TECHNICAL SCHEDULES

Schedule-A

(See Clauses 2.1 and 8.1)

Site of the Project

1. The Site

(i) Site of the Slope Protection Work and Re-construction of the Road on the 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 showing the location of landslide / protection works of the Project Highway are specified in **Annex-III**. No modification in the existing alignment of the Project Highway is contemplated.

(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 'Slope protection and landslide mitigation and Re-construction of Road section (from km 94+745 to km 95+734) on NH-717A near Reshi border on EPC mode in the State of West Bengal'. The land, carriageway and slope protection locations comprising the Site are described below.

Sl no.	Chainage		Length (m)	Side (Hill /Valley)
	From	To		
1	94+745	95+734	989	Hill and Valley

2. Land

The Site of the Project Highway comprises the land (Existing Right of Way) as described in the Annex-II.

3. Carriageway

The present carriageway of the Project Highway from Km 94+745 to Km 95+734 of NH-717A is constructed for Two Lane with paved shoulder. The type of the existing pavement is flexible. The carriageway was constructed Two Lane with paved shoulder in hilly terrain but got heavily affected due to erosion/slide. The proposed measures as mentioned in Schedule-B is to be constructed.

4. Major Bridges/Viaduct

The Site includes the following Major Bridges/Viaduct:

S. No.	Chainage (Km)	Type of Structure			No. of Spans with span length (m)	Width (m)
		Foundation	Sub-structure	Super-structure		
1		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)
		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)
1	95+542	Cast-in-situ Box Culvert	1x1.5x2	12
2	95+667	Cast-in-situ Box Culvert	1x1.5x2	12

11. Bus shelter

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

S. No.	Chainage (Km)	Length (m)	Left Hand Side	Right Hand Side
1	16+920	5	Left	-

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)	Side	Masonry/CC (Pucca)	Earthen (Kutcha)
1	95+740	95+800	LHS	CC	-

14. Major / Minor 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								

15. 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				

16. Existing Retaining / Breast wall Protection Works

S. No.	Ch. From	Ch. To	Retaining Wall Length (m)	Breast Wall Length (m)	Remarks
1	94+745	95+734	141	716	-

The Retaining / Breast wall were constructed in hilly terrain but got heavily affected / damaged due to landslide. The proposed measures as mentioned in Schedule-B is to be constructed.

17. Existing Utilities

NIL

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:

S. No.	From km to km		Length (m)	Date of providing Right of Way*
(1)	(2)		(3)	(4)
(i) Full Right of Way (full width)				
(a)	94+745	95+734	989	On Appointed Date
(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 plan shall be followed. No modification in the existing alignment of the Project Highway is contemplated.

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

1. Construction for Slope Protection Measures

Survey, identification of extent of instability, investigations, detailed designing and execution / construction of Slope Protection measures shall be done 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 any one of the IITs during construction stage (it shall be EPC Contractor's responsibility to get the vetted drawings from IITs) and its maintenance for 5 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

Development of the project shall include Specialized Slope Protection measures as described in Annex-I of this Schedule B and Schedule-C.

3. Specifications and Standards

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

Annex - I

(Schedule-B)

Description

CONSTRUCTION FOR SLOPE PROTECTION MEASURES

1. Execution/ Construction of Slope Protection Measures

(i) The Project refers to Slope protection and landslide mitigation and Re-construction of Road section (from km 94+745 to km 95+734) on NH-717A in the State of West Bengal on Pedong Bypass – Reshi Border section.

(ii) The design and construction of the slope protection measures shall be carried out in accordance with the applicable codes, manuals, and specifications of the Indian Standards Institution (ISI), Indian Roads Congress (IRC) including its Special Publications, as well as relevant circulars and guidelines issued by the Ministry of Road Transport and Highways (MoRTH).

(iii) The proposed landslide protection works, retaining structures, drains etc. of the project highway as indicated in Schedule B and Schedule C and their Annexures shall be treated as minimum requirements. Based on site condition and design requirements the Contractor shall finalise their Detailed Designs and submit to Authority & its Engineer and Safety Auditor for its review / approval, before start of the project execution in accordance with Article 10 of the EPC Agreement. The designs so approved shall not be in contradiction with the scope of the project. For avoidance of doubt, the provisions/measures mentioned in Schedule B & C shall not be changed, only the design of the components is to be submitted for review / approval by following details & minimum requirement given in Schedule-B, C and D.

(iv) General Scope and Features

The Contractor shall carryout Survey, Identify the extent of instability, investigations, detailed designing duly checked by the Proof & Safety Consultant as stipulated under Article-10 and duly vetted by any one of the IITs at their own cost. The investigations shall comprise of geological, geo-physical and geotechnical exploration works required for stability analysis and design of slope protection measures. All the civil works shall be carried out as per approved design and drawings of slope protection measures and as per technical specifications as given in Annexure-I of Schedule-D.

2. Widening of the existing highway

i. Width of Carriageway

(a) The present carriageway of the Project highway is heavily damaged at majority of the section length. The proposed slope protection measures shall be executed

at damaged locations to reinstate the present carriageway to the original configuration (2-Lane with paved shoulder, i.e. Paved carriageway shall be 7m wide with 1.5 m paved shoulder both side and 1.0 m earthen shoulder valley side).

(b) The existing carriageway shall be protected by the Contractor and if any damages occurred to the existing carriageway during the execution shall be reinstated by the Contractor. The entire cross-sectional elements shall be accommodated in the available/proposed ROW.

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. except in cases where the same is not possible and for such cases design speed shall be in accordance with provisions for Mountainous & Steep terrain as per the Hill Road Manual.

(iii) Improvement of the existing road geometrics

The raising in road level shall match existing Finished Road Level (FRL) at either ends of the protection work stretches as per Geometric design. Alignment of the protection work shall follow the existing alignment (at present damaged due to landslide) plan of the Project as provided in Appendix-B-1. Raising upto 8m may be required in certain lengths affected

(iv) Right of Way

Details of the Right of Way are given in Annex-II of Schedule-A. The existing shoulder including the roadside drain shall be re-constructed and its adequacy to be established in the length of proposed slope protection measures.

(v) Site Location of the Protection and Road Reconstruction

Sl. no.	Chainage		Length (m)	Remarks
	From	To		
1	94+745	95+734	989	The measures for slope protection and re-construction of the Road section shall be done as per provisions of Schedule-B, C and D.

(vi) Drawings (TCS) of the Project of Slope Protection

The Applicable drawings / typical cross section for slope protection measures shall be developed as given in table below with minimum scope as explained in Schedule-B, C & D:

S. No.	Chainages in km	Drawing Type	Stretch Length (m)	Details of minimum Scope
1	94+745 to 95+734	TCS-1	989	Construction of Road as per Plan & Profile enclosed as D-1 and Typical Cross Section of road as TCS-1 other protection measures as mentioned below.
2	94+940 to 95+040	D-2		At hill side construction of RCC stepped wall (M35) (breast wall) of minimum height of 8 meter; over minimum 18m deep & 300mm diameter RCC Micro-pile in 68 nos minimum (M35). RCC wall anchored by 38/19MM (outer/inner) diameter, SDA with minimum 68 nos having minimum 10m length each. Further, this shall be strengthened laterally with installation of 30 m long 100T capacity pre-stressed cable Anchors @ 5m c/c in a row within the fabricated RCC cage of this wall. The wall shall be constructed after 3m hill side cutting.
3	95+200 to 95+360	D-3	160	At hill side construction of RCC stepped wall (M35) (breast wall) of minimum height of 8 meter; over minimum 18m deep & 300mm diameter RCC Micro-pile in 108 nos minimum (M35). RCC wall anchored by 38/19MM (outer/inner) diameter, SDA with minimum 108 nos having minimum 10m length each. Further, this shall be strengthened laterally with installation of 30 m long 100T capacity pre-stressed cable Anchors @ 5m c/c in a row within the fabricated RCC cage of this wall.
4	95+380 to 95+560	D-4	180	At hill side construction of RCC stepped wall (M35) (breast wall) of minimum height of 8 meter; over minimum 18m deep & 300mm diameter RCC Micro-pile in 122 nos minimum (M35). RCC wall anchored by 38/19MM (outer/inner) diameter, SDA with minimum 122 nos having minimum 10m length each.
5	95+684 to 95+734	D-5	50	At hill side construction of RCC stepped wall (M35) (breast wall) of minimum height of 8 meter; over a raft & bundled SDRA [each bundle consists of 8m, 10m & 12m SDA length SDA]. Each bundle @3m c/c in two rows minimum 36 bundles; RCC wall anchored by 38/19MM (outer/inner) diameter, SDA with minimum 36 nos having minimum 8m length each
6	94+840 to 94+940	D-6	100	At valley side, (i) Construction of 12m high, Shored RS wall with Gabion Facia.

S. No.	Chainages in km	Drawing Type	Stretch Length (m)	Details of minimum Scope
				(ii) Construction of RCC stepped wall (retaining wall) (M35) of minimum height of 7 meter; over minimum 18m deep & 350mm diameter RCC Micro-pile in 68 nos minimum (M35). RCC wall anchored by 38/19MM (outer/inner) diameter, SDA with minimum 68 nos having minimum 10m length each.
7	95+360 to 95+560 & 95+610 to 95+660	D-7	250	At valley side, (i) Construction of 4m high CC Gravity wall (M25) with weep holes with 100mm dia HDPE pipe @ 1.5m c/c longitudinally & Vertically (staggered) in (1:20) slope. (ii) Construction of RCC stepped wall (M35) (retaining wall) of minimum height of 7 meter; over minimum 18m deep & 300mm diameter RCC Micro-pile in 202 nos minimum (M35). RCC wall anchored by 38/19MM (outer/inner) diameter, SDA with minimum 202 nos having minimum 10m length each
8	94+745 to 95+734	To be assessed by contractor with approval from Authority's Engineer	989	Apart from above, Supply and installation of rock fall barrier (Category A) in 150m length at location to be specified by the Authority.

Note –

- Filter media with granular materials/stone crushed aggregates satisfying the requirements laid down in clause 2504.2.2. of MoRT&H specifications shall be provided along the full length & height of RCC stepped walls for a minimum width of 0.6 m.

(vii) Instrumentation and INSAR Monitoring - The monitoring & alert system shall be provided with minimum 6 number of instruments (6 Piezometer, 6 Inclinometer) spaced to cover the slide extents and critical spots near the site on NH-717A from km 94+745 to km 95+734 in the state of West Bengal. The technical criteria for the monitoring & alert system shall be in accordance with as specified in Schedule D. INSAR Monitoring of the landslide location shall be as per technical specifications mentioned in Schedule-D.

Providing and installing of Early Warning System (EWS) design, supply, install, test, and commission a comprehensive Early Warning System (EWS) for real-time monitoring of slope stability and associated geotechnical hazards. Additionally, EWS for detection of abnormal conditions, the system generates automated alerts through dashboards, SMS, or sirens, enabling timely intervention and risk mitigation. EWS is widely applied in hill road projects, slope protection

works, and infrastructure safety monitoring, enhancing resilience and reducing potential loss of life and assets.

(viii) PROVISION OF DISASTER MANAGEMENT

The Contractor shall maintain a comprehensive Disaster Management system to mitigate and respond to all emergencies, including but not limited to slope failures, hydraulic surges, and hazardous incidents within the Project corridor. This mandate requires the integration of resilient engineering standards and the deployment of an Emergency Response Team to protect personnel, the Environment, and the Permanent Works. The Contractor's objective is to ensure the immediate containment of any catastrophic event and the preservation of the Right-of-Way as a functional transport artery, minimizing Project disruption through rigorous preparedness and rapid recovery protocols.

The scope of this Provision is strictly confined to the designated Right-of-Way for the duration of the Construction Period. Obligations include the performance of mandatory hazard assessments, procurement of emergency infrastructure, and the execution of site-specific evacuation and traffic management plans. Contractor liability is bounded by the project chainage (BEYOND ±20m) and terminates upon the issuance of the Taking-Over Certificate. All disaster response, civil protection, and regional recovery efforts beyond these defined limits remain the sole responsibility of the Competent Authorities.

Note-

(a) Extent of work -

• Start and end location of landslide protection work given in above table is tentative and shall be as per site requirements during execution of work.

• Stretch length specified above is minimum and height required for protection shall be as per site condition at the time of execution.

• The proposed type of Retaining Structures and sections mentioned are the minimum requirements and work shall be carried out based on detailed design carried out by the Contractor before execution following same TCS.

• Unfinished work before onset of monsoon must be protected by providing interim drainage measures, and retaining measures so that the executed protection measures are not affected during monsoon.

• All the boundaries / edges of the project site must be protected using relevant slope protection & erosion control measures as per site conditions giving proper closures and merging back to stable natural ground.

• The overall construction shall be top-down in terms of geometric corrections and immediate installation of erosion control measures & Anchors, berm by berm for landslide slope protection works. Drainage provision shall be such to maintain effective drainage at all point of time during construction including final drainage arrangement. No additional working zone beyond the available ROW shall be provided by the Authority and EPC Contractor shall prepare their work plan accordingly.

(b) Investigations - At the start of the work following Survey/Investigations/Studies shall be done.

I. Topographic survey of above sites

II. Hydraulic studies to be carried out with latest topographical details and available rainfall to assess the drainage requirement.

III. Geological mapping and Geotechnical Investigations to establish strata and properties.

IV. Any other investigations including Geophysical studies as required. The Contractor must incorporate these outcomes in detailed designs of landslide & slope protection measures.

(c) Design Basis

I. The slope stability of landslide by geometric corrections, using toe/breast/retaining walls, surface protection, internal reinforcement, etc with consideration of sub-surface and surface water flow impact.

II. Complete surface and sub-surface drainage plan through catch water drains, berm drains, and subsurface drains, including controlling water penetration in to subsoil through avoiding ponding and through cracks treatment behind the landslide top edges; with some of it seen as much behind as hundreds of meters from landslide edges. The treatments should be to fill the cracks up and seal it from top to stop further ingress of water into it, for any further propagation of cracks.

III. Hill cutting shall be undertaken only after the finalization and approval of the cutting scheme and methodology proposed by the contractor with adequate protection and stabilization measures. Under no circumstances shall cut slopes be left unattended or unprotected in accordance with the provisions of IRC/SP:48-2023 and MoRTH guidelines.

4. Minimum scope description for each activity of Landslide Protection Measures and Re-construction of Road is mentioned hereunder:

S. No.	Minimum Scope – From km 94+745 to km 95+734
1	**Scaling of rock chunk lying on the slope** i/c all cost machineries, cost of crakamite powder if required, making the ramp including all cost of labour, material, breaking of rock piece using breaker and disposal of muck as per Technical Specifications. (Removal of loose debris, dismantling of failed structures, overhanging stones & cracked boulders) for a minimum quantity of 35,000 cum. Muck disposal shall be done by EPC Contractor at suitable location identified by EPC Contractor at their own cost inclusive of transportation charges.
2	**Removal of landslide from the pavement area clearing the blockage to enable the movement of traffic. EPC Contractor shall deploy the following machinery for entire construction period**, Hydraulic Excavator with rock breaker 1 no., Front-End Loader 2 nos., and Tippers/Truck of minimum 5 cum capacity 1 nos. exclusively towards removal of landslide. This includes the cost of Supplying of Machineries with drivers, cleaner staffs including traffic control arrangement etc including fuel / lubricant and Idling charges for removal of land slide materials and rock cutting.

S. No.	Minimum Scope – From km 94+745 to km 95+734
	Activities of S. no. 1 and 2 are mutually exclusive and separate. Quantity of landslide removal shall not be counted under S. no.1 and time duration of machines engaged in activity 1 shall not be counted under activity 2.
3	Construction of Road from km 94+745 to km 95+734 with minimum pavement layer thickness mentioned in para 6 of Annex-I of Schedule-B in accordance with Plan & Profile drawings. Further, road side drains including chutes, thrie beam crash barrier, road markings, road signages, road furniture as per concerned provisions of technical schedule.
4	Hill side from km 94+940 to km 95+040 – (Refer drawing D-2) Construction of RCC stepped wall (breast wall) of minimum height of 8 meter in 100 m length; over minimum 18m deep & 300mm diameter RCC Micro-pile @ 3m c/c provided in two rows i.e. 68 nos minimum; RCC wall anchored by 38MM (outer) diameter SDA with minimum 10m length @ 3m c/c longitudinal direction in two rows i.e. 68 nos minimum; Further, this shall be strengthened laterally with installation of 30 m long 100T capacity pre-stressed cable Anchors @ 5m c/c in a row within the fabricated RCC cage of this wall. The wall shall be constructed after 3m hill side cutting. Weep holes in RCC stepped wall with 100mm diameter HDPE pipe @ 2.0m c/c longitudinally & vertically (staggered) in (1:20) slope. (Refer drawing D-2, All the dimensions and the Reinforcement details given in the drawing D-2 are minimum requirement.)
5	Hill side from km 95+200 to km 95+360 – (Refer drawing D-3) Construction of RCC stepped wall (breast wall) of minimum height of 8 meter in 160 m length; over minimum 18m deep & 300mm diameter RCC Micro-pile @ 3m c/c provided in two rows i.e. 108 nos minimum; RCC wall anchored by 38MM (outer) diameter SDA with minimum 10m length @ 3m c/c longitudinal direction in two rows i.e. 108 nos minimum; Further, this shall be strengthened laterally with installation of 30 m long 100T capacity pre-stressed cable Anchors @ 5m c/c in a row within the fabricated RCC cage of this wall. The wall shall be constructed after 3m hill side cutting. Weep holes in RCC stepped wall with 100mm diameter HDPE pipe @ 2.0m c/c longitudinally & vertically (staggered) in (1:20) slope. (Refer drawing D-3, All the dimensions and the Reinforcement details given in the drawing D-3 are minimum requirement.)
6	Hill side from km 95+380 to km 95+560 – (Refer drawing D-4) Construction of RCC stepped wall (breast wall) of minimum height of 8 meter in 180 m length; over minimum 18m deep & 300mm diameter RCC Micro-pile @ 3.0m c/c provided in two rows i.e. 122 nos minimum; RCC wall anchored by 38MM (outer) diameter SDA with minimum 10m length @ 3.0m c/c longitudinal direction in two rows i.e. 122 nos minimum; Weep holes in RCC stepped wall with 100mm diameter HDPE pipe @ 2.0m c/c longitudinally & vertically (staggered) in (1:20) slope. (Refer drawing D-4, All the dimensions and the Reinforcement details given in the drawing D-4 are minimum requirement.)
7	Hill side from km 95+684 to km 95+734 – (Refer drawing D-5) Construction of RCC stepped wall (breast wall) of minimum height of 8 meter in 50 m length over a raft & bundled SDRA; RCC wall anchored by 38MM (outer) diameter SDA with minimum 8m length @ 3.0 m c/c longitudinal direction in two rows i.e. 36 nos minimum; Bundled SDRA arrangement of 8m,10m,12m deep (avg.10m deep), 3nos self-driven hollow anchors (38 mm outer diameter) in a cluster placed @ 3m c/c longitudinal (staggered) i.e. 36 bundles nos minimum;

S. No.	Minimum Scope – From km 94+745 to km 95+734
	Weep holes in RCC stepped wall with 100mm diameter HDPE pipe @ 2.0m c/c longitudinally & vertically (staggered) in (1:20) slope. (Refer drawing D-5, All the dimensions and the Reinforcement details given in the drawing D-5 are minimum requirement.)
8	Valley side from km 94+840 to km 94+940 – (Refer drawing D-6) (i) Construction of 12m high, Shored RS wall with Gabion Facia in two tiers of 6m each; Providing high strength flexible geogrids (Ultimate tensile strength = 200kN/m) for 9000 sqm minimum; Providing Geo-composite drain 740 GSM for 1800 sqm minimum; Providing non-woven Geotextile 150 GSM for 1800 sqm minimum for separation; Providing and installing minimum 11 number subsurface drainage pipes Semi Perforated HDPE pipe (lined with Non -woven Geotextile) of 100mm internal diameter & minimum 8m length as per the drawings etc. @10m c/c in Transverse direction and 1 subsurface drainage pipe Semi Perforated HDPE pipe (lined with Non -woven Geotextile) of minimum 100 m length in Longitudinal direction (ii) Installation of 38MM (outer) diameter SDA with minimum 6m length @ 2.0m c/c horizontal & 1.0m c/c horizontal i.e. 663 nos minimum; (iii) Construction of RCC stepped wall (retaining wall) of minimum height of 7 meter in the 100m length; over minimum 18m deep & 350mm diameter RCC Micro-pile @ 3.0m c/c provided in two rows i.e. 68 nos minimum; RCC wall anchored by 38MM (outer) diameter SDA with minimum 10m length @ 3.0m c/c longitudinal direction in two rows i.e. 68 nos minimum; Weep holes in RCC stepped wall with 100mm diameter HDPE pipe @ 2.0m c/c longitudinally & vertically (staggered) in (1:20) slope. (Refer drawing D-6, All the dimensions and the Reinforcement details given in the drawing D-6 are minimum requirement.)
9	Valley side (from km 95+360 to km 95+560) and (from km 95+610 to km 95+660) – (Refer drawing D-7) (i) Construction of 4m high CC Gravity wall (M25) with minimum top width of 0.8m and bottom width of 1.8m in the given length; along-with Weep holes with 100mm diameter HDPE pipe @ 1.5 m c/c longitudinally & vertically (staggered) in (1:20), to ensure desired road width. (ii) Construction of RCC stepped wall (breast wall) of minimum height of 7 meter in the given length; over minimum 18m deep & 300mm diameter RCC Micro-pile @ 2.5m c/c provided in two rows i.e. 202 nos minimum; RCC wall anchored by 38MM (outer) diameter SDA with minimum 10m length @ 2.5m c/c longitudinal direction in two rows i.e. 202 nos minimum; Weep holes in RCC stepped wall with 100mm diameter HDPE pipe @ 2.0m c/c longitudinally & vertically (staggered) in (1:20) slope. (Refer drawing D-7, All the dimensions and the Reinforcement details given in the drawing D-7 are minimum requirement.)
10	Supply and installation of rock fall barrier (Category A) in 150m length at location to be specified by the Authority. comprising of steel meshes and cables coated in Zn-Al 5% class B, with post to post distance of maximum 10m and energy absorption by deformation including consisting of posts, anchor bolts (6m deep in rock and 8 m deep in consolidated debris), plate for fixing anchor bolts, base anchors, cable anchors, cables/support ropes, clamps, retention panels, energy dissipaters etc.), to complete the work in all respect. ETAG 027/EAD certified rock fall barrier shall

S. No.	Minimum Scope – From km 94+745 to km 95+734
	be used. 10.5m high having minimum energy absorption in the entire system of 8000 K J.
11	Providing and laying of Filter media with granular materials/stone crushed aggregates satisfying the requirements laid down in clause 2504.2.2. of MoRT&H specifications along the full length & height of RCC stepped walls for a minimum width of 0.6 m.
12	Instrumentation and INSAR Monitoring - The monitoring & alert system shall be provided with minimum 6 number of instruments (6 Piezometer, 6 Inclinometer) spaced to cover the slide extents and critical spots near the site on NH-717A from km 94+745 to km 95+734 in the state of West Bengal. The technical criteria for the monitoring & alert system shall be in accordance with as specified in Schedule D. INSAR Monitoring of the landslide location shall be as per technical specifications mentioned in Schedule-D. With; Providing and installing of Early Warning System (EWS) design, supply, install, test, and commission a comprehensive Early Warning System (EWS) for real-time monitoring of slope stability and associated geotechnical hazards. Additionally, EWS for detection of abnormal conditions, the system generates automated alerts through dashboards, SMS, or sirens, enabling timely intervention and risk mitigation. EWS is widely applied in hill road projects, slope protection works, and infrastructure safety monitoring, enhancing resilience and reducing potential loss of life and assets.

Note-

(i) Works for RCC Cladding wall or RCC step wall shall be of minimum grade M35. Steel of Fe 500 Grade

(ii) To determine the design, pull out strength value, 3 numbers of test anchor shall be installed along lower elevation at the site. The pull-out test shall be conducted on these installed anchors as per IS 11309 and average of 3Nos Pull Out strength value shall be considered as Design Pull Out value for all installed anchors at this location. 2% of installed anchors shall be tested on this average value. All the cost towards pull out tests (3 numbers and 2%) at each location shall be borne by EPC Contractor on its own. The tests shall be done in supervision of Authority Engineer.

(iii) Installation of SDA as mentioned in above paras shall include the cement pressure grouting at a min. pressure ranging from 1 to 3 kg/cm^2 till all the cracks are suitably sealed / filled.

(iv) The site is landslide affected

5. Road Embankment and Cut /fill Section

Construction of road embankments/cuttings shall conform to the Specifications and Standards given in IRC: SP:48-2023 and IRC: SP:84-2019. Notwithstanding anything to the contrary contained in this agreement or Manual, the proposed profile of the project locations as indicated in Appendix B1 of Schedule-B shall be treated as minimum

requirement. The project road was being constructed and got damaged due to landslide during construction. The required cut/fill section of the landslide protection works shall follow the detailed drawings/Specifications and Standards prepared for the slope protection measures of the site. The existing road / ground shall be required to be raised / filled to attain the minimum FRL as indicated in Appendix B1 of Schedule-B. The filling may vary from 1 meters to 10 meter. The EPC Contractor shall make the accurate assessment of filling and the cost shall be borne by EPC Contractor.

6. Pavement Design

(i) Pavement design shall be carried out in accordance with section 5 of the IRC: SP: 73-2018. The raising in road level shall match existing Finished Road Level (FRL) at either ends of the protection work stretches as per Geometric design. Alignment of the proposed road work & protection work shall follow the existing alignment (at present damaged due to landslide) plan as provided in AppendixB-1. Accordingly, following stretches of the existing road shall be reconstructed after completion of slope protection measures: -

S. No.	Design Section (Km)		Remarks
	From	To	
1	94+745	95+734	• Reconstruction of road shall be done in 'the length extending 20 m beyond the design chainages of site in each of the directions'.

(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

DBM- 80 mm

WMM- 200 mm

GSB- 250 mm

Sub-grade- As per requirement to match the minimum FRL. EPC Contractor shall assess the cost by visiting the site and bid price shall be inclusive of required thickness to achieve minimum FRL. Raising through subgrade thickness may vary upto 1m - 10m.

(iii) Design requirements

a) Design Period and strategy

Flexible pavement shall be designed for a minimum design period of 15 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.

7. **Hill / Valley side Drainage:** Road side PCC (M-20) drain shall be provided at each (LHS & RHS) side of the road to ensure drainage continuity at either ends of the work stretches as per Geometric design. EPC Contractor shall prepare a drainage plan. Catch water drains to protect the RCC stepped wall & Gabion facia wall shall be constructed to catch the surface water.

   The Contractor shall also provide road side drain along the length of the road. Surface water collected in catch water drain shall be connected to existing drainage system through chutes / cascades. Any modifications required to connect newly constructed drains with existing drainage system shall also be constructed by the contractor. EPC Contractor shall construct catchpit and chutes for the existing culverts in accordance with Chapter 2 of IRC SP:48 – 2023.

   The design shall be prepared by the Contractor as per the manual specified in Schedule D / IRC SP:48 – 2023. The detailed design of structures and drainage plan prepared by the Contractor shall be approved by Authority / Authority's Engineer. The Contractor shall provide continuity of drain to the nearest stable natural stream available to the area.

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)
NIL		

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**

NIL

9. Traffic Control Devices and Road Safety Works;

a) Traffic control devices and road safety works shall be provided in accordance with section 9 of the IRC: SP: 73:2018. National Highway traffic shall be operational in at least 7m width at all times at damaged locations. Roadway Indicators, Hazard markers and Object markers shall be placed along the section as per the Manual.

b) Traffic signs shall be provided as per IRC 67 & MORTH circular no RT – 25035/07/2023-

RS(Part) dated 24.12.2024 as mentioned in Schedule-C. 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. Traffic signs shall be provided as per IRC 67-2022 & & MORTH circular no RT – 25035/07/2023- RS(Part) (221534) dated 24.12.2024.

c) **Road Marking:** The markings shall cover road marking for the pavement at all project sites as per para 6(i) of Annex-I of Schedule-B, as per relevant code and manual. Pavement marking shall be completed as per IRC 35 & & MORTH circular no RT – 25035/07/2023- RS(Part) (221534) dated 24.12.2024.

d) **Road studs :** The Reflective Pavement Markers (RRPM) i.e. road studs shall be provided along the entire section (from km 94+745 to km 95+734 (±20m)) 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.

10. Roadside Furniture

(i) Roadside furniture shall be provided in accordance with the provision relevant manual, Schedule-B and Schedule-C.

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

11. Muck Dumping Sites: The EPC Contractor shall arrange the muck dumping sites at their own cost. The EPC Contractor shall have to present a Muck Disposal Plan according to the applicable rules and regulations of the Government of West Bengal and the Government of India. The excavated material available from excavation may be used by the EPC Contractor for the construction of project- related works provided it meets the standards and specifications as defined in Schedule D and after payments of all applicable royalties and levies, including taxes as per Government of West Bengal and Government of India rules and regulations. The EPC Contractor shall relocate and dump the excess material (at its own cost) at the suitable area identified by EPC Contractor, in a way to avoid any negative impact on the terrestrial and aquatic environment. For stabilization of dumped material, engineering measures and/or other measures, retaining structures shall be proposed by the EPC Contractor (at its own cost), with individual plans and cross sections for all muck disposal areas. The NGT Order dated 01.11.2018 shall be followed for disposal of muck.

12. Damage to structures outside ROW: The Contractor shall adopt such work methodology ensuring that there shall be no damages to structures located outside RoW (either private or Govt. structures such as permanent or temporary building structures, sheds, utilities, trees, or other immovable structures) on account of construction and maintenance of the project highway. To avoid the above issues, it is clarified that the cost of the repair/damaged structures, failing outside the

ROW, should be borne by the Contractor, wherever damages are on account of the Contractor. Further, it shall be Contractor's responsibility to retain videographic and photographic records of structures at vulnerable areas. Authority's decision in such cases 'whether the damages are on account of the Contractor or not' shall be binding on the EPC Contractor.

13. Hazardous Locations

The thrie beam safety barriers (with delineators) shall also be provided at the entire project section referred in para 6(i) of Annex-I of Schedule-B.

14. Breast wall:

It is expected that the existing Breast wall may get damaged during construction of slope protection measures in the concerned stretches. If damaged then, reconstruction of the PCC type breast at such site shall be done by the EPC Contractor. PCC type breast wall shall be constructed with minimum height same as that of existing breast wall.

15. Work Zone Traffic Management Plan

The traffic diversion shall be prepared as per IRC SP 55 for smooth flow of traffic and safety. If required, a diversion plan shall be proposed and traffic management plan for reinstatement of project road at identified locations. The Contractor shall not block carriageway during construction at any time and necessary safety measures required during execution of work shall be provided as per IRC SP: 55, Guidelines on Traffic Management in Work Zones. No separate payment shall be made for providing Traffic Management Plan at site during execution of work.

16. Change of Scope

The Area, width (depth), length, and height of protection works, drainage system, concrete cladding/Retaining structures, breast wall and other items specified herein above shall be treated as minimum tentative requirements. The actual quantities as required on the basis of detailed investigations shall be determined by the Contractor in consultation with Authority and its Engineer and in accordance with the Specifications and Standards.

Any increase in measurement units (length, area) of scope of work measures up to 5% of minimum requirement mentioned in this Schedule -B shall not constitute a Change of Scope, save and except any variations in the quantities arising out of a Change of Scope expressly undertaken in accordance with the provisions of Article 13 of the EPC Contract Agreement. Any decrease in measurement units (length, area) of scope of work measures up to 5% of minimum requirement mentioned in this Schedule -B shall not constitute a Change of Scope,

save and except any variations in the quantities arising out of a Change of Scope expressly undertaken in accordance with the provisions of Article 13 of the EPC Contract Agreement. However, the Authority may direct the EPC Contractor to execute the savings of items (upto 5% of minimum requirement) at other vulnerable slide locations identified by the Authority in the section and this shall not constitute a Change of Scope. Authority's decision in this regard shall be final.

Sl no.	DESCRIPTION OF ITEMS	Measurement units
1	RCC step wall in pile foundation complete all including vibrating and compacting, finishing, curing, sampling, testing etc. (Concrete grade M35)	Length in meters
2	CC wall in open foundation complete all including vibrating and compacting, finishing, curing, sampling, testing etc. (Concrete grade M25)	Length in meters
3	Installation of Self driven rock anchor made of 40CR material with outer dia of 38 mm and inner dia of 19 mm, complete in all respect, including Cement pressure grouting in Rock / overburden with equipment required to complete the grouting work at required pressure and prestressed cable anchor.	Length in meters
4	Construction of friction Micro Pile including drilling in soil mixed with boulders and in soft rock upto desired depth (ODEX drilling using tyre or crawler mounted machine as per site requirement), cement grouting using double packer, redrilling, perforated MS Casing, to complete the work.	Length in meters
5	Surface Drains in as per the direction of the Authority's Engineer.	Length in meters
6	Shored RS wall with Gabion Facia with Perforated HDPE pipes (hill & valley side) Sub-Surface Drains	Area in sqm
7	Rock fall barrier	Length in meters
8	Road work including all miscellaneous items & safety items	Length in meters

17. Utility Shifting

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

Utility Shifting: NIL.

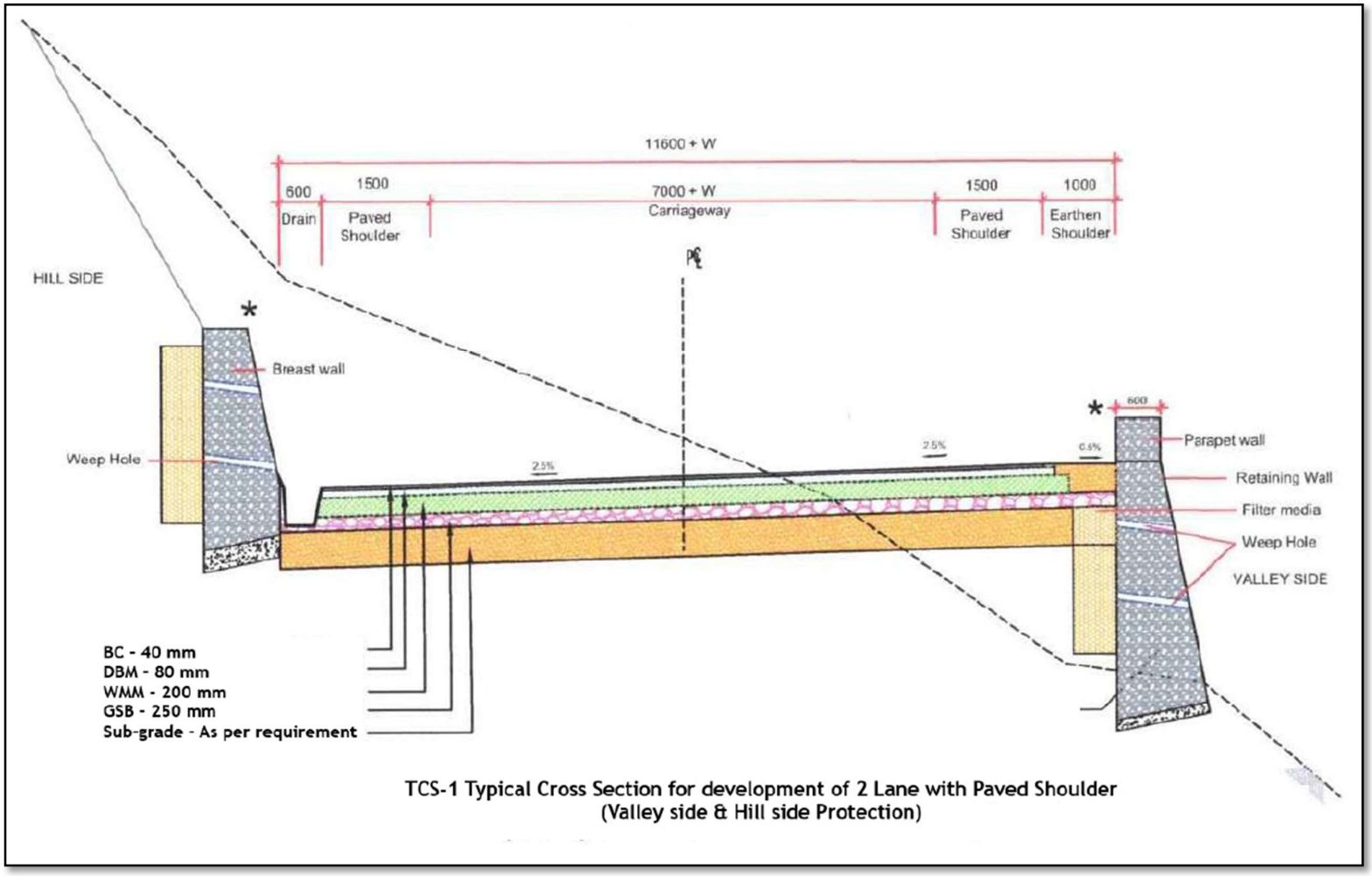
Annexure-B-II

Schedule-B

Widening Scheme:

The proposed slope protection measures shall be executed at damaged locations to reinstate the present carriageway to the original configuration (2-Lane with paved shoulder, i.e. Paved carriageway shall be 7m wide with 1.5 m paved shoulder both side and 1.0 m earthen shoulder valley side).

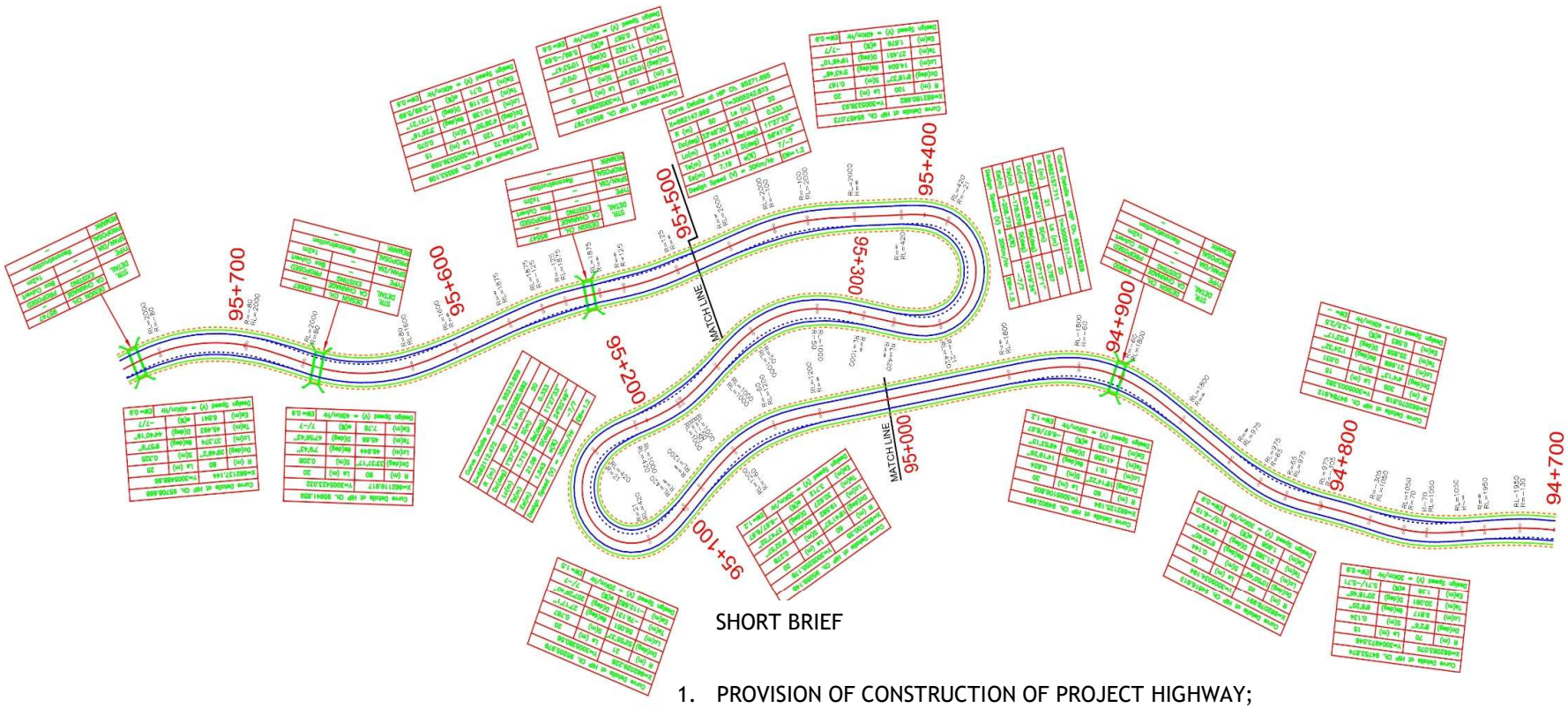
Appendix B-1 –
Applicable TCS-1



TCS-1 Typical Cross Section for development of 2 Lane with Paved Shoulder
(Valley side & Hill side Protection)

Drawing – 1 (D-1)-Plan

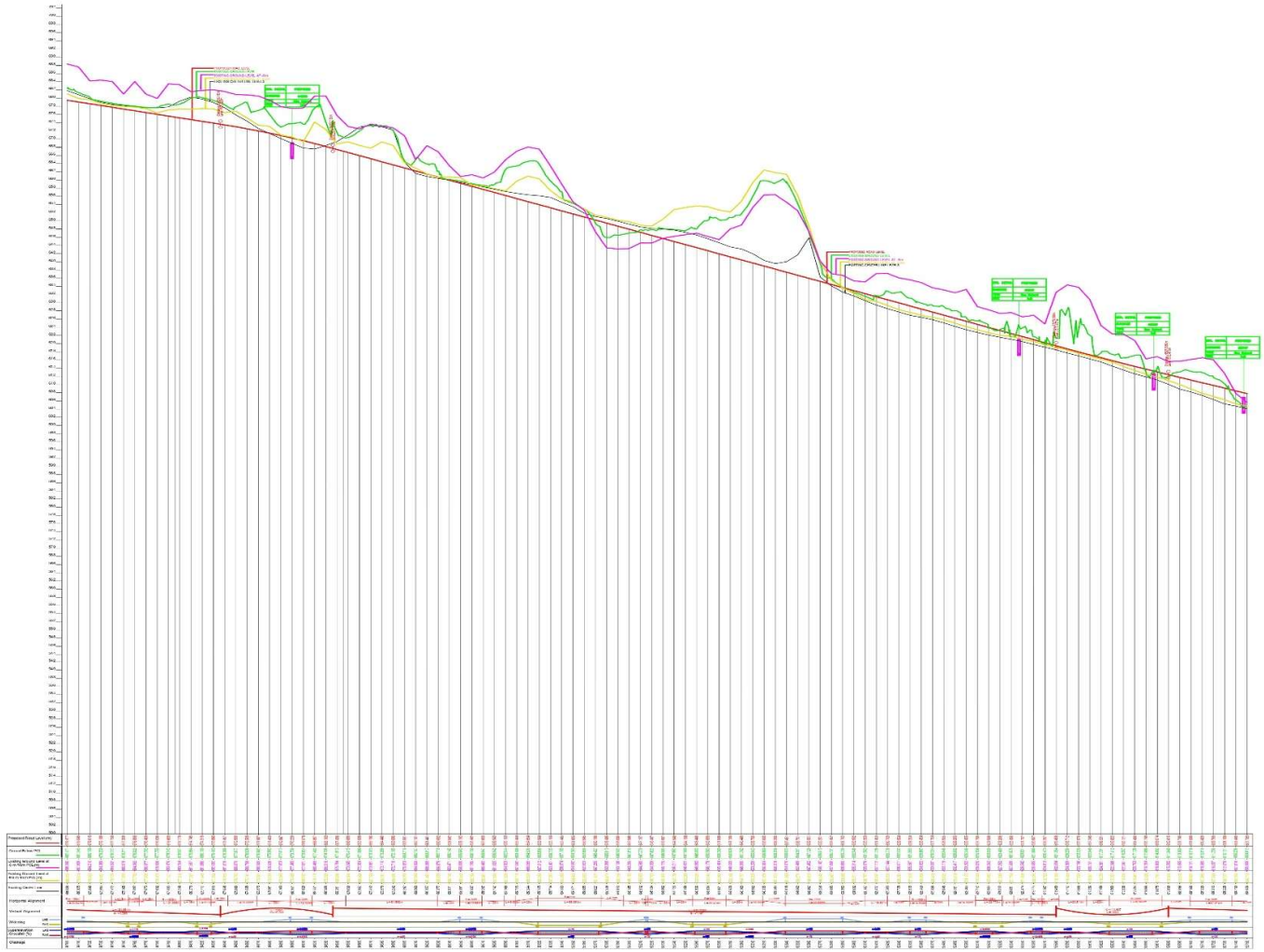
PLAN DRAWING HIGHWAY



SHORT BRIEF

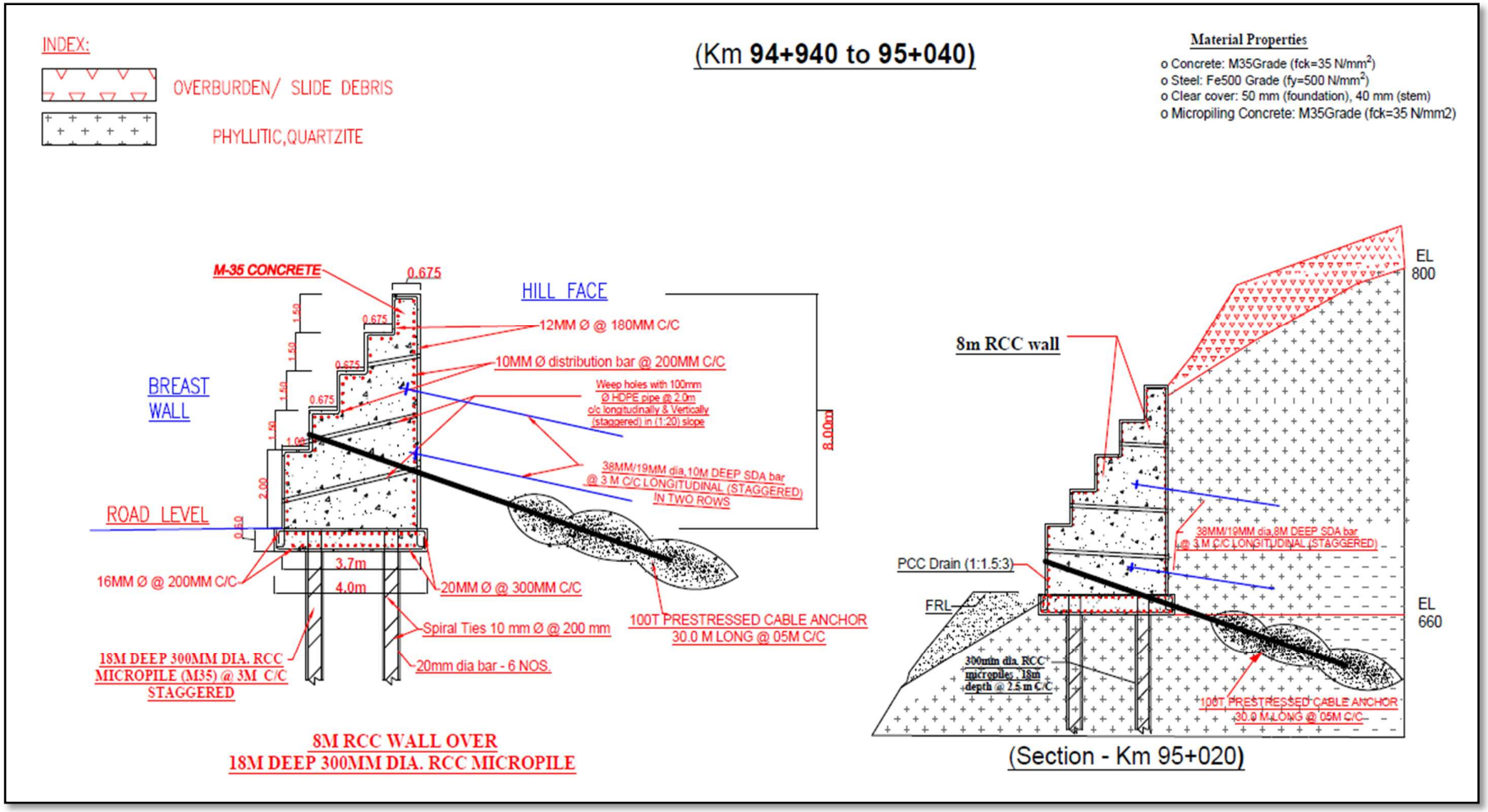
1. PROVISION OF CONSTRUCTION OF PROJECT HIGHWAY; INCLUDING PROVISION OF ROCKFALL BARRIER (CATEGORIE-A, 8000KJ);
2. PROVISION OF SLOPE PROTECTION WORKS INCLUDING LANDSLIDE MITIGATION;
3. PROVISION OF SUPPLY OF MACHINERY, LANDSLIDE CLEARANCE AND DISASTER MANAGEMENT.

Drawing – 1 (D-1)-Profile

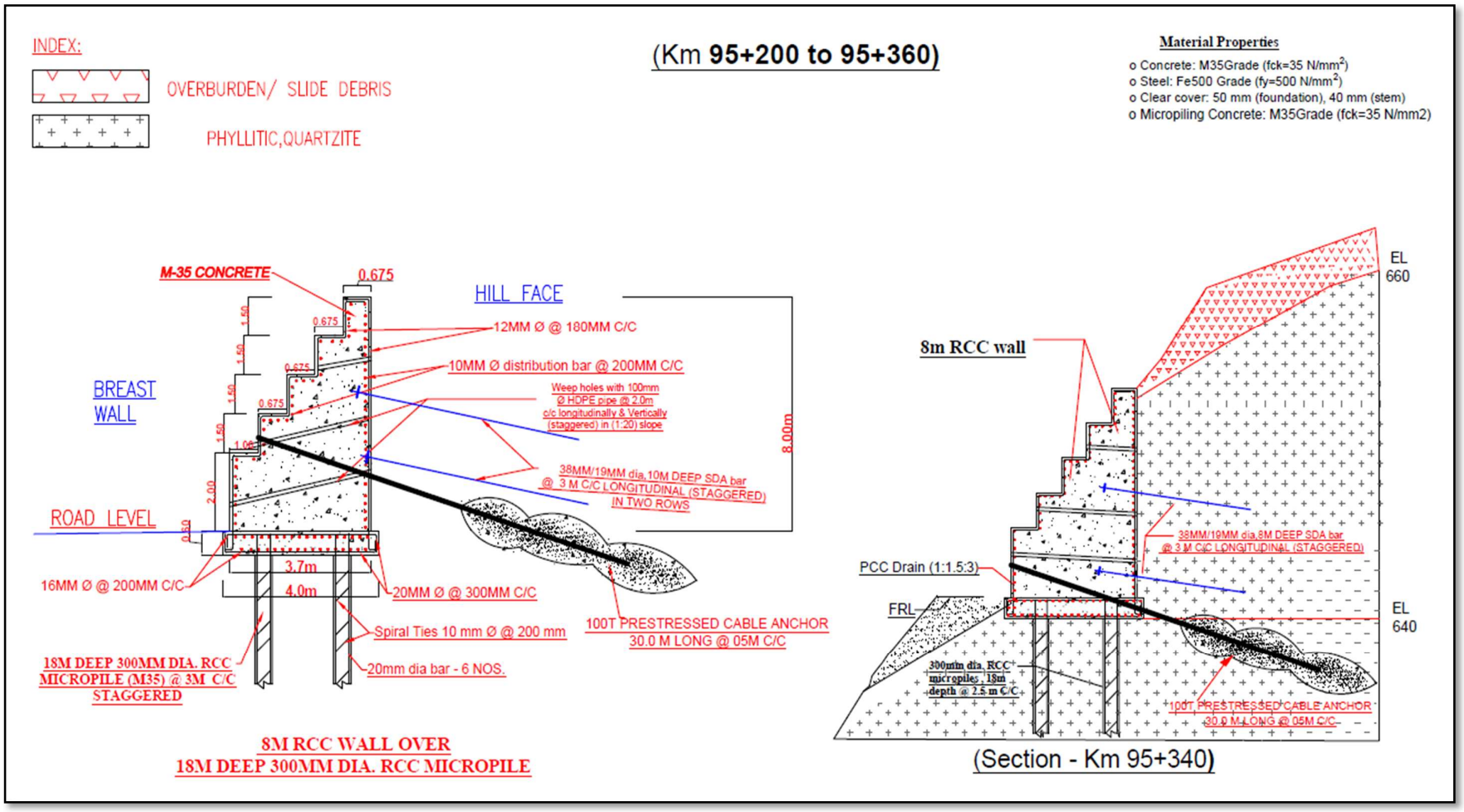


Page- 2 of 7

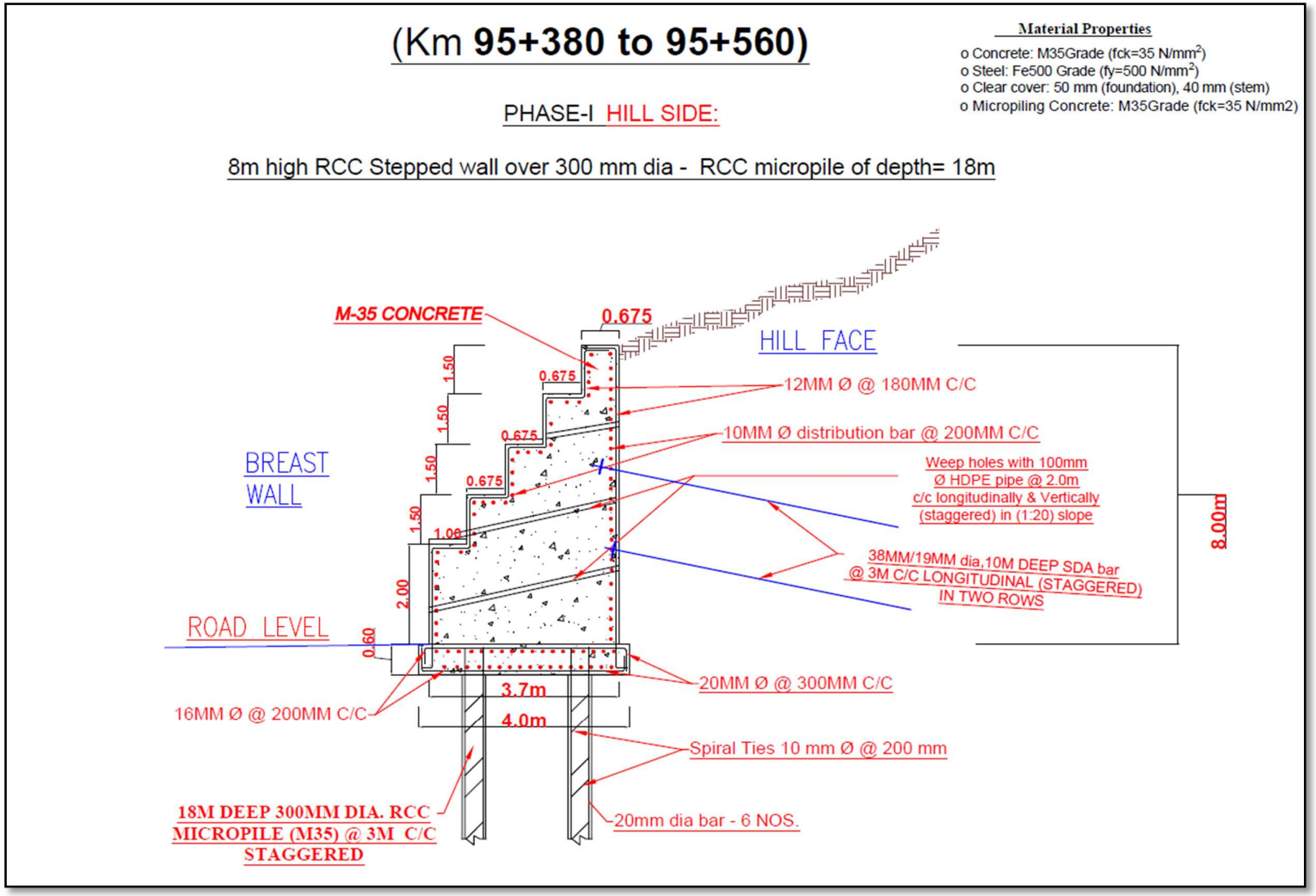
Drawing – 2 (D-2)


INDEX:
OVERBURDEN/ SLIDE DEBRIS
PHYLLITIC,QUARTZITE
(Km 94+940 to 95+040)
Material Properties
o Concrete: M35Grade (fck=35 N/mm²)
o Steel: Fe500 Grade (fy=500 N/mm²)
o Clear cover: 50 mm (foundation), 40 mm (stem)
o Micropiling Concrete: M35Grade (fck=35 N/mm2)
M-35 CONCRETE
0.675
HILL FACE
12MM Ø @ 180MM C/C
10MM Ø distribution bar @ 200MM C/C
Weep holes with 100mm Ø HDPE pipe @ 2.0m c/c longitudinally & Vertically (staggered) in (1:20) slope
BREAST WALL
38MM/19MM dia,10M DEEP SDA bar @ 3 M C/C LONGITUDINAL (STAGGERED) IN TWO ROWS
8.00m
ROAD LEVEL
16MM Ø @ 200MM C/C
3.7m
4.0m
20MM Ø @ 300MM C/C
Spiral Ties 10 mm Ø @ 200 mm
20mm dia bar - 6 NOS.
100T PRESTRESSED CABLE ANCHOR 30.0 M LONG @ 05M C/C
18M DEEP 300MM DIA. RCC MICROPILE (M35) @ 3M C/C STAGGERED
8M RCC WALL OVER 18M DEEP 300MM DIA. RCC MICROPILE
8m RCC wall
EL 800
38MM/19MM dia,8M DEEP SDA bar @ 3 M C/C LONGITUDINAL (STAGGERED)
PCC Drain (1:1.5:3)
FRL
EL 660
300mm dia. RCC micropiles, 18m depth @ 2.5 m C/C
100T PRESTRESSED CABLE ANCHOR 30.0 M LONG @ 05M C/C
(Section - Km 95+020)

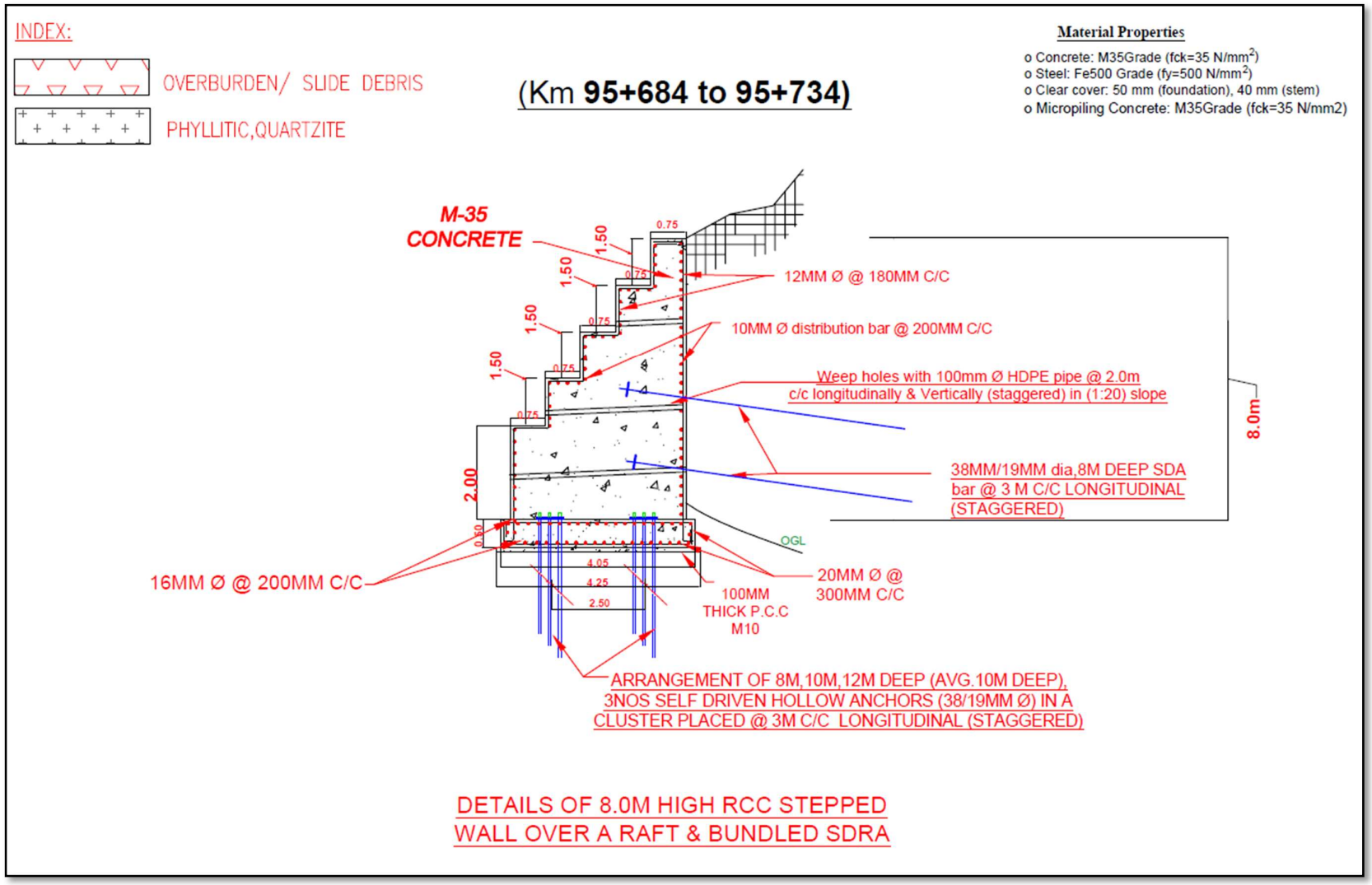
Drawing – 3 (D-3)


INDEX:
OVERBURDEN/ SLIDE DEBRIS
PHYLLITIC,QUARTZITE
(Km 95+200 to 95+360)
Material Properties
o Concrete: M35Grade (fck=35 N/mm²)
o Steel: Fe500 Grade (fy=500 N/mm²)
o Clear cover: 50 mm (foundation), 40 mm (stem)
o Micropiling Concrete: M35Grade (fck=35 N/mm2)
M-35 CONCRETE
0.675
HILL FACE
12MM Ø @ 180MM C/C
10MM Ø distribution bar @ 200MM C/C
Weep holes with 100mm Ø HDPE pipe @ 2.0m c/c longitudinally & Vertically (staggered) in (1:20) slope
38MM/19MM dia,10M DEEP SDA bar @ 3 M C/C LONGITUDINAL (STAGGERED) IN TWO ROWS
8.00m
BREAST WALL
ROAD LEVEL
16MM Ø @ 200MM C/C
3.7m
4.0m
20MM Ø @ 300MM C/C
Spiral Ties 10 mm Ø @ 200 mm
20mm dia bar - 6 NOS.
100T PRESTRESSED CABLE ANCHOR 30.0 M LONG @ 05M C/C
18M DEEP 300MM DIA. RCC MICROPILE (M35) @ 3M C/C STAGGERED
8M RCC WALL OVER 18M DEEP 300MM DIA. RCC MICROPILE
8m RCC wall
EL 660
EL 640
PCC Drain (1:1.5:3)
FRL
38MM/19MM dia,8M DEEP SDA bar @ 3 M C/C LONGITUDINAL (STAGGERED)
300mm dia. RCC micropiles ; 18m depth @ 2.5 m C/C
100T PRESTRESSED CABLE ANCHOR 30.0 M LONG @ 05M C/C
(Section - Km 95+340)

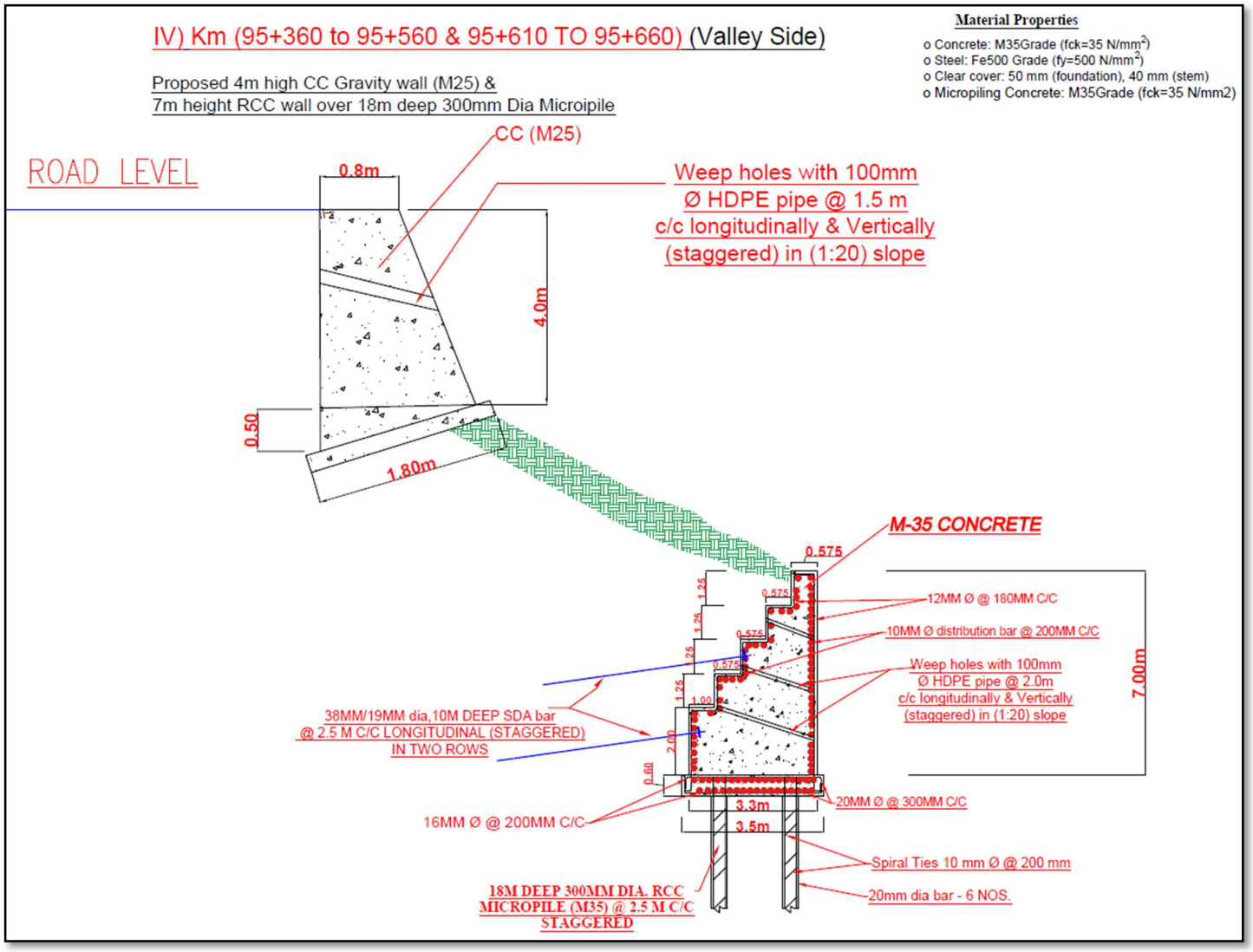
Drawing – 4 (D-4)


(Km 95+380 to 95+560)
Material Properties
o Concrete: M35Grade (fck=35 N/mm²)
o Steel: Fe500 Grade (fy=500 N/mm²)
o Clear cover: 50 mm (foundation), 40 mm (stem)
o Micropiling Concrete: M35Grade (fck=35 N/mm2)
PHASE-I HILL SIDE:
8m high RCC Stepped wall over 300 mm dia - RCC micropile of depth= 18m
M-35 CONCRETE
0.675
HILL FACE
12MM Ø @ 180MM C/C
10MM Ø distribution bar @ 200MM C/C
Weep holes with 100mm Ø HDPE pipe @ 2.0m c/c longitudinally & Vertically (staggered) in (1:20) slope
38MM/19MM dia,10M DEEP SDA bar @ 3M C/C LONGITUDINAL (STAGGERED) IN TWO ROWS
BREAST WALL
ROAD LEVEL
1.50
1.50
1.50
1.50
0.675
0.675
0.675
1.00
2.00
0.60
8.00m
20MM Ø @ 300MM C/C
16MM Ø @ 200MM C/C
3.7m
4.0m
Spiral Ties 10 mm Ø @ 200 mm
18M DEEP 300MM DIA. RCC MICROPILE (M35) @ 3M C/C STAGGERED
20mm dia bar - 6 NOS.

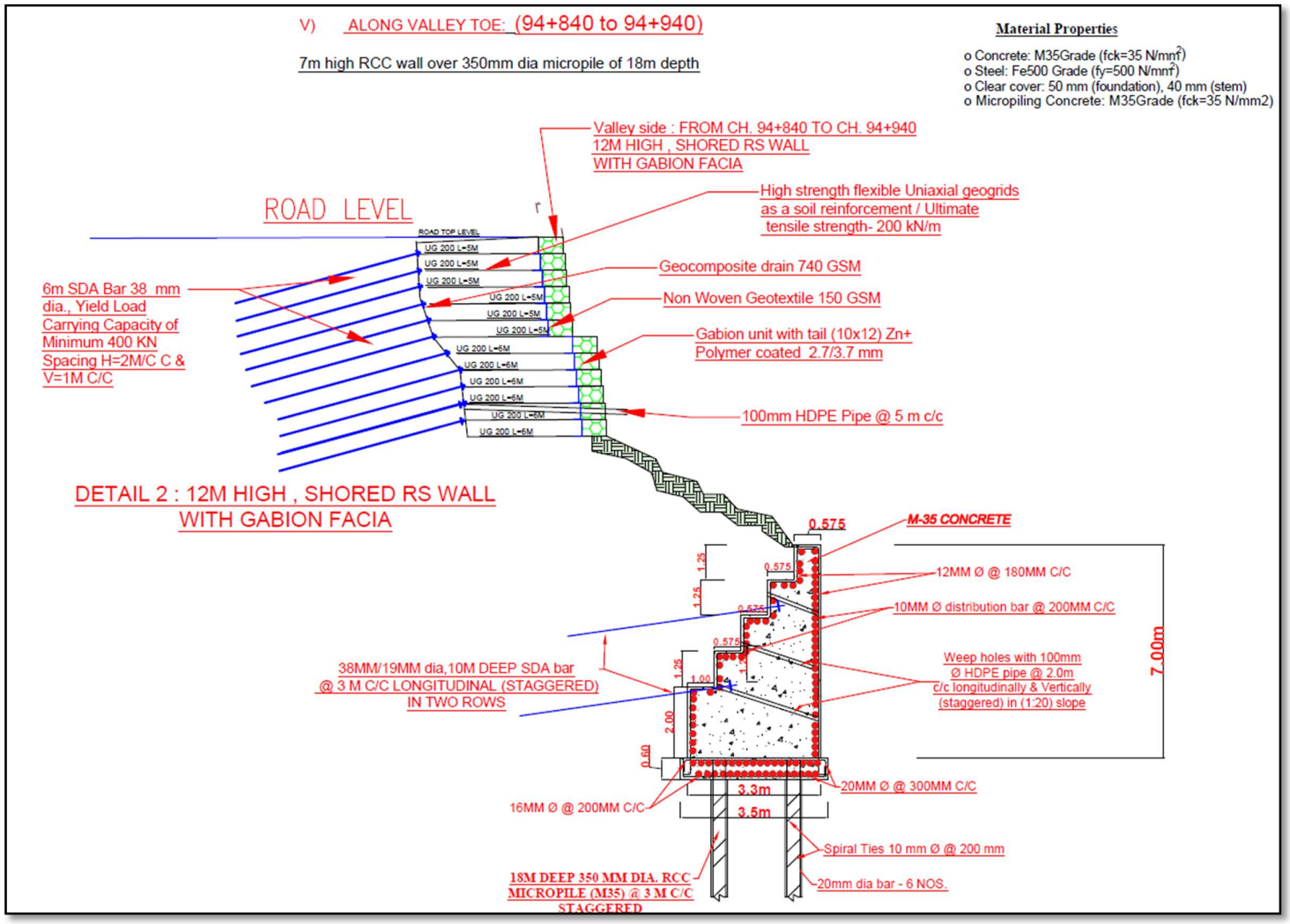
Drawing – 5 (D-5)


INDEX:
OVERBURDEN/ SLIDE DEBRIS
PHYLLITIC,QUARTZITE
(Km 95+684 to 95+734)
Material Properties
o Concrete: M35Grade (fck=35 N/mm2)
o Steel: Fe500 Grade (fy=500 N/mm2)
o Clear cover: 50 mm (foundation), 40 mm (stem)
o Micropiling Concrete: M35Grade (fck=35 N/mm2)
M-35 CONCRETE
12MM Ø @ 180MM C/C
10MM Ø distribution bar @ 200MM C/C
Weep holes with 100mm Ø HDPE pipe @ 2.0m c/c longitudinally & Vertically (staggered) in (1:20) slope
38MM/19MM dia,8M DEEP SDA bar @ 3 M C/C LONGITUDINAL (STAGGERED)
8.0m
2.00
OGL
16MM Ø @ 200MM C/C
20MM Ø @ 300MM C/C
100MM THICK P.C.C M10
ARRANGEMENT OF 8M,10M,12M DEEP (AVG.10M DEEP), 3NOS SELF DRIVEN HOLLOW ANCHORS (38/19MM Ø) IN A CLUSTER PLACED @ 3M C/C LONGITUDINAL (STAGGERED)
DETAILS OF 8.0M HIGH RCC STEPPED WALL OVER A RAFT & BUNDLED SDRA

Drawing – 6 (D-6)


IV) Km (95+360 to 95+560 & 95+610 TO 95+660) (Valley Side)
Proposed 4m high CC Gravity wall (M25) &
7m height RCC wall over 18m deep 300mm Dia Micropile
Material Properties
o Concrete: M35Grade (fck=35 N/mm2)
o Steel: Fe500 Grade (fy=500 N/mm2)
o Clear cover: 50 mm (foundation), 40 mm (stem)
o Micropiling Concrete: M35Grade (fck=35 N/mm2)
CC (M25)
ROAD LEVEL
0.8m
Weep holes with 100mm Ø HDPE pipe @ 1.5 m c/c longitudinally & Vertically (staggered) in (1:20) slope
4.0m
0.50
1.80m
M-35 CONCRETE
0.575
12MM Ø @ 180MM C/C
10MM Ø distribution bar @ 200MM C/C
Weep holes with 100mm Ø HDPE pipe @ 2.0m c/c longitudinally & Vertically (staggered) in (1:20) slope
7.00m
38MM/19MM dia,10M DEEP SDA bar @ 2.5 M C/C LONGITUDINAL (STAGGERED) IN TWO ROWS
16MM Ø @ 200MM C/C
20MM Ø @ 300MM C/C
3.3m
3.5m
Spiral Ties 10 mm Ø @ 200 mm
20mm dia bar - 6 NOS.
18M DEEP 300MM DIA. RCC MICROPILE (M35) @ 2.5 M C/C STAGGERED

Drawing – 7 (D-7)


V) ALONG VALLEY TOE: (94+840 to 94+940)
7m high RCC wall over 350mm dia micropile of 18m depth
Material Properties
o Concrete: M35Grade (fck=35 N/mm²)
o Steel: Fe500 Grade (fy=500 N/mm²)
o Clear cover: 50 mm (foundation), 40 mm (stem)
o Micropiling Concrete: M35Grade (fck=35 N/mm2)
Valley side : FROM CH. 94+840 TO CH. 94+940
12M HIGH , SHORED RS WALL
WITH GABION FACIA
ROAD LEVEL
High strength flexible Uniaxial geogrids as a soil reinforcement / Ultimate tensile strength- 200 kN/m
Geocomposite drain 740 GSM
Non Woven Geotextile 150 GSM
Gabion unit with tail (10x12) Zn+ Polymer coated 2.7/3.7 mm
100mm HDPE Pipe @ 5 m c/c
6m SDA Bar 38 mm dia., Yield Load Carrying Capacity of Minimum 400 KN Spacing H=2M/C C & V=1M C/C
DETAIL 2 : 12M HIGH , SHORED RS WALL WITH GABION FACIA
M-35 CONCRETE
12MM Ø @ 180MM C/C
10MM Ø distribution bar @ 200MM C/C
38MM/19MM dia,10M DEEP SDA bar @ 3 M C/C LONGITUDINAL (STAGGERED) IN TWO ROWS
Weep holes with 100mm Ø HDPE pipe @ 2.0m c/c longitudinally & Vertically (staggered) in (1:20) slope
7.00m
20MM Ø @ 300MM C/C
16MM Ø @ 200MM C/C
3.3m
3.5m
Spiral Ties 10 mm Ø @ 200 mm
20mm dia bar - 6 NOS.
18M DEEP 350 MM DIA. RCC MICROPILE (M35) @ 3 M C/C STAGGERED

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;~~

h) MBCB-Thrie with Delineator;

i) Parapet wall and;

j) **Instrumentation and INSAR Monitoring and alert system** - to detect of abnormal conditions, the system generates automated alerts through dashboards, SMS, or sirens, enabling timely intervention and risk mitigation. Alert System is widely applied in hill road projects, slope protection works, and infrastructure safety monitoring, enhancing resilience and reducing potential loss of life and assets. The Contractor shall design, supply, install, test, and commission a comprehensive Alert System for real-time monitoring of slope stability and associated geotechnical hazards. The Alert System shall comply with the following requirements:

Applicable Standards and Guidelines -The system shall conform to relevant provisions of:

- Schedule-D
- BIS standards (including IS 14458 and IS 14680)
- IRC guidelines for hill roads and slope protection
- NDMA guidelines on landslide risk management
- International best practices (ISO 22320, ISO 31000 or equivalent)

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.

(b) **Traffic Signs & Marking**

i. **Traffic signs** viz roadside signs, overhead signs and kerb mounted signs. Traffic signs include road signs (Mandatory, Cautionary, and Informatory), overhead signs and gantry mounted signs along the entire Project as per design and site conditions. Also, Specifications of the reflective sheeting. Type-XI type of reflective sheeting to be provided as referred to the provision of Section 6.7.1 of IRC: 67-2022 of the Manual.

ii. **Pavement Marking:** Pavement markings shall cover road marking (including Transverse Bar Markings) for the entire Project Highway as per relevant code and manual.

iii. **Traffic Blinkers**

Traffic Blinkers shall cover the entire Project Highway 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 of Slope Protection Measures 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 – 2023 (Hill Road Manual): referred to herein as the Hill Road Manual

c). IRC: SP:106-2015 Engineering guidelines on Landslide Mitigation Measures for Indian Roads

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 Four-Laning of Highways IRC: SP: 84-2019 and Hill Road Manual IRC SP: 48 - 2023 with all amendments till date published by IRC (referred to as "Manual" in this Schedule) and MORT&H Specifications for Road and Bridge Works (5th revision). 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) IRC- HRB- Special Report-23 -State of the Art: Design and Construction of Rock fall Mitigation systems.

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

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

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

(v) BS 8006-2:2011 Code of Practice for Strengthened /Reinforced Soil, Soil nail design

(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.

2. Deviations from Specifications and Standards

(i) The terms "Concessionaire", "Independent Engineer" and "Concession Agreement" used in the manual shall be deemed to be substituted by the terms "Contractor", "Authority's Engineer" and "EPC 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. No.	Item and Clause Reference	Provision as per Manual	Modified
1	Clause 3.5.1 of IRC SP:48 -2023 Approach to Stability Analysis	Specification requirement described under Sn (i) to (iv).	Add following provision: Factor of Safety in case of Seismic Condition for landslide locations shall not be less than 1.00.

(iii) Specifications for monitoring instruments shall be in accordance with section 6 of IRC SP 106- 2015.

(iv) The EPC Contractor shall ensure signing of agreement between the contractor and technology provider before use of material/technology/design. The agreement shall have the provision of involvement of technology provider during execution. Technology provider shall deploy the requisite design expert/material technologist/skilled and trained construction supervision personnel to certify material testing and material characterization for design, proof check of design, approved construction methodology, quality control and supervision and certification of the day-to-day construction/execution. The technology provider shall submit the warranty for the products to be used along with all other documents as required by IRC: SP:112-2017 "Manual for Quality Control in road & bridge works". Copy of such agreement shall be furnished to AE, PMU and to RO NHIDCL for reference and record.

ANNEXURE-II: TECHNICAL SPECIFICATIONS

(SPECIFICATIONS AND STANDARDS FOR DESIGN AND CONSTRUCTION)

The following Specifications and Standards shall be applied in addition to IRC: SP: 84-2019 and IRC SP: 48 – 2023, MoRTH specifications with all amendments till bid due date. Out of given alternatives in the agreement, such specifications and standards shall be adopted, for design of slope protection measures specified in Schedule-B, which are proven to be better. Authority Engineer's decision shall be final in this regard.

1. SUPPLY AND INSTALLATION OF SELF DRILLING ANCHORS (SDA) OF 38/19mm DIAMETER

The SDA shall be designed and arranged to stabilize in-situ strata. The grout shall be made of OPC min. grade 43 & above with suitable admixtures. SDA bars shall have corrosion protection coating including hexagonal nut, washer plate, coupler for connecting bars all with hot dipped Zinc coated of 86micron. Additionally post installation all the exposed portion shall be coated with epoxy coating of minimum 150 micron. 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. As mentioned in Hill Road Manual, BS 8081-2015 shall be referred for design, testing, monitoring, and maintenance.

Installation of Self driven rock anchor made of 40CR material with outer diameter of 38 mm and inner diameter of 19 mm, Yield Load Carrying Capacity of Minimum 400 KN in soil / overburden / rock suitable for drilling placing and cement grouting. Installation with all accessories such as 76 mm diameter sacrificial drill bit, couplers, 200*200mm base plate with 10mm thick and nut and bolt complete in all respect. The cement grouting shall be done at a min. pressure ranging from 1 to 3 kg/cm^2 till all the cracks are suitably sealed / filled.

Any equivalent or greater proven alternative technologies that meet the minimum technical criteria of anchors may be used subject to prior written approval of competent authority in NHIDCL. These criteria include Bond Strength, Anchor Length, Yield load, Tensile strength, Pull-out resistance, and Corrosion protection measures etc. for the design life.

2. SUPPLYING & FIXING THREE-DIMENSIONAL TURF REINFORCEMENT MAT (TRM) MADE OF CONTINUOUS MONOFILAMENTS (3D REINFORCED EROSION CONTROL MAT).

Supplying and fixing reinforced erosion Control mat (for surficial erosion control) made from a polymeric three-dimensional matrix of minimum mass per unit area 400 grams/sqm conforming to EN ISO 9864 extruded onto a primary mesh rhomboidal or mechanically woven double twisted steel wire mesh having longitudinal tensile strength of 55+-5 kN/m, having proven life of >50 years complying with class C3 Site Environmental level mentioned in Tables 4 and 8 of IS:14191-6 including fixing of U pins of 8mm diameter of depth 500mm at 1m c/c spacing complete with all materials, etc.

(i) Geo-mat specifications:

Polymer	**Polypropylene**
Mass per unit area (EN ISO 9864) ± 10%	400 g/m2
Melting point	150 degree C
Density	900 Kg/m3
UV Resistance	UV stabilized

(ii). Reinforcement

Type	**Rhomboidal or Double twisted woven steel wire mesh. Wires protected with galvanization**
Wire dia (Int./Ext.), mm	2.7/3.7
Mesh wire-primary corrosion	Zn-5% Al +Polymer coating as per IS:4826 – 1979

(iii). Characteristics of Steel reinforced Synthetic Geomat

Mechanical Properties of Steel Reinforced Synthetic Geomat		
Mechanical Strength (Length)	kN/m	55 (+) or (-) 5 (Minimum)
Nominal Physical properties of High Strength Reinforced Synthetic Geomat		
Mass per unit area (EN ISO 9864)	g/m2	1900
Voids index	%	>90
Nominal Thickness (EN ISO 9863-1)	mm	12
Geomat colour (*)		Black/Brown/Green

3. CONCRETE:

The minimum concrete grades for various structures shall follow specifications

- Surface CC drains: M20
- PCC/ CC works and Retaining walls / Breast wall: M25
- RCC works and Concrete step wall: M35,

- Foundation works for Micro-pile: M35,

IS 456 shall be used for all concrete related designs, and quality control.

Testing and Acceptance criteria:

The manufacturer of the synthetic mat shall provide Manufacturers Test Certificate / Certificate of Conformity for the material with every lot/shipment. The Manufacturers Test Certificate / Certificate of Conformity for synthetic mat shall be provided for certifying that system confirms to all the technical requirements.

4. Double Twisted Hexagonal Steel Wire Mesh, Zinc + 5% Al Class A + Durable polymer coated;

Supply and fixing of Double Twisted Mesh including all cost of material, labour and T&P required to complete the work in all respect with following properties:

A. Mesh type: 6x8, Mesh opening: 60mm X 80mm

B. Mesh Wire dia. 2.2/3.2mm (ID/OD), mechanically edged/selvedged with galvanization as per EN 10223-3, and shall have minimum 16 numbers of mesh openings per meter of mesh perpendicular to twist.

C. Tensile strength (500 Mpa) at a minimum elongation of 10%. The minimum tensile strength of the mesh panel must be 34.0 kN/m (+/-5kN/m) In the parallel to the twist direction and 13 kN/m in the perpendicular to the twist direction in accordance with the requirements of IS 16014:2018.

D. Zinc Coaling: The coating weight shall be heavily coated and soft type confirming to the requirements of specifications IS 4826:1972. Adhesion of Zinc Coating: No flakes or crack shall be observed while testing for adhesion of zinc coating as per IS 4826:1972.

*ID/OD Internal diameter/Outer diameter of Polymer coated wire.

5. Geo-jute mat;

Supply and fixing layer of Geo-jute mat with spraying of seeds of Lemon grass/Dedonia/Vetiver etc., including all cost of material, with following properties:

a. Material 100% natural,

b. Weight 500 GSM,

c. Minimum Breaking Load along Machine Direction (warp way)-10.0(kN/m), Cross Direction (Weft way)- 10.0(kN/m), d. Max. Elongation at break (in %): Machine Direction (warp way) 10, Cross Direction (Weft way)-12.

6. HT Rolled Cable Net;

High tensile rolled cable net having aperture size not more than 300mm in one direction and minimum longitudinal tensile strength 120 KN/M and punching resistance 220 kN, comprising of minimum 8mm diameter wire rope cable with a minimum breaking load of 40.7kN. The tensile strength of wire of the cable should be 1770 N/sqmm having corrosion protection of having 95% Zn + 5% Al Class-B (Galfan) Coating as per IS/ISO-17746-2016 for treatment of slopes (net, boundary rope(12mm diameter) & rope anchor etc. comprising of the complete system), labour, special labour and T&P required to complete the work in all respect in accordance with drawings, Technical Specifications.

7. SUPPLYING AND FIXING OF EROSION CONTROL COIR MAT AND U-PINS

Geo-jute mat with spraying of seeds of Lemon grass/Dedonia/Vetiver, complying with MoRTH specifications 707 and with following properties:

a. Material 100% natural, biodegradable non-woven

b. Weight 500 GSM,

c. Minimum Breaking Load along Machine Direction (warp way)-10.0(kN/m), Cross Direction (Weft way)- 10.0(kN/m),

d. Max. Elongation at break (in %): Machine Direction (warp way) 10, Cross Direction (Weft way)-12.

8. SUBSURFACE DRAINS

Pressure relief drains shall be of Slotted/perforated pipes, installed in drilled holes drilled as shown in drawings to tap the sub-surface flow. Sub surface drains shall be Corrugated and Slotted High-Density Polyethylene (HDPE) pipes (wrapped with Type-2 non-woven geotextile) of 100 mm internal diameter, installed in pre-bored hole drilled with upward gradient. The space around the pipe at the face of the cut slope / wall shall be packed with rich sand cement mortar mixed in proportion not leaner than 1(cement):4 (sand).

8. **(i) Gabion Facia box -** BIS certified Gabion fascia box with 2m integrated tail of Size 3m(Length of Tail)x3m(Length of Box)x1m(Height of unit) with Mechanically Woven Double Twisted Hexagonal Shaped Wire mesh Gabion Boxes as per IS 16014:2012, MoRT&H's 5th revision clause 2500, of required size, Mesh Type 10x12 (D=100 mm with tolerance of ± 2%) Zn +Polymer coated, Mesh wire diameter 2.70/3.70 mm (ID/OD), mechanically edged/selvedged with partitions at every 1m interval and shall have minimum 10 numbers of openings per meter of mesh perpendicular to twist, tying with lacing wire of diameter 2.2 /3.2 mm (ID/OD), supplied @3% by weight of Gabion boxes, filled with boulders with least dimension of 200 mm, as per drawing.

(ii) High strength flexible geogrids (HSFG) as soil reinforcement / basal reinforcement as per MORTH 3100 and IRC 113, made of high tenacity polyester core with polyethylene coating with Minimum Long Term Design Strength (LTDS) of more than 50% of ultimate tensile strength at 30 degree Celcius corresponding to 12 % strain. (Ultimate tensile strength- 200 kN/m).

(iii) Drainage composite for use behind walls, between two different fills, alongside drains of road, below concrete lining of canals etc. having three dimensional composite with thermobonding a draining core having "W" configuration in extruded monofilaments of minimum thickness 7.2mm, with two filtering UV stabilized polypropylene nonwoven geotextile of minimum thickness of 0.75mm and tensile strength of 8.0 kN/m that will be working as separation or protecting layer, geocomposite having in plane flow capacity of 2.3 L / (m.s) at hydraulic gradient of 1.0 & 20 kPa pressure and tensile strength of 18 kN/m , with mass per unit area of 740 gsm, at easily accessible location including top and bottom, with all leads and lifts, manpower and machinery, materials, labour etc. complete and as directed by Engineer.

(iv) **Needle Punched and mechanically bonded non-woven Geotextile** indigenously manufactured from high quality fibers on the prepared subgrade for Separation. (Ref to MoRT&H's 5 th Specification 702) 150 GSM

9. SPECIFICATIONS OF INSTRUMENTATION, MONITORING

The work comprises of:

- Supply and Installation of all the necessary Instruments, data loggers and other hardware accessories required for setting up the instrument and connecting to data logger
- Calibration and interfacing of instrument with Data Acquisition System and Remote Data Monitoring Software
- Data logging, maintaining data on web, providing live web display of data
- Continuous monitoring of all the instruments for 2 years after commissioning
- Sending SMS/emails of alert and alarm level warnings
- maintaining equipment and data and replacing damaged instruments for continuous functionality when needed

Contractor must ensure that WIFI connection is available to connect data logger with data monitoring website. If not, contractor must ensure availability of satellite-based connection.

Type of Instruments and technical specifications

(a) Piezometer

Piezometer are used to measure groundwater elevations and pore-water pressures in slopes, structures, pipe lines, well etc. It also helps in evaluating the pattern of seepage, zones of potential piping and the effectiveness of seepage control measures undertaken.

Vibrating wire piezometers shall be used which is more accurate, reliable and can measure rapid changes in pore pressure with automatic measurement. The vibrating wire piezometers convert water pressure to a frequency signal via a diaphragm, a tensioned steel wire, and an electro-magnetic coil. So, a change in pressure on the diaphragm causes a change in tension of the wire that can be recorded. Multiple piezometers, installed in one drill hole at different depth is recommended to determine the seepage zone present at various depth. Casing shall be used while drilling borehole to prevent the side wall of borehole from collapsing. The required specifications of Vibrating Wire Piezometer are as follows:

Description	**Specification**
Type	Vibrating Wire with inbuilt thermistor for temperature measurement and surge arrestor for lightning protection.
Measurement Range	0.2 – 10 MPa
Resolution	0.05 % fs
Non-linearity	0.5 % fs
Sensor Accuracy	± 0.25 % fs standard
Operating Temperature Range	- 20°C to + 80°C
Enclosure	Stainless Steel, hermitically sealed
Signal Transfer Length	Good signal transfer with cable of minimum 0.5Km length
Cable	Low capacitance, Multi conductor, polyethylene insulation, polyurethane sheathed cable from sensor to Data logger
Others	To be mentioned by vendor, if needed

(b) Inclinometers and settlement gauges

Inclinometers and settlement gauges are used for determination of zones of

movement within the slope. Inclinometers measure the lateral movement and deformation. It also measures magnitude of inclination or tilt and its variation with time in structures. Inclinometers are installed in boreholes drilled within the landslide mass. They measure the curvature of initially straight boreholes, thus detecting any change in inclination of the borehole casing. In place inclinometers shall be installed in boreholes drilled within the slope as per the procedure given in relevant standards. The detailed specifications of the required In-Place Inclinometer system is given below.

Description	**Specification**
Type	Electron beam welded Biaxial sensors with SDI- 12 protocol.
Measurement range	$\pm 10^0$
Resolution	0.00625% fs
Operating Temperature range	-20^0C to $+80^0$C
Sensor Accuracy	±0.1% fs
Repeatability	0.05% fs
Housing material	Stainless steel
Internal Diameter	Compactable with casing pipe
Outer Diameter	Compactable with casing pipe

Top Support Assembly with placement tube: Top support assembly will be used to hang the sensors down the casing column to avoid down sliding in the borehole, to safely retrieve the sensor column from borehole when required and also to close the top of casing with protective cap.

• Top assembly with protective rope to hang and retrieve the sensors.
• Protective Cap to close the sensor column on the top
• Placement tube 0.5 to 1m

Bottom Support Assembly: It may consist of followings:

• Termination Wheel
• Bottom Protective Cap for casing

IPI Wheel Assembly: Pivoted sprung wheel assembly to connect biaxial sensors.

Gauge Tube: It is required to join and maintain separation between consecutive IPI's sensors and wheel assembly.

- Gauge Tube: 2-3 m in length

Casing: Flexible, impact and corrosion resistant

• ABS plastic with top and bottom caps
• Deflectable with ground within material or structure
• Self-aligning four grooved access tube
• Fixed or telescopic couplings with all mounting accessories such as pop-rivets, Self-tapping screws, rivet gun etc. Provision of mastic tape over the joints to prevent the ingress of water or grout.
• Internal Diameter: 58 mm
• External Diameter: 70 mm
• Length: 2-3 m

Associated Accessories:

• Multi conductor cable for interface of sensors with each other and Data-logger, Top and bottom caps with all mounting accessories such as pop rivets, self-tapping screws, tape etc.
• Mastic, sealing tape
• Others: To be mentioned by vendor, if required

The settlement gauge/measuring system consist of settlement cell that contains a pressure transducer with vibrating wire which helps to monitor the settlement in slope and structures. The system consists of a steel base plate and extension rods equipped with necessary threaded end connections enabling the rods to connect with each other, as well as to connect with the base plate connected to a reference station by a twin tubing filled with water (or anti-freeze solution) and fitted with stainless steel connectors. The reference station consists of a sealed liquid-filled reservoir open to atmospheric pressure and located at a known elevation. The settlement or heave is measured relatively to the elevation of the reservoir.

The whole assembly shall embed at the location where settlement measurement is required. As the settlement cell goes down due to settlement or goes up due to heave there is change in the head of fluid above the pressure transducer. The pressure transducer measures the change in resulting pressure from which the change in fluid head in millimeters is obtained by calculation. Technical specification of settlement measuring system is given below:

Description	**Specification**
Transducer Type	Vibrating wire or optic fibre
Measuring range	5-70m
Base plate	300 mmx300 mmx 3mm
System accuracy	±0.25%-1% fs
Temperature limit	-20^{0}C to 80^{0}C
Reservoir housing	PVC or ABS
Transducer housing	Stainless steel
Senser accuracy	±0.1% fs
Thermistor	0.1” standard
Fluid type	A mixture containing 50 % ethylene glycol and 50 % deaired water
Fluid tube	Twin nylon tube

Data Acquisition

(a) Technical specifications

Data acquisition system consists of a programmable data logger, sensor interface cards, solar chargeable power backup and corrosion resistant weather proof enclosure. The data logger provides multiple sensor measurements, communication interfaces, data / program storage and control functions.

Data Logger: Data-logger with enclosures should have the following specifications:

Input	Sensors with SDI-12 signal interface
No. of channels	2-3
No. of sensors per channel	Each channel to have min. 50 sensors connection.
Scan/upload interval	5 seconds to hours, depending on sampling rate
Memory capacity	Flash Memory (64-Mbit); at least 2 Million data points.
Data output format	CSV text file required. Should be easily imported to Microsoft Excel for further processing
SDI-12 version	Version 1.3 or latest version
Communication port	RS-232 (Standard); 115 kbps
Temp. measurement range	-20°C to +50°C with 0.1°C resolution required.
Operating temperature range	- 20 °C to 50°C
Humidity	100 % capability
Power supply	• 2 x D size 3.6 V/19 Ah Lithium cells, or • 2 x D size 1.5 V Alkaline high-power cells, or • 12V SMF battery chargeable from AC mains or solar panel.
Housing	Should be corrosion resistant weather proof enclosure.

Sensor Interface Cards

Extensometer, Crack meter & Creep	• Direct interface of vibrating wire sensors. Measurement Resolution: 0.001 Hz • Capability to eliminate problem of incorrect noisy readings • Capable to retrieve frequency of interest •

SDI-12 Interface Card for connecting Tipping Bucket Rain Gauge to SDI-12 port of Data Logger.	
Enclosure Temperature Connector Power Input Voltage Internal backup power run time Internal backup power charge time Internal backup power charging current Communication Protocol	Potted enclosure for humid environments. -20°C to +50°C 5 pin connector 4V-20V DC. 10 Hours (min.) ~ 16-18 Hours (approx.) 25mA (fully discharged) to 100µA (fully charged) SDI-12 v1.3 (SDI communication will be disabled when running off internal backup power

Weatherproof Enclosure: Dust, water, sunlight and environment pollutant proof IP65 rated enclosure to house data logger, modem, cables, interface unit, power supply, solar panel and other accessories.

Communication Interface: GSM/GPRS/EDGE/UMTS/HSPA/LTE cards compatible with systems are required at the site with data logger and at the receiving station. The GSM/GPRS/EDGE/ UMTS/HSPA/LTE modem will be housed in the data logger enclosure. The desired specifications are:

Description	**Specification**
Standard Compliance	GSM/GPRS/EDGE/UMTS/HSPA/LTE for fast data transfer
Frequency Bands	Quad band 850/900 MHz and 1800/1900 MHz
Host Interface	RS-232 serial data port required.
Interface Connector	DB9/USB/Ps/2/Firewire

Data Services	• Eg: GPRS slot Class-12, if GPRS compliant. • Terminal Class with A, B or C • Downlink: 32-48 kbps • Uplink: 32-48 Kbps
Specifications for SMS	• Point-to-point MO and MT • SMS cell broadcast • Text and PDU mode
Power Specifications	• Input Voltage 12 V DC to 48 V DC • Consumption @ 12 V DC Transmit: 900 mA or less • Sleep mode for power saving
Operating Environment	-20°C to +50o C
Function Control	Through AT commands
Network Functionality	• Auto register to GPRS network. • Auto reports dynamic IP assignments. • Remote command line interface via Telnet. • Configurable as TCP Server and Client. • Support for TCP, UDP, FTP, Telnet and ICMP. • OTA firmware upgrade using FTP. • SMS Connectivity - should Store up to 4 SMS numbers

Data Management Software:

The purpose of Data monitoring software is to read and interpret the measurements of installed sensors through the above-mentioned communication interface. User friendly manual be provided to understand the functionality of software.

IEEE standard 12207 should be followed for the following documents:

- Software requirements specifications
- Interface requirements Specifications
- Software Installation Plan / Procedure
- Testing and validation Requirements
- Software user documentation / user manual shall be provided. The desired specifications of the software are given below:

Type of application software	• Network based • Multiple users can view the data (minimum 04 users at a time) • Software must be available in subscription terms and perpetual license. • Login/access shall be provided to users. Administrator capability to create guest users to limit access to software. • Configurable to work on standalone PC also. • Software must support in built camera of total station. • Software must have built in scalability to add projects as requirement expands.
Data acquisition system readout	• Capability to read sensor measurements from data acquisition system. • Software must support variety of sensors including geodetic and geotechnical. • Presentation of graphical overview of individual/group sensor measurements in user selectable engineering units. • Maps-pictorial view and cross-section view required. • Presentation of Day, Month and Duration wise data.
	• Trend Chart. • Export to pdf/rtf. • Functionality be provided to import processed data to software and interpreted graphically in S/w itself. • Data download capability in formats like .xlsx or .txt format.
Data Error Check	• Capability to validate the received data by using some specified minimum and maximum value.
Control of sensor sampling	• Capability to remotely configure the sensor sampling from per second to hours daily.

Threshold based SMS alerts	• Should accept the multiple thresholds for sensors. • Sensor threshold should be changeable. • Capability to compare the sensor measurements (in user selectable engineering units) with specified threshold. • Capability to deliver the over-threshold alarm and alerts at the monitoring station and via SMS and email. • SMS shall be customized as per the warning levels.
Configurability	• Configurability to group sensors for visualization. • Should accept the calibration factor for sensors. • Should accept the formulas to process the received sensor data.
RDMS Interface	• Should automatically store the sensor measurements to Microsoft SQL server.
OS Support	• Microsoft Windows 10 and later version in standalone mode and • Windows Server 2019 and later in network mode
Administrative support	• Backup and restore facility

10. InSAR Monitoring

The Contractor should monitor the landslide using satellite-based synthetic aperture radar (SAR) techniques to provide precise displacement measurements, while maintaining frequent coverage of the area of interest (AOI) using the Sentinel-1 satellite constellation, which has sufficient temporal and spatial resolution or any other similar or better satellite data available.

The AOI being a minimum 500m x 500m area including the Jalogi landslide and surroundings which may possibly be affected. An accurate high-resolution Digital Elevation Model (DEM) of affected area before and after implementation of mitigation measures shall be used as initial input. Differential Interferometric SAR or D-InSAR technique shall be used. A combined approach of Point-like targets (point scatterers, or “PS”) and distributed targets (distributed scatterers, or “DS”) processing to be used. Accuracy (standard deviation) of the InSAR measurements for the mean deformation velocity will be in the mm/year-range, whereas accuracy for the individual deformation between two successive points in the time series will be in the range of a couple of millimeters depending on coherence between acquisition.

Deliverables:

1. Baseline Data Pre & Post construction of mitigation measure
2. Monthly written data report as well as the deformation results as point files in ASCII- or CSV- files, pre-packaged MXD files for use with ESRI products or similar format. Files shall be delivered in the NE coordinate system or as asked by client.
3. The above data to be made available in-service provider's web-tools which allows to investigate the data on an interactive map, including visualization of time-series. Access to data delivered within this project shall only be available to specific users chosen by the client, for whom access credentials will be prepared and provided.
4. Geotechnical Interpretations and risks, if any, to be highlighted in the report.
5. The monitoring and reports to be continued till DLP.

11. SPECIFICATIONS FOR ALERT/WARNING SYSTEM

The device shall be able to detect any impact on the protection meshes or Rockfall Barriers or debris flow barriers that exceed its predefined threshold and shall be calibrated according to the same.

One device shall be able to detect the impacts that occurs on panels of the rockfall protection meshes/ barriers having alert system installed on it, from different points, at least 8 different points.

The alert system shall be robust ergal tested to resist impacts up to 100g acceleration and minimum 8 sensors. Proof of ISO17025 or equivalent must be provided from the laboratory/ testing facility. The device shall be equipped with a geolocation sensor and long-lasting batteries having min. 5 years' service life, which do not require annual replacement or continuous charging.

The device shall be able to operate in the extreme temperature range between -40 c° and +60 c° and shall have self-configuring network. The alert system shall be set up at remote locations without the requirement of calibration during installation.

The device shall be able to forward information continuously, without sim card, in any meteorological condition and in absence of any GSM/GPRS signal.

It shall include a repeater unit with network capability of gsm/gprs or satellite (in

case of no gsm coverage) and signal range shall cover 5 km radius. the repeaters must be capable of support redundancy in the same network of sensors (more repeaters for the same sensors where necessary)

Services shall include data transmission to specific website able to supervise alert system, alarm status, battery level, number and position of each sensor or other events.

The alert system shall comprise of detections units which can detect and transmit the signals of all parameters. This detecting device shall communicate the signals with a repeater which collects and retransmits data via satellite or via GSM, to data collection servers from which they can send to local PCs, apps, mobile and tablets etc in real time basis.

These detection devices shall be installed on wire mesh, rhomboidal wire rope panel/mesh, Posts on the barrier or any other suitable locations and a repeater device shall be installed at an easily accessible locations predominantly near to the road level. Each repeater device shall be able to collect the signals from multiple detection devices and shall be installed in such a way that it should be able to receive the signals from the detection device.

QUALITY ASSURANCE PLAN:

S No	Material or Process / Characteristics	Frequency	Reference Standard	Level of Check
1	**Earth work in filling**			
a	Index properties	1 set of tests per 3000 cum	IS: 2720 Part - 2,3,4,5,6,8,9	Four
b	MDD & OMC		IS 2720 Part 7	Four
c	Thickness	For every layer	Technical Specifications/ drawings	Three
d	Field dry density and moisture content	1 test per 1000 sqm of completed area	IS 2720 Part 28	Three
e	Level and slope	For topmost layer and for outer slope	As per drawing	Three
2	**Anchor**			
1	Diameter	Per lot	MTC	One
2	Length	Per lot	MTC	One
3	Mechanical Properties	Per lot	MTC	One

S No	Material or Process / Characteristics	Frequency	Reference Standard	Level of Check
4	All Relevant Tests of Grouted anchor as per Annex-G BS: 8081-2015			
3	**Cement Concrete**			
a	Mix Design	For each grade of concrete and material source	IS 10262	Three
b	Grade of concrete	For each pour	IS: 456 and drawings	Three
b	Cube Strength		IS 516	Three
c	Slump test		IS 1199	Three
4	**Steel Reinforcement**			
a	Grade of steel		As per approved construction drawings	One
5	**Mechanically Woven DT mesh**			
1	Mesh dimension	1 per 8000 Sqm.	ASTM-A 975	Two
2	Mesh opening (D- dimension)	1 per 8000 Sqm.	EN 10223-3	Two
3	Mesh wire diameter	1 per 8000 Sqm.	EN 10223-3	Two
4	Mesh wire zinc coating thickness	1 per 8000 Sqm.	EN 10244-2	Two
5	Polymer coating thickness	1 per 8000 Sqm.	ASTM-A 975	Two
6	**Grout**			
a	Grouting compound	Per lot	Data Sheet	One
7	**Non -woven geotextile**			
1	Tensile strength & Elongation	Per lot	Cl. 702 MoRTH	One
2	Puncture strength	Per lot	Cl. 702 MoRTH	One
3	Apparent opening size	Per lot	Cl. 702 MoRTH	One
4	Permeability	Per lot	Cl. 702 MoRTH	One
5	Mass per unit area	Per lot	Cl. 702 MoRTH	One
8	**Erosion control mat**			
1	Tensile strength	Per lot	Cl. 706 MoRTH	One
2	Thickness	Per lot	Cl. 706 MoRTH	One
3	Mass per unit area	Per lot	Cl. 706 MoRTH	One
4	UV stability at 500h, Retained strength percentage with respect to original strength	Per lot	Cl. 706 MoRTH	One
9	**Mesh Rope**			
1	Diameter	1 per 8000 Sqm.	As per drawing	One
2	Zinc coating	1 per 8000 Sqm.	IS 1835 (Class A)	One
3	Rope grade	1 per 8000 Sqm.	1770N/mm^2	One
4	Rope type	1 per 8000 Sqm.	IS 2266/ISO 2048	One

S No	Material or Process / Characteristics	Frequency	Reference Standard	Level of Check
5	Tensile strength	1 per 8000 Sqm.	IS 1835	Two
10	**Rhomboidal Wire Rope Panel**			
1	Physical dimension	1 per 1000 Sqm	TDS	One
2	Tear resistance at junction of cable intersections	1 per 8000 Sqm.	15kN	Two
3	Pull apart resistance at junction of cable intersection	1 per 8000 Sqm.	9kN	Two
11	**HDPE Pipe**			
a	Nominal Dimensions		As per approved construction drawings	One
b	Pressure rating		IS 4984	
12	**Jute Geotextile**			
a	Thickness	One test for every 5000 sqm	IS 7702: 1975	One
b	Aperture size		IS 2405 (Part - I & II)-1980	
c	Minimum Breaking load		IS 1969: 1985	
13	**Drainage Composite**			
a	*Hydraulic Properties*	One test for every 5000 sqm		
1	In plane water flow		Cl. 704 MoRTH	Four
2	AOS of filter Geotextile		Cl. 704 MoRTH	Four
b	*Physical and Mechanical Properties*			
S No	**Material or Process / Characteristics**	**Frequency**	**Reference Standard**	**Level of Check**
1	Mass Per Unit Area		Cl. 704 MoRTH	Four
2	Thickness		Cl. 704 MoRTH	Four
3	CBR Puncture Resistance		Cl. 704 MoRTH	Four
4	Tensile Strength		Cl. 704 MoRTH	Four
5	UV Resistance		Cl. 704 MoRTH	Four

Level of Check
One - Manufacturer's Test Certificate
Two - Checks or Confirmatory tests by Contractor
Three - Checks or Confirmatory tests by Contractor and witnessed by consultant Four - Third Party Testing

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 vulnerable locations where slope protection measures taken and drainage system before 1st May every year in accordance with the guidelines contained in IRC: SP35 and other relevant guidelines for slope protection measures. 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 May 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 October and the inspection report together with details of any damages observed and proposed action to remedy the same shall be sent to the Authority's Engineer.

8. Repairs on account of natural calamities

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

Annex – I

(Schedule-E)

Repair/rectification of Defects and deficiencies

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

Table -1: 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 rowspan="2">Frequency of Inspection</th><th rowspan="2">Tools/Equipment</th><th rowspan="2">Standards and References for Inspection and Data Analysis</th><th rowspan="2">Time limit for Rectification/Repair</th><th rowspan="2">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>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></td><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 -2: **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	Clean joint, inspect later.	

Joint Defects						
				trapping incompressible material.		
			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.	

Joint Defects						
					H = w + 20% of w. Within 30 days	
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. Within 30days
			3	f = 6 - 12 mm	Diamond Grinding	
			4	f= 12 - 18 mm	Raise sunken slab.	Replace the slab as appropriate. Within 30days
			5	f> 18 mm	Strengthen subgrade and sub-base by grouting and raising sunken slab	
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.	

Joint Defects						
					Within 30 days	
			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		

Joint Defects						
			4	h > 50 mm or > 20% joints	Stabilise subgrade. Reinstate pavement at normal level if length < 20 m. Within 30 days	
			5	h > 100 mm		
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**	**Long Term**
					No action.	
			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 -3: 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 4: 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 Delamination of concrete not more than 0.25 Sqm. Cracks wider than 0.3 mm not more than 1m aggregate length		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
	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			
	Nature of Defect / Deficiency	**Temporary Measures for Minor rectification**	**Permanent Measures for Major rectification / re-construction**
(i)	Damage to PCC Breast wall / RCC Cladding / RCC step wall	within 48 (forty-eight) hours	15 to 30 (Fifteen to thirty) days as specified by AE
(ii)	HT Rolled cable Net, DT Mesh, Coir Mat, 3D Net, SDA, others such as Gabion Facia with geogrids	within 48 (forty-eight) hours	15 to 30 (Fifteen to thirty) days as specified by AE
(iii)	Any damage to other assets of project,	within 48 (forty-eight) hours	within 15 to 30(fifteen to thirty) days as specified by the Authority's Engineer
(iv)	Landslides requiring clearance	12 (Twelve) 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. 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 ED(P).

Schedule - H

(See Clauses10.1 (iv) and 19.3)

Contract Price Weightages

1.1 The Contract Price for this Agreement is Rs……

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

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 (completed in all respect etc.)	9.58%	**A- 2 Lane Curve Improvement / Realignment / New / Reconstruction**	
		(1) Earth work upto top of Subgrade	27.38%
		(2) Granular Sub-Base Course (GSB) and other layers	18.79%
		(3) Bituminous Base Course/DBM	32.14%
		(4) Wearing Coat/ BC	21.08%
		(5) Earthen / Granular Shoulders	0.61%
		B - Reconstruction and New Construction Culverts.	0%
		(1) Culverts	0%
Slope Protection Works (completed in all	87.20%	**A- Excavation of Hill slope, removal & disposal of material necessary for construction**	2.64%
		B- RCC stepped wall (6m / 7m/ 8m) and CC wall of 4m	34.57%

respect etc.)		**C- Anchor works / Micro-piling Works**	
		(1) Self Drilling Anchors including end plates, cement pressure grouting complete in all respect etc.	7.67%
		(2) 100T capacity Prestressed Cable anchor including end plates, cement pressure grouting complete in all respect etc.	5.66%
		(3) Construction friction Micro Pile including drilling, cement grouting, redrilling, perforated MS Casing to complete the work in all respect in accordance to drawings	23.73%
		D- Erosion Control	
		(1) Shored RS wall with Gabion Facia with Perforated HDPE pipes (hill & valley side) Sub-Surface Drains	7.07%
		(2) Rock fall barrier (Category A)- 10.5m high, minimum energy absorption- 8000 KJ.	17.27%
		(3) Road side CC Drainange works, berm drains, toe drains, catch drains, chute drains etc., Surface drains on hill & valley slope	1.39%
Other works (completed in all respect etc.)	3.22%	(1) Road Markings & Road Studs etc.	19.15%
		(2) Road Signs, Road Safety Devices including safety barrier with delineators, Road Furniture's and other miscellaneous safety items	29.47%
		(3) Instrumentation and INSAR Monitoring with Early Warning System (EWS)	20.83%
		(4) Safety, Traffic Management and DISASTER MANAGEMENT including supply of machinery during construction period.	30.55%

1.3 Procedure of estimating the value of work done.

1.3.1 Road works

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

Table 1.3.1

Stage of for Payment	Percentage Weight in particular Item	Payment Procedure
Road works including culverts		
A- 2 Lane Curve Improvement / Realignment / New / Reconstruction		
(1) Earth work upto top of Subgrade	27.38%	
(2) Granular Sub-Base Course (GSB) and other layers	18.79%	Unit of measurement is linear length. Payment of each stage shall be made on pro rata basis on completion of a stage in a length of not less than 50% of total length.
(3) Bituminous Base Course/DBM	32.14%	
(4) Wearing Coat/ BC	21.08%	
(5) Earthen / Granular Shoulders	0.61%	
B - Reconstruction and New Construction Culverts.	0%	
(1) Culverts	0%	Cost of each culvert shall be determined on pro rata basis with respect to the total number of culverts.

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

1.3.2 Slope Protection Works

Procedure for estimating the value of Slope Protection Work shall be as stated in table 1.3.2

Table 1.3.2

Stage of for Payment	Percentage Weight in particular Item	Payment Procedure
A- Excavation of Hill slope, removal & disposal of material necessary for construction	2.64%	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 5% of the total volume of excavation, removal of muck & safe disposal.
B- RCC stepped wall (6m / 7m/ 8m) and CC wall of 4m	34.57%	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 / Micro-piling Works		
(1) Self Drilling Anchors including end plates, cement pressure grouting complete in all respect etc.	7.67%	
(2) 100T capacity Prestressed Cable anchor including end plates, cement pressure grouting complete in all respect etc.	5.66%	
(3) Construction friction Micro Pile including drilling, cement grouting, redrilling, perforated MS Casing to complete the work in all respect in accordance to drawings	23.73%	
D- Erosion Control		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.
(1) Shored RS wall with Gabion Facia with Perforated HDPE pipes (hill & valley side) Sub-Surface Drains	7.07%	

(2) Rock fall barrier (Category A)- 10.5m high, minimum energy absorption- 8000 KJ.	17.27%	Unit of measurement is linear length of drains. Payment shall be made on pro rata basis on completion of each stage in a length of not less than 10% of the total Rock Fall Barrier length.
(3) Road side CC Drainage works, berm drains, toe drains, catch drains, chute drains etc., Surface drains on hill & valley slope	1.39%	Unit of measurement is linear length of drains. Payment shall be made on pro rata basis on completion of each stage in a length of not less than 10% of the total drain length.

1.3.3 Other works

Procedure for estimating the value of other work shall be as stated in table 1.3.3

Table 1.3.3

Stage of for Payment	**Percentage Weight in particular Item**	**Payment Procedure**
(1) Road Markings & Road Studs	19.15%	Unit of measurement is linear length. Payment of each stage shall be made on pro rata basis on completion of a stage in a length not less than 50% of total length.
(2) Road Signs, Road Safety Devices including safety barrier with delineators, Road Furniture's and other miscellaneous safety items	29.47%	
(3) Instrumentation and INSAR Monitoring with Early Warning System (EWS)	20.83%	Payment shall be made on pro-rata basis on completion of stage/ scope of work.
(4) Safety, Traffic Management and DISASTER MANAGEMENT including supply of machinery during construction period.	30.55%	Payment shall be made on pro-rata basis every three (3) month or quarterly in compliance of the Authority's Engineer.

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) Typical Road section as TCS-1

b) Drawing of Plan & Profile for Road as D-1.

c) Detailed Drawings of RCC stepped wall, CC Wall, Gabion Facia as Protection Measures as D-2, D-3, D-4, D-5, D-6, D-7 and any other if required in this regard.

d) 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 **64th (Sixty-Four) 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 **154th (One Hundred and Fifty Four)** 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.

4. Project Milestone-III

(i) Project Milestone-III shall occur on the date falling on the **264th (Two Hundred and Sixty Four) 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.

5. Scheduled Completion Date

(i) The Scheduled Completion Date shall occur on the **365th (Three Hundred and Sixty Five)** 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. Cost towards all the tests shall be borne by EPC Contractor.

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 and (any test for slope protection measures) 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 (any test for slope protection measures): 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 Slope protection and landslide mitigation and Re-construction of Road section (from km 94+745 to km 95+734) on NH-717A near Reshi border 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 Rain water harvesting and artificial recharging arrangements have been provided by the contractor as per Schedule "C" of the contract agreement and are functional. Details (with location chainage) are as given in Annex.~~

3 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	20%
(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)

Terms of Reference for Authority's Engineer

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 & 2nd Floor, Tower A, World Trade Centre, Nauroji Nagar, New Delhi – 110029 (the "**Authority**") and ..... (the "**Contractor**")[#] Slope protection and landslide mitigation and Re-construction of Road section (from km 94+745 to km 95+734) on NH-717A near Reshi border on EPC mode in the State of West Bengal, and a copy of which is annexed hereto and marked as Annex-A to form part of this TOR.

- In case the bid of Authority's Engineer is invited simultaneously with the bid of EPC project, then the status of bidding of EPC project only to be indicated

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

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.

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.

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 be extended upto 30 (thirty) days. In particular, such comments shall specify the conformity or otherwise of such Drawings with the Scope of the Project and Specifications and Standards.

(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 assurance. For purposes of this Paragraph 4 (ix), the tests specified in the IRC Special Publication-11 (Handbook of Quality Control for Construction of Roads and Runways) and the Specifications for Road and Bridge Works issued by MORTH (the "Quality Control Manuals") or any modification/substitution thereof shall be deemed to be tests conforming to Good Industry Practice for quality assurance.

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

(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 Quality Control Manuals. The tests shall be undertaken on a random sample basis and shall be in addition to, and independent of, the tests

that may be carried out by the Contractor for its own quality assurance in accordance with Good Industry Practice.

(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.

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 repair or 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.

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.

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 -

a). within 10 (ten) days of receipt of the Stage Payment Statement from the Contractor pursuant to Clause 19.4, determine the amount due to the Contractor and recommend the release of 90 (ninety) percent of

the amount so determined as part payment, pending issue of the Interim Payment Certificate; and

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

(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.

Other duties and functions

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

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. 1,50,00,000/- (Rupees One crore 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. 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 required test of Slope Protection.

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 Slope protection and landslide mitigation and Re-construction of Road section (from km 94+745 to km 95+734) on NH-717A near Reshi border on EPC mode in the State of West Bengal 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)

******* End of the Document *******