SCHEDULES

Schedule-A

(See Clauses 2.1 and 8.1)

Site of the Project

1. The Site

(i) Site of the Two-Lane with Paved Shoulder Highway shall include the land, buildings, structures and road works as described in **Annex-I of this Schedule-A**.

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

(iii) 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 (i) of this Agreement.**

(iv) 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, improve/upgrade the Road Profile as indicated in **Annex-III** based on site/design requirement.

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

Annex – I

(Schedule-A)

Site

[Note: All the Chainage/ location referred to in Annex-I to Schedule-A shall be existing Chainage.]

1. Site

The Site of the proposed Two-lane with paved shoulder Project Highway comprises the section of National Highway NH 717-A commencing from Km 25+600 in Nimbong Village to Km 26+100 (Design Length-500m) of Bagrakot-Kafer. The land, carriageway and structures comprising the Site are described below.

2. Land

The Site of the Project Highway comprises the land as described below:

S. No.	Chainage (Km)		Right of Way (m)	Remarks
	From	To		
1	25+600	26+100	Varying from 32m to 304m	As per Annex II of Schedule A.

3. Carriageway

The present carriageway of the Project Highway is Single Lane. The type of the existing pavement is flexible.

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 bridge)/RUB (road under bridge):

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	Type of Structure		No. of Span with span length (m)	width
		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	Superstructure		
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:

S. No.	Chainage (Km)/Culvert No	Type of Culvert	Span /Opening with span length/Dia (m)	Width (m)
NIL				

11. Bus bays

The details of bus bays 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. Roadside 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 (Km)		At grade	Separated	Category of Cross Road			
	From	To			NH	SH	MDR	Others
NIL								

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

15. Minor junctions

The details of the minor junctions are as follows:

S. No.	Location (Km)		Type	
	From	To	Type of junctions (T / Y / +)	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)		Length (in Km)
		From (Km)	To (Km)	
NIL				

17. Other Structure

NIL

18. Existing Utilities

The Site includes the existing utilities as described in **Sheet-I (Annex-I to Schedule-A)**

Sheet-I (Annex-I to Schedule-A)

(i) Electrical Utilities

The site includes the following electrical utilities:-

a) Extra High-Tension Lines (EHT Lines)

S. No.	Design Chainage(Km)		Length (in Km)				Crossings			
	From	To	400KV	220KV	110KV	66KV	400KV	220KV	110KV	66KV
Nil										

b) High Tension / Low Tension Lines (HT / LT Lines)

S. No.	Design Chainage(Km)		Length (in Km)			Crossings			Transformer	
	From	To	33 KV	11KV	LT	33KV	11KV	LT	No	Capacity(KV A)
1.	25+700	25+950			0.25					

(ii) Public Health Utilities (Water / Sewage Pipe Lines)

(iii) Any Other Line

S. No	Chainage (Km)		Length (Km)				Crossings			
	From	To	Water Supply Line		Sewage Line		Water Supply Line		Sewage Line	
			With Pumping	With Gravity Flow	With Pumping	With Gravity Flow	With Pumping	With Gravity Flow	With Pumping	With Gravity Flow
1	25+750	26+00	-	0.250	-	-	-	-	-	-

(This is illustrative and may change as per features of existing Utilities.)

Annex - II

(As per Clause 8.3 (i))

(Schedule-A)

Annex-II: **Dates for providing Right of Way of Construction Zone**

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 (m)	Width (m)	Date of providing Right of
(1)		(2)	(3)	(4)	(5)
(i) Full Right of Way (full width)					
(a)	Stretch-I	25+600 to 25+650	50.00	34.0-49.5	On Appointed Date
(b)	Stretch-II	25+650 to 25+700	50.00	49.5 -54.0	
(c)	Stretch-III	25+700 to 25+750	50.00	54.0-67.0	
(d)	Stretch-IV	25+750 to 25+800	50.00	67.0-256.0	
(e)	Stretch-V	25+800 to 25+850	50.00	256.0- 292.0	
(f)	Stretch-VI	25+850 to 25+900	50.00	292.0- 304.0	
(g)	Stretch-VII	25+900 to 25+950	50.00	304.0-116.0	
(h)	Stretch-VIII	25+950 to 26+000	50.00	116.0-43.0	
(i)	Stretch-IX	26+000 to 26+050	50.00	43.0-39.0	
(j)	Stretch-X	26+050 to 26+100	50.00	39.0-32.0	
(ii) Part Right of Way (part width) : NA					
(iii) Balance Right of Way (width): NA					

*The dates specified herein shall in no case be beyond 150 (one hundred and fifty) days after the Appointed Date.

Annex - III

(Schedule-A)

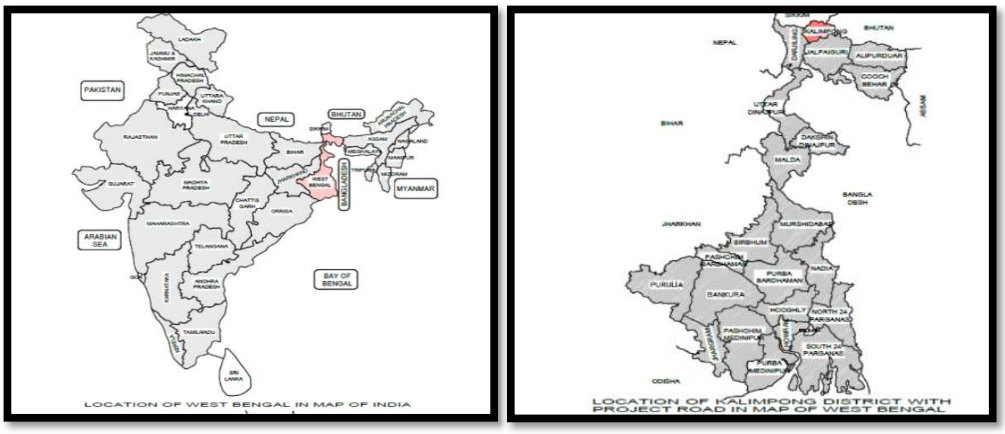
Alignment Plans

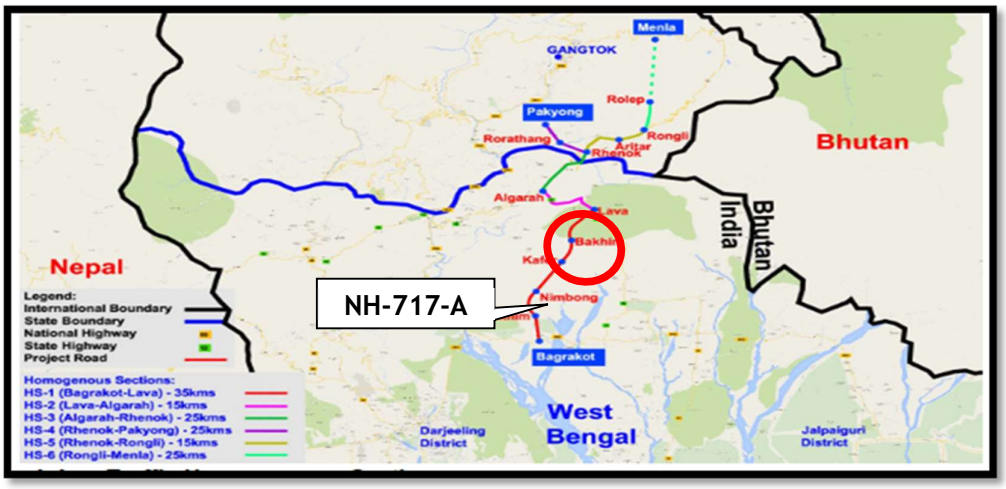
The existing alignment of the Project Highway shall be modified in the following sections as per the alignment plan indicated below:

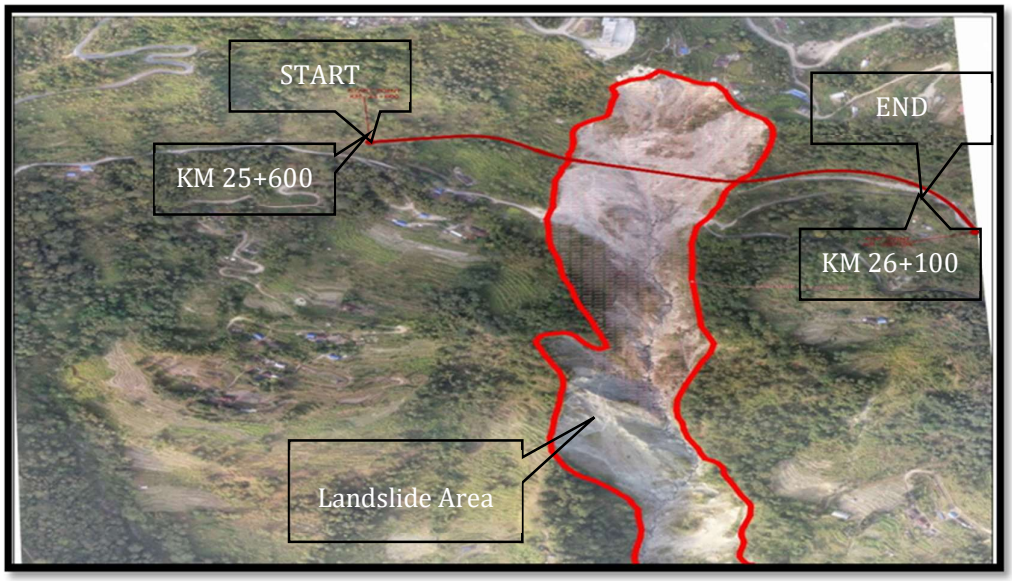
(i) The alignment of the Project Highway is enclosed in alignment plan. Finished road level indicated in the alignment plan shall be followed by the contractor as minimum FRL. In any case, the finished road level of the project highway shall not be less than those indicated in the alignment plan. The 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 the relevant specifications/IRC Codes/Manual, in addition to MoRTH Circular no. RT-25035/07/2023-RS (Part) (221534), dated 20.07.2023.

Alignment Plan







Annex – IV

(Schedule-A)

Environment Clearances

Sr.No.	Clearances	Present Status
1	Environment clearance	Not Applicable

Schedule - B

(See Clause 2.1)

CONSTRUCTION FOR MITIGATION MEASURES FOR SLOPE PROTECTION & DEVELOPMENT OF THE PROJECT HIGHWAY

1. Construction for Mitigation Measures for Slope Protection

Survey, identification of extent of instability, investigations, detailed designing and execution / construction of mitigation measures for Slope Protection as described in Schedule B and in Schedule C as per approved design and standards, duly checked by the Proof & Safety Consultant and vetted by either THDCIL (Tehri Hydro Development Corporation India Limited) or any one of the IITs as stipulated under Article-10, to be followed during construction stage and its maintenance for 10 years from the date of successful completion of the project / works with complete adherence of all relevant codal provisions, specifications and safety standards.

2. Development of the Project Highway

Development of the project highway shall include two laning with paved shoulders of the Project Highway as described in Annex-I of this Schedule B and Schedule-C.

3. Specifications and Standards

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

Annex - I

(Schedule-B)

Description

CONSTRUCTION FOR MITIGATION MEASURES FOR SLOPE PROTECTION & DEVELOPMENT OF THE PROJECT HIGHWAY

1. Execution/ Construction of Mitigation Measures

i. The Project Highway refers to mitigation measures for Slope Protection along NH-717 A between km 25.600 to 26.100 in the State of West Bengal.

ii. Design and development of mitigation measures shall be done in accordance with the relevant codes/manual/specification of Indian Standards Institution (ISI), IRC & its special publication, MoRTH circulars and guidelines. Wherever the Indian standards are not clear and sufficient for sound and safe design, other relevant codes of US / UK / European countries shall be used for design & development of mitigation measures and works shall be carried out as per the designs and drawing approved by the Authority/Authority Engineer. General Arrangement of mitigation measures has been shown in the drawings folder.

iii. General Scope and Features

The area is very prone to landslides and sinking. The Contractor has to carryout Survey, Identify the extent of instability, investigations, detailed designing duly checked by the Proof & Safety Consultant and duly vetted by either THDCIL (Tehri Hydro Development Corporation India Limited) or any one of the IITs as stipulated under Article-10 and execution / construction of mitigation measures as per approved design and standards to be followed during construction stage and its maintenance for 10 years from the date of successful completion of the project / works with complete adherence of safety standards. The investigations comprise of geological, geo-physical and geotechnical exploration works required for stability analysis and design of mitigation measures. All the works are to be carried out as per approved design and drawings of mitigation measures and as per technical specifications as given in Annexure-I of Schedule-D.

2. Widening of the existing highway

i. 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 Mountainous /Steep terrain to the extent land is available.

ii. Width of Carriageway

(a) Two-Laning with paved shoulders shall be undertaken. The paved carriageway shall be 7.0m wide in accordance with the typical cross section

drawings attached.

Provided that in the built-up areas, the width of the carriageway shall be as specified in the following table:

S. No.	Built-up stretch (Township)	Location (Km)		Width (m)	Typical cross section
		From	To		
NIL					

(b) Except as otherwise provided in this Agreement, the width of the paved carriageway and cross-sectional features shall conform to paragraph 1. (i) Above.

3. Geometric Design and General Features

(i) General

Geometric design and general features of the Project Highway shall be in accordance with Section 2 of the Manual, referred to as the Manual and other relevant IRC Codes.

(ii) Design speed

The design speed for the project road shall be the minimum design speed of 40 Km per hr. for Mountainous & Steep terrain as per the Manual.

(iii) Improvement of the existing road geometrics

In the following sections, where improvement of the existing road geometrics to the prescribed standards is not possible, the existing road geometrics shall be improved to the extent possible within the given right of way and proper road signs and safety measures shall be provided:

S. No.	Design Chainage (Km)		Radius (m)	Design speed (Km/hr.)	Remarks
	From	To			
NIL					

(iv) Right of Way

Details of the Right of Way are given in Annex-II of Schedule-A.

(v) Type of shoulder

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

S. No.	Stretch (Km)		Fully paved shoulders/ footpaths	Reference to cross section
	From	To		
NIL				

b) Paved shoulders of 1.5 m width shall be provided on both hill and valley side. The Earthen shoulder of 1.0m width at valley side shall be covered with 150mm

thick compacted layer of granular material.

c) Design and specifications of paved shoulders and granular material shall conform to the requirements specified in the relevant Manual.

(vi) Lateral and vertical clearance at underpasses

a) Lateral and vertical clearances at underpasses and provision of guardrails/crash barriers shall be as per the provision of Manual.

b) Lateral clearance: The width of opening at the underpasses shall as follows:

S. No.	Location (Chainage) (Km)		Span/ opening (m)	Remarks
	From	To		
NIL				

(vii) Lateral and vertical clearances at overpasses

a) Lateral and vertical clearances at overpasses shall be as per the provision of relevant Manual.

b) Lateral clearance: The width of the opening at the overpasses shall be as follows:

S. No.	Location (Chainage) (from Km to Km)	Span/ opening (m)	Remarks
NIL			

(viii) Service roads

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

S.No	Location (Km)		Length (m)	Lane(m)	Side
	From	To			
NIL					

(ix) Grade separated structures

a) Grade separated structures shall be provided as per provision of the relevant Manual. The requisite particulars are given below:

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

b) In the case of grade separated structures, the type of structure and the level of the Project Highway and the cross roads shall be as follows:

S. No	Location (Km)	Type of structure Length (m)	Cross road at			Remarks, if any
			Existing Level(m)	Raised Level(m)	Lowered Level(m)	
NIL						

(x) Cattle and pedestrian underpass /overpass

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

S. No.	Location	Type of crossing
Nil		

(xi) Typical cross-sections of the Project Highway

The Applicable typical cross section shall be developed as TCS-1 to TCS-6 as given in table below: as well as detailed widening Scheme in **Annexure B-II of Schedule-B** confirming to the manual should follow the minimum.

S. No.	Type	Design Length
1	**TCS-1** 25+600-25+800 KM	200
2	**TCS-2** 25+800-25+940 KM (Hill side only)	140
3	**TCS-3** 25+830-25+900 KM AND 25+980-26+050 KM (Valley side only)	140
4	**TCS-4** 25+800-25+930 KM (Valley side only)	130
5	**TCS-5** 25+950-26+050 KM	100
6	**TCS-6** 26+060-26+100 KM	40

4. Intersections and Grade Separators

All intersections and grade separators shall be as per the provision of relevant 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:

(i) **At-grade intersections**

S. No.	Location of intersection	Type of Intersection (+, T, Y)	Other features
	Design Chainage (Km)		Category of Cross Road
NIL			

(ii) **Grade separated intersection with/without ramps**

S. No.	Location (Km)	Salient features	Minimum length of viaduct to be provided	Road to be carried over/under the structures
NIL				

5. Road Embankment and Cut Section

(i) Widening and improvement of the existing road embankment/cuttings and construction of new road embankment/ cuttings shall conform to the Specifications and Standards specified cross-sectional details. Deficiencies in the plan and profile of the existing road shall be corrected.

(ii) Raising of the existing road Refer to the provision of Manual. The existing road shall be raised in the following sections:

S. No.	Design Section (Km)		Length (m)	Extent of raising (Top of finished road level)
	From	To		
NIL				

6. Pavement Design

(i) Pavement design shall be carried out in accordance with the provisions of relevant Manual.

(ii) Type of pavement

Flexible pavement shall be provided for the main carriageway, and it shall be designed in accordance with relevant manual with the minimum crust composition:

BC 40 mm

BSM 110 mm

CTSB 200 mm

(iii) Design requirements:

a) Design Period and strategy

Flexible pavement shall be designed for a minimum design period of 20 years.

b) Design Traffic

Notwithstanding anything to the contrary contained in this Agreement or the Manual, the Contractor shall design the pavement for design traffic of 25 million standard axles.

(iv) Reconstruction of stretches

The following stretches of the existing road shall be reconstructed. These shall be designed as new pavement.

S. No.	Design Section (Km)		Length (m)	Remarks
	From	To		
NIL				

7. Roadside Drainage

a) Drainage system including surface and subsurface drains for the Project Highway shall be provided as per the provision of the relevant Manual.

b) Road-side Cement Concrete Lined Drain (toe drain) of trapezoidal shape as shown in the different typical cross sections in length to be constructed = **492 m**

c) Catch Water Drains (Surface Drains) to be provided as below:

Berm Drain:

S. No.	Design Chainage (km)		Horizontal Drain			Position	Type
	From	To	Rows / Layers	Length of Stretch	Total Length (m)		
1	25+600	25+800	6	200	1200	Hill side	Trapezoidal Drain 0.5 x 0.5m (CC type)
2	25+800	25+940	11	140	1540		
3	25+940	26+050	3	110	330		
4	26+050	26+100	3	50	150		
5	25+830	25+900	1	70	70	Valley Side below RS wall	Trapezoidal Drain 0.5 x 0.5m (CC type)
6	25+980	26+050	1	70	70		

Vertical Drain/ Side drain /Cascade drain:

S. No.	Design Chainage (km)		Total Length (m)	Position	Type
	From	To			
1	25+800	25+830	26		

2	25+815	25+820	132	Hill side	PVC pipes 75mm dia. Wrapped in Non- woven Geotextile
3	25+910	25+930	82		
4	25+600	25+800	230		Trapezoidal Drain 0.5 x 0.5m (CC type)
5	25+800	25+970	336		
6	25+970	26+100	150		

d) Chute Drains

Chute Drain		
S. No	**Total Length (m)**	**Type**
1	285	Trapezoidal Drain (CC type) as per drawing attached

e) Sub-Surface drains

S. No.	Stretch	Proposed Solution	TCS Type
1	25+600-25+800 KM	Hill side: Provision of PVC Perforated drain pipes 75mm dia., 25m long @6m c/c in both directions, wrapped with Non-woven Geotextile in two rows.	TCS-1
2	25+800-25+940 KM	**Hill side:** Provision of PVC Perforated drain pipes 75mm dia. 25m long @6m c/c in both directions, wrapped with Non-woven Geotextile in Ten rows. **Valley side:** Provision of PVC Perforated drain pipes 75mm dia., 25m long @6m c/c in both directions, wrapped with Non-woven Geotextile in two rows.	TCS-2
4	25+950-26+050 Km	**Hill side:** Provision of PVC Perforated drain pipes 75mm dia., 25m long @6m c/c in both directions, wrapped with Non-woven Geotextile in four rows.	TCS-5
5	26+060-26+100 Km	**Hill side:**	TCS-6

S. No.	Stretch	Proposed Solution	TCS Type
		Provision of PVC Perforated drain pipes 75mm dia., 25m long @6m c/c in both directions, wrapped with Non-woven Geotextile in three rows.	

8. Design of Structures

(i) General

a) All bridges, culverts and structures shall be designed and constructed in accordance with provision of the relevant Manual and shall conform to the cross- sectional features and other details specified therein.

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

S. No.	Bridge/structure at (Km)	Width of carriageway and cross-sectional features*
NIL		

c) The following structures shall be provided with footpaths:

S. No.	Location at Km	Remarks
NIL		

d) All bridges shall be high-level bridges.

e) The following structures shall be designed to carry utility services as per site requirement:

S. No	Bridge at (Km)	Utility service to be carried	Remarks
NIL			

f) Cross-section of the new culverts and bridges at deck level for the Project Highway shall conform to the typical cross-sections given.

(ii) Culverts

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

b) **Reconstruction of existing culverts:**
The existing culverts at the following locations shall be re-constructed as new culverts:

S. No.	Culvert location (Km)	Span/Opening (m)	Remarks, if any
NIL			

c) **Widening of existing culverts:**

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

S. No.	Culvert location	Type, span, height and width of existing culvert (m)	Repairs to be carried out [specify]
Nil			

d) Additional new culverts (RCC Box type) shall be constructed as per particulars given in the table below:

S No.	Culvert location (Km)	Span/Opening (m)
1	25+830	4.0 m
2	25+905	4.0 m

e) Repairs/**replacements** of railing/parapets, flooring and protection works of the existing culverts shall be undertaken as follows:

S. No.	Location at Km	Type of repair required
NIL		

f) Floor protection works shall be as specified in the relevant IRC Codes and Specifications.

(iii) **Bridges**

a) Existing bridges to be re- constructed/widened

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

S. No	Bridge location (Km)	Salient details of existing bridge	Adequacy or otherwise of the existing waterway, vertical clearance, etc*	Remarks
NIL				

(ii) The following narrow bridges shall be widened:

S.No.	Location (Km)	Existing width (m)	Extent of widening (m)	Cross-section at deck level for widening
Nil				

b) Additional new bridges

New bridges at the following locations on the Project Highway shall be constructed. GADs for the new bridges are attached in the drawings folder.

S. No.	Location (Km)	Total length (m)	Remarks, if any

NIL

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

S. No.	Location at Km	Remarks
NIL		

d) Repairs/replacements of railing/parapets of the existing bridges shall be undertaken as follows:

S. No.	Location at Km	Remarks
NIL		

e) Drainage system for bridge decks
Not Applicable

f) Structures in marine environment
Not Applicable

(iv) **Rail-road bridges**

a) Design, construction and detailing of ROB/RUB shall be as specified in the provision of relevant Manual.

b) Road over-bridges

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

S. No.	Location of Level crossing (Chainage Km)	Length of bridge (m)
NIL		

c) Road under-bridges

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

S. No.	Location of Level crossing (Chainage Km)	Number and length of Span (m)
NIL		

(v) **Grade separated structures**

The grade separated structures shall be provided at the locations and of the type and length specified in paragraphs 2 (ix) and 3 of this Annex-I of this Schedule. - B.

(vi) **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**

S. No.	Location of bridge (Km)	Nature and extent of repairs /strengthening to be carried out
NIL		

(b) **ROB/RUB**

S. No.	Location of ROB/RUB (Km)	Nature and extent of repairs /strengthening to be carried out
NIL		

(c) **Overpasses/Underpasses and other structures**

S. No.	Location of Structure (Km)	Nature and extent of repairs /strengthening to be carried out
Nil		

(vii) **List of Major Bridges and Structures**

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

Sl. No.	Location	Span Arrangement(m)
NIL		

9. Traffic Control Devices and Road Safety Works

a) Traffic control devices and road safety works shall be provided in accordance with the provisions of the relevant Manual.

b) Specifications of the reflective sheeting shall be Class C sheeting described in IRC:67 and type VIII, IX & XI as per ASTM D 4956-09 fixed over Aluminium or Aluminium Composite Material.

The minimum nos. of traffic sign boards are as hereunder-

S.No	Chainage (Km)	Signs	Minimum Nos	Size (Cm)
1	25+600	Max Speed Limit	1	60 diameter
2	25+673	Right Hand Curve	1	60x60x60

S.No	Chainage (Km)	Signs	Minimum Nos	Size (Cm)
3	25+732	Left Hand Curve	1	60x60x60
4	25+830	Hazard Marker	2	30x90
5	25+834	Hazard Marker	2	30x90
6	25+905	Hazard Marker	2	30x90
7	25+909	Hazard Marker	2	30x90
8	25+934	Left Hand Curve	1	60x60x60
9	25+987	Right Hand Curve	1	60x60x60
10	26+023	Right Hand Curve	1	60x60x60
11	26+035	Single Chevron	2	50x60
12	26+094	Single Chevron	2	50x60
13	26+094	Max Speed Limit	1	60 iameter

c) **Road Marking:** The markings shall cover road marking for the entire Project Highway as per relevant code and manual. The details are given in the table below:

S.No	Chainage (Km)		Edge Line	Centre Line
	From	To		
1	25+600	26+094	Continuous Line as per LM 24	Broken Line as per LM 02

d) Road studs : The Reflective Pavement Markers (RRPM) i.e. road studs shall be provided to improve the visibility in night time and wet weather conditions. These shall be prismatic retroreflective type conforming to ASTM D 4280. Table 9.1 of Manual presents the warrants for providing Road studs in two lane highway and the priorities to be followed along with placement details shall be as per IRC:35. The colour pattern of road studs for edge line and centre line with respect traffic movement is depicted in Fig. 9.3 of Manual.

Chainage(Km)	Chainage(Km)	Length (m)	Min Road Studs
25+600	25+677	76.574	**13**
25+677	25+702	25.000	**4**
25+702	25+705	3.430	**1**
25+705	25+730	25.000	**4**
25+730	25+942	211.77	**35**
25+942	25+962	20.000	**3**
25+962	25+962	0.412	**0**
25+962	25+982	20.000	**3**
25+982	26+047	64.950	**11**
26+047	26+072	25.000	**4**
26+072	26+094	21.455	**4**
		494.0	**246**

10. Roadside Furniture

(i) Roadside furniture shall be provided in accordance with the provision relevant manual.

(ii) Overhead traffic signs: locations and size: NIL

11. Compulsory Afforestation: NIL

12. Hazardous Locations

The safety barriers (Thrie Beam) shall also be provided at the following hazardous locations:

S. No	Design Chainage (Km)		Position	Proposed Length (m)	TCS TYPE
	From	To			
1	25+600	25+630	Valley side	30	TCS-6
2	25+830	25+900	Valley side	70	TCS 3
3	25+980	26+050	Valley side	70	TCS 3
4	26+050	26+100	Valley side	40	TCS-6
Total				**220**	

13. Special Requirement for Hill Roads

(a)Reinforced Soil (RS) Wall in Valley Side

On Right Hand Side (RHS):

RS walls shall be constructed for the length and TCS as given in the table below:

S. No	Design Chainage (Km)	Minimum Height (m)	Proposed Length (m)	TCS TYPE
1.	25+830	7.2	10	TCS 3

S. No	Design Chainage (Km)	Minimum Height (m)	Proposed Length (m)	TCS TYPE
2.	25+840	10.4	10	TCS 3
3.	25+850	8	10	TCS 3
4.	25+860	8	10	TCS 3
5.	25+870	8	10	TCS 3
6.	25+880	8	10	TCS 3
7.	25+890	8	10	TCS 3
8.	25+900	4	10	TCS 3
9.	25+980	6.4	10	TCS 3
10.	25+990	8	10	TCS 3
11.	26+000	5	10	TCS 3
12.	26+010	8	10	TCS 3
13.	26+020	7.2	10	TCS 3
14.	26+030	8.8	10	TCS 3
15.	26+040	7.2	10	TCS 3
16.	26+050	6.4	10	TCS 3
TOTAL=			**140**	

Note: (i) The specifications of RS Wall shall be as per relevant manual.
(ii) The minimum scope of RS wall is defined as above. Any increase in quantity within 10% of the scope defined shall not be considered as a Change of Scope.

(b) Gabion Wall at toe on Hill Side

Gabion wall shall be constructed for the length, height and TCS as given in the table below:

On Left Hand Side:

S. No	Design Chainage (Km)		Position	Proposed Length (m)	Minimum Height (m)	TCS TYPE
	From	To				
1.	25+600	25+800	Hill side	210	3	TCS 1
2.	25+800	26+940	Hill side	140	5	TCS 2
3.	25+600	25+630	Valley side	30	3	TCS-6
4.	26+060	26+100	Valley side	40	3	TCS-6
Total				**430**		

Note: (i) The specifications of Gabian Wall shall be as per relevant manual/Sch-D.

(ii) The minimum scope of Gabion wall is defined as above. Any increase in quantity within 10% of the scope defined shall not be considered as a Change of Scope.

(c) Slope stabilization on Hill Side:

Secured Drapery System shall be provided as per relevant manual/code:

A. On Hill side and Valley side

S. No.	Stretch	Proposed Solution	TCS Type
1	25+600-25+800 KM (Hill side only)	**Hill side:** i. Excavation of slope at 65 degrees from horizontal with benching of 2.5m width and terracing along with berm drain at every 10m height interval for 55.2m (max.) Height above road level. ii. Toe protection with Gabion wall of height 3m. iii. Slope protection with Passive anchors (SDA) 32mm dia. 4m deep @3m c/c in both directions for 40m height above Road level , 6m deep @2m c/c in both directions for 10m height from 40m above road level and 8m deep @2m c/c in both directions for 5.2m height from 50m above road level . Top anchors 4m deep @1.5m c/c in longitudinal direction and 6m deep surface/vertical anchors on RCC Pad @2m c/c in longitudinal direction in two rows . iv. Slope protection with Active anchors (Pre-stress Anchors), 12m deep @ 2m c/c in longitudinal direction in one row above road level. v. Provision for surficial protection with drapery of High strength Rhomboidal mesh (125kN/m), 3-D erosion control mat and Bio-engineering/Hydro seeding over the exposed slope. vi. Provision of PVC Perforated drain pipes 75mm dia., 25m long @6m c/c in both directions, wrapped with Non-woven Geotextile in Four rows.	TCS-1
2	25+800-25+940 KM	**Hill side:** i. Excavation of slope at 50 degrees from horizontal with benching of 2.5m width each except one berm of 5m at 55m height above road level and terracing along with berm drain at every 10m height interval for around 103.3m (max.) height above road level and excavation at hill side crown having tension cracks at 50 degrees for around 10.5m height below the hill side crown of landslide. Toe protection with Gabion wall of height 5m.	TCS-2

S. No.	Stretch	Proposed Solution	TCS Type
		ii. Slope protection with Passive anchors (SDA) 32mm dia. 6m deep @3m c/c in both directions till 74m above the road level after 74m to the crown passive anchors (SDA) 32mm dia. 6m deep @2m c/c in both directions. Top anchors 4m deep @1.5m c/c in longitudinal direction and 6m deep surface & vertical anchors on RCC Pad @2m c/c in longitudinal direction in two rows each. iii. Slope protection with Active anchors (Pre-stress Anchors) 32m deep @2m c/c in longitudinal direction in one row at around 15m above road level. iv. Provision for surficial protection with drapery of High strength mesh (125kN/m), 3-D erosion control mat and Bio-engineering/Hydroseeding over the exposed slope. v. Provision of PVC Perforated drain pipes 75mm dia. 25m long @6m c/c in both directions, wrapped with Non-woven Geotextile in Ten rows. **Valley side: (Valley side design is applicable from CH 25+890)** i. Slope protection with Passive anchors (SDA) 32mm dia. 6m deep @2m/3m c/c in both directions from 34.5m below the road level and 6m deep surface & vertical anchors on RCC Pad @2m c/c in longitudinal direction in two rows each. ii. Slope protection with Active anchors (Pre-stress Anchors) 15m deep @2m c/c in longitudinal direction at around 5m and 30m below road level. iii. Provision for surficial protection with drapery of DT Hexagonal steel wire mesh, coir/jute mat and Bio-engineering over the exposed slope below road level. iv. Provision of PVC Perforated drain pipes 75mm dia., 25m long @6m c/c in both directions, wrapped with Non-woven Geotextile in two rows.	
3	25+800-25+930 Km (Valley Side only)	**Valley side:** i. Provision of anchored Reinforced soil wall of Gabion fascia and geogrids for height of 8.0m below Road level for retention works. Anchors to be installed at bottom of wall SDA 32mm dia., 6m deep @2m c/c in both directions. ii. Slope protection with Passive anchors (SDA) 32mm dia. 6m deep @3m c/c in both directions for around 11m height below Road level, 6m deep	TCS-4

S. No.	Stretch	Proposed Solution	TCS Type
		@2m c/c in both directions for 35.5m height on valley side from 11m below road level, 5m deep @3m c/c in both directions for 18m height on valley side from around 46.5m height below road level and 6m deep surface/vertical anchors on RCC Pad @2m c/c in longitudinal direction in two rows. iii. Slope protection with Active anchors (Pre-stress Anchors) 15m deep @2m c/c in longitudinal direction at around 5m and 30m below road level. iv. Provision for surficial protection with drapery of DT Hexagonal steel wire mesh, coir/jute mat and Bio-engineering/Hydroseeding over the exposed slope for around 93m height below road level.	
4	25+950-26+050 Km (Hill side only)	**Hill side:** i. Excavation of slope at 65 degrees from horizontal with benching of 2.5m width and terracing along with berm drain at every 10m height interval for around 29.5m (max.) height above road level. ii. Slope protection with Passive anchors (SDA) 32mm dia. 4m deep @2.0mm c/c in both directions for 29.5m height above road level up to cut slope. Top anchors 4m deep @1.5m c/c in longitudinal direction. iii. Provision for surficial protection with drapery of High strength mesh (124kN/m), 3-D erosion control mat and Bio-engineering/ Hydroseeding over the exposed slope for around 29.5m height above road level. iv. Provision of PVC Perforated drain pipes 75mm dia., 25m long @6m c/c in both directions, wrapped with Non-woven Geotextile in four rows.	TCS-5
5	26+060-26+100 Km	**Hill side:** i. Excavation of slope at 75 degrees from horizontal with benching of 1.5m width and terracing along with berm drain at every 10m height interval for around 30.5m (max.) height above road level. ii. Slope protection with Passive anchors (SDA) 32mm dia. 5m deep @2m c/c in both directions for 30.5m height above Road level. iii. Provision for surficial protection with drapery of High strength mesh (125kN/m), 3-D erosion control mat and Bio-engineering/Hydroseeding over the exposed slope for around 30.5m height above road level.	TCS-6

S. No.	Stretch	Proposed Solution	TCS Type
		iv. Provision of PVC Perforated drain pipes 75mm dia., 25m long @6m c/c in both directions, wrapped with Non-woven Geotextile in three rows. **Valley side:** i. Provision of retention with Gabion wall of height 3m.	

Note: The special slope protection work is defined for a minimum area of 60257 Sqm. Any increase in quantity of items within 10% of the defined scope shall not be considered as a Change of Scope.

14. Change of Scope

The length of Structures and bridges 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.

15. Utility Shifting

Details are given in **Sheet-II (Annexure-I to Schedule-B)**

Sheet-II (Annexure-I to Schedule-B)

Utility Shifting

Shifting of obstructing existing utilities as indicated in Schedule A to an appropriate location in accordance with the standards and specifications of concerned Utility Owing Department is part of the scope of work of the Contractor. The bidders may visit the site and assess the quantum of shifting of utilities for the project before submission of their bid. Copy of utility relocation plan is enclosed. The specifications of concerned Utility Owning Department shall be applicable and followed.

Notes:

a) The type/spacing/size/specifications of poles/towers/lines/cables to be used in shifting work shall be as per the guidelines of Utility Owing Department and it is to be agreed solely between the Contractor and the Utility Owing Department. No change of scope shall be admissible, and no cost shall be paid for using different type/spacing/size/specifications in shifted work in comparison to those in the existing work or for making any overhead crossings to underground as per requirement of Utility Owing Department and/or/construction of project highway. The Contractor shall carry out joint inspection with Utility Owing Department and get the estimates from Utility Owing Department. The assistance of the Authority is limited to giving forwarding letter on the proposal of Contractor to Utility Owing Department whenever asked by the Contractor. The decision/approval of Utility Owing Department shall be binding on the Contractor.

b) The supervision charges at the rates/charges applicable of the Utility Owing Department shall be paid directly by the Authority to the Utility Owing Department as and when Contractor* furnishes demand of Utility Owning Department along with a copy of estimated cost given by the latter.

c) The dismantled materials/scrap of existing Utility to be shifted/dismantled shall belong to the Contractor who would be free to dispose-off the dismantled material as deemed fit by them unless the Contractor* is required to deposit the dismantled material to Utility Owing Department as per the norms and practice and, in that case the amount of credit for dismantled material may be availed by the Contractor as per the estimate agreed between them.

d) The utilities shall be handed over after shifting work is completed to Utility Owning Department up to their entire satisfaction. The maintenance liability shall rest with the Utility Owning Department after handing over process is complete as far as utility shifting works are concerned.

Note -II Copy of utility shifting plans enclosed as Annexure-II to Schedule B1.

Annexure-B-II

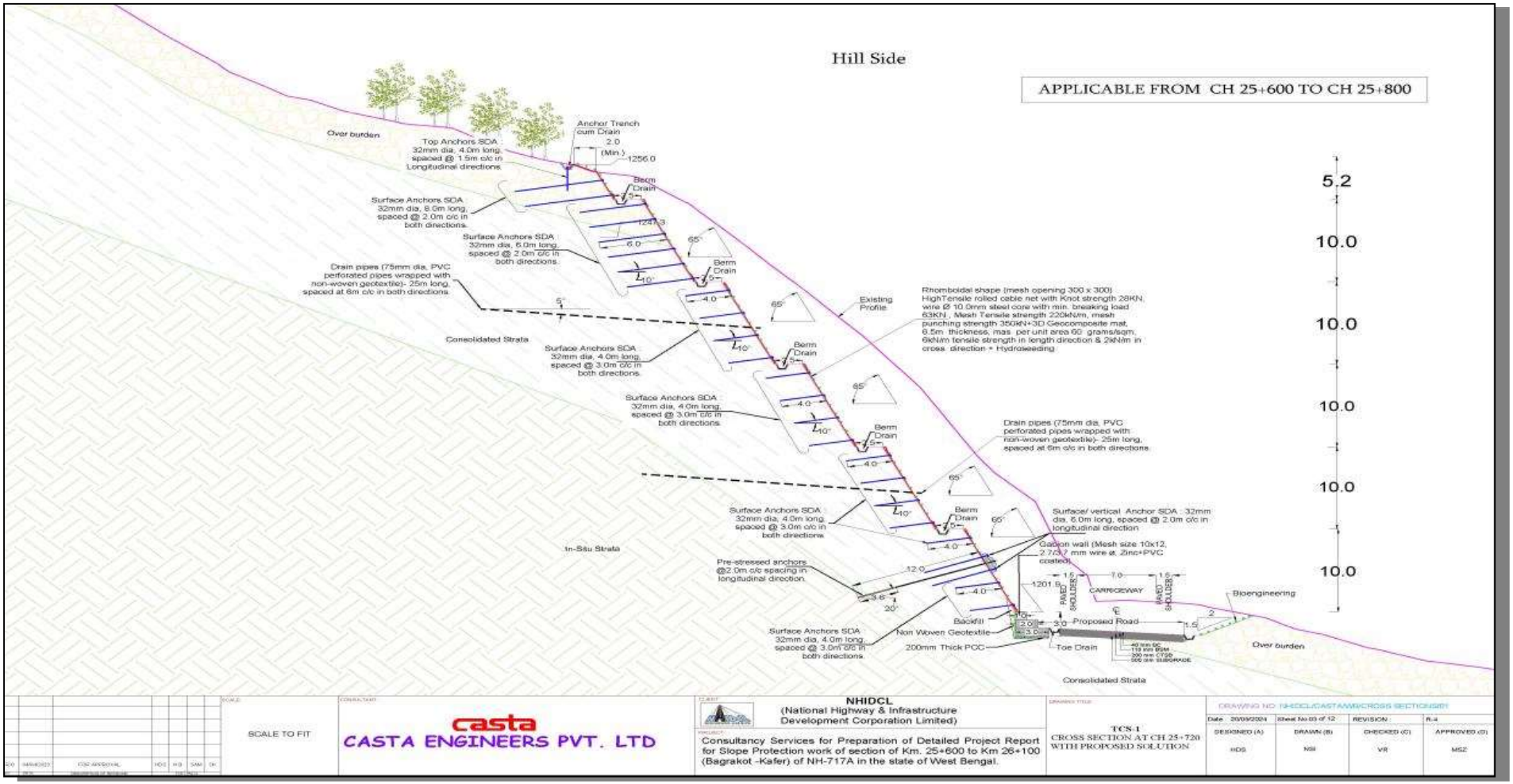
Schedule-B

Widening Scheme

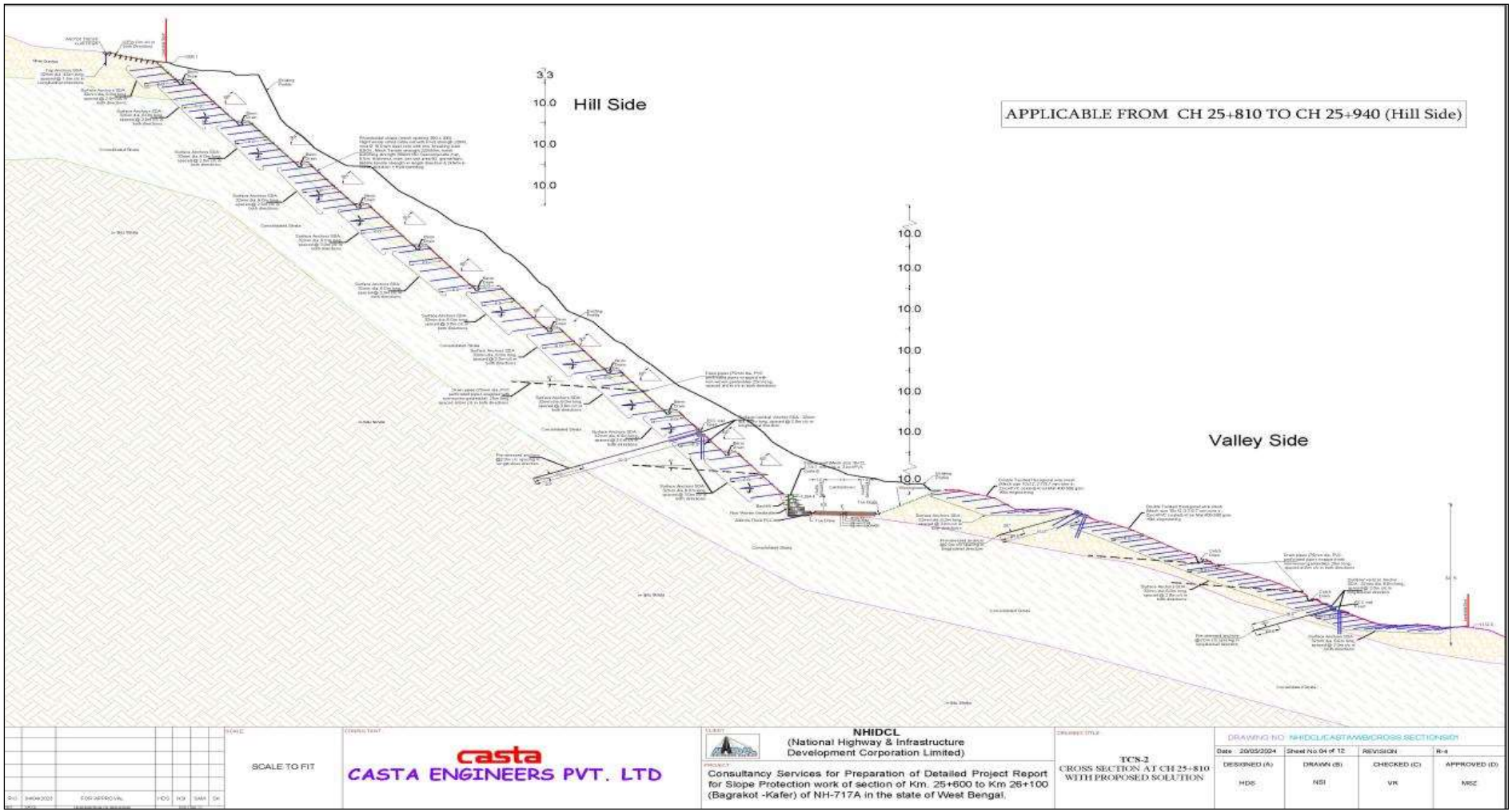
S. No	Chainage (Km)		Length (m)	TCS
	From	To		
1.	25+600	25+650	50.0	TCS 1
2.	25+650	25+700	50.0	TCS 1
3.	25+700	25+750	50.0	TCS 1
4.	25+750	25+800	50.0	TCS 1
5.	25+800	25+850	50.0	TCS 2,TCS 3 & TCS 4
6.	25+850	25+900	50.0	TCS 2,TCS 3 & TCS 4
7.	25+900	25+950	50.0	TCS 2 & TCS 4
8.	25+950	26+000	50.0	TCS 5
9.	26+000	26+050	50.0	TCS 5
10.	26+050	26+100	50.0	TCS 6

Applicable TCS as per Widening Scheme

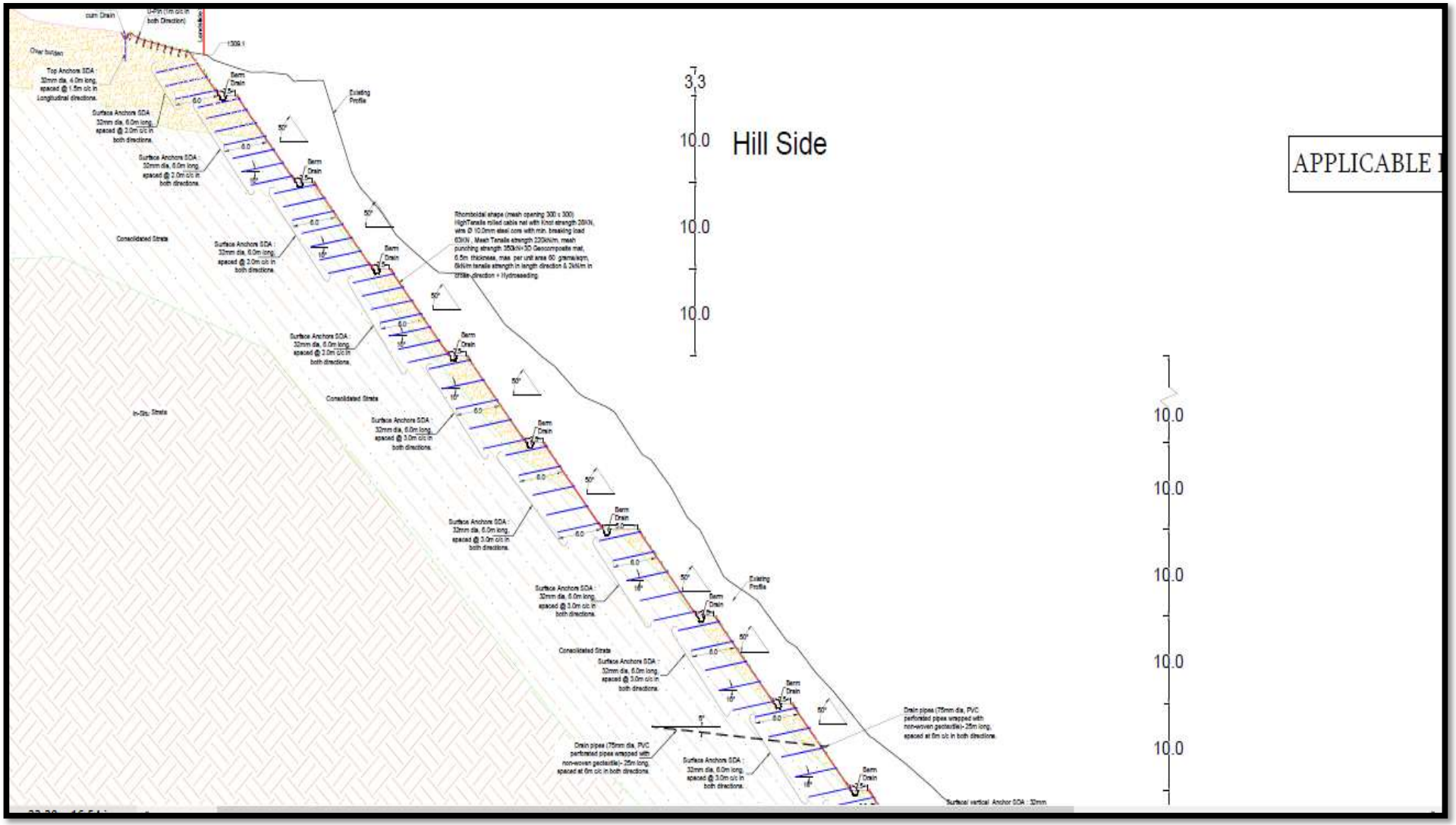
TCS-1 25+600-25+800 KM

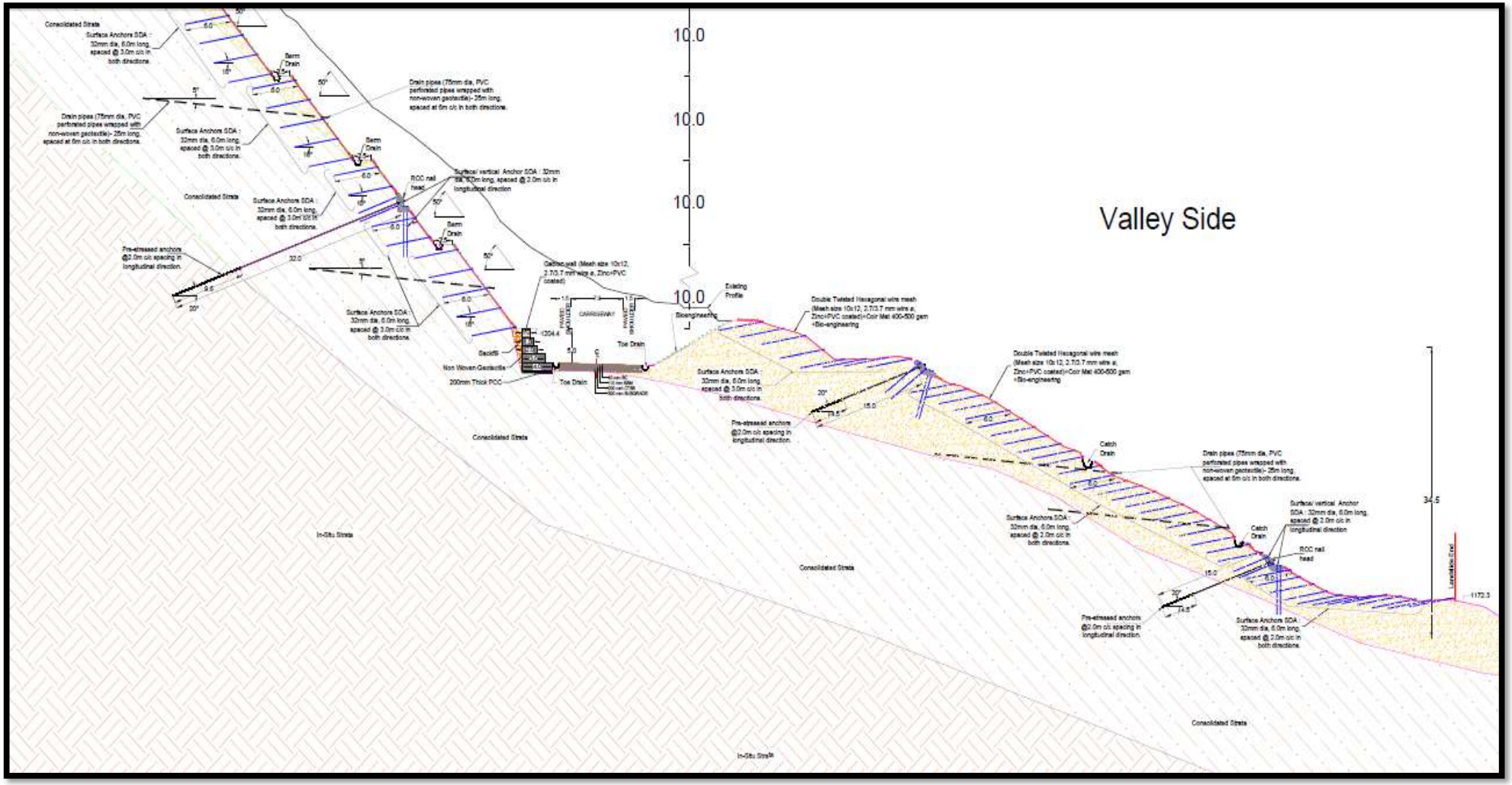


TCS-2 25+810-25+940 KM (Hill side)

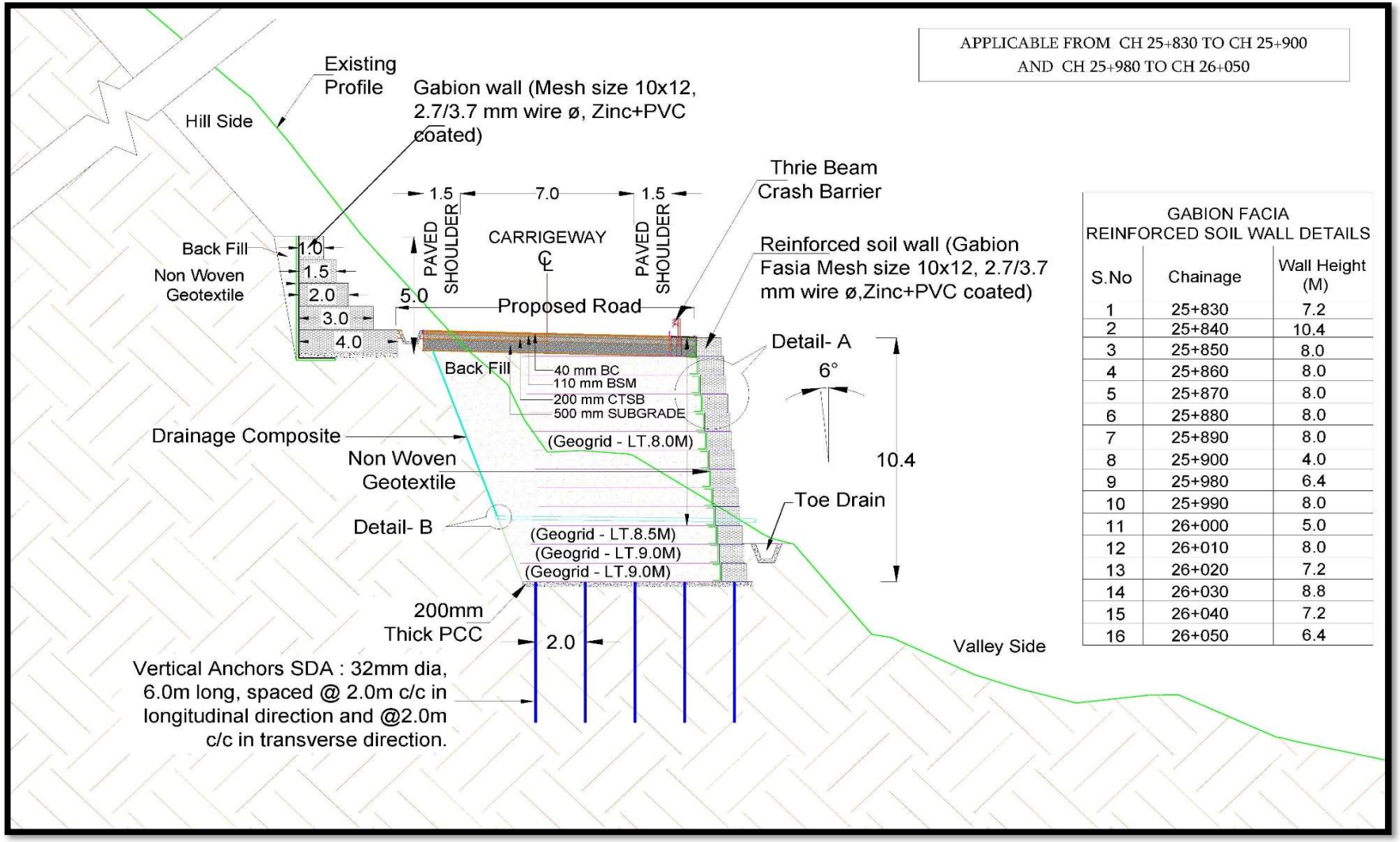


TCS-2 25+810-25+940 KM (Hill side) Part-1





TCS-2 25+810-25+940 KM (Hill side) Part-2

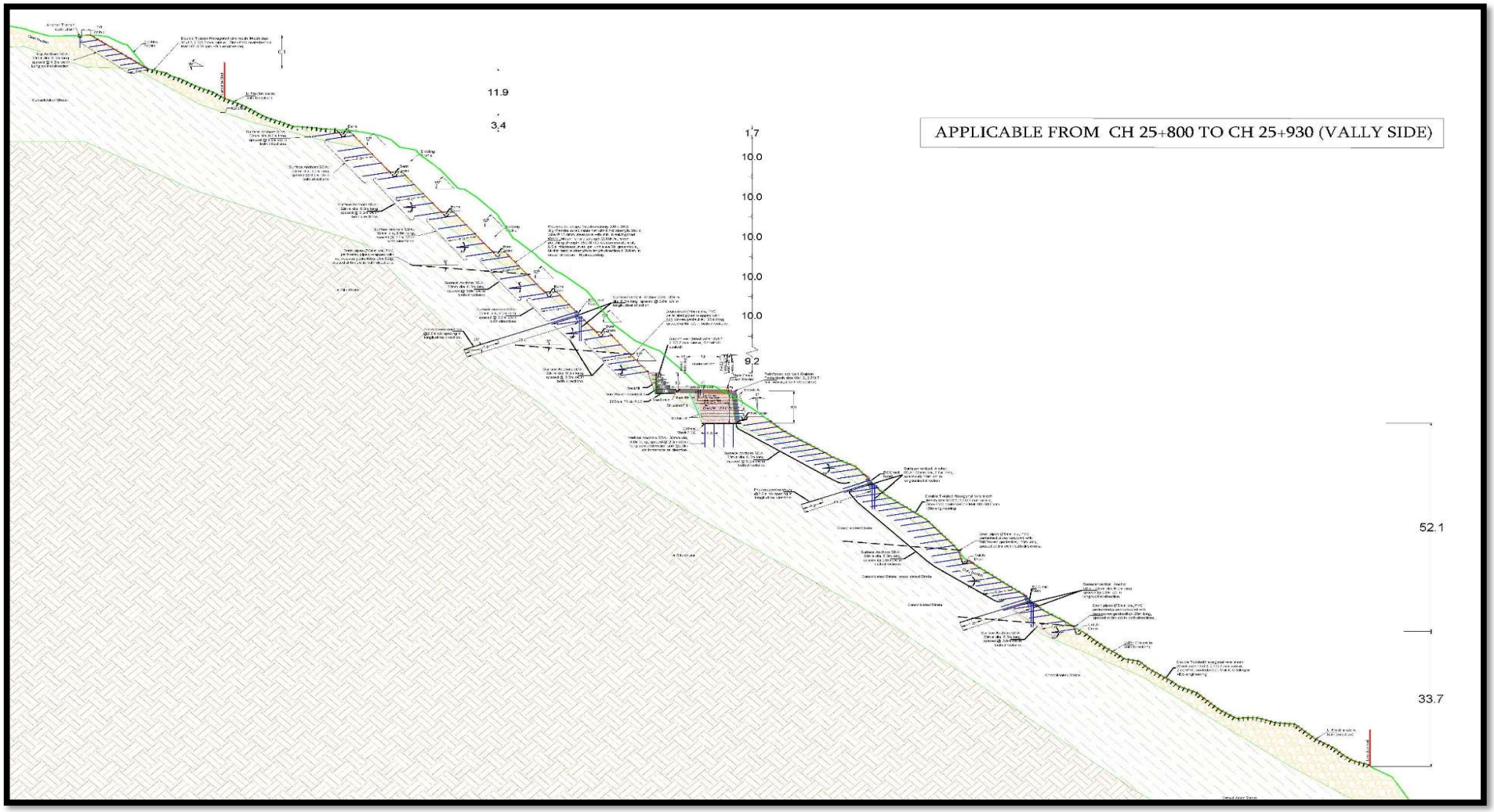


GABION FACIA
REINFORCED SOIL WALL DETAILS

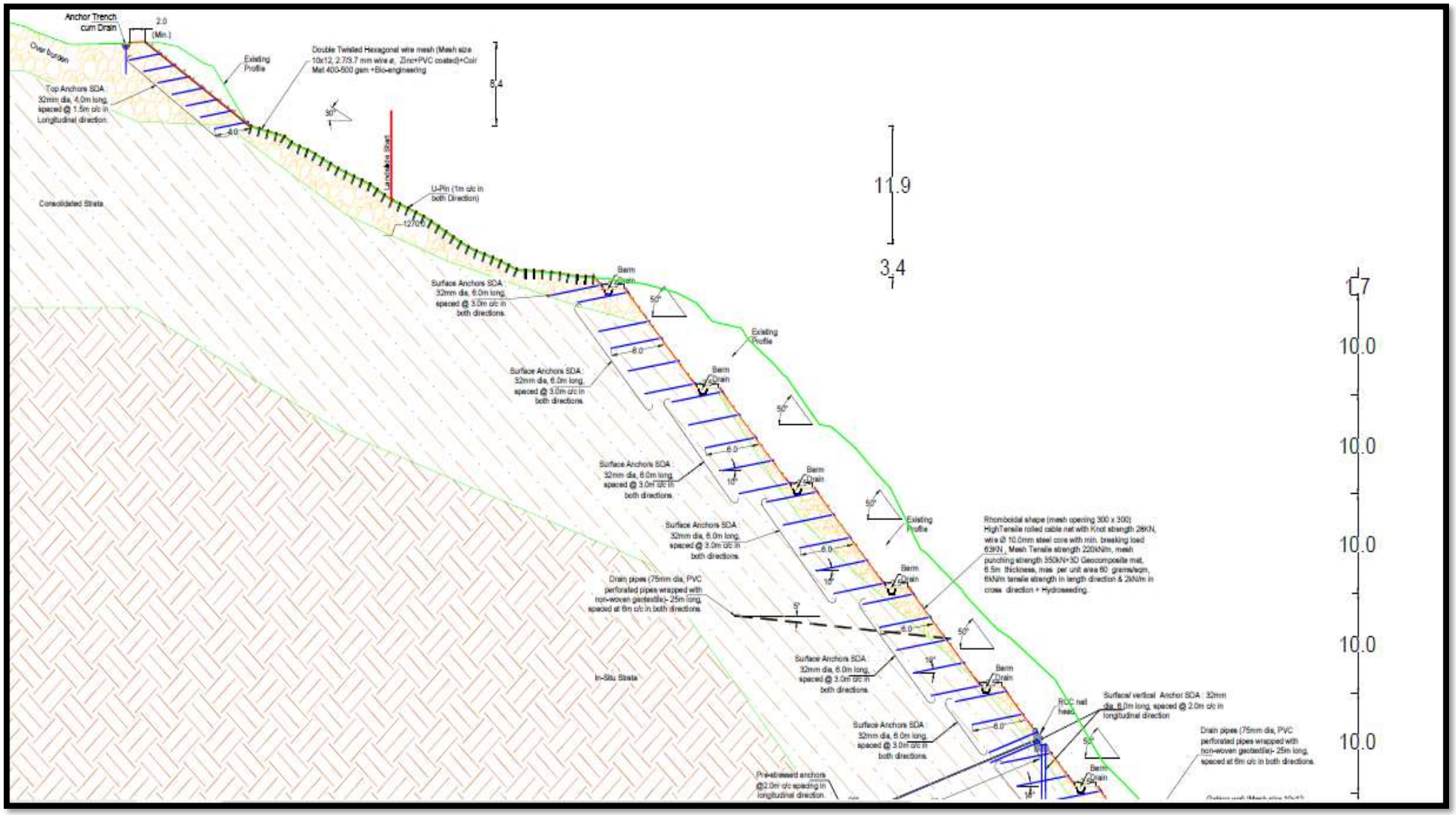
S.No	Chainage	Wall Height (M)
1	25+830	7.2
2	25+840	10.4
3	25+850	8.0
4	25+860	8.0
5	25+870	8.0
6	25+880	8.0
7	25+890	8.0
8	25+900	4.0
9	25+980	6.4
10	25+990	8.0
11	26+000	5.0
12	26+010	8.0
13	26+020	7.2
14	26+030	8.8
15	26+040	7.2
16	26+050	6.4

TCS-3 25+830-25+900 KM AND 25+980-26+050 KM (Reinforced Soil wall Valley side)

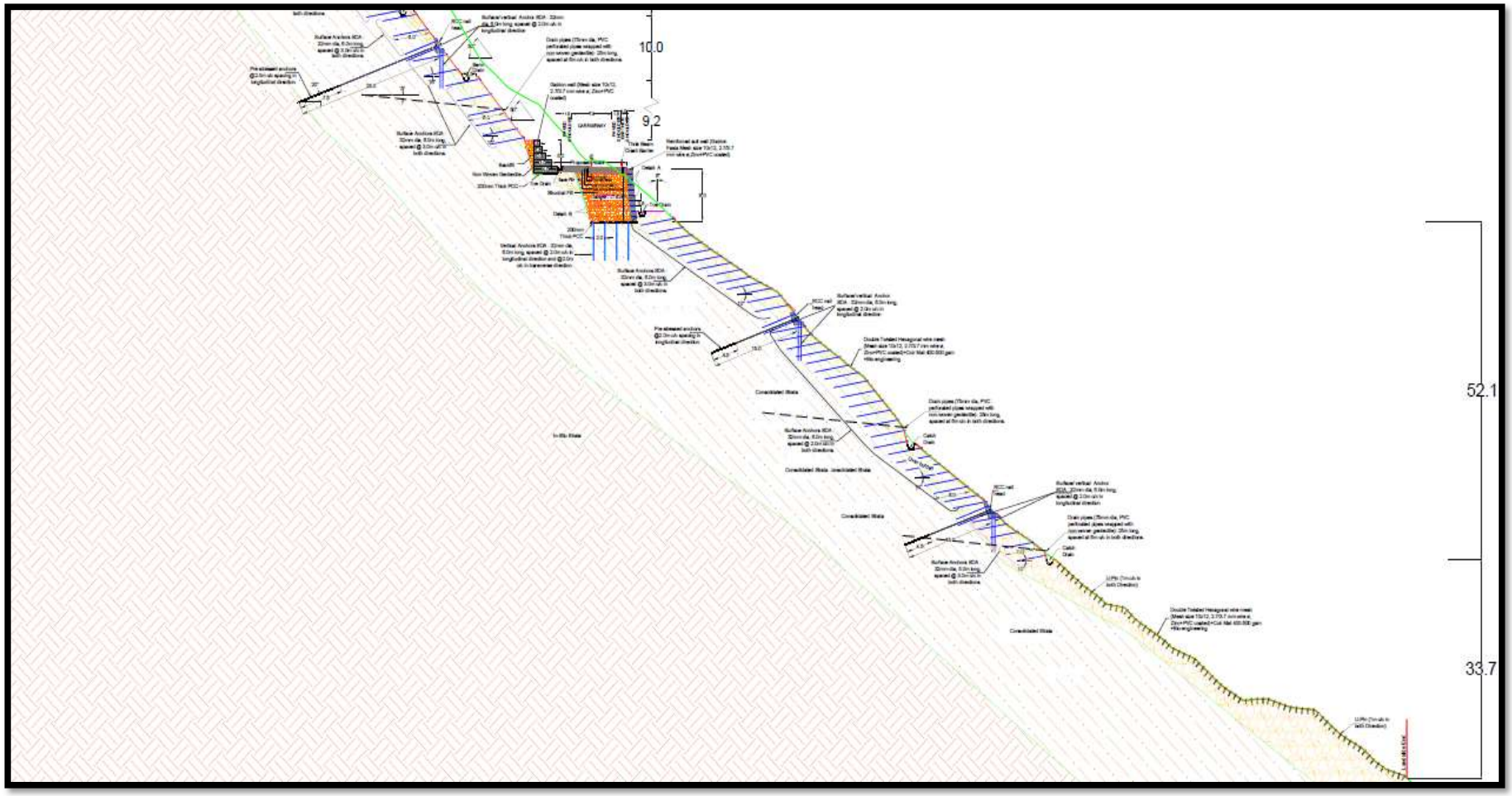
TCS-4 25+800-25+930 KM (Valley Side)



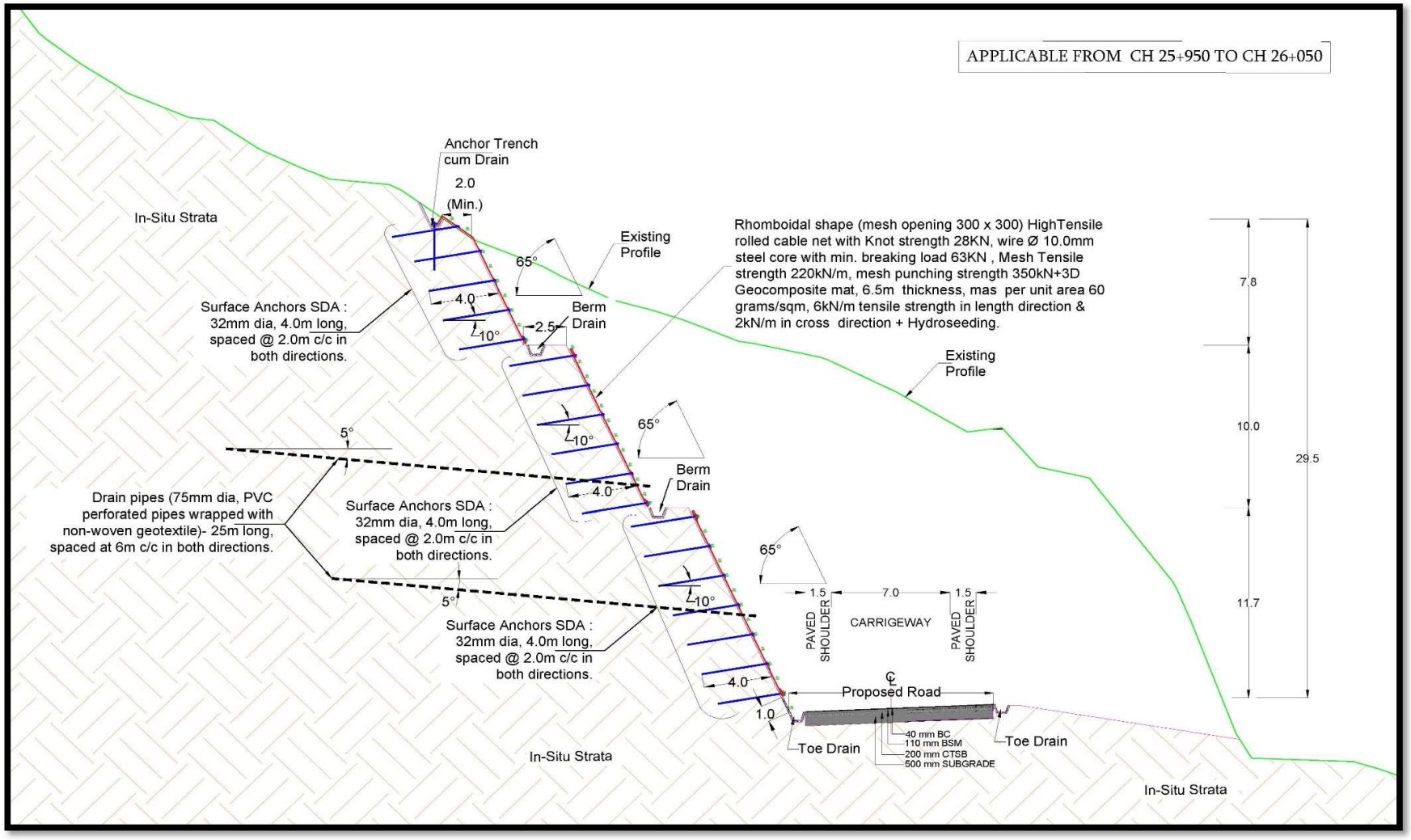
TCS-4 25+800-25+930 KM Part-1

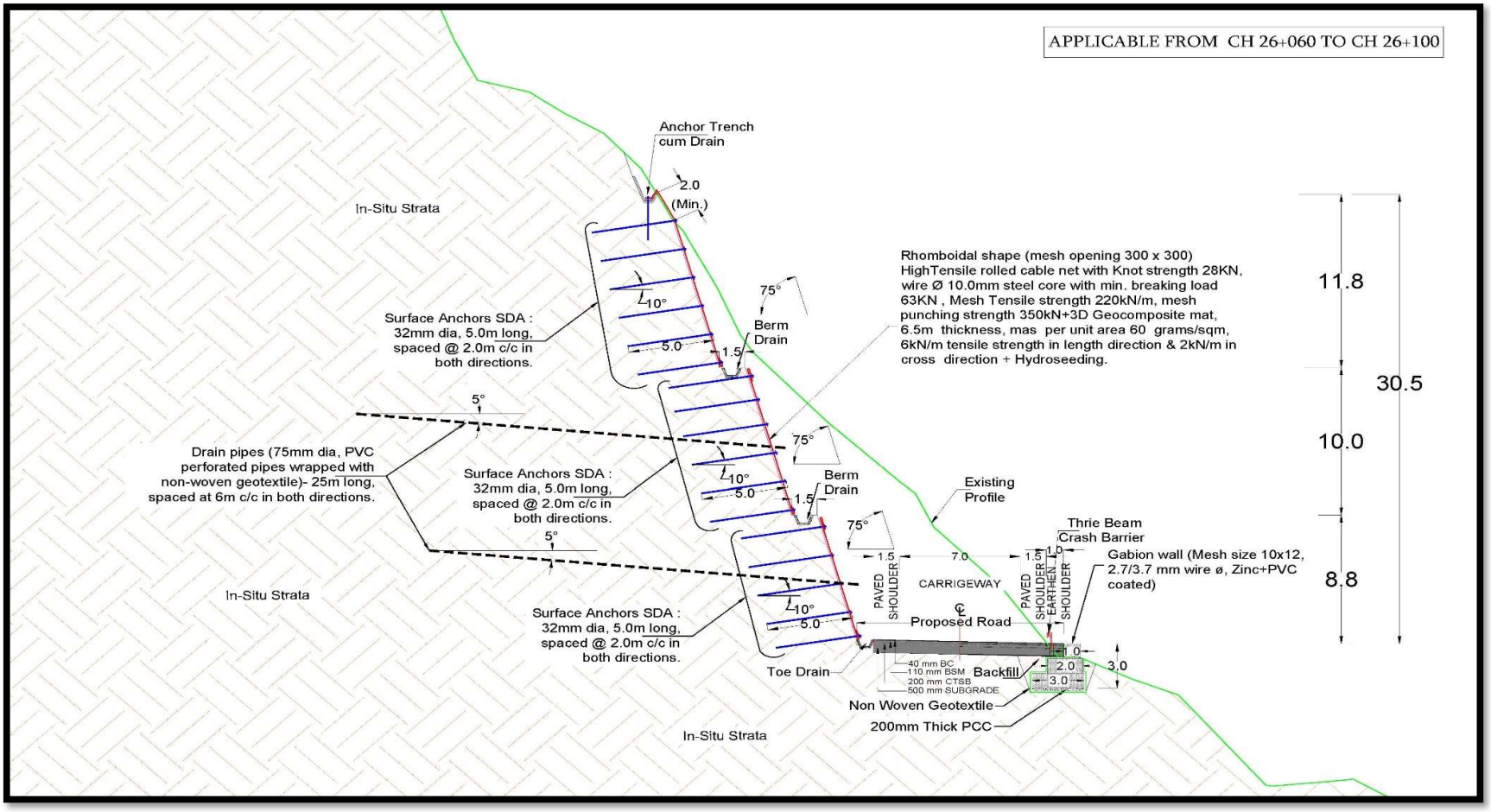


TCS-4 25+800-25+930 KM Part-2



TCS-5 25+950-26+050 KM





TCS-6 26+060-26+100 KM

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;~~

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: As described below.

2. Description of Project Facilities

Each of the Project Facilities is described below:

(a) **Roadside Furniture**

Roadside furniture shall be provided in accordance with the manual of specification & standards.

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 and Annex-I of this Schedule:

a). Manual of Specification and Standards for Two Laning of Highways with paved shoulder (IRC: SP: 73- 2018), referred to herein as the Manual for 2-lane project road.

b). IRC SP: 48 -2018 (Hill Road Manual): referred to herein as the Hill Road Manual

3. As regards, the work of utility shifting, the relevant specification, relevant rules, regulations and acts of Utility Owning Department/ Agencies shall be applicable.

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)], referred to as the Manual, and MORTH Specifications for Road and Bridge Works. In addition, provisions of relevant Codes, Standards, Specifications, Guidelines etc. of IRC, MoRTH, AASHTO, ASTM, Euro Codes and British Codes shall also be referred. Where the specification for a work is not given, Good Industry Practice shall be adopted to the satisfaction of the Authority's Engineer.

1.1 Design Standards

(i) Hill Road Manual IRC SP:48 : 2023

(ii) IRC- HRB- Special Report-23 -State of the Art: Design and Construction of Rock fall Mitigation systems.

(iii) IRC: SP: 42 – 2014, Guidelines of Road Drainage.

(iv) IRC SP: 116-2018 – Guidelines for Design and Installation of Gabion Structures.

(v) BS 8006-1:2010+A1:2016–Code of Practice for Strengthened /Reinforced Soil& other fills.

(vi) BS 8081:2015+A2:2018 – Code of Practice for Grouted Anchors.

(vii) FHWA-NHI-14-007 – Soil Nail Walls Reference Manual (FHWA GEC 007), 2015.

(viii) FHWA-IF-99-015 – Ground Anchors and Anchored System (GEC No. 4), 1999.

(ix) IS 16014:2018, Mechanically Woven, Double-Twisted, Hexagonal Wire Mesh Gabions, Revet Mattresses, Rock Fall Netting and Other Products for Civil Engineering Purposes (Galvanized Steel Wire or Galvanized Steel Wire with Polymer Coating) — Specification.

(x) IS 14268: 2017 - Uncoated Stress Relieved Low Relaxation Seven-Wire (Ply) Strand for Prestressed Concrete— Specification.

(xi) IS: 1893-1 (2016), —Criteria for Earthquake Resistant Design of Structure, Bureau of Indian Standards, and New Delhi.

(xii) Ministry of Road Transport and Highways (MORTH), —Specifications for Road and Bridges Works – Fifth Revision.

(xiii) Geological, geotechnical& Geophysical investigations as per IRC: 78, Specifications for drilling, coring testing etc. issued by ISI. BIS, MoRT&H and other relevant codes are applicable.

(xiv) Other Indian / International Standards applicable as per Good Industry Practice.

1.2 The following Specifications and Standards shall be applied in addition to 'MANUAL OF SPECIFICATIONS and STANDARDS FOR TWO LANING OF HIGHWAYS WITH PAVED SHOULDER' published as IRC: SP: 73, IRC SP: 48, Hill Road Manual.

S. No.	Item	Specification
1	High Tensile Steel Wire Mesh	1. Mesh Tensile Strength >= 200KN/m 2. Punch Resistance >= 420KN 3. Tearing Breaking force of Junction >= 18KN 4. Breaking Strength of Rope >= 63KN 5. ETA Certified 6. The coating shall confirm for medium aggressive environmental level (C3) Zinc Class A as per Annex-A of IS / ISO 17746. 7. Material test shall be in accordance with IS/ISO 17746: 2016 (Steel Wire Rope Net Panels and Rolls – Definition and Specification) or EAD 230025-00-0106 (Flexible Facing Systems for Slope Stabilization and Rock Protection).
2	Double Twisted Hexagonal Shaped Wire Mesh and Gabion Boxes	As per IS 16014:2018, Mechanically Woven, Double-Twisted, Hexagonal Wire Mesh Gabions, Revet Mattresses, Rock Fall Netting and Other Products for Civil Engineering Purposes (Galvanized Steel Wire or Galvanized Steel Wire with Polymer Coating) — Specification.
3	Geosynthetics Erosion Control Mat	Geosynthetics Erosion Control Mat shall satisfy requirement as per Table 700-13 of MORTH Specification
4	Self-Drilling Anchors (SDA)	(i) The diameter of SDA shall be 32 mm with a sacrificial drill bit of min.76mm dia. The SDA shall be CR40 grade with yield strength of min. 500/550 N/mm2 and yield load of min. 230kN. The SDA rod shall be continuously threaded. (ii) The grouting shall be done simultaneously through hollow bar during drilling operation using OPC Grade 43 & above with suitable admixtures.

1.3 The methodology for the construction works is attached as Annex-D1 which is to be followed by the Contractor. Any relaxation/modification in the methodology may be done with the prior approval of the Authority.

2. Deviations from the Specifications and Standards

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

(ii) 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:

S.N	Start	End	Length(m)	Radius(m)	Speed (Kmph)
	Design Chainage (Km)				
	25+600	25+677	76.574		40
	25+677	25+702	25.000		40
1	25+702	25+705	3.430	80	40
	25+705	25+730	25.000		40
	25+730	25+942	211.769		40
	25+942	25+962	20.000		40
2	25+962	25+962	0.412	100	40
	25+962	25+982	20.000		40
	25+982	26+047	64.949		40
	26+047	26+072	25.000		40
3	26+072	26+094	21.455	80	40

S. No	Clause referred In manual	Item	Provision as per Manual	Modified Provision
1	As per clause 2.2.1 & 2.9.4 of manual	General Geometric design and radii of horizontal curves	Ruling design speed for Hilly & Steep terrain is 60 Kmph corresponding to desirable minimum radius which is 150 m.	Absolute Minimum design speed of 40 kmph for Mountainous & Steep terrain with absolute minimum radius of 75 m for Mountainous & Steep terrain to be adopted, due to site constraints.

The following Policy circulars of MoRTH shall be also complied:

Sl. No.	Policy circular No.	Dated	Subject
1	Efile No. RW/NH-33044/55/2021-S&R(P&B)Pt./ Hill slope monitoring (Computer No. 219394)	28th November 2024	Expert Committee Report on Cost Effective Long Term Remedial Measures for landslide prone areas in hilly regions.
2	Efile no. RW/NH-35072/05/2018-S&R(P&B) (Computer No. 165688)	19th April 2024	Recommended Bitumen type & grade for different climate &traffic loading for National Highway and Expressway works in India
3	Efile No. RW/NH-35072/05/2018-S&R(P&B) (E165688)	23rd August 2023	Use of Bitumen: Demand Supply, Type & grade, specifications, source of procurement and quality in construction of National Highway Projects
4	Efile No. RW/NH-36098/25/2022-S&R (P&)/Pt.	16th March 2023	Safety in road construction zone in National Highway Projects – effective and adequate measures to be taken

TECHNICAL SPECIFICATION FOR PROCUREMENT OF REINFORCED FILL / SELECTED FILL (REINFORCED SOIL WALL AND SLOPES)

GENERAL

This work comprises procurement of Reinforced/ Selected fill conforming to the material specifications stated herein, as per the bill of quantity and schedule of supplies enclosed.

2.0 MATERIALS

2.1 General Requirements

The soil fill extending from the facing to the end of the reinforcing element is referred to as 'reinforced fill' or 'selected fill'. The fill material for Mechanically Stabilized Earth Structures shall have an angle of interface friction between the compacted fill and the reinforcing element of not less than 300, measured in accordance with IS: 13326(Part 1). The soil should be predominantly coarse grained; not more than 15% of the particles shall pass 75 micron sieve. The soil shall not contain salts that can have adverse effect, chemically or electrically, on the reinforcing elements. Back fill materials used in the Mechanically Stabilized Earth retaining structure shall be free from organic or otherwise deleterious materials and shall confirm to the following requirements:

2.2 Quality Control & testing

The collected soil shall be tested for physical and mechanical properties by a third-party lab for the parameters defined as per RDSO/2014/GE:G-18. The laboratory shall be NABL Accredited Laboratory for soil and rock testing in accordance with ISO/IEC 17025:2017.

Supplied material shall witness at the NABL Accreditation laboratory by collecting samples from the site to conduct joint tests with the department, client, and contractor's officials.

The contractor shall furnish proof of all the above and it is mandatory.

2.3 Physical and Mechanical Properties

The Physical and Mechanical properties of Reinforced Fill shall conform as per below:

2.3.1Gradation Criteria

Sieve Size	% Passing
150mm	100%
50mm	More than 75%

75 micron	Less than 15%

Coefficient of Uniformity, Cu shall be >=5

Following materials with more than 15% passing 75-micron sieve can also be allowed as fill material;

a) having particles smaller than 15 microns less than 10%

b) having an angle of internal friction ≥ 30 and particles smaller than 15 microns do not exceed 20%.

c) Plasticity Index (PI) < 6

2.3.2 Electrochemical Properties of fill soil

Below are the electrochemical properties required based on the type of reinforcement selected

Table 1: Special condition for use of PET/PVA reinforcement

Type of Reinforcement	Electrochemical characteristics
	pH
Polyester (PET)	3 to 9
PVA	2 to 12

Table 2: Special condition for use of metallic reinforcement

Environment	Electrochemical characteristics		
	pH	Resistivity (Ohm.cm)	Maximum salt contents (ppm)

Out of water	5 TO 10	> 1000	5 [Cl-] + [SO4--] < 1000
Fresh Water	5 TO 10	> 3000	5 [Cl-] + [SO4--] < 500

Both the conditions as per Table-1 and Table-2 shall be complied if PET /PVA reinforcement along with steel connector system is adopted.

3.0 PLACING AND COMPACTING BACKFILL, REINFORCED FILL MATERIAL

The backfill, reinforced fill material shall be placed in layers as per specification by end dumping after placement of filter media/ as per drawings.

Backfill shall be compacted by baby roller and or mechanical compacter of weight < 0.6 MT in layers to achieve good compaction up to 2m behind the fascia. Heavyweight Static of Vibratory Roller not allowed in 2-meter width stretch from the wall line/ fascia.

Movement of construction equipment directly over the backfill, reinforced fill material beyond 2 m line from the fascia shall not be permitted to prevent disturbance in alignment of fascia.

Sudden breaking and sharp turning of construction equipment shall be avoided over 2 m line from the fascia.

TENDER SPECIFICATION FOR SUPPLY OF UNIAXIAL GEOGRID (FOR REINFORCED SOIL WALL & SLOPE APPLICATION)

1.0 GENERAL

This work comprises supply of Knitted & Coated Polyester Uniaxial Geogrid as Reinforced Soil Slope (RSS) and Reinforced Soil Wall (RSW) conforming to the material specifications stated herein, as per the bill of quantity and schedule of supplies enclosed.

2.0 MATERIALS

General Requirements

The Geogrid should be manufactured from high tenacity polyester filament yarns with molecular weight ≥25000 g/mol when measured in accordance with GRI-GG8 / ASTM D4603 and carboxyl end groups ≤ 30 mmol/Kg when measured in accordance with GRI GG7 / ASTM D2455.

The yarns shall be formed into a dimensionally stable grid structure with uniform square or rectangular apertures using a weft insertion warp knitting process (woven type Geogrids, extruded type Geogrids, welded type Geogrids will not be permitted and not accepted).

The Geogrid shall have a durable coating to protect the yarns from mechanical damage and adverse environmental effects (The coating can be manufacturer specific and the geogrid shall be tested for Installation damage).

The Geogrid shall be resistant to the chemicals and microorganisms normally found in soils and shall be stabilized against short-term exposure to solar radiation

Indigenously manufactured Geogrids should be preferred, considering advantages of shorter delivery periods, no inventory pile-up and rates being not affected by fluctuation of exchange rate of foreign currency.

A plant visit by the Engineer's representative to verify the manufacturer's quality control procedures and witness testing of products is also required prior to the dispatch of material.

3.0 Transportation, Storage and Handling

All rolls shall have a protective cover with a label or tag specifying name of the product, name of the manufacturer, roll number, date of manufacture and roll dimension.

Material shall be protected from sunlight, mud, dirt, debris, any other harmful substances or mechanical damage during transportation.

Rolls shall be stored in a secured area sufficiently elevated above the ground and adequately covered to protect them from the following: site construction damage, precipitation, prolonged exposure to ultraviolet radiation including sunlight, chemicals that are strong acids or strong bases, flames including welding sparks, high temperatures, and any other environmental conditions that may damage the physical property values of the Geogrid.

Any material, which is damaged during transportation, handling or storage and do not meet the minimum requirements of the specifications is liable for rejection by the Engineer.

4.0 Quality Control & testing

The manufacturer of geogrids, for use as reinforcing element shall fulfil the following requirements:

- Shall have ISO (ISO-9001) and BBA/CE Certification for manufacturing process and quality control respectively. The manufacturer shall have BIS license for the geogrid products

- The product shall have certification for use as soil reinforcing material from an agency accredited for certifying geosynthetic reinforcement products.

The manufacturer shall provide test reports from an independent laboratory with valid accreditation, for all the tests needed to establish all the reduction factors listed below

RFCR - Reduction factor for creep.

RFID - Reduction factor for installation damage

RFW - Reduction factor for weathering

RFCH - Reduction factor for chemical/ environmental effects.

fs - Factor for the extrapolation of data

All the above factors shall be determined in accordance with the provisions of ISO/TR 20432- "Guide to the determination of long-term strength of geosynthetics for soil reinforcement."

Test for the ultimate tensile strength shall be carried out on a random sample for each grade of reinforcement as per ISO-10319/ASTM D6637. The manufacturer shall also provide the results of ultimate tensile strength for each lot and all grades of reinforcement proposed for use in the project.

Interaction Parameters:

i. Pull-out coefficient as per ASTM D 6706 "Standard Test Method for Measuring Geosynthetic Pullout Resistance in Soil" and

ii. Coefficient of interaction between reinforced fill soil and geogrids as per ASTM D 5321- "Standard Test method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear method" or as per IS: 13326: Part 1-1992 "Method of test for the evaluation of interface friction between geosynthetics and soil: Part 1 Modified direct shear technique" for all types of geogrids.

iii. Manufacturer shall issue a test report stating minimum average roll values of material properties, at the time of shipment is made.

iv. Default values for reduction factor for creep shall not be allowed.

v. Manufacturer shall submit the proof of supply and satisfactory performance for the quantity of 10000 Sqmt at least, for projects in India.

5.0 Physical and Mechanical Properties

The Mechanical properties of knitted and coated uniaxial geogrid shall conform to Table-1 below:

Table-1

Property		Test Method	Unit	UG 40	UG 60	UG 80	UG 100	UG 120	UG 150	UG 200	UG 250	UG 300	UG 350	UG 400
Ultimate tensile strength[1]	MD	ASTM D 6637	kN/ m	40	60	80	100	120	150	200	250	300	350	400
	CD			20	20	30	30	30	30	30	30	30	30	30
Reduction Factors (RF) and factor of safety (fs) for calculation of MD Long-term Design Strength (LTDS)														
Creep (RFCR) -120 years design life at 30° C temperature				1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52
Installation damage (RFID)	Sand/silt/clay			1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
	Coarse gravel (37.5 mm)			1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14
Durability (RFCH), 120 years design life, pH = 5 to 8				1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
Weathering (RFW)	To be covered in 1 day			1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LTDS – 120 years: Sand/silt/clay pH -4-9 kN/006D				22.4	33.7	44.9	56.1	67.3	84.1	112.2	140.2	168.3	196.3	224.3
LTDS – 120 years: Gravel < 37.5 pH -4-9kN/m				**20.1**	**30.1**	**40.1**	**50.2**	**60.2**	**75.3**	**100.4**	**125.5**	**150.5**	**175.6**	**200.7**
Physical properties														

Aperture size (Tolerance± 3 mm)	mm	50x25	50x25	50x25	30x23	30x23	30x23	30x23	30x22	30x20	30x20	30x18
Roll dimensions												
Roll length	m	100			100							
Roll width	m	5.0			5.1/5.9							

[1] Minimum average roll value (Minimum refers to 95 % confidence limit.) MD – Machine Direction CD – Cross Direction.

6.0 INSTALLATION

Site Preparation

Site shall be prepared as per the approved design and drawing for the application such as Reinforced Soil Wall and Slope.

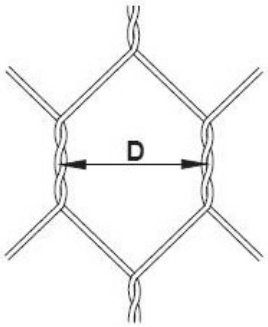
7.0 Placement of Geogrid

Laying of Geogrid shall be carried out as per the approved drawing and strictly under the supervision of the Engineer-In Charge. The geogrid shall be laid smooth without wrinkles or folds on the prepared surface, as per the approved method statement. Laying of Geogrid for these applications are carried out in such a manner that the machine direction of geogrid shall be perpendicular to wall / slope face (Higher tensile strength direction perpendicular to wall and slope facing

TECHNICAL SPECIFICATION OF GABION FACING FOR REINFORCED SOIL STRUCTURES

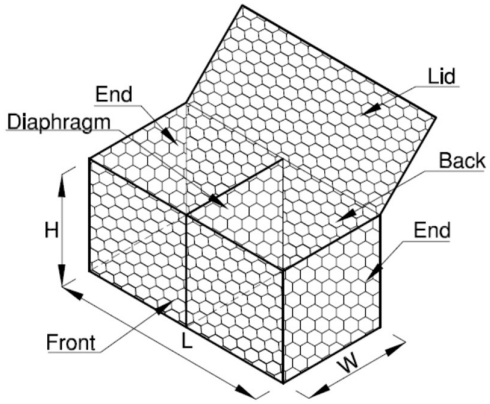
Material:

CE marked Metal Wire Mesh product comprised doubled twisted hexagonally woven hot dipped galvanized mild steel wire of diameter not less than 2.7 mm having minimum Tensile Strength 350 N/mm^2 confirming to IS:280 and or EN 10223-3. The Zinc Galvanization shall be heavy coating for soft condition confirming to IS: 4826 and or EN 10244-2. For corrosive environment, an additional PVC coating of 0.5 mm thickness shall be provided over the Zinc Galvanization. The mesh of the Box shall be of type 8 x 10 and 6 x 8 cm for Metal Gabion respectively as per EN-10223. Mesh shall be doubled twisted at each intersection and shall be mechanically selvedge along the edge of the boxes. The boxes standard sizes shall be as per ASTM A 975. The box shall be divided into compartments by diaphragms placed at 1 m centre to centre.



'D' (mm)=60/80 mm (EN 10223-3 / ASTM A 975

Fig-1



METAL GABION BOX

Fig-2

Following is the filling sequence of Gabion units

Gabion boxes and Mattresses shall be placed in position on the prepared foundation as per designed cross-section with process of unfolding the gabion by bundles, folding them as per size to prepare a box with fastening edges by lacing wire. Adjacent boxes shall be tie with lacing wire on each side. Prior to filling the stones connector arrangement shall be done.

The Metal Gabion shall be filled by carefully hand packing the trap stones size 15-20 cm and or 20-50 Kg in weight as tightly as possible and not by

merely throwing of trap stones. Voids shall be filled by proper hand packing with rubble chips.

All gabions shall be overfilled by 25mm using flat stone to allow for minor settlement and to provide a level surface for subsequent layers.

After filling the Gabion Box up to top; the lid shall stretch and closed tying by lacing wire to the front and side panels of the Gabion Box. The gabion boxes shall be then inspected and backfilling shall be done.

Technical Specifications:

1) **Mesh and Box Characteristics of Metal Gabion:** (IS 16014: 2018, Clauses 5.5, 8.1, 8.2, 8.9 & 12.4)

Mesh Types and Shapes shall confirm to Table:1

Table: 1

MESH TYPE (cm)	'D' NOMINAL SIZE (mm)	TOLERANCES
8 x 10	80	+16% to -4%
6 x 8	60	

Mesh and Box Characteristics of Gabion and Mattresses:

MESH TYPE (cm)	8 x 10	6 x 8
'D' mm	80	60
WIRE TYPE	ZINC + PVC COATED	ZINC + PVC COATED
Mesh Wire Dia., mm	2.70/3.70*	2.20/3.20*
Edge/Selvedge Wire Dia., mm	3.40/4.40*	2.70/3.70*
Lacing Wire Dia., mm	2.20/3.20*	2.20/3.20*

PVC Coating thickness, mm	Nominal-0.50 Minimum-0.38	Nominal-0.50 Minimum-0.38
Typical Sizes, meter Length x Width x Height/ Number of Diaphragms	4x1x1/3 Nos., 3x1x1/2 Nos., 2x1x1/1 No., 1.5x1x1/0 No., 4x1x0.5/3 Nos., 3x1x0.5/2 Nos., 2x1x0.5/1 No., 4x1x0.3/3 Nos., 3x1x0.3/2 Nos., 2x1x0.3/1 No.,	
Tolerances in Size of Gabion Boxes	Length & Width= ±5%, Height >0.3m= ±5%, Height <0.3m= ±10%	

*Internal Diameter/External Diameter of PVC coating wire (ID/OD)

Only standard sizes of Gabion Boxes are indicated in the table above. Special sizes can also be ordered as agreed between the purchaser and manufacturer.

2) Geogrid (Clause 3103.7.2 of MoRTH)

1) The manufacturer of geogrids, for use as reinforcing element shall fulfil the following requirements:

   a) Shall have ISO (ISO-9001) or CE Certification for manufacturing process and quality control, and

   b) The product shall have certification for use as soil reinforcing material from an agency accredited for certifying geosynthetic reinforcement products.

2) The manufacturer shall provide test reports from an independent laboratory with valid accreditation, for all the tests needed to establish all the reduction factors listed below

   RFCR - Reduction factor for creep.

   RFID - Reduction factor for installation damage

   RFW - Reduction factor for weathering

   RFCH - Reduction factor for chemical/ environmental effects.

   fs - Factor for the extrapolation of data

   All the above factors shall be determined in accordance with the provisions of ISO/TR 20432- "Guide to the determination of long-term strength of geosynthetics for soil reinforcement."

3) Test for the ultimate tensile strength shall be carried out on a random sample for each grade of reinforcement as per ISO-10319. The manufacturer shall also provide the results of ultimate tensile strength for each lot and all grades of reinforcement proposed for use in the project.

4) Interaction Parameters:

   a) Pull-out coefficient as per ASTM D 6706 "Standard Test Method for Measuring Geosynthetic Pullout Resistance in Soil" and

   b) Coefficient of interaction between reinforced fill soil and geogrids as per ASTM D 5321- "Standard Test method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear method" or as per IS: 13326: Part 1-1992 "Method of test for the evaluation of interface friction between geosynthetics and soil: Part 1 Modified direct shear technique" for all types of geogrids.

5) One set per project of all the above tests shall be conducted at third party accredited laboratory or at a reputed institute.

3) Connection system between Gabion and Geogrid

- Active type of connection shall be used to connect the gabion and Geogrid units. Refer Figure below.
- Such type of geogrid to rod connection system are preferable for Reinforced Soil Structures in high seismic zones.
- The connection system shall be checked (at reputable institutions like IIT etc.,) and the test results shall be furnished before commencement of works.

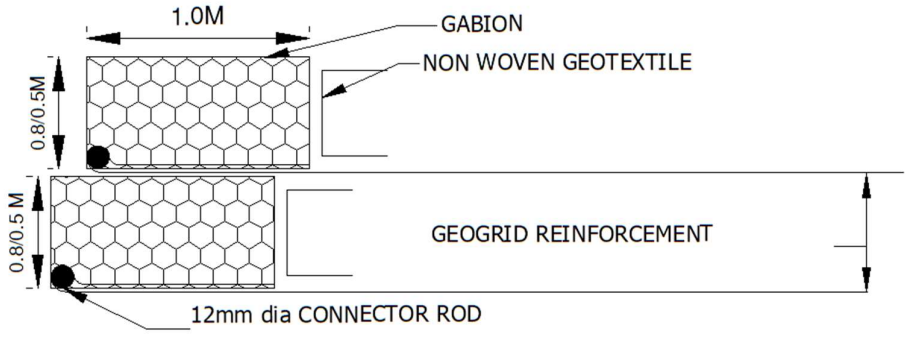


Figure 3: Reinforced Soil Structure Connection system

TENDER SPECIFICATION FOR SUPPLY OF METAL GABION

1.0 GENERAL

This work comprises supply of Metal Gabion (Zinc + PVC Coated) conforming to the material specifications stated herein, as per the bill of quantity and schedule of supplies enclosed.

2.0 MATERIALS

2.1 General Requirements

CE marked Metal Wire Mesh product comprised doubled twisted hexagonally woven hot dipped galvanized mild steel wire of diameter not less than 2.7 mm having minimum Tensile Strength 350 N/mm^2 confirming to IS:280 and or EN 10223-3. The Zinc Galvanization shall be heavy coating for soft condition confirming to IS: 4826 and or EN 10244-2. For corrosive environment, an additional PVC coating of 0.5 mm thickness shall be provided over the Zinc Galvanization. The mesh of the Box shall be of type 8 x 10 for Metal Gabion as per EN-10223. Mesh shall be doubled twisted at each intersection and shall be mechanically selvedge along the edge of the boxes. The boxes standard sizes shall be as per ASTM A 975. The box shall be divided into compartments by diaphragms placed at 1 m centre to centre.

Indigenously manufactured Metal Gabion should be preferred, considering advantages of shorter delivery periods, no inventory pile-up and rates being not affected by fluctuation of exchange rate of foreign currency.

A plant visit by the Engineer's representative to verify the manufacturer's quality control procedures and witness testing of products is also required prior to the dispatch of material.

2.2 Transportation, Storage and Handling

Metal Gabion shall deliver at site in the form of bundles. All bundles shall have a label or tag specifying name of the product, name of the manufacturer, quantity of boxes, date of manufacture and box dimension.

Material shall be protected from mud, dirt, debris, any other harmful substances or mechanical damage during transportation.

Boxes shall be stored in a secured area sufficiently elevated above the ground and adequately covered to protect them from the following: site construction damage, precipitation, prolonged exposure like chemicals that are strong acids or strong bases, flames including welding sparks, high

temperatures, and any other environmental conditions that may damage the physical property values of the Metal Gabion.

Any material, which is damaged during transportation, handling or storage and do not meet the minimum requirements of the specifications is liable for rejection by the Engineer.

2.3 Quality Control & testing

The quality management system of the manufacturer shall conform to the requirements of ISO 9001:2008 and In-house Laboratory should have certificate of NABL Accreditation ISO/IEC 17025:2005.

Manufacturer shall issue a test report stating minimum average values of material properties, at the time of shipment is made.

Manufacturer shall have in-house PVC coating manufacturing, coating and testing facilities as per IS:4826/EN 10245-2 of specific gravity, hardness, tensile strength and elongation.

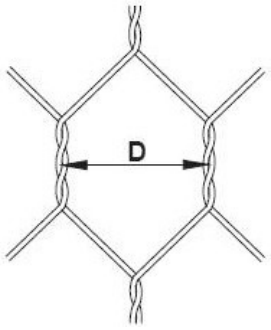
The contractor shall have to give a certificate / (MOU) from the manufacturer regarding Design support, Vetting of Design, Supply sufficient quantity of Double Twisted Wire Mesh Gabion and Technical Assistance during Execution to the contractor for this project.

Supplied material shall witness at manufacturer's NABL Accreditation laboratory by collecting sample from site to conduct joint tests with the department, client and contractor's officials.

Contractor shall furnish proof of all above and it is mandatory.

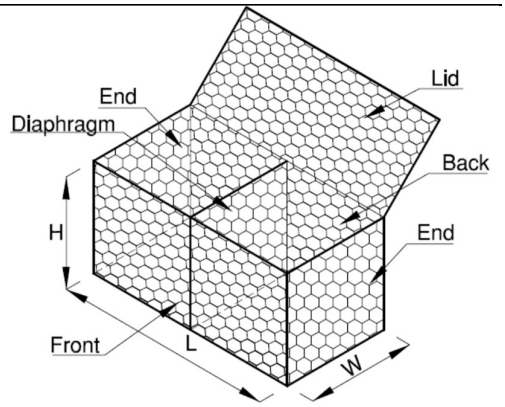
2.4 Physical and Mechanical Properties

The Physical and Mechanical properties of Metal Gabion shall conform as per below:



'D' (mm)=60/80 mm (EN 10223-3 / ASTM A 975

Fig-1



METAL GABION BOX

Fig-2

Mesh and Box Characteristics of Metal Gabion:

Mesh Types and Shapes shall confirm to Table:1

Table: 1

MESH TYPE (cm)	'D' NOMINAL SIZE (mm)	TOLERANCES
8 X 10	80	+16% to -4%

Mesh and Box Characteristics of Gabion:

MESH TYPE (cm)	8 x 10
'D' mm	80
WIRE TYPE	ZINC + PVC COATED
Mesh Wire Dia., mm	2.70/3.70*
Edge/Selvedge Wire Dia., mm	3.40/4.40*

Lacing Wire Dia., mm	2.20/3.20*
PVC Coating thickness, mm	Nominal-0.50 Minimum-0.38
Typical Sizes, meter Length x Width x Height/ Number of Diaphragms	4x1x1/3 Nos., 3x1x1/2 Nos., 2x1x1/1 No., 1.5x1x1/0 No., 4x1x0.5/3 Nos., 3x1x0.5/2 Nos., 2x1x0.5/1 No., 4x1x0.3/3 Nos., 3x1x0.3/2 Nos., 2x1x0.3/1 No.,
Tolerances in Size of Gabion Boxes	Length & Width= ±5%, Height >0.3m= ±5%, Height <0.3m= ±10%

Internal Diameter/External Diameter of PVC coating wire (ID/OD)

Only standard sizes of Gabion Boxes are indicated in the table above. Special sizes can also be ordered as agreed between the purchaser and manufacturer.

Permitted Tolerances on Galvanized Steel Wire Diameters:

NOMINAL DIAMETER OF GALVANIZED WIRE, mm	PERMITTED TOLERANCES (±) ON WIRE DIAMETERS, mm
2.70	0.07
3.40	0.09
2.20	0.06

Mass of Zinc Coating: The coating weight shall conform to the requirements of IS:4826 heavily coated and soft type.

NOMINAL DIAMETER OF GALVANIZED WIRE, mm	MASS OF ZINC COATING g/m²
2.70	**245**

3.40	**265**
2.20	**230**

The Zinc Coating shall remain adherent to the steel wire and conform to IS:4826 such that Zinc Coating does not flake off, nor crack to such an extent that there is possibility of removing any Zinc by rubbing with bare fingers, the use of finger nails being not allowed.

3 TERMINOLOGY OF METAL GABION

3.1 **Double Twisted Wire Mesh:** A non-raveling mesh made by twisting continuous pairs of wires through three-one-half turns (commonly called double-twisted) to form hexagonal shaped openings which are then interconnected to adjacent wires to form hexagonal openings. Fig-1

3.2 **Gabion:** A double-twisted wire mesh container of variable sizes, uniformly partitioned into internal cells having mesh opening (8 x 10) cm, inter-connected with other similar units, and filled with trap stone rubble at the project site to form flexible, permeable, monolithic structures for earth retaining and erosion control projects. Fig-2

3.3 **Selvedge Wire:** A terminal wire used to edge the wire mesh perpendicular to the double-twist by mechanically wrapping the mesh wire around it at least 2.5 times. Fig-3

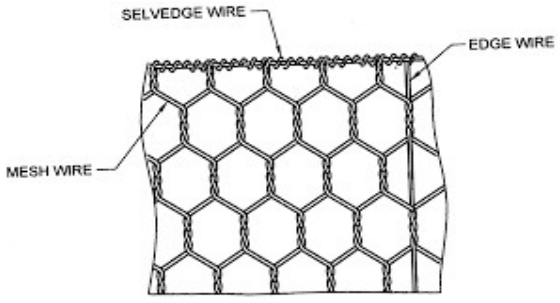


Fig-3

3.4 **Edge Wire:** A terminal wire of the same diameter as the selvedge wire used to edge the wire mesh parallel to the double-twist by continuously weaving it mechanically into the wire mesh. Fig-3

3.5 **Lacing Wire:** A terminal wire used to assemble and interconnect empty units, to close and secure stone-filled units and for internal stiffeners.

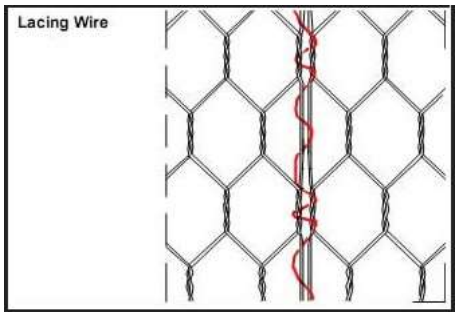


Fig-4

3.6 **Diaphragm:** An internal partition made of same double-twisted wire mesh panel in a gabion that is attached to the bottom, the sides, and after the gabion box is packed with stones, to the lid of the box. Fig-1

3.7 **Bracing Wire:** A length of wire used for support of facing by connecting the front panel to the back panel of gabion box and having the same diameter as the lacing wire. Fig-5

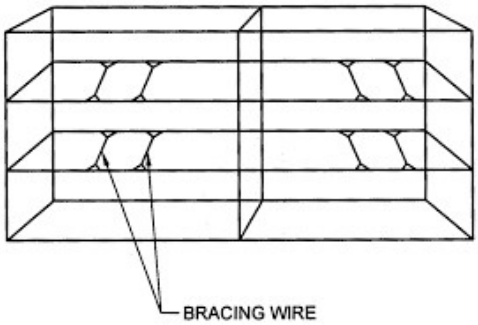


Fig-5

4 INSTALLATIONS

4.1 Site Preparation

The foundation shall be prepared by clearing, grubbing, and excavation or filling the area to the design grade and well compacted to achieve batter as per designed cross section.

4.2 Specification for Assembly and Erection:

Scope

This specification details the requirements from the assembly stage through to the final wiring of the completed Metal Gabion product.

The contractor shall provide to the Engineer, for his approval, full details and specifications of the gabion he proposes to use in this contract. Only those products so approved by the Engineer shall be allowed to be incorporated in the works.

4.2 Assembly

Prior to assembly, the gabion material shall be opened out flat on the ground and stretched to remove all kinks and bends.

The gabion boxes shall be assembled individually, by raising the sides, ends and diaphragms, ensuring that all creases are in the correct position and that the tops of all four sides and the diaphragms are even.

The four corner edges of the Gabion boxes shall be laced first, followed by the edges of internal diaphragms to the sides.

In all cases, lacing shall commence by twisting the end of the lacing wire tightly around the selvedge/s. It shall then pass round the two edges being joined using alternate single and double loops at 100mm intervals and be securely tied off at the bottom. The ends of all lacing wires shall be turned to the inside of the box on completion of each lacing operation. Each loop shall be pulled tight to prevent the joint opening during filling. Tightness of the lacing is essential.

4.3 Placing of Metal Gabion

Gabion boxes shall be placed in position on the prepared foundation as per designed cross-section with process of unfolding the gabion by bundles, folding them as per size to prepare a box with fastening edges by lacing wire. Adjacent boxes shall be tie with lacing wire on each side.

To ensure proper alignment of Metal Gabion, bracing shall be used on the front face of Gabions.

4.4 Geotextile

CE Marked needle punched and mechanically bonded Nonwoven Geotextile indigenously manufactured from high quality polypropylene staple fibres (continuous filament will not be accepted) as per MORTH-700 shall be placed at behind the Gabions to allow passage of water and retention of backfill i.e separation, filtration and drainage application.

4.5 Filling

The Metal Gabion shall be filled by carefully hand packing the trap stones size 15-20 cm and or 20-50 Kg in weight as tightly as possible and not by merely throwing of trap stones. Voids shall be filled by proper hand packing with rubble chips.

All gabions shall be overfilled by 25mm using flat stone to allow for minor settlement and to provide a level surface for subsequent layers.

After filling the Gabion Box upto top; the lid shall stretch and closed tying by lacing wire to the front and side panels of the Gabion Box.

Prior to placing backfill, reinforced fill material as per project requirements the installed Metal Gabion shall be inspected and approved by the Engineer. Any damages during construction shall be repaired and or removed as directed by the Engineer.

4.6 Placing and compacting backfill, reinforced fill material

The backfill, reinforced fill material shall be placed in layers as per specification by end dumping after placement of Nonwoven Geotextile.

Backfill shall be compacted by baby roller and or mechanical compacter of weight < 0.6 MT in layers to achieve good compaction. Heavy weight Static of Vibratory Roller not allowed in 2-meter width stretch from the wall line.

Movement of construction equipment directly over the backfill, reinforced fill material beyond 2 m line from the Gabion wall shall not be permitted to prevent disturbance in alignment of Gabions.

Sudden breaking and sharp turning of construction equipment shall be avoided over 2 m line from the Gabion Wall.

TENDER SPECIFICATION FOR HIGH TENSILE ROPE NET SYSTEM WITH STEEL WIRE KNOT (ROCKFALL PROTECTION AND GEOHAZARD MITIGATION)

1.0 GENERAL

This specification covers the use of rhomboidal shape high tensile rope net system (with steel wire knot) for surface rock fall mitigation including the scope of furnishing and installation as per the special provisions mentioned in the specifications, instructions from the manufacturer/supplier of the rock fall mitigation system and as directed by the Engineer- In-Charge

2.0 MATERIALS

2.1 General Requirements

a) The wire rope net system shall meet the minimum requirements of steel wire rope laid to form a panel, mainly mesh size, mesh opening type, knot, and diameter of wrapping rope and edge rope, Zn Coating and Knot tear resistance as specified in this document.

b) Indigenously manufactured wire rope net system should be preferred, considering advantages of shorter delivery periods, no inventory pile-up and rates being not affected by fluctuation of exchange rate of foreign currency.

c) A plant visits by the Engineer's representative to verify the manufacturer's quality control procedures and witness testing of products is also required prior to the dispatch of material

2.2 Transportation, Storage and Handling

The wire rope net system shall be delivered at site in the form of rolls/bundles. All rolls/bundles shall have a label or tag specifying name of the product, name of the manufacturer, quantity, date of manufacture and dimension.
Material shall be protected from mud, dirt, debris, any other harmful substances or mechanical damage during transportation.
Rolls/bundles shall be stored in a secured area sufficiently elevated above the ground and adequately covered to protect them from the following: site construction damage, precipitation, prolonged exposure to chemicals that

are strong acids or have strong bases, flames including welding sparks, high temperatures, and any other environmental conditions that may damage the physical property values of the wire rope net system.
Any material, which is damaged during transportation, handling or storage and do not meet the minimum requirements of the specifications is liable for rejection by the Engineer.

Rockfall Protection System with Tensile Strength: 220 kN

The following performance specification describes a rolled cable net/high tensile rope net system, consisting of a mesh cover, rock or soil nailing, and connecting resp. boundary elements. The high tensile rope net system shall be tested by independent institutes such as IIT in a testing facility as per ETA (European Technical Approval) Standard. Only ETA certified wire meshes will be accepted.

Minimum Specifications of the High Tensile Rope Net System

Mesh Shape	:	rhomboidal/rectangular
Max opening of mesh (mm)	:	300 x 300 mm
Min wire rope dia. (mm) as per IS 2266:		10
Min tensile strength of rope (N/mm^2) as per IS 2266/ISO2408	:	1960
Breaking strength of rope (kN) as per IS2266:		71
Construction of Rope as per IS 2266	:	6 x7 WSC
Min tensile Strength of mesh (kN/m):		220
Punching Resistance (kN)	:	400
Coating as per EN 10244-2	:	Standard Zn Class A/Class B
Min tearing resistance of knot (kN):		28
Corrosion Protection of Knotting Wire:		95%Zn/5%Al

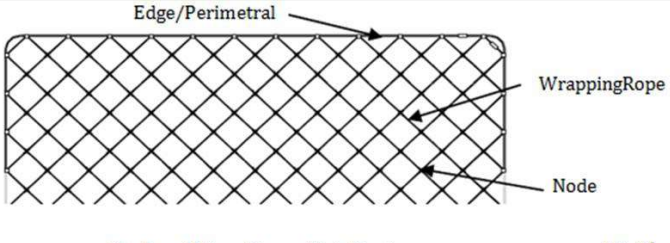


Fig1a : Wire Rope Net System

Fig1b : Junction Details with steel wire knot

Typical Wire Rope Net System

Components of the System

Bearing Plate

Shape:	Square
Size [mm]:	200 x 200
Thickness [mm]:	10
Material:	S355J according to EN 10025-2

Border Ropes

Border rope ø 10 mm	Diameter ø 10 mm

6x19WSC, acc.IS 2266
Tensile strength of single wire rope > 1770 N/mm^2 as per IS2266

Wire finish Galvanized Class B EN 10244-

Bill of Quantity

Item Description	Unit
Supply & installation of High Tensile Rope Net System having rope diameter of 10mm (steel core) with tensile strength of rope 1960 N/mm2 with the intersection of joints having minimum tear capacity of 28 kN and mesh opening of 300 x 300mm. Min. tensile strength of mesh is 220kN/m and a min. ultimate punch load of mesh is 400kN. The system shall include top and bottom support rope, lacing wire or rope required to connect the panels and all accessories such as U clamps, thimbles as shown in drawings and as per technical specifications.	**Sq.m**

4.0 TESTING FACILITY

- **Scope**

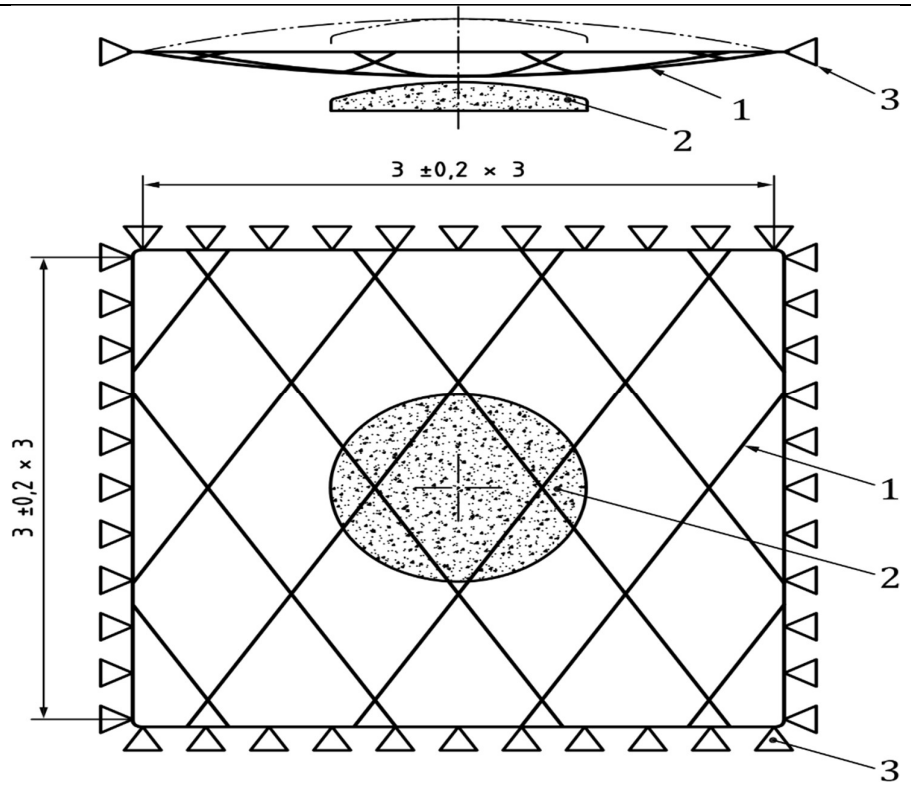
  The following methods shall be used to sample and test wire rope net panels.
  Characteristics Covered
- Wire Rope: The rope characteristics shall be verified as per the inspection documents of type 3.1 according to EN 10204/IS 2266 /ISO 2408 of incoming ropes and by additional tests on ropes according to EN 12385-1+A1/ IS 2266 /ISO 2408 and EN 13411-3+A1/ IS 2266 /ISO 2408.

- Connection components: The knot wires which forms the connection joint shall be inspected for diameter, coating type and mass of coating According to IS280/IS4826 (Al5%Zn95).
- Crossing connection: The tear breaking forces & the slipping forces of the wire Rope Connections shall be tested according to the ISO 17746: 2016 & ETA.
- Wire rope mesh size: The wire rope mesh sizes shall be measured according to ISO 17746: 2016/ETA and shall be in line with the manufacturer specification.
- Tensile strength and elongation of net: The tensile strengths of nets shall be tested according to ISO 17746: 2016.
- Punching resistance and deflection of net: The Punching resistance and deflection of nets shall be tested according to ISO 17746: 2016.
- Durability: Neutral salt spray test of non-ferrous metallic coated net samples according to ETA should not show more than 5 % of DBR (Dark Brown Rust).

- Determining Punching Resistance and deflection of Net:

4.1 Apparatus:

The test piece should be loaded at the intersection of its diagonals (center of test piece), moving the press with a speed not greater than 10 mm/s.
The test consists in loading a sample of net perpendicularly to its plane by means of hemispherical shaped load bearing device and shall be able to test up to 800 kN with minimum panel size of 3m x3m.
The radius of curvature of the press should be 1200 mm and the maximum diameter of the specimen projected on the plane should be 1000 mm. The surface of the press shall be smooth, without any corners. Any attachment devices fitted on the surface of the press shall not interfere in any way with the test piece during the test.
The punching test shall be carried out after fixing the test piece to a rigid frame and it is aimed at measuring the force-movement curve of the central point of the press measured perpendicularly to the plane of the test piece. The panel should be considered to have failed when it is no longer able to support any increase to the applied force. The puncturing strength of a test piece is therefore defined as the maximum force imparted by the test piece during the test.
All the perimeter nets of the test piece shall be fixed to the frame by means of the constraining devices e.g., Shackles, connecting links, steel ropes or other methods. However, the means of constraint shall not interfere with the structural behavior of the test piece of a size suitable to obtain the planarity of the test piece before starting the test by using either specific devices (e.g., screw tensioners) or frames with variable shapes.



Key Components

1 Net
2 Press
3 Perimeter constraining device

Measurements and observations:

The origin of the load-movement diagram shall be measured from the plane holding the panel constraining devices. The following measurements shall be taken continuously during the test: — force exercised by the press; — movement of the press relative to the reference plane. The force shall be measured by class 1 load cells, in accordance with ISO 376/ISO 7500-1:2018.

Test report

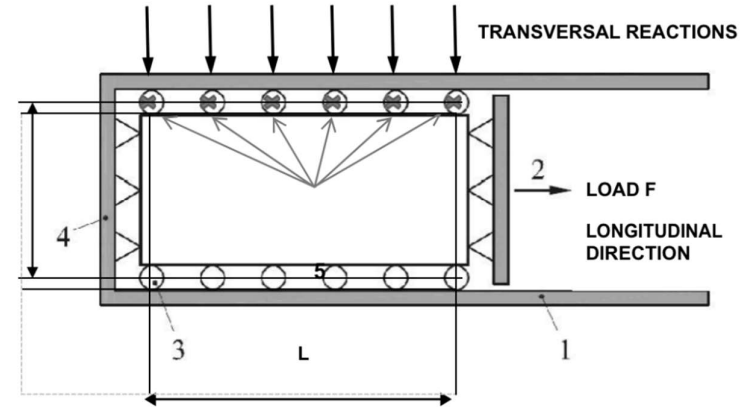
The test report must provide the following information, and give an accurate description of test piece (construction materials and relative strengths, construction characteristics, geometrical characteristics of mesh, etc.)

- Nominal dimensions of test piece and actual dimensions under test conditions.
- Description of instrumentation used and temperature during the testing;

- Detailed description of the test piece constraining condition, complete with photographic documentation;
- Maximum sag be reached at the start of the test in those cases in which it may be measured;
- Detailed description of boundary conditions;
- Description of failure mode.
- Actual failure load and relative stoke;
- Load-Displacement relationship;
- Photographic documentation of the test piece before and after the test.

Determining Net Tensile Strength (Longitudinal Tensile Test with no Lateral Contraction)

- The test determines the actual longitudinal tensile strength and transversal tensile strength, and the relative elongation of wire rope net panel.
- For this purpose, a frame made of four steel beams, one of which is free to slide in the direction of the load (longitudinal direction) shall be used.
- The specimen shall have a width not less than 1 000 mm and a minimum area of 1,0 m2. The specimen shall be fixed to the frame by means of lateral coupling devices, such as shackles or turnbuckles. The side coupling device shall be free to slide along the longitudinal beams.
- The test frame must be equipped with load cells in order to acquire the load applied and the overall side reaction (longitudinal and transversal reactions).
- The rate of longitudinal elongation during the test shall be between 6 mm/min and 10 mm/min. The test end when the specimen broken load or the maximum applicable load is reached.
- The specimen broken load is reached when the specimen is no longer able to support any increase of the applied force. It is also allowed to perform the test without reaching the rupture of the test, in which case, the tensile strength corresponds to the maximum load reached during the test.



Key Components:
1. Fixed frame
2. Movable beam
3. Lateral constraint (movable in longitudinal direction) to which the net is connected
   Note – The number of lateral constraint depends on the configuration of sample
4. Side connection
5. Load cells to measure transversal reactions

Test Set-up

Test report

The test report must contain a full description of the specimen (the base materials and their strengths, construction details, geometric characteristics of the net), Longitudinal strength vs. displacement of movable beam diagram.

i. Full description of sample (construction materials and relative strengths, construction characteristics, geometrical characteristics, technical details, etc.);

ii. Identification of the test method used;

iii. Nominal dimensions of test piece;

iv. Detailed description of the test piece constraining condition, complete with photographic documentation;

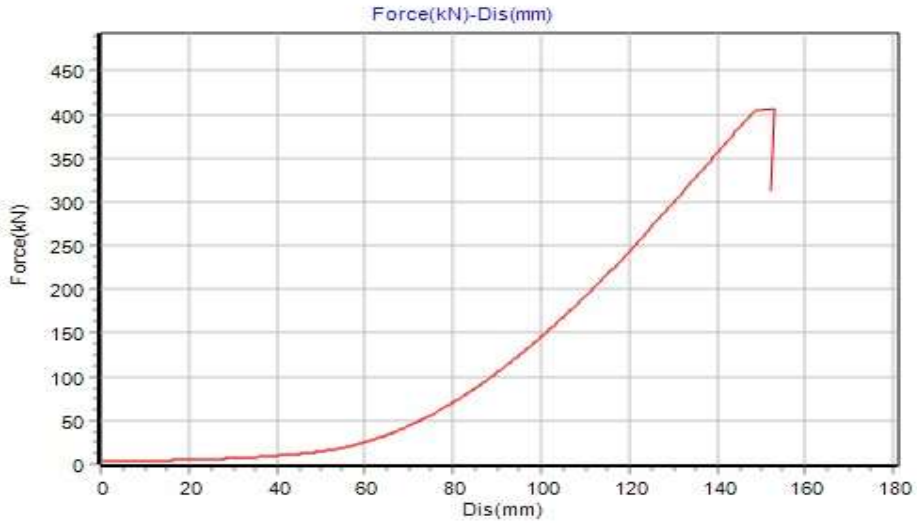
v. Detailed description of the failure mode;

vi. Actual tensile strength and maximum elongation;

vii. load - displacement diagram;

viii. Photographic documentation of the test piece before and after the tests;

ix. Description of instrumentation used and temperature during test.


Force(kN)-Dis(mm)
Force(kN)
450
400
350
300
250
200
150
100
50
0
0
20
40
60
80
100
120
140
160
180
Dis(mm)

TENDER SPECIFICATION FOR SUPPLY OF THREE DIMENSION GEOSYNTHETIC MAT FOR EROSION CONTROL

1.0 GENERAL

Scope of work

This specification covers the requirements for the manufacture, fabrication, supply, and installation of the erosion control mat to the material specifications stated herein, as per the bill of quantity and schedule of supplies enclosed. The geosynthetic Mat and its individual components shall meet or exceed the requirements of this specification. The manufacture, handling, storage, and installation shall be performed in accordance with the procedures provided in this specification.

The CONTRACTOR shall provide all labor, materials, tools, equipment, and perform all operations necessary to furnish, deploy, and install the Drainage Composite in the areas indicated on the Drawings or as required by the ENGINEER, the OWNER or his representative.

Quality Assurance

The quality management system of the MANUFACTURER shall conform to the requirements of ISO 9001:2015

The In-house Laboratory performing Manufacturing Quality Control shall hold a valid GAI-LAP Accreditation, as well as ISO/IEC 17025:2017 Accreditation from NABL for the tests performed in Manufacturing Quality Control.

The MANUFACTURER shall issue a report stating minimum average roll values and results of the test conducted on samples from the rolls delivered to the project at the time of shipment is made. The number of samples tested should be at least one sample per production lot, and at least one sample every 10,000 m^2. The following properties must be declared:

- Weight of the geosynthetic Mat
- Thickness of the geosynthetic Mat
- Tensile properties of the geosynthetic Mat

The ENGINEER, the OWNER or his representative may visit the facility where the product is manufactured and review the quality control procedure as well as the storage and handling conditions at the plant, at their expense.

Indigenously manufactured geosynthetic Mat should be preferred, considering advantages of shorter delivery periods, no inventory pile-up

and cost being unaffected by fluctuation of exchange rate of foreign currency.

A representative of the OWNER or the ENGINEER shall observe and document the unloading, storage, deployment, and installation of the geosynthetic Mat.

If required by a Construction Quality Assurance (CQA) Plan, then OWNER or ENGINEER shall obtain samples of the geosynthetic Mat for conformance testing at the sampling rate defined by the CQA Plan. Each sample shall be at least 600 mm long, taken across full width of the geosynthetic Mat roll for each type of material furnished for Project.

When applicable, third-party sampling, testing and related expenses will be covered by the owner.

Care must be given to put back the packaging in a way that will not expose the rolls to the weather after sampling.

Submittals

The CONTRACTOR shall submit to the ENGINEER for approval data from the MANUFACTURER indicating that the properties of the proposed geosynthetic Mat conform to the requirements of this Specification.

At least 15 days prior to installation, the CONTRACTOR shall submit to the ENGINEER quality control test results from the MANUFACTURER for the rolls produced specifically for the project and certification that the material meets the requirements of this Specification.

At least 15 days prior to installation, the CONTRACTOR shall submit to the ENGINEER:

- Description of proposed method of deployment and provisions for holding geosynthetic Mat temporarily in place until permanently secured.

The CONTRACTOR shall provide all the above-requested documents without exception.

2.0 MATERIALS

General Requirements

The geosynthetic Mat consists of:

A Three-dimensional geosynthetic Mat acting as erosion control, comprised of three sets of parallel overlaid ribs integrally connected to

form a shape made of high-density polyethylene formulated to resist the chemical environment typically prevailing in soils.

Properties of the geosynthetic Mat

The Three-dimensional geosynthetic Mat and its two main constituents are controlled during manufacturing.

The Three-dimensional geosynthetic Mat shall meet or exceed the values provided in Table 2.2-1. Properties shall be measured before assembly to the geotextiles.

Table 1–1 : Properties of the three-dimensional serving as Erosion Control Application.

CHARACTERISTIC	STANDARD	UNIT	VALUE	TOLERANCE
Mass per unit area	EN ISO 9864 / ASTM D 3776	g/m^2	600	Typical
Thickness at 2 kPa	EN ISO 9863-1 / ASTM D 6525	mm	6.5	Min.
Tensile Strength (MD/CD)	ASTM D 5035	kN/m	6.0 /2.0	Min.
Ultravoilet Stability@500Hrs	ASTM D 4355	%	80	Min.
Width	-	Meter	4.0	Min.

Note 1: MD: longitudinal direction; CMD: Transverse direction

Transportation, Storage and Handling

General guidance established in ASTM D4873-16 should be followed for transportation, storage and handling of the geosynthetic Mat

Packaging and Identification

Cover each roll with an opaque wrapping material for protection from damage due to shipment, water, sunlight, or contaminants while being stored or handled in accordance with this guide.

Each roll must be identified with a durable, gummed label, or equivalent, clearly readable on the roll packaging. Roll identification should include the name of the MANUFACTURER, product designation / style number, and the unique roll number. Identification should also include the width and length of the roll.

Receiving and Storing at the job site

While unloading or transferring the geosynthetic Mat from one location to another, prevent damage to the wrapping and to the geosynthetic Mat itself. If practicable, use forklift trucks fitted with poles that can be inserted into the cores of rolls. The poles must be at least two thirds the length of the rolls to avoid breaking the cores and possibly damaging the geosynthetic mat. Slings may be used to carry relatively rigid rolls, provided that the slings do not cause damage to the rolls. Do not drag the rolls as damage may result.

Geosynthetic Mat, when possible, should be stored elevated of the ground and covered to ensure adequate protection from the following:

- Precipitation (because geosynthetic Mat roll goods saturation may lead to handling difficulties),
- Ultraviolet radiation,
- Undesirable chemicals for any extended period of time,
- Flames, including welding sparks,
- Temperatures in excess of 71°C and below 0°C, and
- Any other environmental condition that may affect the properties.

On-Site Handling

While transferring geosynthetic Mat from one location to another, prevent damage to the wrapping and to the geosynthetic Mat itself. Follow the cautions specified in the previous section.

Before unrolling a roll of geosynthetic Mat at the job site, verify its identification. While unrolling the geosynthetic Mat, inspect for damage or defects.

Follow all applicable site or project specifications and recommendations from the MANUFACTURER for handling and installation.

Correct any damage that occurs during storage or installation as directed by the project specifications and the ENGINEER in charge of installation.

TECHNICAL SPECIFICATIONS FOR SELF DRILLING ANCHORS (SDA)

ISO certified SDA shall be designed and arranged in order to stabilize insitu strata. The grout shall be made of OPC grade 53 with suitable admixtures. The SDA, nuts, bearing plates and couplers shall be epoxy coated. In-house testing facility of the manufacturer shall have NABL, GAI-LAP certifications.

Drilling shall be carried out by suitable equipment. Diameter of SDA shall be 32 mm with sacrificial drill bit of approximately 76mm dia. The SDA shall be made of tensile strength of min. 230kN. The SDA rod shall be continuously threaded. For convenience of installation, appropriate arrangement (coupler) shall be made to connect two smaller lengths of SDA to achieve the required length.

Installation guideline

a. The SDA is driven in the required position with help of sacrificial drill bit at the bottom of the anchor bar which facilitates in drilling the hole. The diameter, length and spacing of SDA shall be as specified. Anymore / lesser length or spacing of anchoring/nailing shall be carried out as per site condition and as directed by engineer-in-charge.

b. The grout is pumped through the hollow bar during the drilling process. Grouting shall be done by using OPC grade 53 along with addition of suitable admixture. Mixing shall be done along with potable water so as to form the cementitious paste.

c. The base plates of size 200mm x 200mm x 10 mm shall be placed at rock interface for tightening the nuts.

d. The fascia (if applicable) shall be installed in front and connected to the steel rods with base plate and nuts.

Following equipment deployed on site

1) Grout agitator

2) Compressor – 450 to 600CFM

3) Drilling equipment percussion/rotary type

Expansive plasticizing agent for cement grouts shall be used, typical brand name DR. FIXIT PIDICRETE AM is a shrinkage compensating grout admixture for pressure grouting.

TECHNICAL SPECIFICATIONS FOR PRESTRESSED GROUTED GROUND ANCHORS

The prestressed grouted ground anchors shall be designed and arranged in order to stabilize insitu strata.

Cement used for grouting of anchors shall comply with IS 12269. The grout mix shall be designed to achieve a minimum 150 mm-cube-strength of 32 MPa at 7 days and a minimum 150 mm- cube-strength of 40 MPa at 28 days. The grout shall comprise water and cement in a ratio (by weight) of not greater than 0.40.

Drilling shall be carried out by suitable equipment. Prestressed cable anchors shall be of 6 no.s of 7-wire prestressing steel strand with nominal diameter 15.2 mm dia and nominal tensile strength 1094 MPa with minimum breaking strength of each mono-strand 260.7 kN. Drill hole shall be of minimum 150 mm dia. Fixed grouted length shall be the 30%/15% of the total length of the anchor with grouting in two stages (stage 1: for the fixed grout length and stage 2: full grouting). For convenience of installation, appropriate arrangement (casing) shall be made for drilling in collapsible strata. The strands shall be arranged and located uniformly over the cross section of the sheathing without twisting. Grout filled encapsulation shall be provided around the strands for corrosion protection. Spacers shall be provided in the bond length to ensure separation between the individual strands and thus to ensure the effective penetration of grout to provide adequate bond and load transfer between the strands and the grout. The spacers shall be designed to provide spacing between strands of not less than 5 mm.

After the first stage grouting up to the fixed grout length, prestressing and locking off shall be done. Stressing of grouted anchors shall be carried out under the supervision of a Post-Tensioning Supervisor. Anchors shall not be stressed until the grout surrounding the anchor has attained an age of seven days and the average compressive strength of the grout in the hole has reached 32 MPa. A bond breaker (smooth plastic sleeve) shall be inserted over the prestressing steel element in the free (unbonded) length to prevent the prestressing steel from bonding to the surrounding grout. Prestressing strand shall individually be covered with corrosion inhibiting compound and sheathing in the free stressing length and grout filled encapsulation shall continue for full length.

The second stage grout shall then be carried out through the grouting pipe attached to the prestressing steel element until the hole is filled and grout flushes out through the opening of the base plate and nail head.

Protective sheath shall be provided to cover each anchor head and protruding length of tendon above the slope surface.

The cap shall provide a watertight seal and shall incorporate a system for complete drainage of and refilling with grease and for visual monitoring of the internal grease level. To allow for physical inspection of the anchor head without removal of the complete cap the top of the cap shall incorporate a water tight inspection lid. Grease for strands with sheathing and for the protection of anchor heads shall be neutral, inert and free from any materials or additives which could promote corrosion or reduce the life of the tendons.

The tendon assembly shall make suitable provision for grout lubes, spacers and centralizers and shall permit the free flow of grout to and around all components providing a complete grout cover.

Centralizers shall also be provided outside the sheathing to maintain the sheathing centrally within the drilled hole. centralizers shall be firmly fixed to the sheathing and shall be of form which will not cause any damage to, or impair the water tightness of, the sheathing during installation.

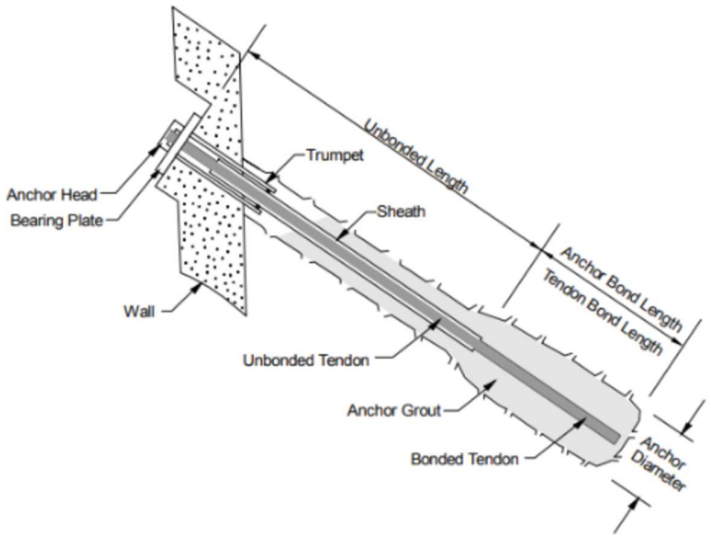
A removable trumpet shall be provided at the collar of the hole to prevent damage to the sheathing or the external centralizers during installation.

All anchors that have a bearing plate that would normally be placed on the ground at the collar of the anchor borehole shall be provided with a concrete block to distribute the pressure underneath the bearing plate into the ground. The size of the concrete block is typically 1 m X 1m in plan. The concrete strength at 28 days shall not be less than 40 MPa. The concrete block shall be reinforced as per final approved drawings.

The anchor head shall possess a centering device so that the tendon force is applied uniformly to the contact surface between the anchor head and the bearing plate.

The critical post-tensioning activities such as drilling & cleaning and water testing and waterproofing of drill holes shall be be carried out at site under the supervision of a post-tensioning supervisor.

Non-shrink admixtures for cement grouts shall be used.



Components of a ground anchor (source: FHWA-IF-99-015)

TECHNICAL SPECIFICATION FOR SUPPLY OF NONWOVEN NEEDLE PUNCHED, MECHANICALLY BONDED GEOTEXTILE (SEPARATION, FILTRATION AND DRAINAGE APPLICATION)

GENERAL

This work comprises supply of Nonwoven Needle Punched Mechanically Bonded Polypropylene Geotextile conforming to the material specifications stated herein, as per the bill of quantity and schedule of supplies enclosed.

MATERIALS

General Requirements

Nonwoven Needle punched mechanically bonded Polypropylene Geotextile shall be made of polypropylene staple fibers. These engineered Geotextiles shall be stabilized to resist degradation due to ultraviolet exposure and shall be resistant to commonly encountered soil chemicals, mildew and insects, and shall be non-biodegradable.

Indigenously manufactured Nonwoven Needle Punched Mechanically Bonded Polypropylene Geotextile should be preferred, considering advantages of shorter delivery periods, no inventory pile-up and rates being not affected by fluctuation of exchange rate of foreign currency.

A plant visit by the Engineer's representative to verify the manufacturer's quality control procedures and witness testing of products is also required prior to the dispatch of material.

Transportation, Storage and Handling

All rolls shall have a protective cover with a label or tag specifying name of the product, name of the manufacturer, roll number, date of manufacture and roll dimension.

Material shall be protected from sunlight, mud, dirt, debris, any other harmful substances or mechanical damage during transportation.

Rolls shall be stored in a secured area sufficiently elevated above the ground and adequately covered to protect them from the following: site construction damage, precipitation, prolonged exposure to ultraviolet radiation including sunlight, chemicals that are strong acids or strong bases, flames including welding sparks, high temperatures, and any other environmental conditions that may damage the physical property values of the Nonwoven Needle Punched Mechanically Bonded
Polypropylene Geotextile.

Any material, which is damaged during transportation, handling or storage and do not meet the minimum requirements of the specifications is liable for rejection by the Engineer.

Quality Control & testing

The Nonwoven geotextile shall meet the requirements as specified in the Table-1. Conformance testing shall be performed on random samples by the manufacturer or supplier in accordance with quality management system of the manufacturer which shall conform to the requirements of ISO 9001:2015 and In-house Laboratory should be certified with GAI-LAP and ISO/IEC 17025:2015 (NABL).

During approvals:
Nonwoven geotextile shall be provided for the third-party testing or testing shall be carried out at manufacturer's laboratory under supervision of Engineer in Charge. The tests that are to be carried out are as mentioned in Table -1.

The in-house laboratory or the third-party laboratory wherein the material shall be tested should be certified with GAI-LAP and ISO/IEC 17025:2015 (NABL).

Manufacturer should have well equipped testing facility and must provide the list of In-house laboratory equipment. Following method should perform In-house laboratory during witness test.

Manufacturer shall issue a test report stating average roll values of material properties, at the time of shipment is made.

CE-certification should be required for supply of material. Manufacturer shall submit the proof of supply for the quantity of 10000 Sqmt at least, for projects in India.

Contractor shall furnish proof of all above and it is mandatory.

Physical and Mechanical Properties

The Mechanical properties of Nonwoven Needle Punched Mechanically Bonded Polypropylene Geotextile shall conform to Table-1 below:
(Confirming to relevant MORT&H, IRC OR BIS standard)

Table-1

Property	Unit	Test Standard	Geotextile Type -3	Geotextile Type-2	Geotextile Type -1
Mechanical Properties					
Grab strength (MD/CD)	N	ASTM D 4632/IS16342	500	700	900
Grab elongation(MD/CD)	%	ASTM D 4632/IS16342	50	50	50
Trapezoidal tear (Weaker Direction)	N	ASTM D 4533/ IS14293	180	250	350
CBR Puncture Resistance	N	ASTM D 6241 / IS 16078	1000	1400	2000
Mullen Burst	kPa	ASTM D 3786	950	1300	1700
Hydraulic Properties					
Permittivity	s^{-1}	ASTM D4491	1.2	1.0	0.8
AOS	µm	ASTM D4751	≤212	≤180	≤180
Physical Identification					
Roll width	M	-	5.0	5.0	5.0
Roll length	M	-	100	100	100

TECHNICAL SPECIFICATION FOR SUPPLY OF DRAINAGE COMPOSITE/ GEOCOMPOSITE DRAIN (SEPARATION, FILTRATION AND DRAINAGE APPLICATION)

GENERAL

This work comprises supply of Drainage Composite conforming to the material specifications stated herein, as per the bill of quantity and schedule of supplies enclosed.

MATERIALS

General Requirements

Drainage Composite shall be made by thermo bonding a drainage core-Geonet comprises of two sets of parallel overlaid ribs integrally connected to have a rhomboidal shape made of High density polyethylene, stabilized by carbon black, black colour and nonwoven geotextile, working as separation, filtration and protection layer made of polypropylene Needle punched & thermally bonded. These engineered Geotextiles shall be stabilized to resist degradation due to ultraviolet exposure and shall be resistant to commonly encountered soil chemicals, mildew and insects, and shall be non-biodegradable.

Indigenously manufactured Drainage Composite should be preferred, considering advantages of shorter delivery periods, no inventory pile-up and rates being not affected by fluctuation of exchange rate of foreign currency.

A plant visit by the Engineer's representative to verify the manufacturer's quality control procedures and witness testing of products is also required prior to the dispatch of material.

Transportation, Storage and Handling

All rolls shall have a protective cover with a label or tag specifying name of the product, name of the manufacturer, roll number, date of manufacture and roll dimension.

Material shall be protected from sunlight, mud, dirt, debris, any other harmful substances or mechanical damage during transportation.

Rolls shall be stored in a secured area sufficiently elevated above the ground and adequately covered to protect them from the following: site construction damage, precipitation, prolonged exposure to ultraviolet radiation including sunlight, chemicals that are strong acids or strong bases, flames including welding sparks, high temperatures, and any other environmental conditions that may damage the physical property values of the Drainage Composite.

Any material, which is damaged during transportation, handling or storage and do not meet the minimum requirements of the specifications is liable for rejection by the Engineer.

Quality Control & testing

The drainage composite shall meet the requirements as specified in the Table-1. Conformance testing shall be performed on random samples by the manufacturer or supplier in accordance with quality management system of the manufacturer which shall conform to the requirements of ISO 9001:2015 and In-house Laboratory should be certified with GAI-LAP and ISO/IEC 17025:2015 (NABL).

During approvals:

Nonwoven geotextile shall be provided for the third-party testing or testing shall be carried out at manufacturer's laboratory under supervision of Engineer in Charge. Testing for nonwoven properties shall be carried out over parent material, not from the final product of drainage composite, for that manufacturer shall have provide the same material for testing. The tests that are to be carried out are as mentioned in Table -1.
The in-house laboratory or the third-party laboratory wherein the material shall be tested should be certified with GAI-LAP and ISO/IEC 17025:2015 (NABL).

Manufacturer should have well equipped testing facility and must provide the list of In-house laboratory equipment. Following method should perform In-house laboratory during witness test.

Manufacturer shall issue a test report stating average roll values of material properties, at the time of shipment is made.

CE-certification should be required for supply of material. Manufacturer shall submit the proof of supply for the quantity of 10000 Sqmt at least, for projects in India.

Contractor shall furnish proof of all above and it is mandatory.

Physical and Mechanical Properties
The Mechanical properties of Drainage Composite shall conform to Table-1 below:

Table-1
(Confirming to relevant MORT&H, IRC OR BIS standard)

Property	Test Method	UOM	Value	Acceptance criteria
FILTER – GEOTEXTILE				
Structure: Needle punched or thermally bonded non-woven geotextile				
Raw Material: Polypropylene				
Characteristic opening size O_{95}	ASTM D 4751	micron	220	Maximum value
Permittivity	ASTM D 4491	s^{-1}	1.0	Minimum value
DRAINAGE CORE – GEONET				
Structure: Sets of parallel ribs overlaid and integrally connected having rhomboidal mesh openings				
Raw Material: High density polyethylene, stabilized by carbon black, black colour				
GEOCOMPOSITE				
Property	**Test Method**	**UOM**	**Value**	Acceptance criteria
Thickness	EN 9863-1	mm	4.5	Minimum value
Mass per unit area	EN ISO 9864	g/m^2	710	Minimum value
CBR puncture resistance	EN ISO 12236	N	3000	Minimum value
Tensile strength	EN ISO 10319	kN/m	16	Minimum value
In-plane flow capacity (MD) (Rigid/Rigid Contact)				
Hydraulic gradient i = 1 at 100 kPa pressure	EN ISO 12958	l/(m.s)	0.55	Minimum Value
Hydraulic gradient i = 1 at 200 kPa pressure			0.45	Minimum Value

Note : Transmissivity Measured value may very between individual labs

MD – LONGITUDINAL DIRECTION **CMD** – TRANVERSE DIRECTION**S/S**

S/S – CONTACT TYPE SOFT/SOFT **R/R** – CONTACT TYPE RIGID/RIGID

INSTALLATION

Site Preparation

As per the requirement of the application for the drainage, site / surface shall be prepared and should be in line with the level required for the placement of the material.

Laying of Drainage Composite

For pavement drainage application, the Drainage Composite shall be laid smooth without wrinkles or folds on the prepared subgrade and or prepared surface if shown in the drawings with the cross-machine direction oriented in the direction of traffic.

For the application for the drainage for retaining walls, drainage composite shall provide vertical (Machine direction is vertical attached with the wall surface. Flow requirement shall be checked as per the height of the wall.

Adjacent rolls (only outer layer of geotextile & not inner core) shall be overlapped as shown on the drawings. Unless otherwise shown on the drawings or directed by the Engineer, the minimum overlap shall be 300 mm. The same process shall be followed for all roll ends.

On curves, the Drainage Composite may be cut to conform to the curves. The fold or overlap shall be in the cross direction of construction and held in place by pins.

Prior to placing subgrade or backfill material as per project requirements the installed Drainage Composite shall be inspected and approved by the Engineer. Any damages shall be repaired by covering the damaged location with a Drainage Composite patch, which extends an amount equal to the required overlap beyond the damaged area, as directed by the Engineer.

Placing and Compacting Subgrade Course
The subgrade shall be placed by end dumping onto the Drainage Composite from the edge of the Drainage Composite.

Movement of construction equipment directly over the Drainage Composite shall not be permitted.

Sudden breaking and sharp turning of construction equipment shall be avoided over the laid Drainage Composite.

Any ruts occurring during construction shall be filled with additional subgrade material, and compacted to the specified density.

Technical Specification of Mechanically Woven Double Twisted Hexagonal Shaped Wire Mesh netting roll, Mesh Type 10x12, Zn + PVC coated Mesh Wire dia. 2.7/3.7mm (ID/OD), end of roll mechanically edged / selvedged, with galvanization as per IS 16014:2012 and MoRTH (Fifth Revision) 2013, Clause 2500.

Scope:

This specification covers the use of mechanically woven hexagonal shaped double twisted (DT) wire mesh rock fall netting for surface rock fall protection including the scope of furnishing and installation as per the special provisions mentioned in the specifications, instructions from the manufacturer/supplier of the rock fall protection system and as directed by the Engineer- In-Charge.

General Requirements:

The DT wire mesh rock fall netting shall meet the minimum requirements of mechanically woven DT hexagonal shaped zinc and PVC coated wire mesh mainly mesh wire diameter, mesh type, zinc coating, PVC coating, wire tensile strength and mesh panel tensile strength as specified in this document.

System Technology:

The DT wire mesh rock fall netting shall be made up of mechanically woven hexagonal DT wire mesh. The steel wire shall be heavily zinc coated soft temper steel. PVC coating shall be applied for added protection, to use in corrosive environment. Nominal PVC thickness of 0.50mm shall be applied. The hexagonal shape of the mesh provides a better distribution of the working tensions along the wires that form the mesh.

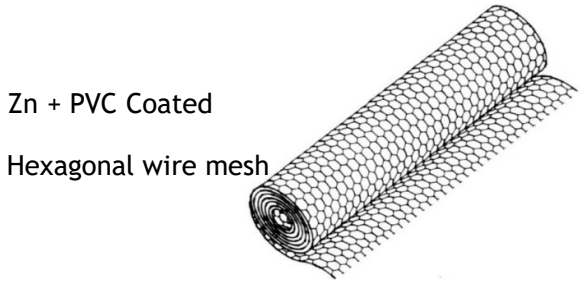


Figure 1 Typical Wire Mesh Rock fall Netting

Material Specifications:

Mechanically Woven Double Twisted Hexagonal shaped Zn + PVC coated wire mesh: All steel wires used in the manufacturing of wire mesh rock fall netting shall

conform to IS 16014:2012. The wire used for the manufacture of mesh shall have a tensile strength between 350-550N/mm2 and elongation shall not be less than 10%. Test shall be carried out on a sample of at least 20 cm length. All tests on the mesh wire, selvedging wire & lacing wire shall be performed prior to manufacturing the mesh. The DT wire mesh shall have peak tensile strength of 40 kN/m tested as per procedure outlined in clause 6 of this specification.

Selvedge wire: The diameter of the selvedging shall be bigger than the wires in the mesh. The diameter of selvedge wire shall be 3.4mm and shall have same characteristics as the mesh wire.

Lacing wire: The diameter of the lacing wire shall be 2.2 mm and shall have same characteristics as the mesh wire and shall have same characteristics as the mesh wire.

Zinc coating

Zinc coating: Minimum quantities of Zinc shown at Table 1 shall meet the requirements of IS 4826:1979.

Adhesion of zinc coating: The adhesion of the zinc coating to the wire shall be such that, when the wire is wrapped ten turns around a mandrel having four times the diameter of the wire, it does not flake or crack when rubbing it with the bare fingers in accordance with IS 4826:1979.

PVC (Polyvinyl Chloride) coating

a. PVC coating thickness: Nominal – 0.5 mm, Minimum – 0.4 mm;

b. Specific weight: 1.3 kg/dm3 – 1.35 kg/dm3 in accordance with IS 13360, Part3, section 1.

c. Hardness: between 50 and 60 Shore D, according to IS 13360, Part5, section 11

d. Tensile strength: Higher than 20.6 MPa, according to IS 13360, Part5, section 1

e. Elongation at break: not less than 200% in accordance with IS 13360, Part5, section 1.5.

f. Color: Grey - RAL 7037.

Wire diameter, tolerances, zinc coating shall conform to values indicated in Table 1: Table 1 Characteristics of Mesh wire, Selvedge wire and Lacing wire

Characteristics of 10x12 mesh	Mesh wire	Selvedge wire	Lacing wire
Mesh Wire Dia mm	2.7	3.4	2.2
Tolerance (+/-) mm	0.07	0.09	0.06
Zn Coating Min (gm/sq.m)	260	270	240

The wire mesh shall have nominal opening of 100mm as shown in Figure 2. The mesh opening tolerances are indicated in Table 2.

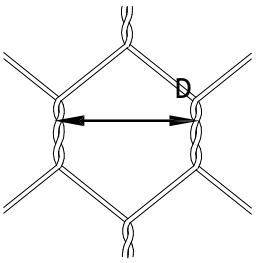


Figure 2 Mesh Details

Tolerances in Mesh Opening size: - 2% to +2%

DT mesh shall have minimum 10 numbers of mesh openings per meter of mesh perpendicular to twist of mesh.

Procedure for verification of mesh opening.

Rockfall netting shall be unfolded on the plain ground.

Any shrink in the unfolded netting shall be removed, by stretching the Mesh panel.

Marking on the ground shall be made from the Centre of the twist of one mesh and the second.

Marking shall be done at 1 m distance.

The number of mesh Openings in the 1 m shall be counted & verified.

Table 2 Standard Mesh

Mesh type	"D"(mm)	Tolerance	Mesh Panel Strength (parallel to twist)	Zinc +PVC coated		
				Diameter of wire (Inner / Outer wire)		
				Mesh wire(mm)	Selvedge wire (mm)	Lacing wire(mm)
10X12	100mm	- 2% to +2%	40kN /m	2.7/3.7	3.4/4.4	2.2/3.2

Dimensions of DT wire mesh rock fall netting

DT wire mesh rock fall netting shall be manufactured in a standard width of 4m and length of 25 or 50m with tolerance of ±5% .Table 3 indicates standard sizes of DT wire mesh rock fall netting Other roll sizes may be required as per site conditions subject to the Engineer's approval. For non-standard roll lengths there may be some variation outside the tolerance limit from the nominal size shown in the contract drawings.

Table 3 Standard sizes of DT wire mesh rock fall netting

Type	**Length (m)**	**Width (m)**
DT wire mesh rock fall netting (Mesh 10x12)	25	4
	50	4
	100	4

Installation:

Vegetation, debris and loose soils and other deleterious matter shall be cleared to the satisfaction of Engineer. Reference benchmarks, line and levels shall be marked at site. The materials, tools and tackles shall be shifted to site without damaging system.

The rolls of DT wire mesh rock fall netting should be rolled down the surface from top anchoring system as per the contract drawings. New roll shall be placed in the same manner directly overlapping the adjacent roll such that longitudinal ropes of both the rolls can be laced together by hand. Lacing shall commence by twisting end of the lacing wire tightly to the wire mesh. It shall then pass round the two edges being joined using alternate single and double loops at approximately 100mm intervals. The lacing wire shall be securely tied off at the bottom of the roll. The bottom anchoring shall be done as per the drawings.

Manufacturer's installation guideline shall be referred for details.

Testing and Acceptance criteria:

Testing shall be done on raw material as per codes specified in Table 4. Approval for the material shall be obtained in the writing from the Engineer before actual start of supply. The manufacturer of the DT wire mesh rock fall netting shall provide manufacturers test certificate for the material with every lot/shipment. The manufacturers test certificate for DT wire mesh rock fall netting shall be provided for certifying that rock fall protection system conforms to all the technical and special requirements.

The punch strength test results shall be 19kN in accordance with MoRTH section 2500 and test specified therein.

DT wire mesh tensile strength test procedure

A tensile test on DT wire mesh sample shall be carried out in order to estimate tensile strength parallel to twist. The test shall be carried out as per procedure outlined below. The DT wire mesh tensile strength shall be minimum 40 kN/m.

a. Take a DT wire mesh of approximately 1.0 m width. The sample shall have edge wire on both the sides.

b. The height of the sample shall be such that after selvedging on both the sides, effective height of the sample shall be more than 300 mm. Sample shall be loaded on the UTM in a direction parallel to twist, with the samples being gripped as shown in the figure 3.

c. The effective height of sample (gauge length) shall be the distance measured between the two rows of inner gripping pins on two grips.

d. Distance between the two end gripping points (pins) along the width of the sample shall be recorded as the unit width under test. The width shall be at least 700 mm.

e. The load shall be applied gradually to the sample and the test be continued till the break point.

f. The peak load and the % elongation shall be recorded.

g. The strength of the DT wire mesh shall be (peak load/unit width under test) expressed in kN/m.

NB. If the sample slips at any of the gripping point during the test, such a test shall be discarded and a new sample shall be taken.

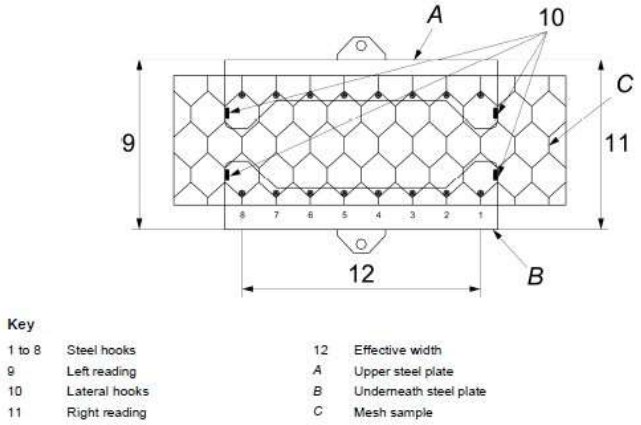


Figure 4 Tensile strength of mesh panel

PVC coating thickness test procedure:

The thickness of the PVC coating shall be determined on a randomly chosen individual piece of wire removed from the coil at 3 places 1 metre apart.

Measure with a micrometer the diameter of the galvanized steel wire with PVC coating. Determine the thickness of the PVC coating by stripping the PVC coating from the wire and measure the reduced diameter with a micrometer. The thickness of the coating is the difference between the diameter of the galvanized steel wire with PVC coating and the measured diameter of the galvanized steel wire divided by two. The thickness values should be as per clause 3.e. While removing the PVC coating by stripping, take care not to remove any of the metallic surfaces.

Table 4 Testing Plan

Sr. No	Test	Reference	Frequency of Testing	Sample size	Remarks
	MESH WIRE				
1	Tensile strength & Elongation%	IS 16014:2012	Once	Three	At DT wire mesh rock fall netting manufacturer's lab
2	Mass of Zinc & adhesion	IS 4826:1979	Once	Three	At DT wire mesh rock fall netting manufacturer's lab
3	DT wire mesh panel strength	Clause 1.6	Once	Three	At DT wire mesh rock fall netting manufacturer's lab
4	Physical dimension of Wire mesh rock fall netting	TDS, Visual checking			At DT wire mesh rock fall netting manufacturer's lab

5	PVC coating thickness	Clause 1.3.5	Once	Three	At DT wire mesh rock fall netting manufacturer's lab
Note:	Testing of wire shall be done on samples from raw material				

Method of Measurement:

Quantity of DT wire mesh rock fall netting shall be determined from cross sections and the linear distance, and paid for under the appropriate bid items

Basis of Payment

Accepted DT wire mesh rock fall netting shall be paid for at the unit price (per square metre area) for each pay item included in the contract.

Schedule - E

(See Clauses 2.1 and 14.2)

Maintenance Requirements

1. Maintenance Requirements

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

(ii) 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-fulfilment 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.

(iii) All Materials, works and construction operations shall conform to the MORTH Specifications for Road and Bridge Works, and the relevant IRC publications. Where the specifications for a work are not given, Good Industry Practice shall be adopted.

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)

Annex-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.

Table -2: Maintenance Criteria for Pavements:

Asset Type	Performance Parameter	Level of Service (LOS)		Frequency of Inspection	Tools/Equipment	Standards and References for Inspection and Data Analysis	Time limit for Rectification/Repair	Maintenance Specifications
		Desirable	Acceptable					
Flexible Pavement (Pavement of MCW, Service Road, approaches of Grade structure, approaches of connecting roads, slip roads, lay	Potholes	Nil	< 0.1 % of area and subject to limit of 10 mm in depth	Daily	Length Measurement Unit like Scale, Tape, odometer etc.	IRC 82: 2015 and Distress Identification Manual for Long Term Pavement Performance Program, FHWA 2003 (http://www.tfhrc.com/pavement/lttp/reports/03031/)	24-48 hours	MORT&H Specification 3004.2
	Cracking	Nil	< 5 % subject to limit of 0.5 sqm for any 50 m length	Daily			7-15 days	MORT&H Specification 3004.3
	Rutting	Nil	< 5 mm	Daily	Straight Edge		15 -30 days	MORT&H Specification 3004.2
	Corrugations and Shoving	Nil	< 0.1 % of area	Daily	Length Measurement Unit like Scale,		2-7 days	IRC:82-2015

Asset Type	Performance Parameter	Level of Service (LOS)		Frequency of Inspection	Tools/Equipment	Standards and References for Inspection and Data Analysis	Time limit for Rectification/Repair	Maintenance Specifications
		Desirable	Acceptable					
byes etc. as applicable)	Bleeding	Nil	< 1 % of area	Daily	Tape, odometer etc.		3-7 days	MORT&H Specification 3004.4
	Ravelling/ Stripping	Nil	< 1 % of area	Daily			7-15 days	IRC:82-2015 read with IRC SP 81
	Edge Deformation/ Breaking	Nil	< 1 m for any 100 m section and width < 0.1 m at any location, restricted to 30 cm from the edge	Daily			7- 15 days	IRC:82-2015
	Roughness BI	2000 mm/km	2400 mm/km	Bi-Annually	Class I Profilometer SCRIM (Sideway-force Coefficient Routine Investigation Machine or equivalent)	Class I Profilometer : ASTM E950 (98) :2004 –Standard Test Method for measuring Longitudinal Profile of Travelled Surfaces with Accelerometer Established Inertial Profiling Reference ASTM E1656 -94: 2000- Standard Guide for Classification of Automatic Pavement Condition Survey Equipment	180 days	IRC:82-2015
	Skid Number	60SN	50SN	Bi-Annually			180 days	BS: 7941-1: 2006
	Pavement Condition Index	3	2.1	Bi-Annually			180 days	IRC:82-2015
	Other Pavement Distresses			Bi-Annually			2-7 days	IRC:82-2015

<table>
<tr><th rowspan="2">Asset Type</th><th rowspan="2">Performance Parameter</th><th colspan="2">Level of Service (LOS)</th><th>Frequency of Inspection</th><th>Tools/Equipment</th><th>Standards and References for Inspection and Data Analysis</th><th>Time limit for Rectification/Repair</th><th>Maintenance Specifications</th></tr>
<tr><th>Desirable</th><th>Acceptable</th></tr>
<tr><td></td><td>Deflection/ Remaining Life</td><td></td><td></td><td>Annually</td><td>Falling Weight Deflecto meter</td><td>IRC 115: 2014</td><td>180 days</td><td>IRC:115-2014</td></tr>
<tr><td rowspan="2">Rigid Pavement (Pavement of MCW, Service Road, Grade structure, approaches of connecting roads, slip roads, lay byes etc. as applicable)</td><td>Roughness BI</td><td>2200mm/km</td><td>2400mm/km</td><td>Bi-Annually</td><td>Class I Profilometer</td><td>ASTM E950 (98) :2004 and ASTM E1656 -94: 2000</td><td>180 days</td><td>IRC:SP:83-2008</td></tr>
<tr><td>Skid</td><td colspan="2">Skid Resistance no. at different speed of vehicles
<table><tr><th>Minimum SN</th><th>Traffic Speed (Km/h)</th></tr><tr><td>36</td><td>50</td></tr><tr><td>33</td><td>65</td></tr><tr><td>32</td><td>80</td></tr><tr><td>31</td><td>95</td></tr><tr><td>31</td><td>110</td></tr></table></td><td>Bi-Annually</td><td>SCRIM (Sideway-force Coefficient Routine Investigation Machine or equivalent)</td><td>IRC:SP:83-2008</td><td>180 days</td><td>IRC:SP:83-2008</td></tr>
<tr><td rowspan="2">Embankment/ Slope</td><td>Edge drop at shoulders</td><td>Nil</td><td>40mm</td><td>Daily</td><td rowspan="2">Length Measurement Unit like Scale, Tape, odometer etc.</td><td rowspan="2">IRC SP:73-2018, IRC 36-2010 & IRC 56-2011</td><td>7-15 days</td><td>MORT&H Specification 408.4</td></tr>
<tr><td>Slope of camber/cross fall</td><td>Nil</td><td><2% variation in prescribed slope of camber /cross fall</td><td>Daily</td><td>7-15 days</td><td>MORT&H Specification 408.4</td></tr>
</table>

Asset Type	Performance Parameter	Level of Service (LOS)		Frequency of Inspection	Tools/Equipment	Standards and References for Inspection and Data Analysis	Time limit for Rectification/Repair	Maintenance Specifications
		Desirable	Acceptable					
	Embankment Slopes	Nil	<15 % variation in prescribe side slope	Daily			7-15 days	MORT&H Specification 408.4
	Embankment Protection	Nil	Nil	Daily	NA		7-15 days	MORT&H Specification
	Rain Cuts/ Gullies in slope	Nil	Nil	Daily Specially During Rainy Season	NA		7-15 days	MORT&H Specification

In addition to the above performance criterion, the contractor shall strictly maintain the rigid pavements as per requirements in the following table

Table -3: **Maintenance Criteria for Rigid Pavements:**

S.No.	Type of Distress	Measured Parameter	Degree of Severity	Assessment Rating	Repair Action	
					For the case d < D/2	For the case d > D/2
CRACKING						
1	**Single Discrete Cracks Not intersecting with any joint**	w = width of crack L = length of crack d = depth of crack D = depth of slab	0	Nil, not discernible	No Action	Not applicable
			1	w < 0.2 mm. hair cracks		
			2	w = 0.2 - 0.5 mm, discernible from slow-moving car	Seal without delay	Seal, and stitch if L > lm. Within 7days
			3	w = 0.5 - 1.5 mm, discernible from fast-moving car		

S.No.	Type of Distress	Measured Parameter	Degree of Severity	Assessment Rating	Repair Action	
					For the case d < D/2	For the case d > D/2
			4	w = 1.5 - 3.0 mm	Seal, and stitch if L > l m. Within 7 days	Staple or Dowel Bar Retrofit, FDR for affected portion. Within 15days
			5	w > 3 mm.		
2	**Single Transverse (or Diagonal) Crack intersecting with one or more joints**	w = width of crack L = length of crack d = depth of crack D = depth of slab	0	Nil, not discernible	No Action	
			1	w < 0.2 mm, hair cracks	Route and seal with epoxy. Within 7 days	Staple or Dowel Bar Retrofit. Within 15days
			2	w = 0.2 - 0.5 mm, discernible from slow vehicle		
			3	w = 0.5 - 3.0 mm, discernible from fast vehicle	Route, seal and stitch, if L > 1 m. Within 7 days	
			4	w = 3.0 - 6.0 mm	Dowel Bar Retrofit. Within 15 days	Full Depth Repair Dismantle and reconstruct affected. Portion with norms and specifications - See Para 5.5 & 9.2 Within 15days
			5	w > 6 mm, usually associated with spalling, and/or slab rocking under traffic	Not Applicable, as it may be full depth	
3	**Single Longitudinal Crack intersecting with one or more joints**	w = width of crack L = length of crack d = depth of crack D = depth of slab	0	Nil, not discernible	No Action	
			1	w < 0.5 mm, discernable from slow moving vehicle	Seal with epoxy, if L > 1 m. Within 7 days	Staple or dowel bar retrofit. Within 15days
			2	w = 0.5 - 3.0 mm, discernible from fast vehicle	Route seal and stitch, if L > l m. Within 15 days	-
			3	w = 3.0 - 6.0 mm	Staple, if L > 1 m. Within 15 days	Partial Depth Repair with stapling.

S.No.	Type of Distress	Measured Parameter	Degree of Severity	Assessment Rating	Repair Action	
					For the case d < D/2	For the case d > D/2
			4	w = 6.0 - 12.0 mm, usually associated with spalling	Not Applicable, as it may be full depth	Within 15 days
			5	w > 12 mm, usually associated with spalling, and/or slab rocking under traffic		Full Depth Repair Dismantle and reconstruct affected portion as per norms and specifications - See Para 5.6.4 Within 15 days
4	**Multiple Cracks intersecting with one or more joints**	**w = width of crack**	0	Nil, not discernible	No Action	-
			1	w < 0.2 mm, hair cracks	Seal, and stitch if L > l m. Within 15 days	
			2	w = 0.2 - 0.5 mm. discernible from slow vehicle		
			3	w = 0.5 - 3.0 mm, discernible from fast vehicle	Full depth repair within 15 days	Dismantle, Reinstate subbase, Reconstruct whole slab as per specifications within 30 days
			4	w = 3.0 - 6.0 mm panel broken into 2 or 3 pieces		
			5	w > 6 mm and/or panel broken into more than 4 pieces		
5	**Corner Break**	w = width of crack L = length of crack	0	Nil, not discernible	No Action	-
			1	w < 0.5 mm; only 1 corner broken	Seal with low viscosity epoxy to secure broken parts Within 7 days	Seal with epoxy seal with epoxy Within 7days
			2	w < 1.5 mm; L < 0.6 m, only one corner broken		
			3	w < 1.5 mm; L < 0.6 m, two corners broken	Partial Depth (Refer Figure 8.3 of IRC:SP: 83-2008) Within 15 days	Full depth repair
			4	w > 1.5 mm; L > 0.6 m or three corners broken		

S.No.	Type of Distress	Measured Parameter	Degree of Severity	Assessment Rating	Repair Action	
					For the case d < D/2	For the case d > D/2
			5	hree or four corners broken		Reinstate sub-base, and reconstruct the slab as per norms and specifications within 30days
6	**Punch-out (Applicable to Continuous Reinforced Concrete Pavement (CRCP) only)**	w = width of crack L = length (m/m2)	0	Nil, not discernible		No Action
			1	w < 0.5 mm; L < 3 m/m^2	Not Applicable, as it may be full depth	Seal with low viscosity epoxy to secure broken parts. Within 15days
			2	either w > 0.5 mm or L < 3 m/m^2		
			3	w > 1.5 mm and L < 3 m/m^2		
			4	w > 3 mm, L < 3 m/m^2 and deformation		Full depth repair - Cut out and replace damaged area taking care not to damage reinforcement. Within 30days
			5	w > 3 mm, L > 3 m/m^2 and deformation		
Surface Defects						
7	Ravelling or Honeycomb type surface	r = area damaged surface/total surface of slab (%) h = maximum depth of damage	0	Nil, not discernible	**Short Term**	**Long Term**
					No action.	Not Applicable
			1	r < 2 %	Local repair of areas damaged and liable to be damaged. Within 15 days	
			2	r = 2 - 10 %		
			3	r = 10-25%	Bonded Inlay, 2 or 3 slabs if Affecting. Within 30 days	
			4	r = 25 - 50 %		

S.No.	Type of Distress	Measured Parameter	Degree of Severity	Assessment Rating	Repair Action	
					For the case d < D/2	For the case d > D/2
			5	r > 50% and h > 25 mm	Reconstruct slabs, 4 or more slabs if affecting. Within 30 days	
8	**Scaling**	r = damaged surface/total surface of slab (%) h = maximum depth of damage	0	Nil, not discernible	**Short Term**	**Long Term**
					No action.	Not Applicable
			1	r < **2 %**	Local repair of areas damaged and liable to be damaged. Within 7days	
			2	r = 2 - 10 %		
			3	r = 10 - 20%	Bonded Inlay within 15 days	
			4	r = 20 - 30 %		
			5	r > 30 % and h > 25 mm	Reconstruct slab within 30 days	
9	**Polished Surface/Glazing**	t = texture depth, sand patch test	0		No action.	Not Applicable
			1	t > 1 mm		
			2 '	t = 1 - 0.6 mm	Monitor rate of deterioration	
			3	t = 0.6 - 0.3 mm		
			4	t = 0.3 - 0.1 mm		
			5	t < 0.1 mm	Diamond Grinding if affecting 50% or more slabs in a continuous stretch of minimum 5 km. Within 30 days	
10	**Pop out (Small Hole), Pothole Refer Para 8.4**	n = number/m^2 d = diameter	0	d < 50 mm; h < 25 mm; n < 1 per 5 m^2	No action.	Not Applicable

S.No.	Type of Distress	Measured Parameter	Degree of Severity	Assessment Rating	Repair Action	
					For the case d < D/2	For the case d > D/2
		h = maximum depth	1	d = 50 - 100 mm; h < 50 mm; n < 1 per 5 m^2	Partial depth repair 65 mm deep. Within 15 days	
			2	d = 50 - 100 mm; h > 50 mm; n < 1 per 5 m^2		
			3	d = 100 - 300 mm; h < 100 mm n < 1 per 5 m^2	Partial depth repair 110mm i.e.10 mm more than the depth of the hole. Within 30 days	
			4	d = 100 - 300 mm; h > 100 mm; n < 1 per 5 m^2		
			5	d > 300 mm; h > 100 mm: n > 1 per 5 m^2	Full depth repair. Within 30 days	

Joint Defects						
11	**Joint Seal Defects**	loss or damage L = Length as % total joint length	0	Difficult to discern.	**Short Term**	**Long Term**
					No action.	Not Applicable
			1	Discernible, L< 25% but of little immediate consequence with regard to ingress of water or trapping incompressible material.	Clean joint, inspect later.	

Joint Defects						
			3	Notable. L > 25% insufficient protection against ingress of water and trapping incompressible material.	Clean and reapply sealant in Selected locations. Within 7 days	
			5	Severe; w > 3 mm negligible protection against ingress of water and trapping incompressible material.	Clean, widen and reseal the joint. Within 7 days	
12	**Spalling of Joints**	w = width on either side of the joint L = length of spalled portion (as % joint length)	0	Nil, not discernible	No action.	Not Applicable
			1	w < 10 mm	Apply low viscosity epoxy resin/ mortar in cracked portion. Within 7 days	
			2	w = 10 - 20 mm, L < 25%		
			3	w = 20 - 40 mm, L > 25%	Partial Depth Repair. Within 15 days	
			4	w = 40 - 80 mm, L > 25%	30 - 50 mm deep, h = w + 20% of w, within 30 days	
			5	w > 80 mm, and L > 25%	50 - 100 mm deep repair. H = w + 20% of w. Within 30 days	

Joint Defects						
13	**Faulting (or Stepping) in Cracks or Joints**	f = difference of level	0	not discernible, < 1 mm	No action.	No action.
			1	f < 3 mm		
			2	f = 3 - 6 mm	Determine cause and observe, take action for diamond grinding	Replace the slab as appropriate.
			3	f = 6 - 12 mm	Diamond Grinding	Within 30days
			4	f= 12 - 18 mm	Raise sunken slab.	Replace the slab as appropriate.
			5	f> 18 mm	Strengthen subgrade and sub-base by grouting and raising sunken slab	Within 30days
14	**Blow-up or Buckling**	h = vertical displacement from normal profile	0	Nil, not discernible	**Short Term**	**Long Term**
			1	h < 6 mm	No Action	
			2	h = 6 - 12 mm	Install Signs to Warn Traffic within 7 days	
			3	h = 12 - 25 mm		
			4	h > 25 mm	Full Depth Repair. Within 30 days	

Joint Defects						
			5	shattered slabs, ie 4 or more pieces	Replace broken slabs. Within 30 days	
15	**Depression**	h = negative vertical displacement from normal profile L =length	0	Not discernible, h < 5 mm	No action.	Not Applicable
			1	h = 5 - 15 mm		
			2	h = 15-30 mm, Nos <20% joints	Install Signs to Warn Traffic within 7 days	
			3	h = 30 - 50 mm		
			4	h > 50 mm or > 20% joints	Strengthen subgrade. Reinstate pavement at normal level if L < 20 m. Within 30 days	
			5	h > 100 mm		
16	**Heave**	h = positive vertical displacement from normal profile. L = length	0	Not discernible. h < 5 mm	**Short Term**	**Long Term**
					No action.	Scrabble
			1	h = 5 - 15 mm	Follow up.	
			2	h = 15 - 30 mm, Nos <20% joints	Install Signs to Warn Traffic within 7 days	
			3	h = 30 - 50 mm		
			4	h > 50 mm or > 20% joints		

Joint Defects						
			5	h > 100 mm	Stabilise subgrade. Reinstate pavement at normal level if length < 20 m. Within 30 days	
17	**Bump**	h = vertical displacement from normal profile	0	h < 4 mm	No action	
			1	h = 4 - 7 mm	Grind, in case of new construction within 7 days	Construction Limit for New Construction.
			3	h = 7 - 15 mm	Grind, in case of ongoing Maintenance within 15 days	Replace in case of new construction. Within 30days
			5	h > 15 mm	Full Depth Repair. Within 30 days	Full Depth Repair. Within 30days
18	**Lane to Shoulder Drop-off**	f = difference of level	0	Nil, not discernible < 3mm	**Short Term** No action.	**Long Term**
			1	f = 3 - 10 mm	Spot repair of shoulder within 7 days	
			2	f = 10 - 25 mm		
			3	f = 25 - 50 mm	Fill up shoulder within 7 dayss	
			4	f = 50 - 75 mm		

Joint Defects						
			5	f > 75 mm		For any 100 m stretch Reconstruct shoulder, if affecting 25% or more of stretch. Within 30days
Drainage						
19	**Pumping**	quantity of fines and water expelled through open joints and cracks Nos	0	not discernible	No Action	
			1 to 2	slight/ occasional Nos < 10%	Repair cracks and joints Without delay.	Inspect and repair sub-drainage at distressed sections and upstream.
			3 to 4	appreciable/ Frequent 10 - 25%	Lift or jack slab within 30 days.	
		Nos/100 m stretch	5	abundant, crack development > 25%	Repair distressed pavement sections. Strengthen subgrade and subbase. Replace slab. Within 30 days	
20	**Ponding**	Ponding on slabs due to blockage of drains	0-2	No discernible problem	No action.	
			3 to 4	Blockages observed in drains, but water flowing	Clean drains etc within 7 days, Follow up	Action required to stop water damaging

Joint Defects						
			5	Ponding, accumulation of water observed	-do-	foundation within 30 days.

Table -4: Maintenance Criteria for Safety Related Items and Other Furniture Items:

<table>
<tr><th>Asset Type</th><th>Performance Parameter</th><th>Level of Service (LOS)</th><th>Frequency of Measurement</th><th>Testing Method</th><th>Recommended Remedial measures</th><th>Time limit for Rectification</th><th>Specifications and Standards</th></tr>
<tr><td>Highway</td><td>Availability of Safe Sight Distance</td><td>As per IRC: 52-2019, a minimum of safe stopping sight distance shall be available throughout.
<table><tr><th>Design Speed, kmph</th><th>Desirable Minimum Sight Distance (m)</th><th>Safe Stopping Sight Distance (m)</th></tr><tr><td>50</td><td>120</td><td>60</td></tr><tr><td>40</td><td>90</td><td>45</td></tr></table></td><td>Monthly</td><td>Manual Measurements with Odometer along with video/ image backup</td><td colspan="2">Removal of obstruction within 24 hours, in case of sight line affected by temporary objects such as trees, temporary encroachments.

In case of permanent structure or design deficiency:
Removal of obstruction/improvement of deficiency at the earliest
Speed Restriction boards and suitable traffic calming measures such as transverse bar marking, blinkers, etc. shall be applied during the period of rectification.</td><td>IRC : 52-2019</td></tr>
<tr><td>Pavement Marking</td><td>Wear</td><td><70% of marking remaining</td><td>Bi-Annually</td><td>Visual Assessment as per Annexure-F of IRC:35-2015</td><td>Re - painting</td><td>Cat-1 Defect – within 24 hours
Cat-2 Defect - within 2 months</td><td>IRC:35-2015</td></tr>
</table>

<table>
<tr><th>Asset Type</th><th>Performance Parameter</th><th>Level of Service (LOS)</th><th>Frequency of Measurement</th><th>Testing Method</th><th>Recommended Remedial measures</th><th>Time limit for Rectification</th><th>Specifications and Standards</th></tr>
<tr><td></td><td>Day time Visibility</td><td>During expected life Service Time
Cement Road - 130mcd/m^2/lux
Bituminous Road - 100mcd/m^2/lux</td><td>Monthly</td><td>As per Annexure-D of IRC:35-2015</td><td>Re - painting</td><td>Cat-1 Defect - within 24 hours
Cat-2 Defect - within 2 months</td><td>IRC:35-2015</td></tr>
<tr><td></td><td>Night Time Visibility</td><td><u>Initial and Minimum Performance for Dry Retro reflectivity during night time:</u>
<table>
<tr><th>Design Speed</th><th colspan="2">(RL) Retro Reflectivity (mcd/m^2/lux)</th></tr>
<tr><td></td><td>Initial (7 days)</td><td>Minimum Threshold level (TL) & warranty period required up to 2 years</td></tr>
<tr><td>Up to 65</td><td>200</td><td>80</td></tr>
<tr><td>65 - 100</td><td>250</td><td>120</td></tr>
<tr><td>Above 100</td><td>350</td><td>150</td></tr>
</table>
<u>Initial and Minimum Performance for Night Visibility under wet condition (Retro reflectivity):</u>
Initial 7 days Retro reflectivity: 100 mcd/m^2/lux</td><td>Bi-Annually</td><td>As per Annexure-E of IRC:35-2015</td><td>Re - painting</td><td>Cat-1 Defect - within 24 hours
Cat-2 Defect - within 2 months</td><td>IRC:35-2015</td></tr>
</table>

Asset Type	Performance Parameter	Level of Service (LOS)	Frequency of Measurement	Testing Method	Recommended Remedial measures	Time limit for Rectification	Specifications and Standards
		Minimum Threshold Level: 50 mcd/m^2/lux					
	Skid Resistance	Initial and Minimum performance for Skid Resistance: Initial (7days): 55BPN Min. Threshold: 44BPN *Note: shall be considered under urban/city traffic condition encompassing the locations like pedestrian crossings, bus bay, bus stop, cycle track intersection delineation, transverse bar markings etc	Bi-Annually	As per Annexure-G of IRC:35-2015		Within 24 hours	IRC:35-2015
Road Signs	Shape and Position	Shape and Position as per IRC:67-2022. Signboard should be clearly visible for the design speed of the section.	Daily	Visual with video/image backup	Improvement of shape, in case if shape is damaged. Relocation as per requirement	48 hours in case of Mandatory Signs, Cautionary and Informatory Signs (Single and Dual post signs) 15 Days in case of Gantry/Cantilever Sign boards	IRC:67-2022
	Retro reflectivity	As per specifications in IRC:67-2022	Bi-Annually	Testing of each signboard using Retro Reflectivity Measuring Device. In accordance	Change of signboard	48 hours in case of Mandatory Signs, Cautionary and Informatory Signs (Single and Dual post signs)	IRC:67-2022

Asset Type	Performance Parameter	Level of Service (LOS)	Frequency of Measurement	Testing Method	Recommended Remedial measures	Time limit for Rectification	Specifications and Standards
				with ASTM D 4956-09.		1 Month in case of Gantry/ Cantilever Sign boards	
Kerb	Kerb Height	As per IRC 86:1983 depending upon type of Kerb	Bi-Annually	Use of distance measuring tape	Raising Kerb Height	Within 1 Month	RC 86:1983
	Kerb Painting	Functionality: Functioning of Kerb painting as intended	Daily	Visual with video/image backup	Kerb Repainting	Within 7-days	RC 35:2015
Other Road Furniture	Reflective Pavement Markers (Road Studs)	Numbers and Functionality as per specifications in IRC:SP 73-2018 and IRC:35-2015, unless specified in Schedule-B.	Daily	Counting	New Installation	Within 2 months	IRC:SP:73-2018, IRC:35-2022
	Pedestrian Guardrail	Functionality: Functioning of guardrail as intended	Daily	Visual with video/image backup	Rectification	Within 15 days	IRC:SP:73-2018,
	Traffic Safety Barriers	Functionality: Functioning of Safety Barriers as intended	Daily	Visual with video/image backup	Rectification	Within 7 days	IRC:SP:73-2018, IRC:119-2015
	End Treatment of Traffic Safety Barriers	Functionality: Functioning of End Treatment as intended	Daily	Visual with video/image backup	Rectification	Within 7 days	IRC:SP:73-2018, IRC:119-2015
	Attenuators	Functionality: Functioning of Attenuators as intended	Daily	Visual with video/image backup	Rectification	Within 7 days	IRC:SP-2014, IRC:119-2015
	Guard Posts and Delineators	Functionality: Functioning of Guard Posts and Delineators as intended	Daily	Visual with video/image backup	Rectification	Within 15 days	IRC: 79 – 2019

Asset Type	Performance Parameter	Level of Service (LOS)	Frequency of Measurement	Testing Method	Recommended Remedial measures	Time limit for Rectification	Specifications and Standards
	Overhead Sign Structure	Overhead sign structure shall be structurally adequate	Daily	Visual with video/image backup	Rectification	Within 15 days	IRC:67-2022
	Traffic Blinkers	Functionality: Functioning of Traffic Blinkers as intended	Daily	Visual with video/image backup	Rectification	Within 7 days	IRC:SP:73-2018,
Highway Lighting System	Highway Lights	Illumination: Minimum 40 Lux illumination on the road surface	Daily	The illumination level shall be measured with luxmeter	Improvement in Lighting System	24 hours	IRC:SP:73-2018
		No major failure in the lighting system	Daily	-	Rectification of failure	24 hours	IRC:SP:73-2018,
		No minor failure in the lighting system	Monthly	-	Rectification of failure	8 hours	IRC:SP:73-2018,
	Toll Plaza Canopy Lights	Minimum 40 Lux illumination on the road surface	Daily	The illumination level shall be measured with luxmeter	Improvement in Lighting System	24 hours	IRC:SP:73-2018,
		No major/minor failure in the lighting system	Daily	-	Rectification of failure	8 hours	IRC:SP:73-2018,

Asset Type	Performance Parameter	Level of Service (LOS)	Frequency of Measurement	Testing Method	Recommended Remedial measures	Time limit for Rectification	Specifications and Standards
Trees and Plantation including median plantation	Obstruction in a minimum head-room of 5.5 m above carriageway or obstruction in visibility of road signs	No obstruction due to trees	Monthly	Visual with video/image backup	Removal of trees	Immediate	IRC:SP:73-2018,
	Deterioration in health of trees and bushes	Health of plantation shall be as per requirement of specifications & instructions issued by Authority from time to time	Daily	Visual with video/image backup	Timely watering and treatment. Or Replacement of Trees and Bushes.	Within 90 days	IRC:SP:73-2018,
	Vegetation affecting sight line and road structures	Sight line shall be free from obstruction by vegetation	Daily	Visual with video/image backup	Removal of Trees	Immediate	IRC:SP:73-2018,
Rest Areas	Cleaning of toilets	-	Daily	-	-	Every 4 hours	
	Defects in electrical, water and sanitary installations	-	Daily	-	Rectification	24 hours	

Asset Type	Performance Parameter	Level of Service (LOS)	Frequency of Measurement	Testing Method	Recommended Remedial measures	Time limit for Rectification	Specifications and Standards
Other Project Facilities and Approach roads	Damage or deterioration in Approach Roads, pedestrian facilities, truck lay-bys, bus-bays, bus-shelters, cattle crossings, Traffic Aid Posts, Medical Aid Posts and other works		Daily	-	Rectification	15 days	IRC:SP:73-2018,

Table 5: Maintenance Criteria for Structures and Culverts:

Asset Type	Performance Parameter	Level of Service (LOS)	Frequency of Measurement	Testing Method	Recommended Remedial measures	Time limit for Rectification	Specifications and Standards
Pipe/box/slab culverts	Free waterway/unobstructed flow section	85% of culvert normal flow area to available.	2 times in a year (before and after rainy season)	Inspection by Bridge Engineer as per IRC SP: 35-1990 and recording of depth of silting and area of vegetation.	Cleaning silt up soils and debris in culvert barrel after rainy season, removal of bushes and vegetation, U/s of barrel, under barrel and D/s of barrel before rainy season.	15 days before onset of monsoon and within 30 days after end of rainy season.	IRC 5-2015, IRC SP:40-2019 and IRC SP:13-2004
	Leak-proof expansion joints if any	No leakage through expansion joints	Bi-Annually	Physical inspection of expansion joints as per IRC SP: 35-1990 if any, for leakage strains on walls at joints.	Fixing with sealant suitably	30 days or before onset of rains whichever comes earlier	IRC SP:40-2019 and IRC SP:69-2011
	Structurally sound	Spalling of concrete not	Bi-Annually	Detailed inspection of all components of	Repairs to spalling, cracking, delamination,	15 days	IRC SP 40-2019 and

Asset Type	Performance Parameter	Level of Service (LOS)	Frequency of Measurement	Testing Method	Recommended Remedial measures	Time limit for Rectification	Specifications and Standards
		more than 0.25 sqm		culvert as per IRC SP:35-1990 and recording the defects	rusting shall be followed as per IRC: SP:40-2019.		MORTH Specifications clause 2800
		Delamination of concrete not more than 0.25 Sqm.					
		Cracks wider than 0.3 mm not more than 1m aggregate length					
	Protection works in good condition	Damaged of rough stone apron or bank revetment not more than 3 sqm, damage to solid apron (concrete apron) not more than 1 sqm	2 times in a year (before and after rainy season)	Condition survey as per IRC SP:35-1990	Repairs to damaged aprons and pitching	30 days after defect observation or 2 weeks before onset of rainy season whichever is earlier.	IRC: SP 40-2019 and IRC: SP:13-2004.
Bridges including ROBs Flyover etc. as applicable	Riding quality or user comfort	No pothole in wearing coat on bridge deck	Daily	Visual inspection as per IRC SP:35-1990	Repairs to BC or wearing coat	15 days	MORT&H Specification 2811

Asset Type	Performance Parameter	Level of Service (LOS)	Frequency of Measurement	Testing Method	Recommended Remedial measures	Time limit for Rectification	Specifications and Standards
Bridge - Super Structure	Bumps	No bump at expansion joint	Daily	Visual inspection as per IRC SP:35-1990	Repairs to BC on either side of expansion joints, profile correction course on approach slab in case of settlement to approach embankment	15 days	MORT&H Specification 3004.2 & 2811.
	User safety (condition of crash barrier and guard rail)	No damaged or missing stretch of crash barrier or pedestrian hand railing	Daily	Visual inspection and detailed condition survey as per IRC SP: 35-1990.	Repairs and replacement of safety barriers as the case may be	3days	IRC: 5-2015, IRC SP: 73-2018 and IRC SP: 40-2019.
	Rusted reinforcement	Not more than 0.25 sq.m	Bi-Annually	Detailed condition survey as per IRC SP: 35-1990 using Mobile Bridge Inspection Unit	All the corroded reinforcement shall need to be thoroughly cleaned from rusting and applied with anti-corrosive coating before carrying out the repairs to affected concrete portion with epoxy mortar / concrete.	15 days	IRC SP: 40-2019 and MORTH Specification 1600.
	Spalling of concrete	Not more than 0.50 sq.m					
	Delamination	Not more than 0.50 sq.m					
	Cracks wider than 0.30 mm	Not more than 1m total length	Bi-Annually	Detailed condition survey as per IRC SP: 35-1990 using Mobile Bridge Inspection Unit	Grouting with epoxy mortar, investigating causes for cracks development and carry out necessary rehabilitation.	48 Hours	IRC SP: 40-2019 and MORTH Specification 2800.

Asset Type	Performance Parameter	Level of Service (LOS)	Frequency of Measurement	Testing Method	Recommended Remedial measures	Time limit for Rectification	Specifications and Standards
	Rainwater seepage through deck slab	Leakage – nil	Quarterly	Detailed condition survey as per IRC SP: 35-1990 using Mobile Bridge Inspection Unit	Grouting of deck slab at leakage areas, waterproofing, repairs to drainage spouts	1 months	MORTH specifications 2600 & 2700.
	Deflection due to permanent loads and live loads	Within design limits.	Once in every 10 years for spans more than 40 m	Load test method	Carry out major rehabilitation works on bridge to retain original design loads capacity	6 months	IRC SP: 51-2015.
	Vibrations in bridge deck due to moving trucks	Frequency of vibrations shall not be more than 5 Hz	Once in every 5 years for spans more than 30m and every 10 years for spans between 15 to 30 m	Laser displacement sensors or laser vibro-meters	Strengthening of super structure	4 months	AASHTO LRFD specifications
	Leakage in Expansion joints	No damage to elastomeric sealant compound in strip seal expansion joint, no leakage of rain water through expansion joint in	Bi-Annually	Detailed condition survey as per IRC SP:35-1990 using Mobile Bridge Inspection Unit	Replace of seal in expansion joint	15 days	MORTH specifications 2600 and IRC SP: 40-2019.

Asset Type	Performance Parameter	Level of Service (LOS)	Frequency of Measurement	Testing Method	Recommended Remedial measures	Time limit for Rectification	Specifications and Standards
		case of buried and asphalt plug and copper strip joint.					
	Debris and dust in strip seal expansion joint	No dust or debris in expansion joint gap.	Monthly	Detailed condition survey as per IRC SP:35-1990 using Mobile Bridge Inspection Unit	Cleaning of expansion joint gaps thoroughly	3 days	MORTH specifications 2600 and IRC SP: 40-2019.
	Drainage spouts	No down take pipe missing/broken below soffit of the deck slab. No silt, debris, clogging of drainage spout collection chamber.	Monthly	Detailed condition survey as per IRC SP: 35-1990 using Mobile Bridge Inspection Unit	Cleaning of drainage spouts thoroughly. Replacement of missing/broken down take pipes with a minimum pipe extension of 500mm below soffit of slab. Providing sealant around the drainage spout if any leakages observed.	3 days	MORTH specification 2700.

Asset Type	Performance Parameter	Level of Service (LOS)	Frequency of Measurement	Testing Method	Recommended Remedial measures	Time limit for Rectification	Specifications and Standards
Bridge-substructure	Cracks/spalling of concrete/ rusted steel	No cracks, spalling of concrete and rusted steel	Bi-Annually	Detailed condition survey as per IRC SP: 35-1990 using Mobile Bridge Inspection Unit	All the corroded reinforcement shall need to be thoroughly cleaned from rusting and applied with anti-corrosive coating before carrying out repairs to substructure by grouting/guniting and micro concreting depending on type of defect noticed	30 days	IRC SP: 40-2019 and MORTH specification 2800.
	Bearings	Delamination of bearing reinforcement not more than 5%, cracking or tearing of rubber not more than 2 locations per side, no rupture of reinforcement or rubber	Bi-Annually	Detailed condition survey as per IRC SP: 35-1990 using Mobile Bridge Inspection Unit	In case of failure of even one bearing on any pier/abutment, all the bearings on that pier/abutment shall be replaced, in order to get uniform load transfer on to bearings.	3 months	MORTH specification 2810, IRC 83 and IRC SP: 40-2019.

Asset Type	Performance Parameter	Level of Service (LOS)	Frequency of Measurement	Testing Method	Recommended Remedial measures	Time limit for Rectification	Specifications and Standards
Bridge Foundation	Scouring around foundations	Scouring shall not be lower than maximum scour level for the bridge	Bi-Annually	Condition survey and visual inspection as per IRC SP:35-1990 using Mobile Bridge Inspection Unit. In case of doubt, use Underwater camera for inspection of deep wells in major Rivers.	Suitable protection works around pier/abutment	1 month	IRC SP: 40-2019, MORTH specification 2500
	Protection works in good condition	Damaged of rough stone apron or bank revetment not more than 3 sq.m, damage to solid apron (concrete apron) not more than 1 sq.m	2 times in a year (before and after rainy season)	Condition survey as per IRC SP:35-1990	Repairs to damaged aprons and pitching.	30 days after defect observation or 2 weeks before onset of rainy season whichever is earlier.	IRC: SP 40-2019 and IRC: SP:13-2022.
Slope Protection (Landslide & Sinking)	Movement & deformation in landslide & sinking zones	Movement & deformation beyond permissible limit should be made	14 Days	Once in month/ as when noticed	Standard method as approved by the Authority QA/QC plan of the contractor	30 days after defect observation or 2 weeks before onset of rainy season whichever is earlier	Refer the Schedule B and Schedule D

Asset Type	Performance Parameter	Level of Service (LOS)	Frequency of Measurement	Testing Method	Recommended Remedial measures	Time limit for Rectification	Specifications and Standards
		good to the design standard					
	Any material or defect development in workmanship used in protection work	The material and workmanship specification should be in accordance with Schedule B and Schedule D	14 Days	Once in month/ as when noticed	Standard method as approved by the Authority QA/QC plan of the contractor	30 days after defect observation or 2 weeks before onset of rainy season whichever is earlier.	Refer the Schedule B and Schedule D

Note: Any Structure during the entire contract period which is found that does not complies with all requirements of this Table will be prepared, rehabilitated or even reconstructed under the scope of the contractor.

Table 5: Maintenance Criteria for Hill Roads

In addition to above, for hill roads the following provisions for maintenance is also to done.

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: For all tables 1 to 5 above, latest BIS & IRC standards (even those not indicated herewith) along with MoRTH specifications shall be binding for all maintenance activities.

A. Flexible Pavement

Nature of Defect or deficiency		Time limit for repair/ rectification
(b)	**Granular earth shoulders, side slopes, drains and culverts**	
(i)	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
(ii)	Edge drop at shoulders exceeding 40 mm	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 (twenty four) 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 (forty eight) hours
(ii)	Painting of km stone, railing, parapets, crash barriers	As and when required/ Once every year
(iii)	Damaged/missing signs road requiring replacement	7 (seven) days
(iv)	Damage to road mark ups	7 (seven) days
(d)	**Road lighting**	
(i)	Any major failure of the system	24 (twenty four) hours
(ii)	Faults and minor failures	8 (eight) hours
(e)	**Trees and plantation**	

Nature of Defect or deficiency		Time limit for repair/ rectification
(i)	Obstruction in a minimum head- room of 5 m above carriageway or obstruction in visibility of road signs	24 (twenty four)hours
(ii)	Removal of fallen trees from carriageway	4 (four) 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 (four) hours
(ii)	Defects in electrical, water and sanitary installations	24 (twenty four) hours
(g)	**[Toll Plaza]**	
(h)	**Other Project Facilities and Approach roads**	
(i)	Damage in approach roads, pedestrian facilities, truck lay- byes, bus-bays, bus-shelters, cattle crossings, [Traffic Aid Posts, Medical Aid Posts], Rain water harvesting/Artificial Recharge Unit and service roads	15 (fifteen) days
(ii)	Damaged vehicles or debris on the road	4 (four) hours
(iii)	Malfunctioning of the mobile crane	4 (four) hours
Bridges		
(a)	**Superstructure**	
(i)	Any damage, cracks, spalling/ scaling Temporary measures Permanent measures	within 48 (forty eight) hours within 15 (fifteen) days or as specified by the Authority's Engineer

Nature of Defect or deficiency		Time limit for repair/ rectification
(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, damages, tilting or shifting of bearings	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 to 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

Nature of Defect or deficiency		Time limit for repair/ rectification
(g)	Slope Protection (Landslide & Sinking) Any damage, Temporary measures Permanent measures	 within 48 (forty eight) hours within 15 (fifteen) days or as specified by the Authority's Engineer
(h)	**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

(i) 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). Licence for use of explosives;

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

e). Licence 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 required under Applicable Laws.

(ii) 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 Clauses 7.1 and 19.2)

Form of Bank Guarantee

Annex-I

(See Clause 7.1)

[Performance Security/Additional Performance Security]

To,

The Managing Director,
National Highways & Infrastructure Development Corporation Limited (NHIDCL)

WHEREAS:

(A) _____[name and address of contractor] (hereinafter called the **"Contractor**") and National Highways & Infrastructure Development Corporation, 1st & 2nd Floor, Tower A, World Trade Centre, Nauroji Nagar, New Delhi – 110029, (hereinafter called the **"Authority"**) have entered into an agreement (hereinafter called the **"Agreement"**) for "Construction of Slope Protection work on section of Km 25.600 to Km 26.100 (Bagrakot-Kafer) of NH-717A in the state of West Bengal (Pkg-IVC)" on Engineering, Procurement and Construction (the "EPC") basis, 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/ Defects Liability Period and Maintenance Period} (as defined in the Agreement) in a sum of Rs….. cr. (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 the {Construction Period/ Defects Liability Period and Maintenance 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 differences 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 ****[$]. 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 authorised 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 paragraph 8 above or until it is released earlier by the Authority pursuant to the provisions of the Agreement.

12. This guarantee shall also be operatable 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. The guarantor/bank hereby confirms that it is on the SFMS (Structural Finance Messaging System) platform & shall invariably send an advice of this Bank Guarantee to the designated bank of NHIDCL, detail of which is as under:

S. No.	Particulars	Details
1.	Name of Beneficiary	National Highways & Infrastructure Development Corporation Ltd. (NHIDCL)
2.	Name of Bank	Canara Bank
3.	Account No.	8598201005819
4.	IFSC Code	CNRB0008598

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

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.

Format of Insurance Surety Bond

[Performance Security/Additional Performance Security]

To

The Managing Director,
National Highway & Highway Development Corporation Ltd.
1st Floor, Tower-A, World Trade Centre, Nauroji Nagar
New Delhi- 110029

WHEREAS_____[name and address of Contractor]

(hereafter called the "Contractor") has undertaken, in pursuance of Letter of Acceptance (LOA) No. _____Dated_____ for construction of "**Specialized Slope Protection Work of Section from Km. 25.600 to Km. 26.100 (Bagrakot - Kafer) of NH - 717 A in the State of West Bengal on EPC mode (Pkg-IVC)"** (hereinafter called the "Contract").

AND WHEREAS the Contract requires the Contractor to furnish an [Performance Security/Additional Performance Security] for due and faithful performance of its obligations, under and in accordance with the Contract, during the [Construction Period/ Defects Liability Period and Maintenance Period) in a sum of Rs …….. cr. (Rupees .... crore) (the "Surety Bond amount")

AND WHEREAS we, through our branch at ……. (the "Surety Insurer") have agreed to furnish this Surety Bond by way of Performance security.

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

1. The Surety Insurer herby unconditionally and irrevocably guarantees the due and faithful performance of the Contractor's obligations during the (Construction Period/ Defects Liability Period and Maintenance Period' under and in accordance with the Contract, 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 Surety Bond 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 [Superintending Engineer of Ministry of Road Transport Et Highways], 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 Contract shall be conclusive, final and binding on the Surety Insurer. The Surety Insurer 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 Contract and its decision that the Contractor is in default shall be final and binding on the Surety Insurer, notwithstanding any differences 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 Surety Bond, the Authority shalt be entitled to act as if the Surety Insurer were the principal debtor and any/Change in the constitution of the Contractor and/or the Surety Insurer, whether by their absorption with any other body or corporation or otherwise, shalt not in any way or manner affect the liability or obligation of the Surety insurer under this Surety Bond

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

5. The Authority shall have the liberty, without affecting in any manner the liability of the Surety Insurer under this Surety Bond, to vary at any time, the terms and conditions of the Contract 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 Contract 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 Contract and/or the securities available to the Authority, and the Surety Insurer 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 Surety Insurer from its liability and obligation under this Surety Bond and the Surety Insurer hereby waives all of its rights under any such law

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

7. Notwithstanding anything contained hereinbefore, the liability of the Surety Insurer under this Surety Bond is restricted to the Surety Bond Amount and this Surety Bond 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 Surety Insurer under this Surety Bond all rights of the Authority under this Surety Bond shall be forfeited and the Surety Insurer shall be relieved from its liabilities hereunder

8. The Surety Bond shall cease to be in force and effect on ****[$]. Unless3 a demand or claim under this Surety Bond is made in writing before expiry of the Surety Bond, the Surety Insurer shall be discharged from its liabilities hereunder.

9. The Surety Insurer undertakes not to revoke this Surety Bond 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 Surety Bond and the undersigned has full powers to do so on behalf of the Surety Insurer.

10. Any notice by way of request, demand or otherwise hereunder may be sent by post addressed to the Surety Insurer 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 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 Surety Bond shall come into force with immediate effect and shall remain in force and effect for up to the date specified in paragraph 8 above or until it is released earlier by the Authority pursuant to the provisions of the Contract.

12. 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:

[$]Insert date atleast 2 (two) years from the date of issuance of this Surety Bond (in accordance with Clause 2.21 of the RFP). The Contractors can submit the BG for periods of two years at one time and keep on renewing the same till the DLP is over if they have problems in getting the BG in one go for the entire DLP.

(Signature)

(Name)

(Designation)

(Code Number)

(Address)

Annex – II

(Schedule - G)

(See Clause 19.2)

Annex-IForm for Guarantee for Advance Payment

The Managing Director,
National Highways & Infrastructure Development Corporation Limited (NHIDCL)
New Delhi

WHEREAS:

(A) ……[name and address of contractor] (hereinafter called the "**Contractor**") has executed an agreement (hereinafter called the "**Agreement**") with the National Highways & Infrastructure Development Corporation, 1st & 2nd Floor, Tower A, World Trade Centre, Nauroji Nagar, New Delhi – 110029, (hereinafter called the **"Authority"**) have entered (hereinafter called the "**Authority**") for "Construction of Slope Protection work on section of Km 25.600 to Km 26.100 (Bagrakot-Kafer) of NH-717A in the state of West Bengal(Pkg-IVC)" on Engineering, Procurement and Construction (the "EPC") basis, subject to and in accordance with the provisions of the Agreement

(B) In accordance with Clause 19.2 of the Agreement, the Authority shall make to the Contractor an interest bearing @*Bank Rate + 3%* advance payment (herein after called "**Advance Payment**") equal to 10% (ten per cent) of the Contract Price; and that the Advance Payment shall be made in two instalments 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 instalment to remain effective till the complete and full repayment of the instalment of the Advance Payment as security for compliance with its obligations in accordance with the Agreement. The amount of {first/second} instalment of the Advance Payment is Rs. ------ cr. (Rupees ------ crore) and the amount of this Guarantee is Rs. ------- cr. (Rupees ------ crore) (the **"Guarantee Amount")**[$]**.**

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

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 repayment on time of the aforesaid instalment 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

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

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 instalment 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 differences 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 ****.[$] 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 authorised 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 up to the date specified in paragraph 8 above or until it is released earlier by the Authority pursuant to the provisions of the Agreement.

12. This guarantee shall also be operatable 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. The guarantor/bank hereby confirms that it is on the SFMS (Structural Finance Messaging System) platform & shall invariably send an advice of this Bank Guarantee to the designated bank of MORT&H, details of which is as under:

S. No.	Particulars	Details
1.	Name of Beneficiary	National Highways & Infrastructure Development Corporation Limited (NHIDCL)
2.	Name of Bank	Canara Bank

[$] 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).

3.	Account No.	8598201005819
4.	IFSC Code	CNRB0008598

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.

Schedule - H

(See Clauses10.1 (iv) and 19.3)

Contract Price Weightages

1. The Contract Price for this Agreement is Rs……

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

Item	Weightage in Percentage to the Contract Price	Stage of for Payment	Percentage Weight in particular Item
1	2	3	4
Road works including culverts	2.80%	**A Reconstruction/New realignment/bypass** (Flexible pavement)	
		(1) Earthwork up to top of the sub-grade	4.45%
		(2) Cement Treated Sub-Base Course (CTSB)	14.79%
		(3) Bituminous Stabilized Material (BSM)	30.18%
		(4) Bituminous Concrete (BC)	19.18%
		(5) Earthen / Granular Shoulders	0.11%
		B - Reconstruction and New Construction Culverts.	
		(1) Culverts	31.29%
Slope Protection Works	89.65%	**A- Excavation of Hill**	9.64%
		B- Reinforced Soil Wall with Gabion Facia and Vertical SDA including backfilling, filter media etc.	6.18%
		C- Anchor works	
		(1) Self Drilling Anchors including end plates, grouting etc.	
		(a) Valley Side	11.89%
		(b) Hill Side	22.24%
		(2) Prestressed Anchors including RCC pad, nail heads, stressing etc.	0.00%
		(a) Valley Side	6.85%
		(b) Hill Side	9.61%
		D- Gabion Wall (hill & valley side) including filter media, backfilling etc	3.66%
		E- Erosion Control	
		(1) High Tensile rolled cable net System	15.76%

		(2) Mechanically Woven Double Twisted Hexagonal Shaped Wire Mesh	1.06%
		(3) 3D net/mat consisting of UV stabilized non degradable Polypropylene/ Polyethylene/ Nylon or similar polymer fibres	5.17%
		(4) Hydroseeding/ Hydromulching on the hill side and valley side slope surface for erosion control by means of vegetation	7.46%
		(5) Geo-jute/Coir-Mat mat with spraying of seeds	0.48%
Other works	7.23%	(1) Drainage works (hill & valley side) including berm drains, toe drains etc.	11.77%
		(2) Perforated PVC pipes (hill & valley side)	83.87%
		(3) Cascade Drain	1.59%
		(4) Chute Drain	2.17%
		(5) Road Markings & Studs	0.37%
		(6) Road Signs, Safety Devices, Road Furniture's Etc.	0.23%
Utility Shifting	0.32%	Utility Shifting	
		(i)EHT crossings	0.000%
		(ii)HT/LT line	50.000%
		(iii) HT/LT crossings	0.000%
		(iv)Water pipeline	50.000%
		(v)Water pipeline crossing	0.000%
		(vi)Sewage Lines	0.000%
		(vii) Sewage Lines crossing	0.000%

Procedure of estimating the value of work done.

(i) Road works Procedure for estimating the value of road work done shall be as follows:

Stage of for Payment	**Percentage Weight in particular Item**	**Payment Procedure**
Road works including culverts		
A-Reconstruction/New realignment/ bypass (Flexible pavement)		
(1) Earthwork up to top of the sub-grade	4.45%	Unit of measurement is linear length. Payment of each stage shall be made on pro rata basis on completion of a stage in full length.
(2) Cement Treated Sub-Base Course (CTSB)	14.79%	
(3) Bituminous Stabilized Material (BSM)	30.18%	
(4) Bituminous Concrete(BC)	19.18%	
(5) Earthen / Granular Shoulders	0.11%	
B - Reconstruction and New Construction Culverts.		

Stage of for Payment	Percentage Weight in particular Item	Payment Procedure
(1) Culverts	31.29%	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 atleast one culvert. 75% of the cost will be payable on completion of box/abutments and slab/pipe and head wall. Remaining 25% will become payable on completion of protection works including return/wing walls and any other work associated with culverts.
Slope Protection Works		
A- Excavation of Hill	9.64%	Unit of measurement is area in sqm. Payment shall be made on pro rata basis on completion of each stage in an area of not less than 10% of the total area.
B- Reinforced Soil Wall with Gabion Facia and Vertical SDA including backfilling, filter media etc.	6.18%	Unit of measurement is linear length. Payment shall be made on pro rata basis on completion of each stage in a length of not less than 10% of the total length.
C- Anchor works		
(1) Self Drilling Anchors including end plates, grouting etc.		
(a) Valley Side	11.89%	Unit of measurement is linear length of anchors. Payment shall be made on pro rata basis on completion of each stage in a length of not less than 10% of the total anchor length.
(b) Hill Side	22.24%	
(2) Prestressed Anchors including RCC pad, nail heads, stressing etc.		
(a) Valley Side	6.85%	Unit of measurement is linear length of anchors. Payment shall be made on pro rata basis on completion of each stage in a length of not less than 10% of the total anchor length.
(b) Hill Side	9.61%	
D- Gabion Wall (hill & valley side) including filter media, backfilling etc	3.66%	Unit of measurement is linear length. Payment shall be made on pro rata basis on completion of each stage in a length of not less than 10% of the total length.
E- Erosion Control		

Stage of for Payment	Percentage Weight in particular Item	Payment Procedure
(1) High Tensile rolled cable net System	15.76%	Unit of measurement is area in sqm. Payment shall be made on pro rata basis on completion of each stage in an area of not less than 10% of the total area.
(2) Mechanically Woven Double Twisted Hexagonal Shaped Wire Mesh	1.06%	
(3) 3D net/mat consisting of UV stabilized non degradable Polypropylene/ Polyethylene/ Nylon or similar polymer fibres	5.17%	
(4) Hydroseeding/ Hydromulching on the hill side and valley side slope surface for erosion control by means of vegetation	7.46%	
(5) Geo-jute/Coir-Mat mat with spraying of seeds of Lemon grass/Dedonia/Vetiver etc.,	0.48%	
Other works		
(1) Drainage works (hill & valley side) including berm drains, toe drains etc.	11.77%	Unit of measurement is linear length. Payment shall be made on pro rata basis on completion of each stage in a length of not less than 10% of the total length.
(2) Perforated PVC pipes (hill & valley side)	83.87%	Unit of measurement is linear length of pipes. Payment shall be made on pro rata basis on completion of each stage in a length of not less than 10% of the total pipe length.
(3) Cascade Drain	1.59%	Unit of measurement is linear length in metre. Payment shall be made on pro rata basis on completion of a stage in a length of not less than 100 m on one side.
(4) Chute Drain	2.17%	
(2) Road Markings & Studs	0.37%	Unit of measurement is linear length in km. Payment shall be made on completion of total scope.
(3) Road Signs, Safety Devices, Road Furniture's Etc.	0.23%	
Utility Shifting		
(i) HT/LT Line	**50.0 %**	Unit of measurement is as per completed activities. Cost per activity shall be determined on pro-rata basis as per its weightage with reference to total cost of LT/ HT line. Payment shall be made for completed activity. (The average weightage of major activities (only for payment purpose) in shifting

Stage of for Payment	Percentage Weight in particular Item	Payment Procedure
		work is (i) Erection of Poles-20% (ii) Conductor stringing including laying of cable30%, (iii) DTR erection (if involved)-10% and (iv) Charging of line including dismantling and site clearance-40% (with DTR) and without DTR
(ii)Water pipeline	**50.0%**	Unit of measurement is as per completed activities. Cost per activity shall be determined on pro-rata basis as per its weightage with reference to total cost of pipe line. Payment shall be made for completed activity. (The average weightage of major activities (only for payment purpose) in shifting work is laying of pipe-50%, Charging of line including all miscellaneous works and dismantling and site clearance-50%

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

Where

P = Contract Price

L = Total equivalent intermediate-Lane length in km as defined above

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 including the length not handed over to the Contractor under clause 8.3 of this Contract Agreement 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

2. Procedure for payment for Maintenance

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

(b) Payment for Maintenance shall be made in accordance with the provisions of Clause 19.7.

Schedule - I

(See Clause 10.2 (iv))

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

A minimum list of the drawings of the various components / elements of the Project Highway and project facilities required to be submitted by the Concessionaire is given below:

a) Detailed Drawings of Plan & Profile with Horizontal intersection Point, Vertical Intersection Points, elements of curves, and sight distances.

b) Detailed Drawings of Cross-section at 10.0m interval along the alignment.

c) Typical Cross-section with details of pavement thickness.

d) Detailed Drawings of all Junctions/intersections.

e) Detailed drawings for individual culverts.

f) Drawing of Plan, Section will all relevant details showing mitigation measures in entire project section.

g) Detailed Drawings of road drainage measures and drainage Plan.

h) Detailed Drawings of slope protection measures like Secured Drapery in Hill Side and RS wall in Valley Side.

i) Detailed Drawings of Nailed Gabion Wall in hill side and Gabion Wall with RS wall in Valley Side.

j) Drawing and details of hydro-seeding.

k) Drawings for Road sign with furniture and drainage system etc.

l) Drawings of road furniture items including traffic signage, markings, safety barriers (modified Thrie beam, new jersey type crash barrier) etc.

m) Drawings for Landscaping, Horticulture & Tree Plantation.

n) Detailed Utility Shifting Drawings (Electrical, HT/EHT Line and Water Supply line etc.)

o) Drawings for traffic diversion plans and traffic control measures in construction zones.

p) Any other drawing relevant to the Project Highway as desired by Authority/Client.

Schedule - J

(See Clause 10.3 (ii))

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

(i) Project Milestone-I shall occur on the date falling on the **192nd (One Hundred Ninety Two)** day from the Appointed Date (the **"Project Milestone- I"**).

(ii) 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

(i) Project Milestone-II shall occur on the date falling on the **329th (Three Hundred and Twenty Nine)** day from the Appointed Date (the **"Project Milestone- II"**).

(ii) 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 35% (thirty five per cent) of the Contract Price and should have started construction of all structures

4. Project Milestone-III

(i) Project Milestone-III shall occur on the date falling on the **466th (Four Hundred and Sixty Six) day from the Appointed Date (the "Project Milestone- III").**

(ii) 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 70% (seventy per cent) of the Contract Price and should have started construction of all project facilities.

5. Scheduled Completion Date

(i) The Scheduled Completion Date shall occur on the **548th (Five Hundred and Forty Eight)** day from the Appointed Date.

(ii) 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

(i) 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.

(ii) 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

(i) 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 (to be decided with Authority's Engineer at the time of physical tests as per standard).

(ii) Riding quality test: Riding quality of each lane of the carriageway shall be checked with the help of a Network Survey Vehicle (NSV) fitted with latest equipment's and the maximum permissible roughness for purposes of this Test shall be 2,000 (two thousand) mm for each kilometre.

(iii) 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 Non-destructive 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.

(iv) 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.

(v) 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.

(vi) 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.

5. The Authority Engineer will carry out tests with following equipment at his own cost in the presence of contractor's representative.

Sr. No.	Key metrics of Asset	Equipment to be used	Frequency of condition survey
1	Surface defects of pavement	Network Survey Vehicle (NSV)	At least twice a year (As per survey months defined for the state basis rainy season)
2	Roughness of pavement	Network Survey Vehicle (NSV)	At least twice a year (As per survey months defined for the state basis rainy season)
3	Strength of pavement	Falling Weight Deflectometer (FWD)	At least once a year
4	Bridges	Mobile Bridge Inspection Unit (MBU)	At least twice a year (As per survey months defined for the state basis rainy season)
5	Road signs	Retro-reflectometer	At least twice a year (As per survey months defined for the state basis rainy season)

The first testing with the help of NSV shall be conducted at the time of issue of Completion Certificate.

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**"), for Rehabilitation and Upgradation to four lane configuration & strengthening of Construction of Slope Protection work on section of Km 25.600 to Km 26.100 (Bagrakot-Kafer) of NH-717A in the state of West Bengal on Engineering, Procurement and Construction (EPC) basis 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

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

(ii) 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.

(iii) 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

(i) 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%

S. No.	Item/Defect/Deficiency	Percentage
(iii)	Painting, repairs/replacement kerbs, railings, parapets, guideposts/crash barriers	5%
(iv)	Any Defects in Special slope protection works	35%
(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**	
(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%

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

$$R = {}^{P}/_{100} \times (M1 \; or \; M2) \times {}^{L1}/_{L}$$

Where,

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

M1= Monthly lump-sum payment in accordance para 1.2 above of this Schedule

M2= Monthly lump-sum payment in accordance para 1.2 above of this Schedule

L1= Non-complying length L = Total length of the road,

R= Reduction (the amount to be deducted for non-compliance 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

(i) 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 shall apply for selection of an experienced firm to discharge the functions and duties of an Authority's Engineer.

(ii) In the event of termination of the Technical Consultants appointed in accordance with the provisions of Paragraph 1.1, 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

(iii) 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

(iv) 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)

Annex-I: Terms of Reference for Authority's Engineer

1. Scope

(i) 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 National Highways & Infrastructure Development Corporation, 1st Floor, Tower A, World Trade Centre, Nauroji Nagar, New Delhi – 110029 (the "**Authority**") and ..... (the "**Contractor**")[#] **Widening and Up-gradation of existing carriageway into 2-lane with paved shoulder configuration from Lavamore (Km 61.100) to Start of Pedong Bypass (Km 79.700) along NH-717A in state of West Bengal** on EPC mode, and a copy of which is annexed hereto and marked as Annex-A to form part of this TOR.

(ii) The TOR shall apply to construction and maintenance of the Project Highway.

2. Definitions and interpretation

(i) 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.

(ii) 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.

(iii) The rules of interpretation stated in Article 1 of the Agreement shall apply, mutatis mutandis, to this TOR.

3. General

(i) 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.

(ii) 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). issuance of Completion Certificate or

e). Any other matter which is not specified in (a), (b), (c) or (d) above and which creates a financial liability on either Party.

(iii) 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.

(iv) 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.

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

(vi) 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

(i) 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 (vi). 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 beextended 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.

(ii) 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.

(iii) 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.

(iv) 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.

(v) 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.

(vi) 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.

(vii) 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.

(viii) 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.

(ix) 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 management. For purpose of this paragraph 4(ix), the tests specified in the MoRTH Specifications for Road and Bridge works and respective Indian Roads Congress Standards/ Guidelines/ Manuals, together with any other Indian/ International Standards mentioned therein including any modifications/ substitutions thereof shall be deemed to be tests confirming to Good Industry Practice for quality management.

(x) The Authority's Engineer shall witness all the quality control tests carried out by the Contractor at its site laboratory/ main laboratory/ field/ plants. These include tests for all materials, mixes, products etc. Authority's Engineer shall also witness all tests of finished products like bearing in the manufacturer's laboratory as mandated in respective standards. Authority's Engineer will also conduct review of quality control documents in respect of factory manufactured materials/ finished products, etc. as per IRC:SP:112.

(xi) 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 MoRTH specifications for Road & Bridge works and respective Indian Roads Congress Standards/ Guidelines/ Manuals together with any other Indian/ International standards referred thereto. 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.

(xii) 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.

(xiii) 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.

(xiv) 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.

(xv) 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 12.2.

(xvi) 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.

(xvii) 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.

(xviii) 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

(i) 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.

(ii) 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.

(iii) 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.

(iv) 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 repairor rectification of any deviation or deterioration beyond the permissible limit.

(v) 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

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

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

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

7. Payments

(i) 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 (iv) (d).

(ii) Authority's Engineer shall -

j). 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

k). 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.

(iii) 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.

(iv) 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

(i) 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.

(ii) 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.

(iii) 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.

(iv) 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.

(v) 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 (i), 19.6 (i), and 19.8 (i))

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 (i) 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 (iii) (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:

iv. For the Works executed (excluding Change of Scope orders);

v. For Change of Scope Orders, and

vi. Taxes deducted

2. Monthly Maintenance Payment Statement

The monthly Statement for Maintenance Payment shall state:

i). The monthly payment admissible in accordance with the provisions of the Agreement;

j). The deductions for maintenance work not done;

k). Net payment for maintenance due, (a) minus (b);

l). Amounts reflecting adjustments in price under Clause 19.12; and

m). 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

(i) The Contractor shall effect and maintain at its own cost, from the Appointed Date till the date of issue of the 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.

(ii) The insurance under sub para (a) and (b) of paragraph 1(i) above shall cover the Authority and the Contractor against all loss or damage from any 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 of not less than 15% of the Contract Price 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 which 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

(i) The Contractor shall insure against its liability for any loss, damage, death or bodily injury, or damage to any 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.

(ii) The insurance cover shall be not less than: Rs. 50,00,000/- (Rupees Fifty Lakh only)

(iii) 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 [2,200 (two thousand and two hundred only)] mm for each kilometre.

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 shall be as per the requirement of maintenance mentioned in Schedule-E.

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 Slope Protection work on section of Km 25.600 to Km 26.100 (Bagrakot-Kafer) of NH-717A in the state of West Bengal on 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 and designation of Authority's Representative)

(Address)

SCHEDULE - S

Procedure for Dispute Resolution Board

The parties to the Contract Agreement mutually agree as follows:

1. The Board shall comprise of three Members having experience in the field of construction or have been involved in the Works related to construction and with the interpretation of contractual documents. One Member shall be selected by each of the Authority and the Contractor from the list maintained by NHIDCL hosted on its website website (https://nhidcl.com/). In the event the parties fail to select the member within 28 days of the date of the signing of Contract agreement, in that eventuality, upon the request of either or both parties such Member shall be selected by SAROD within 14 days. The third Member shall be selected by the other two members from the same list. If the two Members selected by or on behalf of the parties fail to select the third Member within 14 days after the later of their selections, then upon the request of either or both parties such third Member shall be selected by SAROD within 14 days. The third Member shall serve as DG (Road & Development) of the Board.

2. The Board shall be constituted when each of the three Board Members has signed a Board Member's declaration of Acceptance as required by the DRB's rules and procedures (which, along with the declaration of acceptance form, are attached as Annexure herewith).

3. In the event of death, disability, or resignation of any Member, such Member shall be replaced in the same manner as the Member being replaced was selected. If for any other reason, a Member fails or is unable to serve, the Managing Director, NHIDCL (or failing the action of the Managing Director then either of the other Members) shall inform the Parties and such non-serving Member shall be replaced in the same manner as the Member being replaced was selected. Any replacement made by the parties shall be completed within 28 days after the event giving rise to the vacancy on the Board, failing which the replacement shall be made by SAROD in the same manner as described above. Replacement shall be considered complete when the new Member signs the Board Member's Declaration of Acceptance. Throughout any replacement process, the Members not being replaced shall continue to serve and the Board shall continue to function and its activities shall have the same force and effect as if the vacancy had not occurred, provided, however that the Board shall not conduct a hearing nor issue a decision until the replacement is completed.

4. If either the Authority or the Contractor is dissatisfied with any decision of the Board, and/or if the Board fails to issue its decision within 56 days after receipt of all the pleadings (along with the supporting documents) of the parties by the DG (Road & Development) of the Board or any extension mutually agreed upon by the Authority and the Contractor, in such a case,

either the Authority or the Contractor may, within 28 days after his receipt of the decision, or within 28 days after the expiry of the said period, as the case may be, give notice to the other party, with a copy for information to the Authority's Engineer, of his intention to refer the matter to the Conciliation Committee of Independent Experts (CCIE) of the Authority for Conciliation/amicable settlement.

5. It is mandatory to refer all the disputes to DRB before issuance of completion certificate and satisfactory completion of punch list items. No dispute shall be entertained after completion of aforementioned date.

6. If the Board has issued a decision to the Authority and the Contractor within the said 56 days or any extension mutually agreed upon by the Authority and the Contractor and no notice of intention to commence Conciliation by the Conciliation Committee of Independent Experts (CCIE) of the Authority for Conciliation/amicable settlement as to such dispute has been given by either the Authority or the Contractor within 28 days after the parties received such decision from the Board, the decision shall become final and binding upon the Authority and Contractor.

7. Whether or not it has become final and binding upon the Authority and the Contractor, a decision shall be admissible as evidence in any subsequent dispute resolution procedure, including any arbitration or litigation having any relation to the dispute to which the decision relates.

8. All decision of DRB which have become final and binding or till they have been reversed in subsequent conciliation/Arbitration process shall be implemented by the parties forthwith. Such implementation shall also include any relevant action of the Authority's Engineer.

9. If during the Contract Period, the Authority and the Contractor are of the opinion that the Disputes Resolution Board is not performing its functions properly, the Authority and the Contractor may together disband the Disputes Resolution Board and reconstitute it. In that case, a new board shall be selected in accordance with the provisions applying to the selection of the original Board as specified above, except that words "within 28 days after the signing of this Contract agreement" shall be replaced by the words "within 28 days after the date on which the notice disbanding the original Board became effective".

10. The Authority and the Contractor shall jointly signed a notice specifying that the Board shall stand disbanded with effect from the date specified in the notice. The notice shall be posted by the email to each member of the Board. A Member shall be deemed to have received the email even if he refuses to have received the same.
11. All other terms and conditions of the original Contract Agreement shall remain unaltered/unaffected and the parties shall remain bound by terms and conditions as contained therein.

Annexure to Schedule [S]

Disputes Resolution Board's Rules and Procedures

1. Except for providing the services required hereunder, the Board Members shall not give any advice to either party or to the Authority's Engineer concerning conduct of the Works. The Board Members:

   a. Shall have no financial interest in any party to the Contract, or the Authority's Engineer, or a financial interest in the contract, except for payment for services on the Board.

   b. Shall have had no previous employment by, or financial ties to, any party to the Contract Agreement, or the Authority's Engineer, except for fee based consulting services/advisers on other projects, and/or be Retired Government Officers (not connected in whole or part with the project), all of which must be disclosed in writing to both parties prior to appointment to the Board.

   c. Shall have disclosed in writing to both parties prior to appointment to the Board any and all recent or close professional or personal relationships with any director, officer, or employee of any party to the Contract, or the Authority's Engineer, and any and all prior involvement in the project to which the Contract relates:

   d. Shall not, while Board member, be employed whether as a consultant or adviser or otherwise by either party to the Contract, or the Authority's Engineer, except as a Board Member, without the prior consent of the parties and the other Board Members;

   e. Shall not, while a Board Member, engage in discussion or make any agreement with any party to the Contract, or with the Authority's Engineer, regarding employment whether as a consultant or otherwise whether after the Contract is completed or after service as a Board Member is completed.

   f. Shall remain and be impartial and independent of the parties and shall disclose in writing to the Authority, the Contractor and one another any fact or circumstance which might be such as to cause either the Authority or the Contractor to question the continued existence of the impartiality and independence required of Board Members, and

   g. Shall be fluent in the language of the Contract.

2. Except for its participation in the Board's activities as provided in the Contract Agreement and in this Agreement none of the Authority, the Contractor, and or the Authority's Engineer shall solicit advice or consultation from the Board or the Board Members on matters dealing with the conduct of the Works.

3. The Contractor shall:

a. Furnish to each Board member one copy of all documents which the Board may request including Contract Agreement, progress reports and other documents pertinent to the performance of the Contract Agreement.

b. In cooperation with the Authority, coordinate the site visits of the Board, including conference facilities, and secretarial and copying service.

4. The Board shall begin its activities following the signing of a Board Member's Declaration of Acceptance by all three Board Members, and it shall terminate these activities as set forth below:

   a. The Board shall terminate its regular activities when either (i) issuance of completion certificate and completion of punch list items or (ii) the parties have terminated the contract and when, in either case, the Board has communicated to the parties and the Authority's Engineer its decision on all disputes previously referred to it.

   b. Once the Board has terminated its regular activities as provided by the previous paragraph, the Board shall remain available to process any dispute referred to it by either party. In case of such a referral, Board Members shall receive payments as provided in paragraphs 7(a) (ii), (iii) and (iv).

5. Board Members shall not assign or subcontract any of their work under these Rules and Procedures.

6. The Board Members are Independent and not employees or agents of either the Authority or the Contractor.

7. Payments to the Board Members for their services shall be governed by the following provisions.

   a. Each Board Member will receive payments as follows:

      i. A retainer fee per calendar month as specified in the schedule of fee made part of this Schedule and its revision from time to time. This retainer fee shall be considered as payment in full for:

A. Being available, on 7 days' notice, for all hearings, Site Visits, and other meetings of the Board.

B. Being conversant with all project developments and maintaining relevant files.

C. All offices and overhead expenses such as secretarial services, photocopying and office supplies (but not include telephone calls, faxes and telexes) incurred in connection with the duties as a Board Member.

ii. A daily fee as specified in the schedule of fee in respect of fee for site visit & meeting, fee for meeting/ hearing not at site and extra charges for days max. of 02 days for travel on each occasion) other than hearing / meeting days.

iii. Expenses, in addition to the above, all reasonable and necessary travel expenses (including economy class air fare, subsistence, and other direct travel expenses). Receipts for all expenses in excess of Rs. 2000/- (Rupees Two Thousand only) shall be provided.

iv. Reimbursement of any taxes that may be levied on payments made to the Board Member pursuant to this paragraph 7.

b. The retainer fee and other fees shall remain fixed for the period of each Board Member's term until revised by NHIDCL.

c. Phasing out of monthly retainer fee. Beginning with the next month after the completion certificate (or, if there are more than one, the one issued last) has been issued, the Board members shall receive only one-third of the monthly retainer fee till next one year. Beginning with the next month after the Board has terminated its regular activities pursuant to paragraph 4(a) above, the Board members shall no longer receive any monthly retainer fee.

d. Payments to the Board Members shall be shared equally by the Authority and the Contractor. The concerned Project Implementation Unit (PIU) of Authority shall pay members' invoices within 30 calendar days after receipt of such invoices and shall invoice the Contractor for one-half of the amounts of such invoices. The Contractor shall pay such invoices within 30 days' time period after receipt of such invoices.

8. Board Site Visits:

a. The Board shall visit the Site and meet the representatives of the Authority, the Contractor and the Authority's Engineer at regular intervals, at times of critical construction events, at the written request of either party, and in any case not less than 6 times in any period or 12 months. The timing of Site visits shall be as agreed among the Authority, the Contractor and the Board, but failing agreement shall be fixed by the Board.

b. Site visits shall include an informal discussion of the status of the construction of the Works. Site visits shall be attended by personnel from the Authority, the Contractor and the Authority's Engineer.

c. At the conclusion of each Site visit, the Board shall prepare a report covering its activities during the visit and shall send copies to the parties and to the Authority's Engineer.

9. Procedure for Dispute Referral to the Board

a. If either party objects to any action or inaction of the other party or the Authority's Engineer, the objecting party may file a written Notice of Dispute to the other party with a copy to the Authority's Engineer stating that it is given pursuant to the Agreement and state clearly and in details the basis of the dispute.

b. The party receiving the Notice of Dispute will consider it and respond to it in writing within 14 days after receipt.

c. This response shall be final and conclusive on the subject, unless a written appeal to the response is filed with the responding party within 10 days after receiving the response and call upon Authority's Engineer to mediate and assist the parties in arriving an amicable settlement thereof. Both parties are encouraged to pursue the matter further to attempt to settle the dispute.

d. If the Authority's Engineer receiving the Notice of Dispute fails to provide a written response within 14 days after receipt of such Notice or failing mediation by Authority's Engineer, either party may require such dispute to be referred to the Board, either party may refer the dispute to the Board by written Request to the Board. The Request for decision shall state clearly and in full detail the specific issues of the dispute (s) to be considered by Board and shall be addressed to the DG (Road & Development) of the Board, with copies to the other Board Members, the other party, and the Authority Engineer, and it shall state that it is made pursuant to this Agreement.

e. When a dispute is referred to the Board, and the Board is satisfied that the dispute requires the Board's assistance, the Board decide when to conduct a hearing on the dispute. The Board may request that written documentation and arguments from both parties be submitted to each Board Member before the hearing begins. The parties shall submit insofar as possible agreed statements of the relevant facts.

f. During the hearing, the Contractor, the Authority, and the Authority's Engineer shall each have ample opportunity to be heard and to offer evidence. The Board's decision for resolution of the dispute will be given in writing to the Authority, the Contractor and the Authority's Engineer as soon as possible, and in any event not more than 56 days or any mutually extended period between the Authority and the Contractor. The time period of 56 days of issuance of DRB decision will reckon/start from the day of first hearing that begins after submission of complete pleadings (including supporting documents, if any) by the parties.

10. Conduct of Hearings:

a. Normally hearings will be conducted at the Site, but any location that would be more convenient and still provide all required facilities and access to necessary documentation may be utilized by the Board. Private session of the Board may be held at any cost-effective location convenient to the Board. Video recordings of all hearings shall invariably be made.

b. The Authority, the Authority's Engineer and the Contractor shall be given opportunity to have representatives at all hearings. Parties should restrain to bring any Advocate/Law Firm during DRB hearings.

c. During the hearings, no Board Member shall express any opinion concerning the merit of the respective arguments of the parties.

d. After the hearings are concluded, the Board shall meet privately to formulate its decision. The private meeting (s) of the Board shall not exceed 3 sittings. All Board deliberations shall be conducted in private, with all Members' individual views kept strictly confidential. The Board's decisions, together with an explanation of its reasoning shall be submitted in writing to both parties and to the Authority's Engineer. The decision shall be based on the pertinent contract provisions, applicable laws and regulations and the facts and circumstances involved in the dispute.

e. The Board shall make every effort to reach a unanimous decision. If this proves impossible the majority shall decide and the dissenting Member may prepare a written minority report together with an explanation of its reasoning for submission to both parties and to the Authority's Engineer

11. In all procedural matters, including the furnishing of written documents and arguments relating to disputes, site visits and conduct of hearings, the Board shall have full and the final authority. If a unanimous decision on any such matter proves impossible, the majority shall prevail.
12. After having been selected and where necessary approved each Board Member shall sign two copies of the following declaration and make one copy available each to the Authority and to the Contractor.

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