CHAPTER – 83

"Major Bridge No. 338",

Location – Existing Km. - 300/18-20

83.1 LOCATION OF STRUCTURE:

Proposed Major Bridge of Span 8x6.1

83.2 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 21.80m below EGL.

Subsurface profile at the site

BOREHOLE No.	Depth (m)	Type of Soil/Rock	Soil/Rock Characteristics
BH-1(A1)	0.00 to 1.50	Clayey Silt with Sand	Loose
	1.50 to 3.00	Clayey Silt with Sand	Medium Dense
	3.00 to 4.50	Sandy Silt	Medium Dense
	4.50 to 7.50	Silty Sand	Medium Dense
	7.50 to 16.50	Silty Sand	Dense
	16.50 to 23.50	Silty Sand	Very Dense
	23.50 to 3.00	Sandy Silt with Clay	Very Dense
BH-2(P4)	0.00 to 1.50	Clayey Silt with Sand	Loose
	1.50 to 4.50	Clayey Silt with Sand	Medium Dense
	4.50 to 7.50	Silty Sand	Medium Dense
	7.50 to 16.50	Silty Sand	Dense
	16.50 to 25.50	Silty Sand	Very dense
	25.50 to 30.00	Sandy Silt with Clay	Very dense
	Below 30.00	Silty Sand	Very dense
BH-3(A2)	0.00 to 1.50	Clayey Silt with Sand	Loose
	1.50 to 4.50	Clayey Silt with Sand	Medium Dense
	4.50 to 19.50	Silty Sand	Dense
	19.50 to 30.00	Silty Sand	Very Dense

83.3 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	0.0021	NIL	0.0009	0.041
	9.00	8.60	0.005	0.0024	NIL	0.0011	0.025
	23.50	8.70	0.007	0.0025	NIL	0.0012	0.046
BH-2 (P4)	3.00	8.70	0.002	0.0014	NIL	0.0010	0.027
	6.00	8.90	0.010	0.0021	NIL	0.0012	0.023
	12.00	8.70	0.005	0.0021	NIL	0.0010	0.021
BH-3 (A2)	3.00	8.60	0.002	0.0014	NIL	0.0010	0.027
	6.00	9.10	0.012	0.0024	NIL	0.0011	0.022

83.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1 (A1)	3.00	NIL
	9.00	NIL
	12.00	NIL
	23.50	19.00
BH-2 (P4)	3.00	12.00
	6.00	NIL
	12.00	NIL
	18.00	NIL
	24.00	NIL
BH-3 (A2)	3.00	12.00
	6.00	NIL
	12.00	NIL
	15.00	NIL
	21.00	NIL
	27.00	NIL

83.5 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	7.3	66	86	176	740	0.2	2.3	940	600
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	-	-

83.6 SAFE BEARING CAPACITY t/m²

BH -NO.	DEPTH (mtr)	Net Allowable Bearing Pressure (t/m²)
BH-1 (A1)	1.50m	10.00
	3.00m	18.00
	4.50m	19.00
	6.00m	21.00
BH-3 (A2)	1.50 m	7.00
	3.00m	10.00
	4.50m	12.50
	6.00m	13.50

83.7 PILE LOAD CARRYING CAPACITY

83.7.1 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)	20.00	140.00	180.00
	23.00	160.00	200.00
BH-2 (P4)	17.00	120.00	160.00
	20.00	150.00	200.00
BH-3 (A2)	17.00	120.00	150.00
	20.00	150.00	200.00
	23.00	190.00	250.00

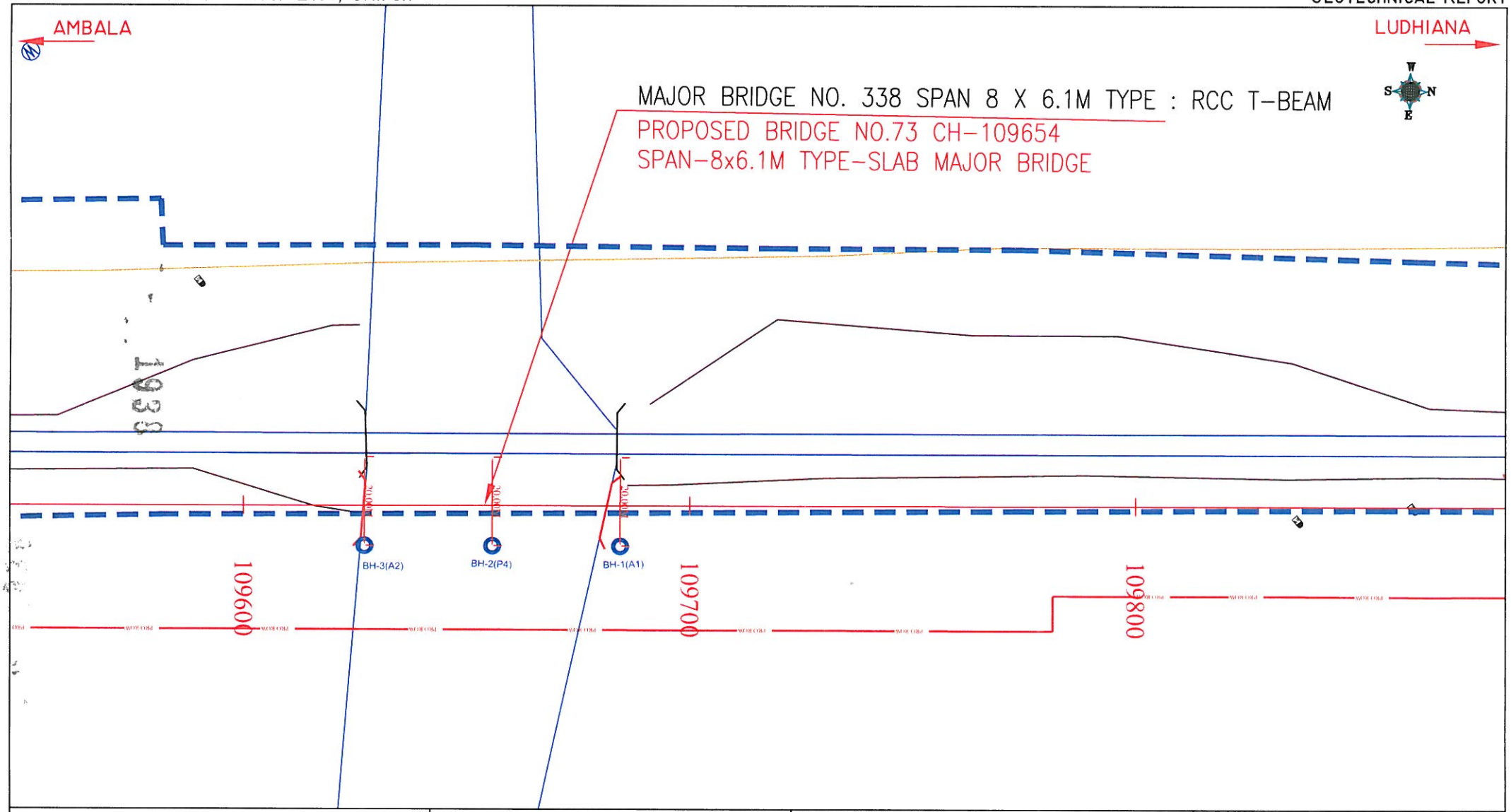
83.8 CONCLUSIONS

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

83.9 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 AT CH. 300/18-20

RL OF BH (AI) = 263.353
RL OF BH (P4) = 263.504
RL OF BH (A2) = 263.281

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) OF MAJOR BRIDGE No. 338 AT CHAINAGE 300/18-20

Project :	Chainage 300/18-20 Bridge No. 338			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				13.06.2009 to 13.06.2009	A1	1	21.80 m.	30.00mtr	263.353

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	13.1	64.79	10.2	6.56	4.12	1.23	0	33	23	10	-	-	-	-	-	-
1.50	16	1.46	23.36	Clayey silt with sand	14.85	61.99	9.90	8.93	3.44	0.89	0.00	35	23	12	-	-	-	-	-	-
3.00	UDS	-	-	Sandy Silt	3.19	58.41	36.55	0.92	0.43	0.50	0.00	26	NIL	NP	1.68	6.25	1.58	2.64	0.00	26.00
4.50	23	1.10	25.30	Silty Sand	4.26	6.82	83.58	4.90	0.44	0.00	0.00	27	NIL	NP	-	-	-	-	-	-
7.50	30	0.92	27.60	Silty Sand	3.16	10.39	81.23	4.83	0.39	0.00	0.00	25	NIL	NP		-	-	-	-	-
9.00	UDS	-	-	Silty Sand	3.56	8.67	86.39	1.38	0.00	0.00	0.00	27	NIL	NP	1.69	6.59	1.59	2.65	0.00	26.00
10.50	26	0.81	21.06	Silty Sand	2.63	10.46	85.39	1.52	0.00	0.00	0.00	26	NIL	NP	-	-	-	-	-	-
12.00	UDS	-	-	Silty Sand	2.97	12.49	71.23	10.26	2.20	0.85	0.00	26	NIL	NP	1.70	7.10	1.59	2.64	0.00	26.00
13.50	49	0.73	35.77	Silty Sand	2.10	9.35	80.25	6.22	1.23	0.85	0.00	24	NIL	NP	-	-	-	-	-	-
16.50	54	0.66	35.64	Silty Sand	2.10	8.02	82.66	6.27	0.39	0.56	0.00	26	NIL	NP		-	-	-	-	-
19.50	62	0.60	37.20	Silty Sand	2.65	10.41	80.21	6.08	0.27	0.38	0.00	27	NIL	NP	-	-	-	-	-	-
22.50	62	0.55	24.55	Silty Sand	3.65	7.48	81.19	6.68	0.33	0.67	0.00	25	NIL	NP	-	-	-	-	-	-
23.50	UDS	-	-	Sandy silt with clay	17.89	67.44	6.45	1.49	2.25	4.48	0.00	34	19	15	1.83	17.25	1.56	2.63	0.15	15.00
25.50	27	0.51	13.77	Sandy silt with clay	14.85	60.11	19.39	3.58	1.59	0.48	0.00	27	15	12	-	-	-	-	-	-
28.50	39	0.47	16.67	Sandy silt with clay	17.11	57.60	19.32	3.66	1.76	0.55	0.00	28	14	14	-	-	-	-	-	-
30.00	52	0.45	19.20	Sandy silt with clay	13.85	61.34	19.28	3.58	1.57	0.38	0.00	29	17	12	-	-	-	-	-	-

CONSULTING Engineers Group Ltd.

1939

ANNEXURE - I

SOIL CHARACTERISTICS OF BORE HOLE AT BH-2 (P4) OF MAJOR BRIDGE No. 338 AT CHAINAGE 300/18-20

Project :	Chainage 300/18-20 Bridge No. 338			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				14.06.2009 to 14.06.2009	P4	2	21.80 m.	30.00mtr	263.504

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	16.85	58.38	10.36	6.21	6.25	1.95	0	32	18	14	-	-	-	-	-	-
1.50	15	1.51	22.65	Clayey silt with sand	17.95	62.72	8.39	5.01	4.62	1.31	0.00	32	17	15	-	-	-	-	-	-
3.00	UDS	-	-	Clayey silt with sand	13.11	51.25	34.97	0.49	0.18	0.00	0.00	25	15	10	1.65	8.03	1.53	2.64	0.10	21.00
4.50	25	1.10	27.50	Silty Sand	2.18	5.97	84.42	7.18	0.25	0.00	0.00	26	NIL	NP	-	-	-	-	-	-
6.00	UDS	-	-	Silty Sand	2.62	7.08	83.72	6.43	0.15	0.00	0.00	25	NIL	NP	1.65	7.54	1.53	2.65	0.00	26.00
7.50	30	0.93	27.90	Silty Sand	2.22	10.88	80.38	6.29	0.23	0.00	0.00	23	NIL	NP	-	-	-	-	-	-
10.50	33	0.82	27.06	Silty Sand	4.56	7.07	82.13	6.13	0.11	0.00	0.00	27	NIL	NP	-	-	-	-	-	-
12.00	UDS	-	-	Silty Sand	2.66	8.90	74.38	14.06	0.00	0.00	0.00	25	NIL	NP	1.71	10.36	1.55	2.65	0.00	26.50
13.50	36	0.73	26.28	Silty Sand	3.15	5.89	70.48	19.87	0.41	0.20	0.00	25	NIL	NP	-	-	-	-	-	-
16.50	51	0.66	33.66	Silty Sand	0.00	7.17	72.98	19.29	0.38	0.18	0.00	26	NIL	NP		-	-	-	-	-
18.00	UDS	-	-	Silty Sand	0.00	8.76	81.54	9.18	0.31	0.21	0.00	24	NIL	NP	1.80	11.25	1.62	2.66	0.00	27.50
19.50	59	0.60	35.40	Silty Sand	0.00	5.85	80.10	13.88	0.17	0.00	0.00	22	NIL	NP	-	-	-	-	-	-
22.50	71	0.55	27.03	Silty Sand	0.00	5.87	80.28	13.72	0.13	0.00	0.00	21	NIL	NP	-	-	-	-	-	-
24.00	UDS	-	-	Silty Sand	0.00	4.81	85.68	8.85	0.37	0.29	0.00	20	NIL	NP	1.93	20.65	1.60	2.64	0.00	27.50
25.50	28	0.51	14.28	Sandy silt with clay	13.21	56.34	20.85	4.61	3.06	1.93	0.00	28	18	10	-	-	-	-	-	-
28.50	32	0.46	14.72	Sandy silt with clay	14.89	55.78	20.19	4.29	2.98	1.87	0.00	29	17	12	-	-	-	-	-	-
30.00	52	0.44	18.94	Silty Sand	0.00	8.48	83.32	7.36	0.60	0.24	0.00	20	NIL	NP	-	-	-	-	-	-

CONSULTING Engineers Group Ltd.

SOIL CHARACTERISTICS OF BORE HOLE AT BH-3 (A2) OF MAJOR BRIDGE No. 338 AT CHAINAGE 300/18-20

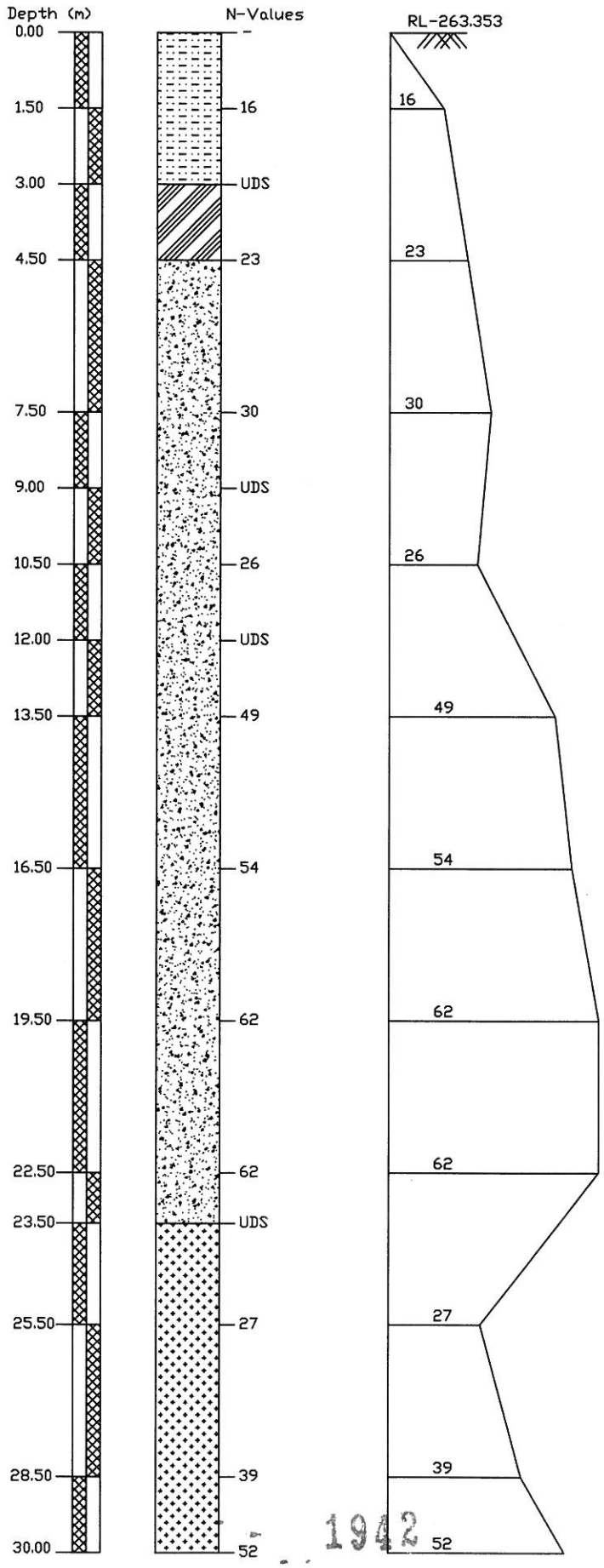
Project :	Chainage 300/18-20 Bridge No. 338			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				14.06.2009 to 14.06.2009	A2	3	21.80 m.	30.00mtr	263.281

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	14.85	62.81	9.66	6.21	5.21	1.26	0	30	18	12	-	-	-	-	-	-
1.50	16	1.53	24.48	Clayey silt with sand	17.66	52.71	17.42	5.10	4.74	2.37	0.00	32	17	15	-	-	-	-	-	-
3.00	UDS	-	-	Clayey silt with sand	11.62	60.96	26.46	0.96	0.00	0.00	0.00	25	16	9	1.58	5.50	1.50	2.64	0.10	22.00
4.50	37	1.12	41.44	Silty Sand	4.55	7.92	84.48	2.45	0.60	0.00	0.00	29	NIL	NP	-	-	-	-	-	-
6.00	UDS	-	-	Silty Sand	2.66	27.14	61.64	3.51	1.87	3.18	0.00	25	NIL	NP	1.65	8.56	1.52	2.65	0.00	26.00
7.50	40	0.94	37.60	Silty Sand	4.51	12.79	80.04	2.27	0.30	0.09	0.00	30	NIL	NP	-	-	-	-	-	-
10.50	43	0.82	35.26	Silty Sand	2.12	13.32	81.60	2.75	0.10	0.11	0.00	23	NIL	NP	-	-	-	-	-	-
12.00	UDS	-	-	Silty Sand	2.30	14.35	80.25	3.10	0.00	0.00	0.00	24	NIL	NP	1.67	7.49	1.55	2.64	0.00	26.00
13.50	47	0.74	34.78	Silty Sand	4.11	5.84	79.83	7.45	1.80	0.97	0.00	28	NIL	NP	-	-	-	-	-	-
15.00	UDS	-	-	Silty Sand	3.26	5.30	80.66	8.92	1.55	0.31	0.00	27	NIL	NP	1.75	10.33	1.59	2.65	0.00	26.50
16.50	48	0.67	32.16	Silty Sand	2.10	7.55	80.42	7.04	1.69	1.20	0.00	23	NIL	NP	-	-	-	-	-	-
19.50	51	0.61	31.11	Silty Sand	2.12	5.98	82.30	7.26	1.87	0.47	0.00	24	NIL	NP	-	-	-	-	-	-
21.00	UDS	-	-	Silty Sand	2.52	7.55	79.90	7.40	1.82	0.81	0.00	24	NIL	NP	1.95	16.25	1.68	2.63	0.00	28.50
22.50	63	0.55	24.83	Silty Sand	3.65	8.13	83.68	3.99	0.55	0.00	0.00	27	NIL	NP	-	-	-	-	-	-
25.50	27	0.50	13.50	Silty Sand	2.41	13.92	78.56	3.26	1.20	0.65	0.00	25	NIL	NP	-	-	-	-	-	-
27.00	UDS	-	-	Silty Sand	2.44	6.59	86.62	3.23	0.70	0.42	0.00	26	NIL	NP	2.07	21.22	1.71	2.66	0.00	29.00
28.50	33	0.46	15.09	Silty Sand	4.59	9.63	81.32	3.53	0.75	0.18	0.00	30	NIL	NP	-	-	-	-	-	-
30.00	50	0.44	18.50	Silty Sand	4.88	10.27	80.24	3.42	0.65	0.54	0.00	28	NIL	NP	-	-	-	-	-	-

CONSULTING
Engineers Group Ltd.

BORELOG OF BH–1(A1) AT EXISTING KM–300/18–20 FOR MAJOR BRIDGE NO.–338,

ON KESARI TO SANEHWAL, LUDHIANA



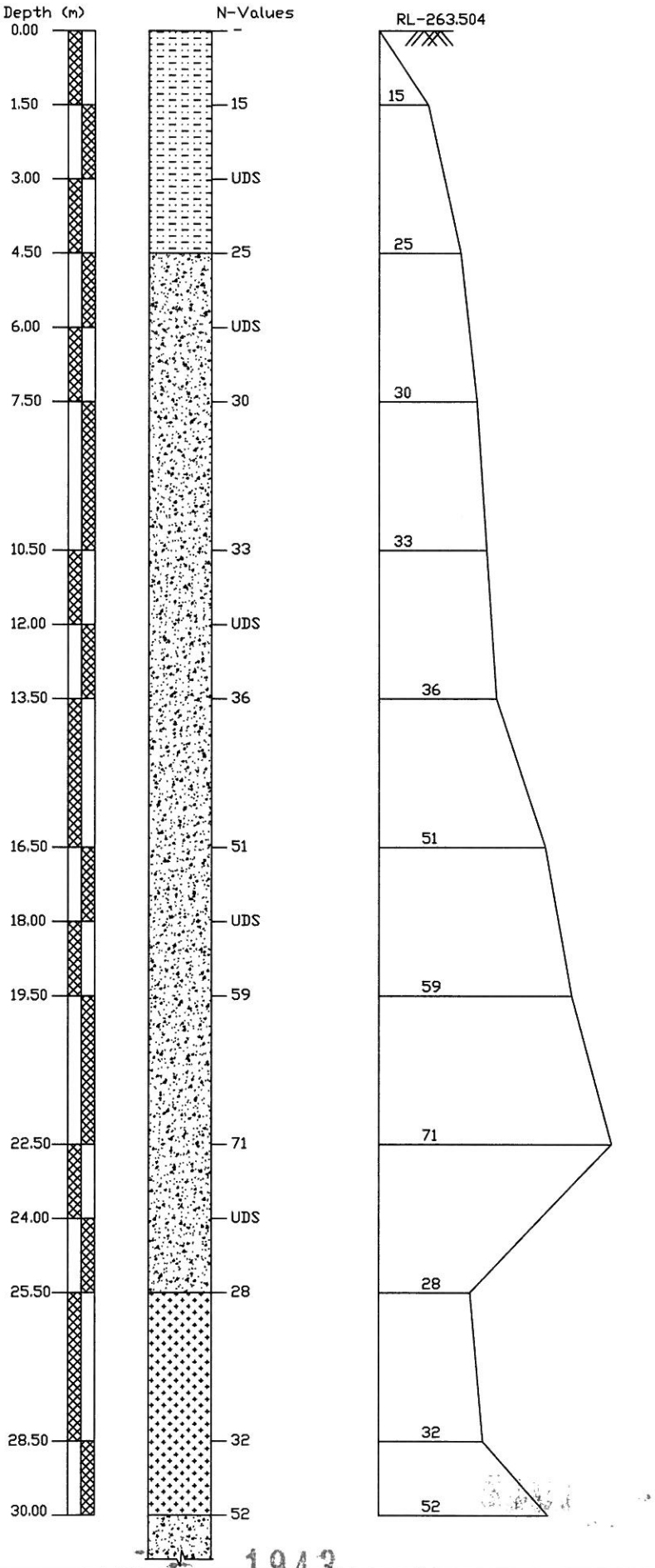
LEGEND

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

1942

CONSULTING Engineers Group Ltd.

BORELOG OF BH–2(P4) AT EXISTING KM–300/18–20 FOR MAJOR BRIDGE NO.–338,
ON KESARI TO SANEHWAL, LUDHIANA



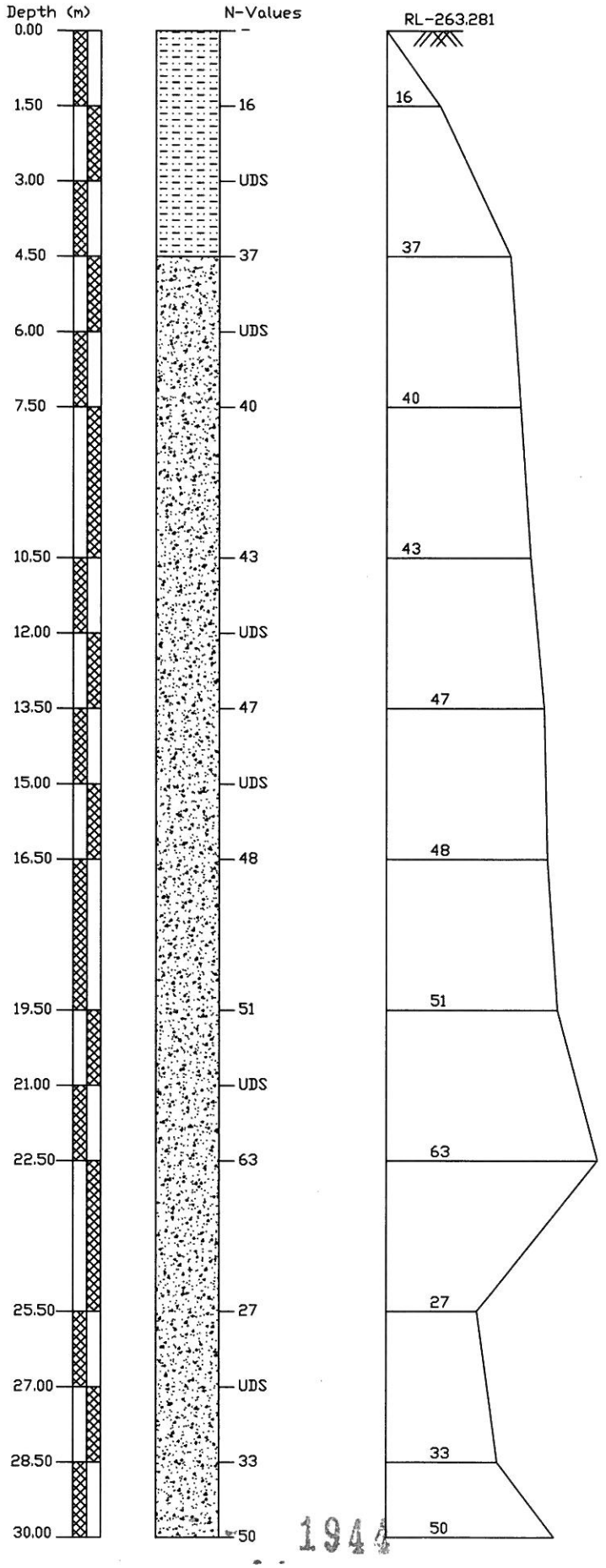
LEGEND

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

1943

CONSULTING Engineers Group Ltd.

BORELOG OF BH–3(A2) AT EXISTING KM–300/18–20 FOR MAJOR BRIDGE NO.–338,
ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

SYMBOL	DESCRIPTION
	CLAYEY SILT WITH SAND
	SILTY SAND

1944

CONSULTING Engineers Group Ltd.

CHAPTER – 84

"Major Bridge No. 331",

Location – Existing Km. - 294/14-18

84.1 LOCATION OF STRUCTURE:

Proposed Major Bridge of Span 15x6.1

84.2 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 21.00m 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 9.00	Sandy Silt	Dense
	9.00 to 10.50	Clayey Silt with Sand	Dense
	10.50 to 12.00	Clayey Silt	Dense
	12.00 to 13.50	Silty Sand with Clay	Dense
	13.50 to 16.50	Silty Sand	Very Dense
	16.50 to 18.00	Sandy Silt	Very Dense
	18.00 to 19.50	Clayey Silt with Sand	Very Dense
	19.50 to 22.50	Silty Sand	Very Dense
	22.50 to 25.50	Clayey Silt with Sand	Very Dense
	25.50 to 30.00	Silty Sand	Very Dense
	Below 30.00	Clayey Silt with Sand	Very Dense
BH-2(P7)	0.00 to 4.50	Clayey Silt with Sand	Loose
	4.50 to 9.00	Clayey Silt	Medium Dense
	9.00 to 10.50	Clayey Silt with Sand	Medium Dense
	10.50 to 12.00	Sandy Silt	Medium Dense
	12.00 to 15.00	Silty Sand	Dense
	15.00 to 19.50	Clayey Silt with Sand	Dense
	19.50 to 25.50	Silty Sand	Dense
	25.50 to 30.00	Silty Sand	Very Dense
	Below 30.00	Sandy Silt with Clay	Very Dense
BH-3(A2)	0.00 to 1.50	Clayey Silt with Sand and Gravels	Loose
	1.50 to 6.00	Clayey Silt with Sand and Gravels	Medium Dense
	6.00 to 7.50	Clayey Silt with Sand	Medium Dense
	7.50 to 10.50	Sandy Silt	Dense
	10.50 to 12.00	Clayey Silt	Dense
	12.00 to 18.00	Silty Sand	Very Dense
	18.00 to 22.50	Silty Sand with Clay	Very Dense
	22.50 to 25.50	Clayey Silt with Sand	Very Dense
	25.50 to 30.00	Silty Sand	Very Dense

1946

	Below 30.00	Clayey Silt	Very Dense

84.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1 (A1)	9.00	8.70	0.010	0.0017	NIL	0.0011	0.022
	12.00	8.70	0.010	0.0024	NIL	0.0013	0.040
BH-2 (P7)	3.00	8.60	0.007	0.0025	NIL	0.0011	0.034
	9.00	9.20	0.015	0.0021	NIL	0.0013	0.033
BH-3 (A2)	3.00	9.10	0.010	0.0031	NIL	0.0014	0.079
	6.00	9.00	0.007	0.0028	NIL	0.0013	0.051
	10.50	8.80	0.007	0.0021	NIL	0.0010	0.046

84.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1 (A1)	3.00	11.00
	9.00	14.00
	12.00	13.00
	18.00	20.00
BH-2 (P7)	3.00	21.00
	9.00	20.00
	15.00	16.00
	21.00	NIL
BH-3 (A2)	3.00	13.00
	6.00	12.00
	10.50	24.00
	18.00	10.00

84.5 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	7.2	69	98	182	730	0.2	2.6	935	603
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	-	-

84.6 SAFE BEARING CAPACITY t/m²

BH -NO.	DEPTH (mtr)	Net Allowable Bearing Pressure (t/m²)

BH-1 (A1)	1.50m	7.00
	3.00m	15.00
	4.50m	16.00
	6.00m	18.00
BH-3 (A2)	1.50m	6.50
	3.00m	11.00
	4.50m	13.00
	6.00m	14.00

84.7 PILE LOAD CARRYING CAPACITY

84.7.1 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)	20.00	130.00	150.00
	23.00	210.00	270.00
BH-2 (P7)	20.00	180.00	230.00
	23.00	230.00	290.00
BH-3 (A2)	20.00	100.00	130.00
	23.00	180.00	230.00

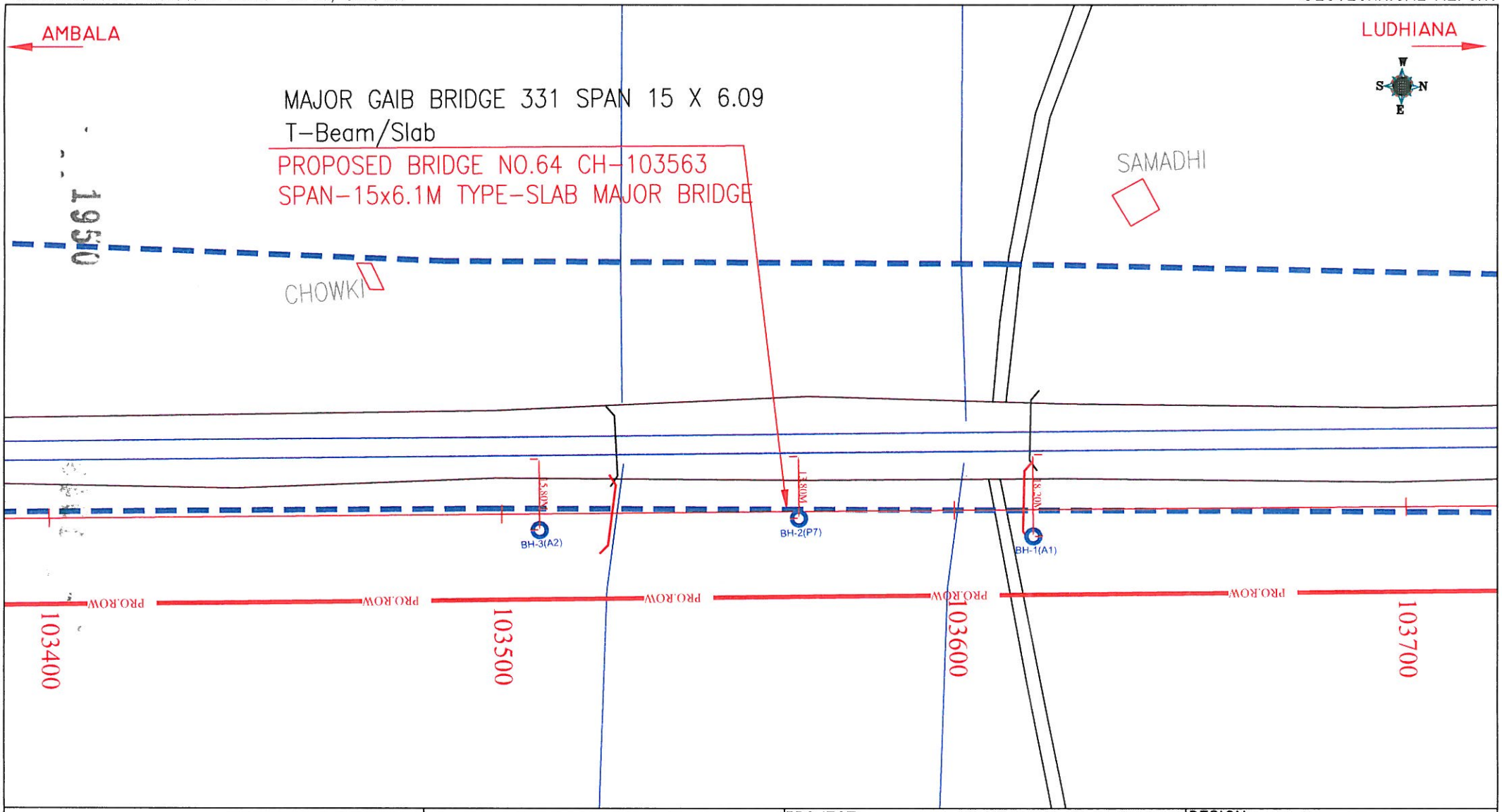
84.8 CONCLUSIONS

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

84.9 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 AT CH. 294/14-18	RL OF BH (AI) = 264.919 RL OF BH (P7) = 264.861 RL OF BH (A2) = 264.788	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) OF MAJOR BRIDGE No. 331 AT CHAINAGE 294/14-18

Project :	Chainage 294/14-18 Bridge No. 331			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				16.06.2009 to 16.06.2009	A1	1	22.00 m.	30.00mtr	264.919

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	12.85	75.00	4.56	3.26	1.22	3.11	0	30	20	10	-	-	-	-	-	-
1.50	7	1.46	10.22	Clayey silt with sand	13.55	77.12	3.98	2.13	1.64	1.58	0.00	30	19	11	-	-	-	-	-	-
3.00	UDS	-	-	Clayey silt with sand	20.10	69.52	2.91	1.56	1.02	4.89	0.00	25	18	7	1.68	7.77	1.56	2.64	0.08	23.00
4.50	16	1.10	17.60	Sandy silt with clay	8.11	59.91	31.74	0.18	0.06	0.00	0.00	21	16	5	-	-	-	-	-	-
7.50	32	0.92	29.44	Sandy Silt	2.23	48.95	47.14	1.06	0.12	0.50	0.00	25	NIL	NP	-	-	-	-	-	-
9.00	UDS	-	-	Clayey silt with sand	13.21	74.70	11.90	0.19	0.00	0.00	0.00	35	24	11	1.75	8.52	1.61	2.65	0.11	20.00
10.50	21	0.81	17.01	Clayey silt	22.21	73.75	2.20	0.47	0.26	1.11	0.00	41	22	19	-	-	-	-	-	-
12.00	UDS	-	-	Silty sand with clay	13.11	30.22	52.54	1.45	0.96	1.72	0.00	30	20	10	1.75	8.26	1.62	2.64	0.10	20.00
13.50	70	0.72	50.40	Silty Sand	2.22	8.63	87.08	1.94	0.13	0.00	0.00	23	NIL	NP	-	-	-	-	-	-
16.50	34	0.65	22.10	Sandy silt	2.16	68.75	28.17	0.71	0.05	0.16	0.00	22	NIL	NP	-	-	-	-	-	-
18.00	UDS	-	-	Clayey silt with sand	17.56	76.30	4.52	0.28	1.12	0.22	0.00	39	24	15	1.93	10.23	1.75	2.64	0.17	16.00
19.50	91	0.59	53.69	Silty Sand	2.11	6.83	88.66	2.27	0.13	0.00	0.00	27	NIL	NP	-	-	-	-	-	-
22.50	43	0.54	19.11	Clayey silt with sand	18.65	70.02	9.59	1.10	0.44	0.20	0.00	34	18	16	-	-	-	-	-	-
25.50	77	0.49	26.37	Silty Sand	2.31	6.22	88.37	1.95	0.34	0.81	0.00	24	NIL	NP	-	-	-	-	-	-
28.50	>100	-	-	Silty Sand	2.52	26.96	69.35	1.07	0.10	0.00	0.00	25	NIL	NP	-	-	-	-	-	-
30.00	43	0.44	16.96	Clayey silt with sand	8.54	82.17	9.29	0.00	0.00	0.00	0.00	25	19	6	-	-	-	-	-	-

SOIL CHARACTERISTICS OF BORE HOLE AT BH-2 (P7) OF MAJOR BRIDGE No. 331 AT CHAINAGE 294/14-18

Project :	Chainage 294/14-18 Bridge No. 331			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				16.06.2009 to 16.06.2009	P7	2	21.00 m.	30.00mtr	264.861

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	16.89	64.14	8.52	3.21	3.55	3.69	0	30	16	14	-	-	-	-	-	-
1.50	9	1.45	13.05	Clayey silt with sand	17.95	62.31	8.65	4.24	4.19	2.66	0.00	31	16	15	-	-	-	-	-	-
3.00	UDS	-	-	Clayey silt with sand	19.11	55.72	15.23	2.63	2.62	4.69	0.00	32	16	16	1.72	8.35	1.59	2.64	0.18	18.00
4.50	16	1.09	17.44	Clayey silt	16.21	78.52	3.03	0.34	0.36	1.54	0.00	31	18	13	-	-	-	-	-	-
7.50	23	0.92	21.16	Clayey silt	12.96	82.20	2.76	0.57	0.54	0.97	0.00	33	23	10	-	-	-	-	-	-
9.00	UDS	-	-	Clayey silt with sand	19.10	66.36	14.34	0.20	0.00	0.00	0.00	39	23	16	1.75	8.56	1.61	2.65	0.20	17.00
10.50	16	0.80	12.80	Sandy silt	4.88	83.28	7.93	0.82	0.75	2.34	0.00	32	NIL	NP	-	-	-	-	-	-
12.00	36	0.76	27.36	Silty Sand	2.15	13.47	80.33	1.20	0.52	2.33	0.00	24	NIL	NP	-	-	-	-	-	-
13.50	46	0.72	33.12	Silty Sand	2.35	8.11	84.55	3.73	0.54	0.72	0.00	25	NIL	NP	-	-	-	-	-	-
15.00	UDS	-	-	Clayey silt with sand	13.11	73.23	4.73	1.83	2.75	4.35	0.00	29	18	11	1.94	14.23	1.70	2.65	0.11	21.00
16.50	42	0.64	26.88	Clayey silt with sand	16.52	64.63	10.13	4.90	3.03	0.79	0.00	30	16	14	-	-	-	-	-	-
19.50	24	0.58	13.92	Silty Sand	2.56	6.62	85.93	3.95	0.46	0.48	0.00	26	NIL	NP	-	-	-	-	-	-
21.00	UDS	-	-	Silty Sand	4.55	6.41	81.89	6.32	0.83	0.00	0.00	28	NIL	NP	2.06	19.66	1.72	2.63	0.00	29.50
22.50	31	0.53	15.72	Silty Sand	2.32	7.46	86.68	1.53	1.03	0.98	0.00	25	NIL	NP	-	-	-	-	-	-
25.50	83	0.48	27.42	Silty Sand	2.55	9.47	82.91	4.55	0.28	0.24	0.00	26	NIL	NP	-	-	-	-	-	-
28.50	>100	-	-	Silty Sand	2.00	5.89	89.08	2.42	0.46	0.15	0.00	22	NIL	NP	-	-	-	-	-	-
30.00	38	0.42	15.48	Sandy silt with clay	11.23	50.42	35.76	2.34	0.25	0.00	0.00	30	21	9	-	-	-	-	-	-

CONSULTING Engineers Group Ltd.

ANNEXURE - I

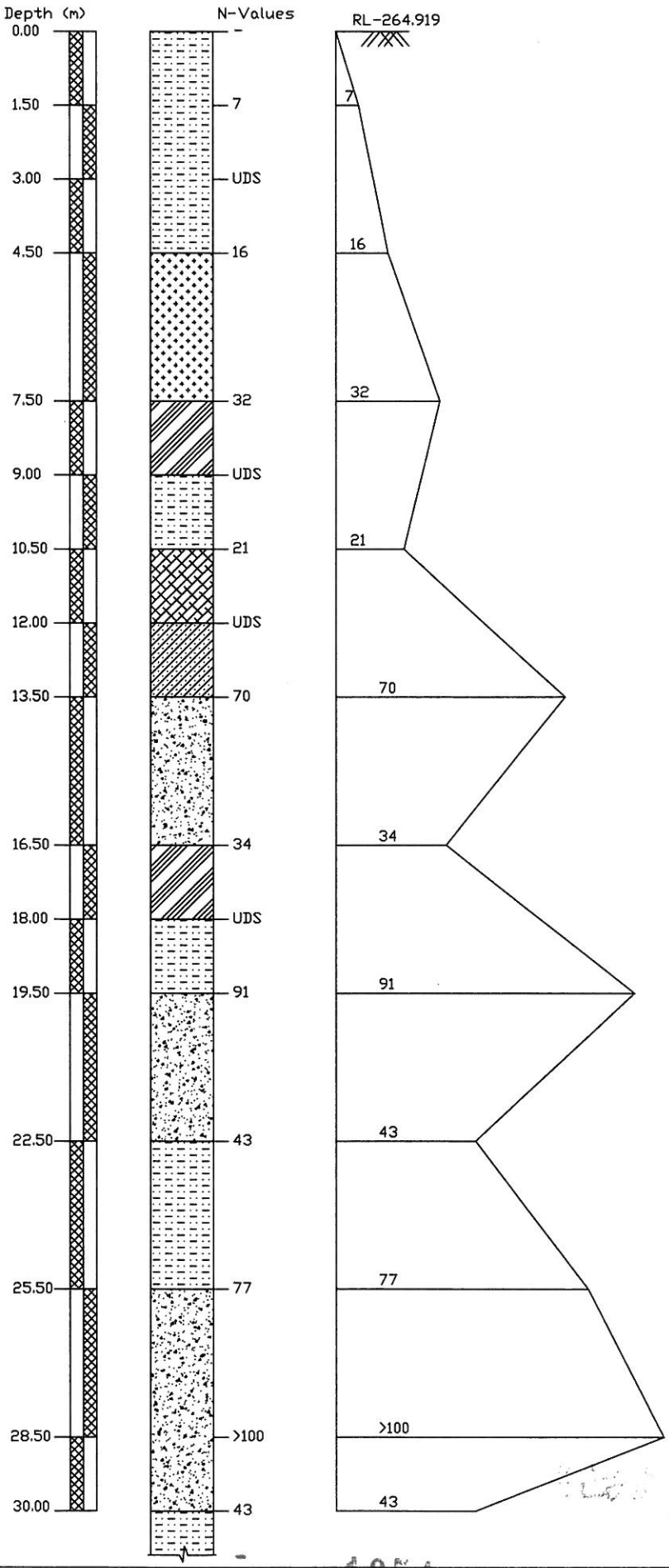
SOIL CHARACTERISTICS OF BORE HOLE AT BH-3 (A2) OF MAJOR BRIDGE No. 331 AT CHAINAGE 294/14-18

Project :	Chainage 294/14-18 Bridge No. 331			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				16.06.2009 to 17.06.2009	A2	3	21.00 m.	30.00mtr	264.788

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 and gravels	11.85	64.48	7.66	2.26	1.39	12.36	0	25	16	9	-	-	-	-	-	-
1.50	27	1.51	40.77	Clayey silt with sand and gravels	10.99	69.33	6.33	1.65	1.39	10.31	0.00	25	16	9	-	-	-	-	-	-
3.00	UDS	-	-	Clayey silt with sand and gravels	11.23	67.67	1.55	3.56	3.40	12.59	0.00	31	22	9	1.64	8.22	1.52	2.65	0.09	22.00
4.50	18	1.10	19.80	Clayey silt with sand and gravels	14.22	71.63	2.89	1.73	1.09	8.44	0.00	29	18	11	-	-	-	-	-	-
6.00	UDS	-	-	Clayey silt with sand	11.20	76.28	10.33	0.69	0.35	1.15	0.00	27	19	8	1.64	8.21	1.52	2.65	0.09	23.00
7.50	36	0.93	33.48	Sandy silt	2.66	50.51	46.78	0.05	0.00	0.00	0.00	26	NIL	NP	-	-	-	-	-	-
10.50	UDS	-	-	Clayey silt	21.33	77.49	0.90	0.28	0.00	0.00	0.00	45	26	19	1.70	10.36	1.54	2.64	0.23	13.00
12.00	57	0.77	43.89	Silty Sand	2.22	15.27	81.35	1.11	0.05	0.00	0.00	25	NIL	NP	-	-	-	-	-	-
13.50	67	0.73	48.91	Silty Sand	2.51	8.98	85.24	2.89	0.25	0.13	0.00	23	NIL	NP	-	-	-	-	-	-
16.50	32	0.66	21.12	Silty Sand	2.24	10.16	84.30	2.71	0.19	0.40	0.00	23	NIL	NP	-	-	-	-	-	-
18.00	UDS	-	-	Silty sand with clay	10.69	17.59	64.76	2.07	2.90	1.99	0.00	27	19	8	2.01	14.26	1.76	2.63	0.10	22.00
19.50	88	0.60	52.80	Silty sand with clay	11.12	25.38	60.46	2.49	0.48	0.07	0.00	26	18	8	-	-	-	-	-	-
22.50	44	0.54	19.38	Clayey silt with sand	9.80	77.78	4.32	1.65	1.55	4.90	0.00	27	19	8	-	-	-	-	-	-
25.50	75	0.49	25.88	Silty Sand	2.25	10.44	83.82	3.08	0.41	0.00	0.00	22	NIL	NP	-	-	-	-	-	-
28.50	>100	-	-	Silty Sand	2.65	8.70	84.72	3.39	0.54	0.00	0.00	24	NIL	NP	-	-	-	-	-	-
30.00	41	0.43	16.32	Clayey silt	20.11	78.58	0.89	0.12	0.10	0.20	0.00	42	25	17	-	-	-	-	-	-

CONSULTING Engineers Group Ltd.

BORELOG OF BH–1(A1) AT EXISTING KM–294/14–18 FOR MAJOR BRIDGE NO.–331,
ON KESARI TO SANEHWAL, LUDHIANA



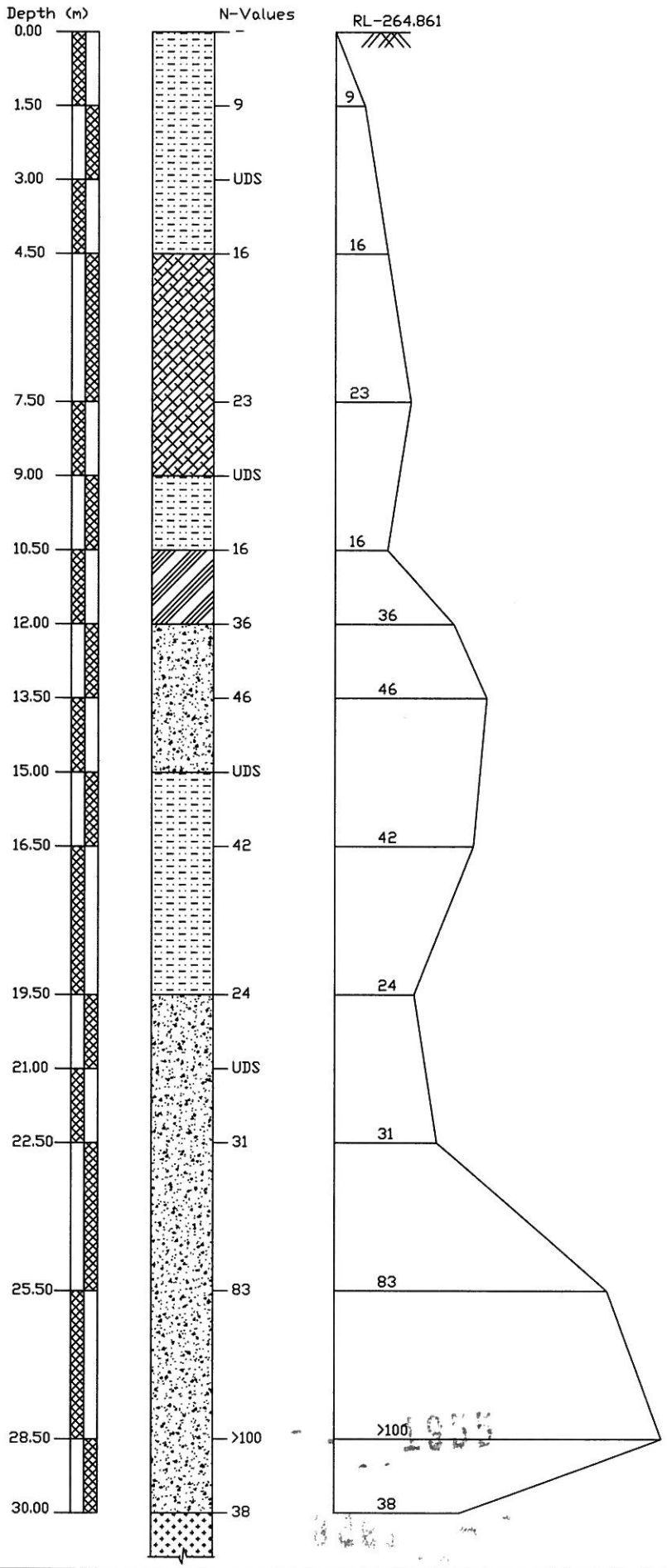
LEGEND

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

1954

CONSULTING Engineers Group Ltd.

BORELOG OF BH–2(P7) AT EXISTING KM–294/14–18 FOR MAJOR BRIDGE NO.–331,
ON KESARI TO SANEHWAL, LUDHIANA

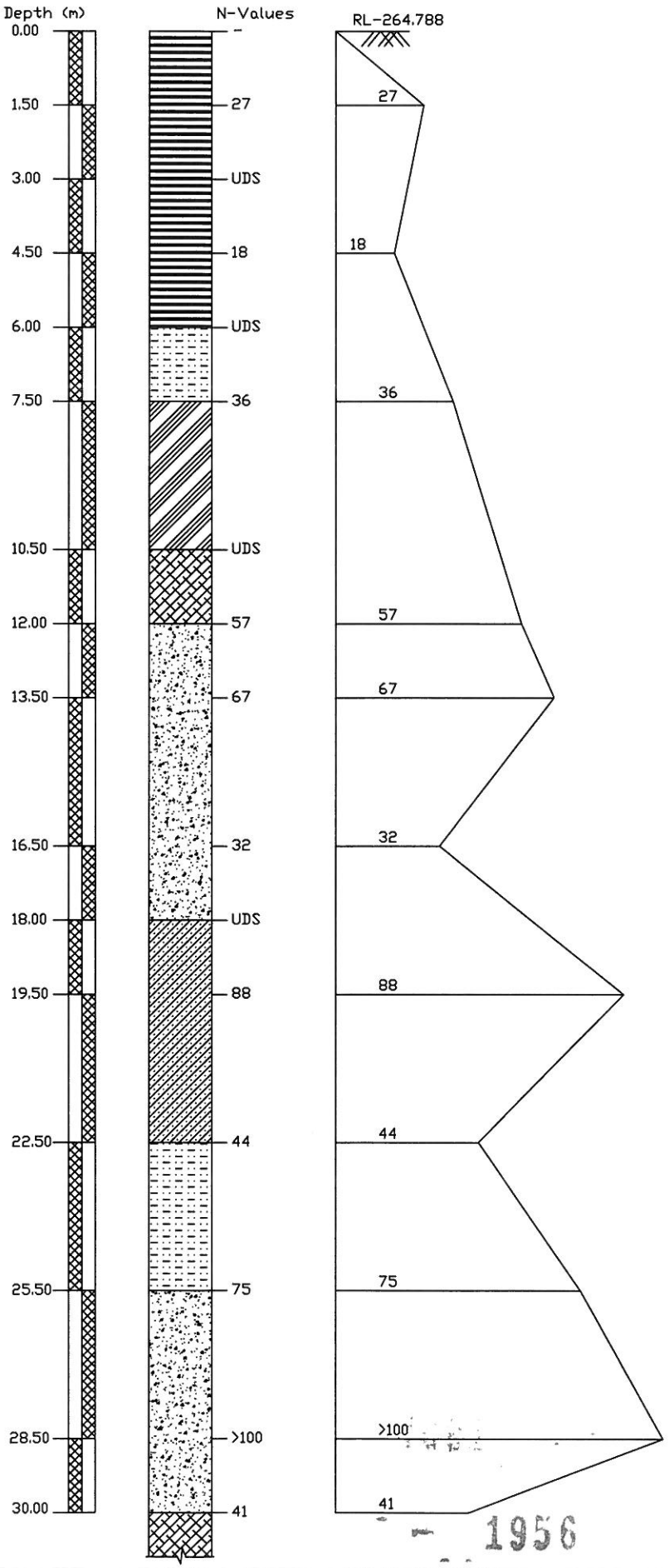


LEGEND

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

BORELOG OF BH-3(A2) AT EXISTING KM-294/14-18 FOR MAJOR BRIDGE NO.-331,

ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

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

1956

CONSULTING Engineers Group Ltd.

CHAPTER – 85

"Major Bridge No. 325",

Location – Existing Km. - 287/18-24

85.1 LOCATION OF STRUCTURE:

Proposed Major Bridge of Span 4 x 30.5

85.2 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 22.40m 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	Clayey Silt with Sand	Loose
	1.50 to 30.00	Clayey Silt with Sand	Medium Dense
BH-2(P2)	0.00 to 1.50	Clayey Silt with Sand	Loose
	1.50 to 9.00	Clayey Silt with Sand	Medium Dense
	9.00 to 12.00	Sandy Silt with Clay	Medium Dense
	12.00 to 26.50	Clayey Silt with Sand	Medium Dense
	26.50 to 30.00	Clayey Silt with Sand	Dense
BH-3(A2)	0.00 to 4.50	Clayey Silt with Sand	Loose
	4.50 to 6.00	Clayey Silt with Sand	Medium Dense
	6.00 to 19.50	Clayey Silt	Medium Dense
	19.50 to 22.50	Clayey Silt with Sand	Medium Dense
	22.50 to 30.0	Clayey Silt with Sand	Dense

85.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1 (A1)	3.00	8.10	NIL	0.0039	NIL	0.0013	0.231
	6.00	7.80	NIL	0.0028	NIL	0.0014	0.049
BH-2 (P2)	9.00	8.30	NIL	0.0028	NIL	0.0012	0.054
BH-3 (A2)	3.00	8.50	NIL	0.0032	NIL	0.0011	0.086
	6.00	8.50	0.002	0.0018	NIL	0.0012	0.049
	12.00	8.50	0.002	0.0024	NIL	0.0011	0.032
	21.00	8.50	0.002	0.0018	NIL	0.0011	0.034
	24.00	8.80	0.007	0.0025	NIL	0.0010	0.047

85.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1 (A1)	3.00	30.00
	6.00	10.00
	12.00	15.00
	15.00	14.00
	24.00	21.00
BH-2 (P2)	3.00	28.00
	9.00	11.00
	15.00	28.00
	24.00	22.00
BH-3 (A2)	3.00	30.00
	6.00	16.00
	12.00	12.00
	21.00	13.00
	24.00	19.00

85.5 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	7.4	98	86	185	850	0.1	2.0	1052	680
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	-	-

85.6 SAFE BEARING CAPACITY t/m²

BH -NO.	DEPTH (mtr)	Net Allowable Bearing Pressure (t/m²)
BH-1 (A1)	1.50m	6.00
	3.00m	8.00
	4.50m	9.00
	6.00m	9.50
BH-3 (A2)	1.50m	8.00
	3.00m	10.00
	4.50m	11.00
	6.00m	12.00

85.7 PILE LOAD CARRYING CAPACITY

85.7.1 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	80.00	90.00
	20.00	100.00	120.00
	23.00	130.00	150.00
BH-2 (P2)	17.00	80.00	100.00
	20.00	110.00	130.00
	23.00	140.00	170.00
BH-3 (A2)	17.00	90.00	110.00
	20.00	130.00	150.00
	23.00	160.00	190.00

85.8 CONCLUSIONS

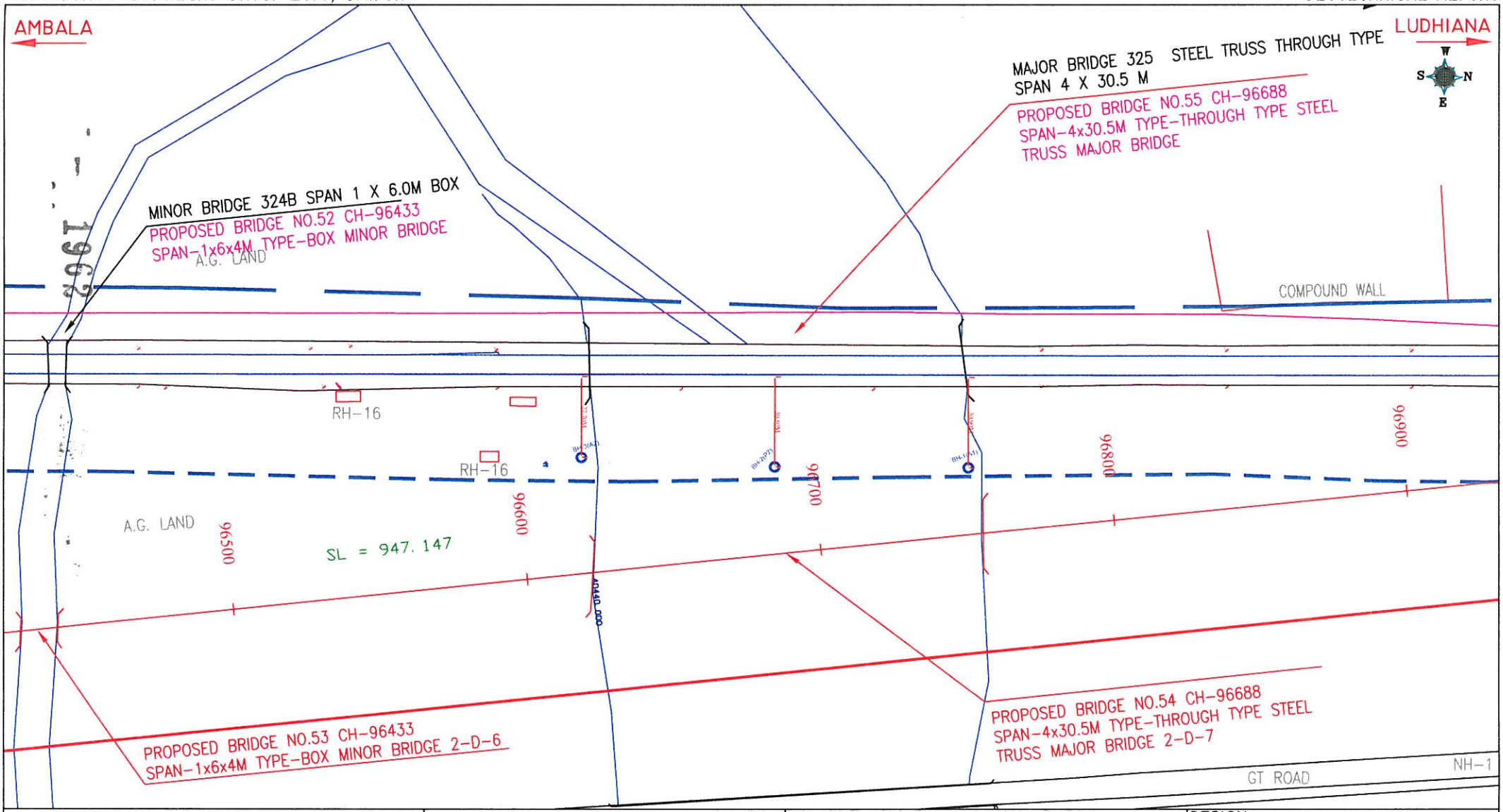
- Subsurface Profiles indicates suitable Soil formation for foundations.
- Chemical contents of Water are within the safe limits for construction purpose.

1960

85.9 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-287/18-24

RL OF BH (A1) = 265.102
RL OF BH (P2) = 264.828
RL OF BH (A2) = 267.71

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) OF MAJOR BRIDGE No. 325 AT CHAINAGE 287/18-24

Project :	Chainage 287/18-24 Bridge No. 325			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				18.06.2009 to 18.06.2009	A1	1	22.40 m.	30.00mtr	265.102

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	22.89	70.10	3.25	2.15	0.66	0.95	0.00	40	20	20	-	-	-	-	-	-
1.50	10	1.51	15.10	Clayey silt with sand	23.88	69.46	2.58	3.02	0.60	0.46	0.00	43	22	21	-	-	-	-	-	-
3.00	UDS	-	-	Clayey silt with sand	26.12	66.32	2.68	1.94	2.22	0.72	0.00	44	21	23	1.65	8.82	1.52	2.66	0.30	10.00
4.50	13	1.10	14.30	Clayey silt with sand	22.95	70.59	3.55	0.69	0.66	1.56	0.00	42	21	21		-	-	-	-	-
6.00	UDS	-	-	Clayey silt with sand	11.21	79.04	3.45	2.09	1.74	2.47	0.00	30	22	8	1.65	8.42	1.52	2.65	0.08	23.00
7.50	17	0.93	15.81	Clayey silt with sand	11.65	61.65	25.59	0.57	0.32	0.22	0.00	29	20	9	-	-	-	-	-	-
10.50	18	0.82	14.76	Clayey silt with sand	13.21	78.52	4.79	1.38	1.25	0.85	0.00	30	19	11	-	-	-	-	-	-
12.00	UDS	-	-	Clayey silt with sand	14.69	77.50	5.23	1.23	0.69	0.66	0.00	30	18	12	1.85	12.33	1.65	2.64	0.13	19.00
13.50	15	0.73	10.95	Clayey silt with sand	13.29	75.41	6.25	2.66	2.39	0.00	0.00	30	19	11	-	-	-	-	-	-
15.00	UDS	-	-	Clayey silt with sand	15.10	75.44	8.87	0.59	0.00	0.00	0.00	29	17	12	1.87	13.22	1.65	2.64	0.13	19.00
16.50	14	0.65	9.10	Clayey silt with sand	18.89	76.69	4.28	0.14	0.00	0.00	0.00	37	21	16	-	-	-	-	-	-
19.50	16	0.59	9.44	Clayey silt with sand	18.10	74.76	5.23	1.26	0.65	0.00	0.00	35	20	15	-	-	-	-	-	-
22.50	15	0.54	8.10	Clayey silt with sand	26.88	60.28	8.00	2.06	1.46	1.32	0.00	39	15	24	-	-	-	-	-	-
24.00	UDS	-	-	Clayey silt with sand	19.89	65.53	8.44	2.10	1.36	2.68	0.00	36	19	17	2.05	20.36	1.70	2.64	0.21	15.00
25.50	20	0.49	9.80	Clayey silt with sand	18.10	74.79	5.23	0.68	1.20	0.00	0.00	34	19	15	-	-	-	-	-	-
28.50	22	0.45	9.90	Clayey silt with sand	17.99	76.10	4.77	0.77	0.37	0.00	0.00	33	18	15	-	-	-	-	-	-
30.00	23	0.43	9.89	Clayey silt with sand	18.59	72.51	6.25	1.29	1.36	0.00	0.00	37	21	16	-	-	-	-	-	-

CONSULTING
Engineers Group Ltd.

SOIL CHARACTERISTICS OF BORE HOLE AT BH-2 (P2) OF MAJOR BRIDGE No. 325 AT CHAINAGE 287/18-24

Project :	Chainage 287/18-24 Bridge No. 325			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				18.06.2009 to 19.06.2009	P2	2	22.40 m.	30.00mtr	264.828

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	22.56	68.11	6.25	2.15	0.68	0.25	0	41	21	20	-	-	-	-	-	-
1.50	15	1.44	21.60	Clayey silt with sand	25.89	62.62	9.41	1.09	0.49	0.50	0.00	41	18	23	-	-	-	-	-	-
3.00	UDS	-	-	Clayey silt with sand	23.58	60.10	6.25	4.22	3.25	2.60	0.00	40	20	20	1.82	8.39	1.68	2.65	0.25	13.00
4.50	18	1.07	19.26	Clayey silt with sand	18.59	65.81	2.85	4.60	4.84	3.31	0.00	35	19	16	-	-	-	-	-	-
7.50	19	0.90	17.10	Clayey silt with sand	13.25	74.56	6.25	2.25	1.59	2.10	0.00	32	22	10	-	-	-	-	-	-
9.00	UDS	-	-	sandy silt with clay	10.66	68.36	20.66	0.32	0.00	0.00	0.00	28	20	8	1.81	8.26	1.67	2.66	0.10	21.00
10.50	21	0.79	16.59	Sandy silt with clay	10.11	70.88	18.66	0.35	0.00	0.00	0.00	27	20	7	-	-	-	-	-	-
12.00	22	0.74	16.28	Clayey silt with sand	21.95	62.04	12.36	2.15	1.25	0.25	0.00	40	20	20	-	-	-	-	-	-
13.50	23	0.70	16.10	Clayey silt with sand	20.15	60.37	14.23	3.25	2.00	0.00	0.00	36	18	18	-	-	-	-	-	-
15.00	UDS	-	-	Clayey silt with sand	23.58	57.03	4.80	3.53	2.19	8.87	0.00	42	21	21	1.94	15.26	1.68	2.65	0.27	12.00
16.50	22	0.63	13.86	Clayey silt with sand	24.16	66.76	4.05	1.91	1.46	1.66	0.00	44	22	22	-	-	-	-	-	-
19.50	23	0.57	13.11	Clayey silt with sand	18.11	74.35	5.59	1.26	0.69	0.00	0.00	35	20	15	-	-	-	-	-	-
22.50	26	0.52	13.52	Clayey silt with sand	20.85	69.06	6.25	2.56	0.95	0.33	0.00	37	19	18	-	-	-	-	-	-
24.00	UDS	-	-	Clayey silt with sand	19.98	70.84	4.08	2.13	1.56	1.41	0.00	36	19	17	2.06	21.10	1.70	2.66	0.18	16.00
25.50	28	0.48	13.44	Clayey silt with sand	22.10	70.15	4.09	1.79	1.29	0.58	0.00	36	17	19	-	-	-	-	-	-
26.50	30	0.46	13.80	Clayey silt with sand	24.56	67.29	5.21	1.59	0.69	0.66	0.00	41	21	20	-	-	-	-	-	-
30.00	32	0.42	13.44	Clayey silt with sand	23.00	68.27	5.26	2.56	0.68	0.23	0.00	40	20	20	-	-	-	-	-	-

CONSULTING Engineers Group Ltd.

ANNEXURE - I

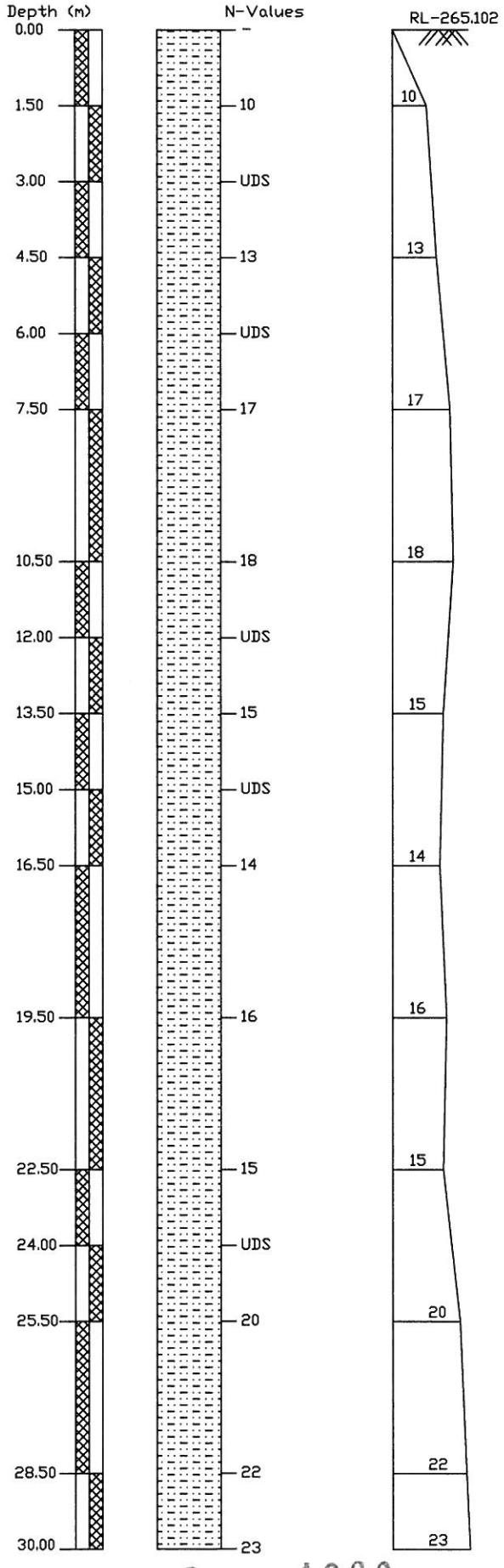
SOIL CHARACTERISTICS OF BORE HOLE AT BH-3 (A2) OF MAJOR BRIDGE No. 325 AT CHAINAGE 287/18-24

Project :	Chainage 287/18-24 Bridge No. 325			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				18.06.2009 to 18.06.2009	A2	3	22.40 m.	30.00mtr	267.710

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	17.89	64.14	10.48	3.58	1.33	2.58	0	37	22	15	-	-	-	-	-	-
1.50	9	1.44	12.96	Clayey silt with sand	15.88	68.05	9.41	2.35	2.54	1.77	0.00	32	19	13	-	-	-	-	-	-
3.00	UDS	-	-	Clayey silt with sand	25.10	60.91	3.95	3.24	2.21	4.59	0.00	42	20	22	1.72	5.42	1.63	2.72	0.26	12.00
4.50	13	1.07	13.91	Clayey silt with sand	22.56	68.72	4.21	3.25	1.26	0.00	0.00	40	20	20	-	-	-	-	-	-
6.00	UDS	-	-	Clayey silt	15.11	82.58	1.27	0.16	0.27	0.61	0.00	33	21	12	1.83	5.91	1.73	2.66	0.13	18.00
7.50	11	0.90	9.90	Clayey silt	13.41	81.19	3.80	0.52	0.30	0.78	0.00	30	19	11	-	-	-	-	-	-
10.50	16	0.78	12.48	Clayey silt	8.52	86.02	2.94	1.08	0.95	0.49	0.00	23	17	6	-	-	-	-	-	-
12.00	UDS	-	-	Clayey silt	12.15	85.23	2.32	0.22	0.08	0.00	0.00	33	23	10	1.87	13.26	1.65	2.65	0.11	20.00
13.50	10	0.70	7.00	Clayey silt	14.93	81.25	2.59	0.68	0.55	0.00	0.00	34	22	12	-	-	-	-	-	-
16.50	10	0.63	6.30	Clayey silt	15.79	79.37	3.29	0.65	0.27	0.63	0.00	32	19	13	-	-	-	-	-	-
19.50	19	0.57	10.83	Clayey silt with sand	12.55	73.73	10.25	2.25	1.22	0.00	0.00	31	21	10	-	-	-	-	-	-
21.00	UDS	-	-	Clayey silt with sand	11.98	74.03	13.92	0.07	0.00	0.00	0.00	25	16	9	1.92	10.40	1.74	2.66	0.09	22.00
22.50	32	0.52	15.82	Clayey silt with sand	18.89	76.49	3.21	1.29	0.12	0.00	0.00	34	18	16	-	-	-	-	-	-
24.00	UDS	-	-	Clayey silt with sand	18.10	75.05	6.57	0.20	0.08	0.00	0.00	32	17	15	2.03	18.26	1.72	2.65	0.17	17.00
25.50	15	0.48	7.20	Clayey silt with sand	20.15	75.18	3.28	0.99	0.40	0.00	0.00	34	17	17	-	-	-	-	-	-
28.50	14	0.44	6.16	Clayey silt with sand	18.89	74.08	4.23	2.25	0.55	0.00	0.00	36	18	16	-	-	-	-	-	-
30.00	22	0.42	9.24	Clayey silt with sand	22.85	71.22	4.13	1.26	0.54	0.00	0.00	40	20	20	-	-	-	-	-	-

CONSULTING
Engineers Group Ltd.

BORELOG OF BH–1(A1) AT EXISTING KM–287/18–24 FOR MAJOR BRIDGE NO.–325,
ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

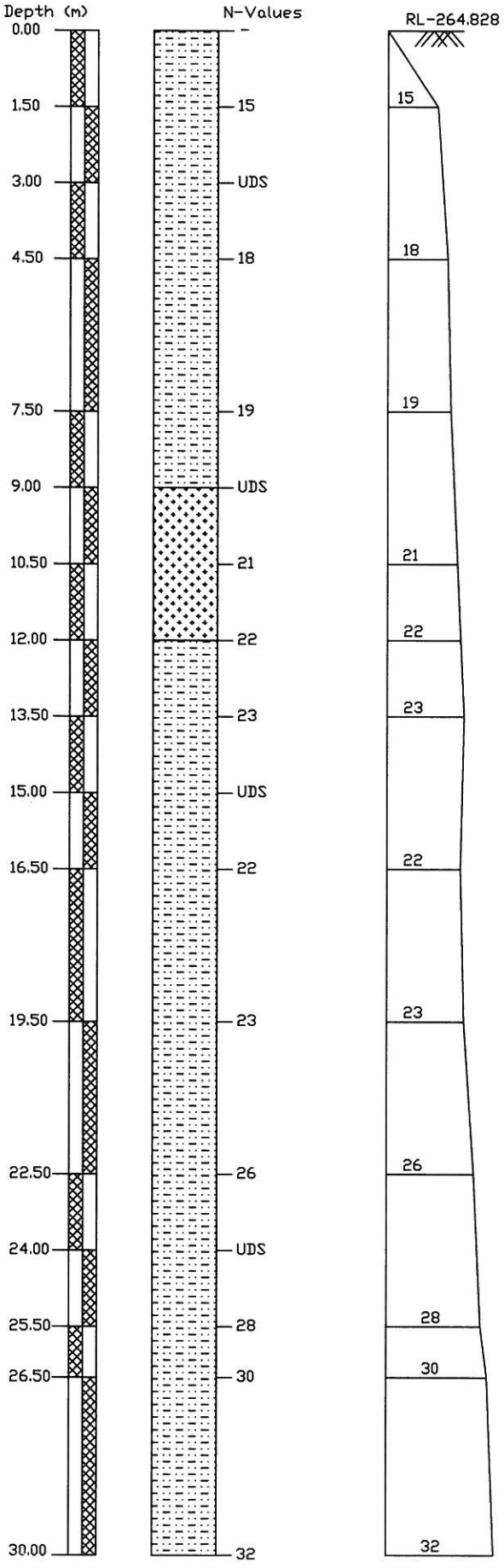
SYMBOL	DESCRIPTION
	CLAYEY SILT WITH SAND

1966

CONSULTING Engineers Group Ltd.

BORELOG OF BH–2(P2) AT EXISTING KM–287/18–24 FOR MAJOR BRIDGE NO.–325,

ON KESARI TO SANEHWAL, LUDHIANA



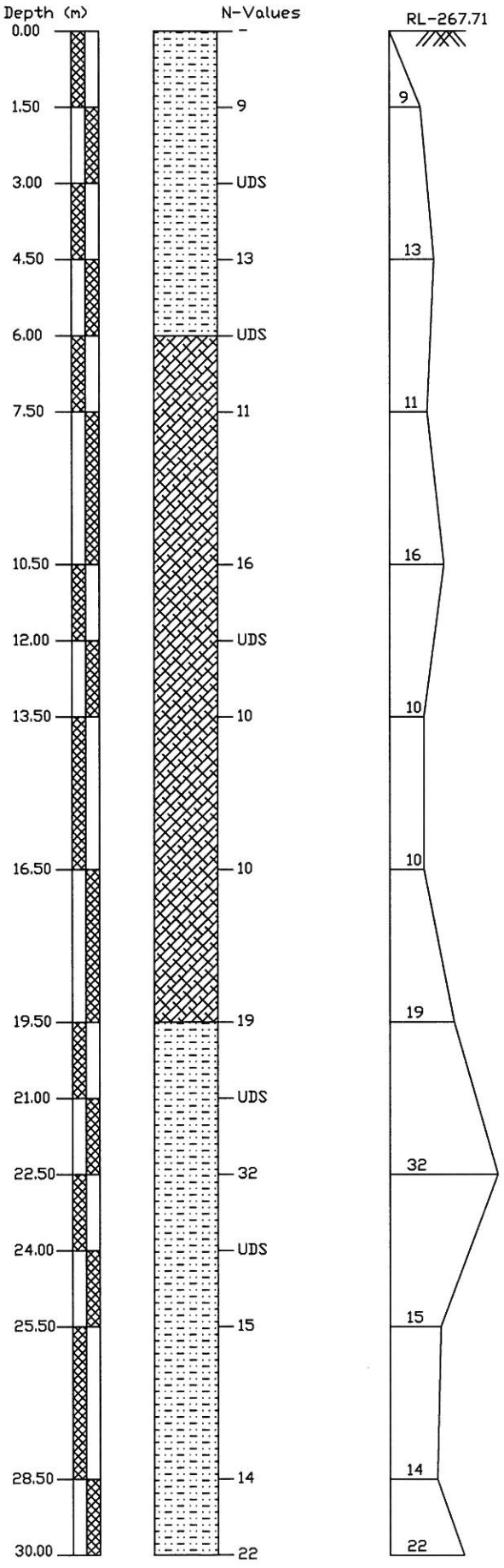
LEGEND

SYMBOL	DESCRIPTION
	CLAYEY SILT WITH SAND
	SANDY SILT WITH CLAY

1967

CONSULTING Engineers Group Ltd.

BORELOG OF BH–3(A2) AT EXISTING KM–287/18–24 FOR MAJOR BRIDGE NO.–325,
ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

SYMBOL	DESCRIPTION
	CLAYEY SILT WITH SAND
	CLAYEY SILT

1968

CONSULTING Engineers Group Ltd.

CHAPTER – 86

"Major Bridge No. 322A",

Location – Existing Km. - 283/12-16

86.1 LOCATION OF STRUCTURE:

Proposed Major Bridge of Span (2x18.3) + (2x12.2)

86.2 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	Sandy Silt with Clay	Loose
	1.50 to 3.00	Sandy Silt with Clay	Medium Dense
	3.00 to 4.50	Clayey Silt with Sand	Medium Dense
	4.50 to 10.50	Silty Sand	Medium Dense
	10.50 to 16.50	Sandy Silt with Clay	Medium Dense
	16.50 to 30.00	Clayey Silt with Sand	Medium Dense
BH-2(P2)	0.00 to 4.50	Sandy Silt with Clay	Loose
	4.50 to 15.00	Sandy Silt with Clay	Medium Dense
	15.00 to 22.50	Clayey Silt with Sand	Medium Dense
	22.50 to 30.0	Sandy Silt with Clay	Very dense
BH-3(A2)	0.00 to 1.50	Clayey Silt with Sand	Loose
	1.50 to 3.00	Clayey Silt with Sand	Medium Dense
	3.00 to 4.50	Clayey Silt	Medium Dense
	4.50 to 25.50	Silty Sand	Medium Dense
	25.50 to 30.00	Silty Sand	Dense

86.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1 (A1)	3.00	8.50	0.002	0.0018	NIL	0.0010	0.069
	9.00	7.70	NIL	0.0021	NIL	0.0011	0.073
	21.00	8.80	0.020	0.0014	NIL	0.0009	0.026
BH-2 (P2)	3.00	8.20	NIL	0.0020	NIL	0.0011	0.023
	9.00	8.62	NIL	0.0028	NIL	0.0015	0.028
BH-3 (A2)	3.00	8.30	NIL	0.0018	NIL	0.0010	0.042

86.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1 (A1)	3.00	29.00
	9.00	NIL
	12.00	12.00
	21.00	22.00
	24.00	21.00
BH-2 (P2)	3.00	10.00
	6.00	14.00
	12.00	13.00
	15.00	20.00
	21.00	17.00
BH-3 (A2)	3.00	28.00
	6.00	NIL
	15.00	NIL
	21.00	NIL

84.5 SAFE BEARING CAPACITY t/m²

BH -NO.	DEPTH (mtr)	Net Allowable Bearing Pressure (t/m²)
BH-1 (A1)	1.50m	7.00
	3.00m	8.50
	4.50m	11.5
	6.00m	12.5
BH-3 (A2)	1.50m	6.00
	3.00m	9.00
	4.50m	10.00
	6.00m	11.00

86.6 PILE LOAD CARRYING CAPACITY

86.6.1 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	80.00	100.00
	20.00	110.00	130.00
	23.00	140.00	170.00
BH-2 (P2)	17.00	80.00	100.00
	20.00	110.00	130.00
	23.00	140.00	170.00
BH-3 (A2)	17.00	140.00	180.00
	20.00	180.00	240.00
	23.00	230.00	300.00

86.6 CONCLUSIONS

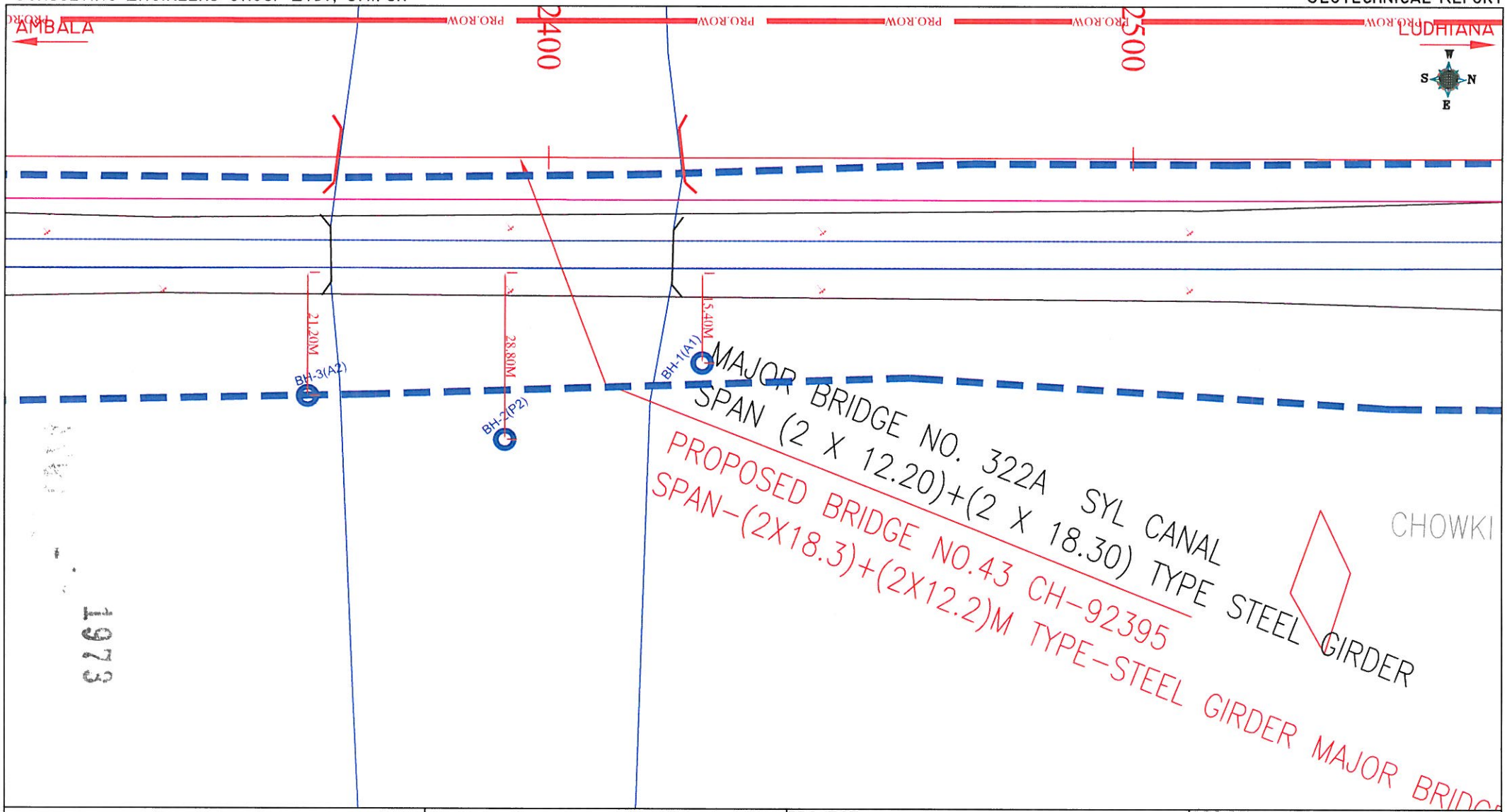
- Subsurface Profiles indicates suitable Soil formation for foundations.

86.7 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.

1972



ALL DIMENSIONS IN METER FIG.:-1 LOCATION PLAN OF PROPOSED MAJOR BRIDGE CH-283/12-16	RL OF BH (A1) = 265.486 RL OF BH (P2) = 261.786 RL OF BH (A2) = 268.458	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) OF MAJOR BRIDGE No. 322A AT CHAINAGE 283/12-16

Project :	Chainage 283/12-16 Bridge No. 322A			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				20.06.2009 to 21.06.2009	A1	1	Below 30.00 m.	30.00mtr	265.486

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	18.1	57.09	20.56	2.59	1.2	0.46	0.00	35	20	15	-	-	-	-	-	-
1.50	45	1.46	65.70	Sandy Silt with clay	16.54	61.35	19.22	1.56	0.56	0.77	0.00	31	17	14	-	-	-	-	-	-
3.00	UDS	-	-	Clayey silt with sand	24.89	67.29	7.16	0.24	0.42	0.00	0.00	40	18	22	1.67	8.45	1.54	2.69	0.27	12.00
4.50	26	1.10	28.60	Silty Sand	2.59	31.31	64.00	1.74	0.18	0.18	0.00	21	NP	NIL	-	-	-	-	-	-
7.50	28	0.93	26.04	Silty Sand	2.98	20.83	74.99	0.80	0.27	0.13	0.00	23	NP	NIL	-	-	-	-	-	-
9.00	UDS	-	-	Silty Sand	3.19	18.67	57.28	4.35	0.98	15.53	0.00	23	NP	NIL	1.74	8.93	1.60	2.66	0.00	26.50
10.50	18	0.81	14.58	Sandy Silt with clay	10.66	42.70	36.00	8.19	0.92	1.53	0.00	26	20	6	-	-	-	-	-	-
12.00	UDS	-	-	Sandy Silt with clay	11.85	49.24	36.45	2.34	0.12	0.00	0.00	29	19	10	1.87	12.28	1.67	2.65	0.10	21.00
13.50	13	0.72	9.36	Sandy Silt with clay	12.98	48.02	28.12	6.54	1.87	2.47	0.00	30	20	10	-	-	-	-	-	-
16.50	19	0.65	12.35	Clayey silt with sand	14.93	76.88	7.32	0.77	0.10	0.00	0.00	31	19	12	-	-	-	-	-	-
19.50	22	0.59	12.98	Clayey silt with sand	18.12	73.75	5.26	2.18	0.69	0.00	0.00	34	19	15	-	-	-	-	-	-
21.00	UDS	-	-	Clayey silt with sand	18.85	75.19	4.17	0.84	0.95	0.00	0.00	33	17	16	2.08	16.73	1.78	2.65	0.18	17.00
22.50	29	0.53	15.37	Clayey silt with sand	16.95	75.83	5.10	1.71	0.41	0.00	0.00	31	17	14	-	-	-	-	-	-
24.00	UDS	-	-	Clayey silt with sand	17.88	74.02	5.26	2.18	0.66	0.00	0.00	33	18	15	2.05	15.66	1.77	2.66	0.17	17.00
25.50	22	0.48	10.56	Clayey silt with sand	15.12	71.92	12.08	0.34	0.22	0.32	0.00	27	15	12	-	-	-	-	-	-
28.50	28	0.44	12.32	Clayey silt with sand	15.59	71.37	10.23	2.15	0.66	0.00	0.00	31	18	13	-	-	-	-	-	-
30.00	46	0.42	19.32	Clayey silt with sand	19.10	63.37	12.36	3.25	1.26	0.66	0.00	34	18	16	-	-	-	-	-	-

CONSULTING Engineers Group Ltd.

ANNEXURE - I

SOIL CHARACTERISTICS OF BORE HOLE AT BH-2 (P2) OF MAJOR BRIDGE No. 322A AT CHAINAGE 283/12-16

Project :	Chainage 283/12-16 Bridge No. 322A			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				20.06.2009 to 21.06.2009	P2	2	Below 30.00 m.	30.00mtr	261.786

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	12.15	66.27	18.56	1.36	1.2	0.46	0.00	29	19	10	-	-	-	-	-	-
1.50	9	1.51	13.59	Sandy Silt with clay	11.89	67.18	18.56	0.96	0.56	0.85	0.00	30	21	9	-	-	-	-	-	-
3.00	UDS	-	-	Sandy Silt with clay	10.89	77.74	8.59	2.36	0.42	0.00	0.00	26	18	8	1.62	6.25	1.52	2.66	0.10	21.00
4.50	20	1.11	22.20	Sandy Silt with clay	14.59	69.43	10.36	5.26	0.18	0.18	0.00	30	18	12	-	-	-	-	-	-
6.00	UDS	-	-	Sandy Silt with clay	13.98	63.73	16.23	5.66	0.27	0.13	0.00	29	18	11	1.60	7.59	1.49	2.65	0.11	21.00
7.50	22	0.94	20.68	Sandy Silt with clay	13.55	57.68	20.36	2.56	0.59	5.26	0.00	29	18	11					-	-
10.50	22	0.83	18.26	Sandy Silt with clay	13.21	42.73	36.00	5.59	0.94	1.53	0.00	28	18	10	-	-	-	-	-	-
12.00	UDS	-	-	Sandy Silt with clay	13.55	69.73	14.26	2.34	0.12	0.00	0.00	29	19	10	1.87	10.26	1.60	2.67	0.10	20.00
13.50	16	0.73	11.68	Sandy Silt with clay	11.85	66.81	13.29	5.49	0.98	1.58	0.00	27	18	9	-	-	-	-	-	-
15.00	UDS	-	-	Clayey silt with sand	18.21	75.17	5.26	1.26	0.10	0.00	0.00	35	20	15	2.08	16.73	1.78	2.67	0.18	17.00
16.50	23	0.65	14.95	Clayey silt with sand	19.11	70.89	6.26	2.18	1.56	0.00	0.00	32	16	16	-	-	-	-	-	-
19.50	24	0.59	14.16	Clayey silt with sand	20.10	70.77	4.59	3.59	0.95	0.00	0.00	38	21	17					-	-
21.00	UDS	-	-	Clayey silt with sand	16.20	71.90	8.26	2.69	0.95	0.00	0.00	31	18	13	2.05	15.66	1.77	2.68	0.14	18.00
22.50	30	0.53	15.90	Sandy Silt with clay	17.85	60.84	17.26	1.69	2.36	0.00	0.00	33	18	15					-	-
25.50	42	0.49	20.58	Sandy Silt with clay	17.23	59.19	20.36	2.68	0.22	0.32	0.00	36	22	14	-	-	-	-	-	-
28.50	45	0.44	19.80	Sandy Silt with clay	19.59	58.38	18.52	2.15	1.36	0.00	0.00	37	20	17	-	-	-	-	-	-
30.00	56	0.43	24.08	Sandy Silt with clay	23.12	45.11	24.59	5.26	1.26	0.66	0.00	40	20	20	-	-	-	-	-	-

CONSULTING Engineers Group Ltd.

SOIL CHARACTERISTICS OF BORE HOLE AT BH-3 (A2) OF MAJOR BRIDGE No. 322A AT CHAINAGE 283/12-16

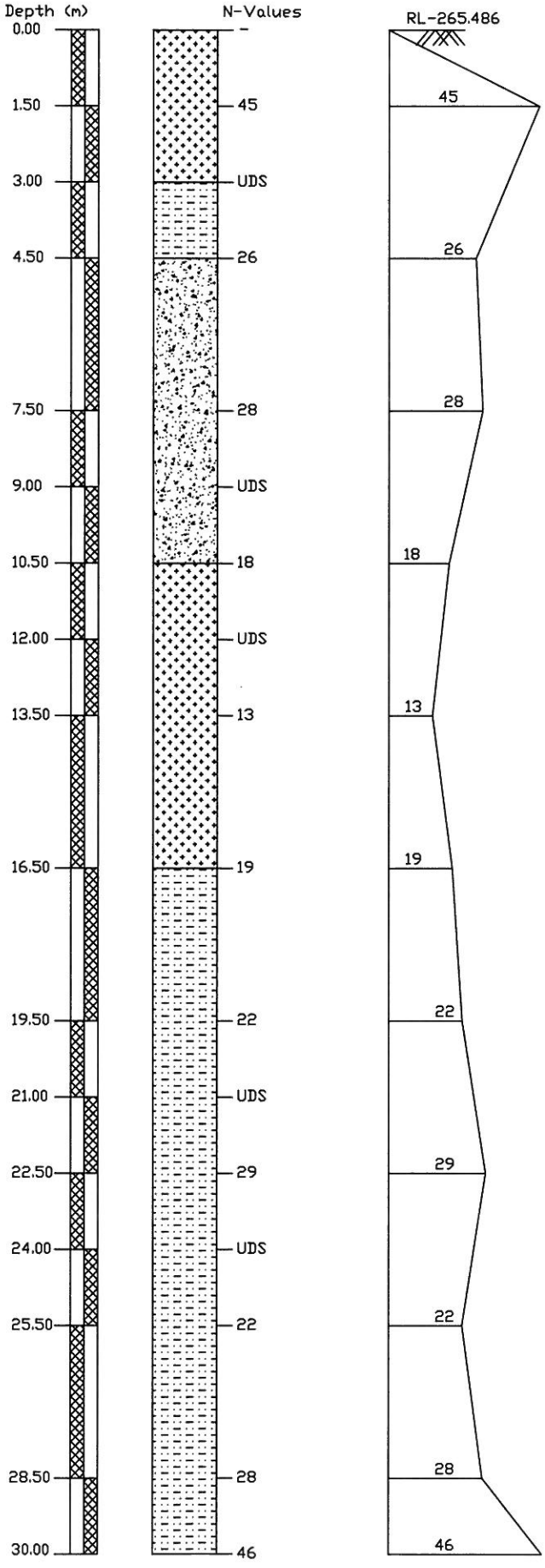
Project :	Chainage 283/12-16 Bridge No. 322A			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				21.06.2009 to 21.06.2009	A2	3	Below 30.00 m.	30.00mtr	268.458

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	67.40	4.56	3.25	1.29	0.65	0	40	20	20	-	-	-	-	-	-
1.50	12	1.51	18.12	Clayey silt with sand	23.68	64.86	6.97	2.25	1.26	0.98	0.00	40	19	21	-	-	-	-	-	-
3.00	UDS	-	-	Clayey silt	23.25	71.91	1.67	1.02	1.30	0.85	0.00	42	21	21	1.65	8.37	1.52	2.65	0.26	13.00
4.50	22	1.10	24.20	Silty sand	2.65	17.69	77.40	2.26	0.00	0.00	0.00	23	NP	NIL	-	-	-	-	-	-
6.00	UDS	-	-	Silty sand	2.61	14.41	70.36	10.36	2.26	0.00	0.00	22	NP	NIL	1.69	8.60	1.56	2.66	0.00	26.50
7.50	27	0.93	25.11	Silty sand	2.22	13.22	69.90	14.60	0.06	0.00	0.00	21.00	NP	NIL		-	-	-	-	-
10.50	14	0.81	11.34	Silty sand	2.67	7.78	74.69	14.29	0.38	0.19	0.00	24	NP	NIL	-	-	-	-	-	-
13.50	15	0.73	10.95	Silty sand	3.25	10.41	72.36	12.36	0.36	1.26	0.00	22	NP	NIL	-	-	-	-	-	-
15.00	UDS	-	-	Silty Sand	2.15	10.15	80.15	6.58	0.69	0.28	0.00	20	NP	NIL	1.83	10.29	1.66	2.65	0.00	27.50
16.50	17	0.66	11.22	Silty Sand	2.25	14.51	78.26	3.36	1.26	0.36	0.00	23	NP	NIL	-	-	-	-	-	-
19.50	21	0.60	12.60	Silty Sand	3.15	8.26	80.14	7.69	0.76	0.00	0.00	22	NP	NIL	-	-	-	-	-	-
21.00	UDS	-	-	Silty Sand	2.42	6.86	82.36	6.32	0.78	1.26	0.00	23	NP	NIL	1.97	15.26	1.71	2.65	0.00	29.50
22.50	25	0.54	13.50	Silty Sand	4.25	11.44	82.18	2.13	0.00	0.00	0.00	25	NP	NIL	-	-	-	-	-	-
25.50	34	0.50	17.00	Silty Sand	2.56	15.59	78.23	2.36	1.26	0.00	0.00	24	NP	NIL	-	-	-	-	-	-
28.50	51	0.45	22.95	Silty Sand	2.85	8.73	82.30	3.26	2.18	0.68	0.00	26	NP	NIL	-	-	-	-	-	-
30.00	57	0.44	25.08	Silty Sand	2.46	10.21	81.36	2.36	2.66	0.95	0.00	22	NP	NIL	-	-	-	-	-	-

CONSULTING
Engineers Group Ltd.

1976

BORELOG OF BH–1(A1) AT EXISTING KM–283/12–16 FOR MAJOR BRIDGE NO.–322 A,
ON KESARI TO SANEHWAL, LUDHIANA



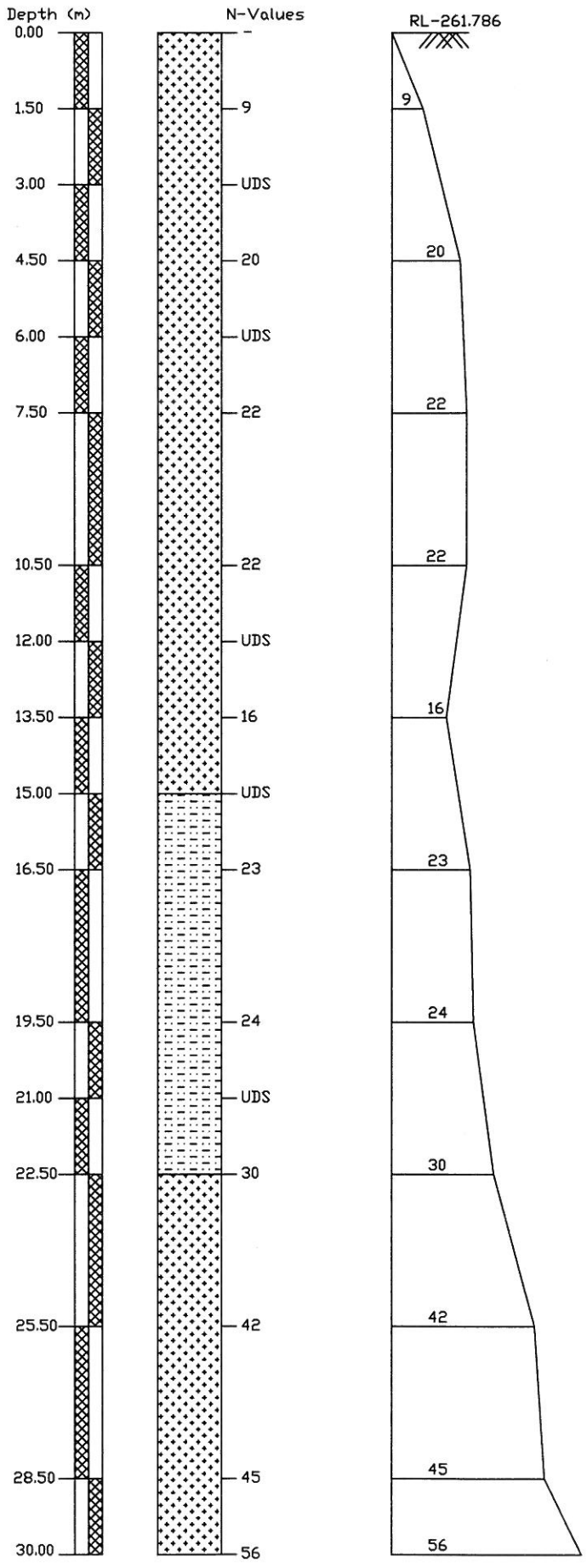
LEGEND

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

1977

CONSULTING Engineers Group Ltd.

BORELOG OF BH–2(P2) AT EXISTING KM–283/12–16 FOR MAJOR BRIDGE NO.–322 A,
ON KESARI TO SANEHWAL, LUDHIANA



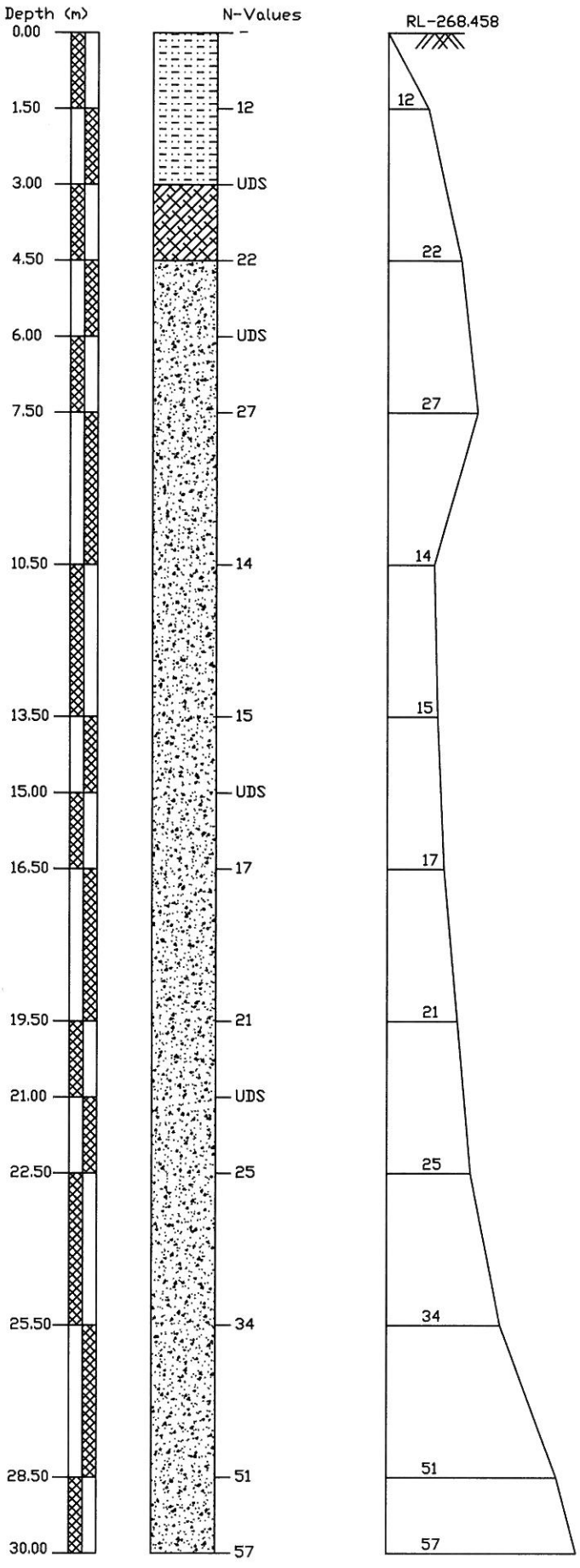
LEGEND

SYMBOL	DESCRIPTION
	SANDY SLIT WITH CLAY
	CLAYEY SILT WITH SAND

1978

CONSULTING Engineers Group Ltd.

BORELOG OF BH–3(A2) AT EXISTING KM–283/12–16 FOR MAJOR BRIDGE NO.–322 A, ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

SYMBOL	DESCRIPTION
	CLAYEY SILT WITH SAND
	CLAYEY SILT
	SILTY SAND

1979

CONSULTING Engineers Group Ltd.

CHAPTER – 87

"Major Bridge No. 316",

Location – Existing Km. – 278/03-05

87.1 LOCATION OF STRUCTURE:

Proposed Major Bridge of Span 4x6.1

87.2 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 > 12.0m 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 3.00	Silty Sand	Medium Dense
	3.00 to 4.50	Sandy Silt with Clay	Medium Dense
	4.50 to 10.50	Silty Sand	Medium Dense
	10.50 to 19.50	Clayey Silt with Sand	Medium Dense
	19.50 to 22.50	Clayey Silt	Medium Dense
	19.50 to 30.00	Clayey Silt with Sand	Medium Dense
BH-2(P2)	0.00 to 4.50	Clayey Silt with Sand	Loose
	4.50 to 10.50	Silty Sand	Medium Dense
	10.50 to 30.00	Clayey Silt with Sand	Medium Dense
BH-3(A2)	0.00 to 1.50	Clayey Silt with Sand	Loose
	1.50 to 3.00	Clayey Silt with Sand	Medium Dense
	3.00 to 13.50	Silty Sand	Medium Dense
	13.50 to 24.00	Sandy Silt with Clay	Medium Dense
	24.00 to 30.00	Clayey Silt with Sand	Medium Dense

87.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1 (A1)	3.00	8.10	NIL	0.0017	NIL	0.0011	0.053
	12.00	8.10	NIL	0.0014	NIL	0.0012	0.060
BH-2 (P2)	12.00	8.30	NIL	0.0021	NIL	0.0012	0.083
BH-3 (A2)	3.00	8.20	NIL	0.0024	NIL	0.0012	0.073
	15.00	8.30	NIL	0.0024	NIL	0.0012	0.095
	24.00	8.20	NIL	0.0021	NIL	0.0012	0.083

87.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1 (A1)	3.00	11.00
	12.00	12.00
	24.00	25.00

BH-2 (P2)	3.00	16.00
	12.00	11.00
	24.00	20.00
BH-3 (A2)	3.00	NIL
	9.50	NIL
	15.00	11.00
	24.00	14.00

87.5 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	7.3	86	82	181	741	0.2	2.3	1020	650
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	-	-

87.6 SAFE BEARING CAPACITY t/m²

BH -NO.	DEPTH (mtr)	Net Allowable Bearing Pressure (t/m²)
BH-1 (A1)	1.50m	8.00
	3.00m	11.50
	4.50m	16.00
	6.00m	17.00
BH-3 (A2)	1.50m	5.00
	3.00m	13.00
	4.50m	14.00
	6.00m	15.00

87.7 PILE LOAD CARRYING CAPACITY

87.7.1 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	90.00	110.00
	20.00	110.00	140.00
	23.00	140.00	170.00
BH-2 (P2)	17.00	100.00	120.00
	20.00	130.00	160.00
	23.00	170.00	200.00
BH-3 (A2)	17.00	110.00	140.00
	20.00	150.00	180.00
	23.00	180.00	220.00

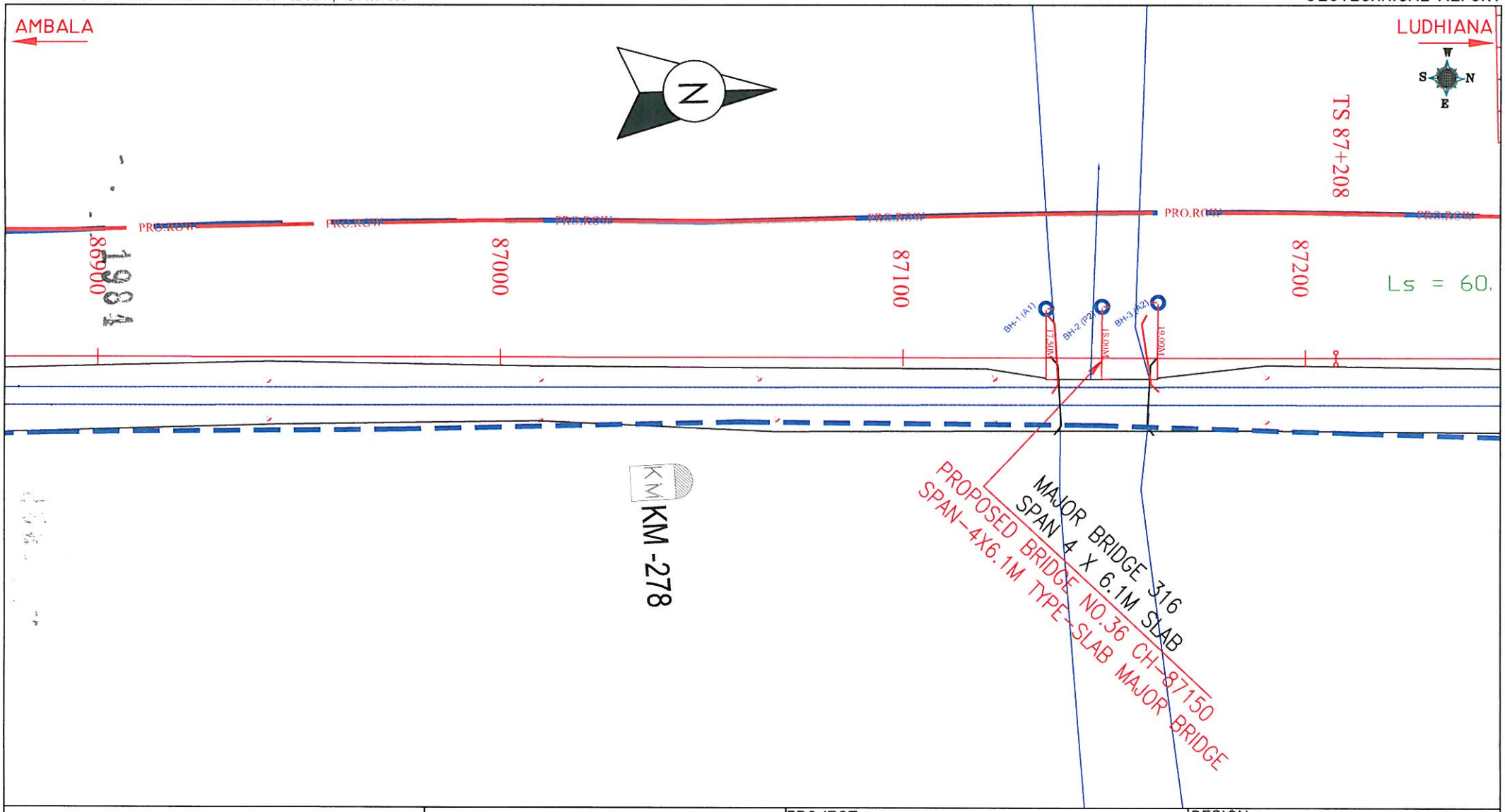
87.8 CONCLUSIONS

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

87.9 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-278/3-5

RL OF BH (AI) = 266.257
RL OF BH (P2) = 265.990
RL OF BH (A2) = 266.025

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 MAJOR BRIDGE No. 316 AT CHAINAGE 278/3-5

Project :	Chainage 278/3-5 Bridge No. 316			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				02.12.2009 to 02.12.2009	1	A1	12.00 m.	30.00mtr	266.257

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	2.1	20.16	76.28	0.78	0.68	0	0	22	NP	NIL	-	-	-	-	-	-
1.50	10	1.40	14.00	Silty Sand	2.68	22.61	74.01	0.56	0.14	0.00	0.00	24	NP	NIL	-	-	-	-	-	-
3.00	UDS	-	-	Sandy Silt with Clay	10.20	66.76	20.75	1.34	0.40	0.55	0.00	27	17	10	1.70	8.53	1.57	2.68	0.10	20.0
4.50	15	1.04	15.60	Silty Sand	3.81	35.36	59.94	0.38	0.23	0.28	0.00	26	NP	NIL	-	-	-	-	-	-
7.50	18	0.87	15.66	Silty Sand	3.55	32.93	62.36	0.43	0.35	0.38	0.00	25	NP	NIL	-	-	-	-	-	-
10.50	16	0.75	12.00	Clayey Silt with Sand	19.56	72.82	6.32	0.44	0.44	0.42	0.00	39	21	18	-	-	-	-	-	-
12.00	UDS	-	-	Clayey Silt with Sand	11.10	83.96	4.73	0.16	0.05	0.00	0.00	30	20	10	2.06	22.35	1.68	2.66	0.12	18.0
13.50	15	0.67	10.05	Clayey Silt with Sand	20.67	70.52	4.35	0.48	0.35	3.63	0.00	38	19	19	-	-	-	-	-	-
16.50	18	0.60	10.80	Clayey Silt with Sand	15.96	66.95	14.31	0.70	0.63	1.45	0.00	34	19	15	-	-	-	-	-	-
19.50	19	0.55	10.45	Clayey Silt	23.64	74.44	1.70	0.17	0.05	0.00	0.00	40	19	21	-	-	-	-	-	-
21.00	UDS	-	-	Clayey Silt	23.10	72.38	2.36	0.66	0.25	1.25	0.00	40	20	20	2.01	23.01	1.63	2.62	0.23	13.0
22.50	16	0.50	8.00	Clayey Silt with Sand	16.33	63.58	14.99	1.13	0.87	3.10	0.00	33	18	15	-	-	-	-	-	-
25.50	20	0.46	9.20	Clayey Silt with Sand	17.52	73.82	6.32	0.85	1.1	0.39	0.00	35	19	16	-	-	-	-	-	-
28.50	24	0.42	10.08	Clayey Silt with Sand	20.34	74.55	4.93	0.18	0.00	0.00	0.00	37	19	18	-	-	-	-	-	-
30.00	28	0.40	11.20	Clayey Silt with Sand	16.35	64.39	16.45	1.39	0.92	0.50	0.00	31	16	15	-	-	-	-	-	-

CONSULTING Engineers Group Ltd.

1985

SOIL CHARACTERISTICS OF BORE HOLE AT BH-P2 (LHS) FOR MAJOR BRIDGE No. 316 AT CHAINAGE 278/3-5

Project :	Chainage 278/3-5 Bridge No. 316			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				01.12.2009 to 01.12.2009	2	P2	12.00 m.	30.00mtr	265.990

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	16.25	64.96	17.85	0.65	0.29	0.00	0.00	34	19	15	-	-	-	-	-	-
1.50	9	1.42	12.78	Clayey Silt with Sand	19.57	64.07	15.85	0.41	0.10	0.00	0.00	39	21	18	-	-	-	-	-	-
3.00	UDS	-	-	Clayey Silt with Sand	15.11	63.13	19.10	2.03	0.63	0.00	0.00	30	16	14	1.92	12.03	1.71	2.66	0.18	16.0
4.50	18	1.05	18.90	Silty Sand	2.48	10.73	85.59	0.92	0.28	0.00	0.00	24	NP	NIL	-	-	-	-	-	-
7.50	15	0.88	13.20	Silty Sand	2.68	10.66	83.77	1.25	0.30	1.34	0.00	25	NP	NIL	-	-	-	-	-	-
10.50	16	0.77	12.32	Clayey Silt with Sand	9.41	81.32	7.39	0.67	0.47	0.74	0.00	29	20	9	-	-	-	-	-	-
12.00	UDS	-	-	Clayey Silt with Sand	10.24	76.77	11.21	0.98	0.45	0.35	0.00	31	21	10	1.96	21.03	1.62	2.55	0.10	19.0
13.50	18	0.68	12.24	Clayey Silt with Sand	20.38	63.66	14.02	0.85	0.38	0.71	0.00	42	23	19	-	-	-	-	-	-
16.50	20	0.61	12.20	Clayey Silt with Sand	15.24	70.82	10.99	1.41	0.51	1.03	0.00	39	24	15	-	-	-	-	-	-
19.50	23	0.55	12.65	Clayey Silt with Sand	17.10	72.74	6.75	1.80	1.08	0.53	0.00	36	21	15	-	-	-	-	-	-
22.50	28	0.51	14.28	Clayey Silt with Sand	16.83	68.23	12.23	1.38	0.43	0.90	0.00	36	21	15	-	-	-	-	-	-
24.00	UDS	-	-	Clayey Silt with Sand	17.68	65.82	14.33	1.62	0.55	0.00	0.00	36	20	16	2.00	22.10	1.63	2.6	0.20	16.0
25.50	26	0.46	11.96	Clayey Silt with Sand	20.65	61.66	15.61	1.50	0.58	0.00	0.00	39	21	18	-	-	-	-	-	-
28.50	28	0.42	11.76	Clayey Silt with Sand	18.18	66.18	13.15	1.25	1.08	0.16	0.00	36	19	17	-	-	-	-	-	-
30.00	31	0.40	12.40	Clayey Silt with Sand	19.33	65.78	13.20	1.01	0.44	0.24	0.00	35	17	18	-	-	-	-	-	-

CONSULTING Engineers Group Ltd.

ANNEXURE - I

SOIL CHARACTERISTICS OF BORE HOLE AT BH-A2 (LHS) FOR MAJOR BRIDGE No. 316 AT CHAINAGE 278/3-5

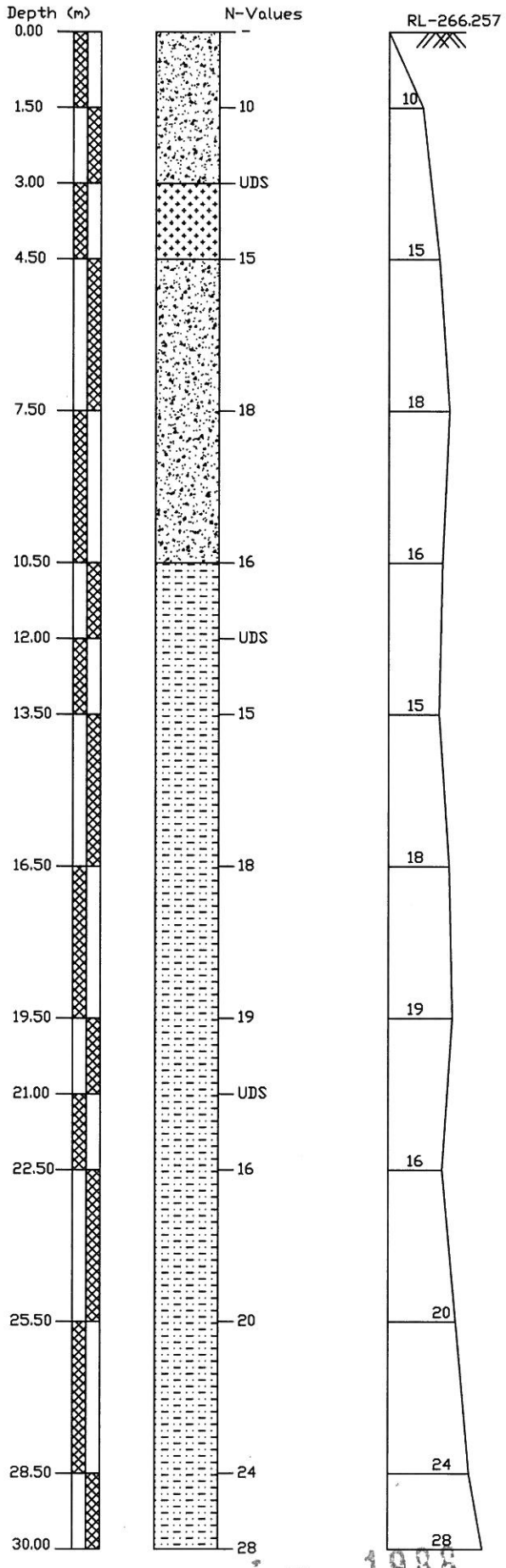
Project :	Chainage 278/3-5 Bridge No. 316			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				30.11.2009 to 30.11.2009	3	A2	12.00 m.	30.00mtr	266.025

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	15.24	68.98	13.25	0.86	0.39	1.28	0.00	33	20	13	-	-	-	-	-	-
1.50	13	1.46	18.98	Clayey Silt with Sand	17.48	69.79	11.08	0.50	0.48	0.67	0.00	37	21	16	-	-	-	-	-	-
3.00	UDS	-	-	Silty Sand	2.10	44.63	51.95	0.62	0.21	0.49	0.00	22	NP	NIL	1.68	8.33	1.55	2.71	0.00	28.0
4.50	18	1.10	19.80	Silty Sand	2.66	29.09	67.74	0.18	0.08	0.25	0.00	26	NP	NIL	-	-	-	-	-	-
7.50	24	0.92	22.08	Silty Sand	2.00	13.19	84.44	0.37	0.00	0.00	0.00	24	NP	NIL	-	-	-	-	-	-
9.50	UDS	-	-	Silty Sand	2.10	12.12	85.36	0.42	0.00	0.00	0.00	26	NP	NIL	2.00	10.41	1.81	2.62	0.00	28.0
10.50	13	0.75	9.75	Silty Sand	0.00	6.21	93.55	0.24	0.00	0.00	0.00	30	NP	NIL	-	-	-	-	-	-
13.50	17	0.67	11.39	Sandy Silt with Clay	7.10	81.11	9.30	0.57	0.30	1.62	0.00	29	22	7	-	-	-	-	-	-
15.00	UDS	-	-	Sandy Silt with Clay	9.45	79.91	10.42	0.14	0.08	0.00	0.00	32	22	10	2.01	22.28	1.64	2.59	0.10	19.0
16.50	20	0.60	12.00	Sandy Silt with Clay	6.25	83.27	10.42	0.06	0.00	0.00	0.00	25	18	7	-	-	-	-	-	-
19.50	12	0.55	6.60	Sandy Silt with Clay	9.35	77.81	12.02	0.31	0.13	0.38	0.00	28	18	10	-	-	-	-	-	-
22.50	13	0.50	6.50	Sandy Silt with Clay	10.14	78.57	10.28	0.36	0.22	0.43	0.00	29	19	10	-	-	-	-	-	-
24.00	UDS	-	-	Clayey Silt with Sand	13.55	80.19	5.09	0.78	0.39	0.00	0.00	35	23	12	2.17	23.02	1.76	2.61	0.13	17.0
25.50	20	0.46	9.20	Clayey Silt with Sand	18.22	72.77	6.53	0.65	0.52	1.31	0.00	36	20	16	-	-	-	-	-	-
28.50	23	0.42	9.66	Clayey Silt with Sand	8.56	81.06	6.45	1.32	0.94	1.67	0.00	27	18	9	-	-	-	-	-	-
30.00	26	0.40	10.40	Clayey Silt with Sand	14.35	79.54	3.56	1.25	0.78	0.52	0.00	30	17	13	-	-	-	-	-	-

CONSULTING Engineers Group Ltd.

BORELOG OF BH–1(A1) AT EXISTING KM–278/3–5 FOR MAJOR BRIDGE NO.–316,

ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

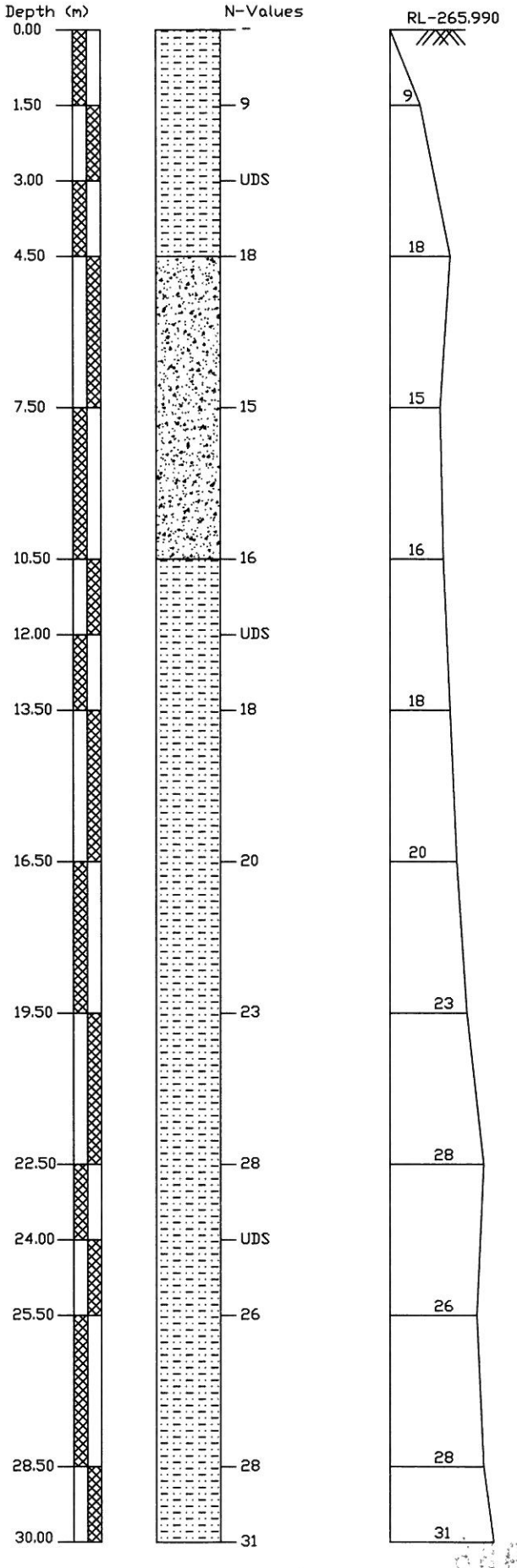
SYMBOL	DESCRIPTION
	SILTY SAND
	SANDY SILT WITH CLAY
	CLAYEY SILT WITH SAND

1986

CONSULTING Engineers Group Ltd.

BORELOG OF BH–2(P2) AT EXISTING KM–278/3–5 FOR MAJOR BRIDGE NO.–316,

ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

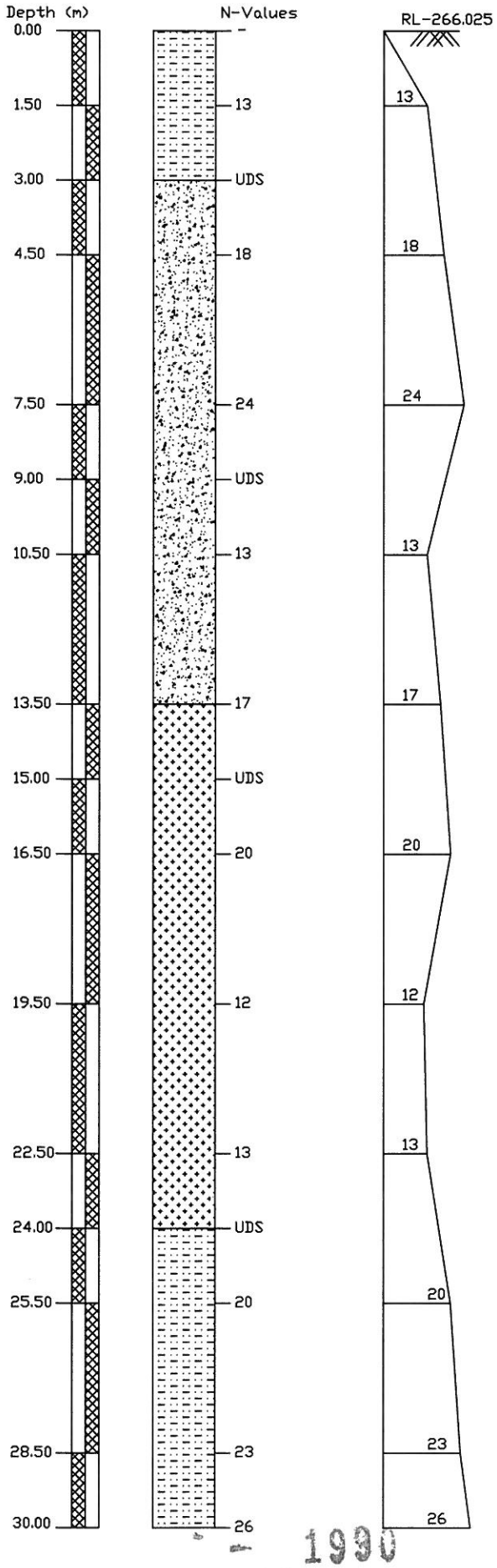
SYMBOL	DESCRIPTION
	CLAYEY SILT WITH SAND
	SILTY SAND

1989

CONSULTING Engineers Group Ltd.

BORELOG OF BH–3(A2) AT EXISTING KM–278/3–5 FOR MAJOR BRIDGE NO.–316,

ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

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

1990

CONSULTING Engineers Group Ltd

CHAPTER – 88

"Major Bridge No. 315",

Location – Existing Km. – 277/07-09

88.1 LOCATION OF STRUCTURE:

Proposed Major Bridge of Span 4x6.1

88.2 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 > 11.0m 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	Sandy Silt with Clay	Loose
	4.50 to 7.50	Clayey Silt with Sand	Medium Dense
	7.50 to 9.00	Sandy Silt with Clay	Medium Dense
	9.00 to 13.50	Clayey Silt	Medium Dense
	13.50 to 22.50	Clayey Silt with Sand	Medium Dense
	22.50 to 25.50	Clayey Silt	Medium Dense
	25.50 to 30.00	Clayey Silt with Sand	
BH-2(P2)	0.00 to 3.00	Clayey Silt with Sand	Loose
	3.00 to 4.50	Sandy Silt with Clay	Medium Dense
	4.50 to 12.00	Clayey Silt with Sand	Medium Dense
	12.00 to 25.50	Clayey 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-3(A2)	0.00 to 1.50	Filled up Strata	Loose
	1.50 to 7.50	Clayey Silt with Sand	Loose
	7.50 to 9.00	Clayey Silt with Sand	Medium Dense
	9.00 to 13.50	Clayey Silt	Medium Dense
	13.50 to 25.50	Clayey Silt with Sand	Dense
	25.50 to 30.00	Clayey Silt with Sand	Very Dense

88.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1 (A1)	3.00	8.20	NIL	0.0028	NIL	0.0013	0.083
	9.00	8.40	NIL	0.0031	NIL	0.0014	0.086
	24.00	8.20	NIL	0.0021	NIL	0.0012	0.083
BH-2 (P2)	3.00	8.40	NIL	0.0031	NIL	0.0012	0.076
	12.00	8.70	0.005	0.0021	NIL	0.0012	0.072
BH-3 (A2)	3.00	8.30	NIL	0.0028	NIL	0.0013	0.083
	9.00	8.80	0.005	0.0031	NIL	0.0014	0.099

88.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1 (A1)	3.00	12.00
	9.00	11.00
	24.00	13.00
BH-2 (P2)	3.00	10.00
	12.00	08.00
	21.00	18.00
BH-3 (A2)	3.00	11.00
	9.00	17.00
	24.00	26.00

88.5 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	82	80	179	750	0.1	2.1	960	620
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	-	-

88.6 SAFE BEARING CAPACITY t/m²

BH -NO.	DEPTH (mtr)	Net Allowable Bearing Pressure (t/m²)
BH-1 (A1)	1.50m	8.00
	3.00m	12.50
	4.50m	13.50
	6.00m	14.50
BH-3 (A2)	1.50m	7.50
	3.00m	12.00
	4.50m	13.00
	6.00m	14.00

88.7 PILE LOAD CARRYING CAPACITY

88.7.1 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	85.00	100.00
	20.00	110.00	140.00
	23.00	145.00	175.00
BH-2 (P2)	17.00	100.00	125.00
	20.00	130.00	160.00
	23.00	160.00	195.00
BH-3 (A2)	17.00	85.00	105.00
	20.00	110.00	140.00
	23.00	140.00	170.00

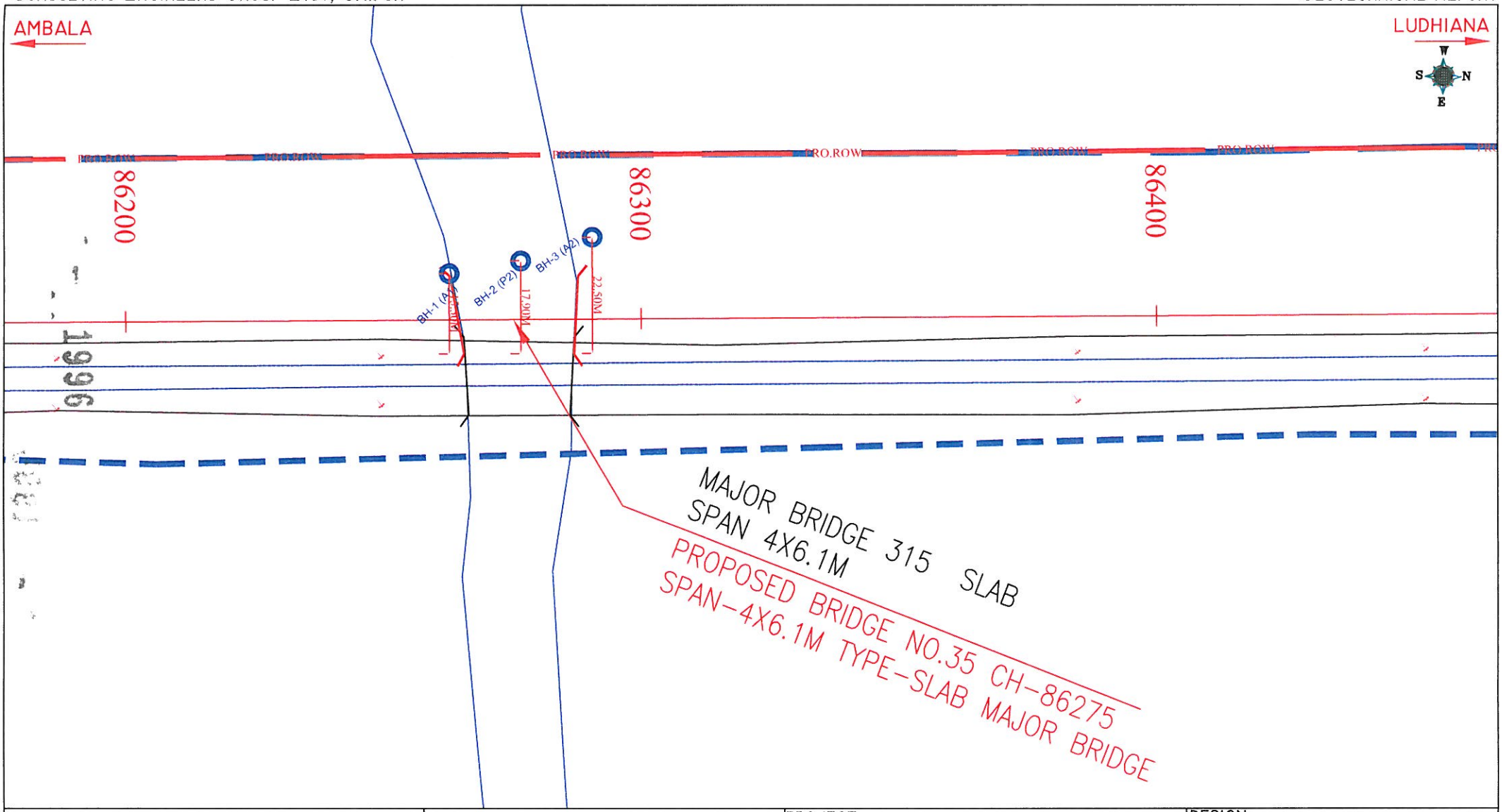
88.8 CONCLUSIONS

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

88.9 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-277/7-9

RL OF BH (AI) = 266.103
RL OF BH (P2) = 265.347
RL OF BH (A2) = 265.563

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-A1(LHS) FOR MAJOR BRIDGE No.315 AT CHAINAGE 277/7-9

Project :	Chainage 277/7-9 Bridge No. 315			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				02.12.2009 to 03.12.2009	1	A1	11.00 m.	30.00mtr	266.103

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	8.53	59.64	28.59	2.66	0.58	0.00	0.00	25	16	9	-	-	-	-	-	-
1.50	7	1.45	10.15	Sandy Silt with Clay	9.41	62.93	25.67	1.58	0.41	0.00	0.00	26	16	10	-	-	-	-	-	-
3.00	UDS	-	-	Sandy Silt with Clay	11.35	63.53	23.17	1.59	0.36	0.00	0.00	28	17	11	1.73	10.84	1.56	2.67	0.10	21.0
4.50	12	1.09	13.08	Clayey Silt with Sand	15.85	74.97	8.12	0.95	0.11	0.00	0.00	34	20	14	-	-	-	-	-	-
7.50	16	0.91	14.56	Sandy Silt with Clay	18.62	65.67	13.68	0.80	0.65	0.58	0.00	37	21	16	-	-	-	-	-	-
9.00	UDS	-	-	Clayey Silt	12.65	83.22	2.43	1.58	0.12	0.00	0.00	35	25	10	2.01	20.92	1.60	2.65	0.12	20.0
10.50	18	0.75	13.50	Clayey Silt	16.15	79.17	3.52	0.55	0.20	0.41	0.00	34	20	14	-	-	-	-	-	-
13.50	21	0.67	14.07	Clayey Silt with Sand	11.35	71.95	16.57	0.13	0.00	0.00	0.00	29	18	11	-	-	-	-	-	-
16.50	24	0.60	14.40	Clayey Silt with Sand	21.49	68.90	7.31	0.80	0.80	0.70	0.00	38	19	19	-	-	-	-	-	-
19.50	14	0.55	7.70	Clayey Silt with Sand	18.79	66.32	14.82	0.07	0.00	0.00	0.00	36	19	17	-	-	-	-	-	-
22.50	19	0.50	9.50	Clayey Silt	16.42	78.96	3.55	0.40	0.33	0.34	0.00	33	19	14	-	-	-	-	-	-
24.00	UDS	-	-	Clayey Silt	12.11	86.32	1.47	0.10	0.00	0.00	0.00	33	23	10	1.88	24.24	1.51	2.65	0.10	20.0
25.50	25	0.48	12.00	Clayey Silt with Sand	17.41	71.89	7.69	1.27	0.72	1.02	0.00	34	19	15	-	-	-	-	-	-
28.50	29	0.44	12.76	Clayey Silt with Sand	15.36	73.00	8.49	1.32	1.16	0.67	0.00	34	20	14	-	-	-	-	-	-
30.00	33	0.42	13.86	Clayey Silt with Sand	13.42	73.31	10.74	1.02	1.11	0.40	0.00	29	17	12	-	-	-	-	-	-

CONSULTING
Engineers Group Ltd.

ANNEXURE - I

SOIL CHARACTERISTICS OF BORE HOLE AT BH-P2(LHS) FOR MAJOR BRIDGE No.315 AT CHAINAGE 277/7-9

Project :	Chainage 277/7-9 Bridge No. 315			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				03.12.2009 to 03.12.2009	2	P2	11.00 m.	30.00mtr	265.347

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	16.52	72.16	9.65	0.60	0.55	0.52	0.00	33	18	15	-	-	-	-	-	-
1.50	5	1.42	7.10	Clayey Silt with Sand	18.94	71.80	7.87	0.67	0.37	0.35	0.00	38	21	17	-	-	-	-	-	-
3.00	UDS	-	-	Sandy Silt with Clay	7.66	74.52	9.28	3.42	2.33	2.79	0.00	27	19	8	1.90	14.35	1.66	2.63	0.09	22.0
4.50	10	1.05	10.50	Clayey Silt with Sand	19.42	67.13	9.40	2.22	0.54	1.29	0.00	36	17	19	-	-	-	-	-	-
7.50	16	0.88	14.08	Clayey Silt with Sand	19.31	61.70	15.37	0.80	0.82	2.00	0.00	37	20	17	-	-	-	-	-	-
10.50	18	0.77	13.86	Clayey Silt with Sand	20.18	71.43	6.61	1.15	0.18	0.45	0.00	38	20	18	-	-	-	-	-	-
12.00	UDS	-	-	Clayey Silt	5.86	92.83	1.14	0.17	0.00	0.00	0.00	29	23	6	1.99	28.15	1.55	2.58	0.05	23.0
13.50	20	0.67	13.40	Clayey Silt	11.25	85.73	2.11	0.66	0.25	0.00	0.00	30	20	10	-	-	-	-	-	-
16.50	23	0.60	13.80	Clayey Silt	11.68	82.57	3.83	0.92	0.30	0.70	0.00	32	21	11	-	-	-	-	-	-
19.50	7	0.55	3.85	Clayey Silt	19.45	77.29	2.76	0.18	0.32	0.00	0.00	38	20	18	-	-	-	-	-	-
21.00	UDS	-	-	Clayey Silt	18.97	78.05	2.48	0.26	0.24	0.00	0.00	37	21	16	1.91	23.11	1.55	2.64	0.21	14.0
22.50	13	0.51	6.63	Clayey Silt	18.65	79.27	1.76	0.26	0.06	0.00	0.00	38	21	17	-	-	-	-	-	-
25.50	27	0.47	12.69	Clayey Silt with Sand	17.66	74.83	5.1	0.88	0.2	1.33	0.00	36	20	16	-	-	-	-	-	-
28.50	32	0.44	14.08	Clayey Silt with Sand	19.24	71.70	5.23	0.68	0.35	2.80	0.00	38	21	17	-	-	-	-	-	-
30.00	36	0.42	15.06	Clayey Silt with Sand	17.58	76.31	5.10	0.47	0.34	0.20	0.00	37	21	16	-	-	-	-	-	-

CONSULTING Engineers Group Ltd.

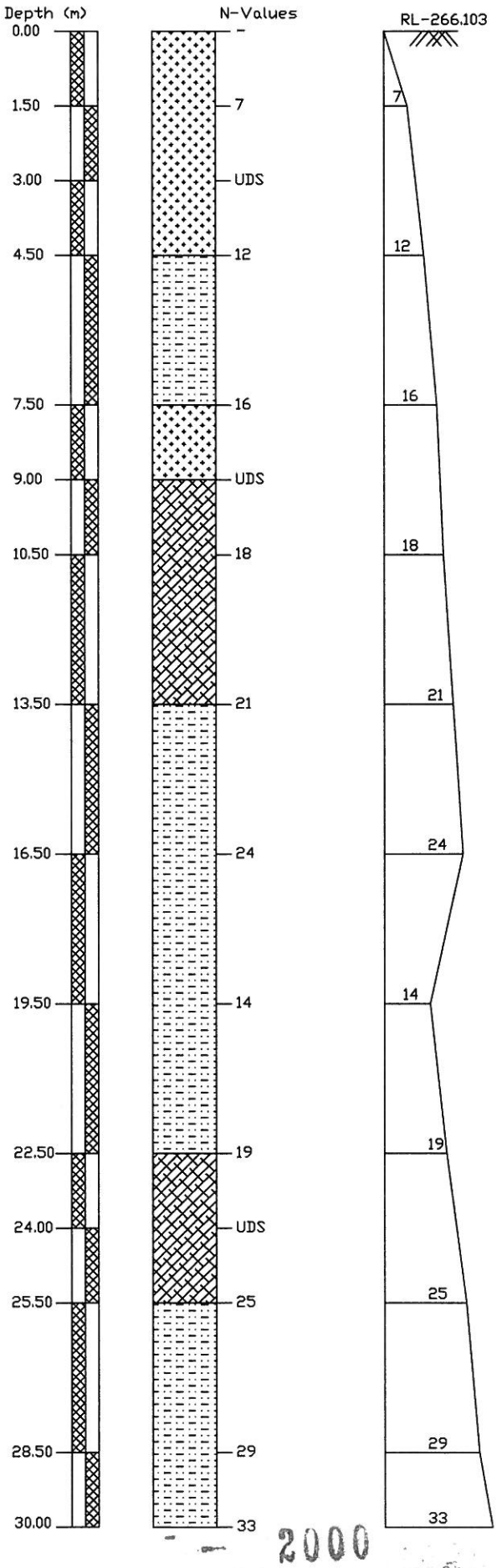
SOIL CHARACTERISTICS OF BORE HOLE AT BH-A2(LHS) FOR MAJOR BRIDGE No.315 AT CHAINAGE 277/7-9

Project :	Chainage 277/7-9 Bridge No. 315			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				04.12.2009 to 04.12.2009	3	A2	11.00 m.	30.00mtr	265.563

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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.50	6	1.46	8.76	Clayey Silt with Sand	15.28	71.73	5.21	0.93	0.58	6.27	0.00	32	18	14	-	-	-	-	-	-
3.00	UDS	-	-	Clayey Silt with Sand	11.10	74.36	10.55	1.90	0.59	1.50	0.00	27	17	10	1.71	9.61	1.56	2.68	0.10	21.0
4.50	8	1.09	8.72	Clayey Silt with Sand	12.18	75.83	9.50	1.58	0.41	0.50	0.00	29	18	11	-	-	-	-	-	-
7.50	15	0.92	13.80	Clayey Silt with Sand	15.98	72.92	4.37	1.02	1.20	4.51	0.00	35	20	15	-	-	-	-	-	-
9.00	UDS	-	-	Clayey Silt	15.38	78.79	0.79	0.14	0.26	4.64	0.00	36	22	14	1.91	18.33	1.61	2.65	0.17	15.0
10.50	21	0.77	16.17	Clayey Silt	18.43	76.95	2.89	0.85	0.24	0.64	0.00	37	21	16	-	-	-	-	-	-
12.00	25	0.72	16.50	Clayey Silt	12.37	83.99	2.52	0.21	0.21	0.70	0.00	32	21	11	-	-	-	-	-	-
13.50	30	0.69	17.85	Clayey Silt with Sand	20.52	70.66	4.22	1.13	0.87	0.93	1.67	38	18	20	-	-	-	-	-	-
16.50	34	0.62	18.04	Clayey Silt with Sand	21.11	70.11	6.23	0.89	0.50	1.16	0.00	39	20	19	-	-	-	-	-	-
19.50	39	0.56	18.42	Clayey Silt with Sand	13.58	77.83	3.23	1.05	1.52	2.79	0.00	33	21	12	-	-	-	-	-	-
22.50	43	0.51	18.47	Clayey Silt with Sand	19.86	69.24	7.92	1.26	0.34	1.38	0.00	41	23	18	-	-	-	-	-	-
24.00	UDS	-	-	Clayey Silt with Sand	20.68	68.69	6.38	1.42	0.65	2.18	0.00	40	20	20	2.01	21.11	1.65	2.66	0.24	13.0
25.50	53	0.46	19.69	Clayey Silt with Sand	22.14	65.87	6.15	1.64	0.88	3.32	0.00	42	22	20	-	-	-	-	-	-
28.50	60	0.42	20.10	Clayey Silt with Sand	18.22	67.44	12.94	0.97	0.26	0.17	0.00	35	19	16	-	-	-	-	-	-
30.00	69	0.40	21.30	Clayey Silt with Sand	22.58	65.55	8.39	0.78	0.29	2.41	0.00	42	23	19	-	-	-	-	-	-

BORELOG OF BH–1(A1) AT EXISTING KM–277/7–9 FOR MAJOR BRIDGE NO.–315,

ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

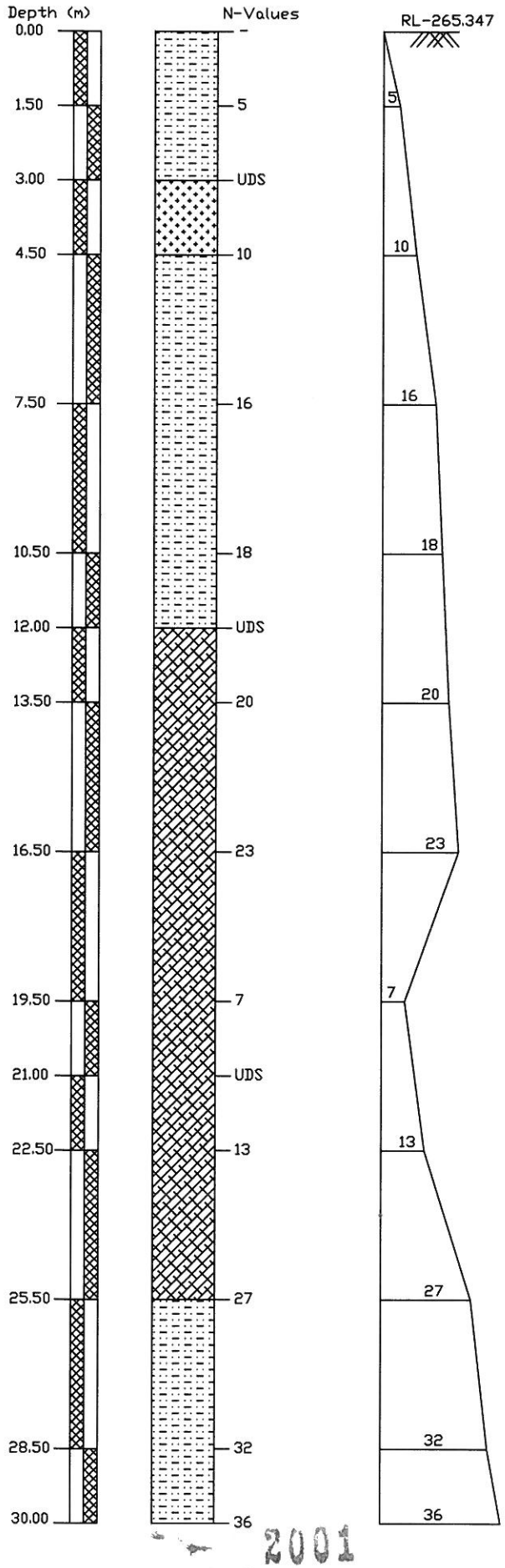
SYMBOL	DESCRIPTION
	SANDY SILT WITH CLAY
	CLAYEY SILT WITH SAND
	CLAYEY SILT

2000

CONSULTING Engineers Group Ltd.

BORELOG OF BH–2(P2) AT EXISTING KM–277/7–9 FOR MAJOR BRIDGE NO.–315,

ON KESARI TO SANEHWAL, LUDHIANA



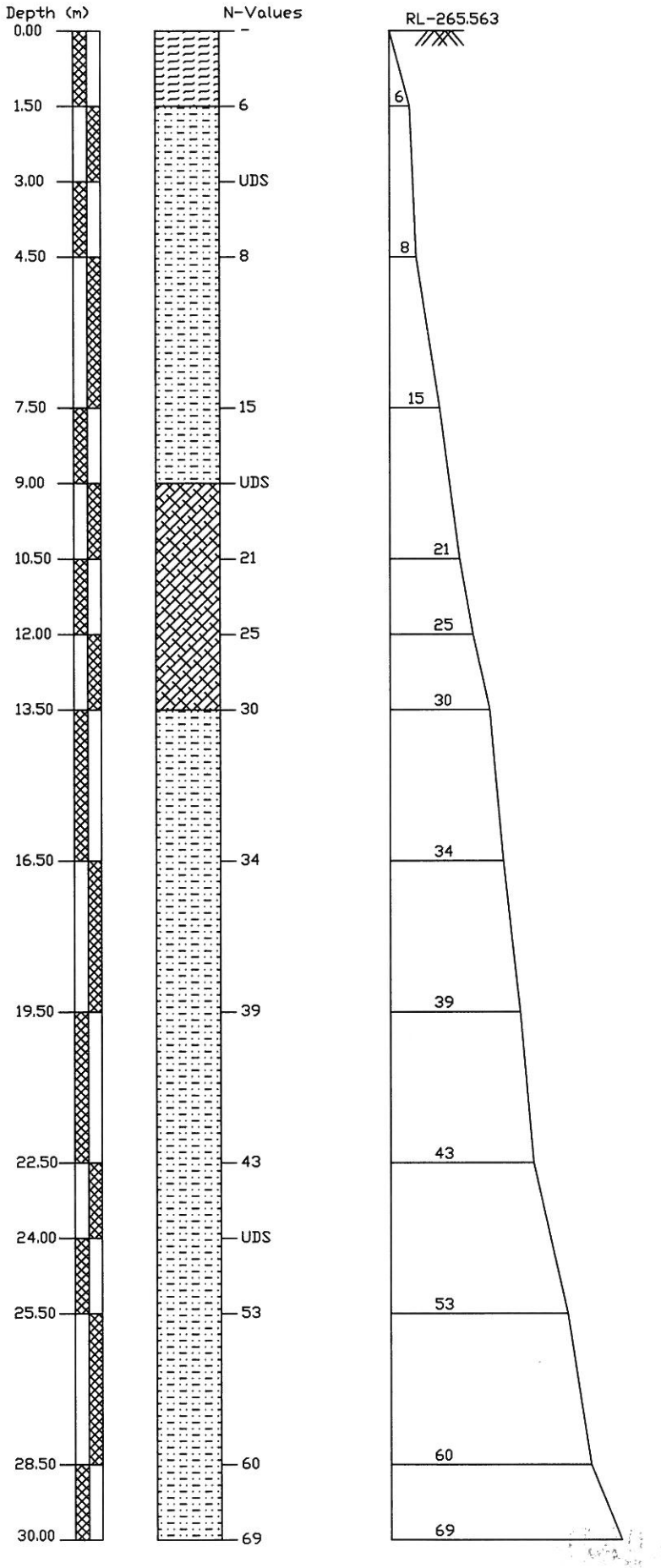
LEGEND

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

2001

CONSULTING Engineers Group Ltd

BORELOG OF BH–3(A2) AT EXISTING KM–277/7–9 FOR MAJOR BRIDGE NO.–315,
ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

SYMBOL	DESCRIPTION
	FILLED UP STRATA
	CLAYEY SILT WITH SAND
	CLAYEY SILT

2002

CONSULTING Engineers Group Ltd.

CHAPTER – 89

"Major Bridge No. 314",

Location – Existing Km. – 275/7-9

CONSULTING
Engineers Group Ltd.