SCHEDULES

SCHEDULE – A
(See Clause 8.1)

SITE OF THE PROJECT

1 The Site

1.1 Site of the Single/Intermediate/Two Project Highway shall include the structures and road works as described in Annex-I of this Schedule-A.

1.2 The alignment plans of the Project Highway are specified in Annex-II, where the restoration / rehabilitation work of project highway is contemplated.

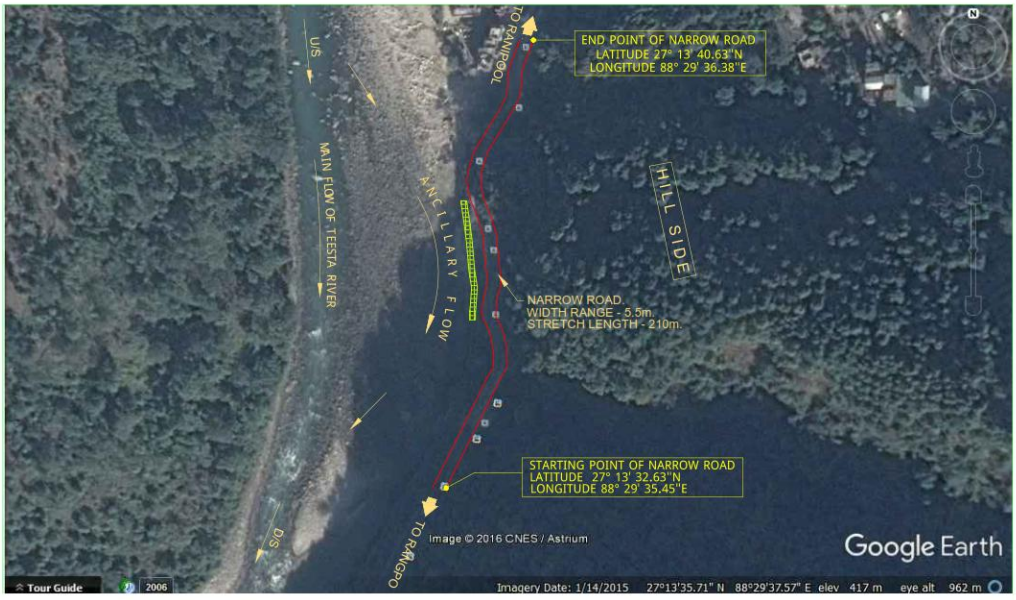
Annex-I
(Schedule-A)

SITE

1. Site

The Site for the Project Highway comprises of the below mentioned sections and alignment plans of National Highway 10 in between Rangpo to Ranipool in the State of Sikkim:

i) Narrow Zone at KM 54 for a stretch length of 250m
ii) Narrow Zone at KM 63 for a stretch length of 210m
iii) Landslide at KM 71 near Martam for a stretch length of 360m
iv) Landslide at KM 72 near Martam for a stretch length of 350m



ALIGNMENT PLAN OF NARROW ZONE AT KM 63

LEGENDS:-
EXISTING TOE WALL FOR SCOUR PROTECTION
ROAD

ALIGNMENT PLAN OF LANDSLIDE ZONE AT KM 71

LEGENDS:-
EXISTING BREAST WALL
ROAD

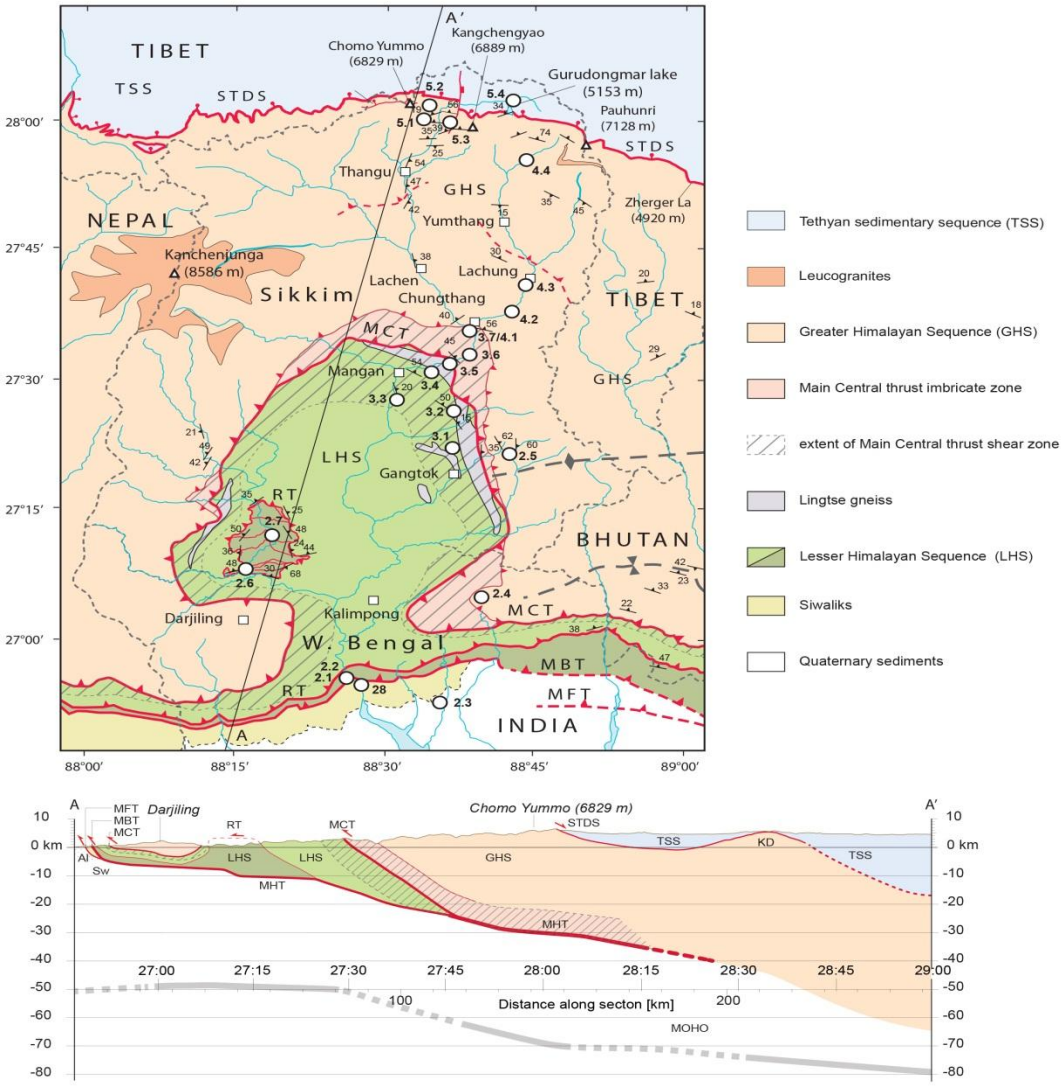
NOTES:-
1.) THIS SATELLITE IMAGE WAS CAPTURED ON JAN 2015, WHICH WAS BEFORE THE COMMENCEMENT OF LANDSLIDE.

2. General Geology

Due to the continuous uplifting of the younger Himalayan Mountain chain, this territory suffers greater instability. The earthquake of different magnitude leads to great disasters like landslides, rockfalls, changes of the course of river, etc. which causes severe problems to the infrastructure, economy and society. The soil in this region has been developed by both fluvial action and lithological disintegration.

Sikkim-Darjeeling Himalayas are Tectono-stratigraphically defined by four domains with characteristic stratigraphic and structural attributes. From south to north they are:

i. Foot hill belt
ii. Inner Belt
iii. Axial Belt and
iv. Trans-Axial Belt.



The state is mostly covered by Precambrian metamorphites of low to medium grade (Daling Group), high grade gneisses (Darjeeling Gneiss and Kanchendzonga Gneiss), Chungthang Formation (quartzite,calc-silicate rocks, marbles, graphite schists and occasionally amphibolites) with intrusive granites (Lingtse granite gneiss) and Phanerezoic rocks including Gondwana and Tethyan sedimentaries. The Paleozoic and Mesozoic (Tethyan) sequence in the northern and north-western part of Sikkim are fossileferous. The Gondwana super Group consists of sandstone, shale and carbonaceous shale with occasional thin bands of coal and pebbly shale horizon. Daling group of rocks can be classified into three formations:

a. Gorubathan Formation: characterized by quartz-chloride-sericite schists, phyllite and quartzite.

b. Reyang Formation: characterized by quartzite (occasionally calcareous), phyllite interbanded with carbonaceous slate.

c. Buxa Formation: characterized by presence of dolomitic limestone occasionally interbanded with phyllite and development of organo sedimentary structure (stromatolites).

The Kanchendzonga Gneiss comprises mainly high-grade gneiss The Chungthang gneiss is a quartzbiotite gneiss. A streaky sheared granite gneiss known as "Lingtse Gneiss" occur as a NE-SW to N-S trending strip of rocks and forms a general line of separation between the Daling and high grade Kanchendzonga Gneiss. The Tethyan sedimentaries, exposed in the northern part of Sikkim represent Everest Phyllite series (shale/phyllite), Mount Everest Limestone series, Lachi Formation (conglomerate with thick diamictite base) and Tso Lhamo Formation (calcareous shale, limestone band, calcareous sandstone).

The hills of Sikkim mainly consist of gneissose and half-schistose rocks, producing generally poor and shallow brown clay soils. The soil is coarse and ranges from neutral to acidic. This type of soil tends to support evergreen and deciduous forests. Most of East Sikkim is covered by Precambrian rock, which is much younger in age than the hills. The rock consists of phyllites and schists, and is highly susceptible to weathering and erosion. This combined with the state's heavy rainfall, causes extensive soil erosion and the loss of soil nutrients through leaching. As a result, landslides are frequent, often isolating rural towns and villages from the major urban centers.

3. A. Site Conditions and Site Description at KM 54:

The existing road at KM 54 which is nearly 2 KMs from Rangpo has narrow zone at a stretch length of 250m, not only have sharp bends but also have limited carriageway width thereby resisting traffic flow and causing economic impact. Due to this there are high chances of having major and/or fatal road accidents and therefore needs widening.

Picture – 1 (First 130 m stretch length of Narrow road zone at KM54)

Picture – 2 (First 130 m stretch length of Narrow road zone at KM54)

Picture – 3 (Long view of initial/first 130m Narrow road zone at KM54)

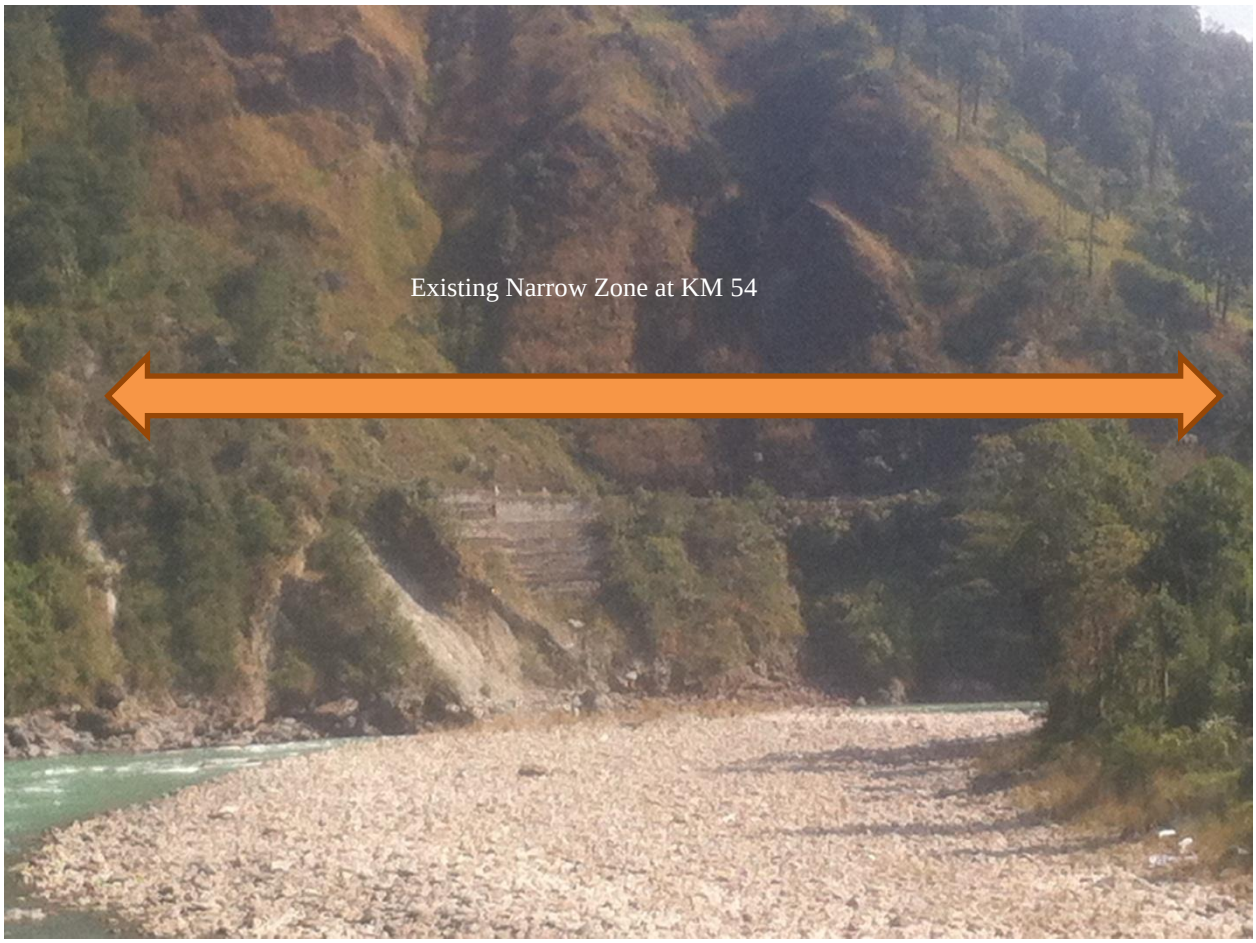
Picture – 4 (Balance 130 m stretch length of Narrow road zone at KM54)

Site Descriptions of Narrow Zone at KM54

- Being a National Highway No. 10, the road stretch at KM 54 is a narrow zone with a limited road width of 5.50m to 6m which doesn't suffice the minimum 2 lane road width criteria of IRC guideline.

- Due to narrow road width and having heavy vehicular movement, there's always a possibility of accident and therefore is a major safety risk.

- The valley slope comprises of slight to moderately weathered slaty to phyllitic rock with two distinctive joint sets. Due to surface runoff there are several surface weathering which can be observed from the edge of the road on the entire valley slope.



Picture – 5 (Long view of balance 130m Narrow road zone at KM54)

- To avoid this, the existing narrow road should be widened to meet 2 lane guideline of IRC.

- Due to the fragmented rocky strata and a steeper profile of the hill slope it is not advisable to cut the hill slope for widening. Moreover, any cutting in the hill slope will disturb the stability of slopes which makes it vulnerable.

- In valley slope great care has to be taken, as the existing valley slope is vulnerable due to surficial erosion followed by scouring of the toe because of river Teesta which is flowing at the toe of the valley slope.

Picture – 6 (Long view of balance 130m Narrow road zone at KM54)

- High velocity of river that varies from 2m/sec in non-monsoon period to 4m/sec during monsoon which exerts high pressure on the toe. River is having a sharp bend at the toe of the slope and exerts a huge pressure which leads to deep scouring at the base of the toe and also disintegrates the rocks into large boulders and soils. This reduces the stability of the slope.

- Heavy rainfall during monsoon that aggravates surface erosion.

3. B. Site Conditions and Site Description at KM 63:

The existing road at KM 63 has narrow zone at a stretch length of 210m that not only have sharp bends but also have limited carriageway width thereby restricting traffic flow and causing economic impact. Due to this there are high chances of having major and/or fatal road accidents and therefore needs immediate attention.

Picture – 1 (Narrow road zone at KM63)

Picture – 2 (Narrow road zone at KM63)

Site Descriptions of Narrow Zone at KM63

- Being a National Highway No. 10, the road stretch at KM 63 is a narrow zone with a limited road width of 5.50m to 6m at a stretch length of 210m which doesn't suffice the minimum 2 lane road width criteria of IRC guideline.

- Due to narrow road width and having heavy vehicular movement, there's always a possibility of accident that may happen at any time and therefore is a major safety risk.

- Hill Slope at KM 63 comprises of mostly weatheredslate and phyllite with few distinctive joint planes and thick vegetation.

Picture – 3 (Narrow road zone at KM63)

Picture – 4 (Narrow road zone at KM63)

- River Teesta is flowing at the valley which has intermediate channels from the main flow at various locations and those intermediate channels are flowing through the toe of the valley slope. These intermediate channels are eroding the valley toe.

- To avoid this, the existing narrow road should be widened to meet 2 lane guideline of IRC.

- High velocity of river that varies from 2m/sec in non-monsoon period to 4m/sec during monsoon which exerts high pressure on the toe. River is having discrete ancillary flow at several locations towards the toe that exerts huge pressure and leads to deep scouring at the base of the toe. This reduces the stability of the valley slope of the existing road.

Picture – 5 (Narrow road zone at KM63

- Heavy rainfall during monsoon that aggravates surface erosion.

3. C. Site Conditions and Site Description at KM 71:

The existing road at KM 71 near Martam has landslide zone at a stretch length of 360m. Due to this there are high chances of having major and/or fatal road accidents and therefore needs immediate attention.

Picture – 1 (Landslide zone at KM71)

Site Description at Km 71

- Being a National Highway No. 10, the 360m road stretch at KM 71 has periodic landslide resulting unsafe passage to commuters
- This also includes sliding of debris followwd by big boulder falls
- Being a high seismic zone and heavy rainfall can trigger landslides most of the time that is a major safety risk and can turn into a fatal accident if immediate preventive measures are not taken
- Total Stretch Length: 360m
- Average height: 25m

Picture – 2 (Landslide zone at KM71)

Picture – 3 (Landslide zone at KM71)

Picture – 1 (Landslide zone at KM71)

3. D. Site Conditions and Site Description at KM 72:

The existing road at KM 72 near Martam has landslide zone at a stretch length of 350m. Due to this there are high chances of having major and/or fatal road accidents and therefore needs immediate attention.

Picture – 1 (Landslide zone at KM72)

Site Description at Km72

- Being a National Highway No. 10, the 350m road stretch at KM 72 has periodic landslide resulting unsafe passage to commuters
- This also includes sliding of debris followwd by big boulder falls
- Being a high seismic zone and heavy rainfall can trigger landslides most of the time that is a major safety risk and can turn into a fatal accident if immediate preventive measures are not taken
- Total Stretch Length: 350m
- Average height: 20m

Picture 2 (Landslide Zone at KM 72)

Picture 3 (Landslide Zone at KM 72)

5. CARRIAGEWAY

The present carriageway of the Project location at Km 54 and Km 63 is narrow in width. The width is varying between 5m to 6m in few locations as mentioned in the alignment plan. Widening as shown in cross section is required.

The present carriageway width of the Project location at Km 71 and Km 72 is adequate and no widening is required.

Annex - II
(Schedule - A)

Dates for providing Right of Way

The dates on which the Authority shall provide Right of Way to the Contractor on different stretches of the Site are stated below: To be filled by NHIDCL

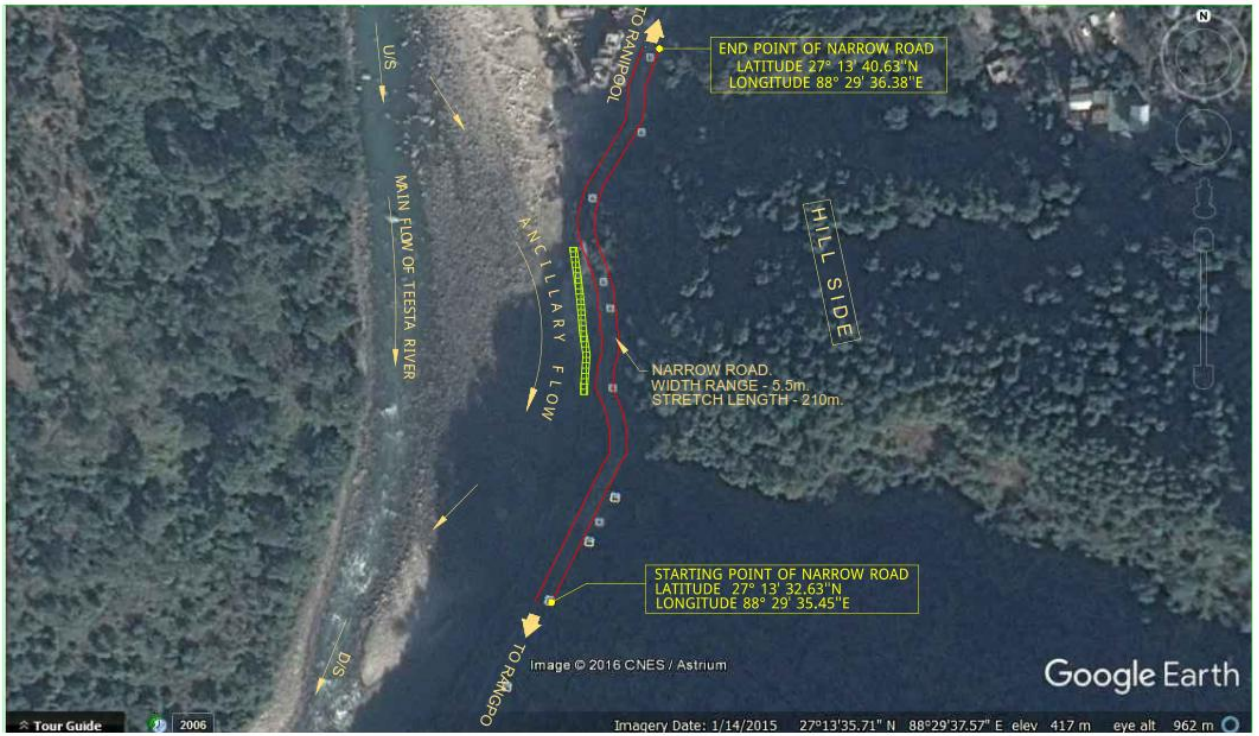
S. No	Location	Length	Total ROW Width (m)	Date of Providing ROW*
1	Km 54	250	24	Appointed Date
2	Km 63	210	24	Appointed Date
3	Km 71	360	24	Appointed Date
4	Km 72	350	24	Appointed Date

* 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 of the Project Highway is provided in the form of GPS map as under;

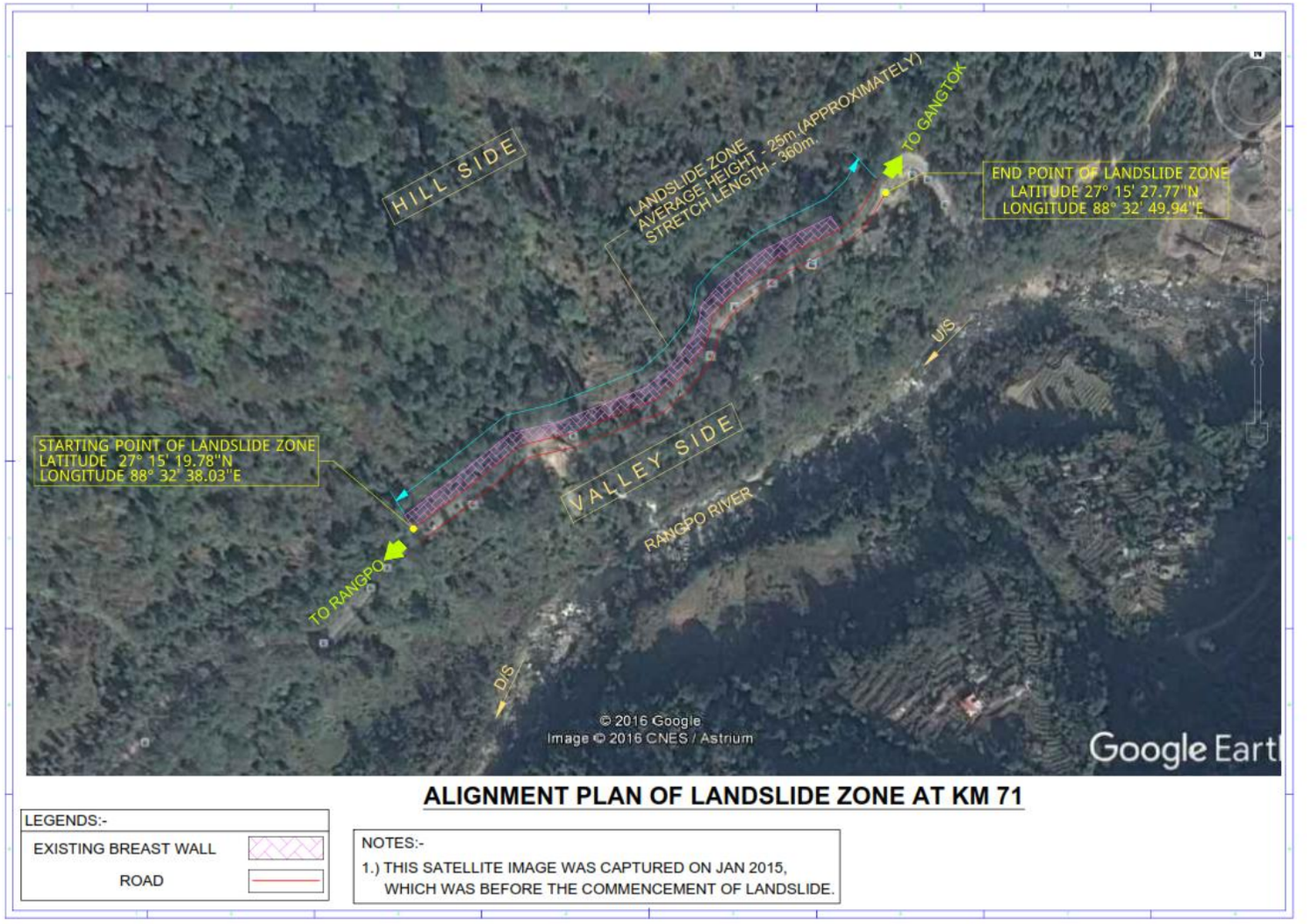


ALIGNMENT PLAN OF NARROW ZONE AT KM 63

LEGENDS:-

EXISTING TOE WALL FOR SCOUR PROTECTION

ROAD



ALIGNMENT PLAN OF LANDSLIDE ZONE AT KM 71

LEGENDS:-	
EXISTING BREAST WALL	
ROAD	

NOTES:-

1.) THIS SATELLITE IMAGE WAS CAPTURED ON JAN 2015, WHICH WAS BEFORE THE COMMENCEMENT OF LANDSLIDE.


HILL SIDE
LANDSLIDE ZONE
AVERAGE HEIGHT - 20m.(APPROXIMATELY)
STRETCH LENGTH - 350m.
TO SANGTOK
END POINT OF LANDSLIDE ZONE
LATITUDE 27° 15' 37.50"N
LONGITUDE 88° 33' 05.84"E
U/S
VALLEY SIDE
RANGPO RIVER
STARTING POINT OF LANDSLIDE ZONE
LATITUDE 27° 15' 28.45"N
LONGITUDE 88° 32' 55.63"E
TO RANGPO
D/S
© 2016 Google
Image © 2016 CNES / Astrium
Google Eart
ALIGNMENT PLAN OF LANDSLIDE ZONE AT KM 72
LEGENDS:-
ROAD
NOTES:-
1.) THIS SATELLITE IMAGE WAS CAPTURED ON JAN 2015,
WHICH WAS BEFORE THE COMMENCEMENT OF LANDSLIDE.

Annex - IV
(Schedule-A)
Environment Clearances

To be filled by the Environment Consultant Appointed by NHIDCL.

SCHEDULE - B
(See Clause 2.1)

DEVELOPMENT OF THE PROJECT HIGHWAY

1 **Development of the Project Highway**

Development of the Project Highway shall include:

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

- Design and construction of the Project Highway for proposed widening at the 210m 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.

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

- Design and construction of the Project Highway for landslide protection at 350m 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 AT KM54

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 Type of Shoulders

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

2.5 Typical Cross-sections of the Project Highway

The typical cross sections should be developed as per Drawing Number NHIDCL/KM71/01 (02 sheets) as included in Annexure - A of this schedule.

3 ROAD EMBANKMENT FOR PROPOSED WIDENING

3.1 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)	Recommendations
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 having yield strength of 670 MPa and UTS of 800 MPa hot dip galvanized (conforming to IS 4759:1996) to minimum thickness of 70 micron. • 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 having minimum bar diameter of 8mm and minimum galvanization thickness of 86 microns. • Soil reinforcing element: Geosynthetic Strips with lateral grooves on both side • Maximum Vertical spacing of soil reinforcement: 0.6m • 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. Average thickness shall be 200mm, grade M25. ➢ 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.

Stretch	Maximum Height of Valley Slope to be widened (m)	Top width of Finished Road (m)	Recommendations
Km 54 (Stretch 2: Length 130m)	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 having yield strength of 670 MPa and UTS of 800 MPa hot dip galvanized (conforming to IS 4759:1996) to minimum thickness of 70 micron. • 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 having minimum bar diameter of 8mm and minimum galvanization thickness of 86 microns. • Soil reinforcing element : Geosynthetic Strips with lateral grooves on both side • Maximum vertical spacing of soil reinforcement: 0.6m • 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 ➢ 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 proposed restoration scheme is presented in Drawing number NHIDCL/KM54/01 (02 sheets) in Annexure - A of Schedule B.

3.2 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 PAVEMENT DESIGN

4.1 Pavement layers shall be constructed in accordance with the thickness provided below table.

4.2 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 ROADSIDE DRAINAGE

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

6 TRAFFIC CONTROL DEVICES AND ROAD SAFETY WORKS

Traffic control devices and road safety works including specifications of the reflective sheeting shall be provided in accordance with IRC guideline.

7 ROADSIDE FURNITURE

Roadside furniture shall be provided in accordance with IRC guidelines.

B. DESCRIPTION OF PROPOSED WIDENING WORKS AT KM63

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-II 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 Type of Shoulders

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

2.5 Typical Cross-sections of the Project Highway

The typical cross sections should be developed as per Drawing Number NHIDCL/KM63/01 (02 sheets) as included in Annexure - A of this schedule.

3 ROAD EMBANKMENT FOR PROPOSED WIDENING

3.1 The proposed widening of the 210m stretch length of road at KM63 narrow zones shall comprises of following minimum components:

Stretch	Height of Valley Slope to be widened (m)	Top width of Finished Road (m)	Recommendations
Km 63	20	12	➢ 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 having yield strength of 670 MPa and UTS of 800 MPa hot dip galvanized (conforming to IS 4759:1996) to minimum thickness of 70 micron. • Length of Nail : 8m minimum • Diameter of Nail : 22mm 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 having minimum bar diameter of 8mm and minimum galvanization thickness of 86 microns. • 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

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

3.2 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 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 PAVEMENT DESIGN

4.1 Pavement layers shall be constructed in accordance with the thickness provided in Drawing.

4.2 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 ROADSIDE DRAINAGE

Drainage system including surface and subsurface drains shall be provided as per proposed

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

6 TRAFFIC CONTROL DEVICES AND ROAD SAFETY WORKS

Traffic control devices and road safety works including specifications of the reflective sheeting shall be provided in accordance with IRC guideline.

7 ROADSIDE FURNITURE

Roadside furniture shall be provided in accordance with IRC guidelines.

C. DESCRIPTION OF PROPOSED LANDSLIDE PROTECTION WORKS AT KM 71

1) TYPICAL CROSS-SECTIONS OF THE LANDSLIDE ZONE

The typical cross sections should be developed as per Drawing Number NHIDCL/KM71/01 (02 sheets) as included in Annexure - A of this schedule.

2) PROPOSED LANDSLIDE PROTECTION WORKS

2.1 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)	Recommendations
Km 71	25	12	➢ Traffic Signages and Temporary barricading ➢ Excavation and Surface Preparation ➢ Fixing High strength steel wire mesh ➢ Strength of Wire : 1770 MPa as per EN 10204 – 2.2 • Tensile resistance of wire : 12.5 kN • Wire diameter: 3mm • Ends : Knotted • Mesh Width : 65mm • Tensile strength of mesh : Zm≥ 150 kN/m • Bearing resistance against puncturing: $D_R \geq 180$ kN • Bearing resistance against shearing-off: $P_R \geq 90$ kN • Bearing resistance against slope parallel tensile stress: $Z_R \geq 30$ kN ➢ Soil Nailing on the existing hill slope considering the following: • Nail : Fully threaded solid bar of 670/800 grade steel having yield strength of 670 MPa and UTS of 800 MPa hot dip galvanized (conforming to IS 4759:1996) to minimum thickness of 70 micron. • 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 proposed restoration scheme is presented in Drawing number NHIDCL/KM71/01 (02 sheets) in Annexure - A of Schedule B.

3.2 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 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.

D. DESCRIPTION OF PROPOSED LANDSLIDE PROTECTION WORKS AT KM72

1 Typical Cross-sections of the Landslide Zone

The typical cross sections should be developed as per Drawing Number NHIDCL/KM72/01 (02 sheets) as included in Annexure - A of this schedule.

2 Proposed Landslide Protection Works

2.1 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)	Recommendations
Km 72	20	12	➢ Traffic Signages and Temporary barricading ➢ Excavation and Surface Preparation ➢ Fixing High strength steel wire mesh as per EN 10204 – 2.2 • Strength of Wire : 1770 MPa • Tensile resistance of wire : 12.5 kN • Wire diameter : 3mm • Ends : Knotted • Mesh Width : 65mm • Tensile strength of mesh : Zm≥ 150 kN/m • Bearing resistance against puncturing: $D_R \geq 180$ kN • Bearing resistance against shearing-off: $P_R \geq 90$ kN • Bearing resistance against slope parallel tensile stress : $Z_R \geq 30$ kN ➢ Soil Nailing on the existing hill slope considering the following: • Nail : Fully threaded solid bar of 670/800 grade steel having yield strength of 670 MPa and UTS of 800 MPa hot dip galvanized (conforming to IS 4759:1996) to minimum thickness of 70 micron. • 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 proposed restoration scheme is presented in Drawing number NHIDCL/KM72/01 (02 sheets) in Annexure - A of Schedule B.

3.2 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.

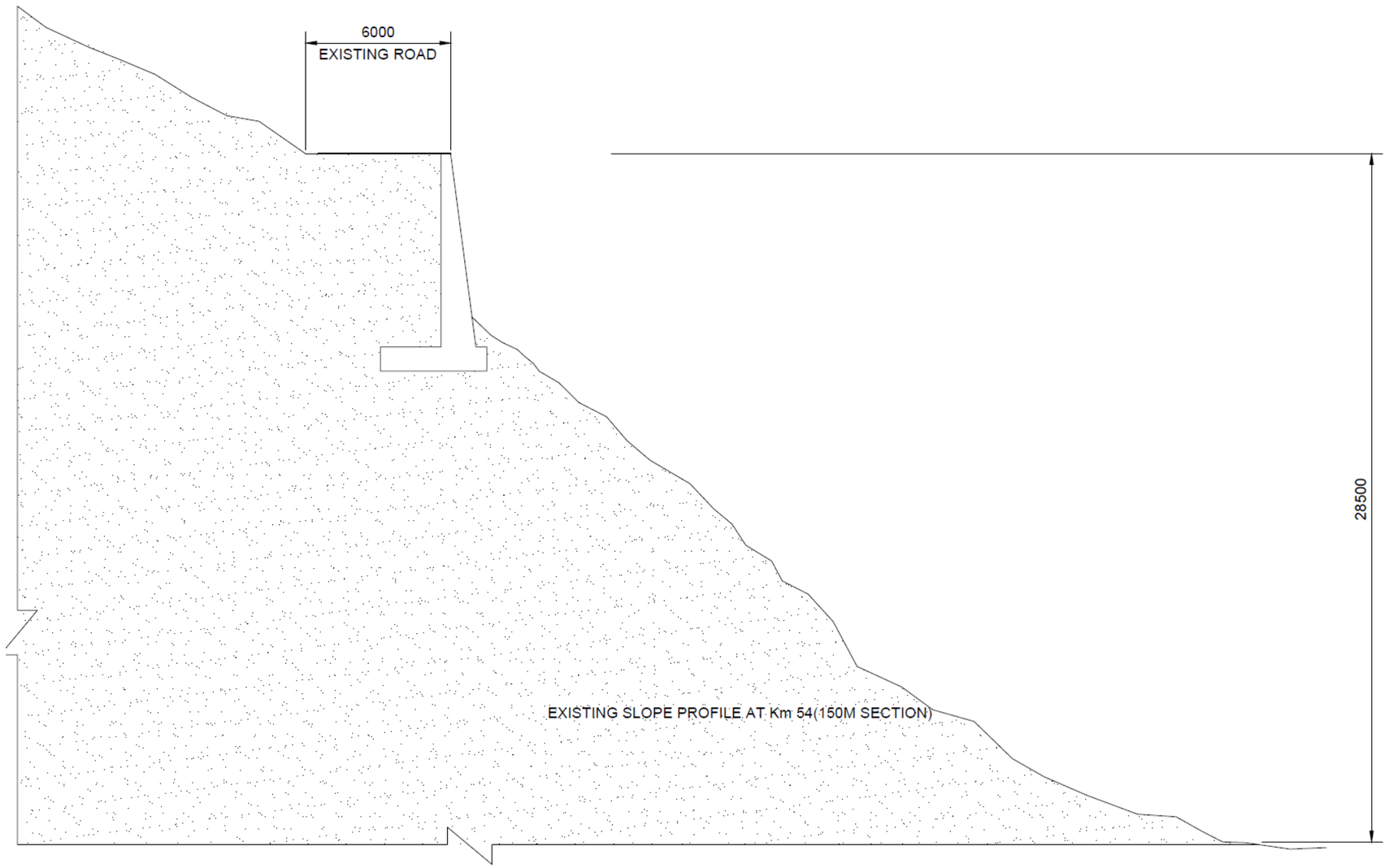
- GEOPHYSICAL INVESTIGATION to know the natural formation and its weak plane / zones in valley slope in addition to the GEOTECHNICAL INVESTIGATION by conducting adequate numbers of boreholes of depth around 30m or termination depth at 1.5m inside hard rock whichever is less by positioning the boreholes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

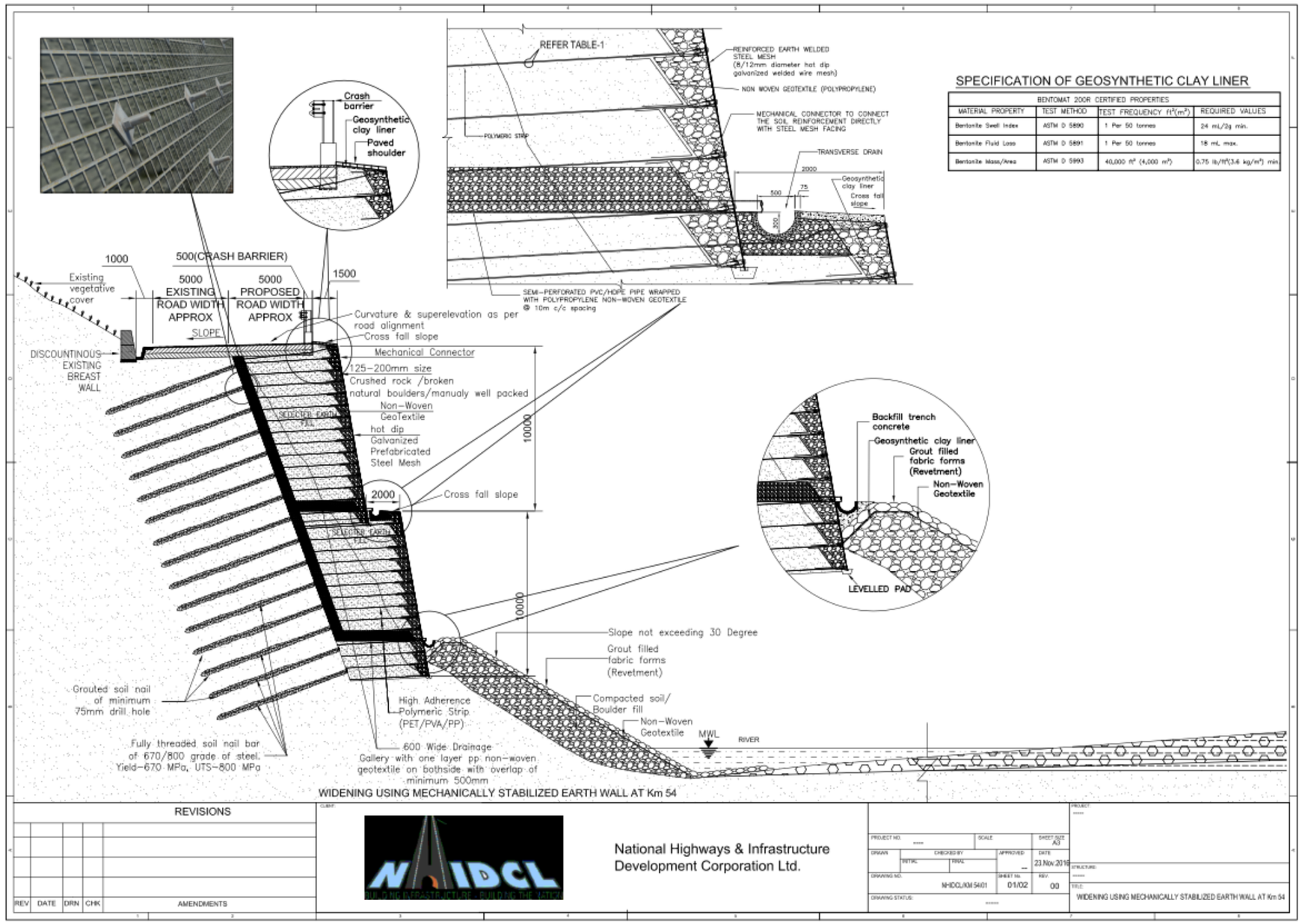
- MAPPING of any kind of crack, fault etc. generated in the entire affected area and its influence zone (beyond the affected zone).

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

Annexure-A
(Schedule B)



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



SPECIFICATION OF GEOSYNTHETIC CLAY LINER

BENTOMAT 200R CERTIFIED PROPERTIES			
MATERIAL PROPERTY	TEST METHOD	TEST FREQUENCY ft²(m²)	REQUIRED VALUES
Bentonite Swell Index	ASTM D 5890	1 Per 50 tonnes	24 mL/2g min.
Bentonite Fluid Loss	ASTM D 5891	1 Per 50 tonnes	18 mL max.
Bentonite Mass/Area	ASTM D 5993	40,000 ft² (4,000 m²)	0.75 lb/ft²(3.6 kg/m²) min

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 POLYMERIC STRIP OF 50MM WIDE WITH LATERAL GROOVE ON BOTH SIDE OF THE STRAP 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).

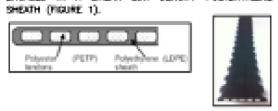
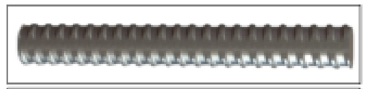


FIGURE1:POLYMERIC STRIPS TYPICAL CROSS SECTION,PROCESSED BY CO-EXTRUSION

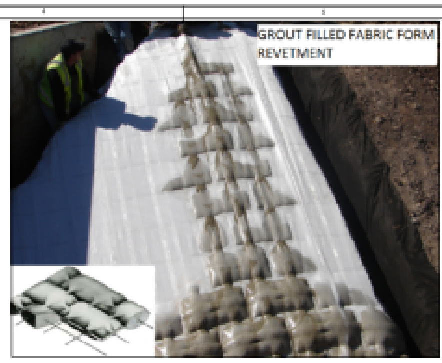
HA POLYMERIC STRIP REINFORCEMENT SPECIFICATION

Properties	Test Method	Unit	Minimum average roll value				
Ultimate Tensile Strength	ASTM D6637	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)	Yied 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)	AS D 5261	g/m²	500
Thickness	AS D 5199	Mm	0.40
Mill Width		M	2.13
MECHANICAL PROPERTIES [1,2]			
Wide-Width Strip Tensile Strength	AS D 4595		
Machine Direction		kN/m	50
Cross Machine Direction		kN/m	60
Elongation at Break	AS D 4595		
Machine Direction		%	8
Cross Machine Direction		%	8
Grab Tensile Strength	AS D 4632		
Machine Direction		N	1395
Cross Machine Direction		N	1395
Elongation at Break	AS D 4632		
Machine Direction		%	25
Cross Machine Direction		%	20
Trapezoidal Tear Strength	AS D 4533		
Machine Direction		N	460
Cross Machine Direction		N	600
CBR Puncture Strength	AS D 6241	N	5450
Mullen Burst Strength	AS D 3786 (Mod.)	kg/cm²	40
HYDRAULIC PROPERTIES [1,2]			
Apparent Opening Size (AOS)	AS D 4751	mm	0.30-0.80
Permittivity	AS D 4491	sec⁻¹	0.40-0.55
Flow Rate	AS D 4491	l/min/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 60Kpa 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 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 STRAP) IS SHOWN IN TABLE NO-01.
13. THE SOIL REINFORCEMENT USED FOR MECHANICALLY STABILIZED REINFORCED EARTH WALL SHALL BE CONNECTED MECHANICALLY WITH THE GROUTED NAIL AND MESH DIRECTLY USING POSITIVE CONNECTION .
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.

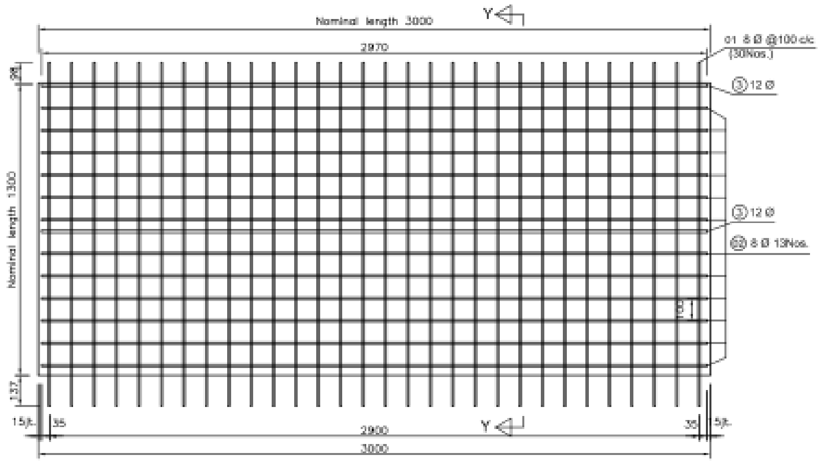
EROSION CONTROL- COIR NON-WOVEN GEOTEXTILE.

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.

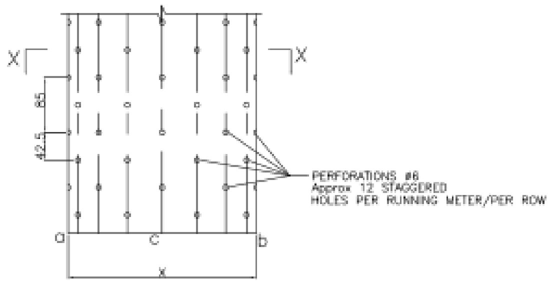
FACING

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.

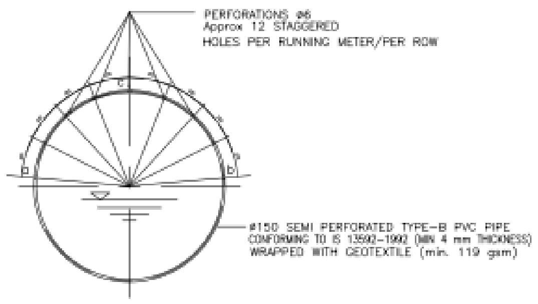
S.No.	Testing Parameters	Acceptable Limits	Frequency	**Responsibility	Code Applicable for Testing
Full Threaded Nail Bar					
A	Ultimate Tensile Strength	800MPa (Minimum)	One Test for 10000 sqm of Hybrid Wall face area Two Test for More Than10000 sqm but Less Than 50000 sqm of Hybrid Wall face area Four Test for More than 50000 sqm of Hybrid Wall	Contractor's Scope	EN 10204 or IS 1608
B	Yeild Strength	670 Mpa (Minimum)			
C	Elongation	7%			
D	Galvanization	500 gm/sqm			BS 729



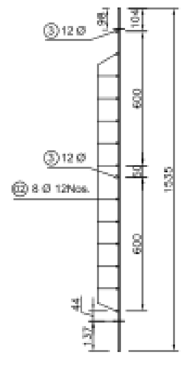
TYPICAL ELEVATION DETAIL OF REINFORCED EARTH STEEL MESH



TOP PLAN AT SEMI PERFORATED PIPE



SECTION X-X



SECTION Y-Y

REV	DATE	DRN	CHK	AMENDMENTS

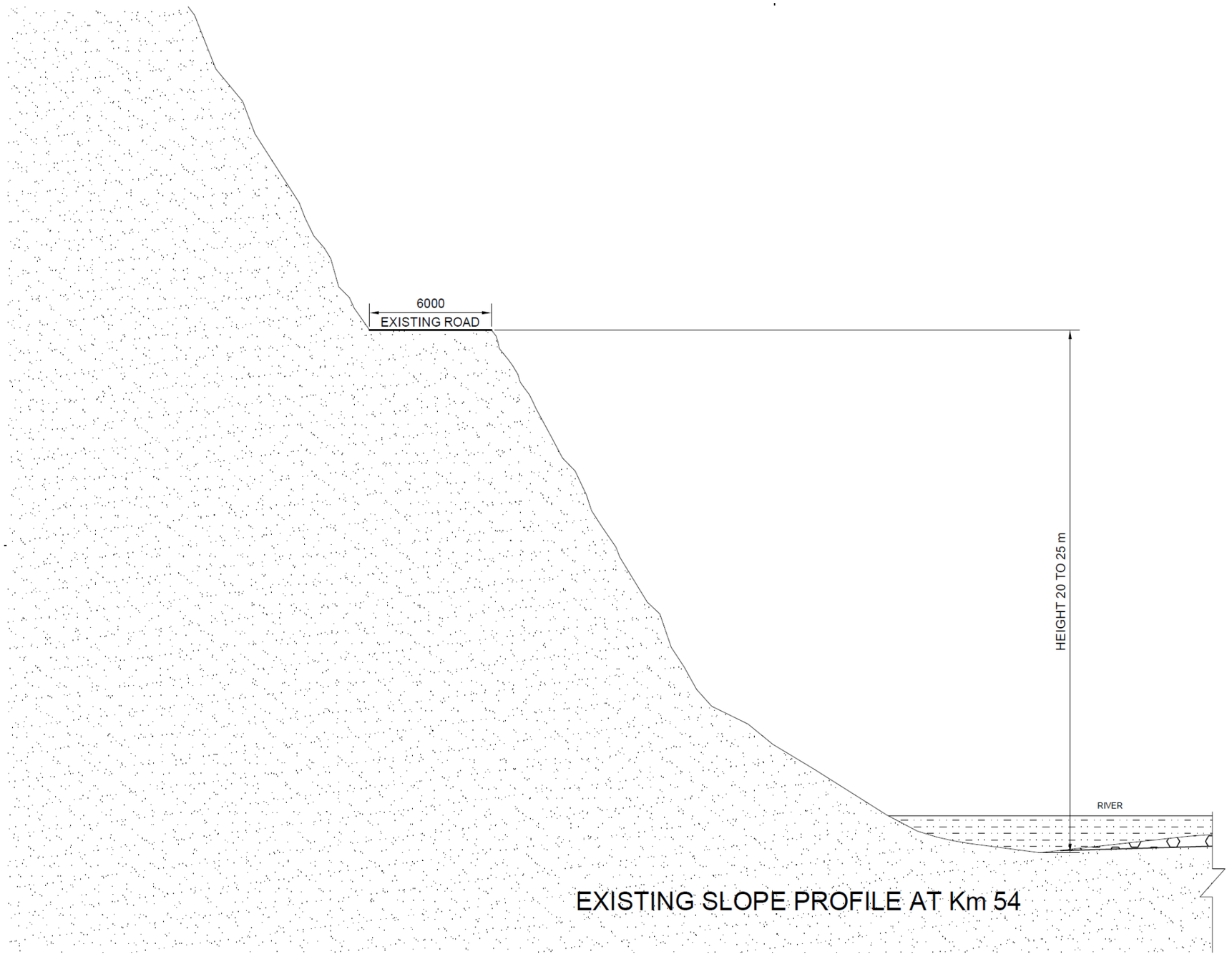
REVISIONS

National Highways & Infrastructure Development Corporation Ltd.

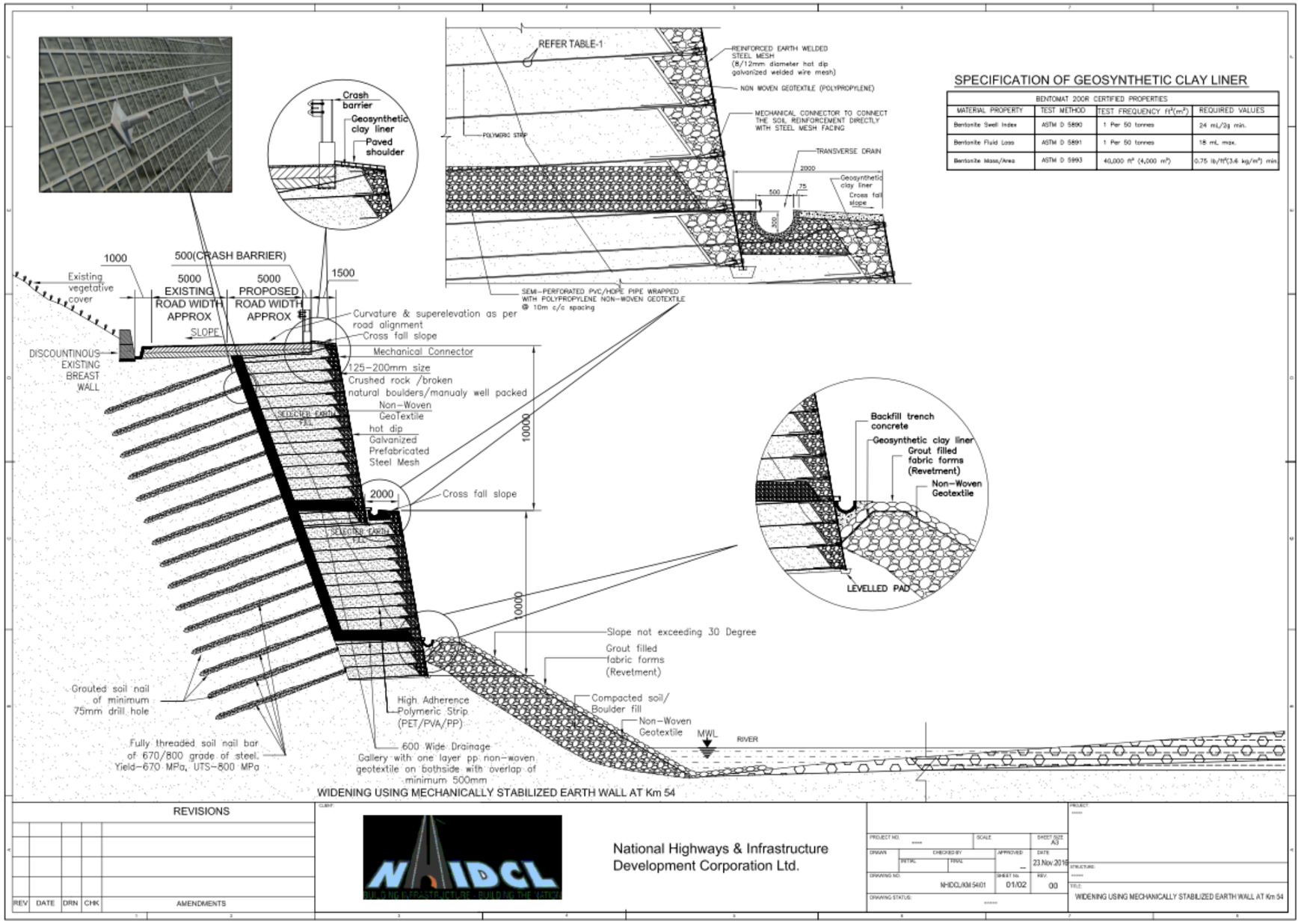
DRAWING NO. NHIDCL/KM 54/01 | SHEET No. 02/02 | REV. 00 | SHEET SIZE A3 | DATE 23 Nov 2016

TITLE: WIDENING USING MECHANICALLY STABILIZED EARTH WALL AT Km 54

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



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



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

SOIL REINFORCEMENT (TABLE-1)

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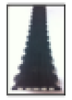

FIGURE1:POLYMERIC STRIPS TYPICAL CROSS SECTION,PROCESSED BY CO-EXTRUSION

HA POLYMERIC STRIP REINFORCEMENT SPECIFICATION

Properties	Test Method	Unit	Minimum average roll value				
Ultimate Tensile Strength	ASTM D6637	kN	20	25	37.5	50	65
Width		mm	49	49	49	49	49
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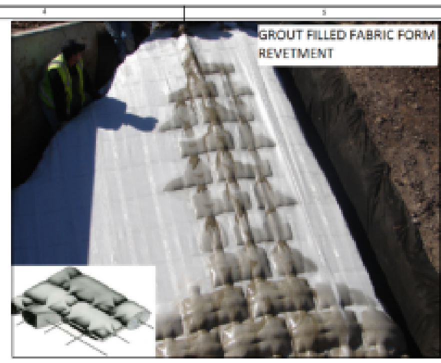

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Cross Machine Direction		kN/m	60
Elongation at Break	AS D 4595		
Machine Direction		%	8
Cross Machine Direction		%	8
Grab Tensile Strength	AS D 4632		
Machine Direction		N	1395
Cross Machine Direction		N	1395
Elongation at Break	AS D 4632		
Machine Direction		%	25
Cross Machine Direction		%	20
Trapezoidal Tear Strength	AS D 4533		
Machine Direction		N	460
Cross Machine Direction		N	600
CBR Puncture Strength	AS D 6241	N	5450
Mullen Burst Strength	AS D 3786 (Mod.)	kg/cm^2	40
HYDRAULIC PROPERTIES [1,2]			
Apparent Opening Size (AOS)	AS D 4751	mm	0.30-0.80
Permittivity	AS D 4491	sec^{-1}	0.40-0.55
Flow Rate	AS D 4491	$l/min/m^2$	1200-1625

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1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METER UNLESS OTHERWISE STATED.
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13. THE SOIL REINFORCEMENT USED FOR MECHANICALLY STABILIZED REINFORCED EARTH WALL SHALL BE CONNECTED MECHANICALLY WITH THE GROUTED NAIL AND MESH DIRECTLY USING POSITIVE CONNECTION .
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)
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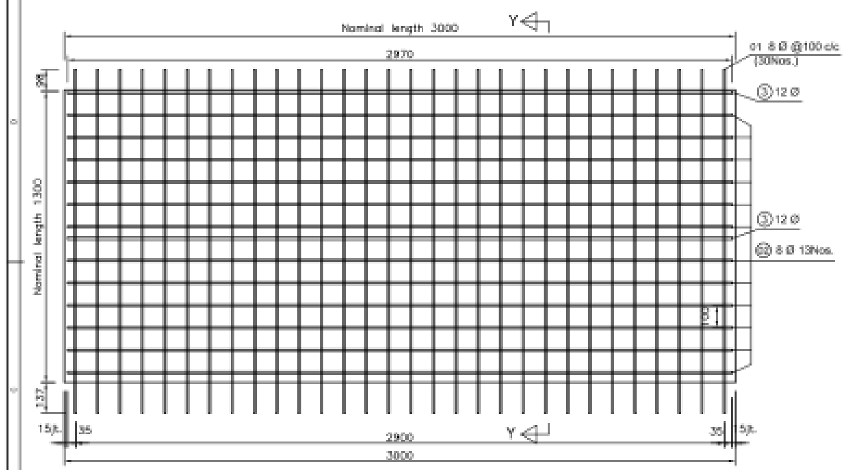
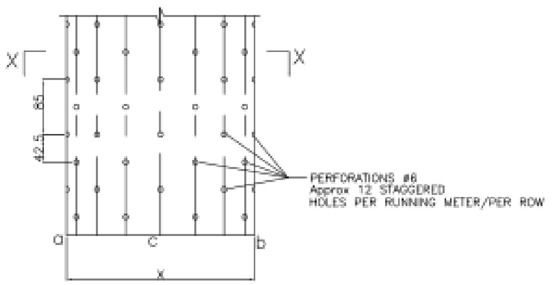
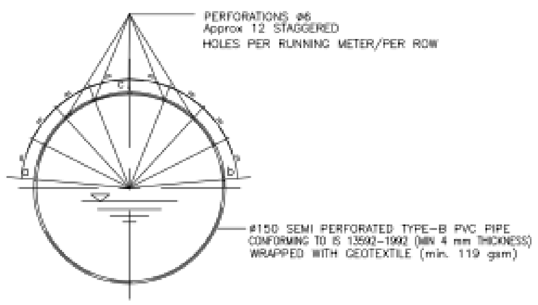
S.No.	Testing Parameters	Acceptable Limits	Frequency	**Responsibility	Code Applicable for Testing
Full Threaded Nail Bar					
A	Ultimate Tensile Strength	800MPa (Minimum)	One Test for 10000 sqm of Hybrid Wall face area Two Test for More Than10000 sqm but Less Than 50000 sqm of Hybrid Wall face area Four Test for More than 50000 sqm of Hybrid Wall	Contractor's Scope	EN 10204 or IS 1608
B	Yeild Strength	670 Mpa (Minimum)			
C	Elongation	7%			
D	Galvanization	500 gm/sqm			BS 729



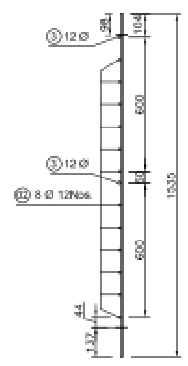
TYPICAL ELEVATION DETAIL OF REINFORCED EARTH STEEL MESH



TOP PLAN AT SEMI PERFORATED PIPE



SECTION X-X



SECTION Y-Y

REVISIONS				
REV	DATE	DRN	CHK	AMENDMENTS

National Highways & Infrastructure Development Corporation Ltd.

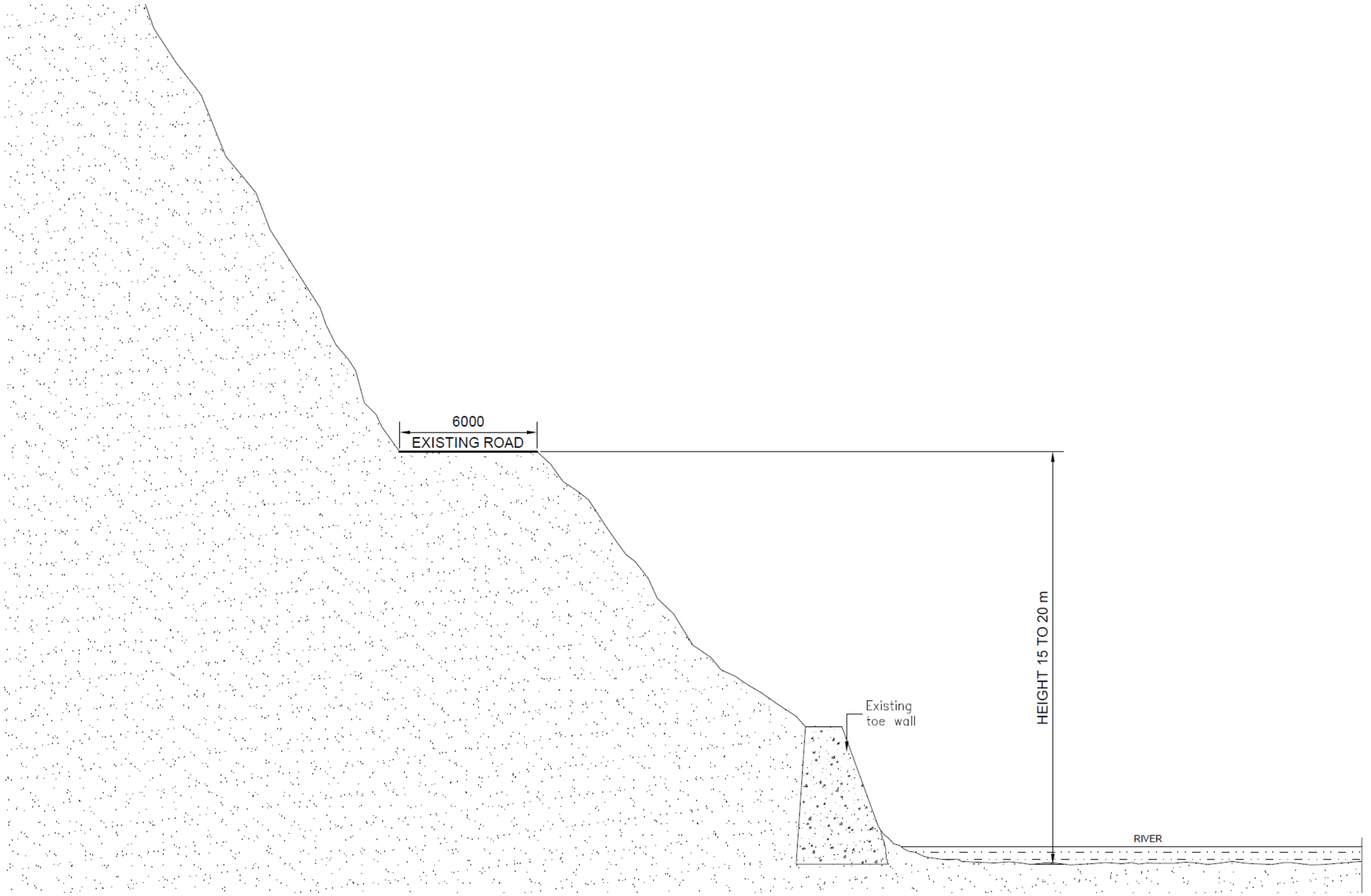
PROJECT NO. ----	SCALE	SHEET SIZE A3
DRAWN / CHECKED BY (INITIAL, FINAL)	APPROVED –	DATE 23.Nov.2016
DRAWING NO. NHIDCL/KM 54/01	SHEET No. 02/02	REV. 00
DRAWING STATUS: -----		

PROJECT: -----

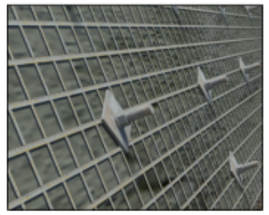
STRUCTURE: ------

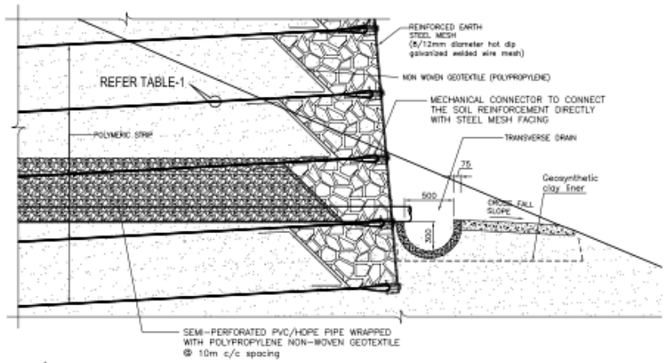
TITLE: WIDENING USING MECHANICALLY STABILIZED EARTH WALL AT Km 54

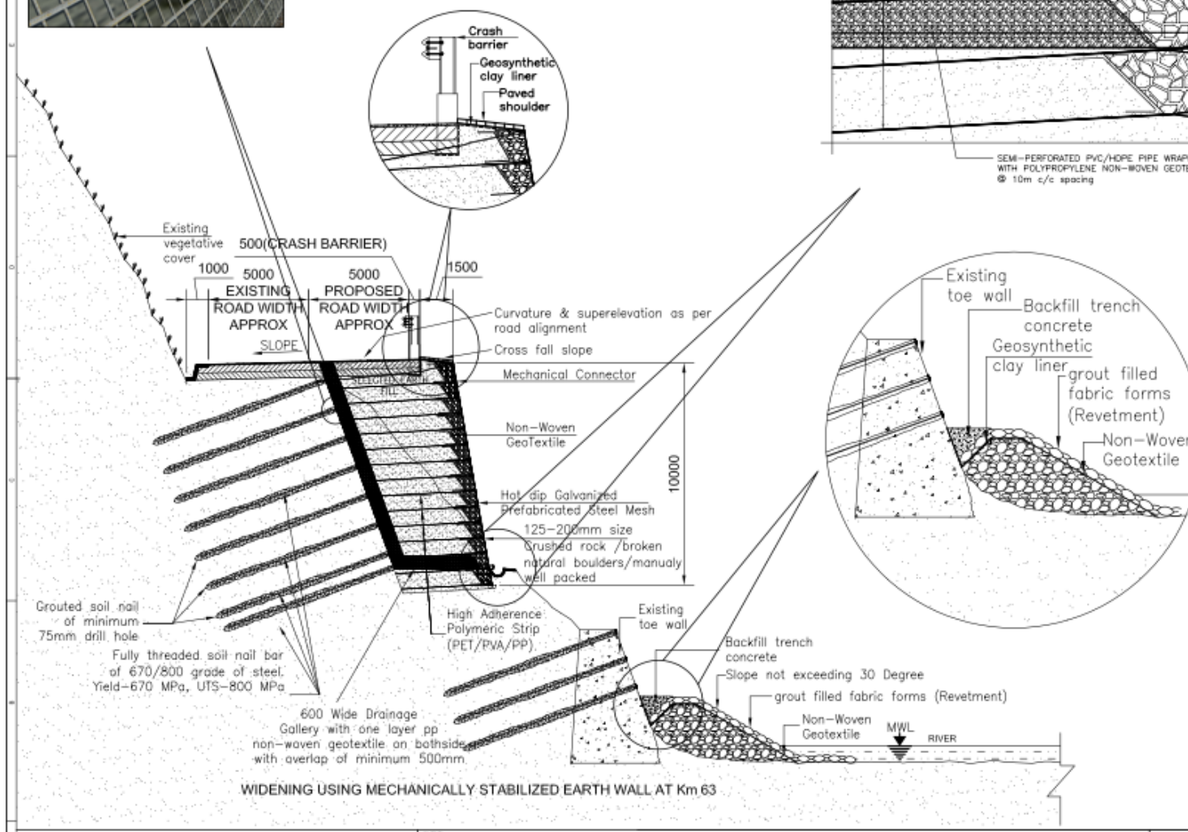
Detail of proposed widening scheme at balance 130m of narrow zone at KM54



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







SPECIFICATION OF GEOSYNTHETIC CLAY LINER

BENTOMAT 200R CERTIFIED PROPERTIES			
MATERIAL PROPERTY	TEST METHOD	TEST FREQUENCY ft²(m²)	REQUIRED VALUES
Bentonite Swell Index	ASTM D 5890	1 Per 50 tonnes	24 mL/2g min.
Bentonite Fluid Loss	ASTM D 5891	1 Per 50 tonnes	18 mL max.
Bentonite Mass/Area	ASTM D 5993	40,000 ft² (4,000 m²)	0.75 lb/ft²(3.6 kg/m²) min.

WIDENING USING MECHANICALLY STABILIZED EARTH WALL AT Km 63

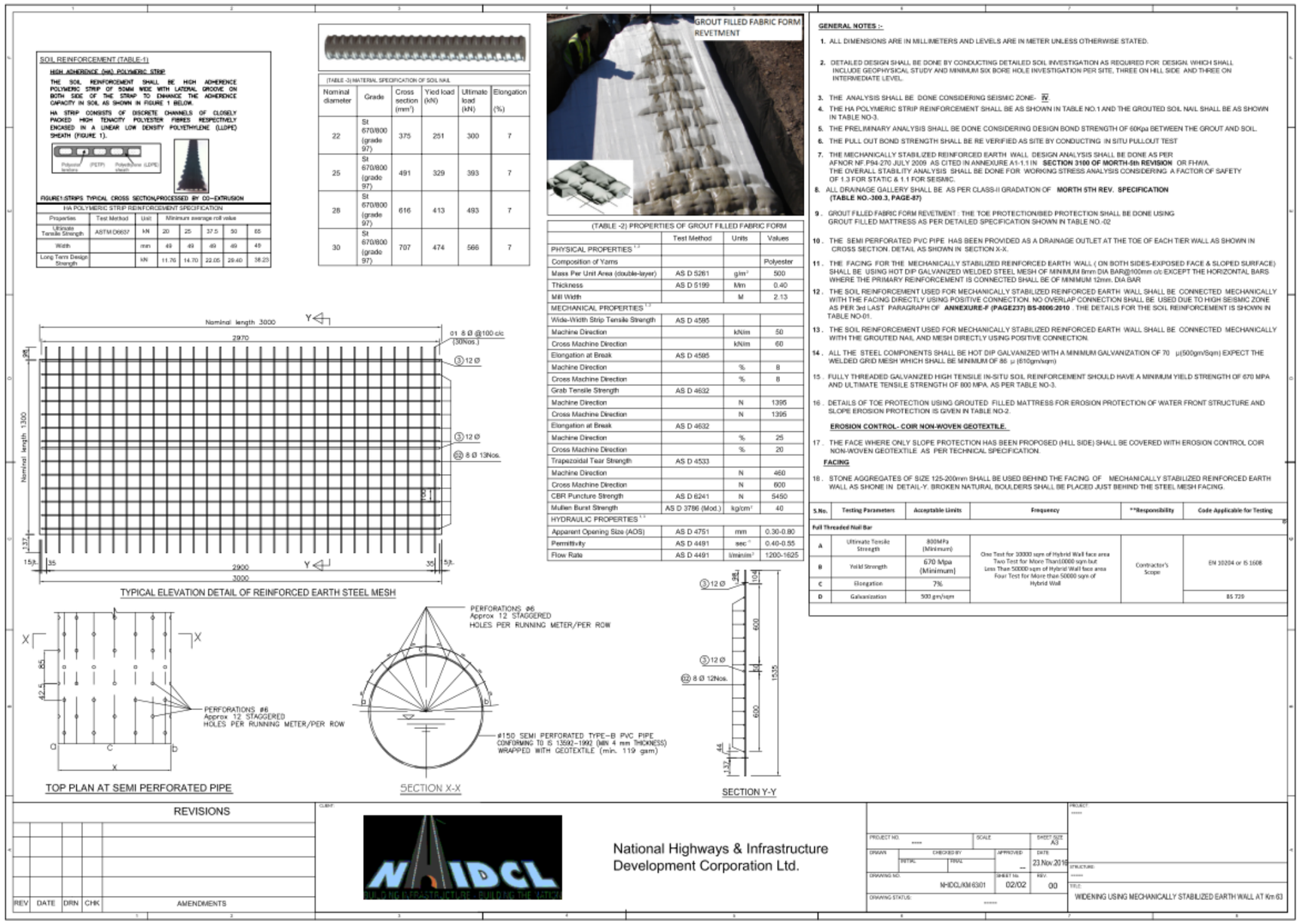
REVISIONS

REV	DATE	DRN	CHK	AMENDMENTS

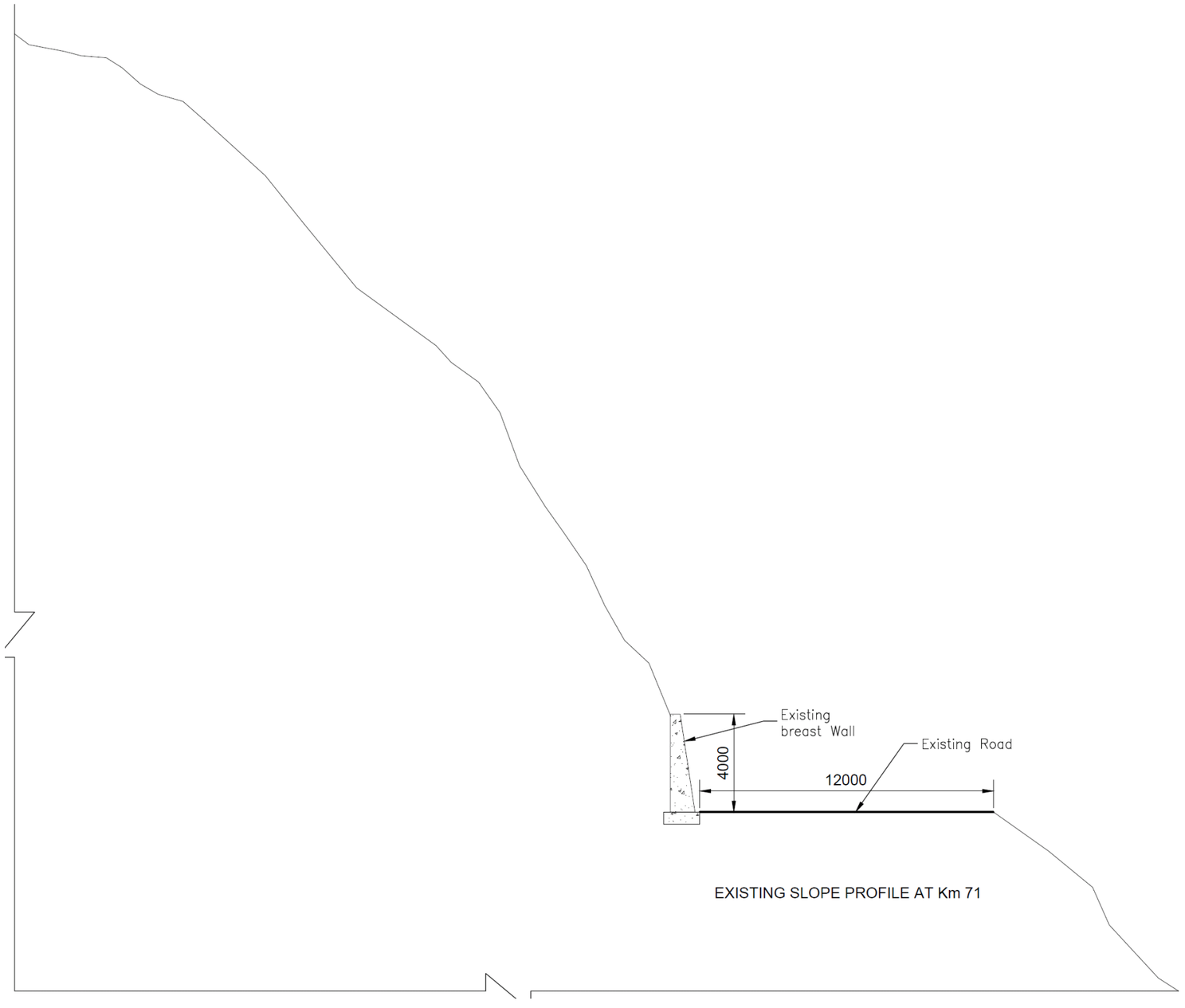
National Highways & Infrastructure Development Corporation Ltd.

PROJECT NO.: ---- | SCALE: | SHEET SIZE: A3
DRAWN | CHECKED BY: INITIAL / FINAL | APPROVED | DATE: 23 Nov 2018
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

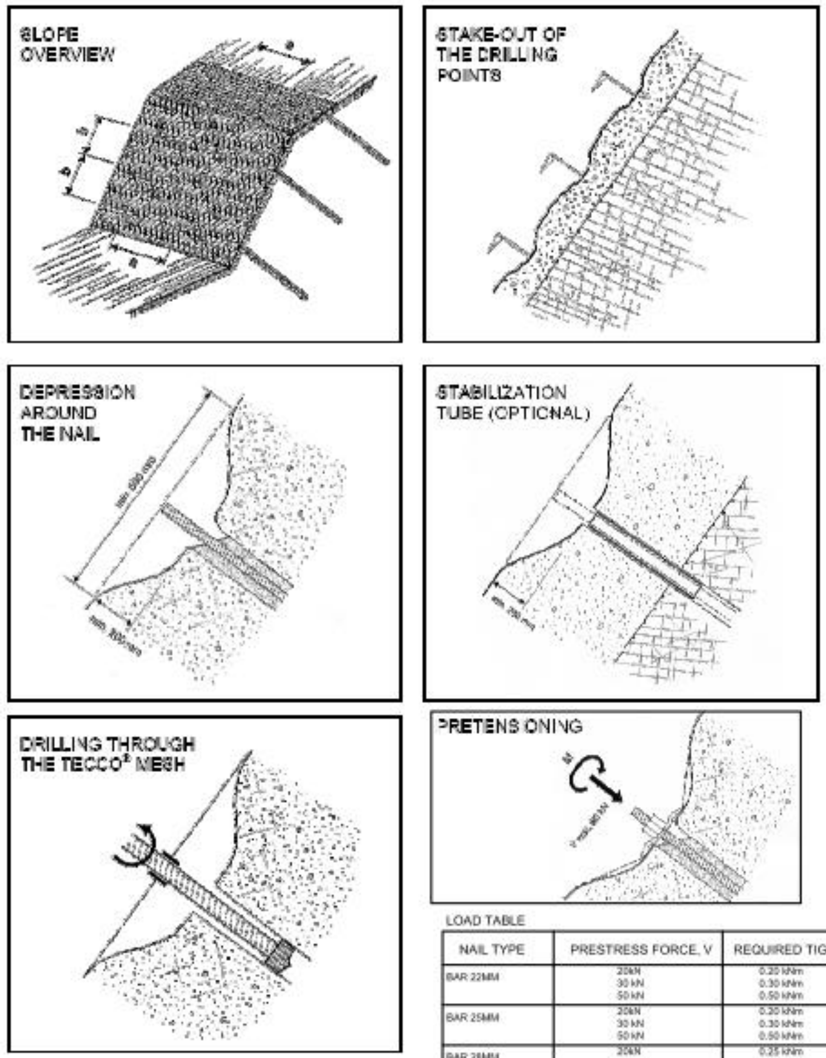


Typical Detail of proposed widening scheme at 210m of narrow zone at KM63



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 :-

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 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 Than10000 sqm but Less Than 50000 sqm of slope face protection Four Test for More than 50000 sqm of slope face protection	Contractor's Scope	EN 10204 or IS 1608
B	Yeild Strength	670 Mpa (Minimum)			
C	Elongation	7%			
D	Galvanization	500 gm/sqm			BS 729

Table number-02

System: High tensile 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

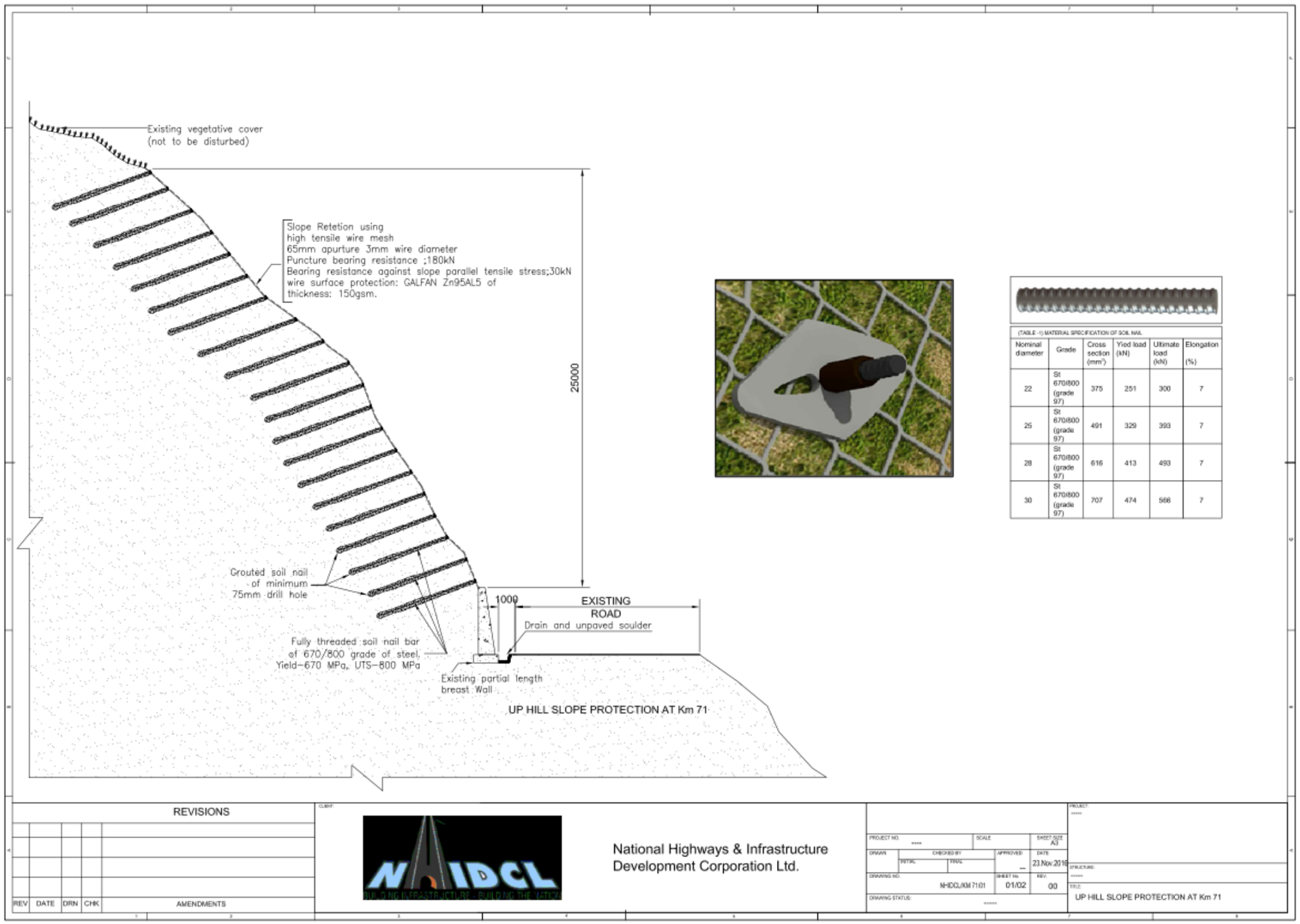
a. Wire diameter [mm] ≥ 3.0
b. Tensile strength high tensile steel wire [N/mm2]:1'770
c. Tensile resistance of a wire [kN]:12.5
d. Mesh width [mm]: 55 to 75
e. Surface finish: GALFAN Coating according to EN 10244-2:2001 CLASS B Zn95Al5
f. Thickness of coating [g/m²]:min. 150
g. Tensile strength of mesh [kN/m]:150
h. Bearing resistance against puncturing [kN]:180 (Spike plate)
i. Bearing resistance against slope-parallel tensile stress [kN]:30 (Spike plate)

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 71/01 | SHEET No. 02/02 | REV. 00
DRAWING STATUS: ----
PROJECT: ----
STRUCTURE: ----
TITLE: UP HILL SLOPE PROTECTION AT Km 71

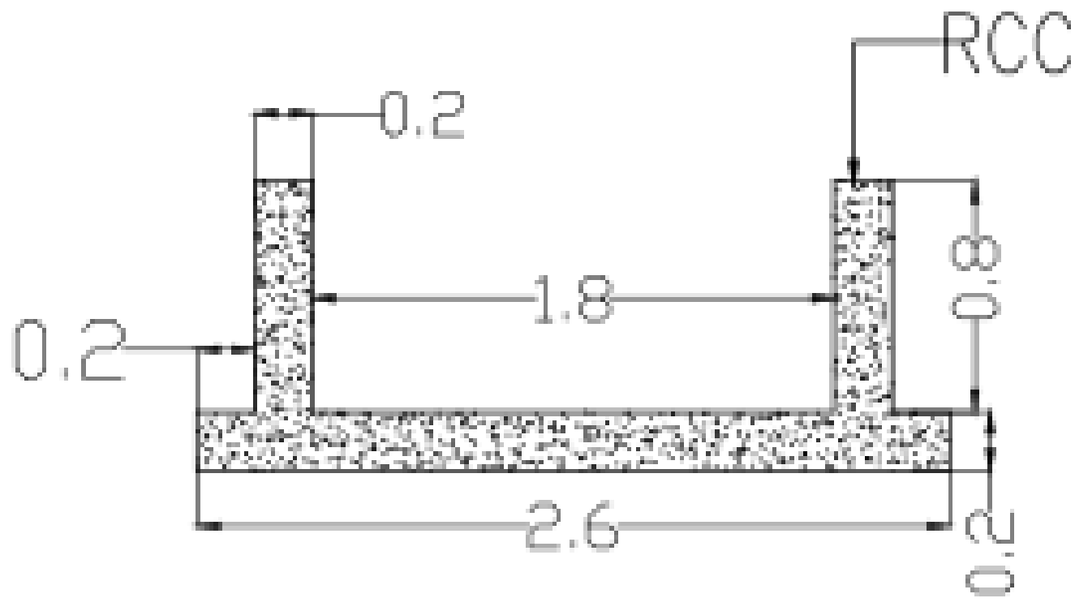
Typical Detail of proposed landslide protection scheme at 360m landslide zone at KM71



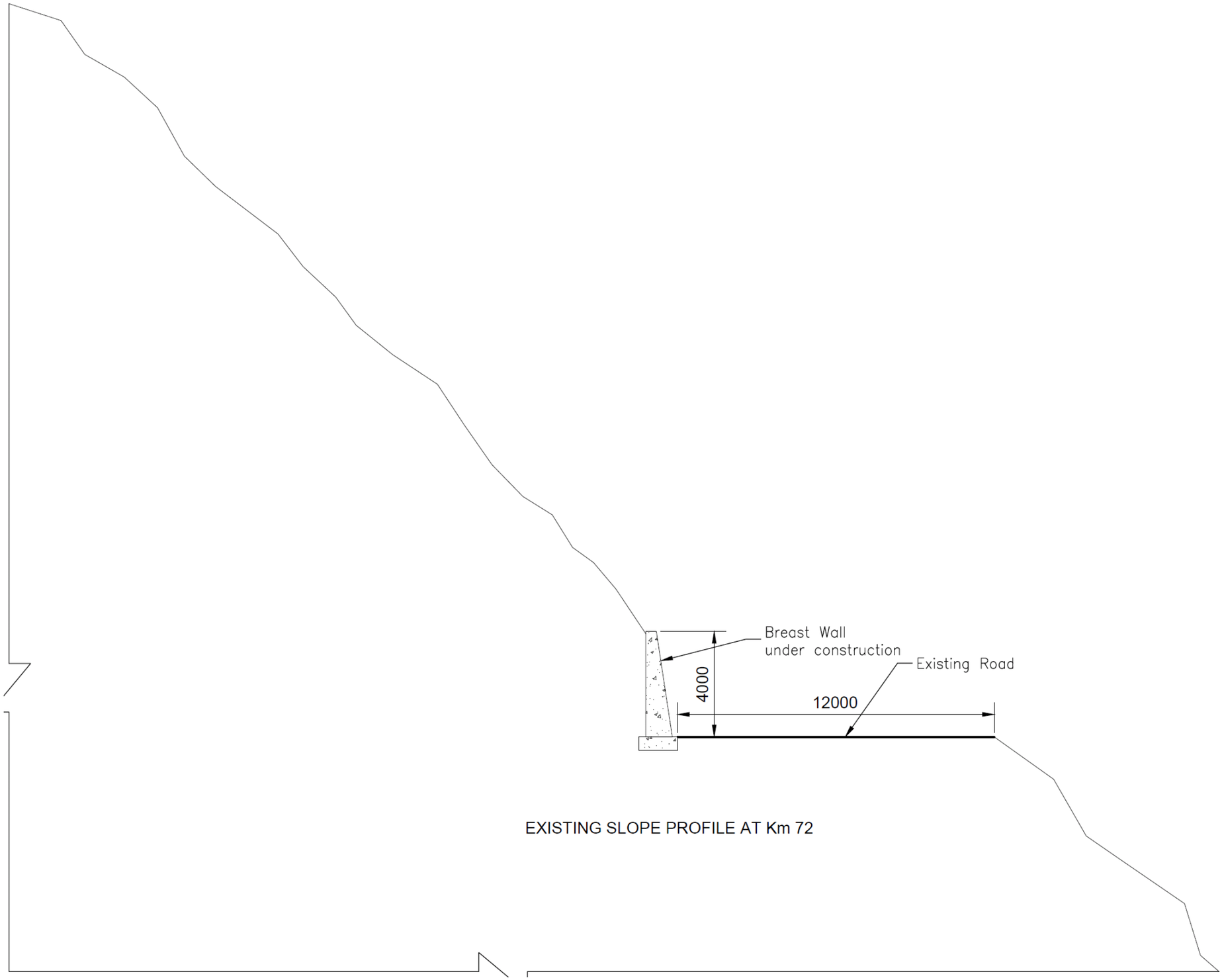
(TABLE -1) MATERIAL SPECIFICATION OF SOIL NAIL

Nominal diameter	Grade	Cross section (mm^2)	Yried 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

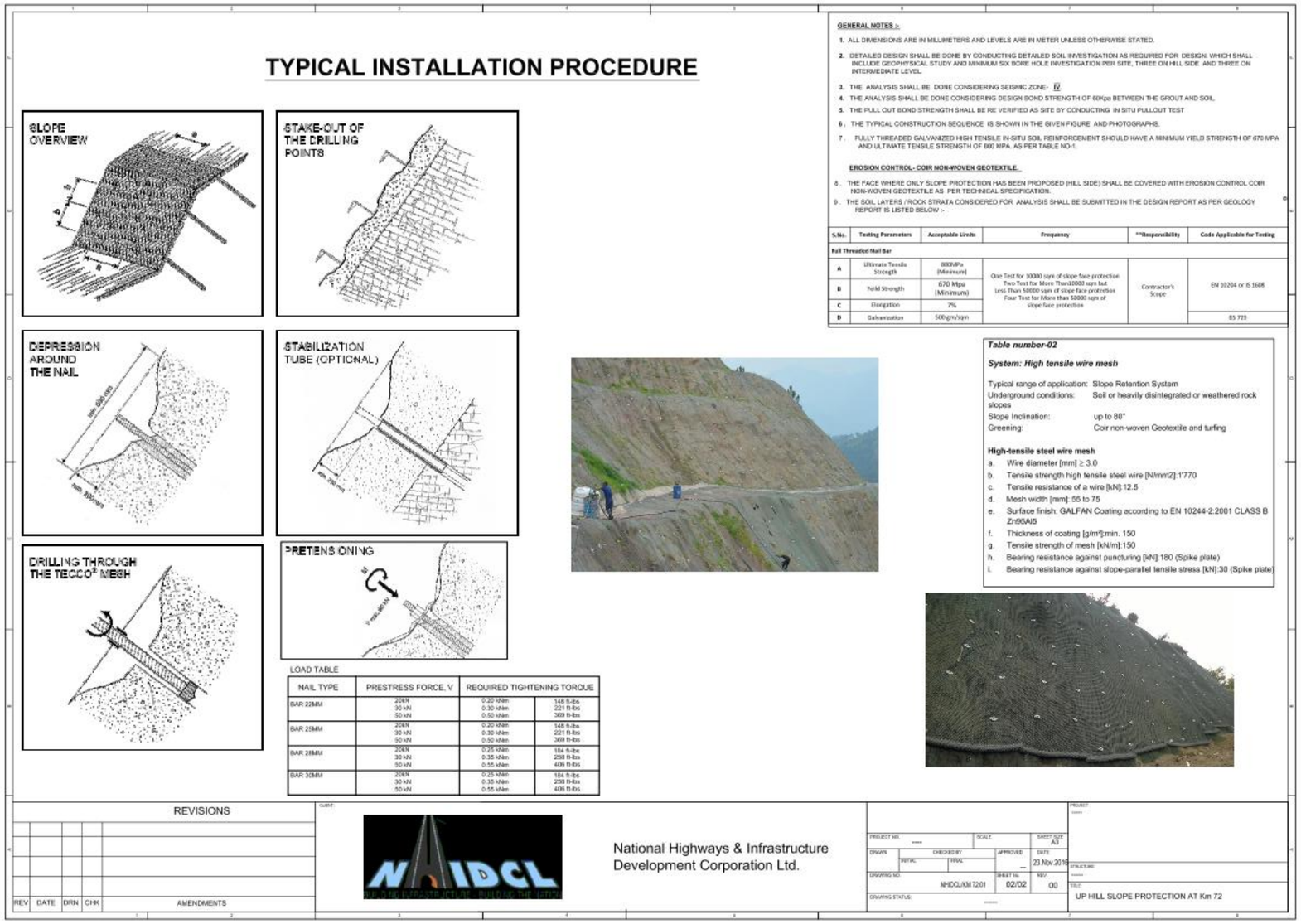
Typical Detail of proposed landslide protection scheme at 360m landslide zone at KM71



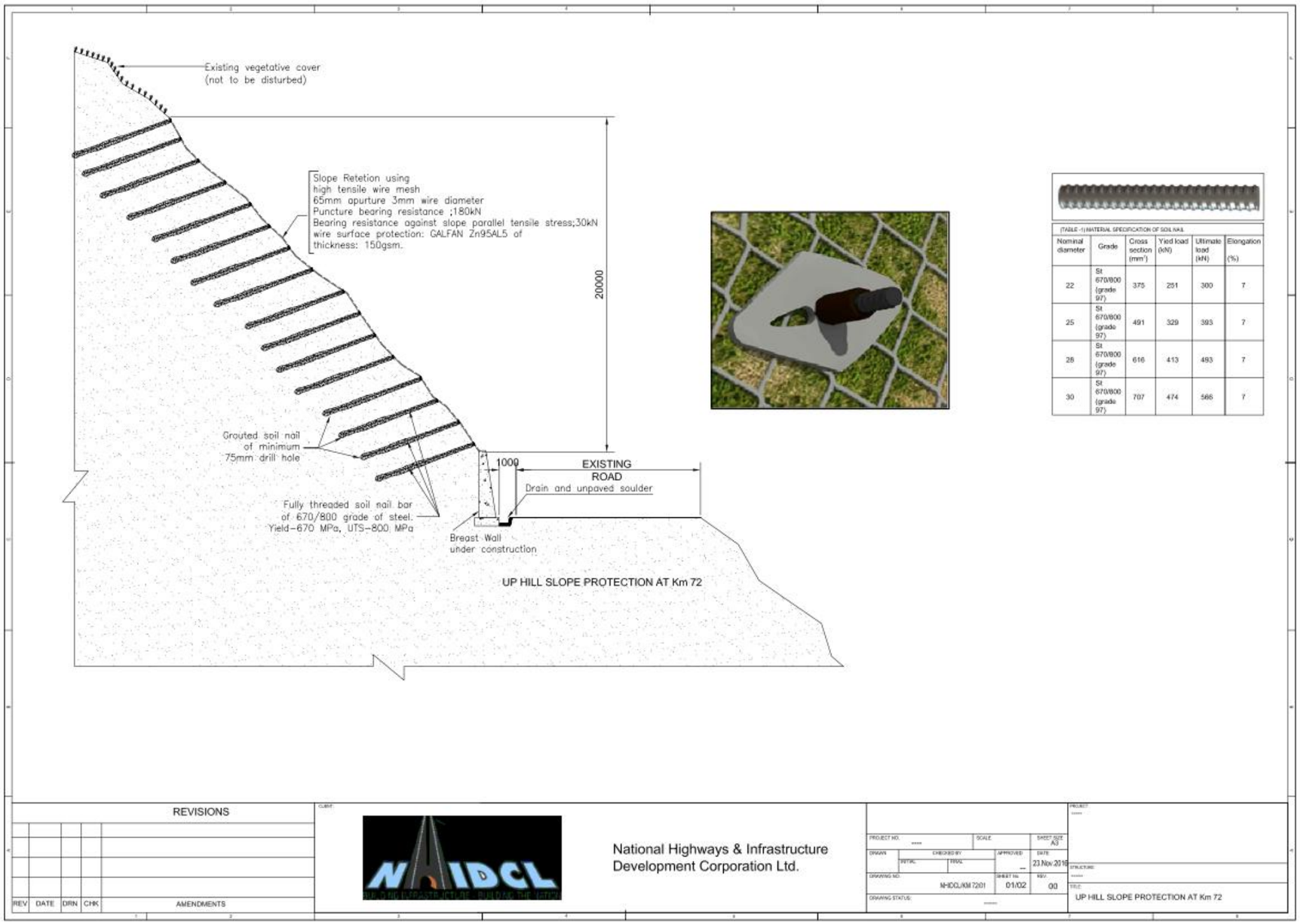
Typical cross section of the drain directed to the nearest culvert at KM71



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



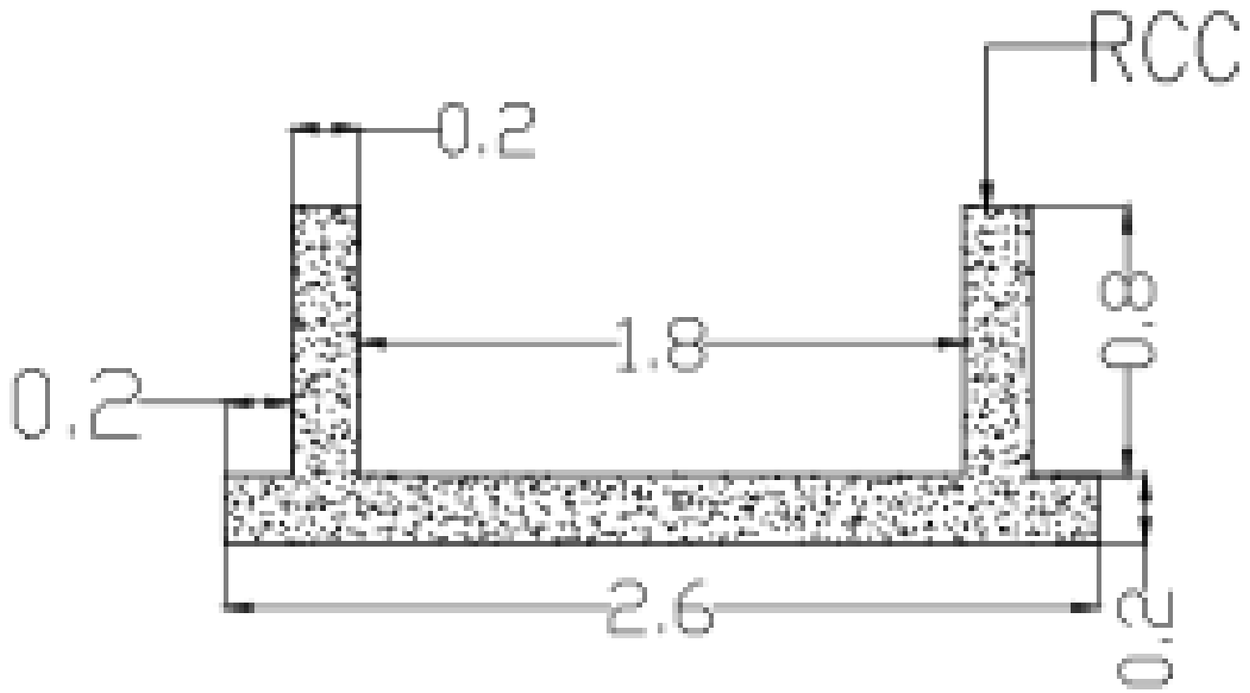
Typical Detail of proposed landslide protection scheme at 350m landslide zone at KM72



(TABLE -1) MATERIAL SPECIFICATION OF SOIL NAIL

Nominal diameter	Grade	Cross section (mm²)	Yied 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 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

SCHEDULE – C

(See Clause 2.1)

PROJECT FACILITIES

1 Project Facilities

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

(a) Project Office;

(b) Site laboratory;

Annex - I
(Schedule-C)

PROJECT FACILITIES

1 Description of ProjectFacilities

TheContractorshallconstructtheProjectFacilitiesinaccordancewiththeprovisions ofthis Agreement. Such ProjectFacilities shallinclude:

(a) Project Office: The contractor shall arrange for furnished project office of adequate space for the staff during the project tenure.

(b) Site laboratory: The contractor shall set up laboratory as required for testing of the materials to be used.

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. Alternative solutions or materials are not allowed in this project.

2 Design Standards

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

Manual of Specifications and Standards for Two Laning of Highways (IRC: SP: 73-2015), referred to herein as the Manual.

Special Report 23, State of the Art: Design, Construction of Rock fall Mitigation System, Published by IRC Highway Research Board, 2014 and European Technical Approval Guidelines (ETAG)-27.

Annex - I
(Schedule-D)

SPECIFICATIONS AND STANDARDS FOR CONSTRUCTION

A. CRITERIA FOR VALLEY SIDE HYBRID RETAINING WALL SYSTEM

The valley side retaining wall shall be in the form of hybrid/composite reinforced soil structure. Hybrid/composite reinforced soil system shall be used as a retaining structure for proposed widening of the Valley Side for those locations wherever requisite design width is not available to lay the soil reinforcing element of the Reinforced Slope Structure.

This includes reinforce and strengthen the unstable valley slopes while doing the excavation in a top-down or bottom-up manner as per the site conditions by incorporating inclusions into the excavated slope surface based on the detail soil investigation and slope stability analysis.

Hybrid/composite reinforced soil System shall consist of reinforced slope directly attached with stabilized slope mass and shall consist of the following key elements:

- **Fascia**: The fascia element shall be of prefabricated and hot deep galvanized mild steel bar steel mesh having minimum bar diameter of 8mm and minimum galvanization thickness of 86 microns in accordance with BS 729: 1971 (1994). The facing detailing shall include one or two layers of special compressible panel to adapt the internal settlement of fill. The detail of compressible panel shall be submitted along with the bid.

- **Soil Reinforcing Element:** Polymeric (PET/PP/PVA) Strips with lateral grooves on both sides to generate high friction and having LLDPE coating for better durability shall be allowed as soil reinforcing element. Any other type of reinforcement like PVC/Latex/ Bitumen coated geo-grid or HDPE geo-grids, or mesh or sheet type shall not be allowed to use.

Specific Properties of the Core Polyester fibre of the Geosynthetic Strips

Specific Properties	Unit	Typical Values	Test Method
Molecular Weight	g/mol	28000	
Elongation at break	%	<15	DIN 53834
Resistance to hydrolysis	%	<25	CEN ENV 124 47

Reinforcement Specification

Geosynthetic Strips		
Grade KN	**Characteristic initial strength (KN)**	**Guaranteed minimum width (mm)**
20	20	49
25	25	49
37.5	37.5	49
50	50	49
65	65	49

- **Connection between fascia and soil reinforcing element:** Only mechanical connection system shall be used which shall be manufactured using carbon steel meeting the long term design strength criteria. After fabrication the connector is hot-dip galvanized to BS 729:1971 requirements or IS 4759:1996, except that the weight of average zinc coating shall not be less than 600 gm/m^2.

- **Fill material:** Backfill material shall be reasonably free from organic or other deleterious materials conforming to MORT&H "Specification for Road and Bridge Works", Latest Revision, Section 3100 or IRC:SP:102-2014 shall conform to the following mechanical and physio-chemical requirements:

Mechanical Requirements	
Sieve size	*Percent Passing*
80 mm (gravel)	*100%*
4.75mm (coarse sand)	*More than 75%*
75 micron (silt)	*Less than 15%*

The backfill material shall be chemically inert having pH, chloride and sulphate content within the prescribed provisions of code**.**

- **Drainage**: Drainage gallery of minimum 600mm wide having 20mm down aggregates as per MoRT&H's specification as filter media which should be wrapped with non-woven geotextile. The non-woven geotextile shall have minimum weight of 142 gm/sqm.

- **Soil Nail**: The Soil Nail(Grade 670/800) shall be fully threaded solid high strength geotechnical bars which are hot – dip galvanized conforming to IS 4759:1996 requirements, except that the average zinc coating weight on the outer surface is not less than 500gm/m^2 and having the physio-mechanical properties as per the below table:

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

The soil nail shall be installed in a pre-drilled hole of minimum 75mm diameter and grouted.

- **Connection between soil reinforcing element and stabilized slope mass:** The reinforced slope mass shall be connected with stabilized existing soil mass in such a way that the total long term design force is effectively transferred to the stabilized soil mass. This is possible by either directly connecting the soil reinforcement with soil nail or anchor head or through another welded wire mesh or in combination of both. All steel components shall be hot-dip galvanized to BS 729:1971 requirements or IS 4759:1996, except that the average zinc coat weight is not less than 610 gm/m^2.

- **Geosynthetic Clay Liner (GCL):** Geosynthetic Clay Liner shall be used for protection of benches as shown in the drawings.

BENTOMAT 200R CERTIFIED PROPERTIES			
MATERIAL PROPERTY	**TEST METHOD**	**TEST FREQUENCY ft^2 (m^2)**	**REQUIRED VALUES**
Bentonite Swell Index[1]	ASTM D 5890	1 Per 50 Tonnes	24mL/2g min
Bentonite Fluid Loss[1]	ASTM D 5891	1 Per 50 Tonnes	18mL max.
Bentonite Mass/Area[2]	ASTM D 5893	40,000 ft^2 (4,000 m^2)	0.75lb/ft^2 (3.6 kg/m^2)min
GCL Tensile Strength[3]	ASTM D 6768	200,000ft^2 (20,000m^2)	30lb/in (53N.cm) MARV
GCL Peel Strength[3]	ASTM D 6496	40,000 ft^2 (4,000 m^2)	1ln/in (1.75 N.cm) min
GCL Index Flux[4]	ASTM D 5887	Weekly	1x 10^8 m^3/m^2 sec max
GCL Hydraulic COnductivity[4]	ASTM D 58887	Weekly	5x10^9 cm/sec max
GCL Hydrated Internal Shear Strenght[5]	ASTM D 5321 ASTM D 6243	Periodic	150 psf (7.2kPa) typical

B. CRITERIA FOR TOE PROTECTION AGAINST SCOUR AND EROSION

Wherever there are chances of toe erosion and scour due to river flowing near or adjacent to the base of composite/ hybrid reinforced earth wall or to protect existing or new structures from erosion, scouring or surficial erosion,Grout filled concrete revetment system shall be used. Grout filled concrete revetment consists of fabric form and fine aggregate concrete as per the details below.

- **Fabric Form:**

  Fabric forms are constructed of woven, double-layer synthetic fabric. Fabric form concrete linings are installed by positioning fabric forms over the areas to be protected and then pumping, high-strength, fine aggregate concrete into the forms. The fabric forms can be placed and filled either underwater or in-the-dry. The high-strength, fine aggregate concrete is used in place of conventional concrete because of its pumpability, compressive strength, density and absorption resistance.

- **Articulating Block (AB) Lining:**

  Articulating Block Linings consist of a series of compartments (blocks) linked by an interwoven perimeter and revetment cables. Ducts interconnect the compartments and high strength revetment cables are installed between and through the compartments and ducts. Once filled, the Articulating Block Linings become a mattress of pillow shaped, rectangular concrete blocks. The interwoven perimeters between the blocks serve as a hinge to permit articulation. The cables remain embedded in the concrete blocks to link the blocks together and facilitate articulation. Relief of hydrostatic pressure is accomplished through the interwoven perimeters of the blocks.

- **Fabric Form Panels**

  Fabric form mill rolls are factory assembled by sewing multiple mill widths of fabric forms side-to-side to form large panels. Mill width rolls of fabric forms are cut to the lengths required and their two layers of fabric separately sewn together, bottom layer to bottom layer and top layer to top layer, to form multiple mill width panels that are comprised of one or more sections divided by baffles at predetermined intervals.

- **Baffle:**

  Baffles are flow-directing longitudinal and/or lateral geotextile walls constructed between sections of fabric form layers. Baffles are an integral part of the fabric form design. Baffles are designed to support the panel section, determine the concrete area of the section and direct the flow of fine aggregate concrete for maximum efficiency.

- **Slide Fastener (Zipper):**

  A device consisting of two flexible strips of molded plastic with interlocking tooth-like projections closed by pulling a slide used to fasten fabric forms panels together.

- **Articulating Block Concrete Form Liner** : The fabric form shall be as per the details specification as under;

PROPERTY REQUIREMENTS – ARTICULATING BLOCK (US) FABRIC			
	Test Method	**Units**	**Values**
PHYSICAL PROPERTIES [1, 2]			
Composition of Yarns			Polyester
Mass Per Unit Area (double-layer)	ASTM D 5261	g/m^2	500
Thickness	ASTM D 5199	Mm	0.40
Mill Width		M	2.13
MECHANICAL PROPERTIES [1, 2]			
Wide-Width Strip Tensile Strength	ASTM D 4595		
Machine Direction		kN/m	50
Cross Machine Direction		kN/m	60
Elongation at Break	ASTM D 4595		
Machine Direction		%	8
Cross Machine Direction		%	8
Grab Tensile Strength	ASTM D 4632		
Machine Direction		N	1395
Cross Machine Direction		N	1365
Elongation at Break	ASTM D 4632		
Machine Direction		%	25
Cross Machine Direction		%	20
Trapezoidal Tear Strength	ASTM D 4533		
Machine Direction		N	460
Cross machine Direction		N	600
CBR Puncture Strength	ASTM D 6241	N	5450
Mullen Burst Strength	ASTM D 3786 (Mod.)	kg/cm^2	40
HYDRAULIC PROPERTIES [1, 3]			
Apparent Opening Size (AOS)	ASTM D 4751	Mm	0.30-0.80
Permittivity	ASTM D 4491	sec^{-1}	0.40-0.55
Flow Rate	ASTM D 4491	$l/min/m^2$	1200-1625

Fabric forms shall be double-layer woven fabric joined together by narrow perimeters of interwoven fabric into a matrix of rectangular compartments that form a concrete articulating block mat with finished nominal block and a finished average thickness of 200 mm as per detailed design. Cords shall connect the two layers of fabric at the center of each compartment. The cords shall be interwoven in two sets of four cords each, one set shall cross from the top layer to the bottom layer and the other from the bottom layer to the top layer. Each cord shall have a minimum breaking strength of 710 N when tested in accordance with ASTM D 2256. Fabric form compartments shall be offset one half a compartment length, in the lateral direction, to form a bonded concrete block pattern.

Fabric form compartments shall each have six ducts, two on each of the long sides and one on each of the short sides to allow passage of the fine aggregate concrete between adjacent compartments. The fine aggregate concrete filled, cross-sectional area of each duct shall be no more than 10 percent of the maximum filled cross-sectional area of the block lateral to the duct.

Cables shall be installed in the longitudinal direction between the two layers of fabric. Two longitudinal cables shall pass through each compartment in a manner which provides for the longitudinal and lateral binding of the finished articulating block mat. The cables shall enter and exit the compartments through opposing ducts. All longitudinal cables within each filled concrete block shall be completely embedded in the fine aggregate concrete.

Cables shall be installed in the lateral direction between the two layers of fabric. One lateral cable shall pass through each compartment in a manner which provides for the lateral binding of the finished articulating block mat. The lateral cables shall enter and exit the compartments through opposing ducts. All cables within each filled concrete block shall be completely embedded in the fine aggregate concrete.

Cables shall be Polyester Revetment Cables. Cables shall be minimum 7mm in diameter with corresponding breaking strength shall be not less than 20kN. Cable fittings shall be selected so that the resultant cable splice shall provide a minimum of 80 percent of the rated breaking strength of the cable. All cable splices shall have a minimum cable overlap of 15.3 cm and be made with aluminum compression fittings.

Mill widths of fabric shall be a minimum of 2.13 m. Each selvage edge of the top and bottom layers of fabric shall be reinforced for a width of not less than 35 mm by adding a minimum of 6 warp yarns to each selvage construction. Mill width rolls shall be cut to the length required, and the double-layer fabric separately joined, bottom layer to bottom layer and top layer to top layer, by means of sewing thread, to form multiple mill width panels with sewn seams on not less than 2.03 m centers.

Fabric forms shall be factory sewn, by joining together the bottom fabric layer to bottom fabric layer and top fabric layer to top fabric layer, into predetermined custom sized panels. All factory sewn seams shall be downward facing. Factory sewn seams and slide fastener (zipper) attachments shall be made using a double line of U.S. Federal Standard Type 401 stitch. Both lines of stitches shall be sewn simultaneously and be parallel to each other, spaced between 6 mm to12 mm apart. Each row of stitching shall consist of 4 to 7 stitches per 25 mm. Thread used for seaming shall be polyester. All factory sewn seams strengths shall not be less than 15.7 kN/m when tested in accordance with ASTM D 4884.

Baffles shall be installed on intervals to regulate the distance of lateral flow of fine aggregate concrete. The baffles shall be designed to maintain a full concrete lining thickness along the full length of the baffle.

The fabric forms shall be kept dry and wrapped such that they are protected from the elements during shipping and storage. If stored outdoors, they shall be elevated and protected with a waterproof cover that is opaque to ultraviolet light. The fabric forms shall be labeled as per ASTM D 4873, "Guide for Identification, Storage and Handling of Geosynthetic Rolls."

- **Drainage Behind Concrete Lining**
  Geotextile Filter Fabric :

The geotextile filter fabric shall be composed of synthetic fibers formed into nonwoven sheets. Fibers used in the manufacture of filter fabric shall be composed of at least 85% by weight of polypropylene. They shall be formed into a network such that the filaments retain

dimensional stability relative to each other. These materials shall conform to the physical requirements specified elsewhere in these Specifications. The geotextile shall be free of defects or flaws which significantly affect its mechanical or hydraulic properties.

The geotextile filter fabric must be permitted to function properly by allowing relief of hydrostatic pressure; therefore, fine soil particles shall not be allowed to clog the geotextile.

The geotextile filter fabric shall be kept dry and wrapped such that they are protected from the elements during shipping and storage. If stored outdoors, they shall be elevated and protected with a waterproof cover that is opaque to ultraviolet light. The fabric forms shall be labeled as per ASTM D 4873, "Guide for Identification, Storage and Handling of Geosynthetic Rolls."

- **Fine Aggregate Concrete**

Fine aggregate concrete shall consist of a proportioned mixture of Portland-Puzzolana cement, fine aggregate (sand) and water. The consistency of the fine aggregate concrete delivered to the concrete pump shall be proportioned and mixed as to have a flow time of 9-12 seconds when passed through the 19 mm orifice of the standard flow cone that is described in ASTM C 939. Additional Puzzolana and/or admixtures may be used with the approval of the Engineer-in-charge. The water/cement ratio varies with the exact granulometry of the fine aggregate (sand) and shall be determined by the ready-mix manufacturer using the above referenced flow cone.

At the direction of the Engineer-in-charge, the Contractor shall demonstrate the suitability of the fine aggregate concrete mix design by placing the proposed fine aggregate concrete into three (3) 50 mm concrete cubes. The mix shall exhibit a minimum compressive strength of 25 N/mm^2 at 28 days, when made and tested in accordance IS: 516. The sand/cement ratio shall be determined by the ready-mix manufacturer and shall be on the order of 2.4:1. The water/cement ratio shall be determined by the ready-mix manufacturer, but generally shall be on the order of 0.7.

Any standing mixing trucks shall be flow cone testing every thirty (30) minutes and water added as required. The mix is expected to have a working fluidity period of a maximum of two (2) hours after which the fluidity or quantity of water added shall render the mix unsuitable.

Cement :
The cement used shall be Portland-Puzzolana conforming to IS: 1489.

Fine Aggregate (Sand) :
Fine aggregate shall consist of suitable clean, hard, strong and durable natural or manufactured sand. It shall not contain dust, lumps, soft or flaky materials, mica or other deleterious materials in such quantities as to reduce the strength and durability of the concrete, or to attack any embedded steel, neoprene, rubber, plastic, etc. Fine aggregate having positive alkali-silica reaction shall not be used. All fine aggregates shall conform to IS: 383, (Parts 1 to VIII). The fineness modulus of fine aggregate shall neither be less than 2.0 nor greater than 3.5. Aggregate grading shall be reasonably consistent and shall not exceed the maximum size which can be conveniently handled with available pumping equipment, nor exceed the maximum size which allows the proper and efficient filling of the fabric formed concrete lining.

REQUIREMENT FOR FINE AGGREGATE			
IS Sieve Size	Percent by Weight Passing the Sieve		
	Zone – I	Zone - II	Zone – III
10 mm	100	100	100
4.75 mm	90-100	90-100	90-100
2.36 mm	60-95	75-100	85-100
1.18 mm	30-70	55-90	75-100
600 micron	15-34	35-59	60-79
300 micron	5-20	8-30	12-40
150 micron	0-10	0-10	0-10

Plasticizing and Air Entraining Admixtures:

Any air entraining agent or any other admixture may be used, as approved, by the Engineer-in-charge to increase workability, to make concrete impervious and more durable. Air entraining admixture shall conform to ASTM, Indian Standards (IS) or International Organization of Standards (ISO).

C. CRITERIA FOR HILL SIDE SLOPE RETENTION SYSTEM

Wherever there is requirement for Hill Side Slope Retention, drilled and grouted soil nail with High Strength steel mesh as facia shall be used as per the detailed specification below;

- **Soil Nail**: The Soil Nail(Grade 670/800) shall be fully threaded solid high strength geotechnical bars which are hot – dip galvanized conforming to IS 4759:1996 requirements, except that the average zinc coating weight on the outer surface is not less than 500gm/m^2 and having the physio-mechanical properties as per the below table:

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

The soil nail shall be installed in a pre-drilled hole of minimum 75mm diameter and grouted.

i. Facing on the slope surface

The facing provides structural connectivity. The facing serves as the bearing surface for the end plate and support the exposed soil. The facing is placed over slope surface after the soil nails are installed and the nut has been tightened. The facing shall be High Tensile Steel Mesh System as described under;

System: High Tensile Steel mesh

Typical range of application:	Slope Stabilization System
Underground conditions:	Soil or heavily disintegrated or weathered rock slopes
Slope Inclination:	up to 80°
Nail pattern:	2.0 – 3.6 m (typical)
Greening:	Close turfing, fibre mats, hydroseeding

Components of the System

High-tensile steel wire mesh

Wire diameter [mm]:	≥3.0
Tensile strength high tensile steel wire [N/mm²]:	1'770
Tensile resistance of a wire [kN]:	12.5 55-75
Mesh width [mm]:	
Surface finish:	GALFAN Coating according to EN 10244-2:2001 CLASS B Zn95Al5
Thickness of coating [g/m²]:	min. 150
Tensile strength of mesh [kN/m]:	150
Bearing resistance against puncturing [kN]:	180 (Spike plate)
Bearing resistance against slope-parallel tensile stress [kN]:	30 (Spike plate)

Spike plate

Shape:	Rhomboid
Size [mm]:	330 x 205
Thickness [mm]:	7
Bore hole diameter [mm]:	Ø 40 mm
Material:	Steel S355J (EN 10025-2)
Mass per unit [kg]:	2.2
Surface finish:	Hot dip galvanized based on EN ISO 1461
Thickness of coating [g/m²]:	Approx. 400 (55 µm) in average

High Strength Steel mesh- Compression claw type 2: Connection of the mesh to border ropes

Shape:	Open chain link
Width [mm]:	40 x 14
Shape:	Open eyelet for compression after installation on site
Material:	Steel S235 JRG (EN 10025-2)
Mass per unit [kg]:	0.034
Surface finish:	Hot dip galvanized based on EN ISO 1461
Thickness of coating [g/m²]:	Approx. 400 (55 µm) in average

High Strength Steel mesh connection clip T3: connection between mesh panels

Shape:	Clip
Width [mm]:	21 x 60
Thickness [mm]:	Ø 4
Shape:	Two reversed hooks on the one side of the clamp
Material:	High-tensile steel wire ø4 mm
Tensile strength:	1770 N/mm² according to EN 10264-2
Surface finish:	GALFAN Coating according to EN 10244-2:2001 CLASS B Zn95Al5

Border ropes

Border rope ø 10 mm	Diameter ø 10 mm, minimum breaking load 63.0 kN 6x19S+IWRC, acc. EN 12385-4 Tensile strength of single wire > 1770 N/mm² EN 10264-2 Wire finish GALFAN Coating according to EN 10244-2:2001 CLASS B Zn95Al5
Border rope ø 12 mm	Diameter ø 12 mm, minimum breaking load 90.7 kN 6x19S+IWRC, acc. EN 12385-4 Tensile strength of single wire > 1770 N/mm² EN 10264-2 Wire finish GALFAN Coating according to EN 10244-2:2001 CLASS B Zn95Al5

Wire rope anchors

Wire rope anchor ø10.5 mm	Wire rope anchor ø10.5 mm, nominal diameter 2 x 10.5 mm Working load 100 kN Heavy galvanized according to EN 10244-2
Wire rope anchor ø14.5 mm	Wire rope anchor ø14.5 mm, nominal diameter 2 x 14.5 mm, Working load 195 kN Heavy galvanized according to EN 10244-2
Accessories	All needed parts incl., clips according to EN 13411-5, all shackles included

Along with the High Strength Steel mesh, one layer of biodegradable erosion control blanket in the form of coir geotextile shall be laid and fixed. The erosion control coir blanket shall conform to the detailed specification as under;

Test carried out	**Coir Blanket 2.5-11-600**
Tensile Strength (KN/m) ASTM D-4595-86	
Machine direction	5.9
Cross machine direction	2.5
Elongation at max: load (%)	
Machine Direction	35.5
Cross machine direction	41.0
CBR Puncture resistance (N)	751.4
Equivalent pore size (microns) (porosity) ASTM D-4751-99 ISO- 12236-96	725
Liquid absorptive capacity (%) ISO =9073-6-2000	86.0

D. PRE-QUALIFICATION REQUIREMENT OF THE SYSTEM | TECHNOLOGY PROVIDER

Since the construction of composite / hybrid wall using soil nail, slope retention system, reinforced soil wall and Grout filled concrete revetment is specialized in nature and inter-related to the global performance of the project, the contractor shall source the materials, technical expertise including on-site technical assistance and other requisite services only from one (1) single specialized technology provider for soil nail, slope retention system, reinforced soil wall and Grout filled concrete revetment. The bidder must enter into Memorandum of Understanding (MoU) with such technology provider prior to bid submission date and submit the MoU along with their bid [this is one of the essential eligibility criteria document of the bidder]. Such specialized technology provider must conform to all the following pre-qualification criteria;

A. The technology provider shall be a firm established under Indian company's act and must be existing in India for minimum ten (10) years. The certificate of incorporation shall be produced to this effect along with the bid.

B. The contractor's specialized technology | system provider must furnish documented proofs such as contract document | completion certificates | case study of construction for all the following along with the bid;

i. The technology provider must have completed minimum 10,000 sqm of Reinforced Earth Wall, and at least two (2) projects in India during last five years using drilled and grouted soil nail technology for stabilization of slope. Projects involving short (less than 5m) driven or grouted anchor (with dead end anchorage) or rock bolts shall not be considered as eligible.

ii. The technology provider must have at least two composite / hybrid wall projects using combination of grouted soil nail and reinforced soil wall technology using polymeric strip as soil reinforcement for stabilization of slope and widening to support traffic load on top in the last five years.

iii. The technology provider must have at least two projects involving Grout filled concrete revetment system for erosion protection of embankment - one in underwater condition and one for dry slope protection in last five years. As a proof of underwater installation experience, photographs from the projects must be submitted with the bid along with the other documents.

iv. The technology provider must be able to supply the high tensile wire mesh as per IRC or European (EN) Specification with due authentication from eligible and approved body.

C. All products and technology used shall strictly conform to the technical specification of the tender document.

D. Only ISO 9001: 2008 certified Indian companies are eligible to qualify for this works. The date of original certification must be at least 10 years prior to date of tender and in continuity. The certificate of registration shall be submitted as documentary evidence along with the bid.

The ***Checklist*** of the submittals for pre-qualification is enclosed as Annexure II of Schedule – D.

Annex - II
(Schedule-D)

List of pre-qualification documents for the technology and system provider to be submitted along with the bid		
Sl. No.	**Documents**	**Check**
1.	Certificate of incorporation of the system provider as an evidence of 10 (ten) years existence in India.	
2.	Experience certificate/ case study/ contract document of 10,000 sqm of TWO Reinforced Earth Wall project in India.	
3.	Experience certificate/ case study/ contract document of two completed drilled and grouted nail project in India in last five years.	
4.	Experience certificate/ case study/ contract document of two hybrid wall project completed in the last five years.	
5.	Experience certificate/ case study/ contract document of two completed Grout filled concrete revetment project – one in underwater condition and one for dry slope erosion protection in the last five years.	
6.	Photographs of underwater installation of Grout filled concrete revetment System.	
7.	Certificate of conformity by eligible and approved body.	
8.	The system provider's ISO 9001:2008 certification with original date of certification as 10 years prior to the date of bid.	
9.	Details of compressible facing element for the Hybrid wall.	
10.	Technical data sheet or specification of high tensile wire mesh.	
11.	Technical data sheet or specification of Polymeric (PET/PP/PVC)Strip.	
12.	Technical data sheet or specification of Soil Nail.	

SCHEDULE -E

(See Clauses 2.1 and 14.2)

MAINTENANCE REQUIREMENTS

1 Maintenance Requirements

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

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

1.3 All Materials, works and construction operations shall conform to the MORTH Specifications for Road and Bridge Works, and the relevant IRC publications and the specification and standards as specified in Schedule-D. Where the specifications for a work are not given, Good Industry Practice shall be adopted.

2 Repair/rectification of Defects and deficiencies

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

3 Other Defects and deficiencies

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

4 Extension of time limit

Notwithstanding anything to the contrary specified in this Schedule-E, if the nature and extent of any Defect or deficiency justifies more time for its repair or rectification than the time specified herein, the Contractor shall be entitled to additional time in conformity with Good Industry Practice. Such additional time shall be determined by the Authority's Engineer and conveyed to the Contractor and the Authority with reasons thereof.

5 Emergency repairs/restoration

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

6 Daily inspection by the Contractor

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

7. Pre-monsoon inspection / Post-monsoon inspection

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

8. Repairs on account of natural calamities

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

Annex -I
(Schedule-E)

REPAIR / RECTIFICATION OF DEFECTS AND DEFICIENCIES

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

Nature of Defect or Deficiency		Time limit for repair/rectification
Roads		
(a)	**Carriageway and Paved Shoulder**	
(i)	Breach or blockade	Temporary restoration of traffic within 24 hours; permanent restoration within 15 (fifteen) days
(ii)	Roughness value exceeding 2,200 mm in a stretch of 1 km (as measured by a calibrated bump integrator)	120 (one hundred and twenty) days
(iii)	Pot Holes	24 Hours
(iv)	Any cracks in road surface	15 (fifteen days)
(v)	Any depressions, rutting exceeding 10mm in road surface	30 (thirty days)
(vi)	Bleeding/skidding	7 (seven) days
(vii)	Any other defect/distress on the Road	15 (fifteen) days
(viii)	Damage to pavement edges	15 (fifteen) days
(ix)	Removal of debris, dead animals	6 hours
(b)	**Granular Earth shoulder, side slopes, drain and culverts**	
(i)	Variation by more than 1 % in the prescribed slope of camber/cross fall (shall not be less than the camber on the main carriageway)	7 (seven) days
(ii)	Edge drop at shoulders exceeding 40 mm	7 (seven) days
(iii)	Variation by more than 15% in the prescribed side (embankment) slopes	30 (thirty) days
(iv)	Rain cuts/gullies in slope	7 (seven) days
(v)	Damage to or silting of culverts and side drains	7 (seven) days
(vi)	De-silting of drains in urban/semi urban	24 hours

	Areas	
(vii)	Railing, parapets, crash barriers	7 (seven) days (Restore immediately if causing safety hazard)
(c)	**Road side furniture including road sign and pavement marking**	
(i)	Damage to shape or position, poor visibility or loss of retro reflectivity	48 hours
(ii)	Painting of km stone, railing, parapets, crash barriers	As and when required/Once every year
(iii)	Damaged/missing road signs requiring replacement	7 (seven) days
(iv)	Damage to road mark ups	7 (seven) days
(d)	**Trees and plantation**	
(i)	Obstruction in a minimum headroom of 5 m above carriageway or obstruction in visibility of road signs	24 hours
(ii)	Deterioration in health of trees and Bushes	Timely watering and treatment
(iii)	Trees and bushes requiring Replacement	30 (thirty) days
(iv)	Removal of vegetation affecting sight line and road structures.	15 (fifteen) days
(e)	**Hill Roads**	
(i)	Damage to retaining wall/breast wall	7 (seven) days
(ii)	Landslides requiring clearance	12 (twelve) hours
(iii)	Snow requiring clearance	24 (twenty four) hours

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

SCHEDULE -F

(See Clause 3.1.7(a))

APPLICABLE PERMITS

1 Applicable Permits

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

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

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

(c) Licence for use of explosives;

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

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

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

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

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

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

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

Schedule-G
(See Clause 7.1.1, 7.5.3 and 19.2)
FORM OF BANK GUARANTEE
Annex-I
(See Clause 7.1.1)
PERFORMANCE SECURITY

The Managing Director,
NHIDCL,
3rd Floor, PTI Building, Sansad Marg,
New Delhi

WHEREAS:

(A) _____ [name and address of contractor] (hereinafter called "the Contractor") and [**NHIDCL, Government of India**], (**"the Authority"**) have entered into an agreement (the **"Agreement"**) for "**Special Repair Works at Narrow Zone and Landslide Area in between Rangpo to Ranipool on NH-10 in the state of Sikkim"**through Engineering, Procurement & Construction (EPC) Basis Contract", subject to and in accordance with the provisions of the Agreement.

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

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

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

1. The Bank hereby unconditionally and irrevocably guarantees the due and faithful performance of the Contractor's obligations during and under and in accordance with the Agreement, and agrees and undertakes to pay to the Authority, upon its mere first written demand, and without any demur, reservation, recourse, contest or protest, and without any reference to the Contractor, such sum or sums up to an aggregate sum of the guarantee amount as the Authority shall claim, without the Authority being required to prove or to show grounds or reasons for its demand and/or for the sum specified therein.
2. A letter from the Authority, under the hand of an officer not below the rank of [Executive Engineer, CGPWD], that the Contractor has committed default in the due and faithful performance of all or any of its obligations under and in accordance with the Agreement shall be conclusive, final and binding on the Bank. The Bank further agrees that the Authority shall be the sole judge as to whether the Contractor is in

default in due and faithful performance of its obligations during and under the Agreement and its decision that the Contractor is in default shall be final, and binding on the Bank, notwithstanding any difference between the Authority and the Contractor, or any dispute between them pending before any court, tribunal, arbitrators or any other Authority or body, or by the discharge of the Contractor for any reason whatsoever.

3. In order to give effect to this Guarantee, the Authority shall be entitled to act as if the Bank were the principal debtor and any change in the constitution of the Contractor and/or the Bank, whether by their absorption with any other body or corporation or otherwise, shall not in any way or manner affect the liability or obligation of the Bank under this Guarantee.
4. It shall not be necessary, and the Bank hereby waives any necessity, for the Authority to proceed against the Contractor before presenting to the Bank its demand under this Guarantee.
5. The Authority shall have the liberty, without affecting in any manner the liability of the Bank under this Guarantee, to vary at any time, the terms and conditions of the Agreement or to extend the time or period for the compliance with, fulfillment and/or performance of all or any of the obligations of the Contractor contained in the Agreement or to postpone for any time, and from time to time, any of the rights and powers exercisable by the Authority against the Contractor, and either to enforce or forbear from enforcing any of the terms and conditions contained in the Agreement and/or the securities available to the Authority, and the Bank shall not be released from its liability and obligation under these presents by any exercise by the Authority of the liberty with reference to the matters aforesaid or by reason of time being given to the Contractor or any other forbearance, indulgence, act or omission on the part of the Authority or of any other matter or thing whatsoever which under any law relating to sureties and guarantors would but for this provision have the effect of releasing the Bank from its liability and obligation under this Guarantee and the Bank hereby waives all of its rights under any such law.
6. This Guarantee is in addition to and not in substitution of any other guarantee or security now or which may hereafter be held by the Authority in respect of or relating to the Agreement or for the fulfillment, compliance and/or performance of all or any of the obligations of the Contractor under the Agreement.
7. Notwithstanding anything contained hereinbefore, the liability of the Bank under this Guarantee is restricted to the Guarantee amount and this Guarantee will remain in force for the period specified in paragraph 8 below and unless a demand or claim in writing is made by the Authority on the Bank under this Guarantee all rights of the Authority under this Guarantee shall be forfeited and the Bank shall be relieved from its liabilities hereunder.
8. The Performance Security shall cease to be in force and effect upto 90 (ninety) days after the end of the Defects Liability Period as set forth in Clauses 17.1 of EPC agreement.
9. The Bank undertakes not to revoke this Guarantee during its currency, except with the previous express consent of the Authority in writing, and declares and warrants

that it has the power to issue this Guarantee and the undersigned has full powers to do so on behalf of the Bank.

10. Any notice by way of request, demand or otherwise hereunder may be sent by post addressed to the Bank at its above referred branch, which shall be deemed to have been duly authorized to receive such notice and to effect payment thereof forthwith, and if sent by post it shall be deemed to have been given at the time when it ought to have been delivered in due course of post and in proving such notice, when given by post, it shall be sufficient to prove that the envelope containing the notice was posted and a certificate signed by an officer of the Authority that the envelope was so posted shall be conclusive.
11. This Guarantee shall come into force with immediate effect and shall remain in force and effect for up to the date specified in para 8 above or until it is released earlier by the Authority pursuant to the provisions of the Agreement.

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

SIGNED, SEALED AND DELIVERED

For and on behalf of the Bank by:

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

NOTES:

(i) The bank guarantee should contain the name, designation and code number of the officer(s) signing the guarantee.
(ii) The address, telephone number and other details of the head office of the Bank as well as of issuing branch should be mentioned on the covering letter of issuing branch.

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

Form for Guarantee for Withdrawal of Retention Money

The Managing Director,
NHIDCL,
3rd Floor, PTI Building, Sansad Marg,
New Delhi

WHEREAS:

[Name and address of contractor] (hereinafter called "**the Contractor**") has executed an agreement (hereinafter called the "Agreement") with the [**NHIDCL, Government of India**], (hereinafter called "**the Authority**") for "**Special Repair Works at Narrow Zone and Landslide Area in between Rangpo to Ranipool on NH-10 in the state of Sikkim"** through Engineering, Procurement & Construction (EPC) Basis Contract", subject to and in accordance with the provisions of the Agreement.

a. in accordance with the Clause 7.5.3 of the Agreement, whenever the amount of the retention money (hereinafter called "Retention Money") held by the Authority exceeds 1% (one per cent) of the Contract Price, the Contractor may, at its option, withdraw the Retention Money after furnishing to the Authority a bank guarantee for an amount equal to the proposed withdrawal.

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

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

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

2. A letter from the Authority, under the hand of an officer not below the rank of [Executive Engineer, CGPWD], that the Contractor has committed default in the due and faithful performance of all or any of its obligations under and in accordance with the Agreement shall be conclusive, final and binding on the Bank. The Bank further agrees that the Authority shall be the sole judge as to whether the Contractor is in default in due and faithful performance of its obligations during and under the Agreement and its decision that the Contractor is in default shall be final, and binding on the Bank, notwithstanding any difference between the Authority and the Contractor, or any dispute between them pending before any court, tribunal, arbitrators or any other Authority or body, or by the discharge of the Contractor for any reason whatsoever.
3. In order to give effect to this Guarantee, the Authority shall be entitled to act as if the Bank were the principal debtor and any change in the constitution of the Contractor and/or the Bank, whether by their absorption with any other body or corporation or otherwise, shall not in any way or manner affect the liability or obligation of the Bank under this Guarantee.
4. It shall not be necessary, and the Bank hereby waives any necessity, for the Authority to proceed against the Contractor before presenting to the Bank its demand under this Guarantee.
5. The Authority shall have the liberty, without affecting in any manner the liability of the Bank under this Guarantee, to vary at any time, the terms and conditions of the Retention Money and any of the rights and powers exercisable by the Authority against the Contractor, and either to enforce or forbear from enforcing any of the terms and conditions contained in the Agreement and/or the securities available to the Authority, and the Bank shall not be released from its liability and obligation under these presents by any exercise by the Authority of the liberty with reference to the matters aforesaid or by reason of time being given to the Contractor or any other forbearance, indulgence, act or omission on the part of the Authority or of any other matter or thing whatsoever which under any law relating to sureties and guarantors would but for this provision have the effect of releasing the Bank from its liability and obligation under this Guarantee and the Bank hereby waives all of its rights under any such law.
6. This Guarantee is in addition to and not in substitution of any other guarantee or security now or which may hereafter be held by the Authority in respect of or relating to the Retention Money.
7. Notwithstanding anything contained hereinbefore, the liability of the Bank under this Guarantee is restricted to the Guarantee amount and this Guarantee will remain in force for the period specified in paragraph 8 below and unless a demand or claim in writing is made by the Authority on the Bank under this Guarantee all rights of the Authority under this Guarantee shall be forfeited and the Bank shall be relieved from its liabilities hereunder.
8. The guarantee shall cease to be in force and effect 90 (ninety) days after the end of the Defects Liability Period specified in Clauses 17.1 of the Agreement.

9. The Bank undertakes not to revoke this Guarantee during its currency, except with the previous express consent of the Authority in writing, and declares and warrants that it has the power to issue this Guarantee and the undersigned has full powers to do so on behalf of the Bank.
10. Any notice by way of request, demand or otherwise hereunder may be sent by post addressed to the Bank at its above referred branch, which shall be deemed to have been duly authorized to receive such notice and to effect payment thereof forthwith, and if sent by post it shall be deemed to have been given at the time when it ought to have been delivered in due course of post and in proving such notice, when given by post, it shall be sufficient to prove that the envelope containing the notice was posted and a certificate signed by an officer of the Authority that the envelope was so posted shall be conclusive.
11. This Guarantee shall come into force with immediate effect and shall remain in force and effect for up to the date specified in para 8 above or until it is released earlier by the Authority pursuant to the provisions of the Agreement.

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

SIGNED, SEALED AND DELIVERED

For and on behalf of the Bank by:

(Signature)

(Name)

(Designation)

(Code Number)

(Address)

NOTES:

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

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

Annex-III

(Schedule-G)
(See Clause 19.2)

Form for Guarantee for Advance Payment

The Managing Director,
NHIDCL,
3rd Floor, PTI Building, Sansad Marg,
New Delhi

WHEREAS:

(A) [name and address of contractor] (hereinafter called "**the Contractor**") has executed an agreement (hereinafter called the "Agreement") with the [**NHIDCL**], (hereinafter called "**the Authority**") "**Special Repair Works at Narrow Zone and Landslide Area in between Rangpo to Ranipool on NH-10 in the state of Sikkim"**through Engineering, Procurement & Construction (EPC) Basis Contract", subject to and in accordance with the provisions of the Agreement.

(B) in accordance with the Clause 19.2 of the Agreement the Authority shall make to the Contractor advance payment (hereinafter called "Advance Payment") equal to 10% (ten per cent) of the contract price for mobilization expenses and acquisition of equipment; and that the Advance Payment shall be made in two installments subject to the Contractor furnishing an irrevocable and unconditional guarantee by a scheduled bank for an amount equal to the amount of each installment to remain effective till the complete and full repayment of the installment of the Advance Payment as security for compliance with its obligations in accordance with the Agreement; and the amount of (first/second) installment of the Advance Payment is Rs. **** cr. (Rupees ***** crore) (the "Guarantee Amount").

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

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

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

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

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

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

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

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

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

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

8. The guarantee shall cease to be in force and effect 90 (ninety) days after the end of the one year from the date of payment of the installment of the Advance Payment, as set forth in Clause 19.2 of the Agreement.

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

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

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

12. Notwithstanding anything contained herein before, our liability under this Bank Guarantee is restricted to Rs. _____(Rs. _____in words) and the bank guarantee shall remain valid till _____. Unless a claim or a demand in writing is served upon us on or before _____ all our liability under this Bank Guarantee shall cease.

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

accept such invocation letter and make payment of amounts so demanded under the said invocation.

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

SIGNED, SEALED AND DELIVERED

For and on behalf of the Bank by:

(Signature)

(Name)

(Designation)

(Code Number)

(Address)

SCHEDULE - H

(See Clauses10.1.4 and 19.3)

CONTRACT PRICE WEIGHTAGES

1.1 The Contract Price for this Agreement is Rs. ******

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

Location	Weightage
250m stretch at Km 54is denoted as S1	28.89%
210m stretch at Km 63is denoted as S2	25.36%
360m stretch at Km 71is denoted as S3	25.27%
350m stretch at Km 72is denoted as S4	20.48%
TOTAL:	**100%**

Further bifurcation of various works for the different locations shall be as under;

Location	Weightage	Special Geotechnical Works	Erosion Protection Works	Other Works	TOTAL
250m stretch at Km 54is denoted as S1	28.89%	74.07% (21.40%)	9.84% (2.84%)	16.09% (4.65%)	100% (28.89%)
210m stretch at Km 63is denoted as S2	25.36%	78.64% (19.95%)	6.36% (1.61%)	15.00% (3.80%)	100% (25.36%)
360m stretch at Km 71is denoted as S3	25.27%	95.74% (24.19%)	0.00%	4.26% (1.08%)	100% (25.27%)
350m stretch at Km 72is denoted as S4	20.48%	91.45% (18.73%)	0.00%	8.55% (1.75%)	100% (20.48%)

Location	Item	Stage for Payment	Percentage weightage of total project cost
1	**2**	**3**	**4**
S1 (28.89%)	**Special Geotechnical Works (21.40%)**	(1) Providing and installing of nails as specified. (2) Providing and installing of composite/ hybrid wall as specified.	**16.41%** **4.99%**
	Erosion Protection Works (2.84%)	(1) Providing Revetment mattress as specified. (2) Installing Revetment mattress as specified.	**1.68%** **1.16%**
	Other Works (4.65%)	(1) Surface preparation and excavation (2) Backfilling works (3) Granular sub-base works (4) WMM works (5) Bituminous Works (6) Misc. works (PCC, Drainage etc.)	**0.05%** **2.60%** **0.07%** **0.07%** **0.24%** **1.62%**
S2 (25.36%)	**Special Geotechnical Works (19.95%)**	(1) Providing and installing of nails as specified. (2) Providing and installing of composite/ hybrid wall as specified.	**15.30%** **4.65%**
	Erosion Protection Works (1.61%)	(1) Providing Revetment mattress as specified. (2) Installing Revetment mattress as specified.	**0.94%** **0.67%**

	Other Works (3.80%)	(1) Surface preparation and excavation	**0.06%**
		(2) Backfilling works	**2.15%**
		(3) Granular sub-base works	**0.06%**
		(4) WMM works	**0.06%**
		(5) Bituminous Works	**0.20%**
		(6) Misc. works (PCC, Drainage etc.)	**1.27%**
S3 (25.27%)	**Special Geotechnical Works (24.19%)**	(1) Providing and installing of nails as specified.	**20.17%**
		(2) Providing and installing high tensile steel mesh as specified	**4.02%**
	Erosion Protection Works (0.00%)	NIL	NIL
	Other Works (1.08%)	(1) Surface preparation and excavation	**0.12%**
		(2) Drain	**0.20%**
		(3) Stone masonry wall	**0.41%**
		(4) Misc. Works (Signages etc.)	**0.35%**
S4 (20.48%)	**Special Geotechnical Works (18.73%)**	(1) Providing and installing of nails as specified.	**15.62%**
		(2) Providing and installing high tensile steel mesh as specified	**3.11%**
	Erosion Protection Works (0.00%)	NIL	NIL
	Other Works (1.75%)	(1) Surface preparation and excavation	**0.09%**
		(2) Drain	**0.20%**
		(3) Stone masonry wall	**1.42%**
		(4) Misc. Works (Signages etc.)	**0.04%**

* The above list is illustrative and may require modification as per the scope of the work.

1.3 Payment Procedure

1.3.1 Procedure for estimating the value of various Works done in location S1 shall be as follows:

Table 1.3.1

Location	Item	Stage for Payment	Percentage weightage	Payment Procedure
1	2	3	4	5
S1 (28.89%)	**Special Geotechnical Works (21.40%)**	(1) Providing and installing of nails as specified.	**16.41%**	**Payment shall be made on pro-rata basis on completion of a stage measured in height and the height in consideration should not be less than 5% (Five percent) of the total height**
		(2) Providing and installing of composite/ hybrid wall as specified.	**4.99%**	
	Erosion Protection Works (2.84%)	(1) Providing Revetment mattress as specified.	**1.68%**	**Unit of measurement is surface area measure in Sqm. Payment of each stage shall be made on pro-rata basis on completion of a stage in area of not less than 10 (ten) percent of the total area.**
		(2) Installing Revetment mattress as specified.	**1.16%**	
	Other Works (4.65%)	(1) Surface preparation and excavation	**0.05%**	**Payment shall be made in 'sqm' after completion.**
		(2) Backfilling works	**2.60%**	**Unit of measurement shall be in volume on pro rata basis on completion of a stage in volume of not less than 10 (ten) percent of the total volume.**

		(3) Granular sub-base works	**0.07%**	**Unit of measurement shall be in volume. Payment shall be made after completion.**
		(4) WMM works	**0.07%**	**Unit of measurement shall be in volume. Payment shall be made after completion.**
		(5) Bituminous Works	**0.24%**	**Unit of measurement shall be in volume. Payment shall be made after completion.**
		(6) Misc. works (PCC, Drainage etc.)	**1.62%**	**Unit of measurement shall be in length. Payment shall be made after completion.**

1.3.2 Procedure for estimating the value of various Works done in location S2 shall be as follows:

Table 1.3.2

Location	**Item**	**Stage for Payment**	**Percentage weightage**	**Payment Procedure**
1	**2**	**3**	**4**	**5**
S2 (25.36%)	Special **Geotechnical Works (19.95%)**	(1) Providing and installing of nails as specified. (2) Providing and installing of composite/ hybrid wall as specified.	**15.30%** **4.65%**	**Payment shall be made on pro-rata basis on completion of a stage measured in height and the height in consideration should not be less than 5% (Five percent) of the total height**
	Erosion Protection Works (1.61%)	(1) Providing Revetment mattress as specified. (2) Installing Revetment mattress as specified.	**0.94%** **0.67%**	**Unit of measurement is surface area measure in Sqm. Payment of each stage shall be made on pro-rata basis on completion of a stage in area of not less than 10 (ten) percent of the total area.**

	Other Works (3.80%)	(1) Surface preparation and excavation	**0.06%**	**Payment shall be made in 'sqm' after completion.**
		(2) Backfilling works	**2.15%**	**Unit of measurement shall be in volume on pro rata basis on completion of a stage in volume of not less than 10 (ten) percent of the total volume.**
		(3) Granular sub-base works	**0.06%**	**Unit of measurement shall be in volume. Payment shall be made after completion.**
		(4) WMM works	**0.06%**	**Unit of measurement shall be in volume. Payment shall be made after completion.**
		(5) Bituminous Works	**0.20%**	**Unit of measurement shall be in volume. Payment shall be made after completion.**
		(7) Misc. works (PCC, Drainage etc.)	**1.27%**	**Unit of measurement shall be in length. Payment shall be made after completion.**

1.3.3 Procedure for estimating the value of various Works done in location S3 shall be as follows:

Table 1.3.3

Location	**Item**	**Stage for Payment**	**Percentage weightage**	**Payment Procedure**
1	**2**	**3**	**4**	**5**
S3 (25.27)	**Special Geotechnical Works (24.19%)**	(1) Providing and installing of nails as specified. (2) Providing and installing high tensile steel mesh as specified	**20.17%** **4.02%**	**Payment shall be made on pro-rata basis on completion of a stage measured in height and the height in consideration should not be less than 5% (Five percent) of the total height**

	Erosion Protection Works (0.00%)	NIL	NIL	**Not Applicable**
	Other Works (1.08%)	(1) Surface preparation and excavation	**0.12%**	**Payment shall be made in 'sqm' after completion.**
		(2) Drain	**0.20%**	**Unit of measurement shall be in length. Payment shall be made after completion.**
		(3) Stone masonry wall	**0.41%**	**Unit of measurement shall be in volume. Payment shall be made after completion.**
		(4) Misc. Works (Signages etc.)	**0.35%**	**Unit of measurement shall be in length. Payment shall be made after completion.**

1.3.4 Procedure for estimating the value of various Works done in location S4 shall be as follows:

Table 1.3.4

Location	**Item**	**Stage for Payment**	**Percentage weightage**	**Payment Procedure**
1	**2**	**3**	**4**	**5**
S4 (20.48%)	**Special Geotechnical Works (18.73%)**	(1) Providing and installing of nails as specified. (2) Providing and installing high tensile steel mesh as specified	**15.62%** **3.11%**	**Payment shall be made on pro-rata basis on completion of a stage measured in height and the height in consideration should not be less than 5% (Five percent) of the total height**
	Erosion Protection Works (0.00%)	NIL	NIL	**Not Applicable**

	Other Works (1.75%)	(1) Surface preparation and excavation	**0.09%**	**Payment shall be made in 'sqm' after completion.**
		(2) Drain	**0.20%**	**Unit of measurement shall be in length. Payment shall be made after completion.**
		(3) Stone masonry wall	**1.42%**	**Unit of measurement shall be in volume. Payment shall be made after completion.**
		(5) Misc. Works (Signages etc.)	**0.04%**	**Unit of measurement shall be in length. Payment shall be made after completion.**

2. Procedure for payment for Maintenance

2.1 The cost for maintenance shall be as stated in Clause 14.1.1.

2.2 Payment for Maintenance shall be made in quarterly installments in accordance with the provisions of Clause 19.7.

SCHEDULE -I

(See Clause 10.2.4)

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 projectfacilities required to be submitted by the Concessionaire is given below:

- Drawing showing plan and sectional details of valley slope restoration scheme.
- Drawings showing details of soil nail/soil reinforcement along with its connectiondetails.
- Drawings of drainage work showing drains.
- Drawings showing details of erosion protection scheme to be adopted for protection of rebuiltvalley slope and below the toe of proposed restoration scheme.

SCHEDULE -J

(See Clause 10.3.2)

PROJECT COMPLETION SCHEDULE

1 Project Completion Schedule

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

2 Project Milestone-I

2.1 Project Milestone-I shall occur on the date falling on the 120th (One Hundred Twentieth) day from the Appointed Date (the "**Project Milestone-I**").

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

3 Project Milestone-II

3.1 Project Milestone-II shall occur on the date falling on the 180th (One Hundred Eightieth) day from the Appointed Date (the "**Project Milestone-II**").

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

4 Project Milestone-III

4.1 Project Milestone-III shall occur on the date falling on the 270th (Two Hundred Seventieth)] day from the Appointed Date (the "**Project Milestone-III**").

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

5 Scheduled Completion Date

5.1 The Scheduled Completion Date shall occur on the 365th (Three Hundred Sixty fifth) day from the Appointed Date.

5.2 On or before the Scheduled Completion Date, the Contractor shall have completed

construction in accordance with this Agreement.

6 Extension of time

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

SCHEDULE -K

(See Clause 12.1.2)

TESTS ON COMPLETION

1 Schedule for Tests

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

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

2 Tests

2.1 Visual and physical test: The Authority's Engineer shall conduct a visual and physical check of construction to determine that all works and equipment forming part thereof conform to the provisions of this Agreement. The physical tests shall include [***].

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

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

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

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

3 Agency for conducting Tests

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

4 Completion Certificate

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

SCHEDULE -L

(See Clause 12.2 and 12.4)

PROVISIONAL CERTIFICATE

1 I, …….. (Name of the Authority's Engineer), acting as the Authority's Engineer, under and in accordance with the Agreement dated ……. (the **"Agreement"**), for the Special Repair Works at narrow zone and landslide area in between Rangpo to Ranipool on NH-10 in the state of Sikkim(the **"Project Highway"**) 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 undertaken to determine compliance of the Project Highway with the provisions of the Agreement.

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

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

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

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 the Special Repair Works at narrow zone and landslide area in between Rangpo to Ranipool on NH-10 in the state of Sikkim (the "**Project Highway**") on Engineering, Procurement and Construction (EPC) basis through …….. (Name of Contractor), hereby certify that the Tests in accordance with Article 12 of the Agreement have been successfully undertaken to determine compliance of the Project Highway with the provisions of the Agreement, and I am satisfied that the Project Highway can be safely and reliably placed in service of the Users thereof.

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

SIGNED, SEALED AND DELIVERED

For and on behalf of

the Authority's Engineer by:

(Signature)

(Name)

(Designation)

(Address)

SCHEDULE -M

(See Clauses 14.6, 15.2 and 19.7)

PAYMENT REDUCTION FOR NON-COMPLIANCE

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

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

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

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

2 Percentage reductions in lump sum payments

2.1 The following percentages shall govern the payment reduction:

	Item/Defect/Deficiency	Percentag
(a)	**Carriageway/Pavement**	
(i)	Potholes, cracks, other surface defects	10%
(ii)	Repairs of Edges, Rutting	5%
(b)	**Road,Embankment,Cuttings,Shoulders**	
(i)	Edge drop, inadequate cross-fall, undulations, settlement, potholes, ponding, obstructions	5%
(ii)	Deficient slopes, rain-cuts, disturbed pitching, vegetation growth, pruning of trees	5%
(c)	**HillRoadsandSpecialGeotechnicalWorksforLandslideRehabilitat**	
(i)	Non-replacement of Defective Polymeric Reinforcement	15%
(ii)	Non-replacement of Defective soil nails	5%
(iii)	Non-replacement of Defective Facia	5%
(iv)	Non-replacement of Defective Revetment Mattress	5%
(d)	**Roadside**Drains	
(i)	Cleaning and repair of drains	10%
(f)	**MiscellaneousItems**	
(i)	Removalofdeadanimals,brokendown/accidentalvehicles,fallentrees,road blockadesormalfunctioningofmobilecrane	5%

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

R=P/IOO x M x L1/L

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

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

L1 = Non-complying length

L = Total length of the road,

R = Reduction (the amount to be deducted for 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 18.1.1)

SELECTION OF AUTHORITY'S ENGINEER

1 Selection of Authority's Engineer

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

1.2 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

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

3 Appointment of Government entity as Authority's Engineer

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

Annex – I
(Schedule -N)

TERMS OF REFERENCE FOR AUTHORITY'S ENGINEER

1. Scope

1.1 These Terms of Reference (the "TOR") for the Authority's Engineer are being specified pursuant to the EPC Agreement dated ..... (the "Agreement), which has been entered into between the [name and address of the Authority] (the "Authority") and ..... (the "Contractor") for the Special Repair Works at narrow zone and landslide area in between Rangpo to Ranipool on NH-10 in the state of Sikkim**(the "Project Highway")** on Engineering, Procurement, Construction (EPC) basis, and a copy of which is annexed hereto and marked as Annex-A to form part of this TOR.

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

2. Definitions and interpretation

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

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

2.3 The rules of interpretation stated in Clauses 1.2, 1.3 and 1.4 of the Agreement shall apply, *mutatis mutandis*, to this TOR.

3. General

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

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

(a) any Time Extension;

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

(c) the Termination Payment; or

(d) any other matter which is not specified in (a), (b) or (c) above and which creates an obligation or liability on either Party for a sum exceeding Rs. 5,000,000 (Rs. fifty lakh).

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

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

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

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

4. Construction Period

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

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

4.3 The Authority's Engineer shall review the Quality Assurance Plan submitted by the Contractor and shall convey its comments to the Contractor within a period of 21 (twenty-one) days stating the modifications, if any, required thereto.

4.4 The Authority's Engineer shall complete the review of the methodology proposed to be adopted by the Contractor for executing the Works, and convey its comments to

the Contractor within a period of 10 (ten) days from the date of receipt of the proposed methodology from the Contractor.

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

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

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

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

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

4.10 The Authority's Engineer shall test check at least 20 (twenty) percent of the quantity or number of tests prescribed for each category or type of test for quality control by the Contractor.

4.11 The timing of tests referred to in Paragraph 4.9, and the criteria for acceptance/ rejection of their results shall be determined by the Authority's Engineer in accordance with the Quality Control Manuals. The tests shall be undertaken on a random sample basis and shall be in addition to, and independent of, the tests that may be carried out by the Contractor for its own quality assurance in accordance with Good Industry Practice.

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

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

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

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

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

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

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

5. Maintenance Period

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

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

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

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

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

6. Determination of costs and time

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

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

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

7. Payments

7.1 The Authority's Engineer shall withhold payments for the affected works for which the Contractor fails to revise and resubmit the Drawings to the Authority's Engineer in accordance with the provisions of Clause 10.2.4 (d).

7.2 Authority's Engineer shall

(a) within 10 (ten) days of receipt of the Stage Payment Statement from the Contractor pursuant to Clause 19.4, determine the amount due to the

Contractor and recommend the release of 90 (ninety) percent of the amount so determined as part payment, pending issue of the Interim Payment Certificate; and

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

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

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

8. Other duties and functions

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

9. Miscellaneous

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

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

9.3 Within 90 (ninety) days of the Project Completion Date, the Authority's Engineer shall obtain a complete set of as-built Drawings, in 2 (two) hard copies and in micro film form or in such other medium as may be acceptable to the Authority, reflecting the Project Highway as actually designed, engineered and constructed, including an as-built survey illustrating the layout of the Project Highway and setback lines, if any, of the buildings and structures forming part of Project Facilities; and shall hand them over to the Authority against receipt thereof.

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

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

SCHEDULE -O

(See Clauses 19.4.1, 19.6.1, and 19.8.1)

FORMS OF PAYMENT STATEMENTS

1. Stage Payment Statement for Works

The Stage Payment Statement for Works shall state:

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

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

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

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

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

(f) Deductions:
  (i) Any amount to be deducted in accordance with the provisions of the Agreement except taxes;
  (ii) Any amount towards deduction of taxes; and
  (iii) Total of (i) and (ii) above.

(g) Net claim: (e) – (f) (iii);

(h) The amounts received by the Contractor up to the last claim:
  (i) For the Works executed (excluding Change of Scope orders);
  (ii) For Change of Scope Orders, and
  (iii) Taxes deducted

2. Monthly Maintenance Payment Statement

The monthly Statement for Maintenance Payment shall state:

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

(b) the deductions for maintenance work not done;

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

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

(e) amount towards deduction of taxes

3. Contractor's claim for Damages

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

SCHEDULE -P

(See Clause 20.1)

INSURANCE

1 Insurance during Construction Period

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

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

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

1.2 The insurance under paragraph 1.1 (a) and (b) above shall cover the Authority and the Contractor against all loss or damage from 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 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

3.1 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.

The insurance cover shall be not less than: Rs. [50 lakh]

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

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

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

4 Insurance to be in joint names

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

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