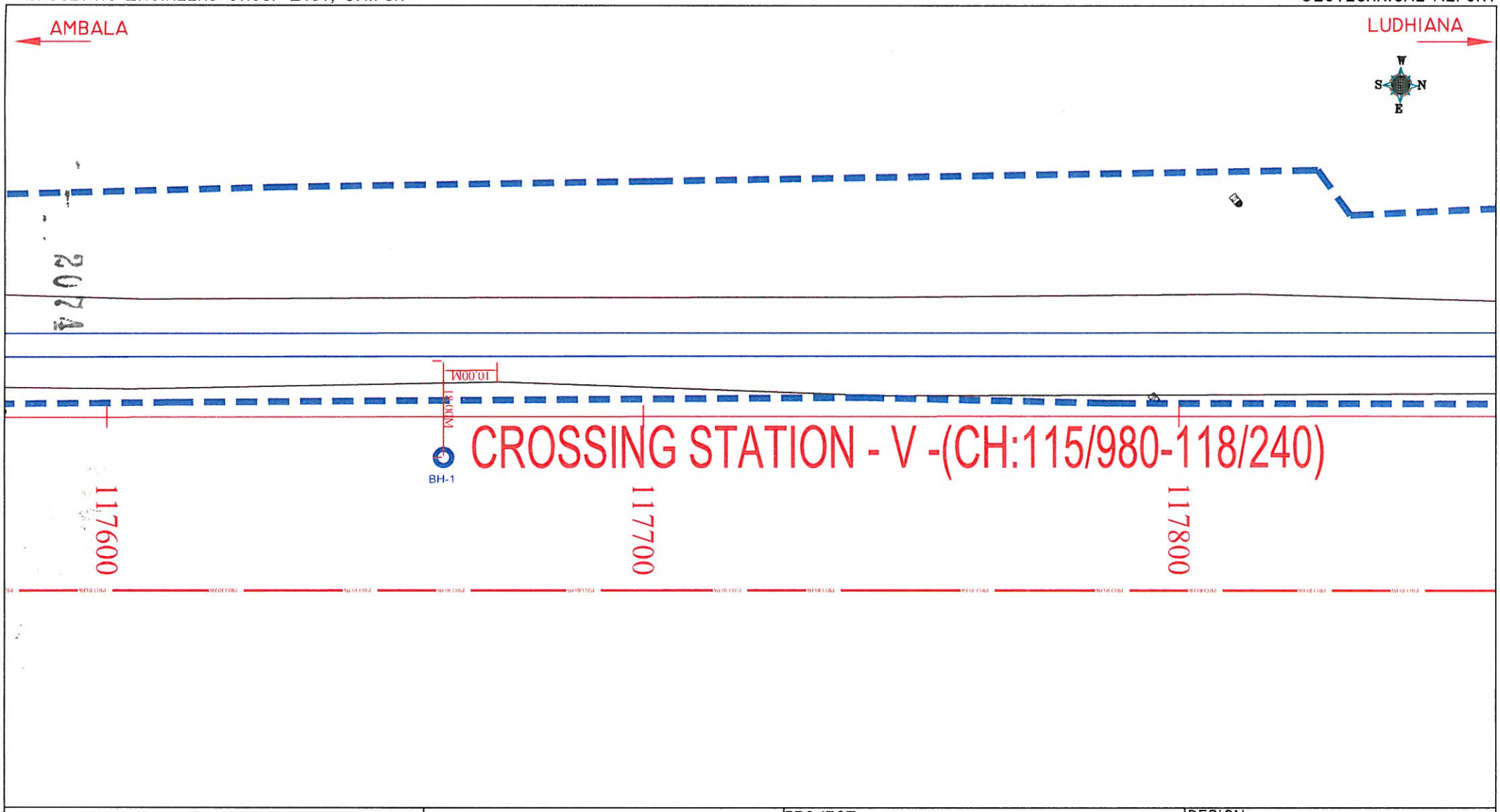

ALL DIMENSIONS IN METER FIG.:-1 LOCATION PLAN OF PROPOSED ALIGNMENT AT CH. 308/15-17	RL OF BH-1 =264.215	PROJECT :- LUDHIANA-AMBALA (DFCCIL)	DESIGN :- CONSULTING ENGINEERS GROUP LTD. E-12,Moji Colony,Malviya Nagar Jaipur-17 Tel: +91-141- 2520899, 2521899, 2520556 Fax: 2521348, E-Mail: ceg@cegindia.com

SOIL CHARACTERISTICS OF BORE HOLE AT BH-1 (LHS) OF ALIGNMENT AT CHAINAGE 308/15-17

Project :	Chainage 308/15-17			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				10.06.2009 to 10.06.2009	1	1 (LHS)	21.00 m.	12.00mtr	264.215

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	2.15	31.26	60.36	2.22	1.33	2.68	0	22	NIL	NP	-	-	-	-	-	-
1.50	7	1.51	10.57	Silty Sand	2.10	38.73	55.04	0.58	1.37	2.18	0.00	22	NIL	NP	-	-	-	-	-	-
3.00	UDS	-	-	Silty Sand	3.55	7.51	88.79	0.15	0.00	0.00	0.00	27	NIL	NP	1.63	5.37	1.55	2.63	0.00	26.00
4.50	23	1.11	25.53	Silty Sand	4.58	7.41	72.73	9.07	0.92	5.29	0.00	33	NIL	NP	-	-	-		-	
6.00	UDS	-	-	Silty Sand	2.88	6.07	78.56	3.46	1.55	7.48	0.00	26	NIL	NP	1.66	6.45	1.56	2.61	0.00	26.50
7.50	26	0.93	24.18	Silty Sand	2.33	6.65	82.08	5.67	2.52	0.75	0.00	29	NIL	NP	-	-	-	-	-	-
10.50	30	0.82	24.60	Silty Sand	3.52	5.08	85.06	3.75	1.54	1.05	0.00	27	NIL	NP	-	-	-	-	-	-
12.00	32	0.77	24.64	Silty Sand	2.26	5.01	70.24	19.22	1.97	1.30	0.00	26	NIL	NP	-	-	-	-	-	-

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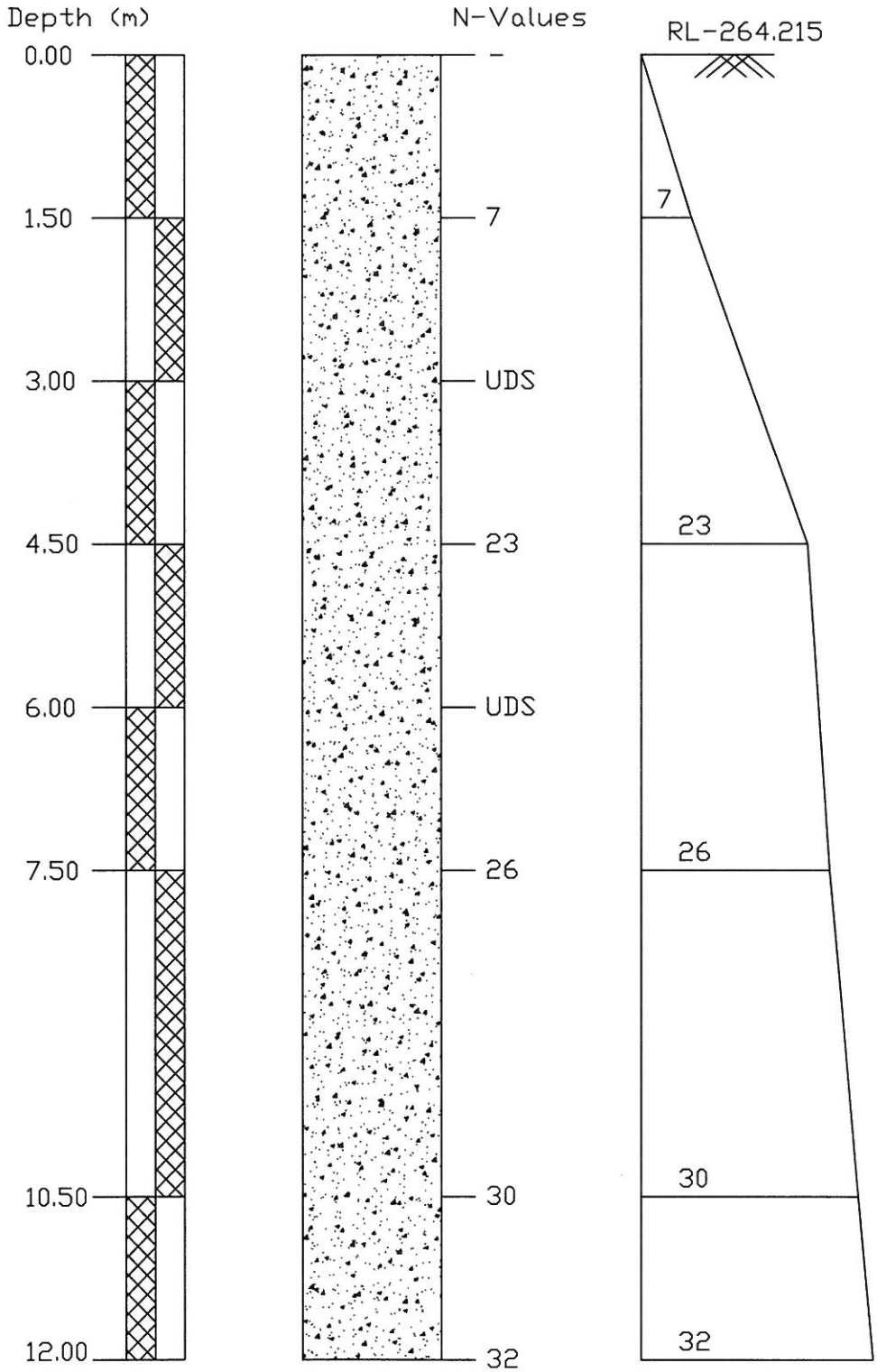
BORELOG OF BH–1(LHS) AT EXISTING KM–308/15–17 FOR ALIGNMENT ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

SYMBOL	DESCRIPTION
	SILTY SAND

2076

CONSULTING Engineers Group Ltd.

CHAPTER – 97

"Alignment",

Location – Existing Km. – 298/10-12

97.1 LOCATION OF STRUCTURE:

Alignment at existing km 298/10-12.

97.2 BOREHOLE DESCRIPTIONS:

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

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

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

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

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

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

Subsurface profile at the site

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

97.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1	3.00	9.20	0.015	0.0035	NIL	0.0012	0.087
	6.00	8.90	0.010	0.0024	NIL	0.0014	0.041

97.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1	3.00	22.00
BH-1	6.00	19.00

97.5 NET ALLOWABLE BEARING PRESSURE

Borehole No.	Depth from EGL (m)	Net Allowable Bearing Pressure (t/m²)
BH-1	1.50	08.00
	3.00	11.00
	4.50	13.00
	6.00	14.00

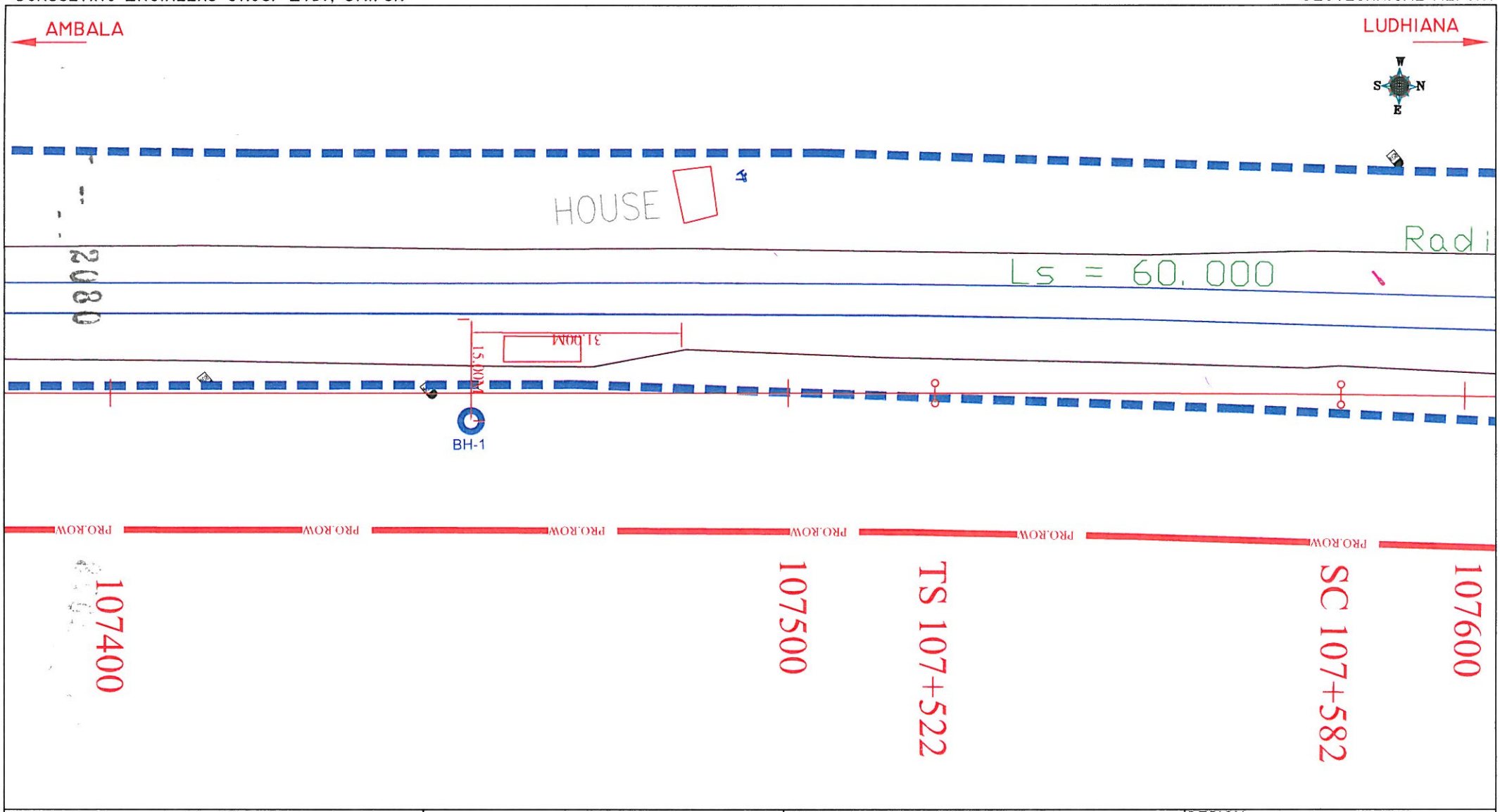
97.6 CONCLUSIONS

- Subsurface Profiles indicates suitable Soil formation for foundations.

97.7 RECOMMENDATIONS

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

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



ALL DIMENSIONS IN METER

FIG.:-I

LOCATION PLAN OF PROPOSED ALIGNMENT AT CH. 298/10-12

RL OF BH-I = 264.595

PROJECT :-

LUDHIANA-AMBALA (DFCCIL)

DESIGN :-

CONSULTING ENGINEERS GROUP LTD.
E-12,Moji Colony,Malviya Nagar Jaipur-17
Tel: +91-141- 2520899, 2521899, 2520556
Fax: 2521348, E-Mail: ceg@cegindia.com

SOIL CHARACTERISTICS OF BORE HOLE AT BH-1 (LHS) OF ALIGNMENT AT CHAINAGE 298/10-12

Project :	Chainage 298/10-12			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation	Ref. Code
				15.06.2009 to 15.06.2009	1	1 (LHS)	22.40 m.	12.00mtr	264.594	

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	22.89	57.56	10.23	3.25	2.59	3.25	0.23	40	20	20	-	-	-	-	-	-
1.50	10	1.45	14.50	Clayey silt with sand	23.85	60.04	5.02	2.54	3.95	4.60	0.00	41	20	21	-	-	-	-	-	-
3.00	UDS	-	-	Clayey silt with sand	20.10	74.56	3.86	0.34	0.15	0.99	0.00	40	23	17	1.73	10.62	1.56	2.64	0.20	15.00
4.50	19	1.09	20.71	Clayey silt with sand	13.15	81.08	3.74	1.05	0.98	0.00	0.00	33	23	10	-	-	-	-	-	-
6.00	UDS	-	-	Clayey silt with sand	18.21	62.50	19.17	0.12	0.00	0.00	0.00	35	20	15	1.72	14.03	1.51	2.58	0.18	17.00
7.50	27	0.92	24.84	Silty Sand	0.00	6.98	87.43	4.16	0.54	0.89	0.00	23	NIL	NP	-	-	-	-	-	-
10.50	33	0.80	26.40	Silty Sand	0.00	7.48	87.13	4.02	0.49	0.88	0.00	22	NIL	NP	-	-	-	-	-	-
12.00	39	0.76	29.64	Silty Sand	0.00	6.98	87.43	4.16	0.54	0.89	0.00	24	NIL	NP	-	-	-	-	-	-

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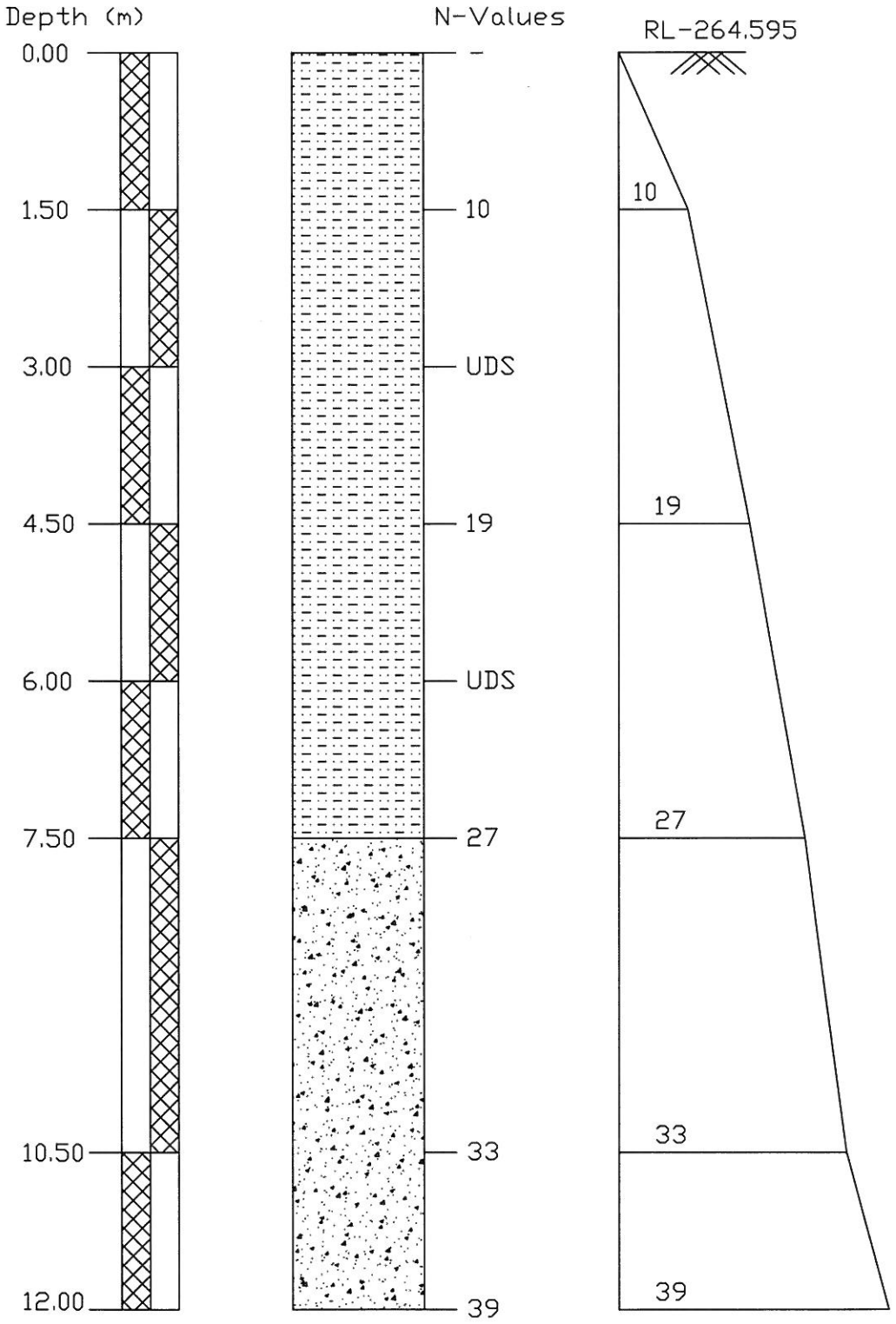
BORELOG OF BH–1(LHS) AT EXISTING KM–298/10–12 FOR ALIGNMENT ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

SYMBOL	DESCRIPTION
	CLAYEY SILT WITH SAND
	SILTY SAND

2082

CONSULTING Engineers Group Ltd.

CHAPTER – 98

"Alignment",

Location – Existing Km. – 296/2-4

98.1 LOCATION OF STRUCTURE:

Alignment at existing km 296/2-4.

98.2 BOREHOLE DESCRIPTIONS:

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

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

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

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

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

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

Subsurface profile at the site

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

98.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1	3.00	8.10	NIL	0.0043	NIL	0.0013	0.025
	6.00	8.20	NIL	0.0035	NIL	0.0012	0.029

98.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1	3.00	13.00
BH-1	6.00	19.00

98.5 NET ALLOWABLE BEARING PRESSURE

Borehole No.	Depth from EGL (m)	Net Allowable Bearing Pressure (t/m²)
BH-1	1.50	08.00
	3.00	13.00
	4.50	20.00
	6.00	22.00

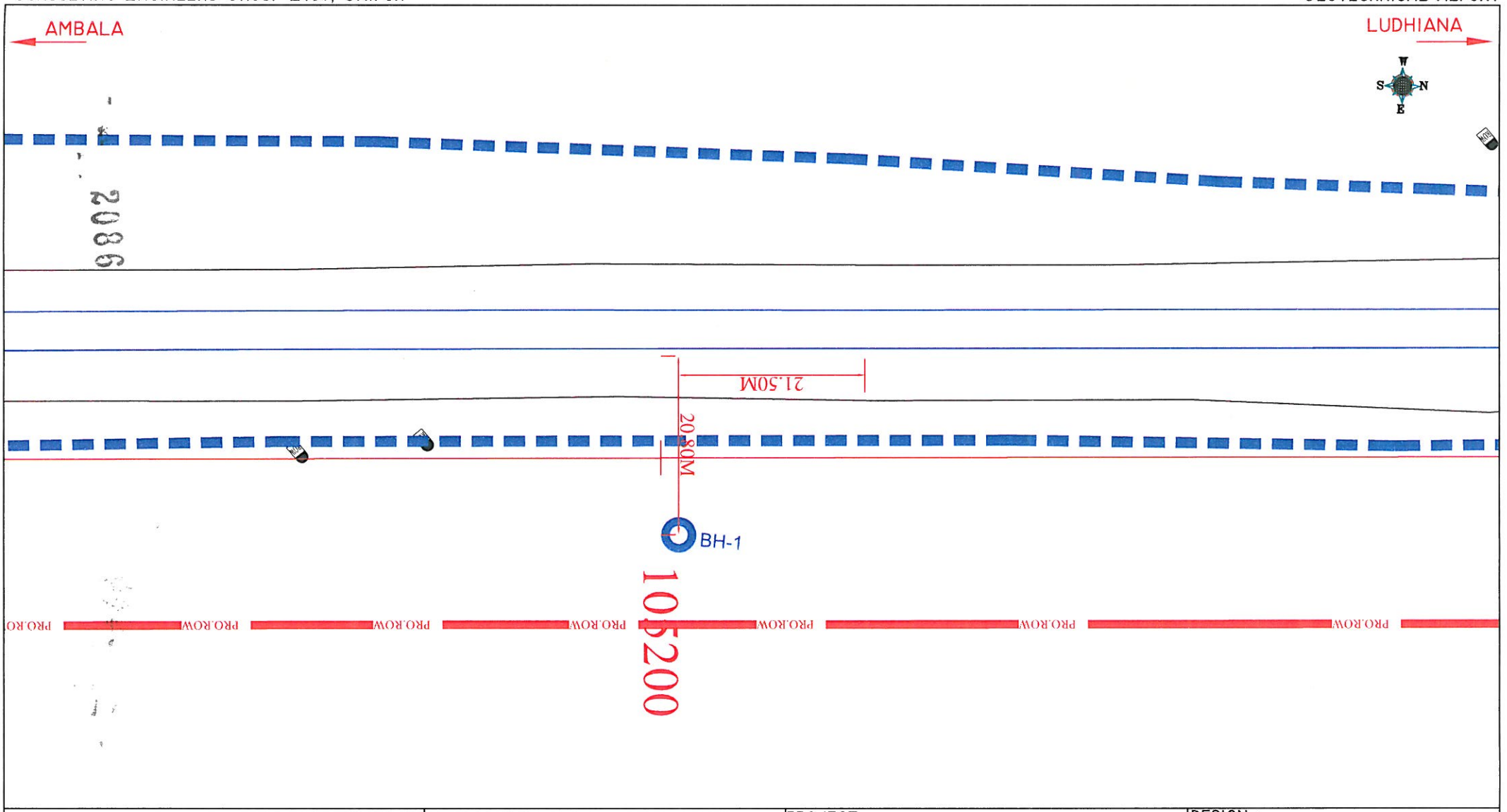
98.6 CONCLUSIONS

- Subsurface Profiles indicates suitable Soil formation for foundations.

98.7 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 ALIGNMENT AT CH. 296/2-4

RL OF BH-I = 265.936

PROJECT :-

LUDHIANA-AMBALA (DFCCIL)

DESIGN :-

CONSULTING ENGINEERS GROUP LTD.
E-12,Moji Colony,Malviya Nagar Jaipur-17
Tel: +91-141- 2520899, 2521899, 2520556
Fax: 2521348, E-Mail: ceg@cegindia.com

SOIL CHARACTERISTICS OF BORE HOLE AT BH-1 (LHS) OF ALIGNMENT AT CHAINAGE 296/2-4

Project :	Chainage 296/2-4			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation	Ref. Code
				16.06.2009 to 16.06.2009	1	1	24.00 m.	12.00mtr	265.936	

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	15.21	65.07	10.32	5.21	2.26	1.28	0.65	33	21	12	-	-	-	-	-	-
1.50	11	1.45	15.95	Clayey silt with sand	17.89	62.41	12.36	2.25	3.54	0.94	0.61	38	23	15	-	-	-	-	-	-
3.00	UDS	-	-	Clayey silt with sand	13.99	64.99	16.32	2.18	1.20	1.32	0.00	30	19	11	1.74	8.23	1.61	2.67	0.11	18.00
4.50	14	1.08	15.12	Clayey silt with sand	16.85	71.04	6.25	3.14	2.10	0.62	0.00	35	21	14	-	-	-	-	-	-
6.00	UDS	-	-	Clayey silt with sand	18.80	65.07	8.52	4.23	2.18	1.20	0.00	38	22	16	2.04	11.21	1.83	2.67	0.19	16.00
7.50	16	0.89	14.24	Silty Sand	2.35	36.69	45.26	12.35	2.35	1.00	0.00	22	NIL	NP	-	-	-	-	-	-
10.50	17	0.77	13.09	Silty Sand	2.95	40.47	48.23	2.15	4.10	2.10	0.00	23	NIL	NP	-	-	-	-	-	-
12.00	36	0.72	25.92	Silty Sand	2.33	39.97	52.32	3.21	0.95	1.22	0.00	21	NIL	NP	-	-	-	-	-	-

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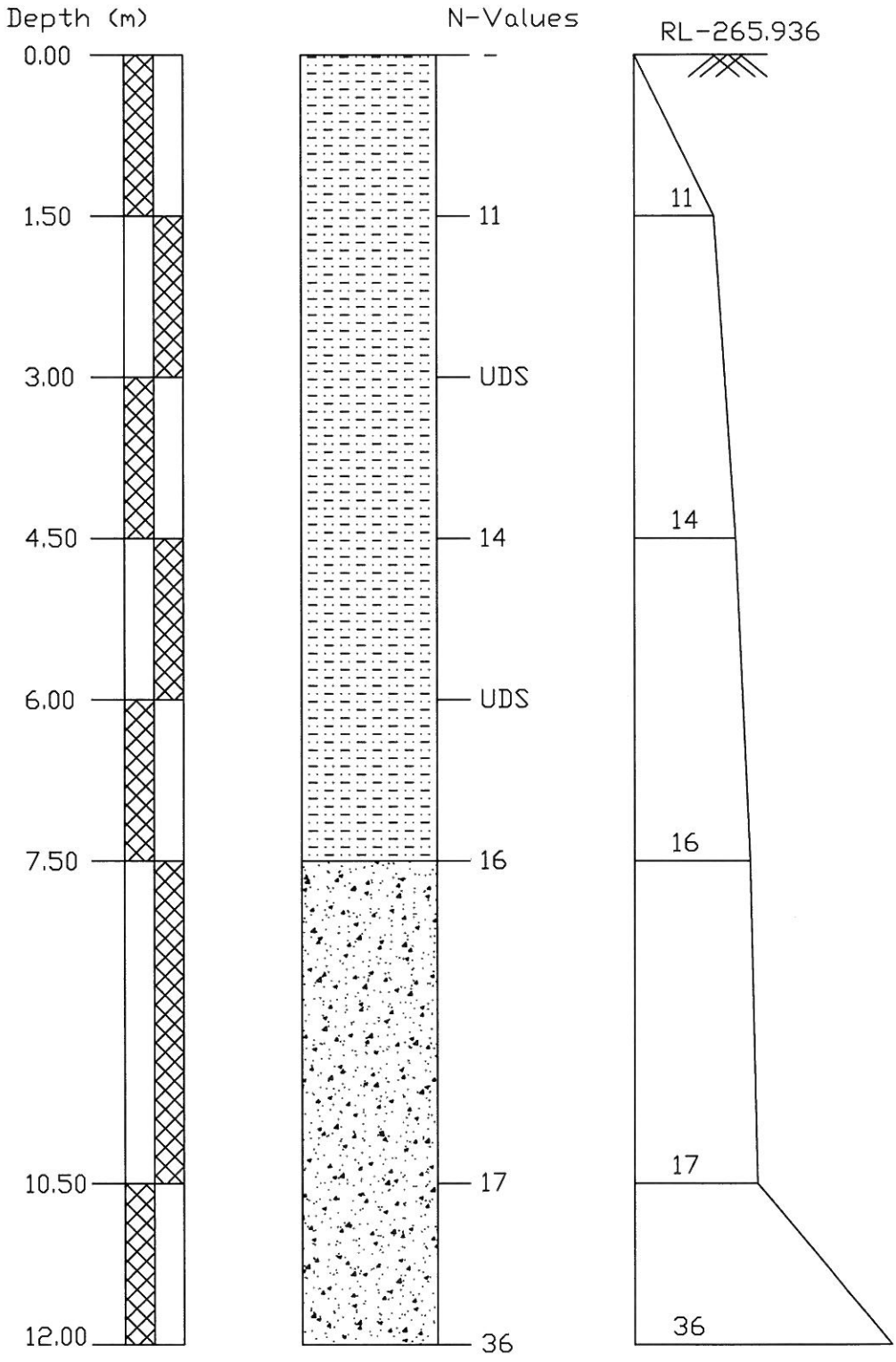
BORELOG OF BH–1(LHS) AT EXISTING KM–296/2–4 FOR ALIGNMENT ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

SYMBOL	DESCRIPTION
	CLAYEY SILT WITH SAND
	SILTY SAND

2088

CONSULTING Engineers Group Ltd.

CHAPTER – 99

"Alignment",

Location – Existing Km. – 296/30-31

99.1 LOCATION OF STRUCTURE:

Alignment at existing km 296/30-31.

99.2 BOREHOLE DESCRIPTIONS:

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

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

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

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

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

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

Subsurface profile at the site

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

99.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1	6.00	8.80	0.012	0.0018	NIL	0.0009	0.029

99.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1	3.00	14.00
BH-1	6.00	21.00

99.5 NET ALLOWABLE BEARING PRESSURE

Borehole No.	Depth from EGL (m)	Net Allowable Bearing Pressure (t/m^2)
BH-1	1.50	09.00
	3.00	14.50
	4.50	19.00
	6.00	20.00

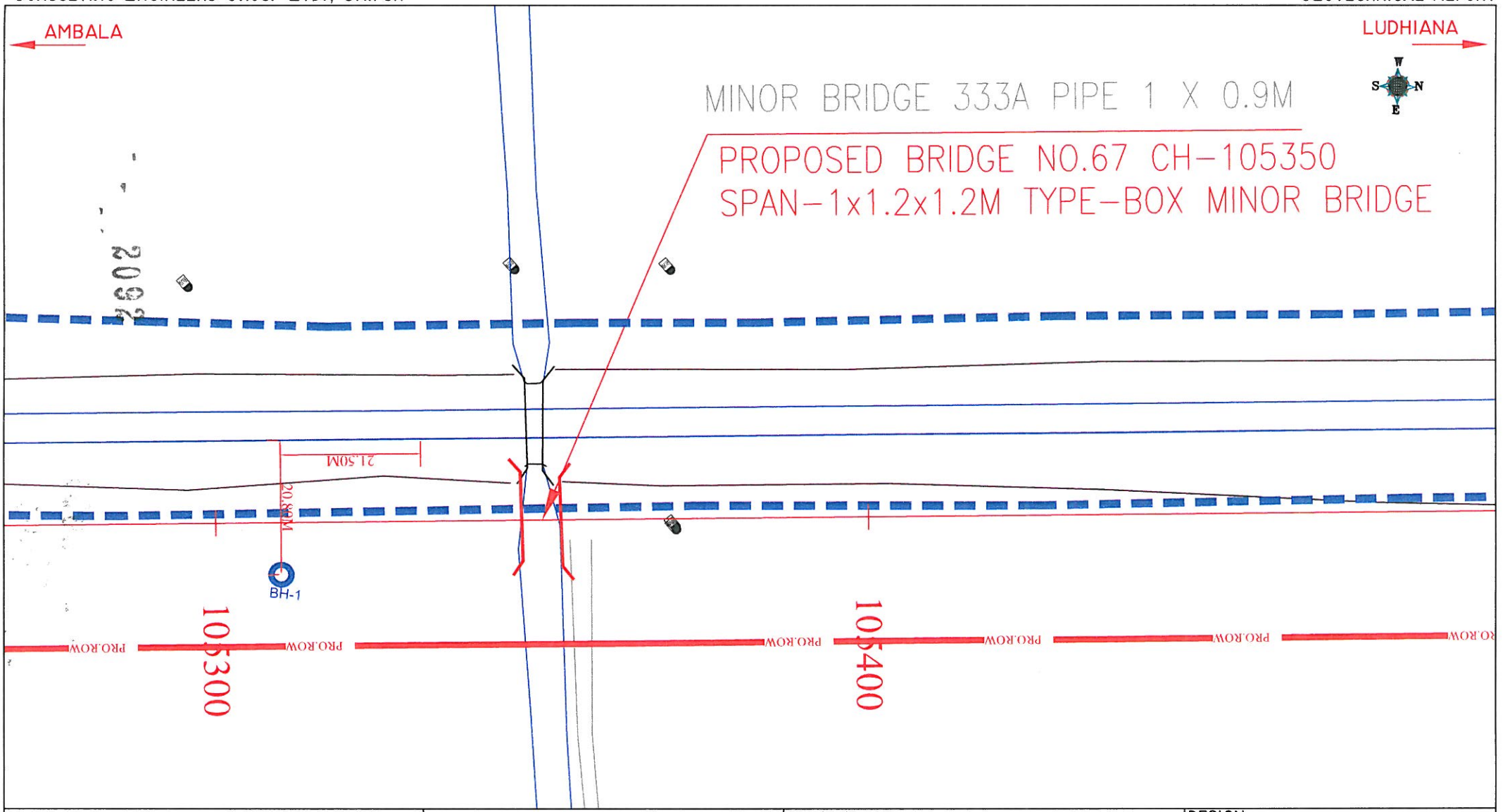
99.6 CONCLUSIONS

- Subsurface Profiles indicates suitable Soil formation for foundations.

99.7 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 ALIGNMENT AT CH. 296/30-31	RL OF BH-I = 265.671	PROJECT :- LUDHIANA-AMBALA (DFCCIL)	DESIGN :- CONSULTING ENGINEERS GROUP LTD. E-12,Moji Colony,Malviya Nagar Jaipur-17 Tel: +91-141- 2520899, 2521899, 2520556 Fax: 2521348, E-Mail: ceg@cegindia.com

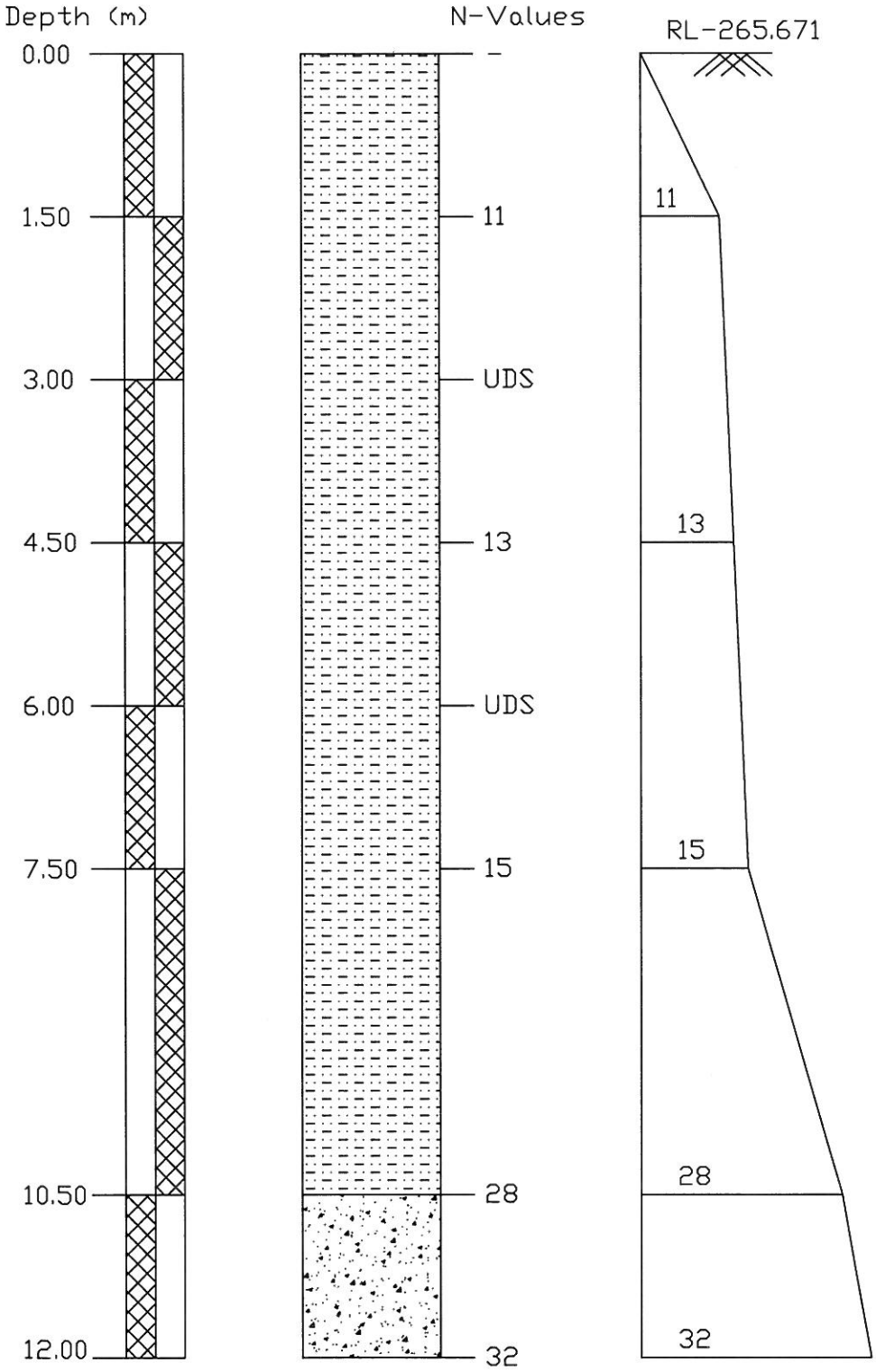
SOIL CHARACTERISTICS OF BORE HOLE AT BH-1 (LHS) OF ALIGNMENT AT CHAINAGE 296/30-31

Project :	Chainage 296/30-31			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				15.06.2009 to 15.06.2009	1	1 (LHS)	24.50 m.	12.00mtr	265.671

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	12.85	69.00	16.25	1.25	0.65	0.00	0.00	28	18	10	-	-	-	-	-	-
1.50	11	1.44	15.84	Clayey silt with sand	16.21	68.38	14.64	0.46	0.31	0.00	0.00	29	16	13	-	-	-	-	-	-
3.00	UDS	-	-	Clayey silt with sand	13.85	65.66	20.43	0.06	0.00	0.00	0.00	29	18	11	1.78	8.51	1.64	2.66	0.12	20.00
4.50	13	1.08	14.04	Clayey silt with sand	14.12	80.01	0.95	1.31	1.53	2.08	0.00	33	22	11	-	-	-	-	-	-
6.00	UDS	-	-	Clayey silt with sand	19.94	76.16	3.79	0.11	0.00	0.00	0.00	37	20	17	2.08	15.35	1.80	2.67	0.21	15.00
7.50	15	0.88	13.20	Clayey silt with sand	22.65	71.52	4.43	0.62	0.78	0.00	0.00	39	20	19	-	-	-	-	-	-
10.50	28	0.76	21.28	Silty Sand	2.62	5.72	89.13	2.53	0.00	0.00	0.00	22	NIL	NP	-	-	-	-	-	-
12.00	32	0.71	22.72	Silty Sand	2.66	9.62	85.27	2.45	0.00	0.00	0.00	23	NIL	NP	-	-	-	-	-	-

CONSULTING
Engineers Group Ltd.

BORELOG OF BH–1(LHS) AT EXISTING KM–296/30–31 FOR ALIGNMENT ON KESARI TO SANEHWAL, LUDHIANA



2094

LEGEND

SYMBOL	DESCRIPTION
	CLAYEY SILT WITH SAND
	SILTY SAND

CONSULTING Engineers Group Ltd.

CHAPTER – 100

"Alignment",

Location – Existing Km. – 292/20-22

100.1 LOCATION OF STRUCTURE:

Alignment at existing km 292/20-22.

100.2 BOREHOLE DESCRIPTIONS:

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

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

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

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

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

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

Subsurface profile at the site

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

100.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1	3.00	8.30	NIL	0.0024	NIL	0.0014	0.052
	6.00	8.90	0.020	0.0014	NIL	0.0010	0.027

100.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1	3.00	24.00
BH-1	6.00	18.00

100.5 NET ALLOWABLE BEARING PRESSURE

Borehole No.	Depth from EGL (m)	Net Allowable Bearing Pressure (t/m²)
BH-1	1.50	10.00
	3.00	14.00
	4.50	20.00
	6.00	21.00

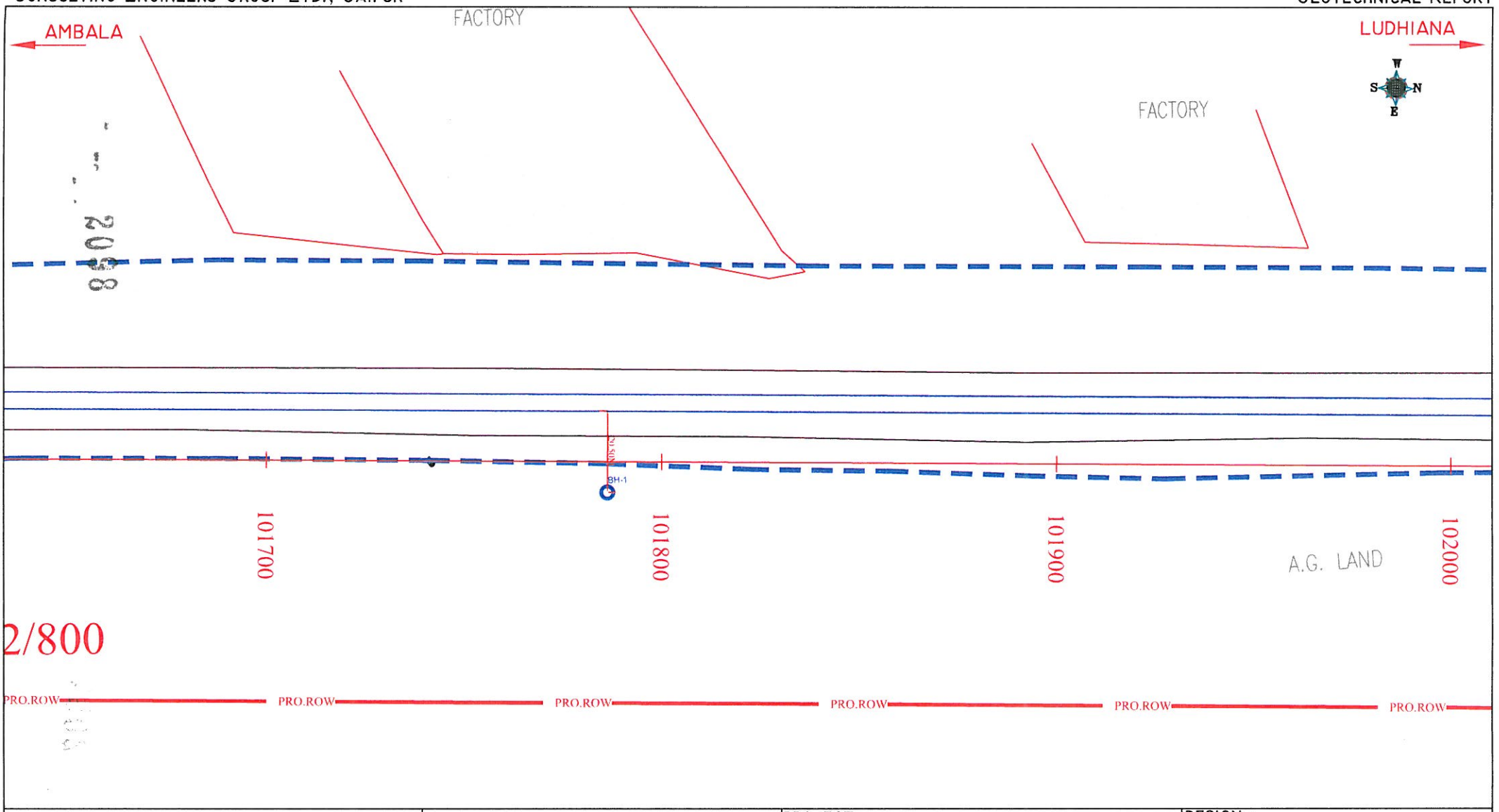
100.6 CONCLUSIONS

- Subsurface Profiles indicates suitable Soil formation for foundations.

100.7 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 ALIGNMENT AT CH. 292/20-22

RL OF BH I = 264.885

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 OF ALIGNMENT AT CHAINAGE 292/20-22

Project :	Chainage 292/20-22			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation	Ref. Code
				17.06.2009 to 17.06.2009	1	1	25.00 m.	12.00mtr	264.885	

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	21.85	-	5.26	2.21	0.68	1.20	0.00	38	19	19	-	-	-	-	-	-
1.50	9	1.43	12.87	Clayey silt with sand	22.62	69.72	5.65	1.06	0.60	0.35	0.00	40	20	20	-	-	-	-	-	-
3.00	UDS	-	-	Clayey silt with sand	21.52	71.17	4.95	0.60	0.37	1.39	0.00	38	19	19	1.87	12.12	1.67	2.67	0.23	13.00
4.50	14	1.06	14.84	Clayey silt with sand	24.11	69.02	6.74	0.13	0.00	0.00	0.00	40	19	21	-	-	-	-	-	-
6.00	UDS	-	-	Clayey silt with sand	15.98	77.73	5.76	0.25	0.28	0.00	0.00	30	17	13	2.07	13.76	1.82	2.67	0.14	17.00
7.50	15	0.87	13.05	Clayey silt	22.12	70.52	3.25	0.75	0.67	2.69	0.00	38	19	19	-	-	-	-	-	-
9.00	18	0.81	14.58	Clayey silt	23.10	70.08	3.12	0.61	0.58	2.51	0.00	38	19	19	-	-	-	-	-	-
10.50	22	0.76	16.72	Clayey silt	22.86	69.73	3.35	0.72	0.61	2.73	0.00	38	19	19	-	-	-	-	-	-
12.00	34	0.71	24.14	Clayey silt	16.59	73.81	1.64	0.89	0.49	6.58	0.00	37	22	15	-	-	-	-	-	-

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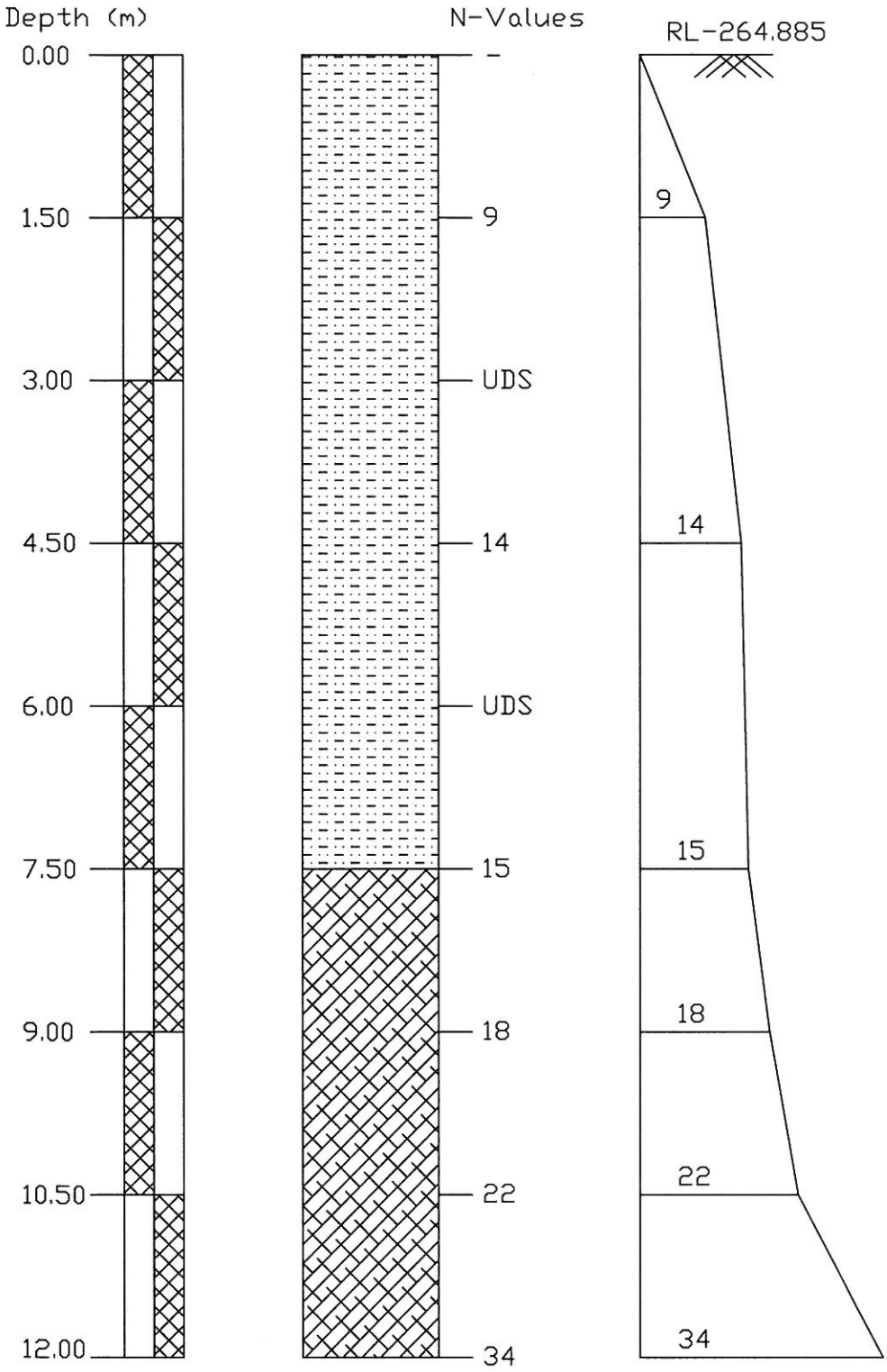
BORELOG OF BH–1 AT EXISTING KM–292/20–22 FOR ALIGNMENT ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

SYMBOL	DESCRIPTION
	CLAYEY SILT WITH SAND
	CLAYEY SILT

2100

CONSULTING Engineers Group Ltd.

CHAPTER – 101

"Alignment",

Location – Existing Km. – 290/06-08

101.1 LOCATION OF STRUCTURE:

Alignment at existing km 290/06-08

101.2 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 7.00m below EGL.

Subsurface profile at the site

BOREHOLE No.	Depth (m)	Type of Soil/Rock	Soil/Rock Characteristics
BH-1	0.00 to 2.00	Filled up Strata	Loose
	2.00 to 4.50	Sandy Silt with Clay	Loose
	4.50 to 6.00	Clayey Silt with Sand	Loose
	6.00 to 7.50	Clayey Silt with Sand	Medium Dense
	7.50 to 12.00	Sandy Silt with Clay & Gravels	Medium Dense

101.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1	2.00	8.20	NIL	0.0042	NIL	0.0013	0.061
	6.00	8.30	NIL	0.0040	NIL	0.0012	0.058

101.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1	2.00	17.00
	6.00	18.00

101.5 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	7.0	82	86	186	761	0.3	2.0	980	640
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	-	-

101.6 NET ALLOWABLE BEARING PRESSURE

Borehole No.	Depth from EGL (m)	Net Allowable Bearing Pressure (t/m^2)
BH-1	3.00	15.00
	4.50	16.00
	6.00	18.00

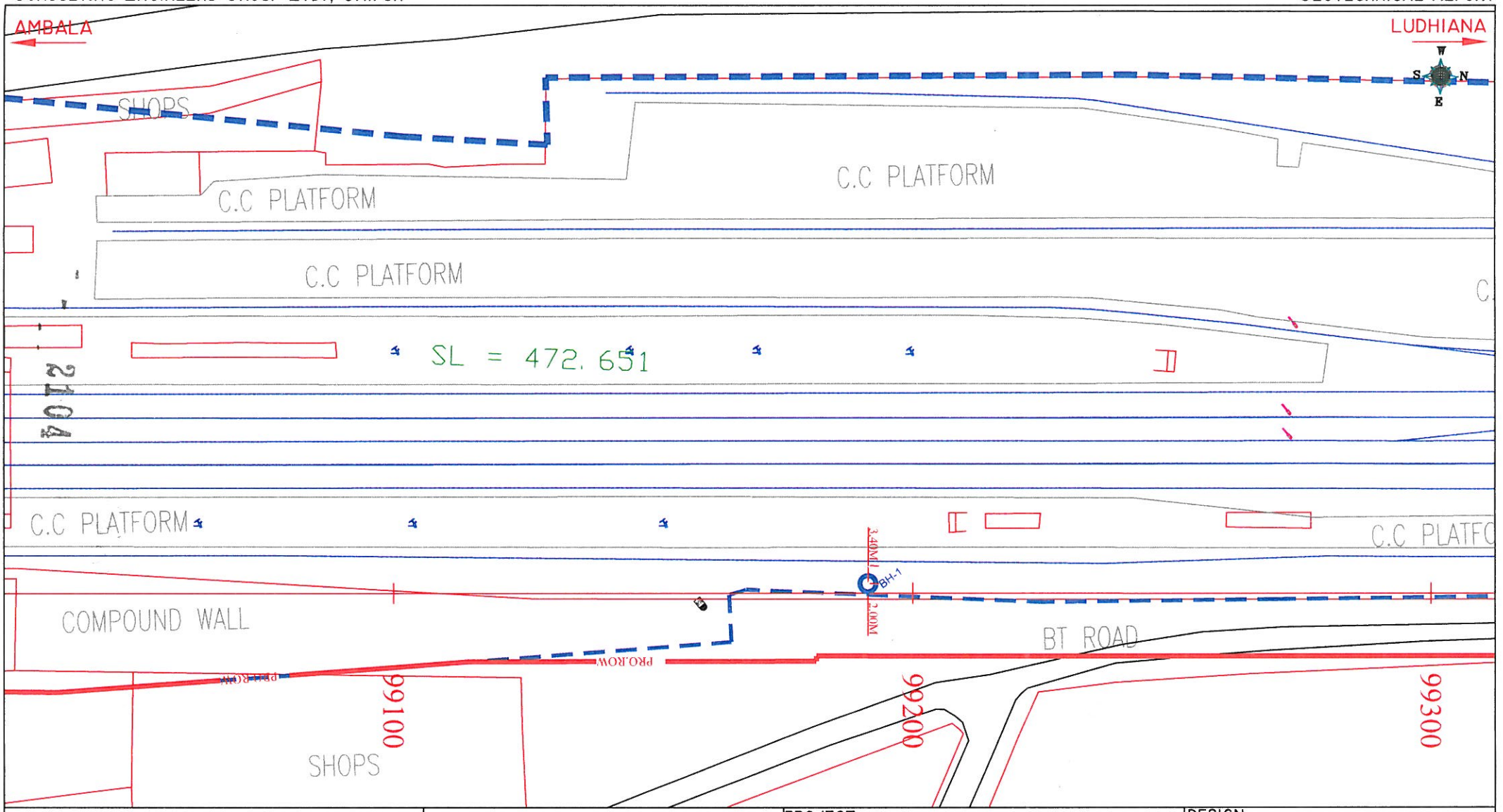
101.7 CONCLUSIONS

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

101.8 RECOMMENDATIONS

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

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



ALL DIMENSIONS IN METER FIG.:-I LOCATION PLAN OF PROPOSED ALIGNMENT CH-290/6-8	RL OF BH-I = 268.174	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(LHS) FOR ALIGNMENT AT CHAINAGE 290/6-8

Project :	Chainage 290/6-8			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				05.12.2009 to 05.12.2009	1	1	07.00 m.	12.00mtr	268.174

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	UDS	-	-	Sandy Silt with Clay	16.98	62.79	18.85	1.10	0.28	0.00	0.00	36	21	15	1.85	12.82	1.64	2.62	0.20	15.0
4.50	9	1.06	9.54	Clayey Silt with Sand	18.12	69.47	6.20	1.50	1.02	3.69	0.00	37	20	17	-	-	-	-	-	-
6.00	UDS	-	-	Clayey Silt with Sand	15.68	67.39	8.41	2.11	1.68	4.73	0.00	35	20	15	1.88	14.21	1.64	2.6	0.20	15.0
7.50	16	0.89	14.24	Sandy Silt with Clay & Gravels	14.22	42.25	27.5	5.97	3.85	6.21	0.00	32	20	12	-	-	-	-	-	-
10.50	19	0.77	14.63	Sandy Silt with Clay & Gravels	12.26	38.25	25.3	4.87	3.43	15.89	0.00	29	16	13	-	-	-	-	-	-
12.00	28	0.73	17.72	Sandy Silt with Clay & Gravels	14.28	40.92	25.24	5.23	3.30	11.03	0.00	30	16	14	-	-	-	-	-	-

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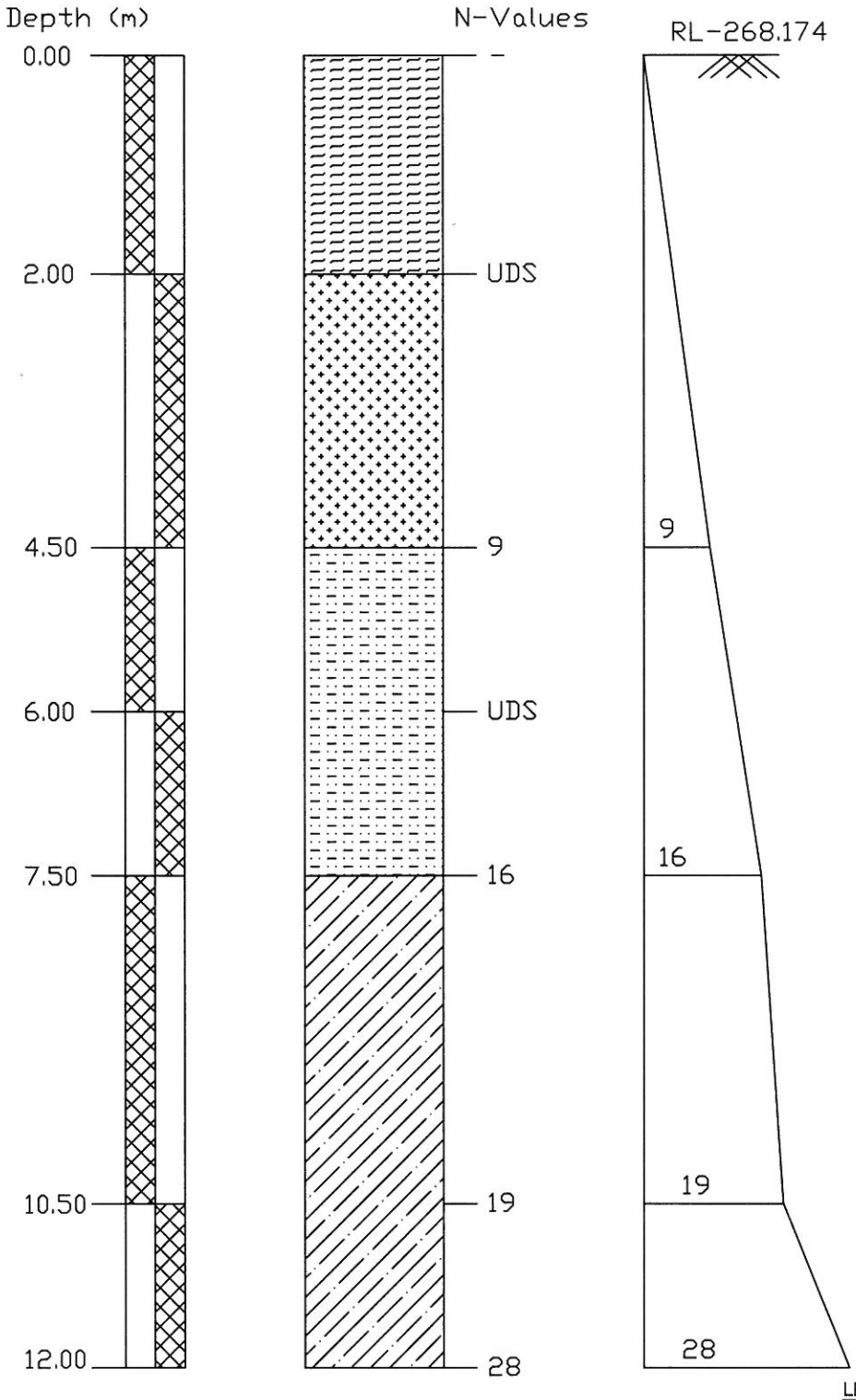
Engineers Group Ltd.

BORELOG OF BH–1 AT EXISTING KM–290/6–8 FOR ALIGNMENT,

ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

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

202106.

CHAPTER – 102

"Alignment",

Location – Existing Km. – 288/13-15

102.1 LOCATION OF STRUCTURE:

Alignment at existing km 288/13-15.

102.2 BOREHOLE DESCRIPTIONS:

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

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

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

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

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

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

Subsurface profile at the site

BOREHOLE No.	Depth (m)	Type of Soil/Rock	Soil/Rock Characteristics
BH-1	0.00 to 1.50	Clayey Silt with Sand	Loose
	1.50 to 6.00	Clayey Silt with Sand	Medium Dense
	6.00 to 12.00	Clayey Silt	Medium Dense

102.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1	3.00	9.40	0.020	0.0041	NIL	0.0014	0.079
	6.00	8.80	0.010	0.0038	NIL	0.0014	0.088

102.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1	3.00	13.00
BH-1	6.00	28.00

102.5 NET ALLOWABLE BEARING PRESSURE

Borehole No.	Depth from EGL (m)	Net Allowable Bearing Pressure (t/m²)
BH-1	1.50	06.00
	3.00	09.00
	4.50	14.00
	6.00	15.00

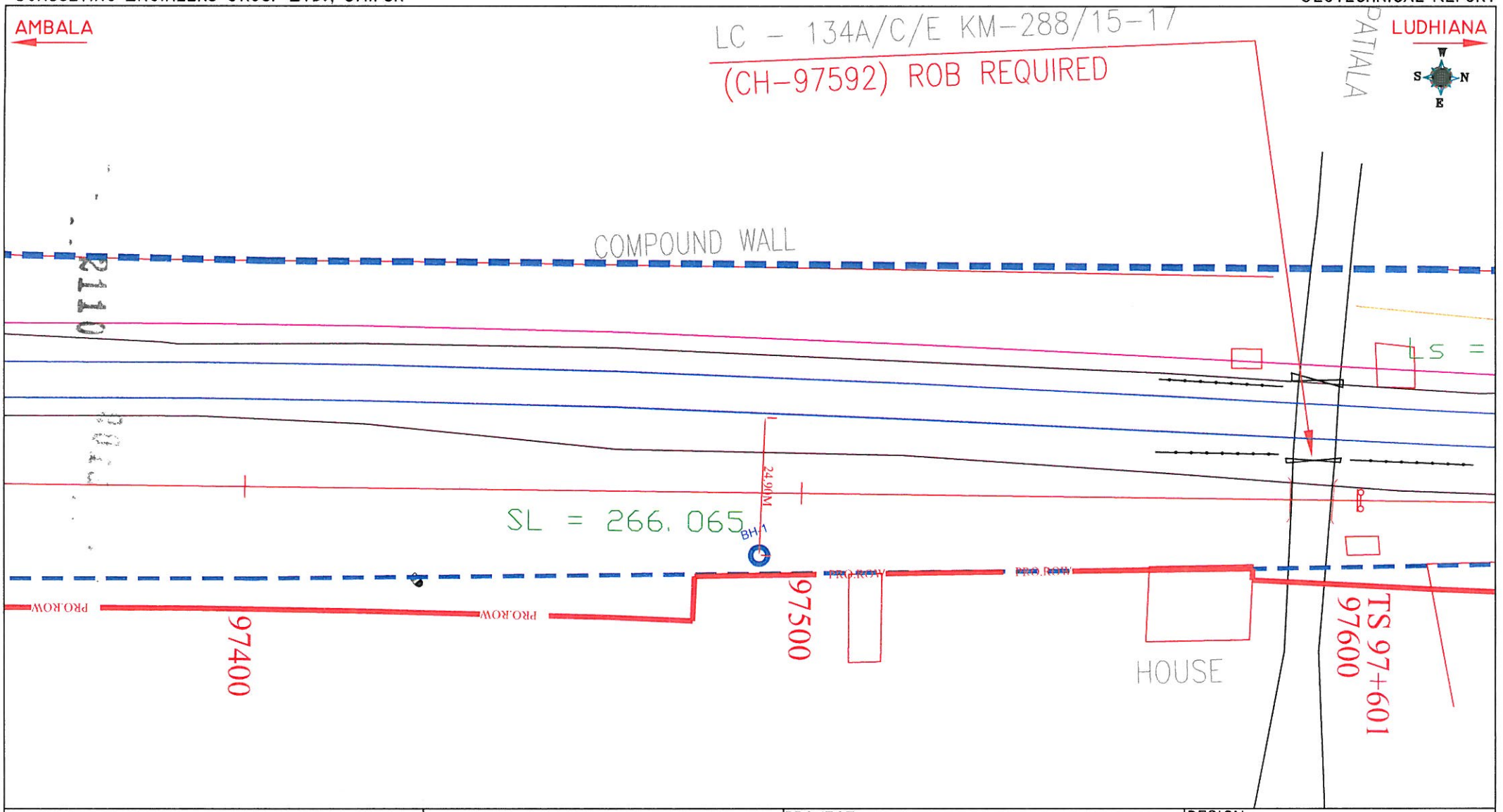
102.6 CONCLUSIONS

- Subsurface Profiles indicates suitable Soil formation for foundations.

102.7 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.:-1 LOCATION PLAN OF PROPOSED ALIGNMENT CH-288/13-15	RL OF BH-1 = 266.963	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

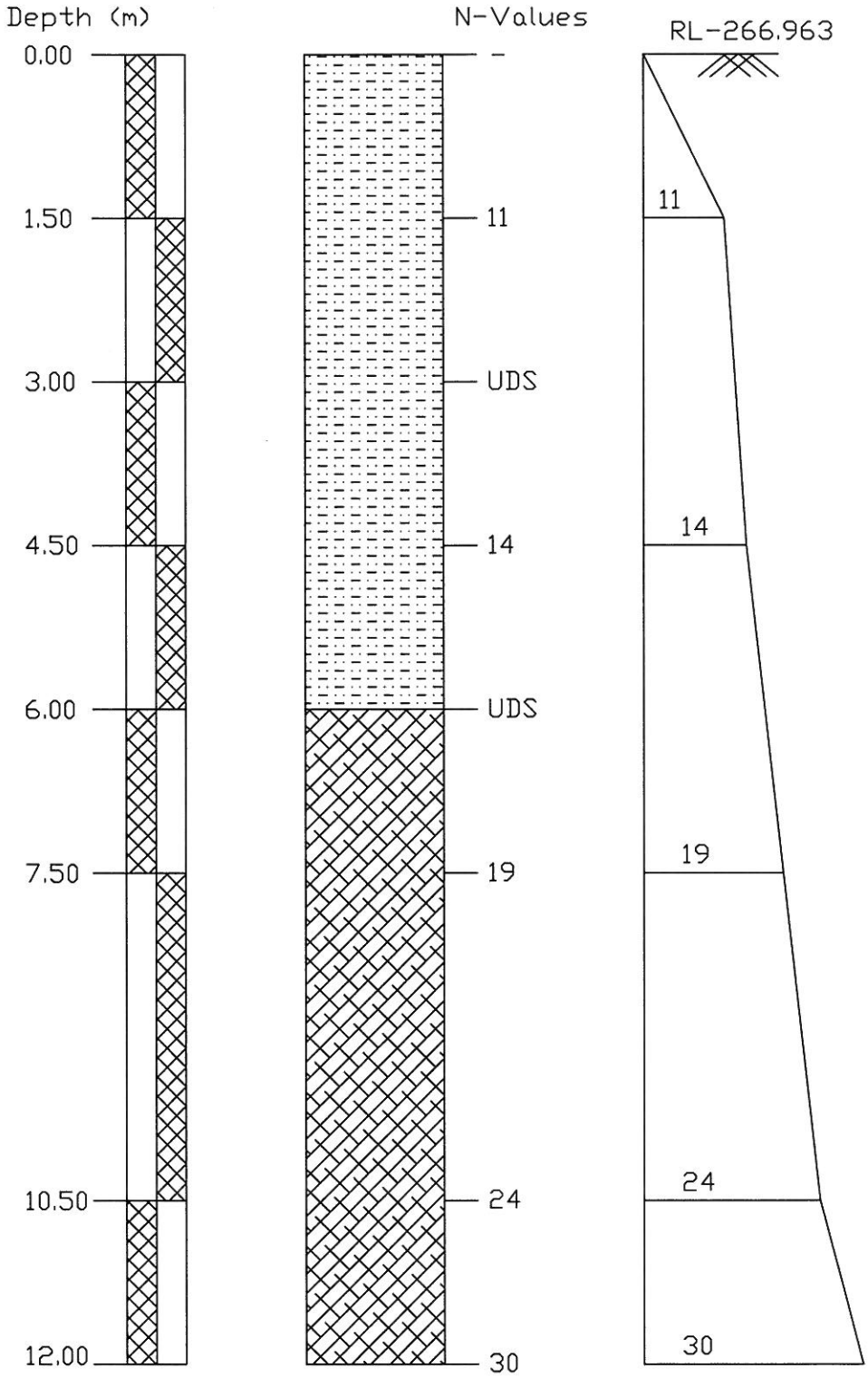
SOIL CHARACTERISTICS OF BORE HOLE AT BH-1 OF ALIGNMENT AT CHAINAGE 288/13-15

Project :	Chainage 288/13-15			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation	Ref. Code
				18.06.2009 to 18.06.2009	1	1	26.10 m.	12.00mtr	266.963	

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	13.85	66.15	10.23	6.25	3.21	0.31	0.00	27	16	11	-	-	-	-	-	-
1.50	11	1.43	15.73	Clayey silt with sand	12.59	72.78	12.46	1.58	0.30	0.29	0.00	25	15	10	-	-	-	-	-	-
3.00	UDS	-	-	Clayey silt with sand	13.15	76.18	8.77	0.78	0.36	0.76	0.00	31	21	10	1.65	10.33	1.50	2.65	0.09	20.00
4.50	14	1.05	14.70	Clayey silt with sand	14.22	68.25	4.06	6.96	4.22	2.29	0.00	28	17	11	-	-	-	-	-	-
6.00	UDS	-	-	Clayey silt	23.96	74.60	1.15	0.29	0.00	0.00	0.00	41	19	22	1.77	13.66	1.56	2.61	0.28	13.00
7.50	19	0.87	16.53	Clayey silt	21.99	74.14	2.36	1.25	0.26	0.00	0.00	40	20	20	-	-	-	-	-	-
10.50	24	0.75	18.00	Clayey silt	20.33	76.61	3.06	0.00	0.00	0.00	0.00	38	20	18	-	-	-	-	-	-
12.00	30	0.70	21.00	Clayey silt	21.23	73.98	2.69	1.23	0.68	0.19	0.00	38	20	18	-	-	-	-	-	-

CONSULTING
Engineers Group Ltd.

BORELOG OF BH–1 AT EXISTING KM–288/13–15 FOR ALIGNMENT ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

SYMBOL	DESCRIPTION
	CLAYEY SILT WITH SAND
	CLAYEY SILT

2112

CHAPTER – 103

"Alignment",

Location – Existing Km. – 286/14-15

103.1 LOCATION OF STRUCTURE:

Alignment at existing km 286/14-15.

103.2 BOREHOLE DESCRIPTIONS:

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

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

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

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

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

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

Subsurface profile at the site

BOREHOLE No.	Depth (m)	Type of Soil/Rock	Soil/Rock Characteristics
BH-1	0.00 to 1.50	Clayey Silt	Loose
	1.50 to 12.00	Clayey Silt	Medium Dense

103.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1	3.00	7.50	NIL	0.0061	NIL	0.0015	0.149

103.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1	3.00	33.00
BH-1	6.00	28.00

103.5 NET ALLOWABLE BEARING PRESSURE

Borehole No.	Depth from EGL (m)	Net Allowable Bearing Pressure (t/m²)
BH-1	1.50	07.00
	3.00	09.00
	4.50	13.00
	6.00	14.00

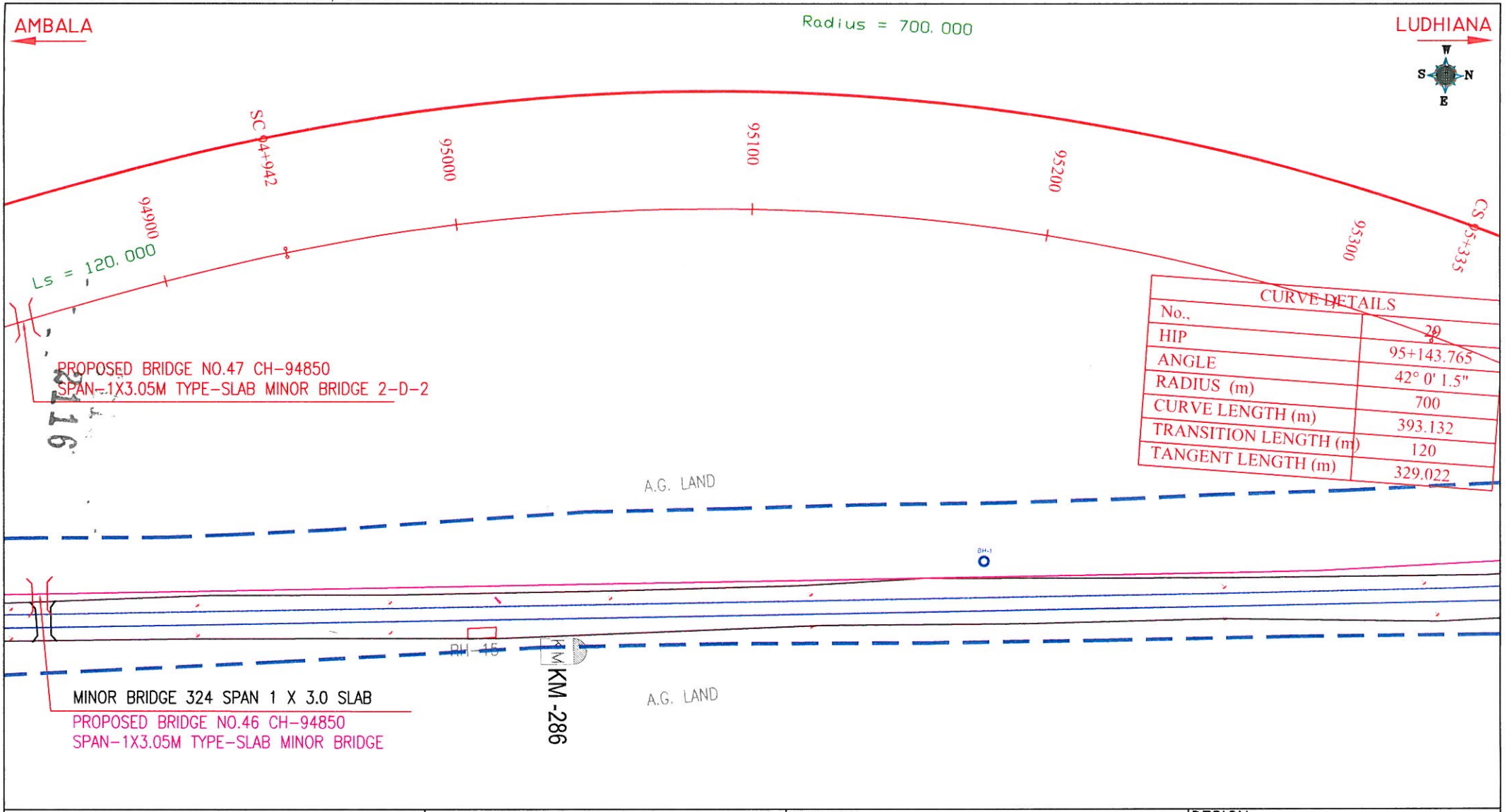
103.6 CONCLUSIONS

- Subsurface Profiles indicates suitable Soil formation for foundations.

103.7 RECOMMENDATIONS

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

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



ALL DIMENSIONS IN METER FIG.:-I LOCATION PLAN OF PROPOSED ALIGNMENT CH-286/14-15	RL OF BH-I = 266.215	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

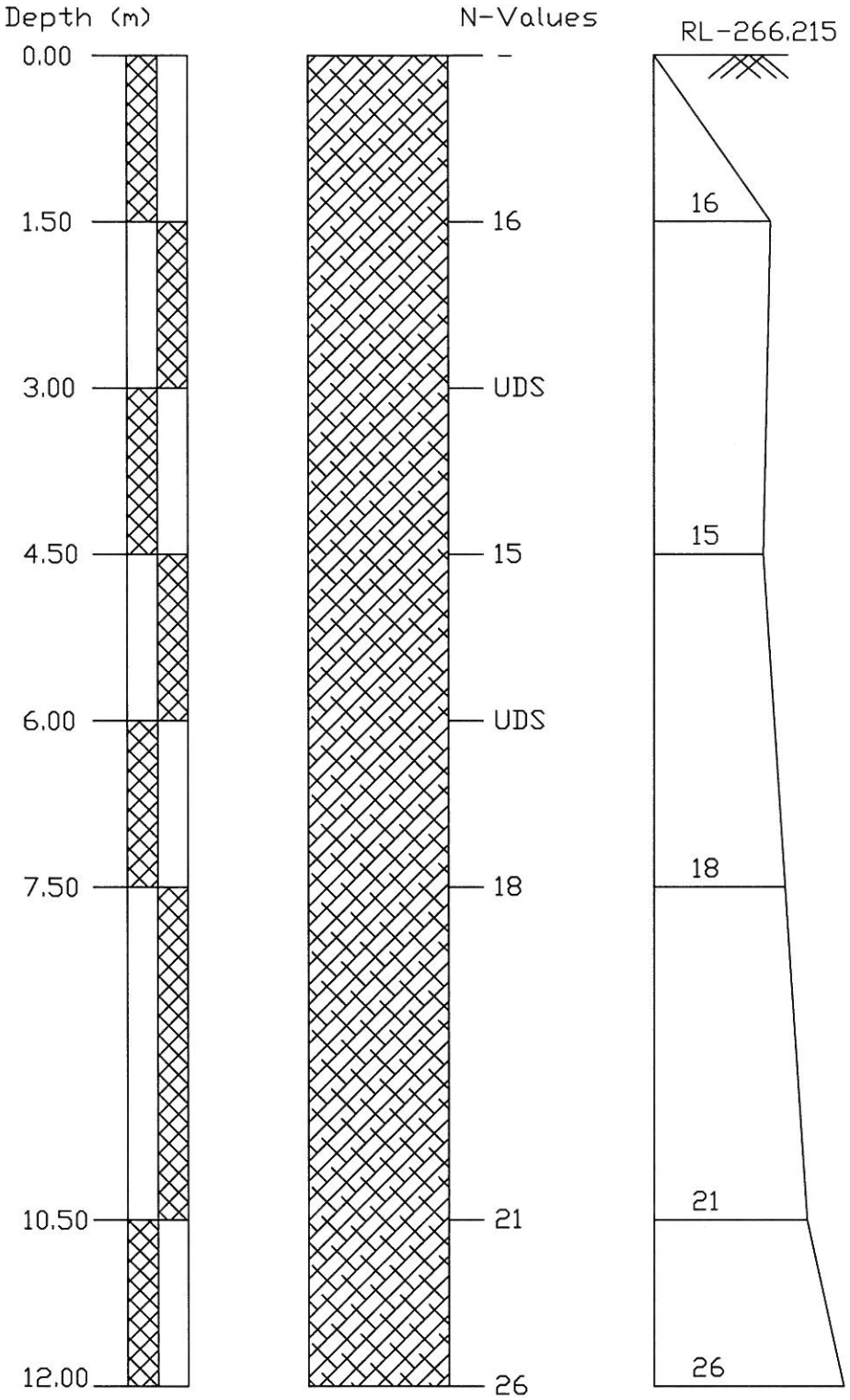
SOIL CHARACTERISTICS OF BORE HOLE AT BH-1 OF ALIGNMENT AT CHAINAGE 286/14-15

Project :	Chainage 286/14-15			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation	Ref. Code
				19.06.2009 to 19.06.2009	1	1	26.50 m.	12.00mtr	266.215	

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	22.89	-	2.35	1.25	0.25	0.00	0.00	44	24	20	-	-	-	-	-	-
1.50	16	1.40	22.40	Clayey silt	26.21	71.68	1.69	0.30	0.12	0.00	0.00	47	24	23		-	-	-	-	-
3.00	UDS	-	-	Clayey silt	28.95	67.58	3.05	0.42	0.00	0.00	0.00	46	20	26	1.76	15.26	1.53	2.64	0.30	10.00
4.50	15	1.03	15.45	Clayey silt	27.56	69.00	3.18	0.10	0.16	0.00	0.00	47	22	25	-	-	-	-	-	-
6.00	UDS	-	-	Clayey silt	22.96	75.18	1.86	0.00	0.00	0.00	0.00	45	24	21	1.82	16.22	1.57	2.62	0.25	13.00
7.50	18	0.86	15.48	Clayey silt	24.59	72.59	2.65	0.17	0.00	0.00	0.00	44	22	22	-	-	-	-	-	-
10.50	21	0.74	15.54	Clayey silt	25.69	70.68	3.15	0.26	0.22	0.00	0.00	44	21	23	-	-	-	-	-	-
12.00	26	0.70	18.20	Clayey silt	23.69	71.91	2.85	1.22	0.33	0.00	0.00	43	22	21	-	-	-	-	-	-

CONSULTING
Engineers Group Ltd.

BORELOG OF BH–1 AT EXISTING KM–286/14–15 FOR ALIGNMENT ON KESARI TO SANEHWAL, LUDHIANA



2118

LEGEND

SYMBOL	DESCRIPTION
	CLAYEY SILT

CHAPTER – 104

"Alignment",

Location – Existing Km. – 284/14-16

104.1 LOCATION OF STRUCTURE:

Alignment at existing km 284/14-16.

104.2 BOREHOLE DESCRIPTIONS:

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

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

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

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

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

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

Subsurface profile at the site

BOREHOLE No.	Depth (m)	Type of Soil/Rock	Soil/Rock Characteristics
BH-1	0.00 to 4.50	Clayey Silt with Sand	Loose
	4.50 to 9.00	Clayey Silt with Sand	Medium Dense

104.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1	3.00	7.30	NIL	0.0028	NIL	0.0013	0.054
	6.00	7.50	NIL	0.0024	NIL	0.0011	0.032

104.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1	3.00	21.00
BH-1	6.00	13.00

104.5 NET ALLOWABLE BEARING PRESSURE

Borehole No.	Depth from EGL (m)	Net Allowable Bearing Pressure (t/m^2)
BH-1	1.50	06.00
	3.00	09.00
	4.50	13.50
	6.00	14.50

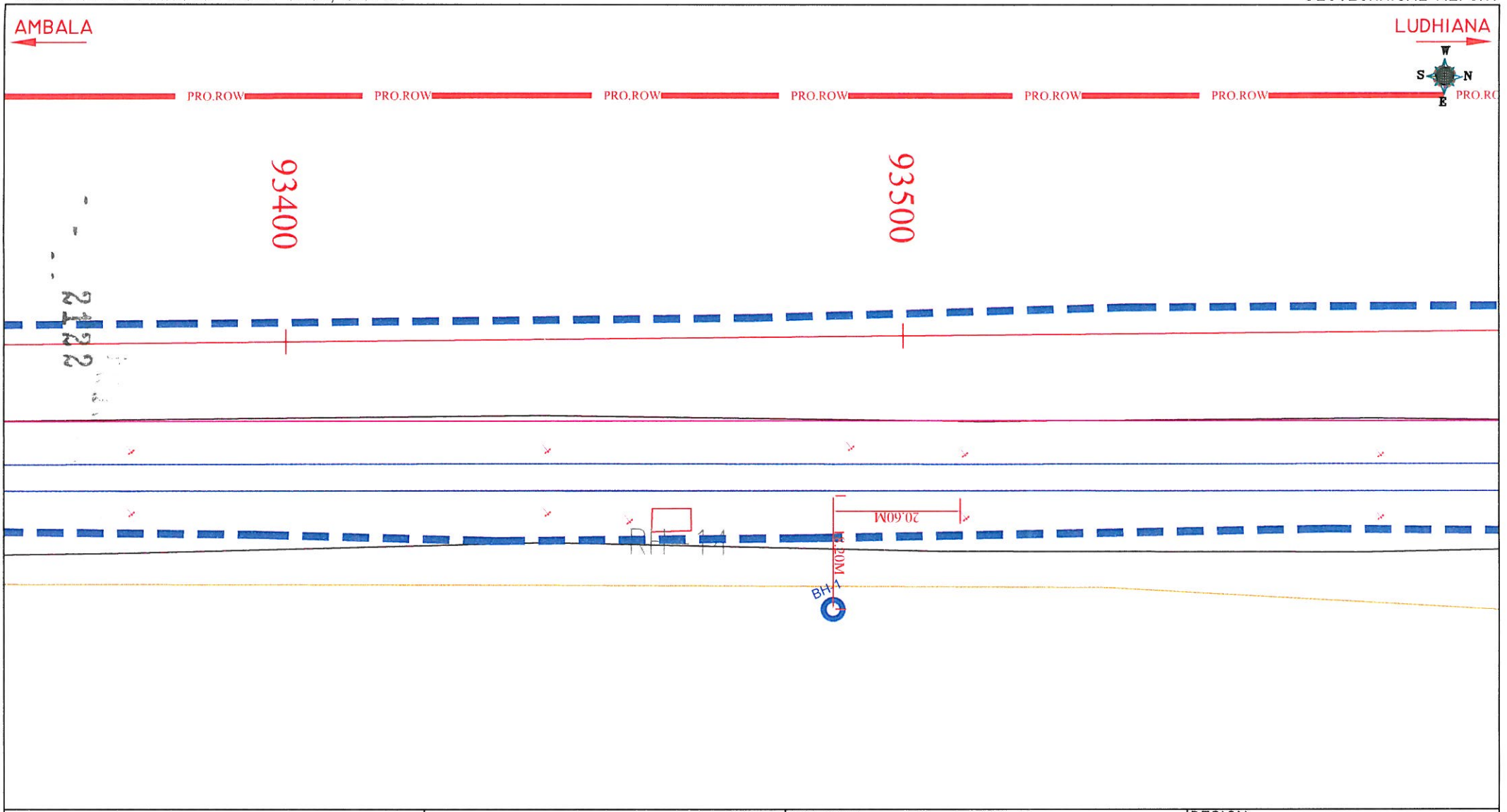
104.6 CONCLUSIONS

- Subsurface Profiles indicates suitable Soil formation for foundations.

104.7 RECOMMENDATIONS

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

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



ALL DIMENSIONS IN METER FIG.:-I LOCATION PLAN OF PROPOSED ALIGNMENT CH-284/14-16	RL OF BH-I = 268.438	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 (LHS)OF ALIGNMENT AT CHAINAGE 284/14-16

Project :	Chainage 284/14-16			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				19.06.2009 to 19.06.2009	1	1 (LHS)	26.00 m.	12.00mtr	268.438

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	14.86	77.10	6.25	0.59	1.2	0.00	0.00	32	20	12	-	-	-	-	-	-
1.50	5	1.44	7.20	Clayey silt with sand	15.84	78.07	5.61	0.40	0.08	0.00	0.00	32	19	13	-	-	-	-	-	-
3.00	UDS	-	-	Clayey silt with sand	18.59	64.50	14.15	2.56	0.20	0.00	0.00	33	17	16	1.60	10.21	1.45	2.63	0.19	18.00
4.50	13	1.07	13.91	Clayey silt with sand	11.10	48.69	39.03	0.98	0.20	0.00	0.00	22	17	8	-	-	-	-	-	-
6.00	UDS	-	-	Clayey silt with sand	12.98	74.37	12.47	0.18	0.00	0.00	0.00	28	18	10	1.68	10.33	1.52	2.61	0.10	22.00
7.50	18	0.89	16.02	Clayey silt with sand	19.10	61.08	18.18	1.09	0.55	0.00	0.00	35	19	16	-	-	-	-	-	-
10.50	26	0.78	20.28	Clayey silt with sand	18.11	68.24	10.26	2.18	1.21	0.00	0.00	35	20	15	-	-	-	-	-	-
12.00	28	0.74	20.72	Clayey silt with sand	14.86	74.02	9.48	1.09	0.55	0.00	0.00	26	14	12	-	-	-	-	-	-

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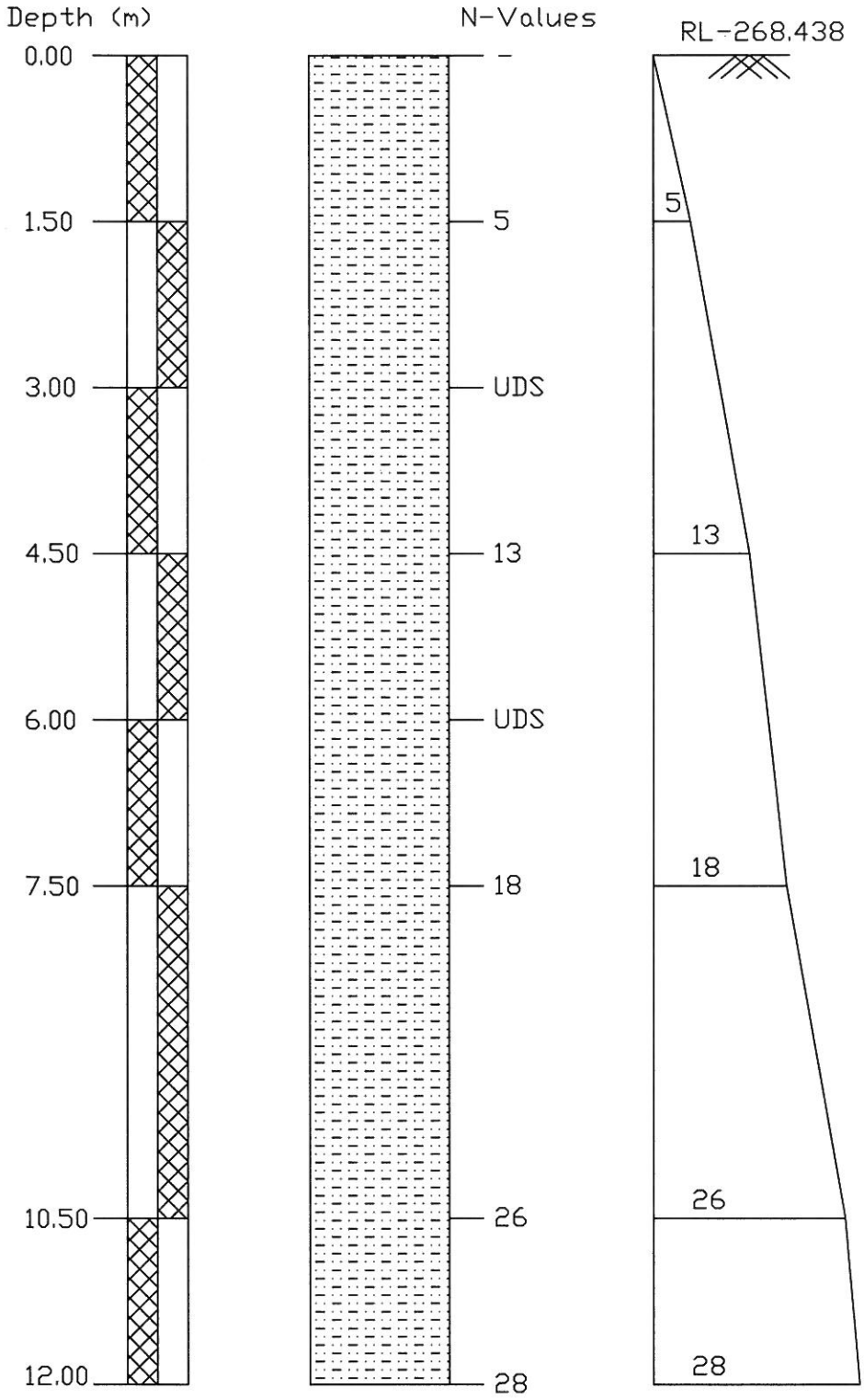
BORELOG OF BH–1(LHS) AT EXISTING KM–284/14–16 FOR ALIGNMENT ON KESARI TO SANEHWAL, LUDHIANA



2124

LEGEND

SYMBOL	DESCRIPTION
	CLAYEY SILT WITH SAND

CONSULTING Engineers Group Ltd.

CHAPTER – 105

"Alignment",

Location – Existing Km. – 282/08-10

105.1 LOCATION OF STRUCTURE:

Alignment at existing km 282/08-10

105.2 BOREHOLE DESCRIPTIONS:

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

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

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

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

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

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

Subsurface profile at the site

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

105.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1	3.00	8.30	NIL	0.0017	NIL	0.0011	0.046
	9.00	8.20	0.005	0.0021	NIL	0.0011	0.062

105.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1	3.00	18.00
	9.00	15.00

105.5 NET ALLOWABLE BEARING PRESSURE

Borehole No.	Depth from EGL (m)	Net Allowable Bearing Pressure (t/m²)
BH-1	1.50	09.00
	3.00	14.00
	4.50	16.00
	6.00	17.00

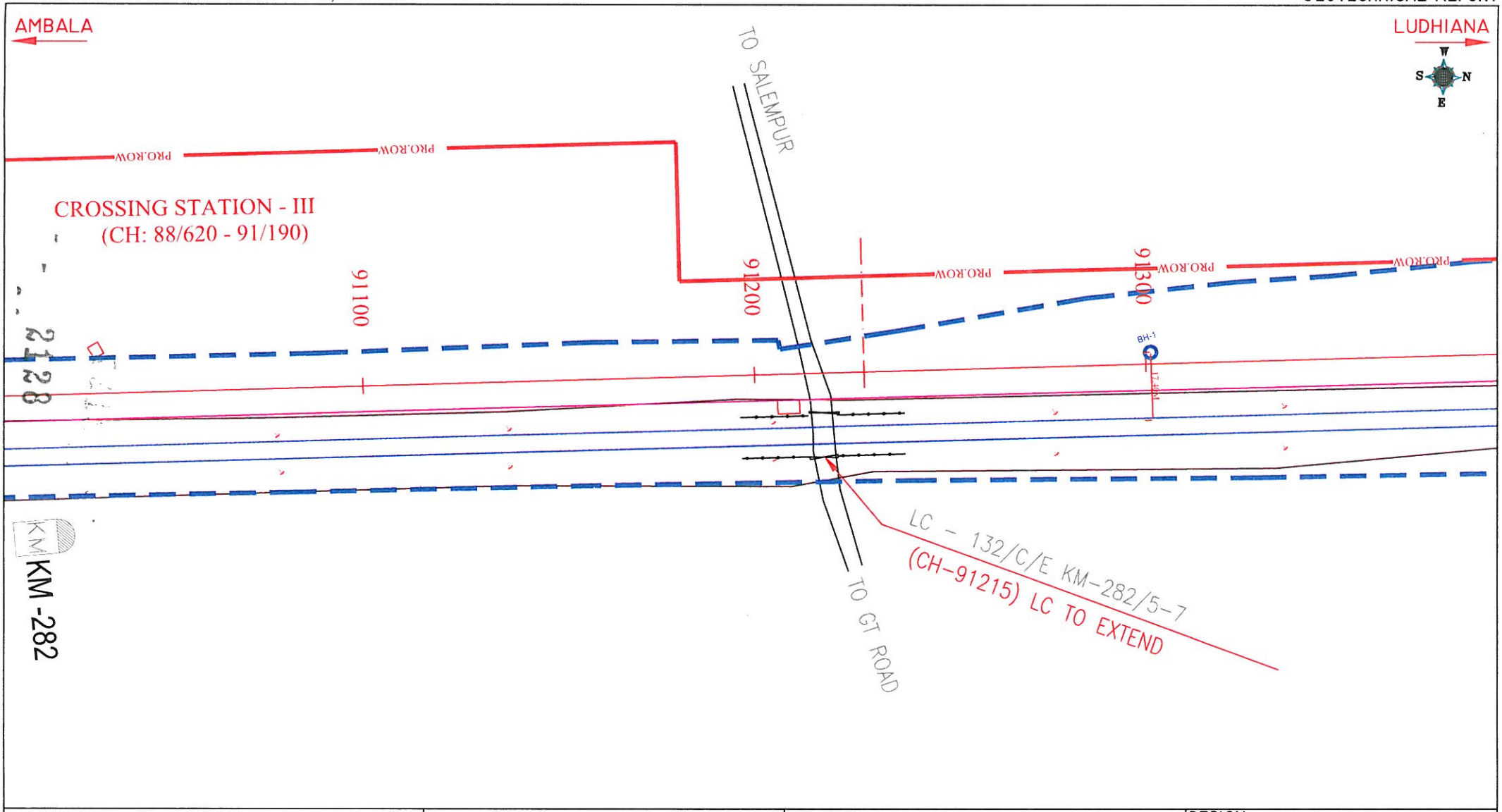
105.6 CONCLUSIONS

- Subsurface Profiles indicates suitable Soil formation for foundations.

105.7 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 ALIGNMENT CH-282/8-10	RL OF BH-I = 266.304	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(LHS) FOR ALIGNMENT AT CHAINAGE 282/8-10

Project :	Chainage 282/8-10 Bridge No. 000			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				27.11.2009 to 27.11.2009	1	1 (LHS)	below 20.00 m.	12.00mtr	266.304

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	0.00	3.29	90.36	6.35	0.00	0.00	0.00	23	NP	NIL	-	-	-	-	-	-
1.50	9	1.42	12.78	Silty Sand	0.00	5.21	89.16	5.63	0.00	0.00	0.00	25	NP	NIL	-	-	-	-	-	-
3.00	UDS	-	-	Sandy Silt with Clay	14.28	68.81	15.31	1.20	0.40	0.00	0.00	29	16	13	1.90	20.88	1.57	2.58	0.12	20.0
4.50	8	1.05	8.40	Sandy Silt with Clay	11.32	70.41	14.93	1.56	0.76	1.02	0.00	27	17	10	-	-	-	-	-	-
7.50	16	0.88	14.08	Clayey Silt with sand	23.58	67.32	4.70	1.33	0.78	2.29	0.00	46	24	22	-	-	-	-	-	-
9.00	UDS	-	-	Clayey Silt with sand	12.33	81.92	1.74	3.04	0.97	0.00	0.00	33	22	11	1.92	21.62	1.58	2.61	0.10	20.0
10.50	20	0.75	15.00	Silty Sand	0.00	5.83	86.68	7.49	0.00	0.00	0.00	28	NP	NIL	-	-	-	-	-	-
12.00	21	0.70	14.70	Sandy Silt with Clay	6.95	66.76	21.08	3.75	0.84	0.62	0.00	25	17	8	-	-	-	-	-	-

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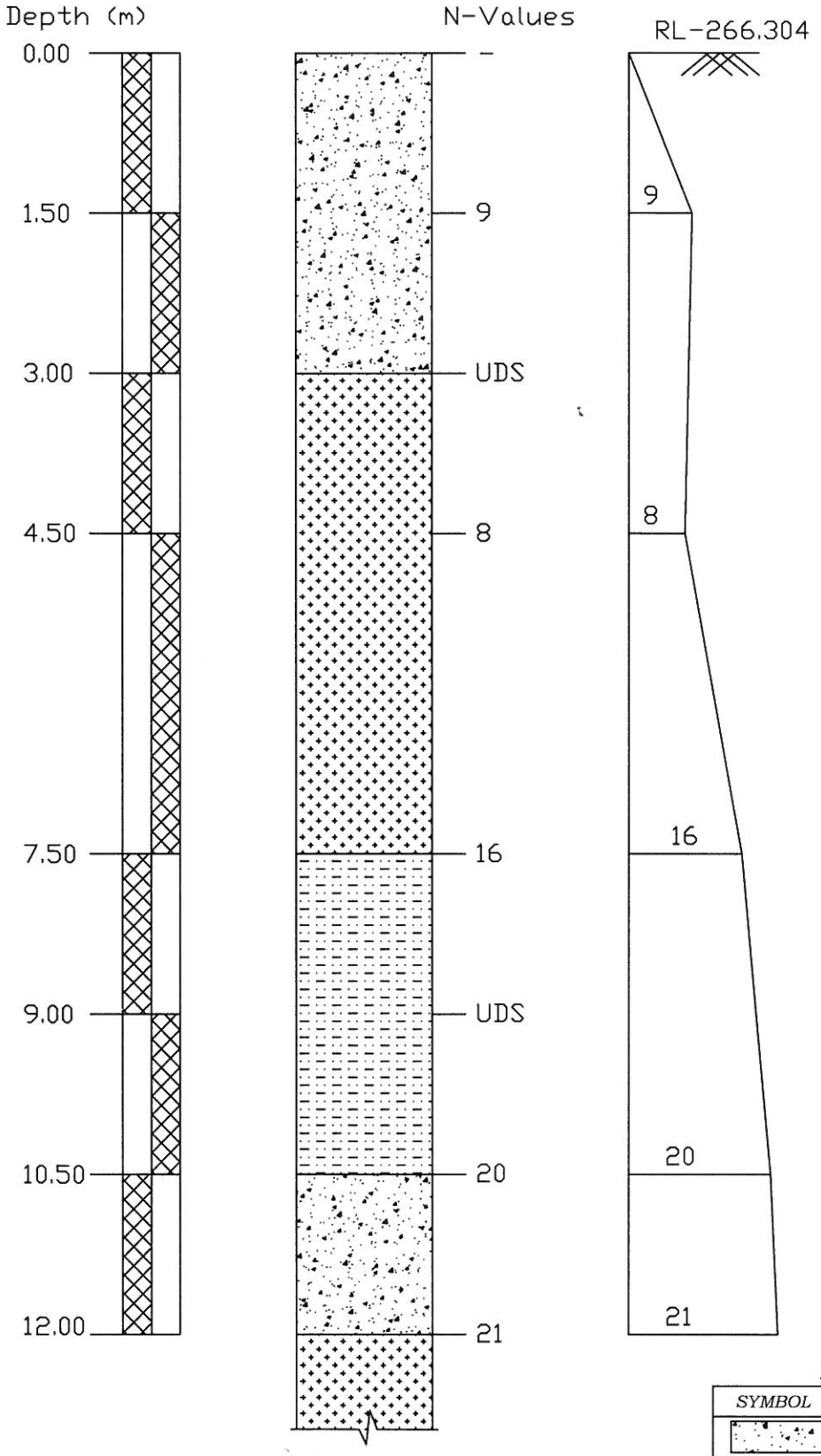
BORELOG OF BH–1 AT EXISTING KM–282/8–10 FOR ALIGNMENT,

ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

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

2130

CONSULTING Engineers Group Ltd.

CHAPTER – 106

"Alignment",

Location – Existing Km. – 279/13-15

106.1 LOCATION OF STRUCTURE:

Alignment at existing km 279/13-15

106.2 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 ≥17.00m below EGL.

Subsurface profile at the site

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

106.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1	3.00	8.10	NIL	0.0017	NIL	0.0011	0.058
	6.00	8.10	NIL	0.0038	NIL	0.0013	0.107
	13.00	8.10	NIL	0.0024	NIL	0.0012	0.087

106.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1	3.00	28.00
	6.00	15.00

106.5 NET ALLOWABLE BEARING PRESSURE

Borehole No.	Depth from EGL (m)	Net Allowable Bearing Pressure (t/m^2)
BH-1	1.50	05.50
	3.00	09.00
	4.50	12.00
	6.00	13.00

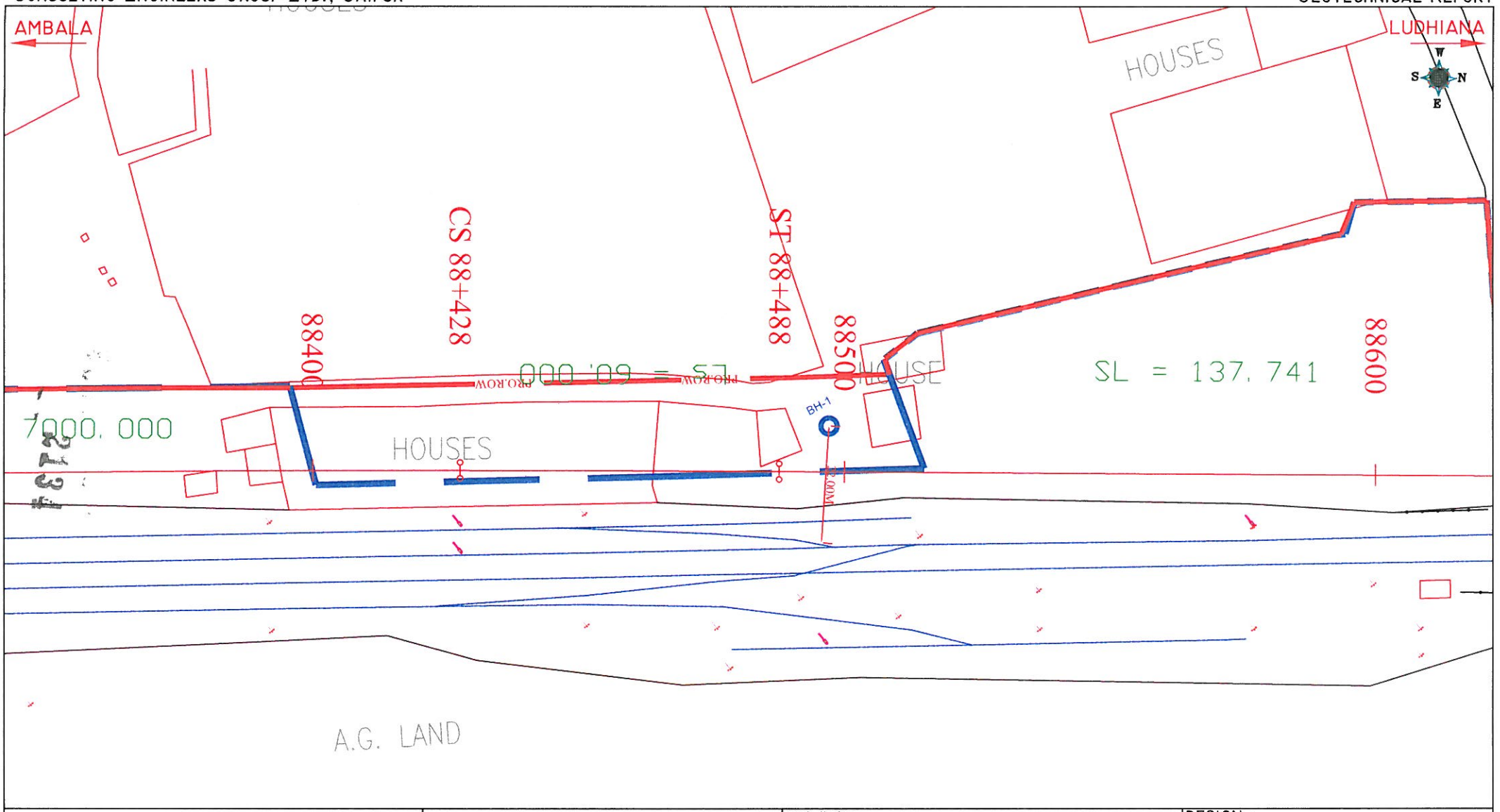
106.6 CONCLUSIONS

- Subsurface Profiles indicates suitable Soil formation for foundations.

106.7 RECOMMENDATIONS

(i)	*Type of foundation*	Open foundation
(ii)	*Depth of foundation below GL*	Below 6.00m 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 ALIGNMENT CH-279/13-15	RL OF BH-I = 267.823	PROJECT :- LUDHIANA-AMBALA (DFCCIL)	DESIGN :- CONSULTING ENGINEERS GROUP LTD. E-12,Moji Colony,Malviya Nagar Jaipur-17 Tel: +91-141- 2520899, 2521899, 2520556 Fax: 2521348, E-Mail: ceg@cegindia.com

SOIL CHARACTERISTICS OF BORE HOLE AT BH-1(LHS) FOR ALIGNMENT AT CHAINAGE 279/13-15

Project :	Chainage 279/13-15 Bridge No. 000			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				29.11.2009 to 29.11.2009	1	1 (LHS)	below 17.00 m.	12.00mtr	267.823

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	8.12	59.83	30.26	1.25	0.28	0.26	0.00	27	19	8	-	-	-	-	-	-
1.50	11	1.43	15.73	Sandy Silt with Clay	6.12	65.89	27.14	0.56	0.10	0.19	0.00	24	18	6	-	-	-	-	-	-
3.00	UDS	-	-	Clayey Silt	22.36	75.33	2.14	0.11	0.06	0.00	0.00	47	26	21	1.75	12.58	1.55	2.67	0.30	10.0
4.50	14	1.06	14.84	Clayey Silt	26.58	66.97	1.34	1.93	1.43	1.75	0.00	48	24	24	-	-	-	-	-	-
6.00	UDS	-	-	Clayey Silt with Sand	13.42	77.98	2.65	2.36	2.27	1.32	0.00	34	22	12	1.77	14.74	1.54	2.62	0.15	17.0
7.50	16	0.92	14.72	Clayey Silt with Sand	21.35	68.57	2.74	3.13	2.70	1.51	0.00	40	21	19	-	-	-	-	-	-
10.50	16	0.81	12.96	Clayey Silt with Sand	19.58	71.24	3.33	2.97	2.34	0.54	0.00	38	20	18	-	-	-	-	-	-
12.00	19	0.76	14.44	Clayey Silt with Sand	22.39	68.40	2.12	3.35	2.67	1.07	0.00	43	22	21	-	-	-	-	-	-

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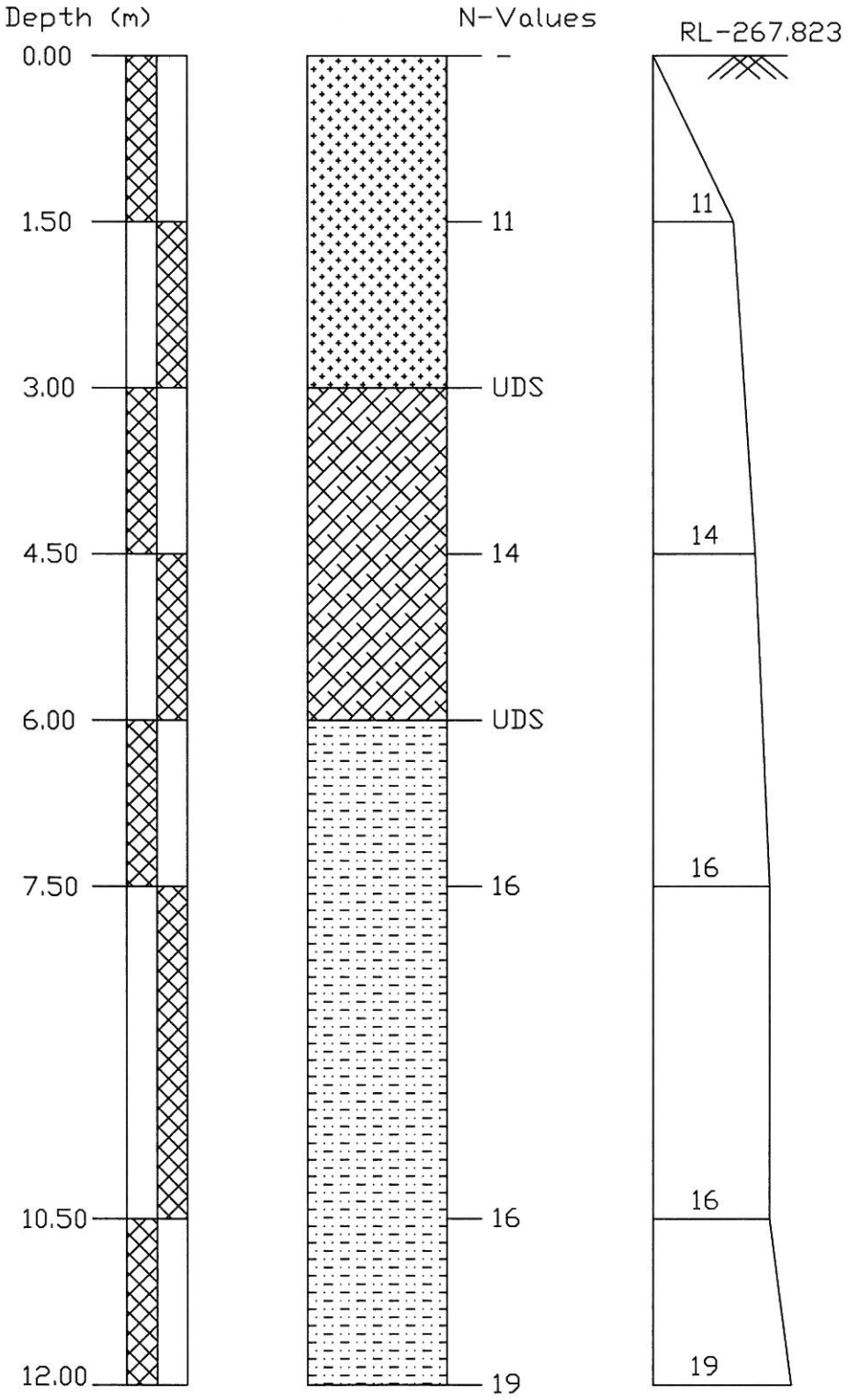
BORELOG OF BH–1(LHS) AT EXISTING KM–279/13–15 FOR ALIGNMENT,

ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

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

2136

CONSULTING Engineers Group Ltd.

CHAPTER – 107

"Alignment",

Location – Existing Km. – 276/7-9

107.1 LOCATION OF STRUCTURE:

Alignment at existing km 276/7-9.

107.2 BOREHOLE DESCRIPTIONS:

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

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

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

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

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

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

Subsurface profile at the site

BOREHOLE No.	Depth (m)	Type of Soil/Rock	Soil/Rock Characteristics
BH-1	0.00 to 3.00	Clayey Silt with Sand	Loose
	3.00 to 4.50	Silty Sand	Loose
	4.50 to 6.00	Silty Sand	Medium Dense
	6.00 to 7.50	Clayey Silt with Sand	Medium Dense
	7.50 to 10.50	Silty Sand	Medium Dense
	10.50 to 12.00	Clayey Silt with Sand	Medium Dense

107.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1	6.00	7.60	NIL	0.0021	NIL	0.0012	0.057

107.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1	3.00	NIL
BH-1	6.00	21.00

107.5 NET ALLOWABLE BEARING PRESSURE

Borehole No.	Depth from EGL (m)	Net Allowable Bearing Pressure (t/m²)
BH-1	1.50	06.00
	3.00	11.00
	4.50	12.00
	6.00	14.00

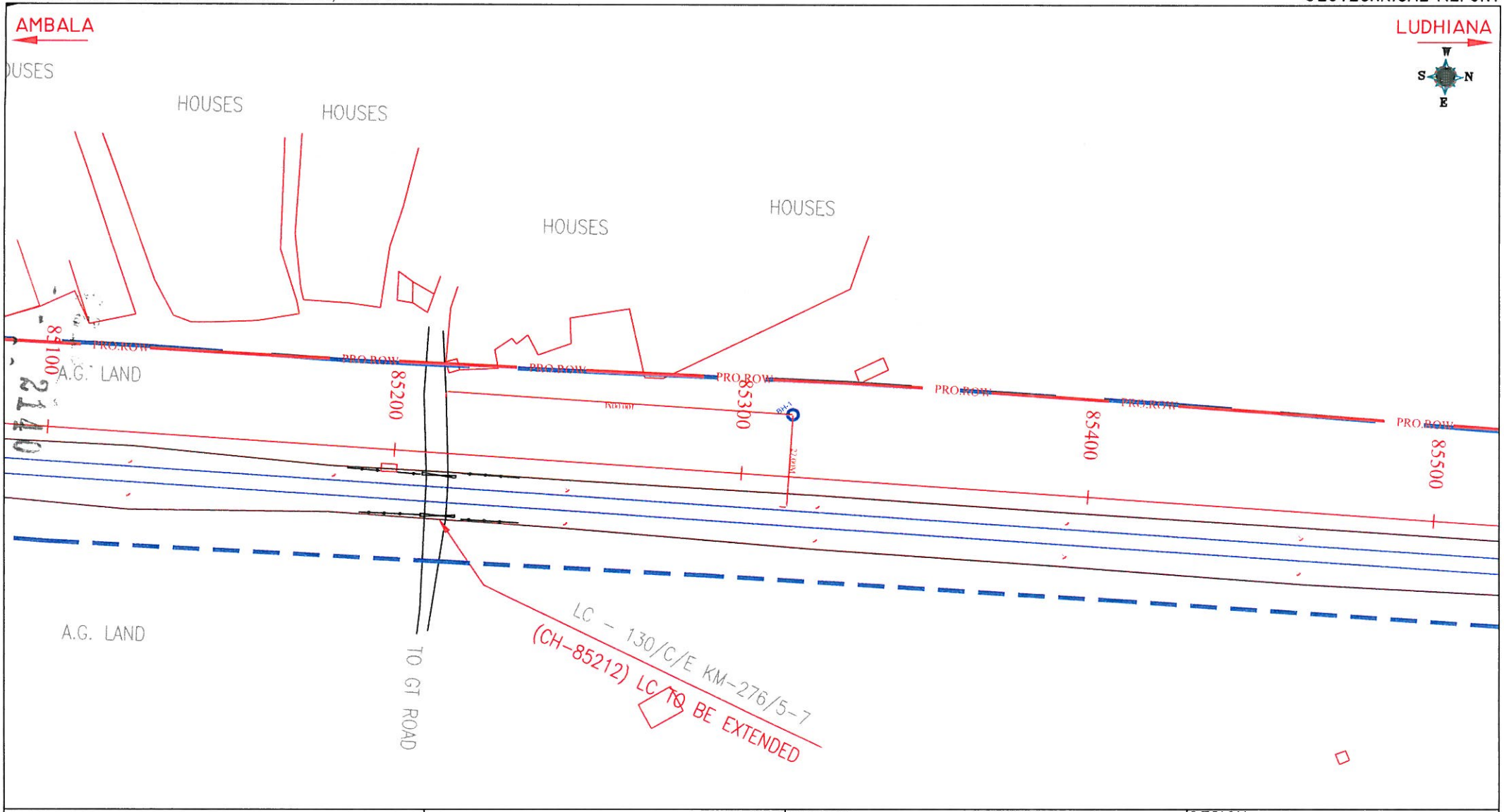
107.6 CONCLUSIONS

- Subsurface Profiles indicates suitable Soil formation for foundations.

107.7 RECOMMENDATIONS

(i)	*Type of foundation*	Open foundation
(ii)	*Depth of foundation below GL*	Below 6.00m 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 ALIGNMENT CH-276/7-9	RL OF BH-I = 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

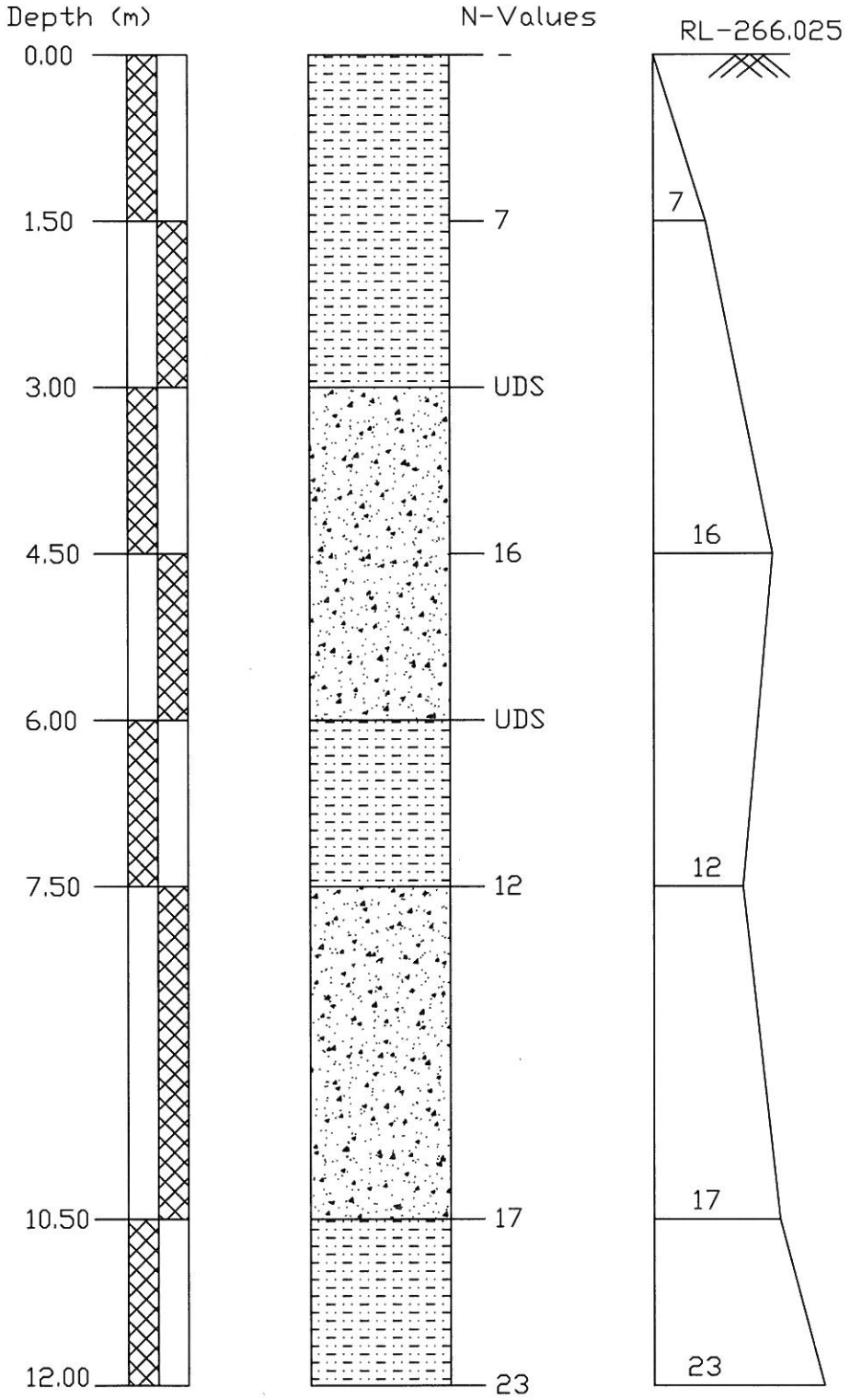
SOIL CHARACTERISTICS OF BORE HOLE AT BH-1 (RHS) OF ALIGNMENT AT CHAINAGE 276/7-9

Project :	Chainage 276/7-9			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation	Ref. Code
				06.07.2009 to 07.07.2009	1	1(RHS)	28.00 m.	12.00mtr	266.025	

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	-	-	-	Clay silt with sand	14.59	78.80	3.26	1.25	0.90	1.20	0.00	32	20	12	-	-	-	-	-	-
1.50	7	1.51	10.57	Clay silt with sand	15.21	77.51	4.29	0.78	1.49	0.72	0.00	31	19	12	-	-	-	-	-	-
3.00	UDS	-	-	Silty sand	2.25	8.15	88.85	0.75	0.00	0.00	0.00	25	NIL	NP	1.65	10.33	1.50	2.64	0.00	26.0
4.50	16	1.08	17.28	Silty sand	3.12	10.57	85.03	0.98	0.30	0.00	0.00	24	NIL	NP	-	-	-	-	-	-
6.00	UDS	-	-	Clay silt with sand	18.65	65.11	8.87	1.50	1.25	4.62	0.00	36	20	16	1.67	9.26	1.53	2.62	0.20	17.0
7.50	12	0.90	10.80	Silty sand	4.15	48.37	46.69	0.42	0.37	0.00	0.00	28	NIL	NP		-	-	-	-	-
10.50	17	0.78	13.26	Clay silt with sand	13.2	73.88	7.99	0.91	0.72	3.30	0.00	28	16	12	-	-	-	-	-	-
12.00	23	0.74	17.02	Clay silt with sand	12.86	80.56	5.06	1.11	0.41	0.00	0.00	28	18	10	-	-	-	-	-	-

CONSULTING
Engineers Group Ltd.

BORELOG OF BH–1(RHS) AT EXISTING KM–276/7–9 FOR ALIGNMENT ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

SYMBOL	DESCRIPTION
	CLAYEY SILT WITH SAND
	SILTY SAND

2142

CONSULTING Engineers Group Ltd.

CHAPTER – 108

"Alignment",

Location – Existing Km. – 274/19-21

CONSULTING
Engineers Group Ltd.

108.1 LOCATION OF STRUCTURE:

Alignment at existing km 274/19-21.

108.2 BOREHOLE DESCRIPTIONS:

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

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

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

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

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

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

Subsurface profile at the site

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

108.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1	3.00	8.10	NIL	0.0051	NIL	0.0014	0.361
	6.00	7.20	NIL	0.0060	NIL	0.0014	0.367

108.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1	3.00	23.00
BH-1	6.00	21.00

108.5 NET ALLOWABLE BEARING PRESSURE

Borehole No.	Depth from EGL (m)	Net Allowable Bearing Pressure (t/m²)
BH-1	1.50	06.50
	3.00	10.00
	4.50	16.00
	6.00	18.00

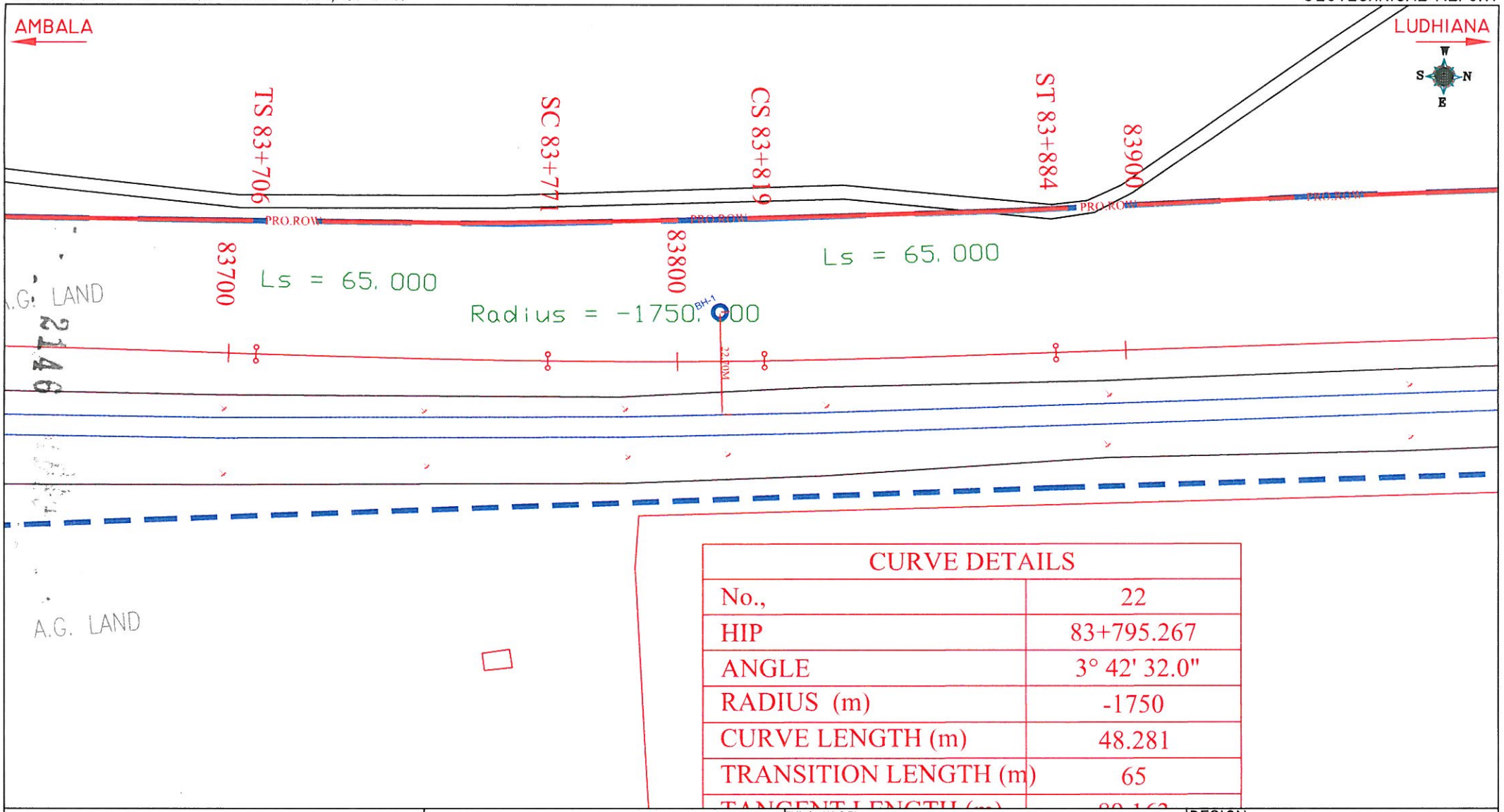
108.6 CONCLUSIONS

- Subsurface Profiles indicates suitable Soil formation for foundations.

108.7 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.



CURVE DETAILS	
No.,	22
HIP	83+795.267
ANGLE	3° 42' 32.0"
RADIUS (m)	-1750
CURVE LENGTH (m)	48.281
TRANSITION LENGTH (m)	65
TANGENT LENGTH (m)	89.162

ALL DIMENSIONS IN METER

FIG.:-I

LOCATION PLAN OF PROPOSED ALINGMENT

CH-274/19-21

RL OF BH (AI) = 266.238

PROJECT :-

LUDHIANA-AMBALA (DFCCIL)

DESIGN :-

CONSULTING ENGINEERS GROUP LTD.
E-12,Moji Colony,Malviya Nagar Jaipur-17
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SOIL CHARACTERISTICS OF BORE HOLE AT BH-1 (RHS) OF ALIGNMENT AT CHAINAGE 274/19-21

Project :	Chainage 274/19-21			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				10.07.2009 to 10.07.2009	1	1(RHS)	18.00 m.	12.00mtr	266.238

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	12.85	72.38	10.36	1.26	0.69	2.15	0.31	31	21	10	-	-	-	-	-	-
1.50	9	1.44	12.96	Clayey silt with sand	18.59	69.25	9.43	0.66	0.75	1.32	0.00	34	18	16	-	-	-	-	-	-
3.00	UDS	-	-	Clayey silt with sand	20.14	64.86	11.25	2.70	0.60	0.45	0.00	36	19	17	1.65	7.59	1.53	2.65	0.21	16.0
4.50	12	1.06	12.72	Clayey silt with sand	15.96	69.34	12.59	0.97	0.53	0.61	0.00	29	16	13	-	-	-	-	-	-
6.00	UDS	-	-	Clayey silt with sand	18.54	50.20	28.19	1.42	1.39	0.26	0.00	31	15	16	1.74	9.33	1.59	2.67	0.18	19
7.50	14	0.88	12.32	Clayey silt with sand	18.96	70.04	6.15	2.55	1.80	0.50	0.00	34	18	16	-	-	-	-	-	-
10.50	18	0.76	13.68	Clayey silt with sand	17.96	66.17	11.35	2.00	1.21	1.31	0.00	32	17	15	-	-	-	-	-	-
12.00	20	0.72	14.40	Clayey silt with sand	15.99	67.68	10.27	2.68	1.91	1.47	0.00	31	17	14	-	-	-	-	-	-

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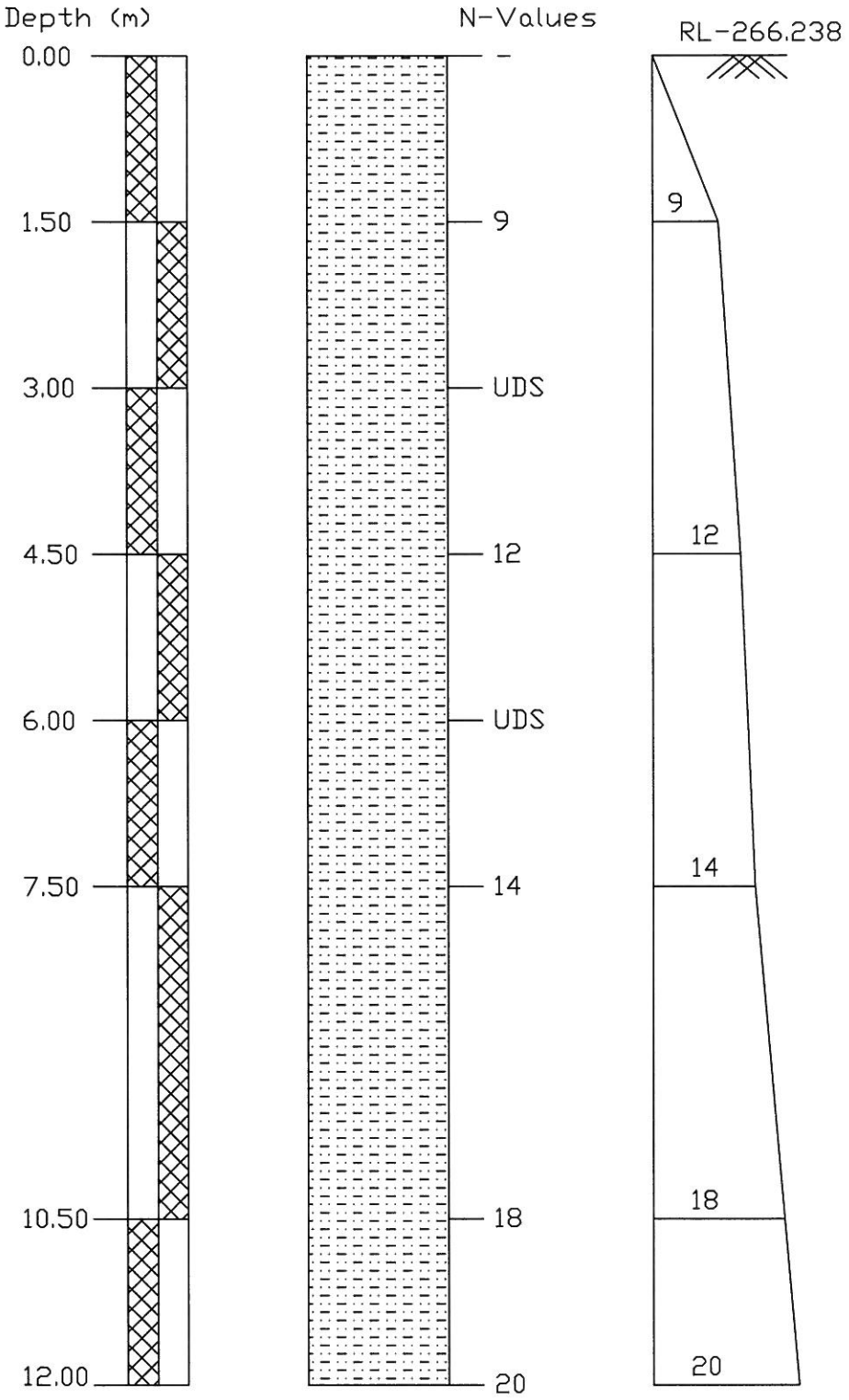
BORELOG OF BH–1(RHS) AT EXISTING KM–274/19–21 FOR ALIGNMENT ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

SYMBOL	DESCRIPTION
	CLAYEY SILT WITH SAND

2148

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CHAPTER – 109

"Alignment",

Location – Existing Km. – 272/20-22

109.1 LOCATION OF STRUCTURE:

Alignment at existing km 272/20-22

109.2 BOREHOLE DESCRIPTIONS:

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

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

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

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

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

(f) Depth of water Table 6.00m below EGL.

Subsurface profile at the site

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

109.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1	3.00	8.70	0.005	0.0055	NIL	0.0014	0.349
	6.00	8.00	NIL	0.0035	NIL	0.0013	0.103

109.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1	3.00	12.00
	6.00	28.00

109.5 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	87	99	185	756	0.3	2.1	967	636
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	-	-

109.6 NET ALLOWABLE BEARING PRESSURE

Borehole No.	Depth from EGL (m)	Net Allowable Bearing Pressure (t/m²)
BH-1	1.50	06.50
	3.00	10.00
	4.50	10.00
	6.00	10.50

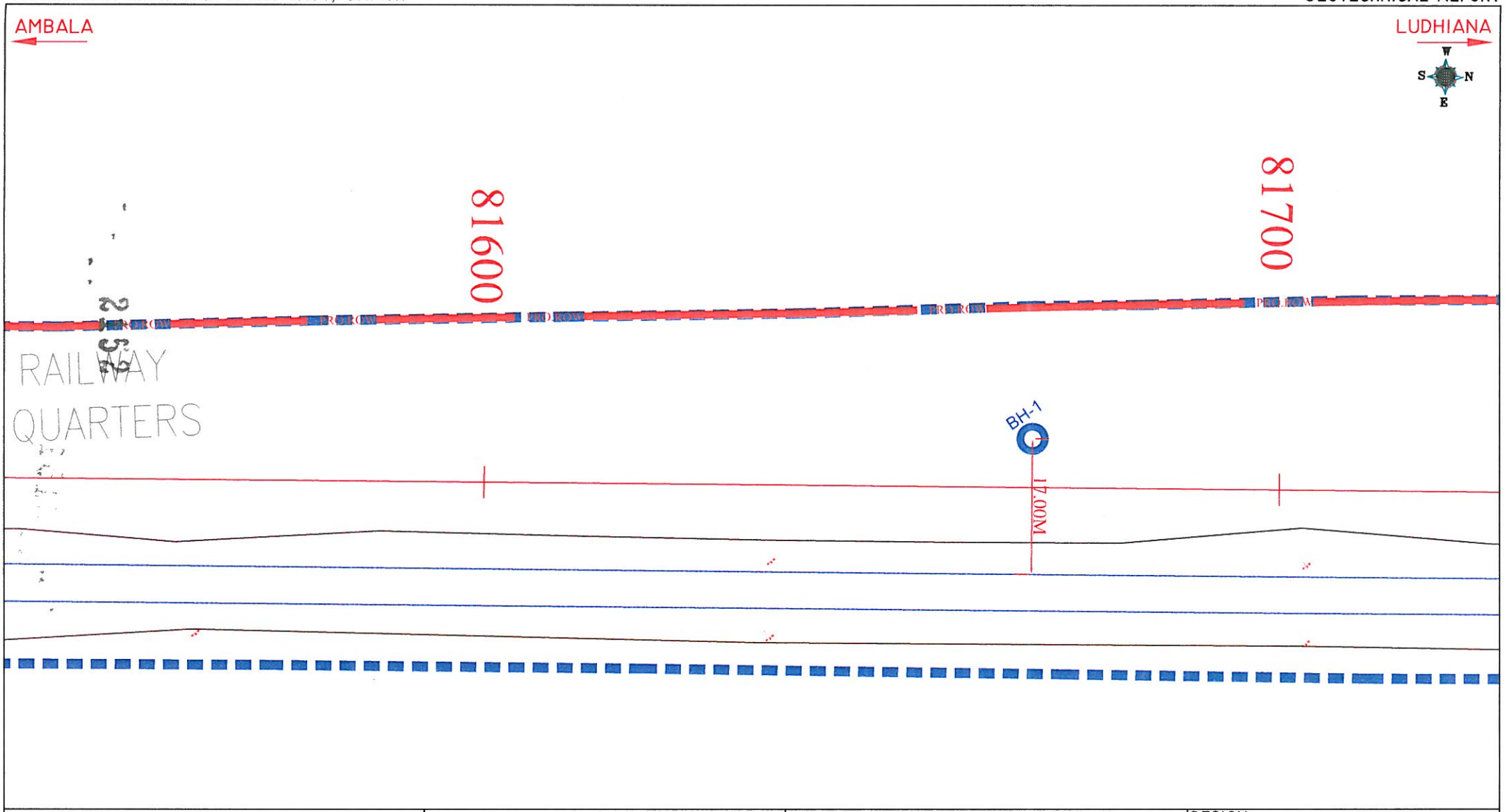
109.7 CONCLUSIONS

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

109.8 RECOMMENDATIONS

(i)	*Type of foundation*	Open foundation
(ii)	*Depth of foundation below GL*	Below 6.00m 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 ALIGNMENT CH-272/20-22	RL OF BH-I = 265.532	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(LHS) FOR ALIGNMENT AT CHAINAGE 272/20-22

Project :	Chainage 272/20-22 Bridge No. 000			Date of Testing	Location at	B.H. No.	Depth of Water Table	Termination Depth	Surface Elevation
				04.12.2009 to 04.12.2009	1	1 (LHS)	06.00 m.	12.00mtr	265.532

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	8.24	71.48	18.68	1.14	0.46	0	0	27	18	9	-	-	-	-	-	-
1.50	5	1.46	7.30	Sandy Silt with Clay	9.28	74.72	15.06	0.79	0.15	0.00	0.00	27	17	10	-	-	-	-	-	-
3.00	UDS	-	-	Sandy Silt with Clay	10.42	77.38	10.45	1.28	0.29	0.18	0.00	28	18	10	1.70	13.01	1.50	2.64	0.09	22.0
4.50	8	1.09	8.72	Sandy Silt with Clay	6.18	74.88	13.20	2.07	0.55	3.12	0.00	25	19	6	-	-	-	-	-	-
6.00	UDS	-	-	Clayey Silt with Sand	26.58	68.30	3.88	1.15	0.09	0.00	0.00	47	22	25	1.80	22.84	1.46	2.58	0.30	10.0
7.50	14	0.90	12.60	Sandy Silt with Clay	8.13	76.50	10.05	2.40	1.39	1.53	0.00	27	19	8	-	-	-	-	-	-
10.50	21	0.79	15.80	Clayey Silt	26.36	69.46	3.06	0.65	0.15	0.32	0.00	48	24	24	-	-	-	-	-	-
12.00	28	0.74	17.86	Clayey Silt	26.59	70.26	2.47	0.50	0.18	0.00	0.00	50	26	24	-	-	-	-	-	-

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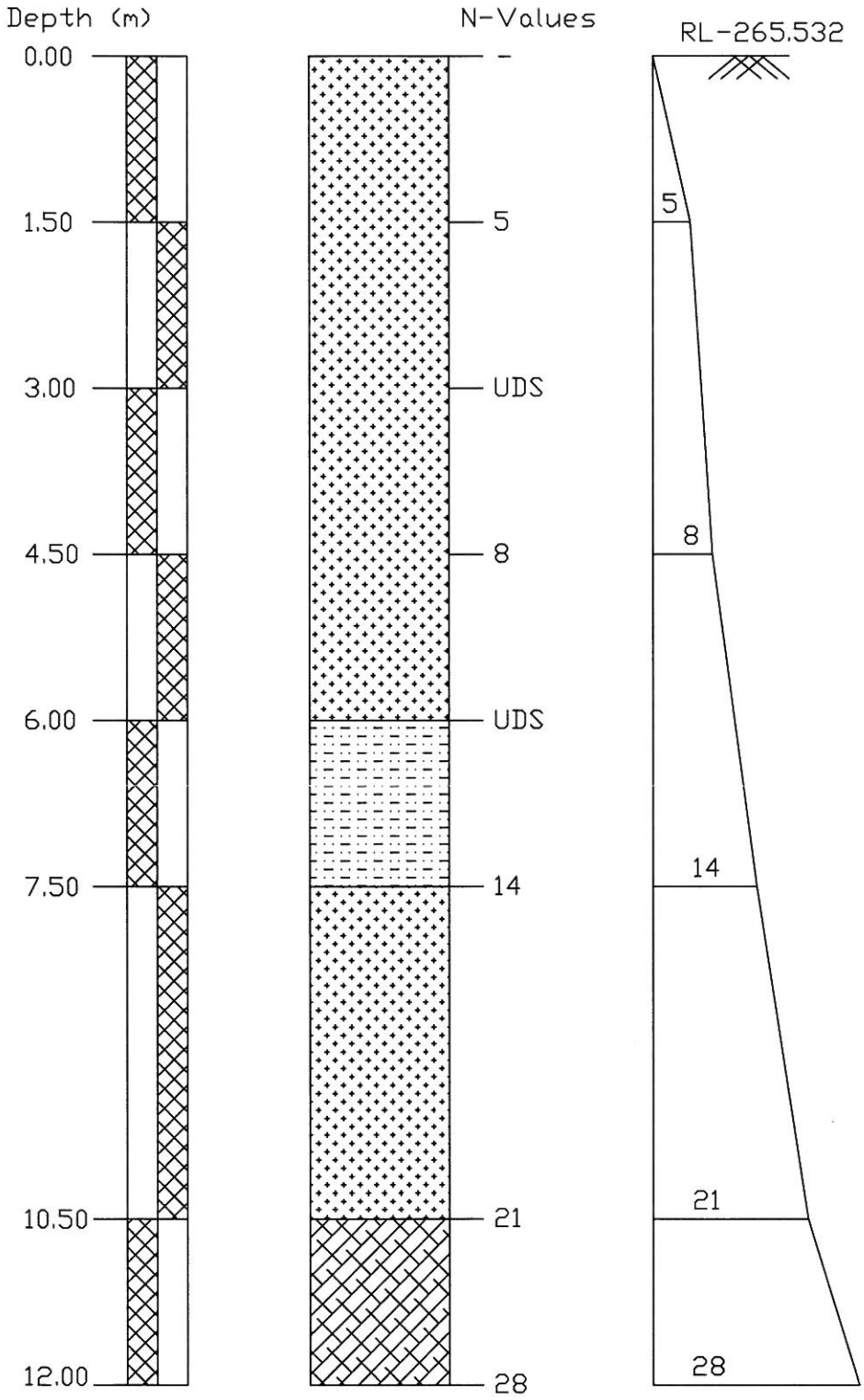
BORELOG OF BH–1(LHS) AT EXISTING KM–272/20–22 FOR ALIGNMENT,

ON KESARI TO SANEHWAL, LUDHIANA



LEGEND

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

2154

CONSULTING Engineers Group Ltd.

CHAPTER - 110

"RFO (ROR",

Location - Proposed RFO (ROR) - 286/15 (286+360)

110.1 LOCATION OF STRUCTURE:
Proposed ROR of 286/15 (286+3110)

110.2 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 10.00m below EGL.

Subsurface profile at the site

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

110.3 CHEMICAL ANALYSIS OF SOIL:

BOREHOLE		CHEMICAL PROPERTIES					
No.	Depth (m)	pH	Carbonate	Chlorides %	Sulphate %	Nitrate %	Salinity %
BH-1 (A1)	3.00	8.00	NIL	0.0024	NIL	0.0012	0.079
	9.00	7.80	NIL	0.0017	NIL	0.0012	0.085
BH-2 (A2)	3.00	8.10	NIL	0.0024	NIL	0.0012	0.062
	12.00	8.10	NIL	0.0035	NIL	0.0014	0.103
	18.00	8.20	NIL	0.0045	NIL	0.0015	0.111
	24.00	8.40	NIL	0.0031	NIL	0.0014	0.093

110.4 DIFFERENTIAL FREE SWELL INDEX (DFS)

Bore Hole No.	Depth (m)	DFS Index in %
BH-1 (A1)	3.00	11.00
	6.00	22.00
	21.00	30.00
	27.00	24.00
BH-2 (A2)	3.00	20.00
	12.00	NIL
	18.00	27.00
	24.00	18.00

110.5 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	91	84	165	739	0.2	2.2	971	632
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	-	-

110.6 SAFE BEARING CAPACITY t/m²

BH -NO.	DEPTH (mtr)	Net Allowable Bearing Pressure (t/m²)
BH-1 (A1)	1.50m	11.00
	3.00m	17.00
	4.50m	25.00
	6.00m	27.00
BH-2 (A2)	1.50m	09.50
	3.00m	13.00
	4.50m	14.00
	6.00m	15.00

110.7 PILE LOAD CARRYING CAPACITY

110.7.1 Normal Bored Cast in- situ Pile Foundations:

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

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

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

Pile load carrying capacity in t

BH -NO.	PILE DEPTH (mtr)	PILE CARRYING CAPACITY IN TONNE	
		Pile Diameter= 1.0 m	Pile Diameter= 1.2 m
BH-1 (A1)	17.00	70.00	90.00
	20.00	90.00	110.00
	23.00	110.00	135.00
BH-2 (A2)	17.00	95.00	120.00
	20.00	120.00	150.00
	23.00	150.00	180.00

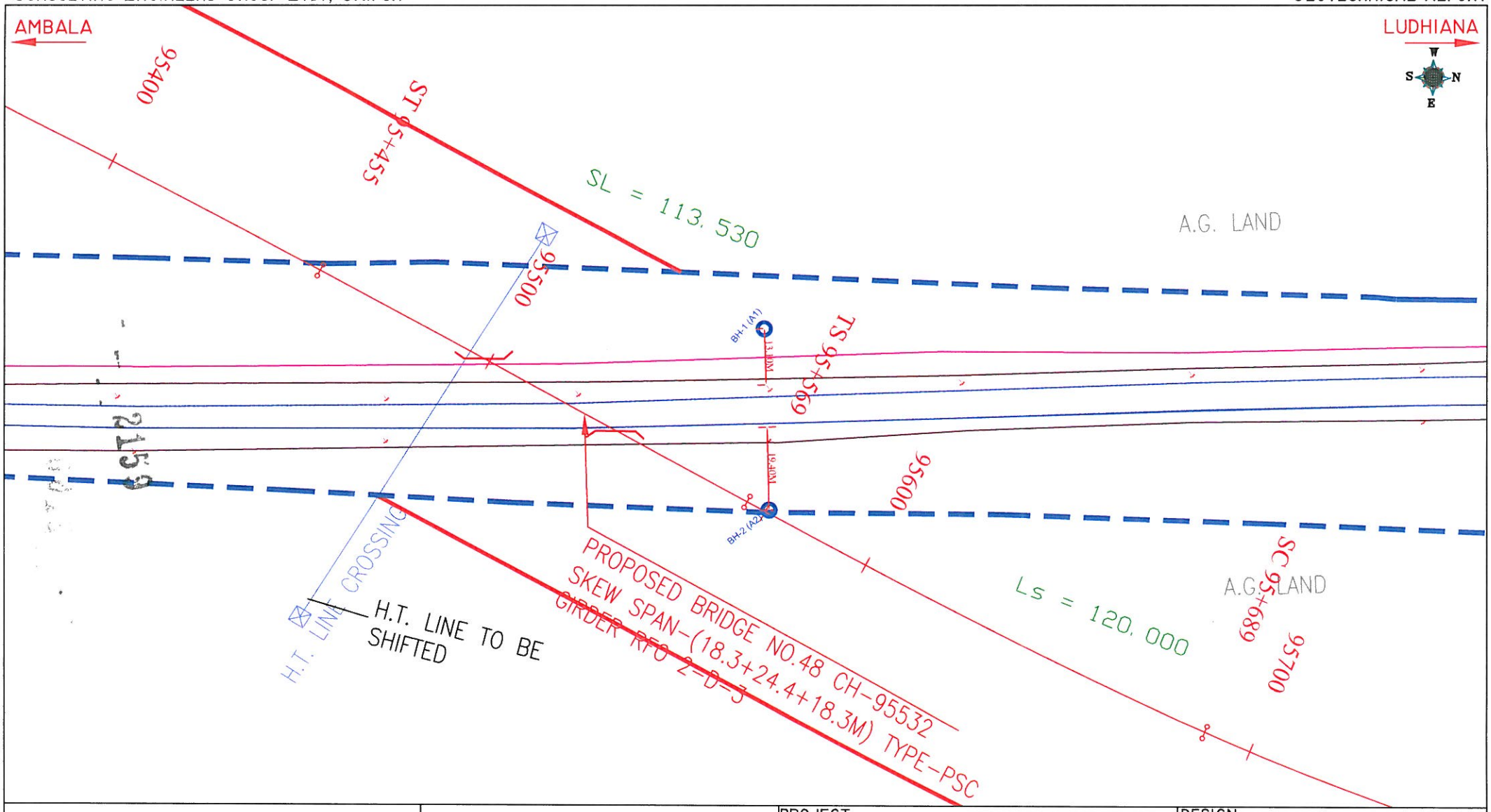
110.8 CONCLUSIONS

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

110.8 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 RFO (ROR) AT CH-286/380

RL OF BH-A1 = 265.838
RL OF BH-A2 = 267.178

PROJECT :-

LUDHIANA-AMBALA (DFCCIL)

DESIGN :-

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