SOIL CHARACTERISTICS OF BORE HOLE AT BH-A1(LHS) FOR ROF (ROR) AT CHAINAGE 286/380

Project :	Chainage 286/15 Bridge No. 000			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				03.12.2009 to 05.12.2009	1	A1	10.00 m.	30.00mtr	265.838

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	21.94	68.74	6.58	1.55	0.52	0.67	0	40	20	20	-	-	-	-	-	-
1.50	9	1.43	12.87	Clayey Silt with Sand	23.33	71.12	4.46	0.53	0.29	0.27	0.00	44	23	21	-	-	-	-	-	-
3.00	UDS	-	-	Sandy Silt with Clay	11.10	59.63	28.38	0.27	0.62	0.00	0.00	26	16	10	1.85	11.63	1.66	2.59	0.15	20.0
4.50	13	1.06	13.78	Sandy Silt with Clay	15.29	55.75	28.75	0.12	0.09	0.00	0.00	34	20	14	-	-	-	-	-	-
7.50	16	0.89	14.24	Clayey Silt with Sand	27.41	65.92	4.89	0.41	0.73	0.64	0.00	49	24	25	-	-	-	-	-	-
9.00	UDS	-	-	Clayey Silt with Sand	20.33	73.34	3.64	2.24	0.45	0.00	0.00	41	23	18	1.92	20.73	1.59	2.61	0.23	12.0
10.50	23	0.77	16.36	Clayey Silt with Sand	23.65	62.46	11.75	1.14	0.63	0.37	0.00	44	22	22	-	-	-	-	-	-
13.50	25	0.68	16.00	Silty Sand	2.39	6.22	85.95	4.78	0.31	0.35	0.00	25	NP	NIL	-	-	-	-	-	-
16.50	32	0.62	17.42	Clayey Silt with Sand	28.67	61.64	8.10	0.86	0.36	0.37	0.00	49	23	26	-	-	-	-	-	-
19.50	35	0.56	17.30	Clayey Silt with Sand	26.69	61.39	10.14	1.10	0.52	0.16	0.00	46	22	24	-	-	-	-	-	-
21.00	UDS	-	-	Clayey Silt with Sand	28.64	55.37	13.52	2.15	0.21	0.11	0.00	48	22	26	1.98	21.21	1.63	2.62	0.30	10.0
22.50	39	0.50	17.25	Clayey Silt with Sand	26.58	57.42	12.09	0.62	0.42	2.87	0.00	44	21	23	-	-	-	-	-	-
25.50	44	0.46	17.62	Clayey Silt with Sand	22.66	62.69	11.26	1.52	0.35	1.52	0.00	42	20	22	-	-	-	-	-	-
27.00	UDS	-	-	Clayey Silt with Sand	23.50	59.67	13.26	2.1	0.25	1.22	0.00	40	20	20	2.00	21.81	1.64	2.63	0.28	10.0
28.50	46	0.42	17.16	Clayey Silt with Sand	25.33	58.94	11.53	3.12	0.22	0.86	0.00	42	19	23	-	-	-	-	-	-
30.00	49	0.41	17.55	Clayey Silt with Sand	26.52	58.06	12.62	1.26	0.44	1.10	0.00	44	20	24	-	-	-	-	-	-

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Engineers Group Ltd.

SOIL CHARACTERISTICS OF BORE HOLE AT BH-A2(RHS) FOR ROF (ROR) AT CHAINAGE 286/380

Project :	Chainage 286/15 Bridge No. 000			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				04.12.2009 to 05.12.2009	2	A2	10.00 m.	30.00mtr	267.178

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	18.42	73.55	7.25	0.55	0.23	0.00	0.00	36	20	16	-	-	-	-	-	-
1.50	6	1.43	8.58	Clayey Silt with Sand	20.66	74.83	4.11	0.28	0.12	0.00	0.00	41	23	18	-	-	-	-	-	-
3.00	UDS	-	-	Clayey Silt with Sand	19.62	46.35	30.60	2.32	1.11	0.00	0.00	35	18	17	1.85	15.82	1.59	2.57	0.21	13.0
4.50	12	1.06	12.72	Clayey Silt with Sand	10.68	82.38	6.65	0.29	0.00	0.00	0.00	28	18	10	-	-	-	-	-	-
7.50	17	0.89	15.13	Clayey Silt with Sand	15.67	64.98	15.43	1.87	1.47	0.58	0.00	30	16	14	-	-	-	-	-	-
10.50	22	0.78	16.08	Silty Sand	2.85	25.47	64.78	6.90	0.00	0.00	0.00	25	NP	NIL	-	-	-	-	-	-
12.00	UDS	-	-	Silty Sand	3.97	10.99	74.88	8.67	0.39	1.10	0.00	27	NP	NIL	1.87	18.87	1.57	2.60	0.00	27.0
13.50	26	0.69	16.47	Silty Sand	3.26	9.41	79.86	6.99	0.30	0.18	0.00	23	NP	NIL	-	-	-	-	-	-
16.50	33	0.63	17.90	Clayey Silt with Sand	15.67	75.72	7.13	0.54	0.14	0.80	0.00	34	20	14	-	-	-	-	-	-
18.00	UDS	-	-	Clayey Silt with Sand	25.39	62.31	8.50	2.64	1.16	0.00	0.00	48	25	23	1.90	19.38	1.59	2.64	0.28	11.0
19.50	16	0.56	8.96	Clayey Silt with Sand	14.62	71.93	12.22	0.74	0.23	0.26	0.00	28	16	12	-	-	-	-	-	-
22.50	35	0.52	16.60	Clayey Silt with Sand	14.69	74.96	9.41	0.78	0.16	0.00	0.00	34	21	13	-	-	-	-	-	-
24.00	UDS	-	-	Clayey Silt with Sand	17.86	76.32	2.84	1.91	0.9	0.17	0.00	36	20	16	2.00	20.42	1.66	2.58	0.21	15.0
25.50	42	0.46	17.16	Clayey Silt with Sand	20.36	73.05	2.54	2.00	1.89	0.16	0.00	36	18	18	-	-	-	-	-	-
28.50	45	0.42	16.95	Clayey Silt with Sand	13.57	76.44	8.70	0.80	0.11	0.38	0.00	33	21	12	-	-	-	-	-	-
30.00	48	0.40	17.10	Clayey Silt with Sand	12.69	78.47	7.38	0.51	0.18	0.77	0.00	32	20	12	-	-	-	-	-	-

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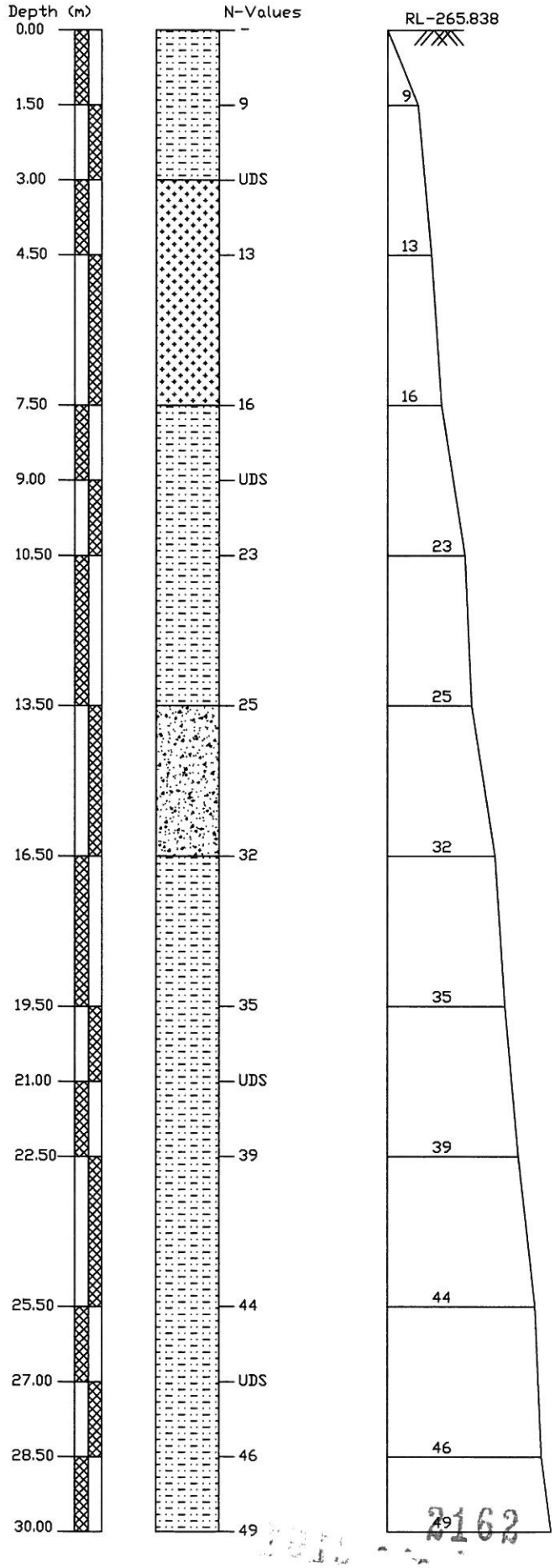
BORELOG OF BH–1(A1) AT PROPOSED KM–286/15 (286+380) FOR ROR,

ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

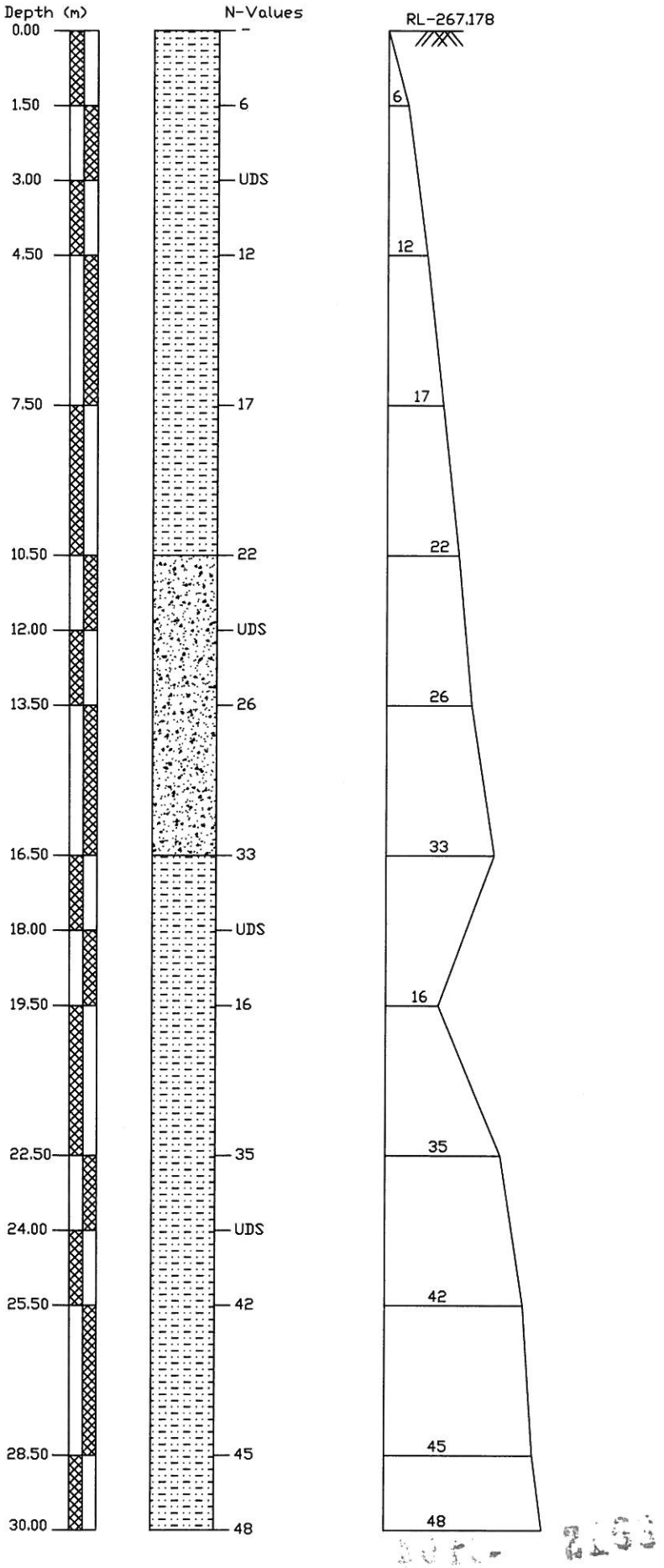
SYMBOL	DESCRIPTION
	CLAYEY SILT WITH SAND
	SANDY SILT WITH CLAY
	SILTY SAND

2162

CONSULTING Engineers Group Ltd.

BORELOG OF BH–2(A2) AT EXISTING KM–286/15 (286+380) FOR ROR,

ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

SYMBOL	DESCRIPTION
	CLAYEY SILT WITH SAND
	SILTY SAND

CONSULTING Engineers Group Ltd.

CHAPTER - 111

"Alignment" on Km. 317+510 at 340m,

Detour Section of (317+510 to 315+700),

Location - Proposed Chainage - 71650

111.1 LOCATION OF STRUCTURE:

Alignment at Proposed Chainage 71650

111.2 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 ≥14.00m below EGL.

Subsurface profile at the site

BOREHOLE No.	Depth (m)	Type of Soil/Rock	Soil/Rock Characteristics
BH-1	0.00 to 3.00	Clayey Silt with Sand	Loose
	3.00 to 4.50	Silty Sand	Loose
	4.50 to 6.00	Clayey Silt with Sand	Medium Dense
	6.00 to 7.50	Clayey Silt with Sand & Gravels	Dense
	7.50 to 12.00	Silty Sand	Dense

111.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1	3.00	8.30	NIL	0.0028	NIL	0.0011	0.025
	6.00	8.70	0.007	0.0025	NIL	0.0011	0.022

111.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1	3.00	NIL
	6.00	12

111.5 NET ALLOWABLE BEARING PRESSURE

Borehole No.	Depth from EGL (m)	Net Allowable Bearing Pressure (t/m²)
BH-1	1.50	10.00
	3.00	16.00
	4.50	17.00
	6.00	18.00

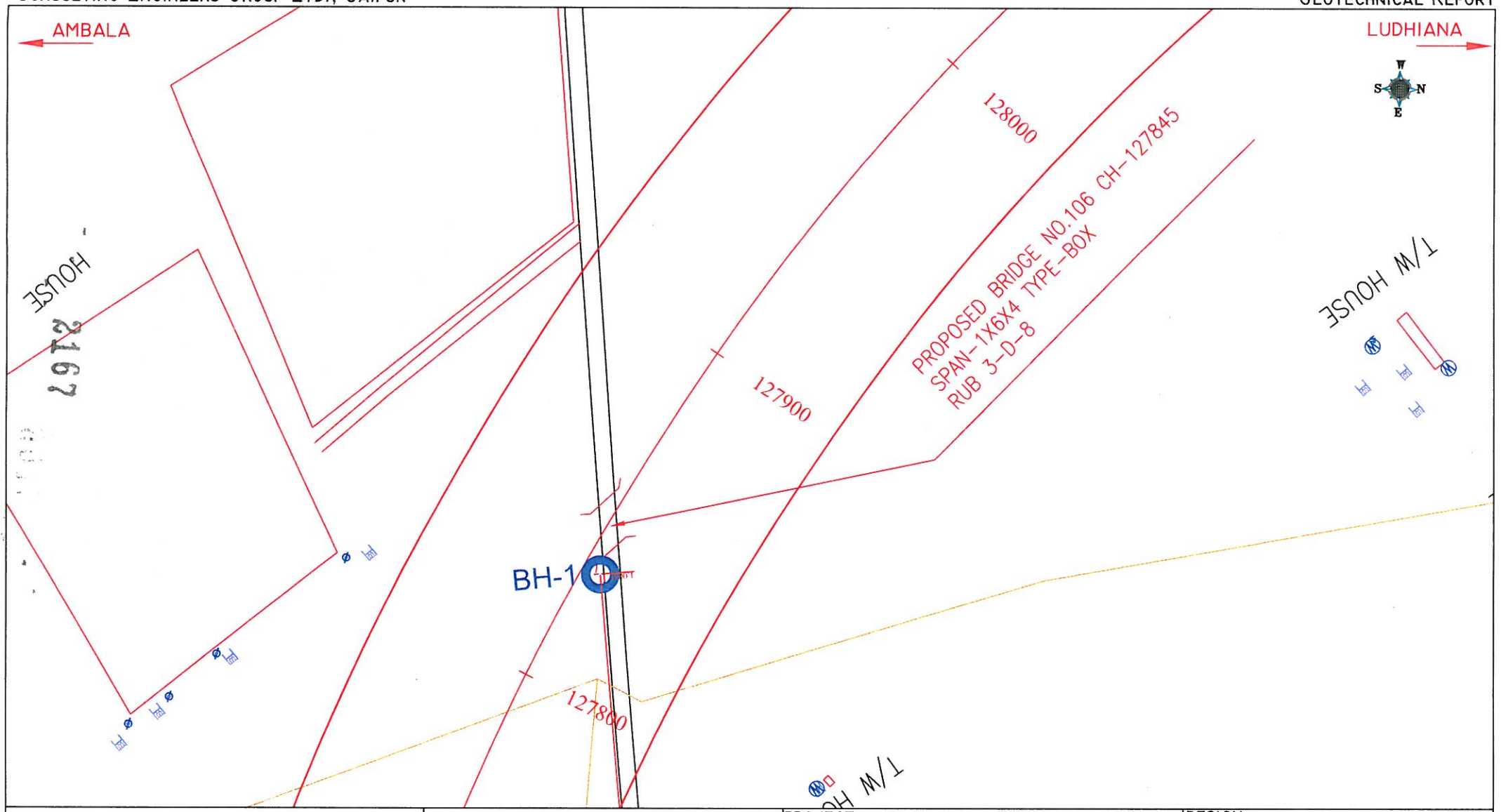
111.6 CONCLUSIONS

- Subsurface Profiles indicates suitable Soil formation for foundations.

111.7 RECOMMENDATIONS

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

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



ALL DIMENSIONS IN METER

FIG.:-I

LOCATION PLAN OF PROPOSED DETOUR SECTION AT CH. 71650

RL OF BH-I = 264.292

PROJECT :-

LUDHIANA-AMBALA (DFCCIL)

DESIGN :-

CONSULTING ENGINEERS GROUP LTD.

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ANNEXURE - I

SOIL CHARACTERISTICS OF BORE HOLE AT BH-1(LHS) FOR ALIGNMENT AT CHAINAGE 71650

Project :	Chainage 71650 Bridge No. 000			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				13.11.2009 to 13.11.2009	1	1 (LHS)	Below 14.00 m	12.00mtr	264.292

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	14.52	69.09	12.23	2.1	1.21	0.85	0	32	20	12						
1.50	8	1.45	11.60	Clayey Silt with Sand	16.89	66.79	13.01	1.24	1.64	0.43	0.00	35	21	14						
3.00	UDS	-	-	Silty Sand	3.52	36.14	59.49	0.85	0	0.00	0.00	24	NP	NIL	1.73	10.90	1.59	2.56	0.00	28.5
4.50	12	1.09	13.08	Clayey Silt with Sand	17.69	70.77	2.6	2.68	2.61	3.65	0.00	35	20	15						
6.00	UDS	-	-	Clayey Silt with Sand & Gravels	12.14	64.06	3.93	2.99	3.27	7.90	5.71	33	23	10	1.86	15.00	1.61	2.65	0.12	20.0
7.50	31	0.89	27.59	Silty Sand	0.00	12.80	80.6	6.28	0.32	0.00	0.00	21	NP	NIL						
10.50	34	0.78	26.52	Silty Sand	0.00	7.09	87.86	4.63	0.42	0.00	0.00	25	NP	NIL						
12.00	38	0.73	27.74	Silty Sand	0.00	9.26	85.5	5.08	0.16	0.00	0.00	26	NP	NIL						

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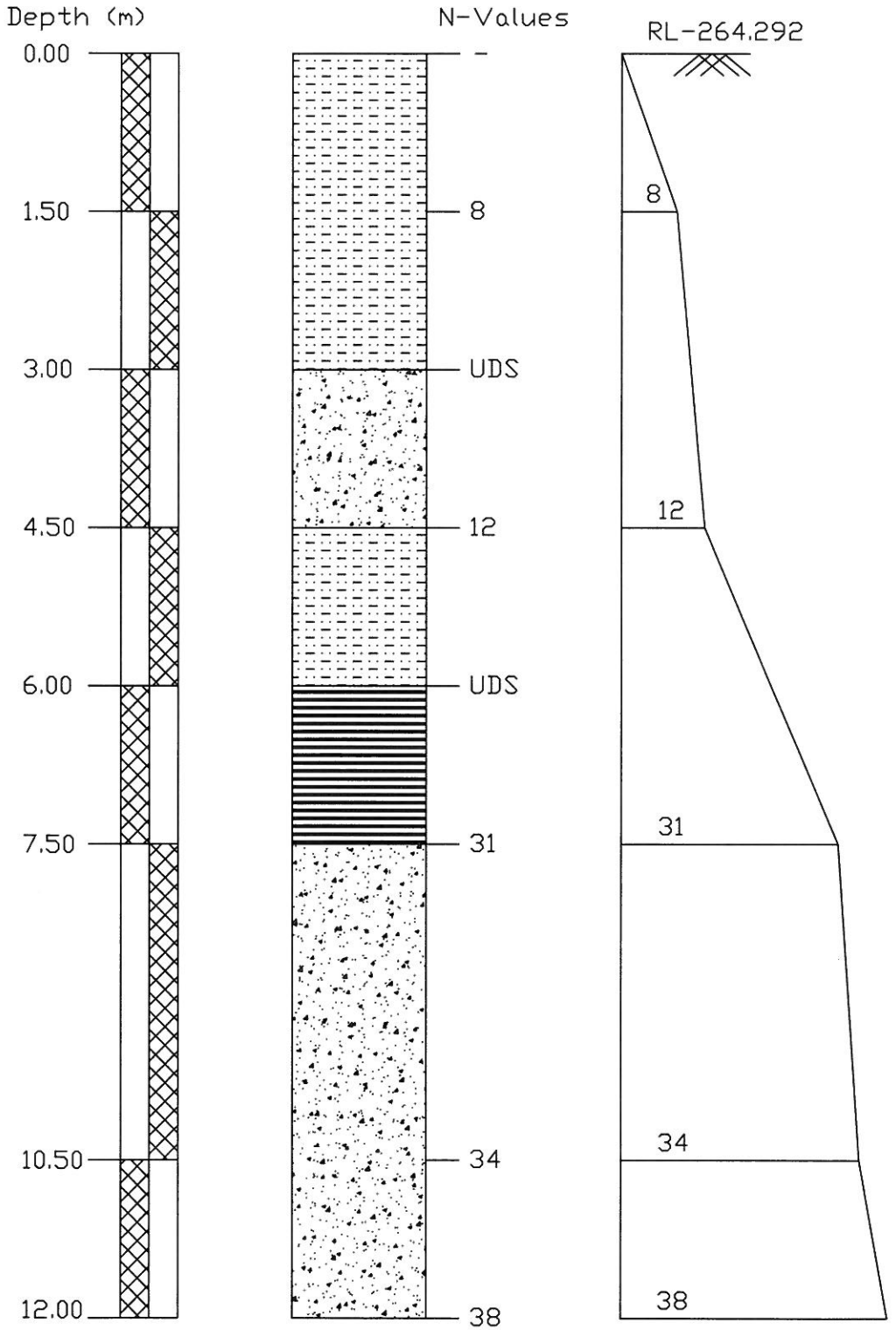
Engineers Group Ltd.

BORELOG OF BH–1(LHS) AT PROPOSED KM–71650 FOR ALIGNMENT ON KM–317+510 AT 340M,
DETOUR SECTION OF 317+510 TO 315+700,
ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

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

2169

CHAPTER – 112

"RFO (ROR" on Km. 317+370 Crossing, Detour Section of (317+510 to 315+700)

Location – Proposed Chainage – 71300

112.1 LOCATION OF STRUCTURE:

Proposed RFO (ROR) of 71300

112.2 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 14.00m below EGL.

Subsurface profile at the site

BOREHOLE No.	Depth (m)	Type of Soil/Rock	Soil/Rock Characteristics
BH-1(A1)	0.00 to 1.50	Sitly Sand with Gravels	Loose
	1.50 to 3.00	Clayey Silt with Sand & Gravels	Loose
	3.00 to 4.50	Clayey Silt with Sand	Loose
	4.50 to 12.00	Silty Sand	Medium Dense
	12.00 to 13.50	Sandy Silt	Medium Dense
	13.50 to 16.50	Silty Sand	Medium Dense
	16.50 to 30.00	Silty Sand	Dense
BH-2(A2)	0.00 to 1.50	Sandy Silt with Gravels	Loose
	1.50 to 3.00	Clayey Silt with Sand	Loose
	3.00 to 4.50	Clayey Silt with Sand & Gravels	Loose
	4.50 to 7.50	Clayey Silt with Sand & Gravels	Medium Dense
	7.50 to 10.50	Sandy Silt	Medium Dense
	10.50 to 16.50	Silty Sand	Dense
	16.50 to 25.50	Silty Sand	Dense
	25.50 to 30.00	Silty Sand	Very Dense

112.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1 (A1)	3.00	8.40	NIL	0.0042	NIL	0.0012	0.035
	12.00	8.80	0.007	0.0021	NIL	0.0011	0.029
	27.00	9.10	0.012	0.0039	NIL	0.0012	0.029
BH-2 (A2)	3.00	8.60	0.002	0.0049	NIL	0.0013	0.045
	6.00	8.70	0.005	0.0025	NIL	0.0011	0.025

112.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1 (A1)	03.00	12.00
	12.00	NIL
	27.00	NIL
BH-2 (A2)	03.00	18.00
	12.00	NIL
	24.00	NIL

112.5 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	78	83	170	745	0.2	2.3	942	590
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	-	-

112.6 PILE LOAD CARRYING CAPACITY

112.6.1 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.

Safe bearing capacity in t/m^2

BH -NO.	PILE DEPTH (mtr)	Net Allowable Bearing Pressure (t/m^2)
BH-1 (A1)	1.50m	08.50
	3.00m	12.00
	4.50m	16.00
	6.00m	18.00

BH-2 (A2)	1.50	11.00
	3.00m	14.00
	4.50m	15.50
	6.00m	16.50

Pile load carrying capacity in t

BH -NO.	PILE DEPTH (mtr)	PILE CARRYING CAPACITY IN TONNE
		Pile Diameter= 1.0 m
BH-1 (A1)	17.00	140.00
	20.00	180.00
	23.00	230.00
BH-2 (A2)	17.00	140.00
	20.00	180.00
	23.00	230.00

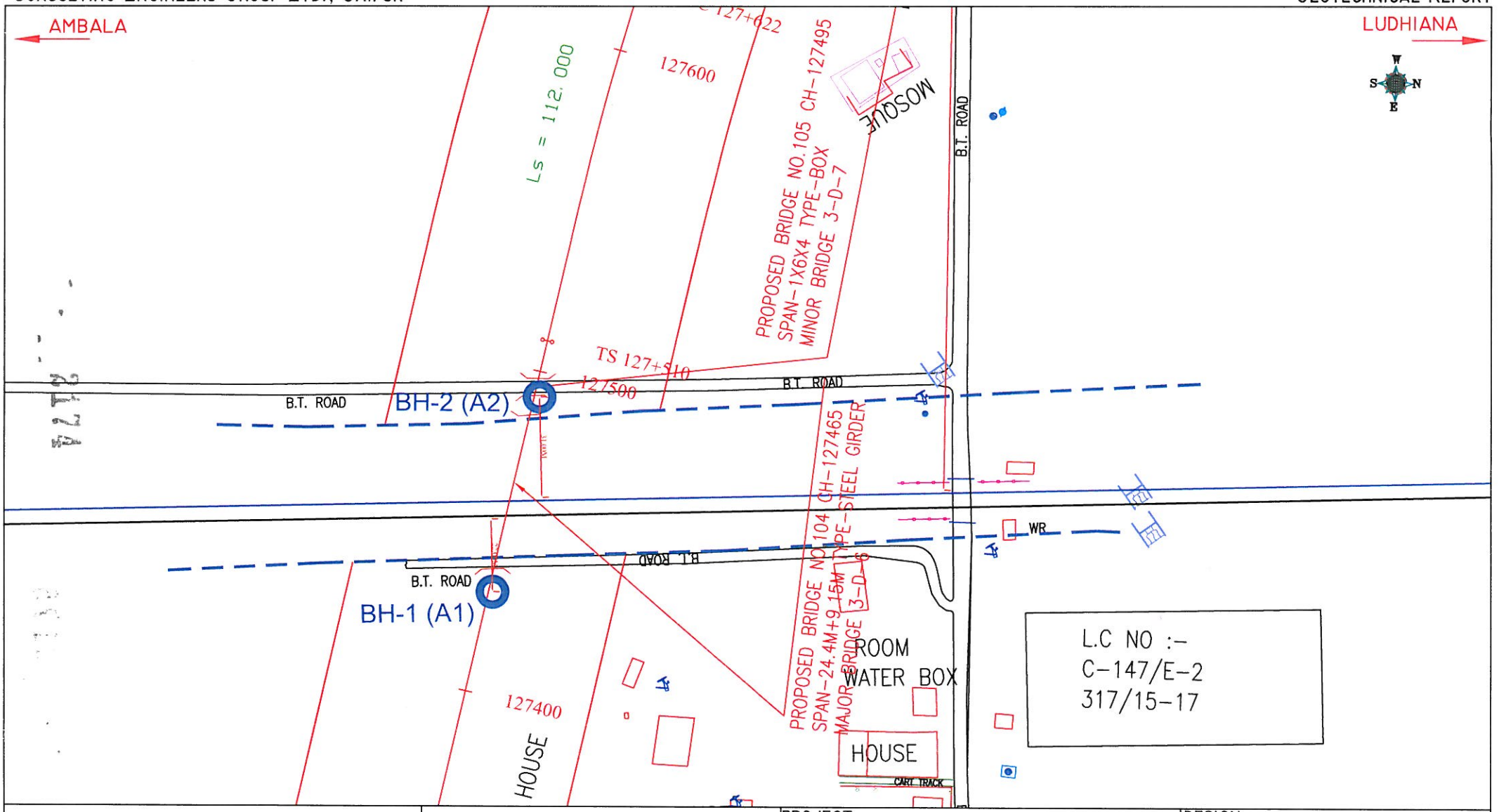
112.7 CONCLUSIONS

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

112.8 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 DETOUR SECTION AT CH. 71300

RL OF BH-A1 = 263.667
RL OF BH-A2 = 263.862

PROJECT :-

LUDHIANA-AMBALA (DFCCIL)

DESIGN :-

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ANNEXURE - I

SOIL CHARACTERISTICS OF BORE HOLE AT BH-1(LHS) FOR ALIGNMENT AT CHAINAGE 71650

Project :	Chainage 71300 Bridge No. 000			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				13.11.2009 to 14.11.2009	1	A1	Below 14.00 m	30.00mtr	263.667

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 with Gravels	0	5.86	74.56	8.56	2.34	8.68	0.00	25	NP	NIL						
1.50	9	1.46	13.14	Clayey Silt with Sand & Gravels	15.83	61.64	8.75	3.37	2.92	7.49	0.00	34	21	13						
3.00	UDS	-	-	Silty Sand	12.55	80.58	3.67	1.00	0.69	1.51	0.00	38	28	10	1.71	9.00	1.57	2.65	0.13	18.0
4.50	12	1.09	13.08	Silty Sand	3.65	37.07	51.02	7.34	0.76	0.16	0.00	24	NP	NIL						
7.50	19	0.92	17.48	Silty Sand	3.21	5.47	81.84	7.07	2.06	0.35	0.00	24	NP	NIL						
10.50	23	0.81	18.63	Silty Sand	0.00	9.72	79.06	6.93	2.02	2.27	0.00	28	NP	NIL						
12.00	UDS	-	-	Sandy Silt	4.65	62.96	23.65	1.51	2.38	4.85	0.00	35	NP	NIL	1.73	11.12	1.56	2.59	0.00	27.0
13.50	26	0.72	18.72	Silty Sand	0.00	6.96	79.63	9.35	2.59	1.47	0.00	28	NP	NIL						
16.50	30	0.65	17.25	Silty Sand	2.59	10.17	76.25	8.61	1.86	0.52	0.00	27	NP	NIL						
19.50	35	0.60	18.00	Silty Sand	0.00	9.35	76.15	11.62	2.88	0.00	0.00	28	NP	NIL						
22.50	43	0.55	19.33	Silty Sand	0.00	8.37	76.52	12.53	2.58	0.00	0.00	26	NP	NIL						
25.50	47	0.51	19.49	Silty Sand	0.00	7.68	72.82	13.87	5.33	0.30	0.00	28	NP	NIL						
27.00	UDS	-	-	Silty Sand	3.25	39.73	47.34	3.99	1.53	4.16	0.00	23	NP	NIL	1.75	14.90	1.50	2.66	0.00	28.0
30.00	53	0.45	19.43	Silty Sand	4.36	9.87	68.94	12.41	4.42	0.00	0.00	27	NP	NIL						

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ANNEXURE - I

SOIL CHARACTERISTICS OF BORE HOLE AT BH-1(LHS) FOR ALIGNMENT AT CHAINAGE 71650

Project :	Chainage 71300 Bridge No. 317/11			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				14.11.2009 to 15.11.2009	2	A2	14.00 m	30.00mtr	263.862

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 Gravels	3.58	79.68	8.59	1.21	0.36	6.58	0.00	25	NP	NIL						
1.50	9	1.42	12.78	Clayey Silt with Sand	22.51	72.12	3.08	2.16	0.13	0.00	0.00	42	22	20						
3.00	UDS	-	-	Clayey Silt with Sand & Gravels	18.25	65.07	2.98	2.04	1.98	9.68	0.00	39	23	16	1.89	12.00	1.67	2.62	0.21	13.00
4.50	12	1.06	12.72	Clayey Silt with Sand & Gravels	10.26	65.05	5.87	1.86	2.22	14.74	0.00	30	21	9						
7.50	18	0.89	16.02	Sandy Silt	4.14	83.80	6.25	1.42	3.14	1.25	0.00	27	NP	NIL						
10.50	24	0.77	18.48	Silty Sand	0.00	7.04	85.57	5.30	0.35	1.74	0.00	30	NP	NIL						
12.00	UDS	-	-	Silty Sand	0.00	11.00	82.35	5.26	0.25	1.14	0.00	28	NP	NIL	1.90	8.69	1.74	2.66	0.00	28.00
13.50	27	0.69	18.63	Silty Sand	0.00	10.84	78.59	10.25	0.32	0.00	0.00	27	NP	NIL						
16.50	34	0.62	18.04	Silty Sand	0.00	5.79	80.08	13.94	0.19	0.00	0.00	30	NP	NIL						
19.50	37	0.56	17.86	Silty Sand	0.00	9.59	81.59	8.60	0.22	0.00	0.00	26	NP	NIL						
22.50	43	0.52	18.68	Silty Sand	0.00	6.70	86.88	6.24	0.13	0.05	0.00	32	NP	NIL						
24.00	UDS	-	-	Silty Sand	0.00	6.84	85.62	7.26	0.28	0.00	0.00	29	NP	NIL	1.92	20.21	1.59	2.67	0.00	28.00
25.50	58	0.47	21.13	Silty Sand	0.00	5.42	87.44	6.97	0.17	0.00	0.00	33	NP	NIL						
28.50	59	0.43	20.19	Silty Sand	0.00	6.48	86.62	5.69	1.21	0.00	0.00	31	NP	NIL						
30.00	62	0.42	20.52	Silty Sand	0.00	6.41	84.84	8.09	0.66	0.00	0.00	33	NP	NIL						

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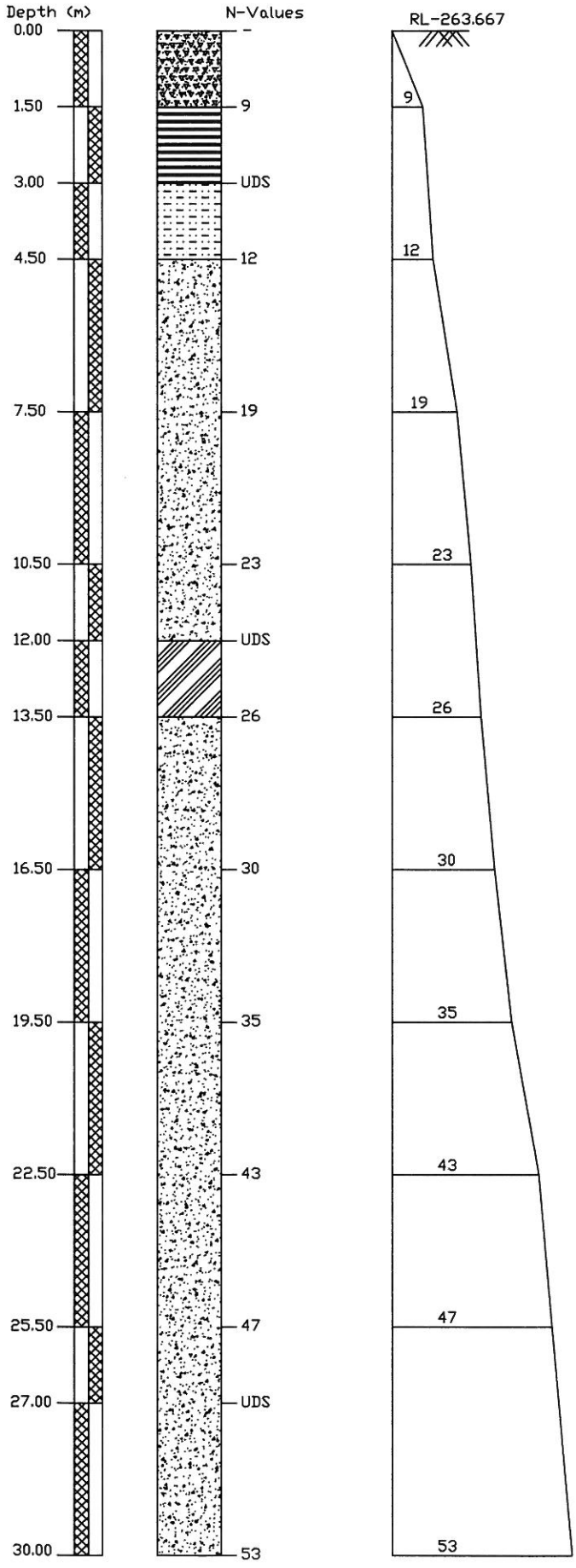
BORELOG OF BH–1(A1) AT PROPOSED KM–71300 FOR ROR ON KM–317+370 CROSSING,
DETOUR SECTION OF 317+510 TO 315+700,
ON KESARI TO SANEHWAL, LUDHIANA



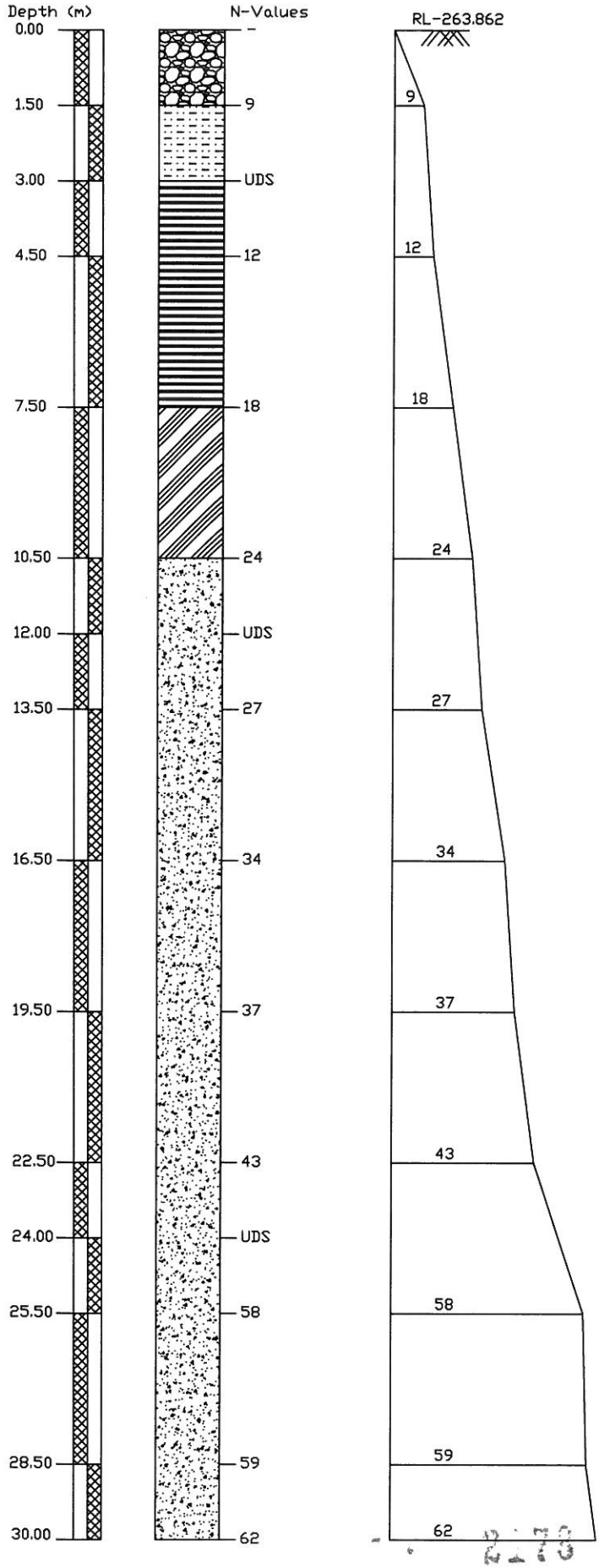
LEGEND

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

2177

CONSULTING Engineers Group Ltd.

BORELOG OF BH–2(A2) AT PROPOSED KM–71300 FOR ROR ON KM–317+370 CROSSING,
DETOUR SECTION OF 317+510 TO 315+700,
ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

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

CHAPTER – 113

"Alignment" on Km. 317+220 at 550m,

Detour Section of (317+510 to 315+700)

Location – Proposed Chainage – 70700

113.1 LOCATION OF STRUCTURE:

Alignment at Proposed Chainage 70700

113.2 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 ≥14.00m below EGL.

Subsurface profile at the site

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

113.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1	3.00	8.80	0.010	0.0035	NIL	0.0013	0.031
	6.00	8.90	0.010	0.0046	NIL	0.0013	0.038

113.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

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

113.5 NET ALLOWABLE BEARING PRESSURE

Borehole No.	Depth from EGL (m)	Net Allowable Bearing Pressure (t/m²)
BH-1	1.50	08.50
	3.00	13.00
	4.50	13.50
	6.00	14.00

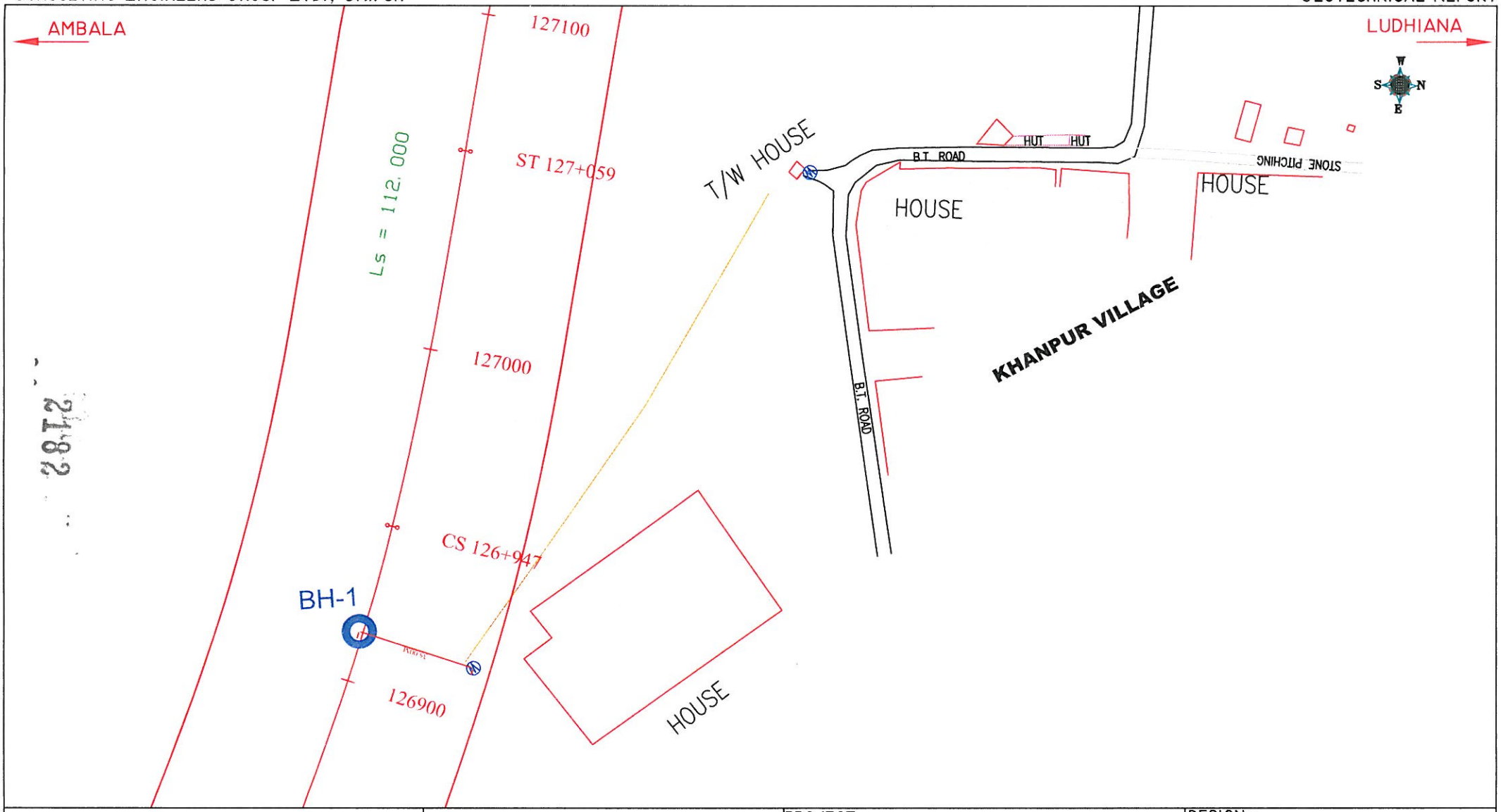
113.6 CONCLUSIONS

- Subsurface Profiles indicates suitable Soil formation for foundations.

113.7 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 DETOUR SECTION AT CH. 70700

RL OF BH-I = 225.164

PROJECT :-

LUDHIANA-AMBALA (DFCCIL)

DESIGN :-

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ANNEXURE - I

SOIL CHARACTERISTICS OF BORE HOLE AT BH-1(RHS) FOR ALIGNMENT AT CHAINAGE 70700

Project :	Chainage 70700 Bridge No. 000			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				15.11.2009 to 16.11.2009	1	1 (RHS)	Below 14.00 m	12.00mtr	225.164

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	30.91	65.89	0.59	0.47	0.00	0.00	22	NP	NIL						
1.50	9	1.51	13.59	Silty Sand	2.00	34.28	62.72	0.67	0.33	0.00	0.00	20	NP	NIL						
3.00	UDS	-	-	Silty Sand with Gravels	2.59	27.34	42.31	1.98	0.59	15.09	10.10	25	NP	NIL	1.65	9.28	1.51	2.63	0.00	29.0
4.50	12	1.10	13.20	Sandy Silt	4.22	85.73	7.72	0.27	0.43	1.63	0.00	29	NP	NIL						
6.00	UDS	-	-	Sandy Silt	3.68	74.82	5.52	1.33	1.13	13.52	0.00	31	NP	NIL	1.69	10.70	1.52	2.67	0.00	27.5
7.50	13	0.92	11.96	Sandy Silt	4.80	91.90	2.08	0.20	0.15	0.87	0.00	30	NP	NIL						
10.50	18	0.81	14.58	Silty Sand	2.15	12.67	82.63	1.10	0.20	1.25	0.00	24	NP	NIL						
12.00	22	0.77	16.94	Silty Sand	2.20	9.48	86.40	1.61	0.31	0.00	0.00	25	NP	NIL						

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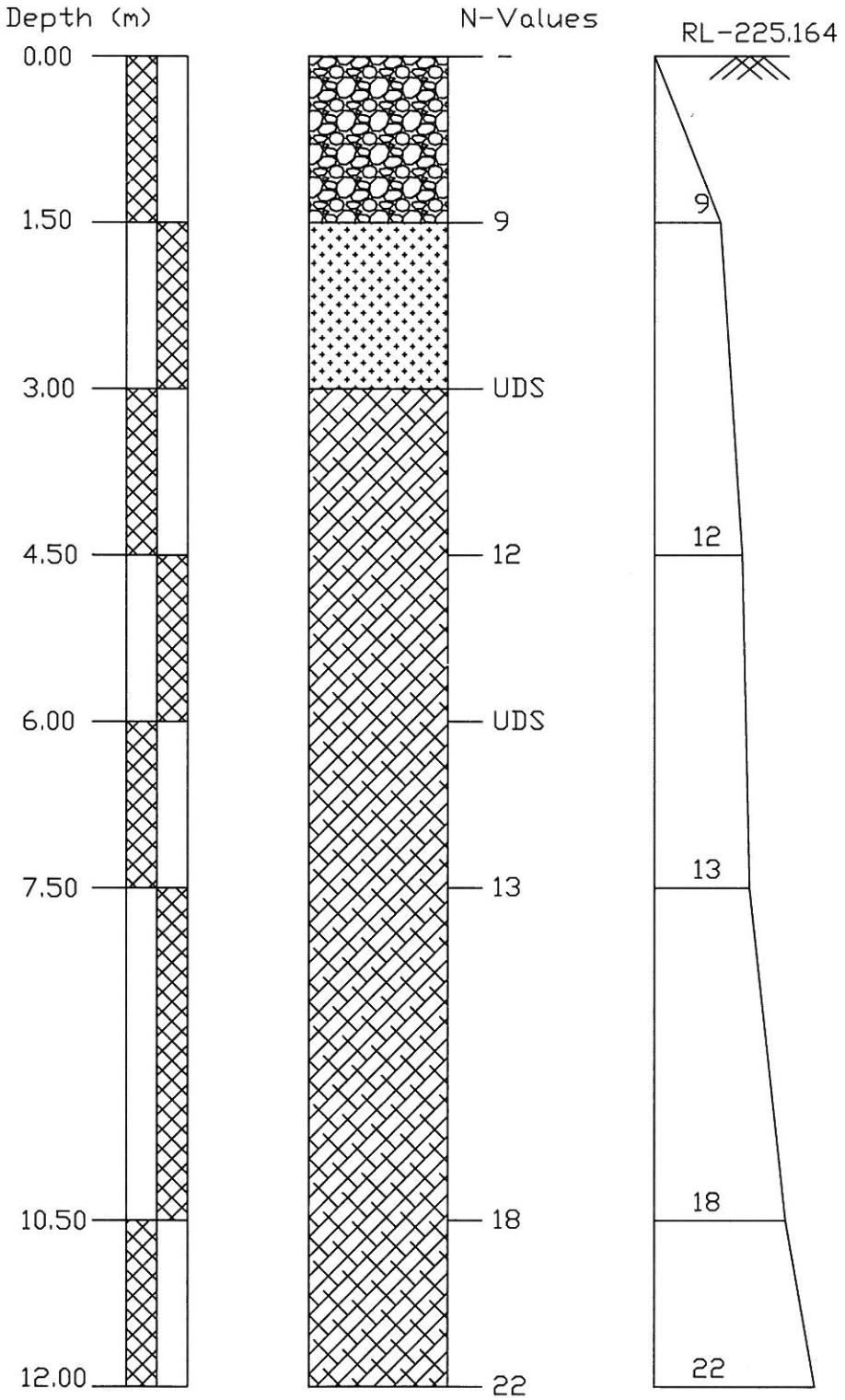
BORELOG OF BH–1(RHS) AT PROPOSED KM–70700 FOR ALIGNMENT ON KM–317+220 AT 550M,
DETOUR SECTION OF 317+510 TO 315+700,
ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

SYMBOL	*DESCRIPTION*
	SANDY SILT WITH GRAVELS
	SANDY SILT WITH CLAY
	CLAYEY SILT

225.164

CONSULTING Engineers Group Ltd.

CHAPTER – 114

"RFO (ROR" on Km. 316+600 at 970m, Detour Section of (317+510 to 315+700)

Location – Proposed Chainage – 69950

CONSULTING
Engineers Group Ltd.

114.1 LOCATION OF STRUCTURE:

Proposed RFO (ROR) of 69950

114.2 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 13.50m 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	Sandy Silt with Clay & Gravels	Loose
	3.00 to 4.50	Silty Sand	Loose
	4.50 to 13.50	Silty Sand	Medium Dense
	13.50 to 22.50	Silty Sand	Dense
	22.50 to 30.00	Silty Sand	Very Dense
BH-2(A2)	0.00 to 4.50	Silty Sand with gravels	Medium Dense
	4.50 to 16.50	Silty Sand	Medium Dense
	16.50 to 25.50	Silty Sand	Dense
	25.50 to 30.00	Silty Sand	Very Dense

114.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1 (A1)	3.00	8.50	NIL	0.0039	NIL	0.0012	0.037
	9.00	8.90	0.010	0.0039	NIL	0.0011	0.032
	12.00	8.70	0.005	0.0028	NIL	0.0011	0.026
BH-2 (A2)	3.00	8.60	0.002	0.0032	NIL	0.0012	0.030
	12.00	8.80	0.005	0.0032	NIL	0.0011	0.025
	18.00	9.00	0.012	0.0035	NIL	0.0011	0.023
	24.00	8.90	0.010	0.0049	NIL	0.0013	0.046

114.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1 (A1)	3.00	NIL
	9.00	NIL
	21.00	NIL
BH-2 (A2)	3.00	NIL
	12.00	NIL
	24.50	NIL

114.5 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	81	78	173	763	0.1	2.4	965	608
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	-	-

114.6 PILE LOAD CARRYING CAPACITY

114.6.1 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.

Safe bearing capacity in t/m²

BH -NO.	PILE DEPTH (mtr)	Net Allowable Bearing Pressure (t/m²)
BH-1 (A1)	1.50m	09.50
	3.00m	17.50
	4.50m	18.50
	6.00m	19.00
BH-2 (A2)	1.50m	13.00
	3.00m	19.00
	4.50m	20.00
	6.00m	21.00

Pile load carrying capacity in t

BH -NO.	PILE DEPTH (mtr)	PILE CARRYING CAPACITY IN TONNE
		Pile Diameter= 1.0 m
BH-1 (A1)	17.00	150.00
	20.00	190.00
	23.00	235.00
BH-2 (A2)	17.00	140.00
	20.00	180.00
	23.00	230.00

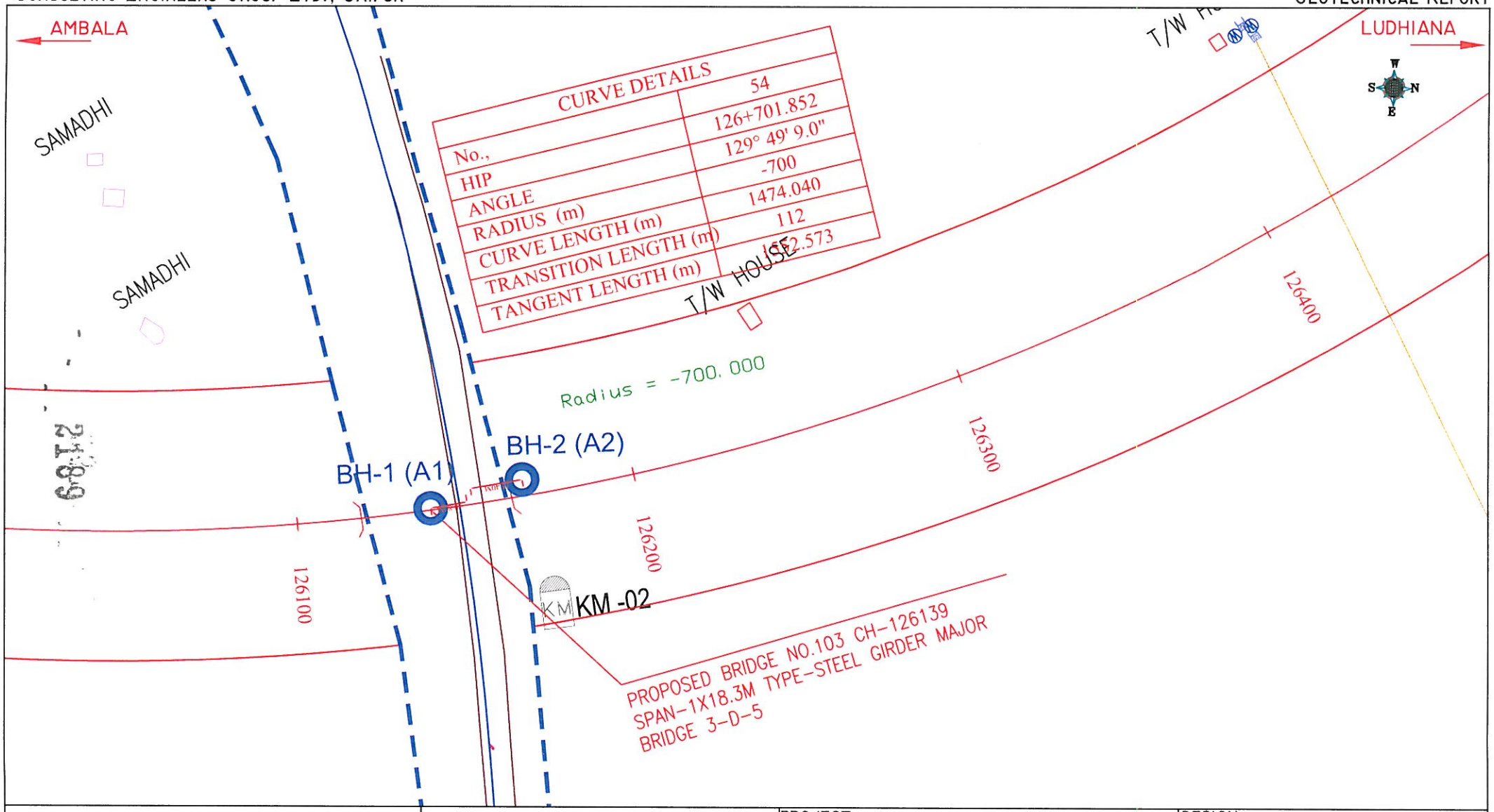
114.7 CONCLUSIONS

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

114.8 RECOMMENDATIONS

(i)	*Type of foundation*	Open / 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 DETOUR SECTION AT CH. 69950

RL OF BH-A1 = 265.909
RL OF BH-A2 = 263.869

PROJECT :-

LUDHIANA-AMBALA (DFCCIL)

DESIGN :-

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ANNEXURE - I

SOIL CHARACTERISTICS OF BORE HOLE AT BH-A1(RHS) FOR PROPOSED RFO (ROR) AT CHAINAGE 69950

Project :	Chainage 69950 Bridge No. 000			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				17.11.2009 to 18.11.2009	1	A1	13.50 m	30.00mtr	265.909

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 & Gravels	8.14	41.40	32.52	3.22	5.14	9.58	0.00	28	20	8						
1.50	9	1.45	13.05	Sandy Silt with Clay & Gravels	6.11	46.00	29.98	3.08	4.11	10.72	0.00	26	19	7						
3.00	UDS	-	-	Silty Sand	2.56	17.17	67.21	10.02	1.69	1.35	0.00	25	NP	NIL	1.73	6.67	1.62	2.67	0.00	28.0
4.50	15	1.09	16.35	Silty Sand	2.41	12.47	79.63	4.37	0.80	0.32	0.00	24	NP	NIL						
7.50	19	0.91	17.29	Silty Sand	2.30	7.97	80.12	8.16	1.08	0.37	0.00	25	NP	NIL						
9.00	UDS	-	-	Silty Sand	2.68	10.53	72.54	4.08	0.35	9.82	0.00	25	NP	NIL	1.76	10.40	1.59	2.57	0.00	28.0
10.50	23	0.80	18.40	Silty Sand	2.54	6.97	87.41	3.05	0.03	0.00	0.00	24	NP	NIL						
13.50	30	0.71	18.15	Silty Sand	2.63	12.09	75.76	5.95	3.57	0.00	0.00	24	NP	NIL						
16.50	35	0.65	18.88	Silty Sand	2.76	8.64	86.50	2.10	0.00	0.00	0.00	26	NP	NIL						
19.50	39	0.59	19.01	Silty Sand	2.43	7.55	87.08	2.88	0.06	0.00	0.00	25	NP	NIL						
21.00	UDS	-	-	Silty Sand	2.68	11.84	80.69	3.58	1.21	0.00	0.00	24	NP	NIL	1.78	22.76	1.45	2.66	0.00	28.0
22.50	50	0.54	21.00	Silty Sand	2.82	9.33	79.43	6.46	0.98	0.98	0.00	24	NP	NIL						
25.50	60	0.50	22.50	Silty Sand	2.46	8.84	82.01	6.15	0.33	0.21	0.00	23	NP	NIL						
28.50	70	0.46	23.60	Silty Sand	2.63	9.82	80.86	5.97	0.51	0.21	0.00	24	NP	NIL						
30.00	83	0.44	25.76	Silty Sand	2.50	13.51	76.26	4.67	2.02	1.04	0.00	25	NP	NIL						

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ANNEXURE - I

SOIL CHARACTERISTICS OF BORE HOLE AT BH-A2(RHS) FOR PROPOSED RFO (ROR) AT CHAINAGE 69950

Project :	Chainage 69950 Bridge No. 000			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				16.11.2009 to 17.11.2009	2	A2	13.50 m	30.00mtr	263.869

Depth	Observ-	Correction	Corrected	Soil	Grain Size Distribution % wt retained							Atterberg Limits %			B.D.	M.C.	D.D.	Specific	Shear Strength	
from	ed	Factor		Description	Clay	Silt	Sand			Gravel								Gravity	c kg/cm^2	ϕ
GL (m)	N	C_n	N_n	(Soil Group)			Fine	Medium	Coarse	Fine	Coarse	L.L.	P.L.	P.I.	gm/cc	%	gm/cc			degree
0.00	-	-	-	Silty Sand with Gravels	2.15	24.18	63.58	3.25	2.15	4.69	0.00	22	NP	NIL						
1.50	11	1.46	16.06	Silty Sand with Gravels	2.35	28.58	60.16	2.41	1.88	4.62	0.00	23	NP	NIL						
3.00	UDS	-	-	Silty Sand with Gravels	4.15	19.55	53.59	3.39	2.35	12.55	4.42	29	NP	NIL	1.68	5.26	1.59	2.6	0.00	27.0
4.50	17	1.10	18.70	Silty Sand	3.22	8.03	70.24	11.35	0.75	6.41	0.00	25	NP	NIL						
7.50	21	0.92	19.32	Silty Sand	2.10	10.69	79.51	7.48	0.22	0.00	0.00	22	NP	NIL						
10.50	25	0.81	20.25	Silty Sand	2.69	8.01	81.84	6.28	0.19	0.99	0.00	26	NP	NIL						
12.00	UDS	-	-	Silty Sand	3.69	12.25	76.04	3.61	0.21	4.20	0.00	28	NP	NIL	1.72	9.81	1.57	2.56	0.00	27.0
13.50	28	0.72	17.58	Silty Sand	2.69	7.93	80.70	8.16	0.52	0.00	0.00	25	NP	NIL						
16.50	33	0.65	18.23	Silty Sand	3.22	8.14	80.46	7.80	0.38	0.00	0.00	24	NP	NIL						
19.50	37	0.60	18.60	Silty Sand	3.15	13.62	80.36	2.87	0.00	0.00	0.00	26	NP	NIL						
22.50	41	0.55	18.78	Silty Sand	2.86	6.28	81.69	6.89	2.28	0.00	0.00	25	NP	NIL						
24.00	UDS	-	-	Silty Sand	3.52	19.45	70.98	3.61	0.31	2.13	0.00	26	NP	NIL	2.01	13.93	1.76	2.67	0.00	28.0
25.50	67	0.46	22.91	Silty Sand	2.96	7.28	81.72	7.59	0.45	0.00	0.00	24	NP	NIL						
28.50	82	0.42	24.72	Silty Sand	3.00	9.53	80.15	4.75	2.57	0.00	0.00	24	NP	NIL						
30.00	87	0.40	24.90	Silty Sand	3.10	9.01	80.67	5.03	2.19	0.00	0.00	25	NP	NIL						

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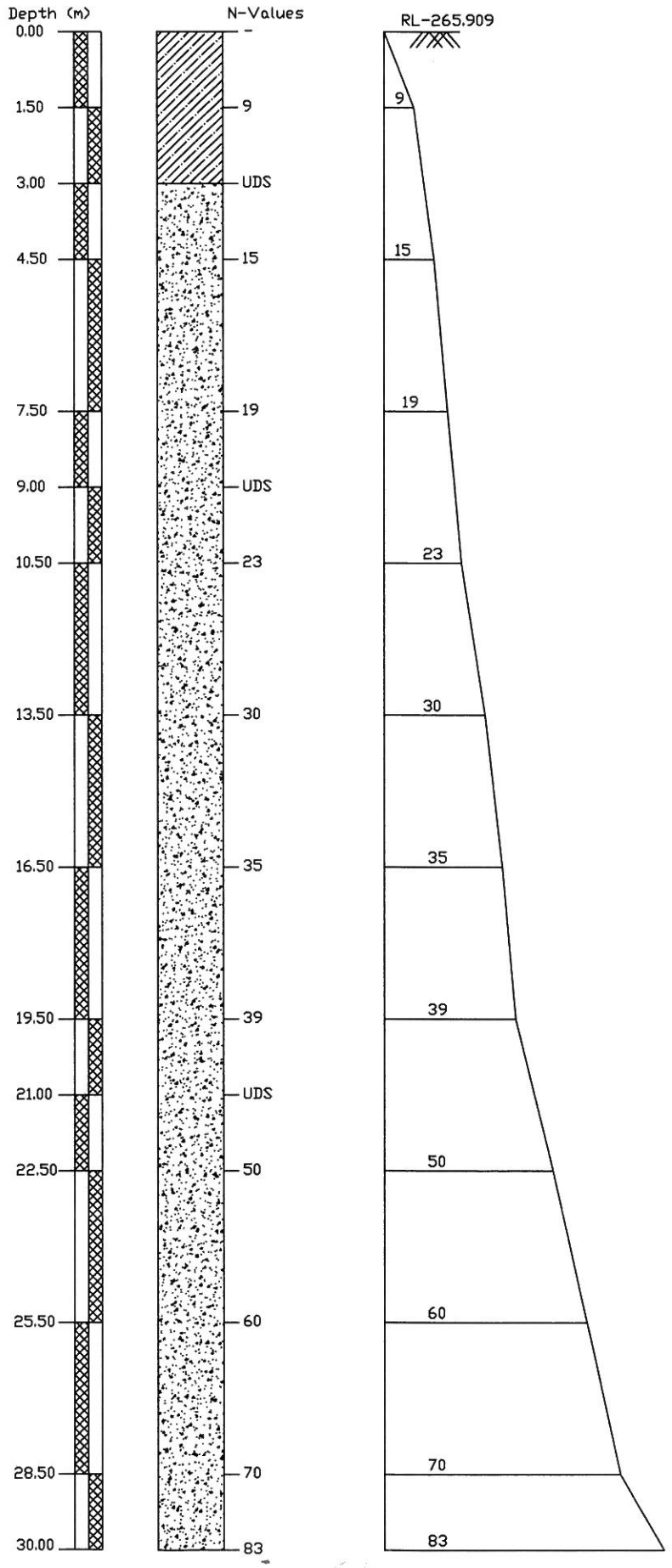
BORELOG OF BH–1(A1) AT PROPOSED KM–69950 FOR ROR ON KM–316+600 AT 970M,
DETOUR SECTION OF 317+510 TO 315+700,
ON KESARI TO SANEHWAL, LUDHIANA



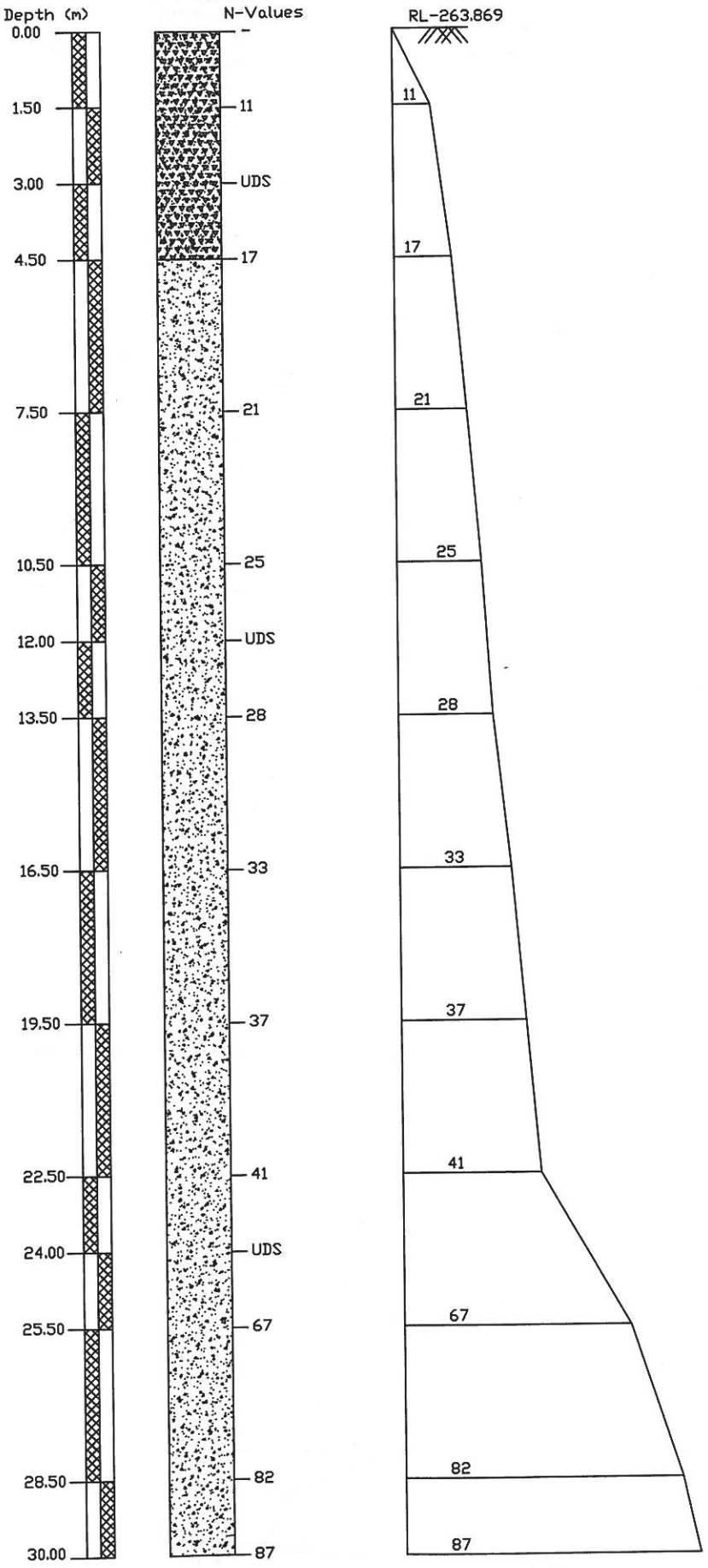
LEGEND

SYMBOL	DESCRIPTION
	SANDY SILT WITH CLAY & GRAVELS
	SILTY SAND

2192

CONSULTING Engineers Group Ltd.

BORELOG OF BH–2(A2) AT PROPOSED KM–69950 FOR ROR ON KM–316+600 AT 970M,
DETOUR SECTION OF 317+510 TO 315+700,
ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

SYMBOL	DESCRIPTION
	SILTY SAND WITH GRAVELS
	SILTY SAND

2193

CHAPTER – 115

"Major Bridge" on Km. 316+250 at 880m,

Detour Section of (317+510 to 315+700),

Location – Proposed Chainage - 69550

115.1 LOCATION OF STRUCTURE:

Proposed Major Bridge 69550

115.2 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 2.00m below EGL.

Subsurface profile at the site

BOREHOLE No.	Depth (m)	Type of Soil/Rock	Soil/Rock Characteristics
BH-1(A1)	0.00 to 1.50	Sandy Silt with Clay	Loose
	1.50 to 3.00	Sandy Silt with Clay	Medium Dense
	3.00 to 13.50	Silty Sand	Medium Dense
	13.50 to 25.50	Silty Sand	Dense
	25.50 to 30.00	Silty Sand	Very Dense
BH-2(P1)	0.00 to 3.00	Clayey Silt with Sand	Loose
	3.00 to 4.50	Silty Sand	Loose
	4.50 to 13.50	Silty Sand	Medium Dense
	13.50 to 22.50	Silty Sand	Dense
	22.50 to 30.00	Silty Sand	Very Dense
BH-3(A2)	0.00 to 3.00	Sandy Silt with Clay	Loose
	3.00 to 4.50	Silty Sand	Loose
	4.50 to 13.50	Silty Sand	Medium Dense
	13.50 to 19.50	Silty Sand	Dense
	19.50 to 30.00	Silty Sand	Very Dense

115.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1 (A1)	3.00	8.60	0.005	0.0035	NIL	0.0012	0.026
BH-2 (P1)	3.00	8.60	0.005	0.0042	NIL	0.0013	0.033
	9.00	8.60	0.007	0.0035	NIL	0.0012	0.031
BH-3 (A2)	27.00	8.80	0.007	0.0049	NIL	0.0013	0.049

115.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1 (A1)	3.00	NIL
	12.00	NIL
	22.50	NIL
BH-2 (P1)	3.00	NIL
	9.00	NIL
	21.00	NIL

BH-3 (A2)	3.00	NIL
	18.00	NIL
	27.00	NIL

115.5 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	70	80	179	740	0.2	2.2	930	602
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	-	-

115.6 PILE LOAD CARRYING CAPACITY

115.6.1 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.

Safe bearing capacity in t/m²

BH -NO.	DEPTH (mtr)	Net Allowable Bearing Pressure (t/m²)
BH-1 (A1)	1.50m	09.00
	3.00m	23.00
	4.50m	24.00
	6.00m	24.00
BH-3 (A2)	1.50m	07.00
	3.00m	14.50
	4.50m	15.50
	6.00m	16.50

Pile load carrying capacity in t

BH -NO.	PILE DEPTH (mtr)	PILE CARRYING CAPACITY IN TONNE
		Pile Diameter= 1.0 m
BH-1 (A1)	17.00	150.00
	20.00	190.00
	23.00	240.00
BH-2 (P1)	17.00	150.00
	20.00	190.00
	23.00	250.00
BH-3 (A2)	17.00	140.00
	20.00	190.00
	23.00	240.00

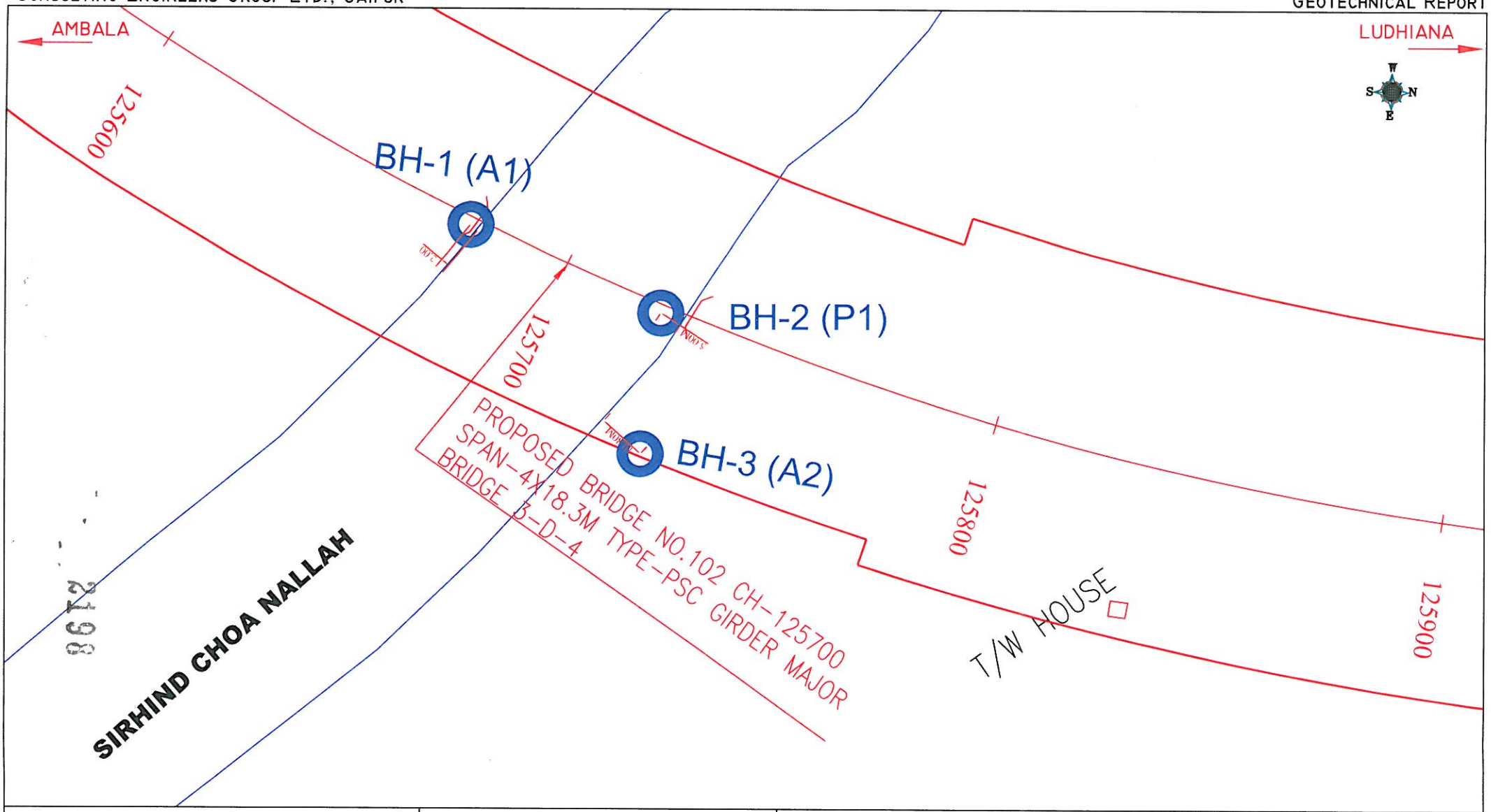
115.7 CONCLUSIONS

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

115.8 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 DETOUR SECTION AT CH. 69550	RL OF BH-AI = 263.158 RL OF BH-PI = 262.358 RL OF BH-A2 = 263.163	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(RHS) FOR PROPOSED MAJOR BRIDGE AT CHAINAGE 69550

Project :	Chainage 69550 Bridge No. 000			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				19.11.2009 to 20.11.2009	1	A1	10.50 m	30.00mtr	263.158

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	9.14	44.08	26.89	10.52	6.88	2.49	0.00	27	18	9						
1.50	10	1.46	14.60	Sandy Silt with Clay	10.18	48.91	24.00	8.26	5.53	3.12	0.00	28	18	10						
3.00	UDS	-	-	Silty Sand	3.28	22.66	72.23	1.21	0.54	0.08	0.00	25	NP	NIL	1.70	10.15	1.54	2.57	0.00	28.0
4.50	23	1.09	25.07	Silty Sand	4.12	20.48	71.15	2.41	0.91	0.93	0.00	28	NP	NIL						
7.50	25	0.92	23.00	Silty Sand	3.25	14.69	78.22	2.66	0.74	0.44	0.00	25	NP	NIL						
10.50	28	0.81	18.84	Silty Sand	2.45	10.27	81.48	4.91	0.66	0.23	0.00	24	NP	NIL						
12.00	UDS	-	-	Silty Sand	2.22	10.11	81.26	5.48	0.65	0.28	0.00	24	NP	NIL	1.74	18.21	1.47	2.65	0.00	28.0
13.50	32	0.72	19.02	Silty Sand	2.64	8.03	81.59	6.34	1.15	0.25	0.00	25	NP	NIL						
16.50	35	0.65	18.88	Silty Sand	2.25	9.88	80.58	6.15	0.83	0.31	0.00	25	NP	NIL						
19.50	38	0.59	18.71	Silty Sand	2.60	8.62	81.03	6.57	0.90	0.28	0.00	25	NP	NIL						
22.50	UDS	-	-	Silty Sand	2.11	9.47	80.65	6.48	0.46	0.83	0.00	24	NP	NIL	1.81	20.21	1.51	2.66	0.00	28.0
25.50	54	0.49	20.73	Silty Sand	2.00	7.53	82.33	6.83	0.25	1.06	0.00	23	NP	NIL						
28.50	66	0.45	22.35	Silty Sand	2.10	8.32	81.68	6.68	0.36	0.86	0.00	22	NP	NIL						
30.00	47	0.44	17.84	Silty Sand	2.36	9.94	80.16	6.78	0.76	0.00	0.00	24	NP	NIL						

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6612

SOIL CHARACTERISTICS OF BORE HOLE AT BH-P1(RHS) FOR PROPOSED MAJOR BRIDGE AT CHAINAGE 69550

Project :	Chainage 69550 Bridge No. 000			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				20.11.2009 to 21.11.2009	2	P1	02.00 m	30.00mtr	262.358

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	22.69	60.16	15.53	0.66	0.52	0.44	0.00	40	20	20						
1.50	7	1.51	10.57	Clayey Silt with Sand	24.59	59.96	14.35	0.46	0.32	0.32	0.00	41	19	22						
3.00	UDS	-	-	Silty Sand	4.22	39.91	53.95	1.22	0.70	0.00	0.00	27	NP	NIL	1.65	15.96	1.42	2.66	0.00	27.0
4.50	12	1.10	13.20	Silty Sand	2.15	13.62	67.17	10.45	2.59	4.02	0.00	23	NP	NIL						
7.50	19	0.93	17.67	Silty Sand	2.14	11.12	71.29	10.35	1.85	3.25	0.00	25	NP	NIL						
9.00	UDS	-	-	Silty Sand	2.00	5.93	77.69	10.19	1.28	2.91	0.00	27	NP	NIL	1.89	20.70	1.57	2.66	0.00	27.0
10.50	24	0.77	16.74	Silty Sand	2.86	17.49	73.76	5.54	0.35	0.00	0.00	24	NP	NIL						
13.50	30	0.69	17.85	Silty Sand	2.10	11.70	80.36	5.39	0.45	0.00	0.00	23	NP	NIL						
16.50	35	0.62	18.35	Silty Sand	2.20	9.68	81.12	5.74	1.05	0.21	0.00	23	NP	NIL						
19.50	42	0.57	19.47	Silty Sand	2.00	7.77	83.39	5.78	0.58	0.48	0.00	25	NP	NIL						
21.00	UDS	-	-	Silty Sand	2.36	8.22	82.27	6.14	0.66	0.35	0.00	24	NP	NIL	1.93	21.30	1.59	2.66	0.00	28.0
22.50	51	0.51	20.51	Silty Sand	2.11	9.33	81.56	6.38	0.62	0.00	0.00	23	NP	NIL						
25.50	68	0.47	23.48	Silty Sand	2.58	8.59	81.71	6.48	0.64	0.00	0.00	25	NP	NIL						
28.50	68	0.43	22.12	Silty Sand	3.20	9.20	80.39	5.92	1.29	0.00	0.00	25	NP	NIL						
30.00	67	0.41	21.24	Silty Sand	3.25	9.15	78.53	5.83	1.70	1.54	0.00	26	NP	NIL						

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SOIL CHARACTERISTICS OF BORE HOLE AT BH-A2(RHS) FOR PROPOSED MAJOR BRIDGE AT CHAINAGE 69550

Project :	Chainage 69550 Bridge No. 000			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				18.11.2009 to 19.11.2009	3	A2	12.00 m	30.00mtr	263.163

Depth from GL (m)	Observ-ed N	Correction Factor C_n	Corrected N_n	Soil Description (Soil Group)	Grain Size Distribution % wt retained							Atterberg Limits %			B.D. gm/cc	M.C. %	D.D. gm/cc	Specific Gravity	Shear Strength	
					Clay	Silt	Sand			Gravel									c kg/cm^2	ϕ degree
							Fine	Medium	Coarse	Fine	Coarse	L.L.	P.L.	P.I.						
0.00	-	-	-	Sandy Silt with Clay	15.16	62.43	22.26	0.15	0.00	0.00	0.00	31	16	15						
1.50	9	1.46	13.14	Sandy Silt with Clay	17.42	60.98	21.31	0.29	0.00	0.00	0.00	33	17	16						
3.00	UDS	-	-	Silty Sand	4.26	40.15	53.12	2.16	0.31	0.00	0.00	28	NP	NIL	1.67	10.43	1.51	2.62	0.00	27.5
4.50	22	1.10	24.20	Silty Sand	0.00	9.24	88.01	2.75	0.00	0.00	0.00	25	NP	NIL						
7.50	24	0.93	22.32	Silty Sand	0.00	8.64	88.53	2.83	0.00	0.00	0.00	24	NP	NIL						
10.50	28	0.81	22.68	Silty Sand	0.00	5.66	92.78	1.56	0.00	0.00	0.00	26	NP	NIL						
13.50	30	0.73	18.45	Silty Sand	0.00	6.27	91.25	2.48	0.00	0.00	0.00	25	NP	NIL						
16.50	46	0.66	22.68	Silty Sand	0.00	5.68	90.69	3.63	0.00	0.00	0.00	24	NP	NIL						
18.00	UDS	-	-	Silty Sand	2.25	13.59	80.36	3.25	0.55	0.00	0.00	23	NP	NIL	1.72	19.11	1.44	2.67	0.00	28.0
19.50	54	0.60	23.70	Silty Sand	3.14	9.81	81.33	4.50	0.75	0.47	0.00	25	NP	NIL						
22.50	60	0.55	24.00	Silty Sand	3.33	9.51	84.25	2.25	0.66	0.00	0.00	25	NP	NIL						
25.50	68	0.51	24.84	Silty Sand	3.58	4.64	89.29	2.34	0.15	0.00	0.00	25	NP	NIL						
27.00	UDS	-	-	Silty Sand	2.86	14.96	65.28	12.37	2.41	2.12	0.00	24	NP	NIL	1.99	19.83	1.66	2.61	0.00	29.0
28.50	72	0.42	22.62	Silty Sand	3.14	21.56	62.36	10.36	2.58	0.00	0.00	24	NP	NIL						
30.00	66	0.40	20.70	Silty Sand	3.35	37.84	54.86	1.77	2.18	0.00	0.00	25	NP	NIL						

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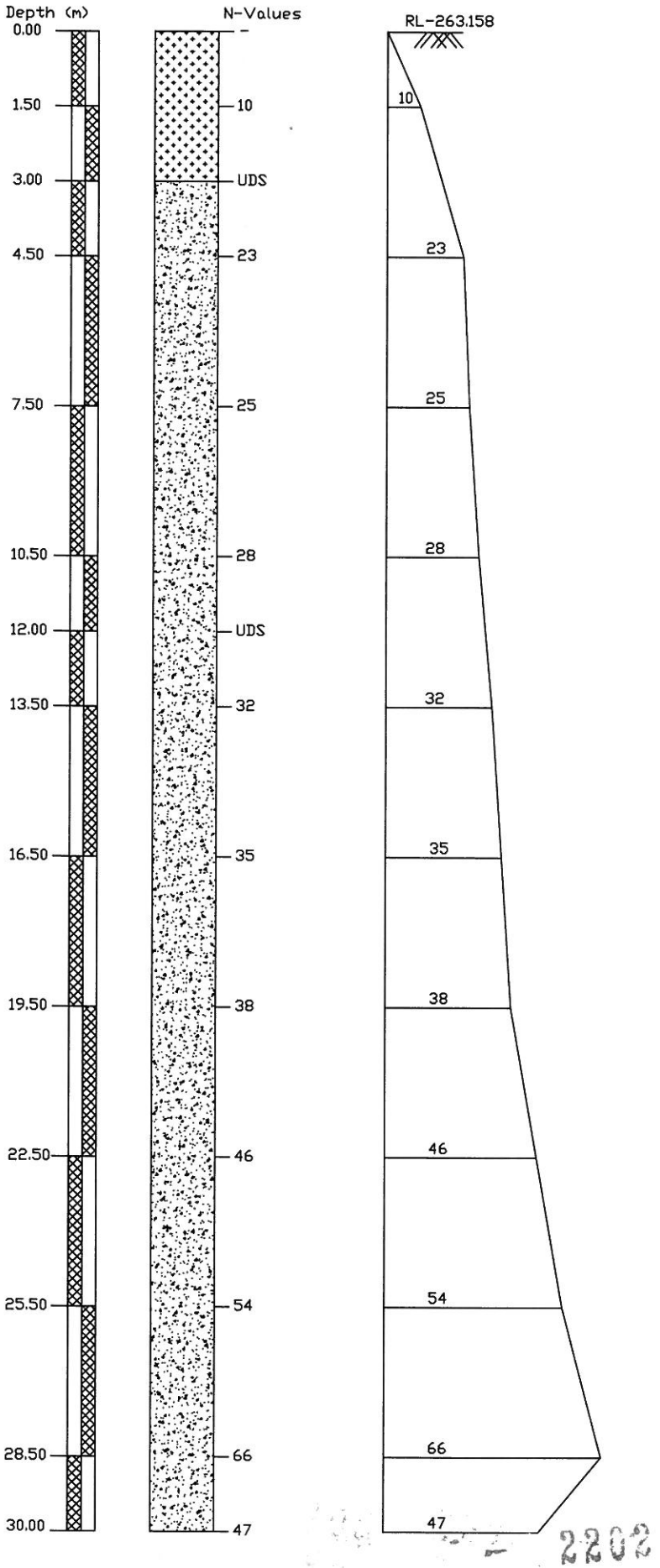
BORELOG OF BH–1(A1) AT PROPOSED KM–69550 FOR MAJOR BRIDGE ON KM–316+250 AT 880M,
DETOUR SECTION OF 317+510 TO 315+700,
ON KESARI TO SANEHWAL, LUDHIANA



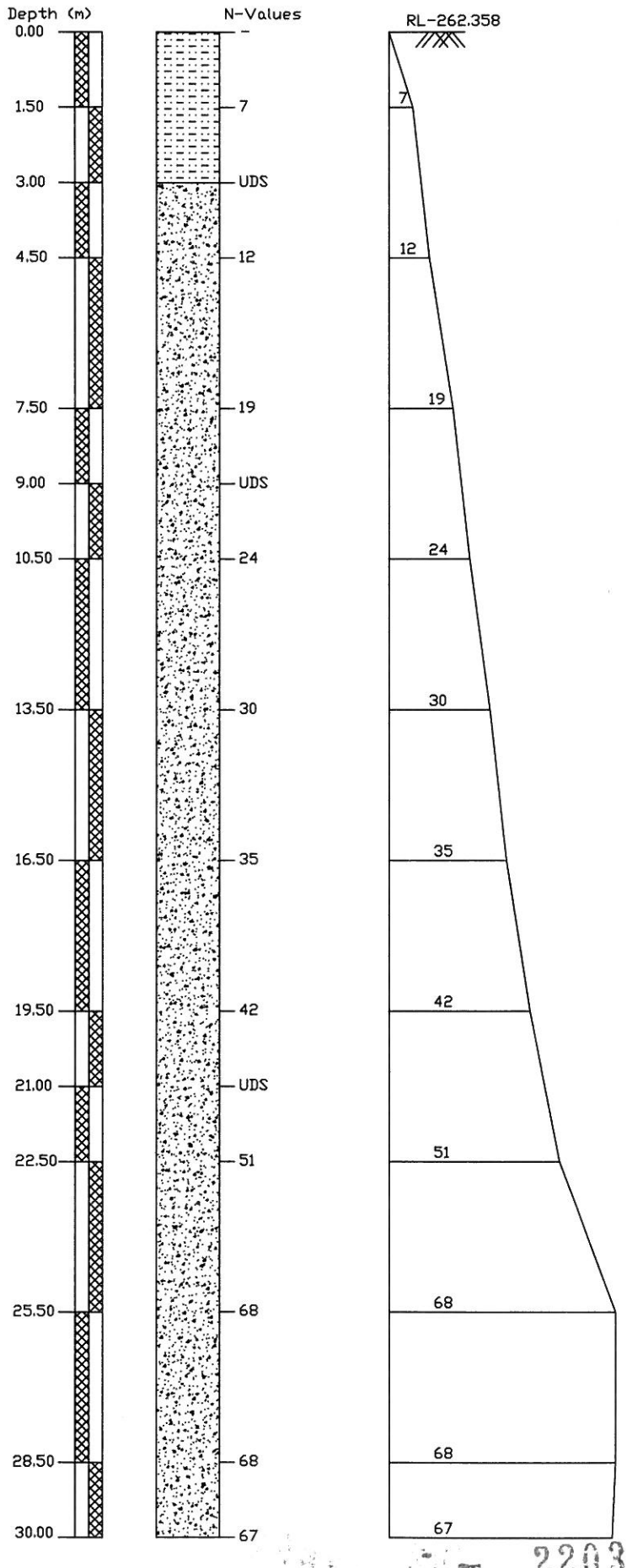
LEGEND

SYMBOL	DESCRIPTION
	SANDY SILT WITH CLAY
	SILTY SAND

2202

CONSULTING Engineers Group Ltd.

BORELOG OF BH–2(P1) AT PROPOSED KM–69550 FOR MAJOR BRIDGE ON KM–316+250 AT 880M,
DETOUR SECTION OF 317+510 TO 315+700,
ON KESARI TO SANEHWAL, LUDHIANA



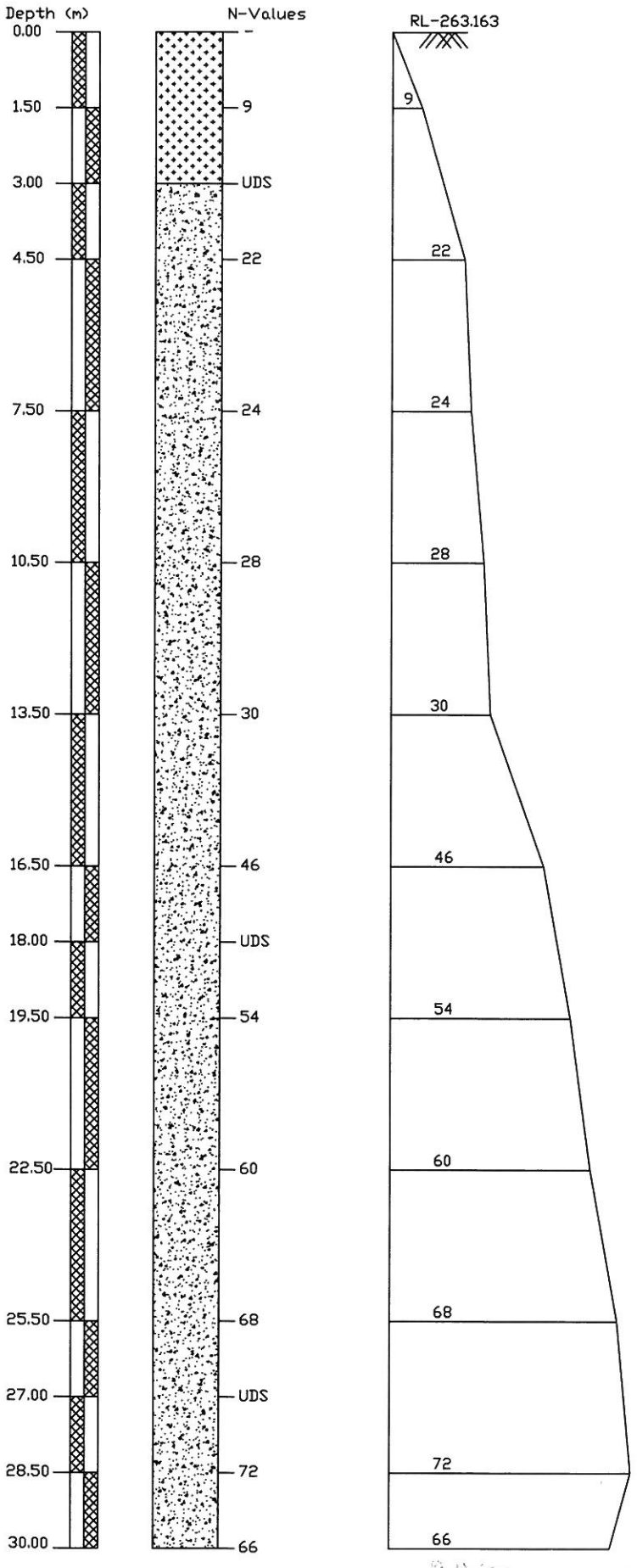
LEGEND

SYMBOL	DESCRIPTION
	CLAYEY SILT WITH SAND
	SILTY SAND

2203

CONSULTING Engineers Group Ltd.

BORELOG OF BH–3(A2) AT PROPOSED KM–69550 FOR MAJOR BRIDGE ON KM–316+250 AT 880M,
DETOUR SECTION OF 317+510 TO 315+700,
ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

SYMBOL	DESCRIPTION
	SANDY SILT WITH CLAY
	SILTY SAND

2204

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CHAPTER – 116

"ROB" on Km. 315+900 at 330m, Detour Section of (317+510 to 315+700)

Location – Proposed Chainage – 69050

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116.1 LOCATION OF STRUCTURE:

Proposed ROB of 69050

116.2 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 16.0m below EGL.

Subsurface profile at the site

BOREHOLE No.	Depth (m)	Type of Soil/Rock	Soil/Rock Characteristics
BH-1(A1)	0.00 to 2.00	Filled up Strata	Loose
	2.00 to 4.50	Sandy Silt with Clay	Loose
	4.50 to 7.50	Sandy Silt with Clay	Medium Dense
	7.50 to 13.50	Silty Sand	Medium Dense
	13.50 to 22.50	Silty Sand	Dense
	22.50 to 30.00	Silty Sand	Very Dense
BH-2(A2)	0.00 to 3.00	Sandy Silt with Clay	Loose
	3.00 to 4.50	Silty Sand	Loose
	4.50 to 10.50	Silty Sand	Medium Dense
	10.50 to 19.50	Sandy Silt	Dense
	19.50 to 30.00	Silty Sand	Very Dense

116.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1 (A1)	3.00	8.20	NIL	0.0046	NIL	0.0014	0.073
	12.00	8.80	0.010	0.0032	NIL	0.0012	0.032
BH-2 (A2)	3.00	8.40	NIL	0.0035	NIL	0.0012	0.032
	12.00	8.70	0.005	0.0035	NIL	0.0011	0.028
	27.00	8.90	0.010	0.0035	NIL	0.0013	0.033

116.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1 (A1)	3.00	15.00
	12.00	NIL
	27.00	NIL
BH-2 (A2)	3.00	NIL
	12.00	NIL
	27.00	NIL

116.5 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	72	92	182	750	0.1	2.1	943	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	-	-

116.6 PILE LOAD CARRYING CAPACITY

116.6.1 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.

Safe bearing capacity in t/m²

BH -NO.	DEPTH (mtr)	Net Allowable Bearing Pressure (t/m²)
BH-1 (A1)	2.00m	10.00
	3.00m	14.00
	4.50m	15.00
	6.00m	16.00
BH-2 (A2)	1.50m	10.00
	3.00m	23.00
	4.50m	27.00
	6.00m	27.50

Pile load carrying capacity in t

BH -NO.	PILE DEPTH (mtr)	PILE CARRYING CAPACITY IN TONNE
		Pile Diameter= 1.0 m
BH-1 (A1)	17.00	160.00
	20.00	210.00
	23.00	260.00
BH-2 (A2)	17.00	150.00
	20.00	200.00
	23.00	250.00

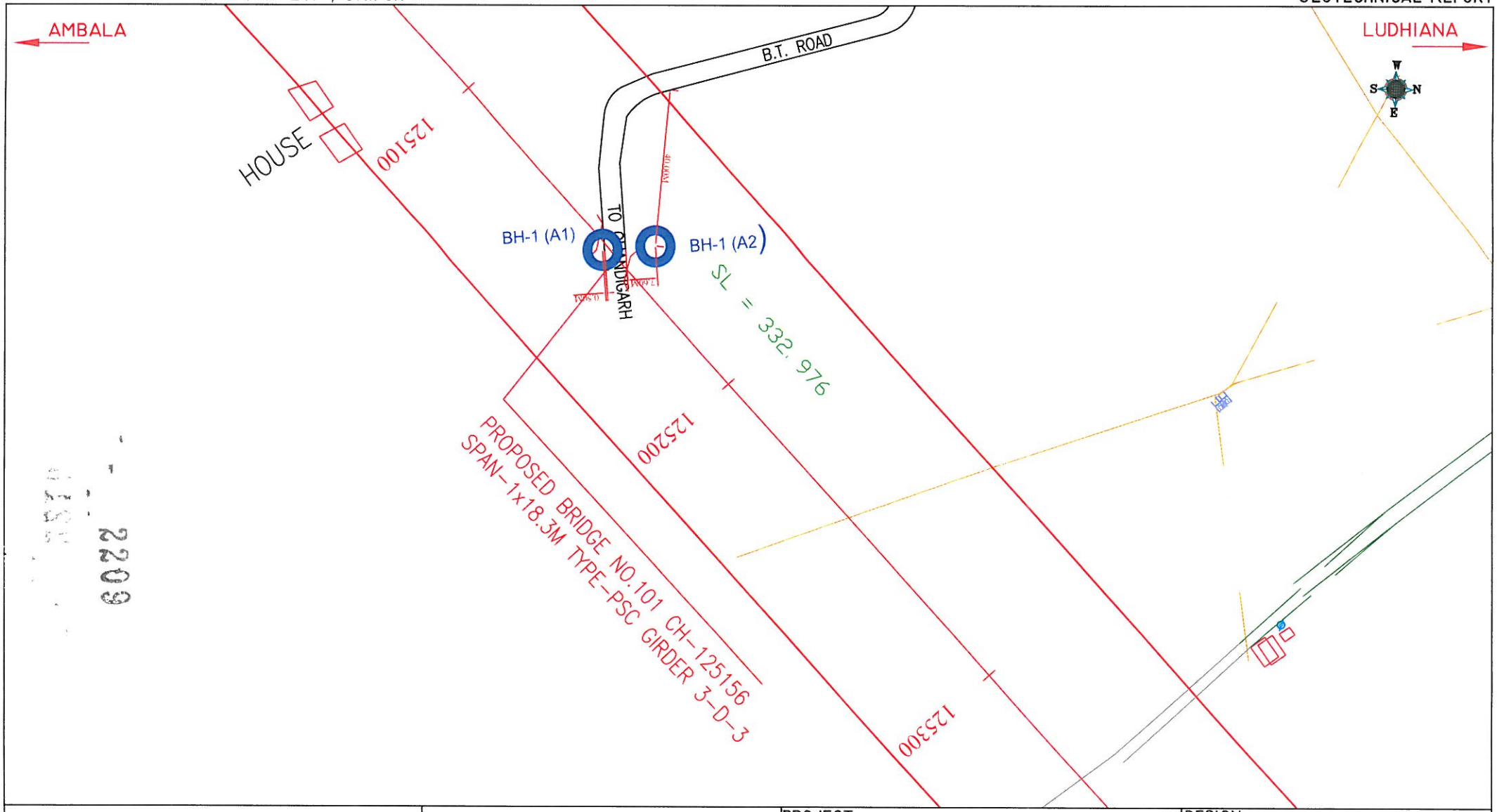
116.7 CONCLUSIONS

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

116.8 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 DETOUR SECTION AT CH. 69050	RL OF BH-AI = 267.171 RL OF BH-A2 = 265.011	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(RHS) FOR PROPOSED ROB AT CHAINAGE 69050

Project :	Chainage 69050 Bridge No. 000			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				23.11.2009 to 23.11.2009	1	A1	17.00 m	30.00mtr	267.171

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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.00	-	-	-	Sandy Silt with Clay	12.69	67.37	15.97	0.49	0.20	3.28	0.00	32	20	12						
3.00	UDS	-	-	Sandy Silt with Clay	14.69	67.18	17.76	0.27	0.10	0.00	0.00	33	20	13	1.81	10.83	1.63	2.62	0.15	16.0
4.50	12	1.07	12.84	Sandy Silt with Clay	10.39	67.65	11.35	3.26	3.03	4.32	0.00	30	21	9						
7.50	21	0.90	18.90	Silty Sand	0.00	6.05	82.62	10.69	0.10	0.54	0.00	26	NP	NIP						
10.50	26	0.79	20.54	Silty Sand	0.00	10.24	80.69	8.55	0.52	0.00	0.00	27	NP	NIP						
12.00	UDS	-	-	Silty Sand	0.00	6.05	85.02	8.61	0.32	0.00	0.00	29	NP	NIP	1.80	14.99	1.56	2.67	0.00	27.0
13.50	35	0.70	24.50	Silty Sand	0.00	5.80	90.23	2.75	0.80	0.42	0.00	22	NP	NIP						
16.50	38	0.64	24.32	Silty Sand	2.68	8.34	83.32	5.38	0.28	0.00	0.00	25	NP	NIP						
19.50	43	0.58	19.97	Silty Sand	2.52	10.91	81.26	4.68	0.63	0.00	0.00	25	NP	NIP						
22.50	54	0.53	21.81	Silty Sand	0.00	6.62	87.15	5.80	0.43	0.00	0.00	26	NP	NIP						
25.50	64	0.49	23.18	Silty Sand	0.00	9.24	84.65	5.56	0.55	0.00	0.00	24	NP	NIP						
27.00	UDS	-	-	Silty Sand	0.00	7.42	85.66	6.25	0.67	0.00	0.00	25	NP	NIP	1.90	18.22	1.60	2.66	0.00	28.0
28.50	79	0.44	24.88	Silty Sand	0.00	7.65	86.24	5.60	0.51	0.00	0.00	25	NP	NIP						
30.00	82	0.42	24.72	Silty Sand	0.00	9.96	85.44	4.42	0.18	0.00	0.00	21	NP	NIP						

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ANNEXURE - I

SOIL CHARACTERISTICS OF BORE HOLE AT BH-A1(RHS) FOR PROPOSED ROB AT CHAINAGE 69050

Project :	Chainage 69050 Bridge No. 000			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				23.11.2009 to 23.11.2009	2	A2	16.00 m	30.00mtr	265.011

Depth	Observ-	Correction	Corrected	Soil	Grain Size Distribution % wt retained							Atterberg Limits %			B.D.	M.C.	D.D.	Specific	Shear Strength	
from	ed	Factor		Description	Clay	Silt	Sand			Gravel								Gravity	c kg/cm^2	ϕ
GL (m)	N	C_n	N_n	(Soil Group)			Fine	Medium	Coarse	Fine	Coarse	L.L.	P.L.	P.I.	gm/cc	%	gm/cc			degree
0.00	-	-	-	Sandy Silt with Clay	10.89	69.85	13.58	2.58	1.58	1.52	0.00	31	21	10	-	-	-	-	-	-
1.50	8	1.46	11.68	Sandy Silt with Clay	14.25	68.77	12.99	1.20	1.69	1.10	0.00	32	20	12						
3.00	UDS	-	-	Silty Sand	3.66	51.71	42.15	0.88	0.42	1.18	0.00	24	NP	NIL	1.77	10.76	1.60	2.63	0.00	29.0
4.50	23	1.09	25.07	Silty Sand	2.18	10.78	78.43	5.17	1.52	1.92	0.00	25	NP	NIL						
7.50	28	0.92	25.76	Silty Sand	2.30	8.63	80.36	6.28	1.23	1.20	0.00	24	NP	NIL						
10.50	31	0.81	25.11	Silty Sand	2.17	7.12	84.16	5.80	0.75	0.00	0.00	24	NP	NIL						
12.00	UDS	-	-	Silty Sand	4.22	13.08	48.31	1.89	1.21	31.29	0.00	32	NP	NIL	1.80	11.72	1.61	2.69	0.00	27.0
13.50	34	0.70	23.80	Silty Sand	2.10	11.53	77.65	7.30	1.17	0.25	0.00	23	NP	NIL						
16.50	37	0.64	23.68	Silty Sand	2.48	9.65	79.58	6.55	1.15	0.59	0.00	25	NP	NIL						
19.50	58	0.58	24.32	Silty Sand	2.66	9.96	83.28	3.80	0.30	0.00	0.00	26	NP	NIL						
22.50	64	0.53	24.46	Silty Sand	2.28	9.47	81.59	5.28	0.59	0.79	0.00	25	NP	NIL						
25.50	68	0.49	24.16	Silty Sand	2.10	6.76	83.11	6.76	0.38	0.89	0.00	24	NP	NIL						
27.00	UDS	-	-	Silty Sand	3.14	13.20	80.61	1.84	0.71	0.50	0.00	27	NP	NIL	1.86	21.09	1.54	2.69	0.00	28.0
28.50	70	0.44	22.90	Silty Sand	2.18	9.53	82.32	4.69	0.86	0.42	0.00	26	NP	NIL						
30.00	79	0.43	24.49	Silty Sand	2.14	10.57	81.78	5.12	0.39	0.00	0.00	25	NP	NIL						

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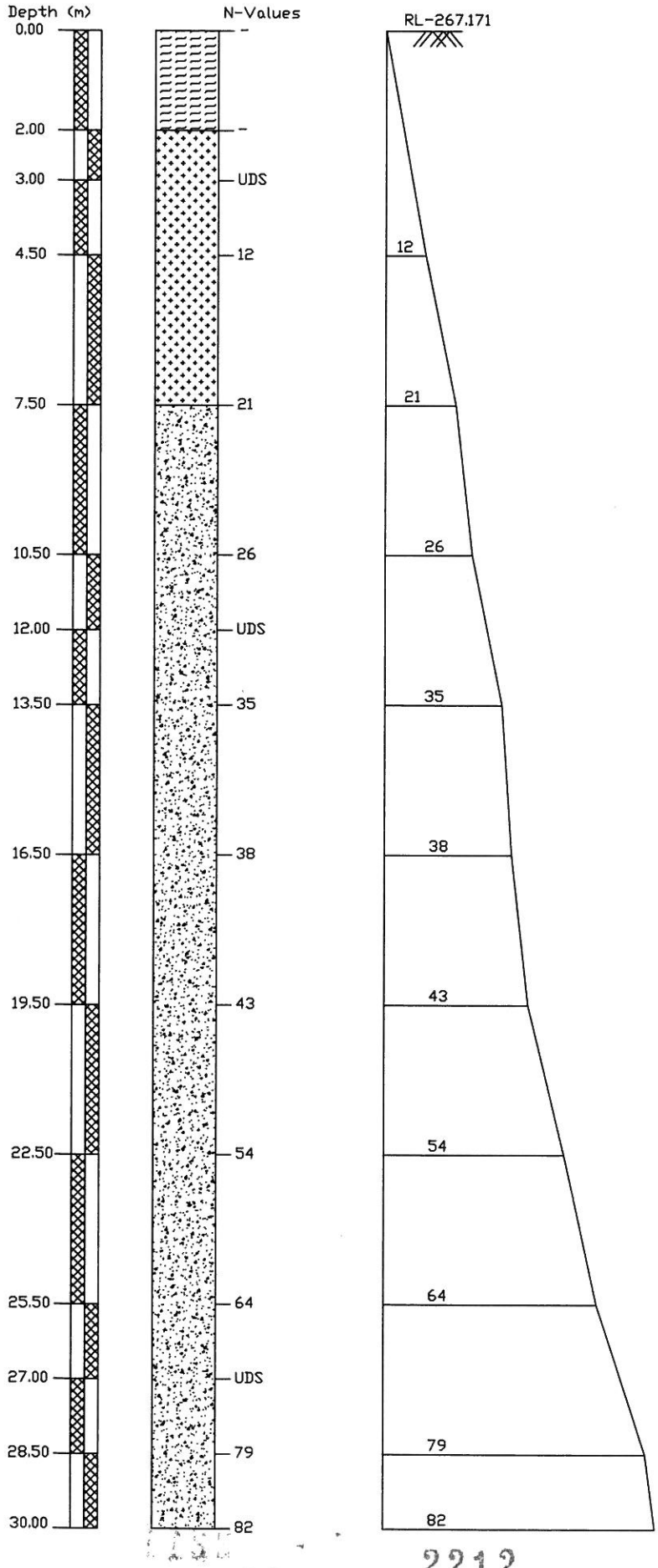
BORELOG OF BH–1(A1) AT PROPOSED KM–69050 FOR ROB ON KM–315+900 AT 330M,
DETOUR SECTION OF 317+510 TO 315+700,
ON KESARI TO SANEHWAL, LUDHIANA



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LEGEND

SYMBOL	DESCRIPTION
	FILLED UP STRATA
	SANDY SILT WITH CLAY
	SILTY SAND

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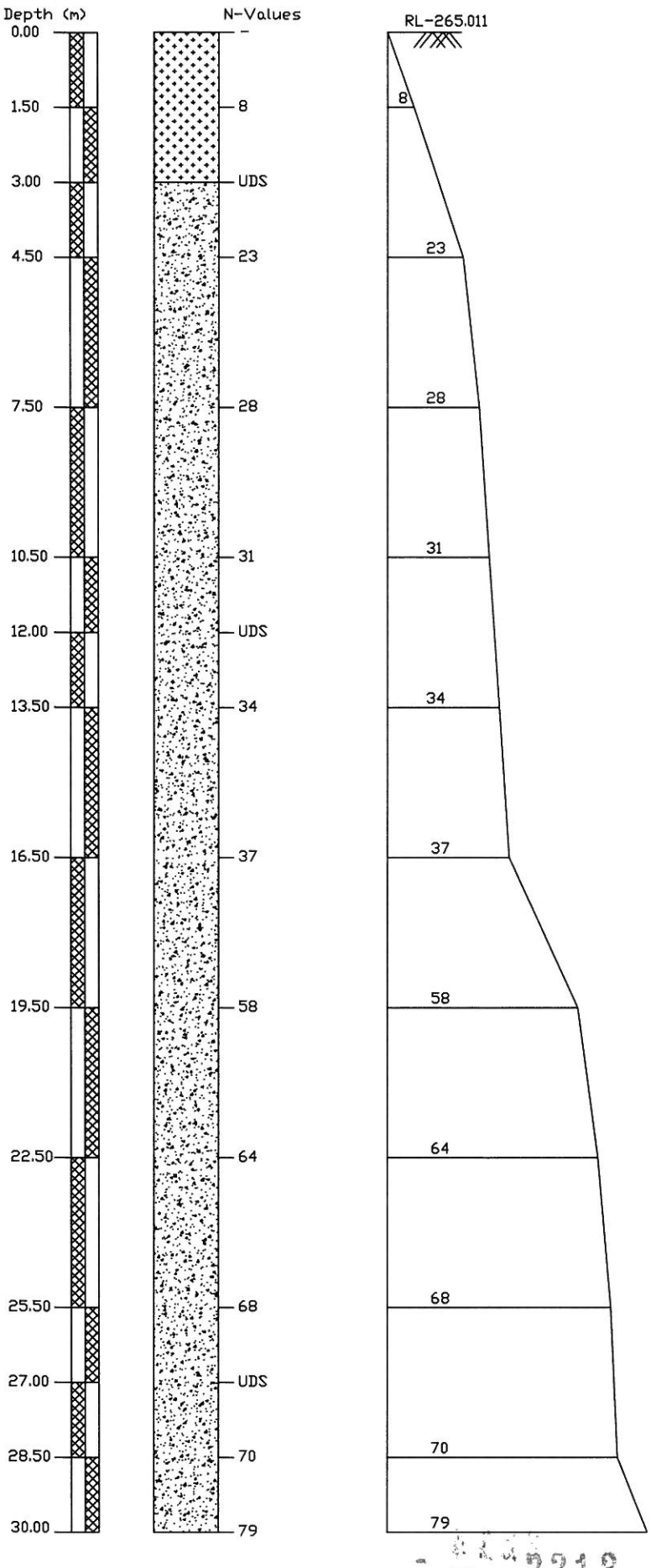
BORELOG OF BH–2(A2) AT PROPOSED KM–69050 FOR ROB ON KM–315+900 AT 330M,
DETOUR SECTION OF 317+510 TO 315+700,
ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

SYMBOL	DESCRIPTION
	SANDY SILT WITH CLAY
	SILTY SAND

2213

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CHAPTER - 117

"RUB" on Km. 315+700 at 170m,

Detour Section of (317+510 to 315+700)

Location - Proposed Chainage - 68850

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117.1 LOCATION OF STRUCTURE:

Proposed RUB of 68850

117.2 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 13.0m below EGL.

Subsurface profile at the site

BOREHOLE No.	Depth (m)	Type of Soil/Rock	Soil/Rock Characteristics
BH-1	0.00 to 3.00	Sandy Silt with Clay	Loose
	3.00 to 4.50	Silty Sand	Loose
	4.50 to 6.00	Silty Sand with Gravels	Medium Dense
	6.00 to 12.00	Silty Sand	Medium Dense

117.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1	3.00	8.60	0.005	0.0021	NIL	0.011	0.031

117.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

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

117.5 NET ALLOWABLE BEARING PRESSURE

Borehole No.	Depth from EGL (m)	Net Allowable Bearing Pressure (t/m²)
BH-1	1.50	09.50
	3.00	17.00
	4.50	20.00
	6.00	23.00

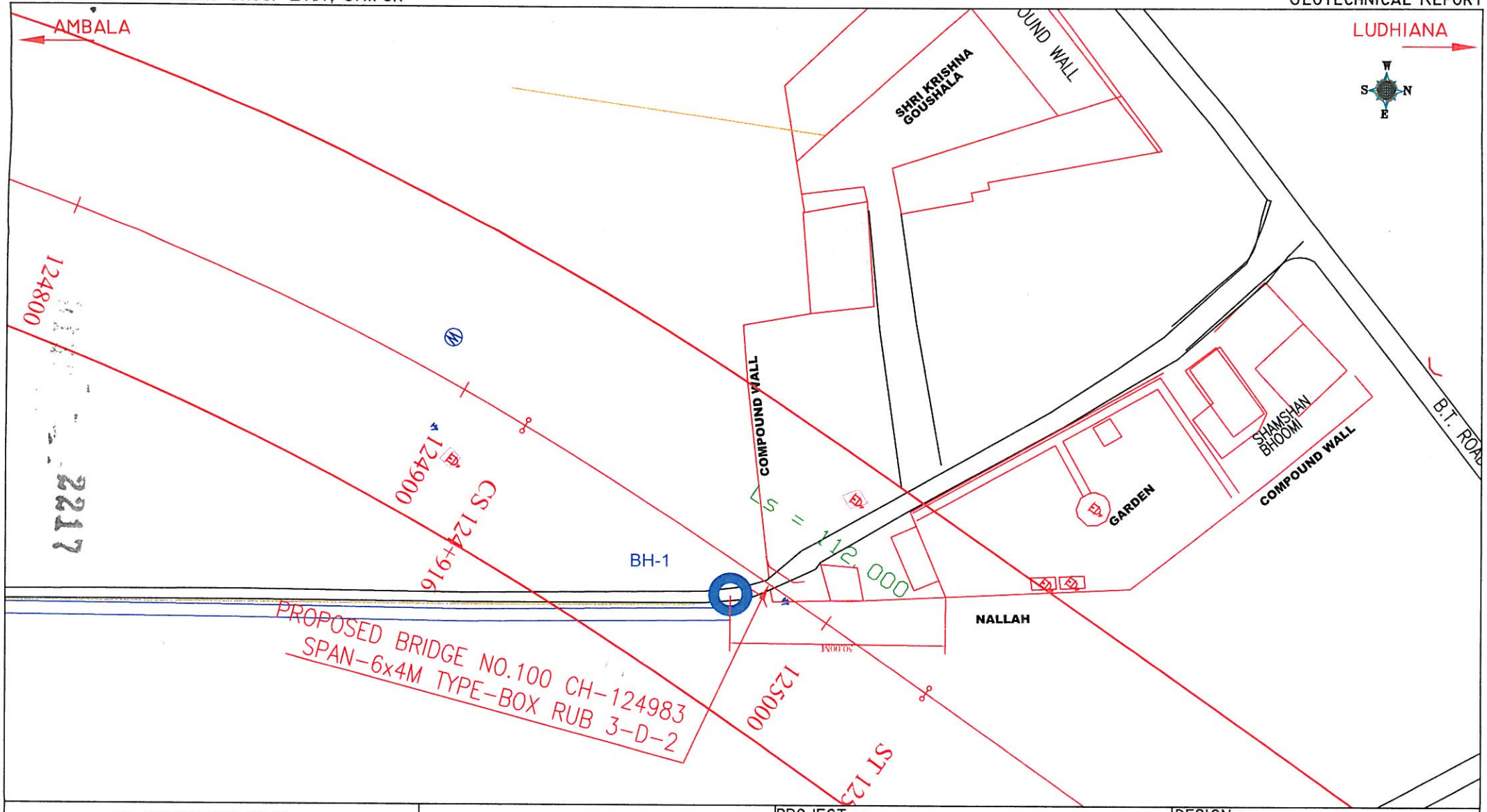
117.6 CONCLUSIONS

- Subsurface Profiles indicates suitable Soil formation for foundations.

117.7 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.



ALL DIMENSIONS IN METER

FIG.:-I

LOCATION PLAN OF PROPOSED DETOUR SECTION AT CH. 68850

RL OF BHI = 264.738

PROJECT :-

LUDHIANA-AMBALA (DFCCIL)

DESIGN :-

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ANNEXURE - I

SOIL CHARACTERISTICS OF BORE HOLE AT BH-1(RHS) FOR PROPOSED RUB AT CHAINAGE 68850

Project :	Chainage 68850 Bridge No. 000			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				25.11.2009 to 25.11.2009	1	1 (RHS)	Below 13.00 m	12.00mtr	264.738

Depth	Observ-	Correction	Corrected	Soil	Grain Size Distribution % wt retained							Atterberg Limits %			B.D.	M.C.	D.D.	Specific	Shear Strength	
from	ed	Factor		Description	Clay	Silt	Sand			Gravel								Gravity	c kg/cm^2	ϕ
GL (m)	N	C_n	N_n	(Soil Group)			Fine	Medium	Coarse	Fine	Coarse	L.L.	P.L.	P.I.	gm/cc	%	gm/cc			degree
0.00	-	-	-	Sandy Silt with Clay	10.56	48.93	40.26	0.25	0.00	0.00	0.00	28	18	10						
1.50	8	1.46	11.68	Sandy Silt with Clay	9.24	47.27	42.90	0.59	0.00	0.00	0.00	23	14	9						
3.00	UDS	-	-	Silty Sand	4.68	24.85	61.35	5.11	2.71	1.30	0.00	29	NP	NIL	1.68	5.34	1.59	2.65	0.00	29.0
4.50	14	1.10	15.40	Silty Sand with Gravels	3.98	8.03	75.04	1.20	0.21	11.54	0.00	26	NP	NIL						
6.00	UDS	-	-	Silty Sand	4.68	10.20	78.87	3.16	0.43	2.66	0.00	28	NP	NIL	1.70	7.20	1.58	2.58	0.00	28.5
7.50	24	0.92	22.08	Silty Sand	2.66	6.25	88.42	2.67	0.00	0.00	0.00	25	NP	NIL						
10.50	28	0.81	22.68	Silty Sand	2.14	5.22	89.09	3.04	0.51	0.00	0.00	25	NP	NIL						
12.00	45	0.76	34.20	Silty Sand	3.59	32.33	53.77	4.44	2.98	2.89	0.00	25	NP	NIL						

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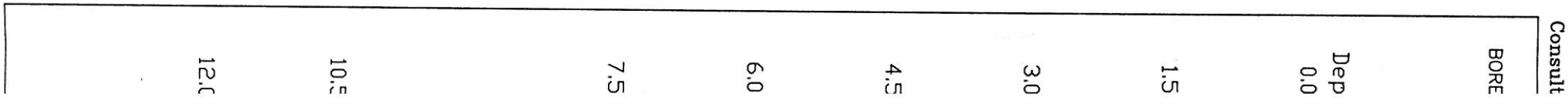
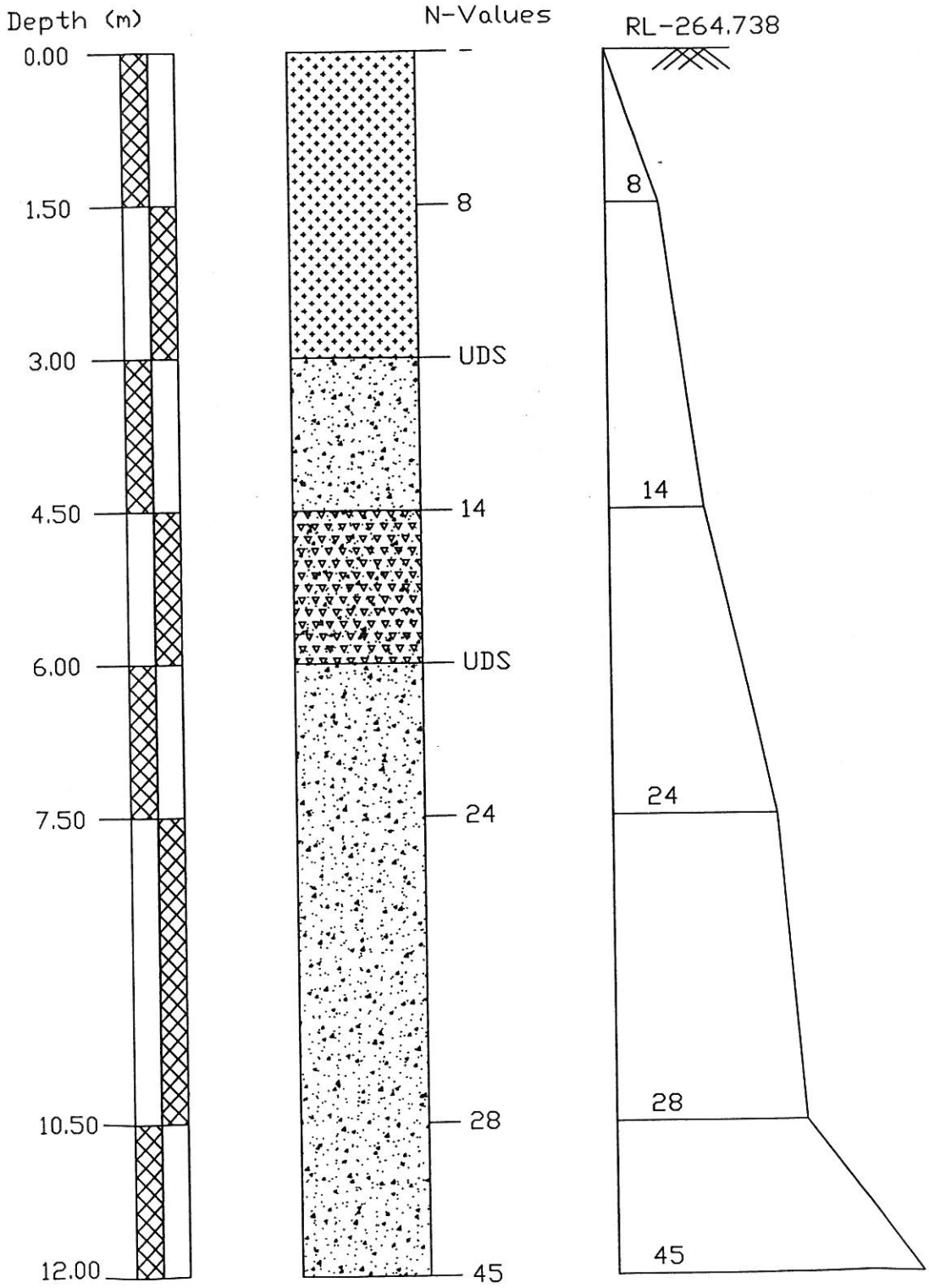


BORELOG OF BH–1(RHS) AT PROPOSED KM–68850 FOR RUB ON KM–315+700 AT 170M,
DETOUR SECTION OF 317+510 TO 315+700,
ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

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

2219

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