TECHNICAL SCHEDULE

PHASE - I

PACKAGE - II

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 attached 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, Truck Lay bye, 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 THE PROJECT

BANGALORE CHENNAI EXPRESSWAY (Phase-I Package-II)

1. Site

1.1 Project Expressway

Proposal is for Construction of Bangalore Chennai Expressway from Km 26+400 to Km 53+500 (Malur to Bangarpet Section of Bangalore Chennai Expressway) in the State of Karnataka under Bharatmala on Hybrid Annuity Mode (HAM).

The Bangalore Chennai Expressway (BCE) is a Greenfield alignment.

The distribution of alignment in the States of Karnataka is given:

Chainage (Km)			District/UT/State
Start	**End**	**Length (Km)**	
26.400	53.500	27.100	Kolar/Karnataka
Total Length		**27.100**	

1.2 Alignment

Bangalore Chennai Expressway (Phase I - Package II)

The project highway is a Greenfield alignment and starts at Km 26+400 in Malur and traverses parallel to SH 95, Hoskote – Malur – Bangarpet and Bethmangala road and crosses SH 99 & SH 5 enroute and finally ends at Km 53+500 near Bangarpet. Latitude and longitude of the project corridor lies between Latitude 13° 02' 7.3839" N, Longitude 78° 01' 25.5048" E and Latitude 13° 00' 42.1517" N, Longitude 78° 16' 10.4319" E.

The Proposed Right of Way coordinates are given in Annex II and the alignment plan and profile is given Annex III of this schedule.

2. Land

The Site of the Project comprises the. Land described below:

S. No.	Chainage (km)		ROW (m)	Remarks
	From	**To**		
Nil				Since the project is a Green field alignment, there is no Existing ROW. The details of PROW has been given in Schedule B

3. Carriageway

Since the project is a Green field alignment, there is no existing Carriageway.

4. Major Bridges

The Site includes the following Major Bridges:

S. No.	Chainage (km)	Type of Structure			No. o Spans with spanlength (m)	Width (m)
		Foundation	Sub-structure	Superstructure		
Nil						

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

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

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

Railway level crossings

The Site includes the following railway level crossings:

S. No.	Location (km)	Remarks
1	Nil	--

6. Grade separators

The Site includes the following grade separators:

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

7. Minor bridges

The Site includes the following minor bridges:

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

8. Total number of structures

The total number of structures on the Site is noted 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 Vehicular and Non Vehicular Underpasses	NIL
(f)	No. of Box Culverts	NIL
(g)	No. of Pipe Culverts	NIL
(h)	No. of Slab Culverts	NIL

9. Bus bays and Truck Lay byes

The total number of bus bays and truck lay byes on the Project is noted below: [(a) No. of Bus bays on LHS

(a)	No. of Bus bays on RHS	-	NIL
(b)	No. of Truck lay-byes on LHS	-	NIL
(c)	No. of Truck lay-byes on RHS	-	NIL

10. 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.

11. Wayside amenities

The Site includes the following parcels of land for provision of wayside Amenities as given in Schedule C.

12. Details of Existing Utilities

The Site includes utilities. Details at Annex-IV of Schedule-A

Annex - II

(Schedule-A)

Proposed RoW co-ordinates

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

a) Main Carriageway

Sl.No.	PROPOSED CHAINAGE (m)	PROW LEFT SIDE		PROW RIGHT SIDE		Remarks
		EASTING (m)	NORTHING (m)	EASTING (m)	NORTHING (m)	
1	26450	177223.219	1442976.623	177207.209	1442888.059	
2	26500	177272.405	1442967.731	177256.411	1442879.164	
3	26550	177320.938	1442959.018	177305.992	1442870.348	
4	26600	177369.249	1442951.258	177356.160	1442862.228	
5	26650	177417.662	1442944.975	177407.499	1442855.553	
6	26700	177465.632	1442940.292	177459.053	1442850.535	
7	26750	177514.354	1442937.236	177510.602	1442847.211	
8	26800	177563.248	1442935.511	177561.287	1442845.480	
9	26850	177613.099	1442934.442	177611.296	1442844.460	
10	26900	177663.089	1442933.440	177661.286	1442843.458	
11	26950	177713.079	1442932.438	177711.276	1442842.456	
12	27000	177763.069	1442931.436	177761.266	1442841.454	
13	27050	177813.059	1442930.434	177811.256	1442840.452	
14	27100	177863.049	1442929.432	177861.246	1442839.450	
15	27150	177913.039	1442928.430	177911.235	1442838.448	
16	27200	177963.029	1442927.428	177961.225	1442837.446	
17	27250	178013.019	1442926.425	178011.215	1442836.444	
18	27300	178063.009	1442925.423	178061.205	1442835.441	
19	27350	178112.999	1442924.421	178111.195	1442834.439	
20	27400	178162.989	1442923.419	178161.185	1442833.437	
21	27450	178212.979	1442922.417	178211.175	1442832.435	
22	27500	178262.969	1442921.415	178261.165	1442831.433	
23	27550	178312.959	1442920.413	178311.155	1442830.431	
24	27600	178362.949	1442919.411	178361.145	1442829.429	
25	27650	178412.939	1442918.409	178411.135	1442828.427	
26	27700	178462.929	1442917.407	178461.125	1442827.425	
27	27750	178512.919	1442916.405	178511.115	1442826.423	
28	27800	178562.909	1442915.403	178561.105	1442825.421	
29	27850	178612.899	1442914.400	178611.095	1442824.419	
30	27900	178662.889	1442913.398	178661.085	1442823.416	
31	27950	178712.879	1442912.396	178711.075	1442822.414	
32	28000	178762.868	1442911.394	178761.065	1442821.412	
33	28050	178812.858	1442910.392	178811.055	1442820.410	
34	28100	178862.848	1442909.390	178861.045	1442819.408	
35	28150	178912.838	1442908.388	178911.035	1442818.406	
36	28200	178962.828	1442907.386	178961.025	1442817.404	
37	28250	179012.818	1442906.384	179011.015	1442816.402	
38	28300	179062.808	1442905.382	179061.004	1442815.400	
39	28350	179112.798	1442904.380	179110.994	1442814.398	
40	28400	179162.508	1442903.445	179161.267	1442813.454	

Sl.No.	PROPOSED CHAINAGE (m)	PROW LEFT SIDE		PROW RIGHT SIDE		Remarks
		EASTING (m)	NORTHING (m)	EASTING (m)	NORTHING (m)	
41	28450	179212.055	1442902.860	179211.564	1442812.895	
42	28500	179261.963	1442902.711	179261.804	1442812.711	
43	28550	179311.963	1442902.623	179311.804	1442812.623	
44	28600	179361.963	1442902.534	179361.804	1442812.535	
45	28650	179411.963	1442902.446	179411.804	1442812.447	
46	28700	179461.963	1442902.358	179461.804	1442812.358	
47	28750	179511.963	1442902.270	179511.804	1442812.270	
48	28800	179561.963	1442902.182	179561.804	1442812.182	
49	28850	179611.962	1442902.094	179611.804	1442812.094	
50	28900	179661.962	1442902.006	179661.804	1442812.006	
51	28950	179711.503	1442901.885	179712.264	1442811.889	
52	29000	179760.899	1442902.432	179762.860	1442812.454	
53	29050	179810.280	1442903.771	179813.744	1442813.772	
54	29100	179859.334	1442905.886	179864.293	1442816.024	
55	29150	179908.349	1442908.782	179915.104	1442819.037	
56	29200	179957.749	1442912.632	179965.550	1442822.971	
57	29250	180006.490	1442917.147	180016.232	1442827.676	
58	29300	180055.585	1442922.623	180066.520	1442833.290	
59	29350	180104.586	1442928.885	180116.710	1442839.706	
60	29400	180153.289	1442935.902	180166.984	1442846.950	
61	29450	180202.707	1442943.510	180216.402	1442854.558	
62	29500	180252.124	1442951.119	180265.820	1442862.167	
63	29550	180301.542	1442958.727	180315.237	1442869.775	
64	29600	180350.960	1442966.336	180364.655	1442877.384	
65	29650	180400.378	1442973.944	180414.073	1442884.992	
66	29700	180449.795	1442981.552	180463.490	1442892.601	
67	29750	180499.213	1442989.161	180512.908	1442900.209	
68	29800	180548.631	1442996.769	180562.326	1442907.817	
69	29850	180598.049	1443004.378	180611.744	1442915.426	
70	29900	180647.466	1443011.986	180661.161	1442923.034	
71	29950	180696.884	1443019.595	180710.579	1442930.643	
72	30000	180746.302	1443027.203	180759.997	1442938.251	
73	30050	180795.719	1443034.811	180809.415	1442945.860	
74	30100	180845.137	1443042.420	180858.832	1442953.468	
75	30150	180894.555	1443050.028	180908.250	1442961.076	
76	30200	180943.973	1443057.637	180957.668	1442968.685	
77	30250	180993.390	1443065.245	181007.085	1442976.293	
78	30300	181042.808	1443072.854	181056.503	1442983.902	
79	30350	181092.226	1443080.462	181105.921	1442991.510	
80	30400	181141.644	1443088.070	181155.339	1442999.119	
81	30450	181191.061	1443095.679	181204.756	1443006.727	
82	30500	181240.479	1443103.287	181254.174	1443014.335	
83	30550	181289.897	1443110.896	181303.592	1443021.944	
84	30600	181339.400	1443118.496	181352.699	1443029.485	
85	30650	181389.733	1443125.610	181401.612	1443036.398	
86	30700	181440.518	1443132.087	181450.332	1443042.491	
87	30750	181490.846	1443137.423	181499.448	1443047.769	
88	30800	181541.238	1443141.954	181548.344	1443052.235	
89	30850	181591.699	1443145.679	181597.306	1443055.922	
90	30900	181642.214	1443148.599	181646.627	1443058.708	
91	30950	181692.987	1443150.672	181696.005	1443060.720	

Sl.No.	PROPOSED CHAINAGE (m)	PROW LEFT SIDE		PROW RIGHT SIDE		Remarks
		EASTING (m)	NORTHING (m)	EASTING (m)	NORTHING (m)	
92	31000	181743.025	1443152.313	181745.978	1443062.361	
93	31050	181792.998	1443153.954	181795.951	1443064.002	
94	31100	181842.971	1443155.595	181845.924	1443065.643	
95	31150	181892.944	1443157.236	181895.898	1443067.284	
96	31200	181942.917	1443158.877	181945.871	1443068.925	
97	31250	181992.890	1443160.518	181995.844	1443070.566	
98	31300	182042.863	1443162.159	182045.817	1443072.207	
99	31350	182092.836	1443163.800	182095.790	1443073.848	
100	31400	182142.809	1443165.441	182145.763	1443075.489	
101	31450	182192.782	1443167.082	182195.736	1443077.130	
102	31500	182242.755	1443168.723	182245.709	1443078.771	
103	31550	182292.456	1443170.424	182296.252	1443080.439	
104	31600	182341.913	1443172.693	182346.386	1443082.804	
105	31650	182391.852	1443175.178	182396.324	1443085.289	
106	31700	182441.790	1443177.663	182446.262	1443087.774	
107	31750	182491.728	1443180.148	182496.201	1443090.259	
108	31800	182541.666	1443182.633	182546.139	1443092.744	
109	31850	182591.604	1443185.117	182596.077	1443095.229	
110	31900	182641.543	1443187.602	182646.015	1443097.713	
111	31950	182691.481	1443190.087	182695.954	1443100.198	
112	32000	182741.419	1443192.572	182745.892	1443102.683	
113	32050	182791.357	1443195.057	182795.830	1443105.168	
114	32100	182841.296	1443197.541	182845.768	1443107.653	
115	32150	182891.234	1443200.026	182895.706	1443110.137	
116	32200	182941.172	1443202.511	182945.645	1443112.622	
117	32250	182991.110	1443204.996	182995.583	1443115.107	
118	32300	183041.355	1443207.438	183045.220	1443117.521	
119	32350	183091.675	1443209.440	183094.821	1443119.495	
120	32400	183142.012	1443210.959	183144.258	1443120.987	
121	32450	183192.541	1443211.958	183193.888	1443121.968	
122	32500	183242.899	1443212.470	183243.345	1443122.472	
123	32550	183293.438	1443212.459	183292.985	1443122.460	
124	32600	183343.796	1443211.964	183342.442	1443121.974	
125	32650	183394.325	1443210.941	183392.072	1443120.970	
126	32700	183444.842	1443209.433	183441.510	1443119.495	
127	32750	183495.161	1443207.407	183491.109	1443117.498	
128	32800	183545.638	1443204.888	183540.333	1443115.125	
129	32850	183595.881	1443201.864	183590.020	1443112.061	
130	32900	183645.837	1443198.574	183639.911	1443108.769	
131	32950	183695.729	1443195.281	183689.803	1443105.477	
132	33000	183745.620	1443191.989	183739.694	1443102.185	
133	33050	183795.512	1443188.697	183789.586	1443098.892	
134	33100	183844.993	1443185.432	183839.477	1443095.600	
135	33150	183895.295	1443182.113	183889.369	1443092.308	
136	33200	183945.186	1443178.820	183939.260	1443089.016	
137	33250	183995.078	1443175.528	183989.152	1443085.724	
138	33300	184044.969	1443172.236	184039.043	1443082.431	
139	33350	184094.861	1443168.944	184088.935	1443079.139	
140	33400	184144.752	1443165.652	184138.826	1443075.847	
141	33450	184194.644	1443162.359	184188.718	1443072.555	
142	33500	184244.535	1443159.067	184238.609	1443069.263	

Sl.No.	PROPOSED CHAINAGE (m)	PROW LEFT SIDE		PROW RIGHT SIDE		Remarks
		EASTING (m)	NORTHING (m)	EASTING (m)	NORTHING (m)	
143	33550	184294.427	1443155.775	184288.501	1443065.970	
144	33600	184344.318	1443152.483	184338.392	1443062.678	
145	33650	184394.210	1443149.191	184388.284	1443059.386	
146	33700	184444.101	1443145.898	184438.175	1443056.094	
147	33750	184493.993	1443142.606	184488.067	1443052.802	
148	33800	184543.884	1443139.314	184537.958	1443049.509	
149	33850	184593.776	1443136.022	184587.850	1443046.217	
150	33900	184643.667	1443132.730	184637.741	1443042.925	
151	33950	184693.559	1443129.437	184687.633	1443039.633	
152	34000	184743.450	1443126.145	184737.524	1443036.341	
153	34050	184793.342	1443122.853	184787.416	1443033.048	
154	34100	184843.233	1443119.561	184837.307	1443029.756	
155	34150	184893.125	1443116.269	184887.199	1443026.464	
156	34200	184943.016	1443112.976	184937.090	1443023.172	
157	34250	184992.908	1443109.684	184986.982	1443019.880	
158	34300	185042.799	1443106.392	185036.873	1443016.587	
159	34350	185092.691	1443103.100	185086.765	1443013.295	
160	34400	185142.419	1443099.831	185136.686	1443010.014	
161	34450	185191.571	1443096.986	185188.251	1443006.682	
162	34500	185240.419	1443095.238	185239.072	1443005.073	
163	34550	185289.646	1443094.656	185289.512	1443004.621	
164	34600	185339.437	1443094.657	185339.560	1443004.657	
165	34650	185389.437	1443094.725	185389.560	1443004.726	
166	34700	185439.437	1443094.794	185439.560	1443004.794	
167	34750	185489.437	1443094.862	185489.560	1443004.862	
168	34800	185539.437	1443094.931	185539.560	1443004.931	
169	34850	185589.437	1443094.999	185589.560	1443004.999	
170	34900	185639.436	1443095.068	185639.560	1443005.068	
171	34950	185689.436	1443095.136	185689.560	1443005.136	
172	35000	185739.469	1443095.205	185739.527	1443005.205	
173	35050	185789.872	1443095.082	185788.838	1443005.153	
174	35100	185841.138	1443094.101	185837.387	1443004.173	
175	35150	185891.985	1443091.826	185886.886	1443001.971	
176	35200	185943.212	1443088.298	185934.971	1442998.669	
177	35250	185993.882	1443083.484	185984.299	1442993.997	
178	35300	186044.668	1443077.448	186032.811	1442988.233	
179	35350	186094.441	1443070.706	186082.133	1442981.551	
180	35400	186143.971	1443063.868	186131.663	1442974.713	
181	35450	186193.502	1443057.030	186181.194	1442967.876	
182	35500	186243.032	1443050.192	186230.724	1442961.038	
183	35550	186292.562	1443043.354	186280.254	1442954.200	
184	35600	186342.092	1443036.517	186329.784	1442947.362	
185	35650	186391.623	1443029.679	186379.315	1442940.525	
186	35700	186441.153	1443022.841	186428.845	1442933.687	
187	35750	186490.238	1443016.247	186478.571	1442927.006	
188	35800	186538.992	1443010.432	186529.410	1442920.944	
189	35850	186588.138	1443005.434	186580.043	1442915.733	
190	35900	186637.058	1443001.248	186630.675	1442911.378	
191	35950	186686.651	1442997.781	186680.627	1442907.983	
192	36000	186736.539	1442994.435	186730.515	1442904.637	
193	36050	186786.427	1442991.089	186780.403	1442901.291	

Sl.No.	PROPOSED CHAINAGE (m)	PROW LEFT SIDE		PROW RIGHT SIDE		Remarks
		EASTING (m)	NORTHING (m)	EASTING (m)	NORTHING (m)	
194	36100	186836.315	1442987.742	186830.291	1442897.944	
195	36150	186886.202	1442984.396	186880.179	1442894.598	
196	36200	186936.090	1442981.050	186930.067	1442891.252	
197	36250	186985.978	1442977.703	186979.955	1442887.905	
198	36300	187035.866	1442974.357	187029.843	1442884.559	
199	36350	187085.754	1442971.011	187079.731	1442881.213	
200	36400	187135.642	1442967.664	187129.619	1442877.866	
201	36450	187185.530	1442964.318	187179.506	1442874.520	
202	36500	187235.418	1442960.972	187229.394	1442871.174	
203	36550	187285.306	1442957.625	187279.282	1442867.827	
204	36600	187335.193	1442954.279	187329.170	1442864.481	
205	36650	187385.081	1442950.933	187379.058	1442861.135	
206	36700	187434.969	1442947.586	187428.946	1442857.788	
207	36750	187484.863	1442944.240	187478.828	1442854.442	
208	36800	187535.291	1442940.708	187528.459	1442850.969	
209	36850	187586.199	1442936.273	187576.422	1442846.911	
210	36900	187637.501	1442930.214	187624.874	1442841.106	
211	36950	187688.111	1442922.487	187672.546	1442833.983	
212	37000	187739.038	1442913.032	187720.503	1442824.964	
213	37050	187789.022	1442901.952	187768.145	1442814.408	
214	37100	187839.205	1442889.125	187814.845	1442802.487	
215	37150	187888.340	1442874.739	187861.678	1442788.781	
216	37200	187937.380	1442858.661	187907.656	1442773.711	
217	37250	187985.401	1442841.163	187953.588	1442756.974	
218	37300	188032.521	1442823.006	187999.824	1442739.156	
219	37350	188079.097	1442804.812	188046.349	1442720.981	
220	37400	188125.669	1442786.619	188092.922	1442702.788	
221	37450	188172.242	1442768.426	188139.494	1442684.595	
222	37500	188218.815	1442750.232	188186.067	1442666.402	
223	37550	188265.387	1442732.039	188232.640	1442648.209	
224	37600	188311.960	1442713.846	188279.212	1442630.015	
225	37650	188358.533	1442695.653	188325.785	1442611.822	
226	37700	188405.105	1442677.460	188372.357	1442593.629	
227	37750	188451.678	1442659.267	188418.930	1442575.436	
228	37800	188498.250	1442641.073	188465.503	1442557.243	
229	37850	188544.823	1442622.880	188512.075	1442539.049	
230	37900	188591.396	1442604.687	188558.648	1442520.856	
231	37950	188637.968	1442586.494	188605.220	1442502.663	
232	38000	188684.541	1442568.301	188651.793	1442484.470	
233	38050	188731.113	1442550.107	188698.366	1442466.277	
234	38100	188777.686	1442531.914	188744.938	1442448.084	
235	38150	188824.259	1442513.721	188791.511	1442429.890	
236	38200	188870.831	1442495.528	188838.084	1442411.697	
237	38250	188917.404	1442477.335	188884.656	1442393.504	
238	38300	188963.977	1442459.142	188931.229	1442375.311	
239	38350	189010.549	1442440.948	188977.801	1442357.118	
240	38400	189057.122	1442422.755	189024.374	1442338.925	
241	38450	189103.694	1442404.562	189070.947	1442320.731	
242	38500	189150.648	1442386.153	189117.365	1442302.535	
243	38550	189197.498	1442367.038	189162.682	1442284.089	
244	38600	189243.764	1442347.527	189208.708	1442264.635	

Sl.No.	PROPOSED CHAINAGE (m)	PROW LEFT SIDE		PROW RIGHT SIDE		Remarks
		EASTING (m)	NORTHING (m)	EASTING (m)	NORTHING (m)	
245	38650	189289.815	1442328.051	189254.760	1442245.159	
246	38700	189335.866	1442308.576	189300.811	1442225.684	
247	38750	189381.917	1442289.101	189346.862	1442206.208	
248	38800	189427.969	1442269.625	189392.913	1442186.733	
249	38850	189474.020	1442250.150	189438.964	1442167.258	
250	38900	189520.071	1442230.675	189485.026	1442147.776	
251	38950	189565.826	1442211.474	189531.471	1442128.290	
252	39000	189610.664	1442193.600	189578.845	1442109.418	
253	39050	189655.246	1442177.695	189628.372	1442092.019	
254	39100	189701.479	1442164.080	189678.870	1442076.971	
255	39150	189748.322	1442152.710	189729.196	1442064.770	
256	39200	189795.235	1442143.596	189779.865	1442054.922	
257	39250	189843.920	1442135.827	189830.503	1442046.833	
258	39300	189893.254	1442128.496	189880.083	1442039.465	
259	39350	189942.716	1442121.179	189929.545	1442032.148	
260	39400	189992.177	1442113.862	189979.006	1442024.831	
261	39450	190041.639	1442106.544	190028.468	1442017.513	
262	39500	190091.101	1442099.227	190077.930	1442010.196	
263	39550	190140.241	1442092.093	190127.522	1442002.946	
264	39600	190188.600	1442085.806	190178.110	1441996.422	
265	39650	190237.434	1442080.716	190229.182	1441991.096	
266	39700	190285.927	1442076.833	190280.367	1441987.006	
267	39750	190334.954	1442074.190	190331.638	1441984.154	
268	39800	190383.581	1442072.736	190382.517	1441982.744	
269	39850	190432.630	1442072.532	190434.010	1441982.542	
270	39900	190482.076	1442073.366	190484.146	1441983.380	
271	39950	190531.919	1442074.582	190534.131	1441984.609	
272	40000	190581.904	1442075.811	190584.115	1441985.838	
273	40050	190631.889	1442077.039	190634.100	1441987.066	
274	40100	190681.874	1442078.268	190684.085	1441988.295	
275	40150	190731.858	1442079.497	190734.070	1441989.524	
276	40200	190781.843	1442080.725	190784.055	1441990.753	
277	40250	190831.828	1442081.954	190834.040	1441991.981	
278	40300	190881.813	1442083.183	190884.025	1441993.210	
279	40350	190931.873	1442084.395	190933.747	1441994.457	
280	40400	190982.595	1442085.247	190982.974	1441995.267	
281	40450	191033.677	1442084.971	191031.664	1441995.096	
282	40500	191085.003	1442083.457	191080.739	1441993.560	
283	40550	191135.824	1442080.637	191129.321	1441990.975	
284	40600	191187.010	1442076.560	191177.831	1441987.233	
285	40650	191237.625	1442071.204	191227.084	1441981.824	
286	40700	191288.544	1442064.574	191275.326	1441975.551	
287	40750	191338.829	1442056.694	191323.833	1441967.953	
288	40800	191389.352	1442047.527	191371.701	1441959.276	
289	40850	191439.180	1442037.144	191419.768	1441949.264	
290	40900	191489.045	1442025.499	191466.828	1441938.457	
291	40950	191538.187	1442012.774	191514.943	1441925.827	
292	41000	191586.613	1441999.691	191563.056	1441912.829	
293	41050	191634.870	1441986.604	191611.313	1441899.742	
294	41100	191683.127	1441973.517	191659.570	1441886.654	
295	41150	191731.384	1441960.429	191707.827	1441873.567	

Sl.No.	PROPOSED CHAINAGE (m)	PROW LEFT SIDE		PROW RIGHT SIDE		Remarks
		EASTING (m)	NORTHING (m)	EASTING (m)	NORTHING (m)	
296	41200	191779.641	1441947.342	191756.084	1441860.480	
297	41250	191827.898	1441934.255	191804.340	1441847.393	
298	41300	191876.154	1441921.168	191852.597	1441834.305	
299	41350	191924.411	1441908.080	191900.854	1441821.218	
300	41400	191972.668	1441894.993	191949.111	1441808.131	
301	41450	192020.925	1441881.906	191997.368	1441795.044	
302	41500	192069.182	1441868.819	192045.625	1441781.956	
303	41550	192117.439	1441855.731	192093.882	1441768.869	
304	41600	192165.696	1441842.644	192142.138	1441755.782	
305	41650	192213.952	1441829.557	192190.395	1441742.695	
306	41700	192262.209	1441816.470	192238.652	1441729.607	
307	41750	192310.466	1441803.382	192286.909	1441716.520	
308	41800	192358.723	1441790.295	192335.166	1441703.433	
309	41850	192406.980	1441777.208	192383.423	1441690.346	
310	41900	192455.237	1441764.121	192431.680	1441677.258	
311	41950	192503.493	1441751.033	192479.936	1441664.171	
312	42000	192551.750	1441737.946	192528.193	1441651.084	
313	42050	192600.007	1441724.859	192576.450	1441637.997	
314	42100	192648.264	1441711.772	192624.707	1441624.909	
315	42150	192696.521	1441698.684	192672.964	1441611.822	
316	42200	192744.778	1441685.597	192721.221	1441598.735	
317	42250	192793.035	1441672.510	192769.478	1441585.648	
318	42300	192841.291	1441659.423	192817.734	1441572.560	
319	42350	192889.548	1441646.335	192865.991	1441559.473	
320	42400	192937.805	1441633.248	192914.248	1441546.386	
321	42450	192986.062	1441620.161	192962.505	1441533.299	
322	42500	193034.319	1441607.074	193010.762	1441520.211	
323	42550	193082.576	1441593.986	193059.019	1441507.124	
324	42600	193130.833	1441580.899	193107.276	1441494.037	
325	42650	193179.089	1441567.812	193155.532	1441480.950	
326	42700	193227.346	1441554.725	193203.789	1441467.862	
327	42750	193275.603	1441541.637	193252.046	1441454.775	
328	42800	193323.860	1441528.550	193300.304	1441441.687	
329	42850	193371.946	1441515.572	193349.011	1441428.482	
330	42900	193419.287	1441503.367	193397.923	1441415.941	
331	42950	193467.116	1441492.274	193447.839	1441404.364	
332	43000	193514.756	1441482.422	193497.683	1441394.058	
333	43050	193563.106	1441473.723	193548.622	1441384.809	
334	43100	193611.555	1441466.131	193598.604	1441377.035	
335	43150	193660.956	1441458.962	193648.098	1441369.885	
336	43200	193710.443	1441451.818	193697.585	1441362.742	
337	43250	193759.930	1441444.675	193747.072	1441355.598	
338	43300	193809.417	1441437.531	193796.559	1441348.455	
339	43350	193858.904	1441430.388	193846.046	1441341.311	
340	43400	193908.391	1441423.244	193895.533	1441334.168	
341	43450	193957.879	1441416.101	193945.020	1441327.024	
342	43500	194007.366	1441408.958	193994.507	1441319.881	
343	43550	194056.853	1441401.814	194043.994	1441312.737	
344	43600	194106.340	1441394.671	194093.482	1441305.594	
345	43650	194155.827	1441387.527	194142.969	1441298.450	
346	43700	194205.314	1441380.384	194192.456	1441291.307	

Sl.No.	PROPOSED CHAINAGE (m)	PROW LEFT SIDE		PROW RIGHT SIDE		Remarks
		EASTING (m)	NORTHING (m)	EASTING (m)	NORTHING (m)	
347	43750	194254.801	1441373.240	194241.943	1441284.163	
348	43800	194304.288	1441366.097	194291.430	1441277.020	
349	43850	194354.145	1441358.765	194340.509	1441269.805	
350	43900	194404.393	1441350.649	194388.980	1441261.979	
351	43950	194454.198	1441341.717	194437.604	1441253.261	
352	44000	194504.147	1441331.931	194486.082	1441243.764	
353	44050	194553.271	1441321.556	194534.505	1441233.534	
354	44100	194602.172	1441311.130	194583.406	1441223.108	
355	44150	194651.073	1441300.705	194632.307	1441212.683	
356	44200	194699.974	1441290.279	194681.208	1441202.258	
357	44250	194748.875	1441279.854	194730.110	1441191.832	
358	44300	194797.776	1441269.429	194779.011	1441181.407	
359	44350	194846.677	1441259.003	194827.912	1441170.981	
360	44400	194895.578	1441248.578	194876.813	1441160.556	
361	44450	194944.479	1441238.153	194925.714	1441150.131	
362	44500	194993.380	1441227.727	194974.615	1441139.705	
363	44550	195042.281	1441217.302	195023.516	1441129.280	
364	44600	195091.182	1441206.876	195072.417	1441118.855	
365	44650	195140.084	1441196.451	195121.318	1441108.429	
366	44700	195188.985	1441186.026	195170.219	1441098.004	
367	44750	195237.886	1441175.600	195219.120	1441087.578	
368	44800	195286.787	1441165.175	195268.021	1441077.153	
369	44850	195335.688	1441154.749	195316.922	1441066.728	
370	44900	195384.589	1441144.324	195365.823	1441056.302	
371	44950	195433.490	1441133.899	195414.724	1441045.877	
372	45000	195482.391	1441123.473	195463.625	1441035.451	
373	45050	195531.292	1441113.048	195512.526	1441025.026	
374	45100	195580.193	1441102.623	195561.427	1441014.601	
375	45150	195629.094	1441092.197	195610.328	1441004.175	
376	45200	195677.995	1441081.772	195659.229	1440993.750	
377	45250	195727.477	1441070.859	195707.123	1440983.260	
378	45300	195777.000	1441059.106	195755.464	1440971.721	
379	45350	195826.023	1441046.571	195803.033	1440959.558	
380	45400	195874.800	1441033.297	195850.745	1440946.572	
381	45450	195922.981	1441019.933	195898.926	1440933.208	
382	45500	195971.162	1441006.570	195947.107	1440919.844	
383	45550	196019.343	1440993.206	195995.288	1440906.480	
384	45600	196067.524	1440979.842	196043.469	1440893.116	
385	45650	196115.705	1440966.478	196091.650	1440879.752	
386	45700	196163.886	1440953.114	196139.831	1440866.388	
387	45750	196212.067	1440939.750	196188.012	1440853.025	
388	45800	196260.248	1440926.387	196236.193	1440839.661	
389	45850	196308.429	1440913.023	196284.374	1440826.297	
390	45900	196356.610	1440899.659	196332.555	1440812.933	
391	45950	196404.791	1440886.295	196380.736	1440799.569	
392	46000	196452.972	1440872.931	196428.917	1440786.205	
393	46050	196501.153	1440859.567	196477.192	1440772.736	
394	46100	196549.089	1440846.328	196525.681	1440759.357	
395	46150	196597.094	1440833.459	196574.137	1440746.436	
396	46200	196645.378	1440820.798	196622.583	1440733.733	
397	46250	196693.748	1440808.134	196670.953	1440721.069	

Sl.No.	PROPOSED CHAINAGE (m)	PROW LEFT SIDE		PROW RIGHT SIDE		Remarks
		EASTING (m)	NORTHING (m)	EASTING (m)	NORTHING (m)	
398	46300	196742.117	1440795.471	196719.322	1440708.405	
399	46350	196790.487	1440782.807	196767.692	1440695.741	
400	46400	196838.857	1440770.143	196816.062	1440683.077	
401	46450	196887.226	1440757.479	196864.431	1440670.413	
402	46500	196935.596	1440744.815	196912.801	1440657.750	
403	46550	196983.966	1440732.151	196961.171	1440645.086	
404	46600	197032.335	1440719.487	197009.541	1440632.422	
405	46650	197080.705	1440706.823	197057.910	1440619.758	
406	46700	197129.075	1440694.160	197106.280	1440607.094	
407	46750	197177.445	1440681.496	197154.650	1440594.430	
408	46800	197225.814	1440668.832	197203.019	1440581.766	
409	46850	197274.184	1440656.168	197251.389	1440569.103	
410	46900	197322.554	1440643.504	197299.759	1440556.439	
411	46950	197370.844	1440630.883	197348.219	1440543.773	
412	47000	197418.184	1440618.969	197397.321	1440531.424	
413	47050	197465.401	1440608.645	197449.108	1440520.131	
414	47100	197512.124	1440600.668	197499.727	1440511.529	
415	47150	197559.986	1440595.026	197552.493	1440505.147	
416	47200	197608.065	1440591.702	197605.075	1440501.374	
417	47250	197655.353	1440590.905	197657.181	1440500.532	
418	47300	197702.891	1440592.338	197709.331	1440501.997	
419	47350	197751.853	1440595.758	197759.388	1440506.025	
420	47400	197801.372	1440600.023	197809.273	1440510.370	
421	47450	197851.179	1440604.412	197859.080	1440514.759	
422	47500	197900.986	1440608.801	197908.887	1440519.148	
423	47550	197950.793	1440613.190	197958.694	1440523.537	
424	47600	198000.600	1440617.579	198008.501	1440527.927	
425	47650	198050.407	1440621.968	198058.308	1440532.316	
426		198096.089	1440625.994			
427		198091.889	1440675.817			
428		198087.690	1440725.641			
429	47695.85	198083.490	1440775.464			
430		198079.291	1440825.287			
431		198075.092	1440875.111			
432		198072.866	1440901.517			
433	47715.66	198089.718	1440923.887			Rest Area at km 47.906
434	47765.66	198132.981	1440927.533			
435	47815.66	198182.804	1440931.733			
436	47865.66	198232.627	1440935.932			
437	47915.66	198282.451	1440940.132			
438	47965.66	198332.274	1440944.331			
439	48015.66	198382.097	1440948.53			
440	48065.66	198431.921	1440952.73			
441		198494.611	1440958.014			
442		198497.722	1440921.057			
443		198501.915	1440871.233			
444	48120.00	198506.109	1440821.409			
445		198510.303	1440771.585			
457		198514.496	1440721.762			
458		198519.417	1440663.299			
459	47695.85			198101.02	1440536.08	

Sl.No.	PROPOSED CHAINAGE (m)	PROW LEFT SIDE		PROW RIGHT SIDE		Remarks
		EASTING (m)	NORTHING (m)	EASTING (m)	NORTHING (m)	
460				198105.216	1440486.471	
461				198109.437	1440436.65	
462				198112.598	1440399.346	
463	47732.97			198157.185	1440355.459	
464	47766.33			198193.684	1440321.306	
465	47800.00			198230.945	1440287.965	
466	47841.60			198275.500	1440250.293	
467	47883.25			198317.004	1440253.81	
468	47933.25			198366.825	1440258.032	
469	47983.25			198416.647	1440262.254	
470	48033.25			198466.468	1440266.476	
471	48098.00			198530.756	1440271.923	
472				198548.243	1440292.047	
473				198544.359	1440349.204	
474				198540.163	1440399.027	
475	48120.00			198535.967	1440448.851	
476				198531.771	1440498.675	
477				198527.511	1440548.493	
478				198525.339	1440573.472	
479	48150	198548.477	1440665.860	198556.378	1440576.207	
480	48200	198598.284	1440670.249	198606.185	1440580.597	
481	48250	198648.091	1440674.638	198655.992	1440584.986	
482	48300	198698.334	1440678.824	198705.103	1440589.080	
483	48350	198749.121	1440682.214	198754.393	1440592.369	
484	48400	198799.655	1440684.775	198803.729	1440594.867	
485	48450	198849.976	1440686.688	198853.336	1440596.751	
486	48500	198899.941	1440688.554	198903.301	1440598.617	
487	48550	198949.906	1440690.421	198953.266	1440600.483	
488	48600	198999.872	1440692.287	199003.231	1440602.350	
489	48650	199049.837	1440694.153	199053.196	1440604.216	
490	48700	199099.802	1440696.020	199103.161	1440606.082	
491	48750	199149.767	1440697.886	199153.126	1440607.949	
492	48800	199199.732	1440699.752	199203.092	1440609.815	
493	48850	199249.697	1440701.619	199253.057	1440611.681	
494	48900	199299.662	1440703.485	199303.022	1440613.548	
495	48950	199349.628	1440705.351	199352.987	1440615.414	
496	49000	199399.593	1440707.218	199402.952	1440617.280	
497	49050	199449.558	1440709.084	199452.917	1440619.147	
498	49100	199499.523	1440710.950	199502.883	1440621.013	
499	49150	199549.488	1440712.817	199552.848	1440622.879	
500	49200	199599.453	1440714.683	199602.813	1440624.746	
501	49250	199649.419	1440716.549	199652.778	1440626.612	
502	49300	199699.384	1440718.416	199702.743	1440628.479	
503	49350	199749.349	1440720.282	199752.708	1440630.345	
504	49400	199799.314	1440722.149	199802.673	1440632.211	
505	49450	199849.279	1440724.015	199852.639	1440634.078	
506	49500	199899.244	1440725.881	199902.604	1440635.944	
507	49550	199949.210	1440727.748	199952.569	1440637.810	
508	49600	199999.175	1440729.614	200002.534	1440639.677	
509	49650	200049.140	1440731.480	200052.499	1440641.543	
510	49700	200099.105	1440733.347	200102.464	1440643.409	

Sl.No.	PROPOSED CHAINAGE (m)	PROW LEFT SIDE		PROW RIGHT SIDE		Remarks
		EASTING (m)	NORTHING (m)	EASTING (m)	NORTHING (m)	
511	49750	200149.070	1440735.213	200152.430	1440645.276	
512	49800	200199.035	1440737.079	200202.395	1440647.142	
513	49850	200249.000	1440738.946	200252.360	1440649.008	
514	49900	200298.966	1440740.812	200302.325	1440650.875	
515	49950	200348.931	1440742.678	200352.290	1440652.741	
516	50000	200398.896	1440744.545	200402.255	1440654.607	
517	50050	200448.861	1440746.411	200452.220	1440656.474	
518	50100	200498.826	1440748.277	200502.186	1440658.340	
519	50150	200548.855	1440750.131	200551.909	1440660.223	
520	50200	200599.554	1440751.656	200600.727	1440661.866	
521	50250	200650.615	1440752.075	200649.827	1440662.181	
522	50300	200701.957	1440751.261	200698.918	1440661.314	
523	50350	200752.811	1440749.134	200747.973	1440659.265	
524	50400	200804.048	1440745.755	200796.517	1440656.072	
525	50450	200854.732	1440741.089	200844.973	1440651.722	
526	50500	200905.652	1440735.167	200893.582	1440646.094	
527	50550	200955.571	1440728.345	200942.950	1440639.240	
528	50600	201005.102	1440721.320	200992.454	1440632.213	
529	50650	201054.606	1440714.293	201041.958	1440625.186	
530	50700	201104.110	1440707.266	201091.461	1440618.159	
531	50750	201153.614	1440700.239	201140.965	1440611.133	
532	50800	201203.117	1440693.213	201190.469	1440604.106	
533	50850	201252.632	1440686.183	201239.880	1440597.110	
534	50900	201302.401	1440678.935	201288.789	1440589.992	
535	50950	201352.777	1440670.740	201337.472	1440582.051	
536	51000	201403.026	1440661.568	201385.597	1440573.272	
537	51050	201452.721	1440651.426	201433.546	1440563.576	
538	51100	201502.212	1440640.335	201481.616	1440552.724	
539	51150	201551.812	1440628.131	201529.468	1440540.950	
540	51200	201600.884	1440615.101	201577.044	1440528.316	
541	51250	201649.130	1440601.820	201625.212	1440515.056	
542	51300	201697.332	1440588.533	201673.415	1440501.769	
543	51350	201745.534	1440575.245	201721.617	1440488.481	
544	51400	201793.736	1440561.958	201769.819	1440475.194	
545	51450	201841.938	1440548.671	201818.021	1440461.907	
546	51500	201890.140	1440535.383	201866.223	1440448.619	
547	51550	201938.343	1440522.096	201914.425	1440435.332	
548	51600	201986.545	1440508.809	201962.628	1440422.045	
549	51650	202034.747	1440495.521	202010.830	1440408.757	
550	51700	202082.949	1440482.234	202059.032	1440395.470	
551	51750	202131.151	1440468.947	202107.234	1440382.183	
552	51800	202179.353	1440455.659	202155.436	1440368.895	
553	51850	202227.555	1440442.372	202203.638	1440355.608	
554	51900	202275.758	1440429.085	202251.840	1440342.321	
555	51950	202323.960	1440415.797	202300.043	1440329.033	
556	52000	202372.162	1440402.510	202348.245	1440315.746	
557	52050	202420.364	1440389.222	202396.447	1440302.459	
558	52100	202468.566	1440375.935	202444.649	1440289.171	
559	52150	202516.768	1440362.648	202492.851	1440275.884	
560	52200	202564.970	1440349.360	202541.053	1440262.597	
561	52250	202613.173	1440336.073	202589.255	1440249.309	

Sl.No.	PROPOSED CHAINAGE (m)	PROW LEFT SIDE		PROW RIGHT SIDE		Remarks
		EASTING (m)	NORTHING (m)	EASTING (m)	NORTHING (m)	
562	52300	202661.375	1440322.786	202637.458	1440236.022	
563	52350	202709.577	1440309.498	202685.660	1440222.735	
564	52400	202757.779	1440296.211	202733.862	1440209.447	
565	52450	202805.981	1440282.924	202782.064	1440196.160	
566	52500	202854.183	1440269.636	202830.266	1440182.873	
567	52550	202902.385	1440256.349	202878.468	1440169.585	
568	52600	202950.588	1440243.062	202926.670	1440156.298	
569	52650	202998.482	1440229.968	202975.509	1440142.881	
570	52700	203046.015	1440217.664	203024.512	1440130.271	
571	52750	203094.046	1440206.116	203073.710	1440118.444	
572	52800	203141.962	1440195.403	203123.383	1440107.342	
573	52850	203190.351	1440185.463	203173.179	1440097.061	
574	52900	203239.124	1440176.132	203222.393	1440087.701	
575	52950	203288.252	1440166.837	203271.521	1440078.406	
576	53000	203337.381	1440157.542	203320.650	1440069.111	
577	53050	203386.509	1440148.247	203369.778	1440059.816	
578	53100	203435.637	1440138.953	203418.907	1440050.521	
579	53150	203484.766	1440129.658	203468.035	1440041.227	
580	53200	203533.894	1440120.363	203517.164	1440031.932	
581	53250	203583.023	1440111.068	203566.292	1440022.637	
582	53300	203632.151	1440101.774	203615.421	1440013.342	
583	53350	203681.280	1440092.479	203664.549	1440004.047	
584	53400	203730.408	1440083.184	203713.678	1439994.753	
585	53450	203779.537	1440073.889	203762.806	1439985.458	
586	53500	203828.665	1440064.594	203811.935	1439976.163	

PROW Co- Ordinates @ 50M Interval for Interchange at km 52.085

Co-ordinates for RAMP-1			
SL No	Easting (m)	Northing (m)	Right Side of Proposed ROW
1	202328.848	1440553.560	R1
2	202285.604	1440528.461	R2
3	202242.360	1440503.363	R3
4	202197.946	1440480.594	R4
5	202149.026	1440471.298	R5
6	202099.647	1440477.631	R6
7	202051.445	1440490.918	R7
8	202003.243	1440504.206	R8
9	201957.941	1440516.693	R9

Co-ordinates for RAMP-2			
SL No	Easting (m)	Northing (m)	Left Side of Proposed ROW
1	202373.306	1440018.088	L1
2	202378.832	1440067.782	L2
3	202384.358	1440117.476	L3
4	202389.883	1440167.170	L4

5	202388.438	1440216.931	L5
6	202371.082	1440263.584	L6
7	202339.623	1440302.158	L7
8	202297.414	1440328.541	L8
9	202249.572	1440342.946	L9
10	202201.370	1440356.233	L10
11	202153.168	1440369.521	L11
12	202104.965	1440382.808	L12
13	202056.763	1440396.095	L13
14	202008.561	1440409.383	L14
15	201960.359	1440422.670	L15
16	201912.157	1440435.957	L16
17	201886.904	1440442.919	L17

Co-ordinates for RAMP-3			
SL No	**Easting (m)**	**Northing (m)**	**Right Side of Proposed ROW**
1	202442.675	1440026.624	R1
2	202448.200	1440076.318	R2
3	202455.110	1440125.794	R3
4	202475.046	1440171.400	R4
5	202508.693	1440208.078	R5
6	202552.415	1440231.863	R6
7	202601.487	1440240.186	R7
8	202650.675	1440232.378	R8
9	202698.878	1440219.091	R9
10	202747.080	1440205.804	R10
11	202789.380	1440194.143	R11

Co-ordinates for LOOP-1			
SL No	**Easting (m)**	**Northing (m)**	**Right Side of Proposed ROW**
1	202470.880	1440375.297	R1
2	202476.406	1440424.991	R2
3	202481.798	1440474.697	R3
4	202471.492	1440523.017	R4
5	202438.000	1440559.338	R5
6	202390.672	1440573.520	R6
7	202342.725	1440561.602	R7
8	202328.848	1440553.560	R8

Co-ordinates for LOOP-2			
SL No	**Easting (m)**	**Northing (m)**	**Left Side of Proposed ROW**
1	202470.880	1440375.297	L1
2	202519.082	1440362.010	L2

3	202567.284	1440348.723	L3
4	202615.486	1440335.435	L4
5	202663.689	1440322.148	L5
6	202711.891	1440308.861	L6
7	202760.093	1440295.573	L7
8	202808.295	1440282.286	L8
9	202856.497	1440268.999	L9
10	202880.473	1440262.390	L10

Co-ordinates for CONNECTING Road						
SL No	**Easting (m)**	**Northing (m)**	**Left Side of Proposed ROW**	**Easting (m)**	**Northing (m)**	**Right Side of Proposed ROW**
1	202189.968	1438274.181	L1	202237.468	1438276.072	R1
2	202195.494	1438323.874	L2	202242.994	1438325.765	R2
3	202201.019	1438373.568	L3	202248.519	1438375.459	R3
4	202206.545	1438423.262	L4	202254.044	1438425.153	R4
5	202212.070	1438472.956	L5	202259.570	1438474.847	R5
6	202217.595	1438522.649	L6	202265.095	1438524.540	R6
7	202223.121	1438572.343	L7	202270.621	1438574.234	R7
8	202228.646	1438622.037	L8	202276.146	1438623.928	R8
9	202234.172	1438671.731	L9	202281.672	1438673.622	R9
10	202239.697	1438721.424	L10	202287.197	1438723.315	R10
11	202245.222	1438771.118	L11	202292.722	1438773.009	R11
12	202250.748	1438820.812	L12	202298.248	1438822.703	R12
13	202256.273	1438870.506	L13	202303.773	1438872.397	R13
14	202257.638	1438920.459	L14	202313.185	1438921.452	R14
15	202258.360	1438970.454	L15	202323.848	1438970.302	R15
16	202259.082	1439020.449	L16	202334.511	1439019.152	R16
17	202259.804	1439070.444	L17	202345.173	1439068.002	R17
18	202260.526	1439120.438	L18	202358.825	1439112.687	R18
19	202262.958	1439170.326	L19	202392.234	1439127.522	R19
20	202268.483	1439220.020	L20	202397.759	1439177.215	R20
21	202277.781	1439269.089	L21	202403.284	1439226.909	R21
22	202288.558	1439317.914	L22	202377.406	1439251.484	R22
23	202299.334	1439366.739	L23	202369.983	1439294.448	R23
24	202310.111	1439415.564	L24	202370.501	1439344.445	R24
25	202320.486	1439464.475	L25	202371.020	1439394.443	R25
26	202327.810	1439513.880	L26	202371.538	1439444.440	R26
27	202333.335	1439563.573	L27	202372.932	1439494.384	R27
28	202338.860	1439613.267	L28	202378.457	1439544.078	R28
29	202344.386	1439662.961	L29	202383.982	1439593.772	R29
30	202349.911	1439712.655	L30	202389.508	1439643.465	R30
31	202355.437	1439762.348	L31	202395.033	1439693.159	R31
32	202360.962	1439812.042	L32	202400.559	1439742.853	R32
33	202366.372	1439861.745	L33	202406.084	1439792.547	R33

Co-ordinates for CONNECTING Road						
SL No	**Easting (m)**	**Northing (m)**	**Left Side of Proposed ROW**	**Easting (m)**	**Northing (m)**	**Right Side of Proposed ROW**
34	202368.580	1439911.696	L34	202411.610	1439842.240	R34
35	202370.787	1439961.647	L35	202418.485	1439891.738	R35
36	202372.995	1440011.599	L36	202427.311	1439940.953	R36
37	202373.306	1440018.088	L37	202436.137	1439990.168	R37
38				202442.675	1440026.624	R38

Annex – III

(Schedule-A)

Alignment Plans

The indicative alignment plan (not designed) of the Project Highway is only for reference and concessionaire shall design the same as per availability of ROW.

Annexure-A
(Addendum-I)

(Annexure-IV)
Schedule-A
Utilities

The Site includes the following Utilities

(i) Electrical utilities

(a) Extra HighTension Lines (EHT Lines)

Sl. No.	Chainage (m)		Length (in m)				Crossings				
	From	To	400KV	220KV	132KV	66KV	800KV	440KV	220KV	132KV	66KV
1	26343.000	-	-	-	-	179	-	-	-	-	1
2	29021.259	-	-	263	-		-	-	1	-	-
3	39050.000	-	99.000	-	-	-	-	1	-	-	-
4	40201.265	-	-	-	-	117.47	-	-	-	-	1
5	40466.000	-	-	90.66	-	-	-	-	1	-	-

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

Sl. No.	Chainage (m)		Length (in Km)				Crossings			Transformer	
	From	To	33 KV	11KV	LT (440V)	LT (220V)	33KV	11KV	LT (440V)	No.	Capacity
1	27229.917	-	-	-	-	-	-	-	-	1	440V
2	27301.563	-	-	-	-	-	-	-	1	-	-
3	27394.421	-	-	-	-	-	-	-	1	-	-
4	27427.008	-	-	-	-	-	-	-	1	-	-
5	27529.841	-	-	-	-	-	-	1	-	-	-
6	27553.777	-	-	-	-	-	-	-	1	-	-
7	27574.617	-	-	-	-	-	-	1	-	-	-
8	27633.553	-	-	-	-	-	-	1	-	-	-
9	27636.780	-	-	-	-	-	-	1	-	-	-
10	27660.822	-	-	-	-	-	-	1	-	-	-
11	27716.854	-	-	-	-	-	-	1	-	-	-
12	27660.822	27717.854	-	57.26	-	-	-	1	-	-	-
13	27749.910	-	-	-	-	-	-	1	-	-	-
14	27799.860	-	-	-	-	-	-	1	-	-	-
15	27879.359	-	-	-	-	-	-	1	-	-	-
16	27893.312	-	-	-	-	-	-	1	-	-	-
17	28202.949	-	-	-	-	-	-	1	-	-	-
18	28248.469	-	-	-	-	-	-	1	-	-	-
19	28251.945	-	-	-	-	-	-	1	-	-	-
20	28343.133	-	-	-	-	-	-	1	-	-	-
21	28520.855	-	-	-	-	-	-	1	-	-	-
22	28530.524	-	-	-	-	-	-	1	-	-	-
23	28561.569	-	-	-	-	-	-	1	-	-	-

Sl. No.	Chainage (m)		Length (in Km)				Crossings			Transformer	
	From	To	33 KV	11KV	LT (440V)	LT (220V)	33KV	11KV	LT (440V)	No.	Capacity
24	28636.087	-	-	-	-	-	-	1	-	-	-
25	28868.579	-	-	-	-	-	-	1	-	-	-
26	28919.492	-	-	-	-	-	-	1	-	-	-
27	28925.434	-	-	-	-	-	-	1	-	-	-
28	28942.704	-	-	-	-	-	-	1	-	-	-
29	28984.627	-	-	-	-	-	-	1	-	-	-
30	28984.627	29058.010	-	73.81	-	-	-	1	-	-	-
31	29058.010	29132.400	-	74.71	-	-	-	1	-	-	-
32	29132.400	29205.601	-	73.36	-	-	-	1	-	-	-
33	29207.607	-	-	-	-	-	-	1	-	-	-
34	29225.262	-	-	-	-	-	-	1	-	-	-
35	29764.599	-	-	-	-	-	-	1	-	-	-
36	30016.996	-	-	-	-	-	-	1	-	-	-
37	30073.908	-	-	-	-	-	-	1	-	-	-
38	30134.358	-	-	-	-	-	-	1	-	-	-
39	30932.498	-	-	-	-	-	-	-	1	-	-
40	30947.430	-	-	-	-	-	-	-	1	-	-
41	31283.099	-	-	-	-	-	-	1	-	-	-
42	31286.906	-	-	-	-	-	-	1	-	-	-
43	31319.930	-	-	-	-	-	-	1	-	-	-
44	31485.433	-	-	-	-	-	-	1	-	-	-
45	31732.991	-	-	-	-	-	-	-	-	1	11KV
46	31985.980	-	-	-	-	-	-	1	-	-	-
47	32319.449	-	-	-	-	-	-	1	-	-	-
48	32361.654	-	-	-	-	-	-	1	-	-	-
49	34104.877	-	-	-	-	-	-	1	-	-	-
50	34105.004	-	-	-	-	-	-	-	-	1	440V
51	34130.158	-	-	-	-	-	-	-	1	-	-
52	34155.572	-	-	-	-	-	-	-	1	-	-
53	34538.211	-	-	-	-	-	-	1	-	-	-
54	34584.447	-	-	-	-	-	-	1	-	-	-
55	34631.755	-	-	-	-	-	-	-	-	1	11KV
56	34668.032	-	-	-	-	-	-	-	1	-	-
57	34708.891	-	-	-	-	-	-	-	1	-	-
58	34732.643	-	-	-	-	-	-	-	1	-	-
59	34740.403	-	-	-	-	-	-	-	1	-	-
60	35863.073	-	-	-	-	-	-	-	1	-	-
61	35881.430	-	-	-	-	-	-	-	1	-	-
62	35979.375	-	-	-	-	-	-	1	-	-	-
63	35987.552	-	-	-	-	-	-	1	-	-	-
64	36717.115	-	-	-	-	-	-	-	1	-	-

Sl. No.	Chainage (m)		Length (in Km)				Crossings			Transformer	
	From	To	33 KV	11KV	LT (440V)	LT (220V)	33KV	11KV	LT (440V)	No.	Capacity
65	36737.708	-	-	-	-	-	-	-	1	-	-
66	36775.720	-	-	-	-	-	-	-	-	1	440V
67	37334.780	-	-	-	-	-	-	1	-	-	-
68	37362.102	-	-	-	-	-	-	-	1	-	-
69	37401.517	-	-	-	-	-	-	-	1	-	-
70	37425.571	-	-	-	-	-	-	-	1	-	-
71	37630.048	-	-	-	-	-	-	-	1	-	-
72	37643.953	-	-	-	-	-	-	-	1	-	-
73	37643.953	-	-	-	-	-	-	-	1	-	-
74	37991.280	-	-	-	-	-	-	-	1	-	-
75	38022.051	-	-	-	-	-	-	-	1	-	-
76	38457.500	-	-	-	-	-	-	1	-	-	-
77	38798.185	-	-	-	-	-	-	-	1	-	-
78	39027.772	-	-	-	-	-	-	-	1	-	-
79	39031.336	-	-	-	-	-	-	-	1	-	-
80	39035.144	-	-	-	-	-	-	-	1	-	-
81	39095.295	39161.092	-	68.56	-	-	-	-	1	-	-
82	39161.092	-	-	-	-	-	-	-	1	-	-
83	39372.068	-	-	-	-	-	-	1	-	-	-
84	39425.369	-	-	-	-	-	-	1	-	-	-
85	39455.255	-	-	-	-	-	-	-	1	-	-
86	39458.977	-	-	-	-	-	-	1	-	-	-
87	39590.955	-	-	-	-	-	-	1	-	-	-
88	39612.150	-	-	-	-	-	-	-	-	1	440V
89	39673.886	-	-	-	-	-	-	1	-	-	-
90	39679.150	-	-	-	-	-	-	1	-	-	-
91	39708.890	-	-	-	-	-	-	-	1	-	-
92	39747.840	-	-	-	-	-	-	-	1	-	-
93	40424.096	-	-	-	-	-	-	-	1	-	-
94	40632.970	-	-	-	-	-	-	1	-	-	-
95	40639.832	-	-	-	-	-	-	1	-	-	-
96	40701.316	-	-	-	-	-	-	1	-	-	-
97	40733.920	-	-	-	-	-	-	-	1	-	-
98	40749.409	-	-	-	-	-	-	-	1	-	-
99	40769.296	-	-	-	-	-	-	-	1	-	-
100	40840.171	-	-	-	-	-	-	-	1	-	-
101	40884.696	-	-	-	-	-	-	-	1	-	-
102	40904.131	-	-	-	-	-	-	-	1	-	-
103	40923.669	-	-	-	-	-	-	-	-	1	440V
104	40944.988	-	-	-	-	-	-	1	-	-	-
105	40997.460	-	-	-	-	-	-	-	1	-	-
106	41897.899	-	-	-	-	-	-	1	-	-	-

Sl. No.	Chainage (m)		Length (in Km)				Crossings			Transformer	
	From	To	33 KV	11KV	LT (440V)	LT (220V)	33KV	11KV	LT (440V)	No.	Capacity
107	42113.064	-	-	-	-	-	-	1	-	-	-
108	42217.978	-	-	-	-	-	-	1	-	-	-
109	42322.241	-	-	-	-	-	-	-	1	-	-
110	42341.101	-	-	-	-	-	-	-	1	-	-
111	42360.953	-	-	-	-	-	-	-	1	-	-
112	42840.787	-	-	-	-	-	-	-	1	-	-
113	42859.698	-	-	-	-	-	-	-	1	-	-
114	42859.698	42866.265	19.11	-	-	-	-	-	1	-	-
115	42866.265	42906.332	40.53	-	-	-	-	-	1	-	-
116	42906.332	42953.287	142.21	-	-	-	-	-	1	-	-
117	43074.404	-	-	-	-	-	-	1	-	-	-
118	43637.260	-	-	-	-	-	-	1	-	-	-
119	43639.284	-	-	-	-	-	-	1	-	-	-
120	43647.591	-	-	-	-	-	-	-	1	-	-
121	43686.235	-	-	-	-	-	-	1	-	-	-
122	44113.790	-	-	-	-	-	-	-	1	-	-
123	44117.516	-	-	-	-	-	-	-	1	-	-
124	44597.404	-	-	-	-	-	-	-	1	-	-
125	44628.612	-	-	-	-	-	-	-	1	-	-
126	44677.264	-	-	-	-	-	-	-	1	-	-
127	44713.230	-	-	-	-	-	-	-	1	-	-
128	45008.793	-	-	-	-	-	-	1	-	-	-
129	45027.647	-	-	-	-	-	-	1	-	-	-
130	45041.266	-	-	-	-	-	-	1	-	-	-
131	45046.258	-	-	-	-	-	-	1	-	-	-
132	45247.445	-	-	-	-	-	-	-	1	-	-
133	45749.155	-	-	-	-	-	-	-	1	-	-
134	45798.595	-	-	-	-	-	-	-	1	-	-
135	46036.153	-	-	-	-	-	-	-	1	-	-
136	46061.525	-	-	-	-	-	-	-	1	-	-
137	46237.336	-	-	-	-	-	-	-	1	-	-
138	46352.463	-	-	-	-	-	-	-	1	-	-
139	46368.460	-	-	-	-	-	-	-	1	-	-
140	46505.676	-	-	-	-	-	-	-	1	-	-
141	46533.997	-	-	-	-	-	-	-	1	-	-
142	46791.231	-	-	-	-	-	-	-	1	-	-
143	46924.187	-	-	-	-	-	-	-	1	-	-
144	46943.592	-	-	-	-	-	-	-	1	-	-
145	47331.073	-	-	-	-	-	-	-	1	-	-
146	47352.619	-	-	-	-	-	-	-	1	-	-
147	47411.059	-	-	-	-	-	-	-	1	-	-

Sl. No.	Chainage (m)		Length (in Km)				Crossings			Transformer	
	From	To	33 KV	11KV	LT (440V)	LT (220V)	33KV	11KV	LT (440V)	No.	Capacity
148	47472.718	-	-	-	-	-	-	-	1	-	-
149	47501.047	-	-	-	-	-	-	-	1	-	-
150	47546.138	-	-	-	-	-	-	1	-	-	-
151	47641.659	-	-	-	-	-	-	1	-	-	-
152	48515.746	-	-	-	-	-	-	-	1	-	-
153	48518.859	-	-	-	-	-	-	-	1	-	-
154	48518.859	48633.973	-	41.97	-	-	-	1	-	-	-
155	48674.978	-	-	-	-	-	-	1	-	-	-
156	49069.683	-	-	-	-	-	-	-	1	-	-
157	49196.745	-	-	-	-	-	-	-	1	-	-
158	49227.445	-	-	-	-	-	-	-	1	-	-
159	49730.338	-	-	-	-	-	-	1	-	-	-
160	49761.771	-	-	-	-	-	-	1	-	-	-
161	49784.916	-	-	-	-	-	-	1	-	-	-
162	49965.179	50017.306	54.39	-	-	-	-	-	1	-	-
163	50039.125	-	-	-	-	-	-	-	1	-	-
164	50053.326	-	-	-	-	-	-	1	-	-	-
165	50058.567	-	-	-	-	-	-	-	1	-	-
166	50068.757	-	-	-	-	-	-	1	-	-	-
167	50098.942	-	-	-	-	-	-	1	-	-	-
168	50106.273	-	-	-	-	-	-	-	1	-	-
169	50118.612	-	-	-	-	-	-	-	-	1	11KV
170	50269.051	-	-	-	-	-	-	1	-	-	-
171	50279.897	-	-	-	-	-	-	-	1	-	-
172	50419.029	-	-	-	-	-	-	1	-	-	-
173	50457.803	-	-	-	-	-	-	1	-	-	-
174	50507.010	-	-	-	-	-	-	-	-	1	11KV

(ii) Public Health utilities (Water/Sewage Pipe lines):

PKG	Intz Tank Water	90 mm dia PVC Water Pipe Line	110 mm dia PVC Water Pipe Line	140 mm dia PVC Water Pipe Line	160 mm dia PVC Water Pipe Line	200 mm dia PVC Water Pipe Line	250 mm dia HDPC Water Pipe Line	280mm dia HDPC Water Pipe Line	355.6 mm dia MS Water Pipe Line	400 mm dia MS Water Pipe Line	450 mm dia MS Water Pipe Line	600 mm dia MS Water Pipe Line	Parallel to road
Nil													

(iii) Any Other line:

Sl. No.	Chainage	Length (in Km)	Crossings
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 estimation of concerned utility owning dept. and shall be payable.

SCHEDULE - B

(See Clause 2.1)

DEVELOPMENT OF THE PROJECT HIGHWAY

1. Development of the Project

Development of the Project Highway shall include construction of the project as described in this Schedule B and in Schedule C after completion of design by the Concessionaire/Agency as per the Contract.

2. Project Highway (4lane)

2.1 Construction of Four lane Bangalore Chennai Expressway from Km 26.400 to Km 53.500 (Malur to Bangarpet Section in the state of Karnataka under Bharatmala on Hybrid Annuity Mode (Phase I-Package II) as described in Annex-I of **Schedule-B** and in **Schedule-C**.

2.2 The Project Highway shall be designed and constructed by the Agency/Concessionaire in conformity with the Specifications and Standards specified in Schedule-D.

2.3 Project development proposal will include a provision for future widening of additional 4- lanes on inner side of both carriageways (towards median).

Annex – I

(Schedule – B)

DESCRIPTION OF DEVELOPMENT

BANGALORE CHENNAI EXPRESSWAY (PHASE I - PACKAGE-II)

1. Width of Carriageway

1.1 Main Expressway: The Paved Carriageway shall be 22.50 meters for four lane sections excluding median but including edge strip.

1.2 Loops/Ramps: The Paved Carriageway shall be 9.5meters wide for 2lanes, 17.0 meters (2 x 8.5m) for 4 lanes (undivided unidirectional carriageway) and 20.5 meters (2 x 10.25 m) for 4 lanes (divided carriageway) excluding median including edge strip.

1.3 Cross road (Vehicular Overpass): The Paved Carriageway shall be 11.0 meters wide for 2 lanes and 2 x 14.0 meters wide for 4 lanes with a median open to sky.

1.4 In addition to width of paved carriageway mentioned above, additional lane/lanes shall be given as acceleration/deceleration lanes, toll plazas and taper for Loops/Ramps to the required length shall be provided at the respective locations as per specifications.

1.5 Except as otherwise provided in this Agreement, the width of the paved carriageway and cross-sectional features shall conform to above clauses.

2. Project Facilities

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

3. Specifications and Standards

The Project 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 shall be the minimum design speed of 120 km per hour for plain/ rolling terrain.

4.3 Improvement of the existing road geometrics

The existing geometry of the crossroads at Vehicular overpass location and cross roads at Interchange location shall be improved as specified in this schedule and Schedule D.

4.4 Right of Way

Details of Right of Way are given in Annex-II of Schedule-A and **Appendix B-II (A)** of this schedule.

4.5 Type of shoulders

(a) In open country, paved shoulders of 3.0 m width shall be provided and 2.0m width shall be covered with 200 mm thick compacted layer of granular material shall be provided on outer side of each of the carriageway. 1.0m wide earthen

shoulder of 200 mm thick compacted layer of granular material shall be provided on median side of each of the carriageway.

(b) Design and specifications of paved shoulders shall be same as carriageway and granular material on earthen shoulder shall conform to the requirements specified in the Manual.

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 (Clause 4.17).

4.7 Lateral and vertical clearances at Overpasses

The lateral and vertical clearances of all Overpasses shall be as given in this schedule (Clause 4.17).

4.8 Connecting Roads

Connecting Roads shall be constructed in length & width as indicated in Appendix B- III.

4.9 Grade separated structures

i) Grade separated structures shall be provided as given in Appendix-B-IV, Appendix-B-V, Appendix-B-VI, Appendix-B-VI(A), Appendix-B-VII, Appendix-VII(A), Appendix-B-XIII.

ii) In the case of grade separated structures, the type of structure and the level of the Project Highway and the cross roads shall be as specified in Appendixes given in Clause 4.9 (i) above and **Appendix B-II** of this schedule.

4.10 Cattle and Pedestrian underpass /Overpass:

The details are given in Appendix-B-VII(A)

4.11 Typical Cross-sections

i) The Project Expressway shall be constructed to 4 lane fully access controlled expressway configuration with paved shoulders with or without connecting Roads. Typical cross sections for different segments of the project expressway will be developed with help of **Appendix B-II.** List of segments is given in this **Appendix B-I(A)**.

ii) The Loops/Ramps of Interchanges shall be constructed with the lane configuration including paved shoulders except toll plaza as given in **Appendix B-I (B).** (At toll plaza location, the lane width shall be as per lane requirement and taper)

iii) The cross road at vehicular overpass locations shall be constructed to the lane configuration and length as given in **Appendix B-VI(A)**.

4.12 Alignment Plan and Longitudinal Section

An alignment plan and vertical profile of complete project expressway including interchanges along with their ramps & loops is given at Appendix B-II.

The plan and profile of project highway as given in Appendix B-II is tentative and cannot be considered as design plan & profile. The actual design of plan and profile shall be carried out by concessionaire following IRC-SP-99 and adopted vertical profile shall be designed for ISD and horizontal geometry shall be within the land (ROW) provided by the authority as per approval of IE. There shall not be any

COS/variation due to addition in length of approaches, Earth Work, it's RE Wall, drain, slip roads, accelerating/decelerating lane, foot path, separator etc. while adopting ISD as design standard throughout the project length. Further, bottom of sub-grade for embankment/fill portion shall be higher of the following:

(a) 1.00 m above HFL data (100 years or available) from CWC, irrigation department, local enquiry

(b) 1.50m above existing GL

4.13 Intersections and Grade Separators

i) All intersections and grade separators shall be as per Section 3 of the manual and as given in Appendix B- IV, Appendix B- V, Appendix B- VI(A) of this Schedule.

ii) The Project Highway is to be constructed to a fully access controlled expressway configuration and no at grade intersection will be permissible **with expressway.** Interchanges shall be constructed at locations and layouts given in Appendix B-IV and structures shall be constructed as given in Appendix B-VI, Appendix B- VI(A) of this Schedule.

iii) The cross roads at Flyovers, Underpasses shall be treated as at grade intersection. These crossroads shall be developed as at grade intersection up to the extent of ROW.

4.14 Road Embankment and Cut Section

Construction of new road embankment / cuttings shall conform to the Specifications and Standards given in section 4 of the Manual and the specified cross sectional details.

4.15 Pavement Design

4.15.1 Type of pavement:

Flexible Pavement - The Flexible perpetual pavement type for main carriageway and Interchange Loop and Ramp shall be designed for a minimum 300 MSA for minimum design period of 30 years.

Flexible pavement for connecting road shall be designed a minimum design traffic of 10 MSA.

Rigid Pavement - For Toll Plaza including tapering zone shall be designed for design traffic of minimum 300 MSA or a minimum design period of 30 years.

4.16 Roadside Drainage

In addition to the provisions given in TCS, adequate Drainage system including surface and subsurface drains and median drainage system for the total Project Highway shall be provided as per Schedule D and drainage plan enclosed.

4.17 Design of Structures

4.17.1 General

i) All bridges, culverts and structures shall be designed and constructed in accordance with Section 6 of the Manual and shall conform to the cross-sectional features and details specified in **Appendix-B-IV, Appendix-B-V, Appendix-B-VI, Appendix-B-VI(A), Appendix-B-VII, Appendix-B-VII(A), Appendix-B-VIII, Appendix-B-IX, Appendix-B-X, Appendix-B-X(A), Appendix-B-XI, Appendix-B-XII, Appendix-B-XIII, Appendix-B-XV** in this schedule.

ii) Width of the carriageway of bridges and structures shall be as specified in appendixes given in Clause 4.17(i)above.

iii) All bridges shall be high-level bridges.

iv) Cross-section of the new culverts and bridges at deck level for the Project Highway shall conform to the typical cross-sections given in section 6 of the Manual and not less than as specified in this Schedule.

v) All Structures shall be designed by taking the account of loading at cantilever portion as necessary to accommodate future 8-lanes configuration. All bridges, culverts and structures is to be designed for edge movement of the vehicle considering stitching of additional lane for inside widening in future.

vi) All bridges, culverts and structures shall be designed and constructed for IRC class special vehicle (SV) loading as per IRC:6: 2017.

4.17.2 Culverts

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

ii) All culverts shall be designed and constructed in accordance with Section 6 of the Manual and shall conform to the cross-sectional features and details specified in **Appendix B-XIV,** in this schedule.

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

4.17.3 Bridges

Existing bridges to be re- constructed/widened

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

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

ii. The following narrow bridges shall be widened

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

New Bridges

New bridges shall be constructed as given in **Appendix B-VIII, Appendix B-IX, Appendix B-XI, and Appendix B-XII**. Special Type structures shall be constructed as given in Clause 4.25. GADs for the new bridges are attached in the drawings volume, which is only indicative and need to be designed as per manual.

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

Sl. No.	Location at km	Remarks
Nil		

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

Sl. No.	Location at km	Remarks
Nil		

Drainage system for bridge decks

An effective drainage system for bridge decks shall be provided as specified in paragraph 6.12 of the Manual

.

4.17.4 ROB/RUB

Design, construction and detailing of ROB/RUB shall be as specified in section 7 of the Manual.

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

Sl. No.	Location of Level crossing (Km)	Length of bridge (Km)
Nil		

Road under Bridges

Details of ROBs/RUBs to be constructed are given at **Appendix B-XIII**. Following points shall be taken care of:

The proposed span arrangements of the ROBs are tentative and subject to change as per availability of railway boundaries/ requirement of the railways.

ROBs shall be designed, constructed and maintained as per the requirements of Railway authorities. The construction plans shall be prepared in consultation with the concerned railway authority.

The ROBs shall be constructed and maintained by the Concessionaire under supervision of the Railways.

The approaches to ROB in length not less than 100m and on all four sides shall be constructed in full height using RE wall.

All expenditure related to construction, maintenance and supervision of ROBs (except P&E charges) shall be borne by the Concessionaire.

4.18 Grade separated structures

The grade separated structures shall be provided at the locations and of the type and length specified in this Schedule.

4.19 Repairs and strengthening of bridges and structures

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

A. Bridges

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

B. ROB /RUB

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

C. Overpasses/Underpasses/Flyovers and other structures

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

4.20 List of Major Bridges and Structures

The list of Bridges, Structures, Flyovers, Underpasses and Overpasses are as given in this Schedule (Clause 4.17.1).

4.21 Traffic Management Systems

Advance Traffic Management System shall be provided as given in **Appendix-B-XVII and Schedule D.**

4.22 Roadside Furniture

Roadside furniture shall be provided in accordance with the provisions of Section 10 of the Manual.

4.23 Compulsory Afforestation

Median plantation, compulsory afforestation shall be as given Schedule „C".

4.24 Hazardous Locations

The safety measures shall be provided as given in Schedule C. In addition to Schedule C, additional location as directed by IE/ NHAI shall be identified and provided in accordance to Manual.

4.25 Special Structures

NIL

4.26 Retaining Structures

Retaining Wall/ Reinforced Earth Retaining structures shall be constructed to

accommodate the cross section within Right of Way in accordance with **Appendix-B-XV** and **Schedule-D.**

4.27 Slope Protection

The side slopes shall be protected by using suitable slope protection measures wherever required in accordance with **Schedule - D**.

4.28 Special Protection for Ravines Area

NIL

4.29 Ground Improvement

NIL

4.30 Fencing

Fencing shall be provided on the entire length on either side (including transverse requirements at structure locations) as per the detail given in Schedule C.

4.31 Utilities

A minimum 2m wide strip of land at the extreme edge of ROW shall be kept for accommodating utilities.

Provision for crossing of Utility duct shall be provided as per provisions in Schedule C.

4.32 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 Rain Water harvesting structure is mandatory in and around water crisis area, notified by the Central Ground Water Board. The provision of rain water harvesting can be executed as per requirement of IRC:SP:42 and IRC:SP:50.

4.33 Emergency Crossover

Emergency crossovers shall be provided as per stipulation of Manual.

4.34 Overhead Signs

Overhead signs shall be provided in accordance to Manual at the locations given in Appendix B-XIX.

4.35 Utility Shifting:

Shifting of obstructing utilities to an appropriate location in accordance with standards and specifications of concern Utility Departments is a part of scope of work for the contractor. Shifting of all over ground including electrical/power utilities shall be responsibility of the contractor, whether indicated in Schedule B or not. No change of scope (COS) shall be allowed for such over ground utilizes whether indicated in Schedule B or not. However, underground utilities as indicated in the Schedule B 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.

The details are given in Appendix B – XX.

4.36 CHANGE OF SCOPE

The length of Structures and bridges specified herein above shall be treated as an approximate assessment. The actual lengths/widths as required on the basis of detailed investigations shall be determined by the Contractor in accordance with the Specifications and Standards. Any variations in the lengths/widths 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.

Appendix B-I (A)

APPLICABLE STRETCHES OF TYPICAL CROSS SECTION (MAIN EXPRESSWAY)

Sl. No.	Segment		Length (km)	Median width including Edge Strip (m)	Type	Remarks
	From (km)	To (km)				
1	26.400	27.000	0.600	21.0	Type 1	
2	27.000	27.010	0.011	21.0	MNB	Drawing No: BCE/G:MNB-04
3	27.010	27.224	0.214	21.0	Type 1	
4	27.224	27.254	0.030	21.0	MNB	Drawing No: BCE/G:MNB-01
5	27.254	28.050	0.796	21.0	Type 1	
6	28.050	28.120	0.070	21.0	Type 6A	
7	28.120	28.132	0.012	21.0	VUP	Drawing No: BCE/G:VUP-02
8	28.132	28.146	0.014	21.0	Type 6A	
9	28.146	28.154	0.008	21.0	MNB	Drawing No: BCE/G:MNB-04
10	28.154	28.196	0.043	21.0	Type 6A	
11	28.196	28.204	0.008	21.0	MNB	Drawing No: BCE/G:MNB-04
12	28.204	28.246	0.043	21.0	Type 6A	
13	28.246	28.254	0.008	21.0	MNB	Drawing No: BCE/G:MNB-04
14	28.254	28.300	0.046	21.0	Type 6A	
15	28.300	28.674	0.374	21.0	Type 6	
16	28.674	28.686	0.012	21.0	VUP	Drawing No: BCE/G:VUP-02
17	28.686	28.831	0.145	21.0	Type 6	
18	28.831	28.849	0.018	21.0	MNB	Drawing No: BCE/G:MNB-04
19	28.849	29.165	0.316	21.0	Type 6	
20	29.165	29.435	0.270	21.0	BRIDGE (IOCL CROSSING)	Drawing No: BCE/G:PLC-02
21	29.435	29.484	0.049	21.0	Type 5A	
22	29.484	29.496	0.012	21.0	LVUP	Drawing No: BCE/G:LVUP-01
23	29.496	29.650	0.154	21.0	Type 6A	
24	29.650	29.840	0.190	21.0	Type 1	
25	29.840	30.300	0.460	21.0	Type 2	
26	30.300	30.615	0.315	21.0	Type 1	
27	30.615	30.795	0.180	21.0	MJB	Drawing No: BCE/G:MJB-01
28	30.795	30.970	0.175	21.0	Type 1	
29	30.970	31.304	0.334	21.0	Type 2	
30	31.304	31.316	0.012	21.0	VOP	Drawing No: BCE/G:VOP-01
31	31.316	31.500	0.184	21.0	Type 2	
32	31.500	31.900	0.400	21.0	Type 1	
33	31.900	32.000	0.100	21.0	Type 6A	
34	32.000	32.250	0.250	21.0	Type 6	
35	32.250	32.312	0.062	21.0	Type 6A	
36	32.312	32.342	0.030	21.0	VUP	Drawing No: BCE/G:VUP-01
37	32.342	32.350	0.008	21.0	Type 6A	
38	32.350	33.100	0.750	21.0	Type 1	
39	33.100	33.556	0.456	21.0	Type 2	
40	33.556	33.568	0.012	21.0	VOP	Drawing No: BCE/G:VOP-01
41	33.568	33.800	0.232	21.0	Type 2	
42	33.800	34.000	0.200	21.0	Type 2	

Sl. No.	Segment		Length (km)	Median width including Edge Strip (m)	Type	Remarks
	From (km)	To (km)				
43	34.000	34.114	0.114	21.0	Type 1	
44	34.114	34.126	0.012	21.0	LVUP	Drawing No: BCE/G:LVUP-01
45	34.126	34.650	0.524	21.0	Type 1	
46	34.650	34.950	0.300	21.0	Type 2	
47	34.950	35.031	0.081	21.0	Type 1	
48	35.031	35.039	0.009	21.0	MNB	Drawing No: BCE/G:MNB-03
49	35.039	35.216	0.177	21.0	Type 1	
50	35.216	35.238	0.021	21.0	MNB	Drawing No: BCE/G:MNB-04
51	35.238	35.395	0.157	21.0	Type 1	
52	35.395	35.645	0.250	21.0	MJB	Drawing No: BCE/G:MJB-02
53	35.645	35.900	0.255	21.0	Type 6	
54	35.900	36.202	0.302	21.0	Type 1	
55	36.202	36.216	0.013	21.0	MNB	Drawing No: BCE/G:MNB-03
56	36.216	36.446	0.231	21.0	Type 1	
57	36.446	36.458	0.011	21.0	MNB	Drawing No: BCE/G:MNB-03
58	36.458	36.762	0.304	21.0	Type 1	
59	36.762	36.774	0.012	21.0	LVUP	Drawing No: BCE/G:LVUP-01
60	36.774	37.100	0.326	21.0	Type 1	
61	37.100	37.169	0.069	21.0	Type 6A	
62	37.169	37.229	0.060	21.0	Type 5A	
63	37.229	37.241	0.012	21.0	VUP	Drawing No: BCE/G:VUP-02
64	37.241	37.321	0.080	21.0	Type 5A	
65	37.321	37.350	0.029	21.0	Type 6A	
66	37.350	37.450	0.100	21.0	Type 1	
67	37.450	37.600	0.150	21.0	Type 6A	
68	37.600	37.775	0.175	21.0	Type 1	
69	37.775	37.785	0.009	21.0	MNB	Drawing No: BCE/G:MNB-03
70	37.785	38.275	0.490	21.0	Type 1	
71	38.275	38.390	0.115	21.0	Type 3	
72	38.390	38.537	0.147	21.0	Type 1	
73	38.537	38.549	0.012	21.0	LVUP	Drawing No: BCE/G:LVUP-01
74	38.549	38.900	0.351	21.0	Type 1	
75	38.900	39.206	0.306	21.0	Type 6	
76	39.206	39.246	0.040	21.0	MNB	Drawing No: BCE/G:MNB-02
77	39.246	39.550	0.304	21.0	Type 6	
78	39.550	39.604	0.054	21.0	Type 6A	
79	39.604	39.616	0.012	21.0	VUP	Drawing No: BCE/G:VUP-02
80	39.616	39.700	0.084	21.0	Type 6A	
81	39.700	40.589	0.889	21.0	Type 1	
82	40.589	40.601	0.012	21.0	LVUP	Drawing No: BCE/G:LVUP-01
83	40.601	40.793	0.192	21.0	Type 1	
84	40.793	40.835	0.042	21.0	Type 1	
85	40.835	40.925	0.090	21.0	MJB	Drawing No: BCE/G:MJB-03
86	40.925	40.945	0.020	21.0	Type 1	
87	40.945	40.955	0.009	21.0	MNB	Drawing No: BCE/G:MNB-03
88	40.955	41.100	0.145	21.0	Type 1	
89	41.100	41.271	0.171	21.0	Type 6	
90	41.271	41.521	0.250	21.0	MJB	Drawing No: BCE/G:MJB-04
91	41.521	41.810	0.289	21.0	Type 6	
92	41.810	41.909	0.099	17.9	Type 13	ROB Approach (4 lane)

Sl. No.	Segment		Length (km)	Median width including Edge Strip (m)	Type	Remarks
	From (km)	To (km)				
93	41.909	42.011	0.102	17.9	ROB	Drawing No: BCE/G:ROB-01
94	42.011	42.110	0.099	17.9	Type 13	ROB Approach (4 lane)
95	42.110	42.800	0.690	21.0	Type 6	
96	42.800	43.250	0.450	21.0	Type 1	
97	43.250	43.600	0.350	21.0	Type 6	
98	43.600	43.681	0.081	21.0	Type 1	
99	43.681	43.693	0.012	21.0	VUP	Drawing No: BCE/G:VUP-02
100	43.693	43.839	0.146	21.0	Type 1	
101	43.839	44.250	0.411	21.0	Type 1	
102	44.250	44.350	0.100	21.0	MJB	Drawing No: BCE/G:MJB-05
103	44.350	44.613	0.263	21.0	Type 1	
104	44.613	44.717	0.104	21.0	Type 4	
105	44.717	44.855	0.138	21.0	Type 2	
106	44.855	44.875	0.020	21.0	MNB	Drawing No: BCE/G:MNB-12
107	44.875	45.027	0.152	21.0	Type 2	
108	45.027	45.039	0.012	21.0	VOP	Drawing No: BCE/G:VOP-01
109	45.039	45.593	0.554	21.0	Type 2	
110	45.593	45.870	0.277	21.0	Type 1	
111	45.870	46.035	0.165	21.0	MJB+VUP	Drawing No: BCE/G:MJB-06
112	46.035	46.350	0.315	21.0	Type 1	
113	46.350	46.450	0.100	21.0	Type 6	
114	46.450	46.550	0.100	21.0	Type 6A	
115	46.550	46.678	0.128	21.0	Type 1	
116	46.678	46.698	0.020	21.0	MNB	Drawing No: BCE/G:MNB-04
117	46.698	46.900	0.202	21.0	Type 1	
118	46.900	47.239	0.339	21.0	Type 6	
119	47.239	47.251	0.012	21.0	VUP	Drawing No: BCE/G:VUP-03
120	47.251	47.333	0.082	21.0	Type 6	
121	47.333	47.351	0.018	21.0	MNB	Drawing No: BCE/G:MNB-05
122	47.351	47.525	0.174	21.0	Type 6	
123	47.525	47.675	0.150	21.0	MJB	Drawing No: BCE/G:MJB-07
124	47.675	48.050	0.375	21.0	Type 1	
125	48.050	48.250	0.200	21.0	Type 4	
126	48.250	48.371	0.121	21.0	Type 2	
127	48.371	48.482	0.111	21.0	Type 1	
128	48.482	48.494	0.012	21.0	LVUP	Drawing No: BCE/G:LVUP-02
129	48.494	48.918	0.423	21.0	Type 1	
130	48.918	48.935	0.017	21.0	MNB	Drawing No: BCE/G:MNB-04
131	48.935	49.214	0.279	21.0	Type 1	
132	49.214	49.226	0.012	21.0	VUP	Drawing No: BCE/G:VUP-02
133	49.226	49.400	0.174	21.0	Type 6A	
134	49.400	49.650	0.250	21.0	Type 6	
135	49.650	50.100	0.450	21.0	MJB	Drawing No: BCE/G:MJB-08
136	50.100	50.417	0.317	21.0	Type 6	
137	50.417	50.439	0.022	21.0	MNB	Drawing No: BCE/G:MNB-04
138	50.439	50.500	0.061	21.0	Type 6	
139	50.500	50.682	0.182	21.0	Type 1	
140	50.682	50.721	0.039	21.0	Type 4	
141	50.721	50.845	0.124	21.0	Type 2	
142	50.845	50.957	0.112	21.0	Type 3	

Sl. No.	Segment		Length (km)	Median width including Edge Strip (m)	Type	Remarks
	From (km)	To (km)				
143	50.957	51.100	0.143	21.0	Type 1	
144	51.100	51.127	0.027	21.0	Type 6A	
145	51.127	51.141	0.015	21.0	MNB	Drawing No: BCE/G:MNB-03
146	51.141	51.262	0.120	21.0	Type 6A	
147	51.262	51.276	0.015	21.0	MNB	Drawing No: BCE/G:MNB-03
148	51.276	51.300	0.024	21.0	Type 6A	
149	51.300	51.422	0.122	21.0	Type 1	
150	51.422	51.758	0.336	21.0	Type 2	
151	51.758	52.038	0.280	21.0	Type 4	
152	52.038	52.068	0.030	21.0	Type 1	
153	52.068	52.103	0.035	21.0	INTERCHANGE (VUP)	Drawing No: BCE/G:IC-03
154	52.103	52.250	0.148	21.0	Type 1	
155	52.250	52.323	0.073	21.0	Type 6	
156	52.323	52.337	0.015	21.0	MNB	Drawing No: BCE/G:MNB-07
157	52.337	52.450	0.113	21.0	Type 6A	
158	52.450	52.500	0.050	21.0	Type 6	
159	52.500	52.656	0.156	21.0	Type 1	
160	52.656	52.674	0.018	21.0	MNB	Drawing No: BCE/G:MNB-08
161	52.674	53.000	0.326	21.0	Type 1	
162	53.000	53.023	0.023	21.0	Type 6A	
163	53.023	53.043	0.020	21.0	MNB	Drawing No: BCE/G:MNB-04
164	53.043	53.050	0.007	21.0	Type 1	
165	53.050	53.109	0.059	21.0	Type 1	
166	53.109	53.137	0.028	21.0	MNB	Drawing No: BCE/G:MNB-06
167	53.137	53.181	0.044	21.0	Type 1	
168	53.181	53.209	0.028	21.0	MNB	Drawing No: BCE/G:MNB-06
169	53.209	53.284	0.075	21.0	Type 1	
170	53.284	53.324	0.040	21.0	Type 3	
171	53.324	53.459	0.135	21.0	Type 2	
172	53.459	53.500	0.041	21.0	Type 3	
	Total Length (km)		**27.100**			

Note:

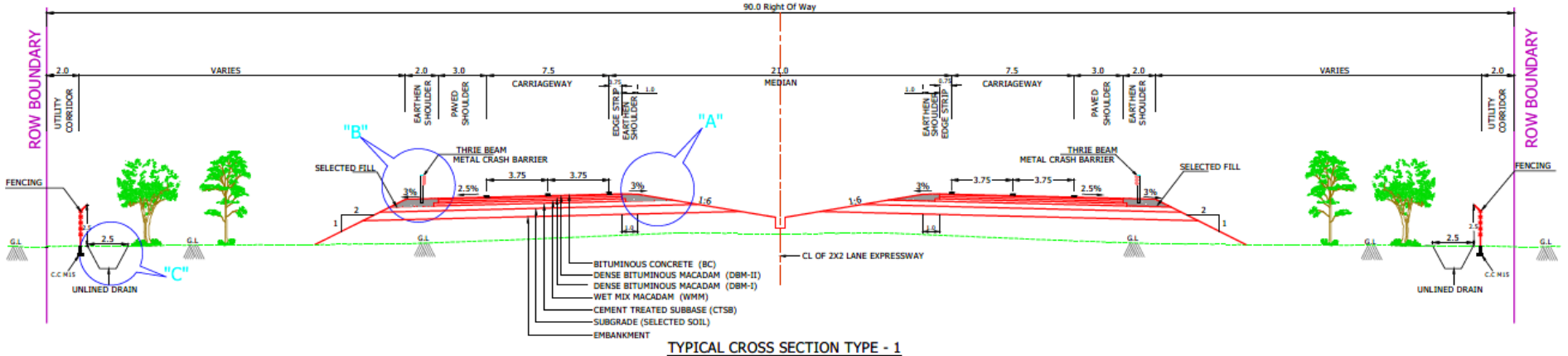
(1) The TCS chainage given above is indicative only. The actual Cross-section shall be adopted based on suitability of terrain and description given in below.

Description of Typical Cross Section	
TCS No.	**Description**
TCS -1	4-LANES EXPRESSWAY IN EMBANKMENT
TCS -2	4-LANES EXPRESSWAY CUTTING
TCS -3	4-LANES EXPRESSWAY EMBANKMENT ON LHS AND CUTTING ON RHS
TCS -4	4-LANES EXPRESSWAY CUTTING ON LHS AND EMBANKMENT ON RHS
TCS -5	4-LANES EXPRESSWAY IN EMBANKMENT WITH RETAINING STRUCTURE WITH CONNECTING ROAD ON BOTH SIDES
TCS -5A	4-LANES EXPRESSWAY IN EMBANKMENT WITH RETAINING STRUCTURE WITH CONNECTING ROAD –LEFT/RIGHT
TCS -6	4-LANES EXPRESSWAY IN EMBANKMENT WITH RETAINING STRUCTURE BOTH SIDES
TCS -6A	4-LANES EXPRESSWAY IN EMBANKMENT WITH RETAINING STRUCTURE LEFT/RIGHT
TCS -7	TYPICAL CROSS SECTION FOR TWO LANE LOOP AND RAMP
TCS -7A	TYPICAL CROSS SECTION FOR WIDER CARRIAGEWAY AT LOOP
TCS -8	TYPICAL CROSS SECTION FOR 4-LANES AT LOOP
TCS -8A	TYPICAL CROSS SECTION FOR 4-LANES AT CONNECTING ROAD TO INTERCHANGE
TCS -9	TYPICAL CROSS SECTION FOR 4-LANES ON CROSS ROAD AT INTERCHANGE JOINING POINT
TCS -10	TYPICAL CROSS SECTION FOR CROSS ROAD APPROACH AT VUP/LVUP
TCS -11	TYPICAL CROSS SECTION FOR 2-LANES CROSS ROAD APPROACH AT OVERPASS
TCS -12	TYPICAL CROSS SECTION FOR 4-LANES CROSS ROAD APPROACH AT OVERPASS
TCS -13	TYPICAL CROSS SECTION FOR 4-LANE APPROACH AT ROB

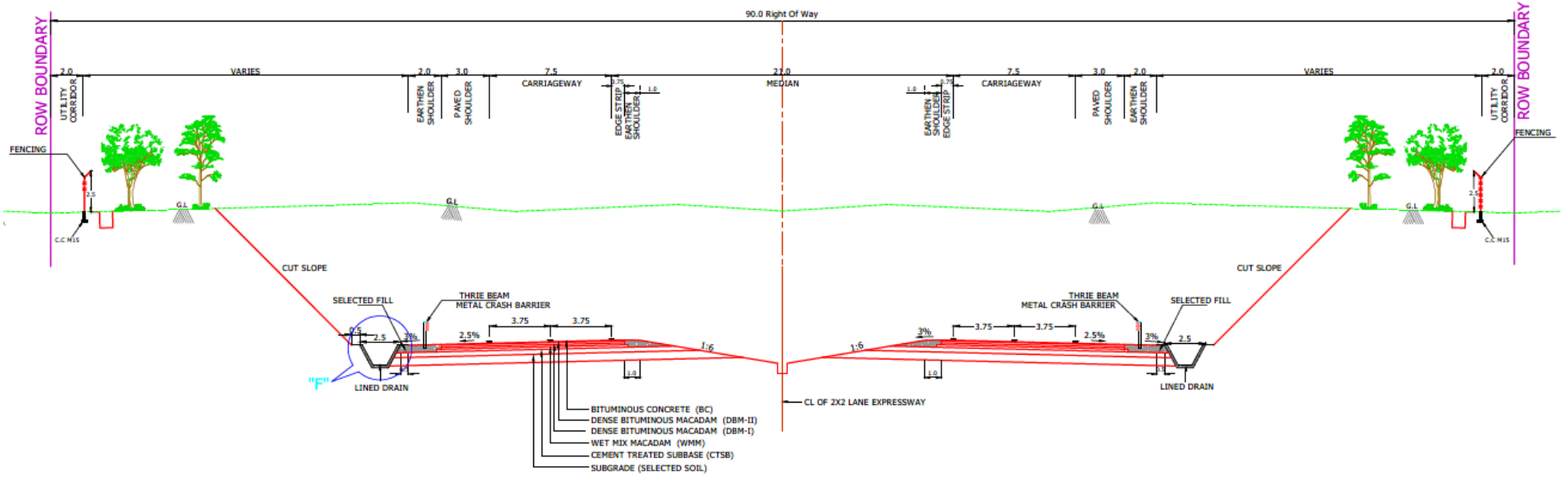
Note:

1. The lane configuration of all structures shall be as per Clause 4.17above.
2. Ifthepavedcarriagewaywidthatstructureismorethanthecarriagewaywidthgiven in TCS, proper pavement tapering (as per manual) shall beprovided.

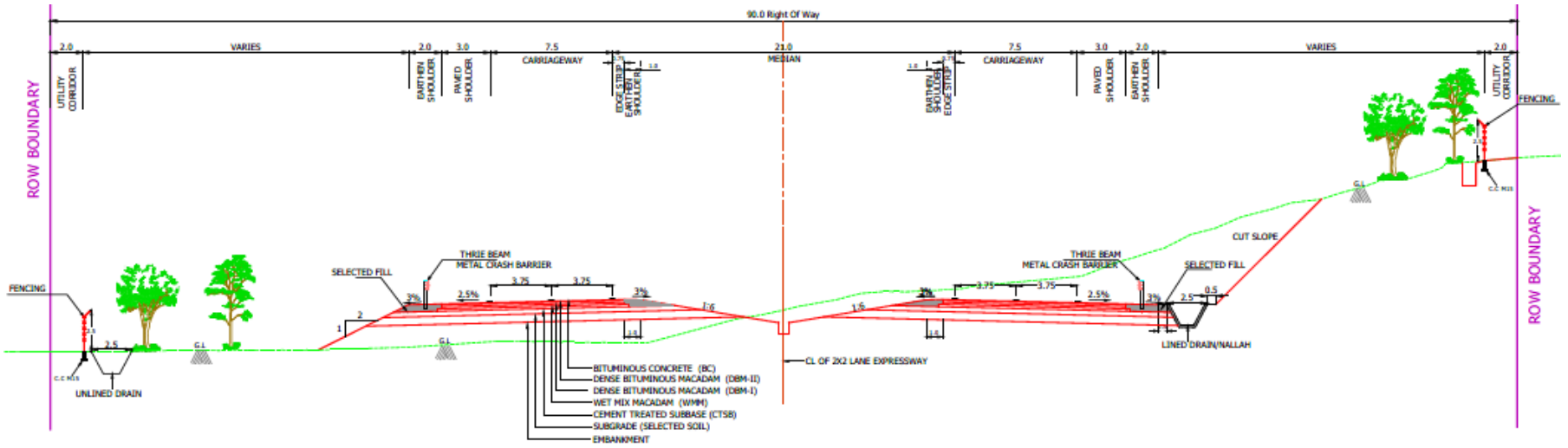
TYPICAL CROSS SECTION (MAIN EXPRESSWAY)



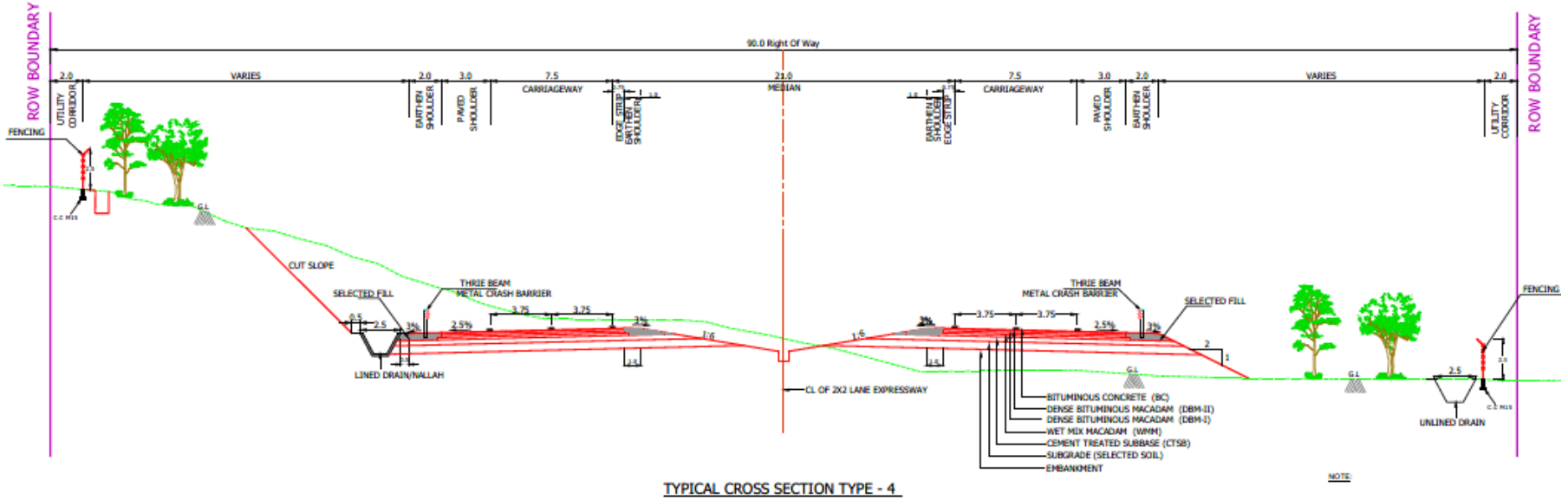
TYPICAL CROSS SECTION TYPE - 1
4-LANE EXPRESSWAY IN EMBANKMENT



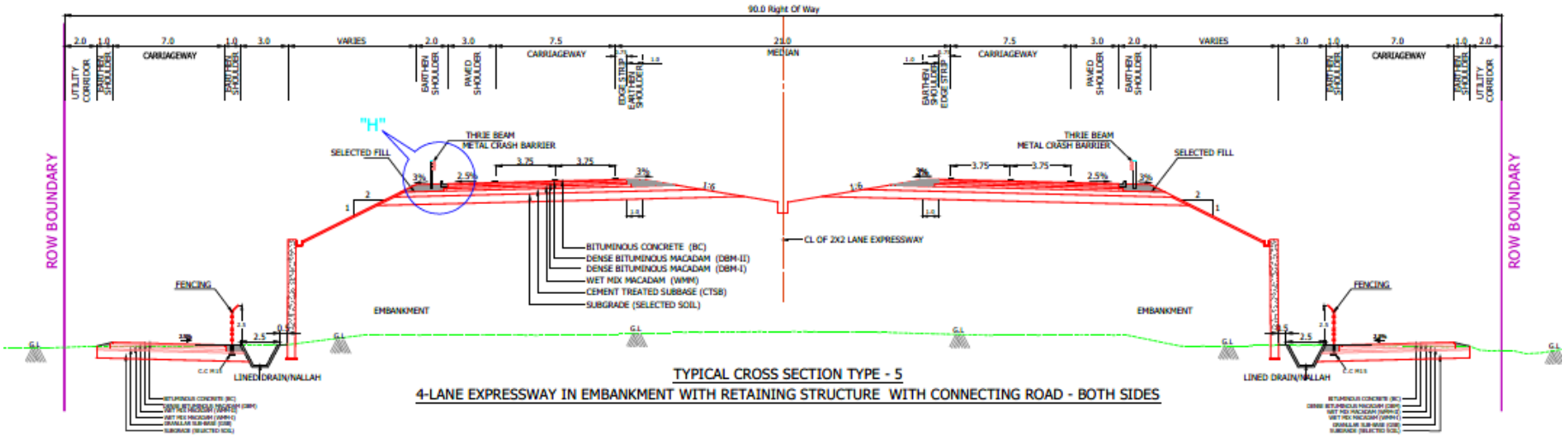
TYPICAL CROSS SECTION TYPE - 2
4-LANE EXPRESSWAY IN CUTTING



TYPICAL CROSS SECTION TYPE - 3
4-LANE EXPRESSWAY (EMBANKMENT ON LHS AND CUTTING ON RHS)

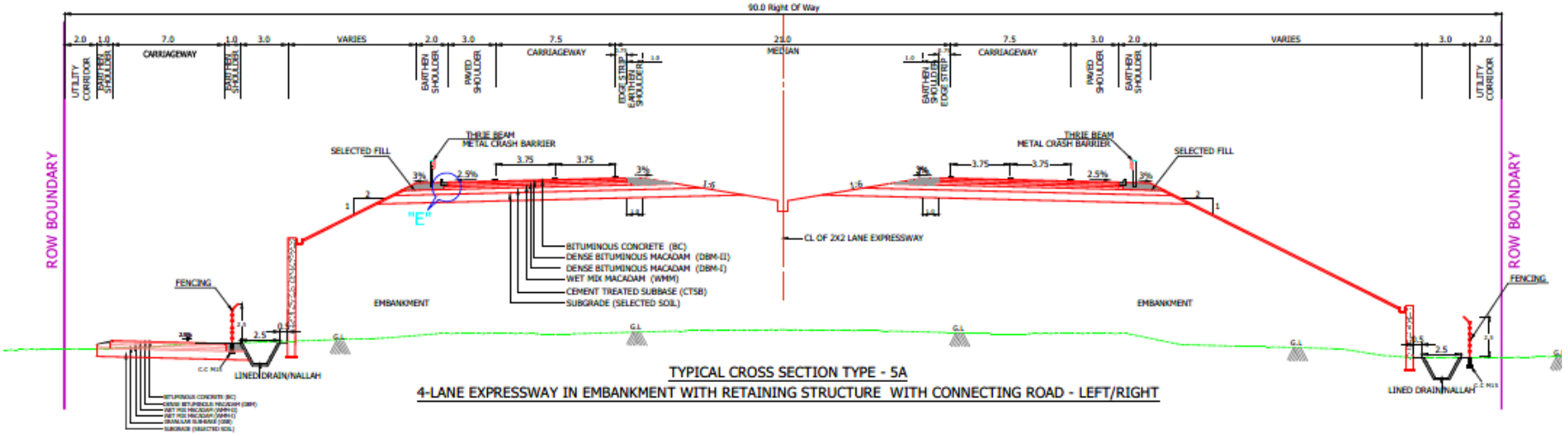


TYPICAL CROSS SECTION TYPE - 4
4-LANE EXPRESSWAY (CUTTING ON LHS AND EMBANKMENT ON RHS)



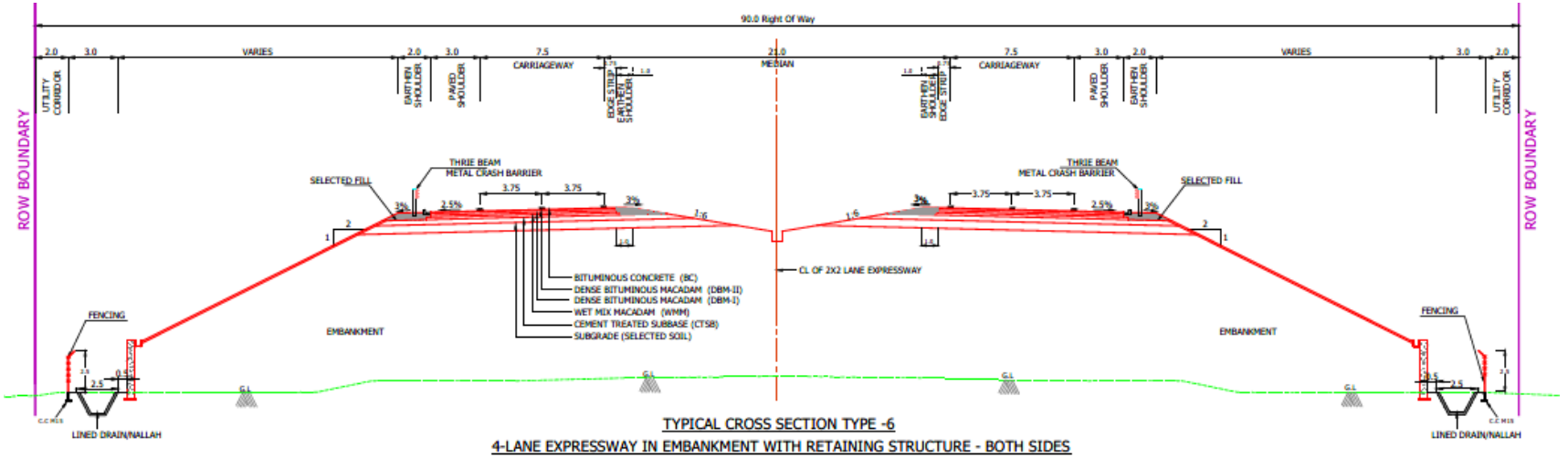
TYPICAL CROSS SECTION TYPE - 5

4-LANE EXPRESSWAY IN EMBANKMENT WITH RETAINING STRUCTURE WITH CONNECTING ROAD - BOTH SIDES

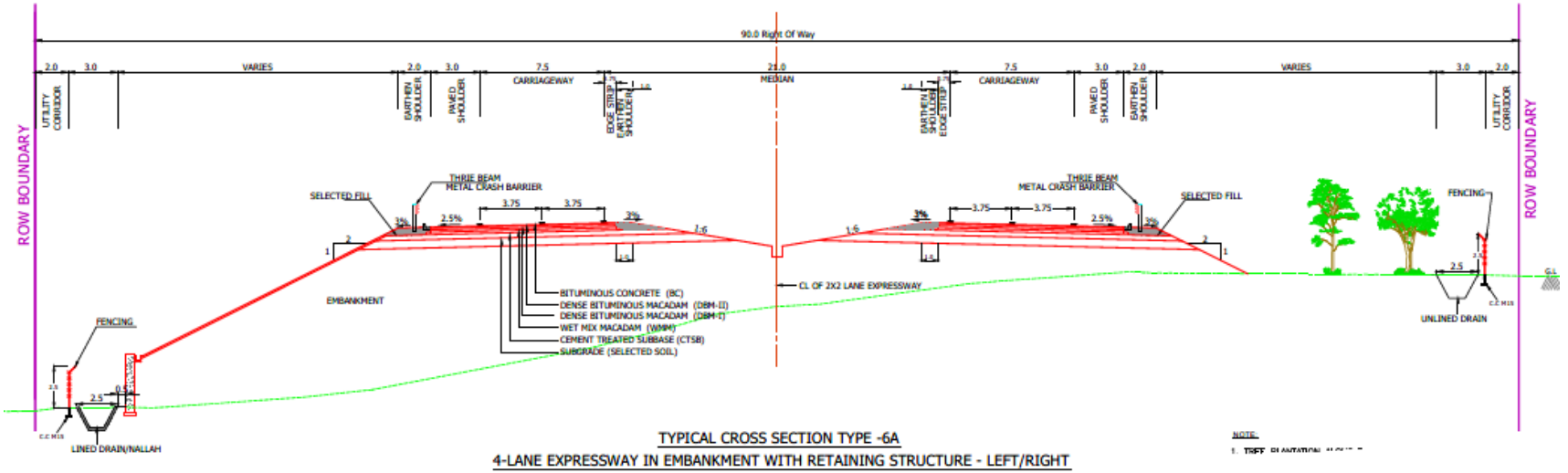


TYPICAL CROSS SECTION TYPE - 5A

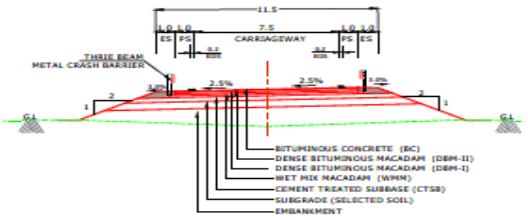
4-LANE EXPRESSWAY IN EMBANKMENT WITH RETAINING STRUCTURE WITH CONNECTING ROAD - LEFT/RIGHT



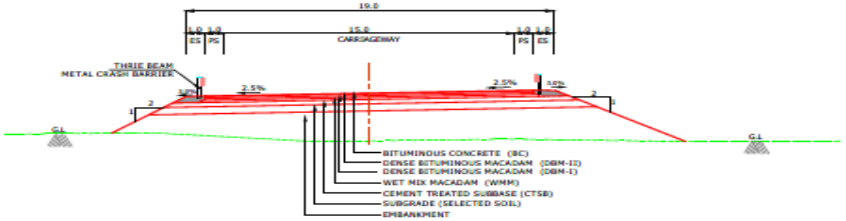
TYPICAL CROSS SECTION TYPE -6
4-LANE EXPRESSWAY IN EMBANKMENT WITH RETAINING STRUCTURE - BOTH SIDES



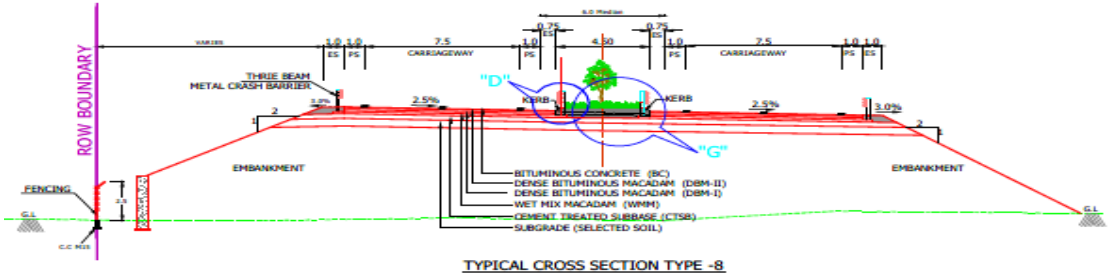
TYPICAL CROSS SECTION TYPE -6A
4-LANE EXPRESSWAY IN EMBANKMENT WITH RETAINING STRUCTURE - LEFT/RIGHT



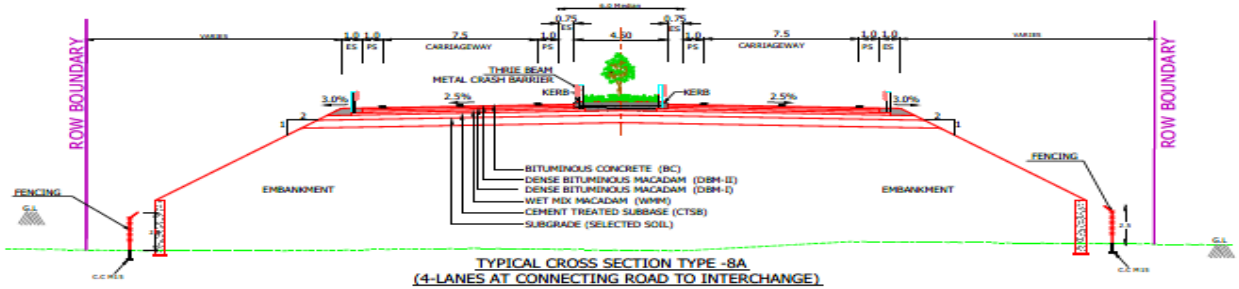
TYPICAL CROSS SECTION TYPE -7
TWO LANE LOOP AND RAMP



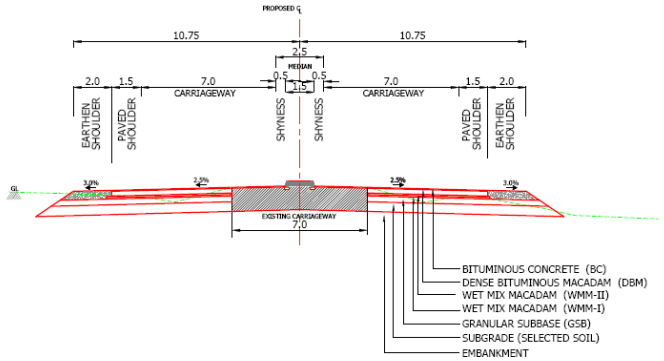
TYPICAL CROSS SECTION TYPE -7A
(WIDER CARRIAGEWAY AT LOOP)



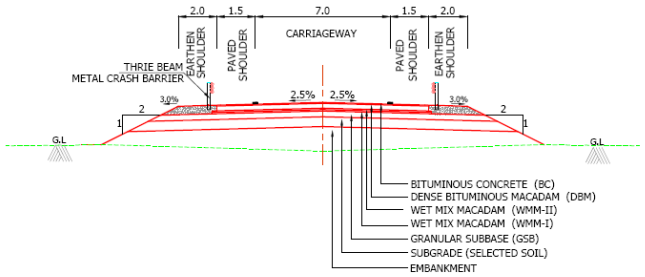
TYPICAL CROSS SECTION TYPE -8
(4-LANES AT LOOPS)



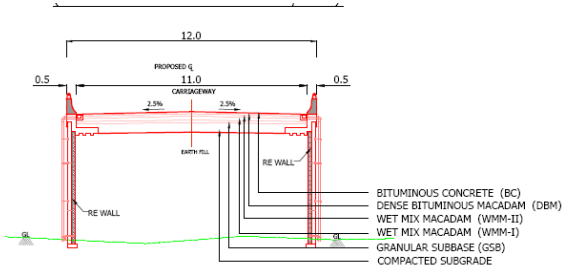
TYPICAL CROSS SECTION TYPE -8A
(4-LANES AT CONNECTING ROAD TO INTERCHANGE)



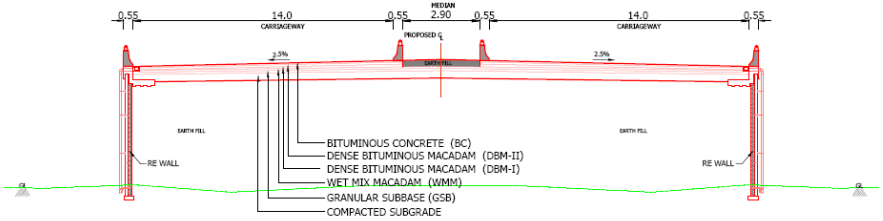
TYPICAL CROSS SECTION TYPE -9
(4-LANES ON CROSS ROAD AT INTERCHANGE JOINING POINT)



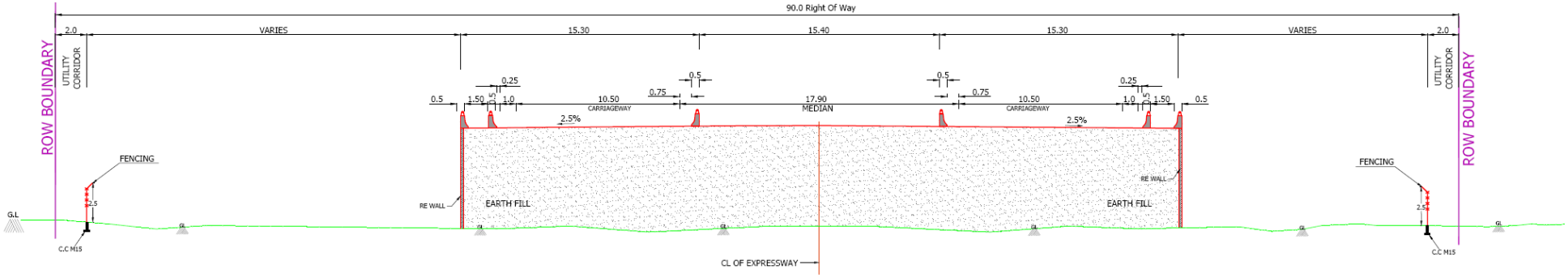
TYPICAL CROSS SECTION TYPE -10
(CROSS ROAD APPROACH AT VUP/LVUP)



TYPICAL CROSS SECTION TYPE -11
(2 LANE CROSS ROAD APPROACH AT OVERPASS)



TYPICAL CROSS SECTION TYPE -12

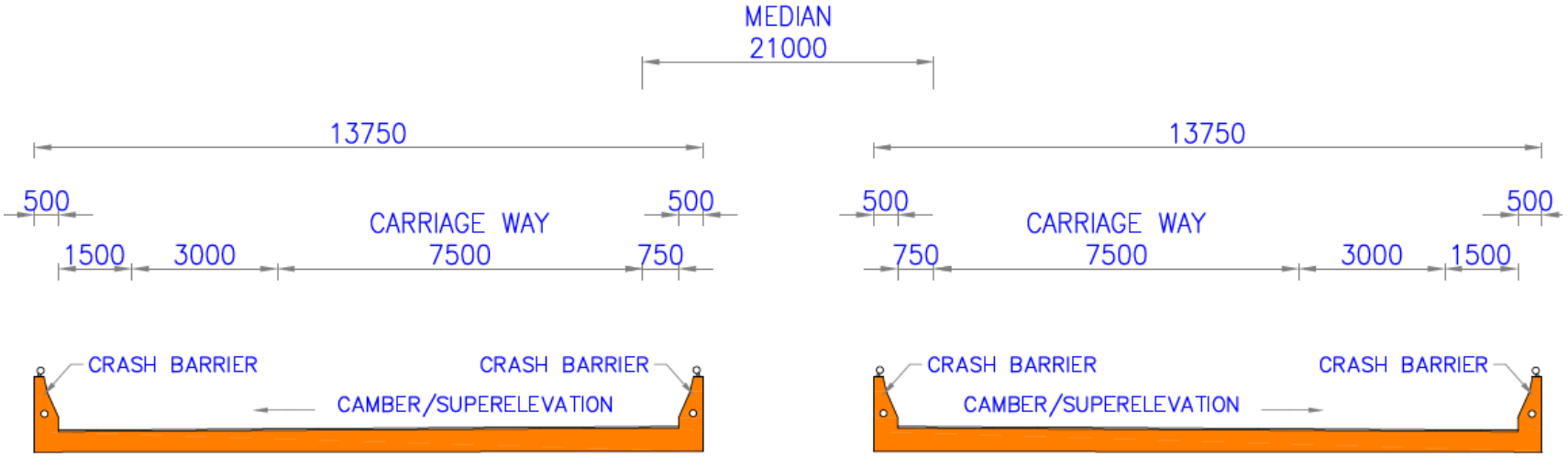


TYPICAL CROSS SECTION TYPE -13
4 LANE APPROACH TO ROAD OVER BRIDGE CH. 41+960

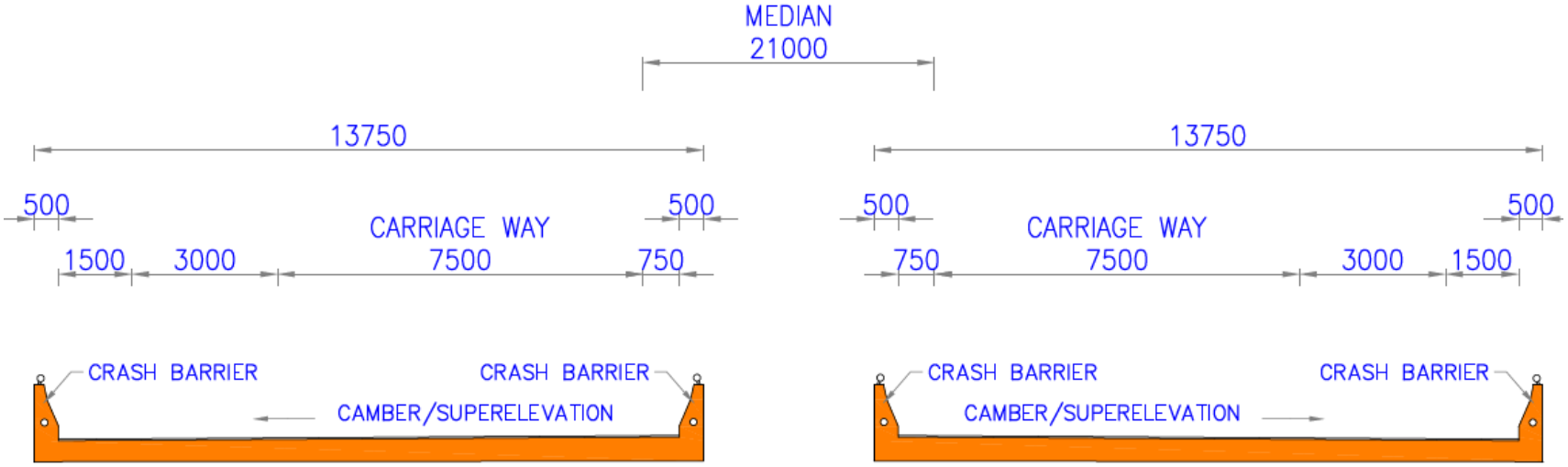
NOTE:

1. TREE PLANTATION ALONG THE EXPRESSWAY SHALL BI
2. ROAD SIDE DRAIN & MEDIAN DRAIN DESIGN, TYPE &

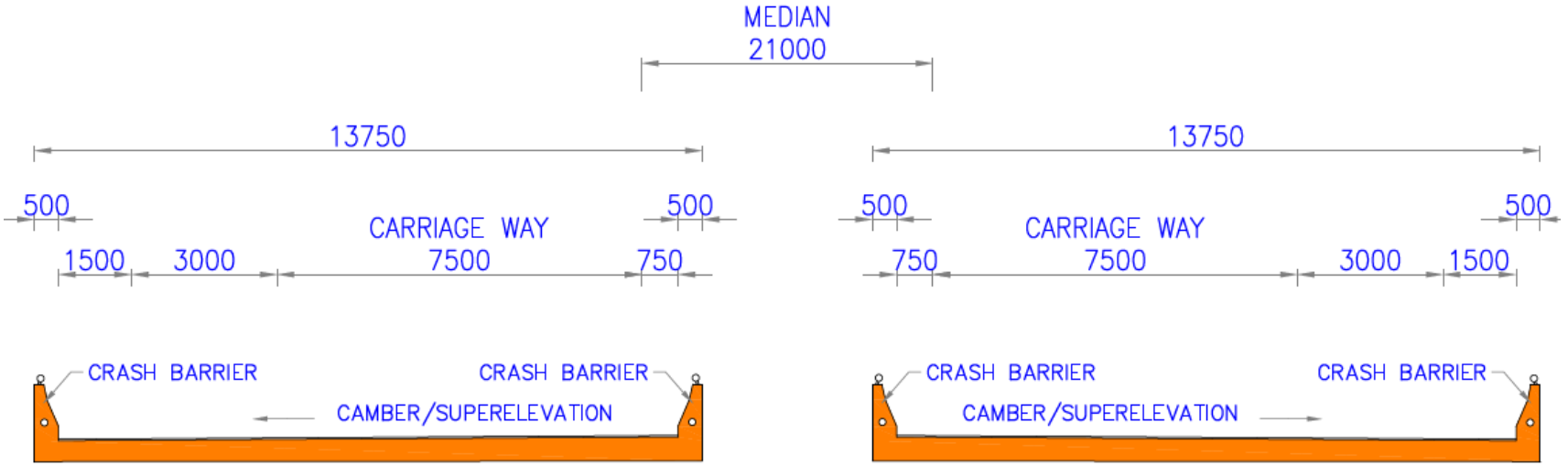
CROSS SECTION OF MAJOR BRIDGE (All dimension in mm)



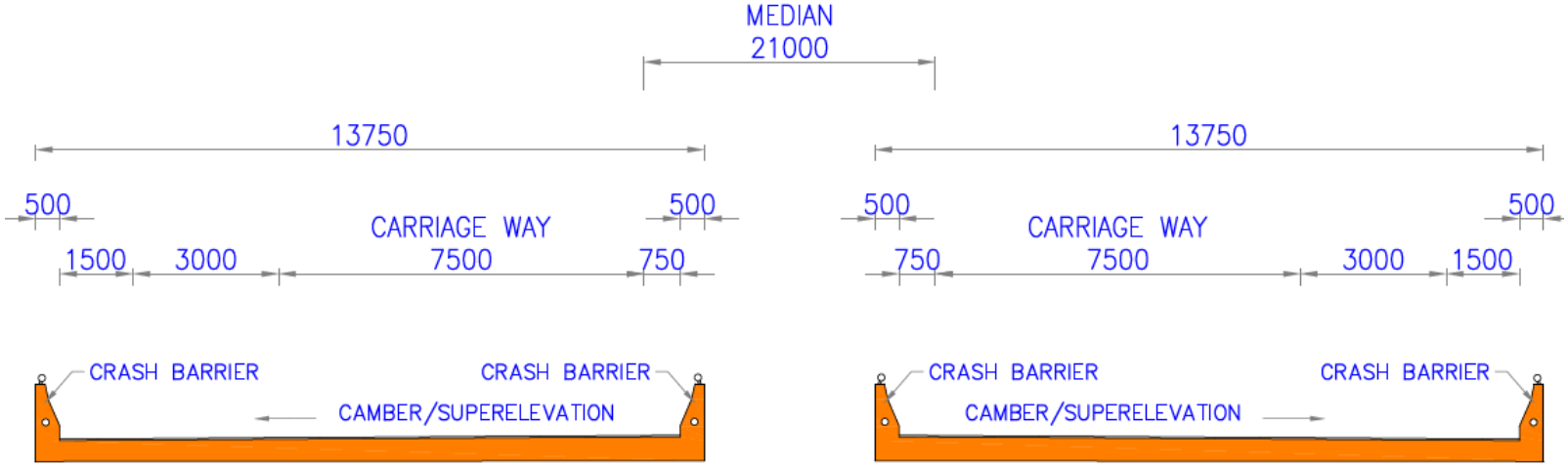
CROSS SECTION OF MINOR BRIDGE(All dimension in mm)



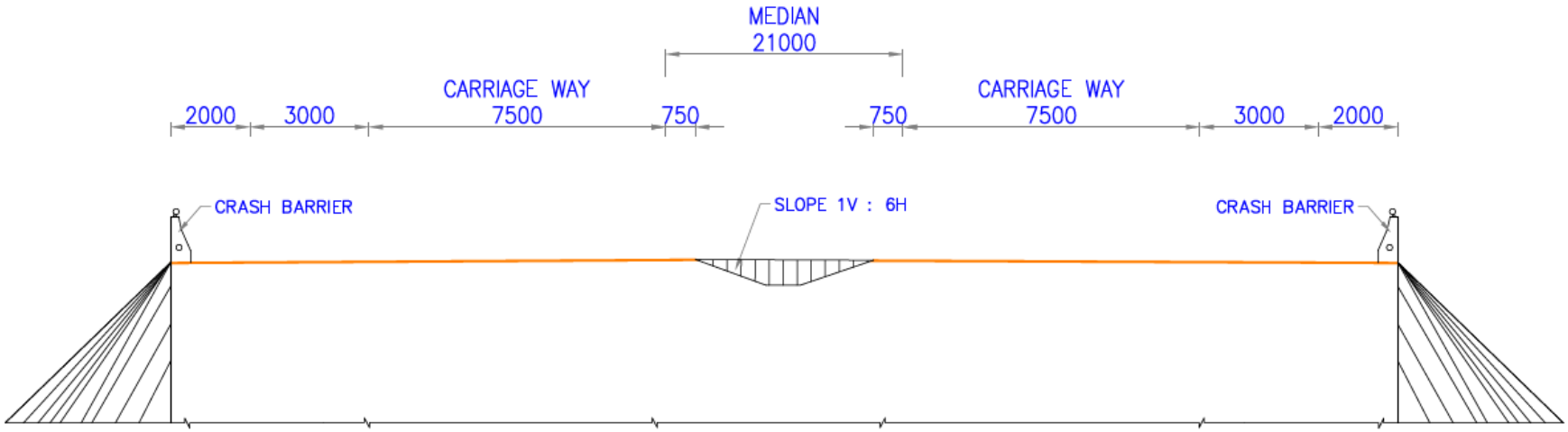
CROSS SECTION OF VEHICULAR UNDERPASS (All dimension in mm)



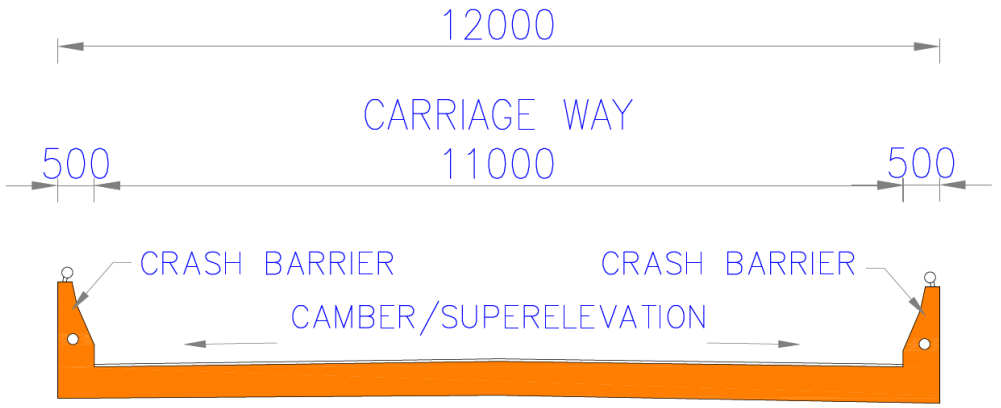
CROSS SECTION OF LIGHT VEHICULAR UNDERPASS (All dimension in mm)



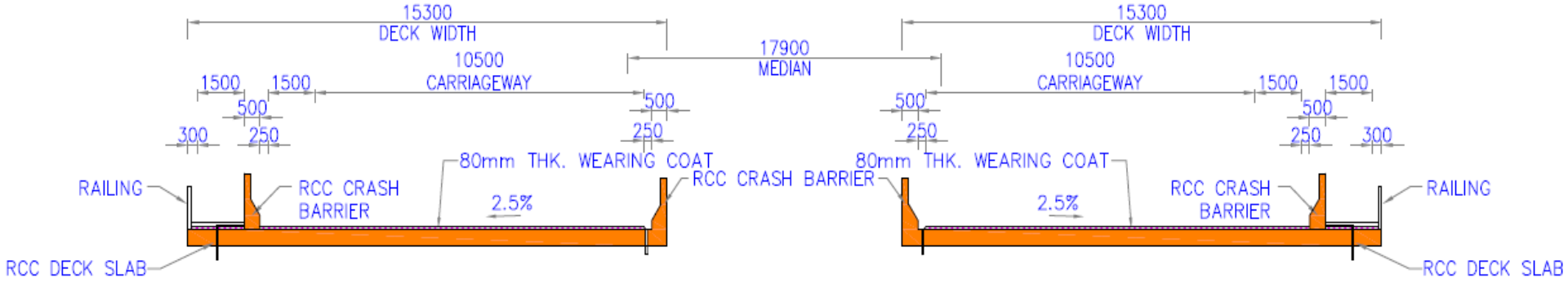
CROSS SECTION OF BOX CULVERTS (All dimension in mm)



CROSS SECTION OF VEHICULAR OVERPASS (All dimension in mm)



CROSS SECTION OF ROB (All dimension in mm)



Appendix B-I (B)

TYPICAL CROSS SECTION (LOOP/RAMP)

Minimum number of traffic lanes required in the opening year on Loop/ Ramp for each interchange is as follows:

Interchange No & Chainage (on BCE in Km)	Ramp No	Description	Lane Configuration	TCS Type
Main Expressway				
INT-03 & km 52.085	Loop-1 (Loop Ramp)	From Ch.0.000 to 0.306 From Kolar Gold Fields SH-95 (Bethmangala-Bangarpet road) to Chennai	4 lane	Type 8
	Loop-2 (Loop Ramp)	From Ch.0.000 to 0.719 From Kolar Gold Fields SH-95 (Bethmangala-Bangarpet road) to Chennai	2 Lane	Type 7
	Ramp-1 (Semi-directional Ramp)	From Ch.0.409 to 0.000 From Bangalore to Kolar Gold Fields SH-95 (Bethmangala-Bangarpet road)	2 lane	Type 7
	Ramp-2 (Directional Ramp)	From Ch.0.000 to 0.798 From Kolar Gold Fields SH-95 (Bethmangala-Bangarpet road) to Bangalore	2 lane	Type 7
	Ramp-3 (Directional Ramp)	From Ch.0.520 to 0.000 From Chennai to Kolar Gold Fields SH-95 (Bethmangala-Bangarpet road)	2 lane	Type 7

Note:

1. The width of Paved Carriageway shall be minimum as given in TCS. However, where toll plaza has to be constructed on Loop/Ramp, the width of Paved carriageway shall be as per the toll plaza lane configuration given in Schedule C and its taper (as per manual)
2. Any structure falling within Ramp/ Loop shall be constructed asper Clause 4.17 above.
3. Chainage mentioned in the above table is tentative as per design.
4. For Typical Cross Section applicable for loop/ramps refer TCS drawings attached

Appendix B-II

Alignment Plan and longitudinal Section are enclosed in digital form in CD marked as **Appendix B-II**

Appendix B-II (A)

DETAILS OF PROPOSED RIGHT OF WAY

Sl. No.	Stretches		Length (in km)	ROW Width (in m)	Remarks
	From (km)	To (km)			
Main Expressway					
1	26.400	47.693	21.293	90	
2	47.693	48.118	0.425	345+345	Rest Area- As per Design
3	48.118	51.725	3.607	90	
4	51.725	52.350	0.625	Varying as per Drawing No BCE/ML/INT/52+085-01A	Interchange Area
5	52.350	53.500	1.150	90	
Interchange - Connecting Road (IC at Km 52+085)					
1	0.000	2.143	2.143	Varying as per Drawing No BCE/ML/INT/52+085-01A & 01B	

Note:

1. The Concessionaire shall design the horizontal and vertical geometrics within the available ROW as detailed in Annexure-II of Schedule A and in consultation with IE/AE.

Appendix B-III

DETAILS OF CONNECTING ROADS

A. Connecting Roads – Main Expressway

Sl. No.	Stretches (Km)		Length (km)	Width (m)*
	From	To		
Left side Connecting Road (Main Expressway)				
1	37.169	37.241	0.072	As per Typical CS
Right side Connecting Road (Main Expressway)				
1	29.330	29.500	0.170	As per Typical CS
2	37.229	37.321	0.092	

B. CONNECTING ROADS-Interchange location

The approach road to interchanges shall be developed for certain length as per details given below;

Sl. No.	Start (km)	End (km)	Length (km)	Carriageway Width (m)	TCS Type	Remarks
Connecting Road – Interchange (Main Expressway) – INT-03 at km 52+085						
1	0.000	0.327	0.327	2x 10.25	Type-8A	
2	0.327	0.567	0.240	MJB		Drawing No: BCE/G:MJB (INT) - 09
3	0.567	0.685	0.118	2x 10.25	Type-8A	
4	0.685	0.947	0.262	Varies		Toll Plaza Area - Varying as per Drawing No BCE/ML/INT/52+085-01A & 01B
5	0.947	1.027	0.080			
6	1.027	1.225	0.198			
7	1.225	1.233	0.008	MNB		Drawing No: BCE/G:MNB (INT) - 10
8	1.233	1.289	0.056	Varies		Toll Plaza Area
9	1.289	1.515	0.226	2x 10.25	Type-8A	
10	1.515	1.540	0.025	MNB		Drawing No: BCE/G:MNB (INT) - 11
11	1.540	1.661	0.122	2x 10.25	Type-8A	
12	1.661	2.143	0.482	Varies		Varying as per Drawing No BCE/ML/INT/52+085-01A & 01B
Total Length (km)			**2.143**			

Note: The Chainage specified in above table considering the Loop ramp joining the NH/SH as center.

The length indicated in the above table is tentative and shall be finalized as per site condition in consultation with Authority/NHAI. Any change in length shall not be construed as change of scope.

Any structure (culvert/bridge) identified along the above connecting road, shall be widened/retained/reconstructed as per its structural condition as per schedule D in consultation with Authority/NHAI.

Appendix B-IV

STRUCTURE DETAILS OF INTERCHANGES

Sl. No.	Chainage (km)	Connecting Roads	Span Arrangement c/c Expansion (m)	Carriage way width	Deck Configuration (m)	Total Length (m)	Remarks
1	52+085	Kolar Gold Field Road-Bethamangala Road (SH-95)	1 x 35	26.25+15.75	27.25 + 16.75	35	Trumpet

Note**:** The minimum vertical clearance of all interchanges shall be 5.5m

Notes: (1) The span mentioned above is clear span measured in square direction only. The locations, orientation of the above mentioned structures are tentative and may vary as per the actual site condition. For cross road in skew the proposed structure shall be provided in skew only

(2) The exact location of structures shall be finalized in consultation with the IE and any change in location shall not be construed as change in the scope of work.

(3) Minimum vertical clearance shall be maintained by re-grading cross roads, if necessary, along with approaches (by providing same pavement as existing road) as per site condition as per standard codal provisions. This shall not be construed as change in scope of work.

(4) Adequate lighting, ventilation, provisions for protection against rain, etc. shall be made in consultation with IE/NHAI.

(5) All underneath cross roads shall be reconstructed and developed as per requirement of relevant IRC standards.

(6) Pumping arrangements including pumping station, sump etc. for dewatering the underpass shall be provisioned as per the requirement in addition to efficient natural drainage system. Requirement of structures as per site conditions identified during construction shall be considered as part of the project. The length of such structures shall be as per cross section, skew & location.

(7) Requirement of structures as per site conditions identified during construction shall be considered as part of the project. The length of such structures shall be as per cross section, skew & location.

Appendix B-V

DETAILS OF FLYOVERS

S.No	Location Design Chainage (km)	No. & length	SKEW ANGLE (Deg)	Total Length (excluding earth retaining structure)	Carriageway width (m)	Deck width (m)	Remarks
NIL							

Notes:

(1) The span mentioned above is clear span measured in square direction only. The locations, orientation of the above mentioned structures are tentative and may vary as per the actual site condition. For cross road in skew the proposed structure shall be provided in skew only

(2) The exact location of structures shall be finalized in consultation with the IE and any change in location shall not be construed as change in the scope of work.

(3) Minimum vertical clearance shall be maintained by re-grading cross roads, if necessary, along with approaches (by providing same pavement as existing road) as per site condition as per standard codal provisions. This shall not be construed as change in scope of work.

(4) Adequate lighting, ventilation, provisions for protection against rain, etc. shall be made in consultation with IE/NHAI.

(5) All underneath cross roads shall be reconstructed and developed as per requirement of relevant IRC standards.

(6) Pumping arrangements including pumping station, sump etc. for dewatering the underpass shall be provisioned as per the requirement in addition to efficient natural drainage system.

(7) Requirement of structures as per site conditions identified during construction shall be considered as part of the project. The length of such structures shall be as per cross section, skew & location.

Appendix B-VI

DETAILS OF VEHICULAR UNDERPASSES

Sl. No.	Chainage (km)	Type of Crossing	Horizontal Clearance (m)	Deck Configuration (m)	Width of Open Median (m)	Minimum Vertical Clearance (m)
	Main Expressway					
1	28.126	VR	12	2 x 13.75	18.5	5.5
2	28.680	VR	12	2 x 13.75	18.5	5.5
3	32.327	SH 99	30	2 x 13.75	18.5	5.5
4	37.235	VR	12	2 x 13.75	18.5	5.5
5	39.610	VR	12	2 x 13.75	18.5	5.5
6	43.687	VR	12	2 x 13.75	18.5	5.5
7	47.245	VR	12	13.75+21.25	18.5	5.5
8	49.220	VR	12	2 x 13.75	18.5	5.5

Notes: (1) The span mentioned above is clear span measured in square direction only. The locations, orientation of the above mentioned structures are tentative and may vary as per the actual site condition. For cross road in skew the proposed structure shall be provided in skew only

(2) The exact location of structures shall be finalized in consultation with the IE and any change in location shall not be construed as change in the scope of work.

(3) Minimum vertical clearance shall be maintained by re-grading cross roads, if necessary, along with approaches (by providing same pavement as existing road) as per site condition as per standard codal provisions. This shall not be construed as change in scope of work.

(4) Adequate lighting, ventilation, provisions for protection against rain, etc. shall be made in consultation with IE/NHAI.

(5) Pumping arrangements including pumping station, sump etc. for dewatering the underpass shall be provisioned as per the requirement in addition to efficient natural drainage system.

(6) Requirement of structures as per site conditions identified during construction shall be considered as part of the project. The length of such structures shall be as per cross section, skew & location.

Appendix B-VI(A)

DETAILS OF VEHICULAR OVERPASSES

Sl. No.	Chainage (km)	Type of Crossing	Span Arrangement c/c Expansion (m)	Carriageway Width (m)	Deck Configuration (m)	Minimum Vertical Clearance (m)
1	31.310	VR	2 x 40	1 x 11	1 x 12	5.5
2	33.562	VR	2 x 40	1 x 11	1 x 12	5.5
3	45.033	VR	2 x 40	1 x 11	1 x 12	5.5

Notes: (1) The span mentioned above is clear span measured in square direction only. The locations, orientation of the above mentioned structures are tentative and may vary as per the actual site condition. For cross road in skew the proposed structure shall be provided in skew only

(2) The exact location of structures shall be finalized in consultation with the IE and any change in location shall not be construed as change in the scope of work.

(3) Minimum vertical clearance shall be maintained by re-grading cross roads, if necessary, along with approaches (by providing same pavement as existing road) as per site condition as per standard codal provisions. This shall not be construed as change in scope of work.

(4) Adequate lighting, ventilation, provisions for protection against rain, etc. shall be made in consultation with IE/NHAI.

(5) Pumping arrangements including pumping station, sump etc. for dewatering the underpass shall be provisioned as per the requirement in addition to efficient natural drainage system.

(6) Requirement of structures as per site conditions identified during construction shall be considered as part of the project. The length of such structures shall be as per cross section, skew & location.

Appendix B-VII

DETAILS OF LIGHT VEHICULAR UNDERPASSES

Sl. No.	Chainage (in km)	Type of Crossing	Horizontal Clearance (m)	Deck configuration (m)	Width of Open Median (m)	Minimum Vertical Clearance (m)
Main Expressway						
1	29.490	VR	12	2x13.75	18.5	4.0
2	34.120	VR	12	2x13.75	18.5	4.0
3	36.768	VR	12	2x13.75	18.5	4.0
4	38.543	VR	12	2x13.75	18.5	4.0
5	40.595	VR	12	2x13.75	18.5	4.0
6	48.488	VR	12	21.25+13.75	18.5	4.0

Notes:

(1) The span mentioned above is clear span measured in square direction only. The locations, orientation of the above mentioned structures are tentative and may vary as per the actual site condition. For cross road in skew the proposed structure shall be provided in skew only

(2) The exact location of structures shall be finalized in consultation with the IE and any change in location shall not be construed as change in the scope of work.

(3) Minimum vertical clearance shall be maintained by re-grading cross roads, if necessary, along with approaches (by providing same pavement as existing road) as per site condition as per standard codal provisions. This shall not be construed as change in scope of work.

(4) Adequate lighting, ventilation, provisions for protection against rain, etc. shall be made in consultation with IE/NHAI.

(5) Pumping arrangements including pumping station, sump etc. for dewatering the underpass shall be provisioned as per the requirement in addition to efficient natural drainage system.

(6) Requirement of structures as per site conditions identified during construction shall be considered as part of the project. The length of such structures shall be as per cross section, skew & location.

Appendix B-VII(A)

DETAILS OF PEDESTRIAN / CATTLE UNDERPASSES

Sl. No.	Chainage (in km)	Type of Crossing	Type of Structure	Horizontal Clearance (m)	Deck configuration (m)	Width of open median (m)	Minimum vertical clearance (m)
Nil							

Notes:

(1) The span mentioned above is clear span measured in square direction only. The locations, orientation of the above mentioned structures are tentative and may vary as per the actual site condition. For cross road in skew the proposed structure shall be provided in skew only

(2) The exact location of structures shall be finalized in consultation with the IE and any change in location shall not be construed as change in the scope of work.

(3) Minimum vertical clearance shall be maintained by re-grading cross roads, if necessary, along with approaches (by providing same pavement as existing road) as per site condition as per standard codal provisions. This shall not be construed as change in scope of work.

(4) Adequate lighting, ventilation, provisions for protection against rain, etc. shall be made in consultation with IE/NHAI.

(5) Pumping arrangements including pumping station, sump etc. for dewatering the underpass shall be provisioned as per the requirement in addition to efficient natural drainage system.

(6) Requirement of structures as per site conditions identified during construction shall be considered as part of the project. The length of such structures shall be as per cross section, skew & location.

Appendix B-VIII

MAJOR BRIDGES

Sl. No.	Chainage (km)	Name of Bridge	Linear waterway (m)	Carriageway Width (m)	Deck Configuration (m)	Width of open median (m)
1	30.705	Kuntanahalli Tank	180	2 x 12.75	2x13.75	18.5
2	35.520	Naganathapura Tank	250	2 x 12.75	2x13.75	18.5
3	40.880	Kuppanahalli Tank	90	2 x 12.75	2x13.75	18.5
4	41.396	-	250	2 x 12.75	2x13.75	18.5
5	44.300	Margal Tank	100	2 x 12.75	2x13.75	18.5
6	45.953	Iythandahalli Tank	150 + 15 (MJB + VUP)	2 x 12.75	2x13.75	18.5
7	47.600	Kaveranahalli Tank	150	2 x 31.0	2 x 32.00	18.5
8	49.875	Karapanahalli Tank	450	2 x 12.75	2x13.75	18.5
II	**Interchange Locations**					
1	0.447	Krishnarajapura Tank	240	2 x 10.75	2 x 11.75	3.5

Notes: (1) The span mentioned above is clear span measured in square direction only. The locations, orientation of the above mentioned structures are tentative and may vary as per the actual site condition. For Nala/stream/tanks in skew, the proposed structure shall be provided in skew only

(2) No. of expansion joints shall be reduced by provision of continuous spans, as directed by IE.

(3) The exact location of structures shall be finalized in consultation with the IE and any change in location shall not be construed as change in the scope of work.

(4) The Deck level of the above Bridges shall be governed by guidelines of Concerned Authorities

(5) Desilting shall be carried out in the tank area up to the confirmed bed level as directed by IE. Requirement of structures as per site conditions identified during construction shall be considered as part of the project. The length of such structures shall be as per cross section, skew & location.

(7) Requirement of structures as per site conditions identified during construction shall be considered as part of the project. The length of such structures shall be as per cross section, skew & location.

Appendix B-IX

MAJOR – CANAL OVER BRIDGES

S.No	Design Chainage (Km)	Carriageway width (m)	Overall width (m)	Span Arrangement (m)	SKEW ANGLE (Deg)	Super Structure	Sub-structure
NIL							

Notes: (1) The span mentioned above is clear span measured in square direction only. The locations, orientation of the above mentioned structures are tentative and may vary as per the actual site condition. For Nala/stream/tanks in skew, the proposed structure shall be provided in skew only

(2) No. of expansion joints shall be reduced by provision of continuous spans, as directed by IE.

(3) The exact location of structures shall be finalized in consultation with the IE and any change in location shall not be construed as change in the scope of work.

(4) The Deck level of the above Bridges shall be governed by guidelines of Concerned Authorities

(5) Desilting shall be carried out in the tank area up to the confirmed bed level as directed by IE.

(6) Requirement of structures as per site conditions identified during construction shall be considered as part of the project. The length of such structures shall be as per cross section, skew & location.

Appendix B-X

SPECIAL STRUCTURES (OVER RIVERS/ STREAMS/ NALLAS)

Sl. No.	Chainage(km)	Name of Bridge	Span Arrangement c/c Expansion	Total length F/F of Dirt wall (m)	Structure Type	Carriage way width (m)	Deck Configur ation (m)	Width of open median (m)
Nil								

Appendix B-X(A)

UTILITY STRUCTURES (Structures to be constructed for utility crossing the proposed expressway)

S.No	Design Chainage (Km)	Carriageway width (m)	Overall width (m)	SKEW ANGLE (Deg)	length (m)
1	29.300	2 x 12.75	2 x 13.75	82	26

Notes: (1) The length mentioned above is clear span measured in square direction only. Span arrangement shall be finalized in consultation with Utility owning agency/IOCL. The locations, orientation of the above mentioned structures are tentative and may vary as per the actual site condition. For cross road in skew the proposed structure shall be provided in skew only

(2) The exact location of structures shall be finalized in consultation with the IE and any change in location shall not be construed as change in the scope of work.

(3) The Deck level of the above Bridges shall be governed by guidelines of Concerned Authorities.

(4) The location and ROW of the pipelines shall be confirmed in consultation with the GAS/OIL Authority along with the IE. Barricading shall be provided at the pipeline ROW

(5) Requirement of structures as per site conditions identified during construction shall be considered as part of the project. The length of such structures shall be as per cross section, skew & location.

Appendix B-XI

MINOR BRIDGE

Sl. No.	Chainage (km)	Linear Waterway (m)	Carriage-way Width (m)	Deck Configuration (m)	Width of open median (m)	Existing Feature
I	**Main Expressway**					
1	27.005	9	2 X 12.75	2 x 13.75	18.5	Stream
2	27.239	30	2 X 12.75	2 x 13.75	18.5	Stream
3	28.150	7.5	2 X 12.75	2 x 13.75	18.5	Stream
4	28.200	7.5	2 X 12.75	2 x 13.75	18.5	Stream
5	28.250	7.5	2 X 12.75	2 x 13.75	18.5	Stream
6	28.840	18	2 X 12.75	2 x 13.75	18.5	Stream
7	35.035	8	2 X 12.75	2 x 13.75	18.5	Stream
8	35.227	19.5	2 X 12.75	2 x 13.75	18.5	Stream
9	36.209	12	2 X 12.75	2 x 13.75	18.5	Stream
10	36.452	10	2 X 12.75	2 x 13.75	18.5	Stream
11	37.780	8	2 X 12.75	2 x 13.75	18.5	Stream
12	39.226	40	2 X 12.75	2 x 13.75	18.5	Stream
13	40.950	8	2 X 12.75	2 x 13.75	18.5	Stream
14	44.865	20	2 X 12.75	2 x 13.75	18.5	Stream
15	46.688	18	2 X 12.75	2 x 13.75	18.5	Stream
16	47.342	15	16.25 + 20.25	17.25 + 21.25	18.5	Stream
17	48.926	15	2 X 12.75	2 x 13.75	18.5	Stream
18	50.428	19.5	2 X 12.75	2 x 13.75	18.5	Stream
19	51.134	13	2 X 12.75	2 x 13.75	18.5	Stream
20	51.269	13	2 X 12.75	2 x 13.75	18.5	Stream
21	52.330	13	2 x 12.75 + 2 x 10.50	2 x 13.75 + 2 x 11.50	18.5	Stream
22	52.665	16.5	21.4 + 12.75	22.4 + 13.75	18.5	Stream
23	53.033	18	2 X 12.75	2 x 13.75	18.5	Stream
24	53.123	26	2 X 12.75	2 x 13.75	18.5	Stream
25	53.195	26	2 X 12.75	2 x 13.75	18.5	Stream
II	**Interchange Locations**					
1	1.229 of Connecting Road of INT-03	8	2 x 17.50	2 x 18.50	3.5	Stream
2	1.527 of Connecting Road of INT-03	25	2 x 10.75	2 x 11.75	3.5	Stream

Notes: (1) The span mentioned above is clear span measured in square direction only. The locations, orientation of the above mentioned structures are tentative and may vary as per the actual site condition. For cross road in skew the proposed structure shall be provided in skew only

(2) The exact location of structures shall be finalized in consultation with the IE and any change in location shall not be construed as change in the scope of work.

(3) The Deck level of the above Bridges shall be governed by guidelines of Concerned Authorities.

(4) *The location and ROU of the pipelines shall be confirmed in consultation with the GAS/OIL Authority along with the IE. Barricading shall be provided at the pipeline ROU. The structure

shall be provided for required width and length considering the skew of the utility and shall not be construed as change in Scope of work.

(6) Desilting shall be carried out in the tank area up to the confirmed bed level as directed by IE.

(7) Requirement of structures as per site conditions identified during construction shall be considered as part of the project. The length of such structures shall be as per cross section, skew & location.

Appendix B-XII

MINOR – CANAL OVER BRIDGE

S.No	Design Chainage (Km)	Carriageway width (m)	Overall width (m)	SKEW ANGLE (Deg)	Span Arrangement (m)	Super Structure	Sub-structure
Nil							

Note: The proposed span arrangement is tentative as listed in Appendix B-IX and B-XII and the same shall be finalized in consultation with Irrigation Authority & IC duly taking into account future 8 laning of structures. Any change in span arrangement shall not be treated as change in scope of work. Requirement of structures as per site conditions identified during construction shall be considered as part of the project. The length of such structures shall be as per cross section, skew & location.

Appendix B-XIII

RAILWAY OVER BRIDGES(ROBS)

Sl. No	Chainage (km)	Name of Bridge	Type of Structure	Span Arrangement c/c Expansion (m)	Total length F/F of Dirt wall (m)	Carriageway width (m)	Deck Configuration (m)	Skew Angle (Deg)
1	41.960	Railway crossing & existing SH- 5	PSC I girder/ Steel Composite Girder	1 x 33.25 + 2 x 13.25 + 1 x 36.0	102.2	2 x 14.3	2 x 15.3	38°

The span arrangements decided after site visit with railway official and the same shall be followed as per the approved GAD by the concern railway authority & any change in span arrangement shall not be treated as change in the scope of work.

Notes: (1) The span mentioned above is clear span measured in square direction only. The locations, orientation of the above mentioned structures are tentative and may vary as per the actual site condition. For cross road in skew the proposed structure shall be provided in skew only

(2) Detailed drawings for the above structures shall be confirmed/ approved with concerned Railway authorities and IE/NHAI. Any change shall not be construed as change in scope of work.

(3) The exact location of structures shall be finalized in consultation with the IE and any change in location shall not be construed as change in the scope of work.

(4) The Deck level of the above Bridges shall be governed by guidelines of Concerned Authorities.

(5) The approaches to ROB in length not less than 100m on all four sides shall be constructed in full height using RE wall.

(6) Adequate lighting, ventilation, provisions for protection against rain, etc. shall be made in consultation with IE/NHAI.

(7)Instrumentation in the Railway Superstructure across Railway Bridge portion shall be implemented as per Circular No. NHAI/GM/ROB-RUB/2012 dated 25 Apr 2016 and with all amendments and additions till date.

The Concessionaire shall do instrumentation in the Railway Superstructure across Railway Bridge portion to ensure and carry out regular monitoring of the health of bridge to meet its serviceability and functionality requirement during the Concession period.

1. Phase-I: Installation of sensors and response monitoring during Construction and pre-stressing.
2. Phase-II: Study of performance parameters:
   a. Monitoring during Peak Summer
   b. Monitoring during Peak Winter
   c. Global Response Test
3. Long term performance monitoring of the bridge:
   Monitoring stages for different structural parameters

   a. Temperature measurements through embedded Sensors
   b. Strain Measurements through embedded V.W./Optical Fibre Strain Gauges.
   c. Tilt/Rotation Measurements.
   d. Deflection measurements of Superstructure.

e. Pre-stressing force measurement.
f. Settlement of Substructure.

Appendix B-XIV

LIST OF CULVERTS FOR CROSS DRAINAGE

(a) Main Carriageway

S. No.	Culvert Location (Design chainage)	Type of Culvert	Span / opening (No. x Length in m x Height in m)
1	26.860	Box	1 x 2.0 x 2.5
2	27.529	Box	1 x 2.0 x 2.5
3	27.764	Box	2 X 2.0 X 2.5
4	27.966	Box	1 x 2.0 x 2.5
5	28.113	Box	2 X 2.5 X 3.0
6	28.333	Box	3 x 2.0 x 2.5
7	29.640	Box	1 x 2.0 x 2.5
8	30.500	Box	1 x 2.0 x 2.5
9	31.735	Box	1 x 2.0 x 2.5
10	32.166	Box	1 x 2.0 x 2.5
11	33.000	Box	1 x 2.0 x 2.5
12	34.160	Box	1 x 2.0 x 2.5
13	34.205	Box	1 x 2.0 x 2.5
14	34.315	Box	1 x 2.0 x 2.5
15	34.540	Box	1 x 3.0 x 3.0
16	35.800	Box	1 x 2.0 x 2.5
17	37.110	Box	1 x 2.0 x 2.5
18	38.920	Box	1 x 2.0 x 2.5
19	39.780	Box	1 x 2.0 x 2.5
20	40.380	Box	1 x 2.0 x 2.5
21	41.665	Box	1 x 2.0 x 2.5
22	42.475	Box	1 x 2.0 x 2.5
23	42.938	Box	1 x 6.0 x 3.0
24	43.395	Box	2 x 3.0 x 3.0
25	43.603	Box	1 x 3.0 x 3.0
26	45.698	Box	2 X 3.0 X 3.0
27	46.275	Box	1 x 2.0 x 2.5
28	46.900	Box	1 x 2.0 x 2.5
29	48.450	Box	1 x 2.0 x 2.5
30	48.720	Box	1 x 2.0 x 2.5
31	49.455	Box	1 x 2.0 x 2.5
32	52.960	Box	2 x 3.0 x 3.0

(b) Interchanges

Sl.No.	Interchange (on BCE in km)	Type	Location		Size No x Width (m) x Height (m)
			Ramp/loop	Chainage (km)	
1	52.085	RCC Box	Connecting Road	1.323	1 x 3 x 3

Notes: (1) The overall width of the above culverts (as per paragraph 16 of Annex-I of Schedule-B) shall be equal to Roadway width including the gap between main carriageway & service road/Connection road, in case there is any service road/connection 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.

(2) The span mentioned above is clear span measured in square direction only. The locations, orientation of the above mentioned structures are tentative and may vary as per the actual site condition. For cross road in skew the proposed structure shall be provided in skew only

(3) The exact location of structures shall be finalized in consultation with the IE and any change in location shall not be construed as change in the scope of work.

(4) Requirement of culverts as per site conditions identified during construction shall be considered as part of the project. The length of such culverts shall be as per cross section, skew & location.

Appendix B-XV

Stretches for Provision of Retaining Wall

(A) Main Carriageway

S. No	Design Chainage		Length (m)	Side	Remarks
	From	To			
1	28300	28674	374	LHS	
2	28686	28831	145	LHS	
3	28849	29165	316	LHS	
4	32015	32250	235	LHS	
5	33569	33800	231	LHS	Cutting
6	35750	35900	150	LHS	
7	37100	37229	129	LHS	
8	37241	37350	109	LHS	
9	37450	37600	150	LHS	
10	38900	39206	306	LHS	
11	39246	39550	304	LHS	
12	41200	41810	610	LHS	
13	42110	42800	690	LHS	
14	43250	43600	350	LHS	
15	44900	45027	127	LHS	Cutting
16	45040	45350	310	LHS	Cutting
17	46350	46550	200	LHS	
18	46900	47239	339	LHS	
19	47251	47333	82	LHS	
20	47351	47525	164	LHS	
21	49400	49650	250	LHS	
22	50100	50350	250	LHS	
23	50350	50417	67	LHS	
24	50439	50500	61	LHS	
25	51150	51200	50	LHS	
26	51200	51262	62	LHS	
27	51276	51300	24	LHS	
Total Length in meter on Left Hand Side			**6085**		

S. No	Design Chainage		Length (m)	Side	Remarks
	From	To			
1	28050	28120	70	RHS	
2	28132	28146	14	RHS	
3	28154	28196	43	RHS	
4	28204	28246	43	RHS	
5	28254	28674	420	RHS	
6	28686	28831	145	RHS	

S. No	Design Chainage		Length (m)	Side	Remarks
7	28849	29165	316	RHS	
8	29435	29484	49	RHS	
9	29496	29650	154	RHS	
10	31900	32250	350	RHS	
11	32250	32312	62	RHS	
12	33500	33800	300	RHS	Cutting
13	35800	35900	100	RHS	
14	37241	37321	80	RHS	
15	38900	39206	306	RHS	
16	39246	39600	354	RHS	
17	39616	39700	84	RHS	
18	41100	41810	710	RHS	
19	42110	42650	540	RHS	
20	43300	43600	300	RHS	
21	45000	45027	27	RHS	Cutting
22	45040	45300	260	RHS	Cutting
23	46350	46450	100	RHS	
24	46900	47239	339	RHS	
25	47251	47333	82	RHS	
26	47351	47525	174	RHS	
27	49226	49650	379	RHS	
28	50100	50417	317	RHS	
29	50441	50500	59	RHS	
30	52350	52450	100	RHS	
31	53000	53023	23	RHS	
Total Length in meter on Right Hand Side			**6300**		

(B) Interchange at km 52.085

Location	Design Chainage		Length (m)	Side	Remarks
	From	To			
Main Expressway	51.725	51.750	25	LHS	Cutting
Ramp 1	0.210	0.250	40	LHS	Cutting
Ramp 2	0.155	0.798	643	LHS	Cutting
Ramp 3	0.100	0.150	50	LHS	Cutting
Ramp 3	0.300	0.400	100	LHS	
Loop 2	0.300	0.686	386	LHS	
Connecting road	0.300	0.327	27	LHS	
Connecting road	0.567	0.700	133	LHS	
Connecting road	0.900	1.139	239	LHS	Cutting
Connecting road	1.500	1.643	143	LHS	
Total Length in meter on Left Hand Side			**1786**		

Location	Design Chainage		Length (m)	Side	Remarks
	From	To			
Main Expressway	51.725	51.750	25	RHS	Cutting
Main Expressway	51.800	51.900	100	RHS	
Main Expressway	52.200	52.323	123	RHS	
Main Expressway	52.337	52.350	13	RHS	
Ramp 1	0.250	0.409	159	RHS	Cutting
Ramp 2	0.155	0.250	95	RHS	Cutting
Ramp 2	0.350	0.388	38	RHS	Cutting
Ramp 3	0.300	0.350	50	RHS	
Ramp 3	0.350	0.520	170	RHS	
Loop 1	0.050	0.306	256	RHS	Cutting
Loop 2	0.150	0.200	50	RHS	Cutting
Connecting road	0.300	0.327	27	RHS	
Connecting road	0.567	0.718	151	RHS	
Connecting road	1.350	1.643	293	RHS	
Total Length in meter on Right Hand Side			**1550**		

Notes: (1) Negative values in the height column indicates cutting.

(2) The exact location and type of retaining structures shall be finalized in consultation with the IE and any change in location shall not be construed as change in the scope of work.

(3) The above list is indicative. RE wall/Retaining wall/Toe wall shall be provided wherever required in order to restrict the embankment slope within the proposed Right of Way. The actual lengths as required on the basis of detailed investigations shall be determined in accordance with the Specifications and Standards. The change in length shall not be construed as change in scope of work.

Appendix B-XVI

STRETCHES FOR SPECIAL PROTECTION IN RAVINES AREA

Sl. No.	Stretches (Km)		Type of Protection / TCS Type
	From	To	
Nil			

Appendix B-XVII

ADVANCE TRAFFIC MANAGEMENT SYSTEM (ATMS)

Sl. No.	Type of ATMS	Location	Remarks
1	Mobile Communication System	At such locations so as to cover entire length with mobile communications.	
2	Variable Message Signs	Near starting and Ending of the project either side of the main carriageway near the interchanges and other locations as decided by IE/NHAI	
3	Meteorological Data System	Interchange/near toll Plaza	
4	Automatic Traffic Counter and Vehicle Classification	At every Toll Plaza	
5	Video Surveillance System	Cameras shall be provided, at not less than 2 km interval, along the project section to monitor the traffic flow for entire project highway.	
6	Video Incident Detection System	At all Operation and Maintenance centers.	
7	Emergency Call Box (ECB)	ECB shall be provided at every 2 km on each side in a staggered manner, as per Schedule D	

Note: In addition to above locations, additional locations shall be identified and provided in accordance to schedule D.

Appendix B-XVIII

GROUND IMPROVEMENT

The following stretches shall have ground improvement as specified.

Sl. No.	Stretches (In Km)		Length (In Km)	Location	Type of Improvement	Remarks
	From	To				
Nil						

Appendix B-XIX

OVERHEAD SIGNS

Overhead Signs shall be provided at the following locations

Sl. No.	Description	Location(Km)	Remarks
1	Approaches to Interchanges	• **Gantry mounted sign on expressway:** Provide Exit ramp informatory sign at 2km, 1km and 500m ahead indicating the exit no and direction/destination details of cross roads (NH/SH).	For all Interchanges given in Schedule C
2	On Expressway	• **Gantry mounted sign on expressway:** Provide after crossing of Exit ramp of interchange for the confirmation of direction/destination details of next exit/cross roads (NH/SH).	At all Interchange crossing as given in Schedule C
3	Entry to toll plaza	• **Gantry Mounted sign:** Provide Toll Gate Ahead sign at 1km, 2km and500m • Provide Fig 17.28 Guide sign on Toll lane portal. • Provide Boards indicating the toll rate of various types of vehicles (2 nos. for each approach) • Provide ETC indicator sign • Provide Fig 16.08 “Toll booth ahead”(2 nos. on each approach) • Provide Guide sign on Toll lane portal	For all toll plazas as given in Schedule C
4	Traffic volume display	**Gantry Mounted sign:** On exit of each toll plaza	For all toll plazas as given in Schedule C
5	Before Way side Amenities	• **Gantry mounted sign on expressway:** Provide Way Side Amenity area informatory sign at 2km, 1km and 500m ahead indicating facilities available in pictorial form.	For all facilities as given in Schedule C

Note: In addition to above, additional signs shall be provided as indicated in Schedule C and Schedule D in consultation with IE and NHAI.

Appendix B-XX

Shifting of Utilities (Ph-I PKG-II)

(i) Electrical utilities

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

S. No	Chainage (m)		Circuit (TC/DC/SC)	Crossings (Nos)		Poles		Conductor		Size of Cable (m)
	From	To		Over Head	Under Ground	Tower Truss/ Unipole	No	No	Size	
1	26343.000	-	66 KV/ DC	1	-	Truss	3	-	-	-
2	29021.259	-	220 KV/ DC	1	-	Truss	2	-	-	-
3	39050.000		400 KV/ DC	1	-	Truss	2	-	-	-
4	40201.265	-	66 KV/ DC	1	-	Truss	3	-	-	-
5	40466.000	-	220 KV/ DC	1	-	Truss	2	-	-	-

Procurement of land for tower foundation shall be acquired by concern utility agency with reasonable assistance by EPC Contractor.

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

S. No	Chainage (m)		Type of Circuit (TC/DC/SC)	Poles		Conductor		Cable		Crossings		Transformer	
	From	To		Type	No	No	Size	No	Size	U/G	Overhead	Capacity	No
1	27529.841	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
2	27574.617	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
3	27633.553	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
4	27636.780	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
5	27660.822	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
6	27716.854	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
7	27660.822	27717.854	SC	Unipole	1	Rabbit ACSR					OH	-	-

S. No	Chainage (m)		Type of Circuit (TC/DC/SC)	Poles		Conductor		Cable		Crossings		Transformer	
	From	To		Type	No	No	Size	No	Size	U/G	Overhead	Capacity	No
8	27749.910	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
9	27799.860	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
10	27879.359	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
11	27893.312	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
12	28202.949	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
13	28248.469	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
14	28251.945	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
15	28343.133	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
16	28520.855	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
17	28530.524	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
18	28561.569	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
19	28636.087	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
20	28868.579	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
21	28919.492	-	-	Unipole	1	Rabbit ACSR					OH	-	-
22	28925.434	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
23	28942.704	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
24	28984.627	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
25	28984.627	29058.010	SC	Unipole	1	Rabbit ACSR					OH	-	-
26	29058.010	29132.400	SC	Unipole	1	Rabbit ACSR					OH	-	-
27	29132.400	29205.601	SC	Unipole	1	Rabbit ACSR					OH	-	-
28	29207.607	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
29	29225.262	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
30	29764.599	-	SC	Unipole	1	Rabbit ACSR					OH	-	-

S. No	Chainage (m)		Type of Circuit (TC/DC/SC)	Poles		Conductor		Cable		Crossings		Transformer	
	From	To		Type	No	No	Size	No	Size	U/G	Overhead	Capacity	No
31	30016.996	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
32	30073.908	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
33	30134.358	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
34	31283.099	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
35	31286.906	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
36	31319.930	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
37	31485.433	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
38	31732.991	-		Unipole	1	Rabbit ACSR					OH	11KV	1
39	31985.980	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
40	32319.449	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
41	32361.654	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
42	34104.877	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
43	34538.211	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
44	34584.447	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
45	34631.755	-		Unipole	1	Rabbit ACSR					OH	11KV	1
46	35979.375	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
47	35987.552	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
48	37334.780	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
49	38457.500	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
50	39372.068	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
51	39425.369	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
52	39458.977	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
53	39590.955	-	SC	Unipole	1	Rabbit ACSR					OH	-	-

S. No	Chainage (m)		Type of Circuit (TC/DC/SC)	Poles		Conductor		Cable		Crossings		Transformer	
	From	To		Type	No	No	Size	No	Size	U/G	Overhead	Capacity	No
54	39673.886	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
55	39679.150	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
56	40632.970	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
57	40639.832	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
58	40701.316	-	-	Unipole	1	Rabbit ACSR					OH	-	-
59	40944.988	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
60	41897.899	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
61	42113.064	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
62	42217.978	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
63	43074.404	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
64	43637.260	-	SC	RCC	1	Rabbit ACSR					OH	-	-
65	43639.284	-	SC	RCC	1	Rabbit ACSR					OH	-	-
66	43686.235	-	SC	RCC	1	Rabbit ACSR					OH	-	-
67	45008.793	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
68	45027.647	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
69	45041.266	-	SC	RCC	1	Rabbit ACSR					OH	-	-
70	45046.258	-	SC	RCC	1	Rabbit ACSR					OH	-	-
71	47546.138	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
72	47641.659	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
73	48518.859	48633.973	SC	Unipole	1	Rabbit ACSR					OH	-	-
74	48674.978	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
75	49730.338	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
76	49761.771	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
77	49784.916	-	SC	Unipole	1	Rabbit ACSR					OH	-	-

S. No	Chainage (m)		Type of Circuit (TC/DC/SC)	Poles		Conductor		Cable		Crossings		Transformer	
	From	To		Type	No	No	Size	No	Size	U/G	Overhead	Capacity	No
78	50053.326	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
79	50068.757	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
80	50098.942	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
81	50118.612	-		Unipole	1	Rabbit ACSR					OH	11KV	1
82	50269.051	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
83	50419.029	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
84	50457.803	-	SC	Unipole	1	Rabbit ACSR					OH	-	-
85	50507.010	-	-	Unipole	1	Rabbit ACSR					OH	11KV	1

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

(c) Low Tension Lines (LT Lines)*

S. No	Chainage (m)		Type of Circuit (TC/DC/SC)	Poles		Conductor		Cable		Crossings		Transformer	
	From	To		Type	No	No	Size	No	Size	U/G	Overhead	Capacity	No
1	27229.917	-	-	RCC	1						OH	440V	1
2	27301.563	-	SC	RCC	1						OH	-	-
3	27394.421	-	SC	RCC	1						OH	-	-
4	27427.008	-	SC	RCC	1						OH	-	-
5	27553.777	-	SC	RCC	1						OH	-	-
6	30932.498	-	SC	RCC	1						OH	-	-
7	30947.430	-	SC	RCC	1						OH	-	-
8	34105.004	-	-	RCC	1						OH	440V	1
9	34130.158	-	SC	RCC	1						OH	-	-
10	34155.572	-	SC	RCC	1						OH	-	-
11	34668.032	-	SC	RCC	1						OH	-	-
12	34708.891	-	SC	RCC	1						OH	-	-
13	34732.643	-	SC	RCC	1						OH	-	-
14	34740.403	-	SC	RCC	1						OH	-	-
15	35863.073	-	SC	RCC	1						OH	-	-

S. No	Chainage (m)		Type of Circuit (TC/DC/SC)	Poles		Conductor		Cable		Crossings		Transformer	
16	35881.430	-	SC	RCC	1						OH	-	-
17	36717.115	-	SC	RCC	1						OH	-	-
18	36737.708	-	SC	RCC	1						OH	-	-
19	36775.720	-	-	RCC	1						OH	440V	1
20	37362.102	-	SC	RCC	1						OH	-	-
21	37401.517	-	SC	RCC	1						OH	-	-
22	37425.571	-	SC	RCC	1						OH	-	-
23	37630.048	-	SC	RCC	1						OH	-	-
24	37643.953	-	SC	RCC	1						OH	-	-
25	37643.953	-	SC	RCC	1						OH	-	-
26	37991.280	-	SC	RCC	1						OH	-	-
27	38022.051	-	SC	RCC	1						OH	-	-
28	38798.185	-	SC	RCC	1						OH	-	-
29	39027.772	-	SC	RCC	1						OH	-	-
30	39031.336	-	SC	RCC	1						OH	-	-
31	39035.144	-	SC	RCC	1						OH	-	-
32	39095.295	39161.092	SC	RCC	1						OH	-	-
33	39161.092	-	SC	RCC	1						OH	-	-
34	39455.255	-	SC	RCC	1						OH	-	-
35	39612.150	-	-	RCC	1						OH	440V	1
36	39708.890	-	SC	RCC	1						OH	-	-
37	39747.000	-	SC	RCC	1						OH	-	-
38	40424.096	-	SC	RCC	1						OH	-	-
39	40733.920	-	SC	RCC	1						OH	-	-
40	40749.409	-	SC	RCC	1						OH	-	-
41	40769.296	-	SC	RCC	1						OH	-	-
42	40840.000	-	SC	RCC	1						OH	-	-
43	40884.696	-	SC	RCC	1						OH	-	-
44	40904.131	-	SC	RCC	1						OH	-	-
45	40923.669	-	-	RCC	1						OH	440V	1
46	40997.000	-	SC	RCC	1						OH	-	-
47	42322.241	-	SC	RCC	1						OH	-	-
48	42341.101	-	SC	RCC	1						OH	-	-
49	42360.953	-	SC	RCC	1						OH	-	-
50	42840.787	-	SC	RCC	1						OH	-	-
51	42859.698	-	SC	RCC	1						OH	-	-
52	42859.698	42866.265	SC	RCC	1						OH	-	-
53	42866.265	42906.332	SC	RCC	1						OH	-	-
54	42906.332	42953.287	SC	RCC	1						OH	-	-

S. No	Chainage (m)		Type of Circuit (TC/DC/SC)	Poles		Conductor		Cable		Crossings		Transformer	
55	43647.591	-	SC	RCC	1						OH	-	-
56	44113.790	-	SC	RCC	1						OH	-	-
57	44117.516	-	SC	RCC	1						OH	-	-
58	44597.404	-	SC	RCC	1						OH	-	-
59	44628.612	-	SC	RCC	1						OH	-	-
60	44677.264	-	SC	RCC	1						OH	-	-
61	44713.230	-	SC	RCC	1						OH	-	-
62	45247.445	-	SC	RCC	1						OH	-	-
63	45749.155	-	SC	RCC	1						OH	-	-
64	45798.595	-	SC	RCC	1						OH	-	-
65	46036.153	-	SC	RCC	1						OH	-	-
66	46061.525	-	SC	RCC	1						OH	-	-
67	46237.336	-	SC	RCC	1						OH	-	-
68	46352.463	-	SC	RCC	1						OH	-	-
69	46368.460	-	SC	RCC	1						OH	-	-
70	46505.676	-	SC	RCC	1						OH	-	-
71	46533.997	-	SC	RCC	1						OH	-	-
72	46791.231	-	SC	RCC	1						OH	-	-
73	46924.187	-	SC	RCC	1						OH	-	-
74	46943.592	-	SC	RCC	1						OH	-	-
75	47331.073	-	SC	RCC	1						OH	-	-
76	47352.619	-	SC	RCC	1						OH	-	-
77	47411.059	-	SC	RCC	1						OH	-	-
78	47472.718	-	SC	RCC	1						OH	-	-
79	47501.047	-	SC	RCC	1						OH	-	-
80	48515.746	-	SC	RCC	1						OH	-	-
81	48518.859	-	SC	RCC	1						OH	-	-
82	49069.683	-	SC	RCC	1						OH	-	-
83	49196.745	-	SC	RCC	1						OH	-	-
84	49227.445	-	SC	RCC	1						OH	-	-
85	49965.179	50017.306	SC	RCC	1						OH	-	-
86	50039.125	-	SC	RCC	1						OH	-	-
87	50058.567	-	SC	RCC	1						OH	-	-
88	50106.273	-	SC	RCC	1						OH	-	-
89	50279.000	-	SC	RCC	1						OH	-	-

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

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

The site included the following Public Health utilities:

Water Pipelines:

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

Sewage Pipelines:

S. No	Chainage		Type of Lines (Pressure/Under Gravity)	Pipe				Crossings
	From	To		Type	Nos	Size	Nos	Length
	Nil							

* For details, refer utility shifting plan enclosed with this schedules

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 Contractor 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 Contractor 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 Contractor to utility owning department whenever asked by the Contractor. The decision/approval of utility owning department shall be binding on the Contractor. 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 Contractor 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 Contractor/Concessionaire who would be free to dispose-off the dismantled material as deemed fit by them. If the Contractor 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 Contractor 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 contractor accordingly.

SCHEDULE – C

(See Clause2.1)

PROJECT FACILITIES

1 Project Facilities

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

a) Toll plazas
b) Road side furniture
c) Operation and Maintenance Centers
d) Way side amenities / Service Areas
e) Smaller Parking places with Toilet facilities service area
f) Truck Parking Areas with Toilet facilities
g) Pedestrian facilities/Cattle crossings/SVUP
h) Lighting
i) Environmental Management Plan
j) Land Scaping and Tree Plantation
k) Advanced Traffic Management System(ATMS)
l) Utilities
m) Rain water harvesting

1.2 Project Facilities to be completed on or before project completion date have been described in Annex-I of this Schedule-C.

Annex – I

(Schedule-C)

1. Project Facilities

The Contractor shall construct the Project Facilities described in this Annex-I to form part of the Project Highway. The Project Facilities shall include:

a) Toll plazas
b) Road side furniture
c) Operation and Maintenance Centers
d) Way side amenities / Service Areas
e) Smaller Parking Places with Toilet Facilities Service Area
f) Truck Parking Areas with Toilet facilities
g) Pedestrian Facilities/ Cattle Crossings/SVUP
h) Lighting
i) Environmental Management Plan
j) Land Scaping and Tree Plantation
k) Advanced Traffic Management System (ATMS)
l) Utilities
m) Rain water harvesting

2 Description of Project Facilities

2.1 Toll Plazas

The Toll Plaza on main carriageway and on loops / ramps of Trumpet interchange shall be provided as per Schedule D and minimum lane requirement in the opening year are as follows.

Toll Plaza location and Minimum Lane Requirement in the Opening Year

Interchange No.	Interchange/ ExpChainage on BCE (in km.)	Toll Plaza	Location	Direction (Entry: to expressway, Exit: from Expressway)	No. of toll lanes (Fastag + Extra Wide)
Toll Plaza on Main Expressway					
INT-03	**52+085**(Connecting Road to Interchange)	TP 03	Ch. 0+985 of Connecting Road	Entry	4+1
				Exit	8+1

Entry approach to each toll plaza shall be having medium speed Weigh in Motion equipment as per NHAI Policy Circular No. NHAI/13013/2016-17/CO/Hybrid ETC/ 122586 dated 20/08/2018 and tunnel shall be constructed for connecting toll booths and toll office for collection of toll fees as per Schedule D.

Based on the minimum toll lane requirement as given above, toll booths, toll plaza complex, weigh bridges, electrical systems, toll plaza and all other facilities required/mentioned in manual shall be provided as per Schedule D with approval from IE and NHAI. All the structures shall be RCC framed structure as per schedule D.

No. of toll lanes specified above are minimum indicative. The Concessionaire shall design and provide toll lane as per IRC: SP:99-2013 subject to minimum specified above. Any increase in no. of toll lane shall not be treated as 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.

RE wall/Retaining wall shall be provided at toll plaza locations to restrict the embankment slope within the right of way.

2.2 Road side furniture

2.2.1 Kilometer and Hectometers tones

Kilometer and Hectometer stones shall be provided in accordance with **Schedule – D**.

2.2.2 Road Signs

The Road Signs on Highway shall be provided in accordance with **Schedule-B** &**Schedule – D**.

2.2.3 Road Marking

The Road Marking on Highway shall be provided in accordance with **Schedule – D**.

2.2.4 Road Delineators

The Road Delineators on Highway shall be provided in accordance with **Schedule – D**.

2.2.5 Reflective Pavement Markers &Solar Studs

The Reflective Pavement Markers & Solar Studs on Highway shall be provided in accordance with **Schedule – D**.

2.2.6 Traffic Impact Attenuators

The Traffic Impact Attenuators on Highway shall be provided in accordance with **Schedule – D**.

2.2.7 Crash Barriers

Thrie Beam Steel Barriers

Thrie beam metal crash barriers shall be provided in entire length on outer side of each main carriageway (i.e. on earthen shoulder of the carriageway) and Thrie beam metal crash barriers shall be provided on both sides of the Loops and Ramps of interchanges excluding stretches covered by bridges and RE wall structures, where concrete barriers to be provided.

Concrete crash barriers shall be provided on bridges/structures, RE Walls/ retaining walls as specified in Schedule B and schedule D.

2.2.8 Road Boundary Stone

Road boundary stones shall be provided at the boundary on both sides of the Right of Way at 100m intervals in accordance with Schedule B & Schedule D.

2.2.9 Fencing

As the Expressway is completely access controlled facility, fencing is its integral part to

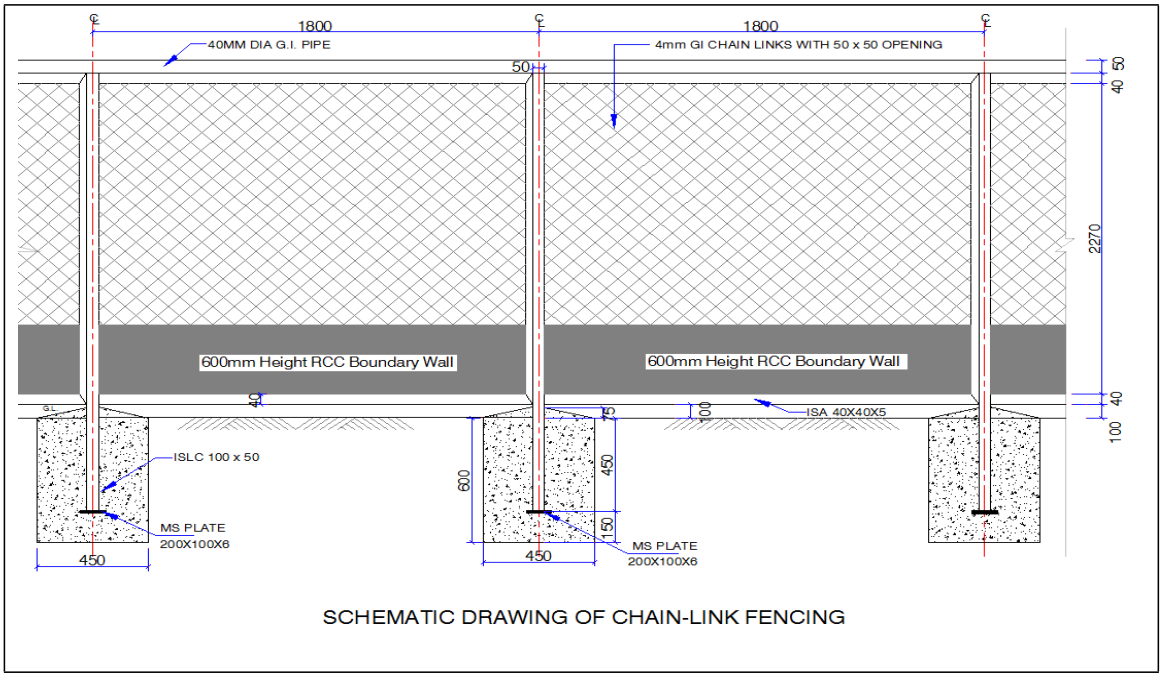
help enforcing of the acquired access rights. Access control extends to the limits of the legal access control on the ramps i.e., along the ramps to the beginning of the taper on the local road.

Chain link Fencing shall be provided along the entire length on either side (including transverse requirements at structure locations) as per the detail given below in accordance with Schedule D. The fencing shall be embedded on concrete of minimum M15 grade as per design. The total height of fencing shall be 2.5 m above ground.

Chain link fencing conforming to ASTM F 1553-06 shall be fixed on GI pipe/RCC posts. GI pipe/RCC posts shall be embedded in concrete to a sufficient depth.

The fence shall be placed 2m inside from the ROW edge on both sides as per the manual in accordance with Schedule-D. At connecting roads, it shall be provided between expressway and connecting road and on expressway side of the connecting road to arrest the illegal access to the expressway.

At all CD structure locations, the fencing shall be discontinued by turning it towards the wing/return wall to allow crossing through these structures during dry seasons.



SCHEMATIC DRAWING OF CHAIN-LINK FENCING

2.2.10 Glare Reduction

Shall be provided as per Schedule D

2.3 Operation and Maintenance Centers

Operation and Maintenance Centre shall be provided in accordance to Schedule D.
Operation and Maintenance activities shall be taken up simultaneously during Construction for the safety of Road Users for which Incident Management Vehicles such as Ambulances and Patrol Vehicles fitted with GPS/VTS system shall be deployed.
Minimum one set of the Ambulances, Towing Vehicles, Cranes and Patrol Vehicles fitted with GPS/VTS system with specifications equal to or better than those stated in NHAI Policy No. 12.19 dated 20 Mar 2018, including Addendums/Amendments, if any, shall be deployed. Drivers of the above vehicles shall be provided with Smart phones and trained to operate the same. Specifications stated in “Constructional

and Functional Requirements for Road Ambulances (National Ambulance Code)" shall also be ensured for the Ambulances. All these facilities shall be integrated with the helpline No. 1033.

Suitable measures shall be taken to ensure lane discipline. Adequate Nos. of Overhead gantry boards, pictorial lane marking, etc. depicting the lane for each type of vehicle or any other methods, as approved by IE/NHAI shall be used to ensure lane discipline

2.4 Way side Amenities / Service Areas

2.4.1 Facilities

A) Way side Amenities / Service Areas

Wayside amenities shall be a part of the Highway and shall be constructed with the minimum facilities such as Parking areas (Trucks, Buses, Cars, Mini Buses), Fuel Station and garage for minor repair, Hotel/ Motel, Trauma Center, Rest Areas, Fast Food Centre, Travel Information Facilities, Toilets and Bath Facilities, space for Maintenance staff & Vehicle Service Station, Dormitory, Generator room/ solar system area, Play Area & security personnel, etc.

Wayside amenities on the left and right side of areas 12.75 and 11.65 Hectares respectively shall be developed at the above locations in accordance to relevant codal provisions, standards and technical specifications mentioned in Schedule - D. The layout with minimum number of units per facility and the minimum area per facility to be developed is given in Appendix C-1 (for Left Way side Amenities) and Appendix C-2 (for Right Way side Amenities). However, the provisions given in Appendix C-1& C-2 shall be minimum. The connecting Ramps (all ramps shall be constructed with same specifications of loop/ ramps of interchange given in Schedule B) from/to expressway shall be provided as per Schedule B.RE wall/Retaining wall shall be provided to restrict the embankment slope within the right of way.

Sl. No.	Location (Km)	Side
1	47+906	Ithandahalli & Kavaranahalli

Locations for Border Check posts

Sl. No.	Location (Km)	Side	Remarks
NIL			

B) Provision for Truck Parking

Truck parking areas of minimum facilities as per design shall be constructed at the following locations in accordance to relevant codal provisions, standards and technical specifications mentioned in Schedule – D. The layout with minimum number of units per facility to be developed is given in Appendix C-3. However, the provisions given in Appendix C-3 shall be minimum. The connecting Ramps (all ramps shall be constructed with same specifications of loop/ ramps of interchange given in schedule B) from/to expressway.

Sl. No.	Location (Km)	Side
Nil		

Apart from the above-mentioned facilities, Traffic Aid Booth (plinth area 25 sqm.) and

Medical Aid Booths (including an aid post buildings) shall be considered as Mandatory facilities over and above the over and above the plinth area mentioned. Traffic Aid Booth and Medical Aid Booths shall be constructed with the type designs prescribed for such buildings by the State Government or a substitute thereof within the site premises with easy accessibility and shall vest with the Authority. All the facilities shall be developed as warm shell structures by the Concessionaire at its own cost.

Notes: for all facilities mentioned in Para above

- Toilet should be provided separately for men, women and physically challenged
- Concessionaire will not be allowed to charge rents from the customers for drinking water, toilets, parking, first aid box and emergency telephone services

2.4.2 Specifications and Standards for above facilities

The Project shall be constructed in conformity with the Specifications and Standards specified in this schedule and Schedule-D.

2.4.3 Scope of Work

The project scope would include the following major activities:

Design and Construction of the Project

(a) The Concessionaire will be required to develop the facilities as warm shell structures with detailed conceptual plan, layout plan, detailed architectural and structural designs, engineering drawings, construction methodology, quality assurance procedures, and the procurement, engineering and construction time schedule for all the areas and facilities forming a part of the Project using the basic layout plan provided by the Authority at the time of bidding and/or thereafter. The detailed development proposal for the site shall be submitted to the Independent Engineer and subsequently to the Authority for approval. The Concessionaire shall not deviate from the broad layout However, the Concessionaire will be allowed to modify the site-specific layout, subject to approval from the Authority, while developing at least the minimum areas and facilities mentioned in this Schedule.

(b) The land earmarked as future expansion shall, in conformity with Applicable Laws and in conformity with all conditions specified in this document, be utilized for provision of such amenities or facilities which are useful for the Users of the Project and the local population in future.

(c) The total covered area of the site after development of any facilities shall not be more than 20% of the total site area. For the Fuel station, the ground coverage shall be considered only for the actual area covered by the administrative buildings, equipment and other such objects and shall not include the open hardstand space for vehicle movement under the canopy.

(d) Review of the entire site specific information provided along with the bid documents carrying out necessary revisions or additions, preparation of all engineering drawings as required for proper execution and completion of the project as envisaged with the approval of the Authority in compliance with applicable local bye-laws, National Building Code and other standards mentioned in Schedule D. To save time and prevent wastage of effort, it is suggested that the Concessionaire gets the Line Plan of all the buildings in the Project reviewed by the Authority within 15 days of receiving the Letter of Award.

(e) Site Development, Procurement etc. for construction of the Project as per Design, Codes, Architectural and Engineering Drawings, complying to all relevant codal provisions, Standards and Technical Specifications mentioned in schedule D. The Project shall include facilities specified above along with site boundary wall, roads / driveway, parking & pathway, roads marking and rumble strips / speed breakers for parking areas, septic tank/soakage well/sewer line, waste compost plant, water supply, storm water drain, street lighting with LED/CFL lamps, underground sump/overhead

tank, firefighting, security features, HVAC, signage, landscaping, horticulture operations / arboriculture etc., RO water plant, rainwater harvesting, provision for tube/bore wells & pumps including water tank, electrical substation / transformer, trenches / ducts for UG cables / pipeline, DG set, shading device, children play area, outdoor furniture, digital display wall system, solar power panel, provision for helipad, high mast lamp and hoarding board etc. Actual project facilities to be provided in a particular location will vary.

(f) Construction of modern user and environment friendly facilities as per the specifications approved by the Authority. The site shall be developed based on green design principles like GRIHA three star ratings for building norms, zero effluent discharge, use of recycled water, use of renewable energy system as an alternate source of power generation, bio-mechanization technology for generation of cooking gas, rainwater harvesting etc. to make the facility self-sustaining.

(g) The contractor shall provide, construct, operate and maintain the basic warm shell infrastructure for the wayside amenities as per the typical layout and requirements specified in Schedule C and Schedule D with prior approval from IE and NHAI. Subsequent establishment and commercial operation of the wayside amenities including fuel stations shall be responsibility of the Authority.

2.4.4 Project Facilities development

The Project Facilities may include the following activities; however, the final detailed set of activities to be performed shall be submitted to the Independent Engineer and NHAI for approval prior to initiating development on the site:

Sl. No.	Description
I (a)	**Site Development**
	i. Site clearances & Area development
	a. Leveling, Cutting & Filling Soil (Total Plot Area)
	ii. a. Cutting of Trees – As required to match site Specific Layouts.
	b. Dismantling / Demolishing including disposal
	c. Rerouting of EB, Water & Telephone Services (Above / Below Ground)– including local liasioning charges
	d. Additional Filling/Cutting – To match levels indicated in the Site Specifications Drawings.
	iii. 1. Construction of Retaining wall / Slope Stability Arrangements
	2. Compound Wall, Fencing, Gate, Culvert& Kerb wall, Deceleration Zone, Acceleration Zone, Buffer Zone and Service / Access Road.
	a. Compound Wall
	b. Gate – Shall be provided for Entrance to Children Play Area
	c. RCC Slab / Pipe Culvert (Outside the Premises)
	d. Kerbwall– Parking Areas, Landscaping and Pathways

Sl. No.	Description
	e. Bollards To be provided in front of Dhaba / Food Court / Restaurants /Kiosks
	f. Access Road (outside the premises) / Approach road
	g. Deceleration Zone (outside the premises)
	h. Acceleration Zone (outside the premises)
	i. Buffer Zone
	j. Service Road (outside the premises) / Exit Road / Existing Service Roads including necessary crash barriers as percodes
I b.	**Services:-**
	i. Roads & Pathway as per MoRTH Specifications
	a. Roads / Driveway, Parking & Path way (BT / CC Paver Block): (All Driveway / Roads / Parking facing Dhaba / Food Court / Restaurants / and Kiosks within the premises shall be ofCCPaver Blocks. All other areas inside the premises and approach roads outside premises shall be ofBT.
	b. Roads Marking and Rumble Strips, Speed Breakers (Readymade speed breakers with reflective arrow) for parking area.
	ii. Sewer Line including Chambers, Manholes, Gully Trap, etc.
	iii. Water supply & Distribution System
	iv. Storm water drain with Gratings / Cover Slab
	v. External Electrical Works Including Street Light
	vi. a. Underground Sump / RCC water Retaining Structures
	b. Fire Fighting
	vii.Signages:
	a. External Signages (Building Signages, Parking Signages, Prohibition Signages, Safety Signages,etc)
	b. Internal Signages
	c. Neon Signages
	d. Key Map Signages
	e. Highway Way finding Signages on the Main Road (on both sides of the project) –1Km, 500m and 100m
	f. Totem

Sl. No.	Description	
	g. Frontlight / Backlight Facia for Food Court &Dhaba	
I c.	**Landscaping And Arboriculture**	
	a. Landscaping	
	b. Horticulture Operations / Arboriculture	
II	**Civil Work / Buildings (Including Internal services)**	
	1. Food Court with Motels – Capacity as indicated in Site Specific drawings	
	2. Restaurant - As shown in Site Specific drawings	
	3. Dhaba– As shown in the Site Specific drawings.	
	4. Dormitory – As shown in the Site Specific drawings.	
	5. Minor Repair shop – As shown in the Site Specific drawings.	
	6. Kiosks for misc. items – As shown in the Site Specific drawings.	
	7. Toilet Blocks	
	a. Toilet Block (Near Food Court) - As shown in the Site Specific drawings. (The size of the Toilet Block shown is minimum required. The size may be increased retaining the same concept to accommodate more facilities by the Contractor at his own cost without reducing the parking facilities)	**Ladies Toilet:**
		IWC
		EWC
		Trough
		PC Toilet
		Gents Toilet:
		Urinals
		IWC
		EWC
		Trough
		PC Toilet
	b. Toilet Block (Car & Bus user parking zone) – As shown in the Site-Specific drawings. (The size of the Toilet Block shown is minimum required. The size may be increased retaining the same concept to accommodate more facilities by the Contractor at his own cost without reducing the parking facilities)	**Ladies Toilet:**
		IWC
		EWC
		Trough
		Gents Toilet:

Sl. No.	Description	
		Urinals
		IWC
		EWC
		Trough
		PC Toilet
	c. Toilet Block (Truck parking zone) – As shown in the Site-Specific drawings. (The size of the Toilet Block shown is minimum required. The size may be increased retaining the same concept to accommodate more facilities by the Contractor at his own cost without reducing the parking facilities)	**Ladies Toilet:**
		IWC
		EWC
		Gents Toilet:
		Urinals
		IWC
		EWC
		IWC
		EWC
		Trough
		Gents Toilet:
		Urinals
		IWC
		EWC
		Trough
		PC Toilet
	9.Parking	
	a) Car	
	b) Car – PC	
	c) Bus	
	d)Truck	
	e)Trailer	
III	**Furniture & Fixtures**	

Sl. No.	Description
IV	**Equipment**
	a. Special Items of Work
	i. RO Water Plant
	ii. Rainwater Harvesting
	iii. Septic Tank & Soak Pit with Anaerobic Filter
	iv. Tube wells &pumps including overhead water tank and sump
	v. CCTV &Security system
	vi. Electrical substation/ Transformer / Panel Board/ Earth pit / LT Switch Board / Panel Boards
	vii. Trenches/ Ducts for UG cables / Pipe line
	viii. DG Set(s)
	ix. Entertainment – Satellite TV &WIFI
	x. Shading Device As required for operations. (For certain openings / areas requiring protection from sun/rain. Shading device includes Awnings, Tension structures, etc.,)
	xi. Outdoor Furniture
	xii. Children Play Area Developments
	xiii. Digital Display Wall System
	xiv. Advertisement Balloon
	xv. Solar Power Panel
	xvi. Hoarding Board
	xvii. High Mast Lamp & Lightening Arrester
	b. Additional Green Building Features:-
	i. Wind Mill
	ii. Solar Lighting
	iii. Provision for Cooking Gas from Food Waste
	iv. All Utility Connections, Deposits etc.,
	c. Other Equipment:-
	HVAC

2.5 Lighting

The Concessionaire shall provide lighting as per **Schedule – D** at following locations of the Project Highway.

(i) Toll Plazas area

(ii) Operation and maintenance centers

(iii) Way side amenities / Service Areas

(iv) Small parking places with toilet facilities

(v) Interchanges

(vi) Flyovers

(vii) Underpasses and Overpasses

(viii) Traffic aid posts, vehicle rescue posts, medical aid posts and all other facility & service buildings.

(ix) Interior illuminated signs

(x) Yellow flashing lights to alert drivers

In addition to the above locations the following locations shall be continuous Expressway Lighting.

Sl. No.	Locations	Stretches	Remarks
1	Urban Areas	Nil	--
2	Stretches along Highway from start to end of approaches of all Service Areas (Way side amenities, Truck parking and Smaller parking places with toilet facilities)	Locations as given this Schedule C	--

Minimum level illumination on locations of the Project Highway where exterior lighting is provided shall be 40 lux. In general, 'code of practice for lighting of public thoroughfare IS 1944 shall be followed. All facility buildings shall be illuminated adequately.

The lighting fittings (with LED features) shall be powered by solar system with back up facilities (power and battery both) at all locations.

The solar system will be used for the entire highway. The solar panel at interchange toll plazas and bridges shall be grid connected whereas the other places shall be battery backup. The electrical connection with all its infrastructures shall be done by the contractor. Additional battery backup shall be provided.

2.6 Environmental Management Plan

The Contractor shall implement the Environmental Management plan & action Plan for undertaking possible mitigation measures in accordance with guidelines for Highway Projects of the Ministry of Environment and Forests and Wild life Department. The conditions & directions stipulated by the MOEF & CC shall be made available by the Authority.

2.7 Land Scaping and Tree Plantation

The Contractor shall plant trees and shrubs of required numbers and types at the appropriate locations within Right of Way and in the land earmarked by the Authority for afforestation as per Schedule D at the following areas.

Sl. No.	Types of Plantation	Location (Km)	Remarks
1	Shrubs	In median except Structures	Ornamental type plantation shall be provided
2	Land Scaping	All interchanges/ Service Areas / Toll plazas / O & M Centers	Ornamental type plantation shall be provided
3	Plantations	Available open land within ROW	Minimum 4665 nos. of trees of desired type in one row at a distance of 14 m from the center of paved shoulder on both sides at spacing of 10 m each and minimum 23310 nos. of shrubs in two rows, keeping row one at distance of 3m from the center of median and row two at distance of 6m from row one, with spacing 3m and 6m respectively. Some of the trees and shrubs suitable for climate are Acassiaausiculitrormis, Bomboxceaba, Callistemon citrinus ,Ceibapentandra, Cochlospermumreligiosam, Erothrinavariegatum, Heterosphrogmaadenophyllum, Millingtoniahortensis, Pwmeriosp, Syzygiumumini, Bougainvellia Garden glory, Cassia glauca, Cassia alata, Jatropapodagarica.

Drip irrigation system for median plantation by gravity/pressure sources with all necessary components / systems and emitting devices at plants shall be provided.

The Contractor shall maintain the trees and shrubs in good condition during maintenance period as per the maintenance schedule.

2.8 Advanced Traffic Management System(ATMS)

Advance Traffic Management System (ATMS) shall be provided as specified as per Schedule D as given in Schedule – B.

The Concessionaire is required to design, install, operate and maintain Highway Traffic Management System (HTMS) / Advanced Traffic Management System (ATMS) as part of the project facilities. Advanced Traffic Management System shall be provided as specified the manual and as per NHAI Policy Matter – Technical (214/2016) vide reference No. 11041/218/2007-Admn dated 15.09.2016.

Briefly, the ATMS components to be deployed shall inter alia include:

(i) Video Surveillance System

- CCTV PTZ Dome at every one km on both sides of the road
- Fixed Camera

(ii) Video Incident Detection System

(iii) Vehicle Actuated Radar Speed Displays

(iv) Emergency Roadside Telephones – These shall be provided in the Zones experiencing telecom black-spots along project highway.

(v) Fixed Variable Message Sign (Full) –

Location shall be finalized in consultation with Independent Engineer / Project Director, NHAI.

(vi) Fixed Variable Message Sign (Compact) – These shall be provided before built up locations on the project highway as specified in Annex-I of Schedule-A and shall be finalized in consultation with Independent Engineer / Project Director, NHAI.

(vii) Portable Variable Message Sign – to be temporarily deployed before locations related to road works and incidents affecting traffic movement

(viii) Meteorological System – at proposed ATMS Control Centre

(ix) Portable Weigh in Motion

(x) Automatic Traffic Counter cum Classifier

(xi) The ATMS Control Centre including the equipment (hardware, software, and local networking)

(xii) Communications System utilizing Optic fiber, GSM/GPRS and Wi-Fi Communications linked to ATMS Control Centre.

(xiii) Power supplies for field equipment: working on Mains power supported with back-up (largely on renewable energy) to facilitate 24x7 operation and for the ATMS Control Centre working on Mains power supported by UPS and Diesel generator set of adequate capacities, to facilitate 24x7 operation.

Type of ATMS	Location
Mobile Communication System	At such locations so as to cover entire length with mobile communications.
Variable Message Signs	Near starting and Ending of the project either side of the main carriageway near the interchanges and other locations as decided by IE/NHAI
Meteorological Data System	Interchange/near toll Plaza
Automatic Traffic Counter and Vehicle Classification	At every Toll Plaza
Video Surveillance System	Cameras shall be provided, at not less than 2 km interval, along the project section to monitor the traffic flow for entire project highway.
Video Incident Detection System	At all Operation and Maintenance centers.
Emergency Call Box (ECB)	ECB shall be provided at every 2 km on each side in a staggered manner, as per Schedule D

Notes:

(1) Minimum requirements shall be as per NHAI Circular No. 11041/218/2007-Admn dated 15 Sep 2016 including addendums/amendments, if any.

(2) In addition to above locations, additional locations shall be identified and provided in accordance to Schedule D

2.9 Utilities

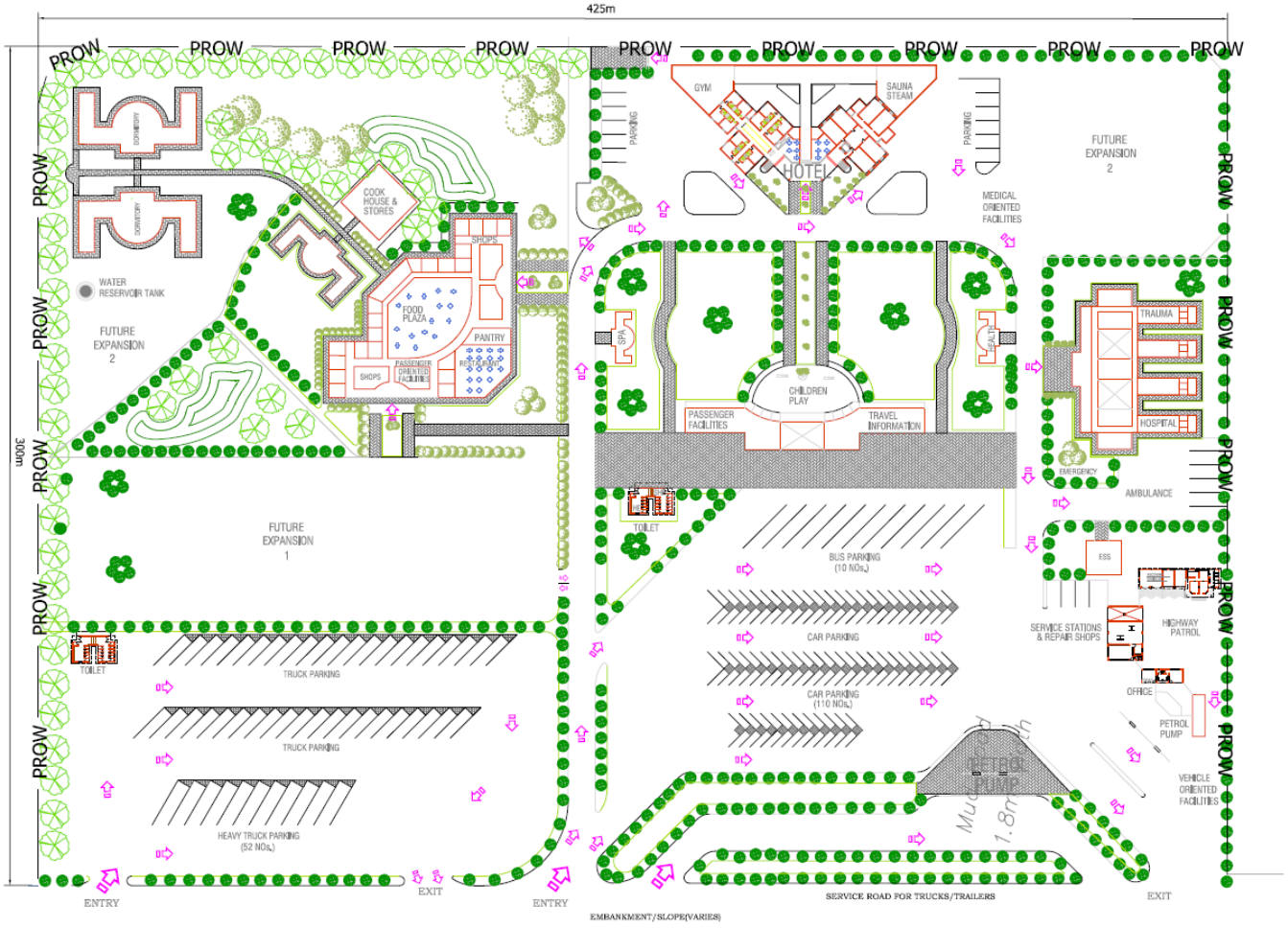
Provision of accommodating utilities shall be made within utility corridor on either side of Project Expressway. Box/H.P. culverts proposed in Schedule B shall be used for crossing of underground utilities, wherever required. However, in location where the distance between two adjacent box culverts is more than 1 km, utility ducts in form of NP-4 Hume Pipe 1.2m diameter shall be provided across the Project Highway and along with inspection chamber as per IRC: SP:99-2013 requirements. Location for such utility crossing shall be finalized in consultation with Independent Engineer

2.10 Rain Water Harvesting

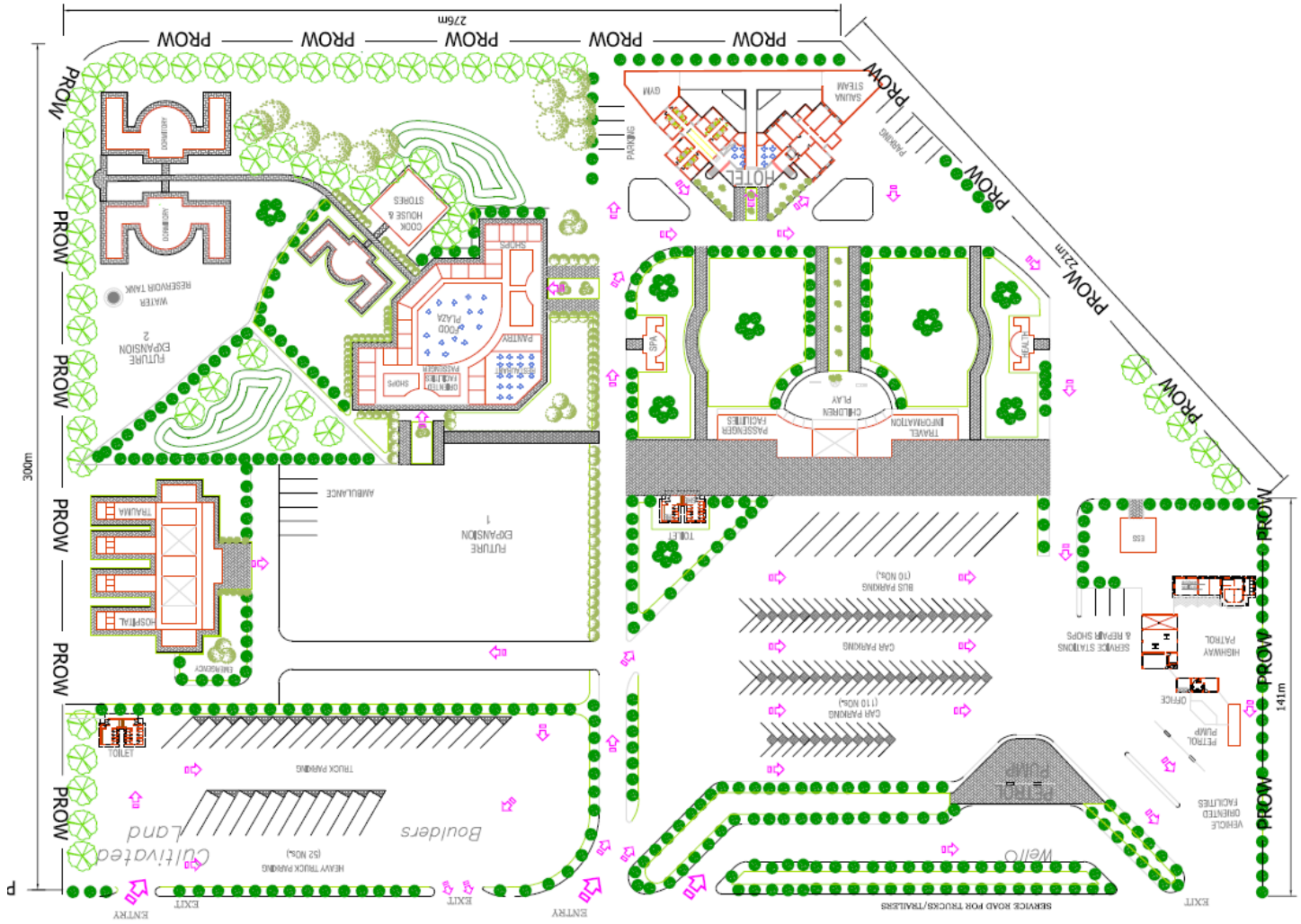
As per Ministry of Environment and Forests Notification, New Delhi dated 14.01.1997 (as amended on 13.01.1998, 05.01.1999 & 6.11.2000), the construction of rain water harvesting structure is mandatory in and around Water Crisis area, notified by the Central Ground Water Board. The provision of rain water harvesting shall be provided at every 500m in the entire project length and shall be executed as per requirement of IRC SP: 42-2014 and IRC SP: 50-2013.

APPENDIX C1

Typical Rest Area Plan (Left side)



Typical Rest Area Plan (Right side)



APPENDIX C3

Typical Truck lay bye Plan

Not Applicable

SCHEDULE – D

(See Clause 2.1)

SPECIFICATIONS ANDSTANDARDS

1. Construction

TheConcessionaireshallcomplywiththe SpecificationsandStandardssetforthin Annex-Iof this Schedule-D for construction of the Project Highway:

2. Design Standards

The Expressway including Project Facilities shall conform to design requirements set out in the following documents.

3. As regards, the work of utility shifting, the relevant specifications, relevant rules, regulations and acts of Utility owning department/agencies shall be applicable.

Annex – I

(Schedule-D)

SPECIFICATIONS AND STANDARDS FOR EXPRESSWAYS

1 Manual of Specifications and Standards to apply

All Materials, works and construction operations shall conform to the Manual of Specifications and Standards for Expressways (IRC: SP:99:2013) published by IRC (referred to as "Manual" in this Schedule) with all amendments and additions till date and MORTH Specifications for Road and Bridge Works. Where the specification for a work is not given, Good Industry Practice shall be adopted to the satisfaction of the Authority's Engineer.

As regards, the work of utility shifting, the relevant specifications, relevant rules, regulations and acts of Utility Owning Department/ Agencies shall be applicable.

2 Deviations from the Manual

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

Sl. No.	Provisions in IRC:SP:99:2013		Description of Deviation
	Cl. No.	Details	
1	2.5.1	Table 2.3 states, Desirable Median Width (m) as 15 m.	The median Width provided is as given in Schedule B (TCS) - 21.0 m wide median shall include 0.75m wide edge strip on each side having same pavement configuration of Main Carriageway.
2	2.10.2	Table 2.11 – The lateral and Vertical clearance at LVUP as 3.5 m.	The lateral and vertical clearance of all Light vehicular underpasses shall be as given in Schedule B.
3	2.16	Fig 2.1 (a) - Typical Cross Section for 4-lane Expressway with Depressed Median of 30 m	The typical cross section shall be as given in Schedule B with Depressed Median of 21 m.
4	3.3.6	Table 3.1 - Ramp design speed – Service Interchange	Loop design speed is 40-60km/h Direct/Semi direct design speed is 60-80km/h
5	3.3.7	Ramp Width and Cross Section	Cross sections of Ramps (11.5 m) and Loops (11.5 m/19.0 m) of the Interchanges shall be as per TCS given in Schedule B.
6	Fig 3.3	Ramp Cross Section is 10.5 m	Total width of Ramp is 11.5m as per TCS given in Schedule B.

Sl. No.	Provisions in IRC:SP:99:2013		Description of Deviation
	Cl. No.	Details	
7	4.2.2	Embankment fill Slopes 1V:4H or flatter	In fill section the embankment side slope shall be minimum 1V:2H. The embankment height >6m shall be designed in accordance with IRC: 75. For sections having embankment height more than 6m, benching with 1m at every 6m height interval shall be provided
8	5.3 and 5.4.1 (i)	Pavement design life	Flexible perpetual pavement shall be designed for a minimum design life of 30 years as given in Schedule B.
9	6.3	Overall width of structures	The Overall Deck Configuration of all structures at Interchanges shall be as per Schedule B. Further Road Over Bridges shall be as per RDSO Dwg No. RDSO/B 11775 Dated 31 Oct 2016 as per the GAD approved and as per Schedule B.
10	9.2	Side Drains	Lined/unlined Side Drains shall be provided along the project except cross drainage (River, nalla, canal etc.) as per TCS given in Schedule B. Also nalla/river training has to be done as per design drawings.
11	9.3	Median Drainage	Suitable longitudinal drain in the median shall be designed to take the discharge of storm water from the median area and from one side carriageway in super-elevation sections.
12	9.4	Drainage where Embankment Height is more than 6 meters	Adequate Continuous Surface RCC drain (Except Structures having approach slabs) shall be provided on both side Earthen Shoulder including RCC Chutes at designed intervals with energy dissipation basin irrespective of any Height of Embankment. The drainage system shown in TCS shall be treated as minimum.
13	10.7.1	Roadside safety barriers	Thrie beam metal crash barriers shall be provided in entire length on outer side earthen shoulder of each main carriageway and Loops/ Ramps of interchanges as per TCS referred in Schedule-B but excluding stretches covered by bridges and RE wall structures, where concrete barriers to be provided.
14	10.7.2	Median Barriers	Thrie beam metal crash barrier shall be provided on both sides of the raised median for Interchanges Connecting Road as per TCS given in Schedule B.
14	11.0	Traffic Management System	Additional specification for Traffic Management System shall be as given in Annex II of Schedule D.

Sl. No.	Provisions in IRC:SP:99:2013		Description of Deviation
	Cl. No.	Details	
16	12.4	Layout and Design of Toll Plaza	The layout of Toll Plaza shall be as given in Schedule B and schedule C shall be considered as minimum.
17	12.4.17 (iv)	Street lighting	Swaged steel tubular pole with swan neck or any other design approved by the Independent Engineer and NHAI shall be used for road side lighting conforming to IS 2713-1980 controlled by suitable digital time switch. The average level of Illumination shall be 40 Lux.
18	13	Project Facilities	The project facilities and building structures shall be provided in accordance with schedule-C and annex III of schedule D.
19	No provision of fly ash in Manual	Fly ash details	As per Ministry of Environment, Forest and Climate change notification S.O 254 (E), fly ash in the construction activities within a specific radius of 300 km is utilized.
20	NA	Manufactures Aggregates	Ministry Circular No.RW/NH-34066/09/2017-S&R(B) dated 21.07.2020 regarding use of manufactures aggregate shall be allowed.

Annex - II
(Schedule-D)

ADVANCED TRAFFIC MANAGEMENT SYSTEMS (ATMS)

The following Specifications and Standards shall be applied in addition to 'Manual on Specifications and Standards for Expressways' published as IRC: SP: 99-2013 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 center system or management of emergency call boxes housed in a control center 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 Expressway users:

- make emergency calls to Control Centre in case of accidents, breakdown, fire and ambulance.
- pre-warn the Expressway 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, 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 center through transmission system preferably comprising optical fibre cable, copper cable and interface equipment. There shall be one control center per package and shall be located at any one of the toll plazas or administrative building and shall have monitoring equipment, online 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 Expressway and to be used by the road users to make alarm call to the CCR in case of accidents & other problems on the expressway.

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 expressway 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
   b. Headphone, speaker and microphone (Answering Unit)
   c. Voice recorder/logger
   d. Application software
   e. 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 expressway 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 expressway with all Emergency telephones marked in accordance with their actual locations.
    b. The GUI shall be user friendly. ECBs shall be displayed in grey color 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. 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. 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/ Aluminium 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, expressway 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 an expressway 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 expressway 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 expressway. 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 Expressway.

The most critical locations for installing permanent VMSs are in advance of interchanges or expressways 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 colors.

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 expressway 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 color. 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
    - Color: 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 color	:	True color (36bit), text displayed in Amber color
Pixel size	:	25mm
Pixel pitch	:	25mm
LED life	:	> 100,000 hours
Operating Voltage	:	AC 220V, 50Hz
Language	:	Hindi, English, Gujarati, Marathi
Character height	:	up to 450mm
Horizontal viewing angle	:	$>80^0$
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 expressway.

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 aluminium. 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 aluminium 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 Expressway 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 Expressway.
- 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 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 expressway 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

2. 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 expressway 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 360^0 continuous pan and vertical tilt shall be 90^0 down to 0^0 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 expressway.

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, NO_2 and SO_2.

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 , NO_2 and SO_2.
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 downloading of data from Analyzer
    - 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 expressway. 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 expressway. 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 expressway 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 expressway 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 labels 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 expressway 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 expressway 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 Expressway users, collect data for the use of expressway authorities and to monitor and control the Traffic on the expressway 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 expressway 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 in any toll plaza.

Major Components

- Emergency Call Operator Station (Emergency calls from ECB's)
- Mobile Call Operator Station (Mobile radio calls)
- Integrated Expressway 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 expressway locations (from camera locations) to the control center.
2) Emergency communication system for communication from the predefined ECB locations to the control center.

3) Real time information to the users from control center (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 center, ambulances, patrol vehicles, etc.
7) Traffic Control System at the interchanges
8) Monitoring and control of the expressway traffic from the main control center using integrated expressway 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 expressway
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	:	up to 52ppm letter; up to 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: Aluminium
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.	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, Meteorological Data System, Mobile radio	• Common server and database for all 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 Expressway 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)	:	0^oC to + 50^oC
Relative Humidity	:	up to 95% (non-condensing)

Outdoor Equipment

Temperature (Operating)	:	5^oC to + 60^oC
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 (Temp cycling) as per IS:9000 (part xiv/sec1)	(i) Low Temp 0°C + 3°C (ii) High Temp 60°C + 2°C
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.

Annex - III

(Schedule-D)

SPECIFICATIONS AND STANDARDS FOR DEVELOPMENT OF WAY SIDE AMENITIES

1. General: National Building Code of India – 2005

2. Code for Structural design and details:

CODE OF PRACTICE FOR LOADS AND COMBINATIONS	
IS 875 Part I	Dead Loads - Unit weights of building Materials and stored materials.
IS 875 Part II	Imposed loads.
IS 875 Part III	Wind Loads.
IS 875 Part V	Special Loads and Combinations.
CODES OF DESIGN AND FABRICATION FOR PRE - ENGINEERED BUILDING	
IS 800 : 2007	General construction in steel
IS 808 : 1989	Dimensions for hot Rolled steel sections.
IS 801 : 1975	Code of Practice for use of Cold Formed light gauge steel structural members in general building
IS 811	Code of Practice for use of Cold Formed light gauge structural steel sections
AISC : 2000	Design Code
IBC : 2002	Building Code
AISI : 2001	Purlin Code
ANS : 2006	Welding Code
SP - 38 (S&T): 1987	Handbook of typified designs for structures with steel Roof trusses
IS 816 : 1969	Code of Practice for use of metal arc welding for general construction in mild steel
IS 456 : 2000	Plain and Reinforced Concrete Code of Practice.
IS 1893: 2002	Criteria for Earthquake resistant design of structures
IS 6403: 1981	Code of Practice for determination of bearing capacity of shallow foundations
IS 1786: 2008	Specification for high strength deformed steel bars and wires for concrete reinforcement
IS 13920: 1983	Code of practice for ductile detailing of reinforced concrete Structures subjected to seismic forces.
SP - 16 (Design Aids for Reinforced Concrete) :1978	Design aids for reinforced concrete to IS 456.
SP - 34:1987	Hand book on concrete reinforcement and detailing

3. All relevant BIS Code of India for Civil, Electrical, Water Supply, Sanitary, HVAC and Solar Panels.

4. Energy Conservation Code - 2007.

5. Roads / Driveway / Parking: IRC 37-1984 / MORTH specifications.

6. Indian Electricity Rules / State Electricity Rules.

7. ASHRAE Standards.

8. All local bylaws.

9. Hand Book of Water Supply and Drainage, BIS, SP-35.

10. CPWD - Specifications published by Director General (Works) CPWD, New Delhi including subsequent amendments, upto date correction slips, revisions.

a. CPWD Specifications 2009 (Volume I & II)
b. CPWD General Specifications for Electrical Works Part IV Sub Station - 2013
c. CPWD General Specifications for Electrical Works Part IV Sub Station - 2013.
d. CPWD General Specifications for Electrical Works Part VII D.G. Sets - 2013.
e. General Specifications for Heating, Ventilation & Air-Conditioning(HVAC) - 2004

11. Specifications published by Director General (Works), MES, E-in-C branch, Kashmere House New Delhi, including subsequent amendments, upto date correction slips, revisions

a. MES SSR Part I 2009,
b. TI's issued by E-in-C branch for specified purpose from time to time

Note: Any reference to codes and standards shall be deemed to include all subsequent revisions, up to date corrections slips, updates, amendments etc.