डेडीकेटेड फ्रेट कोरीडोर

DESIGN AND CONSTRUCTION OF CIVIL, STRUCTURES AND TRACK WORKS FOR SINGLE LINE RAILWAY INVOLVING FORMATION IN EMBANKMENTS/CUTTINGS, BALLAST ON FORMATION, TRACK WORKS, BRIDGES, STRUCTURES, BUILDINGS, YARDS, INTEGRATION WITH IR EXISTING RAILWAY SYSTEM AND TESTING & COMMISSIONING ON DESIGN-BUILD LUMP SUM BASIS FOR SAHNEWAL - PILKHANI SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

Contract Package: 301

ICB No. HQ/EN/EC/D-B/SAHNEWAL - PILKHANI

PART - 4 - REFERENCE DOCUMENT

GEO TECH DATA - VOLUME - 3

SAHNEWAL TO PILKHANI

From Km. 360.200 to Km. 187.500

GEO TECH DATA

From Km. 270.000 to Km. 316.000

VOL 3/7

EMPLOYER

DEDICATED FREIGHT CORRIDOR CORPORATION OF INDIA LIMITED

(A GOVERNMENT OF INDIA ENTERPRISES)

MINISTRY OF RAILWAYS

COUNTRY : INDIA

S.No
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Geotech Data (Km 270 - Km 316)					
S.No	Chainage	IR KM	Exist. No.	Prop. No.	Page Numbers
1	Appendix				1594-1611
		Bridges Locations			
2	122805	313/19-21	358	158	1612-1622
3	122090	312/27	357	157	1623-1629
4	121275	312/5-7	356A	156	1630-1640
5	120688	311/15-17	356	155	1641-1648
6	119243	310/8-10	355	154	1649-1657
7	119841	310/21-23	355A	153	1658-1668
8	118668	309/17-19	354	152	1669-1679
9	118145	309/2-4	353A	151	1680-1692
10	116770	307/24-26	353	150	1693-1703
11	116215	307/5-7	352	149	1704-1714
12	115254	306/3-5	350	147	1715-1725
13	114637	305/15-17	348	145	1726-1736
14	114341	305/4-6	347	144	1737-1749
15	113413	304/9-11	345	142	1750-1761
16	112435	303/12-14	342	138	1762-1774
17	111543	302/14-16	341	137	1775-1786
18	109543	300/08-10	337		1787-1797
19	108904	299/31-33	336	133	1798-1803
20	108072	298/33-35	335	131	1804-1809
21	106823	297/22-24	334	130	1810-1815
22	104574	295/14-16	333	128	1816-1821
23	103190	294/3-5	330	125	1822-1827
24	102518	293/-13-15	329	124	1828-1833
25	101086	291/32-34	328	123	1834-1839
26	100564	291/15-17	326	121	1840-1845
27	100133	291/4-8	325A	119	1846-1851
28	98582	289/8-10	325B	118	1852-1857
29	94473	285/14-16	323	104	1858-1863
30	92000	282/27-29	322	102	1864-1869
31	90516	281/14-16	321	101	1870-1875
32	90105	281/2-4	320	100	1876-1881
33	89456	280/12-14	318	98	1882-1887
34	87493	278/13-15	317	97	1888-1898
35	115550	306/12-14	351	148	1899-1910
36	113176	304/2-4	344	140	1911-1922
37	110723	301/20-22	339	135	1923-1933
38	109654	300/18-20	338	134	1934-1944
39	103563	294/14-18	331	126	1945-1956
40	96688	287/18-24	325	114	1957-1968
41	92395	283/12-16	322A	103	1969-1979
42	87150	278/3-5	316	96	1980-1990
43	86275	277/7-9	315	95	1991-2002
44	84206	275/7-9	314	93	2002-2013
45	84550	275/13-15	314B	94	2013-2025
46	84355	275/3-5	314A	92	2026-2036
47	82722	273/21-29	313	91	2037-2047
48	80763	271/19-21	312 New	90	2048-2058

Geotech Data (Km 270 - Km 316)					
S.No	Chainage	IR KM	Exist. No.	Prop. No.	Page Numbers
Alignment & Sirhind Detour					
49		315/20-22			2059-2064
50		314/20-22			2065-2070
51		308/15-17			2071-2076
52		298/10-12			2077-2082
53		296/2-4			2083-2088
54		296/30-31			2089-2094
55		292/20-22			2095-2100
56		290/6-8			2101-2106
57		288/13-15			2107-2112
58		286/14-15			2113-2118
59		284/14-16			2119-2124
60		282/8-10			2125-2130
61		279/13-15			2131-2136
62		276/7-9			2137-2143
63		274/19-21			2144-2148
64		272/20-22			2149-2154
65	95532	286/380		108	2155-2163
66	127845 (71650)			167	2164-2169
67	127457 (71300)			165	2170-2178
68	126900 (70700)				2179-2184
69	126147 (69950)	Sirhind Detour		164	2185-2193
70	125700 (69550)			163	2194-2204
71	125156 (69050)			162	2205-2213
72	124983 (68850)	Sirhind Detour		161	2214-2219

Disclaimer : This Booklet does not contain Page Numbers from 2220 to 2884 as these are not relevant to this section and have been deleted.

DEDICATED FREIGHT CORRIDOR CORPORATION OF INDIA LTD.

(LUDHIANA TO AMBALA)

PART - II OF PART A
RAILWAY KM. 316.00-271.00
SAHNEWAL (LUDHIANA) TO SIRHIND SECTION

DETAIL FOR DEPTH OF BOREHOLES

Minor Bridges :	396.00	m
MajorBridges :	1260.00	m
Alingnment :	192.00	m
Rail Flyover (ROR):	60.00	m
Detour Section:	306.00	m
Total Depth :	2214.00	m

CONTENTS — PAGE NO.

27	73	325B	289/8-10	1	12.00	18.06.2009	
28	74	323	285/14-16	1	12.00	19.06.2009	
29	75	322	282/27-29	1	12.00	26.11.2009 - 27.11.2009	
30	76	321	281/14-16	1	12.00	28.11.2009	
31	77	320	281/2-4	1	12.00	28.11.2009	
32	78	318	280/12-14	1	12.00	29.11.2009	
33	79	317	278/13-15	1	12.00	26.11.2009	
Total Depth Detail of Minor Bridge					**396.00**		

MAJOR BRIDGES

S.No	Chapter No.	Bridge No.	Location	Bore hole No.	Depth of Borehole	Date	Page No.
34	80	351	306/12-14	A1	30.00	11.06.2009	
				P3	30.00	11.06.2009-12.06.2009	
				A2	30.00	11.06.2009	
35	81	344	304/2-4	A1	30.00	12.06.2009	
				P4	30.00	13.06.2009	
				A2	30.00	12.06.2009	
36	82	339	301/20-22	A1	30.00	14.06.2009	
				P4	30.00	14.06.2009	
				A2	30.00	13.06.2009	
37	83	338	300/18-20	A1	30.00	13.06.2009	
				P4	30.00	14.06.2009	
				A2	30.00	14.06.2009	
38	84	331	294/14-18	A1	30.00	16.06.2009	
				P7	30.00	16.06.2009	
				A2	30.00	16.06.2009-17.06.2009	
39	85	325	287/18-24	A1	30.00	18.06.2009	
				P2	30.00	18.06.2009-19.06.2009	
				A2	30.00	18.06.2009	
40	86	322A	283/12-16	A1	30.00	20.06.2009-21.06.2009	
				P2	30.00	20.06.2009-21.06.2009	
				A2	30.00	21.06.2009	
41	87	316	278/3-5	A1	30.00	02.12.2009	
				P2	30.00	01.12.2009	
				A2	30.00	30.11.2009	
42	88	315	277/7-9	A1	30.00	02.12.2009	
				P2	30.00	03.12.2009	
				A2	30.00	04.12.2009	
43	89	314	275/7-9	A1	30.00	07.07.2009-08.07.2009	
				P6	30.00	09.07.2009-10.07.2009	
				A2	30.00	08.07.2009-09.07.2009	
44	90	314 B	275/13-15	A1	30.00	10.07.2009-11.07.2009	
				P8	30.00	11.07.2009-12.07.2009	
				A2	30.00	12.07.2009-13.07.2009	
45	91	314A	275/3-5	A1	30.00	13.07.2009-14.07.2009	
				P8	30.00	14.07.2009-15.07.2009	
				A2	30.00	15.07.2009-16.07.2009	

46	92	313	273/21-29	A1	30.00	16.07.2009-17.07.2009	
				P3	30.00	17.07.2009-18.07.2009	
				A2	30.00	18.07.2009-19.07.2009	
47	93	New Found	271/19-21	A1	30.00	28.11.2009-01.12.2009	
				P1	30.00	28.11.2009-30.11.2009	
				A2	30.00	30.11.2009-02.12.2009	
Total Depth Detail of Major Bridge					**1260.00**		

ALIGNMENT							
S.No	Chapter No.	Bridge No.	Location	Bore hole No.	Depth of Borehole	Date	Page No.
48	94		315/20-22	1	12.00	24.11.2009	
49	95		314/20-22	1	12.00	24.11.2009	
50	96		308/15-17	1	12.00	10.06.2009	
51	97		298/10-12	1	12.00	15.06.2009	
52	98		296/2-4	1	12.00	16.06.2009	
53	99		296/30-31	1	12.00	15.06.2009	
54	100		292/20-22	1	12.00	17.06.2009	
55	101		290/6-8	1	12.00	05.12.2009	
56	102		288/13-15	1	12.00	18.06.2009	
57	103		286/14-15	1	12.00	19.06.2009	
58	104		284/14-16	1	12.00	19.06.2009	
59	105		282/8-10	1	12.00	27.11.2009	
60	106		279/13-15	1	12.00	29.11.2009	
61	107		276/7-9	1	12.00	06.07.2009-07.07.2009	
62	108		274/19-21	1	12.00	10.07.2009	
63	109		272/20-22	1	12.00	04.12.2009	
Total Depth Detail of Alignment					**192.00**		
PROPOSED RFO (ROR)							
S.No	Chapter No.	Bridge No.	Location	Bore hole No.	Depth of Borehole	Date	Page No.
64	110		286/380	A1	30.00	03.12.2009	
				A2	30.00	05.12.2009	
Total Depth Detail of RFO (ROR)					**60.00**		
DETOUR SECTION							
S.No	Chapter No.	Bridge No.	Location	Bore hole No.	Depth of Borehole	Date	Page No.
65	111	Inter Dist.	71650	1	12.00	13.11.2009	
66	112	Proposed RFO (ROR)	71300	A1	30.00	13.11.2009-14.11.2009	
				A2	30.00	14.11.2009-15.11.2009	
67	113	Inter Dist.	70700	1	12.00	15.11.2009-16.11.2009	
68	114	Proposed RFO (ROR)	69950	A1	30.00	17.11.2009-18.11.2009	
				A2	30.00	16.11.2009-17.11.2009	
69	115	Proposed Major Br.	69550	A1	30.00	19.11.2009-20.11.2009	
				P1	30.00	20.11.2009-21.11.2009	
				A2	30.00	18.11.2009-19.11.2009	
70	116	Proposed ROB	69050	A1	30.00	22.11.2009-23.11.2009	
				A2	30.00	21.11.2009-22.11.2009	
71	117	Proposed RUB	68850	1	12.00	25.11.2009	
Total Depth Detail of Detour Section					**306.00**		
Total Depth Detail of Part - II of Part - A					**2214.00**		

APPENDIX – B : GEOTECHNICAL SUBSURFACE PROFILE AND FOUNDATION DETAILS AT A GLANCE
PART - II (CH. 316.00 - 271.00)

Minor Bridges

S.No.	Bridge No.	Chainage	Proposed Bridge Detail		No. of Bore-hole	Bore-hole Identification	BH Level (m)	Depth of Bore-hole Actual	Ground Water Table Position (m.)	Sub Soil Strata Profile	Recommended Net SBC (t/m2)	Pile Load Carrying Capacity (t)		Expected Depth of Foundation	Type of expected Foundation
			Span Length	Type of Super Structure								1.0m Dia	1.20 m Dia		
1	358	313/19-21	1 x 3 x 3	Box	1	BH-1	263.253	12.00	Below 20.00	0.00-3.00m. - Sandy Silt with Clay 3.00-12.00m - Silty Sand	1.50m - 05.50 3.00m – 10.00 4.50m – 26.00 6.00m – 28.00	-	-	Below 4.50m from EGL	Open
2	357	312/30-313/2	1 x 3 x 2	Box	1	BH-1	264.009	12.00	Below 15.00	0.00-3.00m. - Sandy Silt with Clay 3.00-4.50m - Silty Sand with Gravels 4.50-12.00m - Silty Sand	1.50m - 07.50 3.00m – 13.00 4.50m – 21.00 6.00m – 24.00	-	-	Below 4.50m from EGL	Open
3	356-A	312/5-7	1 x 2 x 2	Box	1	BH-1	264.106	12.00	Below 20.00	0.00-3.00m. - Silty Sand with Gravels 3.00-12.00m - Silty Sand	1.50m - 08.00 3.00m – 12.00 4.50m – 19.00 6.00m – 21.00	-	-	Below 4.50m from EGL	Open
4	356	311/15-17	1 x 3 x 2	Box	1	BH-1	262.205	12.00	Below 20.00	0.00-3.00m. - Clayey Silt with Sand & Gravels 3.00-12.00m - Silty Sand	1.50m - 15.00 3.00m – 26.00 4.50m – 27.00 6.00m – 30.00	-	-	Below 3.00m from EGL	Open
5	355	310/4-6	2 x 2 x 2	Box	1	BH-1	263.368	12.00	Below 15.00	0.00-3.00m. - Sandy Silt with Clay 3.00-4.50m - Claycy Silt with Sand 4.50-12.00m - Silty Sand	1.50m - 14.00 3.00m – 18.00 4.50m – 26.00 6.00m – 28.00	-	-	Below 3.00m from EGL	Open
6	355-A	310/21-23	1 x 3 x 2	Box	1	BH-1	263.514	12.00	Below 20.00	0.00-1.50m. - Sandy Silt with Clay 1.50-3.00m - Sandy Silt with Clay & Gravels 3.00-12.00m - Silty Sand	1.50m - 07.00 3.00m – 14.00 4.50m – 26.00 6.00m – 27.00	-	-	Below 4.50m from EGL	Open
7	354	309/17-19	1 x 3 x 3	Box	1	BH-1	263.568	12.00	Below 15.00	0.00-1.50m. - Sandy Silt with Clay 1.50-3.00m - Sandy Silt 3.00-6.00m - Silty Sand 6.00-7.50m - Silty Sand with Gravels 7.50-12.00m - Silty Sand	1.50m - 08.00 3.00m – 15.00 4.50m – 18.00 6.00m – 19.00	-	-	Below 4.50m from EGL	Open
8	353-A	309/2-4	1 x 1.2 x 1.2	Box	1	BH-1	264.033	12.00	Below 20.00	0.00-3.00m. - Sandy Silt with Clay 3.00-12.00m - Silty Sand	1.50m - 07.00 3.00m – 12.00 4.50m – 19.00 6.00m – 21.00	-	-	Below 4.50m from EGL	Open

9	353	307/24-26	2 x 3.66	Slab	1	BH-1	263.615	12.00	Below 20.00	0.00-1.50m. - Sandy Silt with Clay 1.50-12.00m - Silty Sand	1.50m - 07.00 3.00m – 13.00 4.50m – 25.00 6.00m – 26.00	-	-	Below 4.50m from EGL	Open
10	352	307/5-7	1 x 3 x 3	Box	1	BH-1	263.677	12.00	Below 20.00	0.00-1.50m. - Sandy Silt with Clay 1.50-3.00m - Silty Sand 3.00-6.00m - Silty Sand with Gravels 6.00-12.00m - Silty Sand	1.50m – 06.00 3.00m – 11.00 4.50m – 15.00 6.00m – 16.00	-	-	Below 4.50m from EGL	Open
11	350	306/3-5	2 x 3 x3	Box	1	BH-1	263.693	12.00	Below 20.00	0.00-1.50m. - Sandy Silt with Clay 1.50-3.00m - Silty Sand with Clay 3.00-6.00m - Silty Sand 6.00-7.50m - Silty Sand with Gravel 7.50-12.00m - Silty Sand	1.50m - 06.00 3.00m – 10.00 4.50m – 20.00 6.00m - 21.00	-	-	Below 4.50m from EGL	Open
12	348	305/15-17	2 x 9.15	Slab	1	BH-1	263.458	12.00	Below 20.00	0.00-3.00m. - Sandy Silt with Clay 3.00-12.00m - Silty Sand	1.50m - 05.00 3.00m – 10.00 4.50m – 11.00 6.00m – 12.00	-	-	Below 6.00m from EGL	Open
13	347	305/8-10	1 x 3x3	Box	1	BH-1		12.00	Below 15.00	0.00-4.50m. - Sandy Silt with Clay 4.50-12.00m - Silty Sand	1.50m – 08.00 3.00m – 14.00 4.50m – 21.00 6.00m – 22.50	-	-	Below 4.50m from EGL	Open
14	345	304/9-11	2 x4x2	Box	1	BH-1	263.653	12.00	Below 20.00	0.00-3.00m. - Clayey Silt with Sand 3.00-12.00m - Silty Sand	1.50m – 05.00 3.00m – 10.00 4.50m – 18.00 6.00m – 20.00	-	-	Below 4.50m from EGL	Open
15	342	303/12-14	2 x 3 x2	Box	1	BH-1	263.99	12.00	Below 20.00	0.00-4.50m. - Clayey Silt with Sand 4.50-12.00m - Silty Sand	1.50m - 06.50 3.00m – 10.00 4.50m – 16.00 6.00m – 17.00	-	-	Below 4.50m from EGL	Open
16	341	302/14-16	5 x 3.05	Slab	1	BH-1	262.748	12.00	Below 20.00	0.00-3.00m. - Clayey Silt with Sand and Gravels 3.00-4.50m - Sandy Silt with Clay 4.50-12.00m - Silty Sand	1.50m - 11.50 3.00m – 19.00 4.50m – 26.00 6.00m – 35.00	-	-	Below 3.00m from EGL	Open
17	337	300/8-10	2 x 3.05	Slab	1	BH-1	263.337	12.00	Below 20.00	0.00-1.50m. - Clayey Silt with Sand 1.50-3.00m - Sandy Silt with Gravels 3.00-4.50m - Sandy Silt 4.50-12.00m - Silty Sand	1.50m – 11.00 3.00m – 20.00 4.50m – 31.00 6.00m – 33.00	-	-	Below 3.00m from EGL	Open
18	336	299/31-33	2 x 3.05	Slab	1	BH-1	263.425	12.00	Below 20.00	0.00-4.50m. - Clayey Silt with Sand 4.50-12.00m - Silty Sand	1.50m – 12.00 3.00m – 17.00 4.50m – 25.00 6.00m – 27.00	-	-	Below 3.00m from EGL	Open

19	335	298/33-35	2 x 3.05	Slab	1	BH-1	264.197	12.00	Below 20.00	0.00-1.50m. - Clayey Silt with Sand 1.50-3.00m - Silty Sand 3.00-7.50m - Sandy Silt 7.50-12.00m - Silty Sand	1.50m - 05.50 3.00m – 10.00 4.50m – 17.00 6.00m – 18.00	-	-	Below 4.50m from EGL	Open
20	334	297/22-24	4 x 3.05	Slab	1	BH-1	264.315	12.00	Below 20.00	0.00-6.00m. - Clayey Silt with Sand 6.00-12.00m - Silty Sand	1.50m - 7.00 3.00m – 10.00 4.50m – 11.00 6.00m – 13.00	-	-	Below 6.00m from EGL	
21	333	295/14-16	2 x 3.05	Slab	1	BH-1	264.916	12.00	Below 20.00	0.00-7.50m. - Clayey Silt with Sand 7.50-12.00m - Silty Sand	1.50m - 06.00 3.00m – 10.00 4.50m – 16.00 6.00m – 17.00	-	-	Below 4.50m from EGL	Open
22	330	294/3-5	3 x 3.05	Slab	1	BH-1	264.495	12.00	Below 20.00	0.00-3.00m. - Clayey Silt with Sand 3.00-6.00m - Sandy Silt 6.00-10.50m - Clayey Silt with Sand 10.50-12.00m - Silty Sand	1.50m - 07.00 3.00m – 09.00 4.50m – 09.50 6.00m – 10.50	-	-	Below 6.00m from EGL	Open
23	329	293/14-16	4 x 3.05	Slab	1	BH-1	264.358	12.00	Below 20.00	0.00-6.00m. - Clayey Silt with Sand 6.00-12.00m - Sandy Silt	1.50m - 06.50 3.00m – 09.00 4.50m – 10.00 6.00m – 17.00	-	-	Below 6.00m from EGL	Open
24	328	291/32-34	2 x 9.15	Slab	1	BH-1	265.345	12.00	Below 20.00	0.00-10.50m. - Clayey Silt with Sand 10.50-12.00m - Silty Sand	1.50m - 06.00 3.00m – 09.00 4.50m – 12.00 6.00m – 13.00	-	-	Below 6.00m from EGL	Open
25	326	291/15-17	1 x 3 x 3	Box	1	BH-1	265.576	12.00	Below 20.00	0.00-10.50m. - Clayey Silt with Sand 10.50-12.00m - Silty Sand	1.50m - 09.50 3.00m – 14.00 4.50m – 24.00 6.00m – 25.00	-	-	Below 4.50m from EGL	Open
26	325-A	291/4-8	1 x 1.2 x 1.2	Box	1	BH-1	265.768	12.00	Below 20.00	0.00-10.50m. - Clayey Silt with Sand 10.50-12.00m - Silty Sand	1.50m - 11.00 3.00m – 17.00 4.50m – 21.00 6.00m – 23.00	-	-	Below 3.00m from EGL	Open
27	325-B	289/8-10	1 x 1.2 x 1.2	Box	1	BH-1		12.00	Below 25.00	0.00-1.50m - Filled up Strata 1.50-3.00m. - Silty Sand 3.00-7.50m - Clayey Silt with Sand 7.50-12.00m - Silty Sand	1.50m - 09.00 3.00m – 13.00 4.50m – 20.00 6.00m – 21.00	-	-	Below 4.50m from EGL	Open
28	323	285/14-16	2 x 3.05	Slab	1	BH-1	266.567	12.00	Below 25.00	0.00-4.50m. - Clayey Silt with Sand 4.50-12.00m - Silty Sand	1.50m - 12.00 3.00m – 18.50 4.50m – 20.00 6.00m – 22.00	-	-	Below 3.00m from EGL	Open
29	322	282/28 283/2	1 x 3 x 2	Box	1	BH-1	267.300	12.00	Below 20.00	0.00-12.00m - Clayey Silt with Sand	1.50m - 12.00 3.00m – 15.00 4.50m – 15.00 6.00m – 16.00	-	-	Below 3.00m from EGL	Open

30	321	281/14-16	1 x 2 x 2	Box	1	BH-1	268.736	12.00	Below 20.00	0.00-1.50m - Filled up Strata 1.50-3.00m. - Silty Sand 3.00-4.50m - Sandy Silt with Clay 4.50-9.00m - Clayey Silt 9.00-12.00m - Sandy Silt with Clay Below 12.00m - Silty Sand	1.50m - 11.00 3.00m – 14.50 4.50m – 16.00 6.00m – 18.00	-	-	Below 3.00m from EGL	Open
31	320	281/2-4	1 x 2 x 2	Box	1	BH-1	267.735	12.00	Below 20.00	0.00-3.00m - Silty Sand 3.00-6.00m - Clayey Silt with Sand 6.00-7.50m - Silty Sand 7.50-12.00m - Clayey Silt with Sand Below 12.00m - Silty Sand	1.50m - 09.00 3.00m – 14.50 4.50m – 16.00 6.00m – 18.00	-	-	Below 3.00m from EGL	Open
32	318	280/12-14	1 x 2 x 2	Box	1	BH-1	267.853	12.00	Below 15.00	0.00-4.50 - Clayey Silt with Sand 4.50-7.50m - Sandy Silt with Clay 7.50-12.00m - Clayey Silt with Sand	1.50m - 14.00 3.00m – 18.00 4.50m – 20.00 6.00m – 23.00	-	-	Below 3.00m from EGL	Open
33	317	278/13-15	1 x 3.66	Slab	1	BH-1	266.787	12.00	Below 13.00	0.00-3.00m - Silty Sand 3.00-4.50m - Sandy Silt with Clay 4.50-9.00m - Clayey Silt with Sand 9.00-10.50m - Clayey Silt 10.50-12.00m - Clayey Silt with Sand Below 12.00 - Sandy Silt with Clay	1.50m - 8.00 3.00m – 15.00 4.50m – 17.00 6.00m – 18.00	-	-	Below 3.00m from EGL	Open
					28			**396.00**							

Major Bridges															
34	351	306/12-14	5 x 6.1	Slab	1	A1	263.776	30.00	15.50	0.00-3.00m. - Sandy Silt with Clay 3.00-13.50m - Silty Sand 13.50-15.00m - Sandy Silt with Clay 15.00-16.50m - Sandy Silt with Gravels 16.50-25.50m - Silty Sand 25.50-28.50m - Sandy Silt with Gravels 28.50-30.00m - Sandy Silt with Clay & Gravels	1.50m - 7.00 3.00m – 12.00 4.50m – 13.00 6.00m – 19.00	17.00m - 140.00 20.00m - 180.00 23.00m - 250.00	17.00m - 180.00 20.00m - 240.00 23.00m - 330.00	-	Pile
					1	P3	263.775	30.00	15.50	0.00-1.50m - Sandy Silt with Clay 1.50-12.00m - Silty Sand 12.00-13.50m - Sandy Silt with Clay 13.50-30.00m - Silty Sand	3.00m – 12.00 4.50m – 14.00 6.00m – 15.00	17.00m - 120.00 20.00m - 150.00 23.00m - 190.00	17.00m - 160.00 20.00m - 200.00 23.00m - 250.00	-	Pile
					1	A2	263.796	30.00	15.50	0.00-3.00m - Sandy Silt with Clay 3.00-12.00m - Silty Sand 12.00-13.50m - Sandy Silt 13.50-30.00m - Silty Sand	1.50m - 9.00 3.00m – 17.00 4.50m – 18.00 6.00m – 18.50	17.00m - 140.00 20.00m - 180.00 23.00m - 230.00	17.00m - 190.00 20.00m - 240.00 23.00m - 300.00	-	Pile
35	344	304/2-4	8 x 6.1	Slab	1	A1	263.949	30.00	21.00	0.00-3.00m - Clayey Silt with Sand 3.00-4.50m - Sandy Silt 4.50-13.50m - Silty Sand 13.50-14.00m - Clayey Silt with Sand 14.00-30.00m - Silty Sand	1.50m - 7.00 3.00m – 13.00 4.50m – 16.00 6.00m – 18.00	17.00m - 140.00 20.00m - 180.00 23.00m - 250.00	17.00m - 180.00 20.00m - 240.00 23.00m - 330.00	-	Pile
					1	P4	264.058	30.00	21.00	0.00-4.50m - Clayey Silt with Sand 4.50-13.50m - Silty Sand 13.50-16.50m - Clayey Silt with Sand 16.50-30.00m - Silty Sand	3.00m – 10.00 4.50m – 18.00 6.00m – 19.00	17.00m - 120.00 20.00m - 160.00 23.00m - 200.00	17.00m - 160.00 20.00m - 200.00 23.00m - 250.00	-	Pile
					1	A2	263.999	30.00	21.00	0.00-3.00m - Clayey Silt with Sand 3.00-4.50m - Sandy Silt with Clay 4.50-13.50m - Silty Sand 13.50-19.50m - Clayey Silt with Sand 19.50-30.00m - Silty Sand	1.50m - 7.50 3.00m – 12.00 4.50m – 20.00 6.00m – 21.00	17.00m - 140.00 20.00m - 180.00 23.00m - 230.00	17.00m - 190.00 20.00m - 240.00 23.00m - 300.00	-	Pile
36	339	301/20-22	8 x 6.1	Slab	1	A1	264.319	30.00	21.80	0.0-4.50m - Clayey Silt with Sand 4.50-6.00m - Silty Sand 6.00-7.50m - Clayey Silt with Sand 7.50-10.50m - Sandy Silt 10.50-30.00m - Silty Sand	1.50m - 7.00 3.00m – 8.50 4.50m – 15.00 6.00m – 16.00	17.00m - 140.00 20.00m - 180.00 23.00m - 230.00	17.00m - 190.00 20.00m - 240.00 23.00m - 300.00	-	Pile
					1	P4	263.178	30.00	22.00	0.00-3.00m - Clayey Silt with Sand 3.00-30.00m - Silty Sand	3.00m – 15.00 4.50m – 28.00 6.00m – 29.00	17.00m - 120.00 20.00m - 160.00 23.00m - 200.00	17.00m - 160.00 20.00m - 210.00 23.00m - 250.00	-	Pile
					1	A2	263.276	30.00	21.70	0.00-4.50m - Clayey Silt with Sand 4.50-6.00m - Silty Sand 6.00-10.50m - Clayey Silt with Sand 10.50-30.00m - Silty Sand	1.50m - 6.00 3.00m – 9.50 4.50m – 13.00 6.00m – 14.00	17.00m - 120.00 20.00m - 160.00 23.00m - 200.00	17.00m - 160.00 20.00m - 210.00 23.00m - 260.00	-	Pile

37	338	300/18-20	8 x 6.1	Slab	1	A1	263.353	30.00	21.80	0.00-3.00m - Clayey Silt with Sand 3.00-4.50m - Sandy Silt 4.50-23.50m - Silty Sand 23.50-30.00m - Sandy Silt with Clay	1.50m - 10.00 3.00m - 18.00 4.50m - 19.00 6.00m - 21.00	20.00m - 140.00 23.00m - 160.00	20.00m - 180.00 23.00m - 200.00	-	Pile
					1	P4	263.504	30.00	21.80	0.00-4.50m - Clayey Silt with Sand 4.50-25.50m - Silty Sand 25.50-30.00m - Sandy Silt with Clay Below 30.00m - Silty Sand	3.00m - 11.00 4.50m - 15.00 6.00m - 16.00	17.00m - 120.00 20.00m - 150.00	17.00m - 160.00 20.00m - 200.00	-	Pile
					1	A2	263.281	30.00	21.80	0.00-4.50m - Clayey Silt with Sand 4.50-30.00m - Silty Sand	1.50m - 7.00 3.00m - 10.00 4.50m - 12.50 6.00m - 13.50	17.00m - 120.00 20.00m - 150.00 23.00m - 190.00	17.00m - 150.00 20.00m - 200.00 23.00m - 250.00	-	Pile
38	331	294/14-18	15 x 6.1	Slab	1	A1	264.919	30.00	22.00	0.00-4.50m - Clayey Silt with Sand 4.50-7.50m - Sandy Silt with Clay 7.50-9.00m - Sandy Silt 9.00-10.50m - Clayey Silt with Sand 10.50-12.00m - Clayey Silt 12.00-13.50m - Silty Sand with Clay 13.50-16.50m - Silty Sand 16.50-18.00m - Sandy Silt 18.00-19.50m - Clayey Silt with Sand 19.50-22.50m - Silty Sand 22.50-25.50m - Clayey Silt with Sand 25.50-30.00m - Silty Sand Below 30.00m - Clayey Silt with Sand	1.50m - 7.00 3.00m - 15.00 4.50m - 16.00 6.00m - 18.00	20.00m - 130.00 23.00m - 210.00	20.00m - 150.00 23.00m - 270.00	-	Pile
					1	P7	264.861	30.00	21.00	0.00-4.50m - Clayey Silt with Sand 4.50-9.00m - Clayey Silt 9.00-10.50m - Clayey Silt with Sand 10.50-12.00m - Sandy Silt 12.00-15.00m - Silty Sand 15.00-19.50m - Clayey Silt with Sand 19.50-30.00m - Silty Sand Below 30.00m - Sandy Silt with Clay	3.00m - 15.00 4.50m - 16.00 6.00m - 18.00	20.00m - 180.00 23.00m - 230.00	20.00m - 230.00 23.00m - 290.00	-	Pile
					1	A2	264.788	30.00	21.00	0.00-6.00m - Clayey Silt with Sand & Gravels 6.00-7.50m - Clayey Silt with Sand 7.50-10.50m - Sandy Silt 10.50-12.00m - Clayey Silt 12.00-18.00m - Silty Sand 18.00-22.50m - Silty Sand with Clay 22.50-25.50m - Clayey Silt with Sand 25.50-30.00m - Silty Sand Below 30.00m - Clayey Silt	1.50m - 6.50 3.00m - 11.00 4.50m - 13.00 6.00m - 14.00	20.00m - 100.00 23.00m - 180.00	20.00m - 130.00 23.00m - 230.00	-	Pile

39	325	287/18-24	4 x 30.5	Through Type Steel Truss	1	A1	265.102	30.00	22.40	0.00-30.00m - Clayey Silt with Sand	1.50m - 6.00 3.00m - 8.00 4.50m - 9.00 6.00m - 9.50	17.00m - 80.00 20.00m - 100.00 23.00m - 130.00	17.00m - 90.00 20.00m - 120.00 23.00m - 150.00	-	Pile
					1	P2	264.828	30.00	22.40	0.00-9.00m - Clayey Silt with Sand 9.00-12.00m - Sandy Silt with Clay 12.00-30.00m - Clayey Silt with Sand	3.00m - 16.00 4.50m - 18.00 6.00m - 20.00	17.00m - 80.00 20.00m - 110.00 23.00m - 140.00	17.00m - 100.00 20.00m - 130.00 23.00m - 170.00	-	Pile
					1	A2	267.71	30.00	22.40	0.00-6.00m - Clayey Silt with Sand 6.00-19.50m - Clayey Silt 19.50-30.00m - Clayey Silt with Sand	1.50m - 8.00 3.00m - 10.00 4.50m - 11.00 6.00m - 12.00	17.00m - 90.00 20.00m - 130.00 23.00m - 160.00	17.00m - 110.00 20.00m - 150.00 23.00m - 190.00	-	Pile
40	322A	283/12-16	2 x 18.3+2 x 12.2	Steel Girder	1	A1	265.486	30.00	Below 30.00	0.00-3.00m - Sandy Silt with Clay 3.00-4.50m - Clayey Silt with Sand 4.50-10.50m - Silty Sand 10.50-16.50m - Sandy Silt with Clay 16.50-30.00m - Clayey Silt with Clay	1.50m - 7.00 3.00m - 8.50 4.50m - 11.50 6.00m - 12.50	17.00m - 80.00 20.00m - 110.00 23.00m - 140.00	17.00m - 100.00 20.00m - 130.00 23.00m - 170.00	-	Pile
					1	P2	261.786	30.00	Below 30.00	0.00-15.00m - Sandy Silt with Clay 15.00-22.50m - Clayey Silt with Sand 22.50-30.00m - Sandy Silt with Clay	3.00m - 10.00 4.50m - 11.00 6.00m - 12.00	17.00m - 80.00 20.00m - 110.00 23.00m - 140.00	17.00m - 100.00 20.00m - 130.00 23.00m - 170.00	-	Pile
					1	A2	268.458	30.00	Below 30.00	0.00-3.00m - Clayey Silt with Sand 3.00-4.50m - Clayey Silt 4.50-30.00m - Silty Sand	1.50m - 6.00 3.00m - 9.00 4.50m - 10.00 6.00m - 11.00	17.00m - 140.00 20.00m - 180.00 23.00m - 230.00	17.00m - 180.00 20.00m - 240.00 23.00m - 300.00	-	Pile
41	316	278/3-5	4 x 6.10	Slab	1	A1	266.257	30.00	12.00	0.00-3.00m - Silty Sand 3.00-4.50m - Sandy Silt with Clay 4.50-10.50m - Silty Sand 10.50-19.50m - Clayey Silt with Sand 19.50-22.50m - Clayey Silt 22.50-30.00m - Clayey Silt with Sand	1.50m - 8.00 3.00m - 11.50 4.50m - 16.00 6.00m - 17.00	17.00m - 90.00 20.00m - 110.00 23.00m - 140.00	17.00m - 110.00 20.00m - 140.00 23.00m - 170.00	-	Pile
					1	P2	265.990	30.00	12.00	0.00-4.50m - Clayey Silt with Sand 4.50-10.50m - Silty Sand 10.50-30.00m - Clayey Silt with Sand	3.00m - 14.00 4.50m - 14.00 6.00m - 15.00	17.00m - 100.00 20.00m - 130.00 23.00m - 170.00	17.00m - 120.00 20.00m - 160.00 23.00m - 200.00	-	Pile
					1	A2	266.025	30.00	12.00	0.00-3.00m - Clayey Silt with Sand 3.00-13.50m - Silty Sand 13.50-24.00m - Sandy Silt with Clay 24.00-30.00m - Clayey Silt with Sand	1.50m - 5.00 3.00m - 13.00 4.50m - 14.00 6.00m - 15.00	17.00m - 110.00 20.00m - 150.00 23.00m - 180.00	17.00m - 140.00 20.00m - 180.00 23.00m - 220.00	-	Pile

42	315	277/7-9	4 x 6.10	Slab	1	A1	266.103	30.00	11.00	0.00-4.50m - Sandy Silt with Clay 4.50-7.50m - Clayey Silt with Sand 7.50-9.00m - Sandy Silt with Clay 9.00-13.50m - Clayey Silt 13.50-22.50m - Clayey Silt with Sand 22.50-25.50m - Clayey Silt 25.50-30.00m - Clayey Silt with Sand	1.50m - 8.00 3.00m – 19.50 4.50m – 13.50 6.00m – 14.50	17.00m - 85.00 20.00m - 110.00 23.00m - 145.00	17.00m - 100.00 20.00m - 140.00 23.00m - 175.00	-	Pile
					1	P2	265.347	30.00	11.00	0.00-3.00m - Clayey Silt with Sand 3.00-4.50m - Sandy Silt with Clay 4.50-12.00m - Clayey Silt with Sand 12.00-25.50m - Clayey Silt 25.50-30.00m - Clayey Silt with Sand	3.00m – 11.50 4.50m – 13.00 6.00m – 14.50	17.00m - 100.00 20.00m - 130.00 23.00m - 160.00	17.00m - 125.00 20.00m - 160.00 23.00m - 195.00	-	Pile
					1	A2	265.563	30.00	11.00	0.00-1.50 - Filled up Strata 1.50-9.00m - Clayey Silt with Sand 9.00-13.50m - Clayey Silt 13.50-30.00m - Clayey Silt with Sand	1.50m - 7.50 3.00m – 12.00 4.50m – 13.00 6.00m – 14.00	17.00m - 85.00 20.00m - 110.00 23.00m - 140.00	17.00m - 105.00 20.00m - 140.00 23.00m - 170.00	-	Pile
43	314	275/7-9	12.2+9.15+6.10+9.15+12.2	Slab	1	A1	264.767	30.00	Below 30.00	0.00-4.50m - Clayey Silt with Sand 4.50-10.50m - Sandy Silt 10.50-12.00m - Clayey Silt 12.00-24.00m - Clayey Silt with Sand 24.00-25.50m - Sandy Silt 25.50-30.00m - Clayey Silt with Sand	1.50m - 7.50 3.00m – 11.00 4.50m – 12.00 6.00m – 13.00	17.00m - 90.00 20.00m - 110.00 23.00m - 140.00	17.00m - 100.00 20.00m - 130.00 23.00m - 180.00	-	Pile
					1	P6	265.536	30.00	Below 30.00	0.00-7.50m - Clayey Silt 7.50-30.00m - Clayey Silt with sand	3.00m – 08.00 4.50m – 09.00 6.00m – 10.00	17.00m - 70.00 20.00m - 110.00 23.00m - 130.00	17.00m - 90.00 20.00m - 120.00 23.00m - 160.00	-	Pile
					1	A2	265.337	30.00	Below 30.00	0.00-3.00m - Cleyey Silt with Sand 3.00-7.50m - Silty Sand 7.50-12.00m - Clayey Silt with Sand 12.00-13.50m - Clayey Silt 13.50-30.00m - Clayey Silt with Sand	1.50m - 7.00 3.00m – 11.00 4.50m – 12.00 6.00m – 12.50	17.00m - 90.00 20.00m - 120.00 23.00m - 150.00	17.00m - 110.00 20.00m - 150.00 23.00m - 180.00	-	Pile

1606

44	314 B	275/13-15	16 x 4 x 2	Box	1	A1	265.586	30.00	30.00	0.00-4.50m - Silty Sand 4.50-7.50m - Clayey Silt with Sand 7.50-13.50m - Clayey Silt 13.50-19.50m - Clayey Silt with Sand 19.50-30.00m - Clayey Silt	1.50m - 8.00 3.00m - 8.50 4.50m - 12.00 6.00m - 15.00	17.00m - 70.00 20.00m - 100.00 23.00m - 120.00	17.00m - 80.00 20.00m - 120.00 23.00m - 150.00	-	Pile
					1	P8	264.870	30.00	30.00	0.00-7.50m - Silty Sand 7.50-10.50m - Clayey Silt with Sand 10.50-22.50m - Clayey Silt 22.50-24.00m - Clayey Silt with Sand 24.00-30.00m - Clayey Silt	1.50m - 10.00 3.00m - 13.00 4.50m - 13.00	17.00m - 80.00 20.00m - 110.00 23.00m - 160.00	17.00m - 100.00 20.00m - 130.00 23.00m - 220.00	-	Pile
					1	A2	265.480	30.00	30.00	0.00-3.00m - Sandy Silt with Clay 3.00-4.50m - Silty Sand with Clay 4.50-10.50m - Clayey Silt with Sand 10.50-22.50m - Clayey Silt 22.50-30.00m - Clayey Silt with Sand	1.50m - 07.00 3.00m - 10.00 4.50m - 17.00 6.00m - 11.50	17.00m - 100.00 20.00m - 130.00 23.00m - 170.00	17.00m - 120.00 20.00m - 160.00 23.00m - 210.00	-	Pile
45	314A	275/3-5	16 x 4 x 2	Box	1	A1	265.114	30.00	Below 30.00	0.00-7.50m - Silty Sand 7.50-12.00m - Clayey Silt 12.00-16.50m - Clayey Silt with Sand 16.50-19.50m - Clayey Silt 19.50-30.00m - Clayey Silt with Sand	1.50m - 07.50 3.00m - 14.00 4.50m - 15.00 6.00m - 16.00	17.00m - 90.00 20.00m - 120.00 23.00m - 160.00	17.00m - 110.00 20.00m - 150.00 23.00m - 190.00	-	Pile
					1	P8	265.441	30.00	Below 30.00	0.00-10.50m - Silty Sand 10.50-30.00m - Clayey Silt with Sand	1.50m - 06.00 3.00m - 11.00 4.50m - 11.00	17.00m - 80.00 20.00m - 100.00 23.00m - 130.00	17.00m - 100.00 20.00m - 130.00 23.00m - 160.00	-	Pile
					1	A2	265.145	30.00	Below 30.00	0.00-12.00m - Silty Sand 12.00-30.00m - Clayey Silt with Sand	1.50m - 5.50 3.00m - 10.50 4.50m - 11.00 6.00m - 12.00	17.00m - 80.00 20.00m - 110.00 23.00m - 130.00	17.00m - 100.00 20.00m - 140.00 23.00m - 160.00	-	Pile
46	313	273/21-29	6 x 30.5	Through Type Steel Girder	1	A1	268.118	30.00	6.80	0.00-3.00m - Silty Sand 3.00-4.50m - Sandy Silt 4.50-7.50m - Silty Sand 7.50-13.50m - Clayey Silt 13.50-16.50m - Clayey Silt with Sand 16.50-22.50m - Clayey Silt 22.50-25.50m - Clayey Silt with Sand 25.50-30.00m - Clayey Silt	1.50m - 5.00 3.00m - 9.50 4.50m - 10.00 6.00m - 11.00	17.00m - 90.00 20.00m - 120.00 23.00m - 160.00	17.00m - 110.00 20.00m - 150.00 23.00m - 190.00	-	Pile
					1	P3	261.568	30.00	6.50	0.00-4.50m - Silty Sand 4.50-12.00m - Clayey Silt with Sand 12.00-13.50m - Clayey Silt 13.50-16.50m - Clayey Silt with Sand 16.50-19.50m - Clayey Silt 19.50-30.00m - Clayey Silt with Sand	1.50m - 8.00 3.00m - 12.00 4.50m - 12.50 6.00m - 12.50	17.00m - 90.00 20.00m - 110.00 23.00m - 150.00	17.00m - 110.00 20.00m - 140.00 23.00m - 180.00	-	Pile
					1	A2	267.651	30.00	9.00	0.00-7.50m - Silty Sand 7.50-12.00m - Clayey Silt with Sand 12.00-19.50m - Sandy Silt with Clay 19.50-30.00m - Clayey Silt with Sand	1.50m - 7.50 3.00m - 11.00 4.50m - 12.00 6.00m - 12.50	17.00m - 100.00 20.00m - 110.00 23.00m - 150.00	17.00m - 120.00 20.00m - 150.00 23.00m - 180.00	-	Pile

47	New Found	271/19-21	4 x 4 x 2	Box	1	A1	266.663	30.00	14.00	0.00-4.50m - Clayey Silt with Sand 4.50-7.50m - Sandy Silt with Clay 7.50-13.50m - Clayey Silt with Sand 13.50-30.00m - Clayey Silt	1.50m - 6.00 3.00m - 9.00 4.50m - 9.50 6.00m - 10.50	-	-	Below 4.50m from EGL	Open
					1	P1	265.703	30.00	14.00	0.00-4.50m - Clayey Silt with Sand 4.50-7.50m - Sandy Silt with Clay 7.50-19.50m - Clayey Silt 19.50-24.00m - Clayey Silt with Sand 24.00-25.50m - Clayey Silt with Sand & Gravels 25.50-28.50m - Clayey Silt with Gravels 28.50-30.00m - Clayey Silt	1.50m - 11.00 3.00m - 13.00 4.50m - 15.00 6.00m - 16.00	-	-		
					1	A2	265.897	30.00	14.00	0.00-3.00m - Clayey Silt 3.00-6.00m - Clayey Silt with Sand 6.00-7.50m - Sandy Silt with Clay 7.50-30.00m - Clayey Silt	1.50m - 7.00 3.00m - 8.00 4.50m - 9.00 6.00m - 10.00	-	-		
					42			**1260.00**							

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Alignment															
48		315/20-22			1	BH-1	264.853	12.00	Below 16.00	0.00-2.50m - Filled up Strata 2.50-12.00m - Silty Sand	3.00m – 14.00 4.50m – 16.50 6.00m – 17.50	-	-	Below 4.50m from EGL	Open
49		314/20-22			1	BH-1	266.546	12.00	Below 16.00	0.00-2.50m - Filled up Strata 2.50-12.00m - Silty Sand	3.00m – 16.00 4.50m – 17.00 6.00m – 18.00	-	-	Below 4.50m from EGL	Open
50		308/15-17			1	BH-1	264.215	12.00	Below 20.00	0.00-12.00m - Silty Sand	1.50m - 08.00 3.00m – 15.00 4.50m – 20.00 6.00m – 21.00	-	-	Below 3.00m from EGL	Open
51		298/10-12			1	BH-1	264.595	12.00	Below 20.00	0.00-7.50m - Clayey Silt with Sand 7.50-12.00m - Silty Sand	1.50m - 08.00 3.00m – 11.00 4.50m – 13.00 6.00m – 14.00	-	-	Below 4.50m from EGL	Open
52		296/2-4			1	BH-1	265.936	12.00	Below 20.00	0.00-7.50m - Clayey Silt with Sand 7.50-12.00m - Silty Sand	1.50m - 08.00 3.00m – 13.00 4.50m – 20.00 6.00m – 22.00	-	-	Below 3.00m from EGL	Open
53		296/30-31			1	BH-1	265.671	12.00	Below 20.00	0.00-10.50m - Clayey Silt with Sand 10.50-12.00m - Silty Sand	1.50m - 9.00 3.00m – 14.50 4.50m – 19.00 6.00m – 20.00	-	-	Below 3.00m from EGL	Open
54		292/20-22			1	BH-1	264.885	12.00	Below 20.00	0.00-7.50m - Clayey Silt with Sand 7.50-12.00m - Clayey Silt	1.50m - 10.00 3.00m – 14.00 4.50m – 20.00 6.00m – 21.00	-	-	Below 3.00m from EGL	Open
55		290/6-8			1	BH-1	268.174	12.00	7.00	0.00-2.00m - Filled up Strata 2.00-4.50m - Sandy Silt with Clay 4.50-7.50m - Clayey Silt with Sand 7.50-12.00m - Sandy Silt with Clay & Gravels	3.00m – 15.00 4.50m – 16.00 6.00m – 18.00	-	-	Below 4.50m from EGL	Open
56		288/13-15			1	BH-1	266.963	12.00	Below 20.00	0.00-6.00m - Clayey Silt with Sand 6.00-12.00m - Clayey Silt	1.50m - 06.00 3.00m – 09.00 4.50m – 14.00 6.00m – 15.00	-	-	Below 4.50m from EGL	Open
57		286/14-15			1	BH-1	266.215	12.00	Below 20.00	0.00-12.00m - Clayey Silt	1.50m - 07.00 3.00m – 09.00 4.50m – 13.00 6.00m – 14.00	-	-	Below 4.50m from EGL	Open
58		284/14-16			1	BH-1	268.438	12.00	Below 20.00	0.00-12.00m - Clayey Silt with Sand	1.50m - 6.00 3.00m – 9.00 4.50m – 13.50 6.00m – 14.50	-	-	Below 4.50m from EGL	Open
59		282/8-10			1	BH-1	266.304	12.00	Below 20.00	0.00-3.00m - Silty Sand 3.00-7.50m - Sandy Silt with Clay 7.50-10.50m - Clayey Silt with Sand 10.50-12.00m - Silty Sand Below 12.00m - Sandy Silt with Clay	1.50m - 09.00 3.00m – 14.00 4.50m – 16.00 6.00m – 17.00	-	-	Below 3.00m from EGL	Open

60		279/13-15			1	BH-1	267.823	12.00	Below 17.00	0.00-3.00 - Sandy Silt with Clay 3.00-6.00m - Clayey Silt 6.00-12.00m - Clayey Silt with Sand	1.50m - 05.50 3.00m - 09.00 4.50m - 12.00 6.00m - 13.00	-	-	Below 6.00m from EGL	Open
61		276/7-9			1	BH-1	266.025	12.00	Below 20.00	0.00-3.00m - Clayey Silt with Sand 3.00-6.00m - Silty Sand 6.00-7.50m - Clay Silt with Sand 7.50-10.50m - Silty Sand 10.50-12.00m - Clay Silt with Sand	1.50m - 06.00 3.00m - 11.00 4.50m - 12.00 6.00m - 14.00	-	-	Below 6.00m from EGL	Open
62		274/19-21			1	BH-1	266.238	12.00	Below 15.00	0.00-12.00m - Clayey Silt with Sand	1.50m - 06.50 3.00m - 10.00 4.50m - 16.00 6.00m - 18.00	-	-	Below 4.50m from EGL	Open
63		272/20-22			1	BH-1	265.532	12.00	6.00	0.00-6.00m - Sandy Silt with Clay 6.00-7.50m - Clayey Silt with Sand 7.50-10.50m - Sandy Silt with Clay 10.50-12.00m - Clayey Silt	1.50m - 06.50 3.00m - 10.00 4.50m - 10.00 6.00m - 10.50	-	-	Below 6.00m from EGL	Open
					16			**192.00**							
Proposed RFO (ROR)															
64		286/15 (286/380)			1	A1	265.838	30.00	10.00	0.00-3.00m - Clayey Silt with Sand 3.00-7.50m - Sandy Silt with Clay 7.50-13.50m - Clayey Silt with Sand 13.50-16.50m - Silty Sand 16.50-30.00m - Clayey Silt with Sand	1.50m - 11.00 3.00m - 17.00 4.50m - 25.00 6.00m - 27.00	17.00m - 70.00 20.00m - 90.00 23.00m - 110.00	17.00m - 90.00 20.00m - 110.00 23.00m - 135.00	-	Pile
					1	A2	267.178	30.00	10.00	0.00-10.50m - Clayey Silt with Sand 10.50-16.50m - Silty Sand 16.50-30.00m - Clayey Silt with Sand	1.50m - 9.50 3.00m - 13.00 4.50m - 14.00 6.00m - 15.00	17.00m - 95.00 20.00m - 120.00 23.00m - 150.00	17.00m - 120.00 20.00m - 150.00 23.00m - 180.00	-	Pile
					2			**60.00**							

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Detour Section															
65		71650			1	BH-1	264.292	12.00	Below 14.00	0.00-3.00m - C layey Silt with Sand 3.00-4.50m - Silty Sand 4.50-6.00m - Clayey Silt with Sand 6.00-7.50m - Clayey Silt with Sand & Gravels 7.50-12.00m - Silty Sand	1.50m - 10.00 3.00m - 16.00 4.50m - 17.00 6.00m - 18.00	-	-	Below 3.00m from EGL	Open
66		71300			1	A1	263.667	30.00	14.00	0.00-1.50m - Silty Sand with Gravels 1.50-3.00m - Clayey Silt with Sand & Gravels 3.00-30.00m - Silty Sand	1.50m - 8.50 3.00m - 12.00 4.50m - 16.00 6.00m - 18.00	17.00m - 140.00 20.00m - 180.00 23.00m - 230.00	17.00m - 190.00 20.00m - 230.00 23.00m - 290.00	-	Pile
					1	A2	263.862	30.00	14.00	0.00-1.50m - Sandy Silt with Gravels 1.50-3.00m - Clayey Silt with Sand 3.00-7.50m - Clayey Silt with Sand & Gravels 7.50-10.50m - Sandy Silt 10.50-30.00m - Silty Sand	1.50m - 11.00 3.00m - 14.00 4.50m - 15.50 6.00m - 16.50	17.00m - 140.00 20.00m - 180.00 23.00m - 230.00	17.00m - 190.00 20.00m - 240.00 23.00m - 290.00	-	
67		70700			1	BH-1	225.164	12.00	Below 14.00	0.00-3.00m - Silty Sand 3.00-4.50m - Silty Sand with Gravels 4.50-10.50m - Sandy Silt 10.50-12.00m - Silty Sand	1.50m - 8.50 3.00m - 13.00 4.50m - 13.50 6.00m - 14.00	-	-	Below 4.50m from EGL	Open
68		69950			1	A1	265.909	30.00	13.50	0.00-3.00m - Sandy Silt with Clay & Gravels 3.00-30.00m - Silty Sand	1.50m - 09.50 3.00m - 17.50 4.50m - 18.50 6.00m - 19.00	17.00m - 150.00 20.00m - 190.00 23.00m - 235.00	17.00m - 190.00 20.00m - 240.00 23.00m - 300.00	Below 3.00m from EGL	Open / Pile
					1	A2	263.869	30.00	13.50	0.00-4.50m - Silty Sand with Gravels 4.50-30.00m - Silty Sand	1.50m - 13.00 3.00m - 19.00 4.50m - 20.00 6.00m - 21.00	17.00m - 140.00 20.00m - 180.00 23.00m - 230.00	17.00m - 190.00 20.00m - 240.00 23.00m - 290.00		
69		69550			1	A1	263.158	30.00	10.50	0.00-3.00m - Sandy Silt with Clay 3.00-30.00m - Silty Sand	1.50m - 09.00 3.00m - 23.00 4.50m - 24.00 6.00m - 24.00	17.00m - 150.00 20.00m - 190.00 23.00m - 240.00	17.00m - 190.00 20.00m - 240.00 23.00m - 300.00	-	Pile
					1	P1	262.358	30.00	12.00	0.00-3.00m - Clayey Silt with Sand 3.00-30.00m - Silty Sand		17.00m - 150.00 20.00m - 190.00 23.00m - 250.00	17.00m - 200.00 20.00m - 250.00 23.00m - 320.00	-	
					1	A2	263.163	30.00	12.00	0.00-3.00m - Sandy Silt with Clay 3.00-30.00m - Silty Sand	1.50m - 07.00 3.00m - 14.50 4.50m - 15.50 6.00m - 16.50	17.00m - 140.00 20.00m - 190.00 23.00m - 240.00	17.00m - 190.00 20.00m - 240.00 23.00m - 300.00	-	
70		69050			1	A1	267.171	30.00	16.00	0.00-2.00m - Filled up Strata 2.00-7.50m - Sandy Silt with Clay 7.50-30.00m - Silty Sand	2.00m - 10.00 3.00m - 14.00 4.50m - 15.00 6.00m - 16.00	17.00m - 160.00 20.00m - 210.00 23.00m - 260.00	17.00m - 210.00 20.00m - 270.00 23.00m - 330.00	-	Pile
					1	A2	265.011	30.00	17.00	0.00-3.00m - Sandy Silt with Clay 3.00-30.00m - Silty Sand	1.50m - 10.00 3.00m - 23.00 4.50m - 27.00 6.00m - 27.50	17.00m - 150.00 20.00m - 200.00 23.00m - 250.00	17.00m - 200.00 20.00m - 260.00 23.00m - 320.00	-	
71		68850			1	BH-1	264.738	12.00	Below 13.00	0.00-3.00m - Sandy Silt with Clay 3.00-4.50m - Silty Sand 4.50-6.00m - Silty Sand with Gravels 6.00-12.00m - Silty Sand	1.50m - 09.50 3.00m - 17.00 4.50m - 20.00 6.00m - 23.00	-	-	Below 3.00m from EGL	Open
					12			306							
Total Borehole Depth & Borehole of Part - II					100			2214							

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CHAPTER – 47

"Minor Bridge No. 358",

Location – Existing Km. - 313/19-21

47.1 LOCATION OF STRUCTURE:

Proposed Minor Bridge of Span 1x3x3

47.2 BOREHOLE DESCRIPTIONS:

(a) Location of Structure, Boreholes with RL shown in **FIGURE-1.**

(b) Subsurface Characteristic of Soil/Rock shown in *ANNEXURE-I.*

(c) Borelogs and sub soil profile shown in *ANNEXURE-II.*

(d) Calculations of Safe Bearing Capacities in *ANNEXURE-III.*

(e) Calculations of Probable Settlement in *ANNEXURE-IV.*

(f) Depth of water Table ≥20.00m below EGL.

Subsurface profile at the site

BOREHOLE No.	Depth (m)	Type of Soil/Rock	Soil/Rock Characteristics
BH-1	0.00 to 1.50	Sandy Silt with Clay	Loose
	1.50 to 3.00	Sandy Silt with Clay	Medium Dense
	3.00 to 4.50	Silty Sand	Medium Dense
	4.50 to 12.00	Silty Sand	Dense

47.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1	6.00	8.80	0.007	0.0025	NIL	0.0013	0.044

47.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1	3.00	NIL
	6.00	NIL

47.5 NET ALLOWABLE BEARING PRESSURE

Borehole No.	Depth from EGL (m)	Net Allowable Bearing Pressure (t/m^2)
BH-1	1.50	05.50
	3.00	10.00
	4.50	26.00
	6.00	28.00

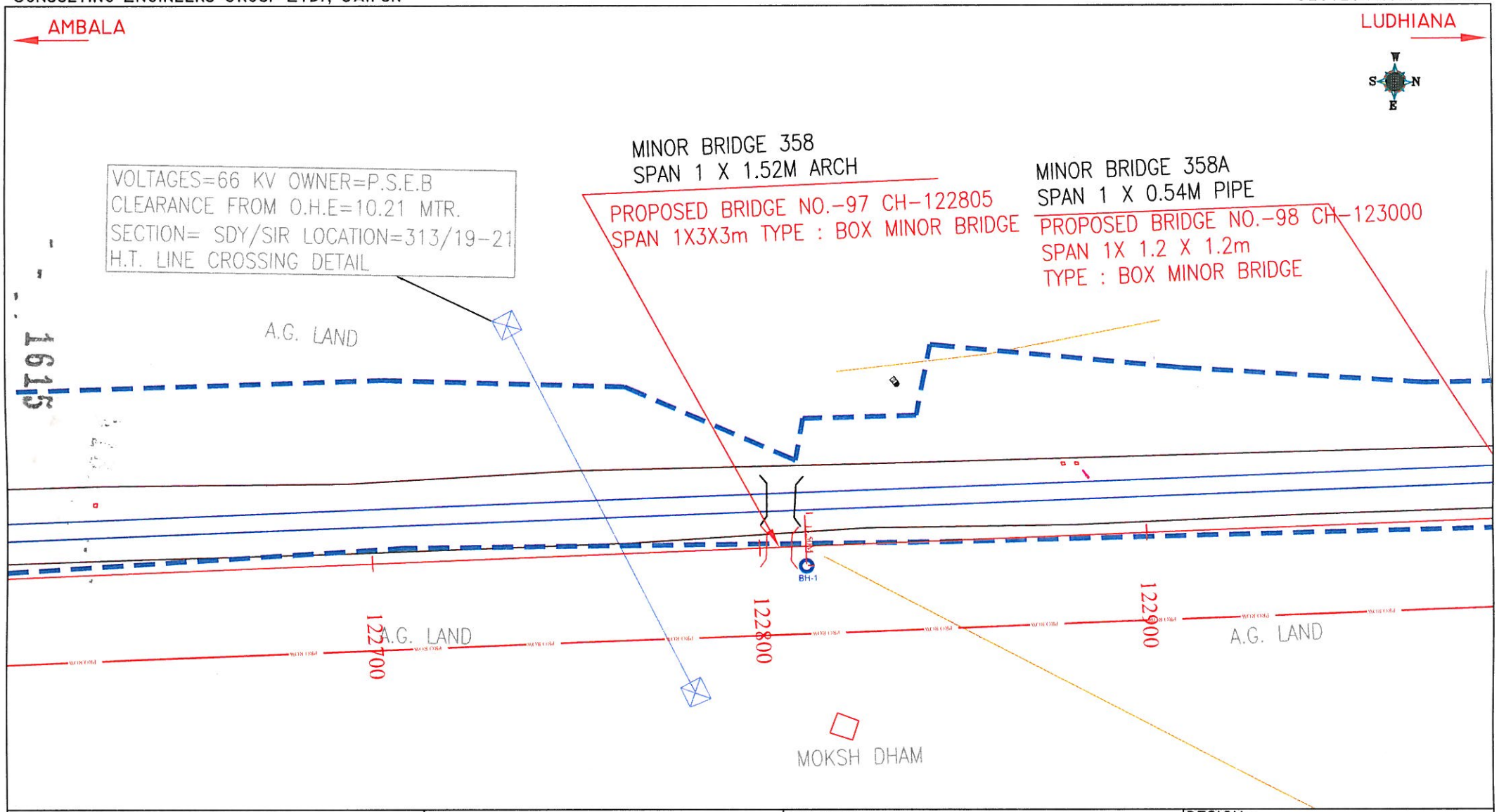
47.6 CONCLUSIONS

- Subsurface Profiles indicates suitable Soil formation for foundations.

47.7 RECOMMENDATIONS

(i)	*Type of foundation*	Open foundation
(ii)	*Depth of foundation below GL*	Below 4.50 m from EGL

Note- The above recommendations are based on the field and laboratory tests conducted on the soil, and our experience in this regard. If the actual subsoil conditions during excavation for the foundation differ from the observations reported here, the design experts/consultants should be referred for suggestion, further investigations. However, the Depth and Type of foundation is to be decided by the structure designer depending upon the type of loading/structure and site conditions.



ALL DIMENSIONS IN METER FIG.:-I LOCATION PLAN OF PROPOSED MINOR BRIDGE AT CH. 313/19-21	RL OF BH-I =263.253	PROJECT :- LUDHIANA-AMBALA (DFCCIL)	DESIGN :- CONSULTING ENGINEERS GROUP LTD. E-12,Moji Colony,Malviya Nagar Jaipur-17 Tel: +91-141- 2520899, 2521899, 2520556 Fax: 2521348, E-Mail: ceg@cegindia.com

SOIL CHARACTERISTICS OF BORE HOLE AT BH-1(LHS) FOR MINOR BRIDGE No. 358 AT CHAINAGE 313/19-21

Project :	Chainage 313/19-21 Bridge No. 358			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				08.06.2009 to 08.06.2009	1	1(LHS)	below 20.00 m.	12.00mtr	263.253

Depth from GL (m)	Observ-ed N	Correction Factor C_n	Corrected N_n	Soil Description (Soil Group)	Grain Size Distribution % wt retained							Atterberg Limits %			B.D. gm/cc	M.C. %	D.D. gm/cc	Specific Gravity	Shear Strength	
					Clay	Silt	Sand			Gravel										c kg/cm^2	ϕ degree
							Fine	Medium	Coarse	Fine	Coarse	L.L.	P.L.	P.I.						
0.00	-	-	-	Sandy Silt with Clay	9.21	62.16	26.33	1.65	0.65	0.00	0.00	19	12	7	-	-	-	-	-	-
1.50	11	1.52	16.72	Sandy Silt with Clay	7.27	67.65	24.10	0.85	0.13	0.00	0.00	19	13	6		-		-	-	
3.00	UDS	-	-	Silty Sand	2.11	6.49	85.53	5.36	0.51	0.00	0.00	29	NIL	NP	1.61	7.50	1.50	2.65	0.00	26.00
4.50	33	1.11	36.63	Silty Sand	0.00	12.42	80.79	6.79	0.00	0.00	0.00	24	NIL	NP	-	-	-	-	-	
6.00	UDS	-	-	Silty Sand	2.02	6.85	66.19	20.68	1.53	2.73	0.00	29	NIL	NP	1.76	9.99	1.60	2.63	0.00	27.50
7.50	41	0.93	38.13	Silty Sand	0.00	5.19	75.56	18.18	1.07	0.00	0.00	26	NIL	NP	-	-	-	-	-	-
10.50	47	0.81	38.07	Silty Sand	0.00	6.99	79.58	13.22	0.21	0.00	0.00	26	NIL	NP	-	-	-	-	-	-
12.00	52	0.76	39.52	Silty Sand	0.00	6.11	77.38	16.28	0.23	0.00	0.00	24	NIL	NP	-	-	-	-	-	-

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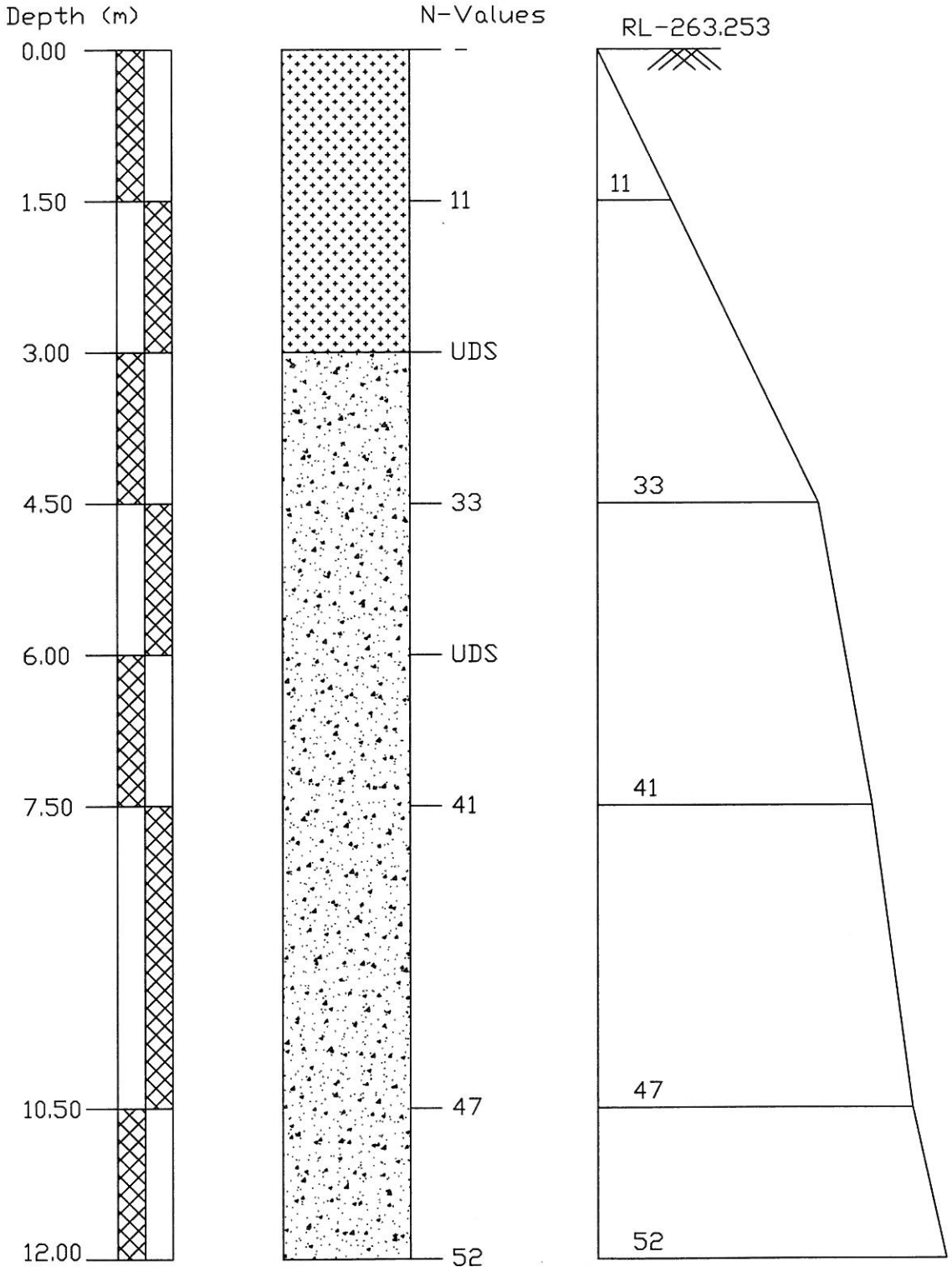
BORELOG OF BH–1(LHS) AT EXISTING KM–313/19–21 FOR MINOR BRIDGE NO.–358,

ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

SYMBOL	DESCRIPTION
	SANDY SILT WITH CLAY
	SILTY SAND

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ANNEXURE - III

Calculation of SBC for shallow foundations as per IS : 6403 - 1981

INPUT DATA

Minor Bridge No 313/19-21 BH-1

Type of footing

1	Continuous Strip		
2	Rectangular	***Rectangular***	**2**
3	Square		
4	Circular		

Angle of internal friction (ϕ°)	26.00
Cohesion (c in t/m2)	0.00
Void ratio (e)	0.77
Direction of load with vertical ($^{\circ}$)	0.00
Density of surcharge (t/m^3)	1.61
Density of foundation soil (t/m^3)	1.61
Depth of water table(m)	1.50
Factor of safety	3.00

S.no.	Depth (m)	Width (m)	Length (m)
1	1.50	3.00	8.00
2	3.00	3.00	8.00

SHEAR FAILURE CRITERIA

Assumptions and formula used in calculation as per IS:6403-1981 are given below -

The ultimate net bearing capacity in case of general shear failure is given by

$$q_d = c\,N_c\,s_c\,d_c\,i_c + q\,(N_q-1)\,s_q\,d_q\,i_q + (1/2)\,B\,\gamma\,N_\gamma\,s_\gamma\,d_\gamma\,i_\gamma\,W'$$

The ultimate net bearing capacity in case of local shear failure is given by

$$q'_d = (2/3)\,c\,N'_c\,s_c\,d_c\,i_c + q\,(N'_q-1)\,s_q\,d_q\,i_q + (1/2)\,B\,\gamma\,N'_\gamma\,s_\gamma\,d_\gamma\,i_\gamma\,W'$$

Where,

$d_c = 1 + 0.2\,(D_f/B)*SQRT(N_\phi)$

$d_q = d_\gamma = 1$ for $\phi < 10^{\circ}$

$d_q = d_\gamma = 1 + 0.1\,(D_f/B)*SQRT(N_\phi)$ for $\phi > 10^{\circ}$

$N_\phi = \tan^2(\pi/4 + \phi/2)$

ϕ' for local shear failure $= \tan^{-1}(0.67\tan\phi)$

OUTPUT

The computer aided results for shear failure criteria are tabulated below. The results are interpolated values of bearing capacity obtained from general and local shear failure criteria.

ANNEXURE - III

Bearing capacity factors :

ϕ	26.00
N_c	22.60
N_q	12.21
N_γ	13.18

ϕ'	18.10
N'_c	13.36
N'_q	5.46
N'_γ	4.35

Shape factors :

S.no.	Width(m)	Length (m)	S_c	S_q	S_γ
1	3.00	8.00	1.08	1.08	0.85
2	3.00	8.00	1.08	1.08	0.85

Depth factors :

S.no.	Depth(m)	Width(m)	dc	d_q	d_γ
1	1.50	3.00	1.16	1.08	1.08
2	3.00	3.00	1.32	1.16	1.16

Inclination factors :

$i_c = (1-\alpha/90)^2$	$i_q = (1-\alpha/90)^2$	$i_\gamma = (1-\alpha/\phi)^2$
1.00	1.00	1.00

Water table factor :

S.no.	Depth(m)	Width(m)	Z_w/B	W'
1	1.50	3.00	0.00	0.50
2	3.00	3.00	-0.50	0.50

Safe Bearing Capacity

S.no.	Depth(m)	Width(m)	Length (m)	SBC in (t/m^2)		
				General shear	Local shear	Actual
1	1.50	3.00	8.00	15.35	5.78	5.78
2	3.00	3.00	8.00	27.74	10.69	10.69

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ANNEXURE - III

Calculation of SBC for shallow foundations as per IS : 6403 - 1981

INPUT DATA

Minor Bridge No 313/19-21 BH-1

Type of footing

1	Continuous Strip		
2	Rectangular	***Rectangular***	**2**
3	Square		
4	Circular		

Angle of internal friction (ϕ°)	27.50
Cohesion (c in t/m2)	0.00
Void ratio (e)	0.64
Direction of load with vertical ($^\circ$)	0.00
Density of surcharge (t/m^3)	1.61
Density of foundation soil (t/m^3)	1.76
Depth of water table(m)	1.50
Factor of safety	3.00

S.no.	Depth (m)	Width (m)	Length (m)
1	4.50	3.00	8.00
2	6.00	3.00	8.00

SHEAR FAILURE CRITERIA

Assumptions and formula used in calculation as per IS:6403-1981 are given below -

The ultimate net bearing capacity in case of general shear failure is given by

$$q_d = c\, N_c\, s_c\, d_c\, i_c + q\,(N_q-1)\, s_q\, d_q\, i_q + (1/2)\, B\, \gamma\, N_\gamma\, s_\gamma\, d_\gamma\, i_\gamma\, W'$$

The ultimate net bearing capacity in case of local shear failure is given by

$$q'_d = (2/3)\, c\, N'_c\, s_c\, d_c\, i_c + q\,(N'_q-1)\, s_q\, d_q\, i_q + (1/2)\, B\, \gamma\, N'_\gamma\, s_\gamma\, d_\gamma\, i_\gamma\, W'$$

Where,

$d_c = 1 + 0.2\,(D_f/B)*SQRT(N_\phi)$

$d_q = d_\gamma = 1$ for $\phi < 10^\circ$

$d_q = d_\gamma = 1 + 0.1\,(D_f/B)*SQRT(N_\phi)$ for $\phi > 10^\circ$

$N_\phi = \tan^2(\pi/4 + \phi/2)$

ϕ' for local shear failure $= \tan^{-1}(0.67 \tan\phi)$

OUTPUT

The computer aided results for shear failure criteria are tabulated below. The results are interpolated values of bearing capacity obtained from general and local shear failure criteria.

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ANNEXURE - III

Bearing capacity factors :

ϕ	27.50
N_c	25.43
N_q	14.53
N_γ	16.64

ϕ'	19.23
N'_c	14.24
N'_q	6.02
N'_γ	4.97

Shape factors :

S.no.	Width(m)	Length (m)	S_c	S_q	S_γ
1	3.00	8.00	1.08	1.08	0.85
2	3.00	8.00	1.08	1.08	0.85

Depth factors :

S.no.	Depth(m)	Width(m)	dc	d_q	d_γ
1	4.50	3.00	1.49	1.25	1.25
2	6.00	3.00	1.66	1.33	1.33

Inclination factors :

$i_c = (1-\alpha/90)^2$	$i_q = (1-\alpha/90)^2$	$i_\gamma = (1-\alpha/\phi)^2$
1.00	1.00	1.00

Water table factor :

S.no.	Depth(m)	Width(m)	Z_w/B	W'
1	4.50	3.00	-1.00	0.50
2	6.00	3.00	-1.50	0.50

Safe Bearing Capacity

S.no.	Depth(m)	Width(m)	Length (m)	SBC in (t/m^2)		
				General shear	Local shear	Actual
1	4.50	3.00	8.00	36.97	13.15	26.25
2	6.00	3.00	8.00	39.41	14.02	27.99

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ANNEXURE - IV

Settlement Calculation As per IS 8009 (Part 1)	
Location	Minor Bridge
Chainage	313/19-21
Bore Hole No.	1

Footing Depth (m)	1.50
SBC (t/m2)	5.50
Average N value	17
Settlement for 10 t/m2 (mm)	18.00
Total Settlement (mm)	9.90
Depth Correction	0.91
Rigidity factor	0.8
Corrected Settlement (mm)	7.2

Footing Depth (m)	3.00
SBC (t/m2)	10.00
Average N value	27
Settlement for 10 t/m2 (mm)	10.00
Total Settlement (mm)	10.00
Depth Correction	0.83
Rigidity factor	0.8
Corrected Settlement (mm)	6.6

Footing Depth (m)	4.50
SBC (t/m2)	26.00
Average N value	37
Settlement for 10 t/m2 (mm)	7.00
Total Settlement (mm)	18.20
Depth Correction	0.74
Rigidity factor	0.8
Corrected Settlement (mm)	10.8

Footing Depth (m)	6.00
SBC (t/m2)	28.00
Average N value	37
Settlement for 10 t/m2 (mm)	7.00
Total Settlement (mm)	19.60
Depth Correction	0.68
Rigidity factor	0.8
Corrected Settlement (mm)	10.7

CHAPTER – 48

"Minor Bridge No. 357",

Location – Existing Km. - 312/30-313/2

48.1 LOCATION OF STRUCTURE:

Proposed Minor Bridge of Span 1x3x2

48.2 BOREHOLE DESCRIPTIONS:

(a) Location of Structure, Boreholes with RL shown in **FIGURE-1**.

(b) Subsurface Characteristic of Soil/Rock shown in *ANNEXURE-I.*

(c) Borelogs and sub soil profile shown in *ANNEXURE-II.*

(d) Calculations of Safe Bearing Capacities in *ANNEXURE-III.*

(e) Calculations of Probable Settlement in *ANNEXURE-IV.*

(f) Depth of water Table ≥12.00m below EGL.

Subsurface profile at the site

BOREHOLE No.	Depth (m)	Type of Soil/Rock	Soil/Rock Characteristics
BH-1	0.00 to 1.50	Sandy Silt with Clay	Loose
	1.50 to 3.00	Sandy Silt with Clay	Medium Dense
	3.00 to 4.50	Silty Sand with Gravels	Medium Dense
	4.50 to 10.50	Silty Sand	Medium Dense
	10.50 to 12.00	Silty Sand	Dense

48.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1	3.00	9.00	0.012	0.0021	NIL	0.0011	0.023

48.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1	3.00	NIL
	6.00	NIL

49.5 NET ALLOWABLE BEARING PRESSURE

Borehole No.	Depth from EGL (m)	Net Allowable Bearing Pressure (t/m^2)
BH-1	1.50	07.50
	3.00	13.00
	4.50	21.00
	6.00	24.00

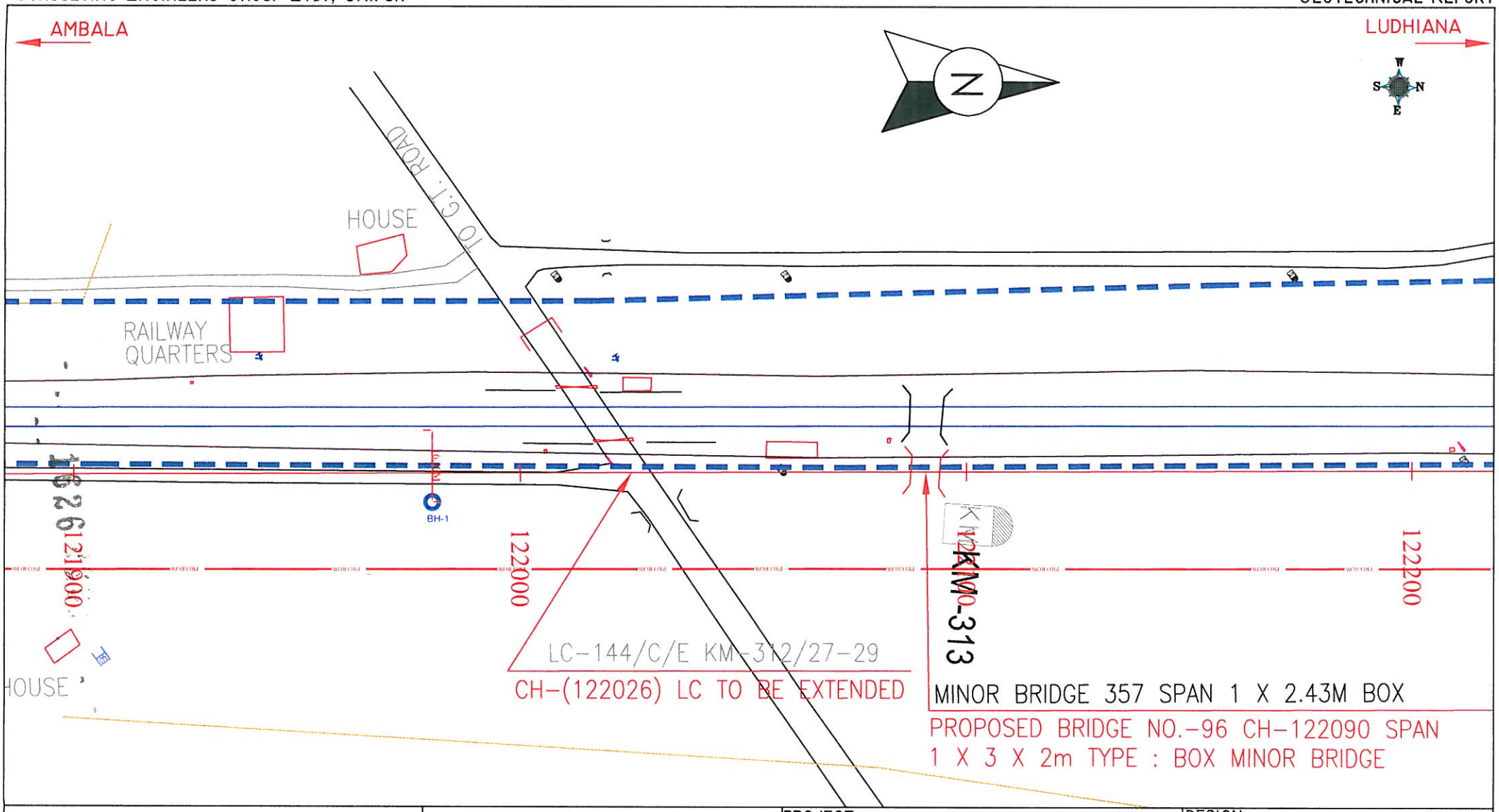
48.6 CONCLUSIONS

- Subsurface Profiles indicates suitable Soil formation for foundations.

48.7 RECOMMENDATIONS

(i)	*Type of foundation*	Open foundation
(ii)	*Depth of foundation below GL*	Below 4.50 m from EGL

Note- The above recommendations are based on the field and laboratory tests conducted on the soil, and our experience in this regard. If the actual subsoil conditions during excavation for the foundation differ from the observations reported here, the design experts/consultants should be referred for suggestion, further investigations. However, the Depth and Type of foundation is to be decided by the structure designer depending upon the type of loading/structure and site conditions.



ALL DIMENSIONS IN METER

FIG.:-I

LOCATION PLAN OF PROPOSED MINOR BRIDGE AT CH. 312/27

RL OF BH-I =264.009

PROJECT :-

LUDHIANA-AMBALA (DFCCIL)

DESIGN :-

CONSULTING ENGINEERS GROUP LTD.
E-12,Moji Colony,Malviya Nagar Jaipur-17
Tel: +91-141- 2520899, 2521899, 2520556
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SOIL CHARACTERISTICS OF BORE HOLE AT BH-1(LHS) FOR MINOR BRIDGE No. 357 AT CHAINAGE 312/27

Project :	Chainage 312/27 Bridge No. 357			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				09.06.2009 to 09.06.2009	1	1(LHS)	below 20.00 m.	12.00mtr	264.009

Depth from GL (m)	Observed N	Correction Factor C_n	Corrected N_n	Soil Description (Soil Group)	Grain Size Distribution % wt retained							Atterberg Limits %			B.D. gm/cc	M.C. %	D.D. gm/cc	Specific Gravity	Shear Strength	
					Clay	Silt	Sand			Gravel										c kg/cm^2	ϕ degree
							Fine	Medium	Coarse	Fine	Coarse	L.L.	P.L.	P.I.						
0.00	-	-	-	Sandy Silt with Clay	15.23	54.08	20.39	3.25	2.18	3.66	1.21	30	17	13	-	-	-	-	-	-
1.50	11	1.53	16.83	Sandy Silt with Clay	14.85	47.06	29.03	2.15	2.40	4.51	0.00	29	16	13	-	-	-	-	-	
3.00	UDS	-	-	Silty Sand with Gravels	1.77	14.91	62.51	1.00	1.30	18.51	0.00	27	NIL	NP	1.57	3.37	1.52	2.60	0.00	26.00
4.50	15	1.12	16.80	Silty Sand	2.15	8.40	82.05	6.94	0.46	0.00	0.00	25	NIL	NP	-	-	-	-	-	
6.00	UDS	-	-	Silty Sand	0.00	8.30	76.32	14.87	0.51	0.00	0.00	22	NIL	NP	1.74	4.73	1.66	2.62	0.00	26.50
7.50	24	0.93	22.32	Silty Sand	0.00	9.55	79.11	10.09	1.25	0.00	0.00	23	NIL	NP	-	-	-	-	-	-
10.50	30	0.81	24.30	Silty Sand	0.00	6.36	78.96	13.82	0.86	0.00	0.00	24	NIL	NP	-	-	-	-	-	-
12.00	33	0.77	25.41	Silty Sand	0.00	8.88	80.23	9.99	0.90	0.00	0.00	23	NIL	NP	-	-	-	-	-	-

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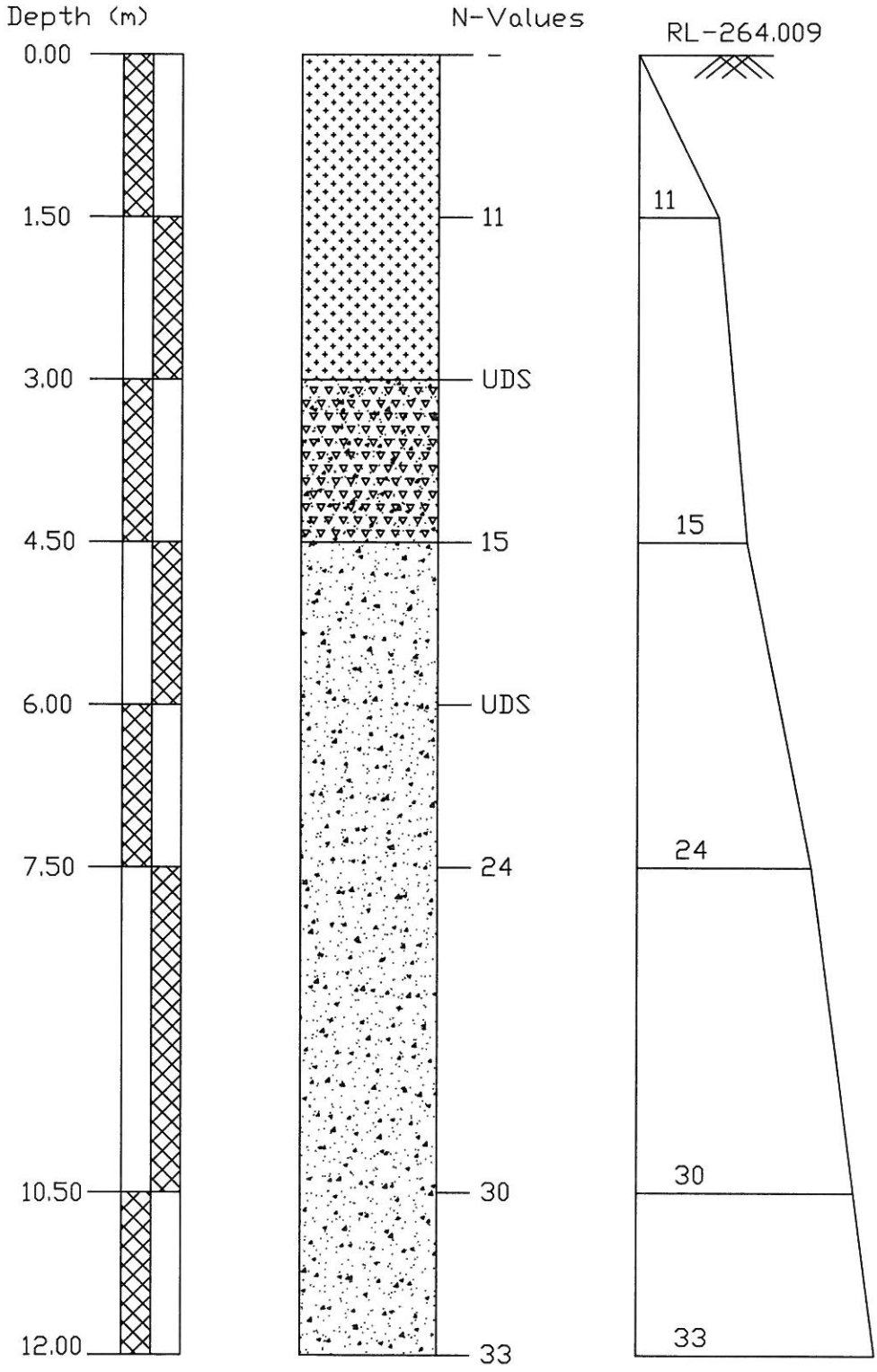
BORELOG OF BH–1(LHS) AT EXISTING KM–312/27 FOR MINOR BRIDGE NO.–357,

ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

SYMBOL	DESCRIPTION
	SANDY SILT WITH CLAY
	SILTY SAND WITH GRAVELS
	SILTY SAND

1628

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ANNEXURE - IV

Settlement Calculation As per IS 8009 (Part 1)	
Location	Minor Bridge
Chainage	312/(30) 313/(2)
Bore Hole No.	1

Footing Depth (m)	**1.50**
SBC (t/m2)	7.50
Average N value	17
Settlement for 10 t/m2 (mm)	18.00
Total Settlement (mm)	13.50
Depth Correction	0.91
Rigidity factor	0.8
Corrected Settlement (mm)	**9.8**

Footing Depth (m)	**3.00**
SBC (t/m2)	13.00
Average N value	17
Settlement for 10 t/m2 (mm)	18.00
Total Settlement (mm)	23.40
Depth Correction	0.83
Rigidity factor	0.8
Corrected Settlement (mm)	**15.5**

Footing Depth (m)	**4.50**
SBC (t/m2)	21.00
Average N value	20
Settlement for 10 t/m2 (mm)	15.00
Total Settlement (mm)	31.50
Depth Correction	0.74
Rigidity factor	0.8
Corrected Settlement (mm)	**18.6**

Footing Depth (m)	**6.00**
SBC (t/m2)	24.00
Average N value	22
Settlement for 10 t/m2 (mm)	13.80
Total Settlement (mm)	33.12
Depth Correction	0.68
Rigidity factor	0.8
Corrected Settlement (mm)	**18.0**

CHAPTER – 49

"Minor Bridge No. 356A",

Location – Existing Km. - 312/05-07

49.1 LOCATION OF STRUCTURE:

Proposed Minor Bridge of Span 1x2x2

49.2 BOREHOLE DESCRIPTIONS:

(a) Location of Structure, Boreholes with RL shown in **FIGURE-1**.

(b) Subsurface Characteristic of Soil/Rock shown in *ANNEXURE-I*.

(c) Borelogs and sub soil profile shown in *ANNEXURE-II*.

(d) Calculations of Safe Bearing Capacities in *ANNEXURE-III*.

(e) Calculations of Probable Settlement in *ANNEXURE-IV*

(f) Depth of water Table ≥20.00m below EGL.

Subsurface profile at the site

BOREHOLE No.	Depth (m)	Type of Soil/Rock	Soil/Rock Characteristics
BH-1	0.00 to 1.50	Silty Sand with Gravels	Loose
	1.50 to 3.00	Silty Sand with Gravels	Dense
	3.00 to 12.00	Silty Sand	Dense

49.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1	3.00	8.50	NIL	0.0028	NIL	0.0012	0.047
	6.00	8.70	0.007	0.0024	NIL	0.0011	0.028

49.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1	3.00	NIL
	6.00	NIL

49.5 NET ALLOWABLE BEARING PRESSURE

Borehole No.	Depth from EGL (m)	Net Allowable Bearing Pressure (t/m^2)
BH-1	1.50	08.00
	3.00	12.00
	4.50	19.00
	6.00	21.00

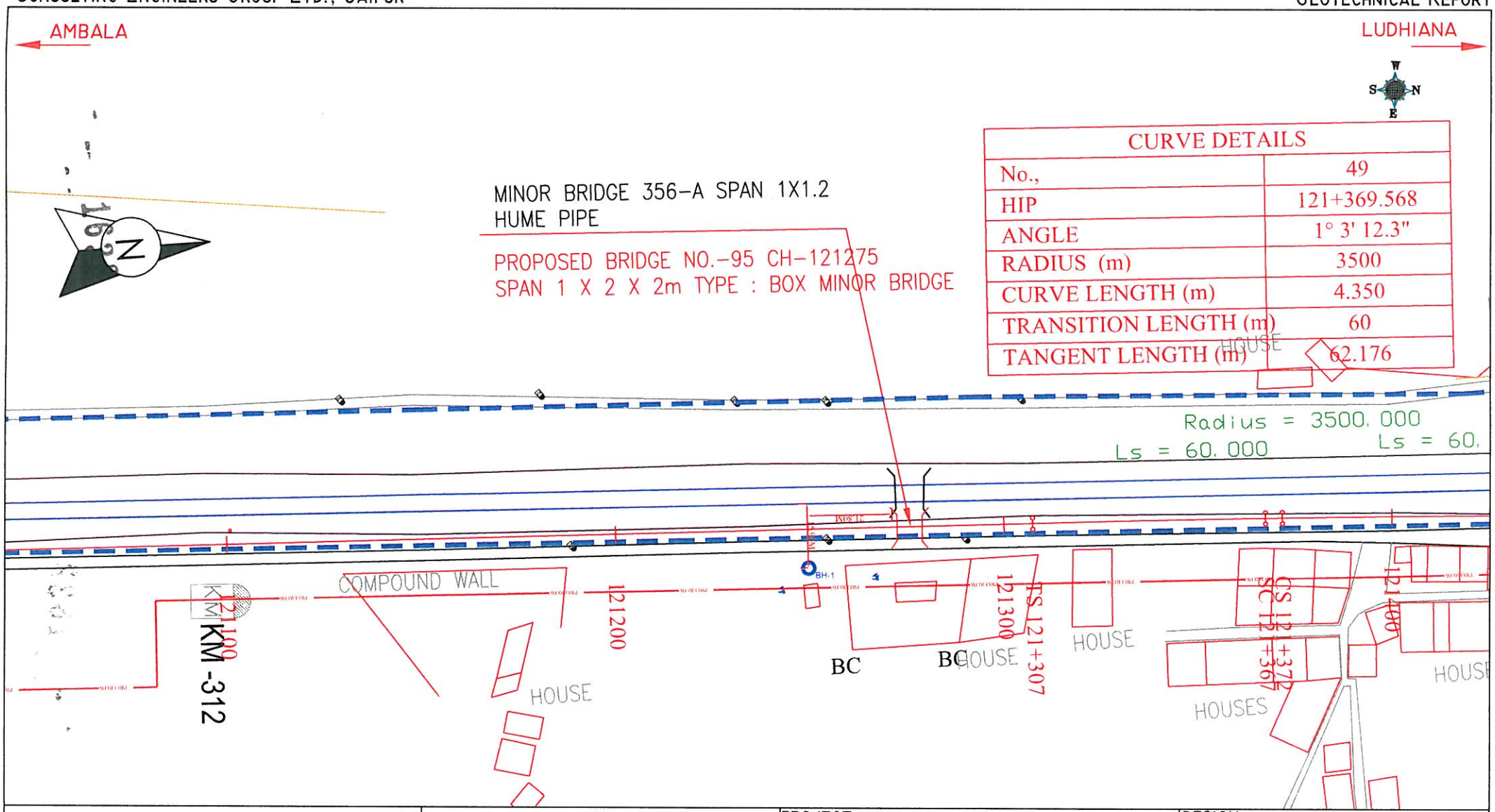
49.6 CONCLUSIONS

- Subsurface Profiles indicates suitable Soil formation for foundations.

49.7 RECOMMENDATIONS

(i)	*Type of foundation*	Open foundation
(ii)	*Depth of foundation below GL*	Below 4.50 m from EGL

Note- The above recommendations are based on the field and laboratory tests conducted on the soil, and our experience in this regard. If the actual subsoil conditions during excavation for the foundation differ from the observations reported here, the design experts/consultants should be referred for suggestion, further investigations. However, the Depth and Type of foundation is to be decided by the structure designer depending upon the type of loading/structure and site conditions.



ALL DIMENSIONS IN METER FIG.:-I LOCATION PLAN OF PROPOSED MINOR BRIDGE AT CH. 312/5-7	RL OF BH-I =264.106	PROJECT :- LUDHIANA-AMBALA (DFCCIL)	DESIGN :- CONSULTING ENGINEERS GROUP LTD. E-12,Moji Colony,Malviya Nagar Jaipur-17 Tel: +91-141- 2520899, 2521899, 2520556 Fax: 2521348, E-Mail: ceg@cegindia.com

SOIL CHARACTERISTICS OF BORE HOLE AT BH-1(LHS) FOR MINOR BRIDGE No. 356-A AT CHAINAGE 312/5-7

Project :	Chainage 312/5-7 Bridge No. 356-A			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				09.06.2009 to 09.06.2009	1	1(LHS)	below 22.00 m.	12.00mtr	264.106

Depth	Observ-	Correction	Corrected	Soil	Grain Size Distribution % wt retained							Atterberg Limits %			B.D.	M.C.	D.D.	Specific	Shear Strength	
from	ed	Factor		Description	Clay	Silt	Sand			Gravel								Gravity	c kg/cm^2	ϕ
GL (m)	N	C_n	N_n	(Soil Group)			Fine	Medium	Coarse	Fine	Coarse	L.L.	P.L.	P.I.	gm/cc	%	gm/cc			degree
0.00	-	-	-	Silty Sand with Gravels	0.00	8.27	75.68	4.66	0.94	9.24	1.21	22	NIL	NP	-	-	-	-	-	-
1.50	32	1.50	48.00	Silty Sand with Gravels	2.33	15.24	70.36	2.99	2.16	6.92	0.00	23	NIL	NP	-	-	-	-	-	
3.00	UDS	-	-	Silty Sand	2.17	9.91	87.19	0.73	0.00	0.00	0.00	24	NIL	NP	1.66	4.83	1.58	2.65	0.00	26.00
4.50	22	1.10	24.20	Silty Sand	2.33	8.21	87.33	1.89	0.05	0.19	0.00	23	NIL	NP	-	-	-	-	-	
6.00	UDS	-	-	Silty Sand	1.37	18.54	68.05	11.38	0.17	0.49	0.00	25	NIL	NP	1.74	7.59	1.62	2.66	0.00	27.50
7.50	31	0.92	28.52	Silty Sand	2.47	18.00	67.89	11.13	0.13	0.38	0.00	26	NIL	NP	-	-	-	-	-	
10.50	43	0.81	34.83	Silty Sand	2.18	10.86	83.89	2.71	0.19	0.17	0.00	23	NIL	NP	-	-	-	-	-	-
12.00	51	0.76	38.76	Silty Sand	2.31	11.19	83.59	2.67	0.13	0.11	0.00	24	NIL	NP	-	-	-	-	-	-

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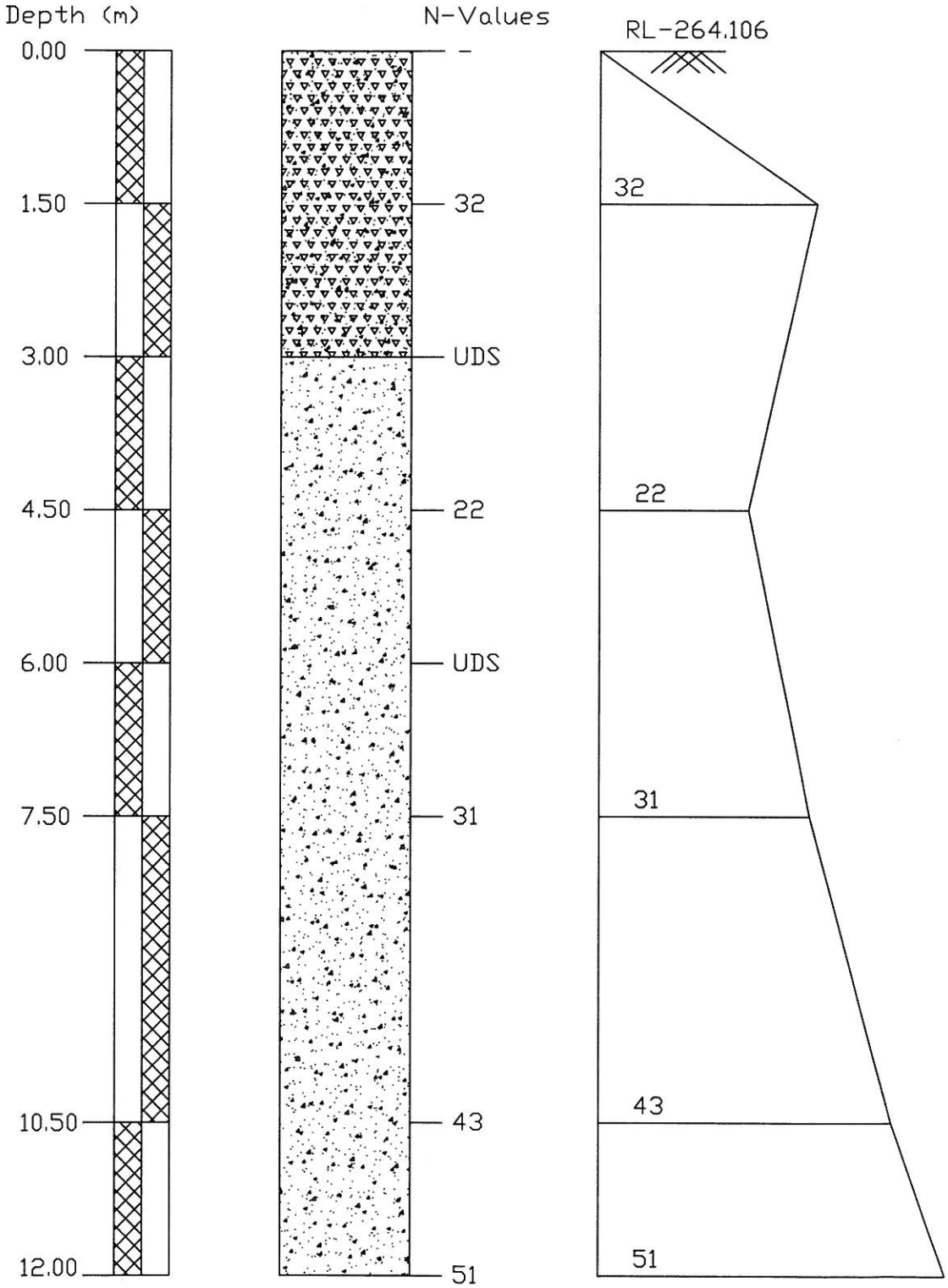
BORELOG OF BH–1(LHS) AT EXISTING KM–312/5–7 FOR MINOR BRIDGE NO.–356 A, ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

SYMBOL	DESCRIPTION
	SILTY SAND WITH GRAVELS
	SILTY SAND

1635

CONSULTING Engineers Group Ltd.

ANNEXURE - III

Calculation of SBC for shallow foundations as per IS : 6403 - 1981

INPUT DATA

Minor Bridge No 312/5-7 BH-1

Type of footing

1	Continuous Strip		
2	Rectangular	***Rectangular***	**2**
3	Square		
4	Circular		

Angle of internal friction (ϕ°)	26.00
Cohesion (c in t/m2)	0.00
Void ratio (e)	0.68
Direction of load with vertical ($^\circ$)	0.00
Density of surcharge (t/m^3)	1.66
Density of foundation soil (t/m^3)	1.66
Depth of water table(m)	1.50
Factor of safety	3.00

S.no.	Depth (m)	Width (m)	Length (m)
1	1.50	2.00	8.00
2	3.00	2.00	8.00

SHEAR FAILURE CRITERIA

Assumptions and formula used in calculation as per IS:6403-1981 are given below -

The ultimate net bearing capacity in case of general shear failure is given by

$$q_d = c\,N_c\,s_c\,d_c\,i_c + q\,(N_q-1)\,s_q\,d_q\,i_q + (1/2)\,B\,\gamma\,N_\gamma\,s_\gamma\,d_\gamma\,i_\gamma W'$$

The ultimate net bearing capacity in case of local shear failure is given by

$$q'_d = (2/3)\,c\,N'_c\,s_c\,d_c\,i_c + q\,(N'_q-1)\,s_q\,d_q\,i_q + (1/2)\,B\,\gamma\,N'_\gamma\,s_\gamma\,d_\gamma\,i_\gamma W'$$

Where,

$d_c = 1 + 0.2\,(D_f/B)*SQRT(N_\phi)$

$d_q = d_\gamma = 1$ for $\phi < 10^\circ$

$d_q = d_\gamma = 1 + 0.1\,(D_f/B)*SQRT(N_\phi)$ for $\phi > 10^\circ$

$N_\phi = \tan^2(\pi/4 + \phi/2)$

ϕ' for local shear failure = $\tan^{-1}(0.67\tan\phi)$

OUTPUT

The computer aided results for shear failure criteria are tabulated below. The results are interpolated values of bearing capacity obtained from general and local shear failure criteria.

ANNEXURE - III

Bearing capacity factors :

ϕ	26.00	ϕ'	18.10
N_c	22.60	N'_c	13.36
N_q	12.21	N'_q	5.46
N_γ	13.18	N'_γ	4.35

Shape factors :

S.no.	Width(m)	Length (m)	S_c	S_q	S_γ
1	2.00	8.00	1.05	1.05	0.90
2	2.00	8.00	1.05	1.05	0.90

Depth factors :

S.no.	Depth(m)	Width(m)	dc	d_q	d_γ
1	1.50	2.00	1.24	1.12	1.12
2	3.00	2.00	1.48	1.24	1.24

Inclination factors :

$i_c = (1-\alpha/90)^2$	$i_q = (1-\alpha/90)^2$	$i_\gamma = (1-\alpha/\phi)^2$
1.00	1.00	1.00

Water table factor :

S.no.	Depth(m)	Width(m)	Z_w/B	W'
1	1.50	2.00	0.00	0.50
2	3.00	2.00	-0.75	0.50

Safe Bearing Capacity

S.no.	Depth(m)	Width(m)	Length (m)	SBC in (t/m^2)		
				General shear	Local shear	Actual
1	1.50	2.00	8.00	14.62	5.57	8.74
2	3.00	2.00	8.00	20.22	7.77	12.13

ANNEXURE - III

* Calculation of SBC for shallow foundations as per IS : 6403 - 1981

INPUT DATA

Minor Bridge No 312/5-7 BH-1

Type of footing

1	Continuous Strip		
2	Rectangular	***Rectangular***	**2**
3	Square		
4	Circular		

Angle of internal friction (ϕ°)	27.50
Cohesion (c in t/m2)	0.00
Void ratio (e)	0.64
Direction of load with vertical ($^\circ$)	0.00
Density of surcharge (t/m^3)	1.66
Density of foundation soil (t/m^3)	1.74
Depth of water table(m)	1.50
Factor of safety	3.00

S.no.	Depth (m)	Width (m)	Length (m)
1	4.50	2.00	8.00
2	6.00	2.00	8.00

SHEAR FAILURE CRITERIA

Assumptions and formula used in calculation as per IS:6403-1981 are given below -

The ultimate net bearing capacity in case of general shear failure is given by

$$q_d = c\,N_c\,s_c\,d_c\,i_c + q\,(N_q-1)\,s_q\,d_q\,i_q + (1/2)\,B\,\gamma\,N_\gamma\,s_\gamma\,d_\gamma\,i_\gamma\,W'$$

The ultimate net bearing capacity in case of local shear failure is given by

$$q'_d = (2/3)\,c\,N'_c\,s_c\,d_c\,i_c + q\,(N'_q-1)\,s_q\,d_q\,i_q + (1/2)\,B\,\gamma\,N'_\gamma\,s_\gamma\,d_\gamma\,i_\gamma\,W'$$

Where,

$d_c = 1 + 0.2\,(D_f/B)*SQRT(N_\phi)$

$d_q = d_\gamma = 1$ for $\phi < 10^\circ$

$d_q = d_\gamma = 1 + 0.1\,(D_f/B)*SQRT(N_\phi)$ for $\phi > 10^\circ$

$N_\phi = \tan^2(\pi/4 + \phi/2)$

ϕ' for local shear failure = $\tan^{-1}(0.67\tan\phi)$

OUTPUT

The computer aided results for shear failure criteria are tabulated below. The results are interpolated values of bearing capacity obtained from general and local shear failure criteria.

ANNEXURE - III

Bearing capacity factors :

ϕ	27.50	ϕ'	19.23
N_c	25.43	N'_c	14.24
N_q	14.53	N'_q	6.02
N_γ	16.64	N'_γ	4.97

Shape factors :

S.no.	Width(m)	Length (m)	S_c	S_q	S_γ
1	2.00	8.00	1.05	1.05	0.90
2	2.00	8.00	1.05	1.05	0.90

Depth factors :

S.no.	Depth(m)	Width(m)	dc	d_q	d_γ
1	4.50	2.00	1.74	1.37	1.37
2	6.00	2.00	1.99	1.49	1.49

Inclination factors :

$i_c = (1-\alpha/90)^2$	$i_q = (1-\alpha/90)^2$	$i_\gamma = (1-\alpha/\phi)^2$
1.00	1.00	1.00

Water table factor :

S.no.	Depth(m)	Width(m)	Z_w/B	W'
1	4.50	2.00	-1.50	0.50
2	6.00	2.00	-2.25	0.50

Safe Bearing Capacity

S.no.	Depth(m)	Width(m)	Length (m)	SBC in (t/m^2)		
				General shear	Local shear	Actual
1	4.50	2.00	8.00	27.50	9.77	19.53
2	6.00	2.00	8.00	29.98	10.65	21.29

ANNEXURE - IV

Settlement Calculation As per IS 8009 (Part 1)	
Location	Minor Bridge
Chainage	312/5-7
Bore Hole No.	1

Footing Depth (m)	1.50
SBC (t/m2)	8.00
Average N value	25
Settlement for 10 t/m2 (mm)	12.00
Total Settlement (mm)	9.60
Depth Correction	0.91
Rigidity factor	0.8
Corrected Settlement (mm)	**7.0**

Footing Depth (m)	3.00
SBC (t/m2)	12.00
Average N value	25
Settlement for 10 t/m2 (mm)	12.00
Total Settlement (mm)	14.40
Depth Correction	0.83
Rigidity factor	0.8
Corrected Settlement (mm)	**9.6**

Footing Depth (m)	4.50
SBC (t/m2)	19.00
Average N value	26
Settlement for 10 t/m2 (mm)	11.00
Total Settlement (mm)	20.90
Depth Correction	0.74
Rigidity factor	0.8
Corrected Settlement (mm)	**12.4**

Footing Depth (m)	6.00
SBC (t/m2)	21.00
Average N value	29
Settlement for 10 t/m2 (mm)	9.60
Total Settlement (mm)	20.16
Depth Correction	0.68
Rigidity factor	0.8
Corrected Settlement (mm)	**11.0**

CHAPTER – 50

"Minor Bridge No. 356",

Location – Existing Km. - 311/15-17

50.1 LOCATION OF STRUCTURE:

Proposed Minor Bridge of Span 1x3x2

50.2 BOREHOLE DESCRIPTIONS:

(a) Location of Structure, Boreholes with RL shown in **FIGURE-1**.

(b) Subsurface Characteristic of Soil/Rock shown in *ANNEXURE-I.*

(c) Borelogs and sub soil profile shown in *ANNEXURE-II.*

(d) Calculations of Safe Bearing Capacities in *ANNEXURE-III.*

(e) Calculations of Probable Settlement in *ANNEXURE-IV*

(f) Depth of water Table ≥20.00m below EGL.

Subsurface profile at the site

BOREHOLE No.	Depth (m)	Type of Soil/Rock	Soil/Rock Characteristics
BH-1	0.00 to 1.50	Clayey Silt with Sand & Gravels	Loose
	1.50 to 3.00	Clayey Silt with Sand & Gravels	Medium Dense
	3.00 to 7.50	Silty Sand	Medium Dense
	7.50 to 12.00	Silty Sand	Dense

50.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1	3.00	8.40	0.002	0.0014	NIL	0.0009	0.025
	6.00	8.70	0.005	0.0021	NIL	0.0014	0.036

50.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1	3.00	NIL
	6.00	NIL

50.5 NET ALLOWABLE BEARING PRESSURE

Borehole No.	Depth from EGL (m)	Net Allowable Bearing Pressure (t/m^2)
BH-1	1.50	15.00
	3.00	26.00
	4.50	27.00
	6.00	30.00

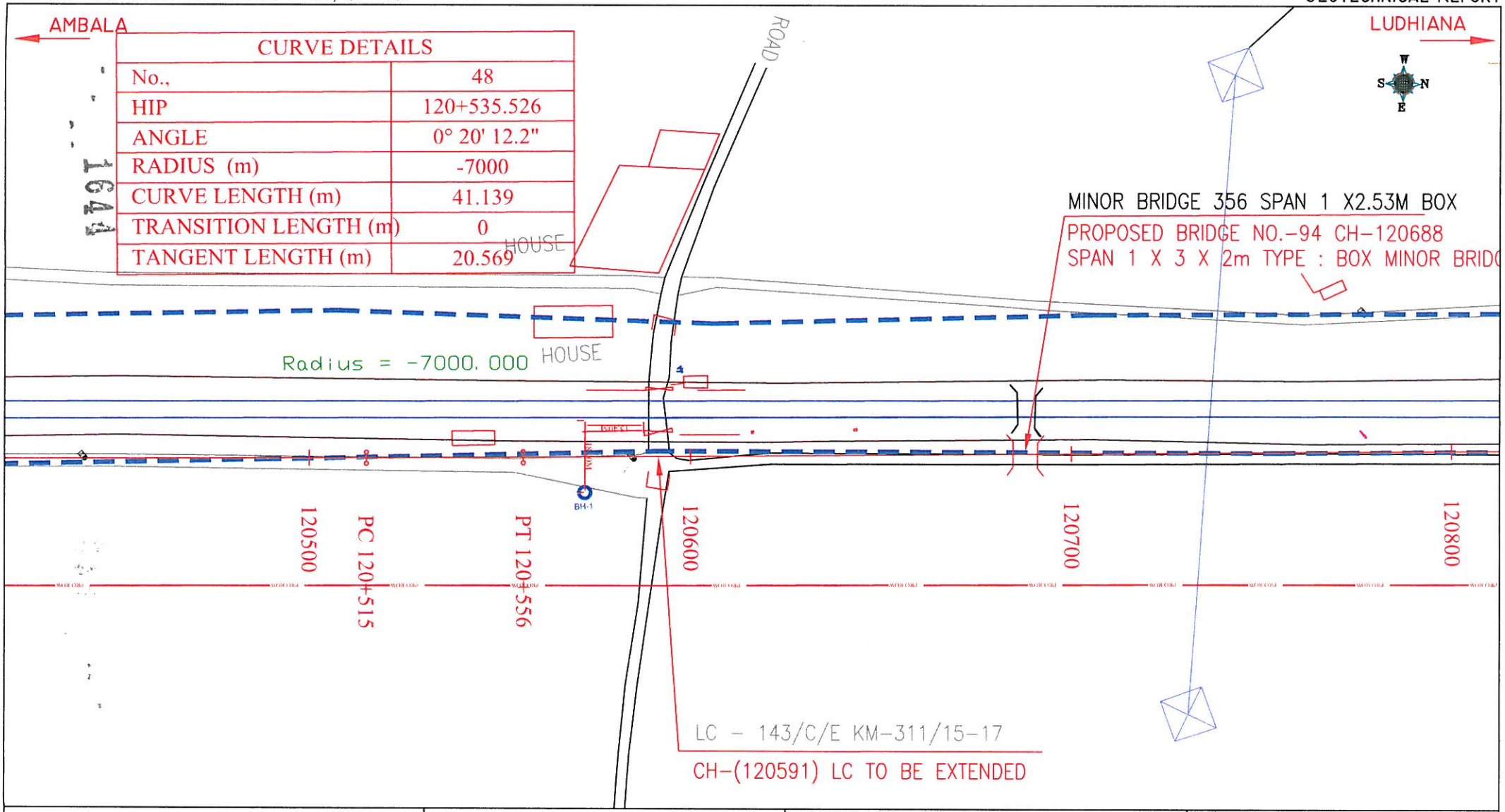
50.6 CONCLUSIONS

- Subsurface Profiles indicates suitable Soil formation for foundations.

50.7 RECOMMENDATIONS

(i)	*Type of foundation*	Open foundation
(ii)	*Depth of foundation below GL*	Below 3.00 m from EGL

Note- The above recommendations are based on the field and laboratory tests conducted on the soil, and our experience in this regard. If the actual subsoil conditions during excavation for the foundation differ from the observations reported here, the design experts/consultants should be referred for suggestion, further investigations. However, the Depth and Type of foundation is to be decided by the structure designer depending upon the type of loading/structure and site conditions.



ALL DIMENSIONS IN METER

FIG.:-I
LOCATION PLAN OF PROPOSED MINOR BRIDGE AT CH. 311/15-17

RL OF BH-I =262.205

PROJECT :-
LUDHIANA-AMBALA (DFCCIL)

DESIGN :-
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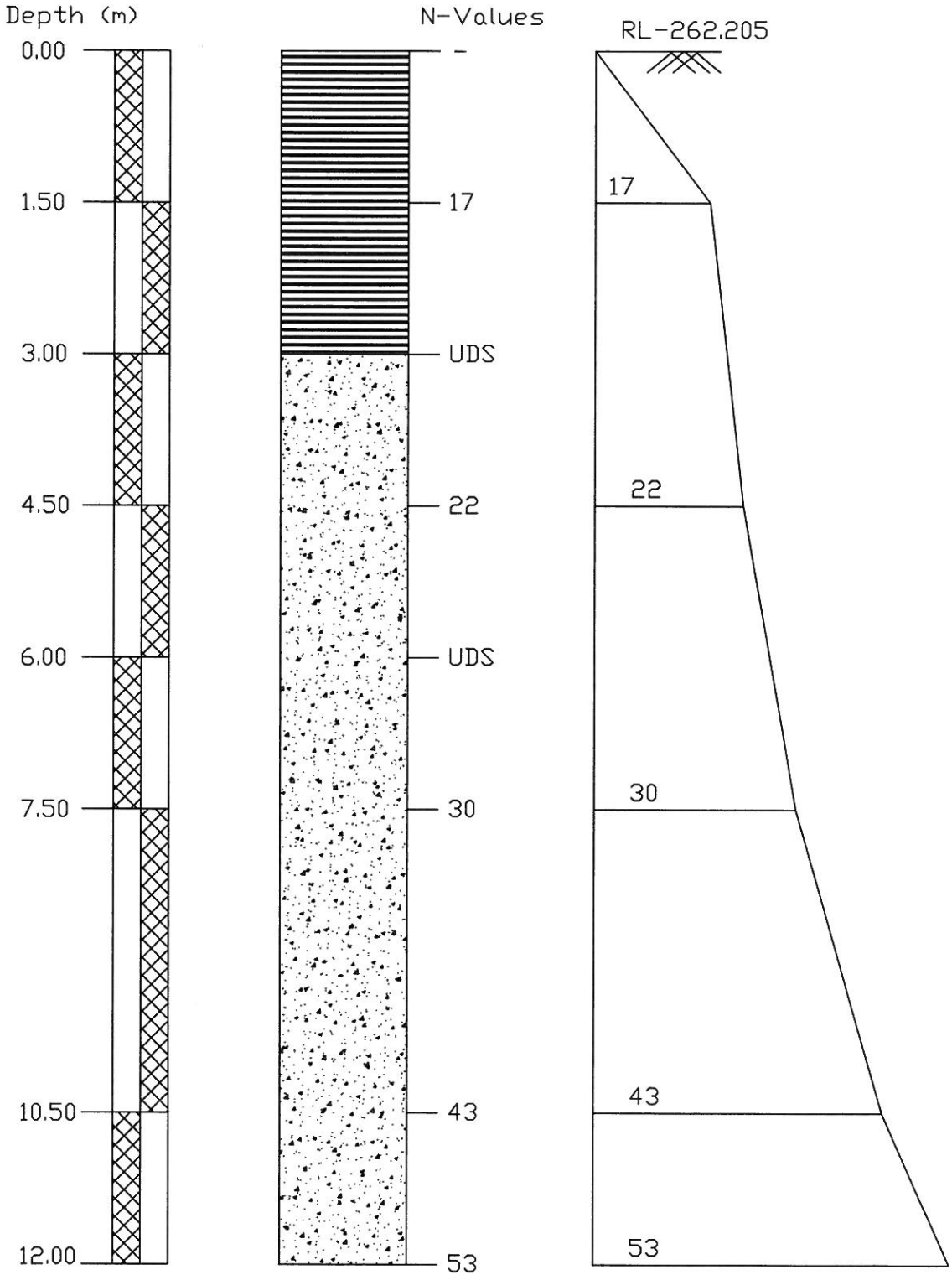
SOIL CHARACTERISTICS OF BORE HOLE AT BH-1(LHS) FOR MINOR BRIDGE No. 356 AT CHAINAGE 311/15-17

Project :	Chainage 311/15-17 Bridge No. 356			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				09.06.2009 to 09.06.2009	1	1(LHS)	below 20.00 m.	12.00mtr	262.205

Depth from GL (m)	Observed N	Correction Factor C_n	Corrected N_n	Soil Description (Soil Group)	Grain Size Distribution % wt retained							Atterberg Limits %			B.D. gm/cc	M.C. %	D.D. gm/cc	Specific Gravity	Shear Strength	
					Clay	Silt	Sand			Gravel										c kg/cm^2	ϕ degree
							Fine	Medium	Coarse	Fine	Coarse	L.L.	P.L.	P.I.						
0.00	-	-	-	Clayey Silt with Sand & Gravels	17.86	66.22	6.26	3.21	0.86	5.59	0.00	40	25	15	-	-	-	-	-	-
1.50	17	1.44	24.48	Clayey Silt with Sand & Gravels	15.88	67.35	4.72	2.80	2.55	6.70	0.00	38	24	14	-	-	-	-	-	
3.00	UDS	-	-	Silty Sand	0.00	41.84	57.30	0.60	0.26	0.00	0.00	24	NIL	NP	1.80	9.47	1.64	2.67	0.00	27.5
4.50	22	1.07	23.54	Silty Sand	1.58	9.87	78.55	8.46	0.93	0.61	0.00	27	NIL	NP	-	-	-	-	-	-
6.00	UDS	-	-	Silty Sand	0.00	4.55	93.28	2.17	0.00	0.00	0.00	22	NIL	NP	1.86	9.31	1.70	2.66	0.00	28.50
7.50	30	0.90	27.00	Silty Sand	0.00	9.31	74.54	15.73	0.27	0.15	0.00	24	NIL	NP	-	-	-	-	-	-
10.50	43	0.78	33.54	Silty Sand	0.88	8.59	75.03	15.17	0.13	0.20	0.00	26	NIL	NP	-	-	-	-	-	-
12.00	53	0.74	39.22	Silty Sand	0.00	9.04	75.37	15.29	0.11	0.19	0.00	25	NIL	NP	-	-	-	-	-	-

CONSULTING
Engineers Group Ltd.

BORELOG OF BH–1(LHS) AT EXISTING KM–311/15–17 FOR MINOR BRIDGE NO.–356, ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

SYMBOL	DESCRIPTION
	CLAYEY SILT WITH SAND & GRAVELS
	SILTY SAND

1646

CONSULTING Engineers Group Ltd.

ANNEXURE - IV

Settlement Calculation As per IS 8009 (Part 1)	
Location	Minor Bridge
Chainage	311/15-17
Bore Hole No.	1

Footing Depth (m)	3.00
SBC (t/m2)	26.00
Average N value	24
Settlement for 10 t/m2 (mm)	12.60
Total Settlement (mm)	32.76
Depth Correction	0.83
Rigidity factor	0.8
Corrected Settlement (mm)	**21.8**

Footing Depth (m)	4.50
SBC (t/m2)	27.00
Average N value	24
Settlement for 10 t/m2 (mm)	12.60
Total Settlement (mm)	34.02
Depth Correction	0.74
Rigidity factor	0.8
Corrected Settlement (mm)	**20.1**

Footing Depth (m)	6.00
SBC (t/m2)	30.00
Average N value	25
Settlement for 10 t/m2 (mm)	12.00
Total Settlement (mm)	36.00
Depth Correction	0.68
Rigidity factor	0.8
Corrected Settlement (mm)	**19.6**

ANNEXURE - IV

Settlement Calculation As per IS 8009 (Part 1) **Ch . 311 15-17**

BH No. (A1)

Depth of foundation		=	1.5	m
Length of footing (L)		=	8.0	m
Width of footing (B)		=	3.0	m
Initial effective stress at mid of layer	Po	=	6.75	t/m^2
Concentrated load *P*		=	15.00	t/m^2
Incerase in pressure at mid of layer	ΔP	=	$P \times I_B$	
	I_B	=	0.247	
	ΔP	=	3.7	t/m^2
Compression Index	Cc	=	0.108	
Thickness of clay layer	H	=	1.5	m
Initial Void ratio	e_o	=	0.63	
	$\frac{Po + \Delta p}{Po}$	=	1.54889	

Settlement of clay layer $S_f = \frac{Cc}{1+ eo} H \log_{10} \frac{Po + \Delta P}{Po}$

S_f = 0.01889 m

= 18.8854 mm

Correction for Depth and Rigidity of foundation on total settlement

Depth Factor Calculation

$D/(LB)^{\wedge 0.5}$ = 0.61

D = Depth of Foundation

L/B = 2.67

Depth Factor = 0.91

Rigidity Factor = $\frac{\text{Total Settlement of Rigid foundation}}{\text{Total Settlement at the centre of Flexible foundation}}$

= 0.8

Pore Pr. Correction = 0.85

Total Settlement = $S_f \times D.F. \times R.F.$

S_{f2} = 11.7 mm

Footing Depth (m)	**1.50**
SBC (t/m2)	15.00
Average N value	24
Settlement for 10 t/m2 (mm)	12.00
Total Settlement (mm)	18.00
Depth Correction	0.91
Rigidity factor	0.8
Corrected Settlement (mm)	**13.10**
Total Settlement (mm) =	**24.8**

CHAPTER – 51

"Minor Bridge No. 355",

Location – Existing Km. - 310/04-06

51.1 LOCATION OF STRUCTURE:

Proposed Minor Bridge of Span 2x2x2

51.2 BOREHOLE DESCRIPTIONS:

(a) Location of Structure, Boreholes with RL shown in **FIGURE-1**.

(b) Subsurface Characteristic of Soil/Rock shown in *ANNEXURE-I.*

(c) Borelogs and sub soil profile shown in *ANNEXURE-II.*

(d) Calculations of Safe Bearing Capacities in *ANNEXURE-III.*

(e) Calculations of Probable Settlement in *ANNEXURE-IV*

(f) Depth of water Table ≥15.00m below EGL.

Subsurface profile at the site

BOREHOLE No.	Depth (m)	Type of Soil/Rock	Soil/Rock Characteristics
BH-1	0.00 to 1.50	Sandy Silt with Clay	Loose
	1.50 to 3.00	Sandy Silt with Clay	Medium Dense
	3.00 to 4.50	Clay Silt with Sand	Medium Dense
	4.50 to 7.50	Silty Sand	Medium Dense
	7.50 to 12.00	Silty Sand	Dense

51.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1	3.00	8.60	0.002	0.0018	NIL	0.0010	0.028
	6.00	8.70	0.007	0.0014	NIL	0.0011	0.017

51.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1	3.00	16.00
	6.00	NIL

51.5 NET ALLOWABLE BEARING PRESSURE

Borehole No.	Depth from EGL (m)	Net Allowable Bearing Pressure (t/m^2)
BH-1	1.50	14.00
	3.00	18.00
	4.50	26.00
	6.00	28.00

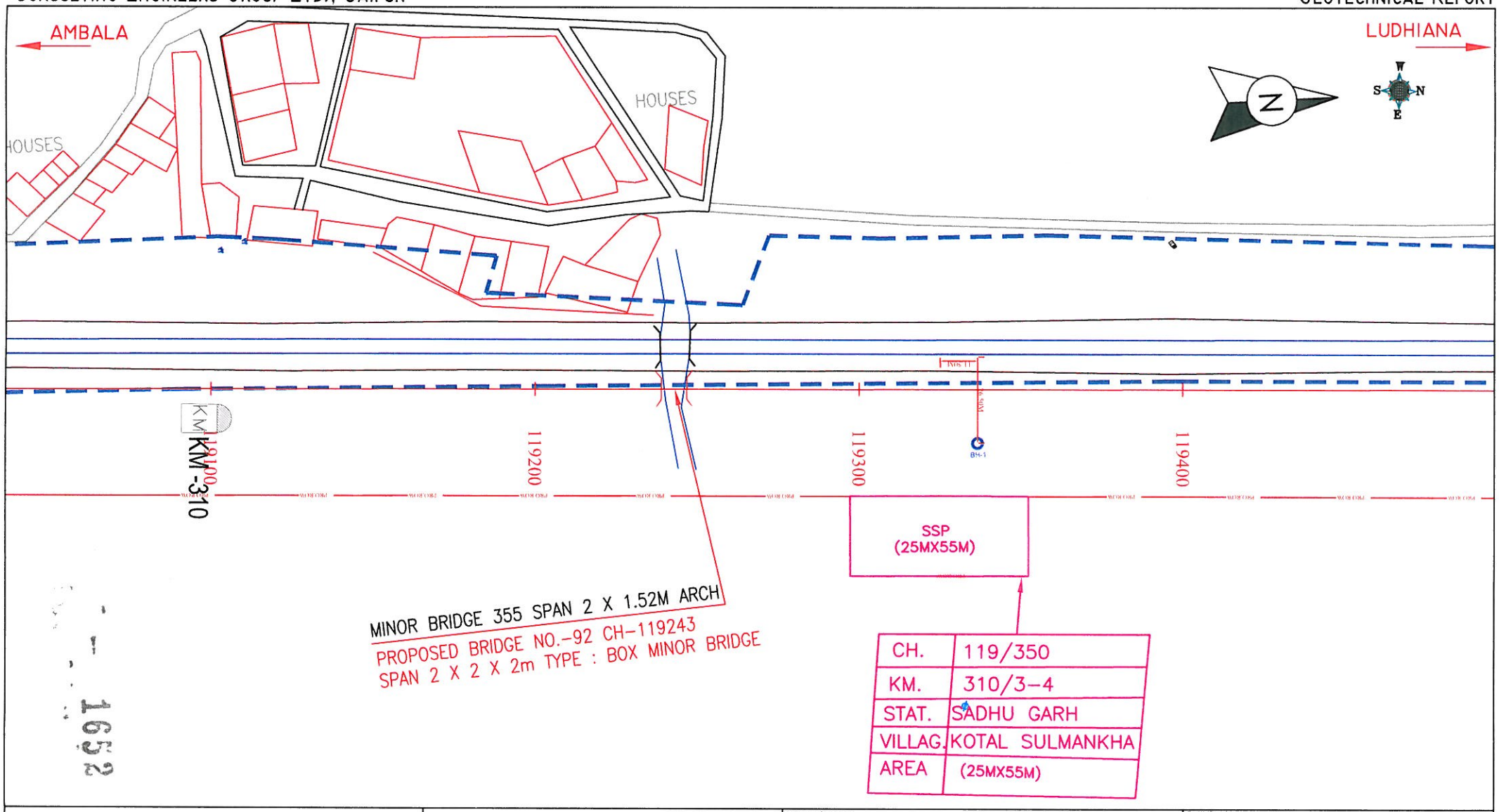
51.6 CONCLUSIONS

- Subsurface Profiles indicates suitable Soil formation for foundations.

51.7 RECOMMENDATIONS

(i)	*Type of foundation*	Open foundation
(ii)	*Depth of foundation below GL*	Below 3.00 m from EGL

Note- The above recommendations are based on the field and laboratory tests conducted on the soil, and our experience in this regard. If the actual subsoil conditions during excavation for the foundation differ from the observations reported here, the design experts/consultants should be referred for suggestion, further investigations. However, the Depth and Type of foundation is to be decided by the structure designer depending upon the type of loading/structure and site conditions.



ALL DIMENSIONS IN METER

FIG.:-I

LOCATION PLAN OF PROPOSED MINOR BRIDGE AT CH. 310/8-10

RL OF BH-I =263.368

PROJECT :-

LUDHIANA-AMBALA (DFCCIL)

DESIGN :-

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SOIL CHARACTERISTICS OF BORE HOLE AT BH-1(LHS) FOR MINOR BRIDGE No. 355 AT CHAINAGE 310/8-10

Project :	Chainage 310/8-10 Bridge No. 355			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				10.06.2009 to 10.06.2009	1	1(LHS)	below 15.00 m.	12.00mtr	263.368

Depth	Observ-	Correction	Corrected	Soil	Grain Size Distribution % wt retained							Atterberg Limits %			B.D.	M.C.	D.D.	Specific	Shear Strength	
from	ed	Factor		Description	Clay	Silt	Sand			Gravel								Gravity	c kg/cm^2	ϕ
GL (m)	N	C_n	N_n	(Soil Group)			Fine	Medium	Coarse	Fine	Coarse	L.L.	P.L.	P.I.	gm/cc	%	gm/cc			degree
0.00	-	-	-	Sandy Silt with Clay	8.00	68.81	20.39	2.18	0.62	0.00	0.00	22	16	6	-	-	-	-	-	-
1.50	16	1.43	22.88	Sandy Silt with Clay	9.28	60.95	29.10	0.67	0.00	0.00	0.00	22	15	7	-	-	-	-	-	
3.00	UDS	-	-	Clayey Silt with Sand	15.21	75.66	8.13	0.68	0.32	0.00	0.00	34	22	12	1.86	6.11	1.75	2.67	0.11	20.00
4.50	22	1.06	23.32	Silty Sand	2.62	10.67	84.23	2.13	0.19	0.16	0.00	25	NIL	NP	-	-	-	-	-	-
6.00	UDS	-	-	Silty Sand	1.85	5.00	86.91	6.24	0.00	0.00	0.00	26	NIL	NP	1.91	7.29	1.78	2.66	0.00	29.00
7.50	31	0.89	27.59	Silty Sand	2.33	12.00	80.94	1.62	0.80	2.31	0.00	24	NIL	NP	-	-	-	-	-	-
10.50	52	0.77	40.04	Silty Sand	2.41	15.35	77.53	2.86	1.13	0.72	0.00	23	NIL	NP	-	-	-	-	-	-
12.00	32	0.73	23.36	Silty Sand	2.59	11.43	83.56	1.90	0.33	0.19	0.00	25	NIL	NP	-	-	-	-	-	-

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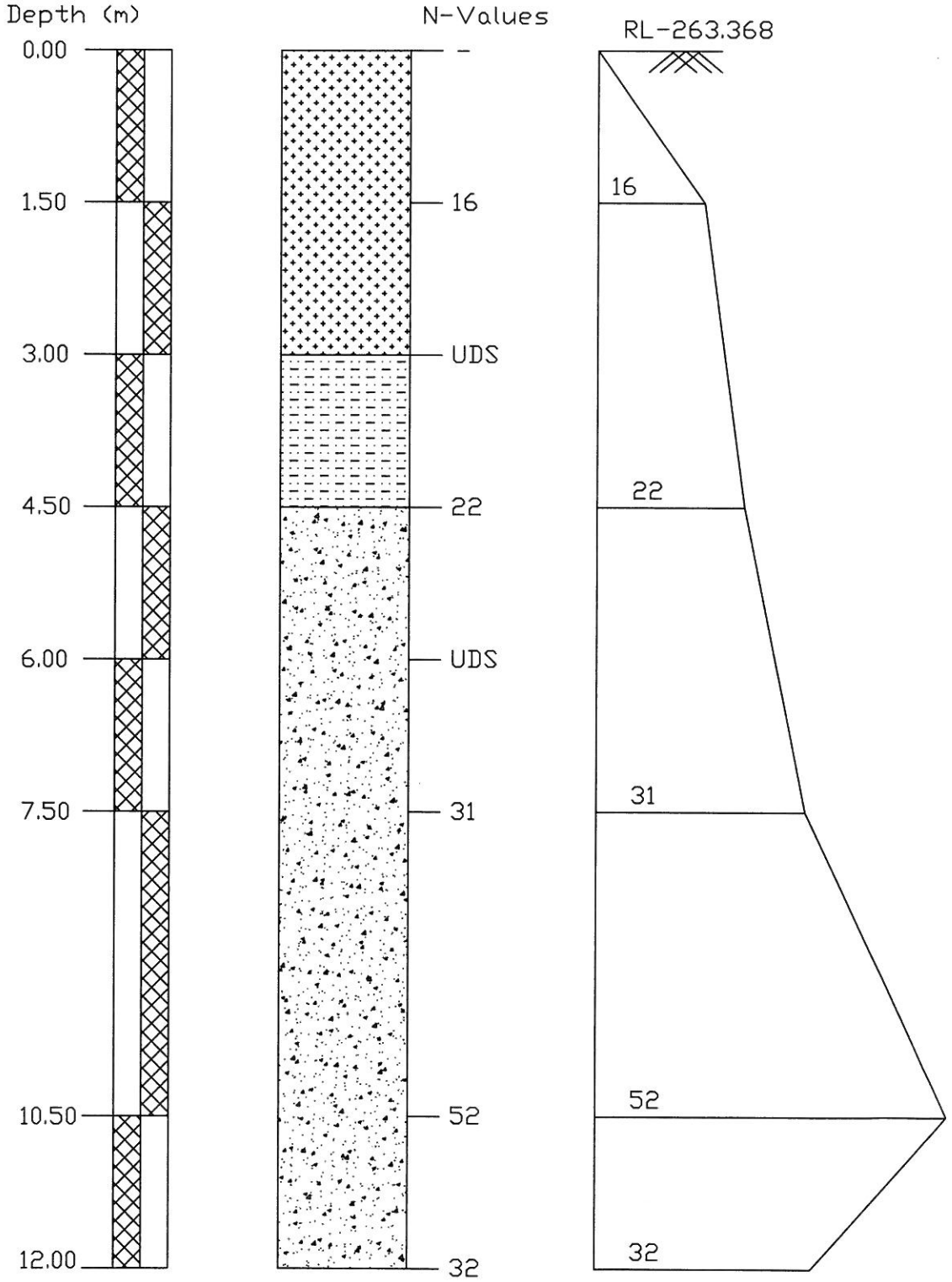
Engineers Group Ltd.

BORELOG OF BH–1(LHS) AT EXISTING KM–310/8–10 FOR MINOR BRIDGE NO.–355,

ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

SYMBOL	DESCRIPTION
	SANDY SILT WITH CLAY
	CLAYEY SILT WITH SAND
	SILTY SAND

1654

CONSULTING Engineers Group Ltd.

ANNEXURE - IV

Settlement Calculation As per IS 8009 (Part 1) **Ch. 310 4-6**

BH No. (A1)

Depth of foundation = 1.5 m

Length of footing (L) = 8.0 m

Width of footing (B) = 3.0 m

Initial effective stress at mid of layer Po = 7.725 t/m^2

Concentrated load *P* = 14.00 t/m^2

Incerase in pressure at mid of layer $\Delta P = P \times I_B$

I_B = 0.17

ΔP = 2.4 t/m^2

Compression Index Cc = 0.078

Thickness of clay layer H = 3 m

Initial Void ratio e_o = 0.53

$\frac{Po + \Delta p}{Po}$ = 1.30809

Settlement of clay layer $S_f = \frac{Cc}{1+ eo} H \log_{10} \frac{Po + \Delta P}{Po}$

S_f = 0.01784 m

= 17.8387 mm

Correction for Depth and Rigidity of foundation on total settlement

Depth Factor Calculation

$D/(LB)^{\wedge 0.5}$ = 0.61

D = Depth of Foundation

L/B = 2.67

Depth Factor = 0.91

Rigidity Factor = $\frac{\text{Total Settlement of Rigid foundation}}{\text{Pore water pressure correction}}$ = N.A.

Total Settlement at the centre of Flexible foundation

= 0.8

Pore Pr. Correction = 0.85

Total Settlement = S_f x D.F.x R.F.

S_{f2} = 11.0 mm

Footing Depth (m)	**1.50**
SBC (t/m2)	14.00
Average N value	23
Settlement for 10 t/m2 (mm)	13.20
Total Settlement (mm)	18.48
Depth Correction	0.91
Rigidity factor	0.8
Corrected Settlement (mm)	**13.5**
Total Settlement (mm) =	**24.5**

1655

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ANNEXURE - IV

Settlement Calculation As per IS 8009 (Part 1) **Ch. 310 4-ℓ**

BH No. (A1)

Depth of foundation		=	3.0	m
Length of footing (L)		=	8.0	m
Width of footing (B)		=	3.0	m
Initial effective stress at mid of layer	Po	=	6.795	t/m^2
Concentrated load *P*		=	18.00	t/m^2
Incerase in pressure at mid of layer	ΔP	=	$P \times I_B$	
	I_B	=	0.247	
	ΔP	=	4.4	t/m^2
Compression Index	Cc	=	0.08	
Thickness of clay layer	H	=	1.5	m
Initial Void ratio	e_o	=	0.53	
	$\frac{Po + \Delta p}{Po}$	=	1.6543	

Settlement of clay layer

$$S_f = \frac{Cc}{1+eo} \; H \; \log_{10} \frac{Po + \Delta P}{Po}$$

S_f = 0.01715 m

= 17.1463 mm

Correction for Depth and Rigidity of foundation on total settlement

Depth Factor Calculation

$D/(LB)^{\wedge 0.5}$ = 0.61

D = Depth of Foundation

L/B = 2.67

Depth Factor = 0.83

$$\text{Rigidity Factor} = \frac{\text{Total Settlement of Rigid foundation}}{\text{Total Settlement at the centre of Flexible foundation}}$$

= 0.8

Pore Pr. Correction = 0.85

Total Settlement = S_f x D.F.x R.F.

S_{f2} = 9.7 mm

Footing Depth (m)	**3.00**
SBC (t/m2)	18.00
Average N value	24
Settlement for 10 t/m2 (mm)	12.60
Total Settlement (mm)	22.68
Depth Correction	0.83
Rigidity factor	0.8
Corrected Settlement (mm)	**15.06**
Total Settlement (mm)	**15.1**

1656

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ANNEXURE - IV

Settlement Calculation As per IS 8009 (Part 1)	
Location	Minor Bridge
Chainage	310/04-06
Bore Hole No.	1

Footing Depth (m)	**4.50**
SBC (t/m2)	26.00
Average N value	24
Settlement for 10 t/m2 (mm)	12.60
Total Settlement (mm)	32.76
Depth Correction	0.74
Rigidity factor	0.8
Corrected Settlement (mm)	**19.39**

Footing Depth (m)	**6.00**
SBC (t/m2)	28.00
Average N value	25
Settlement for 10 t/m2 (mm)	12.00
Total Settlement (mm)	33.60
Depth Correction	0.68
Rigidity factor	0.8
Corrected Settlement (mm)	**18.28**

CHAPTER – 52

"Minor Bridge No. 355A",

Location – Existing Km. - 310/21-23

52.1 LOCATION OF STRUCTURE:

Proposed Minor Bridge of Span 1x3x2

52.2 BOREHOLE DESCRIPTIONS:

(a) Location of Structure, Boreholes with RL shown in **FIGURE-1**.

(b) Subsurface Characteristic of Soil/Rock shown in *ANNEXURE-I.*

(c) Borelogs and sub soil profile shown in *ANNEXURE-II.*

(d) Calculations of Safe Bearing Capacities in *ANNEXURE-III.*

(e) Calculations of Probable Settlement in *ANNEXURE-IV*

(f) Depth of water Table ≥20.00m below EGL.

Subsurface profile at the site

BOREHOLE No.	Depth (m)	Type of Soil/Rock	Soil/Rock Characteristics
BH-1	0.00 to 1.50	Sandy Silt with Clay	Loose
	1.50 to 3.00	Sandy Silt with Clay & Gravels	Medium Dense
	3.00 to 10.50	Silty Sand	Medium Dense
	10.50 to 12.00	Silty Sand	Dense

52.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1	3.00	9.00	0.012	0.0014	NIL	0.0011	0.019

52.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1	3.00	NIL
	6.00	NIL

52.5 NET ALLOWABLE BEARING PRESSURE

Borehole No.	Depth from EGL (m)	Net Allowable Bearing Pressure (t/m^2)
BH-1	1.50	07.00
	3.00	14.00
	4.50	26.00
	6.00	27.00

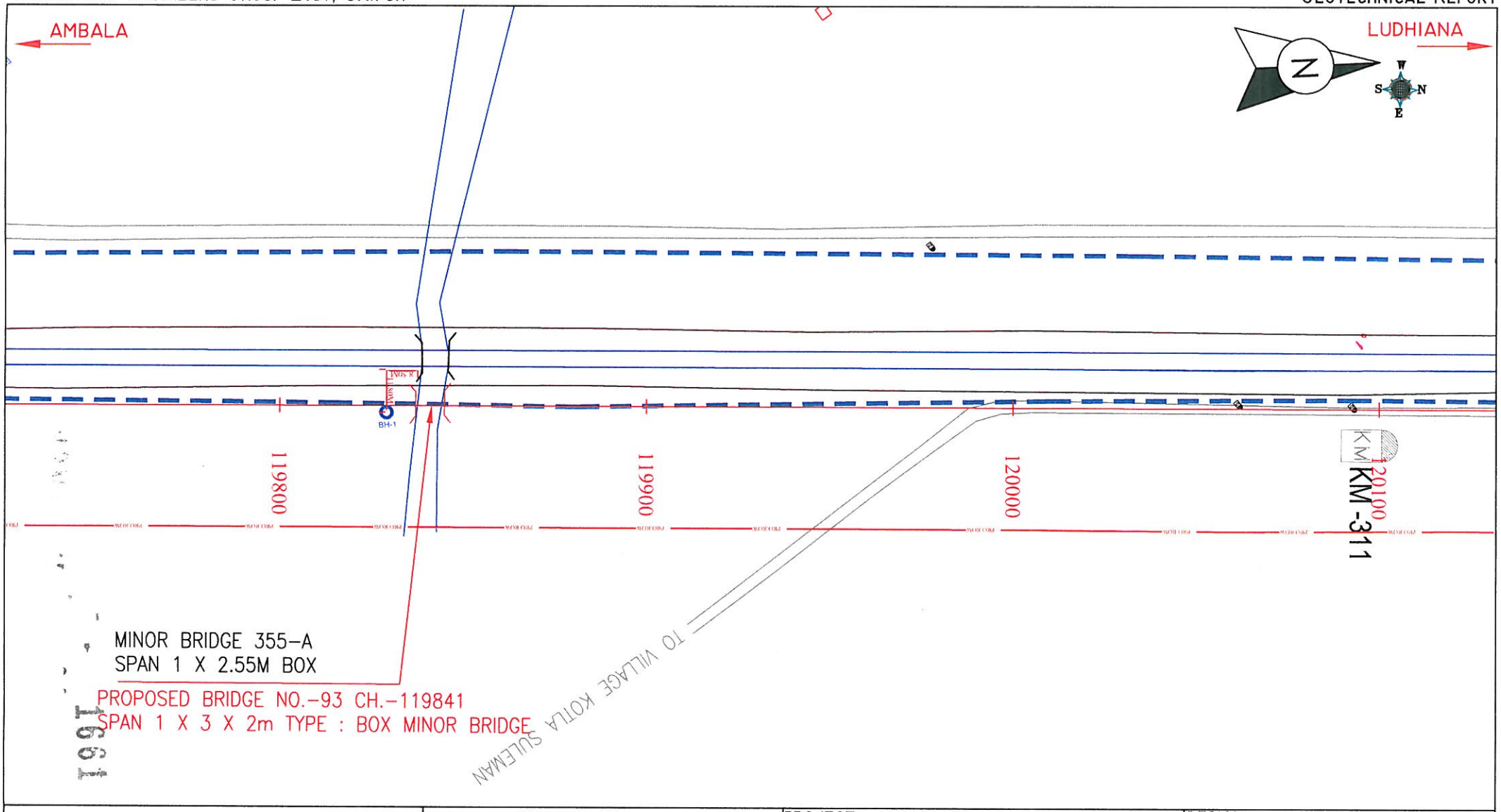
52.6 CONCLUSIONS

- . Subsurface Profiles indicates suitable Soil formation for foundations.

52.7 RECOMMENDATIONS

(i)	*Type of foundation*	Open foundation
(ii)	*Depth of foundation below GL*	Below 4.50 m from EGL

Note- The above recommendations are based on the field and laboratory tests conducted on the soil, and our experience in this regard. If the actual subsoil conditions during excavation for the foundation differ from the observations reported here, the design experts/consultants should be referred for suggestion, further investigations. However, the Depth and Type of foundation is to be decided by the structure designer depending upon the type of loading/structure and site conditions.



ALL DIMENSIONS IN METER

FIG.:-I

LOCATION PLAN OF PROPOSED MINOR BRIDGE AT CH. 310/21-23

RL OF BH-I =263.514

PROJECT :-

LUDHIANA-AMBALA (DFCCIL)

DESIGN :-

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SOIL CHARACTERISTICS OF BORE HOLE AT BH-1(LHS) FOR MINOR BRIDGE No. 355-A AT CHAINAGE 310/21-23

Project :	Chainage 310/21-23 Bridge No. 355-A			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				09.06.2009 to 09.06.2009	1	1(LHS)	below 20.00 m.	12.00mtr	263.514

Depth	Observ-	Correction	Corrected	Soil	Grain Size Distribution % wt retained							Atterberg Limits %			B.D.	M.C.	D.D.	Specific	Shear Strength	
from	ed	Factor		Description	Clay	Silt	Sand			Gravel								Gravity	c kg/cm^2	ϕ
GL (m)	N	C_n	N_n	(Soil Group)			Fine	Medium	Coarse	Fine	Coarse	L.L.	P.L.	P.I.	gm/cc	%	gm/cc			degree
0.00	-	-	-	Sandy Silt with Clay	13.01	68.76	5.29	3.21	5.68	3.84	0.21	30	19	11	-	-	-	-	-	-
1.50	18	1.51	27.18	Sandy Silt with Clay & Gravels	12.69	43.94	3.13	2.82	10.56	20.14	6.72	28	18	10	-	-	-	-	-	-
3.00	UDS	-	-	Silty Sand	0.00	10.78	83.14	6.08	0.00	0.00	0.00	28	NIL	NP	1.63	4.90	1.55	2.65	0.00	26.00
4.50	21	1.11	23.31	Silty Sand	0.00	10.74	83.09	6.17	0.00	0.00	0.00	27	NIL	NP	-	-	-	-		-
6.00	UDS	-	-	Silty Sand	2.65	12.38	81.28	2.84	0.85	0.00	0.00	28	NIL	NP	1.73	6.25	1.63	2.66	0.00	27.50
7.50	26	0.93	24.18	Silty Sand	2.58	12.75	81.07	2.79	0.81	0.00	0.00	27	NIL	NP	-	-	-	-	-	-
10.50	33	0.81	26.73	Silty Sand	2.38	13.18	80.98	2.68	0.78	0.00	0.00	29	NIL	NP	-	-	-	-	-	-
12.00	40	0.76	30.40	Silty Sand	0.00	15.42	81.11	2.79	0.68	0.00	0.00	26	NIL	NP	-	-	-	-	-	-

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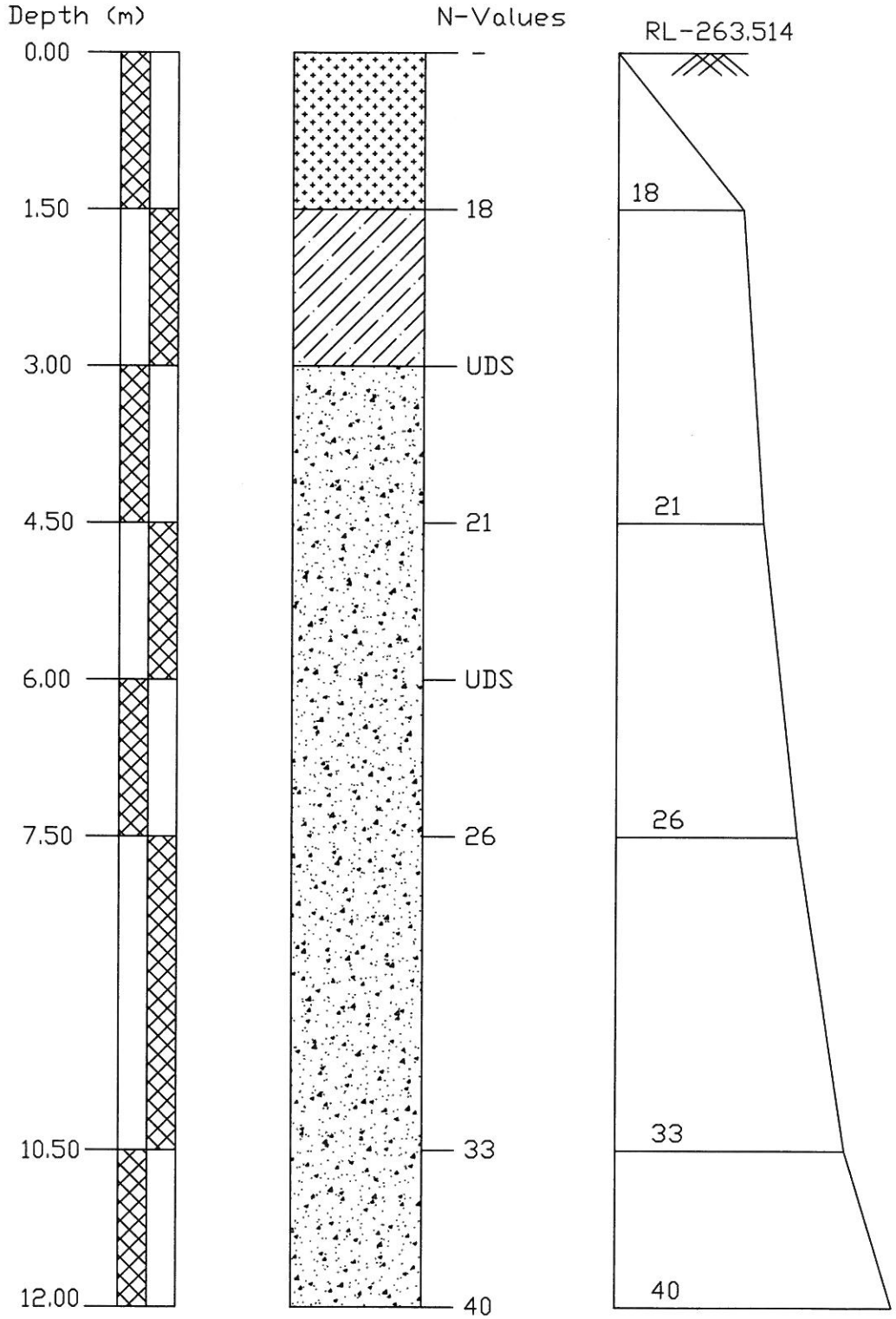
BORELOG OF BH–1(LHS) AT EXISTING KM–310/21–23 FOR MINOR BRIDGE NO.–355 A,

ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

SYMBOL	DESCRIPTION
	SANDY SILT WITH CLAY
	SANDY SILT WITH CLAY & GRAVELS
	SILTY SAND

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ANNEXURE - III

Calculation of SBC for shallow foundations as per IS : 6403 - 1981

INPUT DATA

Minor Bridge No 310/21-23 BH-1

Type of footing

1	Continuous Strip		
2	Rectangular	***Rectangular***	**2**
3	Square		
4	Circular		

Angle of internal friction (ϕ °)	26.00
Cohesion (c in t/m2)	0.00
Void ratio (e)	0.71
Direction of load with vertical (°)	0.00
Density of surcharge (t/m^3)	1.63
Density of foundation soil (t/m^3)	1.63
Depth of water table(m)	1.50
Factor of safety	3.00

S.no.	Depth (m)	Width (m)	Length (m)
1	1.50	3.00	8.00
2	3.00	3.00	8.00

SHEAR FAILURE CRITERIA

Assumptions and formula used in calculation as per IS:6403-1981 are given below -

The ultimate net bearing capacity in case of general shear failure is given by

$$q_d = c\,N_c\,s_c\,d_c\,i_c + q\,(N_q-1)\,s_q\,d_q\,i_q + (1/2)\,B\,\gamma\,N_\gamma\,s_\gamma\,d_\gamma\,i_\gamma\,W'$$

The ultimate net bearing capacity in case of local shear failure is given by

$$q'_d = (2/3)\,c\,N'_c\,s_c\,d_c\,i_c + q\,(N'_q-1)\,s_q\,d_q\,i_q + (1/2)\,B\,\gamma\,N'_\gamma\,s_\gamma\,d_\gamma\,i_\gamma\,W'$$

Where,

$d_c = 1 + 0.2\,(D_f/B)*SQRT(N_\phi)$

$d_q = d_\gamma = 1$ for $\phi < 10^o$

$d_q = d_\gamma = 1 + 0.1\,(D_f/B)*SQRT(N_\phi)$ for $\phi > 10^o$

$N_\phi = \tan^2(\pi/4 + \phi/2)$

ϕ' for local shear failure = $\tan^{-1}(0.67\tan\phi)$

OUTPUT

The computer aided results for shear failure criteria are tabulated below. The results are interpolated values of bearing capacity obtained from general and local shear failure criteria.

ANNEXURE - III

Bearing capacity factors :

ϕ	26.00
N_c	22.60
N_q	12.21
N_γ	13.18

ϕ'	18.10
N'_c	13.36
N'_q	5.46
N'_γ	4.35

Shape factors :

S.no.	Width(m)	Length (m)	S_c	S_q	S_γ
1	3.00	8.00	1.08	1.08	0.85
2	3.00	8.00	1.08	1.08	0.85

Depth factors :

S.no.	Depth(m)	Width(m)	dc	d_q	d_γ
1	1.50	3.00	1.16	1.08	1.08
2	3.00	3.00	1.32	1.16	1.16

Inclination factors :

$i_c = (1-\alpha/90)^2$	$i_q = (1-\alpha/90)^2$	$i_\gamma = (1-\alpha/\phi)^2$
1.00	1.00	1.00

Water table factor :

S.no.	Depth(m)	Width(m)	Z_w/B	W'
1	1.50	3.00	0.00	0.50
2	3.00	3.00	-0.50	0.50

Safe Bearing Capacity

S.no.	Depth(m)	Width(m)	Length (m)	SBC in (t/m^2)		
				General shear	Local shear	Actual
1	1.50	3.00	8.00	15.54	5.85	7.79
2	3.00	3.00	8.00	28.08	10.82	14.27

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ANNEXURE - III

Calculation of SBC for shallow foundations as per IS : 6403 - 1981

INPUT DATA

Minor Bridge No 310/21-23 BH-1

Type of footing

1	Continuous Strip		
2	Rectangular	***Rectangular***	**2**
3	Square		
4	Circular		

Angle of internal friction (ϕ°)	27.50
Cohesion (c in t/m2)	0.00
Void ratio (e)	0.63
Direction of load with vertical ($^\circ$)	0.00
Density of surcharge (t/m^3)	1.63
Density of foundation soil (t/m^3)	1.73
Depth of water table(m)	1.50
Factor of safety	3.00

S.no.	Depth (m)	Width (m)	Length (m)
1	4.50	3.00	8.00
2	6.00	3.00	8.00

SHEAR FAILURE CRITERIA

Assumptions and formula used in calculation as per IS:6403-1981 are given below -

The ultimate net bearing capacity in case of general shear failure is given by

$$q_d = c\,N_c\,s_c\,d_c\,i_c + q\,(N_q-1)\,s_q\,d_q\,i_q + (1/2)\,B\,\gamma\,N_\gamma\,s_\gamma\,d_\gamma\,i_\gamma\,W'$$

The ultimate net bearing capacity in case of local shear failure is given by

$$q'_d = (2/3)\,c\,N'_c\,s_c\,d_c\,i_c + q\,(N'_q-1)\,s_q\,d_q\,i_q + (1/2)\,B\,\gamma\,N'_\gamma\,s_\gamma\,d_\gamma\,i_\gamma\,W'$$

Where,

$d_c = 1 + 0.2\,(D_f/B)*SQRT(N_\phi)$

$d_q = d_\gamma = 1$ for $\phi < 10^\circ$

$d_q = d_\gamma = 1 + 0.1\,(D_f/B)*SQRT(N_\phi)$ for $\phi > 10^\circ$

$N_\phi = \tan^2(\pi/4 + \phi/2)$

ϕ' for local shear failure $= \tan^{-1}(0.67\tan\phi)$

OUTPUT

The computer aided results for shear failure criteria are tabulated below. The results are interpolated values of bearing capacity obtained from general and local shear failure criteria.

ANNEXURE - III

Bearing capacity factors :

ϕ	27.50
N_c	25.43
N_q	14.53
N_γ	16.64

ϕ'	19.23
N'_c	14.24
N'_q	6.02
N'_γ	4.97

Shape factors :

S.no.	Width(m)	Length (m)	S_c	S_q	S_γ
1	3.00	8.00	1.08	1.08	0.85
2	3.00	8.00	1.08	1.08	0.85

Depth factors :

S.no.	Depth(m)	Width(m)	dc	d_q	d_γ
1	4.50	3.00	1.49	1.25	1.25
2	6.00	3.00	1.66	1.33	1.33

Inclination factors :

$i_c = (1-\alpha/90)^2$	$i_q = (1-\alpha/90)^2$	$i_\gamma = (1-\alpha/\phi)^2$
1.00	1.00	1.00

Water table factor :

S.no.	Depth(m)	Width(m)	Z_w/B	W'
1	4.50	3.00	-1.00	0.50
2	6.00	3.00	-1.50	0.50

Safe Bearing Capacity

S.no.	Depth(m)	Width(m)	Length (m)	SBC in (t/m^2)		
				General shear	Local shear	Actual
1	4.50	3.00	8.00	37.20	13.25	27.62
2	6.00	3.00	8.00	39.66	14.12	29.44

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ANNEXURE - IV

Settlement Calculation As per IS 8009 (Part 1)	
Location	Minor Bridge
Chainage	310/21-23
Bore Hole No.	1

Footing Depth (m)	**1.50**
SBC (t/m2)	7.00
Average N value	24
Settlement for 10 t/m2 (mm)	12.60
Total Settlement (mm)	8.82
Depth Correction	0.91
Rigidity factor	0.8
Corrected Settlement (mm)	**6.4**

Footing Depth (m)	**3.00**
SBC (t/m2)	14.00
Average N value	24
Settlement for 10 t/m2 (mm)	12.60
Total Settlement (mm)	17.64
Depth Correction	0.83
Rigidity factor	0.8
Corrected Settlement (mm)	**11.7**

Footing Depth (m)	**4.50**
SBC (t/m2)	26.00
Average N value	24
Settlement for 10 t/m2 (mm)	12.60
Total Settlement (mm)	32.76
Depth Correction	0.74
Rigidity factor	0.8
Corrected Settlement (mm)	**19.4**

Footing Depth (m)	**6.00**
SBC (t/m2)	27.00
Average N value	25
Settlement for 10 t/m2 (mm)	12.00
Total Settlement (mm)	32.40
Depth Correction	0.68
Rigidity factor	0.8
Corrected Settlement (mm)	**17.6**

CHAPTER – 53

"Minor Bridge No. 354",

Location – Existing Km. - 309/17-19

53.1 LOCATION OF STRUCTURE:

Proposed Minor Bridge of Span 1x3x3

53.2 BOREHOLE DESCRIPTIONS:

(a) Location of Structure, Boreholes with RL shown in **FIGURE-1**.

(b) Subsurface Characteristic of Soil/Rock shown in *ANNEXURE-I.*

(c) Borelogs and sub soil profile shown in *ANNEXURE-II.*

(d) Calculations of Safe Bearing Capacities in *ANNEXURE-III.*

(e) Calculations of Probable Settlement in *ANNEXURE-IV*

(f) Depth of water Table ≥15.00m below EGL.

Subsurface profile at the site

BOREHOLE No.	Depth (m)	Type of Soil/Rock	Soil/Rock Characteristics
BH-1	0.00 to 1.50	Sandy Silt with Clay	Loose
	1.50 to 3.00	Sandy Silt	Medium Dense
	3.00 to 6.00	Silty Sand	Medium Dense
	6.00 to 7.50	Silty Sand with Gravels	Medium Dense
	7.50 to 10.50	Silty Sand	Medium Dense
	10.50 to 12.00	Silty Sand	Dense

53.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1	3.00	8.30	NIL	0.0024	NIL	0.0012	0.026
	6.00	8.70	0.005	0.0021	NIL	0.0011	0.022

53.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1	3.00	NIL
	6.00	NIL

53.5 NET ALLOWABLE BEARING PRESSURE

Borehole No.	Depth from EGL (m)	Net Allowable Bearing Pressure (t/m^2)
BH-1	1.50	08.00
	3.00	15.00
	4.50	18.00
	6.00	19.00

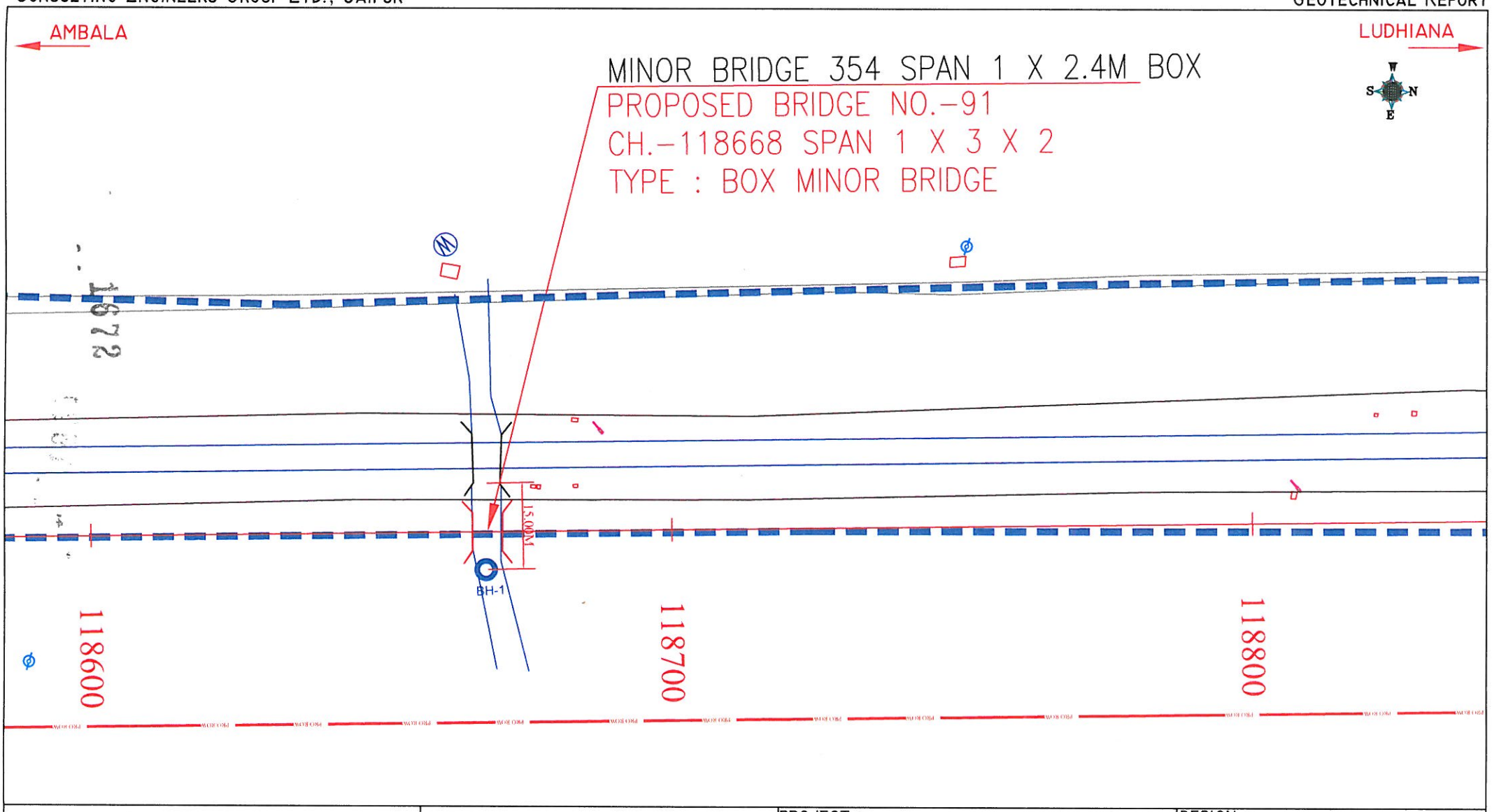
53.6 CONCLUSIONS

- Subsurface Profiles indicates suitable Soil formation for foundations.

53.7 RECOMMENDATIONS

(i)	*Type of foundation*	Open foundation
(ii)	*Depth of foundation below GL*	Below 4.50 m from EGL

Note- The above recommendations are based on the field and laboratory tests conducted on the soil, and our experience in this regard. If the actual subsoil conditions during excavation for the foundation differ from the observations reported here, the design experts/consultants should be referred for suggestion, further investigations. However, the Depth and Type of foundation is to be decided by the structure designer depending upon the type of loading/structure and site conditions.



ALL DIMENSIONS IN METER FIG.:-I LOCATION PLAN OF PROPOSED MINOR BRIDGE AT CH. 309/17-19	RL OF BH-I =263.568	PROJECT :- LUDHIANA-AMBALA (DFCCIL)	DESIGN :- CONSULTING ENGINEERS GROUP LTD. E-12,Moji Colony,Malviya Nagar Jaipur-17 Tel: +91-141- 2520899, 2521899, 2520556 Fax: 2521348, E-Mail: ceg@cegindia.com

SOIL CHARACTERISTICS OF BORE HOLE AT BH-1(LHS) FOR MINOR BRIDGE No. 354 AT CHAINAGE 309/17-19

Project :	Chainage 309/17-19 Bridge No. 354			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				09.06.2009 to 09.06.2009	1	1(LHS)	below 15.00 m.	12.00mtr	263.568

Depth	Observ-	Correction	Corrected	Soil	Grain Size Distribution % wt retained							Atterberg Limits %			B.D.	M.C.	D.D.	Specific	Shear Strength	
from	ed	Factor		Description	Clay	Silt	Sand			Gravel									Gravity	c kg/cm^2	ϕ
GL (m)	N	C_n	N_n	(Soil Group)			Fine	Medium	Coarse	Fine	Coarse	L.L.	P.L.	P.I.	gm/cc	%	gm/cc			degree
0.00	-	-	-	Sandy Silt with Clay	10.86	60.77	23.25	1.29	1.68	2.15	0.00	32	24	8	-	-	-	-	-	-
1.50	10	1.51	15.10	Sandy Silt	3.77	49.60	44.45	0.62	0.00	1.56	0.00	26	NIL	NP	-	-	-	-	-	
3.00	UDS	-	-	Silty Sand	2.68	23.73	71.28	2.24	0.07	0.00	0.00	26	NIL	NP	1.62	5.26	1.54	2.60	0.00	26.00
4.50	20	1.11	22.20	Silty Sand	2.55	6.86	85.87	2.92	0.44	1.36	0.00	26	NIL	NP	-	-	-	-	-	
6.00	UDS	-	-	Silty Sand with Gravels	2.15	14.04	62.02	8.49	3.64	9.66	0.00	25	NIL	NP	1.68	8.17	1.55	2.63	0.00	27.00
7.50	24	0.93	22.32	Silty Sand	2.69	11.40	81.66	3.35	0.48	0.42	0.00	25	NIL	NP	-	-	-	-	-	-
10.50	31	0.82	25.42	Silty Sand	2.41	11.35	83.03	2.48	0.37	0.36	0.00	24	NIL	NP	-	-	-	-	-	-
12.00	39	0.77	30.03	Silty Sand	2.66	6.68	83.40	7.26	0.00	0.00	0.00	25	NIL	NP	-	-	-	-	-	-

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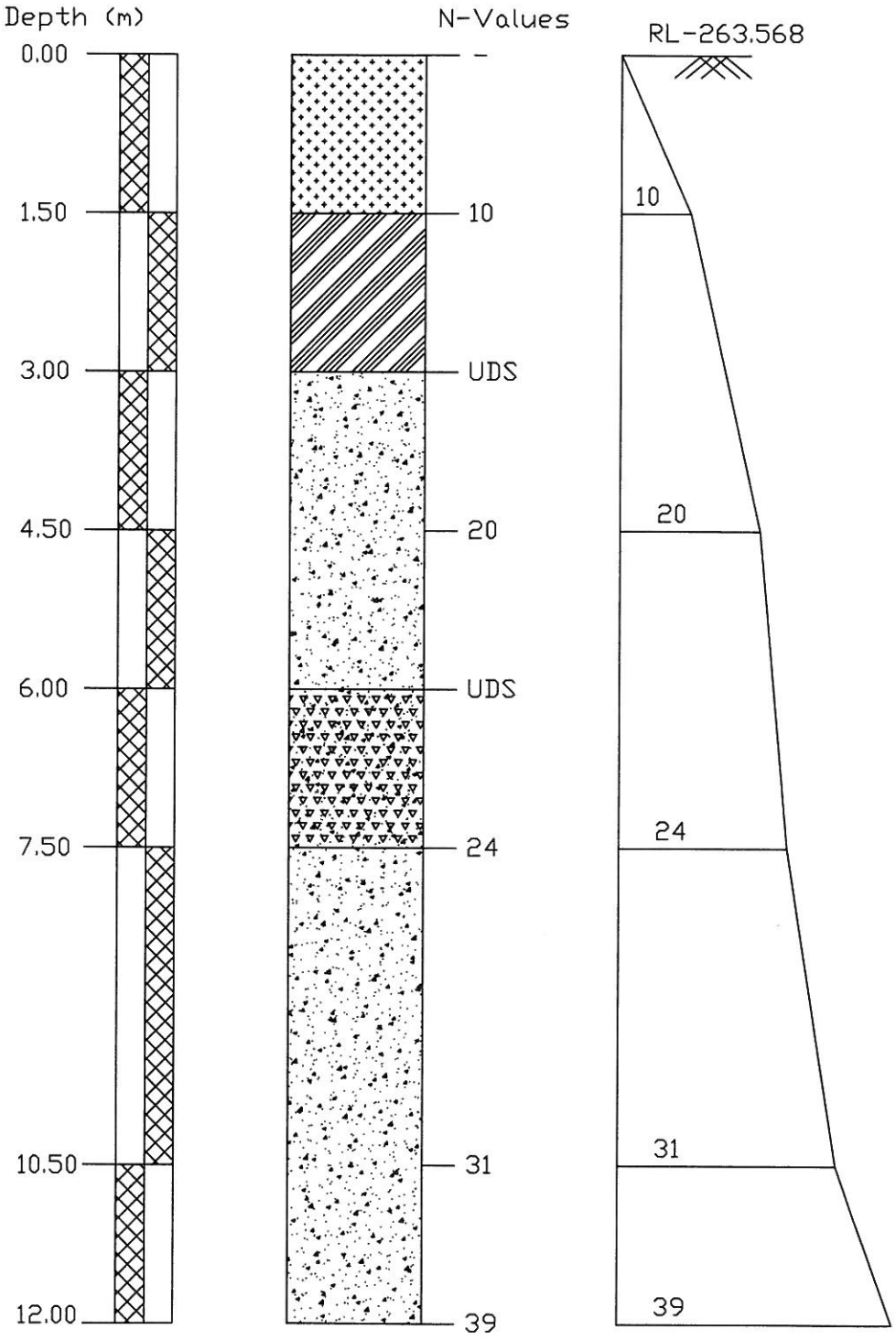
BORELOG OF BH–1(LHS) AT EXISTING KM–309/17–19 FOR MINOR BRIDGE NO.–354,

ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

SYMBOL	DESCRIPTION
	SANDY SILT WITH CLAY
	SANDY SILT
	SILTY SAND
	SILTY SAND WITH GRAVELS

ANNEXURE - III

Calculation of SBC for shallow foundations as per IS : 6403 - 1981

INPUT DATA

Minor Bridge No 309/17-19 BH-1

Type of footing

1	Continuous Strip		
2	Rectangular	***Rectangular***	**2**
3	Square		
4	Circular		

Angle of internal friction (ϕ °)	26.00
Cohesion (c in t/m2)	0.00
Void ratio (e)	0.69
Direction of load with vertical (°)	0.00
Density of surcharge (t/m^3)	1.62
Density of foundation soil (t/m^3)	1.62
Depth of water table(m)	1.50
Factor of safety	3.00

S.no.	Depth (m)	Width (m)	Length (m)
1	1.50	3.00	8.00
2	3.00	3.00	8.00

SHEAR FAILURE CRITERIA

Assumptions and formula used in calculation as per IS:6403-1981 are given below -

The ultimate net bearing capacity in case of general shear failure is given by

$$q_d = c\,N_c\,s_c\,d_c\,i_c + q\,(N_q-1)\,s_q\,d_q\,i_q + (1/2)\,B\,\gamma\,N_\gamma\,s_\gamma\,d_\gamma\,i_\gamma\,W'$$

The ultimate net bearing capacity in case of local shear failure is given by

$$q'_d = (2/3)\,c\,N'_c\,s_c\,d_c\,i_c + q\,(N'_q-1)\,s_q\,d_q\,i_q + (1/2)\,B\,\gamma\,N'_\gamma\,s_\gamma\,d_\gamma\,i_\gamma\,W'$$

Where,

$d_c = 1 + 0.2\,(D_f/B)*SQRT(N_\phi)$

$d_q = d_\gamma = 1$ for $\phi < 10°$

$d_q = d_\gamma = 1 + 0.1\,(D_f/B)*SQRT(N_\phi)$ for $\phi > 10°$

$N_\phi = \tan^2(\pi/4 + \phi/2)$

ϕ' for local shear failure = $\tan^{-1}(0.67\tan\phi)$

OUTPUT

The computer aided results for shear failure criteria are tabulated below. The results are interpolated values of bearing capacity obtained from general and local shear failure criteria.

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ANNEXURE - III

Bearing capacity factors :

ϕ	26.00
N_c	22.60
N_q	12.21
N_γ	13.18

ϕ'	18.10
N'_c	13.36
N'_q	5.46
N'_γ	4.35

Shape factors :

S.no.	Width(m)	Length (m)	S_c	S_q	S_γ
1	3.00	8.00	1.08	1.08	0.85
2	3.00	8.00	1.08	1.08	0.85

Depth factors :

S.no.	Depth(m)	Width(m)	dc	d_q	d_γ
1	1.50	3.00	1.16	1.08	1.08
2	3.00	3.00	1.32	1.16	1.16

Inclination factors :

$i_c = (1-\alpha/90)^2$	$i_q = (1-\alpha/90)^2$	$i_\gamma = (1-\alpha/\phi)^2$
1.00	1.00	1.00

Water table factor :

S.no.	Depth(m)	Width(m)	Z_w/B	W'
1	1.50	3.00	0.00	0.50
2	3.00	3.00	-0.50	0.50

Safe Bearing Capacity

S.no.	Depth(m)	Width(m)	Length (m)	SBC in (t/m^2)		
				General shear	Local shear	Actual
1	1.50	3.00	8.00	15.44	5.81	8.70
2	3.00	3.00	8.00	27.91	10.75	15.90

ANNEXURE - III

Calculation of SBC for shallow foundations as per IS : 6403 - 1981

INPUT DATA

Minor Bridge No 309/17-19 BH-1

Type of footing

1	Continuous Strip		
2	Rectangular	***Rectangular***	**2**
3	Square		
4	Circular		

Angle of internal friction (ϕ°)	27.00
Cohesion (c in t/m2)	0.00
Void ratio (e)	0.70
Direction of load with vertical ($^\circ$)	0.00
Density of surcharge (t/m^3)	1.62
Density of foundation soil (t/m^3)	1.68
Depth of water table(m)	1.50
Factor of safety	3.00

S.no.	Depth (m)	Width (m)	Length (m)
1	4.50	3.00	8.00
2	6.00	3.00	8.00

SHEAR FAILURE CRITERIA

Assumptions and formula used in calculation as per IS:6403-1981 are given below -

The ultimate net bearing capacity in case of general shear failure is given by

$$q_d = c\,N_c\,s_c\,d_c\,i_c + q\,(N_q-1)\,s_q\,d_q\,i_q + (1/2)\,B\,\gamma\,N_\gamma\,s_\gamma\,d_\gamma\,i_\gamma\,W'$$

The ultimate net bearing capacity in case of local shear failure is given by

$$q'_d = (2/3)\,c\,N'_c\,s_c\,d_c\,i_c + q\,(N'_q-1)\,s_q\,d_q\,i_q + (1/2)\,B\,\gamma\,N'_\gamma\,s_\gamma\,d_\gamma\,i_\gamma\,W'$$

Where,

$d_c = 1 + 0.2\,(D_f/B)*SQRT(N_\phi)$

$d_q = d_\gamma = 1$ for $\phi < 10^\circ$

$d_q = d_\gamma = 1 + 0.1\,(D_f/B)*SQRT(N_\phi)$ for $\phi > 10^\circ$

$N_\phi = \tan^2(\pi/4 + \phi/2)$

ϕ' for local shear failure $= \tan^{-1}(0.67\tan\phi)$

OUTPUT

The computer aided results for shear failure criteria are tabulated below. The results are interpolated values of bearing capacity obtained from general and local shear failure criteria.

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ANNEXURE - III

Bearing capacity factors :

ϕ	27.00
N_c	24.49
N_q	13.76
N_γ	15.49

ϕ'	18.85
N'_c	13.94
N'_q	5.83
N'_γ	4.76

Shape factors :

S.no.	Width(m)	Length (m)	S_c	S_q	S_γ
1	3.00	8.00	1.08	1.08	0.85
2	3.00	8.00	1.08	1.08	0.85

Depth factors :

S.no.	Depth(m)	Width(m)	dc	d_q	d_γ
1	4.50	3.00	1.49	1.24	1.24
2	6.00	3.00	1.65	1.33	1.33

Inclination factors :

$i_c = (1-\alpha/90)^2$	$i_q = (1-\alpha/90)^2$	$i_\gamma = (1-\alpha/\phi)^2$
1.00	1.00	1.00

Water table factor :

S.no.	Depth(m)	Width(m)	Z_w/B	W'
1	4.50	3.00	-1.00	0.50
2	6.00	3.00	-1.50	0.50

Safe Bearing Capacity

S.no.	Depth(m)	Width(m)	Length (m)	SBC in (t/m^2)		
				General shear	Local shear	Actual
1	4.50	3.00	8.00	34.53	12.59	18.08
2	6.00	3.00	8.00	36.80	13.42	19.26

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ANNEXURE - IV

Settlement Calculation As per IS 8009 (Part 1)	
Location	Minor Bridge
Chainage	309/17-19
Bore Hole No.	1

Footing Depth (m)	1.50
SBC (t/m2)	8.00
Average N value	19
Settlement for 10 t/m2 (mm)	16.00
Total Settlement (mm)	12.80
Depth Correction	0.91
Rigidity factor	0.8
Corrected Settlement (mm)	**9.3**

Footing Depth (m)	3.00
SBC (t/m2)	15.00
Average N value	21
Settlement for 10 t/m2 (mm)	14.40
Total Settlement (mm)	21.60
Depth Correction	0.83
Rigidity factor	0.8
Corrected Settlement (mm)	**14.3**

Footing Depth (m)	4.50
SBC (t/m2)	18.00
Average N value	23
Settlement for 10 t/m2 (mm)	13.20
Total Settlement (mm)	23.76
Depth Correction	0.74
Rigidity factor	0.8
Corrected Settlement (mm)	**14.1**

Footing Depth (m)	6.00
SBC (t/m2)	19.00
Average N value	23
Settlement for 10 t/m2 (mm)	13.20
Total Settlement (mm)	25.08
Depth Correction	0.68
Rigidity factor	0.8
Corrected Settlement (mm)	**13.6**

CHAPTER – 54

"Minor Bridge No. 353A",

Location – Existing Km. - 309/02-04

54.1 LOCATION OF STRUCTURE:

Proposed Minor Bridge of Span 1x1.2x1.2

54.2 BOREHOLE DESCRIPTIONS:

(a) Location of Structure, Boreholes with RL shown in **FIGURE-1.**

(b) Subsurface Characteristic of Soil/Rock shown in *ANNEXURE-I.*

(c) Borelogs and sub soil profile shown in *ANNEXURE-II.*

(d) Calculations of Safe Bearing Capacities in *ANNEXURE-III.*

(e) Calculations of Probable Settlement in *ANNEXURE-IV*

(f) Depth of water Table ≥20.00m below EGL.

Subsurface profile at the site

BOREHOLE No.	Depth (m)	Type of Soil/Rock	Soil/Rock Characteristics
BH-1	0.00 to 1.50	Sandy Silt with Clay	Loose
	1.50 to 3.00	Sandy Silt with Clay	Medium Dense
	3.00 to 12.00	Silty Sand	Medium Dense

54.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1	3.00	8.00	NIL	0.0014	NIL	0.0009	0.026
	6.00	8.80	0.010	0.0017	NIL	0.0012	0.020

54.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1	3.00	NIL
	6.00	NIL

54.5 NET ALLOWABLE BEARING PRESSURE

Borehole No.	Depth from EGL (m)	Net Allowable Bearing Pressure (t/m^2)
BH-1	1.50	07.00
	3.00	12.00
	4.50	19.00
	6.00	21.00

54.6 CONCLUSIONS

- Subsurface Profiles indicates suitable Soil formation for foundations.

54.7 RECOMMENDATIONS

(i)	*Type of foundation*	Open foundation
(ii)	*Depth of foundation below GL*	Below 4.50 m from EGL

Note- The above recommendations are based on the field and laboratory tests conducted on the soil, and our experience in this regard. If the actual subsoil conditions during excavation for the foundation differ from the observations reported here, the design experts/consultants should be referred for suggestion, further investigations. However, the Depth and Type of foundation is to be decided by the structure designer depending upon the type of loading/structure and site conditions.

CONSULTING
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