chapter 3 Summary of Surveys and Investigations

3.1 Surveys and Investigations

Detailed engineering survey and investigations were carried out by the consultant on project roads. Following field surveys and investigations carried out during in the forms of:

Primary Survey

- ◊ **Inventory**
  - Road;
  - Culvert;
  - Bridge; and
  - Protection Work;
- ◊ **Condition Surveys**
  - Pavement;
  - Culverts;
  - Bridges;
  - Protection Works; and
  - Longitudinal Drainage;
- ◊ **Topographic Survey**
- ◊ **Pavement Investigations**
  - Existing Pavement Composition;
  - Existing Sub-grade Investigation; and
  - Construction Material Investigations
- ◊ **Sub Soil and Geotechnical Investigations for Structures**
- ◊ **Slope Stability and Land Slide Surveys**

Secondary Survey

Consultant has tried to collect all relevant data from respective State PWD regarding construction history, traffic surveys, construction materials, road alignment etc. The consultant also made an in-depth desk study of the available data and maps so as to make an overall assessment of road condition, geometry, topographic features, drainage characteristics and ROW constraints. All the data obtained from State PWD is presented as Annexure in Appendix to Volume I: Primary and Secondary Data.

3.2 Road Inventory

As per Terms of Reference for the project works, the consultant is required to carry out detailed road inventory survey to collect details of all existing road features along the existing road sections. A detailed inventory was carried out in months of April and May 2014 along the project road corridor in order to collect relevant information in respect of:

- Terrain (plain, rolling, mountainous, steep);
- Land-use (agriculture, barren, built-up dense built-up scattered, plantation)
- Name of village/town/city;
- Carriageway width;
- Shoulder surfacing type and width;
- Hill / Valley Side (Left /Right);
- Box Cutting;
- Roadway / Formation width;
- Overflow / Submergence;
- Horizontal curve;
- Road intersection type and details;
- Utilities/services/facilities;
- Rivers/streams/water courses; and
- Any other feature not covered above

The Road Inventory data for Project road sections was collected for each 100 m and part thereof as warranted by appreciable change in the physical features. The consultant has carried out and collected information in respect of road inventory details in accordance with formats submitted in Inception Report, March 2014. The Road Inventory data, thus collected during field surveys has been entered in tabular formats in Microsoft Excel sheets.

Major features of Road Inventory Survey are described, project road wise, in following paragraphs and complete data is presented as **Annexure 1: Road Inventory** in Appendix to Volume I: Primary and Secondary Data in separate volume.

3.2.1. Merangkong – Tamlu – Mon Road

Project Road starts from Junction with National Highway 61 in Merangkong Village and terminates at km Stone No. 161 which is start point of Project 'Sewak' of Border Roads Organization (BRO) in Mon District. The Project Road traverses in Mokokchung, Longleng and Mon Districts of Nagaland.

Terrain Classification

The Project Road passes through mountainous to steep terrain except for small stretch of project road which is classified as Rolling / Plain. Distribution of Terrain along project road is presented below:

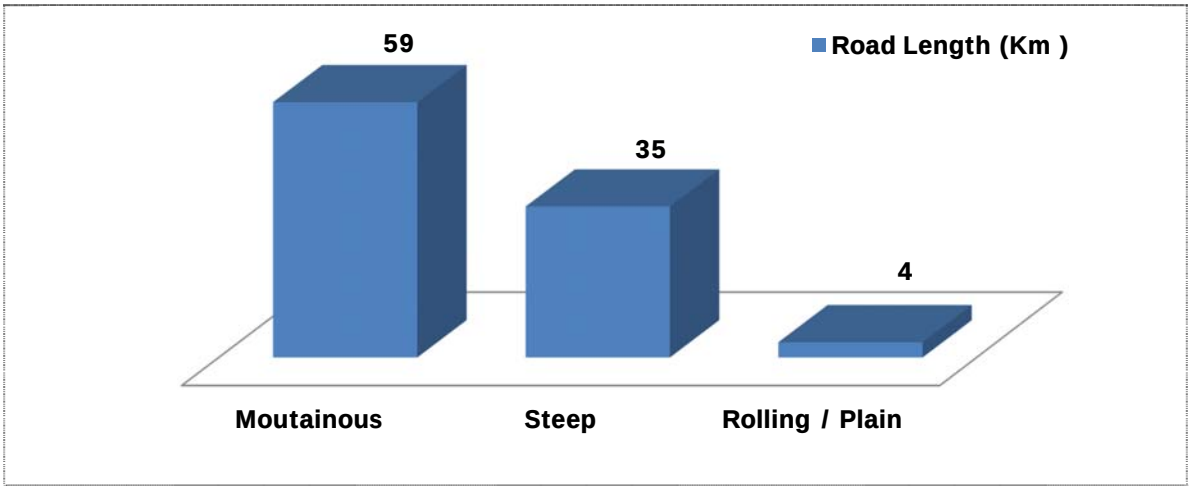


Figure 3-1: Terrain Classification along M T M Road

Villages & Towns along Project Road

Project Road traverse through various villages & Town. The location, Administrative Headquarters, Project Road section length having built-up areas and population of these villages is summarized as below:

Table 3-1: Village and Town along M T M Road

S. No.	Village/Town	ADM HQ.	Built-Up Locations (From – To), Km	Population (in No.)
1	Merangkong	Tuli	0/000 - 0/100 0/300 - 0/500 0/600 - 0/700 0/900 - 1/000 1/300 - 1/500 2/200 - 2/900	3880
2	Netnyu		11/600 - 11/700	668
3	Kangching	Tamlu	11/800 - 12/400	4975
4	Tamlu	Tamlu	16/200 - 18/200 19/000 - 19/200	5842
5	Namsang	Tamlu	33/200 - 33/300	1222
6	Wanching	Wakching	65/000 - 65/300	300

S. No.	Village/Town	ADM HQ.	Built-Up Locations (From – To), Km	Population (in No.)
7	Wakching	Wakching	65/800 - 68/000	2200
8	Tanhai	Wakching	75/800 - 77/500 78/000 - 78/200	2300
9	Lengnyu	Mon	89/100 - 89/300	1190
10	MON	Mon	93/700 - 94/400	700
11	MON TOWN	Mon	94/400 - 96/000	1600
12	MON	Mon	96/000 - 98/065	2065

About 73% project road traverse through barren land, 14% project road section passes through built-up section and 13% project road passes through plantation / agricultural land.

Existing Roadway/Formation Width

Existing available Roadway width along project road varies from 4.2 to 25 m. The details of roadway width along project road section in length (km) and in (% of Project Road Length) are presented below.

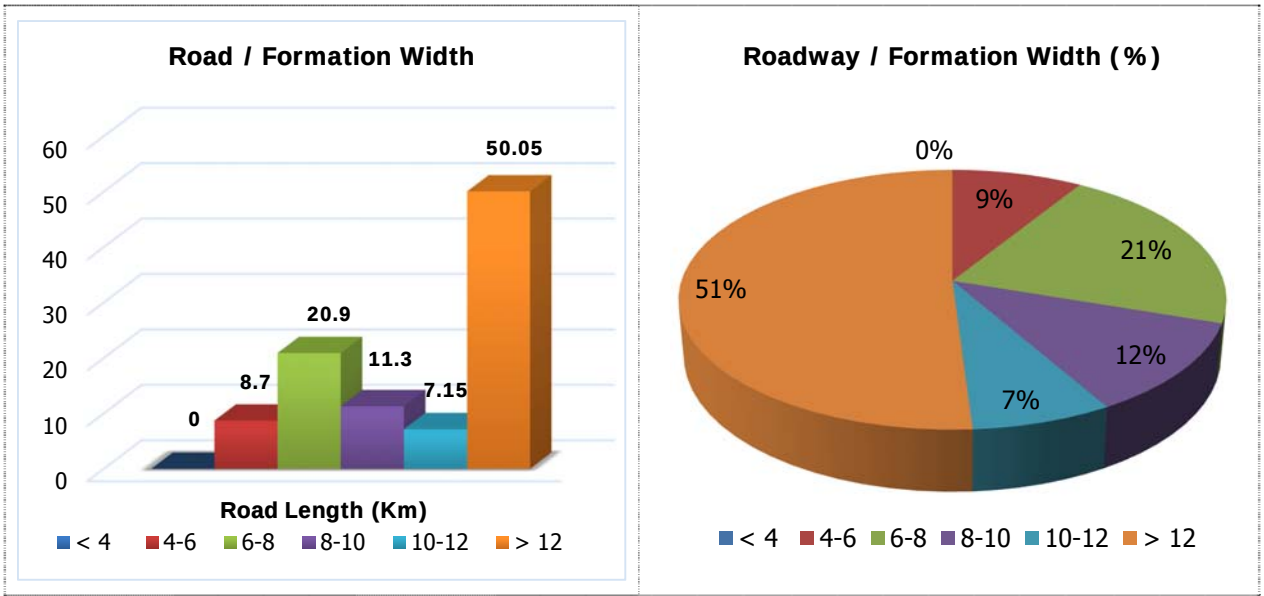


Figure 3-2: Existing Roadway/Formation Width (M T M Road)

Junctions/Cross Roads along Project Road

There are 88 Junctions/Cross Roads offsetting from the project road having Bituminous, Concrete, Gravel or Earthen Surface with carriageway width varying from 2.5 to 7.0 m. The Location wise detail of Junctions/Cross Roads is presented in table below.

Table 3-2: Junctions / Cross Roads along M T M Road

S. No.	Location (Km)	Side	To Village / Location	Type	Width
1	0/000	L / R	Tuli / Mokokchung	BT	5.5
2	0/315	L	Field	G	3.5
3	0/515	R	NH 61	G	3.5
4	0/575	L	Merangkong	ER	3.5
5	1/590	R	Merangkong	ER	3.5
6	2/460	R	Mokokchung	BT	3.5
7	2/700	L	Merangkong	BT	3.5
8	3/185	L	Merangkong	BT	3.5
9	3/455	R	Mokokchung	G	3

S. No.	Location (Km)	Side	To Village / Location	Type	Width
10	9/275	R	Village	ER	2.5
11	11/655	R	Netnyu Village	ER	3
12	11/670	L	Govt. High School	ER	2.5
13	11/775	L	Village	ER	3
14	11/855	R	Dikhu	BT	3.5
15	12/530	R	Kangching Village	BT	3.5
16	13/330	R	Kangching Village	BT	3
17	15/825	R	Police Outpost	ER	3
18	16/210	L	Police Post	ER	3
19	16/315	R	Hospital	ER	3
20	16/600	R	Hospital	ER	3
21	16/845	L	Govt. High School	BT	3
22	16/875	R	Church	ER	3
23	17/175	R	ADC Office	BT	3
24	17/375	R	Tamlu Town	BT	3
25	17/500	R	Church	ER	3
26	17/790	L	St. Thomas School	G	3
27	18/000	R	Hospital	G	3
28	19/145	L	Tamlu Town	ER	3
29	31/080	R	Agricultural Field	ER	3.0
30	33/250	L	Namsang Village	G	3.5
31	34/175	L	Village	ER	3
32	35/750	L	Namsang Village	ER	3
33	36/672	R	Village	ER	3
34	38/195	L	Village	G	3
35	42/675	R	Village	ER	3
36	47/340	L	Nagnimora	BT	3.5
37	47/345	L	Mine	ER	3
38	65/255	R	Wakching Village	ER	3
39	66/055	R	Wakching	G	3
40	66/370	L	Agricultural Field	ER	3
41	66/375	L and R	Army Camp / Village	BT/E	3
42	66/475	L and R	Church / Village	BT/G	3
43	66/960	L	DC Office	ER	3
44	67/490	R	School	G	3
45	67/985	L	SDO Civil Colony	BT	3
46	67/960	R	Seong	G	3
47	71/450	L	Awok Village	ER	3
48	73/625	R	Tea Garden	ER	3
49	76/060	R	Village	ER	3
50	76/105	R	School	ER	3
51	76/995	L	Tanhai Village	ER	2.5
52	78/000	R	Tanhai Village	ER	3.5

S. No.	Location (Km)	Side	To Village / Location	Type	Width
53	78/095	R	Agriculture Field	ER	3
54	79/245	L	Pongkong Village	G	3
55	84/450	L	Longkei Village	BT	3
56	86/600	L	Village	G	3
57	89/175	L	Lengnyu	E	3
58	94/520	L	Mon Town	BT	5
59	94/670	R	Mon Built Up	BT	3
60	94/675	L	Mon Built Up	BT	3
61	94/680	L	Mon Built Up	E	3.5
62	94/965	L	Mon Built Up	G	3.5
63	94/975	R	Mon Built Up	G	3
64	95/125	L	Mon Built Up.	BT	3
65	95/190	L	Phom Baptist Church	BT	3
66	95/192	L	DC Residence	BT	3
67	95/195	R	All to built Up	BT	3
68	95/245	R	All to built Up	BT	3
69	95/310	L	Built Up	CC	3
70	95/450	R	Built Up	BT	3.5
71	95/595	R	Police Station	BT	7
72	95/630	L	Sonari (Assam)	BT	6
73	95/835	L	Mon Built Up	ER	3
74	95/965	R	Mon Built Up	BT	5
75	96/060	R	School	BT	7
76	96/340	L	Built Up	BT	3
77	96/455	L	Built Up	G	3
78	96/456	L	Built Up	G	3
79	96/470	R	Built Up	G	3
80	96/540	L	Built Up	G	3
81	96/565	R/R	Jail	G/G	5.5
82	96/570	R	Built Up	G	3.5
83	96/650	R	Indoor stadium	BT	3
84	96/900	L	Village	G	3
85	97/075	L/L	Both to Village	BT/BT	3/5/3
86	97/095	R	Mon Town	BT	3.5
87	97/510	R	Village	ER	3
88	97/610	R	Village	ER	3
*BT = Bituminous; CC= Concrete; G = Gravel; ER = Earthen Surface Layer					

The table above details that there are 34 Bituminous/CC, 22 Gravel and 32 earthen road offsetting from the project road. Offsetting roads having Bituminous/Concrete Surface would be upgraded as AT grade junction in improvement proposal.

3.2.2. Changtongya – Longleng Road

Project Road starts from Junction with National Highway 61 in Changtongya Village. It connects Longleng District Head Quarters with National Highway. The Project Road traverses through Mokokchung and Longleng districts of Nagaland.

Terrain Classification

The Project road traverses through Mountainous and Steep terrain. Distribution of Terrain along project road is presented below:

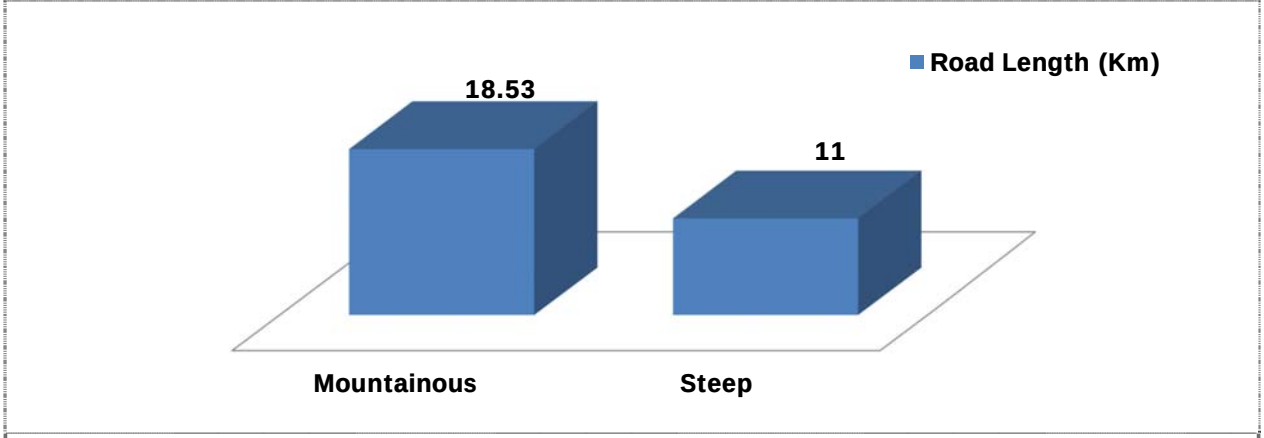


Figure 3-3: Terrain Classification along C L Road

Villages / Towns along Project Road

Project Road traverse through various villages/Town. The location, Administrative Headquarters, Project Road section length having built-up areas and population of these villages is summarized as below:

Table 3-3: Village / Towns along C L Road

S. No.	Village / Town	ADM HQ.	Built-Up Locations (From – To), km	Population (in No.)
1	Changtongya	Changtongya	0/000-0/800	2262
3	Nepali Basti		7/000-7/500	30
4	Panikhuti		8/600-8/800	
5	Tippu		9/700-10/000	
7	Yaunglyichen		12/300-13/000	
8	Yaongyimchen	Longleng	16/600-16/800	
9	Alayong		16/800-17/400	
10	Yaong		18/800-19/050	
11	Orangkong	Longleng	26/800-28/000	6307
12	Longleng	Longleng	28/000-29/400	2011

About 68% project road traverse through barren land, 16% project road section passes through built-up section and 16% project road passes through plantation / agricultural land.

Existing Roadway/Formation Width

Existing available Roadway width along project road varies from 4.0 to 23 m. The detail of roadway width along project road section in length (km) and in % of Project Road Length is presented below.

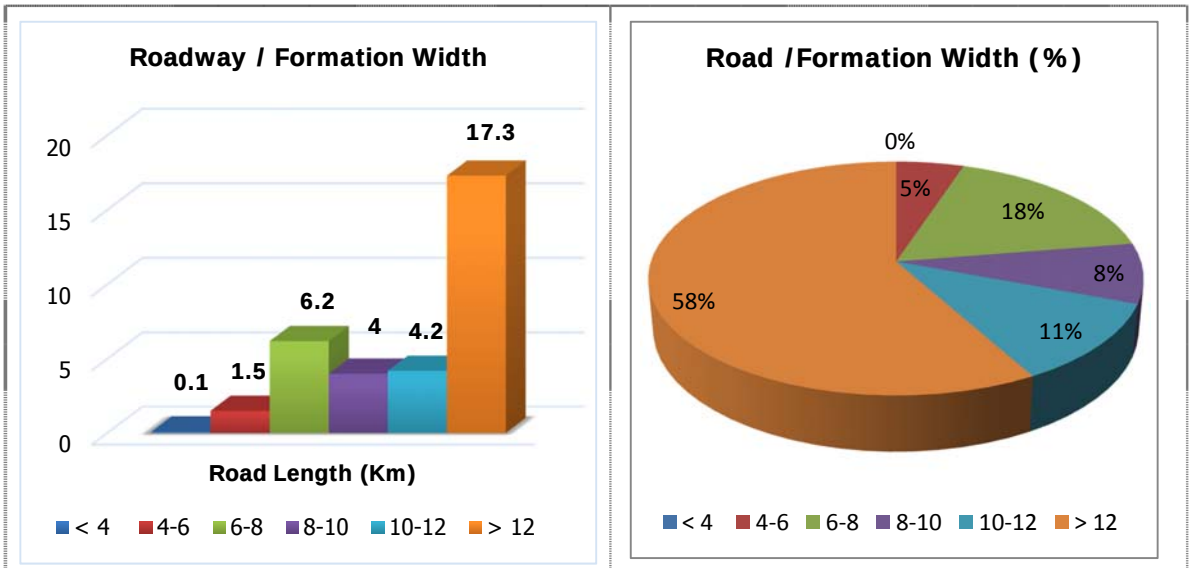


Figure 3-4: Existing Roadway / Formation widths along C L Road

Junctions/Cross Roads along Project Road

There are 30 Junctions/Cross Roads offsetting from the project road having Bituminous, Concrete, Gravel or Earthen Surface with carriageway width varying from 2.5 to 5.5 m. The Location wise detail of Junctions/Cross Roads is presented in table below.

Table 3-4: Junctions/Cross Roads along C L Road

S. No.	Location (Km)	Side	To Village/Location	Type	Width
1	0/000	L /R	Tuli / Mokokchung	BT	5.5
2	0/120	L	Changtongya Village	ER	3
3	2/890	L	Agricultural Field	ER	3
4	7/225	L	Yoonguimchem Village	G	3.5
5	10/115	R	village	ER	3
6	11/540	R	Village	G	2.5
7	11/660	L	Yaung Village	G	2.8
8	11/860	L	Sanglu Village	G	3
9	13/015	R	Village	G	2.5
10	15/300	R	Village	G	3.5
11	16/895	L	Yoonguimchem Village	ER	3
12	17/125	L	Alayong Village	BT	4
13	17/150	R	School	G	3.5
14	17/205	R	Alayong Village	ER	3
15	17/255	R	Alayong Village	ER	3
16	17/365	L	Alayong Village	G	3
17	20/810	L	Stone Crusher	G	3
18	23/640	L	Chingtok Village	BT	3.5
19	24/725	R	Agricultural Field	G	3
20	27/100	R	Agricultural Field	ER	3
21	27/190	L/R	Orankong Village	BT/ER	3
22	27/750	L	Police Station	ER	3
23	28/100	R	Police Quarters	ER	3

S. No.	Location (Km)	Side	To Village/Location	Type	Width
24	28/145	R	Village	ER	3
25	28/425	R	Village	ER	3
26	28/690	R	Agricultural Field	G	2.5
27	28/915	R	Longleng Village	G	2.5
28	29/531	L	Longleng Builtup	BT	4.0
29	29/531	R	Longleng Builtup	G	3.5
30	29/531	R	Longleng Builtup	BT	3.5

*BT = Bituminous; G = Gravel; ER = Earthen Surface Layer

The table above details that there are 6 Bituminous, 13 Gravel and 11 earthen road offsetting from the project road. Offsetting roads having Bituminous/Concrete Surface would be upgraded as AT grade junction in improvement proposal.

3.2.3. Chakabama – Zunheboto Road

The Project Road starts from Junction with National Highway 29 in Chakabama Village. It terminates at Junction after traversing Zunheboto town, near Assam Rifle establishment gate.

Terrain Classification

The Project Road passes through mountainous to steep terrain. Distribution of Terrain along project road is presented below:

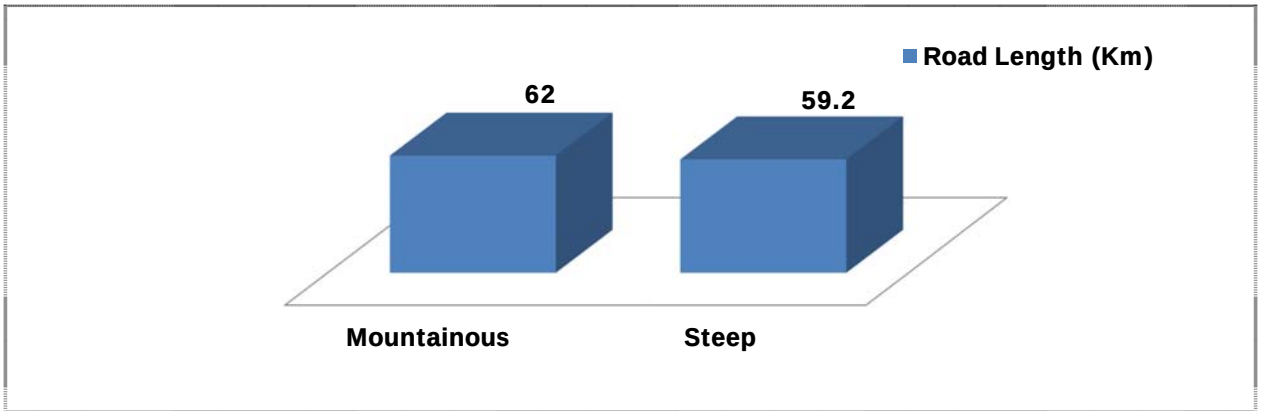


Figure 3-5: Terrain Classification along C Z Road

Villages / Towns along Project Road

Project Road traverse through various villages/Town. The location, Administrative Headquarters, Project Road section length having built-up areas and population of these villages is summarized as below:

Table 3-5: Village / Towns along C Z Road

S. No.	Village / Town	ADM HQ.	Built-Up Locations (From – To), km	Population (in No.)
1	Chakhabama	Kezocha	1/600-2/300	
2	Chetheba	Chetheba	28/300-29/400	
3	Chesuzu	Chetheba	30/300-30/500 31/500-32/300	2627
4	Chozuba	Chozuba	41/400-43/425	1858
5	Chozuba Town	Chozuba	44/000-46/300	
6	Ruzazho	Sukrezu	52/100-52/200	
7	SuthozuBasa/Bawe	Sukrezu	53/600-53/800	1097
8	Sekruzu	Sukrezu	57/600-57/987	

S. No.	Village / Town	ADM HQ.	Built-Up Locations (From – To), km	Population (in No.)
9	Dzulhami	Sukrezu	65/100-65/400 65/600-66/000	2354
10	Kilomi	Ghatashi	78/530-78/900	
11	Kilo old	Satakha	95/500-95/700	350
12	Satakha	Satakha	97/600-98/200	910
13	Zhekiye	Satakha	103/100-103/200	860
14	Shoixe	Satakha	107/200-107/800	800
15	Sukhalu	Zunheboto	112/000-112/500	375
16	Zunheboto Town	Zunheboto	115/000-115/400 115/800-116/000 116/200-122/250	18317

About 84% project road traverse through barren land and 16% project road section passes through built-up section.

Existing Roadway/Formation Width

Existing available Roadway width along project road varies from 3.5 to 23 m. The details of roadway width along project road section in length (km) and in (% of Project Road Length) are presented below.

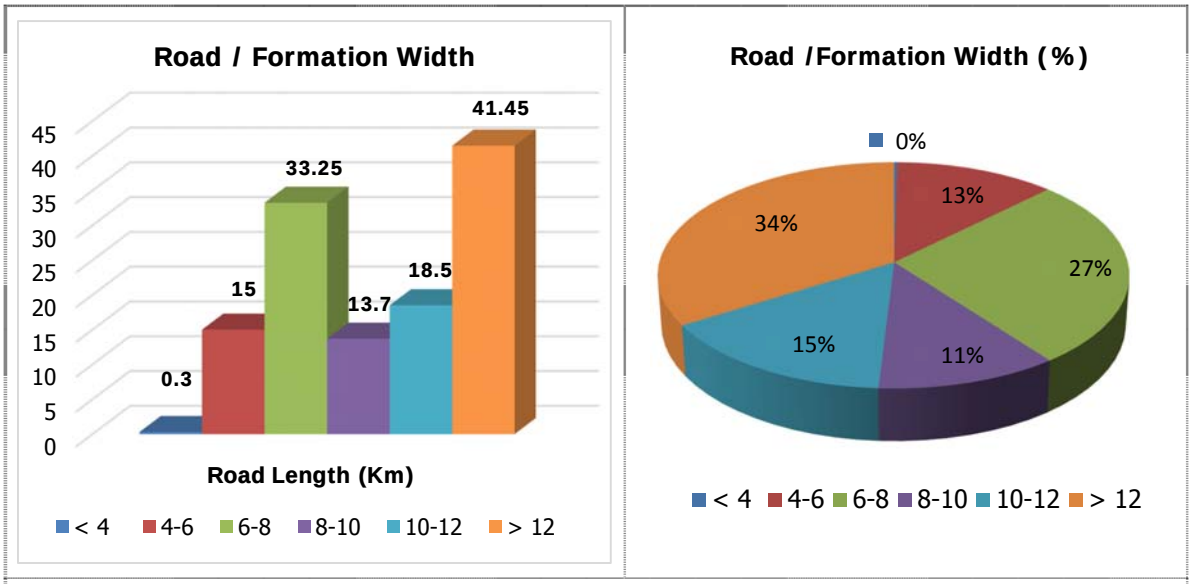


Figure 3-6: Existing Roadway/Formation Width along C Z Road

Junctions/Cross Roads along Project Road

There are 155 Junctions/Cross Roads offsetting from the project road having Bituminous, Concrete, Gravel or Earthen Surface with carriageway width varying from 3 to 3.75 m. The Location wise details of Junctions/Cross Roads are presented in table below.

Table 3-6: Junctions/Cross Roads along C Z Road

S. No	Location (km)	Side	To Village/Location	Type	Width
1	1/495	L	Local	ER	3.5
2	1/935	R	School	G	3.5
3	2/085	L	Local	ER	3
4	2/100	L	Dhoma village	BT	3.5
5	4/715	L	Local	ER	3.5

S. No	Location (km)	Side	To Village/Location	Type	Width
6	10/525	R	Local	G	3.5
7	15/377	L	Local	ER	3
8	16/520	L	Local	G	3
9	24/230	R	Local	G	3
10	26/224	L	Local	G	3
11	28/675	R	Thenyizum Village	BT	3.5
12	28/675	L	Local	G	3
13	28/675	R	Local	G	3
14	28/810	L	Chethaba Church	BT	3.5
15	29/150	R	To Pfutsero (PMGSY)	BT	3.5
16	30/495	L	Local	G	3.5
17	30/940	L	Local	G	3.5
18	31/300	R	Chesuzu village	G	3
19	31/880	R	Chesuzu village	G	3.5
20	31/997	R	Chesuzu village	G	3.5
21	32/000	L	Field	ER	3
22	32/170	R	Local	G	3
23	34/830	R	Local	G	3.5
24	34/835	R	Local	G	3
25	36/525	L	Local	G	3
26	38/235	L	Local	G	3
27	38/220	R	To Phek	G	3.5
28	39/452	L	Rungezu	G	3.5
29	39/452	L	Local	G	3
30	40/390	L	Local	G	3.5
31	40/975	L	Local	G	3.5
32	41/290	L	Zaka village	G	3.5
33	41/960	L	Local	G	3
34	41/990	L	Ighavito village	G	3.5
35	41/990	R	Local	G	3
36	41/990	R	Local	G	3
37	42/025	R	Local	G	3.5
38	42/360	R	Chozuba village	G	3.5
39	42/365	R	Chozuba village	G	3.5
40	42/915	R	Local	G	3.5
41	43/005	L	Local	G	3.5
42	43/005	R	Local	G	3
43	43/005	R	Local	G	3.5
44	43/075	R	Chozuba village	G	3.5
45	43/10.5	R	Chozuba village	G	3.5
46	43/135	L	Ighanumi village	G	3.5
47	43/400	L	Local	G	3.5
48	44/047	L	Local	ER	3
49	44/645	L	Community health center	BT	3.5
50	44/645	L	Local	BT	3.5
51	44/790	R	School	CC	5
52	44/900	R	Chozuba HQ.	BT	3.5
53	44/900	R	Police station	G	3.5

S. No	Location (km)	Side	To Village/Location	Type	Width
54	45/500	R	Local	G	3
55	45/825	R	Local	BT	3.25
56	46/005	L	School	BT	3.5
57	46/010	R	Local	G	3.5
58	46/185	L	Chirstianspritual therapy center	G	3
59	46/430	R	Local	G	3
60	46/970	L	Local	G	3.5
61	48/675	L	Local	G	3.5
62	48/675	R	Local	G	3.5
63	50/150	R	Yoruba village	G	3.5
64	51/210	L	FDA Project	G	3.5
65	51/855	L	Local	G	3.5
66	51/950	R	Ruzazho	G	3.5
67	53/710	L	Local	G	3.5
68	53/775	L	Local	G	3.5
69	54/060	R	Local	G	3.5
70	57/155	L	Local	G	3.5
71	57/595	L	Sekruzo Church	G	3.5
72	57/803	L	Local	G	3.5
73	58/115	R	Local	G	3
74	58/305	R	New creation ministry	G	3.5
75	58/310	R	Local	G	3.5
76	65/175	L	Local	G	3
77	65/375	R	Local	G	3.5
78	65/925	L	Local	G	3.5
79	71/180	R	Dzulhami church	G	3
80	78/590	L	Local	G	3
81	78/765	L	CI post BSF Kilomi	BT	3.5
82	78/850	L	CI post BSF Kilomi	G	3
83	79/500	L	Khugutomi	G	3.5
84	81/685	L	Local Crusher	G	3.5
85	85/670	R	Local	G	3
86	90/990	L	Local	G	3.5
87	91/030	R	Local	G	3.5
88	95/700	R	Local	BT	3
89	95/760	L	Kilo old village.	G	3
90	95/905	L	Kilo old village.	G	3
91	96/090	R	Pithutsa	G	3.5
92	97/740	L	Satakha	BT	3.5
93	97/900	L	Local	G	3.5
94	102/612	R	Satoi	BT	3.5
95	103/175	R	Local	G	3.5
96	103/520	L	Local	G	3
97	104/260	L	Local	G	3.5
98	105/225	L	Local	G	3
99	105/820	L	Aguito	G	3.5
100	107/200	R	Kiyekhu	G	3.5
101	107/235	L	Local	G	3.5

S. No	Location (km)	Side	To Village/Location	Type	Width
102	107/770	L	Local	G	3.5
103	108/045	L	Local	G	3
104	110/540	R	Gethsemaeprayar house	G	3.5
105	111/655	R	Local	G	3
106	112/070	L	Sukhalu village	G	3.5
107	112/300	R	Local	G	3
108	112/300	R	Local	G	3
109	112/300	R	Local	G	3
110	112/425	L	Sukhalu village	G	3
111	113/210	R	Local	G	3.5
112	113/560	L	Local	G	3.5
113	114/330	L	Local	G	3.5
114	114/460	R	Local	G	3
115	114/490	R	Local	G	3
116	114/675	R	Local	G	3.5
117	115/105	R	Local	G	3
118	115/450	R	Police reserve	G	3
119	115/820	L	Local	G	3.5
120	116/475	R	Local	G	3
121	116/582	R	Local	G	3
122	116/720	L	Local	G	3.5
123	116/815	L	Local	G	3
124	116/950	L	Local	G	3
125	116/975	L	Local	G	3
126	117/050	R	Church	G	3
127	117/175	L	Local	G	3
128	117/670	L	Local	BT	3
129	117/740	R	Local	BT	3
130	117/775	L	Local	G	3.5
131	117/940	R	Local	G	3.5
132	118/005	R	Local	BT	3.5
133	118/055	R	Zunheboto tower	BT	3.6
134	118/250	L	Local	G	2.75
135	118/330	R	Local	BT	3
136	118/635	L	Local	G	3
137	118/825	L	Circuit house	BT	3.25
138	119/145	L	Nathala oil	BT	3.5
139	119/189	R	Local	BT	3
140	119/190	R	Local	BT	3.5
141	119/425	L	Local	BT	3
142	119/565	R	Local	BT	3
143	119/565	R	DC office	BT	3.5
144	119/722	R	Local	BT	3
145	119/722	R	Local	BT	3
146	119/740	R	Local	BT	3
147	120/190	R	Local	BT	3
148	120/225	L	Local	BT	3
149	120/925	L	Local	ER	3.5

S. No	Location (km)	Side	To Village/Location	Type	Width
150	121/425	R	Assam rifle	G	3
151	121/250	L	Local	G	3
152	121/553	R	Local	BT	3
153	121/553	L	Local	G	3
154	122/100	R	Assam rifle	G	3.5
155	122/250	R	Assam rifle	BT	5

*BT = Bituminous; CC= Concrete; G = Gravel; ER = Earthen Surface Layer

The table above details that there are 32 Bituminous, 1 Concrete, 115 Gravel and 7 earthen road offsetting from the project road. Offsetting roads having Bituminous/Concrete Surface would be upgraded as AT grade junction in improvement proposal.

3.2.4. Pfutsero – Phek Road

Project Road starts from Pfutsero, at junction with National Highway 29 and Ends in Phek at junction in front of Gate of camp area of 'Assam Rifle'. The Project Road would provide 2-lane connectivity to Phek district Headquarters from NH-29 through interior and remote villages.

Terrain Classification

The Project road traverses through Mountainous and Steep terrain. Distribution of Terrain along project road is presented below:

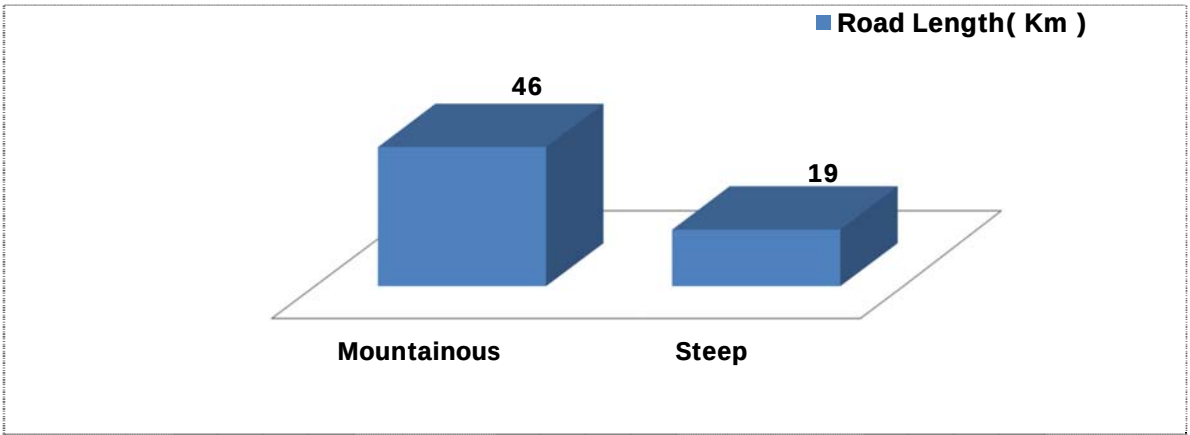


Figure 3-7: Terrain Classification along P P Road

Villages / Towns along Project Road

Project Road traverse through various villages/Town. The location, Administrative Headquarters, Project Road section length having built-up areas and population of these villages is summarized as below:

Table 3-7: Village / Towns along P P Road

S. No.	Village / Town	ADM HQ.	Built-Up Locations (From – To), km	Population (No.)
1	Pfutsero	Pfutsero	0/000-1/800	11220
2	Porba	Sakraba	8/200-9/800	4002
3	Sarkraba	Sakraba	14/800-15/100 15/700-16/600	1334
4	Pholami	Sakraba	24/100-24/400	1856
5	Middle Khomi	Sakraba	37/500-38/000	1345
6	Losami	Phek	50/700-51/100	2100
7	Chosaba	Phek	62/500 - 62/700	234
8	Phek, Town	Phek	64/000 - 65/275	4350

About 81% project road traverse through barren land, 11% project road section passes through built-up section and 8% project road passes through plantation / agricultural land.

Existing Roadway/Formation Width

Existing available Roadway width along project road varies from 3 to 30 m. The details of roadway width along project road section in length (km) and in (% of Project Road Length) are presented below.

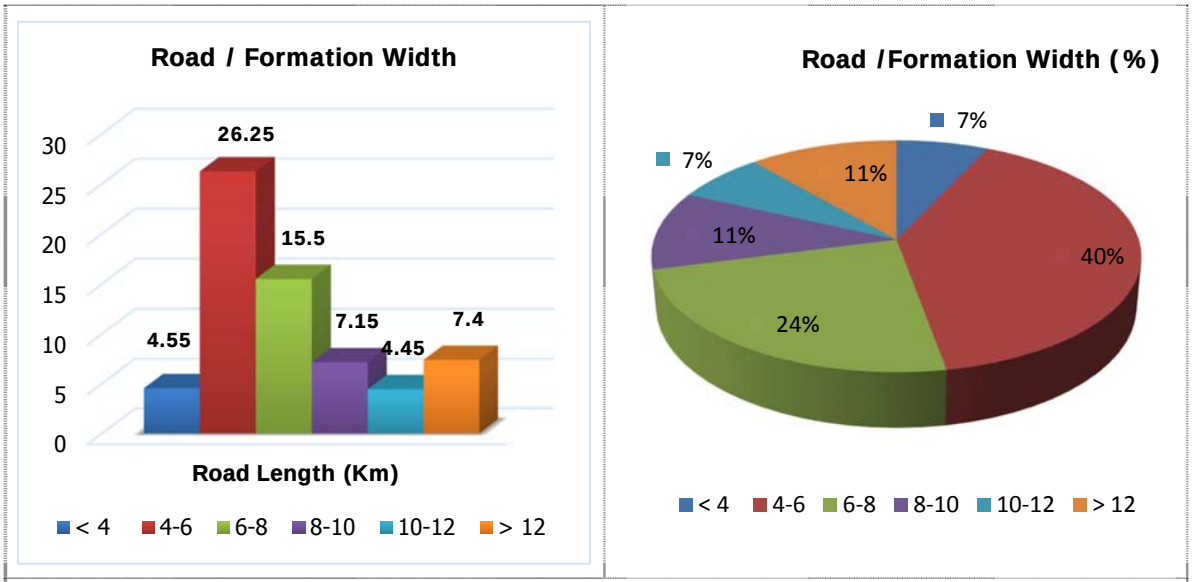


Figure 3-8: Existing Roadway/Formation Width along P P Road

Junctions/Cross Roads along Project Road

There are 46 Junctions/Cross Roads offsetting from the project road having Bituminous, Gravel or Earthen Surface with carriageway width varying from 3 to 3.75 m. The Location wise details of Junctions/Cross Roads are presented in table below.

Table 3-8: Junctions/Cross Roads along P P Road

S. No	Location (km)	Side	To Village/Location	Type	Width
1	0/000	R	Chasami	BT	3.5
2	0/255	R	Chasami	BT	3.5
3	0/270	L	Church	G	3.5
4	1/175	L	Chetheba	BT	3.75
5	1/245	L	Church	G	3
6	1/960	L	Forest	G	3.5
7	2/320	L	Crusher	G	3
8	2/960	L	Crusher	G	3.5
9	8/305	L	ICAR Institute	G	3
10	8/800	R	Porba village	G	3.5
11	9/125	L	National Research centre	BT	3.5
12	14/910	L	Church	ER	3.5
13	15/910	L	Sakraba village	ER	3
14	16/035	L	Sakraba village	ER	3
15	16/095	R	Sakrabavillage	BT	3
16	16/205	R	PHC Sakraba	ER	3
17	16/395	L	Govt. High School	G	3
18	16/405	R	village	BT	3
19	23/090	R	Phalomi village	ER	3
20	24/105	L	Phalomi village	G	3.5

S. No	Location (km)	Side	To Village/Location	Type	Width
21	24/410	R	Phalomi village	G	3
22	24/535	R	Phalomi village	ER	3
23	24/852	L	School	G	3
24	24/848	R	village	G	3.5
25	37/710	R	village	G	3
26	37/750	L	village	ER	3
27	37/810	R	village	G	3.5
28	39/190	L	Upper khomi	G	3.5
29	43/645	R	Middle khomi	ER	3
30	45/705	R	Agg link road losami village	ER	3.5
31	49/895	L	village	ER	3
32	50/765	L	Losami village	G	3.5
33	50/860	R	Losami village	BT	3.5
34	58/945	R	Local	G	3.5
35	61/540	L	Local	G	3
36	61/640	R	Phek village	BT	3.5
37	62/395	R	Pig breeding center	G	3.5
38	62/695	R	Local	ER	3.5
39	62/835	L	Local	ER	3
40	63/560	L	Local	ER	3
41	63/740	L	Local	ER	3
42	64/230	R	Local	G	3.5
43	64/453	L	Local	G	3.5
44	64/740	L	Forest Office	G	3.5
45	64/910	L	Local	G	3.5
46	65/130	L	Local	G	3
*BT = Bituminous; G = Gravel; ER = Earthen Surface Layer					

The table above details that there are 8 Bituminous, 24 Gravel and 14 earthen road offsetting from the project road. Offsetting roads having Bituminous Surface would be upgraded as AT grade junction in improvement proposal.

3.3 Culvert Inventory

A Detailed Culvert Inventory survey was carried out along project roads during April and May 2014, in order to collect relevant information in respect of:

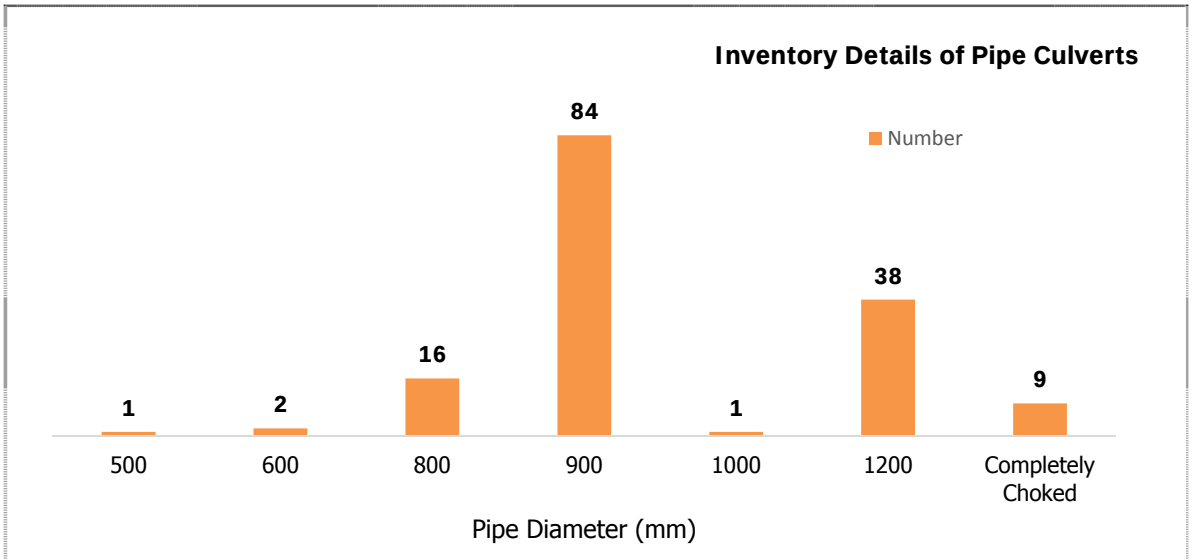
- Culvert Number;
- Location (Km);
- Type of Structure (Pipe/Slab/Box/Arch);
- Span Arrangement and Total Waterway (No. x length, in m);
- Carriageway Width (m);
- Overall Width of Culvert (m);
- Head Wall;
- Wing Wall/Return Wall;
- Parapet/Handrail;
- Presence of Scour at Inlet and Outlet;
- Adequacy of Waterway;
- Catch Pit details:
- Direction of Flow;
- Protection Works; and
- Special problem, if any

Culvert Inventory surveys have been carried out using visual means supplemented by simple tape measurements as per Inspection Proforma detailing in IRC:SP-19 and IRC:SP-35. The Proforma have been submitted in Inception Report, March 2014. The information, thus collected has been collated based on local inquires and discussions with Nagaland PWD officials.

The summary of inventory details of existing culverts has been presented in following paragraphs and complete complied Data has been collated in tabular formats in Microsoft Excel Sheets and data has been presented in **Annexure 2: Culvert Inventory and Condition Survey** in Appendix to Volume-I: Primary and Secondary Data in separate volume.

3.3.1. Merangkong- Tamlu – Mon Road

There are 289 culverts consisting of 151 RCC pipe, 138 RCC slab on the project road. Further, inventory details of Pipe and Slab Culverts based on their size viz. Diameter of Pipe (in mm) and Vent way opening (in m) is presented in Figure below.



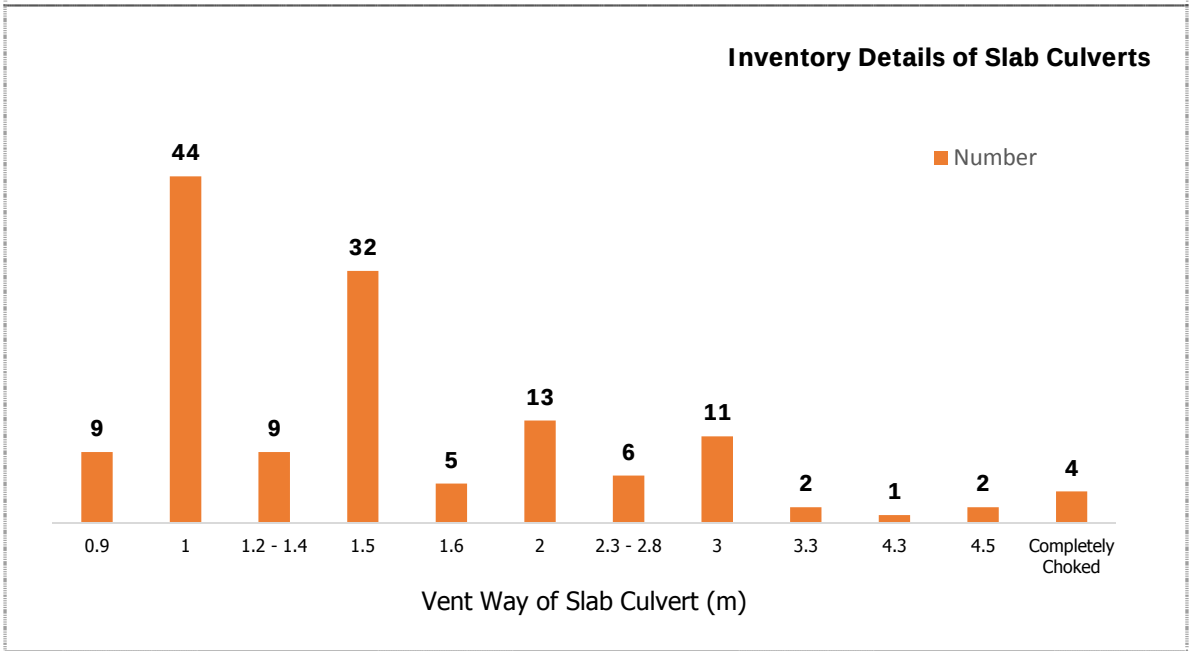


Figure 3-9: Summary of Culvert Inventory on M T M Road

3.3.2. Changtongya – Longleng Road

There are total 76 culverts along Changtongya – Longleng Road consisting of 68 RCC pipe and 8 RCC slab. Apart from above stated 76 culverts, 1 culvert has left side 1 x 2.0 m span slab culvert and right side 2 x 0.60 m pipe culvert.

Further, inventory details of Pipe and Slab Culverts based on their size viz. Diameter of Pipe (in mm) and Vent way opening (in m) is presented in Figure below.

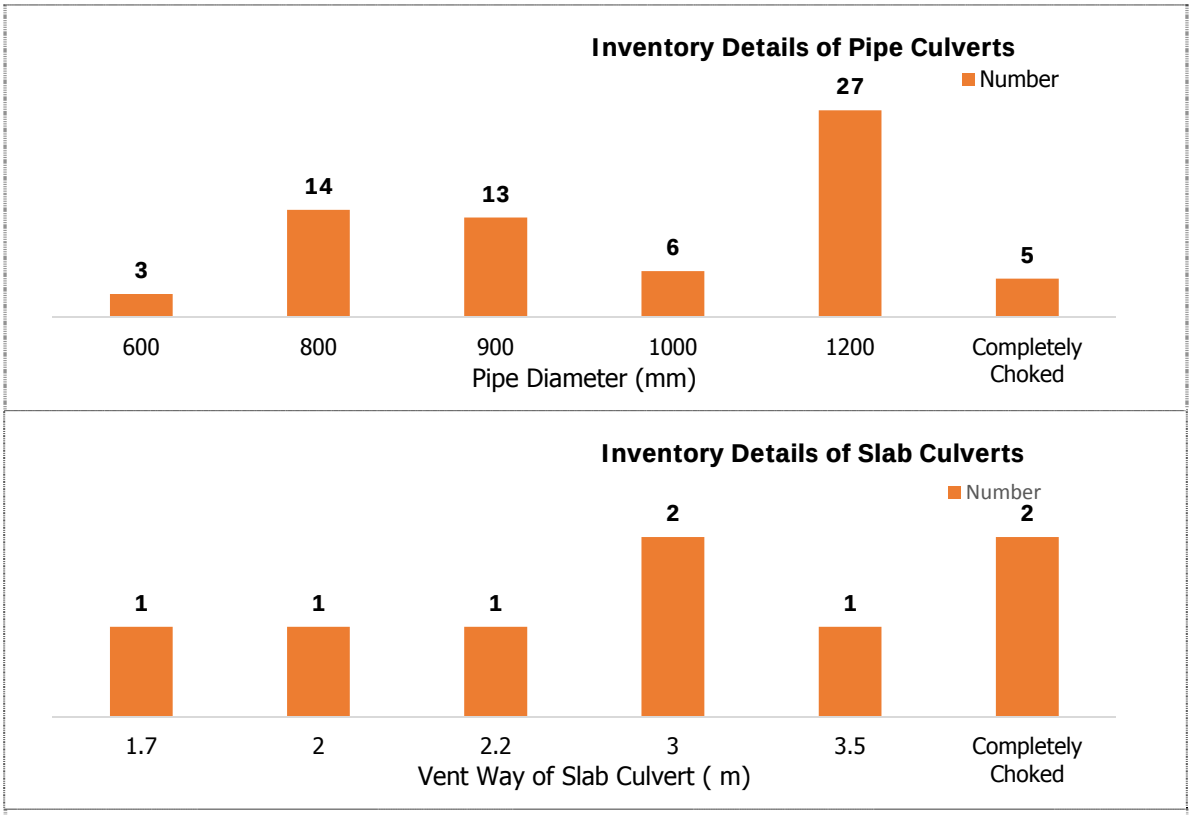
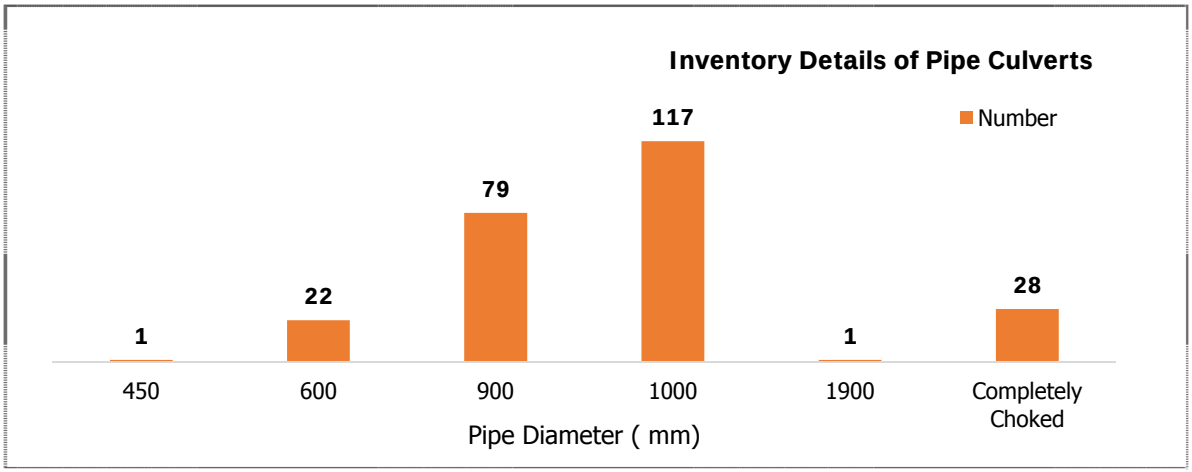


Figure 3-10: Summary of Culvert Inventory on C L Road

3.3.3. Chakabama - Zunheboto Road

There are 379 culverts consisting of 248 RCC Pipe, 129 RCC slab, 1 culvert has pipe & slab both and 1 culvert is under construction on project road. Further, inventory details of Pipe and Slab Culverts based on their size viz. Diameter of Pipe (in mm) and Vent way opening (in m) is presented in Figure below.



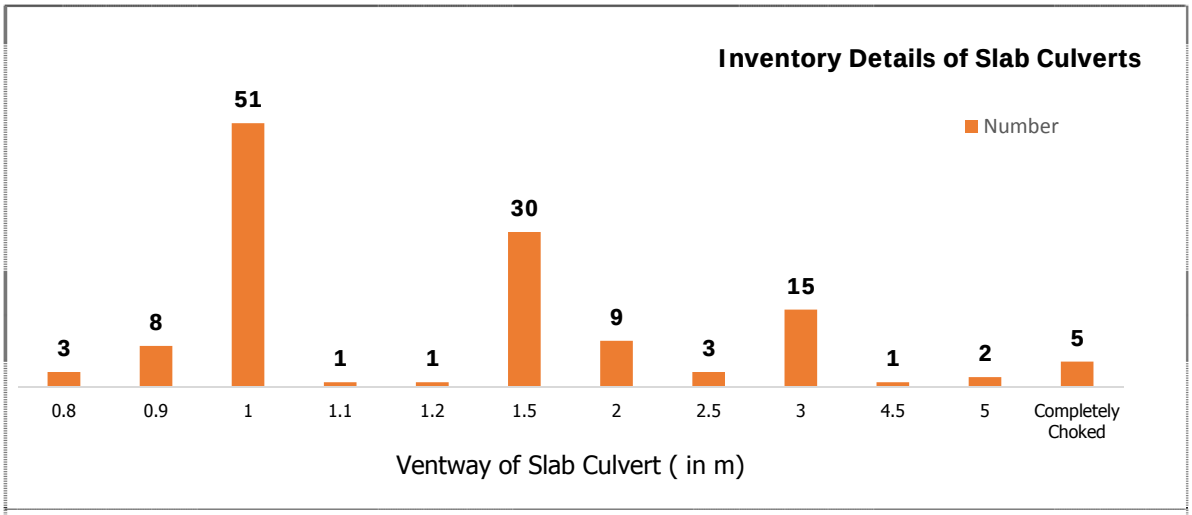
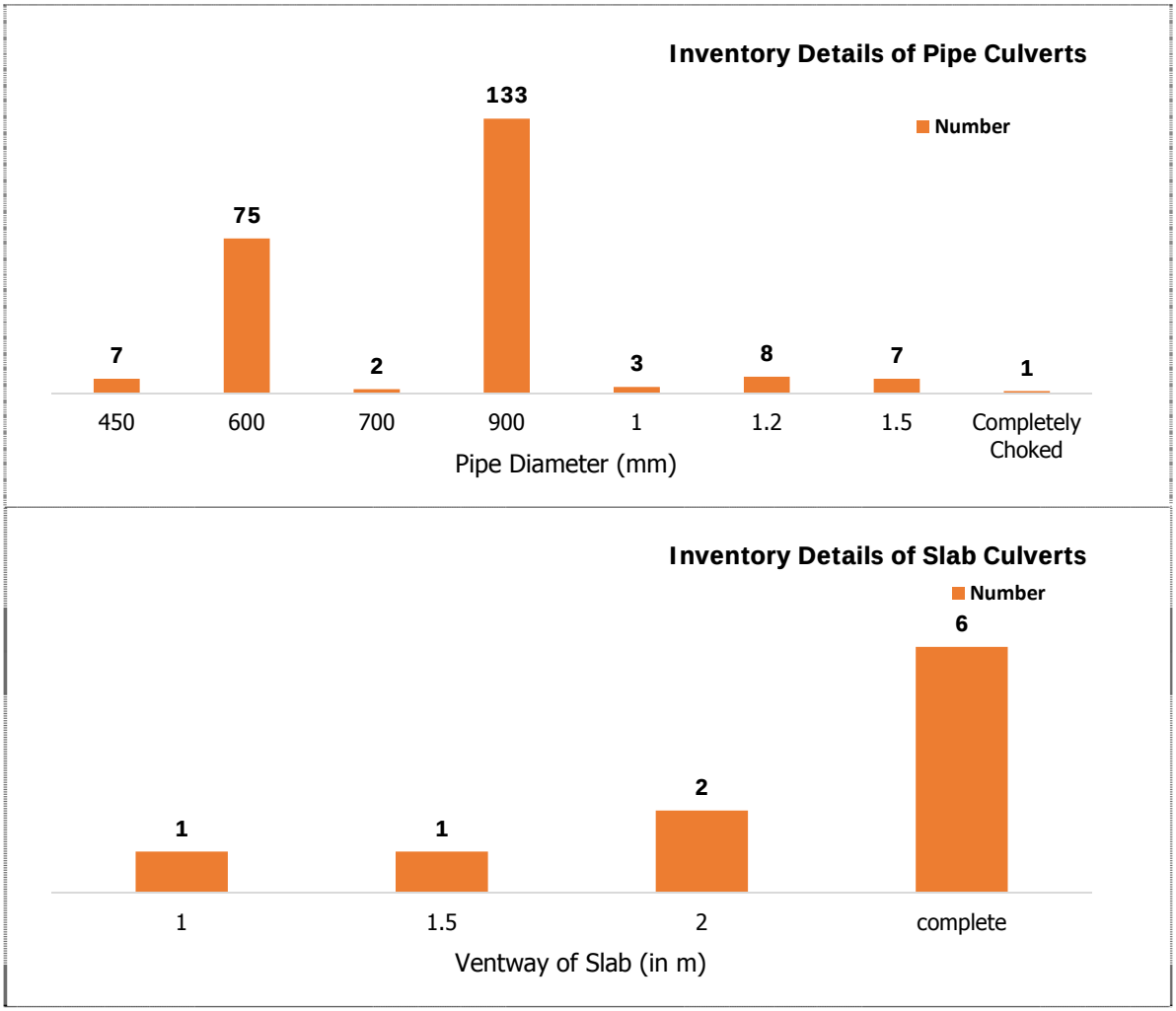


Figure 3-11: Summary of Culvert Inventory on C Z Road

3.3.4. Pfutsero - Phek Road

There are 248 culverts consisting of 236 RCC pipe, 10 RCC slab and 2 box culvert on project road. Further, inventory details of Pipe, Slab and Box Culverts based on their size viz. Diameter of Pipe (in mm) and Vent way opening (in m) is presented in Figure below



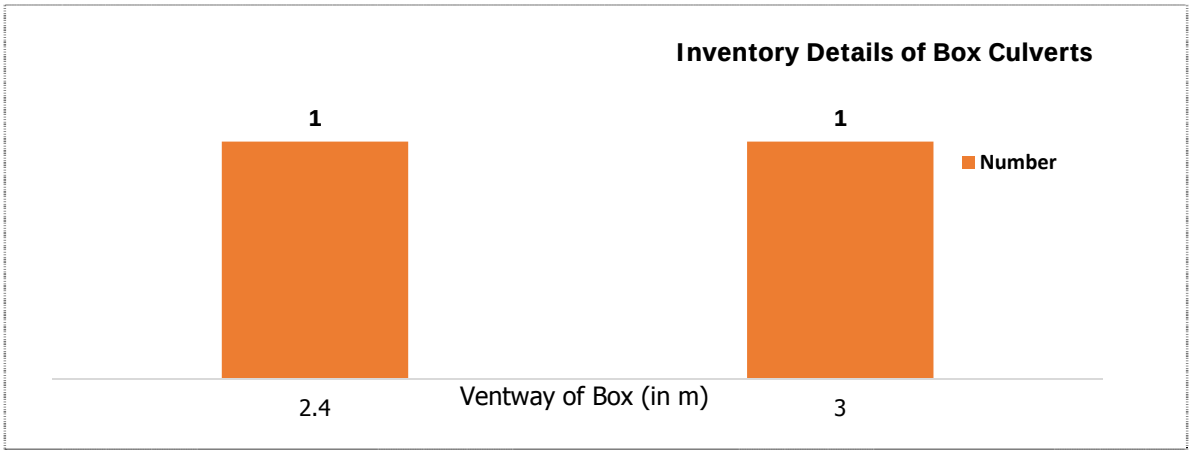


Figure 3-12: Summary of Culvert Inventory on P P Road

3.4 Bridge Inventory

All Existing bridge structures have been thoroughly inspected by senior experts and all data have been collected as per Inspection Performa of IRC: SP-19 and IRC: SP-35. All information regarding HFL, LWL, discharge velocity etc. has been collected available from past records, local enquiries, visible signs (if any) on structural components and embankments. Bridge dimensions have been collected using visual means supplemented by simple tape measurements.

The summary of inventory details of existing bridges has been presented in following paragraphs/tables and complete complied Data has been collated in tabular formats in Microsoft Excel Sheets and data has been presented in **Annexure 3: Bridge Inventory and Condition Survey** in Appendix to Volume-I: Primary and Secondary Data in separate volume.

3.4.1. Merangkong- Tamlu – Mon Road

Summary of Inventory of Existing Bridges along the Merangkong – Tamlu - Mon Road is presented in table below:

Table 3-9: Inventory of Bridges along M T M Road

S. No.	Location (km)	Minor / Major Bridge	Type	Span Arrangement (m)	Length (m)	Carriageway Width (m)	Total Width (m)	Type of Substructure	Type of Foundation
1	32/467	Minor	Steel Truss	1X31.7	31.7	3.35	5.4	Stone Masonry Abutment	Open (May Be)
2	35/570	Minor	RCC Slab	1X6.1	6.1	6.1	6.9	Stone Masonry Abutment	Open (May Be)
3	39/912	Minor	Steel Truss	1X16.5	16.5	3.3	3.9	Stone Masonry Abutment	Open (May Be)
4	41/500	Major	Steel Truss Girder	1X12.5 + 1X75.5 + 1X15.5	103.5	4.5	4.7	RCC Abutment + RCC Pier	Pile (May Be, Not Visible)
5	89/900	Minor	Steel Truss Girder + RCC Slab	1X15.25	15.5	3.5	4.0	Stone Masonry Abutment	Open (May Be)
6	98/024	Minor	RCC Slab	1X6.0	6.0	4.3	7.2	Stone Masonry Abutment	Open (May Be)

3.4.2. Changtongya- Longleng Road

The Inventory of existing bridges along the Changtongya – Longleng Road is presented in table below:

Table 3-10: Inventory of Bridges along C L Road

S. No.	Location (km)	Minor / Major Bridge	Type	Span Arrangement (m)	Length (m)	Carriageway Width (m)	Total Width (m)	Type of Substructure	Type of Foundation
1	4/200	Minor	RCC Slab+ Steel Truss	1X31.2	31.2	3.9	4.55	RCC Abutment	Not Visible
2	6/861	Minor	RCC Slab+ Steel Girder	1X10.45+ 1X29.80+ 1X8.15	48.4	7.5	11.2	RCC Abutment + RCC Pier	Open (May be)
3	7/367	Minor	RCC Slab+ Steel Girder	1X7.45	7.45	4.7	5.2	Stone Masonry Abutment	Open

3.4.3. Chakabama - Zunheboto Road

Chakabama – Zunheboto Road has 5 Minor Bridges. The Summary of Inventory of existing bridges on project road is presented below:

Table 3-11: Inventory of Bridges along C Z Road

S. No.	Location (km)	Type of Bridge	Span Arrangement (m)	Length (m)	Carriageway Width (m)	Total Width (m)	Type of Substructure	Type of Foundation
1	9/173	RCC Slab + Steel Girder	1X12.3	12.3	-	4.5	Stone Masonry abutment	Open
2	10/638	RCC/PSC Bridge	1X40.8	40.8	7.5	8.5	RCC wall Type Abutment	Not Visible
3	14/085	RCC Slab + Steel Girder	1X8.2	8.2	-	4.6	RCC wall Type Abutment	Not Visible
4	18/120	RCC Slab +(I Beam) Steel Girder	1X8.0	8.0	-	4.3	RCC wall Type Abutment	Open
5	18/490	RCC Slab +(I Beam) Steel Girder	1X9.4	9.4	3.75	4.4	Stone Masonry abutment	Open

3.4.4. Pfutsero - Phek Road

There is no Existing Bridge in Pfutsero – Phek Road.

3.5 Protection Work Inventory

Detailed inventory has been carried out to collect the details of retaining structures such as retaining wall/ toe wall wherever visible using simple tape measurements and is presented below.

3.5.1. Merangkong- Tamlu – Mon Road

Inventory of existing retaining/toe walls along Merangkong – Tamlu - Mon Road is presented in table below:

Table 3-12: Inventory of Toe /Retaining Walls along M T M Road

S. No.	Location (Km)		Length (m)	Height (m)	Type	LHS/RHS
	From	To				
1	15/575	15/588	13	3.0	Stone	RHS
2	17/275	17/290	15	2.0	Stone	BOTH
3	23/425	23/436	11	3.0	Stone	RHS
4	23/805	23/825	20	4.0	Stone	RHS
5	29/723	29/736	13	5.0	Stone	RHS
6	29/890	29/920	30	5.0	Stone	RHS
7	30/800	30/900	100	5.0	Stone	RHS
8	31/682	31/696	14	2.5	Stone	RHS
9	32/725	32/780	55	3.0	Stone	RHS
10	39/360	39/480	120	3.0	Stone	RHS
11	47/028	47/043	15	5.0	Stone	LHS
12	48/325	48/345	20	4.0	Stone	LHS
13	48/325	48/385	60	4.0	Stone	RHS
14	48/407	48/467	60	4.0	Stone	LHS
15	49/035	49/055	20	3.5	Stone	LHS
16	49/150	49/165	15	5.0	Stone	RHS
17	50/835	50/850	15	8.0	Stone	LHS
18	52/480	52/500	20	3.0	Stone	LHS
19	53/770	53/790	20	3.0	Stone	LHS
20	53/990	54/005	15	4.0	Stone	LHS
21	54/350	54/360	10	4.0	Stone	LHS
22	54/440	54/470	30	4.0	Stone	LHS
23	54/665	54/675	10	6.0	Stone	LHS
24	54/675	54/735	60	5.0	Stone	LHS
25	55/065	55/071	6	3.0	Stone	LHS
26	56/153	56/165	12	6.0	Stone	LHS
27	56/195	56/225	30	5.0	Stone	LHS
28	57/075	57/165	90	3.0	Stone	LHS
29	57/253	57/259	6	5.0	Stone	LHS
30	57/342	57/400	58	3.0	Stone	LHS
31	57/596	57/611	15	3.0	Stone	LHS
32	57/900	57/907	7	3.0	Stone	RHS
33	59/163	59/171	8	5.0	Stone	LHS
34	59/180	59/188	8	3.0	Stone	LHS
35	60/000	60/005	5	3.0	Stone	LHS
36	63/665	63/668	3	2.5	Stone	RHS
37	67/550	67/560	10	3.0	Stone	RHS
38	67/650	67/665	15	3.0	Stone	RHS
39	73/525	73/550	25	3.0	Stone	RHS
40	73/600	73/610	10	3.0	Stone	RHS
41	74/450	74/458	8	3.0	Stone	LHS
42	81/120	81/130	10	5.0	Stone	RHS
43	87/575	87/585	10	5.0	Stone	RHS
44	91/955	91/965	10	3.0	Stone	LHS
45	95/350	95/365	15	3.0	Stone	RHS
46	94/615	94/635	20	3.0	Stone	LHS

S. No.	Location (Km)		Length (m)	Height (m)	Type	LHS/RHS
	From	To				
47	94/615	94/640	25	3.0	Stone	RHS
48	95/725	95/775	50	3.0	Stone	LHS
49	95/825	95/840	15	3.0	Stone	LHS
50	97/600	97/605	5	3.0	Stone	LHS
		Total	1237			

3.5.2. Changtongya- Longleng Road

Inventory of Retaining Walls and Toe Walls along Changtongya – Longleng Road is presented in table below:

Table 3-13: Inventory of Toe /Retaining Walls along C L Road

S. No.	Location (Km)		Total length (m)	Height (m)	Type	Side
	From	To				
1	0.015	0.120	105	7.0	Stone masonry	LHS
2*	0.015	0.180	165	10.0	Stone masonry	RHS
3	0.470	0.485	15	5.0	Stone masonry	LHS
4	7.050	7.075	25	3.0	Stone masonry	RHS
5	7.500	7.575	75	3.0	Stone masonry	RHS
6	12.900	12.965	65		Stone masonry	LHS
7	13.475	13.500	25		Stone masonry	LHS
8	13.575	13.625	50		Stone masonry	LHS
9	22.980	22.992	12	3.2	Stone masonry	RHS
10	28.605	28.630	25	5.0	Stone masonry	LHS
11	28.740	28.760	20	5.0	Stone masonry	LHS
12	29.292	29.315	23	5.0	Stone masonry	RHS
		Total	605			
* Toe Wall						

3.5.3. Chakabama - Zunheboto Road

Inventory of existing Toe Walls on Hill Side along Chakabama – Zunheboto Road is presented below:

Table 3-14: Inventory of Toe /Retaining Walls along C Z Road

S. No.	Location (Km)		Length (m)	Height (m)	Type	Side
	Start	**End**				
1	5/263	5/275	12	1.5	Stone masonry	RHS
2	6/980	7/000	20	5.5	Stone masonry	RHS
3	10/820	10/842	22	1.5	Stone masonry	RHS
4	10/900	10/920	20	1.5	Stone masonry	RHS
5	15/330	15/360	30	1.8	Stone masonry	RHS
6	15/383	15/420	37	2	Stone masonry	RHS
7	15/550	15/560	10	1.5	Stone masonry	LHS
8	16/525	16/535	10	1.5	Stone masonry	RHS
9	20/410	20/450	40	2	Stone masonry	LHS
10	22/520	22/540	20	2	Stone masonry	RHS
11	42/068	42/110	42	2	Stone masonry	RHS
12	45/840	45/847	7	2	Stone masonry	RHS
13	120/375	120/415	40	2	Stone masonry	RHS
		Total	310			

Inventory of existing Retaining walls on Valley Side along project road is presented below:

Table 3-15: Inventory of Retaining Walls on Valley Side along C Z Road

S. No.	Location (Km)		Length (m)	Type	Valley side
	Start	End			
1	0/260	0/290	30	Gabion Stone masonry	LHS
2	4/245	4/260	15	Stone masonry	RHS
3	4/320	4/335	15	Stone masonry	RHS
4	5/005	5/015	10	Stone masonry	LHS
5	5/030	5/040	10	Stone masonry	LHS
6	5/110	5/135	25	Gabion Stone masonry	LHS
7	5/190	5/210	20	Stone masonry	LHS
8	7/000	7/035	35	Stone masonry	LHS
9	7/680	7/700	20	Stone masonry	LHS
10	7/780	7/800	20	Stone masonry	LHS
11	11/205	11/240	35	Stone masonry	LHS
12	11/900	11/935	35	Stone masonry	LHS
13	13/570	13/590	20	Stone masonry	LHS
14	14/690	14/700	10	Stone masonry	LHS
15	14/775	14/800	25	Gabion Stone masonry	LHS
16	14/965	14/975	10	Gabion Stone masonry	LHS
17	15/210	15/360	150	Stone masonry	LHS
18	15/535	15/550	15	Stone masonry	RHS
19	15/700	15/735	35	Stone masonry	RHS
20	16/030	16/045	15	Stone masonry	RHS
21	16/570	16/590	20	Stone masonry	LHS
22	20/420	20/450	30	Stone masonry	RHS
23	20/670	20/705	35	Stone masonry	LHS
24	20/905	20/930	25	Stone masonry	RHS
25	21/015	21/050	35	Stone masonry	RHS
26	21/385	21/415	30	Stone masonry	RHS
27	22/290	22/365	75	Stone masonry	LHS
28	22/585	22/600	15	Stone masonry	LHS
29	22/650	22/680	30	Stone masonry	LHS
30	22/770	22/790	20	Stone masonry	LHS
31	22/850	22/875	25	Stone masonry	LHS
32	22/890	22/905	15	Stone masonry	LHS
33	23/245	23/285	40	Stone masonry	LHS
34	24/730	24/745	15	Stone masonry	LHS
35	24/865	24/885	20	Stone masonry	LHS
36	25/225	25/245	20	Stone masonry	LHS
37	25/560	25/570	10	Stone masonry	LHS
38	25/740	25/765	25	Stone masonry	LHS
39	26/085	26/100	15	Stone masonry	LHS
40	26/140	26/160	20	Stone masonry	LHS
41	30/080	30/090	10	Stone masonry	LHS
42	45/065	45/075	10	Stone masonry	LHS
43	45/100	45/120	20	Stone masonry	LHS
44	45/130	45/140	10	Stone masonry	LHS
45	46/197	46/205	8	Stone masonry	RHS
46	53/280	53/290	10	Stone masonry	RHS
47	57/410	57/435	25	Stone masonry	RHS
48	62/375	62/395	20	Stone masonry	LHS
49	63/955	63/975	20	Stone masonry	LHS
50	64/050	64/060	10	Stone masonry	LHS
51	64/535	64/546	11	Stone masonry	LHS

S. No.	Location (Km) Start	End	Length (m)	Type	Valley side
52	64/610	64/660	50	Stone masonry	LHS
53	64/740	64/760	20	Stone masonry	LHS
54	64/1020	64/1046	26	Stone masonry	LHS
55	65/860	65/870	10	Stone masonry	LHS
56	73/315	73/325	10	Stone masonry	LHS
57	73/380	73/402	22	Stone masonry	LHS
58	74/170	74/177	7	Stone masonry	LHS
59	74/725	74/740	15	Stone masonry	LHS
60	75/310	75/320	10	Stone masonry	LHS
61	75/495	75/510	15	Stone masonry	LHS
62	75/875	75/882	7	Stone masonry	LHS
63	75/960	76/020	60	Stone masonry	LHS
64	77/380	77/425	45	Stone masonry	LHS
65	77/440	77/460	20	Stone masonry	LHS
66	77/640	77/660	20	Stone masonry	LHS
67	77/680	77/730	50	Stone masonry	LHS
68	77/755	77/785	30	Stone masonry	LHS
69	77/845	77/850	5	Stone masonry	LHS
70	77/885	77/910	25	Stone masonry	LHS
71	78/670	78/685	15	Stone masonry	LHS
72	86/895	86/930	35	Stone masonry	LHS
73	87/238	87/260	22	Stone masonry	LHS
74	87/750	87/760	10	Stone masonry	LHS
75	87/1010	87/1020	10	Stone masonry	LHS
76	88/080	88/090	10	Stone masonry	LHS
77	88/805	88/815	10	Stone masonry	LHS
78	88/875	88/885	10	Stone masonry	LHS
79	91/580	91/600	20	Stone masonry	LHS
80	92/235	92/250	15	Stone masonry	LHS
81	92/750	92/785	35	Stone masonry	LHS
82	92/880	92/890	10	Stone masonry	LHS
83	93/065	93/080	15	Stone masonry	LHS
84	93/225	93/245	20	Stone masonry	LHS
85	94/020	94/065	45	Stone masonry	LHS
86	94/125	94/140	15	Stone masonry	LHS
87	94/220	94/240	20	Stone masonry	LHS
88	97/440	97/510	70	Stone masonry	LHS
89	97/520	97/550	30	Stone masonry	LHS
90	97/615	97/650	35	Stone masonry	LHS
91	97/675	97/700	25	Stone masonry	LHS
92	97/850	97/860	10	Stone masonry	LHS
93	97/880	97/900	20	Stone masonry	LHS
94	98/250	98/275	25	Stone masonry	LHS
95	98/405	98/440	35	Stone masonry	LHS
96	98/560	98/580	20	Stone masonry	LHS
97	98/840	98/860	20	Stone masonry	LHS
98	99/003	99/040	37	Stone masonry	LHS
99	99/135	99/180	45	Stone masonry	LHS
100	99/325	99/350	25	Stone masonry	LHS
101	99/503	99/535	32	Stone masonry	LHS
102	99/595	99/660	65	Stone masonry	LHS
103	99/700	99/750	50	Stone masonry	LHS
104	99/875	99/900	25	Stone masonry	LHS

S. No.	Location (Km) Start	End	Length (m)	Type	Valley side
105	99/930	99/980	50	Stone masonry	LHS
106	100/100	100/140	40	Stone masonry	LHS
107	100/195	100/215	20	Stone masonry	LHS
108	101/130	101/140	10	Stone masonry	RHS
109	104/085	104/095	10	Stone masonry	RHS
110	115/050	115/150	100	Stone masonry	LHS
111	116/065	116/100	35	Stone masonry	LHS
112	116/995	116/1019	24	Stone masonry	LHS
113	117/024	117/032	8	Stone masonry	LHS
114	117/177	117/192	15	Stone masonry	LHS
115	117/465	117/480	15	Stone masonry	RHS
116	118/598	118/625	27	Stone masonry	LHS
117	119/080	119/090	10	Stone masonry	LHS
118	121/220	121/245	25	Stone masonry	LHS
119	121/450	121/475	25	Stone masonry	LHS
		Total	2971		

3.5.4. Pfutsero - Phek Road

The Inventory of protection works along Pfutsero – Phek Road are presented as below:

Existing Toe Wall on Hill Side:

Table 3-16: Inventory of Toe Walls on hill Side along P P Road

S. No	Location Start Km	End Km	Length (m)	Height (m)	Type	Side
1	0/060	0/555	495	1.5	Stone masonry	RHS
2	0/650	0/660	10	1.5	Stone masonry	RHS
3	0/750	0/770	20	1.6	Stone masonry	RHS
4	1/260	1/350	90	2.0	Stone masonry	RHS
5	1/790	1/850	60	1.25	Stone masonry	RHS
6	2/375	2/385	10	2.0	Stone masonry	RHS
7	3/965	3/980	15	1.5	Stone masonry	LHS
8	62/800	62/835	35	1.8	Stone masonry	LHS
9	63/308	63/340	32	1.8	Stone masonry	LHS
10	64/200	64/223	23	1.4	Stone masonry	LHS
		Total	790			

Existing Retaining Wall on Valley Side:

Table 3-17: Inventory of Retaining Walls on Valley Side along P P Road

S. No	Location Start (Km)	End (Km)	Length (m)	Type	Side
1	0/385	0/400	15	Stone masonry	LHS
2	0/855	0/890	35	Stone masonry	LHS
3	0/900	0/935	35	Stone masonry	LHS
4	1/050	1/070	20	Stone masonry	LHS
5	1/252	1/300	48	Stone masonry	RHS
6	2/035	2/070	35	Stone masonry	RHS
7	2/165	2/175	10	Stone masonry	RHS
8	47/245	47/310	65	Stone masonry	RHS
9	51/353	51/370	17	Stone masonry	RHS
10	53/055	53/110	55	Stone masonry	RHS
11	53/310	53/348	38	Stone masonry	RHS
12	54/240	54/255	15	Stone masonry	RHS
13	55/235	55/275	40	Stone masonry	RHS

S. No	Location		Length (m)	Type	Side
	Start (Km)	End (Km)			
14	62/300	62/320	20	Stone masonry	RHS
15	63/760	63/820	60	Stone masonry	RHS
16	65/272	65/285	13	Stone masonry	RHS
		Total	521		

3.6 Pavement Condition Survey

A detailed visual pavement condition survey was carried out in month of April and May 2014 along the project road sections in order to collect relevant information in respect of following:

- Carriageway Type (Bituminous/Gravel/Earthen);
- Pavement condition (Severity Level and Extent Level);
  - Cracking;
  - Ravelling;
  - Potholing;
  - Edge Cracking; and
  - Rut Depth;
- Shoulder type and condition (Good/ Fair/ Poor/ Failed/Non Existing);
- Embankment condition (Good/ Fair/ Poor);
- Drainage Condition (Non-existing/Partially Functional/Functional);

The Visual Pavement Condition Surveys for Project road sections were carried out for each 100 m length section and part thereof as warranted to show distressed pavements.

The consultant has carried out and collected information in respect of Pavement Condition Survey in accordance with formats submitted in Inception Report, March 2014. The Pavement Condition Survey data, thus collected during field surveys has been entered in tabular formats in Microsoft Excel sheets.Major features of Pavement Condition Survey are described, project road wise, in following paragraphs and complete data is presented in Annexure 4: Pavement Condition Survey in Appendix to Volume-I: Primary and Secondary Data in separate volume.

3.6.1. Merangkong- Tamlu – Mon Road

Type of Carriageway Surface

The Project Road has Bituminous, Gravel and Earthen Surfacing layer. The Bituminous Surface Layer has largely been damaged. The existing pavement crust has seen his life and entire pavement crust including surfacing for entire road length would require new construction.

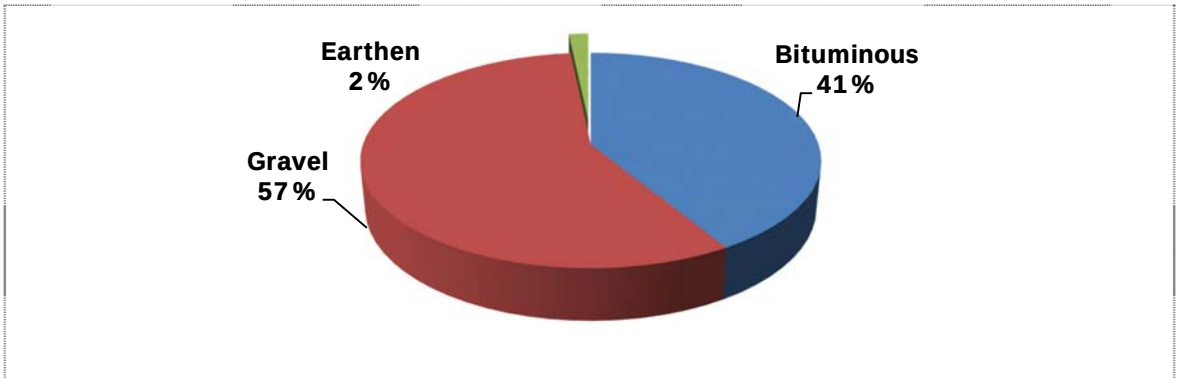


Figure 3-13: Surfacing Layer Distribution along M T M Road

Condition of Bituminous Surface

Bituminous surface distresses were measured in severity (Low/ Medium/ High) and extent (Occasional/ Frequent/ Extensive) level. The results of pavement condition survey for bituminous surfacing lengths are summarized and presented in pie charts format:

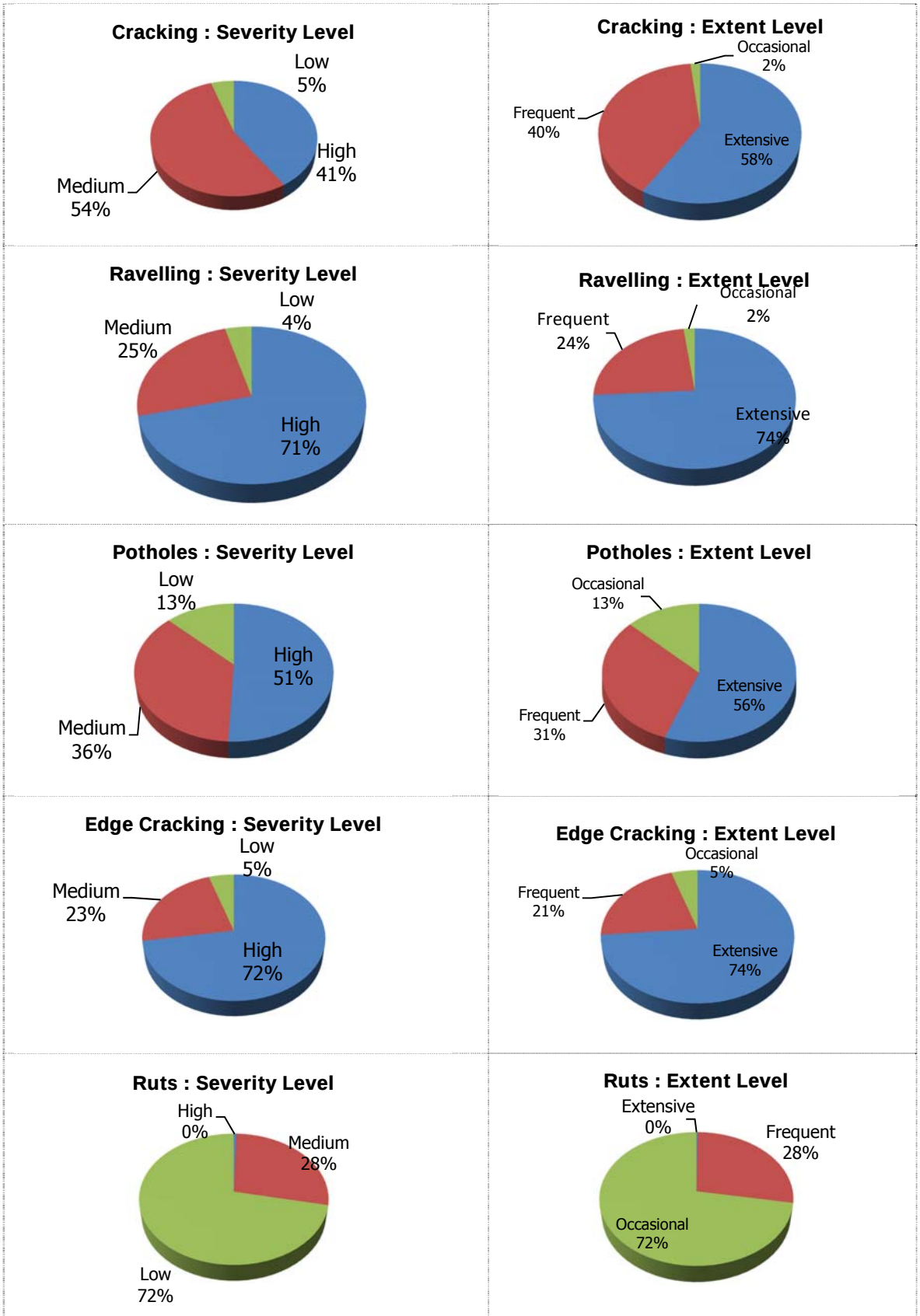


Figure 3-14: Condition of Bituminous Pavement M T M Road

Shoulder

Existing Project Road Cross Section has Unpaved Shoulder (Granular/Earthen) having width varying from 0.5 m to 1.0 m. Granular Shoulder exists on both or one side for 53.465 km length and is in poor to very poor condition. Earthen Shoulder exists on both or one side for 15.300 km length and in poor to failed condition. Dense Bushes/Grass exists on both or one shoulder for 48.900 km length. 13.700 km length of project road does not have shoulder on one or both sides.

Embankment

Generally project road is on hill cut section except at km 31.400 to km 33.700. In this stretches embankment height varies from 0.3 m to 1.2 m and condition is fair to poor due to submergence.

Drain

Unlined earthen drain is exists on left or right side of road for 13.700 km length on Hill Side. Partially functional Open lined drain is exists on left or right side of road for 1.000 km length in Mon Town.

3.6.2. Changtongya- Longleng Road

Type of Carriageway Surface

The Project Road has Gravel Surfacing layer which is completely damaged. The summary of pavement condition survey details that 99% of project length has gravel surface.

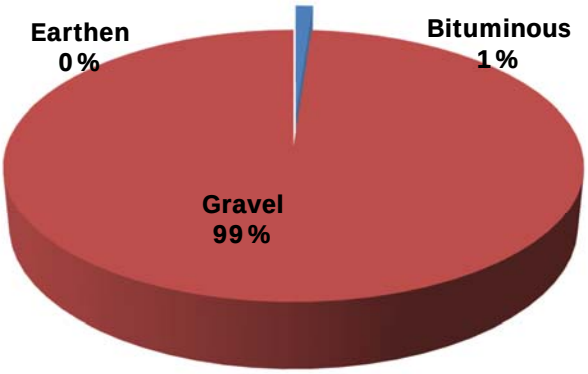


Figure 3-15: Surfacing Layer Distribution along C L Road

Shoulder

Existing Project Road Cross Section has earthen shoulder having 1.0 m width on both sides for 0.700 km length which is in poor condition and for remaining 28.830 km length project road cross section does not possesses any shoulder.

Drain

Unlined earthen drain exists on left or right side of road for 15.100 km length on Hill Side. Partially functional Open water channel exists on right side (Hill Side) of road for 0.530 km length in Longleng Town.

3.6.3. Chakabama – Zunheboto Road

Type of Carriageway Surface

The Project Road has Bituminous and Gravel Surfacing layer which is completely damaged. The existing pavement crust has seen his life and entire pavement crust including surfacing for entire road length would require new construction. In some part of project road, pavement is in under-construction.

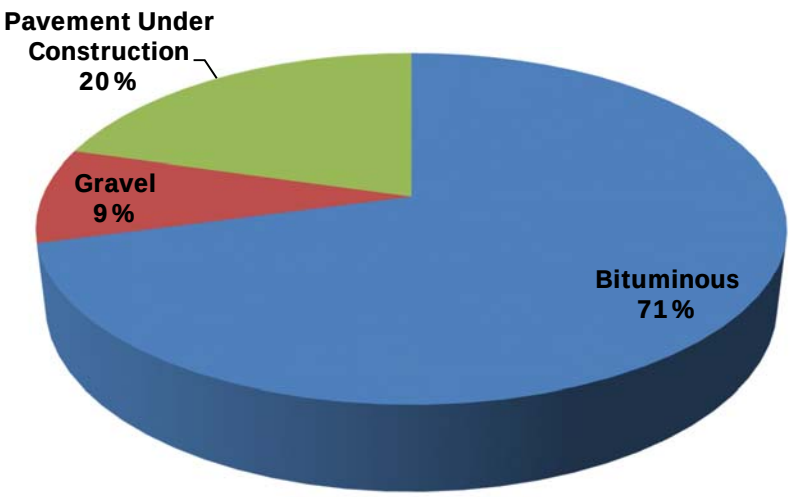
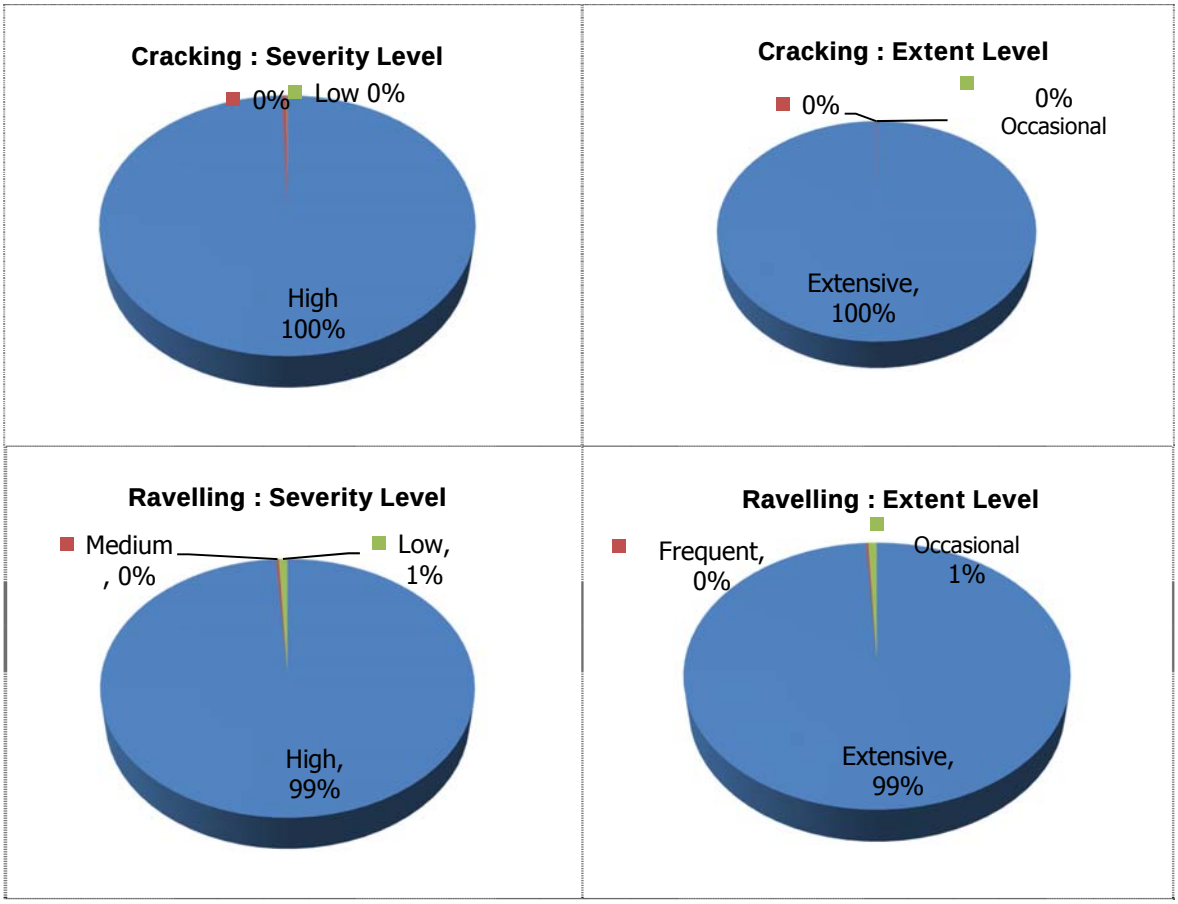


Figure 3-16: Surfacing Layer Distribution along C Z Road

Condition of Bituminous Surface

Bituminous surface distresses were measured in severity (Low/ Medium/ High) and extent (Occasional/ Frequent/ Extensive) level. The results of pavement condition survey for bituminous surfacing lengths are summarized and presented in pie charts format:



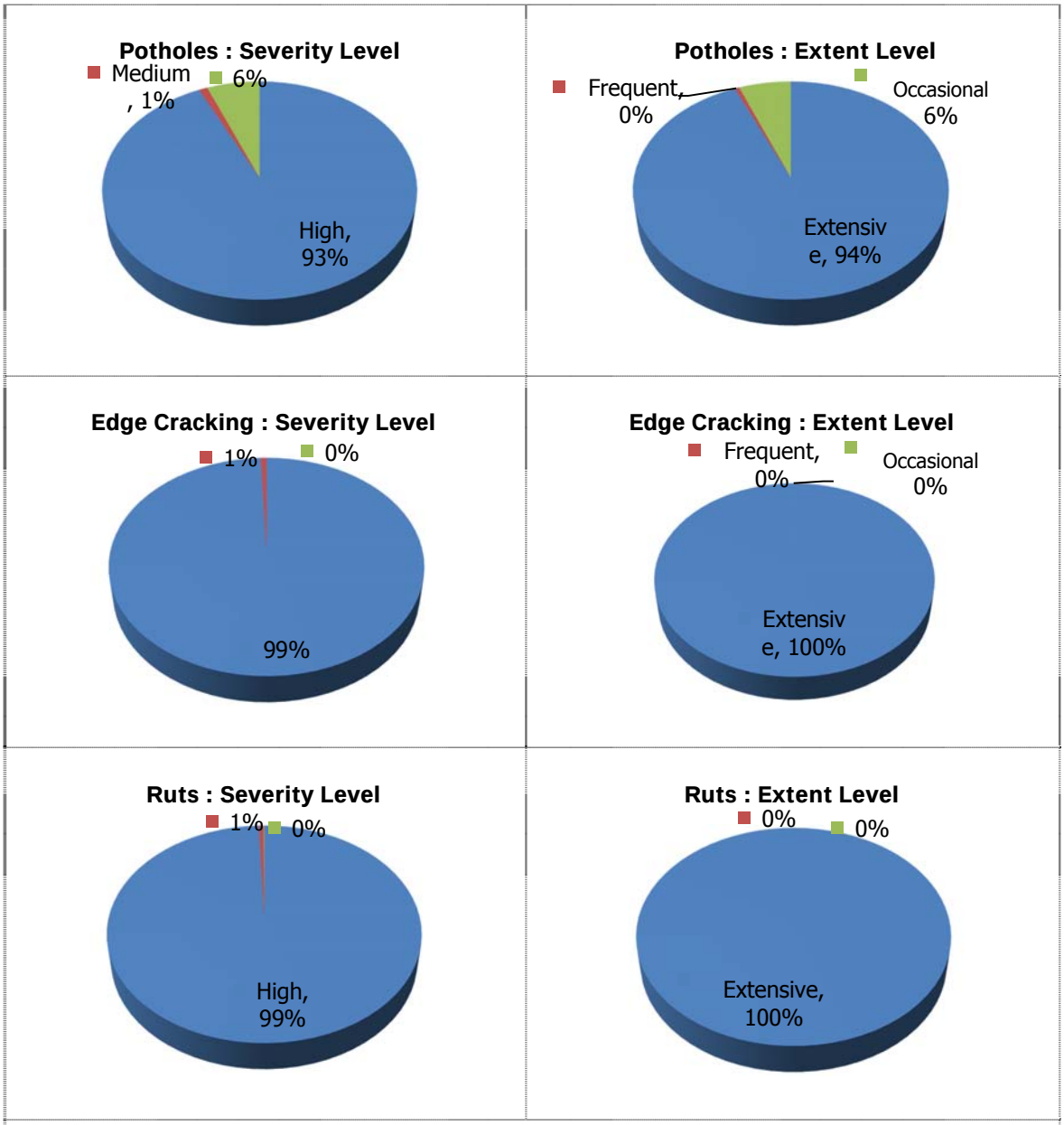


Figure 3-17: Condition of Bituminous Pavement C Z Road

Shoulder

Generally, shoulder does not existing on both sides of project road stretches.

Drain

Unlined Earthen Drain exists on Hill Side (left or right) of road for 6.600 km length. Lined drain is exists on Right Side of Road for 1.600 km length in Zunheboto Town.

3.6.4. Pfutsero – Phek Road

Type of Carriageway Surface

The Project Road has Bituminous and Gravel Surfacing layer which is completely damaged. The existing pavement crust has seen his life and entire pavement crust including surfacing for entire road length would require new construction.

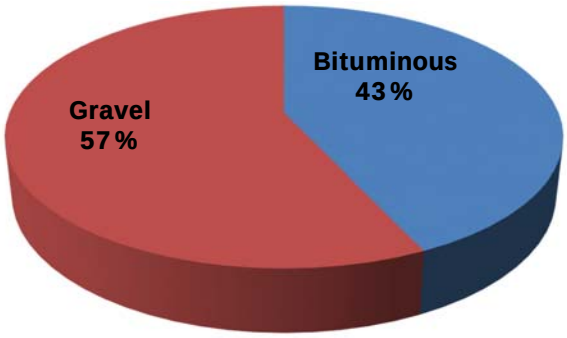
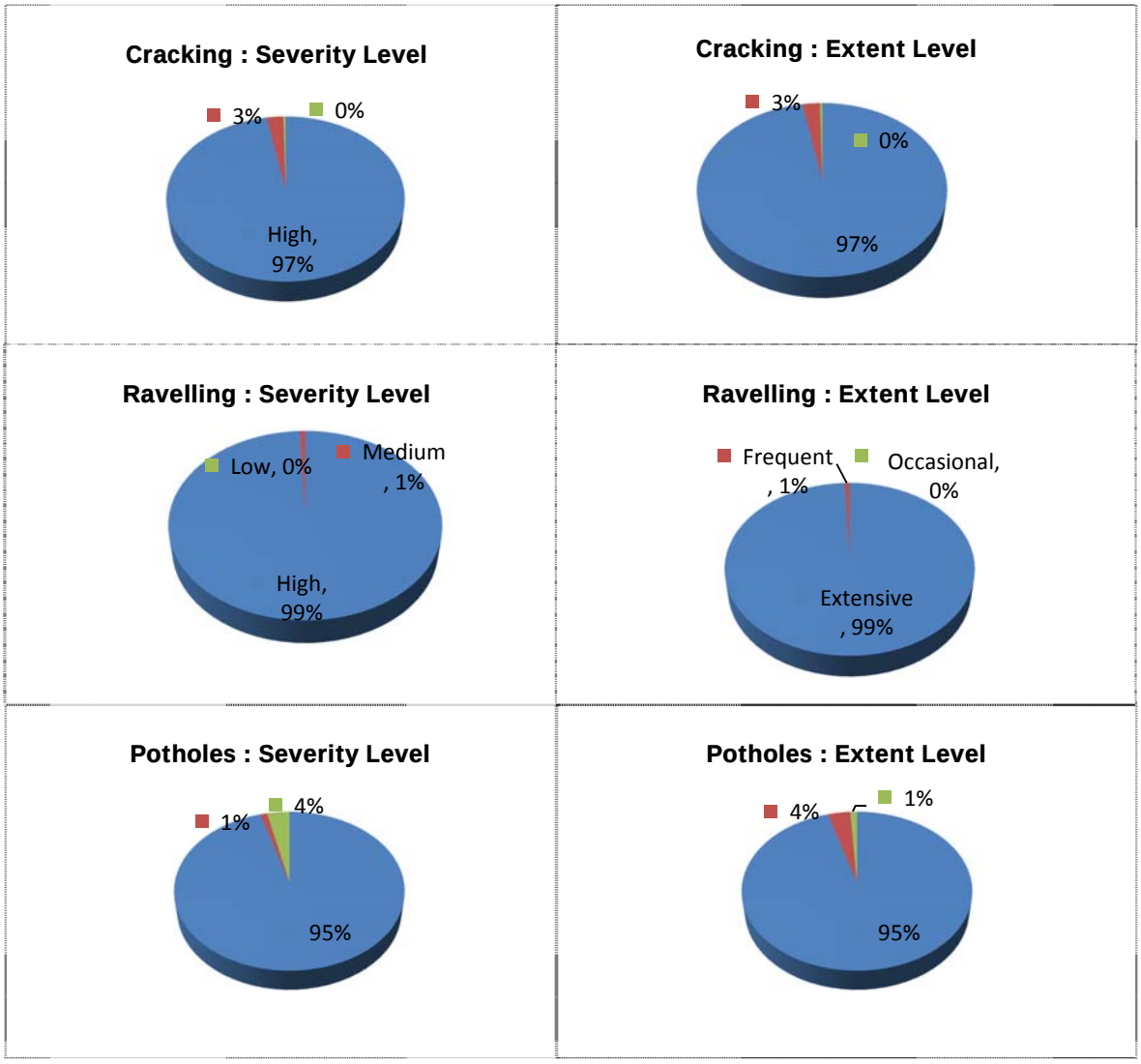


Figure 3-18: Surfacing Layer Distribution along P P Road

Condition of Bituminous Surface

Bituminous surface distresses were measured in severity (Low/ Medium/ High) and extent (Occasional/ Frequent/ Extensive) level. The results of pavement condition survey for bituminous surfacing lengths are summarized and presented in pie charts format:



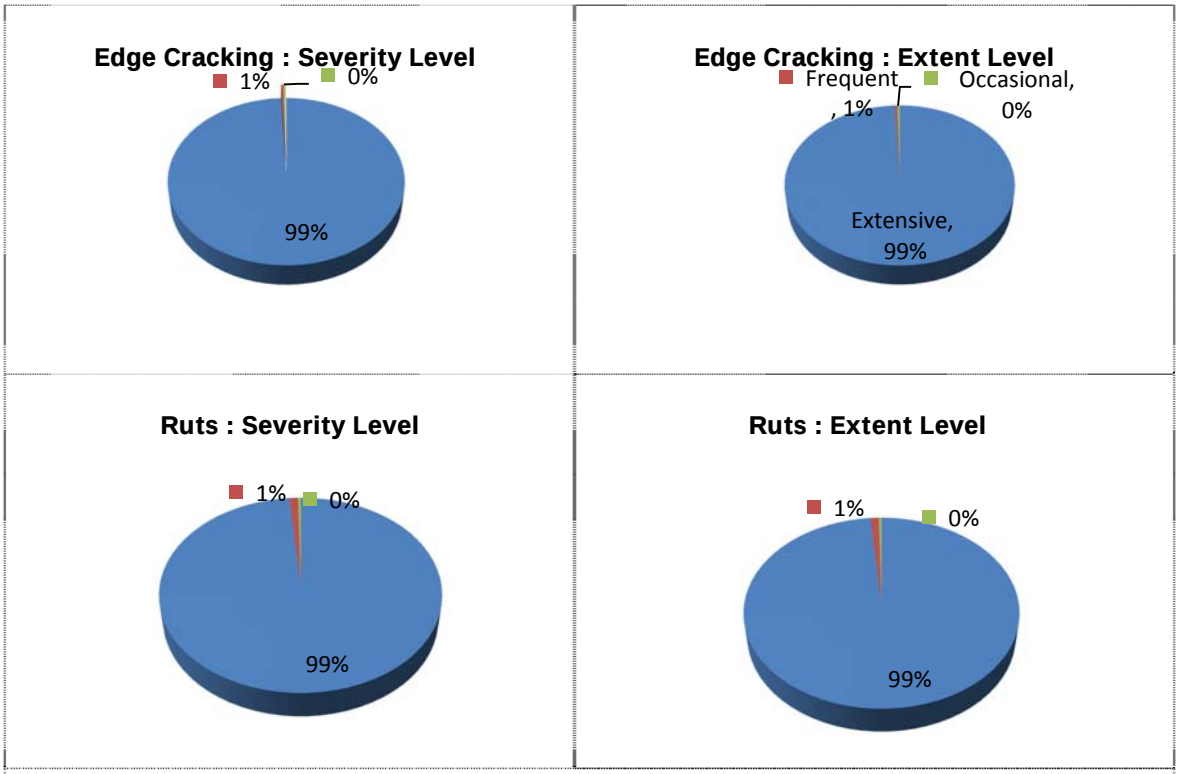


Figure 3-19: Condition of Bituminous Pavement P P Road

Shoulder

Project Road Cross Section does not have shoulder for 62.3 km length and unpaved Shoulder (Granular/ Earthen) having width varying from 0.25 m to 0.5 m wide exists on both side of project road for 3.000 km length and it is in failed condition.

Drain

Unlined Earthen Drain exists on Hill Side (Left or Right) of road for 8.800 km length. Partially Functional Lined drain exists on left side (Hill Side) of road for 0.500 km length near Phek Village Junction.

Analysis of Pavement Condition Survey detailed above, details that Existing Pavement of all Project Roads is in very poor to poor condition w.r.t. all critical parameters of Pavement Failure. Thus, it is recommended to reconstruct complete pavement crust along complete length of project roads except in locations where no geometric improvement is possible wherein over lay with 50 mm Dense Bituminous Concrete and 30 mm Bituminous Concrete is adopted for improvement.

3.7 Condition Survey of Culverts

Detailed Culvert Condition survey was carried out along project roads during April and May 2014, at site by senior experts and all data regarding their condition has been collected as per Inspection proforma presented in IRC:SP-19 and IRC:SP-35. These have been submitted in Inception Report, March 2014.

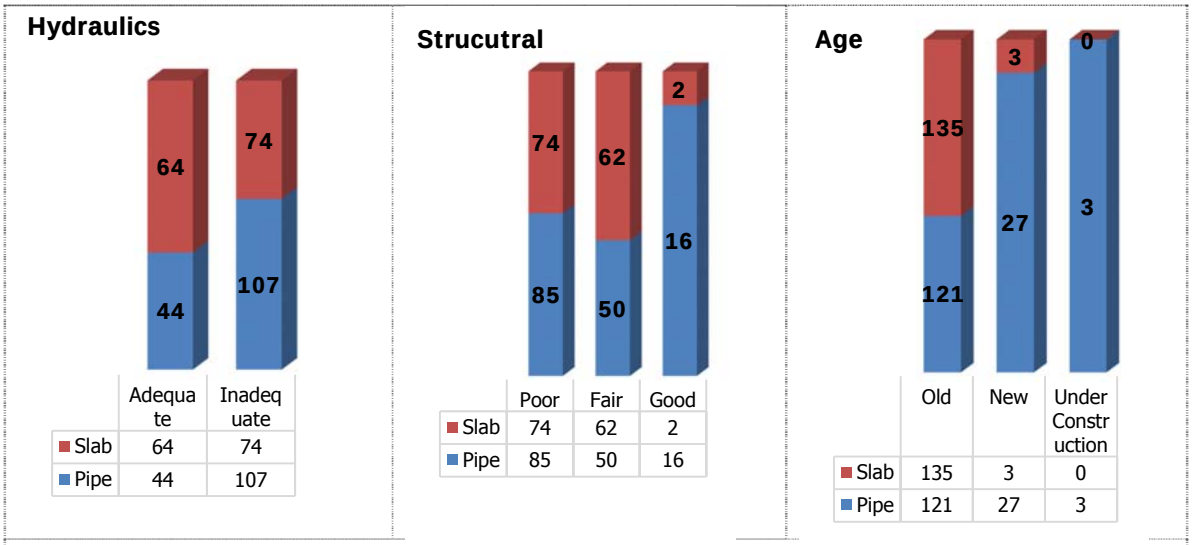
Culvert Condition surveys have been carried out using visual means supplemented by simple tape measurements. The information, thus collected has been collated based on local inquires and discussions with Nagaland PWD officials. The data so collected has been compiled so as to make an assessment concerning the structural and hydraulic adequacies of the existing structures.

The analysis of collected data is presented in following paragraphs and Complete Complied Data has been collated in tabular formats in Microsoft Excel Sheets and data has been presented in **Annexure 2: Culvert Inventory and Condition Survey** in Appendix to Volume-I: Primary and Secondary Data in separate volume.

3.7.1. Merangkong- Tamlu – Mon (M T M) Road

Out of total 289 culverts

- 108 are adequate and 168 are inadequate and 13 culverts are completely choked.
- 159 culverts are in poor condition, 112 culverts in fair condition and 18 culverts are in good condition.
- 256 culverts are old, 30 culverts are new and 3 culverts are under construction.



	Adequate	Inadequate
Slab	64	74
Pipe	44	107

	Poor	Fair	Good
Slab	74	62	2
Pipe	85	50	16

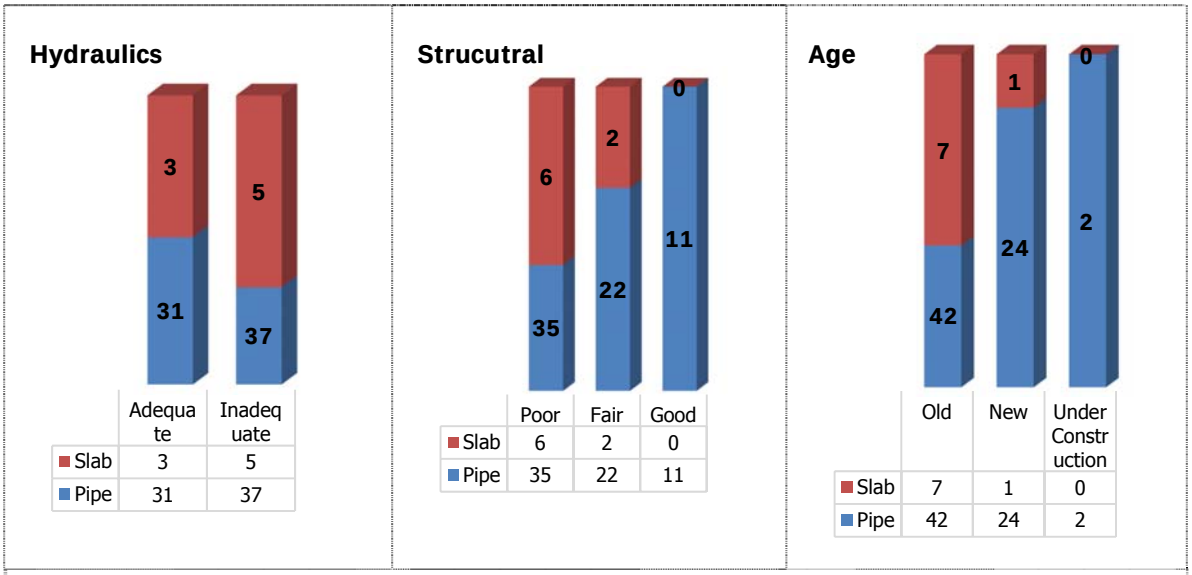
	Old	New	Under Construction
Slab	135	3	0
Pipe	121	27	3

Figure 3-20: Summary of Culvert Condition on M T M Road

3.7.2. Changtongya – Longleng (C L) Road

Out of total 76 culverts

- 34 culverts are adequate and 35 culverts are inadequate and 7 culverts are completely choked.
- 41 culverts are in poor condition, 24 culverts are in fair condition and 11 culverts are in good condition.
- 49 culverts are old, 25 culverts are new and 2 culverts are under construction.



	Adequate	Inadequate
Slab	3	5
Pipe	31	37

	Poor	Fair	Good
Slab	6	2	0
Pipe	35	22	11

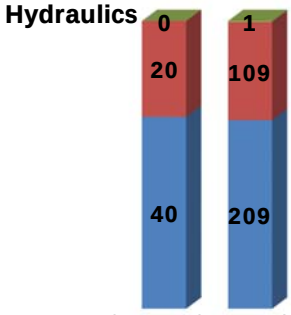
	Old	New	Under Construction
Slab	7	1	0
Pipe	42	24	2

Figure 3-21: Summary of Culvert Condition on C L Road

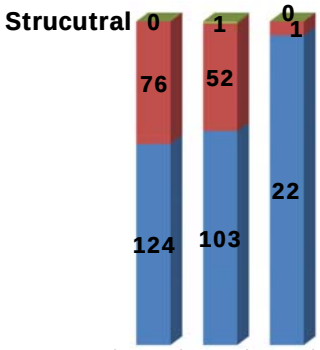
3.7.3. Chakabama – Zunheboto (C Z) Road

Out of total 379 culverts

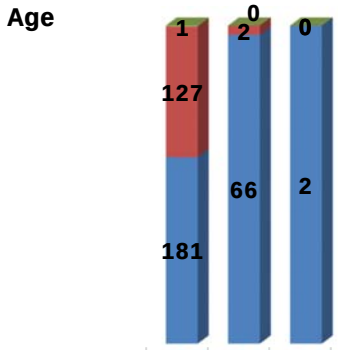
- 60 culverts are adequate, 284 culverts are inadequate and 35 culverts are completely choked.
- 309 culverts are old, 68 culverts are new and 02 culverts are under construction.
- 200 culverts are in poor condition, 156 culverts in fair condition and 23 culverts are in good condition.



	Adequate	Inadequate
Pipe + Slab	0	1
Slab	20	109
Pipe	40	209



	Poor	Fair	Good
Pipe + Slab	0	1	0
Slab	76	52	1
Pipe	124	103	22



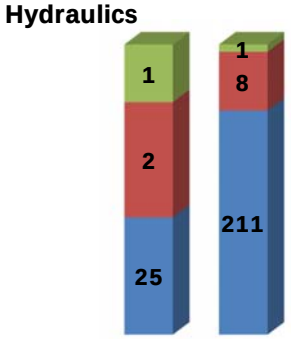
	Old	New	Under Construction
Pipe + Slab	1	0	0
Slab	127	2	0
Pipe	181	66	2

Figure 3-22: Summary of Culvert Condition on C Z Road

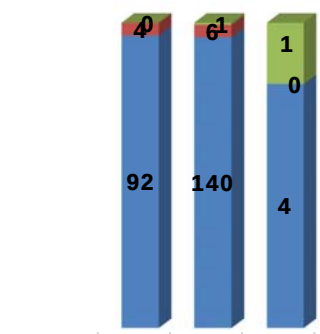
3.7.4. Pfutsero – Phek (P P) Road

Summary of Condition Survey: Out of total 248 culverts,

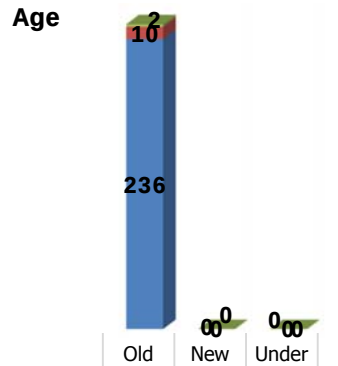
- 28 culverts are adequate, 219 culverts are inadequate and 1 culvert is abandoned.
- 96 culverts are in poor condition, 147 culverts in fair condition and 5 culverts are in good condition.



	Adequate	Inadequate
Box	1	1
Slab	2	8
Pipe	25	211



	Poor	Fair	Good
Box	0	1	1
Slab	4	6	0
Pipe	92	140	4



	Old	New	Under Construction
Box	2	0	0
Slab	10	0	0
Pipe	236	0	0

Figure 3-23: Summary of Culvert Condition on P P Road

3.8 Condition Survey of Bridges

A detailed condition survey of existing bridges has been carried out at the site by the team of bridge experts and all data regarding their condition has been collected as per the Inspection proforma of IRC:SP-19 and IRC:SP-35.

The Complete Complied Data has been collated in tabular formats in Microsoft Excel Sheets and data has been presented in **Annexure 3: Bridge Inventory and Condition Survey** in Appendix to Volume-I: Primary and Secondary Data in separate volume.

3.8.1. Merangkong- Tamlu – Mon Road

Summary of Condition Survey of Existing Bridges along the Merangkong – Tamlu - Mon Road is presented in table below:

Table 3-18: Condition of Bridges along M T M Road

S. No.	Location (km)	Minor / Major Bridge	Type	Length (m)	Type & Condition of Substructure	Type & Condition of Foundation	Condition of Superstructure
1	32/467	Minor	Steel Truss	31.7	Stone Masonry Abutment in Poor Condition	Open (May Be)	Old Structure, Poor Condition
2	35/570	Minor	RCC Slab	6.1	Stone Masonry Abutment in Poor Condition	Open (May Be)	Old Structure, Poor Condition
3	39/912	Minor	Steel Truss	16.5	Stone Masonry Abutment in Poor Condition	Open (May Be)	Old Structure, Poor Condition
4	41/500	Major	Steel Truss Girder	103.5	RCC Abutment + RCC Pier in Fair Condition	Pile (May Be, Not Visible)	Old Structure, Fair Condition
5	89/900	Minor	Steel Truss Girder + RCC Slab	15.5	Stone Masonry Abutment in Poor Condition	Open (May Be)	Old Structure, Poor Condition
6	98/024	Minor	RCC Slab	6.0	Stone Masonry Abutment in Good Condition	Open (May Be)	Old Structure, Fair Condition

3.8.2. Changtongya- Longleng Road

Summary of Condition survey of existing bridges along the Changtongya – Longleng Road is presented in table below:

Table 3-19: Condition survey of Bridges along C L Road

S. No.	Location (km)	Minor / Major Bridge	Type	Length (m)	Type & Condition of Substructure	Type & Condition of Foundation	Condition of Superstructure
1	4/200	Minor	RCC Slab+ Steel Truss	31.2	RCC Abutment in Poor Condition	Not Visible	Old, Poor Condition
2	6/861	Minor	RCC Slab+ Steel Girder	48.4	RCC Abutment + RCC Pier in Good Condition	Open (May be)	New, Good Condition
3	7/367	Minor	RCC Slab+ Steel Girder	7.45	Stone Masonry Abutment in Poor Condition	Open	Old, Poor Condition

3.8.3. Chakabama - Zunheboto Road

The Summary of Condition Survey of existing bridges on project road is presented below:

Table 3-20: Condition of Bridges along C Z Road

S. No.	Location (Km)	Type of Bridge	Length (m)	Type & Condition of Sub Structure	Type & Condition of Foundation	Condition of Superstructure
1	9/173	RCC Slab + Steel Girder	12.3	Stone Masonry abutment in Poor	Open	Old Structure, Poor Condition

S. No.	Location (Km)	Type of Bridge	Length (m)	Type & Condition of Sub Structure	Type & Condition of Foundation	Condition of Superstructure
2	10/638	RCC/PSC Bridge	40.8	RCC wall Type Abutment in Good	Not Visible	Good Condition
3	14/085	RCC Slab + Steel Girder	8.2	RCC wall Type Abutment in Fair	Not Visible	Old Structure, Poor Condition
4	18/120	RCC Slab +(I Beam) Steel Girder	8.0	RCC wall Type Abutment in Poor	Open	Old Structure, Poor Condition
5	18/490	RCC Slab +(I Beam) Steel Girder	9.4	Stone Masonry abutment in fair	Open	Old Structure, Poor Condition

3.8.4. Pfutsero - Phek Road

There is no Existing Bridge in Pfutsero – Phek Road.

3.9 Condition Survey of Protection Work

A detailed condition survey of existing retaining wall, toe or breast wall has been carried out at the site. It has been found that most of these existing structures are in damaged or in poor condition.

3.9.1. Merangkong- Tamlu – Mon Road

Condition of existing retaining/toe walls along Merangkong – Tamlu - Mon Road is presented in table below:

Table 3-21: Condition of Toe /Retaining Walls along M T M Road

S. No.	Location (Km)		Total length (m)	Condition
	From	To		
1	15/575	15/588	13.0	Fair
2	17/275	17/290	15.0	Fair
3	23/425	23/436	11.0	Fair
4	23/805	23/825	20.0	Fair
5	29/723	29/736	13.0	Fair
6	29/890	29/920	30.0	Fair
7	30/800	30/900	100.0	Fair
8	31/682	31/696	14.0	Fair
9	32/725	32/780	55.0	Poor
10	39/360	39/480	120.0	Fair
11	47/028	47/043	15.0	Fair*
12	48/325	48/345	20.0	Fair
13	48/325	48/385	60.0	Fair
14	48/407	48/467	60.0	Fair
15	49/035	49/055	20.0	Fair
16	49/150	49/165	15.0	Fair
17	50/835	50/850	15.0	Fair
18	52/480	52/500	20.0	Fair
19	53/770	53/790	20.0	Fair
20	53/990	54/005	15.0	Fair
21	54/350	54/360	10.0	Fair
22	54/440	54/470	30.0	Fair
23	54/665	54/675	10.0	Fair
24	54/675	54/735	60.0	Fair
25	55/065	55/071	6.0	Fair
26	56/153	56/165	12.0	Fair

S. No.	Location (Km)		Total length (m)	Condition
	From	To		
27	56/195	56/225	30.0	Fair
28	57/075	57/165	90.0	Poor
29	57/253	57/259	6.0	Fair
30	57/342	57/400	58.0	Not Visible
31	57/596	57/611	15.0	Poor
32	57/900	57/907	7.0	Fair
33	59/163	59/171	8.0	Fair
34	59/180	59/188	8.0	Fair
35	60/000	60/005	5.0	Fair
36	63/665	63/668	3.0	Fair
37	67/550	67/560	10.0	Fair
38	67/650	67/665	15.0	Fair
39	73/525	73/550	25.0	Fair
40	73/600	73/610	10.0	Fair
41	74/450	74/458	8.0	Fair
42	81/120	81/130	10.0	Fair
43	87/575	87/585	10.0	Fair
44	91/955	91/965	10.0	Poor
45	95/350	95/365	15.0	Fair
46	94/615	94/635	20.0	Fair
47	94/615	94/640	25.0	Fair
48	95/725	95/775	50.0	Fair
49	95/825	95/840	15.0	Fair
50	97/600	97/605	5.0	Fair

3.9.2. Changtongya- Longleng Road

Condition Survey of Retaining Walls and Toe Walls along Changtongya – Longleng Road is presented in table below:

Table 3-22: Condition of Toe /Retaining Walls along C L Road

S. No.	Location (Km)		Total length (m)	Condition
	From	To		
1	0.015	0.120	105.0	Poor/washed away
2*	0.015	0.180	165.0	Fair
3	0.470	0.485	15.0	Fair
4	7.050	7.075	25.0	Fair
5	7.500	7.575	75.0	Poor
6	12.900	12.965	65.0	Under construction/Only foundation constructed
7	13.475	13.500	25.0	Under construction/Only foundation constructed
8	13.575	13.625	50.0	Under construction/Only foundation constructed
9	22.980	22.992	12.0	Fair
10	28.605	28.630	25.0	Fair
11	28.740	28.760	20.0	Fair
12	29.292	29.315	23.0	Fair

3.9.3. Chakabama - Zunheboto Road

Condition Survey of existing Toe Walls on Hill Side along Chakabama – Zunheboto Road is presented below:

Table 3-23: Condition survey of Toe Walls on hill Side along C Z Road

S. No.	Location (Km)		Length (m)	Condition
	Start	End		
1	5/263	5/275	12	Fair
2	6/980	7/000	20	Fair
3	10/820	10/842	22	Fair
4	10/900	10/920	20	Poor
5	15/330	15/360	30	Poor
6	15/383	15/420	37	Poor
7	15/550	15/560	10	Poor
8	16/525	16/535	10	Fair
9	20/410	20/450	40	Poor
10	22/520	22/540	20	Poor
11	42/068	42/110	42	Poor
12	45/840	45/847	7	Fair
13	120/375	120/415	40	Fair
		Total	310	

Condition Survey of existing Retaining walls on Valley Side along project road is presented below:

Table 3-24: Condition of Retaining Walls on Valley Side along C Z Road

S. No.	Location (Km)		Length (m)	Condition
	Start	End		
1	0/260	0/290	30	Fair
2	4/245	4/260	15	Fair
3	4/320	4/335	15	Fair
4	5/005	5/015	10	Fair
5	5/030	5/040	10	Fair
6	5/110	5/135	25	Fair
7	5/190	5/210	20	Fair
8	7/000	7/035	35	Fair
9	7/680	7/700	20	Fair
10	7/780	7/800	20	Fair
11	11/205	11/240	35	Fair
12	11/900	11/935	35	Fair
13	13/570	13/590	20	Fair
14	14/690	14/700	10	Fair
15	14/775	14/800	25	Fair
16	14/965	14/975	10	Fair
17	15/210	15/360	150	Fair
18	15/535	15/550	15	Poor
19	15/700	15/735	35	Fair
20	16/030	16/045	15	Fair
21	16/570	16/590	20	Poor
22	20/420	20/450	30	Poor
23	20/670	20/705	35	Fair
24	20/905	20/930	25	Fair
25	21/015	21/050	35	Fair
26	21/385	21/415	30	Fair
27	22/290	22/365	75	Poor
28	22/585	22/600	15	Fair
29	22/650	22/680	30	Fair

S. No.	Location (Km)		Length (m)	Condition
	Start	End		
30	22/770	22/790	20	Fair
31	22/850	22/875	25	Fair
32	22/890	22/905	15	Fair
33	23/245	23/285	40	Fair
34	24/730	24/745	15	Fair
35	24/865	24/885	20	Fair
36	25/225	25/245	20	Fair
37	25/560	25/570	10	Fair
38	25/740	25/765	25	Fair
39	26/085	26/100	15	Fair
40	26/140	26/160	20	Fair
41	30/080	30/090	10	Fair
42	45/065	45/075	10	Fair
43	45/100	45/120	20	Poor
44	45/130	45/140	10	Fair
45	46/197	46/205	8	Fair
46	53/280	53/290	10	Fair
47	57/410	57/435	25	Fair
48	62/375	62/395	20	Fair
49	63/955	63/975	20	Fair
50	64/050	64/060	10	Fair
51	64/535	64/546	11	Fair
52	64/610	64/660	50	Fair
53	64/740	64/760	20	Fair
54	64/1020	64/1046	26	Fair
55	65/860	65/870	10	Fair
56	73/315	73/325	10	Fair
57	73/380	73/402	22	Fair
58	74/170	74/177	7	Fair
59	74/725	74/740	15	Fair
60	75/310	75/320	10	Fair
61	75/495	75/510	15	Fair
62	75/875	75/882	7	Fair
63	75/960	76/020	60	Fair
64	77/380	77/425	45	Fair
65	77/440	77/460	20	Fair
66	77/640	77/660	20	Fair
67	77/680	77/730	50	Fair
68	77/755	77/785	30	Fair
69	77/845	77/850	5	Fair
70	77/885	77/910	25	Fair
71	78/670	78/685	15	Fair
72	86/895	86/930	35	Good
73	87/238	87/260	22	Poor
74	87/750	87/760	10	Fair
75	87/1010	87/1020	10	Fair
76	88/080	88/090	10	Fair
77	88/805	88/815	10	Fair
78	88/875	88/885	10	Fair
79	91/580	91/600	20	Fair
80	92/235	92/250	15	Fair
81	92/750	92/785	35	Fair
82	92/880	92/890	10	Fair

S. No.	Location (Km)		Length (m)	Condition
	Start	End		
83	93/065	93/080	15	Fair
84	93/225	93/245	20	Fair
85	94/020	94/065	45	Fair
86	94/125	94/140	15	Fair
87	94/220	94/240	20	Fair
88	97/440	97/510	70	Fair
89	97/520	97/550	30	Fair
90	97/615	97/650	35	Fair
91	97/675	97/700	25	Fair
92	97/850	97/860	10	Fair
93	97/880	97/900	20	Fair
94	98/250	98/275	25	Fair
95	98/405	98/440	35	Fair
96	98/560	98/580	20	Fair
97	98/840	98/860	20	Fair
98	99/003	99/040	37	Fair
99	99/135	99/180	45	Fair
100	99/325	99/350	25	Fair
101	99/503	99/535	32	Fair
102	99/595	99/660	65	Fair
103	99/700	99/750	50	Fair
104	99/875	99/900	25	Fair
105	99/930	99/980	50	Fair
106	100/100	100/140	40	Fair
107	100/195	100/215	20	Fair
108	101/130	101/140	10	Fair
109	104/085	104/095	10	Fair
110	115/050	115/150	100	Poor
111	116/065	116/100	35	Fair
112	116/995	116/1019	24	Fair
113	117/024	117/032	8	Fair
114	117/177	117/192	15	Fair
115	117/465	117/480	15	Fair
116	118/598	118/625	27	Fair
117	119/080	119/090	10	Fair
118	121/220	121/245	25	Fair
119	121/450	121/475	25	Fair
		Total	2971	

3.9.4. Pfutsero - Phek Road

The Condition Survey details of protection works along Pfutsero – Phek Road are presented as below:

Existing Toe Wall on Hill Side:

Table 3-25: Condition of Toe Walls on hill Side along P P Road

S. No	Location		Length (m)	Condition
	Start (Km)	End (Km)		
1	0/060	0/555	495	Fair
2	0/650	0/660	10	Fair
3	0/750	0/770	20	Fair
4	1/260	1/350	90	Fair
5	1/790	1/850	60	Fair
6	2/375	2/385	10	Fair
7	3/965	3/980	15	Fair

S. No	Location		Length (m)	Condition
	Start (Km)	End (Km)		
8	62/800	62/835	35	Fair
9	63/308	63/340	32	Fair
10	64/200	64/223	23	Fair
		Total	790	

Existing Retaining Wall on Valley Side:

Table 3-26: Condition of Retaining Walls on Valley Side along P P Road

S. No	Location		Length (m)	Condition
	Start (Km)	End (Km)		
1	0/385	0/400	15	Fair
2	0/855	0/890	35	Fair
3	0/900	0/935	35	Fair
4	1/050	1/070	20	Fair
5	1/252	1/300	48	Fair
6	2/035	2/070	35	Fair
7	2/165	2/175	10	Fair
8	47/245	47/310	65	Fair
9	51/353	51/370	17	Fair
10	53/055	53/110	55	Fair
11	53/310	53/348	38	Fair
12	54/240	54/255	15	Fair
13	55/235	55/275	40	Fair
14	62/300	62/320	20	Fair
15	63/760	63/820	60	Fair
16	65/272	65/285	13	Fair
		Total	521	

3.10 Topographic Survey

3.10.1. Fixing Control Stations Using DGPS

The GPS Control Points in Pairs has been located along Project Roads at every 5 km (approx.) and at inter-visible locations. The horizontal control established on steel bar of 10 mm dia. fixed in RCC (M-20) pillar of size 25 cm X 25 cm X 60 cm embedded in concrete (M-15) (7.5cm all around) up to a depth of 40 cm and the balance 20 cm above the ground and has been painted yellow. The Control Point and Secondary Control Point are typically spaced around 250 meters with respect to each other.

Base stations (Reference Co-ordinates) observations have been made on static mode. The DGPS sets are used with at least 8 satellites having differential post processed accuracy at control station within +3cm. The minimum observation time at base station was 30 minutes and for others, the observation time was of minimum 15 minutes depending upon environmental conditions and length of base line.

The raw GPS data downloaded and thereafter applied suitable projection system so as to arrive at grid coordinates (Northing, Easting and Elevation with reference to Mean Sea Level) from geographical coordinates (Latitude, Longitude & Ellipsoidal Height) observed at site. The coordinates for the entire section are with reference to single arbitrary grid in metric system and WGS84 reference frame on UTM projection system. The list of DGPS Pillar location project road sections is presented in tables below.

Table 3-27: List of DGPS Control Stations along M T M Road

GPS Name	Km	Easting (m)	Northing (m)	Side
GPS-1	0+100	664193.554	2943916.137	Right
GPS-1A	0+209	664279.292	2943983.393	Right
GPS-2	4+96	666747.533	2945079.513	Right
GPS-2A	5+050	666838.346	2945054.910	Right
GPS-3	9+500	668904.025	2946761.704	Left

GPS Name	Km	Easting (m)	Northing (m)	Side
GPS-3A	9+600	668900.6319	2946635.445	Right
GPS-4	14+242	671632.909	2949258.589	Right
GPS-4A	14+307	671735.449	2949318.931	Right
GPS-5	19+242	673885.073	2951159.827	Right
GPS-5A	19+381	674041.488	2951218.816	Right
GPS-6	23+978	675383.252	2951117.763	Right
GPS-6A	24+408	675285.050	2951307.486	Right
GPS-7	30+340	676003.338	2952239.357	Right
GPS-7A	30+634	676176.560	2952406.321	Left
GPS-8	35+620	678483.311	2954391.598	Right
GPS-8A	35+752	678526.124	2954298.843	Right
GPS-9	39+800	681461.829	2956008.324	Right
GPS-9A	39+980	681539.036	2956042.599	Right
GPS-10	45+090	682760.418	2957898.009	Right
GPS-10A	45+282	682770.457	2957987.595	Right
GPS-11	47+838	684384.0227	2958295.186	Right
GPS-11A	48+062	684514.184	2958174.489	Right
GPS-12	53+600	685630.324	2956918.705	Right
GPS-12A	53+835	685514.558	2957050.297	Right
GPS-13	58+140	686288.285	2955423.479	Left
GPS-13A	58+480	686510.045	2955450.044	Left
GPS-14	63+830	686118.854	2954853.636	Left
GPS-14A	64+021	686301.936	2954837.641	Left
GPS-15	69+462	689199.911	2955892.086	Left
GPS-15A	69+495	689345.752	2955979.735	Left
GPS-16	74+729	691939.607	2957419.735	Left
GPS-16A	74+923	692120.854	2957389.766	Right
GPS-17	79+492	694999.6203	2959473.667	Right
GPS-17A	79+680	695157.9239	2959388.216	Right
GPS-18	85+228	698373.738	2960468.787	Right
GPS-18A	85+541	698598.365	2960499.072	Right
GPS-19	89+472	700192.649	2958947.607	Right
GPS-19A	89+671	700326.313	2958949.900	Right
GPS-20	98+037	700926.945	2955983.421	Right
GPS-20A	98+173	701033.951	2955963.256	Left

Table 3-28: List of DGPS Control Stations along C L Road

GPS Pillar Name	Km	Easting (m)	Northing (m)	Side
GPS-1	0+000	667071.587	2935539.439	Left
GPS-1A	0+100	667002.716	2935510.711	Right
GPS-2	5+816	668439.574	2932714.328	Left
GPS-2A	5+884	668464.235	2932648.339	Left
GPS-3	11+727	670073.839	2931476.690	Left
GPS-3A	11+805	670113.813	2931542.302	Left
GPS-4	14+489	671730.504	2932271.047	Right
GPS-4A	14+703	671916.684	2932320.573	Right
GPS-5	20+021	675386.142	2934041.935	Right
GPS-5A	20+152	675492.766	2934023.521	Right

GPS Pillar Name	Km	Easting (m)	Northing (m)	Side
GPS-6	26+050	678917.425	2933045.793	Right
GPS-6A	26+310	679033.797	2932894.498	Right
GPS-7	27+694	679274.2930	2932015.6493	Left
GPS-7A	28+750	679451.5031	2931615.1760	Left

Table 3-29: List of DGPS Control Stations along C Z Road

S. No.	DGPS Pillar No.	Easting (m)	Northing (m)	Chainage	Offset (m)	Side
1	GCP-1	619580.3354	2839333.197	0+000	9.0	Left
2	GCP-1A	619707.8070	2839376.285	0+075	3.5	Right
3	GCP-2	620931.9655	2841297.718	5+010	2.5	Left
4	GCP-2A	620840.1599	2841254.882	5+100	3.0	Left
5	GCP-3	621945.0139	2839333.087	9+800	9.5	Left
6	GCP-3A	622032.8277	2839274.633	10+000	5.8	Left
7	GCP-4	623355.5059	2840011.21	15+000	3.0	Left
8	GCP-4A	623339.9640	2840100.208	15+100	2.7	Left
9	GCP-5	623689.0735	2838294.574	19+995	2.5	Right
10	GCP-5A	623747.4341	2838224.472	20+090	2.8	Right
11	GCP-6	625188.4756	2838526.161	25+050	5.0	Left
12	GCP-6A	625201.9084	2838670.979	25+260	2.8	Left
13	GCP-7	626929.1400	2840421.13	29+925	2.5	Left
14	GCP-7A	626849.3589	2840465.27	30+050	4.0	Left
15	GCP-8	629828.1724	2841278.255	34+950	4.3	Left
16	GCP-8A	629746.3855	2841343.592	35+100	2.2	Left
17	GCP-9	631216.1827	2843689.353	39+980	4.5	Right
18	GCP-9A	631323.2964	2843762.598	40+120	9.5	Right
19	GCP-10	632526.6894	2846954.736	45+830	3.2	Left
20	GCP-10A	632540.5031	2847108.011	46+000	8.2	Left
21	GCP-11	634740.084	2848047.581	49+885	10.8	Left
22	GCP-11A	634841.4945	2848125.848	50+025	15.2	Left
23	GCP-12	638165.8827	2850662.055	54+985	4.3	Right
24	GCP-12A	638204.0400	2850765.212	55+075	6.7	Right
25	GCP-13	639651.3890	2853549.645	59+950	4.3	Left
26	GCP-13A	639650.5856	2853655.987	60+050	8.1	Left
27	GCP-14	640440.6087	2856414.622	64+850	4.6	Left
28	GCP-14A	640358.0379	2856546.224	64+975	7.6	Left
29	GCP-15	642093.4992	2857552.77	69+755	8.4	Left
30	GCP-15A	642042.0219	2857692.011	70+030	8.3	Left
31	GCP-16	644147.8733	2859216.655	74+425	3.4	Left
32	GCP-16A	643988.4958	2859416.421	74+975	4.4	Left
33	GCP-17	643086.4235	2861802.33	79+990	8.5	Left
34	GCP-17A	643193.5274	2861767.308	80+075	9.2	Left
35	GCP-18	645262.8967	2861403.266	85+030	3.8	Left
36	GCP-18A	645318.1137	2861509.499	85+220	6.2	Left
37	GCP-19	646096.388	2864574.016	90+085	5.2	Left
38	GCP-19A	645984.8681	2864618.459	90+225	9.3	Left
39	GCP-20	645970.5384	2866898.082	94+800	6.2	Right
40	GCP-20A	645842.2991	2866807.267	94+965	8.2	Left
41	GCP-21	647123.2334	2868504.485	100+350	4.4	Left
42	GCP-21A	647169.9167	2868693.365	100+500	3.5	Right
43	GCP-22	649546.3785	2869353.416	105+100	6.2	Right
44	GCP-22A	649642.2247	2869476.359	105+290	7.1	Right
45	GCP-23	649921.4892	2872804.47	109+810	5.7	Right
46	GCP-23A	650073.8527	2872831.798	110+050	3.6	Right
47	GCP-24	651017.4861	2875628.293	115+125	3.2	Left
48	GCP-24A	650981.5986	2875748.212	115+225	4.1	Left
49	GCP-25	652396.3012	2880222.121	122+000	6.2	Right
50	GCP-25A	652293.0197	2880237.674	122+100	3.2	Left

Table 3-30: List of DGPS Control Stations along P P Road

S. No.	DGPS Pillar No.	Easting (m)	Northing (m)	Chainage	Offset (m)	Side
1	GCP1	630480.3905	2829543.007	0+735	3.1	Left
2	GCP1A	630463.2215	2829628.238	0+835	3.1	Left
3	GCP2	631658.0621	2832250.835	5+100	4.5	Right
4	GCP2A	631816.5033	2832291.204	5+250	5	Right
5	GCP3	633693.9672	2834313.583	10+100	6.4	Right
6	GCP3A	633799.6374	2834356.286	10+200	13.5	Right
7	GCP4	636537.1005	2834153.472	15+000	14.5	Right
8	GCP4	636732.7528	2834216.956	15+200	12.5	Right
9	GCP5	636513.9109	2836504.399	19+750	6.1	Right
10	GCP5A	636623.9611	2836531.178	19+850	7.2	Right
11	GCP6	638358.9584	2838176.566	25+050	3.5	Right
12	GCP6A	638368.3539	2838288.172	25+150	3.2	Right
13	GCP7	639171.4984	2840724.476	30+000	9.2	Right
14	GCP7A	639063.7284	2840835.279	30+200	9.5	Right
15	GCP8	640430.5108	2841149.366	34+800	6	Left
16	GCP8A	640450.3585	2841041.928	34+925	5.2	Left
17	GCP9	641055.1449	2839074.758	40+250	3.8	Left
18	GCP9A	641128.3456	2838967.971	40+325	3.1	Left
19	GCP10	643362.3847	2837918.494	44+650	3.5	Right
20	GCP10A	643356.9877	2837824.651	44+775	3.1	Right
21	GCP11	644730.2608	2835333.194	50+210	2.8	Right
22	GCP11A	644761.4971	2835257.936	50+300	3.2	Right
23	GCP12	644338.5458	2838200.544	55+490	4	Right
24	GCP12A	644446.2443	2838250.646	55+600	9.1	Right
25	GCP13	645954.6461	2839880.476	6+150	3.5	Right
26	GCP13A	646033.3096	2839734.723	60+250	5	Right
27	GCP14	646171.7192	2841875.184	63+725	10.1	Right
28	GCP14A	646127.5421	2841986.772	63+850	5.7	Right

3.10.2. Topographic Survey

The Consultants have carried out detailed topographic survey as per detailed methodology and TOR. It includes carrying out continuous open traverse along the existing road, establishing the elevations of the survey stations by using Auto Levels/Digital level, topographic survey by using Total Station/Scanner instrument.

Detailed Topographic Survey has been undertaken by the Consultants for capturing all the physical features along the project road corridor for facilitating proposals for the centerline of the proposed road, keeping in view of the possible geometric improvements.

The survey covered a strip of roadway covering sufficient width on valley side and hill side with cross sections taken at regular intervals to form Digital Terrain Model (DTM). Minimum 3 points for road way width has been taken. The details i.e. spot levels, existing pavement, under construction pavement, typical features; point of hill top & hill toe, point of valley start, details of drain/parapet wall, habitation, canals, drain, rivers etc. have been mapped during topographic survey. The plan covers all permanent features near the alignment, the existing road way, locations of culverts, bridges, retaining walls, house/buildings, trees(girth more than 300mm), utility services i.e. under-ground (Optical fiber cables, Water pipe lines etc.) and over ground (Electricity Transmission tower, Electricity poles, Telephone poles etc.).

In case of Major junction the details up to 500m and in case of Minor junctions the details up to 200m has been captured. In case of bridges (total length less than 30m) cross sections at approx. 50m interval has been taken on upstream & downstream side. In case of bridges (total length more than 30m) cross sections at approx. 100m interval has been taken on upstream & downstream side.

To control the traverse, cement concrete reference pillars at an interval of 250m along the project roads have been established before running an open traverse. Three coordinates (X, Y and Z i.e. Easting, Northing and Elevation) of control beacons, with respect to the cumulative Km of alignment would be finalized after completion of improvement proposal. The reference pillars were also connected with the

benchmark (if available) by carrying out double run leveling by Auto Levels/Digital Levels for vertical control.

The topographic survey thus carried out contains the details of all physical and topographical features within the survey corridor such as roads, rivers, streams, rail crossings, electric / telephone lines, high / low tension lines and their offsets from the road edge, buildings, religious structures, trees, etc. Survey data has been plotted and all the feature lines are joined with 3D polylines in computer and compared with Google earth and available topo-sheets.

The capturing of existing topographic details for two project roads (Merangkong Tamlu Mon Road and Changtongya Longleng Road) has been completed and has been presented in submitted Alignment Plan in Volume III. Topographic survey for other two roads is in progress and would be presented after completion. The Works on topographic surveys on these two roads (Chakabama Zunheboto Road and Pfutsero Phek Road) have been delayed to disturbance by local unsocial elements. However, consultant is trying to complete works by pursing the matter with local authorities.

3.11 Existing Pavement Investigations

Investigations of existing subgrade along the project road have been carried out to assess the strength of existing subgrade and recommendation thereof for reconstruction / replacement of the project road. The Samples of Existing Subgrade Soils have been collected along all project roads by excavating Test pits of 1m x 1m and depth up to subgrade level. In general Test Pit has been done at a frequency of 1 km. However, for the problematic soil locations (having failure of existing subgrade, visibly) frequency of testing on sub grade soil samples has been increased to 500 m. Followings activities have been carried out at each trial pit:

- Marking Existing km on each Test Pit;
- Assigning the unique identification number e.g. MTM_TP_00X, for each Test Pit (MTM: Merangkong – Tamlu - Mon Road, TP: Test Pit, 00X: Serial number of Pit);
- The Existing Pavement Composition has been studied at each Test Pit and recording the type of Material and Thickness of each layer of Pavement;
- Field Dry Density and Field Moisture Content at each Test Pit has been carried out;
- Field CBR using TRRL DCP CBR method has been conducted at each Test Pit.
- Existing Subgrade Soil sample have been collected from each Test Pit for further testing in Laboratory for assessing its physical strength parameters.

The Consultant has established Laboratory near Public Works Department Office in Pfutsero for carrying out following Tests on Subgrade Soil Sample collected from each Test pit.

- Characterization
    - Grain size Analysis;
    - Atterberg's Limits (Liquid Limit, Plastic Limit and Plasticity Index);
- Specific Gravity;
- Laboratory moisture density characteristics (modified Compaction as per IS 2720 Part 8); and
- Laboratory CBR (Uncooked & Soaked compacted at three energy levels).

IS Code for CBR (IS 2720 Part 16) does not provide methodology for carrying out CBR at three energy levels. However, the reference is available in AASHTO. The AASHTO code recommends, carrying out CBR with three different compactive efforts (10, 30 and 65 blows). For Design of Pavement (IRC 37-2012), the CBR value of subgrade is required. Clause 305.2.2.4 of Section 300, MoRTH specification, 2013 details to achieve relative compaction of 97% of MDD for subgrade layer. It is difficult to achieve compaction equivalent to 97% of MDD while carrying out one CBR test. Thus, to have a relation between CBR and Dry Density, the CBR test/value is required at three energy levels (Dry Densities). In view of above and present project conditions w.r.t. existing subgrade materials, the testing of CBR at three energy levels has been completed by giving compactive effort of 25, 40 and 60 blows. The remaining details for carrying out CBR are in accordance with IS 2720 Part-16.

Summary of all Test results, test details and analysis thereof have been presented in **Chapter 2: Subgrade Characteristics and Strength Volume III: Materials Report, submitted along with this report.**

3.12 Construction Materials Investigations

Materials Investigation are required to ascertain their availability along Project Length and Project Influence Corridor with Most Economic Lead Minimum Lead to ensure economy and also to avoid time consuming operation of Materials haulage.

Consultant has carried out survey for identification of prospective sources for naturally available materials viz. Earth/ Soil, Gravels, Sand, Stones which can be used in road construction directly or after some processing. The information so arrived has been got confirmed from concerned Sub-Division & Divisions of State PWD. Representative samples in sufficient quantities have been collected to assess their suitability for various components of road construction.

Scope of Works for Materials Investigations has been defined in Para 11.8 of Terms of Reference and has been discussed in earlier chapter. The Consultant has carried out Site Sampling and testing of representative samples in accordance with relevant specification.

Summary of all Test results, test details and analysis for suitability thereof have been presented in **Chapter 3: Materials Investigation of Volume III: Materials Report, submitted along with this report.**

3.13 Hydrology for Cross Drainage

Hydrological investigations were carried out to examine the adequacy with respect to the HFL at existing clear span or waterways of cross-drainage structures against flood peak of 50 years return period in the case of Bridges and 25 years return period for culverts. Based on various computational techniques given in IRC codes SP-13:2004 & IRC-5:1998, CWC Flood estimation report for sub zone 2(b), survey data, structural data, map studies, hydrological studies have been carried out for design discharge, effective linear waterway, clear span, design HFL, scour depth, afflux and velocity for the bridges on existing and realigned section of project roads. Waterway/opening required for overtopped stretches and inadequate culverts were also assessed.

The details regarding Data Collection (Topographic, Stream and Rainfall); Methodology for discharge computation, Design Discharge, Design HFL, Recommended Waterway for Bridges, Scour Depth, Afflux, Culverts and its Hydrology, Longitudinal Drains have been presented in Volume II: Design Report Part II:

3.14 Geotechnical Investigations

Geo technical investigations were carried out along the project roads to obtain all soil and sub-soil data needed as input for the design and analysis of performance of formation in embankments/cuttings and structures on the alignment. The criteria adopted for fixing up the frequency of borehole locations were mainly based on TOR requirement.

The locations of borehole were decided prior to the execution of the field work. The detail of boreholes like depth and nos. of boreholes of each bridge sites for each along with field work details including collection of distributed and undistributed soil samples, conducting standard penetration tests at regular intervals, rock core cutting and measuring Core Recovery (CR) and Rock Quality Designation (RQD) values of rock samples and following laboratory testing of obtained soil sample have been presented in Volume II Design Report PARt II and its Annexure.

- Soil characterization (Grain Size Distribution and Atterberg Limits)
- Moisture Content
- Natural Density
- Shear Strength Parameters
- Consolidation Parameters

3.15 Land Slide Studies and Analysis

A landslide study of the project area has been carried out by the Engineering Geologist. The Geologist collected relevant geological maps, other documents and also took photographs for carrying out this study. This study comprises of:

- Structure and nature of soil
- Regional Geology

- General Geology along the road corridor
- Identification of vulnerable sections of alignment, in terms of landslides, slope failures etc.
- Measures for protection of road from landslides and slope failures.

3.15.1 Regional Geology of Nagaland

Facing the Himalayan ranges across the Brahmaputra valley and stretching. NE-SW along the eastern margin of Northeast India, bordering Myanmar, there lies the Naga Hills. It represents the northern extension of the Indo Burma Ranges (IBR) linking the Arunachal Himalaya to the north and Andaman-Nicobar Islands to the south. The N-S trending Patkai, Barail and associated ranges with their varied structural styles impart youthful geomorphology to the Naga Hills.

The Cenozoic sedimentary cover in Nagaland accounts for nearly 95 percent of the area whereas the rest is being occupied by igneous and crystalline rocks of Mesozoic-Cenozoic age. These exhibit general trends of NNE-SSW with moderate to steep dips towards NW and SE direction. Based on the morpho-tectonic elements, the Naga Hills has been longitudinally divided, from west to east, into three distinct units, namely-the Schuppen Belt, the Inner Fold Belt and the Ophiolite Belt.

The Schuppen Belt has been defined as a narrow linear belt of imbricate thrust slices which follows the boundary of Assam valley for a distance of 350 km along the flank of Naga-Patkai hill ranges. It is postulated that this belt comprises of eight or possibly more over thrusts along which the Naga Hills have moved north-westwards relative to the Foreland spur. The total horizontal movement of all the thrusts together is estimated to be over 200 km. The Schuppen belt is delineated on the east by Halflong-Disang thrust and on the west by the Naga thrust which has an en-echelon disposition. Sediments ranging in age between Eocene-Oligocene and Plio-Pleistocene along with total absence of Disang rocks together characterize the Schuppen Belt.

The Inner Fold Belt occupies the central part of Naga Hills and extends up to Pangsu pass in Arunachal Pradesh. A large spread of Disang rocks with isolated covers of Barail as well as Disang-Barail transition sequences characterizes the geological setting of this belt. The Paleocene rocks have been folded into series of anticlines and synclines and are confined within two major tectonic zones viz. Halflong - Disang thrust to the west and the Ophiolite Disang thrust to the east. The Inner Fold Belt is occupied by two major synclinorium, namely the Kohima synclinorium to the south and Patkai synclinorium to the north, Mokokchung and adjoining areas being culmination point of the two. In Kohima synclinorium the younger Surma rocks are developed in its core.

The NE-SW trending Ophiolite belt of Naga Hills extends along the eastern margin of the Nagaland state for nearly 200 Km bordering Myanmar. It is characterized by dismembered tectonic slices of serpentinites, cumulates and volcanic. The associated pelagic sediments include mainly chert and lime-stones that are often inter-bedded with the volcanic. Cherts are usually bedded and contain radiolarians. The fossil assemblages from the limestone inter-bands have suggested an Upper Cretaceous to Lower Eocene age for the Ophiolites. These Ophiolite zone of rocks are uncomfortably overlain by an Ophiolite derived volcaniclastic and open marine to paralic sedimentary cover which have been designated as Phokphur Formation. The Eocene Disang Series and the Oligocene Barail Series cover a major portion of Nagaland. These are unconformably overlain by the middle and upper tertiary rocks represented in the hills bordering the plains Assam. The generalized geological succession of Nagaland is given below:

Table 3-31: Geological Succession of Nagland

Age	Series	Lithology
Recent and Pleistocene	Alluvium and high level terraces	Gravel, sand and clays
Pliocene	Dihing Series	Pebble beds, sandstone, clay and sand beds
Mio - Pliocene	Namsang Beds	Soft, unconsolidated, coarse bluish sand rocks, coal, conglomerate and mottled clays
Miocene	Tipam Series	Girujan Clay Stage – mainly mottled clays of various colors, thin bands of fine grained hard sandstone
		Tipam sandstone stage – greenish, blue, coarse & medium grained, micaceous, moderately hard sandstone, siltstone and a few beds of

Age	Series	Lithology
		mottled clay, fossil wood common.
Oligocene	Barail Series	Tikak Parvat Stage – Medium to coarse grained, quartzose sandstone, ferruginous carbonaceous shale and thick workable coal seams
		Baragolai Stage – Alternations of sandstone and shale with thin coal seams
		Naogaon Stage – Hard, flaggy, bluish grey sandstone, siltstone & shale.
Eocene - Paleocene	Disang Series	Dark grey, splintery shale, black carbonaceous shale / slate with thin fine grained sandstone intruded by thin quartz veins and a few serpentinised intrusions.

The geological map of the Nagaland on regional scale showing different litho units in different parts of the state is shown in Fig. below:

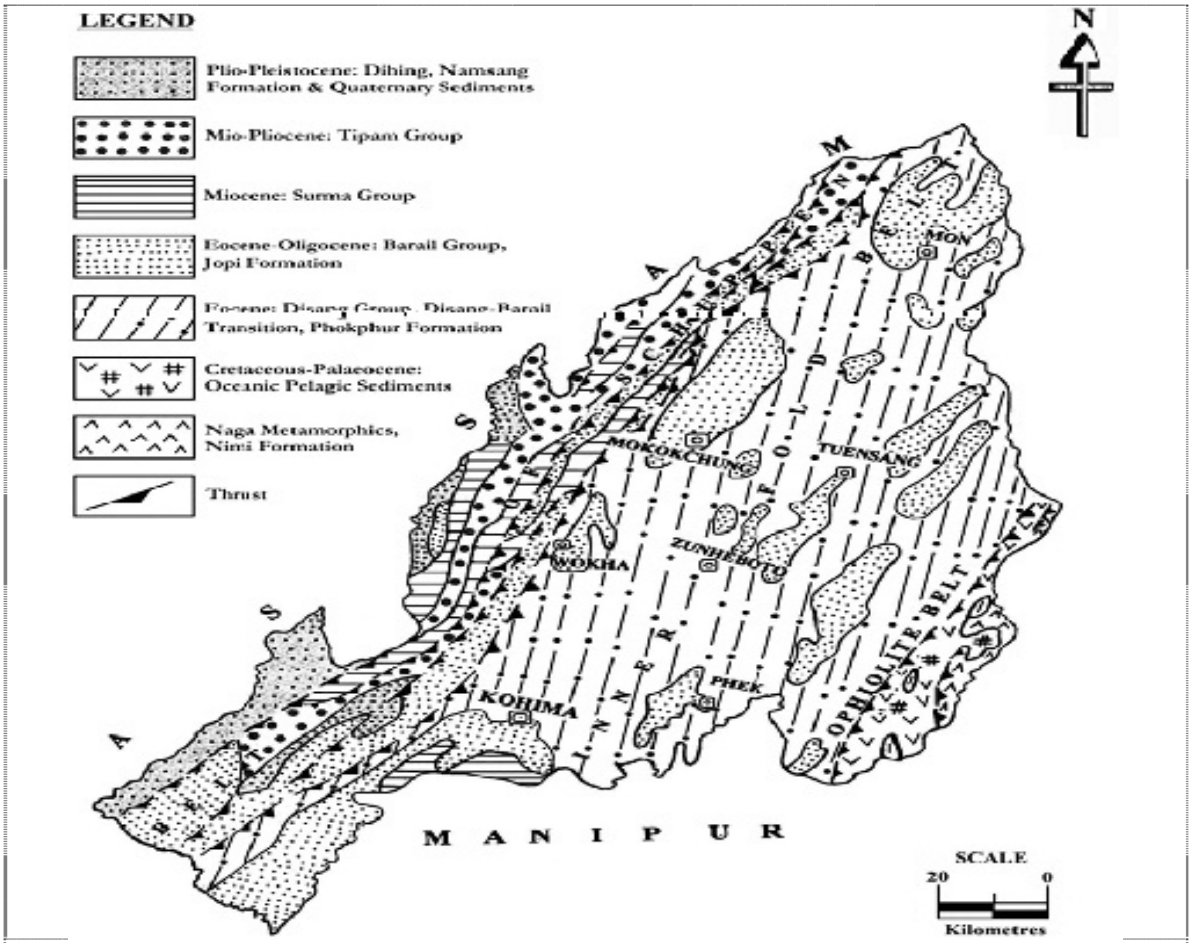


Figure 3-24: Geological Map of Nagaland

3.15.2 Geomorphology

Nagaland consists of a narrow strip of hilly terrain trending North-east to South-west and facing the Assam plains to its North and North-west. The Barail range enters the state at the South- west corner and runs in a North-easterly direction almost up to Kohima. Near Kohima the Barail range merges with the mountain ranges which have extended to Manipur and the main range assumes a much more northerly trend. This range is considerably higher than the Barail, with peaks like Saramati and Mataung Kien at its extreme east. Between Mao and Kohima, there are several very high peaks including Japvo. North of Kohima the main range declines in height, and as far north as Mokokchung district, the Japukong range attains an average elevation of 750m. In general, 94% area falls under hilly and rugged terrain and only 6% land is plain, especially those bordering Assam plains along western

boundary of the state. The State has a rolling landscape with low hills covered with very dense vegetation. The geo-morphological and lineament map of Nagaland and project area are shown in Figure below:

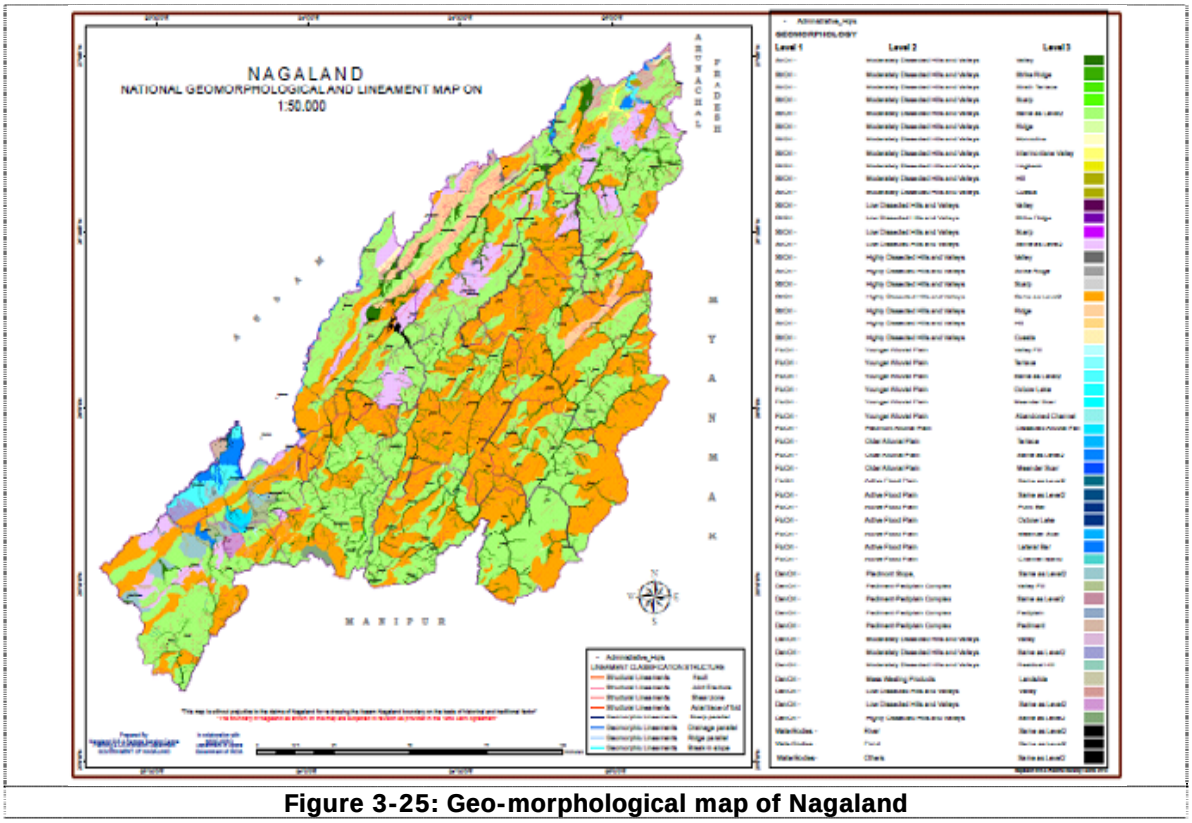


Figure 3-25: Geo-morphological map of Nagaland

3.15.3 Drainage System

The main rivers that flow through the state are Dhansiri, Doyang, Dikhu, Tizu and Melak. There is no waterfall in Nagaland. The only natural lake well known is the Lacham lake located near Washello in Phek district. The Barail and Japvo ranges form the watershed of the state, but none of the streams are of considerable dimensions. Almost as far north as Mokokchung, the whole of the drainage of the north-western slope face of hills ultimately finds its way into Dhansiri River. Diphupani is an important tributary of Dhansiri. Doyang River originates near Mao and follows a north- north easterly course and then flows northwest cutting across the main chain of hills till it joins its largest tributary, the Rongmapani. North of Doyang, the principal streams are Desai and Jhanzi, which ultimately flows into the Brahmaputra. The drainage map of the Nagaland state & project areas on regional scale are shown in Figure below:

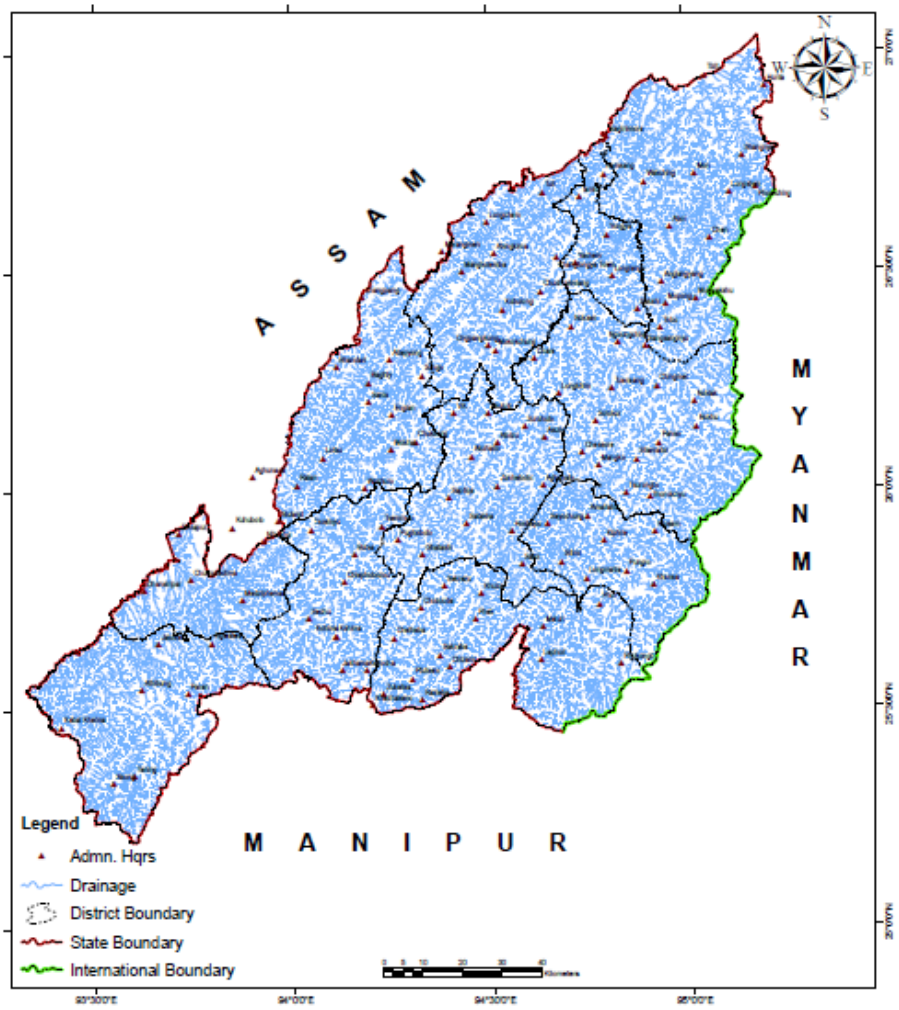


Figure 3-26: Drainage Map of Nagaland

3.15.4 Structure and Seismicity

Earthquakes are a real and potential danger to the State of Nagaland. The accepted and working definition of an earthquake is "a sudden and violent motion of the earth which lasts for a short time, within a very limited region". Earthquakes occur without any prior warning and are therefore unpredictable. The extent and impact of an earthquake depends on its magnitude, location and time of occurrence. The North East of India (latitude 22-29º N and longitude 90-98º E) is one of the most seismically active regions in the World. The region is jawed between the two ranges (arcs), the Himalayan Range to the North and the Indo-Burmese (IBR) to the East. The Mishmi Hills occur at the junction between the Eastern Himalayas and the IBR. The northern part of the NS trending sigmoid IBR has been named as the Naga Hills. The Naga Hills link the Eastern Himalayas (Arunachal Himalayas) to the North and the Andaman Nicobar Islands to the South. Belts of narrow tectonised but nearly continuous late Mesozoic-Eocene Ophiolite suite of rocks (igneous rocks) and associated sediments (chert and limestone) skirt along the northern margin of the Himalayan range and the Eastern margin of the IBR(the Naga Ophiolite) that owe their origin to the collision history of the Indian Plate with the Tibetan Plate (towards the north) and later with the Burmese Plate (towards the East) respectively, sometimes 30 million years ago, leading to the development of fold- thrust belts of the Himalayas and the IBR. It is the outcome of that plate convergence and collision which makes the NE Indian region one of the most seismically active areas of the world. Nagaland is a multi hazard prone State in the North Eastern Region of India. It comes under the seismic zone V and hence, falls under a very high damage risk zone. The general area is low-lying hills which are prone to landslides due to unstable rock materials, especially during the rainy season which lasts from May to September. Flash floods often occur due to deep depressions and local climatic conditions. The natural tectonic setting makes

Nagaland prone to Earthquakes resulting in loss of life and material. A large number of moderate to large magnitude earthquakes have occurred within the State boundaries as well as within a range of 100km around it. The major lineaments and tectonic contacts/features are trending NNE-SSW demarcating the regional structural behaviour of the rock mass are shown in Figure below:

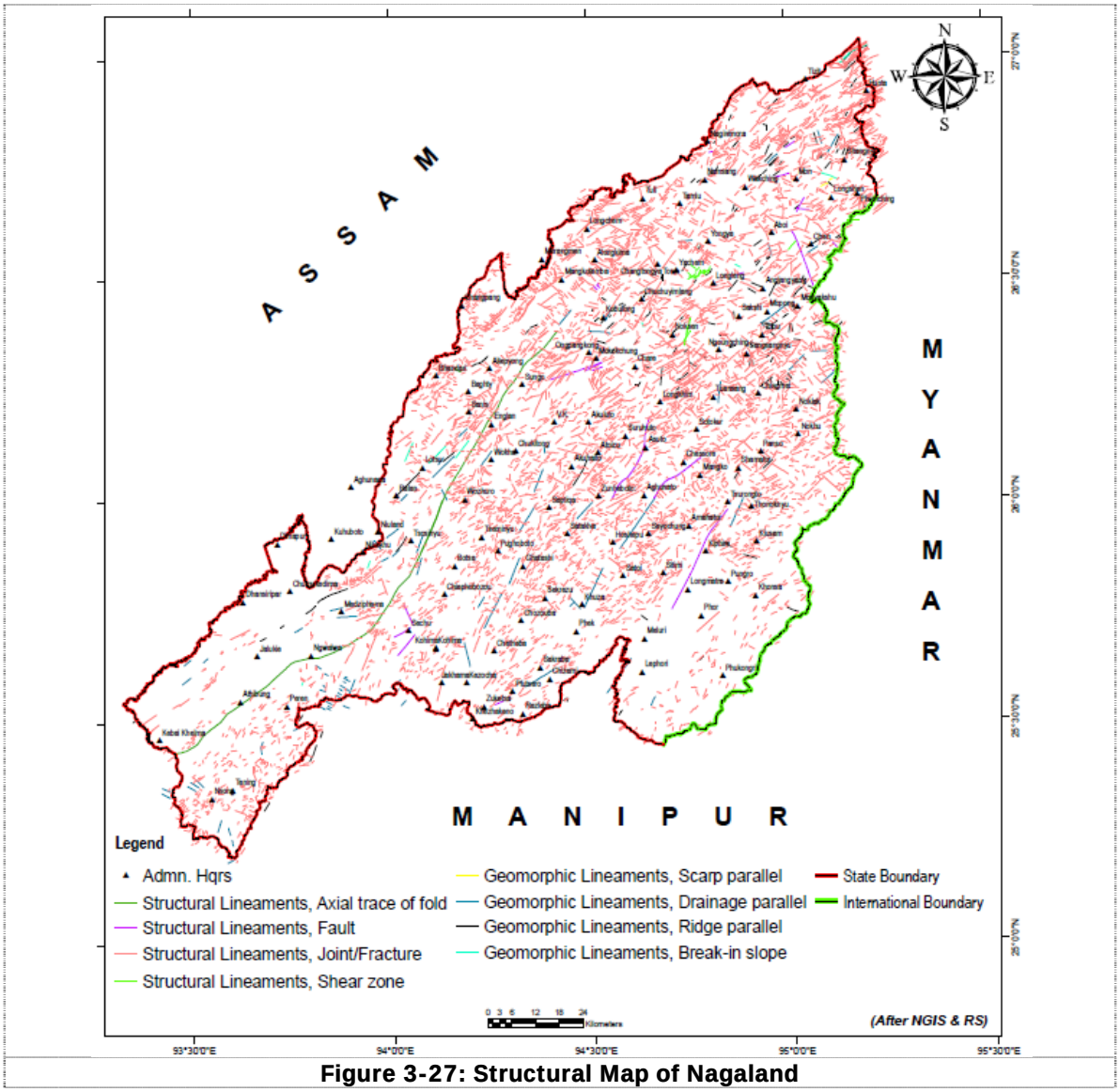


Figure 3-27: Structural Map of Nagaland

3.15.5 General Geology along the alignment

The rocks exposed in project area along the alignments belong to Disang formation which is represented by inter-bedded sequence of shale, sandstone and carbonaceous black shale of Eocene age. The geology along remains almost same and the alignments are located in Disang formation and the only variation is in the proportion of different litho units. In major part of the area the alignments has exposed bed rock along the river/nala and road cutting sections. Exposure/outcrops along hill slopes are scanty and obscure because of the cover of weathered products of Disang sediments which are very much susceptible to weathering and erosive agencies. The exposures of Disang Formation comprises predominantly of shale with occasional bands of siltstone, sandstone and rarely of impure limestone. The shale is grey to dark grey black and khaki to buff and purple in color. It is predominantly splintery in nature and is also well jointed which on breaking produce splinters/needles. This is the characteristic nature of Disang shale which has possibly developed because of multiple deformations. They are dominantly argillaceous in composition, however the arenaceous content has been found to increase towards the top of the formation. Due to metamorphic

effects on argillaceous sediments, spheroid shaped weathering is common in Disang shale. Siltstone and sandstone are also seen as thinly bedded and hard bands/lenses in Disang shale. At first they are of insignificant thickness but gain significant thickness towards the top of the formation. They are generally grey to dark grey and grayish brown to purple and buff in color. The splintery shale are becoming more arenaceous towards the contact, thereby losing their characteristic splintery nature.

3.15.6 Field Observations

Field traverses were carried out along the alignment in order to understand the geology, conditions & nature of the strata exposed, stability of slopes and study of major landslides including causes & suitable remedial measures along both the alignments.

Much of the state is very hilly comprising of steep slopes and high relief. Nagaland is predominantly made up of shale and sandstone in various combinations. Most of the rocks, particularly the shale are sheared, fractured, crumpled, and weathered to various extents. They are normally saturated with water which leads to the building up of high pore-water pressure thereby causing the loss of shearing strength and collapse of the soil structure. Sandstone at places is weak due to poor cementation and compaction. Repeated thrusting and faulting have further weakened the rocks. Such sandstone areas are known for rock falls and debris slides.

Most roads in Nagaland are cut across the mountain ranges, without culverts and proper drainage system, making the roads carry the entire water flow from above, to accumulate or flow to a concentrated outlet stream, causing flash floods.

The Nagaland State receives an average rainfall of 2500 mm. Nagaland comprises, for the most part a highly dissected, young and relatively immature mountainous terrain. This geo-dynamically sensitive region is characterized by intense tectonic activity which has caused large scale folding and faulting that has resulted in severe shearing, fracturing, and crumpling of the rocks. This geologically unstable area experiences landslides and other mass movements which cause considerable damage every year. Such phenomena commonly occur towards middle to late monsoon and during heavy rains. They are the most common and widespread of the natural hazards in the State. Landslides occur mainly around settlements, in cultivated tracts, and along road sections. Slope stability is governed by geo-morphological, geological, and hydro-geological conditions. Any changes in these conditions due to human interference, precipitation, and geodynamic processes including seismicity can lead to slope failure. Most landslides in Nagaland have been initiated during intense monsoon precipitation. Cloudbursts are very common phenomena in this region. The stability of hill slopes is directly or indirectly influenced by land use practices and land cover because these factors control the rate of weathering and erosion of the underlying formations. Faulty land use practices such as heavy constructions are landslide initiators. Another important factors causing landslides is faulty road construction methods. Landslides occur because road construction design and slope stabilization structures are very poor. Besides natural Environmental factors, excavation for rocks and slope modification for domestic uses have made many parts of our environment susceptible to mass wasting. Nagaland is placed in Zone -V of the Seismic Zone Map of India with an expected maximum magnitude greater than 8. Large seismic shocks, particularly towards late monsoon and during storms or cloudbursts could trigger massive landslides.

Detailed studies of the project roads have lead us to deduce that both natural and anthropogenic causes are the main responsible factors for the landslides and slope failures:

Natural Causes

- Most part of Nagaland comprises of highly dissected, young and relatively immature mountainous terrain, which cannot sustain the natural processes of weathering and erosion. Presence of clay and shale has also aggravated the slope failure when they become wet.
- Geological structure and tectonic activity have an inherent instability on the sites under investigation. Stress created due to folding, faulting has resulted in jointing, shearing and imbrications in structures.
- Medium relief and steep slope prevailing on the project roads are not conducive for the stability of slopes.

- The region receives heavy rainfall. The heavy precipitation leads to oversaturation, causing loss in shear resistance with the increment in pore water pressure. Surface runoff induces rapid weathering and erosion of slope materials, decreasing the angle of repose.

Anthropogenic Causes

- Deforestation for domestic purposes, current jhum cultivation practices on the slopes in the proximity of the highway and catchment areas of stream leads to failure of slope.
- Improper land-use and land-cover practices, like excessive hill slope cutting either due to quarrying, construction of new road and widening of the existing roads.
- Excessive quarrying for construction materials ignoring stability of slopes has led to small scale sliding along the project roads.

3.15.7 Category of slide based on vulnerability:

The slides observed/studies during the present study are classified into three categories based on their vulnerability/ severity.

Category-I- Highly Vulnerable slides

This includes slides having steep slope (>45^0) with non-cohesive, unconsolidated material, slope debris, highly to completely weathered rock having high pore water pressure, high cutting slope with unfavorable dips of strata, berm totally failed in cutting, heavy ingress of water along nala.

Category-II- Medium Vulnerable slides

This includes slides having moderate slope (>30-45^0) with soft and jointed nature of rock, ingress of water through joints, partly berm failed, unfavorable dip of strata with moderate height of cutting, problem of plane and wedge failure.

Category-III- Low Vulnerable slides

This includes area having gentle slope (20-≤30^0) with thickly bedded sandstone/shale dipping inside the hill and rock mass is less jointed whereas in case of soil, consolidated with cohesive nature of soil with low pore water pressure, unfavorable dip of strata with low slope height, minor problem of wedge and plane failure etc.

3.15.7.1 Merangkong – Tamlu – Mon Road

The project road stretches falling in various categories of Vulnerability of Slides for Merangkong – Tamlu – Mon Road are as detailed below.

Category-I: Project Road Stretch between km 5.40-5.75, 6.40-6.90, 7.70-8.10, 8.54-8.60, 14.68-14.80, 18.65-18.80, 19.40-19.90, 29.16-29.66, 30.00-30.16, 34.30-34.40, 59.20-60.30, 61.30-62.45, 83.40-83.80, 86.60-86.90, 87.95-88.30 falls in highly vulnerable slides.

Category-II: Project Road Stretch between km 1.60-1.70, 3.20-3.90, 7.30-7.70, 8.10-8.40, 10.10-10.50, 14.15-14.68, 15.40-16.55, 18.30-18.65, 19.90-20.10, 20.90-21.30, 21.50-21.60, 23.85-24.06, 24.26-24.36, 24.55-24.76, 28.41-28.66, 34.40-34.50, 41.50-42.60, 52.30-52.90, 55.50-56.30, 60.30-61.30, 62.45-62.77, 65.00-65.90, 72.10-72.30, 81.29-81.53, 81.61-82.24, 82.87-82.95, 84.30-84.65, 91.15-91.65, 92.90-94.90 falls in medium vulnerable slides.

Category-III: Project Road Stretch between km 3.90-4.70, 5.00-5.25, 6.90-7.30, 10.05-10.10, 10.50-10.90, 13.30-14.15, 14.80-15.40, 17.80-18.00, 19.05-19.40, 22.00-23.30, 23.65-23.85, 24.06-24.26, 24.76-25.66, 27.71-28.26, 28.66-29.16, 30.76-30.96, 33.00-33.20, 34.50-35.50, 36.60-37.00, 37.20-37.70, 37.95-38.80, 39.90-40.50, 40.62-41.50, 43.60-45.90, 47.70-48.30, 49.70-50.30, 52.90-55.50, 56.30-56.50, 58.00-59.20, 63.95-64.25, 65.90-68.60, 69.00-69.10, 69.80-69.90, 70.10-70.75, 75.40-75.45, 76.80-77.10, 78.70-78.80, 79.60-81.21, 81.53-81.61, 82.63-82.75, 82.95-83.40, 84.25-84.30, 84.65-85.15, 85.60-85.65, 85.90-86.40, 89.50- 89.95, 90.15-90.45 falls in low vulnerable slide zones.

3.15.7.2 Changtongya – Longleng Road

The project road stretches falling in various categories of Vulnerability of Slides for Changtongya – Longleng Road are as detailed below.

Category-I: Project Road Stretch between km 4.22–5.02, 5.50–5.60, 6.60–6.85, 7.80-8.15, 9.40-9.60, 16.15-16.30, 16.45-16.85, 20.10-20.25, 21.40-21.50, 21.60-21.90, 22.90-22.95, 23.05-23.25 & 29.60-33.00 falls in highly vulnerable slides.

Category-II: Project Road Stretch between km 1.20-1.50, 1.60-1.75, 2.30-2.70, 4.10-4.22, 14.80-15.30, 15.60-16.05, 19.30-20.10, 20.25-20.80, 21.90-22.50, 23.60-23.90, 24.10-24.30, 24.70-25.00, 26.80-27.40 & 28.90-29.40 falls in medium vulnerable slides.

Category-III: Project Road Stretch between km 0.00-0.60, 1.05-1.20, 5.70-5.90, 25.50-26.50, 27.40-28.30 & 28.60-28.90 falls in low vulnerable slide zones.

3.15.7.3 Chakabama – Zunheboto Road

The project road stretches falling in various categories of Vulnerability of Slides for Chakabama – Zunheboto Road are as detailed below.

Category-I- The area/alignment between km 4.70-5.30, 8.65-8.75, 9.35-9.85, 9.85-9.95, 9.95-10.25, 11.10-11.25, 12.25-12.30, 13.70-13.85, 16.35-16.50, 17.40-18.10, 18.15-18.30, 20.25-20.50, 21.50-21.55, 21.90-22.85, 23.30-23.90, 24.00-24.20, 24.20-24.27, 25.00-25.255, 25.550-26.30, 27.25-27.30,33.0-33.15, 33.30-33.50, 33.50-33.80, 47.05-47.20, 48.37-48.625, 52.50-52.75,56.50-56.60, 56.70-56.80, 61.50-61.70, 71.40-72.00, 72.10-72.35, 72.60-72.75, 73.00-73.40, 75.00-75.30, 75.35-76.00, 76.25-76.35, 79.15-79.30, 82.15-82.30, 84.80-85.10, 98.80-99.05, 99.05-99.25, 100.30-100.50, 111.00-111.05, 113.40-113.60, 113.75-113.90 falls in highly vulnerable slides.

Category-II- The area/alignment between km 0.70-1.00, 5.50-5.85, 8.45-8.55, 13.15-13.30, 13.95-14.05, 16.65-16.75, 18.10-18.15, 20.50-21.30, 21.65-21.75, 27.715-27.25, 27.45-27.75, 27.75-28.00, 29.60-29.96, 36.40-36.50, 38.25-38.74, 38.74-39.35, 47.20-47.50,49.235-50.50, 60.20-60.55,60.60-60.90, 64.475-64.80, 66.10-66.50, 67.50-67.75, 72.35-72.50, 73.45-74.30, 77.30-78.10, 78.10-78.542, 79.60-79.80, 80.10-80.50, 82.30-82.755, 83.18-83.70, 83.80-85.155, 88.50-90.00, 90.15-90.25, 96.10-96.65, 102.40-102.60, 111.30-114.70, 114.00-114.05, 114.10-114.40, 114.40-115.00, 115.00-116.50 falls in medium vulnerable slides.

Category-III- The area/alignment between km 2.40-2.80, 4.10-4.70, 7.60-8.15, 8.15-8.45, 8.75-9.10,9.10-9.15, 12.50-12.80, 14.32-14.60, 15.10-15.25, 15.25-15.95, 16.00-16.30, 17.15-17.65, 18.30-18.85, 19.10-20.25, 21.30-21.40, 23.90-24.00, 25.255-25.550, 26.85-27.15, 28.24-28.40, 43.60-44.10, 56.05-56.35, 68.40-69.00, 70.30-70.35, 101.7-101.9, 102.7-102.95 falls in low vulnerable slides.

3.15.7.4 Pfutsero – Phek Road

The project road stretches falling in various categories of Vulnerability of Slides for Pfutsero – Phek Road are as detailed below.

Category-I- The area/alignment between km 2.70-2.85, 3.70-4.05, 4.40-4.53, 5.60-5.75, 5.90-6.10, 6.63-6.65,7.10-7.30, 7.80-8.20, 11.25-11.75, 12.75-12.85, 13.70-13.80, 21.00-21.20, 26.70-27.15, 28.60-28.80, 28.80-28.90, 34.65-35.00, 36.20-36.55, 55.55-55.62, 55.94-56.03, 56.03-56.32, 59.09-59.12 falls in highly vulnerable slides.

Category-II- The area/alignment between km 0.00-0.60, 2.55-2.70, 3.30-3.70, 4.15-4.27, 6.35-6.56, 6.85-7.10, 8.64-9.55, 9.55-9.60, 10.20-10.52, 12.50-12.75, 13.90-14.50, 17.30-17.65, 17.65-17.80, 19.05-19.40, 19.40-19.50, 19.70-19.80, 20.30-20.50, 21.30-21.50, 21.50-21.70, 21.95-23.70, 25.50-26.15, 27.40-27.80, 27.80-28.35, 28.580-28.60, 28.90-29.20, 34.50-34.55, 36.55-37.00,41.00-41.55, 41.55-43.90, 46.80-48.00, 53.00-53.42, 54.40-55.42, 57.50-57.70, 60.45-60.48, 60.50-61.20, 62.48-62.65 falls in medium vulnerable slides.

Category-III- The area/alignment between km 0.60-1.50, 2.40-2.55, 3.10-3.30, 4.53-5.10, 10.52-10.90, 15.50-15.65, 15.65-17.20, 17.80-18.15, 18.50-18.70, 19.82-19.90, 20.10-20.30, 29.20-29.40, 30.53-33.10,33.10-34.30, 35.60-35.90, 35.90-36.25, 37.000-40.20, 45.95-46.80, 46.20-52.00, 52.00-52.18, 52.30-53.00, 57.70-58.50, 58.50-58.65, 58.85-59.095, 63.80-64.50 falls in low vulnerable slides.

3.15.8 Type of Failures and Problems

Those sections / Chainage which are not discussed above are seems to be stable & no any major problem has been anticipated and hence not mentioned in the above table- 01 & 02.

Based on field observations and traverse studies, it has been found that the following are the main types of the failures / problems generally recorded along both the alignment:

3.15.8.1 Rotational / Circular Failures

The sliding of material along a curved surface called a rotational slide. These are of two types: circular and non-circular. While failures of this type do not necessarily occur along a purely circular arc, some form of curved failure surface is normally apparent. Circular shear failures are influenced by the size and the mechanical properties of the particles in the soil or the rock mass.

Figure below illustrates a typical circular shear failure. This failure can occur in rock structures that exhibit no plane of weakness, and may not be associated with any underlying critical discontinuity. In general, circular failures are associated with homogeneous soil conditions and non-circular slips with non-homogeneous conditions.

A circular failure occurs when the individual particles in soil or rock mass are very small as compared to the size of the slope. The broken rock in a fill tends to behave as soil and fail in a circular mode, when the slope dimension is substantially greater than the dimension of the rock fragments. Highly weathered rocks, and rocks with closely spaced, randomly oriented discontinuities such as rapidly cooled basalts also tend to fail in this manner. If soil conditions are not homogeneous or if geologic anomalies exist, slope failures may occur on non-circular shear surfaces.

Such type of failures is quite common along Project Roads particularly where in slope materials consists of slope debris material and weathered shale.

Some of the major failures of this type are recorded between km 5.0 to 5.2, 7.7 to 7.8, 8.54 to 8.6, 19.40 to 19.90, 41.00, 44.2, 77.00, 79.00, 85.15, 90.15 & 92.20 on Merangkong Tamlu Mon Road, from km 5.50 to 5.60, 6.60 to 6.85 and along Changtongya - Longleng Road; km 9.35 to 9.85 to 9.95, 79.15 to 79.30, 80.10 to 80.50, 82.15 to 82.30, 83.18 to 83.70, 113.73 to 113.7 along Chakabama – Zunheboto Road and from km 0.60 to 1.50, 3.10 to 3.30, 4.40 to 4.53, 5.60 to 5.75, 6.63 to 6.65, 12.75 to 12.85, 17.65 to 17.80, 19.7 to 19.8, 28.80 to 28.90, 28.90 to 29.20 along Pfutsero Phek Road.

3.15.8.2 Plane Failures

A rock slope undergoes this mode of failure when combinations of discontinuities in the rock mass form blocks or wedges within the rock which are free to move. The pattern of the discontinuities may be comprised of a single discontinuity or a pair of discontinuities that intersect each other, or a combination of multiple discontinuities that are linked together to form a failure mode.

The favorable conditions of plane failure are as follows:

- The dip direction of the planar discontinuity must be within ($\pm 20^0$) of the dip direction of the slope face.
- The dip of the planar discontinuity must be less than the dip of the slope face.
- The dip of the planar discontinuity must be greater than the angle of friction of the surface.

The study of planar failure mechanism provides insight knowledge of the behavior of rock slopes, and is particularly valuable for investigating the sensitivity of slope behaviour to variations in parameters such as shear strength of failure surfaces and groundwater conditions.

A planar failure of rock slope occurs when a mass of rock in a slope slides down along a relatively planar failure surface. The failure surfaces are usually structural discontinuities such as bedding planes, faults, joints or the interface between bedrock and an overlying layer of weathered rock. Block sliding along a single plane (Figure below) represents the simplest sliding mechanism. Figure below also details a three dimension representation of such a type of failure. In case of a plane failure, at least one joint set strike approximately parallel to the slope strike and dips toward the excavation slope and the joint angle is less than the slope angle.

Many dip slope failures are ascribable to strain incompatibility between materials of contrasting permeability or stiffness, such as sandstone and shale.

Plane failures are quite common along both the alignments particularly in slope debris material & bed rock transition zones and sections where the alignment is running parallel to the strike of strata with dip towards slope.

Some of the major failures of this type are recorded between 3.2 to 3.3, 6.5 to 7.1, 10.00 to 10.10, 10.40 to 10.90, 18.60 & 62.77 on Merangkong Tamlu Mon Road and km 4.90 to 5.025, 5.70 to 5.90, 15.60 to 16.05, 16.45 to 16.85, 31.80 to 33.00 on Changtongya – Longleng Road; km 27.75 to 28.00, 75.35 to 75.60, 77.30 to 78.10, 82.15 to 82.30, 83.18 to 83.70, 83.8 to 84.155, 102.40 to 102.60, 114.10 to 114.4 on Chakabama – Zunheboto Road and km 6.85 to 7.10, 8.64 to 9.60, 11.25 to 11.75 on Pfutsero - Phek Road.

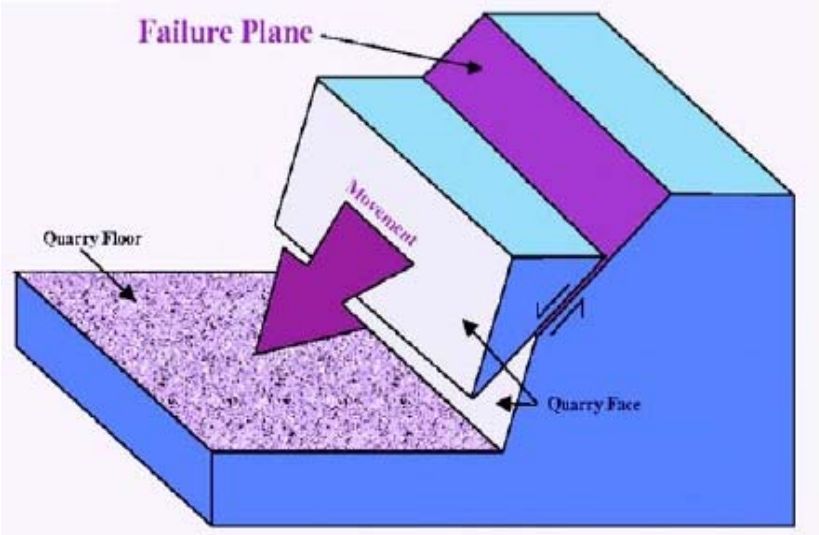


Figure 3-28: 3D view of plane failure along single discontinuities

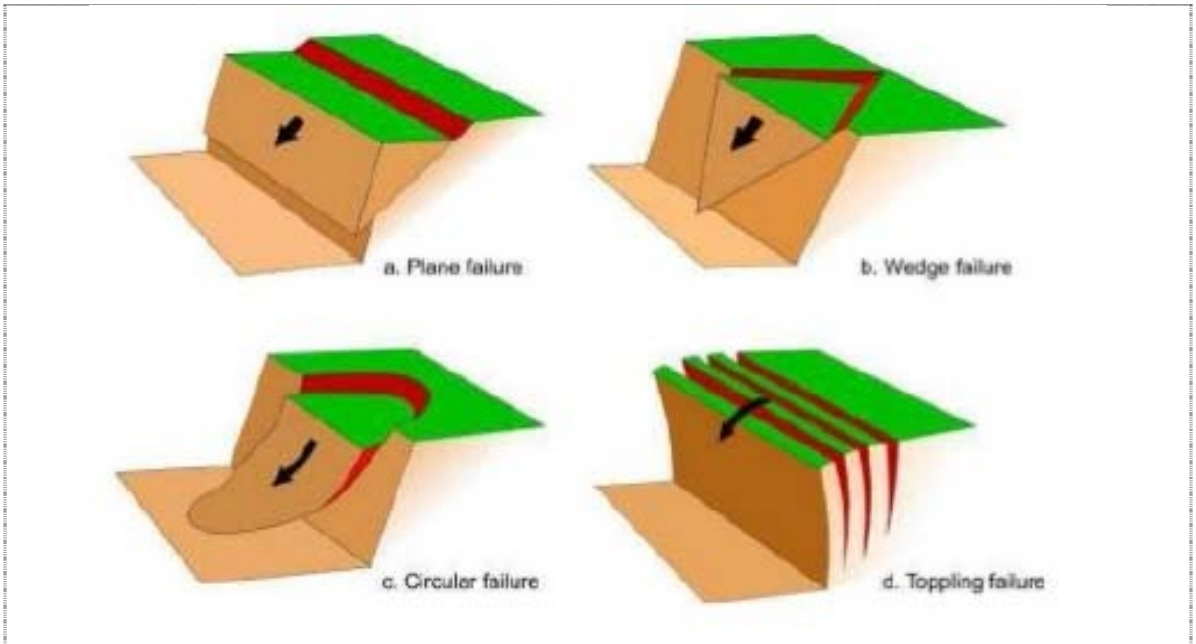


Figure 3-29: 3D view of plane failure along single discontinuities

3.15.8.3 Wedge Failures:

Wedge failure of rock slope results when rock mass slides along two intersecting discontinuities, both of which dip out of the cut slope at an oblique angle to the cut face, thus forming a wedge-shaped block (Fig: 11 (c), 12 & 13). Wedge failure can occur in rock mass with two or more sets of discontinuities whose lines of intersection are approximately perpendicular to the strike of the slope and dip towards the plane of the slope. This mode of failure requires that the dip angle of at least one joint intersect is

greater than the friction angle of the joint surfaces and that the line of joint intersection intersects the plane of the slope.

Depending upon the ratio between peak and residual shear strength, wedge failure can occur rapidly, within seconds or minutes, or over a much longer time frame in the order of several months. The size of a wedge failure can range from a few cubic meters to very large slides from which the potential for destruction can be enormous. The formation and occurrence of wedge failures are dependent primarily on lithology and structure of the rock mass. Rock mass with well-defined orthogonal joint sets or cleavages in addition to inclined bedding are generally favorable situations for wedge failure. Shale and sandstone tend to be more prone to wedge failure development than some other rock types. However, lithology alone does not control development of wedge failures. Fig: 12 & 13 shows a typical geometry of wedge failure and photograph obtained in field. The necessary structural conditions for this failure are summarized as follows:

- The trend of the line of intersection must approximate the dip direction of the slope face.
- The plunge of the line of intersection must be less than the dip of the slope face. The line of intersection under this condition is said to daylight on the slope.
- The plunge of the line of intersection must be greater than the angle of friction of the surface.

The wedge failures are quite common along both alignments particularly in sandstone dominant zone where the rock mass is traversed by three to four sets of joints. Some of the major failures of this type are recorded between and km 3.8 to 4.0, 4.10 to 4.15, 5.3, 6.9 to 7.1, 75.40 & 86.66 on Merangkong Tamlu Mon Road; km 1.60 to 1.75, 4.90 to 5.025, 5.50 to 5.60, 23.60 to 23.90 on Changtongya-Longleng Road; km 8.15 to 8.45, 75.35 to 75.60, 77.30 to 78.10, 82.15 to 82.30, 83.18 to 83.70, 113.75 to 113.90, 114.10 to 144.40 on Chakabama - Zunheboto Road and km 2.55 to 2.70, 2.70 to 2.75, 7.80 to 8.20, 20.10 to 20.30 on Pfutsero - Phek Road.

3.15.8.4 Failures due to improper berm width and lack of proper arrangement for drainage system:

circular failures and planes failures are mainly associated with this type of problem and some areas where failures have been resulted due to this type of problem are 4.225 to 5.90, 6.60 to 6.85, 22.90 to 22.95, 23.05 to 23.25 and 3.55, 4.1, 34.30 to 34.40, 58.50, 63.95 & 82.95 to 83.15 etc. For details, refer the table-01 & 02 above.

circular failures and planes failures are mainly associated with this type of problem and some areas where failures have been resulted due to this type of problem are 17.30 to 17.65, 25.50 to 26.15, 27.80 to 28.35 & 8.65 to 8.75, 9.95 to 10.25, 12.25 to 12.30, 18.15 to 18.30, 24.20 to 24.27, 27.25 to 27.30, 29.80 to 29.96, 33.00 to 33.15 etc. along Pfutsero - Phek section & Chakabama - Zunheboto section respectively.

3.15.8.5 Failures due to Unsystematic Query of stones:

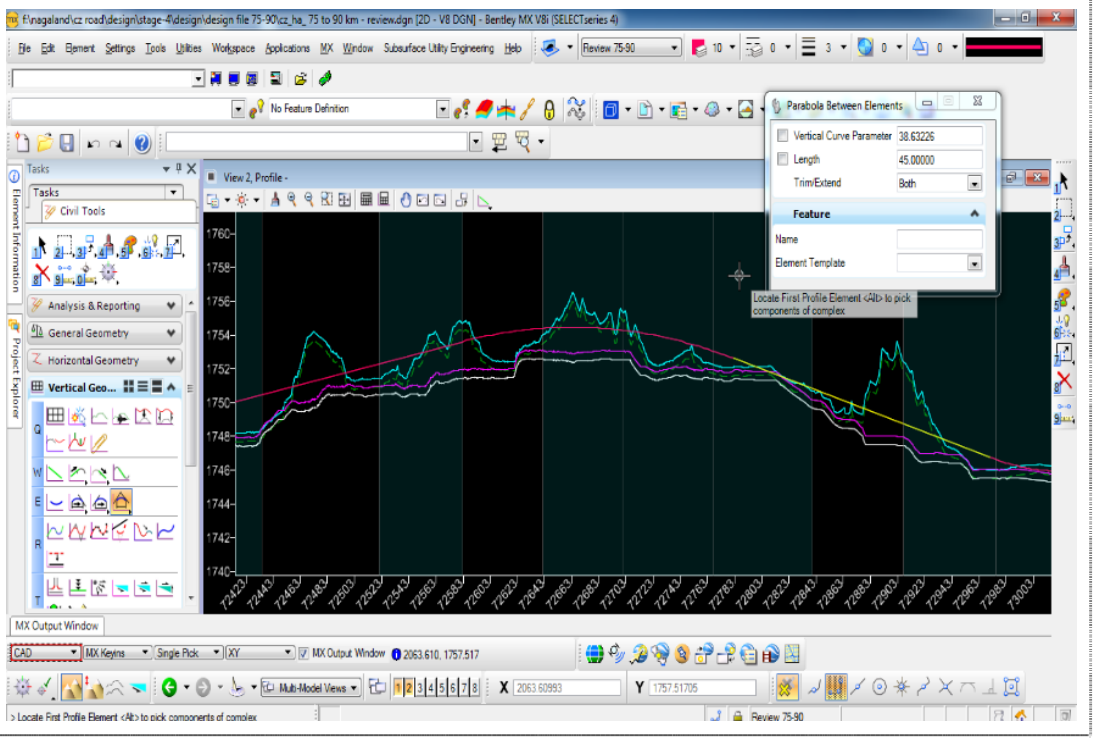
The failures occurred due to this reason are mainly plane failures, wedge failures in bed rock and circular failures in overlying slope debris material. Some of the locations where this type of problem is prominent are km 5.70 to 5.90, 23.60 to 23.90, 26.00 to 26.50 and 1.70, 3.50 to 3.55 & 88.00 etc. For details, refer the table-01 & 02 above.

The failures occurred due to this reason are mainly plane failures, wedge failures in bed rock and circular failures in overlying slope debris material. Some of the locations where this type of problem is prominent are km 4.15 to 4.27, 17.80 to 18.15, 20.30 to 20.50 & 67.50 to 67.75, 68.40 to 69.00, 70.30 to 70.35, 72.35 to 72.50, 78.10 to 78.542, 83.70 to 83.80, 102.40 to 104.60 etc. along Pfutsero - Phek section & Chakabama - Zunheboto section respectively

Those sections / Chainage which are not discussed above are seems to be stable & no any major problem has been anticipated and hence not mentioned in the provided tables.

Chapter 4

Improvement Proposal



Chapter 4 Improvement Proposal

4.1 Improvement Proposals

The Ministry of Road Transport & Highways has initiated Mega Road Development Programme in North East with name ***'Special Accelerated Road Development Programme in North East (SARDP-NE)'***. The Present Project is part of *'district head quarter connectivity' under SARDP-NE*. As it is envisaged, under the program, to develop existing single / intermediate lane carriageway configuration to 2-lane with paved shoulders carriageway configuration in order to all weather connectivity to ensure smooth speed of travel with comfort and safety, the **Project Road have been proposed and designed to have provisions compatible with National Highway Standard in accordance with Indian Roads Congress Guidelines**.

The improvement proposals for up-gradation of existing single/intermediate/two lane carriageway facility of project roads to 2-lane with paved shoulders carriageway configuration have been proposed and detailed in following paragraphs. The proposed improvement proposals are based on findings from *Engineering Survey & Investigations* and Project Roads Salient features. The proposed improvement would thus have better performance and advantages viz. smooth and fluent geometry (horizontal & vertical), Deletion of substandard geometry and Liberty in construction of new carriageway and pavement

During detailed inventory of roads & pavement and topographic surveys, efforts have been made to identify the critical sections such as sub-standard geometrics, sharp horizontal curves, steep gradients, sub-standard structures, sub-standard drainage, protection works and major junctions to propose a cost-effective proposal of 2-lane carriageway configuration road to the National Highway standards. Further it is important to note that unplanned, haphazard and unnecessary excavation of hills and hence disposal of excavated materials on valley side all along project roads, during construction contract, has resulted

- in choking of existing drainage system, which was already highly inadequate, resulting in excessive buildup to pore water pressures, hence aggravating landslides.
- Piling of excavated materials along existing Valley line has resulted in creation of apparent valley line which is highly unstable and adds to momentum of moving soil mass resulting in landslides
- existing hill slopes have been cut and exposed to extent of their existing heights which range from 10 to 50 m or more. Proposals for assessing preventive measures for slope stability would be impracticable and uneconomical for such high heights.

Improvement proposals for a Highway essentially consist of two components, Geometric and Structural.

Geometric improvement deals with visible dimensions of roadway and is dictated by Traffic and Economic considerations. Geometric design involves several design elements such as horizontal and vertical alignments, sight distance considerations, cross sectional elements, lateral and vertical clearances and intersection treatment etc. The **structural component** deals with the pavement, embankment, and drainage structure design aspects, i.e., the ability of the highway to adequately carry and support the vehicle/ wheel loads over the design period.

The improvement proposals for proposed widening to 2-lane configuration with paved shoulders system include provisions for following major items:

- **Alignment Improvements proposal;**
  - Geometric Improvement Proposal;
  - Realignment Proposal; and
  - Widening Improvement;
- **Pavement Construction Improvement Proposal;**
  - Rehabilitation; and
  - Reconstruction/New Construction and

- **Junction Improvement Proposal**

  Major Junctions; and

  Minor Junctions;
- **Bridges Improvement Proposal;**
- **Culverts Improvement Proposal;**
- **Longitudinal Drainage Improvement Proposal;**
- **Protection Works Improvement Proposal;**
- **Slope Stability and Land Slide Preventive measures; and**
- **Road Appurtenances;**

4.2 Improvement Proposal for Alignment of Project Roads

All project roads traverses through Mountainous to Steep terrain having single lane/intermediate/2 lane carriageway configuration. Detailed study terrain along existing project road alignment was carried through topographic surveys. In general observations on alignment components Horizontal and Vertical are as below.

4.2.1 Existing Horizontal Alignment

Existing Project Roads have **substandard Horizontal Geometry** which,

- in general possess Curves with radius less than absolute minimum radius of 30 m;
- is having Curve Length less than minimum Curve Length required as per IRC Standards for attainment of Super Elevation; and
- is having Straight Length less than minimum Straight length required as per IRC Standards for attainment of Super Elevation.

4.2.2 Existing Vertical Alignment

Existing vertical geometry at certain location is extreme at certain locations on project roads having Gradients steeper than exceptional gradient greater than 8% for a length of 100 m

Gradients along existing project roads are not in compliance with relevant IRC Specifications for Merangkong Tamlu Mon Road and Changtongya Longleng Road. The Km wise summary of gradients as up to ruling (6%), Limiting (6 -7%), Exceptional (7-8%) and Beyond Exceptional (>8%) has been worked out for these two project roads viz. Merangkong Tamlu Mon Road and Changtongya Longleng Road, wherein vertical geometry is having shortfalls w.r.t. IRC standards. The details have been presented in Chapter 3 of Volume II Design Report Part I Road Features.

Existing vertical alignment on other two project roads viz. Chakabama Zunheboto Road and Pfutsero Phek Road generally meets relevant IRC Specifications and hence analysis is not presented.

4.2.3 Existing Hair Pin Bends

Further, **existing geometry at all Hair Pin Bends** is having

- horizontal radius less than minimum radius of 14.5 for inner edge;
- Vertical Gradients steeper than 2.5%

4.2.4 Methodology for Alignment Geometric Design

Geometric Design of project roads has been carried out in accordance with criteria detailed in Chapter for Design Standards.

Alignment improvement proposals has been designed by procedure detailed as below:

Step 1:

- Horizontal alignment has been traced along existing alignment corridor by keeping absolute minimum lengths for horizontal alignment elements (Tangent and Curves).

- Carrying out indicative Vertical Alignment Design along above designed horizontal alignment.

Step 2:

- Now, Project Road Stretches having gradients more than exceptional gradients, the Horizontal Alignment has been reworked by proposing geometric improvement / Realignment. These geometric improvement / realignment corridors are having entirely new alignment corridor.

Proposed alignment has been designed in such a way to fulfill all horizontal & vertical standards with minimum cutting & filling to economize construction cost with a combination of allowable combination of exceptional and ruling gradients as per relevant IRC Specifications.

With due consideration to various existing constraints and above detailed inherent problems in existing geometry, the consultants has proposed various geometric improvement / realignments proposals along different project road sections, which have been designed to suit National Highway standards as well the proposed alignment geometry would be more fluent and aesthetic.

4.2.5 Alignment Improvement Proposal

Project Roads alignment has been designed using Bentley Mx Roads V8i Select Series 4 Version by creating digital terrain model of existing ground features captured during Topographic Surveys of Project Roads.

The details of designed project length after proposed improvements as per IRC Standards keeping in view existing terrain conditions is presented in table below.

Table 4-1: Alignment Improvement Proposal: Summary of Project Road Lengths

S. No.	Name of State Road	Length (km) as per ToR	Actual Length at Site (km)	Proposed Project Road Length (km)	Road Length in Tangents (km)	Road Length in Curves including Spirals (km)
1	Merangkong – Tamlu – Mon Road (M T M Road)	100	98.1	86.8	31.2	55.6
2	Changtongya – Longleng Road (C L Road)	35	29.53	38.5	19.1	19.4
3	Chakabama – Zunheboto Road (C Z Road)	128	121.2	115.5	29.5	86.0
4	Pfutsero – Phek Road (P P Road)	66	65.3	62.6	10.7	51.9
	Total	**329**	**314.13**	**303.4**	**90.5**	**212.9**

4.2.6 Realignment Proposal for Project Roads

The realignment of Project Road alignments away from existing project corridor have been proposed based on absolute minimum alignment design criteria's and same have been submitted in our reports of Stage 3: Draft Project Report (Volume I to Volume III) in January 2015, August 2015 and November 2015). The Consultant has explained technical requirement for proposing of these realignments during various technical discussions held with Client Officials from October 2014. The Project Road wise Realignments Proposals, (w.r.t. existing Chainage) are

Merangkong – Tamlu – Mon Road

Realignment from km 60+400 to km 73+500

Changtongya – Longleng Road

Realignment from km 0+000 to km 4+930

Realignment from km 6+810 to km 16+585

Realignment from km 23+640 to km 28+545

Pfutsero Phek Road.

Realignment for Losami Village from km 49+935 to km 52+000

The Details have been presented in Chapter 3 of Volume II: Design Report, Part I Road Features.

4.2.7 Type of Improvement Proposal

Proposed Improvement for Project Roads is classified (w.r.t. existing alignment location) as

- Widening with Geometric Improvement on

  Left Side; Right Side and Concentric

- Realignments
- No Geometric Improvement.

The Summary of Improvement Proposal for all project roads is presented in table below.

Table 4-2: Project Roads Widening Proposals

Project Road	Widening With Geometric Improvement			Realignment	No Geometric Improvement
	LHS	RHS	Concentric		
Merangkong – Tamlu – Mon Road (M T M Road)	27830	41770	2800	10400	6035
Changtongya – Longleng Road (C L Road)	8070	2530	0	27900	0
Chakabama – Zunheboto Road (C Z Road)	35485	66075	9810	0	4165
Pfutsero – Phek Road (P P Road)	60558	1500	0	150	60558
Total	**131943**	**111875**	**12610**	**38450**	**70758**

4.2.8 Horizontal Alignment Details

The Plan of designed horizontal alignment for project roads has been presented in drawing folder submitted in Volume VIII: Drawings. The summary of number of horizontal curves along project road alignment for all project roads is presented in table below. As evident, the horizontal alignment design has been carried out keeping minimum radius of horizontal curve as more than 30m except for hair pin bend locations and in Mon, Chozuba and Zunheboto Town where in proposed horizontal alignment is tracing existing project road to avoid huge land acquisition.

Table 4-3: Summary of Number of Horizontal Curves

Radius (m)	Number of Horizontal Curves				Remarks
	Merangkong - Tamlu-Mon Road	Changtongya - Longleng Road	Chakabama - Zunheboto Road	Pfutsero -Phek Road	
< 21	0	0	0	0	
21 to 33	21	9	7	0	Hair pin bend
= 33	85	10	131	80	
33 to 41	60	10	91	47	
41 to 61	131	40	219	117	
61 to 101	185	73	312	169	
101 to 301	172	79	259	192	
> 301	25	15	24	26	
Total	**679**	**236**	**1043**	**631**	

4.2.9 Vertical Alignment Details

The Profile of designed Vertical Alignment for project roads has been presented in drawings folder submitted in Volume VIII: Drawings. The Summary of Vertical grades provided in designed vertical alignment is presented in table below.

Table 4-4: Summary of Number of Vertical Gradients

Project Road	Length (km)	
	Ruling Gradient (up to 6%)	Exceptional Gradient (7% – 8%)
Merangkong – Tamlu – Mon Road (M T M Road)	70.3	12.4
Changtongya – Longleng Road (C L Road)	32.4	6.3
Chakabama – Zunheboto Road (C Z Road)	107.3	3.8
Pfutsero – Phek Road (P P Road)	58.0	4.5

4.3 Typical Cross Sections

In terms with the detailed discussions held in design standards, the proposed Typical Cross Sections for project roads are

TCS I (a): TCS for project road sections in Hill / Valley locations

This Typical Cross Section includes following cross sectional elements

- Carriageway Width as 7.0 m;
- Paved Shoulder on Both Sides (Hill / Valley) = 1.5 m;
- Trapezoidal Random Rubble Masonry Drain on hill Side with base width of 0.3 m and depth varying from 0.5 m having thickness of masonry as 0.2 m.
- Slope Stability / Erosion Control Preventive Measures on Hill Side along with a Catch Water Drain in Top Most Cut Slope;
- Random Rubble Masonry Parapet wall on Valley Side;
- Total Roadway Width = 12.6 m

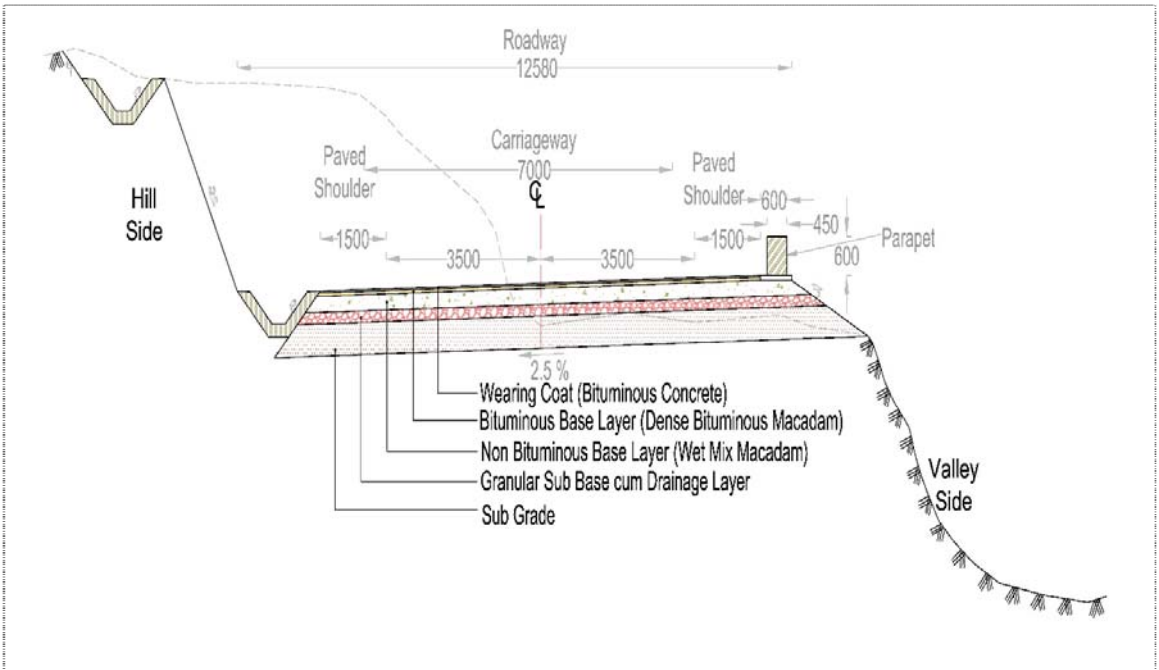


Figure 4-1: Typical Cross Section in Hill/Valley Locations, TCS I(a)

TCS I (b): TCS for Project Road Sections requiring Fill on Valley Side

This Typical Cross Section includes following cross sectional elements

- Carriageway Width as 7.0 m;
- Paved Shoulder on Both Sides = 1.5 m;
- Trapezoidal Random Rubble Masonry Drain on hill Side with base width of 0.3 m and depth varying from 0.5 m having thickness of masonry as 0.2 m.
- Slope Stability / Erosion Control Preventive Measures on Hill Side along with a Catch Water Drain in Top Most Cut Slope;
- Retaining / Reinforced Earth Wall on Valley Side with Parapet Wall;
- Total Roadway Width = 12.5 m

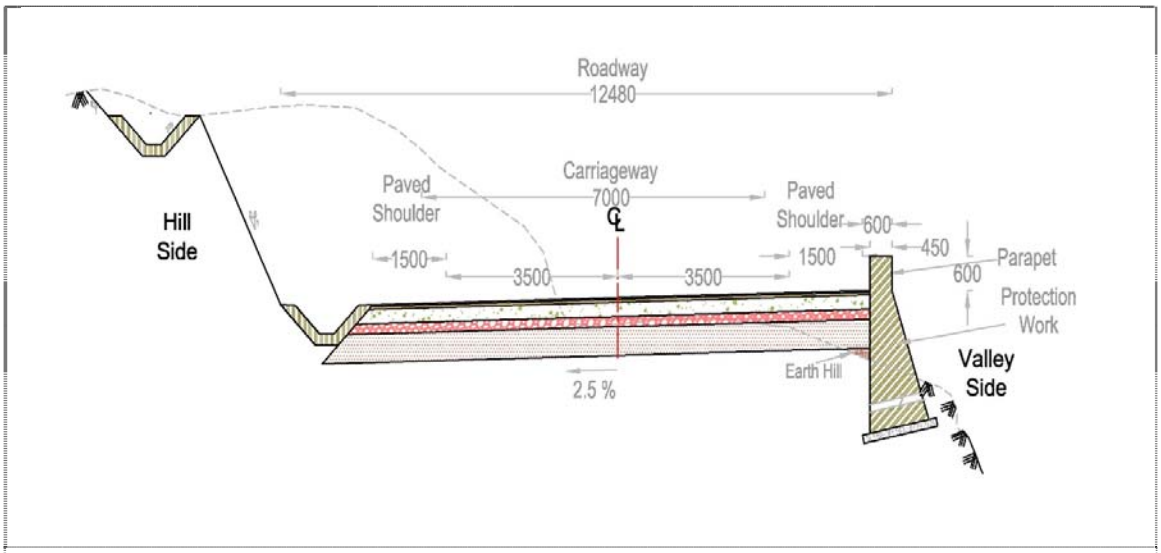


Figure 4-2: TCS for Project Road Sections requiring Fill on Valley Side TCS I(b)

TCS II: Typical Cross Section for project road section on ridge

This Typical Cross Section includes following cross sectional elements

- Carriageway Width as 7.0 m;
- Paved Shoulder on either Side = 1.5 m;
- Trapezoidal Random Rubble Masonry Drain on hill Side with base width varying from 0.3 m to 0.5 m and depth varying from 0.5 m to 0.6 m having thickness of masonry as 0.2 m.
- In general Height of Finished Road Level from ground is 1 m; and
- Total Roadway Width = 19 – 24 m.

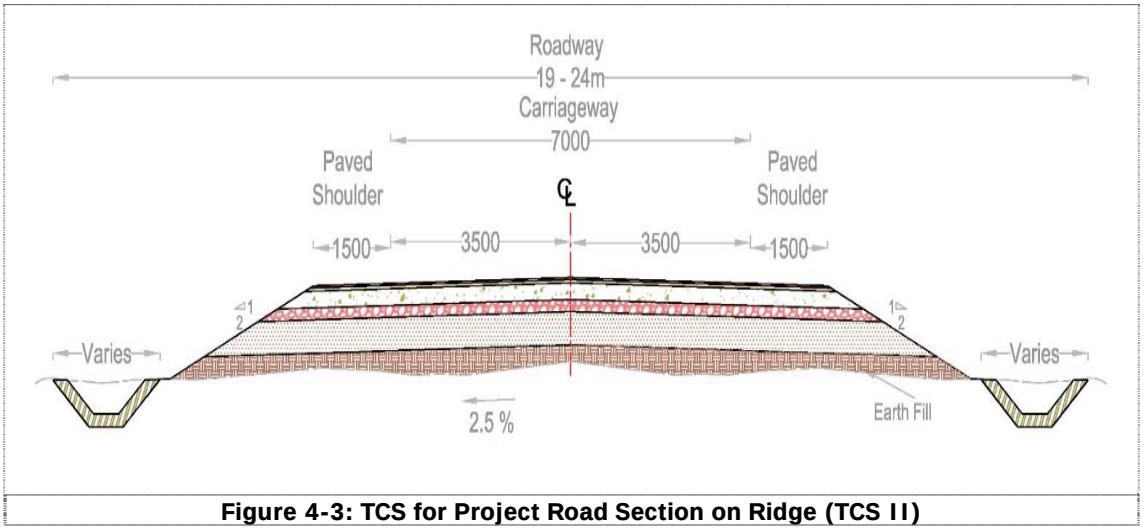


Figure 4-3: TCS for Project Road Section on Ridge (TCS II)

TCS III: TCS for Project Road Sections through Box Cut Locations

This Typical Cross Section includes following cross sectional elements

- Carriageway Width as 7.0 m;
- Paved Shoulder on either Side = 1.5 m;
- Trapezoidal Random Rubble Masonry Drain on hill Side with base with varying from 0.3 m to 0.5 m and depth varying from 0.5 m to 0.6 m having thickness of masonry as 0.2 m.
- Slope Stability / Erosion Control Preventive Measures on Hill Side along with a Catch Water Drain in Top Most Cut Slope;
- Total Roadway Width = 13.8 m;

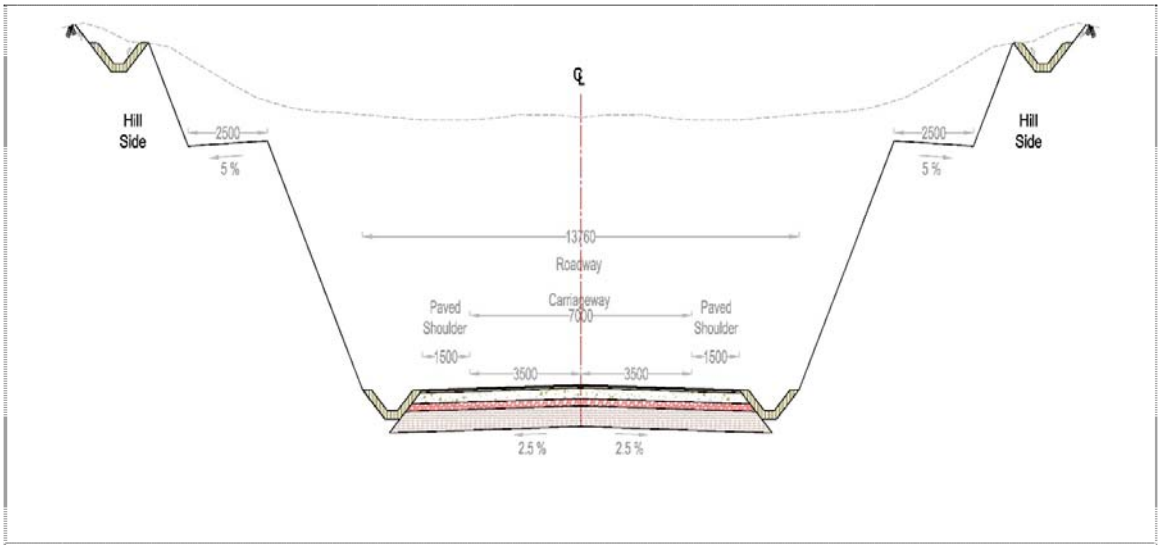


Figure 4-4: TCS for Project Road Sections through Box Cut Locations (TCS III)

TCS IV: Typical Cross Section for Project Road Section through Town with Hill Valley Combination

This Typical Cross Section includes following cross sectional elements

- Carriageway Width as 7.0 m;
- Paved Shoulder on Both Sides = 1.5 m;
- RCC Drain on hill side with Cover Slab;
- Street Lighting; and
- Total Roadway Width = 12.4 m

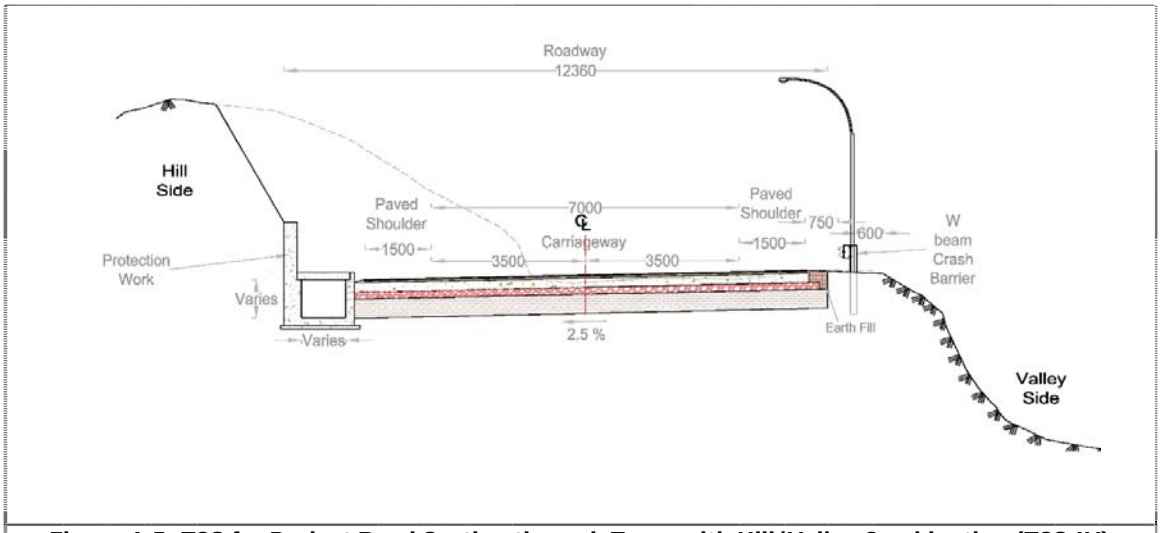


Figure 4-5: TCS for Project Road Section through Town with Hill/Valley Combination (TCS IV)

Type V: Typical Cross Section for Project Road Section through Town on Ridge

This Typical Cross Section includes following cross sectional elements

- Carriageway Width as 7.0 m;
- Paved Shoulder on either Side = 1.5 m;
- RCC Drain on hill side with Cover Slab on either side;
- Street Lighting in Staggered position ;
- Paver Blocks in available space between Paved Shoulder and (Building line – Drain Width)
- Total Roadway Width = 13 m

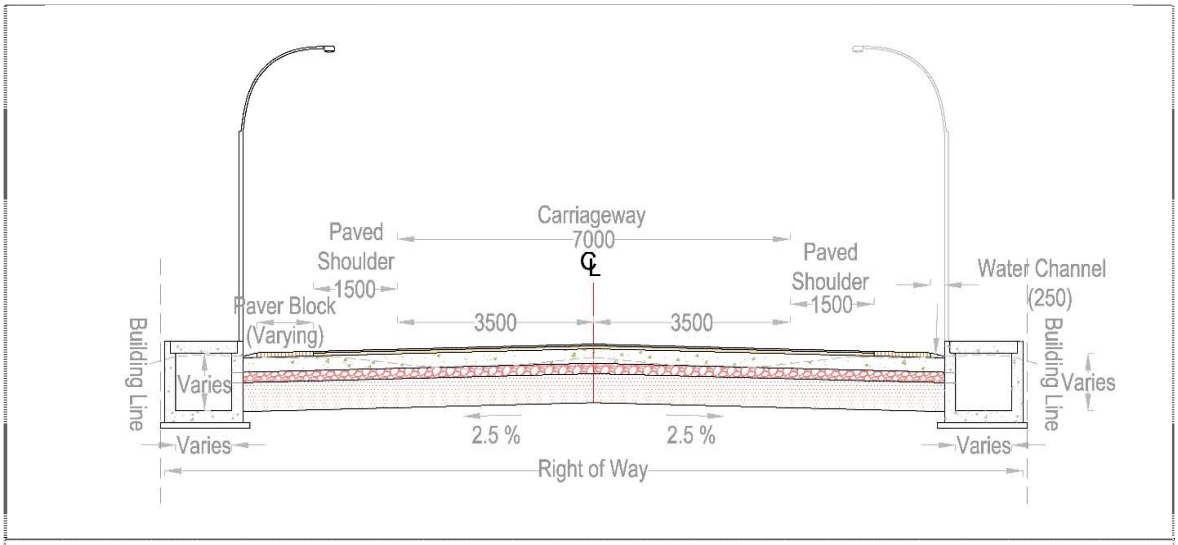


Figure 4-6: TCS for Project Road Section through Town on Ridge (TCS V)

The Summary of length of different type of cross sections along project roads is presented in table below.

Table 4-5: Summary of Length of Typical Cross Sections along Project Road (in km)

S. No.	Project Road	Type-I	Type-II	Type-III	Type-IV	Type-V	Bridge	Total
1	Merangkong-Tamlu-Mon Road	75.7	3.8	3.1	0.0	4.1	0.1	86.8
2	Changtongya-Longleng Road	34.9	0.5	2.3	0.7	0.0	0.1	38.5
3	Chakabama Zunheboto Road	105.4	0.8	1.3	3.2	4.6	0.2	115.5
4	Pfutsero-Phek Road	60.0	0.1	0.9	1.5	0.0	0.0	62.6
**Bridges having length more than 50 m (approach to approach) have been defined under Bridge in above table. Minor Bridges and Culverts locations have been taken in type of project road sections (Type I to Type V).*								

4.4 Improvement Proposal for Pavement

In accordance with Plates 4 to 6 of IRC 37 2012, it is proposed and recommended to provide a pavement layers for 5 msa and available effective CBR of 5%, 6% and 7% for existing subgrade materials. The details of pavement design are presented in chapter 4 of Volume II: Design Report. The Summary of pavement composition proposed for project roads is

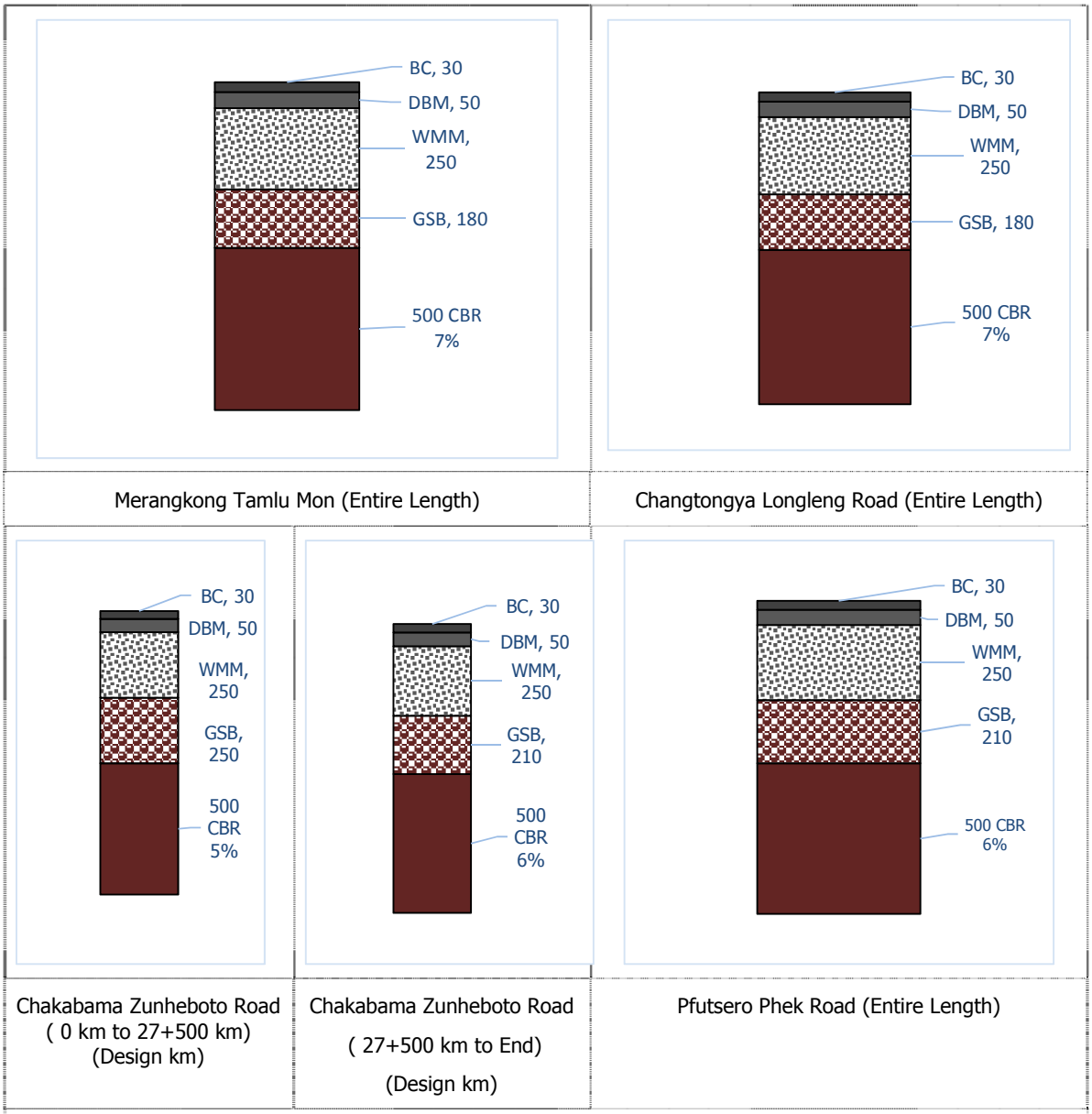


Figure 4-7: Pavement Crust for Project Roads (Thickness in mm)

4.5 Improvement Proposal for Junctions

All Project Roads originate from a Junction with National Highway 61 or 29. These Junctions would require improvement as At Grade Junction of Two National Highways in accordance with Type Design for Intersections on National Highways published by Ministry of Road Transport and Highways and available terrain and site specific constraints. The Proposed recommended Junction improvement have been submitted in Volume III: Drawings in August 2015. The same is reproduced in figures below.

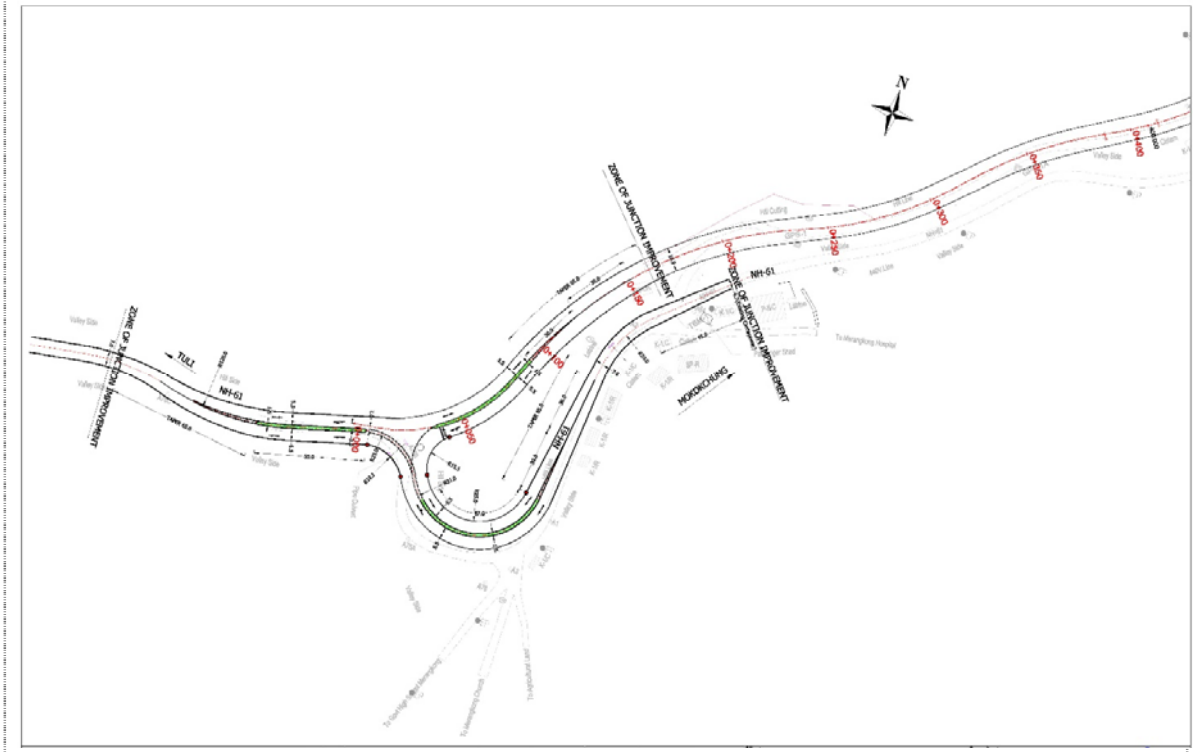


Figure 4-8: Junction Improvement Proposal for Junction with NH 61 and M T M Road at Km 0/000

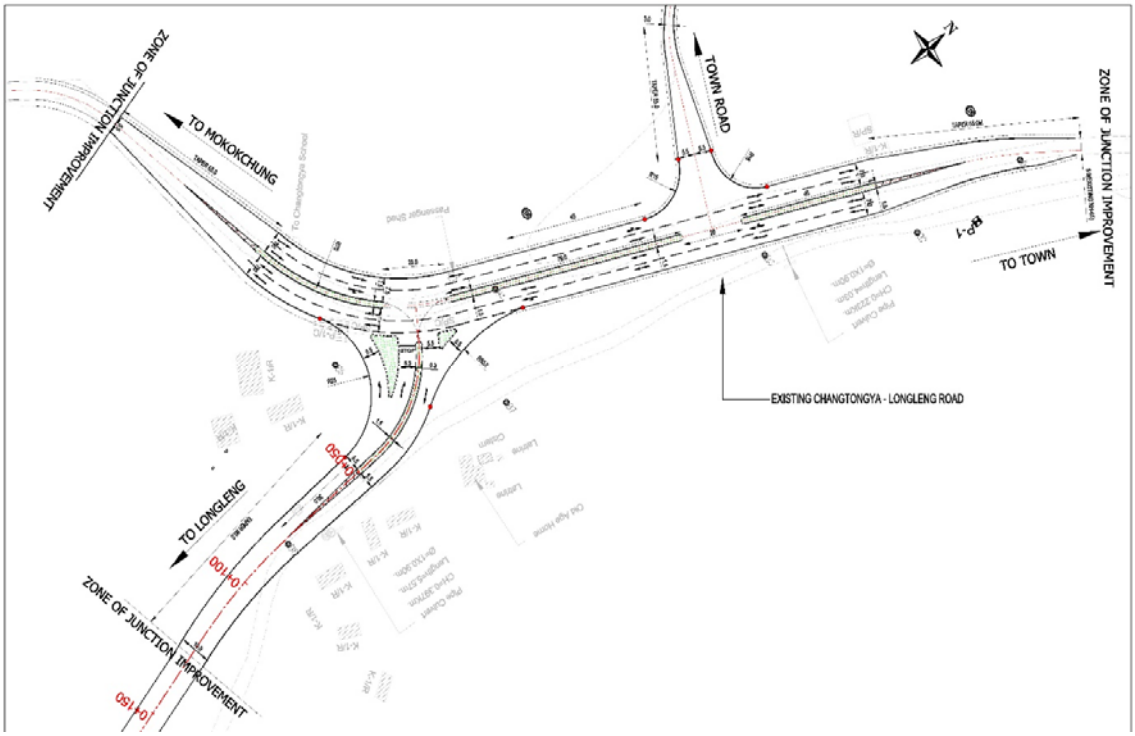


Figure 4-9: Junction Improvement Proposal for Junction with NH 61 and C L Road at Km 0/000

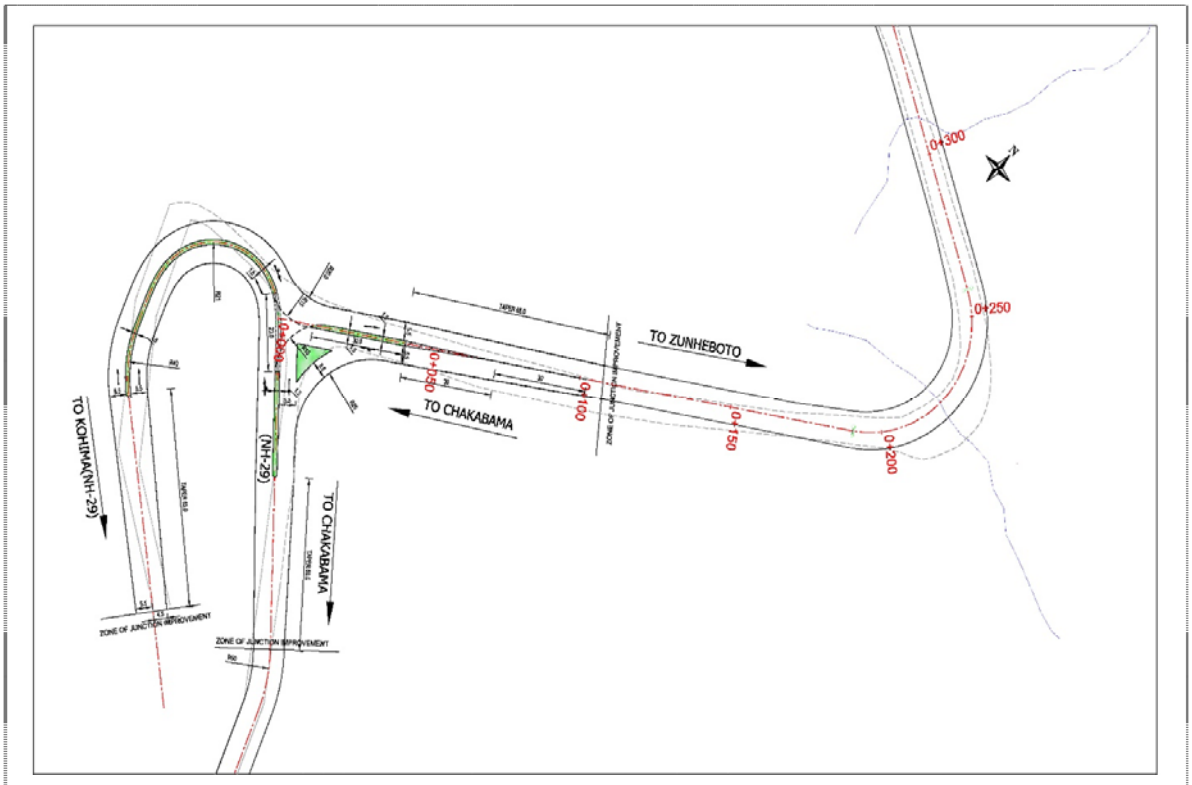


Figure 4-10: Junction Improvement Proposal for Junction with NH 29 and C Z Road at Km 0/000

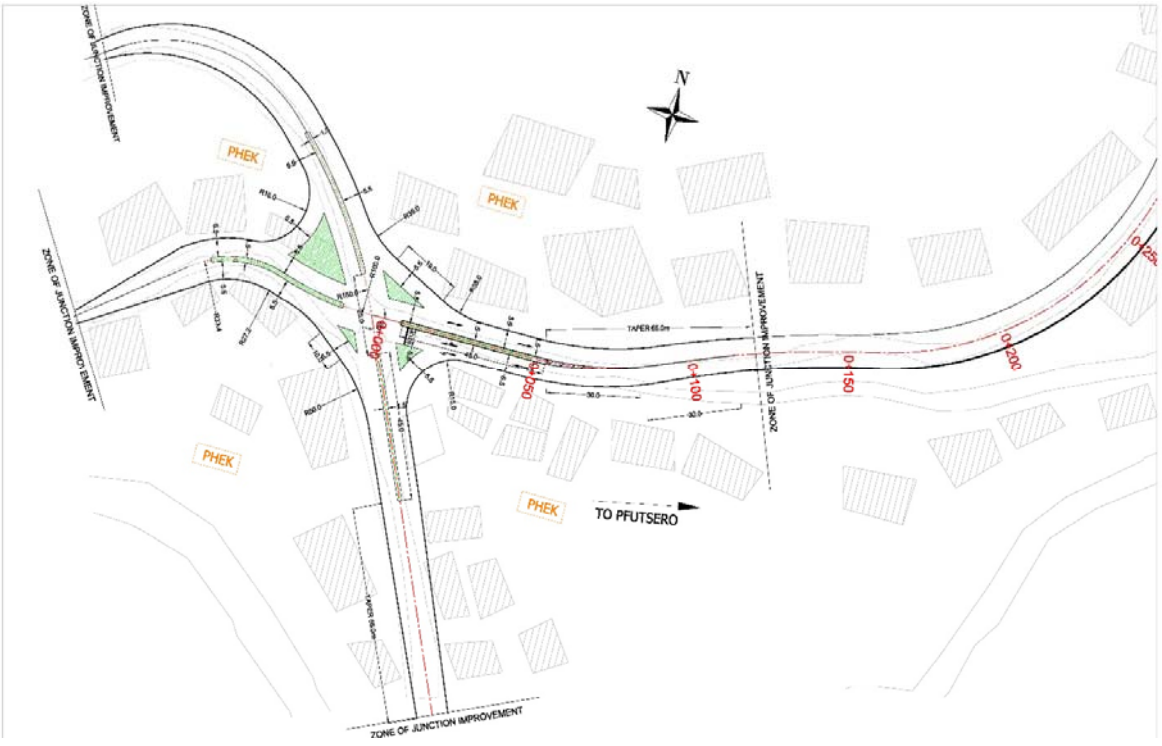


Figure 4-11: Junction Improvement Proposal for Junction with NH 29 and P P Road at Km 0/000

In addition to Originating Junction with National Highway(s), project road crosses / merges with existing State Highways. These locations would also require junction improvement as National Highway and State Highway crossing / offsetting improvement in accordance with Type Design for Intersections on National Highways published by Ministry of Road Transport and Highways. The proposed improvement for such locations on project roads is detailed below and junction improvement proposal is depicted in Figures below.

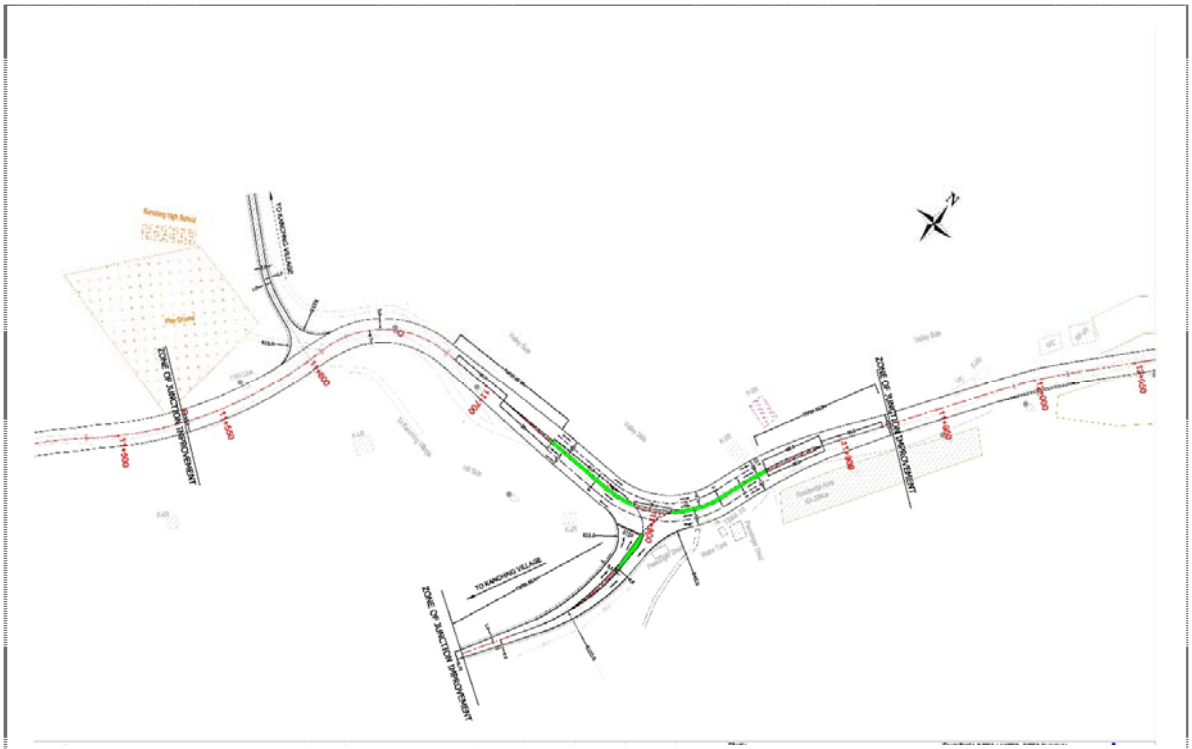


Figure 4-12: Junction Improvement at km 11+800 on M T M Road

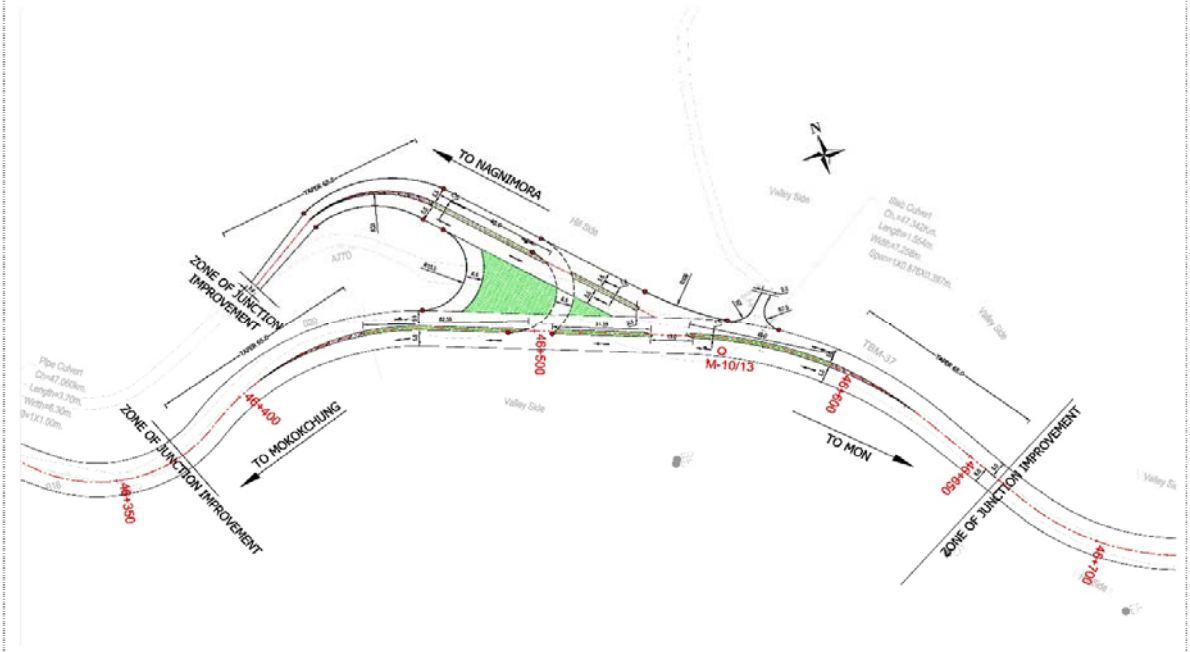


Figure 4-13: Junction Improvement at km 46+550 on M T M Road

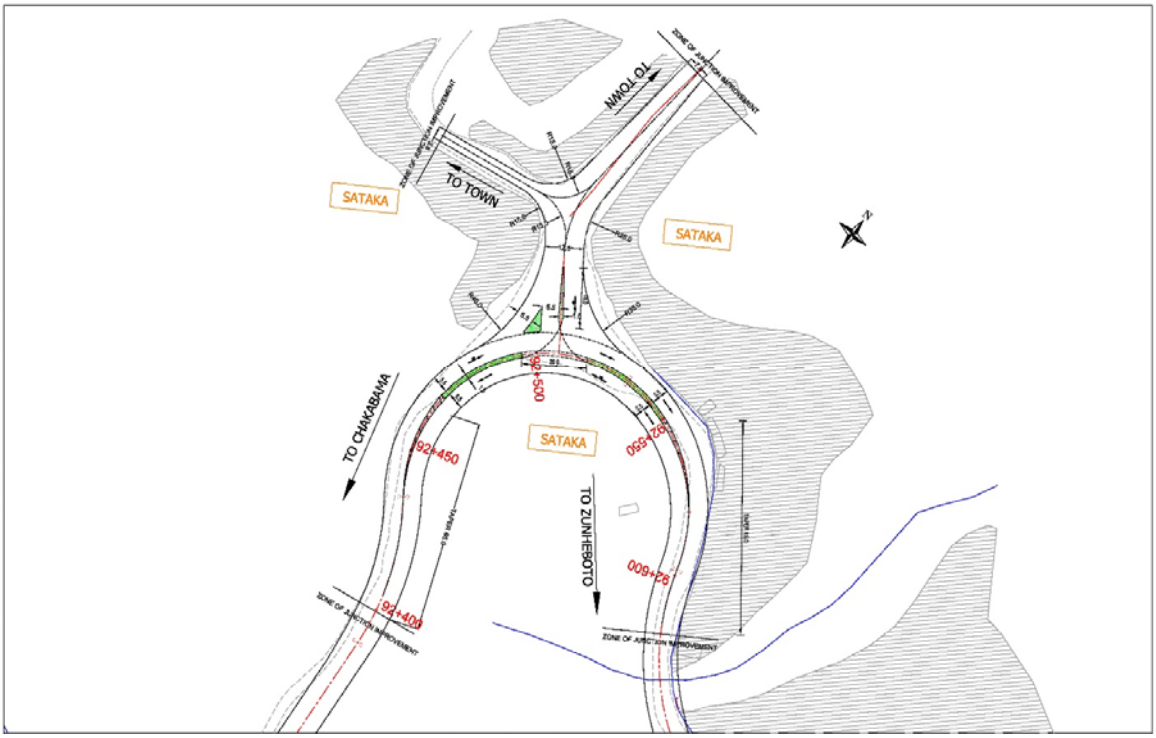


Figure 4-14: Junction Improvement at km 92+510 on C Z Road

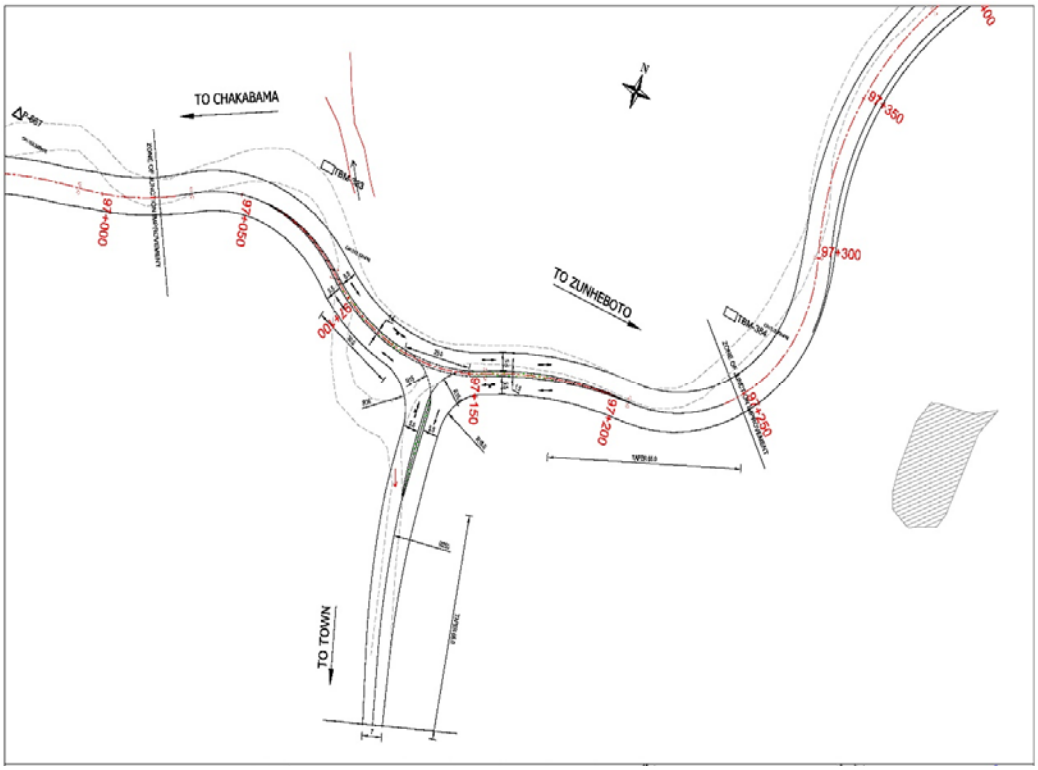


Figure 4-15: Junction Improvement at km 97+135 on C Z Road

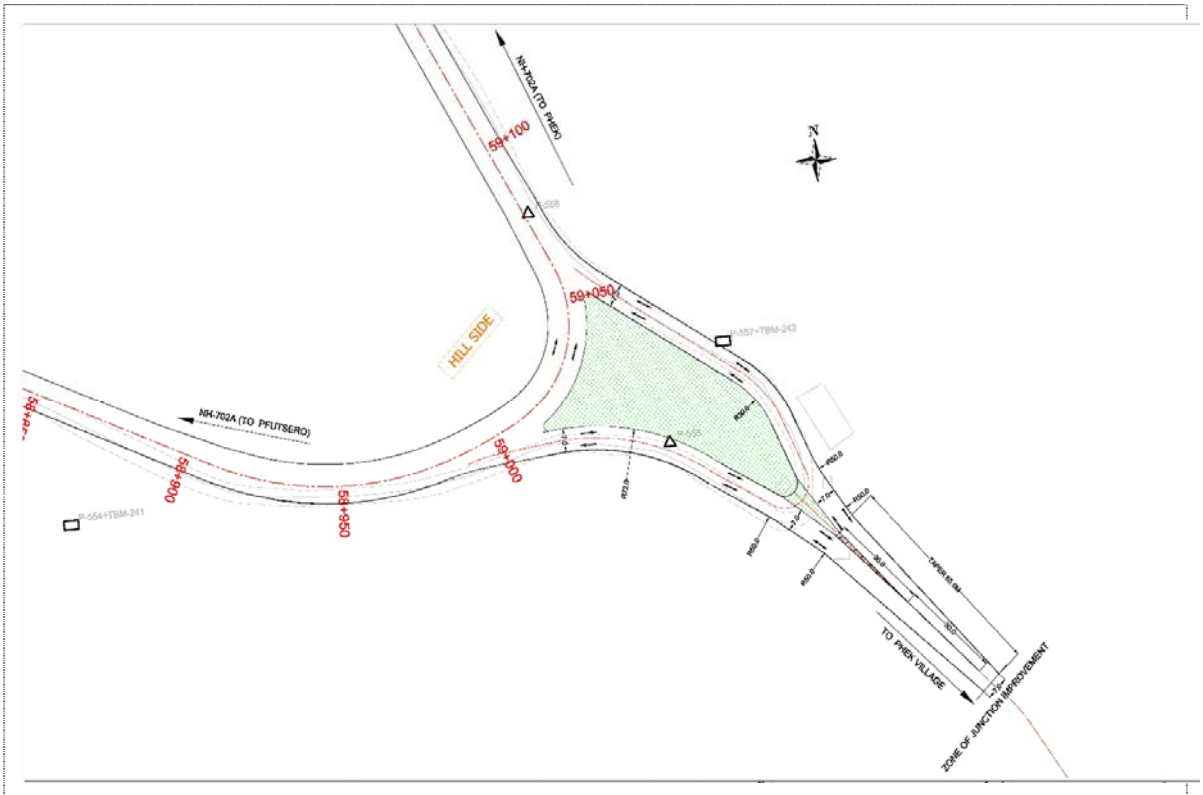


Figure 4-16: Junction Improvement at km 59+030 on P P Road

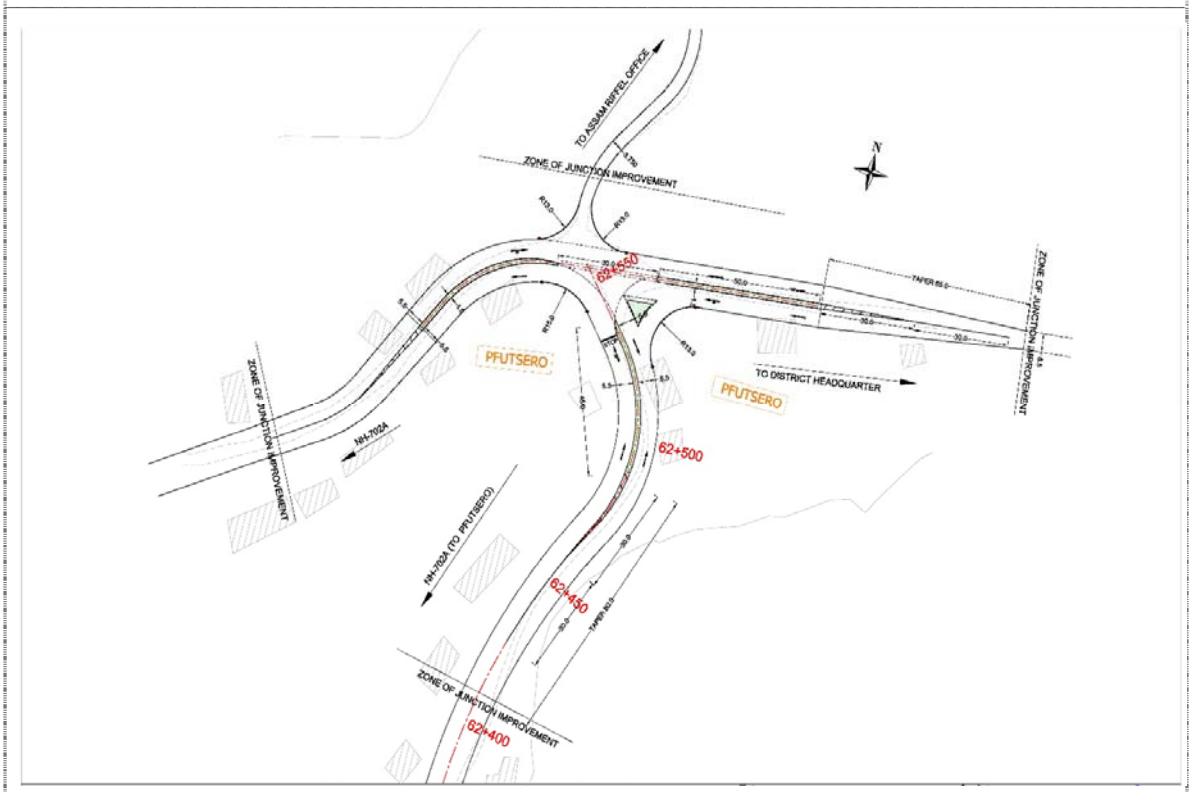


Figure 4-17: Junction Improvement at km 62+558 on P P Road

4.6 Improvement Proposal for Bridges

Improvement Proposal for Bridges has been classified in following types.

Table 4-6: Type of Bridges Proposed

Type	Description of Structure and Foundation	Span (meters)
Type I	RCC Slab + Open Foundation	1X8.0
Type II	RCC Slab + Open Foundation	1X10.0
Type III	RCC Voided Slab + Open Foundation	1X14.0
Type IV	RCC Voided Slab + Open Foundation	1x8.0+1x18.0+1x8.0
Type V	RCC Voided Slab + Open Foundation	1X18.0
Type VI	RCC Voided Slab + Open Foundation	1X20.0
Type VII	Steel Composite Girder + Open Foundation	1X23.0
Type VIII	Steel Composite Girder + Open Foundation	2X23.0
Type IX	Steel Composite Girder + Open Foundation	2X23.0+3X32.0

Project Road wise detail of improvement proposal for bridge is summarized as below

4.6.1 Merangkong- Tamlu – Mon Road

The Improvement proposal for the Bridges along Merangkong – Tamlu - Mon Road has been summarized in following table.

Table 4-7: Improvement Proposal for Bridges: Merangkong Tamlu Mon Road

S.NO.	Existing CHAINAGE (km)	DESIGN CHAINAGE	TYPE OF BRIDGE	SPAN (M)	LENGTH (M)	TOTAL WIDTH (M)	Improvement Proposal	Type	Proposed Structure	Proposed span	Proposed length	Overall Width
1	32.467	31.565	STEEL COMPOSITE GIRDER	1X31.7	31.7	5.4	Reconstruction	Type VIII	RCC T beam composite girder + open foundation	2X23	46	12
2	35.57	34.485	RCC VOIDED SLAB	1X6.1	6.1	6.9	Reconstruction	Type III	RCC Voided + open foundation	1X14	14	13.5
3	39.912	38.722	STEEL COMPOSITE GIRDER	1X16.5	16.5	3.9	Reconstruction	Type VII	RCC T beam composite girder + open foundation	1X23	23	12
4	41.500	40.184	STEEL COMPOSITE GIRDER	1X12.5 +1X75. 5+1X15 .5	103.5	4.7	Reconstruction	Type IX	RCC T beam composite girder + open foundation	2X23+3 X32	142	12
5	89.900	79.045	RCC VOIDED SLAB	1X15.25	15.5	4.0	Reconstruction	Type VI	RCC Voided Slab Bridge	1X20	20	13.2
6	98.024	86.795	RCC SLAB	1X6.0	6.0	7.2	Reconstruction	Type II	RCC Slab + open foundation	1X10	10	13.5

4.6.2 Changtongya Longleng Road

The Improvement proposal for Bridges along the Changtongya – Longleng Road is presented in table below.

Table 4-8: Improvement Proposal for Bridges: Changtongya Longleng Road

SL.NO	CHAINAGE (km)	DESIGN CHAINAGE	TYPE OF BRIDGE	SPAN (M)	LENGTH (M)	TOTAL WIDTH (M)	Improvement Proposal	Type	Proposed Structure	Proposed span	Proposed length	Width
1	4.200	3.970	RCC SLAB + STEEL TRUSS	1X31.2	31.2	4.55	Reconstruction	Type IV	RCC Voided Slab + open foundation	1x8+1x18 +1x8	34	12.9
2	6.861	9.160	RCC SLAB + STEEL GIRDER	1X10.45 +1X29. 80+1X8 .15	48.4	11.2	Retained with repairs		Retained			
3		9.230	New	-	-	-	New Construction	Type III	RCC Voided Slab + open foundation	1X14.0	14	12
4.		10.418	New	-	-	-	New Construction	Type I	RCC Slab + open foundation	1X8.0	8	12.9

4.6.3 Chakabama - Zunheboto Road

The improvement proposal for the bridges on this project road is presented below:

Improvement proposal has been summarized in following table.

Table 4-9: Improvement Proposal for Bridges: Chakabama Zunheboto Road

SL.NO	CHAINAGE (km)	DESIGN CHAINAGE	TYPE OF BRIDGE	SPAN (M)	LENGTH (M)	TOTAL WIDTH (M)	Improvement Proposal	Type	Proposed Structure	Proposed span	Proposed length	Width
1	7.940	7.490	slab	1 x 5.0	5.0	5.2	Reconstruction	Type II	RCC Slab + open foundation	1x10	10	13.5
2	9.173	8.690	RCC SLAB + STEEL GIRDER	1X12.3	12.3	4.5	Reconstruction	Type III	RCC voided Slab + open foundation	1x14	14	13.5
3	10.638	….	RCC/PSC BRIDGE	1X40.8	40.8	8.5	Retained after minor repairs					
4	14.085	13.455	RCC SLAB + STEEL GIRDER	1X8.2	8.2	4.6	Reconstruction	Type III	RCC voided Slab + open foundation	1x14	14	12.2

SL.NO	CHAINAGE (km)	DESIGN CHAINAGE	TYPE OF BRIDGE	SPAN (M)	LENGTH (M)	TOTAL WIDTH (M)	Improvement Proposal	Type	Proposed Structure	Proposed span	Proposed length	Width
5	18.120	17.472	RCC SLAB + (I-BEAM) STEEL GIRDER	1X8.0	8.0	4.3	Reconstruction	Type III	RCC voided Slab + open foundation	1x14	14	12.2
6	18.490	17.823	RCC SLAB + (I-BEAM) STEEL GIRDER	1X9.4	9.4	4.4	Reconstruction	Type III	RCC voided Slab + open foundation	1x14	14	13.5
7	84.155	83.285	Slab	1 x 5.0	5.0	7.0	Reconstruction	Type I	RCC Slab + open foundation	1x8	8	12.6

4.6.4 Pfutsero Phek Road

There is no existing bridge on this project road. But keeping in view of hydraulic capacity, carriageway requirements and road alignment three existing culverts are proposed to be replaced by minor bridges.

Table 4-10: Improvement Proposal for Bridges: Pfutsero Phek Road

SL.NO	CHAINAGE (km)	DESIGN CHAINAGE	TYPE OF BRIDGE	SPAN (M)	LENGTH (M)	TOTAL WIDTH (M)	Improvement Proposal	Type	Proposed Structure	Proposed span	Proposed length	Width
1	27.165	...	RCC SLAB CULVERT	1X3.0	3.6	5.50	Reconstruction	Type I	RCC Slab + open foundation	1x8	8	13.5
2	31.531	...	RCC SLAB CULVERT	1X3.0	3.6	7.50	Reconstruction	Type II	RCC Slab + open foundation	1x10	10	13.5

4.7 Improvement Proposal for Culverts

Generally existing culverts on project roads are RCC pipe, RCC slab and RCC box structures. Most of the culverts are very old structures and have a single lane carriageway. They are inadequate in respect of hydraulic capacity and narrow with respect to proposed carriageway. Various components of these culverts are predominantly made up of stone masonry, which has been cracked and broken and having poor structural strength. Majority of culverts are chocked with debris from hills and are nonfunctional resulting in overflow of water over road surface and causing damage to pavement structure.

Culverts, which are in poor condition, insufficient width or hydraulically inadequate, are proposed to be replaced with new culverts. Those culverts which are hydraulically adequate and structurally sound but having insufficient carriageway width are proposed for widening if they also fit to the proposed

alignment. Those culverts which are hydraulically adequate, structurally sound and having sufficient carriageway width are proposed for retention with minor repairs. Additional New culverts are also proposed at various locations wherever required as per the drainage requirement. Proposed culverts shall be of RCC pipe, RCC slab and RCC box structures with RCC/PCC/Stone masonry headwalls, abutments, return walls and retaining walls.

Table 4-11: Improvement Proposals for Culverts (Numbers)

S. No.	Improvement Proposal	Pipe	Box	Total
Merangkong-Tamlu-Mon Road				
1	Retained	0	0	0
2	Widening	1	0	1
3	Reconstruction	117	129	246
4	New Proposed	165	20	185
5	Dismantle / Abandon	0	0	0
		283	**149**	**432**
Changtongya-Longleng Road				
1	Retained	0	0	0
2	Widening	0	0	0
3	Reconstruction	32	7	39
4	New Proposed	143	21	164
5	Dismantle / Abandon	0	0	0
		175	**28**	**203**
Chakabama-Zunheboto Road				
1	Retained	0	0	0
2	Widening	0	0	0
3	Reconstruction	92	286	378
4	New Proposed	217	54	271
5	Dismantle / Abandon	0	0	0
		309	**340**	**649**
Pfutsero-Phek Road				
1	Retained	0	0	0
2	Widening	0	0	0
3	Reconstruction	115	115	230
4	New Proposed	185	21	206
5	Dismantle / Abandon	0	0	0
		300	**136**	**436**

The improvement for culverts in accordance with their configuration of Diameter / Vent way is presented in table below.

Table 4-12: Improvement Proposals for Culverts (Configuration)

Type of Culvert	Diameter /Vent way (m)	Overall Width (m)	No
Merangkong -Tamlu-Mon Road			
Pipe	1x1.2	11	241
Pipe	2x1.2	11	42
Box	1x3.0x3.0	12	43
Box	2x2.0x2.0	12	2
Box	2x2.5x3.0	12	10
Box	1x2.0x2.0	12	94
			432
Changtongya - Longleng Road			
Pipe	1x1.2	11	156
Pipe	2x1.2	11	19
Box	1x3.0 x3.0	12	13
Box	2x2.5 x3.0	12	7
Box	1x2.0 x 2.0	12	8
			203
Chakabama - Zunheboto Road			
Pipe	1x1.2	11	267
Pipe	2x1.2	11	42
Box	1x3.0 x3.0	12	94
Box	2x2.0 x2.0	12	12
Box	2x2.5 x3.0	12	12
Box	1 x 2.0 x 2.0	12	222
			649
Pfutsero – Phek Road			
Pipe	1x1.2	11	235
Pipe	2x1.2	11	56
Slab	1x3.0 x3.0	12	40
Slab	2x2.0 x2.0	12	12
Slab	2x2.5 x3.0	12	7
Box	1 x 2.0 x 2.0	12	86
			436

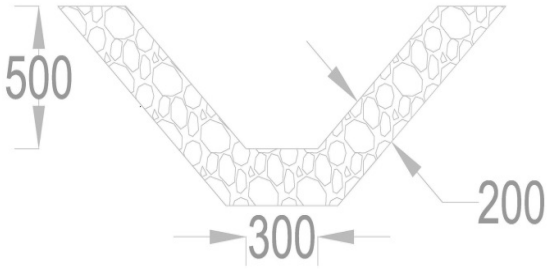
4.8 Improvement Proposal for Longitudinal Drainage

Existing project road does not have adequate and connected longitudinal drainage system. This inadequate drainage results in flowing/overflowing of discharge over road pavement which in turn results in overflow/submergence of project road sections causing damage to the pavement structure. Inadequate longitudinal drainage further adds to excessive pore water pressures which can lead to minor/major landslides.

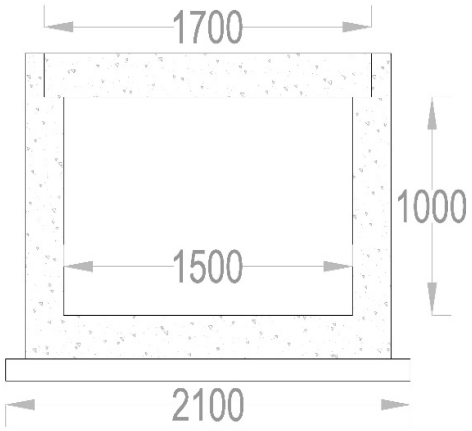
In order to avoid stated problems, stone masonry (random rubble) trapezoidal longitudinal drain is proposed all along project road lengths on hill side as on preventive measure. Different type of longitudinal drains proposed for project roads are

(a) The average proposed base width as 0.3 m and depth as 0.5 m and Top width as 1.3 m.
(b) In built up stretches, the RCC drain with cover slab is proposed.

Typical Longitudinal / Side Drain section are presented in Figure below.



Trapezoidal Drain Section on hill side along majority of project road stretches



RCC Drain Section in built up stretches

Figure 4-18: Longitudinal Drains Sections

The Improvement Proposal for construction of longitudinal drains is in accordance with Type of Typical Cross Section proposed for the project road stretch under consideration as detailed in previous sections of this chapter.

Stone Aggregate drains are proposed to be constructed underneath trapezoidal random rubble masonry drain for a depth of 450 mm along hill side wherein there are visible sign of seepage of water from Hill side.

4.9 Improvement Proposal for Slope Stability & Protective works

Proposed Cut Slopes have been analyzed for Slope Stability and detailed have been presented in Chapter 5 of Volume II: Design Report Part I Road Features submitted along with this report. In general all cut slope have adequate factor of safety under proposed improved slope conditions.

Project Road Stretches Prone to Land Slides (Category I) as detailed in Chapter 3 under Slope Stability Surveys have been proposed to be improved by provision of Geosynthetic Mat, Soil Nails (6 m per 4 sqm) Temporary Facing in bottom most cut slope.

Table 4-13: Improvement Proposals: lengths of Land Slide Prone Stretches

Design Chainage		Length
From	To	
Merangkong Tamlu Mon Road		
4+210	4+310	100
5+430	5+780	350
6+380	6+870	490
6+770	7+370	600
7+640	8+290	650
8+520	8+580	60
10+570	10+875	305
14+560	14+680	120
17+940	18+430	490
18+465	18+545	80
19+000	19+610	610
22+615	22+715	100
24+880	24+980	100

Design Chainage		Length
From	To	
25+410	25+510	100
26+360	26+460	100
27+115	27+315	200
27+515	27+615	100
28+540	28+740	200
29+120	29+280	160
33+270	33+370	100
49+130	49+230	100
52+420	52+520	100
56+910	57+010	100
57+850	58+950	1100
71+875	72+175	300
72+425	72+610	185
73+160	73+530	370
75+930	76+220	290
77+240	77+590	350
Total		**7910**
Changtongya Longleng Road		
6+162	6+222	60
6+780	7+450	670
8+000	8+100	100
9+050	9+230	180
23+840	24+000	160
24+130	24+480	350
27+720	27+870	150
29+050	29+150	100
29+170	29+470	300
30+430	30+470	40
30+570	30+760	190
31+395	31+490	95
Total		**2395**
Chakabama Zunheboto Road		
4+250	4+950	700
8+150	8+250	100
8+860	9+400	540
9+400	9+500	100
9+500	9+760	260
10+580	10+760	180
11+700	11+760	60
13+030	13+200	170
15+720	15+880	160
16+760	17+670	910
19+460	19+790	330

Design Chainage		Length
From	To	
19+780	19+830	50
21+090	22+150	1060
22+550	23+150	600
23+150	23+370	220
23+370	23+440	70
24+250	24+500	250
24+770	25+530	760
26+270	26+340	70
31+710	31+860	150
32+000	32+200	200
32+200	32+450	250
45+070	45+190	120
46+310	46+600	290
50+120	50+350	230
54+080	54+170	90
54+250	54+360	110
58+610	58+800	190
67+800	68+400	600
68+500	68+750	250
68+850	69+000	150
69+190	69+590	400
71+140	71+380	240
71+450	72+080	630
72+290	72+400	110
75+000	75+280	280
77+950	78+070	120
78+370	78+680	310
79+550	80+050	500
80+290	80+600	310
83+590	83+620	30
84+910	84+970	60
85+120	85+170	50
90+830	91+000	170
91+540	91+610	70
93+540	93+750	210
93+750	93+930	180
94+960	95+160	200
104+620	104+680	60
106+790	106+970	180
107+100	107+260	160
Total		**13490**
Pfutsero Phek Road		
2+560	2+710	150

Design Chainage		Length
From	To	
3+045	3+145	100
3+630	3+885	255
4+275	4+575	300
5+480	5+730	250
5+850	6+050	200
6+380	7+000	620
7+500	7+900	400
11+130	11+620	490
12+790	12+900	110
13+660	13+760	100
21+140	21+340	200
26+960	27+470	510
28+920	29+110	190
29+110	29+210	100
30+680	30+855	175
36+350	36+700	350
44+070	44+100	30
53+030	53+330	300
53+570	53+660	90
53+660	53+940	280
55+175	55+375	200
56+610	56+645	35
57+200	57+280	80
57+670	57+720	50
Total		**5565**

Project Road Stretches Vulnerable to Slope Stability problems detailed in Chapter 3 (under Category II and III) have been proposed to be improved by providing Seeding and Mulching for erosion control with polymer mats.

Table 4-14: Improvement Proposals Lengths for Category II and III Stretches

Design Chainage		
From	To	Length
Merangkong Tamlu Mon Road		
1+700	1+800	100
3+190	3+890	700
4+110	4+910	800
5+040	5+290	250
6+870	7+270	400
7+270	7+650	380
8+300	8+600	300
10+030	10+080	50
10+080	10+480	400
10+480	10+880	400
13+230	14+070	840

Design Chainage		
From	To	Length
14+680	15+270	590
15+270	16+370	1100
17+070	17+600	530
18+100	18+450	350
18+680	19+000	320
19+500	19+700	200
20+410	20+810	400
21+010	21+110	100
21+530	22+710	1180
23+160	23+260	100
23+260	23+470	210
23+470	23+670	200
23+670	23+750	80
23+900	24+110	210
24+110	24+970	860
26+860	27+370	510
27+520	27+800	280
27+800	28+240	440
29+910	30+110	200
32+085	32+285	200
33+370	33+470	100
33+470	34+410	940
35+460	35+860	400
36+060	36+510	450
36+760	37+590	830
38+700	39+300	600
39+420	40+180	760
40+180	41+130	950
44+660	45+220	560
46+930	47+480	550
48+810	49+430	620
51+330	51+930	600
51+930	54+430	2500
55+110	55+910	800
56+710	57+850	1140
58+950	59+230	280
65+730	65+780	50
67+020	67+320	300
68+860	68+960	100
69+710	71+120	1410
71+120	71+330	210
71+330	71+410	80
71+410	72+060	650

Design Chainage		
From	To	Length
72+460	72+580	120
72+630	72+710	80
72+780	73+160	380
74+010	74+360	350
74+360	74+780	420
75+230	75+280	50
75+530	76+010	480
78+620	79+100	480
79+300	79+600	300
80+170	80+670	500
81+900	82+800	900
		31620
Changtongya Longleng Road		
0+000	0+350	350
0+350	0+500	150
0+500	0+750	250
0+850	0+900	50
1+350	1+650	300
6+200	6+300	100
7+970	8+200	230
22+800	23+250	450
23+310	23+750	440
26+950	27+750	800
27+920	28+370	450
29+450	30+010	560
31+140	31+450	310
31+630	31+860	230
32+180	32+450	270
32+600	33+050	450
		5390
Chakabama Zunheboto Road		
0+650	0+900	250
2+250	2+620	370
3+850	4+420	570
5+170	5+550	380
7+180	7+800	620
7+800	8+150	350
8+100	8+250	150
8+330	8+730	400
8+600	8+650	50
11+950	12+240	290
12+450	12+650	200
13+290	13+400	110

Design Chainage		
From	To	Length
13+700	13+990	290
14+500	14+650	150
14+650	15+360	710
15+410	15+700	290
16+040	16+150	110
16+520	17+010	490
17+450	17+530	80
17+670	18+180	510
18+400	19+450	1050
19+770	20+510	740
20+510	20+610	100
20+870	20+950	80
23+150	23+230	80
24+520	24+810	290
25+940	26+180	240
26+480	26+750	270
26+750	26+980	230
27+240	27+380	140
28+560	28+900	340
34+810	35+040	230
36+630	37+090	460
37+090	37+700	610
41+750	42+220	470
45+190	45+480	290
47+100	48+170	1070
53+650	53+960	310
57+370	57+660	290
57+710	58+000	290
61+390	61+680	290
63+000	63+330	330
64+250	64+490	240
65+380	65+600	220
66+460	66+790	330
68+680	68+850	170
69+250	70+440	1190
73+340	74+060	720
74+060	74+500	440
75+520	75+690	170
75+950	76+390	440
78+020	78+480	460
79+080	79+470	390
79+580	80+550	970
83+770	85+190	1420

Design Chainage		
From	To	Length
85+280	85+350	70
90+920	91+450	530
96+280	96+490	210
96+970	97+120	150
97+210	97+390	180
104+900	105+300	400
107+350	107+410	60
107+460	107+720	260
107+720	108+340	620
108+340	109+760	1420
		25360
Pfutsero Phek Road		
0+000	0+600	600
0+600	1+490	890
2+410	2+560	150
2+560	2+710	150
3+045	3+245	200
3+245	3+650	405
4+125	4+245	120
4+500	5+070	570
6+330	6+500	170
6+600	6+795	195
8+640	9+545	905
9+545	9+595	50
10+180	10+500	320
10+500	10+880	380
12+550	12+795	245
13+855	14+480	625
15+490	15+635	145
15+635	17+200	1565
17+295	17+650	355
17+650	17+820	170
17+820	18+210	390
18+540	18+710	170
19+130	19+470	340
19+470	19+580	110
19+810	19+910	100
19+930	20+100	170
20+240	20+440	200
20+440	20+620	180
21+460	21+660	200
21+660	21+860	200
22+100	23+900	1800

Design Chainage		
From	To	Length
25+750	26+420	670
27+740	28+110	370
28+110	28+670	560
28+895	28+920	25
29+220	29+520	300
29+520	29+730	210
30+730	33+340	2610
33+340	34+450	1110
34+640	34+700	60
35+760	36+050	290
36+050	36+400	350
36+700	37+120	420
37+120	40+260	3140
40+820	41+370	550
41+370	43+750	2380
45+750	46+610	860
46+610	47+800	1190
48+960	49+810	850
49+810	49+990	180
50+060	50+780	720
50+780	51+180	400
52+040	53+060	1020
55+070	55+290	220
55+290	56+010	720
56+010	56+150	140
56+345	56+585	240
57+940	57+970	30
57+990	58+660	670
59+810	59+980	170
61+110	61+800	690
	Total	**33215**

Valley Side Protective Works for retaining of Earth has been proposed to be carried out by using Gabion retaining walls. The Details are presented in tables below.

Table 4-15: Improvement Proposals: Gabion Wall Length for MTM Road

S. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
1	0+325	0+365	40
2	0+468	0+515	47
3	0+675	0+695	20
4	0+735	0+745	10
5	0+785	0+805	19
6	0+865	0+885	20
7	1+185	1+225	40
8	1+235	1+245	10
9	1+275	1+335	60
10	1+370	1+495	125

S. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
11	1+573	1+607	34
12	1+655	1+725	70
13	1+735	1+745	10
14	1+755	1+775	20
15	1+785	1+794	9
16	1+865	1+945	80
17	1+965	2+036	71
18	2+075	2+085	10
19	2+105	2+127	22
20	2+265	2+306	41
21	2+345	2+405	60
22	2+455	2+645	190
23	2+695	2+705	10
24	2+755	2+885	130
25	2+925	2+945	20
26	2+975	3+045	70
27	3+093	3+135	42
28	3+155	3+225	70
29	3+255	3+295	40
30	3+307	3+455	148
31	3+495	3+505	10
32	3+535	3+655	120
33	3+705	3+735	30
34	3+775	3+815	40
35	3+856	3+895	39
36	3+945	3+955	10
37	3+964	3+995	31
38	4+005	4+025	20
39	4+065	4+215	150
40	4+575	4+605	30
41	4+875	4+885	10
42	4+895	4+931	36
43	4+981	5+005	24
44	5+056	5+069	13
45	5+075	5+202	127
46	5+325	5+382	57
47	5+425	5+446	21
48	5+453	5+492	39
49	5+547	5+615	68
50	5+705	5+735	30
51	5+925	5+938	13
52	6+055	6+085	30

S. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
53	6+125	6+135	10
54	6+255	6+265	10
55	6+285	6+375	90
56	6+457	6+535	78
57	6+725	6+785	60
58	6+835	6+865	30
59	6+905	6+945	40
60	7+515	7+535	20
61	7+555	7+575	20
62	7+585	7+705	120
63	7+885	7+985	100
64	7+995	8+025	30
65	8+225	8+255	30
66	8+275	8+357	82
67	8+575	8+615	40
68	8+624	8+645	21
69	8+655	8+685	30
70	8+695	8+786	92
71	8+835	8+875	40
72	9+015	9+055	40
73	9+085	9+125	40
74	9+185	9+395	210
75	9+435	9+465	30
76	9+585	9+595	10
77	9+615	9+625	10
78	10+445	10+535	90
79	10+545	10+605	60
80	10+655	10+745	90
81	10+855	10+925	70
82	10+965	11+035	70
83	11+175	11+225	50
84	11+255	11+265	10
85	11+487	11+495	8
86	11+615	11+775	160
87	11+834	11+865	31
88	11+885	11+975	90
89	12+065	12+075	10
90	12+123	12+135	13
91	12+143	12+156	13
92	12+245	12+295	50
93	12+345	12+395	50
94	12+405	12+415	10

S. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
95	12+575	12+615	40
96	12+645	12+723	78
97	12+774	12+945	171
98	12+958	12+976	18
99	12+995	13+095	100
100	13+485	13+495	10
101	13+565	13+585	20
102	14+175	14+201	26
103	14+405	14+455	50
104	14+626	14+655	29
105	14+731	14+731	1
106	14+745	14+865	120
107	14+915	14+942	27
108	14+985	15+025	40
109	15+075	15+083	8
110	15+112	15+215	103
111	15+235	15+245	10
112	15+265	15+288	23
113	15+294	15+415	121
114	15+435	15+525	90
115	15+565	15+585	20
116	15+625	15+715	90
117	15+735	15+825	90
118	15+865	15+945	80
119	16+015	16+205	190
120	16+215	16+255	40
121	16+335	16+557	222
122	16+565	16+645	80
123	16+655	16+675	20
124	16+765	16+915	150
125	16+935	16+945	10
126	17+025	17+105	80
127	17+135	17+195	60
128	17+235	17+242	7
129	17+255	17+400	145
130	17+435	17+465	30
131	17+515	17+535	20
132	17+565	17+625	60
133	17+635	17+660	25
134	17+690	17+775	85
135	17+785	17+855	70
136	17+865	17+885	20
137	17+915	17+935	20
138	17+945	17+986	41
139	17+995	18+015	20
140	18+025	18+175	150
141	18+215	18+235	20
142	18+395	18+405	10
143	18+442	18+447	5
144	18+615	18+633	18
145	18+645	18+655	10
146	18+725	18+735	10
147	18+745	18+815	70
148	19+005	19+044	39
149	19+103	19+135	32
150	19+505	19+573	68
151	19+599	19+645	46
152	19+674	19+755	81
153	19+805	19+837	32
154	19+935	19+975	40
155	20+005	20+195	190
156	20+225	20+287	62
157	20+303	20+355	52
158	20+385	20+475	90
159	20+545	20+625	80
160	20+805	20+835	30
161	21+035	21+095	60
162	21+115	21+195	80
163	21+205	21+232	27
164	21+365	21+399	34
165	21+485	21+505	20
166	21+655	21+664	9
167	21+772	21+815	43
168	21+834	21+868	34
169	22+146	22+215	69
170	22+235	22+255	20
171	22+305	22+325	20
172	22+445	22+485	40
173	22+555	22+625	70
174	22+708	22+785	77
175	22+815	22+847	32
176	22+945	22+955	10
177	22+965	22+975	10
178	23+006	23+045	39

S. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
179	23+085	23+174	89
180	23+205	23+226	21
181	23+405	23+455	50
182	23+515	23+525	10
183	23+545	23+555	10
184	23+725	23+755	30
185	23+797	23+825	28
186	23+865	23+998	133
187	24+016	24+081	65
188	24+146	24+205	59
189	24+229	24+245	16
190	24+255	24+265	10
191	24+315	24+375	60
192	24+495	24+515	20
193	24+564	24+585	21
194	24+605	24+635	30
195	24+675	24+755	80
196	24+825	24+875	50
197	24+915	24+935	20
198	24+997	25+045	48
199	25+086	25+115	29
200	25+145	25+184	39
201	25+231	25+264	33
202	25+378	25+412	34
203	25+505	25+545	40
204	25+633	25+645	12
205	25+705	25+796	91
206	25+808	25+835	27
207	26+055	26+075	20
208	26+122	26+225	103
209	26+323	26+335	12
210	26+385	26+416	31
211	26+465	26+507	42
212	26+538	26+565	27
213	26+677	26+684	7
214	26+725	26+745	20
215	26+825	26+832	7
216	26+837	26+855	18
217	26+994	27+065	71
218	27+075	27+115	40
219	27+135	27+153	18
220	27+305	27+338	33
221	27+345	27+411	66
222	27+465	27+475	10
223	27+805	27+845	40
224	27+955	28+015	60
225	28+065	28+085	20
226	28+124	28+165	41
227	28+216	28+255	39
228	28+378	28+385	7
229	28+676	28+685	9
230	28+695	28+765	70
231	28+795	28+815	20
232	28+888	28+935	47
233	29+245	29+265	20
234	30+123	30+155	32
235	30+165	30+205	40
236	30+274	30+285	11
237	30+296	30+315	19
238	30+345	30+395	50
239	30+605	30+615	10
240	30+705	30+715	10
241	30+925	30+936	11
242	31+295	31+315	20
243	31+345	31+425	80
244	31+465	31+471	6
245	31+601	31+605	5
246	31+735	31+755	20
247	32+195	32+245	50
248	32+265	32+295	30
249	32+402	32+425	23
250	32+497	32+534	37
251	32+855	32+875	20
252	33+025	33+048	23
253	33+262	33+285	23
254	33+355	33+377	22
255	33+446	33+481	35
256	33+547	33+905	358
257	33+965	34+082	117
258	34+115	34+137	22
259	34+175	34+205	30
260	34+225	34+235	10
261	34+285	34+319	34
262	34+385	34+415	30

S. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
263	34+575	34+615	40
264	34+695	34+725	30
265	34+972	34+985	13
266	35+125	35+131	6
267	35+525	35+613	88
268	35+695	35+765	70
269	35+845	35+877	32
270	35+925	35+945	20
271	35+955	35+965	10
272	36+205	36+245	40
273	36+475	36+485	10
274	36+505	36+555	50
275	36+855	36+865	10
276	36+915	36+944	29
277	37+015	37+047	32
278	37+063	37+095	32
279	37+205	37+215	10
280	37+315	37+330	15
281	37+355	37+385	30
282	37+555	37+565	10
283	37+654	37+705	51
284	37+735	37+773	38
285	37+823	37+875	52
286	37+895	37+903	8
287	37+925	38+055	130
288	38+085	38+095	10
289	38+135	38+145	10
290	38+165	38+225	60
291	38+305	38+315	10
292	38+395	38+545	150
293	38+605	38+675	70
294	38+805	38+845	40
295	38+872	39+005	133
296	39+095	39+115	20
297	39+166	39+275	109
298	39+295	39+305	10
299	39+313	39+325	12
300	39+395	39+556	161
301	39+575	39+705	130
302	39+745	39+985	240
303	40+396	40+425	29
304	40+445	40+454	9
305	40+465	40+483	18
306	40+525	40+535	10
307	40+575	40+605	30
308	40+632	40+655	23
309	40+725	40+736	11
310	40+845	40+865	20
311	40+925	40+984	59
312	41+035	41+055	20
313	41+075	41+095	20
314	41+155	41+165	10
315	41+175	41+201	26
316	41+206	41+255	49
317	41+355	41+405	50
318	41+465	41+868	403
319	42+185	42+345	160
320	42+355	42+421	66
321	42+435	42+564	129
322	42+715	42+835	120
323	42+845	43+115	270
324	43+145	43+375	230
325	43+385	43+475	90
326	43+565	43+665	100
327	43+815	43+995	180
328	44+185	44+265	80
329	44+306	44+525	219
330	44+675	44+695	20
331	44+715	44+755	40
332	44+805	44+835	30
333	44+985	45+055	70
334	45+103	45+125	22
335	45+175	45+185	10
336	45+215	45+251	36
337	45+275	45+305	30
338	45+325	45+345	20
339	45+425	45+437	12
340	45+445	45+472	27
341	45+474	45+477	3
342	45+535	45+635	100
343	45+655	45+845	190
344	45+915	45+956	41
345	46+121	46+244	123
346	46+255	46+285	30

S. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
347	46+298	46+305	7
348	46+315	46+435	120
349	46+487	46+525	38
350	46+575	46+595	20
351	46+665	46+765	100
352	46+775	46+906	131
353	46+925	47+055	130
354	47+065	47+092	27
355	47+145	47+165	20
356	47+225	47+263	38
357	47+297	47+375	78
358	47+395	47+485	90
359	47+527	47+655	128
360	47+755	47+835	80
361	47+875	47+985	110
362	48+125	48+145	20
363	48+205	48+225	20
364	48+295	48+315	20
365	48+435	48+485	50
366	48+527	48+565	38
367	48+865	48+905	40
368	48+985	49+125	140
369	49+892	49+912	19
370	49+917	49+965	48
371	50+125	50+265	140
372	50+275	50+345	70
373	50+415	50+455	40
374	50+468	50+505	37
375	50+705	50+777	72
376	50+835	50+845	10
377	51+055	51+095	40
378	51+125	51+236	111
379	51+275	51+344	69
380	51+355	51+395	40
381	51+575	51+585	10
382	51+596	51+617	21
383	51+675	51+853	178
384	51+858	51+895	37
385	51+921	51+938	17
386	52+029	52+035	6
387	52+075	52+085	10
388	52+154	52+175	21
389	52+215	52+355	140
390	52+416	52+435	19
391	52+464	52+595	131
392	52+615	52+663	48
393	52+885	53+015	130
394	53+025	53+125	100
395	53+155	53+225	70
396	53+275	53+295	20
397	53+335	53+436	101
398	53+607	53+625	18
399	53+656	53+675	19
400	53+785	53+805	20
401	53+835	53+910	75
402	53+913	53+925	12
403	53+965	54+085	120
404	54+115	54+205	90
405	54+265	54+286	21
406	54+455	54+505	50
407	54+885	54+975	90
408	54+985	55+055	70
409	55+075	55+095	20
410	55+115	55+127	12
411	55+153	55+198	45
412	55+235	55+250	15
413	55+425	55+455	30
414	55+507	55+515	7
415	55+585	55+635	50
416	55+666	55+685	19
417	55+705	55+775	70
418	56+068	56+093	25
419	56+172	56+185	13
420	56+275	56+305	30
421	56+315	56+486	171
422	56+635	56+654	19
423	56+905	56+975	70
424	57+035	57+045	10
425	57+055	57+075	20
426	57+106	57+156	49
427	57+195	57+305	110
428	57+372	57+445	73
429	57+505	57+555	50
430	57+684	57+695	11

S. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
431	57+745	57+755	10
432	57+845	57+865	20
433	58+045	58+115	70
434	58+129	58+165	36
435	58+235	58+295	60
436	58+455	58+493	38
437	58+505	58+515	10
438	58+624	58+685	61
439	58+695	58+705	10
440	58+935	58+945	10
441	59+022	59+035	13
442	59+155	60+235	1080
443	60+268	60+295	27
444	60+335	61+006	671
445	61+025	61+035	10
446	61+043	61+515	472
447	61+535	61+594	59
448	61+607	61+625	18
449	61+655	61+685	30
450	61+735	63+795	2060
451	64+425	64+437	12
452	64+563	64+568	5
453	64+595	64+613	18
454	64+755	64+765	10
455	64+975	64+985	10
456	65+285	65+375	90
457	65+485	65+495	10
458	65+532	65+545	13
459	65+605	65+625	20
460	65+695	65+707	12
461	65+782	65+815	33
462	65+916	65+965	49
463	66+055	66+085	30
464	66+096	66+115	19
465	66+875	66+885	10
466	67+045	67+055	10
467	67+095	67+145	50
468	67+252	67+335	83
469	67+365	67+386	21
470	67+455	67+475	20
471	67+555	67+565	10
472	68+425	68+435	10

S. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
473	68+876	68+883	7
474	69+015	69+025	10
475	69+865	69+876	11
476	70+045	70+075	30
477	70+285	70+325	40
478	70+355	70+415	60
479	70+615	70+625	10
480	70+659	70+685	26
481	70+745	70+807	62
482	70+904	70+935	31
483	70+995	71+165	170
484	71+415	71+438	23
485	71+575	71+605	30
486	71+701	71+725	24
487	71+755	71+763	8
488	71+768	71+795	27
489	71+824	71+855	31
490	71+884	71+925	41
491	71+935	71+945	10
492	71+985	71+995	10
493	72+006	72+015	9
494	72+065	72+165	100
495	72+175	72+265	90
496	72+315	72+365	50
497	72+555	72+575	20
498	72+616	72+644	28
499	72+695	72+715	20
500	73+015	73+075	60
501	73+105	73+145	40
502	73+275	73+315	40
503	73+345	73+435	90
504	73+455	73+565	110
505	73+578	73+645	67
506	73+775	73+855	80
507	73+905	73+965	60
508	73+994	74+035	41
509	74+325	74+355	30
510	74+415	74+445	30
511	74+455	74+495	40
512	75+515	75+525	10
513	75+565	75+605	40
514	75+645	75+685	40

S. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
515	75+829	75+874	45
516	75+943	76+025	82
517	76+045	76+105	60
518	76+147	76+225	78
519	76+265	76+295	30
520	76+335	76+345	10
521	76+375	76+405	30
522	76+535	76+575	40
523	76+605	76+665	60
524	76+725	76+735	10
525	76+740	76+755	15
526	76+813	76+905	92
527	76+965	77+046	81
528	77+083	77+115	32
529	77+255	77+275	20
530	77+405	77+455	50
531	77+525	77+538	13
532	77+807	77+836	29
533	77+855	77+863	8
534	77+904	77+915	11
535	77+955	77+995	40
536	78+155	78+206	51
537	78+245	78+255	10
538	78+315	78+428	113
539	78+485	78+513	28
540	78+535	78+596	61
541	78+698	78+808	110
542	78+815	78+825	10
543	78+855	78+865	10
544	78+878	78+956	79
545	78+956	78+958	2
546	79+516	79+545	29
547	79+575	79+605	30
548	79+635	79+665	30

S. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
549	79+684	79+705	21
550	79+735	79+795	60
551	79+855	79+885	30
552	79+955	80+015	60
553	80+069	80+085	16
554	80+105	80+175	70
555	80+215	80+305	90
556	80+465	80+578	113
557	80+595	80+635	40
558	80+667	80+745	78
559	80+805	80+815	10
560	80+865	81+015	150
561	81+055	81+085	30
562	81+125	81+130	5
563	81+135	81+185	50
564	81+195	81+254	59
565	81+265	81+545	280
566	81+565	81+585	20
567	81+595	81+615	20
568	81+625	81+635	10
569	81+775	81+845	70
570	81+855	81+915	60
571	81+985	82+075	90
572	82+095	82+175	80
573	82+205	82+325	120
574	82+335	82+453	118
575	82+475	82+485	10
576	82+496	82+525	29
577	82+545	82+566	21
578	82+595	82+675	80
579	82+685	82+695	10
580	82+735	82+800	65
			32855

Table 4-16: Improvement Proposals: Gabion Wall Length for C L Road

Sl. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
1	0+006	0+024	19
2	0+066	1+239	1173
3	1+275	3+005	1730

Sl. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
4	3+025	3+108	83
5	3+135	3+165	30
6	3+175	3+215	40

Sl. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
7	3+455	3+462	7
8	3+555	3+895	340
9	3+905	4+403	498
10	4+635	4+785	150
11	4+795	4+825	30
12	4+885	4+915	30
13	4+989	5+035	46
14	5+093	5+165	72
15	5+328	5+375	47
16	5+454	5+555	101
17	5+698	5+763	66
18	5+831	5+895	64
19	6+145	6+338	193
20	6+355	6+505	150
21	6+547	6+552	6
22	6+711	6+878	167
23	6+879	7+266	387
24	7+311	7+339	28
25	7+475	7+481	6
26	7+785	7+825	40
27	7+855	8+068	213
28	8+814	8+818	4
29	8+875	9+021	146
30	9+184	9+187	4
31	9+285	9+345	60
32	9+385	9+475	90
33	9+495	9+505	10
34	9+525	9+535	10
35	9+785	9+845	60
36	10+025	10+315	290
37	10+343	10+375	32
38	10+535	10+545	10
39	10+625	10+635	10
40	10+645	11+064	419
41	11+075	11+085	10
42	11+097	11+165	68
43	11+175	11+275	100
44	11+295	11+695	400
45	11+712	11+756	43
46	11+758	11+945	187
47	11+975	12+035	60
48	12+045	12+235	190
49	12+245	12+295	50
50	12+355	12+815	460
51	12+975	13+005	30
52	13+085	13+452	367
53	13+486	13+525	39
54	13+665	13+756	91
55	13+765	13+915	150
56	13+935	14+043	108
57	14+046	14+125	78
58	14+145	14+385	240
59	14+445	14+745	300
60	14+775	14+988	213
61	14+995	15+315	320
62	15+355	15+605	250
63	15+685	15+815	130
64	16+105	16+264	159
65	16+275	16+325	50
66	16+345	16+701	356
67	16+705	17+165	460
68	17+255	17+315	60
69	17+338	17+395	57
70	17+425	17+478	53
71	17+485	17+610	125
72	17+615	17+835	220
73	17+915	17+995	80
74	18+055	18+372	317
75	18+376	18+565	189
76	18+603	18+625	22
77	18+675	18+752	77
78	18+756	19+615	859
79	19+655	19+705	50
80	19+835	20+125	290
81	20+195	20+225	30
82	20+365	20+385	20
83	20+595	20+625	30
84	20+725	20+795	70
85	20+805	21+155	350
86	21+255	21+515	260
87	21+555	21+825	270
88	22+005	22+045	40
89	22+105	22+735	630
90	22+865	23+283	418

Sl. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
91	23+287	23+396	109
92	23+415	23+894	479
93	23+897	24+044	147
94	24+047	24+135	88
95	24+195	24+237	42
96	24+237	24+505	268
97	24+605	24+615	10
98	24+679	24+685	6
99	24+703	24+764	61
100	24+815	24+855	40
101	25+535	25+576	41
102	25+619	25+637	18
103	25+695	25+715	20
104	25+875	25+895	20
105	25+916	25+957	41
106	25+981	25+986	5
107	26+075	26+085	10
108	26+135	26+142	7
109	26+175	26+225	50
110	26+277	26+315	38
111	26+325	26+365	40
112	26+395	26+455	60
113	26+615	26+625	10
114	26+718	26+725	7
115	26+875	26+915	40
116	26+985	27+014	29
117	27+045	27+105	60
118	27+155	27+165	10
119	27+205	27+228	23
120	27+267	27+355	88
121	27+649	27+655	6
122	27+695	27+705	10
123	27+765	27+776	11
124	27+835	27+945	110
125	27+977	28+060	83
126	28+324	28+329	5
127	28+785	28+796	11
128	28+865	28+885	20
129	28+965	29+035	70
130	29+065	29+076	11
131	29+096	29+139	43
132	29+205	29+265	60
133	29+295	29+335	40
134	29+382	29+387	5
135	29+555	29+564	9
136	29+575	29+585	10
137	29+645	29+655	10
138	29+705	29+755	50
139	29+875	29+882	7
140	29+935	29+965	30
141	29+975	29+995	20
142	30+059	30+066	6
143	30+125	30+135	10
144	30+194	30+205	11
145	30+233	30+243	10
146	30+363	30+385	22
147	30+395	30+435	40
148	30+455	30+465	10
149	30+555	30+585	30
150	30+695	30+725	30
151	30+755	30+854	99
152	30+857	30+876	19
153	30+925	30+950	25
154	30+995	31+025	30
155	31+033	31+038	5
156	31+044	31+064	20
157	31+085	31+115	30
158	31+135	31+208	73
159	31+229	31+553	324
160	31+615	31+631	16
161	31+959	32+035	76
162	32+136	32+295	159
163	32+335	32+662	327
164	32+754	32+826	71
165	32+855	32+865	10
166	32+905	32+954	49
167	33+025	33+065	40
168	33+144	33+707	563
169	33+796	34+132	336
170	34+134	34+216	82
171	34+384	34+456	72
172	34+483	34+505	22
173	34+513	34+575	62
174	34+615	34+645	30

Sl. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
175	34+705	35+132	427
176	35+305	35+600	295
177	35+603	35+625	22
178	35+882	35+921	39
179	35+926	36+000	74
180	36+005	36+155	150
181	36+211	36+237	26
182	36+375	36+378	3
183	36+384	36+595	211
184	36+605	36+815	210
185	36+817	37+145	328
186	37+165	37+244	79
187	37+247	37+297	50
188	37+470	37+630	160
189	37+634	37+735	101
190	37+765	37+915	150
191	37+964	37+968	4
192	38+009	38+284	275
193	38+325	38+395	70
194	38+415	38+475	60
			24218

Table 4-17: Improvement Proposals: Gabion Wall Length for CZ Road

Sl. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
1	1+675	1+688	13
2	2+015	2+047	32
3	2+395	2+415	20
4	3+155	3+186	31
5	3+425	3+435	10
6	3+505	3+547	42
7	3+665	3+685	20
8	3+695	3+745	50
9	3+935	3+985	50
10	4+065	4+126	61
11	4+155	4+164	9
12	4+318	4+337	19
13	4+635	4+665	30
14	4+715	4+725	10
15	4+765	4+785	20
16	4+795	4+825	30
17	4+867	4+885	18
18	4+935	4+944	9
19	5+464	5+485	21
20	5+675	5+694	19
21	5+755	5+764	9
22	5+865	5+875	10
23	5+888	5+895	7
24	6+195	6+238	43
25	6+408	6+415	7
26	6+455	6+485	30
27	6+555	6+565	10
28	6+595	6+645	50
29	6+985	7+015	30
30	7+065	7+099	34
31	7+265	7+285	20
32	7+355	7+375	20
33	7+557	7+578	21
34	7+585	7+655	70
35	7+885	7+895	10
36	8+145	8+175	30
37	8+325	8+363	38
38	8+405	8+495	90
39	8+585	8+635	50
40	8+805	8+855	50
41	9+255	9+265	10
42	9+285	9+335	50
43	9+583	9+615	32
44	9+625	9+665	40
45	9+755	9+786	31
46	9+805	9+835	30
47	9+905	9+958	53
48	10+025	10+044	19
49	10+073	10+135	62
50	10+275	10+295	20

Sl. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
51	10+345	10+367	22
52	10+486	10+505	19
53	10+695	10+745	50
54	10+755	10+775	20
55	10+815	10+855	40
56	10+965	10+985	20
57	10+993	10+996	3
58	11+025	11+035	10
59	11+555	11+585	30
60	12+145	12+225	80
61	12+465	12+487	22
62	12+497	12+505	8
63	12+655	12+705	50
64	12+742	12+755	13
65	12+785	12+825	40
66	12+865	12+885	20
67	12+955	13+005	50
68	13+085	13+105	20
69	13+175	13+186	11
70	13+276	13+295	19
71	13+314	13+325	11
72	13+335	13+405	70
73	13+555	13+615	60
74	13+622	13+645	23
75	13+753	13+767	13
76	13+825	13+855	30
77	13+860	13+875	16
78	13+895	13+905	10
79	13+965	13+975	10
80	14+093	14+118	26
81	14+125	14+245	120
82	14+275	14+283	8
83	14+405	14+435	30
84	14+515	14+575	60
85	14+755	14+760	5
86	14+785	14+795	10
87	15+020	15+076	56
88	15+083	15+095	12
89	15+175	15+255	80
90	15+285	15+305	20
91	15+326	15+336	10
92	15+414	15+445	31
93	15+495	15+535	40
94	15+575	15+585	10
95	15+625	15+645	20
96	15+695	15+714	19
97	15+885	15+914	29
98	15+935	16+025	90
99	16+075	16+095	20
100	16+253	16+305	52
101	16+444	16+465	21
102	16+595	16+615	20
103	16+965	16+995	30
104	17+025	17+105	80
105	17+145	17+165	20
106	17+195	17+215	20
107	17+235	17+275	40
108	17+315	17+445	130
109	17+595	17+655	60
110	17+695	17+705	10
111	17+712	17+725	13
112	17+885	17+985	100
113	18+035	18+135	100
114	18+205	18+267	62
115	18+495	18+545	50
116	18+565	18+595	30
117	18+635	18+705	70
118	18+775	18+795	20
119	18+925	18+972	47
120	19+045	19+069	24
121	19+145	19+175	30
122	19+305	19+395	90
123	19+442	19+535	93
124	19+555	19+565	10
125	19+605	19+614	9
126	19+655	19+725	70
127	19+735	19+765	30
128	19+803	19+815	12
129	19+834	19+875	41
130	19+895	19+945	50
131	19+985	20+045	60
132	20+055	20+105	50

Sl. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
133	20+125	20+175	50
134	20+235	20+355	120
135	20+401	20+425	24
136	20+465	20+503	38
137	20+515	20+525	10
138	20+535	20+585	50
139	20+615	20+635	20
140	20+675	20+715	40
141	20+915	20+925	10
142	20+961	20+966	5
143	21+057	21+115	58
144	21+235	21+244	9
145	21+355	21+365	10
146	21+435	21+535	100
147	21+583	21+601	18
148	21+615	21+632	17
149	21+675	21+702	27
150	21+715	21+885	170
151	21+898	21+905	7
152	21+913	21+945	32
153	21+989	22+006	17
154	22+035	22+065	30
155	22+105	22+143	38
156	22+154	22+165	11
157	22+185	22+225	40
158	22+235	22+255	20
159	22+285	22+305	20
160	22+362	22+395	33
161	22+405	22+415	10
162	22+445	22+515	70
163	22+545	22+551	6
164	22+555	22+617	62
165	22+785	22+822	37
166	22+835	22+854	19
167	22+876	22+885	9
168	22+905	22+925	20
169	23+265	23+292	27
170	23+655	23+714	59
171	23+735	23+774	39
172	23+845	23+905	60
173	23+935	23+975	40

Sl. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
174	24+025	24+031	6
175	24+095	24+155	60
176	24+222	24+245	23
177	24+305	24+332	27
178	24+429	24+437	7
179	24+498	24+522	24
180	24+565	24+585	20
181	24+665	24+685	20
182	24+725	24+775	50
183	24+818	24+834	16
184	24+877	24+925	48
185	24+945	25+005	60
186	25+284	25+406	122
187	26+125	26+145	20
188	26+185	26+195	10
189	26+724	26+729	5
190	26+735	26+775	40
191	26+814	26+855	40
192	26+865	26+875	10
193	27+233	27+285	52
194	27+295	27+345	50
195	27+415	27+422	7
196	27+475	27+585	110
197	27+815	27+835	20
198	27+945	27+986	41
199	28+265	28+295	30
200	28+305	28+315	10
201	28+715	28+725	10
202	28+929	28+950	21
203	30+685	30+693	8
204	30+745	30+775	30
205	30+846	30+855	9
206	31+835	31+898	63
207	32+095	32+105	10
208	32+153	32+165	12
209	34+819	34+825	6
210	35+425	35+435	10
211	36+725	36+735	10
212	36+755	36+835	80
213	37+025	37+055	30
214	37+165	37+215	50

Sl. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
215	37+295	37+332	37
216	37+375	37+395	20
217	37+595	37+635	40
218	38+362	38+415	53
219	38+465	38+474	9
220	38+935	38+955	20
221	39+345	39+356	11
222	39+715	39+737	22
223	40+063	40+068	5
224	40+085	40+095	10
225	40+105	40+135	30
226	40+175	40+215	40
227	40+245	40+255	10
228	40+305	40+315	10
229	40+438	40+465	27
230	40+725	40+735	10
231	40+755	40+771	16
232	41+325	41+375	50
233	42+045	42+052	7
234	43+577	43+595	18
235	43+625	43+655	30
236	43+675	43+729	54
237	43+738	43+916	179
238	43+924	43+955	31
239	44+145	44+194	49
240	44+245	44+255	10
241	44+353	44+372	19
242	44+535	44+543	8
243	44+655	44+715	60
244	44+865	44+883	18
245	44+965	44+975	10
246	45+185	45+205	20
247	45+845	45+875	30
248	45+995	46+007	12
249	46+019	46+025	6
250	46+067	46+075	8
251	46+085	46+098	13
252	46+245	46+255	10
253	46+302	46+307	5
254	46+575	46+625	50
255	46+675	46+706	31

Sl. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
256	47+769	47+775	6
257	47+802	47+815	13
258	47+895	47+918	23
259	47+955	47+975	20
260	50+558	50+595	37
261	50+705	50+725	20
262	50+745	50+755	10
263	51+148	51+169	21
264	51+325	51+385	60
265	51+405	51+445	40
266	51+625	51+645	20
267	51+665	51+785	120
268	52+475	52+505	30
269	52+515	52+555	40
270	52+685	52+755	70
271	52+765	52+775	10
272	52+815	52+845	30
273	53+124	53+165	41
274	53+171	53+176	5
275	53+205	53+235	30
276	53+255	53+308	53
277	53+455	53+475	20
278	53+768	53+845	77
279	54+260	54+275	15
280	54+495	54+505	10
281	54+515	54+545	30
282	54+785	54+975	190
283	56+635	56+675	40
284	57+135	57+145	10
285	58+703	58+708	5
286	58+844	58+849	5
287	59+127	59+145	18
288	59+325	59+365	40
289	59+394	59+445	51
290	59+545	59+565	20
291	59+615	59+665	50
292	59+742	59+776	34
293	59+937	59+945	8
294	59+975	60+005	30
295	60+055	60+075	20
296	60+135	60+205	70

Sl. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
297	60+265	60+305	40
298	60+343	60+405	62
299	60+465	60+485	20
300	60+525	60+645	120
301	60+656	60+697	40
302	60+805	60+834	29
303	60+927	60+932	6
304	61+006	61+015	9
305	61+075	61+115	40
306	61+205	61+235	30
307	61+281	61+347	67
308	61+375	61+395	20
309	61+475	61+494	19
310	61+535	61+555	20
311	61+625	61+755	130
312	62+016	62+035	20
313	62+263	62+270	7
314	62+272	62+318	45
315	62+391	62+422	32
316	62+695	62+720	25
317	62+725	62+745	20
318	62+924	62+935	11
319	63+005	63+015	10
320	63+445	63+465	20
321	63+595	63+625	30
322	63+665	63+685	20
323	65+615	65+645	30
324	65+655	65+665	10
325	66+265	66+325	60
326	66+365	66+455	90
327	66+805	66+845	40
328	66+875	66+885	10
329	66+945	66+955	10
330	67+065	67+095	30
331	67+635	67+655	20
332	68+095	68+135	40
333	68+185	68+205	20
334	68+215	68+225	10
335	68+235	68+265	30
336	68+345	68+365	20
337	68+375	68+435	60
338	68+455	68+495	40
339	68+725	68+735	10
340	68+745	68+755	10
341	68+765	68+805	40
342	68+935	68+975	40
343	69+025	69+065	40
344	69+185	69+245	60
345	69+325	69+445	120
346	69+515	69+535	20
347	69+555	69+575	20
348	69+785	69+835	50
349	69+965	69+995	30
350	70+015	70+025	10
351	70+135	70+275	140
352	70+315	70+335	20
353	70+405	70+425	20
354	70+445	70+495	50
355	70+505	70+525	20
356	70+565	70+605	40
357	70+665	70+675	10
358	70+705	70+727	22
359	70+998	71+025	27
360	71+055	71+114	59
361	71+165	71+175	10
362	71+195	71+215	20
363	71+235	71+300	65
364	71+303	71+325	22
365	71+335	71+400	65
366	71+405	71+455	51
367	71+495	71+523	28
368	71+603	71+625	22
369	71+653	71+687	34
370	71+705	71+785	80
371	71+865	71+931	66
372	71+995	72+035	40
373	72+075	72+080	5
374	72+085	72+125	40
375	72+201	72+203	1
376	72+206	72+228	21
377	72+295	72+315	20
378	72+408	72+434	25

Sl. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
379	72+535	72+555	20
380	72+585	72+613	28
381	72+616	72+640	24
382	72+644	72+665	21
383	72+713	72+743	31
384	72+765	72+784	19
385	72+955	72+985	30
386	73+025	73+063	38
387	73+197	73+222	25
388	73+245	73+266	21
389	73+385	73+440	55
390	73+445	73+485	40
391	73+505	73+537	32
392	73+595	73+605	10
393	73+655	73+675	20
394	73+685	73+700	15
395	73+705	73+735	30
396	73+765	73+875	110
397	73+886	73+915	29
398	74+221	74+255	34
399	74+414	74+485	71
400	74+735	74+745	10
401	74+785	74+845	60
402	74+865	74+908	43
403	74+965	75+055	90
404	75+475	75+500	25
405	75+505	75+626	121
406	75+787	75+815	28
407	75+862	75+915	53
408	76+165	76+173	8
409	76+177	76+245	68
410	76+385	76+495	110
411	76+557	76+607	50
412	76+635	76+645	10
413	76+805	76+815	10
414	77+745	77+765	20
415	78+095	78+115	20
416	78+283	78+304	21
417	78+647	78+665	18
418	78+684	78+689	5
419	79+393	79+451	58
420	79+615	79+665	50
421	79+713	79+793	81
422	79+875	79+895	20
423	79+905	79+982	77
424	79+995	80+045	50
425	80+055	80+215	160
426	80+285	80+335	50
427	80+474	80+504	29
428	80+535	80+586	51
429	80+665	80+695	30
430	80+775	80+805	30
431	80+815	80+884	69
432	80+889	80+944	55
433	80+985	81+005	20
434	81+015	81+055	40
435	81+075	81+175	100
436	81+235	81+266	31
437	81+385	81+405	20
438	81+435	81+445	10
439	81+473	81+478	5
440	81+495	81+545	50
441	81+582	81+604	22
442	81+625	81+655	30
443	81+685	81+719	34
444	81+765	81+815	50
445	81+955	82+015	60
446	82+045	82+055	10
447	82+075	82+119	44
448	82+155	82+205	50
449	82+225	82+235	10
450	82+255	82+375	120
451	82+385	82+535	150
452	82+595	82+615	20
453	82+685	82+715	30
454	82+725	82+755	30
455	82+795	82+855	60
456	82+895	83+145	250
457	83+165	83+194	29
458	83+205	83+235	30
459	83+305	83+384	79
460	83+415	83+500	85

Sl. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
461	83+505	83+525	20
462	83+545	83+555	10
463	83+655	83+685	30
464	83+729	83+875	146
465	83+915	83+948	33
466	83+955	84+005	50
467	84+025	84+065	40
468	84+125	84+185	60
469	84+194	84+200	6
470	84+205	84+285	80
471	84+295	84+325	30
472	84+364	84+381	17
473	84+386	84+390	4
474	84+393	84+415	22
475	84+425	84+435	10
476	84+465	84+785	320
477	84+886	85+005	119
478	85+025	85+045	20
479	85+085	85+103	18
480	85+158	85+197	39
481	85+265	85+285	20
482	85+325	85+335	10
483	85+462	85+500	38
484	85+505	85+545	40
485	85+615	85+723	108
486	85+754	85+795	41
487	85+875	85+897	23
488	85+975	85+994	19
489	86+005	86+024	19
490	86+124	86+255	131
491	86+279	86+325	46
492	86+365	86+405	40
493	86+415	86+455	40
494	86+494	86+498	4
495	86+505	86+545	40
496	86+605	86+651	46
497	86+705	86+785	80
498	86+855	86+872	17
499	87+275	87+325	50
500	87+365	87+389	24
501	87+434	87+495	61
502	87+514	87+536	23
503	87+635	87+685	50
504	87+725	87+795	70
505	87+805	87+935	130
506	87+941	88+105	164
507	88+115	88+143	28
508	88+175	88+235	60
509	88+252	88+284	32
510	88+655	88+685	30
511	88+805	88+825	20
512	88+835	88+915	80
513	88+965	89+165	200
514	89+198	89+235	37
515	89+273	89+315	42
516	89+335	89+395	60
517	89+424	89+442	18
518	90+175	90+185	10
519	90+237	90+245	7
520	90+405	90+445	40
521	90+495	90+515	20
522	90+525	90+555	30
523	90+675	90+835	160
524	90+845	90+875	30
525	90+905	90+955	50
526	91+015	91+024	9
527	91+045	91+065	20
528	91+095	91+105	10
529	91+145	91+154	9
530	91+195	91+245	50
531	91+325	91+435	110
532	91+615	91+665	50
533	91+695	91+815	120
534	91+855	91+946	91
535	92+145	92+205	60
536	92+245	92+255	10
537	92+275	92+325	50
538	92+335	92+392	56
539	92+397	92+405	8
540	92+425	92+475	50
541	92+585	92+625	40
542	92+918	92+927	9

Sl. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
543	93+016	93+045	29
544	93+055	93+125	70
545	93+155	93+172	17
546	93+275	93+325	50
547	93+382	93+433	50
548	93+454	93+485	32
549	93+695	93+725	30
550	93+865	93+965	100
551	93+980	93+985	5
552	93+995	94+080	85
553	94+115	94+135	20
554	94+195	94+315	120
555	94+375	94+425	50
556	94+605	94+645	40
557	94+735	94+805	70
558	94+845	94+886	41
559	94+925	94+962	37
560	95+075	95+108	33
561	95+486	95+507	21
562	96+015	96+023	8
563	96+675	96+685	10
564	97+935	97+955	20
565	98+285	98+296	11
566	98+505	98+535	30
567	99+295	99+361	66
568	99+456	99+464	8
569	99+684	99+710	26
570	99+955	99+961	6
571	100+343	100+355	12
572	100+789	100+795	6
573	102+654	102+659	5
574	102+776	102+787	12
575	103+342	103+362	20
576	104+082	104+087	5
577	104+345	104+405	60
578	104+915	104+965	50
579	105+092	105+097	5
580	105+215	105+229	14
581	105+235	105+245	10
582	105+795	105+975	180
583	106+223	106+245	22
584	106+315	106+327	12
585	106+435	106+443	8
586	106+813	106+851	38
587	106+875	106+895	20
588	107+097	107+115	18
589	107+185	107+195	10
590	107+385	107+415	30
591	107+895	107+925	30
592	108+335	108+375	40
593	108+475	108+504	29
594	108+583	108+664	81
595	108+725	108+743	18
596	108+825	108+925	100
597	108+956	108+985	29
598	109+003	109+055	52
599	109+155	109+255	100
600	109+274	109+385	111
601	109+395	109+455	60
602	112+985	113+025	40
603	113+106	113+115	10
604	113+427	113+623	196
605	113+635	113+835	200
606	114+345	114+385	40
607	114+415	114+458	43
608	114+775	114+795	20
609	114+815	114+825	10
610	114+875	114+915	40
611	114+943	115+007	64
612	115+015	115+065	50
613	115+175	115+185	10
614	115+205	115+245	40
615	115+255	115+303	48
616	115+330	115+533	203
			23856

Table 4-18: Improvement Proposals: Gabion Wall Length for PP Road

S. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
1	0+005	0+195	190
2	0+365	0+625	260
3	0+645	0+835	190
4	0+965	1+005	40
5	1+035	1+128	93
6	1+130	1+135	5
7	1+335	1+365	30
8	1+565	1+615	50
9	1+668	1+715	47
10	1+765	1+846	81
11	1+995	2+065	70
12	2+100	2+135	35
13	2+195	2+215	20
14	3+385	3+405	20
15	3+539	3+617	78
16	3+705	3+715	10
17	3+795	3+803	8
18	3+866	3+878	13
19	4+415	4+425	10
20	4+995	5+035	40
21	5+157	5+175	18
22	5+225	5+265	40
23	5+733	5+755	22
24	5+911	5+955	44
25	5+965	5+985	20
26	6+065	6+085	20
27	6+115	6+165	50
28	6+195	6+205	10
29	6+275	6+325	50
30	6+345	6+395	50
31	6+469	6+505	36
32	6+551	6+605	54
33	6+675	6+686	11
34	7+095	7+113	18
35	7+125	7+165	40
36	7+307	7+325	18
37	7+335	7+425	90
38	7+436	7+475	39
39	7+495	7+515	20
40	7+585	7+595	10
41	7+665	7+675	10
42	7+682	7+695	13
43	7+745	7+862	117
44	7+866	7+945	79
45	8+115	8+130	15
46	8+133	8+165	32
47	8+185	8+195	10
48	8+223	8+263	40
49	8+315	8+405	90
50	8+425	8+435	10
51	8+445	8+467	22
52	8+485	8+495	10
53	8+515	8+531	16
54	8+535	8+545	10
55	8+555	8+565	10
56	8+725	8+785	60
57	8+895	8+965	70
58	9+025	9+045	20
59	9+061	9+085	24
60	9+158	9+195	37
61	9+251	9+355	104
62	9+485	9+575	90
63	9+705	9+715	10
64	9+895	9+935	40
65	10+126	10+139	12
66	10+139	10+175	36
67	10+315	10+355	40
68	10+425	10+475	50
69	10+533	10+605	72
70	10+615	10+625	10
71	10+705	10+745	40
72	10+817	10+831	14
73	10+836	10+846	10
74	10+957	10+965	8
75	11+135	11+286	151
76	11+375	11+405	30
77	11+567	11+646	79
78	11+687	11+705	18
79	11+745	11+825	80
80	11+885	11+905	20
81	11+955	11+975	20
82	12+043	12+046	3

S. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
83	12+048	12+105	57
84	12+407	12+465	58
85	12+475	12+594	119
86	12+665	12+701	36
87	12+735	12+785	50
88	12+875	12+895	20
89	12+945	13+035	90
90	13+072	13+073	2
91	13+077	13+145	68
92	13+155	13+365	210
93	13+425	13+457	32
94	13+515	13+535	20
95	13+755	13+785	30
96	13+825	13+845	20
97	13+985	13+989	5
98	13+995	14+002	7
99	14+007	14+013	7
100	14+018	14+035	17
101	14+085	14+117	32
102	14+119	14+255	136
103	14+314	14+395	81
104	14+433	14+505	72
105	14+655	14+665	10
106	14+745	14+795	50
107	15+067	15+085	18
108	15+165	15+245	80
109	15+285	15+335	50
110	15+365	15+445	80
111	15+465	15+495	30
112	15+551	15+556	5
113	15+565	15+605	40
114	15+674	15+735	61
115	15+782	15+805	23
116	15+815	16+185	370
117	16+195	16+353	158
118	16+405	16+825	420
119	16+866	16+925	59
120	17+005	17+300	295
121	17+300	17+425	125
122	17+435	17+565	130
123	17+585	17+726	141
124	17+728	17+865	137

S. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
125	17+885	17+945	60
126	18+085	18+155	70
127	18+335	18+362	27
128	18+366	18+449	83
129	18+462	18+545	83
130	18+567	18+596	29
131	18+605	18+765	160
132	18+885	19+001	116
133	19+085	19+117	32
134	19+265	19+375	110
135	19+395	19+424	29
136	19+565	19+575	10
137	19+975	19+988	13
138	20+045	20+085	40
139	20+105	20+165	60
140	20+195	20+240	45
141	20+245	20+346	102
142	20+348	20+440	92
143	20+475	20+497	22
144	20+535	20+541	6
145	20+546	20+585	39
146	20+985	20+991	6
147	20+991	21+025	34
148	21+055	21+075	20
149	21+216	21+240	24
150	21+277	21+375	98
151	21+475	21+514	39
152	21+789	21+837	48
153	22+075	22+155	80
154	22+226	22+245	19
155	22+265	22+285	20
156	22+315	22+427	112
157	22+555	22+595	40
158	22+625	22+785	160
159	23+135	23+187	52
160	23+245	23+287	42
161	23+294	23+305	11
162	23+315	23+445	130
163	23+485	23+525	40
164	23+565	23+615	50
165	23+635	23+705	70
166	23+755	23+795	40

S. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
167	23+835	23+890	55
168	24+325	24+335	10
169	24+615	24+705	90
170	25+024	25+035	11
171	25+066	25+095	29
172	25+188	25+221	33
173	25+255	25+365	110
174	25+505	25+575	70
175	25+585	25+645	60
176	25+735	25+885	150
177	25+965	26+035	70
178	26+175	26+285	110
179	26+335	26+445	110
180	26+585	26+605	20
181	26+655	26+717	62
182	26+735	26+805	70
183	26+855	26+915	60
184	26+995	27+105	110
185	27+165	27+195	30
186	27+245	27+285	40
187	27+475	27+485	10
188	27+585	27+695	110
189	27+765	27+805	40
190	27+822	27+885	63
191	27+904	27+935	31
192	27+972	27+995	23
193	28+005	28+078	73
194	28+105	28+155	50
195	28+175	28+195	20
196	28+205	28+215	10
197	28+235	28+295	60
198	28+325	28+385	60
199	28+444	28+553	109
200	28+675	28+704	29
201	29+125	29+155	30
202	29+265	29+306	41
203	29+535	29+615	80
204	30+107	30+145	38
205	30+225	30+265	40
206	30+365	30+375	10
207	30+515	30+545	30
208	30+624	30+655	31
209	30+965	30+995	30
210	31+043	31+085	42
211	31+145	31+205	60
212	31+215	31+240	25
213	31+337	31+375	38
214	31+387	31+415	28
215	31+635	31+685	50
216	31+695	31+765	70
217	31+785	31+815	30
218	31+925	31+995	70
219	32+045	32+085	40
220	32+105	32+139	34
221	32+145	32+255	110
222	32+285	32+373	88
223	32+415	32+425	10
224	32+479	32+482	3
225	32+487	32+525	38
226	32+555	32+571	16
227	32+615	32+625	10
228	32+685	32+734	49
229	32+767	32+805	38
230	32+853	32+875	22
231	32+905	32+961	56
232	33+005	33+185	180
233	33+195	33+209	14
234	33+335	33+345	10
235	33+395	33+425	30
236	33+455	33+485	30
237	33+665	33+735	70
238	33+915	33+965	50
239	34+004	34+025	21
240	34+125	34+135	10
241	34+205	34+255	50
242	34+315	34+335	20
243	34+435	34+445	10
244	34+485	34+515	30
245	34+735	34+755	20
246	34+758	34+775	18
247	34+824	34+892	68
248	34+894	34+910	16
249	34+915	34+926	11
250	35+025	35+065	40

S. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
251	35+221	35+255	34
252	35+415	35+505	90
253	35+815	35+868	53
254	35+885	35+925	40
255	36+124	36+155	31
256	36+285	36+335	50
257	36+365	36+385	20
258	36+425	36+479	54
259	36+525	36+555	30
260	36+575	36+612	37
261	36+655	36+662	7
262	37+116	37+275	159
263	37+375	37+525	150
264	37+565	37+615	50
265	37+675	37+855	180
266	37+905	37+945	40
267	37+975	38+008	33
268	38+159	38+165	6
269	38+215	38+285	70
270	38+325	38+355	30
271	38+485	38+528	43
272	38+565	38+584	19
273	38+587	38+683	96
274	38+688	38+700	13
275	38+755	38+775	20
276	38+835	38+895	60
277	38+915	38+945	30
278	38+995	39+085	90
279	39+336	39+377	40
280	39+486	39+505	19
281	39+532	39+634	102
282	39+639	39+645	6
283	39+702	39+935	233
284	39+995	40+025	30
285	40+035	40+046	11
286	40+095	40+125	30
287	40+155	40+335	180
288	40+375	40+417	42
289	40+538	40+545	7
290	40+565	40+605	40
291	40+675	40+715	40
292	40+840	40+845	5
293	41+055	41+117	62
294	41+405	41+475	70
295	41+544	41+595	51
296	41+605	41+685	80
297	41+745	41+935	190
298	41+956	42+005	49
299	42+035	42+075	40
300	42+095	42+125	30
301	42+187	42+215	28
302	42+225	42+235	10
303	42+245	42+305	60
304	42+375	42+435	60
305	42+479	42+515	36
306	42+575	42+605	30
307	42+635	42+655	20
308	42+705	42+746	41
309	42+815	42+865	50
310	42+885	43+055	170
311	43+107	43+115	8
312	43+125	43+237	112
313	43+238	43+285	47
314	43+366	43+371	5
315	43+405	43+542	137
316	43+555	43+815	260
317	44+045	44+055	10
318	44+095	44+122	27
319	44+157	44+185	28
320	44+225	44+253	28
321	44+335	44+345	10
322	44+377	44+435	58
323	44+455	44+475	20
324	44+524	44+555	31
325	44+625	44+715	90
326	44+718	44+805	87
327	44+825	44+865	40
328	44+895	44+925	30
329	44+985	45+015	30
330	45+095	45+125	30
331	45+195	45+245	50
332	45+285	45+345	60
333	45+391	45+455	64
334	45+515	45+535	20

S. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
335	45+575	45+595	20
336	45+735	45+765	30
337	45+776	45+815	39
338	45+997	46+105	108
339	46+135	46+195	60
340	46+265	46+303	37
341	46+325	46+375	50
342	46+475	46+535	60
343	46+575	46+594	19
344	46+645	46+715	70
345	46+725	46+875	150
346	46+880	46+885	5
347	47+075	47+083	8
348	47+124	47+225	101
349	47+386	47+425	39
350	47+805	47+863	58
351	47+875	47+984	109
352	48+035	48+065	30
353	48+095	48+125	30
354	48+386	48+455	69
355	48+552	48+605	53
356	48+665	48+695	30
357	48+819	48+935	116
358	49+127	49+155	28
359	49+185	49+215	30
360	49+295	49+305	10
361	49+312	49+317	5
362	49+345	49+445	100
363	49+775	49+835	60
364	49+925	49+955	30
365	49+975	50+015	40
366	50+055	50+245	190
367	50+305	50+315	10
368	50+665	50+725	60
369	50+795	50+915	120
370	50+975	51+065	90
371	51+115	51+135	20
372	51+204	51+252	48
373	51+525	51+552	27
374	51+624	51+655	31
375	51+661	51+665	5
376	51+933	51+965	32

S. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
377	52+108	52+146	38
378	52+186	52+265	79
379	52+315	52+425	110
380	52+585	52+665	80
381	52+769	52+825	56
382	52+865	52+885	20
383	53+045	53+065	20
384	53+105	53+165	60
385	53+245	53+395	150
386	53+405	53+465	60
387	53+485	53+518	33
388	53+565	53+605	40
389	53+653	53+695	42
390	53+825	53+843	18
391	53+865	53+916	51
392	53+925	53+984	59
393	54+004	54+072	68
394	54+295	54+325	30
395	54+438	54+535	97
396	54+555	54+595	40
397	54+765	54+785	20
398	55+306	55+355	49
399	55+405	55+425	20
400	55+495	55+515	20
401	55+565	55+585	20
402	55+605	55+625	20
403	55+835	55+875	40
404	55+925	55+965	40
405	56+035	56+055	20
406	56+085	56+105	20
407	56+311	56+335	24
408	56+515	56+535	20
409	56+595	56+625	30
410	56+695	56+725	30
411	56+795	56+855	60
412	56+995	57+006	11
413	57+225	57+235	10
414	57+375	57+395	20
415	57+555	57+568	13
416	57+985	58+025	40
417	58+065	58+075	10
418	58+265	58+275	10

S. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
419	58+325	58+418	93
420	58+448	58+465	17
421	58+557	58+645	88
422	58+654	58+723	70
423	58+754	58+835	81
424	58+935	58+996	61
425	59+075	59+095	20
426	59+186	59+209	22
427	59+209	59+265	56
428	59+295	59+355	60
429	59+775	60+044	269
430	60+215	60+244	29
431	60+325	60+445	120
432	60+645	60+716	71
433	60+745	60+885	140
434	60+925	60+935	10
435	60+965	61+005	40
436	61+015	61+157	142
437	61+165	61+175	10
438	61+305	61+475	170
439	61+515	61+605	90
440	61+625	61+675	50
441	61+715	61+763	48
442	61+875	61+903	28
443	61+965	62+002	37
444	62+025	62+105	80
445	62+164	62+536	372
			24217

Table 4-19: Improvement Proposals: Reinforced Earth Wall Length for MTM Road

S. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
1	3+505	3+535	30
2	7+535	7+555	20
3	9+395	9+435	40
4	9+595	9+615	20
5	11+775	11+795	20
6	11+805	11+834	29
7	14+865	14+915	50
8	15+083	15+088	5
9	15+094	15+112	18
10	17+105	17+135	30
11	17+660	17+690	29
12	18+015	18+025	10
13	18+175	18+215	40
14	18+385	18+395	10
15	20+287	20+296	9
16	24+805	24+825	20
17	24+895	24+915	20
18	30+435	30+605	170
19	31+605	31+695	90
20	31+705	31+735	30
21	32+245	32+265	20
22	40+535	40+545	10
23	40+553	40+575	22
24	41+055	41+075	20
25	41+325	41+355	30
26	41+405	41+435	30
27	41+445	41+465	20
28	44+755	44+805	50
29	45+195	45+215	20
30	45+264	45+275	11
31	45+305	45+315	10
32	48+905	48+985	80
33	51+243	51+275	32
34	53+295	53+335	40
35	55+095	55+115	20
36	63+875	63+915	40
37	73+565	73+573	8
38	75+525	75+565	40
39	75+605	75+645	40
40	75+685	75+723	38
41	75+735	75+795	60
42	75+805	75+815	10
43	78+513	78+535	23
44	79+665	79+675	10
45	82+525	82+545	20
			1394

Table 4-20: Improvement Proposals: Reinforced Earth Wall Length for CL Road

Sl. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
1	0+024	0+061	37
2	1+239	1+275	36
3	9+135	9+184	49
4	9+505	9+525	20
5	10+375	10+405	30
6	11+064	11+069	5
7	13+452	13+486	34
8	18+625	18+675	50
9	22+055	22+063	8
10	22+075	22+105	30
11	24+135	24+195	60
12	31+565	31+615	50
			409

Table 4-21: Improvement Proposals: Reinforced Earth Wall Length for CZ Road

S. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
1	10+135	10+155	20
2	17+275	17+315	40
3	17+805	17+825	20
4	40+735	40+755	20
5	43+595	43+625	30
6	69+535	69+555	20
7	81+405	81+435	30
8	85+994	86+005	11
			191

Table 4-22: Improvement Proposals: Reinforced Earth Wall Length for PP Road

S. No.	From Chainage (in m)	To Chainage (in m)	Length (m)
1	57+875	57+895	20
2	57+905	57+985	80
3	61+675	61+715	40
			140

Chapter 5

Cost Estimate

Chapter 5 Cost Estimate

5.1 General

The concise and updated estimate of costs involved to implement improvement proposals discussed, is presented in this chapter. The project improvement proposal implementation would involve excavation of hills, construction of new pavements structure, new major/minor bridges, cross drainage structures (culverts), Longitudinal Drainage, Protection works, Erosion Control measures and Road Appurtenances etc.

This cost estimate has been worked out using quantities for different items of works derived from detailed design and unit rates derived from state Schedule of Rates/Market.

5.2 Item of Works

For estimation of quantities & costs, various work items have been grouped under the following heads:

Table 5-1: Major items of Works

Item of Works	Description of Items
Site Clearance Works	Clearing and Grubbing of Roadway; Dismantling of Stone Masonry; Dismantling of PCC/RCC Structures; Removal of Cement Concrete Pipes;
Earthworks	Excavation in soil and ordinary Rock; Excavation of Hard Rock; Construction of Embankment using roadway excavation materials; Sub-grade Construction by Loosening and Compaction; Sub grade Construction by using roadway excavation materials; Sub grade construction by using Borrow Earth Materials; Subgrade construction in rocky formations;
Non–Bituminous Sub-base & Base courses	Granular Sub-Base Wet Mix Macadam
Bituminous Works	Prime Coat Tack Coat Dense Bituminous Macadam (DBM) Bituminous Concrete (BC)
Bridges	Bridges (all types)
Cross Drainage Structures	Pipe Culverts; Slab Culverts; Box Culverts;
Drainage & Protective Works	Lined Drains (Stone Pitched) RCC Drains Gabion Wall Chute Drains Erosion Control Measures Nailing Parapet Wall W Beam Crash Barrier
Appurtenances	Hectometer, Kilometer and 5th Km Stones; Sign Boards; Pavement marking; Crash barrier; Gantry Sign Boards;
Road Side Amenities	Bus bays; Truck Park/Rest Area & Recreational Area;
Safety devices during Construction	Construction of Temporary Diversion and Providing traffic safety, Maintenance of temporary diversions;
Utility's Relocation	Power Line/Water/Telephone Poles/Cables
Environmental Improvement Works	Environmental Mitigation Measures viz. construction of temporary diversions, bus bays and rest areas

5.3 Specifications

The Specifications for various items of work based on the general practice for normal construction of road, bridge and allied activities. The detailed specifications for each and every required activity has been defined in Volume IV: Technical Specification. The Proposed Technical Specifications are primarily based on Ministry of Road Transport and Highways "Specification for Road and Bridge Works, 5th Edition, 2013.

There are certain specific item which have not been defined and detailed in MoRTH specifications. The same have been added and presented as Additional Technical Specifications and have been complied in **Volume IV: Technical Specification**, submitted along with this report.

5.4 Unit Rates

5.4.1 General Approach

Unit rates of majority items of works have been worked out based on the "Standard Data Book for Analysis of Rates" of Ministry of Shipping, Road Transport & Highways and unit rates of Plant and Machinery, Labour, & Materials have been taken as per Nagaland State PWDs Schedule of Rates, SOR (2013-14), With minor modifications if required, prevailing market rates have been adopted for items not covered by the Standard Data Book for Analysis of Rates" wherever considered appropriate. Further an escalation of 10% has been considered for arriving at Rates for current financial year (2015-16).

The details have been presented in **Volume V: Rate Analysis**, submitted along with this report.

5.5 Quantity Estimate

Detailed Estimate of Quantities of item of construction in accordance with proposed improvement proposals presented in Chapter 4 of this report and **Volume II: Design Report** have been carried out and presented in **Volume VI: Cost Estimate** submitted along with this report.

5.6 Abstract of Cost Estimate

Based on estimate of quantities required to be executed for proposed improvement proposals and rates for each road, the summary of Bill wise project cost estimate for each project road is presented in tables below.

5.6.1 Merangkong Tamlu Mon (M T M) Road

Table 5-2: Abstract of Cost Estimate for M T M Road

Bill No.	Description	Amount (Rs.)	Figure in Crore
A	**Civil Works**		
1	Site Clearance and Dismantling	1,41,27,661	1.41
2	Earthworks	83,15,31,036	83.15
3	Granular Sub Base and Base Course	1,43,40,95,177	143.41
4	Bituminous Course	85,70,42,688	85.70
5	Cross Drainage	1,62,55,10,839	162.55
6	Bridge	47,51,53,196	47.52
7	Repair of Existing Bridges	0	0.00
8	Drainage and Protective Works	4,62,27,62,595	462.28
9	Traffic Signs, Road Markings and Appurtenances	23,59,19,826	23.39
10	Miscellaneous	7,26,39,590	7.26
	Sub Total for Civil Works (A)	**10,16,87,82,607**	1016.88
B	Utility Shifting Cost	2,00,00,000	2.00
	Sub Total (A+B)	**10,18,87,82,607**	1018.88
C	Physical Contingencies @5% on	50,93,12,887	50.93

Bill No.	Description	Amount (Rs.)	Figure in Crore
	(A+B)		
	Grand Total(A+B+C)	**10,69,82,21,738**	1069.82
	Length of the package Road (km)	**86.8**	**Km**
	Cost per km on TPC	**12.3**	**Crore**

5.6.2 Changtongya Longleng (C L) Road

Table 5-3: Abstract of Cost Estimate for C L Road

Bill No.	Description	Amount (Rs.)	Figure in Crore
A	**Civil Works**		
1	Site Clearance and Dismantling	65,31,709	0.65
2	Earthworks	59,21,80,240	59.22
3	Granular Sub Base and Base Course	67,53,28,538	67.53
4	Bituminous Course	39,29,40,187	39.29
5	Cross Drainage	69,32,95,778	69.33
6	Bridge	13,19,19,657	13.19
7	Repair of Existing Bridges	0	0.00
8	Drainage and Protective Works	2,82,33,05,121	282.33
9	Traffic Signs, Road Markings and Appurtenances	9,54,16,668	9.54
10	Miscellaneous	1,54,44,655	1.54
	Sub Total for Civil Works (A)	**5,42,63,62,552**	542.64
B	Utility Shifting Cost	80,00,000	0.80
	Sub Total (A+B)	**5,43,43,62,552**	543.44
C	Physical Contingencies @5% on (A+B)	27,17,18,128	27.17
	Grand Total(A+B+C)	**5,70,60,80,679**	570.61
	Length of the package Road (km)	**38.5**	**Km**
	Cost per km on TPC	**14.8**	**Crore**

5.6.3 Chakabama Zunheboto (C Z) Road

Table 5-4: Abstract of Cost Estimate for C Z Road

Bill No.	Description	Amount (Rs.)	Figure in Crore
A	**Civil Works**		
1	Site Clearance and Dismantling	2,71,49,647	2.71
2	Earthworks	2,16,47,19,927	216.47
3	Granular Sub Base and Base Course	2,46,28,24,986	246.28
4	Bituminous Course	1,27,14,46,928	127.14
5	Cross Drainage	2,72,83,23,192	272.83

Bill No.	Description	Amount (Rs.)	Figure in Crore
6	Bridge	27,61,76,075	27.62
7	Repair of Existing Bridges	1,54,320	0.02
8	Drainage and Protective Works	5,79,43,89,633	579.44
9	Traffic Signs, Road Markings and Appurtenances	35,52,64,745	35.53
10	Miscellaneous	16,97,61,090	16.98
	Sub Total for Civil Works (A)	**15,25,02,10,542**	1525.02
B	Utility Shifting Cost	2,50,00,000	2.50
	Sub Total (A+B)	**15,27,52,10,542**	1527.52
C	Physical Contingencies @5% on (A+B)	76,37,60,527	76.38
	Grand Total(A+B+C)	**16,03,89,71,069**	1603.90
	Length of the package Road (km)	**115.5**	**Km**
	Cost per km on TPC	**13.9**	**Crore**

5.6.4 Pfutsero Phek (P P) Road

Table 5-5: Abstract of Cost Estimate for P P Road

Bill No.	Description	Amount (Rs.)	Figure in Crore
A	**Civil Works**		
1	Site Clearance and Dismantling	1,53,18,649	1.53
2	Earthworks	1,23,12,45,505	123.12
3	Granular Sub Base and Base Course	1,31,77,33,700	131.77
4	Bituminous Course	68,63,33,109	68.63
5	Cross Drainage	1,70,75,62,820	170.76
6	Bridge	6,16,38,010	6.16
7	Repair of Existing Bridges	0	0.00
8	Drainage and Protective Works	3,21,18,65,097	321.19
9	Traffic Signs, Road Markings and Appurtenances	17,47,90,136	17.48
10	Miscellaneous	6,78,61,785	6.79
	Sub Total for Civil Works (A)	**8,47,43,48,810**	847.43
B	Utility Shifting Cost	1,30,00,000	1.30
	Sub Total (A+B)	**8,48,73,48,810**	848.73
C	Physical Contingencies @5% on (A+B)	42,43,67,441	42.44
	Grand Total(A+B+C)	**8,91,17,16,251**	891.17
	Length of the package Road (km)	**62.6**	**Km**
	Cost per km on TPC	**14.2**	**Crore**

Chapter 6

Conclusions and Recommendations

Chapter 6 Conclusion and Recommendations

The Department of Road Transport & Highways, Ministry of Road Transport and Highways, Government of India requires **Revised Detailed Project Report and Verification Report of executed items** for widening to 2-lane of 4 roads in the state of Nagaland under SARDP-NE Phase 'A'.

The total length of roads is 329 km. Most of the length passes through hilly terrain. The construction works for 2 – laning of these 4 roads was sanctioned by the Ministry of Road Transport and Highways on 09.12.2010 for Rs. 1296.00 Crore. The Original DPRs for above 4 state Roads were prepared by the State PWD of Nagaland by engaging the Consultant. The work was awarded at a contract price of Rs. 1130.67 Crore and the up to date physical progress as reported is about 20% with and presently the work is at stand still.

Further, as following New National Highways have been declared in State of Nagaland.

- **Changtongya** - **Longleng** - Longching - Mon - Lapa - Tizit - Assam Border as 'NH 702 New'
- Mokokchung - **Zunheboto** - **Chozuba** - Thaveopheshu - **Phek** - **Lanye** as 'NH 702 A'.

and, following sections / roads included in preparation of Revised Detailed Project Report would be part of New National Highway System.

- **Changtongya** - **Longleng** Road for Complete Length of 30 km (approx.)
- **Chozuba** (near Km 38/200 on Chakabama - Zunheboto Road from Chakabama) - **Zunheboto** Section of Chakabama Zunheboto Road, Length 84 Km (Approx.)
- **Assam Riffle Check Post** (End Point of Pfutsero - Phek Road) to **Phek Village** Junction, Section of Pfutsero Phek Road, Length 3.5 km (Approx.)

The Consultant have carried out assigned duties up to present stage and prepared & assessed improvement proposals coherent with project requirement which have been detailed in previous chapters of this report.

The Conclusions and recommendations for implementation of revised project and updated project proposals have been detailed below.

- The up-gradation of existing single / intermediate lane road with substandard geometrics to 2-Lane with Paved Shoulders configuration of National/State Highway Standard shall return benefit by
    - Reduction in Travel time
    - Reduction / Savings in vehicles operation cost and
    - Significant reduction in road accidents (by Improving Substandard Geometrics)
    - An Effective National Development work to encourage Road Transport to IRC Standards ensuring safe and smooth journey.

- Project roads are planned to be upgraded to be 2- lane with paved shoulders carriageway configuration facility with National Highways / State Highways Design Standards In spite of much below 'the warrant of design service volume' of traffic values as recommended by Indian Roads Congress.

- Project Road sections are part of road connectivity from National Highway to District Head Quarters via selected villages and route. The existing road width varies from single lane to intermediate lane. Also, there are many substandard curves, makes it difficult for maneuvering of commercial traffic. The improved facility would encourage movement of traffic, resulting in increase in economic activity and hence overall development of project influence area.

- Technically, The project Proposals stand feasible and recommended for implementation

- Four years duration for project implantation has been proposed with a phasing of 20%, 20%, 35% and 25% respectively in each year.

- Total Project Cost of Works is in range of INR 12.3 to 14.8 Crores per km which is attributed to non-availability of construction materials, entire reconstruction of existing roadway formation, pavement structure, extensive cross drainage, longitudinal drainage, Protection & Erosion Control

measures, **high rates** of commercial materials viz. Bitumen, Cement & Steel and **Carriage of materials at Site**.

- Project would be Economically Viable with social economic costs viz. all weather connectivity to population, increase in agricultural productivity due to reduction in wastage, Vehicle Operating Cost and Passenger time Cost but financially not viable.

- Project is to be taken up under EPC for urgent Implementation for Overall Development of Road Network and Socio Economic Development of Project Area.