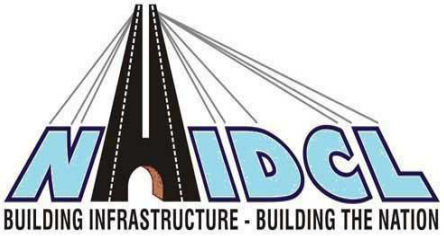
National Highways & Infrastructure Development Corporation Limited



ENGINEERING PROCUREMENT AND CONSTRUCTION (EPC) AGREEMENT & TECHNICAL SCHEDULES

FOR

Construction of Uni-Directional Khellani Tunnel of length 1.574 Km & its approach Road from Km 29.030 to Km 31.449 of total length of 2.419 Km on NH-244 in Union Territory of Jammu & Kashmir on EPC Mode

ON

ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC) MODE

NATIONAL HIGHWAYS & INFRASTRUCTURE DEVELOPMENT CORPORATION LTD

(MINISTRY OF ROAD TRANSPORT & HIGHWAYS, GOVT. OF INDIA)

JUNE, 2020

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

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SCHEDULES

Schedule-A

(See Clauses 2.1 and 8.1)

Site of the Project

1. The Site

(i) Project site starts from Goha at Ch. 29.030 and end at Khellani at Ch. 31.449.This proposed section of Goha - Khellani falls on the newly proposed alternate route for the Goha-Khellani and is a part of new alignment for NH-244. Project Highway shall include the land, buildings, structures and road works as described in **Annex-I** of this Schedule-A.

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

(iii) An inventory of the Site including the land, buildings, structures, road works, trees and any other immovable property on, or attached to, the Site shall be prepared jointly by the Authority Representative and the Contractor, and such inventory shall form part of the memorandum referred to in Clause 8.2 (i) of this Agreement.

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

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

Annex – I

(Schedule-A)

1. Site

Construction of Uni-directional Khellani Tunnel i.e. length of 1.541/1.574km (Tube-1/Tube-2) & its approaches from km 29.030 to km 31.449 of total length 2.419km including a rotary on West Portal side, 1 Major Bridge on East Portal side,& 5Culverts on Sudhmahadev - Goha - Khellani road section of NH-244 in Union Territory of Jammu & Kashmir. The land, carriageway and structures comprising the site are described below.

2. Land

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

Sr. No.	Chainage (km)		Right of Way (m)	Remarks
	From	To		
Nil				

3. Carriageway

There is no existing road since it is a new alignment.

4. Major Bridges

The Site includes the following Major Bridges:

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

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

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

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

6. Grade separators

The Site includes the following grade separators:

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

7. Minor bridges

The Site includes the following minor bridges:

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

8. Railway level crossings

The Site includes the following railway level crossings:

S. No.	Location (km)	Remarks
Nil		

9. Underpasses (vehicular, non-vehicular)

The Site includes the followingunderpasses:

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

10. Culverts

The Site has the following culverts:

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

11. Bus bays

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

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

12. Truck Lay byes

The details of truck lay byes are as follows:

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

13. Roadside drains

The details of the roadside drains are as follows:

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

14. Major junctions

The details of major junctions are as follows:

S. No.	Location		At grade	Separated	Category of Cross Road			
	From km	to km			NH	SH	MDR	Others
Nil								

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

15. Minor junctions

The details of the minor junctions are as follows:

S. No.	Location	Type	Remarks
Nil			

16. Bypasses

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

S. No.	Name of bypass (town)	Chainage (km) From km to km	Length (in Km)
Nil			

17. Other structure

Nil

Annex – II

(As per Clause 8.3 (i))

(Schedule-A)

Dates for providing Right of Way of Construction Zone

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

Sl. No.	From (Km)	To (Km)	Length (m)	Width (m)	Date of providing Right of Way of Construction Zone *
1	2		3	4	5
(i) Full Right of Way (full width) New Alignment	29.030	29.100	70.0	14.00	150th (one hundred & fifty) days after the Appointed Date -
	29.100	29.200	100.0	17.35	
	29.200	29.300	100.0	21.59	
	29.300	29.400	100.0	27.57	
	29.400	29.490	90.0	40.56	
	31.100	31.200	100.0	47.00	
	31.200	31.300	100.0	35.65	
	31.300	31.400	100.0	41.00	
(ii) Part Right of Way (part width)	29.490	31.100	1610.0	25.75	Working permission will be provided on Appointed date
(iii) Balance Right of Way (width)	29.490	31.100	1610.0	25.75	150th (one hundred & fifty) days after the Appointed Date

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

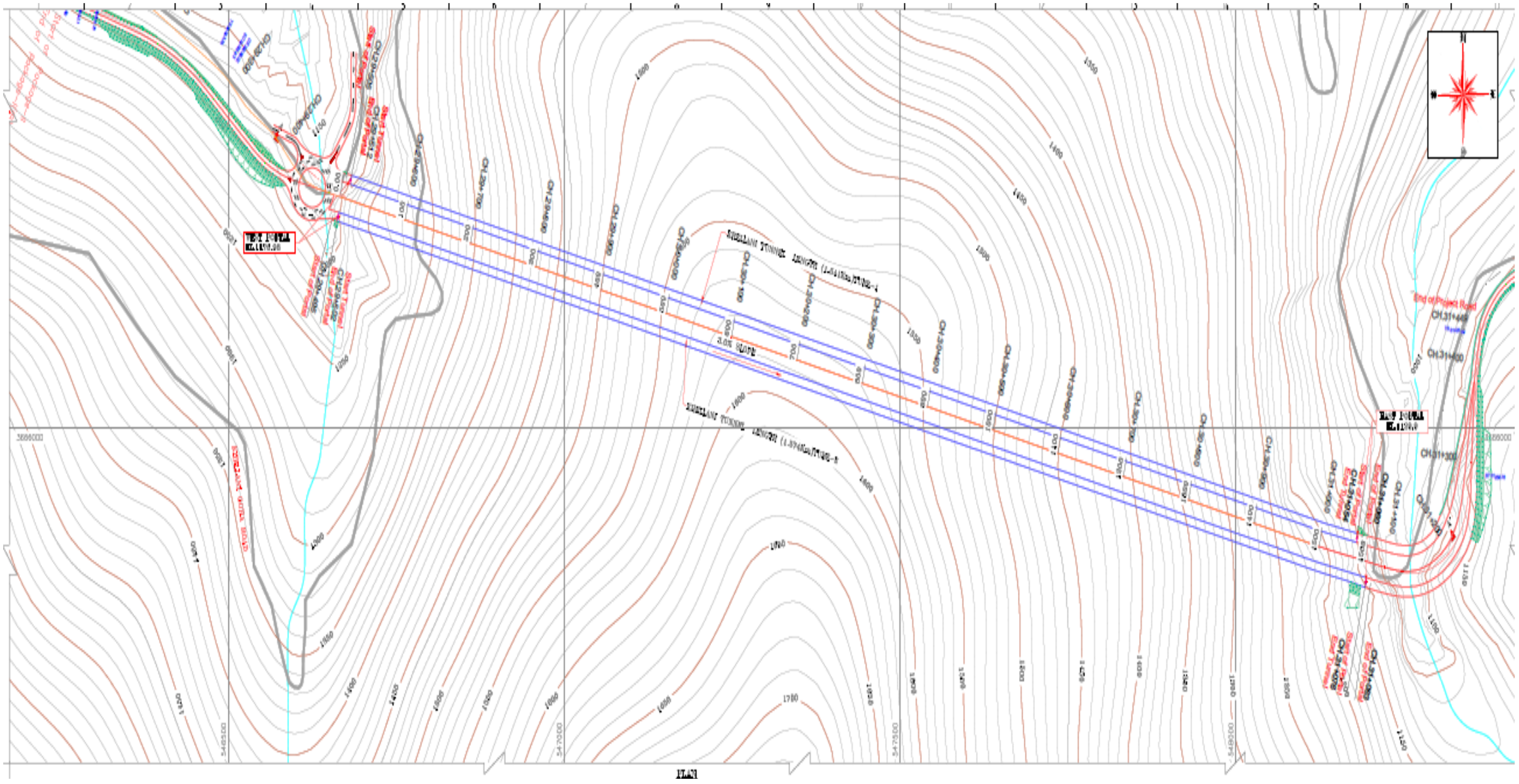
Annex - III

(Schedule-A)

Alignment Plans

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

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

(Schedule-A)

Environment Clearances

As per EIA notification 2006 and its amendment S.O.2559 (E) Dt 22nd August 2013, S.O 996(E) Dt 10th April 2015, S.O 382(E) Dt 3rd February 2015 Environmental Clearance Exempted from the purview of the Environmental Impact Assessment.

Schedule - B

(See Clause 2.1)

Development of the Project Highway

1. Development of the Project Highway

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

2. Rehabilitation and augmentation

Nil

3. Specifications and Standards

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

Annex – I

(Schedule-B)

Description of the Project

Construction of Uni-directional Khellani Tunnel i.e. length of 1.541/1.574km (Tube-1/Tube-2) & its approaches from km 29.030 to km 31.449 to 2-lane with paved shoulder of total length 2.419km including a rotary on West Portal side, 1 Major Bridge on East Portal side, & 5 Culverts on Sudhmahadev - Goha - Khellani road section of NH-244 in Union Territory of Jammu & Kashmir. Details of the proposed project section are as given below:

Tunnel (Uni-directional/Twins Tube)

Length of Tube-1 (Left)	1.541 km
Length of Tube-2 (Right)	1.574 km
Western Portal	
Elevation	1176.98 m
Location	E546681.801 N3666249.380 (Tube-1)
	E546662.606 N3666212.343 (Tube-2)
Approach road to portal	two lane approach road of 482m (Tube-1) length (including a rotary, bridges and viaducts)
	two lane approach road of 472m (Tube-2) length (including a rotary, bridges and viaducts)
Eastern Portal	
Elevation	1129.90 m
Location	E548180.338, N3665890.313 (Tube-1)
	E548193.493, N3665846.127 (Tube-2)
Approach road to portal	two lane approach road of 395m (For Tube-1) length (including bridges and viaducts)
	two lane approach road of 373m (For Tube-2) length (including bridges and viaducts)

1. Development of the project section

(i) The Project Highway shall follow the new alignment unless otherwise specified by the Authority and shown in the alignment plans specified in Annex-III of Schedule-A.

(ii) Width of the proposed tunnel and its approach road carriageway

A. Tunnel Details

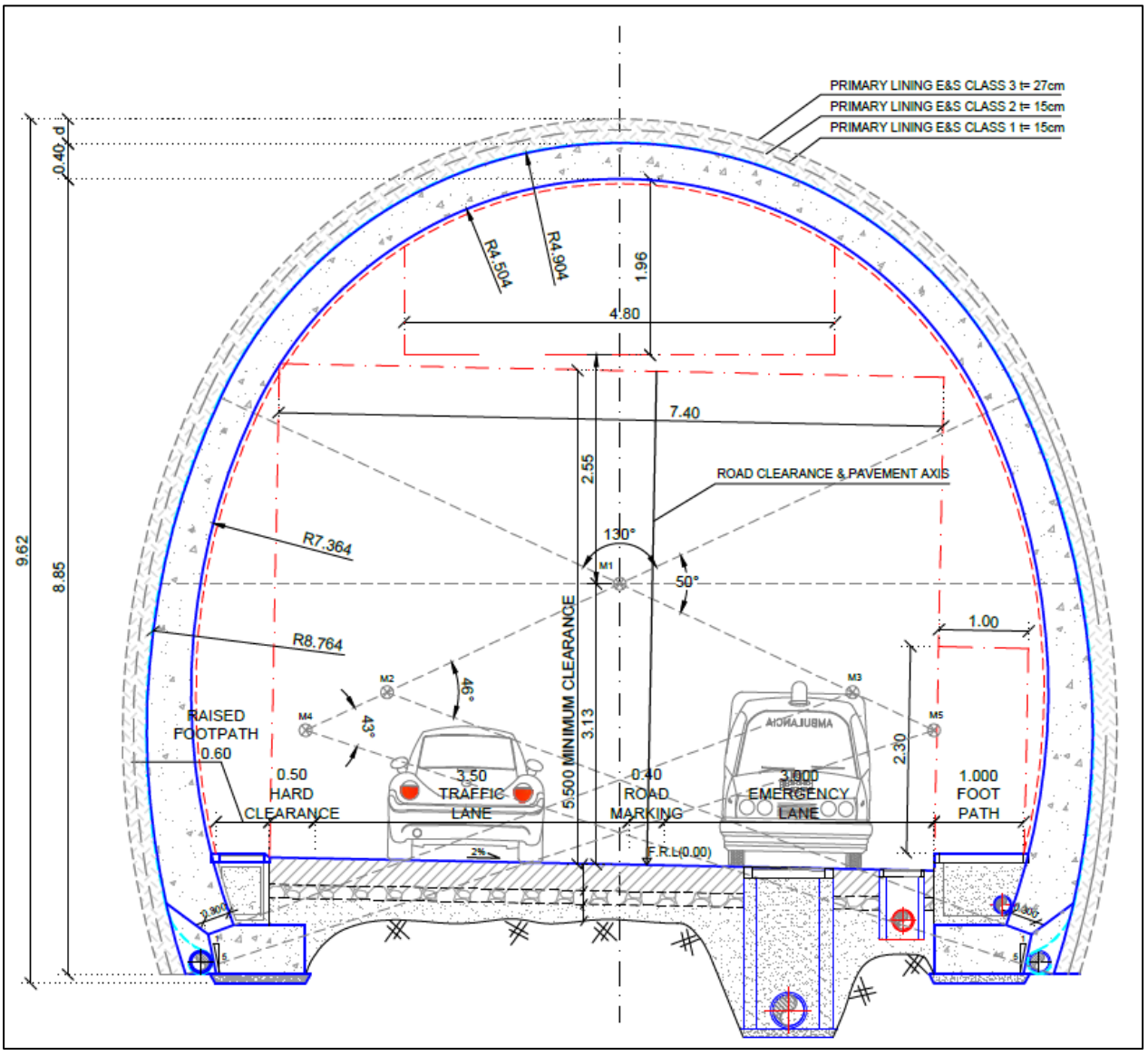
a) Cross Section Width and Height of proposed Tunnel

Summary of Road Cross Section inside the tunnel is given below:

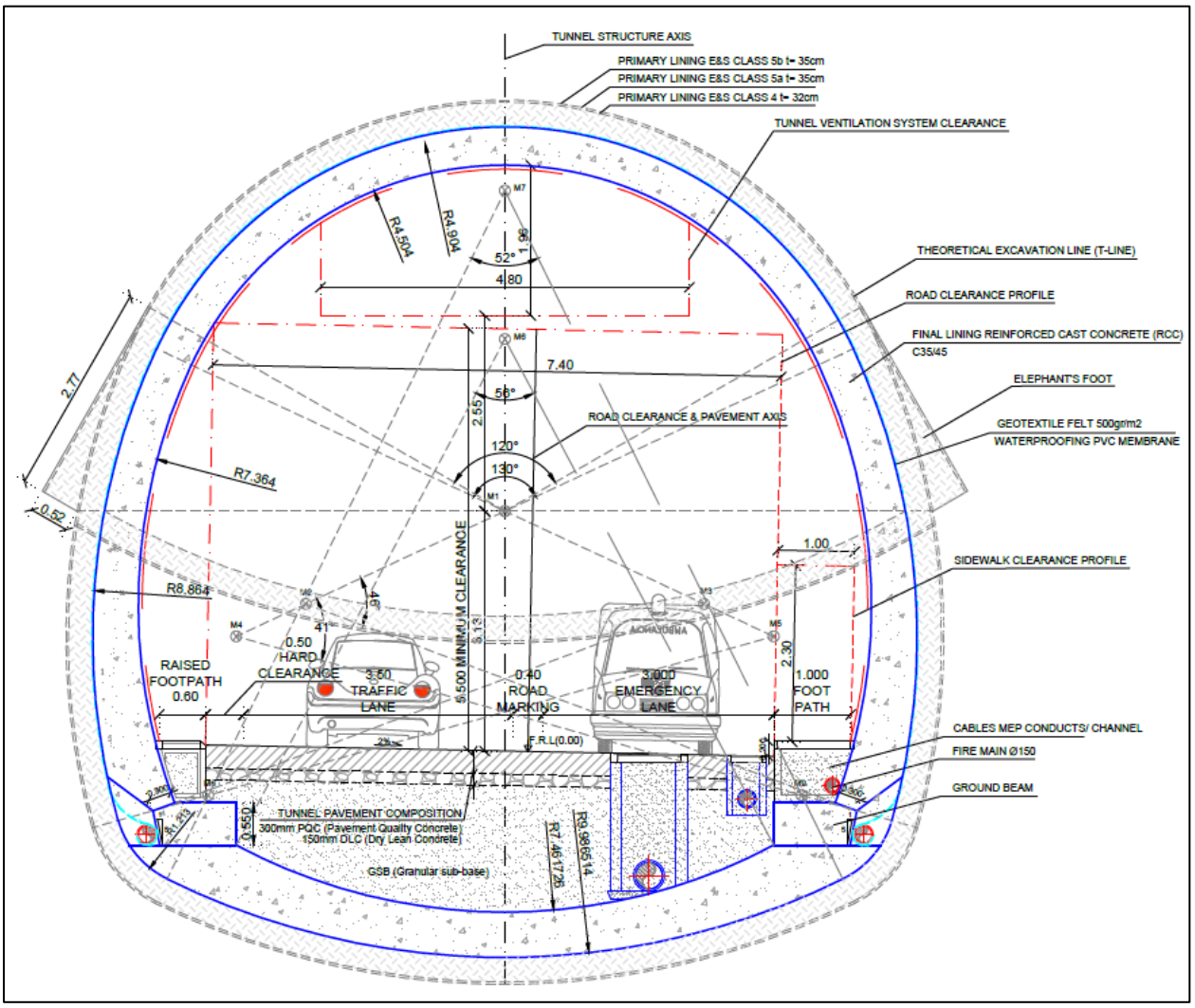
Cross Section Element	Width
Walkway	0.60m
Hard Shoulder	0.50m
Driving Lane	3.50m

Road Marking	0.40m
Emergency Lane	3.00m
Walkway	1.00m
Overall	**9.00m**

Cross section of the tunnel is given below.



Uni-directional Tunnel Cross Section without invert



Uni-directional Tunnel Cross Section with invert

b) Pavement

The road pavement in the tunnel consists of following layers,

- 300 mm pavement quality concrete
- 150 mm dry lean cement concrete subbase layer
- 450 mm GSB

c) Ventilation

A longitudinal ventilation system shall be provided for Khellani Tunnels. Ventilation system shall be provided as per the Technical specifications and Guidelines for Road Tunnels IRC: SP: 91-2010, NFPA 502 (2017), PIARC Technical Committee C4 – Road Tunnels: Vehicle Emissions and Air Demand for Ventilation (2011).

d) Final Interior Finish

The main traffic tunnel shall have a final interior finish of a fire-resistant material of suitable surface characteristics as per Contractor's detailed design subject to approval by Authority Engineer.

e) Lighting and E&M Facilities

As per Contractor's detailed design subject to approval by the Authority Engineer. Normal Lighting & Emergency Lighting in the Road tunnel shall be designed according to the Technical Specifications and CIE 88:2004 standard "Guide for the Lighting of Road Tunnels and Underpasses" for two- way traffic including Cable & cable laying, Main Electrical panel & Sub

Panels, earthing of complete offered system, galvanized supporting structure and all other necessary accessories, etc. as per the design requirement. Also, the Guidelines for Road Tunnels IRC: SP: 91-2010 will be considered. The light intensity of the entry and exit zones shall be adapted to the actual outside lighting level according to external conditions (day/night, regulation through measurement of luminous density).

Tunnel safety facilities such as CCTV- cameras, traffic lights, variable message signs, traffic loop detectors, emergency communications, alarm push buttons, fire detection systems etc. shall be provided as per Contractors detailed design.

f) Drainage and Waterproofing Concept

The tunnel shall be designed as a dry and drained tunnel as per contractor's detailed design. A waterproofing membrane shall be provided as per the drawing of cross section of tunnel. The water is drained along the bottom of the side walls with perforated drainage pipes.

g) Construction Concept

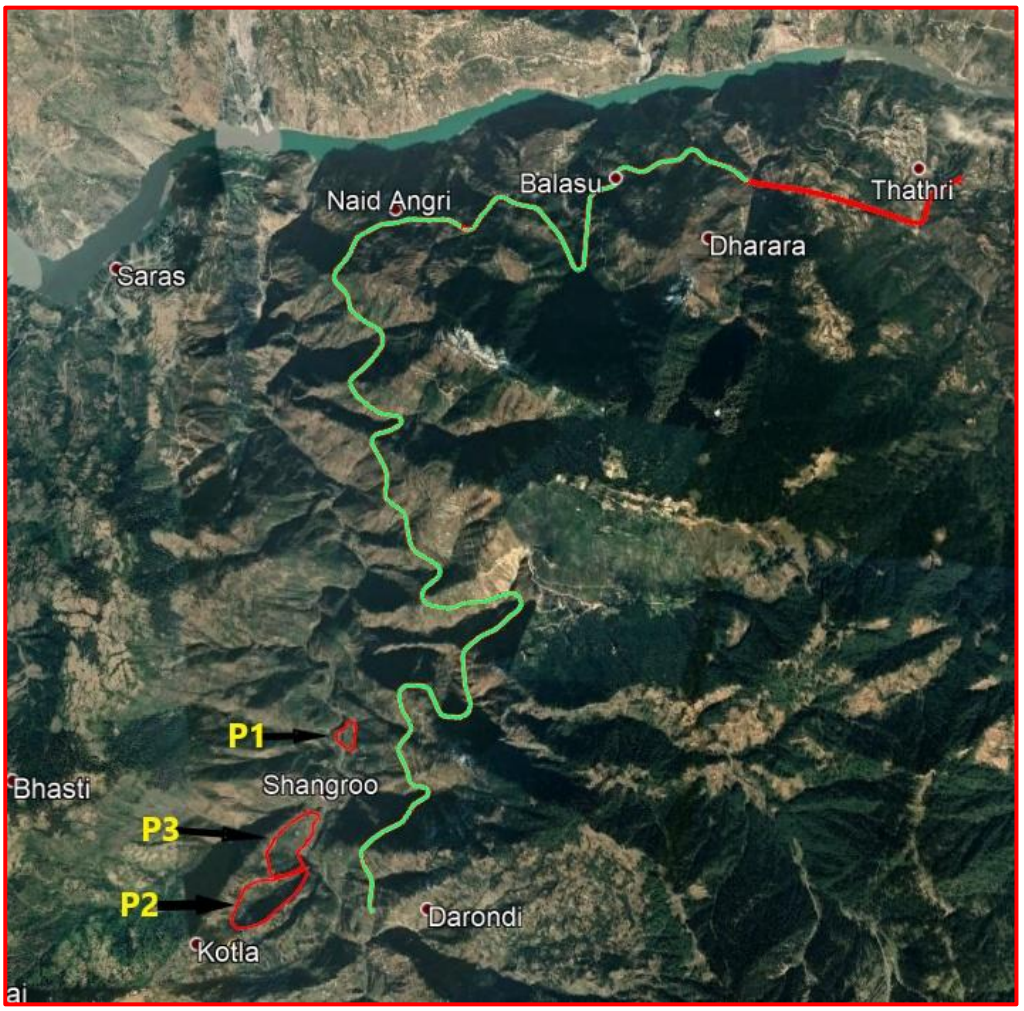
The construction method of the tunnel shall be internationally accepted method as proposed in the Technical proposal maintaining the clear profile with prior approval of NHIDCL in consultation with the Authority Engineer. However, the method of construction is Contractor's choice. The Tunnel will be constructed from both the tunnel portals.

h) Muck Dump Disposal

Up to three muck dumping sites have been proposed for the construction of tunnel and approach roads. Prior to any disposal of muck dump material, necessary permission shall be obtained from the local authorities (Civil administration/Forest/Wildlife) as per law for which the local NHIDCL office will provide necessary assistance. For estimation of capacity of the individual pockets the Contractors are required to carry out reconnaissance in coordination with local NHIDCL authorities. Muck disposal and management shall be carried out in accordance with the Environmental Laws of State/Central Govt.

The most suitable locations for dumping the muck that would be generated from the Goha Khellani tunnel and its approach road have been shown in below table.

Sl. No.	Area name	Pocket	Approx. Area in Kanal (1 Kanal = 505.857 sq.m)	Location	Photograph	Co-ordinates
1	Sangru	P1	39500	Near Sangru	Not Available	33° 5′ 5″ N 75° 27′ 24.5″E
2	Near Bari Village	P2	150000	Near Bari	Not available	33° 4′ 29″ N 75° 27′ 3.5″E
3	Near Bari Village	P3	183000	Near Bari	Not Available	33° 4′ 14.25″ N 75° 26′ 56″E
Total			**372500/735**			



B. Width of Approach road Carriageway

(a) Two-Laning with paved shoulders shall be undertaken. The paved carriageway shall be 9m wide & 10m for road section and 9m wide for tunnel section accordance with the typical cross section's drawings.

(b) Except as otherwise provided in this agreement, the width of the paved carriageway and cross-sectional features shall confirm to paragraph 1.1 above.

2. Geometric Design and General Features

(i) General

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

(ii) Design speed

The design speed shall be the maximum design speed of 60 Km/hr. and minimum design speed of 40 km/hr. for mountainous/hilly terrain as per IRC: SP-73:2018 and IRC: SP-48:1998

(iii) Improvement of the existing roadgeometrics

In the following sections, where improvement of the existing road geometrics to the prescribed standards is not possible, since the existing road is being abandoned and new alignment is being proposed.

Sl. No.	Stretch (from km to km)	Type of deficiency	Remarks
Nil			

(iv) Right ofWay

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

(v) Type of shoulders

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

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

(b) In open country/hilly areas, paved shoulders of 1.5m width shall be provided either side or balance 1.0m width earthen shoulder at valley side only shall be covered with 150 mm thick compacted layer of granular material.

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

(vi) Lateral and vertical clearances at underpasses

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

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

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

(vii) Lateral and vertical clearances at overpasses

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

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

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

(viii) Serviceroads

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

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

(ix) Grade separated structures

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

[Refer to the provision of relevant Manual and provide details]

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

In the case of grade separated structures, the type of structure and the level of the Project Highway and the crossroads shall be as follows:

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

(x) Cattle and pedestrian underpass/overpass

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

Sl. No.	Location	Type of crossing
Nil		

(xi) Typical cross-sections of the ProjectHighway

Following typical cross sections shall be provided for the Project Highway However to be designed as per manual.

Summary of TCS (Main Road)				
Sr. No.	Detail	TCS	Length	
			(m)	Kms
1	2-lane carriageway with paved shoulder in mountainous terrain one side cut & one side with protection as applicable (New construction)	1A	54	0.054
2	2-lane carriageway with paved shoulder in mountainous terrain one side cut & one side with protection as applicable (Reconstruction)	1B	320	0.320
3	2-lane carriageway with paved shoulder in mountainous terrain with both side cut (New construction)	3A	30	0.030
4	2-lane carriageway with paved shoulder in mountainous terrain with both side cut & with rock bolting on RHS (New construction)	5A	120	0.120
8	Major Bridge		175	0.175
9	Tunnel		1565	1.565
	Tunnel portal		30	0.030
	Junction		125	0.125
Total Design Length			**2419**	**2.419**

3. Intersections and Grade Separators

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

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

(i) At-grade intersections

Sl. No.	Location of intersection	Type ofinter section	Other features
1	29+458	Y	On Rotary

(ii) Grade separated intersection with/without ramps

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

4. Road Embankment and Cut Section

(i) Construction of new road embankment/ cuttings shall conform to the Specifications and Standards given in Section 4 of the Manual and the specified cross-sectional details.

(ii) Raising of the existing road

The existing road shall be raised in the following sections:

Sl. No.	Section (from km to km)	Length	Extent of raising [Top of finished road level]

Nil

5. Pavement Design

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

(ii) Type ofpavement

Flexible pavement is proposed at the main carriageway of highway in accordance with IRC: 37-2018.

Layer	Thickness (mm)
BC	40
DBM	70
WMM (Upper layer)	125
WMM (Bottom layer)	125
GSB (Upper layer)	100
GSB (Bottom Layer)	100
Subgrade	500
Total Thickness	**1060**

(iii) Design requirements

(a) Design Period andstrategy

Flexible pavement for new pavement shall be designed for a period of 15 years and rigid pavement shall be designed for a minimum design period of 30 years. Stage construction shall not be permitted.

(b) Design Traffic

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

6. Roadside Drainage

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

Sr. No.	Design Chainage (Km)		Length (m)	Drain	Side
	From	To			
1	29+030	29+350	320	PCC Drain	RHS
2	31+245	31+260	15	PCC Drain	RHS
3	31+260	31+380	2x120	PCC Drain	LHS+RHS
4	31+380	31+410	2x30	PCC Drain	LHS+RHS
5	31+410	31+449	39	PCC Drain	RHS

1312m length of Catch drain shall be constructed in this stretch from km 29+030 to km 31+449.

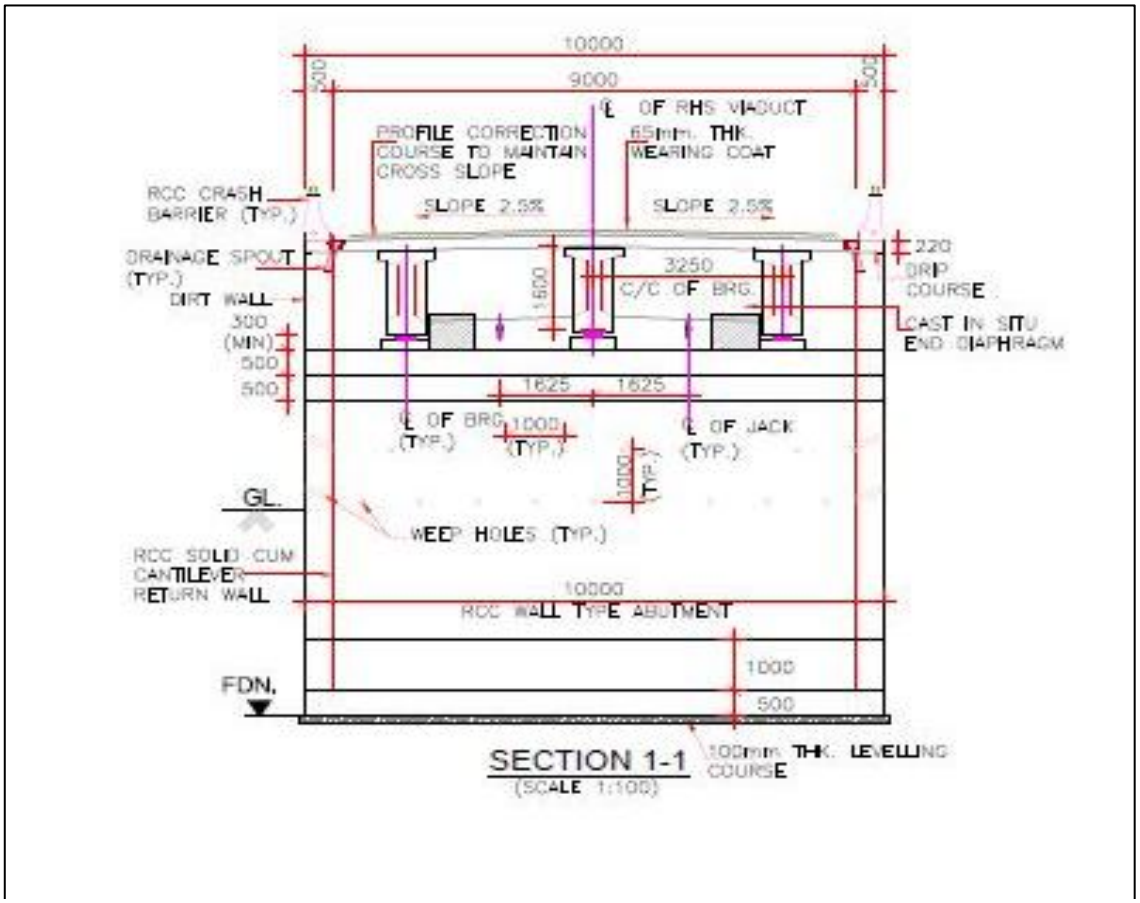
7. Design of Structures

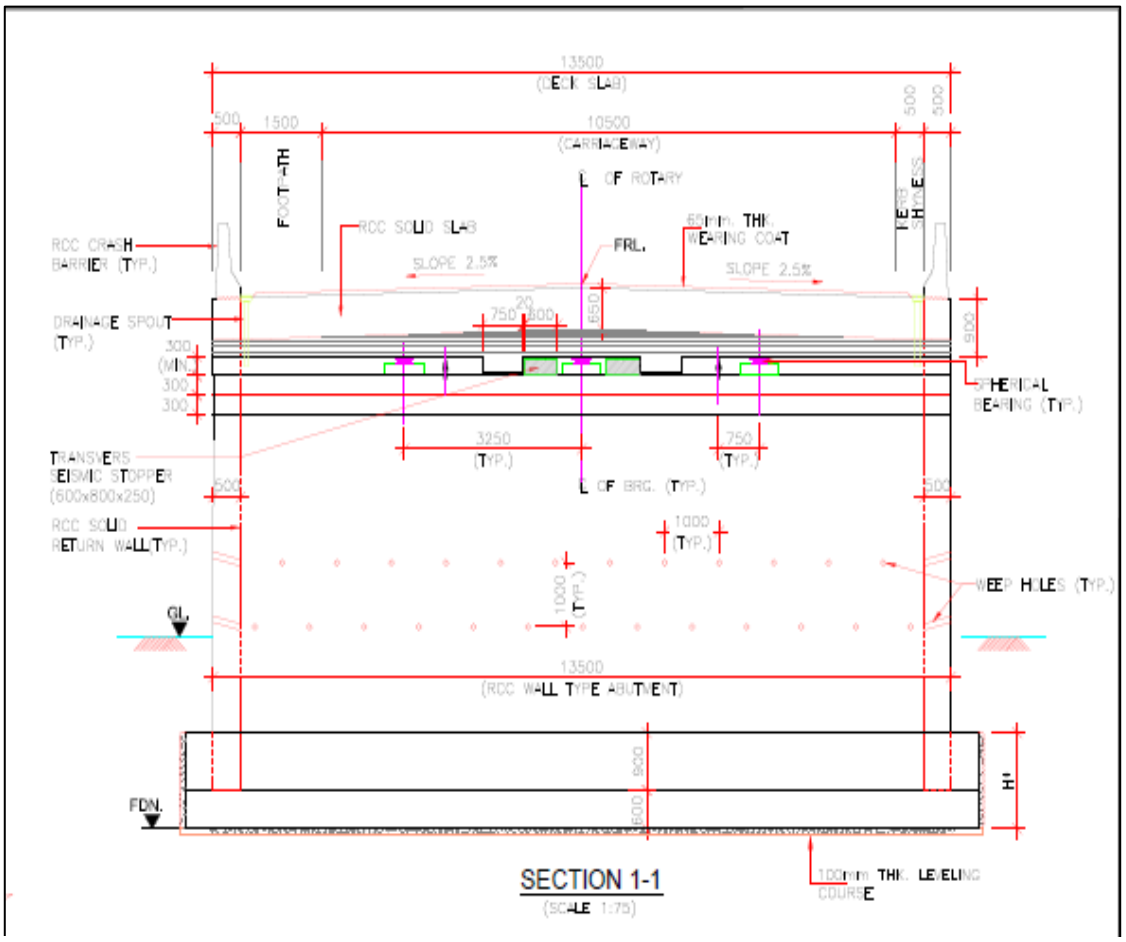
(i) General

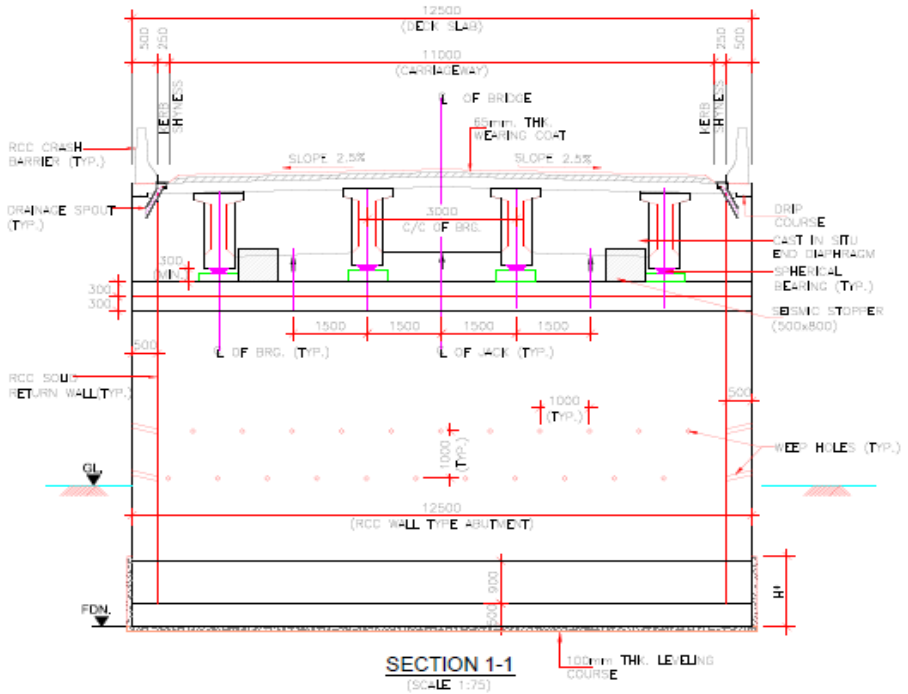
(a) All bridges, culverts and structures shall be designed and constructed in accordance with the provision of relevant Manual and shall conform to the cross- sectional features and other details specified therein.

(b) Width of the carriageway of new bridges and structures shall be asfollows:

Sl. No.	Structure/ Bridge at km	Width of carriageway and cross-sectional features*
1	31+158 (LHS) & 31+140 (RHS)	Width of Carriageway – 9.0 m including KS Crash Barrier – 0.5 m (both sides) Total Width – 10 m
2	29+470(RHS) & 29+485(LHS)	Width of Carriageway –11m including KS Width of footpath – 1.5m (one sides) Crash Barrier – 0.5m (both sides) Total Width – 13.5m







(c) The following structures shall be provided withfootpaths:

Sl. No.	Location at km	Span Arrangement No. x Length (m)	Remarks
1	31+158	7X25m	LHS
2	31+140	4X25m	RHS

(d) All bridges shall be high-level bridges.

Refer to the provision of relevant Manual and state if there is any exception

(e) The following structures shall be designed to carry utility services specified in table below:

Sl. No.	Bridge at km	Utility service to be carried	Remarks
1	29+470	Electricity cables, OFC cables etc.	LHS
	29+458	Electricity cables, OFC cables etc.	RHS
2	31+158	Electricity cables, OFC cables etc.	LHS
	31+140	Electricity cables, OFC cables etc.	RHS

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

(ii) Culverts

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

(b) Reconstruction of existing culverts:

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

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

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

(c) Widening of existingculverts:

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

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

(d) Additional new culverts shall be constructed as per particulars given in the tablebelow:

Main Road			
Sl. No.	**Culvert Type**	**Chainage in km**	**Proposed Span No. x Length x Ht.**
1	Box culvert	29+060	1x3x3
2	Box culvert	29+332	1x3x3
3	Box culvert	31+340	1x3x3
4	Box culvert	31+425	1x3x3
5	Box culvert	31+455	1x3x3

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

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

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

(iii) Bridges

(a) Existing bridges to be re-constructed/widened

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

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

*Attach GAD

(ii) The following narrow bridges shall bewidened:

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

@ Attach cross-section

(b) Additional newbridges

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

Main Road							
Sl.No.	Type of Structure	Design Chainage	Total Length (m)	Span Arrangement	Type of Superstructure	Deck Width (m)	Remarks
1	Rotary	29+470	24	2X12	RCC Solid slab	13.5	2 Lane on RHS
		29+458	60	5X12	RCC Solid slab	13.5	2 Lane on LHS
2	Major Bridge	31+140	100	4x25	Steel Composite I Girder with cast in situ deck slab	2 X 10	2 Lane Bridge on RHS
		31+158	175	7x25			2 Lane Bridge on LHS

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

Sl. No.	Location at km	Remarks
Nil		

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

Sl. No.	Location at km	Remarks
Nil		

(e) Drainage system for bridge decks

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

(f) Structures in marine environment

Refer to the provision of relevant Manual and specify the necessary measures / treatments for protecting structures in marine environment, where applicable.

(iv) Rail-road bridges

(a) Design, construction and detailing of ROB/RUB shall be as specified in the provision of relevant Manual. [Refer to the provision of relevant Manual and specify modification, if any]

(b) Road over-bridges

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

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

(c) Road under-bridges

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

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

(v) Grade separated structures

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

(vi) Repairs and strengthening of bridges and structures

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

(a) Bridges

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

(b) ROB /RUB

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

(c) Overpasses/Underpasses and otherstructures

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

(vii) List of Bridges andStructures

The following is the list of the Bridges and Structures:

S. No.	Type of Structure	Design Chainage	Remarks
1	Rotary	29+470	2 Lane Bridge on RHS
		29+458	2 Lane Bridge on LHS
2	Major Bridge	31+140	2 Lane Bridge on RHS
		31+158	2 Lane Bridge on LHS

8. Design of Tunnel

(i) General

(a) Tunnel shall be designed and constructed in accordance with the provision of relevant Indian/International standards and shall conform to the cross- sectional features and other details specifiedtherein.

(b) Width of the carriageway of tunnel shall be asfollows:

Sl. No.	Tunnel Chainage from to (in km)	Width of carriageway
1	29+512to 31+054	9 m
	29+502 to 31+076	9m

(c) The following tunnel shall be provided with footpaths:

Sl. No.	Location at km	Remarks

1	29+512/29+502 to 31+054/31+076 (Tube-1/Tube-2)	Tunnel

(d) Cross-section of the tunnel the Project Highway shall conform to the typical cross-sections given in the provision of relevant Manual.

9. Traffic Control Devices and Road Safety Works

(i) Traffic control devices and road safety works shall be provided in accordance with the provision of relevantManual.

(ii) Specificationsofthereflectivesheeting.

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

Main Road			
Sl. No.	**Traffic Signages, Road Marking and other appurtenances**	**unit**	**Quantity**
1	Road Marking: -Lines, dashes, arrows	Sq. m	1452
2	900 mm triangular	Nos.	8
3	900 mm circular	Nos.	2
4	Rectangular 920x1620 mm	Nos.	2
5	Rectangular 900x450 mm	Nos.	12
6	5th Km Stone	Nos.	1
7	Ordinary Km Stone	Nos.	2
8	Hectometre Stone	Nos.	9
9	Studs	Nos.	201
10	Boundary pillars	Nos.	20

10. Roadside Furniture

Roadside furniture shall be provided in accordance with the provision of relevant Manual.

(i) Direction and Place Identification signs (2000mm x 1500mm) = 3 sq. m.

(ii) Gantry Mounted Advance Direction signs = 3 Ton

(iii) Delineators = 69 Nos.

11. Compulsory Afforestation

Refer to the provision of relevant Manual and specify the number of trees which are required to be planted by the Contractor as compensatory afforestation.

12. Hazardous Locations

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

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

13. **Retaining and Beast wall**

Retaining wall and Breast walls shall be provided to arrest damage cause to the valley side and the road, by under cutting by stream or other water course as per site requirement.

Breast wall Left Hand Side			
From	To	Length in m	Height in m
31+270	31+290	20	10
TOTAL LENGTH		20	

Right Hand Side			
From	To	Length in m	Height in m

29+300	29+310	10	10
29+370	29+410	40	10
31+060	31+070	10	10
TOTAL LENGTH		60	

Retaining wall Left Hand Side			
Chainage		Length	Height Adopted
From	To		
29+290	29+310	20	2.50
29+370	29+390	20	2.50
Total Length		40	

Retaining wall Left Hand Side			
Chainage		Length	Height Adopted
From	To		
29+200	29+210	10	3.50
29+320	29+350	30	3.50
Total Length		40	

14. Special Requirement for Hill Roads

In accordance with section 13 of the manual (from IRC: SP: 73-2018), IRC: SP 48: 1998 and Recommended practices for Treatment of Embankment and Roadside slopes for Erosion control (First Revision), IRC: 56-2011 and relevant IRC codes.

15. Slope Protection

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

Gabion Wall (Main Road)					
Sr. No.	**Chainage (km)**		**Length (km)**	**Height (m)**	**Side**
	From	**To**			
1	29+420	29+430	10	10	LHS
2	31+070	31+250	180	8	LHS
3	31+410	31+450	40	7	LHS
Total			**230**		

16. Change of Scope

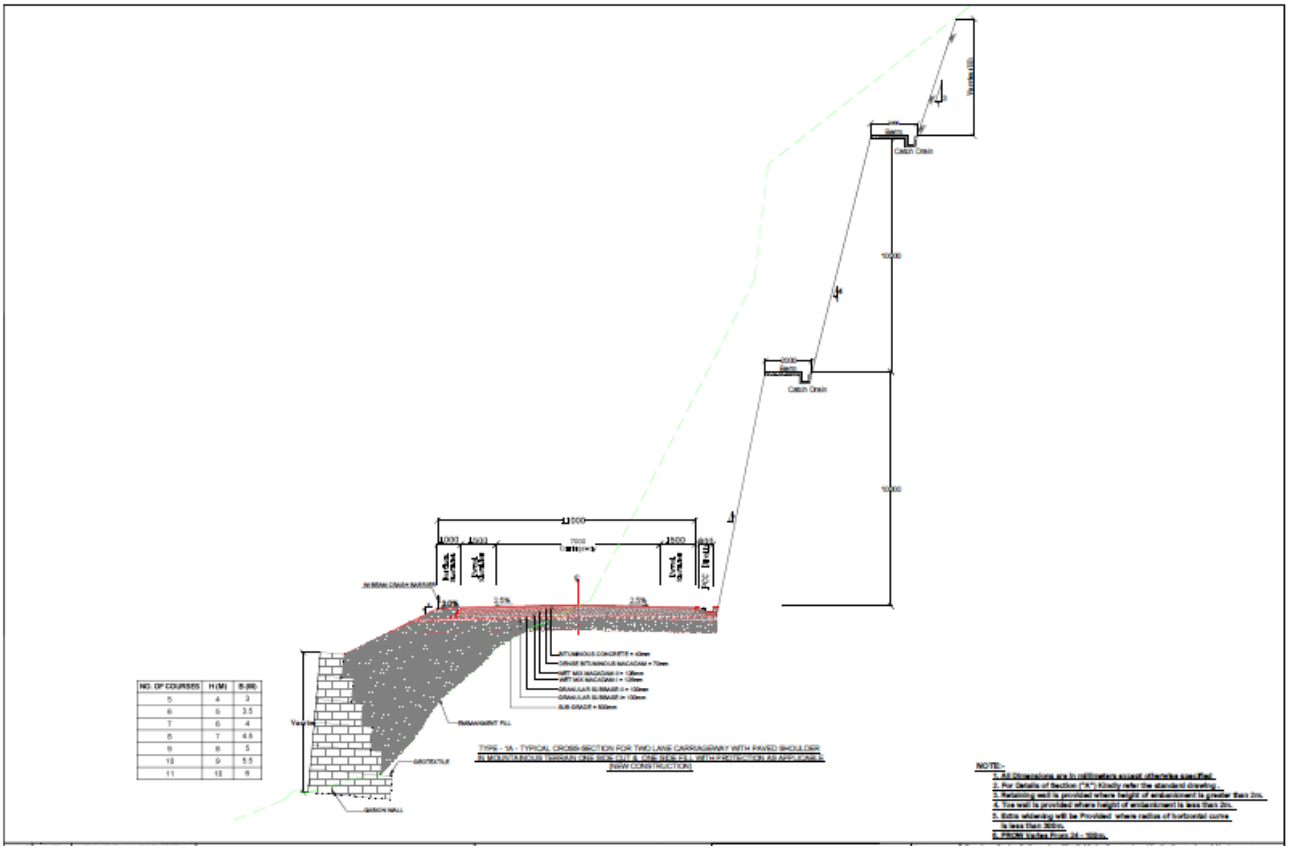
The length of Structures and bridges specified hereinabove shall be treated as an approximate assessment. The actual lengths as required on the basis of detailed investigations shall be determined by the Contractor in accordance with the Specifications and Standards. Any variations in the lengths specified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

17. Indicative Chainages with applicable typical Cross section

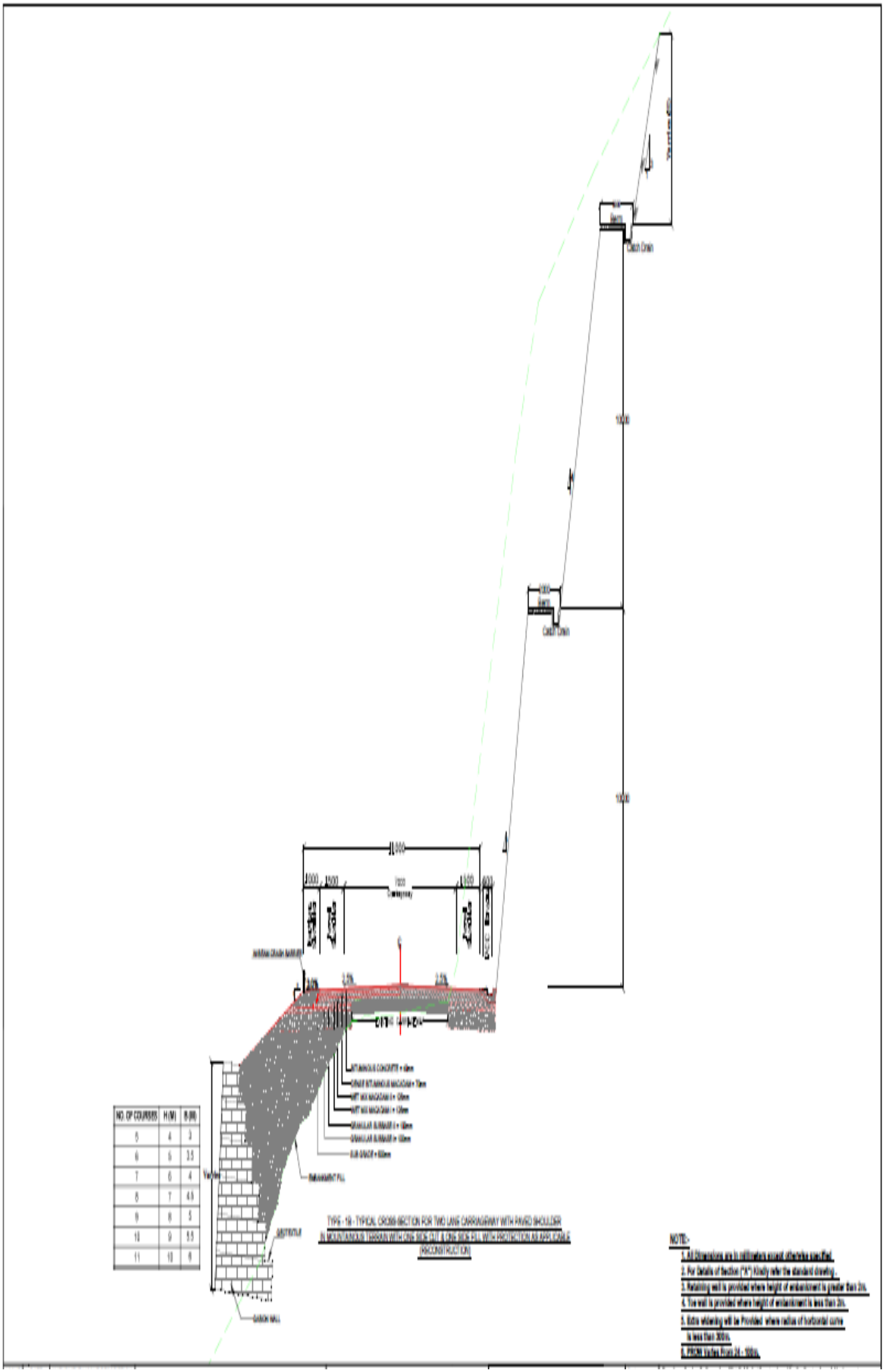
TCS Schedule of Main Road					
Sr. No.	**Chainage in km**		**Length in m**	**TCS Type**	**TCS DETAILS**
	From	**To**			
1	29+030	29+350	320	TCS-1B	One side cut & one side with protection as applicable (Reconstruction)
2	29+350	29+475	125	Rotary	Rotary

TCS Schedule of Main Road					
Sr. No.	**Chainage in km**		**Length in m**	**TCS Type**	**TCS DETAILS**
	From	**To**			
3	29+475	29+490	15	TUNNEL portal	
4	29+490	31+055	1565	TUNNEL	Tunnel Approach Left Viaduct/ Right Cut
5	31+055	31+070	15	TUNNEL portal	
6	31+070	31+245	175	MAJOR BRIDGE	Tunnel Approach Left Viaduct/ Right Cut
7	31+245	31+260	15	TCS-1A	One side cut & one side with protection as applicable (New construction)
8	31+260	31+380	120	TCS-5A	Both side cut with rock bolting on RHS (New construction)
9	31+380	31+410	30	TCS-3A	Both side cut (New construction)
10	31+410	31+449	39	TCS-1A	One side cut & one side with protection as applicable (New construction)

TCS of Main Road



NO. OF COURSES	H (M)	B (M)
5	4	3
6	5	3.5
7	6	4
8	7	4.5
9	8	5
10	9	5.5
11	10	6

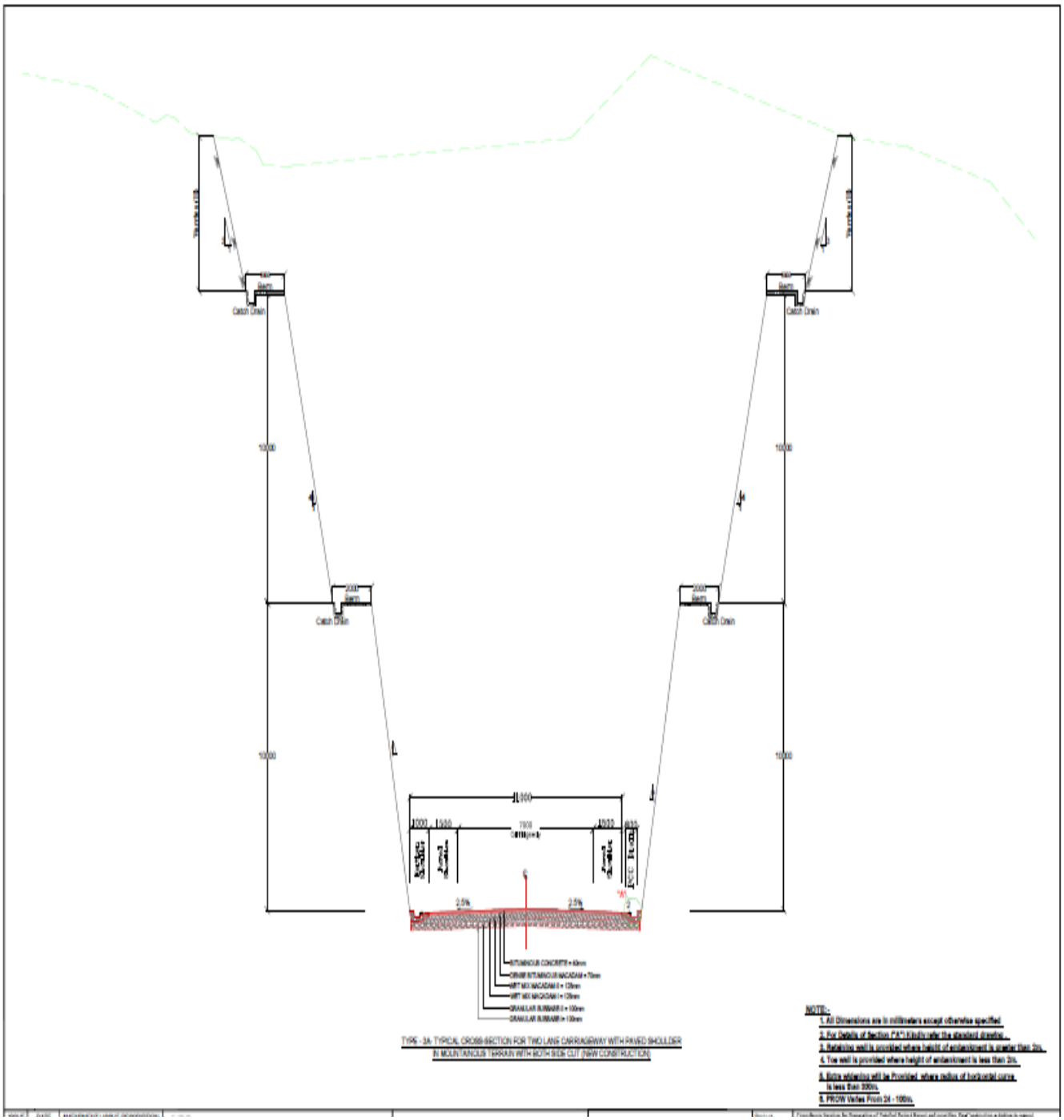


NO. OF COURSES	H (M)	B (M)
5	4	3
6	5	3.5
7	6	4
8	7	4.5
9	8	5
10	9	5.5
11	10	6

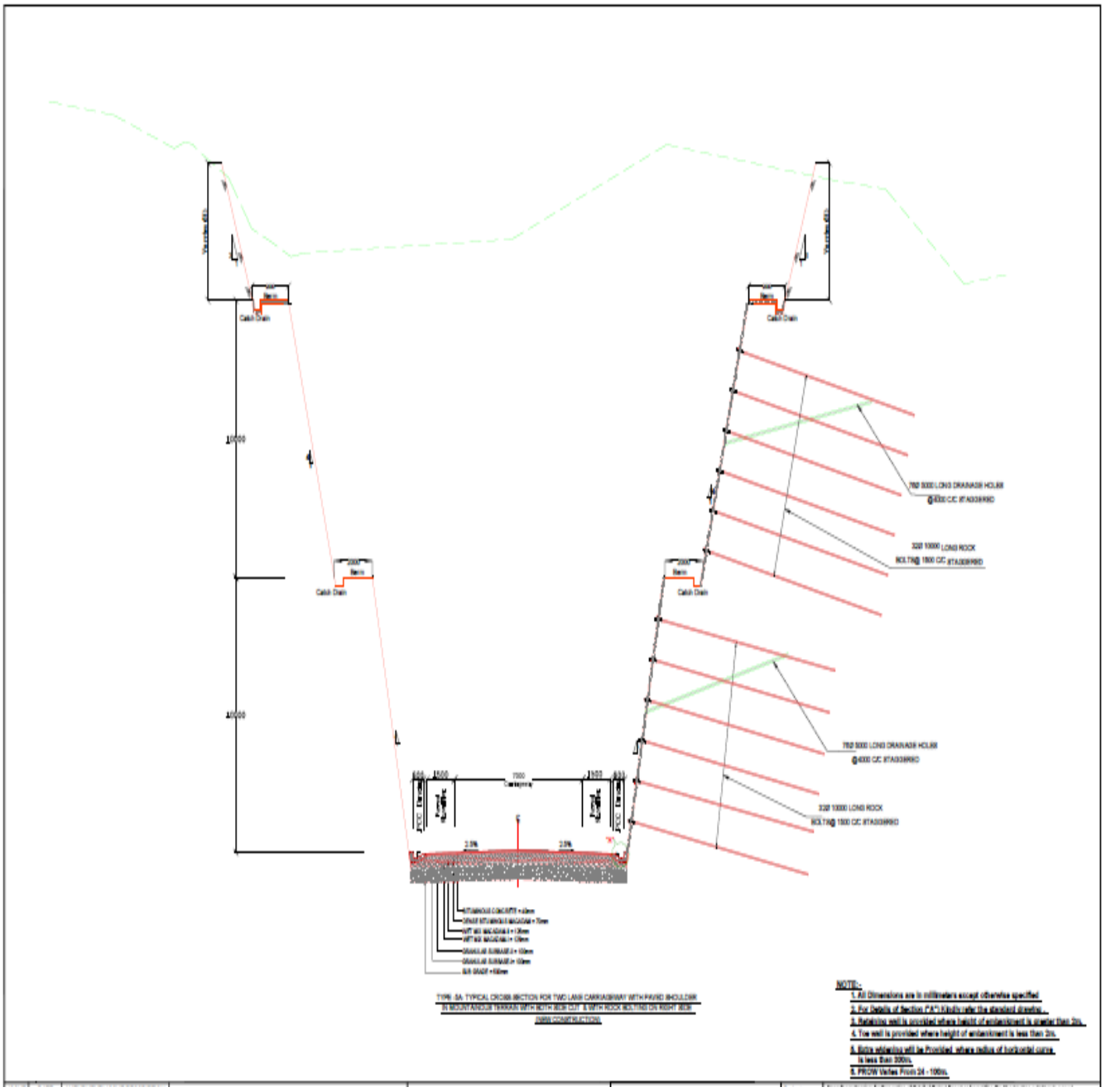
TYPE - 16 : TYPICAL CROSS SECTION FOR TWO LANE CARRIAGEWAY WITH PAVED SHOULDER IN MOUNTAINOUS TERRAIN WITH CUTTING ON BOTH SIDE & CUTTING ON ONE SIDE WITH PROTECTION AS AND CHAIN PROTECTION

NOTE:-

1. All Dimensions are in millimeters except otherwise specified.
2. For Details of Section ("A") Kindly refer the standard drawing.
3. Retaining wall is provided where height of embankment is greater than 2m.
4. Toe wall is provided where height of embankment is less than 2m.
5. Extra widening will be Provided where radius of horizontal curve is less than 300m.
6. PRCW is also From 24 - 100m.



TYPE - 3A: TYPICAL CROSS SECTION FOR TWO LANE CARRIAGEWAY WITH PAVED SHOULDER IN MOUNTAINOUS TERRAIN WITH BOTH SIDE CUT (NEW CONSTRUCTION)


Catch Drain
Berm
10000
10000
7000
Carriageway
1500
1500
2.5%
2.5%
NOTE:-
1. All Dimensions are in millimeters except otherwise specified.
2. For Depths of Section CA"(kindly refer the standard drawing.
3. Retaining wall is provided where height of embankment is greater than 3m.
4. Toe wall is provided where height of embankment is less than 3m.
5. Extra widening will be Provided where radius of horizontal curve is less than 300m.
6. ROW Varies From 24 - 100m.

(Schedule B-1)
Schedule B-1

The shifting of utilities and felling of trees shall be carried out by the contractor. The cost of the same shall be borne by the Authority. The details of utilities are as follows:

Sl. No.	**Type of Utility**	**Unit**	**Quantity**	**Location/stretch (LHS/RHS)**
A	**Electrical Utilities**			
A1	Electrical poles	Nos.	11	10 LHS/1 RHS
A2	Electrical cables	Meters	Nil	-
A3	Transformers	Nos.	Nil	-
B	**Felling of Trees**	**Nos.**	100	LHS/RHS
C	OFC	No.	3	2 RHS/1 LHS

Electric Polls				
	Chainage		**Light Pole**	
S.No	**From**	**To**	**RHS**	**LHS**
1	29148			**1**
2	29220			1
3	29300			1
4	29339			1
5	29385			1
6	29390			1
7	29415			1
8	29422			1
9	29450		1	
10	29485			1
11	29486 BT side road			1
Total			**1**	**10**

Utility Plan (OFC Cables)				
	Chainage		**OFC Stone**	
S.No	**From**	**To**	**RHS**	**LHS**
1	29087		1	
2	29273		1	
3	31165			1
Total			**2**	**1**

Schedule - C

(See Clause 2.1)

Project Facilities

1. ProjectFacilities

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

(a) tollplaza[s];

(b) roadside furniture;

(c) pedestrian facilities;

(d) tree plantation;

(e) truck lay-byes;

(f) bus-bays and bus shelters;

(g) rest areas

(h) rain water harvesting

(i) highway lightning; and

(j) others to be specified

2. Description of ProjectFacilities

Each of the Project Facilities is described below:

(a) Toll Plaza -Nil

(b) Rainwater Harvesting: As per Ministry of Environment and Forest notification, dated 8 October 2019 and 23 April 2010, construction of rain water harvesting structure has been adopted accordingly. 2 nos. of recharge shaft of 0.5 m dia for 10 to 15 m depth one on each side of the carriageway are proposed.

(c) Highway Lightning: 2 nos. of high mast lightning are proposed at rotary.

Schedule - D

(See Clause 2.1)

Specifications and Standards

1. Construction

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

2. Design Standards

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

Annex – I

(Schedule-D)

Specifications and Standards for Construction

1. Specifications andStandards

All Materials works and construction operations shall conform to the Manual of Specifications and Standards for Two-Laning of Highways IRC:SP:73-2018, Hill Road Manual (IRC:SP: 48-1998) and Guidelines for Road Tunnel(IRC SP:91) referred to as the Manual, and MORTH Specifications for Road and Bridge Works. Where the specification for a work is not given, Good Industry Practice shall be adopted to the satisfaction of the Authority'sEngineer.

2. Deviations from the Specifications and Standards

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

(ii) Notwithstanding anything to the contrary contained in Paragraph 1 above, the following Specifications and Standards shall apply to the Project Highway, and for purposes of this Agreement, the aforesaid Specifications and Standards shall be deemed to be amended to the extent set forthbelow:

Sl. No.	Item	Provisions	Deviation
1	Width of Structure	For open country mountainous terrain total width of the structure should be 18 m as per Clause 7.3(ii) of IRC: SP:73-2018 (Fig.- 7.6).	Provided total width of Viaduct cum bridge & Viaduct–10m and 12.5m of carriageway width 9m & 7.5m.
2	Overall width of Road	Typical Cross section of project highway given in Fig. 2.1 to Fig 2.10	Provided over all width of project highway–10m (7mc/w+1mPS either side +1m ES on valley side).

ATTACHMENT-DI

TECHNICAL SPECIFICATIONS FOR ROAD TUNNELS & BRIDGE

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1 Technical specification
2 Standards and Units
3 Listing of Standards
4 International Standards (for Information)
5 Tunnel Excavation
6 Check of System Behaviour
7 Updating of Design
8 Blasting
9 Controlled perimeter blasting
10 Explosives
11 Blasting Vibrations
12 Geological mapping
13 Exploratory Drillings
14 Excavation Cross Section Check
15 Excavation Material Disposal
16 Survey
17 Temporary Ventilation System
18 Ventilation
19 Lighting
20 Tunnel Excavation Monitoring
21 Instrumentation
22 Probing Ahead
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30 Forepoling
31 Lagging
32 Yielding Elements
33 DEWATERING
34 Testing
35 Cross Section Check of Primary Lining
36 Concrete
37 Reinforcement
38 Pavement
39 Water Proofing System

1. Technical Specifications

These Technical Specifications define the technical and quality standards specifically for NATM tunnel construction works.

The construction works shall be executed according to the quality requirements defined in the Specification. Any item of work arising from the execution of the works, not covered by the Technical Specification, shall be according to a Standard as agreed with the Employer's Representative and the Contractor.

This Technical Specification is based on the "Specification for Tunnelling, Third Edition", British Tunnelling Society, Institution of Civil Engineers, 2010 and "MORTH Specification for Road and Bridge Works", Ministry of Road Transport and Highways, 2000.

2. Standards and Units

Materials, equipment and methods shall comply with the Standards and Codes of Practice indicated using the versions that are current at the date for submission of tenders. The Contractor may propose the adoption of alternative standards and shall provide explanations with any proposals. The use of such standards shall be subject to the agreement of the Employer's Representative.

Some Indian, European and British Standards and Guidelines are listed below. The list is provided for information. All Work shall follow these Standards and Guidelines. First and foremost, the compliance of Indian Standards is required unless defined otherwise in this Specification. International (in the first step European) Standards and Guidelines shall be accessed to when no Indian Standards/Guidelines are available for the specific matter.

References to sources for Standards, Guidelines and Recommendations cited in the in Table 1 below. The list is provided for information only.

References to sources of Standards, Guidelines and Recommendation

Abbreviation	Name
ASTM	American Society for Testing and Materials, 100 Bar Harbor Dive West, Conshohocken PA 19429 – 2595, U.S.A.
BSI (BS)	British Standards Institute, 389 Chiswick High Road, London, W4 4AL UK.
DIN	Deutsches Institute für Normung e.V. Beuth Verlag GmbH, Burggrafenstrasse 6 D-10787, Berlin, Germany.
EFNARC	European Federation of Producers and Applicators of Special Building Products, Association House, 235 Ash Road, Aldershot, Hampshire, GU12 4DD, United Kingdom.
EN, ENV	European Committee for Standardisation, Central Secretariat, Rue de Stassart 36 B-1050, Brussels.
IRC	The Indian Road Congress, Jamnagar House, Shahjahan Road, New Delhi-110011.
IS	Bureau of Indian Standards, Manak Bhavan, 9 Bahdur Shah Zafar Marg, New Delhi – 110002.
ISO	International Organization for Standardisation 1, rue de Varembé CP 56, CH- 1211 Genéve 20, Switzerland.
ÖNORM:	Austrian Standard Institute, Heinestraße 38, 1020 Wien, Austria
RVS (Austrian Code for Road Construction)	Austrian Association on Road, Rail and Transport (FSV), Karlsgasse 5, 1040 Wien, Austria
ÖGG	Austrian Society for Geomechanics, Bayerhamerstrasse 14, 5020 Salzburg, Austria

3. Listing of Standards

The list is provided for information only.

Indian Standards

ID of Standard	Description
IS 10262-2009	Guidelines for concrete mix design proportioning
IS 1077-1992	Common Burnt Clay Building Bricks
IS 11171-1985	Dry-Type Power Transformers
IS 1199-1959	Methods of sampling and analysis of concrete
IS 12269-1987	53 grade ordinary Portland cement
IS 12330-1988	Specification for sulphate resisting Portland cement
IS 1248	Direct Acting Indicating Analogue Electrical Measuring Instruments and their Accessories
IS 1278-1972	Filler rods and wires for gas welding
IS 1343-1980	Code of Practice for Prestressed Concrete
IS 1542-1992	Sand for plaster
IS 1554-1988	(Part 1): PVC insulated (heavy duty) electric cables: Part 1 For working voltages up to and including 1 100 V
IS 1566-1982	hard-drawn steel wire fabric for concrete reinforcement
IS 1885-1993	Electrotechnical Vocabulary: Part 32 Electric cables
IS 1651-1991	Stationary cells and batteries, lead-acid type (with tubular positive plates)
IS 8130-1984	Conductors for insulated electric cables and flexible cords
IS 1786-2008	High strength deformed steel bars and wires for concrete reinforcement-
IS 1791-1985	General Requirements for Batch Type Concrete Mixers
IS 1905-1987	Code of practice for structural safety of buildings; masonry walls
IS 2062-2011	Hot Rolled Medium and High Tensile Structural Steel
IS 2116-1980	Sand for masonry mortars
IS/IEC 60947-1-2007	Low-voltage Switchgear and Control gear: Part 1 General Rules
IS 2180-1988	heavy duty burnt clay building bricks
IS 2309-1989	Code of practice for the protection of buildings and allied structures against lightning
IS 2386-1963	(Part 1 & 8): methods of tests for aggregates for concrete
IS 2502-1963	Code of Practice for Bending and Fixing of Bars for Concrete Reinforcement
IS 2505-1992	Concrete vibrators - Immersion type - General requirements
IS 2514-1963	Concrete vibrating tables
IS/IEC 60947-2-2003	Low-Voltage Switchgear and Control gear - Part 2: Circuit Breakers
IS 13118-1991	High-Voltage Alternating-Current Circuit-Breakers
IS/IEC 60947-3-1999	Low voltage switchgear and control gear: Part 3 Switches, disconnectors, switch-disconnectors and fuse combination units
IS 269-1989	Ordinary and low heat Portland cement (33 GRADE)
IS 2705-1992	Current transformers
IS 2750-1964	Steel Scaffoldings
IS 2751-1979	Code of Practice for Welding of Mild Steel Plain and Deformed Bars for Reinforced Concrete Construction
IS 280-2006	Mild Steel Wire for General Engineering Purposes
IS 13925-1-2012	Shunt capacitors for ac power systems having a rated voltage above 1000 V Part 1: General

IS 2961-1973	Chrome retain finished upper leather
IS 8130-1984	Conductors for insulated electric cables and flexible cords
IS 3043-1987	Code of practices for earthing
IS 3085-1965	Method of Test for Permeability of Cement Mortar and Concrete
IS 3156-1992	Voltage transformers
IS 3231-1986	Electrical relays for power systems protection
IS 3427-1997	A.C. Metal Enclosed Switchgear and Control gear for Rated Voltages Above 1 kV and Up to and Including 52 kV
IS 3443-1980	Crane rail sections
IS 3558-1983	Code of practice for use of immersion vibrators for consolidating concert
IS 3597-1998	Concrete pipes - Methods of test
IS 5578-1984	Guide for marking of insulated conductors
IS 11353-1985	Guide for Uniform System of Marking and Identification of Conductors and Apparatus Terminals
IS 3764-1992	Code of safety for excavation work
IS 383-1970	Coarse and Fine Aggregates from Natural Sources for Concrete
IS 3954-1991	Hot Rolled Steel Channel Sections for General Engineering Purposes – Dimensions
IS 4031-1989	Methods of physical tests for hydraulic cement
IS 4032-1985	Method of chemical analysis of hydraulic cement
IS 4081-1986	Safety code for blasting and related drilling operations
IS 4138-1977	Safety code for working in compressed air
IS 432-1982	Mild Steel and Medium Tensile Steel Bars and Hard-Drawn Steel Wire for Concrete Reinforcement
IS 456-1978	Plain and Reinforced Concrete - Code of Practice
IS 457-1957	Code of Practice for General Construction of Plain and Reinforced Concrete for Dams and Other Massive Structures
IS 458-2003	Precast Concrete Pipes (with and without Reinforcement)
IS 4756-1978	Safety code for tunneling work
IS 4880 (Part 1-7)	Code of practice for design of tunnels conveying water
IS 4925-2004	Concrete Batching and Mixing Plant
IS 4988-1968	(Part 1-5): Glossary of terms and classification of earth moving machinery
IS 5082-1998	Wrought aluminum and aluminum alloy bars, rods, tubes and sections for electrical purposes
IS 516-1959	Method of Tests for Strength of Concrete
IS 5525-1969	Recommendation for detailing of reinforcement in RCC
IS 5640-1970	Method of test for determining aggregate impact value of soft
	coarse aggregates
IS 5819-1970	Recommended Short-circuit Ratings of High Voltage PVC Cables
IS 5831-1984	PVC insulation and sheath of electric cables
IS 5878-1971	(Part 1-7): Code of Practice for Construction of Tunnels
IS 5892-2004	Concrete transit mixers & agitators
IS 6430-1985	Mobile air compressor for construction purposes
IS 6461-1972	Glossary of terms relating to cement concrete: Part I Concrete aggregates
IS 6461-1972	Glossary of Terms Relating to Cement Concrete - Part III: Concrete

	Reinforcement
IS 650-1991	Standard Sand for Testing of Cement
IS 694-2010	POLYVINYL CHLORIDE INSULATED UNSHEATHED AND SHEATHED CABLES/CORDS WITH RIGID AND FLEXIBLE CONDUCTOR FOR RATED VOLTAGES UP TO AND INCLUDING 450/750 V
IS 7098-1988	Crosslinked polyethylene insulated PVC sheathed cables: Part 1 For working voltage up to and including 1 100 V
IS 7245-1974	Concrete payers
IS 7251-1974	Concrete finishers
IS 7293-1974	Safety code for working with construction machinery
IS 7319-1974	perforated concrete pipes
IS 783-1985	Code of Practice for Laying of Concrete Pipes
IS 7861-1981	(Part 2): Code of practice for extreme weather concreting: Part II Recommended practice for cold weather concreting
IS 7861-1981	(Part 1): Code of practice for extreme weather concreting Part 1 Recommended practice for hot weather concreting
IS 800-2007	General Construction in Steel - Code of Practice
IS 808-1989 (2004)	Dimensions for Hot Rolled Steel Beam, Column, Channel and Angle Sections
IS 8041-1990	Specification for rapid hardening Portland cement (2nd revision)
IS 8112-1989	High strength ordinary Portland cement (43 grade)
IS 814-2004	Covered Electrodes for Manual Metal Arc Welding of Carbon and Carbon Manganese Steel
IS 816-1969	Code of practice for use of metal arc welding for general construction in mild steel
IS 817-1992	(Part 1): Training of Welders - Code of Practice: Part 1 Manual metal arc welding
IS 818-1968	Code of Practice for Safety and Health Requirements in Electric and Gas Welding and Cutting Operations
IS 2062-2011	Hot Rolled Medium and High Tensile Structural Steel
IS 8623-1993	Low-Voltage Switchgear and Control gear Assemblies
IS/IEC 60898 -2002	Electrical accessories - Circuit-breakers for overcurrent protection for household and similar installations: Part 1 Circuit-breakers for ac operation
IS 9012-1978	Recommended practice for shotcreting
IS 9103-1999	Concrete Admixtures
IS 9284-1979	Method of test for abrasion resistance of concrete
IS 9417-1989	Recommendations for welding cold worked bars for reinforced concrete construction.

European Standards (for Information)

Eurocode 1	Basis of design and actions on structures
Eurocode 2	Design of concrete structures
Eurocode 3	Design of steel structures
Eurocode 5	Design of timber structures
Eurocode 7	Geotechnical design
Eurocode 8	Design of structures for earthquake resistance
BS EN ISO 62:2008	Plastics. Determination of water absorption

BS EN 196:2005	Methods of testing cement
BS EN 197-1:2011	Cement. Composition, specifications and conformity criteria for common cements
BS EN 197-1:2004	Cement – Part 1: Composition, specifications and conformity criteria for common cements
BS EN 206-1:2001	Specification, performance, production and conformity
BS EN 295-7:1996	Requirements for vitrified clay pipes and joints for pipe jacking
BS EN 338:2010	Structural timber. Strength classes
BS EN 450-1:2005	Fly ash for concrete – Part 1: Definitions, specifications and conformity criteria A1:2007
BS EN 471:2004	High-visibility warning clothing for professional use - Test methods and requirements
BS EN 480:2006	Admixtures for concrete, mortar and grout. Test methods
BS EN ISO 527-3:1996	Plastics. Determination of tensile properties. Test conditions for films and sheets
BS EN 681-2:2000	Elastomeric seals. Material requirements for pipe joint seals used in water and drainage applications. Thermoplastic elastomers
BS EN 771-3:2011	Specification for masonry units. Aggregate concrete masonry units (dense and light-weight aggregates)
BS EN 772-2:1998	Methods of test for masonry units. Determination of percentage area of voids in masonry units (by paper indentation)
BS EN 791:1996	Drill rigs – safety
BS EN 815:1997	Safety of unshielded tunneling boring machines and rod less shaft boring machines for rock
BS EN 932-6:1999	Tests for general properties of aggregates. Definitions of repeatability and reproducibility
BS EN 933-1:2012	Tests for geometrical properties of aggregates. Determination of particle size distribution. Sieving method
BS EN 934-2:2009	Admixtures for concrete, mortar and grout – Part 2: Concrete admixtures – Definitions and requirements, conformity, marking and labelling
BS EN 1008:2002	Mixing water for concrete – Specification for sampling, testing and assessing the suitability of water, including water recovered from processes in the concrete industry, as mixing water for concrete
BS EN 1011-1:2009	Welding - Recommendations for welding of metallic materials - General guidance for arc welding
BS EN 1011-2:2001	Welding. Recommendations for welding of metallic materials. Arc welding of ferritic steels
BS EN 1062-7:2004	Paints and varnishes. Coating materials and coating systems for exterior masonry and concrete. Determination of crack bridging properties
BS EN 1090-2:2008	Execution of steel structures and aluminium structures. Technical requirements for steel structures
BS EN 1097	Tests for mechanical and physical properties of aggregates
BS EN 1367	Tests for thermal and weathering properties of aggregates
BS EN ISO 1461:2009	Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods
BS EN 1537:2000	Execution of special geotechnical work – rock anchors
BS EN 1542:1999	Products and systems for the protection and repair of concrete structures.

	Test methods. Measurement of bond strength by pull-off
BS EN 1562:2012	Founding. Malleable cast irons
BS EN 1563:2012	Founding. Spheroidal graphite cast iron
BS EN 1744	Tests for chemical properties of aggregates
BS EN 1849-2:2010	Flexible sheets for waterproofing. Determination of thickness and mass per unit area. Plastic and rubber sheets
BS EN 1928:2000	Flexible sheets for waterproofing. Bitumen, plastic and rubber sheets for roof waterproofing. Determination of water tightness
BS EN ISO 3506-2: 2009	Mechanical properties of corrosion-resistant stainless-steel fasteners - Nuts
BS EN ISO 4624:2003	Paints and varnishes. Pull-off test for adhesion
BS EN ISO 9001:2008	Quality management systems. Requirements
BS EN 10025:2004	Hot rolled products of structural steels
BS EN 10080:2005	Steel for the reinforcement of concrete. Weldable reinforcing steel. General
BS EN 10164:2004	Steel products with improved deformation properties perpendicular to the surface of the product – technical delivery conditions
BS EN 10226-1:2004	Pipe threads where pressure tight joints are made on the threads. Taper external threads and parallel internal threads. Dimensions, tolerances and designation
BS EN ISO 11925-2:2011	Reaction to fire tests. Ignitability of products subjected to direct impingement of flame. Single-flame source test
BS EN 12110:2002	Tunnelling machines – Air locks – Safety requirements
BS EN 12111:2002	Tunnelling machines – Road headers, continuous miners and impact rippers – Safety requirements
BS EN 12310-2:2000	Flexible sheets for waterproofing. Determination of resistance to tearing (nail shank). Plastic and rubber sheets for roof waterproofing
BS EN 12317-2:2010	Flexible sheets for waterproofing. Determination of shear resistance of joints. Plastic and rubber sheets for roof waterproofing
BS EN 12336:2005	Tunnelling machines - Shield machines, thrust boring machines, auger boring machines, lining erection equipment - Safety requirements
BS EN 12350	Testing fresh concrete
BS EN 12390	Testing hardened concrete
BS EN 12504-1	Testing concrete in structures – Part 1: Cored specimens – Taking, examining and testing in compression
BS EN 12588:2007	Lead and lead alloys. Rolled lead sheet for building purposes
BS EN 12620:2002	Aggregates for concrete
BS EN 12878:2005	Pigments for the colouring of building materials based on cement and/or lime. Specifications and methods of test
BS EN 12889:2000	Trenchless construction and testing of drains and sewers
BS EN 13055-1:2002	Lightweight aggregates. Lightweight aggregates for concrete, mortar and grout
BS EN 13139:2002	Aggregates for mortar
BS EN 13263-1:2005	Silica fume for concrete – Part 1: Definitions, requirements and conformity criteria
BS EN 13492:2004 (E)	Geosynthetic barriers - Characteristics required for use in the construction of liquid waste disposal sites, transfer stations or secondary containment
DIN EN 13670-	Execution of concrete structures

1:2011	
BS EN 13791:2007	Assessment of in-situ compressive strength in structures and pre-cast concrete components
BS EN 14487-1:2006	Sprayed concrete – Part 1: Definitions, specifications and conformity
BS EN 14487-2:2006	Sprayed concrete – Part 2: Execution
BS EN 14488-1:2005	Testing sprayed concrete – Part 1: Sampling fresh and hardened concrete
BS EN 14488-2:2006	Testing sprayed concrete – Part 2: Compressive strength of young sprayed concrete
BS EN 14488-3:2006	Testing sprayed concrete – Part 3: Flexural strengths (first peak, ultimate and residual) of fibre reinforced beam specimens
BS EN 14488-4:2005	Testing sprayed concrete – Part 4: Bond strength of cores by direct tension
BS EN 14488-5:2006	Testing sprayed concrete – Part 5: Determination of energy absorption capacity of fibre reinforced slab specimens
BS EN 14488-7:2006	Testing sprayed concrete – Part 7: Fibre content of fibre reinforced concrete
BS EN 14889-1:2006	Fibres for concrete – Part 1: Steel fibres. Definitions, specifications and conformity
BS EN 14889-2:2006	Fibres for concrete – Part 2: Polymer fibres. Definitions, specifications and conformity
BS EN 15167-1:2006	Ground granulated blast furnace slag for use in concrete, mortar and grout – definitions, specifications and conformity criteria
BS EN 60204	Safety of machinery. Electrical equipment of machines
BS EN 61672-1:2003	Electroacoustics. Sound level meters. Specifications
DD CEN/TS 14416:2005	Geosynthetic barriers. Test method for determining the resistance to roots
PD CLC/TR 50426:2006	Assessment of inadvertent initiation of bridge wire electro-explosive devices by radio-frequency radiation. Guide

British Standards (for information)

BS 143 and 1256:2000	Threaded pipe fittings in malleable cast iron and cast copper alloy
BS 1134:2010	Assessment of surface texture. Guidance and general information
BS 4190:2001	ISO metric black hexagon bolts, screws and nuts. Specification
BS 4449:2005	Steel for the reinforcement of concrete – Weldable reinforcing steel – Bar, coil and decoiled product
BS 4482:2005	Steel wire for the reinforcement of concrete products. Specification
BS 4483:2005	Steel fabric for the reinforcement of concrete
BS 4921:1988	Specification for sherardized coatings on iron or steel
BS 5228-1:2009	Code of practice for noise and vibration control on construction and open sites. Noise
BS 5228-2:2009	Code of practice for noise and vibration control on construction and open sites. Vibration

BS 5607:1998	Code of practice for the safe use of explosives in the construction industry
BS 5911-1	Concrete pipes and ancillary concrete products. Specification for unreinforced and reinforced concrete pipes (including jacking pipes) and fittings with flexible joints (complementary to BS EN 1916:2002)
BS 5975:2008	Code of practice for temporary works procedures and the permissible stress design of falsework
BS 6100	Building and civil engineering. Vocabulary. (various dates)
BS 6164:2011	Code of practice for health and safety in tunnelling in the construction industry
BS 6319	Testing of resin and polymer cement compositions for use in construction (various dates)
BS 6472:2008	Guide to evaluation of human exposure to vibration in buildings (1–80 Hz)
BS ISO 4866:2010	Mechanical vibration and shock. Vibration of fixed structures. Guidelines for the measurement of vibrations and evaluation of their effects on structures
BS 7385-2:1993	Evaluation and measurement for vibration in buildings. Guide to damage levels from ground borne vibration (Part 2)
BS 7668:2004	Weldable structural steels. Hot finished structural hollow sections in weather resistant steels. Specification
BS 7671:2011	Requirements for electrical installations
BS 7973-1:2001	Spacers and chairs for steel reinforcement and their Specification. Product performance requirements
BS 7973-2:2001	Spacers and chairs for steel reinforcement and their Specification. Fixing and application of spacers and chairs and tying of reinforcement
BS 7979:2001	Specification for limestone fines for use with Portland cement
BS 8102:2009	Code of practice for protection of below ground structures against water from the ground
BS 8500-1:2006	Concrete – Complementary British Standard to BS EN 206-1. Method of specifying and guidance for the specifier
BS 8500-2:2006	Concrete. Complementary British Standard to BS EN 206-1. Specification for constituent materials and concrete
BS 8666:2005	Scheduling, dimensioning, bending and cutting of steel reinforcement for concrete. Specification

4. International Standards (for Information)

ASTM D 1777	Standard Test Method for Thickness
ASTM D 3776	Standard Test Methods for Mass Per Unit Area (Weight) of Fabric
ASTM D 4491a	Standard Test Method for Water permittivity
ASTM D 4751	Standard Test Method for Apparent opening size of a Geotextile
ASTM D 4632	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
ASTM D 3786	Standard Test Method for Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method
ASTM D 4833	Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
ASTM D 4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles

ASTM D 4355	Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
ASTM D 3787	Standard Test Method for Bursting Strength of Textiles-Constant-Rate-of-Traverse (CRT) Ball Burst Test
ASTM D 4157	Standard Test Method for Abrasion Resistance of Textile Fabrics (Oscillatory Cylinder Method)
EFNARC-1996	European Specification for Sprayed Concrete
ASTM C-39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C-78	Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C-94/C	Standard Specification for Ready-Mixed Concrete
ASTM C-172/C	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C-685/C	Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing
EFNARC Three Point Bending Test on Square Panel with Notch 2011	Testing Sprayed Concrete - Flexural tensile strength of fibre concrete on sprayed test specimen.
Austrian concrete society publications	Guide line on shotcrete and testing methods
Austrian concrete society publications	Inner lining concrete
JSCE -2004	Recommendation for design and construction of steel fibre reinforced concrete, Publications of Japan society of civil Employer's Representatives
DIN 67524 (Part 1/02)	Lighting of street tunnels and underpasses
DIN 67524-2008	Tunnel illumination
DIN 5035	Artificial lighting
RABT (2006)	Guidelines for equipment and operation of road tunnels

5. Tunnel Excavation

Tunnel excavation in any kind of ground shall be performed in accordance with modern blasting and excavating practice, using methods and techniques that will reduce over break to a minimum outside of the line of excavation (pay line), and which will preserve, in the soundest possible condition, the structural integrity of the rock beyond the line of excavation.

Excavations shall not be advanced until the pattern ground support for the previous round has been installed and the profile of the previous round has been checked and all rock remaining inside the line of excavation has been removed. The Employer's Representative may stop the work for removal of undercuts at any time if undercutting is observed.

Tunnel excavation shall not be started until the exposed rock faces in its portal excavation have been stabilized with rock support and shotcrete and drainage measures have been installed as given in the drawings.

The Contractor shall maintain accurate records of all blasting and excavating operations and at the end of each shift he shall provide the Employer's Representative. The forms shall bear the signatures of the Contractor's and the Employer's Representative certifying that records are accurate and complete and include but not limited to the following:

- length of tunnel excavated, and theoretical volume of solid materialexcavated

- quantity of any rock supportinstallation
- occurred rock falls, zones of instability and logs of pilot holes
- water inflow at the head and rate of discharge at the tunnelportal
- Unusual occurrences and all delays with reasons forthese.

Holes drilled in swelling ground shall be conducted without water.

Determination of Excavation and Support and Prediction of System Behaviour

For the final determination of the excavation and support method, it must be checked if the ground conditions conform to the design assumptions. When the observed conditions conform to the predicted ones, stipulations in the framework plan must be followed when determining the construction measures.

In case of a deviation exceeding the specified tolerance in the framework plan, the designer must be informed to allow for an adaptation of the prediction, based on new findings. The designer shall agree with the required additional measures in due time and update the framework plan accordingly.

The final decisions on the applied construction measures are based on the design and additional information gained during construction. The goal is a safe and economical construction.

6. Check of System Behaviour

The actual deformation in the supported area and in the final stage shall be compared to the predicted behaviour, and checked, whether the behaviour is within the specified limits of the warning criteria. Additional measurements or evaluations may be required.

Deviations between the expected and the observed behaviours must be analysed and documented.

The reasons for the deviation in behaviour must be analysed. In case the assumptions regarding the influencing factors are inappropriate, the parameters must be modified. The modifications must be supported by appropriate data and analyses and documented in an updated framework plan.

In case the ground quality is better than predicted, the geotechnical model must be revised. In case of a significant deviation, the criteria for the determination of excavation and support must be modified.

In case the ground quality is worse than predicted and warning levels exceeded, contingency measures according to the safety management plan must be implemented, and excavation and support shall be adjusted accordingly. This can be done for example by additional bolting, installation of a temporary invert, etc. In some cases, the installation of a stronger support in the following rounds may be enough to achieve the target.

In case of significant deviations, the geotechnical model has to be revised and the criteria for the determination of excavation and support have to be modified. This generally requires that the framework plan is updated

7. Updating of Design

Due to limited information available during design, a number of assumptions and simplified models have to be used to arrive at a design, which is the basis for the framework plan and the tender documents.

A continuously update of the geotechnical design with the increasing level of information shall be done. This applies to the determination of the Ground Types, the assignment and calibration of key parameters and criteria as well as for the determination of the behaviour. The refinement of parameter categories, the introduction of additional criteria, etc. help in

improving the geotechnical model.

The tunnel engineer on site must report to the designer in case of significant deviations of the actual geological/geotechnical situation from the predicted ones, as outlined in the framework plan. A detailed report, containing all relevant information and coordinated with the site geologist must be prepared and submitted.

8. Blasting

Not less than 40 days prior to commencement of rock excavation in each area, the Contractor shall submit, for review by the Employer's Representative, details of the drilling and blasting methods which he intends to use in that area. If, at any time in a specific area, a plan which has been previously adopted does not produce conditions at the excavated rock face that conform to the requirements of these Specifications, the Contractor shall submit a revised plan to the Employer's Representative before continuing excavation in adjacent areas.

The Contractor shall develop controlled blasting techniques, which will satisfy the excavation requirements specified herein. In each different type of rock conditions, the Contractor's initial blasts shall be performed as trials, and the burden, drill hole pattern and depth, explosive type and quantity, blasting sequence and drill delay pattern shall be modified to achieve the requirements specified herein.

Blasting means have to follow the licensing requirements and orders as well as the manufacturer's instructions.

Blasting operations shall be carried out only under the direction of an experienced operator. The Contractor shall appoint one competent person to be responsible for the security of explosives.

Blasting shall be carried out carefully so as to avoid loosening or shattering rock beyond the required line of excavation, and loose or shattered rock (where it does not contribute to stability of the excavation) shall be removed by scaling down or other means before personnel will be permitted to restart operations after blasting.

Notices of blasting operations shall be posted on site. Before each firing, the Contractor shall give audible warning, clear the area and shall take positive measures to prevent personnel from entering the danger area.

The Contractor shall monitor the results of blasting closely and, where it is proper to do so, shall propose changes to his blasting operation for the agreement of the Employer's Representative.

Under no circumstances shall any holes be charged until completion of all drilling operations at the face.

After each blasting operation the tunnel drive shall be sufficiently ventilated to remove any nitrous gases and the atmospheric conditions shall be constantly checked prior to personnel accessing the excavated face.

No person shall be allowed to approach the face and no face operation shall commence until the Contractor's authorized person in charge of the operation has given permission after blasting round.

As soon as practicable after blasting and without undue delay the Contractor shall erect such support as may be necessary to safeguard the excavation and personnel.

The shot-firer must keep a record of the number of shots fired, their time of firing, type and weights of explosives used, and the type and number of detonators used, together with a record of the post-blast situation for each and every location. A copy of the record shall be available to the Employer's Representative at the end of every shift on which shots are fired.

9. Controlled perimeter blasting

Controlled perimeter blasting techniques shall be used to produce rock faces conforming to the required excavation lines, slopes, elevations and dimensions shown on the drawings with a minimum of disturbance to the rock at, or outside of, the excavation pay lines.

Drill holes for controlled perimeter blasting shall not be less than 42 millimetres in diameter and shall be a single row of closely spaced holes drilled to a maximum depth of one round length along the excavation pay lines and a spacing of 0.4 to

0.6 m depending on the ground condition. The spacing of the perimeter holes may be modified on the basis of results obtained and in agreement with the Employer's Representative.

All blast holes within a distance of 5 meters normal to the excavation pay lines shall be less than 75 millimetres in diameter and shall be loaded in a manner and detonated in a sequence to ensure that a minimum of damage will result to the face when the main charge is fired

10. Explosives

The Contractor shall use explosives only in circumstances where it is safe to do so having due regard to the safety of persons, third-party property and the safety of the Works. Explosives shall not be used without the agreement of the Employer's Representative.

The Contractor shall obtain all necessary licences and consents and shall provide secure storage facilities for all explosives and equipment in accordance with Indian or International Standards Code of practice for the safe use of explosives in the construction industry and the requirements of the local Authorities and the Employer's Representative.

Explosives shall be handled and used only by the Contractor's duly authorized personnel. The names and qualifications of such personnel shall be submitted to the Employer's Representative in writing in advance of any possible use of explosives.

At an early stage, in advance of the proposed use of explosives, the Contractor shall notify the Employer's Representative, third parties, statutory authorities and services which have an interest in or are likely to be affected by blasting operations, of the general nature of the operation. The Contractor shall subsequently give a minimum of 14 days' notice to the Employer's Representative and others described above of the proposed use of explosives. With this notification the Contractor shall submit to the Employer's Representative a detailed method statement on all aspects of the proposed use of explosives, including the treatment of misfires.

The Contractor shall comply with the following documents in respect of the use of explosives:

- Indian Explosives Act 1884
- Indian Explosive Rules 2008 and further amendment in Jan.2009
- The Manufacture and Storage of Explosives Regulations 2005
- BS 5607:1998 Code of practice for the safe use of explosives in the construction industry
- Control of Explosives Regulations 1991
- Carriage of Explosives by Road. Road Traffic (Carriage of Explosives) Regulations 1996
- PD CLC/TR 50426:2004 Assessment of inadvertent initiation of bridge wire electro-explosive devices by radio- frequency radiation. Guide Quarries (Explosives) Regulations 1988, as far as it is relevant to tunnel works

11. Blasting Vibrations

For structures in the proximity of blasting, the peak particle velocity shall be measured at the locations immediately adjacent to the structure nearest to the face being blasted or any other location where it is necessary to limit vibration.

Vibration monitoring proposals shall be submitted to the Employer's Representative for his agreement.

The measurement of peak particle velocity shall be obtained from instruments capable of measuring along three orthogonal axes, one of them shall be aligned parallel to the center line of the excavation and another shall be vertical. The Contractor has to provide supports for the measuring instrument if so, required by the manufacturer's instructions.

The measurements of the particle velocities shall be the responsibility of the Contractor. Copies of the readings in an agreed form shall be supplied to the Employer's Representative.

Prior to the commencement of blasting in any location, the Contractor shall demonstrate using test firings, or by other means, that neither the peak particle velocities given in the particular Standards and Specifications will be exceeded.

The maximum allowable blasting vibrations shall be defined by the Contractor for every influenced structure with reference to the applicable Standards and Specifications for the relevant structure. The allowable blasting vibrations shall be approved by the Employer's Representative prior to any blasting operations.

12. Geological mapping

Geological mapping shall be performed by qualified geologist to provide a documentation of rock and rock mass condition encountered during excavation. Additionally, all exposed rock surfaces of the open and underground excavations shall be washed down for inspection and geological mapping. Exposed rock surfaces at the required excavation pay lines shall be mapped after preparation but before shotcrete application. Tunnel and other underground faces shall be mapped just before the start of drilling. The Contractor shall allow in his construction procedure and schedule for the geological mapping of each tunnel face not less than 30 minutes.

The geological mapping shall include but not limited to the following information:

- excavation face
- tunnel meter
- geological unit
- intact rock:
  - rock type and lithology description
  - weathering and alteration degree
  - uniaxial and unconfined compressive strength (from point load tests)
- rock mass:
  - jointing degree
  - geometry, orientation (strike and sip) and properties of discontinuities
  - face condition (homogeneous or heterogeneous)
  - water inflow
  - over breaks (separated in geological and non-geological)
  - ground response
  - suspected pervious zone
- the GSI value and the corresponding excavation class
- groundwater appearance

The Contractor shall provide lights, ladders, platforms and free access and shall assist the Employer's Representative to carry out inspection and geological mapping.

In case of sudden and unexpected changes of the geological conditions shall be informed

immediately.

13. Exploratory Drillings

Long exploratory drillings with full core recovery shall be carried out when deemed necessary and required. Based on the geological mapping and the exploratory drillings may require rock mechanic laboratory tests.

14. Excavation Cross Section Check

Tunnels will be constructed to the center lines as defined herein and subsequently agreed on site. Average deviation of the tunnel centreline from the design centreline, along a 100 m length of any tunnel section, shall not exceed 30 mm. If deviations in tunnels excavated exceed the specified tolerance, the Contractor shall be required to adapt his working methods so that the specified tolerances are achieved.

Immediately after excavation and before support installation the cross section of the actual round must be checked to avoid unexcavated ground reaching into the excavation area as per excavation and support category. The check must be done with proper instrumentation, either with free positioned theodolite or with temporarily installed monitoring device for profile check. When all ground material inside the excavation area is removed the support installation shall start earliest.

In case of partial excavation, the similar procedure shall be executed for each partial excavation area.

15. Excavation Material Disposal

The disposal of excavation material shall be in accordance with specified compliance.

Excavation material suitable to be utilized in the Works shall be stockpiled separately from materials to be disposed. The use of excavation material in the Works shall agree with the Employer's Representative.

Suitable materials shall, wherever possible, be transported directly from the required excavation to the various designated final locations.

Excavated materials, not suitable for or in excess of the construction requirements, shall be disposed of in spoil areas designated by the Local Authorities or the Employer's Representative. Unless otherwise provided for, spoil areas shall be built up in layers, with a maximum layer thickness of 0.6 m, and evenly compacted by the traffic of the construction equipment, aimed at minimizing future differential settlement. Final sloping and shaping of surfaces shall be as indicated on the Drawings. Other details of the work such as stabilization and drainage measures are shown on the Drawings.

All activity by the Contractor at spoils areas shall be confined to the limits designated by the Local Authorities or the Employer's Representative. The limits shall be clearly marked and, where directed barricaded to prevent traffic in areas outside the limits.

16. Survey

The Contractor shall be entirely responsible for the accuracy of the control survey and the plotting and periodic checking thereafter. Location and positioning of all survey control stations, reference pillars, bench marks etc. must be presented in coordinates and in a map (scale 1:1000) and approved by the Employer's Representative before the start of any works.

The Contractor shall install all necessary above ground survey stations and reference points well in advance of the commencement of excavation works to allow the Employer's Representative sufficient time to check the initial control survey and subsequent setting out for the alignment and levels of the respective tunnels.

Survey stations, center lines, bench marks and grade lines shall be clearly marked in paint on the tunnel walls, chainages at 10-meter intervals or as otherwise agreed by the Employer's

Representative. The Contractor shall appoint and employ the necessary qualified and experienced staff to carry out the required survey and setting out. The Contractor shall provide all necessary instruments, equipment, record books, level books measuring devices etc. required for survey and setting out. The Employer's Representative shall have use of any of the survey equipment required for the checking of survey work and setting out throughout the period of the Contract. Chainmen and transport shall be provided by the Contractor for checking purposes at the request of the Employer's Representative.

All additional work found to be necessary because of negligence in/or incorrect setting out, shall be carried out immediately by the Contractor as directed by the Employer's Representative at no additional costs.

17. Temporary Ventilation System

Pits, tunnels and headings shall always be kept ventilated to maintain an atmosphere fit for respiration and free from oxygen deficiency, potentially explosive or noxious gases and dust, whether present naturally or otherwise. Ventilation shall also be used to maintain a safe working temperature.

Underground works shall be ventilated in accordance with all applicable regulations. Details of the proposed ventilation system shall be submitted to the Employer's Representative, for review, not less than 40 days prior to the start of commencement.

Where more than one pollutant is present any adverse interaction between them shall be identified and mitigated.

All diesel engines used in the underground works shall be provided with means, which shall be maintained in efficient order, of cooling exhaust gases and reducing the concentration of toxic gases to acceptable levels, filtering particulates and preventing emission of flames or sparks.

In underground workings and in confined spaces the air breathed by persons shall contain not less than 19% of oxygen by volume, and shall not contain concentration of gases, vapor or dust greater than is safe for the health or workmen, having regard to the effects of time, temperature, humidity and the combined effects contaminants.

Smoking is forbidden in tunnels, headings, pits or shafts and all confined spaces.

In rock excavation all drill holes shall be wet drilled unless otherwise specified in this Specification in compliance with special ground condition.

18. Ventilation

The Contractor shall agree ventilation proposals with the Employer's Representative. Agreement shall not relieve the Contractor of his obligations under the Contract.

Proposals shall include but not be limited to the types of fan employed, sitting arrangements where appropriate, the power supply and the fan performance data, together with duct characteristics.

In forcing systems, fans shall normally be placed on the surface. The inlet to any surface forcing fan shall have unobstructed access to fresh air. It shall not be in the vicinity of a storage site for oil, chemical or diesel drums. The fan shall also be sited so that it cannot draw in internal combustion engine fumes or gas from charging batteries.

Blasting fumes shall be discharged from the underground works into a filter system or diverted adequately to ensure that concentrations of noxious or other harmful gases or dust are kept to the minimum limit as stated in the applicable laws/ Standards or the limits specified in the contract of lower.

If booster fans are to be employed by in-line staging, they shall be of an approved flameproof (FLP) construction and a monitoring system shall be installed so that the status and condition of such fans can always be monitored.

Provision shall be made for the fan to be run continuously whether persons are within the underground works or not. After tunnel break-through the ventilating system shall be kept in operation in order to maintain the fresh air-volume requirements stated hereinafter.

If a ventilation system ceases to function for any reason and for a period exceeding

30 minutes, all work in areas being ventilated by that ventilation system shall immediately cease and all workers shall immediately leave the areas.

Where a fan has been stopped and restarted, the condition of the air shall be tested before personnel enter the tunnel. If only forcing surface-mounted fans are employed, the ventilation system should be restarted and run continuously ensuring that any plugs of oxygen-deficient, flammable or noxious mixtures of gas are flushed out. Care should be taken that workmen do not encounter any plugs of these gases on re-entry to the tunnel. The Contractor should consider that air residence time in long drives can be several hours and that layered gases of different densities are difficult to disperse, especially where the gradient of the tunnel changes.

All equipment and ventilation duct shall always be maintained in sound working order. Any damage to ventilation duct shall be repaired within 12 hours of the damage.

The outlet of the duct shall be kept as close to the face as is practicable, designed to avoid turbulence and creation of dust and not more than 10 m away.

Where dust is being produced by the tunnelling system, exhaust ventilation shall be used to extract such dust from the working area.

Tunnelling shall not continue more than 10 m from the shaft or pit unless positive ventilation has been established.

The fresh air supply for underground works shall not be less than two cubic meters per minute at the face for each man underground and four cubic meters per minute per kW power for all diesel units operating underground. These fresh air volumes shall be cumulative, and the Contractor shall allow, in his design calculations, for the maximum number of persons and diesel-powered equipment deployed in the Works at any one time. Any estimated losses, e.g. due to the leaks in the ducts, shall be considered. The fresh air supply shall also be adequate to produce a linear velocity of 0.3 meters per second throughout the underground works.

Testing devices shall be provided for measuring carbon monoxide, methane, oxides of nitrogen and aldehydes in underground works during the operation of internal combustion engines. Readings of carbon monoxide content shall be taken by the Contractor at least once during each shift. Readings of oxides of nitrogen content and of aldehydes content shall be taken frequently to ensure safety of the workers. A record of all taken readings shall be kept by the Contractor and submitted to the Employer's Representative daily.

Ventilation ducts shall be firmly fixed to the vaults in such position that a minimum clearance of 20 cm remains between the duct and the extremities of vehicular traffic employed in the Underground Works.

19. Lighting

Floodlighting on the site surface shall be adequate for the safe operation of the site. It shall be shrouded where necessary to ensure the light is directed to areas within the site, and to avoid nuisance.

Lighting in the tunnel shall extend the full length and not be less than that required for safe working and access. Lamps shall be located with an interval of 25 m.

An alternative source of power and emergency lighting system shall be provided to allow emergency securing operations and evacuation safely in the event of a primary power failure. An adequate number of hand lamps shall be located at key points underground.

The Contractor shall also provide suitable movable lamps to illuminate any area in Underground Works including areas for instrumentation and where the Engineer may wish to

carry out inspection and rock mechanics tests or instrumentation.

Lighting illumination by flame is strictly not permitted in the underground Works.

20. Tunnel Excavation Monitoring

The Contractor shall survey, monitor and record tunnel and shaft construction as it proceeds to form a record of the Work. Monitoring shall generally be per unit of advance and include line, level, cross-sectional accuracy, shift advance and total advance.

Where grouting is carried out, the type, volume and pressure of grout shall be recorded.

All information recorded by the Contractor shall be provided to the Employer's Representative daily unless another interval has been agreed.

3-dimensional deformations of the tunnel lining shall be monitored by means of optical methods. The points to be observed are marked by targets or reflectors mounted on standard convergence bolts.

Where the Contractor considers that any corrective action, he may take will exceed the tolerances in the Contract, he shall so inform the Employer's Representative and obtains his agreement. Measurements shall be carried out with a free-stationed high precision electronic theodolite with integrated coaxial EDM device. The flow of data shall be fully automatic. The software shall allow determination of displacements in an absolute coordinate system with an accuracy of min ± 1.0 mm.

The Contractor shall determine the elevation of tunnel crown or any other point as directed by the Employer's Representative during tunnel excavation to monitor vertical settlements and bottom heaves and to be able to interpret and figure the absolute amount of displacements together with convergence readings out. The method of performing the level measurements shall be such as to ensure an accuracy of ±1 mm. Necessary conclusions shall be drawn from the geotechnical measurements, from their magnitude, alterations and tendencies about stability of the primary lining and surrounding rock, performance of the initial support applied and utilization of the supporting elements.

The locations and spacing between geotechnical measurement sections depends on geological conditions, frequency of geological alterations, rock mechanical behaviour, length of tunnels, primary stress conditions and size of tunnels. The location of designed measurement sections shall be modified during tunnelling according to the local geological conditions and the experience gained during tunnel driving and as required and approved by the Employer's Representative.

The strata exposed in the tunnel face shall be mapped and recorded where possible, and the nature of the excavated material shall be noted in all cases. The Contractor shall keep copies of all recent face records at the workface for the information of supervisory personnel.

All significant groundwater ingress shall be recorded and monitored.

21. Instrumentation

The supply of all labor, supervisors, plant, Contractor's Equipment and materials and the execution of all work necessary to supply, assemble, check, calibrate, drill, install, backfill, embed, test and protect instrumentation in the tunnel and appurtenant structures or elsewhere as specified on the drawings and as specified herein, shall be provided by the Contractor.

During the period of the Contract, the Contractor shall ensure that his construction operations do not interfere with, or damage any of the existing instrumentation, shown on the drawings, or the instrumentation to be installed by the Contractor and by others. The Contractor will be penalized, as specified herein if any of the existing instruments or instruments that have been installed by others or by the Contractor, are damaged by his construction equipment. In addition to the penalty, the Contractor, within the days required by the Employer's Representative, shall supply and install a replacement instrument adjacent to each instrument

that was damaged by his construction equipment, at no additional cost to the Employer.

Not less than 120 days prior to the required installation date of each instrument, which is shown on the Contractor's work schedule, the Employer's Representative will either confirm that the instrument to be supplied is to conform to the requirements of the Specifications or he will issue information on the number, type, model number, manufacturer, supplier, location and other details of the instrument or instruments that are to be supplied and installed.

The Contractor's request for approval to supply and install alternative instruments shall provide enough information on each alternative instrument for the Employer's Representative to compare it with the specified instrument. The information shall be submitted to the Employer's Representative not less than 90 days prior to the first installation of that instrument.

Not less than 60 days prior to the start of instrument installation, the Contractor shall submit to the Employer's Representative a detailed description of all instrumentation, cabling and accessories including any ancillary measuring equipment, details of his checking, testing, calibrating, installing and monitoring procedures for each of the instruments.

Not less than 30 days prior to installation, each instrument shall be checked, tested and calibrated according to the instrument manufacturer's instructions and as specified herein to ensure that the instruments are in good working order and properly calibrated. A report on each such checking, testing and calibration of each instrument shall be submitted to the Employer's Representative not more than seven days after the checking, testing and calibration of that instrument.

Each instrument shall have a certificate from the manufacturer stating that the instrument was inspected before leaving the factory and presenting details of the instrument calibration. A copy of the certificate for each instrument shall be submitted to the Employer's Representative not more than three days after the delivery of the instrument to the site.

A manual shall be provided with each type of instrument.

The Contractor shall supply all components, accessories and electrical leads for the instruments from the sensor to the observation house or station including materials, equipment and tools required to install, calibrate and protect the instruments as specified herein and as shown on the drawings.

All instruments and their accessories shall be new and have been successfully performed in similar projects.

Instruments shall be assembled, tested and calibrated by the manufacturer before delivery to the site. The instruments and accessories shall be stored at the site by the Contractor under the condition conforming to the manufacturer's requirements.

Instruments shall be handled, stored and installed with care so as to avoid damage. If during handling, storing and installation instruments are damaged, the Contractor shall replace and reinstall the instruments within 30 days as specified herein, as shown on the drawings or as required by the Employer's Representative and at no additional cost to the Employer.

All instruments and equipment used and required for the geotechnical measurements shall be made available to the Employer's Representative throughout the construction period.

22. Probing Ahead

Where required the Contractor shall be responsible for probing ahead of the tunnel face in order to prove or investigate the ground.

The selection of plant for probing shall be agreed with the Employer's Representative and shall take the probable nature of the ground ahead and its water-bearing capacity into account.

Probing shall be carried out in such way to allow modification of the excavation and support according to the encountered ground conditions. The number of probes, the diameter of

drilling, their positions in the face and angles with respect to the tunnel drive shall be governed by the actual ground conditions and the machinery in use. The maximum probed distance ahead of the face shall be governed by the ground conditions and the degree of uncertainty with distance.

The diameter of probe holes shall be not less than 38 mm.

23. Primary Support Measures

Generally, the primary support measures are installed immediately after the performed blasting round and a break of work prior to support construction is not permitted. The type and amount of tunnel support is directly related to the Rock Classification as established.

The Contractor shall ensure that support elements will be installed or applied in such a manner and sequence as to prevent disintegration and loosening of the rock mass surrounding the excavated tunnel.

Comprehensive records, containing all particulars of the tunnel support installed and its performance in the course of the works, shall be prepared and maintained by the Contractor and made available to the Employer's Representative on a daily basis. These records shall include type, quantity and location of installed support elements, the clearance profile after installation of support, deviations from the designed support systems, observations of excessive deformations, shotcrete cracking, etc. Observations of excessive deformations, shotcrete cracking, etc. shall be reported immediately to the Employer's Representative.

The Contractor shall keep a record of the chainage of each face position and shall keep this record updated as the face progresses. This record shall be available for consultation at any time at a convenient location close to the relevant face.

The Contractor shall record the results of all tests performed on the rock bolts prior to, during and after their installation, and submit these documents to the Employer's Representative. The Contractor shall apply shotcrete on rock masses which tend to local over break immediately.

Structural support consisting of wood is only permitted temporarily. It is not permitted to leave wooden support in the shotcrete or concrete layer.

Damaged rock mass support system due to re-profiling shall be reconstructed subsequently.

The Contractor must provide an adequate amount of rock mass support systems and required equipment on the site; hence no delays of excavation shall occur. Prior to the beginning of excavation, the required rock supports shall be provided by the Contractor on the site.

Blasting round lengths, time schedules, construction sequences, quantity and location of installed support elements shall be constructed as per drawings. Deviations from the designed support systems shall be reported immediately to the Employer's Representative and shall be approved.

The Contractor shall in case of emergency be obliged to undertake independently such support measures as he deems necessary without the prior consent of the Employer's Representative. In such cases the Contractor shall inform the Employer's Representative immediately.

Rock mass support is defined as follows:

- Primary support: is defined as the support which is installed systematically within the heading, bench and invert zone in order to ensure the short-term integrity of the underground excavation and safety of personnel during excavation. The installation of primary support is an essential element of the excavationcycle.
- Final lining: is defined as support which is installed subsequent to the primary and supplementary support and which does not form part of the normal excavation cycle. It serves as the permanent lining of the tunnel and shall be a cast in situ concrete lining, plain or reinforced according to structural requirements.

The final lining may be installed in any section of the tunnel, with the Employer's Representative's approval, at any time after convergence measurements show that movement in the rock in the immediate vicinity has stabilized.

24. Rock Bolts, Anchors

Unless otherwise defined herein, rock bolts shall comply with the following Indian Standards or their equivalent International Standards:

- IS: 1786 Specifications for high strength deformed-steel bars and wires for concrete reinforcement
- IS: 2062 Steel for general structural purposes

Rock bolts are intentioned steel bars threaded at one end and provided with a face plate, shim plates and a conical seated washer and nut or split or deformed steel tubes. Steel bars shall be grade 500 N/mm^2, deformed type 2 bars complying with BS 4449. Threaded parts of bars, nuts and seating shall comply with the requirements of BS 4190. Face plates shall be of a dish shape in steel to the appropriate standard and shall have a hemispherical seating with centralized slot to suit dimensions of the rock dowels.

Rock bolts shall be installed according to the length, direction, placement and number as per approved design drawings for each relevant Excavation Class unless otherwise determined by the Employer's Representative. Rock bolt length, direction, placement and number shall be adjusted to the Ground Type.

Comprehensive records about details of the installation of rock bolts during drivage, such as reference number, grout consistency, drilling depth, length, inclination and type of rock bolts, deviations from the theoretical position, type and time of grouting, time of tightening, special observations, details of tests carried out, geological ground condition, etc. shall be kept for each rock bolt and round by the Contractor and countersigned by the Employer's supervisory personnel. Copies of these records should be submitted to the Employer's Representative.

The trademark of rock bolts and anchors to be installed shall be approved by the Employer's Representative. A quality assessment is required, unless common anchor steel and anchor plates were used. The Contractor's construction execution shall comply with the manufacturer's specifications and recommendations regarding drilling, installing, testing and maintenance of rock bolts. The characteristic bearing capacity of the anchor plate and the connection between the anchor and anchor plate shall be equal to the characteristic bearing capacity (according to BS EN 1537) of the anchor steel.

The diameter of the drillings and the drilling technique shall be adjusted to the anchor type and Ground Type. Holes for the installation of bolts shall be drilled straight and with an accuracy of ±10°.

The drilling hole shall be flushed and cleaned with compressed air or water immediately prior to the installation of the bolt. The used technique shall be adjusted on the Ground Type (e.g. bore holes drilled in swelling ground no water flushing is permitted).

The water pressure during drilling may have an inadequate impact on the surrounding ground (e.g. decrease of mechanical strength properties) due to this the water pressure may be reduced or dry drilling may be conducted as directed by the Employer's Representative.

Unless instructed otherwise, rock bolts shall be installed and tensioned prior to the excavation of the next bench or round excavation. The tension force shall be determined by the Employer's Representative after completion of the initial testing program.

The Contractor shall provide torque wrenches of a type acceptable to Employer's Representative. All impact and torque wrenches shall be calibrated once every month.

The grouted hole shall be completely filled with grout. This shall be done by filling the drilled hole from the bottom of the hole and withdrawing the grout slowly, always maintaining the

hose embedded in the grout. A regular surface shall be provided to seat the face plate by trimming rock surfaces or forming pads of quick-setting mortar. Where mortar pads are required, they shall be of adequate thickness and extend beyond the face plate by 25 mm all round at that thickness before being chamfered at 45°. Care shall be taken to ensure that the mortar does not interfere with the installed bolt.

25. Shotcrete

Shotcrete shall be mixed, charged, applied, cured and tested according to given Specifications which are based on "Specification for tunnelling" by British Tunnelling Society. Additionally to these Specifications and where these specifications do not cover any aspect the "Guideline for Sprayed Concrete", Austrian Society forConcrete- and Construction Technology, 2005, Austria. Enclosed in Addendum 2 shall be applied.

70 days prior to any shotcrete application the Contractor shall submit detailed description of shotcrete to the Employer's Representative for review and approval such as:

- Number and type of equipment used for mixing, batching and applying shotcrete.
- Manufacturer's certificates detailing any proposed admixture, inter alia, accelerator admixture and the Contractor's proposals for the use of such admixtures
- mix design

The Contractor shall, 42 days prior to commencement of the actual work of spraying concrete or as otherwise approved, submit results of preconstruction tests of sprayed concrete with the actual materials, inclusive of admixtures, mixed in the proportions proposed for the Works for approval.

The Contractor shall make available testing, production and application records daily to the Employer's Representative when concrete is applied. The application records shall contain information on when, where and how much sprayed concrete was applied in each operation.

The sprayed concrete shall comply with the BS EN 14487-1 Sprayed concrete, except as noted otherwise below.

The requirements listed below generally refer to high-quality temporary or permanent sprayed concrete.

This Specification is primarily for the use of wet-mix sprayed concrete but in certain circumstances dry-mix sprayed concrete may be suitable.

Sprayed concrete shall be applied by either the wet or dry process as appropriate to the circumstances. All aspects of the application of sprayed concrete shall be subject to the agreement of the Employer's Representative. Emphasis shall be placed on the provision of adequate ventilation.

The compressive strength of shotcrete in-situ (taken from the tunnel lining or from panels sprayed in the tunnel) shall develop progressively to a final strength according to the minimum requirements specified below. Uniaxial compressive strength tests shall be done in accordance with the provisions stipulated in relevant codes. The strength development due to suitability tests must exceed the specified in-situ strength by a factor of 1/0.85 (=1.18)

The sprayed concrete mix design shall, unless otherwise stated, comply with the characteristic strengths specified by the detailed design for early-age and long-term loading.

The 28-day-strength (cube) of shotcrete shall be minimum 30 N/mm^2. The strength development of shotcrete shall be such to meet 2 N/mm2 after 9 hours, 5 N/mm2 after 24 and 17.5 N/mm2 after 7 days.

Fibres are generally accepted for use in concrete conforming to BS EN 206-1 and BS 8500 if the fibre conforms to BS EN 14889, a European Technical Approval.

Fibre-reinforced concrete will be trialled and tested to ensure it meets the designers'

requirements before inclusion in the works. Historical data of the same fibre and dosage will be accepted in place of trials provided the data are deemed appropriate.

26. Grouting

Cementitious grouting material shall be injected starting from the furthest point of the drilled hole so that the dowel is completely encased in grout. Grout shall not be used after a period equivalent to its initial setting time. Where cement grout is used, a set of six cubes of cement grout shall be taken when each series of rock dowels is in progress. Sampling, preparation, curing and testing shall be in accordance with BS EN 196. Half the cubes shall be tested at 1 day and the remainder at 28 days. The average compressive strength determined from any group of cubes shall exceed the specified characteristic strength given in Table 2 of EN 197-1:2000 or equivalent Indian Standard.

Grouting operation is defined as follows:

- contact or cavity grouting, at pressures up to 300 kPa, to fill voids between final concrete lining and primary sprayed concrete lining, or between the primary lining and rock
- consolidation grouting or strata grouting, at pressures up to 6 MPa, of the rock surrounding the excavated space, which shall commence after completion of contact grouting, where applied
- consolidation grouting or strata grouting in the heading zone, at pressures up to 6 MPa, in zones of sheared and disturbed material or of high-water inflow
- final grouting of temporary drainage holes

The Contractor shall prepare a detailed grouting Specification to suit best the actual conditions encountered. This grouting specification shall be submitted to the Employer's Representative for approval unless otherwise agreed or directed by the Employer's Representative. The Tunnel Designer's Representative shall specify the maximum pressures to be used for grout injection at each location. The pressures specified are subject to approval by the Employer's Representative.

Records of all details of grouting works such as location, inclination, diameter of boreholes, drilling time, equipment used, results of water pressure tests, mix, quantity, pressure of grouting, development and special events during grouting operation etc. shall be kept by the Contractor, countersigned on site by the Employer's supervising personnel and submitted to the Employer's Representative.

Where necessary due to the nature of the ground conditions or where adverse water conditions are anticipated, the requirements for the use of special grouts shall be stated in the Contract.

Special grouts supplied by proprietary manufacturers may be used subject to agreement with the Employer's Representative.

Preconstruction grout trials shall be undertaken to demonstrate that the required setting times and strength gains will be achieved. Details of the trials and results shall be submitted to the Employer's Representative.

Quality control of grout mortar shall be in compliance with specified code.

As directed by the Employer's Representative, water pressure tests shall be carried out.

All grout mixes shall be prepared using high speed, high shearing action mixers to produce a grout of uniform consistency.

Grout holes shall be drilled either with percussion type or rotary type drilling equipment, depending on Ground Type.

The diameter at the bottom of the grout holes shall not be less than 35 mm. For percussion drill holes the diameter of the drilling bit shall be at least 8 mm larger than the diameter of the

couplings used for the drill rods.

Only water shall be used for flushing during drilling unless directed otherwise by the Employer's Representative. All holes shall be thoroughly cleaned immediately after drilling using water and/or air under pressure. After washing, downward holes shall be kept plugged until the commencement of grouting operation.

When, prior to pumping, mixed grout is to be stored for short periods, purpose made agitator tanks shall be used. Grout shall be used within 1 hour of mixing.

When clay or bentonite additives are used, separate mixing tanks shall be provided for mixing and agitation.

Grouts containing polymer additives shall only be mixed in a colloidal-type mixer.

Water meters shall be provided for accurate measurement of water used for mixing. Pressure gauges, safety valves, by-pass valves etc. shall be provided where required on mixers, agitators, pumps and injection hoses.

Special grouts from proprietary manufacturers shall be mixed and used in accordance with the manufacturers' instructions.

27. Reinforcement – Wire Mesh

Cutting of reinforcement for better placing due to edges is permitted; hence additional reinforcement in these sections is required.

Welded wire mesh fabric shall be installed in surface excavations in conjunction with sprayed concrete, as shown on the drawings, or as directed by the Employer's Representative. Chain link fabric may be used for surface applications if previously approved by the Employer's Representative.

Welded wire mesh fabric shall conform to the requirements of IS: 4948 and shall have a mesh size of 150 x 150 x 6 mm as shown on the drawings, or as required by the Employer's Representative.

The diameter of additional steel bars shall be limited to 14 mm according to Austrian Guideline "Sprayed Concrete". The characteristic yield strength of the welded wire mesh shall be 500 N/mm^2.

Welded wire fabrics shall be installed in such way so that it follows as close as possible the irregularities of the excavation surface or previous layers of shotcrete. It shall be firmly fixed to prevent vibration and change of position during spraying of shotcrete. The use of wooden pegs or pins for attaching the wire mesh to the rock surface shall not be permitted. Welded wire fabrics shall be installed in the longest practical length. The overlap for welded wire fabrics applied in the shotcrete lining shall be at least twice the pitch distance in circumferential direction. In longitudinal direction, the overlap shall be at least one pitch distance for the first layer of fabric and at least twice the pitch distance for the second layer of fabric.

A minimum concrete cover at the tunnel side of 4.0 cm of all wire mesh layers shall be provided.

28. Lattice Girder

Steel arches or lattice girders shall be installed to maintain the designed shape of the opening and if necessary, provide an immediate support at the working face over the length of the last excavation completed. The lattice girder mainly functions as reinforcement. If necessary, the installation of steel arches or lattice girders shall also prevent ground loss and shall improve load distribution.

For the application of support arches and lattice girders the following shall be considered:

- axial stress and bending moment in the steel arch ribs induced by the ground loads

- lateral stability and bracing of steel arches or lattice girders
- method of installing the steel arches or lattice girders
- method of blocking and spacing of blocking points
- bearing capacity of the ground at the toe of the arch ribs
- the stand-up time of the unsupported part of the excavation
- the groundwater regime and permeability of the ground

Lattice girders shall consist of three primary bars, connected by stiffening elements to the manufacturer's design or as shown on the drawings. They shall be designed so as to:

- facilitate sprayed concrete penetration into and behind the girder, thereby minimizing the creation of projection shadows and/or voids
- provide good-quality bonding between the steel and sprayed concrete, to form a composite structure acting as a continuous reinforced concrete lining
- make allowance for the specified tolerances including convergence

29. Steel Ribs

Steel ribs provide an immediate support of the excavation after installation and shall subsequently act as reinforcement and load distributing members for the shotcrete lining. Steel ribs are required as support for forepoling elements, which are installed in advance of the excavation. During the entire construction period, they will contribute as load bearing members within the shotcrete lining.

The steel ribs shall be manufactured to meet the geometrical requirements for the excavation geometries for each Excavation Class including the relevant tolerances.

Prior to the beginning of the work the complete fabrication details, installation procedures and layout, details of joints, rib connections, rib spacers, geometry etc. and certificates of compliance of the materials shall be submitted to the Employer's Representative for approval.

The fabrication and installation of structural steel support shall conform to the latest edition of the following Indian Standards or, where not covered by these Standards, to the equivalent International Standards:

- IS: 800 Code of practice for general construction in steel
- IS: 808 Dimensions for Hot Rolled Steel Beam, Column, Channel and Angle Sections
- IS: 816 Code of practice for use of metal arc welding for general construction in mild steel
- IS: 2062 Steel for general structural purposes

Rib splices shall be welded or connected with bolted plates. Splices shall not reduce the section moment of resistance. Where possible all connections shall be welded, and all field connections shall be bolted.

Arches, base plates, ties and connections shall be formed from steel with the characteristic in accordance to reinforced concrete standards. Arches shall be rolled to suit the dimensional requirements of the Contract. Welding shall conform with BS EN 1011-1. Holes for ties, struts and any bolted connections shall be drilled. No burning will be allowed whether for temporary Works items or permanent elements. Threaded tie rods and struts shall be of adequate length to suit arch centres and allow 25 mm projection each end beyond the nut.

Where arches are to be provided as part of the Contractor's obligation for support the Contractor shall provide dimensional details of the arches, calculations regarding imposed loads and design and such other information that the Employer's Representative may reasonably request.

Galvanized arches, where required, shall be treated in accordance with BS EN ISO 1461. All

components, including the rods, fish plates, nuts and bolts, shall be galvanized.

30. Forepoling

To support the excavation roof (tunnel crown) forepoling elements are installed if required at the upper part of the tunnel excavation face. Forepoling shall be applied in rock and soil conditions which tend to produce over break, collapses or material inflows immediately following excavation. Forepoling shall be applied locally or systematically, as the circumstances require for the safety of the works and for preventing over break. The installation of forepoling always requires the erection of steel ribs. They shall be driven from the supporting frame in a slightly upwardly inclined direction at the crown of the heading and should penetrate at least half a set beyond the next excavation cycle.

Forepoling shall be applied as shown on the approved detail design drawings by the Contractor or as instructed by the Tunnel Designer's Representative and/or the Employer's Representative.

Forepoling shall be properly supported by the steel rib and the shotcrete above the steel rib. Therefore, the shotcreting of the gap between steel rib and the shotcreted sealed rock surface along the area of forepoling shall be completed after the installation of forepoling.

Spacing between consecutive forepoling pipes or bars around the crown of the excavation profile shall not exceed the maximum distance specified on the approved design drawings and shall be reduced if the actually prevailing geological conditions at the tunnel face require to do so.

Great care shall be taken to prevent the disturbance of face boards and supports in general during the fore poling cycle.

31. Lagging

Steel lagging (sheet piles) shall be employed mainly in weak ground with low cohesion with the purpose of preventing a collapse of material during and immediately after excavation. The use of lagging will always require the erection of steel ribs.

Steel lagging sheets with a thickness of 4 to 6 mm shall be used.

Lengths shall be in accordance with the round length of excavation and the support requirements beyond the face as defined by the drawings or directed by the Employer's Representative.

Voids and gaps behind the lagging sheets shall be either filled with shotcrete or by contact grouting with a suitable cement mortar.

Lagging sheets shall be driven at distances shown on the approved detail design drawings. They shall be driven in advance of excavation of the respective round to a depth extending a minimum length of 0.5 meters beyond the face of the subsequently round length into the ground.

32. Yielding Elements

Large deformations occurring during tunnel excavation in rock with unfavourable characteristics shall be managed with yielding elements.

The primary tunnel lining shall be divided into segments by means of longitudinal gaps. To make better use of the lining capacity, yielding elements (LSC – Lining Stress Controller or equivalent) consisting of multiple steel pipes in a concentric assembly with a total length of app. 510 mm are installed in the deformation gaps in the circumferential direction.

The yielding elements shall be used to achieve controlled ductility of the tunnel lining in order to prevent overstressing. To allow a smooth initial load development, special provisions have to be foreseen (predetermined breaking points at the ends of the load tube). In order to optimize the bearing capacity of the shotcrete lining, a

Multi-stage system may be used in agreement with the Employer's Representative, where the bearing capacity of the element unit is increased stepwise.

It shall be possible to adjust the bearing load of the yielding elements to the actual ground conditions (e.g. variation of steel cylinders of LSC).

Installation shall be done prior to any shotcreting. The elements shall be fixed to the wire mesh or to steel ribs. The elements shall be protected to ensure functionality after primary lining installation prior to shotcreting.

The elements shall have proper contact to the shotcrete lining to transfer the lining forces.

33. Dewatering

The Contractor shall design, furnish, maintain and remove temporary works for protecting the Works under construction against flood flows in rivers and creeks, and design, furnish, operate, maintain and dismantle the temporary dewatering facilities required to remove water from construction activities and from natural surface flow or groundwater seepage from working areas on the surface as well as in the tunnel.

The Contractor's working methods and systems shall be designed to control ground and surface water to permit the construction of shafts, tunnels, breakouts and portal structures.

Where dewatering operations are used, they shall be kept to the minimum necessary for the execution of the Works. If, at any time, during construction, the inflow of water increases more than the installed pumping capacity, the Contractor shall be required to install additional pumping facilities and perform additional sealing as required by the Employer's Representative. The dewatering system shall include a system for identifying ingress of soil material during the dewatering operation.

In planning temporary pumping systems, the Contractor shall take due consideration of water quality, pressure, quantity and variations in water levels.

Settlement ponds and other measures shall be provided so as to ensure that potentially contaminated or polluted matter from the execution of the Works is nowhere released into creeks, rivers or the ground.

The Contractor will be held responsible for all damage caused by his dewatering procedures or the lack of such, and he shall reinstate or repair disturbed ground or structures to their original condition or as otherwise approved.

Plant shall be delivered to site and maintained in good working order. Plant and pipe work shall be fitted with appropriate valves, controls and gauges. Each dewatering well shall be capable of individual adjustment and being shut down and isolated from the rest of the system. Appropriate standby equipment and spares shall be maintained on site at all times.

34. Testing

Rock Bolts

The required bearing capacity of rock bolts is to be ensured by pull out test procedures, in agreement with the Employer's Representative. The pull-out tests shall be conducted with a hydraulic press, in appearance of the Employer's Representative. The test results shall be recorded and forwarded to the Employer's Representative for review.

The equipment for pull out test procedures shall be provided and maintained by the Contractor during the whole construction phase.

Grout

Prior to acceptance tests of rock bolts, tests with available cements and sands shall be carried out to determine an appropriate mix design to achieve the specified strength and a proper workability in association with the grouting equipment used.

Additives may be used to improve workability. The influence of the additive on the strength

development shall be followed by tests. The grout mortar shall be tested on cubes 5 x 5 x 5 cm. The cubes shall be cured in water. Five numbers of cubes shall be prepared for each compressive strength test. The resultant strength is the average evaluated from the three remaining values after elimination of the highest and the lowest value.

During construction, cube sample shall be taken weekly at each five bolts drivage from the grouting hose at the nozzle. Preparation and evaluation shall follow the procedure as described above.

Shotcrete

The testing procedure and quantity of tests shall be in accordance with: "Guideline for Sprayed Concrete", Austrian Society for Concrete- and ConstructionTechnology, 2005, Austria.

An Employer's Representative shall be on site at all times to check the consistency of materials and workmanship with the design intent, and to ensure that ground and groundwater conditions are in accordance with design assumptions. The Contractor shall establish a procedure to respond effectively to changes in ground and groundwater conditions from the design assumptions.

Measures to establish the total thickness of shotcrete shall be set up by the Contractor and approved by the Employer's Representative. These may include visual guides installed prior to shotcreting or holes drilled after completion of shotcreting.

All required drillings for the testing procedure shall be filled with concrete subsequently.

The thickness of shotcrete is defined as a minimum thickness, consequently the shotcrete shall not be less than nominal design thickness at any place. 5 independent tests shall be done per every 500 m^3 of applied shotcrete per construction element (e.g. tunnel lining).

35. Cross Section Check of Primary Lining

No reduction of the theoretical thickness of the inner concrete lining is permitted unless it is approved by the Employer's Representative. To achieve this requirement, no support elements such as shotcrete, anchor heads, steel ribs etc. may protrude into the theoretical inner concrete lining, as shown on the drawings.

The primary lining must be constructed outside the inner lining and inside the over break-line at any point.

In the area of the invert and the foundation beams no rock parts or rock peaks may protrude into the theoretical excavation line.

For tunnel sections with no concreted invert arch the Contractor shall excavate the bottom level of the invert with an accuracy of +0 to -100 mm related to the theoretical excavation line of the invert.

If the bottom excavation level, after the clearing of all detritus material, is more than 100 mm below the designed theoretical excavation line, the Contractor shall backfill such areas up to the designed, theoretical level by means of sub-base material or as directed and approved by the Employer's Representative.

For tunnel sections with a concrete invert arch no reduction of the designed, theoretical thickness of the concrete structure is permitted. Over excavation must be compensated with structural concrete for the invert arch as specified or as directed by the Employer's Representative. The inside face of the invert arch may deviate not more than +/- 50 mm in elevation from the theoretical cross section.

36. Concrete

Concrete shall be mixed, charged, applied, cured and tested according to given Specifications which are based on "Specification for tunnelling" by BTS and the Indian Standards. For the tunnel inner lining and where these Specifications do not cover all aspect the Addendum 1 -

"Guideline for Inner Shell Concrete", AustrianSociety for Concrete- and Construction Technology, 2006, Austria shall be applied.

All structural elements must be designed for fire load if required according to the standards and guidelines.

The final lining cross section geometry shall be checked, and the tolerances shall be in accordance with these Specifications.

If squeezing ground conditions are observed during primary lining construction, stress gauges and pressure cells shall be installed in the final lining to monitor the actual stress-strain condition of the final lining. Minimum three stress gauges and pressure cells shall be installed in cross sections where squeezing ground conditions are encountered or as directed by the Employer's Representative. Records shall be kept available at site and submitted to the Employer's Representative for review.

Concrete and concrete constituents and all materials and operations relating to concrete shall meet the requirements of the Indian Standards Code of Practice for Plain and Reinforced Concrete IS 456 unless otherwise specified herein and as required by the Employer's Representative.

Where concrete is to be placed in aggressive ground, appropriate ground investigation shall be undertaken to identify the nature of the chemical composition of groundwater and ground.

The grade and properties of the concrete used in each part of the work shall be as stated on the drawings or in the Specification.

No material shall be added to ready-mixed concrete at the site unless approved by the Employer's Representative. Full responsibility shall be taken for ensuring that any materials added to ready-mixed concrete on site not causes the concrete to fail the quality control testing requirements of this Specification. Items made from such concrete which fail the quality control testing shall be rectified.

Concrete mixed by the Contractor or any other Sub-Contractor shall comply with the exposition classes and strength classes as defined in the approved detailed design drawings and BS EN 206-1.

The maximum chloride content of concrete shall be in accordance with IS 456.

Chloride content class for concrete containing steel reinforcement shall be Cl 0.20 (maximum Cl content by mass of cement 0.20%) and for concrete containing pre- stressed steel reinforcement Cl 0.10 (maximum Cl content by mass of cement 0.10%), unless otherwise directed by the Employer's Representative.

Consistence of concrete mix, other than concrete mix used for tunnel lining, shall be in compliance with IS: 456.

The Contractor shall provide at the site, modern and dependable, automatically or semi-automatically controlled batching and mixing plant or plants, in an "as new" condition, capable of supplying concrete in accordance with the Specifications and at a continuous rate adequate to meet the requirements of his schedule for concrete placement. Each plant shall have not less than two concrete mixers, each with a separate power and drive system with a standby generator and other equipment to ensure a continuous supply of concrete during concrete placement operations.

The Contractor shall provide, operate and maintain all necessary equipment and plant required to determine accurately and to control the amount of each separate ingredient entering the concrete mix. The actual amount of fine aggregate, each size of coarse aggregate, cement, fly ash, admixtures, ice and water entering each batch of concrete shall be determined by automatic weighing of each ingredient separately and not cumulatively. All constituents shall be weighed or metered in compliance with the limits prescribed in BS EN 206.

Proportioning of concrete mixes shall be in accordance with IS 456-1978 and IS 4925. Concrete is not permitted to contact to aluminium during mixing, conveying and placing.

The concrete shall be protected from damage due to load overstress, heavy shocks, excessive vibrations and the effects of rain and running water particularly during the curing period.

Curing and protection of concrete in cold weather shall be carried out in compliance with IS 7861 Part. Joints in concrete are either movement (deflection, expansion or contraction) joints or construction joints. All construction joints shall comply with IS 11817.

37. Reinforcement

The items of work falling within the scope of work under this section shall be in accordance with the Indian and European Standards Specification (Latest edition) given under:

- IS:280-1978: Specifications for mild steel wire for General Engineering purposes
- IS:432-1966/82: Specifications for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement
- IS:432 (Part I): Mild steel and medium tensile bars
- IS:432 (Part II): Hard drawn steel wire
- IS:456-1978: Code of practice for plain and reinforced concrete
- IS:814-1974: Specifications for covered electrodes for metal arc welding of structural steel
- IS:814 (Part I): For welding products other than sheets
- IS:814 (Part II): For welding sheets
- IS:1139-1966: Hot rolled mild steel medium tensile steel and high yield strength deformed bar for concrete reinforcement
- IS:1786-1979: Specifications for cold worked steel high yield strength deformed bars for concrete reinforcement
- IS:2502-1963: Code for practice for bending and fixing of bar for concrete reinforcement
- IS:5525-1979: Recommendations for detailing of reinforcement in reinforced concrete constructions
- IS:9417-1979: Recommendations for welding cold-worked bars for reinforcement concrete constructions
- BS EN 10080: Steel for the reinforcement of concrete. Weldable reinforcing steel. General
- BS 4449: Steel for the reinforcement of concrete – Weldable reinforcing steel
- – Bar, coil and de-coiled product
- BS 4482: Steel wire for the reinforcement of concrete products. Specification
- BS 4483: Steel fabric for the reinforcement of concrete

38. Pavement

The Contractor shall furnish all materials, equipment and labour necessary for permanent roadwork. The design for the permanent roadwork will be provided by the Employer.

The Contractor shall design and furnish all materials, equipment and labour necessary for construction roads or tracks to other work sites, to spoil areas, to installation areas and to camps to the extent that he considers necessary for his activities. These roads shall be constructed at the minimum standard necessary for the Contractor to safely execute the Works. The layout and design for all temporary roadwork shall be provided by the Contractor and approved by the Employer before the work commences.

The Contractor shall place compacted and treated, if necessary, selected backfill, either from required excavations or approved borrow areas, to completed structures.

All permanent road work, materials, workmanship, quality, construction tolerances, testing and etc. shall be carried out in accordance with the "Specifications for Road and Bridge Works" by Ministry of Road Transport and Highways (MoRT&H 2000), unless otherwise specified. This requirement applies to both the road outside the tunnel or portal buildings/structures as well as that inside these. The main Clauses of the "Specifications for Road and Bridge Works" (MoRT&H 2000) which shall be applied will be summarized in detail specification.

The concrete pavement work shall consist of construction of unreinforced, dowel jointed, plain cement concrete pavement in accordance with the requirements of these Specifications and in conformity with the lines, grades and cross sections shown on the drawings. The work shall include furnishing of all plant and equipment, materials and labour and performing all operations in connection with the Work, as approved by the Employer's Representative.

Concrete in rigid or rigid composite pavements shall be of the class C32/40 XF4.

Prior to commencement of any concrete works the base layer shall be checked of adequate bearing capacity. The check has to be in appropriate time prior to commencement hence measures shall be taken contemporary and no time delay may occur.

If the thickness of the base layer is not in the range of the tolerances the base layer shall be corrected. If this is not possible, the base layer shall be fully replaced.

The base layer shall be clean and free of deleterious material.

The concrete slab shall be laid in two layers. The surface layer shall be laid monolithically with the lower layer. The surface layer shall be not less than 50 mm thick.

Sampling and testing for and compliance with the specified characteristic core strength of designed concretes shall be undertaken by compressive strength testing in accordance with BS EN 13877-2 on cores cut from the full depth of the slab.

39. Water Proofing System

Sheet waterproofing membrane systems for the tunnel shall comprise of a geotextile fleece fixed to the primary lining substrate in combination with a sheet waterproofing membrane fastened to this.

Waterproofing shall be applied to crown and sidewalls above footing or invert arch level. The waterproofing membrane shall always be located between shotcrete support and final concrete lining. As the underground structures referred to be not immersed below a distinct groundwater table no membrane waterproofing will be provided for tunnel inverts.

The design life of the water proofing membrane shall be minimum 100 years.

Where the waterproofing system is to be divided into sectors, the water stops should be formed of material that can be welded to the sheet waterproofing membrane.

Additional drainage capacity shall be provided in case of water inflows in agreement with the Employer's Representative by studded drainage membrane made from thermoplastic material (dimpled sheet) attached prior to installation of the geotextile fleece or equivalent drainage layer approved by the Employer's Representative.

Waterproof membranes shall not be stored in direct sunlight prior to use. Waterproof membranes shall be protected from damage at all times especially during installation of reinforcement. The water proofing membrane shall have a signal layer to indicate damages due to handling and installation of reinforcement. The integrity of the signal layer shall be checked prior to concreting of final lining.

Fire protection measures during construction of water proofing system are required as but not limited to the following.

- The amount of membrane stored in the tunnel shall not exceed two working day's production to minimize the fire load stored underground.
- The installation length of the water proofing system in advance of the final lining shall not exceed 300 m, unless special measures are considered in agreement with the Employer's Representative.

The waterproof membrane shall consist of a continuous impermeable heat-welded sheet of one of the following materials:

- soft polyvinyl chloride (PVC) unreinforced
- flexible polyolefin (FPO/TPO) unreinforced

The membrane as supplied shall be of such dimensions and shape as will result in the minimum of on-site seam welds.

The installation of recycled membranes and/or membranes including DEHP (DOP) plasticizer is not permitted.

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SECTION 500 Base and Surface Courses (Bituminous)

Sub-Clause 501.2 Materials

Sub clause 501.2.1 Binder

Binder of VG-30 grade shall be used or if available viscosity grade of bitumen shall be used in accordance with IS: 73

CLAUSE 505 DENSE BITUMINOUS MACADAM

CLAUSE 507 BITUMINOUS CONCRETE

Binder of CRMB-60 grade shall be used.

SECTION 800 Traffic Signs, Markings and Other Road Appurtenances

CLAUSE 803 ROAD MARKINGS

CLAUSE 806 ROAD DELINATORS

TECHNICAL SPECIFICATIONS

1 The Technical Specifications contained herein shall be read in conjunction with the other Bidding Documents as specified in Volume-IX.

1.1 Site Information General

1.1.1 The information given hereunder and provided elsewhere in these documents is given in good faith by the Employer, but the Contractor shall satisfy himself regarding all aspects of site conditions and no claim will be entertained on the plea that the information supplied by the Employer is erroneous or insufficient.

1.1.2 The area in which the works are located is in hilly terrain, the project road starts from 33.161899° N and 75.800597° E and ends at 33.170924° N and 75.807764° E in the state of Jammu & Kashmir.

1.1.3 Climatic Conditions

1.1.3.1 The temperature in this region is as under:

i) During summer months, the temperature varies from 14°C to 30°C.

ii) During winter months, the temperature varies from -2°C to 10°C.

iii) The location receives about 300 mm of rain, with January the wettest month.

1.1.4 Seismic Zone

The stretch lies in Seismic Zone-IV as defined in Fig. 18 of IRC: 6-2017.

2 GENERAL REQUIREMENTS

The Technical Specifications in accordance with which the entire work described hereinafter shall be constructed and completed by the Contractor shall comprise of the following:

2.1 Part-I: General Technical Specifications

The General Technical Specifications shall be the "SPECIFICATIONS FOR ROAD AND BRIDGE WORKS" (Fifth Revision, April 2013), issued by the Ministry of Road Transport and Highways, Government of India and published by the Indian Roads Congress, henceforth called MORT&H Specifications and deemed to be bound into this document.

2.2 Part-II: Supplementary Technical Specifications

The Supplementary Technical Specifications shall comprise of various Amendments/Modifications/ Additions to the "SPECIFICATIONS FOR ROAD AND BRIDGE WORKS" referred to in Part-I above and Additional Specifications for item of works which are not covered in Part-I.

2.3 A clause or a part thereof in "SPECIFICATIONS FOR ROAD AND BRIDGE WORKS (Fifth Revision April 2013",), referred in Part-I above, where Amended/Modified/Added upon, and incorporated in Part-II, referred to above, such Amendment/Modification/ Addition supersedes the relevant Clause or part of the Clause.

2.3.1 The Additional Specifications shall comprise of specifications for item of works which not covered in Part-I.

2.3.2 When an Amended/Modified/Added Clause supersedes a Clause or part thereof in the said Specifications, then any reference to the superseded Clause shall be deemed to refer to the Amended/Modified/Added Clause or partthereof.

2.3.3 In so far as Amended/Modified/Added Clause may come in conflict or be inconsistent with any of the provisions of the said MORT&H Specifications under reference; the Amended/Modified/Added Clause shall alwaysprevail.

2.3.4 The following Clauses in the "SPECIFICATIONS FOR ROAD AND BRIDGE WORKS (Fifth Revision

April 2013",) have been Amended/Modified/Added upon

Sr. No.	Section No.	Section Title	Clause No.
1.	100	General	102,106,108,109, 111,112,114,115 and 120
2.	200	Site Clearance	201 and 202
3.	300	Earthwork, Erosion Control and Drainage	301,304,305 and 306
4.	400	Sub-base, Bases (Non-Bituminous) and Shoulder	401and 406
4.	500	Bases and Surface Courses (Bituminous)	501,505 and 507
5.	800	Traffic signs, Markingsand other RoadAppurtenances	803 and 806
6.	2100	Open Foundations	2104

2.4 PART-III Specifications for Miscellaneous Works

Technical Specifications for Miscellaneous works shall be the latest "Specifications volume I to VI, 1996 for Civil Works and General Specifications for Electrical Works PART I – INTERNAL, PART – II, EXTERNAL for electric work 1994 as published by the Central Public Works Department (CPWD), Government of India" and deemed to be bound into this document.

2.5 The latest edition till 28 days before the final date of submission of the bid of all specifications / standard shall beapplicable.

SCOPE OF WORKS

The "Works" consist of "Construction of Uni-directional Tunnel i.e. length of 1.541/1.574km (Tube-1/Tube-2) and its approach road from km 29+030 to km 31+449 of total length 2.419 km including rotary on west side portal, 1 major Bridge on East Portal & 5 Culverts on Goha-Khellani Section of NH -244 in the Union Territory of Jammu & Kashmir". The works shall, inter alias, include the following, as specified or as directed:

Road Works

Site clearance; setting-out and layout; widening of existing carriageway and strengthening including camber corrections; construction of new road/ parallel service road; bituminous pavements remodelling/construction of junctions, intersections, bus bays, lay byes; supplying and placing of drainage channels, flumes, guard posts, guard rails and other related items; construction/extension of cross drainage works, bridges, approaches and other related works; road markings, road signs and kilometer/ hectometre stones; protective works for roads/ bridges; all aspects of quality assurance of various components of works; rectification of the defects in the completed works during the Defect Liability Period; submission of "As built" drawings and any other related documents; and other items of work as may be required to be carried out for completing the works inaccordancewiththedrawingsandprovisionsof theContracttoinsuresafety.

Other Items

Execution of any other items of work for the construction and completion of the Works in accordance with the provisions of the Contract including all incidental items as well as preparation and submittal of reports, plans as may be required.

During the period of the Contract the right of way and all existing roads shall be kept open for traffic and maintained in a safe and usable condition. Residents along and adjacent to the works are always to be provided with safe and convenient access to their properties. Traffic control and traffic diversions shall be used as necessary to protect the works and maintenance will be carried out as directed by the Engineer and provided in the Contract.

Any other items as required to fulfil all contractual obligations as per the Bid Documents.

PART II

SUPPLEMENTARY TECHNICALSPECIFICATION

AMENDMENTS/MODIFICATIONS/ADDITIONS TO EXISTING CLAUSES OF GENERAL TECHNICAL SPECIFICATIONS

SECTION100 General

CLAUSE 102 DEFINITIONS

The following abbreviations shall be added in this Clause: "MORT&H" : Ministry of Road Transport & Highways

(Previously known as 'MOST', Ministry of Surface Transport)

"NHAI" : National Highways Authority ofIndia

CLAUSE 106 CONSTRUCTION EQUIPMENT

Add the following sub para (g) and (h) after sub para (f)

- Adequate standby equipment including spare parts shall beavailable.
- All measuring devices and gauges shall be in good working condition. Measuring devices that can affect product quality shall be calibrated prior to use and at prescribed intervals against certified equipment. Calibration procedures shall be established, maintained and documented and corrective actions taken when results are unsatisfactory. Accuracy and fitness of measuring devices shall be ensured by propermaintenance.

CLAUSE 108 SITE INFORMATION

Sub-Clause108.4 This clause shall be asfollows:

"Identification of quarry sites and borrow areas shall be the responsibility of the Contractor. Materials procured from quarry sites and borrow areas identified by Contractor and to be used in Works must comply with the requirements of quality as stipulated in the Technical Specification for particular items of work."

CLAUSE 109 SETTING OUT

Sub-Clause109.8 Delete the 2nd and 3rd sentences in Clause 109.8 and substitute the following: "Setting out of the road alignment and measurement of angles shall be done by using Total Station."

CLAUSE 111 PRECAUTIONS FOR SAFEGUARDING THE ENVIRONMENT

Sub-Clause 111.1 General

Delete the text of Clause 111.1 in its entirety and substitute the following:

"The Contractor shall take all necessary measures and precautions and otherwise ensure that the execution of the Works and all associated operations on site or off-site are carried out in conformity with statutory and regulatory requirements including those prescribed elsewhere in this document.

The Contractor shall take all measures and precautions to avoid any nuisance or disturbance arising for the execution of the Works. This shall wherever possible be achieved by suppression of the nuisance at source rather than abatement of the nuisance once generated. All vehicles deployed for material haulage shall be spillageproof.

Haul roads shall be inspected at least once daily to clear any accidental spillage. In the event of any spoil, debris, wastes or any deleterious substance

from the Site being deposited on any adjacent land, the Contractor shall immediately remove all such material at no cost to the Contract and restore the affected area to its original state to the satisfaction of theEngineer."

Sub-Clause 111.2 Borrow Pits for Embankment Construction

Delete the text of Clause 111.2 and substitute the following:

"Prior approval shall be sought from the concerned State Authorities, and the Contractor shall comply with all local environmental regulations. For all borrow areas, the actual extent of area/zones to be excavated shall be demarcated with the signboards and the operational areas shall be access controlled.

In the case of borrow from tank beds, a regrade/improvement of the inlet channels (at least up to 100m stretch) shall be undertaken in consultation with the concerned state government departments (the Minor Irrigation department of the State PWD) and local bodies. The Contractor shall ensure that excavation of tank beds is uniform over the entire area and that the finished profile of the bed issmooth.

In the case of borrow from the dry highlands, all borrow areas shall be reinstated by the formation gentle side slopes, re-vegetated and connected to the nearest drainage channel to avoid the formation of pools during/after the rainy seasons.

Plant and machinery used in the borrow areas shall conform to State noise emission regulations. All operation areas shall be water sprinkled to contain dust levels to the National Ambient Air Quality Standards."

Sub-Clause 111.3 Quarry Operations

Delete the text of Clause 111.3 and substitute the following:

"Aggregates shall be sourced only from quarry sites that comply with the local/state environmental and other applicable regulations. Occupational safety procedures/practices for the work force in all quarries shall be in accordance with applicable laws. Quarry and crushing units shall have adequate dust suppression measures, such as sprinklers, in work areas and along all approach roads to the quarry sites. These shall preferable be located on the upwind side."

Sub-Clause 111.5 Pollution from Hot-Mix Plant and Batching Plants

Delete the 1st sentence of Clause 111.5 and substitute the following:

"Bituminous hot mix plant and concrete batching plants shall be located at least one(1)km awayfrom thesensitivereceptors(schools,hospitals,etc.)andatleast 500m from urban settlements, unless otherwise required by the statutory requirements."

Sub-Clause 111.8.1 Environmental Protection:

Add the following sentences in the first paragraph of Sub Clause 111.8.1:

Water tankers with suitable sprinkling system shall be deployed along the haulage roads and in the work sites. Water shall be sprinkled regularly all along the routes to suppress airborne dusts from truck/dumper movements particularly on unpaved roads. Actual frequency will be agreed with the Engineer to suit site conditions."

Sub-Clause 111.8.2 Air Quality

The Contractor shall device and implement methods of working to minimize

dust, gaseous and other air-borne emissions and carry out the Works in such a manner as to minimize adverse impacts on the air quality. Construction camps shall have facilities for LPG fuel. The use of firewood shall not be permitted.

The Contractor shall utilize effective water sprays during delivery, manufacture, processing and handling of materials when dust is likely to be created, and to dampen stored materials during dry and windy weather. Stockpiles of friable materials shall be covered with clean tarpaulins, with applications of sprayed water during dry and windy weather. Stockpiles of materials or debris shall be dampened prior to their movement, except where this is contrary to the Specification.

Any vehicle with an open load-carrying area used for transporting potentially dust- producing material shall have properly fitting side and tail boards. Materials having the potential to produce dust shall not be loaded to a level higher than the side and tail boards and shall be covered with clean tarpaulins in good condition. The tarpaulin shall be properly secured and extend at least 300mm over the edges of the side of the side and tailboards.

The Contractor shall monitor air-quality once weekly in all operational areas under the project and take the necessary steps to comply with the specified requirements. Air quality parameters will include SPM, RPM, SO_2, NO_X, HC and CO. operational areas include work sites, haulage roads, hot mix plants, quarries, crushing plants, stockpiles, borrow sites and spoil disposal sites.

Sub-Clause 111.8.3 Water Sources and Water Quality

The Contractor shall provide independent sources of water supply, such as bore wells, for use in the Works and for associated storage, workshop and work force compounds. Prior approval shall be obtained from the relevant State Authorities and all installations shall follow local regulations. Bore wells installed and used for the project shall be left in good operating condition for the use of NHAI and local communities. The Contractor shall prevent any interference with the supply to or abstraction from and prevent any pollution of water resources(includingundergroundpercolatingwater)asaresultoftheexecutionof the Works.

Areas where water is regularly or repetitively used for dust suppression purposes shall be laid to fall to specially constructed settlement tanks to permit sedimentation of particulate matter. After settlement, the water may be re-used for dust suppression and rinsing. The Contractor shall protect all watercourses, waterways, ditches, canals, drains, lakes and the likes from pollution as a result of the execution of the Works.

All water and other liquid waste products arising on the Site shall be collected and disposed of at a location on or off the Site and in a manner that shall not cause either nuisance orpollution.

The Contractor shall at all times ensure that all existing stream courses and drains within, and adjacent to, the Site are kept safe and free from any debris and any materials arising from the Works. The Contractor shall not discharge or deposit any matter arising from the execution of the Works into any water except with the permission of the Engineer and the regulatory authority concerned.

Work force camps shall have septic tank and soak away pits. Operational areas like POL storage areas/hot mix plant areas shall comply with local/state environmental regulations and safety procedures. Storage and handling areas shall be impervious and surrounded by an impervious lined drain to catch any

accidental spills. Storm water shall be stored in lined holding tanks with oil, grease-tapping facility prior to disposal in to nearby watercourses. The trappings and sludge of holding tanks shall be disposed off in accordance with the procedures approved by the local regulatory authority.

Sub-Clause 111.20 Control and Disposal of Wastes

The Contractor shall control the disposal of all forms of waste generated by the construction operations and in all associated activities. No uncontrolled deposition or dumping shall be permitted. Wastes to be so controlled shall include, but shall not be limited to, all forms of fuels and engine oils, all types of bitumen, cement, and surplus aggregates, gravels, bituminous mixtures etc. The Contractor shall make specific provision for the proper disposal of these and any other waste products, conforming to local regulations and acceptable to the Engineer.

Spilling of oil and bituminous products during construction and transport shall be avoided to reduce the chances of contamination of surface as well as ground water.

Degraded materials shall be disposed of in a manner as approved by the Engineer and wastewater shall be disposed into septic tanks and soak pits etc. The Contractor shall make arrangements to clean-up spoil as soon as the work finishes in a stretch. If such sites are located outside the ROW, restoration of the site to a level acceptable to the land owner(s) will be carried out within a time period agreed between landowner(s) and the Contractor. Separators shall be used to separate POL materials from wastewater prior to discharging to the watercourses or as approved by the Engineer in conformance with directives andguidelines.

Disposal of solid waste materials shall be outlined in a plan for which environmental clearances shall be obtained from State environmental regulatory authorities. Potential locations for solid waste disposal are the natural depressions and borrow areas. The areas used for dumping of uncontaminated debris shall be covered with 300mm soil and shall be planted. Contaminated debris shall be dumped in depressions whose bed must be impervious e.g., stone quarry sites or depressions made impervious with 450mm thick impervious floor apron as per MORT&HTechnicalSpecifications.Eachsuccessive1.0mlayersshallbecovered with 500mm thick soil layer, and the area will be covered with 300mm thick layer andplanted.

After Clause 111.12 add the following new Clauses 111.13 to 111.17

Sub-Clause 111.13 Haulage Roads

Existing roads used for hauling shall be strengthened and/ or widened by the Contractor in accordance with the requirements for normal and construction traffic.

Where such roads are not existing, the Contactor shall construct project specific single lane paved roads in settlement areas and gravel roads in open areas conforming to the Ministry of Road Transport and Highways (MORT&H) specifications.

The alignment of the haulage roads shall be fixed to avoid agricultural land to the extent possible. In unavoidable circumstances, suitable compensation shall be paid to the people whose land will be temporarily acquired for the duration of the operations. The compensation shall cover for loss of income for the

duration of temporary acquisition and land restoration. Prior to the construction of the haul roads, topsoil shall be stripped and stockpiled for re-use.

Material dumping sites shall be access controlled to prevent the unauthorized entry of the people, grazing cattle and stray animals.

Haulage roads shall be reinstated upon completion of hauling for the use of local communities."

Sub-Clause 111.14 Equipment and Vehicles used for the Works

Equipments and vehicles deployed for the construction activities shall not be older than 5 years. Equipments used for road and bridge works shall be based on new technology and shall generate noise and pollutants not exceeding the limits specified by the relevant State Authorities. Vehicles and machineries used for road and bridge works are to be regularly maintained to conform to the National Air Quality Standards. Blasting, if any, will be carried out using smallcharges.

Sub-Clause 111.15 Noise Control

The Contractor shall consider noise as an environmental constrain in the planning and execution of the Works.

The Contractor shall take all necessary measures so that the operation of all mechanical equipment and construction processes on and off the site shall not cause any unnecessary or excessive noise, taking in to account applicable environmental requirements. The Contractor shall use all necessary measures and shall maintains all plant and silencing equipment in good conditions so as to minimize the noise emission during constructionworks.

Any member of the work force likely to be exposed to beyond their thresholdnoise levels shall be provided with protective equipment, such as earplugs, and shall be rotated every fourhours.

Construction operations shall be limited to daytime hours only, particularly in the settlement areas.

Sub-Clause 111.16 Vibration Control

The Contractor shall take measures during construction activities to control the movement of the work force and construction machinery/equipment, and to avoid/ minimize activities, which produce vibrations.

Sub-Clause 111.17 Measurement

Monitoring of Air/Water/Noise and Soil quality shall be paid as per numbers of samples tested. For Compliance of all other provisions made in this Clause 111, it shall be deemedtobeincidentaltotheworkandnoseparatemeasurementshallbemade. The Contractor shall be deemed to have made allowance for such compliance with these provisions in the preparations of his prices for items of work included in the Bills of Quantities and full compensation for such compliance shall be deemed to be covered bythem."

CLAUSE 112 ARRANGEMENT FOR TRAFFIC DURING CONSTRUCTION

Sub-Clause 112.4 Traffic Safety and Control

Last line of Para 5 shall be read as under:

"The signs shall be of approved design and of reflector type." **Add the following paragraph at the end of the clause:**

"Before commencement of any construction, the Contractor shall prepare and submit details of the arrangements for passing traffic during construction, design of barricades, signs, markings, lights, flags etc. conforming and satisfying the requirements of the "Guidelines on Safety in Road Construction Zones" of IRC: SP 55-2001 and get the same approved by theEngineer.

Sub-Clause 112.6 Measurement for Payment and Rates

a) The provision of treated shoulder including construction of temporary cross drainage structures, if required, as described in Clause 112.2 including their maintenance, dismantling and clearing debris, where necessary, shall be considered as incidental to the works and shall be Contractor'sresponsibility.

b) The Construction of temporary diversion including temporary cross drainage structures asdescribedinsubclause112.3,shallbemeasuredinlinearmeterand the unit contract rate shall be inclusive of full compensation for construction (including supply of material, labor, tools, etc.), maintenance as per sub clause 112.5, final dismantling, anddisposal.

c) All Traffic safety and control devices during construction as per sub clause 112.4 including providing, erecting and maintaining barrier, signs, markings, flags, lights and providing flag men etc. is included in item rate.

CLAUSE 114 SCOPE OF RATES FOR DIFFERENT ITEMS OF WORK

Sub-Clause114.2 Item (ii) of Clause 114.2 shall read as follows:

A detailed resource-based construction programme including resources planning using computerized critical path network method/PERT in a form, which facilitates control of the progress of the works and consequences of any changes in terms of time. The programme shall also include detailed network, activities for the submission and approval of materials, procurement of critical materials and equipment, fabrication of special products/ equipment and their installation and testing and for all activities of the Contractor that are likely to affect the progress of work etc. including updating all such activities on the basis of decisions taken at the periodic site review meetings or as directed by the Engineer. The Contractor shall submit data via electronic media to the Engineer in a form readily compatible with Engineer's planningsystem.

The first issue of the detailed construction programme including the detailed description of the system and the procedures shall be submitted to the Engineer for acceptance not later than 28 days after the date of receipt of the letter of acceptance.

The contractor shall submit to the Engineer for approval & consent, the updated & revised programme at every three months interval or as such as directed by the Engineer. The updated & revised programme shall be submitted showing the actual progress achieved (physical & financial) and the effects of the progress achieved on the timing of the remaining work including any change to the sequence of the activities

CLAUSE 115 METHODOLOGY AND SEQUENCE OF WORK

The Clause shall be substituted as follows:

Sub-Clause115.1 Submission of Method Statement

The Contractor shall submit methods statement within 28 days after the date of letter of acceptance. The methods statement shall be submitted in two parts.

The General part of the methods statement shall describe the Contractor's proposals regarding preliminary works, common facilities, and items that require consideration at the early stage of the Contract. The General part shall be furnished along with the first issue of the construction programme (refer clause 114.2) and shall include information on:

a) Sources of materials like coarse aggregate and fine aggregate, quantity and quality of materials available in differentsources;

b) Sources of manufactured materials like cement, steel, bitumen reinforcement, prestressing strands and bearings. Wherever possible the Contractor shall identify at least two sources for each of the items; he shall also submit test certificates of recently manufactured materials for the consideration of theEngineer.

c) Locations of site facilities like batching plant, hot mix plant, aggregate processing plant, crushing plantetc.

d) Details of facilities/approaches for transportation of men, equipment and materials for construction of pavements, foundations and substructure in riverbed, and plan for free traffic flow and safedrainage.

e) Information on procedures to be adopted by the Contractorfor prevention and mitigation of negative environmental impact due to constructionactivities.

f) Any other information required by the Engineer subsequent to the scrutiny of methodstatement

The General part of the Q.A. Programme shall accompany the methodsstatement under sub-clause105.3.

The Special part of the methods statement shall be submitted to the Engineer by the Contractor for each important item of work like construction of embankments and subgrade, pavements, pile/well foundations, concreting, prestressing, repair and rehabilitation of existing structures, concrete superstructure, dismantling of structures and pavement and for any other item as directed by the Engineer.

These statements shall give information on

i) Details of personnel both for execution and quality control of thework.

ii) Equipment deployment with details of number of units, capacity, standby arrangements

iii) Sequence of construction, details of temporary or enabling works like, diversions, cofferdams, formwork including specialized formwork for superstructure, details of borrow areas, method of construction of embankment and subgrade, pavements, piles, wells, concreting procedures, details of proprietary process and products (e.g. details of prestressing systems, proprietary piling systems, bearings, expansion joints etc.) and details of equipment to be deployed. Wherever necessary, technical literature, design calculations and drawings shall be included in the methodsstatement.

iv) Testing and acceptance procedures includingdocumentation.

v) Special part of the Q.A. Programme referred in clause 105.3 for the particular item of work shall be submitted along with the methods statement for the concernedactivity.

vi) Engineer shall examine and approve the methods statement or direct

the Contractor to resubmit the statement with required modifications. The modified statement shall be submitted within 14 days of receipt of Engineer'scomments.

The sole responsibility for the safety and adequacy of the methods adopted by the Contractor shall rest on the Contractor irrespective of any approval given by the Engineer.

Sub-Clause115.2 Approval of Proprietary Product/Process/System

Only proprietary products proven by International usage in comparable projects shall be permitted to be used. Fully authenticated details of licensing and collaboration arrangement shall be submitted by the manufacturer, where relevant.

Within 90 days of award of work the Contractor shall submit the following information for all proprietary products for approval by the Engineer.

i) Name of manufacturer and name of product/ process/system.

Complete details of the manufacturer of the product/ process/ system shall be furnished. Details of projects where similar product/process/system has been successfully used shall be furnished. Authenticated copies of license/collaboration agreement shall be furnished.

ii) General features of the product/product process/system.

Detailed write up with methods statements shall be furnished for each product/ process/ system. This shall include complete working drawings & installation drawings, technical specifications covering fabrication, materials, system of corrosion protection etc.

i) Details of product development and developmenttesting.

ii) Acceptance test andcriteria.

Manufacturer shall submit a quality assurance system document. Details of acceptance test and criteria of acceptance shall be furnished in this document.

i) Installationprocedure.

ii) Maintenance procedure andschedule.

iii) Warranty proposal.

The Engineer may instruct any additional tests for the purpose of accepting the product. The charges of these additional tests shall be borne by the Employeronly in case the product satisfies thespecifications.

CLAUSE 120 FIELD LABORATORY

Sub-Clause 120.2 Description

Replace the words "indicated in the drawings" in the first sentence of second paragraph of this Clause with the words "per provisions indicated in this Clause and at a location approved by the Engineer."

Replace "electric supply etc." to the second sentence of first paragraph by "including uninterrupted power supply etc."

Delete the first sentence of second paragraph "The floor space in the drawing" and substitute the following:

"The floor space required for the field laboratory shall be not less than 200 sq.m.

"The fourth sentenceofsecond paragraphs "Thefurnishing In Table100-2" shall

read as under.

"A good semi furnished office accommodation shall be provided to the Material Engineers of the Supervision Team as per the direction of the Engineer."

Add the following at the end of this Clause:

"There shall also be provided a concrete paved area, for storing samples adjacent to the laboratory, of about 100 sq.m and another 75 sq.m shall be suitably roofed with open sides giving protection against sun and rain.

Within 14 (fourteen) days of the commencement date, the Contractor shall prepare and submit a layout plan and details of the laboratory building and make/supplier of theequipment totheEngineerforhisapproval.

The field laboratory to be provided under the Contract shall be handed over to the Engineer in finished and fully equipped condition not later than 2 months after the receipt of Notice to Commence Work, and the field laboratory with all equipment/ instrument shall be to the entire satisfaction of the Engineer. During the 2-monthperiod starting from the Notice to Commence work, the laboratory tests shall be performed in another laboratory proposed by the Contractor and approved by the Engineer.

Laboratory Equipment

General

The items of laboratory equipment shall be provided in the field laboratory depending upon the items to be executed as per Table mentioned below instead of Table 100-2 shown in MORTH:

The following items of laboratory equipment shall be provided in the field laboratory:

The equipment and instruments shall be new and shall be quality certified by Bureau of Indian Standards (BIS).

Sr. No.	Sub No.	Item, Specifications	Nos. required
A: General			
(i)	**Balance**		
	(a)	7 kg to 10 kg capacity semi -self indicating Electronic Type –Accuracy 1 gm	2
	(b)	500 gm capacity semi-self-indicating Electronic Type – Accuracy 0.01 gm	2
	(c)	Chemical balance 100gm capacity - Accuracy 0.0001gm	1
	(d)	Pan balance 5 kg capacity - Accuracy 0.5 gm	2
	(e)	Platform Scale – 300 kg capacity	1
	(f)	Triple Beam balance-25kg capacity Accuracy 1gm	2
(ii)	**Ovens – Electrically operated, thermostatically controlled**		
	(a)	From 100°C to 220°C – Sensitivity	2
(iii)	**Sieves, as per IS 460-1962**		
	(a)	IS Sieves 450 mm internal dia. of sieve sets as per BIS of required sieve sizes complete with lid and pan	2 set
	(b)	IS sieve 200 mm internal dia. (brass frame and steel or brass wire cloth mesh) consisting of sieve sets of required sieve sizes complete with lid and pan	2 set
(iv)	Sieve shaker capable of taking 200 mm and 450 mm dia. Sieves electrically		1

	operated with time switch assembly (As per BIS)		
(v)	200 tones compression testing machine		1
(vi)	Stop watches 1/5 sec. Accuracy		2
(vii)	Glassware comprising of Beakers, Pipettes, dishes, measuring cylinders (100 to 1000 cc capacity) glass rods and funnels, glass thermometers range 0°C to 100°C and metallic thermometers range 300°C		1 Dozen each
(viii)	Hot plates 200 mm dia (1500 watt)		6
(ix)	**Enamel trays**		
	(a)	600 mm x 450 mm x 50 mm	10
	(b)	450 mm x 300 mm x 40 mm	10
	(c)	300 mm x 250 mm x 40 mm	6
	(d)	Circular plates of 250 mm dia.	6
(x)	Water Testing Kit		1
(xi)	First Aid Box		1
(xii)	Spatula Set of 100 and 200 long		3
(xiii)	Digging Tools (pixels, shovel, fork etc.)		As reqd.
(xiv)	Miscellaneous tools (sledge hammer, lump hammer, wooden pegs etc.)		As reqd.
(xv)	Maximum and Minimum Thermometer		2 Set
(xvi)	Rain Gauge		1 Set
(xvii)	Timer 0-60 minutes with alarm & 1/5 sec accuracy.		3 Sets

	B: For Soils and Aggregates		
(i)	Water still, 3 litre/hr with fittings and accessories		1
(ii)	Liquid limit device with Casagrande and ASTM grooving tools as per IS: 2720		1
(iii)	Sampling pipettes fitted with pressure and suction inlets, 10 mlCapacity		2 set
(iv)	Compaction apparatus (Proctor) as per IS: 2720 (Part 8) complete with collar, base plate and hammer		1 set
(v)	Modified AASHTO compaction apparatus as per IS. 2720 (Part 7) 1980 or Heavy Compaction Apparatus as per IS complete with collar, base plate and hammer		1 set
(vi)	Sand pouring cylinder with conical funnel and tap and complete as per IS 2720 (Part 28) 1980 including modified equipment		4
(vii)	Sampling tins with lids 100 mm dia x 75 mm ht ½ kg capacity and miscellaneous items like moisture,tins with lid (50 grams) etc.		12
(viii)	Lab CBR testing equipment for conducting CBR testing, load frame with 5 Ton capacity, electrically operated with speed control as per IS: 2720 (Part 16), and consisting of following:		**1 set**
	(a)	CBR moulds 150-mm dia – 175-mm ht complete with collar, base plateetc.	**24**
	(b)	Tripod stands for holding dial gauge holder	**24**
	(c)	CBR plunger with settlement dial gauge holder	**1**
	(d)	Surcharge weight 147-mm dia 2.5 kg weight with centralhole	48
	(e)	Spacer disc 148-mm dia, 47.7-mm ht. With handle	3
	(f)	Perforated plate (Brass)	24
	(g)	Soaking tank for accommodating 24 CBR moulds	
	(h)	Provingringsof1000kg,2500kgand5000kgcapacity	1
	(i)	Dial gauges, 25 mm travel- 0.01 mm/division	each 10
	(j)	**Aluminium Tis**	
	50x30m		36

		nos
	55x35m	36 nos
	70x45m	36 nos
	70x50m	36 nos
	80x50m	36 nos
(ix)	Standard Penetration test equipment	1
(x)	Nuclear Moisture Density Meter or equivalent	2
(xi)	Speedy moisture meter complete with chemicals	2
(xii)	Unconfined compression test apparatus	1 set
(xiii)	Aggregate Impact Test Apparatus	1
(xiv)	Aggregate Impact Test Apparatus as per IS 2386 (Part 4)1963	1
(xv)	Los Angeles abrasion Test Apparatus as per IS 2386 (Part 4)1963	1
(xvi)	Riffle Box of Slot size of 50mm as per ASTM C-136	1

	C: For Bitumen and Bituminous Mixes	
(i)	Constant temperature bath for accommodating bitumen	2
	Test specimen electrically operated and thermostatically controlled, 50-liter capacity temp. range ambient 80o C	
(ii)	Penetrometer automatic type, adjustable weight arrangement and needles as per IS. 1203 – 1978	2
(iii)	Solvent extraction or centrifuge type apparatus complete (AASHTO, T-164) with extraction thimbles with stocks of solvent and filter paper	1
(iv)	Laboratory mixer including required accessories about .02 cum capacity electrically operated fitted with heating jacket	1
(v)	Marshall compaction apparatus automatically operated as per ASTM 1559-62 T and complete with electrically operated loading unit, compaction pedestal heating head assembly, dial micrometre and bracket for flow measurement, load transfer bar, specimen mould 100 mm dia. (4 in) with base plate, collars, specimen extractor, compaction hammer 4.53 kg (10 lb.) x457 mm (18 in) fall	1 set
(vi)	Distant Reading Digital Thermometer for Measuring Temperatures in Asphaltic Mixes	As required
(vii)	Riffle Box	1
(viii)	Automatic Asphalt Content Gauge [Nuclear are equivalent]	1
(ix)	Thin film Oven test apparatus to the requirement of AASHTO T 179, including accessories	1
(x)	Ring Ball Apparatus as per IS 1205- 1978	1
(xi)	Asphalt Institute Vacuum Viscometer as per IS 1206(part II) – 1978	1
(xii)	BS U- Tube Modified Reverse Floro Viscometer IS 1206(Part III) – 1978	1
(xiii)	Apparatus for Determination of Ductility Test as per IS 1208 – 1978	1
(xiv)	Pen Sky – Martars closed Tester for testing flashand fire point as per IS 1209 – 1978.	1

(xv)	Apparatus for Float Test – IS – 1210 – 1978	1
(xvi)	Apparatus for Determination of water content (Dean and Shark Method) IS – 1211 – 1978	1
(xvii)	Apparatus for Determination of Loss on Heading IS– 1212-1978.	1
(xviii)	Apparatus of Determination of specified Gravity IS- 1202-1978	1
(xix)	Core cutting machine with 100mm dia. Diamond cutting Edge	1
(xx)	Apparatus for Elastic Recovery test for Modified Bitumen	1
(xxi)	Apparatus for Storage Stability test for Modified Bitumen	1
(xxii)	Apparatus for Separation test for modified bitumen	1

D: For Cement, Cement Concrete and Materials			
(i)	Water still		1
(ii)	Vicat needle apparatus for setting time with plungers, as per IS. 269-1967		1
(iii)	Moulds		
	(a)	150 mm x 300 mm ht cylinder with capping component	As required
	(b)	150mmx150 mm x150mm cubical for compressive strength	As required
	(c)	150mmx100 mm x600mm beam for flexural strength	As required
(iv)	Concrete permeability apparatus		1
(v)	High frequency mortar cube vibrator for cement testing		1
(vi)	Concrete mixer power driven, 1 cu ft. capacity		1
(vii)	Variable frequency and amplitude vibrating table size 1 metre x 1 metre, as per the relevant British Standard		1
(viii)	Flakiness & Elongation test apparatus		2each
(ix)	Aggregate impact test apparatus as per IS 2386 (Part 4) 1963		2
(x)	Los Angeles abrasion apparatus as per IS. 2386 (Part 4) 1963		1
(xi)	Flow table as per IS 712-1973		1
(xii)	(a)	Equipment for slump test	2
	(b)	Compaction factor test equipment	1
(xiii)	Equipment for determination of specific gravity for fine and coarse aggregate as per IS 2386 (Part 3) 1963		2
(xiv)	Flexural attachment to compression testing machine		1
(xv)	Core cutting machine with 150 mm dia. Diamond cutting edge		1
(xvi)	Needle vibrator		1
(xvii)	Vibrating hammer as per BS specification		1
(xviii)	Air entrainment meter ASTM C – 231		1
(xix)	0.5 Cft, 1 Cft cylinder for checking bulk density of aggregate with tamping rod		1
(xx)	Soundness testing apparatus for cement		1
(xxi)	Flexural Beam testing machine with accessories		1
(xxii)	Chemicals solutions and consumable		As reqd.
(xxiii)	Chloride Testing kit for chemical analysis of chloride content.		1
(xxiv)	ION Exchange kit for rapid determination of sulphate content.		1

E: For Control of Profile and Surface Evenness			
(i)	Digital Level complete with all accessories		2 sets
(ii)	Distomat or equivalent		2 Nos.
(iii)	Theodolite – Electronically operated with computerized output attachment		2 sets
(iv)	Total Station with all accessories		2 sets
(v)	Towed Fifth Wheel Bump Indicator		1 set
(vi)	3meter straight edge and measuring wedge		2 sets
	Camber templates 2 lane		
(vii)	String line Arrangement with paver and sensor powers		1
	(a)	Crown type cross-section	2 sets
	(b)	Straight run cross-section	2 sets
(viii)	Steel tape		
	(a)	5 m long	as reqd
	(b)	10 m long	as reqd
	(c)	20 m long	as reqd
	(d)	30 m long	as reqd
	(e)	50 m long	As reqd
	(e)	50 m long	As reqd
(ix)	Precision Staff		3 Sets

Note: The laboratory set-up must be complete including a set of reference standards, adequately staffed and operational to the satisfaction of the Engineer not later than 2 months from the date of receipt of Notice to commence theworks.

Sub-Clause 120.3 Ownership

This Clause shall read as under:

"Land for the laboratory shall be provided by the Contractor."

Sub-Clause 120.4 Maintenance

This Clause shall read as under:

"The Contractor shall arrange to maintain the field laboratory including sample store yards in a satisfactory manner until the issue of Taking over Certificate for the whole work. Maintenance includes all activities described in Clause 120.4 and maintenance of equipment and running of the same including chemicals and consumables."

Sub-Clause 120.5 Rate

The construction, supply, installation, maintenance, and operation including all consumables like chemicals &reagents etc., and all other expenses involved in connection thereto for the field laboratory shall be incidental to the work, and shall not be paid for separately.

SECTION 200 Site Clearance

CLAUSE 201 CLEARING AND GRUBBING

Sub-Clause 201.1 Scope

Replace with following Para:

This work shall consist of cutting, excavating, removing, and disposing of all materials such as trees of girth up to 300 mm, bushes, shrubs, stumps, roots, grass weeds, rubbish etc. and top soil up to 150 mm, which in the opinion of

Engineer isunsuitable for incorporation in the work including draining out stagnant water if any from the area of road land, drain, cross drainage structure and other area as specified in the drawing or instructed by Engineer. It shall include necessary excavation by harrow discs or any other suitable equipment, backfilling of the pits by suitable soil, resulting from uprooting of trees & stumps and making the surface in proper grade by suitable equipment and compacted by power roller to required compaction as per Clause 305.3.4. The work also includes handling, salvaging and disposal of cleared material. Clearing and grubbing shall be performed less than one month in advance of earthwork operation and in accordance with requirement of thesespecifications.

CLAUSE 202 DISMANTLING CULVERTS, BRIDGES AND OTHER STRUCTURES/ PAVEMENTS

Sub-Clause 202.5 Disposal of Materials

The first paragraph of the sub clause shall read as below:

All materials obtained of dismantling/milling shall be the property of the Contractor for which he shall quote a rate for rebate in BOQ Bill No. 1, and the Contractor shall be free to use this material in work, or he may sell/dispose the material to as desired / deemed fit by him.

The existing pavement crust shall be reused as indicated below:

Contractor shall be free to use dismantled / milled material, as is where basis is, or by suitably modifying the material, or by crushing the material, or by breaking the material, and screening the same, provided it meets the specifications and is approved by the Engineer.

SECTION 300 Earthwork, Erosion Control and Drainage

CLAUSE 301 EXCAVATION FOR ROADWAY AND DRAINS

Sub-Clause 301.1 Scope

Add the following as second paragraph under this clause:

"The work shall also include excavation for channel training at culverts/bridges, excavation of existing shoulders and medians for purposes of widening the pavement and excavation of existing embankment for reconstruction to specification."

CLAUSE 304 EXCAVATION FOR STRUCTURES

Sub-Clause 304.3.2 Excavation

At the end of 1st paragraph of Clause 304.3.2 inserts the following additional sentences:

"TheContractor shall ensure the stability and structural integrity of adjacent existing foundations and structures and if necessary shall, at his own expense,install temporary or permanent sheet piles, coffer dams, shoring or similar as support or protection to the satisfaction of theEngineer."

CLAUSE 305 EMBANKMENT CONSTRUCTION

Sub-Clause 305.2 Material and General Requirements

Sub-Clause 305.2.1 Physical Requirements:

Sub-Clause 305.2.1.2 Add the following after second paragraph:

"Soils having medium and high swelling potential shall be defined based onLiquid Limit, Plastic Limit, Shrinkage Limit, Gradation, Free swelling Index, Field dry Density and Field Moisture Content and types of Clay minerals present in the soil

and as directed by the Engineer. The location and the extent of these soils with medium to high swelling potential should be defined as directed by the Engineer."

Sub-Clause 305.2.2.2 Borrow Materials

Para 1 of this Clause shall read as under:

" No borrow area shall be made available by the Employer for this work. The arrangement for the source of supply of the material for embankment and sub-grade as well as compliance to the different environmental requirements in respect of excavation and borrow areas as stipulated, from time to time, by the Ministry of Environmental and Forest, Government of India and the local bodies, as applicable, shall be the sole responsibility of the Contractor."

Sub-Clause 305.2.2.4 Compaction Requirements

In Clause 305.2.2.4 delete Table 300-2 and substitute the following:

Table 300-2

Compaction Requirements of Embankment and Subgrade

Sr. No.	Type of Work/Material	Relative Compaction as %age of maximum laboratory dry density as per IS 2720 (Part 8)
1	Subgrade and earthen shoulders	Not less than 97%
2	Embankment	Not less than 95%
3	Expansive clays	Not allowed
4	Design CBR of Subgrade & Shoulder has been taken 8. The borrow earth used for subgrade material must satisfied the requirement of the design CBR of 8 %	

Para 2 of this Clause given below Table 300-2 shall read as under:

The contractor shall at least 21 working days before commencement of construction of embankment and the subgrade; submit the following to the Engineer for approval:

(i) The values of maximum dry density and optimum moisture content obtained in accordance with IS: 2720 (Part 8) for each fill material proposed to be used in the construction of embankment andsubgrade.

(ii) The graphs of Density plotted against moisture content from which each of the values in (i) above of maximum dry density and optimum moisture content were determined.

(iii) The dry density-moisture content-CBR relationships, heavy comp active efforts conformingtotheIS2770(part 8)foreachofthefillmaterialproposedtobeused in thesubgrade.

The above information shall form the basis for compaction only upon its approval by the Engineer."

Sub-Clause 305.3 Construction Operations

Sub-Clause 305.3.4 Compacting Ground Supporting Embankment/Subgrade

Para 1 of this clause shall be read as

"Where necessary the original ground shall be levelled, scarified, mixed with water and then compacted by rolling to facilitate placement of first layer of embankment so astoachieveminimum drydensityasgiveninTable300-2.

Sub-Clause 305.8 Measurement for Payment

Substitute Clause 305.8.1 shall be read as

"Earth embankment/sub-grade construction shall be measured separately by taking cross sections at intervals after clearing and grubbing and if necessary compaction of original ground before the embankment work starts and after its completion and computing the volumes of earthwork in cubic metres by the method of average and areas."

CLAUSE 306 SOIL EROSION AND SEDIMENTATION CONTROL

Sub-Clause 306.4 Measurements for Payment

Substitute Clause 306.4 as follows:

"All temporary sedimentation and pollution control works shall be deemed as incidental to the earthwork and other items of work and as such no separate payment shall be made for thesame."

SECTION 400 Sub-Bases, Bases (Non-Bituminous) and Shoulders

CLAUSE 401 GRANULAR SUB BASE

Sub-Clause 401.1 Scope

Add the following at the end of this Clause:

"A site trial shall be performed in accordance with Clause 901.16."

Sub-Clause 401.2.2 Physical Requirements

Add at the end of this clause as under:

The Contractor shall, at least 21 working days before the commencement of the construction of the sub-base course, submit to the Engineer, the results for approval of the laboratory testing on the physical properties defined above. The construction of the sub-base course shall be taken up only upon the Engineer's approval of the material.

Grading-I of table 400-1 shall be adopted at site.

CLAUSE 406 WET MIX MACADAM SUB BASE/BASE

Sub-Clause 406.4 Opening to Traffic

The Clause shall be read as follows:

No vehicular traffic of any kind shall be allowed on the finished wet mix macadam surface.

SECTION 500 Base and Surface Courses (Bituminous)

Sub-Clause 501.2 Materials

Sub clause 501.2.1 Binder

Binder of VG-30 grade shall be used or if available viscosity grade of bitumen shall be used in accordance with IS: 73

Sub-Clause 501.2.2 Delete "Crushed gravel or other hard material" from first Line of Para 1."

Para 3 isdeleted.

CLAUSE 505 DENSE BITUMINOUS MACADAM

Sub-Clause 505.2.1 Bitumen

Binder of VG-30 grade shall be used or if available viscosity grade of bitumen shall be used in accordance with IS: 73.

CLAUSE 507 BITUMINOUS CONCRETE

Sub-Clause 507.2.1 Bitumen

Binder of CRMB-60 grade shall be used.

SECTION 800 Traffic Signs, Markings and Other Road Appurtenances

CLAUSE 803 ROAD MARKINGS

Sub-Clause 803.2 Materials

This clause shall read as under:

"Road markings shall be hot applied thermoplastic compound and the materials shall meet the requirements as specified in Clause 803.4.

The road markings shall be laid in one layer with appropriate road marking machine approved by the Engineer. Before the road-marking machine is used on the permanent works, the satisfactory working of the machine shall be demonstrated on a suitable site, which is not part of the permanent works. The rate of application shall be checked and adjusted as necessary before application on a large scale is commenced, and thereafterdaily."

CLAUSE 806 ROAD DELINATORS

Sub-Clause806.2 This clause shall read as follows:

a) Triangular Object Marker shall be 300mm side with four red reflectors, made out of 2mm thick aluminium sheet, face to be fully covered by high intensity grade white retro reflective sheeting of encapsulated lens type as per clause 801. The background/border/symbolsshall bemadebyscreen-printingof desiredcolouras per sign details. The sign plate shall be fixed with 6mm dia. aluminium rivets on MS angle iron frame. The angle iron frame shall be made with angle of size 40mmx40mmx5mm. The sign shall be fixed with nut-bolts & welding on MS pipe 50mm dia (NB-MW) and 500mmhigh.

b) Rectangular hazard marker 600mm x 300mm made out of 2mm thick aluminium sheet, face to be fully covered by high intensity grade white retro reflective sheeting of encapsulated lens type. The background/ border/ symbols shall be made by screen-printing of desired colour as per sign details. The sign plate shall be fixed with 6mm dia aluminium rivets on MS angle iron frame. The angle iron frame shall be made with angle of size 40mmx40mmx5mm. The sign shall be fixed to 80mm dia (NB-MW) MSpipe.

c) Roadway Indicators shall be 1000mm high made with 100 mm dia. NB medium weight MS pipe. One reflector of high intensity grade retro reflective sheeting with encapsulated lens shall be provided on top of the reflector. The white & red reflector shall be provided alternatively of 40mm width, so that total width of reflector shall be 120mm. A wire mesh cover of 150mm height shall be provided ontop.

d) All components of signs & supports shall be thoroughly descaled, cleaned, primed and painted with two coats of epoxy paint. The sign backside shall be with grey colour and post shall be white colour/ alternate white & black bands. The post below ground shall be painted with three coats of redlead.

Clause 2100 Open Foundation

Sub-Clause 2104.1 Preparation of Foundation

Please add the following as a last para-

Considering the soil SBC as per Geotechnical report, 1 m of depth below the

founding level of bridges shall be removed and replaced with granular sand. The cost of the excavation and sand shall be made from respective items.

Schedule - E

(See Clauses 2.1 and 14.2)

Maintenance Requirements

1. MaintenanceRequirements

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

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

(iii) All Materials works and construction operations shall conform to the MORTH Specifications for Road and Bridge Works, and the relevant IRC publications. Where thespecificationsforaworkarenotgiven,GoodIndustryPractice shallbeadopted.

[Specify all the relevant documents]

2. Repair/rectification of Defects anddeficiencies

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 anddeficiencies

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'sEngineer.

4. Extension of timelimit

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. Emergencyrepairs/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 theContractor

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-monsooninspection

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 naturalcalamities

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

Annex -I

(Schedule-E)

Repair/rectification of Defects and deficiencies

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

Table -1: Maintenance Criteria for Pavements:

Asset Type	Performance Parameter	Level of Service (LOS)		Frequency of Inspection	Tools/Equipment	Standards and References for Inspection and Data Analysis	Time limit for Rectification/ Repair	Maintenance Specifications
		Desirable	Acceptable					
Flexible Pavement (Pavement of MCW, Service Road, Approaches of Grade structure, approaches of connecting roads, slip roads, lay byes etc. as applicable)	Potholes	Nil	< 0.1 % of area and subject to limit of 10 mm in depth	Daily	Length Measurement Unit like Scale, Tape, odometer etc.	IRC 82: 2015 and Distress Identification Manual for Long Term Pavement Performance Program, FHWA 2003 (http://www.tfhrc.com/pavement/lttp/reports/03031/)	24-48 hours	MORT&H Specification 3004.2
	Cracking	Nil	< 5 % subject to limitof 0.5 sq.m for any 50 m length	Daily			7-15 days	MORT&H Specification 3004.3
	Rutting	Nil	< 5 mm	Daily	Straight Edge		15 -30 days	MORT&H Specification 3004.2
	Corrugations and Shoving	Nil	< 0.1% ofarea	Daily	Length Measurement Unit like		2-7 days	IRC:82- 2015
	Bleeding	Nil	< 1 % of area	Daily	Scale, Tape, odometer etc.		3-7 days	MORT&H Specification 3004.4
	Ravelling/Stripping	Nil	< 1 % of area	Daily			7-15 days	IRC:82- 2015 read with IRC SP 81
	Edge Deformation/ Breaking	Nil	< 1 m for any 100 m section and width < 0.1 m at any location, restricted to 30 cm from the edge	Daily			7- 15 days	IRC:82- 2015
	Roughness BI	2000 mm/km	2400 mm/km	Bi- Annually	Class I Profilometer SCRIM (Sideway- force Coefficient Routine Investigation Machine or equivalent)	Class I Profilometer : ASTM E950 (98) :2004 –Standard Test Method for measuring Longitudinal Profile of Travelled Surfaces with Accelerometer Established Inertial Profiling Reference ASTM E1656 -94: 2000- Standard	180 days	IRC:82- 2015
	Skid Number	60SN	50SN	Bi- Annually			180 days	BS: 7941-1: 2006
	Pavement	3	2.1	Bi- Annually			180 days	IRC:82- 2015

Asset Type	Performance Parameter	Level of Service (LOS)		Frequency of Inspection	Tools/Equipment	Standards and References for Inspection and Data Analysis	Time limit for Rectification/ Repair	Maintenance Specifications
		Desirable	**Acceptable**					
	Condition Index					Guide for Classification of Automatic Pavement Condition Survey Equipment		
	Other Pavement Distresses			Bi- Annually			2-7 days	IRC:82- 2015
	Deflection/ Remaining Life			Annual ly	Falling Weight Deflectometer	IRC 115: 2014	180 days	IRC:115- 2014
Rigid Pavement (Pavement of MCW, Service Road, Grade structure, approaches of connecting road, slip roads, lay byes etc. as applicable)	Roughness BI	2200m m/km	2400mm /km	Bi- Annually	Class I Profilometer	ASTM E950 (98) :2004 and ASTM E1656 - 94: 2000	180 days	IRC:SP:83- 2008
	Skid	Skid Resistance no. at different speed of vehicles		Bi- Annuall y	SCRIM (Sideway- force	IRC:SP:83-2008	180 days	IRC:SP:83- 2008
		Minimum SN 36 33 32 31 31		**traffic Speed (Km/h)** 50 65 80 95 110	Coefficient Routine Investigation Machine or equivalent)			
Embankment/ Slope	Edge drop at shoulders	Nil	40m m	Daily	Length Measurement Unit like Scale, Tape, odometer etc.	IRC	7-15 days	MORT&H Specification 408.4
	Slope of camber/cross fall	Nil	<2% variation in prescribed slope of camber /cross fall	Daily			7-15 days	MORT&H Specification 408.4
	Embankment Slopes	Nil	<15 % variation in prescribe side slope	Daily			7-15 days	MORT&H Specification 408.4
	Embankment Protection	Nil	Nil	Daily	NA		7-15 days	MORT&H Specification
	Rain Cuts/ Gullies in slope	Nil	Nil	Daily Specially During Rainy Season	NA		7-15 days	MORT&H Specification

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

Table -2:Maintenance Criteria for Rigid Pavements:

Sr.No.	Type of Distress	Measured Parameter	Degree of Severity	Assessment Rating	Repair Action	
					For the case d < D/2	**For the case d > D/2**
CRACKING						
1	**Single Discrete Cracks Not intersecting with any joint**	w = width of crack L = length of crack d = depth of crack D = depth ofslab	0	Nil, not discernible	No Action	Not applicable
			1	w < 0.2 mm. hair cracks		
			2	w = 0.2 - 0.5 mm, discernible from slow-movingcar	Seal without delay	Seal, and stitch if L > lm. Within 7days
			3	w = 0.5 - 1.5 mm, discernible from fast-movingcar		
			4	w = 1.5 - 3.0 mm	Seal, and stitch if L > l m. Within 7 days	Staple or Dowel Bar Retrofit, FDR for affected portion. Within 15days
			5	w > 3 mm.		
2	**Single Transverse (or Diagonal) Crack intersecting with one or morejoints**	w = width of crack L = length of crack d = depth of crack D = depth ofslab	0	Nil, not discernible	No Action	
			1	w < 0.2 mm, hair cracks	Route and seal with epoxy. Within 7 days	Staple or Dowel Bar Retrofit. Within 15days
			2	w = 0.2 - 0.5 mm, discernible from slow vehicle		
			3	w = 0.5 - 3.0 mm, discernible from fast vehicle	Route, seal and stitch, if L > 1m. Within 7 days	
			4	w = 3.0 - 6.0 mm	Dowel Bar Retrofit. Within 15 days	Full Depth Repair Dismantle and reconstructaffected.
			5	w > 6 mm, usually associated with spalling, and/or slab rocking under traffic	Not Applicable, as it may befull depth	Portion with norms and specifications - See Para 5.5 & 9.2 Within 15days
3	**Single Longitudinal Crack intersecting with one or more joints**	w = width of crack L = length of crack d = depth of crack D = depth ofslab	0	Nil, not discernible	No Action	
			1	w < 0.5 mm, discernable from slow movingvehicle	Seal with epoxy, if L > 1 m. Within 7 days	Staple or dowel bar retrofit. Within 15days
			2	w = 0.5 - 3.0 mm, discernible from fast vehicle	Route seal and stitch, ifL> l m. Within 15 days	-
			3	w = 3.0 - 6.0 mm	Staple, if L > 1 m. Within 15 days	Partial Depth Repair withstapling. Within 15 days
			4	w = 6.0 - 12.0 mm, usually associated withspalling	Not Applicable, as it may befull depth	
			5	w > 12 mm, usually associated with spalling, and/or slab rocking under traffic		Full Depth Repair Dismantle and reconstruct affected portion as pernorms And specifications - See Para 5.6.4 Within 15 days
4	**Multiple Cracks intersecting with one or morejoints**	**w = width of crack**	0	Nil, not discernible	No Action	
			1	w < 0.2 mm, hair cracks	Seal, and stitch if L > l m. Within	

Sr.No.	Type of Distress	Measured Parameter	Degree of Severity	Assessment Rating	Repair Action	
					For the case d < D/2	**For the case d > D/2**
			2	w = 0.2 - 0.5 mm. discernible from slow vehicle	15 days	
			3	w = 0.5 - 3.0 mm, discernible from fast vehicle	Full depth repair within 15 days	Dismantle, Reinstate subbase, Reconstruct whole slab as per specifications within 30 days
			4	w = 3.0 - 6.0 mm panel broken into 2 or 3pieces		
			5	w > 6 mm and/or panelbroken into more than 4 pieces		
5	**Corner Break**	w = width of crack L = length of crack	0	Nil, not discernible	No Action	-
			1	w < 0.5 mm; only 1 corner broken	Seal with low viscosity epoxy to secure broken parts Within 7 days	Seal with epoxy seal withepoxy Within 7days
			2	w < 1.5 mm; L < 0.6 m, only one cornerbroken		
			3	w < 1.5 mm; L < 0.6 m, two corners broken	Partial Depth (Refer Figure 8.3 of IRC:SP: 83-2008) Within 15 days	Full depth repair Reinstate sub-base, and reconstructthe slab as per norms and specifications within 30days
			4	w > 1.5 mm; L > 0.6 m or three corners broken		
			5	three or four corners broken		
6	**Punch out (Applicable to Continuous Reinforced Concrete Pavement (CRCP) only)**	w = width of crack L = length(m/m2)	0	Nil, not discernible		No Action
			1	w < 0.5 mm; L < 3 m/m^2	Applicable, as it may be fulldepth	Seal with low viscosity epoxy to secure broken parts. Within 15days
			2	either w > 0.5 mm or L < 3 m/m^2		
			3	w > 1.5 mm and L < 3 m/m^2		
			4	w > 3 mm, L < 3 m/m^2 and deformation		Full depth repair - Cut out and replace damaged area taking care not to damage reinforcement. Within30days
			5	w > 3 mm, L > 3 m/m^2 and deformation		
7	Ravelling or Honeycomb type surface	r = area damaged surface/total surface of slab (%) h = maximum depth of damage	0	Nil, not discernible	Short Term No action.	Long Term Not Applicable
			1	r < 2 %	Local repair of areas damaged and liable to be damaged. Within 15 days	
			2	r = 2 - 10 %		
			3	r = 10-25%	Bonded Inlay, 2 or 3 slabs if affecting. Within 30 days	
			4	r = 25 - 50 %		
			5	r > 50% and h > 25 mm	Reconstruct slabs, 4 or more slabs ifaffecting. Within 30 days	
8	**Scaling**	r = damaged surface/total surface of slab (%) h = maximum depth of	0	Nil, not discernible	**Short Term** No action.	**Long Term** Not Applicable
			1	r <**2 %**	Local repair of areas	

Sr.No.	Type of Distress	Measured Parameter	Degree of Severity	Assessment Rating	Repair Action	
					For the case d < D/2	**For the case d > D/2**
		damage	2	r = 2 - 10 %	damaged and liable to be damaged. Within 7days	
			3	r = 10 - 20%	Bonded Inlay within 15 days	
			4	r = 20 - 30 %		
			5	r > 30 % and h > 25 mm	Reconstruct slab within 30 days	
9	**Polished Surface/Glazing**	t = texture depth, sand patchtest	0		No action.	Not Applicable
			1	t > 1 mm		
			2	t = 1 - 0.6 mm	Monitor rate of deterioration	
			3	t = 0.6 - 0.3 mm		
			4	t = 0.3 - 0.1 mm		
			5	t < 0.1 mm	Diamond Grinding if affecting 50% or more slabs ina continuous stretch of minimum 5 km. Within 30 days	
10	**Pop out (Small Hole), Pothole Refer Para 8.4**	n = number/m^2 d = diameter h = maximumdepth	0	d < 50 mm; h < 25 mm; n < 1 per 5 m^2	No action.	Not Applicable
			1	d=50-100mm;h<50mm;n<1 per 5 m^2	Partial depth repair 65 mm deep. Within 15 days	
			2	d=50-100mm;h>50mm;n<1 per 5 m^2		
			3	d = 100 - 300 mm; h < 100 mm n < 1 per 5m^2		
			4	d = 100 - 300 mm; h > 100 mm; n < 1 per 5m^2		
			5	d > 300 mm; h > 100 mm: n > 1 per 5 m^2		
Joint Defects						
					Short Term	**Long Term**
11	**Joint Seal Defects**	loss or damage L = Length as % total jointlength	0	Difficult to discern.	No action.	Not Applicable
			1	Discernible, L< 25% but of little immediate consequence with regard to ingress of water or trapping incompressible material.	Clean joint, inspect later.	
			3	Notable. L > 25% insufficient protection against ingress of water and trapping incompressible material.	Clean and reapply sealant in selected locations. Within 7 days	
			5	Severe; w > 3 mm negligible protection	Clean, widen and reseal the	

Sr.No.	Type of Distress	Measured Parameter	Degree of Severity	Assessment Rating	Repair Action	
					For the case d < D/2	**For the case d > D/2**
				against ingress ofwater and trapping incompressible material.	joint. Within 7 days	
12	**Spalling of Joints**	w = width on either side of the joint L = length of spalled portion (as % joint length)	0	Nil, not discernible	No action.	Not Applicable
			1	w < 10 mm	Apply low viscosity epoxy resin/ mortar in crackedportion. Within 7 days	
			2	w = 10 - 20 mm, L < 25%		
			3	w = 20 - 40 mm, L > 25%	Partial Depth Repair. Within 15 days	
			4	w = 40 - 80 mm, L > 25%	30 - 50 mm deep, h = w + 20% of w, within 30 days	
			5	w > 80 mm, and L > 25%	50 - 100 mm deep repair. H = w + 20% of w. Within 30 days	
13	**Faulting (orStepping) in Cracks or Joints**	f = difference of level	0	not discernible, < 1 mm	No action.	No action.
			1	f < 3 mm		
			2	f = 3 - 6 mm	Determine cause and observe, take action for diamondgrinding	Replace the slab as appropriate. Within 30days
			3	f = 6 - 12 mm	Diamond Grinding	
			4	f= 12 - 18 mm	Raise sunken slab.	Replace the slab as appropriate. Within 30days
			5	f> 18 mm	Strengthen subgrade and sub-base by groutingand raising sunken slab	
14	**Blow-up or Buckling**	H = vertical displacement from normalprofile	0	Nil, not discernible	**Short Term**	**Long Term**
			1	h < 6 mm	No Action	
			2	h = 6 - 12 mm	Install Signs to Warn Traffic	
			3	h = 12 - 25 mm	within 7 days	
			4	h > 25 mm	Full Depth Repair. Within 30 days	
			5	shattered slabs, i.e. 4 or morepieces	Replace broken slabs. Within 30 days	
15	**Depression**	H = negative vertical displacement from normal profile L=length	0	Not discernible, h < 5 mm	No action.	Not Applicable
			1	h = 5 - 15 mm		
			2	h = 15-30 mm, Nos<20% joints	Install Signs to Warn Traffic within 7 days	
			3	h = 30 - 50 mm		
			4	h > 50 mm or > 20% joints	Strengthen subgrade. Reinstate pavement at normal level	

Sr.No.	Type of Distress	Measured Parameter	Degree of Severity	Assessment Rating	Repair Action	
					For the case d < D/2	**For the case d > D/2**
			5	h > 100 mm	If L < 20 m. Within 30 days	
16	**Heave**	h = positive vertical displacement from normal profile. L = length	0	Not discernible. h < 5 mm	**Short Term** No action.	**Long Term**
			1	h = 5 - 15 mm	Follow up.	
			2	h = 15 - 30 mm, Nos <20% joints	Install Signs to Warn Traffic within 7 days	
			3	h = 30 - 50 mm		
			4	h > 50 mm or > 20% joints	Stabilise subgrade. Reinstate pavement at normal level if length < 20 m. Within 30 days	
			5	h > 100 mm		scrabble
17	**Bump**	H = vertical displacement from normalprofile	0	h < 4 mm	No action	
			1	h = 4 - 7 mm	Grind, in case of new construction within 7 days	Construction Limit for New Construction.
			3	h = 7 - 15 mm	Grind, in case of ongoing Maintenance within 15 days	Replace in case of new construction. Within 30days
			5	h > 15 mm	Full Depth Repair. Within 30 days	Full Depth Repair. Within 30days
18	**Lane to Shoulder Drop-off**	f = difference oflevel	0	Nil, not discernible < 3mm	**Short Term** No action.	**Long Term**
			1	f = 3 - 10 mm	Spot repair of shoulder within 7 days	
			2	f = 10 - 25 mm		
			3	f = 25 - 50 mm	Fill up shoulder within 7 days	For any 100 m stretch Reconstruct shoulder, if affecting 25% or more ofstretch. Within 30days
			4	f = 50 - 75 mm		
			5	f > 75 mm		
Drainage						
19	**Pumping**	quantity of fines and water expelled through open joints and cracks Nos Nos/100 m stretch	0	not discernible	No Action	
			1 to 2	slight/ occasional Nos < 10%	Repair cracks and joints Without delay.	Inspect and repair sub-drainage at distressed sections and upstream.
			3 to 4	appreciable/ Frequent 10 -25%	Lift or jack slab within 30 days.	
			5	abundant, crack development >25%	Repair distressed pavement sections. Strengthen subgrade and subbase. Replace slab. Within 30 days	
20	**Ponding**	Ponding on slabs due to blockage of drains	0-2	No discernible problem	No action.	
			3 to 4	Blockages observed in drains, but water flowing	Clean drains etc. within 7 days, Follow up	Action required to stop water damaging foundation within 30

Sr.No.	Type of Distress	Measured Parameter	Degree of Severity	Assessment Rating	Repair Action	
					For the case d < D/2	**For the case d > D/2**
			5	Ponding, accumulation of water observed	-do-	days.

Table -3: Maintenance Criteria for Safety Related Items and Other Furniture Items:

Asset Type	Performance Parameter	Level of Service (LOS)			Frequency of Measurement	Testing Method	Recommended Remedial measures	Time limit for Rectification	Specifications and Standards
Highway	Availability of Safe Sight Distance	As per IRC SP: 84-2014, a minimum of safe stopping sight distance shall be available throughout.			Monthly	Manual Measurements with Odometer along with video/image backup	Removal of obstruction within 24 hours, in case of sight line affected by temporary objects such as trees, temporary encroachments. In case of permanent structure or design deficiency: Removal of obstruction/improvement of deficiency at theearliest Speed Restriction boards and suitable traffic calming measures such as transverse bar marking, blinkers, etc. shall be applied during the period of rectification.		IRC:SP 84-2014
		Design Speed, kmph	**Desirable Minimum Sight Distance (m)**	**Safe Stopping g Sight Distance (m)**					
		100	360	180					
		80	260	130					
Pavement Marking	Wear	<70% of marking remaining			Bi- Annually	Visual Assessment as per Annexure-F of IRC:35-2015	Re - painting	Cat-1 Defect –within 24 hours Cat-2 Defect within 2months-	IRC:35-2015
	Day tim e Visibility	During expected life Service Time Cement Road - 130mcd/m^2/lux Bituminous Road- 100mcd/m^2/lux			Monthly	As per Annexure-D of IRC:35-2015	Re - painting	Cat-1 Defect – within 24 hours Cat-2 Defect – within 2 months	IRC:35- 2015
	Night Tim e Visibility	Initial and Minimum Performancefor Dry Retro reflectivity during night time:			Bi-Annually	As per Annexure-E of IRC:35-2015	Re - painting	Cat-1 Defect – within 24 hours Cat-2 Defect – within 2 months	IRC:35-2015
		Design Speed	(RL) Retro Reflectivity (mcd/m^2/lux)						
			Initial (7 days)	Minimum Threshold level					

Asset Type	Performance Parameter	Level of Service (LOS)			Frequency of Measurement	Testing Method	Recommended Remedial measures	Time limit for Rectification	Specifications and Standards
				(TL) & warranty period required up to 2 years					
		Up to 65	200	80					
		65 - 100	250	120					
		Above 100	350	150					
		Initial and Minimum Performance for Night Visibility under wet condition(Retro reflectivity):							
		Initial 7 days Retro reflectivity: 100 mcd/m^2/lux Minimum Threshold Level: 50 mcd/m^2/lux							
	Skid Resistance	Initial and Minimum performance for SkidResistance: Initial (7days): 55BPN Min. Threshold: 44BPN *Note: shall be considered under urban/city traffic condition encompassing the locations like pedestrian crossings, bus bay, bus stop, cycle track intersection delineation, transverse bar markings etc.			Bi-Annually	As per Annexure-G of IRC:35-2015		Within 24 hours	IRC:35-2015
Road Signs	Shape Position and	Shape and Position as per IRC: 67-2012. Signboard should be clearly visible for the design speed of the section.			Daily	Visual with video/image backup	Improvement of shape, in case if shape is Damaged.	48 hours in case of Mandatory Signs, Cautionary and Informatory Signs (Single and Dual post signs) 15 Days in case of Gantry/Cantilever	IRC:67-2012
	Retro reflectivity	As per specifications in IRC:67-2012			Bi-Annually	Testing of each Signboard using Retro Reflectivity Measuring Device.	Relocation as per requirement hange of signboard		RC:67-2012

Asset Type	Performance Parameter	Level of Service (LOS)	Frequency of Measurement	Testing Method	Recommended Remedial measures	Time limit for Rectification	Specifications and Standards
				In accordance with ASTM D 4956-09.		Sign boards 48 hours in case of Mandatory Signs, Cautionary and Informatory Signs (Single and Dual postsigns) 1 Month in case of Gantry/Cantilever Sign boards	
Kerb	Kerb Height	As per IRC 86:1983 depending upon type of Kerb	Bi-Annually	Use of distance measuring tape	Raising Kerb Height	Within 1 Month	RC 86:1983
	Kerb Painting	Functionality: Functioning of Kerb painting as intended	Daily	Visual with video/image Backup	Kerb Repainting	Within 7-days	RC 35:2015
Other Road Furniture	Reflective Pavement Markers (Road Studs)	Numbers and Functionality as per specifications in IRC:SP:84-2014 and IRC: 35-2015, unless specified in Schedule-B.	Daily	Counting	New Installation	Within 2 months	IRC:SP:84-2014,IRC:35-2015
	Pedestrian Guardrail	Functionality: Functioning ofguardrail asintended	Daily	Visual with video/image Backup	Rectification	Within 15 days	IRC:SP:84-2014
	Traffic Safety Barriers	Functionality: Functioning of Safety Barriers as intended	Daily	Visual with video/image backup	Rectification	Within 7 days	IRC:SP:84-2014, IRC:119-2015
	End Treatment of	Functionality: Functioning of End Treatment as intended	Daily	Visual with video/image	Rectification	Within 7 days	IRC:SP:84-2014,
	Traffic Safety Barriers			Backup			IRC:119- 2015
	Attenuators	Functionality: Functioning	Daily	Visual with video/image backup	Rectification	Within 7 days	IRC:SP-2014, IRC:119- 2015

Asset Type	Performance Parameter	Level of Service (LOS)	Frequency of Measurement	Testing Method	Recommended Remedial measures	Time limit for Rectification	Specifications and Standards
	Guard Posts and Delineators	Functionality: Functioning of Guard Posts and Delineators as intended	Daily	Visual with video/image backup	Rectificatio n	Within 15 days	IRC: 79 - 1981
	Overhead Sign Structure	Overhead sign structure shall be structurally adequate	Daily	Visual with video/image Backup	Rectification	Within 15 days	IRC:67-2012
	Traffic Blinkers	Functionality: Functioning of Traffic Blinkers as intended	Daily	Visual with video/image Backup	Rectification	Within 7 days	IRC:SP:84-2014
Highway Lighting System	Highway Lights	Illumination: Minimum 40 Lux illumination on the road surface	Daily	The illumination level shall be measured with Luxmeter	Improvement in Lighting System	24 hours	IRC:SP:84-2014
		No major failure in the lighting system	Daily	-	Rectification offailure	24 hours	IRC:SP:84-2014
		No minor failure in the lighting system	Monthly	-	Rectification offailure	8 hours	IRC:SP:84-2014
	Toll Plaza Canopy Lights	Minimum 40 Lux illumination on the road surface	Daily	The illumination level shall be measured with Luxmeter	Improvement in Lighting System	24 hours	IRC:SP:84-2014
		No major/minor failure in the lighting system	Daily	-	Rectification of failure	8 hours	IRC:SP:84-2014
Trees and Plantation including median plantation	Obstruction in a minimum head-room of 5.5 m above carriageway or obstruction in visibility of road signs	No obstruction due to trees	Monthly	Visual with video/image backup	Removal of trees	Immediate	IRC:SP:84-2014
	Deterioration in health of trees and bushes	Health of plantation shall be as per requirement of specifications &instructions issued by Authority from time to time	Daily	Visual with video/image backup	Timely watering and treatment. Or Replacement of Trees and Bushes.	Within 90 days	IRC:SP:84-2014
	Vegetation			Visual with	Removal of Trees	Immediate	IRC:SP

Asset Type	Performance Parameter	Level of Service (LOS)	Frequency of Measurement	Testing Method	Recommended Remedial measures	Time limit for Rectification	Specifications and Standards
	affecting sight line and road structures	Sight line shall be free	Daily	video/image backup			84 - 2014
Rest Areas	Cleaning of toilets	-	Daily	-	-	Every 4 hours	
	Defects in electrical, water and sanitary installations	-	Daily	-	Rectification	24 hours	
Other Project Facilities and Approach roads	Damage or deterioration in Approach Roads, pedestrian facilities, truck lay-bys, bus-bays,bus-shelters, cattle crossings, Traffic Aid Posts, Medical Aid Posts and other works		Daily	-	Rectification	15 days	IRC:SP 84 - 2014
Pipe/box/slab culverts	Free waterway/ unobstructed flow section	85% of culvert normal flow area to available.	2 times in a year (before and after rainy season)	Inspection by Bridge Engineer as per IRC SP: 35-1990 and recording of depth of silting and area of vegetation.	Cleaning silt up soils and debris in culvert barrel after rainy season, removal of bushes and vegetation, U/s of barrel, under barrel and D/s of barrelbefore rainy season.	15 days before onset of monsoon and within 30 days after end ofrainy season.	IRC 5-2015, IRC SP:40-1993 and IRC SP:13 - 2004
	Leak-proof expansion joints if any	No leakage through expansionjoints	Bi-Annually	Physical inspection of expansion joints as per IRC SP: 35-1990 if any, for leakage strains on	Fixing with sealant suitably	30 days or before onset of rains whichever comes earlier	IRC SP:40-1993 and IRC SP:69-2011

Asset Type	Performance Parameter	Level of Service (LOS)	Frequency of Measurement	Testing Method	Recommended Remedial measures	Time limit for Rectification	Specifications and Standards
				walls at joints.			
	Structurally sound	Spalling of concrete not more than 0.25 sqm Delamination of concrete not more than 0.25 sq.m. Cracks wider than 0.3 mm not more than 1m aggregatelength	Bi-Annually	Detailed inspection of all components of culvert as per IRC SP:35-1990 and recording	Repairs to spalling, cracking, delamination, rusting shall be followed as perIRC:SP:40-1993.	15 days	IRC SP 40-1993 and MORTH Specification s clause 2800
	Protection works in good condition	Damaged of rough stone apron or bank revetment not more than 3 sqm, damage to solid apron (concrete apron) not more than 1 sqm	2 times in a year (before and after rainy season)	Condition survey as per IRC SP:35-1990	Repairs to damaged aprons andpitching	30 days after defect observation or 2 weeks before onset of rainy season whichever is earlier.	IRC: SP 40-1993 and IRC:SP:13-2004.
Bridges including ROBs Flyover etc. as applicable	Riding quality or user comfort	No pothole in wearing coat on bridge deck	Daily	Visual inspection as per IRC SP:35-1990	Repairs to BC or wearing coat	15 days	MORT&H Specification 2811
Bridge - Super Structure	Bumps	No bump at expansionjoint	Daily	Visual inspection as per IRC SP:35-1990	Repairs to BC on either side of expansion joints, profile correction course on approach slab in case of settlement to approach embankment	15 days	MORT&H Specification 3004 & 2811.
	User safety (condition of crash barrier andguard rail)	No damaged or missing stretch of crash barrier or pedestrian hand railing	Daily	Visual inspection and detailed condition survey as per IRC SP: 35-1990.	Repairs and replacement of safety barriers as the case may be	3days	IRC: 5-1998, IRC SP: 84-2014 and IRC SP: 40-1993.
	Rusted reinforcement Spalling of concrete Delamination	Not more than 0.25 sq.m Not more than 0.50 sq.m Not more than 0.50 sq.m	Bi- Annually	Detailed condition survey as per IRC SP: 35-1990 using Mobile Bri	All the corroded reinforcement shall need to be thoroughly cleaned from rusting and applied with anti-corrosive coating before carrying	15 days	IRC SP: 40-1993 and MORTH Specificatio n

Asset Type	Performance Parameter	Level of Service (LOS)	Frequency of Measurement	Testing Method	Recommended Remedial measures	Time limit for Rectification	Specifications and Standards
				dge InspectionUnit	out the repairs to affected concrete portionwith epoxy mortar / concrete.		1600.
	Cracks wider than 0.30 mm	Not more than 1m total length	Bi-Annually	Detailed condition survey as per IRC SP: 35-1990 using Mobile Bridge InspectionUnit	Grouting with epoxy mortar, investigating causes for cracks development and carry out necessary rehabilitation.	48 Hours	IRC SP: 40-1993 and MORTH Specification 2800.
	Rainwater seepage through deck slab	Leakage - nil	Quarterly	Detailed condition survey as per IRC SP: 35-1990 using Mobile Bridge InspectionUnit	Grouting of deck slab at leakage areas, water proofing, repairs to drainage spouts	1 months	MORTH specifications 2600 & 2700.
	Deflection due to permanent loads and live loads	Within design limits.	Once in every 10 years for spans more than 40 m	Load test method	Carry out major rehabilitation works on bridge to retain original design loadscapacity	6 months	IRC SP: 51-1999.
	Vibrations in bridge deck due to moving trucks	Frequency of vibrations shall not be more than 5 Hz	Once in every 5 years for spans more than 30m and every 10 years for spans between 15 to 30 m	Laser displacement sensors or laser vibro-meters	Strengthening structure of super	4 months	AASHTO LRFD specifications
	Leakage in Expansion joints	No damage to elastomeric sealant compound in Strip seal expansion joint, no leakage of rain water through expansion joint in case of buried and asphalt plug and copper stripjoint.	Bi-Annually	Detailed condition survey as per IRC SP:35-1990 using Mobile Bridge InspectionUnit	Replace of expansionjoint seal in	15 days	MORTH specifications 2600 and IRC SP: 40-1993.

Asset Type	Performance Parameter	Level of Service (LOS)	Frequency of Measurement	Testing Method	Recommended Remedial measures	Time limit for Rectification	Specifications and Standards
	Debris and dust in strip seal expansion joint	No dust debris expansion or in joint gap.	Monthly	Detailed condition survey as per IRC SP:35-1990 using Mobile Bridge InspectionUnit	Cleaning of expansion joint gapsthoroughly	3 days	MORTH specification s 2600 and IRC SP: 40-1993.
	Drainage spouts	No down take pipe missing/broken below soffit of the deck slab. No silt, debris, clogging of drainage spout collection chamber.	Monthly	Detailed condition survey as per IRC SP: 35-1990 using Mobile Bridge InspectionUnit	Cleaning of drainage spouts thoroughly. Replacement of missing/broken down take pipes with a minimum pipe extension of 500mm below soffit of slab. Providing sealant around the drainagespout if any leakages observed.	3 days	MORTH specification 2700.
Bridge-substructure	Cracks/spalling of concrete/ rusted steel	No cracks, spalling of concrete and rusted steel	Bi-Annually	Detailed condition survey as per IRC SP: 35-1990 using Mobile Bridge InspectionUnit	All the corroded reinforcement shall need to be thoroughly cleaned from rusting and applied with anti-corrosive coating before carrying out repairs to substructure by grouting/guniting and micro concreting expending on type of defect noticed	30 days	IRC SP: 40-1993 and MORTH specification 2800.
	Bearings	Delamination of bearing reinforcement not more than 5%, cracking or tearing of rubber not more than 2 locations per side, no rupture ofreinforcement or rubber	Bi-Annually	Detailed condition survey as per IRC SP: 35-1990 using Mobile Bridge InspectionUnit	In case of failure of even one bearing on any pier/abutment, all the bearings on that pier/abutment shall be replaced, in order to get uniform load transfer on tobearings.	3 months	MORTH specification 2810and IRC SP: 40-199.
Bridge	Scouring	Scouring shall not be lower than	Bi-Annually	Condition survey	Suitable protection works	1 month	

Asset Type	**Performance Parameter**	**Level of Service (LOS)**	**Frequency of Measurement**	**Testing Method**	**Recommended Remedial measures**	**Time limit for Rectification**	**Specifications and Standards**
Foundations	around foundations	maximum scour level for the bridge		and visual inspection as per IRC SP:35-1990 Using Mobile Bridge Inspection Unit. In case of doubt, use Underwater camera Rivers.	around pier/abutment		IRC SP: 40-1993,IRC 83-2014, MORTH specification 2500
	Protection works in good condition	Damaged of rough stone apron or bank revetment not more than 3	2 times in a year (before and after rainy season)	Condition survey as per IRC SP:35-1990	Repairs to damaged aprons andpitching.	30 days after defect observation or2	IRC: SP 40-1993 and IRC: SP: 13-2004.
		sq.m, damage to solid apron (concrete apron) not more than 1 sq.m				weeks before onset of rainy season whichever is earlier.	
Note: Any Structure during the entire contract period which is found that does not complies with all requirements of this Table will be prepared, rehabilitated or even reconstructed under the scope of thecontractor.							

Table 4: Maintenance Criteria for Hill Roads

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

Hill Roads		
(i)	Damage to Retaining wall/ Breast wall	7 (Seven) days
(ii)	Landslides requiring clearance	12 (Twelve) hours
(iii)	Snow requiring clearance	24 (Twenty-Four) hours

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

A. FlexiblePavement

Nature of Defect or deficiency		**Time limit for repair/ rectification**
(b)	**Granular earth shoulders, side slopes, drains andculverts**	
(i)	Variation by more than 1 % in the prescribed slope of camber/cross fall (shall not be less than the camber on the main carriageway)	7 (seven) days
(ii)	Edge drop at shoulders exceeding 40 mm	7 (seven) days
(iii)	Variation by more than 15% in the prescribed side (embankment) slopes	30 (thirty) days
(iv)	Rain cuts/gullies in slope	7 (seven) days
(v)	Damage to or silting of culverts and side drains	7 (seven) days
(vi)	Desilting of drains in urban/semi- urban areas	24 (twenty-four) hours
(vii)	Railing, parapets, crash barriers	7 (seven) days (Restore immediately if causing safety hazard)
(c)	**Road side furniture including road sign and pavementmarking**	
(i)	Damage to shape or position, poor visibility or loss of retro-reflectivity	48 (forty-eight) hours
(ii)	Painting of km stone, railing, parapets, crash barriers	As and when required/ Once every year
(iii)	Damaged/missing signs road requiring replacement	7 (seven) days
(iv)	Damage to road mark ups	7 (seven) days
(d)	**Roadlighting**	
(i)	Any major failure of the system	24 (twenty-four) hours
(ii)	Faults and minor failures	8 (eight) hours
(e)	**Trees andplantation**	
(i)	Obstruction in a minimum head- room of 5 m above carriageway or obstruction in visibility of road signs	24 (twenty-four)hours
(ii)	Removal of fallen trees from carriageway	4 (four) hours
(iii)	Deterioration in health of trees and bushes	Timely watering and treatment
(iv)	Trees and bushes requiringreplacement	30 (thirty) days
(v)	Removal of vegetation affecting sight line and road structures	15 (fifteen) days
(f)	**Rest area**	
(i)	Cleaning of toilets	Every 4 (four) hours
(ii)	Defects in electrical, water and sanitary installations	24 (twenty-four) hours
(g)	**[TollPlaza]**	
(h)	**Other Project Facilities and Approach roads**	
(i)	Damage in approach roads, pedestrian facilities, truck lay- byes, bus-bays, bus-shelters, cattle crossings, [Traffic Aid Posts, Medical Aid Posts] and service roads	15 (fifteen) days
(ii)	Damaged vehicles or debris on the road	4 (four) hours

(iii)	Malfunctioning of the mobilecrane	4 (four) hours
Bridges		
(a)	**Superstructure**	
(i)	Any damage, cracks, spalling/ scaling Temporarymeasures Permanentmeasures	within 48 (forty-eight) hours within 15 (fifteen) days or as specified by the Authority's Engineer
(b)	**Foundations**	
(i)	Scouring and/or cavitation	15 (fifteen) days
(c)	**Piers, abutments, return walls and wingwalls**	
(i)	Cracks and damages including settlement and tilting, spalling, scaling	30 (thirty) days
(d)	**Bearings (metallic) ofbridges**	
(i)	Deformation, damages, tilting or shifting ofbearings	15 (fifteen) days Greasing of metallic bearings once in a year
(e)	**Joints**	
(i)	Malfunctioning of joints	15 (fifteen) days
(f)	**Otheritems**	
(i)	Deforming of pads in elastomeric bearings	7 (seven) days
(ii)	Gathering of dirt in bearings and joints; or clogging of spouts, weep holes and vent-holes	3 (three) days
(iii)	Damage or deterioration in kerbs, parapets, handrails and crash barriers	3 (three) days (immediately within 24 hours if posing danger to safety)
(iv)	Rain-cuts or erosion of banks of the side slopes of approaches	7 (seven) days
(v)	Damage to wearing coat	15 (fifteen) days
(vi)	Damage or deterioration in approach slabs, pitching, apron, toes, floor or guidebunds	30 (thirty) days
(vii)	Growth of vegetation affecting the structure or obstructing the waterway	15 (fifteen) days
(g)	**HillRoads**	
(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.]

Table 5: Repair/Rectification of Defects and deficiencies in the Tunnel

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
(a)	**Tunnel lighting (Street lighting and Telecom ATMS)**	
(i)	Any major failure of the system	24 hrs
	Faults and minor failures	8hrs
(b)	**Tunnel Ventilation System**	
(i)	Any major Failure of thesystem	No Major Failure
(ii)	Faults and minor failures	Immediate
(c)	**Tunnel Traffic Control System**	
(i)	Any major Failure of the system	No Major Failure
(ii)	Faults and minor failures	Immediately within 1 hour
(d)	**Tunnel Power Supply System (Mains)**	
(i)	Any major Failure of the system	No Major Failure
(ii)	Faults and minor failures	½ hour
(e)	**Tunnel CCTV Monitoring System**	
(i)	Any major Failure of the system	No Major Failure
(ii)	Faults and minor failures	1 hour
(f)	**Tunnel Fire Safety System**	Contingency plan involving routine check-up so as to ensure that there is no major failure
(i)	Any major Failure of the system	No Major Failure

Schedule - F

(See Clause 4.1 (vii)(a))

Applicable Permits

1. Applicable Permits

(i) The Contractor shall obtain, as required under the Applicable Laws, the following ApplicablePermits:

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

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

(c) Licence for use ofexplosives;

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

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

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

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

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

(i) Any other permits or clearances required under ApplicableLaws.

(ii) Applicable Permits, as required, relating to environmental protection and conservation shall have been procured by the Authority in accordance with the provisions of thisAgreement.

Schedule – G

(See Clauses 7.1 and 19.2)

Annex-I

(See Clause 7.1)

Form of Bank Guarantee

[Performance Security/Additional Performance Security]

[Managing Director, NHIDCL payable at New Delhi] WHEREAS:

(A) ____[name and address of contractor] (Hereinafter called the "**Contractor**") and [name and address of the authority], (hereinafter called the **"Authority"**) have entered into an agreement (hereinafter called the "**Agreement**") for the construction of Uni-directional Khellani Tunnel i.e. length of 1.541/1.574km (Tube-1/Tube-2) & its approaches from km 29.030 to km 31.449 of total length 2.419km including a rotary on West Portal side, 1 Major Bridge on East Portal side,&5 Culvertson Sudhmahadev - Goha - Khellani road section of NH-244(hereinafter called the "NH - 244") in Union Territory of Jammu & Kashmir on Engineering, Procurement and Construction (the "**EPC**") basis, subject to and in accordance with the provisions of the Agreement

(B) The Agreement requires the Contractor to furnish a Performance Security for due and faithful performance of its obligations, under and in accordance with the Agreement, during the {Construction Period/ Defects Liability Period and MaintenancePeriod}(asdefinedintheAgreement)inasumofRs…..cr.(Rupees …….….. crore) (the "**Guarantee Amount**").

(C) We, through ourbranchat (the "**Bank**") have agreedto furnish this bank guarantee (hereinafter called the **"Guarantee**") by way of Performance Security.

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

1. The Bank hereby unconditionally and irrevocably guarantees the due and faithful performance of the Contractor's obligations during the {Construction Period/ Defects Liability Period and Maintenance Period} under and in accordance with the Agreement, and agrees and undertakes to pay to the Authority, upon its mere first written demand, and without any demur, reservation, recourse, contest or protest, and without any reference to the Contractor, such sum or sums up to an aggregate sum of the Guarantee Amount as the Authority shall claim, without the Authority being required to prove or to show grounds or reasons for its demand and/or for the sum specifiedtherein.

2. AletterfromtheAuthority,underthehandofanofficernotbelowtherankof [General Manager in the National Highways Authority of India], that the Contractor has committed default in the due and faithful performance of all orany of its obligations under and in accordance with the Agreement shall be conclusive, final and binding on the Bank. The Bank further agrees that the Authority shall be the sole judge as to whether the Contractor is in default in due and faithful performance of its obligations during and under the Agreement and its decision that the Contractor is in default shall be final and binding on the Bank, notwithstanding any differences between the Authority and the Contractor, or any dispute between them pending before any court, tribunal, arbitrators or any other authority or body, or by the discharge of the Contractor for any reason whatsoever.

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

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 thisGuarantee.

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, fulfilment 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 suchlaw.

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 fulfilment, compliance and/or performance of all or any of the obligations of the Contractor under theAgreement.

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 GuaranteeallrightsoftheAuthorityunderthisGuaranteeshallbeforfeitedand the Bank shall be relieved from its liabilities hereunder.

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

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

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

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

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) Thebankguaranteeshouldcontainthename,designation andcodenumberofthe officer(s) signing theguarantee.

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

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

Annex – II

(Schedule - G)

(See Clause 19.2)

Form for Guarantee for Advance Payment

[Managing Director, NHIDCL payable at New Delhi] WHEREAS:

(A) [name and address of contractor] (hereinafter called the "**Contractor**") has executed an agreement (hereinafter called the "**Agreement**") with the [name and address of the authority], (hereinafter called the "**Authority**") for the construction of Uni-directional Khellani Tunnel i.e. length of 1.541/1.574km (Tube-1/Tube-2) & its approaches from km 29.030 to km 31.449 of total length 2.419km including a rotary on West Portal side, 1 Major Bridge on East Portal side,&5 Culvertson Sudhmahadev - Goha - Khellani road section of NH-244(hereinafter called the "NH - 244") in Union Territory of Jammu & Kashmir on Engineering, Procurement and Construction (the "**EPC**") basis, subject to and in accordance with the provisions of theAgreement

(B) In accordance with Clause 19.2 of the Agreement, the Authority shall make to the Contractor an interest bearing @Bank Rate + 3% advance payment (herein after called"**AdvancePayment**")equalto10%(tenpercent)oftheContractPrice;and that the Advance Payment shall be made in two instalments subject to the Contractor furnishing an irrevocable and unconditional guarantee by a scheduled bank for an amount equivalent to 110% (one hundred and ten percent) of such instalment to remain effective till the complete and full repayment of the instalment of the Advance Payment as security for compliance with its obligations in accordance with the Agreement. The amount of {first/second} instalment of the Advance Payment is Rs. ------ cr. (Rupees crore) andthe amount of this Guarantee is Rs. ------- cr. (Rupees ------ crore) (the **"Guarantee Amount") $.**

(C) We, …….. through ourbranchat..... (the "**Bank"**) have agreedto 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:

The Bank hereby unconditionally and irrevocably guarantees the due and faithful repayment on time of the aforesaid instalment of the Advance Payment under and in accordance with the Agreement, and agrees and undertakes to pay tothe 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 specifiedtherein.

1. A letter from the Authority, under the hand of an officer not below the rank of Managing Director in the National Highways and Infrastructure Development Corporation Limited, that the Contractor has committed default in the due and faithful performance of all orany of its obligations for the repayment of the instalment of the Advance Payment under and in accordance with the Agreement shall be conclusive, final and binding on the Bank. The Bank further agrees that the Authority shall be the sole judge as to whether the Contractor is in default in due and faithful performance of its obligations during and under the Agreement and its decision that the ContractorisindefaultshallbefinalandbindingontheBank,notwithstandingany differences between the Authority and the Contractor, or any dispute between them pending before any court, tribunal, arbitrators or any other authority or body, or by the discharge of the Contractor for any reasonwhatsoever.

2. 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.

3. 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.

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

4. 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.

5. 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.

6. 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.

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

8. 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.

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

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

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) Thebankguaranteeshouldcontainthename,designationandcodenumberofthe officer(s) signing theguarantee.

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

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

Schedule - H

See Clauses10.1 (iv) and 19.3

Contract Price Weightages

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

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

Item	Weightage in percentage to the Contract Price	Stage of Payment	Percentage Weightage
1	**2**	**3**	**4**
Road works including culverts, widening and repair of culverts.	**1.278%**	**B.1 - Reconstruction/New 2-lane realignment/bypass (Flexible pavement)**	
		(1) Earthwork up to top of sub-grade	53.835%
		(2) Sub-Base Course	2.982%
		(3) Non-Bituminous Base Course	4.155%
		(4) Bituminous Base Course	4.374%
		(5) Wearing Coat	2.681%
		D - Re-Construction and New culverts on existing road, realignments, bypasses:	
		(1) Culverts (length < 6m)	31.973%
Major Bridge (Length > 60m) works and ROB/RUB/Elevated sections/Flyovers including Viaducts, if any	**7.824%**	**A.2- New Major Bridges**	
		1) Foundation	27.343%
		2) Sub-structure	33.090%
		3) Super-structure (including bearings)	22.762%
		4) Wearing Coat including expansion joints	1.783%
		5) Miscellaneous Items like handrails, crash barriers, road markings etc.)	0.876%
		6) Wing walls/return walls	0.000%
		7) Guide Bunds, River Training works etc.	0.000%
		8) Approaches (including Retaining walls, stone pitching and protection works)	0.263%
		C.2 -New Elevated Section/Flyovers/ Grade Separators	
		(i) Foundation	4.097%
		(ii) Sub-structure	3.547%
		(iii) Super-structure (including bearings)	4.922%
		(iv) Wearing Coat including expansion joints.	0.812%
		(v) Miscellaneous Items like handrails, crash barriers, road markings etc.	0.305%
		(vi) Wing walls/return walls	0.000%
		(vii) Approaches (including Retaining walls, stone pitching and protection works)	0.200%
Tunnel	**1.603%**	**A. Investigation & Design**	

Item	Weightage in percentage to the Contract Price	Stage of Payment	Percentage Weightage
1	**2**	**3**	**4**
		A1 Investigation	60%
		A2 Detailed Design	40%
	4.648%	**B. Portals**	
		B1- Temporary Dewatering Arrangement	0.997%
		B2- Open Excavation and Earthwork (Loose excavation, rock excavation, etc.)	25.453%
		B3- Primary support measures (Bolts & Anchors, Shotcrete & Wire Mesh)	43.709%
		B4- Permanent Dewatering	4.657%
		B5-Concrete Works at portal	8.437%
		B6- Pavement	0.069%
		B7-Construction of buildings	16.678%
	64.561%	**C. Tunnel**	
		C1- Temporary Dewatering Arrangement	0.775%
		C2- Underground Excavation for tunnel in Support Category dominating the Face Area including Drilling and Grouting	38.941%
		C3- Permanent Dewatering Arrangement,	3.251%
		C4- Primary Support Measures (Bolts & Anchors, Shotcrete & Wire Mesh)	29.920%
		C5-Concrete Works	23.096%
		C6-Instrumentation and Monitoring	0.497%
		C7-Pavement	3.520%
	12.209%	**D. Electro and Mechanical Equipment**	100%
	0.936%	**E. Ventilation System**	100%
	5.655%	**F. Site Facility**	100%
Other Works	**1.286%**	(i) Toll plaza	0.000%
		(ii) Roadside drains	1.401%
		(iii) Road signs, markings, km stones, safety devices, …	5.094%
		(iv) Project Facilities	
		a) Bus bays	0.000%
		b) Truck lay-byes	0.000%
		c) Rest areas	
		d) others i.e. rain harvesting	0.288%
		(v) Junction	20.321%
		(vi) High must Light	0.576%
		(vii) Roadside plantation	0.465%
		(viii) Protection works other than approaches to the bridges, elevated sections/ flyovers& ROB/RUB.	
		a) Retaining/Toe Wall	33.831%
		b) Slope Protection work via rock bolting on hill side	38.024%
		(ix) Safety and traffic management	0.000%

Item	Weightage in percentage to the Contract Price	Stage of Payment	Percentage Weightage
1	**2**	**3**	**4**
		during construction	

1.3 Procedure of estimating the value of work done

1.3.1 Road works

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

Table 1.3.1

Stage of Payment	Percentage - Weightage	Payment Procedure
B.1 - Reconstruction/New 2-lane realignment/bypass (Flexible pavement)		Unit of measurement is linear length. Payment of each stage shall be made on pro rata basis on completion of a stage in length 10% of total length.
Site Clearance		
(1) Earthwork up to top of the sub-grade	53.835%	
(2) Sub-base Course	2.982%	
(3) Non-Bituminous Course	4.155%	
(4) Bituminous Base Course	4.374%	
(5) Wearing Coat	2.681%	
D - Re-Construction and New culverts on existing road, realignments, bypasses:		
(1) Culverts (length < 6m)	31.973%	Cost of each culvert shall be determined on pro rata basis with respect to the total number of culverts. Payment shall be made on the completion of at each culverts.

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

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

Where P= Contract Price

L = Total length in km

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

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

1.3.2 Minor Bridges and Underpasses/Overpasses.

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

1.3.3 Major Bridge works, ROB/RUB and Structures.

Procedure for estimating the value of Major Bridge works, ROB/RUB and Structures shall be as

stated in table 1.3.3:

Table 1.3.3

Stage of Payment	**Weightage**	**Payment Procedure**
1	**2**	**3**
A.2- New Major Bridges		
(i) Foundation	27.343%	Cost of each Major Bridge shall be determined on pro rata basis with respect to the total linear length (m) of the Major Bridge. Payment against foundation shall be made on prorata basis on completion of a stage i.e. not less than 25% of the scope of foundation of the major Bridge subject to completion of each foundations of the major Bridge.
(ii) Sub-structure	33.090%	Payment against Substructure shall be made on pro-rata basis on completion of a stage i.e. not less than 25% of the scope of substructure of the major bridge subject to completion of each sub-structures of abutments/piers up to abutment/pier cap level of the major bridge.
(iii) Wing walls/return walls	0.000%	Payments shall be made on completion of all wing walls/return walls complete in all respects as specified.
(iv) Super-structure: (including bearings)	22.762%	Payment shall be made on pro-rata basis on completion of a stage i.e. completion of super-structure including bearings of at least one span in all respects as specified.
(v) Wearing Coat including expansion joints	1.783%	Payment shall be made on completion of wearing coat including expansion joints complete in all respects as specified.
(vi) Miscellaneous Items like handrails, crash barriers, road markings etc.	0.876%	Payments shall be made on completion of all miscellaneous works like hand rails, crash barriers, road markings etc. complete in all respects as specified.
(vii) Guide Bunds, River Training works etc.	0.000%	Payments shall be made on completion of all guide bunds/river training works etc. complete in all respects as specified.
(viii) Approaches (including Retaining walls, stone pitching and protection works)	0.263%	Payments shall be made on completion of both approaches including stone pitching, protection works, etc. complete in all respects as specified.
C.2 -New Elevated Section/Flyovers/ Grade Separators/Rotary		
(i) Foundation	4.097%	(i) Foundation: Cost of each structure shall be determined on pro rata basis with respect to the total linear length (m) of the structure. Payment against foundation shall be made on prorata basis on completion of a stage i.e. not less than 25% of the scope of foundation of the Structure subject to completion of each ~~at least two~~ foundations of the Structure. In case where load testing is required for foundation, the trigger of first payment shall

Stage of Payment	**Weightage**	**Payment Procedure**
1	**2**	**3**
		include load testing also where specified.
(ii) Sub-structure	3.547%	Payment against Substructure shall be made on pro-rata basis on completion of a stage i.e. not less than 25% of the scope of substructure of the Structure subject to completion of each ~~at least~~ two sub-structures of abutments/piers up to abutment/pier cap level of the Structure.
(iii) Super-structure (including bearings)	4.922%	Payment shall be made on pro-rata basis on completion of a stage i.e. completion of super-structure including bearings of at least one span in all respects as specified.
(a) on pre –casting of girders (Subject to verification by A.E.)		
(b) On erection of girders, casting of cross girders , end diaphragms, bearings and complete cast –in situ deck slab.		
(iv) Wearing Coat including expansion joints.	0.812%	Payment shall be made on completion of wearing coat including expansion joints complete in all respects as specified.
(v) Miscellaneous Items like handrails, crash barriers, road markings etc.	0.305%	Payments shall be made on completion of all miscellaneous works like hand rails, crash barriers, road markings etc. complete in all respects as specified.
(vi) Wing walls/return walls	0.000%	Payments shall be made on completion of all wing walls/return walls complete in all respects as specified.
(vii) Approaches (including Retaining walls, stone pitching and protection works)	0.200%	Payments shall be made on completion of both approaches including stone pitching, protection works, etc. complete in all respects as specified.

Note:

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

(2) The Schedule for exclusive tunnel projects may be prepared as per site requirements before bidding with due approval of Competent Authority.

1.3.4 Tunnel

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

Table 1.3.4

Stage of Payment	**Weightage**	**Payment Procedure**
A-Investigation and Design		Unit of measurement in submission of

Stage of Payment	Weightage	Payment Procedure
A1 Investigation	60.000%	Detailed Design and Investigation report complete payment shall be made on the completion of a stage.
A2 Design	40.000%	
B-Portal		
B1- Temporary Dewatering Arrangement	0.997%	Unit of measurement is completion of portal in all respect. The payment shall be made on the completion of a stage in portals area. **Note**- Payment against item B1 shall be made on completion of portal in all respect.
B2- Open Excavation and Earthwork (Loose excavation, rock excavation, etc.)	25.453%	
B3- Primary support measures (Bolts & Anchors, Shotcrete & Wire Mesh)	43.709%	
B4- Permanent Dewatering	4.657%	
B5-Concrete Works at portal	8.437%	
B6- Pavement	0.069%	
B7-Construction of buildings	16.678%	
C. Tunnel		
C1- Temporary Dewatering Arrangement	0.775%	Unit of measurement is linear length-meter.Payment of each stage shall be made on pro rata basis of completion of a stage in a continuous length of 50meter of induvial tube.
C2- Underground Excavation for tunnel in Support Category dominating the Face Area including Drilling and Grouting	38.942%	
C3- Permanent Dewatering Arrangement,	3.251%	
C4- Primary Support Measures (Bolts & Anchors, Shotcrete & Wire Mesh)	29.920%	
C5-Concrete Works	23.096%	
C6-Instrumentation and Monitoring	0.497%	
C7-Pavement	3.520%	
D-Ventilation System	100%	On delivery, installation and commissioning of E&M equipment in the ratio of 20:40:40.
E- Site Facility Costs	100%	30% of the cost shall be paid after completing the portals excavation and support installation work and on the commencement of mined tunnel excavation. The 50% of Balance amount shall be paid on the basis of tunnel progress with respect to the excavation and supports installation on quarterly basis and 50% of the balance amount in quarterly instalments in each year over the remaining construction period.
F- Electro and Mechanical Equipment	100%	On delivery, installation and commissioning of E&M equipment in the ratio of 20:40:40.

1.3.5 Other works.

Procedure for estimating the value of other works done shall be as stated in table 1.3.5.

Table 1.3.5

Stage of Payment	Weightage	Payment Procedure
(i) Toll plaza	0.000%	Unit of measurement is each completed toll plaza. Payment of each toll plaza shall be made on pro rata basis with respect to the total of all toll plazas.

Stage of Payment	Weightage	Payment Procedure
(ii) Road-side drains	1.401%	Unit of measurement is linear length in km. Payment shall be made on pro rata basis on completion of a stage in a length of not less than 10 % (ten per cent) of the total length.
(iii) Road signs, markings, km stones, safety devices, …	5.094%	
(iv) Project Facilities		
a) Bus bays	0.000%	Payment shall be made on pro rata basis for completed facilities.
b) Truck lay-byes	0.000%	
c) Rest areas	0.000%	
d) others i.e. Rainwater harvesting	0.288%	
(v) Junctions	20.321%	
(vi) High mast lightning	0.576%	
(vii) Roadside plantation	0.465%	Unit of measurement is linear length.
(viii) Protection works other than approaches to the bridges, elevated sections/ flyovers/grade separators and ROBs/RUBs.		Payment shall be made on pro rata basis on completion of a stage in a length of not less than 10% (ten per cent) of the total length.
a) Retaining/Toe Wall	33.841%	
b) Slope Protection work via rock bolting	38.023%	
(ix) Safety and traffic management during construction	0.000%	Payment shall be made on prorata basis every six months.

Schedule - I

(See Clause 10.2 (iv))

Drawings

1. Drawings

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

2. Additional Drawings

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

Annex – I

(Schedule - I)

List of Drawings

1. The Project drawings, as defined in Clause 1.1, Definitions, Article 1, Definitions and Interpretation, Part-I: Preliminary, of the Contract Agreement shall consist:

   (a) Working Drawings of all the components/elements of the Project as determined by Authority Engineer/Authority, and

   (b) As-built drawings for the Project components/elements as determined by AE/Authority. As-built drawings shall be duly certified by Authority Engineer.

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

A. GENERAL LAYOUT PLAN

Tunnel Layout Plan and L-Section

Tunnel Cross Section

B. TUNNEL GEOLOGICAL DRAWINGS

Geological Layout Plan

Geological L-Section

Geological Cross Section

C. TUNNEL CIVIL & MEP DRAWINGS

Excavation and Support Drawings

Portal Development Drawings

Instrumentation Details

Detailed Drawing of Concrete Outline and Reinforcement

Drawings of clearance profile and installations without invert slab

Drawings of clearance profile and installations with invert slab

Detailed Drawings of Tunnel lighting.

Drawings of Tunnel system and installations

Tunnel MEP Drawings

D. BRIDGE

General Arrangement Drawing

Detailed Drawings of Structures/Bridges

E. ROAD (PLAN & PROFILE)

Plan & Profile

Cross Sections

Drawings of horizontal alignment, vertical profile and cross sections

Drawings of cross drainage works

Drawings of traffic diversion plans and traffic control measures

Drawings of road drainage measures

Drawings of typical details slope protection measures

Drawings of landscaping and horticulture

Drawings of street lighting

F. STANDARD DRAWINGS

Detail of Mandatory Regulatory Signs

Detail of Mandatory Regulatory Signs & Compulsory Direction Control and Other Signs

Detail of Informatroy Signs

Detail of Cautionary Signs-TS

Detail of cautionary warning signs

Detail of cautionary warning signs

Details of route marking (chevron marking)

Details of road marking

Details of directional signs

Details Toe drain

Details of pitching, filter material, chute drain and energy dissipation basin-std

Details of double head metal beam crash barrier

Details for 200 meter 1 km & km post

Detail for boundary stone & guard post

Drain retaining wall & kerb

Gabion wall

Schedule - J

(See Clause 10.3 (ii))

Project Completion Schedule

1. Project Completion Schedule

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

2. Project Milestone-I

(i) Project Milestone-I shall occur on the date falling on the **255**th(two hundred & fifty five) day from the Appointed Date (the "**Project Milestone-I**").

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

3. Project Milestone-II

(i) Project Milestone-II shall occur on the date falling on the 438**th** (Four hundred & thirty eight) day from the Appointed Date **(the "Project Milestone- II").**

(ii) Prior to the occurrence of Project Milestone-II, the Contractor shall have continued with construction of the Project Highway and submitted to the Authority duly and validly prepared Stage Payment Statements for an amount not less than 35% (thirty-five per cent) of the Contract Price and should have started construction of all bridges.

4. Project Milestone-III

(i) Project Milestone-III shall occur on the date falling on the **620th** (Six hundred & twenty) day from the Appointed Date **(the "Project Milestone- III").**

(ii) Prior to the occurrence of Project Milestone-III, the Contractor shall have continued with construction of the Project Highway and submitted to the Authority duly and validly prepared Stage Payment Statements for anamount not less than 70% (seventy per cent) of the Contract Price and should have started construction of all project facilities.

5. Scheduled Completion Date

(i) The Scheduled Completion Date shall occur on the **730th** (Seven hundred and thirty) day from the Appointed Date.

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

6. Extension of time

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

Schedule - K

(See Clause 12.1 (ii))

Tests on Completion

1. Schedule forTests

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

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

2. Tests

A. Road and Bridge

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

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

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

(iv) Other tests: The Authority's Engineer may require the Contractor to carry out or cause to be carried additional tests, in accordance with Good Industry Practice, for determining the compliance of the Project Highway with Specifications and Standards, except tests as specified in clause 5,but shall include measuring the reflectivity of road markings and road signs; and measuring the illumination level (lux) of lighting using requisite testing equipment.

B. Tunnel

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

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

(iii) Other tests: The Authority's Engineer may require the Contractor to carry out or

cause to be carried additional tests, in accordance with Good Industry Practice, for determining the compliance of the Project Highway with Specifications and Standards, except tests as specified in clause 5, but shall include measuring the reflectivity of road markings and road signs; and measuring the illumination level (lux) of lighting using requisite testing equipment.

C. Other Tests

(i) 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.

(ii) 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 conductingTests

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. CompletionCertificate

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

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

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

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

Schedule - L

(See Clause 12.2)

Completion Certificate

1 I, …….. (Name of the Authority's Engineer), acting as the Authority's Engineer, under and in accordance with the Agreement dated.....(the "**Agreement**"), for construction of Uni-directional Khellani Tunnel i.e. length of 1.541/1.574km (Tube-1/Tube-2) & its approaches from km 29.030 to km 31.449 of total length 2.419km including a rotary on West Portal side, 1 Major Bridge on East Portal side, & 5 Culverts on Sudhmahadev - Goha - Khellani road section of NH-244 (hereinafter called the "NH -244") in Union Territory of Jammu & Kashmir (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 forentryintooperationonthisthe…….dayof…….20…,ScheduledCompleted

Date for which was the ……. day of …….20…..

SIGNED, SEALED ANDDELIVERED

For and on behalf of the Authority's Engineerby:

(Signature)

(Name) (Designation)(Address)

Schedule - M

(See Clauses 14.6, 15.2 and 19.7)

Payment Reduction for Non-Compliance

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

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

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

(iii) The Authority's Engineer shall calculate the amount of payment reduction on the basis of weightage in percentage assigned to non-conforming items as given in Paragraph2.

2. Percentage reductions in lump sum payments on monthlybasis

(i) The following percentages shall govern the paymentreduction:

S. No.	Item/Defect/Deficiency	Percentage
(a)	**Carriageway/Pavement**	
(i)	Potholes, cracks, other surface defects	15%
(ii)	Repairs of Edges, Rutting	5%
(b)	**Road, Embankment, Cuttings, Shoulders**	
(i)	Edge drop, inadequate cross fall, undulations, settlement, potholes, ponding, obstructions	10%
(ii)	Deficient slopes, rain cuts, disturbed pitching, vegetation growth, pruning of trees	5%
(c)	**Bridges and Culverts**	
(i)	Desilting, cleaning. vegetation growth, damaged pitching, flooring, parapets, wearing course, footpaths, any damage to foundations	20%
(ii)	Any Defects in superstructures, bearings and sub-structures	10%
(iii)	Painting, repairs/replacement kerb, railings, parapets, guideposts/crash barriers	5%
(d)	**Tunnel**	
(i)	Tunnel lighting (Street lighting and Telecom ATMS)	
	➢ Any major/ minor faults and failure of the system	15%
(ii)	Tunnel Ventilation system	
	➢ Any major/ minor faults and failure of the system	10%
(iii)	Tunnel Traffic Control system	
	➢ Any major/ minor faults and failure of the system	10%
(iv)	Tunnel Power Supply system	
	➢ Any major/ minor faults and failure of the system	10%
(v)	Tunnel CCTV monitoring system	
	➢ Any major/ minor faults and failure of the system	10%
(vi)	Tunnel Fire Safety system	
	➢ Any major/ minor faults and failure of the system	12.5%
(e)	**Roadside Drains**	
(i)	Cleaning and repair of drains	5%
(f)	**Road Furniture**	
(i)	Cleaning, painting, replacement of road signs, delineators, road markings, 200 m/km/5th kmstones	5%

(g)	**Miscellaneous Items**	
(i)	Removal of dead animals, broken down/accidental vehicles, fallen trees, road blockades or malfunctioning of mobile crane	10%
(ii)	Any other Defects in accordance with paragraph 1.	5%
(h)	**Defects in Other Project Facilities**	5%

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

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

Where,

P= Percentage of particular item/Defect/deficiency fordeduction

M1= Monthly lump-sum payment in accordance para 1.2 above of this Schedule M2= Monthly lump-sum payment in accordance para 1.2 above of this Schedule L1= Non-complying length L = Total length of the road,

R= Reduction (the amount to be deducted for non-compliance for a particular item/Defect/deficiency

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

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

Schedule - N

(See Clause 18.1 (i))

Selection of Authority's Engineer

1. Selection of Authority'sEngineer

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

(ii) In the event of termination of the Technical Consultants appointed in accordance with the provisions of Paragraph 1.1, the Authority shall appoint another firm of Technical Consultants forthwith and may engage a government-owned entity in accordance with the provisions of Paragraph 3 of thisSchedule-N.

2. Terms ofReference

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'sEngineer

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

(i) TheseTermsofReference(the"**TOR**")fortheAuthority'sEngineerarebeingspecified pursuant to the EPC Agreement dated ..... (the "**Agreement**), which has been enteredintobetweenthe[nameandaddressoftheAuthority](the"**Authority**")and ..... (the "**Contractor**")# for construction of Uni-directional Khellani Tunnel i.e. length of 1.541/1.574km (Tube-1/Tube-2) & its approaches from km 29.030 to km 31.449 of total length 2.419km including a rotary on West Portal side, 1 Major Bridge on East Portal side, & 5 Culverts on Sudhmahadev - Goha - Khellani road section of NH-244 (hereinafter called the "NH -244") in Union Territory of Jammu & Kashmir 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.

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

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

2. Definitions and interpretation

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

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

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

3. General

(i) The Authority's Engineer shall discharge its duties in a fair, impartial and efficient manner, consistent with the highest standards of professional integrity and Good IndustryPractice.

(ii) The Authority's Engineer shall perform the duties and exercise the authority in accordance with the provisions of this Agreement, but subject to obtaining prior written approval of the Authority beforede

(iii) termining:

(a) any Time Extension;

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

(c) the Termination Payment; or

(d) issuance of Completion Certificate or

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

(iv) 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.

(v) 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.

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

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

4. Construction Period

(i) During the Construction Period, the Authority's Engineer shall review and approve the Drawings furnished by the Contractor along with supporting data, including the geo-technical and hydrological investigations, characteristics of materials from borrow areas and quarry sites, topographical surveys, and the recommendations of the Safety Consultant in accordance with the provisions of Clause 10.1 (vi). The Authority's Engineer shall complete such review and approval and send its observations to the Authority and the Contractor within 15 (fifteen) days of receipt of such Drawings; provided, however that in case of a Major Bridge or Structure, the aforesaid period of 15 (fifteen) days may be extended upto 30 (thirty) days. In particular, such comments shall specify the conformity or otherwise of such Drawings with the Scope of the Project and Specifications and Standards.

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

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

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

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

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

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

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

(ix) For determining that the Works conform to Specifications and Standards, the Authority's Engineer shall require the Contractor to carry out, or cause to be carried out, tests at such time and frequency and in such manner as specified in the Agreement and in accordance with Good Industry Practice for quality assurance. For purposes of this

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

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

(xi) The timing of tests referred to in Paragraph 4 (ix), and the criteria for acceptance/ rejection of their results shall be determined by the Authority's Engineer in accordance with the Quality Control Manuals. The tests shall be undertaken on a random sample basis and shall be in addition to, and independent of, the tests that may be carried out by the Contractor for its own quality assurance in accordance with Good Industry Practice.

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

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

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

(xv) The Authority's Engineer shall obtain from the Contractor a copy of all the Contractor's quality control records and documents before the Completion Certificate is issued pursuant to Clause 12.2.

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

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

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

5. Maintenance Period

(i) The Authority's Engineer shall aid and advise the Contractor in the preparation of its monthly Maintenance Programme and for this purpose carry out a joint monthly

inspection with the Contractor.

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

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

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

(v) The Authority's Engineer shall examine the request of the Contractor for closure of any lane(s) of the Project Highway for undertaking maintenance/repair thereof, and shall grant permission with such modifications, as it may deem necessary, within 5 (five) days of receiving a request from the Contractor. Upon expiry of the permitted period of closure, the Authority's Engineer shall monitor the reopening of such lane(s), and in case of delay, determine the Damages payable by the Contractor to the Authority under Clause14.5.

6. Determination of costs and time

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

(ii) TheAuthority'sEngineershalldeterminetheperiodofTimeExtensionthatisrequired to be determined by it under the Agreement.

(iii) The Authority's Engineer shall consult each Party in every case of determination in accordance with the provisions of Clause18.5.

7. Payments

(i) The Authority's Engineer shall withhold payments for the affected works for which the Contractor fails to revise and resubmit the Drawings to the Authority's Engineer in accordance with the provisions of Clause 10.2 (iv)(d).

(ii) Authority's Engineer shall-

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

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

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

(iv) The Authority's Engineer shall certify final payment within 30 (thirty) days of the receipt of the final payment statement of Maintenance in accordance with the provisions of Clause19.16.

8. Other duties and functions

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

9. Miscellaneous

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

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

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

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

(v) TheAuthority'sEngineershallinformtheAuthorityandtheContractorofanyeventof Contractor's Default within one week of its occurrence.

Schedule - O

(See Clauses 19.4 (i), 19.6 (i), and 19.8 (i))

Forms of Payment Statements

1. Stage Payment Statement for Works

The Stage Payment Statement for Works shall state:

(a) theestimatedamountfortheWorksexecutedinaccordancewithClause19.3

(i) subsequent to the last claim;

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

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

(d) amountsreflectingadjustmentinprice,ifany,for(c)aboveinaccordancewith the provisions of Clause 13.2 (iii)(a);

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

(f) Deductions:

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

ii. Any amount towards deduction of taxes;and

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

(g) Net claim: (e) – (f)(iii);

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

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

ii. For Change of Scope Orders, and

iii. Taxesdeducted

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 oft axes

3. Contractor's claim for Damages

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

Schedule - P

(See Clause 20.1)

Insurance

1. Insurance during Construction Period

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

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

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

(ii) The insurance under sub para (a) and (b) of paragraph 1(i) above shall cover the Authority and the Contractor against all loss or damage from any cause arising under paragraph 1.1 other than risks which are not insurable at commercial terms.

2. Insurance for Contractor's Defect Liability

The Contractor shall effect and maintain insurance cover of not less than 15% of the Contract Price for the Works from the date of issue of the Completion Certificate until the end of the Defects Liability Period for any loss or damage for which the Contractor is liable and which arises from a cause occurring prior to the issue of the Completion Certificate. The Contractor shall also maintain other insurances for maximum sums as may be required under the Applicable Laws and in accordance with Good Industry Practice.

3. Insurance against injury to persons and damage to property

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

The insurance cover shall be not less than: Rs. 2,00,00,000/- (Two Crore only)

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

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

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

4. Insurance to be in joint names

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

Schedule-Q

(See Clause 14.10)

Tests on Completion of Maintenance Period

1. Riding Quality test

Riding quality test: Riding quality of each lane of the carriageway shall be checked with the help of a calibrated bump integrator and the maximum permissible roughness for purposes of this Test shall be [2,200 (two thousand and two hundred only)] mm for each kilometer.

2. Visual and physical test

The Authority's Engineer shall conduct a visual and physical check of construction to determine that all works and equipment forming part thereof conform to the provisions of this Agreement. The physical tests shall include measurement of cracking, rutting, stripping and potholes and shall be as per the requirement of maintenance mentioned in Schedule-E.

Schedule-R

(See Clause 14.10)

Taking Over Certificate

I, …….. (Name and designation of the Authority's Representative) under and in accordance with the Agreement dated …….. (the "**Agreement**"), for construction of Uni-directional Khellani Tunnel i.e. length of 1.541/1.574km (Tube-1/Tube-2) & its approaches from km 29.030 to km 31.449 of total length 2.419km including a rotary on West Portal side, 1 Major Bridge on East Portal side,&5 Culverts on Sudhmahadev - Goha - Khellani road section of NH-244(hereinafter called the "NH -244") in Union Territory of Jammu & Kashmir (the "**Project Highway**") on Engineering, Procurement and Construction (EPC) basis through(NameofContractor),herebycertifythattheTestsoncompletionof Maintenance Period in accordance with Article 14 of the Agreement have been successfully undertaken to determine compliance of the Project Highway with the provisions of the Agreement and I hereby certify that the Authority has taken over the Project highway from the Contractor on this day.....

SIGNED, SEALED ANDDELIVERED

(Signature)

(Name and designation of Authority's Representative)

(Address)

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