

Annexure-C (Ramagundam)

SOIL DATA AND FOUNDATION SYSTEM

Employer has carried out geotechnical investigation in the vicinity of proposed area. Logs of boreholes of proposed area are enclosed with this Annexure.

- a) The minimum founding level and the corresponding net allowable bearing pressure shall be as given in Table – 1 below;

Table-1

Founding RL	Net Allowable Bearing Pressure T/m ²		
	Isolated and combined footings		Rafts (width > 6m)
	Width upto 3.0m	Width > 3.0m upto 6m	
RL (+) 151.0 M (in Soil)	12	11	14
RL (+) 150.5 M (in Soil)	16	15	18
RL (+) 150.0 M (in Soil)	20	18	22
In case where rock is encountered			
0.3m embedment in rock	30	30	30
0.6m embedment in rock	35	35	35
1.0m embedment in rock	40	40	40

For Finished ground level (FGL) refer General layout plan (GLP)

In case any loose/soft pockets is encountered at founding level, the same shall be removed completely upto the hard strata and filled up with PCC (1:4:8).

The net allowable bearing pressure higher than above mentioned values shall not be permitted. At intermediate levels the bearing capacity shall be same as the net allowable bearing pressure corresponding to the immediate shallower level mentioned above.

For open foundations, the total permissible settlement shall be governed by IS: 1904 / IS: 13063 and from functional requirements whichever is more stringent. However, total settlement shall be restricted to the following:

Isolated & Strip	40 mm
Raft	75 mm
Foundations in Weathered rock / rock	12 mm

In case the total permissible settlement is to be restricted to less than as above specified from functional requirements, then the net allowable bearing pressure shall be reduced after review in consultation with Engineer.

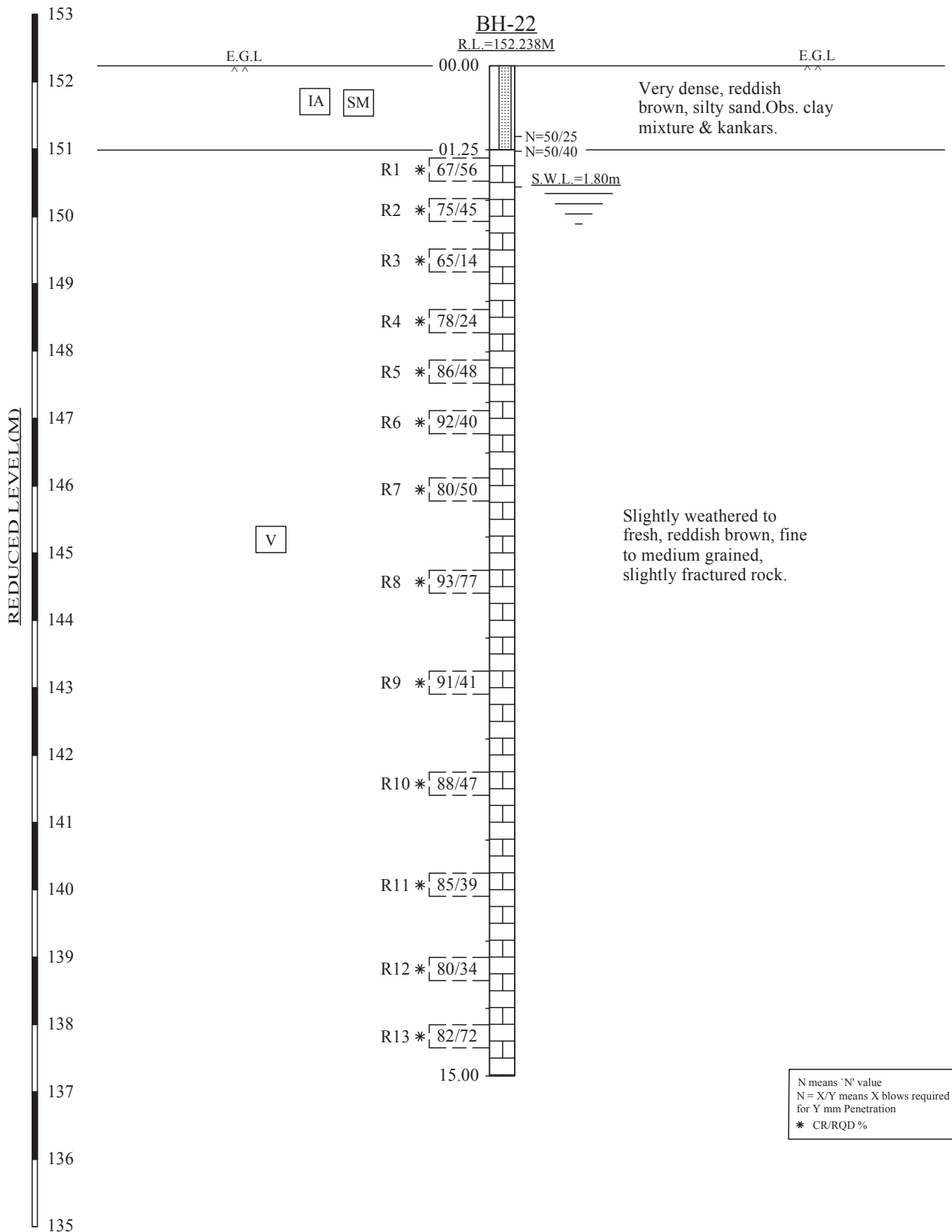


FIG. 2.10 : GENERALISED SOIL PROFILE
(RWPH AREA)

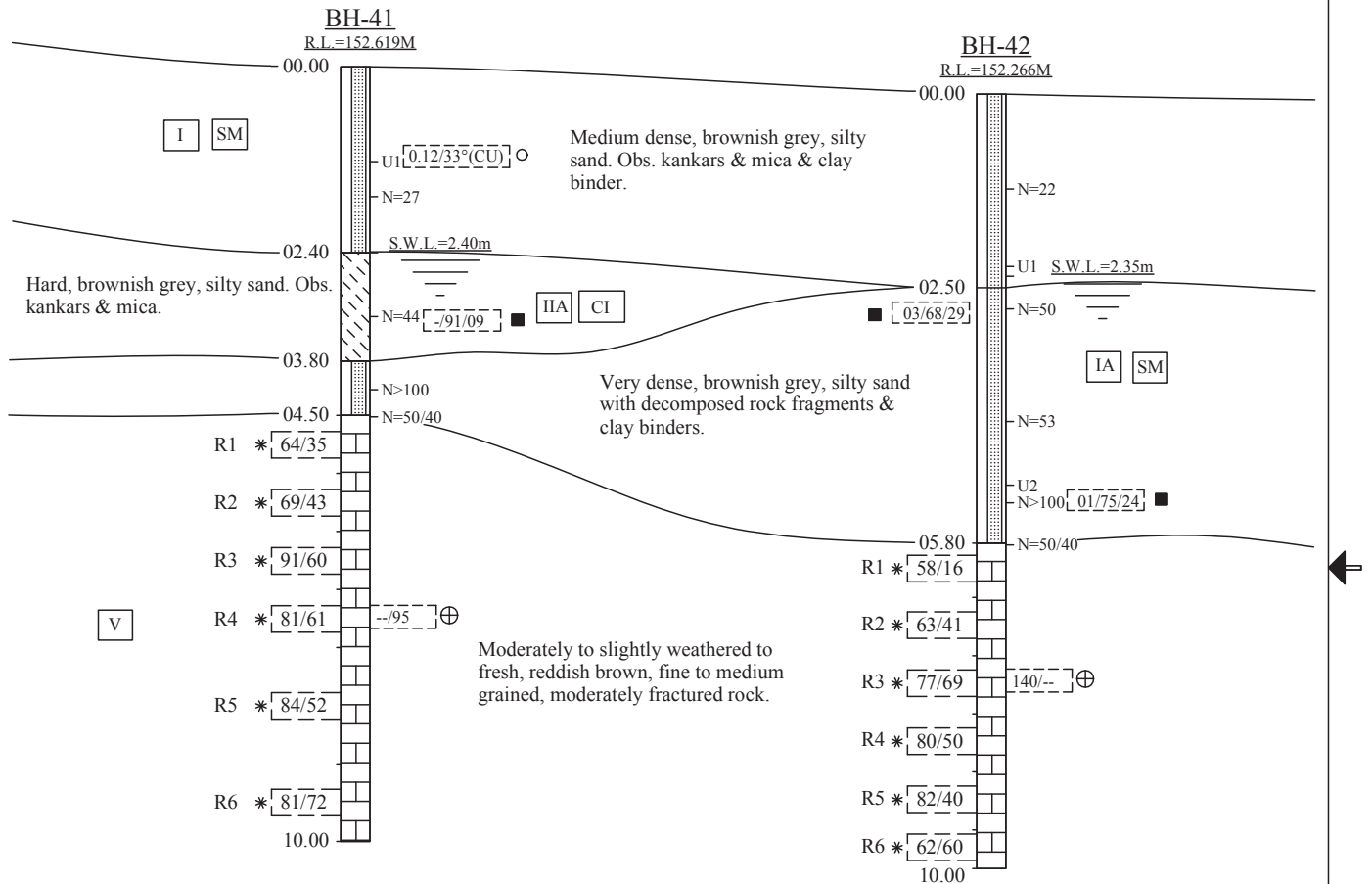


FIG. 2.16 : GENERALISED SOIL PROFILE

(Near Safety Office)

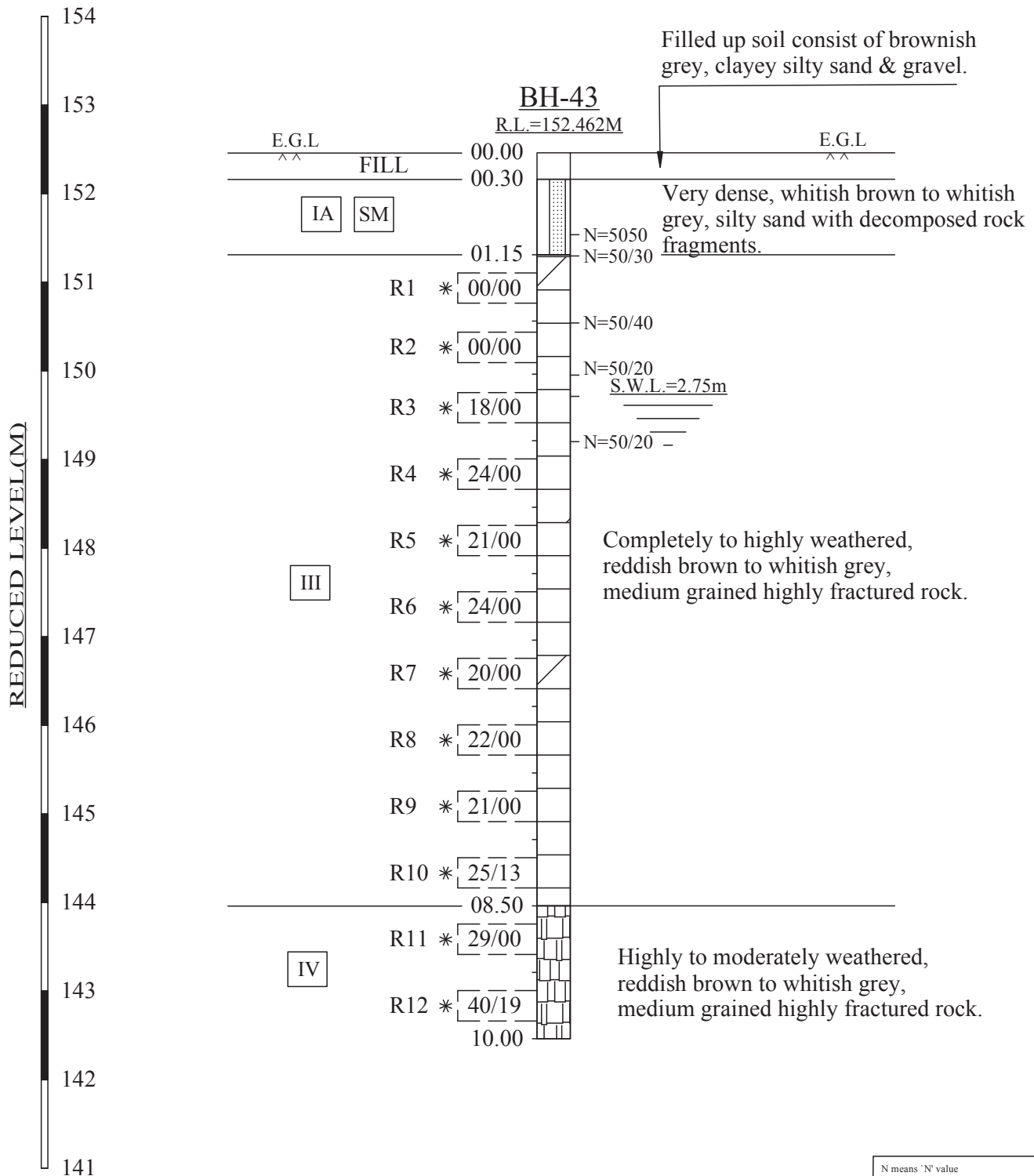


FIG. 2.17 : GENERALISED SOIL PROFILE
(NEAR 33/11 KV SUB STATION.)

Job No : 3931

Created by : T.SAHA

Created on : 25/04/2017

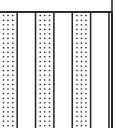
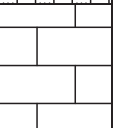
Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.22

Co-ordinates E=1642.000
N=322.000

Field Test	Nos	Samples	Nos	Commencement Date : 07/04/2017
Penetrometer (SPT)	2	Undisturbed (UDS)	0	Completion Date : 08/04/2017
Cone (Pc)		Penetrometer (SPT)	2	Bore Hole Diameter : 150 mm./ N.X
Vane (V)		Disturbed (DS)	1	Level Of Ground : 152.238 M.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 1.80 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN=15CM						Ref. No	Depth (m)
0.00m Very dense, reddish brown, silty sand. Obs. clay mixtured & kankars.								DS-1	0.50
								SPT-1	1.00-1.10
1.25m								*SPT-2	1.25-1.29
								R1	CR=67% RQD=56%
								R2	CR=75% RQD=45%
								R3	CR=65% RQD=14%
								R4	CR=78% RQD=24%
								R5	CR=86% RQD=48%
								R6	CR=92% RQD=40%
								R7	CR=80% RQD=50%
								R8	CR=93% RQD=77%
								R9	CR=91% RQD=41%
								R10	CR=88% RQD=47%
								R11	CR=85% RQD=39%
								R12	CR=80% RQD=34%
								R13	CR=82% RQD=72%
15.00m									

Slightly weathered to fresh, reddish brown, fine to medium grained, slightly fractured rock.

N.B. - '*' means sample could not be recovered.

Job No : 3931

Created by : T.SAHA

Created on : 11/05/2017

Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.41

Co-ordinates E=1585.000
N=675.000

Field Test	Nos	Samples	Nos	Commencement Date : 12/04/2017
Penetrometer (SPT)	4	Undisturbed (UDS)	1	Completion Date : 13/04/2017
Cone (Pc)		Penetrometer (SPT)	4	Bore Hole Diameter : 150 mm./ N.X
Vane (V)		Disturbed (DS)	2	Level Of Ground : 152.619 M.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 2.40 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN=15CM						Ref. No	Depth (m)
0.00m									
Medium dense, brownish grey, silty sand. Obs. kankars & mica.								DS-1	0.50
								UDS-1	1.00-1.45
								SPT-1	1.45-1.90
2.40m								DS-2	2.40
Hard, brownish grey, silty clay with sand mixture. Obs. mica								SPT-2	3.00-3.45
3.80m								SPT-3	4.00-4.34
Very dense, brownish grey, silty sand. Obs. kankars & mica.								*SPT-4	4.50-4.54
4.50m								R1	4.50
								R2	5.25
								R3	6.00
								R4	6.75
								R5	7.50
								R6	9.00
									10.00
10.00m									

N.B. - '*' means sample could not be recovered.

Job No : 3931

Created by : T.SAHA

Created on : 25/04/2017

Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.42

Co-ordinates E=1620.000
N=610.000

Field Test	Nos	Samples	Nos	Commencement Date : 11/04/2017
Penetrometer (SPT)	5	Undisturbed (UDS)	2	Completion Date : 12/04/2017
Cone (Pc)		Penetrometer (SPT)	5	Bore Hole Diameter : 150 mm./ N.X
Vane (V)		Disturbed (DS)	2	Level Of Ground : 152.266 M.
		Water Sample (WS)	0	Water Struck At : Standing Water Level : 2.35 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN=15CM						Ref. No	Depth (m)
0.00m								DS-1	0.50
Medium dense, brownish grey, silty sand. Obs. gravel & clay binders.		7	9	13	22			SPT-1	1.00-1.45
2.50m		12	19	31	50			UDS-1	2.00-2.45
Very dense, brownish grey, silty sand with decomposed rock fragments. Obs. clay binder.								SPT-2	2.55-3.00
4.00m		13	18	35	53			DS-2	3.50
Very dense, brownish grey, silty sand. Obs. kankars, clay binder & mica.		20	35	50	>100			SPT-3	4.00-4.45
5.80m		50						*UDS-2	5.00-5.10
								SPT-4	5.10-5.45
								*SPT-5	5.80-5.84
								R1	5.80-6.50
								R2	6.50-7.25
								R3	7.25-8.00
								R4	8.00-8.75
								R5	8.75-9.50
								R6	9.50-10.00
10.00m									

N.B. - '*' means sample could not be recovered.

Job No : 3931

Created by : T.SAHA

Created on : 18/05/2017


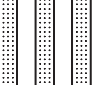
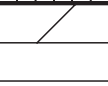
Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.43

Co-ordinates E=1615.000
N=418.000

Field Test	Nos	Samples	Nos	Commencement Date : 04/05/2017
Penetrometer (SPT)	5	Undisturbed (UDS)	0	Completion Date : 05/05/2017
Cone (Pc)		Penetrometer (SPT)	5	Bore Hole Diameter : 150 mm./ N.X
Vane (V)		Disturbed (DS)	1	Level Of Ground : 152.462 M.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 2.75 m.

DESCRIPTION	SYMBOL	N-VALUE				SAMPLES	
		EACH DIVN=15CM				Ref. No	Depth (m)
Filled up soil consist of brownish grey, clayey silty sand & gravel.						DS-1	0.50
Very dense, whitish brown to whitish grey, silty with decomposed rock fragments.						*SPT-1	0.90-0.95
						*SPT-2	1.15-1.18
						R1	CR=NIL RQD=NIL
Completely weathered, reddish brown, medium grained, decomposed & disintegrated rock partical collected as sludge.						*SPT-3	1.90-1.94
						R2	CR=NIL RQD=NIL
						*SPT-4	2.50-2.52
						R3	CR=18% RQD=NIL
						*SPT-5	3.25-3.27
						R4	CR=24% RQD=NIL
							4.00
						R5	CR=21% RQD=NIL
							4.75
						R6	CR=24% RQD=NIL
							5.50
						R7	CR=20% RQD=NIL
							6.25
						R8	CR=22% RQD=NIL
							7.00
						R9	CR=21% RQD=NIL
							7.75
						R10	CR=25% RQD=13%
							8.50
						R11	CR=29% RQD=NIL
							9.25
						R12	CR=40% RQD=19%
							10.00

N.B. - '*' means sample could not be recovered.

Test Locations	Depth of Test (M)	Permeability (cm/sec)
BH-87	0.80 – 1.50	7.716×10^{-7}
	4.80 – 6.50	3.361×10^{-6}
	9.80 – 11.50	5.331×10^{-6}
	13.50 – 15.20	6.117×10^{-6}
	18.30 – 20.00	7.167×10^{-6}
BH-89	0.70 – 1.30	6.817×10^{-7}
	2.70 – 3.20	1.236×10^{-6}
	4.80 – 6.50	9.484×10^{-6}
	7.70 – 9.40	4.571×10^{-6}
	11.50 – 13.20	6.839×10^{-6}
BH-91	0.80 – 1.50	1.265×10^{-6}
	2.80 – 4.50	5.137×10^{-7}
	4.80 – 6.50	5.138×10^{-7}
	7.80 – 9.50	6.306×10^{-7}
	11.80 – 13.50	5.159×10^{-7}
BH-97	0.70 – 1.40	9.136×10^{-7}
	2.80 – 4.50	5.452×10^{-7}
	4.80 – 6.50	5.335×10^{-7}
	7.80 – 9.50	5.574×10^{-7}
	11.80 – 13.50	5.476×10^{-7}
BH-102	0.80 – 2.50	1.962×10^{-6}
	2.80 – 4.50	1.015×10^{-6}
	4.80 – 6.50	6.176×10^{-7}
	7.80 – 9.50	5.104×10^{-7}
	11.80 – 13.50	5.939×10^{-7}

5.7. CHEMICAL TESTS:

Chemical tests were performed on few soil samples for determining the pH value, Sulphate, Chloride content etc. The results are given in a tabular form below:

CHEMICAL TEST RESULTS ON SOIL SAMPLES:-

BH/Sample No.	Depth (m)	pH value	Sulphate as SO ₃ (%)	Chloride as Cl (%)	Carbonate as Co ₃ (%)	Organic Matter (%)
09 / DS-01	0.50	9.23	BDL*	0.011	3.90	0.1260
11 / UDS-01	1.00	8.21	BDL*	0.010	4.84	2.4233
12 / DS-01	0.50	8.50	BDL*	0.012	3.00	0.3168
16 / DS-01	0.50	9.52	BDL*	0.012	2.70	0.2518
21 / UDS-01	1.00	8.36	BDL*	0.009	12.79	0.1879
27 / UDS-01	1.00	7.90	BDL*	0.014	2.69	0.4992
28 / UDS-01	1.00	6.94	BDL*	0.009	2.39	0.6024
29 / UDS-01	2.00	7.76	BDL*	0.008	3.31	0.8674
31 / UDS-01	2.00	8.51	BDL*	0.012	3.00	0.2477
10 / UDS-01	1.20	8.22	BDL*	0.009	4.53	1.6978
52 / DS-01	0.50	8.94	BDL*	0.008	4.50	0.1425
55 / DS-01	0.50	8.83	BDL*	0.009	3.60	0.1966

BH/Sample No.	Depth (m)	pH value	Sulphate as SO ₃ (%)	Chloride as Cl (%)	Carbonate as Co ₃ (%)	Organic Matter (%)
56 / DS-02	2.00	8.63	BDL*	0.009	2.40	0.1572
69 / DS-02	2.00	8.60	BDL*	0.007	9.00	0.1097
70 / DS-01	0.50	8.32	BDL*	0.006	1.66	0.1471
71 / DS-02	2.00	8.70	BDL*	0.008	2.88	0.0789
72 / DS-03	2.20	8.86	BDL*	0.008	3.79	0.0973
74 / SPT-02	2.20	8.37	BDL*	0.007	3.22	0.1215
75 / DS-02	1.00	8.86	BDL*	0.006	4.75	0.1306
82 / DS-02	1.80	8.66	BDL*	0.006	9.31	0.0951
85 / DS-02	2.00	8.81	BDL*	0.007	2.57	0.1003
86 / SPT-02	2.00	8.96	BDL*	0.007	2.30	0.0850
87 / SPT-02	2.50	8.83	BDL*	0.006	1.35	0.1064
88 / SPT-03	3.00	8.78	BDL*	0.008	1.34	0.0851
89 / DS-01	0.50	8.82	BDL*	0.007	1.69	0.0426

BDL = Below Detection Limit (<0.05%)

CHEMICAL TEST RESULTS ON WATER SAMPLE:-

BH/Sample No.	Depth (m)	pH value	Sulphate as SO ₄ (mg/ltr)	Chloride as Cl (mg/ltr)	Organic Matter (mg/ltr)
01 / WS-01	3.50	5.14	480	72	16.62
13 / WS-01	1.65	5.62	480	58	13.85
28 / WS-01	2.80	4.86	540	82	11.08
33 / WS-01	3.70	5.05	540	83	13.85
35 / WS-01	3.10	5.05	540	76	16.62
38 / WS-01	3.60	5.18	540	75	13.85
93 / WS-01	2.70	4.95	540	79	16.62
100 / WS-01	2.30	4.88	540	80	11.08
Permissible Limit		>6	400	500	--

It is seen that the pH values are low and hence concrete should be densely compacted i.e. use of higher grade of concrete is recommended. Chloride content is well below permissible limit. Considering Sulphate concentration, **either Ordinary Portland cement or Portland slag cement or Portland pozzolana cement can be used for the purpose. Also Supersulphated cement or sulphate resisting Portland cement can also be used.**

5.8. STANDARD PROCTOR COMPACTION & CBR TEST:

Standard Proctor Compaction tests were carried out in the laboratory to determine the Optimum Moisture Content (OMC) and Maximum Dry Density (MDD). Thereafter, CBR (4 days soaked) tests were carried out on the samples prepared at MDD. The test results are presented below and the graphs are presented in Volume 2.

It may also please be noted that in the present investigation we have measured only the apparent resistivity which may be taken as a first approximation to the weighted average of the true resistivity of the subsurface stratum in which the current lines flow.

The area of investigation rests on Godavari River Basin - mainly comprised of Gondwana Group of rocks consisting of red clays and sand stones of Maleri group of rocks and Barren Measures of greenish to grey-white medium to coarse grained sand stone with variegated clays are present in the sequence of lithology of the area. This is typical Godavari Valley Coalfield area of Godavari River Basin.

ERT 01 & 02 rests on slag area, ERT 03 is on steel dump area, ERT 05 to 12 are in the switch yard area where overburden is removed. Around locations of ERT 14 to 21 are the filling area and the filling is of thickness 2 mts approximately. Around ERT 25 & 27 the top soil is very hard.

In the present scenario the ERT curves indicate a nature of A, & Q types. Due to clay and carbonaceous rocks the order of resistivity goes down sharply from higher to lower one with the increase of depth within 6/7 mtrs after that the same increases with further increase of depth. And at places it increases with the increase of depth where there is presence of highly weathered sand stone within the limit of our observation.

The apparent resistivity (as per Polar Diagram) of soil is presented below.

Sl. No.	ERT Location	Coordinate & RL	Apparent Resistivity from Polar Diagram Ohm - m
1.	ERT- 01	E :- 2084.000, N :- 733.000, R.L. :- 153.412 M	4.21
2.	ERT- 02	E :- 2180.000, N :- 708.000, R.L. :- 154.532 M	4.70
3.	ERT- 03	E :- 2188.000, N :- 505.000, R.L. :- 153.692M	18.97
4.	ERT- 04	E :- 2088.000, N :- 428.000, R.L. :- 153.952M	17.71
5.	ERT- 05	E :- 3192.000, N :- 958.000, R.L. :- 146.782 M	12.97
6.	ERT- 06	E :- 3278.000, N :- 985.000, R.L. :- 146.836 M	8.63
7.	ERT- 07	E :- 3370.000, N :- 1025.000, R.L. :- 146.952 M	9.12
8.	ERT- 08	E :- 3205.000, N :- 880.000, R.L. :- 147.052 M	19.51
9.	ERT- 29	E :- 3325.000, N :- 920.000, R.L. :- 146.952 M	11.05
10.	ERT- 10	E :- 3232.000, N :- 827.000, R.L. :- 147.213 M	13.36
11.	ERT- 11	E :- 3303.000, N :- 853.000, R.L. :- 147.112 M	6.04
12.	ERT- 12	E :- 3388.000, N :- 880.000, R.L. :- 146.967 M	5.55
13.	ERT- 13	E :- 1657.000, N :- 320.000, R.L. :- 151.995M	22.99

Sl. No.	ERT Location	Coordinate & RL	Apparent Resistivity from Polar Diagram Ohm - m
14.	ERT- 14	E :- 2958.000, N :- 1018.000, R.L. :- 148.352 M	13.22
15.	ERT- 15	E :- 2975.000, N :- 976.000, R.L. :- 148.312 M	15.98
16.	ERT- 16	E :- 2932.000, N :- 957.000, R.L. :- 148.292 M	7.42
17.	ERT- 17	E :- 2967.000, N :- 932.000, R.L. :- 148.304 M	12.81
18.	ERT- 18	E :- 2958.000, N :- 860.000, R.L. :- 148.326 M	7.68
19.	ERT- 19	E :- 2975.000, N :- 822.000, R.L. :- 148.300 M	9.53
20.	ERT- 20	E :- 2932000, N :- 804.000, R.L. :- 148.325 M	11.00
21.	ERT- 21	E :- 2971.000, N :- 785.000, R.L. :- 148.309 M	6.67
22.	ERT- 22	E :- 1880.000, N :- 1080.000, R.L. :- 150.452 M	13.56
23.	ERT- 23	E :- 1430.000, N :- 700.000, R.L. :- 152.519 M	15.11
24.	ERT- 24	E :- 3088.000, N :- 366.000, R.L. :- 152.972 M	15.88
25.	ERT- 25	E :- 2835.000, S :- 247.000, R.L. :- 156.932.M	95.59
26.	ERT- 26	E :- 3890.000, S :- 70.000, R.L. :- 151.092 M	9.83
27.	ERT- 27	E :- 4668.000, S :- 68.000, R.L. :- 161.812 M	52.26
28.	ERT- 28	E :- 4541.000, S :- 2900.000, R.L. :- 165.952 M	16.54
29.	ERT- 29	E :- 4454.419, S :- 2895.875, R.L. :- 166.362 M	17.41
30.	ERT- 30	E :- 4399.516, S :- 2959.812, R.L. :- 166.132 M	19.33