89.1 LOCATION OF STRUCTURE:

Proposed Major Bridge of Span 12.2+9.15+6.10+9.15+12.2

89.2 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 > 30.0m below EGL.

Subsurface profile at the site

BOREHOLE No.	Depth (m)	Type of Soil/Rock	Soil/Rock Characteristics
BH-1(A1)	0.00 to 4.50	Clayey Silt with Sand	Loose
	4.50 to 10.50	Sandy Silt	Medium Dense
	10.50 to 12.00	Clayey Silt	Medium Dense
	12.00 to 24.00	Clayey Silt with Sand	Medium Dense
	24.00 to 25.50	Sandy Silt	Medium Dense
	25.50 to 28.50	Clayey Silt with Sand	Medium Dense
	28.50 to 30.00	Clayey Silt with Sand	Dense
BH-2(P1)	0.00 to 4.50	Clayey Silt	Loose
	4.50 to 7.50	Clayey Silt	Medium Dense
	7.50 to 28.50	Clayey Silt with Sand	Medium Dense
	28.50 to 30.00	Clayey Silt with Sand	Dense
BH-3(P4)	0.00 to 1.50	Clayey Silt with Sand	Loose
	1.50 to 3.00	Clayey Silt with Sand	Medium Dense
	3.00 to 7.50	Silty Sand	Medium Dense
	7.50 to 12.00	Clayey Silt with Sand	Medium Dense
	12.00 to 13.50	Clayey Silt	Medium Dense
	13.50 to 30.00	Clayey Silt with Sand	Medium Dense

89.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1 (A1)	3.00	7.60	NIL	0.0025	NIL	0.0012	0.045
	12.00	7.50	NIL	0.0042	NIL	0.0015	0.168
	24.00	8.10	NIL	0.0014	NIL	0.0011	0.035
BH-2 (P6)	3.00	7.50	NIL	0.0025	NIL	0.0013	0.089
	12.00	7.70	NIL	0.0035	NIL	0.0013	0.075
BH-3 (A2)	3.00	8.50	0.005	0.0028	NIL	0.0012	0.047
	12.00	7.80	NIL	0.0018	NIL	0.0011	0.040

89.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1 (A1)	3.00	12.00
	12.00	14.00
	24.00	NIL
BH-2 (P6)	3.00	27.00
	12.00	24.00
	18.00	21.00
BH-2 (A2)	3.00	NIL
	12.00	22.00
	27.00	28.00

89.5 SAFE BEARING CAPACITY t/m^2

BH -NO.	DEPTH (mtr)	Net Allowable Bearing Pressure (t/m^2)
BH-1 (A1)	1.50m	7.50
	3.00m	11.00
	4.50m	12.00
	6.00m	13.00
BH-3 (A2)	1.50m	7.00
	3.00m	11.00
	4.50m	12.00
	6.00m	12.50

89.6 PILE LOAD CARRYING CAPACITY

89.6.1 Normal Bored Cast in- situ Pile Foundations:

Normal bored cast in situ RCC pile foundation is envisaged for the proposed bridge and have been analysed in the subsequent paragraphs. The Axial load carrying capacity of Pile in Rock is determined as per IRC- 78: 2000 appendix-5.

The safe Load carrying capacities of piles have been worked out on the basis of IRC-78 as per provision/assumptions provided therein.. For calculating designed Capacity of pile recommendation of IS: 2911 should be followed. The minimum factor of safety on ultimate axial capacity should be as per clause 709.3.2 of IRC 78: 2000.The final design/construction of foundations, the safe /allowable load carrying capacity of these piles should be taken by conducting actual initial load tests on these piles casted in the respective area.

Further the piles should have necessary structural strength to transmit/sustain the design load.

Pile load carrying capacity in t

BH -NO.	PILE DEPTH (mtr)	PILE CARRYING CAPACITY IN TONNE	
		Pile Diameter= 1.0 m	Pile Diameter= 1.2 m
BH-1 (A1)	17.00	90.00	100.00
	20.00	110.00	130.00
	23.00	140.00	180.00
BH-2 (P6)	17.00	70.00	90.00
	20.00	100.00	120.00
	23.00	130.00	160.00
BH-3 (A2)	17.00	90.00	110.00
	20.00	120.00	150.00
	23.00	150.00	180.00

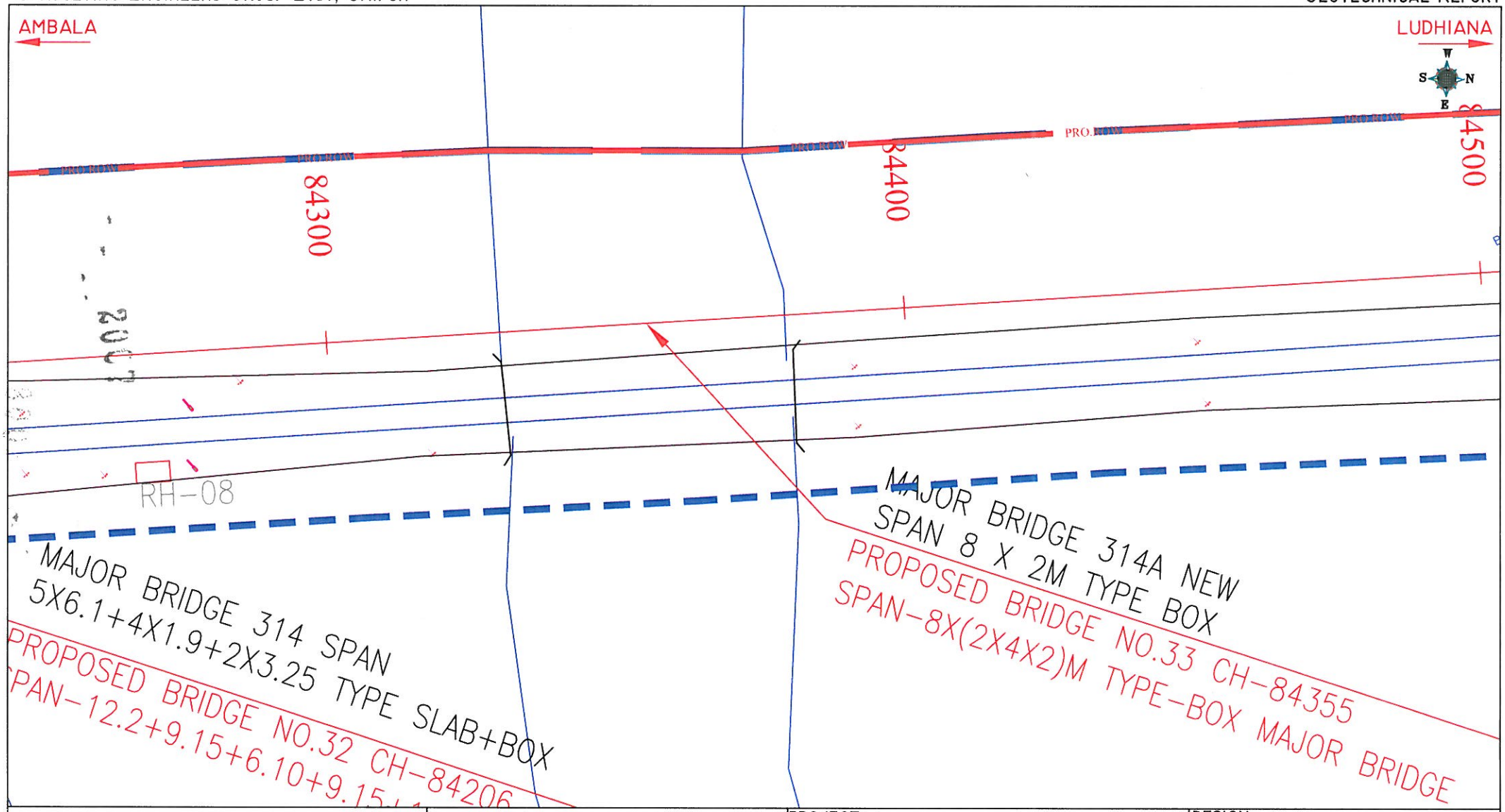
89.7 CONCLUSIONS

- Subsurface Profiles indicates suitable Soil formation for foundations.

89.8 RECOMMENDATIONS

(i)	*Type of foundation*	Pile foundation

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 MAJOR BRIDGE CH-275/7-9

RL OF BH (A1) = 264.767
RL OF BH (P6) = 265.536
RL OF BH (A2) = 265.337

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 (A1) RHS OF MAJOR BRIDGE No. 314 AT CHAINAGE 275/7-9

Project :	Chainage 275/7-9 Bridge No. 314			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				07.07.2009 to 08.07.2009	A1	1(RHS)	Below 30.00 m.	30.00mtr	264.767

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	-	-	-	Clayey silt with sand	17.58	66.38	14.23	1.23	0.58	0	0	35	20	15	-	-	-	-	-	-
1.50	8	1.51	12.08	Clayey silt with sand	15.26	72.11	12.26	0.37	0.00	0.00	0.00	30	17	13	-	-	-	-	-	-
3.00	UDS	-	-	Clayey silt with sand	12.69	80.24	4.13	0.70	0.99	1.25	0.00	30	20	10	1.63	5.29	1.55	2.65	0.11	20.00
4.50	12	1.11	13.32	Sandy Silt	2.36	54.03	43.29	0.19	0.13	0.00	0.00	25	NIL	NP	-	-	-	-	-	-
7.50	16	0.93	14.88	Sandy Silt	3.25	60.79	30.76	0.54	0.47	4.19	0.00	27	NIL	NP	-	-	-	-	-	-
10.50	21	0.82	17.22	Clayey silt	15.21	82.81	1.20	0.32	0.46	0.00	0.00	29	17	12	-	-	-	-	-	-
12.00	UDS	-	-	Clayey silt with sand	12.58	79.49	7.24	0.62	0.07	0.00	0.00	24	14	10	1.80	6.28	1.69	2.66	0.10	21.00
13.50	21	0.73	15.33	Clayey silt with sand	13.25	81.20	5.01	0.42	0.12	0.00	0.00	30	19	11	-	-	-	-	-	-
16.50	25	0.66	16.50	Clayey silt with sand	14.25	79.06	2.55	2.50	0.46	1.18	0.00	30	18	12	-	-	-	-	-	-
19.50	20	0.60	12.00	Clayey silt with sand	20.21	72.96	6.74	0.09	0.00	0.00	0.00	35	18	17	-	-	-	-	-	-
22.50	26	0.55	14.30	Clayey silt with sand	20.85	70.12	5.05	0.43	1.15	2.40	0.00	34	17	17	-	-	-	-	-	-
24.00	UDS	-	-	Sandy silt	4.58	88.56	5.86	0.42	0.28	0.30	0.00	28	NIL	NP	1.95	14.26	1.71	2.65	0.00	29.00
25.50	29	0.50	14.50	Clayey silt with sand	18.25	73.03	2.94	2.55	0.25	2.98	0.00	33	18	15	-	-	-	-	-	-
28.50	32	0.46	14.72	Clayey silt with sand	20.99	73.90	4.90	0.21	0.00	0.00	0.00	36	19	17	-	-	-	-	-	-
30.00	32	0.44	14.08	Clayey silt with sand	18.58	74.03	5.40	0.85	0.31	0.83	0.00	34	18	16	-	-	-	-	-	-

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8002

SOIL CHARACTERISTICS OF BORE HOLE AT BH-2 (P6) RHS OF MAJOR BRIDGE No. 314 AT CHAINAGE 275/7-9

Project :	Chainage 275/7-9 Bridge No. 314			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				08.07.2009 to 09.07.2009	P6	2(RHS)	Below 30.00 m.	30.00mtr	265.536

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	-	-	-	Clayey silt	18.12	78.35	3.23	0.3	0	0	0	34	19	15	-	-	-	-	-	-
1.50	7	1.52	10.64	Clayey silt	20.11	75.37	4.35	0.17	0.00	0.00	0.00	35	18	17	-	-	-	-	-	-
3.00	UDS	-	-	Clayey silt	23.98	74.09	1.93	0.00	0.00	0.00	0.00	44	23	21	1.60	5.36	1.52	2.68	0.26	12.00
4.50	12	1.11	13.32	Clayey silt	24.66	71.42	3.23	0.49	0.20	0.00	0.00	45	22	23	-	-	-	-	-	-
7.50	17	0.94	15.98	Clayey silt with sand	15.16	72.57	10.93	0.29	1.05	0.00	0.00	28	16	12	-	-	-	-	-	-
10.50	23	0.83	19.09	Clayey silt with sand	22.64	62.81	7.55	1.59	0.97	4.44	0.00	38	19	19	-	-	-	-	-	-
12.00	UDS	-	-	Clayey silt with sand	21.33	73.10	3.99	0.40	0.78	0.40	0.00	41	23	18	1.78	5.67	1.68	2.68	0.22	14.00
13.50	20	0.74	14.80	Clayey silt with sand	18.86	65.55	10.50	1.07	0.45	3.57	0.00	33	17	16	-	-	-	-	-	-
16.50	18	0.66	11.88	Clayey silt with sand	20.16	64.50	12.09	1.00	0.45	1.80	0.00	35	18	17	-	-	-	-	-	-
18.00	UDS	-	-	Clayey silt with sand	18.95	72.94	5.23	2.26	0.62	0.00	0.00	36	20	16	2.00	15.22	1.74	2.66	0.18	17.00
19.50	22	0.60	13.20	Clayey silt with sand	19.65	70.11	3.62	2.33	0.67	3.62	0.00	36	19	17	-	-	-	-	-	-
22.50	25	0.54	13.50	Clayey silt with sand	19.66	65.27	9.92	1.33	0.63	3.19	0.00	32	16	16	-	-	-	-	-	-
25.50	28	0.50	14.00	Clayey silt with sand	25.10	68.73	2.20	3.68	0.29	0.00	0.00	42	20	22	-	-	-	-	-	-
28.50	32	0.45	14.40	Clayey silt with sand	20.33	67.60	5.38	1.32	1.14	4.23	0.00	38	21	17	-	-	-	-	-	-
30.00	35	0.43	15.05	Clayey silt with sand	17.62	62.27	14.10	2.50	2.29	1.22	0.00	32	17	15	-	-	-	-	-	-

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SOIL CHARACTERISTICS OF BORE HOLE AT BH-3 (A2) RHS OF MAJOR BRIDGE No. 314 AT CHAINAGE 275/7-9

Project :	Chainage 275/7-9 Bridge No. 314			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				08.07.2009 to 09.07.2009	A2	3(RHS)	Below 30.00 m.	30.00mtr	265.337

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	-	-	-	Clayey silt with sand	22.85	45.99	10.36	6.58	10.66	3.56	0	40	20	20	-	-	-	-	-	-
1.50	12	1.46	17.52	Clayey silt with sand	23.15	37.84	12.68	11.33	11.55	3.45	0.00	38	18	20	-	-	-	-	-	-
3.00	UDS	-	-	Silty sand	2.36	16.10	70.27	5.59	1.68	4.00	0.00	26	NIL	NP	1.68	9.65	1.53	2.68	0.00	26.00
4.50	14	1.10	15.40	Silty sand	2.51	15.70	63.28	10.71	4.71	3.09	0.00	24	NIL	NP	-	-	-	-	-	-
7.50	12	0.92	11.04	Clayey silt with sand	16.98	63.54	17.20	0.47	0.93	0.88	0.00	31	17	14	-	-	-	-	-	-
10.50	14	0.81	11.34	Clayey silt with sand	21.36	71.45	5.47	1.40	0.19	0.13	0.00	36	17	19	-	-	-	-	-	-
12.00	UDS	-	-	Clayey silt	18.52	77.40	2.63	0.46	0.75	0.24	0.00	34	18	16	1.86	10.33	1.69	2.66	0.18	17.00
13.50	19	0.72	13.68	Clayey silt with sand	20.33	63.54	9.95	1.88	1.99	2.31	0.00	37	19	18	-	-	-	-	-	-
16.50	23	0.65	14.95	Clayey silt with sand	18.21	61.97	18.24	0.91	0.67	0.00	0.00	31	16	15	-	-	-	-	-	-
19.50	26	0.59	15.34	Clayey silt with sand	16.95	65.25	15.46	0.94	0.82	0.58	0.00	31	17	14	-	-	-	-	-	-
22.50	19	0.54	10.26	Clayey silt with sand	19.33	59.54	13.44	2.12	1.92	3.65	0.00	36	19	17	-	-	-	-	-	-
25.50	22	0.49	10.78	Clayey silt with sand	23.10	56.44	12.33	1.69	1.65	4.79	0.00	38	18	20	-	-	-	-	-	-
27.00	UDS	-	-	Clayey silt with sand	22.69	57.72	12.36	2.36	1.62	3.25	0.00	39	19	20	2.01	15.36	1.74	2.67	0.24	13.00
28.50	26	0.45	11.70	Clayey silt with sand	21.90	64.28	11.14	1.01	0.42	1.25	0.00	39	20	19	-	-	-	-	-	-
30.00	31	0.43	13.33	Clayey silt with sand	18.16	61.60	14.39	1.35	0.80	3.70	0.00	31	16	15	-	-	-	-	-	-

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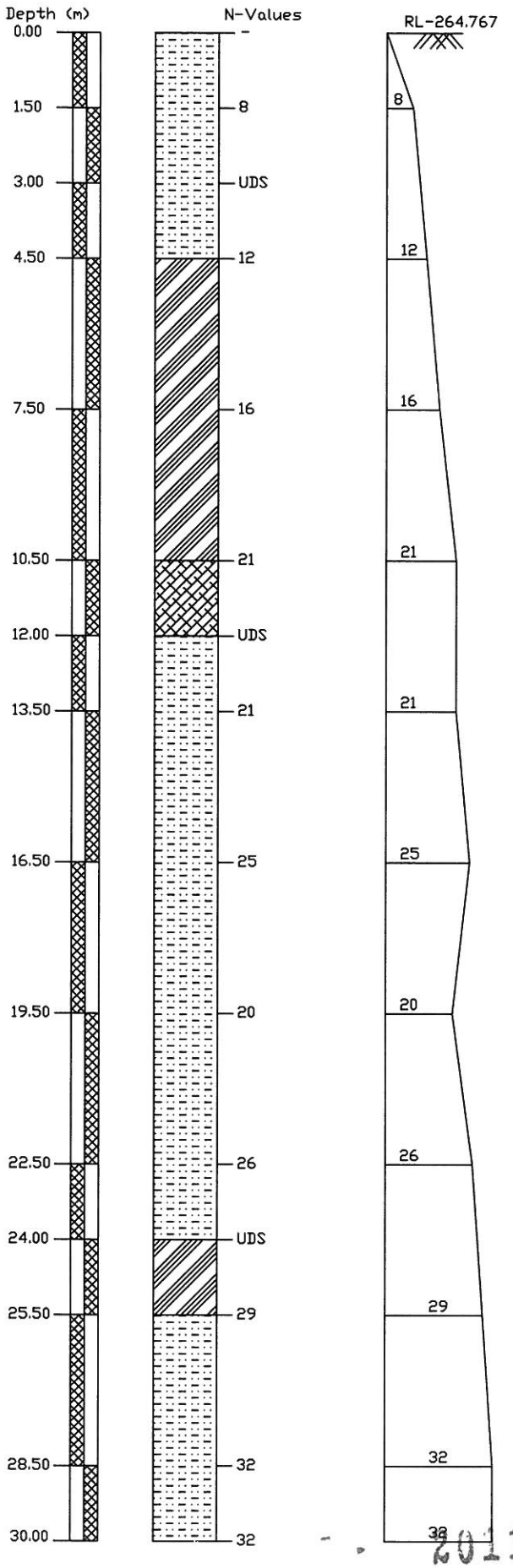
BORELOG OF BH–1(A1) RHS AT EXISTING KM–275/7–9 FOR MAJOR BRIDGE NO.–314,
ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

SYMBOL	DESCRIPTION
	CLAYEY SILT WITH SAND
	SANDY SLIT
	CLAYEY SILT

2011

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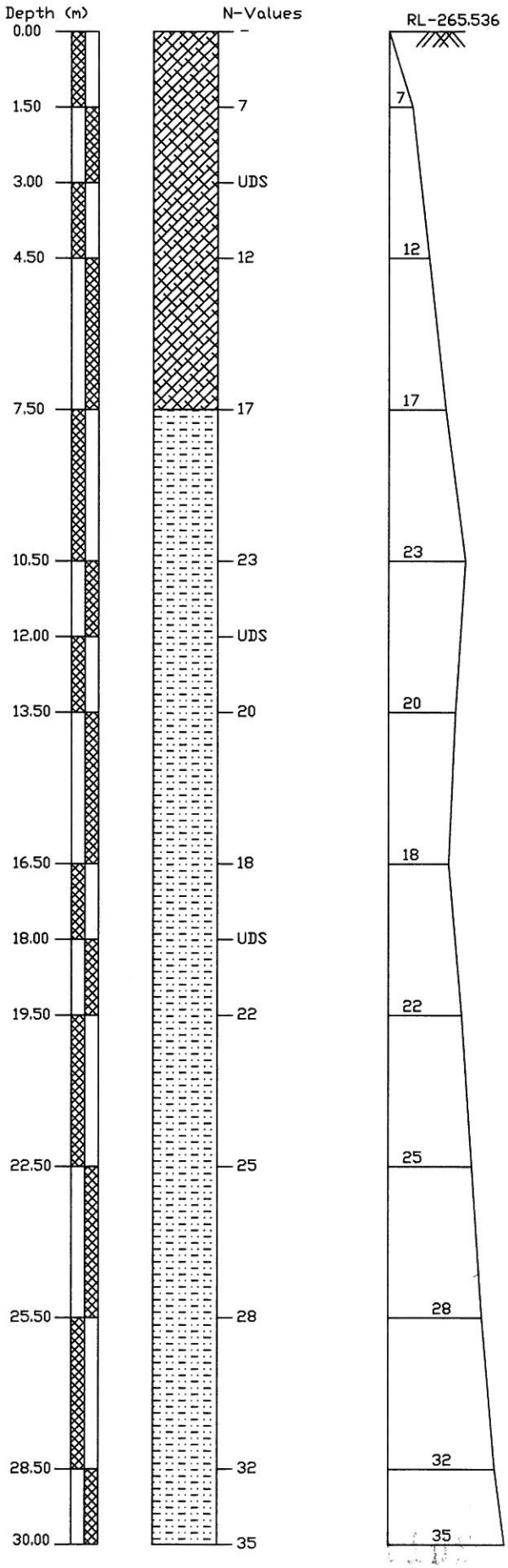
BORELOG OF BH–2(P6) RHS AT EXISTING KM–275/7–9 FOR MAJOR BRIDGE NO.–314,

ON KESARI TO SANEHWAL, LUDHIANA



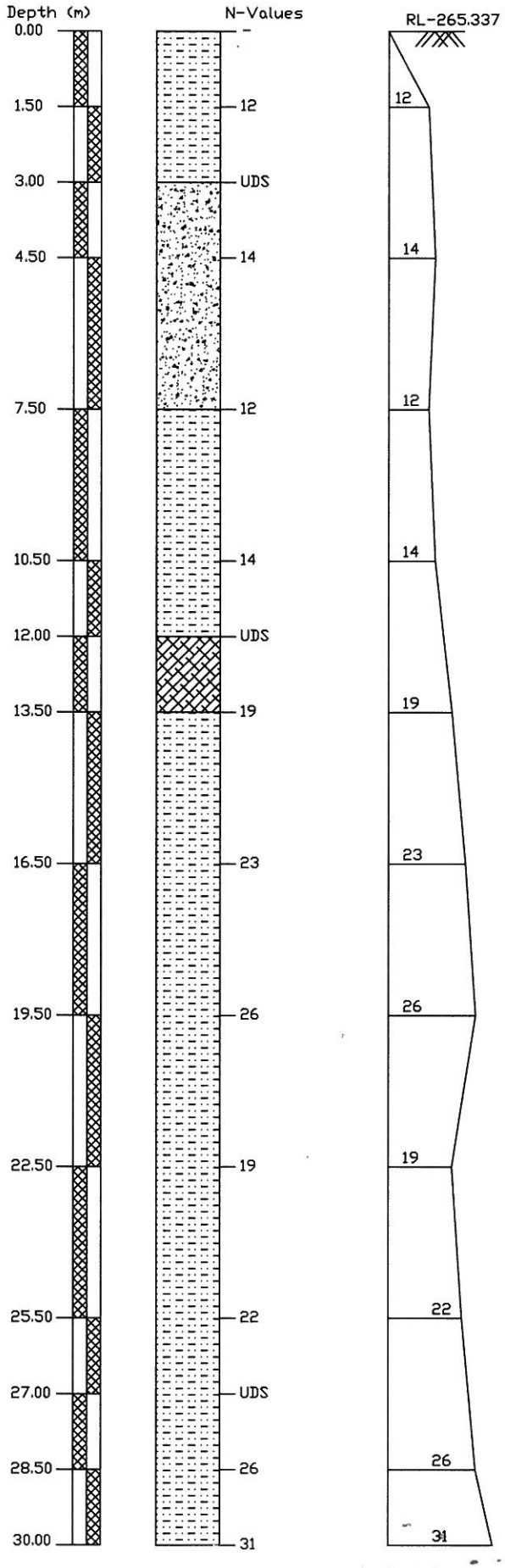
LEGEND

SYMBOL	DESCRIPTION
	CLAYEY SILT
	CLAYEY SILT WITH SAND

2012

CONSULTING Engineers Group Ltd.

BORELOG OF BH–3(A2) RHS AT EXISTING KM–275/7–9 FOR MAJOR BRIDGE NO.–314,
ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

SYMBOL	DESCRIPTION
	CLAYEY SILT WITH SAND
	SILTY SAND
	CLAYEY SILT

2013

CONSULTING Engineers Group Ltd.

CHAPTER – 90

"Major Bridge No. 314B",

Location – Existing Km. - 275/13-15

2014

90.1 LOCATION OF STRUCTURE:

Proposed Major Bridge of Span 16x4x2

90.2 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 30.0m below EGL.

Subsurface profile at the site

BOREHOLE No.	Depth (m)	Type of Soil/Rock	Soil/Rock Characteristics
BH-1(A1)	0.00 to 1.50	Silty Sand	Loose
	1.50 to 4.50	Silty Sand	Medium Dense
	4.50 to 7.50	Clayey Silt with Sand	Medium Dense
	7.50 to 13.50	Clayey Silt	Medium Dense
	13.50 to 19.50	Clayey Silt with Sand	Medium Dense
	19.50 to 25.50	Clayey Silt	Medium Dense
	25.50 to 30.00	Clayey Silt	Dense
BH-2(P8)	0.00 to 1.50	Silty Sand	Loose
	1.50 to 7.50	Silty Sand	Medium Dense
	7.50 to 10.50	Clayey Silt with Sand	Medium Dense
	10.50 to 22.50	Clayey Silt	Medium Dense
	22.50 to 24.00	Clayey Silt with Sand	Medium Dense
	24.00 to 28.50	Clayey Silt	Medium Dense
	28.50 to 30.00	Clayey Silt	Very dense
BH-3(A2)	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 Clay	Medium Dense
	4.50 to 10.50	Clayey Silt with Sand	Medium Dense
	10.50 to 22.50	Clayey Silt	Medium Dense
	22.50 to 25.50	Clayey Silt with Sand	Medium Dense
	25.50 to 30.00	Clayey Silt with Sand	Very Dense

90.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1 (A1)	3.00	8.50	0.005	0.0017	NIL	0.0011	0.019
	12.00	8.40	NIL	0.0032	NIL	0.0012	0.067
	18.00	8.30	NIL	0.0028	NIL	0.0013	0.104
	24.00	8.50	0.002	0.0042	NIL	0.0014	0.175
BH-2 (P8)	3.00	8.60	0.005	0.0024	NIL	0.0012	0.027
	12.00	8.70	0.005	0.0018	NIL	0.0011	0.041

2015

BH-3 (A2)	3.00	8.10	NIL	0.0017	NIL	0.0010	0.018
	12.00	8.80	0.007	0.0018	NIL	0.0012	0.039

90.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1 (A1)	3.00	NIL
	12.00	24.00
	21.00	18.00
	24.00	26.00
BH-2 (P8)	3.00	NIL
	12.00	22.00
	24.00	24.00
BH-3 (A2)	3.00	20.00
	12.00	16.00
	24.00	15.00

90.5 CHEMICAL ANALYSIS OF ENCOUNTERED WATER FROM BOREHOLE

Chemical Properties	pH Value	Chlorides mg/lit	Sulphate mg/lit	Organic Matter mg/lit	Inorganic Matter mg/lit	Acidity (ml)	Alkalinity (ml)	Total Disso. Solids (ppm)	Conductivity (µS/cm)
Test Result	7.5	62	90	170	479	0.2	2.0	670	430
Requirement as per IS:456 / Mosrth's	Not less then 6.0	2000 for CC and 500 for RCC	400	200	3000	5 ml of 0.02 normal NaoH	25 ml of 0.02 normal H_2SO_4	-	-

90.6 SAFE BEARING CAPACITY t/m²

BH -NO.	DEPTH (mtr)	Net Allowable Bearing Pressure (t/m²)
BH-1 (A1)	1.50m	8.00
	3.00m	8.50
	4.50m	12.00
	6.00m	15.00
BH-3 (A2)	1.50m	7.00
	3.00m	10.00
	4.50m	11.00
	6.00m	11.50

90.7 PILE LOAD CARRYING CAPACITY

90.7.1 Normal Bored Cast in- situ Pile Foundations:

Normal bored cast in situ RCC pile foundation is envisaged for the proposed bridge and have been analysed in the subsequent paragraphs. The Axial load carrying capacity of Pile in Rock is determined as per IRC- 78: 2000 appendix-5.

The safe Load carrying capacities of piles have been worked out on the basis of IRC-78 as per provision/assumptions provided therein.. For calculating designed Capacity of pile recommendation of IS: 2911 should be followed. The minimum factor of safety on ultimate axial capacity should be as per clause 709.3.2 of IRC 78: 2000.The final design/construction of foundations, the safe /allowable load carrying capacity of these piles should be taken by conducting actual initial load tests on these piles casted in the respective area.

Further the piles should have necessary structural strength to transmit/sustain the design load.

Pile load carrying capacity in t

BH -NO.	PILE DEPTH (mtr)	PILE CARRYING CAPACITY IN TONNE	
		Pile Diameter= 1.0 m	Pile Diameter= 1.2 m
BH-1 (A1)	17.00	70.00	80.00
	20.00	100.00	120.00
	23.00	120.00	150.00
BH-2 (P8)	17.00	80.00	100.00
	20.00	110.00	130.00
	23.00	160.00	220.00
BH-3 (A2)	17.00	100.00	120.00
	20.00	130.00	160.00
	23.00	170.00	210.00

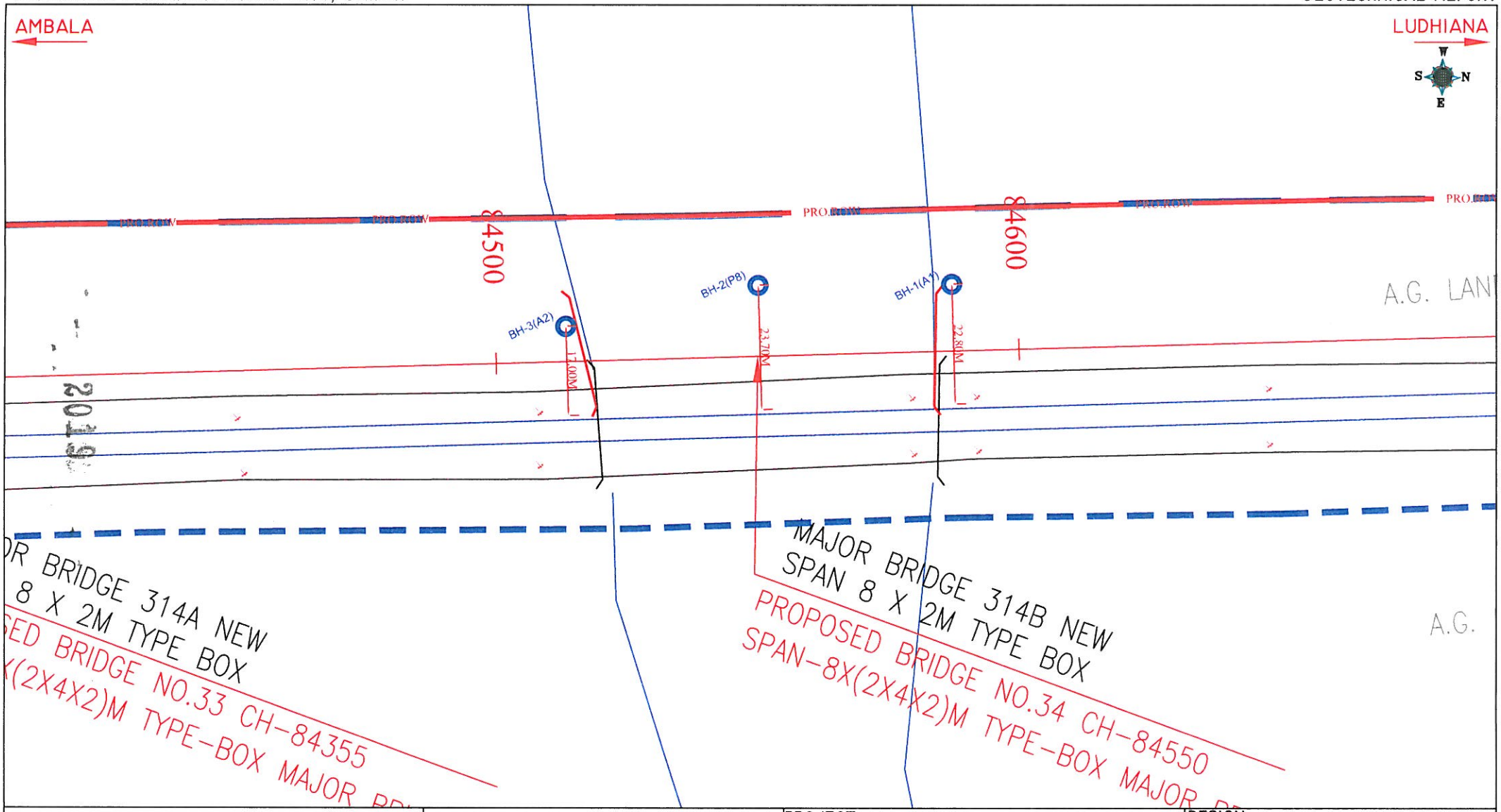
90.8 CONCLUSIONS

- Subsurface Profiles indicates suitable Soil formation for foundations.
- Chemical contents of Water are within the safe limits for construction purpose.

90.9 RECOMMENDATIONS

(i)	*Type of foundation*	Pile foundation

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 MAJOR BRIDGE CH-275/13-15

RL OF BH (AI) = 265.586
RL OF BH (P8) = 264.870
RL OF BH (A2) = 265.480

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

ANNEXURE - I

SOIL CHARACTERISTICS OF BORE HOLE AT BH-1 (A1) RHS OF MAJOR BRIDGE No. 314B AT CHAINAGE 275/13-15

Project :	Chainage 275/13-15 Bridge No. 314B			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				10.07.2009 to 11.07.2009	A1	1(RHS)	30.00 m.	30.00mtr	265.586

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	-	-	-	Silty Sand	2.15	10.55	85.69	1.25	0.36	0	0	23	NIL	NP	-	-	-	-	-	-
1.50	17	1.50	25.50	Silty Sand	2.32	7.75	89.45	0.37	0.11	0.00	0.00	25	NIL	NP	-	-	-	-	-	-
3.00	UDS	-	-	Silty Sand	2.18	6.07	90.25	0.70	0.25	0.55	0.00	24	NIL	NP	1.66	6.68	1.56	2.67	0.00	26.00
4.50	10	1.10	11.00	Clayey silt with sand	16.36	71.98	10.88	0.52	0.26	0.00	0.00	29	16	13	-	-	-	-	-	-
7.50	12	0.93	11.16	Clayey silt	20.14	76.31	0.70	0.84	0.26	1.75	0.00	35	18	17	-	-	-	-	-	-
10.50	15	0.82	12.30	Clayey silt	18.69	76.26	2.84	0.07	0.55	1.59	0.00	34	18	16	-	-	-	-	-	-
12.00	UDS	-	-	Clayey silt	21.33	75.28	3.39	0.00	0.00	0.00	0.00	36	18	18	1.68	6.22	1.58	2.68	0.21	14.00
13.50	16	0.73	11.68	Clayey silt with sand	16.36	72.18	11.42	0.04	0.00	0.00	0.00	30	16	14	-	-	-	-	-	-
16.50	14	0.66	9.24	Clayey silt with sand	21.20	69.88	4.02	0.86	1.31	2.73	0.00	36	18	18	-	-	-	-	-	-
19.50	16	0.61	9.76	Clayey silt	22.30	72.78	2.05	0.27	0.63	1.97	0.00	38	19	19	-	-	-	-	-	-
21.00	UDS	-	-	Clayey silt	16.25	79.77	1.26	2.36	0.36	0.00	0.00	31	17	14	1.83	10.33	1.66	2.66	0.15	18.00
22.50	12	0.56	6.72	Clayey silt	15.10	79.02	3.11	0.89	1.16	0.72	0.00	32	20	12	-	-	-	-	-	-
24.00	UDS	-	-	Clayey silt	20.33	76.46	1.48	1.49	0.24	0.00	0.00	40	22	18	2.01	18.25	1.70	2.67	0.22	15.00
25.50	30	0.51	15.30	Clayey silt	22.15	75.64	2.08	0.13	0.00	0.00	0.00	38	19	19	-	-	-	-	-	-
28.50	34	0.46	15.64	Clayey silt	19.99	73.27	3.16	0.75	0.59	2.24	0.00	38	21	17	-	-	-	-	-	-
30.00	30	0.44	13.20	Clayey silt	19.21	72.92	4.71	1.80	0.94	0.42	0.00	35	19	16	-	-	-	-	-	-

CONSULTING Engineers Group Ltd.

SOIL CHARACTERISTICS OF BORE HOLE AT BH-2 (P8) RHS OF MAJOR BRIDGE No. 314B AT CHAINAGE 275/13-15

Project :	Chainage 275/13-15 Bridge No. 314B			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				11.07.2009 to 12.07.2009	P8	2(RHS)	30.00 m.	30.00mtr	264.870

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	-	-	-	Silty Sand	2.32	15.29	80.36	1.23	0.25	0.55	0	23	NIL	NP	-	-	-	-	-	-
1.50	11	1.50	16.50	Silty Sand	2.25	11.44	84.77	0.84	0.18	0.52	0.00	25	NIL	NP	-	-	-	-	-	-
3.00	UDS	-	-	Silty sand	2.31	11.49	83.40	0.75	0.25	1.80	0.00	25	NIL	NP	1.62	5.26	1.54	2.66	0.00	26.50
4.50	19	1.10	20.90	Silty sand	3.14	9.70	86.82	0.17	0.07	0.10	0.00	25	NIL	NP	-	-	-	-	-	-
7.50	12	0.93	11.16	Clayey silt with sand	20.10	61.80	13.00	0.40	0.40	4.30	0.00	37	20	17	-	-	-	-	-	-
10.50	15	0.82	12.30	Clayey silt	22.10	77.05	0.80	0.05	0.00	0.00	0.00	38	19	19	-	-	-	-	-	-
12.00	UDS	-	-	Clayey silt	18.95	80.21	0.84	0.00	0.00	0.00	0.00	37	21	16	1.73	6.26	1.63	2.68	0.18	17.00
13.50	18	0.73	13.14	Clayey silt	19.66	77.29	2.95	0.05	0.05	0.00	0.00	36	19	17	-	-	-	-	-	-
16.50	17	0.66	11.22	Clayey silt	18.21	78.52	2.60	0.25	0.42	0.00	0.00	37	22	15	-	-	-	-	-	-
19.50	21	0.60	12.60	Clayey silt	17.99	79.90	1.67	0.07	0.06	0.31	0.00	34	18	16	-	-	-	-	-	-
22.50	26	0.55	14.30	Clayey silt with sand	20.55	51.32	14.97	2.49	1.30	9.37	0.00	39	21	18	-	-	-	-	-	-
24.00	UDS	-	-	clayey silt	19.95	73.78	2.36	2.56	1.35	0.00	0.00	39	22	17	2.01	16.25	1.73	2.67	0.20	15.00
25.50	28	0.50	14.00	clayey silt	18.96	76.74	3.00	0.40	0.50	0.40	0.00	31	15	16	-	-	-	-	-	-
28.50	32	0.46	14.72	clayey silt	22.21	74.29	2.96	0.21	0.33	0.00	0.00	36	17	19	-	-	-	-	-	-
30.00	35	0.44	15.40	clayey silt	23.66	72.28	2.35	0.49	0.33	0.89	0.00	41	2	21	-	-	-	-	-	-

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Engineers Group Ltd.

ANNEXURE - I

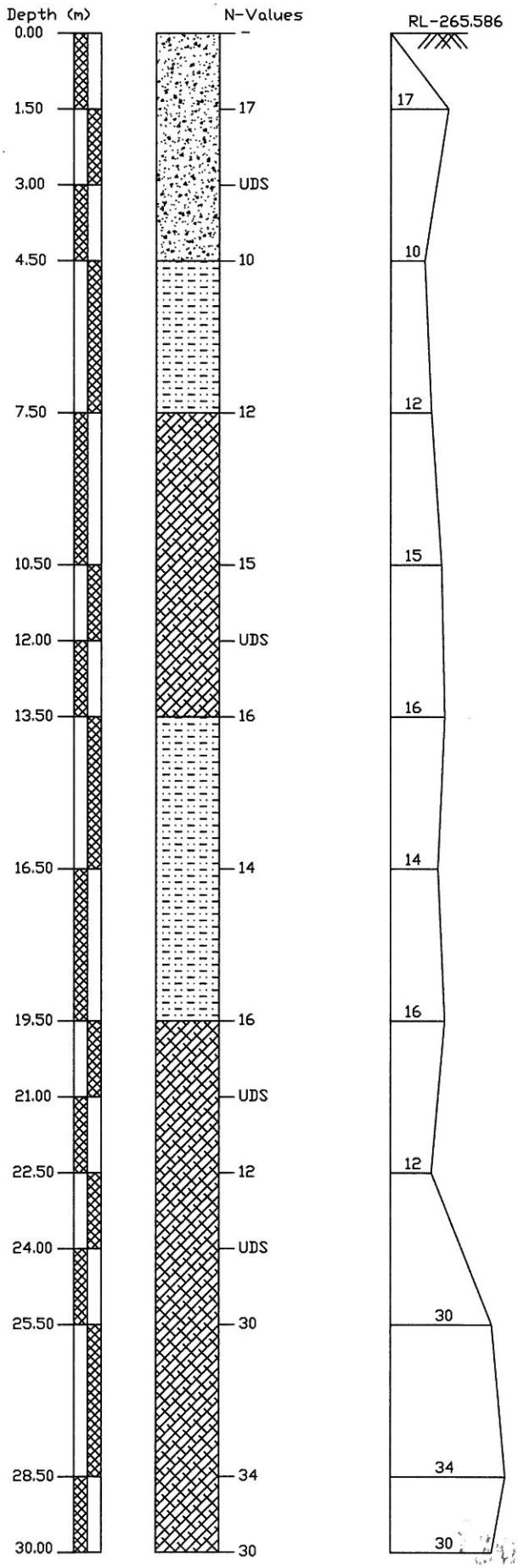
SOIL CHARACTERISTICS OF BORE HOLE AT BH-3 (A2) RHS OF MAJOR BRIDGE No. 314B AT CHAINAGE 275/13-15

Project :	Chainage 275/13-15 Bridge No. 314B			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				12.07.2009 to 13.07.2009	A2	3(RHS)	30.00 m.	30.00mtr	265.480

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	17.56	50.61	30.25	1.23	0.35	0	0	32	17	15	-	-	-	-	-	-
1.50	10	1.51	15.10	Sandy silt with clay	18.21	51.60	29.50	0.48	0.21	0.00	0.00	29	17	12	-	-	-	-	-	-
3.00	UDS	-	-	Silty sand with clay	14.69	13.26	67.40	0.40	1.05	3.20	0.00	30	18	12	1.65	8.65	1.52	2.66	0.13	20.00
4.50	8	1.10	8.80	Clayey silt with sand	20.69	56.51	18.09	1.10	0.43	3.18	0.00	35	17	18	-	-	-	-	-	-
7.50	11	0.93	10.23	Clayey silt with sand	19.88	57.76	17.11	0.41	0.52	4.32	0.00	35	18	17	-	-	-	-	-	-
10.50	13	0.82	10.66	Clayey silt	23.14	75.68	0.78	0.40	0.00	0.00	0.00	39	19	20	-	-	-	-	-	-
12.00	UDS	-	-	Clayey silt	15.21	83.44	0.85	0.50	0.00	0.00	0.00	33	21	12	1.80	8.66	1.66	2.67	0.14	20.00
13.50	16	0.73	11.68	Clayey silt	19.99	75.53	3.08	0.92	0.33	0.15	0.00	35	18	17	-	-	-	-	-	-
16.50	19	0.66	12.54	Clayey silt	20.32	74.68	3.44	0.66	0.60	0.30	0.00	34	17	17	-	-	-	-	-	-
19.50	23	0.60	13.80	Clayey silt	18.95	75.00	4.35	0.25	0.70	0.75	0.00	34	18	16	-	-	-	-	-	-
22.50	27	0.55	14.85	Clayey silt with sand	16.32	60.33	20.65	1.55	1.10	0.05	0.00	28	15	13	-	-	-	-	-	-
24.00	UDS	-	-	Clayey silt with sand	14.66	75.61	5.26	3.25	1.22	0.00	0.00	30	18	12	1.98	15.36	1.72	2.67	0.12	21.00
25.50	32	0.50	16.00	Clayey silt with sand	16.33	66.62	11.70	1.25	0.65	3.45	0.00	29	16	13	-	-	-	-	-	-
28.50	34	0.46	15.64	Clayey silt with sand	25.64	69.05	4.79	0.45	0.07	0.00	0.00	43	20	23	-	-	-	-	-	-
30.00	36	0.44	15.84	Clayey silt with sand	17.89	67.71	8.25	1.30	1.60	3.25	0.00	34	19	15	-	-	-	-	-	-

CONSULTING Engineers Group Ltd.

BORELOG OF BH–1(A1) RHS AT EXISTING KM–275/13–15 FOR MAJOR BRIDGE NO.–314 B,
ON KESARI TO SANEHWAL, LUDHIANA



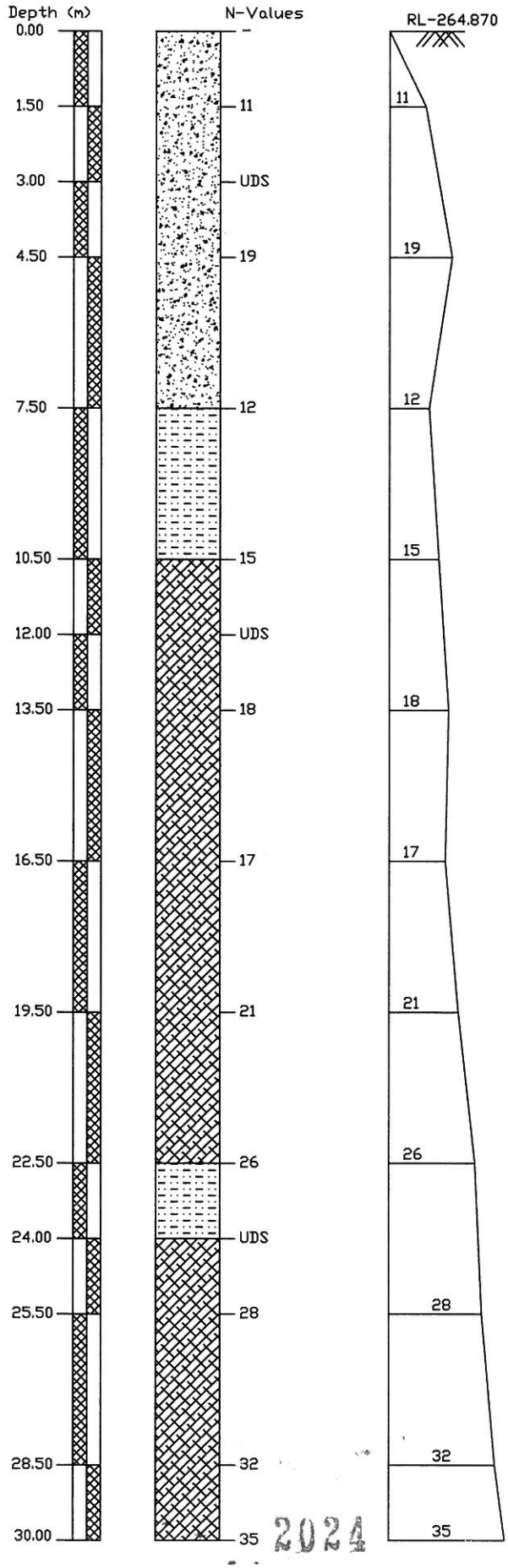
LEGEND

SYMBOL	DESCRIPTION
	SILTY SAND
	CLAYEY SILT WITH SAND
	CLAYEY SILT

2023

CONSULTING Engineers Group Ltd.

BORELOG OF BH–2(P8) RHS AT EXISTING KM–275/13–15 FOR MAJOR BRIDGE NO.–314 B, ON KESARI TO SANEHWAL, LUDHIANA



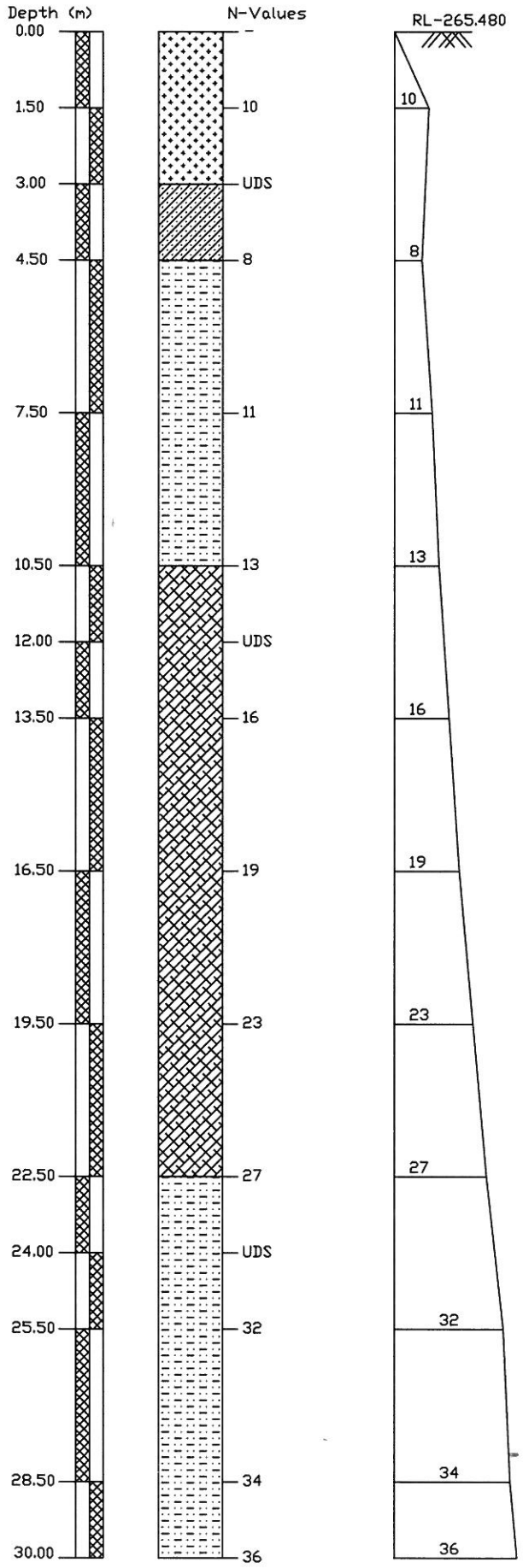
2024

LEGEND

SYMBOL	DESCRIPTION
	SILTY SAND
	CLAYEY SILT WITH SAND
	CLAYEY SILT

CONSULTING Engineers Group Ltd.

BORELOG OF BH–3(A2) RHS AT EXISTING KM–275/13–15 FOR MAJOR BRIDGE NO.–314 B, ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

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

2025

CHAPTER – 91

"Major Bridge No. 314A",

Location – Existing Km. - 275/3-5

91.1 LOCATION OF STRUCTURE:

Proposed Major Bridge of Span 16x4x2

91.2 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 >30.0m below EGL.

Subsurface profile at the site

BOREHOLE No.	Depth (m)	Type of Soil/Rock	Soil/Rock Characteristics
BH-1(A1)	0.00 to 1.50	Silty Sand	Loose
	1.50 to 7.50	Silty Sand	Medium Dense
	7.50 to 12.00	Clayey Silt	Medium Dense
	12.00 to 16.50	Clayey Silt with Sand	Medium Dense
	16.50 to 19.50	Clayey Silt	Medium Dense
	19.50 to 25.50	Clayey Silt with Sand	Medium Dense
	25.50 to 30.0	Clayey Silt with Sand	Very dense
BH-2(P8)	0.00 to 1.50	Silty Sand	Loose
	1.50 to 10.50	Silty Sand	Medium Dense
	10.50 to 28.50	Clayey Silt with Sand	Medium Dense
	28.50 to 30.00	Clayey Silt with Sand	Dense
BH-3(A2)	0.00 to 1.50	Silty Sand	Loose
	1.50 to 12.00	Silty Sand	Medium Dense
	12.00 to 30.00	Clayey Silt with Sand	Medium Dense

91.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1 (A1)	3.00	8.60	0.007	0.0021	NIL	0.0012	0.024
	12.00	8.40	NIL	0.0018	NIL	0.0011	0.041
	24.00	8.50	0.002	0.0021	NIL	0.0012	0.059
BH-2 (P8)	3.00	8.20	NIL	0.0028	NIL	0.0010	0.032
	6.00	7.90	NIL	0.0025	NIL	0.0013	0.039
BH-3 (A2)	3.00	8.70	0.010	0.0021	NIL	0.0011	0.025

91.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1 (A1)	3.00	NIL
	12.00	16.00
	18.00	21.00
	24.00	23.00

2027

BH-2 (P8)	3.00	NIL
	12.00	18.00
	21.00	20.00
BH-3 (A2)	3.00	NIL
	12.00	24.00
	27.00	25.00

91.5 SAFE BEARING CAPACITY t/m²

BH -NO.	DEPTH (mtr)	Net Allowable Bearing Pressure (t/m²)
BH-1 (A1)	1.50m	7.50
	3.00m	14.00
	4.50m	15.00
	6.00m	16.00
BH-3 (A2)	1.50m	5.50
	3.00m	10.50
	4.50m	11.00
	6.00m	12.00

91.6 PILE LOAD CARRYING CAPACITY

91.6.1 Normal Bored Cast in- situ Pile Foundations:

Normal bored cast in situ RCC pile foundation is envisaged for the proposed bridge and have been analysed in the subsequent paragraphs. The Axial load carrying capacity of Pile in Rock is determined as per IRC- 78: 2000 appendix-5.

The safe Load carrying capacities of piles have been worked out on the basis of IRC-78 as per provision/assumptions provided therein.. For calculating designed Capacity of pile recommendation of IS: 2911 should be followed. The minimum factor of safety on ultimate axial capacity should be as per clause 709.3.2 of IRC 78: 2000.The final design/construction of foundations, the safe /allowable load carrying capacity of these piles should be taken by conducting actual initial load tests on these piles casted in the respective area.

Further the piles should have necessary structural strength to transmit/sustain the design load.

Pile load carrying capacity in t

BH -NO.	PILE DEPTH (mtr)	PILE CARRYING CAPACITY IN TONNE	
		Pile Diameter= 1.0 m	Pile Diameter= 1.2 m
BH-1 (A1)	17.00	90.00	110.00
	20.00	120.00	150.00
	23.00	160.00	190.00
BH-2 (P8)	17.00	80.00	100.00
	20.00	100.00	130.00
	23.00	130.00	160.00
BH-3 (A2)	17.00	80.00	100.00
	20.00	110.00	140.00
	23.00	130.00	160.00

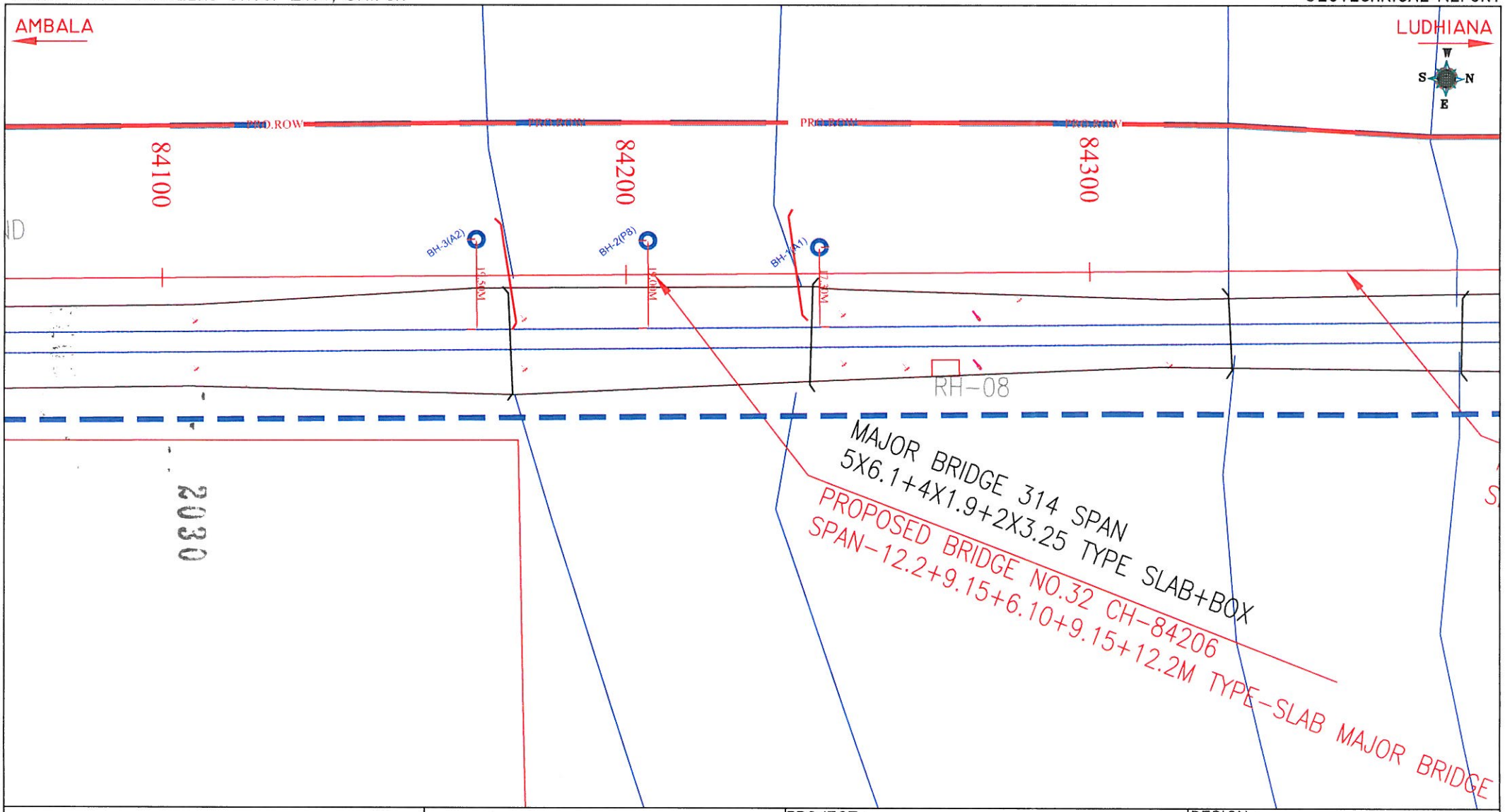
91.7 CONCLUSIONS

- Subsurface Profiles indicates suitable Soil formation for foundations.

91.8 RECOMMENDATIONS

(i)	*Type of foundation*	Pile foundation

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 MAJOR BRIDGE CH-275/3-5	RL OF BH (A1) = 265.114 RL OF BH (P8) = 265.441 RL OF BH (A2) = 265.145	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 (A1) RHS OF MAJOR BRIDGE No. 314A AT CHAINAGE 275/3-5

Project :	Chainage 275/3-5 Bridge No. 314A			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				13.07.2009 to 14.07.2009	A1	1(RHS)	Below 30.00 m.	30.00mtr	265.114

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	2.14	15.09	78.23	2.1	1.22	1.22	0	22	NIL	NP	-	-	-	-	-	-
1.50	14	1.51	21.14	Silty Sand	2.33	16.59	75.38	1.58	0.32	1.29	2.51	26	NIL	NP	-	-	-	-	-	-
3.00	UDS	-	-	Silty Sand	2.34	7.16	90.15	0.35	0.00	0.00	0.00	25	NIL	NP	1.64	5.26	1.56	2.67	0.00	26.00
4.50	19	1.10	20.90	Silty Sand	2.16	6.13	87.36	4.21	0.14	0.00	0.00	25	NIL	NP	-	-	-	-	-	-
7.50	18	0.93	16.74	Clayey silt	18.66	76.43	1.82	0.62	0.29	2.18	0.00	34	18	16	-	-	-	-	-	-
10.50	12	0.82	9.84	Clayey silt	16.33	72.89	6.11	0.61	0.54	3.52	0.00	31	17	14	-	-	-	-	-	-
12.00	UDS	-	-	Clayey silt with sand	15.22	75.01	8.82	0.29	0.66	0.00	0.00	30	18	12	1.91	12.41	1.70	2.68	0.12	21.00
13.50	17	0.72	12.24	Clayey silt with sand	14.63	42.82	42.45	0.05	0.05	0.00	0.00	29	17	12	-	-	-	-	-	-
16.50	15	0.65	9.75	Clayey silt	18.22	76.62	2.79	0.73	1.29	0.35	0.00	35	20	15	-	-	-	-	-	-
18.00	UDS	-	-	Clayey silt	19.21	77.89	1.46	0.14	0.56	0.74	0.00	36	20	16	1.91	12.33	1.70	2.68	0.18	17.00
19.50	18	0.59	10.62	Clayey silt with sand	18.86	65.63	13.98	0.13	0.44	0.96	0.00	33	17	16	-	-	-	-	-	-
22.50	22	0.54	11.88	Clayey silt with sand	17.56	59.89	21.80	0.35	0.40	0.00	0.00	33	18	15	-	-	-	-	-	-
24.00	UDS	-	-	Clayey silt with sand	17.22	73.82	6.91	0.96	1.09	0.00	0.00	35	20	15	1.98	15.22	1.72	2.67	0.17	18.00
25.50	38	0.49	18.62	Clayey silt with sand	21.10	73.06	5.49	0.33	0.02	0.00	0.00	37	19	18	-	-	-	-	-	-
28.50	42	0.45	18.90	Clayey silt with sand	17.56	71.58	7.00	1.82	1.59	0.45	0.00	32	17	15	-	-	-	-	-	-
30.00	45	0.43	19.35	Clayey silt with sand	19.11	69.34	7.00	1.45	1.99	1.11	0.00	32	16	16	-	-	-	-	-	-

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ANNEXURE - I

SOIL CHARACTERISTICS OF BORE HOLE AT BH-2 (P8) OF MAJOR BRIDGE No. 314A AT CHAINAGE 275/3-5

Project :	Chainage 275/3-5 Bridge No. 314A			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				14.07.2009 to 15.07.2009	P8	2	Below 30.00 m.	30.00mtr	265.441

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	2.14	13.61	80.23	3.25	0.56	0.21	0	20	NIL	NP	-	-	-	-	-	-
1.50	12	1.46	17.52	Silty Sand	2.33	13.77	79.75	2.60	0.75	0.80	0.00	22	NIL	NP	-	-	-	-	-	-
3.00	UDS	-	-	Silty Sand	2.46	17.27	78.56	1.26	0.45	0.00	0.00	23	NIL	NP	1.68	10.22	1.52	2.66	0.00	26.50
4.50	17	1.10	18.70	Silty Sand	2.62	10.23	82.63	2.22	0.26	2.04	0.00	25	NIL	NP	-	-	-	-	-	-
7.50	17	0.92	15.64	Silty Sand	2.51	39.62	56.06	0.17	0.04	1.60	0.00	25	NIL	NP		-	-	-	-	-
10.50	8	0.81	6.48	Clayey silt with sand	20.39	74.22	5.15	0.06	0.18	0.00	0.00	35	17	18	-	-	-	-	-	-
12.00	UDS	-	-	Clayey silt with sand	17.56	68.19	8.20	1.65	2.15	2.25	0.00	33	18	15	1.82	10.22	1.65	2.66	0.16	17.00
13.50	12	0.72	8.64	Clayey silt with sand	20.21	72.14	4.25	1.25	1.30	0.85	0.00	35	18	17	-	-	-	-	-	-
16.50	16	0.65	10.40	Clayey silt with sand	22.15	64.83	9.25	0.78	1.37	1.62	0.00	38	19	19	-	-	-	-	-	-
19.50	18	0.59	10.62	Clayey silt with sand	19.32	67.33	12.10	0.75	0.35	0.15	0.00	34	17	17	-	-	-	-	-	-
21.00	UDS	-	-	Clayey silt with sand	18.11	69.38	10.12	1.22	0.65	0.52	0.00	35	20	15	1.99	15.21	1.73	2.65	0.17	16.00
22.50	21	0.54	11.34	Clayey silt with sand	14.56	75.94	7.30	1.10	0.50	0.60	0.00	29	17	12	-	-	-	-	-	-
25.50	28	0.49	13.72	Clayey silt with sand	20.33	66.62	4.85	1.85	2.85	3.50	0.00	35	17	18	-	-	-	-	-	-
28.50	37	0.45	16.65	Clayey silt with sand	19.58	67.92	5.10	2.40	2.40	2.60	0.00	34	17	17	-	-	-	-	-	-
30.00	43	0.43	18.49	Clayey silt with sand	18.59	72.29	4.88	1.38	1.35	1.51	0.00	34	18	16	-	-	-	-	-	-

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SOIL CHARACTERISTICS OF BORE HOLE AT BH-3 (A2) RHS OF MAJOR BRIDGE No. 314A AT CHAINAGE 275/3-5

Project :	Chainage 275/3-5 Bridge No. 314A			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				14.07.2009 to 15.07.2009	A2	3	Below 30.00 m.	30.00mtr	265.145

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	-	-	-	Silty Sand	2.14	25.91	70.25	1.21	0.16	0.33	0	20	NIL	NP	-	-	-	-	-	-
1.50	14	1.52	21.28	Silty Sand	2.66	23.89	71.68	1.21	0.19	0.37	0.00	27	NIL	NP	-	-	-	-	-	-
3.00	UDS	-	-	Silty Sand	2.15	12.30	81.40	0.35	0.05	3.75	0.00	25	NIL	NP	1.61	6.22	1.52	2.66	0.00	26.50
4.50	12	1.11	13.32	Silty Sand	4.58	86.13	3.20	0.74	0.77	4.58	0.00	29	NIL	NP	-	-	-	-	-	-
7.50	17	0.94	15.98	Silty Sand	2.15	19.20	74.25	2.60	0.55	1.25	0.00	23	NIL	NP	-	-	-	-	-	-
10.50	21	0.83	17.43	Silty Sand	3.15	23.85	69.72	1.37	0.46	1.45	0.00	25	NIL	NP	-	-	-	-	-	-
12.00	UDS	-	-	Clayey silt with sand	18.65	75.40	5.10	0.60	0.25	0.00	0.00	33	19	16	1.70	6.25	1.60	2.65	0.17	17.00
13.50	14	0.74	10.36	Clayey silt with sand	18.54	76.85	4.47	0.14	0.00	0.00	0.00	37	21	16	-	-	-	-	-	-
16.50	17	0.67	11.39	Clayey silt with sand	20.11	72.64	4.25	1.60	1.15	0.25	0.00	34	17	17	-	-	-	-	-	-
19.50	15	0.61	9.15	Clayey silt with sand	16.89	64.97	12.71	1.20	2.14	2.09	0.00	30	16	14	-	-	-	-	-	-
22.50	18	0.56	10.08	Clayey silt with sand	18.55	61.97	13.97	0.87	1.67	2.97	0.00	32	16	16	-	-	-	-	-	-
25.50	25	0.52	13.00	Clayey silt with sand	20.66	58.30	15.60	0.76	0.97	3.71	0.00	36	18	18	-	-	-	-	-	-
27.00	UDS	-	-	Clayey silt with sand	20.88	64.35	14.26	0.25	0.26	0.00	0.00	36	18	18	2.03	17.25	1.73	2.65	0.21	13.00
28.50	29	0.47	13.63	Clayey silt with sand	23.11	67.27	7.24	0.65	0.28	1.45	0.00	40	20	20	-	-	-	-	-	-
30.00	38	0.45	17.10	Clayey silt with sand	22.85	63.30	11.85	0.55	0.20	1.25	0.00	38	18	20	-	-	-	-	-	-

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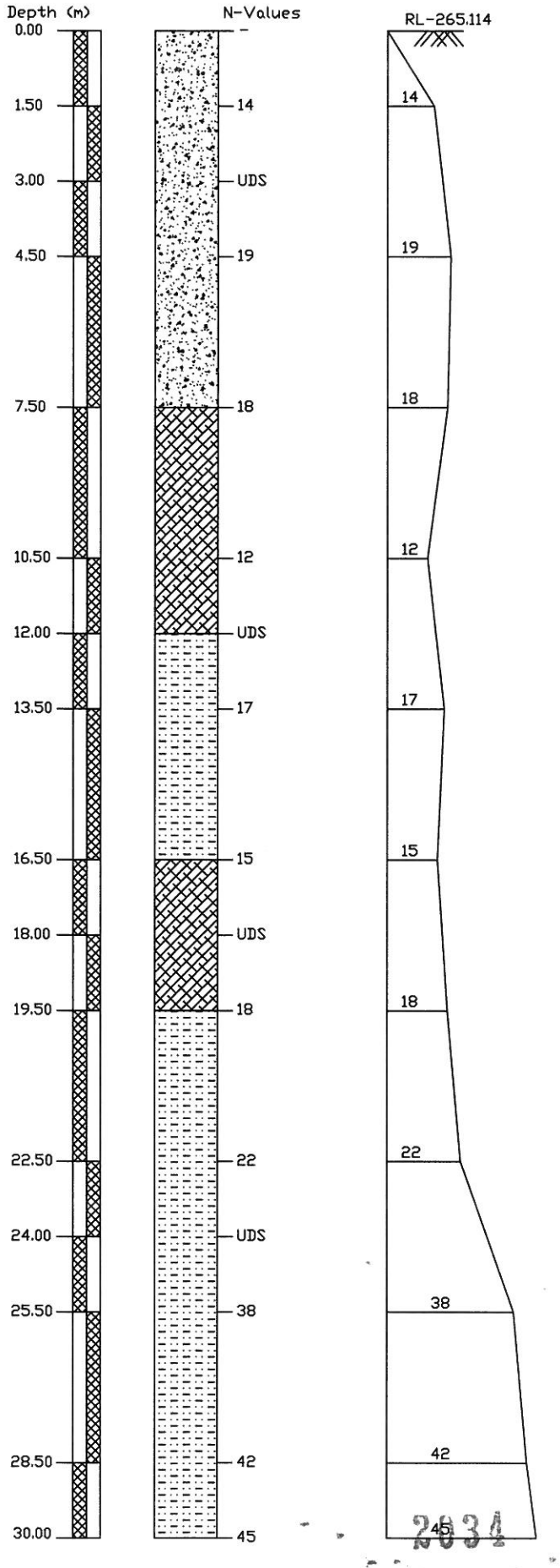
BORELOG OF BH–1(A1) RHS AT EXISTING KM–275/3–5 FOR MAJOR BRIDGE NO.–314 A,
ON KESARI TO SANEHWAL, LUDHIANA



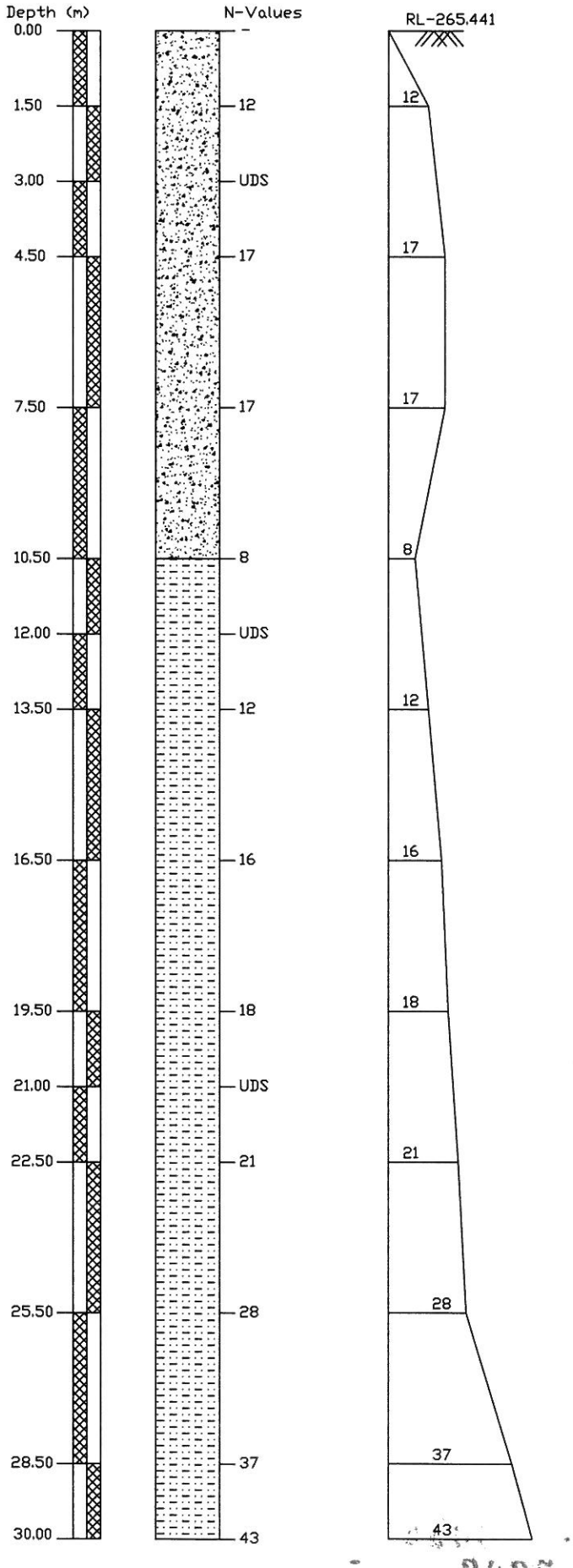
LEGEND

SYMBOL	DESCRIPTION
	SILTY SAND
	CLAYEY SILT
	CLAYEY SILT WITH SAND

2031

CONSULTING Engineers Group Ltd

BORELOG OF BH-2(P8) AT EXISTING KM-275/3-5 FOR MAJOR BRIDGE NO.- 314 A,
ON KESARI TO SANEHWAL, LUDHIANA



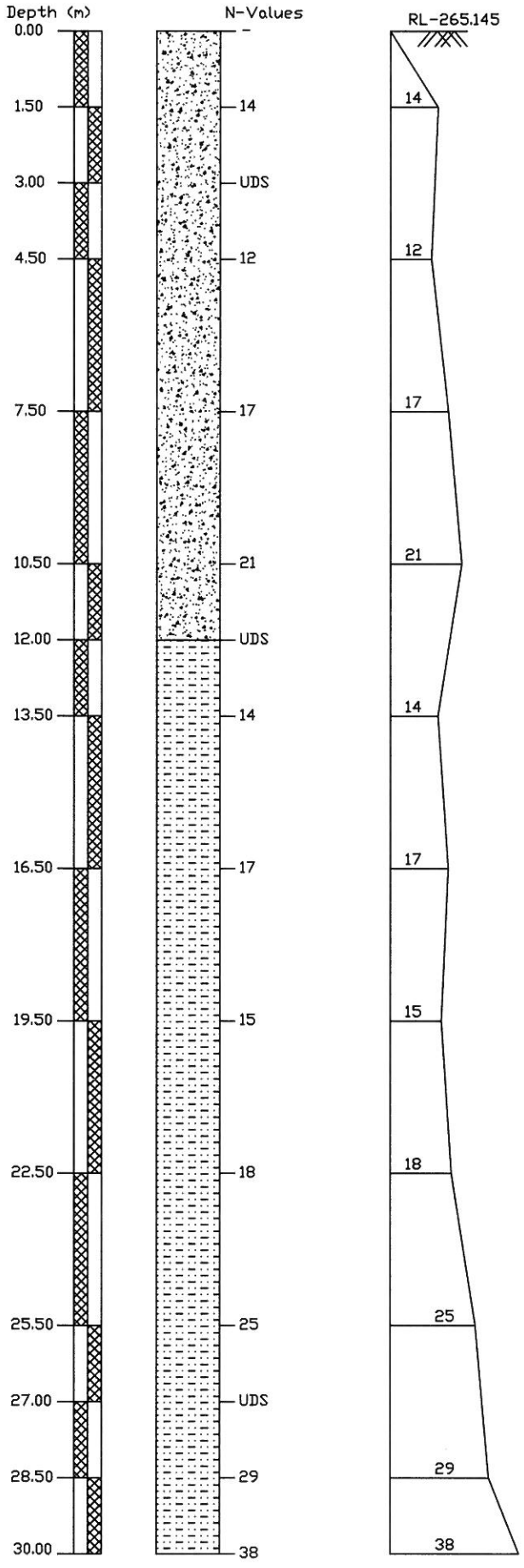
LEGEND

SYMBOL	DESCRIPTION
	SILTY SAND
	CLAYEY SILT WITH SAND

2035

CONSULTING Engineers Group Ltd.

BORELOG OF BH–3(A2) RHS AT EXISTING KM–275/3–5 FOR MAJOR BRIDGE NO.–314 A, ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

SYMBOL	DESCRIPTION
	SILTY SAND
	CLAYEY SILT WITH SAND

2036

CONSULTING Engineers Group Ltd.

CHAPTER – 92

"Major Bridge No. 313",

Location – Existing Km. - 273/21-29

92.1 LOCATION OF STRUCTURE:

Proposed Major Bridge of Span 6x30.5

92.2 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 6.80m below EGL.

Subsurface profile at the site

BOREHOLE No.	Depth (m)	Type of Soil/Rock	Soil/Rock Characteristics
BH-1(A1)	0.00 to 3.00	Silty Sand	Loose
	3.00 to 4.50	Sandy Silt	Medium Dense
	4.50 to 7.50	Silty Sand	Medium Dense
	7.50 to 13.50	Clayey Silt	Medium Dense
	13.50 to 16.50	Clayey Silt with Sand	Medium Dense
	16.50 to 22.50	Clayey Silt	Medium Dense
	22.50 to 25.50	Clayey Silt with Sand	Medium Dense
	25.50 to 30.00	Clayey Silt	Medium Dense
BH-2(P3)	0.00 to 1.50	Silty Sand	Loose
	1.50 to 4.50	Silty Sand	Medium Dense
	4.50 to 12.00	Clayey Silt with Sand	Medium Dense
	12.00 to 13.50	Clayey Silt	Medium Dense
	13.50 to 16.50	Clayey Silt with Sand	Medium Dense
	16.50 to 19.50	Clayey Silt	Medium Dense
	19.50 to 30.00	Clayey Silt with Sand	Medium Dense
BH-3(A2)	0.00 to 1.50	Silty Sand	Loose
	1.50 to 7.50	Silty Sand	Medium Dense
	7.50 to 12.00	Clayey Silt with Sand	Medium Dense
	12.00 to 19.50	Sandy Silt with Clay	Medium Dense
	19.50 to 30.00	Clayey Silt with Sand	Medium Dense

92.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH 1 (A1)	3.00	7.90	NIL	0.0035	NIL	0.0013	0.073
	12.00	8.40	NIL	0.0021	NIL	0.0010	0.044
	24.00	8.50	0.002	0.0018	NIL	0.0012	0.040
BH 2 (P3)	3.00	8.40	NIL	0.0024	NIL	0.0011	0.034
	12.00	8.30	NIL	0.0014	NIL	0.0011	0.032
BH 3 (A2)	3.00	8.30	NIL	0.0014	NIL	0.0013	0.024
	12.00	8.20	NIL	0.0011	NIL	0.0010	0.032

92.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1 (A1)	3.00	NIL
	12.00	23.00
	18.00	24.00
	24.00	21.00
BH-2 (P3)	3.00	NIL
	12.00	20.00
	21.00	22.00
BH-3 (A2)	3.00	NIL
	12.00	12.00
	27.00	28.00

92.5 CHEMICAL ANALYSIS OF ENCOUNTERED WATER FROM BORE HOLE

Chemical Properties	pH Value	Chlorides mg/lit	Sulphate mg/lit	Organic Matter mg/lit	Inorganic Matter mg/lit	Acidity (ml)	Alkalinity (ml)	Total Disso. Solids (ppm)	Conductivity (µS/cm)
Test Result	7.6	120	85	183	450	0.2	2.0	660	425
Requirement as per IS: 456 / Mosrth's	Not less then 6.0	2000 for CC and 500 for RCC	400	200	3000	5 ml of 0.02 normal NaoH	25 ml of 0.02 normal H_2SO_4	-	-

92..6 SAFE BEARING CAPACITY t/m²

BH -NO.	DEPTH (mtr)	Net Allowable Bearing Pressure (t/m²)
BH-1 (A1)	1.50m	5.00
	3.00m	9.50
	4.50m	10.00
	6.00m	11.00
BH-3 (A2)	1.50m	7.50
	3.00m	11.00
	4.50m	12.00
	6.00m	12.50

92.6 PILE LOAD CARRYING CAPACITY

92.6.1 Normal Bored Cast in- situ Pile Foundations:

Normal bored cast in situ RCC pile foundation is envisaged for the proposed bridge and have been analysed in the subsequent paragraphs. The Axial load carrying capacity of Pile in Rock is determined as per IRC- 78: 2000 appendix-5.

The safe Load carrying capacities of piles have been worked out on the basis of IRC-78 as per provision/assumptions provided therein.. For calculating designed Capacity of pile recommendation of IS: 2911 should be followed. The minimum factor of safety on ultimate axial capacity should be as per clause 709.3.2 of IRC 78: 2000.The final design/construction of foundations, the safe /allowable load carrying capacity of these piles should be taken by conducting actual initial load tests on these piles casted in the respective area.

Further the piles should have necessary structural strength to transmit/sustain the design load.

Pile load carrying capacity in t

BH -NO.	PILE DEPTH (mtr)	PILE CARRYING CAPACITY IN TONNE	
		Pile Diameter= 1.0 m	Pile Diameter= 1.2 m
BH-1 (A1)	17.00	90.00	110.00
	20.00	120.00	150.00
	23.00	160.00	190.00
BH-2 (P3)	17.00	90.00	110.00
	20.00	110.00	140.00
	23.00	150.00	180.00
BH-3 (A2)	17.00	100.00	120.00
	20.00	120.00	150.00
	23.00	150.00	180.00

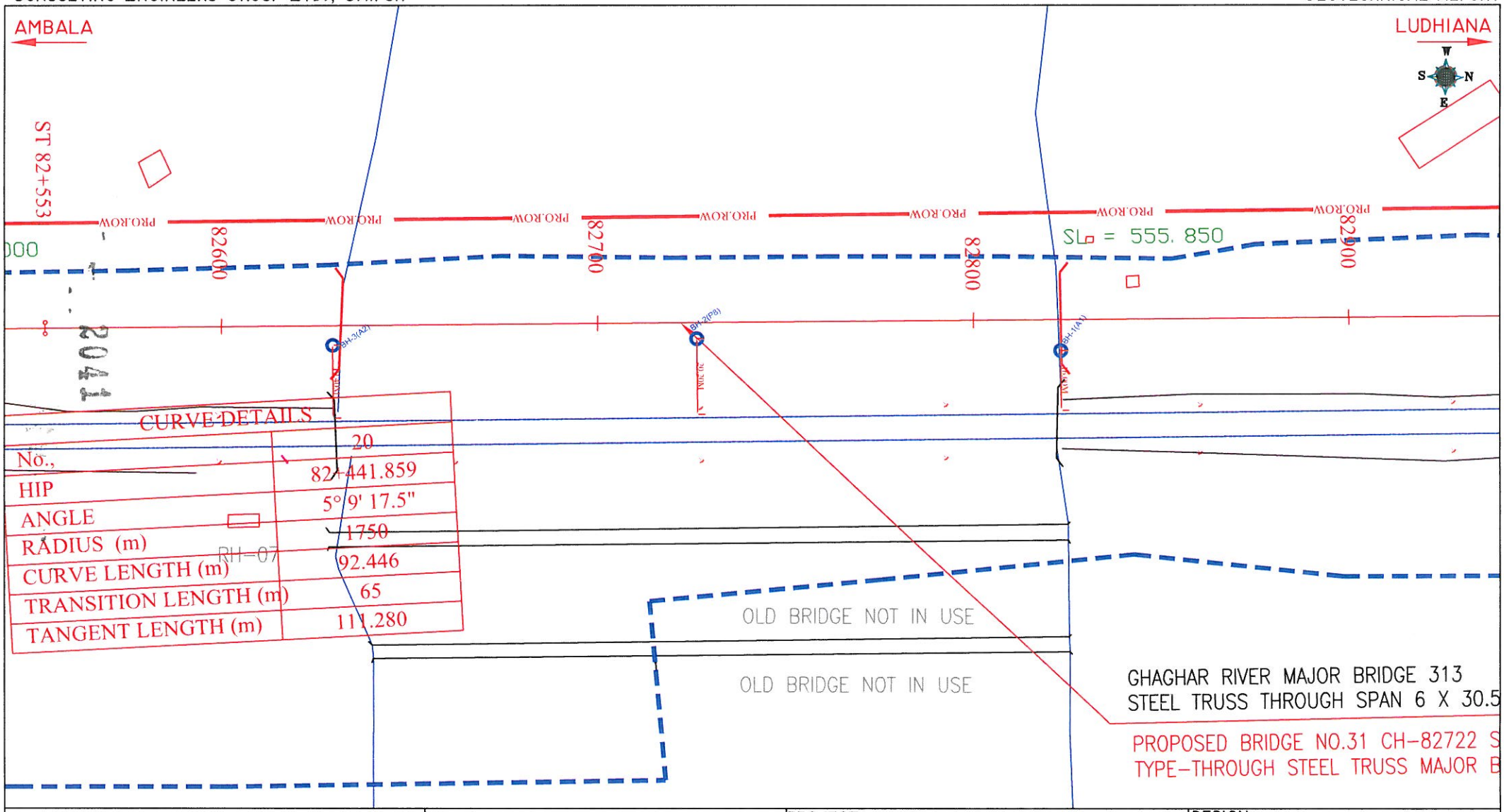
92.7 CONCLUSIONS

- Subsurface Profiles indicates suitable Soil formation for foundations.
- Chemical contents of Water are within the safe limits for construction purpose.

92.8 RECOMMENDATIONS

(i)	*Type of foundation*	Pile foundation

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 MAJOR BRIDGE
CH-273/21-29

RL OF BH (A1) = 268.118
RL OF BH (P3) = 261.568
RL OF BH (A2) = 267.651

PROJECT :-
LUDHIANA-AMBALA (DFCCIL)

DESIGN :-
CONSULTING
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E-12,Moji Colony,Malviya Nagar Jaipur-17
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SOIL CHARACTERISTICS OF BORE HOLE AT BH-1 (A1) RHS OF MAJOR BRIDGE No. 313 AT CHAINAGE 273/21-29

Project :	Chainage 273/21-29 Bridge No. 313			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				16.07.2009 to 17.07.2009	A1	1(RHS)	06.80 m.	30.00mtr	268.118

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	2.18	44.56	50.23	1.2	0.62	1.21	0.00	23	NIL	NP	-	-	-	-	-	-
1.50	7	1.51	10.57	Silty Sand	2.16	43.74	53.50	0.05	0.05	0.50	0.00	24	NIL	NP	-	-	-	-	-	-
3.00	UDS	-	-	Sandy Silt	2.59	58.28	39.03	0.10	0.00	0.00	0.00	25	NIL	NP	1.62	6.58	1.52	2.67	0.00	25.00
4.50	15	1.11	16.65	Silty Sand	2.00	27.55	70.05	0.25	0.15	0.00	0.00	21	NIL	NP	-	-	-	-	-	-
7.50	12	0.94	11.28	Clayey silt	18.86	74.84	4.05	0.20	0.05	2.00	0.00	35	19	16	-	-	-	-	-	-
10.50	15	0.82	12.30	Clayey silt	20.11	77.19	1.70	0.50	0.15	0.35	0.00	38	21	17	-	-	-	-	-	-
12.00	UDS	-	-	Clayey silt	20.98	74.21	3.25	0.20	0.76	0.60	0.00	41	22	19	1.88	18.95	1.58	2.66	0.24	13.00
13.50	18	0.73	13.14	Clayey silt with sand	17.85	70.30	10.30	0.60	0.50	0.45	0.00	35	20	15	-	-	-	-	-	-
16.50	21	0.65	13.65	Clayey silt	19.21	76.94	3.80	0.05	0.00	0.00	0.00	34	18	16	-	-	-	-	-	-
18.00	UDS	-	-	Clayey silt	16.85	78.52	2.56	1.23	0.25	0.59	0.00	34	19	15	2.06	21.22	1.70	2.68	0.16	17.00
19.50	24	0.59	14.16	Clayey silt	16.62	81.33	2.00	0.05	0.00	0.00	0.00	33	19	14	-	-	-	-	-	-
22.50	27	0.53	14.31	Clayey silt with sand	22.88	67.72	7.40	1.00	0.40	0.60	0.00	41	21	20	-	-	-	-	-	-
24.00	UDS	-	-	Clayey silt with sand	18.12	74.67	4.06	1.95	1.20	0.00	0.00	33	18	15	2.07	20.36	1.72	2.67	0.16	17.00
25.50	23	0.49	11.27	Clayey silt	26.58	71.17	1.55	0.20	0.50	0.00	0.00	45	21	24	-	-	-	-	-	-
28.50	25	0.44	11.00	Clayey silt	24.85	73.65	1.45	0.05	0.00	0.00	0.00	43	21	22	-	-	-	-	-	-
30.00	27	0.42	11.34	Clayey silt	21.12	77.68	1.15	0.05	0.00	0.00	0.00	39	20	19	-	-	-	-	-	-

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ANNEXURE - I

SOIL CHARACTERISTICS OF BORE HOLE AT BH-2 (P3) RHS OF MAJOR BRIDGE No. 313 AT CHAINAGE 273/21-29

Project :	Chainage 273/21-29 Bridge No. 313			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				17.07.2009 to 18.07.2009	P3	2(RHS)	06.50 m.	30.00mtr	261.568

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	-	-	-	Silty Sand	2.00	5.40	80.55	6.33	1.22	4.5	0.00	22	NIL	NP	-	-	-	-	-	-
1.50	12	1.51	18.12	Silty Sand	2.11	6.24	82.15	5.70	1.35	2.45	0.00	23	NIL	NP	-	-	-	-	-	-
3.00	UDS	-	-	Silty Sand	3.95	7.55	84.50	0.25	0.55	3.20	0.00	26	NIL	NP	1.65	8.59	1.52	2.67	0.00	26.00
4.50	10	1.10	11.00	Clayey silt with sand	23.56	65.34	8.45	0.80	0.95	0.90	0.00	39	18	21	-	-	-	-	-	-
7.50	13	0.93	12.09	Clayey silt with sand	12.66	80.54	5.65	0.30	0.25	0.60	0.00	30	20	10		-	-	-	-	-
10.50	14	0.82	11.48	Clayey silt with sand	21.59	69.26	9.05	0.05	0.05	0.00	0.00	29	20	19	-	-	-	-	-	-
12.00	UDS	-	-	Clayey silt	20.10	79.27	0.58	0.05	0.00	0.00	0.00	37	20	17	1.97	18.52	1.66	2.67	0.20	16.00
13.50	17	0.72	12.24	Clayey silt with sand	21.23	67.57	7.75	1.20	1.00	1.25	0.00	38	19	19	-	-	-	-	-	-
16.50	19	0.64	12.16	Clayey silt	27.85	69.60	2.20	0.20	0.05	0.10	0.00	45	20	25	-	-	-	-	-	-
19.50	24	0.58	13.92	Clayey silt with sand	20.68	69.47	4.95	1.15	1.55	2.20	0.00	38	20	18	-	-	-	-	-	-
21.00	UDS	-	-	Clayey silt with sand	17.55	71.49	5.22	1.62	2.12	2.00	0.00	35	20	15	2.09	20.33	1.74	2.66	0.17	17.00
22.50	26	0.53	13.78	Clayey silt with sand	18.95	73.50	4.85	1.05	0.70	0.95	0.00	34	18	16	-	-	-	-	-	-
25.50	31	0.48	14.88	Clayey silt with sand	20.12	69.73	7.85	1.15	1.10	0.05	0.00	35	18	17	-	-	-	-	-	-
28.50	26	0.44	11.44	Clayey silt with sand	22.83	66.22	7.45	1.70	1.20	0.60	0.00	39	19	20	-	-	-	-	-	-
30.00	29	0.42	12.18	Clayey silt with sand	21.36	71.34	5.85	0.65	0.45	0.35	0.00	39	20	19	-	-	-	-	-	-

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SOIL CHARACTERISTICS OF BORE HOLE AT BH-3 (A2) RHS OF MAJOR BRIDGE No. 313 AT CHAINAGE 273/21-29

Project :	Chainage 273/21-29 Bridge No. 313			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				18.07.2009 to 19.07.2009	A2	2(RHS)	09.00 m.	30.00mtr	267.651

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	2.45	38.88	56.25	1.21	0.86	0.35	0	23	NIL	NP	-	-	-	-	-	-
1.50	11	1.46	16.06	Silty Sand	4.69	40.41	53.75	0.70	0.35	0.10	0.00	28	NIL	NP	-	-	-	-	-	-
3.00	UDS	-	-	Silty Sand	2.00	38.68	59.32	0.00	0.00	0.00	0.00	19	NIL	NP	1.68	8.56	1.55	2.67	0.00	26.50
4.50	14	1.10	15.40	Silty Sand	2.10	12.35	83.80	1.50	0.25	0.00	0.00	22	NIL	NP	-	-	-	-	-	-
7.50	17	0.92	15.64	Clayey silt with sand	20.88	64.82	4.35	2.45	3.10	4.40	0.00	37	19	18		-	-	-	-	-
10.50	18	0.81	14.58	Clayey silt with sand	18.59	61.06	19.45	0.50	0.25	0.15	0.00	34	18	16	-	-	-	-	-	-
12.00	UDS	-	-	Sandy silt with clay	12.10	55.47	32.00	0.26	0.17	0.00	0.00	30	21	9	1.95	20.36	1.62	2.66	0.10	21.00
13.50	20	0.72	14.40	Sandy silt with clay	16.58	56.32	23.90	2.25	0.40	0.55	0.00	29	15	14	-	-	-	-	-	-
16.50	16	0.64	10.24	Sandy silt with clay	18.10	58.65	20.65	2.15	0.45	0.00	0.00	32	17	15	-	-	-	-	-	-
19.50	18	0.58	10.44	Clayey silt with sand	19.65	60.15	17.70	1.55	0.50	0.45	0.00	35	18	17	-	-	-	-	-	-
22.50	22	0.53	11.66	Clayey silt with sand	22.85	64.50	8.65	1.05	1.10	1.85	0.00	40	20	20	-	-	-	-	-	-
25.50	25	0.49	12.25	Clayey silt with sand	23.62	67.23	6.35	0.95	0.75	1.10	0.00	39	18	21	-	-	-	-	-	-
27.00	UDS	-	-	Clayey silt with sand	22.15	69.41	5.26	1.29	0.66	1.23	0.00	40	20	20	2.06	21.22	1.70	2.67	0.24	12.00
28.50	25	0.44	11.00	Clayey silt with sand	23.10	67.55	7.25	0.80	0.70	0.60	0.00	39	19	20	-	-	-	-	-	-
30.00	30	0.42	12.60	Clayey silt with sand	21.10	71.85	5.45	0.80	0.70	0.10	0.00	37	18	19	-	-	-	-	-	-

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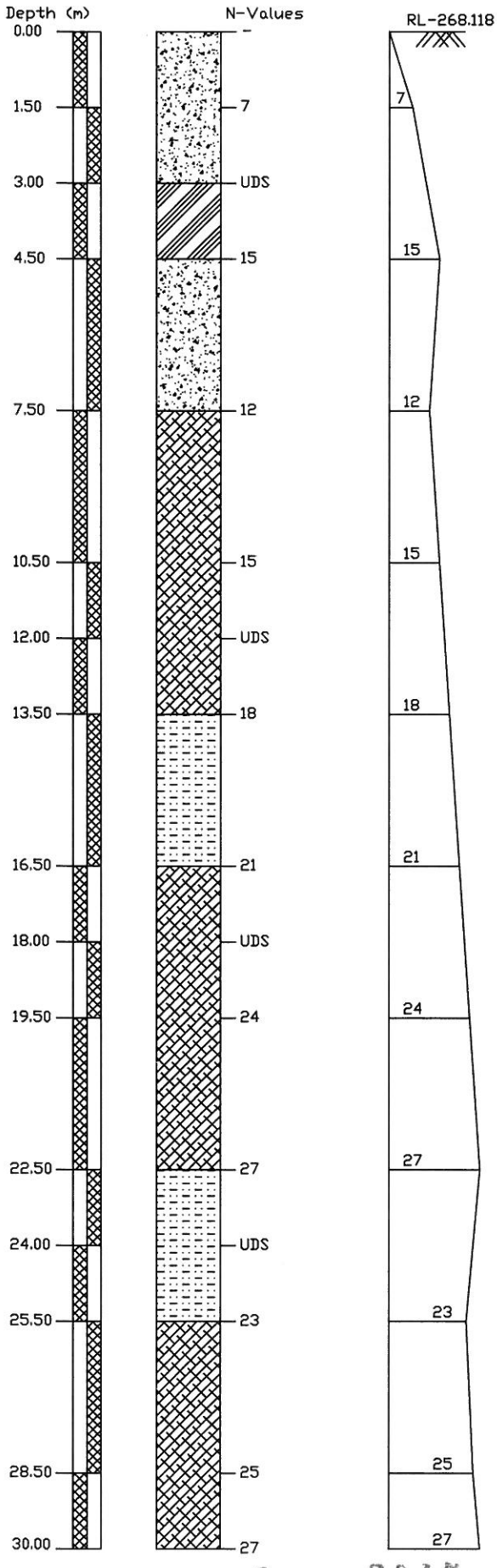
BORELOG OF BH–1(A1) RHS AT EXISTING KM–273/21–29 FOR MAJOR BRIDGE NO.–313, ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

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

2045

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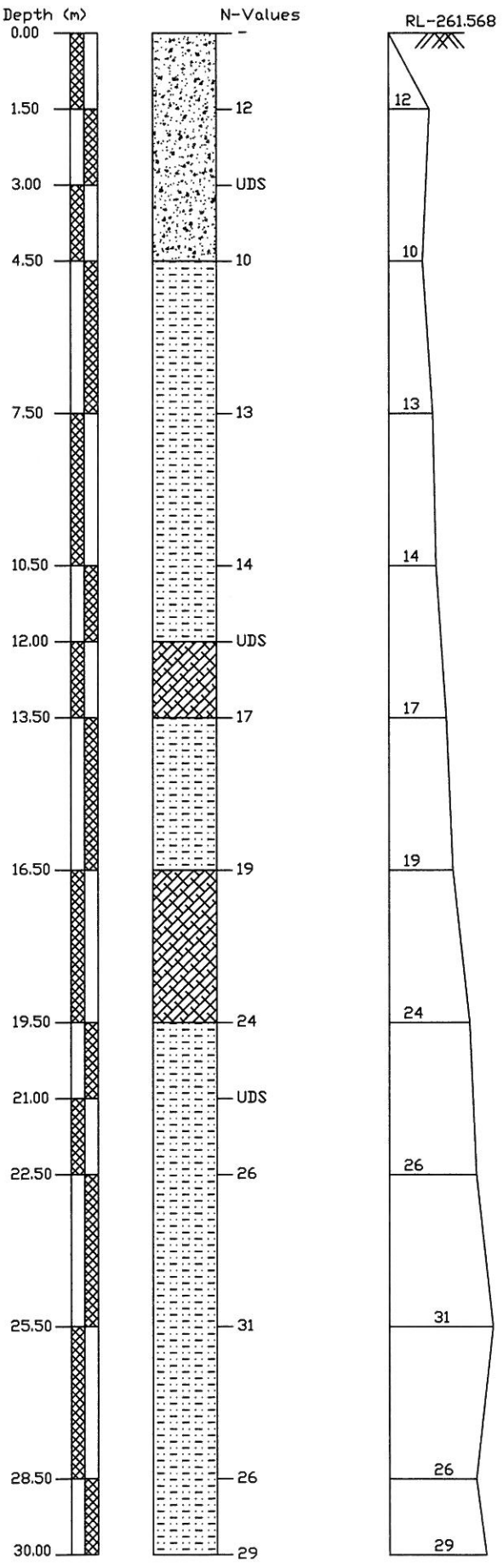
BORELOG OF BH–2(P3) RHS AT EXISTING KM–273/21–29 FOR MAJOR BRIDGE NO.–313,
ON KESARI TO SANEHWAL, LUDHIANA



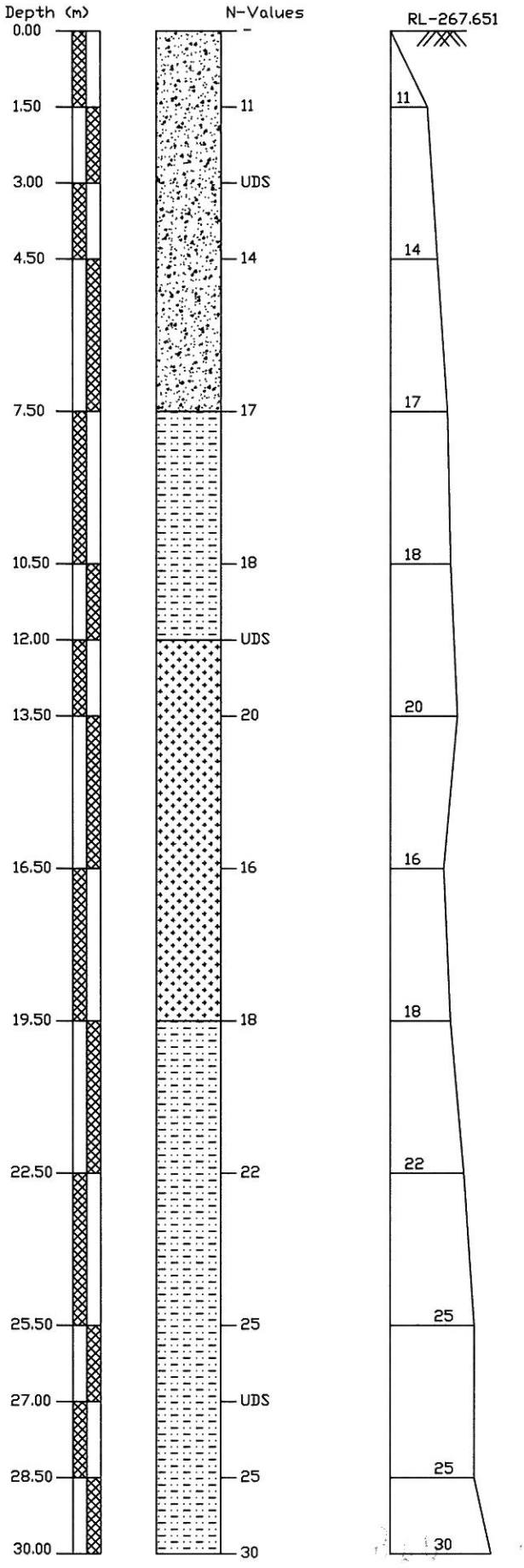
LEGEND

SYMBOL	DESCRIPTION
	SILTY SAND
	CLAYEY SILT WITH SAND
	CLAYEY SILT

2046

CONSULTING Engineers Group Ltd.

BORELOG OF BH–3(A2) RHS AT EXISTING KM–273/21–29 FOR MAJOR BRIDGE NO.–313,
ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

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

2047

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CHAPTER – 93

"Proposed Major Bridge",

Location – Existing Km. – 271/19-21

93.1 LOCATION OF STRUCTURE:

Proposed Major Bridge of Span 4x4x2

93.2 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 > 14.0m below EGL.

Subsurface profile at the site

BOREHOLE No.	Depth (m)	Type of Soil/Rock	Soil/Rock Characteristics
BH-1(A1)	0.00 to 4.50	Clayey Silt with Sand	Loose
	4.50 to 7.50	Sandy Silt with Clay	Medium Dense
	7.50 to 13.50	Clayey Silt with Sand	Medium Dense
	13.50 to 16.50	Clayey Silt	Medium Dense
	16.50 to 28.50	Clayey Silt	Dense
	28.50 to 30.00	Clayey Silt	Very Dense
BH-2(P1)	0.00 to 4.50	Clayey Silt with Sand	Loose
	4.50 to 7.50	Sandy Silt with Clay	Medium Dense
	7.50 to 16.50	Clayey Silt	Medium Dense
	16.50 to 19.50	Clayey Silt	Dense
	19.50 to 24.00	Clayey Silt with Sand	Dense
	24.00 to 25.50	Clayey Silt with Sand & Gravels	Dense
	25.50 to 28.50	Clayey Silt	Dense
	28.50 to 30.00	Clayey Silt	Very Dense
BH-3(A2)	0.00 to 3.00	Clayey Silt	Loose
	3.00 to 6.00	Clayey Silt with Sand	Loose
	6.00 to 7.50	Clayey Silt with Sand	Loose
	7.50 to 16.50	Sandy Silt with Clay	Medium Dense
	16.50 to 28.50	Clayey Silt	Dense
	28.50 to 30.00	Clayey Silt	Very Dense

93.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1 (A1)	3.00	8.30	NIL	0.0024	NIL	0.0012	0.069
	9.00	8.60	0.005	0.0038	NIL	0.0014	0.121
BH-2 (P1)	3.00	8.30	NIL	0.0031	NIL	0.0015	0.123
	12.00	8.20	NIL	0.0024	NIL	0.0014	0.081
	24.00	8.40	NIL	0.0028	NIL	0.0012	0.069
BH-3 (A2)	3.00	8.10	NIL	0.0035	NIL	0.0014	0.122
	6.00	8.10	NIL	0.0024	NIL	0.0012	0.081

93.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1 (A1)	3.00	19.00
	9.00	28.00
	27.00	24.00
BH-2 (P1)	3.00	21.00
	12.00	18.00
	21.00	16.00
BH-3 (A2)	3.00	15.00
	6.00	NIL
	21.00	29.00

93.5 CHEMICAL ANALYSIS OF ENCOUNTERED WATER FROM BOREHOLE

Chemical Properties	pH Value	Chlorides mg/lit	Sulphate mg/lit	Organic Matter mg/lit	Inorganic Matter mg/lit	Acidity (ml)	Alkalinity (ml)	Total Disso. Solids (ppm)	Conductivity (µS/cm)
Test Result	7.1	89	91	175	741	0.2	2.2	970	630
Requirement as per IS: 456 / Mosrth's	Not less then 6.0	2000 for CC and 500 for RCC	400	200	3000	5 ml of 0.02 normal NaoH	25 ml of 0.02 normal H_2SO_4	-	-

93.6 SAFE BEARING CAPACITY t/m²

Borehole No.	Depth from EGL (m)	Net Allowable Bearing Pressure (t/m²)
BH-1 (A1)	1.50	6.00
	3.00	9.00
	4.50	9.50
	6.00	10.50
BH-3 (A2)	1.50	7.00
	3.00	8.00
	4.50	9.00
	6.00	10.00

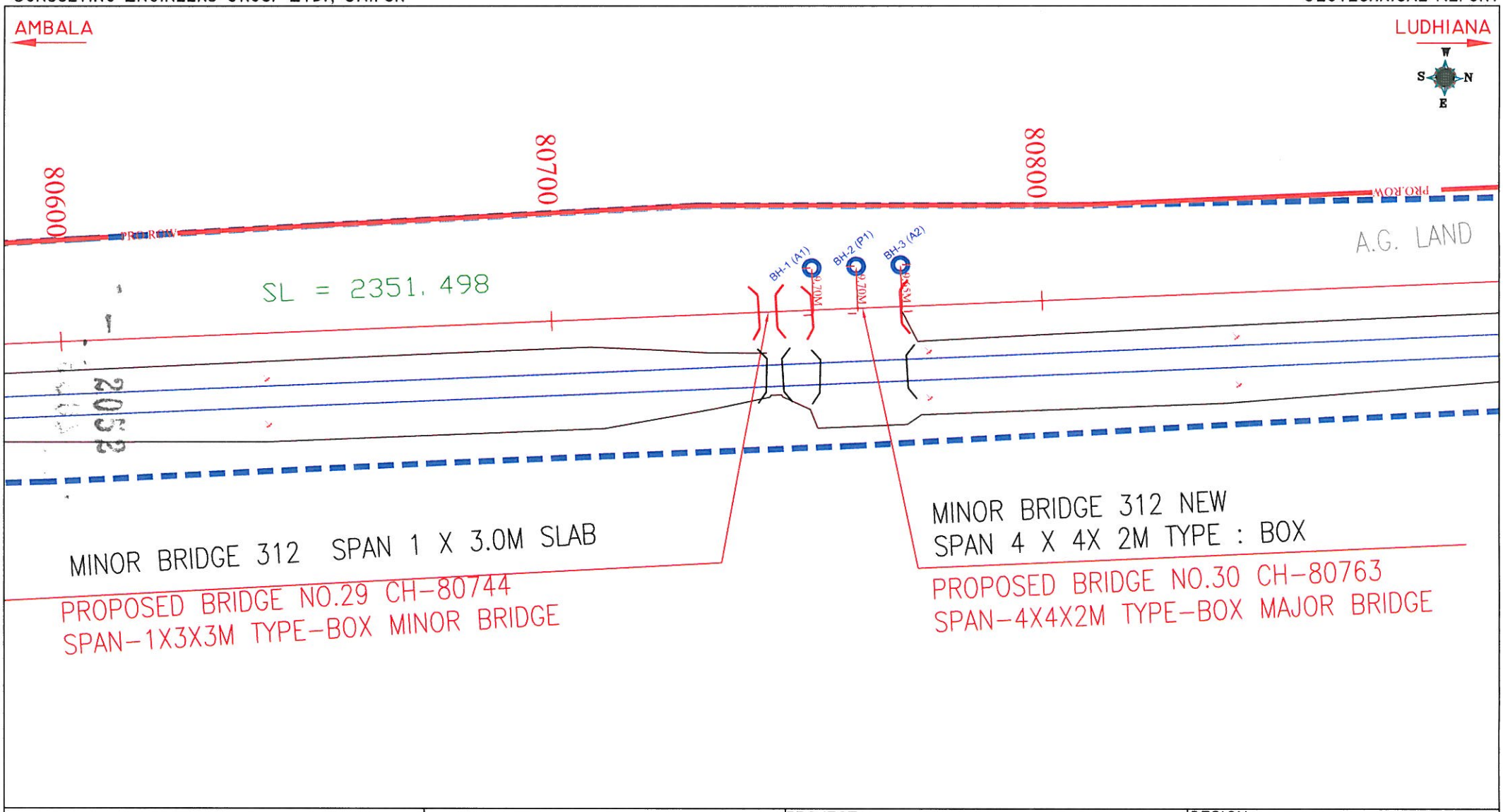
93.7 CONCLUSIONS

- Subsurface Profiles indicates suitable Soil formation for foundations.
- Chemical contents of Water are within the safe limits for construction purpose.

93.8 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 MAJOR BRIDGE CH-271/19-21	RL OF BH (AI) = 266.663 RL OF BH (PI) = 265.703 RL OF BH (A2) = 265.897	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

ANNEXURE - I

SOIL CHARACTERISTICS OF BORE HOLE AT BH-A1(LHS) FOR PROPOSED MAJOR BRIDGE AT CHAINAGE 271/19-21

Project :	Chainage 271/19-21 Bridge No. 000			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				28.11.2009 to 01.12.2009	1	A1	14.00 m.	30.00mtr	266.663

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	-	-	-	Clayey Silt with Sand	9.52	80.76	5.58	1.94	0.68	1.52	0	30	20	10	-	-	-	-	-	-
1.50	7	1.43	10.01	Clayey Silt with Sand	13.37	77.15	6.41	1.36	0.70	1.01	0.00	31	19	12	-	-	-	-	-	-
3.00	UDS	-	-	Clayey Silt with Sand	18.92	71.28	5.94	1.56	1.06	1.24	0.00	36	19	17	1.70	10.63	1.54	2.68	0.2	15.0
4.50	12	1.06	12.72	Sandy Silt with Clay	12.76	60.42	14.91	4.13	2.94	4.84	0.00	29	18	11	-	-	-	-	-	-
7.50	15	0.92	13.80	Clayey Silt with Sand	33.59	59.37	4.65	0.76	0.67	0.96	0.00	61	30	31	-	-	-	-	-	-
9.00	UDS	-	-	Clayey Silt with Sand	26.37	64.88	2.32	2.34	1.14	2.95	0.00	47	24	23	1.85	12.03	1.65	2.69	0.30	10.5
10.50	20	0.81	16.20	Clayey Silt with Sand	26.55	67.12	3.03	2.19	0.76	0.35	0.00	45	21	24	-	-	-	-	-	-
13.50	24	0.72	17.28	Clayey Silt	16.69	80.26	2.77	0.19	0.09	0.00	0.00	36	21	15	-	-	-	-	-	-
16.50	30	0.66	17.40	Clayey Silt	21.15	73.76	4.38	0.46	0.25	0.00	0.00	42	23	19	-	-	-	-	-	-
19.50	37	0.60	18.60	Clayey Silt	29.25	68.48	1.74	0.36	0.17	0.00	0.00	52	28	24	-	-	-	-	-	-
22.50	41	0.55	18.78	Clayey Silt	28.65	68.48	2.06	0.42	0.39	0.00	0.00	49	25	24	-	-	-	-	-	-
25.50	46	0.51	19.23	Clayey Silt	26.55	71.44	1.45	0.38	0.18	0.00	0.00	48	25	23	-	-	-	-	-	-
27.00	UDS	-	-	Clayey Silt	24.52	72.87	1.69	0.43	0.49	0.00	0.00	44	22	22	1.92	18.11	1.62	2.62	0.30	11.0
28.50	52	0.47	19.72	Clayey Silt	21.29	75.60	2.05	0.53	0.53	0.00	0.00	46	26	20	-	-	-	-	-	-
30.00	62	0.46	21.76	Clayey Silt	25.34	69.77	4.31	0.51	0.07	0.00	0.00	46	23	23	-	-	-	-	-	-

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ANNEXURE - I

SOIL CHARACTERISTICS OF BORE HOLE AT BH-P1 (LHS) FOR PROPOSED MAJOR BRIDGE AT CHAINAGE 271/19-21

Project :	Chainage 271/19-21 Bridge No. 000			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation									
				28.11.2009 to 30.11.2009	2	P1	14.00 m.	30.00mtr	265.703									
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	-	-	-	Clayey Silt with Sand	13.52	78.62	6.25	0.68	0.28	0.65	0.00	34	22	12	-	-	-	-	-	-
1.50	8	1.43	11.44	Clayey Silt with Sand	16.25	78.02	4.86	0.59	0.11	0.17	0.00	37	23	14	-	-	-	-	-	-
3.00	UDS	-	-	Clayey Silt with Sand	20.17	68.70	4.00	2.25	0.76	4.12	0.00	39	21	18	1.88	12.68	1.67	2.61	0.21	14.0
4.50	10	1.03	10.30	Sandy Silt with Clay	12.14	68.48	13.81	0.71	1.05	3.81	0.00	30	19	11	-	-	-	-	-	-
7.50	17	0.86	14.62	Clayey Silt	32.29	60.52	1.24	1.31	0.87	3.77	0.00	54	23	31	-	-	-	-	-	-
10.50	21	0.75	15.75	Clayey Silt	28.91	67.83	2.24	0.72	0.3	0.00	0.00	53	27	26	-	-	-	-	-	-
12.00	UDS	-	-	Clayey Silt	18.59	74.66	2.87	1.95	0.44	1.49	0.00	38	22	16	2.06	17.17	1.75	2.69	0.20	15.0
13.50	28	0.66	18.48	Clayey Silt	23.14	71.53	1.28	1.63	1.14	1.28	0.00	43	23	20	-	-	-	-	-	-
16.50	34	0.59	17.53	Clayey Silt	20.67	76.49	1.64	0.66	0.20	0.34	0.00	47	29	18	-	-	-	-	-	-
19.50	39	0.54	18.03	Clayey Silt with Sand	6.29	72.73	18.58	0.51	0.16	1.73	0.00	26	20	6	-	-	-	-	-	-
22.50	44	0.49	18.28	Clayey Silt with Sand	11.37	69.73	15.64	0.67	1.24	1.35	0.00	30	20	10	-	-	-	-	-	-
24.00	UDS	-	-	Clayey Silt with Sand &Gravels	14.12	64.53	5.09	1.75	2.48	12.03	0.00	32	19	13	2.05	21.69	1.68	2.66	0.17	16.0
25.50	51	0.45	18.98	Clayey Silt with Gravels	15.64	69.22	1.73	0.17	0.28	12.96	0.00	34	21	13	-	-	-	-	-	-
28.50	60	0.41	19.80	Clayey Silt	21.43	76.50	1.59	0.10	0.27	0.11	0.00	40	22	18	-	-	-	-	-	-
30.00	68	0.39	20.76	Clayey Silt	17.93	78.91	1.01	0.72	0.34	1.09	0.00	37	21	16	-	-	-	-	-	-

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ANNEXURE - I

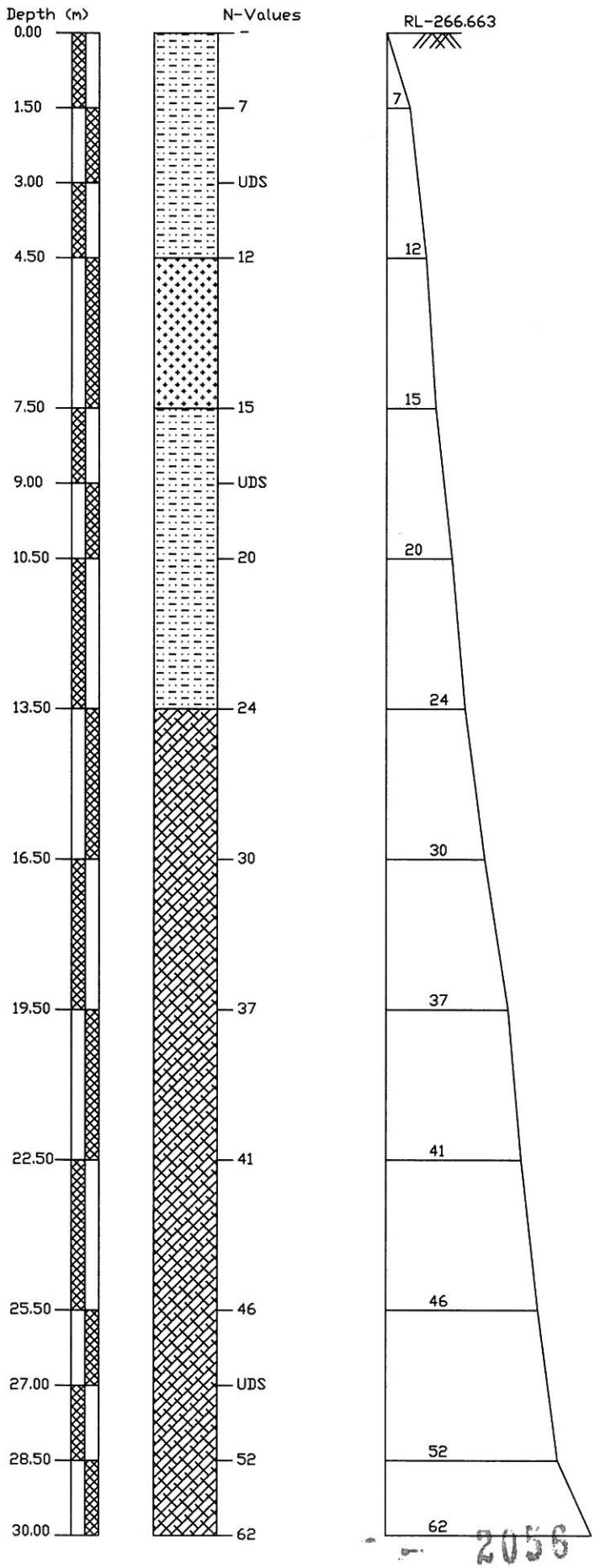
SOIL CHARACTERISTICS OF BORE HOLE AT BH-A2(LHS) FOR PROPOSED MAJOR BRIDGE AT CHAINAGE 271/19-21

Project :	Chainage 271/19-21 Bridge No. 000			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				30.11.2009 to 02.12.2009	3	A2	14.00 m.	30.00mtr	265.897

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	-	-	-	Clayey Silt	21.25	74.30	3.25	0.68	0.52	0.00	0.00	42	22	20	-	-	-	-	-	-
1.50	5	1.42	7.10	Clayey Silt	23.64	73.54	2.39	0.33	0.10	0.00	0.00	47	26	21	-	-	-	-	-	-
3.00	UDS	-	-	Clayey Silt with Sand	12.68	78.81	6.63	1.10	0.39	0.39	0.00	32	20	12	1.70	17.49	1.54	2.68	0.11	20.0
4.50	7	1.05	7.35	Clayey Silt with Sand	16.32	63.57	8.3	2.7	1.89	7.22	0.00	34	20	14	-	-	-	-	-	-
6.00	UDS	-	-	Sandy Silt with Clay	7.42	47.18	44.66	0.54	0.20	0.00	0.00	23	16	7	1.94	18.79	1.63	2.65	0.09	22.0
7.50	15	0.88	13.20	Clayey Silt	21.35	73.37	1.93	1.90	0.71	0.74	0.00	42	23	19	-	-	-	-	-	-
10.50	18	0.76	13.68	Clayey Silt	25.36	70.60	2.02	0.31	0.28	1.43	0.00	47	24	23	-	-	-	-	-	-
13.50	25	0.68	17.00	Clayey Silt	22.76	72.71	1.83	1.01	0.67	1.02	0.00	49	28	21	-	-	-	-	-	-
16.50	32	0.61	17.26	Clayey Silt	20.83	73.36	4.10	0.65	0.50	0.56	0.00	41	23	18	-	-	-	-	-	-
19.50	35	0.56	17.30	Clayey Silt	27.43	70.25	1.95	0.23	0.06	0.08	0.00	49	25	24	-	-	-	-	-	-
21.00	UDS	-	-	Clayey Silt	27.23	70.44	1.64	0.46	0.23	0.00	0.00	48	25	23	2.00	20.10	1.66	2.64	0.30	10.0
22.50	42	0.50	18.00	Clayey Silt	26.35	71.48	1.64	0.35	0.18	0.00	0.00	50	28	22	-	-	-	-	-	-
25.50	49	0.46	18.77	Clayey Silt	24.36	72.85	1.84	0.43	0.34	0.18	0.00	43	21	22	-	-	-	-	-	-
28.50	58	0.42	19.68	Clayey Silt	26.53	71.73	1.19	0.32	0.23	0.00	0.00	48	23	25	-	-	-	-	-	-
30.00	66	0.40	20.70	Clayey Silt	25.60	67.30	6.21	0.38	0.36	0.15	0.00	46	23	23	-	-	-	-	-	-

CONSULTING
Engineers Group Ltd.

BORELOG OF BH–1LHS (A1) AT EXISTING KM–271/19–21 FOR PROPOSED MAJOR BRIDGE, ON KESARI TO SANEHWAL, LUDHIANA



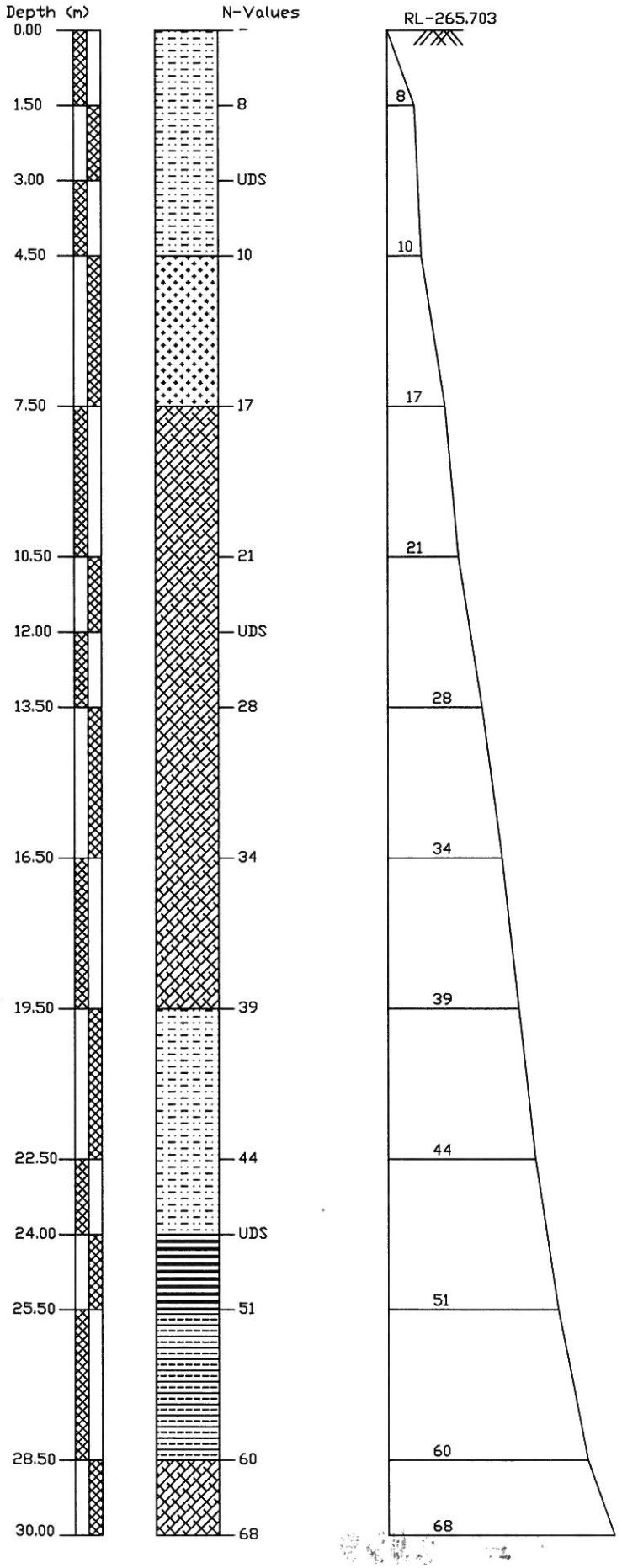
LEGEND

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

2056

CONSULTING Engineers Group Ltd

BORELOG OF BH–2(P1) AT EXISTING KM–271/19–21 FOR PROPOSED MAJOR BRIDGE, ON KESARI TO SANEHWAL, LUDHIANA



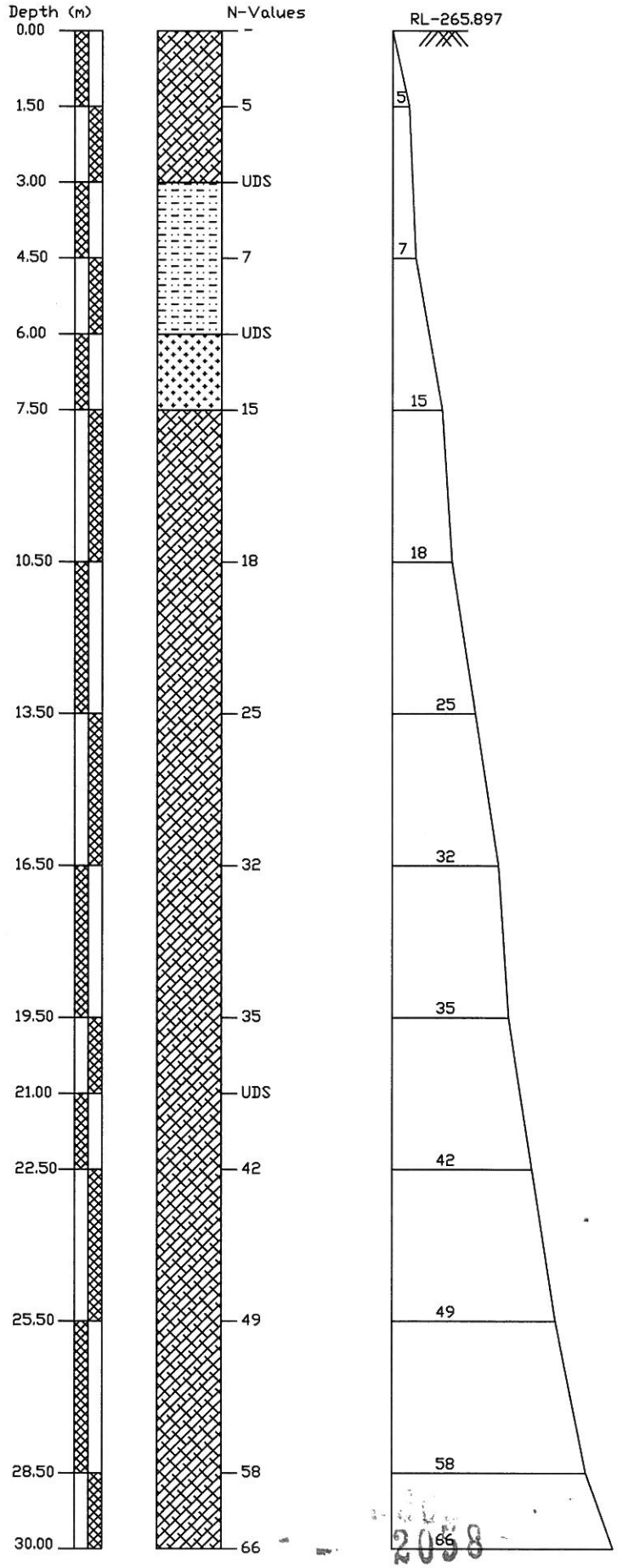
LEGEND

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

2057

CONSULTING Engineers Group Ltd.

BORELOG OF BH–3LHS (A2) AT EXISTING KM–271/19–21 FOR PROPOSED MAJOR BRIDGE, ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

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

CONSULTING Engineers Group Ltd.

CHAPTER – 94

"Alignment",

Location – Existing Km. – 315/20-22

94.1 LOCATION OF STRUCTURE:

Alignment at existing km 315/20-22

94.2 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 ≥16.00m below EGL.

Subsurface profile at the site

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

94.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1	3.00	8.30	NIL	0.0032	NIL	0.0011	0.028
	6.00	8.80	0.007	0.0025	NIL	0.0012	0.032

94.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

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

94.5 NET ALLOWABLE BEARING PRESSURE

Borehole No.	Depth from EGL (m)	Net Allowable Bearing Pressure (t/m²)
BH-1	3.00	14.00
	4.50	16.50
	6.00	17.50

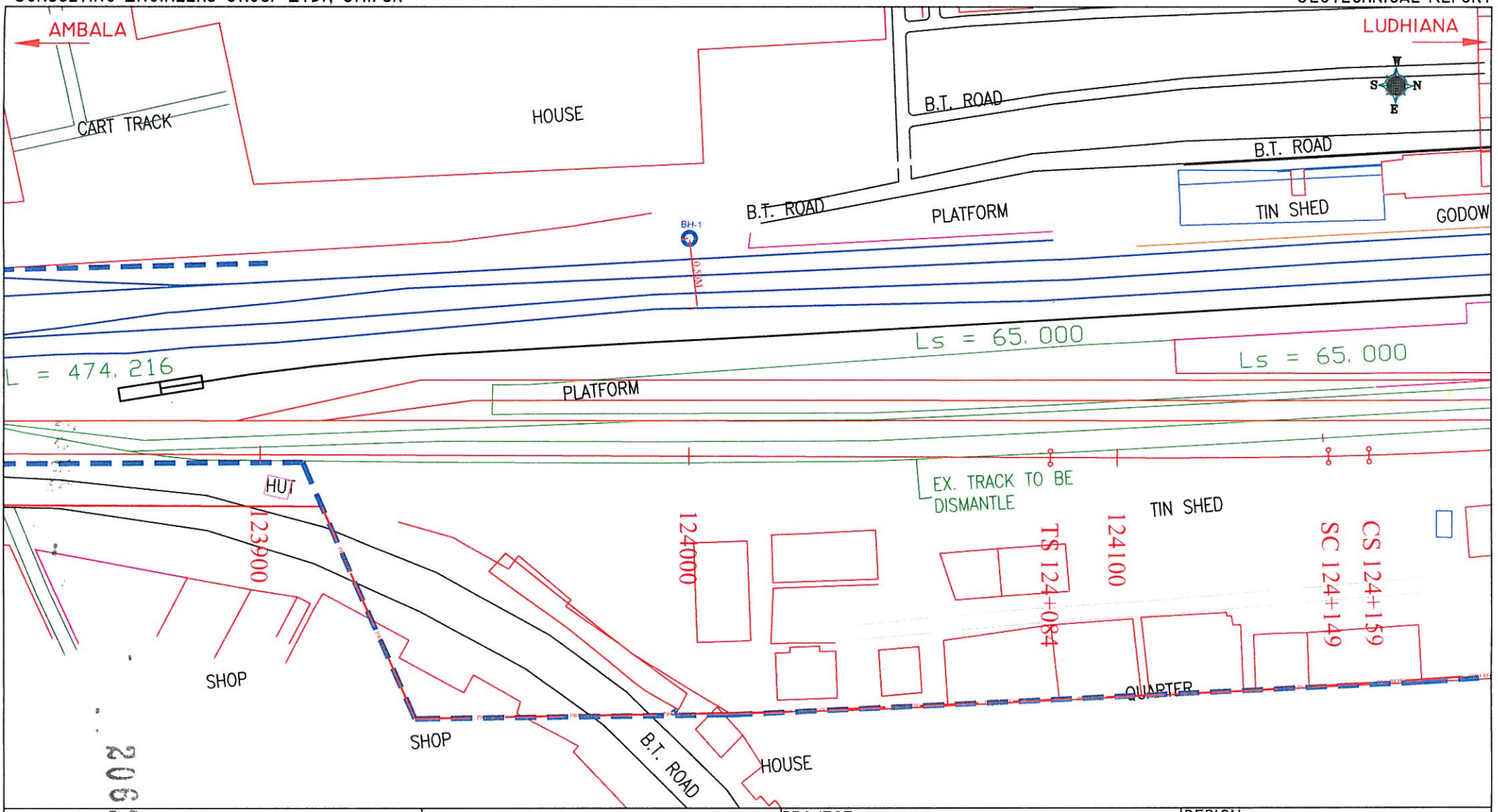
94.6 CONCLUSIONS

- Subsurface Profiles indicates suitable Soil formation for foundations.

94.7 RECOMMENDATIONS

(i)	*Type of foundation*	Open foundation
(ii)	*Depth of foundation below GL*	Below 4.50m 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 ALIGNMENT AT CH. 315/20-22

RL OF BH-I = 264.853

PROJECT :-

LUDHIANA-AMBALA (DFCCIL)

DESIGN :-

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SOIL CHARACTERISTICS OF BORE HOLE AT BH-1(RHS) FOR ALIGNMENT AT CHAINAGE 315/20-22

Project :	Chainage 315/20-22 Bridge No. 000			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				24.11.2009 to 24.11.2009	1	1 (RHS)	below 16.00 m.	12.00mtr	264.853

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	2.10	24.09	68.59	1.2	1.88	2.14	0.00	22	NP	NIL	-	-	-	-	-	-
1.50	8	1.43	11.44	Silty sand	2.00	28.53	65.77	0.95	1.73	1.02	0.00	21	NP	NIL	-	-	-	-	-	-
3.00	UDS	-	-	Silty sand	2.58	8.57	85.88	2.97	0.00	0.00	0.00	26	NP	NIL	1.85	12.52	1.64	2.65	0.00	28.5
4.50	12	1.06	12.72	Silty sand	2.85	9.11	82.55	3.1	2.39	0.00	0.00	26	NP	NIL	-	-	-	-	-	-
6.00	UDS	-	-	Silty sand	3.21	7.28	0.28	16.68	72.55	0.00	0.00	28	NP	NIL	1.90	15.99	1.63	2.66	0.00	29.0
7.50	19	0.88	16.72	Silty sand	0.00	7.15	83.2	5.43	1.99	2.23	0.00	27	NP	NIL	-	-	-	-	-	-
10.50	22	0.77	16.94	Silty sand	0.00	4.10	85.36	7.25	1.63	1.66	0.00	25	NP	NIL	-	-	-	-	-	-
12.00	34	0.73	24.82	Silty sand	0.00	6.26	84.24	8.74	0.76	0.00	0.00	26	NP	NIL	-	-	-	-	-	-

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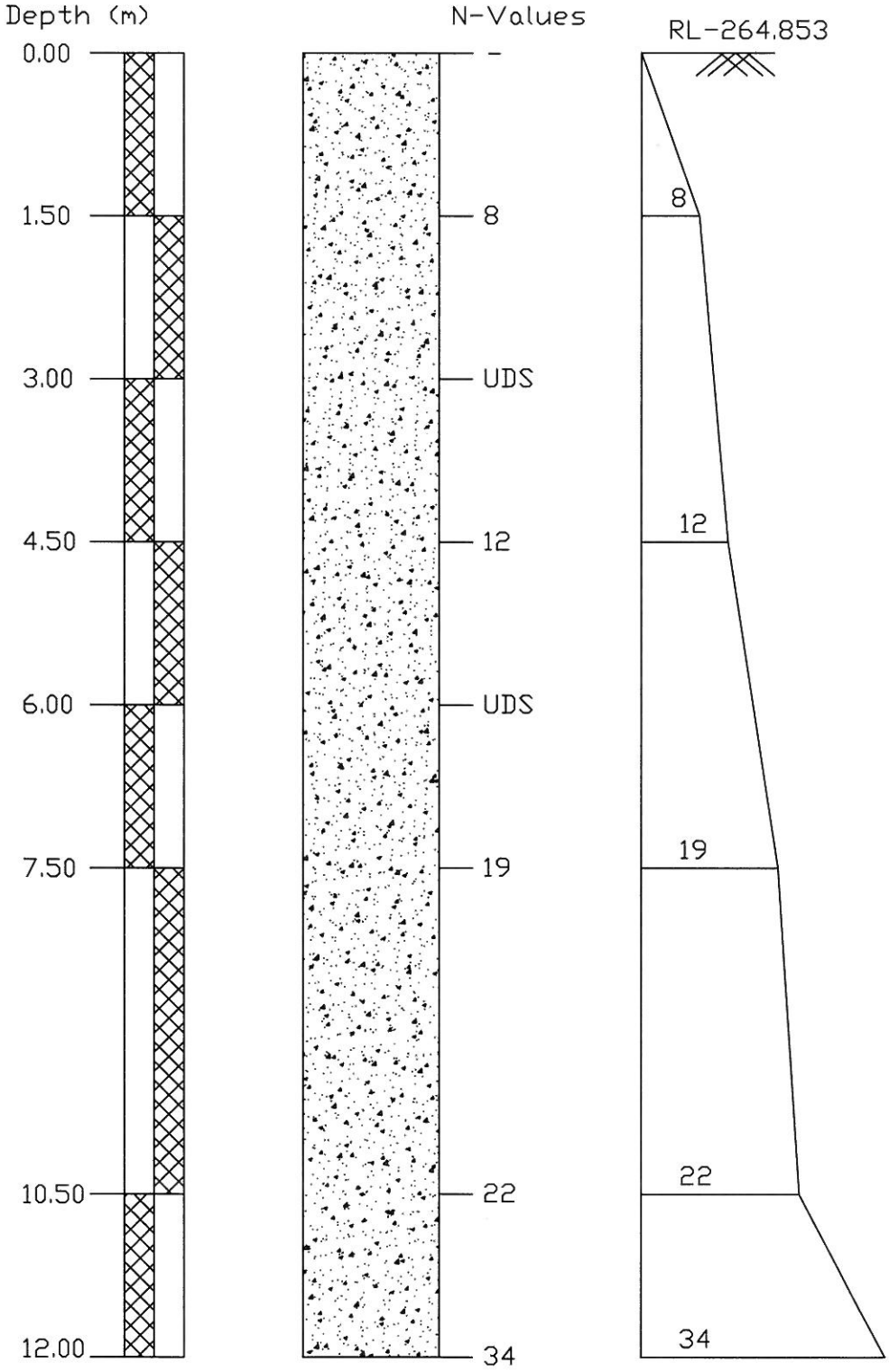
BORELOG OF BH–1(RHS) AT EXISTING KM–315/20–22 FOR ALIGNMENT,

ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

SYMBOL	DESCRIPTION
	SILTY SAND

2064

CHAPTER – 95

"Alignment",

Location – Existing Km. – 314/20-22

95.1 LOCATION OF STRUCTURE:

Alignment at existing km 314/20-22

95.2 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 ≥16.00m below EGL.

Subsurface profile at the site

BOREHOLE No.	Depth (m)	Type of Soil/Rock	Soil/Rock Characteristics
BH-1	0.00 to 2.50	Filled up strata	Loose
	2.50 to 4.50	Silty Sand	Loose
	4.50 to 12.00	Silty Sand	Medium Dense

95.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1	3.00	8.60	0.002	0.0042	NIL	0.0013	0.037
	6.00	8.90	0.010	0.0042	NIL	0.0011	0.030

95.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

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

95.5 NET ALLOWABLE BEARING PRESSURE

Borehole No.	Depth from EGL (m)	Net Allowable Bearing Pressure (t/m²)
BH-1	3.00	16.00
	4.50	17.00
	6.00	18.00

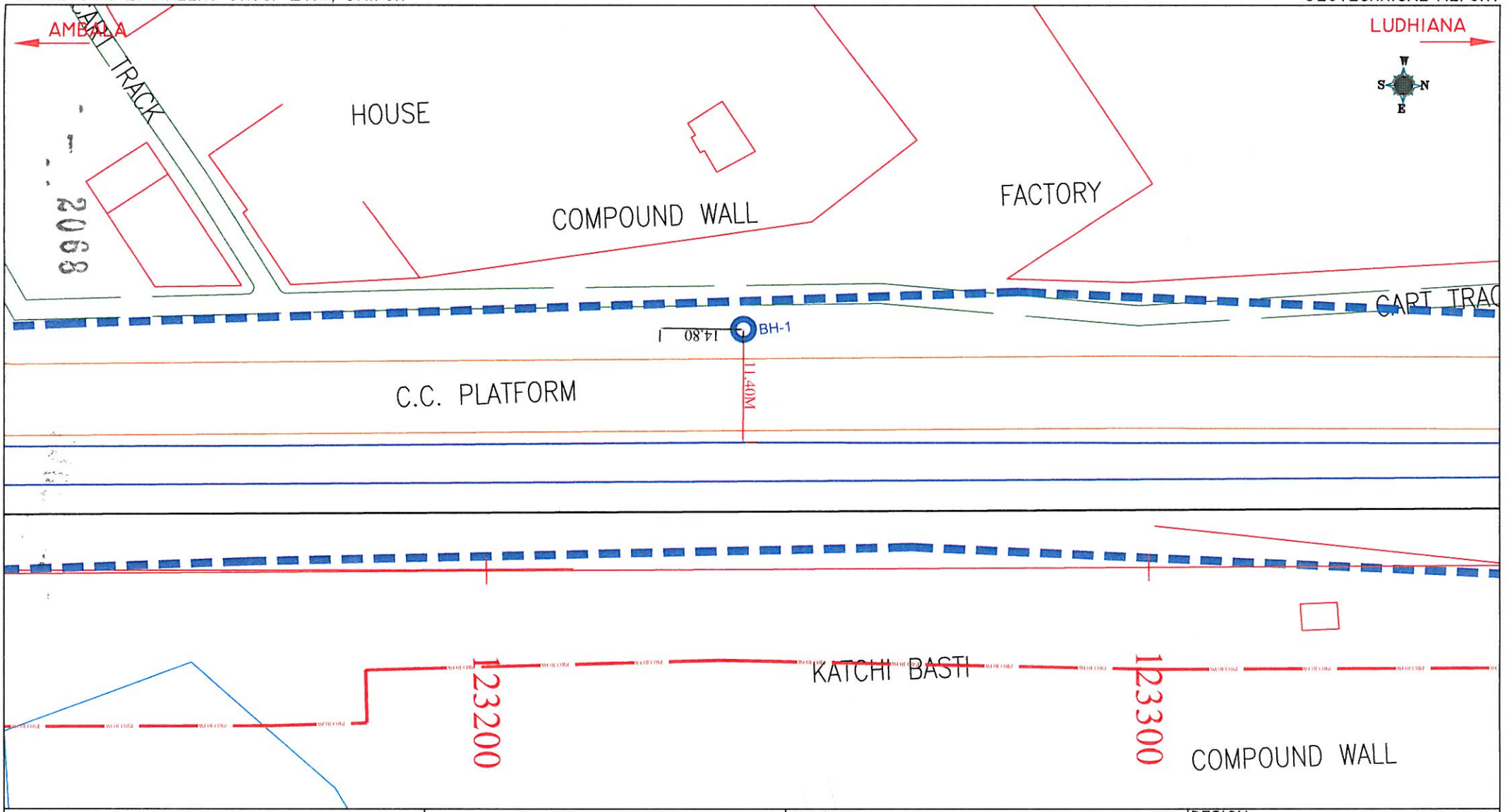
95.6 CONCLUSIONS

- Subsurface Profiles indicates suitable Soil formation for foundations.

95.7 RECOMMENDATIONS

(i)	*Type of foundation*	Open foundation
(ii)	*Depth of foundation below GL*	Below 4.50m 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 ALIGNMENT AT CH. 314/20-22

RL OF BH-I =266.546

PROJECT :-

LUDHIANA-AMBALA (DFCCIL)

DESIGN :-

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ANNEXURE - I

SOIL CHARACTERISTICS OF BORE HOLE AT BH-1(RHS) FOR ALIGNMENT AT CHAINAGE 314/20-22

Project :	Chainage 314/20-22 Bridge No. 000			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				24.11.2009 to 24.11.2009	1	1 (RHS)	below 16.00 m.	12.00mtr	266.546

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	-	-	-	Filled up strata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.50	-	-	-	Silty sand	0.00	8.27	84.67	4.14	1.66	1.26	0.00	26	NP	NIL	-	-	-	-	-	-
3.00	UDS	-	-	Silty sand	3.15	10.55	80.25	3.58	1.65	0.82	0.00	27	NP	NIL	1.75	10.31	1.58	2.58	0.00	28.0
4.50	14	1.08	15.12	Silty sand	2.58	7.88	81.62	7.22	0.70	0.00	0.00	26	NP	NIL	-	-	-	-	-	-
6.00	UDS	-	-	Silty sand	0.00	5.62	73.87	20.04	0.47	0.00	0.00	28	NP	NIL	1.90	13.51	1.67	2.65	0.00	28.0
7.50	18	0.88	15.84	Silty sand	3.68	9.69	75.69	10.36	0.58	0.00	0.00	27	NP	NIL	-	-	-	-	-	-
10.50	24	0.77	18.48	Silty sand	0.00	6.04	85.34	7.84	0.78	0.00	0.00	27	NP	NIL	-	-	-	-	-	-
12.00	35	0.73	25.55	Silty sand	0.00	6.12	88.36	4.26	0.93	0.33	0.00	25	NP	NIL	-	-	-	-	-	-

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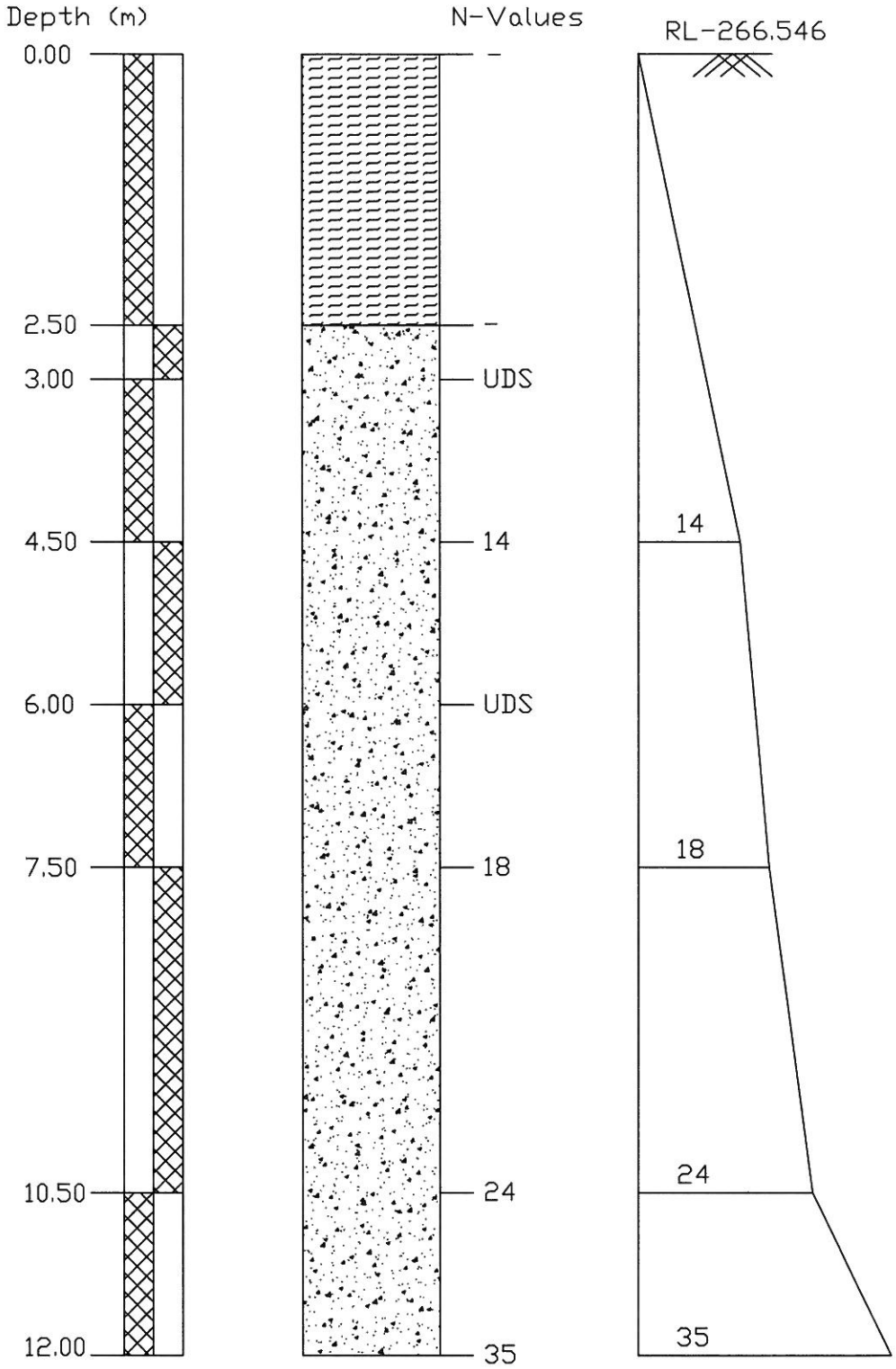
BORELOG OF BH–1(RHS) AT EXISTING KM–314/20–22 FOR ALIGNMENT,

ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

SYMBOL	DESCRIPTION
	FILLEDUP STRATA
	SILTY SAND

2070

CONSULTING
Engineers Group Ltd.

CHAPTER – 96

"Alignment",

Location – Existing Km. – 308/15-17

96.1 LOCATION OF STRUCTURE:

Alignment at existing km 308/15-17.

96.2 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 4.50	Silty Sand	Loose
	4.50 to 10.50	Silty Sand	Medium Dense
	10.50 to 12.00	Silty Sand	Dense

96.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1	3.00	8.30	NIL	0.0014	NIL	0.0011	0.012
	6.00	8.60	0.005	0.0021	NIL	0.0011	0.022

96.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

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

96.5 NET ALLOWABLE BEARING PRESSURE

Borehole No.	Depth from EGL (m)	Net Allowable Bearing Pressure (t/m²)
BH-1	1.50	08.00
	3.00	15.00
	4.50	20.00
	6.00	21.00

96.6 CONCLUSIONS

- Subsurface Profiles indicates suitable Soil formation for foundations.

96.7 RECOMMENDATIONS

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