National Highways Authority of India

(Ministry of Road, Transport & Highways)
Government of India

Development of Six Lane Kantakapalle – Sabbavaram Section of NH-130-CD Road from km 445+100 to km 464+662 under Raipur-Visakhapatnam Economics Corridor in the state of in the state of Andhra Pradesh on Hybrid Annuity Mode

TECHNICAL SCHEDULE (A to D)

SEPTEMBER 2020

G-5 & 6, Sector – 10, Dwarka, New Delhi – 110 075

SCHEDULE-A

(See Clause 10.1)

SITE OF THE PROJECT

1 THE SITE

1.1 Site of the Project Highway shall include the land, buildings, structures and road works as described in **Annex-I** of this **Schedule-A**.

1.2 An inventory of the Site including the land, buildings, structures, road works, trees and any other immovable property on, or attach to, the Site shall be prepared jointly by the Authority Representative and the Concessionaire, and such inventory shall form part of the memorandum referred to in Clause 10.3.1 of the Agreement.

1.3 Additional land required for Toll Plazas, Bus Bays/Shelter, Traffic Aid Posts, Medical Aid Posts and vehicle rescue posts or for construction of works specified in the Change of Scope Order issued under Clause 16.2.3 of this Agreement shall be acquired in accordance with the provisions of Clause 10.3.6 of this Agreement. Upon acquisition, such land shall form part of the Site and vest in the Authority.

Annex – I

(Schedule-A)

Site for Six Laning

1 Site

The proposed Greenfield alignment commencing from Kantakapalle Village at km 445+100 in Vizianagaram District in the State of Andhra Pradesh and ends near Sabbavaram section of NH-130-CD in the State of Andhra Pradesh at km 464+662.

The start and end chainage coordinates of the package are given below:

S. No.	Easting	Northing	Remarks
1	733098.5346E	1987370.4985N	Start of Project Road
2	727257.2799E	1969788.0120N	End of Project Road

The land, carriageway and structures comprising the Site are described below.

The Index Map / location plan of the project highway is given at **Appendix A-I of Schedule-A.**

2 Land

The site of the project highway comprises the land (existing right of way) as described below:

S. No.	Proposed Chainage (km)		Right of Way (m)	Remarks
	From	To		
1	445+100	446+900	60	
2	446+800	447+900	Varying	Refer Plan / Interchange Drawing
3	447+900	455+300	60	
4	455+300	456+300	Varying 60 m to 200 m (Toll Plaza)	Refer Plan & Profile
5	456+300	464+662	60	

Note:

(i) The ROW has been taken as 60m for the proposed highway except at Interchange location, Toll Plaza location, Junction Improvement location and Wayside Amenities

Area (wherever applicable), where the ROW varies as per drawings and design requirements.

(ii) The proposed centerline coordinates for realignment and bypass given in Appendix A-II of Schedule-A

3 Carriageway

This Project envisages construction of a fully access controlled highway with 6-lane divided carriageway.

The project highway crosses the existing cross roads at locations of interchanges, Flyovers, Underpasses etc. as given in Clause 11 of Annex-I of Schedule A.

4 Major Bridges-

The site includes the following major bridges:

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

Railway Line / Level Crossings

The Site includes the following Railway Line / Level Crossing:

S. No.	Location (Proposed Chainage, km)	Remarks
Nil		

6 Grade Separators

The site includes the following Grade Separators:

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

8 Cross Drainage Structures / Culverts - NIL

The Site includes the following culverts:

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

9 Total Number of Structures

The total number of structures on the site is indicated below:

(a) No. of Major Bridges – NIL

(b) No. of Railway Over Bridges – NIL

(c) No. of Grade Separators –NIL

(d) No. of Minor Bridges – NIL

(e) No. of Culverts – NIL

10 Bus Shelters and Truck lay-byes

10.1 Bus Shelters

The location of existing bus shelters are given below:

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

10.2 Truck Lay-byes

The location of existing truck lay byes are given below:

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

11 Cross Roads

The details of cross roads are as follows:

S. No.	Proposed Chainage (km)	Type of Junction	Category of Road	Road Crossing
1)	447+867	+	SH -39	LHS-Visakhapatnam RHS-Araku
2)	450+480	+	ODR	LHS-Nimallapalem RHS-Engineering college
3)	450+881	x	ODR	LHS-Devapalli RHS-Narapam
4)	451+869	+	MDR	LHS-Tummikapalli RHS-Musiram
5)	453+683	+	MDR	LHS-Kothavalasa RHS-K. Kotapadu
6)	455+082	+	ODR	LHS-Tummikapalle RHS-Cheepuruvalasa
7)	461+112	x	MDR	LHS-Kothavalasa RHS-Sabbavaram
8)	462+186	+	MDR	LHS-Mogalipuram RHS-Gullepalle
9)	464+662	T	NH-16	LHS-Ankapalle RHS-Anandapuram

12 Permanent Bridge, Bye Pass or Tunnel costing Rs. 50 crore or more

The project is a green field project hence there is no existing structures. The new structures shall be constructed as per Schedules.

13 Other Structures - Existing Tank/Pond

S. No	Proposed Chainage (km)		Length of Tank/Pond along alignment (in m)
	From	To	
1	445+385	445+504	119
2	451+517	451+712	195
3	460+967	461+068	101
4	462+861	463+113	252

14 Details of Existing Utilities

(i) Electrical utilities

The site includes the following electrical utilities: -

(a) **Extra High-Tension Lines (EHT Lines) ***

SL No	Design Chainage (km)		Length (in Km)						Crossings						Remarks (Name of power supply agency)
	From	To	765 KV	400 KV	220 KV	132 KV	110 KV	66 KV	765 KV	400 KV	220 KV	132 KV	110 KV	66 KV	
1	460+950	463+800	-	0.550	-	-		-	-	1	-	-	-	-	APEPDCL
2	464+300	464+400	-	0.600	-	-		-	-	1	-	-	-	-	APEPDCL

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

S No	Design Chainage (km)		Length (in Km)			Crossings			Transformer		Remarks
	From	To	33 KV	11 KV	LT	33 KV	11 KV	LT	No	Capacity (approx.)	
1	447+850	447+880	-	0.030	-	-	5.00	-	-	-	APEPDCL
2	448+110	448+410	-	0.300	-	-	5.00	-	-	-	APEPDCL
3	450+670	450+895	-	0.225	-	-	3.00	-	-	-	APEPDCL
4	451+850	451+880	-	0.030	-	-	4	-	-	-	APEPDCL
5	453+680	453+690	-	0.010	-	-	2	-	-	-	APEPDCL
6	455+790	455+840	-	0.050	-	-	2	-	-	-	APEPDCL

S No	Design Chainage (km)		Length (in Km)			Crossings			Transformer		Remarks
	From	To	33 KV	11 KV	LT	33 KV	11 KV	LT	No	Capacity (approx.)	
7	457+560	457+570	-	0.010	-	-	1	-	-	-	APEPDCL
8	460+540	460+685	-	0.145	-	-	7	-	-	-	APEPDCL
9	461+140	461+995	-	0.855	-	-	11	-	-	-	APEPDCL
10	462+180	462+455	-	0.275	-	-	4	-	-	-	APEPDCL
11	463+530	463+755	-	0.225	-	-	4	-	-	-	APEPDCL
12	464+420	464+500	-	0.080	-	-	3	-	-	-	APEPDCL

(ii) Public Health utilities (Water/Sewage Pipelines) *

The site includes the following Public Health utilities:-

(a) Major Water Supply Pipe Line

S No	Design Chainage (km)		Length (in Km)				Crossings			
	From	To	Water Supply line		Sewage line		Water Supply line		Sewage line	
			With Pumping	With Gravity Flow	With Pumping	With Gravity Flow	With Pumping	With Gravity Flow	With Pumping	With Gravity Flow
NIL										

(b) Minor Water Supply Pipe Line

S No	Design Chainage (km)		Length (in Km)				Crossings			
	From	To	Water Supply line		Sewage line		Water Supply line		Sewage line	
			With Pumping	With Gravity Flow	With Pumping	With Gravity Flow	With Pumping	With Gravity Flow	With Pumping	With Gravity Flow
NIL										

(iii) Any Other Line -

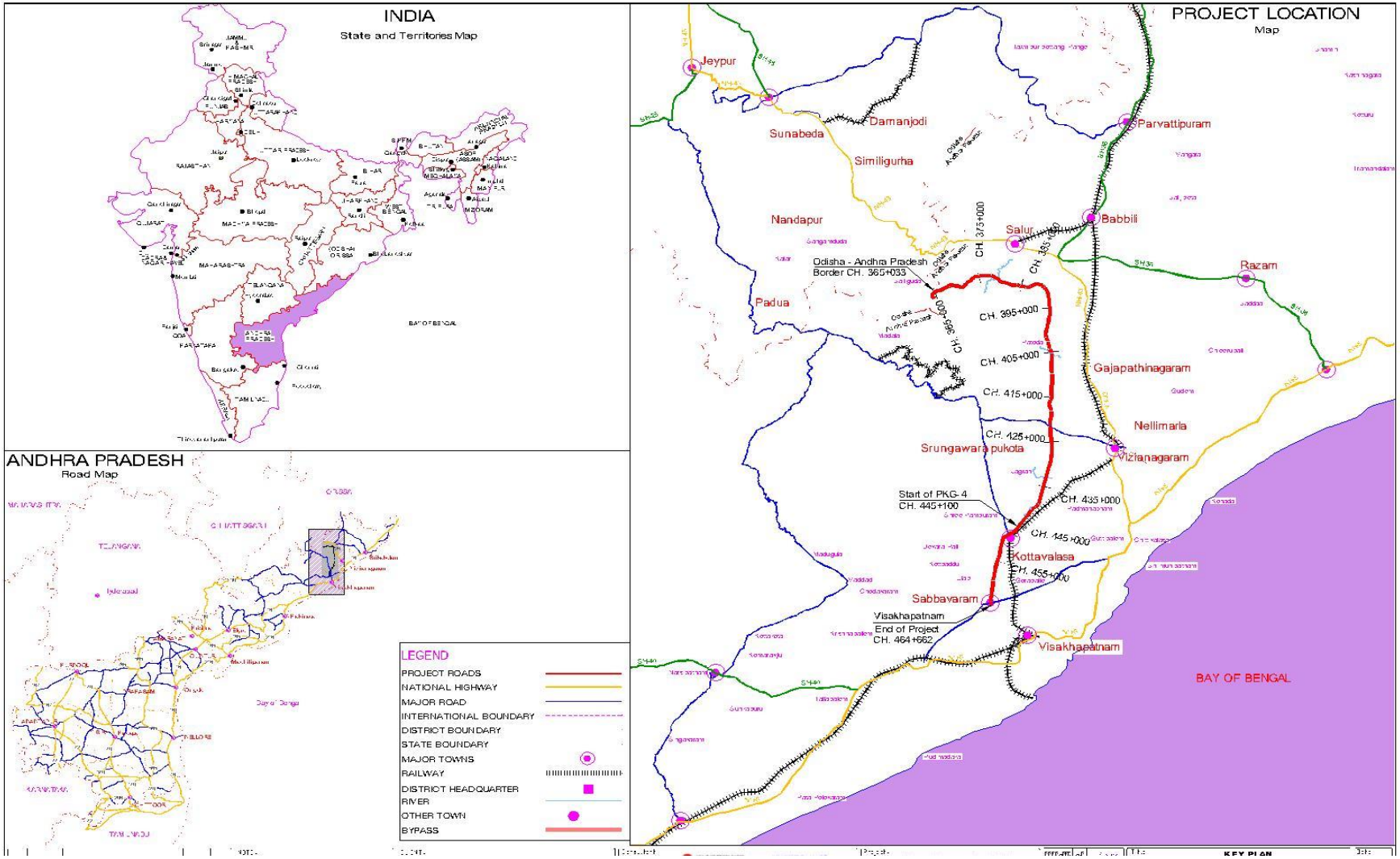
S No	Design Chainage (km)		Length (in Km)		Remarks
	From	To	With Pumping	With Gravity Flow	
Nil					

No change of scope shall be paid for any over-ground utilities. However, for any underground utilities not mentioned in Schedule 'B' shall form change of scope, which shall be worked out as per the estimation of the concerned utility owning dept. and shall be payable

Appendix A-I

(Schedule-A)

INDEX MAP / LOCATION MAP OF PROJECT HIGHWAY



Appendix A-II

(Schedule-A)

PROJECT CENTER LINE COORDINATES

Project is entirely a Greenfield alignment starting at km 445+100 near Kantakapalle Village (in Vizianagaram District in the State of Andhra Pradesh and ending at km 464+662. The design Co-ordinates at centre of ROW,) at every 100m distance are given below.

Coordinate System - Universal Transverse Mercator (UTM)-WGS84 (Zone 44N)

S. No.	Design Chainage (km)	Easting	Northing
1	445+100	733098.579	1987370.559
2	445+200	733039.376	1987289.967
3	445+300	732980.173	1987209.375
4	445+400	732920.97	1987128.784
5	445+500	732861.767	1987048.192
6	445+600	732802.564	1986967.6
7	445+700	732743.361	1986887.009
8	445+800	732684.158	1986806.417
9	445+900	732624.955	1986725.825
10	446+000	732565.753	1986645.234
11	446+100	732506.55	1986564.642
12	446+200	732447.077	1986484.25
13	446+300	732385.627	1986405.364
14	446+400	732321.585	1986328.568
15	446+500	732255.018	1986253.949
16	446+600	732186.002	1986181.59
17	446+700	732114.613	1986111.571
18	446+800	732040.929	1986043.971
19	446+900	731965.034	1985978.863
20	447+000	731887.011	1985916.321
21	447+100	731806.947	1985856.415
22	447+200	731724.931	1985799.209

S. No.	Design Chainage (km)	Easting	Northing
23	447+300	731641.054	1985744.769
24	447+400	731555.414	1985693.146
25	447+500	731468.643	1985643.441
26	447+600	731381.763	1985593.923
27	447+700	731294.884	1985544.406
28	447+800	731208.004	1985494.889
29	447+900	731121.125	1985445.371
30	448+000	731034.245	1985395.854
31	448+100	730947.366	1985346.337
32	448+200	730860.487	1985296.82
33	448+300	730773.607	1985247.302
34	448+400	730686.728	1985197.785
35	448+500	730599.848	1985148.268
36	448+600	730512.969	1985098.75
37	448+700	730426.089	1985049.233
38	448+800	730339.21	1984999.716
39	448+900	730252.33	1984950.198
40	449+000	730165.451	1984900.681
41	449+100	730078.572	1984851.164
42	449+200	729992.127	1984800.902
43	449+300	729910.466	1984743.295
44	449+400	729836.616	1984675.966

S. No.	Design Chainage (km)	Easting	Northing
45	449+500	729771.736	1984599.956
46	449+600	729716.838	1984516.45
47	449+700	729672.78	1984426.751
48	449+800	729640.249	1984332.259
49	449+900	729619.581	1984234.477
50	450+000	729605.321	1984135.5
51	450+100	729591.312	1984036.486
52	450+200	729576.128	1983937.654
53	450+300	729554.068	1983840.133
54	450+400	729530.219	1983743.018
55	450+500	729506.37	1983645.904
56	450+600	729482.522	1983548.789
57	450+700	729458.673	1983451.675
58	450+800	729434.824	1983354.56
59	450+900	729410.975	1983257.446
60	451+000	729387.126	1983160.331
61	451+100	729363.278	1983063.217
62	451+200	729339.429	1982966.102
63	451+300	729315.58	1982868.988
64	451+400	729291.731	1982771.873
65	451+500	729267.882	1982674.758
66	451+600	729244.034	1982577.644
67	451+700	729220.185	1982480.529
68	451+800	729196.336	1982383.415
69	451+900	729172.487	1982286.3
70	452+000	729148.639	1982189.186
71	452+100	729124.79	1982092.071
72	452+200	729101.722	1981994.771
73	452+300	729081.756	1981896.789
74	452+400	729065.067	1981798.196

S. No.	Design Chainage (km)	Easting	Northing
75	452+500	729051.673	1981699.102
76	452+600	729041.589	1981599.617
77	452+700	729034.827	1981499.85
78	452+800	729030.703	1981399.936
79	452+900	729026.79	1981300.012
80	453+000	729022.311	1981200.116
81	453+100	729013.527	1981100.513
82	453+200	728999.776	1981001.473
83	453+300	728981.093	1980903.245
84	453+400	728957.523	1980806.073
85	453+500	728929.126	1980710.2
86	453+600	728895.973	1980615.867
87	453+700	728858.147	1980523.308
88	453+800	728815.746	1980432.754
89	453+900	728771.276	1980343.186
90	454+000	728726.805	1980253.618
91	454+100	728683.884	1980163.308
92	454+200	728645.465	1980070.994
93	454+300	728611.707	1979976.875
94	454+400	728582.695	1979881.187
95	454+500	728558.055	1979784.275
96	454+600	728534.206	1979687.16
97	454+700	728510.358	1979590.046
98	454+800	728486.509	1979492.931
99	454+900	728462.66	1979395.816
100	455+000	728438.811	1979298.702
101	455+100	728414.963	1979201.587
102	455+200	728391.114	1979104.473
103	455+300	728367.265	1979007.358
104	455+400	728343.416	1978910.244

S. No.	Design Chainage (km)	Easting	Northing
105	455+500	728319.567	1978813.129
106	455+600	728295.719	1978716.015
107	455+700	728271.87	1978618.9
108	455+800	728248.021	1978521.786
109	455+900	728224.172	1978424.671
110	456+000	728200.323	1978327.556
111	456+100	728176.475	1978230.442
112	456+200	728152.626	1978133.327
113	456+300	728128.777	1978036.213
114	456+400	728105.818	1977938.886
115	456+500	728084.808	1977841.119
116	456+600	728065.757	1977742.953
117	456+700	728048.674	1977644.424
118	456+800	728033.564	1977545.574
119	456+900	728019.852	1977446.519
120	457+000	728006.193	1977347.456
121	457+100	727992.535	1977248.393
122	457+200	727978.877	1977149.33
123	457+300	727965.218	1977050.267
124	457+400	727951.56	1976951.205
125	457+500	727937.901	1976852.142
126	457+600	727924.243	1976753.079
127	457+700	727910.584	1976654.016
128	457+800	727896.926	1976554.953
129	457+900	727883.268	1976455.89
130	458+000	727869.609	1976356.827
131	458+100	727853.666	1976258.117
132	458+200	727832.813	1976160.326
133	458+300	727807.099	1976063.699
134	458+400	727777.112	1975968.306

S. No.	Design Chainage (km)	Easting	Northing
135	458+500	727746.453	1975873.121
136	458+600	727715.795	1975777.937
137	458+700	727685.542	1975682.625
138	458+800	727659.259	1975586.152
139	458+900	727637.83	1975488.485
140	459+000	727621.31	1975389.87
141	459+100	727609.739	1975290.552
142	459+200	727603.146	1975190.78
143	459+300	727601.548	1975090.803
144	459+400	727604.455	1974990.85
145	459+500	727608.132	1974890.917
146	459+600	727611.809	1974790.985
147	459+700	727615.195	1974691.043
148	459+800	727614.665	1974591.055
149	459+900	727609.139	1974491.218
150	460+000	727598.63	1974391.783
151	460+100	727585.016	1974292.714
152	460+200	727571.358	1974193.651
153	460+300	727557.7	1974094.588
154	460+400	727544.041	1973995.525
155	460+500	727530.383	1973896.462
156	460+600	727516.724	1973797.4
157	460+700	727503.066	1973698.337
158	460+800	727489.407	1973599.274
159	460+900	727475.749	1973500.211
160	461+000	727462.09	1973401.148
161	461+100	727448.432	1973302.085
162	461+200	727434.774	1973203.022
163	461+300	727421.115	1973103.96
164	461+400	727407.457	1973004.897

S. No.	Design Chainage (km)	Easting	Northing
165	461+500	727393.798	1972905.834
166	461+600	727380.14	1972806.771
167	461+700	727366.481	1972707.708
168	461+800	727352.823	1972608.645
169	461+900	727339.165	1972509.583
170	462+000	727325.506	1972410.52
171	462+100	727311.848	1972311.457
172	462+200	727298.189	1972212.394
173	462+300	727284.531	1972113.331
174	462+400	727270.872	1972014.268
175	462+500	727257.214	1971915.205
176	462+600	727243.556	1971816.143
177	462+700	727229.897	1971717.08
178	462+800	727216.239	1971618.017
179	462+900	727202.58	1971518.954
180	463+000	727188.922	1971419.891
181	463+100	727175.263	1971320.828
182	463+200	727161.605	1971221.766
183	463+300	727147.946	1971122.703
184	463+400	727134.288	1971023.64
185	463+500	727120.63	1970924.577
186	463+600	727106.971	1970825.514
187	463+700	727094.065	1970726.354
188	463+800	727086.246	1970626.678
189	463+900	727085.082	1970526.703
190	464+000	727090.581	1970426.873
191	464+100	727102.719	1970327.631
192	464+200	727121.44	1970229.418
193	464+300	727146.66	1970132.67
194	464+400	727176.727	1970037.3
195	464+500	727207.475	1969942.144
196	464+600	727238.223	1969846.989
197	464+662	727257.28	1969788.012

SCHEDULE – B

(See Clause 2.1)

DEVELOPMENT OF THE PROJECT HIGHWAY

1 Development of the Project Highway

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

2 Project Highway (Six Lane)

2.1 Six Laning shall include construction of the Six Lane Project Highway as described in **Annex-I** of this **Schedule-B** and **Annex-I** of **Schedule C**.

2.2 The Project Highway shall be designed and constructed in conformity with the specifications and standards set forth in **Annex-I** of **Schedule-D**.

ANNEX – I

(Schedule-B)

Description of Six Laning

1. Width of carriageway

1.1 Construction of Six-Lane project highway shall be undertaken. The paved carriageway shall be as per paragraph 4.7 of Annex-I of Schedule-B.

1.2 The entire cross sectional elements shall be accommodated in the available/ proposed ROW. If required, suitable retaining structures shall be provided to accommodate the highway cross section within the available/proposed ROW and the same shall not constitute a Change of Scope.

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

1.4 In addition to width of paved carriageway mentioned in clauses above, additional lane/lanes shall be given as acceleration/deceleration lane and taper for Loops/Ramps to the required length shall be provided at interchange locations in accordance with IRC 92 :2017 and MoRTH Specifications.

1.5 In addition to width of paved carriageway mentioned in clause above, at RE wall and Retaining wall locations, the width of paved carriageway including paved shoulder and edge strip shall be as given in the corresponding TCS.

2. Project Facilities

Project facilities shall be constructed in conformity with **Annex-I** of **Schedule-C**.

3. Specifications and Standards

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

4. Other Features of Project Highway

4.1 Geometric Design and General Features

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

4.2 Design Speed

The design speed of the Project Highway shall be in accordance with Section 2 of the Manual.

4.3 Improvement of the Existing Road Geometrics

The existing geometry of the cross-roads at Vehicular Underpass location, Light Vehicular Underpass location and at Interchange location shall be improved as specified in this schedule and Schedule D.

4.4 Right of Way

Details of the proposed Right of Way are given in Clause 7 of Annex-I of Schedule B.

4.5 Type of Shoulders

The shoulder on the outer side (on either side of the carriageway) shall be 3.0m wide earthen. The earthen shoulder shall be stabilized with cement /suitable admixtures to prevent erosion as well as to provide a stable platform for occasional parking of errant vehicles. Hard earthen shoulders shall meet the following strength parameters:

(i) Unconfined compressive strength (UCS) equivalent to the strength defined for the bound sub-base layer as per IRC: 37.

(ii) CBR of laboratory mix at 95% MDD shall be Minimum 60.

4.6 Lateral and Vertical Clearances at Flyovers/Underpasses/Interchanges

The lateral and vertical clearances of all flyover/ Underpasses shall be as given in this schedule.

4.7 Cross Sections

The Project Highways are proposed to be constructed to Six lane standards. The widening of project road shall be as indicated below:

S. No.	Design Chainage (km)		Design Length (m)	TCS Type
	From	To		
1	445+100	445+362	262.000	TCS 1
2	445+362	445+512	150.000	TCS 3
3	445+512	447+740	2228.000	TCS 1
4	447+740	447+850	109.500	TCS 2
5	447+850	447+885	35.000	TCS 3
6	447+885	448+097	212.500	TCS 2
7	448+097	448+157	60.000	TCS 3
8	448+157	448+270	113.000	TCS 2
9	448+270	448+320	50.000	TCS 1
10	448+320	448+360	40.000	TCS 2
11	448+360	448+704	344.000	TCS 1
12	448+704	448+710	6.000	TCS 3
13	448710	448910	200	TCS 1
14	448910	449961	1051	TCS 4
15	449961	450474	513	TCS 7
16	450474	450486	12	TCS 3
17	450+486	450+530	44.000	TCS 1
18	450+530	450+540	10.000	TCS 2
19	450+540	450+670	130.000	TCS 1
20	450+670	450+710	40.000	TCS 2
21	450+710	450+760	50.000	TCS 1
22	450+760	450+820	60.000	TCS 2
23	450+820	450+875	55.000	TCS 1
24	450+875	450+887	12.000	TCS 3
25	450+887	451+607	720.000	TCS 1
26	451+607	451+727	120.000	TCS 3
27	451+727	451+730	3.000	TCS 1
28	451+730	451+859	129.000	TCS 2
29	451+859	451+879	20.000	TCS 3
30	451+879	452+090	211.000	TCS 2
31	452+090	453+210	1120.000	TCS 1

S. No.	Design Chainage (km)		Design Length (m)	TCS Type
	From	To		
32	453+210	453+666	455.500	TCS 6
33	453+666	453+701	35.000	TCS 3
34	453+701	454+730	1029.500	TCS 1
35	454+730	454+740	10.000	TCS 2
36	454+740	454+830	90.000	TCS 1
37	454+830	454+850	20.000	TCS 2
38	454+850	454+880	30.000	TCS 1
39	454+880	454+905	25.000	TCS 2
40	454+905	454+950	45.000	TCS 1
41	454+950	454+960	10.000	TCS 2
42	454+960	455+076	116.000	TCS 1
43	455+076	455+088	12.000	TCS 3
44	455+088	455+917	829.000	TCS 1
45	455+917	455+927	10.000	TCS 3
46	455+927	457+169	1242.000	TCS 1
47	457+169	457+175	6.000	TCS 3
48	457+175	458+400	1225.000	TCS 1
49	458+400	459+200	800.000	TCS 7
50	459+200	460+957	1756.500	TCS 1
51	460+957	461+082	125.000	TCS 3
52	461+082	461+102	20.500	TCS 2
53	461+102	461+122	20.000	TCS 3
54	461+122	461+300	178.000	TCS 2
55	461+300	462+050	750.000	TCS 1
56	462+050	462+176	126.000	TCS 2
57	462+176	462+196	20.000	TCS 3
58	462+196	462+200	4.000	TCS 1
59	462+200	462+420	220.000	TCS 2
60	462+420	462+847	427.000	TCS 1
61	462+847	463+117	270.000	TCS 3
62	463+117	464+097	980.000	TCS 1

S. No.	Design Chainage (km)		Design Length (m)	TCS Type
	From	To		
63	464+097	464+167	70.000	TCS 3
64	464+167	464+530	363.000	TCS 1
65	464+530	464+632	102.000	TCS 2
66	464+632	464+662	30.000	TCS 3
Total Length (m)			19.562	

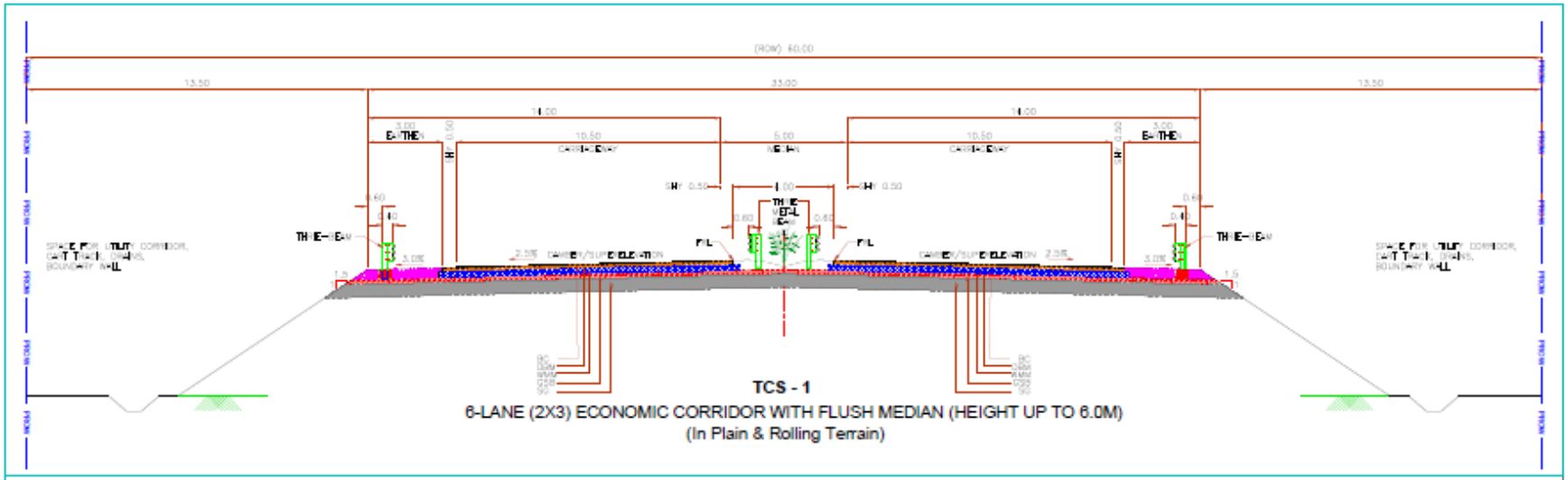
Note:

(i) The lane configuration and width of all structures shall be as per respective clauses of this schedule.

(ii) If the paved carriageway width of structure is more than the carriageway width of approaches, then proper pavement tapering (as per manual) shall be provided.

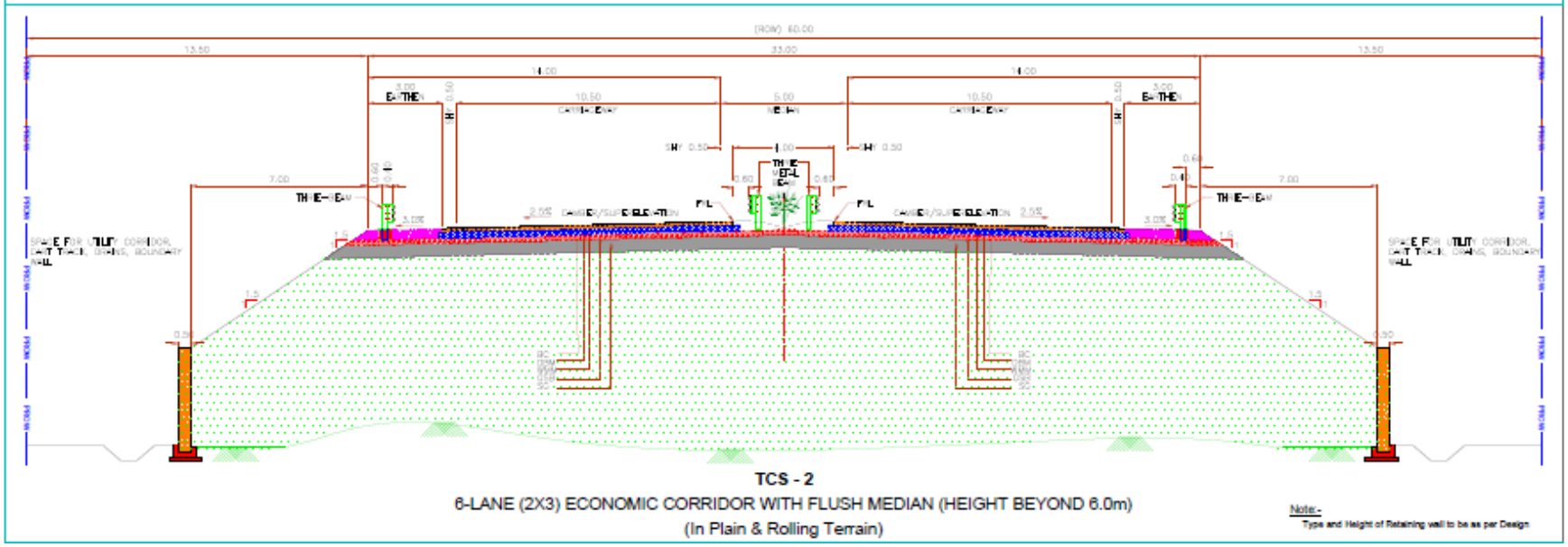
(iii) Any variations in the lengths specified in the above table shall not constitute a Change of Scope, save and except any variations in the length arising out of a Change of Scope expressly undertaken in accordance with the provisions of Article 16.

TYPICAL CROSS SECTION



TCS - 1

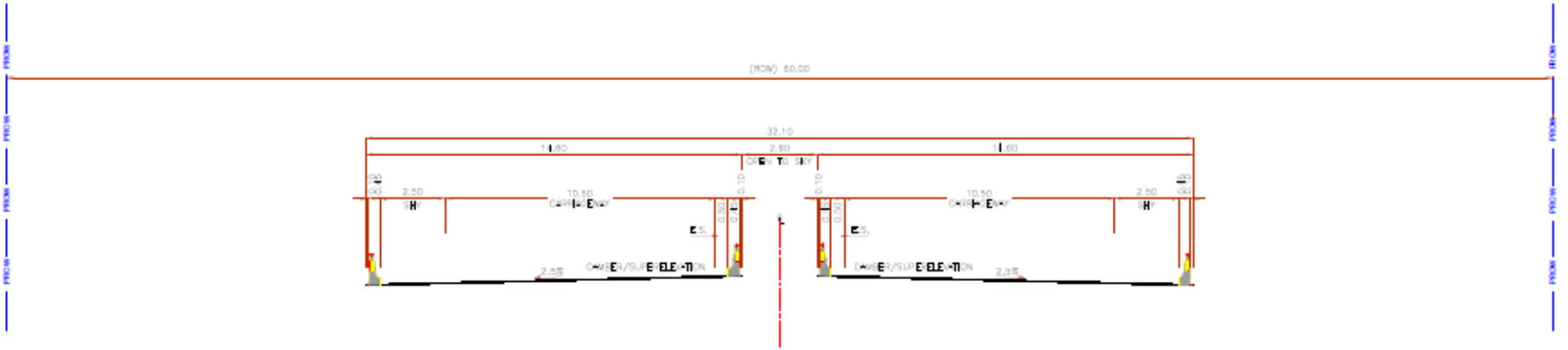
6-LANE (2X3) ECONOMIC CORRIDOR WITH FLUSH MEDIAN (HEIGHT UP TO 6.0M)
(In Plain & Rolling Terrain)



TCS - 2

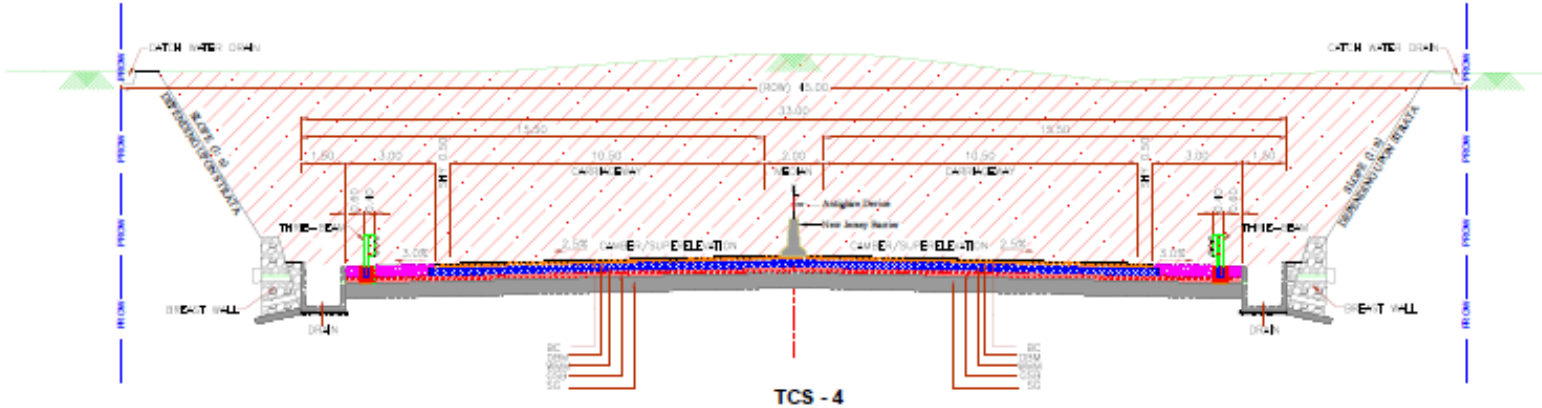
6-LANE (2X3) ECONOMIC CORRIDOR WITH FLUSH MEDIAN (HEIGHT BEYOND 6.0m)
(In Plain & Rolling Terrain)

Note:-
Type and Height of Retaining wall to be as per Design



TCS - 3

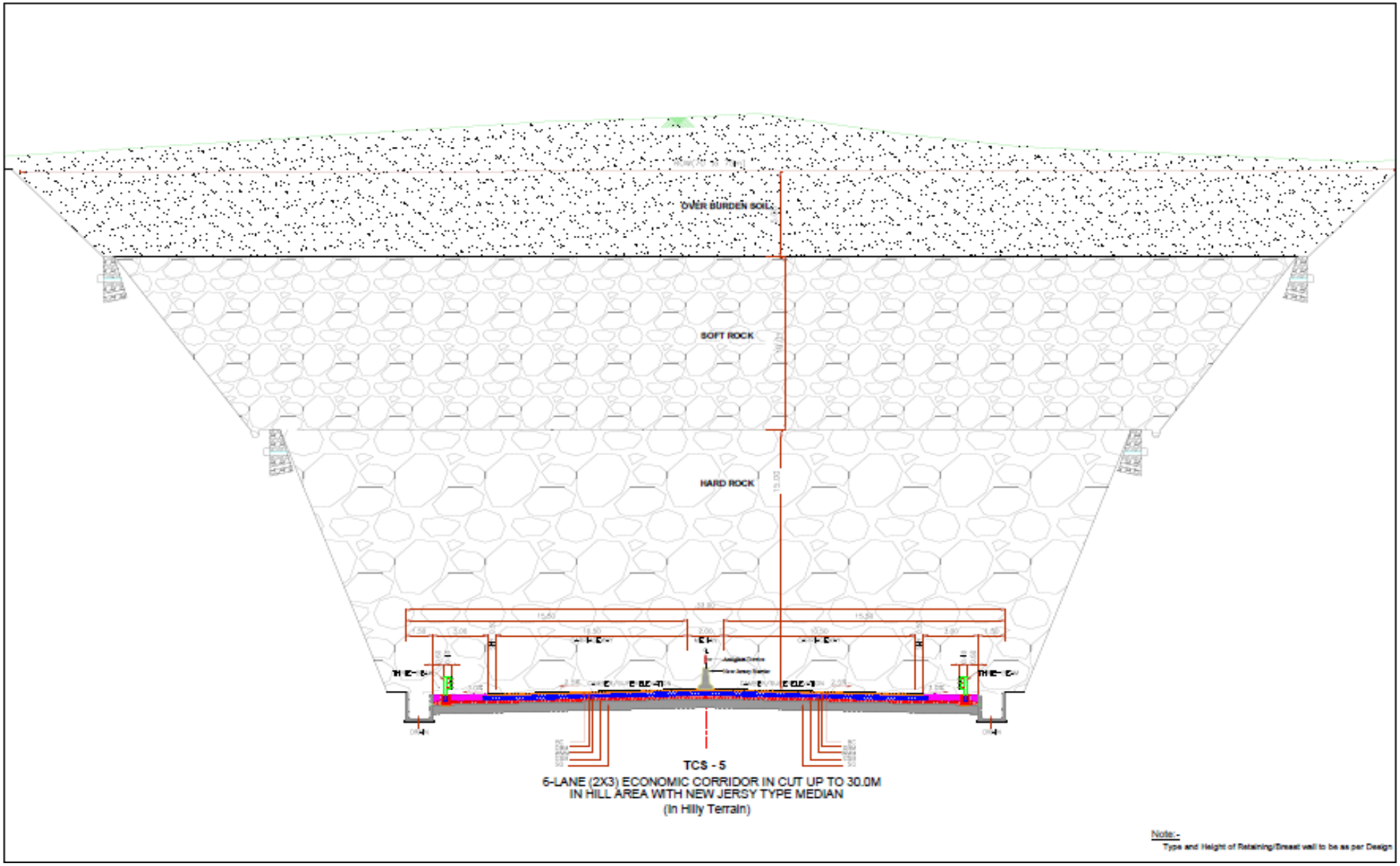
6-LANE (2X3) BRIDGE & GRADE SEPARATED STRUCTURES (LVUP/ VUP)
(In Plain & Rolling Terrain)

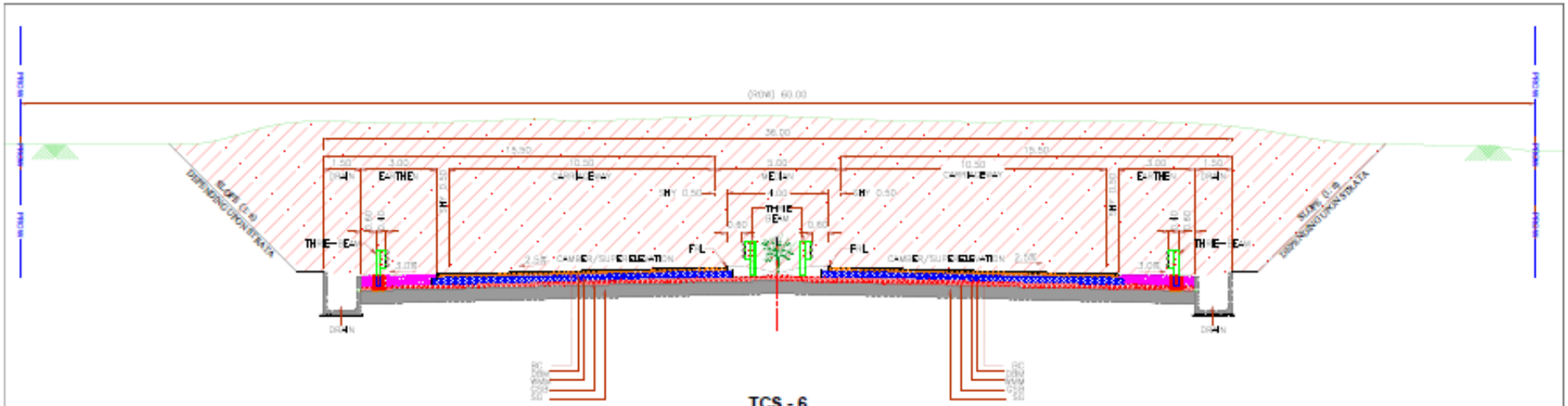


TCS - 4

6-LANE (2X3) ECONOMIC CORRIDOR IN CUT WITH BOTH SIDE BREAST WALL
IN FOREST AREA AND HILLY TERRAIN WITH NEW JERSEY TYPE MEDIAN
(Rolling/Hilly Terrain)

Type and Height of Retaining/Breast wall to be as per Design

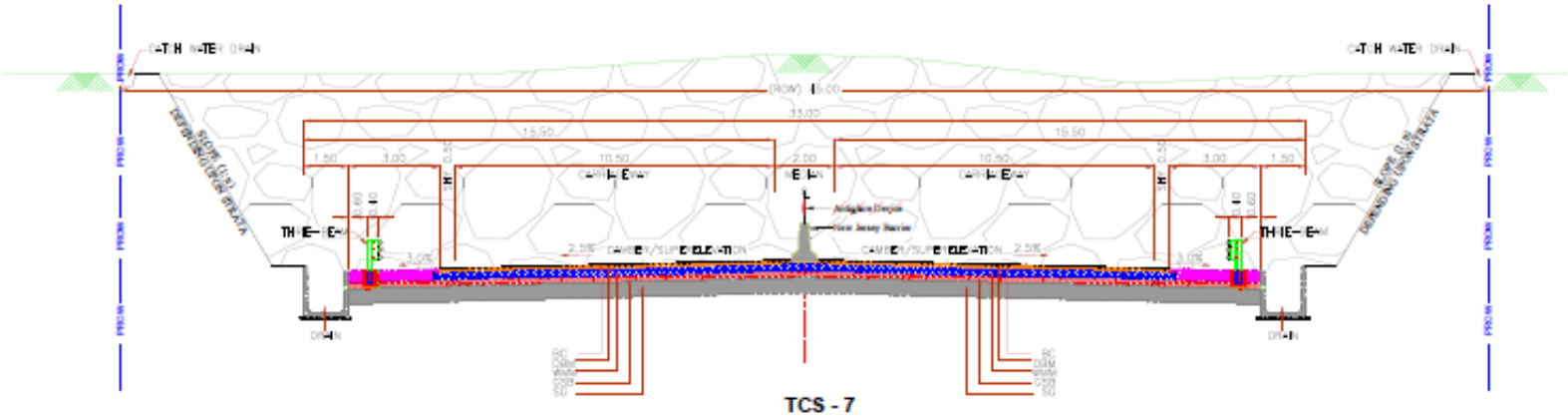

OVER BURDEN SOIL
SOFT ROCK
HARD ROCK
TCS - 5
6-LANE (2X3) ECONOMIC CORRIDOR IN CUT UP TO 30.0M
IN HILL AREA WITH NEW JERSY TYPE MEDIAN
(In Hilly Terrain)
Note:-
Type and Height of Retaining/Breast wall to be as per Design



TCS - 6

6-LANE (2X3) ECONOMIC CORRIDOR WITH DEPRESSED MEDIAN IN CUT ON BOTH SIDE UP TO 3.0M
(In Plain & Rolling Terrain)

Note:-
Type and Height of Retaining/Breast wall to be as per Design



TCS - 7

6-LANE (2X3) ECONOMIC CORRIDOR IN CUT WITH BOTH SIDE
IN FOREST AREA AND HILLY TERRAIN WITH NEW JERSEY TYPE MEDIAN
(Rolling/Hilly Terrain - Hard Rock)

4.8 Alignment Plan and Longitudinal Section

An alignment Plan and longitudinal section (Plan & Profile) of the project highway are enclosed at Appendix B-I in soft copy for reference only, longitudinal profile to be designed based on Schedule-D. Finished road level indicated in the alignment plan shall be treated as an approximate assessment. The Concessionaire shall design the road profile of the project highway based on site/design requirement specified in Schedule-D.

4.9 Traffic Signage Plan

Traffic Signage plan of the Project Highway showing numbers & location of traffic signs is enclosed at Appendix B-II in soft copy. The contractor shall, however, improve/upgrade upon the traffic signage plan as indicated in Appendix B-II based on site/design requirement as per IRC:SP:87-2019 and IRC:67-2012.

5. Pavement Design

Type of pavement :

Flexible Pavement - The Flexible pavement shall be designed for minimum 131 MSA for Design Period of 20 years and CBR 8% for the main carriageway and 5 msa for connecting roads and slip road (in accordance with PMGSY guidelines).

Rigid Pavement - for Toll Plaza including tapering zone

6. Slip Road / Connecting Road

The Slip / Connecting Road shall be provided as indicated below:

S. No.	Proposed Chainage (km)		Side (LHS/RHS / Both Side)	Length (m)	Width (m)	Remarks
1	464+100	464+650	Both Side	1100	7	Refer Interchange no. 6 at 464+662 Location in Plan and Profile
	-		Parallel to NH-16 on both Side	2950	7	
2	454+800	455+237	LHS	437	3.75(Paved)+1x2 (earthen Shoulder)	Connecting road

S. No.	Proposed Chainage (km)		Side (LHS/RHS / Both Side)	Length (m)	Width (m)	Remarks
3	454+948	455+250	RHS	302	3.75(Paved)+1x2 (earthen Shoulder)	Connecting Road

Note:

(i) Provision shall be made for proper entry and exit ramps between the main highway and the Slip roads through properly designed acceleration and deceleration length. The acceleration and deceleration lanes and transition lengths shall be considered as incidental to project and shall not be counted towards Slip road length.

(ii) Above length of the Slip/Connecting roads is indicative and minimum specified. The actual length of the Slip/Connecting roads shall be determined by the Concessionaire in accordance with the Manual requirements with approval from the Independent Engineer. Any increase in the length specified in this Clause of Schedule-B shall not constitute a Change of Scope.

7. Proposed Right of Way (ROW)

Details of Proposed Right of Way are given below:-

S. No.	Proposed Chainage (km)		Right of Way (m)	Remarks
	From	To		
6	445+100	446+900	60	
7	446+800	447+900	Varying	Refer Plan / Interchange Drawing
8	447+900	455+300	60	
9	455+300	456+300	Varying 60 m to 200 m (Toll Plaza)	Refer Plan & Profile
10	456+300	464+662	60	

Note: *The ROW has been taken as 60m for the proposed highway except at Interchange location, Toll Plaza location, Junction Improvement location and Wayside Amenities Area (wherever applicable), where the ROW varies as per drawings and design requirements.*

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8. Improvement of Cross Roads

Improvement of Cross Roads shall be carried out at the following locations:

S. No.	Proposed Chainage (km)	Type of Junction	Category of Road	Road Crossing
1	447+867	+	SH -39	LHS-Visakhapatnam RHS-Araku
2	450+480	+	ODR	LHS-Nimallapalem RHS-Engineering college
3	450+881	x	ODR	LHS-Devapalli RHS-Narapam
4	451+869	+	MDR	LHS-Tummikapalli RHS-Musiram
5	453+683	+	MDR	LHS-Kothavalasa RHS-K. Kotapadu
6	455+082	+	ODR	LHS-Tummikapalle RHS-Cheepuruvalasa
7	461+112	x	MDR	LHS-Kothavalasa RHS-Sabbavaram
8	462+186	+	MDR	LHS-Mogalipuram RHS-Gullepalle
9	464+662	T	NH-16	LHS-Ankapalle RHS-Anandapuram

Note:

(i) All underneath cross roads shall be reconstructed as per requirement of relevant IRC SP 41 :1994 standards within the proposed ROW

(ii) All cross roads junctions intersecting the main carriageway and Slip/Connecting road shall be developed as per relevant IRC Standards.

9. Underpasses

Lateral and vertical clearances for VUP / Flyover and provision of guardrails / crash barriers shall be as per paragraph 2.10 of the Manual. The width of the opening at the underpasses / flyover locations shall be as follows:

9.1 Vehicular Underpasses (VUP)

The proposed Vehicular Underpasses (VUP) are as given below.

S. No.	Design Chainage (km)	Total Width (m)	Span Arrangement Clear (m)	Skew Angle (in degrees)	Proposed Structure Type	Category of road	Remarks
1	447+867	2 x 14.6	1 X 35 X 5.5	9	PSC GIRDER	SH -39	2x10.5(Paved) + 2x0.5(Kerb shyness) + 2x2.5(Paved Shoulder) + 4x0.55(Crash Barrier)
2	451+869	2 x 14.6	1 X 20 X 5.5	6	PSC GIRDER	MDR	
3	453+683(VOP)	2 x 20	1 X 20 X 5.5	1	PSC GIRDER	MDR	
4	461+112	2 x 14.6	1 X 20 X 5.5	46	PSC GIRDER	MDR	
5	462+186	2 x 14.6	1 X 20 X 5.5	25	PSC GIRDER	MDR	
6	464+450	2 x 14.6	1 x 20 x 5.5	0	PSC GIRDER	ODR	
7	464+662	2 x 14.6	2 X 35 X 5.5	0	PSC GIRDER	NH-16	

Note:

(i) The superstructure of all bridges, culverts and structures is to be designed for edge movement of the vehicle considering stitching of new superstructure in future due to widening for additional lane.

(ii) Special vehicle loading as per IRC 6 is to be considered in Design of structures.

9.2 Light Vehicular Underpasses (LVUP)

The proposed Light Vehicular Underpasses (LVUP) are as given below.

S. No.	Design Chainage (km)	Total Width (m)	Span Arrangement (m)	Skew Angle (in degrees)	Proposed Structure Type	Remarks
1	450+480	2 x 14.6	1 x 12 x 4.0	0	RCC BOX	2x10.5(Paved) + 2x0.5(Kerb shyness) + 2x2.5(Paved Shoulder) +
2	450+881	2 x 14.6	1 x 12 x 4.0	47	RCC BOX	
3	455+082	2 x 14.6	1 x 12 x 4.0	0	RCC BOX	

S. No.	Design Chainage (km)	Total Width (m)	Span Arrangement (m)	Skew Angle (in degrees)	Proposed Structure Type	Remarks
						4x0.55(Crash Barrier)

Note:

(i) The superstructure of all bridges, culverts and structures is to be designed for edge movement of the vehicle considering stitching of new superstructure in future due to widening for additional lane.

(ii) Special vehicle loading as per IRC 6 is to be considered in Design of structures.

10. Interchange

The interchange shall be provided as per the details below:

S. No.	Design Chainage (km)	Total Width (m)	Span Arrangement (m)	Skew Angle (in degrees)	Proposed Structure Type	Interchange Type	Remarks
1	448+085	Refer Interchange Drawing	2 X 20	0	PSC Girder	Double trumpet	On main Carriageway
			1 X 30	0	PSC Girder	Double trumpet	SH-39
2	464+662	Refer Interchange Drawing	2 X 35	19	PSC GIRDER	Trumpet	NH-16

Note:

(i) Refer typical Interchange drawings attached at Appendix B-IV of Schedule-B.

(ii) The superstructure of all bridges, culverts and structures is to be designed for edge movement of the vehicle considering stitching of new superstructure in future due to widening for additional lane.

(iii) Special vehicle loading as per IRC 6 is to be considered in Design of structures.

(iv) Detailed design of all interchange shall be done in accordance with this Schedule, Manual and MoRTH type design.

(v) Any other junction not mentioned above but observed during the construction of the project shall be improved as per manual requirements. The same shall not constitute a

Change of Scope, save and except any variations arising out of a Change of Scope expressly undertaken in accordance with the provisions of Article 16.

(vi) The Concessionaire shall take up 'Detailed Engineering study' to ascertain further details of all intersections and treatment of the intersections shall be designed in accordance with the latest guidelines mentioned out in section-3 of IRC: SP: 87-2019. The same shall not constitute a Change of Scope, save and except any variations arising out of a Change of Scope expressly undertaken in accordance with the provisions of Article 16.

(vii) Junction improvement at interchanges shall be carried out as per Interchange drawings.

(viii) Any other structures falling within acceleration / deceleration lane /taper shall be constructed to the required width. These changes shall not be treated as change of scope.

(ix) The minimum vertical clearance of all interchange structures shall be 5.5m.

11. Road Over Bridges (ROB)

The Road Over Bridges (ROBs) shall be provided as per the details below:

S. No.	Design Chainage - (km)	No. of Tracks	Proposed Structure Type	Proposed Span arrangement No of span x span length (m)	Skew Angle (in degrees)	Total width of the structure (m)	Vertical Clearance as per Indian Railway SOD (m)
1	448+127	2	As per GAD approved by Railways Authority	1x24+1x36	11	2 X 14.6	6.5

Note:

(i) The superstructure of all bridges, culverts and structures is to be designed for edge movement of the vehicle considering stitching of new superstructure in future due to widening for additional lane.

(ii) Special vehicle loading as per IRC 6 is to be considered in Design of structures.

12. Bridges

12.1 Major Bridges

(A) Widening / Repair / Rehabilitation of Existing Major Bridges

NIL

(B) Reconstruction of Existing Major Bridges

NIL

(C) Construction of New Major Bridges on Main Carriageway (Over River / Streams / Nallah)

S. No.	Design Chainage (km)	Proposed Structure Type	Proposed Span Arrangement (m)	Skew Angle (in degrees)	Total Width (m)	Remarks
1	464+132	PSC GIRDER	2 x 35	-	2 x 14.6	2x10.5(Paved) + 2x0.5(Kerb shyness) + 2x2.5(Paved Shoulder) + 4x0.55(Crash Barrier)

Note:

(i) The superstructure of all bridges, culverts and structures is to be designed for edge movement of the vehicle considering stitching of new superstructure in future due to widening for additional lane.

(ii) Special vehicle loading as per IRC 6 is to be considered in Design of structures.

(D) Construction of New elevated structure (Major) on Main Carriageway (Over Pond)

S. No.	Design Chainage (km)	Proposed Structure Type	Proposed Span Arrangement (m)	Skew Angle (in degrees)	Total Width (m)	Remarks
1	445+437	PSC GIRDER	5 x 30	0	2 X 14.6	Bridge over Pond
2	451+667	PSC GIRDER	4 x 30	0	2 X 14.6	Bridge over Pond
3	461+019	PSC GIRDER	5 x 25	0	2 X 14.6	Bridge over Pond
4	462+982	PSC GIRDER	9 x 30	0	2 X 14.6	Bridge over Pond

Note:

(i) The superstructure of all bridges, culverts and structures is to be designed for edge movement of the vehicle considering stitching of new superstructure in future due to widening for additional lane.

(ii) *Special vehicle loading as per IRC 6 is to be considered in Design of structures.*

12.2 Minor Bridges

(A) Widening / Repair / Rehabilitation of Existing Minor Bridges

NIL

(B) Reconstruction of Existing Minor Bridges

NIL

(C) Construction of New Minor Bridges on Main Carriageway

S. No.	Design Chainage (km)	Proposed Structure Type	Proposed Span Arrangement (m)	Skew Angle (in degrees)	Total Width (m)	Remarks
1	448+707	RCC BOX	1 x 6	0	2 x 14.6	2x10.5(Paved) + 2x0.5(Kerb shyness) + 2x2.5(Paved Shoulder) + 4x0.55(Crash Barrier)
2	455+922	RCC BOX	1 x 10	15	2 x 14.6	
3	457+172	RCC BOX	1 x 6	4	2 x 14.6	

Note:

(i) The superstructure of all bridges, culverts and structures is to be designed for edge movement of the vehicle considering stitching of new superstructure in future due to widening for additional lane.

(ii) *Special vehicle loading as per IRC 6 is to be considered in Design of structures.*

(D) Construction of New elevated structure (Minor) on Main Carriageway (Over Pond)

S. No.	Design Chainage (km)	Proposed Structure Type	Proposed Span Arrangement (m)	Skew Angle (in degrees)	Total Width (m)	Remarks
Nil						

Note:

(i) The superstructure of all bridges, culverts and structures is to be designed for edge movement of the vehicle considering stitching of new superstructure in future due to widening for additional lane.

(ii) *Special vehicle loading as per IRC 6 is to be considered in Design of structures.*

13. Culverts

13.1 Widening of Existing Culverts - NIL

13.2 Reconstruction of Existing Culverts - NIL

13.3 Construction of New Culverts

S. No.	Proposed Chainage (km)	Type of Culvert	Span Arrangement (m)
1	445+272	RCC BOX	1 x 3
2	445+712	RCC BOX	1 x 3
3	446+290	RCC BOX	1 x 3
4	446+645	RCC BOX	1 x 3
5	447+030	RCC BOX	1 x 3
6	447+590	RCC BOX	1 x 3
7	448+320	RCC BOX	1 x 3
8	448+630	RCC BOX	1 x 3
9	448+798	RCC BOX	1 x 3
10	450+535	RCC BOX	1 x 3
11	450+680	RCC BOX	1 x 3
12	450+865	RCC BOX	1 x 3
13	451+213	RCC BOX	1 x 3
14	451+426	RCC BOX	1 x 3
15	452+496	RCC BOX	1 x 3
16	452+725	RCC BOX	1 x 3
17	454+730	RCC BOX	1 x 5
18	455+532	RCC BOX	1 x 3
19	456+390	RCC BOX	1 x 3
20	456+550	RCC BOX	1 x 3

S. No.	Proposed Chainage (km)	Type of Culvert	Span Arrangement (m)
21	456+810	RCC BOX	1 x 5
22	457+390	RCC BOX	1 x 3
23	457+687	RCC BOX	1 x 3
24	458+150	RCC BOX	1 x 5
25	459+500	RCC BOX	1 x 3
26	459+900	RCC BOX	1 x 3
27	460+127	RCC BOX	1 x 3
28	460+441	RCC BOX	1 x 3
29	460+544	RCC BOX	1 x 3
30	460+680	RCC BOX	1 x 3
31	461+662	RCC BOX	1 x 3
32	461+987	RCC BOX	1 x 3
33	462+281	RCC BOX	1 x 3
34	462+500	RCC BOX	1 x 3
35	462+778	RCC BOX	1 x 3
36	463+532	RCC BOX	1 x 3
37	463+745	RCC BOX	1 x 3
38	463+801	RCC BOX	1 x 3
39	464+270	RCC BOX	1 x 3

Note:

(i) The superstructure of all bridges, culverts and structures is to be designed for edge movement of the vehicle considering stitching of new superstructure in future due to widening for additional lane.

(ii) *Special vehicle loading as per IRC 6 is to be considered in Design of structures.*

(iii) The length of Culverts shall be as per cross section, Skew & location.

(iv) The overall width of the above culverts shall be equal to Roadway width including the gap between main carriageway & Slip/Connecting road, in case there is any Slip/Connecting

road. Any additional Barrel length required as per site conditions shall not constitute a Change of Scope, save and except any variations arising out of a Change of Scope expressly undertaken in accordance with the provisions of Article 16.

(v) Span arrangement locations of the above culverts are indicative and minimum specified. Exact location of these culverts shall be decided in consultation with Independent Engineer. The actual vent way/span arrangements of culverts shall be determined on the basis of detailed investigations by the Concessionaire in accordance with the Specifications and Standards. Any variations in vent way/span arrangements specified above shall not constitute a Change of Scope expressly undertaken in accordance with the provisions of Article 16.

14. Road Side Drainage

Drainage system including surface and subsurface drains for the Project Highway shall provide as per drainage plan enclosed at Appendix B-III in soft copy. The contractor shall, however, improve/upgrade upon the drainage plan as indicated in Appendix B-III based on site/design requirement as per Schedule D.

15. RETAINING STRUCTURES

RCC Retaining Wall for a minimum length of 1.13 km(both sides inclusive), Toe wall for a minimum length of 3.1 Km (both sides inclusive) shall be constructed to accommodate the cross section within Right of Way. The tentative height of retaining structures shall be based on plan and profile drawings. The length specified herein above shall be treated as an approximate assessment. Based on site investigations and design requirements, the actual requirement of height of retaining structures and length of retaining structures shall be investigated and determined by the Concessionaire in accordance with the Specifications and Standards in consultation with Independent Engineer and Authority. In addition to above, Retaining wall shall be provided at other locations to restrict the embankment slope within the right of way and cross wall shall be provided behind each abutment. Any variations in the lengths specified in this Schedule-B shall not constitute a Change of Scope, save and except any variations arising out of a Change of Scope expressly undertaken in accordance with the provisions of Article 16.

16. SLOPE PROTECTION

The side slope shall be protected by using suitable slope protection measures wherever required along the project road. The slope protection up to 3m height shall be carried out with turfing and slope protection above 3m height shall be carried out with geogrid

as per IRC:SP:59-2019. The locations shall be finalized in consultation with Independent Engineer and Authority.

17. RAIN WATER HARVESTING STRUCTURE

As per Ministry of Environment and Forests Notification, New Delhi dated 14.01.1997 (as amended on 13.01.1998, 05.01.1999, & 6.11.2000), the construction of Rainwater harvesting structure is mandatory in and around water crisis area, notified by the Central Ground Water Board. Rainwater Harvesting Pit will be provided on either side of road in 500m interval subject to the first aquifer is below 10m and the oil interceptors will be considered in design to avoid water contamination. The provision of rain water harvesting shall be executed as per requirement of IRC: SP: 42-2017 and IRC: SP: 50-2013.

The source of water during construction shall be Surface Water. The Concessionaire will purchase water tankers from the empanelled agencies of respective districts. The Concessionaire will obtain permission from State Authority / CGWA if required.

18. SPECIAL REQUIREMENT FOR HILL ROADS

Special requirements for hill roads shall be followed as per manual IRC: SP: 48-1998.

19. FENCING / BOUNDARY WALL

RCC boundary wall shall be provided along the entire length on either side (including transverse requirements at structure locations) as per details as mentioned in **Schedule C.**

20. CHANGE OF SCOPE

The length of Structures and bridges specified herein above shall be treated as an approximate assessment. The actual lengths as required on the basis of detailed investigations shall be determined by the Concessionaire 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 16.

21. Utility Shifting

Shifting of obstructing utilities to an appropriate location in accordance with the standards and specifications of concern Utility Departments is a part of scope of work for the Concessionaire. Shifting of all over-ground utilities including electrical/power utilities shall be responsibility of the Concessionaire, whether indicated in Schedule-B or not. No Change of Scope (CoS) shall be allowed for such over ground utilities whether indicated in Schedule-B or not. However, underground utilities as indicated in the Schedule-B will only be considered as part of scope of work. Underground utilities, if any, not included in the Schedule-B shall be treated as Change of Scope. The bidder may visit the site and assess the quantum of shifting of utilities for the project before submission of their bid. Copy of Utility relocation plan is enclosed. The specifications are to be as per the specification of concerned utility owning department.

Brief Details of shifting of utilities are as below:

(i) Electrical utilities

(a) Extra High Tension Lines (EHT Lines)*

S No	Chainage		Circuit (TC / DC / SC)	Crossings (Nos)		Poles		Conductor		Size of Cable	Grid Line	Remarks
	From	To		Over Head	Under Ground	Tower Truss / Unipole	No	No	Size			
1	460+950	463+800	SC	1	-	Tower	-				APEPDCL	Shifting required
2	464+300	464+400	SC	1	-	Tower	-				APEPDCL	Shifting required

TC - Triple circuit, DC - Double circuit, SC - Single circuit

Utility Shifting Plan and drawings enclosed as Appendix EHT1 and Appendix EHT2 respectively.

(b) High Tension Lines (HT Lines) * 33KV/11KV

S No	Chainage		Type of Circuit (SC/DC/TC)	Poles		Nos	Conductor		Cable		Crossings		Transformer		Remarks
	From	To		Type	LHS	RHS	No	Size	No	Size	U/G	Overhead	Capacity	No	
1	447+850	447+880	DC	RCC	3	2									Shifting required
2	448+110	448+410	DC	RCC	4	1									Shifting required
3	450+670	450+895	DC	RCC	2	1									Shifting required
4	451+850	451+880	DC	RCC	2	2									Shifting required
5	453+680	453+690	DC	RCC	1	1									Shifting required
6	455+790	455+840	DC	RCC	-	2									Shifting required
7	457+560	457+570	DC	RCC	-	1									Shifting required
8	460+540	460+685	DC	RCC	3	4									Shifting required

S No	Chainage		Type of Circuit (SC/DC/TC)	Poles		Nos	Conductor		Cable		Crossings		Transformer		Remarks
	From	To		Type	LHS	RHS	No	Size	No	Size	U/G	Overhead	Capacity	No	
9	461+140	461+995	DC	RCC	6	5									Shifting required
10	462+180	462+455	DC	RCC	1	3									Shifting required
11	463+530	463+755	DC	RCC	2	2									Shifting required
12	464+420	464+500	DC	RCC	2	1									Shifting required

TC - Triple circuit, DC - Double circuit, SC- Single circuit, U/G – Underground

(c) Low Tension Lines (LT Lines)*

S No	Chainage		Type of Circuit (SC/DC/TC)	Poles		Conductor		Cable		Crossings		Transformer	
	From	To		Type	No	No	Size	No	Size	U/G	Overhead	Capacity	No
NIL													

TC - Triple circuit, DC - Double circuit, SC- Single circuit, U/G – Underground

Detailed drawings enclosed as Appendix HT1 and Appendix HT2 respectively.

(ii) Public Health utilities (Water/Sewage Pipe Lines) *

The site included the following Public Health utilities:-

(c) Major Water Supply Pipe Line

S No	Chainage		Type of lines (Pressure / Under Gravity)	Pipe			Sluice Valve	Crossings	
	From	To		Type	No	Size	Nos	Nos	Length
NIL									

(b) Minor Water Supply Pipe Line

S No	Chainage		Type of lines (Pressure / Under Gravity)	Pipe			Sluice Valve	Crossings	
	From	To		Type	No	Size	Nos	Nos	Length
NIL									

(ii) Any Other Line - IOCL Line (Indian Oil Croporation Limited)

S No	Existing Chainage		Length (in Km)		Remarks
	From	To	With Pumping	With Gravity Flow	
NIL					

Notes:

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

(b) The supervision charges at the rates/charges applicable between implementing agencies of MoRTH and utility owning department shall be paid directly by the Authority to the Utility Owning Entity as and when Concessionaire furnishing a demand of Utility Owning Department along with a copy of sanctioned estimate.

(c) The credit of dismantled materials has been accounted for in the estimated cost. The dismantled material /scrap of existing Utility to be shifted/dismantled shall belong to the Concessionaire who would be free to dispose-off the dismantled material as deemed fit by them. If the Concessionaire is forced to deposit the dismantled material to utility owning department then the amount of credit for dismantled material indicated in the sanctioned estimates of utility owning department will be reimbursed to the Concessionaire after submitting the duly authenticated receipt of the dismantled material from utility owning department to the Authority.

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

(e) No change of scope shall be paid for any over-ground utilities. However, for any underground utilities not mentioned in Schedule 'B' shall form change of scope, which shall be worked out as per the estimation of the concerned utility owning dept. and shall be payable to the Concessionaire accordingly.

Appendix B-I (Schedule-B)

Alignment Plan and longitudinal Section are enclosed in digital form in CD marked as **Appendix B-I (Schedule-B).**

Appendix B-II (Schedule-B)

Traffic Signage Plan of the Project Highway showing numbers & location of traffic signs is enclosed in digital form in CD marked as **Appendix B-II (Schedule-B).**

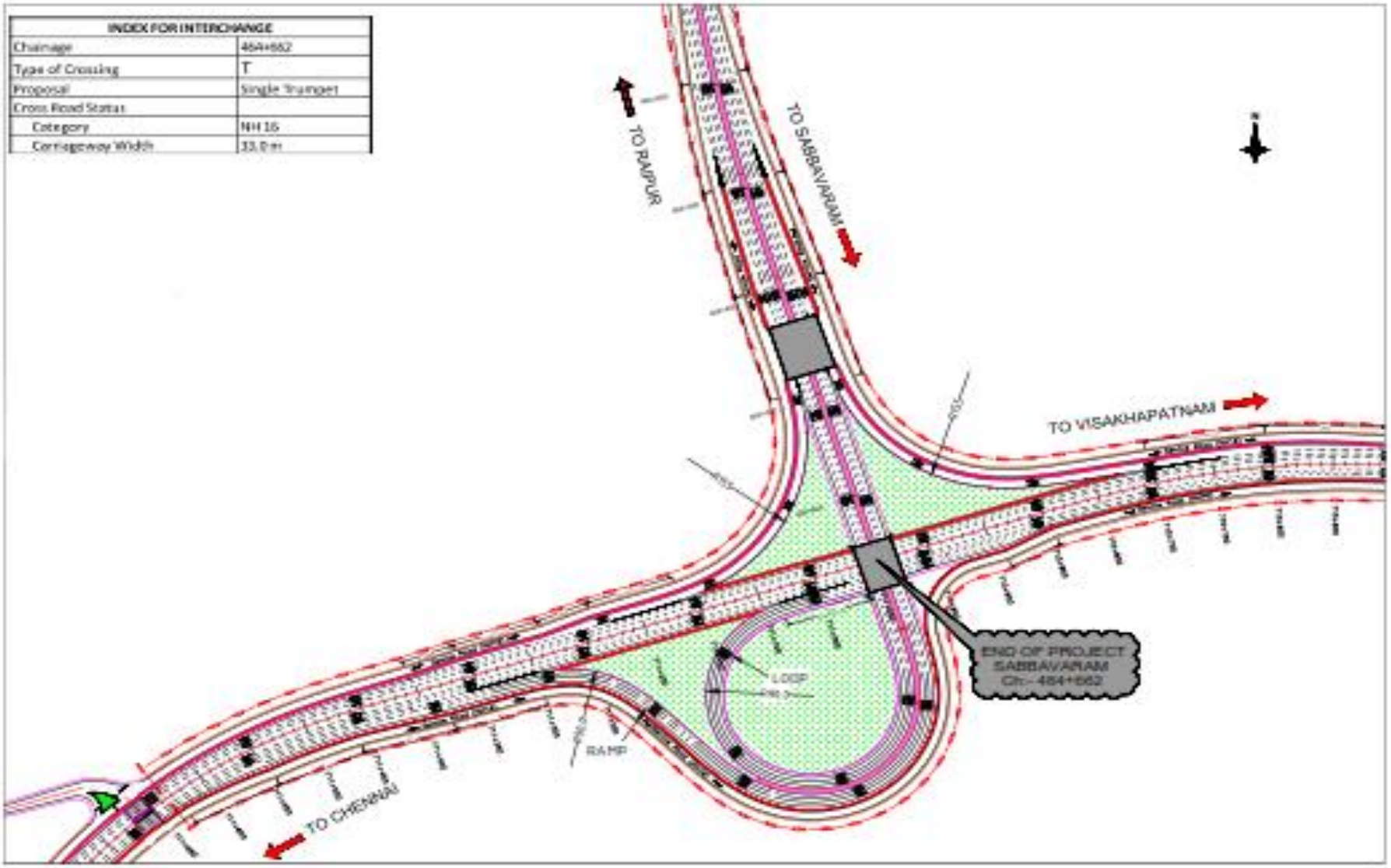
Appendix B-III (Schedule-B)

Drainage Plan of the Project Highway is enclosed in digital form in CD marked as **Appendix B-III (Schedule-B).**

Appendix B-IV (Schedule-B)



DOUBLE TRUMPET INTERCHANGE AT DESIGN CHAINAGE KM 448+000 (+ JUNCTION WITH EXISTING SH-39)



TRUMPET INTERCHANGE AT DESIGN CHAINAGE KM 464+662 (T JUNCTION WITH PROPOSED NH-16)

SCHEDULE – C

(See Clause 2.1)

PROJECT FACILITIES

1. Project Facilities

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

a) Toll plazas and ramp plazas;

b) Traffic Control Devices, Road Safety Devices and Roadside Furniture;

c) Lighting / illumination;

d) Landscaping & tree plantation;

e) Highway Patrol Unit

f) Emergency Medical Services

g) Crane Services

h) Telecom System;

i) Bus shelters along Slip roads

j) Advanced traffic management system (ATMS);

k) Wayside Amenities;

2 Project Facilities for Project Highway

Project Facilities forming part of Project Highway and to be completed on or before the scheduled date have been described in Annex-I of this Schedule-C.

Annex – I

SCHEDULE – C

(See Clause 2.1)

PROJECT FACILITIES

1. Project Facilities

The Concessionaire shall construct the Project Facilities described in this Annex-1 to form part of the Six-Lane Project. The project facilities shall include:

a) Toll plazas and ramp plazas;

b) Traffic Control Devices, Road Safety Devices and Roadside Furniture;

c) Lighting / illumination;

d) Landscaping & tree plantation;

e) Highway Patrol Unit

f) Emergency Medical Services

g) Crane Services

h) Telecom System;

i) Bus shelters along Slip Roads

j) Advanced traffic management system (ATMS);

k) Wayside Amenities;

2. Description of Project Facilities

Each of the project facilities is described below:

(a) Toll Plazas and Ramp Plazas

(i) As stipulated in Manual of Specifications and Standards for Six – Laning of Highways through Public Private Partnership (IRC:SP:87-2019), Toll Plaza shall be provided at the following locations:

S. No.	Chainage (km)		Length (m)	Lanes	Remarks
	From	To			
1	455+300	456+300	1000	12 + 12	Near Cheepuruvalasa Village; Tehsil Kothavalasa Vizianagaram District

One Toll Plaza as per section-10 of IRC:SP:87-2019, complete in all respect including service area, Toll Plaza complex, Traffic Aid Post and medical aid post, toll booth, canopy etc. complete shall be provided between km 455.300 to km 456.300 as mentioned above. Layout of Toll Plazas shall be designed for 24 lanes i.e. 12 lanes + 12 lanes (with all lanes enabled for combination of cash, smart card and ETC system) including one lane each on outer side for Over dimensioned vehicle. Equipment for toll plaza shall be as per section - 10 of the Manual. If any software/hardware/equipment is determined to be necessary by the Independent Engineer for safe and efficient operation of toll / Ramp Plaza and is not mentioned in the "Manual", the required software/ hardware/ equipment shall be provided by the Concessionaire.

(ii) Toll Plaza Complex/Building as per Section 10 of the Manual shall be provided for Toll Plaza. A power sub- station including generator of sufficient capacity shall be installed to meet out all power requirement of the toll plaza complex; booths and external lighting. The size of the office complex shall be with adequate provision for future expansion taking into consideration various requirements.

(iii) Prevention of Overloading: Weigh in Motion Systems to prevent overloading: Toll plaza/ toll booth location shall also be provided with system for checking and preventing overloading of vehicles at toll plaza/booth. For this purpose, weigh in motion systems at approaches to each toll lane are to be installed. Separate space along with static weigh bridge shall be provided and area to hold off-loaded goods from overloaded vehicles shall also be provided after the toll barriers for each entry direction of travel.

(iv) Concessionaire shall also provide all required furniture for Toll Plaza complex, Toll Booth, Lane canopy camera in all lanes, Cash room camera, cash vault camera, Fog light, speed breaker to slow down vehicles, PA system and ID scan camera etc. in all booths.

Interchange/Ramp Plaza:

There will be 4 Toll Booth with a canopy at center of interchange at km 448+000 as given in schedule-B with 3 nos. of toll lanes (i.e. two toll lanes for normal sized vehicles and one toll lane for over dimensioned vehicle) on each links (ramps/slips). All toll booths shall be equipped for ETC and shall have toll/fee through cash or smart card as a back-up. At Interchange/Slip Road locations all necessary provisions, equipment, as per section -10 of the Manual, the state of the art facilities etc. shall be provided for smooth toll collection, safety to commuters and facilities for commuters, toll collection and O & M staff. Along with WIM, separate space for static weigh bridge, supply and installation of static weigh bridge and area to hold off-loaded goods from overloaded vehicles shall be provided after the toll barriers for each entry direction of travel. Concessionaire shall also provide all required furniture for tool booths, Lane canopy camera in

all lanes, cash room camera, Cash Vault camera, Fog Light, Speed Breaker to slow down vehicles, PA system and ID scan camera etc. in all booths. If any software/hardware/equipment/structures is determined to be necessary by the Independent Engineer for safe and efficient operation of Ramp Plaza and toll collection and the same is not mentioned in the "Manual", or in the schedule the required software/hardware/equipment/structure shall be provided by the Concessionaire.

Toilet Block

Separate Toilet Blocks with full facilities for public use shall be provided within the toll plaza for public access. The provisions listed below are

i) 4 Nos. urinals (Ladies) along with wash basin
ii) 4 Nos. urinals (Gents) along with wash basin
iii) 2 Nos WC in each washroom
iv) Drinking Water facilities shall also be provided.
v) Water Supply/Electrical fixtures shall also be provided.
vi) Landscaping along with parking space shall also be provided.

(b) Traffic Control Devices, Road Safety Devices and Roadside Furniture

Traffic Control Devices, Road Safety Devices and roadside furniture shall be provided as per Section – 9 and 10 of IRC:SP:87-2019:

i. **Road Signs:** Road Signs include roadside signs; chevron signs; overhead signs and kerb mounted signs along the entire Project Highway and Slip/Connecting road.

   All road signs shall be of Prismatic Grade Sheeting corresponding to Class ‘C’ Sheeting described in IRC: 67 and any of the types VIII; IX or XI as per ASTM D-4956-09. The road signs and overhead signs erected on the Project highway and Slip/Connecting road with regard to requirement of number of signs, type and size of sign, size of letter, color of sign, layout of sign; etc. including signs installations shall conform to Section-9 and Section-10 of “Manual” and IRC: 67, Code of Practice for Road Signs. Chevron signs shall be installed on curves and interchange loops/ramps. In addition to signs prescribed in “Manual” other signs such as signs showing safety slogans, toll free numbers, nearby hospital and police station facilities, lane discipline signs on gantry, headway etc. will also be provided as directed by Independent Engineer.

   The overhead signs shall be placed on a structurally sound gantry or cantilever structure made of tubular structure or steel structure. The final locations shall be finalized in consultation with the Independent Engineer. The height, lateral clearance and installation of the sign structures shall be as per the MoRTH/IRC guidelines.

Design and location of overhead gantry sign ,route marker signs for Project Highway shall be as per the IRC: 67.

On cross roads where interchange/slip roads has been provided, necessary information signboards on cross roads on both sides at 500m, 1km., 2km., and 5 km. distance from an interchange/slip roads, shall also be fixed suitable for the category of cross road.

ii. **Pavement Markings**: Pavement markings shall cover the entire Project Highway and Slip/Connecting road and shall be as per section- 9 of the "Manual" and IRC: 35. These markings shall be applied to road centre lines; edge lines; continuity line; stop lines; give-way lines; diagonal/chevron markings; zebra crossing and at parking areas, toll booths etc. by means of an approved self-propelled machine which has a satisfactory cut-off valve capable of applying broken lines automatically.

Road markings other than on main carriageway edges (both shoulder and median side) shall be of hot applied thermoplastic materials with glass reflectorizing beads as per relevant sub clauses of MoRTH specifications;

Raised profile edge lines as per Clause 7.7 of IRC 35 shall be provided on main carriageway, loop, ramp and slip road edges (both sides i.e. shoulder and median side/right lane).

Acrylic water based road marking paint shall be used for kerb, concrete barrier painting, and to display details of structure number; span arrangement etc. on all culverts and bridges with required description as per MoRTH guidelines.

iii. **Boundary (ROW) Stones**: These shall be provided for the entire Project Highway at an interval of 50m c/c as per clause 9.8 of the "Manual".

iv. **100m & Kilometer Distance marker:** The km. and 100m marker shall be provided in accordance with Schedule D.

v. **Crash Barrier:** shall be provided as per clause 9.7 of section-9 of IRC:SP:87-2019.

Retro-reflective (same material as of road signs and Fluorescent yellow / white colour) Stickers (150mm width) shall be provided on alternative vertical posts of Thrie beam barrier throughout and W beam guards rail along service road as indicated in TCS and TCS Schedule.

vi. **Raised Pavement Markers, Reflection pavement markers and Solar Studs:**

Raised pavement markers shall be provided as per clause 7 of IRC 35 – 2015 on both shoulder edges and median sides. Reflection pavement markers and solar studs shall be as per clause 9.5 and Table 9.1 of "Manual"

vii. **Delineators** shall be provided as per clause 10.4 of "Manual". At merging/diverging areas; service areas; ramps of interchanges; bridges and their approaches; the spacing shall be reduced to 30m. The design; location and materials to be used for road delineators shall be as per IRC: 79.

viii. **Blinker Lights:** Yellow flashing lights using solar power with full alternative power back-up shall be provided to alert the drivers about oncoming interchange; major bridge and toll plaza.

ix. **Boundary Wall**

As the Highway is completely access controlled facility, boundary wall is its integral part to help enforcing of the acquired access rights.

Access control extends to the limits of the legal access control on the ramps i.e., along the ramps to the beginning of the taper on the local road.

RCC boundary wall shall be provided along the entire length on either side (including transverse requirements at structure locations) in accordance with Schedule D.

(c) Lighting/Illumination: External and Internal Lighting will be as per Section-12 of the "Manual". Street Lighting shall be provided at the locations of toll / ramp plaza, interchanges/slip roads and lighting on structures such as major bridges, ROB's, Flyovers, Minor Bridges and Underpasses including high mast at toll plaza, interchange/slip roads . Lighting facilities shall be provided both above and beneath at the locations of Interchanges, VUPs and LVUPs. A power connection of appropriate load (including load other than illumination such as load of air conditioner, computers, other instruments installed on toll/ramp plaza, load required due to solar plant) shall be taken from state electricity department at above locations including all expenses**.** The use of solar power is optional in lieu of a regular power connection for isolated locations such as Bridges, ROBs, underpasses and flyovers. Provision of adequate capacity Diesel Generator sets as standby arrangement for loads as mentioned above shall be made at Toll / Ramp Plaza, Interchange and Slip road.

Various themes and layouts of the lighting system together with type of luminaries for different locations shall be specially designed and finalized in consultation with the Independent Engineer.

Arrangement of lighting installations shall be staggered except on curves. The layout and design of lighting poles; their height and spacing shall be finalized in consultation with the Independent Engineer so that the minimum level of illumination on locations of the Project Highway where exterior lighting is provided shall be minimum 40 lux. In general, code of practice for lighting of public thoroughfare IS 1944 shall be followed.

Overhead electrical power and telecommunication lines erected within the ROW by the Concessionaire shall be provided with adequate clearance so that safe use of the highway is not affected. Overhead lines would be erected only at places where underground cabling through duct is not possible. Vertical and horizontal clearances shall conform to IRC: 32.

(d) Landscaping & Tree plantation

Landscaping and Plantation shall provide in accordance with the Manual of Specifications and Standards as referred in Schedule-D, as well as taking into consideration the latest Central government and/or State Government policies. Landscaping of Road shall be as per IRC SP-21. Four rows of tree on the side where Slip/Connecting road is not provided and 2 row of tree on the side of Slip/Connecting road shall be provided. Compensatory afforestation (1 (Cutting): 10 (Compensation) shall be undertaken within ROW as prescribed in environment and forest clearances. Landscape treatment shall be provided in the entire open areas near major bridges, at interchanges, toll / ramp plaza, and O & M areas.

Planting along the Project Highway shall follow a variety of schemes depending upon location requirement as per the IRC: SP: 21. The choice of trees to be planted shall also be made as per IRC: SP: 21; “Manual of Landscaping”. Eucalyptus (all species) is not recommended for planting. Local, indigenous species that grow in that area shall be preferred.

On medians and island: planting of dust and gaseous substance- absorbing shrubs shall be provided.

The treatment of the highway embankment slopes shall be as per the recommendations of IRC: 56; depending upon the soil type involved and the provisions mentioned elsewhere in this document.

Visibility of any signs; signals or any other devices erected for traffic control, traffic guidance and/or information shall not be obstructed by plantation.

The central island of trumpet and loop area of interchanges has space for attractive landscaping which provide scope for both soft and hard landscape. Special attention will be given that each interchange has a distinct and unique landscape based on some theme. The theme and design of landscaping of each interchange will blend with the local surroundings. Careful selection of plant species will be done in order to match the climatic conditions to merge with the surrounding area.

Rainwater/ ground water recharging system should also be integrated with landscaping in order to provide proper drainage to avoid ponding of water. The plantation will be inter-mixed with evergreen species and seasonal flowers. Plantation of flowering species will be done in such a way that each area has different colour pattern. The outer margins of the central islands in the

loops of interchange must have low ground covers to avoid any vision obstruction of the drivers to ensure visibility. The central portions of these islands will be provided with objects of any art; creation of pleasing/ attractive land pattern including plantation of trees keeping the aspect of vision in view. Designer lights along the periphery of the islands and central lighting in the form of high masts will be suitably provided for ensuring proper illumination of the area. Different types of water fountains may also be erected at the interchanges. No private advertisements; commercial information; hoardings etc. shall be permitted inside the interchange area. The scheme of landscape for each interchange has to be approved by the Independent Engineer.

(e) Highway Patrol Unit: Provide 1 no. Highway Patrol Vehicle (Vehicle shall be of GPS mounted with tracking facility) for covering the entire project highway. These shall confirm to the specifications mentioned in Schedule D.

(f) Emergency Medical Services: Emergency Medical Services (EMS) shall be provided as per clause 12.11 of the Manual. These services shall include setting up medical aid posts by the Concessionaire. The Concessionaire shall provide GPS fitted "Two Patient Capacity" rescue ambulance(s) with all lifesaving equipment, trained staff and first aid items including the supply of consumable items, which will be replenished as and when required for movement on 24 hours x 7 days of a week basis during the entire Concession period at suitable location in consultation with the Independent Engineer/Project Director, NHAI so that it can reach the site of the incident within 15 minutes of call.

(g) Crane Services: The Concessionaire shall provide cranes of capacity as prescribed in Clause 17.5 of Contract Agreement and as per clause 12.12 of the Manual at suitable location in consultation with the Independent Engineer/Project Director, NHAI with all necessary equipment so that it can reach the site of the incident within 30 minutes of call and clear the disabled/accident met vehicles. It shall also be fitted with GPS based Vehicle Tracking System to monitor its movement.

(h) Telecom system: All necessary hardware, equipment, software, optical fibre cable etc. required for Communication System to interconnect Toll Plaza, Ramp Plazas /Toll Booths etc. within the interchange area will be provided by the Concessionaire.

(i) Bus Shelters along Slip Roads

Bus Shelters shall be provided at following locations in accordance with the Manual of Specifications and Standards as referred in Schedule-D.

S. No.	Proposed Chainage (km)	Side (LHS/RHS)	Remarks

Nil

Note: *Above indicated location of Bus Shelters are indicative. The actual location of the Bus Shelter shall be determined by the Concessionaire in accordance with the Manual requirements with approval from the Independent Engineer. Any Additional location of Bus Shelters specified in this Clause of Schedule-C shall not constitute a Change of Scope.*

(j) Advanced traffic management system (ATMS)

Advance Traffic Management System (ATMS) shall be provided for a length of approximately 19.562 kms **(i.e from km 445+100 to km 464+662)** which shall cover Package-III and Package-IV of Andhra Pradesh Project, at the following minimum locations as specified below in accordance with the Manual of Specifications and Standards and as referred in Schedule-D.

S. No.	Type of ATMS	Location	Remarks
1	Mobile Communication System	At such locations so as to cover entire length (from km **445+100 to km 464+662**) with mobile communications.	From km **445+100 to km 464+662**
2	Variable Message Signs	As per Schedule D	From km **445+100 to km 464+662**
3	Meteorological Data System	One location (near toll Plaza)	From km **445+100 to km 464+662**
4	Automatic Traffic Counter and Vehicle Classification	At Toll Plaza / and every Ramp Plaza	From km **445+100 to km 464+662**
5	Video Surveillance System	At each side of all Interchanges on both direction.	From km **445+100 to km 464+662**
6	Video Incident Detection System	At every Operation and Maintenance centers.	From km **445+100 to km 464+662**

Note: *In addition to above locations, additional locations shall be identified and provided in accordance to schedule D in consultation with Independent Engineer / NHAI. The same 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 16*

(k) Wayside Amenities –

Way side amenity is proposed at one location in the project highway with full facility i.e. location will be fully fledged rest area where provision of food court, Motels, parking area for all type of vehicles, Dormitory, Helipad, Washroom facility, park for children, some recreational facilities will be provided. The location for way side amenity is given below in Table

S.N.	Design Chainage	Side	Type of Facility
1.	453+000	RHS	Full

SCHEDULE – D

(See Clause 2.1)

SPECIFICATIONS AND STANDARDS

1. SIx Laning

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

Annex - I

(Schedule-D)

SPECIFICATIONS AND STANDARDS

1 Specifications and Standards

All Materials, works and construction operations shall conform to the Manual of Specifications and Standards for Six-Lane Highways (IRC:SP:87-2019) and Hill road manual IRC: SP: 48-1998 published by IRC (referred to as "Manual" in this Schedule) 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 Independent Engineer.

2 Deviations from the Specifications and Standards

2.1 Notwithstanding anything to the contrary contained in the aforesaid Manual, the following Specifications and Standards shall apply to the Six-Lane Project Highway, and for purposes of this Agreement, the aforesaid Manual shall be deemed to be amended to the extent set forth below:

S. No.	Clause No.	Manual Provision	Modified Provision
1.	2.5	Median	The median shall be as per Typical cross section as given in Annex-I (Schedule-B)
2.	2.6	Shoulders	The shoulder width shall be as per Typical cross section as given in Annex-I (Schedule-B)
3.	2.12.2.1	Slip / Connecting Road	Slip Roads / Connecting Roads are proposed. The roadway width of Slip/Connecting road shall be as per Typical cross section as given in Annex-I (Schedule-B)
4.	2.17	Typical cross-sections	The typical cross section shall be as given in Annex-I (Schedule-B).

S. No.	Clause No.	Manual Provision	Modified Provision
5.	4.2.3.2	Embankment Fill Side Slope	In fill section the embankment side slope shall be minimum 1.5(H):1(V). The embankment height >6m shall be designed in accordance with IRC: 75.
6.	5.2	Type of Pavement	The type of pavement shall as specified in Annex-I of Schedule-B.
7.	5.4	Design Requirements for New Pavement Sections	Design requirements for new pavement sections shall be as specified in Annex-I of Schedule B.
8.	7.3	Width of Structures	The Overall Deck Configuration of all structures shall be as per Schedule B.
9.	9.7.1 (i)	Road Side and Median Safety Barriers	Thrie- beam metal crash barriers shall be provided in entire length on both sides of median and shoulder edge excluding stretches covered by bridges and RE wall structures, where concrete barriers to be provided. Thrie- beam metal crash barriers shall be provided at edge of carriageway and along slip/connecting road as per site condition and design.
10.	12.10 and 12.11	Highway Patrol Unit(s) and Emergency Medical Services	In addition to Section 12.10 and 12.11 of Manual, NHAI Circular Ref. NHAI/ Policy/ guidelines/ Strengthening the incident management services/ 2018 Policy no 12.19 dated 20.03.18 shall be followed.
11.	12.14	Advanced Traffic Management Systems (ATMS)	Additional specification for Advance Traffic Management System shall be as given in Annex-II of Schedule D.

Annex - II

(Schedule-D)

ADVANCED TRAFFIC MANAGEMENT SYSTEMS (ATMS)

The following Specifications and Standards shall be applied in addition to "Manual of Specifications and Standards for Six Laning of Highways" published as IRC: SP: 87-2019 with all amendments and additions till date.

1. Advanced Traffic Management Systems (ATMS)

1.1 General

The work would cover design, supply, installation, commissioning and/or operation and maintenance of Advance Traffic Management Systems (which is one of the components of Intelligent Transport Systems - ITS). The system would include out-door equipment including emergency call boxes, variable message sign systems, meteorological data system, close circuit TV camera (CCTV) system, traffic counting and classification system and transmission system. The indoor equipment would comprise a large display board, central computer (with Network Management System - NMS), CCTV monitor system, call centre system or management of emergency call boxes housed in a control centre with uninterrupted power supply. Any new technology, meeting the requirements specified in these specifications should not be excluded. The systems shall meet following objectives:

- Smooth and uninterrupted traffic flow
- Enhance road safety
- Real time information and guidance to users
- Emergency assistance round the clock
- Alerts for abnormal road and weather conditions
- Reduced journey time and inconvenience

1.2 System Requirement

ATMS shall provide the following facilities to highway users:

- Make emergency calls to Control Centre in case of accidents, breakdown, fire and ambulance.
- Pre-warn the highway users about unusual condition on the road.

ATMS shall provide the following information/data to traffic managers for efficient and effective handling of traffic.

- Information regarding location of any incident, incoming calls, and help required and messages to be passed to third parties.
- Information regarding traffic congestion, speed and weather conditions.

ATMS shall provide the following controls to traffic managers:

- Change the variable message signs from the Control Centre.
- Mobilize the movement of ambulances, cranes & patrolling vehicles.

ATMS shall provide online recording and reviewing of the voice & visual information for record and analysis.

Value Added Systems in information dissemination to users of the Project, may be taken up in future. These shall include the following:

(i) Value Added Systems in the form of real time information on traffic conditions, unusual events, congestion levels, weather conditions etc.; to facilitate project users as also the operator.
(ii) Through relevant websites including that for the Project SPV/Concessionaire
(iii) Subscription based alert systems
(iv) Dedicated TV channels pertaining to traffic movement
(v) Tie ups with FM radio channels or creation of dedicated AM radio channel
(vi) Dedicated Toll Free Telephone Systems

Note: Local language is emphasized in above systems.

The ATMS shall among many things comprise following sub-systems:

i. Communication backbone
ii. Emergency Communication System
iii. Mobile Communication System
iv. Variable Message Sign System
v. Meteorological Data System
vi. Automatic traffic counter-cum-classifier system
vii. Video Surveillance System
viii. Video Incident Detection System (VIDS)
ix. Central Control Room (CCR)
x. Weigh in motion for axle load measurement
xi. Power Supply System

These systems shall have outdoor equipment consisting of ECBs, VMS panels, weather sensors, traffic sensors, video camera etc. The outdoor equipment shall be connected

to the control centre through transmission system preferably comprising optical fibre cable, copper cable and interface equipment. There shall be one control centre at the toll plazas and shall have monitoring equipment, on line information acquisition equipment, processing equipment etc. It shall also have graphic display board showing the highway and the locations of equipment and of incidents.

1.3 Emergency Call System

Purpose and General Information

This is a communication medium to be installed on the highway and to be used by the road users to make alarm call to the CCR in case of accidents & other problems on the highway.

Location

ECB shall be installed every 2km on either side of the road with one unit directly across the road from the other i.e. two call boxes every 2km. It shall be placed along the left side of the carriage-way for each direction of travel on the verge adjacent to the hard shoulders. At each location one ECB shall be master and the other slave. The master ECB shall be equipped with fibre optic interface, solar panel, battery back-up and voice communication mechanism and shall also comply with all the requirements specified in this section for ECBS. The slave ECB shall be equipped at least with – activation button, vandal sensing mechanism, call progress indication LED, microphone, speakers – in a weather proof housing. To discourage motorists who break down near the start or finish of the highway from leaving it to obtain assistance, no telephones should be provided within the first and the last 300meters.

To achieve maximum visibility, care should be taken to avoid siting telephones near structures (e.g. bridge piers), particularly where these are close to the hard shoulder on left hand bends.

Based on the above policy and the site condition, the location of the ECBs can be adjusted within 10% variation, however, only with the consent of the NHAI.

The optical fiber and splicing boxes shall be placed in the central median.

Major Components

Main components of the Emergency Call subsystem are:

1. Field components:
    a. Emergency Call Box – Master and Slave units
    b. (Solar) power supply
    c. Guard rail for protection
2. CCR components
    a. ECB server

a. Headphone, speaker and microphone (Answering Unit)
b. Voice recorder/logger
c. Application software
d. Database software

Functional Specifications

1. The system shall be connected to the CCR over the OFC backbone.
2. ECB shall have loud speaker, microphone, solar panel, and battery and activation button with LED indicating conversation. It shall be housed in vandal proof casing and operate in highway noise levels with built in diagnostic features.
3. The road user just needs to press the push button on the ECB and shall be connected to the CCR. In case the CCR operator is busy, the user shall hear a recorded message and shall hold till he/she is connected. The Master unit shall be connected to the CCR over the communication backbone. The Slave unit shall be connected to the CCR through the Master unit.
4. The CCR can also call any specific ECB for testing/calling in which case the ECB shall ring. The ring shall go off when someone presses the push button and connects to the CCR.
5. The ECB shall have the following features :
   a. Vandal proof casing with tamper detection switch
   b. Push button
   c. Activation LED
   d. Loud speaker
   e. Microphone
   f. Two way communication between ECB and CCR
   g. Solar panel with batteries
6. ECB shall have hands free operation.
7. Each ECB shall have usage instructions in Hindi, English, Marathi and Guajarati pasted or printed on it along with graphical instructions.
8. Reflective stickers facing the motorist shall be pasted on the ECB indicating that it is a phone.
9. The CCR software shall manage the calls to and from the ECB.
10. The ECB shall have Ringing Tone to indicate progress of call when button is pressed; Confidence Tone to indicate call is still connected when on hold and recorded message if line is busy.

11. There shall be up to four programmable auto dial numbers associated with the push button. The ECB shall automatically dial subsequent numbers if the first number is busy or unavailable.
12. The ECB shall automatically end call when CCR telephone is disconnected.
13. All calls shall be recorded in the CCR voice logger/recorder along with date/time stamp. The voice recorder shall check for following minimum fault conditions :
    - Failure of recording electronics
    - Failure of storage media used for recording
    - Excessive recoverable errors on the storage medium
    - Lack of activity on a channel
    - Constant activity on a channel
    - Constant ringing on channel (answered calls)
14. ECBs shall be programmable from the CCR and from the field by laptop.
15. The system shall have in-built diagnostics and shall be able to detect activation of tamper switch, mic/loudspeaker faulty, line faulty, low DC voltage on line, cross talk and short circuit. Any diagnosed problem shall trigger an audio video alarm in the ECB server at CCR.
16. The diagnosed problems shall be stored in the system as events in the CCR. It should be possible to draw and print report of all such events on time and event category basis. ECB software at CCR shall allow recording and storing of maintenance and corrective action of each event when it is resolved.
17. ECB shall be powered by DC batteries which in turn shall be charged by solar panel. The battery shall support 7 days of operation (under normal circumstances) with minimum talk time of 90 minutes over 3 days in succession in case there is no sunlight for this period.
18. The ECB shall have tamper resistant screw bits on the outside and shall be security locked. It shall not be possible to open the ECB with normal tools or keys.
19. ECB foundation shall be concrete. Cables (communication/power) shall enter from the base of the ECB foundation.
20. Each ECB pillar shall be numbered.
21. The ECB mic/speaker shall be located 1-1.5m above ground.
22. The system shall not permit cancellation of any call before answering.
23. CCR Equipment
    a. The CCR equipment shall consist of an ECB server with large TFT display screen and voice logger for recording of all calls. It shall be possible to play back any call by time specified. Playback should not interfere with record function. The

screen shall show the map of the highway with all Emergency telephones marked in accordance with their actual locations.

b. The GUI shall be user friendly. ECBs shall be displayed in grey colour icons on the screen. When a call is initiated, the icon shall turn green and blink. When the call is in progress, the icon shall be green and stationary. On-hold calls shall be displayed in orange blinking. Faulty ECBs shall be displayed in red, without blink.

c. The software shall have the following features:
   i. password protected & accessible only with relevant passwords
   ii. data logging with the currently logged user/ operator details
   iii. different levels of authorization for logging into the system
   iv. automatic Call location identification
   v. call disconnection by operator only
   vi. operator call back facility
   vii. automatic testing facility running in the background at operator selectable intervals
   viii. operator initiated ECB test facility
   ix. facility for holding at least 10 calls from ECB"s
   x. Low battery and tamper alerts.

d. The following shall be recorded by the system software:
   i. Time of incoming call
   ii. ii. Time of call answering
   iii. Time of call termination
   iv. Time of fault occurrence
   v. Time of happening of events

e. It shall be possible to :
   i. connect to any of the Calls on Hold
   ii. ii. hang up the call
   iii. put on Hold the currently connected call
   iv. call back any of the ECB
   v. monitor faults and events
   vi. send e-mail to defined personnel intimating them about emergency

f. It shall be possible to draw the following minimum reports for each ECB as well as all/selected ECBs :
   i. Call count based on time period selection
   ii. Average call duration
   iii. Average waiting period for on-hold calls
   iv. Unanswered calls (count)

v. Fault and diagnostics report
vi. Incident category-wise report
vii. The reports shall be tabular as well as graphical.

24. The following technical specifications are advised for ECBs. However the system integrator/operator can choose any other technology as long as other requirements are met.
    a) Working : Work on VoIP
    b) Communication : Ethernet type over optic fiber
    c) Power : 12/24V DC, solar powered max 10W
    d) Audio output : >95dB
    e) Microphone : unidirectional, noise cancellation type
    f) Wind speed resistance : 180kmph
    g) Mean Opinion Score : Min 4.0
25. ECB shall connect to the Outdoor Technical Cabinet Switch on optic fiber port/copper port (Ethernet may also be used, wherever feasible).
26. The ECB shall be vandal resistant in construction. It shall be made of stainless steel/ Aluminum alloy/ FRP.
27. ECB components shall be corrosion resistant; PCBs shall be coated to prevent water, moisture and fungus.
28. Each ECB shall be protected against external EMI, lighting and static by adequate shielding and earthing. The enclosure shall be provided with a grounding lug for connection to ground wire.
29. ECB enclosure shall be IP65 rated and shall be vermin and rodent proof. Doors shall be with labyrinthine seal, butyl-rubber gaskets, security locks, and metal hinges in conformity with UNE20324 standard.
30. The ECB shall operate in full duplex mode and use signaling which is inaudible to the user.
31. It shall be possible to adjust the acoustic properties.

1.4 Variable Message Signs (VMS)

Purpose and General Information

Variable Massage Signs (VMSs) are to be installed for conveying the traffic conditions ahead to the drivers on real time basis as well as to display messages to support national road safety campaigns. It may also include the variable traffic speed limit depending upon the requirements.

Variable message signs (VMSs) shall provide traveler information for warning, regulating, routing, and managing the traffic in order to improve the overall traffic flow.

The philosophy is to inform the driver of impending conditions with up-to-date information. The overall goal of VMS application is to provide permanently located signs that can be programmed remotely to communicate with the drivers the necessary information such that the driver can choose or be directed to the most appropriate route. The VMSs shall be controlled from the main CCR. Based on requirement, the VMS may be fixed or portable in nature.

VMSs shall be used during the following conditions:

- Recurring Conditions

Mainly peak-period traffic congestion where demand exceeds capacity for relatively short periods of time.

- Non-recurring Conditions

Caused by random or unpredictable incidents. An “incident” is defined as any non-recurring event that causes a reduction of roadway capacity or an abnormal increase in demand. Such events include traffic crashes, disabled vehicles, spilled cargo, highway maintenance and construction projects and adverse weather conditions.

VMS Usage Priorities

VMS should be used whenever pertinent messages will assist motorists to make helpful decisions. If, however, a situation arises, which requires the usage of a specific VMS for more than one ongoing condition, the following priority criteria should be used for displaying messages, in the order listed.

- Safety

Any VMS message that is necessary to provide safety to the motoring public has the highest priority. Examples include failure of a highway bridge, roadway or any major incident. In general, safety messages should be kept current and relate to a specific safety campaign. The period of time that a specific message is displayed for a safety campaign should be limited to a few weeks. Motorists tend to ignore messages that are displayed for long periods of time.

- Roadway Closure

The VMS message shall include motorists regarding the roadway (particular carriageway, lanes of the highway or cross road) closure is important because such a closure directly affects the route a driver would take.

- Minor Traffic Impact

A pre-warning message shall generally be used for planned full closures of carriageway of particular part of the highway. The message shall be displayed no more than four days prior to the closure, and shall be immediately replaced with an appropriate message when the closure commences.

- Pre-Warning

This category includes construction lane closures, blocking-incidents, and delay information.

- Test

Test messages may be used to sign operation for testing the operating system and prior to placing a VMS into service.

- Public Service Information

Public service information messages do not require the drivers to make any unexpected maneuvers with regards to upcoming traffic conditions. Some examples include “Buckle Up,” “Speed Kills,” and “Don"t Drink and Drive.”

Various situations where VMS would be appropriate are as below:

- Incident signs as accidents, traffic diversions, incident management, monitor road work (men at work) adverse weather and road conditions and operation with lane control signals;
- Traveler information such as display of road construction activity in near future, messages for testing of the system and special events that effect the traffic flow;
- Public service announcements like messages relating to driver safety campaign.

Location

VMS shall be provided as per locations determined later. A general policy adopted for locating VMSs is to provide VMS at an average interval of 10km in each direction (not necessarily on the same gantry) to guide and forewarn the users about the traffic and weather conditions on the highway.

The most critical locations for installing permanent VMSs are in advance of interchanges on highways where drivers can have the opportunity to take some action in response to messages displayed on VMSs. A VMS should not compete with existing roadway signs.

Drivers generally do not anticipate using a different route until they see and read a VMS message. Drivers who are traveling in the inside lanes need ample time to read the message and change lanes to exit.

In general, a VMS should be permanently installed at the following locations:

- Upstream from major decision points (e.g., exit ramps, freeway-to-freeway interchanges, or intersection of major routes that will allow drivers to take an alternate route).
- Upstream of bottlenecks, if any
- Where regional information concerning weather conditions such as fog, wind, or dust is essential.

The portable VMS can be mounted at the back of the truck or similar vehicle. The VMS sign mounted on truck could be powered by solar energy or battery.

The exact location shall be adjusted for the maximum utility to the users based on the site conditions, however, only with the consent of the NHAI.

Major Components

The design of the system will be modular except for the housing.

Main components of the VMS subsystem shall be:

- Field components – consists of the sign module having:
  a) VMS case
  b) VMS sign (display modules)
  c) Power supply
  d) Dimmer control (ambient light photo sensor system)
  e) Microcontroller
- CCR components
  a) VMS server
  b) VMS Application software
  c) VMS Database software

Specifications

1) VMS shall be able to display all colours.
2) The VMS shall be able to display the following:
   - English text
   - Hindi text

- Gujarati text
- Marathi text
- Numeric
- Punctuation marks
- Graphics
- Preset messages – at least 10 preset messages shall be displayed and shall be able to change automatically and sequentially in programmable intervals of 1-10 minutes

3) The mounting structure to be provided for the VMS units shall be sturdy, aesthetically designed and capable of bearing wind loads at least up to 200 kmph. The lowest hung part of the display board shall have vertical clearance of at least 5.5 m from the road level. It shall be provided with a walkway to allow at least 2 persons to carry out maintenance of the VMS without obstructing the carriageway. Safety barriers shall be provided at gantry support column (s) for their protection and for safety of road users. The concrete pedestal for support column should be flushed with ground but in no case should protrude for more than 15 cm.
4) The minimum distance of VMS on an highway should be 1.5 km. prior to decision point. The signs should be visible from a distance of 300m.
5) There should be clear distance between existing road sign and VMS. The minimum distance between road signs and VMS should be at least 250m.
6) The average driver of motorized vehicle at high rate of speed can comprehend two message panels. Each panel should be complete phrase and each phrase should be independent of the other. The messages should consist of:

A problem statement	Road work/accident ahead
An effect statement	Delay/congestion
An attention statement for certain group	Motorist
An action statement	Take the next carriageway

7) Software – The VMS application software shall be installed in the CCR and shall have the following features:
   - GUI display
   - Login/password protected access
   - Database for storing messages and history
   - Reports for – preconfigured messages, login time and user, date/time of display, fault history.
8) Maintenance walkway shall be provided on the gantry at the rear of the sign- case. All component parts shall be easily and readily accessible by a single person for

inspection and maintenance. There shall be room for a technician to work. The VMS should have in-built lighting to assist maintenance work during night.

9) Standards

VMS shall be designed to comply to with the following protocols:

- EN 12966 parts 1,2 and 3

10) VMS shall be full matrix, true colour. It shall be made of modules and shall have equally spaced LEDs.

11) Text display - VMS shall be compliant to EN 12966. This includes the following for LED panel:

- Beam : B3
- Colour : C1
- Luminance : L3
- Temperature : T3
- Resistance to pollution : D3
- For wind pressure on enclosure refer EN 12899

12) Display specifications

Sign dimensions	:	Length 8000mm, height 2500mm
Pixel colour	:	True colour (36bit), text displayed in Amber colour
Pixel size	:	25mm
Pixel pitch	:	25mm
LED life	:	> 100,000 hours
Operating Voltage	:	AC 220V, 50Hz
Language	:	Hindi, English, Gujarati, Marathi
Character height	:	upto 450mm
Horizontal viewing angle	:	>800
Viewing distance	:	15-300m
Ingress protection	:	IP65 for front (LED face); IP55 for rear
Communication	:	Serial, Ethernet, OFC

13) The LED Cluster shall consist of individual LED"s encapsulated in a resonated plastic housing proving protection to the elements under worst climatic conditions.

14) The modules shall be individually addressable and field replaceable.

15) Failure of one LED module should not affect the output of any other.

16) The system design shall be such so as the display is legible from a distance of between 15m to 300 m in all weather and lighting conditions.

17) Elaborate Fault diagnostics shall be provided as per EN12966 or other equivalent international standards. Each pixel shall be monitored and feedback shall be provided for the healthy status. Minimum of following shall be provided :
    - Power Failure at VMS
    - Processor PCB Failure
    - LED Cluster Failure
    - Loss of incoming message / data not properly received.
    - Temperature monitoring
18) The VMS shall withstand shock and vibration existing on the highway.
19) Controller functionalities
    - The controller unit shall provide brightness control facility. The intensity of the VMS shall have at least six levels and it shall select the correct level automatically depending on ambient light conditions. For this, the VMS shall have photo sensor and dimmer control.
    - The controller unit shall provide the monitoring of ambient temperature of the housing.
    - The controller shall be provided with a test port for local diagnostics via laptop.
20) The VMS software should permit the following :
    - Broadcast messages
    - Specific address messages
21) It shall be possible to perform fault diagnostics from the central control room via the software.
22) Maintenance panels shall be provided on the rear of the housing
23) Maintenance walkway shall be provided on the gantry at the rear of the sign-case. All component parts shall be easily and readily accessible by a single person for inspection and maintenance. There shall be room for a technician to work. Access shall be made by entering the side of the housing. The housing shall be weather tight, and compliant to the NEMA 3R Standard. The bottom panel of the housing shall have a minimum of four drain holes, with snap-in, drain filter plug inserts.
24) Ventilation - The ventilation system shall be forced air. The system shall be designed to adequately cool the pixels from all sides along with the front and rear of the display module and all other internal components. The ventilation system shall have the following properties:
    - Positive pressure (exhaust fans are not acceptable).
    - The fans shall have ball or roller bearings, shall be permanently lubricated and shall require no periodic maintenance. The fans are to be positioned in such a

manner so as to provide a balanced air flow to the ventilation system in the event of failure of any fan.

a) **Sign-case**

- All parts shall be made of corrosion resistant materials, such as plastic, stainless steel or aluminum. Painted steel is not acceptable. No self-tapping screws shall be used. The finish shall be matte black. The main body of the sign housing shall be constructed of aluminum with a natural mill finish. All exterior seams shall be continuously welded by an inert gas process, except for the coated fascia material. The sign-case shall be constructed of non-ferrous material to avoid rusting. The VMS sign-case shall have CFL lighting for maintenance during low light conditions.
- The performance of the sign, including the visibility and legibility of the display, shall not be impaired due to continuous vibration caused by wind, traffic or other factors.
- The angular alignment of the sign housing shall be adjustable in the vertical direction from (0 to 10 degrees) down in one-degree increments to optimize the viewing angle.
- The housing shall be capable to withstand the following conditions for Vibration Test

1. Frequency range	:	10- 50Hz
2. Vibration amplitude	:	0.35mm
3. Duration of endurance	:	20 sweeps cycle
4. Duration at resonant frequency	:	30 min+ 1 min

The Gantries for the VMS shall be designed and the design shall be got approved from the NHAI. It includes all civil works like foundations etc., and shall be done as per relevant standards.

1.5 Automatic Traffic Counter-cum-Classifier (ATCC)

Purpose and General Information

- This system shall be used for identifying and recording all types of vehicles on the highway for effective monitoring and data collection at Control Centre. The system shall be capable of detecting and recording all types of vehicles plying on the highway.

- Besides the above vehicle classes, the system shall be capable of classifying any other vehicle category as per need. Vehicle classification should be user selectable based on vehicle parameters.
- The system shall have interface with the ATMS software for central monitoring.

Location

- ATCC is proposed to be installed at at suitable location. The final location may be adjusted as per the site condition, only with the consent of the NHAI/Traffic and Transportation expert.
- The ATCC cabinet shall be installed in median or on the side of the highway at a distance of 2 to 3 meters from the soft shoulder.

Major Components

Main components are:

a) Field components – consists of :
   a. ATCC roadside cabinet / electronics/data logger
   b. In-road/non-intrusive sensors and cables
   c. Field computer/laptop
   d. Power supply
   e. Lightning protection and earthing

b) CCR components
   a. ATCC server
   b. Application software
   c. Database software
   d. Report printer

Specifications

- The ATCC should be designed for 8 lanes of traffic i.e. one cabinet/data logging unit should be able to record data for at least 8 lanes (4 in each direction)
- System shall use a combination of loop and piezo sensors or any other sensor mechanism (intrusive or non-intrusive) for correctly counting and classifying vehicles.
- Piezo sensor installation shall be in concrete. ASTM 1318-02 recommends a concrete pavement of 90m (60m before sensor and 30m after) to ensure good accuracy.
- The ATCC shall detect all classes of vehicles as per toll classification scheme.
- One or more of the following information shall be generated by the ATCC for each lane to correctly count and classify the vehicle:

a. Vehicle length
b. Vehicle speed
c. Number of axles
d. Axle spacing
e. Axle load (WIM) and GVW
f. Vehicle profile
g. Vehicle image
h. Any other proven technology with the consent of the Engineer and NHAI

- The ATCC shall provide the following additional information:
  a. Occupancy
  b. Headway
  c. Gap
  d. Average Speed
  e. Flow rate

c) Data logger (roadside electronics): The requisite number of entry and exit ports to communication system shall be provided. The logic unit shall be micro-processor based. The system shall be able to count and classify vehicle in each lane. There shall be an indication to display vehicle detection.

d) Data logger shall have a Tamper Detection Alarm facility. Any effort to tamper with the data logger shall trigger an audio and visual alarm in the CCR.

e) Data collection: The system shall be capable of sending data to the ATMS Software which shall enable the Software to count and classify the vehicles, and provide other required information Data collection shall be by RS232, RS422 or RS485 interface or IP connection.

f) Data Storage: The system should be able to upload data to the system as it occurs. The unit shall store data of at least two weeks in event of communication failure.

g) System Accuracy (@95% confidence), whichever is applicable

a. Vehicle length(m)	:	$\pm$ 5%
b. Vehicle speed (kmph)	:	$\pm$ 1.5%
c. Vehicle count(nos.)	:	$\pm$ 1%,
d. Number of axles (nos.)	:	$\pm$ 2%
e. Axle spacing (m)	:	$\pm$ 2%,
f. Vehicle class	:	$\pm$ 3% for Class Car/Jeep/Van (of detected vehicles)
	:	$\pm$ 5% for Class LCV
	:	$\pm$ 3% for Class Truck/Bus (Two Axles)

	:	± 2% for higher classes
g. Headway (m sec)	:	± 7%
h. Gap (cm)	:	± 8%
i. WIM accuracy	:	± 15% on axle; ± 10% on GVW
j. Vehicle speed	:	10-195 kmph

h) Coincidence detection (lane straddling): The ATCC shall be capable of determining and recording vehicles that straddle adjacent lanes. This reduces double counting of vehicles on sites where lane discipline is a problem.

i) Weather: The ATCC shall be capable of working with above mentioned accuracies, 24x7, in all weather conditions including heavy rain, dense fog and specified temperature range.

j) Reverse detection: The ATCC shall be capable of detecting and recording any vehicles traveling in reverse direction.

k) Data retrieval: The system shall be capable of data retrieval, direct data transfer through the Fiber Optic Network or locally through laptop.

l) Recording capability: The system shall have capability of recording vehicle counting and classification, speed, headway at set interval of 1-10 minutes.

m) Compatibility: The system shall have compatibility to transmit data over Optical Fiber Cable.

n) Fault monitoring : The system shall be capable of detecting and reporting the following fault events:

- Mains power failure
- Battery low voltage
- Modem communication error
- Laptop communication error
- CPU reset
- CPU failure
- Sensor fault (for each sensor)
- Door tamper

Software

The Application Software shall have the following features:

- It shall be GUI based
- The Opening Screen shall have password authentication
- Communications Parameters setting
- Configuration Parameters setting
- Raw and Binned data Retrieval
- Vehicle by vehicle Real Time Traffic Display

- Diagnostic Functions – Sensor Test
- Vehicle Classification Configuration & Weight Limits

Specifications for CCR equipment

- Server – The server supplied shall be the latest available in the market at the time of supply. However, the minimum specifications are given in subsection on “Servers” under section “Miscellaneous Equipment”.
- Application Software
  a. Shall be a single software for all data loggers in each package
  b. Shall be Windows based
  c. Shall have unlimited period use license for each package
  d. All upgrades shall be free of cost.
  e. Shall communicate to each data loggers in the field and
  f. Shall be GUI based
  g. Password protected
- Database Software
  a. Shall be password protected
  b. records shall not be editable
  c. Shall not be notepad, MS Word, Excel
- Reports – system shall be able to generate reports. All reports can be time-wise, lane-wise, location-wise or total summary reports for all data loggers. The reports shall be in tabular and graphic form. All reports shall be in metric units and dd/mm/yy time format. The following are the minimum reports :
  a. Average Speed per Vehicle Category per Lane per Day
  b. Traffic Volume per Vehicle Category per Lane per Day
  c. Traffic Volume per Hour per Lane per Day
  d. Axle Volume per Weight Band per Lane per Day
  e. Volume (count) per Class per Lane
  f. Average Speed per Class per Lane
  g. Volume per Lane per Time Band
  h. Volume per Speed Band per Lane
  i. Overloaded Vehicles per Class per Lane
  j. Average Speed per Category
  k. Malfunction Management Report (fault report)
  l. Traffic Volume by Category by Lane (binned data)

m. The reports shall be transferrable to MS Excel and Acrobat pdf format.

n. Multiyear calendar adjusted for leap years

1.6 Video Surveillance System

Purpose and General Information

The purpose of the Video surveillance system is to monitor specific areas of the highway remotely from the CCR by use of cameras installed at such critical junctions. This shall help in managing incidents.

The system shall also record and store video for analysis and future reference.

Major Components

Major components are:

- Field components :
  a) CCTV camera with housing
  b) CCTV pole
  c) Video transmission unit (encoder)
  d) PTZ control
  e) Power supply – solar panel
  f) Lightning protection and earthing
- CCR components
  a) Server with OS
  b) CCTV decoder/ switcher unit
  c) PTZ control/joystick
  d) Video Wall
  e) DVR
  f) Application software
  g) Database software

Functional Specifications

- Camera
  a. The CCTV shall be PTZ type video camera.
  b. The Video Camera shall be of dome type to avoid pilferage, be resistant to vandalism and weather-proof. The dome shall be of smoked glass so that it shall not be possible to see the camera (inside the dome) from roadside.
  c. PTZ Cameras shall have 6 or more pre-defined positions.

d. The camera viewing distance of at least 1km in each direction. The horizontal rotation shall be 3600 continuous pan and vertical tilt shall be 900 down to 00 horizontal.
e. The video camera shall transmit a clear video even in low light and night conditions.
f. The camera and associated units shall be dust-proof and protected against water ingress.
g. The CCTV video camera roadside cabinet shall house the power supply system and video encoding and transmission equipment.
h. CCTV video camera shall preferably run on solar power.
i. There must be a single encoder for each camera.

- Camera mounting
  a. The camera shall be mounted on a properly designed pole of at least 10m height. The Video Camera mounting shall have easy accessibility for maintenance purposes while being protected from unauthorized access.
  b. The mounting and equipment housing shall be able to withstand adverse weather conditions.
  c. The camera mount should be of the same make as that of camera and suitable for the model number offered as specified by the manufacturer and should be an integrated unit.
  d. Should support the weight of camera and accessories in a wind speed of 180kmph (min).
- Camera control & display
  a. The camera images from all cameras shall be transmitted to the CCR for monitoring and storage.
  b. All CCTV cameras shall be controlled by the CCR operator. Each camera shall be individually selectable and also the Pan, Tilt and Zoom functions for each camera.
  c. The CCR shall have the facility to decode the video, record the video, display live and recorded video on a large video display and have PTZ controls.
  d. The video from CCTV video cameras shall be viewed in the CCR on a video wall. The video wall shall be formed of expandable modules. The system shall allow CCR operator to blow individual images to fit the entire screen or any other size.
  e. The CCTV video shall be recorded in the CCR in a DVR or computer.
  f. Privacy Zone Masking: the camera software shall blocks scenes/areas that should not be displayed.

g. The CCR shall be designed in a way to ergonomically seat the CCR operators. There shall be one operator for every 6 video images.
h. System to have facility of additional camera installation beyond the originally planned capacity.

- CCTV software and recording
  a. The CCR shall have a server with latest specifications for image processing, control and display.
  b. System shall be triplex i.e. it should provide facility of Viewing, Recording & Replay simultaneously.
  c. CCR shall have facility to record all videos from all simultaneously and store at least 30 days of video. This may be done by a separate DVR or recording on the hard disk of the server. System shall have provision to automatically over-write the new information after the period of 30/31 days (First In First Out)
  d. The old recording shall be overwritten by new recording after 30 days
  e. The CCR Server shall have application software to control PTZ functions, select individual camera, playback video. It shall have access control (through password/login) so that no unauthorized person may view /edit any videos.
  f. The software should be able to control all cameras i.e. PTZ control, Iris control, auto /manual focus, and color balance of camera, Selection of presets, Video tour selection etc.
  g. The System should ensure that once recorded, the video cannot be altered, ensuring the audit trail is intact for evidential purposes.
  h. System must provide built-in facility of watermarking or Digital certificate to ensure tamperproof recording so that these can be used as evidence at a later date, if so desired. The recording shall support audit trail feature.
  i. The OS shall be off-the-shelf, preferably Windows.
  j. The offered system shall have facility to export the desired portion of clipping (from a desired date/time to another desired date/time) on CD or DVD. Viewing of this recording shall be possible on standard PC using standard software like windows media player etc.
  k. The software is required to generate reports of stored device configuration.
  l. The system shall provide User activity log (audit trail) with user id, time stamp, and action performed, etc.
  m. The administrator should be able to add, edit & delete users with rights. It shall be possible to view ability / rights of each user or the cameras which can be viewed & controlled as per the permission assigned by the administrator.

n. The software for Employers should also be working on a browser based system for remote users. This will allow any authorized user to view the video of any desired camera on his monitor.

o. Retrieval: The CCTV application should allow retrieval of data instantaneously or any date / time interval chosen through search functionality of the application software. In case data is older than 30 days and available, the retrieval should be possible. The system should also allow for backup of specific data on any drives like CD/DVD/Blu ray Recorders or any other device in a format which can be replayed through a standard PC based software. Log of any such activity should be maintained by the system which can be audited at a later date.

p. Backup: Online backup should be maintained to protect against storage failure.

- Power

a. Surveillance CCTV System shall operate on 230 V, 50 Hz single -phase power supply.

b. Power for all the equipment will be conditioned using on-line UPS with minimum 30minutes back up.

c. If any equipment operates on any voltage other than the supply voltage and supply frequency, necessary conversion/correction device for supply shall be supplied along with the equipment

1.7 Mobile Radio Communication System

Purpose and General information

This Specification lays down the General, Functional and Technical requirements of Mobile Radio Communication System (MRCS) to be used as a sub-system of the Advanced Traffic Management System. All communication shall be to and from the CCR. The frequency band of operation is envisaged to be in the VHF band.

Mobile sets shall be installed in patrol vehicles, cranes and ambulances and shall communicate with CCR and also among themselves. The system shall use a pair of frequencies to be allotted to the concessionaire with the approval of relevant government bodies.

Major Components

The MRCS shall comprise of:

- Base Station Unit
- Repeater Unit
- Mobile Radio Unit
- Control Centre Equipment
- Rack

a) Base Station Unit:

- Transmitter
- Receiver
- Antenna with tower/mast
- Switch
- Radio Engineering terminal
- Radio Operator terminal
- Power Supply

b) Repeater Unit:

- Transmitter
- Receiver
- Antenna with tower/mast
- Repeater
- Power Supply

c) Mobile Radio Unit:

- Transmitter
- Receiver
- Antenna with tower/mast
- Control Unit
- Power Supply

d) Control Centre Equipment:

- Network Management System
- Headphone and microphone
- Voice recorder (optional)

Specifications

1) The system shall establish voice communication on radio between the Control Centre and the emergency mobile vehicles such as ambulances, cranes & patrolling vehicles.
2) The system shall cover the entire route.
3) The topology of the communication system shall cell centric (Repeater System).
4) All the Repeaters and Control Station shall be connected via Optical Fiber Cable (OFC) backbone on Ethernet port
5) There shall be minimum distortion in overlap areas of two towers.
6) All communication shall be half duplex
7) The system shall use one pair of VFH frequency allocated by WPC. In case two pairs are allocated, they may be reused in alternate sections.

8) The network shall be laid such that all the field mobiles are approachable to at least one Repeater.
9) The system design shall be modular in nature and easily configurable through on site programming.
10) The system shall have voice logger at the CCR to record all calls.
11) The system shall have Operator PC and microphone & speaker for the CCR operator.
12) The system design shall be modular in concept.
13) The radio base/repeater units shall be connected over OFC.
14) The system shall have the following features:
    - Operate in half or full duplex mode
    - Operate in VHF preferably using one pair of frequency (i.e. two frequencies- one RX and one TX). If only one frequency is available, half duplex mode is acceptable.
    - Programmable VOX operation.
    - CCIR / DTMF tones for Mobile to Repeater Communications.
    - Mobile/handheld to mobile/handheld communication.
    - Mobile/handheld to CCR communication
    - CCR to Mobile/handheld communication.
    - Group call communication.
    - Broad Cast Communication
    - Call Limit Timer.
    - Digital display on mobile units
    - OFC connectivity. The mobile radio shall be integrated with the Fibre Optic Communication system.
    - PTT (Push To Talk)
15) The system shall work satisfactorily under adverse conditions like storm, rain, and vandalism resistant. The system shall be compact & rugged in design having ease of maintenance.
16) The system shall neither affect functioning of other telecom equipment installed adjacent or along it, nor get affected by the presence of other equipment / systems.
17) The Mobile Radio shall have provision for mounting the mobile set on ambulances, cranes and patrolling vehicles.
18) The walkie-talkies shall work on re-chargeable batteries with 24 hrs. back-up. Mobile sets shall derive power from battery of the vehicle in which installed.

19) The equipment shall have facility to configure the network for individual, sub-group or broadcast mode of operation for both selective calling and group calling operation.

20) The system shall have the facility to terminate the mobile to mobile connection under the following conditions:

- One of the two parties hangs up
- One of the two parties receives a call from the Control Centre
- The duration of the conversation exceeds 5-minute limit

1.8 Meteorological Data System

Purpose and General Information

Purpose

The Meteorological Data System shall be capable of providing data regarding weather including Air Pollution parameters, atmospheric temperature, humidity, visibility, wind speed & direction. The information based on these data shall be made available to the road users through VMS so that they are forewarned of the weather conditions on the highway.

Air Quality Index (AQI):

An Air Quality Index (AQI) has been developed by Central Pollution Control Board based on the dose-response relationship of various pollutants. This is called Indian AQI or IND-AQI (for India).

A minimum number of three pollutant parameters (Suspended Particulate Matter (SPM), Sulphur Dioxide (SO2) and Nitrogen Dioxide (NO2) are essential to calculate the AQI. Any additional information on other pollutants such as Respirable Particulate Matter (RSPM or PM 10), Carbon Monoxide (CO) and Ozone (O3) are included to calculate conclusive and complete value of AQI.

The developed index is classified in five categories: Good (0-100), Moderate (101-200), Poor (201-300), Very poor (301-400) and severe (401-500).

The SPM, SO2 and NO2 shall be used and IND-AQI calculated.

Location

The Meteorological Data System shall be located at an interval of average 100km. However, required adjustment in the locations can be made only with the consent of the NHAI.

Major Components

The Meteorological Data System shall have following components:

a) Sensor for atmospheric temperature

b) Sensor for road surface temperature

c) Sensor for humidity

d) Sensor for visibility

e) Sensor for wind speed & direction

f) Sensor for air pollution parameters like SPM, NO2 and SO2.

g) Data Acquisition Unit / Logger

h) Control room computer

i) Software – application, OS, database

Specifications

1) The Meteorological Data System shall provide data regarding
    - atmospheric temperature
    - humidity
    - visibility,
    - wind speed & direction
    - air pollution parameters - SPM , NO2 and SO2.
2) The data from all sensors shall be fed into the data logger.
3) This information shall be made available to the users through the variable message signs as per requirement.
4) The Meteorological Data System shall have the facility to communicate through PIJF/Optical fibre cable.
5) The Meteorological Data System shall be compact, rugged in design and have ease of maintenance.
6) The software in the CCR shall be capable of processing sensor data, store and retrieve it and draw reports.
7) The software shall also calculate AQI and generate reports.
8) All reports shall be tabular as well as graphical.
9) The weather data shall automatically be fed to the VMS subsystem. The VMS may also be then capable of display these data at fixed time intervals.
10) Specification of Application Software (in the CCR)
    - The application software for continuous air monitoring shall be Windows based.
    - Provision of Calibration windows for analyzer calibration from computer.
    - Main windows for real time display of all major parameters with status of all analyzers and sensors.
    - Control Panel window for control of each analyzer.
    - Alarm window for alarms of all analyzers and sensors

- Real time and multi curves / graphs for all parameters.
- Historic multi curves/ graphs over user selectable time period.
- Real time status & diagnostics for maintenance people.
- Programmable down loading of data from Analyser
- Report generation over user selectable time period.

1.9 Video Incident Detection System (VIDS)

Purpose and General Information

The purpose of the VIDS is to sense, detect and record the incident. The system shall be an intelligent image detection using camera. The VIDS shall have inbuilt intelligence to ascertain when the image has meaningfully deviated from the standard image originally recorded. A pilot run for VIDS is suggested before implementation.

Location

VIDS is established at strategic locations.

Major Components

The major components are

- Field components :

a) VID camera with housing

a) pole

b) Data transmission unit (encoder)

c) Power supply – solar panel

d) Lightning protection and earthing

- CCR components

a) Server with OS

b) Data analyzer

c) DVR

d) Application software

e) Database software

Functional Specifications

The system shall capable to

- Measure traffic flow speed between 0 and design speed for up to 6 lanes
- Detect vehicles diving in wrong direction
- Detect stopped vehicles within 10 secs and for up to 16 detection zones
- Detect deceleration
- Detect fog/smoke

- Detect automatically types of traffic flow: normal, dense, delayed, congested and stop and go
- Monitor zone occupancy of the detection area
- Generate alarms for events: queue, stop, Inverse direction, speed drop, no video signal, fog/smoke and error,

1.10 OFC Backbone

Purpose and General Information

The purpose of the OFC backbone is to transport voice, data, LAN and video services between the field equipment and CCR.

As the transmission system would be used as a backbone network, the system shall have following characteristics:

a) High Availability

b) High Reliability

c) Dual ring configuration

d) Easy to install and operate

e) Scalability

f) High degree of flexibility with respect to the types of interfaces

Location

OFC shall be laid all through the highway. It may be laid on RHS or LHS of the main carriageway or in the median. Lateral elements shall be connected on OFC or copper.

Major Components

The major components are

- Optic fibers
- Ducts
- Manholes/pulling chambers

Specifications

1) Number of cores shall be sufficient to carry all data with 100% spare data carrying capacity.
2) Topology

Each backbone shall consist of access nodes (see section on OTC) interconnected by a dual physical fiber optic ring for redundancy.

The standby ring shall take over automatically with minimum delay whenever a problem occurs on the active ring. If a complete cable break occurs, which means that both the active and standby rings are interrupted, the system shall automatically perform a loop-

back operation, isolating the fault, and maintaining communications of all user equipment connected to the network.

After a power failure, a ring reconfiguration or when a new node is added to the ring, the complete network shall start up automatically.

1) The backbone OFC shall connect to field switches (in outdoor cabinets) which are further connected to field devices (cameras etc.). The ECBs may directly be connected with each other i.e. without external field switches.
2) The backbone OFC shall be single mode fiber.
3) Duct –HDPE ducts shall be used to carry OFC along the highway. In areas where ducting is not possible, trenchless laying shall be done. Road crossovers shall be done using HDD.
4) All fiber optic cable runs installed shall be either main backbone cable or lateral cables. The main backbone cable shall be terminated in the Communications Node. The lateral fiber cables shall be terminated with a fan-out kit at the termination block in the field equipment cabinet.
5) Main backbone and lateral cables shall be suitable for conduit installation. Lateral cables that connect the main backbone cable to the equipment controller cabinets shall be completed with continuous runs of cable. All lateral cable shall include a maximum of three locations of appropriate strain relief within the field equipment cabinets.
6) All optical cables shall comply with International Telecommunications Union (ITU-T).
7) All optical cables shall be new, unused and of current design and manufacture.

1.11 Outdoor Technical Cabinet (OTC)

Purpose and General Information

There shall be data concentrators or integrator switches (also called “field switch” or simply “switch”) installed along the highway which shall connect the field equipment to the OFC backbone. The purpose of the Outdoor Technical Cabinet (OTC) is to house these field integrator switches or data concentrators along with other necessary equipment and accessories.

The other purpose is to provide a secure and environment controlled surroundings to the equipment housed in it.

Location

The OTCs shall be located along the highway on the central median.

Major Components

The OTC unit shall consist of:

a) Cabinet

b) Data Concentrator or integrator Switches

c) Power supply and UPS

d) Termination panels

e) Environmental controls

Specifications

The functional specifications are as follows:

1) Cabinet & environmental controls

- The cabinet shall be mounted on concrete pads.
- It shall be lockable and shall have tamper proof lables affixed on it providing details of serial number, date of manufacture etc.
- It shall be weatherproof and shall not allow ingress of water and smoke. It shall maintain an internal temperature within the ambient range of all equipment housed in it. For this it shall have fans and heaters as necessary.
- It shall have a maintenance lamp which shall switch on automatically whenever the door is opened. The lamp shall be easily replaceable and shall be powered by the OTC"s power supply.
- It shall be designed in such a manner that all the equipment mounted inside it are easily accessible. For this, it may have doors at the rear.
- It shall have two lifting eyes for lifting during installation.
- It shall have tamper switch and temperature sensors which give an alarm to the CCR if any tampering is being done or if the temperature goes out of the design limit. The sensors shall be connected to the CCR through the switch over NMS.
- The wires and connectors shall be neatly tied and harnessed through channels.
- It shall be properly earthed and have adequate protection from lightning.

2) Power Supply

- The power supply shall be suitable for all the equipment housed in the cabinet. It may be DC or AC or a combination of both.
- The power supply / UPS shall have adequate protection from noise, surge and lighting. For this it may have fuse, MOV and circuit breaker.
- It shall be online type with automatic voltage regulation.
- It shall include sealed maintenance free batteries with backup time of at least 30minutes.
- It shall have overvoltage and over current shutdown.

- The power supply shall have a port which shall connect to the Data Concentrator switch. The data from this port shall notify the CCR of the health of the power supply through NMS.
- It shall have LEDs/display/audio alarm or other indicators on its cabinet which shall indicate health and fault conditions including input voltage, overload, battery charging etc.

3) Termination panels
   - The termination panels shall be housed inside the cabinet.
   - The communication cables from field equipment shall terminate in this panel.
   - Patch-chords shall be used to connect this panel to the Data Concentrator.
4) Data Concentrator or Integrator switches
   - The switches shall connect to all field equipment and also to the OFC backbone.
   - ECBs and other ATMS equipment shall not be connected on the same switch.
   - The switches shall adequate number of ports to connect all field equipment. It shall also have 10% spare ports.
   - The switch shall ports cable of handling all output types generated by the field equipment which may include analogue and digital - audio, video and data.

1.12 Power Management System

Functional specifications

1) Solar power shall be preferred over State Electricity Board (mains) and DG power.
2) Mains power shall be preferred over DG.
3) Wherever DG is used, it shall be used to power as many equipment as possible.
4) UPS with minimum 60 min backup shall be used wherever DG power is used. The DG shall be rated to at least twice the UPS rating.
5) The preferred power distribution is as follows :
   - ECB – solar power
   - CCTV/VIDS – solar
   - VMS – DG
   - ATCC – solar
   - Mobile radio - DG
   - Meteorological Data System – DG
   - Outdoor cabinet – solar / DG
   - CCR – mains / DG

1.13 Communication System

Purpose and General information

The purpose of the Communication System is to act as an interface between the field equipment and the CCR devices like displays and monitoring & control devices.

The communication system shall be “transparent” between field equipment and CCR i.e. it shall appear to the CCR device as if the remote field device is connected directly to it.

The communication system shall be fast, reliable, support required data rates and have some built in redundancy.

Location

The communication system is located along the highway and the CCR.

Major components

The communication system shall consist of:

- OFC (including termination panels, manholes, splicing, cables and connectors)
- OTC
- NMS
- Data concentrator at the CCR

Functional specifications

As defined in sections covering OFC, OTC and NMS

Technical specifications

As defined in sections covering OFC, OTC and NMS

1.14 Network Management System (NMS)

Purpose and General Information

The Fibre Optic Transmission System shall be equipped with a user friendly, Microsoft® Windows®-based Network Management System (NMS). The NMS shall allow the operator to manage and monitor multiple sub-networks in an efficient way.

The NMS shall have the following functionality: network configuration, configuration of services, monitoring, diagnostics, activation-deactivation of interface modules, bandwidth allocation, alarms and event logging and graphical network representation.

The network management hardware shall consist of a Personal Computer, which at the time of installation is the current industry standard. The NMS architecture shall be based on Employer-server technology. It shall be possible to connect multiple active Employers to the NMS server allowing network management from multiple and/or remote locations or by multiple users

Location

Software at CCR

Major Components

1) Personal computer

2) NMS software

Functional Specifications

1) It shall be possible to connect the NMS system to the network at any node via Ethernet.
2) Using the NMS, it shall be possible to configure the hardware modules that make up the network: nodes, network cards, interface cards and optical transceivers.
3) The Network Management System shall allow the user to activate or deactivate an interface module.
4) It shall be possible to create various services over the network.
5) The NMS shall allocate the transmission channels to virtual point-to-point or multi-point services in order to achieve an optimal bandwidth allocation. It shall be possible to configure the network and the services without being connected to the network, either via the Graphical User Interface (GUI) or via scripting.
6) NMS shall display a simple map of the network in form of a tree.
7) NMS shall provide Real Time Management Information Bases (MIBs).
8) Automatic reconfiguration

   The management platform shall not be critical in the reconfiguration sequence of the system. It will only report the event in detail to the network operator.

   Relevant configuration details shall be stored in the Random Access Memory (RAM) module of each node. After configuration, the network shall continue to work autonomously and shall reconfigure in error situations. It is therefore necessary that the reconfiguration algorithm resides in the nodes themselves.
9) NMS database

   The NMS shall contain the network database containing all kinds of information: sub-network names, node names, and node configurations including installed network and interface cards. It shall be possible to make the following on-line changes: activation or deactivation of interface cards, addition or removal of interface cards, and addition, changing or removal of services. Each change shall automatically update the database on the hard disk of the network management PC and the RAM memory of the relevant node(s). It shall be possible to use the database to restore the network configuration in case settings in one or more nodes are lost due to a hardware defect.
10) Fault and Alarm Management

    It shall be possible to easily monitor the operation of the different sub-networks that make up the network. During normal operation, the NMS shall continuously poll all the network nodes. It shall compare the status of the network with the information resident in its network database. If a fault or change occurs, the GUI screen on the NMS PC will display an alarm message indicating the nature and

location of possible errors or changes. The alarm messages shall include at least the date, time, node, interface slot and/or interface port, alarm severity and description. Via the GUI, it shall be possible to register following events: loss of synchronization, network reconfiguration, node failure, interface card errors and external alarms. It shall be possible to store the events in the NMS database.

Errors and unexpected conditions shall be reported by the network management system in another color than the one used upon correct operation.

11) Internal alarm forwarding

The NMS shall be capable, via an alarm relay card, of forwarding the status of internal alarms to other devices such as beepers or lamps. It shall be possible to use this alarm relay card to convey network alarms to a third party umbrella alarm management system. An SNMP agent on the management system shall offer basic alarm forwarding and retrieval to an SNMP-based umbrella management system. It shall be possible to forward internal alarms to third party equipment via CORBA (Common Object Request Broker Architecture).

12) External event Management

It shall be possible to display the status of external events on the NMS system. It shall also be possible to forward this alarm information to an alarm relay card connected to the NMS PC.

1.15 Central Control Room (CCR)

Purpose and General Information

The purpose of the CCR is to monitor the highway and to provide information to the road user. The CCR also houses the central servers and data processing equipment.

The CCR shall provide the real-time information and assistance to the highway users, collect data for the use of highway authorities and to monitor and control the Traffic on the highway as per the requirements.

The CCR shall be designed for round the clock operations of monitoring, on-line information acquisition and processing the same for decision making. The CCR shall be the repository of all the data acquired from the field and their processing, storing, and archiving. All the information for real time monitoring oh highway shall be generated at the CCR and the relevant information shall be disseminated to the users through VMS, and to O&M teams through mobile radio.

Location

There shall be one CCR located at toll plaza location.

Major Components

- Emergency Call Operator Station (Emergency calls from ECB"s)
- Mobile Call Operator Station (Mobile radio calls)

- Integrated Highway Management / Traffic Manager station (Operating Variable Message Signs, Traffic Counting & Classifying System, Meteorological Data System, CCTV & Video Incident Detection)
- Video Wall
- Servers
- Switches
- Administration Computer and Network Printer
- Computer for NMS for fiber Optic Communication system.
- CCTV console equipment
- VIDS control equipment
- Computers for VMS, AVCC, Met, Traffic Control
- A network printer
- An office computer (administration terminal)
- A power supply and backup system

Functional Specification

The CCR shall have the following functions and capabilities:

1) Real time images of the highway locations (from camera locations) to the control centre.
2) Emergency communication system for communication from the predefined ECB locations to the control centre.
3) Real time information to the users from control centre (about the route conditions, traffic situation, etc.) using variable message signs installed on gantries.
4) Real time monitoring of the traffic situation and collection of traffic data using traffic counting and classifying system
5) Monitoring of the weather conditions
6) Dedicated Mobile Radio system for communication between the control centre, ambulances, patrol vehicles, etc.
7) Traffic Control System at the interchanges
8) Monitoring and control of the highway traffic from the main control centre using integrated highway system
9) Compilation, recording, analysis, processing, storage of traffic information and data
10) Monitoring and control of the various sub-systems and devices installed on the highway
11) The following shall be the servers at CCR:
    - Server for Emergency Call System
    - Server for Video Surveillance system, VIDS system

- Common server for VMS, ATCC, Meteorological Data System
- Server for Mobile Radio Communication System

1.16 Miscellaneous Equipment

Server

Servers shall be located in the CCR and run application software. The server supplied shall be of the latest configuration at the time of installation. However the minimum specifications are as follows:

1. OS : Windows Server (Enterprise) preloaded
2. Processor : Quad Core, 3 GHz, 2x4MB shared cache, 1333MHz FSB
3. Memory : 8GB DDR2 , 800MHz
4. Drive controllers : Integrated serial ATA controller with RAID0, 1,5 and 10, removable boot drive option.
5. Hard drive : minimum 5 SATA drives of 500GB each with RAID5
6. Network adapter : Dual embedded gigabit Ethernet NIC & PCI NIC
7. Optical drives : DVD/CD RW combo
8. Database : Oracle, MySQL or equivalent shall be included
9. Monitor : 19 inch TFT included
10. Keyboard and mouse : included
11. Mounting : 19” rack mountable

Printer

There shall be one network printer in the CCR for reports. The printer supplied shall be of the latest configuration at the time of installation. However the minimum specifications are as follows:

1) Print speed : upto 52ppm letter; upto 50ppm A4

2) Speed : first page out < 9sec

3) Resolution : min 1200x1200 dpi

UPS

UPS shall be installed wherever necessary, for backup of all electronic equipment so that overall service levels and requirements mentioned in this document are met.

UPS of adequate backup time shall be installed at least for

a) All CCR equipment‟s

b) Outdoor Technical Cabinets

c) All other equipment wherever power backup is required

Specifications

The UPS shall have the following specification:

1) Minimum backup time for UPS backed up by other power supply/DG shall be minimum 10 minutes. It shall be ensured by the vendor that power supply

(combination of UPS, Solar, Generator , mains or any other supply) is provided in such a manner that all equipment is powered at all times, round the clock.

2) Input

Nominal Input Voltage : 220 V AC

Input Voltage Range : 140 V – 300 V AC on Full Load

Nominal Input Frequency : 50 Hz

Input Frequency Range : 45 – 55 Hz

Input Power factor : >0.97 at 220 V AC for full resistive

Modes of Operation

The UPS shall be designed to operate continuously at rated capacity as an on-line, automatic system in the following modes:

1) Normal - The inverter continuously supplies AC power to the critical load. The converter converts commercial AC power to regulated DC power which then serve as the inverter input and, simultaneously, as a float charge input to the storage battery.
2) Emergency - In the event of a commercial AC power failure, the inverter shall derive its input from the system battery, thus providing uninterrupted power to the critical load. This transition shall be accomplished without any switching or coupling, and with no interruption of power to the critical load from either a failure or restoration of the commercial AC power.
3) Recharge - Subsequent to restoration of commercial AC power, the converter shall automatically reactivate and provide DC power to the inverter, simultaneously recharging the system battery. This occurs automatically and without interruption to the critical load.
4) Bypass - In the event that the UPS must be taken off line due to an overload condition or UPS failure, the critical load shall be transferred to the bypass source via the static switch without interruption of power to the critical load. The static switch shall only be utilized for automatic emergency transfers. A re-transfer from bypass to inverter shall be performed automatically in overload conditions. A re-transfer shall be inhibited if satisfactory synchronization of the inverter and bypass is not accomplished.

Diesel Generator

The Concessionaire shall provide diesel generators wherever required (primarily for VMS and CCR). The rating of the DG set shall depend on the connected load, however DG of 10kVA single phase for VMS and 175kVA 3phase for CCR is suggested. The DG arrangement shall have the following requirements:

1) DGs shall be provided in pairs i.e. two DGs per site with each running continuously for maximum 6 hours.
2) It shall be self-start with 12V DC starter motor.
3) Battery charging Alternator.
4) It shall be silent type.
5) Conform to BS 5514 / ISO 3046
6) Output per phase 220V +1%, 50Hz
7) Instrument panel with starting switch & key, indication for battery voltage, water temperature, lube oil pressure, engine speed, engine hour counter, battery voltmeter, output voltage and frequency.

Solar Panel

The vendor shall provide Solar Panels of adequate capacity wherever required. The following are the minimum specifications.

1) Photo Voltaic (PV) cells shall be made of crystalline silicon
2) Cell encapsulation: ethylene vinyl acetate (EVA)
3) Mounting: pole mounted
4) Frame structure: Aluminum
5) Front side : Glass with thickness of min 3mm
6) Operating temp range ; -40 to +90 0C
7) Storage temp range ; -40 to +90 0C
8) Wind resistance: 60m/s

Rack

Equipment supplied at the CCR shall be rack mountable wherever possible. This includes servers, controllers, UPS, fiber patch panel etc.

CCR Software

The requirements of individual ATMS subsystems have been defined in relevant sections. The following are the integration requirements of application softwares of the ATMS subsystems:

Sl. No.	**Subsystem**	**Requirements**
1	ECB	• Separate Server with application software, OS and database
2	Video Surveillance System, VIDS	• Separate Server with application software, OS and database • Video may be recorded in Server or DVR
3	VMS, ATCC,	• Common server and database for all

Sl. No.	Subsystem	Requirements
	Meteorological Data System, Mobile radio	these applications. • The relevant weather and ATCC data shall automatically be fed to VMS.
4	NMS	• Can be run on any server

Features

The following features are required from the ATMS software

1) The following shall be provided as option –
   - Although separate servers have been specified for separate applications, it shall also be possible to run any application from any server and all applications from one server in which case there shall be one common database.
   - One additional server to function as database server.
2) Alarm conditions of each subsystem shall triggered in respective application software.
3) The software shall have facility to send e-mail to pre-configured e-mails as per the following :

- Breakdown events – to maintenance team
- Emergency events – to concerned relevant external authorities like police and to designated internal staff. Emergency events shall be triggered by the personnel manning the ECB, CCTV and Radio stations.

The “e-mail send” process shall be configurable to “manual” and “automatic”

4) The configuration as shown in the table above is suggestive. However, as all computers / servers are on the network, it shall be possible to run any application on any computer.
5) The system software shall run on industry standard server platform.
6) The integrated ATMS software shall monitor and record online all data from all sub-systems of ATMS

1.17 Data Base Management

The database used by the ATMS software shall be an industry standard database like ORACLE, SQL, dbase etc. The system shall have facility to perform certain selected database operations only by authorized users.

1.18 Storage

The system shall store at least 12 months of data. Older data may be archived. However, the system shall provide tools for the retrieval, manipulation and presentation of data. Data store shall be clearly marked with an indicator to show day or period type e.g. normal, holiday, weekly off; by reference to the system calendar. It shall be possible

to export data to an external system for further analysis. Transfer shall be available in .xls, csv or any standard formats.

1.19 Archive and Restore

This facility shall allow the archiving of the database to a tape/External HD/DVD . The data archived shall then be deleted from the database. Data may only be archived when it is more than two years old. Only one archive request may be outstanding at a time. Once archived, part or all of the data may be restored by copying from the tape back onto the system, where it remains for 30 days. Only one restore request may be outstanding at a time.

It shall be possible to define a series of notification levels which will raise an alarm when the disk space reaches a specified limit. This is used to alert an operator to the need to archive data.

1.20 Database Back-Up

The system management procedures for producing daily and weekly back-ups shall not need any operator intervention.

1.21 Timetable and Calendar

The system shall have a time table facility. The timetable shall allow commands by day of the week, time of day, day type. The system calendar shall allow days to be marked as normal, holiday, weekly off, etc.

1.22 System Log

The system shall retain a log of all events, alarms, timetable actions, and operator actions (together with operator username). In addition to system generated events the operators shall have facilities to enter events or incidents into the log. It shall be possible to search the log by time/date, event type, operator user name, strategy, location.

The log facility shall provide the means to:

a) Record all important events that occur in the operation of the integrated highway management system, both manual and automatic View and manage the status of alarm events,
b) Collect and collate incident information from both manual and automatic sources,
c) Allow the user to record routine operational messages,
d) View all changes and actions taken on the ATMS,
e) Record and view useful contact names and other details.

1.23 Asset Management

a) The system shall incorporate a facility to store records of assets for ATMS.
b) The asset register shall store data relating to location, type, and number of equipment as well as electricity ratings.

1.24 User Management

This facility shall provide the means to make user access to ATMS secure. Only the system administrator(s) shall have access to this facility and will set up details for other users. Each user shall have a username that needs to be configured so that it matches a PC log-in. Hence logging on to the PC will automatically mean that access to ATMS is available for the chosen users. Each user can also be configured to have access to none, some or all of the ATMS facilities.

1.25 Availability Requirements

The inability to perform any required function, the occurrence of unexpected action or degradation of performance below the specifications shall be considered as a failure. The Mean-time-between-failure (MTBF) shall be the average operating time accumulated by the total population of identical items between failures. The system supplier/Concessionaire shall submit MTBF and MTTR figures. The ATMS shall have an overall system availability of better than 99 percent. The ATMS shall be considered unavailable if any of its function cannot be properly executed and when any of the following conditions persist for more than 8 hours on the entire stretch.

i) Variable Message System Failure**:** No display/Improper Display of VMS or failure of their related transmission/control system which would render the VMS inoperative
ii) Emergency Call System Failure: Failure of any three consecutive Call boxes or failure of their related transmission system which would render the call boxes inoperative.
iii) ATCC Failure: Failure of more than one ATCC or failure of their related transmission system which would render the ATCC inoperative.
iv) Met Failure: Failure of more than one Met or failure of their related transmission system which would render the Met inoperative.
v) Video Surveillance System Failure: Failure of more than two Video Cameras or failure of their related transmission/control system which would render the cameras inoperative.
vi) Video Incident Detection System Failure: Failure of more than one Video Cameras or failure of their related transmission/control system which would render the cameras inoperative.
vii) Display at Control Centre: Whenever Control Centre is unable to get display of messages initiated by the Control Centre in-charge.

In addition to the above the system shall be considered unavailable when failure of the integrated ATMS Software or its hardware persists for more than 8 hours.

1.26 Maintainability Requirements

The Mean-Time-to-Repair (MTTR) of the ATMS to full normal operation following a failure shall be less than 8 hours all inclusive.

1.27 System Safety Requirements

All metal enclosures shall be provided with an earthing terminal and earthing of all equipment shall be carried out in accordance with overall earthing policy.

1.28 Environmental/Climatic Requirements

Indoor Equipment:

Temperature (Operating) : 0oC to + 50oC

Relative Humidity : up to 95% (non-condensing)

Outdoor Equipment

Temperature (Operating) : 5oC to + 60oC

Relative Humidity : up to 95% (non-condensing)

The system and the equipment used as a minimum shall meet the following climatic and environmental requirements as specified in IS:9000:

Tests Severities

Change of Temperature (i) Low Temp 0°C + 3°C

(Temp cycling) as per (ii) High Temp 60°C + 2°C

IS:9000 (part xiv/sec1)

Rate of cooling and heating 1°C/m (iii) Duration for each cycle 3 hours

(iv) No of Cycles 3

1.29 Warranty: The Concessionaire/supplier of the advanced traffic management systems (ATMS) shall furnish the warranty/guarantee for successful commissioning and operation of ATMS for a minimum period of 5 years. The Concessionaire/supplier shall also furnish the certificate that there is no proprietary item and that the systems shall be interoperable. All components and equipment shall be tested for commissioning. The documents with regard to design, technical details, installation details, testing and commissioning, details of fault diagnostics, operation and maintenance manuals and reports shall be submitted to the NHAI by the Concessionaire/supplier.

These guidelines include hardware and software functionalities. Alternately, some guidelines are available in “Specifications for Road and Bridge Works (Fifth Revision) published by IRC” – also called Orange Book, Section 816.