National Highways & Infrastructure Development Corporation Limited

BUILDING INFRASTRUCTURE - BUILDING THE NATION

SCHEDULES

FOR

***Construction of Chhiahtlang bypass and Serchhip bypass (Package-1) on Aizawl-Tuipang section of NH-54 in the State of Mizoram* on Engineering, Procurement and Construction (EPC) mode, with Japan International Cooperation Agency (JICA) loan assistance.**

on

ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC) MODE

NATIONAL HIGHWAYS & INFRASTRUCTURE DEVELOPMENT CORPORATION LTD
(MINISTRY OF ROAD TRANSPORT & HIGHWAYS, GOVT. OF INDIA)

JANUARY, 2020

NHIDCL, 3RD FLOOR, PRESS TRUST OF INDIA BUILDING, 4, PARLIAMENT STREET, NEW DELHI – 110001

Schedule-A

(See Clauses 2.1 and 8.1)

Site of the Project

1. The Site

1.1 Site of the Two-Lane Project Highway shall include the land, buildings, structures and road works as described in **Annex-I** of this Schedule-A.

1.2 The dates of handing over the Right of Way to the Contractor are specified in **Annex-II** of this Schedule-A.

1.3 An inventory of the Site including the land, buildings, structures, road works, trees and any other immovable property on, or attached to, the Site shall be prepared jointly by the Authority Representative and the Contractor, and such inventory shall form part of the memorandum referred to in Clause 8.2.1 of this Agreement.

1.4 The alignment plans of the Project Highway are specified in **Annex-III**. In the case of sections where no modification in the existing alignment of the Project Highway is contemplated, the alignment plan has not been provided. Alignment plans have only been given for sections where the existing alignment is proposed to be upgraded. The proposed profile of the Project Highways shall be followed by the contractor with minimum FRL as indicated in the alignment plan. The Contractor, however has to improve/upgrade the Road Profile as indicated in Annexure-III based on site/design requirement.

1.5 The status of the environment clearances obtained or awaited is given in **Annex-IV**.

Annexure -I

(Schedule-A)

Site

Note: Through suitable drawings and description in words, the land, buildings, structures and road works comprising the Site are specified briefly but precisely in this Annex-I. All the chainages/ location referred to in Annex-I to Schedule-A are existing chainages.

1. Site

The Site of the Two-Lane Project Highway comprises the section of National Highway-54 of Chhiahtlang bypass Start near 94.460 km and End near 96.665 km and Serchhip bypass Start near 101.860 km and End near 111.500 km on Aizawl–Tuipang Section in the State of Mizoram. The land, carriageway and structures comprising the Site are described below.

2. Land

The Site of the Project Highway comprises the land (sum total of land already in possession and land to be possessed) as described below:

Sl. No.	Existing Chainage (km)		Design Chainage (km)		Length in m (Design)	Existing/ Available ROW (m)	Remarks
	From	To	From	To			
1	Chhiahtlang bypass		0+000	2+571	2.571	24	ROW available in realignment stretches as given in para 3.3 of Annexure-1 Schedule B
2	Serchhip bypass		0+000	11+829	11.829	24	

3. Carriageway

The entire package is green field alignment. There is no existing carriageway.

4. Major Bridges

The Site includes the following Major Bridges:

S. No.	Chainage (km)	Type of Structure			No. of Spans with span length (m)	Width (m)
		Foundation	Sub-structure	Super-structure		

Nil

5. Road over-bridges (ROB)/ Road under-bridges (RUB):

The Site includes the following ROB (road over railway line)/RUB (road under railway line):

S. No.	Chainage (km)	Type of Structure		No. of Spans with span length (m)	Width (m)	ROB/ RUB
		Foundation	Superstructure			
Nil						

6. Grade separators

The Site includes the following grade separators:

S. No.	Chainage (km)	Type of Structure		No. of Spans with span length (m)	Width (m)
		Foundation	Superstructure		
Nil					

7. Minor Bridges

The Site includes the following minor bridges

S. No.	Chainage (km)	Type of Structure			No. of Spans with span length (m)	Width (m)
		Foundation	Sub-structure	Super-structure		
Nil						

8. Railway level crossings

The Site includes the following railway level crossings

S. No.	Location (km)	Remarks
Nil		

9. Underpasses (Vehicular, Non Vehicular)

The Site includes the following underpasses:

S. No.	Chainage (km)	Type of Structure	No. of Spans with span length (m)	Width (m)
Nil				

10. Culverts

The Site has the following culverts:

Sl. No.	Chainage (km)	Type of Culvert	Span/Opening with span length (m)	Width (m)
Nil				

11. Bus bays/Bus Shelters

The details of bus bays/Shelter on the Site are as follows:

S. No.	Chainage (km)	Length (m)	Left Hand Side	Right Hand Side
Nil				

12. Truck Lay byes

The details of truck lay byes are as follows:

S. No.	Chainage (km)	Length (m)	Left Hand Side	Right Hand Side
Nil				

13. Road side drains

The details of the roadside drains are as follows:

S. No.	Location		Type	
	From km	to km	Masonry/cc (Pucca)	Earthen (Kutcha)
Nil				

14. Major junctions

The details of major junctions are as follows:

S. No.	Location	At	Separated	Category of Cross Road

	Existing Ch.	Design Ch.	grade		NH	SH	MDR	Others
Nil								

(NH: National Highway, SH: State Highway, MDR: Major District Road)

15. Minor junctions

The details of the minor junctions (all at grade) are as follows:

Sl. No	Existing Chainage (Km)		Type	
	From km	To km	T -junction	Cross road
Nil				

16. Bypasses

The details of the existing road sections proposed to be bypassed are as follows:

S. No.	Name of bypass (town)	Chainage (km) From km to km	Length (in Km)
1	Chhiahtlang Bypass	Start near 94.460 km and End near 96.665 km	2.571
2	Serchhip Bypass	Start near 101.860 km and End near 111.500 km	11.829

17. Other structures

NIL.

Annex - II

(As per Clause 8.3 (i))

(Schedule-A)

Dates for providing Right of Way

The dates on which the Authority shall provide Right of Way of Construction Zone to the Contractor on different stretches of the Site are stated below:

Sl. No	From km to km	Length (km)	Width (m)	Date of providing Right of Way*
(1)	**(2)**	**(3)**	**(4)**	**(5)**
(i) Full Right of Way (full width)	Km 0+000 to Km 2+571	2.571	24 m	90% of full Right of Way on Appointed Date
(ii) Balance 10% of full Right of Way	Km 0+000 to Km 11+829	11.829	24 m	Within 90 days of Appointed Date

*The dates specified herein shall in no case be beyond 90 (ninety) days after the Appointed Date.

Annex - III

(Schedule-A)

Alignment Plans

The existing alignment of the Project Highway shall be modified in the following sections as per the alignment plan indicated below:

(i) The alignment of the Project Highway is enclosed in alignment plan. Finished road level indicated in the alignment plan shall be followed by the contractor as minimum FRL. In any case, the finished road level of the project highway shall not be less than those indicated in the alignment plan. The contractor shall, however, improve/upgrade the Road profile as indicated in Annex-III based on site/design requirement.

(ii) Traffic Signage plan of the Project Highway showing numbers & location of traffic signs is enclosed. The contractor shall, however, improve/upgrade upon the traffic signage plan as indicated in Annex-III based on site/design requirement as per IRC: SP: 99 & IRC: 67.

The alignment plan of the Project Highway is available on CPP Portal i.e. https://eprocure.gov.in/cppp/ and NHIDCL website i.e. https://nhidcl.com/.

Annex - IV

(Schedule-A)

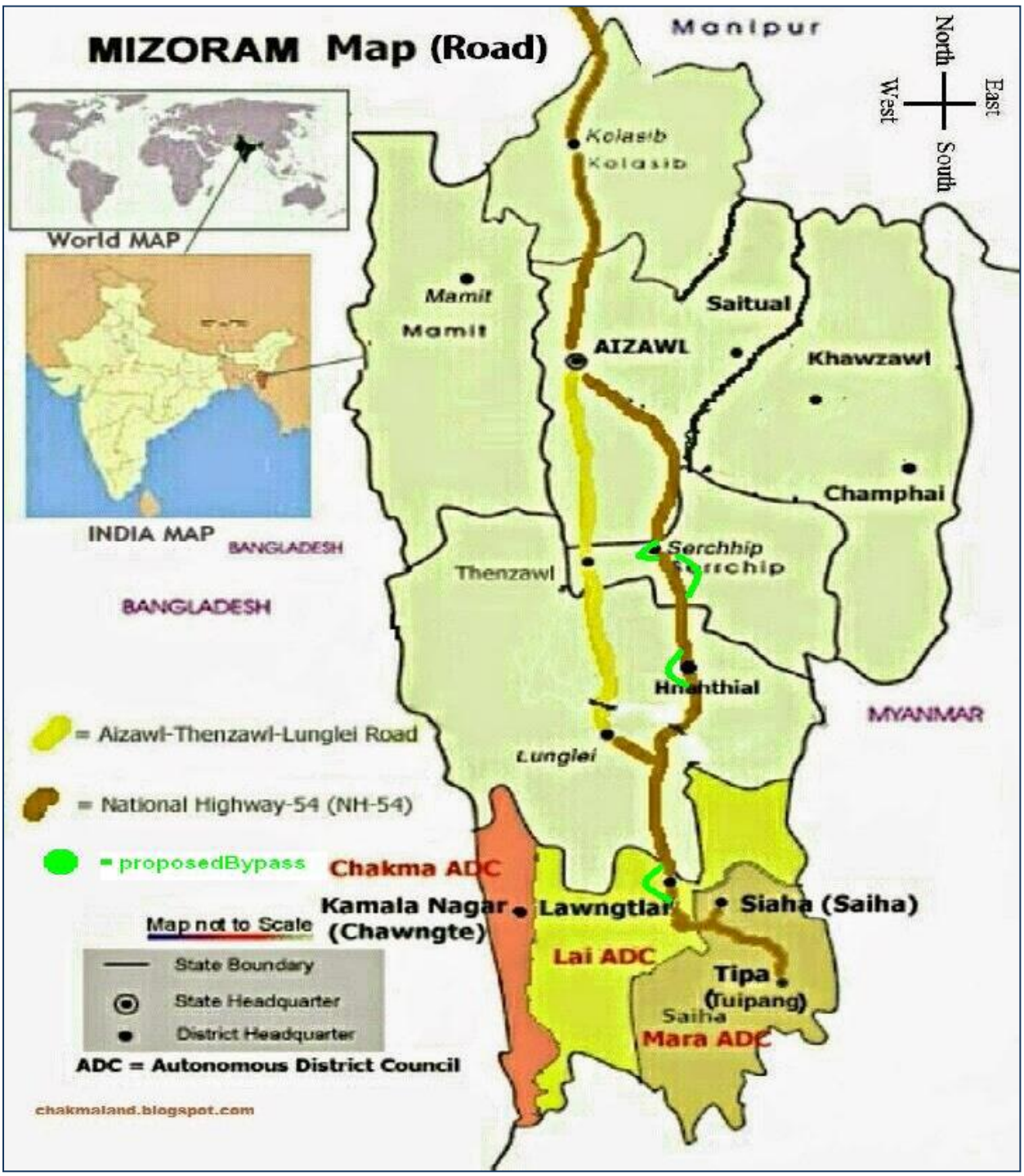
Environment Clearances

The project Highway does not require Environment Clearance as per MoRTH corrigendum dated 22.08.2013. The muck dumping sites in forest area stand identified and freezed by Forest department to be abided by agency during dumping of muck as stated in Schedule 'F'

Annex-V

(Schedule-A)

Index Map of Project Highways



Schedule - B

(See Clause 2.1)

Development of the Project Highway

1. Development of the Project Highway

Development of the Project Highway shall include design and construction of the Project Highway as described in this Schedule-B and in Schedule-C.

2. Rehabilitation and Up-gradation

Rehabilitation and augmentation shall include Two-Laning with Hard shoulder and Strengthening of the Project Highway as described in Annex-I of this Schedule-B and in Schedule-C.

3. Specifications and Standards

The Project Highway shall be designed and constructed in conformity with the Specifications and Standards specified in Annex-I of Schedule-D.

Annex -I

(Schedule –B)

Description of Two –Laning

1. Widening of the Existing Highway

1.1 The Project Highway shall follow the existing alignment unless otherwise specified by the Authority and shown in the alignment plans specified in Annex-III of Schedule-A. Geometric deficiencies, if any, in the existing horizontal and vertical profiles shall be corrected as per the prescribed standards for [plain/rolling] terrain to the extent land is available.

1.2 **Width of Carriageway**

1.2.1 Two-Laning with Hard shoulders shall be undertaken. The paved carriageway shall be 7 (seven) m wide in accordance with the typical cross sections of the Project highway in paragraphs 2.11 and Schedule-I: Drawings. Additional widths for widening at horizontal curve shall be as per the requirements of the design criteria.

The Project Highway passes through the following built up areas. (Proposed carriageway width in these areas shall not be less than existing carriageway width; however, four laning is not required):

Sl. No.	Built-up stretch (Township)	Location in m		Width (m)	Typical cross section (Ref. to Manual)
		From	To		
Nil					

1.2.2 Except as otherwise provided in this Agreement, the width of the paved carriageway and cross-sectional features shall conform to paragraph 1.1 above.

1.2.3 For the bypass planned section as shown in Table below or shown in Drawing widening and improvement of existing road is not required. However, replacement or rehabilitation of pavement of the existing road is required for the section.

2. Geometric Design and General Features

2.1 General

Geometric design and general features of the Project Highway shall be in accordance with Section 2 of the Manual.

2.2 Design Speed

The design speed shall be the ruling design speed of 40 km per hr and minimum design speed of 30 km per hr for Mountainous/ Steep terrain.

2.3 Improvement of the existing road geometry

The hilly gradients shall be corrected in such a way so as to attain a gradient preferably upto 6% in order to achieve longitudinal drainage. Also vertical curves shall be improved / introduced so that the vertical curves meet IRC: SP-73 - 2018 standards.

The horizontal alignment of the Project Highway shall be improved as per the standards set out in IRC-SP: 48:1998.

The improvement shall be done in consultation with the Independent consultant / Project Company ensuring that the proposed improvements are accommodated within the land width available as far as practical otherwise action to acquire more land shall be resorted to through NHIDCL.

The proposed horizontal and vertical alignment is available in digital format and this is for information and the Authority shall not be held responsible for any implications of the contract. EPC contractor shall carry out his own survey and investigations and due diligence both during bidding and during design and construction.

2.4 Right of Way

The site of the Project Highway comprises the land as described in Annexure-II of Schedule-A.

2.5 Type of shoulders

(a) In built-up sections, footpaths/fully paved shoulders shall be provided in the following stretches:

Sl. No.	Stretch (from km to km)	Fully paved shoulders/ footpaths	Reference to cross section
Nil			

(b) In open country, earthen shoulders of 2.5 m width shall be covered with 150 mm thick compacted layer of granular material.

(c) Design and specifications of hard shoulders and granular material shall conform to the requirements specified in paragraphs 5.10 of the Manual.

2.6 Lateral and vertical clearances at underpasses

The width of the opening at the overpasses shall be as follows:

Sl. No	Location (Chainage) (from km to km)	Span/ opening (m)	Remarks
Nil			

2.7 Lateral and vertical clearances at overpasses

The width of the opening at the overpasses shall be as follows:

Sl. No	Location (Chainage) (from km to km)	Span/ opening (m)	Remarks
Nil			

2.8 Service roads

Service roads shall be constructed at the locations and for the lengths indicated below:

Sl. No.	Location of service road (from km to km)	Right hand side (RHS)/Left hand side (LHS)/ or Both sides	Length (km) of service road
Nil			

2.9 Grade separated structures

The requisite particulars are given below:

Sl. No.	Location of structure	Length (m)	Number and length of spans	Approach gradient	Remarks, if any
Nil					

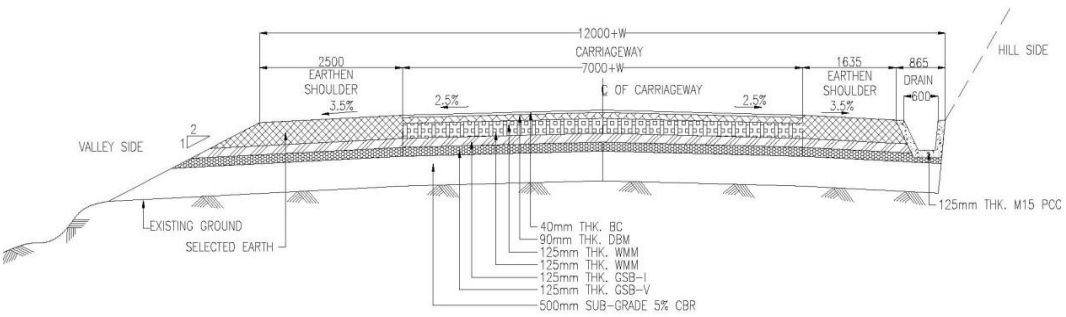
2.10 Cattle and pedestrian underpass /overpass

Cattle and pedestrian underpass/ overpass shall be constructed as follows:

Sl. No.	Location	Type of crossing
Nil		

2.11 Typical cross-sections of the Project Highway

Indicative typical cross sections along with different types of cross-sections required to be developed in different segments of the project highway are indicated in Figure 2.11 shown below.



TYPICAL PAVEMENT DETAILS FOR MAIN ROAD

3. INTERSECTIONS AND GRADE SEPARATORS

All intersections and grade separators shall be as per Section 3 of the Manual. Existing intersections which are deficient shall be improved to the prescribed standards.

Properly designed intersections shall be provided at the locations and of the types and features given in the tables below:

a) At-grade intersections (Major & Minor Junction)

Sl. No.	Location of intersection	Type of intersection	Other features
Chhiahtlang Bypass			
1	0.000	Major	Starting point
2	2.571	Major	End Point
3		Minor	
4		Minor	
Serchhip Bypass			
1	0.000	Major	Starting point
2	11.829	Major	End Point
3		Minor	
4		Minor	

b) Grade separated intersection with/without ramps

Sl. No.	Location	Salient features	Minimum length of viaduct to be provided	Road to be carried over/under the structures
Nil				

4. Road Embankment and Cut Section

4.1 Widening and improvement of the existing road embankment/cuttings and construction of new road embankment/cuttings shall conform to the Specifications and Standards given in Section 4 of the Manual and the specified

cross sectional details. Deficiencies in the plan and profile of the existing road shall be corrected.

4.2 Raising of the existing road

The existing road shall be raised at the required locations as per proposed plan and profile or further raised to meet the requisite specifications.

4.3 All of surplus cutting soils shall be transported and be disposed to the Spoil Banks in accordance with the Schedule C (Project Facilities).

5. Pavement Design

5.1. Pavement design shall be carried out in accordance with Section 5 of the Manual.

5.2. Type of pavement

The contractor is to adopt flexible pavement for the project highway as per manual and technical specifications.

5.3. Design Requirements

Pavement design shall be as per Section 5 of the Manual and technical specifications.

5.3.1 Design Period and strategy

Flexible pavement for new pavement or for widening and strengthening of the existing pavement shall be designed for a minimum design period of 15 years. Stage construction shall not be permitted.

5.3.2 Design Traffic

Notwithstanding anything to the contrary contained in this Agreement or the Manual, the Contractor shall design the pavement for minimum design traffic of 20 million standard axles.

5.4. Reconstruction of stretches

Reconstruction of stretches for matching the proposed plan & profile or meeting the technical specifications and standards shall be taken up as per actual requirements.

6. Roadside Drainage

Drainage system including surface and subsurface drains for the Project Highway shall be provided as per Section 6 of the Manual.

The improvements in the drainage and the slope erosion shall be made as per the following norms:

Open side trapezoidal lined cross section drain shall be provided on hill sides of the project highway in order to intercept surface water from the carriageway, shoulders and hill slopes. The drains outfall into the natural water courses i.e. either in culverts or bridges. Table below gives the location of lined drains.

These are guidelines for minimum provisions. However, contractor has to design as per requirement of road in accordance with manual.

Sr. No.	Chainage in m		Length in m	Remarks
	From	To		
1	0+000	2+577	2931	Trapezoidal PCC line drain (Chhiahtlang bypass)
2	0+000	11+874	13709	Trapezoidal PCC line drain (Serchhip bypass)

Note: (The above locations shall be reviewed in consultation with the AE at the time of construction as per the site condition).

7. Design of Structures

7.1 General

7.1.1 All bridges, culverts and structures shall be designed and constructed in accordance with Section 7 of the Manual and shall conform to the cross-sectional features and other details specified therein.

7.1.2 Width of the carriageway of new bridges and structures shall be as follows:

Sr. No.	Bridge at Km	Width of carriageway and cross-sectional features*
1	CH:-4+542	Carriageway width 10.5 m and total width 12.90 m
2	CH:- 10+885	Carriageway width 10.5 m and total width 12.90 m

7.1.3 The structures shall be provided with footpaths, if required as per the provisions of the manual and technical specifications.

7.1.4 All bridges shall be high-level bridges.

7.1.5 The structures shall be designed to carry utility services as per the requirement of site.

7.1.6 Cross-section of the new culverts and bridges at deck level for the Project Highway shall conform to the typical cross-sections given in section 7 of the Manual.

7.2 Culverts

7.2.1 Overall width of all culverts shall be equal to the roadway width of the approaches.

7.2.2 **Reconstruction of existing culverts**:

The existing culverts at the following locations shall be re-constructed as new culverts:

Sl. No.	Culvert location	Span/Openings(m)	Remarks, if any
Nil			

Note: (The above locations and size shall be reviewed in consultation with the AE at the time of construction as per the site condition).

7.2.3 **Widening of existing culverts:**

All existing culverts which are not to be reconstructed shall be widened upto the roadway width of the Project Highway as per the typical cross section given in section 7 of the Manual. Repairs and strengthening of existing structures where required shall be carried out.

Sl. No	Culvert location	Type, span, height and width of existing culvert	Repairs to be carried out
Nil			

7.2.4 Additional new culverts shall be constructed as per particulars given in the table below:

Sr. No.	Culvert Location	Type	Span/Opening (m)
Chhiahtlang Bypass			
1	0.006	Hume Pipe	1.20 D
2	0.290	Hume Pipe	1.20 D
3	0.444	Box	2 x 2
4	0.601	Hume Pipe	1.20 D
5	0.830	Box	2 x 2
6	1.000	Box	2 x 2
7	1.272	Hume Pipe	1.20 D
8	1.578	Hume Pipe	1.20 D
9	1.695	Hume Pipe	1.20 D
10	1.835	Hume Pipe	1.20 D
11	2.124	Hume Pipe	1.20 D
12	2.288	Box	2 x 2
13	2.565	Hume Pipe	1.20 D
Serchhip Bypass			
1	0.007	Hume Pipe	1.20 D
2	0.105	Hume Pipe	1.20 D
3	0.267	Box	2 x 2
4	0.353	Box	2 x 2
5	0.442	Box	2 x 2
6	0.515	Box	2 x 2
7	0.662	Hume Pipe	1.20 D

Sr. No.	Culvert Location	Type	Span/Opening (m)
8	0.919	Box	2 x 2
9	1.125	Hume Pipe	1.20 D
10	1.297	Hume Pipe	1.20 D
11	1.453	Box	2 x 2
12	1.674	Box	2 x 2
13	1.865	Box	2 x 2
14	2.172	Hume Pipe	1.20 D
15	2.255	Hume Pipe	1.20 D
16	2.390	Hume Pipe	1.20 D
17	2.533	Hume Pipe	1.20 D
18	2.834	Hume Pipe	1.20 D
19	2.998	Box	3 x 3
20	3.070	Box	2 x 2
21	3.154	Box	2 x 2
22	3.197	Box	2 x 2
23	3.332	Box	2 x 2
24	3.411	Box	2 x 2
25	3.554	Box	2 x 2
26	3.663	Box	2 x 2
27	3.717	Box	2 x 2
28	3.865	Box	2 x 2
29	3.925	Box	2 x 2
30	4.075	Hume Pipe	1.20 D
31	4.363	Box	2 x 2
32	4.452	Box	2 x 2
33	4.542	Box	8 x 6
34	4.710	Hume Pipe	1.20 D
35	4.888	Box	2 x 2
36	5.147	Hume Pipe	1.20 D
37	5.285	Hume Pipe	1.20 D
38	5.485	Hume Pipe	1.20 D
39	5.729	Hume Pipe	1.20 D
40	5.885	Box	2 x 2

Sr. No.	Culvert Location	Type	Span/Opening (m)
41	5897	Box	2 x 2
42	6.238	Hume Pipe	1.20 D
43	6437	Box	2 x 2
44	6.477	Box	2 x 2
45	6.754	Hume Pipe	1.20 D
46	7.103	Box	4 x 4
47	7.177	Box	2 x 2
48	7.430	Hume Pipe	1.20 D
49	7.819	Box	2 x 2
50	7.923	Box	2 x 2
51	8.079	Box	2 x 2
52	8.421	Box	3 x 3
53	8.587	Hume Pipe	1.20 D
54	8.750	Hume Pipe	1.20 D
55	8.882	Hume Pipe	1.20 D
56	9.175	Hume Pipe	1.20 D
57	9.251	Box	2 x 2
58	9.448	Box	4 x 4
59	9.707	Hume Pipe	1.20 D
60	9.866	Box	2 x 2
61	9.970	Box	2 x 2
62	10.114	Box	2 x 2
63	10.446	Hume Pipe	1.20 D
64	10.596	Hume Pipe	1.20 D
65	10.738	Box	2 x 2
66	11.061	Hume Pipe	1.20 D
67	11.282	Box	2 x 2
68	11.403	Box	2 x 2
69	11.530	Box	2 x 2
70	11.624	Hume Pipe	1.20 D

Note: (The above locations and size shall be reviewed in consultation with the AE at the time of construction as per the site condition).

7.2.5 Repairs/replacements of railing/parapets, flooring and protection works of the existing culverts shall be undertaken as required as per standard and specifications:

7.2.6 Floor protection works shall be as specified in the relevant IRC Codes and Specifications

7.3 Bridges

7.3.1 Existing bridges to be re- constructed/widened

(i) The existing bridges at the following locations shall be re-constructed as new Structures.

Sl. No.	Bridge Location(Km)	Salient details of existing bridge	Adequacy or otherwise of the existing waterway, vertical clearance, etc	Remarks
Nil				

*Attach GAD

(ii) The following narrow bridges shall be widened:

Sl. No.	Location (km)	Existing width (m)	Extent of widening (m)	Cross-section at deck level for widening @
Nil				

@ Attach cross-section

7.3.2 Additional new bridges

New bridges at the following locations on the Project Highway shall be constructed.

Sl. No.	Location in m	Super structure	Foundation	Remarks	Span Arrangement
Chhiahtlang Bypass					
Nil					
Serchhip Bypass					
1	CH:-4+542	RCC Box	Raft	Box cell	1x8
2	CH:- 10+885	PSC Arch	Open	Arch	1x20+110+1x20

7.3.3 The railings of existing bridges shall be replaced by crash barriers at the following locations:

Sl. No.	Location at Km	Remarks, if any
Nil		

7.3.4 Repairs/replacements of railing/parapets of the existing bridges shall

be undertaken as follows:

Sl. No.	Location at Km	Remarks, if any
Nil		

7.3.5 Drainage system for bridge decks

An effective drainage system for bridge decks shall be provided as specified in paragraph 7.20 of the Manual

7.3.6 Structures in marine environment

The Project alignment does not lie in marine environment.

7.4 Rail-road bridges

7.4.1 Design, construction and detailing of ROB/RUB shall be as specified in section 7 of the Manual-**Nil**

7.4.2 Road over-bridges

Road over-bridges (road over rail) shall be provided at the following level crossings, as per GAD drawings attached:

Sl. No.	Location of Level crossing (Chainage Km)	Length of bridge (m)
Nil		

7.4.3 Road under-bridges

Road under-bridges (road under railway line) shall be provided at the following level crossings, as per GAD drawings attached:

Sl. No.	Location of Level crossing (Chainage Km)	Number and length of span (m)
Nil		

7.5 Grade separated structures

The grade separated structures shall be provided at the locations and of the type and length specified in paragraphs 2.9 and 3 of this Annex-I.

7.6 Repairs and strengthening of bridges and structures

The existing bridges and structures to be repaired/strengthened, and the nature and extent of repairs /strengthening required are given below:

(a) Bridges

Sl. No.	Location of bridge (km)	Nature and extent of repairs /strengthening to be carried out

Nil

(b) ROB/RUB

Sl. No.	Location of ROB/RUB (km)	Nature and extent of repairs /strengthening to be carried out
Nil		

(c) Overpasses/Underpasses and other structures

Sl. No.	Location of structure (km)	Nature and extent of repairs /strengthening to be carried out
Nil		

7.7 List of Major Bridges and Structures

The following is the list of the Major Bridges and Structures:

Sl. No.	Location
Nil (New Major Bridge as mentioned at Sub-Para (iii) (b) above is to be Constructed).	

Note: -

1. The location and vent size of all the culverts proposed for irrigation purposes shall be decided in consultation with Authority's Engineer.

2. Width of culvert shall be reconciled as per cross section at that location

3. Cross road culvert to be provided at the location of Major Junction/ Minor Junctions or utility purposes etc. shall be decided with independent Engineer shall not be treated as change of scope.

7.8 Slope Protection Structures

7.8.1 Structures for Slope protection and Retaining Walls shall be designed and constructed as stipulated in Schedule-D: Specification and Standards.

7.8.2 Structures for Retaining Walls and other works for slope protection shown in the following Table shall be constructed.

As the project involves cutting of the hill slopes, it's imperative that slopes are stabilized for ensuring longevity of the slopes and the road. Slope stability, erosion control and landslide correction shall be accomplished in accordance with IRC: SP 48:1998. Reference may be drawn from IRC: 56-2011.

The minimum quantity of protection works may be taken as below:

Sl. No	Description of Item	Unit	Chhiahtlang Bypass	Serchhip Bypass
1	Vetiver grass	Sqm	3209.50	19733.00
2	Seeding and Mulching	Sqm	4126.50	25371.00

Sl. No	Description of Item	Unit	Chhiahtlang Bypass	Serchhip Bypass
3	Erosion Control Blanket	Sqm	1834.00	11276.00
4	Retaining wall for 2.0 m Height Plum concrete	Rm	510.00	1730.00
5	Retaining wall for 3.0 m Height Plum concrete	Rm	205.00	660.00
6	Retaining wall for 4.0 m Height Plum concrete	Rm	90.00	700.00
7	Retaining wall for 5.0 m Height RCC Relief Shelves	Rm	160.00	390.00
8	Retaining wall for 7.0 m Height RCC Relief Shelves	Rm	200.00	1020.00
9	Retaining wall for 9.0 m Height RCC Relief Shelves	Rm	30.00	370.00
10	Retaining wall for 11.0 m Height RCC Relief Shelves	Rm	20.00	50.00
11	Retaining wall for 13.0 m Height RCC Relief Shelves	Rm	10.00	40.00
12	Breast Wall 2.00m Height Plum concrete	Rm	440.00	1815.00
13	Breast Wall 3.00m Height Plum concrete	Rm	545.00	2655.00
14	Revetment wall	Rm	225.00	140.00
15	Gabion Wall 2.00 m high	Rm	300.00	775.00
16	Gabion Wall 3.00 m high	Rm	150.00	600.00
17	Toe Wall 2.00 m Height Plum concrete	Rm	70.00	90.00
18	Toe Wall 3.00 m Height Plum concrete	Rm	20.00	30.00

Note: 1. The Contractor shall be responsible for accurate assessment of the actual requirement as per site situation and prepare design for slope protection and stabilization as per specification and standards stipulated in Schedule-D and submit the same to the Authority's Engineer/ Authority for review through the Proof Consultant and implement it accordingly thereafter.

2. Any increase in quantity over and above the tentative quantity as mentioned in above table or through change in specifications will not be considered as change of scope. Therefore, Contractor shall make through investigation at site and assess the requirement of slope protection and slide prone zone and other safety features at his own before submission of bid.

3. For executing any of the above type of Slope Protection Works, the Contractor should have the experience of having executed, in last 5 (five) financial years from the date of signing of Agreement, atleast 40% quantity of that type of Slope Protection

Work(s) and provide requisite certificates/ documents to verify the same to the Authority/ Authority Engineer.

4. If the Contractor does not have requisite experience for any/ some of the above type of Slope Protection Works, then he has to engage specialized firm(s) as sub-contractor(s) who has/ have successfully completed in last 5 (five) financial years atleast 40% quantity of such work(s). The Contractor shall submit the credentials and the qualifying experience of the specialized sub-contractor(s) for the approval of Authority before the commencement of such Slope Protection Works.

5. The cutting slope surface except on Hard Rock classified as per Clause 301.2 of MoRTH Specifications for Road and Bridge Works shall be protected by the Seeding and Mulching as per Clause 308 of MORTH Specification, and the embankment slope shall be protected by Turfing as per Clause 307 of MORTH Specification.

8. Traffic Control Devices and Road Safety Works

8.1. Traffic control devices and road safety works including traffic signs, overhead signs, pavement marking, safety barriers etc. shall be provided in accordance with Section 9 of the Manual.

8.2. Specifications of the reflective sheeting.

The minimum quantity of Traffic signages and pavement marking are tabulated here:

Sl. No.	Traffic Signages, Road Marking and other appurtenances	unit	Quantity Chhiahtlang Bypass	Quantity Serchhip Bypass
1	90 cm equilateral triangle	each	12	15
2	60 cm equilateral triangle	each	6	45
3	60 cm circular	each	6	45
4	80 mm x 60 mm rectangular	each	4	8
5	60 cm x 45 cm rectangular	each	0	0
6	60 cm x 60 cm square	each	0	0
7	Direction and Place Identification signs upto 0.9 sqm size board	Sqm	4	6
8	Road Marking with Hot Applied Thermoplastic Compound with Reflectorising Glass Beads on Bituminous Surface	Sqm	771.3	3548.70
9	Road Delineators	each	180	180
10	Street Furniture	each	490	1984
11	Boundary pillar	each	26	119

12	Kilo Metre Stone			
(i)	5th kilometre stone (precast)	each	0	2
(ii)	Ordinary Kilometer stone (Precast)	each	2	9
(iii)	Hectometer stone (Precast)	each	11	48

9. ROAD SIDE FURNITURE

9.1. Road side furniture including Road Boundary Stone, Pedestrian Guard Rail, Pedestrian Crossings, Delineators, MS Railing etc. shall be provided in accordance with the provisions of the Manual and Scheduled D.

9.2. Overhead traffic signs: location and size

Full width overhead signs 2 nos. (Start and end of Project road) and at other locations shall be provided as per requirement of site in consultation with the Authority's Engineer.

9.3. COMPULSORY AFFORESTATION

The number of trees which are required to be planted by the Agency as compensatory afforestation should be as per Forest Conservation Act, thrice the number of trees to be cut.

9.4. HAZARDOUS LOCATIONS

Provide W-beam crash barrier along the project highway at the locations as suggested in the Manual. The safety barriers shall also be provided at all hazardous locations in consultation with the Authority's Engineer.

9.5. SPECIAL REQUIREMENTS FOR HILL ROAD

[Refer to paragraphs 14.5 and 14.8 of the Manual and provide details where relevant and required.]

9.6. Change of Scope

The length of Structures, Bridges, Culverts and Slope Protection works specified hereinabove shall be treated as an approximate assessment. The actual lengths as required on the basis of detailed investigations shall be determined by the Contractor in accordance with the Specifications and Standards. Any variations in the lengths specified in this Schedule-B shall not constitute a Change of Scope, save and except any variations in the length arising out of a Change of Scope expressly undertaken in accordance with the provisions of Article 13.

Schedule - C

(See Clause 2.1)

Project Facilities

1. Project Facilities

The Contractor shall construct the Project Facilities in accordance with the provisions of this Agreement. Such Project Facilities shall include:

(a) toll plaza[s];

(b) roadside furniture;

(c) pedestrian facilities;

(d) tree plantation;

(e) truck lay-byes;

(f) bus-bays and bus shelters;

(g) rest areas; and

(h) others to be specified

2. Description of Project Facilities

Each of the Project Facilities is described below:

(a) Toll Plaza
Toll plaza shall be designed as per the guidelines of manual and it is provided at following locations:

S. No.	Toll Plaza Location (Design Chainage in Km)
Nil	

(b) Roadside Furniture/ Traffic control devices/ Road Safety devices
Road side furniture/Traffic control devices/Road safety devices shall be provided in accordance with the Manual of Specifications and Standards as referred in schedule "D" including the provisions mentioned in Schedule "B".

(c) Pedestrian Facilities
Pedestrian Facilities shall be provided in accordance with the Manual of Specifications and Standards as referred in schedule "D".

(d) Landscaping and Tree Plantation
Landscaping of the highway shall be done in accordance with the Manual of Specifications and Standards as referred in schedule "D".

(e) Truck Lay-byes

Truck lay byes shall be provided at the following locations.

Sr. No.	Proposed Ch.
Nil	

(f) Bus Bays and Bus Shelters

Bus Bays shall be provided at locations given below:

Sl. No.	Existing Chainage	Design Chainage	Sides	Village
Nil				

Note: * refer IRC SP-73:2018

(g) Rest Areas, NiL.

(h) Others

(i) Highway Lighting

Lighting shall be provided at the following locations (Minimum 40 Lux to be maintained):

(i) Lighting shall be provided at approach to bridges, Built up areas, Toll plaza, Bus stops, truck Lay-bys, and as per manual recommended in Schedule D.

(ii) High Mast Lighting shall be provided at all Major Junctions, Toll plaza locations,

(ii) Highway Patrol

Not applicable

(iii) Ambulances

Not applicable

(iv) Cranes

Not applicable

(v) Advance Traffic Management System (ATMS)

Typical Drawing of Advance Traffic Management System (ATMS) is given and location of the same shall be as per IRC: 67: 2001 and IRC: SP: 84-2014. Provisions of other facilities, if required may be made in similar manner.

(vi) Spoil Banks

Spoil bank shall be proposed in accordance with the Clause 3.1 of Schedule-D (Specification and Standard for the Construction).

Schedule - D

(See Clause 2.1)

Specifications and Standards

1. Construction

The Contractor shall comply with the Specifications and Standards set forth in Annex-I of this Schedule-D for construction of the Project Highway.

2. Design Standards

The Project Highway including Project Facilities shall conform to design requirements set out in the following documents:

Manual of Specifications and Standards for Two- Laning of Highways (IRC: SP: 73 latest version), referred to herein as the Manual.

Annex -I

(Schedule-D)

Specifications and Standards for Construction

1. Specifications and Standards

All Materials, works and construction operations shall conform to the Manual of Specifications and Standards for Two-Laning of Highways (IRC:SP:73: latest available), referred to as the Manual, and MORTH Specifications for Road and Bridge Works. Where the specification for a work is not given, Good Industry Practice shall be adopted to the satisfaction of the Authority's Engineer.

2. Deviations from the Specifications and Standards

2.1. The terms "Concessionaire", "Independent Engineer" and "Concession Agreement" used in the Manual shall be deemed to be substituted by the terms "Contractor", "Authority's Engineer" and "Agreement" respectively.

2.2. Notwithstanding anything to the contrary contained in Paragraph 1 above, the following Specifications and Standards shall apply to the Project Highway, and for purposes of this Agreement, the aforesaid Specifications and Standards shall be deemed to be amended to the extent set forth below:

a) In case of usage of soil stabilization technology, soil stabilizer shall be accredited by IRC.

b) Carriageway shall be 7.0m with 1.5m hard shoulder wherever ROW is available. IRC: SP: 73-2015 (latest version) shall be followed to the extent as required for execution of work in consonance with plan & profile and TCS..

Clause Referred in Manual	Item	Provision as per Manual	Modified Provision	Remarks
2.2.1	Minimum design speed in Steep terrain.	30 kmph	-	-
-		Design Standard	As per Clause 3 given below	

3. Geometric design criteria of the Project Highway shall be in accordance with the Table

below.

Table: Summary of Geometric Design Criteria for Highway

	Design Elements		Type/Value	Remarks
1	Highway Classification		National	
2	Terrain Classification		Steep	
3	Design Speed (km/h)			
		Ruling (km/h)	40	
		Minimum (km/h)	30	
4	Cross-Sectional Elements	Basic Lane Width (m)	3.5	
		Number of Lanes	2	
		Formation Width (m)	12.0	
		Carriageway Width (m)	2 x 3.5	
		Outer Shoulder Paved Width (m)	2 x 1.5	
		Outer Shoulder Earthen Width (m)	2 x 1.0	
		Crossfall of Roadway (%)	2.5	
		Slope of Earthworks		
		Fill	V : H = 1:1.75	
		Cut (soil)	V : H = 1:1.2	Varies
		Cut (rock)	V : H = 1:0.2-0.5	Varies
5	Sight	Stopping Sight Distance, SSD (m)	30 (45)	Figures in () corresponds to speed of 40km/h
		Intermediate Sight Distance, ISD (m)	60 (90)	
		Overtaking Sight Distance, OSD (m)	(165)	
6	Horizontal Alignment	Horizontal Curve		
		Absolute Minimum Radius of Horizontal Curve (m)	30	
		Ruling Minimum Radius of Horizontal Curve (m)	50	
		Widening of Carriageway on Horizontal Curves		
		Widening for Absolute Minimum Radius (20m-40m)	1.5	
		Widening for Ruling Minimum Radius (41m-60m)	1.2	
		Widening for Radius (61m-100m)	0.9	
		Widening for Radius (101m-300m)	0.6	
		Superelevation (Se)		
		Maximum Se for Absolute Minimum Radius (%)	7.0	
		Superelevation Runoff Rate	1/60	
		Transition Curve		
		Minimum Length for Absolute Minimum Radius (m)	30	
		Minimum Length for Ruling Minimum Radius (m)	20	
7	Vertical Alignment	Vertical Gradient		
		Ruling Gradient (%)	6.0	
		Critical length of continuous Ruling Gradient (m)	2000	120m rise in 2km
		Limiting Gradient (%)	7.0	
		Exceptional Gradient (%)	8.0	
		Critical Length for Exceptional Gradient (m)	100	
		Minimum Gradient for Drainage (%)	0.5	Cut sections with
		Vertical Curve		
		Minimum Length of Vertical Curve (m)	15	
		Minimum Radius of Summit (Crest) Curve (m)		
		Absolute Minimum Radius (m)	205	From SSD
		Minimum Radius (m)	375	From ISD
		Desirable Minimum Radius (m)	1500	From OSD
		Minimum Radius of Valley (Sag) Curve (m)		
		Absolute Minimum Radius (m)	355	

4. Particular Specifications

4.1 Earthworks: Re-Usable and Unsuitable Materials

In addition, and without detriment to the requirements specified in Section 4 of the Manual and Section 301 of the MORTH Specifications for Road and Bridge Works related to the re-use and unsuitable material, the following requirements shall be included:

a. Previous to perform the earthworks for road construction (minimum 28 days before commencement of earthworks), the Contractor shall submit for review and approval by the Authority's Engineer, a "Plan for Earthworks" detailed by sections showing the cutting and embankment with respective hauling distances, quantities and location of the re-usable material and respective spoil-banks for wasting of unsuitable material, not re-usable material or exceeding material (from the balance between cutting excavation and fill embankment works), and respective time schedule. The Plan for Earthworks shall be updated and reviewed periodically every 3 months or when required by the Authority's Engineer.

b. When unsuitable material below sub-grade level in cut or below embankment foundation level is planned to be removed, the soil left in place after the removal of the unsuitable material shall be compacted to a depth of 20 cm and a density of 90 percent of the maximum dry density determined according to the relevant specifications.

c. The material to be disposed of as Unsuitable Material shall not be wasted until it is duly approved or directed by the Authority's Engineer.

d. Unsuitable Material shall be removed and disposed of in waste areas provided by the Contractor in such a manner as to present a neat appearance and not to obstruct drainages to any highway nor to cause injury to highway works or property. If it becomes necessary for the Contractor to locate or relocate any waste areas, the Contractor shall obtain previously the approval from the Authority's Engineer to commence the operation for spreading any waste.

e. The Contractor is responsible to perform and follow all the required procedures to obtain respective authorizations for the usage of the areas where it is intended to waste the unsuitable material or to open quarries for borrow material.

f. The relevant and applicable provisions "Environmental Control and Protection" shall be adhered to the Plan for Earthworks for the hauling and disposal of unsuitable materials.

g. Spoil Banks:

The following requirements shall be satisfied for the proper implementation of Spoil-Banks:

- ✧ The Contractor shall submit, at least 15 days before commencing the works for any Spoil-Bank, for review and approval by the Authority's Engineer a detailed plan for implementation of the Spoil-Banks that are being considered

in his "Plan for Earthworks" showing the location, capacity, time schedule and method statement for construction

- ✧ The Spoil-Banks shall be constructed applying the same technical specifications used for road embankment construction regarding preparation of the ground, leveling, thickness and compaction of each layer.
- ✧ The drainage to be implemented in the Spoil-Banks shall be constructed following the applicable standards for road drainage and in accordance with the drawings prepared by the Contractor in accordance with the Article 10: "Design and Construction of the Project Highway" of the Contract Agreement, and reviewed & approved by the Authority's Engineer.

The Spoil-Banks shall be design in accordance with the requirements shown in **Table-1** and the typical arrangement shown in **Figure-1**.

Table-1: Requirements for Design and Construction Spoil Banks

Design Conditions:		
Item	**Description**	**Criteria**
- Topography	Depression or hilly	Prevention against disasters due to landslide and collapse
- Ground Inclination	Less than 22°	ditto
- Embankment' Size	Embankment height shall be 30m or less	ditto
- Land's Use	Land is not urbanized	Environmental protection
- Environment	Not considered as environmental nature reservation. Residential areas (if any) shall not located at downstream of spoil bank.	ditto
Design Requirements:		
Item		**Remarks**
- Installation of open drain or canal		Drain is treated from upstream
- Installation of surface drainage system		Slope feet and berms
- Installation of underground drainage		Swamps and Valley
- Installation of internal-horizontal drainage of embankment		Reduction of water filtration in the embankment and prevention against superficial collapse
- Implementation of the works for Slope Protection		Turfing or Seeding
- Construction of retaining wall in the lower edge		Prevention against collapse
- Installation of check dam structure on the upstream inlets		Concrete Wall
- Implementation of the works for scouring prevention along downstream outlet		Gabion Mat
Special Provisions on the Specifications:		
Item	**Description**	**Special Provision**
- Drainage	Works for channels drainages	50 years return period
	Gutters	25 years return period Minimum 40cm x 40cm
	Horizontal drainage sheet (50cm width, 2m interval)	Every 5m height; L=20m
- French Drain	Large Drain Basin	Perforated pipes of 300mm minimum diameter shall be applied
	Small Drain Basin	Perforated pipes of 100mm minimum diameter shall be applied
- Slope Protection	Sodding	As the standards
- Retaining Wall	Retaining wall by Gabion or Gravity Type	As the standards
- Embankment	Compaction and layer thickness	Compaction of embankment

		equal or higher than 90% shall be secured. Layer thickness same than road embankment.

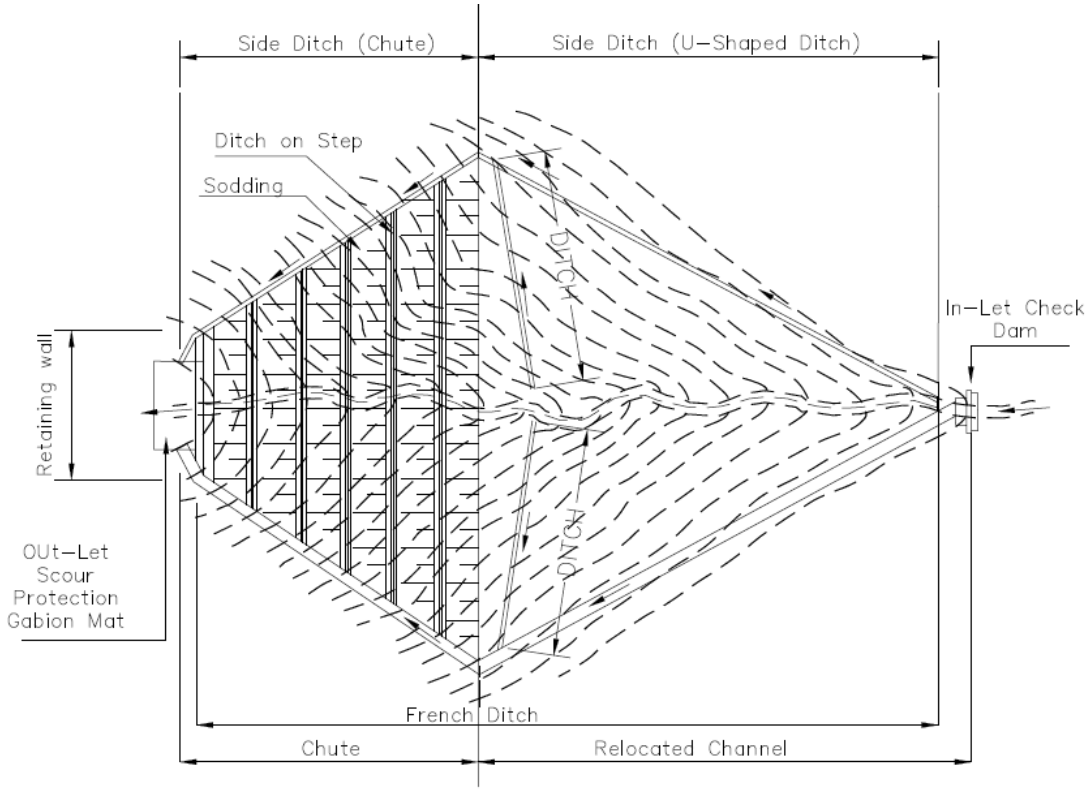


Figure-1(a): Typical Arrangement for Spoil Banks: Plan

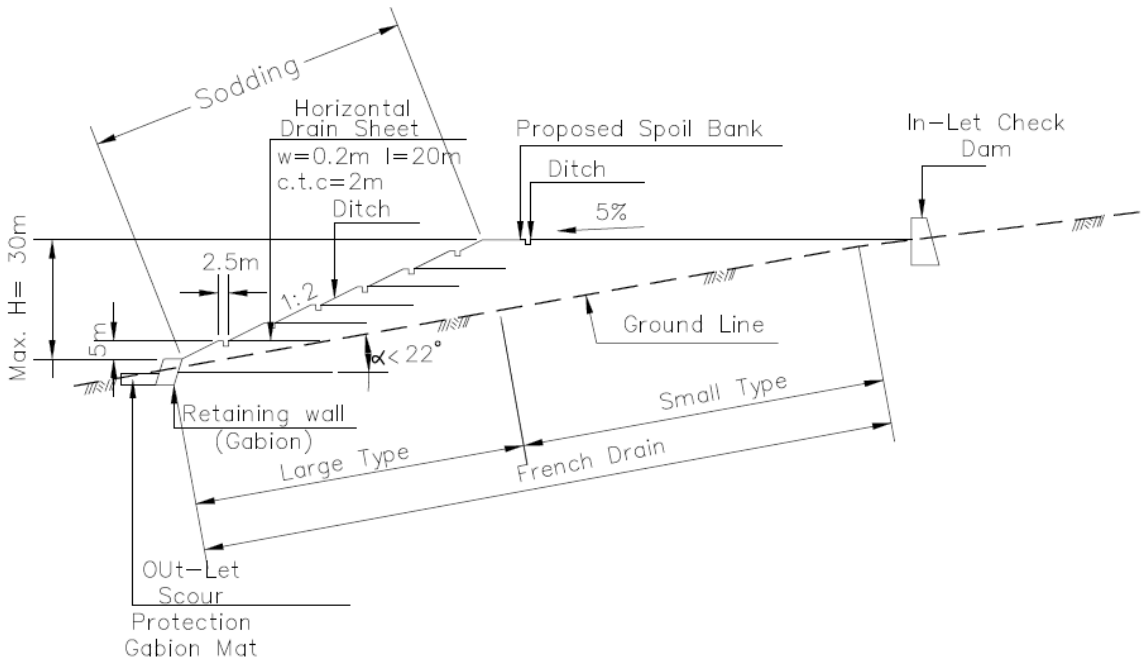


Figure-1(b): Typical Arrangement for Spoil Banks: Profile

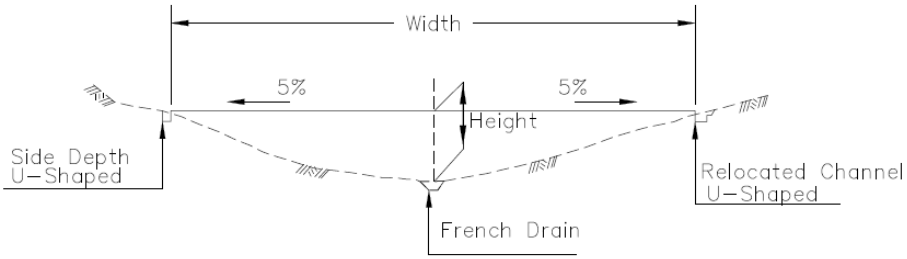


Figure-1(c): Typical Arrangement for Spoil Banks: Cross Section of French Drain

h. Supplementary Works in Case of Disasters by Landslides

The works to be performed in the event of disasters due to landslides, slope failure or soil/rock collapses, etc. occurred during the construction period shall be treated by the Contractor under the following conditions and requirements:

- The material from the disaster area which is disrupting the traffic or operation of the Project road shall be removed and treated as unsuitable material, and shall be disposed in a Spoil Bank in accordance with these specifications.
- The slopes remaining after the effect of the disaster shall be re-arranged and the affected drainages shall be reestablished.
- The quantities and costs for these works will be deemed to be covered in the quoted price and no separate or additional payments will be made under this account.

4.2 Design and Construction Specification for Slope Prevention Works

Slope protection of NH54 shall be designed in accordance with requirements and design conditions described in these Specifications and the requirements specified by IRC: SP 102-2014: "Guidelines for Design and Construction of Reinforced Soil Walls" as applicable. The preliminary design drawings are to be used as per reference.

4.2.1 Sub-Surface Drainage

a. General

In conducting groundwater drainage works, it is important to investigate groundwater conditions, surrounding facilities, etc. beforehand in consideration of its purpose.

b. Planning

The sub-surface drainage shall be able to drain promptly the groundwater that is affecting the landslide activity, taking it to in/outside of the landslide.

The following items shall be considered for preparation of the planning for sub-drainage drainage:

i) Implementation of boreholes of a diameter of 66mm or more to drain shallow groundwater.

ii) The free groundwater shall be drained during the time of rain.

iii) The planned height for groundwater drawdown shall be about 3 m at the landslide layer thickness of about 20 m.

iv) Evaluation of the effect shall be made taking into account the water level before construction, the water level after construction, and the amount of discharge water.

c. Investigation

The groundwater investigation shall be conducted during the rainy season and the dry season and grasp the groundwater level affecting the landslide activity.

The investigation on the groundwater level shall be conducted by using boring holes carried out on the landslide that will be treated.

d. Save Record

Changes in the groundwater level shall be recorded and kept by the responsible person in order to contribute to the evaluation and engineering judgment of the effect of the design / countermeasure work.

e. Material

The following material and respective method for application shall be used:

i) *Groundwater Drainage*: Strainer-processed drainage pipes shall be inserted.

ii) *Drainage Pipe*: PVC pipe (VP-50 [outer diameter 60 mm, inner diameter 51 mm]) shall be used.

iii) *Strainer*: The strainer or slotted type shall be processed for the total length. The diameter of strainer is 2 to 5 mm.

iv) *Protection of Strainer*: Strainers shall be wrapped or covered with a polyethylene sheet for protection to prevent from clogging and disruption.

f. Design and Construction

The design and construction of sub-surface drainage shall apply the following basic procedure or method:

i) Placement in-site of the drainage pipes

ii) Radial or parallel arrangement of the drainage pipes without affecting to other facilities located nearby or around the area

iii) Confirmation of the angle for installation of the drainage pipes. Drainage pipes shall be installed upwardly 5° to 10°.

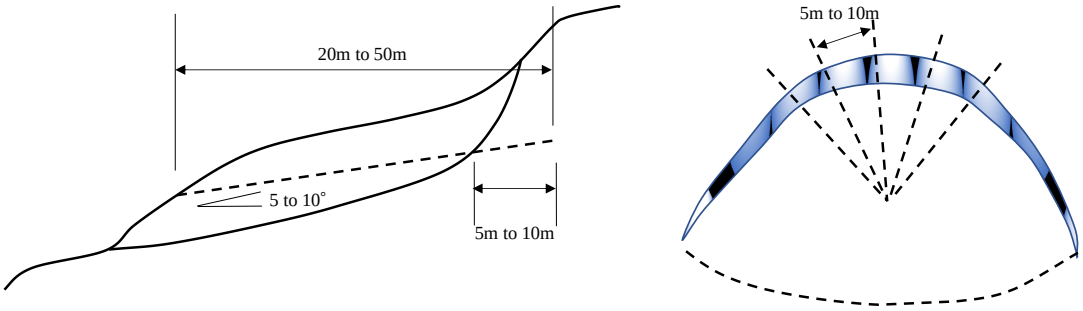
iv) Confirmation of the length of drainage pipes:

- All pipes shall be about 20m to 50m long

- The pipes shall be inserted into the sliding surface in 5m to 10m and shall be installed with a spacing of 5m to 10m

vi) Protection of drilling mouth

- The drilling mouth shall be set on a stable ground.
- To install gabions or concrete walls so that the discharged water does not wash out sediment around the drain outlet.



g. Maintenance

The works for maintenance of the drainage system shall take into account the following main items:

i) Inspection of drainage operative efficiency

The main objective of the groundwater drainage system is to drain promptly all the groundwater at the time of heavy rain.

In order to secure the drainage in good and efficient operative efficiency conditions, periodically inspection is necessary to observe the quantity of drained water immediately after heavy rain to confirm the landslide activity and drainage function.

The period for periodically inspection shall be about 3 to 5 years.

ii) Inspection of drainage pipe

After 10 years or more, the drainage pipe might be clogged at the drilling mouth by the effect of ferric oxide. Therefore, it is necessary to perform regularly inspection of the facilities that have been over operating 10 years or longer period.

Based on the results of the inspection, after confirmation of the existence or absence of clogging, the works for cleaning and washing shall be applied as necessary.

h. Applicable Design Standard

Followings are IRC Specifications, Standards and Design codes majorly applied for the design;

- IRC: Special Report: State of the Art: Landslide Correction Techniques. Sub-Clause 7.8

- IRC: SP 48 -1998: Hill Road Manual. Sub-Clause 11.6.3

4.2.2 Rockfall Prevention Fence and Rockfall Prevention Retaining Wall

a. Rockfall Prevention Fence

✧ General

Rockfall prevention fence is a countermeasure installed besides the road to prevent against the rocks falling from the slopes.

For the design of rockfall prevention fence, it is necessary to assume the external forces that will be applied on the structure. The assumed falling-rock weight, falling speed, direction of action on the protection fence, action position, etc. are different depending on the topography, geology, weathering condition of the slope, and vegetation on each site. Therefore, in designing a rockfall prevention, it is necessary to estimate the value that seems to be the most appropriate on the basis of the investigation at the site and experience of falling rocks in the past.

✧ Design Concept

Rockfall prevention fences are effective as countermeasures against falling rocks of relatively small scale, and the type and size shall be determined according to the situation of the slope. Rockfall prevention fences have the following types:

i) *Wire Rope and Wire Mesh Type*: Using H steel as a support, wire rope and wire mesh are attached to it.

ii) *H Steel Type*: H steel is used as a support, horizontal steel of H steel and expanded metal are attached, and usually old tires are applied as cushioning material.

iii) *High Energy Absorption Type*: A mechanism that easily absorbs energy by elastic-plastic deformation of members such as net (wire mesh), wire rope or strut is incorporated.

✧ Load

The load is the falling-rock load. The falling-rock for design is assumed as a rock with a maximum diameter of 50 cm, a falling height of 10 m or less (within the site range), and with an unit volume weight 26 kN/m3.

✧ Allowable maximum displacement amount and possible absorbed energy

Allowable maximum displacement amount and possible absorbed energy shall be calculated.

b. Rockfall Prevention Retaining Wall

✧ General

Rockfall Prevention Retaining Wall is usually built as gravity type concrete retaining wall. The basic idea is to convert the kinetic energy of the falling rock into deformation energy of the supporting ground and to stop the falling-rock by absorbing it.

For the design, it is necessary to consider the stability of the *Rockfall Prevention Retaining Wall* and reinforcement of the cross section of the structure, taking into consideration the topography and geology as well as the expected falling rock weight, falling height.

✧ Stability of Retaining Wall during Rockfall Collision

Stability of retaining wall during rockfall collision shall be considered.

✧ At Ordinary Times, At Deposition, During Earthquake

Stability of retaining wall at ordinary times, at deposition, during earthquake shall be considered.

c. Applicable Design Standard

The following are IRC Specifications, Standards and Design codes majorly applied for the design;

- IRC: Special Report State of the Art: Landslide Correction Techniques. Sub-Clause 7.3.6 and Sub-Clause 7.9
- IRC: SP 48 -1998: Hill Road Manual. Sub-Clause 8.2.1
- IRC: 78-2014 Standard Specifications and Code of Practice for Road Bridges Section VII Foundation and Substructure (Revised Edition). Sub-Clause 710.7
- IRC: 24-2010 Standard Specifications and Code of Practice for Road Bridges Section V Steel Road Bridge (Third Revision). Clause 502.

The following specifications of JIS (Japanese Industrial Standards) or equivalent shall be applied for the materials:

- JIS G 3101: H steel
- JIS G 3525: Wire rope
- JIS G 3552: Wire net

4.2.3 Anchor Works

a. Design

✧ General

i) In designing an anchor, consideration should be given to safety, workability and economic efficiency so as to conform to the purpose, and to have no harmful influence on surrounding structures, buried objects and so on.

ii) In designing an anchor, in principle, a basic test shall be conducted. If it cannot be carried out before design, it shall be carried out immediately after the start of construction to confirm the validity of the design.

✧ Investigation

i) General investigation: (investigation other than geotechnical investigation)

- literature investigation
- investigation of adjacent structures and their influence
- investigation of buried objects of underground
- surrounding investigation
- investigation of construction conditions.

ii) Geotechnical investigation:

- Investigation on corrosion
- Investigation for design anchor force
- Investigation for finding the installation position of anchor bodies
- Investigation for finding the extreme pull-out force of anchor
- Investigation for design of reaction force body
- Investigation on workability
- Investigation of groundwater

iii) Basic investigation test:

- Pull out test (test to set limiting friction resistance and ultimate bearing resistance of the ground)
- Long term test (Test to presume of decrease tendency of residual tensile force of anchor planned for important structures)

iv) Save record:

- Materials related to the investigation of anchor shall be kept by the responsible person.

✧ Material

i) General:

- Materials shall comply with the IRC's prescribed standards, international standards, Japanese Industrial Standards or equivalent approved by the Authority's Engineer.
- When materials used for anchors are being assembled, materials that do not affect adversely to other materials shall be used.

ii) Grout:

- Cement-based grout: Cement shall conform the requirements of Section 1000 of the Specifications for Road and Bridge Works of MORTH.
- When grouts other than cement-based grout are used, those having required quality and performance shall be used.

iii) Tendon

- Materials of tendon shall conform the requirements of Section 1009 of the Specifications for Road and Bridge Works of MORTH. Also, it shall obtain approval from the Authority's Engineer.
- When steel material is used as a tensile material constituting tendon, it is necessary to use one conforming to the standards and standards of public institutions (JIS G 3536-2008, JIS G 3109-2008, JIS G 3137-2008).
- When continuous fiber reinforcement material is used as a tensile material constituting tendon, it is necessary to use one conforming to the standards of JSCE-E 131-1999 (Japan Society of Civil Engineering).

iv) Fixture

- The fixture shall have a structure and strength that does not break or impair the performance of the anchor before the tensile material is broken.
- The fixing tool shall have a structure adapted to the structure and purpose of use.

v) Other materials

- Head Cap: The head cap shall protect the anchor head and shall have a leak prevention function and strength and durability of the anticorrosive material.
- Bearing Pressure Plate: The bearing pressure plate shall have a shape and strength suitable for the fixture and the structure.

- Sheath: The sheath shall have undamaged abrasion resistance and strength, durability and water tightness against harmful substances when assembling, transporting, inserting and grouting of the tendon.
- Others: The other materials shall be of a shape and material that does not interfere with the function of the anchor, depending on the type of anchor and purpose of use.

✧ Corrosion protection

i) General:

Considering the corrosive environment around the structure, the service period and the importance of the structure, the anchor shall be ensured corrosion prevention so that the function of the anchor is maintained during its use period.

ii) Anticorrosive materials:

The following, or others proposed by the Contractor and approved by the Authority's Engineer, are the applicable anticorrosive materials:

- Filler: Greases, petrolatums, synthetic resins are often used.
- Covering material (sheath): Synthetic resin (polyethylene, polypropylene, etc.), stainless steel, steel materials and so on.
- Coating material: Galvanizing, anti-rust plating, epoxy material and so on.

iii) Anticorrosion method

- The anticorrosive structure of the anchor body shall not interfere with the structure of the anchor body which transmits the tensile force to the ground.
- Corrosion protection of the tension part should be a structure that combines the sheath and other anticorrosive material and shall be able to follow the change of the tension.
- The anti-corrosion structure of the anchor head shall not interfere maintenance and management such as lift-off test or re-tension.
- Since the risk of corrosion is particularly high at the boundary between the tension part and the anchor body or between the tension part and the anchor head part, corrosion protection shall be performed in a reliable manner.

✧ Design

i) Anchor arrangement

- *Anchor arrangement plan*: Anchor placement shall be planned taking into consideration the overall stability including the surrounding

ground of the structure fixed by the anchor, the influence on the adjacent structure, the geology and so on.

- *Tilt angle of anchor*: The tilt angle of anchor shall be determined to ensure that a given anchor can be constructed. But, angles between - 5° and + 5° may effect on the anchor strength by residual slime or grout breathing, so this range should be avoided.
- *Anchor body installation interval*: The installation interval of the anchor bodies shall be determined in consideration of the interaction of the anchors. Generally, an interval of 1.5 m or more shall be secured.

ii) Anchor length

- *Anchor Free Length*: In principle, the minimum length of the anchor free length shall be 4 m, and the anchor free length shall be determined in consideration of the thickness of the earth covering, the stability of the entire structure system and so on.
- *Tendon Free Length*: Tendon's free length shall be determined to allow for deformation and to ensure the required tension.
- *Anchor length*: In principle, the length of the anchor is 3 m or more and 10 m or less, and it shall be determined in consideration of the drawing force of the ground and grout, and the binding force of grout and tendon.

iii) Anchor body

The anchor body shall have a required strength and durability during tension or service period and have a structure that can reliably transmit the anchor force to the ground. The compressive strength of grout such as cement paste and mortar used for anchor bodies shall be 24N/mm^2 or more in consideration of durability against deterioration of grout during service period.

iv) Anchor head

- The anchor head, that is, the fixing tool and the pressure bearing plate is a part provided for reliably transmitting the anchor force to the structure or the ground. It shall have a required strength against the anchor force and be a structure that does not cause harmful deformation.
- The anchoring force decreases with time due to creep of the ground and relaxation of the tensile material. Therefore, when it can be predicted that re-tension is required, the tensile material constituting the tendon shall use a tensile margin which has sufficient length or a fixing tool which can be re-strained.

v) Anchor force

- The design anchor force (Td: the tensile force used for the design): Td shall not exceed the allowable anchor force (Ta).
- The allowable anchor force (Ta) shall be examined for the following three items, and the smallest value shall be adopted:

  ◆ Tendon allowable tensile stress (Tas)

  The tendon allowable tensile force (Tas) shall be set to a smaller value among the Tendon's ultimate tensile force (Tus: the tensile force obtained from the maximum test force prescribed by JIS such as steel used for tendon) and the tendon's yield tensile force (Tys: the tensile force obtained from the test force against 0.2% permanent elongation prescribed by JIS such as steel used for tendon) multiplied by the reduction rate.

  ◆ Allowable binding force of Tendon (Tab)

  Tendon's allowable binding force (Tab: the value obtained by dividing the ultimate binding force of Tendon by the safety factor) shall be a value considering the stress transmission method from tendon to grout material and design standard strength of grout material.

  ◆ Allowable pull-out force of anchor (Tag)

  The allowable pull-out force (Tag) of the anchor shall be a value obtained by dividing the ultimate pull-out force (Tug: the value at which the resistance due to adhesion, friction or bearing occurring between the ground and the anchor body becomes the ultimate limit state) of the anchor by the safety factor.

vi) Tension force at fixing time

The tension force at fixing time shall be determined depending on the purpose of use, considering the stability of the entire structure including the ground.

- *Initial tensile force*: Maximum tensile force when tensioning and fixing the anchor head.
- *Tension force at fixing time*: Tensile force acting on tendon after fixing time is completed.
- *Residual tensile force*: It is the tensile force that ultimately acts on tendon due to ground creep, relaxation of tensile material, and other external forces.

vii) Basic investigation test

- *Pull-out test*: The pull-out test is carried out to confirm the ultimate pull-out force of the anchor and its behavior, and to determine various constants parameters used for anchor's design. For the anchor used in the pull-out test, the specifications of the anchor shall be specified so that the ultimate pull-out force can be confirmed.

  From the test results, it is possible to calculate the ultimate skin friction resistance (τa) or the ultimate bearing resistance (qu) of the anchor body.

  - Test Anchor

  The test anchor shall be carried out in the same way as the anchor to be used. The planned maximum load shall be planned so that ultimate destruction occurs between the ground and the anchor body and can be pulled out.

  - Loading Method

  The loading method shall be carried out in a multi-cycle system in which the relationship between load and elastic displacement amount and plastic displacement amount can be obtained. The number of cycles is decided by the responsible technician's judgment.

- *Long term test*: Long term tests are performed to confirm the long-term behavior of the anchor and to determine the constants used for designing the anchor. The test anchor used for the long-term test shall be carried out with an anchor constructed under the same use conditions as the actually-used anchor

- *Test load*: The maximum load for test shall be as follows:

  - PC steel material: yield tensile load × 0.9 or less
  - Continuous fiber reinforcement material: ultimate tensile load × 0.75 or less

b. Construction

✧ General

In anchor construction, ground conditions, environmental conditions, construction contents and on-site construction conditions shall be grasped to ensure safety, disaster prevention and the surrounding environment conservation. In addition, construction plans shall be formulated to satisfy the design specifications and obtain appropriate quality. Construction shall be carried out by specialized workers under the guidance of responsible technicians who have sufficient knowledge and experience regarding anchors.

✧ Construction plan

i) When constructing an anchor, a construction plan document that defines the construction method, construction management method, and management standard at each construction stage shall be prepared in order to construct an anchor that satisfies the design specifications.

The standard items described in the construction plan document are as follows:

- construction purpose
- construction outline
- plan/design condition
- process
- construction management organization table
- equipment used
- material used
- temporary plan
- work procedure, construction procedure
- construction management, quality control plan
- safety management plan
- technical document, brochure, etc.
- others

ii) The construction plan should take into consideration safety and environmental conservation at the site and its surroundings, and maintenance and management of the anchor.

✧ Construction and construction management

i) Construction and construction management of anchors shall be implemented based on the construction plan.

ii) In the construction of anchors, if a situation different from the conditions assumed at the time of planning occurs, it is necessary to promptly investigate the cause and take appropriate measures as necessary.

✧ Material storage

i) The materials to be used (fixtures, tendons, other materials for processing) shall be kept so as not to impair their functions. The storage location should be level so as not to touch the ground. In addition, it is necessary to take into consideration not to adversely affect the quality due to adhesion of rain water, moisture, salt, mud and the like.

ii) At the time of storage of materials, safety data sheets such as material chemical substances (injection material, rust preventive material, waterproof material, etc.,) should be clearly showed so that the workers can view them at any time as necessary.

✧ Drilling

i) Drilling of the anchor shall satisfy the control value specified in the construction plan concerning the position, hole diameter, length, direction, etc. indicated in the design documents. In drilling, the following points shall be considered:

- The drilling method shall be able to prevent the collapse of the hole wall and be adopted a method that can reliably perform tendon insertion and grout injection. For this reason, it is necessary to select an appropriate method with casing drilling as a standard.
- The control value of drilling precision shall be determined in consideration of the importance of the structure, purpose of use, anchor specification, etc. so that the anchor will not adversely affect other existing structures. Also, it is necessary to set so that the anchors to be constructed do not interfere with each other.
- It is necessary to estimate the position and layer thickness of the installation ground of the anchor body based on the color / state of the slime discharged during drilling and the drilling speed, etc., and to confirm the validity as the installation ground.

ii) If there is concern about the influence on the surrounding ground due to the drilling of the anchor, it shall be prevented by an appropriate method.

iii) In the case where the groundwater level is higher than the drilling mouth, or in the case of artesian water, spouting of considerable water or sediment is assumed from the drilling mouth during the anchor construction, and the state that adversely affects the quality of grout of the anchor body is presumed. If such a situation is assumed, appropriate measures shall be taken to prevent this condition until the anchor body is completed.

iv) Cleaning in the drilling hole shall be carried out by a method using fresh water or air depending on ground conditions and construction conditions. Drilling of soft rocks with slaking properties such as mudstone and tuff shall be taken care as drilling surfaces tend to become muddy and there is a possibility that prescribed skin friction resistance cannot be obtained.

v) In the case of the ground such as gravel, talus or rocks with many cracks, there is a concern that grout of the anchor body may flow out into the ground. In this case, it is necessary to conduct pre-injection with grout.

✧ Assembling and processing Tendon

i) Tendon shall be assembled so as not to impair its function based on design specifications. Since assembly and processing are carried out using parts such as a sheath and a centralizer, each component shall be handled carefully.

ii) Tendon shall ensure the covering of the predetermined grout and assemble to be located it in the center of the hole.

iii) Cutting of tendon is not a method of applying heat such as gas cutting, but it shall be done using a disk cutter and so on so as not to impair its characteristics.

- ✧ Tendon handling

  Tendon shall be handled carefully so as not to scratch, bend sharply, or destroy anticorrosive material. The tendon of the anchor body to which the grout adheres shall be handled carefully so as not to adhere to the oil or soil that impairs the function.

- ✧ Insertion and retaining of Tendon

  Insertion of the tendon shall be performed precisely in a predetermined position so as not to cause harmful damage or deformation and hold the tendon so as not to move until the grout hardens.

- ✧ Injection

  The injection is performed by replacement injection, pressurized injection and filling injection.

i) Substitution Injection:

Replacement injection shall start from the lowest part of the anchor hole in order to smooth drainage and exhaust air in the hole. The work shall be carried out continuously without interruption until the grout having the same properties (the same degree of concentration) as the injected grout is discharged from the drilling mouth.

ii) Pressurized injection:

Methods of pressurized injection include casing pressurization and packer pressurization. The injection shall be carried out by using an appropriate method according to the ground conditions around the anchor body.

iii) Filling Injection:

This purpose is to increase the anticorrosion function of the free length part by filling the gap between the outside of the anchor free long sheath and the ground with grout, and to control the looseness and weathering of the ground around the hole wall.

- ✧ Curing

The anchor shall be cured so as not to adhere foreign matter or not to receive deformation and vibration such as impairing function during the period from the end of the grout injection to the tension of the tendon and from the fixing to the head treatment.

✧ Tension and fixings

i) After the grout reaches the predetermined strength, the predetermined test load and displacement characteristics shall be confirmed by the aptitude test / confirmation test, and the initial tensioning force shall be introduced to obtain the required residual tensile force.

ii) The anchor head fixing work shall be carried out so as to obtain a predetermined fixing tension force. The allowable error of the installation angle at the anchor head shall be ± 5 ° or less.

iii) The initial tensile force shall be determined taking into consideration the set amount (the length by which the tension material is drawn in fixing the anchor).

iv) The tensioning device shall be calibrated.

✧ Head treatment

i) On the back of the anchor head, head treatment shall be carried out in the manner shown in the design documents before tensioning / fixing in order to prevent corrosion at the boundary between the anchor head part and the free length part of the anchor.

ii) The head treatment of the anchor shall be carried out quickly after tension and fixing for the purpose of corrosion prevention and protecting of the anchor head. Specifically, the anchor head shall be covered with a cap, and the cap shall be filled with an anticorrosive material such as rust preventive oil.

✧ Record

At the stage of anchor maintenance management, necessary data shall be recorded and saved.

✧ Acceptance inspection

i) Aptitude test

The aptitude test is carried out in order to check whether the design and construction of the anchor are appropriate from the load-displacement amount characteristic by loading up to a predetermined load in multiple cycles with an anchor to be actually used.

The test shall be selected from a part of the anchors actually used and shall be 5% of the construction quantity and 3 or more in consideration of the ground on which the anchor body is installed, the specifications of the anchor, the setting method.

ii) Confirmation test

The confirmation test is carried out to load the anchor actually used up to a predetermined load in one cycle and to confirm that the anchor is safe against the designed anchor force. The anchor used for the confirmation test shall be carried out against all anchor except for the anchor used for the aptitude test.

✧ Maintenance and management

i) General

- The anchor shall be conducted inspections and investigations, etc. systematically, to maintain the original function. Inspections are basically based on periodic inspections, but if abnormal weather such as heavy rain or earthquakes occurred, they shall be checked promptly as necessary.
- As a result of inspection, if it is judged necessary, soundness investigation should be carried out, and appropriate measures shall be taken against anchors considered to be problematic in soundness.

ii) Inspection of anchor

- *Inspection item*: It shall be decided in consideration of the site situation.
- *Duration and Frequency of Inspection*: The inspection shall be continued, and its frequency shall be determined in consideration of the anchor's purpose, application, circumstances, etc.
- *Records*: It is necessary to record the inspection result and evaluate it. Based on that, it is necessary to judge whether further detailed soundness investigation is necessary or not.

iii) Soundness investigation of anchor

- *Investigation method*: As for investigation of soundness of anchor, preliminary investigation shall be carried out and gather materials necessary for planning soundness investigation. Based on that, it is necessary to select an appropriate method considering the condition of the target anchor and the site conditions, etc. The soundness investigation plan shall be planned in detail in consideration of safety and environmental conservation at the site and its surroundings, regarding the implemental method of investigations and tests and the construction management method. The investigation and test items of the soundness investigation are as follows. a) visual inspection in head detail investigation, b) exposure investigation in head detail investigation, c) lift-off test, d) head back investigation, e) monitoring

- *Evaluation of investigation results*: The necessity and method of countermeasures shall be considered by evaluation of soundness from the investigation results.

iv) Measures

The countermeasures shall be planned after clarifying the purpose of durability improvement measures, repair / reinforcement, renewal, etc.

v) Record

Maintenance records related to inspection / soundness investigation / countermeasures shall be preserved during the service period of the anchor.

c. Applicable Design Standard

Followings are IRC Specifications, Standards and Design codes majorly applied for the design;

- IRC: Special Report: State of the Art: Landslide Correction Techniques. Sub-Clause 7.3
- Ministry of Road Transport & Highways: Specifications for Road and Bridge Works (Fifth Revision) 2013; Section 1700: Structural Concrete.

Followings are design and construction standard of Japanese Geotechnical Society and Anchor materials of JIS (Japanese Industrial Standards). The materials shall be JIS or equivalent.

- Ground anchor design and construction standard: JGS 4101-2012 (Japan Society of Civil Engineering).
- Concrete standard specifications: Civil Engineering Society

4.2.4 Rock Bolt Works

a. Design

✧ General

It is a feature to stabilize the slope by the reinforcement effect of the ground by reinforcing material.

✧ Material

Materials shall comply with the IRC's prescribed standards, international standards, Japanese Industrial Standards, and/or equivalent, and with the approval of the Authority's Engineer.

i) Reinforcing material

- Reinforcing material shall conform the requirements of Section 1000 of the Specifications for Road and Bridge Works of MORTH.

- The reinforcing material shall have a predetermined tensile strength, flexural rigidity and durability.
- The reinforcing material shall be a fully threaded hollow bar steel (self-piercing rod: JIS G 4051 or equivalent: permissible load of 129 kN, yield load of 196 kN) or full screw steel (SD 490-D 22: JIS G 3112 or equivalent: permissible load of 96.8 kN, Yield load 190 kN) shall be used.
- In order to ensure durability, the reinforcing material shall be subjected to surface treatment (hot dip galvanizing treatment, etc.).

ii) Bearing pressure plate

- The bearing pressure plate shall have a predetermined strength (JIS G 3101 or equivalent).
- In order to ensure durability, the bearing pressure plate shall be subjected to surface treatment (hot dip galvanizing treatment, etc.).

iii) Injection material

- The injection material shall ensure pulling resistance force, and shall be superior adhesion, fast strength.
- For cement used for injection material, ordinary Portland cement (JIS R 5210 or equivalent) or blast furnace cement (JIS R 5211 or equivalent) shall be used.

✧ Design

The design of the lock bolt shall be designed so that stability is ensured by sufficient consideration of ground conditions, groundwater condition, surrounding structures etc.

i) Fixing length

The fixing length of the reinforcing material shall be set so as to satisfy the required deterring force against the assumed surface collapse.

ii) Installation angle of reinforcing material

The installation angle of the reinforcing material shall be perpendicular to the sliding surface. However, on a natural slope, it shall be perpendicular to the average slope gradient.

iii) Length of reinforcing material

The length of the reinforcing material shall be equal to or more than "assumed collapse layer thickness + fixing length + surplus length".

b. Construction

✧ General

i) In rock bolt construction, ground conditions, environmental conditions, construction contents and construction conditions shall be grasped to ensure safety, disaster prevention and the surrounding environment conservation.

ii) Construction plans shall be formulated to satisfy the design specifications and obtain appropriate quality.

iii) Construction shall be carried out by specialized workers under the guidance of responsible technicians who have sufficient knowledge and experience regarding rock bolt.

✧ Construction plan

i) When constructing the lock bolt, a construction plan shall be prepared to satisfy the design specifications. The standard items described in the construction plan document are as follows.

- construction purpose,
- construction outline
- plan / design condition
- process
- construction management
- quality control plan
- safety management plan
- technical document, brochure

ii) The construction plan should take into consideration safety and environmental conservation at the site and its surroundings, and maintenance and management.

✧ Construction and construction management

i) Construction and construction management of rock bolt shall be implemented based on the construction plan.

ii) In the construction of rock bolt, if a situation different from the conditions assumed at the time of planning occurs, it is necessary to promptly investigate the cause and take appropriate measures as necessary.

✧ Drilling

Drilling methods include self-drilling, rotary drilling and leg hammer drilling. Drilling shall select an appropriate excavator in consideration of geological and topographical conditions. Drilling shall be carried out based on the design drawing and guided by the Authority's Engineer.

✧ Insertion of reinforcing material

Immediately after the excavation is completed, the lock bolt shall be easily inserted into the borehole to the specified depth. Materials "oil, mud, rust" that reduce the adhesion between lock bolt and grout shall be cleaned before insertion. When using a casing, a spacer shall be attached so that the reinforcing material is arranged in the center of the hole so that mud etc. does not adhere.

✧ Injection

i) Before grout injection, air shall be sent to wash the inside of the hole.

ii) Injection is carried out from the bottom of the hole and shall be injected until the cement milk is discharged from the hole mouth.

iii) The water cement ratio is 40% to 50%.

✧ Curing

After the grout injection is completed, the lock bolt shall be cured so as not to receive deformation or vibration that may impair the function.

✧ Acceptance inspection (Confirmation test)

i) In order to confirm whether or not the fixing power of the reinforcing material satisfies the design value, an acceptance inspection (confirmation test) shall be carried out.

ii) The number of tests shall be 3 or more and 3% or more of the total number.

iii) The maximum test load shall be the design load, but it shall not exceed 80% of the allowable stress degree.

iv) The load cycle shall be a single cycle.

✧ Head treatment

i) A bearing pressure plate shall be installed on the reinforcing material head.

ii) The head of the reinforcing material shall be tightened with a nut.

iii) After tensioning, a cap filled with anticorrosive oil shall be installed.

✧ Record

The necessary data for maintenance and management shall be recorded and preserved.

c. Applicable Design Standard

Followings are IRC Specifications, Standards and Design codes majorly applied for the design;

- Ministry of Road Transport & Highways: Specifications for Road and Bridge Works (Fifth Revision) 2013

4.2.5. Crib Works

a. Design

✧ General

The crib works is a construction method aimed at stabilizing the slope by creating a continuous lattice frame against cutting surfaces and natural slopes. In the grating crib works for stabilizing the slope, there are a shotcrete grating crib works and a cast -in -place grating crib works.

✧ Material

i) General

Materials shall comply with the IRC's prescribed standards, international standards, Japanese Industrial Standards, and equivalent, and with the approval of the Authority's Engineer.

ii) Cement

- Cement-based grout: Cement shall conform the requirements of Section 1000 of the Specifications for Road and Bridge Works of MORTH or JIS R 5210, or equivalent.
- When cement other than ordinary Portland cement is used, it must be confirmed that required performance can be obtained beforehand.

iii) Aggregate

- Aggregate shall be clean, rigid, durable and suitable particle size, and free of dirt, mud, organic impurities, chloride, etc.
- Aggregate shall conform the requirements of Section 1000 of the Specifications for Road and Bridge Works of MORTH or JIS A 5005, or equivalent.
- The sand used as fine aggregate shall have a dry density of 2.5 g/cm3 or more and a water absorption of 3.5% or less.
- The fine aggregate shall be chemically and physically stable.
- Hazardous aggregate showing alkali silica reaction shall not be used.

iv) Admixture

- The admixture shall be of quality assured.
- AE agent, water reducing agent and AE water reducing agent used as admixture shall be one conforming the requirements of Section 1000 of the Specifications for Road and Bridge Works of MORTH or JIS A 6204, or equivalent.

v) Reinforcing Steel

- Reinforcing steel shall conform the requirements of Section 1000 of the Specifications for Road and Bridge Works of MORTH or JIS G 3112, or equivalent.
- Reinforcing bars to be used shall use the ones shown in the design drawing.

vi) Wire Mesh and Formwork

- For wire mesh used for shotcrete grating crib works, rhombus wire mesh conforming to JIS G 3552 or welded wire mesh conforming to JIS G 3551 or equivalent shall be standard.
- The material of the formwork for shotcrete shall be selected by checking the quality and carefully examining the construction conditions, spraying conditions, spraying materials, construction method, etc.

✧ Design

i) General

Based on natural conditions and field survey, the design of grating crib works shall be designed taking into consideration its type, function and scope.

ii) Load

- The load acting on the framework is its own weight (framework material and filling material), the assumed load of collapsed soil, ground reaction force.
- The design load shall be the value obtained by multiplying the working load by the load coefficient.

iii) Inspection

Inspection of the grating crib works shall be conducted according to a prescribed procedure (Reference: Designing and Construction Guidelines for Grating Crib Works: Revised Edition 3rd Edition; 2013 National Specific Slope Protection Association).

b. Construction

✧ General

i) The construction of the shotcrete grating crib works shall be carried out in accordance with the construction plan in consideration of strength, durability, slope condition, environment etc. sufficiently, further considering the safety of the construction, construction environment, etc.

ii) Construction management shall be performed by a technician with sufficient knowledge concerning construction of the shotcrete crib works.

iii) Construction shall be carried out by specialized workers under the guidance of responsible engineers with sufficient knowledge and experience.

✧ Construction plan

i) When constructing the grating crib work, a construction plan shall be prepared to satisfy the design specifications. The standard items described in the construction plan document are as follows:

- construction purpose
- construction outline
- plan / design condition
- process
- construction management
- quality control plan
- safety management plan
- technical document, brochure

ii) The construction plan should take into consideration safety and environmental conservation at the site and its surroundings, and maintenance and management.

✧ Construction and construction management

i) Construction and construction management of rock bolt shall be implemented based on the construction plan.

ii) In the construction of rock bolt, if a situation different from the conditions assumed at the time of planning occurs, it is necessary to promptly investigate the cause and take appropriate measures as necessary.

✧ Assembling the formwork

i) Those that are likely to affect the quality of spraying mortar such as floating stones on the slope and the root system of vegetation shall be removed.

ii) The formwork shall be assembled so as to satisfy a predetermined standard.

✧ People who handles nozzle

Since the quality of the shotcrete mortar is affected by the skill of the person who handles the nozzle, the skill of that person shall be confirmed in advance.

✧ Spraying and surface treatment

i) At the time of spraying, the rebounding mortar shall be removed and cleaned.

ii) Surface treatment of the grating crib works shall be finished smoothly.

iii) After spraying, the interior of the frame shall be cleaned.

✧ Record

The necessary data for maintenance and management shall be recorded and preserved.

c. Applicable Design Standard

Followings are IRC Specifications, Standards and Design codes majorly applied for the design;

- Ministry of Road Transport & Highways: Specifications for Road and Bridge works (Fifth Revision) 2013

4.2.6. Non-Frame Works

a. Design

✧ General

i) The non-frame works is a construction method to stabilize the slope without cutting trees.

ii) This method is characterized by stabilizing the slope due to the reinforcement effect of the reinforcing material "lock bolt", the bearing pressure effect of the surface ground by the bearing pressure plate, and the group effect by head connection.

iii) Because the construction material is lightweight and easy to handle, it is excellent for steep slope construction.

✧ Material

i) General

Conform to the chapter on lock bolt.

ii) Reinforcing material

Conform to the chapter on lock bolt.

iii) Bearing pressure plate

Conform to the chapter on lock bolt.

iv) Head coupling material

- The head connecting material shall have sufficient strength to withstand the tensile force.
- Head connecting material consists of wire rope (JIS G 3525 or equivalent), turn buckle (JIS G 3445, JIS G 3101 or equivalent) etc.

- In order to ensure durability, the head connecting material shall be subjected to surface treatment (alloy plating, hot dip galvanizing treatment, etc.).

v) Injection material

Conform r to the chapter on lock bolt.

✧ Design

i) General

The design of the Non-frame works shall be designed so that stability is ensured by sufficient consideration of ground conditions, groundwater condition, surrounding structures etc.

ii) Arrangement of reinforcement

The arrangement of the reinforcing materials shall be arranged so as to draw an equilateral triangle such that the length of one side is 2 m in principle.

iii) Fixing length

Conform to the chapter on lock bolt.

iv) Installation angle of reinforcing material

Conform to the chapter on lock bolt.

v) Length of reinforcing material

Conform to the chapter on lock bolt.

vi) Bearing pressure plate and Head connecting material

Bearing pressure plates shall be arranged in an equilateral triangle shape and connected by a connecting material.

b. Construction

✧ General

Conform to the chapter on lock bolt.

✧ Construction plan

Conform to the chapter on lock bolt.

✧ Construction and construction management

Conform to the chapter on lock bolt.

✧ Positioning

i) The arrangement of the reinforcing materials shall be arranged so as to draw an equilateral triangle such that the length of one side is 2 m in principle.

ii) When the bearing pressure plate cannot be placed, it shall be positioned so that the length of one side is 3 m and the total of the three sides does not exceed 7 m.

✧ Scaffolding

i) The scaffold area shall be about 2 m × 2 m in the case of self-drilling.

ii) When the casing is used, the scaffold area should be suitable for the weight of the drilling machine.

✧ Drilling

Conform to the chapter on lock bolt.

✧ Insertion of reinforcing material

Conform to the chapter on lock bolt.

✧ Injection

Conform to the chapter on lock bolt.

✧ Curing

After the grout injection is completed, the lock bolt shall be cured so as not to receive deformation or vibration that may impair the function.

✧ Acceptance inspection (Confirmation test)

Conform to the chapter on lock bolt.

✧ Head treatment

Conform to the chapter on lock bolt.

✧ Head connecting material

Head connecting material shall be properly attached to the bearing pressure plate and tensioned (the slack of the wire is less than 2cm).

✧ Record

Conform to the chapter on lock bolt.

c. Applicable Design standard

Followings are IRC Specifications, Standards and Design codes majorly applied for the design:

- Ministry of Road Transport & Highways: Specifications for Road and Bridge works (Fifth Revision) 2013.

4.2.7. Reinforced Earth Wall

a. General

Reinforced earth wall shall be designed and constructed based on followings guidelines and specifications;

- IRC: SP:102-2014, Guidelines for Design and Construction of Reinforced Soil Wall
- MORTH Specifications for Road and Bridge works (Fifth Revision), 2013
- Japanese design or construction standards for reinforced earth walls or equivalent international standards as necessary

b. Elements of Reinforced Earth Wall

✧ Facing Elements
Facing elements shall be designed in accordance with IRC: SP:102-2014 and MORTH Specifications, 2013.

✧ Reinforcement Material
Reinforcement material shall be in accordance with IRC: SP:102-2014 and MORTH Specifications, 2013.

i) Drainage

In order to drain out the water remaining at back of reinforced earth wall, the filter material such as filter geofabric shall be provided properly as shown in the Drawings.

ii) Foundation

In order to avoid the stability failure of the structure, foundation of reinforced earth wall shall be embedded more than 0.5m into rock ground as shown in Drawings.

For reinforced earth wall installed at steep slope terrain, the foundation may be composed as multistage of base concrete as shown in the Drawing. In addition, rock anchors may be required to provide adequate structural stability in some case as shown in Drawing.

When such advanced foundation was applied, the design, material, construction methodology and etc. shall be proposed by the Contractor and require the approval by the Authority's Engineer.

iii) Others

For reinforced earth wall installed at steep slope terrain, it may be difficult to provide enough width of the wall at back side and length of reinforcement materials adequate without huge excavation of slope terrain. In such case, advanced structural details shall be considered in order to reduce the wall width. One of the method to is "Reinforced soil wall by fixing reinforced material with anchor bar" as shown in the Drawings.

When such advanced method was applied, the design of each members, material, connection details, construction methodology and etc. shall be proposed by the Contractor and require the approval by the Authority's Engineer.

c. Design Principles

Basically, reinforced earth wall shall be designed in accordance with IRC:SP: 102-2014 and MORTH Specifications,2013. For the foundation and wall with advanced method applied, the design shall be proposed by the Contractor and require the approval by the Authority's Engineer.

d. Construction and Quality Control Tests

Basically, reinforced earth wall shall be constructed in accordance with IRC: SP:102-2014 and MORTH Specifications,2013. For the foundation and wall with advanced method applied, construction methodology and quality control tests shall be proposed by the Contractor and require the approval by the Authority's Engineer.

5. Environment Management Plan

5.1 Overview

Descriptions of environment management measures during different stages of the project are provided in this chapter.

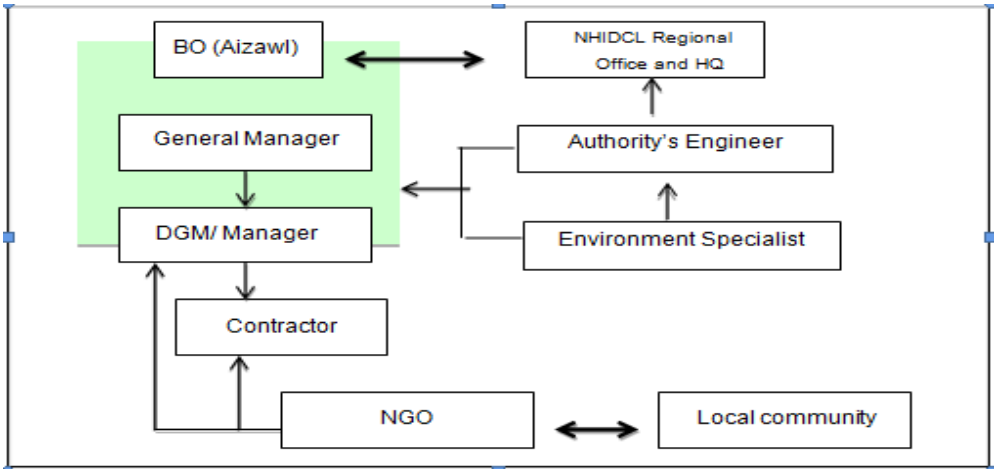
5.1.1. Pre-construction Stage

Required management measures during the pre-construction stage include the clearance of the ROW, plantation of trees, the measures for protecting/replacing community resources such as electric poles, public urinals and water points that are likely to be impacted. Their enhancement shall also be completed before construction work starts so that the community can start using these when the construction activity begins.

5.1.2. Construction Stage

This will be most crucial and active stage for the Environmental Management Plan (EMP). In addition to the monitoring of the construction activity itself to ensure that the environment is not damaged beyond permissible limits, the enhancement of cultural and community properties, mitigation and enhancement measures for water bodies through proper treatment of spoil soils will be undertaken as the construction progresses. To facilitate implementation of the enhancement and mitigation measures suggested, working drawings of the same have been provided in the Appendices. In addition, the provision of proper risk management with respect to construction activities such as accidental spillage is critical at this stage to avoid damage to flora and fauna, agricultural land and other sensitive resources. Typical locations of concerns include the locations of hot-mix plants (spillage of fuel, bitumen etc.) and labor camp sites.

Fig:



Institutional Arrangement for EMP Implementation

5.1.3. Operation Stage

The operation stage will essentially entail monitoring activity along the project area. In addition to checking the efficacy of the protection/ mitigation/ enhancement measures implemented, this will help verify or refuse the predictions made as a part of the impact assessment. Thus, it will complete a very important feedback loop for the project.

5.2. Environment Management Plan for Mitigation of Negative Impacts

The detailed measures adopted and/or to be adopted during different stages of the project to mitigate negative impacts and enhance positive aspects are shown in Table. The responsibility for implementation and supervision of EMPs are vested with three agencies, namely Contractors, Branch Office (BO), and Authority's Engineer (AE). The Contractors herein mean the agency hired for execution of the construction works for the respective contract packages. BO would be implementation agency. The Figure below indicates implementation structure of the EMP.

It has been proposed that General Manager (Projects) based in Aizawl will be in charge for the implementation of EIA and EMP for this project. General Manager will be assisted by Deputy General Manager/Manager by Authority's Engineer (and Environment Specialist) and contractor.

The Authority's Manager are expected to have in-house capacity to advise on and supervise the implementation of the EMP including suggesting enhancement design options and modifications, as necessary. For this purpose, the Authority's Engineer will employ a full-time environmental specialist.

The NGO will be one of the stakeholders in the entire project cycle with primary responsibility of facilitating the implementation of RAP and help NHIDCL/State Government in mitigating the adverse impacts of the project. Meanwhile, they can play a role in successful implementation of EMP, for example by supporting afforestation activity and awareness-raising campaign for traffic safety/risk of HIV/AIDS among others. Compensatory plantation and maintenance and protection of vegetation will be required as part of environmental mitigation and enhancement works. Likewise, spoil soils shall be used, where possible, to create community assets such as playground as per request of the community. In these types of works, the project may engage NGO to liaise with local community for effective implementation of the project.

Table: Environmental Management Plan for Pre-Construction Stage

Sl. No	Environmental Impact	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
Social Environment						
P1	Involuntary Resettlement	● All requirements of the RAP as applicable shall be completed before start of construction works. The activities broadly include acquisition of land and structures, relocation of utilities, payment of compensation and provision assistance	All areas (involuntary resettlement takes place in Bypass 1 and 2)	Before construction begins	Government of Mizoram, District Revenue authorities, Village Councils, NGO	PIU, SC
P2	Land Use ■ Deforestation	● Minimize the scale of vegetation clearing / damage to jhum field by factoring vegetation/forest cover in the final design of the bypass route alignment process ● Removal of trees to be carried out after forest clearance is obtained ● Reforestation/replantation of trees at a term as instructed by the Forest Department ● Activity shall be supervised to avoid poaching of animals	All areas	Before construction begins (Reforestation /plantation may extend to during/after construction)	PIU, Contractor, Forest Dept.	PIU, SC, Forest Dept.

Sl. No	Environmental Impact	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
	■ Setting up construction camp	● Construction camps shall be located reasonably away from the nearest built-up area to avoid nuisance ● Sewage system for a construction workers' camp shall be designed, built and operated to prevent pollution to ground or adjacent water body. Garbage bins shall be provided in the camps and regularly emptied and the garbage disposed of in a hygienic manner, to the satisfaction of the relevant norms and the Engineer. ● All relevant provisions of the Factories Act, 1948 and the Building and other Construction Workers (regulation of Employment and Conditions of Service) Act, 1996 shall be adhered to.	All construction campsite identified by the contractor and approved by SC	During Establishment, Operation and Dismantling of Such Camps	Contractor	PIU, SC
	■ Setting up hot-mix plant	● Hot mix plants and batching plants shall be located sufficiently away from habitation and agricultural operations. ● Where possible such plants will be located at least 1,000 m away from the nearest habitation.	All hot-mix and batching plants	During Erection, Testing, Operation and Dismantling of Such Plants	Contractor	PIU, SC
	■ Finalize the location of soil dumping site	● Location of dumping sites shall be finalized in consultation with relevant village authorities. The site and its design shall meet following conditions: i) dumping does not impact natural drainage courses; ii) no endangered/rare flora is impacted by such dumping	All areas identified as potential dumping sites	During mobilization	Contractor	PIU, SC
P3	Identification of hazard-prone locations	● The contractor shall identify locations sensitive to landslides (in addition to the ones that area already identified) and shall duly report these to the Supervision Consultant (SC) and to PIU.	All areas	During mobilization	Contractor	PIU, SC
P4	Local Economy and Livelihood	● Implementation of Income Restoration Plan	PAPs	Before construction work begins	State Gov.	State Gov.

Sl. No	Environmental Impact	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
P5	Unequal distribution of benefits and damage	• Implementation of Income Restoration Plan	PAPs	Before construction work begins	State Gov.	State Gov.
P6	Religious facilities	• Select the route that minimizes the impact	All areas	Detailed Design	NHIDCL	State Gov.
P7	Sensitive Facilities	• Select the route that minimizes the impact	All areas	Detailed Design	NHIDCL	State Gov.
P8	Poor People	• Implementation of Income Restoration Plan	PAPs	Before construction work begins	State Gov.	State Gov.
P9	Minority/Indigenous People	• Implementation of Income Restoration Plan	PAPs	Before construction work begins	State Gov.	State Gov.
P10	Children's Right	• Provide assistance to children who need to commute longer to school	Children in education	Before construction work begins	State Gov.	State Gov.
Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
Natural Environment						
C1	Topography	• Treat residual soil properly	Soil dumping site	Construction state	Contractor and Supervision Consultant	PIU
C2	Soil Erosion	• The depth of borrow pits shall be restricted so that sides of the excavation shall have a slope not steeper than 1:4 from the edge of the final section of the bank, if applicable	On approved locations of borrow pits.	Construction Stage	Contractor and Supervision Consultant	PIU
		• Agricultural fields or productive land shall be avoided for borrowing earth. If unavoidable, topsoil shall be preserved and used for tree plantation	On approved locations of borrow pits.	Construction Stage	Contractor and Supervision Consultant	PIU
		• Construction equipment and vehicles shall be restricted to move only within designated area to avoid compaction of productive soil	All areas	Construction Stage	Contractor and Supervision Consultant	PIU
		• Pitching shall be done for slope stabilization as per the IRC guidelines, if applicable	At the places of embankments	Construction Stage	Contractor and Supervision Consultant	PIU

Sl. No	Environmental Impact	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
C3	Hydrology	● Construction vehicles and equipment shall be operated and maintained in such a manner so that soil contamination due to its spillage shall be minimum ● Fuel storage shall only be done on vacant area and will be kept away from drainage channels and natural water bodies	Near Labor camp and sites of installation of construction machineries.	Construction Stage	Contractor and Supervision Consultant	PIU
C4	Ecosystem, Flora, Fauna, Biodiversity and Forest	● Three trees shall replace each tree cut for the purpose (as suggested by Environment and Forest Dept. Mizoram). ● The Engineer shall approve such felling only when the NHIDCL receives a "clearance" for such felling from the MOEF, as applicable. ● Trees felled shall be replaced as per the compensatory afforestation criteria in accordance with the Forests (Conservation) Act, 1980.	Throughout the project area	Construction Stage	Contractor and Supervision Consultant Forest Dept.	PIU
		● During construction, at any point of time, if a rare/ threatened/endangered flora species is found, it shall be conserved in a suitable manner in consultation with authorities. The Engineer shall approve detailed conservation processes, plans and designs as well as associated modification in the project design.	Throughout the project area.	Construction Stage	Contractor and Supervision Consultant	PIU
C5	Natural Disaster	● Prepare for fire and water disasters ● Prepare first aid kit and keep contact information of local hospitals	All area	During construction	Contractor and Supervision Consultant	PIU
Living Environment						

Sl. No	Environmental Impact	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
C6	Air Quality	● All vehicles, equipment and machinery shall be selected to meet recognized international and national standards for emissions and shall be maintained and operated in a manner that ensures relevant air, noise and discharge rules. ● Only unleaded petrol and low sulfur diesel or sulfur free diesel shall be used as fuel for vehicles, equipment and machinery.	Wherever the hot mix plant and batching plant is set up.	Construction Stage	Contractor and Supervision Consultant	PIU
		● The asphalt plants, crushers and batching plants shall not be sited at least 500 m in leeward direction from nearest human settlement	Locations near Settlement	Construction Stage	Contractor and Supervision Consultant	PIU
		● Regular monitoring or air quality parameters during the construction period as envisaged in the Environmental Monitoring Plan.	Locations given in Environmental Monitoring Plan.	Construction Stage	Contractor and Supervision Consultant	PIU
		● The dust generated by vehicles on site shall be arrested using a water tanker fitted with sprinkler capable of applying water uniformly with a controllable rate of flow to variable widths of surface but without any flooding.	Wherever the plants are setup and sensitive locations as suggested in monitoring plan.	Construction Stage	Contractor and Supervision Consultant	PIU
C7	Water Quality	● Construction vehicles/ equipment shall be operated and maintained in such a manner to avoid contamination of water bodies due to oil spillage ● Fuel storage shall only be done on vacant area and will be kept away from drainage channels and natural water bodies	Near labor camp and sites of installation of Construction machineries.	Construction Stage	Contractor and Supervision Consultant	PIU
		Contamination of stagnant water body by fecal matters from labor camp	● Labor camp shall not be allowed near any of the water bodies ● The proper sanitation facilities shall be provided	Preapproved locations away from the water bodies	Construction Stage	Contractor and Supervision Consultant

Sl. No	Environmental Impact	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
		Deposition of dust in open wells near construction site	● The mouth/opening of the well shall be covered with suitable material when construction activity is taking place so as to prevent dust entering in the well	All the wells along the bypass route	Construction Stage	Contractor and Supervision Consultant
		●				P
C8	Noise and Vibration	● The plants and equipment used for construction shall conform to CPCB norms. ● Vehicles and equipment used shall be fitted with silencer. ● Any vehicle and machinery shall be kept in good working order and engines turned off when not in use. ● All equipment and plants shall strictly be placed away from educational institutes and hospitals. ● Regular monitoring of noise parameters (Leq) during the construction period as envisaged in the Environmental Monitoring Plan.	Wherever the plants are setup.	Construction Stage	Contractor and Supervision Consultant	PIU
		● Blasting as per Indian Explosives act will be carried out. ● People living near such blasting operation sites shall be informed before the operational hours. ● Workers at blasting sites shall be provided with earplugs.	At the sites where the blasting is required and in quarry sites	Construction Stage	Contractor and Supervision Consultant	PIU

Sl. No	Environmental Impact	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
C9	Waste/Hazardous Material	● Debris generated due to the dismantling of the existing pavement structure and the cutting of the hillside for the widening (where section of existing community road is used for new bypass) shall be suitably reused in the construction, such as for fill materials for embankments ● Debris and other material obtained from existing embankment shall be dumped in approved landfill site identified by concerned agency. All spoils shall be disposed of and the site shall be fully cleaned before hand over ● Construction waste including non-bituminous and bituminous waste shall be dumped in approved landfill site identified by State Pollution Control Board (SPCB) or competent authority. All spoils shall be disposed of and the site shall be fully cleaned before hand over	Solid waste dump site identified and approved by SPCB or competent authority Throughout the area	Construction Stage	Contractor and Supervision Consultant	PIU
		● Demolish all buildings to ensure that waste and effluents pollute local environment	Construction camp	Upon completion of construction work	Contractor and Supervision Consultant	PIU
Social Environment						
C10	Land Use	●				
C11	Utilization of Local Resources	● Use drinking water in a way not to pressure local water availability	Construction site and camp	During construction	Contractor and Supervision Consultant	PIU
C12	Social Infrastructure and Services	● Schedule construction work to minimize disturbance ● Avoid disturbance to hospitals and schools	Local community	During construction	Contractor	Engineer
		● Prepare traffic plan and submit to engineer and inform the local people	Local community	During construction	Contractor	Engineer

Sl. No	Environmental Impact	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
C13	Local Economy, Livelihood	● Schedule construction work to minimize disturbance	Local community	During construction	Contractor	Engineer
C14	Unequal distributions of benefits and damage	● Schedule construction work to minimize disturbance ●	Local community	During construction	Contractor	Engineer
C15	Religious facilities	● Avoid impacts to major religious events, particularly Sunday mass	Local community	During construction	Contractor	Engineer
C16	Sensitive facilities	● Schedule construction work to minimize disturbance	Local community	During construction	Contractor	Engineer
C17	Poor people	● Implementation of IRP	PAP	Prior to construction work	State Gov.	State Gov.
C18	Ethnic minorities/indigenous people	● Implementation of IRP	PAP	Prior to construction work	State Gov.	State Gov.
C19	Gender	● Promote women's participation in construction work ● Separate camp area for men and women	Construction site and camp	During construction	Contractor and Supervision Consultant	PIU
C20	Children's right	● Never allow child labor	Construction site and camp	During construction	Contractor and Supervision Consultant	PIU
C21	Public Health	● Reclamation measure shall be adopted with garland of trees around the periphery. The quarry dust and waste shall be used for refilling. The remaining portion should be covered with trees.	All quarry locations.	Construction Stage	Contractor and Supervision Consultant	PIU
		Prepare and distribute brochures /information kit on HIV/AIDS to construction workers and truck drivers	Construction site and work camp	During construction	Contractor and Supervision Consultant	PIU

Sl. No	Environmental Impact	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
C22	Occupational Health	● The Contractor is required to comply with all the precautions as required for the safety of the workmen as far as those are applicable to this contract. ● The contractor shall supply all necessary safety appliances such as safety goggles, helmets, masks, etc., to the workers and staff. The contractor has to comply with all regulation regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress.	All construction sites	Construction stage	Contractor and Supervision Consultant	PIU
		● Adequate precautions will be taken to prevent danger from electrical equipment. No material or any of the sites will be so stacked or placed as to cause danger or inconvenience to any person or the public. ● All necessary fencing and lights will be provided to protect the public. All machines to be used in the construction will conform to the relevant Indian Standards (IS) codes, will be free from patent defect, will be kept in good working order, will be regularly inspected and properly maintained as per IS provisions and to the satisfaction of the Engineer.	All construction Site	Construction stage	Contractor and Supervision Consultant	PIU

Sl. No	Environmental Impact	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
		● All workers employed on mixing asphaltic material, cement, lime mortars, concrete etc., will be provided with protective footwear and protective goggles. Workers, who are engaged in welding works, would be provided with welder's protective eye-shields. Stone-breakers will be provided with protective goggles and clothing and will be seated at sufficiently safe intervals. ● The use of any herbicide or other toxic chemical shall be strictly in accordance with the manufacturer's instructions. The Engineer shall be given at least 6 working day's notice of the proposed use of any herbicide or toxic chemical. A register of all herbicides and other toxic chemicals delivered to the site shall be kept and maintained up to date by the Contractor. The register shall include the trade name, physical properties and characteristics, chemical ingredients, health and safety hazard information, safe handling and storage procedures, and emergency and first aid procedures for the product. This should comply with Hazardous Material Act.	All construction sites	Construction stage	Contractor and Supervision Consultant	PIU
		● Nobody below the age of 18 years and no woman shall be employed on the work of painting with products containing lead in any form. No paint containing lead or lead products will be used except in the form of paste or readymade paint. ● Facemasks will be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped	All construction sites	Construction stage	Contractor and Supervision Consultant	PIU

Sl. No	Environmental Impact	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
Others						
C23	Accident	● Prior arrangement/traffic diversion for safe passage of vehicles shall be made with proper direction and signage at the construction site. ● Detailed Traffic Control Plans shall be prepared and submitted to the Site Engineer/ Project Director for approval 5 days prior to commencement of works, particularly in section where the bypass intersects with existing road. The traffic control plans shall contain details of temporary diversions, details of arrangements for construction under traffic and details of traffic arrangement after cessation of work each day.	Throughout the project area	Construction stage	Contractor and Supervision Consultant	PIU
		● The Contractor is required to comply with all the precautions as required for the safety of the workmen as far as those are applicable to this contract. ● The contractor shall supply all necessary safety appliances such as safety goggles, helmets, masks, etc., to the workers and staff. The contractor has to comply with all regulation regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress.	All construction sites	Construction stage	Contractor and Supervision Consultant	PIU

Sl. No	Environmental Impact	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
		● Adequate precautions will be taken to prevent danger from electrical equipment. No material or any of the sites will be so stacked or placed as to cause danger or inconvenience to any person or the public. ● All necessary fencing and lights will be provided to protect the public. All machines to be used in the construction will conform to the relevant Indian Standards (IS) codes, will be free from patent defect, will be kept in good working order, will be regularly inspected and properly maintained as per IS provisions and to the satisfaction of the Engineer.	All construction Site	Construction stage	Contractor and Supervision Consultant	PIU

Sl. No	Environmental Impact	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
		● Except as may be provided in the contract or ordered or authorized by the Engineer, the Contractor shall not use explosives. Where the use of explosives is so provided or ordered or authorized, the Contractor shall comply with the requirements of the following Sub-Clauses of this Clause besides the law of the land as applicable. ● The Contractor shall at all times take every possible precaution and shall comply with appropriate laws and regulations relating to the importation, handling, transportation, storage and use of explosives and shall, at all times when engaged in blasting operations, post sufficient warning flagmen, to the full satisfaction of the Engineer. ● The Contractor shall at all times make full liaison with and inform well in advance and obtain such permission as is required from all Government Authorities, public bodies and private parties whatsoever concerned or affected or likely to be concerned or affected by blasting operations.	Place of use of Explosives	Construction stage	Contractor and Supervision Consultant	PIU

Sl. No	Environmental Impact	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
		● The Contractor is required to comply with all the precautions as required for the safety of the workmen as far as those are applicable to this contract. ● The contractor shall supply all necessary safety appliances such as safety goggles, helmets, masks, etc., to the workers and staff. The contractor has to comply with all regulation regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress.	All construction sites	Construction stage	Contractor and Supervision Consultant	PIU
		● Adequate precautions will be taken to prevent danger from electrical equipment. No material or any of the sites will be so stacked or placed as to cause danger or inconvenience to any person or the public. ● All necessary fencing and lights will be provided to protect the public. All machines to be used in the construction will conform to the relevant Indian Standards (IS) codes, will be free from patent defect, will be kept in good working order, will be regularly inspected and properly maintained as per IS provisions and to the satisfaction of the Engineer.	All construction Site	Construction stage	Contractor and Supervision Consultant	PIU

Sl. No	Environmental Impact	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
		● Detailed Traffic Control Plans shall be prepared and submitted to the Site Engineer/ Project Director for approval 5 days prior to commencement of works on areas where bypass intersects with existing road. The traffic control plans shall contain details of temporary diversions, details of arrangements for construction under traffic and details of traffic arrangement after cessation of work each day. ● Special consideration shall be given in the preparation of the traffic control plan to the safety of pedestrians and workers at night. ● The Contractor shall ensure that the running surface is always properly maintained, particularly during the monsoon so that no disruption to the traffic flow occurs. As far as possible idling of engines shall be avoided to curb pollution.	Near built-up areas	During Construction.	Contractor	Engineer
C24	Climate Change	● Reforestation	Location As designated by Forest Dept.	From before the construction work	Contractor and Supervision Consultant	Forest Dept.

Environmental Management Plan for Operation Stage

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
Natural Environment						
O1	Soil erosion	● Prevent soil erosion by proper slope protection and turfing	All area	Continue from construction stage	Contractor and Supervision Consultant	PIU
O2	Hydrology	● Install Gabion and Apron concrete at Calvert	All area	Continue from construction stage	Contractor and Supervision Consultant	PIU

O3	Ecosystem, forest	● Trees planted for reforestation shall be maintained for a period of three years. Maintenance works include, watering of the saplings, replacement of the bamboo fence (if applicable) every year for three years and other necessary measures for survival of the sapling. ● Monitoring of flora and fauna along the highway shall be carried out to assess conditions of ecosystem against the baseline. Condition of nearby protected area shall be collected from Environment Department for checking any indirect impacts due to greater traffic volume.	All area and as per the monitoring plan	Immediately from the planting of sapling, and as per monitoring plan	PIU, NGO	PIU
O4	Natural disaster	● Prevent soil erosion by proper slope protection and turfing	All area	Continue from construction stage	Contractor and Supervision Consultant	PIU
Living Environment						
O5	Air Quality	● Monitoring shall be carried out as specified in the Monitoring plan ● Share air quality data with SPBC and relevant agencies and discuss options for mitigate air quality degradation associated with greater traffic volume	As specified in the monitoring plan	As per monitoring plan	PIU, SPCB	PIU
O6	Water Quality	● Silt fencing, oil & grease traps, etc. shall be provided at sensitive water bodies to ensure that the water quality is not impaired due to contaminants from road run-off ● Monitoring shall be carried out as specified in the monitoring plan	As specified in the monitoring plan	As per monitoring plan	PIU, SPCB	PIU
		● Contingency plans to be in place for cleaning up of spills of oil, fuel and toxic chemicals ● Monitoring shall be carried out as specified in the Monitoring Plan	All area and as specified in the monitoring plan	Plan to be developed at state/district level by early operation stage	PIU, SPCB, Local Government Bodies	PIU

O7	Noise and Vibration	● Monitoring shall be carried out as specified in the Monitoring plan ● Install noise barrier (wall etc.) in sensitive areas, if necessary	As specified in the monitoring plan	As per monitoring plan	PIU, SPCB	PIU
O8	Waste and Hazardous Material	● Compliance with the Hazardous Wastes (Management and Handling) Rules, 1989 including: ✓ For delivery of hazardous substances, permit license, driving license and guidance license will be required. ✓ These vehicles will only be harbored at designated parking lots. ✓ In case of spill of hazardous materials, the relevant departments will be notified at once to deal with it with the spill contingency plan.	All area	Manual/guideline to be prepared during early operation stage	PIU	PIU
Social Impact						
O9	Unequal distribution of benefits and damages	● Monitoring of Resettled PAH, implementation of IRP	PAH	Post resettlement	State Gov	State Gov
O10	Religious Facilities	● Monitoring (particularly for noise and vibration)	As per monitoring plan	As per monitoring plan	PIU, SPCB	PIU
O11	Sensitive Facilities	● Monitoring (particularly for noise and vibration)	As per monitoring plan	As per monitoring plan	PIU, SPCB	PIU
O12	Public Health	● Public awareness camplaign for HIV/AIDS and other STDs	All areas	Continue from construction stage	PIU/NGO	PIU
O13	Occupational Health	● Same as construction state measures	All area	From Construction state	PIU	PIU
Other						
O14	Accidents	● Traffic control measures including speed limits to be enforced strictly. ● Local government bodies and development authorities will be encouraged to control building development along the highway.	All area	Throughout operation stage	PIU, Local Government Bodies	PIU

O15	Climate Change	● Trees planted for reforestation shall be maintained for a period of three years. Maintenance works include, watering of the saplings, replacement of the bamboo fence (if applicable) every year for three years and other necessary measures for survival of the sapling. ● Monitoring of flora and fauna along the highway shall be carried out to assess conditions of ecosystem against the baseline. Condition of nearby protected area shall be collected from Environment Department for checking any indirect impacts due to greater traffic volume.	All area and as per the monitoring plan	Immediately from the planting of sapling, and as per monitoring plan	PIU, NGO	PIU

5.3. Environment Monitoring Plan

To ensure effective implementation of the EMP, it is essential that an effective monitoring plan be designed and carried out. The environmental monitoring plan provides such information on which management decision may be taken during construction and operational phases. It provides basis for evaluating the efficiency of mitigation and enhancement measures and suggest further actions that need to be taken to achieve the desired effect. The monitoring includes: i) Visual observations; ii) Selection of environmental parameters at specific locations; and iii) Sampling and regular testing of these parameters

Monitoring methodology covers the following key aspects: Components to be monitored; parameters for monitoring of the above components; monitoring frequency; monitoring standards; responsibilities for monitoring; direct responsibility, overall responsibility; and monitoring costs. Environmental monitoring of the parameters involved and the threshold limits specified are discussed below.

Ambient air quality

Ambient air quality parameters recommended for monitoring road transportation developments are PM10, PM 2.5, Carbon Monoxide (CO), Oxides of Nitrogen (NO_X), Sulphur Dioxide (SO_2) and Lead (Pb). These will be monitored at designated locations starting from the commencement of construction activity. Data should be generated at all identified locations in accordance to the National Ambient Air Quality Standards, 2009. The location, duration and the pollution parameters will be monitored and the responsible institutional arrangements are detailed out in the Monitoring Plan.

Water quality

The physical and chemical parameters recommended for analysis of water quality relevant to road development projects are pH, total solids, total dissolved solids, total suspended solids, oil and grease, COD, chloride, lead, zinc and cadmium. The location, duration and the pollution parameters to be monitored and the responsible institutional arrangements are detailed in the Environmental Monitoring Plan. The monitoring of the water quality is to be carried out at all identified locations in accordance to the Indian Standard Drinking Water Specification – IS 10500: 1991.

Noise

The measurements for monitoring noise levels would be carried out at all designated locations in accordance to the Ambient Noise Standards formulated by Central Pollution Control Board (CPCB) in 1989. Noise should be recorded at an "A" weighted frequency using a "slow time response mode" of the measuring instrument. The location, duration and the noise pollution parameters to be monitored and the responsible institutional arrangements are detailed in the Environmental Monitoring

Plan

The monitoring plan for the various performance indicators of the project in the construction and operation stages is summarized in the Table below.

Sl. No	Item	Project Stage	Parameters	Guidance	Standards	Location	Frequency	Duration	Responsibility	
									Implementation	Supervision
M1	Air	Construction	SPM, RSMP, SO_2, NOx, CO, HC	• Dust sampler to be located 50m from the plan in the downwind direction. • Use method specified by CPCB for analysis	Air (P&CP) Rules, CPCB, 1994	Hot mix plant/ batching plant	Twice a year for three years	Continuous 24 hours	Contractor through approved monitoring agency	BO
M2		Construction	SPM, RSPM	• Dust sampler to be located 50m from the earthworks site downwind direction. Follow CPCD method for analysis	Air (P&CP) Rules, CPCB, 1994	Stretch of road where construction is underway	Twice a year for three years	Continuous 24 hours	Contractor through approved monitoring agency	BO
M3		Operation	SPM, RSMP, SO_2, NOx, CO, HC	• Use method specified by CPCB for analysis	Air (P&CP) Rules, CPCB, 1994	Sampling location specified in EIA report	Twice a year for one year	Continuous 24 hours	BO	BO
M4	Water	Construction	pH, BOD, COD, TDS, TSS, DO, Oil & Grease and Pb	• Sample collected from source and analyze as per Standard Methods for Examination of Water and Wastewater	Water quality standards by CPCB	Sampling locations specified in EIA report	Twice a year for three years		Contractor through approved monitoring agency	BO
M5		Operation	pH, BOD, COD, TDS, TSS, DO, Oil & Grease and Pb	• Grab sample collected • from source and analyze as per Standard Methods for Examination of Water • and Wastewater	Water quality standards by CPCB	Sampling locations specified in EIA report	Twice a year for one year		BO	BO

M6		Operation	Cleaning of drains and water bodies	• Choked drains, water bodies undergoing siltation and subject to debris disposal should be monitored under cleaning operations	To the satisfaction of the engineer (PWD)	All area	Post-monsoon		BO	BO
M7		**Construction**	Noise levels on dB (A) scale	• Free field at 1m from the equipment whose noise levels are being determined	Noise standards by CPCB	At equipment yard	Once every 3 Month (max) for three years, as required by the Authority's engineer	Reading to be taken at 15 seconds interval for 15 minutes every hour and then averaged	Contractor through approved monitoring agency	BO
M8		**Operation**	Noise levels on dB (A) scale	• Equivalent Noise levels using an integrated noise level meter kept at a distance of 15 m from edge of Pavement	Noise standards by CPCB	At maximum 15 sites inc. those listed in EIA report for noise monitoring locations	Twice a year for 1 years	Readings to be taken at 15 seconds interval for 15 minutes every hour and then averaged.	BO	BO
M9		**Construction**	Turbidity in Storm water; Silt load in ponds, water courses	• Visual observations during site visits	As specified by the Authority 's engineer / Water quality standards	At locations of stream crossings and at locations of retaining wall and breast wall	Pre-monsoon and post-monsoon for three years		Contractor	BO

M10		**Operation**	Turbidity in Storm water; Silt load in ponds, water courses	• Visual observations during site visits	As specified by the Authority's engineer / Water quality standards	As directed by the engineer	Pre-monsoon and post-monsoon for one year		BO	BO
M11		**Construction**	Monitoring of: 1.Storage Area; 2. Drainage Arrangement 3. Sanitation in Camps	• Visual Observations and as directed by the Authority's engineer	To the satisfaction of the Authority's engineer and Water quality standards	At storage area and construction workers' camp	Quarterly during construction stage		BO	BO
M12		**Construction and operation**	Plant survival	• The success of tree planting. Monitor the rate of survival after six months, one year and 18 months in relation to total numbers of trees planted		All area	Minimum three years after planting		NGO, BO	BO
M13		**Construction and Operation**	Condition of ecosystem	• Comparison to pre-project flora and fauna	As specified in TOR	As specified in TOR	Twice a year for three years		BO	BO

*Any amendment/ Corrigendum/ revision of standards as per latest status shall be applicable.

Schedule - E

(See Clauses 2.1 and 14.2)

Maintenance Requirements

1. Maintenance Requirements

1.1. The Contractor shall, at all times maintain the Project Highway in accordance with the provisions of this Agreement, Applicable Laws and Applicable Permits.

1.2. The Contractor shall repair or rectify any Defect or deficiency set forth in Paragraph 2 of this Schedule-E within the time limit specified therein and any failure in this behalf shall constitute non-fulfillment of the Maintenance obligations by the Contractor. Upon occurrence of any breach hereunder, the Authority shall be entitled to effect reduction in monthly lump sum payment as set forth in Clause 14.6 of this Agreement, without prejudice to the rights of the Authority under this Agreement, including Termination thereof.

1.3. All Materials, works and construction operations shall conform to the "SPECIFICATIONS FOR ROAD AND BRIDGE WORKS (FIFTH REVISION, April 2013)", including latest corrections slips, issued by the Ministry of Surface Transport & Highways, Government of India and published by the Indian Roads Congress.

Where the specifications for a work are not given, Good Industry Practice shall be adopted to the satisfaction of the Authority's Engineer.

2. Repair/rectification of Defects and deficiencies

The obligations of the Contractor in respect of Maintenance Requirements shall include repair and rectification of the Defects and deficiencies specified in Annex -I of this Schedule-E within the time limit set forth therein.

3. Other Defects and deficiencies

In respect of any Defect or deficiency not specified in Annex -I of this Schedule-E, the Authority's Engineer may, in conformity with Good Industry Practice, specify the permissible limit of deviation or deterioration with reference to the Specifications and Standards, and any deviation or deterioration beyond the permissible limit shall be repaired or rectified by the Contractor within the time limit specified by the Authority's Engineer.

4. Extension of time limit

Notwithstanding anything to the contrary specified in this Schedule-E, if the nature and extent of any Defect or deficiency justifies more time for its repair or rectification than the time specified herein, the Contractor shall be entitled to additional time in

conformity with Good Industry Practice. Such additional time shall be determined by the Authority's Engineer and conveyed to the Contractor and the Authority with reasons thereof.

5. Emergency repairs/restoration

Notwithstanding anything to the contrary contained in this Schedule-E, if any Defect, deficiency or deterioration in the Project Highway poses a hazard to safety or risk of damage to property, the Contractor shall promptly take all reasonable measures for eliminating or minimizing such danger.

6. Daily inspection by the Contractor

The Contractor shall, through its engineer, undertake a daily visual inspection of the Project Highway and maintain a record thereof in a register to be kept in such form and manner as the Authority's Engineer may specify. Such record shall be kept in safe custody of the Contractor and shall be open to inspection by the Authority and the Authority's Engineer at any time during office hours.

7. Pre-monsoon inspection / Post-monsoon inspection

The Contractor shall carry out a detailed pre-monsoon inspection of all bridges, culverts and drainage system before [1st June] every year in accordance with the guidelines contained in IRC: SP35. Report of this inspection together with details of proposed maintenance works as required on the basis of this inspection shall be sent to the Authority's Engineer before the [10th June] every year. The Contractor shall complete the required repairs before the onset of the monsoon and send to the Authority's Engineer a compliance report. Post monsoon inspection shall be done by the [30th September] and the inspection report together with details of any damages observed and proposed action to remedy the same shall be sent to the Authority's Engineer.

8. Repairs on account of natural calamities

All damages occurring to the Project Highway on account of a Force Majeure Event or wilful default or neglect of the Authority shall be undertaken by the Authority at its own cost. The Authority may instruct the Contractor to undertake the repairs at the rates agreed between the Parties.

Annex -I

(Schedule-E)

Repair/rectification of Defects and deficiencies

The Contractor shall repair and rectify the defects and deficiencies specified in this **Annex-I** of **Schedule-E** within the time limit set forth in the table below.

Nature of Defect or deficiency		Time limit for repair/ rectification
ROADS		
(a)	**Carriageway and paved shoulders**	
(i)	Breach or blockade	Temporary restoration of traffic within 24 hours; permanent restoration within 15 (fifteen) days
(ii)	Roughness value exceeding 2,200 mm in a stretch of 1 km (as measured by a calibrated bump integrator)	120 (one hundred and twenty) days
(iii)	Pot holes	24 hours
(iv)	Any cracks in road surface	15 (fifteen) days
(v)	Any depressions, rutting exceeding 10 mm in road surface	30 (Thirty) days
(vi)	Bleeding/Skidding	7 (seven) days
(vii)	Any other defect/distress on the road	15 (fifteen) days
(viii)	Damage to pavement edges	15 (fifteen) days
(ix)	Removal of debris, dead animals	6 hours
(b)	**Granular earth shoulders, side slopes, drains and culverts**	
(i)	Edge drop at shoulders exceeding 40 mm	7 (Seven) days
(ii)	Variation by more than 1% in the prescribed slope of camber/cross fall (shall not be less than the camber on the main carriageway)	7 (seven) days
(iii)	Variation by more than 15% in the prescribed side (embankment) slopes	30 (thirty) days
(iv)	Rain cuts/gullies in slope	7 (Seven) days
(v)	Damage to or silting of culverts and side drains	7 (Seven) days
(vi)	Desilting of drains in urban/semi-urban areas	24 hours
(vii)	Railing, parapets, crash barriers	7 (Seven) days (Restore immediately if causing safety hazard)
(c)	**Road side furniture including road sign**	

	and pavement marking	
(i)	Damage to shape or position, poor visibility or loss of retro-reflectivity	48 hours
(ii)	Painting of KM stone, railing, parapets, crash barriers	As and when required/Once every year
(iii)	Damaged/missing road signs required replacement	7 (Seven) days
(iv)	Damage to road mark ups	7 (Seven) days
(d)	**Road lighting**	
(i)	Any major failure of the system	24 hours
(ii)	Faults and minor failures	8 hours
(e)	**Trees and plantation**	
(i)	Obstruction in a minimum head-room of 5 m above carriageway or obstruction in visibility of road signs	24 hours
(ii)	Removal of fallen trees from carriageway	4 hours
(iii)	Deterioration in health of trees and bushes	Timely watering and treatment
(iv)	Trees and bushes requiring replacement	30 (Thirty) days
(v)	Removal of vegetation affecting sight line and road structures	15 (fifteen) days
(f)	**Rest area**	
(i)	Cleaning of toilets	Every 4 hours
(ii)	Defects in electrical, water and sanitary installation	24 hours
(g)	**Toll Plaza**	
(h)	**Other Project Facilities, Rest Area and Approach roads**	
(i)	Damage in pedestrian facilities, truck lay-buys, bus-bays, bus-shelters, cattle, crossings, [Traffic Aid Posts, Medical Aid Posts] and service roads	15 (fifteen) days
(ii)	Damaged vehicles or debris on the road	4 (Four) hours
(iii)	Malfunctioning of the mobile cranes	4 (four) hours
Bridges		
(a)	**Superstructure**	
(i)	Any damage, cracks, spalling/scaling Temporary measures Permanent measures	 Within 48 hours Within 15 (fifteen) days or as specified by the Authority's Engineer
(b)	**Foundations**	
(i)	Scouring and/or cavitation	15 (fifteen) days
(c)	**Piers, abutments, return walls and wing walls**	
(i)	Cracks and damages including settlement and tilting, Spalling, scaling	30 (thirty) days

(d)	**Bearings (metallic) of bridges**	
(i)	Deformation	15 (fifteen) days Greasing of metallic bearings once in a year
(e)	**Joints**	
(i)	malfunctioning of joints	15 (fifteen) days
(f)	**Other items**	
(i)	Deforming of pads in elastomeric bearings	7 (seven) days
(ii)	Gathering of dirt in bearings and joints; or clogging of spouts, weep holes and vent-holes	3 (three) days
(iii)	Damage or deterioration in kerbs, parapets, handrails and crash barriers	3 (three) days (immediately within 24 hours if posing danger of safety)
(iv)	Rain-cuts or erosion of banks of the side slopes of approaches	7 (seven) days
(v)	Damage to wearing coat	15 (fifteen) days
(vi)	Damage or deterioration in approach Slabs, pitching, apron, toes, floor or guide bunds	30 (thirty) days
(vii)	Growth of vegetation affecting the structure or obstructing the waterway	15 (fifteen) days
(g)	**Hill Roads**	
(i)	Damage to retaining wall/breast wall	7 (seven) days
(ii)	Landslides requiring clearance	12 (twelve) hours
(iii)	Snow requiring clearance	24 (twenty four) hours

Note: Where necessary, the Authority may modify the time limit for repair/rectification, or add to the nature of Defect or deficiency before issuing the bidding document, with the approval of the competent authority.

Schedule - F

(See Clause 4.1 (vii)(a))

Applicable Permits

1. Applicable Permits

1.1. The Contractor shall obtain, as required under the Applicable Laws, the following Applicable Permits:

(a) Permission of the State Government for extraction of boulders from quarry;

(b) Permission of Village Panchayats and Pollution Control Board for installation of crushers;

(c) License for use of explosives;

(d) Permission of the State Government for drawing water from river/reservoir;

(e) License from inspector of factories or other competent Authority for setting up batching plant;

(f) Clearance of Pollution Control Board for setting up batching plant;

(g) Clearance of Village Panchayats and Pollution Control Board for setting up asphalt plant;

(h) Permission of Village Panchayats and State Government for borrow earth; and

(i) Any other permits or clearances or approvals required under Applicable Laws.

1.2. Applicable Permits, as required, relating to environmental protection and conservation shall have been procured by the Authority in accordance with the provisions of this Agreement.

Schedule - G

(See Clause 7.1.1, 7.5.3 and 19.2)

FORM OF BANK GUARANTEE

(See Clause 7.1.1)

PERFORMANCE SECURITY

The Managing Director,
NHIDCL,
3rd Floor, PTI Building, 4, Parliament Street,
New Delhi-110001

WHEREAS:

(A) _____ [name and address of contractor] (hereinafter called "the Contractor") and [**NHIDCL**], (**"the Authority"**) have entered into an agreement (the **"Agreement"**) for "***Construction of Chhiahtlang bypass and Serchhip bypass (Package-1) on Aizawl-Tuipang section of NH-54 in the State of Mizoram*** **on Engineering, Procurement and Construction (EPC) mode, with Japan International Cooperation Agency (JICA) loan assistance**", subject to and in accordance with the provisions of the Agreement.

(B) The Agreement requires the Contractor to furnish a Performance Security for due and faithful performance of its obligations, under and in accordance with the Agreement, during the Construction Period and Defects Liability Period (as defined in the Agreement) in a sum of Rs. …. Crore (Rupees …. Crore) (the "**Guarantee Amount**").

(C) We, ……..through our branch at ……. (the "**Bank**") have agreed to furnish this bank guarantee (hereinafter called the "**Guarantee**") by way of Performance Security.

NOW, THEREFORE, the Bank hereby, unconditionally and irrevocably, guarantees and affirms as follows:

1. The Bank hereby unconditionally and irrevocably guarantees the due and faithful performance of the Contractor's obligations during Construction Period and Defects

Liability Period under and in accordance with the Agreement, and agrees and undertakes to pay to the Authority, upon its mere first written demand, and without any demur, reservation, recourse, contest or protest, and without any reference to the Contractor, such sum or sums up to an aggregate sum of the guarantee amount as the Authority shall claim, without the Authority being required to prove or to show grounds or reasons for its demand and/or for the sum specified therein.

2. A letter from the Authority, under the hand of an officer not below the rank of General Manager in the NHIDCL that the Contractor has committed default in the due and faithful performance of all or any of its obligations under and in accordance with the Agreement shall be conclusive, final and binding on the Bank. The Bank further agrees that the Authority shall be the sole judge as to whether the Contractor is in default in due and faithful performance of its obligations during and under the Agreement and its decision that the Contractor is in default shall be final, and binding on the Bank, notwithstanding any difference between the Authority and the Contractor, or any dispute between them pending before any court, tribunal, arbitrators or any other Authority or body, or by the discharge of the Contractor for any reason whatsoever.

3. In order to give effect to this Guarantee, the Authority shall be entitled to act as if the Bank were the principal debtor and any change in the constitution of the Contractor and/or the Bank, whether by their absorption with any other body or corporation or otherwise, shall not in any way or manner affect the liability or obligation of the Bank under this Guarantee.

4. It shall not be necessary, and the Bank hereby waives any necessity, for the Authority to proceed against the Contractor before presenting to the Bank its demand under this Guarantee.

5. The Authority shall have the liberty, without affecting in any manner the liability of the Bank under this Guarantee, to vary at any time, the terms and conditions of the Agreement or to extend the time or period for the compliance with, fulfillment and/or performance of all or any of the obligations of the Contractor contained in the Agreement or to postpone for any time, and from time to time, any of the rights and powers exercisable by the Authority against the Contractor, and either to enforce or forbear from enforcing any of the terms and conditions contained in the Agreement and/or the securities available to the Authority, and the Bank shall not be released from its liability and obligation under these presents by any exercise by the Authority of the liberty with reference to the matters aforesaid or by reason of time being given to the Contractor or any other forbearance, indulgence, act or omission on the part of the Authority or of any other matter or thing whatsoever which under any law relating to sureties and guarantors would but for this provision have the effect of releasing the

Bank from its liability and obligation under this Guarantee and the Bank hereby waives all of its rights under any such law.

6. This Guarantee is in addition to and not in substitution of any other guarantee or security now or which may hereafter be held by the Authority in respect of or relating to the Agreement or for the fulfillment, compliance and/or performance of all or any of the obligations of the Contractor under the Agreement.

7. Notwithstanding anything contained hereinbefore, the liability of the Bank under this Guarantee is restricted to the Guarantee amount and this Guarantee will remain in force for the period specified in paragraph 8 below and unless a demand or claim in writing is made by the Authority on the Bank under this Guarantee all rights of the Authority under this Guarantee shall be forfeited and the Bank shall be relieved from its liabilities hereunder.

8. The Guarantee shall cease to be in force and effect on ****[$1]. Unless a demand or claim under this Guarantee is made in writing before expiry of the Guarantee, the Bank shall be discharged from its liabilities hereunder.

9. The Bank undertakes not to revoke this Guarantee during its currency, except with the previous express consent of the Authority in writing, and declares and warrants that it has the power to issue this Guarantee and the undersigned has full powers to do so on behalf of the Bank.

10. Any notice by way of request, demand or otherwise hereunder may be sent by post addressed to the Bank at its above referred branch, which shall be deemed to have been duly authorized to receive such notice and to effect payment thereof forthwith, and if sent by post it shall be deemed to have been given at the time when it ought to have been delivered in due course of post and in proving such notice, when given by post, it shall be sufficient to prove that the envelope containing the notice was posted and a certificate signed by an officer of the Authority that the envelope was so posted shall be conclusive.

11. This Guarantee shall come into force with immediate effect and shall remain in force and effect for up to the date specified in Para 8 above or until it is released earlier by the Authority pursuant to the provisions of the Agreement.

12. This guarantee shall also be operable at our…… Branch at New Delhi, from whom, confirmation regarding the issue of this guarantee or extension/ renewal thereof shall be made available on demand. In the contingency of this guarantee being invoked

[$] Insert date being 2 (two) years from the date of issuance of this Guarantee (in accordance with Clause 7.2 of the Agreement).

and payment thereunder claimed, the said branch shall accept such invocation letter and make payment of amounts so demanded under the said invocation.

13. This Guarantee is subject to the Uniform Rules for Demand Guarantees (URDG) 2010 Revision, ICC Publication no. 758, except that the supporting statement under Article 15 (a) is hereby excluded.

Signed and sealed this …….. day of ……. 20…….. at ……

SIGNED, SEALED AND DELIVERED
For and on behalf of the Bank by:

(Signature)
(Name)
(Designation)
(Code Number)
(Address)

NOTES:

(i) The bank guarantee should contain the name, designation and code number of the officer(s) signing the guarantee.

(ii) The address, telephone number and other details of the head office of the Bank as well as of issuing branch should be mentioned on the covering letter of issuing branch.

Annex-II
(Schedule-G)
(See Clause 7.5.3)

Form for Guarantee for Withdrawal of Retention Money

The Managing Director,
NHIDCL,
3rd Floor, PTI Building, 4, Parliament Street
New Delhi-110001

WHEREAS:

(A) [Name and address of contractor] (hereinafter called "**the Contractor**") has executed an agreement (hereinafter called the "Agreement") with the [NHIDCL], (hereinafter called "the Authority") for the "***Construction of Chhiahtlang bypass and Serchhip bypass (Package-1) on Aizawl-Tuipang section of NH-54 in the State of Mizoram* on Engineering, Procurement and Construction (EPC) mode, with Japan International Cooperation Agency (JICA) loan assistance**", subject to and in accordance with the provisions of the Agreement.

(B) In accordance with the Clause 7.5.3 of the Agreement, the Contractor may withdraw the retention money (hereinafter called "**Retention Money**") after furnishing to the Authority a bank guarantee for an amount equal to the proposed withdrawal.

(C) We, ……..through our branch at ……. (the "**Bank**") have agreed to furnish this bank guarantee (hereinafter called the "**Guarantee**") for the amount of Rs. ……Cr. (Rs.……. in words) (the "**Guarantee Amount"**).

NOW, THEREFORE, the Bank hereby, unconditionally and irrevocably, guarantees and affirms as follows:

1. The Bank hereby unconditionally and irrevocably undertakes to pay to the Authority, upon its mere first written demand, and without any demur, reservation, recourse, contest or protest, and without any reference to the Contractor, such sum or sums up to an aggregate sum of the Guarantee Amount as the Authority shall claim, without the Authority being required to prove or to show grounds or reasons for its demand and/or for the sum specified therein.

2. A letter from the Authority, under the hand of an officer not below the rank of General Manager in the NHIDCL that the Contractor has committed default in the due and faithful performance of all or any of its obligations under and in accordance with the Agreement shall be conclusive, final and binding on the Bank. The Bank further agrees that the Authority shall be the sole judge as to whether the Contractor is in default in due and faithful performance of its obligations during and under the Agreement and its decision that the Contractor is in default shall be final, and binding on the Bank,

notwithstanding any difference between the Authority and the Contractor, or any dispute between them pending before any court, tribunal, arbitrators or any other Authority or body, or by the discharge of the Contractor for any reason whatsoever.

3. In order to give effect to this Guarantee, the Authority shall be entitled to act as if the Bank were the principal debtor and any change in the constitution of the Contractor and/or the Bank, whether by their absorption with any other body or corporation or otherwise, shall not in any way or manner affect the liability or obligation of the Bank under this Guarantee.

4. It shall not be necessary, and the Bank hereby waives any necessity, for the Authority to proceed against the Contractor before presenting to the Bank its demand under this Guarantee.

5. The Authority shall have the liberty, without affecting in any manner the liability of the Bank under this Guarantee, to vary at any time, the terms and conditions of the Retention Money and any of the rights and powers exercisable by the Authority against the Contractor, and either to enforce or forbear from enforcing any of the terms and conditions contained in the Agreement and/or the securities available to the Authority, and the Bank shall not be released from its liability and obligation under these presents by any exercise by the Authority of the liberty with reference to the matters aforesaid or by reason of time being given to the Contractor or any other forbearance, indulgence, act or omission on the part of the Authority or of any other matter or thing whatsoever which under any law relating to sureties and guarantors would but for this provision have the effect of releasing the Bank from its liability and obligation under this Guarantee and the Bank hereby waives all of its rights under any such law.

6. This Guarantee is in addition to and not in substitution of any other guarantee or security now or which may hereafter be held by the Authority in respect of or relating to the Retention Money.

7. Notwithstanding anything contained hereinbefore, the liability of the Bank under this Guarantee is restricted to the Guarantee amount and this Guarantee will remain in force for the period specified in paragraph 8 below and unless a demand or claim in writing is made by the Authority on the Bank under this Guarantee all rights of the Authority under this Guarantee shall be forfeited and the Bank shall be relieved from its liabilities hereunder.

8. The Guarantee shall cease to be in force and effect 90 (ninety) days after the date of the Completion Certificate specified in Clause 12.4 of the Agreement.

9. The Bank undertakes not to revoke this Guarantee during its currency, except with the previous express consent of the Authority in writing, and declares and warrants that it has the power to issue this Guarantee and the undersigned has full powers to do so on behalf of the Bank.

10. Any notice by way of request, demand or otherwise hereunder may be sent by post addressed to the Bank at its above referred branch, which shall be deemed to have been duly authorized to receive such notice and to effect payment thereof forthwith, and if sent by post it shall be deemed to have been given at the time when it ought to have been delivered in due course of post and in proving such notice, when given by post, it shall be sufficient to prove that the envelope containing the notice was posted and a certificate signed by an officer of the Authority that the envelope was so posted shall be conclusive.

11. This Guarantee shall come into force with immediate effect and shall remain in force and effect for up to the date specified in para 8 above or until it is released earlier by the Authority pursuant to the provisions of the Agreement.

12. This guarantee shall also be operable at our…… Branch at New Delhi, from whom, confirmation regarding the issue of this guarantee or extension/ renewal thereof shall be made available on demand. In the contingency of this guarantee being invoked and payment there under claimed, the said branch shall accept such invocation letter and make payment of amounts so demanded under the said invocation.

Signed and sealed this …….. day of ……. 20…….. at ……

SIGNED, SEALED AND DELIVERED

For and on behalf of the Bank by:

(Signature)
(Name)
(Designation)
(Code Number)
(Address)

NOTES:

(i) The bank guarantee should contain the name, designation and code number of the officer(s) signing the guarantee.

(ii) The address, telephone number and other details of the head office of the Bank as well

as of issuing branch should be mentioned on the covering letter of issuing branch.

Annex-III
(Schedule-G)
(See Clause 19.2)

Form for Guarantee for Advance Payment

The Managing Director,
NHIDCL,
3rd Floor, PTI Building, 4, Parliament Street,
New Delhi-110001

WHEREAS:

(A) [name and address of contractor] (hereinafter called "**the Contractor**") has executed an agreement (hereinafter called the "Agreement") with the [**NHIDCL**], (hereinafter called "**the Authority**") for the "***Construction of Chhiahtlang bypass and Serchhip bypass (Package-1) on Aizawl-Tuipang section of NH-54 in the State of Mizoram*** **on Engineering, Procurement and Construction (EPC) mode, with Japan International Cooperation Agency (JICA) loan assistance**", subject to and in accordance with the provisions of the Agreement.

(B) In accordance with the Clause 19.2 of the Agreement, the Authority shall make to the Contractor an interest bearing (@ Bank Rate) advance payment (hereinafter called "**Advance Payment**") equal to 10% (ten per cent) of the contract price; and that the Advance Payment shall be made in two installments subject to the Contractor furnishing an irrevocable and unconditional guarantee by a scheduled bank for an amount equivalent to 110% (one hundred and ten percent) of such installment to remain effective till the complete and full repayment of the installment of the Advance Payment as security for compliance with its obligations in accordance with the Agreement. The amount of {first/second} installment of the Advance Payment is Rs. ------ cr. (Rupees ------ crore) and the amount of this Guarantee is Rs. ------- cr. (Rupees ------ crore) (the **"Guarantee Amount")** [$2]**.**

(C) We, ……..through our branch at ……. (the "**Bank**") have agreed to furnish this bank guarantee (hereinafter called the "**Guarantee**") for the Guarantee Amount.

[$]The Guarantee Amount should be equivalent to 110% of the value of the applicable installment.

NOW, THEREFORE, the Bank hereby, unconditionally and irrevoc**ably, guarantee**s and affirms as follows:

1. The Bank hereby unconditionally and irrevocably guarantees the due and faithful repayment on time of the aforesaid installment of the Advance Payment under and in accordance with the Agreement, and agrees and undertakes to pay to the Authority, upon its mere first written demand, and without any demur, reservation, recourse, contest or protest, and without any reference to the Contractor, such sum or sums up to an aggregate sum of the guarantee amount as the Authority shall claim, without the Authority being required to prove or to show grounds or reasons for its demand and/or for the sum specified therein.

2. A letter from the Authority, under the hand of an officer not below the rank of General Manager in the NHIDCL, that the Contractor has committed default in the due and faithful performance of all or any of its obligations for the repayment of the installment of the Advance Payment under and in accordance with the Agreement shall be conclusive, final and binding on the Bank. The Bank further agrees that the Authority shall be the sole judge as to whether the Contractor is in default in due and faithful performance of its obligations during and under the Agreement and its decision that the Contractor is in default shall be final, and binding on the Bank, notwithstanding any difference between the Authority and the Contractor, or any dispute between them pending before any court, tribunal, arbitrators or any other Authority or body, or by the discharge of the Contractor for any reason whatsoever

3. In order to give effect to this Guarantee, the Authority shall be entitled to act as if the Bank were the principal debtor and any change in the constitution of the Contractor and/or the Bank, whether by their absorption with any other body or corporation or otherwise, shall not in any way or manner affect the liability or obligation of the Bank under this Guarantee.

4. It shall not be necessary, and the Bank hereby waives any necessity, for the Authority to proceed against the Contractor before presenting to the Bank its demand under this Guarantee.

5. The Authority shall have the liberty, without affecting in any manner the liability of the Bank under this Guarantee, to vary at any time, the terms and conditions of the Advance Payment or to extend the time or period of its repayment or to postpone for any time, and from time to time, any of the rights and powers exercisable by the Authority against the Contractor, and either to enforce or forbear from enforcing any of the terms and conditions contained in the Agreement and/or the securities available to

the Authority, and the Bank shall not be released from its liability and obligation under these presents by any exercise by the Authority of the liberty with reference to the matters aforesaid or by reason of time being given to the Contractor or any other forbearance, indulgence, act or omission on the part of the Authority or of any other matter or thing whatsoever which under any law relating to sureties and guarantors would but for this provision have the effect of releasing the Bank from its liability and obligation under this Guarantee and the Bank hereby waives all of its rights under any such law.

6. This Guarantee is in addition to and not in substitution of any other guarantee or security now or which may hereafter be held by the Authority in respect of or relating to the Advance Payment.

7. Notwithstanding anything contained hereinbefore, the liability of the Bank under this Guarantee is restricted to the Guarantee amount and this Guarantee will remain in force for the period specified in paragraph 8 below and unless a demand or claim in writing is made by the Authority on the Bank under this Guarantee all rights of the Authority under this Guarantee shall be forfeited and the Bank shall be relieved from its liabilities hereunder.

8. The guarantee shall cease to be in force and effect on ****.[$3] Unless a demand or claim under this Guarantee is made in writing on or before the aforesaid date, the Bank shall be discharged from its liabilities hereunder.

9. The Bank undertakes not to revoke this Guarantee during its currency, except with the previous express consent of the Authority in writing, and declares and warrants that it has the power to issue this Guarantee and the undersigned has full powers to do so on behalf of the Bank.

10. Any notice by way of request, demand or otherwise hereunder may be sent by post addressed to the Bank at its above referred branch, which shall be deemed to have been duly authorized to receive such notice and to effect payment thereof forthwith, and if sent by post it shall be deemed to have been given at the time when it ought to have been delivered in due course of post and in proving such notice, when given by post, it shall be sufficient to prove that the envelope containing the notice was posted and a certificate signed by an officer of the Authority that the envelope was so posted shall be conclusive.

[$]Insert a date being 90 (ninety) days after the end of one year from the date of payment of the Advance payment to the Contractor (in accordance with Clause 19.2 of the Agreement).

11. This Guarantee shall come into force with immediate effect and shall remain in force and effect for up to the date specified in Para 8 above or until it is released earlier by the Authority pursuant to the provisions of the Agreement.

12. This guarantee shall also be operable at our…… Branch at New Delhi, from whom, confirmation regarding the issue of this guarantee or extension/ renewal thereof shall be made available on demand. In the contingency of this guarantee being invoked and payment thereunder claimed, the said branch shall accept such invocation letter and make payment of amounts so demanded under the said invocation.

13. This Guarantee is subject to the Uniform Rules for Demand Guarantees (URDG) 2010 Revision, ICC Publication no. 758, except that the supporting statement under Article 15 (a) is hereby excluded.

Signed and sealed this …….. day of ……. 20…….. at ……

SIGNED, SEALED AND DELIVERED

For and on behalf of the Bank by:

(Signature)

(Name)

(Designation)

(Code Number)

(Address)

Schedule - H

(See Clauses10.1.4 and 19.3)

Contract Price Weightages

1.1 The Contract Price for this Agreement is Rs. (_____)

1.2 Proportions of the Contract Price for different stages of Construction of the Project Highway shall be as specified below:

Ratio of Contract Price for Chhiahtlang Bypass (16.45%)

Item	Weightage in percentage to the contract Price		Stage for Payment	Percentage Weightage	Percentage Weightage vis a vis Overall Project
1	2		3	4	5
Road works including culverts, widening and repair of culverts.	**54.81%**	**A**	**Widening and strengthening of existing road**	**0.00%**	
		B.1	**Reconstruction/ New 2-Lane realignment/ bypass (Flexible pavement)**	**88.07%**	
		1	Earthwork up to top of the sub-grade	41.19%	22.58%
		2	Earthwork in Shoulders	1.06%	0.58%
		3	Sub-base Course	16.58%	9.09%
		4	Non bituminous Base course	10.02%	5.49%
		5	Bituminous Base course	11.90%	6.52%
		6	Wearing Coat	7.32%	4.01%
		7	Widening and repair of culverts	0.00%	0.00%
		B.2	**Reconstruction/New 2- lane realignment/bypass(Rigid pavement)**	**0.00%**	
		C.1	**Reconstruction/ New service road (Flexible pavement)**	**0.00%**	
		C.2	**Reconstruction/New serviceRoad (Rigid pavement)**	**0.00%**	
		D	**Re- Construction and New culverts on existing road,realignments,bypassed:**	**11.93%**	
			Culverts (length<6m)		

Item	Weightage in percentage to the contract Price		Stage for Payment	Percentage Weightage	Percentage Weightage vis a vis Overall Project
1	2		3	4	5
		1	Pipe Culvert	6.77%	3.71%
		2	RCC Box Culvert	5.16%	2.83%
Other works	**45.19%**	(i)	Toll plaza	0.00%	0.00%
		(ii)	Road side drains	5.16%	2.33%
		(iii)	**Road signs markings, km stones, safety devices,…**		
		a	Traffic Sign	0.24%	0.11%
		b	Pavement marking	0.86%	0.39%
		c	Crash barrier/"W" Metal Beam Crash Barrier	1.53%	0.69%
		d	Boundary stone, km stone,5th km stone, & hectometre stones	0.04%	0.02%
		e	Traffic blinker LED Delineator, stud, reflective payment marker, tree reflector	0.74%	0.33%
		f	Direction and Place Identification signs upto 0.9 sqm size board	0.08%	0.04%
		g	Minor junction	4.79%	2.16%
		h	Major Junction	12.35%	5.58%
		i	Road furniture	0.61%	0.28%
		j	Site Clearance	0.29%	0.13%
		k	Land Slide Clearance	0.00%	0.00%
		(iv)	**Project Facilitities**		
		(v)	**Roadside plantation**		
		a	Road side plantation & medium Plantation.	0.00%	0.00%
		b	Plantation (Vetiver, Hydro seeding& Turfine etc.) for slope protection on exposed hill slopes as slide mitigation measure.	0.58%	0.26%
		(vi)	Repair of protection works other than approaches to the bridges, elevated section/ flyovers/grade separators and ROBs.	0.00%	0.00%
		(vii)	Safety and traffic management during construction	0.00%	0.00%
		(viii)	**Protection works**		
		a	Breast wall	17.97%	8.12%
		b	Retaining wall	41.96%	18.96%

Item	Weightage in percentage to the contract Price		Stage for Payment	Percentage Weightage	Percentage Weightage vis a vis Overall Project
1	2		3	4	5
		c	Gabion wall	5.83%	2.63%
		d	Toe wall	1.32%	0.60%
		e	Revetment wall	3.90%	1.76%
		f	Seeding and Mulching (Soil Cut Slope)	0.92%	0.42%
		g	Erosion Control Blanket	0.83%	0.38%

Ratio of Contract Price for Serchhip Bypass (83.55%)

Item	Weightage in percentage to the contract Price		Stage for Payment	Percentage Weightage	Percentage Weightage vis a vis Overall Project
1	2		3	4	5
Road works including culverts, widening and repair of culverts.	**53.18%**	**A**	**Widening and strengthening of existing road**	**0.00%**	
		B.1	**Reconstruction/ New 2-Lane realignment/ bypass (Flexible pavement)**	**83.83%**	
		1	Earthwork up to top of the sub-grade	40.50%	21.54%
		2	Earthwork in Shoulders	0.98%	0.52%
		3	Sub-base Course	15.31%	8.14%
		4	Non bituminous Base course	9.27%	4.93%
		5	Bituminous Base course	11.00%	5.85%
		6	Wearing Coat	6.77%	3.60%
		B.2	**Reconstruction/New 2- lane realignment/bypass(Rigid pavement)**	**0.00%**	
		C.1	**Reconstruction/ New service road (Flexible pavement)**	**0.00%**	
		C.2	**Reconstruction/New serviceRoad (Rigid pavement)**	**0.00%**	
		D	**Re- Construction and New culverts on existing road,realignments,bypassed:**	**16.17%**	

Item	Weightage in percentage to the contract Price		Stage for Payment	Percentage Weightage	Percentage Weightage vis a vis Overall Project
1	2		3	4	5
			Culverts (length<6m)		
			Pipe Culvert	4.29%	2.28%
		a	RCC Box Culvert	11.88%	6.32%
Minor Bridges	**0.83%**	**A1**	**Widening and Repair of Minor bridges (length>6m and <60 m)**		
			Minor bridgrs	0.00%	0.00%
		A2	**New Minor bridges (length>6 and <60 m.)**		
		1	**Foundation:** On completion of the foundation work including foundations for wing and return walls, abutments, piers.	44.38%	0.37%
		2	**Sub-structure:** On completion of abutments, piers upto the abutment/ pier cap including wing/ return/ retaining wall upto top	35.32%	0.29%
		3	**Super-structure:** On completion of the super-structure in all respects including Girder, Deck slab, bearings	20.30%	0.17%
Major Bridge (length< 60 m.) works	**12.93%**	A1	**Widening and repairs of Major Bridges**		
		A2	**New Major Bridges**		
		1	Foundation	21.96%	2.84%
		2	Sub-structure	16.55%	2.14%
		3	Super-structure (including bearings)	61.02%	7.89%
		4	Wearing Coat including expansion joints	0.47%	0.06%
Other works	**33.06%**	(i)	Toll plaza	0.00%	0.00%
		(ii)	Road side drains	6.55%	2.17%
		(iii)	Road signs markings, km stones, safety devices,…		
		a	Traffic Sign	0.23%	0.08%
		b	Pavement marking	1.07%	0.35%
		c	Crash barrier/"W" Metal Beam Crash Barrier	1.37%	0.45%
		d	Boundary stone, km stone,5th km stone, & hectometre stones	0.05%	0.02%

Item	Weightage in percentage to the contract Price		Stage for Payment	Percentage Weightage	Percentage Weightage vis a vis Overall Project
1	2		3	4	5
		e	Traffic blinker LED Delineator, stud, reflective payment marker, tree reflector	0.20%	0.07%
		f	Direction and Place Identification signs upto 0.9 sqm size board	0.03%	0.01%
		g	Minor junction	1.29%	0.43%
		h	Major Junction	3.33%	1.10%
		i	Road furniture	0.67%	0.22%
		j	Site Clearance	0.38%	0.13%
		k	Land Slide Clearance	0.00%	0.00%
		(iv)	Project Facilitities		
		(v)	Roadside plantation		
		a	Road side plantation & medium Plantation.	0.00%	0.00%
		b	Plantation (Vetiver, Hydro seeding& Turfine etc.) for slope protection on exposed hill slopes as slide mitigation measure.	0.95%	0.31%
		(vi)	Repair of protection works other than approaches to the bridges, elevated section/ flyovers/grade separators and ROBs.	0.00%	0.00%
		(vii)	Safety and traffic management during construction	0.00%	0.00%
		(viii)	**Protection works**		
		a	Breast wall	22.84%	7.55%
		b	Retaining wall	51.82%	17.13%
		c	Gabion wall	5.17%	1.71%
		d	Toe wall	0.49%	0.16%
		e	Revetment wall	0.66%	0.22%
		f	Seeding and Mulching (Soil Cut Slope)	1.52%	0.50%
		g	Erosion Control Blanket	1.38%	0.46%

1.3 Procedure of estimating the value of work done.

1.3.1 Road works

Procedure for estimating the value of road work done shall be as follows:

Table 1.3.1

Chhiahtlang Bypass

	Stage of Payment	Percentage-weightage	Payment Procedure
A	**Widening and strengthening of existing road**		
B.1	**Reconstruction /New 2- lane realignment/bypass (Flexible pavement**	**88.07%**	Unit of measurement is linear length. Payment of each stage shall be made on pro rata basis on completion of stage in a length of not less than **250 m**.
1	Earthwork up top of the sub-grade	41.19%	
2	Earthwork in shoulders	1.06%	
3	Sub-Base Course	16.58%	
4	Non Bituminous Base Course	10.02%	
5	Bituminous Base Course	11.90%	
6	Wearing Coat	7.32%	
B.2	**Reconstruction/New 2- lane realignment/bypass(Rigid pavement)**		
C.1	**Reconstruction/ New service road (Flexible pavement)**		
C.2	**Reconstruction/New serviceRoad (Rigid pavement)**		
D	**Re- Construction and New culverts on existing road, realignments, bypasses,:** Culverts (length,6m)	**11.93%**	Cost of each culvert shall be determined on pro rata basis with respect to the total number of culverts. Payment shall be made on the completion of **each culvert**.
	(a) Pipe Culvert	6.77%	
	(b) RCC Box culvert	5.16%	

Serchhip Bypass

	Stage of Payment	Percentage-weightage	Payment Procedure
A	**Widening and strengthening of existing road**		
B.1	**Reconstruction /New 2- lane realignment/bypass (Flexible pavement**	**83.83%**	Unit of measurement is linear length. Payment of each stage shall be made on pro rata basis on completion of stage in a length of not less than **250 m**.
1	Earthwork up top of the sub-grade	40.50%	
2	Earthwork in shoulders	0.98%	
3	Sub-Base Course	15.31%	
4	Non Bituminous Base Course	9.27%	

	Stage of Payment	Percentage-weightage	Payment Procedure
5	Bituminous Base Course	11.00%	
6	Wearing Coat	6.77%	
7	Widening and repair of culverts		
B.2	**Reconstruction/New 2- lane realignment/bypass(Rigid pavement)**		
C.1	**Reconstruction/ New service road (Flexible pavement)**		
C.2	**Reconstruction/New serviceRoad (Rigid pavement)**		
D	**Re- Construction and New culverts on existing road, realignments, bypasses,:** Culverts (length,6m)	**16.17%**	Cost of each culvert shall be determined on pro rata basis with respect to the total number of culverts. Payment shall be made on the completion of each culvert.
	(a) Pipe Culvert	4.29%	
	(b) RCC Box culvert	11.88%	

@For example, if the total length of bituminous work to be done is 100 km, the cost per km of bituminous work shall be determined as follows:

Cost per km = P x weightage for road work x weightage for bituminous work x (1/L)

Where

P = Contract Price

L = Total length in km

Similarly, the rates per km for other stages shall be worked out accordingly.

Note: The length affected due to law and order problems or litigation during execution due to which the Contractor is unable to execute the work, may be deducted from the total project length for payment purposes. The total length calculated here is only for payment purposes and will not affect and referred in other clauses of the Contract Agreement.

1.3.2 Minor Bridges works

Procedure for estimating the value of Minor bridge and Underpasses/Overpasses shall be as stated in table 1.3.2:

Table 1.3.2

Chhiahtlang Bypass

	Stage of Payment	Percentage-weightage	Payment Procedure
	1	2	3
Nil			

Serchhip Bypass

	Stage of Payment	Percentage-weightage	Payment Procedure
	1	2	3
A.1	**Widening and repair of minor bridges (length>6, and<60m)**		
A.2	**New minor bridges**		
(i)	**Foundation:** On completion of the foundation work including foundations for wing and return walls, abutments, piers.	44.38%	**Foundation:** Cost of each minor bridge shall be determined on pro- rata basis with respect to the total linear length (m) of the minor bridges. Payment against foundation shall be made on pro-rata basis on completion of **each foundation**. In case where load testing is required for foundation, the trigger of first payment shall include load testing also where specified.
(ii)	**Sub-structure:** On completion of abutments, piers upto the abutment/ pier cap including wing/ return/ retaining wall upto top	35.32%	**Sub-structure:** Cost of each minor bridge shall be determined on pro- rata basis with respect to the total linear length (m) of the minor bridges. Payment against sub- structure shall be made on pro-rata basis on completion of **each sub-structure of each bridge**.
(iii)	**Super-structure:** On completion of the super-structure in all respects including wearing coat, bearings, expansion joints, had rails, crash barriers, road signs & marking, tests on completion etc. complete in all respect.	20.30%	**Super-structure:** Payment shall be made on pro-rata basis on completion of a stage i.e. completion of super structure of **at least one span** in all respects as specified in the column of "Stage of Payment" in this sub- clause. In case of structures where pre-cast girders have been proposed by the Contractor, 50% of the stage payment shall be due and payable on casting of girders for each span and balance 50% of the stage payment shall be made on completion of stage specified as above.

1.3.3 Major Bridge works.

Procedure for estimating the value of Major Bridge works, ROB/RUB and Structures Work shall be as stated in table 1.3.3:

Table 1.3.3

Chhiahtlang Bypass

	Stage of Payment	Percentage-weightage	Payment Procedure
	1	2	3
Nil			

Serchhip Bypass

	Stage of Payment	Percentage-weightage	Payment Procedure
	1	2	3
A.1	**Widening and repairs of major Bridges**		
A.2	**New major Bridges**		
1	Foundation: On completion of the foundation work including foundations for return walls, abutments, piers.	21.96%	**Foundation:** Cost of each minor bridge shall be determined on pro- rata basis with respect to the total linear length (m) of the minor bridges. Payment against foundation shall be made on pro-rata basis on completion of **each foundation**. In case where load testing is required for foundation, the trigger of first payment shall include load testing also where specified.
2	Sub-structure: On completion of abutments, piers upto the abutment/ pier cap	16.55%	**Sub-structure:** Cost of each minor bridge shall be determined on pro- rata basis with respect to the total linear length (m) of the minor bridges. Payment against sub- structure shall be made on pro-rata basis on completion of **each sub-structure of each bridge**.
3	Super-structure: On completion of the superstructure in all respects including Girder, Deck slab, bearings	61.02%	**Super-structure:** Payment shall be made on pro-rata basis on completion of a stage i.e. completion of super structure of **at least one span** in all respects as specified in the column of "Stage of Payment" in this sub- clause. In case of structures where pre-cast girders have been proposed by the Contractor, 50% of the stage payment shall be due and payable on casting of girders for each span and balance 50% of the stage payment shall be made on completion of stage specified as above.
4	Wearing Coat including expansion joints	0.47%	**Wearing Coat:** Payment shall be made on completion of wearing coat including expansion joints complete in all respects as specified.

Note: (1) In case of innovative Major Bridge projects like cable suspension/cable stayed/ Extra Dozed and exceptionally long span bridges, the schedule may be modified as per site requirements before bidding with due approval of Competent Authority.

(2) The Schedule for exclusive tunnel projects may be prepared as per site requirements

before bidding with due approval of Competent Authority.

1.3.4 Other Works.

Procedure for estimating the value of other works done shall be as stated in table 1.3.4:

Chhiahtlang Bypass

	Stage of Payment	weightage	Payment Procedure
(i)	Toll plaza	0.00%	
(ii)	Road side drains	5.16%	Unit of measurement is linear length. Payment of each stage shall be made on pro rata basis on completion of stage in a length of not less than **250 m**.
(iii)	Road signs markings, km stones, safety devices,…		
a	Traffic Sign	0.24%	Unit of measurement is linear length. Payment shall be made on pro rata basis on completion of a stage in a length of not less than **01 (one) km**.
b	Pavement marking	0.86%	
c	Crash barrier/"W" Metal Beam Crash Barrier	1.53%	
d	Boundary stone, km stone,5th km stone, & hectometre stones	0.04%	
e	Traffic blinker LED Delineator, stud, reflective payment marker, tree reflector	0.74%	
f	Direction and Place Identification signs upto 0.9 sqm size board	0.08%	
g	Minor junction	4.79%	Payment shall be made on pro rata basis for completion of **each junction**.
h	Major Junction	12.35%	
i	Road furniture	0.61%	Unit of measurement is linear length. Payment shall be made on pro rata basis on completion of a stage in a length of not less than **01 (one) km**.
j	Site Clearance	0.29%	
k	Land Slide Clearance	0.00%	
(iv)	Project Facilitities		
(v)	Roadside plantation		
a	Road side plantation & medium Plantation.	0.00%	Unit of measurement is linear length. Payment shall be made on pro rata basis on completion of a stage in a length of not less than **01 (one) km**.
b	Plantation (Vetiver, Hydro seeding& Turfine etc.) for slope protection on exposed hill slopes as slide mitigation measure.	0.58%	
(vi)	Repair of protection works other than approaches to the bridges, elevated section/ flyovers/grade separators and ROBs.	0.00%	

	Stage of Payment	weightage	Payment Procedure
(vii)	Safety and traffic management during construction	0.00%	
(viii)	**Protection works**		
a	Breast wall	17.97%	Unit of measurement is linear length. Payment of each stage shall be made on pro rata basis on completion of stage in a length of not less than **250 m**.
b	Retaining wall	41.96%	
c	Gabion wall	5.83%	
d	Toe wall	1.32%	
e	Revetment wall	3.90%	
f	Seeding and Mulching (Soil Cut Slope)	0.92%	
g	Erosion Control Blanket	0.83%	

Serchhip Bypass

	Stage of Payment	weightage	Payment Procedure
(i)	Toll plaza	0.00%	
(ii)	Road side drains	6.55%	Unit of measurement is linear length. Payment of each stage shall be made on pro rata basis on completion of stage in a length of not less than **250 m**.
(iii)	Road signs markings, km stones, safety devices,…		
a	Traffic Sign	0.23%	Unit of measurement is linear length. Payment shall be made on pro rata basis on completion of a stage in a length of not less than **01 (one) km**.
b	Pavement marking	1.07%	
c	Crash barrier/"W" Metal Beam Crash Barrier	1.37%	
d	Boundary stone, km stone,5th km stone, & hectometre stones	0.05%	
e	Traffic blinker LED Delineator, stud, reflective payment marker, tree reflector	0.20%	
f	Direction and Place Identification signs upto 0.9 sqm size board	0.03%	
g	Minor junction	1.29%	Payment shall be made on pro rata basis for completion of **each junction**.
h	Major Junction	3.33%	
i	Road furniture	0.67%	Unit of measurement is linear length. Payment shall be made on pro rata basis on completion of a stage in a length of not less than **01 (one) km**.
j	Site Clearance	0.38%	
k	Land Slide Clearance	0.00%	
(iv)	Project Facilitities		
(v)	Roadside plantation		
a	Road side plantation & medium Plantation.	0.00%	Unit of measurement is linear length. Payment shall be made on pro rata basis on

	Stage of Payment	weightage	Payment Procedure
b	Plantation (Vetiver, Hydro seeding& Turfine etc.) for slope protection on exposed hill slopes as slide mitigation measure.	0.95%	completion of a stage in a length of not less than **01 (one) km**.
(vi)	Repair of protection works other than approaches to the bridges, elevated section/ flyovers/grade separators and ROBs.	0.00%	
(vii)	Safety and traffic management during construction	0.00%	
(viii)	**Protection works**		
a	Breast wall	22.84%	Unit of measurement is linear length. Payment of each stage shall be made on pro rata basis on completion of stage in a length of not less than **250 m**.
b	Retaining wall	51.82%	
c	Gabion wall	5.17%	
d	Toe wall	0.49%	
e	Revetment wall	0.66%	
f	Seeding and Mulching (Soil Cut Slope)	1.52%	
g	Erosion Control Blanket	1.38%	

2. Procedure for payment for Maintenance

2.1 The cost for maintenance shall be as stated in Clause 14.1 (i).

2.2 Payment for Maintenance shall be made in accordance with the provisions of Article 14 and Article 19.7

Schedule -I

(See Clause 10.2)

Drawings

1. Drawings

In compliance of the obligations set forth in Clause 10.2 of this Agreement, the Contractor shall furnish to the Authority's Engineer, free of cost, all Drawings listed in Annex-I of this Schedule-I.

2. Additional Drawings

If the Authority's Engineer determines that for discharging its duties and functions under this Agreement, it requires any drawings other than those listed in Annex-I, it may by notice require the Contractor to prepare and furnish such drawings forthwith. Upon receiving a requisition to this effect, the Contractor shall promptly prepare and furnish such drawings to the Authority's Engineer, as if such drawings formed part of Annex-I of this Schedule-I.

Annex -I

(Schedule -I)

List of Drawings

1. A minimum list of the drawings of the various components/elements of the project highway and project facility required to be submitted by the Contractor is given below:

(a) Drawing of horizontal alignment, vertical profile and detailed cross sections;

(b) Drawings of cross drainage works, i.e. Bridges/Culverts/Flyovers and Other Structures;

(c) Drawings for River Training works;

(d) Drawings of interchanges, major intersections and underpasses;

(e) Drawing of control centre;

(f) Drawings of road furniture items including traffic signage, marking, safety barriers, etc;

(g) Drawings of traffic diversions plans and traffic control measures;

(h) Drawings of road drainage measures;

(i) Drawings of typical details slope protection measures;

(j) Drawings of landscaping and horticulture;

(k) Drawings of pedestrian crossing;

(l) Drawings of street lighting;

(m) General Arrangement showing Base Camp and Administrative Block;

(n) Any other drawings as per instruction of Authority Engineer.

Schedule – J

(See Clause 10.3.2)

PROJECT COMPLETION SCHEDULE

1. Project Completion Schedule

During Construction period, the Contractor shall comply with the requirements set forth in this Schedule-J for each of the Project Milestones and the **Scheduled Completion Date.** Within 15 (fifteen) days of the date of each Project Milestone, the Contractor shall notify the Authority of such compliance along with necessary particulars thereof.

2. Project Milestone-I[$]

2.1. Project Milestone-I shall occur on the date falling on the **256th** day from the Appointed Date (the **"Project Milestone-I**").

2.2. Prior to the occurrence of Project Milestone-I, the Contractor shall have commenced construction of the Project Highway and submitted to the Authority duly and validly prepared Stage Payment Statements for an amount not less than 10% (ten per cent) of the Contract Price.

3. Project Milestone-II[$]

3.1. Project Milestone-II shall occur on the date falling on the **438th** day from the Appointed Date (the **"Project Milestone- II").**

3.2. Prior to the occurrence of Project Milestone-II, the Contractor shall have continued with construction of the Project Highway and submitted to the Authority duly and validly prepared Stage Payment Statements for an amount not less than 30% (thirty five per cent) of the Contract Price **and should have started construction of all bridges**

4. Project Milestone-III[$]

4.1. Project Milestone-III shall occur on the date falling on the **621th** day from the Appointed

---

[$]If total project length is say **'L' km** and the unencumbered length along existing road as handed over on the appointed date is **'L_1' km** (including bypasses, re-alignment, structure etc.) and balance length i.e. **'L2' km (L-L1)** is to be handed over on a later date as per the memorandum signed under provision of Clause 8.2.1 of the Contract Document, then the Project Milestone-I, II and III shall be linked to stage payment statement for amount in percentage of the contract price worked out on prorata basis for the **'L_1' km** length handed over of balance length, the subsequent Project Milestone shall be linked to stage payment statement for amount in percentage of the total contract price.

For example:

If the date for Milestone-I and Milestone-II is 180th and 300th day from appointed date and balance **'L_2' km** length is handed over after 300th day from appointed date, then the stage payment statement required for achieving Milestone-I and Milestone-II should be linked to Contract Price worked out on prorata basis for the **L_1 km length** [**i.e. for Contract Price x L_1/L**]. Subsequent Milestone i.e. Milestone-III will be linked to stage payment statement for amount in percentage of the total contract price. **In no case, there shall be any change in the schedule completion date unless extension of time has been granted by the Authority under Clause 10.3 and 10.5 of the contract agreement.**

In order for the above dispensation to come into operation, it is necessary that a suitable mechanism (like escrow account) is evolved between the parties to the effect that the payments released to the contractor under the above dispensation would be used for completion of the project in the first instance and shall be available to the Contractor only after meeting his project related commitments.

Date (the **"Project Milestone- III").**

4.2. Prior to the occurrence of Project Milestone-III, the Contractor shall have continued with construction of the Project Highway and submitted to the Authority duly and validly prepared Stage Payment Statements for an amount not less than 60% (seventy per cent) of the Contract Price.

5. Scheduled Completion Date

5.1. The Scheduled Completion Date shall occur on the **730th** day from the Appointed Date.

5.2. On or before the Scheduled Completion Date, the Contractor shall have completed construction in accordance with this Agreement.

6. Extension of time

Upon extension of any or all of the aforesaid Project Milestones or the Scheduled Completion Date, as the case may be, under and in accordance with the provisions of this Agreement, the Project Completion Schedule shall be deemed to have been amended accordingly.

Schedule - K

(See Clause 12.1 (ii))

Tests on Completion

1. Schedule for Tests

1.1. The Contractor shall, no later than 30 (thirty) days prior to the likely completion of construction, notify the Authority's Engineer and the Authority of its intent to subject the Project Highway to Tests, and no later than 10 (ten) days prior to the actual date of Tests, furnish to the Authority's Engineer and the Authority detailed inventory and particulars of all works and equipment forming part of Works.

1.2. The Contractor shall notify the Authority's Engineer of its readiness to subject the Project Highway to Tests at any time after 10 (ten) days from the date of such notice, and upon receipt of such notice, the Authority's Engineer shall, in consultation with the Contractor, determine the date and time for each Test and notify the same to the Authority who may designate its representative to witness the Tests. The Authority's Engineer shall thereupon conduct the Tests itself or cause any of the Tests to be conducted in accordance with Article 12 and this Schedule-K.

2. Tests

2.1. Visual and physical test: The Authority's Engineer shall conduct a visual and physical check of construction to determine that all works and equipment forming part thereof conform to the provisions of this Agreement. The physical tests shall include all the tests specified in IRC code, manual and MORTH specifications for the road and Bridge works, 5th revision, 2013.

2.2. Riding quality test: Riding quality of each lane of the carriageway shall be checked with the help of a calibrated bump integrator and the maximum permissible roughness for purposes of this Test shall be [2,000 (two thousand)] mm for each kilometer.

2.3. Tests for bridges: All major and minor bridges shall be subjected to the rebound hammer and ultrasonic pulse velocity tests, to be conducted in accordance with the procedure described in Special Report No. 17: 1996 of the IRC Highway Research Board on Nondestructive Testing Techniques, at two spots in every span, to be chosen at random by the Authority's Engineer. Bridges with a span of 15 (fifteen) metres or more shall also be subjected to load testing.

2.4. Other tests: The Authority's Engineer may require the Contractor to carry out or cause to be carried additional tests, in accordance with Good Industry Practice, for determining the compliance of the Project Highway with Specifications and

Standards, except tests as specified in clause 5,but shall include measuring the reflectivity of road markings and road signs; and measuring the illumination level (lux) of lighting using requisite testing equipment.

2.5. Environmental audit: The Authority's Engineer shall carry out a check to determine conformity of the Project Highway with the environmental requirements set forth in Applicable Laws and Applicable Permits.

2.6. Safety Audit: The Authority's Engineer shall carry out, or cause to be carried out, a safety audit to determine conformity of the Project Highway with the safety requirements and Good Industry Practice.

3. Agency for conducting Tests

All Tests set forth in this Schedule-K shall be conducted by the Authority's Engineer or such other agency or person as it may specify in consultation with the Authority.

4. Completion Certificate

Upon successful completion of Tests, the Authority's Engineer shall issue the Completion Certificate in accordance with the provisions of Article 12.

Schedule-L

(See Clause 12.2 and 12.4)

PROVISIONAL CERTIFICATE

1. I, …….. (Name of the Authority's Engineer), acting as the Authority's Engineer, under and in accordance with the Agreement dated …….. (the "**Agreement**"), for "Construction of Chhiahtlang bypass and Serchhip ***bypass on Aizawl-Tuipang section of NH-54 in the State of Mizoram*** **on Engineering, Procurement and Construction (EPC) mode, with Japan International Cooperation Agency (JICA) loan assistance**" through …….(Name of Contractor), hereby certify that the Tests in accordance with Article 12 of the Agreement have been undertaken to determine compliance of the Project Highway with the provisions of the Agreement.

2. Works that are incomplete on account of Time Extension have been specified in the Punch List appended hereto, and the Contractor has agreed and accepted that it shall complete all such works in the time and manner set forth in the Agreement. In addition, certain minor works are incomplete and these are not likely to cause material inconvenience to the Users of the Project Highway or affect their safety. The Contractor has agreed and accepted that as a condition of this Provisional Certificate, it shall complete such minor works within 30 (thirty) days hereof. These minor works have also been specified in the aforesaid Punch List.

3. In view of the foregoing, I am satisfied that that Project Highway from km 8.000 to km 65.000 can be safety and reliably placed in service of the users thereof, and in terms of the Agreement, the Project Highway is hereby provisionally declared fit for entry into operation on this the …day of……. 20 ……

ACCEPTED, SIGNED, SEALED AND DELIVERED For and on behalf of CONTRACTOR by	SIGNED, SEALED AND DELIVERED For and on behalf of AUTHORITY's ENGINEER by:
(Signature)	(Signature)

Schedule - L

(See Clause 12.2)

Completion Certificate

1. I,…… (Name of the Authority's Engineer), acting as the Authority's Engineer, under and in accordance with the Agreement dated (the **"Agreement"),** "Construction of Chhiahtlang bypass and Serchhip ***bypass on Aizawl-Tuipang section of NH-54 in the State of Mizoram*** **on Engineering, Procurement and Construction (EPC) mode, with Japan International Cooperation Agency (JICA) loan assistance"** through…… (Name of Contractor), hereby certify that the Tests in accordance with Article 12 of the Agreement have been successfully undertaken to determine compliance of the Project Highway with the provisions of the Agreement, and I am satisfied that the Project Highway can be safely and reliably placed in service of the Users thereof.

2. It is certified that, in terms of the aforesaid Agreement, all works forming part of Project Highway have been completed, and the Project Highway is hereby declared fit for entry into operation on this the day of ……20….., Scheduled Completed Date for which was the…… day of……..20……..

SIGNED, SEALED AND DELIVERED

For and on behalf of the Authority's Engineer by:

(Signature)

(Name)

(Designation) (Address)

Schedule - M

(See Clauses 14.6, 15.2 and 19.7)

Payment Reduction for Non-Compliance

1. Payment reduction for non-compliance with the Maintenance Requirements

1.1. Monthly lump sum payments for maintenance shall be reduced in the case of non-compliance with the Maintenance Requirements set forth in Schedule-E.

1.2. Any deduction made on account of non-compliance with the Maintenance Requirements shall not be paid even after compliance subsequently. The deductions shall continue to be made every month until compliance is done.

1.3. The Authority's Engineer shall calculate the amount of payment reduction on the basis of weightage in percentage assigned to non-conforming items as given in Paragraph 2.

2. Percentage reductions in lump sum payments on monthly basis

2.1. The following percentages shall govern the payment reduction:

S. No.	Item/Defect/Deficiency	Percentage
(a)	**Carriageway/Pavement**	
(i)	Potholes, cracks, other surface defects	15%
(ii)	Repairs of Edges, Rutting	5%
(b)	**Road, Embankment, Cuttings, Shoulders**	
(i)	Edge drop, inadequate cross fall, undulations, settlement, potholes, ponding, obstructions	10%
(ii)	Deficient slopes, raincuts, disturbed pitching, vegetation growth, pruning of trees	5%
(c)	**Bridges and Culverts**	
(i)	Desilting, cleaning. vegetation growth, damaged pitching, flooring, parapets, wearing course, footpaths, any damage to foundations	20%
(ii)	Any Defects in superstructures, bearings and sub-structures	10%
(iii)	Painting, repairs/replacement kerbs, railings, parapets, guideposts/crash barriers	5%
(d)	**Roadside Drains**	
(i)	Cleaning and repair of drains	5%
(e)	**Road Furniture**	
(i)	Cleaning, painting, replacement of road signs, delineators, road markings, 200 m/km/5th km stones	5%
(f)	**Miscellaneous Items**	

S. No.	Item/Defect/Deficiency	Percentage
(i)	Removal of dead animals, broken down/accidented vehicles, fallen trees, road blockades or malfunctioning of mobile crane	10%
(ii)	Any other Defects in accordance with paragraph 1.	5%
(g)	**Defects in Other Project Facilities**	5%

2.2 The amount to be deducted from monthly lump-sum payment for non-compliance of particular item shall be calculated as under:

R=P/100 x M xL1/L

Where: P = Percentage of particular item//Defect/deficiency for deduction

M = Monthly lump-sum payment in accordance with the Bid

L1 = Non-complying length

L = Total length of the road,

R = Reduction (the amount to be deducted for noncompliance for a particular item/Defect/deficiency)

The total amount of reduction shall be arrived at by summation of reductions for such items/Defects/deficiency or non compliance.

For any Defect in a part of one kilometer, the non-conforming length shall be taken as one kilometer.

Schedule - N

(See Clause 18.1 (i))

Selection of Authority's Engineer

1. Selection of Authority's Engineer

1.1. The provisions of the Model Request for Proposal for Selection of Technical Consultants, issued by the Ministry of Finance in May 2009, or any substitute thereof or 'Guidelines for Employment of Consultants under Japanese ODA Loans' or a combination of certain provisions thereof shall apply for selection of an experienced firm to discharge the functions and duties of an Authority's Engineer.

1.2. The Authority shall invite Expression of Interest from Consulting Engineering firms or bodies corporate to undertake and perform the duties and functions set forth in Annexure-I of Schedule-N and thereupon shortlist qualified firms in accordance with pre-determined criteria.

1.3. The Authority shall invite the aforesaid shortlisted firms to submit their respective technical and financial offers, each in separate sealed cover and/or upload online. All the technical bids so received shall be opened and pursuant to the evaluation thereof, the Authority shall open the financial bids in respect of each shortlisted firm and the order of priority as among these firms shall be determined on the basis of a weighted evaluation where technical and financial score shall be assigned respective weights of 80:20.

1.4. In the event of termination of the Technical Consultants appointed in accordance with the provisions of Paragraph 1.1 to 1.3, the Authority shall appoint another firm of Technical Consultants forthwith and may engage a government-owned entity in accordance with the provisions of Paragraph 3 of this Schedule-N.

2. Terms of Reference

The Terms of Reference for the Authority's Engineer (the **"TOR")** shall substantially conform with Annex 1 to this Schedule N.

3. Appointment of Government entity as Authority's Engineer

Notwithstanding anything to the contrary contained in this Schedule, the Authority may in its discretion appoint a government-owned entity as the Authority's Engineer; provided that such entity shall be a body corporate having as one of its primary functions the provision of consulting, advisory and supervisory services for engineering projects; provided further that a government-owned entity which is owned or controlled by the Authority shall not be eligible for appointment as Authority's Engineer.

Annex -I

(Schedule - N)

TERMS OF REFERENCE FOR AUTHORITY'S ENGINEER

1. Scope

1.1. These Terms of Reference (the **"TOR")** for the Authority's Engineer are being specified pursuant to the EPC Agreement dated……(the **"Agreement),** which has been entered into between the National Highways & Infrastructure Development Corporation Ltd (the **"Authority")** and…… (the "**Contractor")** for "Construction of Chhiahtlang bypass and Serchhip ***bypass on Aizawl-Tuipang section of NH-54 in the State of Mizoram*** **on Engineering, Procurement and Construction (EPC) mode, with Japan International Cooperation Agency (JICA) loan assistance"**, and a copy of which is annexed hereto and marked as Annex-A to form part of this TOR.

1.2. The TOR shall apply to construction and maintenance of the Project Highway.

2. Definitions and interpretation

2.1. The words and expressions beginning with or in capital letters and not defined herein but defined in the Agreement shall have, unless repugnant to the context, the meaning respectively assigned to them in the Agreement.

2.2. References to Articles, Clauses and Schedules in this TOR shall, except where the context otherwise requires, be deemed to be references to the Articles, Clauses and Schedules of the Agreement, and references to Paragraphs shall be deemed to be references to Paragraphs of this TOR.

2.3. The rules of interpretation stated in Article 1 of the Agreement shall apply, *mutatis mutandis*, to this TOR.

3. General

3.1. The Authority's Engineer shall discharge its duties in a fair, impartial and efficient manner, consistent with the highest standards of professional integrity and Good Industry Practice.

3.2. The Authority's Engineer shall perform the duties and exercise the authority in accordance with the provisions of this Agreement, but subject to obtaining prior written approval of the Authority before determining:

(a) any Time Extension;

(b) any additional cost to be paid by the Authority to the Contractor;

(c) the Termination Payment; or

(d) any other matter which is not specified in (a), (b) or (c) above and which creates an obligation or liability on either Party for a sum exceeding 0.2% of Contract Price.

3.3. The Authority's Engineer shall submit regular periodic reports, at least once every month, to the Authority in respect of its duties and functions under this Agreement. Such reports shall be submitted by the Authority's Engineer within 10 (ten) days of the beginning of every month.

3.4. The Authority's Engineer shall inform the Contractor of any delegation of its duties and responsibilities to its suitably qualified and experienced personnel; provided, however, that it shall not delegate the authority to refer any matter for the Authority's prior approval in accordance with the provisions of Clause 18.2.

3.5. The Authority's Engineer shall aid and advise the Authority on any proposal for Change of Scope under Article 13.

3.6. In the event of any disagreement between the Parties regarding the meaning, scope and nature of Good Industry Practice, as set forth in any provision of the Agreement, the Authority's Engineer shall specify such meaning, scope and nature by issuing a reasoned written statement relying on good industry practice and authentic literature.

4. Construction Period

4.1. During the Construction Period, the Authority's Engineer shall review and approve the Drawings furnished by the Contractor along with supporting data, including the geo-technical and hydrological investigations, characteristics of materials from borrow areas and quarry sites, topographical surveys, and the recommendations of the Safety Consultant in accordance with the provisions of Clause 10.1.6. The Authority's Engineer shall complete such review and approval and send its observations to the Authority and the Contractor within 15 (fifteen) days of receipt of such Drawings; provided, however that in case of a Major Bridge or Structure, the aforesaid period of 15 (fifteen) days may be extended upto 30 (thirty) days. In particular, such comments shall specify the conformity or otherwise of such Drawings with the Scope of the Project and Specifications and Standards.

4.2. The Authority's Engineer shall review and approve any revised Drawings sent to it by the Contractor and furnish its comments within 10 (ten) days of receiving such Drawings.

4.3. The Authority's Engineer shall review and approve the Quality Assurance Plan

submitted by the Contractor and shall convey its comments to the Contractor within a period of 21 (twenty one) days stating the modifications, if any, required thereto.

4.4. The Authority's Engineer shall complete the review and approve of the methodology proposed to be adopted by the Contractor for executing the Works, and convey its comments to the Contractor within a period of 10 (ten) days from the date of receipt of the proposed methodology from the Contractor.

4.5. The Authority's Engineer shall grant written approval to the Contractor, where necessary, for interruption and diversion of the flow of traffic in the existing lane(s) of the Project Highway for purposes of maintenance during the Construction Period in accordance with the provisions of Clause 10.4.

4.6. The Authority's Engineer shall review the monthly progress report furnished by the Contractor and send its comments thereon to the Authority and the Contractor within 7 (seven) days of receipt of such report.

4.7. The Authority's Engineer shall inspect the Construction Works and the Project Highway and shall submit a monthly Inspection Report bringing out the results of inspections and the remedial action taken by the Contractor in respect of Defects or deficiencies. In particular, the Authority's Engineer shall include in its Inspection Report, the compliance of the recommendations made by the Safety Consultant.

4.8. The Authority's Engineer shall conduct the pre-construction review of manufacturer's test reports and standard samples of manufactured Materials, and such other Materials as the Authority's Engineer may require.

4.9. For determining that the Works conform to Specifications and Standards, the Authority's Engineer shall require the Contractor to carry out, or cause to be carried out, tests at such time and frequency and in such manner as specified in the Agreement and in accordance with Good Industry Practice for quality assurance. For purposes of this Paragraph 4 (ix), the tests specified in the IRC Special Publication-11 (Handbook of Quality Control for Construction of Roads and Runways) and the Specifications for Road and Bridge Works issued by MORTH (the "Quality Control Manuals") or any modification/substitution thereof shall be deemed to be tests conforming to Good Industry Practice for quality assurance.

4.10. The Authority's Engineer shall test check at least 50 (fifty) percent of the quantity or number of tests prescribed for each category or type of test for quality control by the Contractor.

4.11. The timing of tests referred to in Paragraph 4 (ix), and the criteria for acceptance/ rejection of their results shall be determined by the Authority's Engineer in accordance with the Quality Control Manuals. The tests shall be undertaken on a random sample

basis and shall be in addition to, and independent of, the tests that may be carried out by the Contractor for its own quality assurance in accordance with Good Industry Practice.

4.12. In the event that results of any tests conducted under Clause 11.10 establish any Defects or deficiencies in the Works, the Authority's Engineer shall require the Contractor to carry out remedial measures.

4.13. The Authority's Engineer may instruct the Contractor to execute any work which is urgently required for the safety of the Project Highway, whether because of an accident, unforeseeable event or otherwise; provided that in case of any work required on account of a Force Majeure Event, the provisions of Clause 21.6 shall apply.

4.14. In the event that the Contractor fails to achieve any of the Project Milestones, the Authority's Engineer shall undertake a review of the progress of construction and identify potential delays, if any. If the Authority's Engineer shall determine that completion of the Project Highway is not feasible within the time specified in the Agreement, it shall require the Contractor to indicate within 15 (fifteen) days the steps proposed to be taken to expedite progress, and the period within which the Project Completion Date shall be achieved. Upon receipt of a report from the Contractor, the Authority's Engineer shall review the same and send its comments to the Authority and the Contractor forthwith.

4.15. The Authority's Engineer shall obtain from the Contractor a copy of all the Contractor's quality control records and documents before the Completion Certificate is issued pursuant to Clause 12.4.

4.16. Authority's Engineer may recommend to the Authority suspension of the whole or part of the Works if the work threatens the safety of the Users and pedestrians. After the Contractor has carried out remedial measure, the Authority's Engineer shall inspect such remedial measures forthwith and make a report to the Authority recommending whether or not the suspension hereunder may be revoked.

4.17. In the event that the Contractor carries out any remedial measures to secure the safety of suspended works and Users, and requires the Authority's Engineer to inspect such works, the Authority's Engineer shall inspect the suspended works within 3 (three) days of receiving such notice, and make a report to the Authority forthwith, recommending whether or not such suspension may be revoked by the Authority.

4.18. The Authority's Engineer shall carry out, or cause to be carried out, all the Tests specified in Schedule-K and issue a Completion Certificate, as the case may be. For carrying out its functions under this Paragraph 4 (xviii) and all matters incidental thereto, the Authority's Engineer shall act under and in accordance with the provisions of Article 12 and Schedule-K.

5. Maintenance Period

5.1. The Authority's Engineer shall aid and advise the Contractor in the preparation of its monthly Maintenance Programme and for this purpose carry out a joint monthly inspection with the Contractor.

5.2. The Authority's Engineer shall undertake regular inspections, at least once every month, to evaluate compliance with the Maintenance Requirements and submit a Maintenance Inspection Report to the Authority and the Contractor.

5.3. The Authority's Engineer shall specify the tests, if any, that the Contractor shall carry out, or cause to be carried out, for the purpose of determining that the Project Highway is in conformity with the Maintenance Requirements. It shall monitor and review the results of such tests and the remedial measures, if any, taken by the Contractor in this behalf.

5.4. In respect of any defect or deficiency referred to in Paragraph 3 of Schedule- E, the Authority's Engineer shall, in conformity with Good Industry Practice, specify the permissible limit of deviation or deterioration with reference to the Specifications and Standards and shall also specify the time limit for repair or rectification of any deviation or deterioration beyond the permissible limit.

5.5. The Authority's Engineer shall examine the request of the Contractor for closure of any lane(s) of the Project Highway for undertaking maintenance/repair thereof, and shall grant permission with such modifications, as it may deem necessary, within 5 (five) days of receiving a request from the Contractor. Upon expiry of the permitted period of closure, the Authority's Engineer shall monitor the reopening of such lane(s), and in case of delay, determine the Damages payable by the Contractor to the Authority under Clause 14.5.

6. Determination of costs and time

6.1. The Authority's Engineer shall determine the costs, and/or their reasonableness, that are required to be determined by it under the Agreement.

6.2. The Authority's Engineer shall determine the period of Time Extension that is required to be determined by it under the Agreement.

6.3. The Authority's Engineer shall consult each Party in every case of determination in accordance with the provisions of Clause 18.5.

7. Payments

7.1 The Authority's Engineer shall withhold payments for the affected works for which the

Contractor fails to revise and resubmit the Drawings to the Authority's Engineer in accordance with the provisions of Clause 10.2.4 (d).

7.2 Authority's Engineer shall -

(a) within 10 (ten) days of receipt of the Stage Payment Statement from the Contractor pursuant to Clause 19.4, determine the amount due to the Contractor and recommend the release of 90 (ninety) percent of the amount so determined as part payment, pending issue of the Interim Payment Certificate; and

(b) within 15 (fifteen) days of the receipt of the Stage Payment Statement referred to in Clause 19.4, deliver to the Authority and the Contractor an Interim Payment Certificate certifying the amount due and payable to the Contractor, after adjustments in accordance with the provisions of Clause 19.10.

7.3 The Authority's Engineer shall, within 15 (fifteen) days of receipt of the Monthly Maintenance Statement from the Contractor pursuant to Clause 19.6, verify the Contractor's monthly statement and certify the amount to be paid to the Contractor in accordance with the provisions of the Agreement.

7.4 The Authority's Engineer shall certify final payment within 30 (thirty) days of the receipt of the final payment statement of Maintenance in accordance with the provisions of Clause 19.16.

8. Other duties and functions

The Authority's Engineer shall perform all other duties and functions as specified in the Agreement.

9. Miscellaneous

9.1. A copy of all communications, comments, instructions, Drawings or Documents sent by the Authority's Engineer to the Contractor pursuant to this TOR, and a copy of all the test results with comments of the Authority's Engineer thereon, shall be furnished by the Authority's Engineer to the Authority forthwith.

9.2. The Authority's Engineer shall retain at least one copy each of all Drawings and Documents received by it, including 'as-built' Drawings, and keep them in its safe custody.

9.3. Within 90 (ninety) days of the Project Completion Date, the Authority's Engineer shall obtain a complete set of as-built Drawings, in 2 (two) hard copies and in micro film form

or in such other medium as may be acceptable to the Authority, reflecting the Project Highway as actually designed, engineered and constructed, including an as-built survey illustrating the layout of the Project Highway and setback lines, if any, of the buildings and structures forming part of Project Facilities; and shall hand them over to the Authority against receipt thereof.

9.4. The Authority's Engineer, if called upon by the Authority or the Contractor or both, shall mediate and assist the Parties in arriving at an amicable settlement of any Dispute between the Parties.

9.5. The Authority's Engineer shall inform the Authority and the Contractor of any event of Contractor's Default within one week of its occurrence.

Schedule – O

(See Clauses 19.4.1, 19.6.1, and 19.8.1)

Forms of Payment Statements

1. Stage Payment Statement for Works

The Stage Payment Statement for Works shall state:

(a) the estimated amount for the Works executed in accordance with Clause 19.3.1 subsequent to the last claim;

(b) amounts reflecting adjustments in price for the aforesaid claim;

(c) the estimated amount of each Change of Scope Order executed subsequent to the last claim;

(d) amounts reflecting adjustment in price, if any, for (c) above in accordance with the provisions of Clause 13.2.3(a);

(e) total of (a), (b), (c) and (d) above;

(f) Deductions:

i. Any amount to be deducted in accordance with the provisions of the Agreement except taxes;

ii. Any amount towards deduction of taxes; and

iii. Total of (i) and (ii) above.

(g) Net claim: (e) - (f) (iii);

(h) The amounts received by the Contractor upto the last claim:

i. For the Works executed (excluding Change of Scope orders);
ii. For Change of Scope Orders, and
iii. Taxes deducted

2. Monthly Maintenance Payment Statement

The monthly Statement for Maintenance Payment shall state:

(a) the monthly payment admissible in accordance with the provisions of the Agreement;

(b) the deductions for maintenance work not done;

(c) net payment for maintenance due, (a) minus (b);

(d) amounts reflecting adjustments in price under Clause 19.12; and

(e) amount towards deduction of taxes

3. Contractor's claim for Damages

Note: The Contractor shall submit its claims in a form acceptable to the Authority.

Schedule - P

(See Clause 20.1)

Insurance

1. Insurance during Construction Period

1.1. The Contractor shall effect and maintain at its own cost, from the Appointed Date till the date of issue of the last Completion Certificate, the following insurances for any loss or damage occurring on account of Non Political Event of Force Majeure, malicious act, accidental damage, explosion, fire and terrorism:

(a) insurance of Works, Plant and Materials and an additional sum of 15 (fifteen) per cent of such replacement cost to cover any additional costs of and incidental to the rectification of loss or damage including professional fees and the cost of demolishing and removing any part of the Works and of removing debris of whatsoever nature; and

(b) Insurance for the Contractor's equipment and Documents brought onto the Site by the Contractor, for a sum sufficient to provide for their replacement at the Site.

1.2. The insurance under paragraph 1.1 (a) and (b) above shall cover the authority and the Contractor against all loss or damage from whatsoever cause arising under paragraph 1.1 other than risks which are not insurable at commercial terms.

2. Insurance for Contractor's Defects Liability

The Contractor shall effect and maintain insurance cover for the Works from the date of issue of the Completion Certificate until the end of the Defects Liability Period for any loss or damage for which the Contractor is liable and arises from a cause occurring prior to the issue of the Completion Certificate. The Contractor shall also maintain other insurances for maximum sums as may be required under the Applicable Laws and in accordance with Good Industry Practice.

3. Insurance against injury to persons and damage to property

3.1. The Contractor shall insure against each Party's liability for any loss, damage, death or bodily injury, which may occur to any physical property (except things insured under Paragraphs 1 and 2 of this Schedule or to any person (except persons insured under Clause 20.9), which may arise out of the Contractor's performance of this Agreement. This insurance shall be for a limit per occurrence of not less than the amount stated below with no limit on the number of occurrences. The insurance cover shall be not less than: Rs. [*****]

3.2. The insurance shall be extended to cover liability for all loss and damage to the Authority's property arising out of the Contractor's performance of this Agreement excluding:

(a) the Authority's right to have the construction works executed on, over, under, in or through any land, and to occupy this land for the Works; and

(b) Damage which is an unavoidable result of the Contractor's obligations to execute the Works.

4. Insurance to be in joint names

The insurance under paragraphs 1 to 3 above shall be in the joint names of the Contractor and the Authority.

Schedule-Q

(See Clause 14.10)

Tests on Completion of Maintenance Period

1. Riding Quality test:

Riding quality test: Riding quality of each lane of the carriageway shall be checked with the help of a calibrated bump integrator and the maximum permissible roughness for purposes of this Test shall be 2,500 (two thousand five hundred) mm for each kilometer.

2. Visual and physical test:

The Authority's Engineer shall conduct a visual and physical check of construction to determine that all works and equipment forming part thereof conform to the provisions of this Agreement. The physical tests shall include measurement of cracking, rutting, stripping and potholes and the permissible values are given below: • Area of cracking not more than 2 % area

- Area of rutting with rut depth more than 10 mm - not more than 1 …. % area
- Area of stripping: not more than 2 % area
- Area of potholes: Nil
- Edge drop – Shall not be more than 15 mm

Schedule-R

(See Clause 14.10)

Taking Over Certificate

I,…….. (Name and designation of the Authority's Representative) under and in accordance with the Agreement dated……. (the **"Agreement**"), for ***Construction of Chhiathlang bypass and Serchhip bypass on Aizawl-Tuipang section of NH-54 in the state of Mizoram*** **on Engineering, Procurement and Construction (EPC) mode, with Japan International Cooperation Agency (JICA) loan assistance** (the "**Project Highway**") on Engineering, Procurement and Construction (EPC) basis Through …….. (Name of Contractor), hereby certify that the Tests on completion of Maintenance Period in accordance with Article 14 of the Agreement have been successfully undertaken to determine compliance of the Project Highway with the provisions of the Agreement and I hereby certify that the Authority has taken over the Project highway from the Contractor on this day…….

SIGNED, SEALED AND DELIVERED

(Signature)

(Name of Authority's Engineer)

(Address)

SCHEDULE-S
(See Clause 17.7.2)

Performance Certificate

I, …….. (Name and designation of the Authority's representative) under and in accordance with the Agreement dated …… (the "Agreement"), for construction and maintenance of the ***Construction of Chhiathlang bypass and Serchhip bypass on Aizawl-Tuipang section of NH-54 in the state of Mizoram*** **on Engineering, Procurement and Construction (EPC) mode, with Japan International Cooperation Agency (JICA) loan assistance** ***(Package 1) with JICA loan assistance*** (the "Project Highway") on Engineering, Procurement and Construction (EPC) mode through …….. (Name of Contractor), hereby certify that the Contractor has discharged all its obligations under the Agreement and in accordance with Article 17 of the Agreement I hereby issue Performance Certificate to the Contractor on this day.....

SIGNED, SEALED AND DELIVERED

(Signature)
(Name of Authority's Engineer)
(Address)

SCHEDULE-T

(See Clause 19.1.6)

Name of Currency	**A** **Amount of Currency**	**B** **Rate of Exchange*** **(Local Currency per Unit of Foreign Currency)**	**C** **Local Currency Equivalent**	**D** **Percentage of Net Bid Price (NTP)** **(100 x C) / NTP**
Local Currency (Indian Rupees)				
Foreign Currency 1 (Japanese Yen)				
Foreign Currency 2 (US Dollar)				
Net Bid Price				**100.00**

*The fixed rates of exchange shall be the Exchange Rate (FBIL reference rate) published by Reserve Bank of India for the relevant date. This rate is available at the website of Financial Benchmarks India Pvt. Ltd. under the tab 'DATA AND METHODOLOGY'=> Data => Benchmark Data => Reference Rate; link: http://www.fbil.org.in/securities?op=referencerate&mq=o. The relevant date shall be as on the date 28 days prior to date of bid submission".

1. Regarding damages by the Authority, financing charges for a payment delays will be in corresponding currency amounts.

2. Delay damages will be recovered in currencies in proportion which in which contract price is payable.