Re-Modified Schedule –B

SCHEDULE - B
(See Clause 2.1)

DEVELOPMENT OF THE PROJECT HIGHWAY

1 Development of the Project Highway

Development of the Project Highway shall include:

- **S-1** Design and construction of the Project Highway for proposed widening at the 250 m stretch length at km 54 as per the alignment plan mentioned in Annex-I of Schedule-A and as described in this Schedule-B and in Schedule-C.

- **S-2** Design and construction of the Project Highway for proposed widening at the 210 m stretch length at km 63 as per the alignment plan mentioned in Annex-I of Schedule-A and as described in this Schedule-B and in Schedule-C.

- **S-3** Design and construction of the Project Highway for landslide protection at 360 m stretch length at km 71 as per the alignment plan mentioned in Annex-I of Schedule-A and as described in this Schedule-B and in Schedule-C.

- **S-4** Design and construction of the Project Highway for landslide protection at 350 m stretch length at km 72 as per the alignment plan mentioned in Annex-I of Schedule-A and as described in this Schedule-B and in Schedule-C.

2 Widening and Rehabilitation / Restoration

Widening and Rehabilitation shall include proposed widening of the narrow zone at km 54 and Km 63 including toe protection from erosion and scouring of river with proper drainage works and road works of specified width of the Project Highway on designated locations as described in Annex-I of this Schedule-B and in Schedule-C.

Rehabilitation/ Restoration shall include proposed landslide protection works including necessary drainage works on the designated locations as described in Annex-I of this Schedule-B and in Schedule-C.

3 Specifications and Standards

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

Annex – I
(Schedule – B)

A. DESCRIPTION OF PROPOSED WIDENING WORKS

1 WIDENING OF THE EXISTING HIGHWAY

The Project Highway shall follow the existing alignment unless otherwise specified by the Authority. Geometric deficiencies, if any, in the existing horizontal and vertical profiles shall be corrected as per the prescribed standards for hilly terrain to the extent land is available.

2 GEOMETRIC DESIGN AND GENERAL FEATURES

2.1 General

Geometric design and general features of the Project Highway shall be in accordance with the alignment plan mentioned in Annex-I of Schedule-A.

2.2 Design speed

The design speed shall be as per alignment plan.

2.3 Improvement of the existing road geometrics

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

2.4 Right of Way

[Refer to paragraph 2.3 of the Manual]. Details of the Right of Way are given in Annex II of Schedule-A.

2.5 Type of Shoulders

In the following sections, paved shoulders of 1.5 m width shall be provided.

Sl. No.	Stretch From km to km	Remarks
1	54.255 to 54.505	
2	63.575 to 63.785	

2.6 Lateral and vertical clearances at underpasses

2.6.1 Lateral and vertical clearances at underpasses and provision of guardrails/crash barriers shall be as per paragraph 2.11 of the Manual.

2.6.2 Lateral clearance: The width of the opening at the underpasses shall be as follows:

Sl. No.	**Location (chainage) (from km to km)**	**Span/opening (m)**	**Remarks**
NIL			

2.7 Lateral and vertical clearances at overpasses

2.7.1 Lateral and vertical clearances at overpasses shall be as per paragraph 2.12 of the Manual.

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

Sl. No.	Location (chainage) (from km to km)	Span/opening (m)	Remarks
NIL			

2.8 Service roads

Service roads shall be constructed at the locations and for the lengths indicated below: [Refer to paragraph 2.13 of the Manual and provide details]

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

2.9 Grade separated structures

2.9.1 Grade separated structures shall be provided as per paragraph 2.14 of the Manual. The requisite particulars are given below:

[Refer to paragraphs 2.14.1 of the Manual and provide details]

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

2.9.2 In the case of grade separated structures, the type of structure and the level of the Project Highway and the cross roads shall be as follows: [Refer to paragraphs 2.14.2 of the Manual and specify the type of vehicular under pass/ overpass structure and whether the cross road is to be carried at the existing level, raised or lowered]

Sl.	Location	Type of structure Length (m)	Cross road at			Remarks, if any
			Existing Level	Raised Level	Lowered Level	
NIL						

2.10 Cattle and pedestrian underpass /overpass

Cattle and pedestrian underpass/ overpass shall be constructed as follows: [Refer to paragraphs 2.14.3 of the Manual and specify the requirements of cattle and pedestrian underpass/ overpass]

Sl. No.	**Location**	**Type of crossing**
NIL		

2.11 Typical Cross-sections of the Project Highway

The typical cross sections should be developed as per Drawing Number NHIDCL/KM 54 , KM 63, KM 71 & KM 72/01 (02 sheets) as included in Annexure - A of this schedule.

3 INTERSECTIONS AND GRADE SEPARATORS

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

[Refer to paragraphs 3.1.1, 3.1.2 and 3.3 of the Manual and specify the requirements. Explain where necessary with drawings/sketches/general

arrangement]

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

(a) At-grade intersections

Sl. No.	Location of intersection	Type of intersection	Other features
NIL			

(b) Grade separated intersection with/without ramps

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

4 ROAD EMBANKMENT FOR PROPOSED WIDENING

4.1 The proposed widening of the 250m stretch length of road at KM54 narrow zones shall comprise of following minimum components:

Stretch	Maximum Height of Valley Slope to be widened (m)	Top width of Finished Road (m)	Brief Scope of work
S-1 Km 54 (Stretch 1: Length 130m)	18.50	13	• Traffic Signages and Temporary barricading • Excavation and Surface Preparation ➢ Soil Nailing on the existing valley slope considering the following: • Nail : Fully threaded solid bar of 670/800 grade steel (conforming to IS 4759:1996). • Length of Nail : Minimum 8m • Drill diameter : Minimum 75mm in soil and 50mm in rock. • Diameter of Nail : Minimum 22mm

			• Maximum Horizontal Spacing of Nail : 1.50m c/c • Maximum Vertical Spacing of Nail : 1.30m c/c ➢ Mechanically Stabilized Earth Structure to connect with these soil nails: • Fascia : Prefabricated and hot deep galvanized mild steel bar steel mesh. • Soil reinforcing element: Geosynthetic Strips with lateral grooves on both side • Maximum Vertical spacing of soil reinforcement: 0.6m • Minimum length of soil reinforcement : 3m. • Connection between fascia and soil reinforcement: Mechanical • Connection between soil reinforcement and soil nail: Mechanical ➢ Selected Backfill Soil • Granular fill soil such as river bed material of minimum angle of internal friction of minimum 30 degrees compacted in layers to the requisite height ➢ Broken boulder of 400mm thickness to be provided in between the fascia and selected backfill soil with a non-woven geotextile separator in between to avoid migration of backfill soil. ➢ Sub-Surface Drainage • Chimney Drain of 600mm thickness behind the built up portion of reinforced slope for draining out the entrapped seepage water from the backside of existing slope with Non-woven geotextile on both side ➢ Toe Protection • It is necessary to protect the toe erosion of the structure by Articulating Block Concrete Form Liner known as Revetment to withstand high volatility current & heavy rock mass carrying river water condition or for dry slope protection. Bidder has to ensure soundness/durability and stability of the proposed foundation work. ➢ Pavement Work • Pavement work shall be done for the entire stretch length of 250m as per IRC guidelines with metallic crash barriers, road marking, signages, etc.

S-1 Km 54 (Stretch 2: Length 120m)	20	13	• Traffic Signages and Temporary barricading • Excavation and Surface Preparation ➢ Soil Nailing on the existing valley slope considering the following: • Nail : Fully threaded solid bar of 670/800 grade steel (conforming to IS 4759:1996). • Length of Nail : Minimum 8m • Drill diameter : Minimum 75mm in soil and 50mm in rock. • Diameter of Nail : Minimum 22mm • Maximum Horizontal Spacing of Nail : 1.50m c/c • Maximum Vertical Spacing of Nail : 1.30m c/c ➢ Mechanically Stabilized Earth Structure to connect with these soil nails: • Fascia : Prefabricated and hot deep galvanized mild steel bar steel mesh. • Soil reinforcing element : Geosynthetic Strips with lateral grooves on both side • Maximum vertical spacing of soil reinforcement: 0.6m • Minimum length of soil reinforcement : 3m. • Connection between fascia and soil reinforcement: Mechanical • Connection between soil reinforcement and soil nail: Mechanical ➢ Selected Backfill Soil • Granular fill soil such as river bed material of minimum angle of internal friction of minimum 30 degrees compacted in layers to the requisite height ➢ Broken boulder of 400mm thickness to be provided in between the fascia and selected backfill soil with a non-woven geotextile separator in between to avoid migration of backfill soil ➢ Sub-Surface Drainage • Chimney Drain of 600mm thickness

			behind the built up portion of reinforced slope for draining out the entrapped seepage water from the backside of existing slope with Non-woven geotextile on both side ➢ Toe Protection • It is necessary to protect the toe erosion of the structure by Articulating Block Concrete Form Liner known as Revetment to withstand high volatility current & heavy rock mass carrying river water condition or for dry slope protection. Bidder has to ensure soundness/durability and stability of the proposed foundation work. ➢ Pavement Work • Pavement work shall be done for the entire stretch length of 250m as per IRC guidelines with metallic crash barriers, road marking, signages, etc.

The specifications and size for these items should be as per IRC/BIS standard or other equivalent international code based on design done by EPC Contractor.

The proposed restoration scheme is presented in Drawing number NHIDCL/KM54/01 (02 sheets) in Annexure - A of Schedule B.

4.2 The proposed restoration scheme as presented in this schedule is the minimum requirement. However, the contractor shall check, validate and if require improve/augment the detailed design based on his surveys and investigations of minimum scope as given below before commencement of work.

- **GEOPHYSICAL INVESTIGATION** to know the natural formation and its weak plane / zones in valley slope in addition to the GEOTECHNICAL INVESTIGATION by conducting geophysical study and geotechnical investigation of minimum 6 numbers of boreholes of minimum depth around 30m or termination depth at 1.5m inside hard rock whichever is less by positioning the boreholes all along the valley slope namely at top, intermediate of valley slope

- TOPOGRAPHICAL SURVEY for the Stretch to be rehabilitated including the Detailed Contour Survey and Cross-Section Survey covering the total area in valley sides

- MAPPING of any kind of crack, fault etc. generated in the entire affected area and its influence zone (beyond the affected zone).

  Any associated risk with respect to cost and time due to modification / changes in the design shall be assessed and incorporated in the bid.

4.3 The proposed widening of the 210m stretch length of road at KM 63 narrow zones shall comprises of following minimum components:

Stretch	**Height of Valley Slope to be widened (m)**	**Top width of Finished Road (m)**	**Brief scope of work**
S-2 Km 63	20	13	➢ Traffic Signages and Temporary barricading ➢ Excavation and Surface Preparation ➢ Soil Nailing on the existing valley slope including in the existing toe wall considering the following: • Nail : Fully threaded solid bar of 670/800 grade steel (conforming to IS 4759:1996) • Length of Nail : 8 m minimum • Drill diameter : Minimum 75mm in soil and 50mm in rock. • Diameter of Nail : 22 mm minimum • Maximum Horizontal Spacing of Nail : 1.50m c/c • Maximum Vertical Spacing of Nail : 1.30m c/c ➢ Mechanically Stabilized Earth Structure to connect with these soil nails: • Fascia : Prefabricated and hot deep galvanized mild steel bar steel mesh. • Soil reinforcing element : Geosynthetic Strips with lateral grooves on both side • Maximum Vertical spacing of soil reinforcement: 0.6m • Minimum length of soil reinforcement: 3m • Connection between fascia and soil reinforcement : Mechanical • Connection between soil reinforcement and soil nail: Mechanical ➢ Selected Backfill Soil • Granular fill soil of minimum angle of internal friction of 30 degrees compacted in layers to the requisite height ➢ Broken boulder of 400mm thickness to be provided in between the fascia and selected backfill soil with a non-woven geotextile separator in between to avoid migration of backfill soil ➢ Sub-Surface Drainage

			• Chimney Drain of 600mm thickness behind the built up portion of reinforced slope for draining out the entrapped seepage water from the backside of existing slope ➢ Toe Protection • It is necessary to protect the toe erosion of the structure by Articulating Block Concrete Form Liner known as Revetment to withstand high volatility current & heavy rock mass carrying river water condition or for dry slope protection. Bidder has to ensure soundness/durability and stability of the proposed foundation work. ➢ Pavement Work • Pavement work shall be done for the entire stretch length of 300m as per IRC guidelines with crash barriers, road marking, signages, etc.

The specifications and size for these items should be as per IRC/BIS standard or other equivalent international code based on design done by EPC Contractor.

The proposed restoration scheme is presented in Drawing number NHIDCL/KM63/01 (02 sheets) in Annexure - A of Schedule B.

4.4 The proposed restoration scheme as presented in this schedule is the minimum requirement. However, the contractor shall check, validate and if require improve/augment the detailed design based on his surveys and investigations of minimum scope as given below before commencement of work.

- **GEOPHYSICAL INVESTIGATION** to know the natural formation and its weak plane / zones in valley slope in addition to the GEOTECHNICAL INVESTIGATION by conducting adequate numbers of boreholes of minimum depth around 30m or termination depth at 1.5m inside hard rock whichever is less by positioning the boreholes all along the valley slope namely at top, intermediate of valley slope.

- **TOPOGRAPHICAL SURVEY** for the Stretch to be rehabilitated including the Detailed Contour Survey and Cross-Section Survey covering the total area in valley sides.

- **MAPPING** of any kind of crack, fault etc. generated in the entire affected area and its influence zone (beyond the affected zone).

Any associated risk with respect to cost and time due to modification / changes in the design shall be assessed and incorporated in the bid.

4.5 The proposed landslide protection works of the 360m stretch length at KM71 shall comprises of following minimum components:

Stretch	Average Height of Hill Slope to be widened (m)	Top width of Finished Road (m)	Brief Scope of work
S-3 Km 71	25	12	➢ Traffic Signages and Temporary barricading ➢ Excavation and Surface Preparation ➢ Fixing High strength steel wire mesh ➢ Strength of Wire : 1770 MPa • Tensile resistance of wire : 12.5 kN • Wire diameter: 3mm ➢ Soil Nailing on the existing hill slope considering the following: • Nail : Fully threaded solid bar of 670/800 grade steel (conforming to IS 4759:1996). • Length of Nail : Minimum 8m • Diameter of Nail : Minimum 22mm • Maximum Horizontal Spacing of Nail : 2.0m c/c • Maximum Vertical Spacing of Nail : 1.50m c/c ➢ Drainage Arrangement

The specifications and size for these items should be as per IRC/BIS standard or other equivalent international code based on design done by EPC Contractor.

The proposed restoration scheme is presented in Drawing number NHIDCL/KM71/01 (02 sheets) in Annexure - A of Schedule B.

4.6 The proposed restoration scheme as presented in this schedule is the minimum requirement. However, the contractor shall check, validate and if require improve/augment the detailed design based on his surveys and investigations of minimum scope as given below before commencement of work.

- **GEOPHYSICAL INVESTIGATION** to know the natural formation and its weak plane / zones in valley slope in addition to the GEOTECHNICAL INVESTIGATION by conducting adequate numbers of boreholes of minimum depth around 30m by positioning the boreholes all along the hill slope namely at top, intermediate and bottom of hill slope.

- **TOPOGRAPHICAL SURVEY** for the Stretch to be rehabilitated including the Detailed Contour Survey and Cross-Section Survey covering the total area in valley sides.

- **MAPPING** of any kind of crack, fault etc. generated in the entire affected area and its influence zone (beyond the affected zone).

  Any associated risk with respect to cost and time due to modification / changes in the design shall be assessed and incorporated in the bid.

4.7 The proposed landslide protection works of the 350m stretch length at KM72 shall comprises of following minimum components:

Stretch	**Average Height of Hill Slope to be widened (m)**	**Top width of Finished Road (m)**	**Brief Scope of work**
S-4 Km 72	20	12	➢ Traffic Signages and Temporary barricading ➢ Excavation and Surface Preparation ➢ Fixing High strength steel wire mesh. • Strength of Wire : 1770 MPa • Tensile resistance of wire : 12.5 kN • Wire diameter : 3mm ➢ Soil Nailing on the existing hill slope considering the following: • Nail : Fully threaded solid bar of 670/800 grade steel (conforming to IS 4759:1996). • Length of Nail : 8m minimum • Diameter of Nail : 22mm minimum • Maximum Horizontal Spacing of Nail : 2.0m c/c • Maximum Vertical Spacing of Nail : 1.50m c/c

The specifications and size for these items should be as per IRC/BIS standard or other equivalent international code based on design done by EPC Contractor.

The proposed restoration scheme is presented in Drawing number NHIDCL/KM72/01 (02 sheets) in Annexure - A of Schedule B.

4.8 The proposed restoration scheme as presented in this schedule is the minimum requirement. However, the contractor shall check, validate and if require improve/augment the detailed design based on his surveys and investigations of minimum scope as given below before commencement of work.

- **GEOPHYSICAL INVESTIGATION** to know the natural formation and its weak plane / zones in valley slope in addition to the GEOTECHNICAL INVESTIGATION by conducting adequate numbers of boreholes of depth around 30m or termination

depth at 1.5m inside hard rock whichever is less by positioning the boreholes all along the valley slope namely at top, intermediate of valley slope

- **TOPOGRAPHICAL SURVEY** for the Stretch to be rehabilitated including the Detailed Contour Survey and Cross-Section Survey covering the total area in valley sides.

- **MAPPING** of any kind of crack, fault etc. generated in the entire affected area and its influence zone (beyond the affected zone).

Any associated risk with respect to cost and time due to modification / changes in the design shall be assessed and incorporated in the bid.

5 PAVEMENT DESIGN

5.1 Pavement layers shall be constructed in accordance with the thickness provided below table/Drawing.

5.2 Type of pavement

The project highway is flexible pavement and the layer thicknesses are tabulated below as minimum required provisions:

S.No.	Description	Pavement Thickness (in mm)
1	Bituminous Concrete	40
2	Dense Bituminous Macadam	75
3	WMM	200
4	Granular Sub Base	200

5.3 Design requirements

[Refer to paragraph 5.4, 5.9 and 5.10 of the Manual and specify design requirements and strategy]

5.3.1 Design Period and strategy

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

5.3.2 Design Traffic

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

5.4 Reconstruction of stretches

[Refer to paragraph 5.9.7 of the Manual and specify the stretches, if any, to be reconstructed.]

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

Sl. No.	Stretch From km to km	Remarks
1	54.255 to 54.505	
2	63.575 to 63.785	

6 ROADSIDE DRAINAGE

Drainage system including surface and subsurface drains shall be provided as per proposed restoration scheme presented in Drawing number NHIDCL/KM54 & KM 63/01 (02 sheets) in Annexure - A of Schedule B.

7 DESIGN OF STRUCTURES

7.1 General

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

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

[Refer to paragraph 7.1 (ii) of the Manual and specify the width of carriageway of new bridges and structures of more than 60 metre length, if the carriageway width is different from 7.5 metres in the table below.]

Sl No.	Bridge at km	Width of carriageway and cross-sectional features@

@ Attach typical cross-section, if necessary.

NIL

7.1.3 The following structures shall be provided with footpaths:

[Refer to paragraph 7.1 (iii) of the Manual and provide details of new Structures with footpath.]

Sl. No.	Location at km	Remarks
NIL		

7.1.4 All bridges shall be high-level bridges.

[Refer to paragraph 7.1 (iv) of the Manual and state if there is any exception]

7.1.5 The following structures shall be designed to carry utility services specified in table below:

[Refer to paragraph 7.1 (viii) of the Manual and provide details]

Sl. No.	Bridge at km	Utility service to be carried	Remarks
NIL			

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

7.2 Culverts

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

7.2.2 Reconstruction of existing culverts:

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

[Refer to paragraph 7.3 (i) of the Manual and provide details]

Sl.No.	Culvert location	Span/Opening (m)	Remarks, if any*
NIL			

*[Specify modifications, if any, required in the road level, etc.]

7.2.3 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 section 7 of the Manual. Repairs and strengthening of existing structures where required shall be carried out.

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

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

Sl No.	Culvert location	Span/Opening (m)
NIL		

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

[Refer to paragraph 7.23 of the Manual and provide details]

Sl. No.	Location at km	Type of repair required
NIL		

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

7.3 Bridges

7.3.1 Existing bridges to be re- constructed/widened

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

[Refer to paragraph 7.3.2 of the Manual and provide details]

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

*Attach GAD

(ii) The following narrow bridges shall be widened:

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

@ Attach cross-section

7.3.2 Additional new bridges

[Specify additional new bridges if required, and attach GAD]

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

Sl. No.	**Location (km)**	**Total length (m)**	**Remarks, if any**
NIL			

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

[Refer to paragraph 7.18 (iv) the Manual and provide details:]

Sl. No.	Location at km	Remarks
NIL		

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

[Refer to paragraph 7.18 (v) the Manual and provide details]

Sl. No.	Location at km	Remarks
NIL		

7.3.5 Drainage system for bridge decks

An effective drainage system for bridge decks shall be provided as specified in paragraph 7.21 of the Manual

7.3.6 Structures in marine environment

[Refer to paragraph 7.22 of the Manual and specify the necessary measures / treatments for protecting structures in marine environment, where applicable]

7.4. Rail-road bridges

7.4.1 Design, construction and detailing of ROB/RUB shall be as specified in section 7 of the Manual. [Refer to paragraph 7.19 of the Manual and specify modification, if **any]**

7.4.2 Road over-bridges

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

Sl. No.	Location of Level crossing (chainage km)	Length of bridge (m)
NIL		

7.4.3 Road under-bridges

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

Sl. No.	Location of Level crossing(chainage km)	Number and length of span (m)
NIL		

7.5 Grade separated structures

[Refer to paragraph 7.20 of the Manual]

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

7.6 Repairs and strengthening of bridges and structures

[Refer to paragraph 7.23 of the Manual and provide details]

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

A. Bridges

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

B. ROB / RUB

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

C. Overpasses/Underpasses and other structures

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

7.7 List of Major Bridges and Structures

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

Sl. No.	Location
NIL	

8 TRAFFIC CONTROL DEVICES AND ROAD SAFETY WORKS

8.1 Traffic control devices and road safety works shall be provided in accordance with Section 9 of the Manual.

8.2 Specifications of the reflective sheeting. [Refer to paragraph 9.3 of the Manual and specify]

9 ROADSIDE FURNITURE

9.1 Roadside furniture shall be provided in accordance with the provisions of Section 11 of the Manual. The W- Beam metal Crash barrier shall be provided in the following stretches.

Sl. No.	Stretch From km to km	Remarks
1	54.255 to 54.505	
2	63.575 to 63.785	

9.2 Overhead traffic signs: location and size

[Refer to paragraph 11.5 of the Manual and provide details]

10 COMPULSORY AFFORESTATION

[Refer to paragraph 12.1 of the Manual and specify the number of trees which are required to be planted by the Contractor as compensatory afforestation.]

11 HAZARDOUS LOCATIONS

The safety barriers shall also be provided at the following hazardous locations:

Sl. No.	Location stretch from (km) to (km)	LHS/RHS
NIL		

12 SPECIAL REQUIREMENT FOR HILL ROADS

In accordance with section 13 of the manual (from IRC SP 73 : 2015), IRC : SP 48:1998 and Recommended Practices for the Treatment of Embankment and Roadside slopes for Erosion control(First Revision) IRC: 56 :2011 and relevant IRC codes.

Land slide protection works as para 4.1, 4.3, 4.5 & 4.7 above shall be provided.

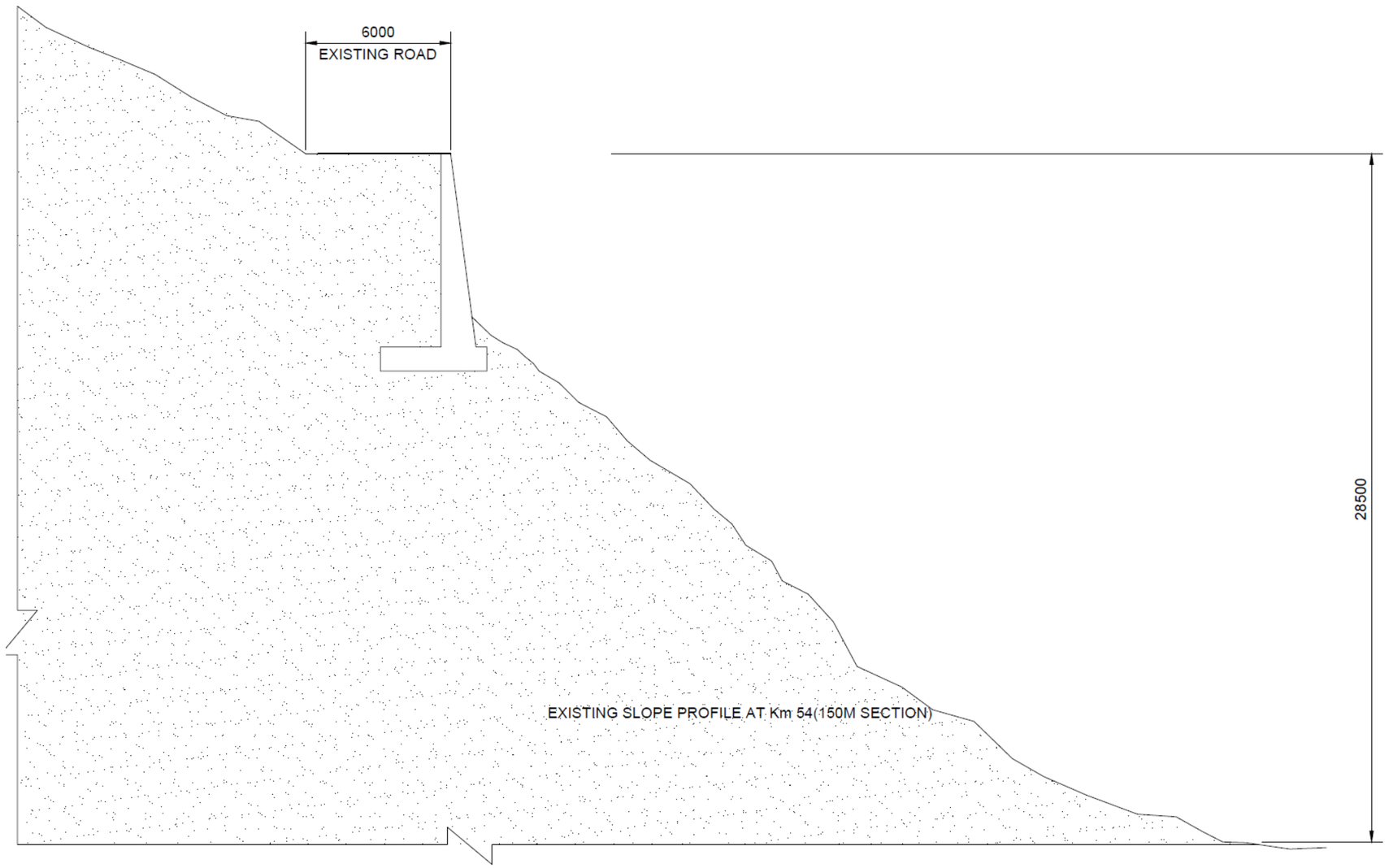
However, the Contractor shall be responsible for accurate assessment of the actual requirement as per site situation & prepare designs for slope protection & stabilization as per the specifications & standards stipulated in schedule 'D' and submit the same to AE for review through the proof consultant and implement it accordingly thereafter.

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

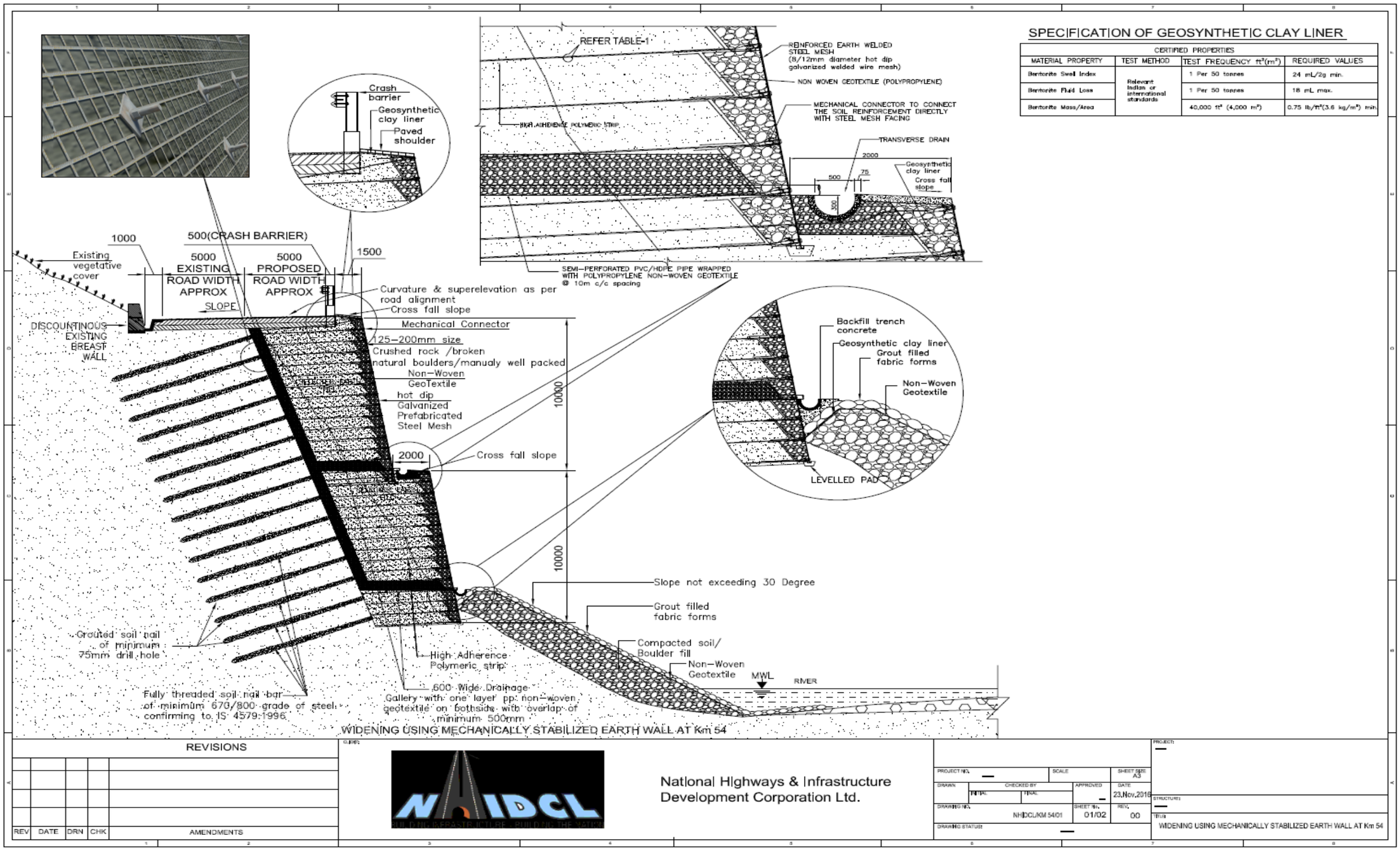
13 CHANGE OF SCOPE

The length of Structures, bridges and slope protection works whatsoever in terms of retaining wall, breast wall and gabion wall or under special requirement of hill slope specified herein above shall be treated as an approximate assessment. The actual lengths as required on the basis of detailed investigations shall be determined by the Contractor in accordance with the specification and standards. Any variations in the lengths and specifications given in the schedule–B shall not constitute a change of Scope.

Annexure-A
(Schedule B)



Existing Cross-Section of first 130m stretch length at KM54 narrow zone



Detail of proposed widening scheme at first 130m of narrow zone at KM54

SOIL REINFORCEMENT (TABLE-1)

HIGH ADHERENCE (HA) POLYMERIC STRIP

THE SOIL REINFORCEMENT SHALL BE HIGH ADHERENCE (HA) POLYMERIC STRIP OF 50MM WIDE WITH LATERAL TEETH ON BOTH SIDE OF THE STRIP TO ENHANCE THE ADHERENCE CAPACITY IN SOIL AS SHOWN IN FIGURE 1 BELOW.

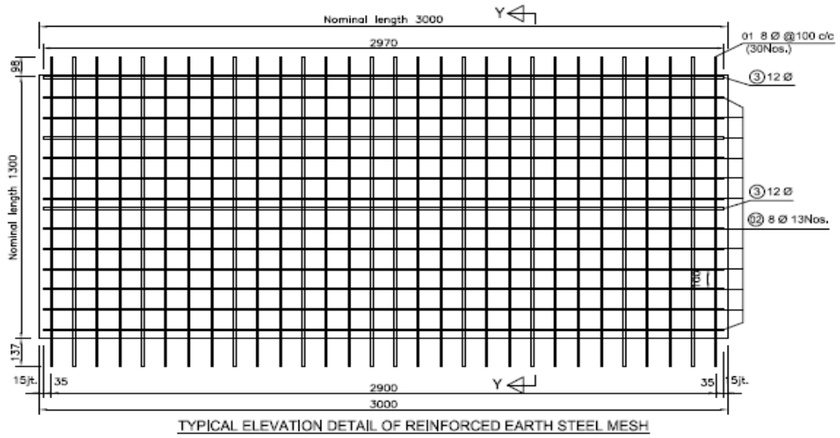
HA STRIP CONSISTS OF DISCRETE CHANNELS OF CLOSELY PACKED HIGH TENACITY POLYESTER FIBRES RESPECTIVELY ENCASED IN A LINEAR LOW DENSITY POLYETHYLENE (LLDPE) SHEATH (FIGURE 1).

FIGURE1:STRIPS TYPICAL CROSS SECTION,PROCESSED BY CO-EXTRUSION

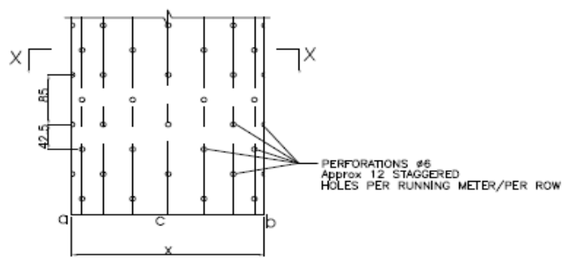
HA POLYMERIC STRIP REINFORCEMENT SPECIFICATION							
Properties	Test Method	Unit	Minimum average roll value				
Ultimate Tensile Strength	Indian or International standard	kN	20	25	37.5	50	65
Width		mm	49	49	49	49	49
Long Term Design Strength		kN	11.76	14.70	22.05	29.40	38.23

(TABLE -3) MATERIAL SPECIFICATION OF SOIL NAIL

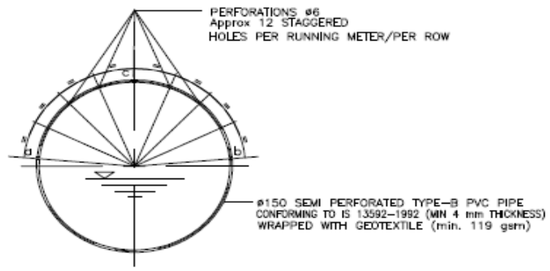
Nominal diameter	Grade	Cross section (mm^2)	Yled load (kN)	Ultimate load (kN)	Elongation (%)
22	St 670/800 (grade 97)	375	251	300	7
25	St 670/800 (grade 97)	491	329	393	7
28	St 670/800 (grade 97)	616	413	493	7
30	St 670/800 (grade 97)	707	474	566	7



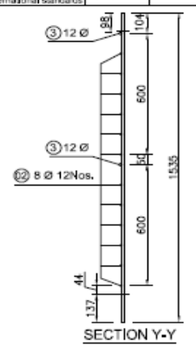
TYPICAL ELEVATION DETAIL OF REINFORCED EARTH STEEL MESH



TOP PLAN AT SEMI PERFORATED PIPE



SECTION X-X



SECTION Y-Y

(TABLE -2) PROPERTIES OF GROUT FILLED FABRIC FORM

	Test Method	Units	Values
PHYSICAL PROPERTIES [1,2]			
Composition of Yarns			Polyester
Mass Per Unit Area (double-layer)	Relevant Indian or International standards	g/m²	500
Thickness		Mm	0.40
Mill Width		M	2.13
MECHANICAL PROPERTIES [1,2]			
Wide-Width Strip Tensile Strength	Relevant Indian or International standards		
Machine Direction		kN/m	50
Cross Machine Direction		kN/m	60
Elongation at Break	Relevant Indian or International standards		
Machine Direction		%	8
Cross Machine Direction		%	8
Grab Tensile Strength	Relevant Indian or International standards		
Machine Direction		N	1395
Cross Machine Direction		N	1395
Elongation at Break	Relevant Indian or International standards		
Machine Direction		%	25
Cross Machine Direction		%	20
Trapezoidal Tear Strength	Relevant Indian or International standards		
Machine Direction		N	460
Cross Machine Direction		N	600
CBR Puncture Strength	Relevant Indian or International standards	N	5450
Mullen Burst Strength	Relevant Indian or International standards	kg/cm²	40
HYDRAULIC PROPERTIES [1,2]			
Apparent Opening Size (AOS)	Relevant Indian or International standards	mm	0.30-0.60
Permittivity	Relevant Indian or International standards	sec⁻¹	0.40-0.55
Flow Rate	Relevant Indian or International standards	l/m/n/m₂	1200-1825

GENERAL NOTES :-

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METER UNLESS OTHERWISE STATED.
2. DETAILED DESIGN SHALL BE DONE BY CONDUCTING DETAILED SOIL INVESTIGATION AS REQUIRED FOR DESIGN. WHICH SHALL INCLUDE GEOPHYSICAL STUDY AND MINIMUM SIX BORE HOLE INVESTIGATION PER SITE, THREE ON HILL SIDE AND THREE ON INTERMEDIATE LEVEL.
3. THE ANALYSIS SHALL BE DONE CONSIDERING SEISMIC ZONE- IV.
4. THE HA POLYMERIC STRIP REINFORCEMENT SHALL BE AS SHOWN IN TABLE NO.1 AND THE GROUTED SOIL NAIL SHALL BE AS SHOWN IN TABLE NO-3.
5. THE PRELIMINARY ANALYSIS SHALL BE DONE CONSIDERING DESIGN BOND STRENGTH OF 80Kpa BETWEEN THE GROUT AND SOIL.
6. THE PULL OUT BOND STRENGTH SHALL BE RE VERIFIED AS SITE BY CONDUCTING IN SITU PULLOUT TEST
7. THE MECHANICALLY STABILIZED REINFORCED EARTH WALL DESIGN ANALYSIS SHALL BE DONE AS PER AFNOR NF,P94-270 JULY 2009 AS CITED IN ANNEXURE A1-1.1 IN **SECTION 3100 OF MORTH-5th REVISION** OR FHWA. THE OVERALL STABILITY ANALYSIS SHALL BE DONE FOR WORKING STRESS ANALYSIS CONSIDERING A FACTOR OF SAFETY OF 1.3 FOR STATIC & 1.1 FOR SEISMIC.
8. ALL DRAINAGE GALLERY SHALL BE AS PER CLASS-II GRADATION OF **MORTH 5TH REV. SPECIFICATION (TABLE NO.-300.3, PAGE-87)**
9. GROUT FILLED FABRIC FORM REVETMENT : THE TOE PROTECTION/BED PROTECTION SHALL BE DONE USING GROUT FILLED MATTRESS AS PER DETAILED SPECIFICATION SHOWN IN TABLE NO.-02
10. THE SEMI PERFORATED PVC PIPE HAS BEEN PROVIDED AS A DRAINAGE OUTLET AT THE TOE OF EACH TIER WALL AS SHOWN IN CROSS SECTION, DETAIL AS SHOWN IN SECTION X-X.
11. THE FACING FOR THE MECHANICALLY STABILIZED REINFORCED EARTH WALL (ON BOTH SIDES-EXPOSED FACE & SLOPED SURFACE) SHALL BE USING HOT DIP GALVANIZED WELDED STEEL MESH OF MINIMUM 8mm DIA BAR@100mm c/c EXCEPT THE HORIZONTAL BARS WHERE THE PRIMARY REINFORCEMENT IS CONNECTED SHALL BE OF MINIMUM 12mm, DIA BAR
12. THE SOIL REINFORCEMENT (HIGH ADHERENCE POLYMERIC STRIP) USED FOR MECHANICALLY STABILIZED REINFORCED EARTH WALL SHALL BE CONNECTED MECHANICALLY WITH THE FACING DIRECTLY USING POSITIVE CONNECTION. NO OVERLAP CONNECTION SHALL BE USED DUE TO HIGH SEISMIC ZONE AS PER 3rd LAST PARAGRAPH OF **ANNEXURE-F (PAGE237) BS-8006:2010** . THE DETAILS FOR THE SOIL REINFORCEMENT (HIGH ADHERENCE POLYMERIC STRIP) IS SHOWN IN TABLE NO-01.
13. THE SOIL REINFORCEMENT (HIGH ADHERENCE POLYMERIC STRIP) USED FOR MECHANICALLY STABILIZED REINFORCED EARTH WALL SHALL BE CONNECTED MECHANICALLY WITH THE GROUTED NAIL AND MESH DIRECTLY USING POSITIVE CONNECTION AS SHOWN IN DETAIL VIEW 'M'.
14. ALL THE STEEL COMPONENTS SHALL BE HOT DIP GALVANIZED WITH A MINIMUM GALVANIZATION OF 70 µ(500gm/Sqm) EXPECT THE WELDED GRID MESH WHICH SHALL BE MINIMUM OF 86 µ (610gm/sqm)
15. FULLY THREADED GALVANIZED HIGH TENSILE IN-SITU SOIL REINFORCEMENT SHOULD HAVE A MINIMUM YIELD STRENGTH OF 670 MPA AND ULTIMATE TENSILE STRENGTH OF 800 MPA, AS PER TABLE NO-3.
16. DETAILS OF TOE PROTECTION USING GROUTED FILLED MATTRESS FOR EROSION PROTECTION OF WATER FRONT STRUCTURE AND SLOPE EROSION PROTECTION IS GIVEN IN TABLE NO-2.

EROSION CONTROL - COIR NON-WOVEN GEOTEXTILE.

17. THE FACE WHERE ONLY SLOPE PROTECTION HAS BEEN PROPOSED (HILL SIDE) SHALL BE COVERED WITH EROSION CONTROL COIR NON-WOVEN GEOTEXTILE AS PER TECHNICAL SPECIFICATION.

FACING

18. STONE AGGREGATES OF SIZE 125-200mm SHALL BE USED BEHIND THE FACING OF MECHANICALLY STABILIZED REINFORCED EARTH WALL AS SHONE IN DETAIL-Y. BROKEN NATURAL BOULDERS SHALL BE PLACED JUST BEHIND THE STEEL MESH FACING.

S.No.	Testing Parameters	Acceptable Limits	Frequency	**Responsibility	Code Applicable for Testing
Full Threaded Nail Bar					
A	Ultimate Tensile Strength	800MPa (Minimum)	One Test for 10000 sqm of Hybrid Wall face area Two Test for More Than10000 sqm but Less Than 50000 sqm of Hybrid Wall face area Four Test for More than 50000 sqm of Hybrid Wall	Contractor's Scope	Relevant Indian or International standards
B	Yeild Strength	670 Mpa (Minimum)			
C	Elongation	7%			
D	Galvanization	500 gm/sqm			Relevant Indian or International standards

REVISIONS

REV	DATE	DRN	CHK	AMENDMENTS

National Highways & Infrastructure Development Corporation Ltd.

PROJECT NO.	SCALE	SHEET SIZE	A3
DRAWN	CHECKED BY: INITIAL / FINAL	APPROVED	DATE: 23.Nov.2015
DRAWING NO.	NHIDCL/KM 54/01	SHEET No.	02/02
DRAWING STATUS		REV.	00

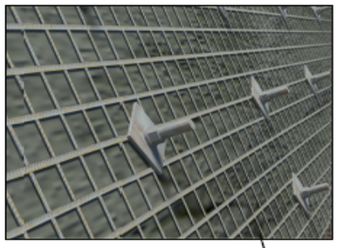
PROJECT:

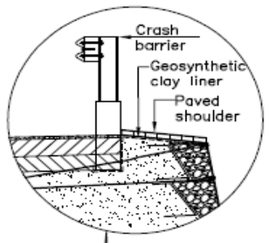
STRUCTURE:

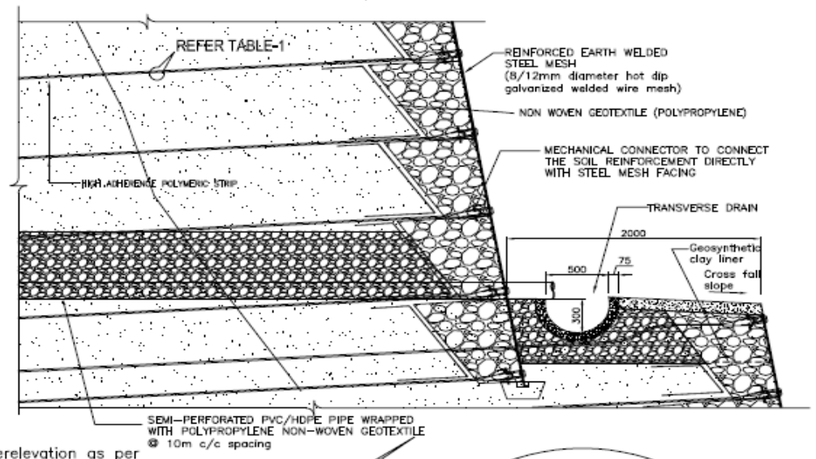
TITLE: WIDENING USING MECHANICALLY STABILIZED EARTH WALL AT Km 54

Detail of proposed widening scheme at balance 130m of narrow zone at KM54

Existing Cross-Section of balance 120m stretch length at KM54 narrow zone

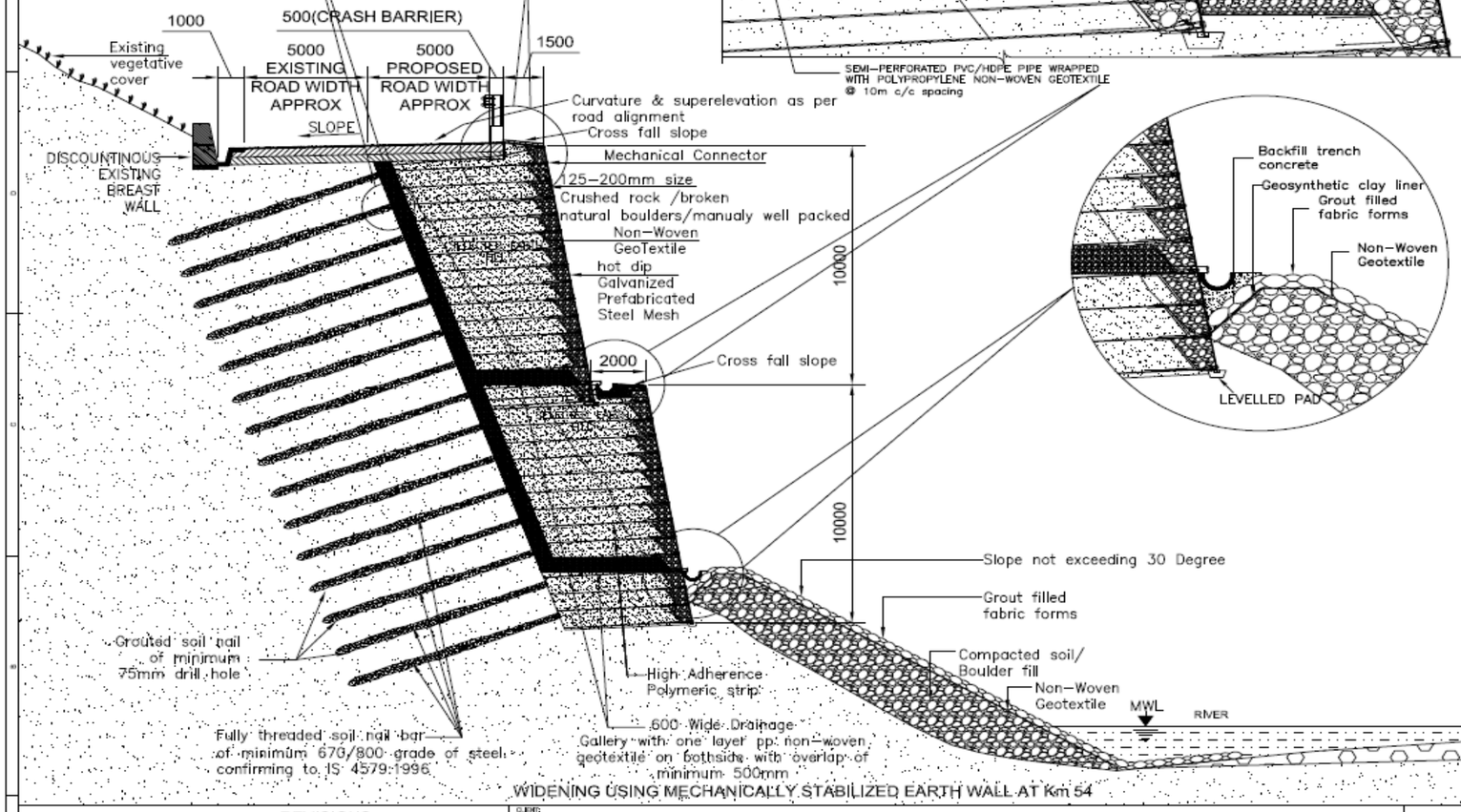






SPECIFICATION OF GEOSYNTHETIC CLAY LINER

CERTIFIED PROPERTIES			
MATERIAL PROPERTY	TEST METHOD	TEST FREQUENCY ft²(m²)	REQUIRED VALUES
Bentonite Swell Index	Relevant Indian or international standards	1 Per 50 tonnes	24 mL/2g min.
Bentonite Fluid Loss		1 Per 50 tonnes	18 mL max.
Bentonite Mass/Area		40,000 ft² (4,000 m²)	0.75 lb/ft²(3.6 kg/m²) min.



WIDENING USING MECHANICALLY STABILIZED EARTH WALL AT Km 54

REVISIONS				
REV	DATE	DRN	CHK	AMENDMENTS

National Highways & Infrastructure Development Corporation Ltd.

PROJECT NO.	—	SCALE	SHEET SIZE A3
DRAWN	CHECKED BY: FINAL	APPROVED	DATE 23.Nov.2018
DRAWING NO.	NHIDCL/KM 54/01	SHEET No. 01/02	REV. 00
DRAWING STATUS	—		

PROJECT: —
STRUCTURE: —
Title: WIDENING USING MECHANICALLY STABILIZED EARTH WALL AT Km 54

Detail of proposed widening scheme at balance 120m of narrow zone at KM54

SOIL REINFORCEMENT (TABLE-1)

HIGH ADHERENCE (HA) POLYMERIC STRIP

THE SOIL REINFORCEMENT SHALL BE HIGH ADHERENCE (HA) POLYMERIC STRIP OF 50MM WIDE WITH LATERAL TEETH ON BOTH SIDE OF THE STRIP TO ENHANCE THE ADHERENCE CAPACITY IN SOIL AS SHOWN IN FIGURE 1 BELOW.

HA STRIP CONSISTS OF DISCRETE CHANNELS OF CLOSELY PACKED HIGH TENACITY POLYESTER FIBRES RESPECTIVELY ENCASED IN A LINEAR LOW DENSITY POLYETHYLENE (LLDPE) SHEATH (FIGURE 1).

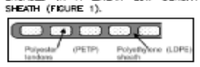


FIGURE1:STRIPS TYPICAL CROSS SECTION,PROCESSED BY CO–EXTRUSION

HA POLYMERIC STRIP REINFORCEMENT SPECIFICATION

Properties	Test Method	Unit	Minimum average roll value				
Ultimate Tensile Strength	Indian or International standard	kN	20	25	37.5	50	65
Width		mm	49	49	49	49	49
Long Term Design Strength		kN	11.76	14.70	22.05	29.40	38.23

(TABLE -3) MATERIAL SPECIFICATION OF SOIL NAIL

Nominal diameter	Grade	Cross section (mm²)	Yled load (kN)	Ultimate load (kN)	Elongation (%)
22	St 670/800 (grade 97)	375	251	300	7
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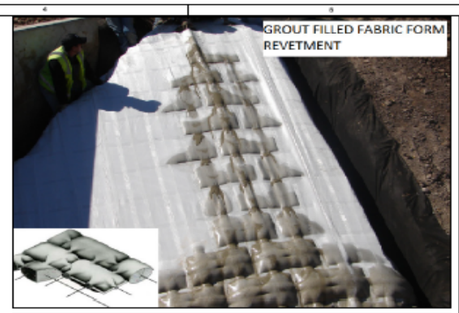

(TABLE -2) PROPERTIES OF GROUT FILLED FABRIC FORM

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Thickness		Mm	0.40
Mll Width		M	2.13
MECHANICAL PROPERTIES [1,2]			
Wide-Width Strip Tensile Strength	Relevant Indian or International standards		
Machine Direction		kN/m	50
Cross Machine Direction		kN/m	60
Elongation at Break	Relevant Indian or International standards		
Machine Direction		%	8
Cross Machine Direction		%	8
Grab Tensile Strength	Relevant Indian or International standards		
Machine Direction		N	1395
Cross Machine Direction		N	1395
Elongation at Break	Relevant Indian or International standards		
Machine Direction		%	25
Cross Machine Direction		%	20
Trapezoidal Tear Strength	Relevant Indian or International standards		
Machine Direction		N	460
Cross Machine Direction		N	600
CBR Puncture Strength	Relevant Indian or International standards	N	5450
Mullen Burst Strength	Relevant Indian or International standards	kg/cm²	40
HYDRAULIC PROPERTIES [1,2]			
Apparent Opening Size (AOS)	Relevant Indian or International standards	mm	0.30-0.60
Permittivity	Relevant Indian or International standards	sec⁻¹	0.40-0.55
Flow Rate	Relevant Indian or International standards	l/m/n/m²	1200-1825

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8. ALL DRAINAGE GALLERY SHALL BE AS PER CLASS-II GRADATION OF **MORTH 5TH REV. SPECIFICATION (TABLE NO.-300.3, PAGE-87)**
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10. THE SEMI PERFORATED PVC PIPE HAS BEEN PROVIDED AS A DRAINAGE OUTLET AT THE TOE OF EACH TIER WALL AS SHOWN IN CROSS SECTION, DETAIL AS SHOWN IN SECTION X-X.
11. THE FACING FOR THE MECHANICALLY STABILIZED REINFORCED EARTH WALL (ON BOTH SIDES-EXPOSED FACE & SLOPED SURFACE) SHALL BE USING HOT DIP GALVANIZED WELDED STEEL MESH OF MINIMUM 8mm DIA BAR@100mm c/c EXCEPT THE HORIZONTAL BARS WHERE THE PRIMARY REINFORCEMENT IS CONNECTED SHALL BE OF MINIMUM 12mm. DIA BAR
12. THE SOIL REINFORCEMENT (HIGH ADHERENCE POLYMERIC STRIP) USED FOR MECHANICALLY STABILIZED REINFORCED EARTH WALL SHALL BE CONNECTED MECHANICALLY WITH THE FACING DIRECTLY USING POSITIVE CONNECTION, NO OVERLAP CONNECTION SHALL BE USED DUE TO HIGH SEISMIC ZONE AS PER 3rd LAST PARAGRAPH OF **ANNEXURE-F (PAGE237) BS-8006:2010** , THE DETAILS FOR THE SOIL REINFORCEMENT (HIGH ADHERENCE POLYMERIC STRIP) IS SHOWN IN TABLE NO-01.
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14. ALL THE STEEL COMPONENTS SHALL BE HOT DIP GALVANIZED WITH A MINIMUM GALVANIZATION OF 70 µ(500gm/Sqm) EXPECT THE WELDED GRID MESH WHICH SHALL BE MINIMUM OF 86 µ (610gm/sqm)
15. FULLY THREADED GALVANIZED HIGH TENSILE IN-SITU SOIL REINFORCEMENT SHOULD HAVE A MINIMUM YIELD STRENGTH OF 670 MPA AND ULTIMATE TENSILE STRENGTH OF 800 MPA, AS PER TABLE NO-3.
16. DETAILS OF TOE PROTECTION USING GROUTED FILLED MATTRESS FOR EROSION PROTECTION OF WATER FRONT STRUCTURE AND SLOPE EROSION PROTECTION IS GIVEN IN TABLE NO-2.

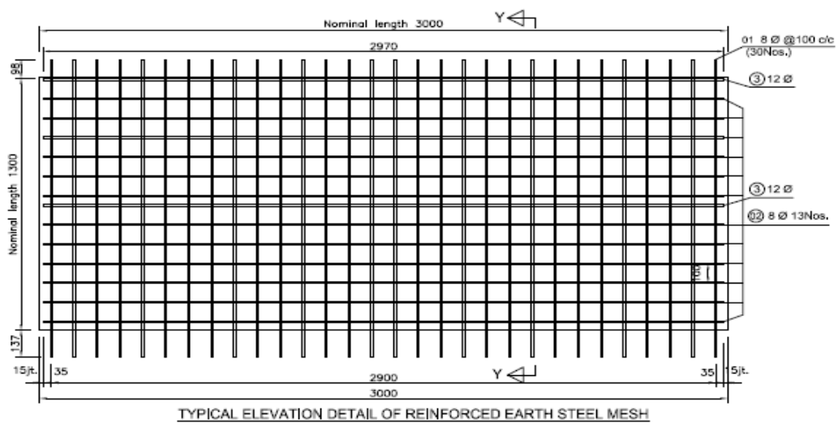
EROSION CONTROL - COIR NON-WOVEN GEOTEXTILE.

17. THE FACE WHERE ONLY SLOPE PROTECTION HAS BEEN PROPOSED (HILL SIDE) SHALL BE COVERED WITH EROSION CONTROL COIR NON-WOVEN GEOTEXTILE AS PER TECHNICAL SPECIFICATION.

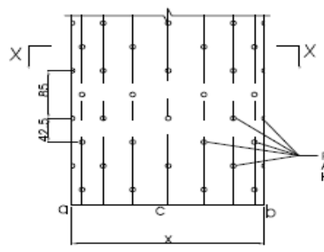
FACING

18. STONE AGGREGATES OF SIZE 125-200mm SHALL BE USED BEHIND THE FACING OF MECHANICALLY STABILIZED REINFORCED EARTH WALL AS SHONE IN DETAIL-Y. BROKEN NATURAL BOULDERS SHALL BE PLACED JUST BEHIND THE STEEL MESH FACING.

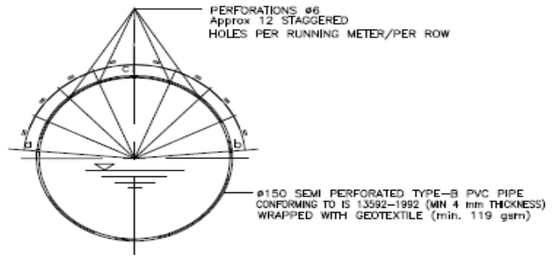
S.No.	Testing Parameters	Acceptable Limits	Frequency	**Responsibility	Code Applicable for Testing
Full Threaded Nail Bar					
A	Ultimate Tensile Strength	800MPa (Minimum)	One Test for 10000 sqm of Hybrid Wall face area Two Tests for More Than10000 sqm but Less Than 50000 sqm of Hybrid Wall face area Four Tests for More than 50000 sqm of Hybrid Wall	Contractor's Scope	Relevant Indian or International standards
B	Yeild Strength	670 Mpa (Minimum)			
C	Elongation	7%			
D	Galvanization	500 gm/sqm			Relevant Indian or International standards



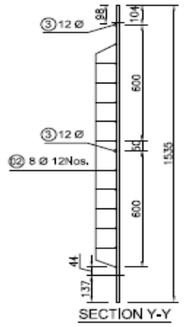
TYPICAL ELEVATION DETAIL OF REINFORCED EARTH STEEL MESH



TOP PLAN AT SEMI PERFORATED PIPE



SECTION X-X



SECTION Y-Y

REVISIONS

REV	DATE	DRN	CHK	AMENDMENTS

CLIENT: NHIDCL — BUILDING INFRASTRUCTURE - BUILDING THE NATION

National Highways & Infrastructure Development Corporation Ltd.

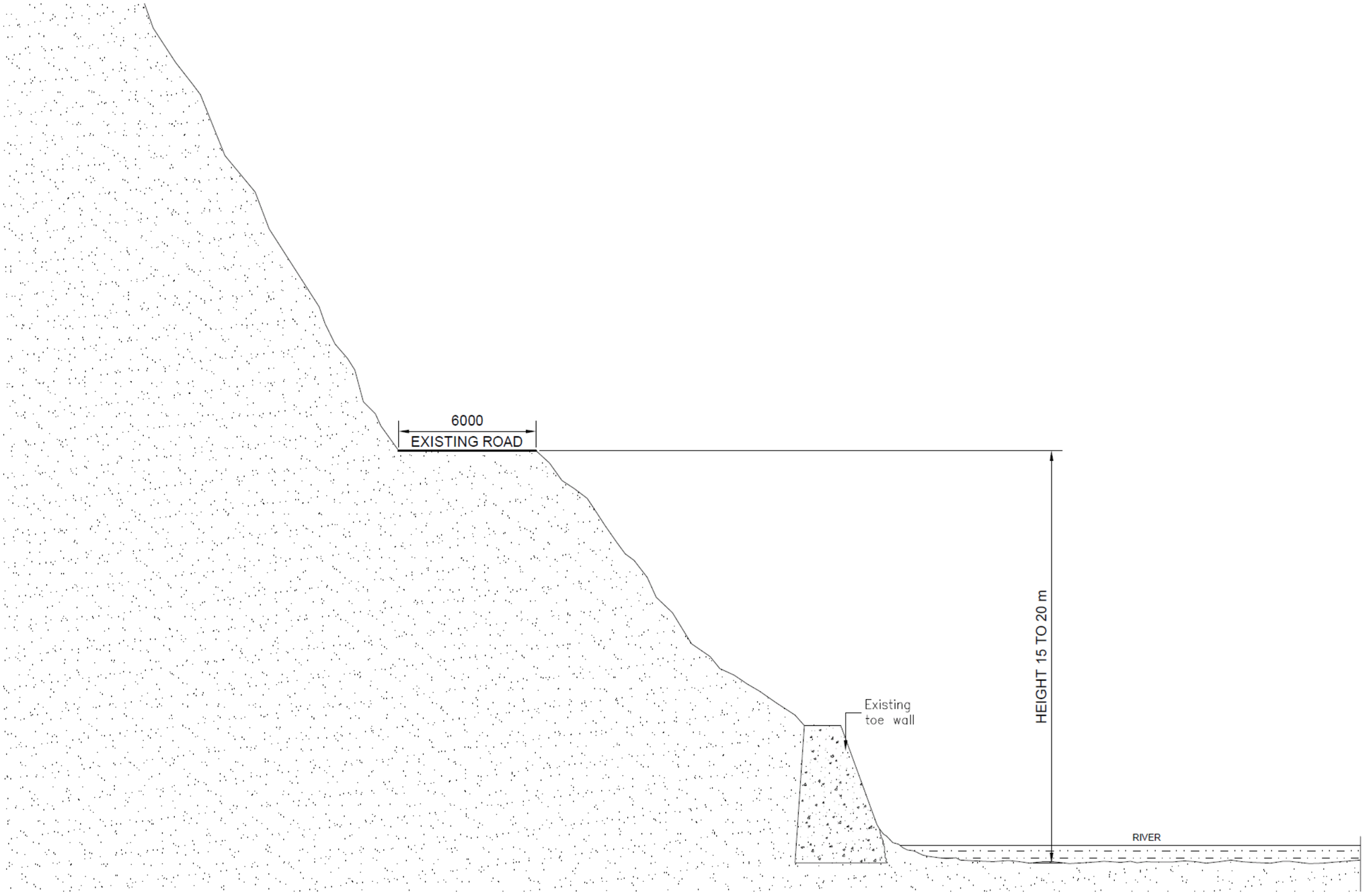
PROJECT NO. —	SCALE	SHEET SIZE A3	
DRAWN	CHECKED BY: INITIAL / FINAL	APPROVED	DATE 23.Nov.2016
DRAWING NO. NHIDCL/KM 54/01	SHEET No. 02/02	REV. 00	
DRAWING STATUS: —			

PROJECT: —

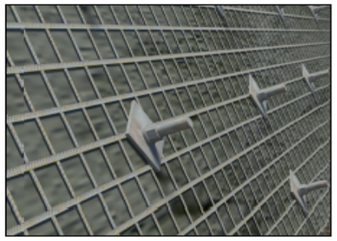
STRUCTURE: —

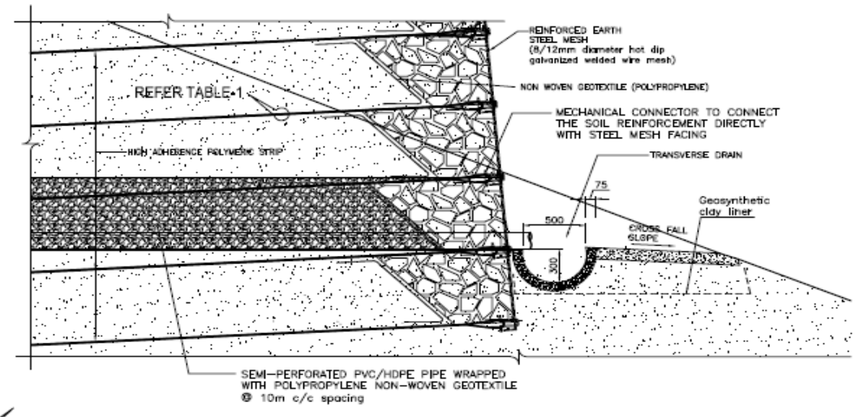
TITLE: WIDENING USING MECHANICALLY STABILIZED EARTH WALL AT Km 54

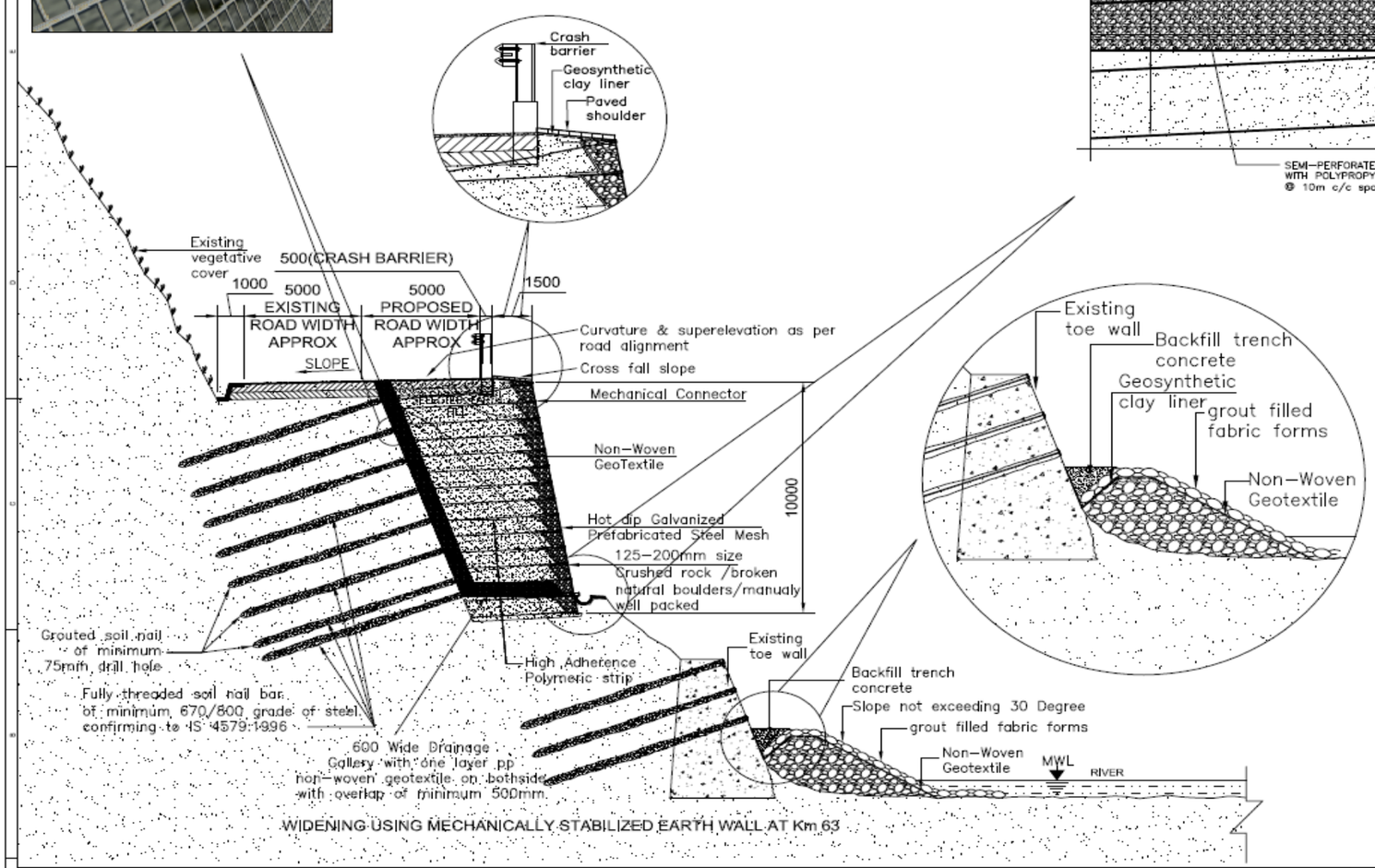
Detail of proposed widening scheme at balance 120m of narrow zone at KM54



Existing Cross-Section of 210m stretch length at KM63 narrow zone







WIDENING USING MECHANICALLY STABILIZED EARTH WALL AT Km 63

SPECIFICATION OF GEOSYNTHETIC CLAY LINER

CERTIFIED PROPERTIES			
MATERIAL PROPERTY	TEST METHOD	TEST FREQUENCY ft²(m²)	REQUIRED VALUES
Bentonite Swell Index	Relevant Indian or international standards	1 Per 50 tonnes	24 mL/2g min.
Bentonite Fluid Loss		1 Per 50 tonnes	18 mL max.
Bentonite Mass/Area		40,000 ft² (4,000 m²)	0.75 lb/ft²(3.6 kg/m²) min.

REVISIONS

REV	DATE	DRN	CHK	AMENDMENTS

National Highways & Infrastructure Development Corporation Ltd.

PROJECT NO. — SCALE — SHEET SIZE A3
DRAWN — CHECKED BY — APPROVED — DATE 23.Nov.2016
DRAWING NO. NHIDCL/KM 63/01 SHEET No. 01/01 REV. 00
DRAWING STATUS: —
PROJECT: —
STRUCTURE: —
TITLE: WIDENING USING MECHANICALLY STABILIZED EARTH WALL AT Km 63

Typical Detail of proposed widening scheme at 210m of narrow zone at KM63

SOIL REINFORCEMENT (TABLE-1)

HIGH ADHERENCE (HA) POLYMERIC STRIP

THE SOIL REINFORCEMENT SHALL BE HIGH ADHERENCE (HA) POLYMERIC STRIP OF 50MM WIDE WITH LATERAL TEETH ON BOTH SIDE OF THE STRIP TO ENHANCE THE ADHERENCE CAPACITY IN SOIL AS SHOWN IN FIGURE 1 BELOW.

HA STRIP CONSISTS OF DISCRETE CHANNELS OF CLOSELY PACKED HIGH TENACITY POLYESTER FIBRES RESPECTIVELY ENCASED IN A LINEAR LOW DENSITY POLYETHYLENE (LLDPE) SHEATH (FIGURE 1).

FIGURE1:STRIPS TYPICAL CROSS SECTION,PROCESSED BY CO-EXTRUSION

HA POLYMERIC STRIP REINFORCEMENT SPECIFICATION							
Properties	Test Method	Unit	Minimum average roll value				
Ultimate Tensile Strength	Indian or International standard	kN	20	25	37.5	50	65
Width		mm	49	49	49	49	49
Long Term Design Strength		kN	11,76	14,70	22,05	29,40	38,23

(TABLE -3) MATERIAL SPECIFICATION OF SOIL NAIL

Nominal diameter	Grade	Cross section (mm^2)	Yield load (kN)	Ultimate load (kN)	Elongation (%)
22	St 670/800 (grade 97)	375	251	300	7
25	St 670/800 (grade 97)	491	329	393	7
28	St 670/800 (grade 97)	616	413	493	7
30	St 670/800 (grade 97)	707	474	566	7

(TABLE -2) PROPERTIES OF GROUT FILLED FABRIC FORM

	Test Method	Units	Values
PHYSICAL PROPERTIES [1,2]			
Composition of Yarns			Polyester
Mass Per Unit Area (double-layer)	Relevant Indian or International standards	g/m²	500
Thickness		Mm	0,40
Mill Width		M	2,13
MECHANICAL PROPERTIES [1,2]			
Wide-Width Strip Tensile Strength	Relevant Indian or International standards		
Machine Direction		kN/m	50
Cross Machine Direction		kN/m	60
Elongation at Break	Relevant Indian or International standards		
Machine Direction		%	8
Cross Machine Direction		%	8
Grab Tensile Strength	Relevant Indian or International standards		
Machine Direction		N	1395
Cross Machine Direction		N	1395
Elongation at Break	Relevant Indian or International standards		
Machine Direction		%	25
Cross Machine Direction		%	20
Trapezoidal Tear Strength	Relevant Indian or International standards		
Machine Direction		N	460
Cross Machine Direction		N	600
CBR Puncture Strength	Relevant Indian or International standards	N	5450
Mullen Burst Strength	Relevant Indian or International standards	kg/cm²	40
HYDRAULIC PROPERTIES [1,2]			
Apparent Opening Size (AOS)	Relevant Indian or International standards	mm	0,30-0,80
Permittivity	Relevant Indian or International standards	sec^{-1}	0,40-0,55
Flow Rate	Relevant Indian or International standards	l/m/m²	1200-1625

GENERAL NOTES :-

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METER UNLESS OTHERWISE STATED.
2. DETAILED DESIGN SHALL BE DONE BY CONDUCTING DETAILED SOIL INVESTIGATION AS REQUIRED FOR DESIGN, WHICH SHALL INCLUDE GEOPHYSICAL STUDY AND MINIMUM SIX BORE HOLE INVESTIGATION PER SITE, THREE ON HILL SIDE AND THREE ON INTERMEDIATE LEVEL.
3. THE ANALYSIS SHALL BE DONE CONSIDERING SEISMIC ZONE- IV.
4. THE HA POLYMERIC STRIP REINFORCEMENT SHALL BE AS SHOWN IN TABLE NO.1 AND THE GROUTED SOIL NAIL SHALL BE AS SHOWN IN TABLE NO-3.
5. THE PRELIMINARY ANALYSIS SHALL BE DONE CONSIDERING DESIGN BOND STRENGTH OF 80Kpa BETWEEN THE GROUT AND SOIL.
6. THE PULL OUT BOND STRENGTH SHALL BE RE VERIFIED AS SITE BY CONDUCTING IN SITU PULLOUT TEST
7. THE MECHANICALLY STABILIZED REINFORCED EARTH WALL DESIGN ANALYSIS SHALL BE DONE AS PER AFNOR NF,P94-270 JULY 2009 AS CITED IN ANNEXURE A1-1.1 IN **SECTION 3100 OF MORTH-5th REVISION** OR FHWA, THE OVERALL STABILITY ANALYSIS SHALL BE DONE FOR WORKING STRESS ANALYSIS CONSIDERING A FACTOR OF SAFETY OF 1.3 FOR STATIC & 1.1 FOR SEISMIC.
8. ALL DRAINAGE GALLERY SHALL BE AS PER CLASS-II GRADATION OF **MORTH 5TH REV. SPECIFICATION (TABLE NO.-300.3, PAGE-87)**
9. GROUT FILLED FABRIC FORM REVETMENT : THE TOE PROTECTION/BED PROTECTION SHALL BE DONE USING GROUT FILLED MATTRESS AS PER DETAILED SPECIFICATION SHOWN IN TABLE NO.-02
10. THE SEMI PERFORATED PVC PIPE HAS BEEN PROVIDED AS A DRAINAGE OUTLET AT THE TOE OF EACH TIER WALL AS SHOWN IN CROSS SECTION, DETAIL AS SHOWN IN SECTION X-X.
11. THE FACING FOR THE MECHANICALLY STABILIZED REINFORCED EARTH WALL (ON BOTH SIDES-EXPOSED FACE & SLOPED SURFACE) SHALL BE USING HOT DIP GALVANIZED WELDED STEEL MESH OF MINIMUM 8mm DIA BAR@100mm c/c EXCEPT THE HORIZONTAL BARS WHERE THE PRIMARY REINFORCEMENT IS CONNECTED SHALL BE OF MINIMUM 12mm, DIA BAR
12. THE SOIL REINFORCEMENT (HIGH ADHERENCE POLYMERIC STRIP) USED FOR MECHANICALLY STABILIZED REINFORCED EARTH WALL SHALL BE CONNECTED MECHANICALLY WITH THE FACING DIRECTLY USING POSITIVE CONNECTION. NO OVERLAP CONNECTION SHALL BE USED DUE TO HIGH SEISMIC ZONE AS PER 3rd LAST PARAGRAPH OF **ANNEXURE-F (PAGE237) BS-8006:2010** , THE DETAILS FOR THE SOIL REINFORCEMENT (HIGH ADHERENCE POLYMERIC STRIP) IS SHOWN IN TABLE NO-01.
13. THE SOIL REINFORCEMENT (HIGH ADHERENCE POLYMERIC STRIP) USED FOR MECHANICALLY STABILIZED REINFORCED EARTH WALL SHALL BE CONNECTED MECHANICALLY WITH THE GROUTED NAIL AND MESH DIRECTLY USING POSITIVE CONNECTION AS SHOWN IN DETAIL VIEW "M".
14. ALL THE STEEL COMPONENTS SHALL BE HOT DIP GALVANIZED WITH A MINIMUM GALVANIZATION OF 70 µ(500gm/Sqm) EXPECT THE WELDED GRID MESH WHICH SHALL BE MINIMUM OF 86 µ (610gm/sqm)
15. FULLY THREADED GALVANIZED HIGH TENSILE IN-SITU SOIL REINFORCEMENT SHOULD HAVE A MINIMUM YIELD STRENGTH OF 670 MPA AND ULTIMATE TENSILE STRENGTH OF 800 MPA, AS PER TABLE NO-3.
16. DETAILS OF TOE PROTECTION USING GROUTED FILLED MATTRESS FOR EROSION PROTECTION OF WATER FRONT STRUCTURE AND SLOPE EROSION PROTECTION IS GIVEN IN TABLE NO-2.

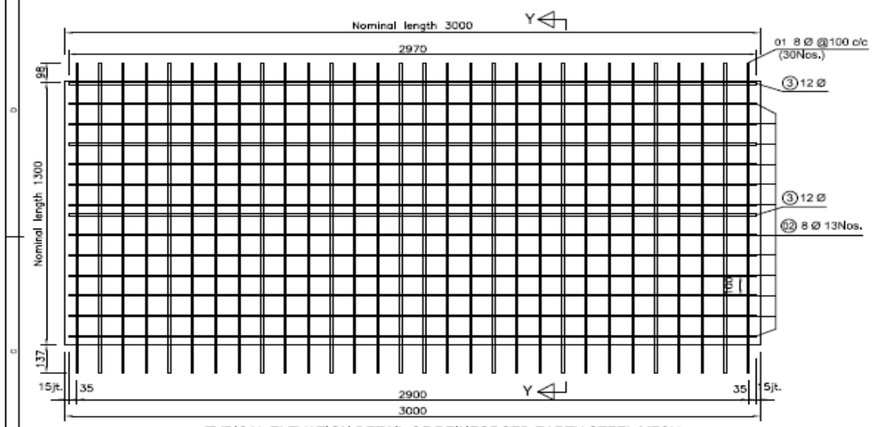
EROSION CONTROL - COIR NON-WOVEN GEOTEXTILE.

17. THE FACE WHERE ONLY SLOPE PROTECTION HAS BEEN PROPOSED (HILL SIDE) SHALL BE COVERED WITH EROSION CONTROL COIR NON-WOVEN GEOTEXTILE AS PER TECHNICAL SPECIFICATION.

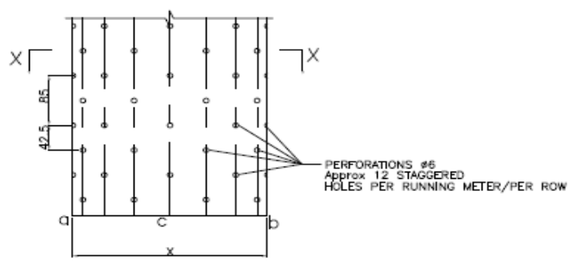
FACING

18. STONE AGGREGATES OF SIZE 125-200mm SHALL BE USED BEHIND THE FACING OF MECHANICALLY STABILIZED REINFORCED EARTH WALL AS SHONE IN DETAIL-Y. BROKEN NATURAL BOULDERS SHALL BE PLACED JUST BEHIND THE STEEL MESH FACING.

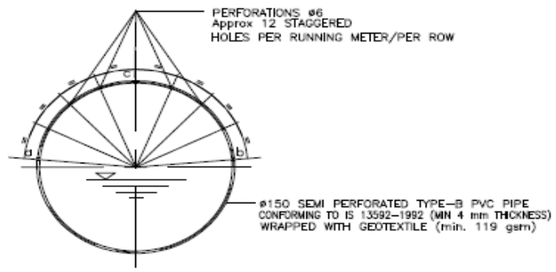
S.No.	Testing Parameters	Acceptable Limits	Frequency	**Responsibility	Code Applicable for Testing
Full Threaded Nail Bar					
A	Ultimate Tensile Strength	800MPa (Minimum)	One Test for 10000 sqm of Hybrid Wall face area Two Tests for More Than10000 sqm but Less Than 50000 sqm of Hybrid Wall face area Four Tests for More than 50000 sqm of Hybrid Wall	Contractor's Scope	Relevant Indian or International standards
B	Yeild Strength	670 Mpa (Minimum)			
C	Elongation	7%			
D	Galvanization	500 gm/sqm			Relevant Indian or International standards



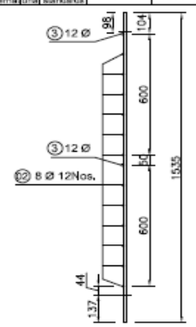
TYPICAL ELEVATION DETAIL OF REINFORCED EARTH STEEL MESH



TOP PLAN AT SEMI PERFORATED PIPE



SECTION X-X



SECTION Y-Y

REVISIONS

REV	DATE	DRN	CHK	AMENDMENTS

OWNER

National Highways & Infrastructure Development Corporation Ltd.

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DRAWN	CHECKED BY: TITAL / TITAL	APPROVED —	DATE 23.Nov.2016
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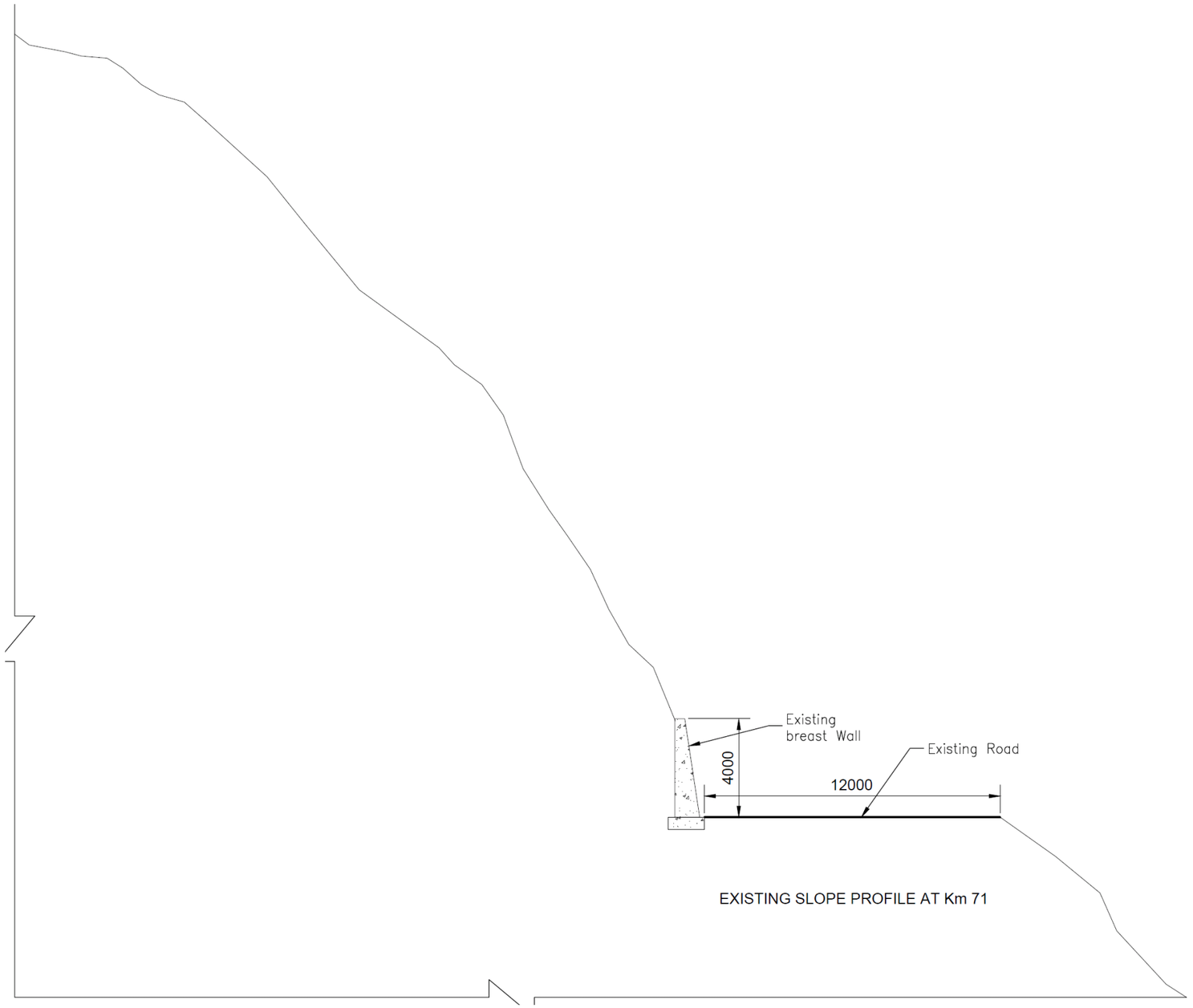
STRUCTURE: —

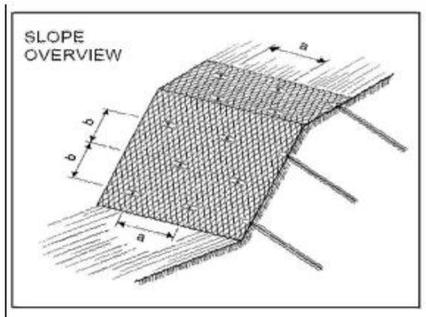
Title: WIDENING USING MECHANICALLY STABILIZED EARTH WALL AT Km 63

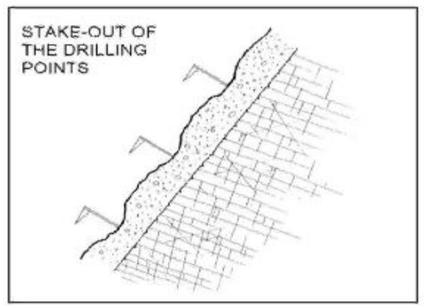
Typical Detail of proposed widening scheme at 210m of narrow zone at KM63

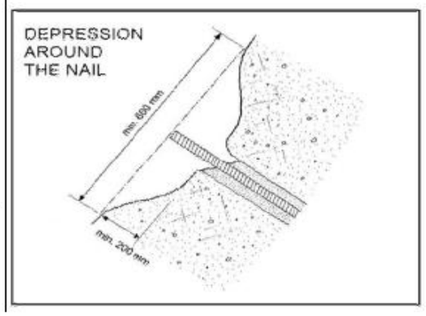


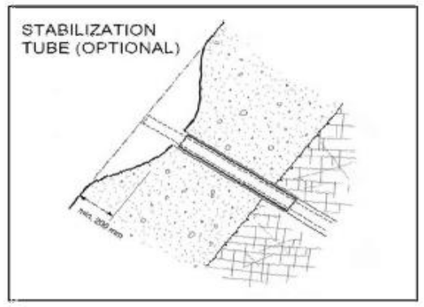
Existing Cross-Section of 360m stretch length at KM71 landslide zone

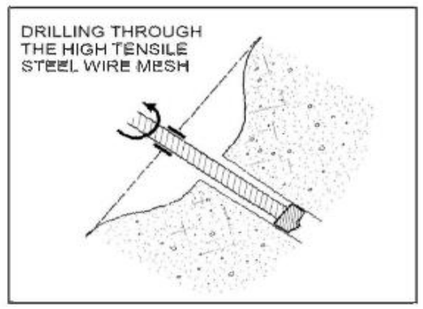
TYPICAL INSTALLATION PROCEDURE

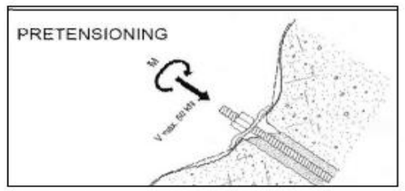












LOAD TABLE

NAIL TYPE	PRESTRESS FORCE, V	REQUIRED TIGHTENING TORQUE	
BAR 22MM	20kN 30 kN 50 kN	0,20 kNm 0,30 kNm 0,50 kNm	148 ft-lbs 221 ft-lbs 369 ft-lbs
BAR 25MM	20kN 30 kN 50 kN	0,20 kNm 0,30 kNm 0,50 kNm	148 ft-lbs 221 ft-lbs 369 ft-lbs
BAR 28MM	20kN 30 kN 50 kN	0,25 kNm 0,35 kNm 0,55 kNm	184 ft-lbs 258 ft-lbs 406 ft-lbs
BAR 30MM	20kN 30 kN 50 kN	0,25 kNm 0,35 kNm 0,55 kNm	184 ft-lbs 258 ft-lbs 406 ft-lbs

GENERAL NOTES :-

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3. THE ANALYSIS SHALL BE DONE CONSIDERING SEISMIC ZONE- IV.
4. THE ANALYSIS SHALL BE DONE CONSIDERING DESIGN BOND STRENGTH OF 60Kpa BETWEEN THE GROUT AND SOIL.
5. THE PULL OUT BOND STRENGTH SHALL BE RE VERIFIED AS SITE BY CONDUCTING IN SITU PULLOUT TEST
6. THE TYPICAL CONSTRUCTION SEQUENCE IS SHOWN IN THE GIVEN FIGURE AND PHOTOGRAPHS.
7. FULLY THREADED GALVANIZED HIGH TENSILE IN-SITU SOIL REINFORCEMENT SHOULD HAVE A MINIMUM YIELD STRENGTH OF 670 MPA AND ULTIMATE TENSILE STRENGTH OF 800 MPA, AS PER TABLE NO-1.

EROSION CONTROL- COIR NON-WOVEN GEOTEXTILE.

8. THE FACE WHERE ONLY SLOPE PROTECTION HAS BEEN PROPOSED (HILL SIDE) SHALL BE COVERED WITH EROSION CONTROL COIR NON-WOVEN GEOTEXTILE AS PER TECHNICAL SPECIFICATION.
9. THE SOIL LAYERS / ROCK STRATA CONSIDERED FOR ANALYSIS SHALL BE SUBMITTED IN THE DESIGN REPORT AS PER GEOLOGY REPORT IS LISTED BELOW :-

S.No.	Testing Parameters	Acceptable Limits	Frequency	**Responsibility	Code Applicable for Testing
Full Threaded Nail Bar					
A	Ultimate Tensile Strength	800MPa (Minimum)	One Test for 10000 sqm of slope face protection Two Test for More Than 10000 sqm but Less Than 50000 sqm of slope face protection Four Tests for More than 50000 sqm of slope face protection	Contractor's Scope	Relevant Indian or International standards
B	Yeild Strength	670 Mpa (Minimum)			
C	Elongation	7%			
D	Galvanization	500 gm/sqm			Relevant Indian or International standards

Table number-02

System: High tensile steel wire mesh

Typical range of application: Slope Retention System
Underground conditions: Soil or heavily disintegrated or weathered rock slopes
Slope Inclination: up to 80°
Greening: Coir non-woven Geotextile and turfing

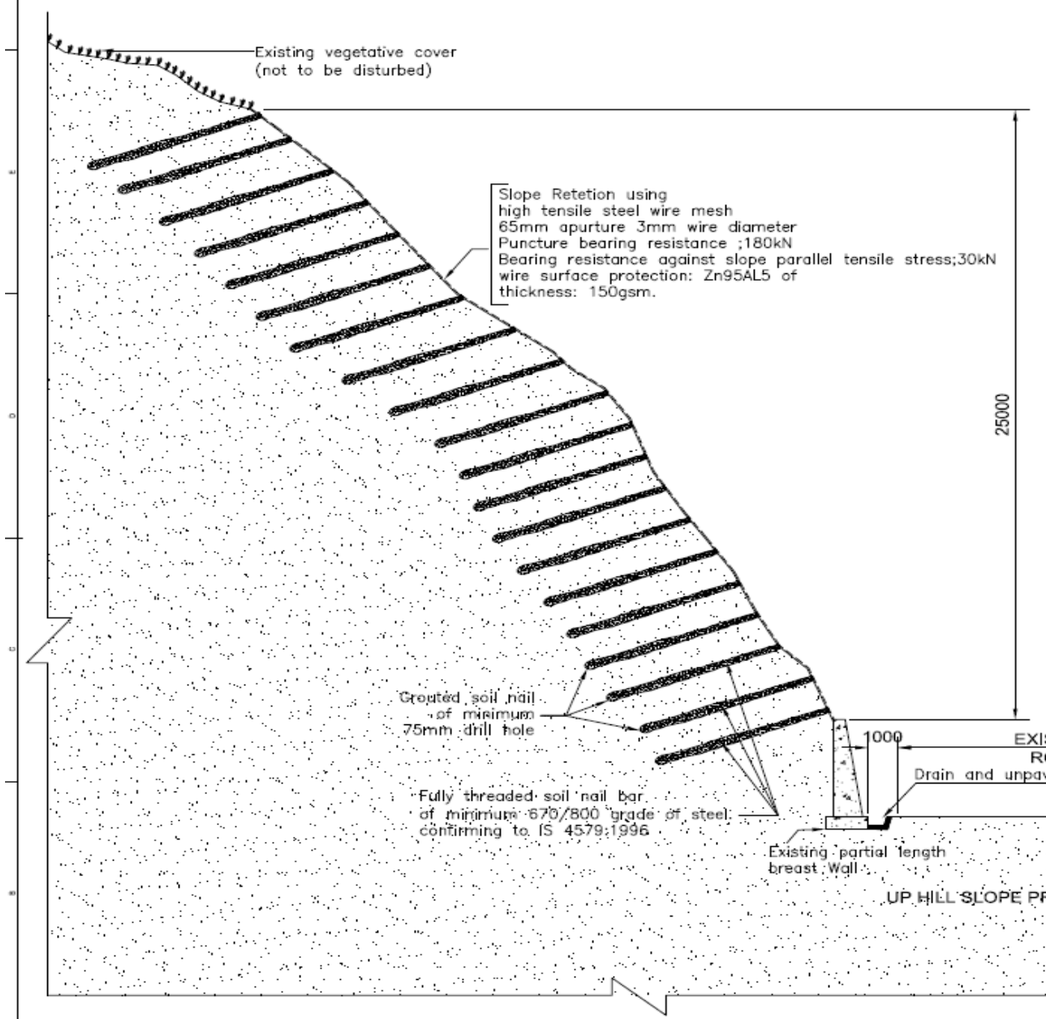
High-tensile steel wire mesh
a. Wire diameter [mm]:3.0
b. Tensile strength high tensile steel wire [N/mm2]:1'770
c. Surface finish: Zn95Al5 coating according to applicable Indian or International standard

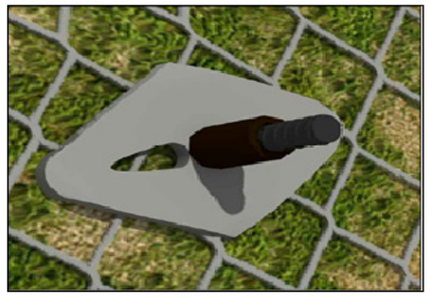
REVISIONS				
REV	DATE	DRN	CHK	AMENDMENTS

National Highways & Infrastructure Development Corporation Ltd.

PROJECT NO. — | SCALE | SHEET SIZE A3
DRAWN | CHECKED BY: INITIAL / FINAL | APPROVED — | DATE 23.Nov.2016
DRAWING NO. NHIDCL/KM 71/01 | SHEET No. 02/02 | REV. 00
DRAWING STATUS: —
PROJECT: —
STRUCTURE: —
Title: UP HILL SLOPE PROTECTION AT Km 71

Typical Detail of proposed landslide protection scheme at 360m landslide zone at KM71





(TABLE -1) MATERIAL SPECIFICATION OF SOIL NAIL

Nominal diameter	Grade	Cross section (mm^2)	Yield load (kN)	Ultimate load (kN)	Elongation (%)
22	St 670/800 (grade 97)	375	251	300	7
25	St 670/800 (grade 97)	491	329	393	7
28	St 670/800 (grade 97)	616	413	493	7
30	St 670/800 (grade 97)	707	474	566	7

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PROJECT NO.: — SCALE: — SHEET SIZE: A3
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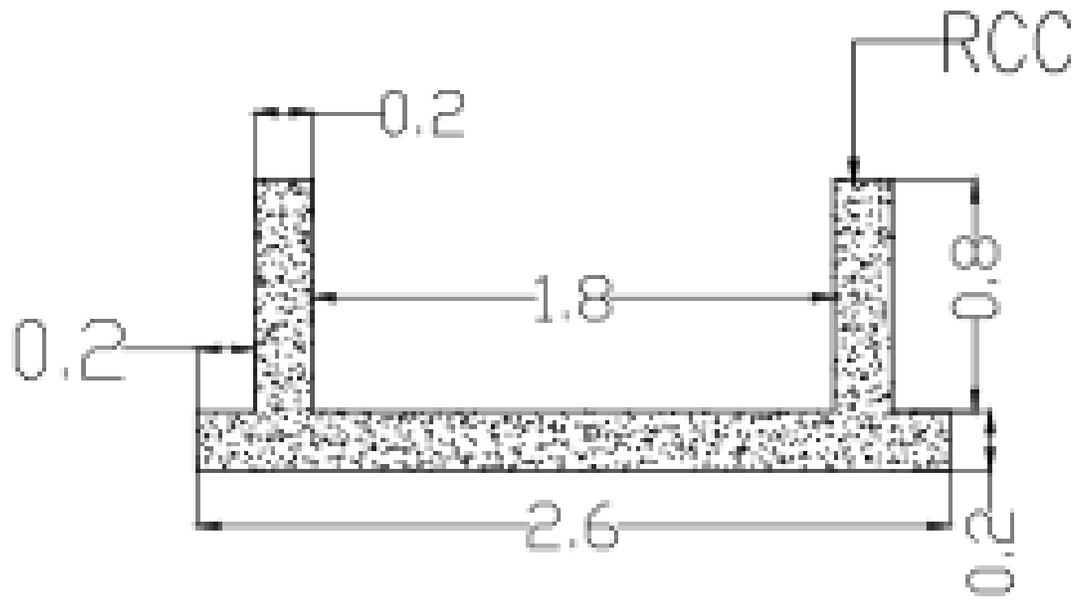
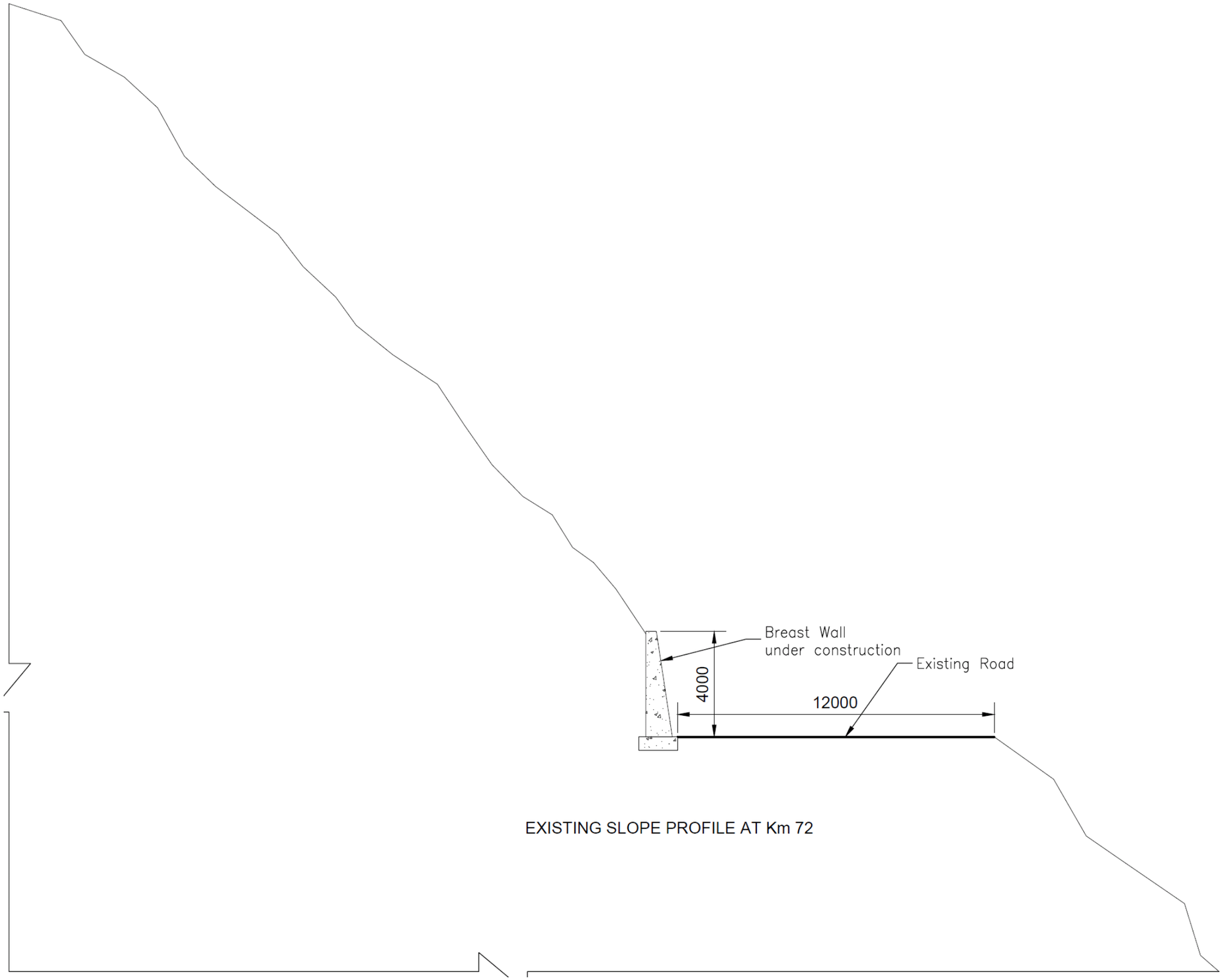
Typical Detail of proposed landslide protection scheme at 360m landslide zone at KM71

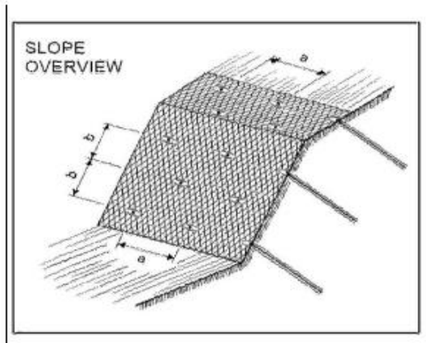


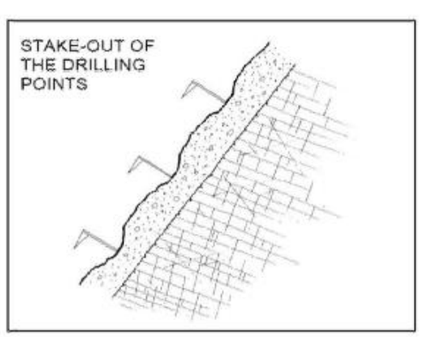
Typical cross section of the drain directed to the nearest culvert at KM71

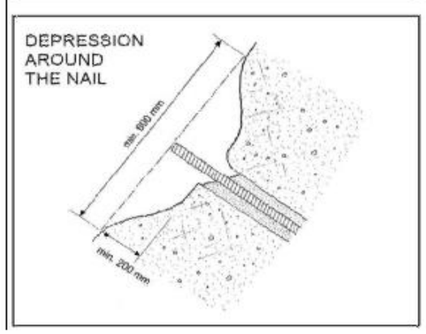


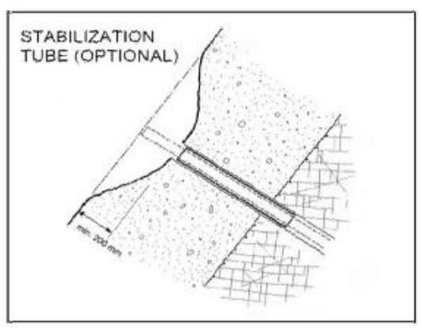
Existing Cross-Section of 350m stretch length at KM72 landslide zone

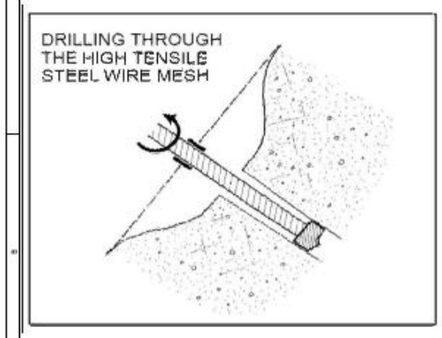
TYPICAL INSTALLATION PROCEDURE

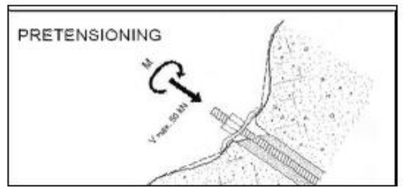












LOAD TABLE

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BAR 28MM	20kN 30 kN 50 kN	0.25 kNm 0.35 kNm 0.55 kNm	184 ft-lbs 258 ft-lbs 406 ft-lbs
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3. THE ANALYSIS SHALL BE DONE CONSIDERING SEISMIC ZONE- IV.
4. THE ANALYSIS SHALL BE DONE CONSIDERING DESIGN BOND STRENGTH OF 60Kpa BETWEEN THE GROUT AND SOIL.
5. THE PULL OUT BOND STRENGTH SHALL BE RE VERIFIED AS SITE BY CONDUCTING IN SITU PULLOUT TEST
6. THE TYPICAL CONSTRUCTION SEQUENCE IS SHOWN IN THE GIVEN FIGURE AND PHOTOGRAPHS.
7. FULLY THREADED GALVANIZED HIGH TENSILE IN-SITU SOIL REINFORCEMENT SHOULD HAVE A MINIMUM YIELD STRENGTH OF 670 MPA AND ULTIMATE TENSILE STRENGTH OF 800 MPA, AS PER TABLE NO-1.

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B	Yeild Strength	670 Mpa (Minimum)			
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Table number-02

System: High tensile steel wire mesh

Typical range of application: Slope Retention System
Underground conditions: Soil or heavily disintegrated or weathered rock slopes
Slope inclination: up to 80°
Greening: Coir non-woven Geotextile and turfing

High-tensile steel wire mesh
a. Wire diameter [mm]:3,0
b. Tensile strength high tensile steel wire [N/mm2]:1770
c. Surface finish: Zn95Al5 coating according to applicable Indian or International standard

REVISIONS

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National Highways & Infrastructure Development Corporation Ltd.

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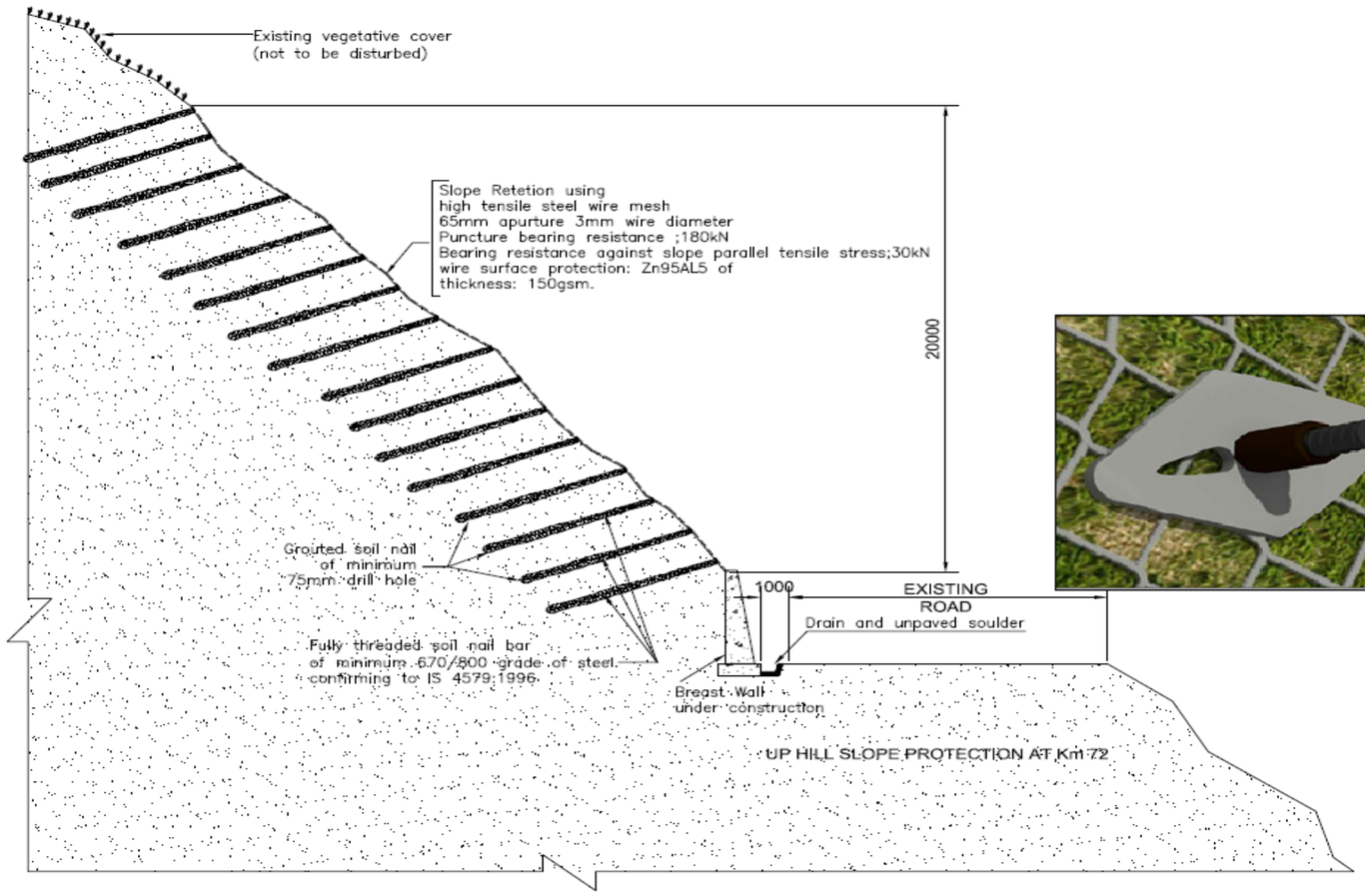
DRAWN | CHECKED BY: INITIAL / FINAL | APPROVED — | DATE 23.Nov.2018
DRAWING NO. NHIDCL/KM 72/01 | SHEET No. 02/02 | REV. 00
DRAWING STATUS: —

PROJECT: —
STRUCTURE: —
Title: UP HILL SLOPE PROTECTION AT Km 72

Typical Detail of proposed landslide protection scheme at 350m landslide zone at KM72



(TABLE -1) MATERIAL SPECIFICATION OF SOIL NAIL

Nominal diameter	Grade	Cross section (mm²)	Yled load (kN)	Ultimate load (kN)	Elongation (%)
22	St 670/800 (grade 97)	375	251	300	7
25	St 670/800 (grade 97)	491	329	393	7
28	St 670/800 (grade 97)	616	413	493	7
30	St 670/800 (grade 97)	707	474	566	7

REVISIONS

REV	DATE	DRN	CHK	AMENDMENTS

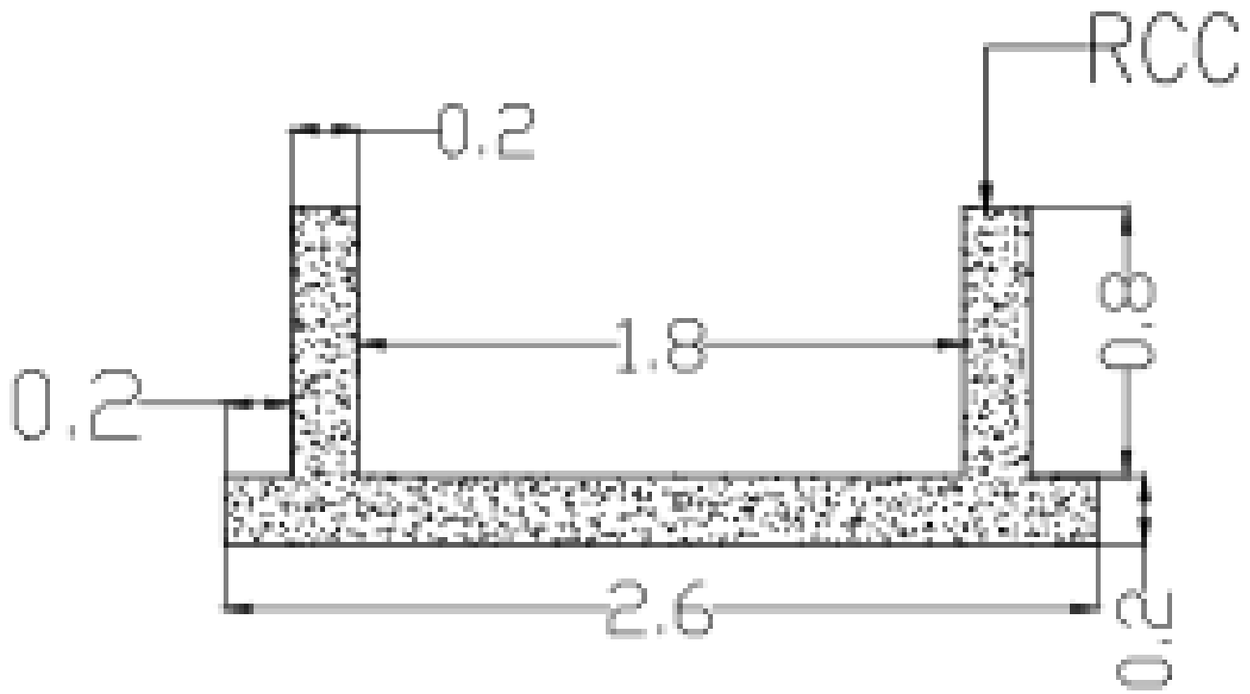
CLIENT:

National Highways & Infrastructure Development Corporation Ltd.

PROJECT NO. —
SCALE
SHEET SIZE A3
DRAWN
CHECKED BY
INITIAL
FINAL
APPROVED —
DATE 23.Nov.2018
DRAWING NO. NHIDCL/KM 72/01
SHEET No. 01/02
REV. 00
DRAWING STATUS: —

PROJECT: —
STRUCTURE: —
TITLE: UP HILL SLOPE PROTECTION AT Km 72

Typical Detail of proposed landslide protection scheme at 350m landslide zone at KM72



Typical cross section of the drain directed to the nearest culvert at KM72