

PROJECT	SUBJECT	DOCUMENT NO.	REV.	SECTION
NLC India Limited NLC Talabira Thermal Power Project- 3x800 MW Jharsuguda, Odisha	Geotechnical Investigation Report Part-6	PE-DC-511-602-C001E	1	
				SHEET NO.
				1



**NLC India Limited
NLC Talabira Thermal
Power Project- 3x800 MW
Jharsuguda, Odisha**

**GEOTECHNICAL INVESTIGATION REPORT
PART-6 FIELD TEST RESULTS**

BHEL DOCUMENT NO. PE-DC-511-602-C001E
(REVISION R1)



**BHARAT HEAVY ELECTRICALS LIMITED
NEW DELHI**

Geotechnical Investigation Report of 3x800 MW NLC Talabira TPS has been divided in following parts as detailed below:

S. No.	Description	Area covered
1	Part-1	BTG area (Transformer yard to Chimney including FGD)
2	Part-2A & 2B	Compound wall
3	Part-3	Thermal project office building, Main gate complex, security & time office, gates, parking lots, rain water collection ponds & rain water pump houses (outside plant boundary)
4	Part-4	BOP area (Switchyard, PT Plant, ETP, STP, WTP, IDCT, CW system, Raw water system, Chlorination system, Miscellaneous. Buildings, Raw water reservoir etc.)
5	Part-5	CHP & AHP area
6	Part-6	Field test results of all areas (DCPT, SCPT, SRT, Pressure meter test, Cross hole shear test, PLT, CPLT, BVT, Pump in & pump out type field permeability etc.)

This is Geotechnical Investigation Report, Part-6



**3 X 800 MW NLC Talabira Thermal Power Project
EPC Package**



COMMENT RESOLUTION SHEET

DOC TITLE		GEO TECH INVESTIGATION REPORT, PART-6 (FIELD TEST RESULTS)	
BHEL DOC NO.		PE-DC-511-602-C001E	
BHEL UNIT			
Sl. No.	Page No. / Clause No. / Sheet No.	NLCIL/DCPL Comments: (Rev No. 00)	BHEL reply
		Date: 14.06.2025	Date: 19.07.2025
		Approval Category : 3	
1	PE-DC-511-602-C001E,Electrical resistivity Test	Spacing of electrode carried out till 10Mtr , this need to be measured till 20Mtr spacing,BHEL to clarify	Generally depth of earthing electrodes are 3 to 5 m below ground level. Spacing of electrodes is related to depth. Hence, spacing of electrodes are 1 to 10 m to cover the depth up to 10 m.Spacing of electrodes beyond 10 m is technically not required and hence not carried out at site.
2	PE-DC-511-602-C001E,Electrical resistivity Test	Wherever average resistivity is differed higher side eg(ERT-5, 791 ohm- m to 75 ohm-m) reason for deviation shall be detailed	Incorporated in the revised report.
3	PE-DC-511-602-C001E,Electrical resistivity Test	Recommendation for soil resistivity to be included	Incorporated in the revised report.
4	PE-DC-511-602-C001E,Electrical resistivity Test	Date of Electrical resistivity Test shall be confirmed ,eg ERT -13 is mentioned as 23.06.2024	Confirmed and it is correct.
5	PE-DC-511-602-C001E	In page 52, in table under para 3.2 - recommendations for plate load test, column title " RL at test level (m)" shall be checked and corrected as " RL at existing ground level (m)".	Checked and corrected in the revised report.
6	PE-DC-511-602-C001E	Reduced level at which plate load test is conducted as indicated in pages 53 to 58 shall be brought as a separate column in Recommendations table in page 52 (Ex.: 198.54-4=194.54m for IPLT-3).	Incorporated in the revised report.
7	PE-DC-511-602-C001E	Typo error " packing shed" shall be corrected as " Parking shed" in location corresponding to test no IPLT-03 in page 52 and page 56.	Corrected in the revised report.
8	PE-DC-511-602-C001E	At PLT-04, suggested SBC is noted to be 6.80 T/sqm. M/s BHEL shall review compound wall foundation shown in PE-DG-511-606-C002 for the zone " Open foundation - Case III" where SBC is considered as 10 T/sqm.	Location and SBC recommendations checked and corrected in the revised report.
9	PE-DC-511-602-C001E	For PLT-04 in page 58, details of yield point shall be marked in first chart, settlement vs load intensity.	Incorporated in the revised report.
10	PE-DC-511-602-C001E	Remaining field tests records shall be included in the report after completion.	Incorporated in the revised report.
11	PE-DC-511-602-C001E	BHEL shall include comparison of SBC recommendations based on field tests and SBC recommendations based on Borehole data as per other volumes. Accordingly, SBC recommendations for open foundations in other volumes shall be corrected to minimum value as applicable.	Noted.

Bharat Heavy Electricals Limited (B H E L)

**Technical Report of Geotechnical Investigation – Field tests
in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power
Project (NTTPP) at village
Hirma, Talabira, Odisha**

Part 6

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1. Static Cone Penetration Test (SCPT):

1.1 Methodology:

Ten number of the Static Cone Penetration Test (SCPT) was conducted to determine soil stratification and estimate the physical and engineering properties of the soil. During the test, the cone penetrometer was advanced into the ground by steady pushing, and the static force required for each unit of penetration was measured. The test was performed using equipment with a 200 kN capacity, in accordance with standard procedures. The SCPT was carried out at locations specified in the approved plot plan and/or at additional locations directed by the Engineer-in-Charge.

A Cone, with an Apex angle of 60° and with end area of 10cm², for obtaining the resistance the cone is pushed downward at steady rate of 10mm per second by applying thrust by hydraulic jack. The sleeve is pushed onto the cone and both are driven to gather into the soil and the combined resistance is also determined. The resistance of sleeve alone is obtained by subtracting the cone resistance from the combined resistance. Thus Cone and frictional resistance of the soil are determined. To use the data of Cone penetration test effectively, some reliable calibration is required like comparing the result with those obtained from conventional tests conducted on UDS or by comparing it with SPT results. The data were used to determine the Safe bearing capacity using provision of IS 6403.

1.2 Recommendations:

1. SCPT test were conducted till refusal depth. The relationship between the cone penetration resistance and N value is summarized as below.

Sr No.	For Depth (m)	Cone resistance (kN/m ²)
1	0.0-3.0	800N
2	3.0-6.0	1500N
3	Above 6.0	2000N

Note: For determination of above correlations the nearest borehole to each of the SCPT locations were considered.

Static Cone Penetration Test No. 1

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

R.L : 205.44m

Co-ordinates : E-1447 N-3354

Date : 08-12-2024

Correction : A	
1) Mass of Cone (m)	1.38 kg
2) Mass of each Sounding Rod (m 1)	1.35 kg
3) Cone area at base (b)	10.00 cm ²
4) Plunger Area (b')	20.00 cm ²
5) Correction factor to be added to gauge reading (m + n m 1)/10	
6) No. of rods used (n)	

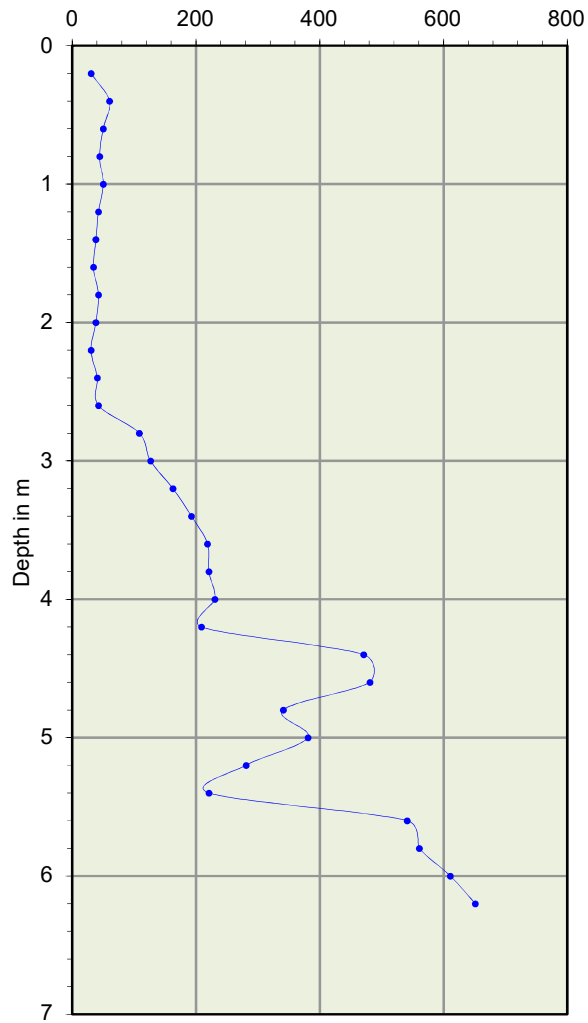
Correction : B	
1) Mass of Friction Jacket (mf)	0.70 kg
2) Outer Dia, of Friction Jacket (d)	3.6 cm
3) Length of Friction Jacket (h)	10 cm
4) Surface area of friction jacket (a)	113.09 cm ²
5) Correction factor to be added to gauge reading (mf / a)	

Depth	Number of rods in use	Gauge reading of Cone Penetration	Cone Penetration Resistance	Correction Factor	Corrected Value of Cone Resistance	Gauge Reading of Cone + Jacket Resistance	Cone + Jacket Resistance	Total Resistance - Cone Resistance	Frictional Resistance	Corrected Frictional Resistance
m		(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)
0.2	1	15.00	30.00	0.27	30.27	21.00	42.00	12.00	1.06	1.07
0.4	1	30.00	60.00	0.27	60.27	36.00	72.00	12.00	1.06	1.07
0.6	1	25.00	50.00	0.27	50.27	30.00	60.00	10.00	0.88	0.89
0.8	1	22.00	44.00	0.27	44.27	25.00	50.00	6.00	0.53	0.54
1.0	1	25.00	50.00	0.27	50.27	30.00	60.00	10.00	0.88	0.89
1.2	2	21.00	42.00	0.41	42.41	23.00	46.00	4.00	0.35	0.36
1.4	2	19.00	38.00	0.41	38.41	27.00	54.00	16.00	1.41	1.42
1.6	2	17.00	34.00	0.41	34.41	19.00	38.00	4.00	0.35	0.36
1.8	2	21.00	42.00	0.41	42.41	22.00	44.00	2.00	0.18	0.18
2.0	2	19.00	38.00	0.41	38.41	27.00	54.00	16.00	1.41	1.42
2.2	3	15.00	30.00	0.54	30.54	21.00	42.00	12.00	1.06	1.07
2.4	3	20.00	40.00	0.54	40.54	22.00	44.00	4.00	0.35	0.36

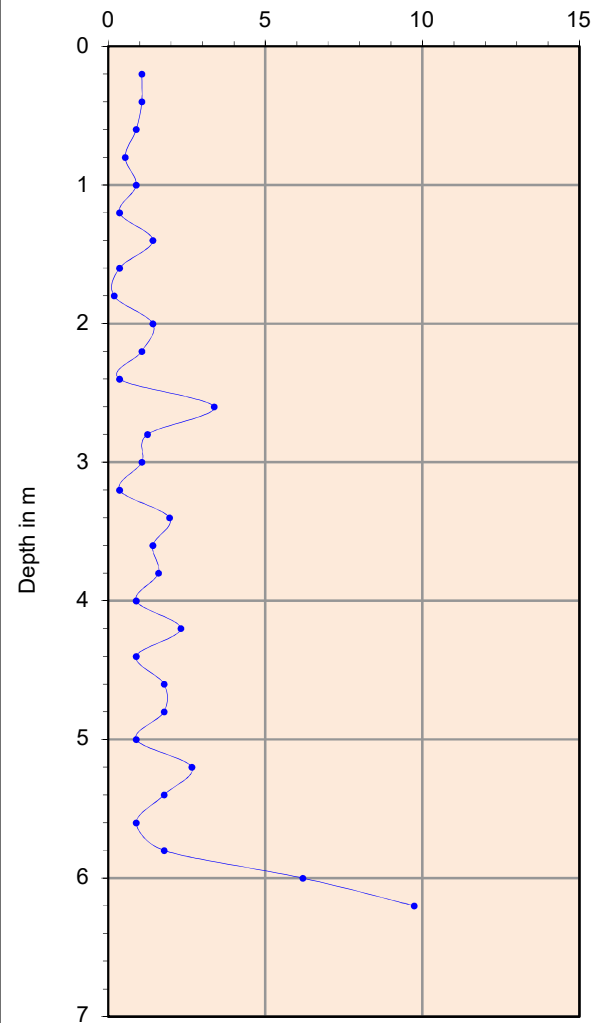
Depth	Number of rods in use	Gauge reading of Cone Penetration	Cone Penetration Resistance	Correction Factor	Corrected Value of Cone Resistance	Gauge Reading of Cone + Jacket Resistance	Cone + Jacket Resistance	Total Resistance - Cone Resistance	Frictional Resistance	Corrected Frictional Resistance
m		(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)
2.6	3	21.00	42.00	0.54	42.54	40.00	80.00	38.00	3.36	3.37
2.8	3	54.00	108.00	0.54	108.54	61.00	122.00	14.00	1.24	1.24
3.0	3	63.00	126.00	0.54	126.54	69.00	138.00	12.00	1.06	1.07
3.2	4	81.00	162.00	0.68	162.68	83.00	166.00	4.00	0.35	0.36
3.4	4	96.00	192.00	0.68	192.68	107.00	214.00	22.00	1.95	1.95
3.6	4	109.00	218.00	0.68	218.68	117.00	234.00	16.00	1.41	1.42
3.8	4	110.00	220.00	0.68	220.68	119.00	238.00	18.00	1.59	1.60
4.0	4	115.00	230.00	0.68	230.68	120.00	240.00	10.00	0.88	0.89
4.2	5	104.00	208.00	0.81	208.81	117.00	234.00	26.00	2.30	2.31
4.4	5	235.00	470.00	0.81	470.81	240.00	480.00	10.00	0.88	0.89
4.6	5	240.00	480.00	0.81	480.81	250.00	500.00	20.00	1.77	1.77
4.8	5	170.00	340.00	0.81	340.81	180.00	360.00	20.00	1.77	1.77
5.0	5	190.00	380.00	0.81	380.81	195.00	390.00	10.00	0.88	0.89
5.2	6	140.00	280.00	0.95	280.95	155.00	310.00	30.00	2.65	2.66
5.4	6	110.00	220.00	0.95	220.95	120.00	240.00	20.00	1.77	1.77
5.6	6	270.00	540.00	0.95	540.95	275.00	550.00	10.00	0.88	0.89
5.8	6	280.00	560.00	0.95	560.95	290.00	580.00	20.00	1.77	1.77
6.0	6	305.00	610.00	0.95	610.95	340.00	680.00	70.00	6.19	6.20
6.2	7	325.00	650.00	1.08	651.08	380.00	760.00	110.00	9.73	9.73

Static Cone Penetration Test No. 1

Cone Resistance

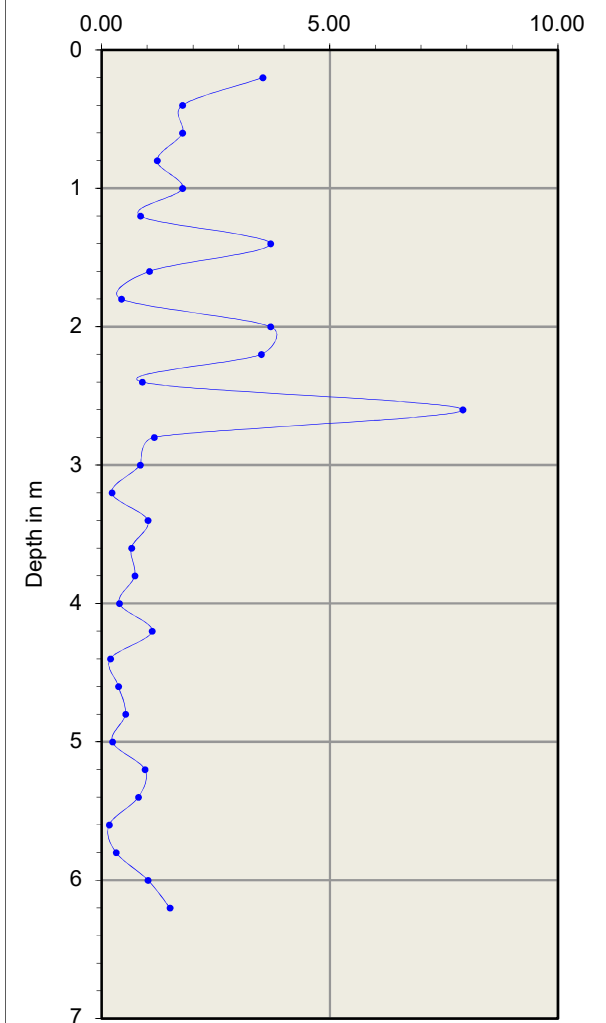
qc in kg / cm²

Frictional Resistance

fc in kg / cm²

Frictional Ratio

fr in %



Static Cone Penetration Test No. 2

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

R.L : 206.59m

Co-ordinates : E-1665 N-3109

Date : 27-07-2024

Correction : A	
1) Mass of Cone (m)	1.38 kg
2) Mass of each Sounding Rod (m 1)	1.35 kg
3) Cone area at base (b)	10.00 cm ²
4) Plunger Area (b')	20.00 cm ²
5) Correction factor to be added to gauge reading (m + n m 1)/10	
6) No. of rods used (n)	

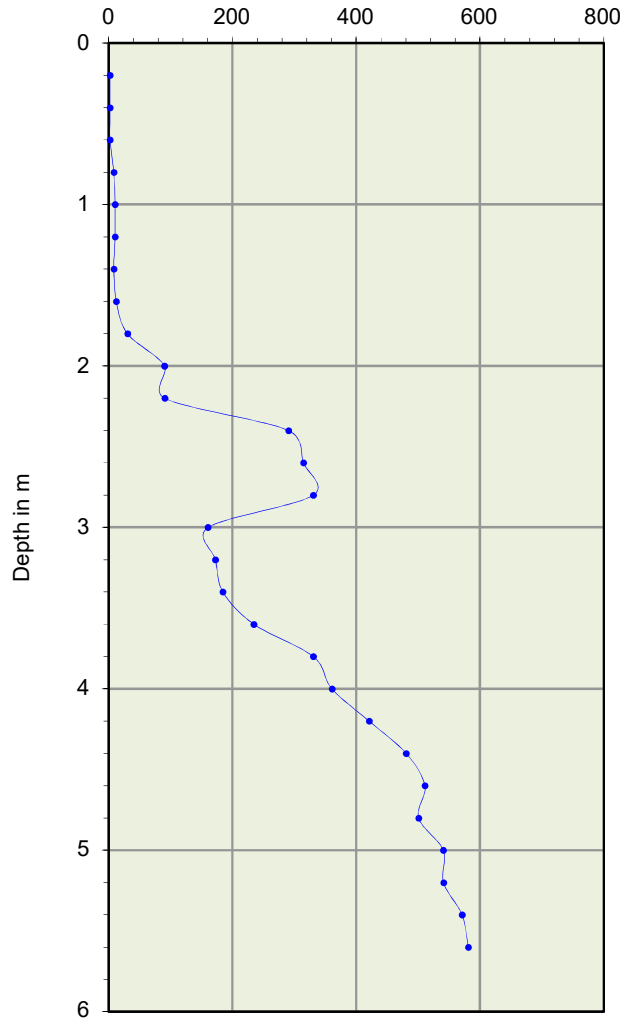
Correction : B	
1) Mass of Friction Jacket (mf)	0.70 kg
2) Outer Dia, of Friction Jacket (d)	3.6 cm
3) Length of Friction Jacket (h)	10 cm
4) Surface area of friction jacket (a)	113.09 cm ²
5) Correction factor to be added to gauge reading (mf / a)	

Depth	Number of rods in use	Gauge reading of Cone Penetration	Cone Penetration Resistance	Correction Factor	Corrected Value of Cone Resistance	Gauge Reading of Cone + Jacket Resistance	Cone + Jacket Resistance	Total Resistance - Cone Resistance	Frictional Resistance	Corrected Frictional Resistance
m		(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)
0.2	1	1.00	2.00	0.27	2.27	1.00	2.00	0.00	0.00	0.01
0.4	1	1.00	2.00	0.27	2.27	1.00	2.00	0.00	0.00	0.01
0.6	1	1.00	2.00	0.27	2.27	2.00	4.00	2.00	0.18	0.18
0.8	1	4.00	8.00	0.27	8.27	3.00	8.00	0.00	0.00	0.01
1.0	1	5.00	10.00	0.27	10.27	5.00	10.00	0.00	0.00	0.01
1.2	2	5.00	10.00	0.41	10.41	5.00	10.00	0.00	0.00	0.01
1.4	2	4.00	8.00	0.41	8.41	6.00	12.00	4.00	0.35	0.36
1.6	2	6.00	12.00	0.41	12.41	5.00	12.00	0.00	0.00	0.01
1.8	2	15.00	30.00	0.41	30.41	25.00	50.00	20.00	1.77	1.77
2.0	2	45.00	90.00	0.41	90.41	50.00	100.00	10.00	0.88	0.89
2.2	3	45.00	90.00	0.54	90.54	125.00	250.00	160.00	14.15	14.15
2.4	3	145.00	290.00	0.54	290.54	150.00	300.00	10.00	0.88	0.89

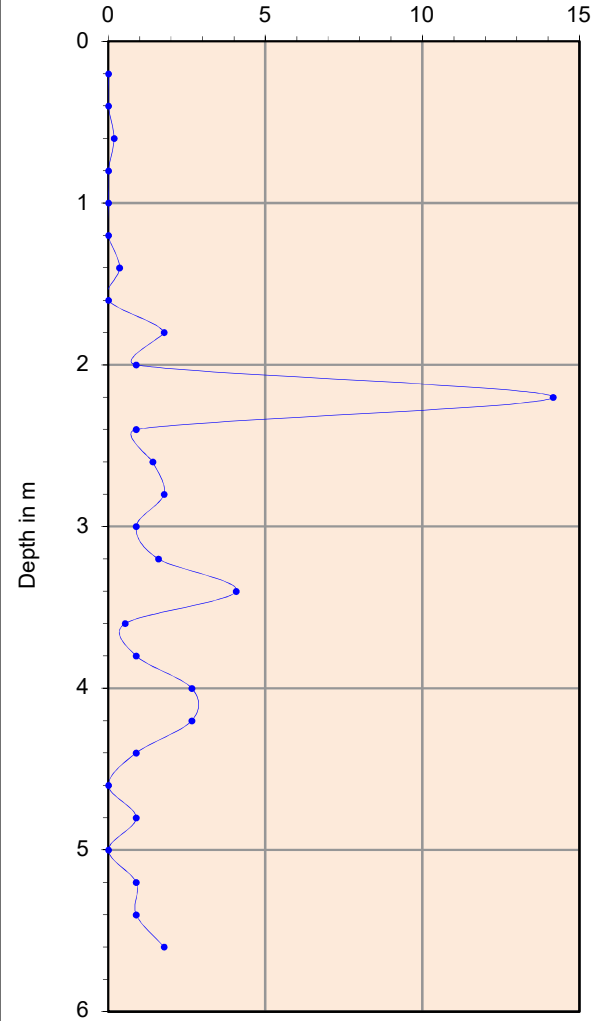
Depth	Number of rods in use	Gauge reading of Cone Penetration	Cone Penetration Resistance	Correction Factor	Corrected Value of Cone Resistance	Gauge Reading of Cone + Jacket Resistance	Cone + Jacket Resistance	Total Resistance - Cone Resistance	Frictional Resistance	Corrected Frictional Resistance
m		(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)
2.6	3	157.00	314.00	0.54	314.54	165.00	330.00	16.00	1.41	1.42
2.8	3	165.00	330.00	0.54	330.54	175.00	350.00	20.00	1.77	1.77
3.0	3	80.00	160.00	0.54	160.54	85.00	170.00	10.00	0.88	0.89
3.2	4	86.00	172.00	0.68	172.68	95.00	190.00	18.00	1.59	1.60
3.4	4	92.00	184.00	0.68	184.68	115.00	230.00	46.00	4.07	4.07
3.6	4	117.00	234.00	0.68	234.68	120.00	240.00	6.00	0.53	0.54
3.8	4	165.00	330.00	0.68	330.68	170.00	340.00	10.00	0.88	0.89
4.0	4	180.00	360.00	0.68	360.68	195.00	390.00	30.00	2.65	2.66
4.2	5	210.00	420.00	0.81	420.81	225.00	450.00	30.00	2.65	2.66
4.4	5	240.00	480.00	0.81	480.81	245.00	490.00	10.00	0.88	0.89
4.6	5	255.00	510.00	0.81	510.81	250.00	510.00	0.00	0.00	0.01
4.8	5	250.00	500.00	0.81	500.81	255.00	510.00	10.00	0.88	0.89
5.0	5	270.00	540.00	0.81	540.81	235.00	540.00	0.00	0.00	0.01
5.2	6	270.00	540.00	0.95	540.95	275.00	550.00	10.00	0.88	0.89
5.4	6	285.00	570.00	0.95	570.95	290.00	580.00	10.00	0.88	0.89
5.6	6	290.00	580.00	0.95	580.95	300.00	600.00	20.00	1.77	1.77

Static Cone Penetration Test No. 2

Cone Resistance

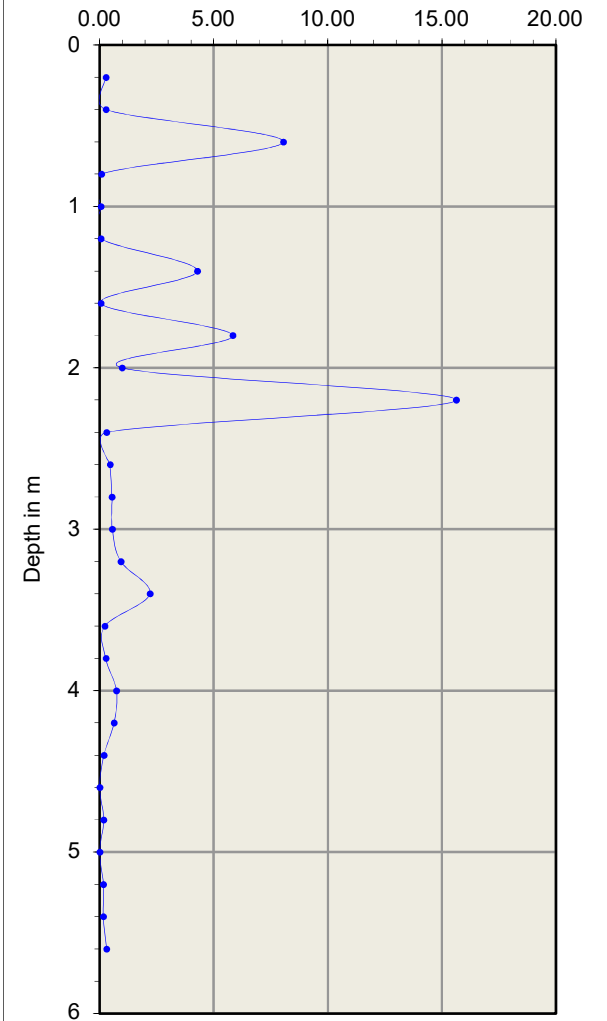
qc in kg / cm²

Frictional Resistance

fc in kg / cm²

Frictional Ratio

fr in %



Static Cone Penetration Test No. 3

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

R.L : 199.55m

Co-ordinates : E-1043 N-3052

Date : 30-07-2024

Correction : A	
1) Mass of Cone (m)	1.38 kg
2) Mass of each Sounding Rod (m 1)	1.35 kg
3) Cone area at base (b)	10.00 cm ²
4) Plunger Area (b')	20.00 cm ²
5) Correction factor to be added to gauge reading (m + n m 1)/10	
6) No. of rods used (n)	

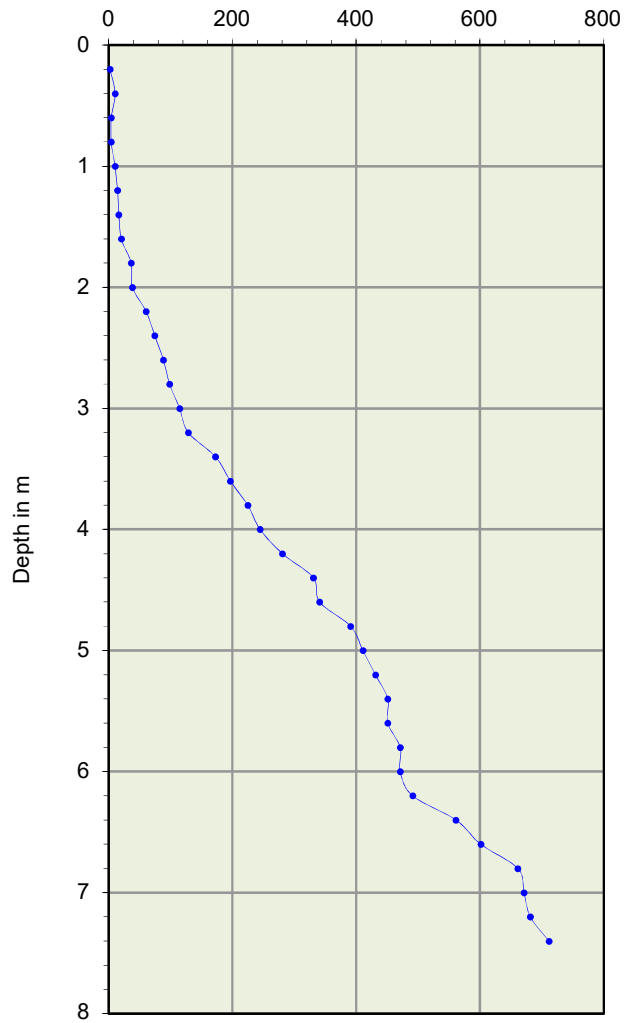
Correction : B	
1) Mass of Friction Jacket (mf)	0.70 kg
2) Outer Dia, of Friction Jacket (d)	3.6 cm
3) Length of Friction Jacket (h)	10 cm
4) Surface area of friction jacket (a)	113.09 cm ²
5) Correction factor to be added to gauge reading (mf / a)	

Depth	Number of rods in use	Gauge reading of Cone Penetration	Cone Penetration Resistance	Correction Factor	Corrected Value of Cone Resistance	Gauge Reading of Cone + Jacket Resistance	Cone + Jacket Resistance	Total Resistance - Cone Resistance	Frictional Resistance	Corrected Frictional Resistance
m		(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)
0.2	1	1.00	2.00	0.27	2.27	3.00	6.00	4.00	0.35	0.36
0.4	1	5.00	10.00	0.27	10.27	3.00	10.00	0.00	0.00	0.01
0.6	1	2.00	4.00	0.27	4.27	1.00	4.00	0.00	0.00	0.01
0.8	1	2.00	4.00	0.27	4.27	3.00	6.00	2.00	0.18	0.18
1.0	1	5.00	10.00	0.27	10.27	5.00	10.00	0.00	0.00	0.01
1.2	2	7.00	14.00	0.41	14.41	10.00	20.00	6.00	0.53	0.54
1.4	2	8.00	16.00	0.41	16.41	9.00	18.00	2.00	0.18	0.18
1.6	2	10.00	20.00	0.41	20.41	12.00	24.00	4.00	0.35	0.36
1.8	2	18.00	36.00	0.41	36.41	23.00	46.00	10.00	0.88	0.89
2.0	2	19.00	38.00	0.41	38.41	20.00	40.00	2.00	0.18	0.18
2.2	3	30.00	60.00	0.54	60.54	35.00	70.00	10.00	0.88	0.89
2.4	3	37.00	74.00	0.54	74.54	38.00	76.00	2.00	0.18	0.18

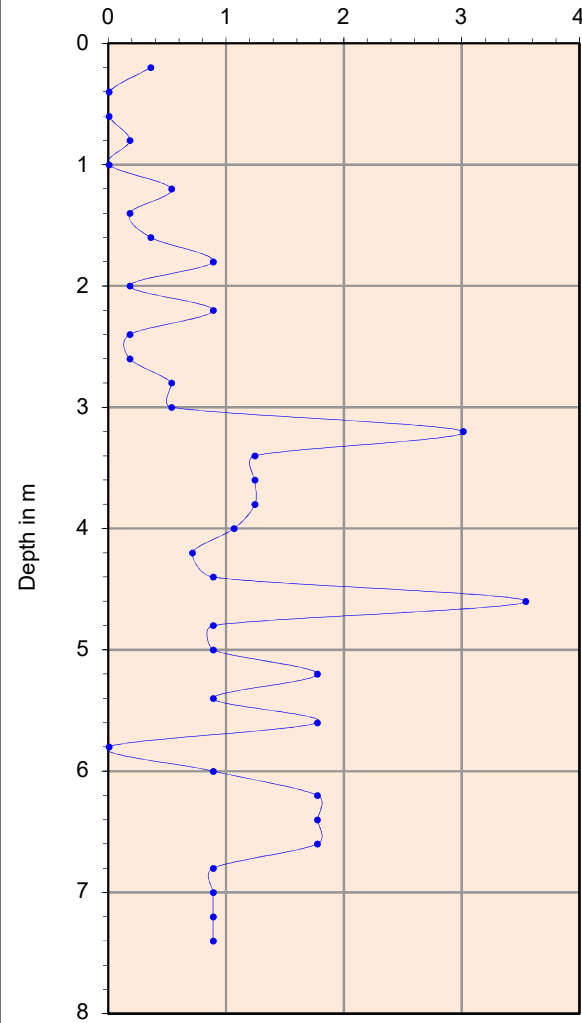
Depth	Number of rods in use	Gauge reading of Cone Penetration	Cone Penetration Resistance	Correction Factor	Corrected Value of Cone Resistance	Gauge Reading of Cone + Jacket Resistance	Cone + Jacket Resistance	Total Resistance - Cone Resistance	Frictional Resistance	Corrected Frictional Resistance
m		(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)
2.6	3	44.00	88.00	0.54	88.54	45.00	90.00	2.00	0.18	0.18
2.8	3	49.00	98.00	0.54	98.54	52.00	104.00	6.00	0.53	0.54
3.0	3	57.00	114.00	0.54	114.54	60.00	120.00	6.00	0.53	0.54
3.2	4	64.00	128.00	0.68	128.68	81.00	162.00	34.00	3.01	3.01
3.4	4	86.00	172.00	0.68	172.68	93.00	186.00	14.00	1.24	1.24
3.6	4	98.00	196.00	0.68	196.68	105.00	210.00	14.00	1.24	1.24
3.8	4	112.00	224.00	0.68	224.68	119.00	238.00	14.00	1.24	1.24
4.0	4	122.00	244.00	0.68	244.68	128.00	256.00	12.00	1.06	1.07
4.2	5	140.00	280.00	0.81	280.81	144.00	288.00	8.00	0.71	0.71
4.4	5	165.00	330.00	0.81	330.81	170.00	340.00	10.00	0.88	0.89
4.6	5	170.00	340.00	0.81	340.81	190.00	380.00	40.00	3.54	3.54
4.8	5	195.00	390.00	0.81	390.81	200.00	400.00	10.00	0.88	0.89
5.0	5	205.00	410.00	0.81	410.81	210.00	420.00	10.00	0.88	0.89
5.2	6	215.00	430.00	0.95	430.95	225.00	450.00	20.00	1.77	1.77
5.4	6	225.00	450.00	0.95	450.95	230.00	460.00	10.00	0.88	0.89
5.6	6	225.00	450.00	0.95	450.95	235.00	470.00	20.00	1.77	1.77
5.8	6	235.00	470.00	0.95	470.95	230.00	470.00	0.00	0.00	0.01
6.0	6	235.00	470.00	0.95	470.95	240.00	480.00	10.00	0.88	0.89
6.2	7	245.00	490.00	1.08	491.08	255.00	510.00	20.00	1.77	1.77
6.4	7	280.00	560.00	1.08	561.08	290.00	580.00	20.00	1.77	1.77
6.6	7	300.00	600.00	1.08	601.08	310.00	620.00	20.00	1.77	1.77
6.8	7	330.00	660.00	1.08	661.08	335.00	670.00	10.00	0.88	0.89
7.0	7	335.00	670.00	1.08	671.08	340.00	680.00	10.00	0.88	0.89
7.2	8	340.00	680.00	1.22	681.22	345.00	690.00	10.00	0.88	0.89
7.4	8	355.00	710.00	1.22	711.22	360.00	720.00	10.00	0.88	0.89

Static Cone Penetration Test No. 3

Cone Resistance

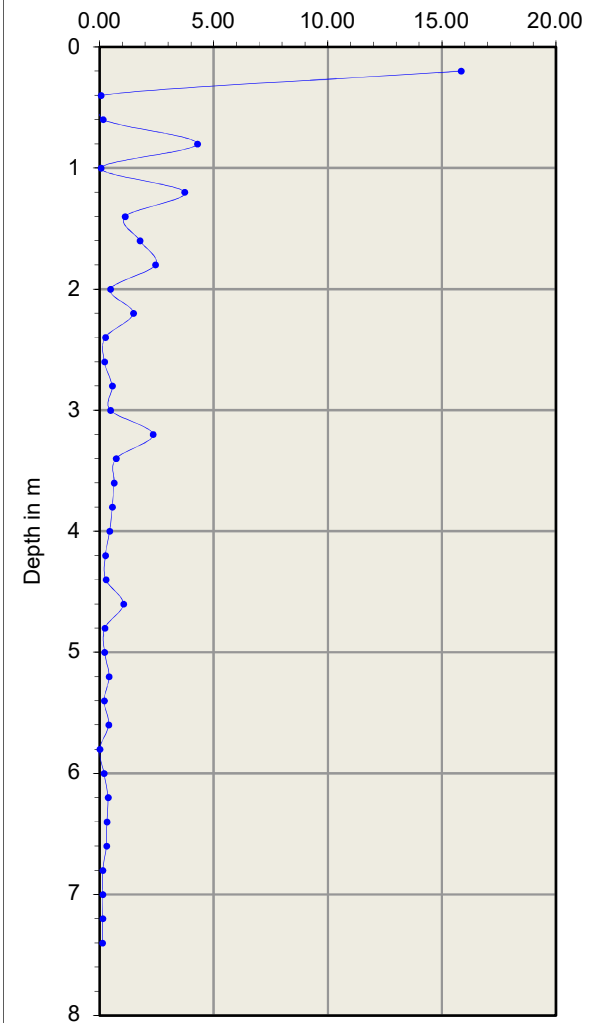
qc in kg / cm²

Frictional Resistance

fc in kg / cm²

Frictional Ratio

fr in %



Static Cone Penetration Test No. 4

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

R.L : 198.87m

Co-ordinates : E 988.83, E 2980.54

Date : 31-07-2024

Correction : A	
1) Mass of Cone (m)	1.38 kg
2) Mass of each Sounding Rod (m 1)	1.35 kg
3) Cone area at base (b)	10.00 cm ²
4) Plunger Area (b')	20.00 cm ²
5) Correction factor to be added to gauge reading (m + n m 1)/10	
6) No. of rods used (n)	

Correction : B	
1) Mass of Friction Jacket (mf)	0.70 kg
2) Outer Dia, of Friction Jacket (d)	3.6 cm
3) Length of Friction Jacket (h)	10 cm
4) Surface area of friction jacket (a)	113.09 cm ²
5) Correction factor to be added to gauge reading (mf / a)	

Depth	Number of rods in use	Gauge reading of Cone Penetration	Cone Penetration Resistance	Correction Factor	Corrected Value of Cone Resistance	Gauge Reading of Cone + Jacket Resistance	Cone + Jacket Resistance	Total Resistance - Cone Resistance	Frictional Resistance	Corrected Frictional Resistance
m		(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)
0.2	1	1.00	2.00	0.27	2.27	3.00	6.00	4.00	0.35	0.36
0.4	1	4.00	8.00	0.27	8.27	5.00	10.00	2.00	0.18	0.18
0.6	1	9.00	18.00	0.27	18.27	9.00	18.00	0.00	0.00	0.01
0.8	1	5.00	10.00	0.27	10.27	9.00	18.00	8.00	0.71	0.71
1.0	1	12.00	24.00	0.27	24.27	17.00	34.00	10.00	0.88	0.89
1.2	2	20.00	40.00	0.41	40.41	29.00	58.00	18.00	1.59	1.60
1.4	2	32.00	64.00	0.41	64.41	44.00	88.00	24.00	2.12	2.13
1.6	2	53.00	106.00	0.41	106.41	62.00	124.00	18.00	1.59	1.60
1.8	2	65.00	130.00	0.41	130.41	80.00	160.00	30.00	2.65	2.66
2.0	2	86.00	172.00	0.41	172.41	84.00	172.00	0.00	0.00	0.01
2.2	3	83.00	166.00	0.54	166.54	96.00	192.00	26.00	2.30	2.31
2.4	3	99.00	198.00	0.54	198.54	97.00	198.00	0.00	0.00	0.01

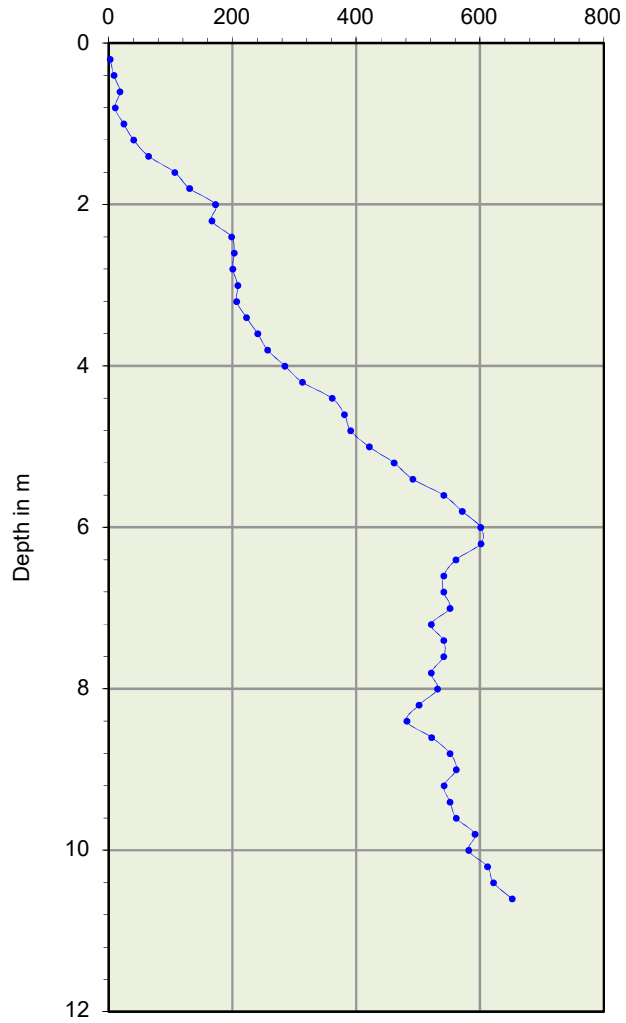
Depth	Number of rods in use	Gauge reading of Cone Penetration	Cone Penetration Resistance	Correction Factor	Corrected Value of Cone Resistance	Gauge Reading of Cone + Jacket Resistance	Cone + Jacket Resistance	Total Resistance - Cone Resistance	Frictional Resistance	Corrected Frictional Resistance
m		(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)
2.6	3	101.00	202.00	0.54	202.54	101.00	202.00	0.00	0.00	0.01
2.8	3	100.00	200.00	0.54	200.54	102.00	204.00	4.00	0.35	0.36
3.0	3	104.00	208.00	0.54	208.54	105.00	210.00	2.00	0.18	0.18
3.2	4	103.00	206.00	0.68	206.68	102.00	206.00	0.00	0.00	0.01
3.4	4	111.00	222.00	0.68	222.68	118.00	236.00	14.00	1.24	1.24
3.6	4	120.00	240.00	0.68	240.68	123.00	246.00	6.00	0.53	0.54
3.8	4	128.00	256.00	0.68	256.68	133.00	266.00	10.00	0.88	0.89
4.0	4	142.00	284.00	0.68	284.68	149.00	298.00	14.00	1.24	1.24
4.2	5	156.00	312.00	0.81	312.81	175.00	350.00	38.00	3.36	3.37
4.4	5	180.00	360.00	0.81	360.81	185.00	370.00	10.00	0.88	0.89
4.6	5	190.00	380.00	0.81	380.81	190.00	380.00	0.00	0.00	0.01
4.8	5	195.00	390.00	0.81	390.81	205.00	410.00	20.00	1.77	1.77
5.0	5	210.00	420.00	0.81	420.81	235.00	470.00	50.00	4.42	4.43
5.2	6	230.00	460.00	0.95	460.95	235.00	470.00	10.00	0.88	0.89
5.4	6	245.00	490.00	0.95	490.95	255.00	510.00	20.00	1.77	1.77
5.6	6	270.00	540.00	0.95	540.95	275.00	550.00	10.00	0.88	0.89
5.8	6	285.00	570.00	0.95	570.95	290.00	580.00	10.00	0.88	0.89
6.0	6	300.00	600.00	0.95	600.95	305.00	610.00	10.00	0.88	0.89
6.2	7	300.00	600.00	1.08	601.08	285.00	600.00	0.00	0.00	0.01
6.4	7	280.00	560.00	1.08	561.08	275.00	560.00	0.00	0.00	0.01
6.6	7	270.00	540.00	1.08	541.08	275.00	550.00	10.00	0.88	0.89
6.8	7	270.00	540.00	1.08	541.08	270.00	540.00	0.00	0.00	0.01
7.0	7	275.00	550.00	1.08	551.08	270.00	550.00	0.00	0.00	0.01
7.2	8	260.00	520.00	1.22	521.22	255.00	520.00	0.00	0.00	0.01
7.4	8	270.00	540.00	1.22	541.22	275.00	550.00	10.00	0.88	0.89

Depth	Number of rods in use	Gauge reading of Cone Penetration	Cone Penetration Resistance	Correction Factor	Corrected Value of Cone Resistance	Gauge Reading of Cone + Jacket Resistance	Cone + Jacket Resistance	Total Resistance - Cone Resistance	Frictional Resistance	Corrected Frictional Resistance
m		(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)
7.6	8	270.00	540.00	1.22	541.22	265.00	540.00	0.00	0.00	0.01
7.8	8	260.00	520.00	1.22	521.22	260.00	520.00	0.00	0.00	0.01
8.0	8	265.00	530.00	1.22	531.22	250.00	530.00	0.00	0.00	0.01
8.2	9	250.00	500.00	1.35	501.35	245.00	500.00	0.00	0.00	0.01
8.4	9	240.00	480.00	1.35	481.35	250.00	500.00	20.00	1.77	1.77
8.6	9	260.00	520.00	1.35	521.35	270.00	540.00	20.00	1.77	1.77
8.8	9	275.00	550.00	1.35	551.35	275.00	550.00	0.00	0.00	0.01
9.0	9	280.00	560.00	1.35	561.35	285.00	570.00	10.00	0.88	0.89
9.2	10	270.00	540.00	1.49	541.49	270.00	540.00	0.00	0.00	0.01
9.4	10	275.00	550.00	1.49	551.49	275.00	550.00	0.00	0.00	0.01
9.6	10	280.00	560.00	1.49	561.49	285.00	570.00	10.00	0.88	0.89
9.8	10	295.00	590.00	1.49	591.49	300.00	600.00	10.00	0.88	0.89
10.0	10	290.00	580.00	1.49	581.49	295.0	590.00	10.00	0.88	0.89
10.2	11	305.00	610.00	1.62	611.62	310.0	620.00	10.00	0.88	0.89

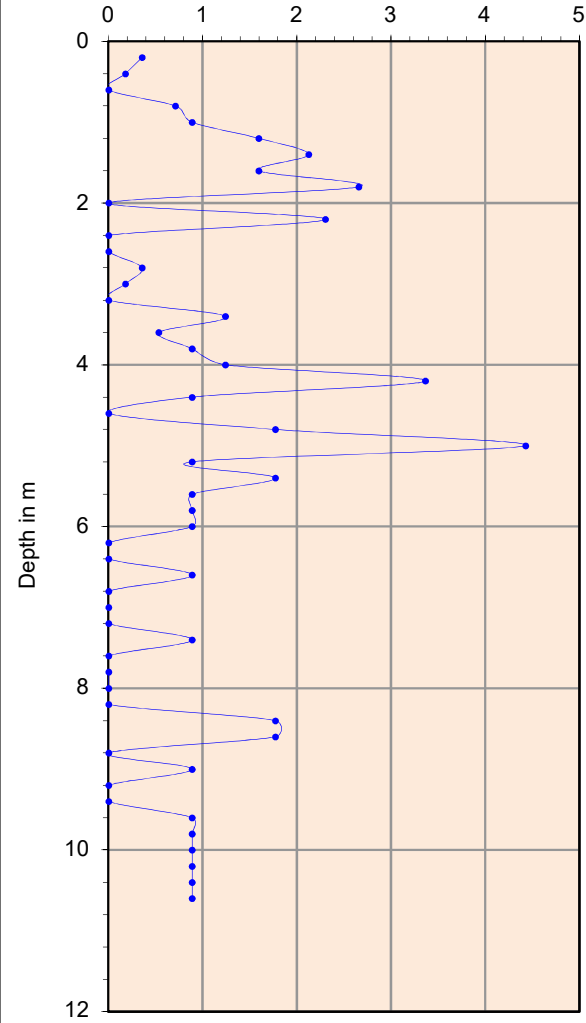
Depth	Number of rods in use	Gauge reading of Cone Penetration	Cone Penetration Resistance	Correction Factor	Corrected Value of Cone Resistance	Gauge Reading of Cone + Jacket Resistance	Cone + Jacket Resistance	Total Resistance - Cone Resistance	Frictional Resistance	Corrected Frictional Resistance
m		(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)
10.4	11	310.00	620.00	1.62	621.62	315.00	630.00	10.00	0.88	0.89
10.6	11	325.00	650.00	1.62	651.62	330.00	660.00	10.00	0.88	0.89

Static Cone Penetration Test No. 4

Cone Resistance

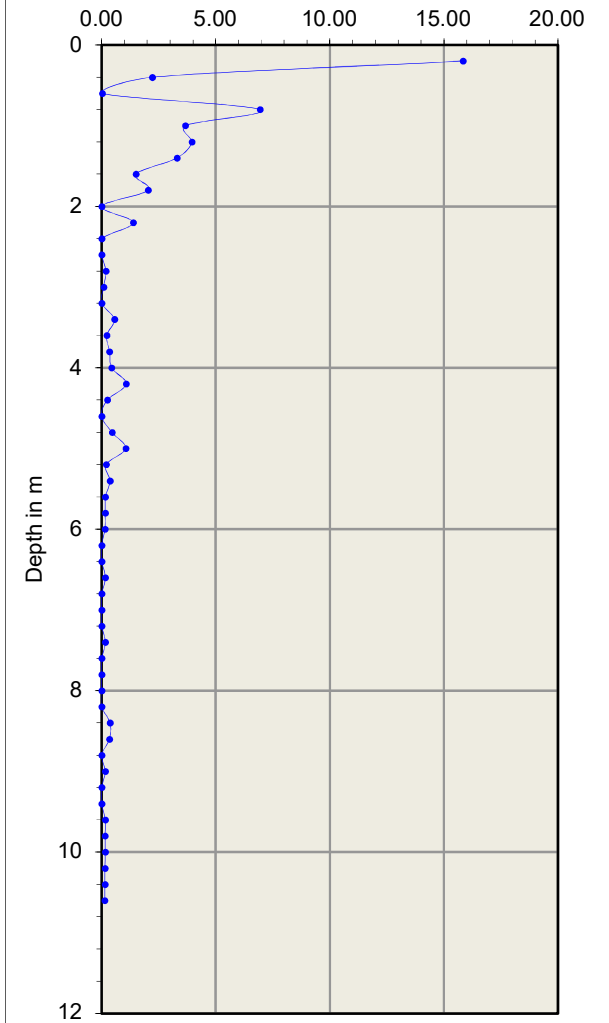
qc in kg / cm²

Frictional Resistance

fc in kg / cm²

Frictional Ratio

fr in %



Static Cone Penetration Test No. 5

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

R.L : 200.56m

Co-ordinates : E-1350 N-2981

Date : 29-07-2024

Correction : A	
1) Mass of Cone (m)	1.38 kg
2) Mass of each Sounding Rod (m 1)	1.35 kg
3) Cone area at base (b)	10.00 cm ²
4) Plunger Area (b')	20.00 cm ²
5) Correction factor to be added to gauge reading (m + n m 1)/10	
6) No. of rods used (n)	

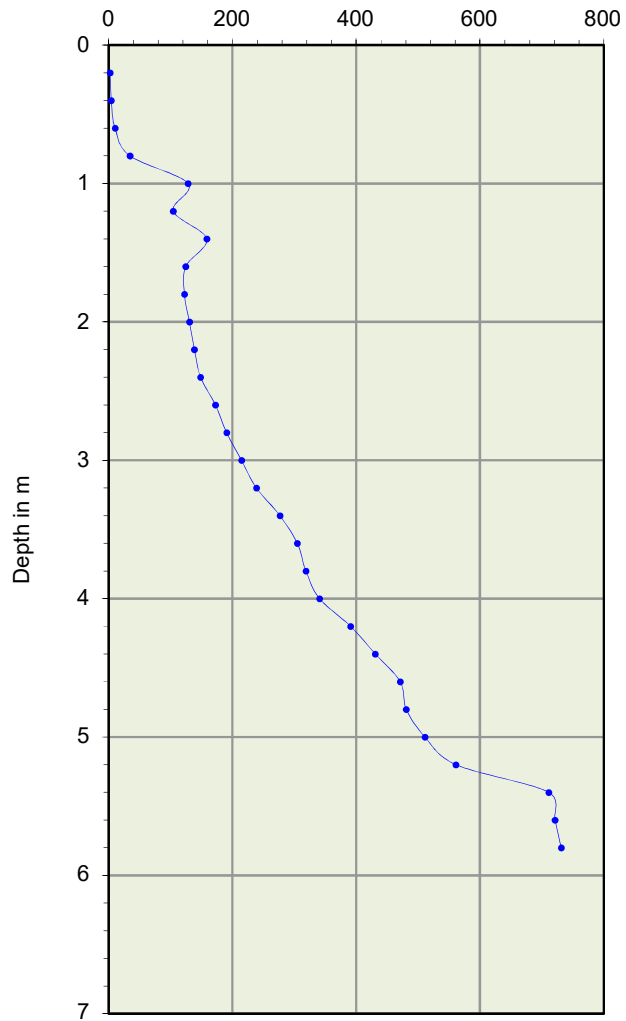
Correction : B	
1) Mass of Friction Jacket (mf)	0.70 kg
2) Outer Dia, of Friction Jacket (d)	3.6 cm
3) Length of Friction Jacket (h)	10 cm
4) Surface area of friction jacket (a)	113.09 cm ²
5) Correction factor to be added to gauge reading (mf / a)	

Depth	Number of rods in use	Gauge reading of Cone Penetration	Cone Penetration Resistance	Correction Factor	Corrected Value of Cone Resistance	Gauge Reading of Cone + Jacket Resistance	Cone + Jacket Resistance	Total Resistance - Cone Resistance	Frictional Resistance	Corrected Frictional Resistance
m		(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)
0.2	1	1.00	2.00	0.27	2.27	1.00	2.00	0.00	0.00	0.01
0.4	1	2.00	4.00	0.27	4.27	3.00	6.00	2.00	0.18	0.18
0.6	1	5.00	10.00	0.27	10.27	12.00	24.00	14.00	1.24	1.24
0.8	1	17.00	34.00	0.27	34.27	25.00	50.00	16.00	1.41	1.42
1.0	1	64.00	128.00	0.27	128.27	72.00	144.00	16.00	1.41	1.42
1.2	2	52.00	104.00	0.41	104.41	64.00	128.00	24.00	2.12	2.13
1.4	2	79.00	158.00	0.41	158.41	71.00	158.00	0.00	0.00	0.01
1.6	2	62.00	124.00	0.41	124.41	66.00	132.00	8.00	0.71	0.71
1.8	2	61.00	122.00	0.41	122.41	64.00	128.00	6.00	0.53	0.54
2.0	2	65.00	130.00	0.41	130.41	65.00	130.00	0.00	0.00	0.01
2.2	3	69.00	138.00	0.54	138.54	71.00	142.00	4.00	0.35	0.36
2.4	3	74.00	148.00	0.54	148.54	79.00	158.00	10.00	0.88	0.89

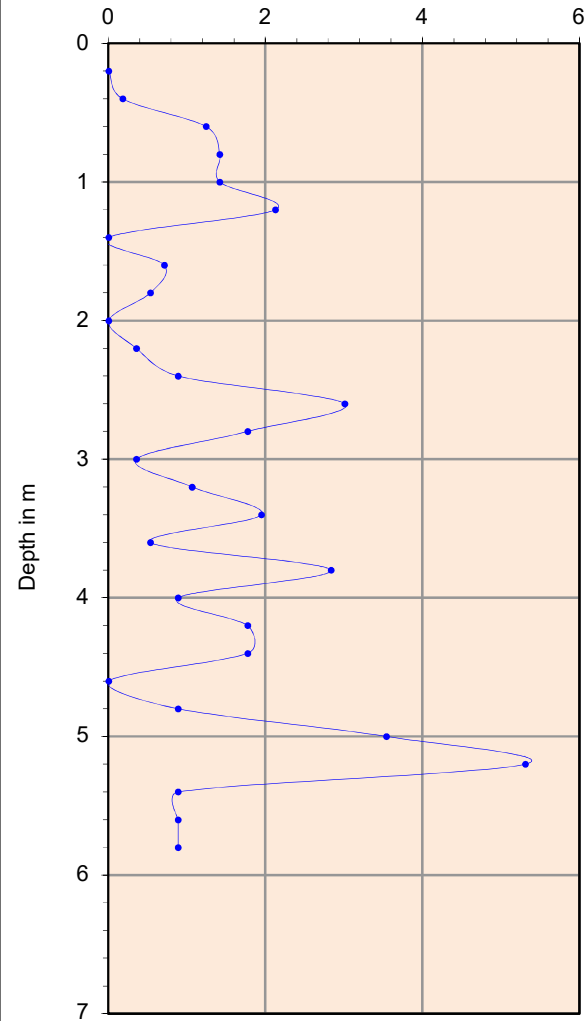
Depth	Number of rods in use	Gauge reading of Cone Penetration	Cone Penetration Resistance	Correction Factor	Corrected Value of Cone Resistance	Gauge Reading of Cone + Jacket Resistance	Cone + Jacket Resistance	Total Resistance - Cone Resistance	Frictional Resistance	Corrected Frictional Resistance
m		(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)
2.6	3	86.00	172.00	0.54	172.54	103.00	206.00	34.00	3.01	3.01
2.8	3	95.00	190.00	0.54	190.54	105.00	210.00	20.00	1.77	1.77
3.0	3	107.00	214.00	0.54	214.54	109.00	218.00	4.00	0.35	0.36
3.2	4	119.00	238.00	0.68	238.68	125.00	250.00	12.00	1.06	1.07
3.4	4	138.00	276.00	0.68	276.68	149.00	298.00	22.00	1.95	1.95
3.6	4	152.00	304.00	0.68	304.68	155.00	310.00	6.00	0.53	0.54
3.8	4	159.00	318.00	0.68	318.68	175.00	350.00	32.00	2.83	2.84
4.0	4	170.00	340.00	0.68	340.68	175.00	350.00	10.00	0.88	0.89
4.2	5	195.00	390.00	0.81	390.81	205.00	410.00	20.00	1.77	1.77
4.4	5	215.00	430.00	0.81	430.81	225.00	450.00	20.00	1.77	1.77
4.6	5	235.00	470.00	0.81	470.81	230.00	470.00	0.00	0.00	0.01
4.8	5	240.00	480.00	0.81	480.81	245.00	490.00	10.00	0.88	0.89
5.0	5	255.00	510.00	0.81	510.81	275.00	550.00	40.00	3.54	3.54
5.2	6	280.00	560.00	0.95	560.95	310.00	620.00	60.00	5.31	5.31
5.4	6	355.00	710.00	0.95	710.95	360.00	720.00	10.00	0.88	0.89
5.6	6	360.00	720.00	0.95	720.95	365.00	730.00	10.00	0.88	0.89
5.8	6	365.00	730.00	0.95	730.95	370.00	740.00	10.00	0.88	0.89

Static Cone Penetration Test No. 5

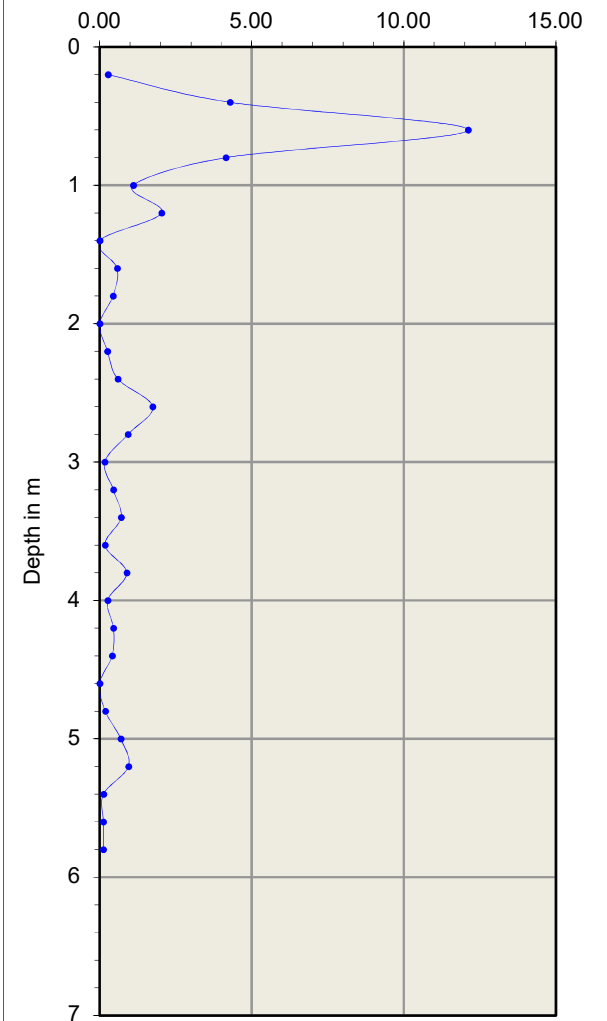
Cone Resistance

 q_c in kg / cm^2 

Frictional Resistance

 f_c in kg / cm^2 

Frictional Ratio

 f_r in %

Static Cone Penetration Test No. 6

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha
 R.L : 200.34m
 Co-ordinates : E-1118 N-2902
 Date : 31-07-2024

Correction : A	
1) Mass of Cone (m)	1.38 kg
2) Mass of each Sounding Rod (m 1)	1.35 kg
3) Cone area at base (b)	10.00 cm ²
4) Plunger Area (b')	20.00 cm ²
5) Correction factor to be added to gauge reading (m + n m 1)/10	
6) No. of rods used (n)	

Correction : B	
1) Mass of Friction Jacket (mf)	0.70 kg
2) Outer Dia, of Friction Jacket (d)	3.6 cm
3) Length of Friction Jacket (h)	10 cm
4) Surface area of friction jacket (a)	113.09 cm ²
5) Correction factor to be added to gauge reading (mf / a)	

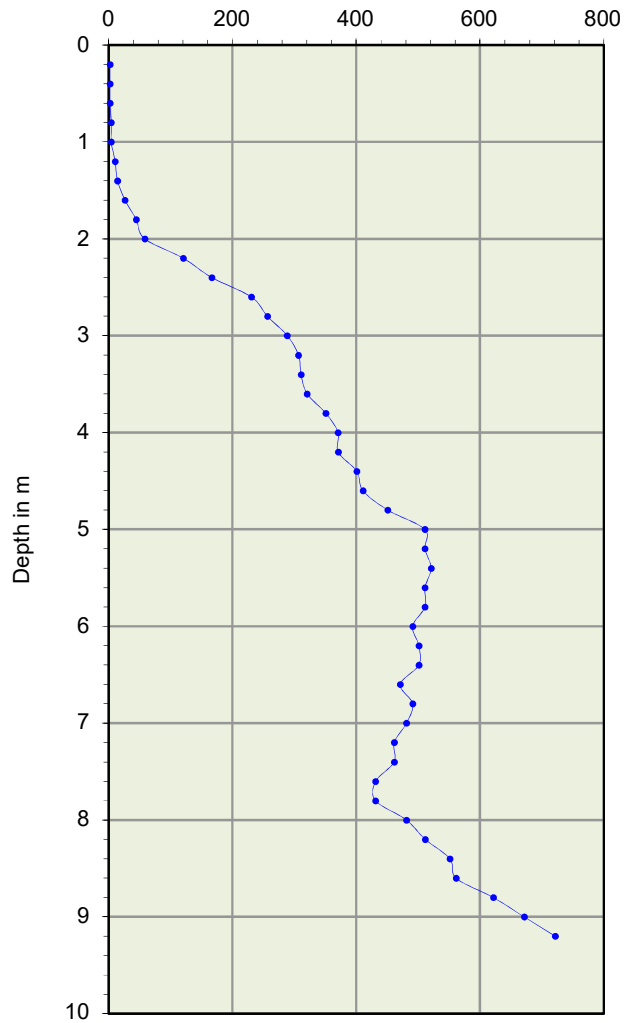
Depth	Number of rods in use	Gauge reading of Cone Penetration	Cone Penetration Resistance	Correction Factor	Corrected Value of Cone Resistance	Gauge Reading of Cone + Jacket Resistance	Cone + Jacket Resistance	Total Resistance - Cone Resistance	Frictional Resistance	Corrected Frictional Resistance
m		(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)
0.2	1	1.00	2.00	0.27	2.27	1.00	2.00	0.00	0.00	0.01
0.4	1	1.00	2.00	0.27	2.27	1.00	2.00	0.00	0.00	0.01
0.6	1	1.00	2.00	0.27	2.27	2.00	4.00	2.00	0.18	0.18
0.8	1	2.00	4.00	0.27	4.27	2.00	4.00	0.00	0.00	0.01
1.0	1	2.00	4.00	0.27	4.27	4.00	8.00	4.00	0.35	0.36
1.2	2	5.00	10.00	0.41	10.41	6.00	12.00	2.00	0.18	0.18
1.4	2	7.00	14.00	0.41	14.41	9.00	18.00	4.00	0.35	0.36
1.6	2	13.00	26.00	0.41	26.41	12.00	26.00	0.00	0.00	0.01
1.8	2	22.00	44.00	0.41	44.41	19.00	44.00	0.00	0.00	0.01
2.0	2	29.00	58.00	0.41	58.41	45.00	90.00	32.00	2.83	2.84
2.2	3	60.00	120.00	0.54	120.54	77.00	154.00	34.00	3.01	3.01
2.4	3	83.00	166.00	0.54	166.54	99.00	198.00	32.00	2.83	2.84

Depth	Number of rods in use	Gauge reading of Cone Penetration	Cone Penetration Resistance	Correction Factor	Corrected Value of Cone Resistance	Gauge Reading of Cone + Jacket Resistance	Cone + Jacket Resistance	Total Resistance - Cone Resistance	Frictional Resistance	Corrected Frictional Resistance
m		(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)
2.6	3	115.00	230.00	0.54	230.54	120.00	240.00	10.00	0.88	0.89
2.8	3	128.00	256.00	0.54	256.54	139.00	278.00	22.00	1.95	1.95
3.0	3	144.00	288.00	0.54	288.54	156.00	312.00	24.00	2.12	2.13
3.2	4	153.00	306.00	0.68	306.68	152.00	306.00	0.00	0.00	0.01
3.4	4	155.00	310.00	0.68	310.68	157.00	314.00	4.00	0.35	0.36
3.6	4	160.00	320.00	0.68	320.68	170.00	340.00	20.00	1.77	1.77
3.8	4	175.00	350.00	0.68	350.68	170.00	350.00	0.00	0.00	0.01
4.0	4	185.00	370.00	0.68	370.68	190.00	380.00	10.00	0.88	0.89
4.2	5	185.00	370.00	0.81	370.81	195.00	390.00	20.00	1.77	1.77
4.4	5	200.00	400.00	0.81	400.81	200.00	400.00	0.00	0.00	0.01
4.6	5	205.00	410.00	0.81	410.81	215.00	430.00	20.00	1.77	1.77
4.8	5	225.00	450.00	0.81	450.81	235.00	470.00	20.00	1.77	1.77
5.0	5	255.00	510.00	0.81	510.81	265.00	530.00	20.00	1.77	1.77
5.2	6	255.00	510.00	0.95	510.95	260.00	520.00	10.00	0.88	0.89
5.4	6	260.00	520.00	0.95	520.95	255.00	520.00	0.00	0.00	0.01
5.6	6	255.00	510.00	0.95	510.95	260.00	520.00	10.00	0.88	0.89
5.8	6	255.00	510.00	0.95	510.95	250.00	510.00	0.00	0.00	0.01
6.0	6	245.00	490.00	0.95	490.95	250.00	500.00	10.00	0.88	0.89
6.2	7	250.00	500.00	1.08	501.08	245.00	500.00	0.00	0.00	0.01
6.4	7	250.00	500.00	1.08	501.08	245.00	500.00	0.00	0.00	0.01
6.6	7	235.00	470.00	1.08	471.08	240.00	480.00	10.00	0.88	0.89
6.8	7	245.00	490.00	1.08	491.08	245.00	490.00	0.00	0.00	0.01
7.0	7	240.00	480.00	1.08	481.08	245.00	490.00	10.00	0.88	0.89
7.2	8	230.00	460.00	1.22	461.22	235.00	470.00	10.00	0.88	0.89
7.4	8	230.00	460.00	1.22	461.22	225.00	460.00	0.00	0.00	0.01

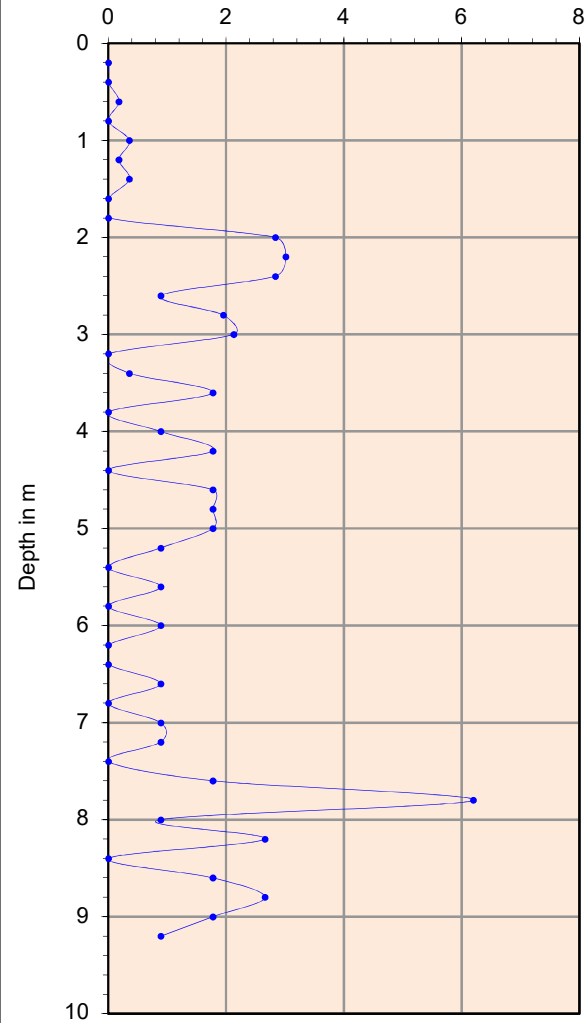
Depth	Number of rods in use	Gauge reading of Cone Penetration	Cone Penetration Resistance	Correction Factor	Corrected Value of Cone Resistance	Gauge Reading of Cone + Jacket Resistance	Cone + Jacket Resistance	Total Resistance - Cone Resistance	Frictional Resistance	Corrected Frictional Resistance
m		(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)
7.6	8	215.00	430.00	1.22	431.22	225.00	450.00	20.00	1.77	1.77
7.8	8	215.00	430.00	1.22	431.22	250.00	500.00	70.00	6.19	6.20
8.0	8	240.00	480.00	1.22	481.22	245.00	490.00	10.00	0.88	0.89
8.2	9	255.00	510.00	1.35	511.35	270.00	540.00	30.00	2.65	2.66
8.4	9	275.00	550.00	1.35	551.35	275.00	550.00	0.00	0.00	0.01
8.6	9	280.00	560.00	1.35	561.35	290.00	580.00	20.00	1.77	1.77
8.8	9	310.00	620.00	1.35	621.35	325.00	650.00	30.00	2.65	2.66
9.0	9	335.00	670.00	1.35	671.35	345.00	690.00	20.00	1.77	1.77
9.2	10	360.00	720.00	1.49	721.49	365.00	730.00	10.00	0.88	0.89

Static Cone Penetration Test No. 6

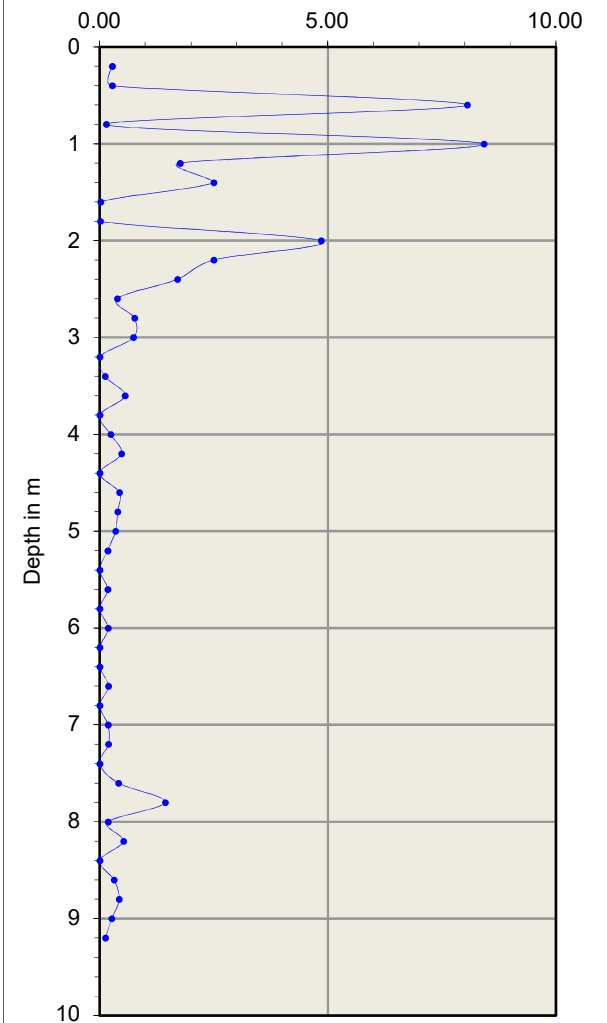
Cone Resistance

 q_c in kg / cm^2 

Frictional Resistance

 f_c in kg / cm^2 

Frictional Ratio

 f_r in %

Static Cone Penetration Test No. 7

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha
 R.L : 204.36m
 Co-ordinates : E-1786 N-2875
 Date : 07-12-2024

Correction : A	
1) Mass of Cone (m)	1.38 kg
2) Mass of each Sounding Rod (m 1)	1.35 kg
3) Cone area at base (b)	10.00 cm ²
4) Plunger Area (b')	20.00 cm ²
5) Correction factor to be added to gauge reading (m + n m 1)/10	
6) No. of rods used (n)	

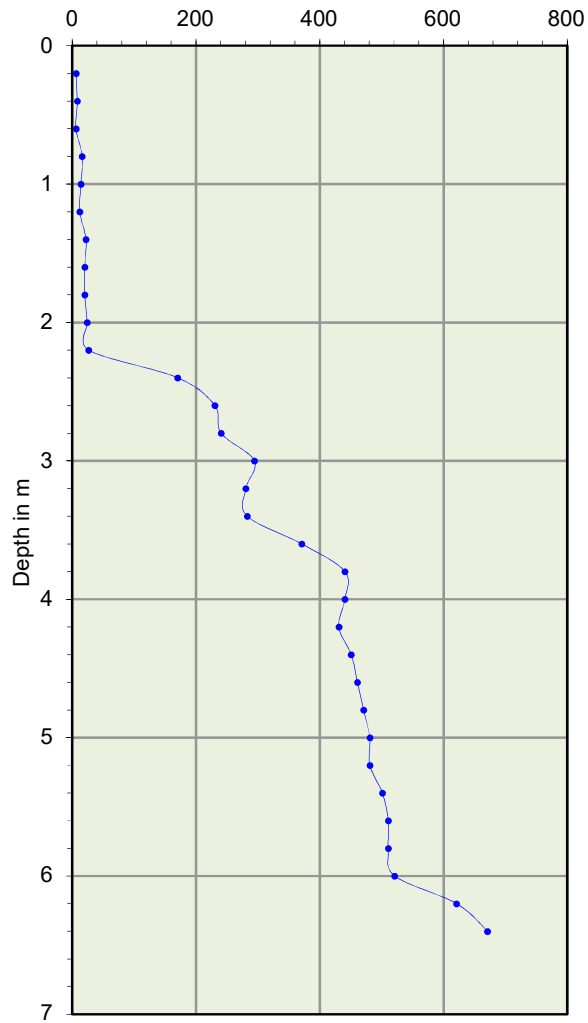
Correction : B	
1) Mass of Friction Jacket (mf)	0.70 kg
2) Outer Dia, of Friction Jacket (d)	3.6 cm
3) Length of Friction Jacket (h)	10 cm
4) Surface area of friction jacket (a)	113.09 cm ²
5) Correction factor to be added to gauge reading (mf / a)	

Depth	Number of rods in use	Gauge reading of Cone Penetration	Cone Penetration Resistance	Correction Factor	Corrected Value of Cone Resistance	Gauge Reading of Cone + Jacket Resistance	Cone + Jacket Resistance	Total Resistance - Cone Resistance	Frictional Resistance	Corrected Frictional Resistance
m		(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)
0.2	1	3.00	6.00	0.27	6.27	5.00	10.00	4.00	0.35	0.36
0.4	1	4.00	8.00	0.27	8.27	7.00	14.00	6.00	0.53	0.54
0.6	1	3.00	6.00	0.27	6.27	8.00	16.00	10.00	0.88	0.89
0.8	1	8.00	16.00	0.27	16.27	9.00	18.00	2.00	0.18	0.18
1.0	1	7.00	14.00	0.27	14.27	10.00	20.00	6.00	0.53	0.54
1.2	2	6.00	12.00	0.41	12.41	12.00	24.00	12.00	1.06	1.07
1.4	2	11.00	22.00	0.41	22.41	15.00	30.00	8.00	0.71	0.71
1.6	2	10.00	20.00	0.41	20.41	16.00	32.00	12.00	1.06	1.07
1.8	2	10.00	20.00	0.41	20.41	14.00	28.00	8.00	0.71	0.71
2.0	2	12.00	24.00	0.41	24.41	18.00	36.00	12.00	1.06	1.07
2.2	3	13.00	26.00	0.54	26.54	17.00	34.00	8.00	0.71	0.71
2.4	3	85.00	170.00	0.54	170.54	110.00	220.00	50.00	4.42	4.43

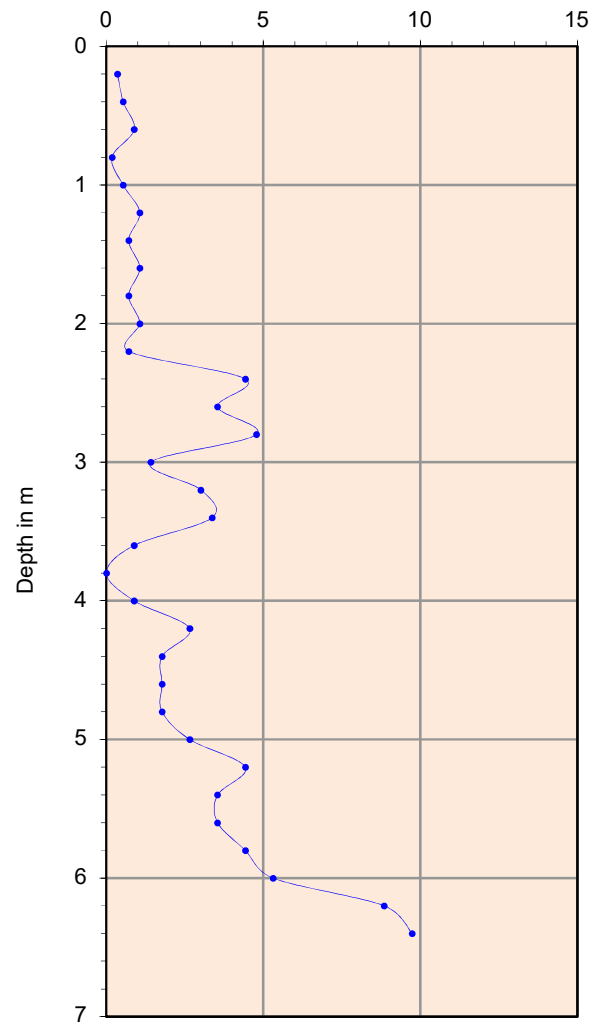
Depth	Number of rods in use	Gauge reading of Cone Penetration	Cone Penetration Resistance	Correction Factor	Corrected Value of Cone Resistance	Gauge Reading of Cone + Jacket Resistance	Cone + Jacket Resistance	Total Resistance - Cone Resistance	Frictional Resistance	Corrected Frictional Resistance
m		(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)
2.6	3	115.00	230.00	0.54	230.54	135.00	270.00	40.00	3.54	3.54
2.8	3	120.00	240.00	0.54	240.54	147.00	294.00	54.00	4.77	4.78
3.0	3	147.00	294.00	0.54	294.54	155.00	310.00	16.00	1.41	1.42
3.2	4	140.00	280.00	0.68	280.68	157.00	314.00	34.00	3.01	3.01
3.4	4	141.00	282.00	0.68	282.68	160.00	320.00	38.00	3.36	3.37
3.6	4	185.00	370.00	0.68	370.68	190.00	380.00	10.00	0.88	0.89
3.8	4	220.00	440.00	0.68	440.68	215.00	440.00	0.00	0.00	0.01
4.0	4	220.00	440.00	0.68	440.68	225.00	450.00	10.00	0.88	0.89
4.2	5	215.00	430.00	0.81	430.81	230.00	460.00	30.00	2.65	2.66
4.4	5	225.00	450.00	0.81	450.81	235.00	470.00	20.00	1.77	1.77
4.6	5	230.00	460.00	0.81	460.81	240.00	480.00	20.00	1.77	1.77
4.8	5	235.00	470.00	0.81	470.81	245.00	490.00	20.00	1.77	1.77
5.0	5	240.00	480.00	0.81	480.81	255.00	510.00	30.00	2.65	2.66
5.2	6	240.00	480.00	0.95	480.95	265.00	530.00	50.00	4.42	4.43
5.4	6	250.00	500.00	0.95	500.95	270.00	540.00	40.00	3.54	3.54
5.6	6	255.00	510.00	0.95	510.95	275.00	550.00	40.00	3.54	3.54
5.8	6	255.00	510.00	0.95	510.95	280.00	560.00	50.00	4.42	4.43
6.0	6	260.00	520.00	0.95	520.95	290.00	580.00	60.00	5.31	5.31
6.2	7	310.00	620.00	1.08	621.08	360.00	720.00	100.00	8.84	8.85
6.4	7	335.00	670.00	1.08	671.08	390.00	780.00	110.00	9.73	9.73

Static Cone Penetration Test No. 7

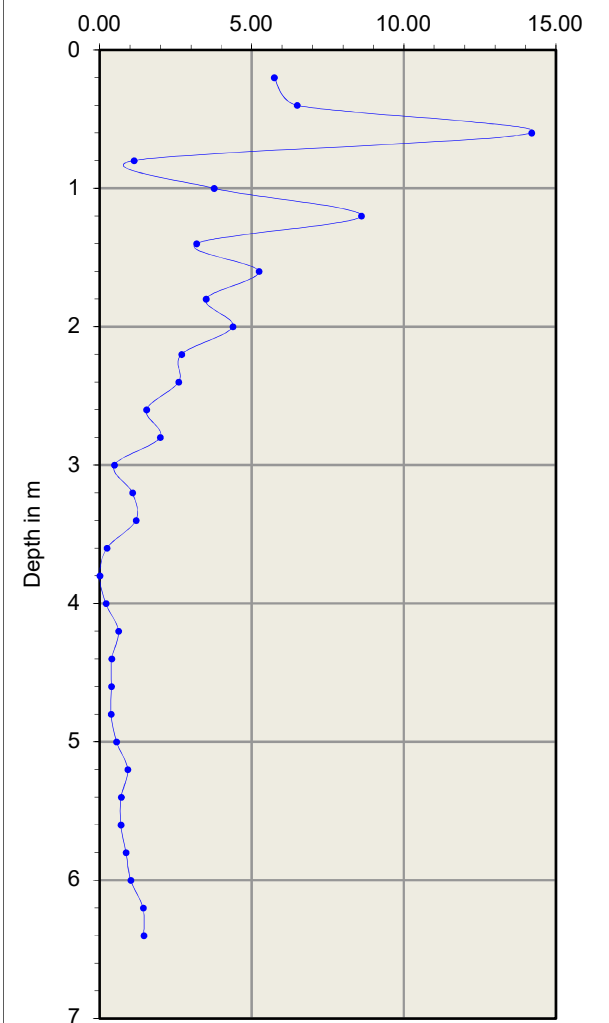
Cone Resistance

 q_c in kg / cm^2 

Frictional Resistance

 f_c in kg / cm^2 

Frictional Ratio

 f_r in %

Static Cone Penetration Test No. 8

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

R.L : 203.63m

Co-ordinates : E-1726 N-2674

Date : 09-12-2024

Correction : A	
1) Mass of Cone (m)	1.38 kg
2) Mass of each Sounding Rod (m 1)	1.35 kg
3) Cone area at base (b)	10.00 cm ²
4) Plunger Area (b')	20.00 cm ²
5) Correction factor to be added to gauge reading (m + n m 1)/10	
6) No. of rods used (n)	

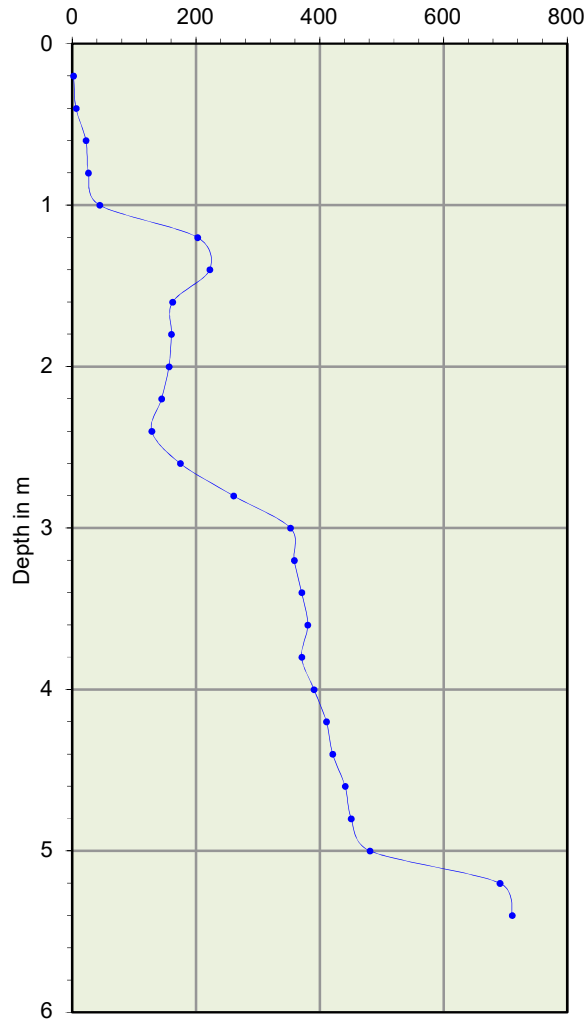
Correction : B	
1) Mass of Friction Jacket (mf)	0.70 kg
2) Outer Dia, of Friction Jacket (d)	3.6 cm
3) Length of Friction Jacket (h)	10 cm
4) Surface area of friction jacket (a)	113.09 cm ²
5) Correction factor to be added to gauge reading (mf / a)	

Depth	Number of rods in use	Gauge reading of Cone Penetration	Cone Penetration Resistance	Correction Factor	Corrected Value of Cone Resistance	Gauge Reading of Cone + Jacket Resistance	Cone + Jacket Resistance	Total Resistance - Cone Resistance	Frictional Resistance	Corrected Frictional Resistance
m		(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)
0.2	1	1.00	2.00	0.27	2.27	3.00	6.00	4.00	0.35	0.36
0.4	1	3.00	6.00	0.27	6.27	5.00	10.00	4.00	0.35	0.36
0.6	1	11.00	22.00	0.27	22.27	17.00	34.00	12.00	1.06	1.07
0.8	1	13.00	26.00	0.27	26.27	19.00	38.00	12.00	1.06	1.07
1.0	1	22.00	44.00	0.27	44.27	25.00	50.00	6.00	0.53	0.54
1.2	2	101.00	202.00	0.41	202.41	115.00	230.00	28.00	2.48	2.48
1.4	2	111.00	222.00	0.41	222.41	123.00	246.00	24.00	2.12	2.13
1.6	2	81.00	162.00	0.41	162.41	101.00	202.00	40.00	3.54	3.54
1.8	2	80.00	160.00	0.41	160.41	83.00	166.00	6.00	0.53	0.54
2.0	2	78.00	156.00	0.41	156.41	85.00	170.00	14.00	1.24	1.24
2.2	3	72.00	144.00	0.54	144.54	81.00	162.00	18.00	1.59	1.60
2.4	3	64.00	128.00	0.54	128.54	66.00	132.00	4.00	0.35	0.36

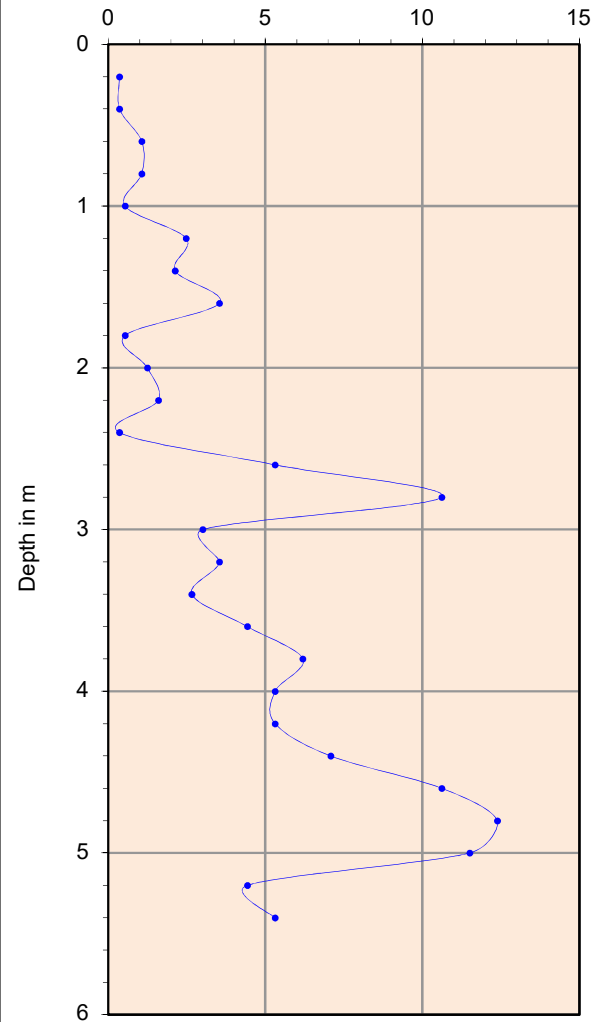
Depth	Number of rods in use	Gauge reading of Cone Penetration	Cone Penetration Resistance	Correction Factor	Corrected Value of Cone Resistance	Gauge Reading of Cone + Jacket Resistance	Cone + Jacket Resistance	Total Resistance - Cone Resistance	Frictional Resistance	Corrected Frictional Resistance
m		(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)
2.6	3	87.00	174.00	0.54	174.54	117.00	234.00	60.00	5.31	5.31
2.8	3	130.00	260.00	0.54	260.54	190.00	380.00	120.00	10.61	10.62
3.0	3	176.00	352.00	0.54	352.54	193.00	386.00	34.00	3.01	3.01
3.2	4	179.00	358.00	0.68	358.68	199.00	398.00	40.00	3.54	3.54
3.4	4	185.00	370.00	0.68	370.68	200.00	400.00	30.00	2.65	2.66
3.6	4	190.00	380.00	0.68	380.68	215.00	430.00	50.00	4.42	4.43
3.8	4	185.00	370.00	0.68	370.68	220.00	440.00	70.00	6.19	6.20
4.0	4	195.00	390.00	0.68	390.68	225.00	450.00	60.00	5.31	5.31
4.2	5	205.00	410.00	0.81	410.81	235.00	470.00	60.00	5.31	5.31
4.4	5	210.00	420.00	0.81	420.81	250.00	500.00	80.00	7.07	7.08
4.6	5	220.00	440.00	0.81	440.81	280.00	560.00	120.00	10.61	10.62
4.8	5	225.00	450.00	0.81	450.81	295.00	590.00	140.00	12.38	12.39
5.0	5	240.00	480.00	0.81	480.81	305.00	610.00	130.00	11.50	11.50
5.2	6	345.00	690.00	0.95	690.95	370.00	740.00	50.00	4.42	4.43
5.4	6	355.00	710.00	0.95	710.95	385.00	770.00	60.00	5.31	5.31

Static Cone Penetration Test No. 8

Cone Resistance

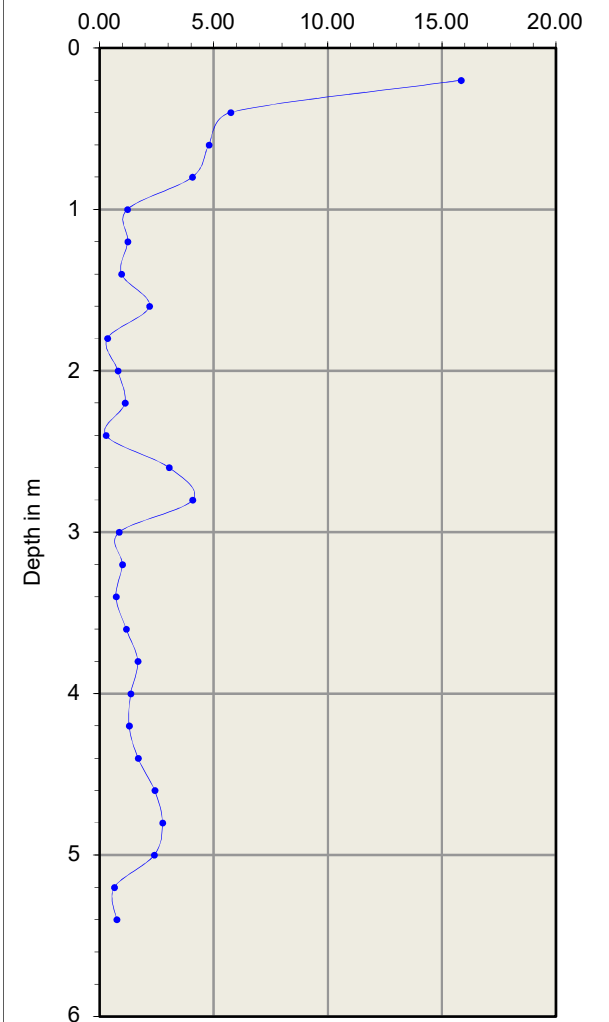
qc in kg / cm²

Frictional Resistance

fc in kg / cm²

Frictional Ratio

fr in %



Static Cone Penetration Test No. 9

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha
 R.L : 197.33m
 Co-ordinates : E-778 N-3269
 Date : 30-07-2024

Correction : A	
1) Mass of Cone (m)	1.38 kg
2) Mass of each Sounding Rod (m 1)	1.35 kg
3) Cone area at base (b)	10.00 cm ²
4) Plunger Area (b')	20.00 cm ²
5) Correction factor to be added to gauge reading (m + n m 1)/10	
6) No. of rods used (n)	

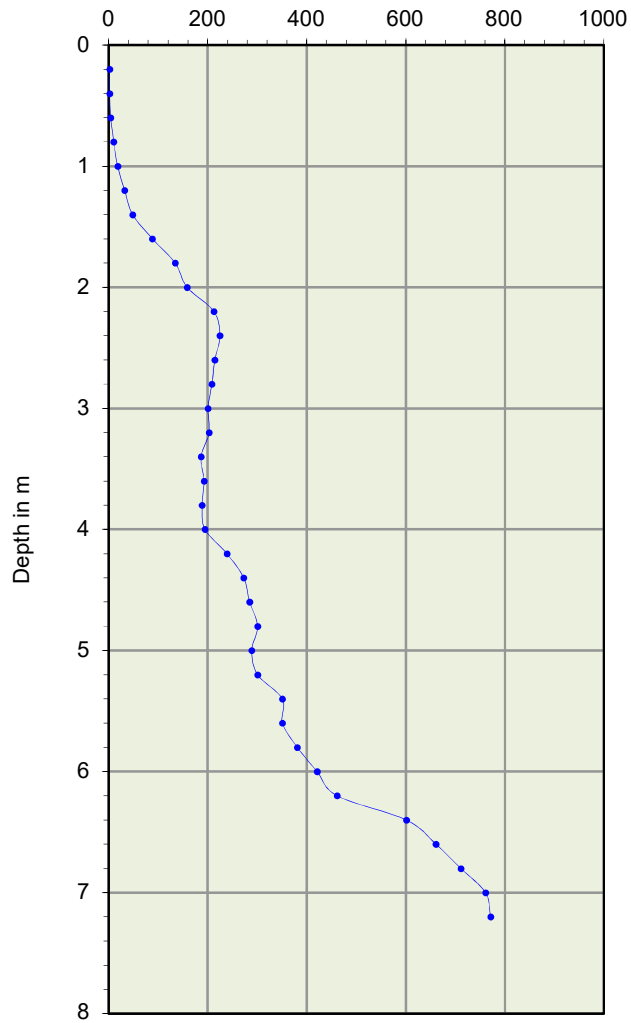
Correction : B	
1) Mass of Friction Jacket (mf)	0.70 kg
2) Outer Dia, of Friction Jacket (d)	3.6 cm
3) Length of Friction Jacket (h)	10 cm
4) Surface area of friction jacket (a)	113.09 cm ²
5) Correction factor to be added to gauge reading (mf / a)	

Depth	Number of rods in use	Gauge reading of Cone Penetration	Cone Penetration Resistance	Correction Factor	Corrected Value of Cone Resistance	Gauge Reading of Cone + Jacket Resistance	Cone + Jacket Resistance	Total Resistance - Cone Resistance	Frictional Resistance	Corrected Frictional Resistance
m		(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)
0.2	1	1.00	2.00	0.27	2.27	1.00	2.00	0.00	0.00	0.01
0.4	1	1.00	2.00	0.27	2.27	1.00	2.00	0.00	0.00	0.01
0.6	1	2.00	4.00	0.27	4.27	5.00	10.00	6.00	0.53	0.54
0.8	1	5.00	10.00	0.27	10.27	7.00	14.00	4.00	0.35	0.36
1.0	1	9.00	18.00	0.27	18.27	10.00	20.00	2.00	0.18	0.18
1.2	2	16.00	32.00	0.41	32.41	21.00	42.00	10.00	0.88	0.89
1.4	2	24.00	48.00	0.41	48.41	49.00	98.00	50.00	4.42	4.43
1.6	2	44.00	88.00	0.41	88.41	64.00	128.00	40.00	3.54	3.54
1.8	2	67.00	134.00	0.41	134.41	69.00	138.00	4.00	0.35	0.36
2.0	2	79.00	158.00	0.41	158.41	85.00	170.00	12.00	1.06	1.07
2.2	3	106.00	212.00	0.54	212.54	110.00	220.00	8.00	0.71	0.71
2.4	3	112.00	224.00	0.54	224.54	114.00	228.00	4.00	0.35	0.36

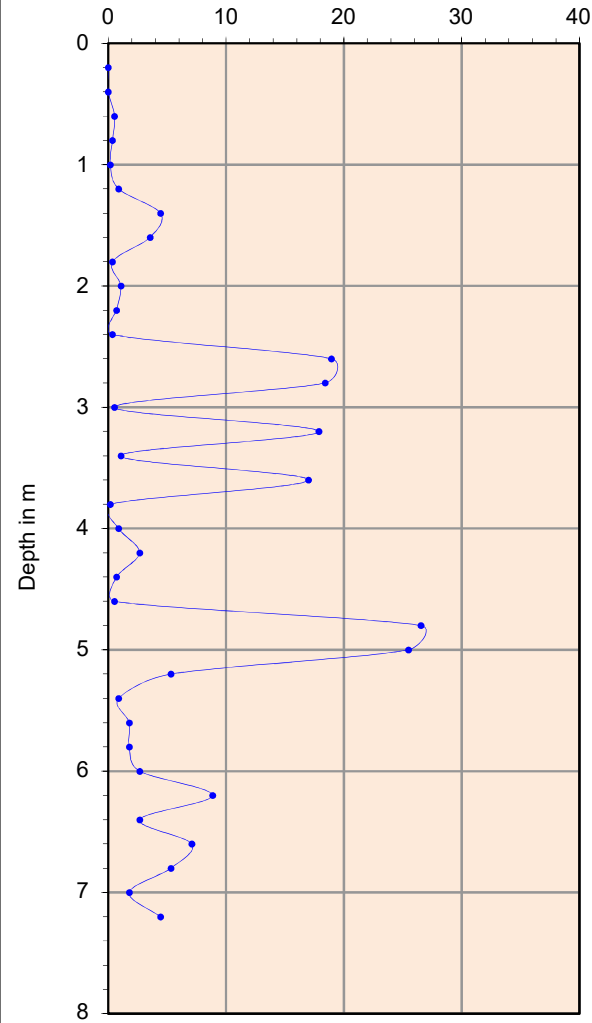
Depth	Number of rods in use	Gauge reading of Cone Penetration	Cone Penetration Resistance	Correction Factor	Corrected Value of Cone Resistance	Gauge Reading of Cone + Jacket Resistance	Cone + Jacket Resistance	Total Resistance - Cone Resistance	Frictional Resistance	Corrected Frictional Resistance
m		(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)
2.6	3	107.00	214.00	0.54	214.54	105.00	210.00	214.00	18.92	18.93
2.8	3	104.00	208.00	0.54	208.54	95.00	190.00	208.00	18.39	18.40
3.0	3	100.00	200.00	0.54	200.54	103.00	206.00	6.00	0.53	0.54
3.2	4	101.00	202.00	0.68	202.68	98.00	196.00	202.00	17.86	17.87
3.4	4	93.00	186.00	0.68	186.68	99.00	198.00	12.00	1.06	1.07
3.6	4	96.00	192.00	0.68	192.68	91.00	182.00	192.00	16.98	16.98
3.8	4	94.00	188.00	0.68	188.68	95.00	190.00	2.00	0.18	0.18
4.0	4	97.00	194.00	0.68	194.68	102.00	204.00	10.00	0.88	0.89
4.2	5	119.00	238.00	0.81	238.81	134.00	268.00	30.00	2.65	2.66
4.4	5	136.00	272.00	0.81	272.81	140.00	280.00	8.00	0.71	0.71
4.6	5	142.00	284.00	0.81	284.81	145.00	290.00	6.00	0.53	0.54
4.8	5	150.00	300.00	0.81	300.81	142.00	284.00	300.00	26.53	26.53
5.0	5	144.00	288.00	0.81	288.81	142.00	284.00	288.00	25.47	25.47
5.2	6	150.00	300.00	0.95	300.95	180.00	360.00	60.00	5.31	5.31
5.4	6	175.00	350.00	0.95	350.95	180.00	360.00	10.00	0.88	0.89
5.6	6	175.00	350.00	0.95	350.95	185.00	370.00	20.00	1.77	1.77
5.8	6	190.00	380.00	0.95	380.95	200.00	400.00	20.00	1.77	1.77
6.0	6	210.00	420.00	0.95	420.95	225.00	450.00	30.00	2.65	2.66
6.2	7	230.00	460.00	1.08	461.08	280.00	560.00	100.00	8.84	8.85
6.4	7	300.00	600.00	1.08	601.08	315.00	630.00	30.00	2.65	2.66
6.6	7	330.00	660.00	1.08	661.08	370.00	740.00	80.00	7.07	7.08
6.8	7	355.00	710.00	1.08	711.08	385.00	770.00	60.00	5.31	5.31
7.0	7	380.00	760.00	1.08	761.08	390.00	780.00	20.00	1.77	1.77
7.2	8	385.00	770.00	1.22	771.22	410.00	820.00	50.00	4.42	4.43

Static Cone Penetration Test No. 9

Cone Resistance

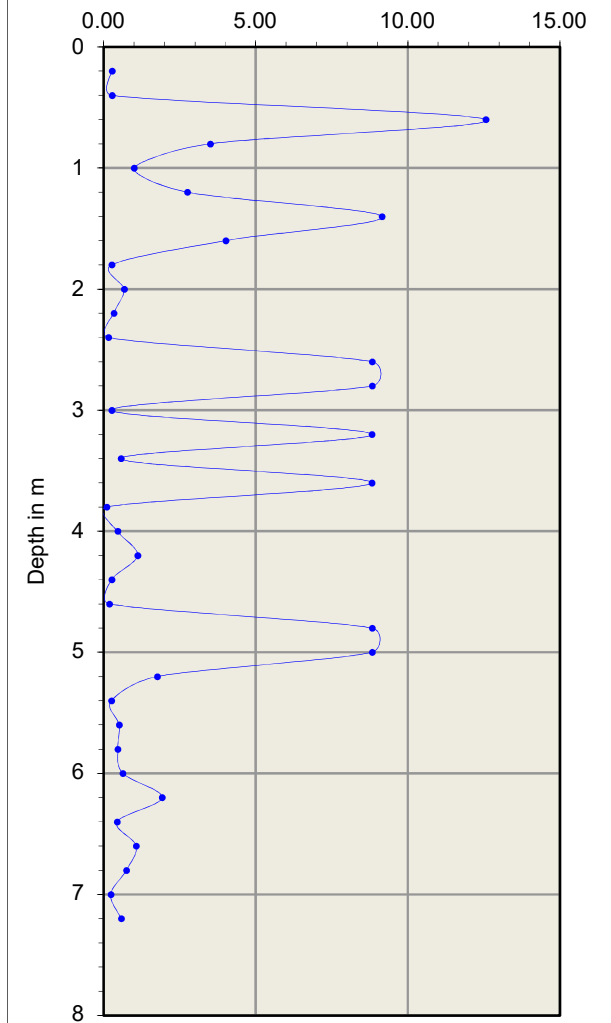
qc in kg / cm²

Frictional Resistance

fc in kg / cm²

Frictional Ratio

fr in %



Static Cone Penetration Test No. 10

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

R.L : 203.80m

Co-ordinates : E-1564 N-2310

Date : 11-12-2024

Correction : A	
1) Mass of Cone (m)	1.38 kg
2) Mass of each Sounding Rod (m 1)	1.35 kg
3) Cone area at base (b)	10.00 cm ²
4) Plunger Area (b')	20.00 cm ²
5) Correction factor to be added to gauge reading (m + n m 1)/10	
6) No. of rods used (n)	

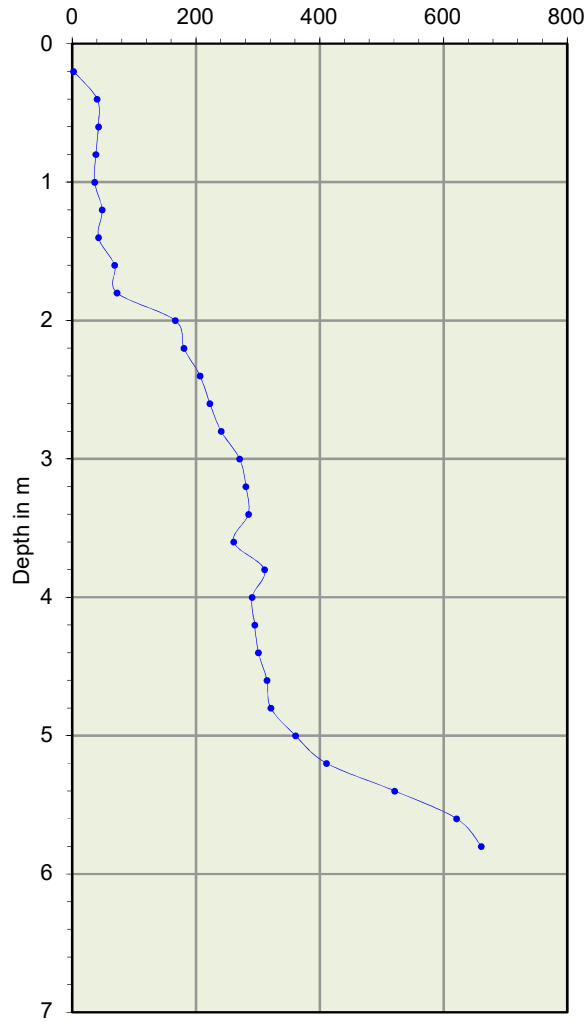
Correction : B	
1) Mass of Friction Jacket (mf)	0.70 kg
2) Outer Dia, of Friction Jacket (d)	3.6 cm
3) Length of Friction Jacket (h)	10 cm
4) Surface area of friction jacket (a)	113.09 cm ²
5) Correction factor to be added to gauge reading (mf / a)	

Depth	Number of rods in use	Gauge reading of Cone Penetration	Cone Penetration Resistance	Correction Factor	Corrected Value of Cone Resistance	Gauge Reading of Cone + Jacket Resistance	Cone + Jacket Resistance	Total Resistance - Cone Resistance	Frictional Resistance	Corrected Frictional Resistance
m		(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)
0.2	1	1.00	2.00	0.27	2.27	5.00	10.00	8.00	0.71	0.71
0.4	1	20.00	40.00	0.27	40.27	30.00	60.00	20.00	1.77	1.77
0.6	1	21.00	42.00	0.27	42.27	24.00	48.00	6.00	0.53	0.54
0.8	1	19.00	38.00	0.27	38.27	31.00	62.00	24.00	2.12	2.13
1.0	1	18.00	36.00	0.27	36.27	25.00	50.00	14.00	1.24	1.24
1.2	2	24.00	48.00	0.41	48.41	32.00	64.00	16.00	1.41	1.42
1.4	2	21.00	42.00	0.41	42.41	27.00	54.00	12.00	1.06	1.07
1.6	2	34.00	68.00	0.41	68.41	51.00	102.00	34.00	3.01	3.01
1.8	2	36.00	72.00	0.41	72.41	75.00	150.00	78.00	6.90	6.90
2.0	2	83.00	166.00	0.41	166.41	117.00	234.00	68.00	6.01	6.02
2.2	3	90.00	180.00	0.54	180.54	119.00	238.00	58.00	5.13	5.13
2.4	3	103.00	206.00	0.54	206.54	127.00	254.00	48.00	4.24	4.25

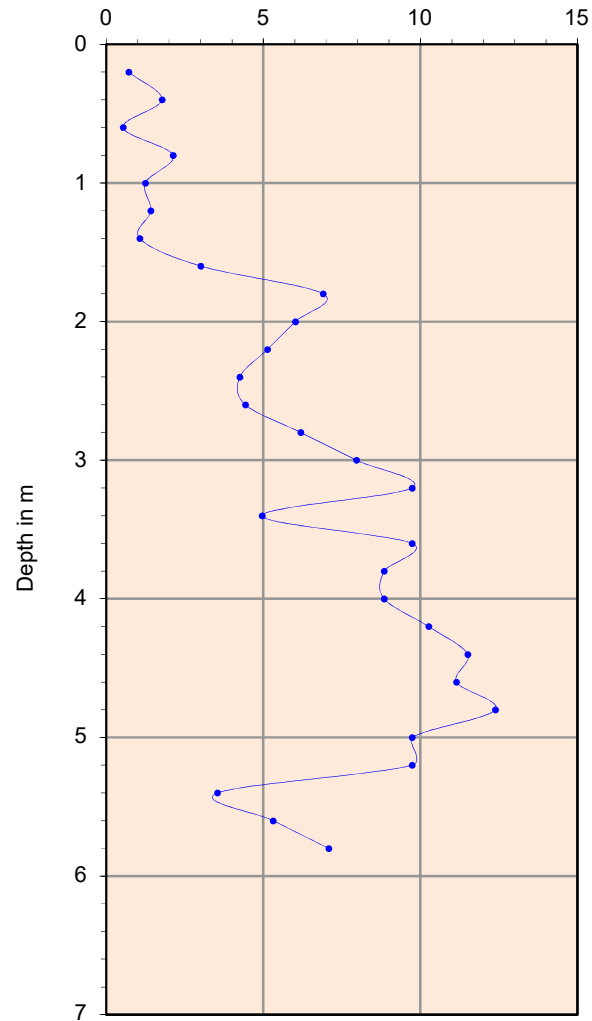
Depth	Number of rods in use	Gauge reading of Cone Penetration	Cone Penetration Resistance	Correction Factor	Corrected Value of Cone Resistance	Gauge Reading of Cone + Jacket Resistance	Cone + Jacket Resistance	Total Resistance - Cone Resistance	Frictional Resistance	Corrected Frictional Resistance
m		(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)	(kg / cm ²)
2.6	3	111.00	222.00	0.54	222.54	136.00	272.00	50.00	4.42	4.43
2.8	3	120.00	240.00	0.54	240.54	155.00	310.00	70.00	6.19	6.20
3.0	3	135.00	270.00	0.54	270.54	180.00	360.00	90.00	7.96	7.96
3.2	4	140.00	280.00	0.68	280.68	195.00	390.00	110.00	9.73	9.73
3.4	4	142.00	284.00	0.68	284.68	170.00	340.00	56.00	4.95	4.96
3.6	4	130.00	260.00	0.68	260.68	185.00	370.00	110.00	9.73	9.73
3.8	4	155.00	310.00	0.68	310.68	205.00	410.00	100.00	8.84	8.85
4.0	4	145.00	290.00	0.68	290.68	195.00	390.00	100.00	8.84	8.85
4.2	5	147.00	294.00	0.81	294.81	205.00	410.00	116.00	10.26	10.26
4.4	5	150.00	300.00	0.81	300.81	215.00	430.00	130.00	11.50	11.50
4.6	5	157.00	314.00	0.81	314.81	220.00	440.00	126.00	11.14	11.15
4.8	5	160.00	320.00	0.81	320.81	230.00	460.00	140.00	12.38	12.39
5.0	5	180.00	360.00	0.81	360.81	235.00	470.00	110.00	9.73	9.73
5.2	6	205.00	410.00	0.95	410.95	260.00	520.00	110.00	9.73	9.73
5.4	6	260.00	520.00	0.95	520.95	280.00	560.00	40.00	3.54	3.54
5.6	6	310.00	620.00	0.95	620.95	340.00	680.00	60.00	5.31	5.31
5.8	6	330.00	660.00	0.95	660.95	370.00	740.00	80.00	7.07	7.08

Static Cone Penetration Test No. 10

Cone Resistance

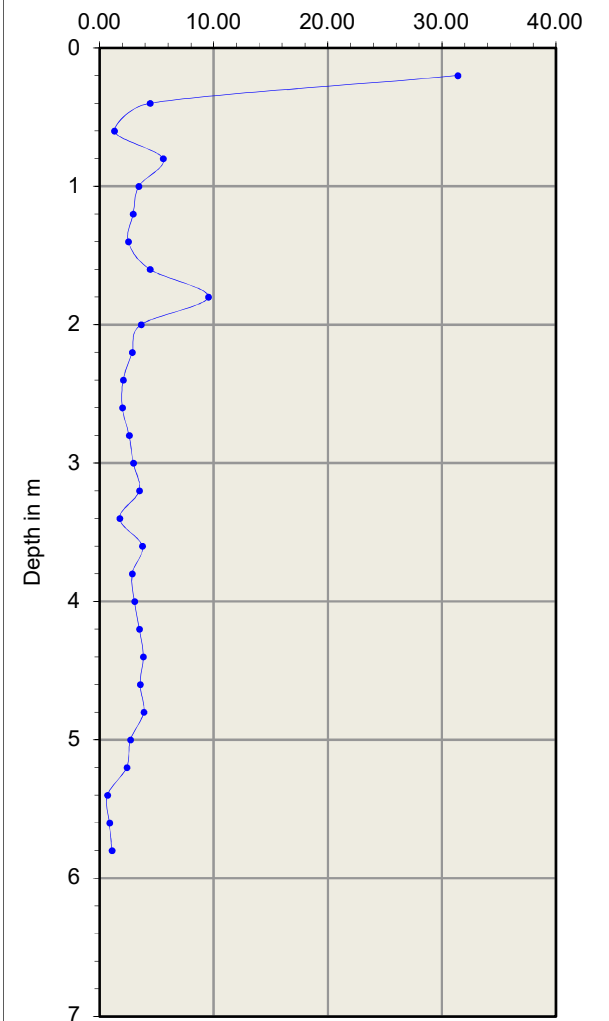
qc in kg / cm²

Frictional Resistance

fc in kg / cm²

Frictional Ratio

fr in %



2. Dynamic Cone Penetration Test (DCPT):

2.1 Methodology:

Fifteen number of Dynamic Cone Penetration Test (DCPT) was conducted to assess soil stratification, density, bearing capacity, and other geotechnical properties. The test was performed by driving a standard-sized cone, attached to a string of drill rods, into the ground. The test proceeded to the specified depth or was terminated earlier if the number of blows exceeded 35 for every 100 mm of penetration when the cone was driven dry, or 20 blows for every 100 mm of penetration when bentonite was circulated to aid penetration. This limitation was enforced to prevent damage to the equipment.

The DCPT was performed using a 62.5 mm cone, in accordance with IS: 4968 (Part I). A 65 kg hammer, falling from a height of 75 cm, was used to drive the cone, and the number of blows required for every 10 cm of penetration was recorded. The number of blows required for 30 cm of penetration was taken as the dynamic cone resistance (N_c). This test is crucial, as it allows for reliable interpolation of soil characteristics between borehole locations using correlations derived from the blow counts.

The results were presented as a continuous record of the number of blows required for every 300 mm of cone penetration. This data was provided in a suitable chart and supplemented by a graphical plot of the blow count for each 300 mm penetration versus depth.

2.2 Recommendations:

1. DCPT test were conducted till refusal depth. The relationship between the N_{cbr} and N_{vle} is summarized as below.

Sr No.	For Depth (m)	N_{cbr}
1	0.0-3.0	1.20N
2	3.0-6.0	2.00N
3	Above 6.0	2.00N

Note: For determination of above correlations the nearest borehole to each of the DCPT locations were considered.

KCT Consultancy Services, Ahmedabad

Dynamic Cone Penetration Tests**IS : 4968 (Part 1), 2002**

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha .

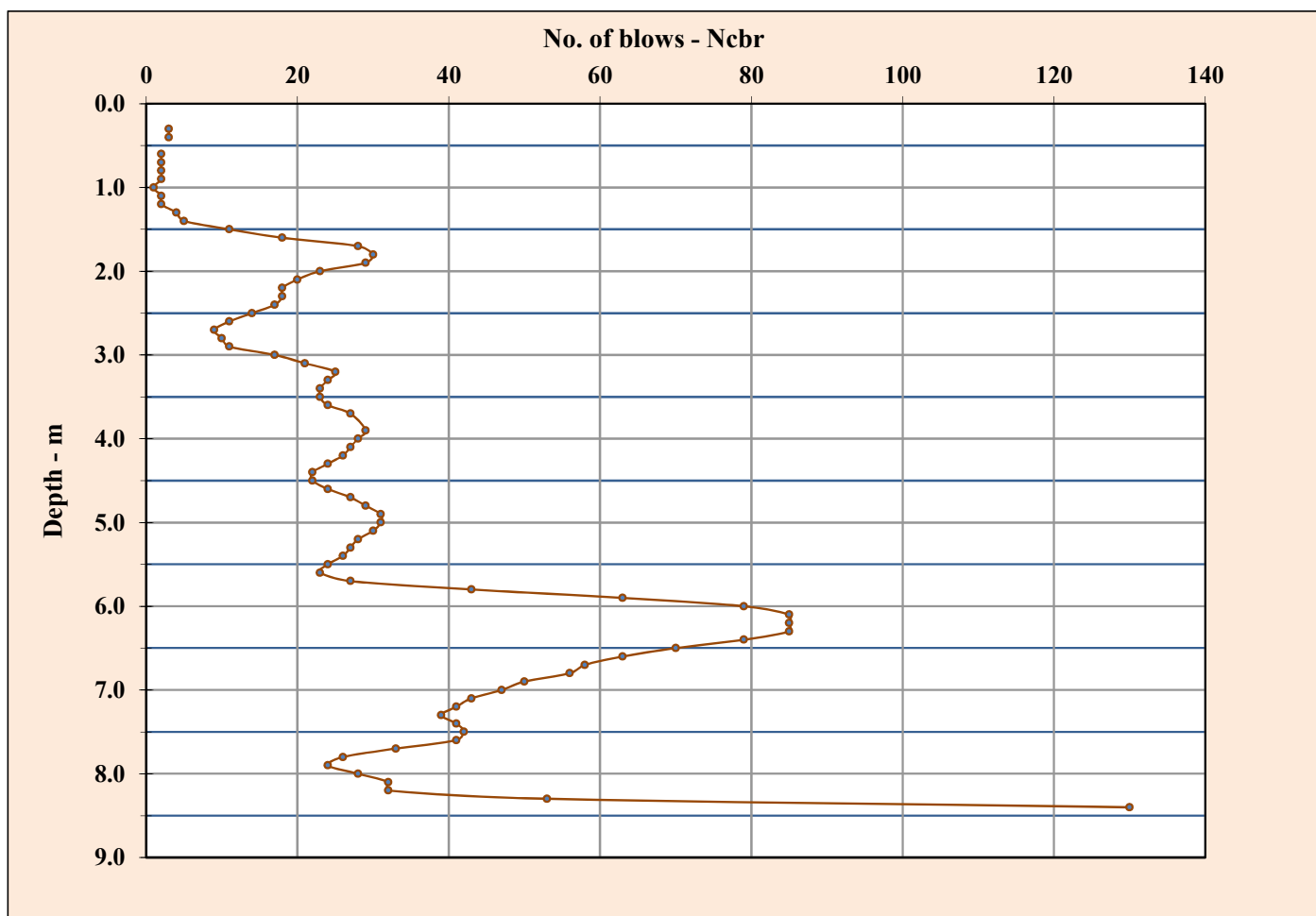
DCPT No. : DCPT-01

Diameter of Cone : 50 mm

Date : 19-07-2024

RL: 207.30m

Co-ordinates : E 1525 ,N 3515

**Notes :-**

1) There was no interruption in probing at any location.

For KCT Consultancy Services

(Dr. K. K. Thaker)

KCT Consultancy Services, Ahmedabad

Dynamic Cone Penetration Tests**IS : 4968 (Part 1), 2002**

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

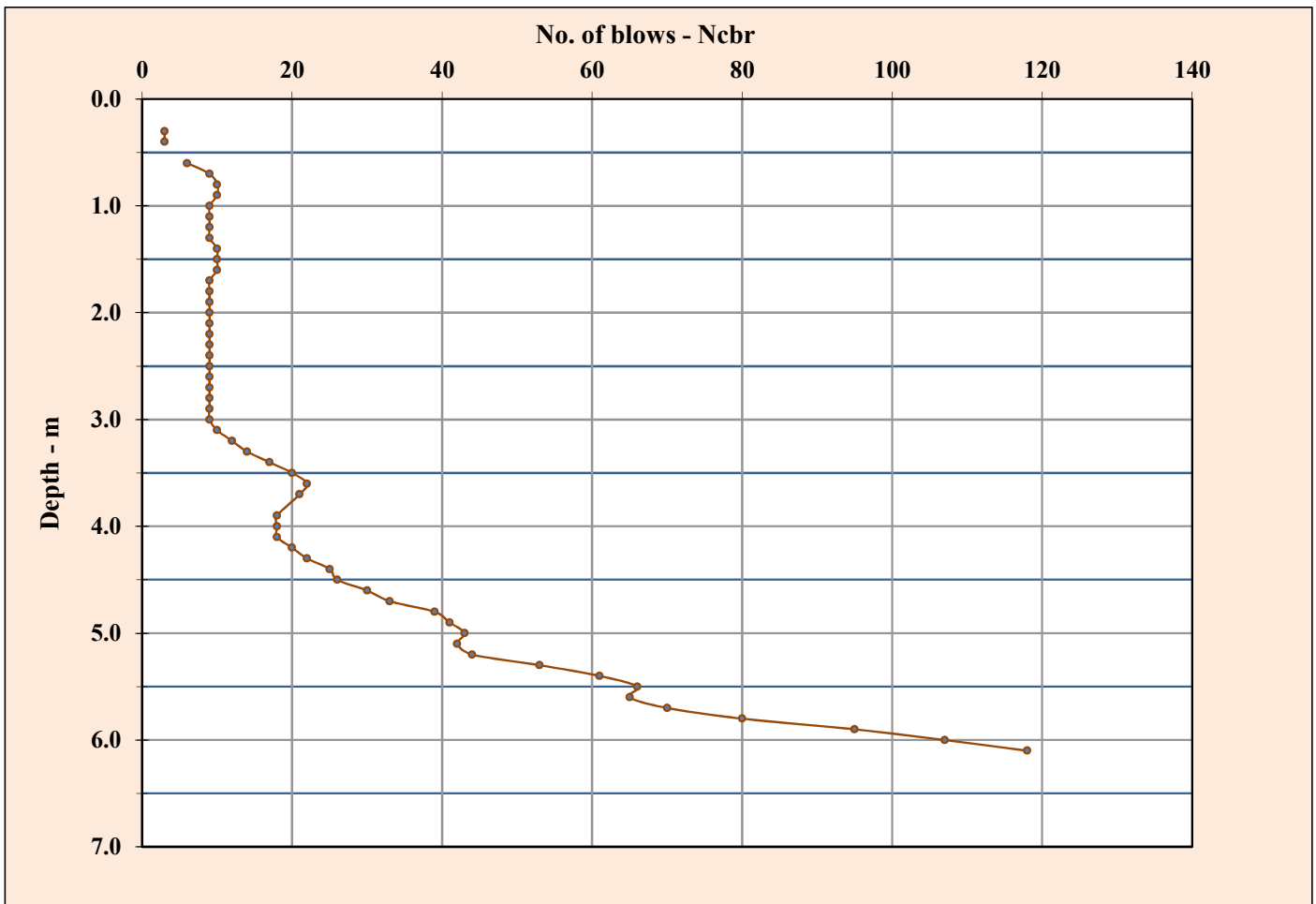
DCPT No. : DCPT-02

Diameter of Cone : 50 mm

Date : 19-07-2024

RL: 200.9m

Co-ordinates : E 1240 ,N 3338

**Notes :-**

1) There was no interruption in probing at any location.

For KCT Consultancy Services

(Dr. K. K. Thaker)

KCT Consultancy Services, Ahmedabad

Dynamic Cone Penetration Tests**IS : 4968 (Part 1), 2002**

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

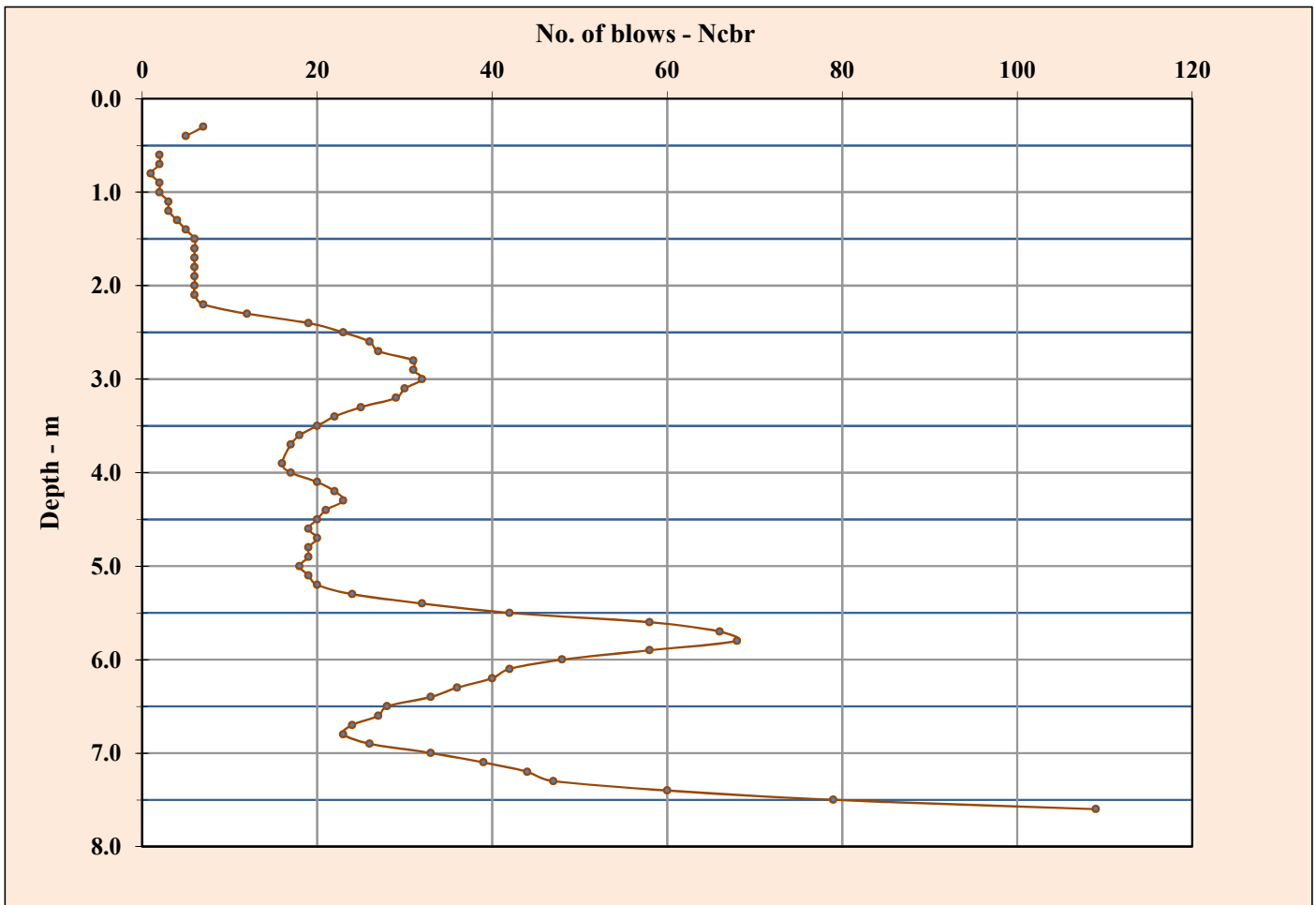
DCPT No. : DCPT-03

Diameter of Cone : 50 mm

Date : 18-07-2024

RL 207.72m

Co-ordinates : E 1647 ,N 3283

**Notes :-**

1) There was no interruption in probing at any location.

For KCT Consultancy Services**(Dr. K. K. Thaker)**

KCT Consultancy Services, Ahmedabad

Dynamic Cone Penetration Tests**IS : 4968 (Part 1), 2002**

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

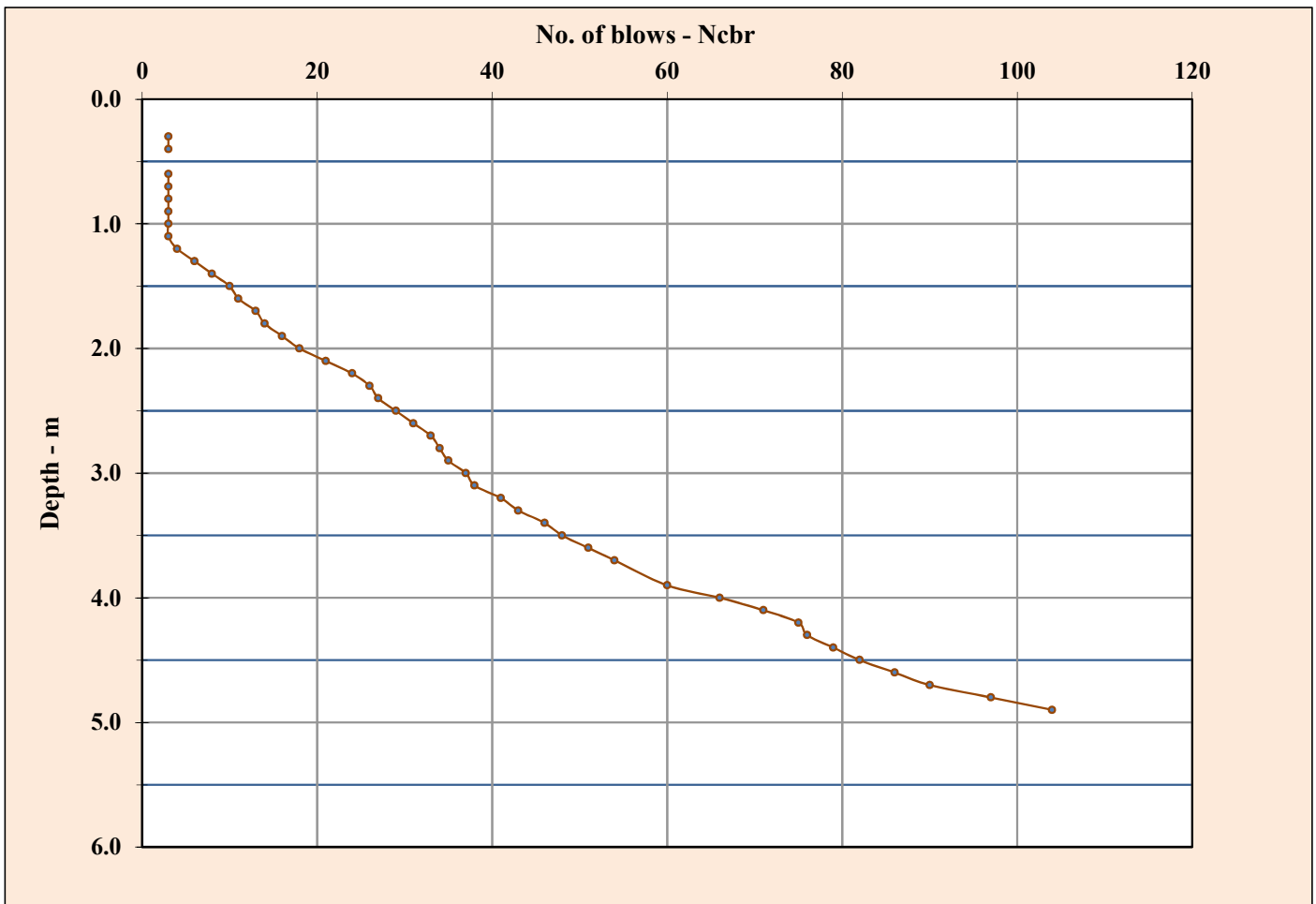
DCPT No. : DCPT-04

Diameter of Cone : 50 mm

Date : 12-01-2025

RL 197.58m

Co-ordinates : E 1127, N 3171

**Notes :-**

1) There was no interruption in probing at any location.

For KCT Consultancy Services**(Dr. K. K. Thaker)**

KCT Consultancy Services, Ahmedabad

Dynamic Cone Penetration Tests**IS : 4968 (Part 1), 2002**

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

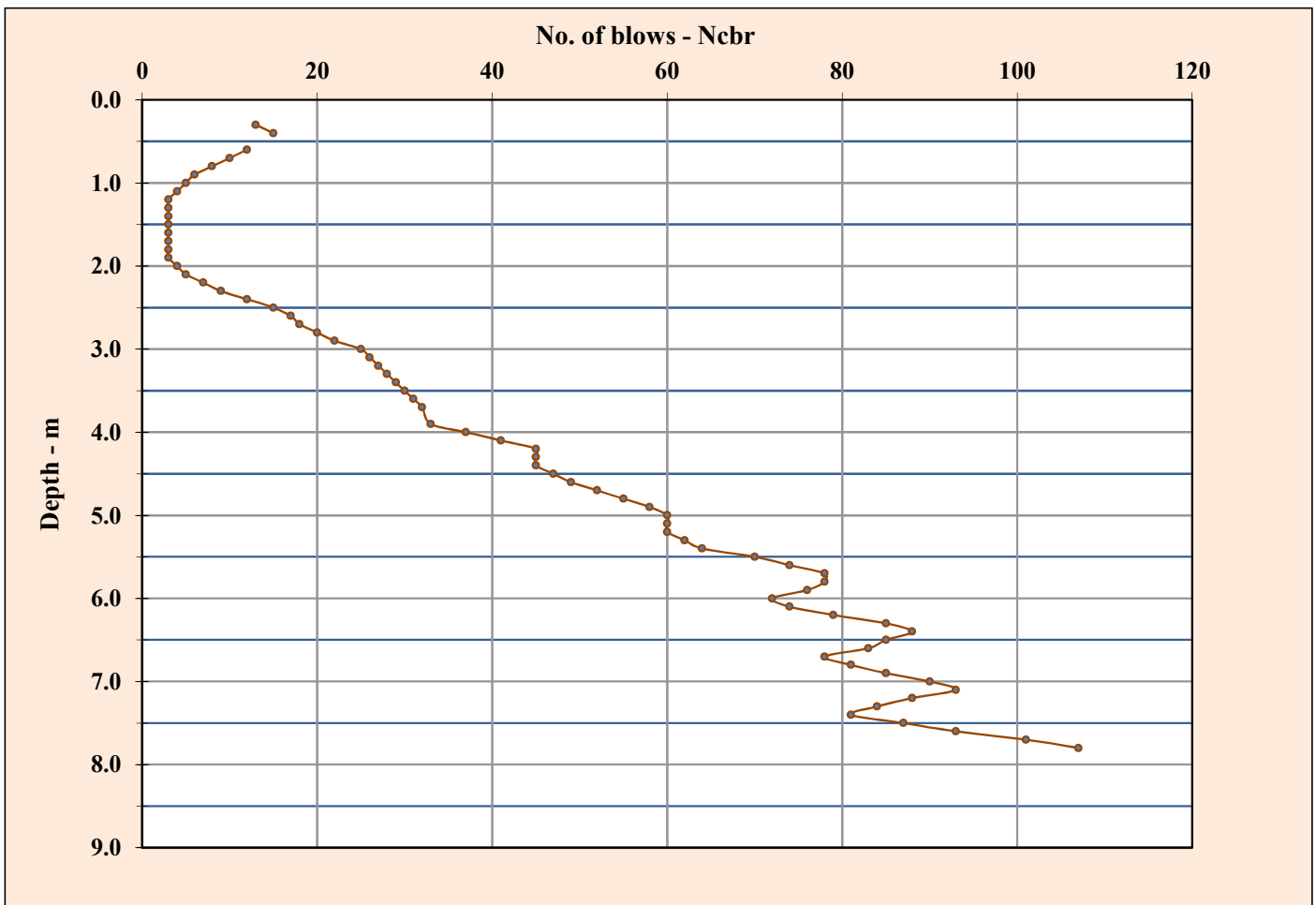
DCPT No. : DCPT-05

Diameter of Cone : 50 mm

Date : 30-12-2024

RL 198.86m

Co-ordinates : E 1027 ,N 3127

**Notes :-**

1) There was no interruption in probing at any location.

For KCT Consultancy Services**(Dr. K. K. Thaker)**

KCT Consultancy Services, Ahmedabad**Dynamic Cone Penetration Tests**

IS : 4968 (Part 1), 2002

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

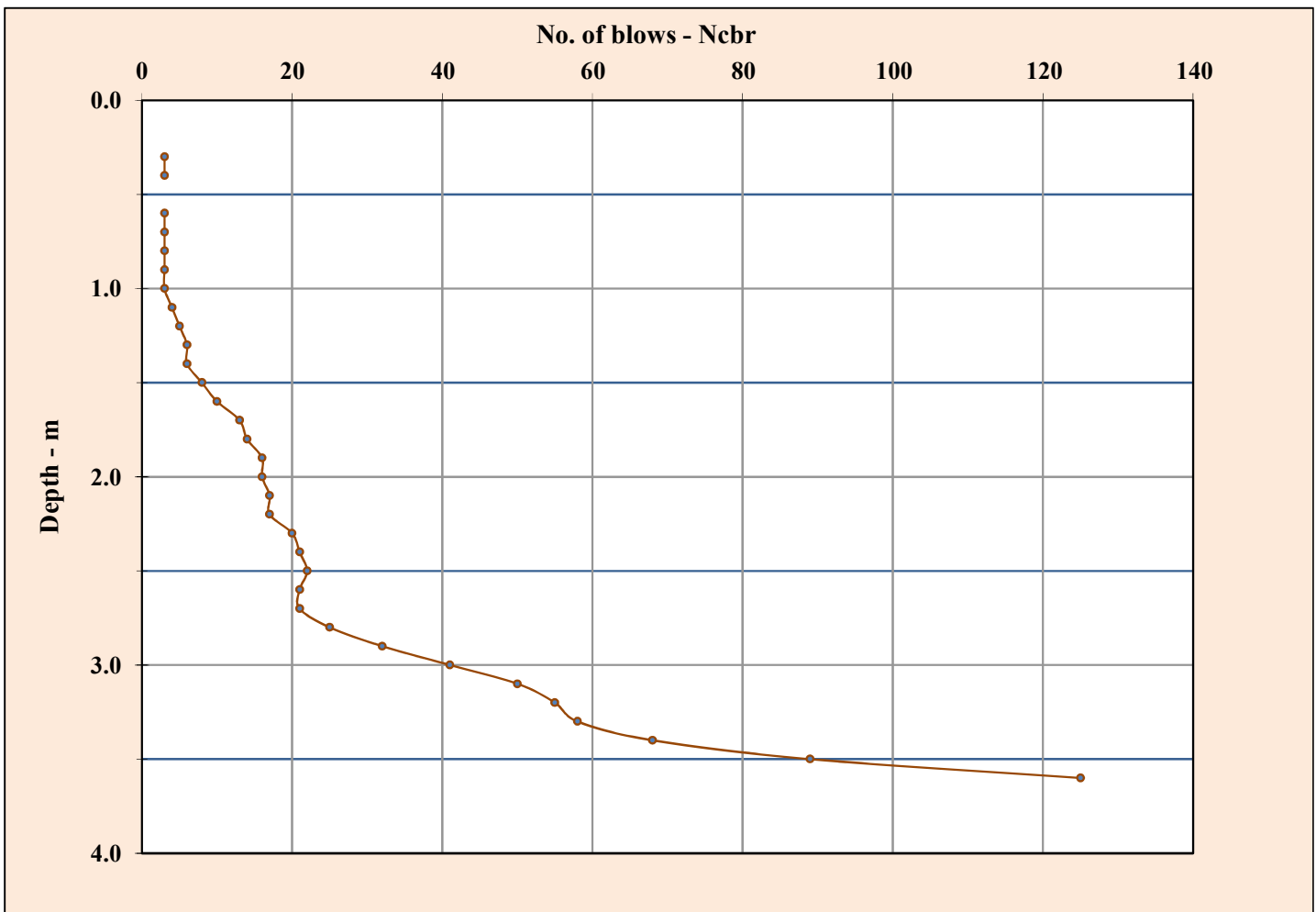
DCPT No. : DCPT-06

Diameter of Cone : 50 mm

Date : 09-04-2025

RL: 195.80m

Co-ordinates : E 1230 ,N 3092

**Notes :-**

1) There was no interruption in probing at any location.

For KCT Consultancy Services

(Dr. K. K. Thaker)

KCT Consultancy Services, Ahmedabad**Dynamic Cone Penetration Tests**

IS : 4968 (Part 1), 2002

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

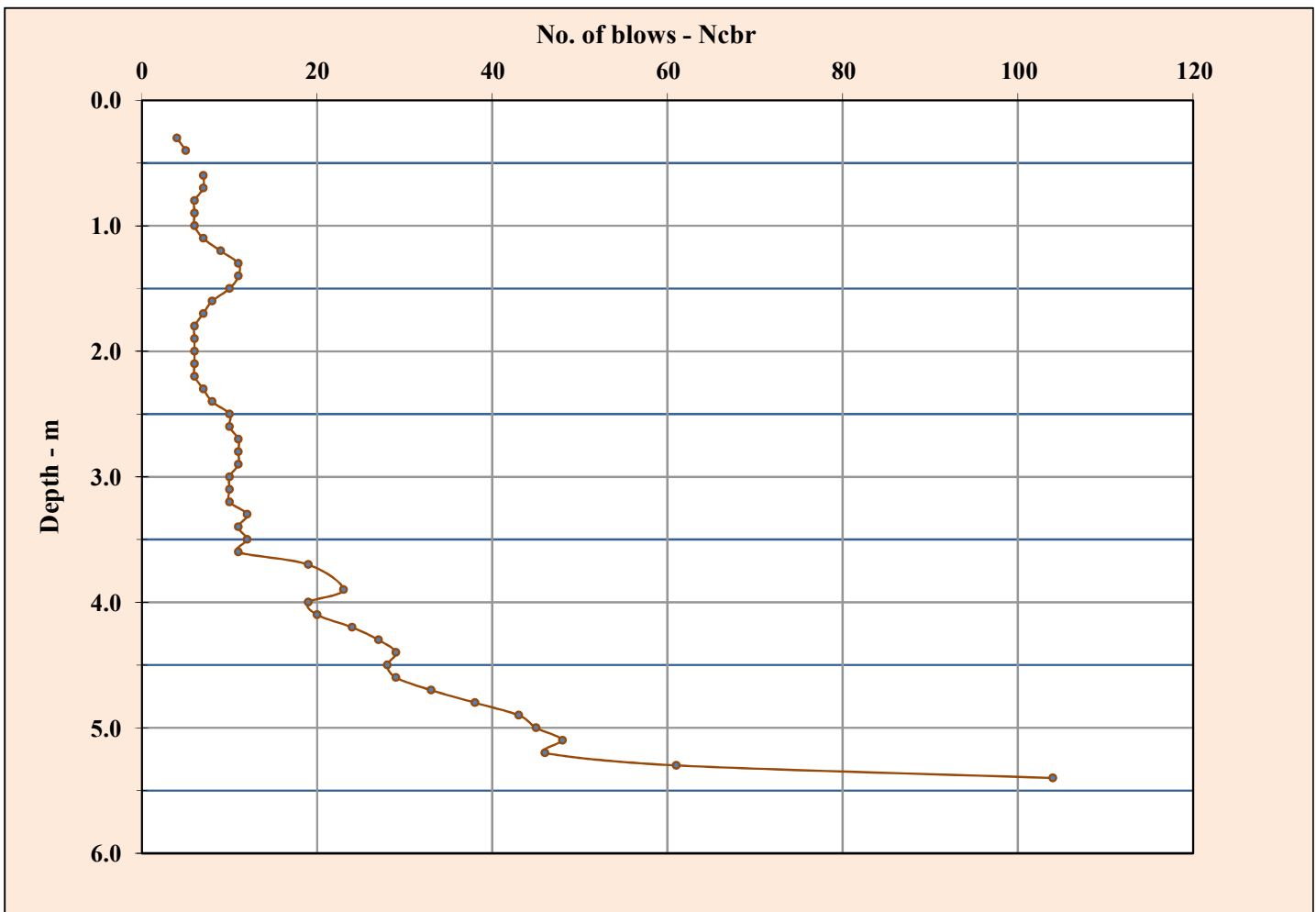
DCPT No. : DCPT-07

Diameter of Cone : 50 mm

Date : 09-04-2025

RL: 199.40m

Co-ordinates : E 1244 ,N 2984

**Notes :-**

1) There was no interruption in probing at any location.

For KCT Consultancy Services

(Dr. K. K. Thaker)

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Dynamic Cone Penetration Tests**IS : 4968 (Part 1), 2002**

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

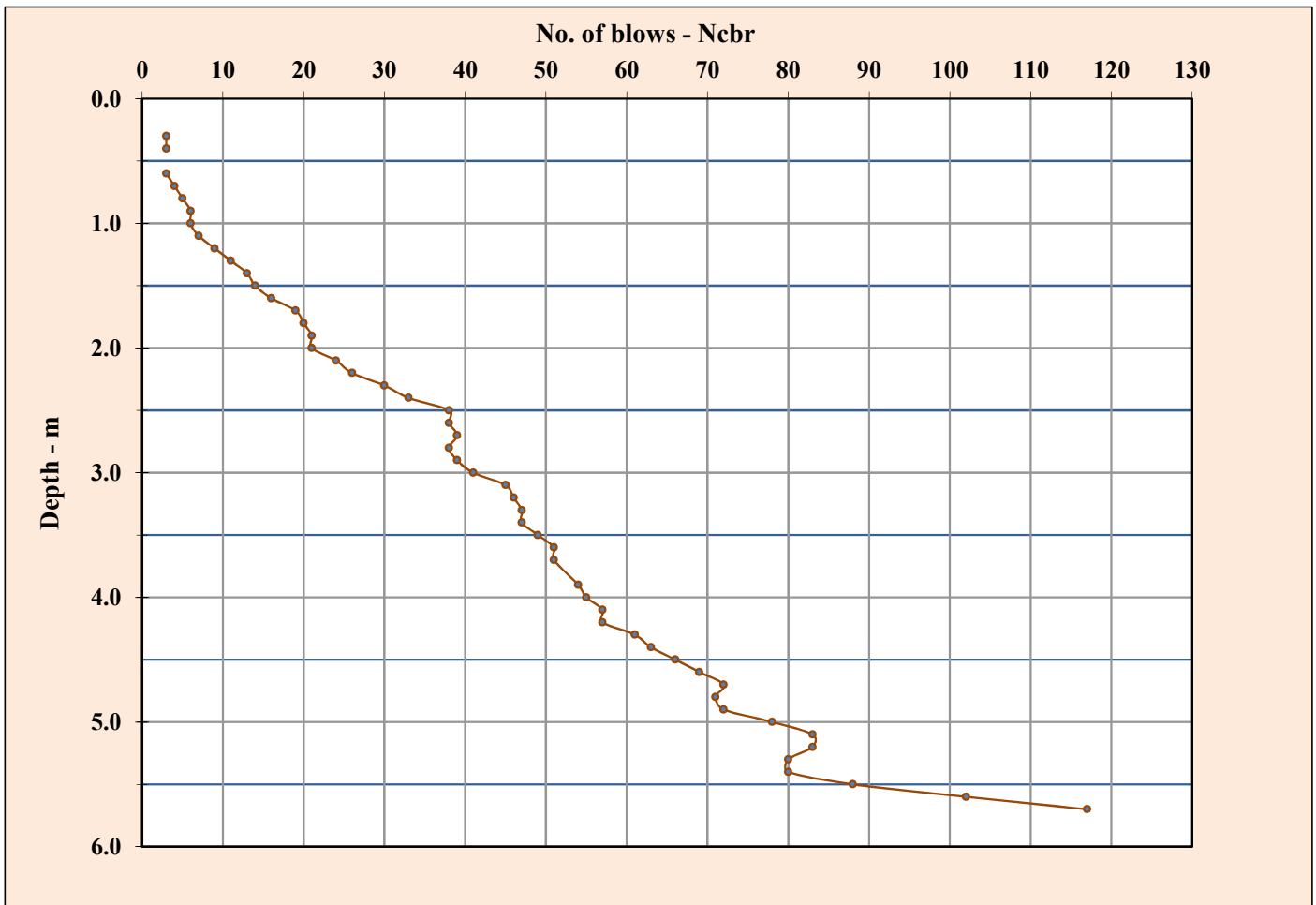
DCPT No. : DCPT-08

Diameter of Cone : 50 mm

Date : 03-09-2024

RL 199.32m

Co-ordinates : E 1025, N 2972

**Notes :-**

1) There was no interruption in probing at any location.

For KCT Consultancy Services**(Dr. K. K. Thaker)**

KCT Consultancy Services, Ahmedabad

Dynamic Cone Penetration Tests**IS : 4968 (Part 1), 2002**

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

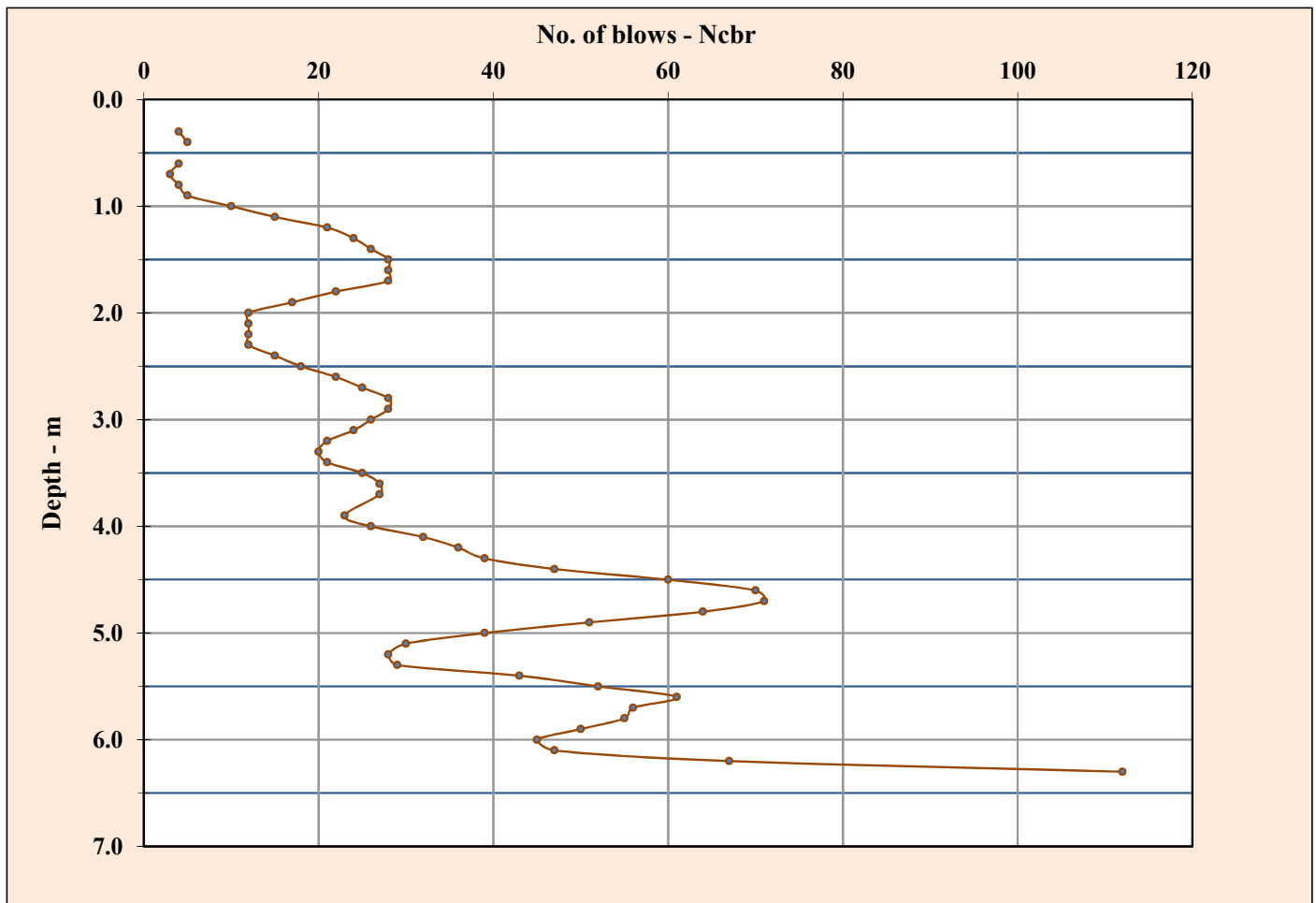
DCPT No. : DCPT-09

Diameter of Cone : 50 mm

Date : 11-01-2025

RL 202.75m

Co-ordinates : E 1919, N 2892

**Notes :-**

1) There was no interruption in probing at any location.

For KCT Consultancy Services

(Dr. K. K. Thaker)

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Dynamic Cone Penetration Tests**IS : 4968 (Part 1), 2002**

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

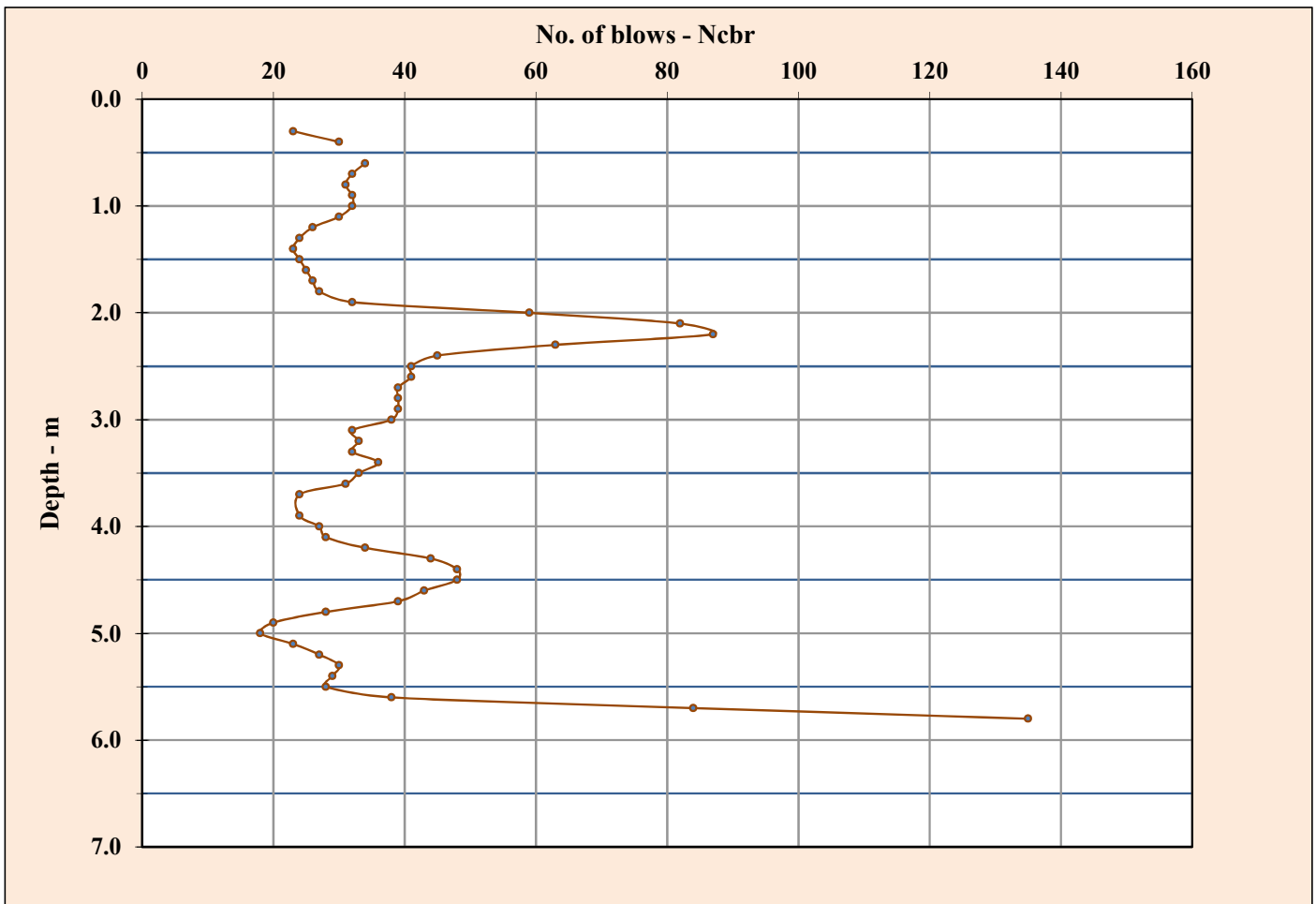
DCPT No. : DCPT-10

Diameter of Cone : 50 mm

Date : 11-01-2025

RL 203.33m

Co-ordinates : E 1915, N 2257

**Notes :-**

1) There was no interruption in probing at any location.

For KCT Consultancy Services**(Dr. K. K. Thaker)**

KCT Consultancy Services, Ahmedabad

Dynamic Cone Penetration Tests**IS : 4968 (Part 1), 2002**

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

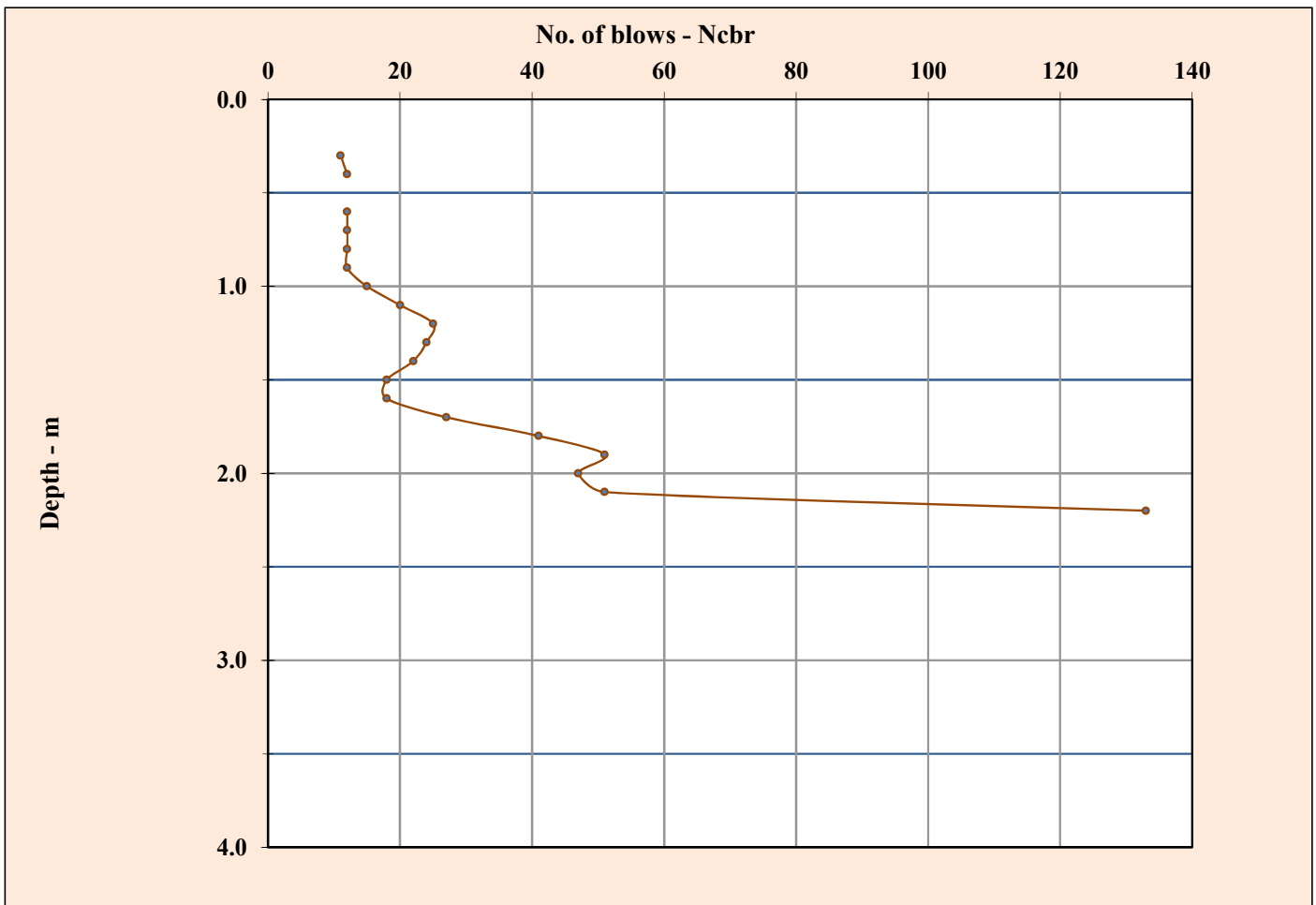
DCPT No. : IDCPT 01

Diameter of Cone : 50 mm

Date : 19-07-2024

RL 203.42m

Co-ordinates : E 1433 ,N 3762

**Notes :-**

1) There was no interruption in probing at any location.

For KCT Consultancy Services**(Dr. K. K. Thaker)**

KCT Consultancy Services, Ahmedabad

Dynamic Cone Penetration Tests**IS : 4968 (Part 1), 2002**

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

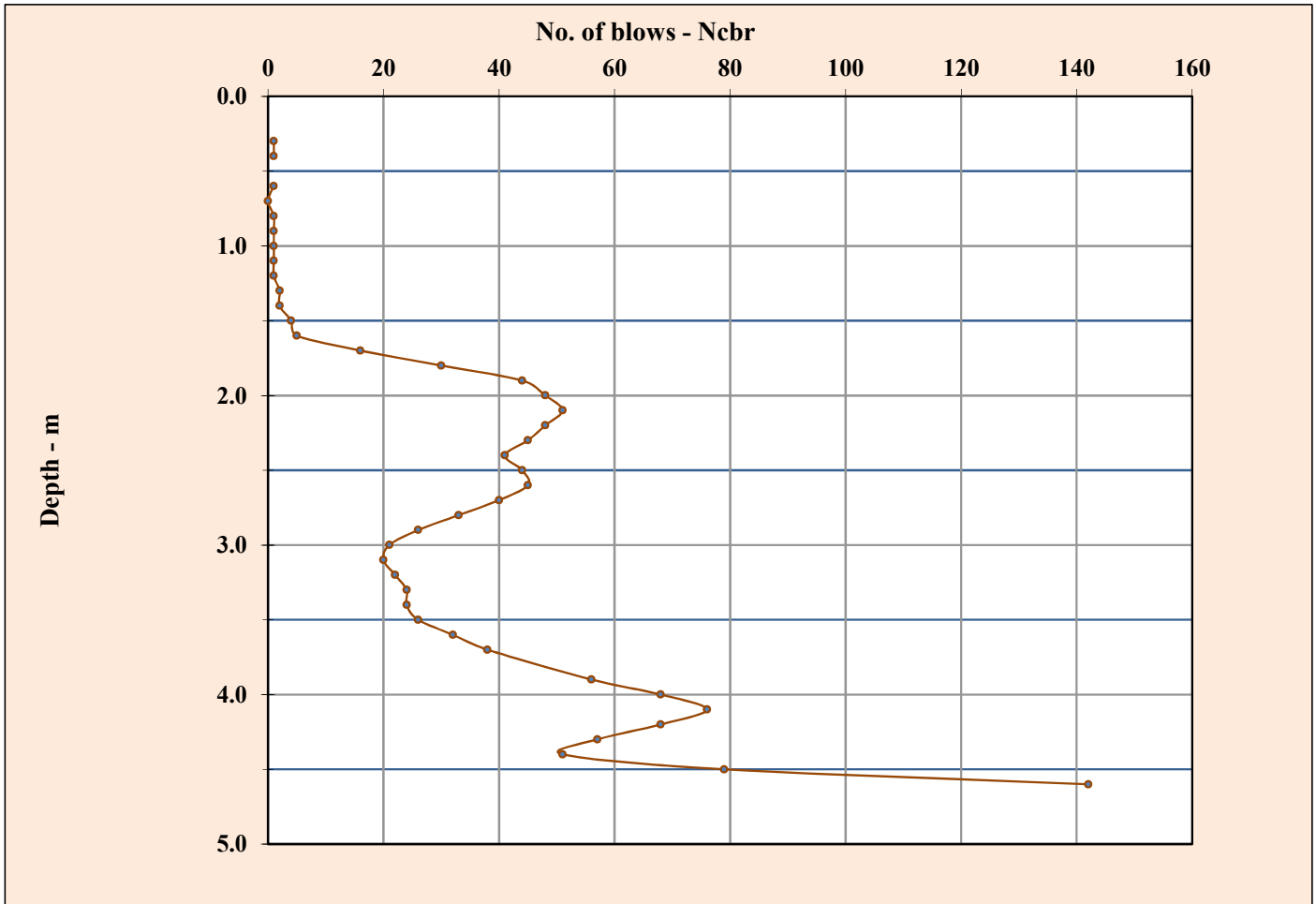
DCPT No. : IDCPT 02

Diameter of Cone : 50 mm

Date : 19-07-2024

RL 208.43m

Co-ordinates : E 1561 ,N 3599

**Notes :-**

1) There was no interruption in probing at any location.

For KCT Consultancy Services

(Dr. K. K. Thaker)

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Dynamic Cone Penetration Tests**IS : 4968 (Part 1), 2002**

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

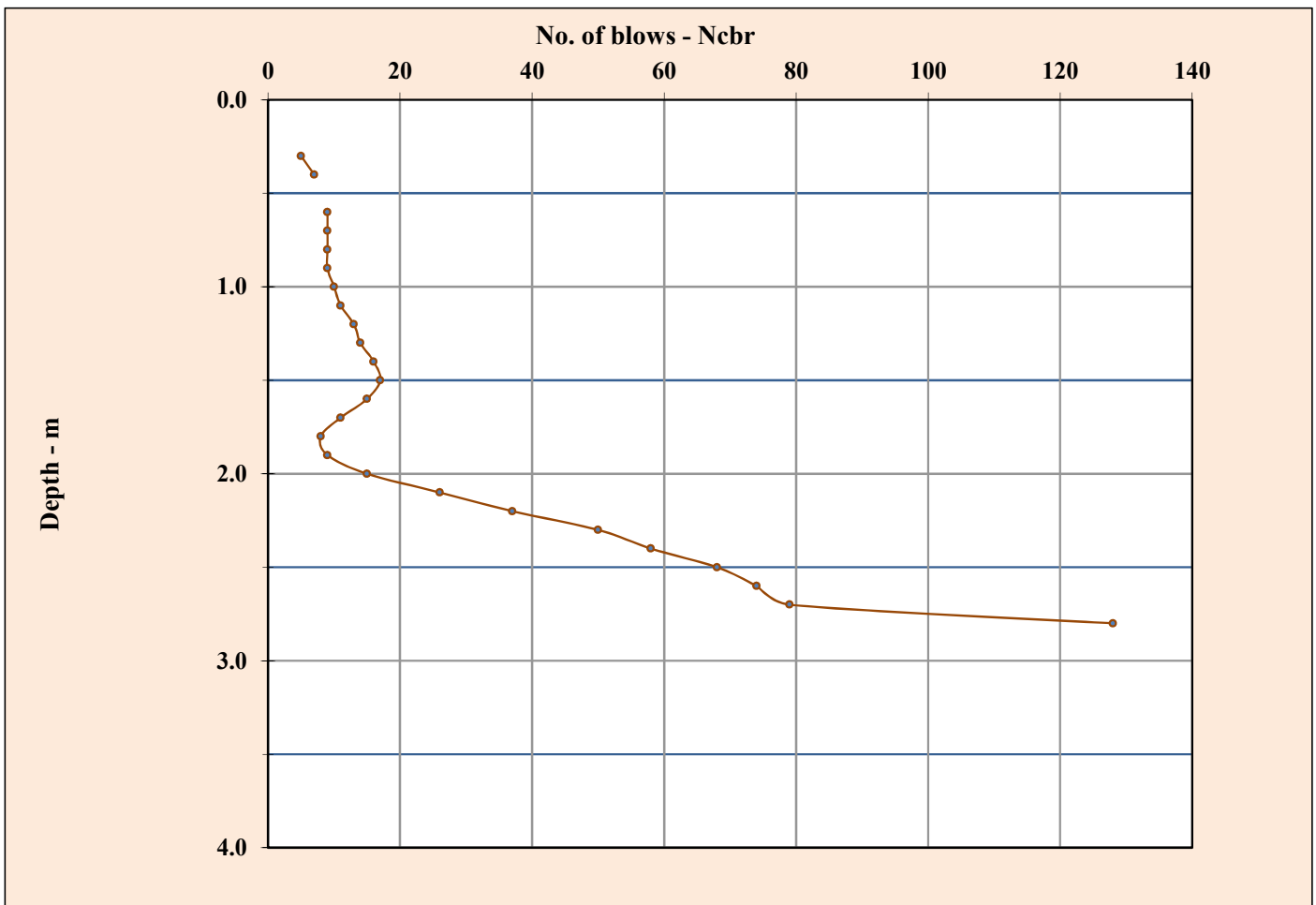
DCPT No. : IDCPT 03

Diameter of Cone : 50 mm

Date : 19-07-2024

RL 194.24m

Co-ordinates : E 960 ,N 3752

**Notes :-**

1) There was no interruption in probing at any location.

For KCT Consultancy Services**(Dr. K. K. Thaker)**

KCT Consultancy Services, Ahmedabad

Dynamic Cone Penetration Tests**IS : 4968 (Part 1), 2002**

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

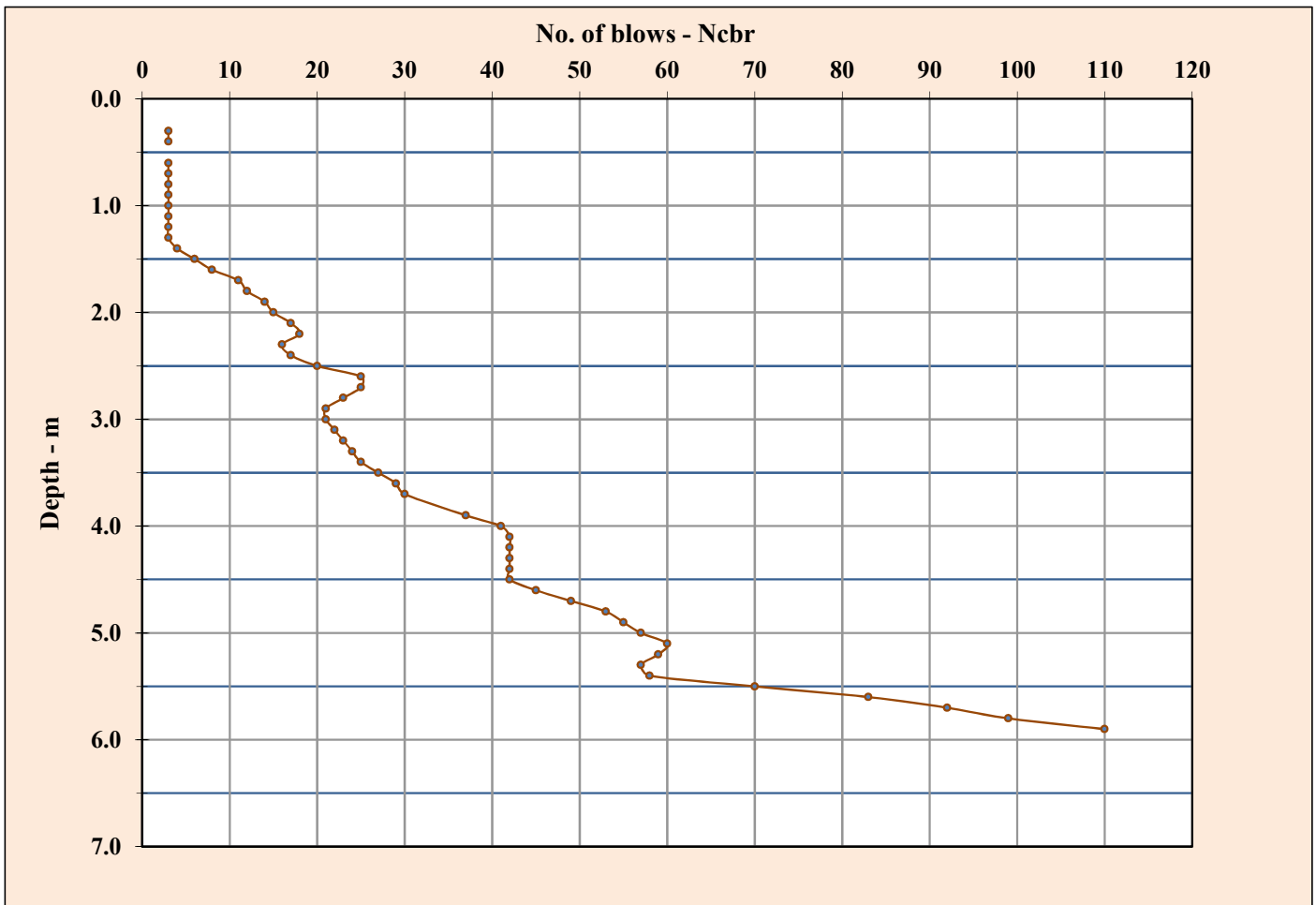
DCPT No. : IDCPT-04

Diameter of Cone : 50 mm

Date : 30-12-2024

RL 199.94m

Co-ordinates : E 1157 ,N 2964

**Notes :-**

1) There was no interruption in probing at any location.

For KCT Consultancy Services

(Dr. K. K. Thaker)

KCT Consultancy Services, Ahmedabad

Dynamic Cone Penetration Tests**IS : 4968 (Part 1), 2002**

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

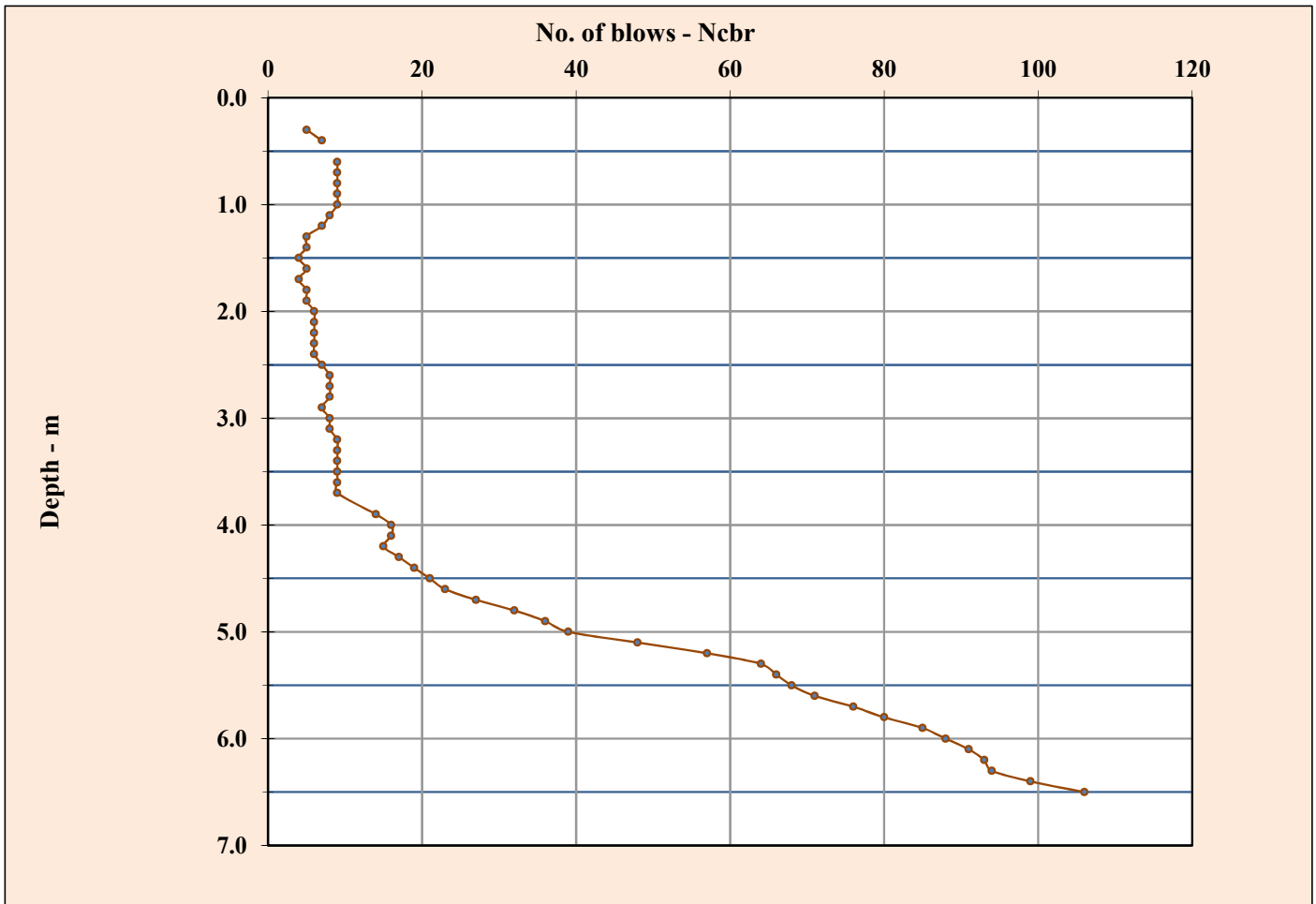
DCPT No. : IDCPT 05

Diameter of Cone : 50 mm

Date : 04-07-2024

RL 200.74m

Co-ordinates : E 1225 ,N 3307

**Notes :-**

1) There was no interruption in probing at any location.

For KCT Consultancy Services**(Dr. K. K. Thaker)**

KCT Consultancy Services, Ahmedabad

Dynamic Cone Penetration Tests**IS : 4968 (Part 1), 2002**

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

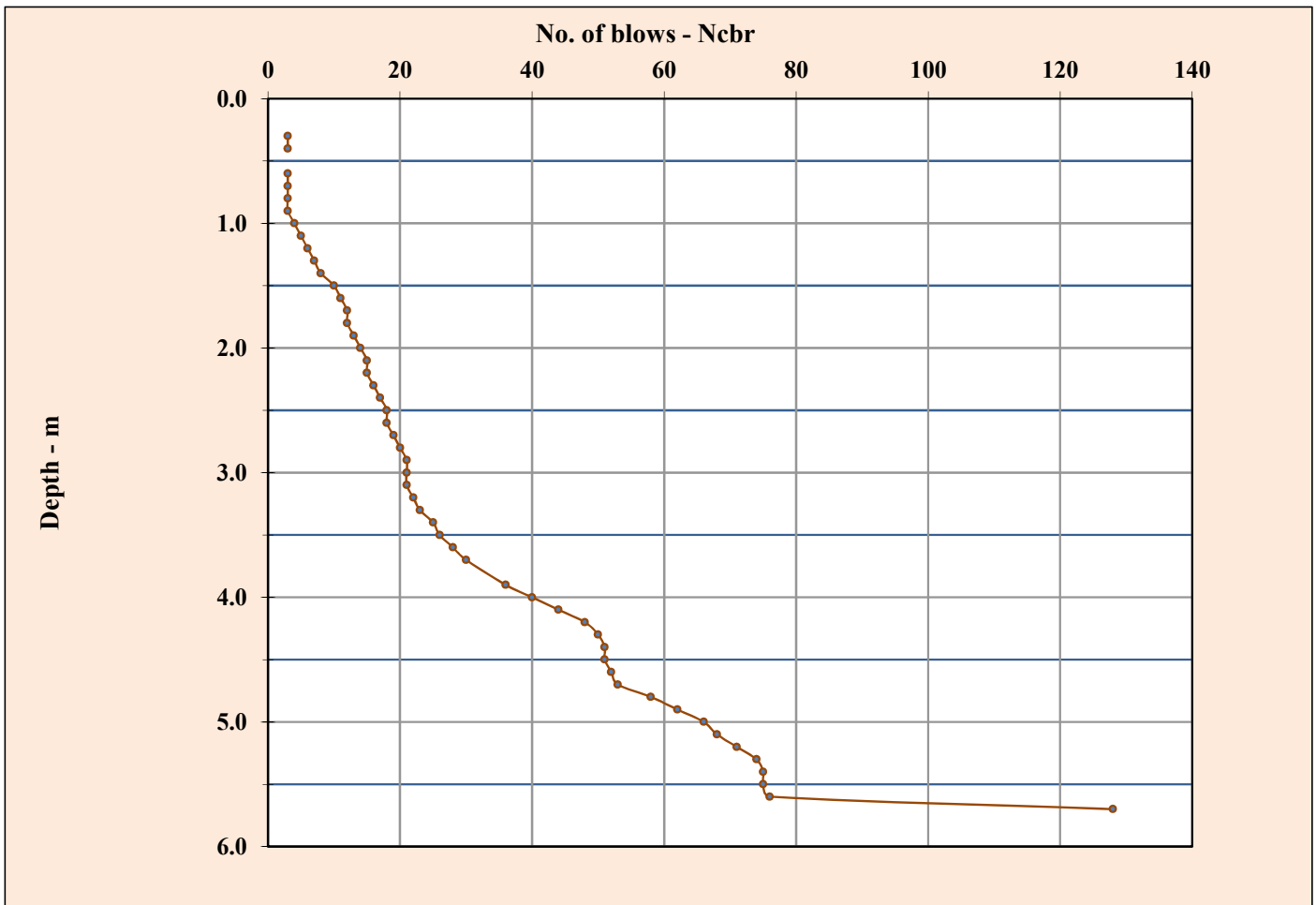
DCPT No. : IDCPT 06

Diameter of Cone : 50 mm

Date : 19-08-2024

RL 197.64m

Co-ordinates : E 766 , N 3194

**Notes :-**

1) There was no interruption in probing at any location.

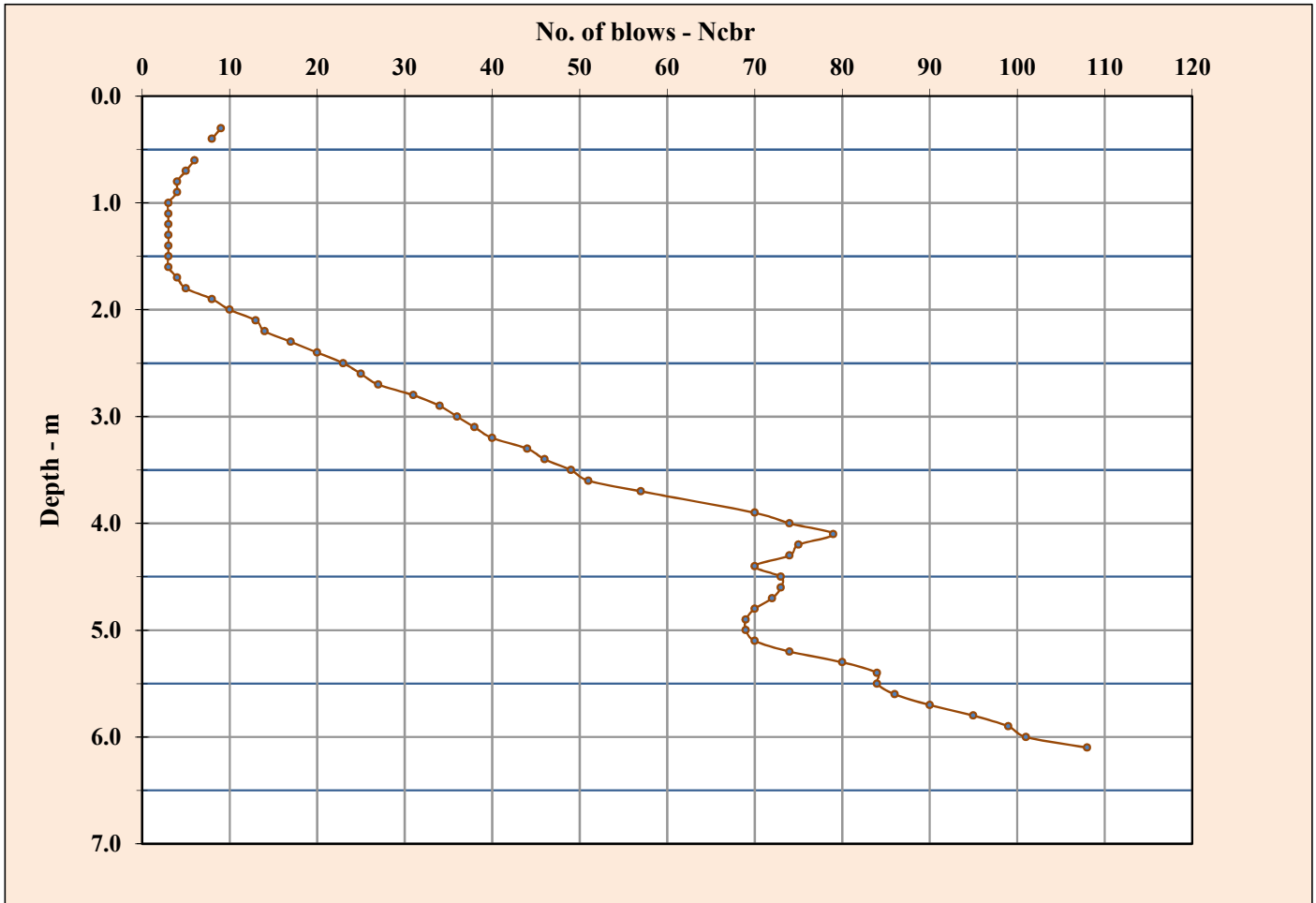
For KCT Consultancy Services

(Dr. K. K. Thaker)

KCT Consultancy Services, Ahmedabad

Dynamic Cone Penetration Tests**IS : 4968 (Part 1), 2002**

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha
 DCPT No. : IDCPT-07
 Diameter of Cone : 50 mm
 Date : 30-12-2024
 RL 197.10m
 Co-ordinates : E 767 ,N 3574

**Notes :-**

- 1) There was no interruption in probing at any location.

For KCT Consultancy Services**(Dr. K. K. Thaker)**

KCT Consultancy Services, Ahmedabad**Dynamic Cone Penetration Tests**

IS : 4968 (Part 1), 2002

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

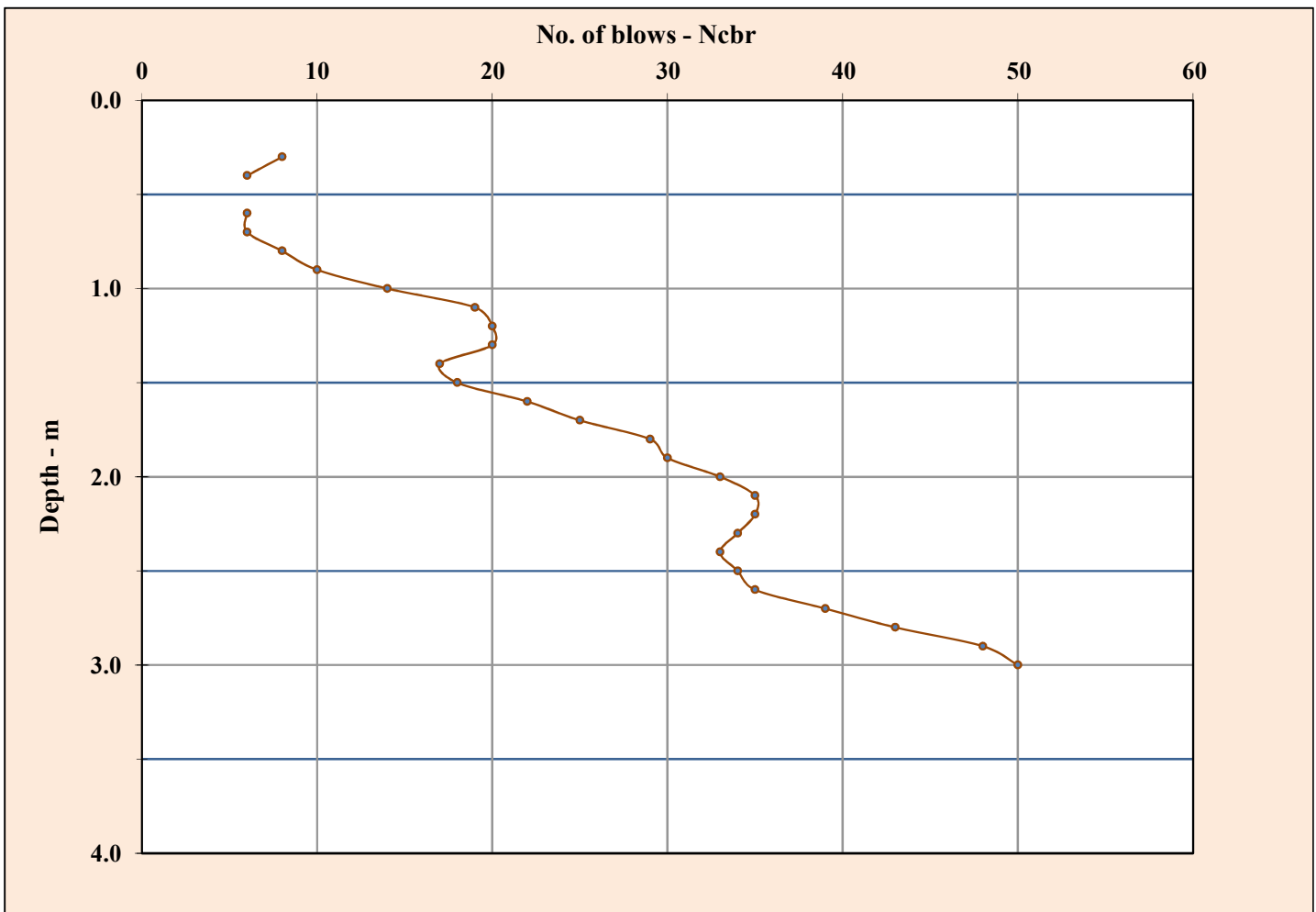
DCPT No. : IDCPT-08

Diameter of Cone : 50 mm

Date : 09-04-2025

RL: 197.69m

Co-ordinates : E 1220 ,N 3148

**Notes :-**

1) There was no interruption in probing at any location.

For KCT Consultancy Services

(Dr. K. K. Thaker)

3. Plate Load Test

3.1 Methodology:

The allowable bearing pressure was determined based on the geotechnical investigation data, which included the physical properties and strength characteristics of the encountered soils. While laboratory tests on samples were adequate, confirmatory field tests were essential for validating the design considerations.

The client proposed conducting a plate load test to determine the ultimate bearing capacity of the soil at the planned foundation level. Although the plate load test provided useful information about the soil, particularly for foundation design, it had limitations. These included varying plate sizes and the prototype foundation, with results reflecting only the soil characteristics at a depth of less than twice the plate's width. Since foundations are larger than the test plates, settlement and shear resistance depend on properties of a thicker stratum. Moreover, this method did not provide ultimate settlements, especially in cohesive soils, where consolidation settlements would take much longer than the test duration.

The test data might not represent granular soils with larger rock fragments or rocks due to mass heterogeneity. Thus, the results were used rationally, despite the test's simplicity and speed, which made it a preferred method.

For this confirmatory investigation phase, the following steps were performed: the plate load test was conducted at eight locations, undisturbed and disturbed soil samples were collected, and the results were analysed. The work was carried out following the provisions and guidelines of IS: 1888.

The procedure was carried out using a built-up RSJ for reaction loading, anchored with spikes. A hydraulic jack was used for load application, and settlement was measured using two calibrated dial gauges. The test plates were square, with a side length of 45 cm, made of mild steel. The test arrangement ensured proper alignment and levelling, and a minimum seating pressure of 0.70 kg/cm² was applied before starting the load test. Load increments were applied in stages, with the maximum load set at 2500 kN/sqm, and settlement readings were recorded at specific intervals. The load was increased until one of two conditions occurred: either the settlement reached 40 mm or more, or a load intensity of 800 kN/sqm was achieved. The results were analysed by plotting a load-settlement curve, and the ultimate bearing capacity was determined from the curve. In cases where the yield point was not well defined, the allowable bearing pressure was determined based on the allowable settlement.

3.2 Recommendations:

The summary of the allowable bearing pressure and modulus of subgrade reaction in each of the plate load test location are as follows,

Sr No	Test No	Location	Co-Ordinates	RL at Existing Ground Level (m)	RL at test Level (m)	Width of Foundation (m)	Allowable bearing pressure Suggested from PLT (t/m ²)	Modulus of Subgrade reaction for 0.45m*0.45m Plate (t/m ³)	Modulus of Subgrade reaction for 2.0m*2.0m Footing (t/m ³)
1	IPLT-01	Crushed coal stock pile, Stacker reclaimers, Wind barrier	N-3757 E-1311	202.60	201.40	2.00	27.50	10100	5052
2	IPLT-02	Bio mass handling system	N-3617 E-1087	199.04	197.54	2.00	24.50	9000	4502
3	IPLT-03	HCSD Slurry pipe corridor	N-2235 E-841	198.54	194.54	2.00	9.00	4000	2001
4	IPLT-04	HCSD Slurry pipe corridor	N-1119 E-892	196.20	192.20	2.00	21.33	1000	500
5	PLT-01	Transformer yard	N-3013 E-1333	200.40	198.40	2.00	16.00	1300	651
6	PLT-02	Gate Complex, Security and time office, parking shed	N-2872 E-1929	202.09	199.09	2.00	21.96	4200	2101
7	PLT-03	IDCT-1 & 2 area	N-2568 E-1673	204.20	202.20	2.00	21.07	4800	2401
8	PLT-04	IDCT-3 area	N-2197 E-1450	202.15	199.15	2.00	21.33	4800	2401

Note: The allowable bearing pressure determined by plate load test is extremely locational specific meaning the test reflects the bearing pressure at a given location and depth. It can be believed that there can be wide variation in the soil properties within a distance of 50m considering which IS code prescribed boreholes at distance not exceeds 50m. In the vast site the allowable bearing pressure suggestions based on exploratory borehole is for a sector in which the weakest data amongst the borehole is considered. Whereas the plate load test may or may not be very close to that borehole and therefore there can be variation in the suggested bearing pressure found by plate load test.

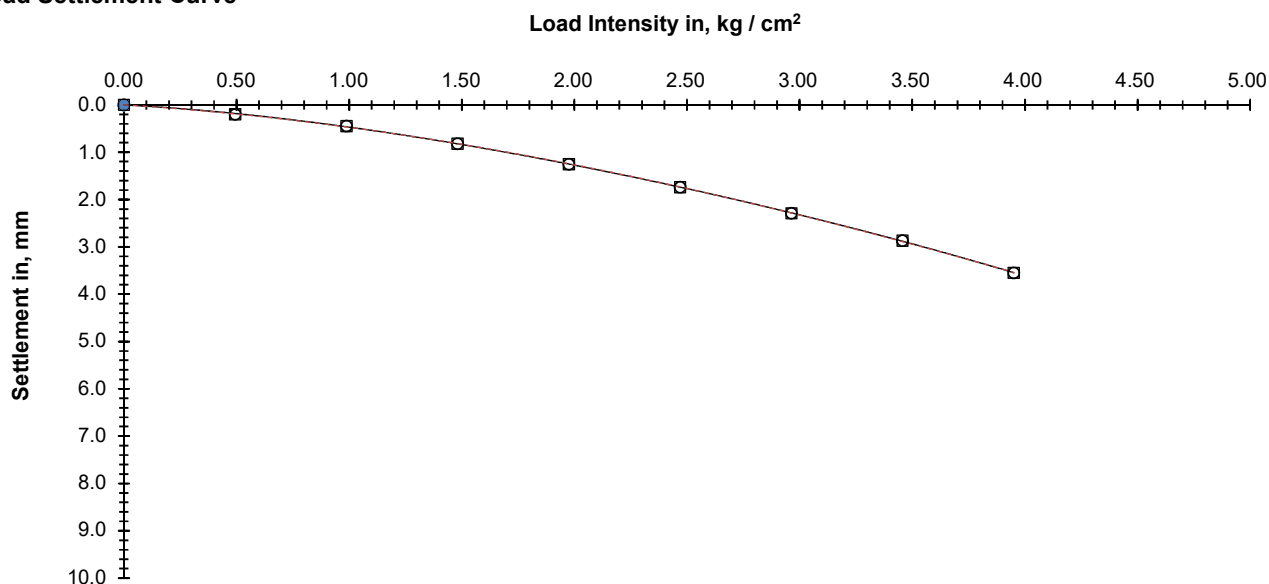
Majority of the plate load test were carried out either near water table level and within capillary zone or below water table. There can be upward water pressure causing the effective stress to change drastically. These can cause a vast and significant drop in allowable bearing pressure were found using plate load test especially in sandy soils. The difference in the allowable bearing pressure between that found based on UDS and plate load test may be due to change in effective stresses. The allowable bearing pressure determined using plate load test therefore shall be considered pragmatically.

Plate Load Test No. IPLT-1

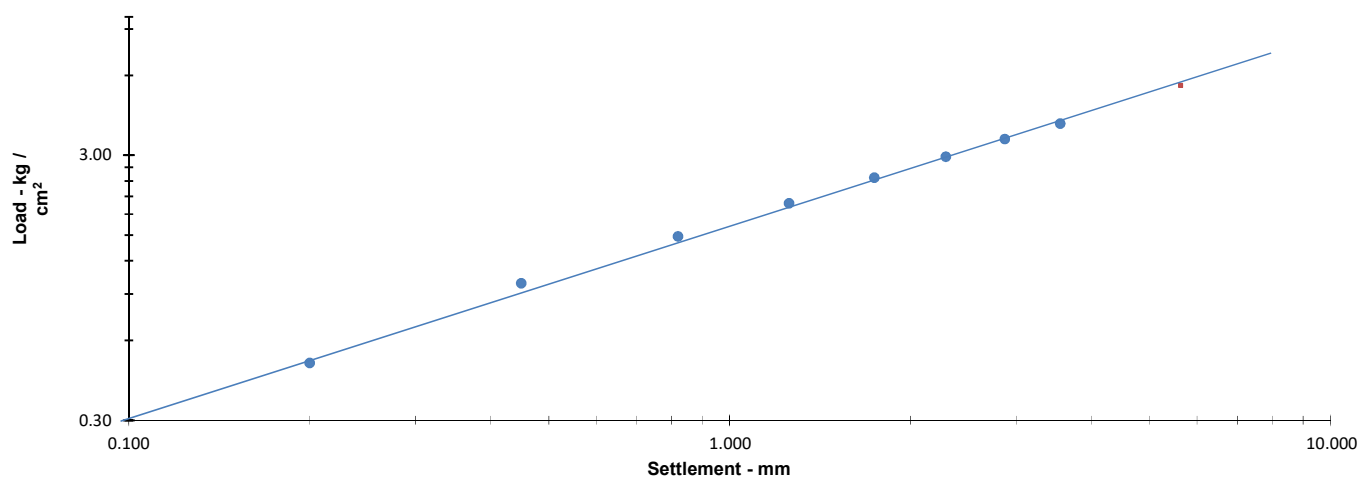
(Ref - IS : 1888, 1997)

Project :	NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha
Location :	Crushed coat stock pile, Stacker reclaimers, Wind barrier
Depth at which test conducted :	1.20m
Size of the Plate :	450mm X 450mm
Size of the Pit :	3.0m X 3.0m
Co-ordinates :	N-3757 E-1311
RL	201.40m
Type of soil	Brownish yellow silty clay with gravels and morum
Date :	27-11-2024

Load Settlement Curve



Load Settlement Curve



Notes :-

- 1) Definite yield point was not observed on the load settlement curve. The corresponding plate settlement would be 5.63 mm for 25 mm settlement of 2.00 m wide foundation considering a plate size of 45 cm. Safe bearing capacity from settlement criteria would be 27.50T/m² after water table correction.
- 2) Safe bearing pressure worked out is for the character of soil at test level. Safe bearing pressure found can be generalised when the sub soil is homogeneous and isotropic and has the same character and state of stress as that of test level. Anisotropy in sub soil can result into significant different allowable bearing pressure than that found and therefore values found shall be utilized cautiously in that case.
- 3) Plate load test is essentially short duration test and therefore long term behavior of soil under loading can not be studied. Effect of water table needs to be applied in case water is envisaged to be within the zone of transfer of stress. Size effect has a major role to play in the carrying capacity and compressibility of soil. All such limitations are to be considered and rational value shall be taken for design.

For KCT Consultancy Services

(Dr. K. K. Thaker)

EXPLANATION OF EVALUATION OF SAFE BEARING CAPACITY FROM SETTLEMENT CRITERIA

For IPLT-01

Considerations,

Maximum Settlement of Footing = 25mm

Size of Footing = 4.00 m

Type of Soil = Brownish yellow silty clay with gravels and morum

$S_f/S_p = B_f/B_p$

S_f = Settlement of Foundation = 25mm

S_p = Equivalent Settlement of Plate ?

B_f = Width of Foundation = 4.00m

B_p = Width of Plate = 0.45m

Equivalent Settlement of Plate = $0.45 \times 25 / 4.00 = 2.81$ mm

Hence reading from Load vs Settlement Curve, the load intensity for settlement of 2.81 mm

= 3.5 kg/cm²

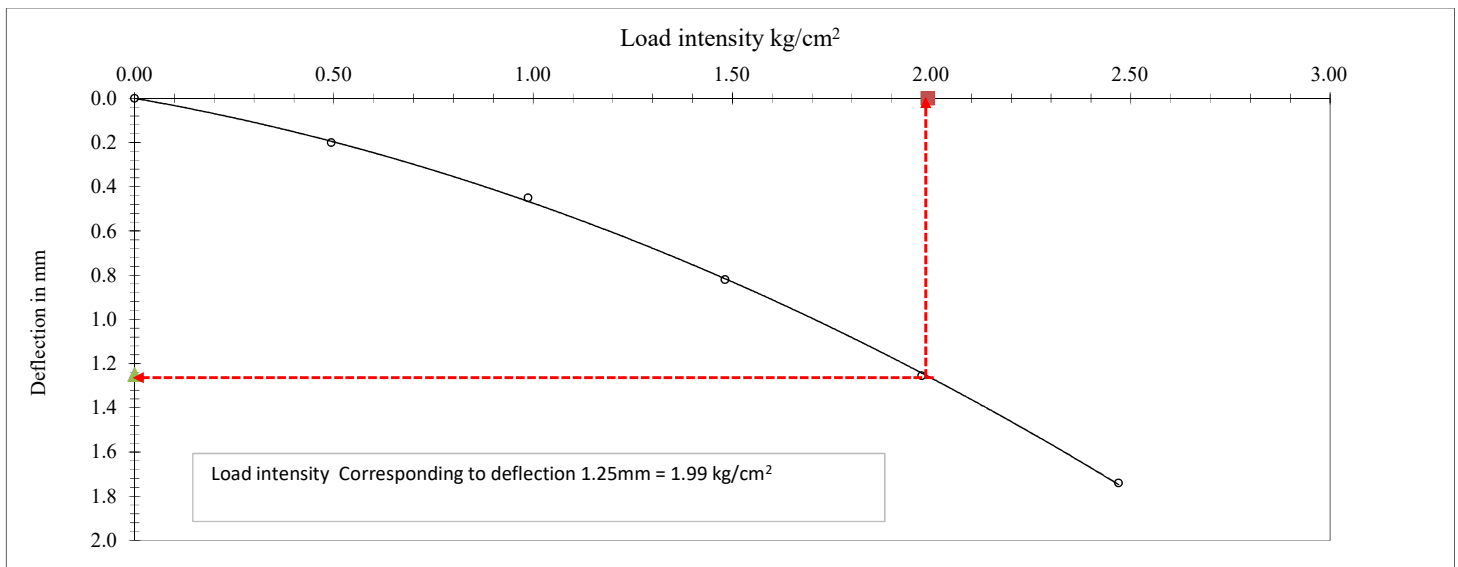
= 35.0 T/m²

K - Value (Modulus of Subgrade Reaction)

(IS : 9214, 1979 reaffirmed in 1987)

For IPLT-01**Results**

Sr No	Load Intensity	Deflection Readings				Average Deflection	Uncorrected value Ku	Correction for				Final Corrected K - Value
		DG 1	DG 2	DG 3	DG 4			Deflection	Bending	Saturation	Size of plate	
	kg/cm ²	mm	mm	mm	mm	mm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm
	1	2	3	4	5	6	7	8	9	10	11	12
1	0.00	0.00	0.00	0.00	0.00	0.00	15.9	15.9	14.0	12.6	10.1	10.1
2	0.49	0.18	0.22	0.00	0.00	0.20						
3	0.99	0.42	0.48	0.00	0.00	0.45						
4	1.48	0.79	0.85	0.00	0.00	0.82						
5	1.98	1.22	1.29	0.00	0.00	1.26						
6	2.47	1.70	1.78	0.00	0.00	1.74						

**Note :-**

1.0 Corrections were carried out as per IS 9214

(Dr. K. K. Thaker)

MODULUS OF SUB GRADE CORRECTION FACTORS

For IPLT-01

Corrections for size and shape effects are applied as given in *Soil Mechanics and Foundation Engineering* by Dr. K.R. Arora, as follows:

1.0 Effect of Size

For Cohesionless Soils

$$K_{B \times B} = K_{0.45 \times 0.45} ((B+0.45)/2B)^2$$

$$K_{2.00 \times 2.00} = K_{0.45 \times 0.45} ((2.00+0.45)/(2 \times 2.00))^2$$

$$K_{2.00 \times 2.00} = 10,100 ((2.45)/(4.00))^2$$

$$K_{2.00 \times 2.00} = 3789 \text{ t/m}^3$$

2.0 Effect of Shape

$$K_{L \times B} = (2/3)K_{B \times B}(1 + B/L)$$

$$K_{2.00 \times 2.00} = (2/3)K_{2.00 \times 2.00}(1 + 2.00/2.00)$$

$$K_{2.00 \times 2.00} = (2/3)3789(1 + 1.00)$$

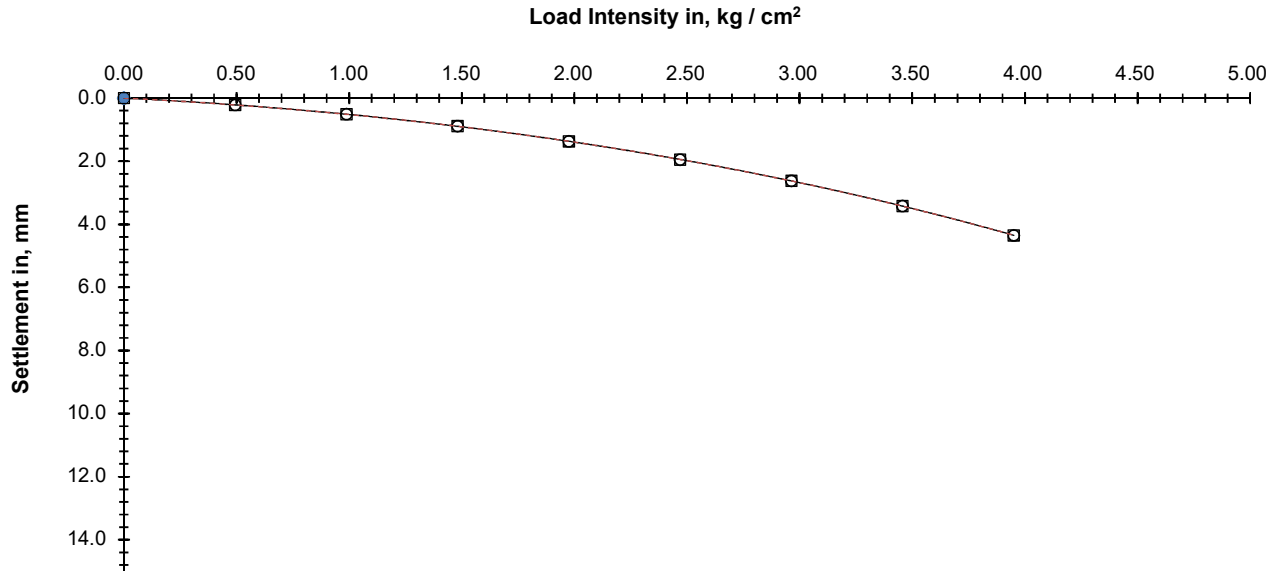
$$K_{2.00 \times 2.00} = 5052 \text{ t/m}^3$$

Plate Load Test No. IPLT-2

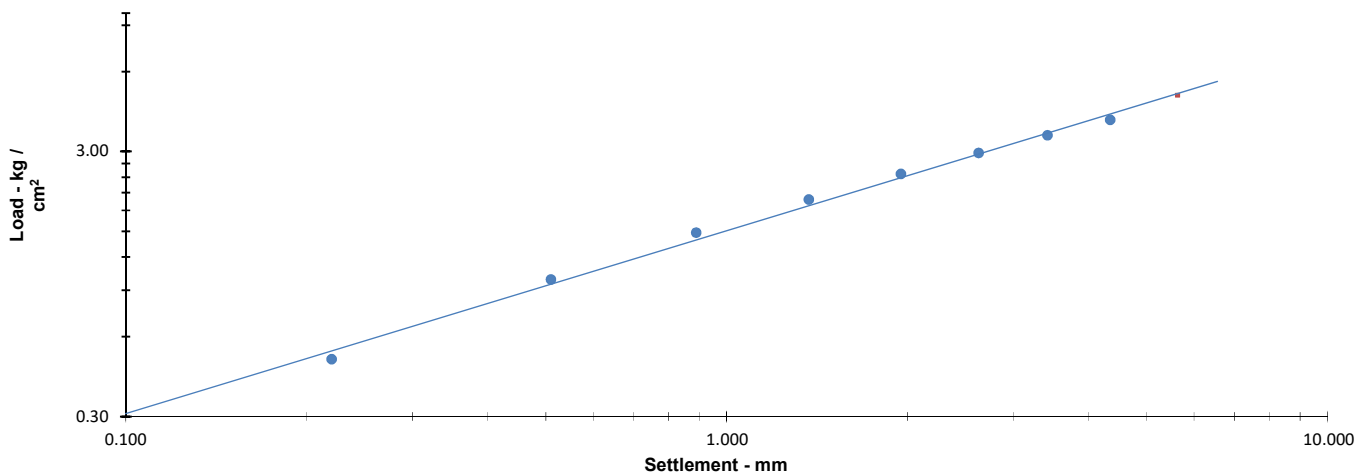
(Ref ~ IS : 1888, 1997)

Project :	NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha
Location :	Bio mass handling system
Depth at which test conducted :	1.50m
Size of the Plate :	450mm X 450mm
Size of the Pit :	2.5m X 3.0m
Co-ordinates :	N-3617 E-1087
RL	197.54m
Type of soil	Brownish yellow silty clay with gravels and morum
Date :	07-12-2024

Load Settlement Curve



Load Settlement Curve



Notes :-

- 1) Definite yield point was not observed on the load settlement curve. The corresponding plate settlement would be 5.63 mm for 25 mm settlement of 2.00 m wide foundation considering a plate size of 45 cm. Safe bearing capacity from settlement criteria would be 24.50T/m² after water table correction.
- 2) Safe bearing pressure worked out is for the character of soil at test level. Safe bearing pressure found can be generalised when the sub soil is homogeneous and isotropic and has the same character and state of stress as that of test level. Anisotropy in sub soil can result into significant different allowable bearing pressure than that found and therefore values found shall be utilized cautiously in that case.
- 3) Plate load test is essentially short duration test and therefore long term behavior of soil under loading can not be studied. Effect of water table needs to be applied in case water is envisaged to be within the zone of transfer of stress. Size effect has a major role to play in the carrying capacity and compressibility of soil. All such limitations are to be considered and rational value shall be taken for design.

For KCT Consultancy Services

(Dr. K. K. Thaker)

EXPLANATION OF EVALUATION OF SAFE BEARING CAPACITY **FROM SETTLEMENT CRITERIA**

For IPLT-02

Considerations,

Maximum Settlement of Footing = 25mm

Size of Footing = 2.00 m

Type of Soil = Brownish yellow silty clay with gravels and morum

$S_f/S_p = B_f/B_p$

S_f = Settlement of Foundation = 25mm

S_p = Equivalent Settlement of Plate ?

B_f = Width of Foundation = 2.00m

B_p = Width of Plate = 0.45m

Equivalent Settlement of Plate = $0.45 \times 25 / 2.00 = 5.63$ mm

Water table correction: 0.50

Hence reading from Load vs Settlement Curve, the load intensity for settlement of 5.63 mm

= 49.00×0.50 kg/cm²

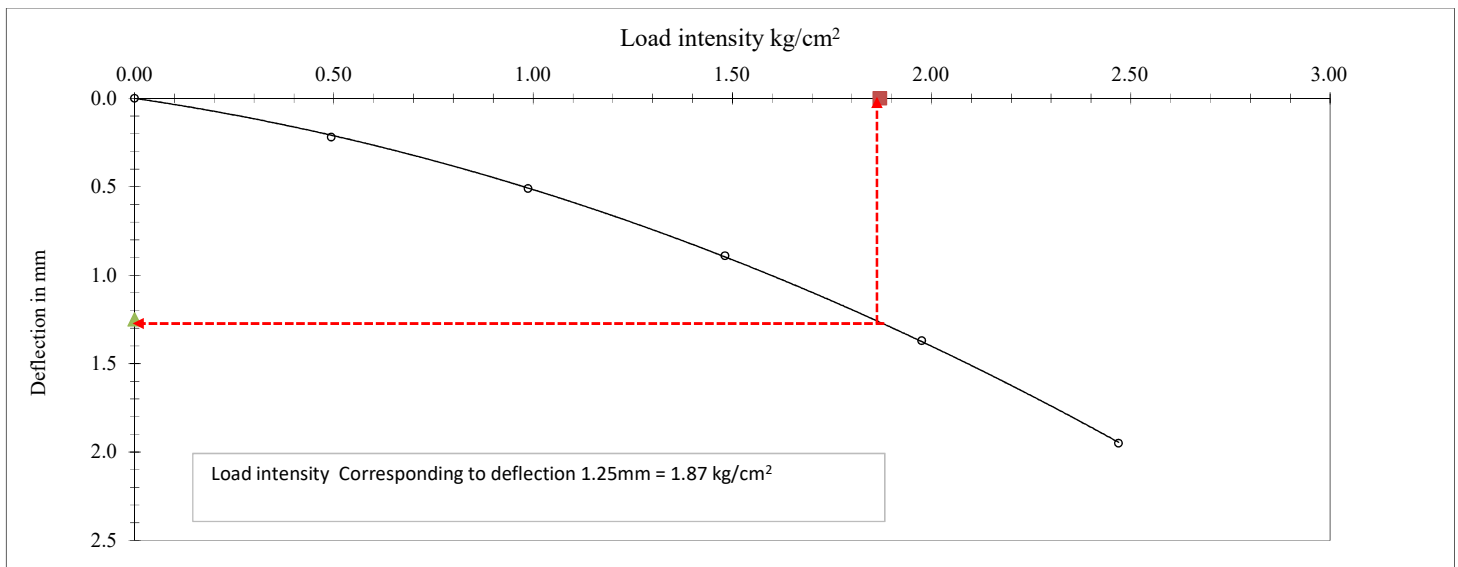
= 24.50 T/m²

K - Value (Modulus of Subgrade Reaction)

(IS : 9214, 1979 reaffirmed in 1987)

For IPLT-02**Results**

Sr No	Load Intensity	Deflection Readings				Average Deflection	Uncorrected value Ku	Correction for				Final Corrected K - Value
		DG 1	DG 2	DG 3	DG 4			Deflection	Bending	Saturation	Size of plate	
	kg/cm ²	mm	mm	mm	mm	mm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm
	1	2	3	4	5	6	7	8	9	10	11	12
1	0.00	0.00	0.00	0.00	0.00	0.00	15.0	15.0	12.5	11.3	9.0	9.0
2	0.49	0.20	0.24	0.00	0.00	0.22						
3	0.99	0.48	0.54	0.00	0.00	0.51						
4	1.48	0.86	0.92	0.00	0.00	0.89						
5	1.98	1.33	1.41	0.00	0.00	1.37						
6	2.47	1.91	1.99	0.00	0.00	1.95						

**Note :-**

1.0 Corrections were carried out as per IS 9214

(Dr. K. K. Thaker)

MODULUS OF SUB GRADE CORRECTION FACTORS

For IPLT-02

Corrections for size and shape effects are applied as given in *Soil Mechanics and Foundation Engineering* by Dr. K.R. Arora, as follows:

1.0 Effect of Size

For Cohesionless Soils

$$K_{B \times B} = K_{0.45 \times 0.45} ((B+0.45)/2B)^2$$

$$K_{2.00 \times 2.00} = K_{0.45 \times 0.45} ((2.00+0.45)/(2 \times 2.00))^2$$

$$K_{2.00 \times 2.00} = 9000 ((2.45)/(4.00))^2$$

$$K_{2.00 \times 2.00} = 3376 \text{ t/m}^3$$

2.0 Effect of Shape

$$K_{L \times B} = (2/3)K_{B \times B}(1 + B/L)$$

$$K_{2.00 \times 2.00} = (2/3)K_{2.00 \times 2.00}(1 + 2.00/2.00)$$

$$K_{2.00 \times 2.00} = (2/3)3376(1 + 1.00)$$

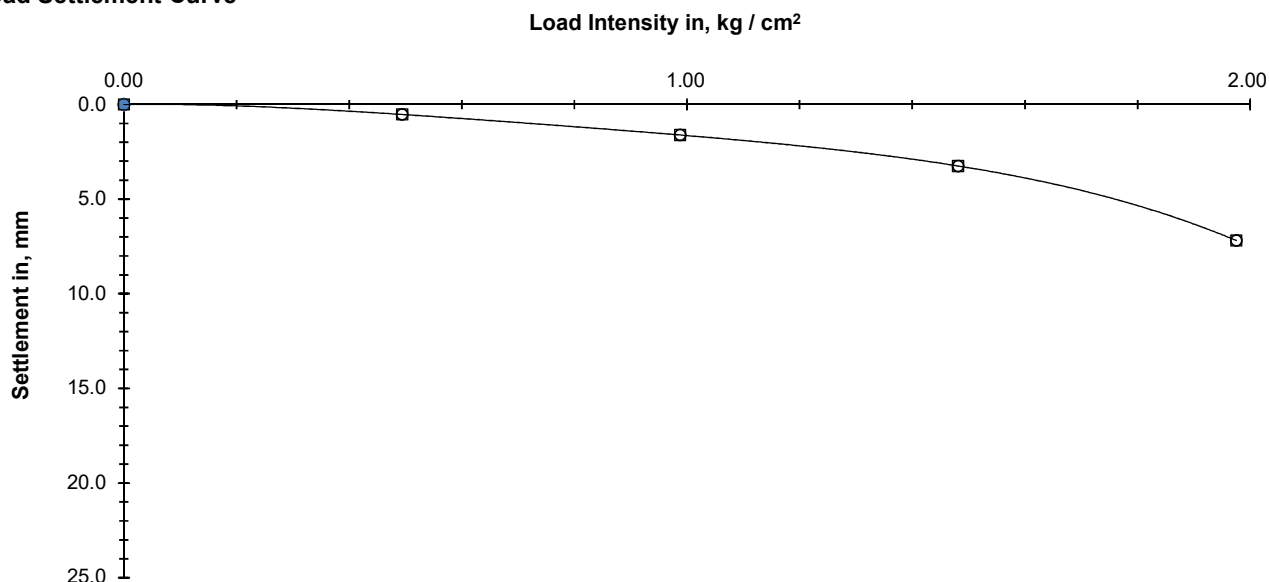
$$K_{2.00 \times 2.00} = 4502 \text{ t/m}^3$$

Plate Load Test No. IPLT-3

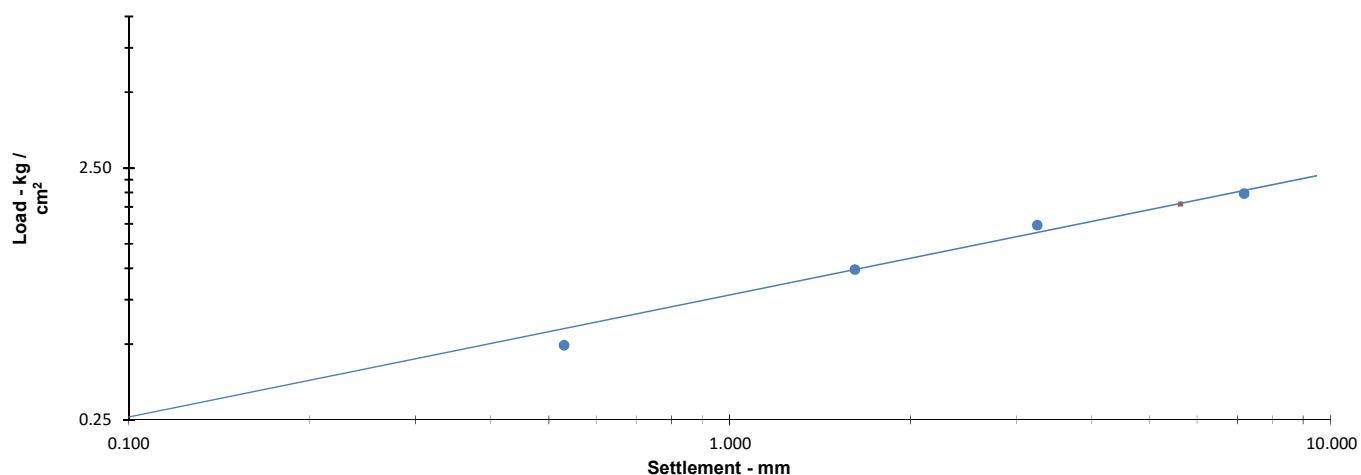
(Ref ~ IS : 1888, 1997)

Project :	NLC Talabira Thermal Power Project (NTTP) at village Hirma, Talabira, Odisha
Location :	HCSD Slurry pipe corridor
Depth at which test conducted :	4.00m
Size of the Plate :	450mm X 450mm
Size of the Pit :	6.0m X 6.0m
Co-ordinates :	N-2235 E-841
RL	194.54m
Type of soil	Brownish grey fine to medium fine sity clay with gravel
Date :	20-01-2025

Load Settlement Curve



Load Settlement Curve



Notes :-

- 1) Definite yield point was not observed on the load settlement curve. The corresponding plate settlement would be 5.63 mm for 25 mm settlement of 2.00 m wide foundation considering a plate size of 45 cm. Safe bearing capacity from settlement criteria would be 9.00T/m² after water table correction.
- 2) Safe bearing pressure worked out is for the character of soil at test level. Safe bearing pressure found can be generalised when the sub soil is homogeneous and isotropic and has the same character and state of stress as that of test level. Anisotropy in sub soil can result into significant different allowable bearing pressure than that found and therefore values found shall be utilized cautiously in that case.
- 3) Plate load test is essentially short duration test and therefore long term behavior of soil under loading can not be studied. Effect of water table needs to be applied in case water is envisaged to be within the zone of transfer of stress. Size effect has a major role to play in the carrying capacity and compressibility of soil. All such limitations are to be considered and rational value shall be taken for design.

For KCT Consultancy Services

(Dr. K. K. Thaker)

EXPLANATION OF EVALUATION OF SAFE BEARING CAPACITY **FROM SETTLEMENT CRITERIA**

For IPLT-03

Considerations,

Maximum Settlement of Footing = 25mm

Size of Footing = 2.00 m

Type of Soil = Brownish grey fine to medium fine sity clay with gravel

$S_f/S_p = B_f/B_p$

S_f = Settlement of Foundation = 25mm

S_p = Equivalent Settlement of Plate ?

B_f = Width of Foundation = 2.00m

B_p = Width of Plate = 0.45m

Equivalent Settlement of Plate = $0.45 \times 25 / 2.00 = 5.63$ mm

Water table correction: 0.50

Hence reading from Load vs Settlement Curve, the load intensity for settlement of 5.63 mm

= 18.00×0.50 kg/cm²

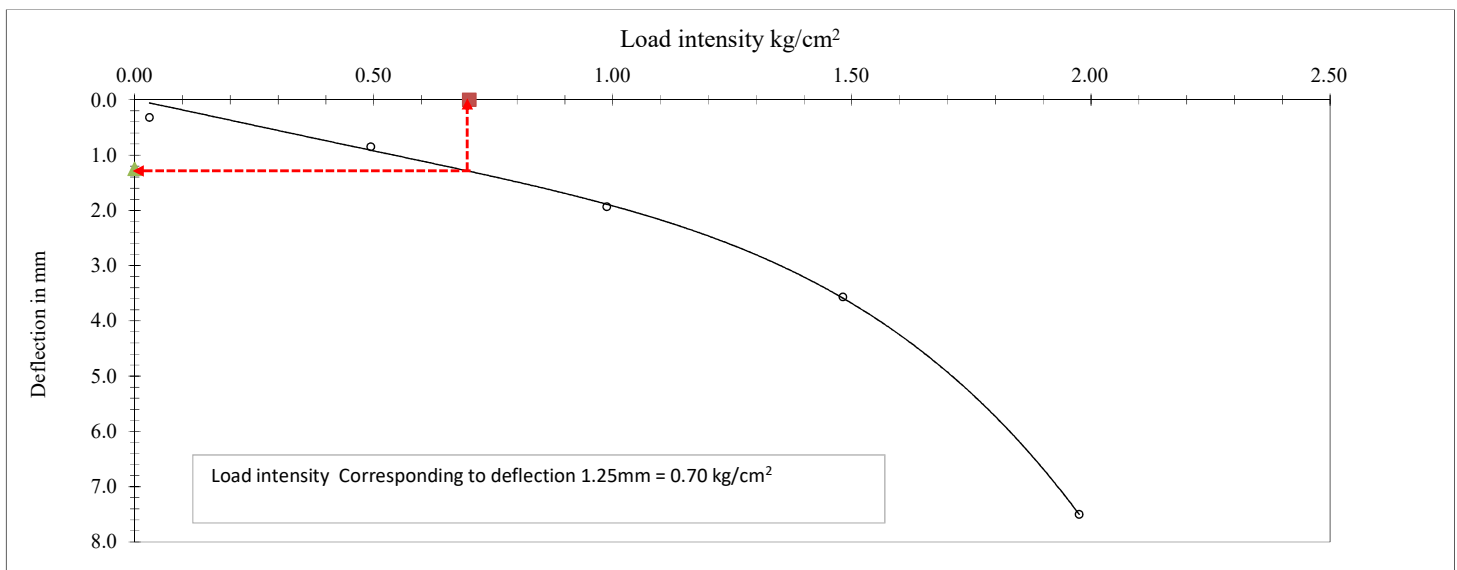
= 9.00 T/m²

K - Value (Modulus of Subgrade Reaction)

(IS : 9214, 1979 reaffirmed in 1987)

For IPLT-03**Results**

Sr No	Load Intensity	Deflection Readings				Average Deflection	Uncorrected value Ku	Correction for				Final Corrected K - Value
		DG 1	DG 2	DG 3	DG 4			Deflection	Bending	Saturation	Size of plate	
	kg/cm ²	mm	mm	mm	mm	mm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm
	1	2	3	4	5	6	7	8	9	10	11	12
1	0.03	0.34	0.30	0.00	0.00	0.32	5.6	5.6	5.6	5.0	4.0	4.0
2	0.49	0.86	0.84	0.00	0.00	0.85						
3	0.99	1.96	1.91	0.00	0.00	1.94						
4	1.48	3.58	3.56	0.00	0.00	3.57						
5	1.98	7.52	7.49	0.00	0.00	7.51						

**Note :-**

1.0 Corrections were carried out as per IS 9214

(Dr. K. K. Thaker)

MODULUS OF SUB GRADE CORRECTION FACTORS

For IPLT-03

Corrections for size and shape effects are applied as given in *Soil Mechanics and Foundation Engineering* by Dr. K.R. Arora, as follows:

1.0 Effect of Size

For Cohesionless Soils

$$K_{B \times B} = K_{0.45 \times 0.45} ((B+0.45)/2B)^2$$

$$K_{2.00 \times 2.00} = K_{0.45 \times 0.45} ((2.00+0.45)/(2 \times 2.00))^2$$

$$K_{2.00 \times 2.00} = 4000 ((2.45)/(4.00))^2$$

$$K_{2.00 \times 2.00} = 1501 \text{ t/m}^3$$

2.0 Effect of Shape

$$K_{L \times B} = (2/3)K_{B \times B}(1 + B/L)$$

$$K_{2.00 \times 2.00} = (2/3)K_{2.00 \times 2.00}(1 + 2.00/2.00)$$

$$K_{2.00 \times 2.00} = (2/3)1501(1 + 1.00)$$

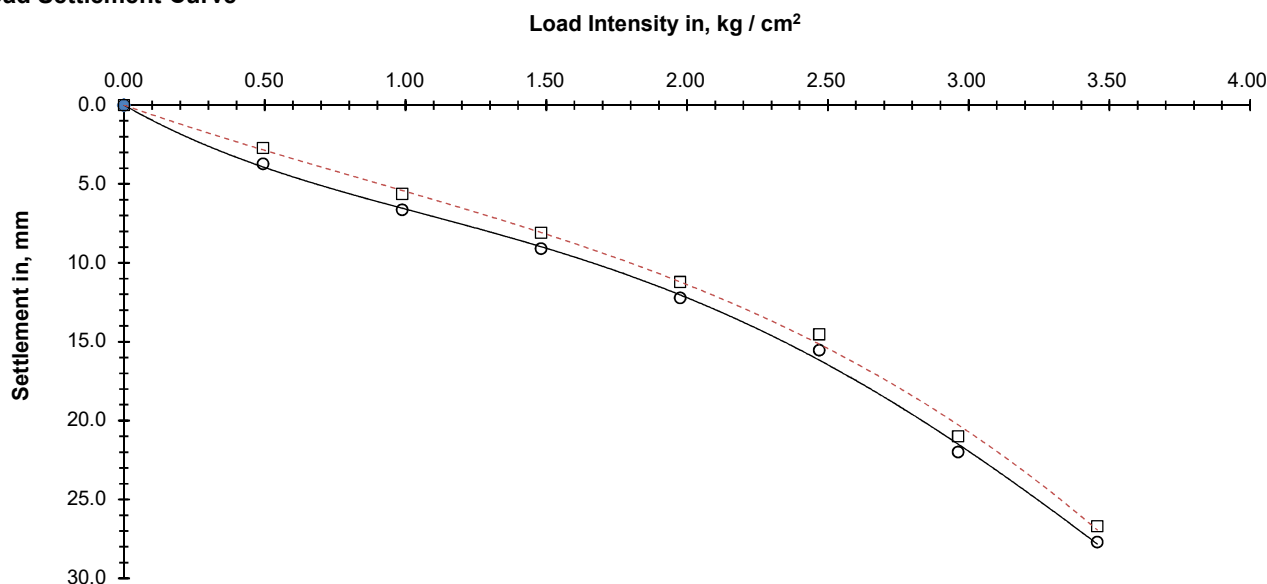
$$K_{2.00 \times 2.00} = 2001 \text{ t/m}^3$$

Plate Load Test No. IPLT-4

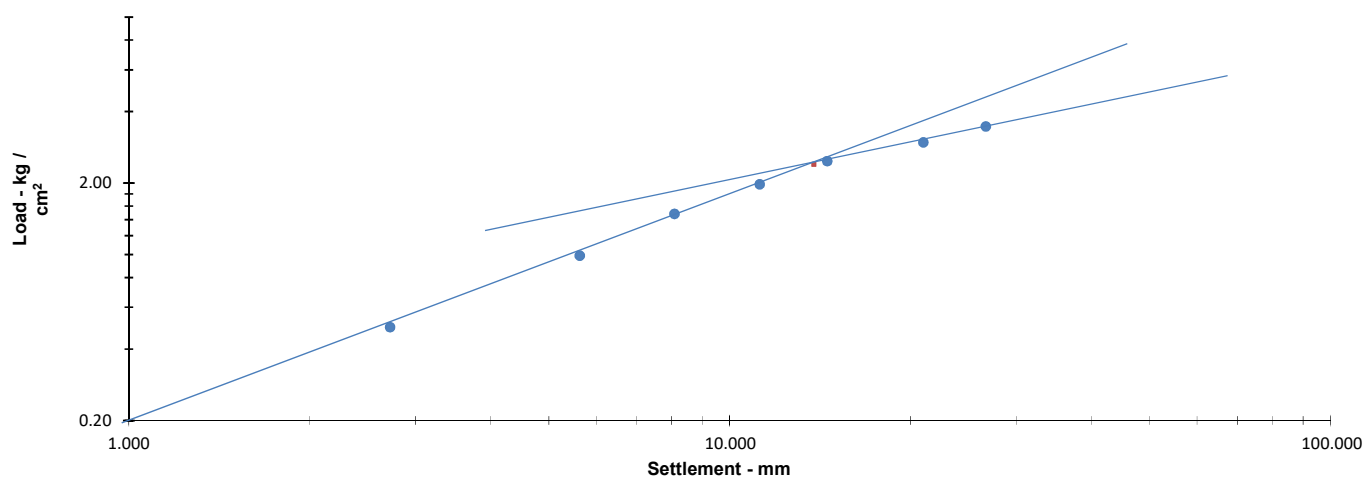
(Ref ~ IS : 1888, 1997)

Project :	NLC Talabira Thermal Power Project (NTTP) at village Hirma, Talabira, Odisha
Location :	HCSD Slurry pipe corridor
Depth at which test conducted :	4.00m
Size of the Plate :	450mm X 450mm
Size of the Pit :	10.00m X 8.00m X 4.00m
Co-ordinates :	N-1119 E-892
RL	192.20m
Type of soil	Blackish brown fine grained silty clay
Date :	08-04-2025

Load Settlement Curve



Load Settlement Curve



Notes :-

- 1) Definite yield point was observed on load settlement curve at 2.40 kg/cm² pressure intensity. Safe bearing capacity corresponding to 2.00m wide footing is 21.33 T/m² considering the factor of safety of 2.5 and after applying water table correction.
- 2) Safe bearing pressure worked out is for the character of soil at test level. Safe bearing pressure found can be generalised when the sub soil is homogeneous and isotropic and has the same character and state of stress as that of test level. Anisotropy in sub soil can result into significant different allowable bearing pressure than that found and therefore values found shall be utilized cautiously in that case.
- 3) Plate load test is essentially short duration test and therefore long term behavior of soil under loading can not be studied. Effect of water table needs to be applied in case water is envisaged to be within the zone of transfer of stress. Size effect has a major role to play in the carrying capacity and compressibility of soil. All such limitations are to be considered and rational value shall be taken for design.

For KCT Consultancy Services

(Dr. K. K. Thaker)

EXPLANATION OF EVALUATION OF SAFE BEARING CAPACITY FROM SHEAR CRITERIA

Pressure intensity corresponding to the foundation width shall be calculated as per J.E. Bowels (5th edition) section 4-12.1, shall be as follow,

For IPLT-04

$$\begin{aligned}
 Q_{\text{Ultimate foundation}} &= Q_{\text{Ultimate plate}} * (\text{Width of foundation} / \text{Width of Plate}) \\
 &= Q_{\text{Ultimate plate}} * (2.00 / 0.45) \\
 &= Q_{\text{Ultimate plate}} * 4.44
 \end{aligned}$$

Water table correction = 0.5

$$\begin{aligned}
 Q_{\text{safe bearing capacity}} &= Q_{\text{Ultimate plate}} * 4.44 * 0.5 / 2.5 \\
 &= 24.0 * 4.44 * 0.5 / 2.5
 \end{aligned}$$

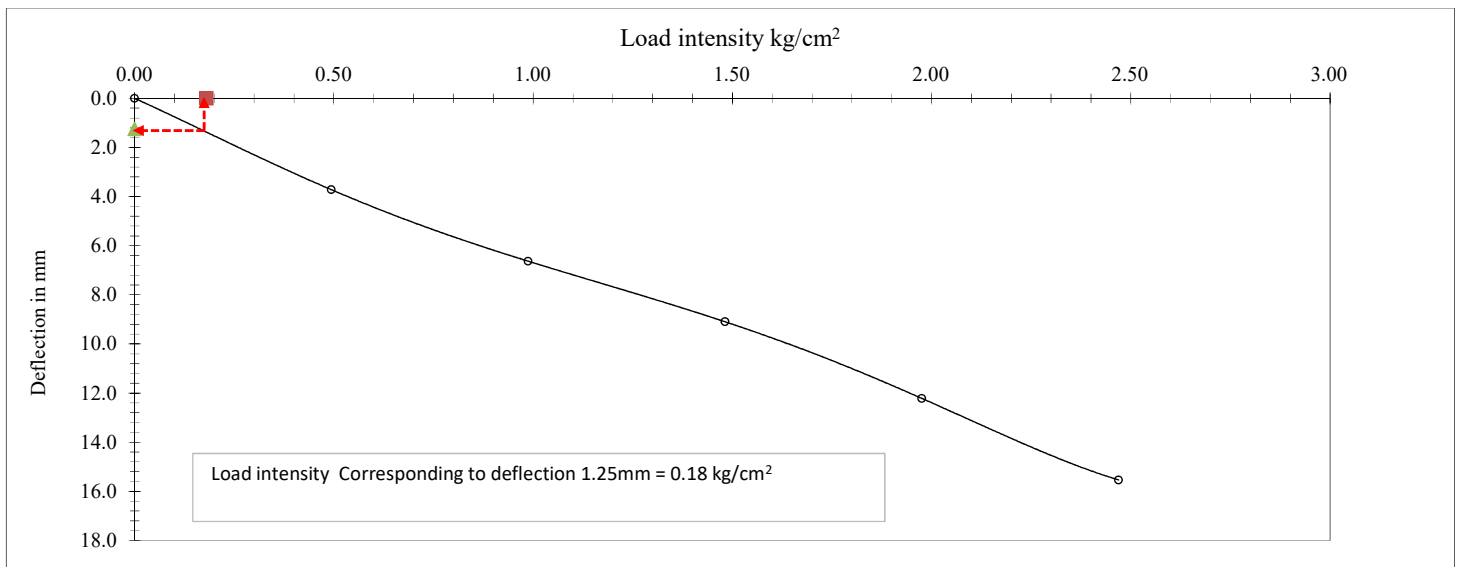
$$Q_{\text{safe bearing capacity}} = 21.33 \text{ t/m}^2 \text{ (for foundation having width 2.00m)}$$

K - Value (Modulus of Subgrade Reaction)

(IS : 9214, 1979 reaffirmed in 1987)

For IPLT-04**Results**

Sr No	Load Intensity	Deflection Readings				Average Deflection	Uncorrected value Ku	Correction for				Final Corrected K - Value
		DG 1	DG 2	DG 3	DG 4			Deflection	Bending	Saturation	Size of plate	
	kg/cm ²	mm	mm	mm	mm	mm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm
	1	2	3	4	5	6	7	8	9	10	11	12
1	0.00	0.00	0.00	0.00	0.00	0.00	1.4	1.4	1.4	1.3	1.0	1.0
2	0.49	3.62	3.82	0.00	0.00	3.72						
3	0.99	6.54	6.72	0.00	0.00	6.63						
4	1.48	8.96	9.23	0.00	0.00	9.10						
5	1.98	12.10	12.33	0.00	0.00	12.22						
6	2.47	15.42	15.65	0.00	0.00	15.54						

**Note :-**

1.0 Corrections were carried out as per IS 9214

(Dr. K. K. Thaker)

MODULUS OF SUB GRADE CORRECTION FACTORS

For IPLT-04

Corrections for size and shape effects are applied as given in *Soil Mechanics and Foundation Engineering* by Dr. K.R. Arora, as follows:

1.0 Effect of Size

For Cohesionless Soils

$$K_{B \times B} = K_{0.45 \times 0.45} ((B+0.45)/2B)^2$$

$$K_{2.00 \times 2.00} = K_{0.45 \times 0.45} ((2.00+0.45)/(2 \times 2.00))^2$$

$$K_{2.00 \times 2.00} = 1000 ((2.45)/(4.00))^2$$

$$K_{2.00 \times 2.00} = 375 \text{ t/m}^3$$

2.0 Effect of Shape

$$K_{L \times B} = (2/3)K_{B \times B}(1 + B/L)$$

$$K_{2.00 \times 2.00} = (2/3)K_{2.00 \times 2.00}(1 + 2.00/2.00)$$

$$K_{2.00 \times 2.00} = (2/3)375(1 + 1.00)$$

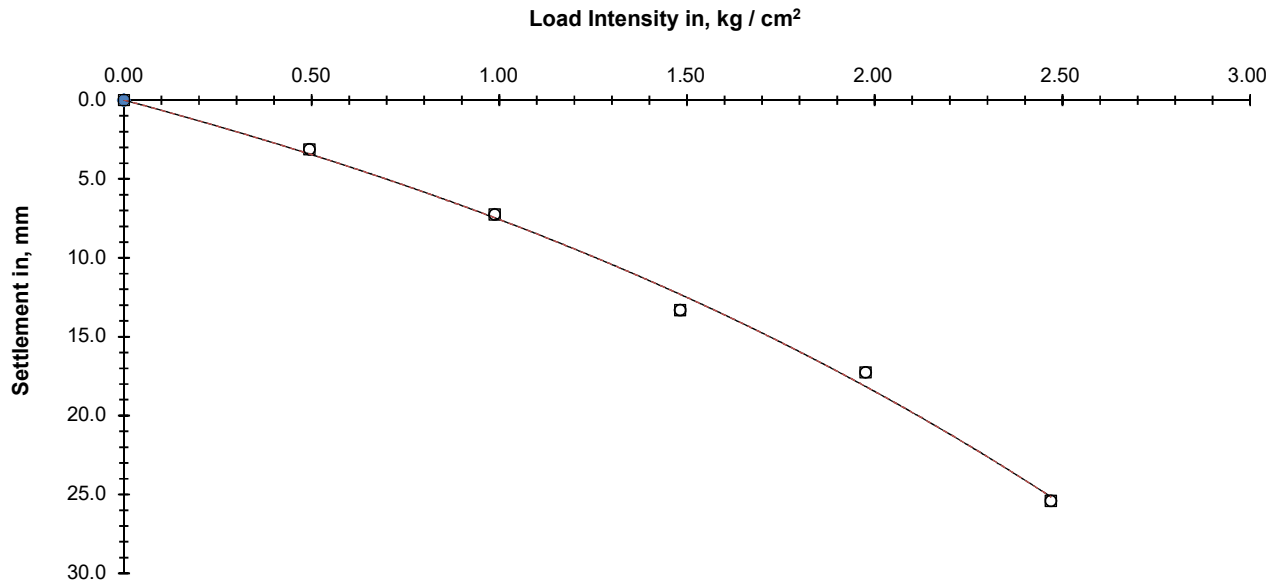
$$K_{2.00 \times 2.00} = 500 \text{ t/m}^3$$

Plate Load Test No. PLT-01

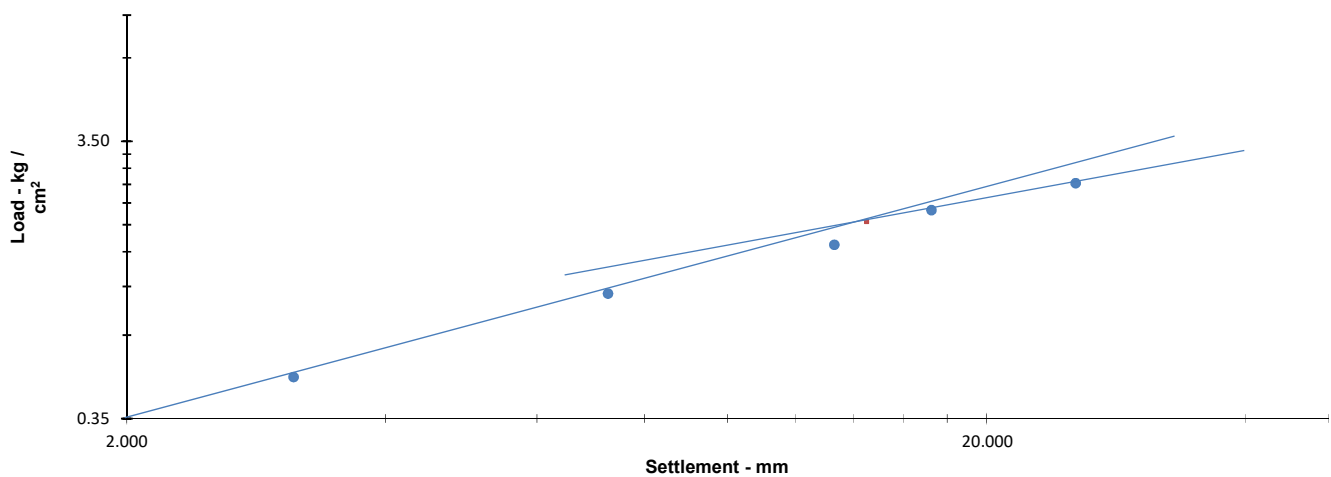
(Ref ~ IS : 1888, 1997)

Project :	NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha
Location :	Transformer Yard
Depth at which test conducted :	2.00m
Size of the Plate :	450mm X 450mm
Size of the Pit :	6.00m X 3.00m
Co-ordinates :	N-3013 E-1333
RL	198.40m
Type of soil	Brownish fine to medium grained sandy clay with gravels
Date :	01-04-2025

Load Settlement Curve



Load Settlement Curve



Notes :-

- 1) Definite yield point was observed on load settlement curve at 1.80 kg/cm² pressure intensity. Safe bearing capacity corresponding to 2.00m wide footing is 16.00 T/m² considering the factor of safety of 2.5 and after applying water table correction.
- 2) Safe bearing pressure worked out is for the character of soil at test level. Safe bearing pressure found can be generalised when the sub soil is homogeneous and isotropic and has the same character and state of stress as that of test level. Anisotropy in sub soil can result into significant different allowable bearing pressure than that found and therefore values found shall be utilized cautiously in that case.
- 3) Plate load test is essentially short duration test and therefore long term behavior of soil under loading can not be studied. Effect of water table needs to be applied in case water is envisaged to be within the zone of transfer of stress. Size effect has a major role to play in the carrying capacity and compressibility of soil. All such limitations are to be considered and rational value shall be taken for design.

For KCT Consultancy Services

(Dr. K. K. Thaker)

EXPLANATION OF EVALUATION OF SAFE BEARING CAPACITY FROM SHEAR CRITERIA

Pressure intensity corresponding to the foundation width shall be calculated as per J.E. Bowels (5th edition) section 4-12.1, shall be as follow,

For PLT-01

$$\begin{aligned}
 Q_{\text{Ultimate foundation}} &= Q_{\text{Ultimate plate}} * (\text{Width of foundation} / \text{Width of Plate}) \\
 &= Q_{\text{Ultimate plate}} * (2.00 / 0.45) \\
 &= Q_{\text{Ultimate plate}} * 4.44
 \end{aligned}$$

Water table correction = 0.5

$$\begin{aligned}
 Q_{\text{safe bearing capacity}} &= Q_{\text{Ultimate plate}} * 4.44 * 0.5 / 2.5 \\
 &= 18.0 * 4.44 * 0.5 / 2.5
 \end{aligned}$$

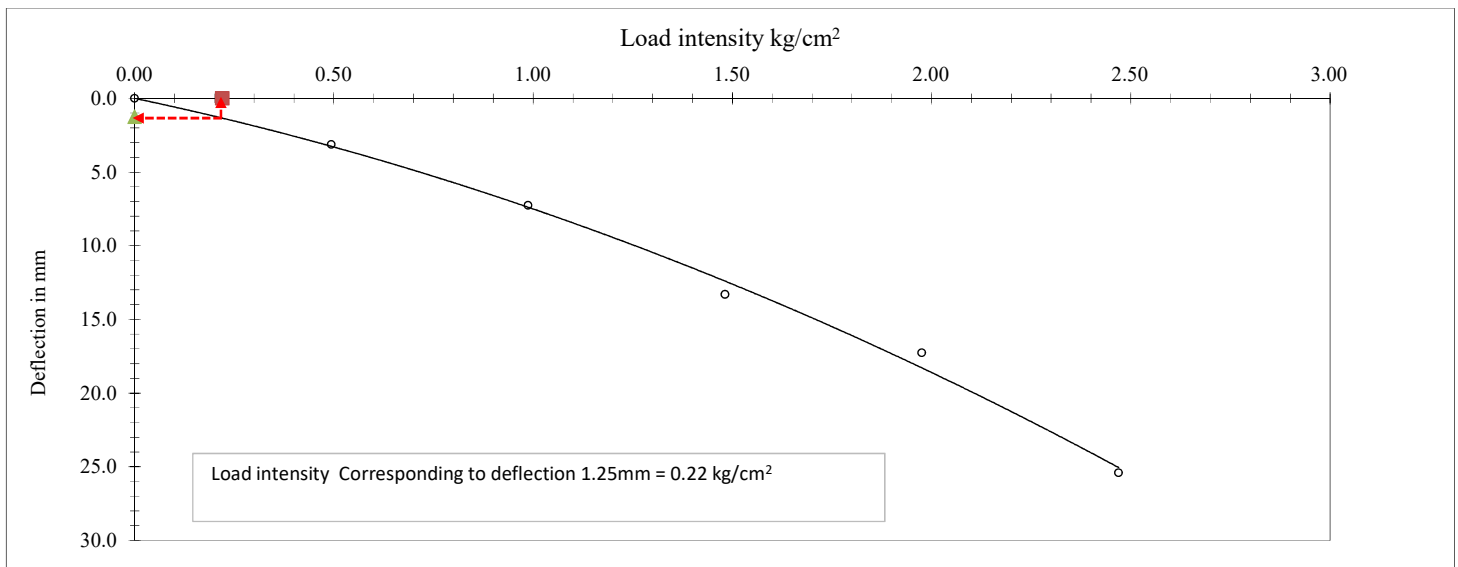
$$Q_{\text{safe bearing capacity}} = 16.00 \text{ t/m}^2 \text{ (for foundation having width 2.00m)}$$

K - Value (Modulus of Subgrade Reaction)

(IS : 9214, 1979 reaffirmed in 1987)

For PLT-01**Results**

Sr No	Load Intensity	Deflection Readings				Average Deflection	Uncorrected value Ku	Correction for				Final Corrected K - Value
		DG 1	DG 2	DG 3	DG 4			Deflection	Bending	Saturation	Size of plate	
	kg/cm ²	mm	mm	mm	mm	mm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm
	1	2	3	4	5	6	7	8	9	10	11	12
1	0.00	0.00	0.00	0.00	0.00	0.00	1.8	1.8	1.8	1.6	1.3	1.3
2	0.49	3.20	3.05	0.00	0.00	3.13						
3	0.99	7.34	7.17	0.00	0.00	7.26						
4	1.48	13.42	13.19	0.00	0.00	13.31						
5	1.98	17.38	17.15	0.00	0.00	17.27						
6	2.47	25.51	25.30	0.00	0.00	25.41						

**Note :-**

1.0 Corrections were carried out as per IS 9214

(Dr. K. K. Thaker)

MODULUS OF SUB GRADE CORRECTION FACTORS

For PLT-01

Corrections for size and shape effects are applied as given in *Soil Mechanics and Foundation Engineering* by Dr. K.R. Arora, as follows:

1.0 Effect of Size

For Cohesionless Soils

$$K_{B \times B} = K_{0.45 \times 0.45} ((B+0.45)/2B)^2$$

$$K_{2.00 \times 2.00} = K_{0.45 \times 0.45} ((2.00+0.45)/(2 \times 2.00))^2$$

$$K_{2.00 \times 2.00} = 1300 ((2.45)/(4.00))^2$$

$$K_{2.00 \times 2.00} = 488 \text{ t/m}^3$$

2.0 Effect of Shape

$$K_{L \times B} = (2/3)K_{B \times B}(1 + B/L)$$

$$K_{2.00 \times 2.00} = (2/3)K_{2.00 \times 2.00}(1 + 2.00/2.00)$$

$$K_{2.00 \times 2.00} = (2/3)488(1 + 1.00)$$

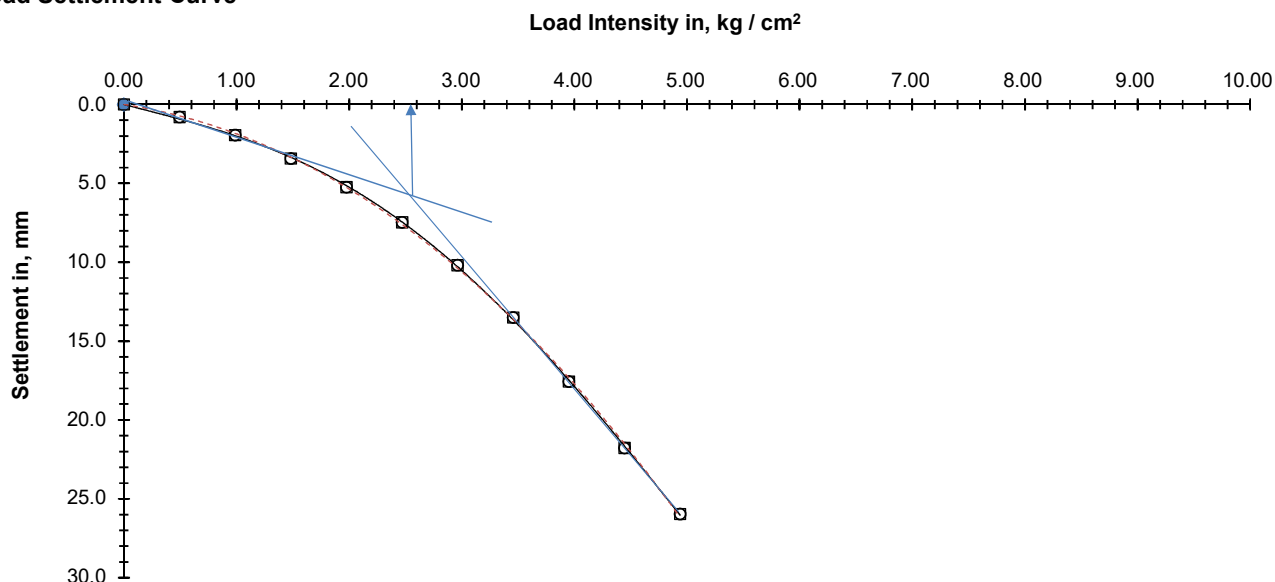
$$K_{2.00 \times 2.00} = 651 \text{ t/m}^3$$

Plate Load Test No. PLT-2

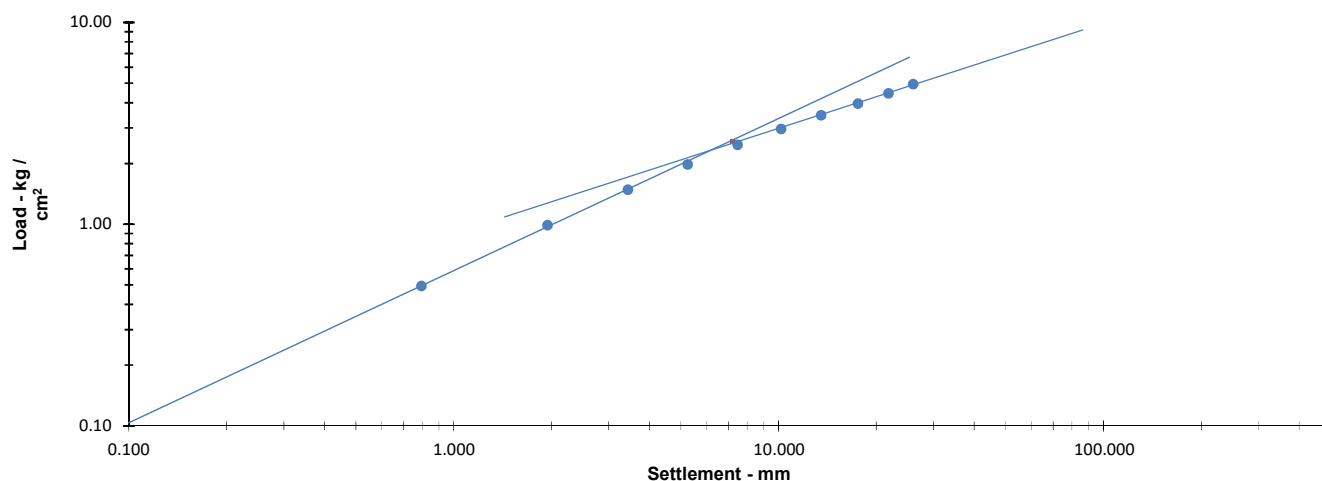
(Ref ~ IS : 1888, 1997)

Project :	NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha
Location :	Gate Complex, Security and time office, packing shed
Depth at which test conducted :	3.00m
Size of the Plate :	450mm X 450mm
Size of the Pit :	2.5m X 3.0m
Co-ordinates :	N-2872 E-1929
RL	199.09m
Type of soil	Reddish brownish yellow sandy clay some silt with gravels morum
Date :	26-12-2024

Load Settlement Curve



Load Settlement Curve



Notes :-

- 1) Definite yield point was observed on load settlement curve at 2.47 kg/cm² pressure intensity. Safe bearing capacity corresponding to 2.00m wide footing is 21.96 T/m² considering the factor of safety of 2.5 and after applying water table correction.
- 2) Safe bearing pressure worked out is for the character of soil at test level. Safe bearing pressure found can be generalised when the sub soil is homogeneous and isotropic and has the same character and state of stress as that of test level. Anisotropy in sub soil can result into significant different allowable bearing pressure than that found and therefore values found shall be utilized cautiously in that case.
- 3) Plate load test is essentially short duration test and therefore long term behavior of soil under loading can not be studied. Effect of water table needs to be applied in case water is envisaged to be within the zone of transfer of stress. Size effect has a major role to play in the carrying capacity and compressibility of soil. All such limitations are to be considered and rational value shall be taken for design.

For KCT Consultancy Services

(Dr. K. K. Thaker)

EXPLANATION OF EVALUATION OF SAFE BEARING CAPACITY FROM SHEAR CRITERIA

Pressure intensity corresponding to the foundation width shall be calculated as per J.E. Bowels (5th edition) section 4-12.1, shall be as follow,

For PLT-02

$$\begin{aligned}
 Q_{\text{Ultimate foundation}} &= Q_{\text{Ultimate plate}} * (\text{Width of foundation} / \text{Width of Plate}) \\
 &= Q_{\text{Ultimate plate}} * (2.00 / 0.45) \\
 &= Q_{\text{Ultimate plate}} * 4.44
 \end{aligned}$$

Water table correction = 0.5

$$\begin{aligned}
 Q_{\text{safe bearing capacity}} &= Q_{\text{Ultimate plate}} * 4.44 * 0.5 / 2.5 \\
 &= 24.7 * 4.44 * 0.5 / 2.5
 \end{aligned}$$

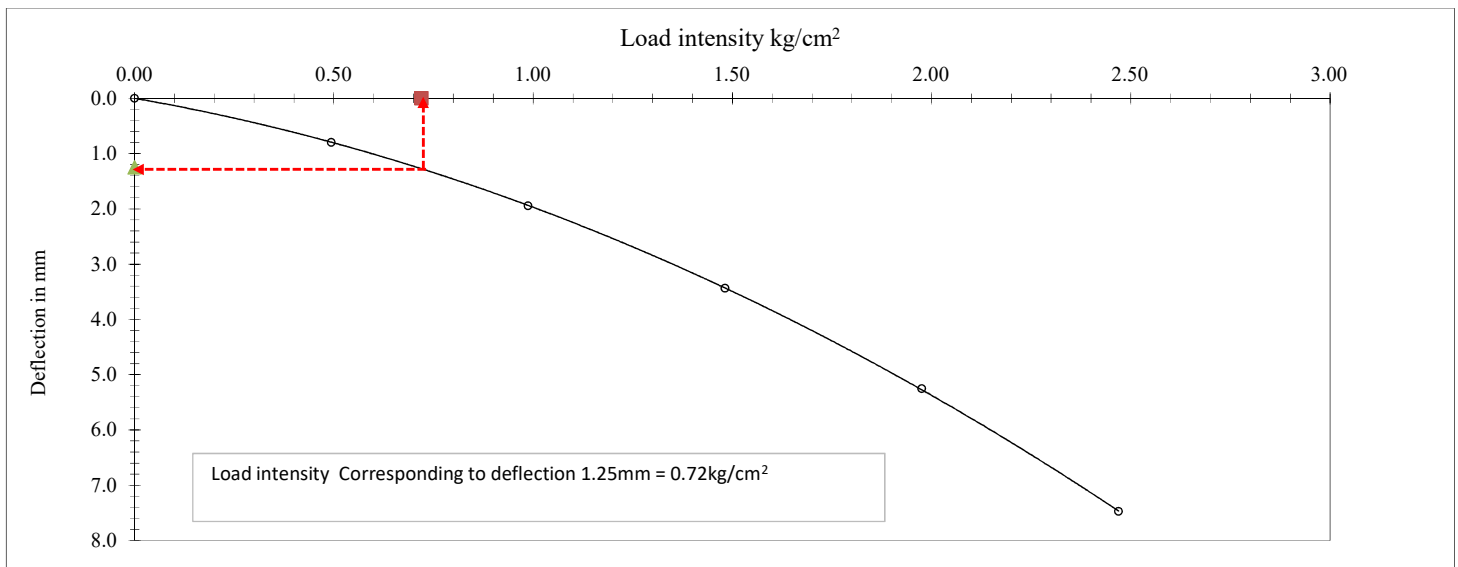
$$Q_{\text{safe bearing capacity}} = 21.96 \text{ t/m}^2 \text{ (for foundation having width 2.00m)}$$

K - Value (Modulus of Subgrade Reaction)

(IS : 9214, 1979 reaffirmed in 1987)

For PLT-02**Results**

Sr No	Load Intensity	Deflection Readings				Average Deflection	Uncorrected value Ku	Correction for				Final Corrected K - Value
		DG 1	DG 2	DG 3	DG 4			Deflection	Bending	Saturation	Size of plate	
	kg/cm ²	mm	mm	mm	mm	mm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm
	1	2	3	4	5	6	7	8	9	10	11	12
1	0.00	0.00	0.00	0.00	0.00	0.00	5.8	5.8	5.8	5.2	4.2	4.2
2	0.49	0.74	0.85	0.00	0.00	0.80						
3	0.99	1.88	2.01	0.00	0.00	1.95						
4	1.48	3.36	3.51	0.00	0.00	3.44						
5	1.98	5.16	5.35	0.00	0.00	5.26						
6	2.47	7.37	7.58	0.00	0.00	7.48						

**Note :-**

1.0 Corrections were carried out as per IS 9214

(Dr. K. K. Thaker)

MODULUS OF SUB GRADE CORRECTION FACTORS

For PLT-02

Corrections for size and shape effects are applied as given in *Soil Mechanics and Foundation Engineering* by Dr. K.R. Arora, as follows:

1.0 Effect of Size

For Cohesionless Soils

$$K_{B \times B} = K_{0.45 \times 0.45} ((B+0.45)/2B)^2$$

$$K_{2.00 \times 2.00} = K_{0.45 \times 0.45} ((2.00+0.45)/(2 \times 2.00))^2$$

$$K_{2.00 \times 2.00} = 4200 ((2.45)/(4.00))^2$$

$$K_{2.00 \times 2.00} = 1576 \text{ t/m}^3$$

2.0 Effect of Shape

$$K_{L \times B} = (2/3)K_{B \times B}(1 + B/L)$$

$$K_{2.00 \times 2.00} = (2/3)K_{2.00 \times 2.00}(1 + 2.00/2.00)$$

$$K_{2.00 \times 2.00} = (2/3)1576(1 + 1.00)$$

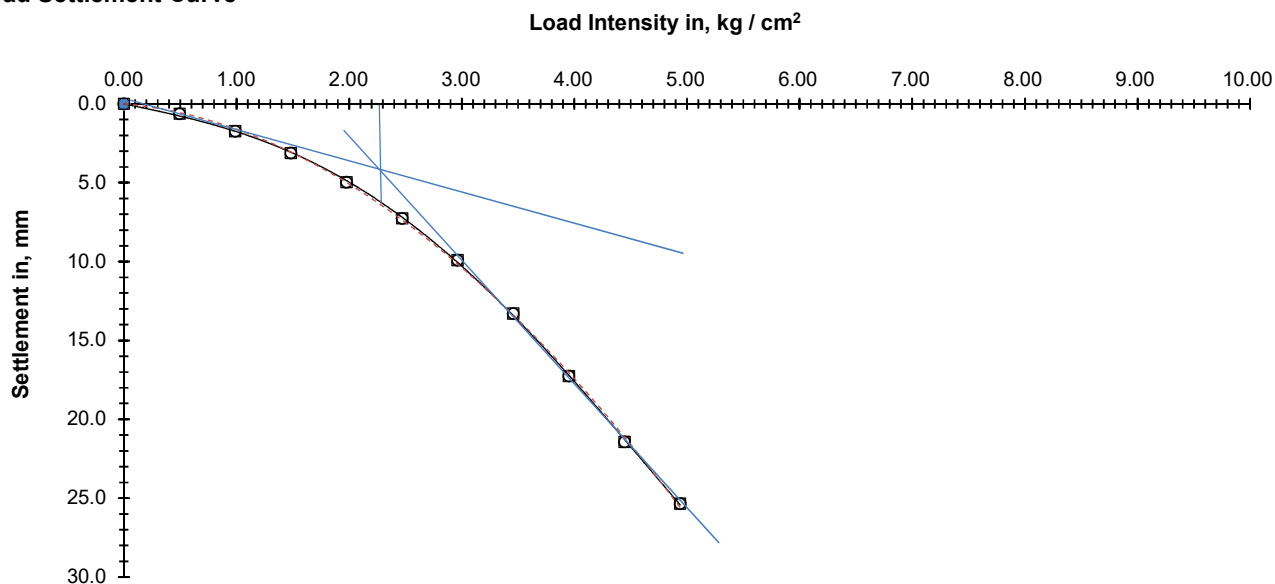
$$K_{2.00 \times 2.00} = 2101 \text{ t/m}^3$$

Plate Load Test No. PLT-3

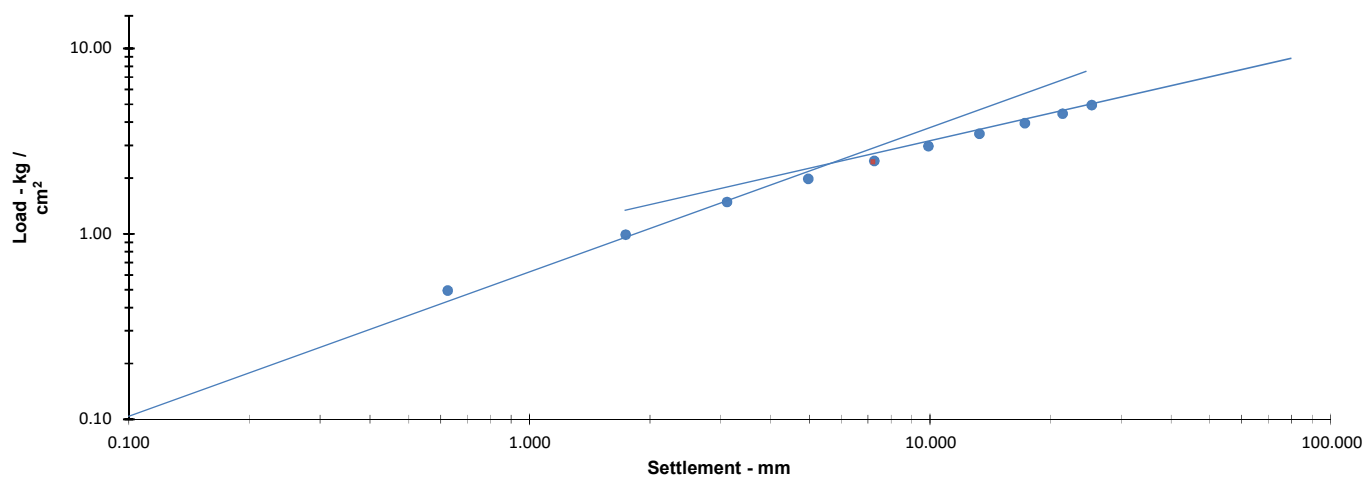
(Ref ~ IS : 1888, 1997)

Project :	NLC Talabira Thermal Power Project (NTTP) at village Hirma, Talabira, Odisha
Location :	IDCT-1&2
Depth at which test conducted :	2.00m
Size of the Plate :	450mm X 450mm
Size of the Pit :	2.5m X 3.0m
RL	202.20m
Co-ordinates :	N-2568 E-1673
Type of soil	Redish brown silty clay with occational sand and gravels
Date :	13-01-2025

Load Settlement Curve



Load Settlement Curve



Notes :-

- 1) Definite yield point was observed on load settlement curve at 2.37 kg/cm² pressure intensity. Safe bearing capacity corresponding to 2.00m wide footing is 21.07 T/m² considering the factor of safety of 2.5 and after applying water table correction.
- 2) Safe bearing pressure worked out is for the character of soil at test level. Safe bearing pressure found can be generalised when the sub soil is homogeneous and isotropic and has the same character and state of stress as that of test level. Anisotropy in sub soil can result into significant different allowable bearing pressure than that found and therefore values found shall be utilized cautiously in that case.
- 3) Plate load test is essentially short duration test and therefore long term behavior of soil under loading can not be studied. Effect of water table needs to be applied in case water is envisaged to be within the zone of transfer of stress. Size effect has a major role to play in the carrying capacity and compressibility of soil. All such limitations are to be considered and rational value shall be taken for design.

For KCT Consultancy Services

(Dr. K. K. Thaker)

EXPLANATION OF EVALUATION OF SAFE BEARING CAPACITY FROM SHEAR CRITERIA

Pressure intensity corresponding to the foundation width shall be calculated as per J.E. Bowels (5th edition) section 4-12.1, shall be as follow,

For PLT-03

$$\begin{aligned}
 Q_{\text{Ultimate foundation}} &= Q_{\text{Ultimate plate}} * (\text{Width of foundation} / \text{Width of Plate}) \\
 &= Q_{\text{Ultimate plate}} * (2.00 / 0.45) \\
 &= Q_{\text{Ultimate plate}} * 4.44
 \end{aligned}$$

Water table correction = 0.5

$$\begin{aligned}
 Q_{\text{safe bearing capacity}} &= Q_{\text{Ultimate plate}} * 4.44 * 0.5 / 2.5 \\
 &= 23.70 * 4.44 * 0.5 / 2.5
 \end{aligned}$$

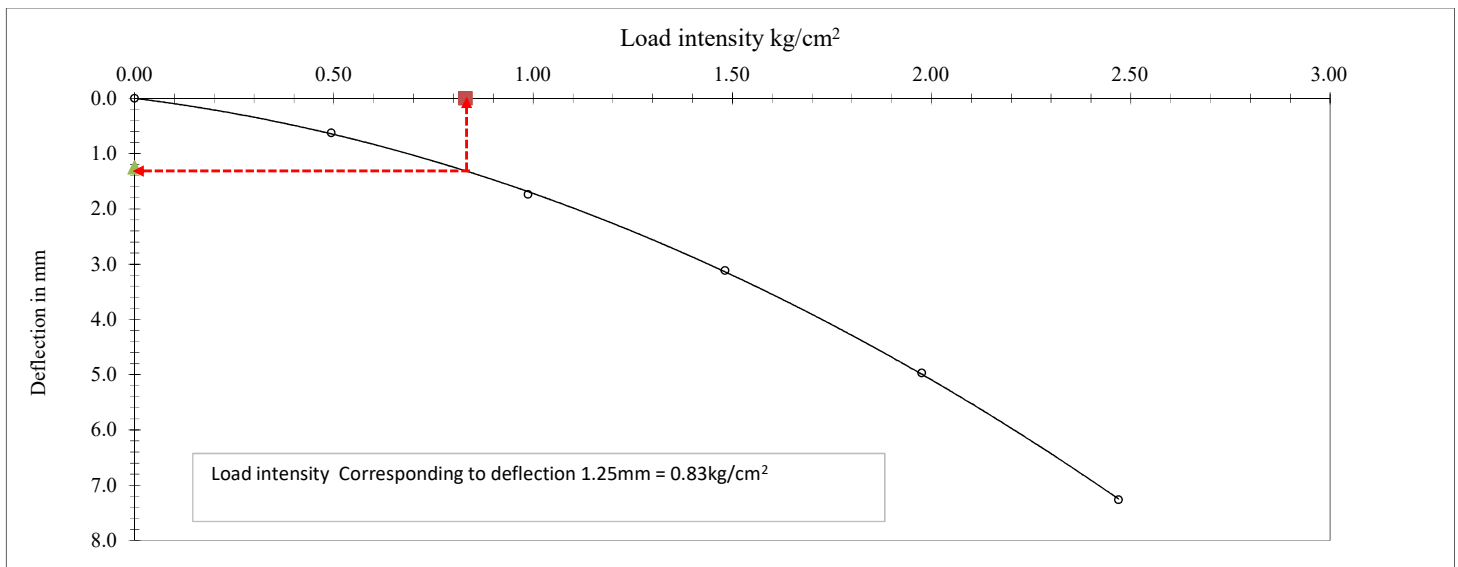
$$Q_{\text{safe bearing capacity}} = 21.07 \text{ t/m}^2 \text{ (for foundation having width 2.00m)}$$

K - Value (Modulus of Subgrade Reaction)

(IS : 9214, 1979 reaffirmed in 1987)

For PLT-03**Results**

Sr No	Load Intensity	Deflection Readings				Average Deflection	Uncorrected value Ku	Correction for				Final Corrected K - Value
		DG 1	DG 2	DG 3	DG 4			Deflection	Bending	Saturation	Size of plate	
	kg/cm ²	mm	mm	mm	mm	mm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm
	1	2	3	4	5	6	7	8	9	10	11	12
1	0.00	0.00	0.00	0.00	0.00	0.00	6.6	6.6	6.6	5.9	4.8	4.8
2	0.49	0.67	0.58	0.00	0.00	0.63						
3	0.99	1.80	1.68	0.00	0.00	1.74						
4	1.48	3.19	3.04	0.00	0.00	3.12						
5	1.98	5.04	4.90	0.00	0.00	4.97						
6	2.47	7.35	7.18	0.00	0.00	7.27						

**Note :-**

1.0 Corrections were carried out as per IS 9214

(Dr. K. K. Thaker)

MODULUS OF SUB GRADE CORRECTION FACTORS

For PLT-03

Corrections for size and shape effects are applied as given in *Soil Mechanics and Foundation Engineering* by Dr. K.R. Arora, as follows:

1.0 Effect of Size

For Cohesionless Soils

$$K_{B \times B} = K_{0.45 \times 0.45} ((B+0.45)/2B)^2$$

$$K_{2.00 \times 2.00} = K_{0.45 \times 0.45} ((2.00+0.45)/(2 \times 2.00))^2$$

$$K_{2.00 \times 2.00} = 4800 ((2.45)/(4.00))^2$$

$$K_{2.00 \times 2.00} = 1801 \text{ t/m}^3$$

2.0 Effect of Shape

$$K_{L \times B} = (2/3)K_{B \times B}(1 + B/L)$$

$$K_{2.00 \times 2.00} = (2/3)K_{2.00 \times 2.00}(1 + 2.00/2.00)$$

$$K_{2.00 \times 2.00} = (2/3)1801(1 + 1.00)$$

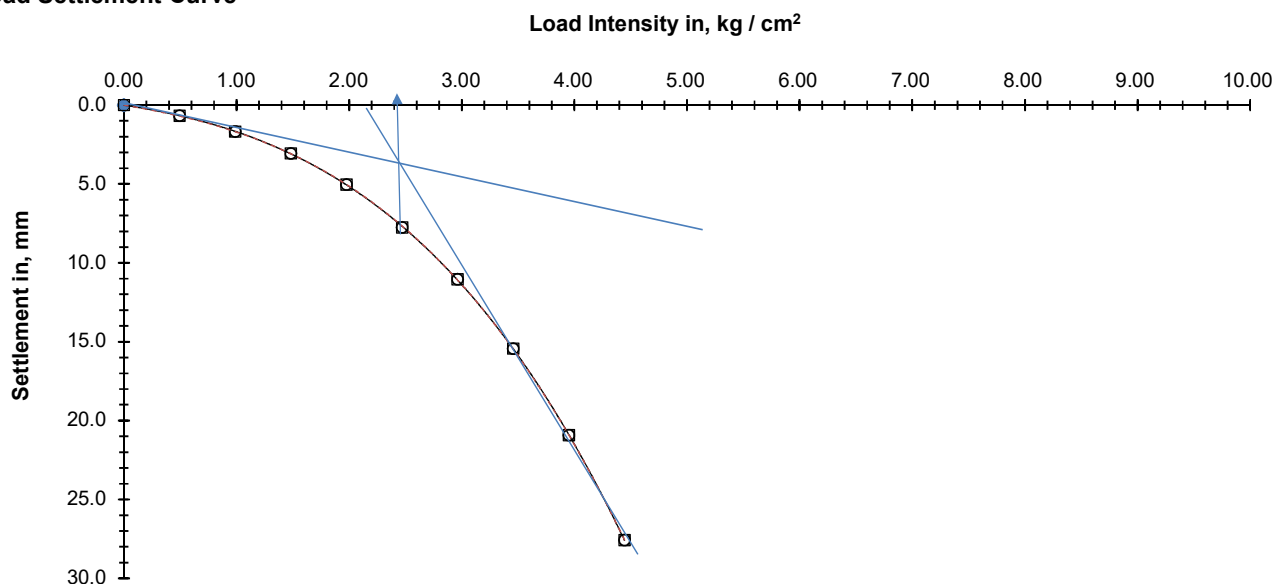
$$K_{2.00 \times 2.00} = 2401 \text{ t/m}^3$$

Plate Load Test No. PLT-4

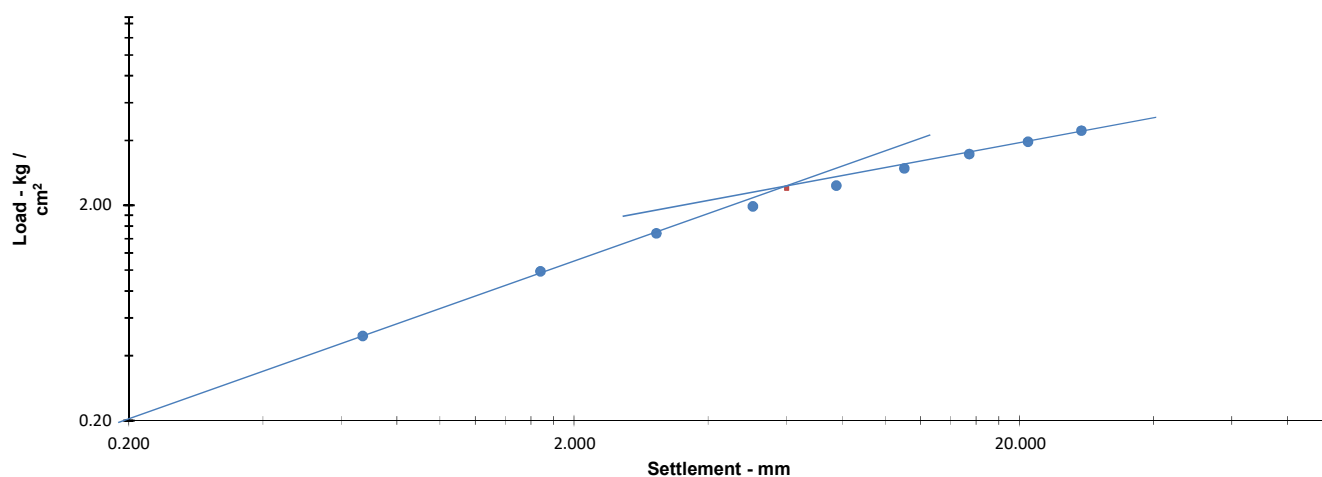
(Ref ~ IS : 1888, 1997)

Project :	NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha
Location :	IDCT-3
Depth at which test conducted :	3.00m
Size of the Plate :	450mm X 450mm
Size of the Pit :	2.5m X 3.0m
Co-ordinates :	N-2197 E-1450
RL	199.15m
Type of soil	Yellowish brown sandy clay with gravels and morum
Date :	08-01-2025

Load Settlement Curve



Load Settlement Curve



Notes :-

- 1) Definite yield point was observed on load settlement curve at 2.40 kg/cm² pressure intensity. Safe bearing capacity corresponding to 2.00m wide footing is 21.33 T/m² considering the factor of safety of 2.5 and after applying water table correction.
- 2) Safe bearing pressure worked out is for the character of soil at test level. Safe bearing pressure found can be generalised when the sub soil is homogeneous and isotropic and has the same character and state of stress as that of test level. Anisotropy in sub soil can result into significant different allowable bearing pressure than that found and therefore values found shall be utilized cautiously in that case.
- 3) Plate load test is essentially short duration test and therefore long term behavior of soil under loading can not be studied. Effect of water table needs to be applied in case water is envisaged to be within the zone of transfer of stress. Size effect has a major role to play in the carrying capacity and compressibility of soil. All such limitations are to be considered and rational value shall be taken for design.

For KCT Consultancy Services

(Dr. K. K. Thaker)

EXPLANATION OF EVALUATION OF SAFE BEARING CAPACITY FROM SHEAR CRITERIA

Pressure intensity corresponding to the foundation width shall be calculated as per J.E. Bowels (5th edition) section 4-12.1, shall be as follow,

For PLT-04

$$\begin{aligned}
 Q_{\text{Ultimate foundation}} &= Q_{\text{Ultimate plate}} * (\text{Width of foundation} / \text{Width of Plate}) \\
 &= Q_{\text{Ultimate plate}} * (2.00 / 0.45) \\
 &= Q_{\text{Ultimate plate}} * 4.44
 \end{aligned}$$

Water table correction = 0.5

$$\begin{aligned}
 Q_{\text{safe bearing capacity}} &= Q_{\text{Ultimate plate}} * 4.44 * 0.5 / 2.5 \\
 &= 24.0 * 4.44 * 0.5 / 2.5
 \end{aligned}$$

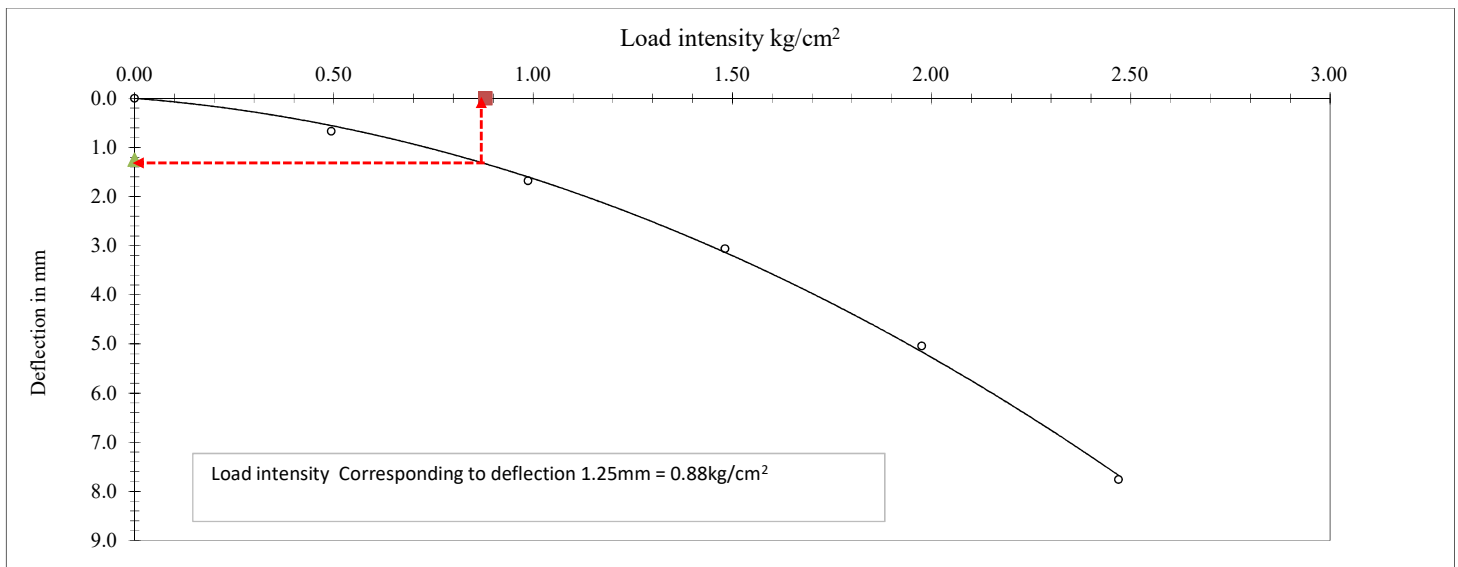
$$Q_{\text{safe bearing capacity}} = 21.33 \text{ t/m}^2 \text{ (for foundation having width 2.00m)}$$

K - Value (Modulus of Subgrade Reaction)

(IS : 9214, 1979 reaffirmed in 1987)

For PLT-03**Results**

Sr No	Load Intensity	Deflection Readings				Average Deflection	Uncorrected value Ku	Correction for				Final Corrected K - Value
		DG 1	DG 2	DG 3	DG 4			Deflection	Bending	Saturation	Size of plate	
	kg/cm ²	mm	mm	mm	mm	mm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm	kg/cm ² /cm
	1	2	3	4	5	6	7	8	9	10	11	12
1	0.00	0.00	0.00	0.00	0.00	0.00	7.0	7.0	6.7	6.0	4.8	4.8
2	0.49	0.64	0.70	0.00	0.00	0.67						
3	0.99	1.64	1.72	0.00	0.00	1.68						
4	1.48	3.02	3.10	0.00	0.00	3.06						
5	1.98	5.00	5.08	0.00	0.00	5.04						
6	2.47	7.71	7.81	0.00	0.00	7.76						

**Note :-**

1.0 Corrections were carried out as per IS 9214

(Dr. K. K. Thaker)

MODULUS OF SUB GRADE CORRECTION FACTORS

For PLT-04

Corrections for size and shape effects are applied as given in *Soil Mechanics and Foundation Engineering* by Dr. K.R. Arora, as follows:

1.0 Effect of Size

For Cohesionless Soils

$$K_{B \times B} = K_{0.45 \times 0.45} ((B+0.45)/2B)^2$$

$$K_{2.00 \times 2.00} = K_{0.45 \times 0.45} ((2.00+0.45)/(2 \times 2.00))^2$$

$$K_{2.00 \times 2.00} = 4800 ((2.45)/(4.00))^2$$

$$K_{2.00 \times 2.00} = 1801 \text{ t/m}^3$$

2.0 Effect of Shape

$$K_{L \times B} = (2/3)K_{B \times B}(1 + B/L)$$

$$K_{2.00 \times 2.00} = (2/3)K_{2.00 \times 2.00}(1 + 2.00/2.00)$$

$$K_{2.00 \times 2.00} = (2/3)1801(1 + 1.00)$$

$$K_{2.00 \times 2.00} = 2401 \text{ t/m}^3$$

4. Electrical resistivity Test

4.1 Methodology:

Geophysical Survey In all geophysical surveys, Electrical Resistivity method is best and reliable to know geological formation of the area or design earthing systems or design the cathodic protection.

All geological formations possess properties called electrical resistivity when the current flows through them. Resistivity thus is defined as the resistance offered by a unit cube of material to direct current flowing through it in a direction perpendicular to two of its opposite faces. The numerical value of the resistivity is expressed in ohm.m in general.

Thus the electrical resistivity is principally based on the study of resistance offered by the sub-surface formation to the flow of current.

The study in turns helps in evaluation of the characteristic of the sub surface layers in terms of electrical resistivity.

For this confirmatory investigation phase, it is necessary to

1. Conduct VES
2. Analysis of results

The work shall be carried out based on venner's configuration as per provisions of IS: 3043.

Vertical electrical soundings (VES) shall be conducted by using resistivity meter DDR 3 of IGIS make with employing direct current by means of batteries in series. The equipment measures resistance. Accessories include cables and electrodes. Two metal stakes called current electrodes into the sub surface transmit the current and the potential response is observed by means two Metal electrodes called potential electrodes.

Observations shall be taken by varying the spacing of the electrodes. The same shall be repeated in 8 direction, keeping the centre of all direction same. Reading of apparent resistivity thus obtained at different depths shall be plotted on the polar diagram. Apparent resistivity is calculated from the equation:-

$$\rho = 2\pi SR$$

$$K = 2\pi S = \text{Geometric factor for electrode spacing (Wenner's configuration)}$$

$$R = \text{Resistance in Ohms}$$

$$S = \text{Spacing between adjacent electrodes in (m)}$$

$$\rho = \text{Resistivity in ohm.m.}$$

After drawing the polar diagram, the area shall be found and the radius of the circle having same area as that of polar diagram gives (as shown below) the apparent average resistivity at that depth. The chart between the depth and apparent resistivity shall be prepared.

4.2 Recommendation:

Electrical Resistivity Test is a location-specific geophysical investigation method, and its results are inherently dependent on subsurface conditions at the point of measurement. A total of 42 ERT tests were conducted across various locations. Due to significant variability observed in the resistivity values across different test sites, it is not appropriate to generalize the results into a single representative value. Instead, ERT data should be interpreted on a location-wise basis, corresponding to the specific test conducted at each site.

In ERT No 4,5,6,9,13,18,21,23,25,28,29,33,34,36 values of ERT are higher. In borehole locations near to above mentioned ERT test locations, compacted granular soils exists and typically in those depth ranges the values of ERT are higher. Referring to table 3 of IS:3043 it can be seen that the presumptive values for different type of soils are shown and the results are quite in agreement to that. It is also worth noting that the presumptive values are given in range which is in response to various parameters including density, moisture content, and texture of the soil, the salt content and the presence of heavy metals. Majority of the parameters excluding moisture content are directly proportional whereas natural moisture content is inversely proportional to the electrical resistivity of the soils. Finer soils show lesser resistivity compare to the pore structure soils therefore it can also be said that within the same layer with different moisture content e.g. above and below water table or having different granular portion e.g. higher and lower sand content can influence the resistivity significantly.

Over all it can be seen that the values found are quite in range with presumptive values and are also align to the various parameter of the soil directly influencing the electrical resistivity of soil.

KCT Consultancy Services, Ahmedabad

RESULTS OF ELECTRICAL RESISTIVITY TEST

(IS : 3043, 1987)

ERT No. : 1

Name of Project : NTTTP

Co-ordinates E 3636, N 970 RL:195.45m

Date: 26-06-2024

Battery Condition : Good

Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

R = V / I in ohm (Ω)

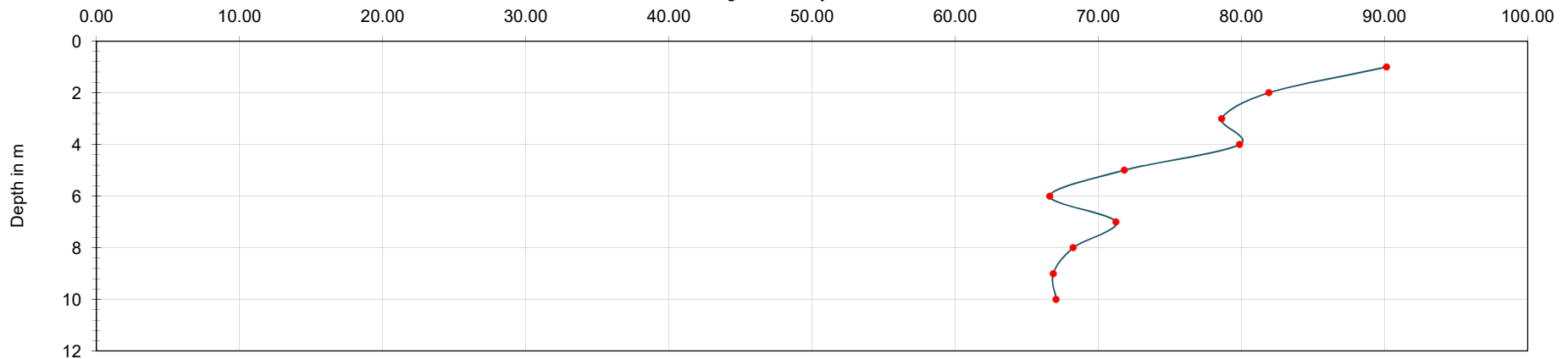
V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	14.66	92.11	14.68	92.24	15.50	97.39	15.58	97.89	14.89	93.56	14.92	93.75	15.35	96.45	15.39	96.70	90.14
2	6.73	84.57	6.73	84.57	6.87	86.33	6.86	86.21	7.12	89.47	7.11	89.35	6.78	85.20	6.77	85.07	81.92
3	4.21	79.36	4.20	79.17	4.29	80.86	4.29	80.86	4.50	84.82	4.49	84.63	4.61	86.90	4.60	86.71	78.62
4	3.15	79.17	3.15	79.17	3.30	82.94	3.30	82.94	3.42	85.95	3.41	85.70	3.55	89.22	3.54	88.97	79.88
5	2.39	75.08	2.37	74.46	2.44	76.65	2.43	76.34	2.44	76.65	2.43	76.34	2.40	75.40	2.38	74.77	71.83
6	1.19	44.86	1.90	71.63	1.99	75.02	1.98	74.64	2.04	76.91	2.04	76.91	1.90	71.63	1.88	70.87	66.62
7	1.66	73.01	1.66	73.01	1.71	75.21	1.70	74.77	1.78	78.29	1.77	77.85	1.69	74.33	1.69	74.33	71.25
8	1.40	70.37	1.39	69.87	1.45	72.88	1.44	72.38	1.55	77.91	1.54	77.41	1.35	67.86	1.33	66.85	68.26
9	1.20	67.86	1.19	67.29	1.29	72.95	1.28	72.38	1.32	74.64	1.30	73.51	1.20	67.86	1.19	67.29	66.86
10	1.10	69.12	1.10	69.12	1.15	72.26	1.15	72.26	1.19	74.77	1.18	74.14	1.07	67.23	1.06	66.60	67.07

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. Depth

Average Resistivity in Ω - m

KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

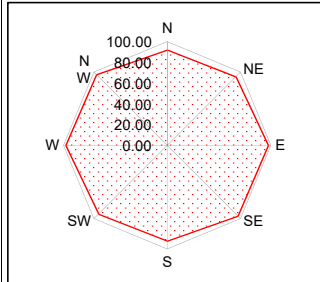
ERT No. : 1

Date : 00-01-1900

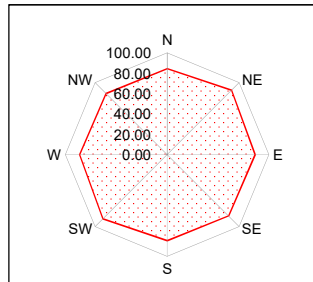
Test Location : E 3636, N 970

Name of Project : NTTTP

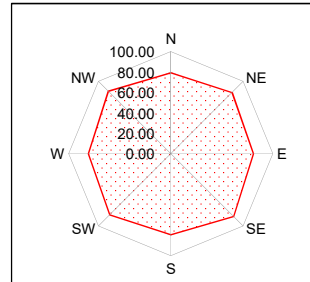
Depth 1 m



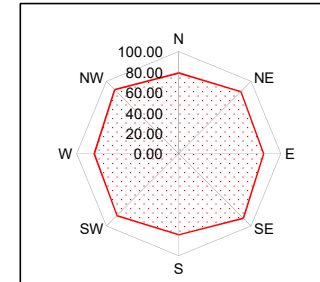
Depth 2 m



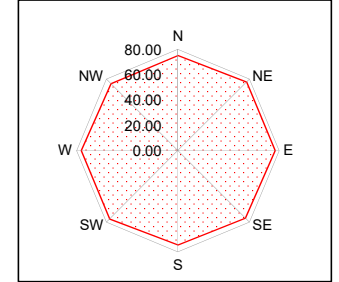
Depth 3 m



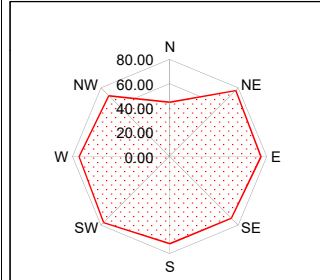
Depth 4 m



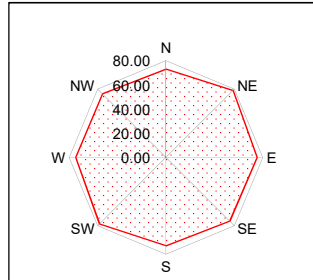
Depth 5 m



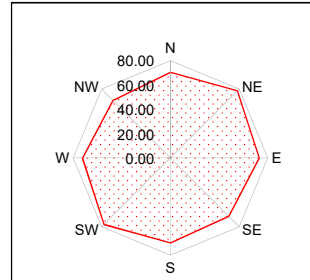
Depth 6 m



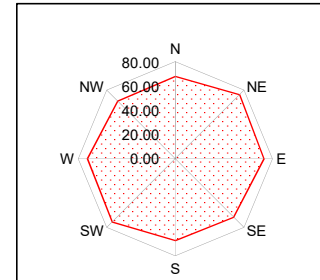
Depth 7 m



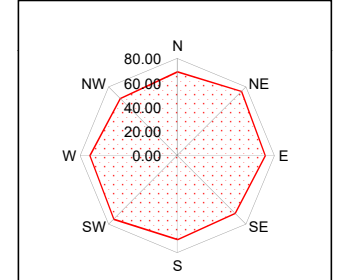
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	25527.88	21082.43	19418.98	20047.86	16211.13	13943.17	15946.47	14636.12	14045.29	14130.07
Radius of the circle having same area as polar diagram	90.14	81.92	78.62	79.88	71.83	66.62	71.25	68.26	66.86	67.07

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad**RESULTS OF ELECTRICAL RESISTIVITY TEST**
(IS : 3043, 1987)

ERT No. : ERT02
 Name of Project : NTPP
 Co-ordinates E 1085 , N 3626 RL: 198.30m

Date: 04-05-2025
 Battery Condition : Good
 Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

ρ = Resistivity in ohm - m (Ω m)

π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

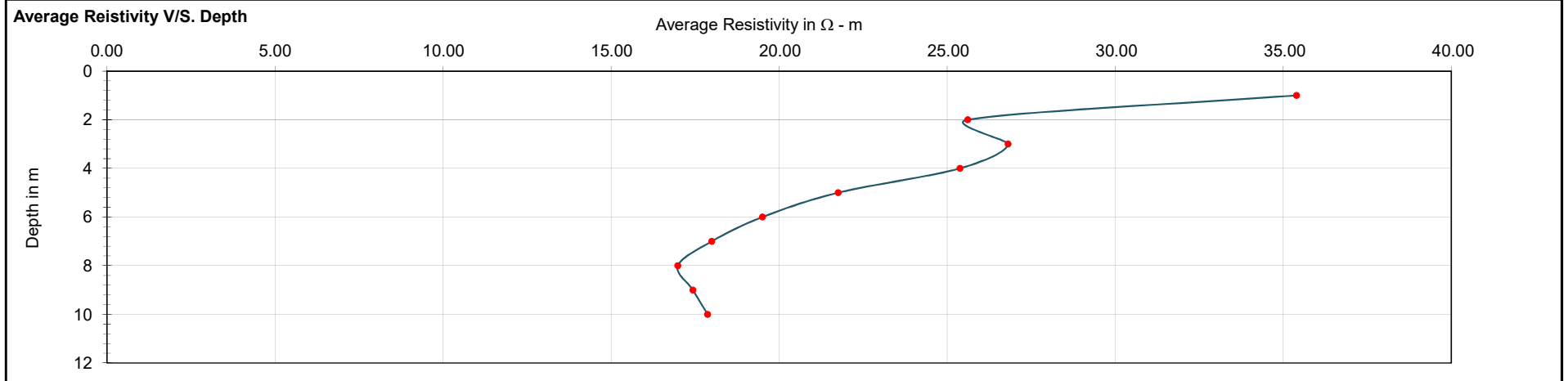
$R = V / I$ in ohm (Ω)

V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	5.92	37.20	5.94	37.32	5.75	36.13	5.76	36.19	7.08	44.48	7.09	44.55	4.98	31.29	4.99	31.35	35.40
2	2.05	25.76	2.07	26.01	1.94	24.38	1.95	24.50	2.85	35.81	2.86	35.94	1.75	21.99	1.76	22.12	25.62
3	1.41	26.58	1.43	26.95	1.35	25.45	1.36	25.64	1.95	36.76	1.96	36.95	1.28	24.13	1.29	24.32	26.81
4	1.02	25.64	1.04	26.14	0.91	22.87	0.92	23.12	1.43	35.94	1.44	36.19	0.89	22.37	0.90	22.62	25.38
5	0.75	23.56	0.77	24.19	0.61	19.16	0.62	19.48	0.98	30.79	0.99	31.10	0.56	17.59	0.57	17.91	21.76
6	0.58	21.87	0.60	22.62	0.44	16.59	0.44	16.59	0.74	27.90	0.75	28.27	0.41	15.46	0.41	15.46	19.51
7	0.48	21.11	0.48	21.11	0.38	16.71	0.39	17.15	0.55	24.19	0.56	24.63	0.30	13.19	0.31	13.63	18.00
8	0.39	19.60	0.40	20.11	0.33	16.59	0.33	16.59	0.41	20.61	0.42	21.11	0.28	14.07	0.29	14.58	16.99
9	0.34	19.23	0.34	19.23	0.30	16.96	0.30	16.96	0.39	22.05	0.39	22.05	0.27	15.27	0.27	15.27	17.43
10	0.30	18.85	0.30	18.85	0.28	17.59	0.28	17.59	0.37	23.25	0.37	23.25	0.25	15.71	0.25	15.71	17.87

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.



KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

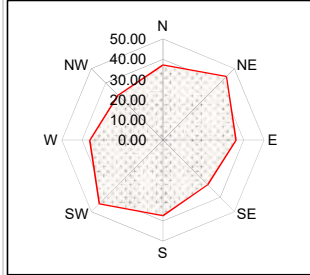
(IS : 3043, 1987)

ERT No. : ERT02
Name of Project : NTPP

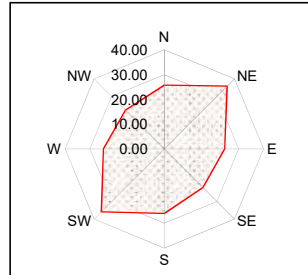
Date : 00-01-1900

Test Location : E 1085 , N 3626 RL: 198.30m

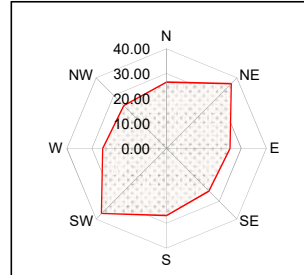
Depth 1 m



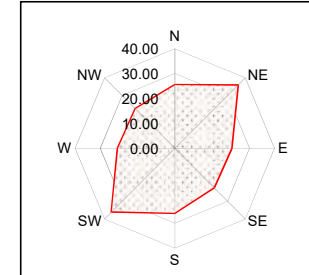
Depth 2 m



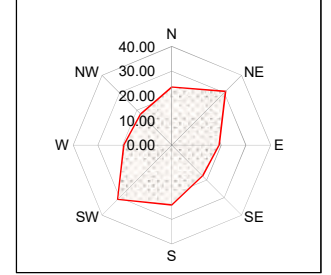
Depth 3 m



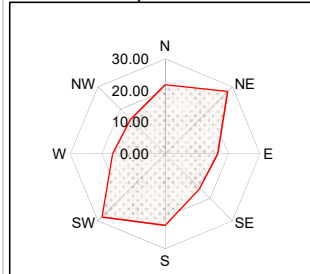
Depth 4 m



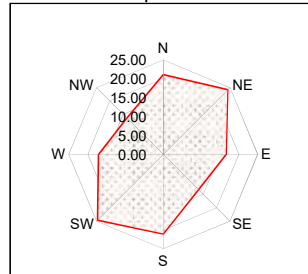
Depth 5 m



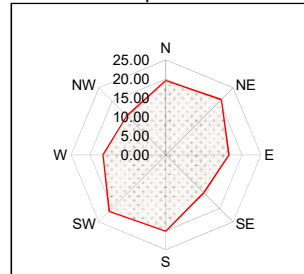
Depth 6 m



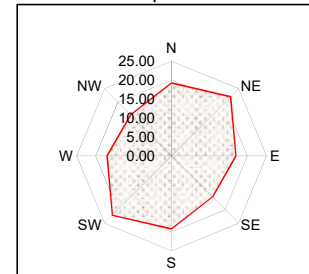
Depth 7 m



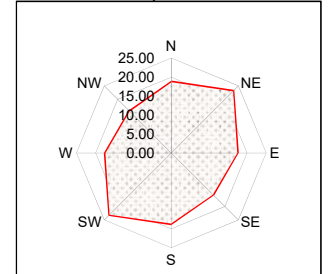
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	3936.55	2061.31	2258.56	2023.86	1487.18	1195.42	1017.46	906.56	954.97	1003.69
Radius of the circle having same area as polar diagram	35.40	25.62	26.81	25.38	21.76	19.51	18.00	16.99	17.43	17.87

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad

RESULTS OF ELECTRICAL RESISTIVITY TEST

(IS : 3043, 1987)

ERT No. : 3

Name of Project : NTTTP

Co-ordinates E 1145, N 3548 RL:196.40m

Date: 26-06-2024

Battery Condition : Good

Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

R = V / I in ohm (Ω)

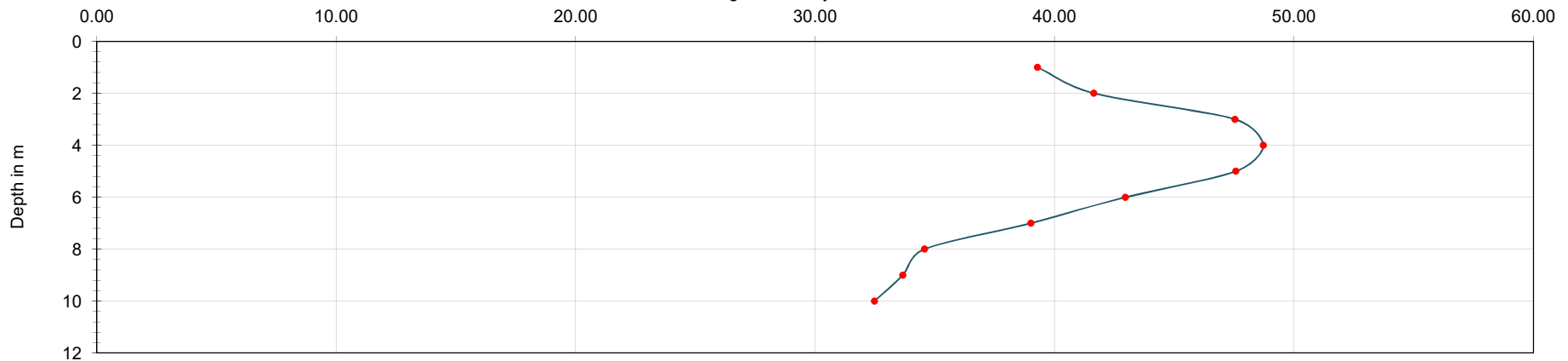
V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	6.77	42.54	6.79	42.66	6.32	39.71	6.33	39.77	6.62	41.59	6.69	42.03	6.59	41.41	6.62	41.59	39.29
2	3.34	41.97	3.33	41.85	3.51	44.11	3.51	44.11	3.39	42.60	3.80	47.75	3.54	44.48	3.53	44.36	41.65
3	2.78	52.40	2.78	52.40	2.47	46.56	2.46	46.37	2.71	51.08	2.70	50.89	2.69	50.71	2.68	50.52	47.54
4	2.10	52.78	2.10	52.78	1.91	48.00	1.91	48.00	2.09	52.53	2.09	52.53	2.08	52.28	2.07	52.02	48.73
5	1.66	52.15	1.65	51.84	1.55	48.69	1.54	48.38	1.61	50.58	1.61	50.58	1.58	49.64	1.57	49.32	47.58
6	1.25	47.12	1.25	47.12	1.18	44.48	1.18	44.48	1.21	45.62	1.20	45.24	1.17	44.11	1.17	44.11	42.96
7	0.92	40.46	0.91	40.02	0.98	43.10	0.97	42.66	0.94	41.34	0.93	40.90	0.92	40.46	0.91	40.02	39.02
8	0.72	36.19	0.72	36.19	0.77	38.70	0.76	38.20	0.69	34.68	0.69	34.68	0.73	36.69	0.72	36.19	34.57
9	0.57	32.23	0.56	31.67	0.72	40.72	0.71	40.15	0.56	31.67	0.55	31.10	0.68	38.45	0.67	37.89	33.66
10	0.51	32.04	0.51	32.04	0.61	38.33	0.61	38.33	0.49	30.79	0.48	30.16	0.58	36.44	0.57	35.81	32.48

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. Depth

Average Resistivity in Ω - m

KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

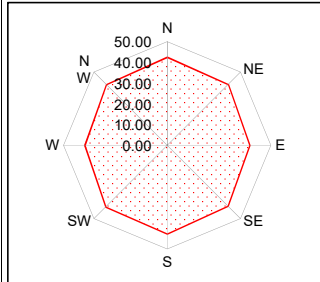
ERT No. : 3

Date : 00-01-1900

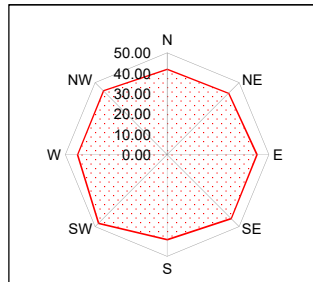
Test Location : E 3543, N 1044

Name of Project : NTTTP

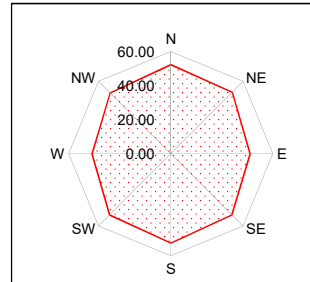
Depth 1 m



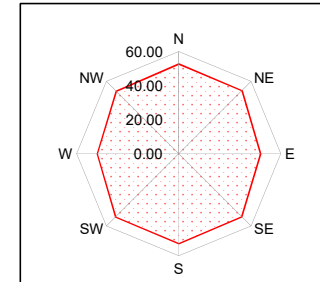
Depth 2 m



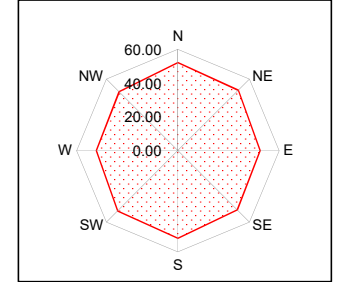
Depth 3 m



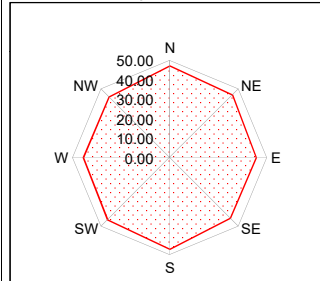
Depth 4 m



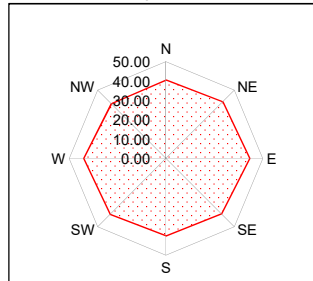
Depth 5 m



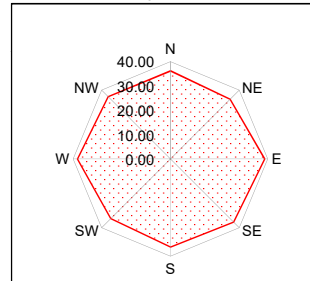
Depth 6 m



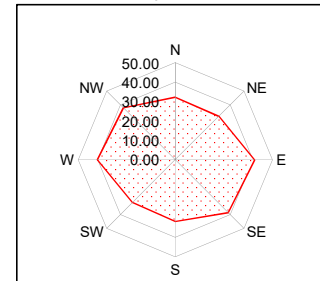
Depth 7 m



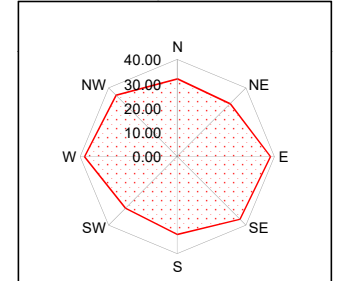
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	4850.21	5448.70	7101.61	7458.62	7111.78	5798.98	4782.06	3753.59	3559.53	3313.62
Radius of the circle having same area as polar diagram	39.29	41.65	47.54	48.73	47.58	42.96	39.02	34.57	33.66	32.48

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad

RESULTS OF ELECTRICAL RESISTIVITY TEST

(IS : 3043, 1987)

ERT No. : 4

Name of Project : NTTTP

Co-ordinates E 3496, N 1012 RL:195.20m

Date: 29-06-2024

Battery Condition : Good

Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

R = V / I in ohm (Ω)

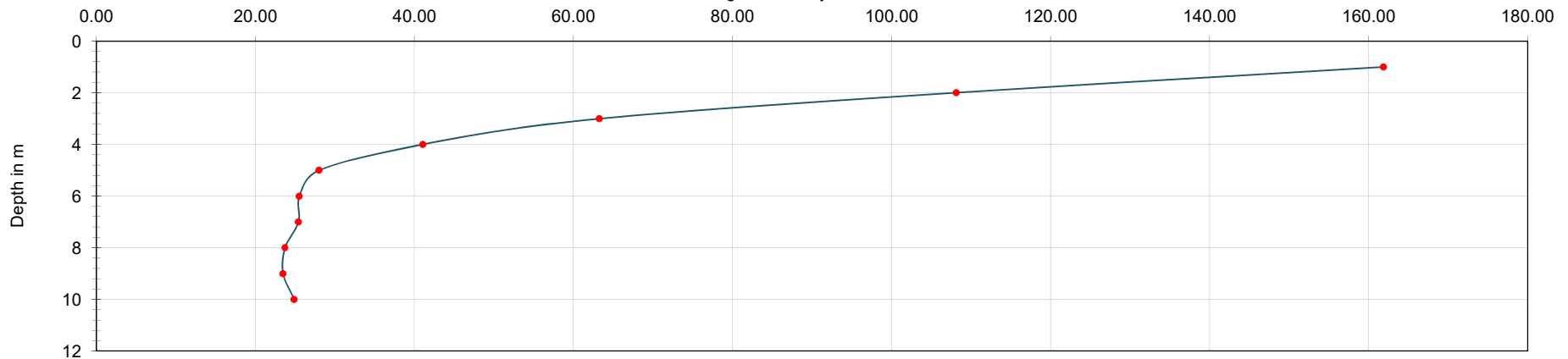
V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	26.69	167.70	26.72	167.89	27.30	171.53	27.35	171.85	27.55	173.10	27.59	173.35	27.01	169.71	27.04	169.90	161.89
2	8.89	111.72	8.89	111.72	9.56	120.13	9.56	120.13	8.50	106.81	8.50	106.81	9.35	117.50	9.34	117.37	108.17
3	3.61	68.05	3.60	67.86	3.52	66.35	3.50	65.97	3.45	65.03	3.44	64.84	3.59	67.67	3.58	67.48	63.24
4	1.72	43.23	1.71	42.98	1.68	42.22	1.67	41.97	1.61	40.46	1.60	40.21	1.90	47.75	1.89	47.50	41.07
5	0.95	29.85	0.94	29.53	0.99	31.10	0.98	30.79	0.90	28.27	0.89	27.96	0.94	29.53	0.93	29.22	28.01
6	0.69	26.01	0.69	26.01	0.73	27.52	0.72	27.14	0.70	26.39	0.69	26.01	0.75	28.27	0.74	27.90	25.53
7	0.62	27.27	0.61	26.83	0.61	26.83	0.61	26.83	0.58	25.51	0.57	25.07	0.64	28.15	0.63	27.71	25.40
8	0.49	24.63	0.48	24.13	0.51	25.64	0.50	25.13	0.53	26.64	0.52	26.14	0.48	24.13	0.47	23.62	23.73
9	0.42	23.75	0.41	23.18	0.45	25.45	0.44	24.88	0.47	26.58	0.46	26.01	0.43	24.32	0.42	23.75	23.47
10	0.39	24.50	0.38	23.88	0.43	27.02	0.43	27.02	0.45	28.27	0.44	27.65	0.41	25.76	0.41	25.76	24.88

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. Depth

Average Resistivity in Ω - m

KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

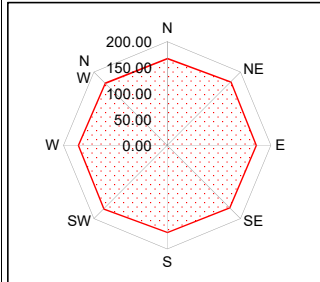
ERT No. : 4

Date : 00-01-1900

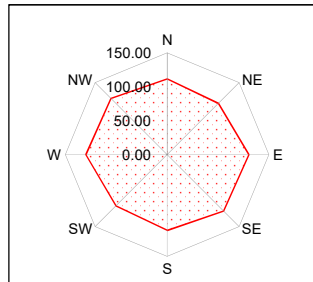
Test Location : E 3496, N 1012

Name of Project : NTTTP

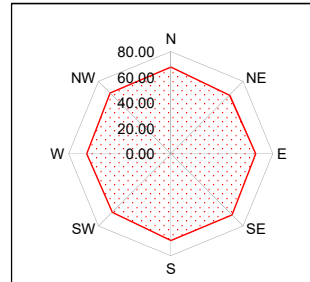
Depth 1 m



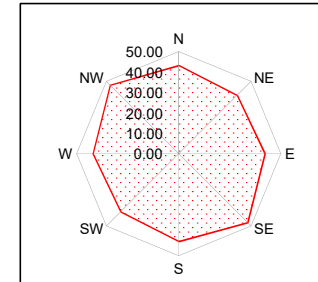
Depth 2 m



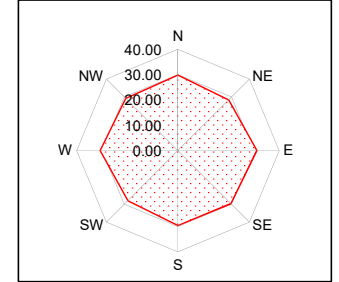
Depth 3 m



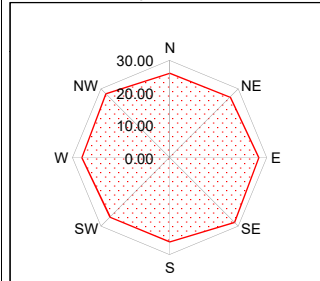
Depth 4 m



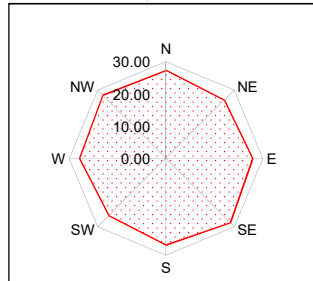
Depth 5 m



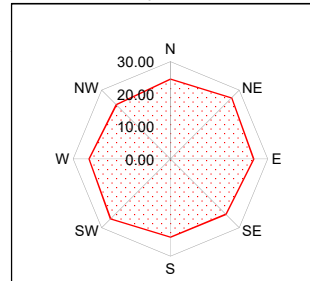
Depth 6 m



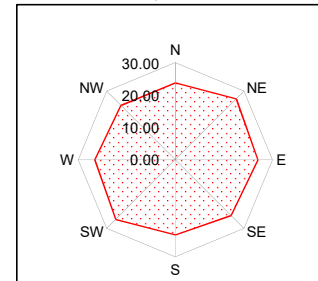
Depth 7 m



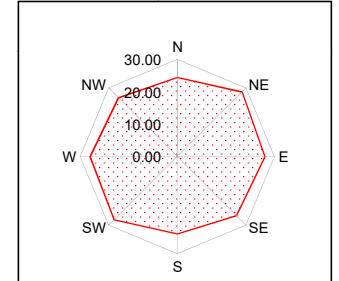
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	82331.71	36758.02	12564.72	5298.69	2464.53	2047.44	2027.20	1768.55	1730.54	1944.99
Radius of the circle having same area as polar diagram	161.89	108.17	63.24	41.07	28.01	25.53	25.40	23.73	23.47	24.88

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad

RESULTS OF ELECTRICAL RESISTIVITY TEST

(IS : 3043, 1987)

ERT No. : 5
 Name of Project : NTPP
 Co-ordinates E 1169, N 3443 RL:199.25m

Date: 05-12-2024
 Battery Condition : Good
 Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

R = V / I in ohm (Ω)

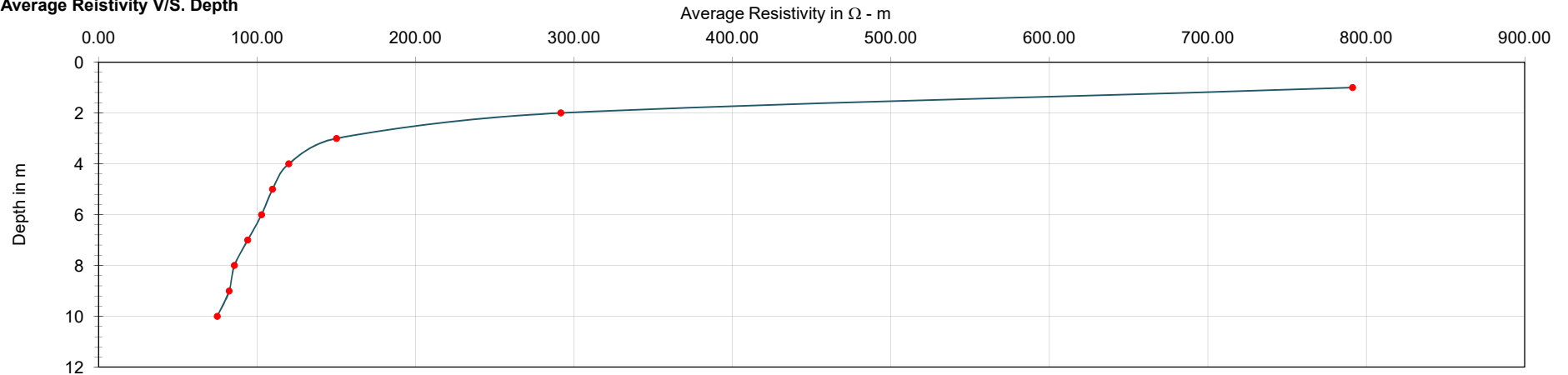
V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	119.61	751.53	119.66	751.85	125.21	786.72	125.25	786.97	142.31	894.16	142.40	894.73	145.47	914.01	145.51	914.27	791.33
2	27.46	345.07	27.48	345.32	22.75	285.88	22.80	286.51	26.47	332.63	26.49	332.88	21.17	266.03	21.19	266.28	291.72
3	7.30	137.60	7.92	149.29	7.97	150.23	7.99	150.61	9.61	181.14	9.63	181.52	8.48	159.84	8.49	160.03	150.23
4	4.75	119.38	4.76	119.63	4.62	116.11	4.63	116.36	5.06	127.17	5.08	127.67	5.75	144.51	5.77	145.02	120.17
5	3.34	104.93	3.34	104.93	3.45	108.38	3.47	109.01	3.61	113.41	3.62	113.73	4.38	137.60	4.38	137.60	109.89
6	2.51	94.62	2.53	95.38	2.83	106.69	2.84	107.07	2.57	96.89	2.57	96.89	3.61	136.09	3.62	136.47	102.92
7	2.61	114.79	2.03	89.28	2.08	91.48	2.10	92.36	2.06	90.60	2.08	91.48	2.53	111.28	2.58	113.47	94.24
8	1.65	82.94	1.66	83.44	1.86	93.49	1.86	93.49	1.66	83.44	1.66	83.44	2.01	101.03	2.03	102.04	85.76
9	1.35	76.34	1.38	78.04	1.72	97.26	1.73	97.83	1.34	75.78	1.36	76.91	1.70	96.13	1.72	97.26	82.49
10	1.24	77.91	1.24	77.91	1.42	89.22	1.43	89.85	1.18	74.14	1.18	74.14	1.19	74.77	1.20	75.40	74.99

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. Depth



KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

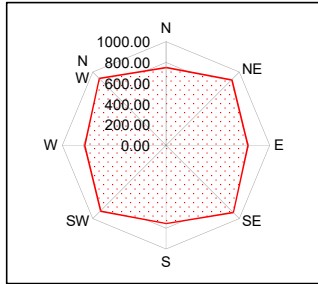
ERT No. : 5

Date : 00-01-1900

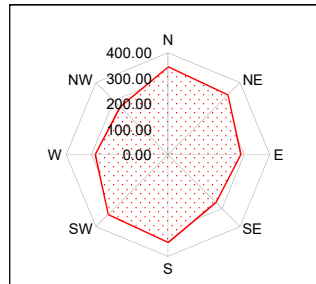
Test Location : E 1169, N 3443

Name of Project : NTPP

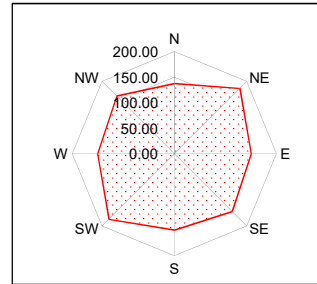
Depth 1 m



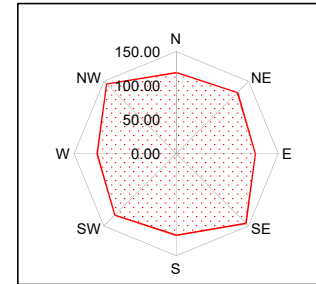
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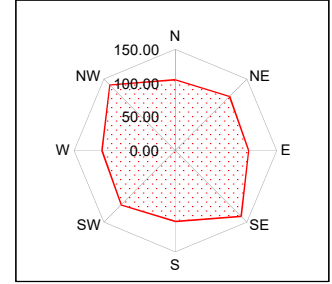
Depth 3 m



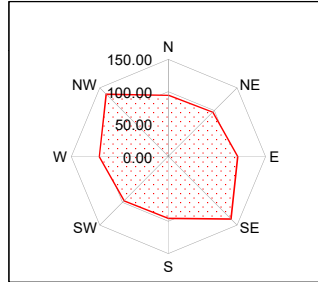
Depth 4 m



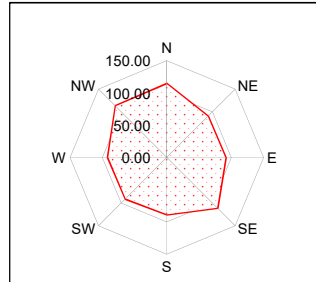
Depth 5 m



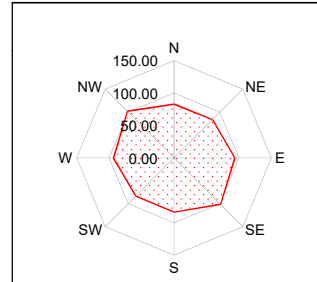
Depth 6 m



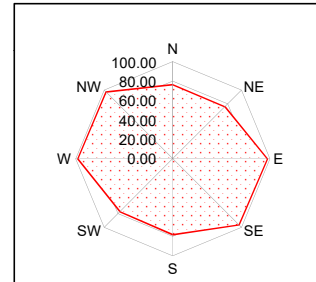
Depth 7 m



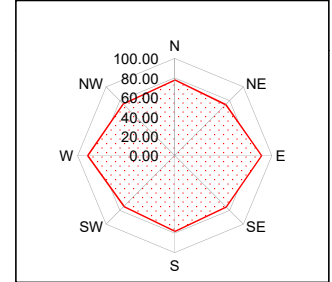
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	1967272.70	267353.65	70903.70	45366.04	37935.60	33279.78	27901.38	23106.31	21377.09	17666.14
Radius of the circle having same area as polar diagram	791.33	291.72	150.23	120.17	109.89	102.92	94.24	85.76	82.49	74.99

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad

RESULTS OF ELECTRICAL RESISTIVITY TEST (IS : 3043, 1987)

ERT No. : 6
Name of Project : NTPP
Co-ordinates E 1313, N 3414 RL:202.90m

Date: 04-12-2024
Battery Condition : Good
Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

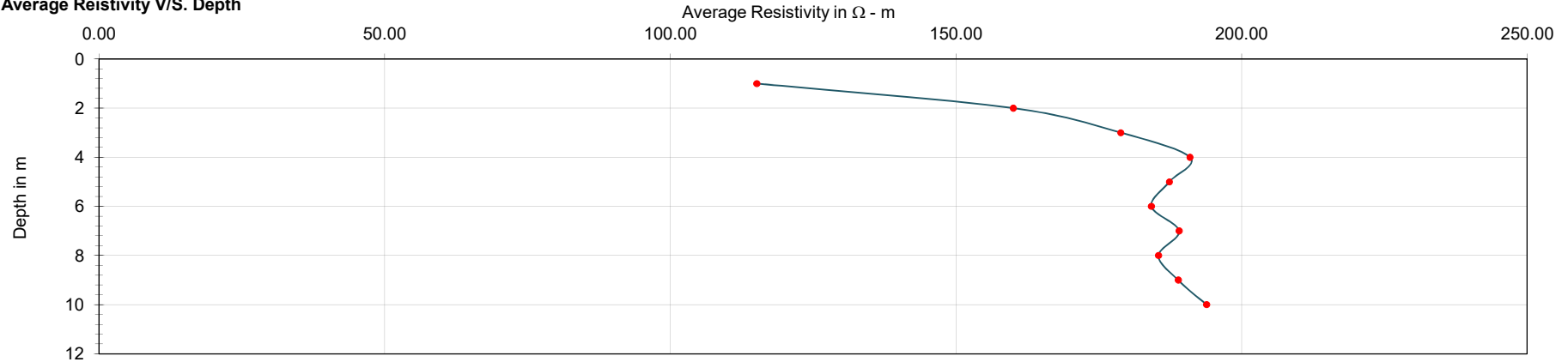
ρ = Resistivity in ohm - m (Ω m)
 π = Value of pi - 22 / 7
 S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

$R = V / I$ in ohm (Ω)
 V = Voltage Drop between inner electrodes in Volt
 I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	21.18	133.08	21.20	133.20	16.77	105.37	16.80	105.56	22.11	138.92	22.17	139.30	17.14	107.69	17.19	108.01	115.16
2	14.21	178.57	14.23	178.82	12.68	159.34	12.68	159.34	13.97	175.55	13.98	175.68	12.81	160.98	12.83	161.23	160.05
3	8.51	160.41	8.51	160.41	11.13	209.80	11.18	210.74	9.01	169.83	9.03	170.21	11.32	213.38	11.33	213.57	178.86
4	6.60	165.88	6.62	166.38	9.47	238.01	9.49	238.51	6.21	156.07	6.63	166.63	9.51	239.01	9.54	239.77	190.97
5	5.36	168.39	5.39	169.33	7.51	235.93	7.03	220.85	5.59	175.62	5.61	176.24	6.89	216.46	6.91	217.08	187.37
6	4.96	186.99	4.98	187.74	5.39	203.20	5.40	203.58	5.01	188.87	5.01	188.87	5.21	196.41	5.24	197.54	184.20
7	4.49	197.48	4.49	197.48	4.48	197.04	4.50	197.92	4.53	199.24	4.55	200.12	4.59	201.88	4.62	203.20	189.08
8	4.01	201.56	4.02	202.07	3.79	190.51	3.81	191.51	4.11	206.59	4.13	207.60	3.61	181.46	3.63	182.46	185.46
9	3.56	201.31	3.57	201.88	3.47	196.22	3.35	189.44	3.79	214.32	3.81	215.45	3.31	187.18	3.31	187.18	188.91
10	3.23	202.95	3.24	203.58	3.31	207.97	3.32	208.60	3.33	209.23	3.35	210.49	3.11	195.41	3.13	196.66	193.89

#REF!

Average Resistivity V/S. Depth



KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

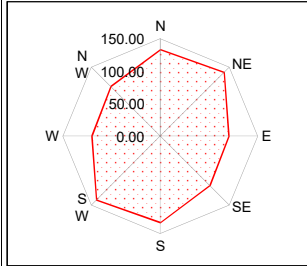
ERT No. : 6

Date : 00-01-1900

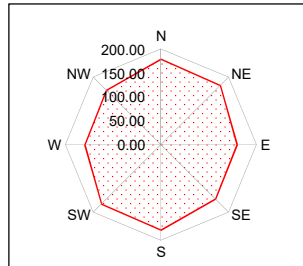
Test Location : E 1169, N 3443

Name of Project : NTPP

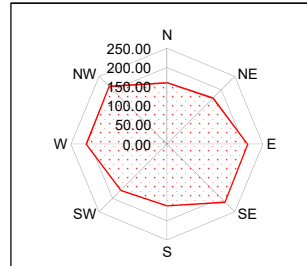
Depth 1 m



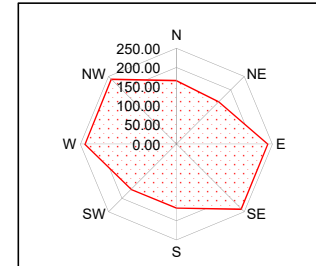
Depth 2 m



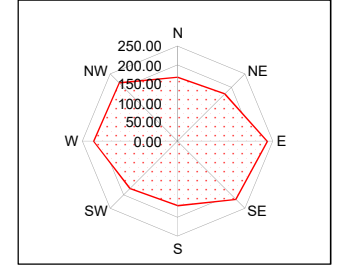
Depth 3 m



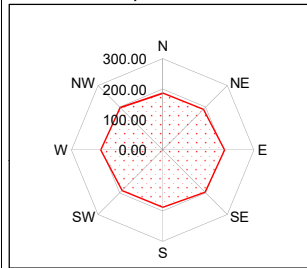
Depth 4 m



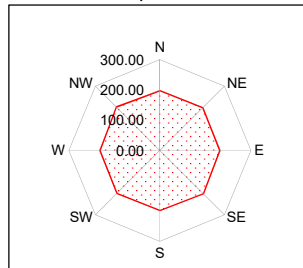
Depth 5 m



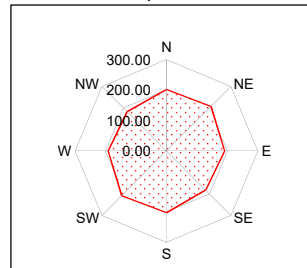
Depth 6 m



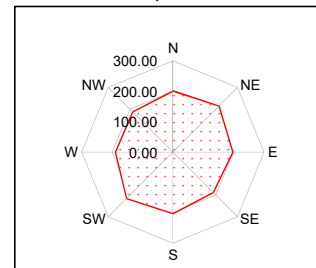
Depth 7 m



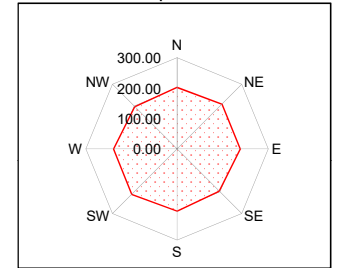
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	41660.55	80472.07	100501.77	114574.19	110289.66	106595.41	112314.70	108051.43	112117.44	118101.11
Radius of the circle having same area as polar diagram	115.16	160.05	178.86	190.97	187.37	184.20	189.08	185.46	188.91	193.89

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad

RESULTS OF ELECTRICAL RESISTIVITY TEST

(IS : 3043, 1987)

ERT No. : 7

Name of Project : NTTTP

Co-ordinates E 3504, N 904 RL:194.20m

Date: 29-06-2024

Battery Condition : Good

Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

 $R = V / I$ in ohm (Ω)

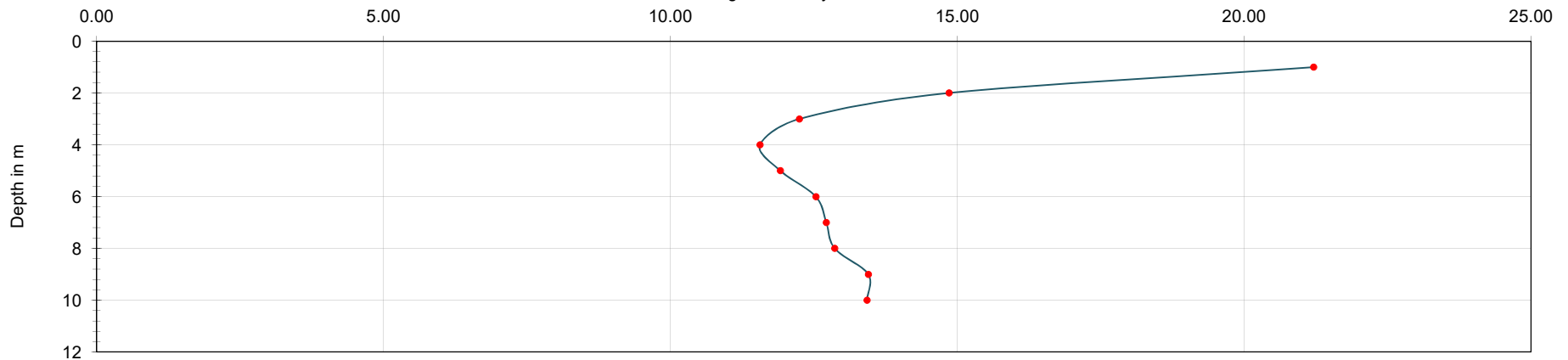
V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	3.53	22.18	3.56	22.37	3.46	21.74	3.48	21.87	3.61	22.68	3.61	22.68	3.59	22.56	3.63	22.81	21.21
2	1.19	14.95	1.19	14.95	1.32	16.59	1.31	16.46	1.21	15.21	1.20	15.08	1.28	16.08	1.27	15.96	14.86
3	0.66	12.44	0.65	12.25	0.71	13.38	0.71	13.38	0.69	13.01	0.68	12.82	0.69	13.01	0.69	13.01	12.25
4	0.49	12.32	0.49	12.32	0.50	12.57	0.49	12.32	0.45	11.31	0.45	11.31	0.51	12.82	0.50	12.57	11.56
5	0.41	12.88	0.40	12.57	0.38	11.94	0.38	11.94	0.40	12.57	0.39	12.25	0.42	13.19	0.42	13.19	11.92
6	0.36	13.57	0.36	13.57	0.35	13.19	0.33	12.59	0.35	13.19	0.34	12.82	0.36	13.57	0.35	13.19	12.54
7	0.32	14.07	0.32	14.07	0.31	13.63	0.31	13.63	0.30	13.19	0.30	13.19	0.29	12.75	0.29	12.75	12.72
8	0.28	14.07	0.28	14.07	0.28	14.07	0.28	14.07	0.27	13.57	0.27	13.57	0.25	12.57	0.25	12.57	12.87
9	0.28	15.83	0.27	15.27	0.26	14.70	0.26	14.70	0.24	13.57	0.24	13.57	0.23	13.01	0.23	13.01	13.45
10	0.26	16.34	0.25	15.71	0.24	15.08	0.24	15.08	0.21	13.19	0.21	13.19	0.20	12.57	0.20	12.57	13.43

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. Depth

Average Resistivity in Ω - m

KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

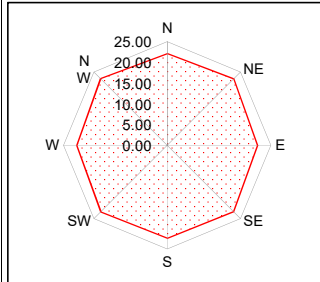
ERT No. : 7

Date : 00-01-1900

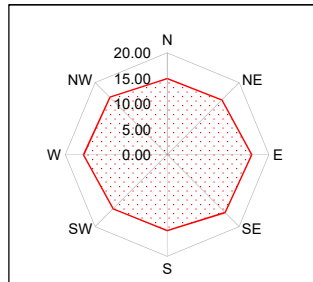
Test Location : E 3504, N 904

Name of Project : NTTTP

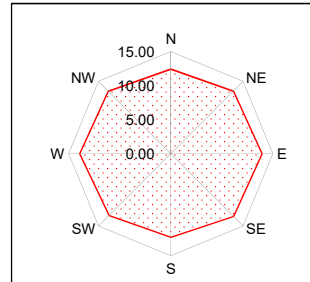
Depth 1 m



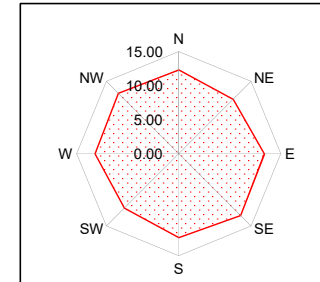
Depth 2 m



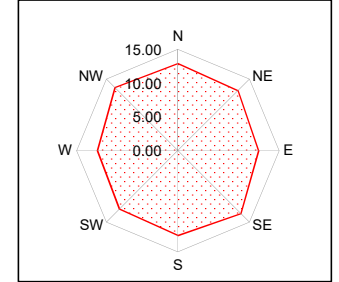
Depth 3 m



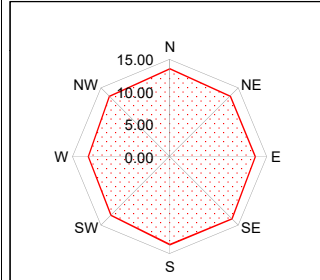
Depth 4 m



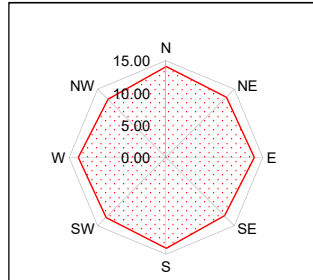
Depth 5 m



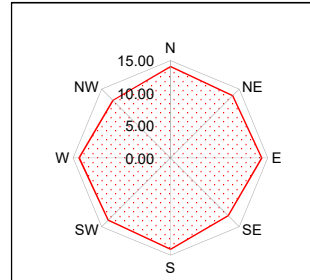
Depth 6 m



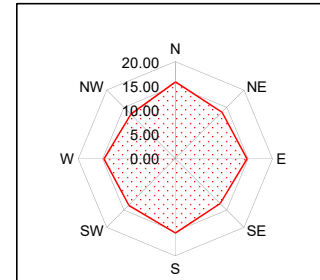
Depth 7 m



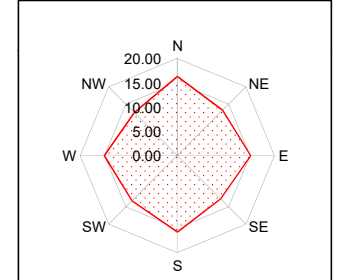
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	1413.65	693.59	471.48	420.10	446.44	493.84	508.36	520.18	568.48	566.46
Radius of the circle having same area as polar diagram	21.21	14.86	12.25	11.56	11.92	12.54	12.72	12.87	13.45	13.43

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad

RESULTS OF ELECTRICAL RESISTIVITY TEST

(IS : 3043, 1987)

ERT No. : 8
 Name of Project : NTPPP
 Co-ordinates E 976, N 3400

Date: 25-11-2024
 Battery Condition : Good
 Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

R = V / I in ohm (Ω)

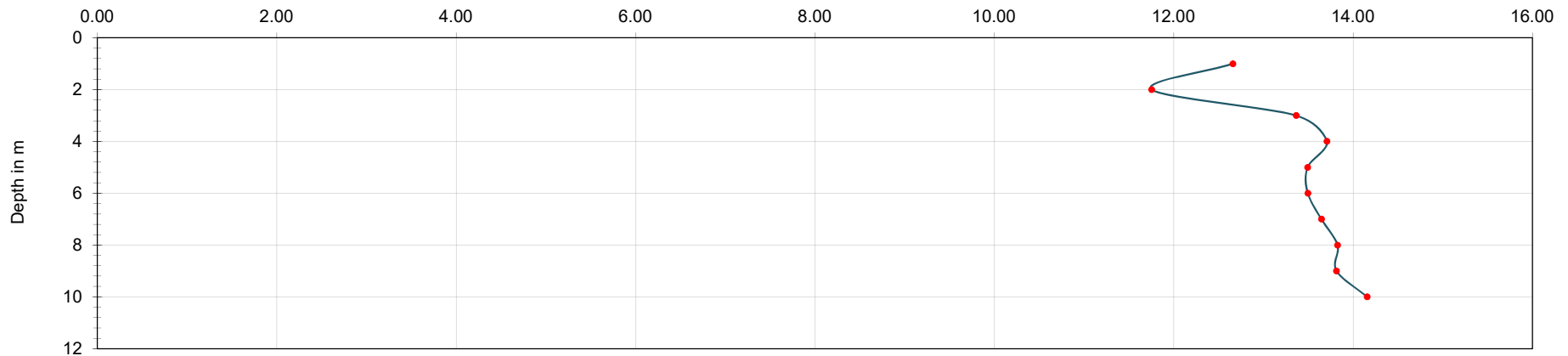
V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	2.13	13.38	2.14	13.45	2.09	13.13	2.10	13.19	2.12	13.32	2.13	13.38	2.14	13.45	2.14	13.45	12.66
2	0.97	12.19	0.99	12.44	0.93	11.69	0.95	11.94	0.98	12.32	1.00	12.57	1.03	12.94	1.04	13.07	11.75
3	0.67	12.63	0.68	12.82	0.65	12.25	0.66	12.44	0.70	13.19	0.71	13.38	0.97	18.28	0.98	18.47	13.37
4	0.53	13.32	0.55	13.82	0.50	12.57	0.51	12.82	0.56	14.07	0.58	14.58	0.69	17.34	0.70	17.59	13.71
5	0.43	13.51	0.44	13.82	0.41	12.88	0.41	12.88	0.45	14.14	0.46	14.45	0.51	16.02	0.52	16.34	13.49
6	0.35	13.19	0.36	13.57	0.37	13.95	0.38	14.33	0.39	14.70	0.39	14.70	0.38	14.33	0.40	15.08	13.50
7	0.29	12.75	0.30	13.19	0.32	14.07	0.33	14.51	0.33	14.51	0.33	14.51	0.35	15.39	0.37	16.27	13.65
8	0.27	13.57	0.28	14.07	0.29	14.58	0.29	14.58	0.29	14.58	0.30	15.08	0.30	15.08	0.30	15.08	13.83
9	0.24	13.57	0.24	13.57	0.26	14.70	0.27	15.27	0.23	13.01	0.25	14.14	0.28	15.83	0.29	16.40	13.81
10	0.22	13.82	0.23	14.45	0.24	15.08	0.25	15.71	0.22	13.82	0.22	13.82	0.25	15.71	0.27	16.96	14.16

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. Depth

Average Resistivity in Ω - m

KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

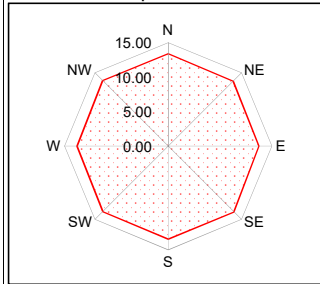
ERT No. : 8

Date : 00-01-1900

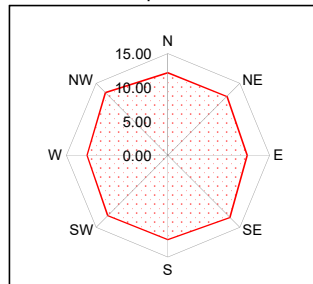
Test Location : E 976, N 3400

Name of Project : NTTTP

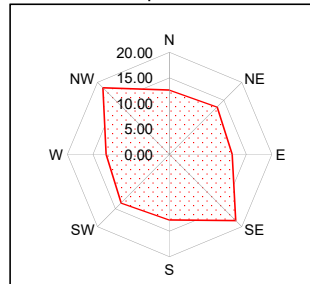
Depth 1 m



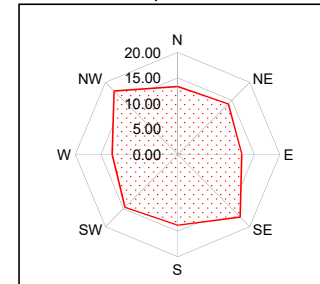
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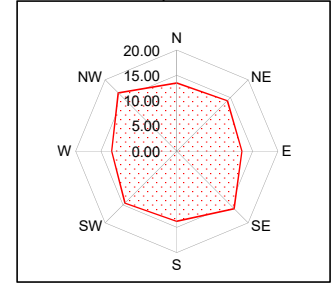
Depth 3 m



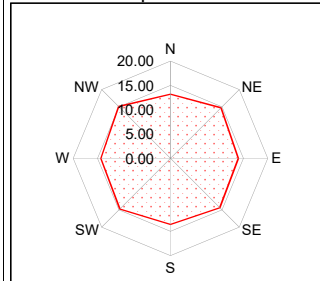
Depth 4 m



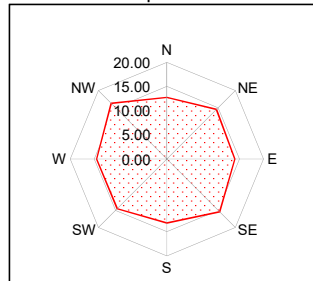
Depth 5 m



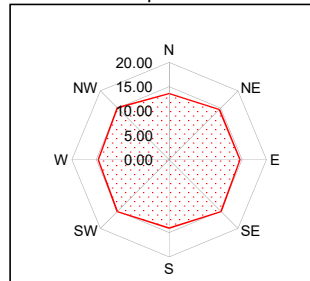
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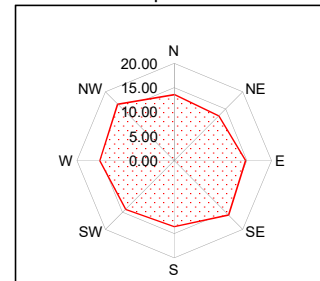
Depth 7 m



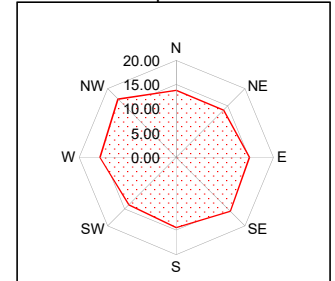
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	503.55	434.10	561.30	590.40	571.94	572.14	585.08	600.56	599.57	629.68
Radius of the circle having same area as polar diagram	12.66	11.75	13.37	13.71	13.49	13.50	13.65	13.83	13.81	14.16

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad

RESULTS OF ELECTRICAL RESISTIVITY TEST (IS : 3043, 1987)

ERT No. : 9
Name of Project : NTPP
Co-ordinates E 1346, N 3380 RL:203.20m

Date: 04-12-2024
Battery Condition : Good
Climatic Condition : hot and Dry

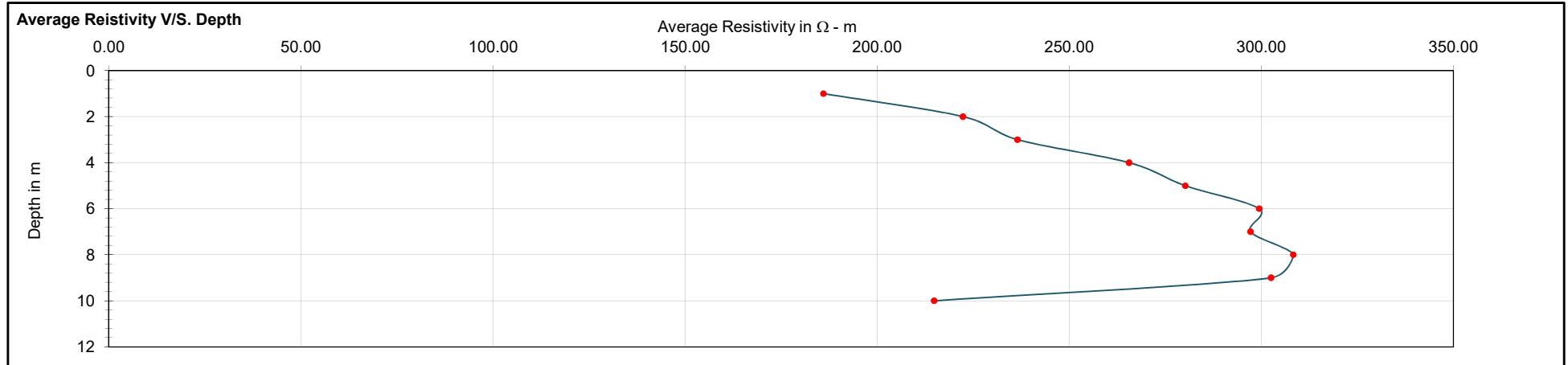
Resistivity at given depth $\rho = 2 \pi S R$
Where

ρ = Resistivity in ohm - m (Ω m)
 π = Value of pi - 22 / 7
S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

R = V // in ohm (Ω)
V = Voltage Drop between inner electrodes in Volt
/ = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	31.90	200.43	31.98	200.94	32.51	204.27	32.59	204.77	29.98	188.37	30.02	188.62	30.37	190.82	30.43	191.20	186.03
2	15.51	194.90	15.54	195.28	22.31	280.36	22.32	280.48	22.06	277.21	22.08	277.47	14.68	184.47	14.70	184.73	222.34
3	9.32	175.68	9.33	175.87	17.07	321.76	17.09	322.14	16.98	320.07	16.99	320.25	9.51	179.26	9.52	179.45	236.54
4	7.22	181.46	7.24	181.96	15.17	381.26	15.19	381.77	14.82	372.47	14.83	372.72	7.31	183.72	7.32	183.97	265.57
5	6.14	192.89	6.14	192.89	12.78	401.50	12.32	387.04	12.50	392.70	12.53	393.64	6.40	201.06	6.40	201.06	280.21
6	5.08	191.51	5.09	191.89	11.40	429.77	11.48	432.79	11.34	427.51	11.35	427.88	5.61	211.49	5.63	212.25	299.44
7	4.46	196.16	4.48	197.04	9.97	438.50	9.98	438.94	9.50	417.83	9.54	419.59	4.51	198.36	4.54	199.68	297.19
8	3.97	199.55	3.99	200.56	8.82	443.34	8.84	444.35	9.24	464.45	9.21	462.95	3.82	192.01	3.83	192.52	308.31
9	3.51	198.49	3.51	198.49	7.81	441.65	7.83	442.78	7.81	441.65	7.82	442.21	3.41	192.83	3.41	192.83	302.53
10	3.06	192.27	3.06	192.27	4.21	264.52	4.21	264.52	4.06	255.10	4.07	255.73	3.07	192.89	3.09	194.15	214.82

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.



KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

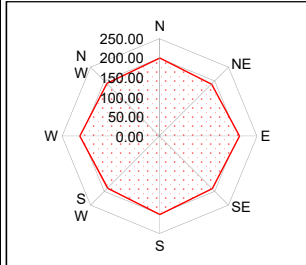
ERT No. : 9

Date : 00-01-1900

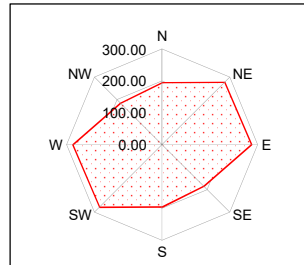
Test Location : E 1346, N 3380

Name of Project : NTTPP

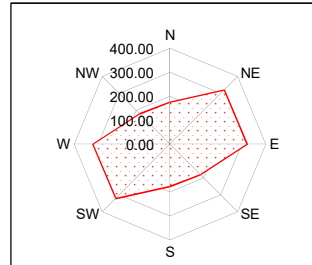
Depth 1 m



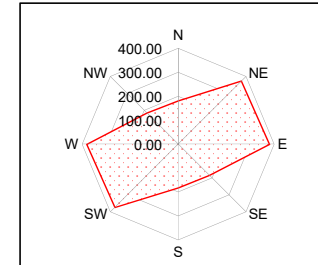
Depth 2 m



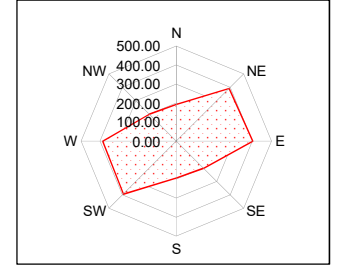
Depth 3 m



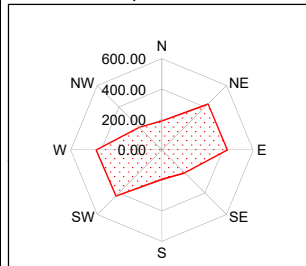
Depth 4 m



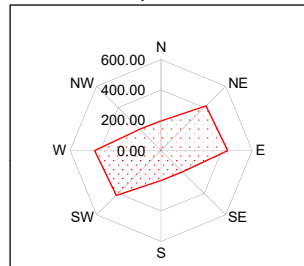
Depth 5 m



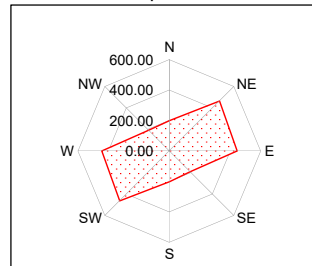
Depth 6 m



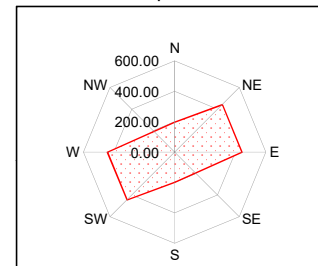
Depth 7 m



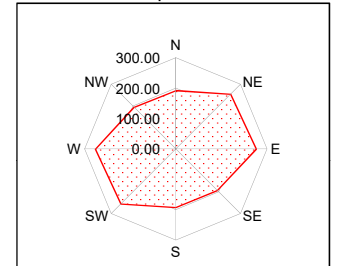
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	108719.80	155297.98	175773.65	221573.95	246678.08	281694.18	277469.34	298619.38	287528.30	144982.57
Radius of the circle having same area as polar diagram	186.03	222.34	236.54	265.57	280.21	299.44	297.19	308.31	302.53	214.82

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad**RESULTS OF ELECTRICAL RESISTIVITY TEST****(IS : 3043, 1987)**

ERT No. : ERT10
 Name of Project : NTPP
 Co-ordinates E 1642 , N 3325 RL: 208.25m

Date: 04-05-2025
 Battery Condition : Good
 Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

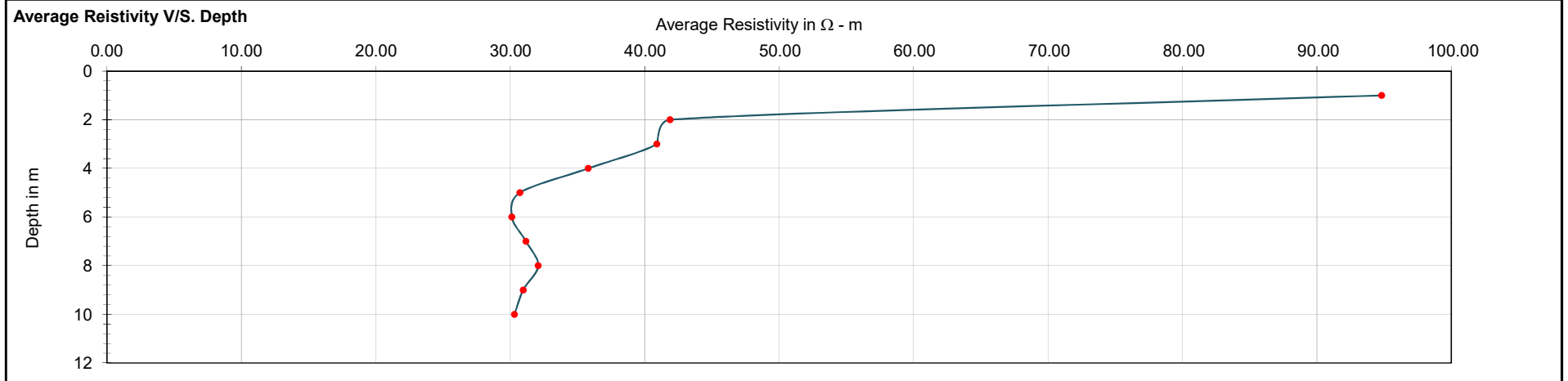
R = V // in ohm (Ω)

V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	13.01	81.74	13.02	81.81	15.40	96.76	15.42	96.89	17.20	108.07	17.22	108.20	18.38	115.48	18.40	115.61	94.82
2	2.52	31.67	2.54	31.92	3.82	48.00	3.83	48.13	3.84	48.25	3.86	48.51	3.91	49.13	3.93	49.39	41.89
3	2.23	42.03	2.25	42.41	2.25	42.41	2.27	42.79	2.29	43.17	2.31	43.54	2.34	44.11	2.36	44.48	40.90
4	1.43	35.94	1.45	36.44	1.46	36.69	1.48	37.20	1.51	37.95	1.53	38.45	1.57	39.46	1.59	39.96	35.81
5	0.98	30.79	0.99	31.10	0.99	31.10	1.01	31.73	1.03	32.36	1.05	32.99	1.09	34.24	1.11	34.87	30.72
6	0.81	30.54	0.82	30.91	0.82	30.91	0.83	31.29	0.84	31.67	0.86	32.42	0.87	32.80	0.89	33.55	30.12
7	0.71	31.23	0.71	31.23	0.72	31.67	0.73	32.11	0.75	32.99	0.77	33.87	0.79	34.75	0.80	35.19	31.17
8	0.62	31.16	0.63	31.67	0.64	32.17	0.65	32.67	0.69	34.68	0.71	35.69	0.72	36.19	0.73	36.69	32.08
9	0.53	29.97	0.53	29.97	0.54	30.54	0.54	30.54	0.60	33.93	0.61	34.49	0.64	36.19	0.64	36.19	30.96
10	0.46	28.90	0.46	28.90	0.48	30.16	0.48	30.16	0.53	33.30	0.53	33.30	0.57	35.81	0.57	35.81	30.31

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.



KCT Consultancy Services, Ahmedabad

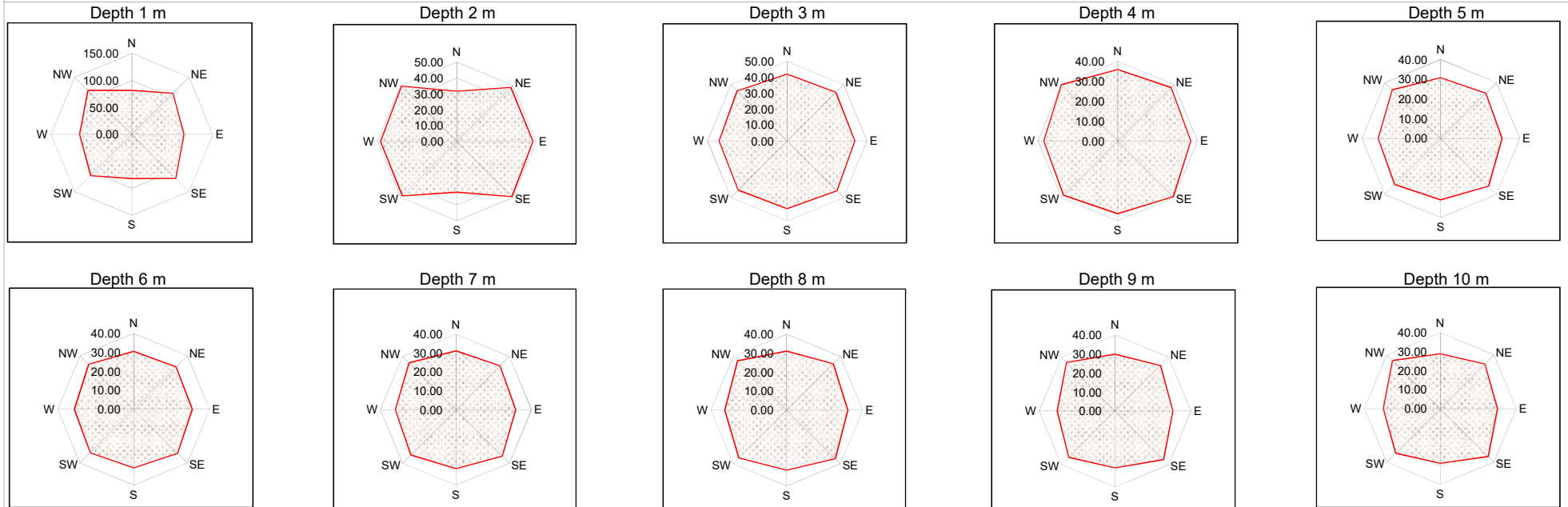
POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

ERT No. : ERT10
Name of Project : NTPP

Date : 00-01-1900

Test Location : E 1642 , N 3325 RL: 208.25m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	28244.23	5512.86	5256.43	4028.69	2964.24	2850.93	3051.91	3232.97	3011.74	2886.02
Radius of the circle having same area as polar diagram	94.82	41.89	40.90	35.81	30.72	30.12	31.17	32.08	30.96	30.31

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad**RESULTS OF ELECTRICAL RESISTIVITY TEST**
(IS : 3043, 1987)

ERT No. : ERT11
 Name of Project : NTPP
 Co-ordinates E 1336 , N 3333 RL: 202.90m

Date: 03-05-2025
 Battery Condition : Good
 Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

ρ = Resistivity in ohm - m (Ω m)

π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

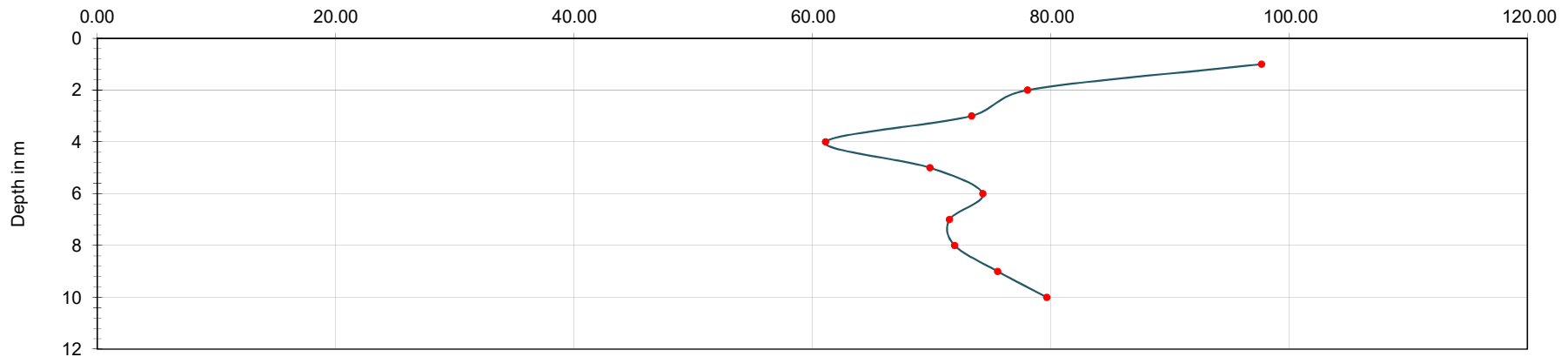
$R = V / I$ in ohm (Ω)

V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	17.62	110.71	17.64	110.84	17.91	112.53	17.93	112.66	15.08	94.75	15.10	94.88	15.12	95.00	15.14	95.13	97.70
2	7.54	94.75	7.56	95.00	7.81	98.14	7.83	98.39	6.81	85.58	6.82	85.70	6.83	85.83	1.85	23.25	78.06
3	4.45	83.88	4.46	84.07	4.51	85.01	4.52	85.20	3.73	70.31	3.75	70.69	3.76	70.87	3.77	71.06	73.37
4	2.88	72.38	2.90	72.88	2.93	73.64	2.94	73.89	2.22	55.79	2.23	56.05	2.28	57.30	2.29	57.55	61.11
5	2.52	79.17	2.52	79.17	2.63	82.62	2.65	83.25	2.10	65.97	2.12	66.60	2.14	67.23	2.16	67.86	69.87
6	2.07	78.04	2.08	78.41	2.23	84.07	2.24	84.45	1.98	74.64	1.99	75.02	2.01	75.78	2.03	76.53	74.30
7	1.71	75.21	1.72	75.65	1.84	80.93	1.86	81.81	1.62	71.25	1.64	72.13	1.66	73.01	1.67	73.45	71.51
8	1.56	78.41	1.58	79.42	1.63	81.93	1.63	81.93	1.41	70.87	1.42	71.38	1.43	71.88	1.43	71.88	71.95
9	1.45	82.00	1.45	82.00	1.51	85.39	1.51	85.39	1.32	74.64	1.33	75.21	1.35	76.34	1.36	76.91	75.56
10	1.38	86.71	1.38	86.71	1.39	87.34	1.39	87.34	1.28	80.42	1.28	80.42	1.30	81.68	1.30	81.68	79.68

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. DepthAverage Resistivity in Ω - m

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POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

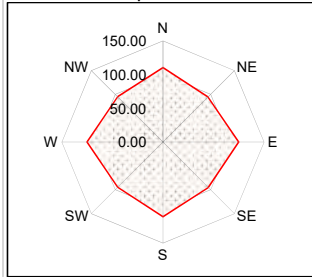
(IS : 3043, 1987)

ERT No. : ERT11
Name of Project : NTTTP

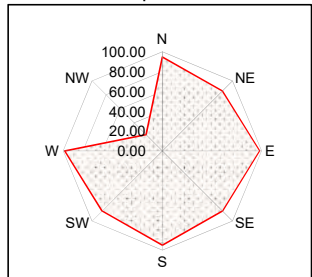
Date : 00-01-1900

Test Location : E 1336 , N 3333 RL: 202.90m

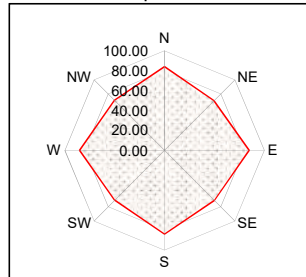
Depth 1 m



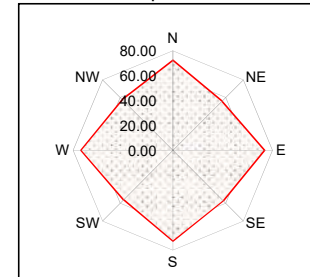
Depth 2 m



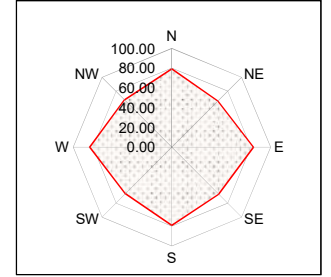
Depth 3 m



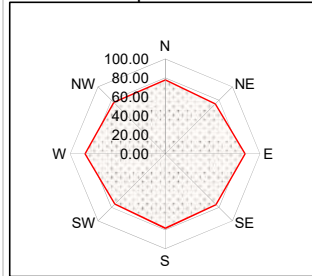
Depth 4 m



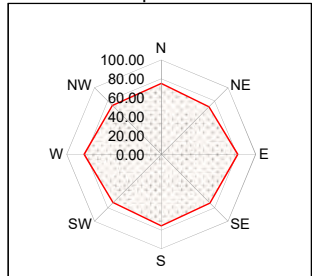
Depth 5 m



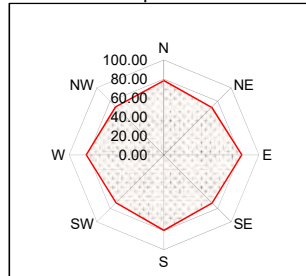
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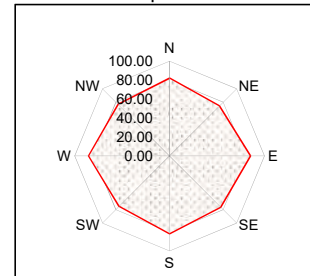
Depth 7 m



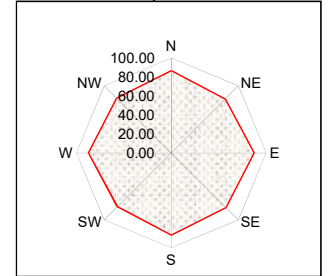
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	29985.64	19141.80	16910.85	11732.01	15338.48	17344.54	16065.59	16262.74	17934.56	19947.05
Radius of the circle having same area as polar diagram	97.70	78.06	73.37	61.11	69.87	74.30	71.51	71.95	75.56	79.68

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad

RESULTS OF ELECTRICAL RESISTIVITY TEST

(IS : 3043, 1987)

ERT No. : 12

Name of Project : NTTTP

Co-ordinates E 1050, N 3318 RL:197.20m

Date: 23-06-2024

Battery Condition : Good

Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

R = V / I in ohm (Ω)

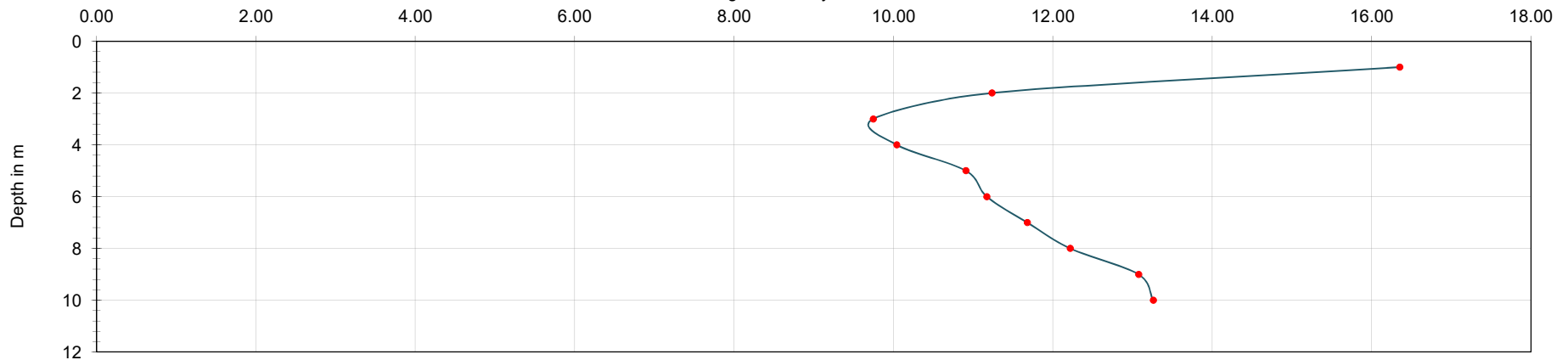
V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	2.85	17.91	2.86	17.97	2.57	16.15	2.60	16.34	2.71	17.03	2.76	17.34	2.78	17.47	2.82	17.72	16.36
2	0.92	11.56	0.91	11.44	0.94	11.81	0.94	11.81	0.99	12.44	0.98	12.32	0.93	11.69	0.93	11.69	11.24
3	0.56	10.56	0.56	10.56	0.52	9.80	0.52	9.80	0.54	10.18	0.53	9.99	0.57	10.74	0.56	10.56	9.75
4	0.41	10.30	0.41	10.30	0.42	10.56	0.40	10.05	0.44	11.06	0.44	11.06	0.43	10.81	0.42	10.56	10.04
5	0.36	11.31	0.36	11.31	0.35	11.00	0.34	10.68	0.38	11.94	0.37	11.62	0.39	12.25	0.38	11.94	10.91
6	0.32	12.06	0.32	12.06	0.29	10.93	0.28	10.56	0.32	12.06	0.31	11.69	0.33	12.44	0.33	12.44	11.17
7	0.28	12.32	0.27	11.88	0.27	11.88	0.27	11.88	0.28	12.32	0.28	12.32	0.30	13.19	0.29	12.75	11.68
8	0.26	13.07	0.25	12.57	0.26	13.07	0.26	13.07	0.25	12.57	0.24	12.06	0.27	13.57	0.26	13.07	12.22
9	0.24	13.57	0.24	13.57	0.25	14.14	0.25	14.14	0.24	13.57	0.23	13.01	0.25	14.14	0.25	14.14	13.08
10	0.23	14.45	0.22	13.82	0.23	14.45	0.23	14.45	0.22	13.82	0.21	13.19	0.22	13.82	0.22	13.82	13.26

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. Depth

Average Resistivity in Ω - m

KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

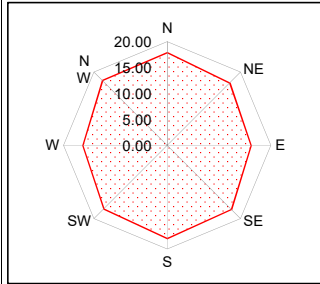
ERT No. : 12

Date : 00-01-1900

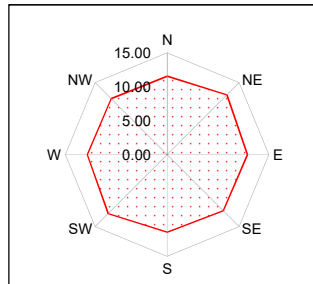
Test Location : E 1050, N 3318

Name of Project : NTTTP

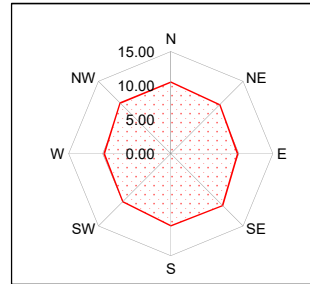
Depth 1 m



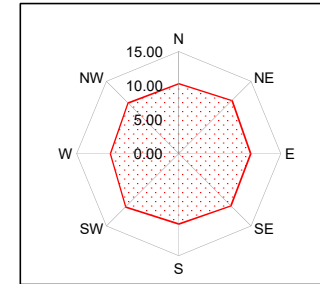
Depth 2 m



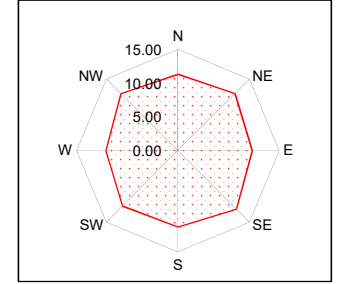
Depth 3 m



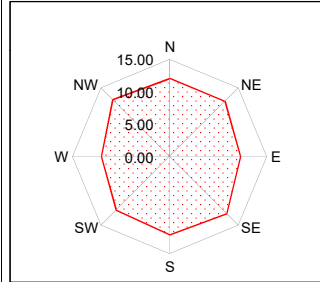
Depth 4 m



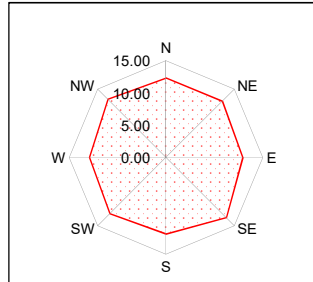
Depth 5 m



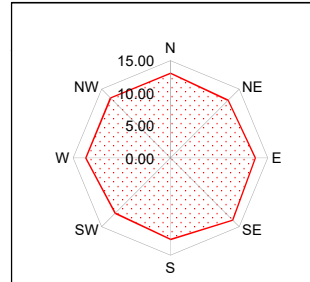
Depth 6 m



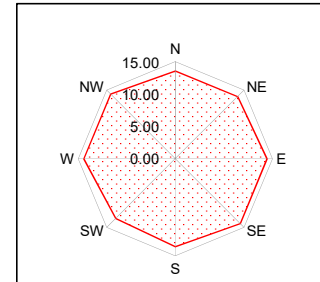
Depth 7 m



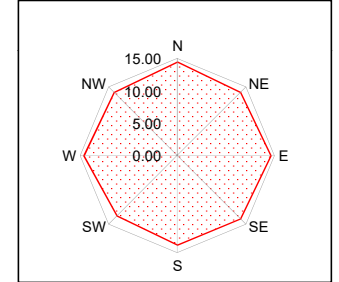
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	840.44	396.60	298.43	316.78	373.91	392.13	428.55	469.18	537.28	552.50
Radius of the circle having same area as polar diagram	16.36	11.24	9.75	10.04	10.91	11.17	11.68	12.22	13.08	13.26

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad

RESULTS OF ELECTRICAL RESISTIVITY TEST

(IS : 3043, 1987)

ERT No. : 13

Name of Project : NTTTP

Co-ordinates E 1258, N 3303 RL:201.60m

Date: 23-06-2024

Battery Condition : Good

Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

R = V / I in ohm (Ω)

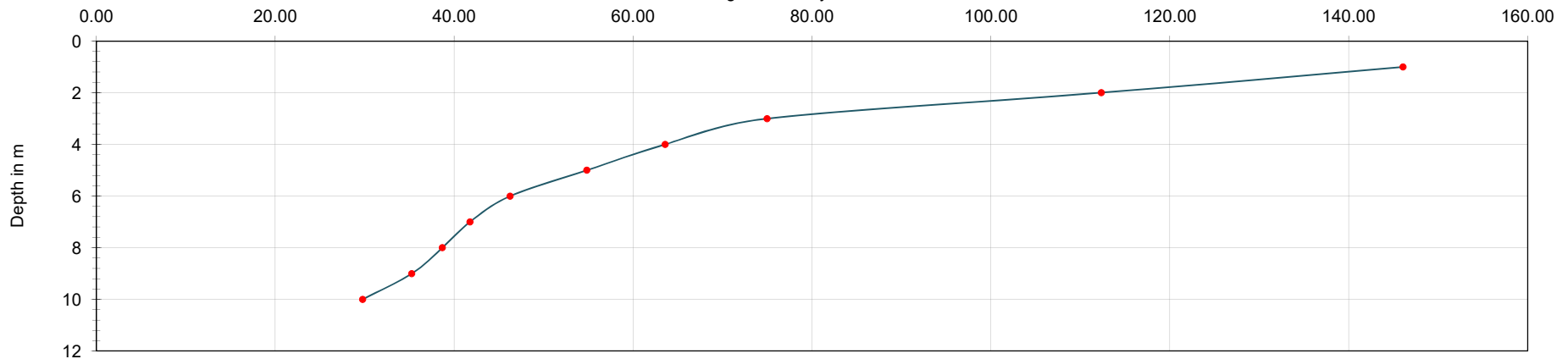
V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	24.44	153.56	24.52	154.06	23.61	148.35	23.59	148.22	25.01	157.14	24.96	156.83	24.97	156.89	24.94	156.70	146.06
2	9.10	114.35	9.09	114.23	8.41	105.68	8.39	105.43	10.10	126.92	10.09	126.79	10.21	128.30	10.19	128.05	112.33
3	3.84	72.38	3.82	72.01	4.41	83.13	4.40	82.94	3.99	75.21	3.98	75.02	4.56	85.95	4.54	85.58	74.97
4	2.44	61.32	2.44	61.32	2.83	71.13	2.81	70.62	2.51	63.08	2.50	62.83	2.91	73.14	2.90	72.88	63.60
5	1.57	49.32	1.56	49.01	1.99	62.52	1.98	62.20	1.59	49.95	1.58	49.64	2.06	64.72	2.40	75.40	54.85
6	1.05	39.58	1.03	38.83	1.50	56.55	1.48	55.79	1.09	41.09	1.09	41.09	1.56	58.81	1.55	58.43	46.26
7	0.93	40.90	0.93	40.90	1.02	44.86	1.01	44.42	0.99	43.54	0.98	43.10	1.07	47.06	1.08	47.50	41.76
8	0.85	42.73	0.86	43.23	0.74	37.20	0.74	37.20	0.87	43.73	0.86	43.23	0.79	39.71	0.78	39.21	38.68
9	0.74	41.85	0.74	41.85	0.60	33.93	0.58	32.80	0.68	38.45	0.67	37.89	0.63	35.63	0.62	35.06	35.28
10	0.59	37.07	0.59	37.07	0.46	28.90	0.45	28.27	0.51	32.04	0.50	31.42	0.45	28.27	0.45	28.27	29.78

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. Depth

Average Resistivity in Ω - m

KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

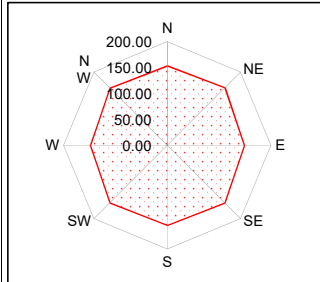
ERT No. : 13

Date : 00-01-1900

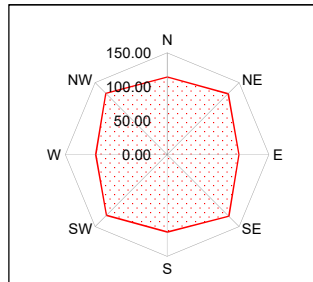
Test Location : E 1258, N 3303

Name of Project : NTTTP

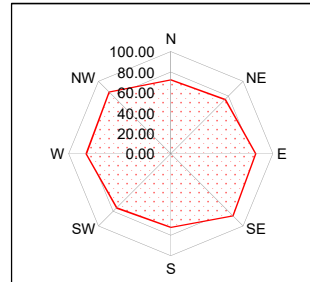
Depth 1 m



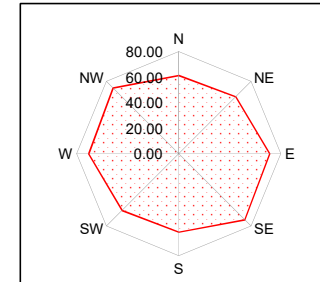
Depth 2 m



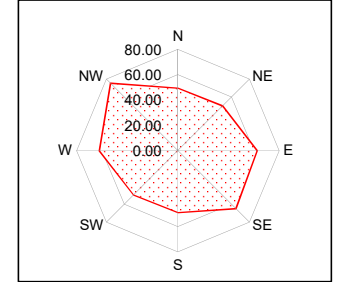
Depth 3 m



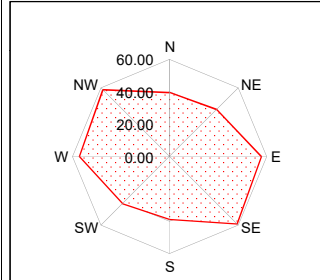
Depth 4 m



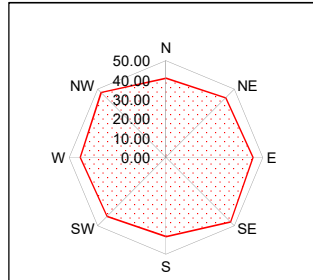
Depth 5 m



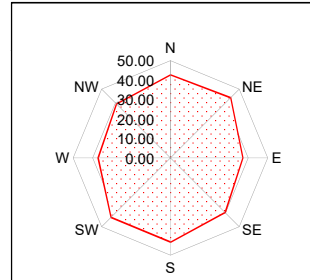
Depth 6 m



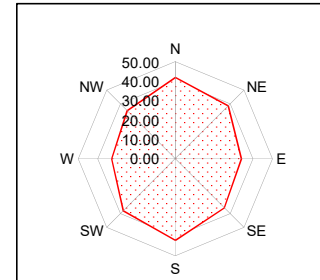
Depth 7 m



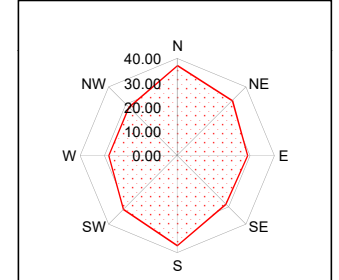
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	67018.11	39640.79	17655.86	12708.19	9450.26	6724.00	5479.77	4701.15	3909.17	2785.54
Radius of the circle having same area as polar diagram	146.06	112.33	74.97	63.60	54.85	46.26	41.76	38.68	35.28	29.78

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad

RESULTS OF ELECTRICAL RESISTIVITY TEST

(IS : 3043, 1987)

ERT No. : 14

Name of Project : NTTTP

Co-ordinates E 874, N 3223 RL:196.09m

Date: 12-12-2024

Battery Condition : Good

Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

R = V / I in ohm (Ω)

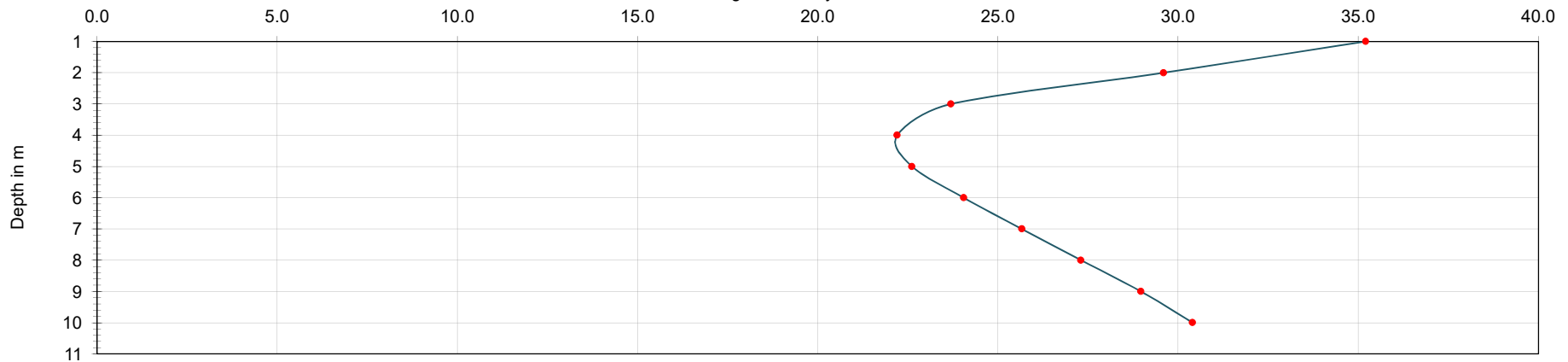
V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	5.92	37.20	5.94	37.32	6.01	37.76	6.03	37.89	5.87	36.88	5.89	37.01	5.78	36.32	5.80	36.44	35.2
2	2.46	30.91	2.48	31.16	2.57	32.30	2.59	32.55	2.50	31.42	2.52	31.67	2.36	29.66	2.38	29.91	29.6
3	1.31	24.69	1.32	24.88	1.36	25.64	1.37	25.82	1.34	25.26	1.35	25.45	1.27	23.94	1.28	24.13	23.7
4	0.91	22.87	0.91	22.87	0.97	24.38	0.98	24.63	0.93	23.37	0.94	23.62	0.90	22.62	0.91	22.87	22.2
5	0.75	23.56	0.75	23.56	0.78	24.50	0.78	24.50	0.76	23.88	0.77	24.19	0.74	23.25	0.74	23.25	22.6
6	0.67	25.26	0.67	25.26	0.69	26.01	0.69	26.01	0.67	25.26	0.67	25.26	0.66	24.88	0.66	24.88	24.1
7	0.61	26.83	0.61	26.83	0.63	27.71	0.63	27.71	0.62	27.27	0.62	27.27	0.60	26.39	0.60	26.39	25.7
8	0.57	28.65	0.57	28.65	0.58	29.15	0.58	29.15	0.58	29.15	0.58	29.15	0.56	28.15	0.56	28.15	27.3
9	0.54	30.54	0.54	30.54	0.55	31.10	0.55	31.10	0.54	30.54	0.54	30.54	0.53	29.97	0.53	29.97	29.0
10	0.51	32.04	0.51	32.04	0.52	32.67	0.52	32.67	0.51	32.04	0.51	32.04	0.50	31.42	0.50	31.42	30.4

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. Depth

Average Resistivity in Ω - m

KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

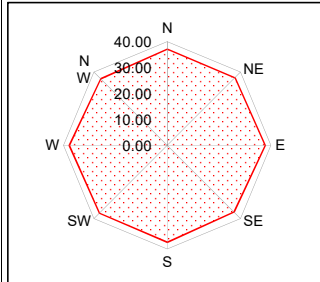
ERT No. : 14

Date : 00-01-1900

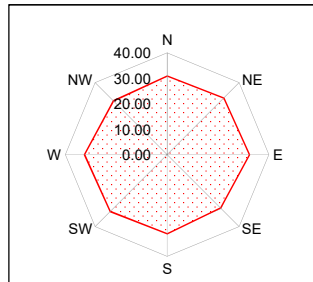
Test Location : E 874, N 3223

Name of Project : NTTTP

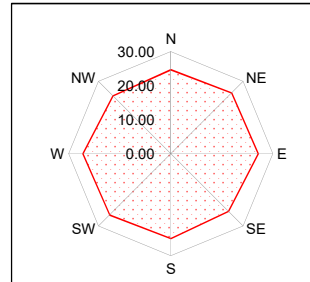
Depth 1 m



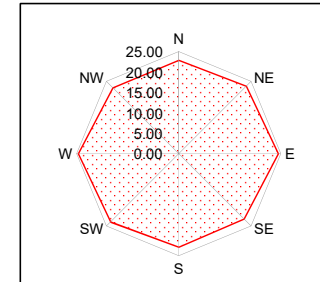
Depth 2 m



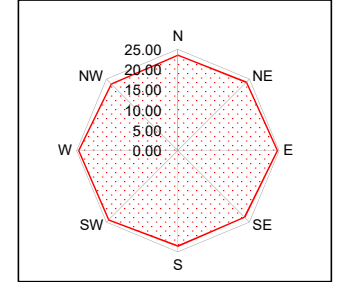
Depth 3 m



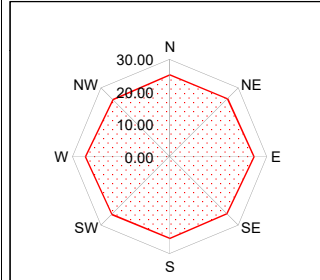
Depth 4 m



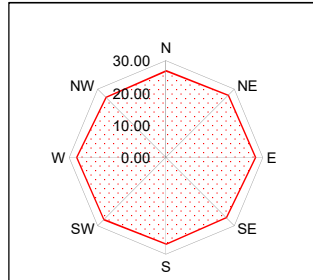
Depth 5 m



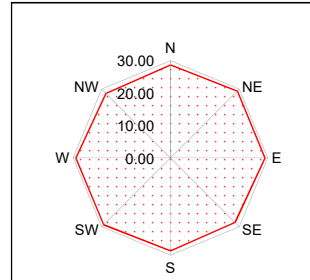
Depth 6 m



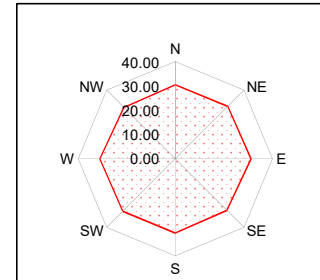
Depth 7 m



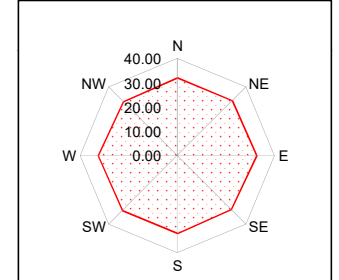
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	3892.41	2751.40	1763.85	1548.94	1606.75	1817.49	2068.98	2341.86	2636.78	2903.61
Radius of the circle having same area as polar diagram	35.20	29.59	23.69	22.20	22.62	24.05	25.66	27.30	28.97	30.40

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad

RESULTS OF ELECTRICAL RESISTIVITY TEST

(IS : 3043, 1987)

ERT No. : 15

Name of Project : NTTTP

Co-ordinates E 1236, N 3239 RL:198.08m

Date: 23-06-2024

Battery Condition : Good

Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

R = V / I in ohm (Ω)

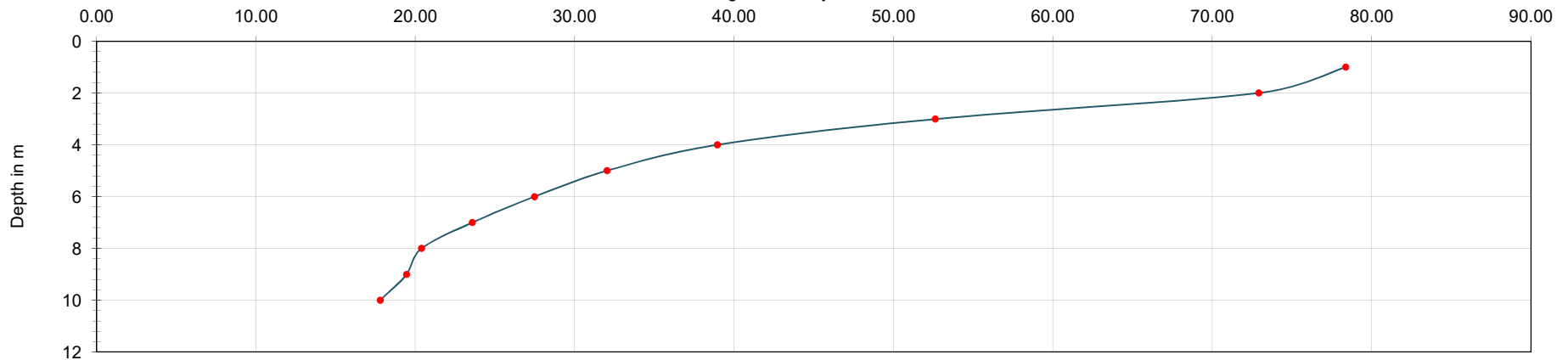
V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	12.09	75.96	12.11	76.09	13.54	85.07	13.55	85.14	14.40	90.48	14.46	90.85	12.50	78.54	12.58	79.04	78.39
2	7.23	90.85	7.21	90.60	4.65	58.43	4.64	58.31	5.53	69.49	5.52	69.37	7.10	89.22	7.08	88.97	72.93
3	3.45	65.03	3.44	64.84	2.44	45.99	2.43	45.80	2.49	46.94	2.48	46.75	3.41	64.28	3.40	64.09	52.62
4	1.78	44.74	1.78	44.74	1.46	36.69	1.45	36.44	1.51	37.95	1.50	37.70	1.80	45.24	1.79	44.99	38.96
5	1.20	37.70	1.19	37.38	0.92	28.90	0.92	28.90	1.04	32.67	1.02	32.04	1.16	36.44	1.15	36.13	32.04
6	0.85	32.04	0.84	31.67	0.64	24.13	0.64	24.13	0.71	26.77	0.70	26.39	0.89	33.55	0.88	33.18	27.48
7	0.64	28.15	0.63	27.71	0.49	21.55	0.48	21.11	0.54	23.75	0.53	23.31	0.61	26.83	0.60	26.39	23.58
8	0.45	22.62	0.45	22.62	0.41	20.61	0.40	20.11	0.44	22.12	0.43	21.61	0.43	21.61	0.41	20.61	20.39
9	0.36	20.36	0.36	20.36	0.35	19.79	0.35	19.79	0.38	21.49	0.38	21.49	0.37	20.92	0.35	19.79	19.44
10	0.30	18.85	0.30	18.85	0.28	17.59	0.27	16.96	0.30	18.85	0.30	18.85	0.32	20.11	0.32	20.11	17.80

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. Depth

Average Resistivity in Ω - m

KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

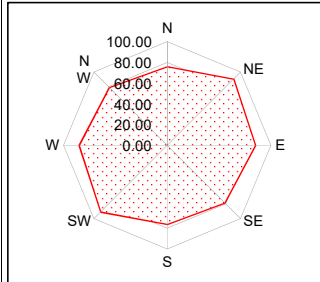
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Date : 00-01-1900

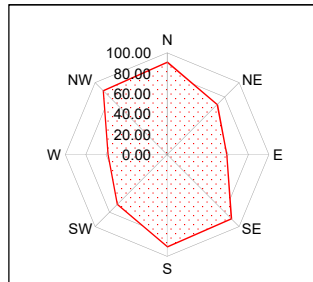
Test Location : E 1236, N 3239

Name of Project : NTPP

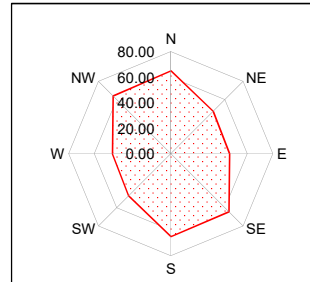
Depth 1 m



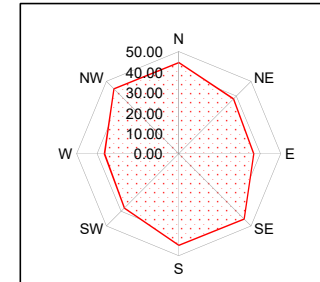
Depth 2 m



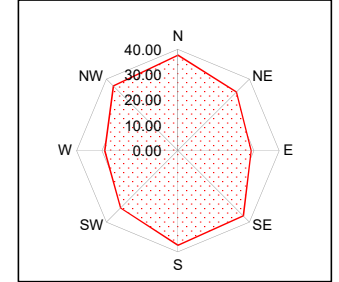
Depth 3 m



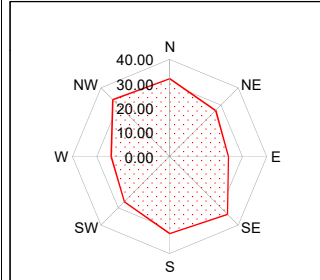
Depth 4 m



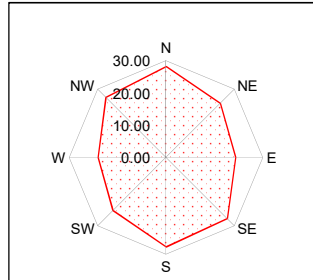
Depth 5 m



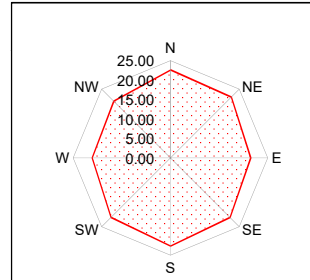
Depth 6 m



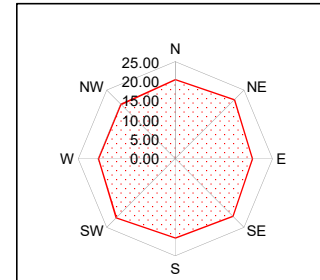
Depth 7 m



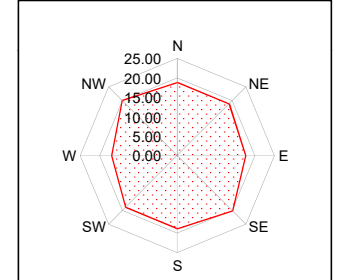
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	19304.70	16710.68	8699.91	4767.49	3224.66	2372.49	1746.28	1305.98	1187.83	995.04
Radius of the circle having same area as polar diagram	78.39	72.93	52.62	38.96	32.04	27.48	23.58	20.39	19.44	17.80

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad

RESULTS OF ELECTRICAL RESISTIVITY TEST

(IS : 3043, 1987)

ERT No. : 16

Name of Project : NTTTP

Co-ordinates E 805, N 3224 RL:197.50m

Date: 12-12-2024

Battery Condition : Good

Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

R = V / I in ohm (Ω)

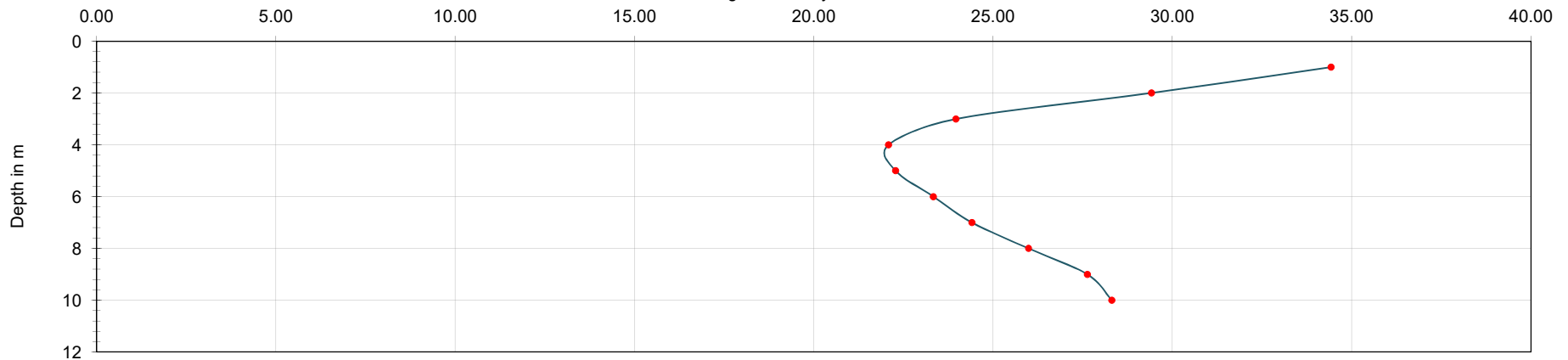
V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	5.65	35.50	5.67	35.63	5.80	36.44	5.82	36.57	5.89	37.01	5.91	37.13	5.72	35.94	5.74	36.07	34.43
2	2.36	29.66	2.38	29.91	2.48	31.16	2.50	31.42	2.54	31.92	2.56	32.17	2.45	30.79	2.47	31.04	29.42
3	1.29	24.32	1.30	24.50	1.35	25.45	1.36	25.64	1.38	26.01	1.39	26.20	1.32	24.88	1.33	25.07	23.96
4	0.89	22.37	0.90	22.62	0.93	23.37	0.94	23.62	0.96	24.13	0.97	24.38	0.90	22.62	0.92	23.12	22.09
5	0.73	22.93	0.73	22.93	0.76	23.88	0.77	24.19	0.78	24.50	0.79	24.82	0.72	22.62	0.70	21.99	22.28
6	0.64	24.13	0.64	24.13	0.66	24.88	0.66	24.88	0.66	24.88	0.66	24.88	0.65	24.50	0.65	24.50	23.34
7	0.57	25.07	0.57	25.07	0.59	25.95	0.59	25.95	0.60	26.39	0.60	26.39	0.58	25.51	0.58	25.51	24.41
8	0.53	26.64	0.53	26.64	0.55	27.65	0.55	27.65	0.56	28.15	0.56	28.15	0.54	27.14	0.54	27.14	25.99
9	0.50	28.27	0.50	28.27	0.52	29.41	0.52	29.41	0.53	29.97	0.53	29.97	0.51	28.84	0.51	28.84	27.63
10	0.47	29.53	0.47	29.53	0.49	30.79	0.49	30.79	0.50	31.42	0.50	31.42	0.40	25.13	0.48	30.16	28.31

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. Depth

Average Resistivity in Ω - m

KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

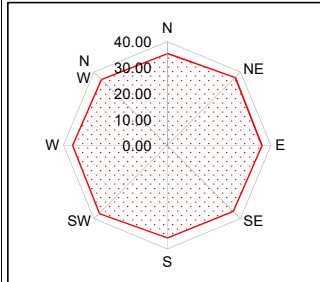
ERT No. : 16

Date : 00-01-1900

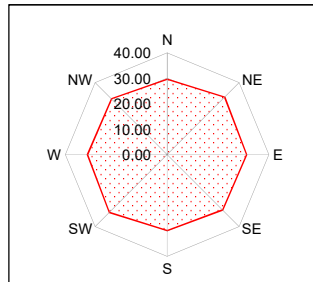
Test Location : E 805, N 3224

Name of Project : NTPP

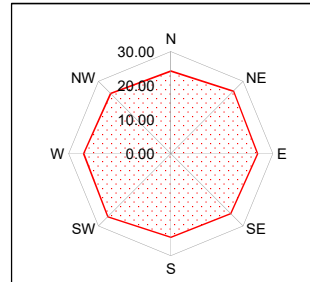
Depth 1 m



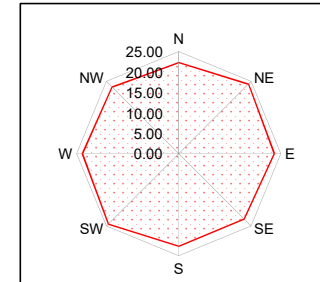
Depth 2 m



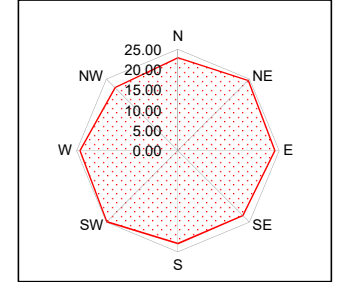
Depth 3 m



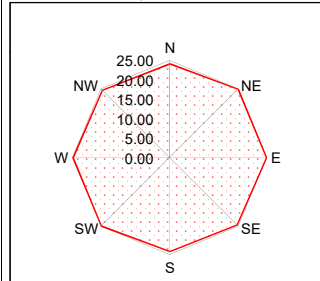
Depth 4 m



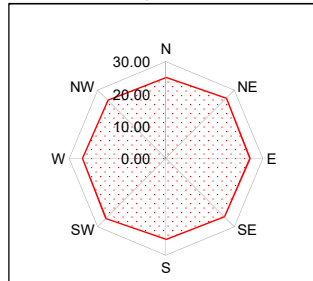
Depth 5 m



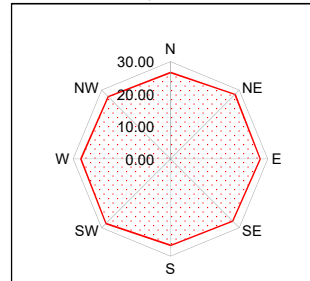
Depth 6 m



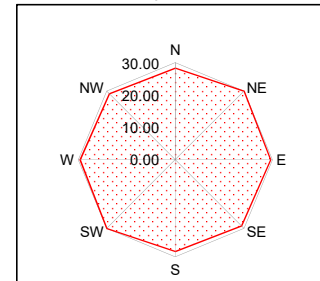
Depth 7 m



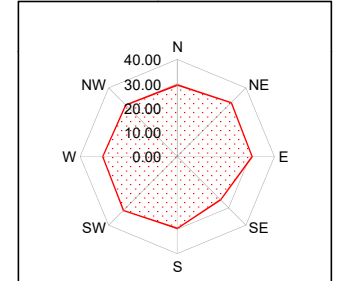
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	3723.26	2718.42	1804.01	1532.35	1559.54	1711.18	1872.04	2122.15	2398.27	2518.71
Radius of the circle having same area as polar diagram	34.43	29.42	23.96	22.09	22.28	23.34	24.41	25.99	27.63	28.31

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad

RESULTS OF ELECTRICAL RESISTIVITY TEST

(IS : 3043, 1987)

ERT No. : 17

Name of Project : NTTPP

Co-ordinates E 748, N 3206 RL:197.60m

Date: 13-12-2024

Battery Condition : Good

Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

 $R = V / I$ in ohm (Ω)

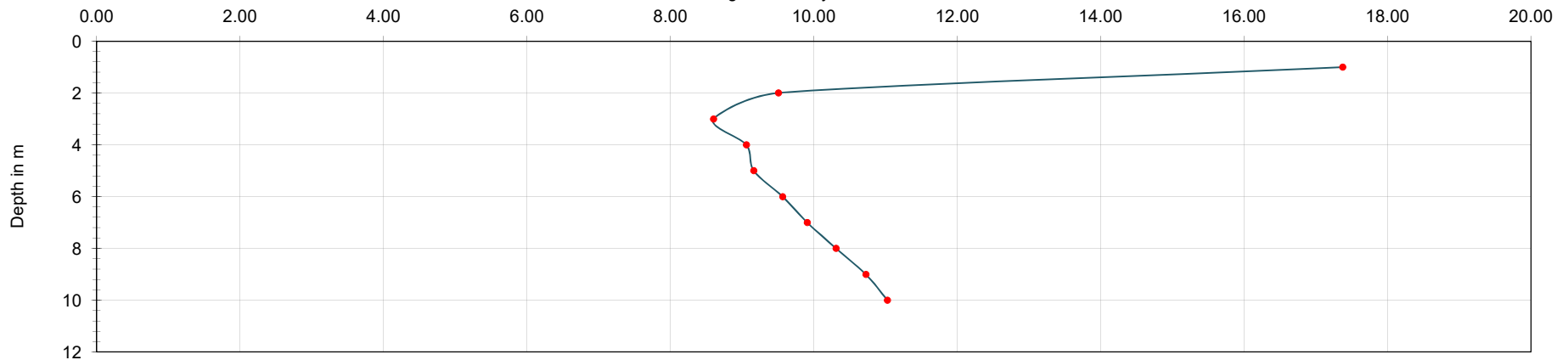
V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	3.08	19.35	3.09	19.42	2.76	17.34	2.77	17.40	2.84	17.84	2.85	17.91	2.96	18.60	2.97	18.66	17.38
2	0.80	10.05	0.81	10.18	0.78	9.80	0.79	9.93	0.76	9.55	0.77	9.68	0.83	10.43	0.84	10.56	9.51
3	0.47	8.86	0.48	9.05	0.46	8.67	0.46	8.67	0.48	9.05	0.49	9.24	0.50	9.42	0.51	9.61	8.60
4	0.38	9.55	0.38	9.55	0.37	9.30	0.37	9.30	0.38	9.55	0.38	9.55	0.39	9.80	0.39	9.80	9.06
5	0.31	9.74	0.31	9.74	0.30	9.42	0.30	9.42	0.30	9.42	0.30	9.42	0.32	10.05	0.32	10.05	9.17
6	0.27	10.18	0.27	10.18	0.26	9.80	0.26	9.80	0.26	9.80	0.26	9.80	0.28	10.56	0.28	10.56	9.57
7	0.24	10.56	0.24	10.56	0.23	10.12	0.23	10.12	0.23	10.12	0.23	10.12	0.25	11.00	0.25	11.00	9.91
8	0.22	11.06	0.22	11.06	0.20	10.05	0.21	10.56	0.21	10.56	0.21	10.56	0.23	11.56	0.23	11.56	10.31
9	0.20	11.31	0.20	11.31	0.19	10.74	0.19	10.74	0.20	11.31	0.20	11.31	0.21	11.88	0.21	11.88	10.73
10	0.19	11.94	0.19	11.94	0.18	11.31	0.18	11.31	0.18	11.31	0.18	11.31	0.19	11.94	0.19	11.94	11.03

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. Depth

Average Resistivity in Ω - m

KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

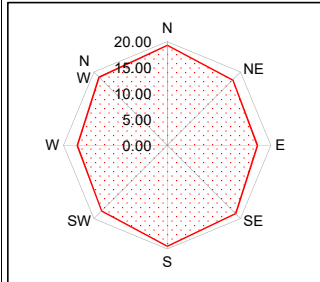
ERT No. : 17

Date : 00-01-1900

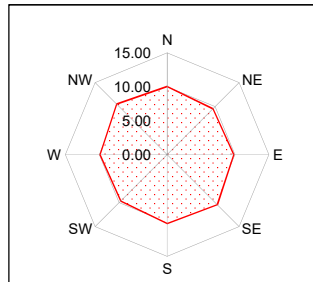
Test Location : E 748, N 3206

Name of Project : NTTTP

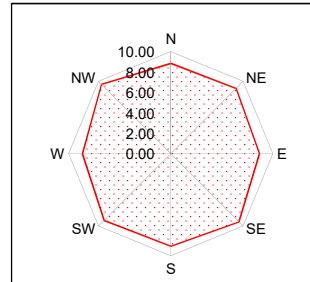
Depth 1 m



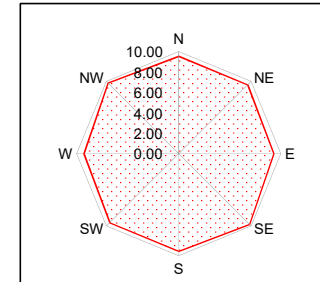
Depth 2 m



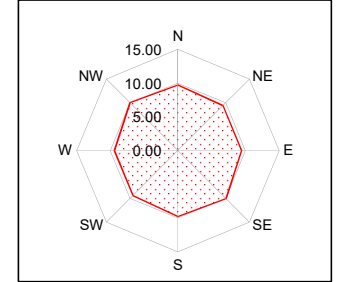
Depth 3 m



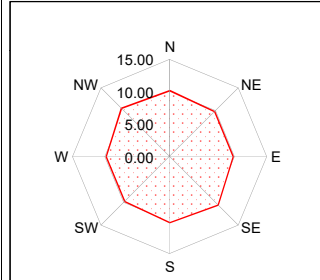
Depth 4 m



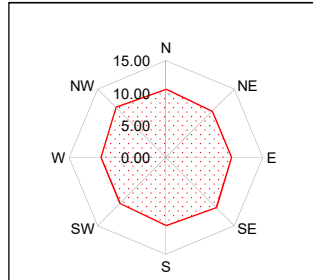
Depth 5 m



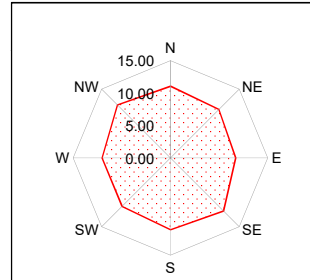
Depth 6 m



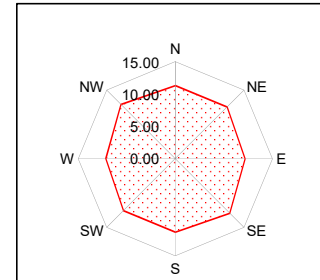
Depth 7 m



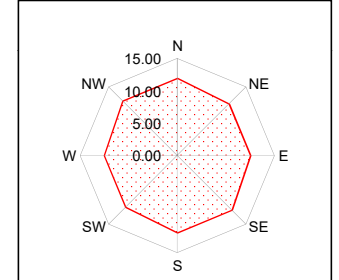
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	948.66	284.03	232.52	257.90	263.90	287.58	308.54	334.04	361.50	382.10
Radius of the circle having same area as polar diagram	17.38	9.51	8.60	9.06	9.17	9.57	9.91	10.31	10.73	11.03

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad

RESULTS OF ELECTRICAL RESISTIVITY TEST (IS : 3043, 1987)

ERT No. : 18
Name of Project : NTTTP
Co-ordinates E 1329, N 3137 RL:200.96m

Date: 07-12-2024
Battery Condition : Good
Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$
Where

ρ = Resistivity in ohm - m (Ω m)

π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

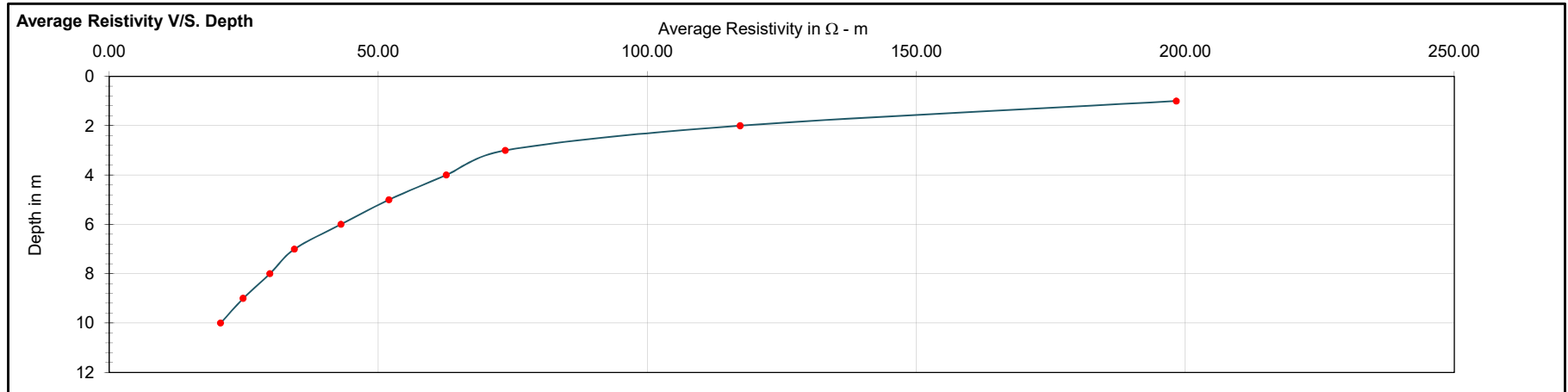
R = V / I in ohm (Ω)

V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	24.21	152.12	24.25	152.37	70.68	444.10	70.71	444.28	26.55	166.82	26.56	166.88	20.09	126.23	20.10	126.29	198.35
2	9.74	122.40	9.74	122.40	13.04	163.89	13.06	164.12	10.32	129.68	10.33	129.81	6.66	83.69	6.67	83.82	117.31
3	4.39	82.75	4.39	82.75	5.60	105.56	5.60	105.56	3.58	67.48	3.58	67.48	3.11	58.62	3.31	62.39	73.65
4	2.56	64.34	2.57	64.59	3.49	87.71	3.49	87.71	2.91	73.14	1.93	48.51	2.14	53.78	2.15	54.04	62.68
5	1.85	58.12	1.86	58.43	2.20	69.12	2.20	69.12	1.51	47.44	1.62	50.89	1.43	44.92	1.45	45.55	52.02
6	1.21	45.47	1.20	45.24	1.52	57.30	1.54	58.06	1.19	44.86	1.14	42.79	0.98	36.95	0.94	35.44	43.07
7	0.79	34.75	0.79	34.75	1.12	49.26	1.11	48.82	0.75	32.99	0.76	33.43	0.67	29.47	0.68	29.91	34.44
8	0.61	30.66	0.61	30.66	0.81	40.72	0.82	41.22	0.56	28.15	0.57	28.65	0.56	28.15	0.51	25.64	29.85
9	0.38	21.49	0.35	19.79	0.61	34.49	0.62	35.06	0.49	27.71	0.49	27.71	0.39	22.05	0.39	22.05	24.91
10	0.24	15.08	0.24	15.08	0.48	30.16	0.48	30.16	0.36	22.62	0.37	23.25	0.30	18.85	0.31	19.48	20.70

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.



KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

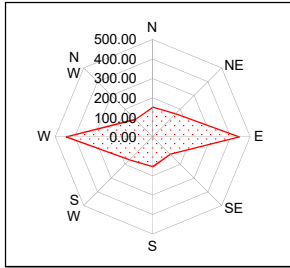
ERT No. : 18

Date : 00-01-1900

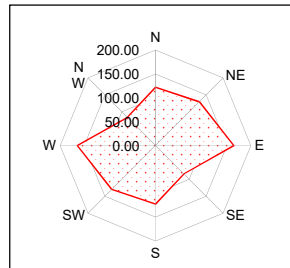
Test Location : E 1329, N 3137

Name of Project : NTPP

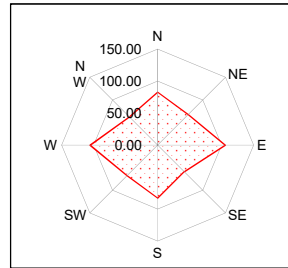
Depth 1 m



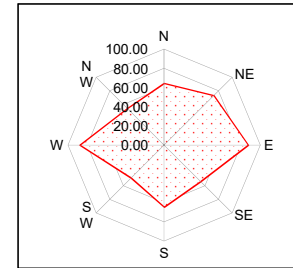
Depth 2 m



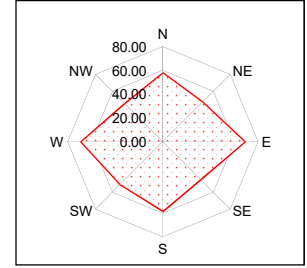
Depth 3 m



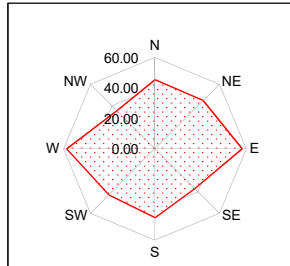
Depth 4 m



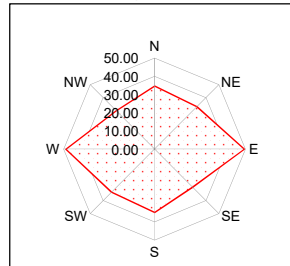
Depth 5 m



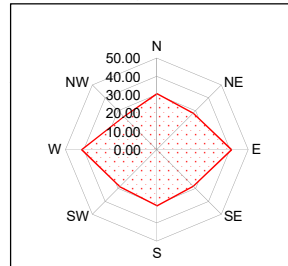
Depth 6 m



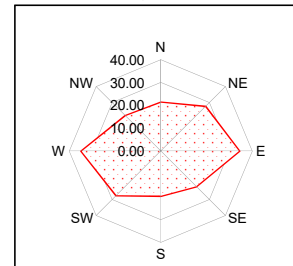
Depth 7 m



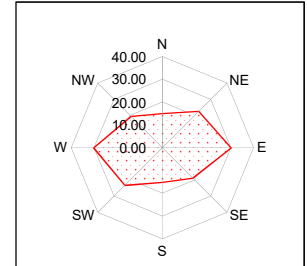
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	123597.99	43231.07	17039.50	12342.84	8502.81	5828.21	3725.62	2799.88	1949.72	1346.44
Radius of the circle having same area as polar diagram	198.35	117.31	73.65	62.68	52.02	43.07	34.44	29.85	24.91	20.70

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad

RESULTS OF ELECTRICAL RESISTIVITY TEST

(IS : 3043, 1987)

ERT No. : 19

Name of Project : NTTTP

Co-ordinates E 759, N 3100 RL:197.60m

Date: 15-12-2024

Battery Condition : Good

Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

R = V / I in ohm (Ω)

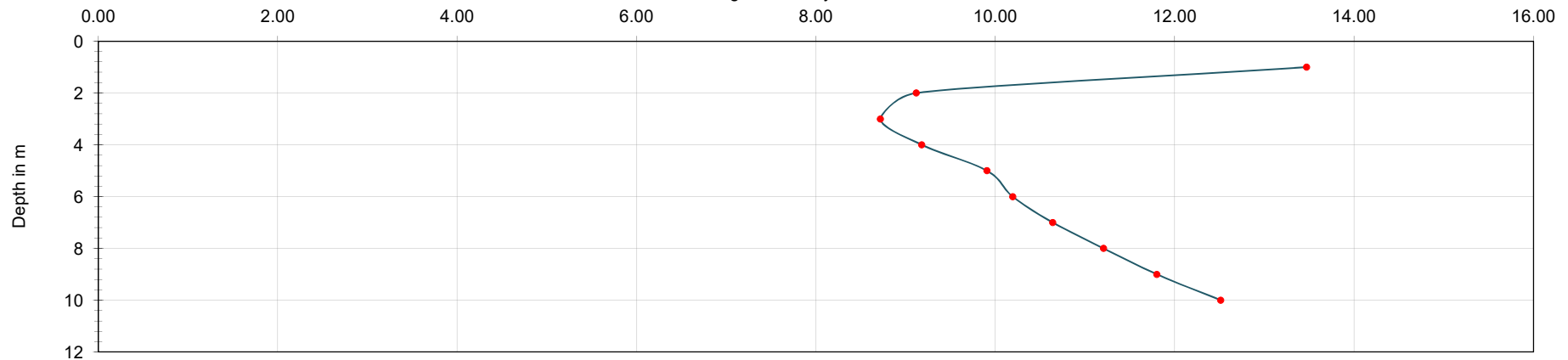
V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	2.21	13.89	2.22	13.95	2.34	14.70	2.35	14.77	2.28	14.33	2.29	14.39	2.19	13.76	2.20	13.82	13.47
2	0.75	9.42	0.76	9.55	0.80	10.05	0.80	10.05	0.70	8.80	0.78	9.80	0.76	9.55	0.77	9.68	9.12
3	0.48	9.05	0.48	9.05	0.50	9.42	0.50	9.42	0.48	9.05	0.48	9.05	0.49	9.24	0.49	9.24	8.72
4	0.38	9.55	0.38	9.55	0.39	9.80	0.39	9.80	0.39	9.80	0.39	9.80	0.38	9.55	0.38	9.55	9.18
5	0.32	10.05	0.32	10.05	0.33	10.37	0.33	10.37	0.33	10.37	0.33	10.37	0.38	11.94	0.32	10.05	9.91
6	0.28	10.56	0.28	10.56	0.29	10.93	0.29	10.93	0.29	10.93	0.29	10.93	0.28	10.56	0.28	10.56	10.19
7	0.25	11.00	0.25	11.00	0.26	11.44	0.26	11.44	0.25	11.00	0.25	11.00	0.26	11.44	0.26	11.44	10.64
8	0.23	11.56	0.23	11.56	0.24	12.06	0.24	12.06	0.23	11.56	0.23	11.56	0.24	12.06	0.24	12.06	11.21
9	0.21	11.88	0.21	11.88	0.22	12.44	0.22	12.44	0.22	12.44	0.22	12.44	0.23	13.01	0.23	13.01	11.80
10	0.20	12.57	0.20	12.57	0.21	13.19	0.21	13.19	0.21	13.19	0.21	13.19	0.22	13.82	0.22	13.82	12.52

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. Depth

Average Resistivity in Ω - m

KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

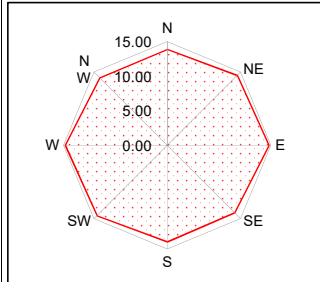
ERT No. : 19

Date : 00-01-1900

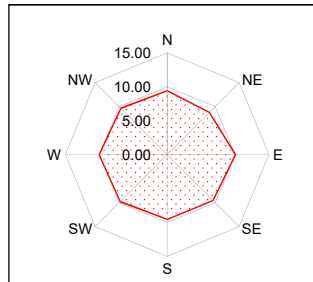
Test Location : E 759, N 3100

Name of Project : NTTTP

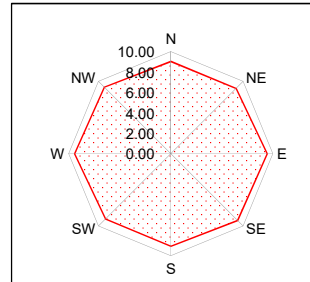
Depth 1 m



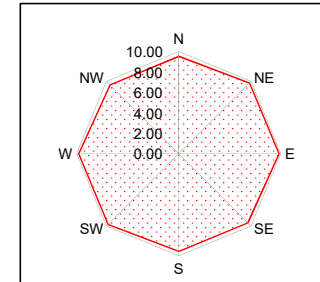
Depth 2 m



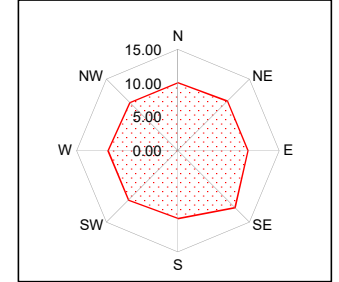
Depth 3 m



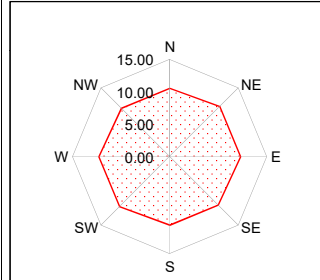
Depth 4 m



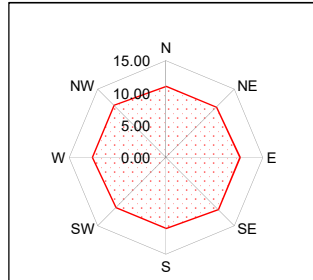
Depth 5 m



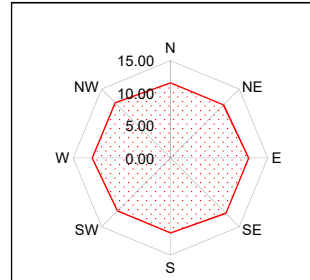
Depth 6 m



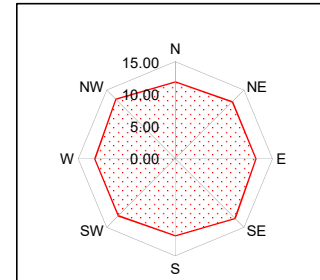
Depth 7 m



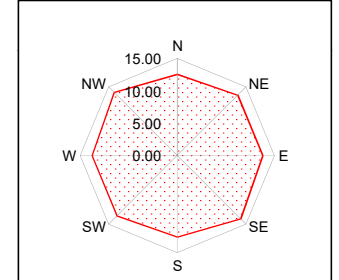
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	570.19	261.30	238.79	264.78	308.42	326.46	355.73	394.60	437.47	492.08
Radius of the circle having same area as polar diagram	13.47	9.12	8.72	9.18	9.91	10.19	10.64	11.21	11.80	12.52

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad

RESULTS OF ELECTRICAL RESISTIVITY TEST

(IS : 3043, 1987)

ERT No. : 20

Name of Project : NTTTP

Co-ordinates E 877, N 3078 RL:196.70m

Date: 13-12-2024

Battery Condition : Good

Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

R = V / I in ohm (Ω)

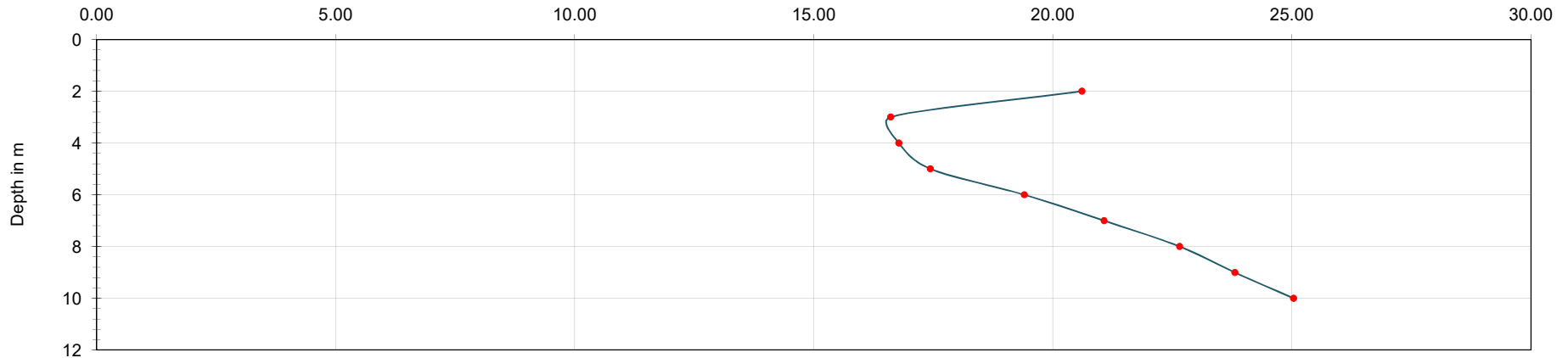
V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1																	
2	1.70	21.36	1.71	21.49	1.77	22.24	1.78	22.37	1.67	20.99	1.68	21.11	1.77	22.24	1.75	21.99	20.61
3	0.91	17.15	0.92	17.34	0.96	18.10	0.97	18.28	0.90	16.96	0.91	17.15	0.90	16.96	0.96	18.10	16.61
4	0.70	17.59	0.70	17.59	0.72	18.10	0.72	18.10	0.68	17.09	0.69	17.34	0.71	17.84	0.71	17.84	16.78
5	0.58	18.22	0.58	18.22	0.60	18.85	0.60	18.85	0.56	17.59	0.56	17.59	0.60	18.85	0.60	18.85	17.44
6	0.54	20.36	0.54	20.36	0.56	21.11	0.56	21.11	0.52	19.60	0.52	19.60	0.55	20.73	0.55	20.73	19.40
7	0.50	21.99	0.50	21.99	0.52	22.87	0.52	22.87	0.49	21.55	0.49	21.55	0.51	22.43	0.51	22.43	21.07
8	0.47	23.62	0.47	23.62	0.49	24.63	0.49	24.63	0.46	23.12	0.46	23.12	0.48	24.13	0.48	24.13	22.65
9	0.44	24.88	0.44	24.88	0.46	26.01	0.46	26.01	0.42	23.75	0.43	24.32	0.45	25.45	0.45	25.45	23.81
10	0.42	26.39	0.42	26.39	0.43	27.02	0.43	27.02	0.41	25.76	0.41	25.76	0.42	26.39	0.42	26.39	25.04

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.As observations could not be taken in 8 directions due to site constraints, average resistivity was calculated by arithmetic mean in those cases.

Average Resistivity V/S. Depth

Average Resistivity in Ω - m

KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

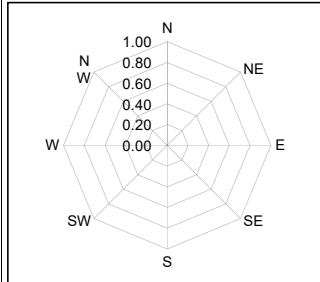
ERT No. : 20

Date : 00-01-1900

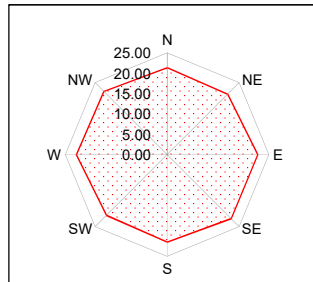
Test Location : E 877, N 3078

Name of Project : NTPP

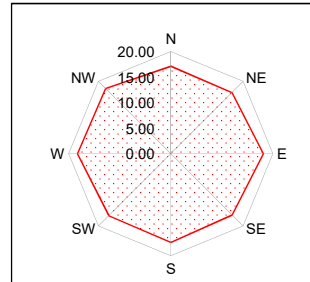
Depth 1 m



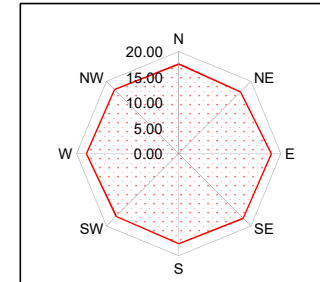
Depth 2 m



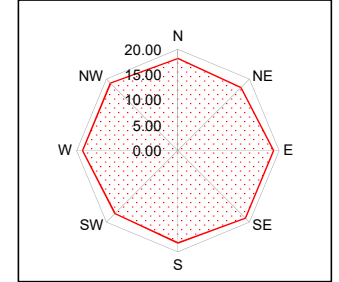
Depth 3 m



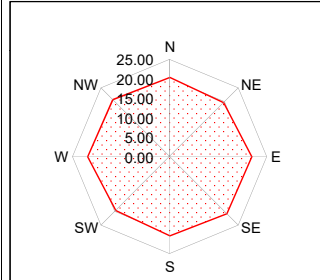
Depth 4 m



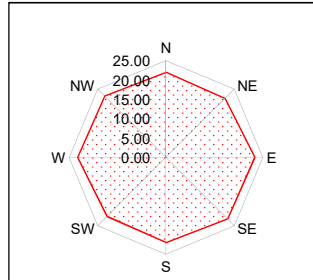
Depth 5 m



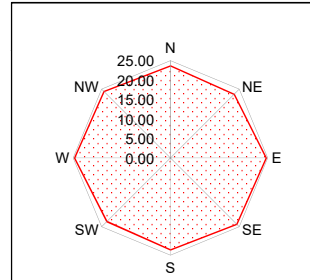
Depth 6 m



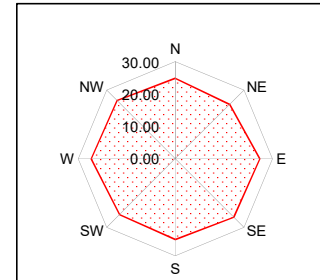
Depth 7 m



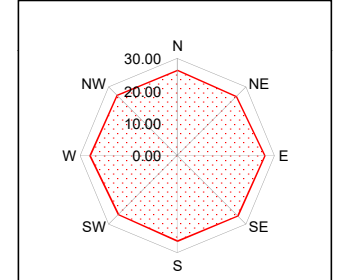
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m		2	3	4	5	6	7	8	9	10
Area of the polar diagram		1334.59	866.61	884.63	955.12	1182.66	1395.00	1611.97	1780.39	1969.14
Radius of the circle having same area as polar diagram		20.61	16.61	16.78	17.44	19.40	21.07	22.65	23.81	25.04

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

2) Observations could not be taken in all 8 directions due to site constraints and therefore full polar diagrams are not plotted for all that depths and not tabulated above.

KCT Consultancy Services, Ahmedabad**RESULTS OF ELECTRICAL RESISTIVITY TEST****(IS : 3043, 1987)**

ERT No. : ERT21
 Name of Project : NTPP
 Co-ordinates E 1646, N 3077 RL: 205.70m

Date: 05-05-2025
 Battery Condition : Good
 Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

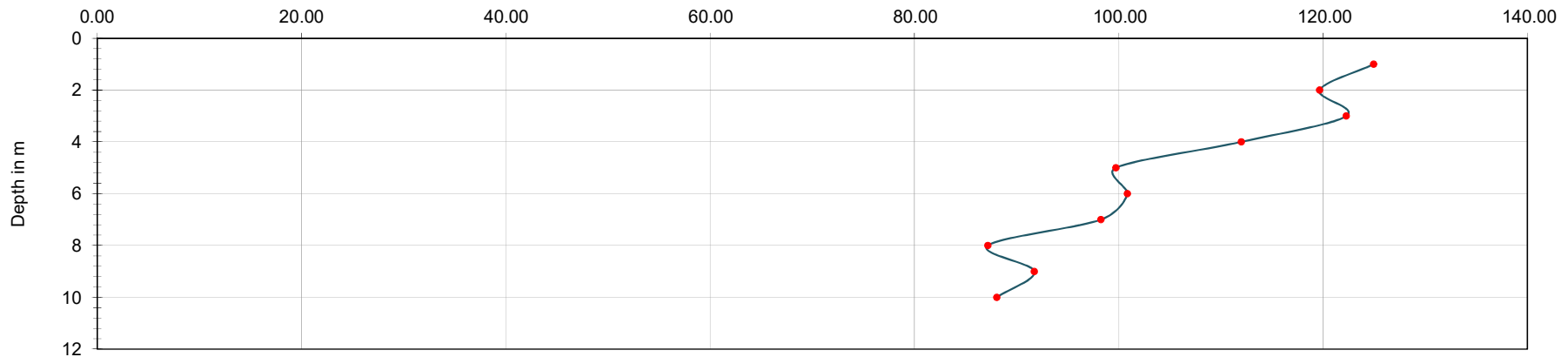
R = V / I in ohm (Ω)

V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	15.30	96.13	15.20	95.50	15.44	97.01	15.46	97.14	35.10	220.54	35.12	220.67	22.12	138.98	22.14	139.11	124.95
2	13.62	171.15	13.64	171.41	8.97	112.72	8.99	112.97	9.50	119.38	9.52	119.63	8.30	104.30	8.32	104.55	119.66
3	6.35	119.69	6.37	120.07	6.49	122.33	6.51	122.71	7.62	143.63	7.63	143.82	6.91	130.25	6.92	130.44	122.28
4	4.22	106.06	4.24	106.56	4.31	108.32	4.33	108.82	5.28	132.70	5.29	132.95	5.03	126.42	5.04	126.67	111.99
5	3.45	108.38	3.46	108.70	2.63	82.62	2.65	83.25	3.76	118.12	3.78	118.75	3.57	112.15	3.58	112.47	99.72
6	2.62	98.77	2.63	99.15	2.71	102.16	2.72	102.54	3.01	113.47	3.03	114.23	2.93	110.46	2.94	110.84	100.85
7	2.14	94.12	2.14	94.12	2.26	99.40	2.26	99.40	2.79	122.71	2.81	123.59	2.74	120.51	1.74	76.53	98.25
8	1.68	84.45	1.69	84.95	1.72	86.46	1.73	86.96	1.98	99.53	1.99	100.03	1.93	97.01	1.94	97.52	87.18
9	1.54	87.08	1.56	88.22	1.61	91.04	1.62	91.61	1.88	106.31	1.89	106.88	1.81	102.35	1.81	102.35	91.74
10	1.21	76.03	1.23	77.28	1.31	82.31	1.31	82.31	1.76	110.58	1.76	110.58	1.69	106.19	1.69	106.19	88.06

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. DepthAverage Resistivity in Ω - m

KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

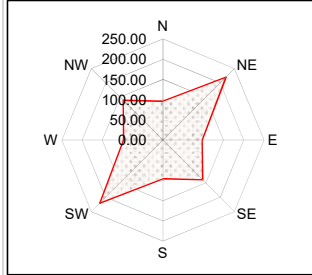
(IS : 3043, 1987)

ERT No. : ERT21
Name of Project : NTPP

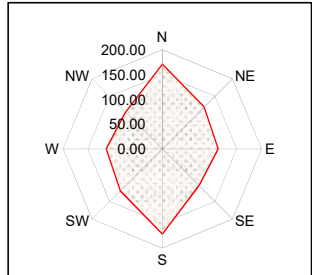
Date : 00-01-1900

Test Location : E 1646, N 3077 RL: 205.70m

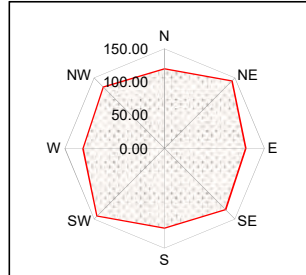
Depth 1 m



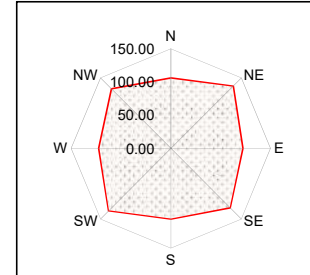
Depth 2 m



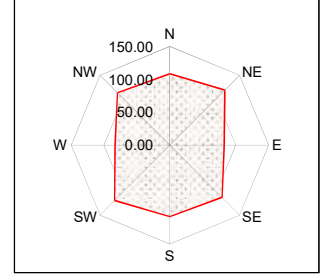
Depth 3 m



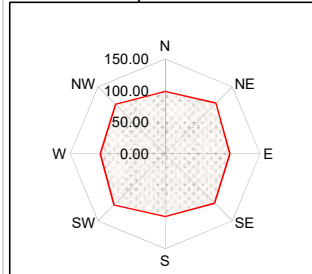
Depth 4 m



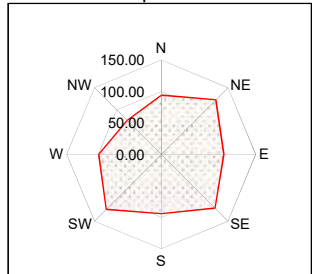
Depth 5 m



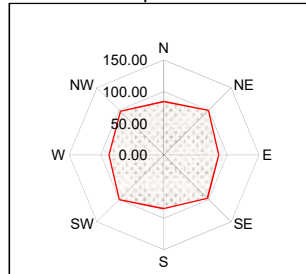
Depth 6 m



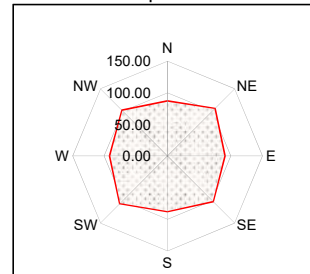
Depth 7 m



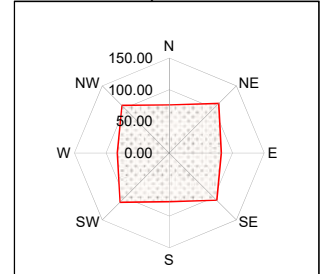
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	49047.54	44982.92	46970.73	39404.47	31238.23	31952.59	30329.02	23878.18	26439.61	24362.33
Radius of the circle having same area as polar diagram	124.95	119.66	122.28	111.99	99.72	100.85	98.25	87.18	91.74	88.06

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad**RESULTS OF ELECTRICAL RESISTIVITY TEST****(IS : 3043, 1987)**

ERT No. : ERT22
 Name of Project : NTPP
 Co-ordinates E 1218 , N 3022 RL:

Date: 17-04-2025
 Battery Condition : Good
 Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

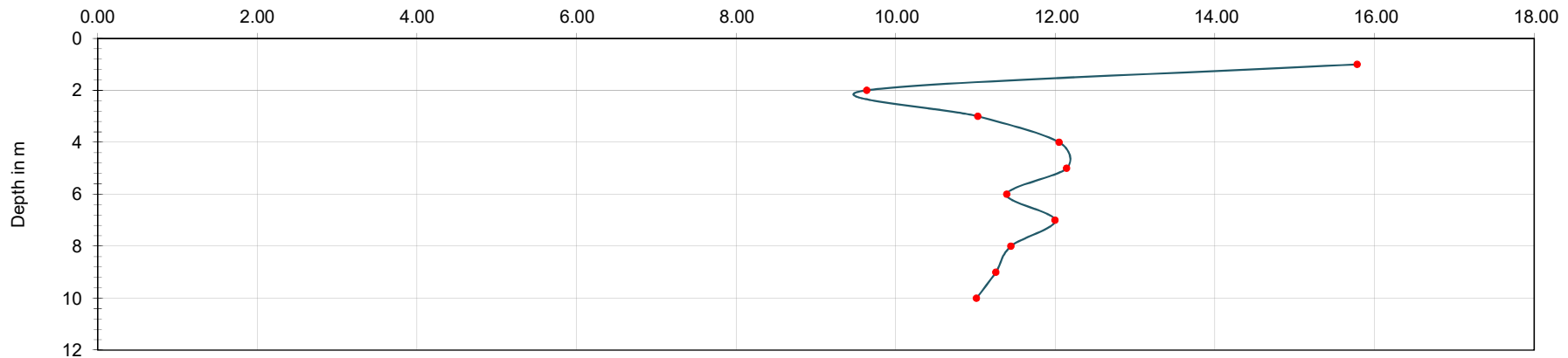
R = V // in ohm (Ω)

V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	2.65	16.65	2.66	16.71	2.69	16.90	2.70	16.96	2.63	16.52	2.64	16.59	2.60	16.34	2.61	16.40	15.78
2	0.88	11.06	0.89	11.18	0.90	11.31	0.91	11.44	0.75	9.42	0.76	9.55	0.71	8.92	0.70	8.80	9.64
3	0.68	12.82	0.68	12.82	0.75	14.14	0.76	14.33	0.55	10.37	0.53	9.99	0.52	9.80	0.52	9.80	11.03
4	0.55	13.82	0.56	14.07	0.62	15.58	0.59	14.83	0.45	11.31	0.45	11.31	0.43	10.81	0.43	10.81	12.05
5	0.41	12.88	0.41	12.88	0.47	14.77	0.48	15.08	0.41	12.88	0.41	12.88	0.34	10.68	0.34	10.68	12.14
6	0.31	11.69	0.31	11.69	0.35	13.19	0.36	13.57	0.33	12.44	0.33	12.44	0.28	10.56	0.28	10.56	11.39
7	0.27	11.88	0.27	11.88	0.31	13.63	0.31	13.63	0.30	13.19	0.30	13.19	0.27	11.88	0.27	11.88	12.00
8	0.22	11.06	0.22	11.06	0.27	13.57	0.27	13.57	0.25	12.57	0.25	12.57	0.22	11.06	0.22	11.06	11.44
9	0.19	10.74	0.19	10.74	0.25	14.14	0.25	14.14	0.22	12.44	0.22	12.44	0.18	10.18	0.18	10.18	11.25
10	0.17	10.68	0.17	10.68	0.22	13.82	0.22	13.82	0.19	11.94	0.19	11.94	0.16	10.05	0.16	10.05	11.01

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. DepthAverage Resistivity in Ω - m

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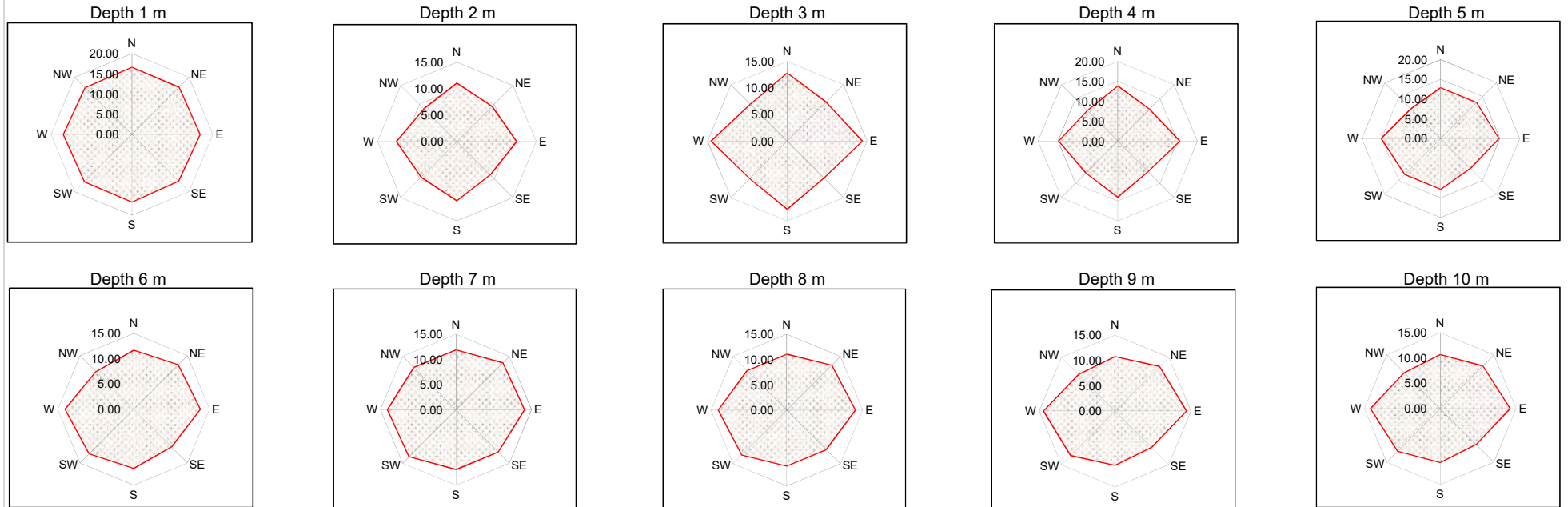
POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

ERT No. : ERT22
Name of Project : NTPP

Date : 00-01-1900

Test Location : E 1218 , N 3022 RL:



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	782.47	291.78	382.09	455.87	463.15	407.60	452.15	411.39	397.90	380.99
Radius of the circle having same area as polar diagram	15.78	9.64	11.03	12.05	12.14	11.39	12.00	11.44	11.25	11.01

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad**RESULTS OF ELECTRICAL RESISTIVITY TEST****(IS : 3043, 1987)**

ERT No. : ERT23
 Name of Project : NTPP
 Co-ordinates E 1665 , N 3145 RL: 202.99m

Date: 03-05-2025
 Battery Condition : Good
 Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

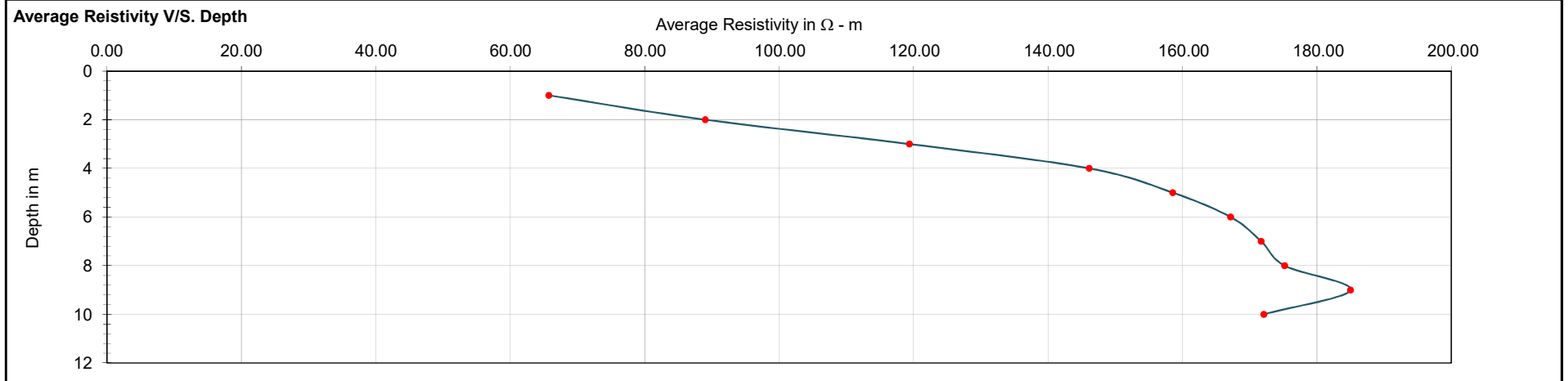
R = V // in ohm (Ω)

V = Voltage Drop between inner electrodes in Volt

/ = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	11.43	71.82	11.45	71.94	10.53	66.16	10.55	66.29	11.53	72.45	11.55	72.57	10.59	66.54	10.61	66.66	65.75
2	7.85	98.65	7.85	98.65	7.03	88.34	7.05	88.59	7.89	99.15	7.91	99.40	7.07	88.84	7.09	89.10	89.03
3	6.99	131.76	7.01	132.14	6.31	118.94	6.32	119.13	7.03	132.51	7.05	132.89	6.34	119.51	6.36	119.88	119.40
4	6.23	156.58	6.25	157.08	5.97	150.04	5.98	150.29	6.27	157.58	6.29	158.08	6.01	151.05	6.03	151.55	146.14
5	5.48	172.16	5.50	172.79	5.11	160.54	5.12	160.85	5.53	173.73	5.55	174.36	5.13	161.16	5.14	161.48	158.57
6	4.80	180.96	4.82	181.71	4.50	169.65	4.51	170.02	4.83	182.09	4.84	182.46	4.54	171.15	4.55	171.53	167.17
7	4.20	184.73	4.21	185.17	3.97	174.61	3.98	175.05	4.24	186.48	4.25	186.92	4.04	177.69	4.03	177.25	171.71
8	3.78	190.00	3.79	190.51	3.52	176.93	3.53	177.44	3.82	192.01	3.84	193.02	3.55	178.44	3.56	178.95	175.20
9	3.50	197.92	3.52	199.05	3.31	187.18	3.31	187.18	3.57	201.88	3.58	202.44	3.39	191.70	3.41	192.83	185.02
10	2.90	182.21	2.91	182.84	2.82	177.19	2.82	177.19	2.94	184.73	2.95	185.35	2.88	180.96	2.88	180.96	172.13

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.



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POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

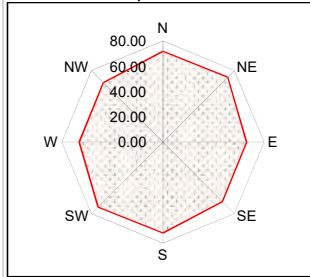
(IS : 3043, 1987)

ERT No. : ERT23
Name of Project : NTPP

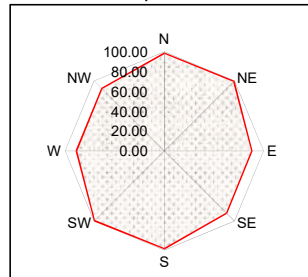
Date : 00-01-1900

Test Location : E 1665 , N 3145 RL: 202.99m

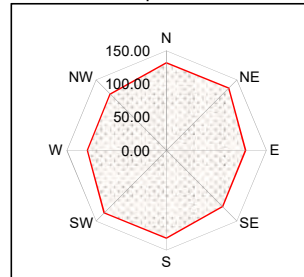
Depth 1 m



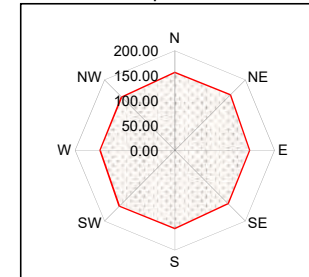
Depth 2 m



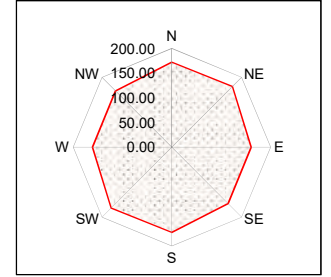
Depth 3 m



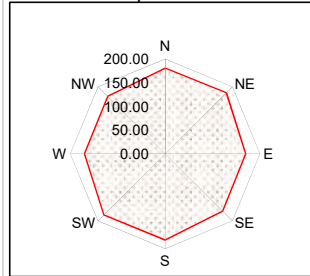
Depth 4 m



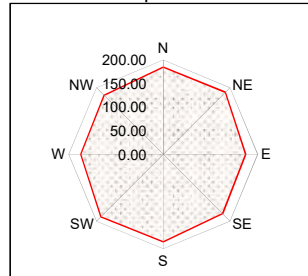
Depth 5 m



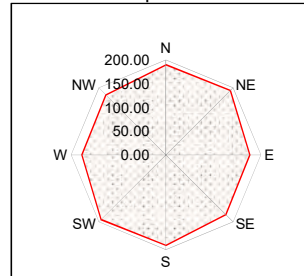
Depth 6 m



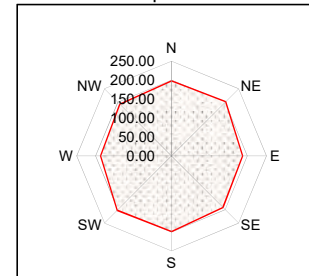
Depth 7 m



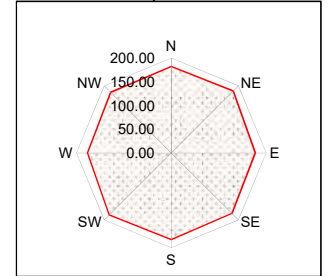
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	13582.65	24902.68	44786.14	67096.21	78994.74	87794.56	92631.61	96433.47	107545.51	93078.83
Radius of the circle having same area as polar diagram	65.75	89.03	119.40	146.14	158.57	167.17	171.71	175.20	185.02	172.13

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

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RESULTS OF ELECTRICAL RESISTIVITY TEST

(IS : 3043, 1987)

ERT No. : 24

Name of Project : NTTTP

Co-ordinates E 1292, N 2983 RL:200.74m

Date: 10-12-2024

Battery Condition : Good

Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

R = V / I in ohm (Ω)

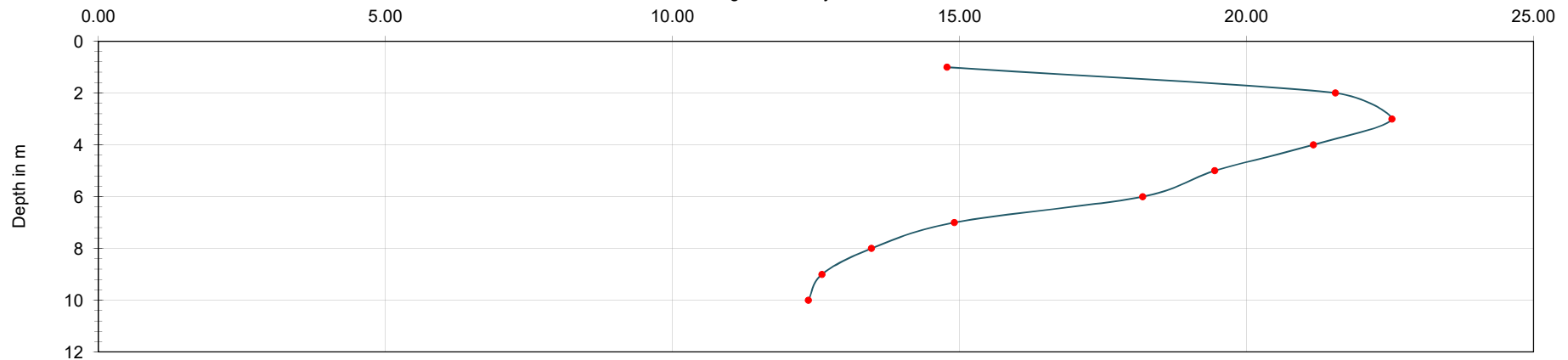
V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	2.54	15.96	2.55	16.02	2.32	14.58	2.33	14.64	2.43	15.27	2.44	15.33	2.61	16.40	2.62	16.46	14.78
2	1.57	19.73	1.55	19.48	1.82	22.87	1.83	23.00	1.87	23.50	1.88	23.62	1.98	24.88	1.99	25.01	21.55
3	1.27	23.94	1.28	24.13	1.21	22.81	1.22	23.00	1.24	23.37	1.25	23.56	1.30	24.50	1.31	24.69	22.53
4	0.90	22.62	0.91	22.87	0.85	21.36	0.86	21.61	0.88	22.12	0.89	22.37	0.90	22.62	0.91	22.87	21.16
5	0.66	20.73	0.67	21.05	0.62	19.48	0.63	19.79	0.63	19.79	0.64	20.11	0.68	21.36	0.69	21.68	19.45
6	0.51	19.23	0.51	19.23	0.48	18.10	0.49	18.47	0.50	18.85	0.51	19.23	0.53	19.98	0.54	20.36	18.19
7	0.37	16.27	0.37	16.27	0.33	14.51	0.32	14.07	0.36	15.83	0.35	15.39	0.38	16.71	0.38	16.71	14.91
8	0.29	14.58	0.29	14.58	0.26	13.07	0.26	13.07	0.28	14.07	0.28	14.07	0.30	15.08	0.30	15.08	13.47
9	0.24	13.57	0.24	13.57	0.22	12.44	0.22	12.44	0.23	13.01	0.23	13.01	0.25	14.14	0.25	14.14	12.61
10	0.21	13.19	0.21	13.19	0.20	12.57	0.20	12.57	0.20	12.57	0.20	12.57	0.22	13.82	0.22	13.82	12.37

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. Depth

Average Resistivity in Ω - m

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POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

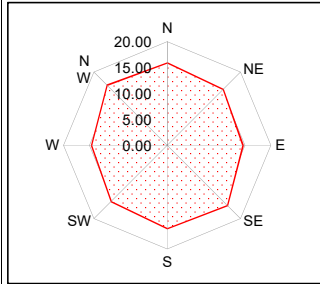
ERT No. : 24

Date : 00-01-1900

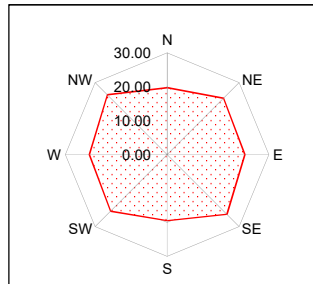
Test Location : E 1292, N 2983

Name of Project : NTTTP

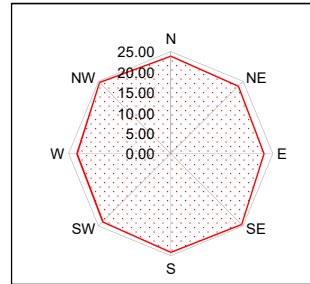
Depth 1 m



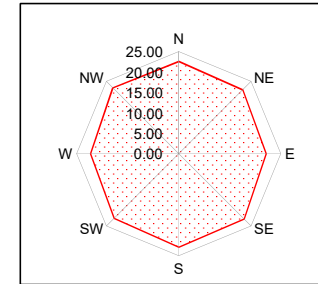
Depth 2 m



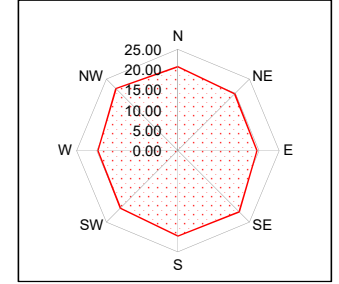
Depth 3 m



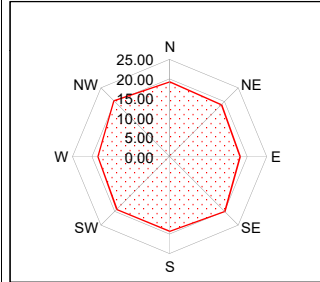
Depth 4 m



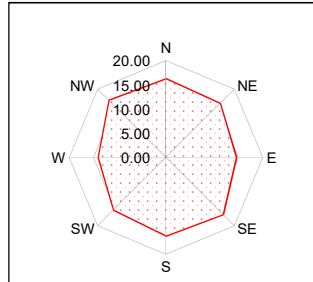
Depth 5 m



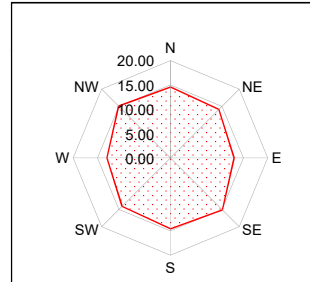
Depth 6 m



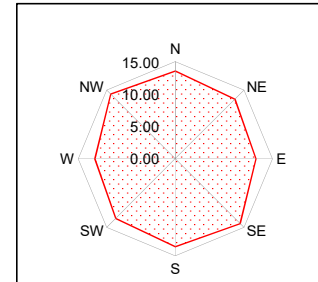
Depth 7 m



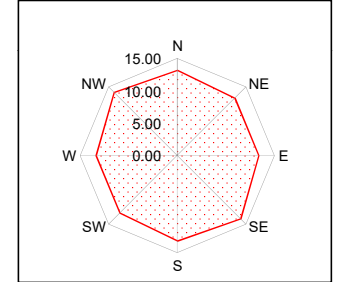
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	686.44	1458.77	1595.01	1406.93	1188.22	1039.82	698.66	569.84	499.19	480.63
Radius of the circle having same area as polar diagram	14.78	21.55	22.53	21.16	19.45	18.19	14.91	13.47	12.61	12.37

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

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RESULTS OF ELECTRICAL RESISTIVITY TEST (IS : 3043, 1987)

ERT No. : 25
Name of Project : NTTPP
Co-ordinates E 1754, N 2896 RL:200.10m

Date: 17-12-2024
Battery Condition : Good
Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

 $R = V / I$ in ohm (Ω)

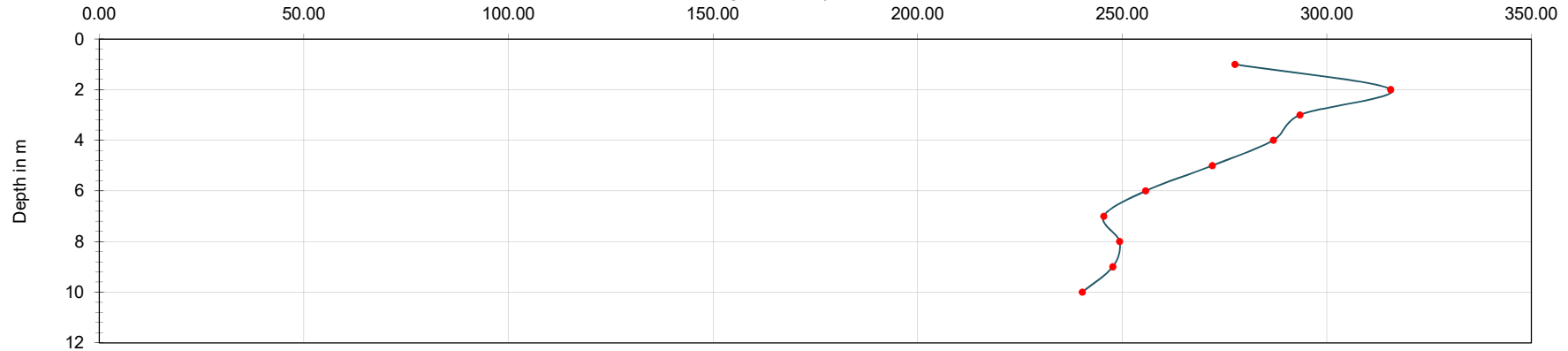
V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	47.60	299.08	47.54	298.70	46.75	293.74	46.70	293.42	45.08	283.25	45.05	283.06	46.90	294.68	46.84	294.30	277.52
2	26.66	335.02	26.61	334.39	27.30	343.06	27.25	342.43	25.70	322.96	25.65	322.33	26.34	331.00	26.29	330.37	315.60
3	16.44	309.89	16.40	309.13	16.53	311.58	16.49	310.83	16.34	308.00	16.30	307.25	16.40	309.13	16.36	308.38	293.43
4	12.04	302.60	12.00	301.59	12.17	305.87	12.14	305.11	11.96	300.59	11.92	299.58	12.03	302.35	12.00	301.59	286.92
5	9.14	287.14	9.11	286.20	9.24	290.28	9.21	289.34	9.08	285.26	9.05	284.31	9.12	286.51	9.06	284.63	272.02
6	7.16	269.93	7.13	268.79	7.25	273.32	7.22	272.19	7.11	268.04	7.08	266.91	7.14	269.17	7.11	268.04	255.74
7	5.89	259.06	5.87	258.18	5.96	262.13	5.94	261.25	5.85	257.30	5.83	256.42	5.87	258.18	5.85	257.30	245.47
8	5.60	281.49	5.14	258.36	5.20	261.38	5.18	260.38	5.14	258.36	5.12	257.36	5.15	258.87	5.30	266.41	249.37
9	4.63	261.82	4.61	260.69	4.68	264.65	4.65	262.95	4.60	260.12	4.58	258.99	4.60	260.12	4.58	258.99	247.67
10	4.04	253.84	4.02	252.58	4.08	256.35	4.06	255.10	4.02	252.58	4.00	251.33	4.02	252.58	4.00	251.33	240.24

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. Depth

Average Resistivity in Ω - m

KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

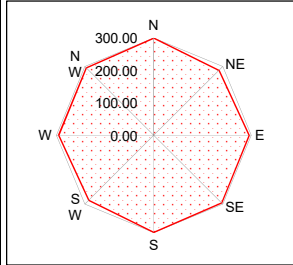
ERT No. : 25

Date : 00-01-1900

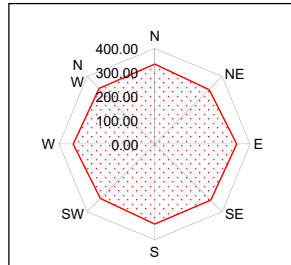
Test Location : E 1754, N 2896

Name of Project : NTPP

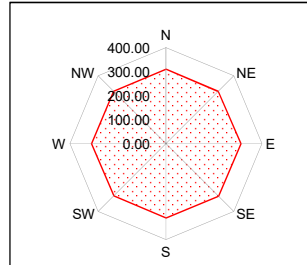
Depth 1 m



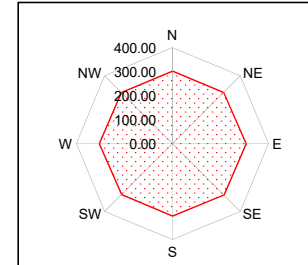
Depth 2 m



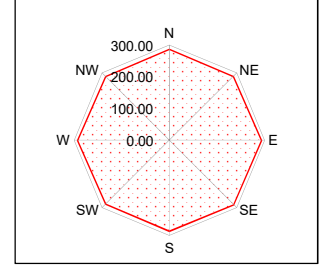
Depth 3 m



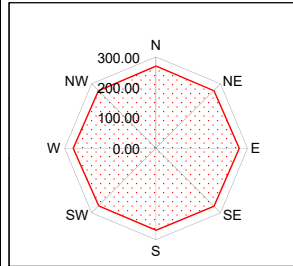
Depth 4 m



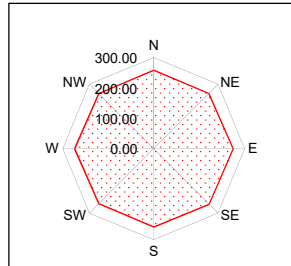
Depth 5 m



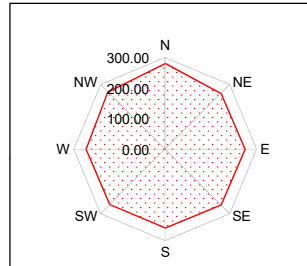
Depth 6 m



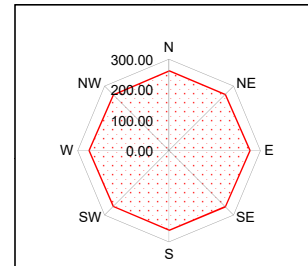
Depth 7 m



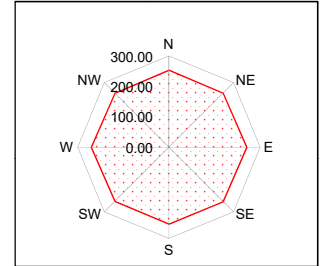
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	241962.87	312916.51	270496.39	258620.09	232462.05	205466.53	189298.19	195365.65	192703.80	181317.56
Radius of the circle having same area as polar diagram	277.52	315.60	293.43	286.92	272.02	255.74	245.47	249.37	247.67	240.24

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

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RESULTS OF ELECTRICAL RESISTIVITY TEST

(IS : 3043, 1987)

ERT No. : 26

Name of Project : NTTTP

Co-ordinates E 1223, N 2869 RL:200.90m

Date: 11-12-2024

Battery Condition : Good

Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

R = V / I in ohm (Ω)

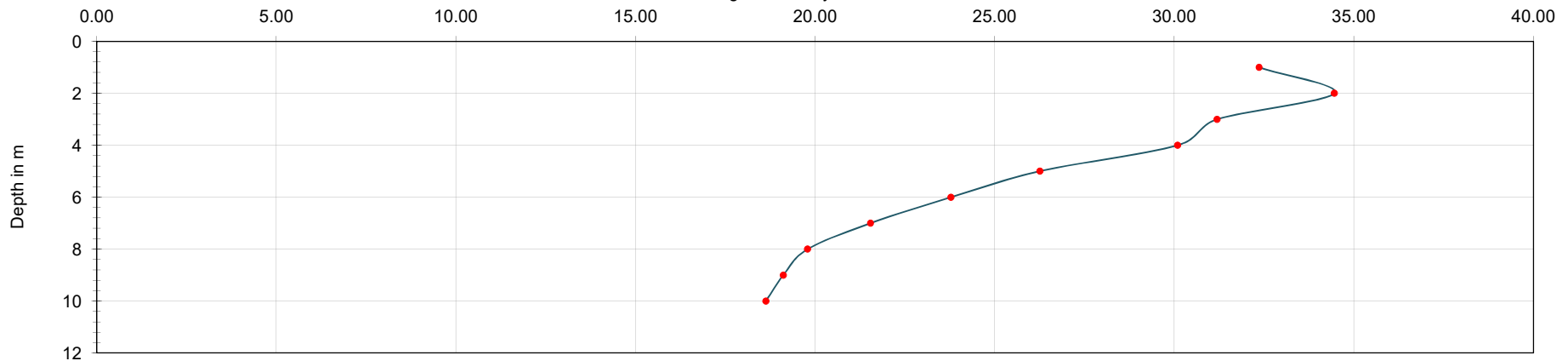
V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	4.90	30.79	4.95	31.10	5.81	36.51	5.82	36.57	5.11	32.11	5.13	32.23	5.85	36.76	5.86	36.82	32.36
2	2.97	37.32	2.98	37.45	2.83	35.56	2.84	35.69	3.01	37.82	3.02	37.95	2.73	34.31	2.74	34.43	34.46
3	1.81	34.12	1.82	34.31	1.78	33.55	1.78	33.55	1.61	30.35	1.63	30.72	1.76	33.18	1.77	33.36	31.19
4	1.46	36.69	1.40	35.19	1.17	29.41	1.17	29.41	1.31	32.92	1.32	33.18	1.13	28.40	1.14	28.65	30.09
5	0.97	30.47	0.98	30.79	0.83	26.08	0.83	26.08	0.90	28.27	0.91	28.59	0.81	25.45	0.82	25.76	26.26
6	0.71	26.77	0.71	26.77	0.64	24.13	0.64	24.13	0.69	26.01	0.70	26.39	0.61	23.00	0.62	23.37	23.78
7	0.52	22.87	0.53	23.31	0.50	21.99	0.50	21.99	0.55	24.19	0.56	24.63	0.48	21.11	0.49	21.55	21.54
8	0.41	20.61	0.41	20.61	0.41	20.61	0.41	20.61	0.45	22.62	0.45	22.62	0.39	19.60	0.39	19.60	19.79
9	0.35	19.79	0.36	20.36	0.36	20.36	0.36	20.36	0.37	20.92	0.37	20.92	0.34	19.23	0.34	19.23	19.11
10	0.31	19.48	0.31	19.48	0.31	19.48	0.31	19.48	0.33	20.73	0.33	20.73	0.30	18.85	0.30	18.85	18.63

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. Depth

Average Resistivity in Ω - m

KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

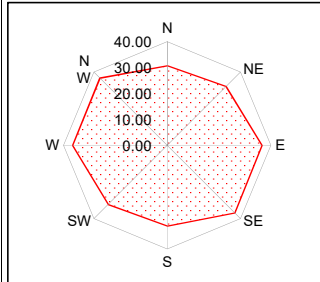
ERT No. : 26

Date : 00-01-1900

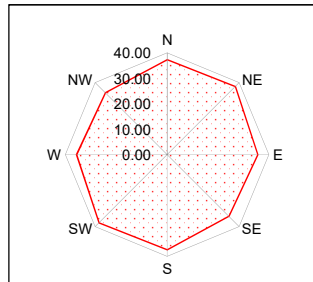
Test Location : E 1223, N 2869

Name of Project : NTTTP

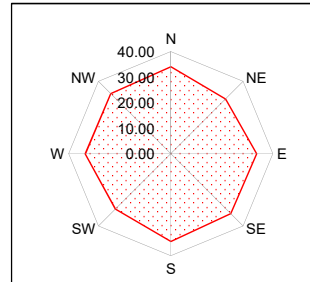
Depth 1 m



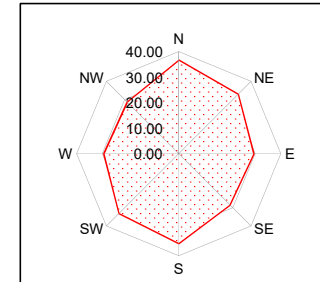
Depth 2 m



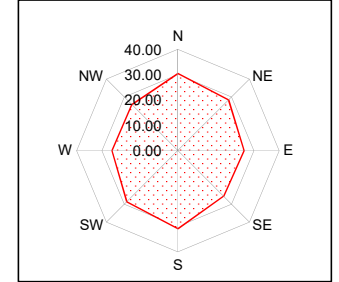
Depth 3 m



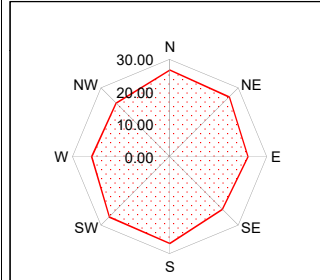
Depth 4 m



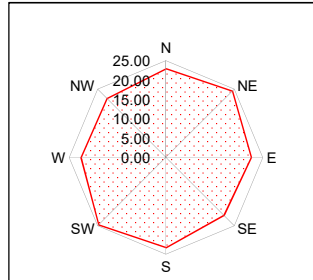
Depth 5 m



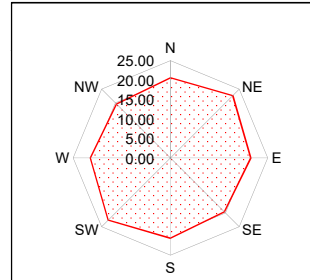
Depth 6 m



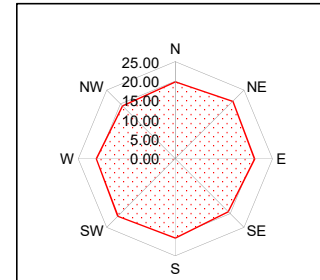
Depth 7 m



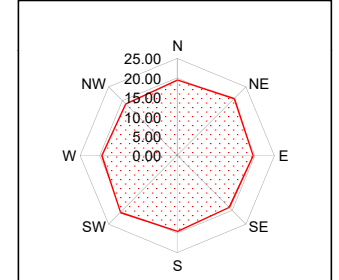
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	3289.95	3729.78	3056.89	2844.71	2166.33	1777.00	1457.92	1230.42	1147.70	1090.21
Radius of the circle having same area as polar diagram	32.36	34.46	31.19	30.09	26.26	23.78	21.54	19.79	19.11	18.63

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad

RESULTS OF ELECTRICAL RESISTIVITY TEST

(IS : 3043, 1987)

ERT No. : 27

Name of Project : NTTTP

Co-ordinates E 1174, N 2847 RL:200.50m

Date: 10-12-2024

Battery Condition : Good

Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

R = V / I in ohm (Ω)

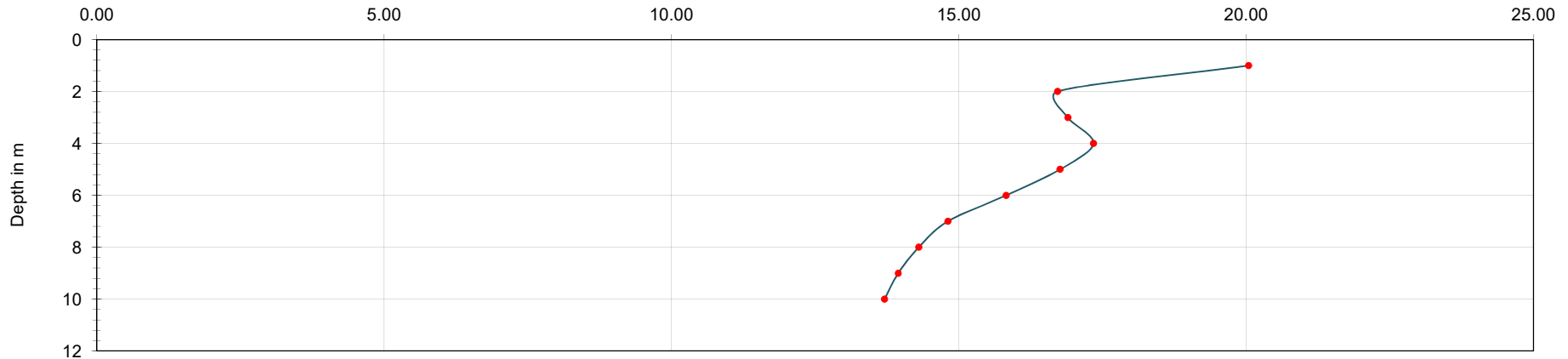
V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	3.43	21.55	3.44	21.61	3.19	20.04	3.20	20.11	3.51	22.05	3.52	22.12	3.30	20.73	3.31	20.80	20.04
2	1.40	17.59	1.41	17.72	1.34	16.84	1.35	16.96	1.46	18.35	1.47	18.47	1.39	17.47	1.40	17.59	16.72
3	0.94	17.72	0.95	17.91	0.91	17.15	0.92	17.34	0.98	18.47	0.99	18.66	0.93	17.53	0.94	17.72	16.90
4	0.73	18.35	0.74	18.60	0.68	17.09	0.69	17.34	0.76	19.10	0.77	19.35	0.72	18.10	0.73	18.35	17.34
5	0.57	17.91	0.58	18.22	0.52	16.34	0.53	16.65	0.59	18.54	0.60	18.85	0.55	17.28	0.56	17.59	16.76
6	0.45	16.96	0.46	17.34	0.41	15.46	0.42	15.83	0.46	17.34	0.47	17.72	0.43	16.21	0.44	16.59	15.83
7	0.36	15.83	0.36	15.83	0.34	14.95	0.34	14.95	0.37	16.27	0.37	16.27	0.35	15.39	0.35	15.39	14.81
8	0.30	15.08	0.30	15.08	0.29	14.58	0.29	14.58	0.31	15.58	0.31	15.58	0.30	15.08	0.30	15.08	14.31
9	0.26	14.70	0.26	14.70	0.25	14.14	0.25	14.14	0.27	15.27	0.27	15.27	0.26	14.70	0.26	14.70	13.95
10	0.23	14.45	0.23	14.45	0.22	13.82	0.22	13.82	0.24	15.08	0.24	15.08	0.23	14.45	0.23	14.45	13.71

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. Depth

Average Resistivity in Ω - m

KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

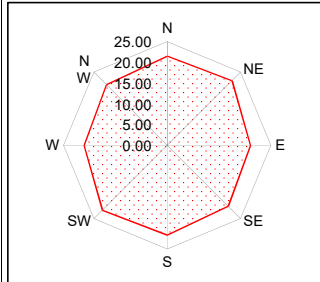
ERT No. : 27

Date : 00-01-1900

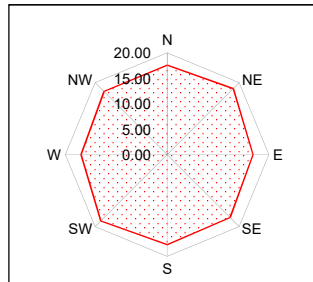
Test Location : E 1174, N 2847

Name of Project : NTTTP

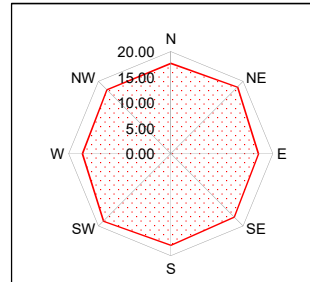
Depth 1 m



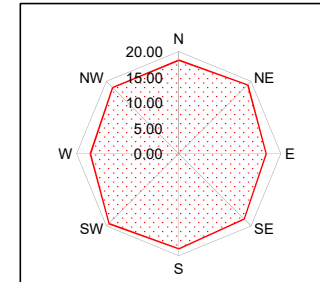
Depth 2 m



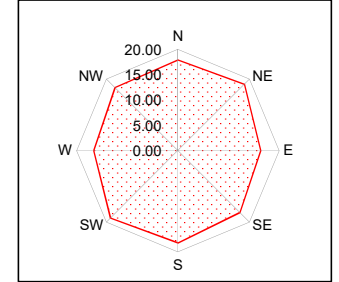
Depth 3 m



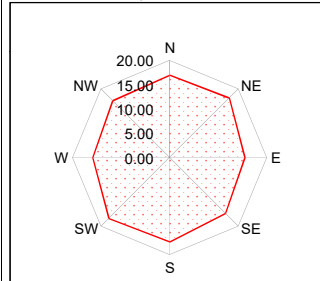
Depth 4 m



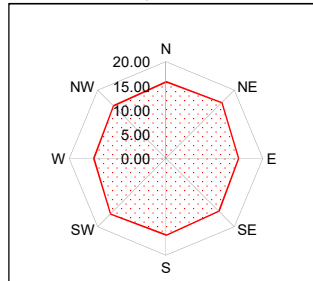
Depth 5 m



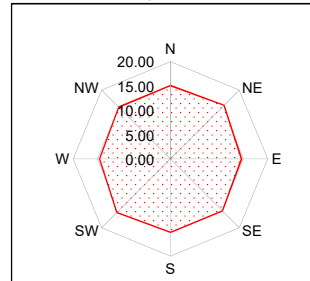
Depth 6 m



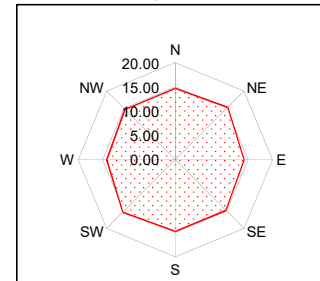
Depth 7 m



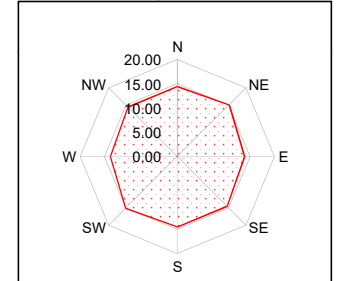
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	1262.05	878.09	897.10	944.90	882.73	786.81	689.30	642.90	611.10	590.32
Radius of the circle having same area as polar diagram	20.04	16.72	16.90	17.34	16.76	15.83	14.81	14.31	13.95	13.71

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

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RESULTS OF ELECTRICAL RESISTIVITY TEST

(IS : 3043, 1987)

ERT No. : 28

Name of Project : NTTTP

Co-ordinates E 1308, N 2844 RL:202.18m

Date: 11-12-2024

Battery Condition : Good

Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

R = V / I in ohm (Ω)

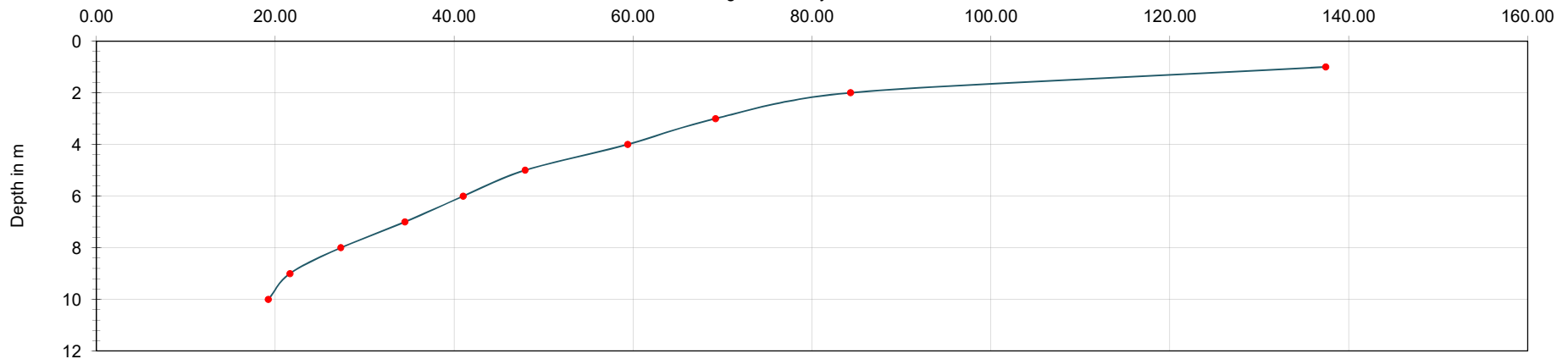
V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	22.28	139.99	22.31	140.18	26.64	167.38	23.66	148.66	21.81	137.04	21.85	137.29	22.97	144.32	22.99	144.45	137.43
2	7.31	91.86	7.34	92.24	6.72	84.45	6.74	84.70	7.61	95.63	7.62	95.76	6.90	86.71	6.33	79.55	84.31
3	3.67	69.18	3.69	69.55	3.85	72.57	3.87	72.95	3.90	73.51	3.92	73.89	4.03	75.96	4.04	76.15	69.21
4	2.33	58.56	2.34	58.81	2.31	58.06	2.32	58.31	2.51	63.08	2.53	63.59	2.81	70.62	2.82	70.87	59.38
5	1.58	49.64	1.59	49.95	1.52	47.75	1.53	48.07	1.70	53.41	1.72	54.04	1.61	50.58	1.62	50.89	47.93
6	1.02	38.45	1.03	38.83	1.04	39.21	1.05	39.58	1.20	45.24	1.23	46.37	1.32	49.76	1.33	50.14	41.01
7	0.72	31.67	0.73	32.11	0.72	31.67	0.73	32.11	0.90	39.58	0.90	39.58	0.98	43.10	0.99	43.54	34.49
8	0.52	26.14	0.52	26.14	0.53	26.64	0.53	26.64	0.63	31.67	0.64	32.17	0.61	30.66	0.62	31.16	27.32
9	0.38	21.49	0.38	21.49	0.38	21.49	0.38	21.49	0.41	23.18	0.42	23.75	0.44	24.88	0.44	24.88	21.62
10	0.30	18.85	0.30	18.85	0.32	20.11	0.32	20.11	0.34	21.36	0.34	21.36	0.33	20.73	0.33	20.73	19.21

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. Depth

Average Resistivity in Ω - m

KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

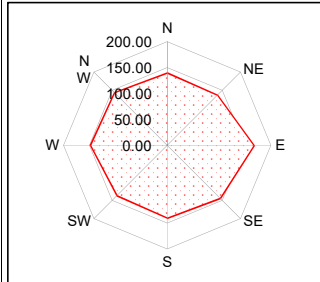
ERT No. : 28

Date : 00-01-1900

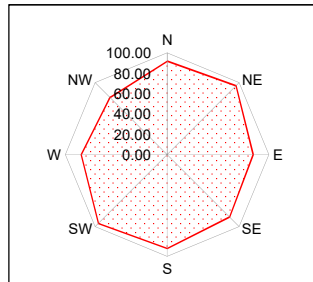
Test Location : E 1308, N 2844

Name of Project : NTPP

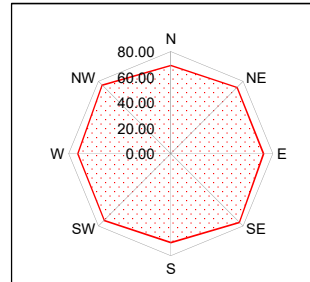
Depth 1 m



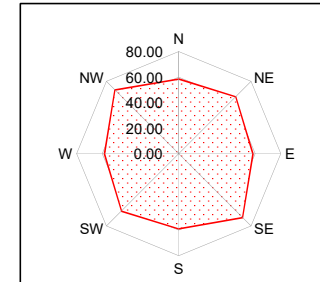
Depth 2 m



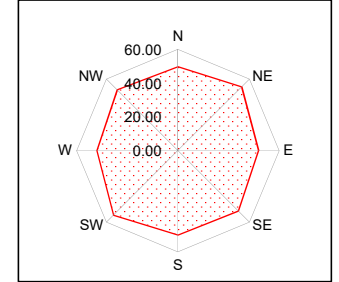
Depth 3 m



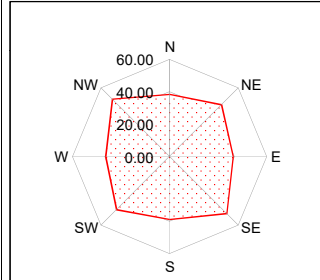
Depth 4 m



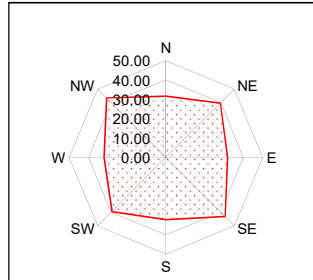
Depth 5 m



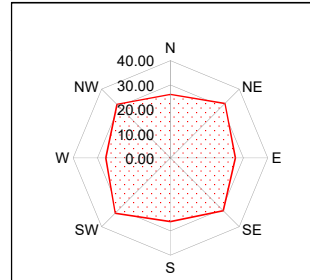
Depth 6 m



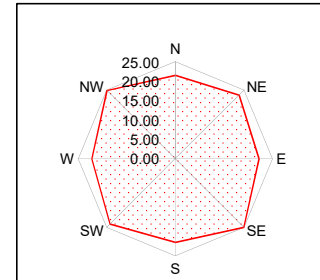
Depth 7 m



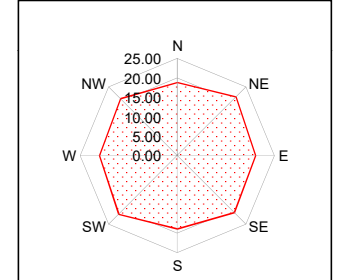
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	59338.35	22329.46	15048.33	11078.69	7215.65	5283.21	3738.13	2344.54	1469.07	1159.43
Radius of the circle having same area as polar diagram	137.43	84.31	69.21	59.38	47.93	41.01	34.49	27.32	21.62	19.21

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad

RESULTS OF ELECTRICAL RESISTIVITY TEST (IS : 3043, 1987)

ERT No. : 29
Name of Project : NTPP
Co-ordinates E 2426, N 2791 RL:196.70m

Date: 18-12-2024
Battery Condition : Good
Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - $22 / 7$

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

R = V / I in ohm (Ω)

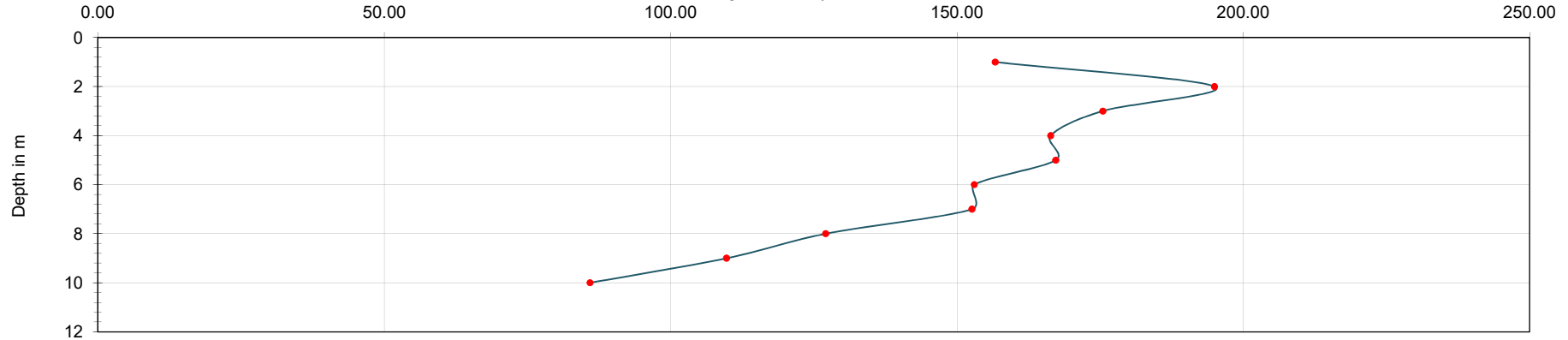
V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	27.35	171.82	27.33	171.74	25.34	159.19	25.28	158.86	26.19	164.54	26.17	164.41	26.32	165.37	26.30	165.27	156.69
2	16.75	210.53	16.74	210.32	16.10	202.36	16.09	202.15	16.13	202.74	16.12	202.53	16.46	206.80	16.44	206.59	194.97
3	10.03	189.00	10.01	188.75	9.67	182.34	9.66	182.15	9.73	183.41	9.72	183.15	9.85	185.61	9.83	185.35	175.49
4	7.18	180.55	7.17	180.25	6.82	171.41	6.80	171.00	6.92	173.92	6.91	173.62	7.01	176.23	7.00	175.93	166.38
5	5.67	177.97	5.65	177.50	5.57	174.83	5.55	174.36	5.62	176.56	5.61	176.09	5.63	176.87	5.61	176.24	167.27
6	4.34	163.72	4.33	163.08	4.23	159.63	4.22	158.98	4.29	161.57	4.27	160.92	4.29	161.57	4.27	160.92	153.04
7	3.72	163.61	3.70	162.73	3.61	158.92	3.59	158.04	3.66	160.98	3.65	160.39	3.67	161.56	3.65	160.68	152.63
8	2.70	135.72	2.68	134.71	2.65	133.04	2.63	132.03	2.67	134.04	2.65	133.04	2.69	135.05	2.67	134.04	127.10
9	2.10	118.75	2.08	117.62	2.01	113.47	1.99	112.34	2.03	114.98	2.01	113.85	2.08	117.62	2.07	116.87	109.76
10	1.47	92.15	1.45	91.32	1.42	89.22	1.41	88.38	1.45	90.90	1.43	90.06	1.46	91.73	1.45	90.90	85.94

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. Depth

Average Resistivity in Ω - m

KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

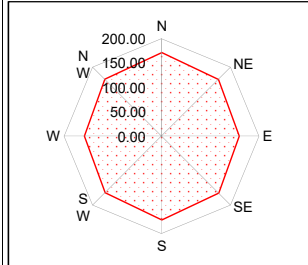
ERT No. : 29

Date : 00-01-1900

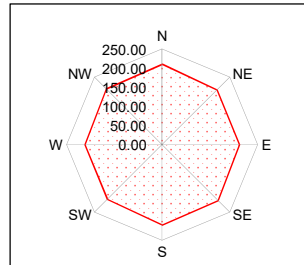
Test Location : E 2426, N 2791

Name of Project : NTPP

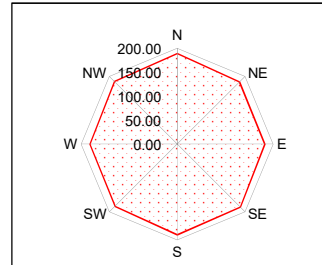
Depth 1 m



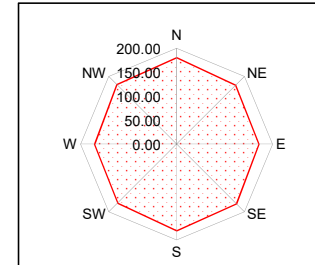
Depth 2 m



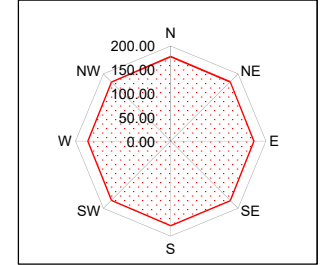
Depth 3 m



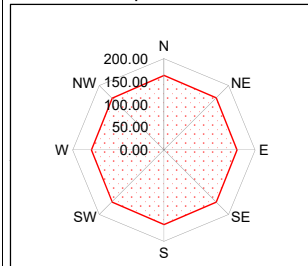
Depth 4 m



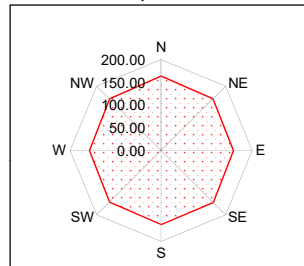
Depth 5 m



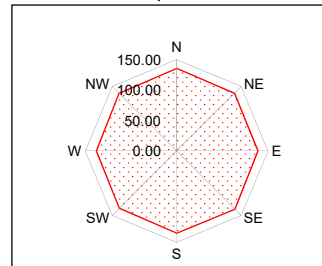
Depth 6 m



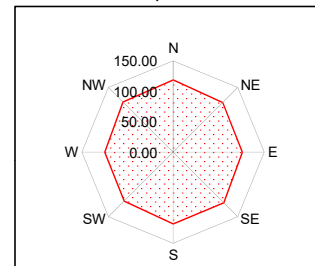
Depth 7 m



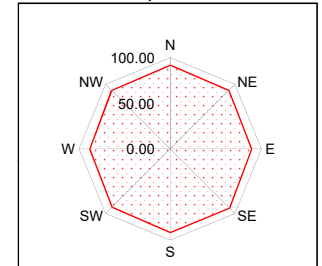
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	77133.03	119427.56	96755.03	86967.36	87901.29	73576.65	73182.11	50747.71	37850.29	23204.29
Radius of the circle having same area as polar diagram	156.69	194.97	175.49	166.38	167.27	153.04	152.63	127.10	109.76	85.94

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad**RESULTS OF ELECTRICAL RESISTIVITY TEST****(IS : 3043, 1987)**

ERT No. : ERT30
 Name of Project : NTPP
 Co-ordinates E 337 , N 2788 RL: 194.93m

Date: 05-05-2025
 Battery Condition : Good
 Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

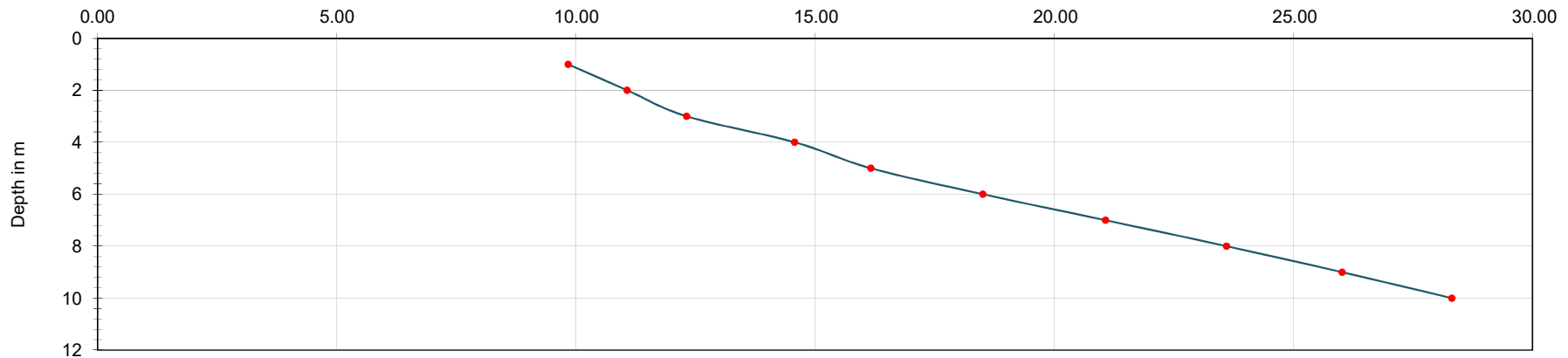
R = V // in ohm (Ω)

V = Voltage Drop between inner electrodes in Volt

/ = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	1.64	10.30	1.65	10.37	1.48	9.30	1.50	9.42	1.66	10.43	1.67	10.49	1.80	11.31	1.82	11.44	9.84
2	0.96	12.06	0.97	12.19	0.86	10.81	0.88	11.06	0.92	11.56	0.93	11.69	0.95	11.94	0.96	12.06	11.07
3	0.70	13.19	0.71	13.38	0.68	12.82	0.65	12.25	0.68	12.82	0.67	12.63	0.71	13.38	0.71	13.38	12.32
4	0.62	15.58	0.62	15.58	0.60	15.08	0.61	15.33	0.60	15.08	0.61	15.33	0.61	15.33	0.62	15.58	14.58
5	0.54	16.96	0.54	16.96	0.57	17.91	0.52	16.34	0.54	16.96	0.54	16.96	0.54	16.96	0.55	17.28	16.17
6	0.52	19.60	0.52	19.60	0.50	18.85	0.51	19.23	0.52	19.60	0.52	19.60	0.52	19.60	0.53	19.98	18.51
7	0.51	22.43	0.51	22.43	0.49	21.55	0.49	21.55	0.51	22.43	0.51	22.43	0.51	22.43	0.51	22.43	21.07
8	0.50	25.13	0.50	25.13	0.48	24.13	0.48	24.13	0.50	25.13	0.50	25.13	0.50	25.13	0.50	25.13	23.61
9	0.49	27.71	0.49	27.71	0.47	26.58	0.47	26.58	0.49	27.71	0.49	27.71	0.49	27.71	0.49	27.71	26.02
10	0.48	30.16	0.48	30.16	0.46	28.90	0.46	28.90	0.48	30.16	0.48	30.16	0.48	30.16	0.48	30.16	28.31

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. DepthAverage Resistivity in Ω - m

KCT Consultancy Services, Ahmedabad

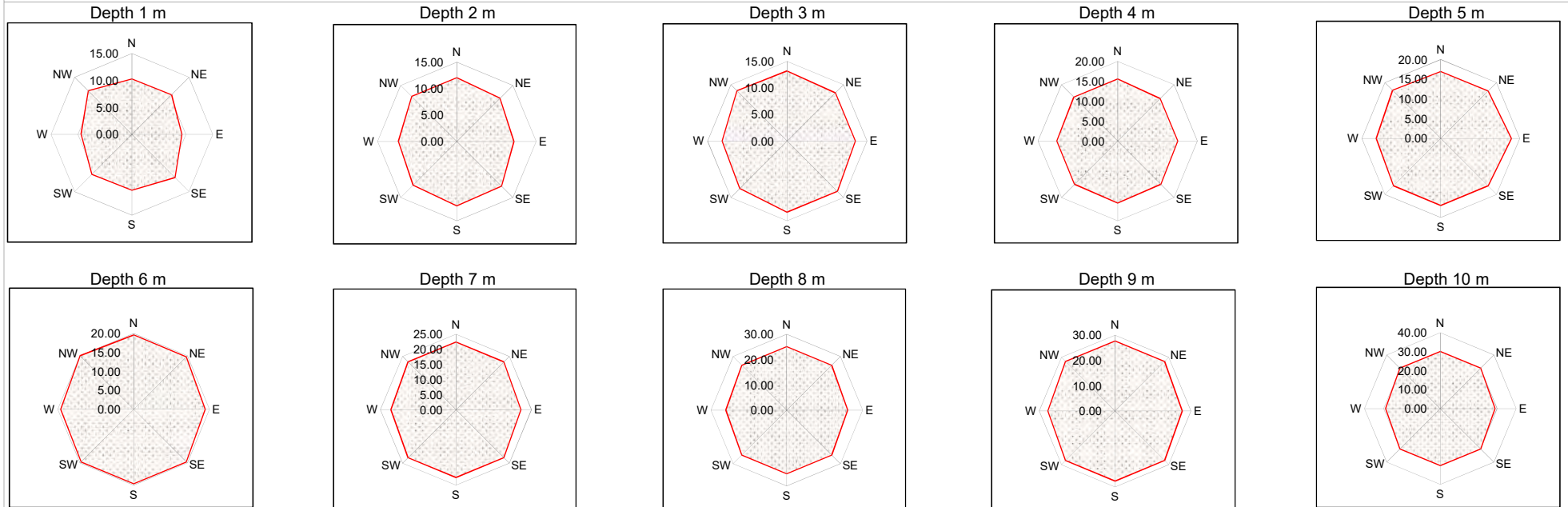
POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

ERT No. : ERT30
Name of Project : NTPP

Date : 00-01-1900

Test Location : E 337 , N 2788 RL: 194.93m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	304.07	385.16	476.65	667.44	821.36	1076.30	1395.00	1750.59	2126.97	2518.71
Radius of the circle having same area as polar diagram	9.84	11.07	12.32	14.58	16.17	18.51	21.07	23.61	26.02	28.31

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad**RESULTS OF ELECTRICAL RESISTIVITY TEST****(IS : 3043, 1987)**

ERT No. : ERT31
 Name of Project : NTPP
 Co-ordinates E 1817 , N 2826 RL: 194.93m

Date: 05-05-2025
 Battery Condition : Good
 Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

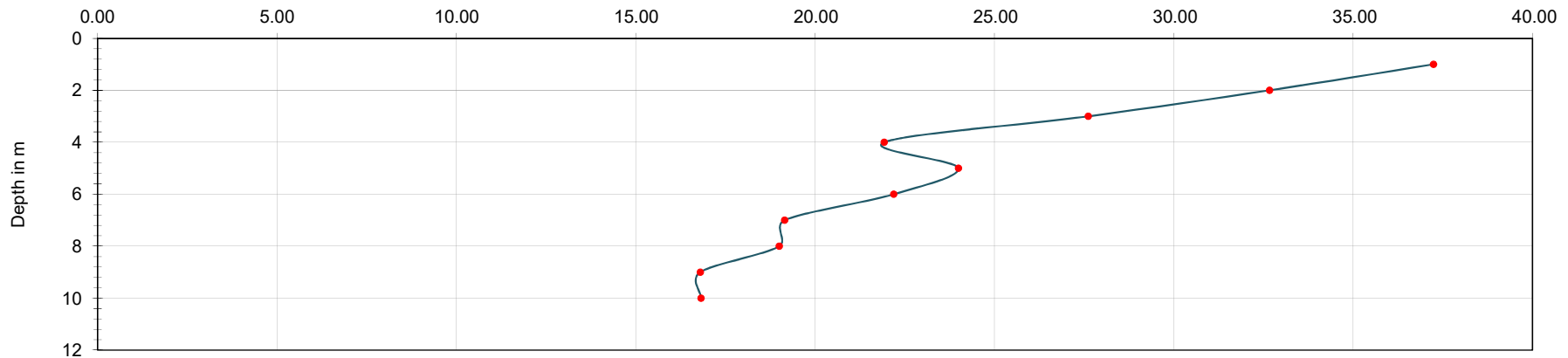
R = V // in ohm (Ω)

V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	5.75	36.13	5.76	36.19	6.29	39.52	6.30	39.58	6.14	38.58	6.15	38.64	6.80	42.73	6.82	42.85	37.24
2	2.42	30.41	2.44	30.66	2.90	36.44	2.91	36.57	2.64	33.18	2.65	33.30	2.98	37.45	2.99	37.57	32.67
3	1.23	23.18	1.24	23.37	1.70	32.04	1.70	32.04	1.51	28.46	1.52	28.65	1.73	32.61	1.74	32.80	27.62
4	0.76	19.10	0.76	19.10	0.97	24.38	0.98	24.63	0.91	22.87	0.92	23.12	1.03	25.89	1.04	26.14	21.93
5	0.63	19.79	0.64	20.11	0.85	26.70	0.86	27.02	0.78	24.50	0.79	24.82	0.95	29.85	0.96	30.16	24.00
6	0.46	17.34	0.47	17.72	0.63	23.75	0.64	24.13	0.61	23.00	0.61	23.00	0.79	29.78	0.79	29.78	22.19
7	0.34	14.95	0.36	15.83	0.51	22.43	0.51	22.43	0.45	19.79	0.46	20.23	0.52	22.87	0.53	23.31	19.15
8	0.29	14.58	0.30	15.08	0.43	21.61	0.44	22.12	0.38	19.10	0.39	19.60	0.48	24.13	0.49	24.63	19.00
9	0.26	14.70	0.27	15.27	0.32	18.10	0.33	18.66	0.31	17.53	0.31	17.53	0.35	19.79	0.36	20.36	16.80
10	0.25	15.71	0.25	15.71	0.29	18.22	0.29	18.22	0.28	17.59	0.28	17.59	0.31	19.48	0.31	19.48	16.82

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. DepthAverage Resistivity in Ω - m

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POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

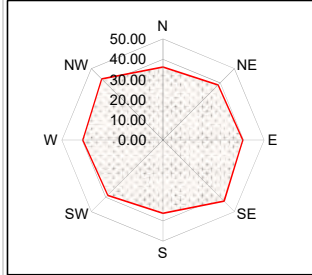
(IS : 3043, 1987)

ERT No. : ERT31
Name of Project : NTPP

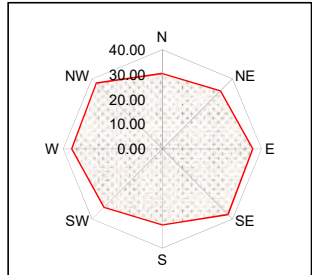
Date : 00-01-1900

Test Location : E 1817 , N 2826 RL: 194.93m

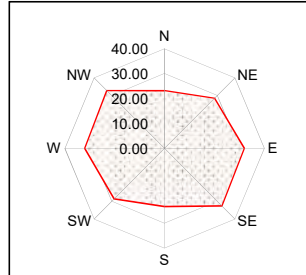
Depth 1 m



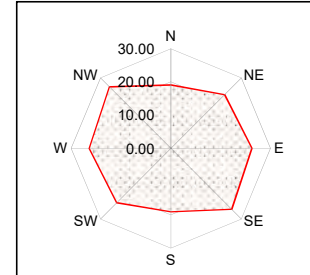
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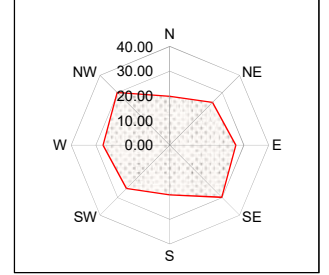
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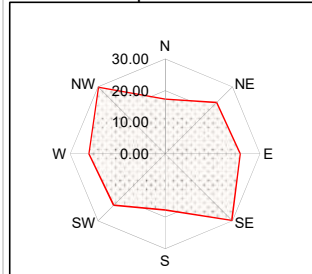
Depth 4 m



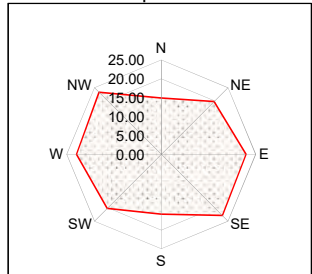
Depth 5 m



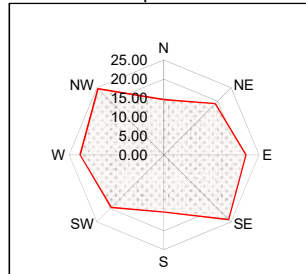
Depth 6 m



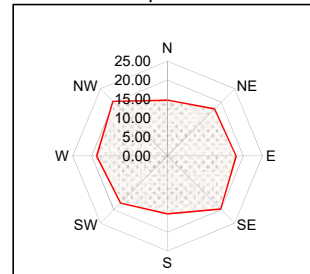
Depth 7 m



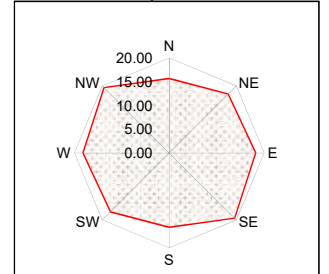
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	4357.16	3353.38	2396.15	1510.91	1809.10	1547.40	1152.66	1134.58	887.03	889.25
Radius of the circle having same area as polar diagram	37.24	32.67	27.62	21.93	24.00	22.19	19.15	19.00	16.80	16.82

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad

RESULTS OF ELECTRICAL RESISTIVITY TEST

(IS : 3043, 1987)

ERT No. : 32
 Name of Project : NTTTP
 Co-ordinates E 929, N 2555

Date: 17-12-2024
 Battery Condition : Good
 Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$
 Where

ρ = Resistivity in ohm - m (Ω m)

π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

$R = V / I$ in ohm (Ω)

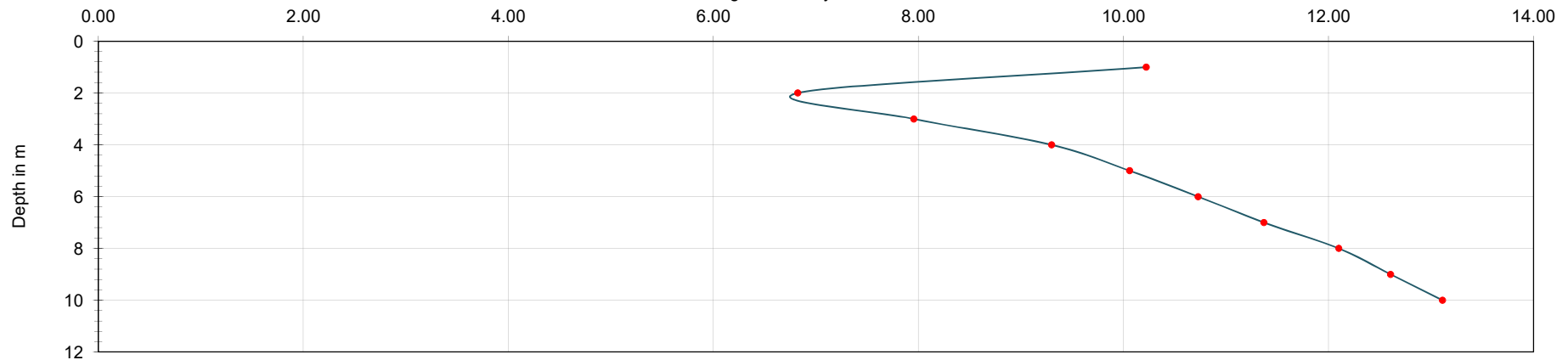
V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	1.62	10.18	1.63	10.24	1.76	11.06	1.77	11.12	1.79	11.25	1.80	11.31	1.67	10.49	1.68	10.56	10.22
2	0.54	6.79	0.54	6.79	0.58	7.29	0.58	7.29	0.60	7.54	0.60	7.54	0.57	7.16	0.57	7.16	6.82
3	0.42	7.92	0.42	7.92	0.45	8.48	0.45	8.48	0.47	8.86	0.47	8.86	0.44	8.29	0.44	8.29	7.96
4	0.38	9.55	0.38	9.55	0.39	9.80	0.39	9.80	0.41	10.30	0.41	10.30	0.38	9.55	0.38	9.55	9.30
5	0.33	10.37	0.33	10.37	0.34	10.68	0.34	10.68	0.35	11.00	0.35	11.00	0.33	10.37	0.33	10.37	10.06
6	0.29	10.93	0.29	10.93	0.30	11.31	0.30	11.31	0.31	11.69	0.31	11.69	0.30	11.31	0.30	11.31	10.73
7	0.27	11.88	0.27	11.88	0.27	11.88	0.27	11.88	0.28	12.32	0.28	12.32	0.27	11.88	0.27	11.88	11.37
8	0.25	12.57	0.25	12.57	0.25	12.57	0.25	12.57	0.26	13.07	0.27	13.57	0.25	12.57	0.25	12.57	12.10
9	0.23	13.01	0.23	13.01	0.23	13.01	0.23	13.01	0.24	13.57	0.24	13.57	0.24	13.57	0.24	13.57	12.61
10	0.21	13.19	0.21	13.19	0.22	13.82	0.22	13.82	0.23	14.45	0.23	14.45	0.22	13.82	0.22	13.82	13.11

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. Depth

Average Resistivity in Ω - m

KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

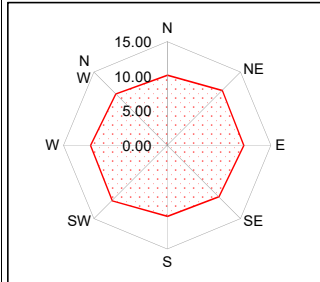
ERT No. : 32

Date : 00-01-1900

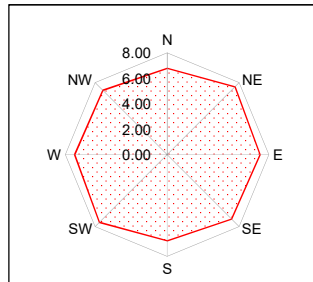
Test Location : E 929, N 2555

Name of Project : NTTTP

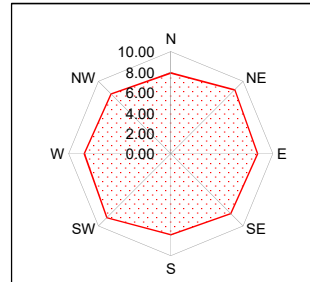
Depth 1 m



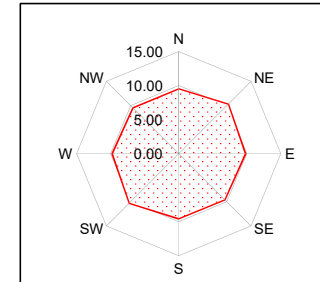
Depth 2 m



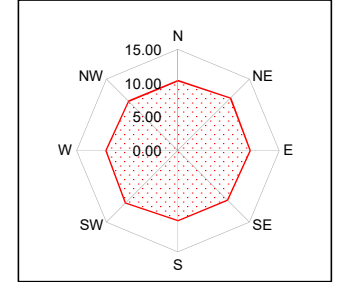
Depth 3 m



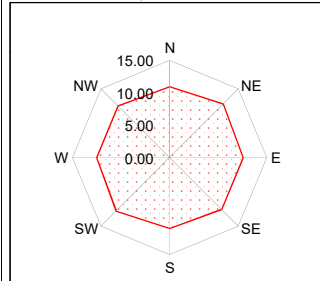
Depth 4 m



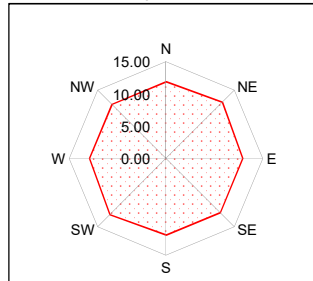
Depth 5 m



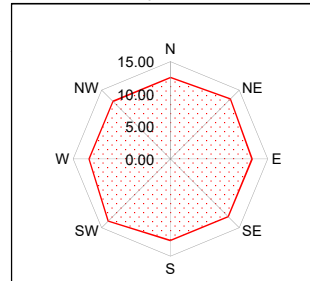
Depth 6 m



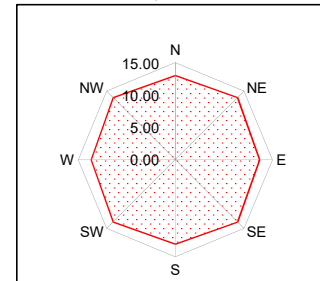
Depth 7 m



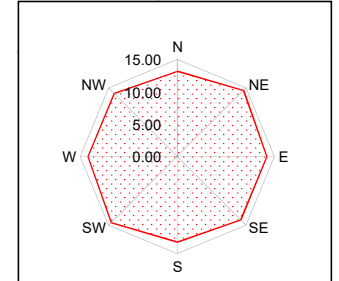
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	328.33	146.30	198.88	271.65	317.91	361.63	406.19	459.98	499.19	540.08
Radius of the circle having same area as polar diagram	10.22	6.82	7.96	9.30	10.06	10.73	11.37	12.10	12.61	13.11

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad**RESULTS OF ELECTRICAL RESISTIVITY TEST**
(IS : 3043, 1987)

ERT No. : ERT33
Name of Project : NTPP
Co-ordinates E 1439 , N 2565 RL: 204.50m

Date: 06-05-2025
Battery Condition : Good
Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

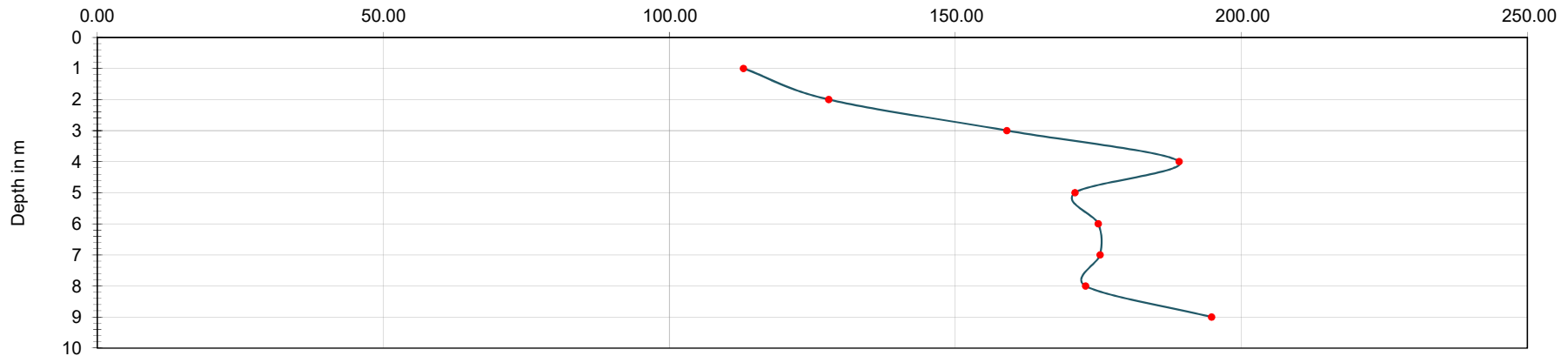
R = V // in ohm (Ω)

V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	18.61	116.93	18.63	117.06	19.30	121.27	19.32	121.39	20.90	131.32	20.93	131.51	18.45	115.92	15.47	97.20	112.98
2	11.10	139.49	11.12	139.74	10.65	133.83	10.66	133.96	10.54	132.45	10.55	132.58	10.59	133.08	10.60	133.20	127.87
3	8.92	168.14	8.94	168.52	8.60	162.11	8.61	162.29	8.57	161.54	8.59	161.92	9.45	178.13	9.46	178.32	159.02
4	7.34	184.47	7.35	184.73	7.76	195.03	7.76	195.03	8.34	209.61	8.35	209.86	8.31	208.85	8.32	209.10	189.14
5	5.78	181.58	5.79	181.90	5.86	184.10	5.87	184.41	5.91	185.67	5.92	185.98	5.37	168.70	5.38	169.02	170.92
6	4.54	171.15	4.55	171.53	4.86	183.22	4.88	183.97	5.55	209.23	5.57	209.98	4.60	173.42	4.62	174.17	175.00
7	3.95	173.73	3.97	174.61	3.95	173.73	3.95	173.73	4.60	202.32	4.62	203.20	4.31	189.56	4.32	190.00	175.31
8	3.74	187.99	3.75	188.50	3.76	189.00	3.77	189.50	3.61	181.46	3.66	168.89	3.50	175.93	3.51	176.43	172.77
9	3.44	194.53	3.45	195.09													194.81
10																	

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.As observations could not be taken in 8 directions due to site constraints, average resistivity was calculated by arithmetic mean in those cases.

Average Resistivity V/S. DepthAverage Resistivity in Ω - m

KCT Consultancy Services, Ahmedabad

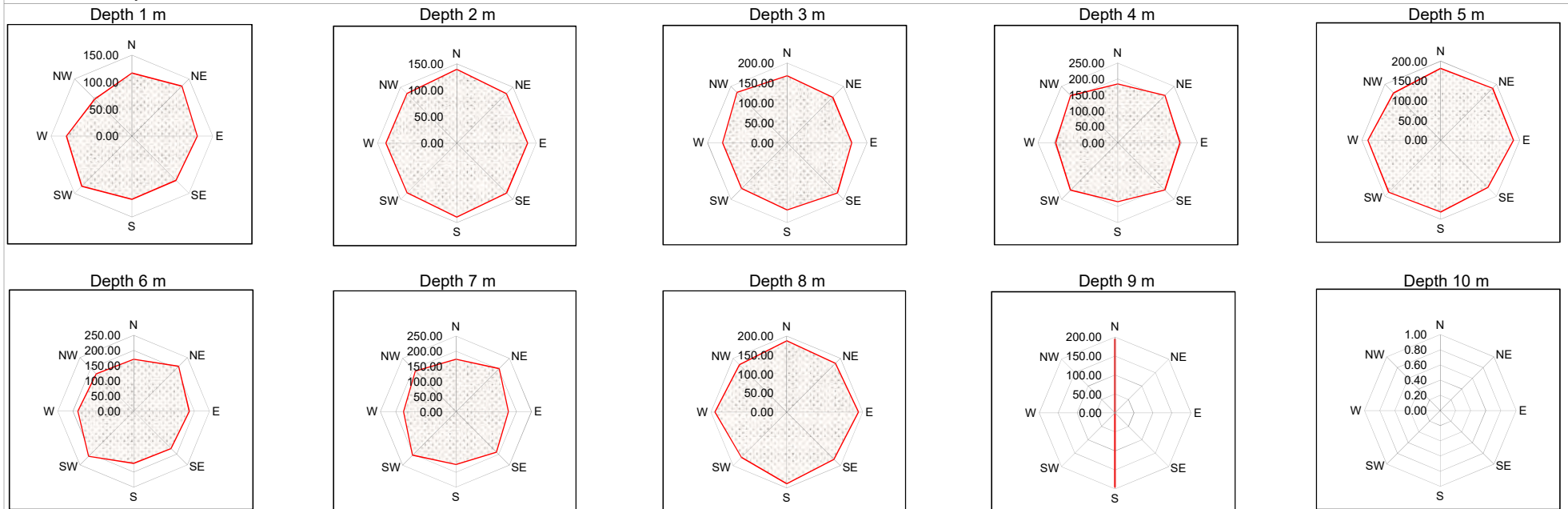
POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

ERT No. : ERT33
Name of Project : NTTTP

Date : 00-01-1900

Test Location : E 1646 , N 2565 RL: 204.50m



Depth of resistivity in m	1	2	3	4	5	6	7	8		
Area of the polar diagram	40097.26	51369.20	79440.83	112381.51	91778.13	96210.80	96551.77	93770.43		
Radius of the circle having same area as polar diagram	112.98	127.87	159.02	189.14	170.92	175.00	175.31	172.77		

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

2) Observations could not be taken in all 8 directions due to site constraints and therefore full polar diagrams are not plotted for all that depths and not tabulated above.

KCT Consultancy Services, Ahmedabad**RESULTS OF ELECTRICAL RESISTIVITY TEST****(IS : 3043, 1987)**

ERT No. : ERT34
 Name of Project : NTPP
 Co-ordinates E 1502 , N 2503 RL: 205.52m

Date: 06-05-2025
 Battery Condition : Good
 Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

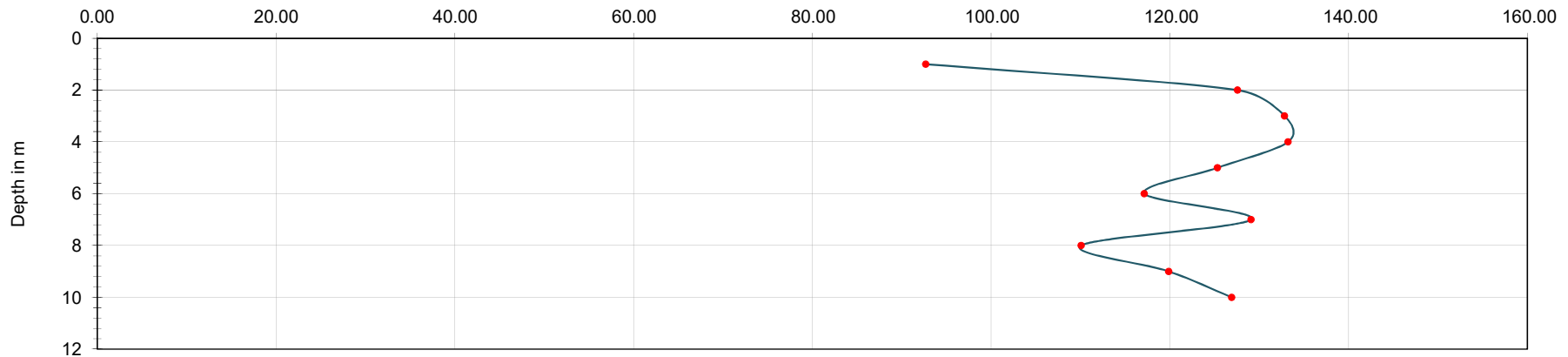
R = V // in ohm (Ω)

V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	17.38	109.20	17.37	109.14	17.28	108.57	17.27	108.51	13.12	82.44	13.13	82.50	14.78	92.87	14.79	92.93	92.69
2	10.92	137.22	10.93	137.35	10.25	128.81	10.26	128.93	10.85	136.35	10.87	136.60	10.75	135.09	10.77	135.34	127.57
3	7.05	132.89	7.07	133.27	6.18	116.49	6.20	116.87	7.91	149.10	7.92	149.29	8.74	164.75	8.74	164.75	132.84
4	5.89	148.03	5.90	148.28	4.93	123.90	4.93	123.90	5.70	143.26	5.71	143.51	5.82	146.27	5.84	146.78	133.23
5	4.39	137.92	4.41	138.54	3.51	110.27	3.52	110.58	4.31	135.40	4.31	135.40	4.62	145.14	4.63	145.46	125.33
6	3.31	124.78	3.33	125.54	2.98	112.34	2.99	112.72	3.27	123.28	3.28	123.65	3.52	132.70	3.54	133.45	117.14
7					2.78	122.27	2.78	122.27					3.08	135.47	3.10	136.35	129.09
8					2.18	109.58	2.20	110.58									110.08
9					2.12	119.88	2.12	119.88									119.88
10					2.02	126.92	2.02	126.92									126.92

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043. As observations could not be taken in 8 directions due to site constraints, average resistivity was calculated by arithmetic mean in those cases.

Average Resistivity V/S. DepthAverage Resistivity in Ω - m

KCT Consultancy Services, Ahmedabad

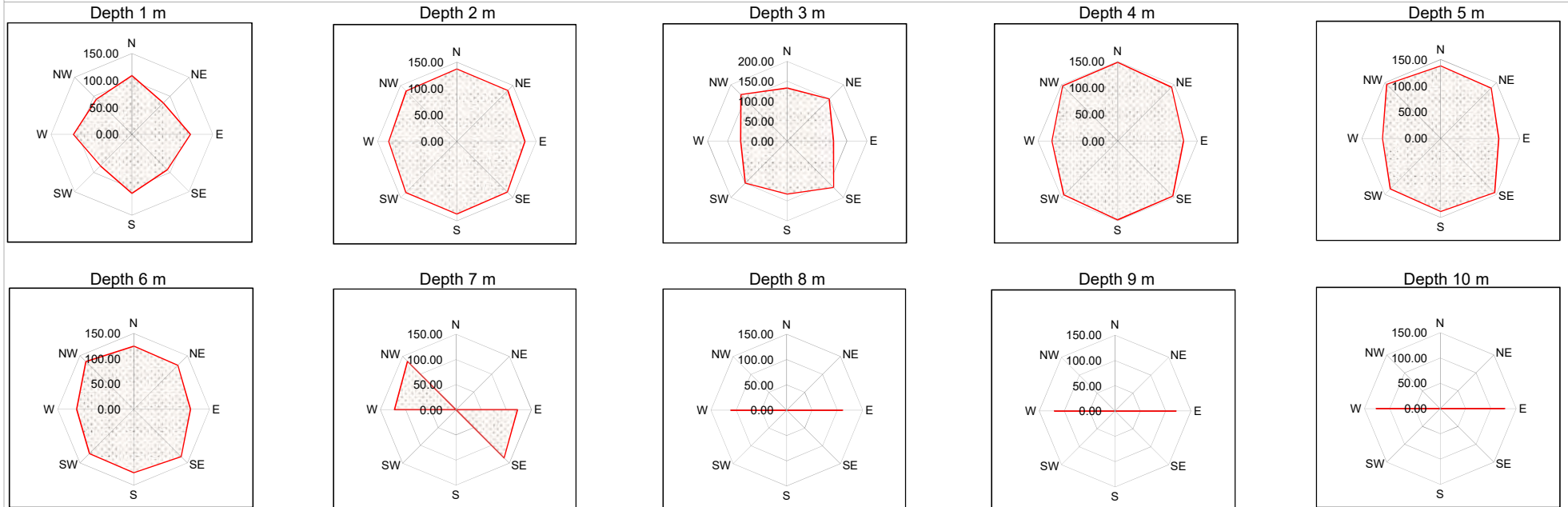
POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

ERT No. : ERT34
Name of Project : NTTTP

Date : 00-01-1900

Test Location : E 1502 , N 2503 RL: 205.52m



Depth of resistivity in m	1	2	3	4	5	6				
Area of the polar diagram	26992.44	51123.54	55434.79	55762.80	49347.42	43111.70				
Radius of the circle having same area as polar diagram	92.69	127.57	132.84	133.23	125.33	117.14				

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

2) Observations could not be taken in all 8 directions due to site constraints and therefore full polar diagrams are not plotted for all that depths and not tabulated above.

KCT Consultancy Services, Ahmedabad

RESULTS OF ELECTRICAL RESISTIVITY TEST

(IS : 3043, 1987)

ERT No. : 35

Name of Project : NTTTP

Co-ordinates E 872, N 2345 RL:198.57m

Date: 18-12-2024

Battery Condition : Good

Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

R = V / I in ohm (Ω)

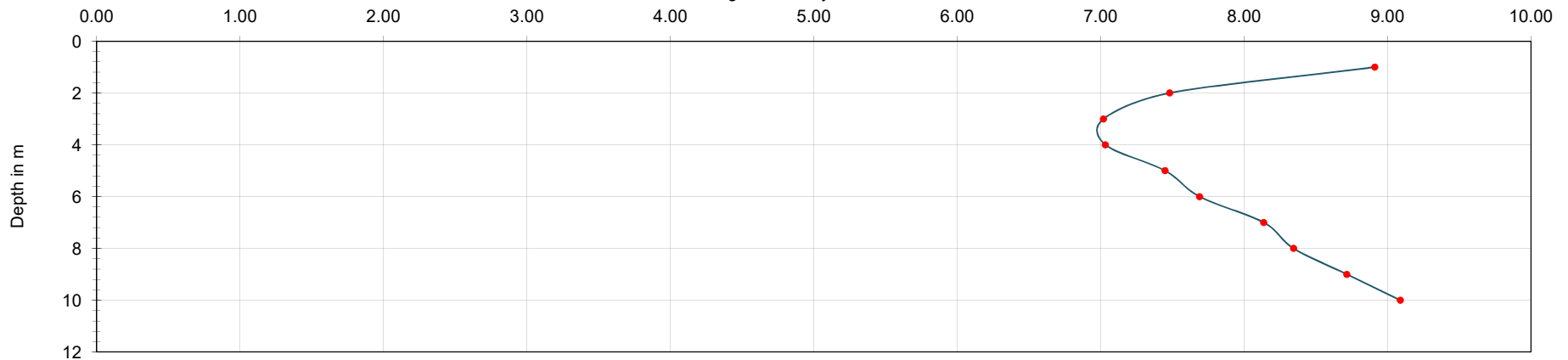
V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	1.52	9.55	1.52	9.55	1.42	8.92	1.42	8.92	1.48	9.30	1.48	9.30	1.56	9.80	1.56	9.80	8.91
2	0.64	8.04	0.64	8.04	0.62	7.79	0.62	7.79	0.60	7.54	0.60	7.54	0.65	8.17	0.65	8.17	7.48
3	0.40	7.54	0.40	7.54	0.39	7.35	0.39	7.35	0.38	7.16	0.38	7.16	0.40	7.54	0.40	7.54	7.02
4	0.31	7.79	0.31	7.79	0.29	7.29	0.29	7.29	0.28	7.04	0.28	7.04	0.30	7.54	0.30	7.54	7.03
5	0.26	8.17	0.26	8.17	0.25	7.85	0.25	7.85	0.24	7.54	0.24	7.54	0.25	7.85	0.25	7.85	7.45
6	0.22	8.29	0.22	8.29	0.21	7.92	0.21	7.92	0.21	7.92	0.21	7.92	0.22	8.29	0.22	8.29	7.69
7	0.20	8.80	0.20	8.80	0.19	8.36	0.19	8.36	0.19	8.36	0.19	8.36	0.20	8.80	0.20	8.80	8.14
8	0.18	9.05	0.18	9.05	0.17	8.55	0.17	8.55	0.17	8.55	0.17	8.55	0.18	9.05	0.18	9.05	8.35
9	0.17	9.61	0.17	9.61	0.16	9.05	0.16	9.05	0.16	9.05	0.16	9.05	0.16	9.05	0.16	9.05	8.72
10	0.16	10.05	0.16	10.05	0.15	9.42	0.15	9.42	0.15	9.42	0.15	9.42	0.15	9.42	0.15	9.42	9.09

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. Depth

Average Resistivity in Ω - m

KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

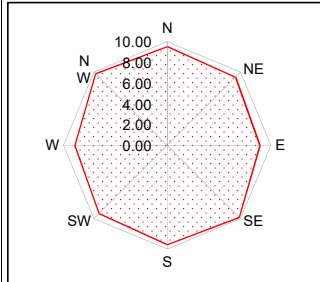
ERT No. : 35

Date : 00-01-1900

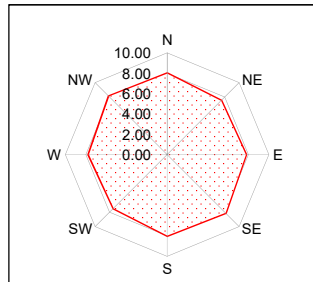
Test Location : E 872, N 2345

Name of Project : NTTTP

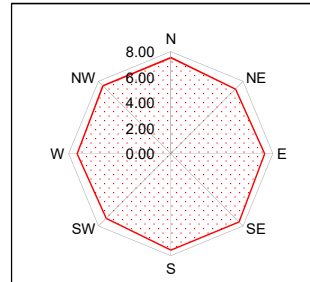
Depth 1 m



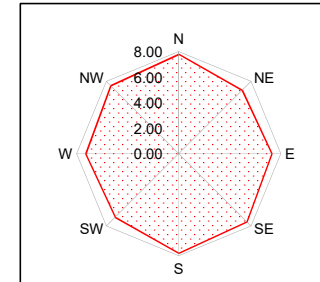
Depth 2 m



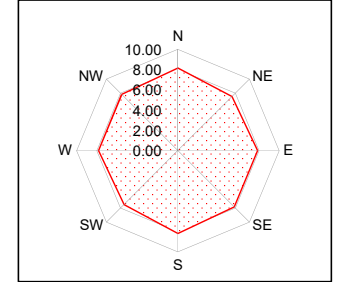
Depth 3 m



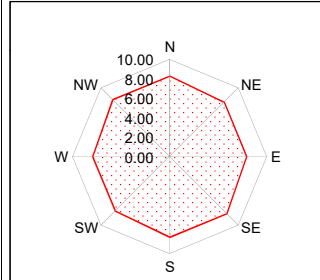
Depth 4 m



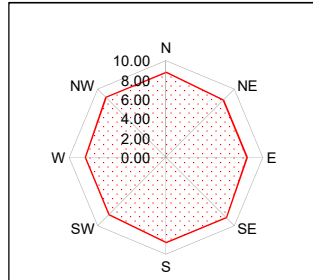
Depth 5 m



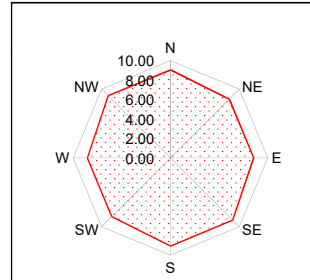
Depth 6 m



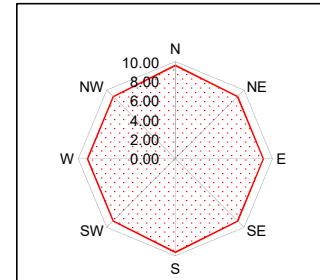
Depth 7 m



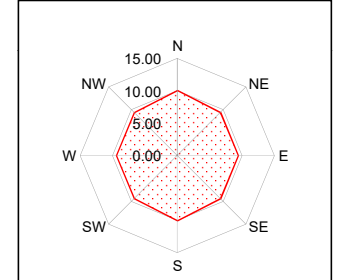
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	249.46	175.84	154.79	155.41	174.38	185.79	208.02	218.82	238.74	259.57
Radius of the circle having same area as polar diagram	8.91	7.48	7.02	7.03	7.45	7.69	8.14	8.35	8.72	9.09

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

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RESULTS OF ELECTRICAL RESISTIVITY TEST (IS : 3043, 1987)

ERT No. : 36
Name of Project : NTPPP
Co-ordinates E 1664, N 2531 RL:204.40m

Date: 22-11-2024
Battery Condition : Good
Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

R = V / I in ohm (Ω)

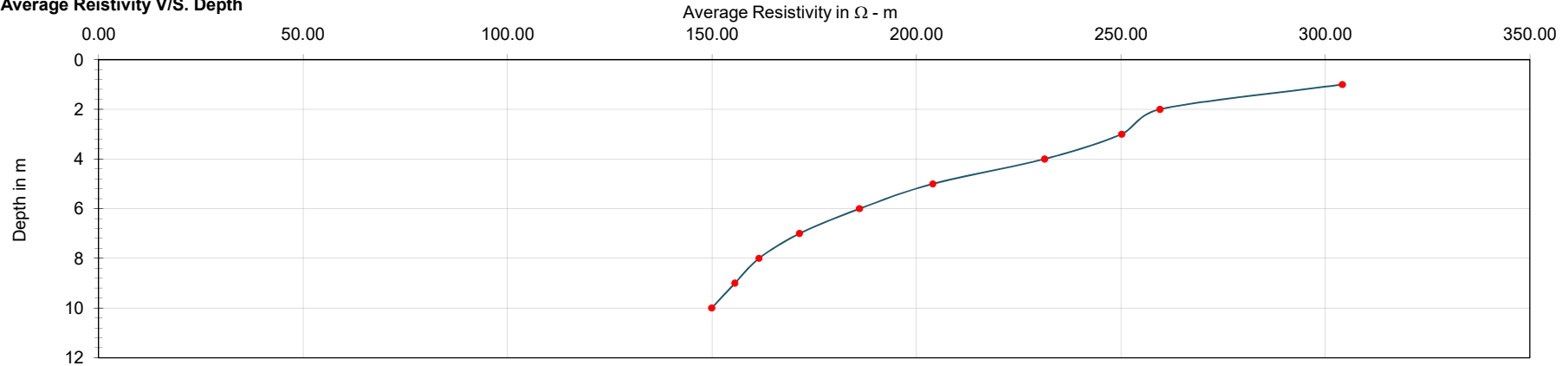
V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	51.06	320.82	51.09	321.01	49.48	310.89	49.52	311.14	51.39	322.89	51.43	323.14	52.09	327.29	52.13	327.54	304.14
2	22.42	281.74	22.45	282.12	20.65	259.50	20.68	259.87	21.29	267.54	21.32	267.92	22.65	284.63	22.68	285.01	259.51
3	14.01	264.08	14.04	264.65	13.70	258.24	13.73	258.80	13.93	262.57	13.93	262.57	14.28	269.17	14.30	269.55	250.19
4	9.80	246.30	9.83	247.05	9.36	235.24	9.39	236.00	9.70	243.79	9.73	244.54	9.89	248.56	9.92	249.32	231.35
5	6.87	215.83	6.90	216.77	6.69	210.17	6.71	210.80	6.81	213.94	6.84	214.88	6.95	218.34	6.98	219.28	203.98
6	5.21	196.41	5.24	197.54	5.08	191.51	5.10	192.27	5.18	195.28	5.21	196.41	5.29	199.43	5.31	200.18	186.08
7	4.10	180.33	4.13	181.65	4.02	176.81	4.05	178.13	4.10	180.33	4.13	181.65	4.15	182.53	4.18	183.85	171.40
8	3.38	169.90	3.41	171.41	3.33	167.38	3.35	168.39	3.36	168.89	3.38	169.90	3.43	172.41	3.45	173.42	161.49
9	2.90	163.99	2.92	165.12	2.85	161.16	2.88	162.86	2.88	162.86	2.90	163.99	2.92	165.12	2.95	166.82	155.59
10	2.51	157.71	2.53	158.96	2.48	155.82	2.51	157.71	2.46	154.57	2.49	156.45	2.56	160.85	2.58	162.11	149.93

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. Depth



KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

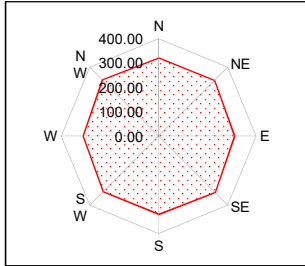
ERT No. : 36

Date : 00-01-1900

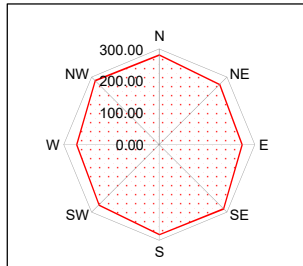
Test Location : E 1664, N 2531

Name of Project : NTPP

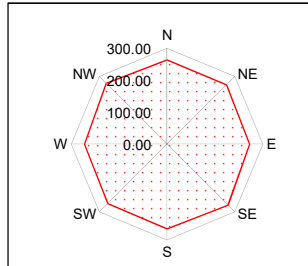
Depth 1 m



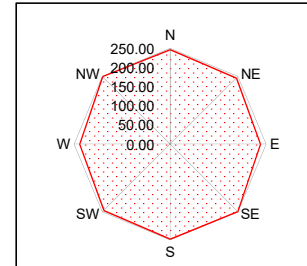
Depth 2 m



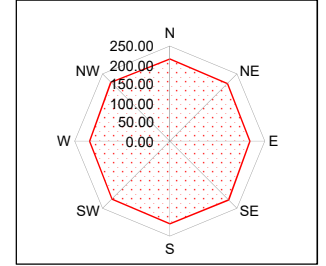
Depth 3 m



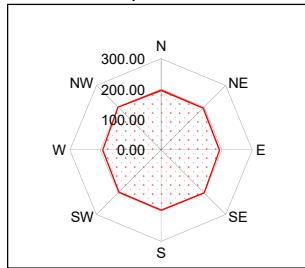
Depth 4 m



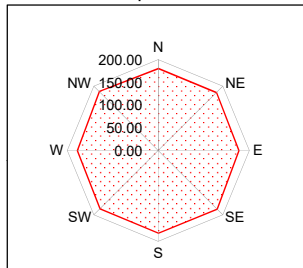
Depth 5 m



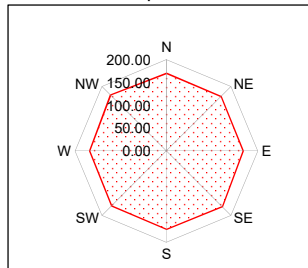
Depth 6 m



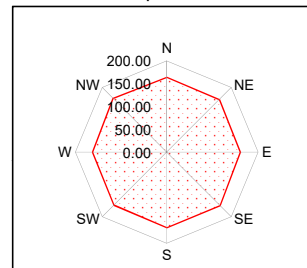
Depth 7 m



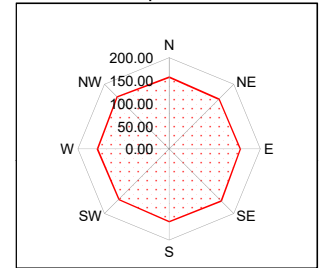
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	290598.58	211579.20	196646.00	168141.00	130720.52	108776.39	92292.43	81930.52	76052.99	70618.51
Radius of the circle having same area as polar diagram	304.14	259.51	250.19	231.35	203.98	186.08	171.40	161.49	155.59	149.93

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

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RESULTS OF ELECTRICAL RESISTIVITY TEST

(IS : 3043, 1987)

ERT No. : 37

Name of Project : NTTTP

Co-ordinates E 1510, N 2262 RL:200.90m

Date: 22-11-2024

Battery Condition : Good

Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

R = V / I in ohm (Ω)

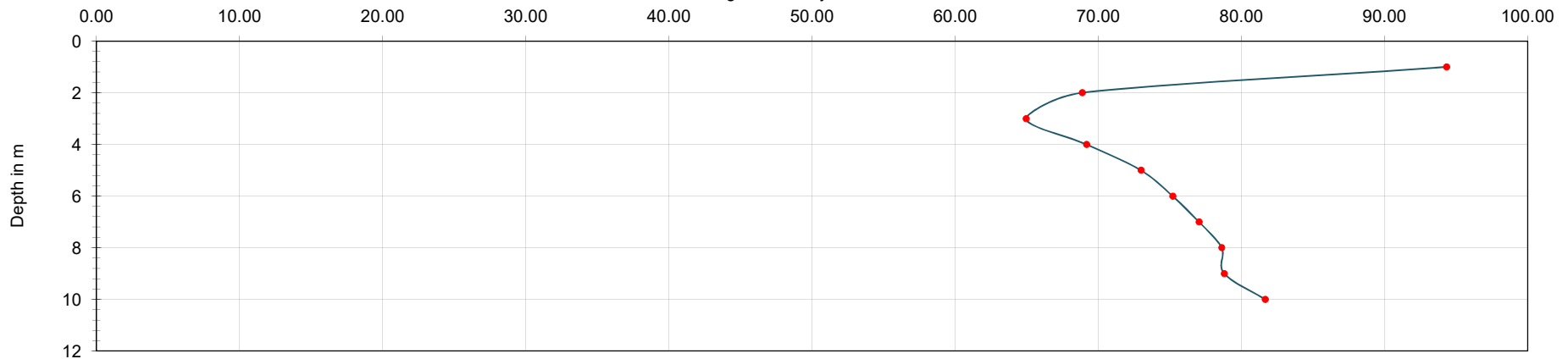
V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	15.26	95.88	15.29	96.07	16.01	100.59	16.05	100.85	15.61	98.08	15.65	98.33	16.36	102.79	16.39	102.98	94.35
2	5.60	70.37	5.63	70.75	5.71	71.75	5.74	72.13	5.80	72.88	5.84	73.39	5.94	74.64	5.97	75.02	68.89
3	3.55	66.92	3.58	67.48	3.60	67.86	3.63	68.42	3.54	66.73	3.57	67.29	3.78	71.25	3.81	71.82	64.96
4	2.86	71.88	2.88	72.38	2.90	72.88	2.93	73.64	2.80	70.37	2.83	71.13	2.99	75.15	3.02	75.90	69.18
5	2.41	75.71	2.44	76.65	2.43	76.34	2.46	77.28	2.38	74.77	2.40	75.40	2.52	79.17	2.55	80.11	72.99
6	2.07	78.04	2.09	78.79	2.10	79.17	2.12	79.92	2.01	75.78	2.04	76.91	2.18	82.18	2.21	83.32	75.20
7	1.81	79.61	1.83	80.49	1.85	81.37	1.87	82.25	1.78	78.29	1.81	79.61	1.90	83.57	1.92	84.45	77.04
8	1.63	81.93	1.65	82.94	1.65	82.94	1.67	83.94	1.58	79.42	1.60	80.42	1.69	84.95	1.72	86.46	78.63
9	1.46	82.56	1.48	83.69	1.45	82.00	1.48	83.69	1.42	80.30	1.44	81.43	1.50	84.82	1.52	85.95	78.80
10	1.37	86.08	1.39	87.34	1.35	84.82	1.37	86.08	1.31	82.31	1.33	83.57	1.41	88.59	1.43	89.85	81.67

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. Depth

Average Resistivity in Ω - m

KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

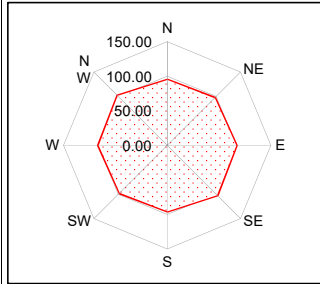
ERT No. : 37

Date : 00-01-1900

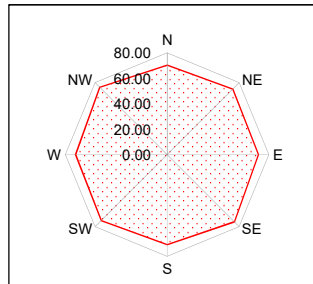
Test Location : E 1510, N 2262

Name of Project : NTTTP

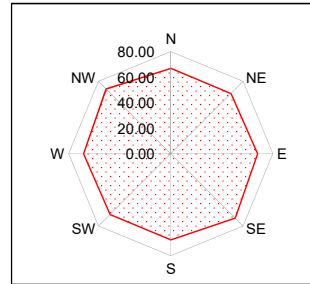
Depth 1 m



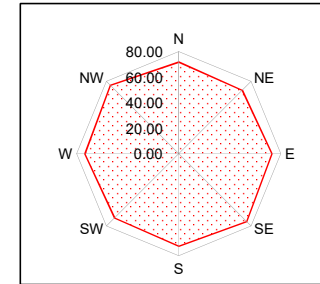
Depth 2 m



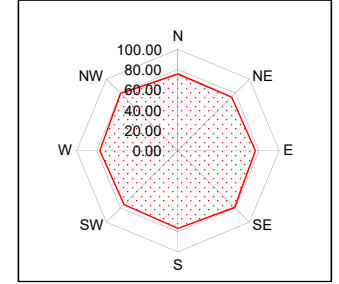
Depth 3 m



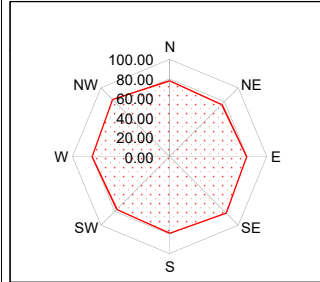
Depth 4 m



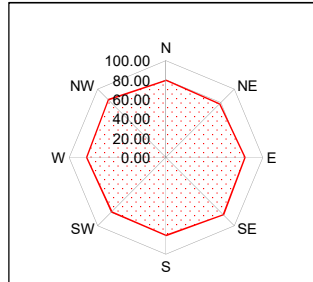
Depth 5 m



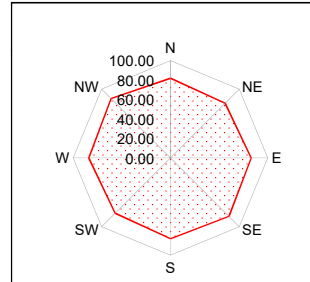
Depth 6 m



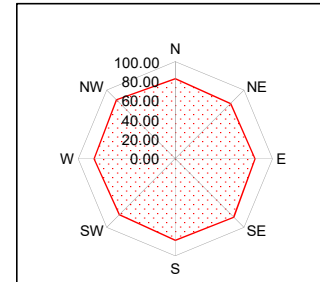
Depth 7 m



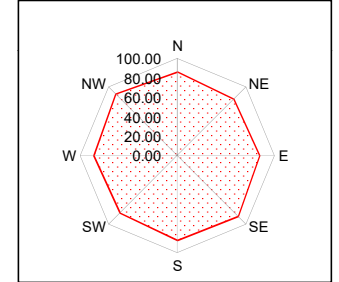
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	27964.76	14907.85	13256.75	15035.96	16736.31	17767.06	18647.51	19423.90	19508.99	20955.20
Radius of the circle having same area as polar diagram	94.35	68.89	64.96	69.18	72.99	75.20	77.04	78.63	78.80	81.67

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad

RESULTS OF ELECTRICAL RESISTIVITY TEST (IS : 3043, 1987)

ERT No. : IERT01
Name of Project : NTPP
Co-ordinates E 1081, N 3739 RL:198.64m

Date: 24-11-2024
Battery Condition : Good
Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - $22 / 7$

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

 $R = V / I$ in ohm (Ω)

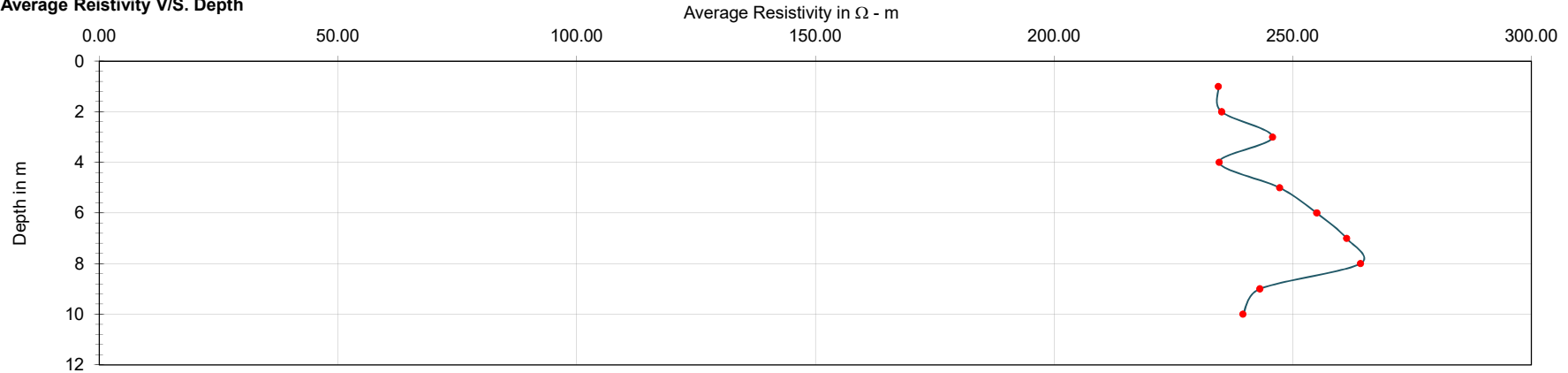
V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	40.93	257.17	40.99	257.55	37.31	234.43	37.40	234.99	39.98	251.20	40.01	251.39	38.95	244.73	39.00	245.04	234.41
2	20.40	256.35	20.09	252.46	19.08	239.77	19.15	240.65	19.54	245.55	19.56	245.80	19.93	250.45	20.00	251.33	235.10
3	13.99	263.71	13.99	263.71	13.04	245.80	13.10	246.93	14.14	266.53	14.15	266.72	13.77	259.56	13.78	259.75	245.79
4	9.94	249.82	9.99	251.08	9.38	235.75	9.40	236.25	9.98	250.82	10.00	251.33	10.01	251.58	10.02	251.83	234.61
5	7.73	242.85	7.81	245.36	8.05	252.90	8.11	254.78	8.53	267.98	8.53	267.98	8.83	277.40	8.84	277.72	247.25
6	5.97	225.06	6.02	226.95	7.00	263.89	7.09	267.29	7.60	286.51	7.62	287.27	7.97	300.46	8.00	301.59	255.03
7	4.93	216.83	4.98	219.03	6.96	306.12	6.28	276.21	6.98	307.00	7.10	312.23	6.51	286.32	6.51	286.32	261.28
8	4.21	211.62	4.31	216.64	6.23	313.15	6.24	313.66	6.35	319.19	6.37	320.19	5.33	267.92	5.34	268.42	264.18
9	3.74	211.49	3.87	218.84	5.03	284.44	5.04	285.01	5.26	297.45	5.30	299.71	4.00	226.19	4.02	227.33	243.10
10	3.40	213.63	3.52	221.17	4.21	264.52	4.25	267.04	4.54	285.26	4.55	285.88	3.85	241.90	3.86	242.53	239.56

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. Depth



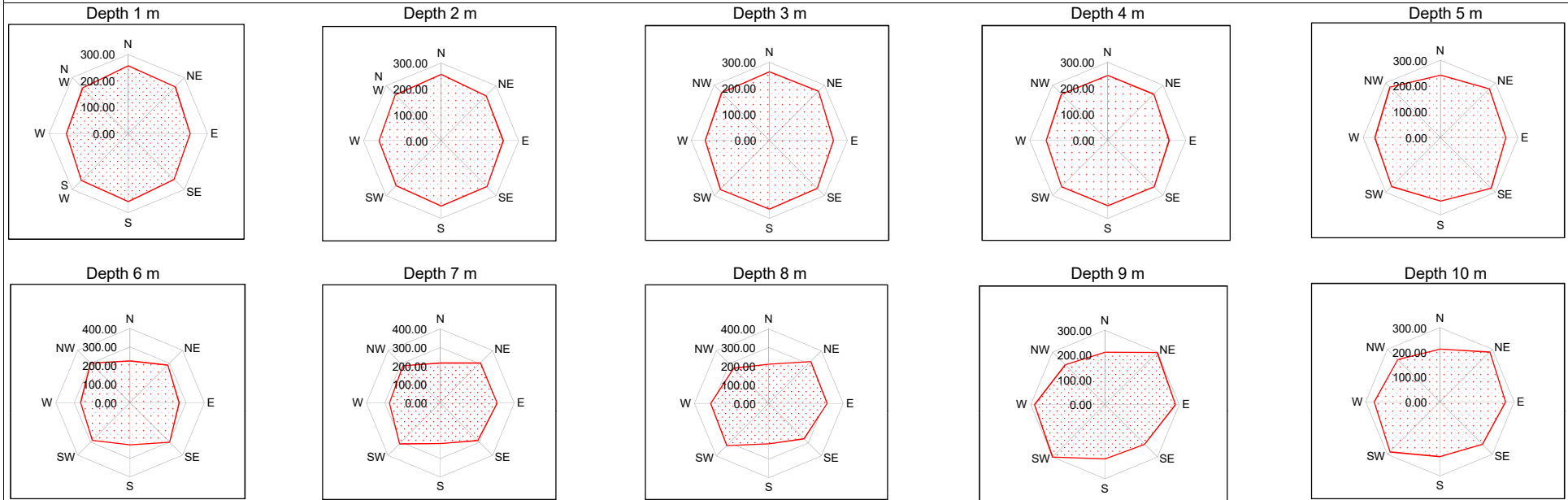
KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS
(IS : 3043, 1987)

ERT No. : IERT01
Name of Project : NTTTP

Date : 00-01-1900

Test Location : E 1081, N 3739



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	172618.11	173643.18	189786.38	172914.40	192053.90	204336.88	214470.52	219251.69	185667.71	180296.01
Radius of the circle having same area as polar diagram	234.41	235.10	245.79	234.61	247.25	255.03	261.28	264.18	243.10	239.56

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad

RESULTS OF ELECTRICAL RESISTIVITY TEST

(IS : 3043, 1987)

ERT No. : IERT02

Name of Project : NTTTP

Co-ordinates E 1168, N 3296 RL:198.92m

Date: 24-11-2024

Battery Condition : Good

Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

R = V / I in ohm (Ω)

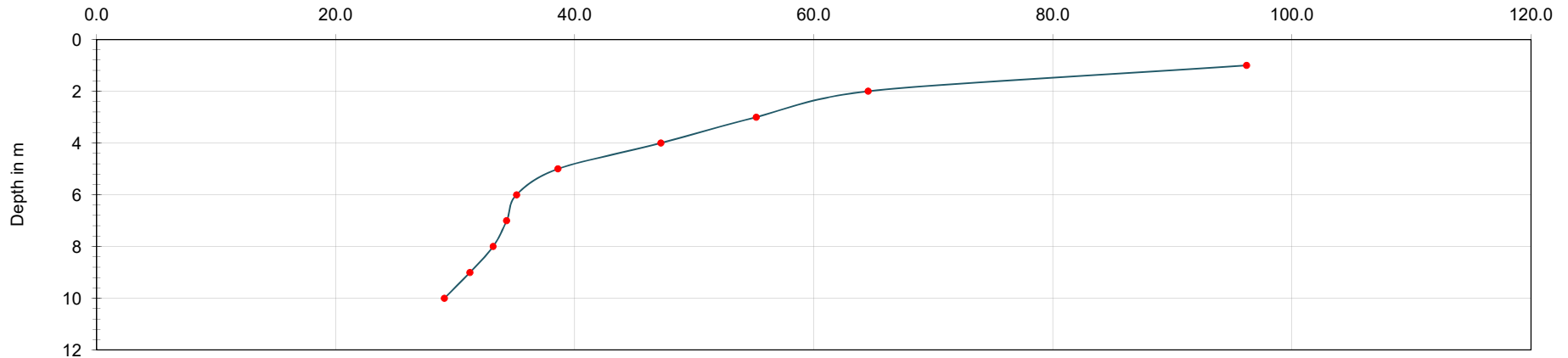
V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	16.80	105.56	16.89	106.12	15.78	99.15	15.80	99.27	15.92	100.03	15.94	100.15	15.98	100.41	16.00	100.53	96.2
2	5.37	67.48	5.38	67.61	5.40	67.86	5.42	68.11	5.45	68.49	5.47	68.74	5.40	67.86	5.42	68.11	64.5
3	3.59	67.67	3.60	67.86	2.80	52.78	2.88	54.29	2.90	54.66	2.90	54.66	3.00	56.55	3.04	57.30	55.2
4	2.17	54.54	2.20	55.29	1.78	44.74	1.80	45.24	1.84	46.24	1.85	46.50	2.09	52.53	2.11	53.03	47.2
5	1.48	46.50	1.50	47.12	1.25	39.27	1.27	39.90	1.28	40.21	1.30	40.84	1.18	37.07	1.12	35.19	38.6
6	1.05	39.58	1.09	41.09	0.89	33.55	0.92	34.68	0.93	35.06	0.96	36.19	0.99	37.32	1.03	38.83	35.1
7	0.82	36.07	0.85	37.38	0.77	33.87	0.79	34.75	0.80	35.19	0.81	35.63	0.85	37.38	0.89	39.14	34.3
8	0.67	33.68	0.70	35.19	0.65	32.67	0.67	33.68	0.69	34.68	0.70	35.19	0.74	37.20	0.75	37.70	33.2
9	0.54	30.54	0.55	31.10	0.58	32.80	0.60	33.93	0.58	32.80	0.59	33.36	0.60	33.93	0.62	35.06	31.2
10	0.49	30.79	0.49	30.79	0.43	27.02	0.45	28.27	0.45	28.27	0.47	29.53	0.54	33.93	0.59	37.07	29.1

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. Depth

Average Resistivity in Ω - m

KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

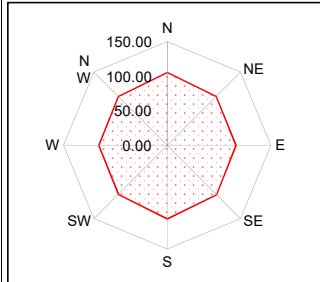
ERT No. : IERT02

Date : 00-01-1900

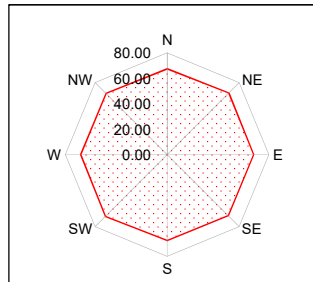
Test Location : E 1168, N 3296

Name of Project : NTTTP

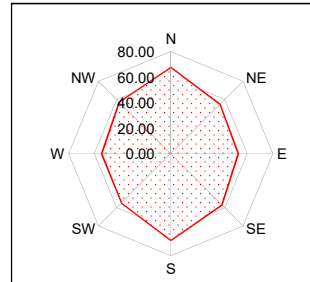
Depth 1 m



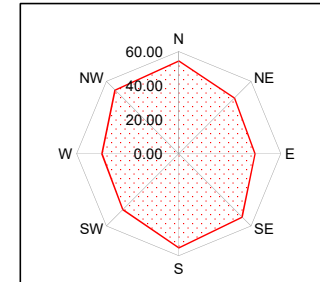
Depth 2 m



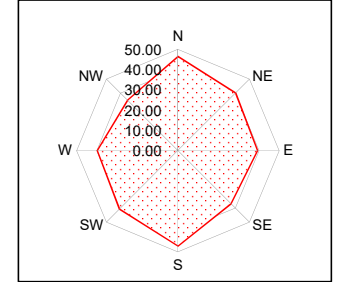
Depth 3 m



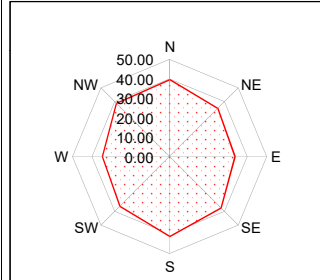
Depth 4 m



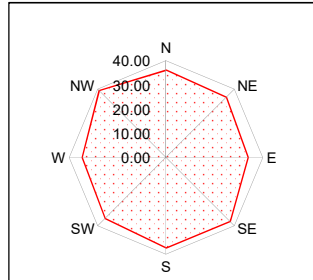
Depth 5 m



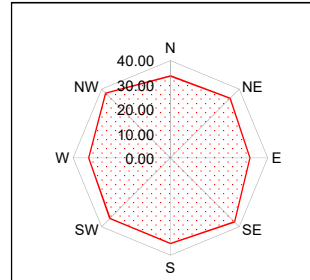
Depth 6 m



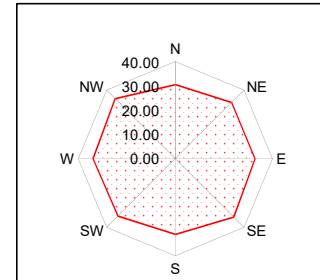
Depth 7 m



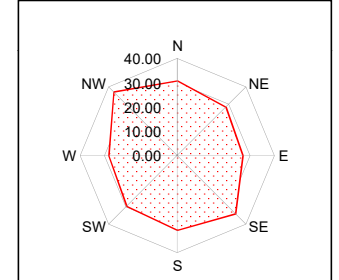
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	29075.40	13088.49	9569.73	7003.02	4682.25	3880.10	3699.70	3459.92	3066.68	2661.62
Radius of the circle having same area as polar diagram	96.20	64.55	55.19	47.21	38.61	35.14	34.32	33.19	31.24	29.11

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad

RESULTS OF ELECTRICAL RESISTIVITY TEST

(IS : 3043, 1987)

ERT No. : IERT03

Name of Project : NTTTP

Co-ordinates E 1085, N 3353 RL:197.81m

Date: 05-12-2024

Battery Condition : Good

Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

R = V / I in ohm (Ω)

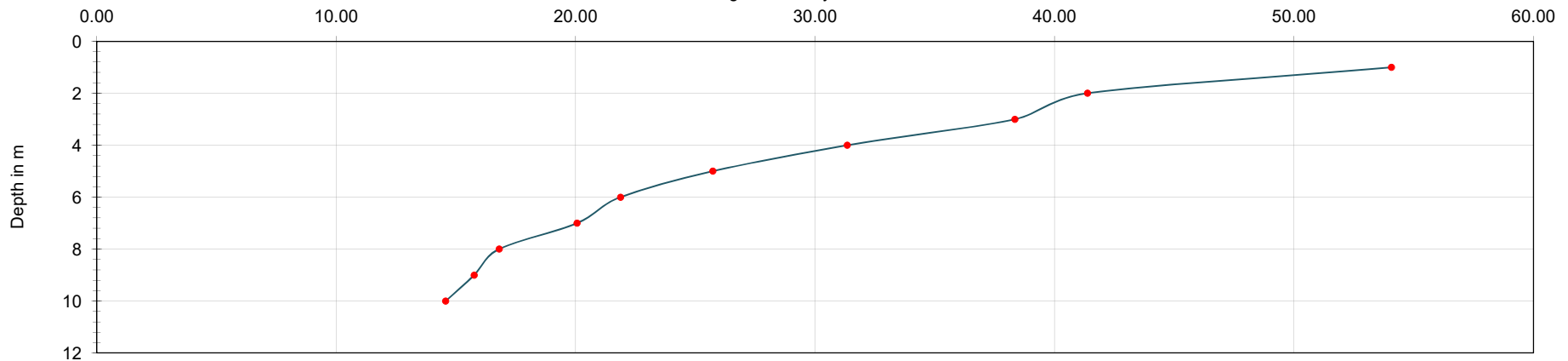
V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	8.95	56.23	8.99	56.49	8.41	52.84	8.45	53.09	5.54	34.81	9.56	60.07	11.34	71.25	11.37	71.44	54.07
2	3.59	45.11	3.61	45.36	2.90	36.44	2.90	36.44	3.82	48.00	3.83	48.13	3.58	44.99	3.59	45.11	41.37
3	2.06	38.83	2.07	39.02	1.87	35.25	1.88	35.44	2.14	40.34	2.14	40.34	2.51	47.31	2.54	47.88	38.34
4	1.20	30.16	1.22	30.66	1.27	31.92	1.29	32.42	1.30	32.67	1.30	32.67	1.47	36.95	1.48	37.20	31.34
5	0.77	24.19	0.79	24.82	0.84	26.39	0.84	26.39	0.87	27.33	0.89	27.96	0.96	30.16	0.96	30.16	25.73
6	0.55	20.73	0.57	21.49	0.59	22.24	0.60	22.62	0.59	22.24	0.61	23.00	0.69	26.01	0.70	26.39	21.87
7	0.45	19.79	0.45	19.79	0.46	20.23	0.46	20.23	0.45	19.79	0.47	20.67	0.54	23.75	0.57	25.07	20.05
8	0.36	18.10	0.37	18.60	0.31	15.58	0.32	16.08	0.31	15.58	0.33	16.59	0.41	20.61	0.41	20.61	16.80
9	0.30	16.96	0.30	16.96	0.29	16.40	0.31	17.53	0.24	13.57	0.27	15.27	0.32	18.10	0.32	18.10	15.76
10	0.27	16.96	0.29	18.22	0.24	15.08	0.25	15.71	0.21	13.19	0.21	13.19	0.24	15.08	0.25	15.71	14.57

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. Depth

Average Resistivity in Ω - m

KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

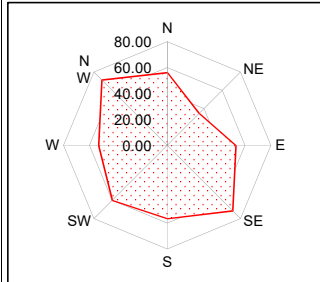
ERT No. : IERT03

Date : 00-01-1900

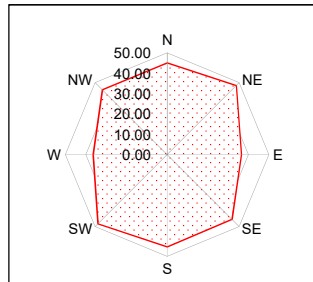
Test Location : E 1085, N 3353

Name of Project : NTTTP

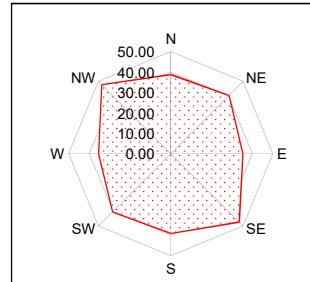
Depth 1 m



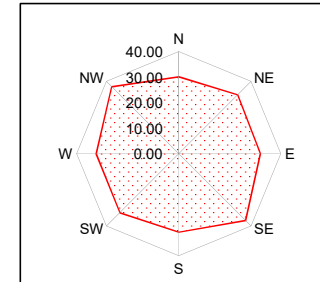
Depth 2 m



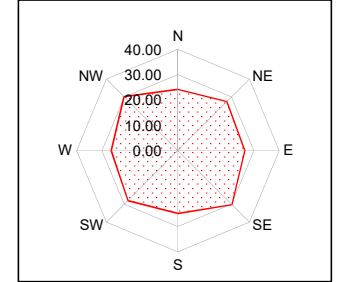
Depth 3 m



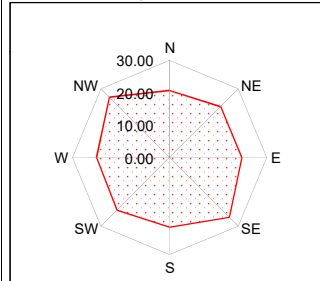
Depth 4 m



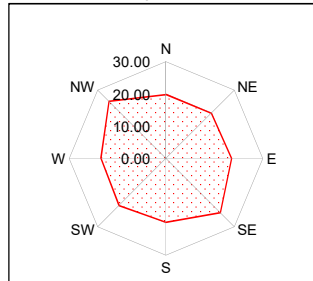
Depth 5 m



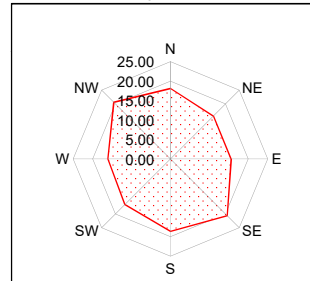
Depth 6 m



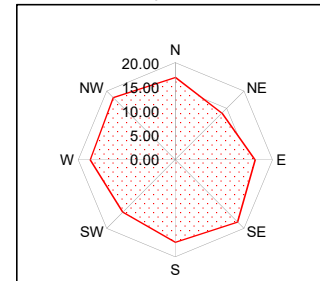
Depth 7 m



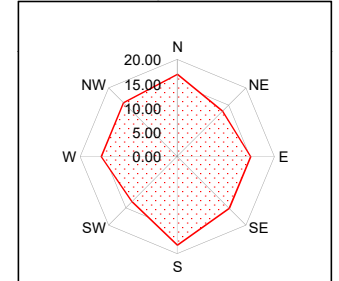
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	9183.56	5377.38	4617.10	3085.76	2080.02	1503.04	1263.23	886.91	780.32	666.66
Radius of the circle having same area as polar diagram	54.07	41.37	38.34	31.34	25.73	21.87	20.05	16.80	15.76	14.57

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad

RESULTS OF ELECTRICAL RESISTIVITY TEST

(IS : 3043, 1987)

ERT No. : IERT04

Name of Project : NTTTP

Co-ordinates E 1127, N 2960 RL:200.40m

Date: 13-12-2024

Battery Condition : Good

Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

R = V / I in ohm (Ω)

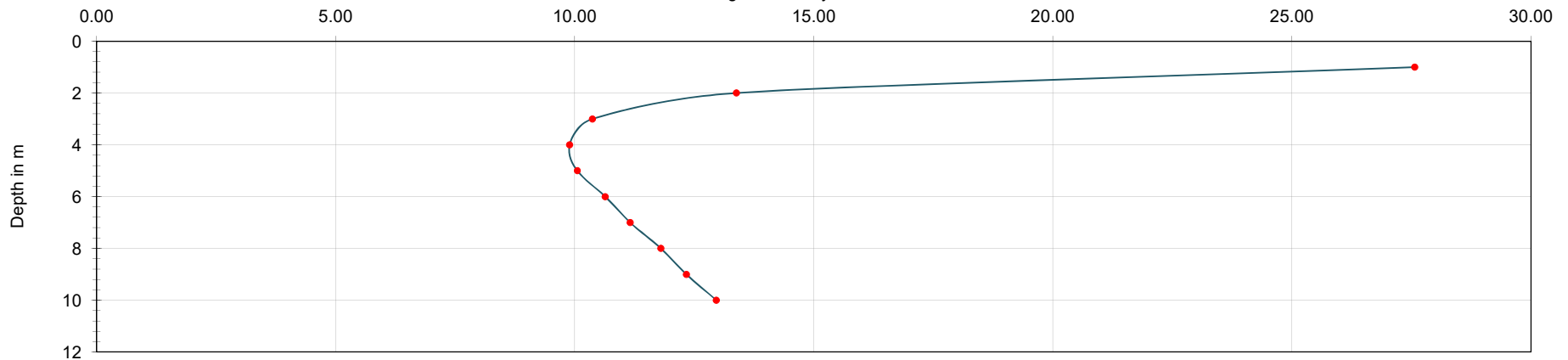
V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	4.49	28.21	4.50	28.27	4.68	29.41	4.69	29.47	4.59	28.84	4.60	28.90	4.72	29.66	4.73	29.72	27.57
2	1.07	13.45	1.08	13.57	1.13	14.20	1.14	14.33	1.10	13.82	1.11	13.95	1.17	14.70	1.18	14.83	13.38
3	0.56	10.56	0.57	10.74	0.58	10.93	0.59	11.12	0.56	10.56	0.57	10.74	0.60	11.31	0.61	11.50	10.37
4	0.40	10.05	0.40	10.05	0.42	10.56	0.42	10.56	0.40	10.05	0.40	10.05	0.44	11.06	0.44	11.06	9.90
5	0.32	10.05	0.32	10.05	0.34	10.68	0.34	10.68	0.33	10.37	0.33	10.37	0.36	11.31	0.36	11.31	10.06
6	0.29	10.93	0.29	10.93	0.30	11.31	0.30	11.31	0.29	10.93	0.29	10.93	0.31	11.69	0.31	11.69	10.64
7	0.26	11.44	0.26	11.44	0.27	11.88	0.27	11.88	0.26	11.44	0.26	11.44	0.28	12.32	0.28	12.32	11.16
8	0.24	12.06	0.24	12.06	0.25	12.57	0.25	12.57	0.24	12.06	0.24	12.06	0.26	13.07	0.26	13.07	11.80
9	0.22	12.44	0.22	12.44	0.23	13.01	0.23	13.01	0.23	13.01	0.23	13.01	0.24	13.57	0.24	13.57	12.34
10	0.21	13.19	0.21	13.19	0.22	13.82	0.22	13.82	0.21	13.19	0.21	13.19	0.23	14.45	0.23	14.45	12.97

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. Depth

Average Resistivity in Ω - m

KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

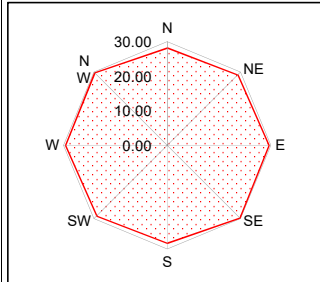
ERT No. : IERT04

Date : 00-01-1900

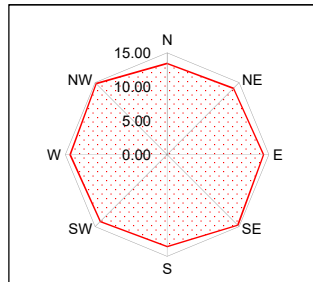
Test Location : E 1127, N 2960

Name of Project : NTTTP

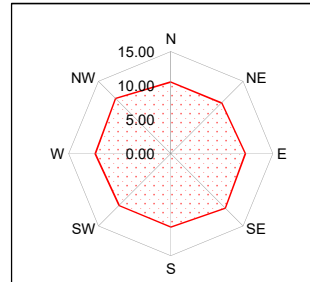
Depth 1 m



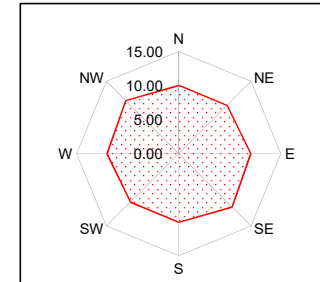
Depth 2 m



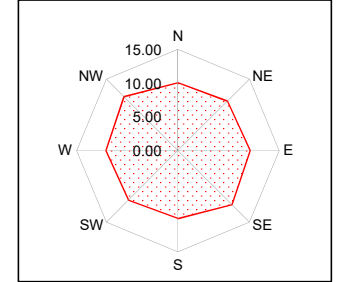
Depth 3 m



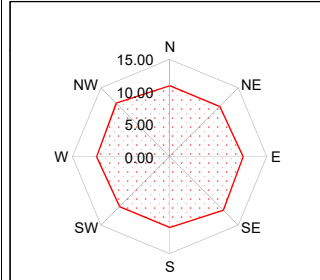
Depth 4 m



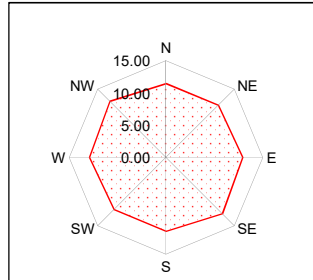
Depth 5 m



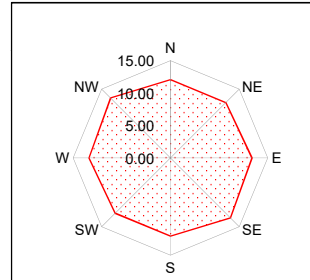
Depth 6 m



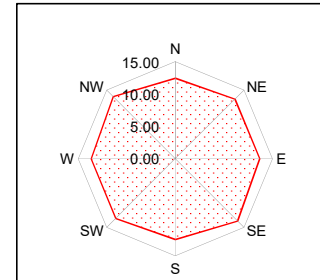
Depth 7 m



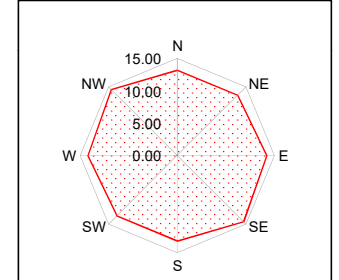
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	2388.02	562.56	338.00	307.60	317.77	355.70	391.42	437.65	478.16	528.08
Radius of the circle having same area as polar diagram	27.57	13.38	10.37	9.90	10.06	10.64	11.16	11.80	12.34	12.97

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

KCT Consultancy Services, Ahmedabad

RESULTS OF ELECTRICAL RESISTIVITY TEST

(IS : 3043, 1987)

ERT No. : IERT-05

Name of Project : NTTTP

Co-ordinates E 831, N 3408 RL:195.90m

Date: 15-12-2024

Battery Condition : Good

Climatic Condition : hot and Dry

Resistivity at given depth $\rho = 2 \pi S R$

Where

 ρ = Resistivity in ohm - m (Ω m) π = Value of pi - 22 / 7

S = Electrode Spacing (equal to the depth at which resistivity is determined) in m

R = V / I in ohm (Ω)

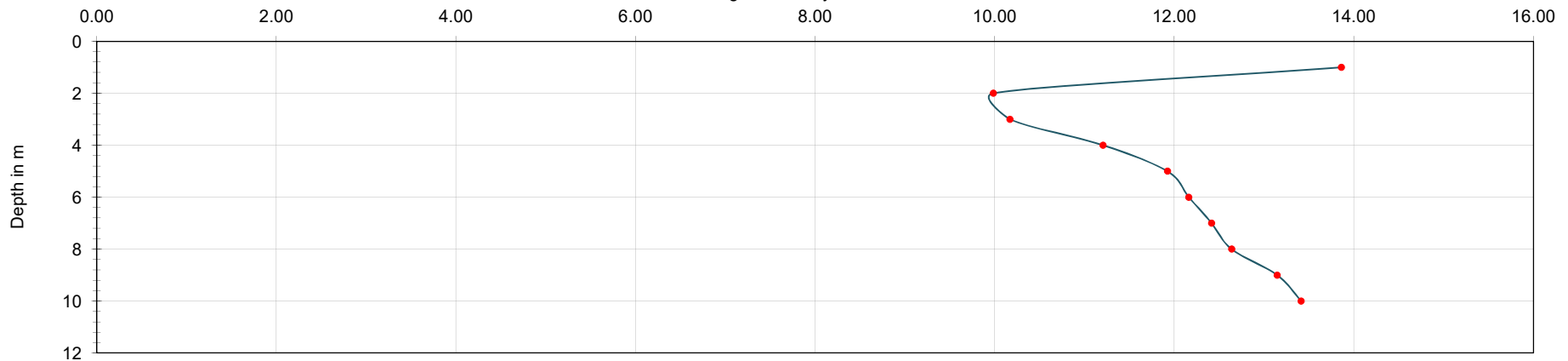
V = Voltage Drop between inner electrodes in Volt

I = Current applied in outer electrodes in Amp.

Spacing of Electrode in (m)	Direction																Average Resistivity (Ω - m)
	N - S				E - W				N E - S W				S E - N W				
	Direct		Reverse		Direct		Reverse		Direct		Reverse		Direct		Reverse		
	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	Resistance Observed in Ω	Resistivity ρ in Ω m	
1	2.24	14.07	2.25	14.14	2.40	15.08	2.41	15.14	2.35	14.77	2.36	14.83	2.29	14.39	2.30	14.45	13.86
2	0.81	10.18	0.82	10.30	0.87	10.93	0.88	11.06	0.85	10.68	0.86	10.81	0.80	10.05	0.81	10.18	9.98
3	0.56	10.56	0.56	10.56	0.59	11.12	0.60	11.31	0.58	10.93	0.58	10.93	0.54	10.18	0.54	10.18	10.17
4	0.46	11.56	0.46	11.56	0.48	12.06	0.48	12.06	0.49	12.32	0.49	12.32	0.45	11.31	0.45	11.31	11.21
5	0.39	12.25	0.39	12.25	0.41	12.88	0.41	12.88	0.42	13.19	0.42	13.19	0.38	11.94	0.38	11.94	11.92
6	0.33	12.44	0.33	12.44	0.35	13.19	0.35	13.19	0.36	13.57	0.36	13.57	0.32	12.06	0.32	12.06	12.16
7	0.29	12.75	0.29	12.75	0.31	13.63	0.31	13.63	0.32	14.07	0.30	13.19	0.28	12.32	0.28	12.32	12.41
8	0.26	13.07	0.26	13.07	0.27	13.57	0.27	13.57	0.28	14.07	0.28	14.07	0.25	12.57	0.25	12.57	12.64
9	0.24	13.57	0.24	13.57	0.25	14.14	0.25	14.14	0.26	14.70	0.26	14.70	0.23	13.01	0.23	13.01	13.14
10	0.22	13.82	0.22	13.82	0.23	14.45	0.23	14.45	0.24	15.08	0.24	15.08	0.21	13.19	0.21	13.19	13.41

Note : Average resistivity is calculated as per clause 36.6 of IS : 3043.

Average Resistivity V/S. Depth

Average Resistivity in Ω - m

KCT Consultancy Services, Ahmedabad

POLAR DIAGRAMS OF ELECTRICAL RESISTIVITY TEST RESULTS

(IS : 3043, 1987)

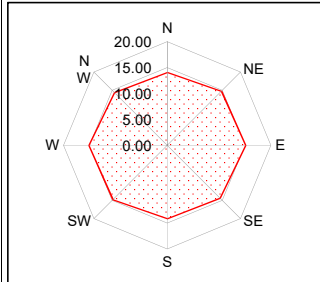
ERT No. : IERT-05

Date : 00-01-1900

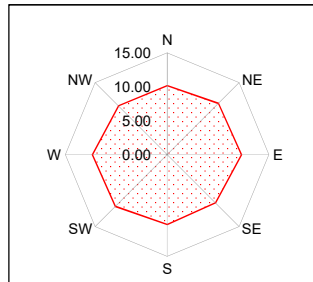
Test Location : E 831, N 3408

Name of Project : NTTTP

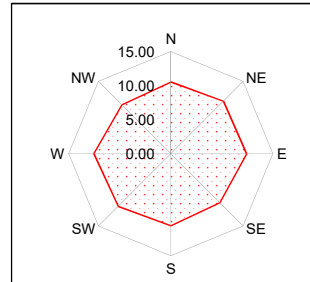
Depth 1 m



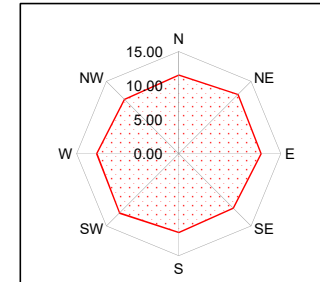
Depth 2 m



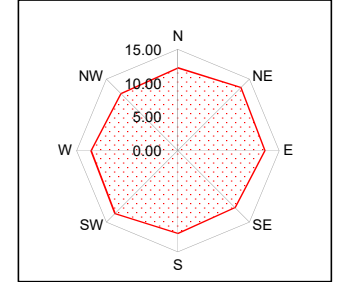
Depth 3 m



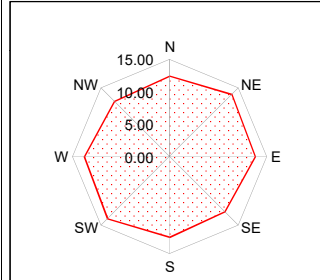
Depth 4 m



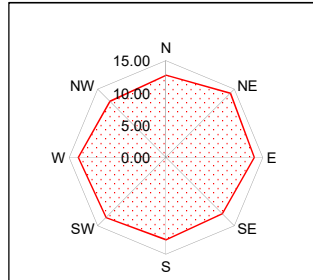
Depth 5 m



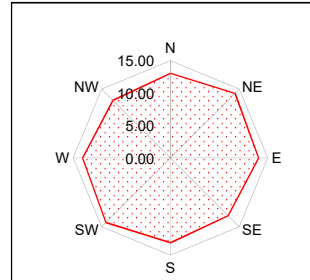
Depth 6 m



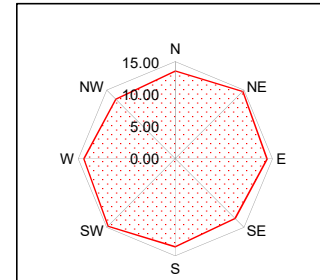
Depth 7 m



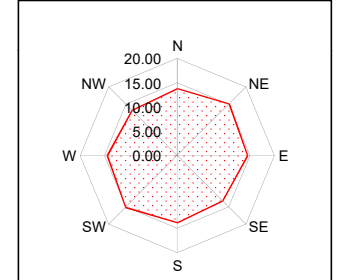
Depth 8 m



Depth 9 m



Depth 10 m



Depth of resistivity in m	1	2	3	4	5	6	7	8	9	10
Area of the polar diagram	603.51	313.21	324.95	394.60	446.58	464.62	484.15	501.78	542.82	565.20
Radius of the circle having same area as polar diagram	13.86	9.98	10.17	11.21	11.92	12.16	12.41	12.64	13.14	13.41

1) Average Resistivity at a given depth shall be equal to the radius of equivalent area circle having same area as that of polar diagram at that level. (Ref: Clause 36.6 of IS: 3043).

5. Pump in Type field Permeability Test

5.1 Methodology

The field permeability is required for several engineering problems, such as design of cut off wall for earth dam, calculation of pumping capacity for dewatering excavations and determination of aquifer constants of subsurface strata.

The coefficient of permeability is evaluated on the basis of Darcy's law which states that the rate of flow through a porous media is proportional to the hydraulic gradient.

The method in which the water level in the test hole is allowed to fall and the equivalent permeability is computed from the data of rate of fall of the water level.

Drill a hole up to the level of the test depth and clean the hole. Insert the casing of 150 / 78mm dia. above the test depth and fill the borehole with water up to the top of the casing and record the rate of fall of water.

The Permeability by falling head method is obtained by:

$K = (d^2/8L) \text{Loge} [(L/r) (\log_e(h_1/h_2)/(t_2-t_1))]$ where,

K = Co-efficient of Permeability, d = diameter of intake pipe

L = Length of Test Zone

h_1 = head of water at time t_1 , h_2 = head of water at time t_2 , r = radius of hole.

The test section shall be terminated at bottom of borehole at time of when inserted in the bore hole. For the test depth where it has to be conducted, borehole must be drilled up to that depth. Perforated hole section of standard length shall be attached below the casing pipe. Access to the test section through the packer shall be by means of a pipe which shall extend to above the ground level. Water shall be filled into the pipe up to the level marked just below the top of the pipe and water allowed to drain into the test section. The water level in the pipe shall be recorded at regular intervals as mentioned in IS: 5529, Part-I, Appendix-B. The test shall be repeated till Constant records of water level are achieved.

Results of Permeability Test (By Falling Head Method)

Project : NTPP Hirma

Test Location : IBH-15

Date of the Test : 24/09/2024

Depth of Test Section : Between 1.50m and 2.50m.

Reddish Brown fine to medium grained sandy clay with gravels

Depth of water table seen just before test in bore hole for permeability = at 3.50m from NGL

Ref : IS 5529 Part 1

Details of test setup

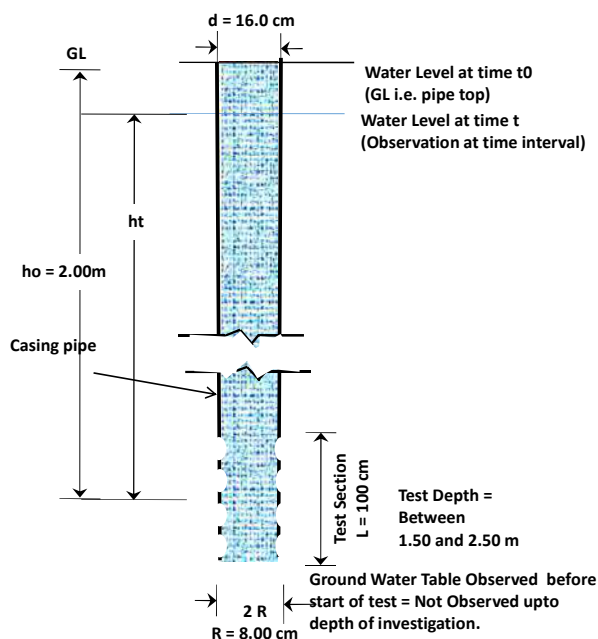
Diameter of stand pipe 'd' in cm = 16

Radius of Hole 'R' in cm = 8

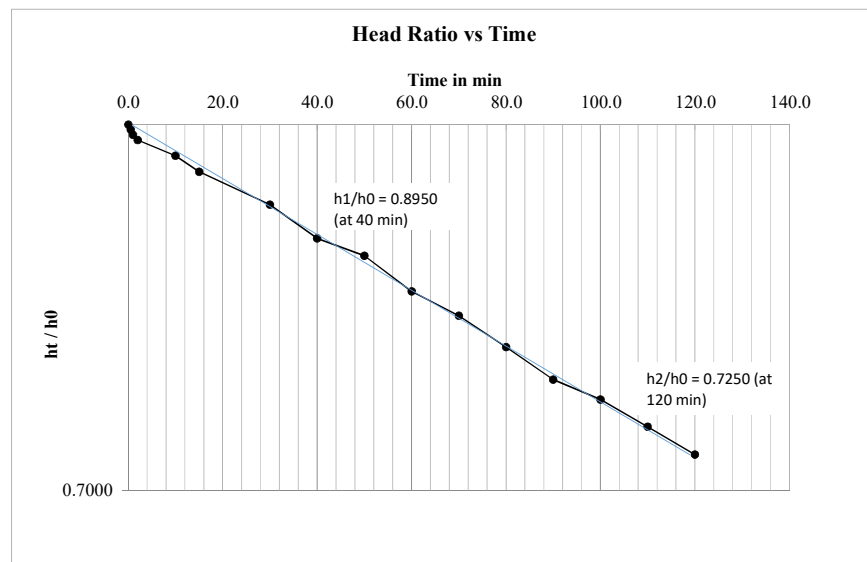
Length of Test Zone 'L' in cm = 100

Observations and calculations

Sr. No.	Time of observation in min	Height of water level at time t, ht = water level in the intake pipe - Elevation of the ground water table in m	Head Ratio ht / ho
1	0.0	2.000	1.0000
2	0.5	1.990	0.9950
3	1.0	1.980	0.9900
4	2.0	1.970	0.9850
5	10.0	1.940	0.9700
6	15.0	1.910	0.9550
7	30.0	1.850	0.9250
8	40.0	1.790	0.8950
9	50.0	1.760	0.8800
10	60.0	1.700	0.8500
11	70.0	1.660	0.8300
12	80.0	1.610	0.8050
13	90.0	1.560	0.7800
14	100.0	1.530	0.7650
15	110.0	1.490	0.7450
16	120.0	1.450	0.7250



Schematic Diagram Not to the scale



h1/h0 =	0.8950	t1	40	min
h2/h0 =	0.7250	t2	120	min

h1/h2 = 1.234

Substituting various values,

$$K = \frac{d^2}{8L} \log_e \frac{L}{R} \frac{\log_e h_1/h_2}{t_2 - t_1}$$

Coefficient of permeability 'k' at 2.00 m depth in cm / min = 6.50E-04

Coefficient of permeability 'k' at 2.00 m depth in mm / sec = 1.08E-04

Results of Permeability Test (By Falling Head Method)

Project : NTPP Hirma

Test Location : IBH-15

Date of the Test : 24/09/2024

Depth of Test Section : Between 3.50 and 4.50 m

Co-ordinates : E=1221, N=3716

Type of soil at the depth of test = Reddish brown fine to medium grained sandy clay with gravels

Depth of water table seen just before test in bore hole for permeability = 3.50 m (from GL)

Ref : IS 5529 part 1

Details of test setup

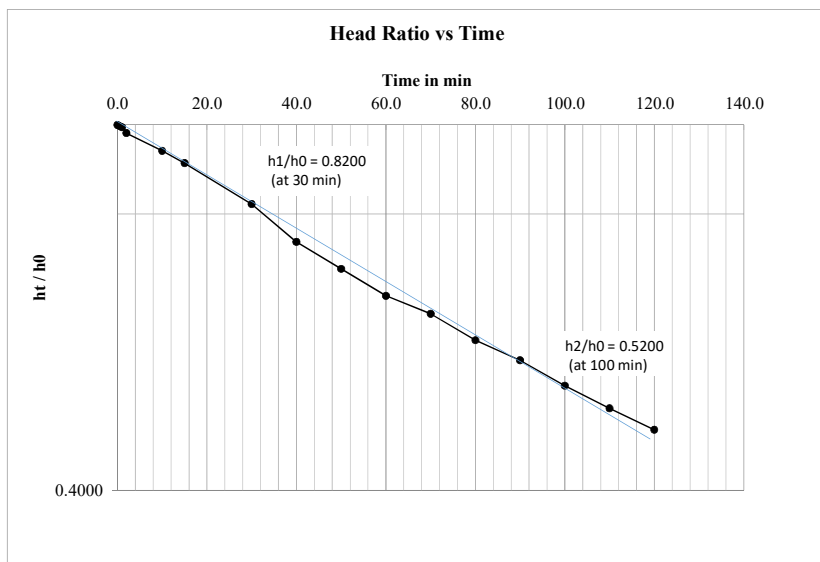
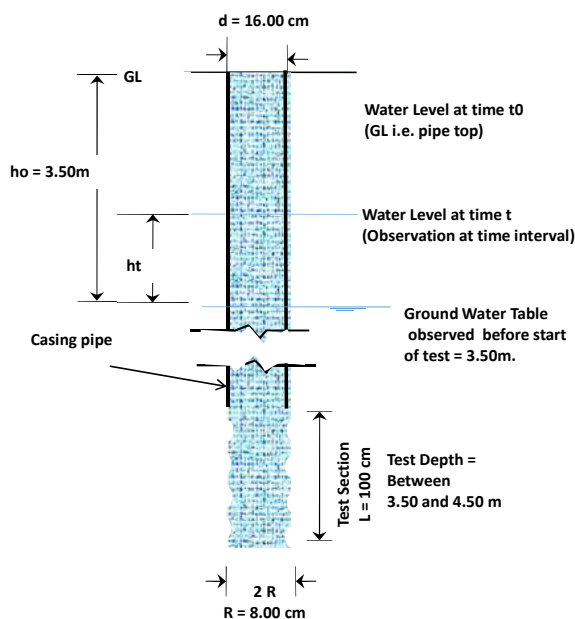
Diameter of stand pipe 'd' in cm = 16

Radius of Hole 'R' in cm = 8

Length of Test Zone 'L' in cm = 100

Observations and calculations

Sr. No.	Time of observation in min	Height of water level at time t, h_t = water level in the intake pipe - Elevation of the ground water table in m	Head Ratio h_t / h_0
1	0.0	3.500	1.0000
2	0.5	3.490	0.9971
3	1.0	3.480	0.9943
4	2.0	3.430	0.9800
5	10.0	3.280	0.9371
6	15.0	3.180	0.9086
7	30.0	2.870	0.8200
8	40.0	2.610	0.7457
9	50.0	2.440	0.6971
10	60.0	2.280	0.6514
11	70.0	2.180	0.6229
12	80.0	2.040	0.5829
13	90.0	1.940	0.5543
14	100.0	1.820	0.5200
15	110.0	1.720	0.4914
16	120.0	1.630	0.4657



$h_1/h_0 = 0.8200$ $t_1 = 30$ min
 $h_2/h_0 = 0.5200$ $t_2 = 100$ min
 $h_1/h_2 = 1.5769$

Substituting various values,

$$K = \frac{d^2}{8L} \log_e \frac{L}{R} \frac{\log_e h_1/h_2}{t_2 - t_1}$$

Coefficient of permeability 'k' at 4.00 m depth in cm / min = 4.74E-03

Coefficient of permeability 'k' at 4.00 m depth in cm / sec = 7.90E-05

Results of Permeability Test (By Falling Head Method)

Project : NTPP Hirna

Test Location : IBH-15

Date of the Test : 26/09/2024

Depth of Test Section : Between 5.50 and 6.50 m

Co-ordinates : E=1221, N=3716

Type of soil at the depth of test = Reddish brown fine to medium grained sandy clay with gravels

Depth of water table seen just before test in bore hole for permeability = 3.50 m (from GL)

Ref : IS 5529 part 1

Details of test setup

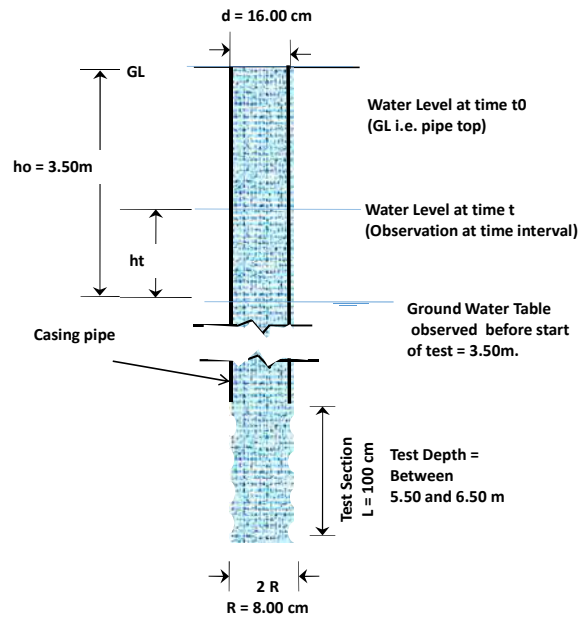
Diameter of stand pipe 'd' in cm = 16

Radius of Hole 'R' in cm = 8

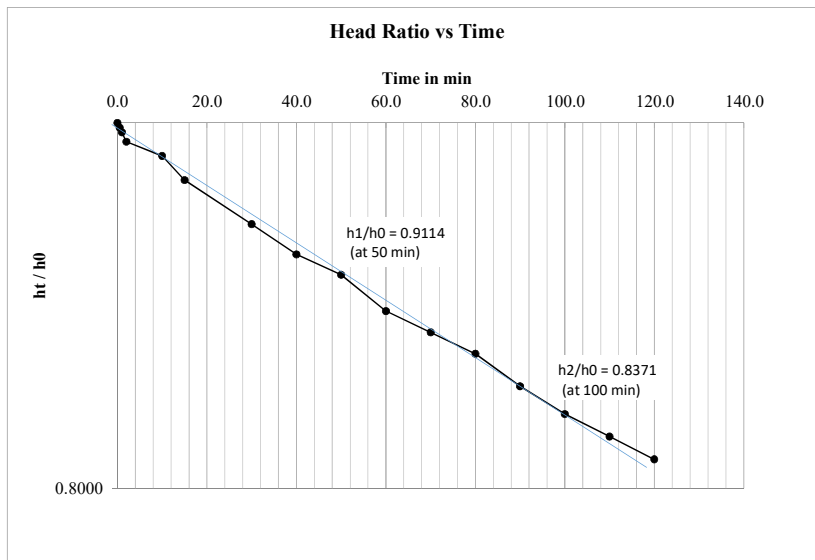
Length of Test Zone 'L' in cm = 100

Observations and calculations

Sr. No.	Time of observation in min	Height of water level at time t, ht = water level in the intake pipe - Elevation of the ground water table in m	Head Ratio ht / ho
1	0.0	3.500	1.0000
2	0.5	3.490	0.9971
3	1.0	3.480	0.9943
4	2.0	3.460	0.9886
5	10.0	3.430	0.9800
6	15.0	3.380	0.9657
7	30.0	3.290	0.9400
8	40.0	3.230	0.9229
9	50.0	3.190	0.9114
10	60.0	3.120	0.8914
11	70.0	3.080	0.8800
12	80.0	3.040	0.8686
13	90.0	2.980	0.8514
14	100.0	2.930	0.8371
15	110.0	2.890	0.8257
16	120.0	2.850	0.8143



Schematic Diagram Not to the scale



$h_1/h_0 = 0.9114$ at $t_1 = 50$ min
 $h_2/h_0 = 0.8371$ at $t_2 = 100$ min
 $h_1/h_2 = 1.0888$

Substituting various values,

$$K = \frac{d^2}{8L} \log_e \frac{L}{R} \frac{\log_e h_1/h_2}{t_2 - t_1}$$

Coefficient of permeability 'k' at 6.00 m depth in cm / min = 1.24E-03

Coefficient of permeability 'k' at 6.00 m depth in cm / sec = 2.07E-05

Results of Permeability Test (By Falling Head Method)

Project : NTPP Hirna

Test Location : IBH-15

Date of the Test : 26/09/2024

Depth of Test Section : Between 7.50 and 8.50 m

Co-ordinates : E=1221, N=3716

Type of soil at the depth of test = Reddish brown fine to medium grained sandy clay with gravels

Depth of water table seen just before test in bore hole for permeability = 3.50 m (from GL)

Ref : IS 5529 part 1

Details of test setup

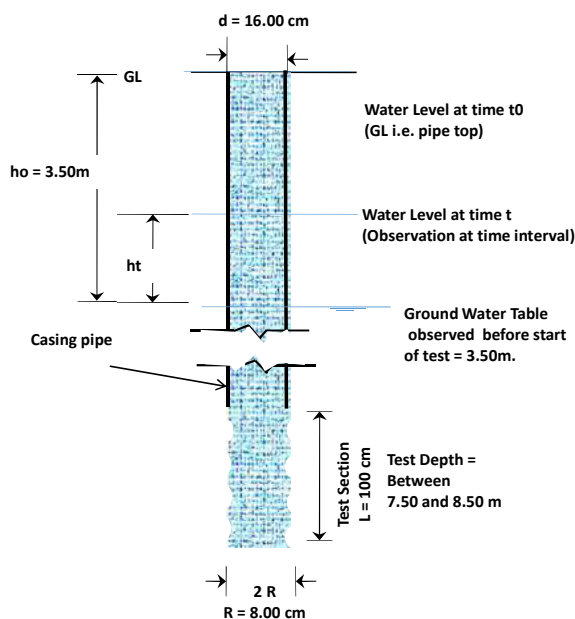
Diameter of stand pipe 'd' in cm = 16

Radius of Hole 'R' in cm = 8

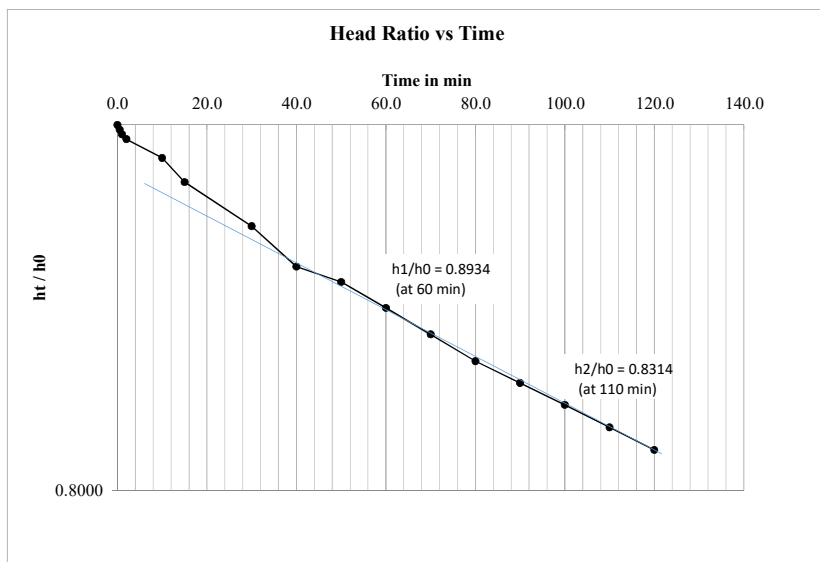
Length of Test Zone 'L' in cm = 100

Observations and calculations

Sr. No.	Time of observation in min	Height of water level at time t, ht = water level in the intake pipe - Elevation of the ground water table in m	Head Ratio ht / ho
1	0.0	3.500	1.0000
2	0.5	3.490	0.9971
3	1.0	3.480	0.9943
4	2.0	3.470	0.9914
5	10.0	3.430	0.9800
6	15.0	3.380	0.9657
7	30.0	3.290	0.9400
8	40.0	3.210	0.9171
9	50.0	3.180	0.9086
10	60.0	3.130	0.8943
11	70.0	3.080	0.8800
12	80.0	3.030	0.8657
13	90.0	2.990	0.8543
14	100.0	2.950	0.8429
15	110.0	2.910	0.8314
16	120.0	2.870	0.8200



Schematic Diagram Not to the scale



$h_1/h_0 = 0.8934$ $t_1 = 60 \text{ min}$
 $h_2/h_0 = 0.8314$ $t_2 = 110 \text{ min}$
 $h_1/h_2 = 1.0746$

Substituting various values,

$$K = \frac{d^2}{8L} \log_e \frac{L}{R} \frac{\log_e h_1/h_2}{t_2 - t_1}$$

Coefficient of permeability 'k' at 8.00 m depth in cm / min = 1.05E-03

Coefficient of permeability 'k' at 8.00 m depth in cm / sec = 1.75E-05

Results of Permeability Test (By Falling Head Method)

Project : NTPP Hirna

Test Location : IBH-15

Date of the Test : 26/09/2024

Depth of Test Section : Between 9.50 and 10.50 m

Co-ordinates : E=1221, N=3716

Type of soil at the depth of test = Reddish brown fine to medium grained sandy clay with gravels

Depth of water table seen just before test in bore hole for permeability = 3.50 m (from GL)

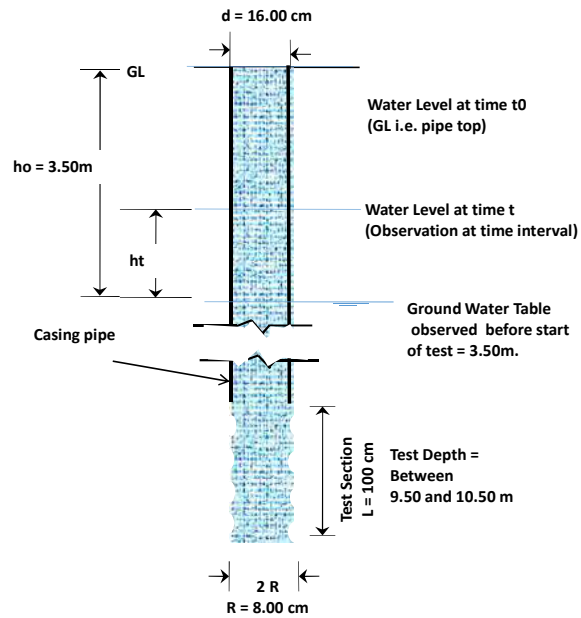
Ref : IS 5529 part 1

Details of test setup

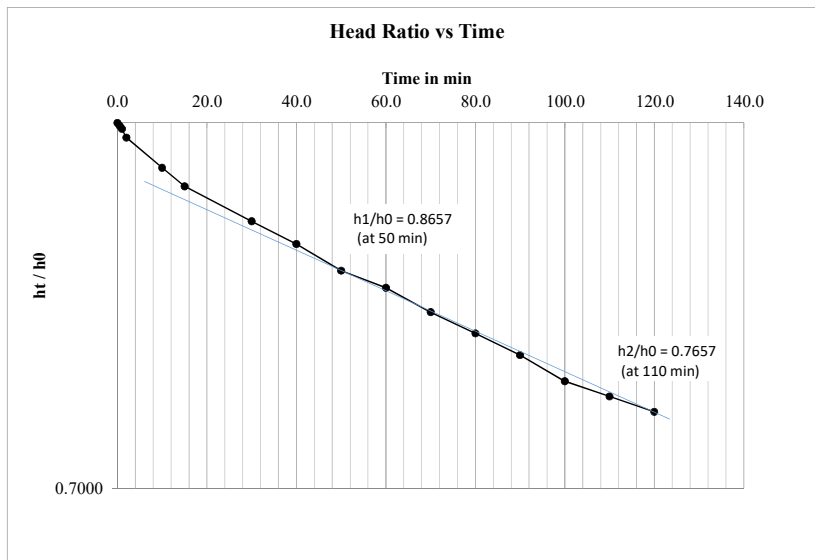
Diameter of stand pipe 'd' in cm = 16
 Radius of Hole 'R' in cm = 8
 Length of Test Zone 'L' in cm = 100

Observations and calculations

Sr. No.	Time of observation in min	Height of water level at time t, ht = water level in the intake pipe - Elevation of the ground water table in m	Head Ratio ht / ho
1	0.0	3.500	1.0000
2	0.5	3.490	0.9971
3	1.0	3.480	0.9943
4	2.0	3.450	0.9857
5	10.0	3.350	0.9571
6	15.0	3.290	0.9400
7	30.0	3.180	0.9086
8	40.0	3.110	0.8886
9	50.0	3.030	0.8657
10	60.0	2.980	0.8514
11	70.0	2.910	0.8314
12	80.0	2.850	0.8143
13	90.0	2.790	0.7971
14	100.0	2.720	0.7771
15	110.0	2.680	0.7657
16	120.0	2.640	0.7543



Schematic Diagram Not to the scale



h1/ho = 0.8670 t1 50 min
 h2/ho = 0.7657 t2 110 min
 h1/h2 = 1.1323

Substituting various values,

$$K = \frac{d^2}{8L} \log_e \frac{L}{R} \frac{\log_e h_1/h_2}{t_2 - t_1}$$

Coefficient of permeability 'k' at 10.00 m depth in cm / min = 1.51E-03

Coefficient of permeability 'k' at 10.00 m depth in cm / sec = 2.51E-05

Results of Permeability Test (By Falling Head Method)

Project : NTPP Hirma

Test Location : BH-55

Date of the Test : 21/09/2024

Depth of Test Section : Between 1.50m and 2.50m.

Brownish yellow fine to very fine grained silty clay

Depth of water table seen just before test in bore hole for permeability = at 2.10m from NGL

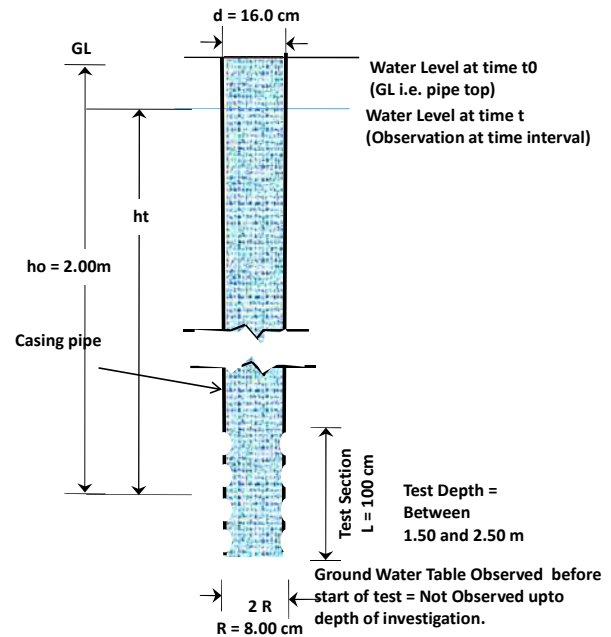
Ref : IS 5529 Part 1

Details of test setup

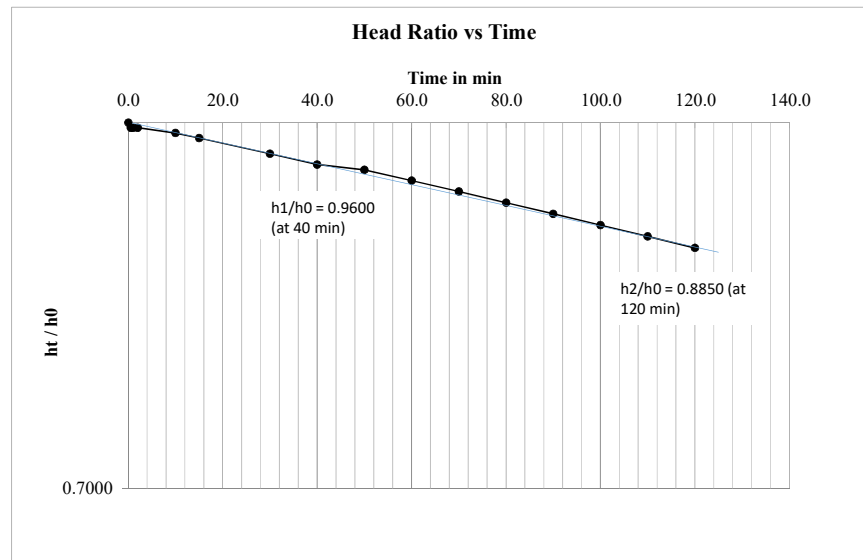
Diameter of stand pipe 'd' in cm = 16
 Radius of Hole 'R' in cm = 8
 Length of Test Zone 'L' in cm = 100

Observations and calculations

Sr. No.	Time of observation in min	Height of water level at time t, ht = water level in the intake pipe - Elevation of the ground water table in m	Head Ratio ht / ho
1	0.0	2.000	1.0000
2	0.5	1.990	0.9950
3	1.0	1.990	0.9950
4	2.0	1.990	0.9950
5	10.0	1.980	0.9900
6	15.0	1.970	0.9850
7	30.0	1.940	0.9700
8	40.0	1.920	0.9600
9	50.0	1.910	0.9550
10	60.0	1.890	0.9450
11	70.0	1.870	0.9350
12	80.0	1.850	0.9250
13	90.0	1.830	0.9150
14	100.0	1.810	0.9050
15	110.0	1.790	0.8950
16	120.0	1.770	0.8850



Schematic Diagram Not to the scale



$h_1/h_0 = 0.9600$ at $t_1 = 40$ min
 $h_2/h_0 = 0.8850$ at $t_2 = 120$ min
 $h_1/h_2 = 1.085$
 Substituting various values,

$$K = \frac{d^2}{8L} \log_e \frac{L}{R} \frac{\log_e h_1/h_2}{t_2 - t_1}$$

Coefficient of permeability 'k' at 2.00 m depth in cm / min = 2.51E-04

Coefficient of permeability 'k' at 2.00 m depth in mm / sec = 4.18E-05

Results of Permeability Test (By Falling Head Method)

Project : NTPP Hirna

Test Location : BH-55

Date of the Test : 21/09/2024

Depth of Test Section : Between 3.50 and 4.50 m

Co-ordinates : E=1314, N=3230

Type of soil at the depth of test = Reddish brown fine to medium grained sandy clay with gravels

Depth of water table seen just before test in bore hole for permeability = 2.10 m (from GL)

Ref : IS 5529 part 1

Details of test setup

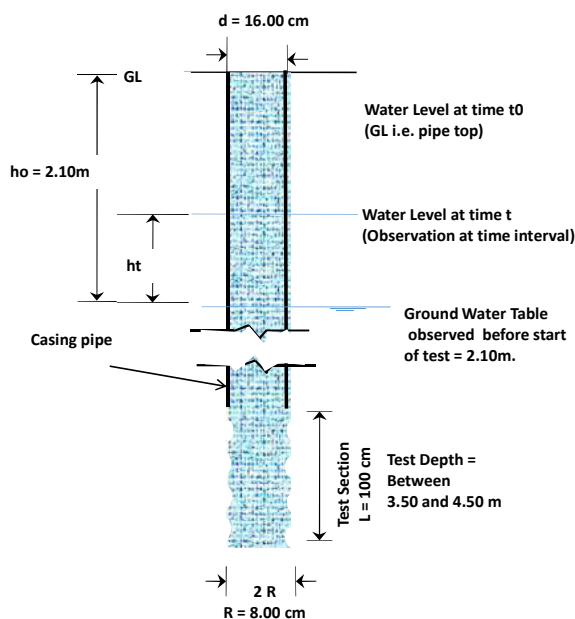
Diameter of stand pipe 'd' in cm = 16

Radius of Hole 'R' in cm = 8

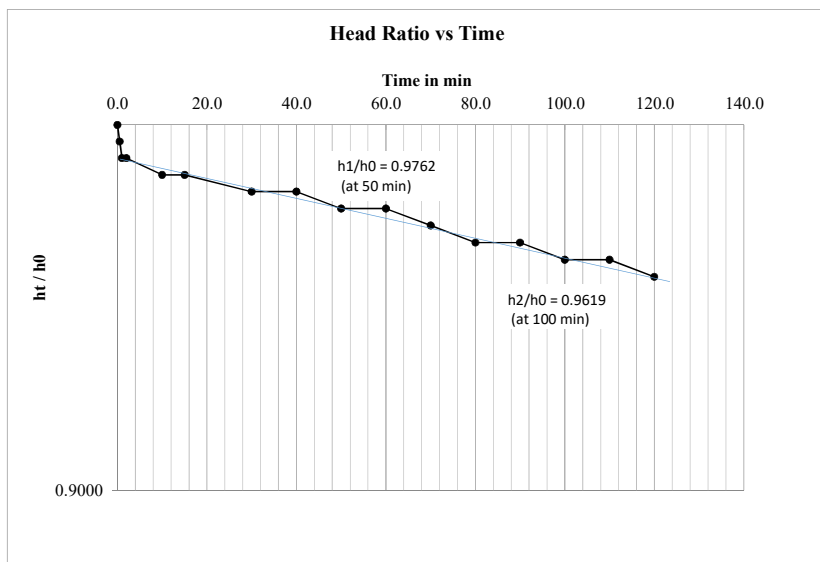
Length of Test Zone 'L' in cm = 100

Observations and calculations

Sr. No.	Time of observation in min	Height of water level at time t, ht = water level in the intake pipe - Elevation of the ground water table in m	Head Ratio ht / ho
1	0.0	2.100	1.0000
2	0.5	2.090	0.9952
3	1.0	2.080	0.9905
4	2.0	2.080	0.9905
5	10.0	2.070	0.9857
6	15.0	2.070	0.9857
7	30.0	2.060	0.9810
8	40.0	2.060	0.9810
9	50.0	2.050	0.9762
10	60.0	2.050	0.9762
11	70.0	2.040	0.9714
12	80.0	2.030	0.9667
13	90.0	2.030	0.9667
14	100.0	2.020	0.9619
15	110.0	2.020	0.9619
16	120.0	2.010	0.9571



Schematic Diagram Not to the scale



h1/h0 = 0.9762 t1 50 min

h2/h0 = 0.9616 t2 100 min

h1/h2 = 1.0152

Substituting various values,

$$K = \frac{d^2}{8L} \log_e \frac{L}{R} \frac{\log_e h_1/h_2}{t_2 - t_1}$$

Coefficient of permeability 'k' at 4.00 m depth in cm / min = 2.20E-04

Coefficient of permeability 'k' at 4.00 m depth in cm / sec = 3.66E-06

Results of Permeability Test (By Falling Head Method)

Project : NTPP Hirna

Test Location : BH-55

Date of the Test : 22/09/2024

Depth of Test Section : Between 5.50 and 6.50 m

Co-ordinates : E=1314, N=3230

Type of soil at the depth of test = Reddish brown fine to medium grained sandy clay with gravels

Depth of water table seen just before test in bore hole for permeability = 2.10 m (from GL)

Ref : IS 5529 part 1

Details of test setup

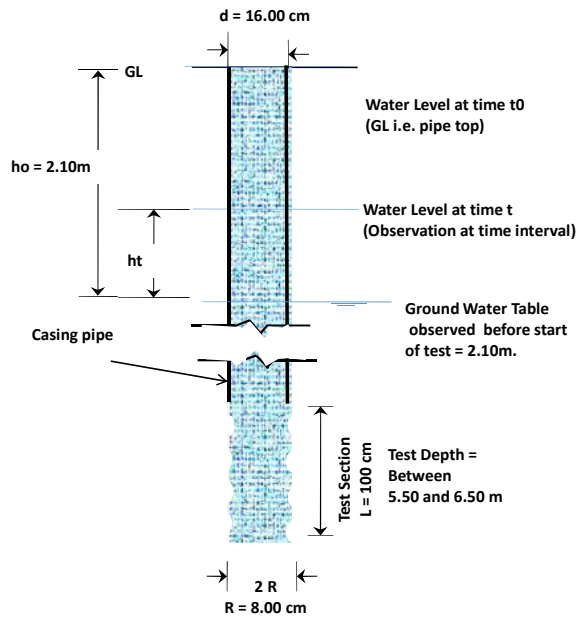
Diameter of stand pipe 'd' in cm = 16

Radius of Hole 'R' in cm = 8

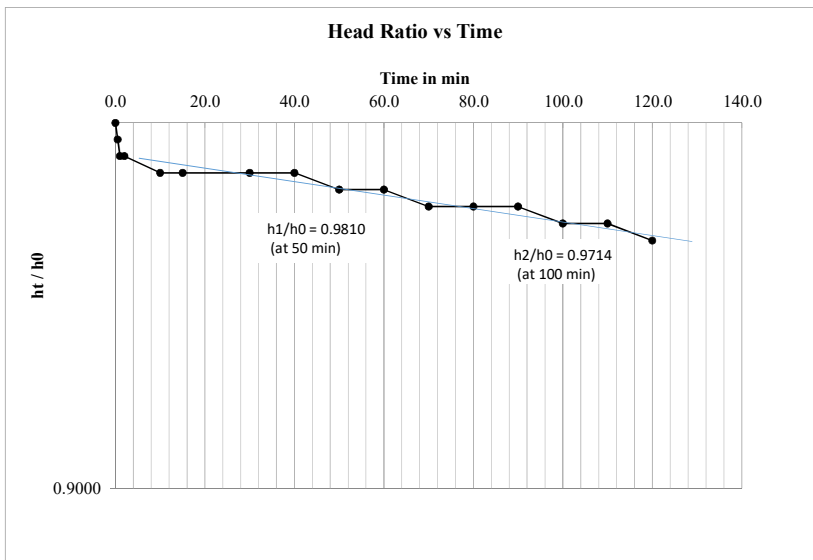
Length of Test Zone 'L' in cm = 100

Observations and calculations

Sr. No.	Time of observation in min	Height of water level at time t, ht = water level in the intake pipe - Elevation of the ground water table in m	Head Ratio ht / ho
1	0.0	2.100	1.0000
2	0.5	2.090	0.9952
3	1.0	2.080	0.9905
4	2.0	2.080	0.9905
5	10.0	2.070	0.9857
6	15.0	2.070	0.9857
7	30.0	2.070	0.9857
8	40.0	2.070	0.9857
9	50.0	2.060	0.9810
10	60.0	2.060	0.9810
11	70.0	2.050	0.9762
12	80.0	2.050	0.9762
13	90.0	2.050	0.9762
14	100.0	2.040	0.9714
15	110.0	2.040	0.9714
16	120.0	2.030	0.9667



Schematic Diagram Not to the scale



$h_1/h_0 = 0.9810$ at $t_1 = 50$ min
 $h_2/h_0 = 0.9714$ at $t_2 = 100$ min
 $h_1/h_2 = 1.0099$

Substituting various values,

$$K = \frac{d^2}{8L} \log_e \frac{L}{R} \frac{\log_{10} h_1/h_2}{t_2 - t_1}$$

Coefficient of permeability 'k' at 6.00 m depth in cm / min = 1.43E-04

Coefficient of permeability 'k' at 6.00 m depth in cm / sec = 2.39E-06

Results of Permeability Test (By Falling Head Method)

Project : NTPP Hirna

Test Location : BH-55

Date of the Test : 22/09/2024

Depth of Test Section : Between 7.50 and 8.50 m

Co-ordinates : E=1314, N=3230

Type of soil at the depth of test = Reddish brown fine to medium grained sandy clay with gravels

Depth of water table seen just before test in bore hole for permeability = 2.10 m (from GL)

Ref : IS 5529 part 1

Details of test setup

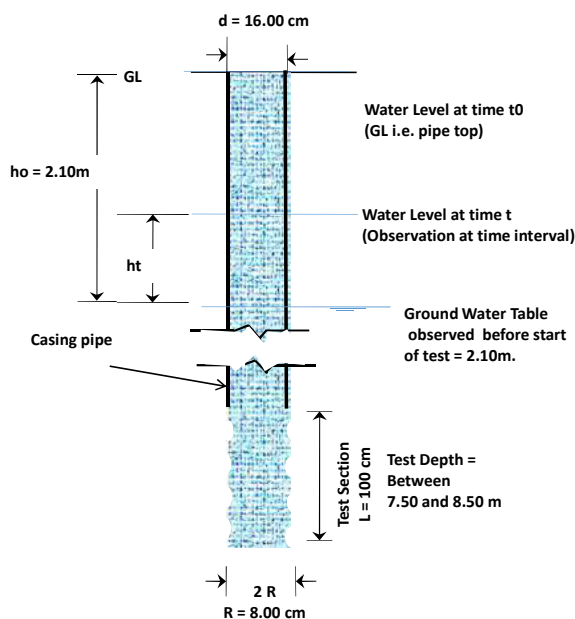
Diameter of stand pipe 'd' in cm = 16

Radius of Hole 'R' in cm = 8

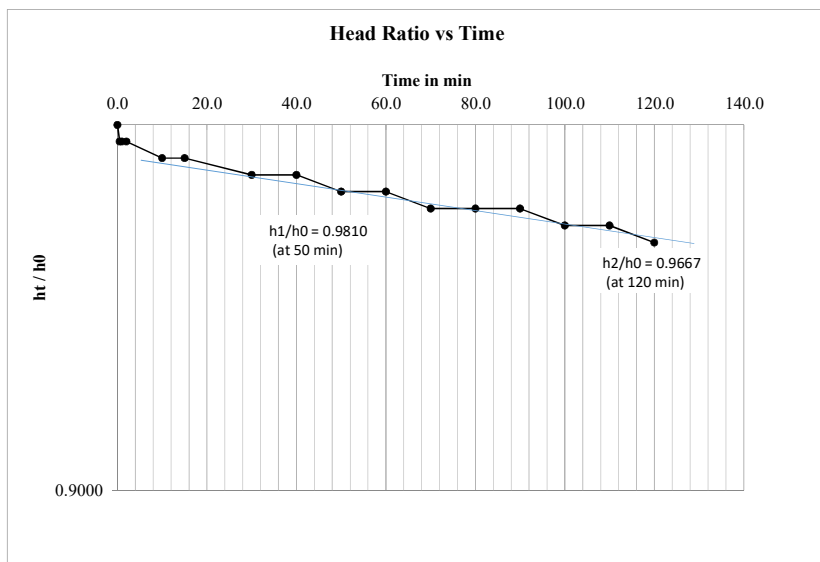
Length of Test Zone 'L' in cm = 100

Observations and calculations

Sr. No.	Time of observation in min	Height of water level at time t, ht = water level in the intake pipe - Elevation of the ground water table in m	Head Ratio ht / ho
1	0.0	2.100	1.0000
2	0.5	2.090	0.9952
3	1.0	2.090	0.9952
4	2.0	2.090	0.9952
5	10.0	2.080	0.9905
6	15.0	2.080	0.9905
7	30.0	2.070	0.9857
8	40.0	2.070	0.9857
9	50.0	2.060	0.9810
10	60.0	2.060	0.9810
11	70.0	2.050	0.9762
12	80.0	2.050	0.9762
13	90.0	2.050	0.9762
14	100.0	2.040	0.9714
15	110.0	2.040	0.9714
16	120.0	2.030	0.9667



Schematic Diagram Not to the scale



$h_1/h_0 = 0.9810$ at $t_1 = 50$ min
 $h_2/h_0 = 0.9667$ at $t_2 = 120$ min
 $h_1/h_2 = 1.0148$

Substituting various values,

$$K = \frac{d^2}{8L} \log_e \frac{L}{R} \frac{\log_e h_1/h_2}{t_2 - t_1}$$

Coefficient of permeability 'k' at 8.00 m depth in cm / min = 1.53E-04

Coefficient of permeability 'k' at 8.00 m depth in cm / sec = 2.55E-06

Results of Permeability Test (By Falling Head Method)

Project : NTPP Hirna

Test Location : BH-55

Date of the Test : 22/09/2024

Depth of Test Section : Between 9.50 and 10.50 m

Co-ordinates : E=1314, N=3230

Type of soil at the depth of test = Reddish brown fine to medium grained sandy clay with gravels

Depth of water table seen just before test in bore hole for permeability = 2.10 m (from GL)

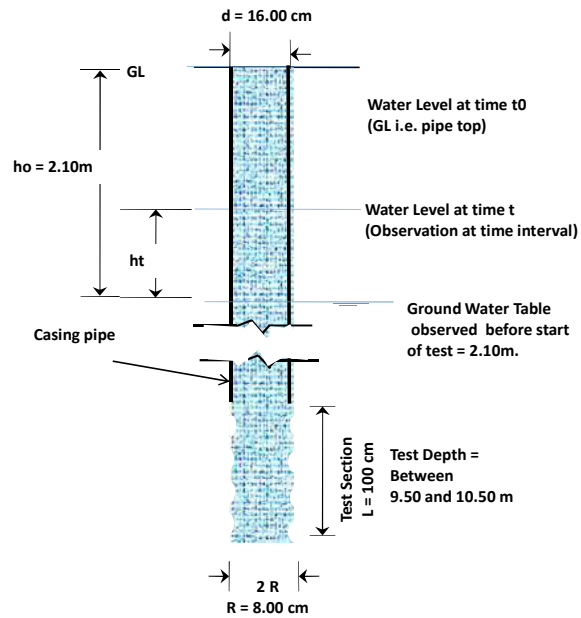
Ref : IS 5529 part 1

Details of test setup

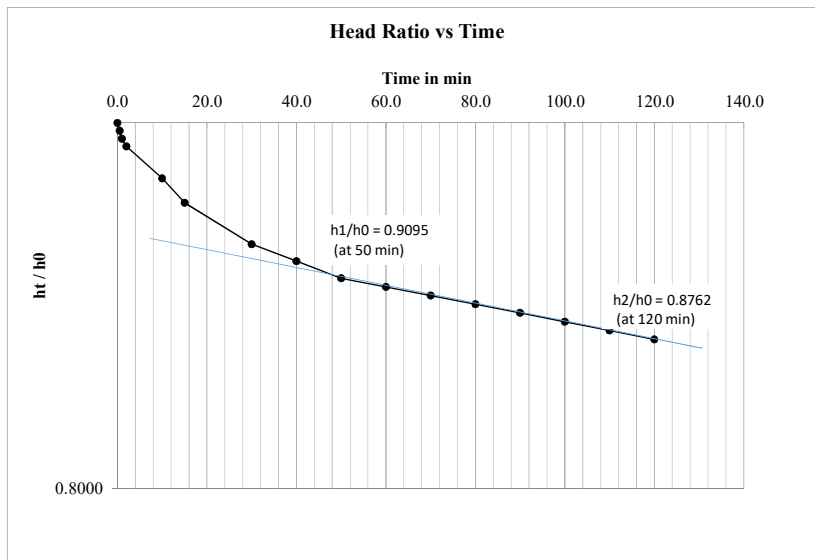
Diameter of stand pipe 'd' in cm = 16
 Radius of Hole 'R' in cm = 8
 Length of Test Zone 'L' in cm = 100

Observations and calculations

Sr. No.	Time of observation in min	Height of water level at time t, ht = water level in the intake pipe - Elevation of the ground water table in m	Head Ratio ht / ho
1	0.0	2.100	1.0000
2	0.5	2.090	0.9952
3	1.0	2.080	0.9905
4	2.0	2.070	0.9857
5	10.0	2.030	0.9667
6	15.0	2.000	0.9524
7	30.0	1.950	0.9286
8	40.0	1.930	0.9190
9	50.0	1.910	0.9095
10	60.0	1.900	0.9048
11	70.0	1.890	0.9000
12	80.0	1.880	0.8952
13	90.0	1.870	0.8905
14	100.0	1.860	0.8857
15	110.0	1.850	0.8810
16	120.0	1.840	0.8762



Schematic Diagram Not to the scale



h1/h0 = 0.9095 t1 50 min
 h2/h0 = 0.8762 t2 120 min
 h1/h2 = 1.0380

Substituting various values,

$$K = \frac{d^2}{8L} \log_e \frac{L}{R} \frac{\log_e h_1/h_2}{t_2 - t_1}$$

Coefficient of permeability 'k' at 10.00 m depth in cm / min = 3.88E-04

Coefficient of permeability 'k' at 10.00 m depth in cm / sec = 6.47E-06

Results of Permeability Test (By Falling Head Method)

Project : NTTTP Hirma

Test Location : BH-106

Date of the Test : 20/12/2024

Depth of Test Section : Between 1.50m and 2.50m.

Type of soil: Brownish yellow fine to medium fine grained some sand with silt clay and gravel

Depth of water table seen just before test in bore hole for permeability = at 2.60m from NGL

Ref : IS 5529 Part 1

Details of test setup

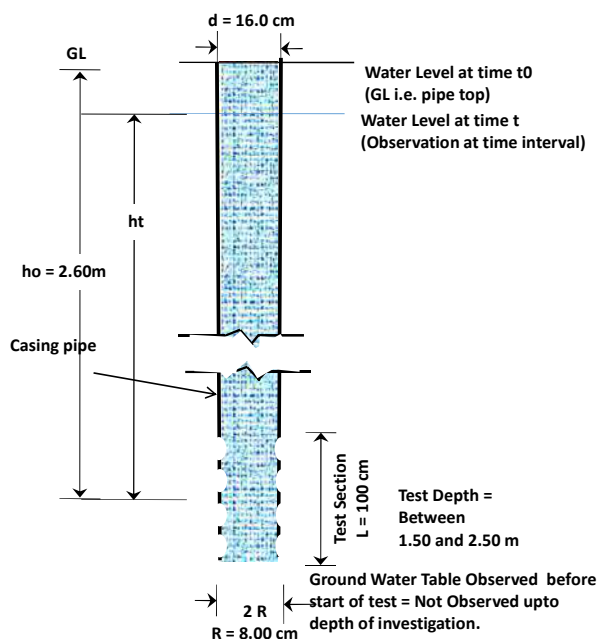
Diameter of stand pipe 'd' in cm = 16

Radius of Hole 'R' in cm = 8

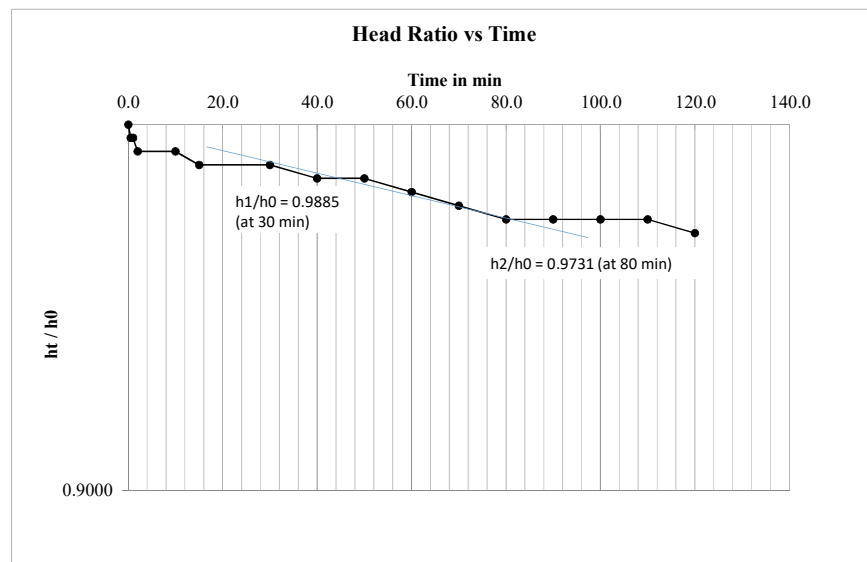
Length of Test Zone 'L' in cm = 100

Observations and calculations

Sr. No.	Time of observation in min	Height of water level at time t, ht = water level in the intake pipe - Elevation of the ground water table in m	Head Ratio ht / ho
1	0.0	2.600	1.0000
2	0.5	2.590	0.9962
3	1.0	2.590	0.9962
4	2.0	2.580	0.9923
5	10.0	2.580	0.9923
6	15.0	2.570	0.9885
7	30.0	2.570	0.9885
8	40.0	2.560	0.9846
9	50.0	2.560	0.9846
10	60.0	2.550	0.9808
11	70.0	2.540	0.9769
12	80.0	2.530	0.9731
13	90.0	2.530	0.9731
14	100.0	2.530	0.9731
15	110.0	2.530	0.9731
16	120.0	2.520	0.9692



Schematic Diagram Not to the scale



$h_1/h_0 = 0.9885$ at $t_1 = 30$ min
 $h_2/h_0 = 0.9731$ at $t_2 = 80$ min

Substituting various values,

$$K = \frac{d^2}{8L} \log_e \frac{L}{R} \frac{\log_e h_1/h_2}{t_2 - t_1}$$

Coefficient of permeability 'k' at 2.00 m depth in cm / min = 7.75E-05

Coefficient of permeability 'k' at 2.00 m depth in mm / sec = 1.29E-05

Results of Permeability Test (By Falling Head Method)

Project : NTPP Hirna

Test Location : BH-106

Date of the Test : 20/12/2024

Depth of Test Section : Between 3.50 and 4.50 m

Co-ordinates : E=888, N=2972

Type of soil at the depth of test = Brownish yellow fine to medium fine grained some sand with silt clay and gravel

Depth of water table seen just before test in bore hole for permeability = 2.60 m (from GL)

Ref : IS 5529 part 1

Details of test setup

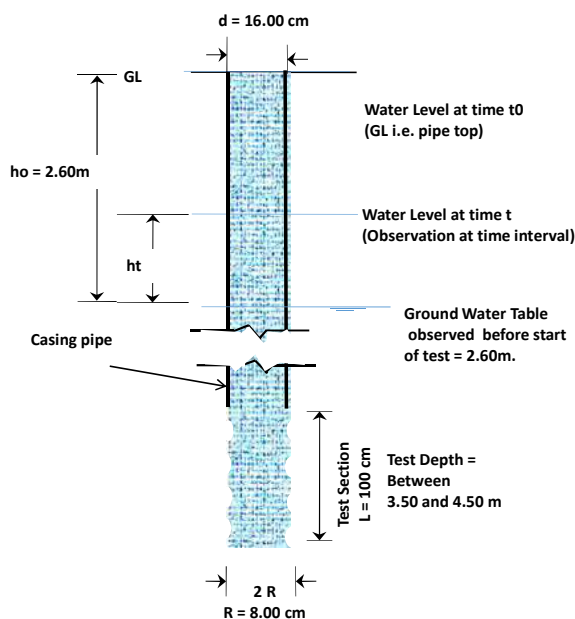
Diameter of stand pipe 'd' in cm = 16

Radius of Hole 'R' in cm = 8

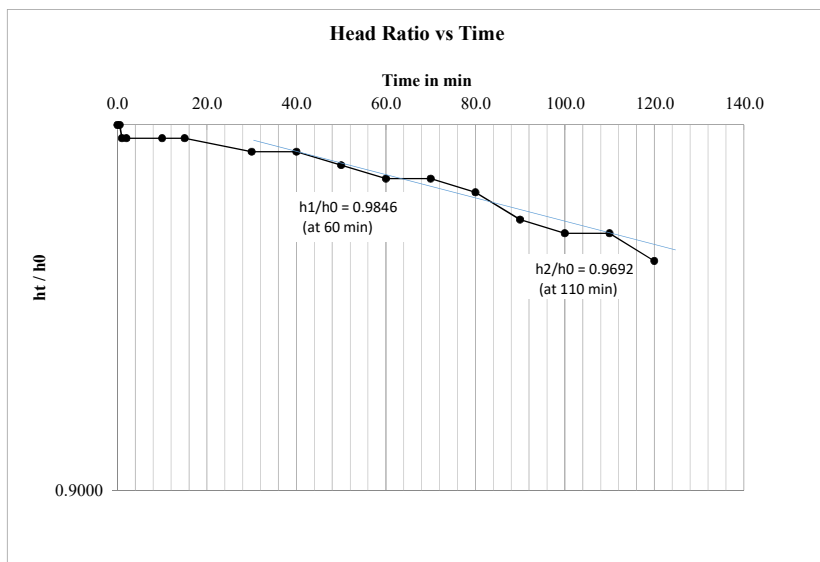
Length of Test Zone 'L' in cm = 100

Observations and calculations

Sr. No.	Time of observation in min	Height of water level at time t, ht = water level in the intake pipe - Elevation of the ground water table in m	Head Ratio ht / ho
1	0.0	2.600	1.0000
2	0.5	2.600	1.0000
3	1.0	2.590	0.9962
4	2.0	2.590	0.9962
5	10.0	2.590	0.9962
6	15.0	2.590	0.9962
7	30.0	2.580	0.9923
8	40.0	2.580	0.9923
9	50.0	2.570	0.9885
10	60.0	2.560	0.9846
11	70.0	2.560	0.9846
12	80.0	2.550	0.9808
13	90.0	2.530	0.9731
14	100.0	2.520	0.9692
15	110.0	2.520	0.9692
16	120.0	2.500	0.9615



Schematic Diagram Not to the scale



h1/ho = 0.9846 t1 60 min

h2/ho = 0.9692 t2 110 min

h1/h2 = 1.0159

Substituting various values,

$$K = \frac{d^2}{8L} \log_e \frac{L}{R} \frac{\log_e h_1/h_2}{t_2 - t_1}$$

Coefficient of permeability 'k' at 4.00 m depth in cm / min = 2.30E-04

Coefficient of permeability 'k' at 4.00 m depth in cm / sec = 3.83E-06

Results of Permeability Test (By Falling Head Method)

Project : NTPP Hirna

Test Location : BH-106

Date of the Test : 21/12/2024

Depth of Test Section : Between 5.50 and 6.50 m

Co-ordinates : E=888, N=2972

Type of soil at the depth of test = Brownish yellow grey white mixed sandy clay with some gravels

Depth of water table seen just before test in bore hole for permeability = 2.60 m (from GL)

Ref : IS 5529 part 1

Details of test setup

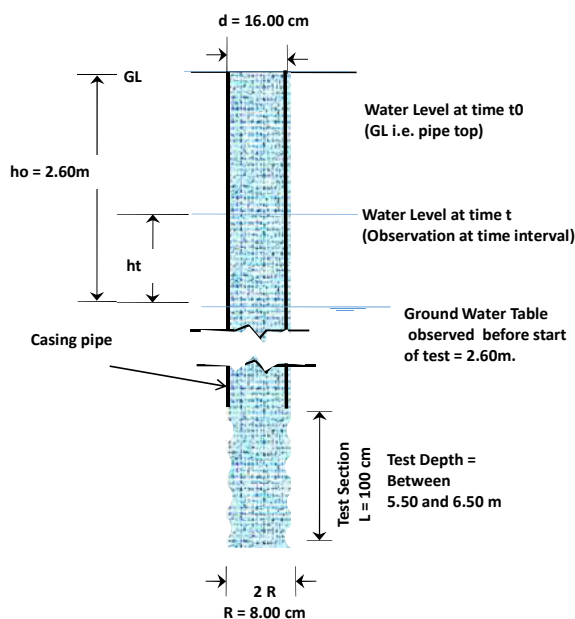
Diameter of stand pipe ' d ' in cm = 16

Radius of Hole ' R ' in cm = 8

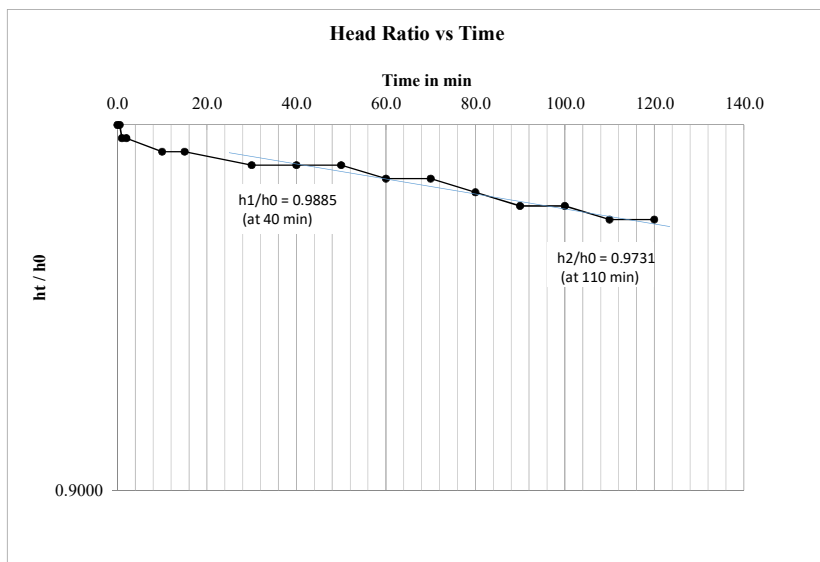
Length of Test Zone ' L ' in cm = 100

Observations and calculations

Sr. No.	Time of observation in min	Height of water level at time t, ht = water level in the intake pipe - Elevation of the ground water table in m	Head Ratio ht / ho
1	0.0	2.600	1.0000
2	0.5	2.600	1.0000
3	1.0	2.590	0.9962
4	2.0	2.590	0.9962
5	10.0	2.580	0.9923
6	15.0	2.580	0.9923
7	30.0	2.570	0.9885
8	40.0	2.570	0.9885
9	50.0	2.570	0.9885
10	60.0	2.560	0.9846
11	70.0	2.560	0.9846
12	80.0	2.550	0.9808
13	90.0	2.540	0.9769
14	100.0	2.540	0.9769
15	110.0	2.530	0.9731
16	120.0	2.530	0.9731



Schematic Diagram Not to the scale



h1/ho = 0.9885 t1 40 min

h2/ho = 0.9731 t2 110 min

h1/h2 = 1.0158

Substituting various values,

$$K = \frac{d^2}{8L} \log_e \frac{L}{R} \frac{\log_e h_1/h_2}{t_2 - t_1}$$

Coefficient of permeability ' k ' at 4.00 m depth in cm / min = 1.63E-04

Coefficient of permeability ' k ' at 4.00 m depth in cm / sec = 2.72E-06

Results of Permeability Test (By Falling Head Method)

Project : NTPP Hirna

Test Location : BH-106

Date of the Test : 22/12/2024

Depth of Test Section : Between 7.50 and 8.50 m

Co-ordinates : E=888, N=2972

Type of soil at the depth of test = Brownish yellow fine to medium fine grained some clay silt with gravel

Depth of water table seen just before test in bore hole for permeability = 2.60 m (from GL)

Ref : IS 5529 part 1

Details of test setup

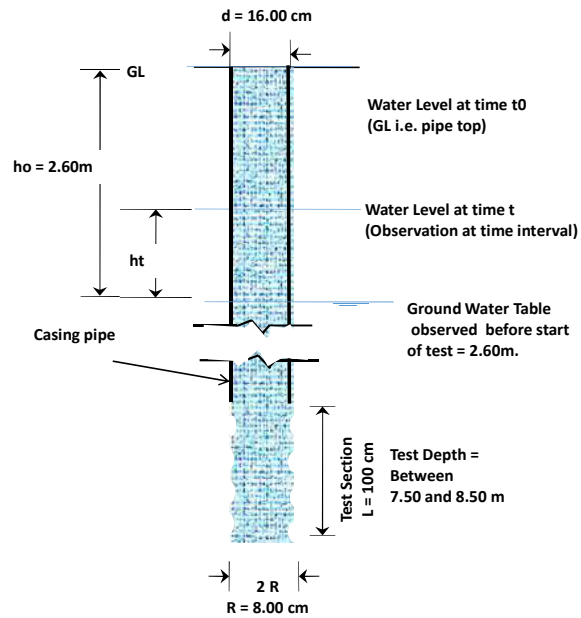
Diameter of stand pipe 'd' in cm = 16

Radius of Hole 'R' in cm = 8

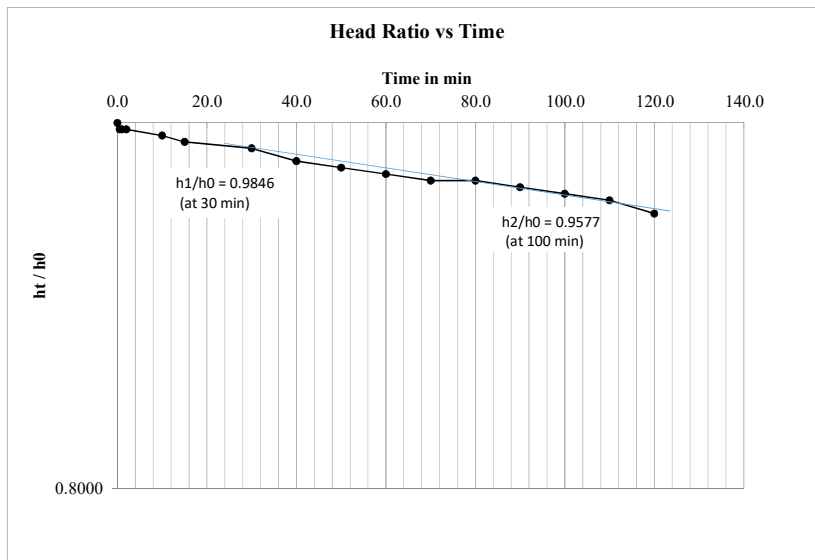
Length of Test Zone 'L' in cm = 100

Observations and calculations

Sr. No.	Time of observation in min	Height of water level at time t, ht = water level in the intake pipe - Elevation of the ground water table in m	Head Ratio ht / ho
1	0.0	2.600	1.0000
2	0.5	2.590	0.9962
3	1.0	2.590	0.9962
4	2.0	2.590	0.9962
5	10.0	2.580	0.9923
6	15.0	2.570	0.9885
7	30.0	2.560	0.9846
8	40.0	2.540	0.9769
9	50.0	2.530	0.9731
10	60.0	2.520	0.9692
11	70.0	2.510	0.9654
12	80.0	2.510	0.9654
13	90.0	2.500	0.9615
14	100.0	2.490	0.9577
15	110.0	2.480	0.9538
16	120.0	2.460	0.9462



Schematic Diagram Not to the scale



$h_1/h_0 = 0.9846$ $t_1 = 30 \text{ min}$
 $h_2/h_0 = 0.9577$ $t_2 = 100 \text{ min}$
 $h_1/h_2 = 1.0281$

Substituting various values,

$$K = \frac{d^2}{8L} \log_e \frac{L}{R} \frac{\log_e h_1/h_2}{t_2 - t_1}$$

Coefficient of permeability 'k' at 4.00 m depth in cm / min = 2.88E-04

Coefficient of permeability 'k' at 4.00 m depth in cm / sec = 4.80E-06

Results of Permeability Test (By Falling Head Method)

Project : NTPP Hirna

Test Location : BH-106

Date of the Test : 23/12/2024

Depth of Test Section : Between 9.50 and 10.50 m

Co-ordinates : E=888, N=2972

Type of soil at the depth of test = Brownish yellow fine to very fine grained clay sand with gravel

Depth of water table seen just before test in bore hole for permeability = 2.60 m (from GL)

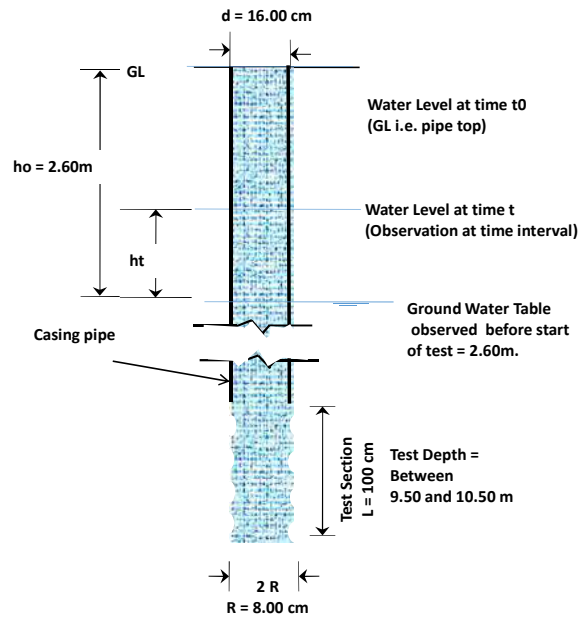
Ref : IS 5529 part 1

Details of test setup

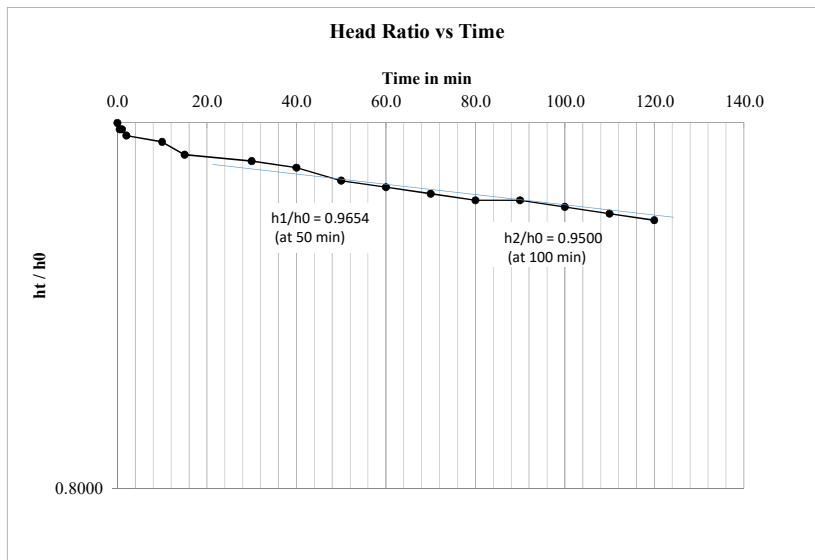
Diameter of stand pipe 'd' in cm = 16
 Radius of Hole 'R' in cm = 8
 Length of Test Zone 'L' in cm = 100

Observations and calculations

Sr. No.	Time of observation in min	Height of water level at time t, ht = water level in the intake pipe - Elevation of the ground water table in m	Head Ratio ht / ho
1	0.0	2.600	1.0000
2	0.5	2.590	0.9962
3	1.0	2.590	0.9962
4	2.0	2.580	0.9923
5	10.0	2.570	0.9885
6	15.0	2.550	0.9808
7	30.0	2.540	0.9769
8	40.0	2.530	0.9731
9	50.0	2.510	0.9654
10	60.0	2.500	0.9615
11	70.0	2.490	0.9577
12	80.0	2.480	0.9538
13	90.0	2.480	0.9538
14	100.0	2.470	0.9500
15	110.0	2.460	0.9462
16	120.0	2.450	0.9423



Schematic Diagram Not to the scale



h1/ho = 0.9654 t1 = 50 min
 h2/ho = 0.9500 t2 = 100 min
 h1/h2 = 1.0162

Substituting various values,

$$K = \frac{d^2}{8L} \log_e \frac{L}{R} \frac{\log_e h_1/h_2}{t_2 - t_1}$$

Coefficient of permeability 'k' at 4.00 m depth in cm / min = 2.34E-04

Coefficient of permeability 'k' at 4.00 m depth in cm / sec = 3.90E-06

Results of Permeability Test (By Falling Head Method)

Project : NTPP Hirna

Test Location : BH-10

Date of the Test : 27/12/2024

Depth of Test Section : Between 1.50 and 2.50 m

Co-ordinates : E=914, N=3614

Type of soil at the depth of test = Brownish yellow very fine grained silty clay

Depth of water table seen just before test in bore hole for permeability = 0.70 m (from GL)

Ref : IS 5529 part 1

Details of test setup

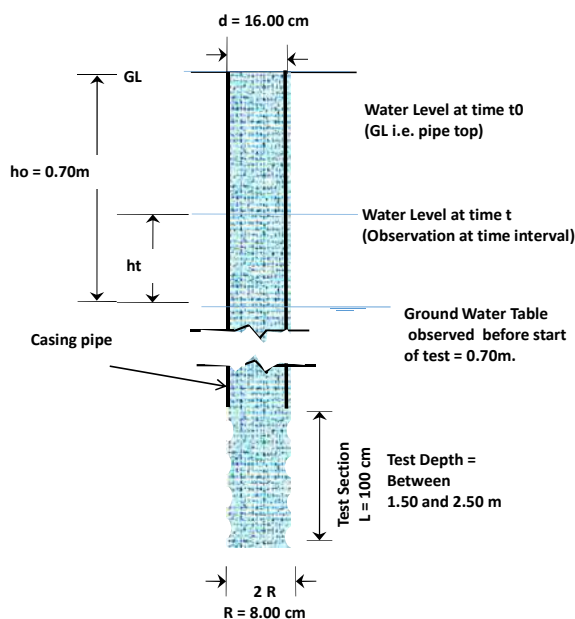
Diameter of stand pipe 'd' in cm = 16

Radius of Hole 'R' in cm = 8

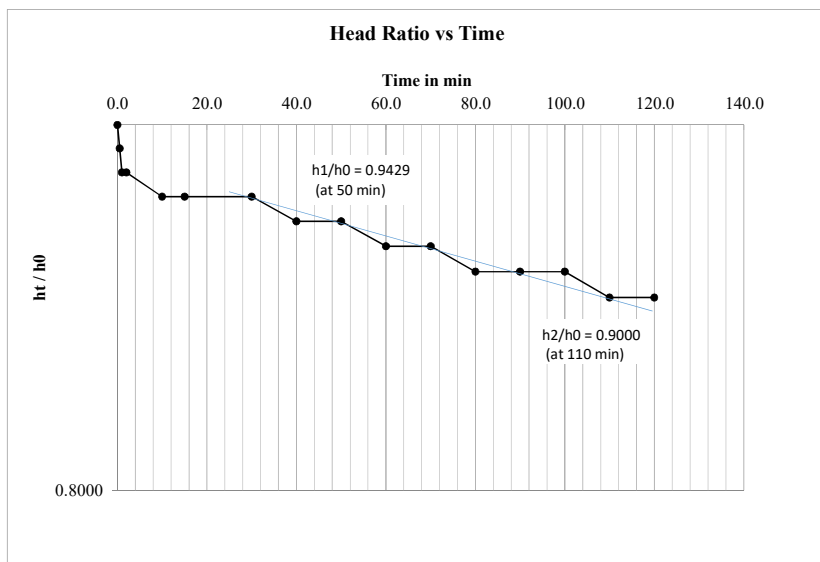
Length of Test Zone 'L' in cm = 100

Observations and calculations

Sr. No.	Time of observation in min	Height of water level at time t, h_t = water level in the intake pipe - Elevation of the ground water table in m	Head Ratio h_t / h_0
1	0.0	0.700	1.0000
2	0.5	0.690	0.9857
3	1.0	0.680	0.9714
4	2.0	0.680	0.9714
5	10.0	0.670	0.9571
6	15.0	0.670	0.9571
7	30.0	0.670	0.9571
8	40.0	0.660	0.9429
9	50.0	0.660	0.9429
10	60.0	0.650	0.9286
11	70.0	0.650	0.9286
12	80.0	0.640	0.9143
13	90.0	0.640	0.9143
14	100.0	0.640	0.9143
15	110.0	0.630	0.9000
16	120.0	0.630	0.9000



Schematic Diagram Not to the scale



$h_1/h_0 = 0.9429$ $t_1 = 50$ min

$h_2/h_0 = 0.9000$ $t_2 = 110$ min

$h_1/h_2 = 1.0477$

Substituting various values,

$$K = \frac{d^2}{8L} \log_e \frac{L}{R} \frac{\log_e h_1/h_2}{t_2 - t_1}$$

Coefficient of permeability 'k' at 2.00 m depth in cm / min = 5.65E-04

Coefficient of permeability 'k' at 2.00 m depth in cm / sec = 9.42E-06

Results of Permeability Test (By Falling Head Method)

Project : NTPP Hirma

Test Location : BH-10

Date of the Test : 27/12/2024

Depth of Test Section : Between 3.50 and 4.50 m

Co-ordinates : E=914, N=3614

Type of soil at the depth of test = Brownish yellow fine to medium grained clayey sand

Depth of water table seen just before test in bore hole for permeability = 0.70 m (from GL)

Ref : IS 5529 part 1

Details of test setup

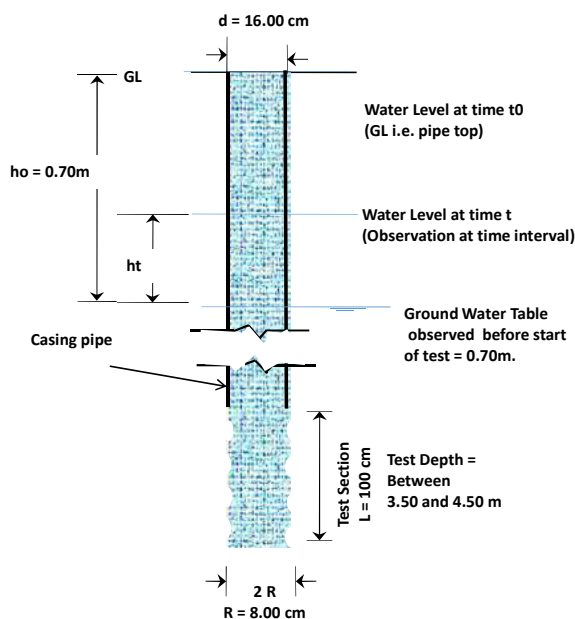
Diameter of stand pipe 'd' in cm = 16

Radius of Hole 'R' in cm = 8

Length of Test Zone 'L' in cm = 100

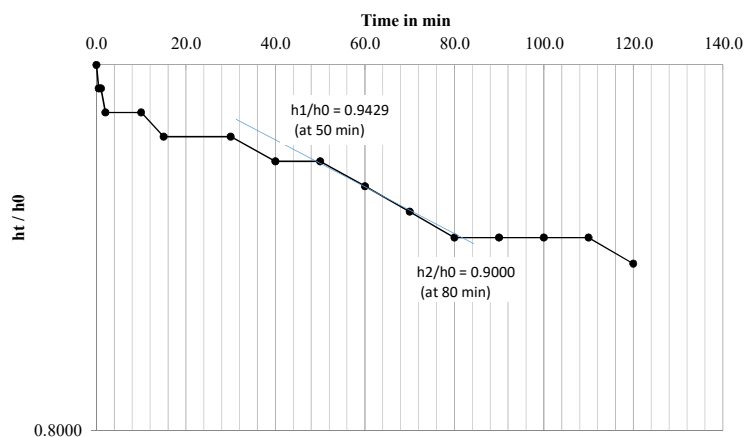
Observations and calculations

Sr. No.	Time of observation in min	Height of water level at time t, h_t = water level in the intake pipe - Elevation of the ground water table in m	Head Ratio h_t / h_0
1	0.0	0.700	1.0000
2	0.5	0.690	0.9857
3	1.0	0.690	0.9857
4	2.0	0.680	0.9714
5	10.0	0.680	0.9714
6	15.0	0.670	0.9571
7	30.0	0.670	0.9571
8	40.0	0.660	0.9429
9	50.0	0.660	0.9429
10	60.0	0.650	0.9286
11	70.0	0.640	0.9143
12	80.0	0.630	0.9000
13	90.0	0.630	0.9000
14	100.0	0.630	0.9000
15	110.0	0.630	0.9000
16	120.0	0.620	0.8857



Schematic Diagram Not to the scale

Head Ratio vs Time

 $h_1/h_0 = 0.9429$ $t_1 = 50$ min $h_2/h_0 = 0.9000$ $t_2 = 80$ min $h_1/h_2 = 1.0477$

Substituting various values,

$$K = \frac{d^2}{8L} \log_e \frac{L}{R} \frac{\log_e h_1/h_2}{t_2 - t_1}$$

Coefficient of permeability 'k' at 4.00 m depth in cm / min = 1.13E-03

Coefficient of permeability 'k' at 4.00 m depth in cm / sec = 1.88E-05

Results of Permeability Test (By Falling Head Method)

Project : NTPP Hirma

Test Location : BH-10

Date of the Test : 28/12/2024

Depth of Test Section : Between 5.50 and 6.50 m

Co-ordinates : E=914, N=3614

Type of soil at the depth of test = Reddish yellow fine to medium grained silty sand

Depth of water table seen just before test in bore hole for permeability = 0.70 m (from GL)

Ref : IS 5529 part 1

Details of test setup

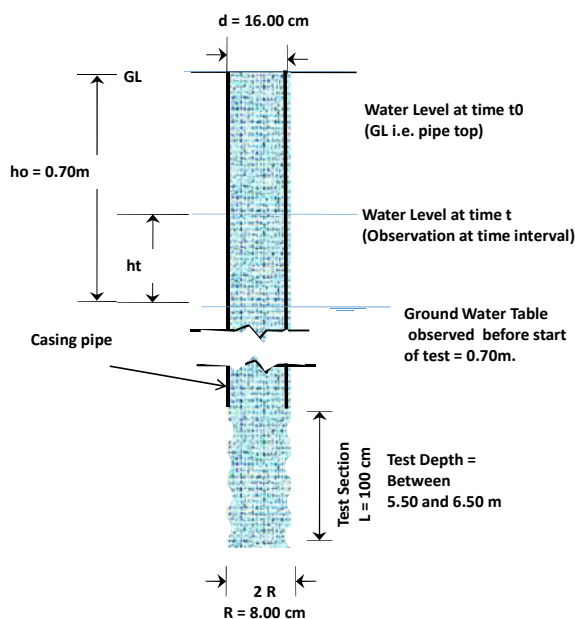
Diameter of stand pipe 'd' in cm = 16

Radius of Hole 'R' in cm = 8

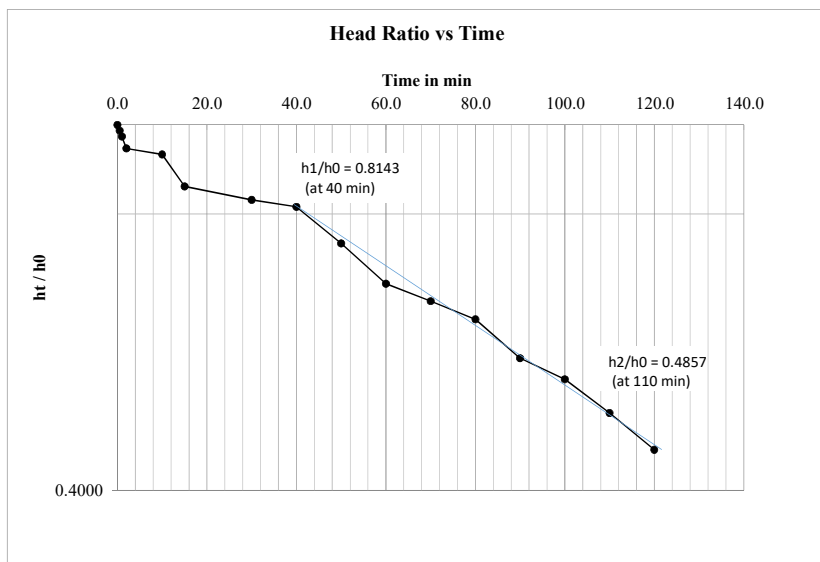
Length of Test Zone 'L' in cm = 100

Observations and calculations

Sr. No.	Time of observation in min	Height of water level at time t, h_t = water level in the intake pipe - Elevation of the ground water table in m	Head Ratio h_t / h_0
1	0.0	0.700	1.0000
2	0.5	0.690	0.9857
3	1.0	0.680	0.9714
4	2.0	0.660	0.9429
5	10.0	0.650	0.9286
6	15.0	0.600	0.8571
7	30.0	0.580	0.8286
8	40.0	0.570	0.8143
9	50.0	0.520	0.7429
10	60.0	0.470	0.6714
11	70.0	0.450	0.6429
12	80.0	0.430	0.6143
13	90.0	0.390	0.5571
14	100.0	0.370	0.5286
15	110.0	0.340	0.4857
16	120.0	0.310	0.4429



Schematic Diagram Not to the scale

 $h_1/h_0 = 0.8143$ $t_1 = 40$ min $h_2/h_0 = 0.4857$ $t_2 = 110$ min $h_1/h_2 = 1.6765$

Substituting various values,

$$K = \frac{d^2}{8L} \log_e \frac{L}{R} \frac{\log_e h_1/h_2}{t_2 - t_1}$$

Coefficient of permeability 'k' at 6.00 m depth in cm / min = 5.38E-03

Coefficient of permeability 'k' at 6.00 m depth in cm / sec = 8.96E-05

Results of Permeability Test (By Falling Head Method)

Project : NTPP Hirma

Test Location : BH-10

Date of the Test : 28/12/2024

Depth of Test Section : Between 7.50 and 8.50 m

Co-ordinates : E=914, N=3614

Type of soil at the depth of test = Reddish yellow fine to medium grained silty sand

Depth of water table seen just before test in bore hole for permeability = 0.70 m (from GL)

Ref : IS 5529 part 1

Details of test setup

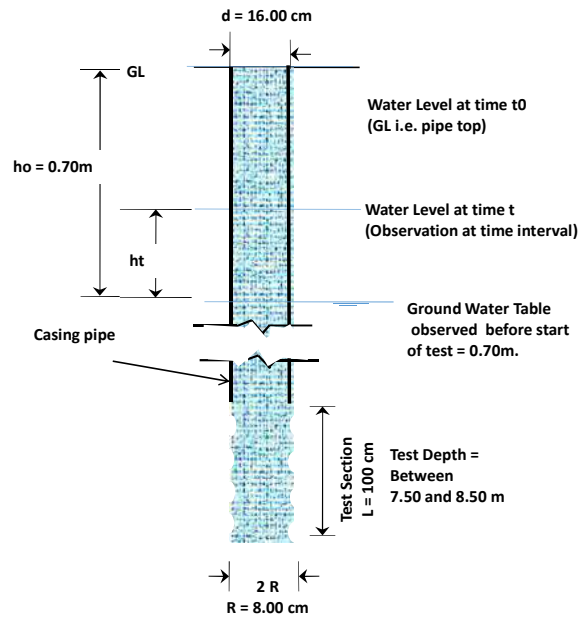
Diameter of stand pipe 'd' in cm = 16

Radius of Hole 'R' in cm = 8

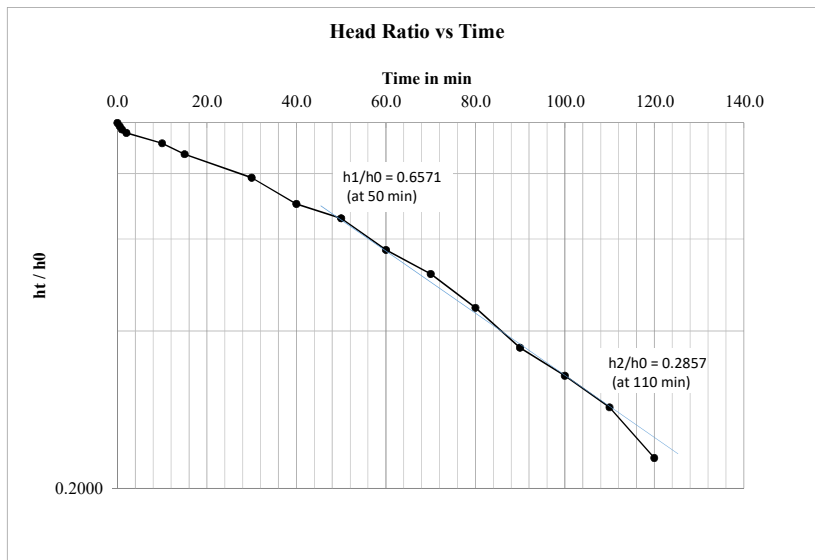
Length of Test Zone 'L' in cm = 100

Observations and calculations

Sr. No.	Time of observation in min	Height of water level at time t, ht = water level in the intake pipe - Elevation of the ground water table in m	Head Ratio ht / ho
1	0.0	0.700	1.0000
2	0.5	0.690	0.9857
3	1.0	0.680	0.9714
4	2.0	0.670	0.9571
5	10.0	0.640	0.9143
6	15.0	0.610	0.8714
7	30.0	0.550	0.7857
8	40.0	0.490	0.7000
9	50.0	0.460	0.6571
10	60.0	0.400	0.5714
11	70.0	0.360	0.5143
12	80.0	0.310	0.4429
13	90.0	0.260	0.3714
14	100.0	0.230	0.3286
15	110.0	0.200	0.2857
16	120.0	0.160	0.2286



Schematic Diagram Not to the scale



h1/ho = 0.6571 t1 = 50 min

h2/ho = 0.2857 t2 = 110 min

h1/h2 = 2.3000

Substituting various values,

$$K = \frac{d^2}{8L} \log_e \frac{L}{R} \frac{\log_e h_1/h_2}{t_2 - t_1}$$

Coefficient of permeability 'k' at 8.00 m depth in cm / min = 1.01E-02

Coefficient of permeability 'k' at 8.00 m depth in cm / sec = 1.69E-04

Results of Permeability Test (By Falling Head Method)

Project : NTPP Hirna

Test Location : BH-10

Date of the Test : 29/12/2024

Depth of Test Section : Between 9.50 and 10.50 m

Co-ordinates : E=914, N=3614

Type of soil at the depth of test = Reddish yellow fine to medium grained silty sand

Depth of water table seen just before test in bore hole for permeability = 0.70 m (from GL)

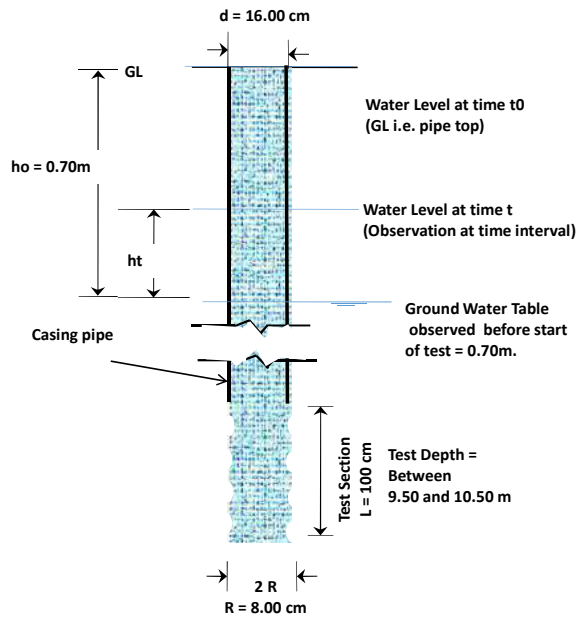
Ref : IS 5529 part 1

Details of test setup

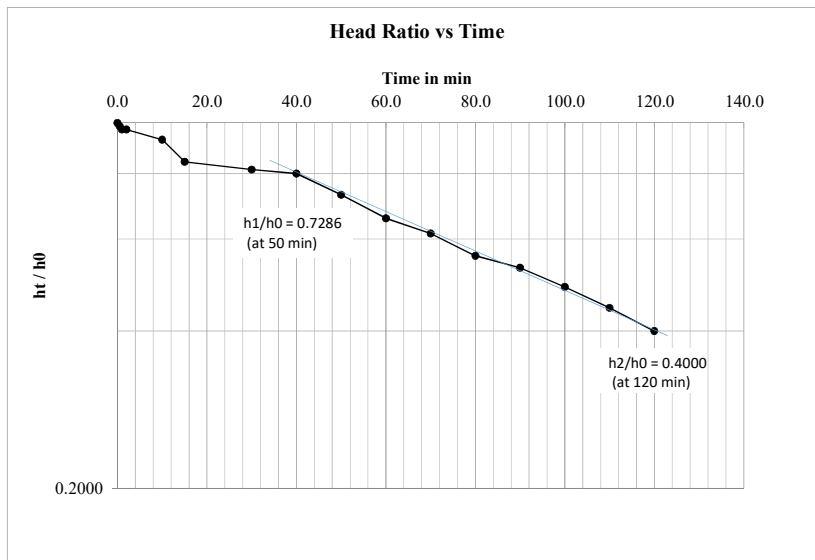
Diameter of stand pipe 'd' in cm = 16
 Radius of Hole 'R' in cm = 8
 Length of Test Zone 'L' in cm = 100

Observations and calculations

Sr. No.	Time of observation in min	Height of water level at time t, h_t = water level in the intake pipe - Elevation of the ground water table in m	Head Ratio h_t / h_0
1	0.0	0.700	1.0000
2	0.5	0.690	0.9857
3	1.0	0.680	0.9714
4	2.0	0.680	0.9714
5	10.0	0.650	0.9286
6	15.0	0.590	0.8429
7	30.0	0.570	0.8143
8	40.0	0.560	0.8000
9	50.0	0.510	0.7286
10	60.0	0.460	0.6571
11	70.0	0.430	0.6143
12	80.0	0.390	0.5571
13	90.0	0.370	0.5286
14	100.0	0.340	0.4857
15	110.0	0.310	0.4429
16	120.0	0.280	0.4000



Schematic Diagram Not to the scale



$h_1/h_0 = 0.7286$ at $t_1 = 50$ min
 $h_2/h_0 = 0.4000$ at $t_2 = 120$ min
 $h_1/h_2 = 1.8215$

Substituting various values,

$$K = \frac{d^2}{8L} \log_e \frac{L}{R} \frac{\log_e h_1/h_2}{t_2 - t_1}$$

Coefficient of permeability 'k' at 10.00 m depth in cm / min = 6.24E-03

Coefficient of permeability 'k' at 10.00 m depth in cm / sec = 1.04E-04

Results of Permeability Test (By Falling Head Method)

Project : NTTP Hirna

Test Location : BH-84

Date of the Test : 27/03/2025

Depth of Test Section : Between 1.50 and 2.50 m

Co-ordinates : E=1152, N=3073

Type of soil at the depth of test = Yellowish grey fine to fine grained silty clay

Depth of water table seen just before test in bore hole for permeability = 1.60 m (from GL)

Ref: IS 5529 part 1

Details of test setup

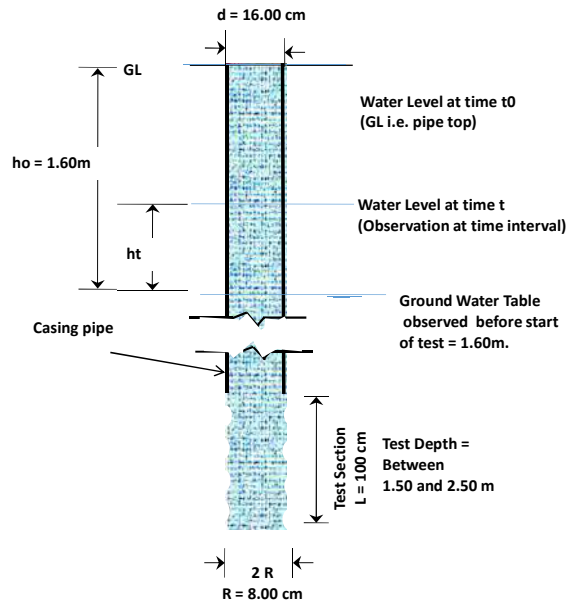
Diameter of stand pipe 'd' in cm = 16

Radius of Hole 'R' in cm = 8

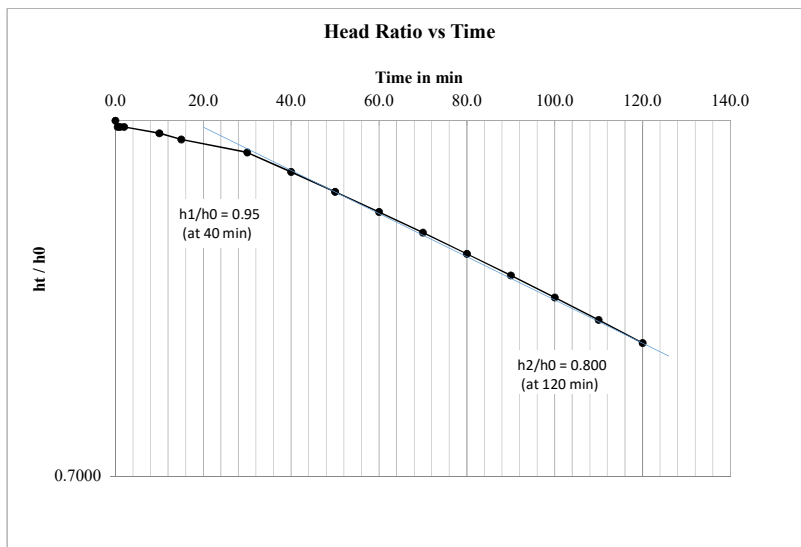
Length of Test Zone 'L' in cm = 100

Observations and calculations

Sr. No.	Time of observation in min	Height of water level at time t, ht = water level in the intake pipe - Elevation of the ground water table in m	Head Ratio ht / ho
1	0.0	1.600	1.0000
2	0.5	1.590	0.9938
3	1.0	1.590	0.9938
4	2.0	1.590	0.9938
5	10.0	1.580	0.9875
6	15.0	1.570	0.9813
7	30.0	1.550	0.9688
8	40.0	1.520	0.9500
9	50.0	1.490	0.9313
10	60.0	1.460	0.9125
11	70.0	1.430	0.8938
12	80.0	1.400	0.8750
13	90.0	1.370	0.8563
14	100.0	1.340	0.8375
15	110.0	1.310	0.8188
16	120.0	1.280	0.8000



Schematic Diagram Not to the scale



$h_1/h_0 = 0.9500$ $t_1 = 40$ min

$h_2/h_0 = 0.8000$ $t_2 = 120$ min

$h_1/h_2 = 1.1875$

Substituting various values,

$$K = \frac{d^2}{8L} \log_e \frac{L}{R} \frac{\log_e h_1/h_2}{t_2 - t_1}$$

Coefficient of permeability 'k' at 2.00 m depth in cm / min = 1.56E-03

Coefficient of permeability 'k' at 2.00 m depth in cm / sec = 2.61E-05

Results of Permeability Test (By Falling Head Method)

Project : NTTP Hirna

Test Location : BH-84

Date of the Test : 27/03/2025

Depth of Test Section : Between 3.50 and 4.50 m

Co-ordinates : E=1152, N=3073

Type of soil at the depth of test = Brownish grey yellowish fine to fine grained silty clay with little gravel

Depth of water table seen just before test in bore hole for permeability = 1.60 m (from GL)

Ref: IS 5529 part 1

Details of test setup

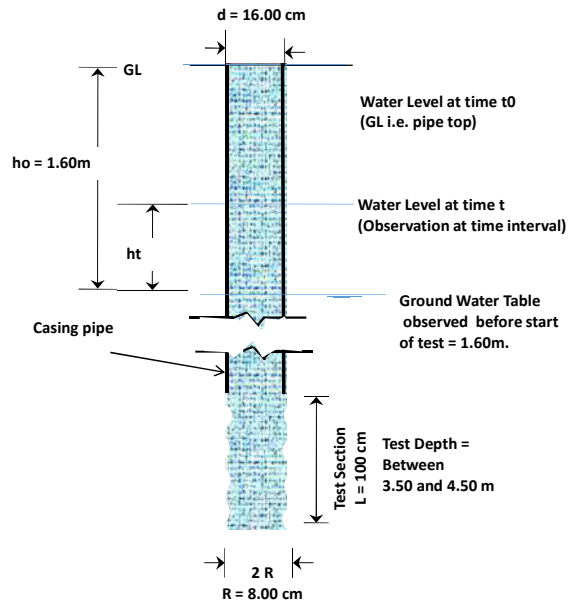
Diameter of stand pipe 'd' in cm = 16

Radius of Hole 'R' in cm = 8

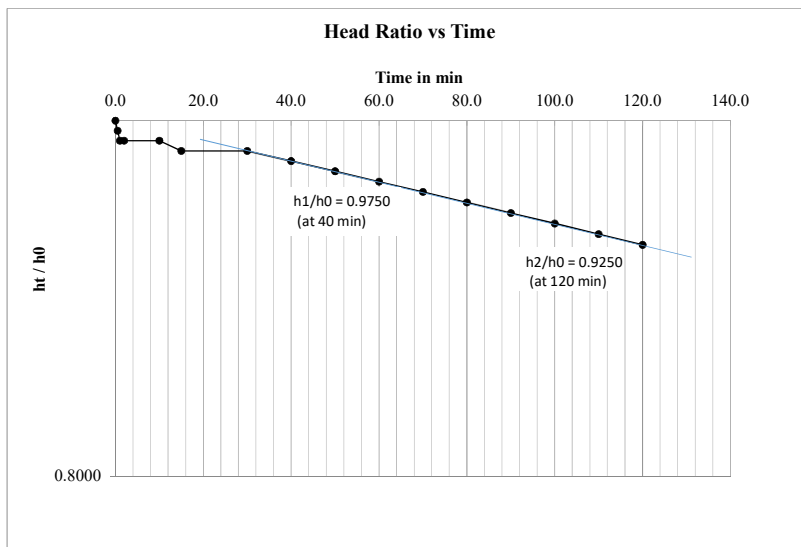
Length of Test Zone 'L' in cm = 100

Observations and calculations

Sr. No.	Time of observation in min	Height of water level at time t, ht = water level in the intake pipe - Elevation of the ground water table in m	Head Ratio ht / ho
1	0.0	1.600	1.0000
2	0.5	1.590	0.9938
3	1.0	1.580	0.9875
4	2.0	1.580	0.9875
5	10.0	1.580	0.9875
6	15.0	1.570	0.9813
7	30.0	1.570	0.9813
8	40.0	1.560	0.9750
9	50.0	1.550	0.9688
10	60.0	1.540	0.9625
11	70.0	1.530	0.9563
12	80.0	1.520	0.9500
13	90.0	1.510	0.9438
14	100.0	1.500	0.9375
15	110.0	1.490	0.9313
16	120.0	1.480	0.9250



Schematic Diagram Not to the scale



$h_1/h_0 = 0.9750$ $t_1 = 40$ min

$h_2/h_0 = 0.9250$ $t_2 = 120$ min

$h_1/h_2 = 1.0541$

Substituting various values,

$$K = \frac{d^2}{8L} \log_e \frac{L}{R} \frac{\log_e h_1/h_2}{t_2 - t_1}$$

Coefficient of permeability 'k' at 4.00 m depth in cm / min = 4.79E-04

Coefficient of permeability 'k' at 4.00 m depth in cm / sec = 7.99E-06

Results of Permeability Test (By Falling Head Method)

Project : NTTP Hirna

Test Location : BH-84

Date of the Test : 27/03/2025

Depth of Test Section : Between 5.50 and 6.50 m

Co-ordinates : E=1152, N=3073

Type of soil at the depth of test = Yellowish grey fine grained silty clay

Depth of water table seen just before test in bore hole for permeability = 1.60 m (from GL)

Ref: IS 5529 part 1

Details of test setup

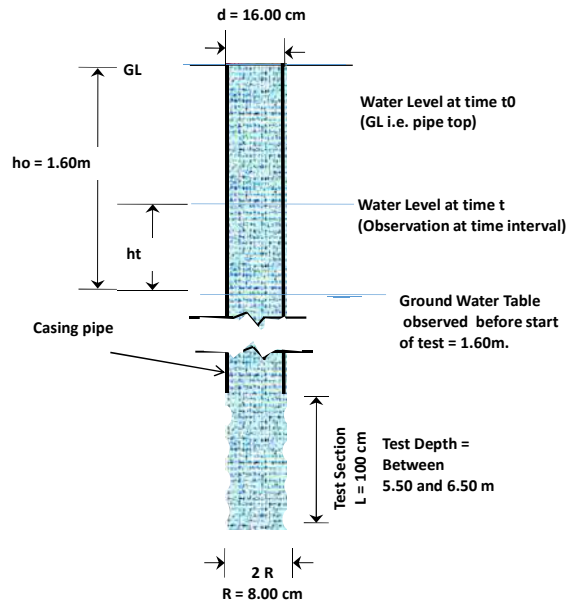
Diameter of stand pipe 'd' in cm = 16

Radius of Hole 'R' in cm = 8

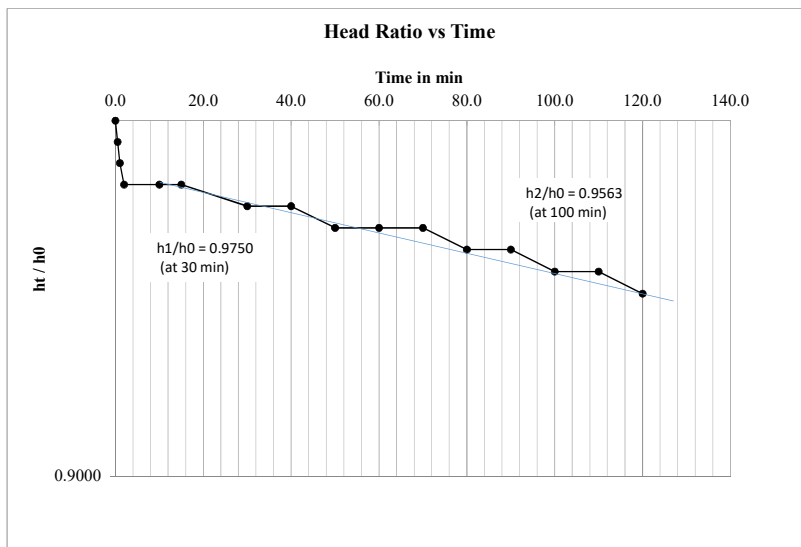
Length of Test Zone 'L' in cm = 100

Observations and calculations

Sr. No.	Time of observation in min	Height of water level at time t, ht = water level in the intake pipe - Elevation of the ground water table in m	Head Ratio ht / ho
1	0.0	1.600	1.0000
2	0.5	1.590	0.9938
3	1.0	1.580	0.9875
4	2.0	1.570	0.9813
5	10.0	1.570	0.9813
6	15.0	1.570	0.9813
7	30.0	1.560	0.9750
8	40.0	1.560	0.9750
9	50.0	1.550	0.9688
10	60.0	1.550	0.9688
11	70.0	1.550	0.9688
12	80.0	1.540	0.9625
13	90.0	1.540	0.9625
14	100.0	1.530	0.9563
15	110.0	1.530	0.9563
16	120.0	1.520	0.9500



Schematic Diagram Not to the scale



$h_1/h_0 = 0.9750$ $t_1 = 30$ min

$h_2/h_0 = 0.9563$ $t_2 = 100$ min

$h_1/h_2 = 1.0196$

Substituting various values,

$$K = \frac{d^2}{8L} \log_e \frac{L}{R} \frac{\log_e h_1/h_2}{t_2 - t_1}$$

Coefficient of permeability 'k' at 6.00 m depth in cm / min = 2.02E-04

Coefficient of permeability 'k' at 6.00 m depth in cm / sec = 3.36E-06

Results of Permeability Test (By Falling Head Method)

Project : NTPP Hirna

Test Location : BH-84

Date of the Test : 27/03/2025

Depth of Test Section : Between 7.50 and 8.50 m

Co-ordinates : E=1152, N=3073

Type of soil at the depth of test = yellowish fine grained silty clay with gravel

Depth of water table seen just before test in bore hole for permeability = 1.60 m (from GL)

Ref: IS 5529 part 1

Details of test setup

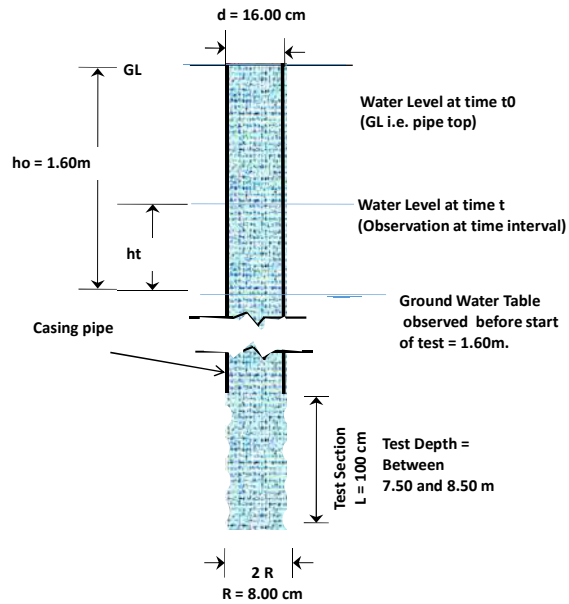
Diameter of stand pipe 'd' in cm = 16

Radius of Hole 'R' in cm = 8

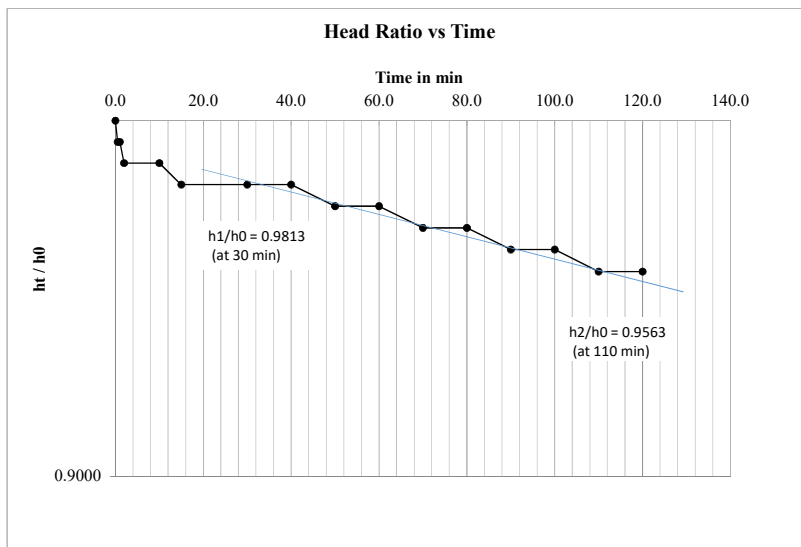
Length of Test Zone 'L' in cm = 100

Observations and calculations

Sr. No.	Time of observation in min	Height of water level at time t, ht = water level in the intake pipe - Elevation of the ground water table in m	Head Ratio ht / ho
1	0.0	1.600	1.0000
2	0.5	1.590	0.9938
3	1.0	1.590	0.9938
4	2.0	1.580	0.9875
5	10.0	1.580	0.9875
6	15.0	1.570	0.9813
7	30.0	1.570	0.9813
8	40.0	1.570	0.9813
9	50.0	1.560	0.9750
10	60.0	1.560	0.9750
11	70.0	1.550	0.9688
12	80.0	1.550	0.9688
13	90.0	1.540	0.9625
14	100.0	1.540	0.9625
15	110.0	1.530	0.9563
16	120.0	1.530	0.9563



Schematic Diagram Not to the scale



$h_1/h_0 = 0.9813$ $t_1 = 30$ min

$h_2/h_0 = 0.9563$ $t_2 = 110$ min

$h_1/h_2 = 1.0261$

Substituting various values,

$$K = \frac{d^2}{8L} \log_e \frac{L}{R} \frac{\log_e h_1/h_2}{t_2 - t_1}$$

Coefficient of permeability 'k' at 8.00 m depth in cm / min = 2.35E-04

Coefficient of permeability 'k' at 8.00 m depth in cm / sec = 3.92E-06

Results of Permeability Test (By Falling Head Method)

Project : NTTP Hirna

Test Location : BH-84

Date of the Test : 27/03/2025

Depth of Test Section : Between 9.50 and 10.50 m

Co-ordinates : E=1152, N=3073

Type of soil at the depth of test = Yellowish fine grained silty clay with gravel

Depth of water table seen just before test in bore hole for permeability = 1.60 m (from GL)

Ref: IS 5529 part 1

Details of test setup

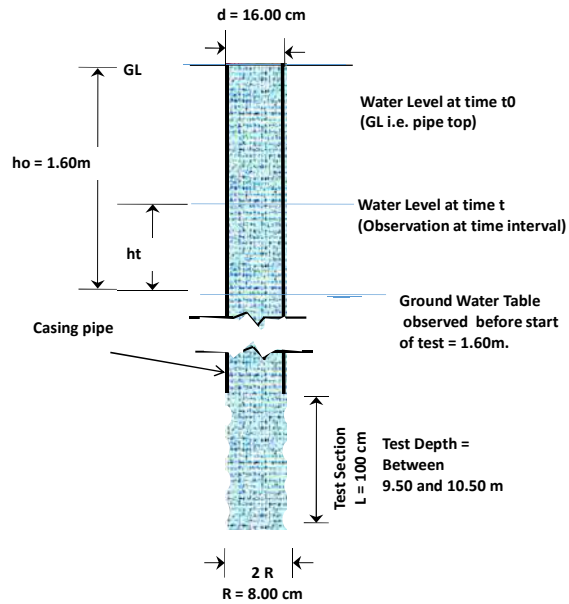
Diameter of stand pipe 'd' in cm = 16

Radius of Hole 'R' in cm = 8

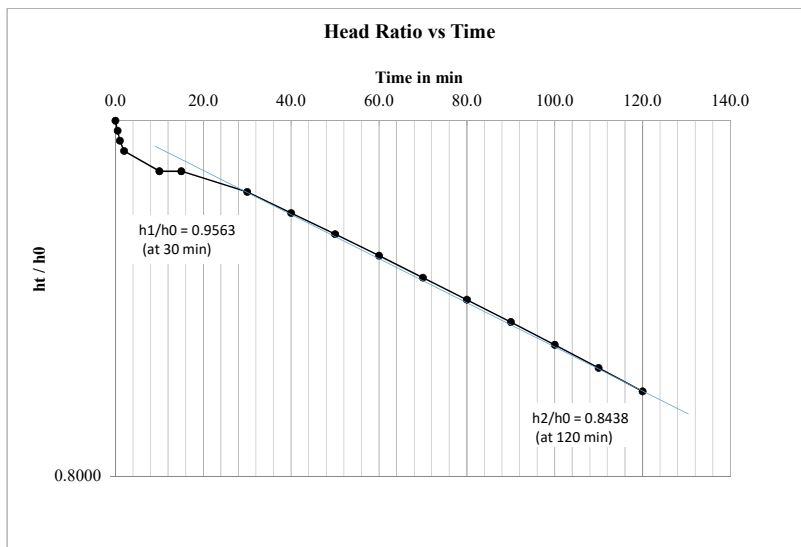
Length of Test Zone 'L' in cm = 100

Observations and calculations

Sr. No.	Time of observation in min	Height of water level at time t, ht = water level in the intake pipe - Elevation of the ground water table in m	Head Ratio ht / ho
1	0.0	1.600	1.0000
2	0.5	1.590	0.9938
3	1.0	1.580	0.9875
4	2.0	1.570	0.9813
5	10.0	1.550	0.9688
6	15.0	1.550	0.9688
7	30.0	1.530	0.9563
8	40.0	1.510	0.9438
9	50.0	1.490	0.9313
10	60.0	1.470	0.9188
11	70.0	1.450	0.9063
12	80.0	1.430	0.8938
13	90.0	1.410	0.8813
14	100.0	1.390	0.8688
15	110.0	1.370	0.8563
16	120.0	1.350	0.8438



Schematic Diagram Not to the scale



h1/h0 = 0.9563 t1 30 min

h2/h0 = 0.8438 t2 120 min

h1/h2 = 1.1333

Substituting various values,

$$K = \frac{d^2}{8L} \log_e \frac{L}{R} \frac{\log_e h_1/h_2}{t_2 - t_1}$$

Coefficient of permeability 'k' at 10.00 m depth in cm / min = 1.01E-03

Coefficient of permeability 'k' at 10.00 m depth in cm / sec = 1.69E-05

6. Field California Bearing Ratio

6.1 Methodology

The Bearing Ratio Test (CBR) was conducted to evaluate the strength of the subgrade and base for the paving area proposed for the BHEL 3x800 MW NLC Talabira TPP, covering Units 1, 2, and 3. The results obtained from these tests will be used in conjunction with the MORTH specifications for the design of flexible pavements in the road area. The test was carried out in the field under soaked conditions. The CBR is defined as the ratio of the force per unit area required to penetrate a soil mass with a standard circular piston at a rate of 1.25 mm per minute, to the force required for a corresponding penetration of a standard material.

For the execution of the tests, we mobilized one set of equipment for the three planned tests. The equipment consists of a mechanical screw loading jack with a swivel head to apply load to the penetration piston. This device was mounted on a truck/excavator for stable operation. The jack, with a capacity of 5000 kg, applied load at a uniform penetration rate of 1.25 mm per minute. The load was measured using a calibrated proving ring with a 5000 kg capacity, coupled with a dial gauge that could read to an accuracy of 0.002 mm, and had a travel range of 5 mm. The metal penetration piston used had a diameter of 50 +/- 0.1 mm. The penetration was recorded using a dial gauge with a 25 mm travel and 0.02 mm accuracy. The test was conducted with a surcharge of 15 kg, comprising one annular metal weight (5 kg) and two circular slotted weights (5 kg each).

The test was carried out for verifying the thickness of various paving layers proposed and to check the strength of layers already laid, to ensure compliance with the design strength. CBR tests were performed on the natural subgrade soil to verify its strength, while for granular sub-base, the test was carried out on the top surface of the filling. It is preferred to carry out both tests at the same spot, as well as at various locations throughout the proposed paving area. The testing locations were chosen based on the paving area, and tests were planned at intervals not exceeding 100 m x 100 m.

Prior to testing, the surface area to be tested was cleaned of loose and dry material and leveled. At each test location, six tests were carried out within an area of 1 m x 1 m. The surface was soaked by sprinkling water while keeping the surcharge weight in place for at least 15 minutes before starting the operation. The test procedure adhered to IS: 2720 (Part 31), and a sample of soil was collected for further testing.

Following the test, calculations were performed, and a load-penetration curve was plotted. If applicable, corrections were applied. The bearing ratio was calculated for penetrations of 2.5 mm and 5.0 mm. In general, the bearing ratio at 2.5 mm penetration is higher than at 5.0 mm, and in such cases, the 2.5 mm value was used for the bearing ratio. However, if the bearing ratio at 5.0 mm penetration was higher, the test was repeated, and if identical results were obtained, the ratio at 5.0 mm penetration was used for design purposes.

The bearing ratio was reported to the first decimal place.

6.2 Recommendations:

For design of roads, design CBR of 4% is recommended. If natural ground level is raised by filled up soil upto FGL, than design CBR should be taken as per laboratory CBR test.

KCT Consultancy Services, Ahmedabad

Results of Field CBR Test No. 1

(IS : 2720 (Part 31) 1969)

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

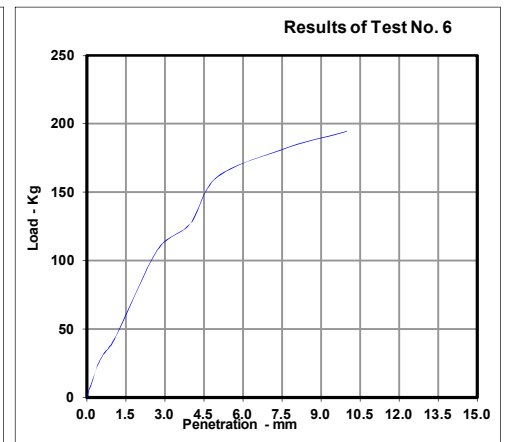
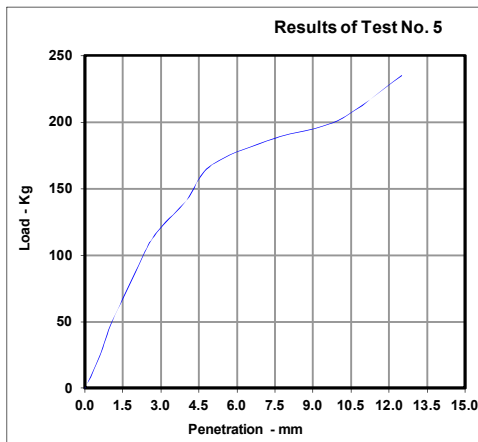
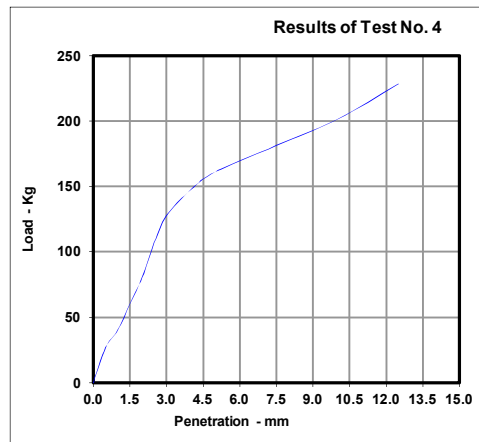
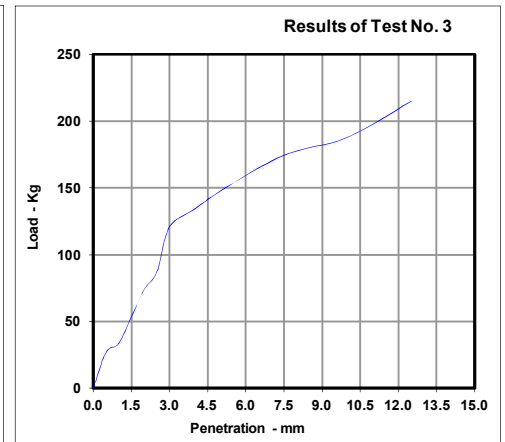
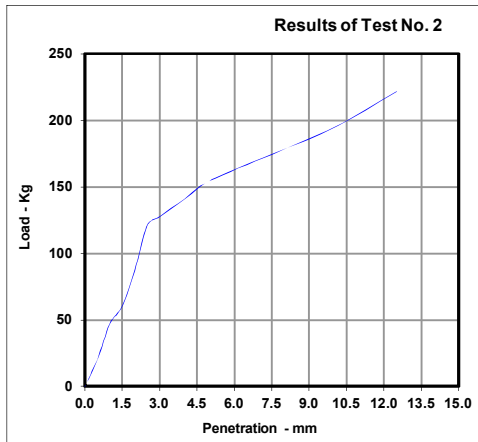
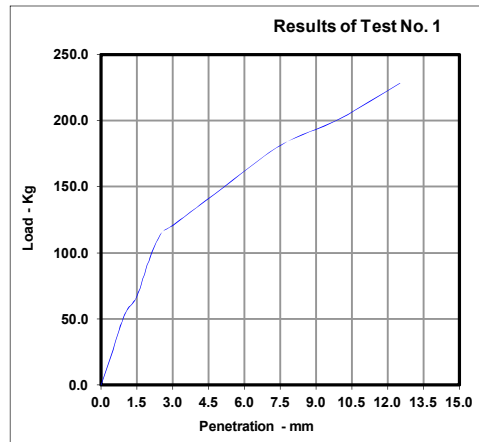
Location / Chainage : E 1194, N 3524 RL: 209.87m

Condition of Soil : At Natural moisture Content

Depth of Test: 0.50m from GL

Surcharge Weight : 15 Kg

Test - 1		Test - 2		Test - 3		Test - 4		Test - 5		Test - 6	
Penetration	Load	Penetration	Load	Penetration	Load	Penetration	Load	Penetration	Load	Penetration	Load
mm	Kg	mm	Kg	mm	Kg	mm	Kg	mm	Kg	mm	Kg
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.5	26.8	0.5	20.1	0.5	26.8	0.5	26.8	0.5	20.1	0.5	26.8
1.0	53.7	1.0	47.0	1.0	33.6	1.0	40.3	1.0	47.0	1.0	40.3
1.5	67.1	1.5	60.4	1.5	53.7	1.5	60.4	1.5	67.1	1.5	60.4
2.0	93.9	2.0	87.2	2.0	73.8	2.0	80.5	2.0	87.2	2.0	80.5
2.5	114.1	2.5	120.8	2.5	87.2	2.5	107.4	2.5	107.4	2.5	100.7
3.0	120.8	3.0	127.5	3.0	120.8	3.0	127.5	3.0	120.8	3.0	114.1
4.0	134.2	4.0	140.9	4.0	134.2	4.0	147.6	4.0	140.9	4.0	127.5
5.0	147.6	5.0	154.3	5.0	147.6	5.0	161.0	5.0	167.8	5.0	161.0
7.5	181.2	7.5	174.5	7.5	174.5	7.5	181.2	7.5	187.9	7.5	181.2
10.0	201.3	10.0	194.6	10.0	187.9	10.0	201.3	10.0	201.3	10.0	194.6
12.5	228.1	12.5	221.4	12.5	214.7	12.5	228.1	12.5	234.9	12.5	221.4



CBR Value at 2.5 mm			CBR Value at 5.0 mm		
Test -1	8.3		Test -1	7.2	
Test -2	8.8		Test -2	7.5	
Test -3	6.4		Test -3	7.2	
Test -4	7.8		Test -4	7.8	
Test -5	7.8		Test -5	8.2	
Test -6	7.3		Test -6	7.8	
Average in %	7.8		Average in %	7.6	

Design CBR recommended = 7.8 %

Legend — Observed Readings while testing

Page No 201 of 359 — Corrected Readings, wherever applicable

KCT Consultancy Services, Ahmedabad

Results of Field CBR Test No. 2

(IS : 2720 (Part 31) 1969)

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

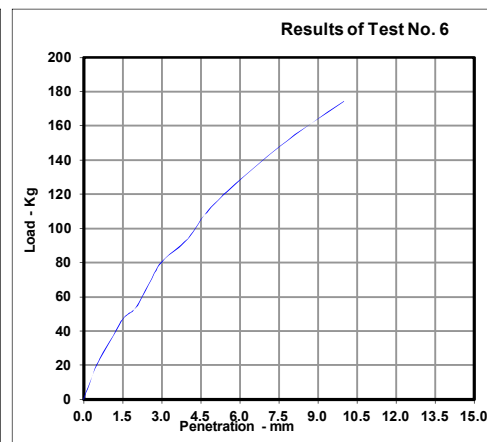
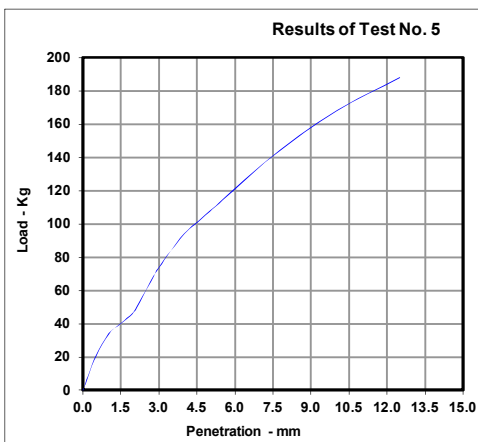
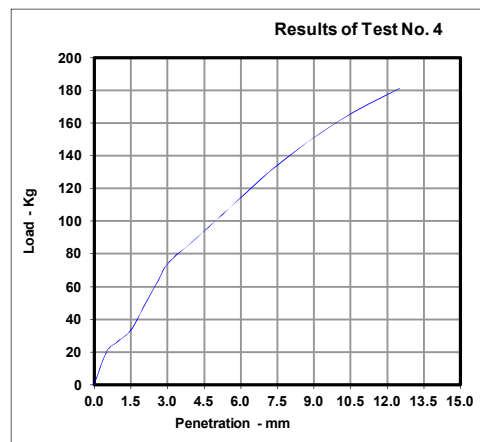
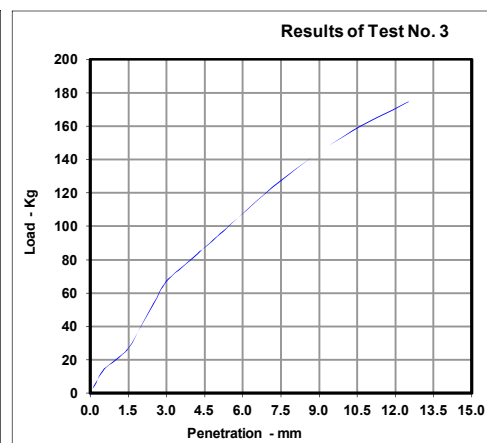
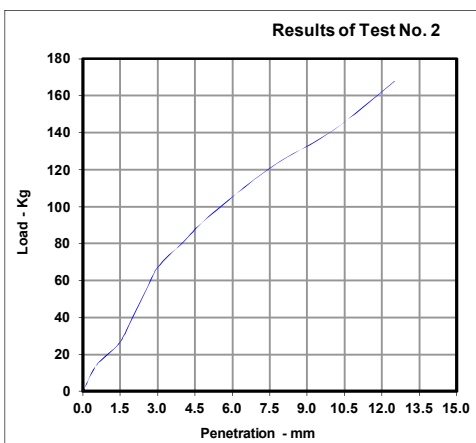
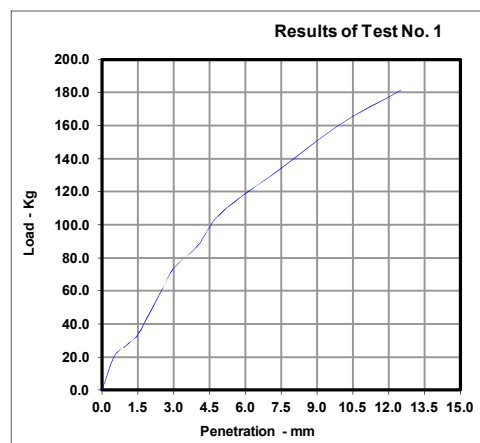
Location / Chainage : E 1991, N 2973 RL: 200.50m

Condition of Soil : At Natural moisture Content

Depth of Test: 0.50m from GL

Surcharge Weight : 15 Kg

Test - 1		Test - 2		Test - 3		Test - 4		Test - 5		Test - 6	
Penetration	Load	Penetration	Load	Penetration	Load	Penetration	Load	Penetration	Load	Penetration	Load
mm	Kg	mm	Kg	mm	Kg	mm	Kg	mm	Kg	mm	Kg
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.5	20.1	0.5	13.4	0.5	13.4	0.5	20.1	0.5	20.1	0.5	20.1
1.0	26.8	1.0	20.1	1.0	20.1	1.0	26.8	1.0	33.6	1.0	33.6
1.5	33.6	1.5	26.8	1.5	26.8	1.5	33.6	1.5	40.3	1.5	47.0
2.0	47.0	2.0	40.3	2.0	40.3	2.0	47.0	2.0	47.0	2.0	53.7
2.5	60.4	2.5	53.7	2.5	53.7	2.5	60.4	2.5	60.4	2.5	67.1
3.0	73.8	3.0	67.1	3.0	67.1	3.0	73.8	3.0	73.8	3.0	80.5
4.0	87.2	4.0	80.5	4.0	80.5	4.0	87.2	4.0	93.9	4.0	93.9
5.0	107.4	5.0	93.9	5.0	93.9	5.0	100.7	5.0	107.4	5.0	114.1
7.5	134.2	7.5	120.8	7.5	127.5	7.5	134.2	7.5	140.9	7.5	147.6
10.0	161.0	10.0	140.9	10.0	154.3	10.0	161.0	10.0	167.8	10.0	174.5
12.5	181.2	12.5	167.8	12.5	174.5	12.5	181.2	12.5	187.9	12.5	201.3



CBR Value at 2.5 mm		CBR Value at 5.0 mm	
Test -1	4.4	Test -1	5.2
Test -2	3.9	Test -2	4.6
Test -3	3.9	Test -3	4.6
Test -4	4.4	Test -4	4.9
Test -5	4.4	Test -5	5.2
Test -6	4.9	Test -6	5.6
Average in %	4.3	Average in %	5.0

Design CBR recommended = 5 %

Legend ——— Observed Readings while testing

Page No 202 of 359 ——— Corrected Readings, wherever applicable

KCT Consultancy Services, Ahmedabad

Results of Field CBR Test No. 3

(IS : 2720 (Part 31) 1969)

Project : NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

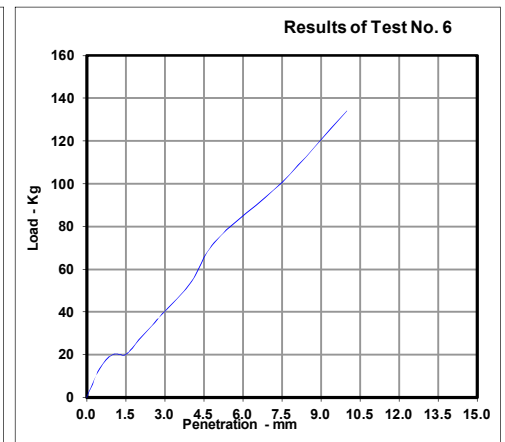
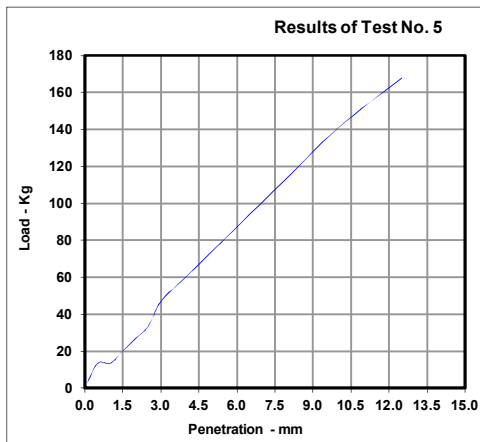
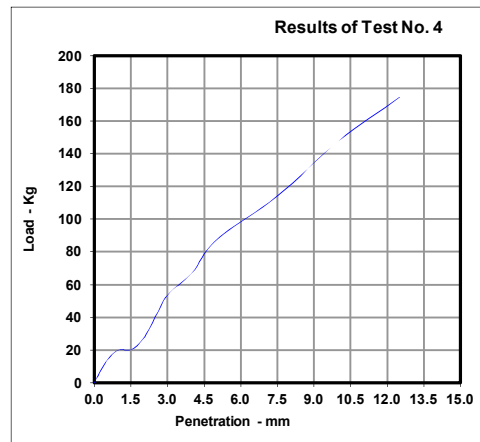
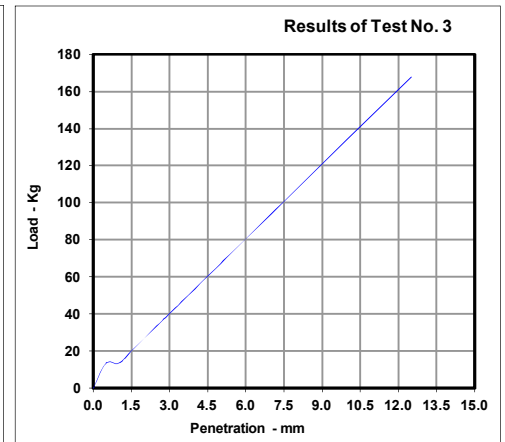
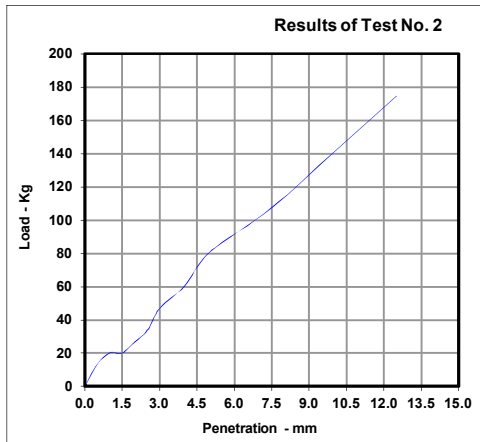
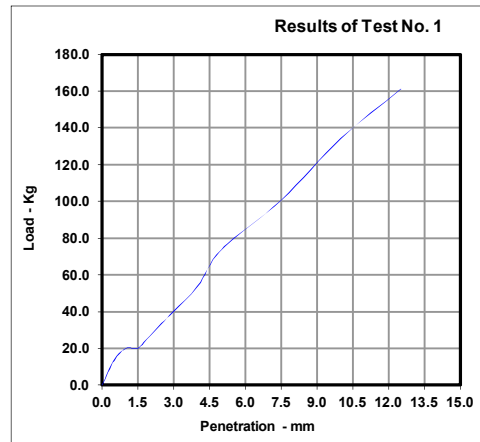
Location / Chainage : E 1493, N 2167 RL: 201.80m

Condition of Soil : At Natural moisture Content

Depth of Test: 0.50m from GL

Surcharge Weight : 15 Kg

Test - 1		Test - 2		Test - 3		Test - 4		Test - 5		Test - 6	
Penetration	Load	Penetration	Load	Penetration	Load	Penetration	Load	Penetration	Load	Penetration	Load
mm	Kg	mm	Kg	mm	Kg	mm	Kg	mm	Kg	mm	Kg
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.5	13.4	0.5	13.4	0.5	13.4	0.5	13.4	0.5	13.4	0.5	13.4
1.0	20.1	1.0	20.1	1.0	13.4	1.0	20.1	1.0	13.4	1.0	20.1
1.5	20.1	1.5	20.1	1.5	20.1	1.5	20.1	1.5	20.1	1.5	20.1
2.0	26.8	2.0	26.8	2.0	26.8	2.0	26.8	2.0	26.8	2.0	26.8
2.5	33.6	2.5	33.6	2.5	33.6	2.5	40.3	2.5	33.6	2.5	33.6
3.0	40.3	3.0	47.0	3.0	40.3	3.0	53.7	3.0	47.0	3.0	40.3
4.0	53.7	4.0	60.4	4.0	53.7	4.0	67.1	4.0	60.4	4.0	53.7
5.0	73.8	5.0	80.5	5.0	67.1	5.0	87.2	5.0	73.8	5.0	73.8
7.5	100.7	7.5	107.4	7.5	100.7	7.5	114.1	7.5	107.4	7.5	100.7
10.0	134.2	10.0	140.9	10.0	134.2	10.0	147.6	10.0	140.9	10.0	134.2
12.5	161.0	12.5	174.5	12.5	167.8	12.5	174.5	12.5	167.8	12.5	167.8



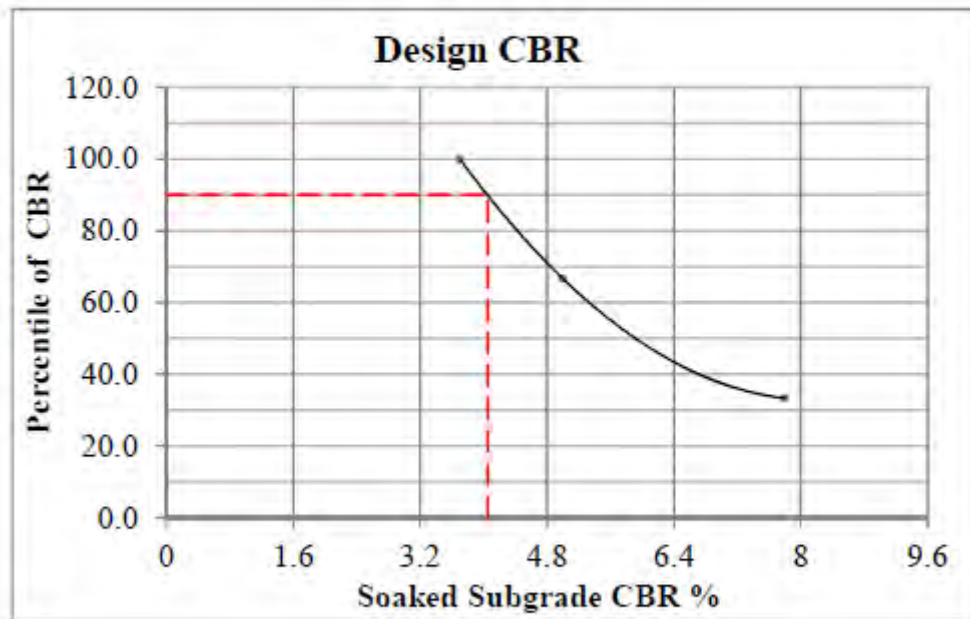
CBR Value at 2.5 mm		CBR Value at 5.0 mm	
Test -1	2.4	Test -1	3.6
Test -2	2.4	Test -2	3.9
Test -3	2.4	Test -3	3.3
Test -4	2.9	Test -4	4.2
Test -5	2.4	Test -5	3.6
Test -6	2.4	Test -6	3.6
Average in %	2.5	Average in %	3.7

Design CBR recommended = 3.7 %

Legend — Observed Readings while testing

Page No 203 of 359 — Corrected Readings, wherever applicable

Project Name : Bhel Talabira



Suggested Design CBR value:- 4.1

7. Cyclic plate load test

7.1.0 Method Statement

7.1.1 Introduction

Cyclic Plate Load Test have to be conducted at site of Talabira. Users of the plant desired to confirm the Dynamic Properties of Soil.

7.1.2 Objective

Cyclic Plate load test is the effective way for the determination of dynamic properties of soil. By conducting cyclic plate load test the plot of pressure vs elastic rebound can be used for finding out the dynamic properties of soil.

For this confirmatory investigation phase, it is necessary to

1. Conduct Cyclic plate load test
2. Analysis of results

The work shall be carried out as per provisions of IS: 1888 & IS: 5249

7.1.3 Scope

Detailed scope of work includes conducting cyclic plate load test at 5 No. of location. Scope of work includes preparation of technical report with findings of exploration.

Reference: IS: 1888 and IS: 5249

Purpose: Determination of Dynamic Properties of Soil.

7.1.4 Equipments

Bearing Plate of 45cm x 45cm, Dial Gauges with Maximum travel upto 50mm having L.C. of 0.01mm, Spikes, Spike holders, 2 RSJ ISMB 250, Hydraulic Jack having 50T Capacity.

7.1.5 Procedure

Apparatus

Reaction load is required to generate loading on to the plate. Different arrangements are possible. The main objective is to make an arrangement which can provide the adequate reaction. Mainly dead weight kentledge or anchored systems are used. We proposed to use a reaction girder in form of rolled steel joists. For anchoring the RSJ the steel plates holding spikes are used which are arresting the girder at both ends adequately so that they remain secured to the ground up to the designed loading and unloading is done.

Test Arrangement

As mentioned above the reaction girder is secured properly with the help of spike holders where, adequate numbers of spikes are inserted in the ground, so that the girder is anchored properly. Also, it should be arranged such that, it provides sufficient working space. No support of loading arrangement should be located within a distance of 2.5 times size of test plate from its centre. The test plate shall be placed over a fine sand layer of maximum thickness 5 mm, so that the centre of plate coincides with the centre of reaction load, with the help of a plumb and bob and horizontally leveled by a spirit level to

avoid eccentric loading. The hydraulic jack should be centrally placed over the plate with the loading column in between the jack and reaction load so as to transfer load to the plate. A minimum seating pressure of 70 g/cm² shall be applied and removed before starting the load test. The two supports of the reference beam or datum rod shall be placed over firm ground, fixed with minimum two dial gauges resting at diametrically opposite ends of the plates. The dial gauges shall be so arranged that settlement is measured continuously without any resetting in between.

Methodology of Test

This test shall be conducted on similar lines as the ordinary plate load test with an addition that unloading shall also be done before each stage of loading. After the set-up has been arranged the initial readings of the dial gauges should be noted and the first increment of static load should be applied to the plate. This load shall be maintained constant throughout for a period till no further settlement occurs or the rate of settlement becomes negligible. The final readings of the dial gauges should then be recorded. The entire load is then removed quickly but gradually and the plate allowed to rebound. After each stage of loading, the load shall be removed in a minimum of two stages and as directed by the engineer-in-charge. After each stage of reduction of load, dial gauge readings and settlements shall be taken for at least one hour until the readings stabilize. Thereafter the next loading stage shall commence. The load shall be increased in stages. These stages shall be 20, 40, 70, 100, 150, 200, 250, 300, 400, 500, 600 and 800kN per sqm or as directed by the engineer-in-charge. The loading and unloading cycles shall be continued till the estimated ultimate load has been reached or continued till the settlement exceeds 25mm. Recording and analysis of test data shall be as per IS: 5249. Therefore, in all cases of loading and unloading sufficient readings are obtained to established trend.

Settlement and Observation

Settlements should be observed for each loading & unloading and should be taken at an interval as follows: for cohesive soils, each load increment must be sustained until the settlement rate is reduced to less than 0.02 mm/min or until 6 hours have passed, whichever is later. Dial gauge readings for settlement shall be recorded at the following intervals: 1, 2.25, 4, 6.25, 9, 16, 25, 60, 90, and 120 minutes from the start of each loading stage. Subsequently, readings should be taken hourly for an additional 4 hours, and every two hours thereafter for the following 6 hours. For non-cohesive soils, each load stage shall be maintained for at least one hour or until the settlement rate falls below 0.02 mm/min, whichever occurs later. The final load increment shall be maintained for a minimum of 24 hours. Loading shall proceed in increments as specified until one of the following conditions is met: a) Failure of soil under the plate i.e. the settlement of the plate at constant load becomes progressive and reaches a value of 40 mm or more. b) Load intensity of 800 kN/sqm is reached without failure of the soil.

7.1.6 Calculations

Load vs Settlement Curve shall be plotted showing elastic rebound after each load intervals. Also load vs elastic rebound trend shall be plotted to find out the dynamic properties. The dynamic properties calculated are Co-efficient of elastic uniform and non-uniform compression and Co-efficient of elastic uniform and non-uniform shear.

7.2 Recommendations:

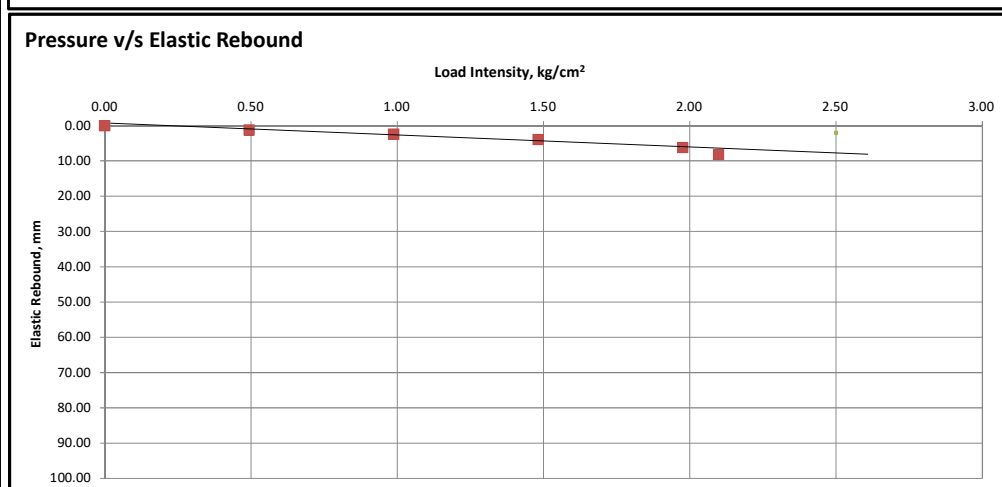
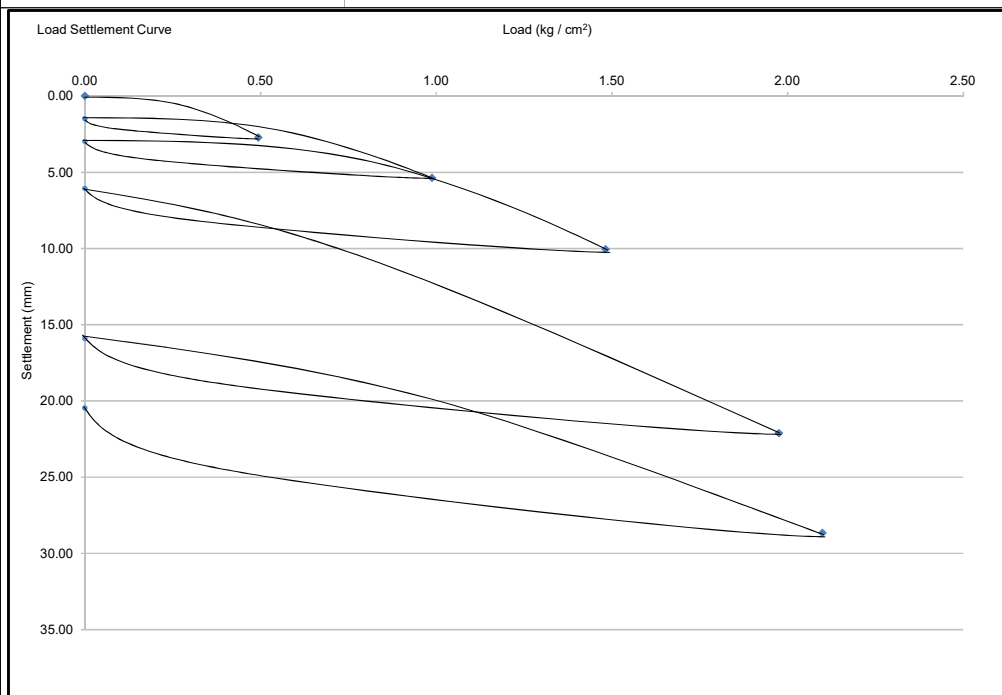
The dynamic properties obtained are summarized as below:

Sr No	Test No	Location	Dynamic Parameters for foundation with Base area of 10m ²						
			Coefficient of elastic uniform compression	Coefficient of elastic non uniform compression	Coefficient of elastic uniform shear	Coefficient of elastic non uniform shear	Modulus of Elasticity	Shear modulus	Bulk Modulus
			kg / sqcm / cm				kg / sqcm		
1	CPLT-1	Boiler Unit-1	0.60	1.00	0.30	0.40	150.36	53.70	250.60
2	CPLT-2	Boiler & Mill bunker unit-1	1.80	3.10	0.90	1.30	451.07	161.10	1503.57
3	CPLT-3	ID Fan Unit 1&2	0.97	1.70	0.49	0.73	243.08	86.81	810.27
4	CPLT-4	Boiler & Mill bunker unit-2	0.70	1.30	0.40	0.60	175.42	62.64	292.37
5	CPLT-5	Gypsum dewatering building and storage area, Process water tank, Lime stone slurry storage tank & agitator	0.85	1.5	0.43	0.64	213.01	76.08	710.03

KCT Consultancy Services, Ahmedabad**Cyclic Plate Load Test No. 1**

(IS : 5249 and 1888)

Project :	NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha
Location :	Boiler Unit-1
Depth at which Test Conducted :	2.00m
Sub soil type:	Brownish fine to fine grained silty sandy clay with some gravel
Size of the Plate :	0.45m x 0.45m
Size of the Pit :	6.00 m X 3.00 m
Co-ordinates:	N 3215,E 1182
RL of test level :	195.25m
RL of EGL level :	197.25m
Date	17-05-2025



Coefficient of elastic uniform compression (Plate) = 4.1 kg / sqcm / cm

Coefficient of elastic uniform compression (10 sqm) = 0.6 kg / sqcm / cm

Coefficient of elastic nonuniform compression = 1 kg / sqcm / cm

Coefficient of elastic uniform shear = 0.3 kg / sqcm / cm

Coefficient of elastic non uniform shear = 0.4 kg / sqcm / cm

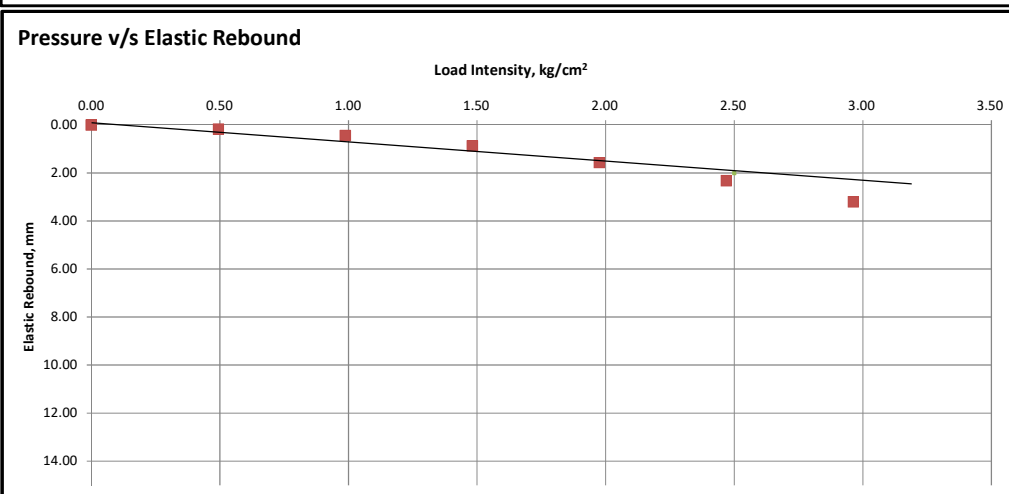
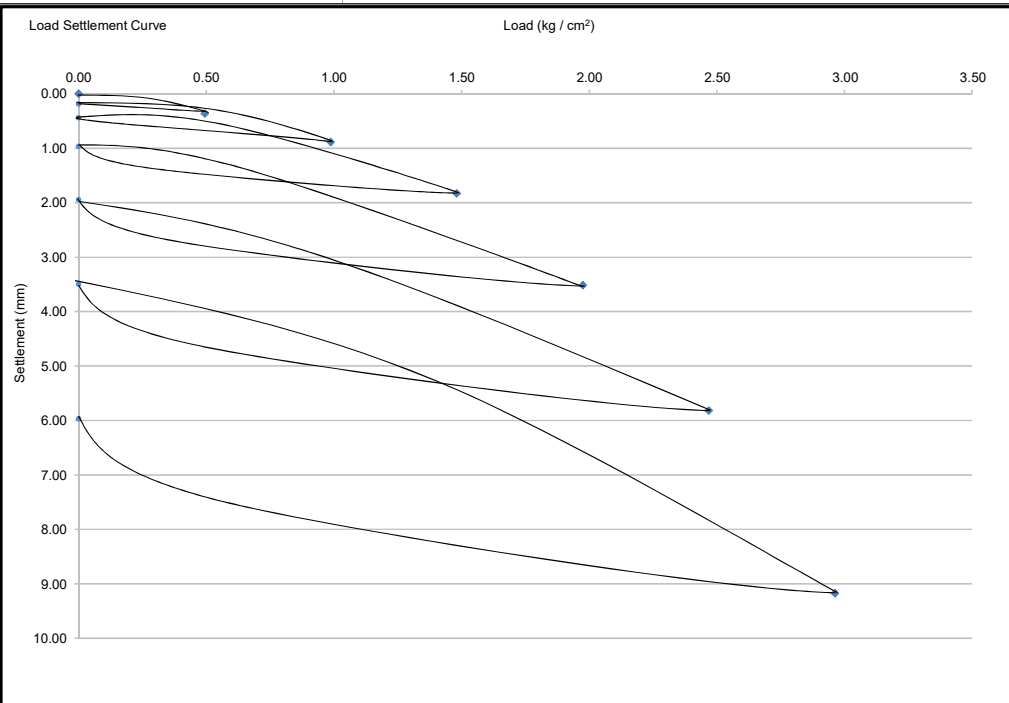
For KCT Consultancy Services,

(Dr. K. K. Thaker)

KCT Consultancy Services, Ahmedabad**Cyclic Plate Load Test No. 2**

(IS : 5249 and 1888)

Project :	NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha
Location :	Boiler & Mill bunker unit-1
Depth at which Test Conducted :	1.20m
Sub soil type:	Yellowish grey sandy clay with some silt and gravels
Size of the Plate :	0.45m x 0.45m
Size of the Pit :	2.50 m X 3.00 m
Co-ordinates:	N 3219.56,E 1196.26
RL of test level :	198.30m
RL of EGL:	199.50m
Date	14-12-2024



Coefficient of elastic uniform compression (Plate) = 12.5 kg / sqcm / cm

Coefficient of elastic uniform compression (10 sqm) = 1.8 kg / sqcm / cm

Coefficient of elastic nonuniform compression = 3.1 kg / sqcm / cm

Coefficient of elastic uniform shear = 0.9 kg / sqcm / cm

Coefficient of elastic non uniform shear = 1.3 kg / sqcm / cm

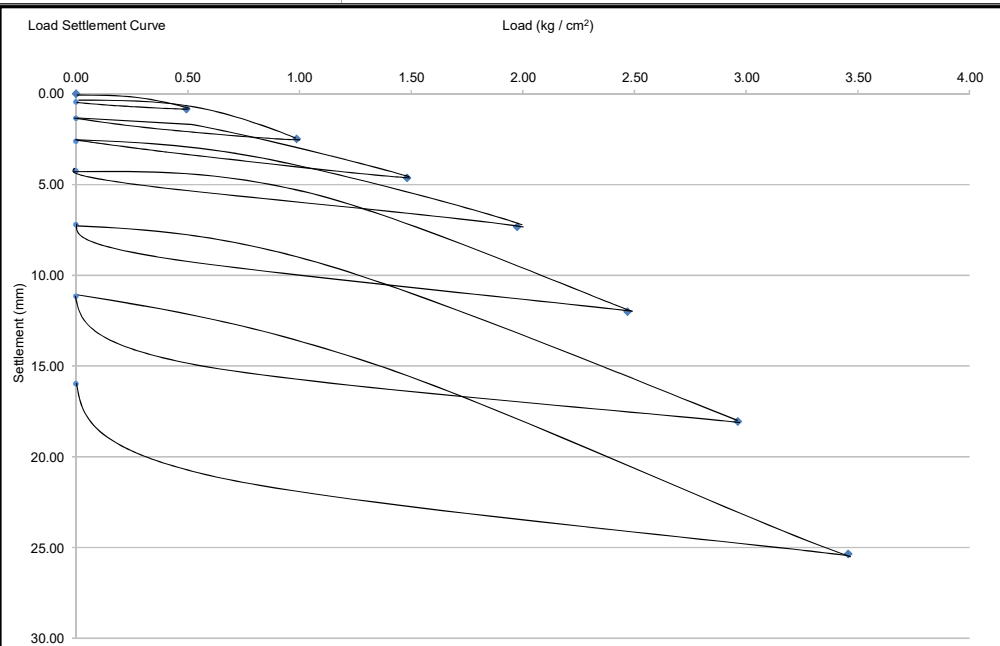
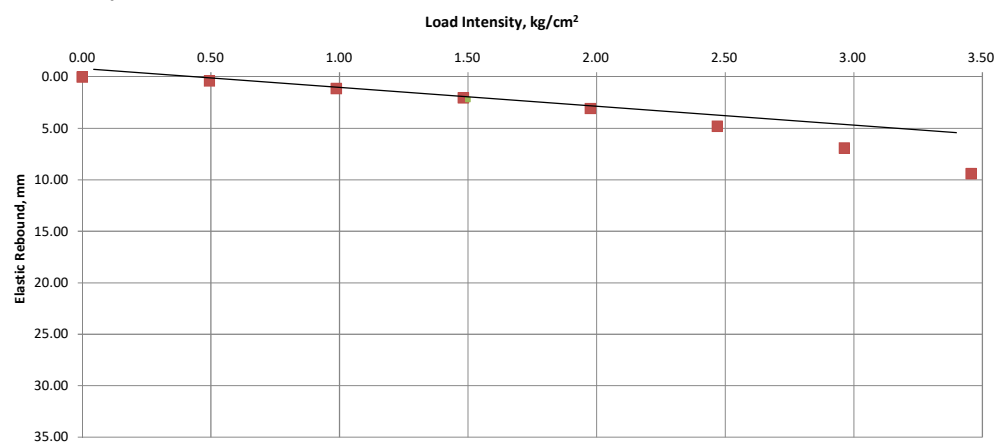
For KCT Consultancy Services,

(Dr. K. K. Thaker)

KCT Consultancy Services, Ahmedabad**Cyclic Plate Load Test No. 3**

(IS : 5249 and 1888)

Project :	NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha
Location :	ID Fan Unit 1&2
Depth at which Test Conducted :	2.00m
Sub soil type:	Yellowish brown clay some silt with gravels
Size of the Plate :	0.45m x 0.45m
Size of the Pit :	2.50 m X 3.00 m
Co-ordinates:	N 3089.716, E 956.68
RL of test level:	196.35m
RL of EGL:	198.35m
Date	30-12-2024

**Pressure v/s Elastic Rebound**

Coefficient of elastic uniform compression (Plate) = 6.8 kg / sqcm / cm

Coefficient of elastic uniform compression (10 sqm) = 0.97 kg / sqcm / cm

Coefficient of elastic nonuniform compression = 1.7 kg / sqcm / cm

Coefficient of elastic uniform shear = 0.49 kg / sqcm / cm

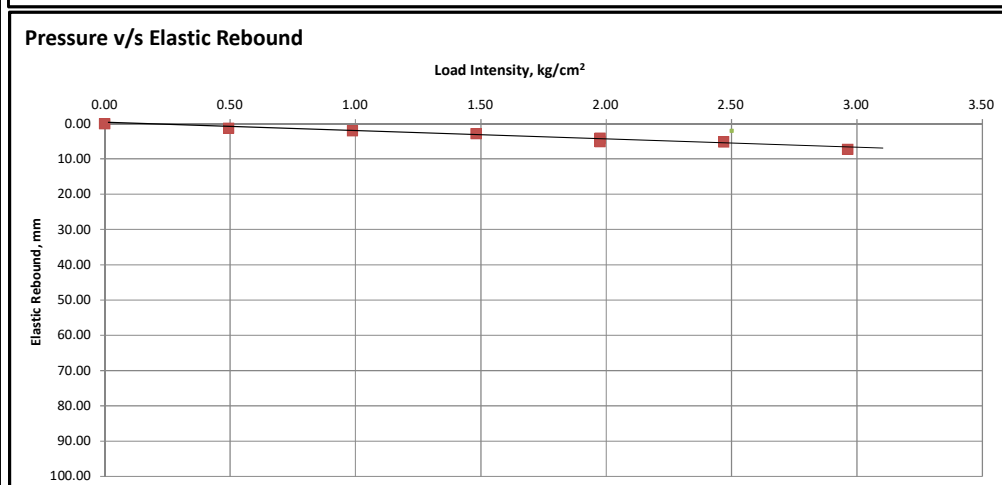
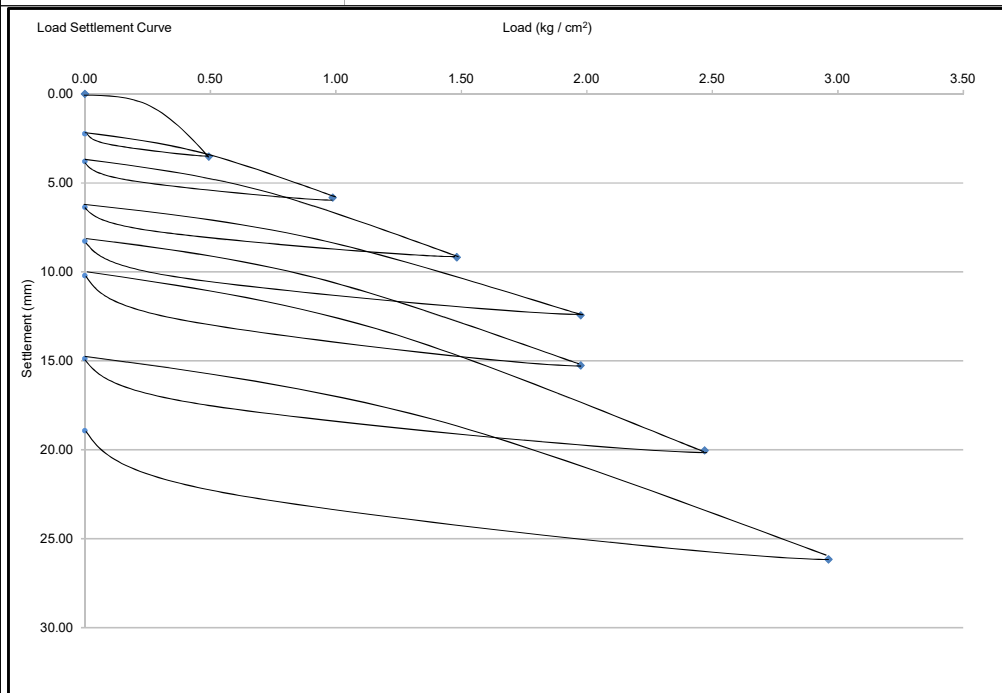
Coefficient of elastic non uniform shear = 0.73 kg / sqcm / cm

For KCT Consultancy Services,**(Dr. K. K. Thaker)**

KCT Consultancy Services, Ahmedabad**Cyclic Plate Load Test No. 4**

(IS : 5249 and 1888)

Project :	NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha
Location :	Boiler & Mill Bunker Unit-2
Depth at which Test Conducted :	3.00m
Sub soil type:	Greyish brown fine grained clay with very soft weather rock
Size of the Plate :	0.45m x 0.45m
Size of the Pit :	6.00 m X 3.00 m
Co-ordinates:	N 3064 ,E 1197
RL of test level:	192.48m
RL of EGL :	195.48m
Date	17-05-2025



Coefficient of elastic uniform compression (Plate) = 5.3 kg / sqcm / cm

Coefficient of elastic uniform compression (10 sqm) = 0.7 kg / sqcm / cm

Coefficient of elastic nonuniform compression = 1.3 kg / sqcm / cm

Coefficient of elastic uniform shear = 0.4 kg / sqcm / cm

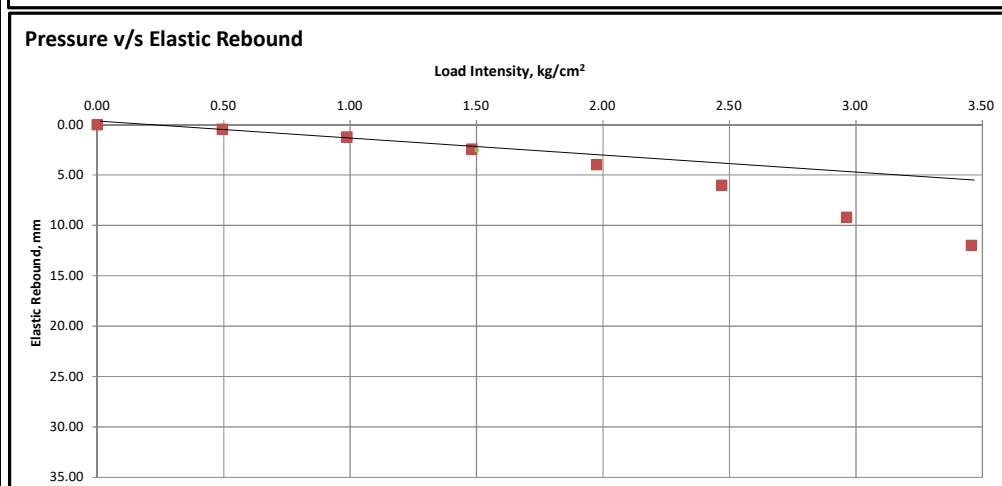
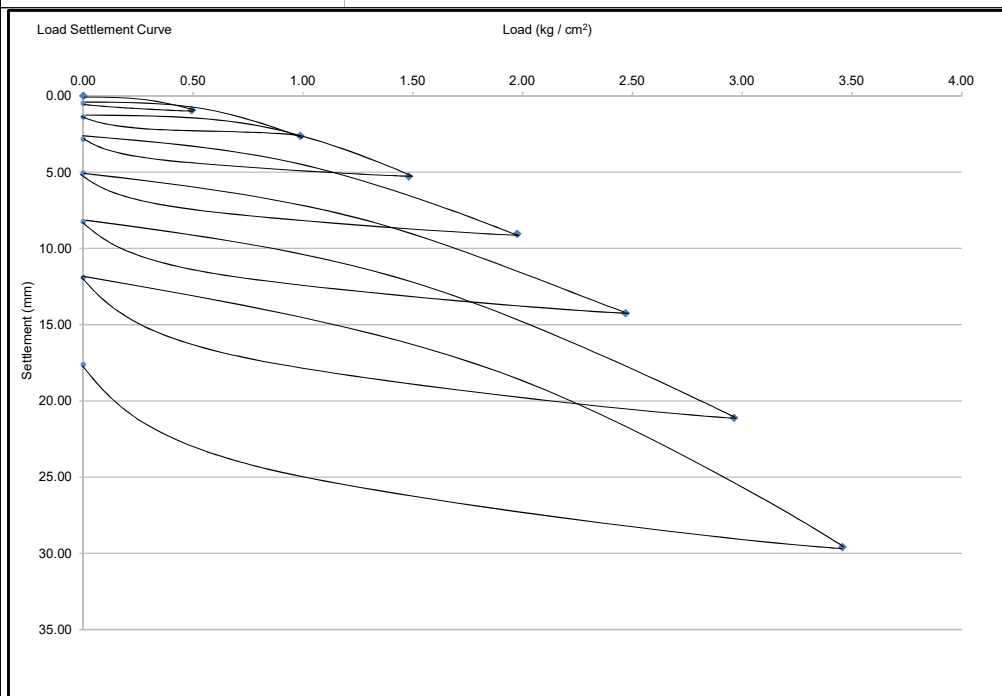
Coefficient of elastic non uniform shear = 0.6 kg / sqcm / cm

For KCT Consultancy Services,**(Dr. K. K. Thaker)**

KCT Consultancy Services, Ahmedabad**Cyclic Plate Load Test No. 5**

(IS : 5249 and 1888)

Project :	NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha
Location :	Gypsum dewatering building and storage area, Process water tank, Lime stone slurry storage tank & agitator
Depth at which Test Conducted :	2.00m
Sub soil type:	Yellowish brown clay some silt with gravels
Size of the Plate :	0.45m x 0.45m
Size of the Pit :	2.50 m X 3.00 m
Co-ordinates:	E3360.35, N801.53
RL of test level:	195.10m
RL of EGL:	197.10m
Date	04-01-2025



Coefficient of elastic uniform compression (Plate) = 6 kg / sqcm / cm

Coefficient of elastic uniform compression (10 sqm) = 0.85 kg / sqcm / cm

Coefficient of elastic nonuniform compression = 1.5 kg / sqcm / cm

Coefficient of elastic uniform shear = 0.43 kg / sqcm / cm

Coefficient of elastic non uniform shear = 0.64 kg / sqcm / cm

For KCT Consultancy Services,**(Dr. K. K. Thaker)**

8. Seismic refraction test

In Seismic Refraction technique, stress waves applied by impact of a hammer at the surface of an elastic media, creates associated strains to propagate as compressive elastic waves in the subsurface material in a pattern of particle deformation travelling with velocities dependent on the elastic properties and densities of the media through which they travel.

The basic principle behind Seismic Refraction Survey is to initiate elastic waves at a point on or near the ground surface, and to determine the arrival times of the Seismic energy that has traveled along discontinuities or interfaces between layers and refracted back to the surface at a number of points.

A Seismic energy by impact of a hammer on a steel plate creates the Seismic elastic waves. The travel times of the Refracted waves are detected by a series of Geophones placed in line on the ground and connected to the Seismograph via Geophone cable. The Seismograph will register the ground response with time of arrival and display them as traces on the Seismograph, the data are stored internally for future retrieval. The characteristic velocities and thickness of the under lying layers can be calculated by processing the arrival times using computer.

Interpretation of the Seismic Refraction data was carried out using the Delay Time method to establish initial model for SIPT2 program from Rim-rock Geophysics Inc., which was refined by iteration process using ray tracing. In this method, the thickness of the subsurface layers and their velocities are calculated. The results were cross-checked by intercept time method. A brief outline of the intercept time method is given below.

In order to calculate the apparent P & S -wave velocities and the intercept times from various subsurface layers, the measured first arrival times are plotted versus distance. These T-X curves are plotted for every shot point.

Intercept time method Seismic Refraction interpretation uses a mathematical model of the subsurface in which each layer has a constant Seismic velocity and is bounded by horizontal or dipping interfaces. The Seismic velocities must increase with depth so that total Refraction can occur at each interface.

Considering a simple case of two layers on one interface, the total time T for Seismic waves to travel from the shot point A to Geophone D would be:

$$T = t_{AB} + t_{BC} + t_{CD} \quad . \quad (1)$$

By simply representing the travel segments AB, BC and CD in the above equation in terms of the layers velocity (V_1 and V_2) thickness (h_1) distance (X) and the incident angle (i_1) total travel time T would be:

$$T = h_1 / (\cos i_1 V_1) + (X - 2 h_1 \tan i_1) / V_2 + h_1 / (\cos i_1 V_1) \quad (2)$$

Applying Snell's Law, where $\sin i_1 / V_1 = \sin i_2 / V_2$ in case of total refraction and by rearranging equation 2, the total time T can be presented as:

$$T = (X / V_2) + (2 h_1 \cos i_1 / V_1) \quad (3)$$

Where the second parameter of this equation equals to the intercept time t_1 (Sketch 1) i.e:

$$t_1 = 2 h_1 \cos i_1 / V_1 \quad (4)$$

To expand this equation to include an n number of layers

$$T = X / V_n + 2 h_i \cos i_1 / V_1 \quad (5)$$

Where the intercept time for the n layer t_n will be:

$n-1$

$$t_n = 2 h_i \cos i_1 / V_1 \quad (6)$$

I = layer number

This Seismic Refraction method depends fundamentally on the propagation of Seismic waves in elastic or visco-elastic media. The Seismic waves travel through the Earth with a definite velocity depending upon the properties of material and along a definite path. The Seismic waves, like the light waves, follow the path which require the least time to travel from source to receiver. The velocity depends particularly upon the degree of consolidation of the subsoil material. A velocity but will be deflected if it passes through a discontinuity where there is distinct change in elastic properties. The amount of deflection follows Snell's Law of Refraction and may be expressed by the equation.

$$\frac{\sin I}{\sin r} = \frac{V_1}{V_2} \quad (7)$$

I = angle of incidence

r = angle of refraction

V_1 = Velocity of propagation of the Seismic wave in the Incident medium, and

V_2 = Velocity of propagation of the Seismic wave in the Refracting medium

In Seismic Refraction Test, the rays which travel in a Critical angle, i.e. become Refracted parallel to the boundary ($r=90^\circ$) and are Refracted back to the surface at the Critical angle are of interest. Accordingly for $r=90^\circ$, equation (7) becomes

$$\sin i = \frac{V_1}{V_2} \quad (8)$$

This phenomenon forms the basis of the Refraction Seismic surveying.

When the detector, commonly known as Geophone is located very close to the shot point in comparison to the depth of the horizontal in the upper medium at a velocity V_1 and will arrive at a time.

$$T_1 = \frac{X}{V_1} \quad (9)$$

Where

X = horizontal distance between the Source and Receiver and

T_1 = time of travel of the Seismic wave from Source to Receiver.

The Time-Distance curve is a straight line starting from the origin and having a slope of $1/V_1$

At certain distance X_c (Critical distance) a wave that has been refracted along the discontinuity will reach the surface at the same time as that traveled along the direct horizontal path with velocity V_1 . At all distances greater than the critical distance X_c , the wave refracted along the surface or horizontal discontinuity will reach the Earth's surface first and therefore, constitute the first arrival.

The time taken between the initiation of the Seismic wave at a shot point and its first arrival at the detector places at a measured distance is known as first arrival time. The first arrival times are plotted against the distances of the corresponding detectors from the source. These points are joined by straight lines. The slopes of different straight lines thus drawn are inversely proportional to the velocities of different layers with contrasting elastic properties. The resultant Time Distance graphs are shown in plots.

From the slope of each straight-line segment, velocities of the mediums with different elastic properties are found out and thickness of the layers are calculated.

Analysis of test results

Results of Seismic Test at each shot point have been analyzed using the following methodology.

1. First arrival Times from all Channels of the Seismic Unit are noted from the response charts and plotted against Geophone distance.
2. Best fit straight lines are drawn through these points
3. Slopes of each segment of straight lines are calculated. The slope is inversely proportional to the apparent velocity (v) of the elastic media.
4. Critical angle of each line segments are calculated as follows:

$$\theta_{12} = \sin^{-1} \frac{V_1}{V_2}$$

$$\theta_{23} = \sin^{-1} \frac{V_2}{V_3}$$

$$\theta_{13} = \sin^{-1} \frac{V_1}{V_3}$$

Where V_1 , V_2 & V_3 are the velocities of P-wave in first, second and the third layers respectively

5. The straight line segments are extended to intercept the time axis of the Time Distance plots, intercept times t_1 and t_2 are noted
6. Thickness of the first and second layers are calculated using the following equations:

$$h_1 = \frac{t_1 V_1}{2 \cos \theta_{12}} \quad . (10)$$

$$h2 = t2 - \left[\frac{2 * h1 * \cos\theta13 * V2}{V1 * 2 * \cos\theta23} \right]$$

Where, h1 and h2 are the thickness of the first and the second layers.

7. Analysis of data and calculations has been carried out using standard software on computer. Summary of the results have been presented in Section II
8. The existing ground levels recorded during ground survey and the reduced levels of interfaces have also been included.

Interpretation of Test Results

The general procedure for processing Refraction data included the following steps:

1. Review of all field report information to determine Refraction acquisition geometry.
2. Playback and analysis of raw data files from selected lines to determine the quality of Refraction arrivals, and if data requires pre-processing filtering or gain adjustments.
3. Perform data filtering, gain adjustments and trace edits to remove bad traces.
4. Load data into Refraction processing program to perform picking of first break Refraction arrivals, input elevation and geometry data.
5. Generate time distance curves for each Refraction line segment, and perform reciprocal time analysis.
6. Perform velocity inversion processing if low velocity layers or lateral velocity changes are high.
7. Interpret data and refine velocity plots.
8. Generate Final Refraction plots.

SEISMIC SURVEY: Seismic refraction survey was conducted along ten seismic profiles in the month of December 2024. The setting out of the Seismic survey lines and Co-ordinates of the tests were carried out prior to the start of the Seismic Refraction survey.

The detailed list of co-ordinates for Seismic Refraction Tests is as shown below,

SRT NO.		Co-ordinates at Start of the Surveyed Stretch		Co-ordinates at End of the Surveyed Stretch	
		E	N	E	N
1	1.1	1300	3275	1186	3282
	1.2	1182	3275	1067	3275
	1.3	1067	3275	952	3275
2	2.1	1292	3275	1292	3160
	2.2	1292	3160	1331	3051
	2.3	1331	3051	1292	2942
	2.4	1292	2942	1292	2827
3	3.1	1292	2836	1177	2836
	3.2	1177	2836	1062	2836
	3.3	1062	2836	946	2836

4	4.1	970	2836	970	2950
	4.2	970	2950	970	3066
	4.3	970	3066	970	3181
	4.4	970	3181	970	3295

PURPOSE OF INVESTIGATIONS

The aim of the Seismic investigation was to provide information regarding the shallow lithology along the surveyed Seismic lines.

LOCATION AND TOPOGRAPHY

Most of the seismic lines were located on relatively clear land with minor undulations, except for SRT Lines 1 and 2. In SRT Line 1, an obstacle was encountered along the SRT-1.1 segment. To mitigate this, the SRT-1.1 line was slightly shifted to avoid the structure. Similarly, in SRT Line 2, a pond was present between segments SRT-2.2 and SRT-2.3. In this case, testing for SRT-2.2 and SRT-2.3 was conducted along the periphery of the pond and below its bund. The layout and execution of the SRT survey are illustrated in the figure below.



SURVEYING OF LOCATION

The Seismic lines were surveyed and start and end points were marked. The ground lengths surveyed are summarized in **Table 1**, the spacing between geophones was 5.00 m.

SRT PROFILES

SRT NO.		Co-ordinates at Start of the Surveyed Stretch		Co-ordinates at End of the Surveyed Stretch		Length Surveyed, m
		E	N	E	N	
1	1.1	1300	3275	1186	3282	115
	1.2	1182	3275	1067	3275	115
	1.3	1067	3275	952	3275	115
2	2.1	1292	3275	1292	3160	115
	2.2	1292	3160	1331	3051	115
	2.3	1331	3051	1292	2942	115
	2.4	1292	2942	1292	2827	115
3	3.1	1292	2836	1177	2836	115
	3.2	1177	2836	1062	2836	115
	3.3	1062	2836	946	2836	115
4	4.1	970	2836	970	2950	115
	4.2	970	2950	970	3066	115
	4.3	970	3066	970	3181	115
	4.4	970	3181	970	3295	115

EQUIPMENTS AND ACCESSORIES

Following Equipments and Accessories were used:

1. **Seismograph** : Model PASI GEA95
Signal Enhancement type fully digital 24 channel
Seismograph
2. **Geophones** : Moving-coil type digital grade vertical &
Horizontal Geophones, Natural Frequency 10
Hertz.
3. **Cable** : Geophone spread cables, maximum 5m spacing between
proof joints, made in Germany
4. **Software** : Rayfract

ENERGY SOURCE

For the Seismic Refraction Survey work Sledge-Hammer is struck vertically on an iron Plate to generate P-wave.



GEOPHONE AND GEOPHONE SPREAD

Low frequency (10Hz) spike Geophones were used to record Seismic signals. Shooting progressed along the lines. Geophones were kept at spacing of 4.20 for entire spread. All 24 channels were used. The Seismic spread consisted of total seven numbers of shots with a minimum of two far end shots at both the ends of line, two mid shots and one center shot.

Care was taken to ensure that the pointed ends (spikes) of the Geophones are fully embedded in the topsoil.

SEISMOGRAPH:





PASI GEA95 – 24 CHANNELS Engineering Seismograph was used to record field data. The Seismograph has the signal enhancement or stacking capability. The Seismograph records the arrival of Seismic waves through 24 channels.

DATA ACQUISITION

A seismic profile consists of a group of geophones connected to the recording system at regular interval along a line. In this study, spread length of 24 geophones were used with a PASI Seismic Survey system, a seismic unit consists basically of amplifiers, geophones, seismic cables, seismic energy source (Mechanical Hammer and recording device. The amplifier's function is to boost the signal detected by the geophones to a level suitable for input to the recording device. The choice of seismic unit involves factors such as frequency response of geophones, length of seismic lines, required spacing between geophones, number of channels and required recording parameters (record length, sampling frequency, etc.). Total 3 seismic spreads at the location as specified by co-ordinates mentioned above as per the plan were covered. All spreads were performed with 4.20m geophone spacing.

Hammer was used as seismic source to generate the seismic waves for each spread of 24 geophones in total and for most of the seismic spreads, maximum 7 shots were executed: 5 shots (2 far end shots for both start and end and 3 mid shots) within the profile to obtain the lateral velocity variation in the top layer(s) and 2 far shots two on either side of the spread, to provide the true seismic velocity of the sub soil stratas.

The seismic record from each shot was verified in the field, as a first step of quality control. Several criteria were adopted:

- The first arrival times on each seismic record must be clean and precise.
- No more than two traces should be absent.
- No end trace should be absent, so as to obtain a good time – distance curve closure. If any of these criteria were not met, the shot was repeated to obtain the desired accuracy.

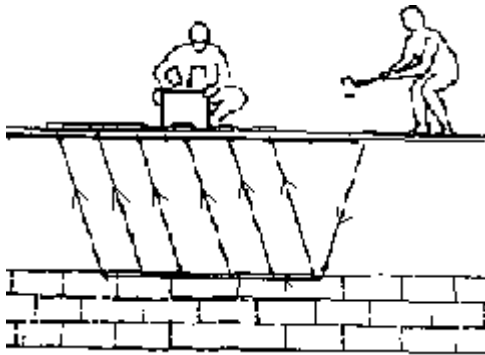
SEISMIC REFRACTION METHOD

The main objective of seismic prospecting is the mapping of geological structures in the uppermost part of the earth's crust. The methods for generating seismic waves are weight dropping techniques, mechanical hammer, mechanical vibrator etc. Any impact-source should ideally provide a pulse of duration of not more than a few milliseconds with large amplitude; the waves are of very short wavelength with periods ranging from 0.002 to 0.15 seconds, the corresponding frequencies being in the range of 5 to 500 Hz at depths of interest for engineering applications. In an elastically homogeneous ground, the source induces instantaneous deformation which causes elastic deformation in the vicinity of the source point. By virtue of elastic behavior of rocks, the elastic deformation propagates in all directions as spherical fronts. In view of, restriction on use of explosives in the project area, the hammer was used as the energy source in this survey.

PROPOGATION OF WAVES

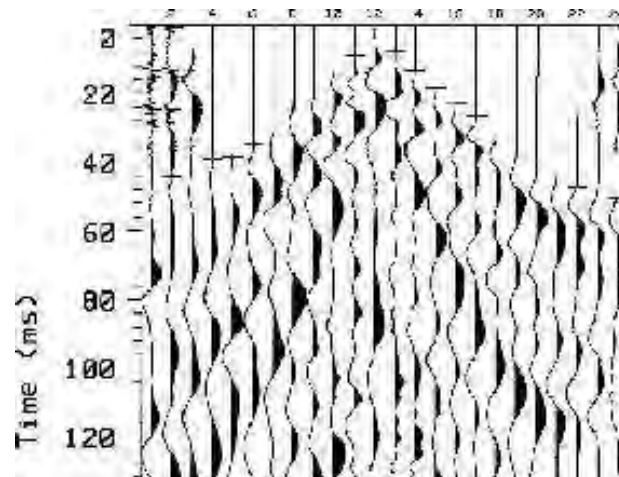
The application of shock force to the ground surface generates four principal types of waves. Two propagate within the ground and are known as body waves (or Compression P-wave and Shear S-wave). The other two propagate along the surface and are called surface waves (or Raleigh and Love waves). The surface waves are used for the SASW (Spectral Analysis of Surface Waves) method while refraction and reflection methods use either P or S waves or in some cases both.

With this seismic technique, in general, a stress applied at the surface of an elastic media creates the conditions for the associated strains to propagate as elastic waves (P & S) in the subsurface material as pattern of particle deformation traveling with velocities that are dependent on the elastic properties and densities of the media through which they travel.



The basic principle behind Seismic Refraction surveys is to initiate elastic waves at a point at or near the ground surface and to determine at a number of other positions the arrival times of the Seismic energy that has traveled along discontinuities or interfaces between surface layers and totally refracted back to the surface.

The Seismic energy source creates the seismic elastic waves. The travel times of these elastic waves are detected by series of Geophones, placed in line into the ground and connected to the Seismograph, via the Geophone cable. The Seismograph will register these times and display them as traces of time for individual Geophones.



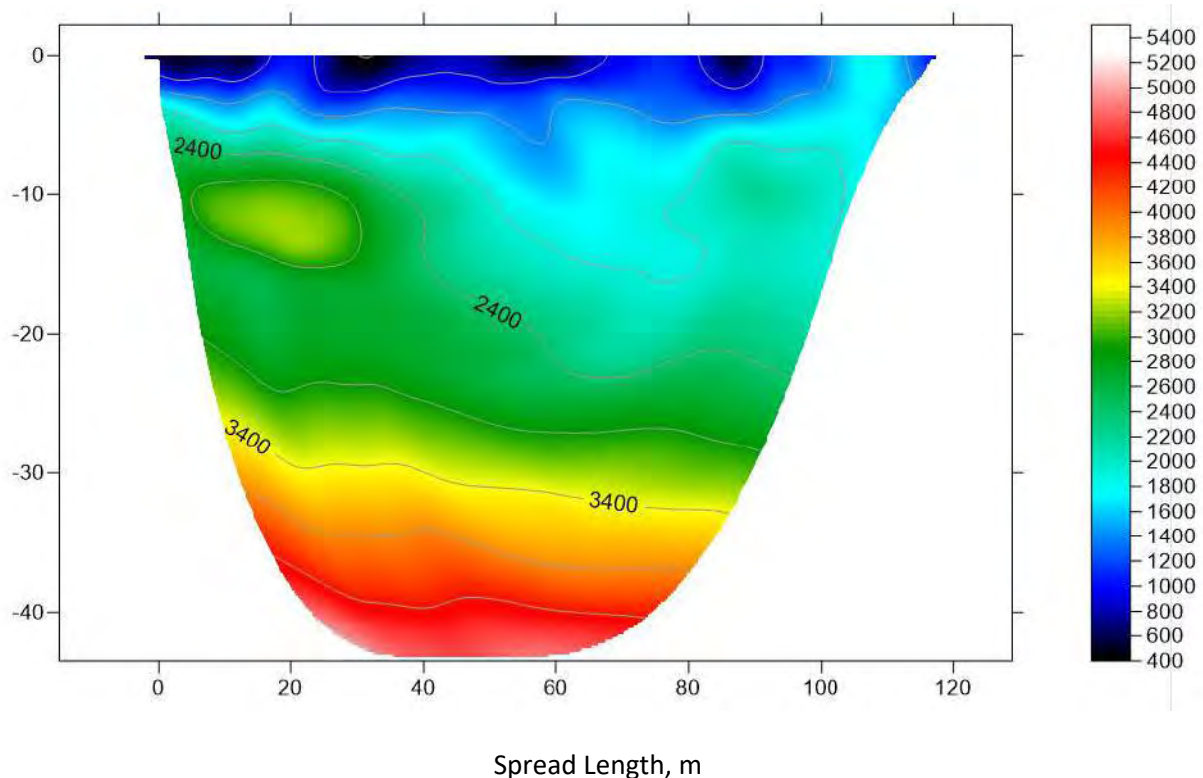
By processing these arrival times, the characteristic velocity and the thickness of the underlying layer can be calculated.

SEISMIC SURVEY RESULTS

1. Seismic wave velocity in soil is dependent on the soil type and its condition and its properties.
2. The velocity models obtained from the Seismic Refraction survey are enclosed.
3. The results show variation in velocities up to the investigated depth associated with soil, where various layers can be clearly identified.
4. There were total 14 seismic refraction profiles, all the profiles have been surveyed for 115m.
5. The area was partially saturated and loose soils exists in top layers and at bottom soil must be of strong consistencies where high compressional wave velocities are encountered in all the profiles.
6. Details of each profiles are provided below,

SEISMIC SURVEY RESULTS

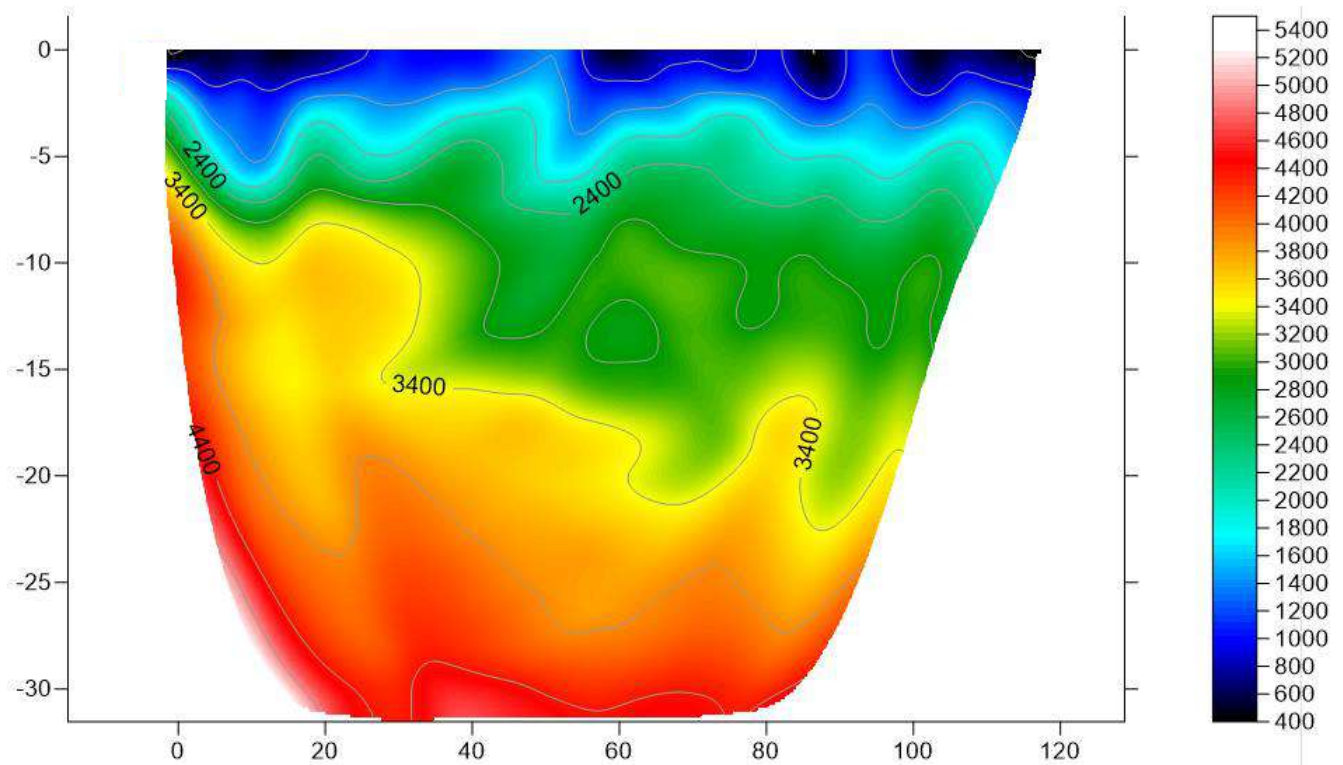
1. SRT-1 .1



COMMENATRIES: -

- Seismic Line-1.1 i.e for SRT1.1 covering 115m length involved laying of 24 geophones with one number of seismic spread.
- A total of 7 shots were taken using hammer as source (2, Far shots, 2 end shots and 2 intermediate shots and 1 mid shot all intermediate shots are taken at every even geophone all along the seismic spread). The seismic velocities are observed in the tomograms using
- Rayfract software is used for analysis of waves.
- However, it is expected that the first layer on the top with compressional velocities in the range of 400 m/s to 800 m/sec up to average 5 m depth from G.L. The second layer with recorded P-wave velocity in the range of 1400 m/sec to 300 m/sec upto about average 25m depth. Below 25m depth up to end of profile the P wave velocity increases up to 4800 m/sec.
- For detailed velocity at specified depths it can be clearly seen from the profile.

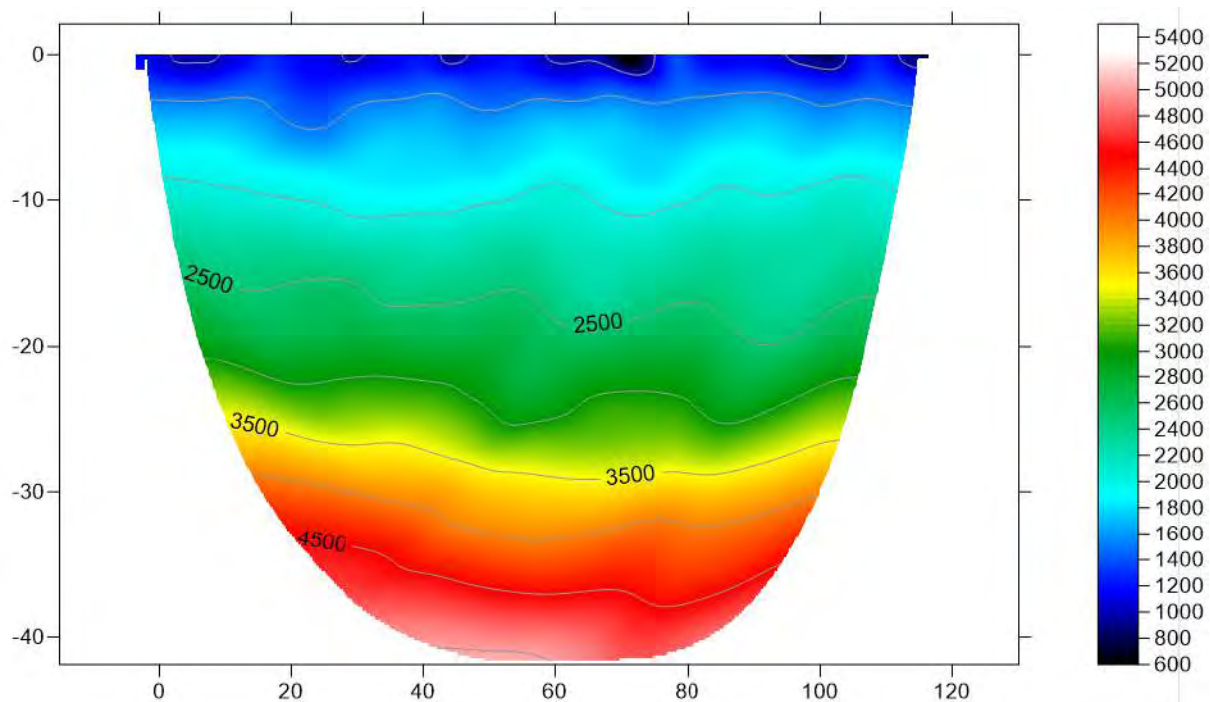
2. SRT-1.2



COMMENATRIES: -

- Seismic Line-1.2 i.e for SRT1.2 covering 115m length involved laying of 24 geophones with one number of seismic spread.
- A total of 7 shots were taken using hammer as source (2, Far shots, 2 end shots and 2 intermediate shots and 1 mid shot all intermediate shots are taken at every even geophone all along the seismic spread). The seismic velocities are observed in the tomograms using
- Rayfract software is used for analysis of waves.
- However, it is expected that the first layer on the top with compressional velocities in the range of 400 m/s to 800 m/sec up to average 5 m depth from G.L. The second layer with recorded P-wave velocity in the range of 2400 m/sec to 3000 m/sec up to about average 18m depth. Also some of the portion represent average velocity around 3400 m/s.
- Below 18 m depth up to 25m profile the P wave velocity increases up to 3500 m/sec.
- Below the 25m up to the end of profile the P-wave velocity increases up to the 4500 m/s.
- For detailed velocity at specified depths, it can be clearly seen from the profile.

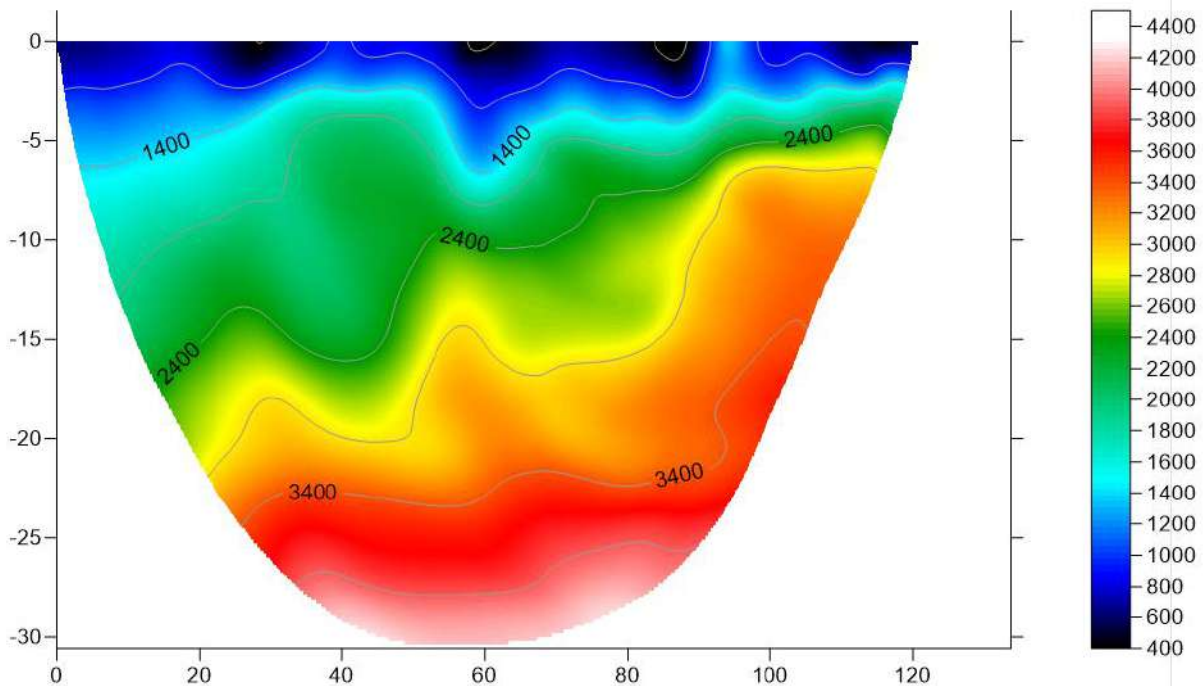
3. SRT-1.3



COMMENATRIES: -

- Seismic Line-1.3 i.e for SRT1.3 covering 115m length involved laying of 24 geophones with one number of seismic spread.
- A total of 7 shots were taken using hammer as source (2, Far shots, 2 end shots and 2 intermediate shots and 1 mid shot all intermediate shots are taken at every even geophone all along the seismic spread). The seismic velocities are observed in the tomograms using
- Rayfract software is used for analysis of waves.
- However, it is expected that the first layer on the top with compressional velocities in the range of 600 m/s to 1400 m/sec up to average 8 m depth from G.L. The second layer with recorded P-wave velocity in the range of 1800 m/sec to 3000 m/sec up to about average 25m depth.
- Below the 25m up to the end of profile the P-wave velocity increases up to the 5000 m/s.
- For detailed velocity at specified depths, it can be clearly seen from the profile.

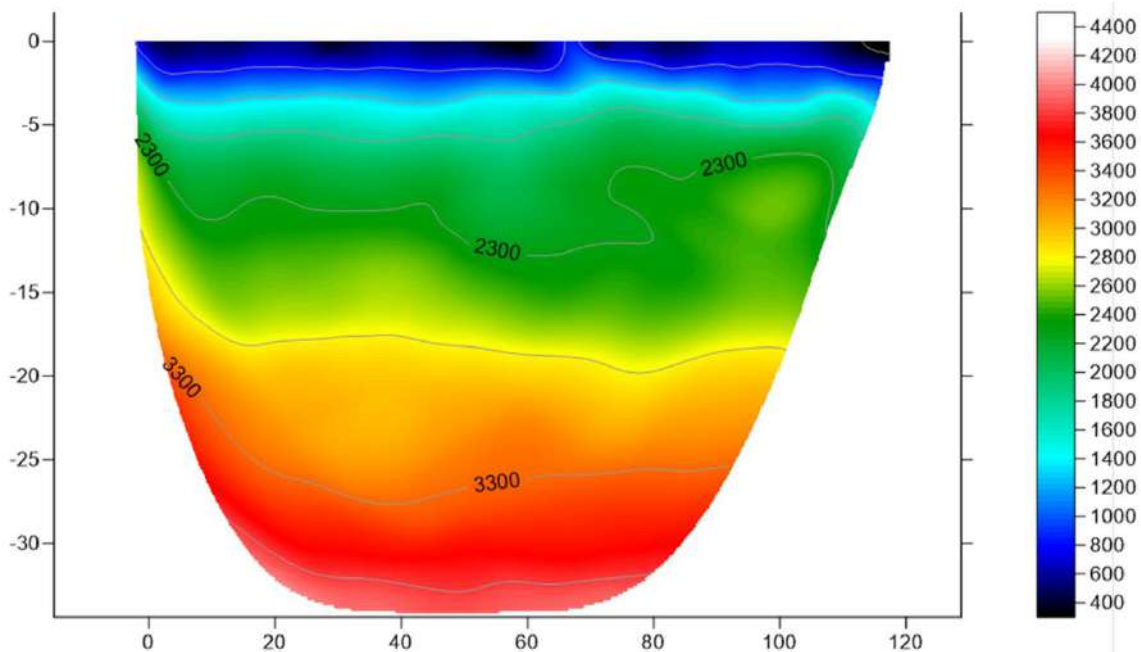
4. SRT-2.1



COMMENATRIES: -

- Seismic Line-2.1 i.e for SRT 2.1 covering 115m length involved laying of 24 geophones with one number of seismic spread.
- A total of 7 shots were taken using hammer as source (2, Far shots, 2 end shots and 2 intermediate shots and 1 mid shot all intermediate shots are taken at every even geophone all along the seismic spread). The seismic velocities are observed in the tomograms using
- Rayfract software is used for analysis of waves.
- However, it is expected that the first layer on the top with compressional velocities in the range of 400 m/s to 1200 m/sec up to average 6 m depth from G.L. The second layer with recorded P-wave velocity in the range of 1400 m/sec to 2600 m/sec up to about average 18m depth.
- Below the 18m up to the end of profile the P-wave velocity increases up to the 44+.00 m/s.
- For detailed velocity at specified depths, it can be clearly seen from the profile.

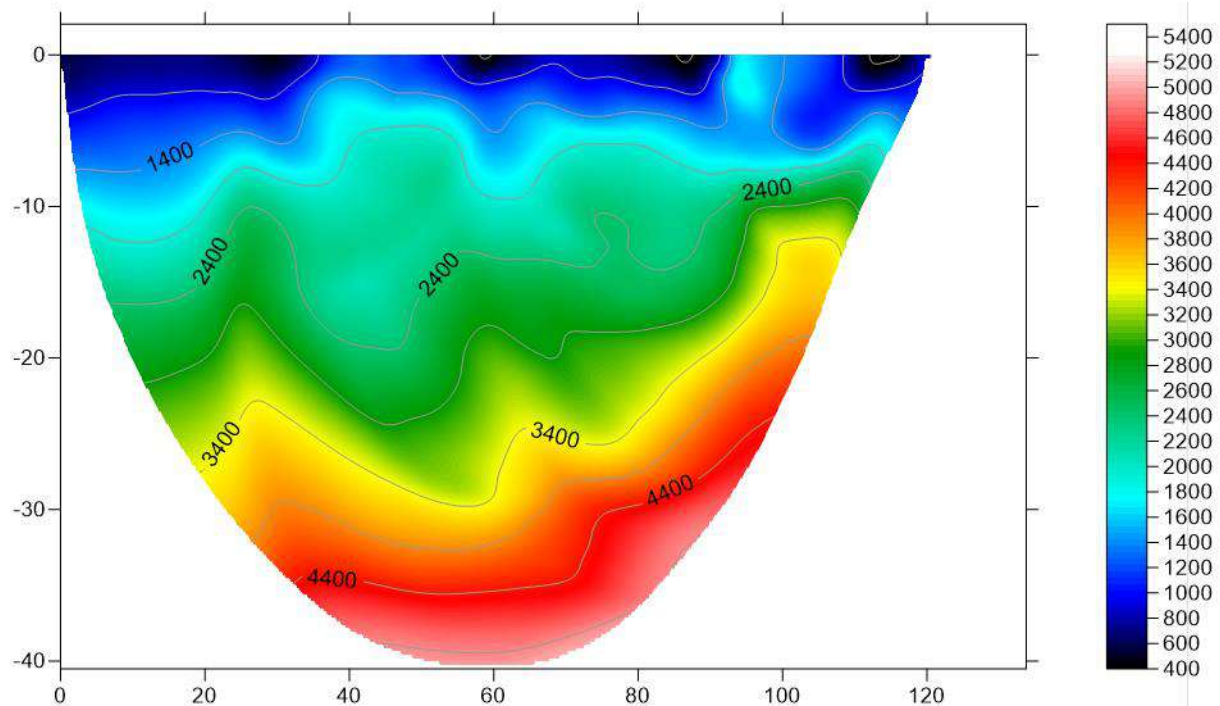
5. SRT-2.2



COMMENATRIES: -

- Seismic Line-2.2 i.e for SRT 2.2 covering 115m length involved laying of 24 geophones with one number of seismic spread.
- A total of 7 shots were taken using hammer as source (2, Far shots, 2 end shots and 2 intermediate shots and 1 mid shot all intermediate shots are taken at every even geophone all along the seismic spread). The seismic velocities are observed in the tomograms using
- Rayfract software is used for analysis of waves.
- However, it is expected that the first layer on the top with compressional velocities in the range of 400 m/s to 1400 m/sec up to average 5 m depth from G.L. The second layer with recorded P-wave velocity in the range of 1800 m/sec to 2600 m/sec up to about average 18m depth.
- Below the 18m up to 25m of profile the P-wave velocity in the range of 2800 m/s to 3300 m/s.
- Below the 25 m up to the end of profile the P-wave velocity increases up to the 4400 m/s.
- For detailed velocity at specified depths, it can be clearly seen from the profile.

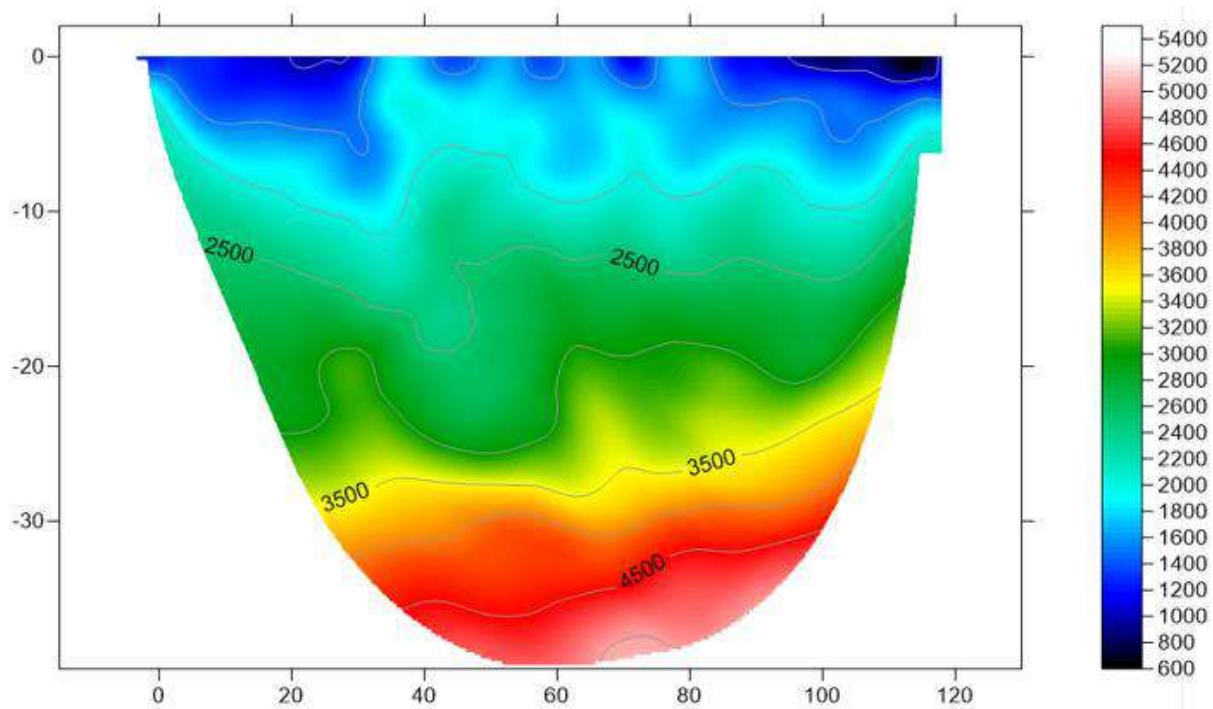
6. SRT-2.3



COMMENATRIES: -

- Seismic Line-2.3 i.e for SRT 2.3 covering 115m length involved laying of 24 geophones with one number of seismic spread.
- A total of 7 shots were taken using hammer as source (2, Far shots, 2 end shots and 2 intermediate shots and 1 mid shot all intermediate shots are taken at every even geophone all along the seismic spread). The seismic velocities are observed in the tomograms using
- Rayfract software is used for analysis of waves.
- However, it is expected that the first layer on the top with compressional velocities in the range of 400 m/s to 1400 m/sec up to average 6 m depth from G.L. The second layer with recorded P-wave velocity in the range of 1800 m/sec to 2600 m/sec up to about average 25m depth.
- Below the 25 m up to the end of profile the P-wave velocity increases up to the 5200 m/s.
- For detailed velocity at specified depths, it can be clearly seen from the profile.

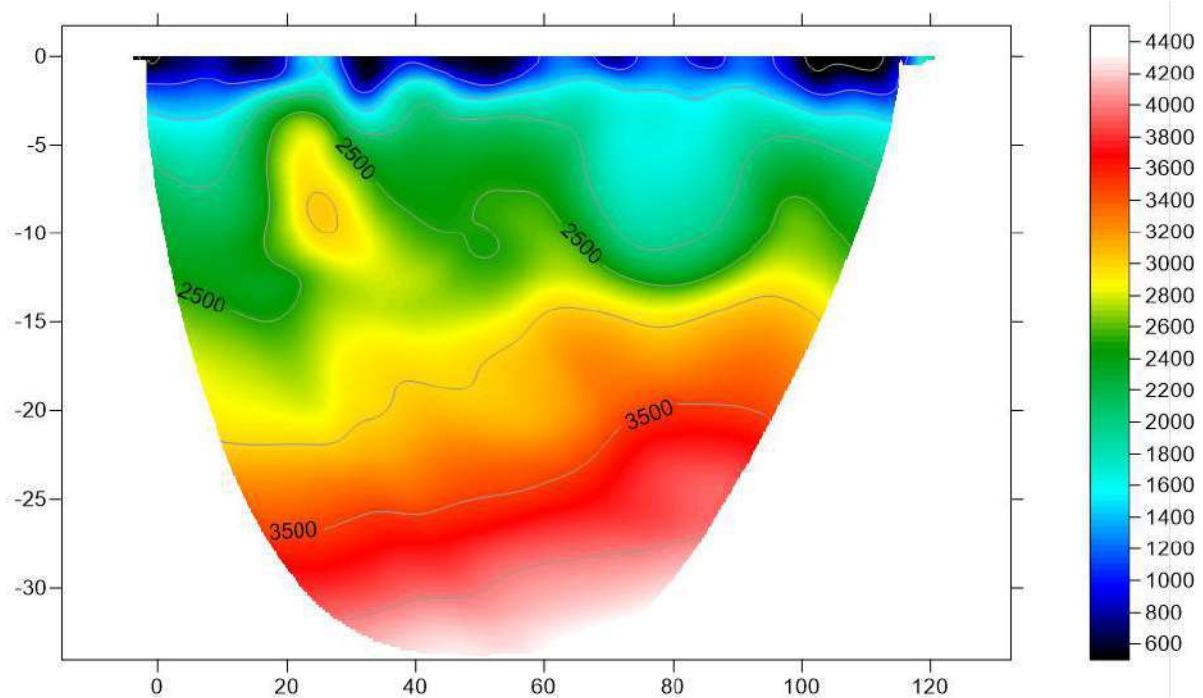
7. SRT-2.4



COMMENATRIES: -

- Seismic Line-2.4 i.e for SRT 2.4 covering 115m length involved laying of 24 geophones with one number of seismic spread.
- A total of 7 shots were taken using hammer as source (2, Far shots, 2 end shots and 2 intermediate shots and 1 mid shot all intermediate shots are taken at every even geophone all along the seismic spread). The seismic velocities are observed in the tomograms using
- Rayfract software is used for analysis of waves.
- However, it is expected that the first layer on the top with compressional velocities in the range of 600 m/s to 1200 m/sec up to average 7 m depth from G.L. The second layer with recorded P-wave velocity in the range of 1800 m/sec to 3200 m/sec up to about average 25m depth. In this layer patches of 3500 m/s P- wave velocity is found.
- Below the 25 m up to the end of profile the P-wave velocity increases up to the 5200 m/s.
- For detailed velocity at specified depths, it can be clearly seen from the profile.

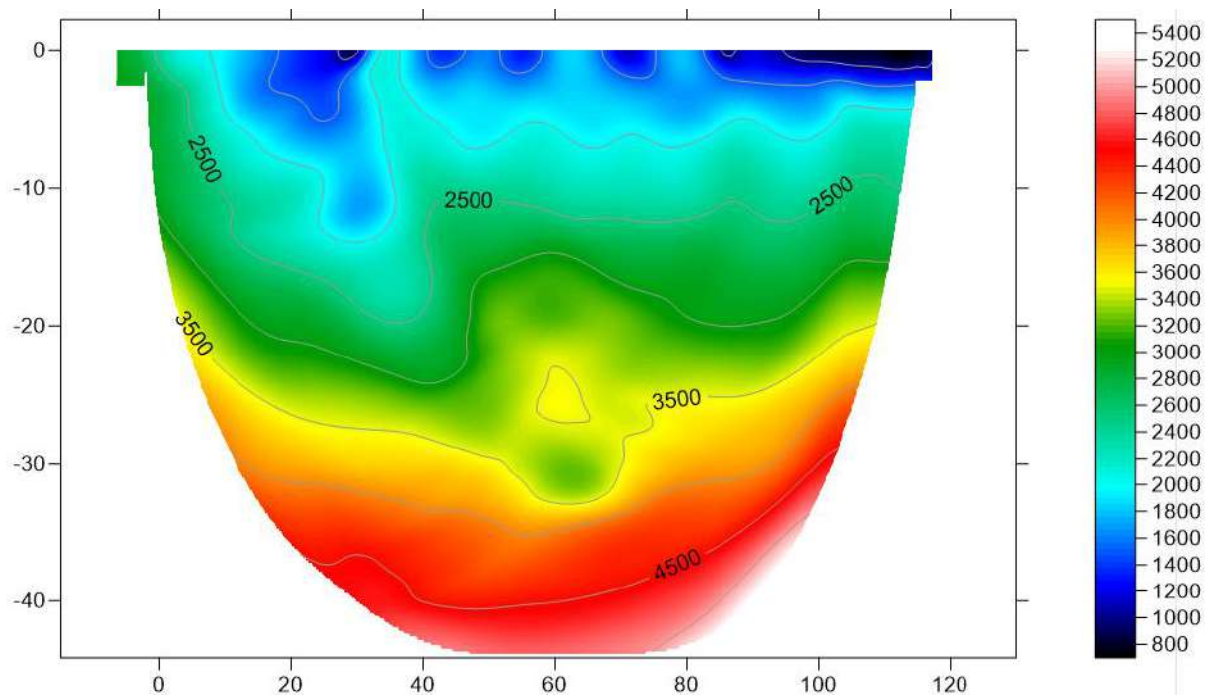
8. SRT-3.1



COMMENATRIES: -

- Seismic Line-3.1 i.e for SRT 3.1 covering 115m length involved laying of 24 geophones with one number of seismic spread.
- A total of 7 shots were taken using hammer as source (2, Far shots, 2 end shots and 2 intermediate shots and 1 mid shot all intermediate shots are taken at every even geophone all along the seismic spread). The seismic velocities are observed in the tomograms using
- Rayfract software is used for analysis of waves.
- However, it is expected that the first layer on the top with compressional velocities in the range of 600 m/s to 1400 m/sec up to average 8m depth from G.L. The second layer with recorded P-wave velocity in the range of 1200 m/sec to 2500 m/sec up to about average 15m depth.
- Below the 15 m up to the end of profile the P-wave velocity increases up to the 4400 m/s.
- For detailed velocity at specified depths, it can be clearly seen from the profile.

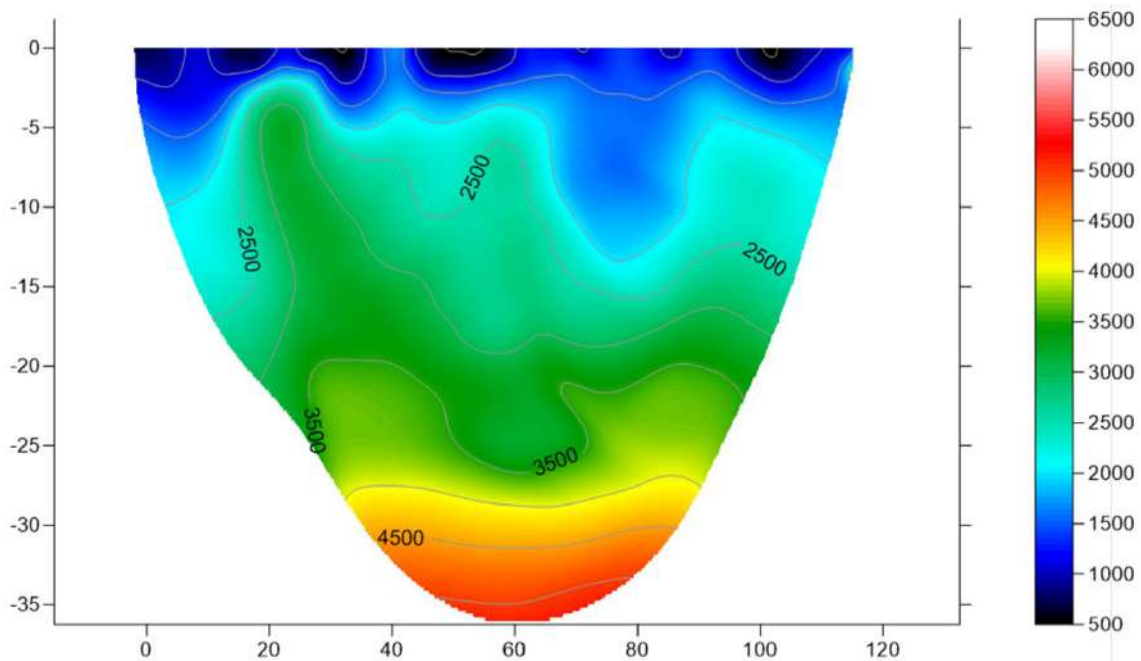
9. SRT-3.2



COMMENATRIES: -

- Seismic Line-3.2 i.e for SRT 3.2 covering 115m length involved laying of 24 geophones with one number of seismic spread.
- A total of 7 shots were taken using hammer as source (2, Far shots, 2 end shots and 2 intermediate shots and 1 mid shot all intermediate shots are taken at every even geophone all along the seismic spread). The seismic velocities are observed in the tomograms using
- Rayfract software is used for analysis of waves.
- However, it is expected that the first layer on the top with compressional velocities in the range of 600 m/s to 1000 m/sec up to average 5m depth from G.L. The second layer with recorded P-wave velocity in the range of 1600 m/sec to 2800 m/sec up to about average 18m depth.
- Below the 18m up to 30m of profile the P-wave velocity in the range of 3000 m/s to 3600 m/s.
- Below the 30 m up to the end of profile the P-wave velocity increases up to the 5000 m/s.
- For detailed velocity at specified depths, it can be clearly seen from the profile.

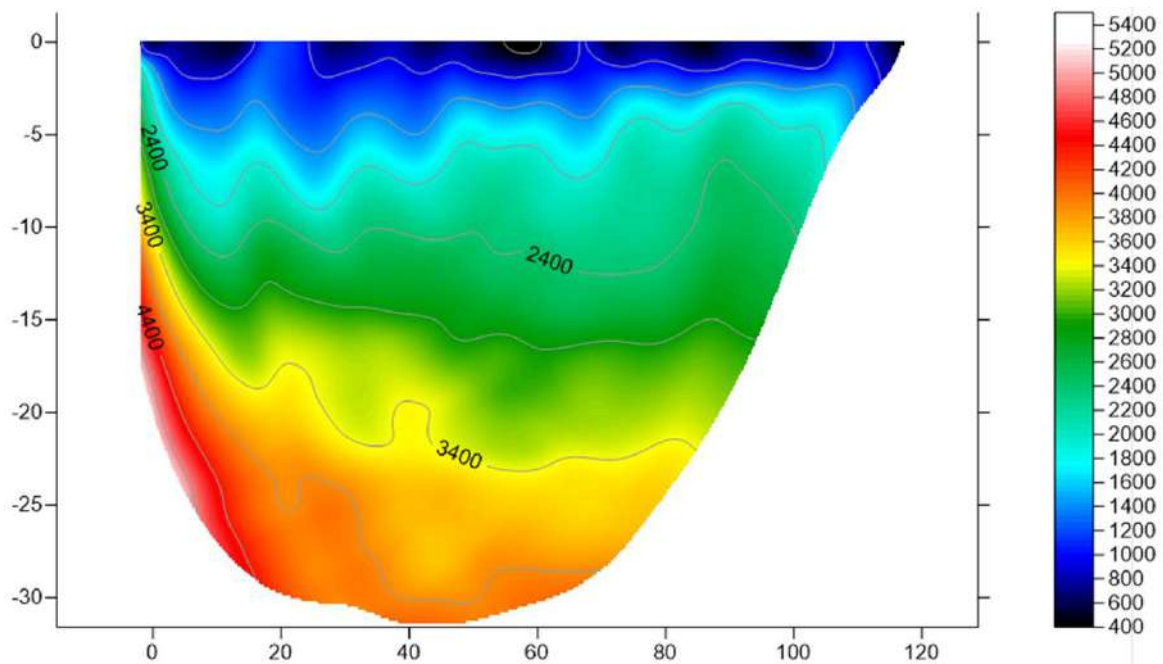
10. SRT-3.3



COMMENATRIES: -

- Seismic Line-3.3 i.e for SRT 3.3 covering 115m length involved laying of 24 geophones with one number of seismic spread.
- A total of 7 shots were taken using hammer as source (2, Far shots, 2 end shots and 2 intermediate shots and 1 mid shot all intermediate shots are taken at every even geophone all along the seismic spread). The seismic velocities are observed in the tomograms using
- Rayfract software is used for analysis of waves.
- However, it is expected that the first layer on the top with compressional velocities in the range of 500 m/s to 1200 m/sec up to average 7m depth from G.L. The second layer with recorded P-wave velocity in the range of 1200 m/sec to 2500 m/sec up to about average 15m depth. In this profile patch of 3500 m/s is also analyzed.
- Below the 15m up to 28m of profile the P-wave velocity in the range of 2500 m/s to 3500 m/s.
- Below the 28 m up to the end of profile the P-wave velocity increases up to the 4800 m/s.
- For detailed velocity at specified depths, it can be clearly seen from the profile.

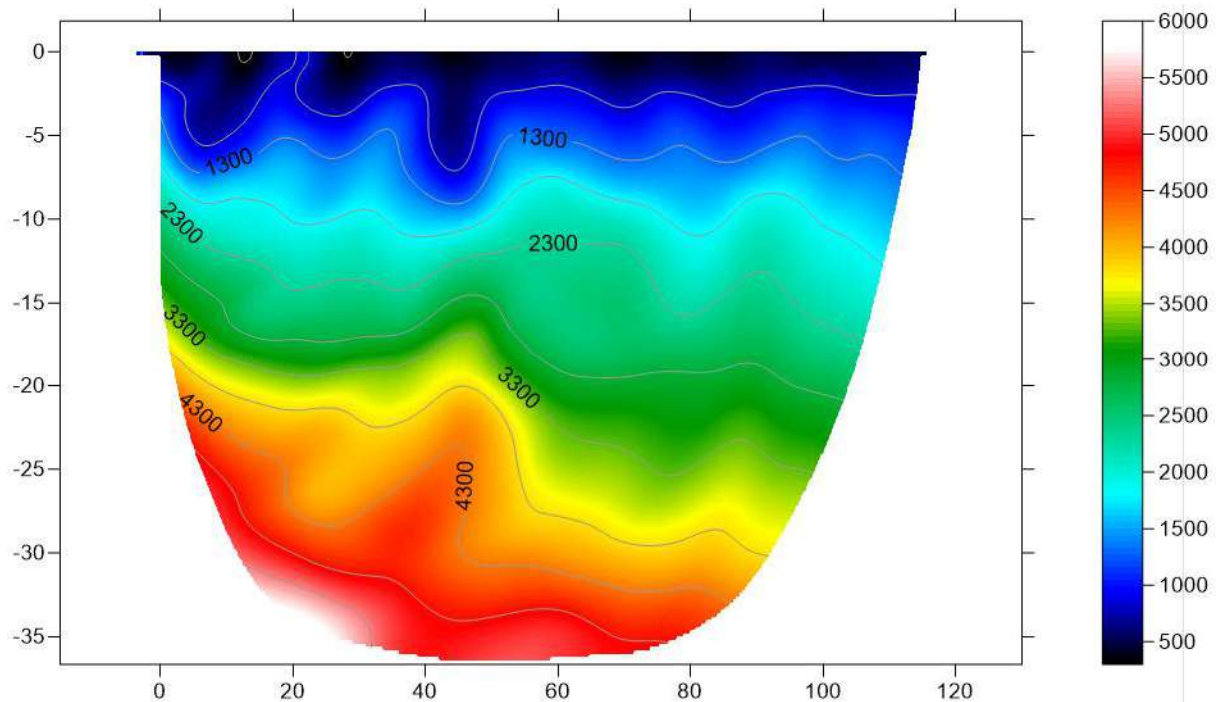
11. SRT-4.1



COMMENATRIES: -

- Seismic Line-4.1 i.e for SRT 4.1 covering 115m length involved laying of 24 geophones with one number of seismic spread.
- A total of 7 shots were taken using hammer as source (2, Far shots, 2 end shots and 2 intermediate shots and 1 mid shot all intermediate shots are taken at every even geophone all along the seismic spread). The seismic velocities are observed in the tomograms using
- Rayfract software is used for analysis of waves.
- However, it is expected that the first layer on the top with compressional velocities in the range of 400 m/s to 1000 m/sec up to average 5m depth from G.L. The second layer with recorded P-wave velocity in the range of 1400 m/sec to 3200 m/sec up to about average 20m depth. In this profile minor patch of 3400 m/s is also analyzed.
- Below the 20 m up to the end of profile the P-wave velocity increases up to the 4200 m/s.
- For detailed velocity at specified depths, it can be clearly seen from the profile.

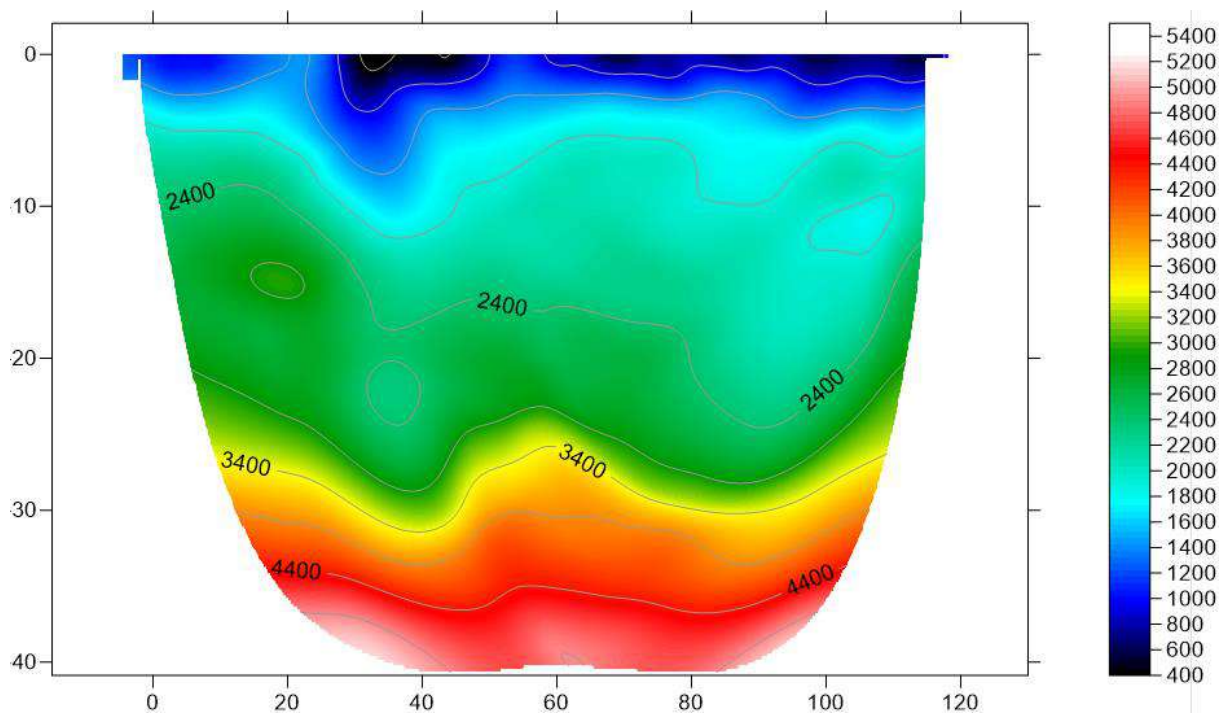
12. SRT-4.2



COMMENATRIES: -

- Seismic Line-4.2 i.e for SRT 4.2 covering 115m length involved laying of 24 geophones with one number of seismic spread.
- A total of 7 shots were taken using hammer as source (2, Far shots, 2 end shots and 2 intermediate shots and 1 mid shot all intermediate shots are taken at every even geophone all along the seismic spread). The seismic velocities are observed in the tomograms using
- Rayfract software is used for analysis of waves.
- However, it is expected that the first layer on the top with compressional velocities in the range of 500 m/s to 1200 m/sec up to average 7m depth from G.L. The second layer with recorded P-wave velocity in the range of 1700 m/sec to 3000 m/sec up to about average 18m depth
- Below the 18 m up to the end of profile the P-wave velocity increases up to the 5000 m/s.
- For detailed velocity at specified depths, it can be clearly seen from the profile.

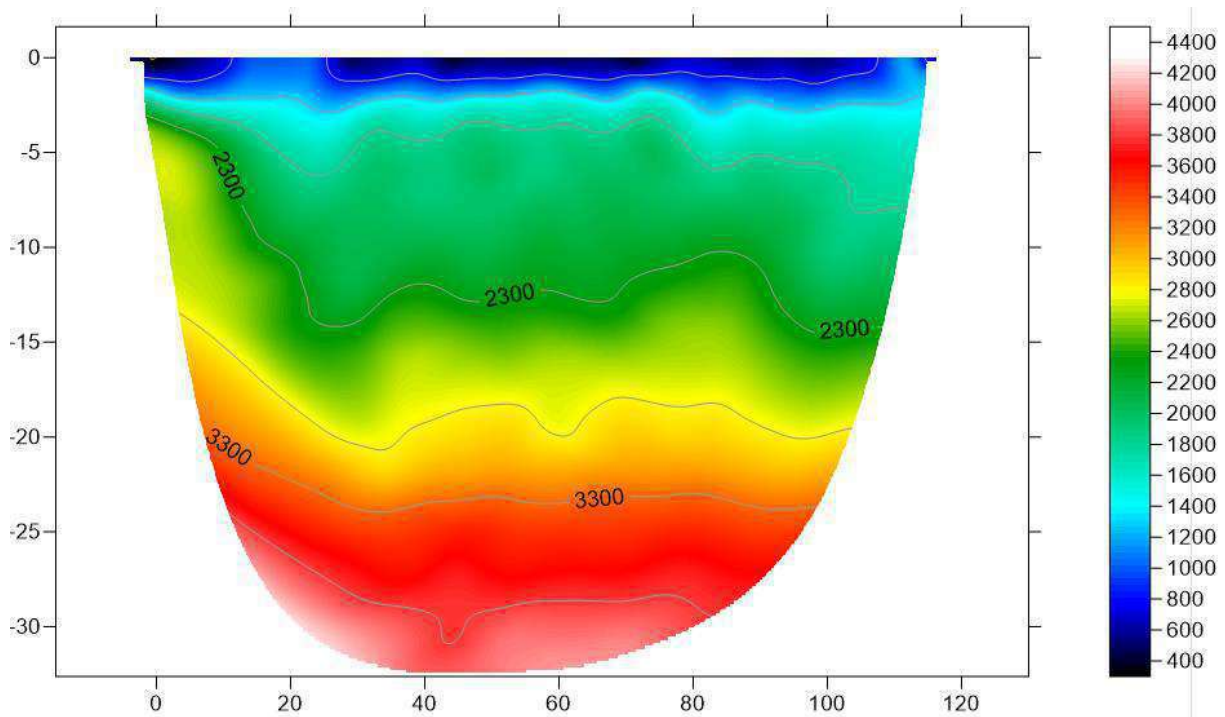
13. SRT-4.3



COMMENATRIES: -

- Seismic Line-4.3 i.e for SRT 4.3 covering 115m length involved laying of 24 geophones with one number of seismic spread.
- A total of 7 shots were taken using hammer as source (2, Far shots, 2 end shots and 2 intermediate shots and 1 mid shot all intermediate shots are taken at every even geophone all along the seismic spread). The seismic velocities are observed in the tomograms using
- Rayfract software is used for analysis of waves.
- However, it is expected that the first layer on the top with compressional velocities in the range of 400 m/s to 1000 m/sec up to average 8m depth from G.L. The second layer with recorded P-wave velocity in the range of 1400 m/sec to 3400 m/sec up to about average 28m depth. In this profile some of the portion having P-Wave velocity of 3000 m/s is also analyzed.
- Below the 28 m up to the end of profile the P-wave velocity increases up to the 5100 m/s.
- For detailed velocity at specified depths, it can be clearly seen from the profile.

14. SRT-4.4



COMMENATRIES: -

- Seismic Line-4.4 i.e for SRT 4.4 covering 115m length involved laying of 24 geophones with one number of seismic spread.
- A total of 7 shots were taken using hammer as source (2, Far shots, 2 end shots and 2 intermediate shots and 1 mid shot all intermediate shots are taken at every even geophone all along the seismic spread). The seismic velocities are observed in the tomograms using
- Rayfract software is used for analysis of waves.
- However, it is expected that the first layer on the top with compressional velocities in the range of 400 m/s to 600 m/sec up to average 3m depth from G.L. The second layer with recorded P-wave velocity in the range of 1200 m/sec to 2300 m/sec up to about average 15m depth
- Below the 15 m up to the end of profile the P-wave velocity increases up to the 4400 m/s.
- For detailed velocity at specified depths, it can be clearly seen from the profile.

9. Seismic cross hole test

Theory of Cross Hole Seismic Survey

The primary purpose of obtaining Cross Hole data is to obtain the most detailed in situ Seismic wave velocity profile for site-specific investigations and material Characterization. Cross Hole velocity data are valuable for assessing man-made materials, soil deposits, or rock formations.

The Seismic technique determines the Compressional (P-) and/ or Shear (S-) wave velocity of materials at depths of engineering and environmental concern where the data can be used in problems related to soil mechanics, rock mechanics, foundation studies, and earthquake engineering. Cross Hole Geophysical testing is generally conducted in the near surface (upper hundred meters) for site-specific engineering applications (Sirles and Viksne, 1990). All of the dynamic elastic moduli of a material can be determined from knowledge of the in situ density, P-, and S-wave velocity. Therefore, since procedures to determine material densities are standardized, acquiring detailed Seismic data yields the required information to analytically assess a site. Low-strain material damping and inelastic attenuation values can also be obtained from Cross Hole surveys. However, the most robust application of Cross Hole testing is the ability to define in situ Shear-wave velocity profiles for engineering investigations associated with earthquake engineering (Mooney, 1984).

The objective of acquiring Cross Hole data can be multipurpose; that is, the Seismic velocity results obtained may be used for evaluation of lateral and vertical material continuity, liquefaction analyses, deformation studies, or investigations concerning amplification or attenuation of strong ground motion. Typically, Cross Hole surveys are a Geophysical tool for performing explorations during what are considered phase two field investigations (where phase one field investigations include surface Geophysical surveys, follow-up drilling, trenching, and sampling of the in situ materials). During phase two field exploration, the information gathered is more critical to the analytical site-specific Characterization. Although both phase one and phase two results are important, the two independent sets of data must be integrated into the final analysis.

Cross Hole techniques are most useful when phase one site explorations indicate horizontal and particularly vertical variability of material properties. When layers of alternating density or stiffness are either known to exist or are encountered during phase one field investigations, Cross Hole Seismic tests are recommended to define the in situ velocities within each layer. Acquiring Cross Hole Seismic data resolves hidden layer velocity anomalies that cannot be detected with conventional surface methods, allows both final interpretation of other surface Geophysical data (Seismic or Electrical), and permits both empirical and theoretical correlation with other Geotechnical material parameters.

In order to have quantitative and quality assured results, Cross Hole tests performed for either engineering or environmental problems should be conducted in accordance with procedures established by the American Society for Testing and Materials (ASTM). Cross Hole Seismic test procedures are outlined in ASTM test designation D4428 M-84 (1984). The ASTM procedures provide specific guidelines for borehole preparation, data acquisition, and data reduction/ interpretation. Based on 10 years of experience, since the inception of the ASTM standard in 1984, Cross Hole Geophysical surveys have become more widely used and accepted for engineering as well as environmental applications. Coupling detailed site information obtained from the Cross Hole tests with the overall acceptance of the validity of the velocity data, these standards use both empirical correlations for liquefaction and specific input parameters for deformation or ground motion analyses (U.S. Bureau of Reclamation, 1989).

Theory

Cross Hole testing takes advantage of generating and recording (Seismic) body waves, both the P- and S-waves, at selected depth intervals where the Source and Receiver(s) are maintained at equal elevations for each measurement. Figure 1 illustrates a general field setup for the Cross Hole Seismic test method. Using Source-Receiver systems with preferential orientations in tandem (i.e., axial orientations, which complement the generated and received wave type/signal) allows maximum efficiency for measurement of in situ P- or S-wave velocity depending on the axial orientation. Due to the different particle motions along the Seismic ray path, it is crucial to use optimal Source-Receiver systems in order to best record Cross Hole P- or S-waves (Hoar, 1982). Because only body waves are generated in the Source borehole during Cross Hole tests, Surface waves (ground roll) are not generated and do not interfere with the recorded Body-wave Seismic signals.

Stokoe (1980) demonstrated that particle motions generated with different Seismic source types used during Cross Hole testing are three-directional. Therefore, three-component Geophones with orthogonal orientations yield optimal results when acquiring Cross Hole P- and/or S-wave Seismic signals. With three-component Geophones, there is one vertically oriented Geophone and two horizontal Geophones. For Cross Hole tests, one horizontal Geophone remains oriented parallel to the axis between the boreholes (radial orientation), and the other one remains oriented perpendicular to the borehole axis (transverse orientation). In this case, the two horizontal axis Geophones must remain oriented, radially and transversely, throughout the survey. This is accomplished with loading poles or with Geophones that can be electronically oriented.

P-waves are generated with a shear wave hammer such that along the assumed straight-ray propagation path the Seismic impulse compresses and rarefies the materials radially toward the Receiver borehole(s). Experience has proven that for optimal measurement of the P-wave signal, a Hydrophone has the greatest pressure-pulse sensitivity for Compressional-wave energy. Also, Hydrophones do not need to be clamped against the borehole wall; however, water must be present in the Receiver borehole in order to couple the Hydrophone to the casing/ formation.

For either Surface or Cross Hole Seismic testing in unconsolidated materials, P-wave velocity measurements are greatly affected by the moisture content or percent saturation (Allen, Rit, and Woods, 1980). In Cross Hole testing, the Seismic measurements encroach closer to the water surface with each successive depth interval. As the vadose zone and water surface are encountered, P-wave velocities become dependent upon the percent saturation, and the Poisson's ratio is no longer a valid representation of the formation characteristics.

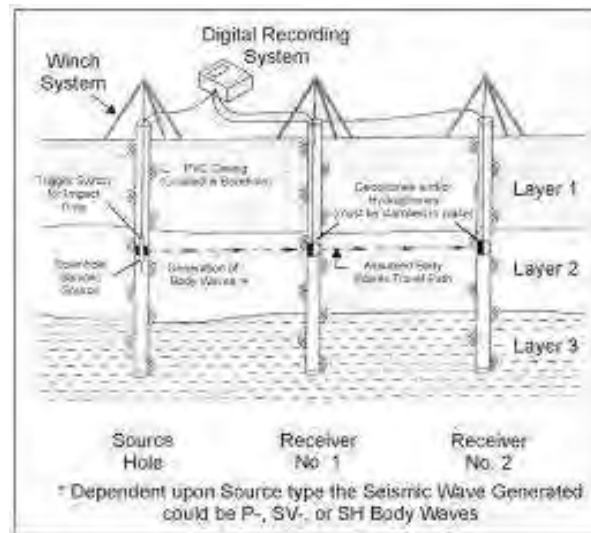


Figure 1. Schematic of Cross Hole method.

(e.g., Poisson's ratio increases to 0.48-0.49 in 100% saturated soils). Hence, below the water surface, the P-wave is commonly termed the fluid wave, because its propagation velocity is governed by the pore fluid(s), not the formation density. Fluid-wave velocities in fresh water range from 1,400 to 1,700 m/s, depending upon water temperature and salt content.

S-waves generated in Cross Hole testing may be split into two wave types, each with different particle motions--SV- and SH-waves, vertical or horizontal particle motions, respectively. Shear waves have the unique capability of polarization, which means that impacting the material to be tested in two directions (up or down, left or right) yields S-wave signals that are 180° out of phase. A Seismic source with reversible impact directions is the key factor for quality Cross Hole S-wave data acquisition and interpretation.

Typically, the S-wave generated in most Cross Hole testing is the SV-wave, which is a vertically polarized horizontally propagating Shear wave. That is, the ray path is horizontal but the (Shear) particle motion along the ray path is in the vertical plane. These SV-waves are easiest to generate because of commercially available borehole impact hammers that have reversible impact directions (up or down), and they are also the easiest to record because only one vertically oriented Geophone is required in each Receiver borehole. Alternatively, SH-waves can be generated and recorded in Cross Hole testing. SH-waves also propagate horizontally, but their (Shear) particle motion is in the horizontal plane (i.e., horizontally polarized horizontally propagating S-waves). Therefore, in order to generate and record SH-wave signals, horizontal impacts and Geophones are required; also, the orientation of the Source and Receiver must be parallel while their respective orientation remains perpendicular to the axis of the boreholes (transverse orientation).

Theoretically, there is no difference in the Body wave velocity for SV- and SH-waves, which justifies use of the uncomplicated vertical source for generation of SV-waves, and vertically oriented Geophones for signal detection. There are studies, however, which indicate significant velocity dependence of the SV- and SH-waves due to anisotropic states of stress in either the horizontal or vertical stress field (particularly in soil deposits; Redpath, et al., 1982) or fractured rock formations (White, 1983).

The requirement for multiple drill holes in Cross Hole testing means that care must be taken when completing each borehole with casing and grout. ASTM procedures call for PVC casing and a grout mix that closely matches the formation density. Basically, borehole preparation and completion

procedures are the success or failure of Cross Hole Seismic testing. Poor coupling between the casing and the formation yields delayed arrival times and attenuated signal amplitudes, particularly for (higher frequency) P-waves. Matching the formation density with a grout mix is not too difficult, but in open coarse-grained soils, problems arise during grout completion with losses into the formation. Even small grout takes begin to affect the velocity measured between two closely spaced drill holes. Several techniques to plug the porosity of the surrounding formation are commercially available (e.g., cotton-seed hulls, crushed walnut shells, or increased bentonite concentration in the grout mix). It should be recognized that increasing the ratio of bentonite/cement within the grout mix does affect density, but so long as the mix sets and hardens between the casing and in situ formation, quality Cross Hole Seismic signals will be obtained.

Another critical element of Cross Hole testing, which is often ignored, is the requirement for borehole directional surveys. There are several very good directional survey tools available that yield detailed deviation logs of each borehole used at a Cross Hole site. Borehole verticality and direction (azimuth) measurements should be performed at every depth interval that Seismic data are acquired. With the deviation logs, corrected Cross Hole distances between each borehole may be computed and used in the velocity analysis. Since Seismic wave travel times should be measured to the nearest tenth of a millisecond, relative borehole positions should be known to within a tenth of a foot. Assuming that the boreholes are vertical and plumb leads to computational inaccuracies and ultimately to data that cannot be quality assured.

Data Acquisition

Recording instruments used in Cross Hole testing vary considerably, but there are no standard requirements other than exact synchronization of the source pulse and instrument trigger for each recording. Cross Hole measurements rely considerably on the premise that the trigger time is precisely known as well as recorded. The recorded trigger signal from zero-time Geophones or accelerometers mounted on the Downhole impact hammer allows accurate timing for the first arrival at each drill hole. This becomes uniquely critical when only two drill holes are used (i.e., Source and one Receiver) because there is no capability of using interval travel times; in this case, the velocity is simply determined through distance traveled divided by direct travel time. Utilizing digital recording equipment affords the operator the ability to store the data on magnetic media for analysis at a later date; but more importantly, digital data can be filtered, smoothed, and time-shifted during analysis. Also, digital signal processing may be directly performed for coherence, frequency-dependent attenuation, and spectral analysis.

Numerous studies have shown that the effects on Cross Hole measurements by the choice of Geophone are not critical to the results (e.g., Hoar, 1982). There are only two requirements for the Receivers: the Receiver (velocity transducer) must have a flat or uniform output response over the frequency range of Cross Hole Seismic waves (25 to 300 Hz); and, a clamping device must force the Receiver against the borehole wall such that it is not free-hanging. The clamping device should not affect the mechanical response of the Geophone (i.e., resonance), nor should the uphole signal wire. If an SH-wave source is selected, then horizontal Geophones must be used and oriented as previously described to detect the SH-wave arrivals. It is paramount that the polarity of each Geophone be known prior to data acquisition because the direct arrivals of S-waves with reversed polarity can be easily misinterpreted. Hoar (1982) provides an excellent description of picking P- and S-wave arrivals off recorded Cross Hole signals. Hoar's dissertation shows that with proper borehole completion, digital recording equipment,

and a preferential Source-Receiver system, clean reversed polarized and interpretable S-wave signals are relatively easy to acquire.

Introduction

Cross-hole Seismic survey was conducted at three locations. One source hole and two receiver holes were used at both these locations.

9.1 Purpose of Investigations

The aim of the cross-hole seismic test method is to provide information pertinent to static / dynamic analysis and computing Shear modulus, Young's modulus, Bulk Modulus and Poisson's ratio.

9.2 Cross-Hole Seismic Test Apparatus

Following equipments and accessories were used:

1. Seismograph : Model Ambrogeo, Signal Enhancement type fully digital 24 Channel Engineering Seismograph,
2. Sensors : Orthogonal Downhole Sensors-02.
3. Cable : Geophone Spread Cables, 10m spacing, Water Proof joints
4. Software : SeisOpt@2D V6.0, WinGeo
5. Energy Source : Shear Wave Hammer

9.2.1 Seismograph:

Ambrogeo 24 channel engineering seismograph was used to record field data. The seismograph has the signal enhancement or stacking capability. The seismograph records the arrival of seismic waves through 24 channels. Only 6 channels were used for recording cross hole data. Data was recorded with various sampling frequency rates. The Seismic waves detected by each Geophone are displayed simultaneously on the screen.



Fig No. 1, Seismograph

9.2.2 Down Hole Sensors:

Orthogonal downhole sensors were used to receive the waves in two receiver holes. The sensors have two horizontal component and one vertical component geophones, encased in a steel tube and having water tight arrangement. The sensors were lowered at the same depth as the source, and bladder attached to them was inflated so as to make them in contact with the borehole wall.

9.2.3 Energy Source:

Shear wave hammer was used for generating waves in the source borehole. The hammer generates waves in both the directions i.e. Up and Down, resulting in polarized energy.



Fig No. 3, Energy Source

9.3 Cross Hole Seismic Test

9.3.1 Surveying Location

One source hole and two receiver holes were used. The cross hole seismic test consists of generation of horizontally traveling P and S waves at a particular level in one borehole (Source Hole) and recording their arrivals at same level in two nearby boreholes (Receiver Holes).

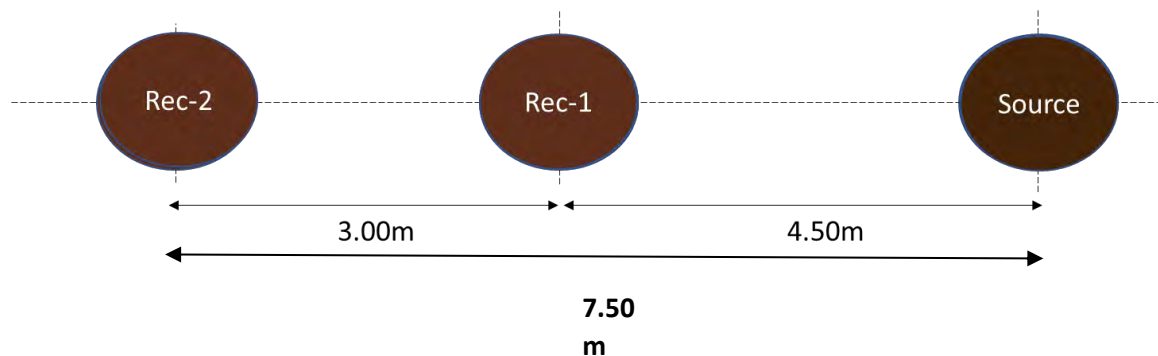


Fig No. 4, Typical configuration of Source hole and Receiver holes used

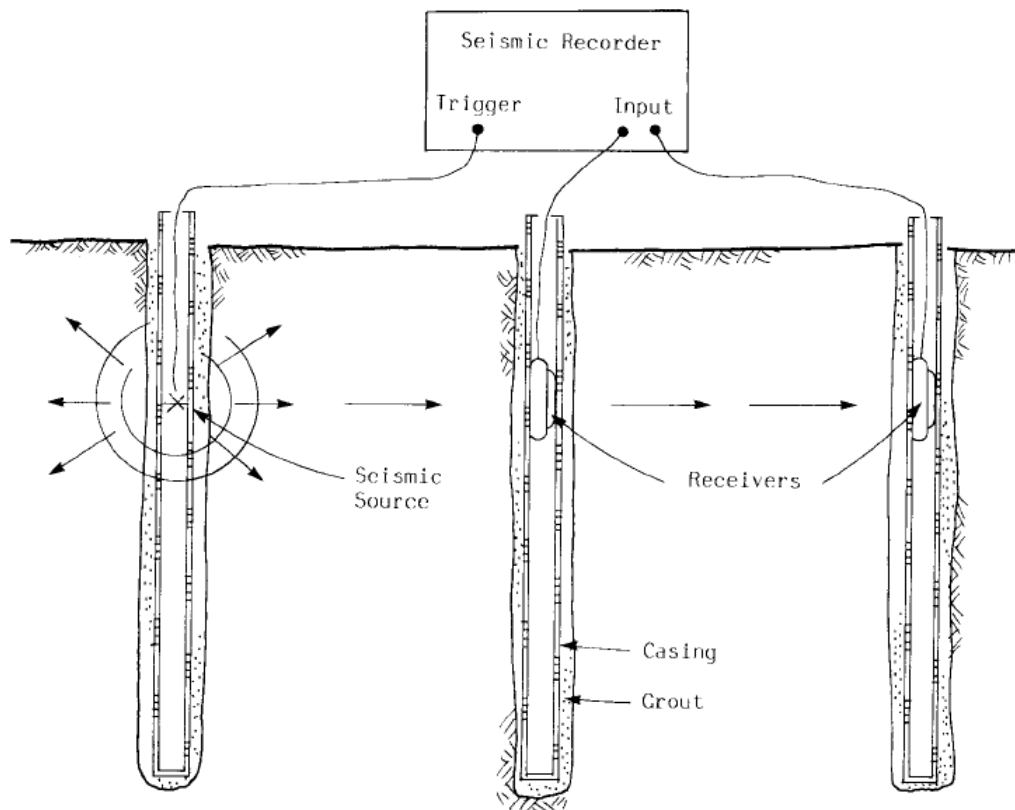


Fig No. 5, Typical section of Source and Receiver holes used (Source: ASTM D 4428)

9.3.2 Cross hole Test Procedure

The Cross hole tests were started by placing the energy source in an end hole at a depth of around 15.00m in to the stratum being investigated. Two receivers were placed at the same elevation in each of the designated receiver holes. Source and receivers were clamped firmly into place. The energy source and display of both receivers are activated simultaneously on the recording device. Signal amplitude and duration are adjusted such that the P-wave train, S-wave train and both are displayed in the entirety. Second observations were taken by taking up the energy source and receivers to a depth not greater than 1.5m, i.e. at 13.50m at test locations. Successive tests at intervals of 1.5m until the top of bore hole depth has been reached were conducted.

9.4 Cross Hole Seismic Survey Data Interpretation

9.4.1 Data Processing

The data is stored in the hard disk of the Seismograph at the time of data acquisition. The data is transferred to the computer for further processing. The processing involves picking the first arrivals. In case of noisy data there are intermediate steps of data processing using filtering, amplitude corrections etc. Data was acquired only during day time.

9.4.2 Picking of First Arrivals

The picking was done manually to see arrival of P and S waves on the respective Geophones. The time of travel from Source to Receiver hole was used to determine the velocity of Seismic waves, as the distances between the boreholes were known. The time at Receiver-1 is subtracted from that of Receiver-2 to arrive at the time taken by the wave to travel from Receiver-1 to Receiver-2.

9.4.3 Velocity Calculation

Velocity calculation was done using the time derives as above and the distance between the two Receiver holes.

9.4.4 Calculation of Soil Parameters

The dynamic soil parameters are calculated from seismic wave and the bulk density of the corresponding of the subsurface strata.

The calculations are based on IS Code 13372 (Part-2).

Poisson's Ratio σ is determined directly from the compressional (primary wave - P) wave and Shear (Secondary Wave - S) wave data. It is expressed by the ratio of transverse strain to longitudinal strain. Its dynamic determination is expressed as:

$$\sigma = (m^2 - 2) / [2*(m^2 - 1)] \text{ where } m = V_P / V_s$$

Young's Modulus E is the uni-axial stress-strain ratio. Its dynamic value is expressed by the following equation:

$$E = \rho V_P^2 (1 + \sigma) (1 - 2\sigma) / (1 - \sigma)$$

Shear Modulus G is the stress-strain ratio for simple shear. Its dynamic value is obtained by the following:

$$G = E / \{2 (1 + \sigma)\} = \rho V_s^2$$

Bulk Modulus K is calculated using the following equation:

$$K = E / (3 - 6\sigma)$$

Where ρ is bulk density in Kg / m³, σ is Poisson's ratio and V_P is P-wave velocity in m/sec, V_s is S-wave velocity in m/sec, **E** & **G** are in N / m².

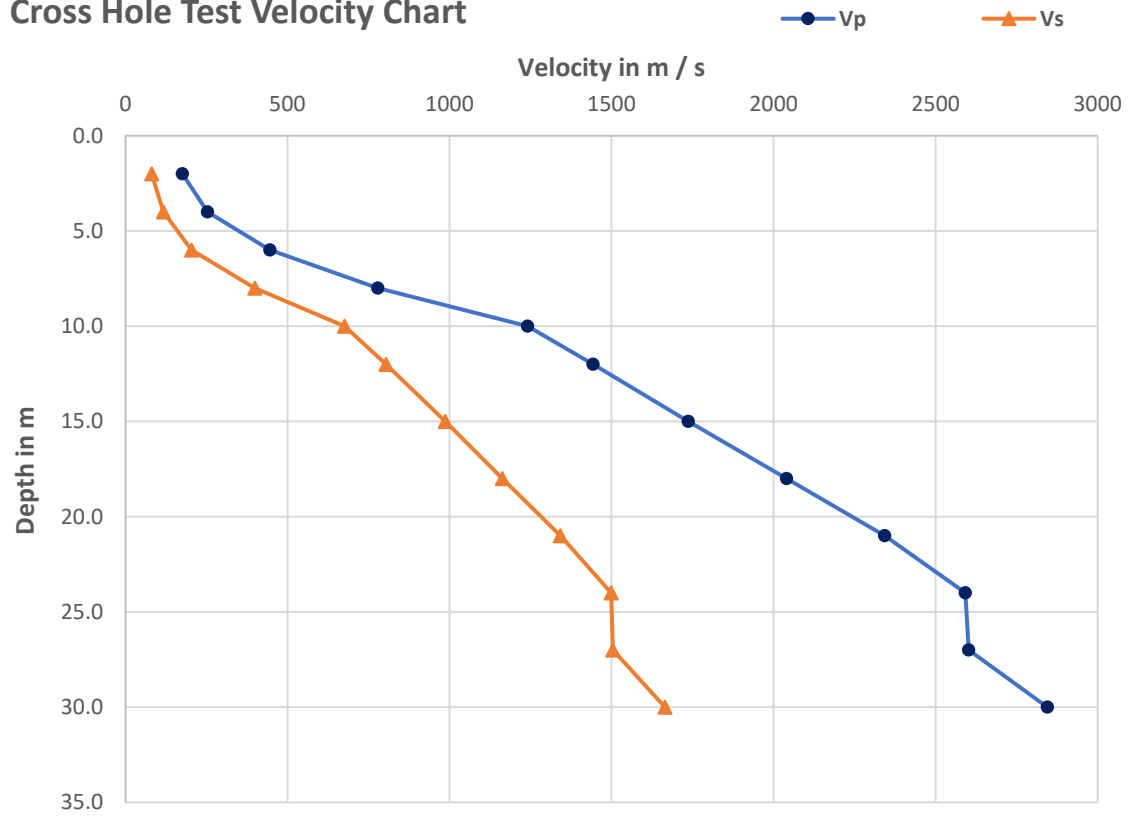
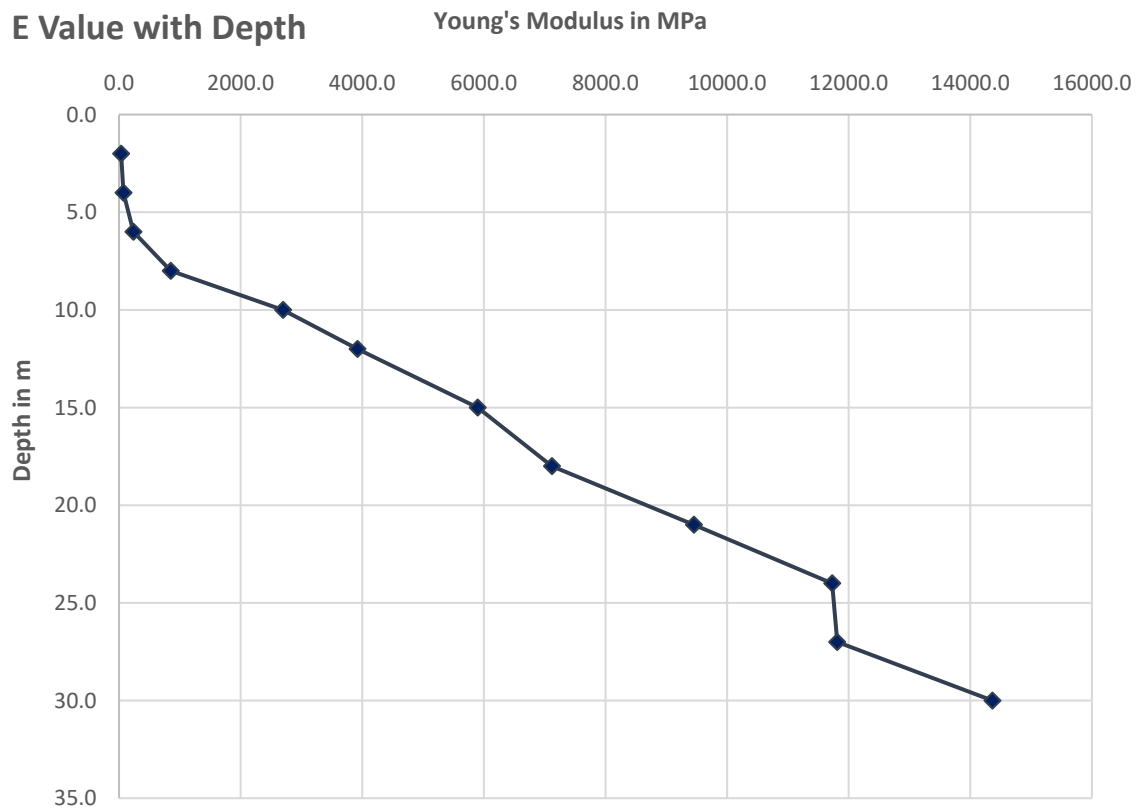
9.5 Observations and Analysis:

The parameters as derived from Cross Hole data are presented as follows,

Co-Ordinates: E953 N 3180

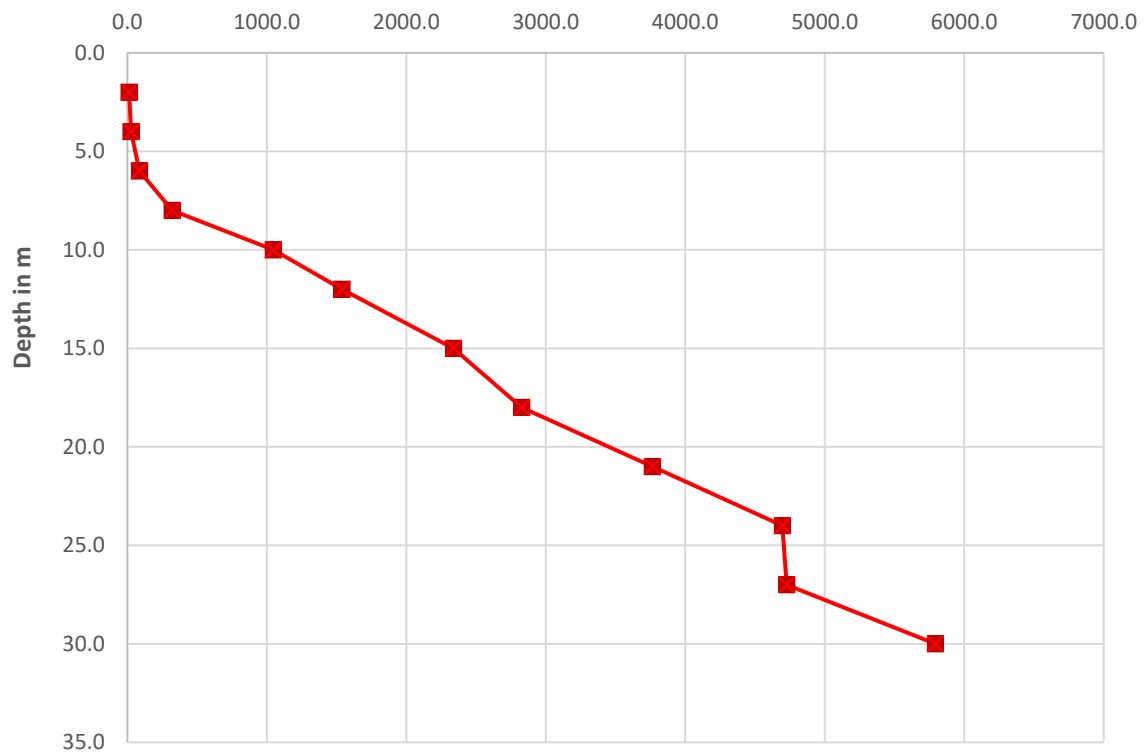
For CHST-1 (RL:198.04m) Location: ID Fan Absorber & RC pump house Unit-1

CROSSHOLE TEST-1								
Calculated Values of Dynamic Parameters								
Depth (m)	Vp (m/s)	Vs (m/s)	Mass Density (kN/m³)	m=(Vp/Vs)	Poisson's Ratio	Young's Modulus (N/mm²)	Shear Modulus (N/mm²)	Bulk Modulus (N/mm²)
2.0	176	81	1.91	2.2	0.37	34.2	12.5	42.4
4.0	253	117	1.95	2.2	0.36	72.9	26.7	89.7
6.0	446	204	2.08	2.2	0.37	236.8	86.6	298.3
8.0	779	399	2.02	2.0	0.32	850.3	321.6	796.1
10.0	1241	676	2.29	1.8	0.29	2697.9	1046.5	2131.5
12.0	1443	804	2.38	1.8	0.27	3922.8	1538.5	2904.5
15.0	1737	987	2.4	1.8	0.26	5899.2	2338.0	4123.9
18.0	2040	1163	2.09	1.8	0.26	7119.4	2826.9	4928.6
21.0	2343	1342	2.09	1.7	0.26	9454.3	3764.0	6454.7
24.0	2592	1499	2.09	1.7	0.25	11728.7	4696.2	7779.9
27.0	2602	1504	2.09	1.7	0.25	11810.8	4727.6	7846.7
30.0	2845	1665	2.09	1.7	0.24	14363.7	5794.0	9191.2

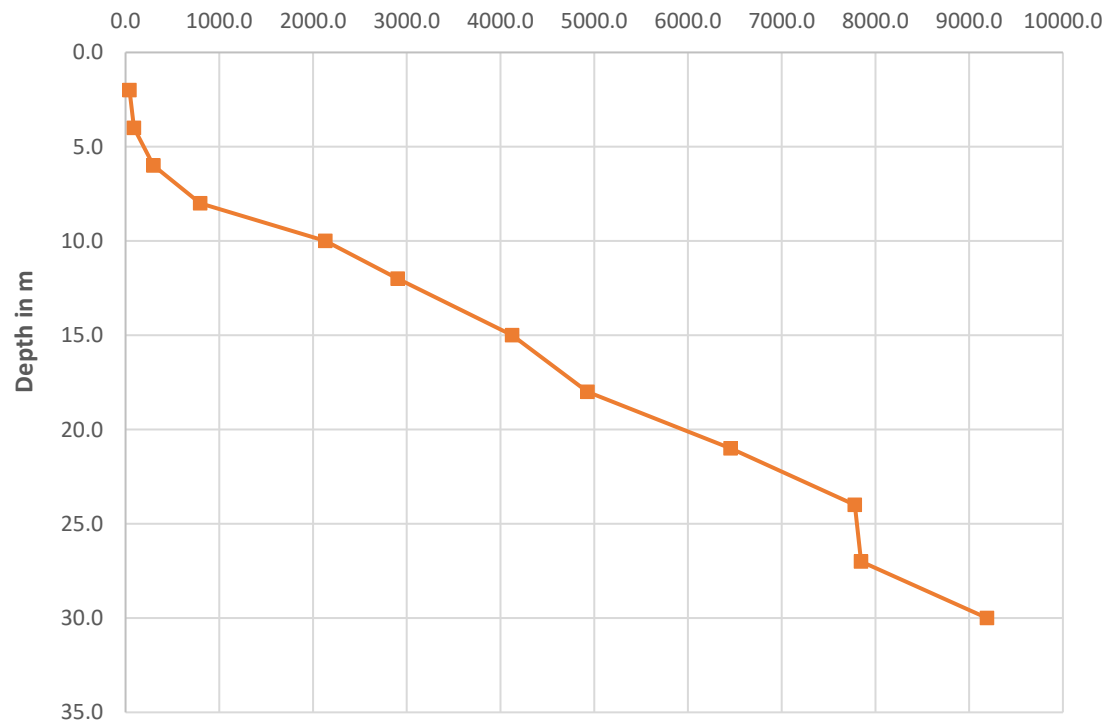
Cross Hole Test Velocity Chart**E Value with Depth**

G Value with Depth

Shear Modulus G in MPa

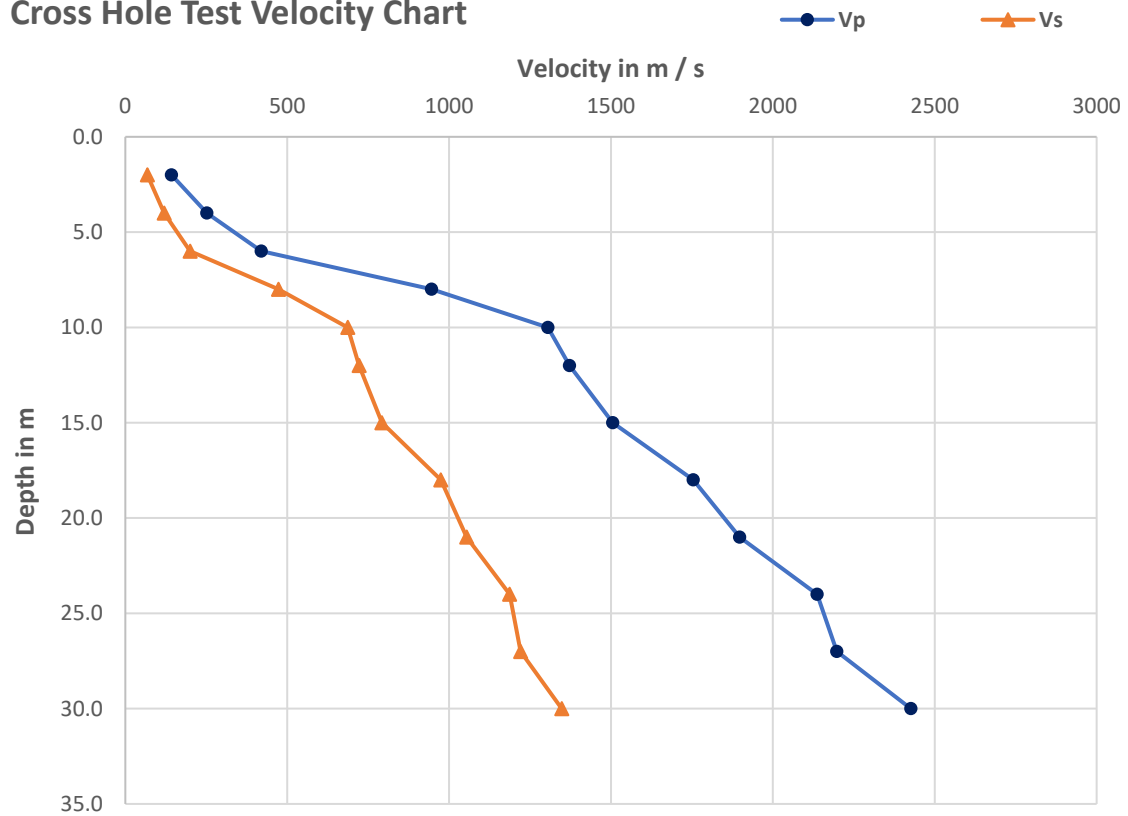
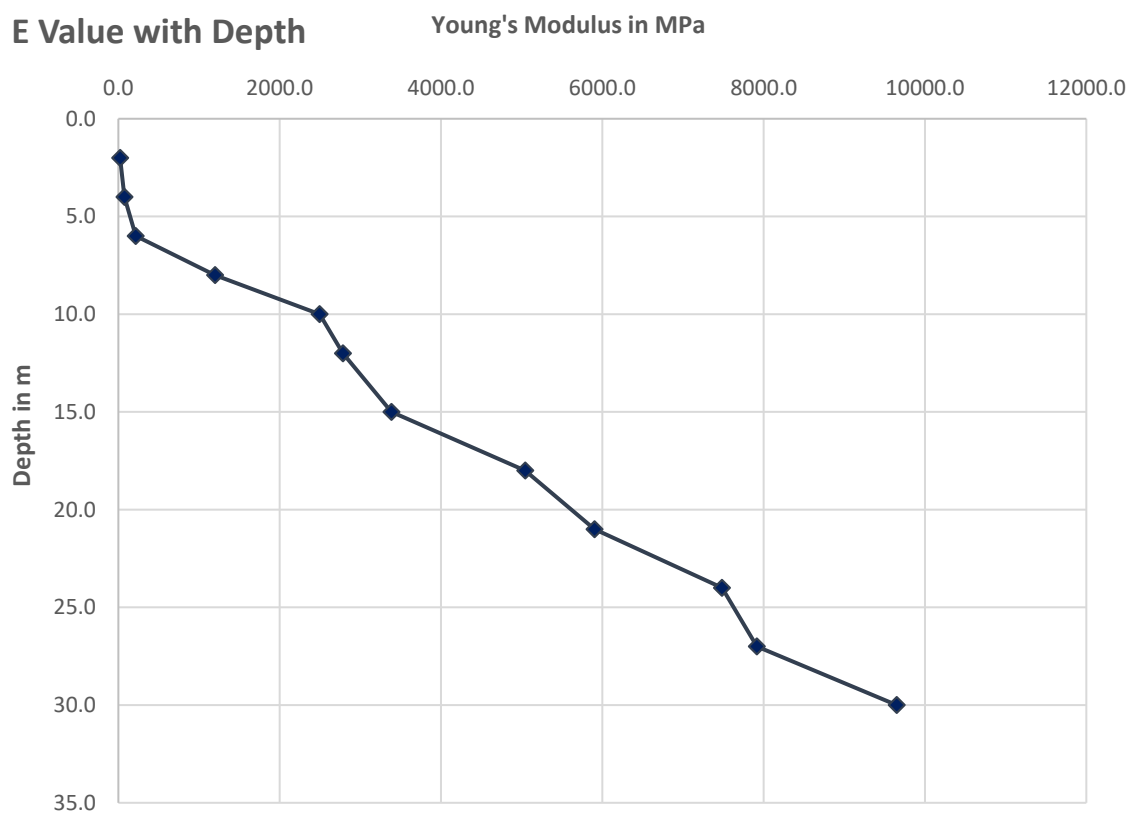
**K Value with Depth**

Bulk Modulus K in MPa



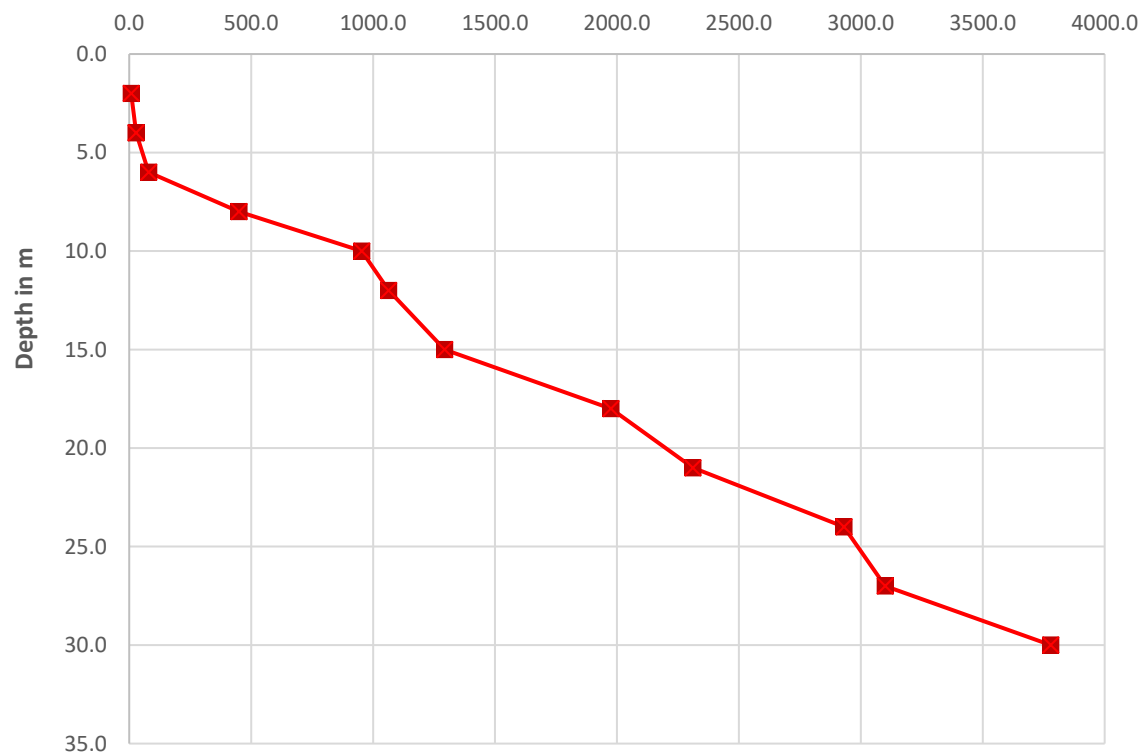
Co-Ordinates: E1247 N 3188
For CHST-2 (RL:200.92m)
Location: Power House Unit-1

CROSSHOLE TEST-2								
Calculated Values of Dynamic Parameters								
Depth (m)	Vp (m/s)	Vs (m/s)	Mass Density (kN/m³)	m=(Vp/Vs)	Poisson's Ratio	Young's Modulus (N/mm²)	Shear Modulus (N/mm²)	Bulk Modulus (N/mm²)
2.0	143	68	1.73	2.1	0.35	21.7	8.0	24.6
4.0	252	120	1.95	2.1	0.35	76.0	28.1	86.4
6.0	420	200	1.99	2.1	0.35	215.5	79.6	244.9
8.0	946	473	2.01	2.0	0.33	1199.2	449.7	1199.2
10.0	1305	687	2.02	1.9	0.31	2494.9	953.4	2170.5
12.0	1372	722	2.04	1.9	0.31	2783.6	1063.7	2421.7
15.0	1506	792	2.06	1.9	0.31	3385.4	1293.7	2945.3
18.0	1754	975	2.08	1.8	0.28	5044.1	1975.3	3766.3
21.0	1898	1054	2.08	1.8	0.28	5903.0	2311.6	4407.5
24.0	2137	1187	2.08	1.8	0.28	7483.7	2930.7	5587.8
27.0	2197	1221	2.08	1.8	0.28	7916.0	3100.0	5910.6
30.0	2426	1348	2.08	1.8	0.28	9649.7	3778.9	7205.1

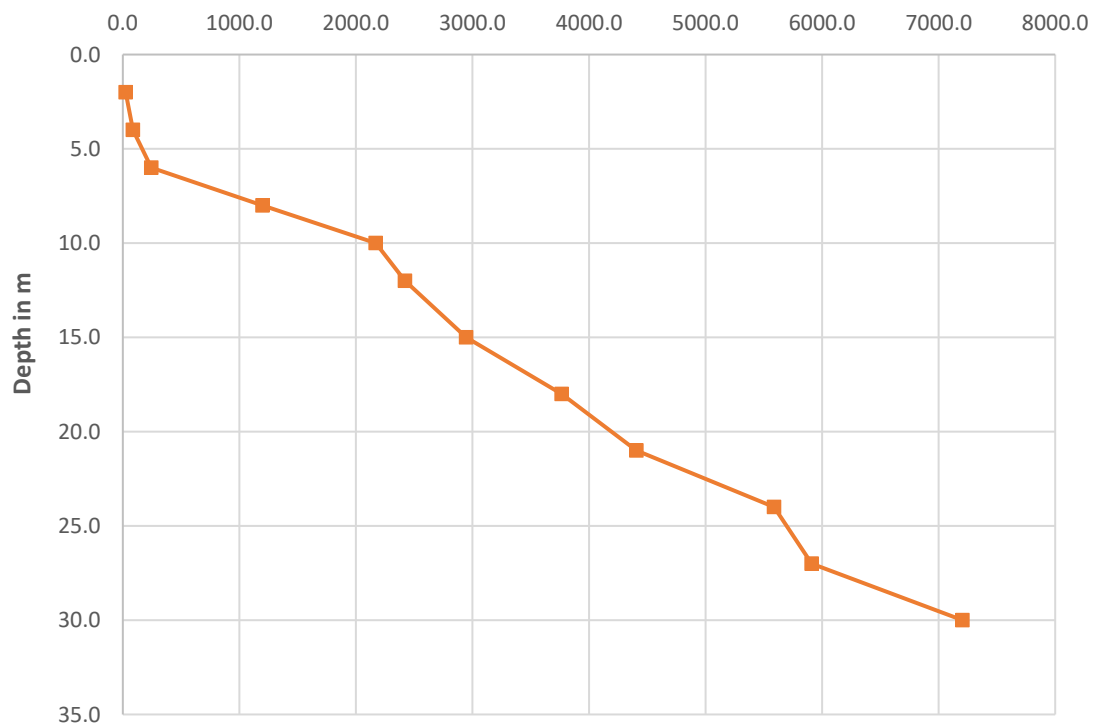
Cross Hole Test Velocity Chart**E Value with Depth**

G Value with Depth

Shear Modulus G in MPa

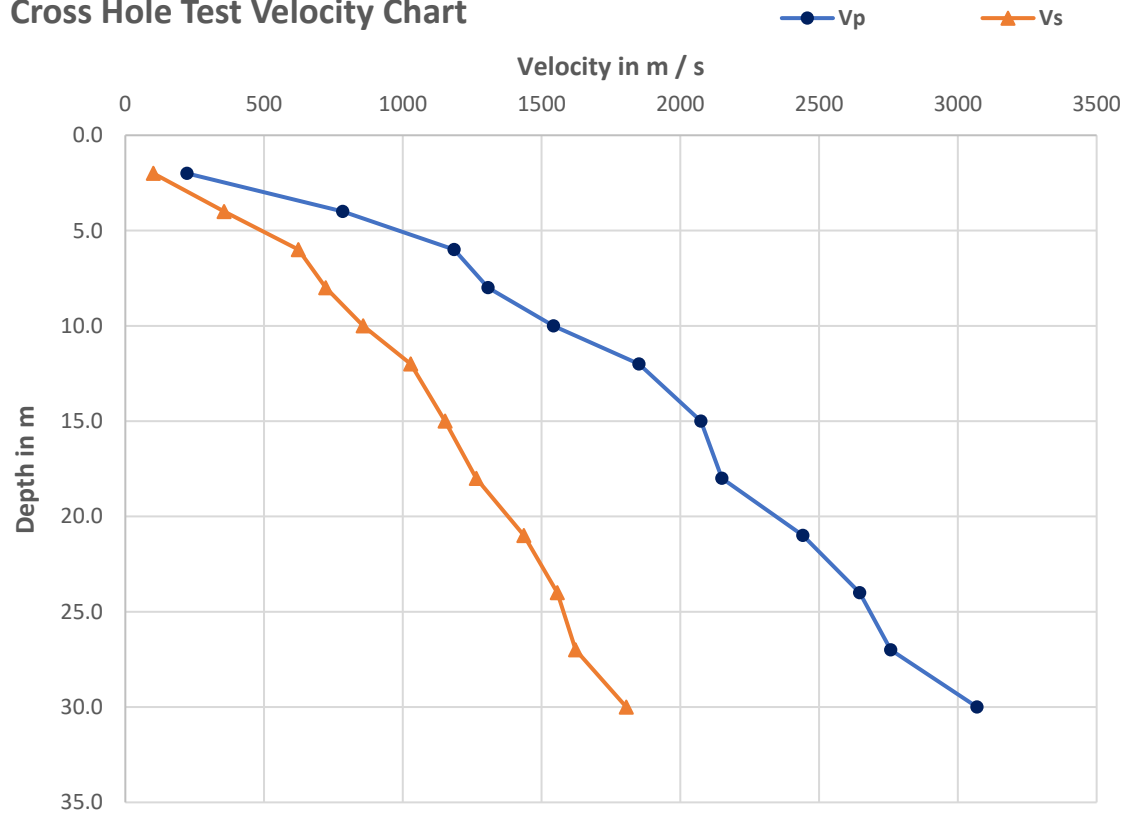
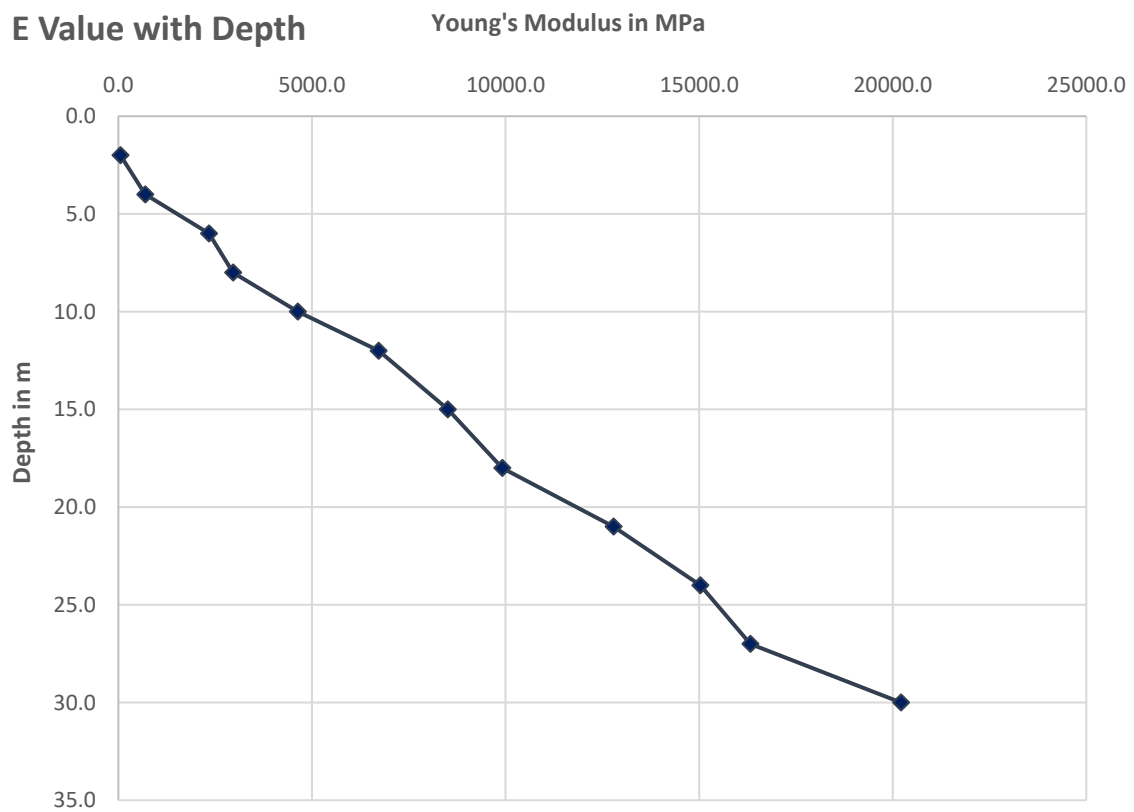
**K Value with Depth**

Bulk Modulus K in MPa



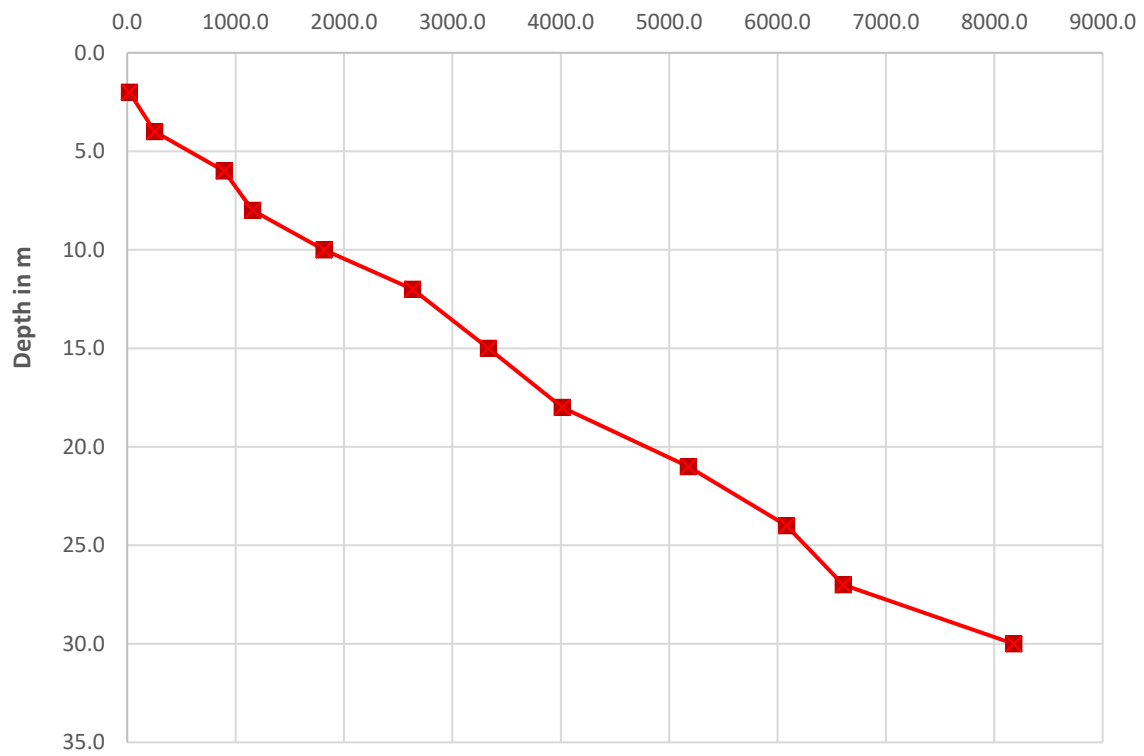
Co-Ordinates: E1196 N 3019
 For CHST-3 (RL:198.60m)
 Location: Boiler Unit-2

CROSSHOLE TEST-3								
Calculated Values of Dynamic Parameters								
Depth (m)	Vp (m/s)	Vs (m/s)	Mass Density (kN/m ³)	m=(Vp/Vs)	Poisson's Ratio	Young's Modulus (N/mm ²)	Shear Modulus (N/mm ²)	Bulk Modulus (N/mm ²)
2.0	222	101	1.91	2.2	0.37	53.4	19.5	68.3
4.0	783	356	2.00	2.2	0.37	694.7	253.6	889.2
6.0	1185	624	2.30	1.9	0.31	2340.3	894.3	2036.0
8.0	1307	722	2.22	1.8	0.28	2964.1	1157.6	2248.9
10.0	1543	857	2.47	1.8	0.28	4635.4	1815.3	3461.1
12.0	1851	1028	2.49	1.8	0.28	6723.5	2633.0	5020.2
15.0	2074	1152	2.51	1.8	0.28	8509.7	3332.5	6353.9
18.0	2150	1265	2.51	1.7	0.24	9917.2	4013.6	6247.8
21.0	2441	1436	2.51	1.7	0.24	12790.7	5176.5	8058.1
24.0	2647	1557	2.51	1.7	0.24	15030.8	6083.1	9469.4
27.0	2758	1622	2.51	1.7	0.24	16323.7	6606.4	10283.9
30.0	3069	1805	2.51	1.7	0.24	20213.8	8180.7	12734.7

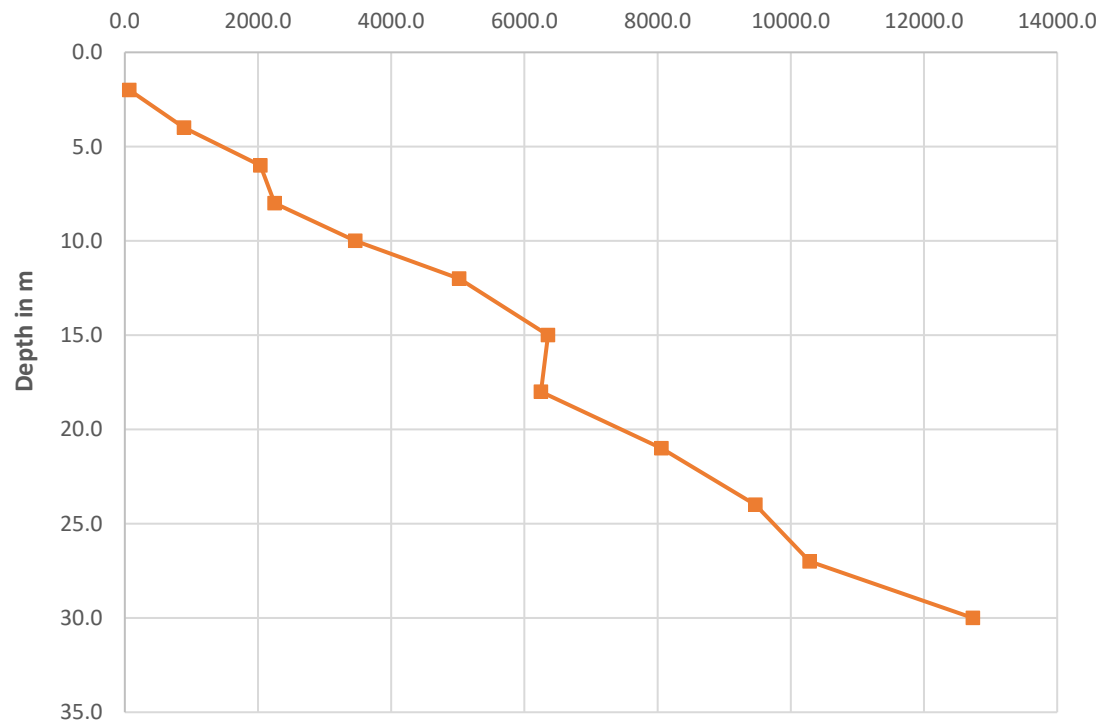
Cross Hole Test Velocity Chart**E Value with Depth**

G Value with Depth

Shear Modulus G in MPa

**K Value with Depth**

Bulk Modulus K in MPa

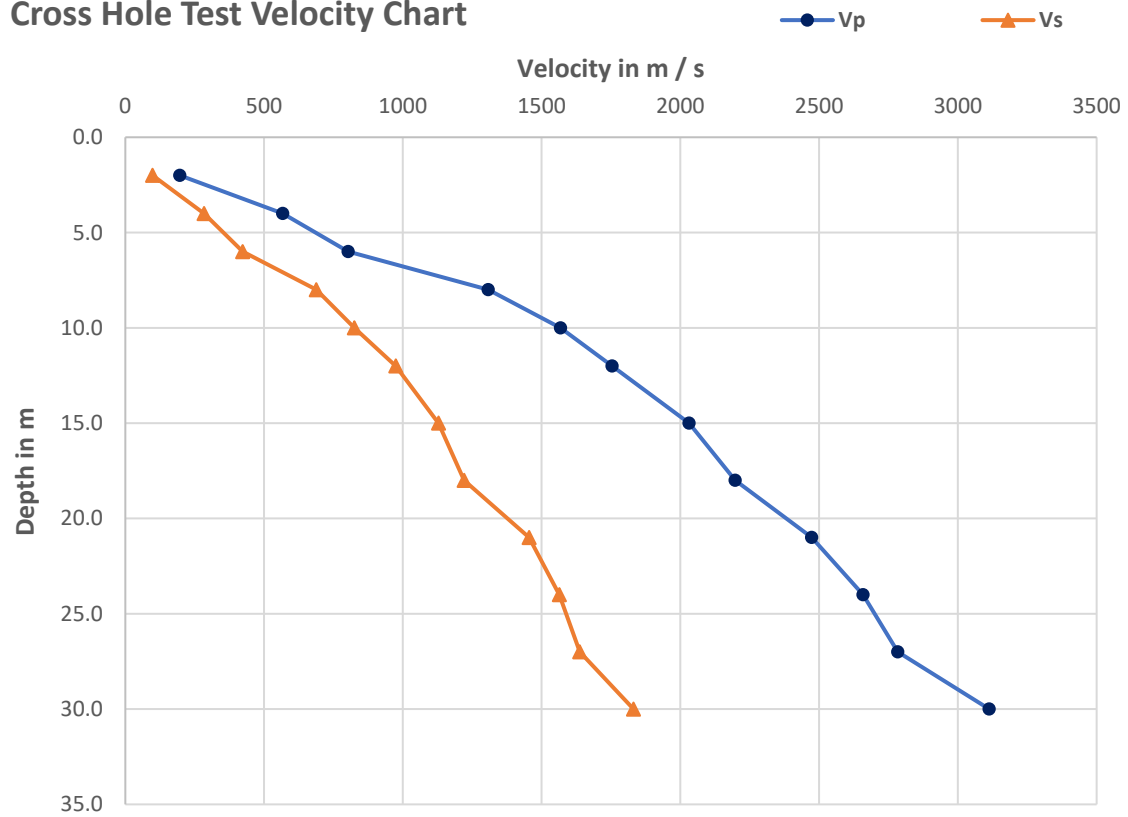
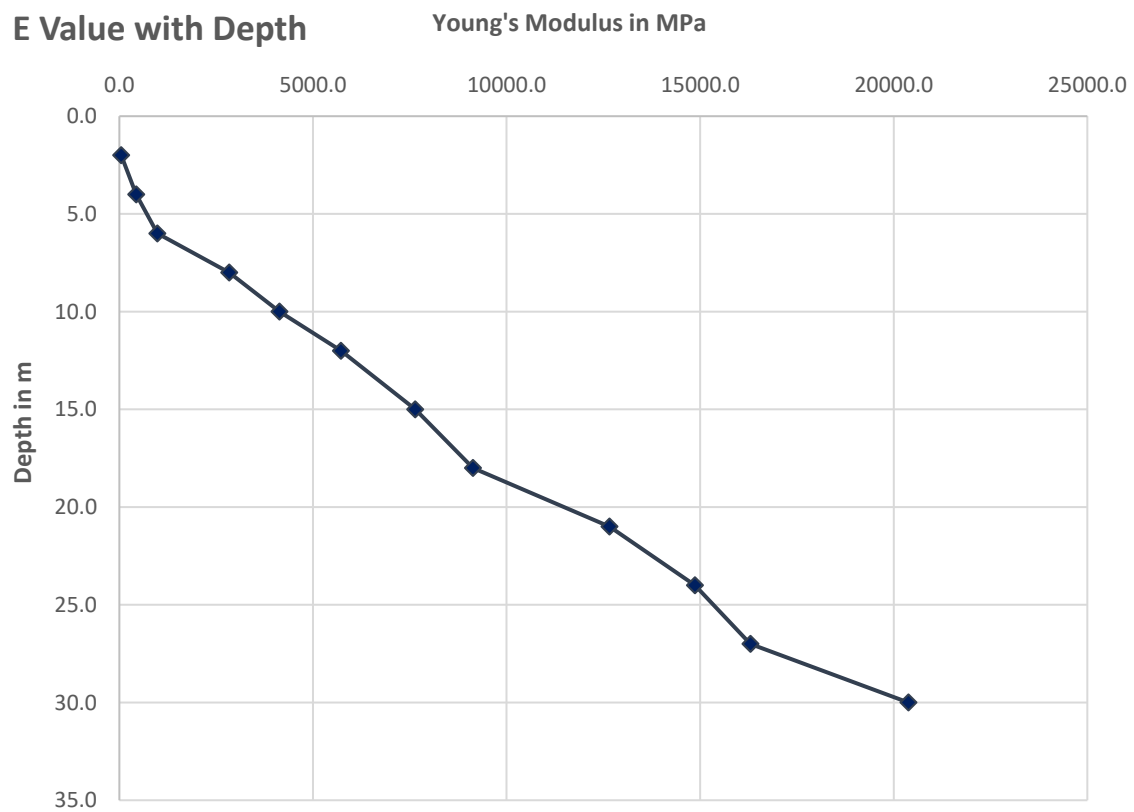


Co-Ordinates: E 1249 N 3042

For CHST 4 (RL:197.69m)

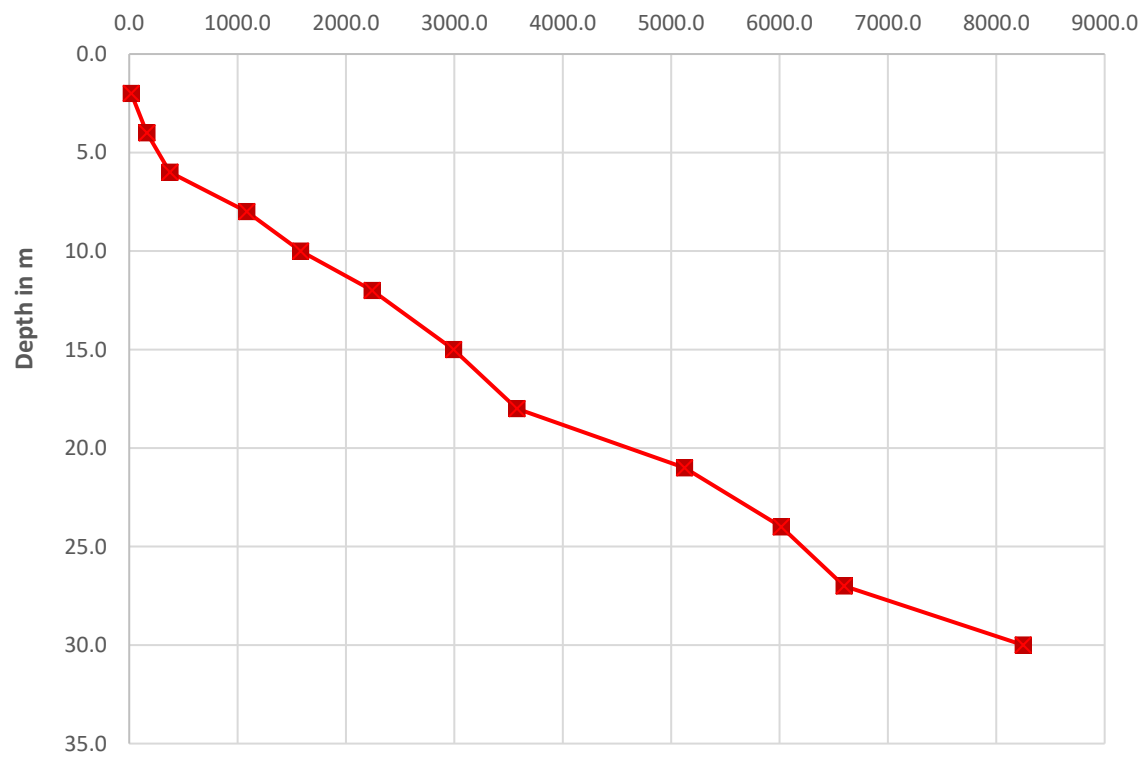
Location: Power House Unit-2

CROSSHOLE TEST-4								
Calculated Values of Dynamic Parameters								
Depth (m)	V _p (m/s)	V _s (m/s)	Mass Density (kN/m ³)	m=(V _p /V _s)	Poisson's Ratio	Young's Modulus (N/mm ²)	Shear Modulus (N/mm ²)	Bulk Modulus (N/mm ²)
2.0	196	98	1.90	2.0	0.33	48.9	18.3	48.9
4.0	567	284	2.03	2.0	0.33	435.4	163.3	435.4
6.0	803	423	2.10	1.9	0.31	982.1	375.3	854.4
8.0	1308	688	2.29	1.9	0.31	2838.1	1084.6	2469.2
10.0	1568	825	2.32	1.9	0.31	4137.0	1580.9	3599.2
12.0	1754	975	2.36	1.8	0.28	5723.1	2241.2	4273.3
15.0	2031	1129	2.35	1.8	0.28	7642.3	2992.8	5706.3
18.0	2197	1221	2.4	1.8	0.28	9133.9	3576.9	6820.0
21.0	2473	1455	2.42	1.7	0.24	12658.8	5123.2	7975.1
24.0	2658	1564	2.46	1.7	0.24	14864.7	6015.9	9364.8
27.0	2784	1638	2.46	1.7	0.24	16298.9	6596.3	10268.3
30.0	3113	1831	2.46	1.7	0.24	20380.9	8248.4	12840.0

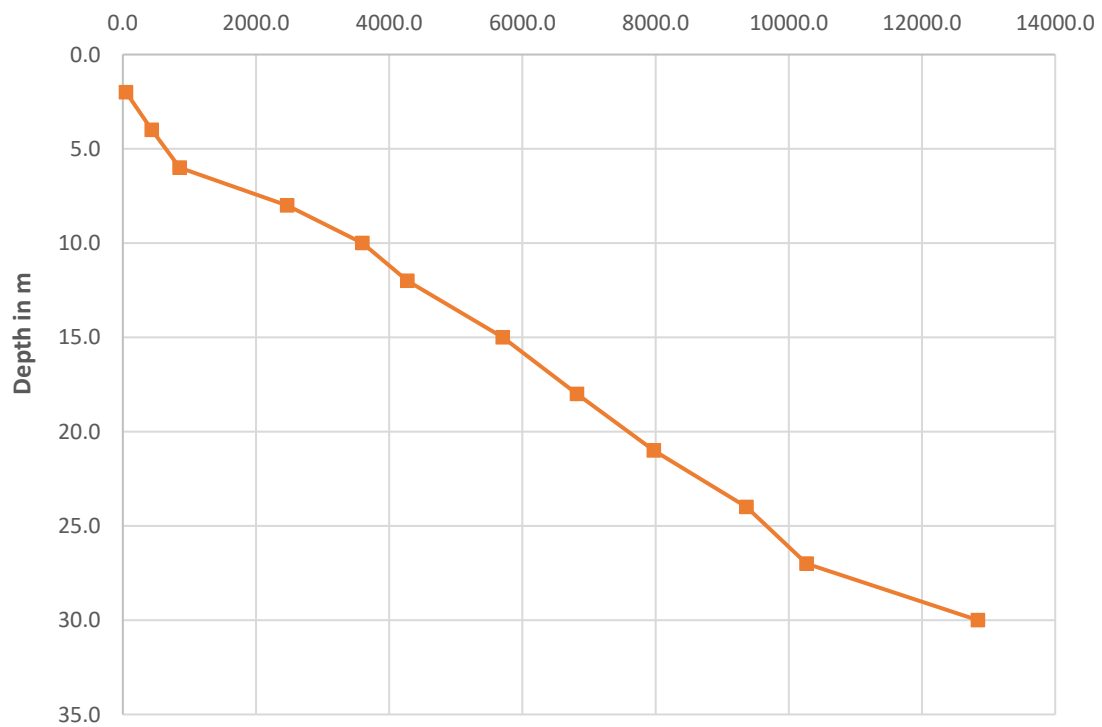
Cross Hole Test Velocity Chart**E Value with Depth**

G Value with Depth

Shear Modulus G in MPa

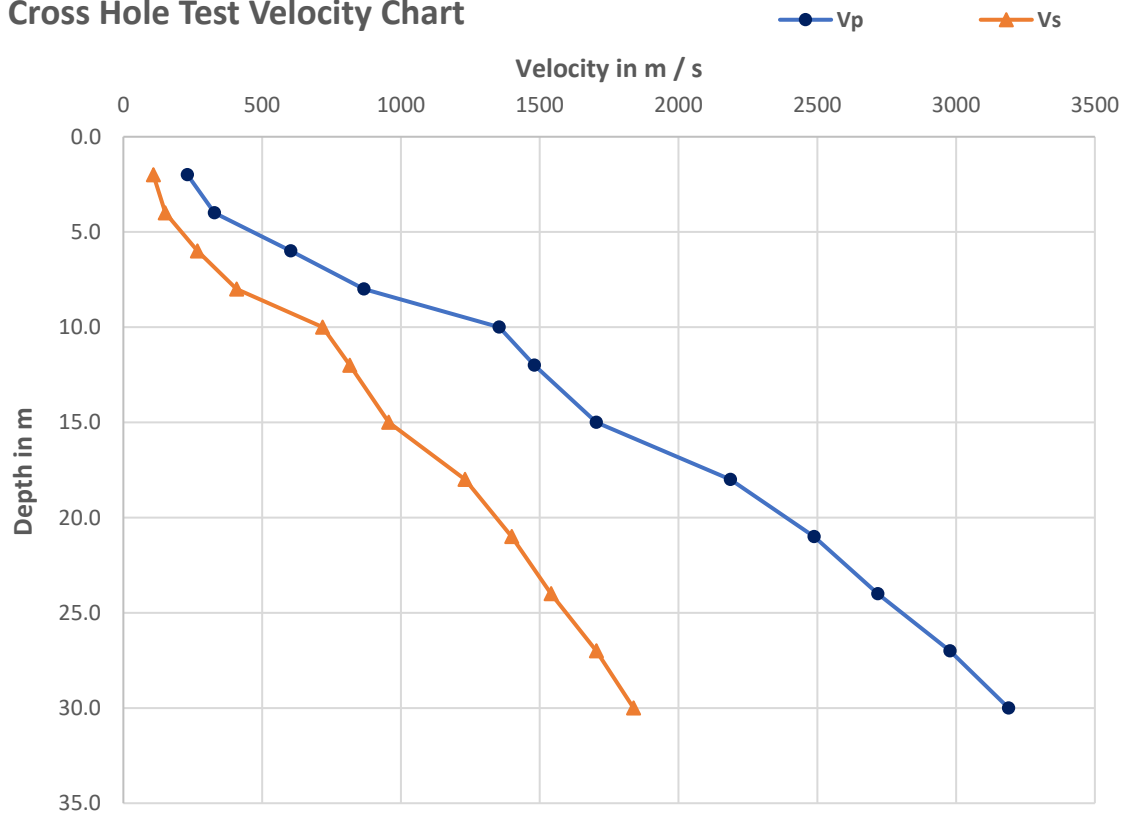
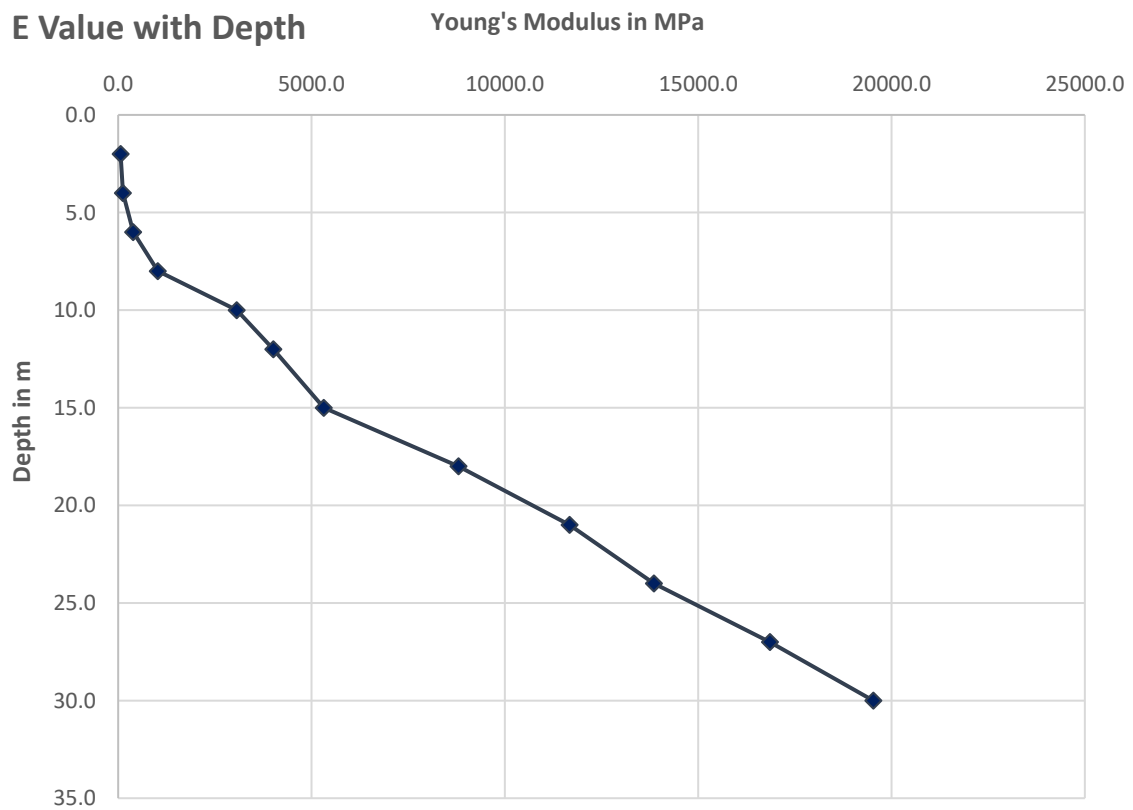
**K Value with Depth**

Bulk Modulus K in MPa



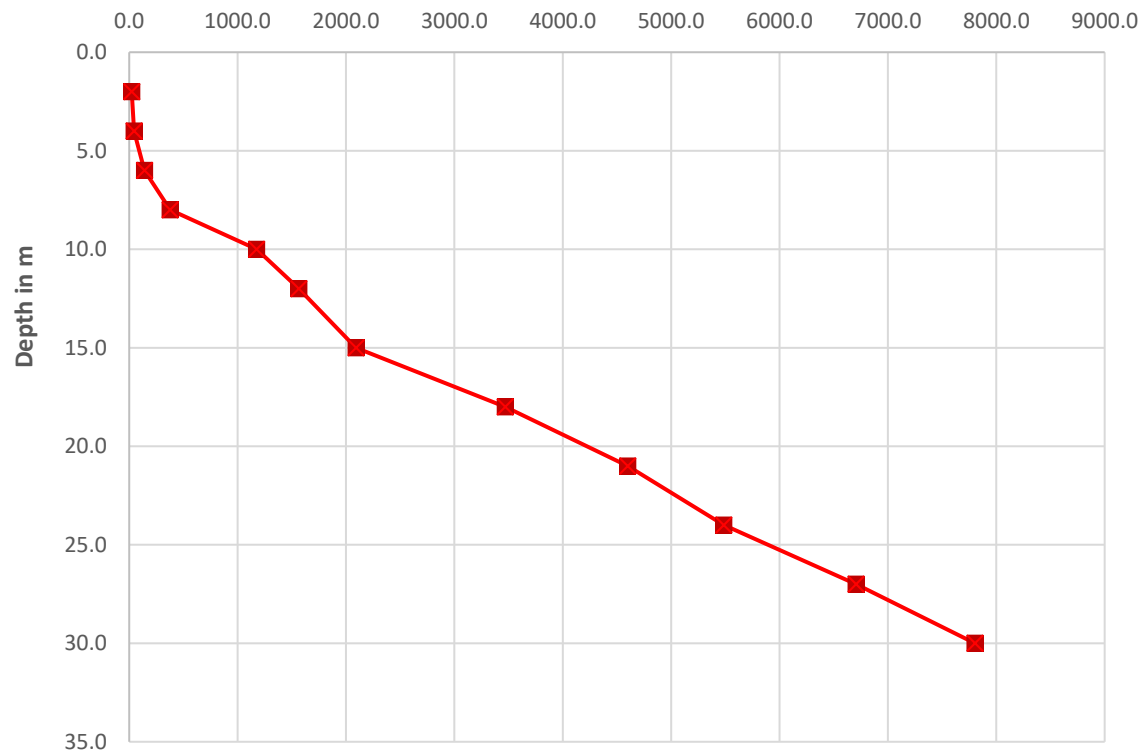
Co-Ordinates: E1258 N 2914
For CHST 5 (RL:201.10m)
Location: Poer House Unit-3

CROSSHOLE TEST-5								
Calculated Values of Dynamic Parameters								
Depth (m)	Vp (m/s)	Vs (m/s)	Mass Density (kN/m³)	m=(Vp/Vs)	Poisson's Ratio	Young's Modulus (N/mm²)	Shear Modulus (N/mm²)	Bulk Modulus (N/mm²)
2.0	231	108	1.97	2.1	0.36	62.5	23.0	74.5
4.0	328	151	1.98	2.2	0.37	123.3	45.1	152.8
6.0	603	267	1.98	2.3	0.38	389.0	141.2	531.7
8.0	867	408	2.27	2.1	0.36	1026.1	377.9	1202.5
10.0	1354	718	2.28	1.9	0.30	3066.4	1175.4	2612.8
12.0	1481	816	2.35	1.8	0.28	4012.2	1564.8	3068.0
15.0	1704	956	2.29	1.8	0.27	5317.4	2092.9	3858.7
18.0	2187	1231	2.29	1.8	0.27	8801.2	3470.2	6326.1
21.0	2489	1399	2.35	1.8	0.27	11674.1	4599.4	8426.0
24.0	2718	1541	2.31	1.8	0.26	13857.9	5485.5	9751.2
27.0	2978	1704	2.31	1.7	0.26	16857.0	6707.4	11543.1
30.0	3189	1838	2.31	1.7	0.25	19529.5	7803.7	13087.1

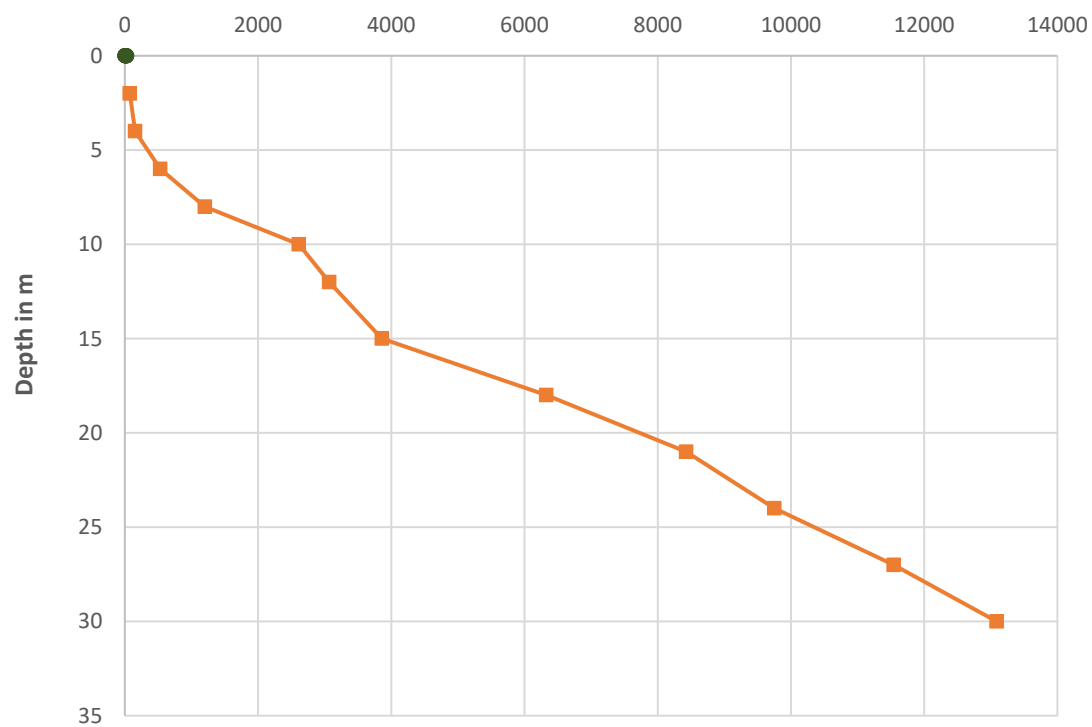
Cross Hole Test Velocity Chart**E Value with Depth**

G Value with Depth

Shear Modulus G in MPa

**K Value with Depth**

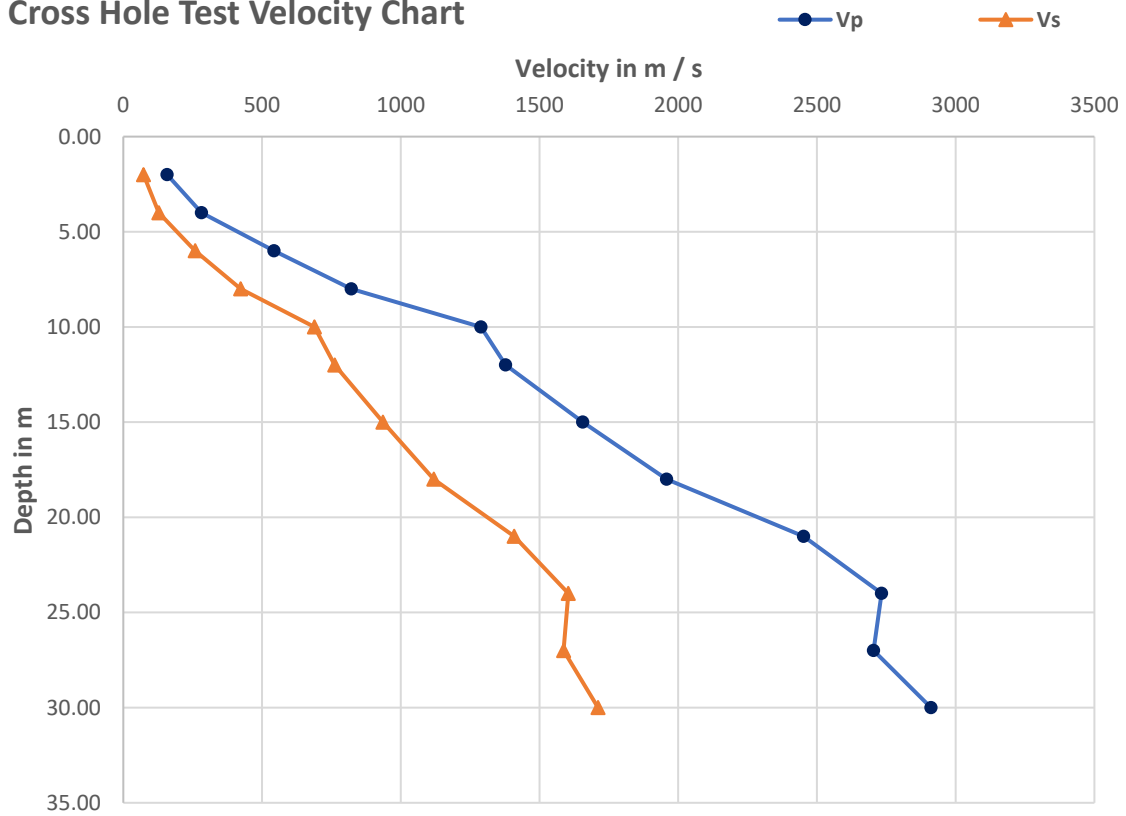
Bulk Modulus K in MPa



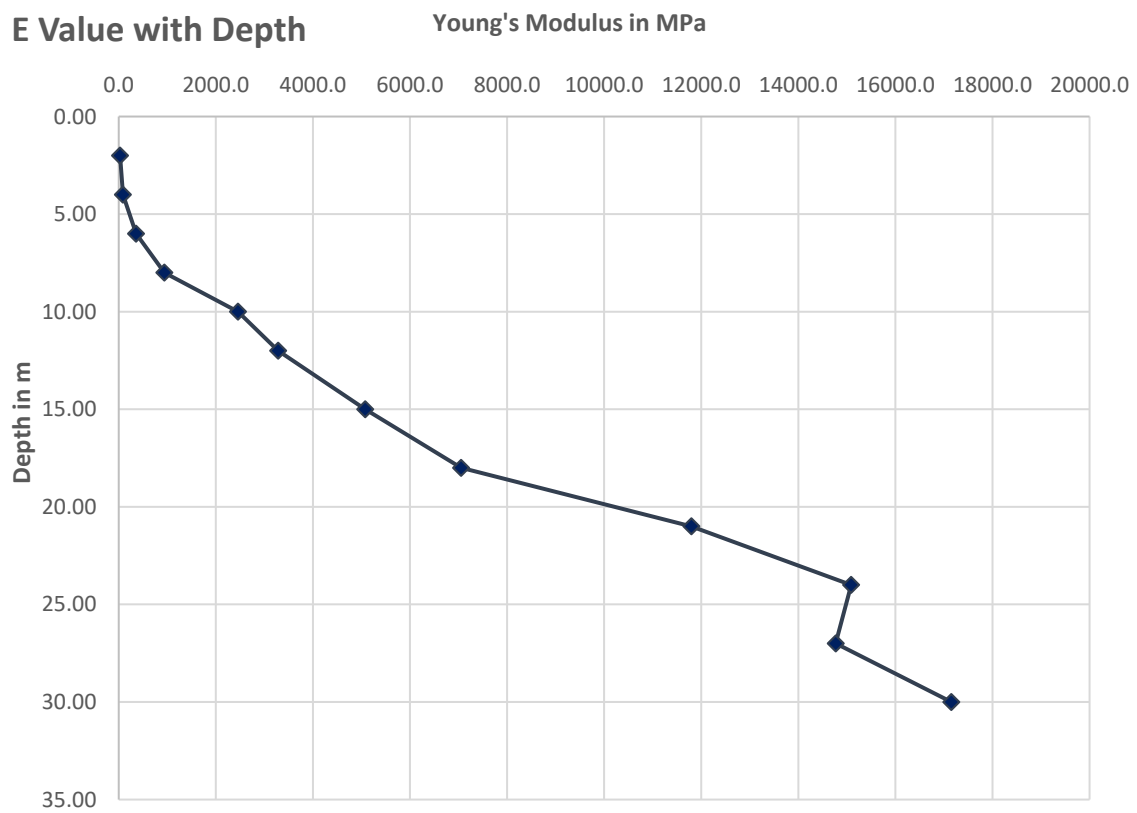
Co-Ordinates: E 955 N 2870
For CHST6 (RL:198.30m)
Location: Boiler area toilet block

CROSSHOLE TEST-6								
Calculated Values of Dynamic Parameters								
Depth (m)	Vp (m/s)	Vs (m/s)	Mass Density (kN/m³)	m=(Vp/Vs)	Poisson's Ratio	Young's Modulus (N/mm²)	Shear Modulus (N/mm²)	Bulk Modulus (N/mm²)
2.00	158	73	1.89	2.2	0.36	27.5	10.1	33.8
4.00	282	128	1.93	2.2	0.37	86.7	31.6	111.3
6.00	543	259	1.97	2.1	0.35	357.5	132.1	404.7
8.00	822	423	1.99	1.9	0.32	940.0	356.1	869.9
10.00	1289	689	1.99	1.9	0.30	2456.2	944.7	2046.8
12.00	1378	762	2.21	1.8	0.28	3284.4	1283.2	2485.6
15.00	1656	936	2.29	1.8	0.27	5077.0	2006.3	3604.9
18.00	1958	1119	2.24	1.7	0.26	7054.1	2804.8	4847.8
21.00	2452	1409	2.37	1.7	0.25	11795.8	4705.1	7975.7
24.00	2733	1604	2.37	1.7	0.24	15088.8	6097.6	9572.1
27.00	2704	1587	2.37	1.7	0.24	14770.5	5969.0	9369.9
30.00	2911	1711	2.37	1.7	0.24	17152.5	6938.2	10832.2

Cross Hole Test Velocity Chart

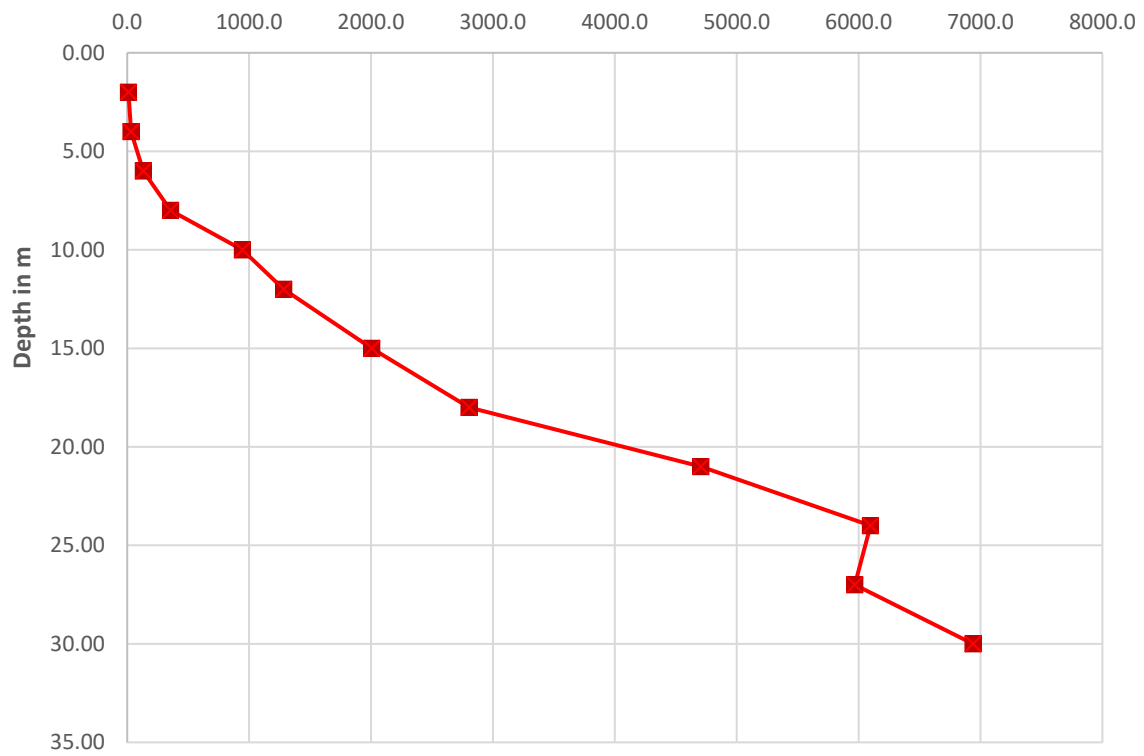


E Value with Depth

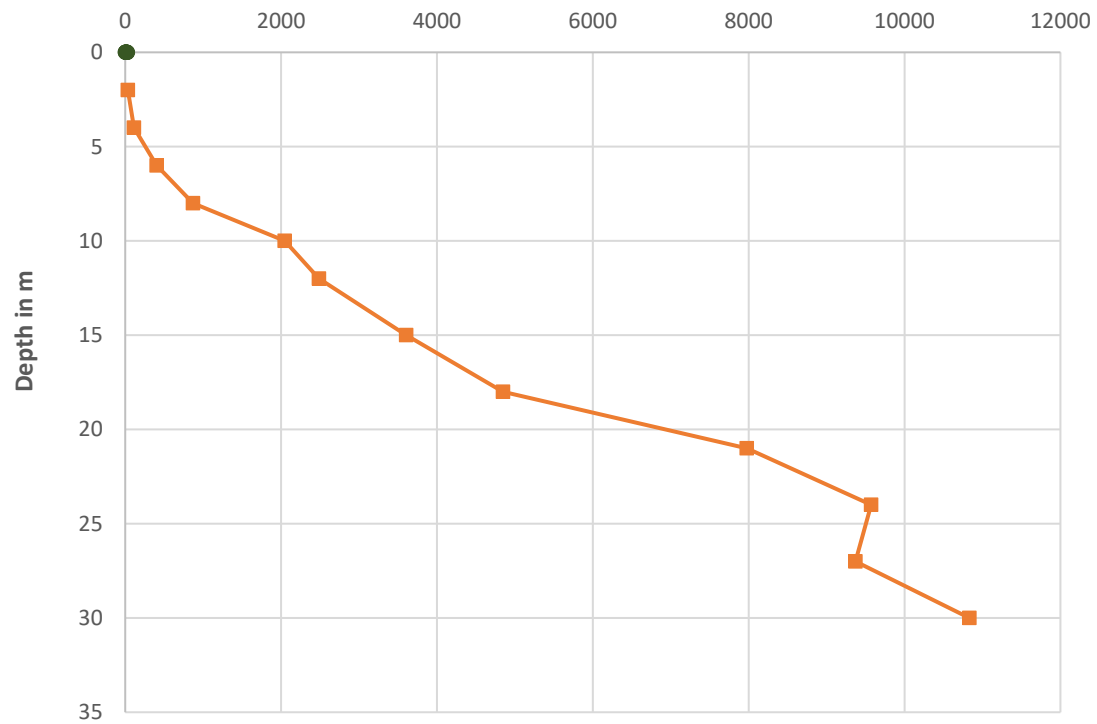


G Value with Depth

Shear Modulus G in MPa

**K Value with Depth**

Bulk Modulus K in MPa



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RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- Trial pit-1

Co-Ordinate :- E 1600 N 3843 RL:206.35m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	14	50	36	30	14	16	-	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
2	0.50	UDS	1.94	1.51	28.12	2.64	1	70	29	27	18	9	-	-	-	-	SC	0.08	24	-	-	DSU	-	-	-	-	-	0.74	42.6
3	1.00	DS	-	-	-	-	0	68	32	26	18	8	-	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
4	1.50	UDS	1.97	1.56	26.63	2.66	0	24	57	19	31	14	17	-	-	-	CL	0.67	7	-	-	TUU	-	-	-	-	-	0.71	41.4
5	2.00	DS	-	-	-	-	0	29	57	14	29	17	12	-	-	-	CL	-	-	-	-	-	-	-	-	-	-	-	-

KCT Consultancy Services, Ahmedabad

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- Trial pit-2

Co-Ordinate :- E 1327 N 3524 RL:203.20m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	4	71	25		27	15	12	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
2	0.50	UDS	1.64	1.48	11.07	2.65	9	64	27		26	18	8	-	-	-	SC	0.07	24	-	-	DSU	-	-	-	-	-	0.79	44.3
3	1.00	DS	-	-	-	-	2	42	47	9	26	18	8	-	-	-	CL	-	-	-	-	-	-	-	-	-	-	-	-
4	1.50	UDS	1.78	1.56	14.23	2.67	4	41	35	20	31	14	17	-	-	-	CL	0.30	10	-	-	TUU	-	-	-	-	-	0.71	41.6
5	2.00	DS	-	-	-	-	6	37	43	14	29	17	12	-	-	-	CL	-	-	-	-	-	-	-	-	-	-	-	-

KCT Consultancy Services, Ahmedabad

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- Trial pit-3

Co-Ordinate :- E 1850 N 3527 RL:209.60m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	0	66	34		30	16	14	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
2	0.50	UDS	1.68	1.56	7.41	2.65	0	68	32		29	18	11	-	-	-	SC	0.06	27	-	-	DSU	-	-	-	-	-	0.69	41.0
3	1.00	DS	-	-	-	-	0	64	36		29	17	12	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
4	1.50	UDS	1.69	1.58	6.89	2.64	0	67	34		28	14	14	-	-	-	SC	0.04	28	-	-	DSU	-	-	-	-	-	0.67	40.1
5	2.00	DS	-	-	-	-	0	64	30		26	17	9	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-

KCT Consultancy Services, Ahmedabad

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- Trial pit-4

Co-Ordinate :- E 1980 N 3065 RL:201.20m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	9	58	34		30	16	14	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
2	0.30	DS	-	-	-	-	8	61	34		29	18	11	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
3	0.50	UDS	1.86	1.43	29.74	2.65	5	63	33		29	17	12	-	-	-	SC	0.05	23	-	-	DSU	-	-	-	-	-	0.85	45.9
4	1.00	DS	-	-	-	-	4	18	55	23	39	18	21	-	-	-	CI	-	-	-	-	-	-	-	-	-	-	-	-
5	1.50	UDS	1.85	1.46	26.41	2.66	3	16	55	26	38	19	19	-	-	-	CI	0.31	9	-	-	TUU	-	-	-	-	-	0.82	45.0
6	2.00	DS	-	-	-	-	2	20	55	23	39	18	21	-	-	-	CI	-	-	-	-	-	-	-	-	21	-	-	-

KCT Consultancy Services, Ahmedabad**RESULTS OF LABORATORY TEST**

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- Trial pit-5

Co-Ordinate :- E 1662 N 372 RL:202.40m

Sr No	Depth of Sample	Type of Sample	Field Bulk Density	Field Dry Density	Natural Moisture Content	Specific Gravity	Grain Size Analysis				Consistency limits				Swelling Pressure	Free Swell Index	Soil Classification	Shear Parameter		Unconfined Compression Test	UCS by Point Load Index in rock	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation	Void Ratio	Porosity
							Gravel	Sand	Silt	Clay	Liquid Limit	Plastic Limit	Plasticity Index					Shrinkage Limit	Cohesion C				Angle of Internal Friction ϕ	Compression Index C _c	Coefficient of Volume Compressibility mv				
	m		gm / cc	gm / cc	%		%	%	%	%	%	%	%	Kg/cm ²	%		Kg/cm ²	Degree	Kg/cm ²	Kg/cm ²		cm ² /kg	kg/cm ²		%		%		
1	0.00	DS	-	-	-	-	0	60	40	29	15	14	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-	
2	0.50	UDS	1.81	1.58	14.52	2.65	0	17	63	20	36	19	17	-	-	-	CI	0.32	5	-	-	TUU	-	-	-	-	-	0.68	40.4
3	1.00	DS	-	-	-	-	0	21	57	22	37	17	20	-	-	-	CI	-	-	-	-	-	-	-	-	-	-	-	
4	1.50	UDS	1.88	1.61	16.41	2.66	0	20	55	25	36	14	22	-	-	-	CI	0.60	7	-	-	TUU	-	-	-	-	-	0.65	39.3
5	2.00	DS	-	-	-	-	0	18	58	24	38	17	21	-	-	-	CI	-	-	-	-	-	-	-	-	-	-	-	-

KCT Consultancy Services, Ahmedabad**RESULTS OF LABORATORY TEST**

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- Trial pit-6

Co-Ordinate :- E 1761 N 2600 RL:202.95m

Sr No	Depth of Sample	Type of Sample	Field Bulk Density	Field Dry Density	Natural Moisture Content	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit	Swelling Pressure	Free Swell Index	Soil Classification	Shear Parameter		Unconfined Compression Test	UCS by Point Load Index in rock	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation	Void Ratio	Porosity	
							Gravel	Sand	Silt	Clay	Liquid Limit	Plastic Limit	Plasticity Index					Cohesion C	Angle of Internal Friction ϕ				Compression Index C _c	Coefficient of Volume Compressibility mv	Pre-consolidation Pressure					
																														%
1	0.00	DS	-	-	-	-	0	34	46	20	35	17	18	-	-	-	CI	-	-	-	-	-	-	-	-	-	-	-	-	-
2	0.50	UDS	1.91	1.55	23.42	2.64	0	22	59	19	36	19	17	-	-	-	CI	0.33	5	-	-	TUU	-	-	-	-	-	-	0.71	41.4
3	1.00	DS	-	-	-	-	0	27	49	24	37	17	20	-	-	-	CI	-	-	-	-	-	-	-	-	-	-	-	-	-
4	1.50	UDS	1.94	1.56	24.41	2.65	0	20	56	24	36	15	21	-	-	-	CI	0.52	6	-	-	TUU	-	-	-	-	-	-	0.70	41.2
5	2.00	DS	-	-	-	-	0	18	58	24	38	17	21	-	-	-	CI	-	-	-	-	-	-	-	-	-	-	-	-	-

KCT Consultancy Services, Ahmedabad**RESULTS OF LABORATORY TEST**

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- Trial pit-7

Co-Ordinate :- E 1419 N 2080 RL:199.50m

Sr No	Depth of Sample	Type of Sample	Field Bulk Density	Field Dry Density	Natural Moisture Content	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit	Swelling Pressure	Free Swell Index	Soil Classification	Shear Parameter		Unconfined Compression Test	UCS by Point Load Index in rock	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation	Void Ratio	Porosity
							Gravel	Sand	Silt	Clay	Liquid Limit	Plastic Limit	Plasticity Index					Cohesion C	Angle of Internal Friction ϕ				Compression Index C _c	Coefficient of Volume Compressibility mv	Pre-consolidation Pressure				
	m		gm / cc	gm / cc	%		%	%	%	%	%	%	%	Kg/cm ²	%		Kg/cm ²	Degree	Kg/cm ²	Kg/cm ²		cm ² /kg	kg/cm ²		%			%	
1	0.00	DS	-	-	-	-	0	51	49	28	14	14	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-	-
2	0.50	UDS	1.65	1.49	10.74	2.64	0	28	52	20	38	20	18	-	-	-	CI	0.27	6	-	-	TUU	-	-	-	-	-	0.77	43.6
3	1.00	DS	-	-	-	-	0	26	53	21	40	21	19	-	-	-	CI	-	-	-	-	-	-	-	-	-	-	-	-
4	1.50	UDS	1.68	1.50	11.87	2.63	0	25	52	23	40	20	20	-	-	-	CI	0.35	7	-	-	TUU	-	-	-	-	-	0.75	42.9
5	2.00	DS	-	-	-	-	0	22	56	22	42	23	19	-	-	-	CI	-	-	-	-	-	-	-	-	-	-	-	-

KCT Consultancy Services, Ahmedabad

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- Trial pit-8

Co-Ordinate :- E 846 N 1842 RL:197.50m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	0	36	48	16	34	17	17	-	-	-	CL	-	-	-	-	-	-	-	-	-	-	-	-
2	0.50	UDS	1.77	1.58	12.03	2.65	0	33	54	13	32	18	14	-	-	-	CL	0.35	6	-	-	TUU	-	-	-	-	-	0.68	40.4
3	1.00	DS	-	-	-	-	0	36	52	12	33	20	13	-	-	-	CL	-	-	-	-	-	-	-	-	-	-	-	-
4	1.50	UDS	1.78	1.58	12.77	2.64	0	33	50	17	31	12	19	-	-	-	CL	0.58	4	-	-	TUU	-	-	-	-	-	0.67	40.2
5	2.00	DS	-	-	-	-	0	28	59	13	34	20	14	-	-	-	CL	-	-	-	-	-	-	-	-	-	-	-	-

KCT Consultancy Services, Ahmedabad

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- Trial pit-9

Co-Ordinate :- E 1427 N 1535 RL:197.42m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	4	63	33		33	17	16	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
2	0.50	UDS	1.75	1.50	16.98	2.64	0	63	37		32	18	14	-	-	-	SC	0.07	26	-	-	DSU	-	-	-	-	-	0.76	43.3
3	1.00	DS	-	-	-	-	1	68	31		30	15	15	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
4	1.50	UDS	1.80	1.53	17.78	2.66	0	36	37	27	46	17	29	-	-	-	CI	0.39	5	-	-	TUU	-	-	-	-	-	0.74	42.5
5	2.00	DS	-	-	-	-	0	28	50	22	40	18	22	-	-	-	CI	-	-	-	-	-	-	-	-	-	-	-	-

11. Block Vibration Test:

11.1 Field Investigation:

For determining various parameters influencing the design of machine foundation like physical properties of elastic base of the foundation, Block Vibration Test were conducted. For this purpose, an oscillator was fixed on the block of size 0.70 X 0.75 X 1.50m and vibration was induced. The vibration peak ups were attached, on this block to measure the frequency and amplitude. The test was conducted as per the provisions of IS 5249 – 1969.

11.2 Recommendations:

Sr No	Test No	Co-Ordinates	RL of test level (m)	RL of EGL (m)	Location	Dynamic Parameters for 10m ² foundation area					
						Coefficient of elastic uniform compression	Coefficient of elastic non uniform compression	Coefficient of elastic uniform shear	Coefficient of elastic non uniform shear	Modulus of Elasticity	Shear modulus
						kg / sqcm / cm				kg / sqcm	
1	BVT-1	E 1230 N 3181	198.50	202.10	Mill Bunker Unit-1	1.84	3.18	0.92	1.38	431.90	154.30
2	BVT-2	E 951 N 2927	195.82	198.32	ID Fan Unit-3	3.80	6.57	1.90	2.85	892.86	318.90
3	BVT-3	E 1258 N 2877	199.63	201.13	Power house Unit-3	4.15	7.17	2.07	3.11	974.61	348.10

Results of Block Vibration Test
(As per IS : 5249, 1992, reaffirmed 1995)

Test No.	1 Location: Mill Bunker Unit-1
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Data

Size of the block	= 0.70 m wide, 0.75 m long and 1.50 m deep
Depth of Conducting test	= 2.50 m (R.L.:199.60m)
Base Area of the Block (A1)	= 0.53 sq. m
Mass of the block	= 1890 kg
Mass of the vibrator	= 37.0 kg
Total vibrating mass (M)	= Mass of block + mass of vibrator = 1927 kg
Acceleration due to gravity (g)	= 9.81 m/sec ²

Terminology

C_u -	Coefficient of elastic uniform compression in kg / cm ³	
C_τ -	Coefficient of elastic uniform shear in kg / cm ³	= 0.50 X C_u
C_ϕ -	Coefficient of elastic non uniform compression in kg / cm ³	= 1.73 X C_u
C_ψ -	Coefficient of elastic non uniform shear in kg / cm ³	= 0.75 X C_u

The above coefficients are reported for foundation contact area, A of 10.0 m² (1,00,000 cm²) or more

C_{u1} -	Coefficient of elastic uniform compression in kg / cm ³ for block of size 0.75m wide, 0.75m long and 1.00m deep = $C_u / \sqrt{A1 / A}$ $= \{ 4 \times \pi^2 \times f_{nz}^2 \times M / (A1 \times g) \} \times 10^{-6} \text{ kg / cm}^3$
G -	Modulus of rigidity of strata in Kg / cm ² , $G = C_u \times \sqrt{A} \times (1 - \mu) / 2.26$
μ -	Poisson's ratio = 0.4 for this particular situation
E -	Modulus of elasticity of strata in kg / cm ² = $G \times 2 \times (1 + \mu)$
f_{nz} -	Resonance frequency of foundation block – soil system in cycles / sec
ϵ -	Damping coefficient

Calculations

From chart between amp v/s. freq f_{nz} = 23.30 cycles / sec and ϵ = 0.19

Coefficient of Elastic uniform compression

$$C_{u1} = \{ 4 \times \pi^2 \times 23.30^2 \times 1927 / (0.70 \times 0.75 \times 9.81) \} \times 10^{-6} = 8.02 \text{ kg/cu.cm}$$

$$C_u = 8.02 \times \sqrt{0.70 \times 0.75 / 10.0} = 1.84 \text{ kg/cu.cm}$$

$$\text{Coefficient of elastic uniform shear } C_\tau = 0.5 \times 1.84 = 0.92 \text{ kg/cu.cm}$$

$$\text{Coefficient of elastic non-uniform compression } C_\phi = 1.73 \times 1.84 = 3.18 \text{ kg/cu.cm}$$

$$\text{Coefficient of elastic non-uniform shear } C_\psi = 0.75 \times 1.84 = 1.38 \text{ kg/cu.cm}$$

$$\text{Modulus of rigidity of strata } G = 1.84 \times \sqrt{100000} \times (1.0 - 0.40) / 2.26 = 154.30 \text{ kg/sq.cm}$$

$$\text{Modulus of elasticity of strata } E = 151.3 \times 2 \times (1 + 0.40) = 431.90 \text{ kg/sq. cm}$$

Results of Block Vibration Test
(As per IS : 5249, 1992, reaffirmed 1995)

Test No.	2 Location: ID Fan Unit-3
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Data

Size of the block	= 0.75 m wide, 0.70 m long and 1.50 m deep
Depth of Conducting test	= 2.50 m (R.L.:195.82m)
Base Area of the Block (A1)	= 0.53 sq. m
Mass of the block	= 1890 kg
Mass of the vibrator	= 37.0 kg
Total vibrating mass (M)	= Mass of block + Mass of Vibrator = 1927 kg
Acceleration due to gravity (g)	= 9.81 m/sec ²

Terminology

C_u -	Coefficient of Elastic Uniform Compression in kg / cm ³	
C_τ -	Coefficient of Elastic Uniform Shear in kg / cm ³	= 0.50 X C_u
C_ϕ -	Coefficient of Elastic Non Uniform Compression in kg / cm ³	= 1.73 X C_u
C_ψ -	Coefficient of Elastic Non Uniform Shear in kg / cm ³	= 0.75 X C_u

The above coefficients are reported for foundation contact area, A of 10.0 m² (1,00,000 cm²) or more

C_{u1} -	Coefficient of elastic uniform compression in kg / cm ³ for block of size 0.70m wide, 0.75m long and 1.50m deep = $C_u / \sqrt{A1 / A}$ = $\{ 4 \times \pi^2 \times f_{nz}^2 \times M / (A1 \times g) \} \times 10^{-6}$ kg / cm ³
G -	Modulus of Rigidity of strata in Kg / cm ² , $G = C_u \times \sqrt{A} \times (1 - \mu) / 2.26$
μ -	Poisson's ratio = 0.40 for the particular situation
E -	Modulus of elasticity of strata in kg / cm ² = $G \times 2 \times (1 + \mu)$
f_{nz} -	Resonance frequency of foundation block – soil system in cycles / sec
ϵ -	Damping Coefficient

Calculations

From chart between amp v/s. freq f_{nz} = 33.50 cycles / sec and ϵ = 0.11

Coefficient of Elastic uniform compression

$$C_{u1} = \{ 4 \times \pi^2 \times 33.50^2 \times 1927 / (0.75 \times 0.70 \times 9.81) \} \times 10^{-6} = 16.58 \text{ kg/cu.cm}$$

$$C_u = 16.58 \times \sqrt{(0.75 \times 0.70 / 10.0)} = 3.80 \text{ kg/cu.cm}$$

$$\text{Coefficient of Elastic Uniform Shear } C_\tau = 0.5 \times 3.80 = 1.90 \text{ kg/cu.cm}$$

$$\text{Coefficient of Elastic Non – Uniform Compression } C_\phi = 1.73 \times 3.80 = 6.57 \text{ kg/cu.cm}$$

$$\text{Coefficient of Elastic Non – Uniform Shear } C_\psi = 0.75 \times 3.80 = 2.85 \text{ kg/cu.cm}$$

$$\text{Modulus of Rigidity of Strata } G = 3.80 \times \sqrt{100000} \times (1.0 - 0.40) / 2.26 = 318.90 \text{ kg/sq.cm}$$

$$\text{Modulus of Elasticity of Strata } E = 318.90 \times 2 \times (1 + 0.40) = 892.86 \text{ kg/sq. cm}$$

Results of Block Vibration Test
(As per IS : 5249, 1992, reaffirmed 1995)

Test No.	3 (Location: Power House Unit-3)
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Data

Size of the block	= 0.70 m wide, 0.75 m long and 1.50 m deep
Depth of Conducting test	= 2.50 m (R.L.:198.63m)
Base Area of the Block (A1)	= 0.53 sq. m
Mass of the block	= 1890 kg
Mass of the vibrator	= 37.0 kg
Total vibrating mass (M)	= Mass of block + Mass of Vibrator = 1927 kg
Acceleration due to gravity (g)	= 9.81 m/sec ²

Terminology

C_u -	Coefficient of Elastic Uniform Compression in kg / cm ³	
C_τ -	Coefficient of Elastic Uniform Shear in kg / cm ³	= 0.50 X C_u
C_ϕ -	Coefficient of Elastic Non Uniform Compression in kg / cm ³	= 1.73 X C_u
C_ψ -	Coefficient of Elastic Non Uniform Shear in kg / cm ³	= 0.75 X C_u

The above coefficients are reported for foundation contact area, A of 10.0 m² (1,00,000 cm²) or more

C_{u1} -	Coefficient of elastic uniform compression in kg / cm ³ for block of size 0.70m wide, 0.75m long and 1.50m deep = $C_u / \sqrt{A1 / A}$ = { $4 \times \pi^2 \times f_{nz}^2 \times M / (A1 \times g)$ } X 10 ⁻⁶ kg / cm ³
G -	Modulus of Rigidity of strata in Kg / cm ² , $G = C_u \times \sqrt{A} \times (1 - \mu) / 2.26$
μ -	Poisson's ratio = 0.40 for the particular situation
E -	Modulus of elasticity of strata in kg / cm ² = $G \times 2 \times (1 + \mu)$
f_{nz} -	Resonance frequency of foundation block – soil system in cycles / sec
ϵ -	Damping Coefficient

Calculations

From chart between amp v/s. freq f_{nz} = 35.00 cycles / sec and ϵ = 0.10

Coefficient of Elastic uniform compression

$$C_{u1} = \{4 \times \pi^2 \times 35.00^2 \times 1927 / (0.75 \times 0.70 \times 9.81)\} \times 10^{-6} = 18.09 \text{ kg/cu.cm}$$

$$C_u = 18.09 \times \sqrt{(0.75 \times 0.70 / 10.0)} = 4.15 \text{ kg/cu.cm}$$

$$\text{Coefficient of Elastic Uniform Shear } C_\tau = 0.5 \times 4.15 = 2.07 \text{ kg/cu.cm}$$

$$\text{Coefficient of Elastic Non – Uniform Compression } C_\phi = 1.73 \times 4.15 = 7.17 \text{ kg/cu.cm}$$

$$\text{Coefficient of Elastic Non – Uniform Shear } C_\psi = 0.75 \times 4.15 = 3.11 \text{ kg/cu.cm}$$

$$\text{Modulus of Rigidity of Strata } G = 4.15 \times \sqrt{100000} \times (1.0 - 0.40) / 2.26 = 348.10 \text{ kg/sq.cm}$$

$$\text{Modulus of Elasticity of Strata } E = 348.10 \times 2 \times (1 + 0.40) = 974.61 \text{ kg/sq. cm}$$

12. Pressure Meter Test:

12.1 Description of test:

The pressuremeter test, discussed in great detail by Martin (1977), Baguelin et al. (1978), Barksdale et al. (1982), and Gambin and Rousseau (1988), is performed by applying pressure to the sidewalls of a borehole. The pressuremeter consists of two parts, the read-out unit, which rests on the ground surface, and the probe that is inserted into the borehole. The probe consists of three independent cells, a measuring cell and two guard cells. The probe can be installed by pre-drilling a hole using hollow stem auger or hand auger, or forcing the probe into the ground and displacing the soil by driving, jacking, or vibrating. Self-boring probes have been used for research. Once the probe is at the test depth, the guard cells are inflated to brace the probe in place. Then the measuring cell is pressurized with water, inflating its flexible rubber bladder, which exerts a pressure on the borehole wall. As the pressure in the measuring cell increases, the borehole walls deform. The pressure within the measuring cell is held constant for approximately 60 seconds, and the increase in volume required maintaining the constant pressure is recorded. A load-deformation diagram, as shown in Figure-1, is recorded for each test run.

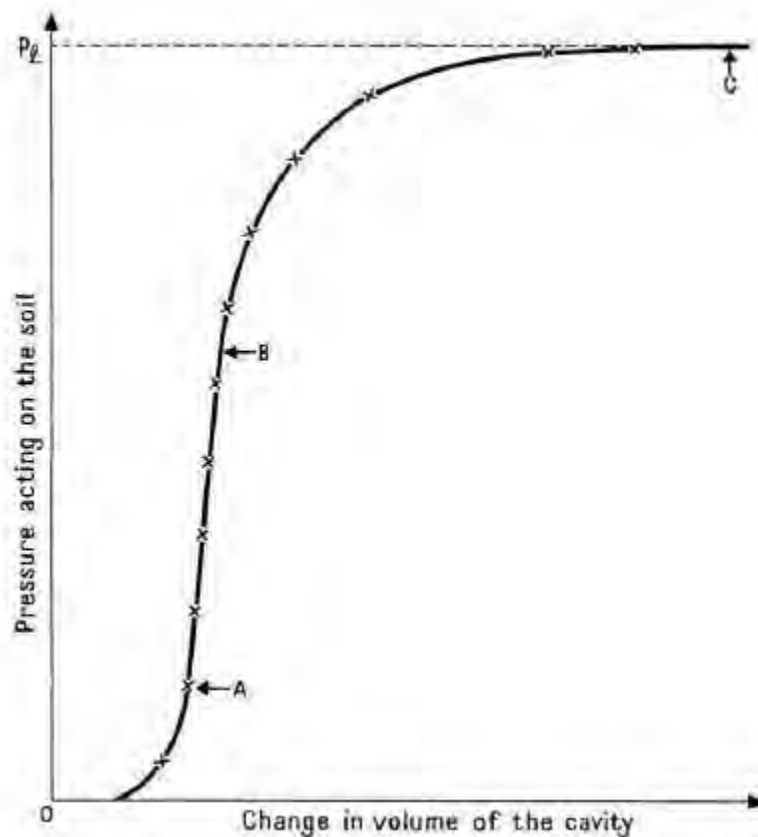


Fig 1: Typical Pressure Vs Volumetric Deformation Plot

12.2 Interpretation of test results

There are three phases of the deformation curve: (1) the re-establishing phase, from the origin to point A; (2) the pseudo-elastic phase, from point A to point B; and (3) the plastic phase, from point B to point C.

After the borehole is drilled and the augers are withdrawn, the borehole walls relax, thus reducing the cavity volume. As the pressure meter probe is initially inflated, the walls of the

borehole are pushed back to their original position. Point A marks the point at which the volume of the borehole cavity has fully returned to its initial position, and is given the coordinates, v_0 , p_0 . The pseudo-elastic phase, the straight-line portion of the curve between points A and B, is dubbed so because of its resemblance to the elastic behavior of steel or concrete. Point B is the point at which creep pressure has been reached, and is given the coordinates, v_f , p_f . The plastic phase begins at point B and extends to point C, which is asymptotic to the limit pressure. Point C, which is given the coordinates v_L , p_L , is defined as the point where the pressure remains constant despite increasing volume.

The limit pressure is defined as the pressure required to expand the measuring cell by an amount v_0 beyond the volume required to inflate the pressure meter (V_C) and to push the borehole wall back to its original position (v_0). This definition of limit pressure is analogous to defining failure in a triaxial test at a given value of axial strain, for example 10% to 15%. The value of V_C depends on the size of the borehole, as shown in Table A-1.

The injected volume at the limit pressure (v_L) is thus:

$$v_L = v_0 + V_C + v_0 = 2v_0 + V_C \text{ (1)}$$

where:

v_0 = volume required to inflate pressure meter and push soil to its original position; and

V_C = initial volume of the measuring cell (see Table A-1).

Table A-1. Values of V_C according to pressure meter probe type

Probe	Diameter of Borehole (mm)	V_C (cm^3)
EX	34	535
AX	44	535
BX	60	535
NX	76	790

If the volumetric increase at the end of the test is less than twice the cavity volume, extrapolation must be used to determine p_L . A plot of pressure versus log-volume for the plastic phase of a test results in an approximate straight line. The straight line can be extended to v_L to determine p_L . Figure 2 demonstrates this extrapolation procedure.

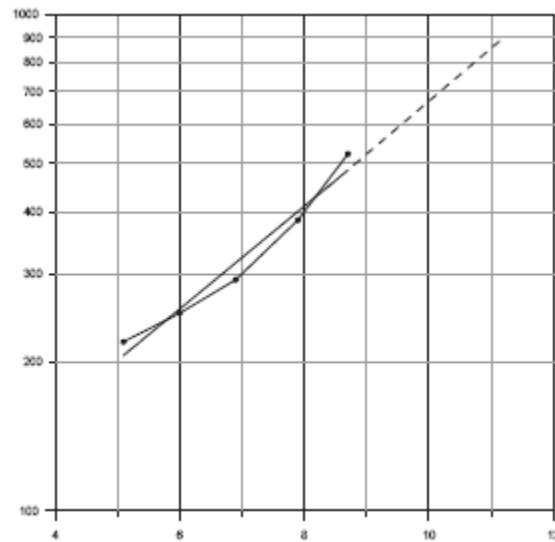


Fig: 2 Pressure vs Volume plot for extrapolation of limit pressure

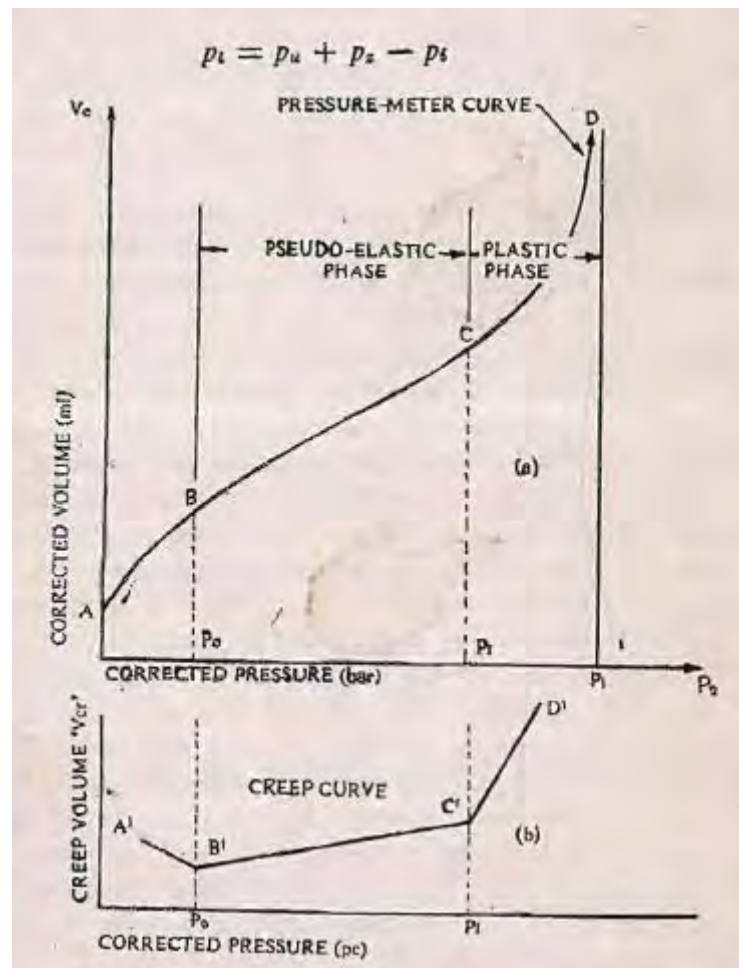


Fig: 3 Curve for limit pressure P_1

The pressure meter can be used to aid in the design of foundations for all types of soils, including residual soils. The settlements of foundations can be estimated using a deformation modulus, E_{PMT} , which can be derived from the pseudo-elastic phase (or straight-line portion) of the load deformation diagram. E_{PMT} is a function of Poisson's ratio, the slope of the straight line,

and the cavity volume in the pseudo-elastic range. However, the cavity volume increases throughout the pseudo-elastic range, so it is conventional to use the mean volume, v_m , of the cavity during this phase. The deformation modulus, E_{PMT} , can be found using equation 2.

The modulus of deformation E of the soil for NX probe is calculated from the following relationship:

$$E_{PMT} = 2 (1 + \mu) V \frac{\Delta p}{\Delta v} \dots \dots (2)$$

Where, μ = Poisson's ratio, typically = 0.25

V = cavity volume during the pseudo-elastic phase = $V_c + v_m$

V_o = initial or at-rest volume of the measuring cell

V_m = the mean volume of the pseudo-elastic phase = $(V_f + V_o) / 2$; and

$\Delta p / \Delta v$ = slope of the pseudo-elastic phase.

12.3 Typical Calculation:

The field data for test are given in Table 1. A typical calculation to get 'E' & 'G' is done here with for the test data at the depth 2 mt.

$$V_c = 790 \text{ cc}$$

$$V_o = 95 \text{ cc (from graph)}$$

$$V_f = 550 \text{ cc (from graph)}$$

$$V_m = 322.5 \text{ cc}$$

$$V = 1112.5 \text{ cc}$$

$$\Delta p / \Delta v = 0.066$$

$$\begin{aligned} E_{PMT} &= 2 (1 + \mu) V \frac{\Delta p}{\Delta v} \\ &= 2 (1 + 0.40) \times 1112.5 \times 0.066 \\ &= 205.59 \text{ kg/cm}^2 \end{aligned}$$

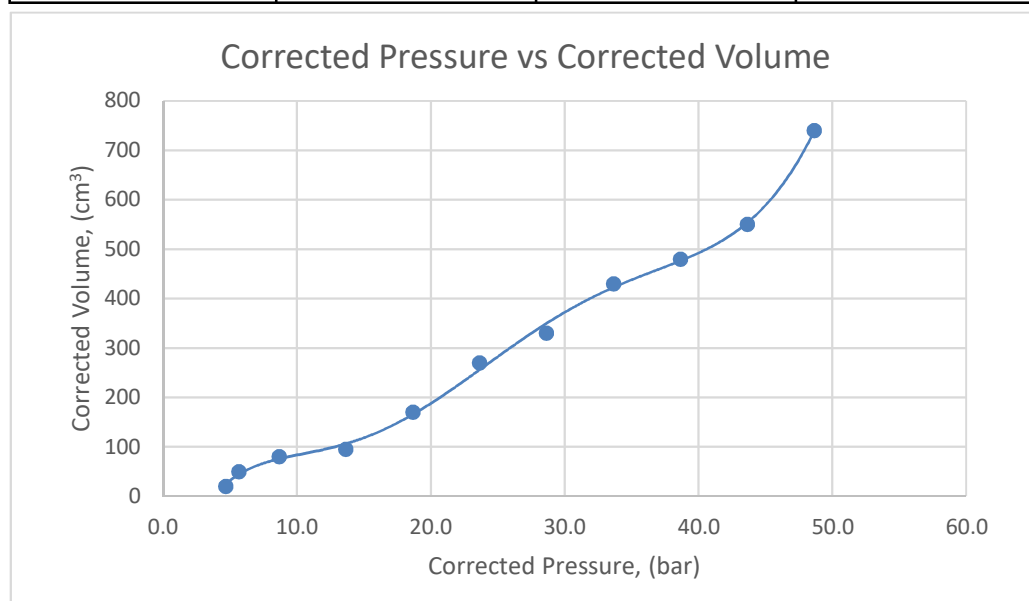
$$\begin{aligned} \text{Shear Modulus } G &= E / 2 (1 + \mu) \\ &= (205.59 / (2 * (1 + 0.40))) \\ &= 73.21 \text{ kg/cm}^2 \end{aligned}$$

12.4 Recommendations:

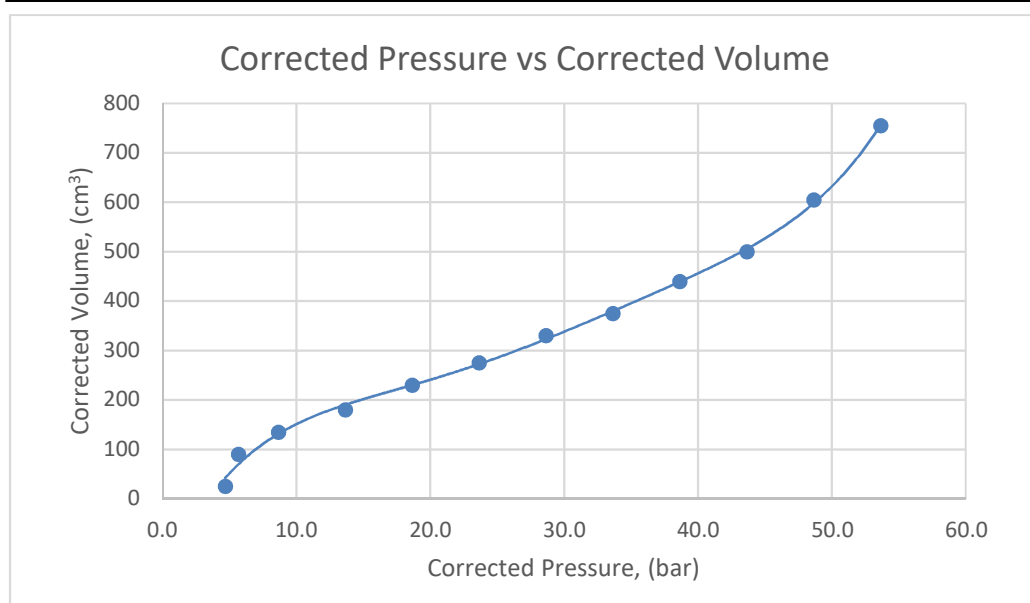
Sr No	Test No	Location of the test	RL of EGL (m)	Co-Ordinates	Depth (m)	Deformation modulus (kg/cm ²)	Shear Modulus (kg/cm ²)	Limit Pressure (kg/cm ²)
1	1	Boiler Unit-1	197.70	E 1143 N 3208	2.00	205	73.21	48.70
2					4.00	276	98.57	53.70
3					6.00	322	119.26	63.70
4					8.00	366	135.56	68.60
5					10.00	401	148.52	73.50
6					12.00	490	181.48	73.50
7					15.00	917	352.69	83.50
8					18.00	1305	522.00	78.50
9					21.00	1621	648.40	78.50
10					24.00	1711	684.40	78.50
11					27.00	1875	750.00	78.50
12					30.00	1887	754.80	73.50
1	2	Power hose Unit-2	196.80	E 1237 N 3121	2.00	111	39.64	18.40
2					4.00	330	117.86	43.40
3					6.00	553	204.81	83.20
4					8.00	847	313.70	83.20
5					10.00	896	344.62	73.20
6					12.00	987	379.62	83.20
7					15.00	1026	410.40	73.20
8					18.00	1056	422.40	68.30
9					21.00	1243	497.20	78.20
10					24.00	1487	594.80	73.20
11					27.00	1653	661.20	83.20
12					30.00	1849	739.60	83.20
1	3	ESP Unit-2	199.60	E 1062 N 3048	2.00	96	34.29	28.20
2					4.00	132	47.14	43.20
3					6.00	186	66.43	48.20
4					8.00	585	208.93	63.20
5					10.00	676	250.37	53.20
6					12.00	793	293.70	68.10
7					15.00	946	363.85	73.00
8					18.00	1137	437.31	68.10
9					21.00	1587	634.80	78.00
10					24.00	1815	726.00	83.00
11					27.00	2240	896.00	78.00
12					30.00	2588	1035.20	83.00
1	4	Boiler area Unit-3	200.64	E 1139 N 2888	2.00	203	72.50	33.90
2					4.00	227	81.07	43.90
3					6.00	367	131.07	48.90
4					8.00	429	153.21	53.90
5					10.00	979	376.54	58.90
6					12.00	1127	450.80	63.90
7					15.00	1190	476.00	63.90
8					18.00	1127	450.80	68.80
9					21.00	1455	582.00	73.80
10					24.00	1512	604.80	68.80
11					27.00	1739	695.60	63.90
12					30.00	1760	704.00	68.80

Sr No	Test No	Location of the test	RL of EGL (m)	Co-Ordinates	Depth (m)	Deformation modulus (kg/cm ²)	Shear Modulus (kg/cm ²)	Limit Pressure (kg/cm ²)
1	5	ESP cum FGD control room Unit-3	197.74	E 871 N 2841	2.00	170	60.71	39.50
2					4.00	197	70.36	49.50
3					6.00	228	84.44	44.50
4					8.00	579	214.44	59.50
5					10.00	648	249.23	64.50
6					12.00	716	275.38	64.50
7					15.00	765	306.00	64.50
8					18.00	801	320.40	69.50
9					21.00	955	382.00	59.50
10					24.00	1018	407.20	59.50
11					27.00	1369	547.60	64.50
12					30.00	1558	623.20	69.50
1	6	Gypsum dewatering building and storage area, Process water tank, Lime stone slurry storage tank & agitator	197.48	E 768 N 3362	2.00	159	56.79	18.70
2					4.00	295	105.36	28.70
3					6.00	324	120.00	43.70
4					8.00	414	153.33	33.70
5					10.00	498	191.54	63.70
6					12.00	527	202.69	53.70
7					15.00	697	278.80	63.70
8					18.00	908	363.20	68.60
9					21.00	912	364.80	58.70
10					24.00	1115	446.00	58.70
11					27.00	1381	552.40	63.70
12					30.00	2118	847.20	68.60

K.C.T Consultancy Services LLP			
Pressure meter Test - 01			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-2.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	20	4.7	20
2	50	5.7	50
5	80	8.7	80
10	95	13.7	95
15	170	18.7	170
20	270	23.7	270
25	330	28.7	330
30	430	33.7	430
35	480	38.7	480
40	550	43.7	550
45	740	48.7	740

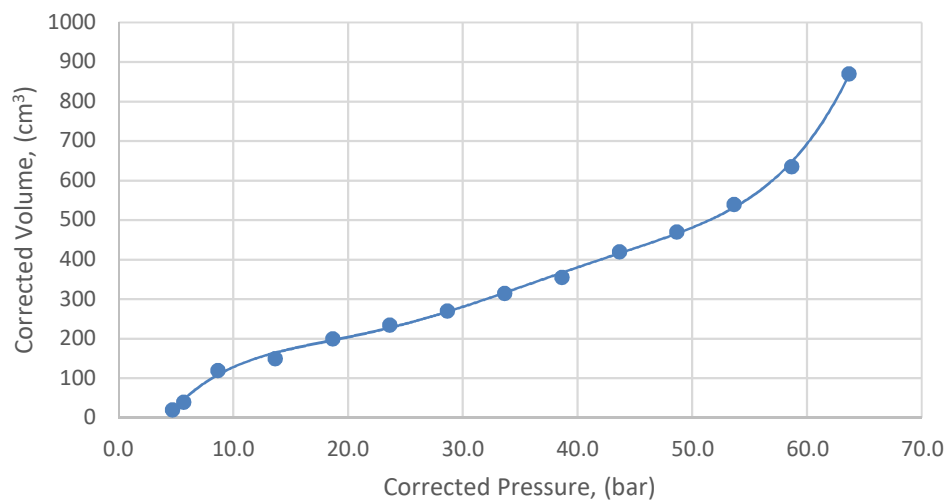


K.C.T Consultancy Services LLP			
Pressure meter Test - 01			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-4.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	25	4.7	25
2	90	5.7	90
5	135	8.7	135
10	180	13.7	180
15	230	18.7	230
20	275	23.7	275
25	330	28.7	330
30	375	33.7	375
35	440	38.7	440
40	500	43.7	500
45	605	48.7	605
50	755	53.7	755



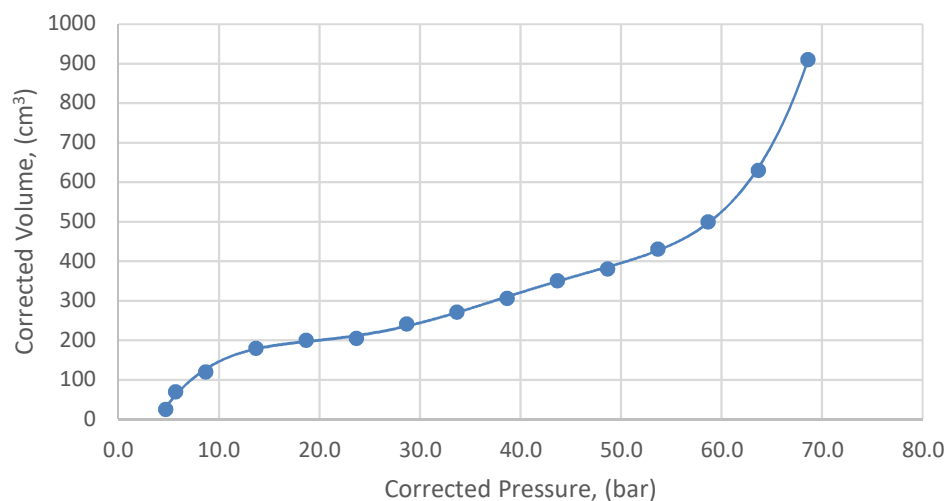
K.C.T Consultancy Services LLP			
Pressure meter Test - 01			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-6.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	20	4.7	20
2	40	5.7	40
5	120	8.7	120
10	150	13.7	150
15	200	18.7	200
20	235	23.7	235
25	270	28.7	270
30	315	33.7	315
35	355	38.7	355
40	420	43.7	420
45	470	48.7	470
50	540	53.7	540
55	635	58.7	635
60	870	63.7	870

Corrected Pressure vs Corrected Volume

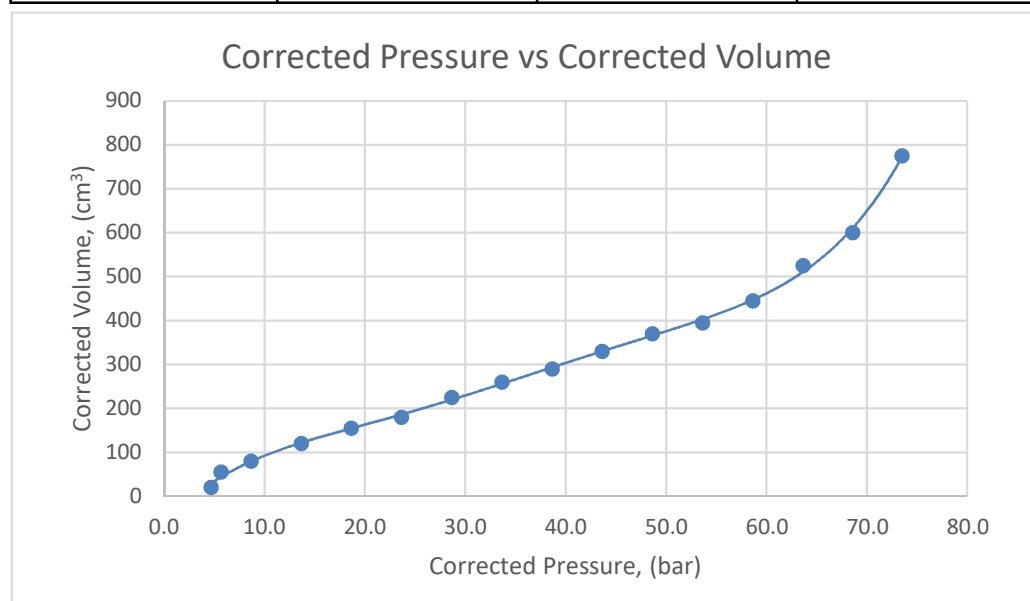


K.C.T Consultancy Services LLP			
Pressure meter Test - 01			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-8.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
bar	60 sec	bar	60 sec
	cc		cc
1	25	4.7	25
2	70	5.7	70
5	120	8.7	120
10	180	13.7	180
15	200	18.7	200
20	205	23.7	205
25	241	28.7	241
30	271	33.7	271
35	306	38.7	306
40	351	43.7	351
45	381	48.7	381
50	431	53.7	431
55	500	58.7	500
60	630	63.7	630
65	910	68.6	910

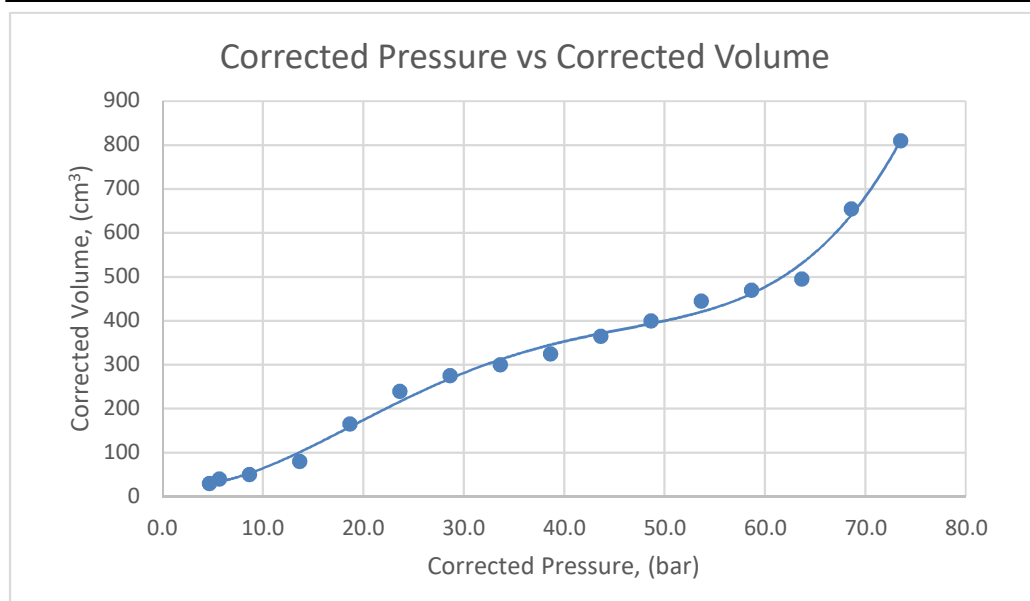
Corrected Pressure vs Corrected Volume



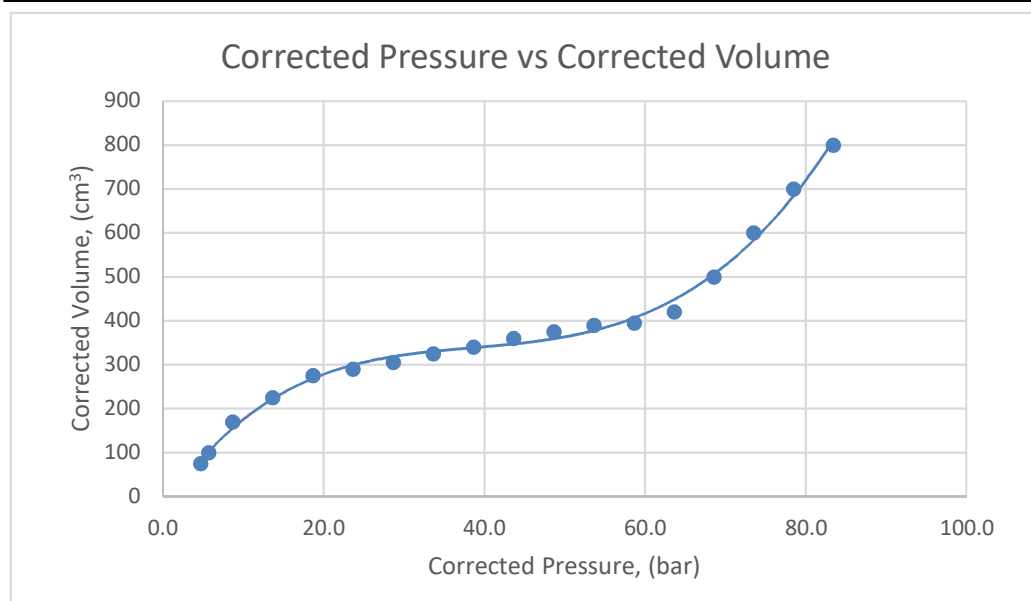
K.C.T Consultancy Services LLP			
Pressure meter Test - 01			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-10.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	20	4.7	20
2	55	5.7	55
5	80	8.7	80
10	120	13.7	120
15	155	18.7	155
20	180	23.7	180
25	225	28.7	225
30	260	33.7	260
35	290	38.7	290
40	330	43.7	330
45	370	48.7	370
50	395	53.7	395
55	445	58.7	445
60	525	63.7	525
65	600	68.6	600
70	775	73.5	775



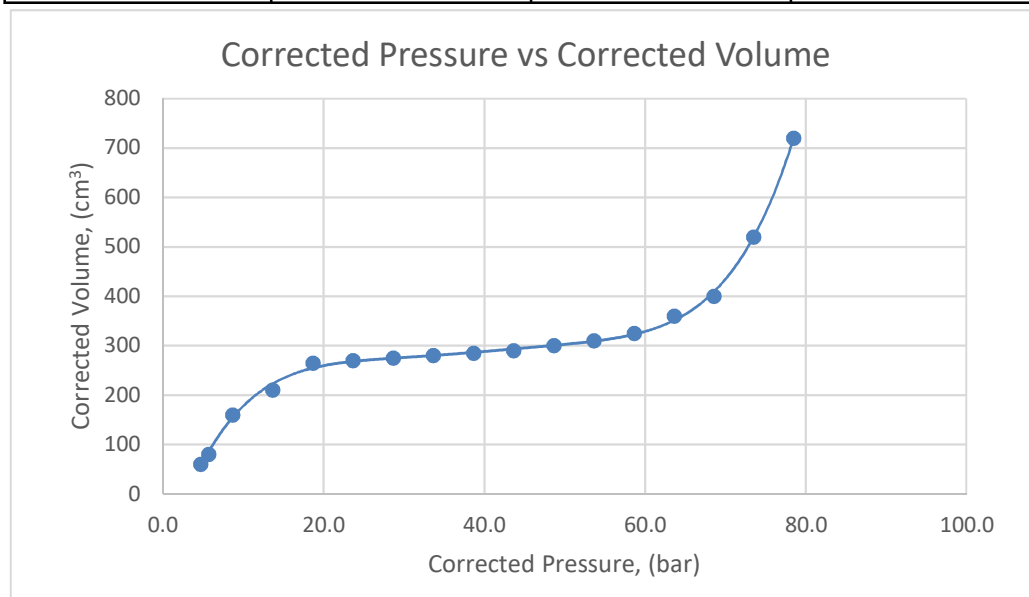
K.C.T Consultancy Services LLP			
Pressure meter Test - 01			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-12.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	30	4.7	30
2	40	5.7	40
5	50	8.7	50
10	80	13.7	80
15	165	18.7	165
20	240	23.7	240
25	275	28.7	275
30	300	33.7	300
35	325	38.7	325
40	365	43.7	365
45	400	48.7	400
50	445	53.7	445
55	470	58.7	470
60	495	63.7	495
65	655	68.6	655
70	810	73.5	810



K.C.T Consultancy Services LLP			
Pressure meter Test - 01			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-15.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	75	4.7	75
2	100	5.7	100
5	170	8.7	170
10	225	13.7	225
15	275	18.7	275
20	290	23.7	290
25	305	28.7	305
30	325	33.7	325
35	340	38.7	340
40	360	43.7	360
45	375	48.7	375
50	390	53.7	390
55	395	58.7	395
60	420	63.7	420
65	500	68.6	500
70	600	73.5	600
75	700	78.5	700
80	800	83.5	800

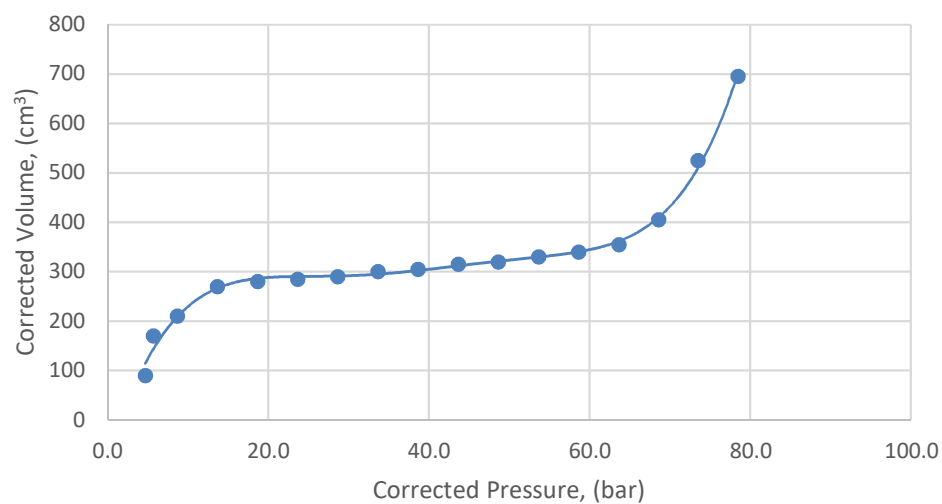


K.C.T Consultancy Services LLP			
Pressure meter Test - 01			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-18.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
bar	60 sec	bar	60 sec
	cc		cc
1	60	4.7	60
2	80	5.7	80
5	160	8.7	160
10	210	13.7	210
15	265	18.7	265
20	270	23.7	270
25	275	28.7	275
30	280	33.7	280
35	285	38.7	285
40	290	43.7	290
45	300	48.7	300
50	310	53.7	310
55	325	58.7	325
60	360	63.7	360
65	400	68.6	400
70	520	73.5	520
75	720	78.5	720



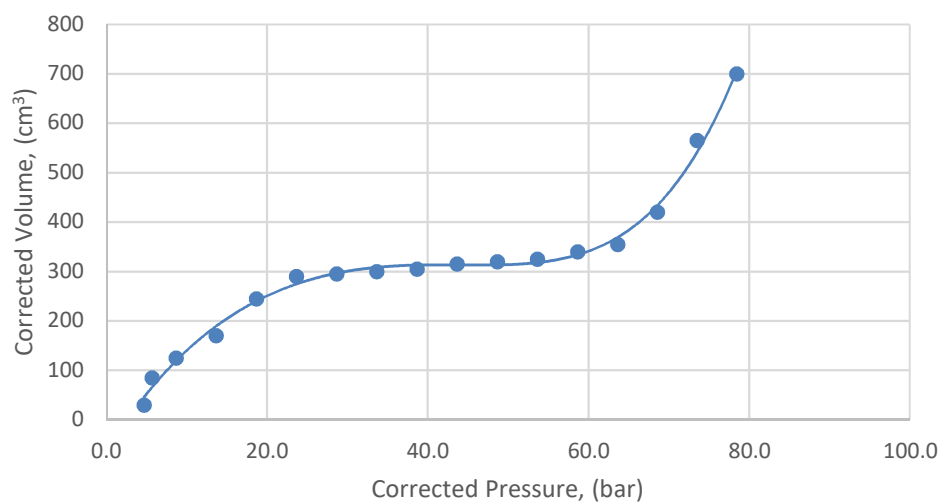
K.C.T Consultancy Services LLP			
Pressure meter Test - 01			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-21.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
bar	60 sec	bar	60 sec
	cc		cc
1	90	4.7	90
2	170	5.7	170
5	210	8.7	210
10	270	13.7	270
15	280	18.7	280
20	285	23.7	285
25	290	28.7	290
30	300	33.7	300
35	305	38.7	305
40	315	43.7	315
45	320	48.7	320
50	330	53.7	330
55	340	58.7	340
60	355	63.7	355
65	405	68.6	405
70	525	73.5	525
75	695	78.5	695

Corrected Pressure vs Corrected Volume



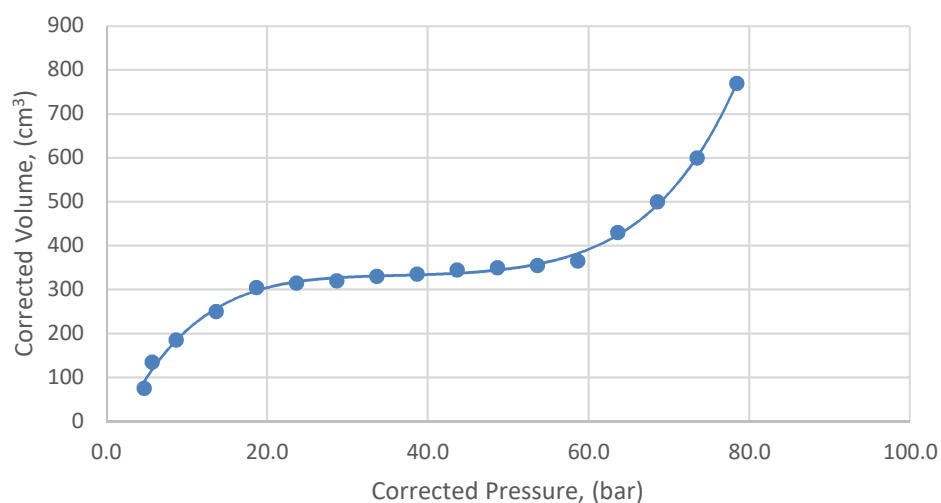
K.C.T Consultancy Services LLP			
Pressure meter Test - 01			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-24.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	30	4.7	30
2	85	5.7	85
5	125	8.7	125
10	170	13.7	170
15	245	18.7	245
20	290	23.7	290
25	295	28.7	295
30	300	33.7	300
35	305	38.7	305
40	315	43.7	315
45	320	48.7	320
50	325	53.7	325
55	340	58.7	340
60	355	63.7	355
65	420	68.6	420
70	565	73.5	565
75	700	78.5	700

Corrected Pressure vs Corrected Volume

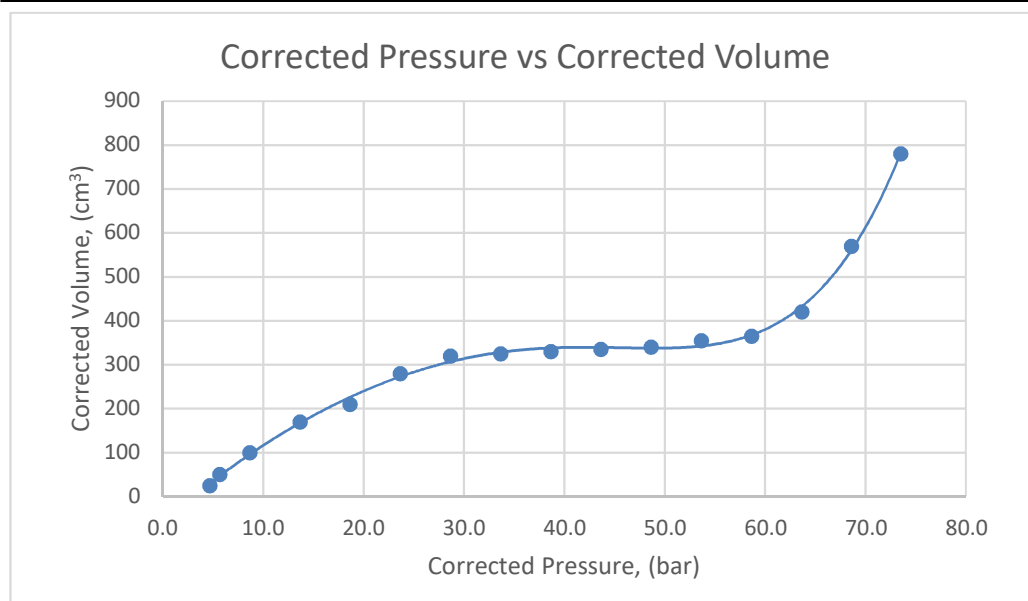


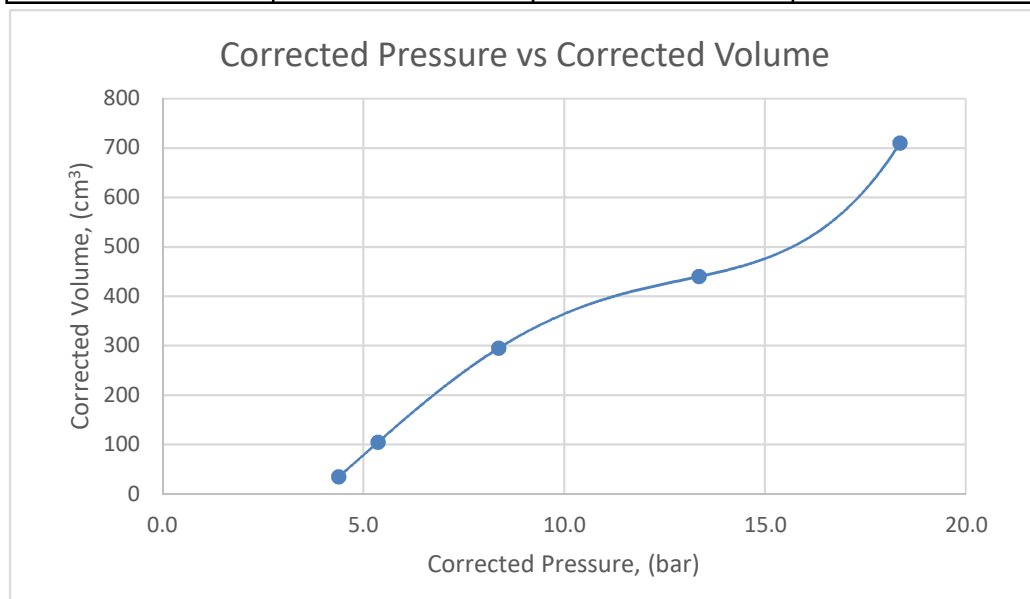
K.C.T Consultancy Services LLP			
Pressure meter Test - 01			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-27.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	75	4.7	75
2	135	5.7	135
5	185	8.7	185
10	250	13.7	250
15	305	18.7	305
20	315	23.7	315
25	320	28.7	320
30	330	33.7	330
35	335	38.7	335
40	345	43.7	345
45	350	48.7	350
50	355	53.7	355
55	365	58.7	365
60	430	63.7	430
65	500	68.6	500
70	600	73.5	600
75	770	78.5	770

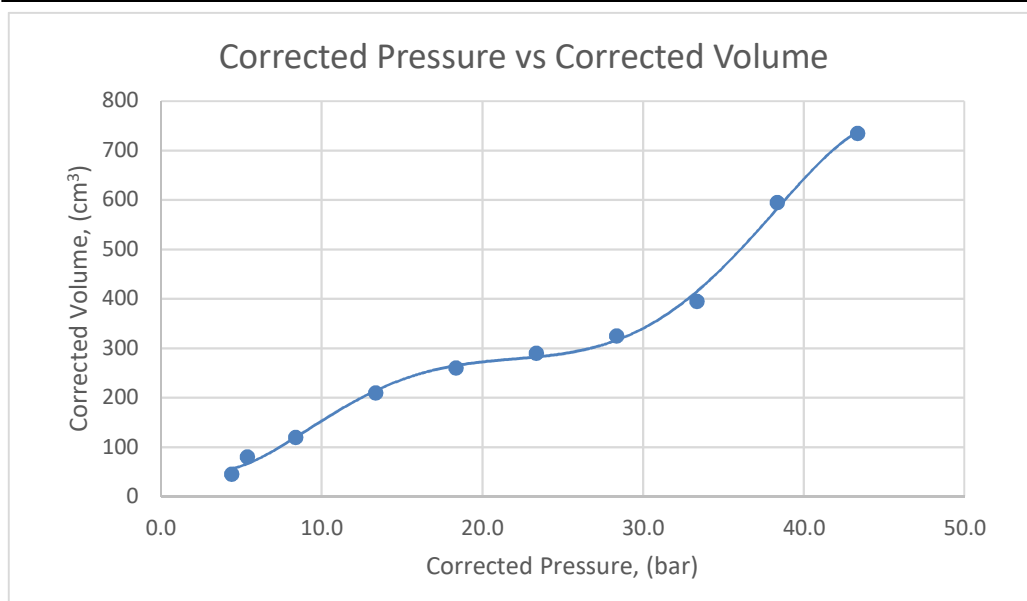
Corrected Pressure vs Corrected Volume



K.C.T Consultancy Services LLP			
Pressure meter Test - 01			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-30.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
bar	60 sec cc	bar	60 sec cc
1	25	4.7	25
2	50	5.7	50
5	100	8.7	100
10	170	13.7	170
15	210	18.7	210
20	280	23.7	280
25	320	28.7	320
30	325	33.7	325
35	330	38.7	330
40	335	43.7	335
45	340	48.7	340
50	355	53.7	355
55	365	58.7	365
60	420	63.7	420
65	570	68.6	570
70	780	73.5	780

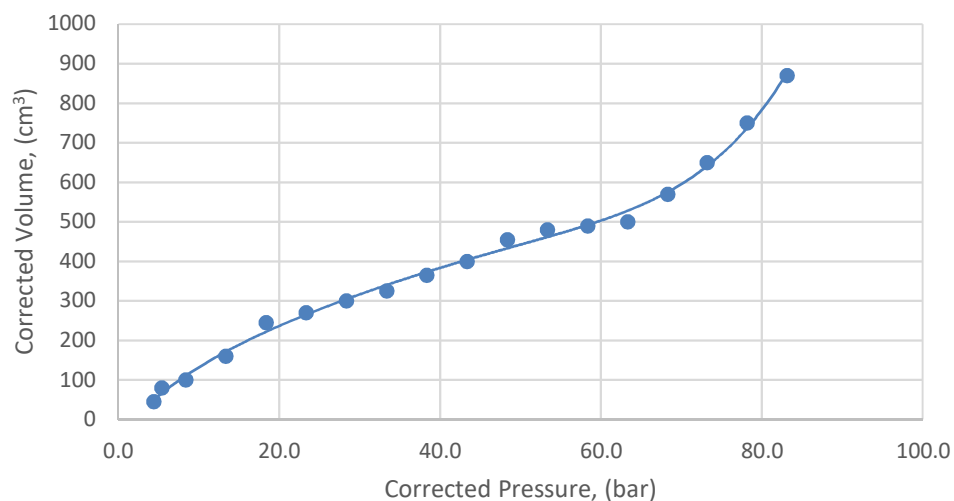


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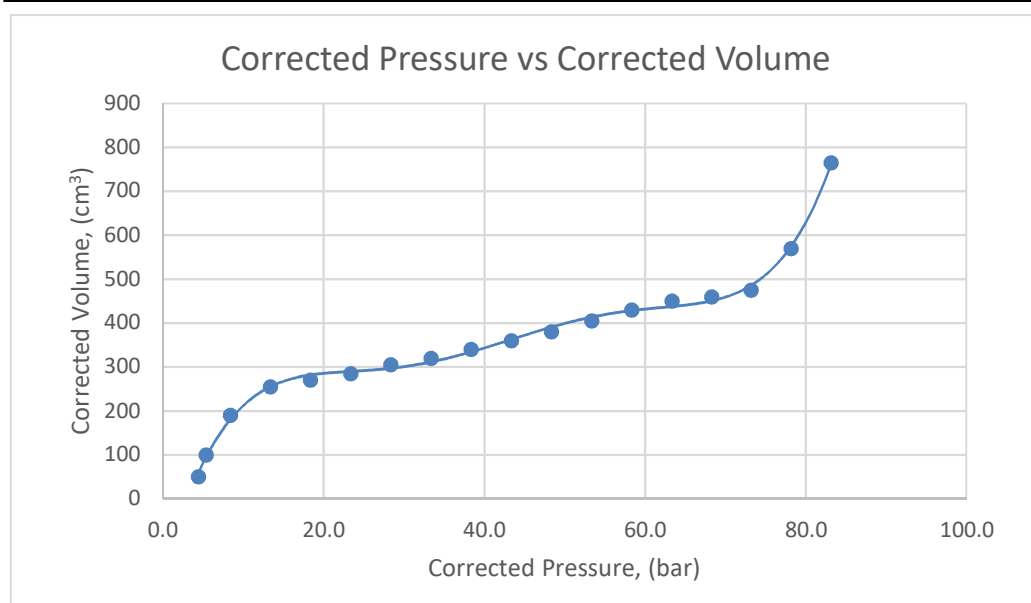
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K.C.T Consultancy Services LLP			
Pressure meter Test - 02			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-6.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
bar	60 sec	bar	60 sec
	cc		cc
1	45	4.4	45
2	80	5.4	80
5	100	8.4	100
10	160	13.4	160
15	245	18.4	245
20	270	23.4	270
25	300	28.4	300
30	325	33.4	325
35	365	38.4	365
40	400	43.4	400
45	455	48.4	455
50	480	53.4	480
55	490	58.4	490
60	500	63.4	500
65	570	68.3	570
70	650	73.2	650
75	750	78.2	750
80	870	83.2	870

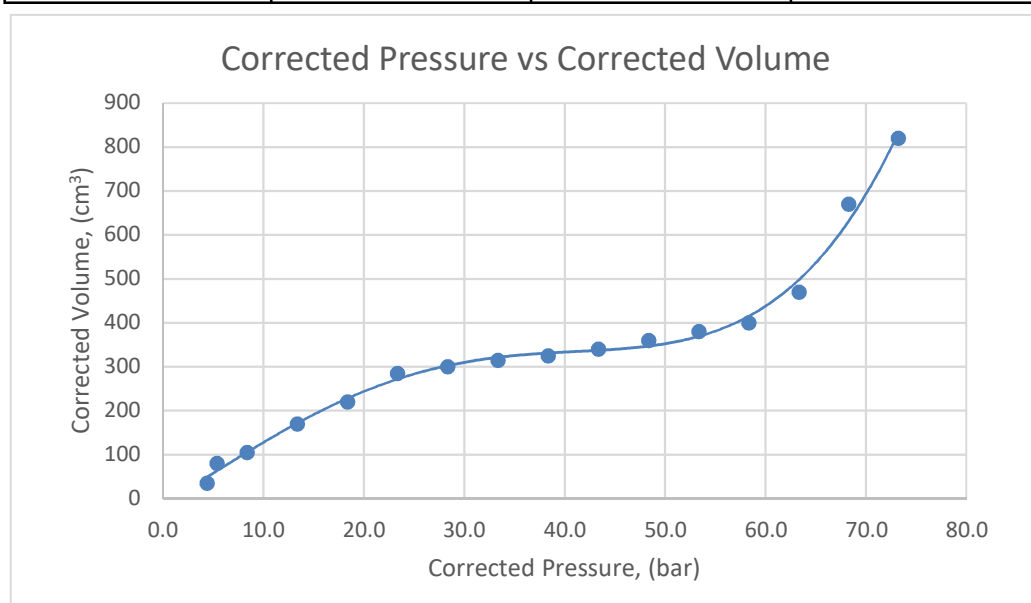
Corrected Pressure vs Corrected Volume



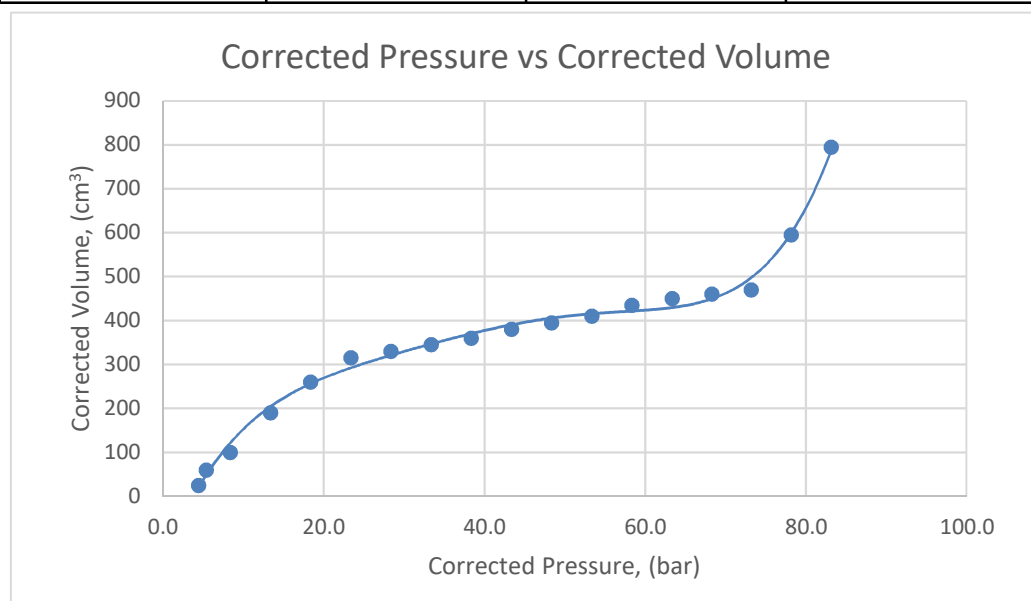
K.C.T Consultancy Services LLP			
Pressure meter Test - 02			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-8.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	50	4.4	50
2	100	5.4	100
5	190	8.4	190
10	255	13.4	255
15	270	18.4	270
20	285	23.4	285
25	305	28.4	305
30	320	33.4	320
35	340	38.4	340
40	360	43.4	360
45	380	48.4	380
50	405	53.4	405
55	430	58.4	430
60	450	63.4	450
65	460	68.3	460
70	475	73.2	475
75	570	78.2	570
80	765	83.2	765



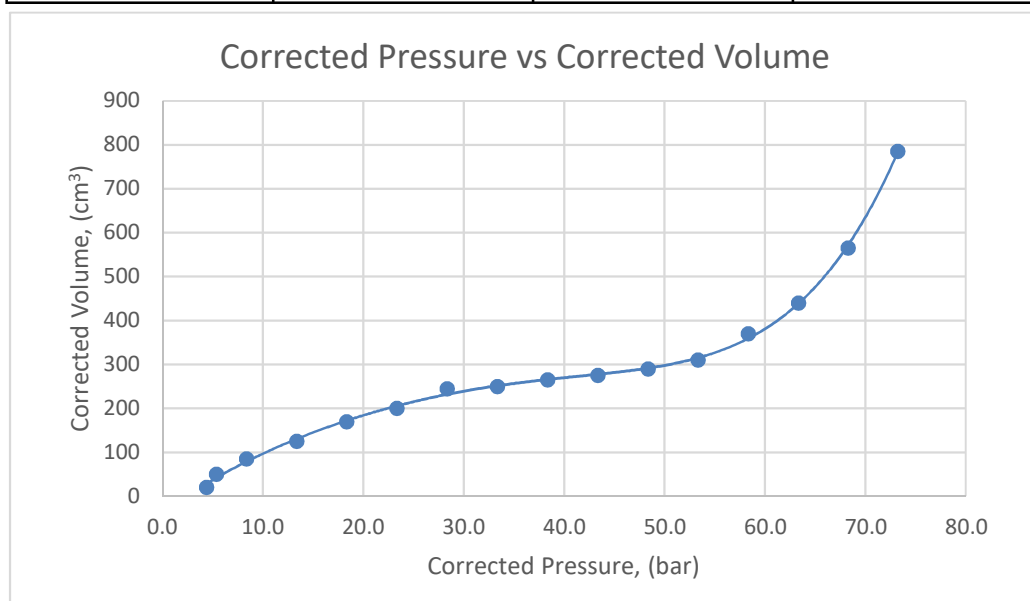
K.C.T Consultancy Services LLP			
Pressure meter Test - 02			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-10.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	35	4.4	35
2	80	5.4	80
5	105	8.4	105
10	170	13.4	170
15	220	18.4	220
20	285	23.4	285
25	300	28.4	300
30	315	33.4	315
35	325	38.4	325
40	340	43.4	340
45	360	48.4	360
50	380	53.4	380
55	400	58.4	400
60	470	63.4	470
65	670	68.3	670
70	820	73.2	820



K.C.T Consultancy Services LLP			
Pressure meter Test - 02			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-12.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	25	4.4	25
2	60	5.4	60
5	100	8.4	100
10	190	13.4	190
15	260	18.4	260
20	315	23.4	315
25	330	28.4	330
30	345	33.4	345
35	360	38.4	360
40	380	43.4	380
45	395	48.4	395
50	410	53.4	410
55	435	58.4	435
60	450	63.4	450
65	460	68.3	460
70	470	73.2	470
75	595	78.2	595
80	795	83.2	795

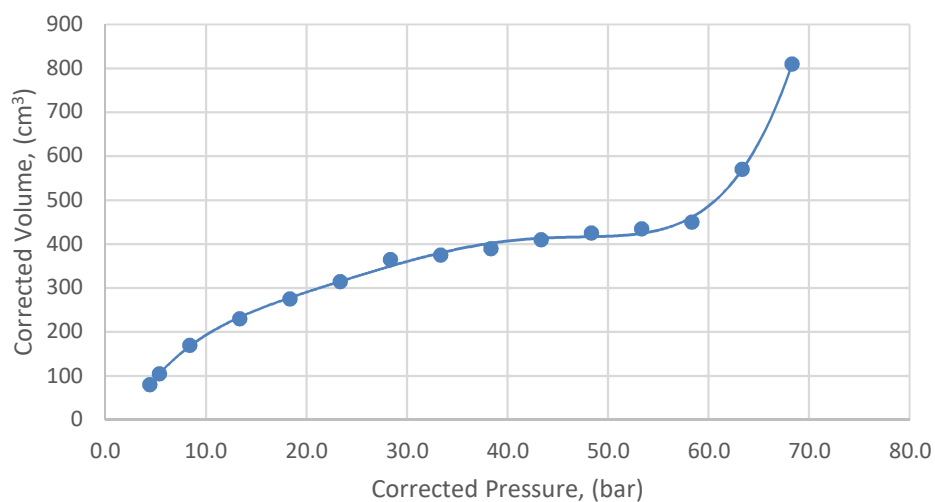


K.C.T Consultancy Services LLP			
Pressure meter Test - 02			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-15.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	20	4.4	20
2	50	5.4	50
5	85	8.4	85
10	125	13.4	125
15	170	18.4	170
20	200	23.4	200
25	245	28.4	245
30	250	33.4	250
35	265	38.4	265
40	275	43.4	275
45	290	48.4	290
50	310	53.4	310
55	370	58.4	370
60	440	63.4	440
65	565	68.3	565
70	785	73.2	785



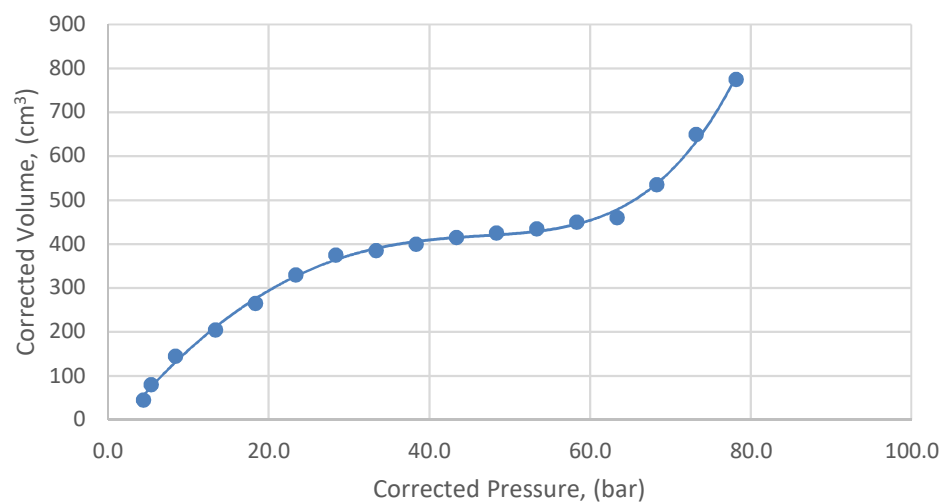
K.C.T Consultancy Services LLP			
Pressure meter Test - 02			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-18.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	80	4.4	80
2	105	5.4	105
5	170	8.4	170
10	230	13.4	230
15	275	18.4	275
20	315	23.4	315
25	365	28.4	365
30	375	33.4	375
35	390	38.4	390
40	410	43.4	410
45	425	48.4	425
50	435	53.4	435
55	450	58.4	450
60	570	63.4	570
65	810	68.3	810

Corrected Pressure vs Corrected Volume

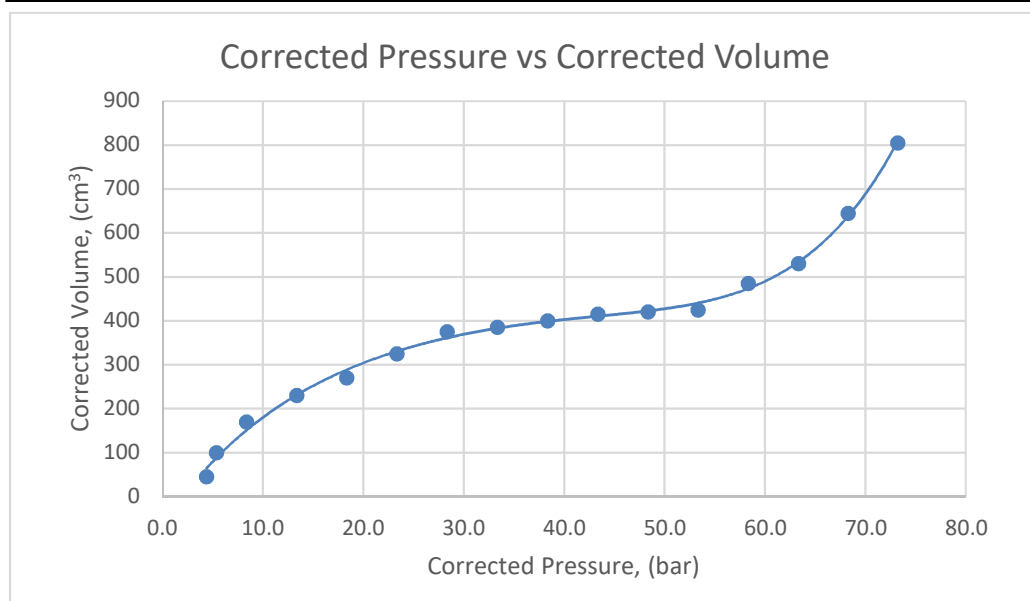


K.C.T Consultancy Services LLP			
Pressure meter Test - 02			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-21.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	45	4.4	45
2	80	5.4	80
5	145	8.4	145
10	205	13.4	205
15	265	18.4	265
20	330	23.4	330
25	375	28.4	375
30	385	33.4	385
35	400	38.4	400
40	415	43.4	415
45	425	48.4	425
50	435	53.4	435
55	450	58.4	450
60	460	63.4	460
65	535	68.3	535
70	650	73.2	650
75	775	78.2	775

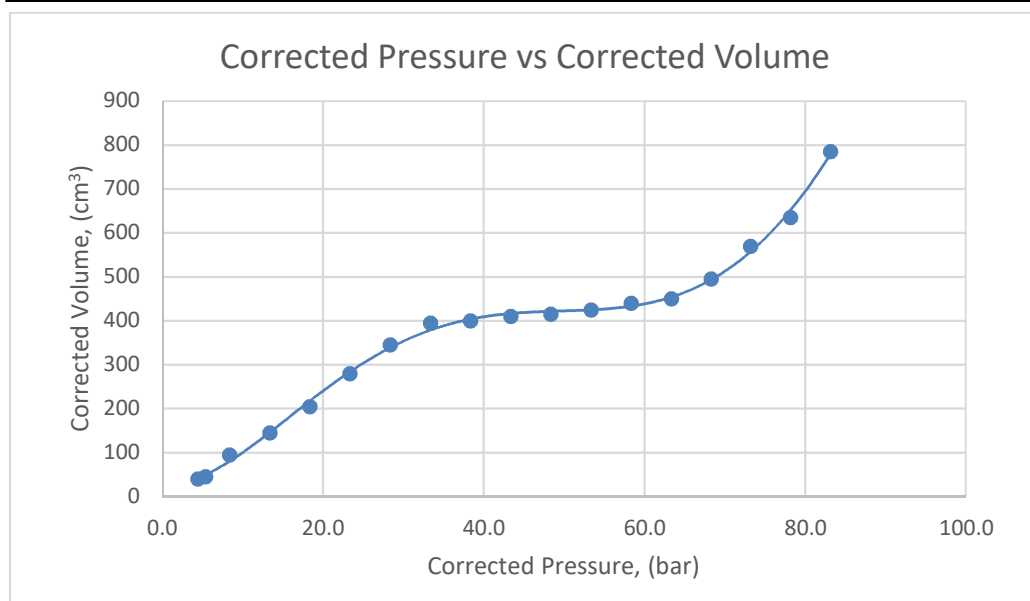
Corrected Pressure vs Corrected Volume



K.C.T Consultancy Services LLP			
Pressure meter Test - 02			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-24.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	45	4.4	45
2	100	5.4	100
5	170	8.4	170
10	230	13.4	230
15	270	18.4	270
20	325	23.4	325
25	375	28.4	375
30	385	33.4	385
35	400	38.4	400
40	415	43.4	415
45	420	48.4	420
50	425	53.4	425
55	485	58.4	485
60	530	63.4	530
65	645	68.3	645
70	805	73.2	805

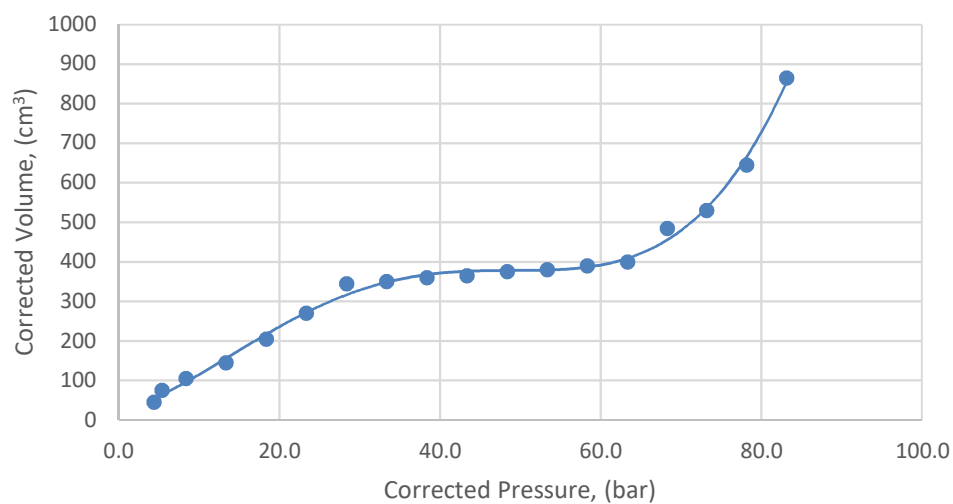


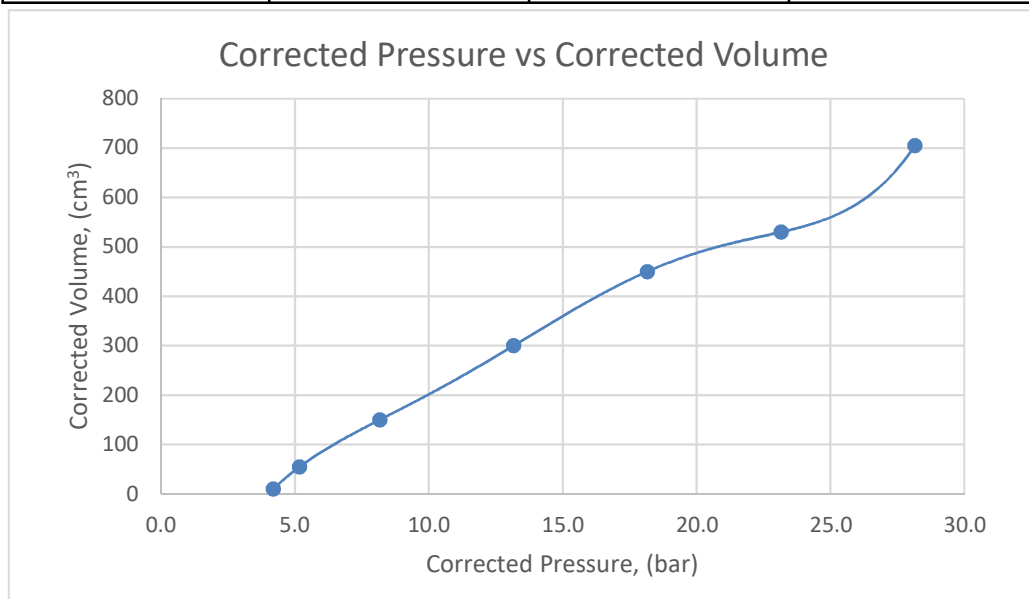
K.C.T Consultancy Services LLP			
Pressure meter Test - 02			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :- 27.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
bar	60 sec cc	bar	60 sec cc
1	40	4.4	40
2	45	5.4	45
5	95	8.4	95
10	145	13.4	145
15	205	18.4	205
20	280	23.4	280
25	345	28.4	345
30	395	33.4	395
35	400	38.4	400
40	410	43.4	410
45	415	48.4	415
50	425	53.4	425
55	440	58.4	440
60	450	63.4	450
65	495	68.3	495
70	570	73.2	570
75	635	78.2	635
80	785	83.2	785



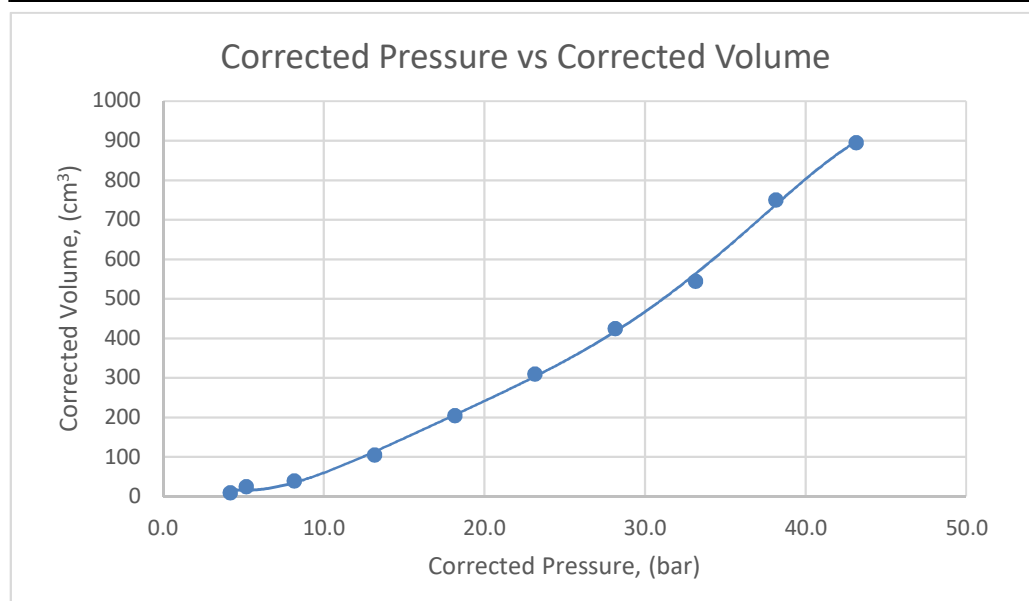
K.C.T Consultancy Services LLP			
Pressure meter Test - 02			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-30.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	45	4.4	45
2	75	5.4	75
5	105	8.4	105
10	145	13.4	145
15	205	18.4	205
20	270	23.4	270
25	345	28.4	345
30	350	33.4	350
35	360	38.4	360
40	365	43.4	365
45	375	48.4	375
50	380	53.4	380
55	390	58.4	390
60	400	63.4	400
65	485	68.3	485
70	530	73.2	530
75	645	78.2	645
80	865	83.2	865

Corrected Pressure vs Corrected Volume

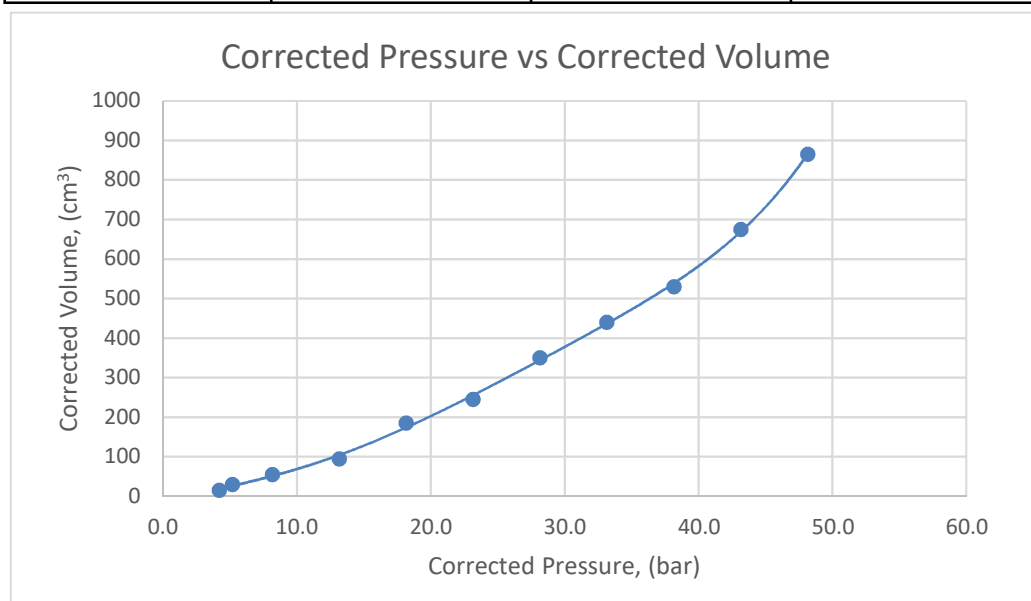


[illegible]

K.C.T Consultancy Services LLP			
Pressure meter Test - 03			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-4.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
bar	60 sec cc	bar	60 sec cc
1	10	4.2	10
2	25	5.2	25
5	40	8.2	40
10	105	13.2	105
15	205	18.2	205
20	310	23.2	310
25	425	28.2	425
30	545	33.2	545
35	750	38.2	750
40	895	43.2	895

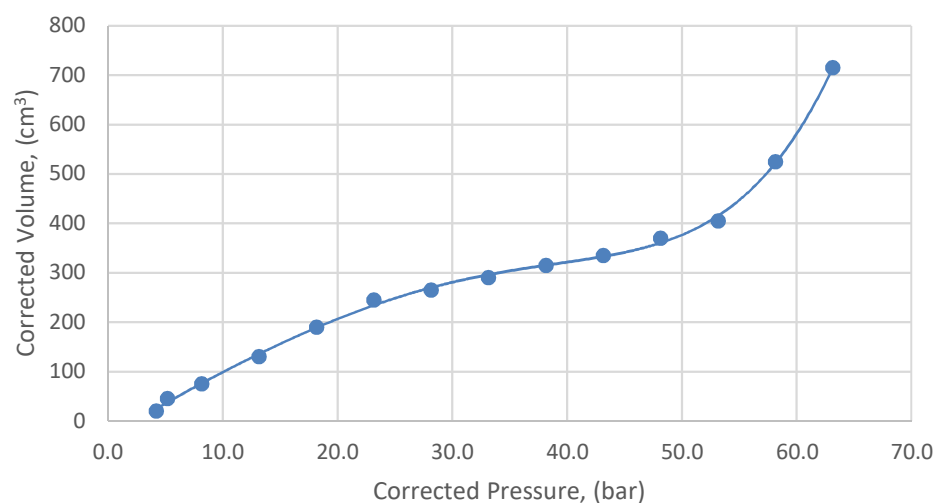


K.C.T Consultancy Services LLP			
Pressure meter Test - 03			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-6.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	15	4.2	15
2	30	5.2	30
5	55	8.2	55
10	95	13.2	95
15	185	18.2	185
20	245	23.2	245
25	350	28.2	350
30	440	33.2	440
35	530	38.2	530
40	675	43.2	675
45	865	48.2	865



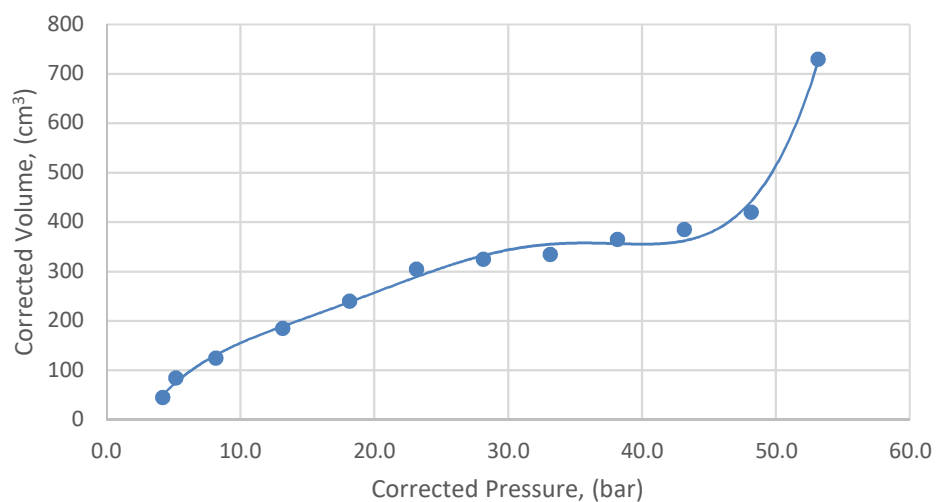
K.C.T Consultancy Services LLP			
Pressure meter Test - 03			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-8.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	20	4.2	20
2	45	5.2	45
5	75	8.2	75
10	130	13.2	130
15	190	18.2	190
20	245	23.2	245
25	265	28.2	265
30	290	33.2	290
35	315	38.2	315
40	335	43.2	335
45	370	48.2	370
50	405	53.2	405
55	525	58.2	525
60	715	63.2	715

Corrected Pressure vs Corrected Volume

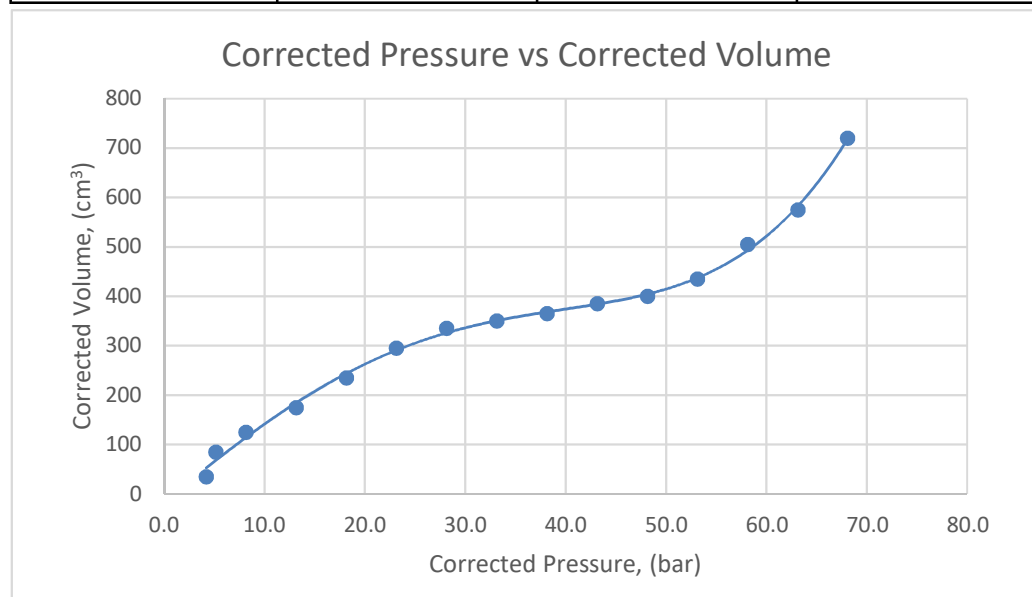


K.C.T Consultancy Services LLP			
Pressure meter Test - 03			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-10.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	45	4.2	45
2	85	5.2	85
5	125	8.2	125
10	185	13.2	185
15	240	18.2	240
20	305	23.2	305
25	325	28.2	325
30	335	33.2	335
35	365	38.2	365
40	385	43.2	385
45	420	48.2	420
50	730	53.2	730

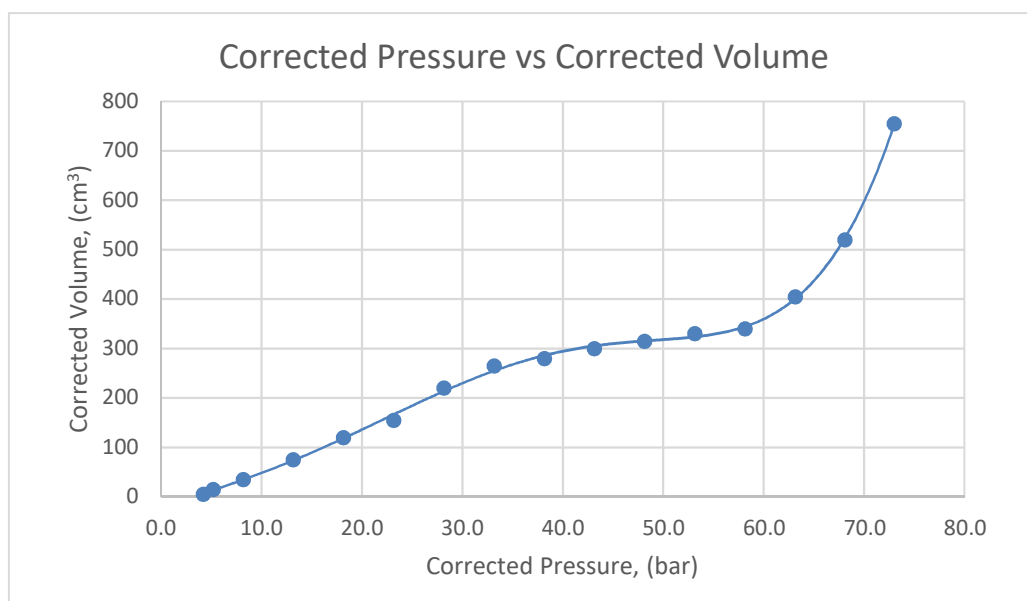
Corrected Pressure vs Corrected Volume



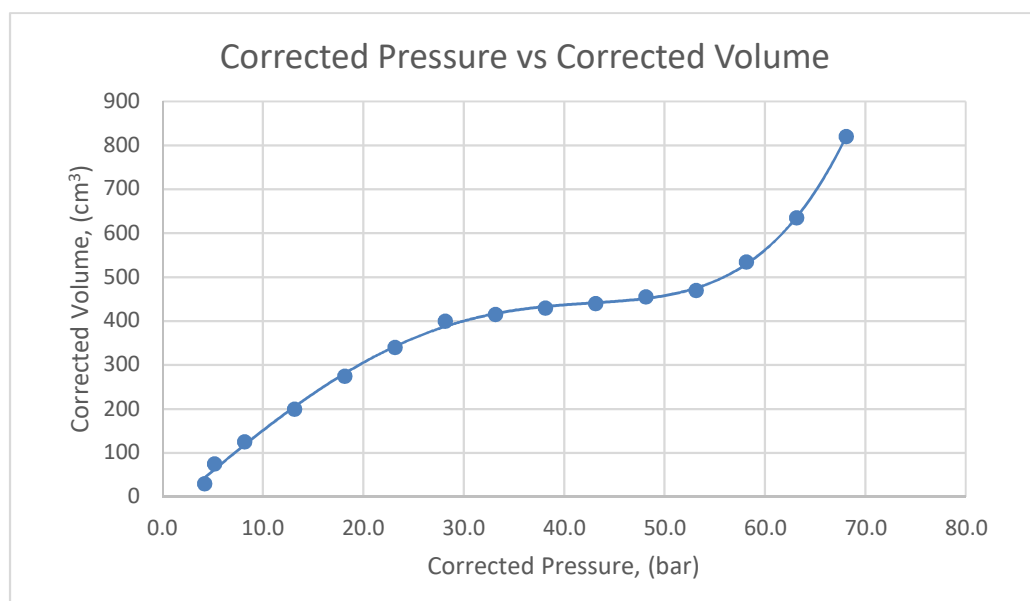
K.C.T Consultancy Services LLP			
Pressure meter Test - 03			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-12.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	35	4.2	35
2	85	5.2	85
5	125	8.2	125
10	175	13.2	175
15	235	18.2	235
20	295	23.2	295
25	335	28.2	335
30	350	33.2	350
35	365	38.2	365
40	385	43.2	385
45	400	48.2	400
50	435	53.2	435
55	505	58.2	505
60	575	63.2	575
65	720	68.1	720



K.C.T Consultancy Services LLP			
Pressure meter Test - 03			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-15.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	5	4.2	5
2	15	5.2	15
5	35	8.2	35
10	75	13.2	75
15	120	18.2	120
20	155	23.2	155
25	220	28.2	220
30	265	33.2	265
35	280	38.2	280
40	300	43.2	300
45	315	48.2	315
50	330	53.2	330
55	340	58.2	340
60	405	63.2	405
65	520	68.1	520
70	755	73.0	755

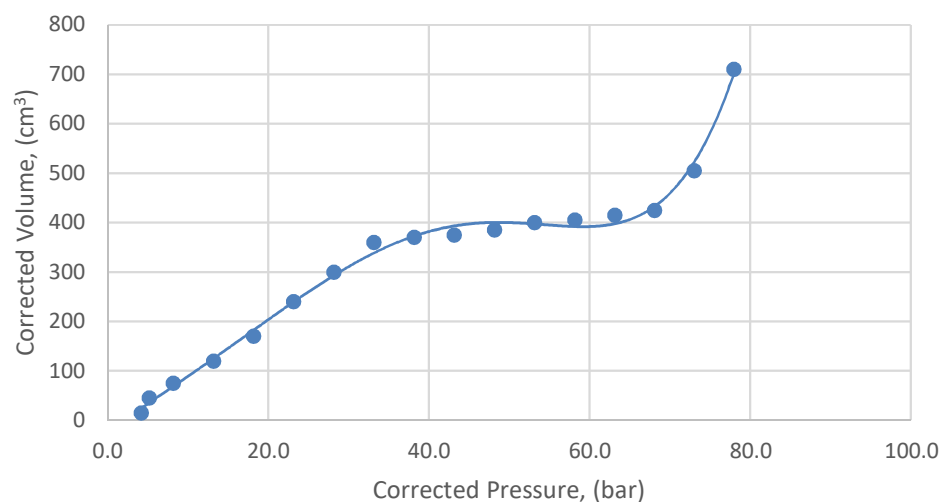


K.C.T Consultancy Services LLP			
Pressure meter Test - 03			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-18.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	30	4.2	30
2	75	5.2	75
5	125	8.2	125
10	200	13.2	200
15	275	18.2	275
20	340	23.2	340
25	400	28.2	400
30	415	33.2	415
35	430	38.2	430
40	440	43.2	440
45	455	48.2	455
50	470	53.2	470
55	535	58.2	535
60	635	63.2	635
65	820	68.1	820

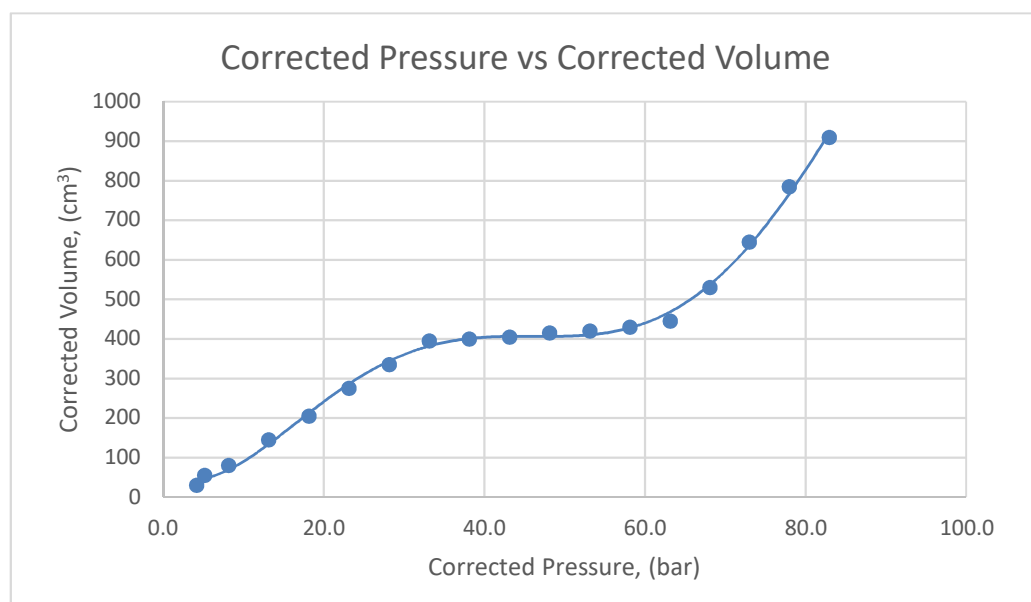


K.C.T Consultancy Services LLP			
Pressure meter Test - 03			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-21.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
bar	60 sec	bar	60 sec
	cc		cc
1	15	4.2	15
2	45	5.2	45
5	75	8.2	75
10	120	13.2	120
15	170	18.2	170
20	240	23.2	240
25	300	28.2	300
30	360	33.2	360
35	370	38.2	370
40	375	43.2	375
45	385	48.2	385
50	400	53.2	400
55	405	58.2	405
60	415	63.2	415
65	425	68.1	425
70	505	73.0	505
75	710	78.0	710

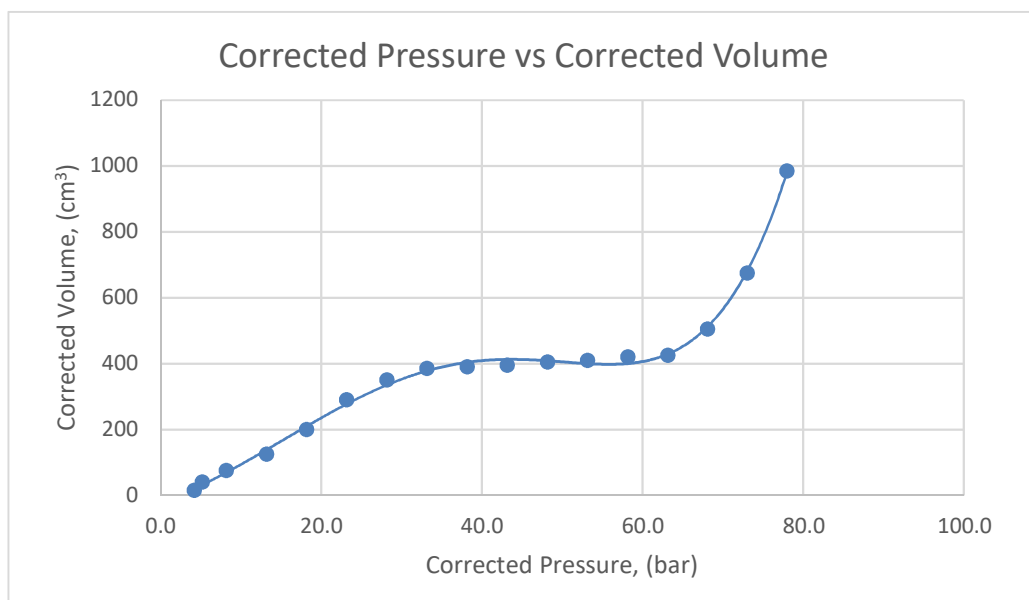
Corrected Pressure vs Corrected Volume



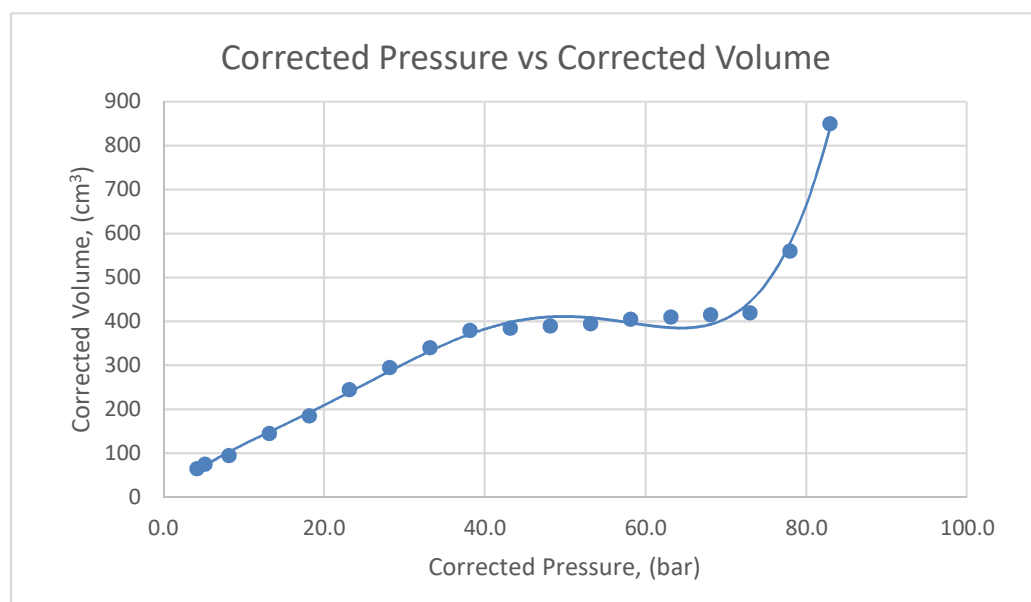
K.C.T Consultancy Services LLP			
Pressure meter Test - 03			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-24.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	30	4.2	30
2	55	5.2	55
5	80	8.2	80
10	145	13.2	145
15	205	18.2	205
20	275	23.2	275
25	335	28.2	335
30	395	33.2	395
35	400	38.2	400
40	405	43.2	405
45	415	48.2	415
50	420	53.2	420
55	430	58.2	430
60	445	63.2	445
65	530	68.1	530
70	645	73.0	645
75	785	78.0	785
80	910	83.0	910



K.C.T Consultancy Services LLP			
Pressure meter Test - 03			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :- 27.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
bar	60 sec cc	bar	60 sec cc
1	15	4.2	15
2	40	5.2	40
5	75	8.2	75
10	125	13.2	125
15	200	18.2	200
20	290	23.2	290
25	350	28.2	350
30	385	33.2	385
35	390	38.2	390
40	395	43.2	395
45	405	48.2	405
50	410	53.2	410
55	420	58.2	420
60	425	63.2	425
65	505	68.1	505
70	675	73.0	675
75	985	78.0	985

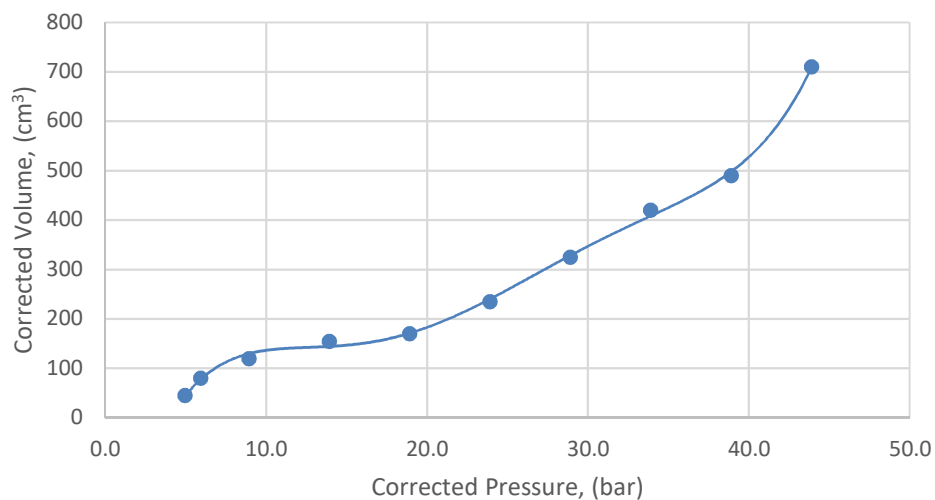


K.C.T Consultancy Services LLP			
Pressure meter Test - 03			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-30.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	65	4.2	65
2	75	5.2	75
5	95	8.2	95
10	145	13.2	145
15	185	18.2	185
20	245	23.2	245
25	295	28.2	295
30	340	33.2	340
35	380	38.2	380
40	385	43.2	385
45	390	48.2	390
50	395	53.2	395
55	405	58.2	405
60	410	63.2	410
65	415	68.1	415
70	420	73.0	420
75	560	78.0	560
80	850	83.0	850

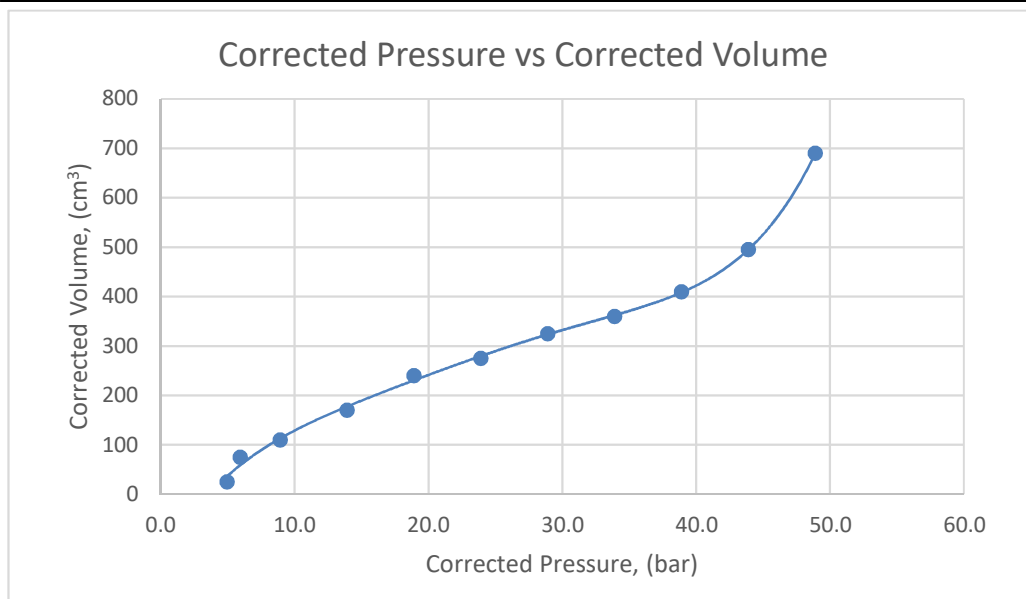


K.C.T Consultancy Services LLP			
Pressure meter Test - 04			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-4.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	45	4.9	45
2	80	5.9	80
5	120	8.9	120
10	155	13.9	155
15	170	18.9	170
20	235	23.9	235
25	325	28.9	325
30	420	33.9	420
35	490	38.9	490
40	710	43.9	710

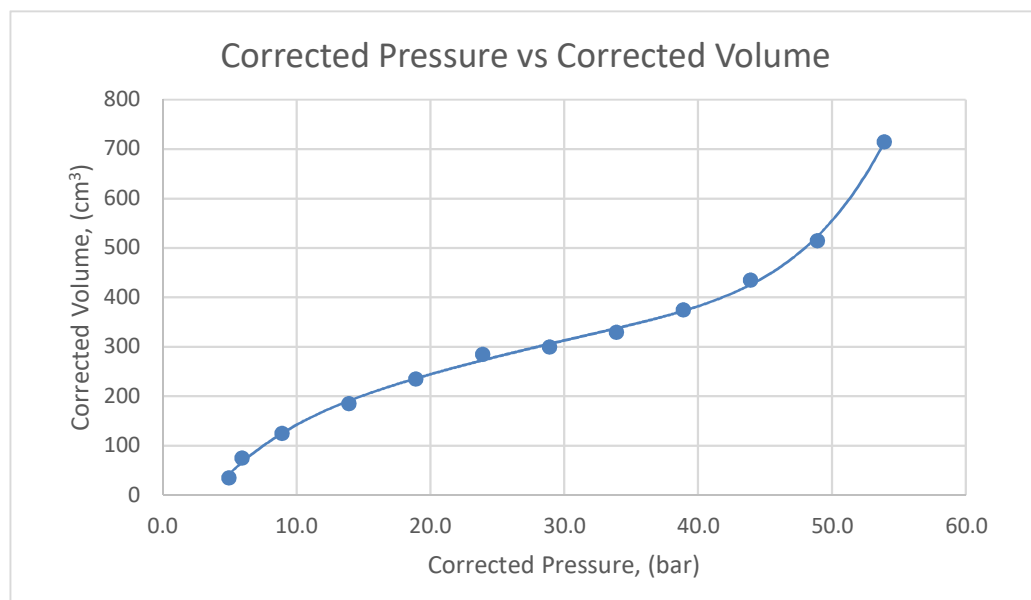
Corrected Pressure vs Corrected Volume



K.C.T Consultancy Services LLP			
Pressure meter Test - 04			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-6.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	25	4.9	25
2	75	5.9	75
5	110	8.9	110
10	170	13.9	170
15	240	18.9	240
20	275	23.9	275
25	325	28.9	325
30	360	33.9	360
35	410	38.9	410
40	495	43.9	495
45	690	48.9	690

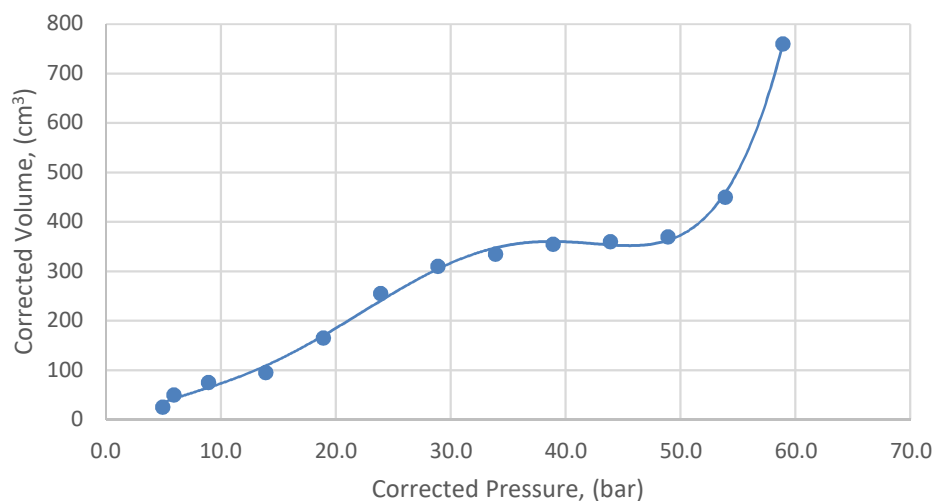


K.C.T Consultancy Services LLP			
Pressure meter Test - 04			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-8.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
bar	60 sec	bar	60 sec
	cc		cc
1	35	4.9	35
2	75	5.9	75
5	125	8.9	125
10	185	13.9	185
15	235	18.9	235
20	285	23.9	285
25	300	28.9	300
30	330	33.9	330
35	375	38.9	375
40	435	43.9	435
45	515	48.9	515
50	715	53.9	715



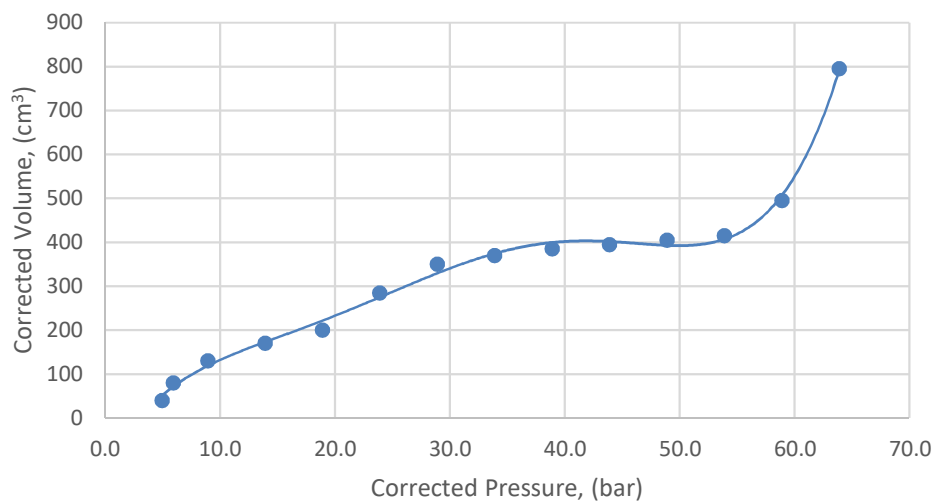
K.C.T Consultancy Services LLP			
Pressure meter Test - 04			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-10.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	25	4.9	25
2	50	5.9	50
5	75	8.9	75
10	95	13.9	95
15	165	18.9	165
20	255	23.9	255
25	310	28.9	310
30	335	33.9	335
35	355	38.9	355
40	360	43.9	360
45	370	48.9	370
50	450	53.9	450
55	760	58.9	760

Corrected Pressure vs Corrected Volume



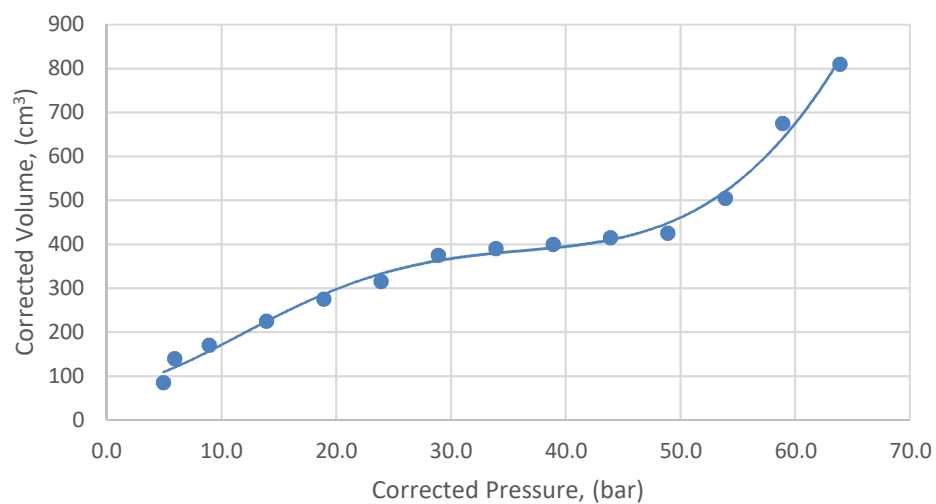
K.C.T Consultancy Services LLP			
Pressure meter Test - 04			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-12.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
bar	60 sec cc	bar	60 sec cc
1	40	4.9	40
2	80	5.9	80
5	130	8.9	130
10	170	13.9	170
15	200	18.9	200
20	285	23.9	285
25	350	28.9	350
30	370	33.9	370
35	385	38.9	385
40	395	43.9	395
45	405	48.9	405
50	415	53.9	415
55	495	58.9	495
60	795	63.9	795

Corrected Pressure vs Corrected Volume

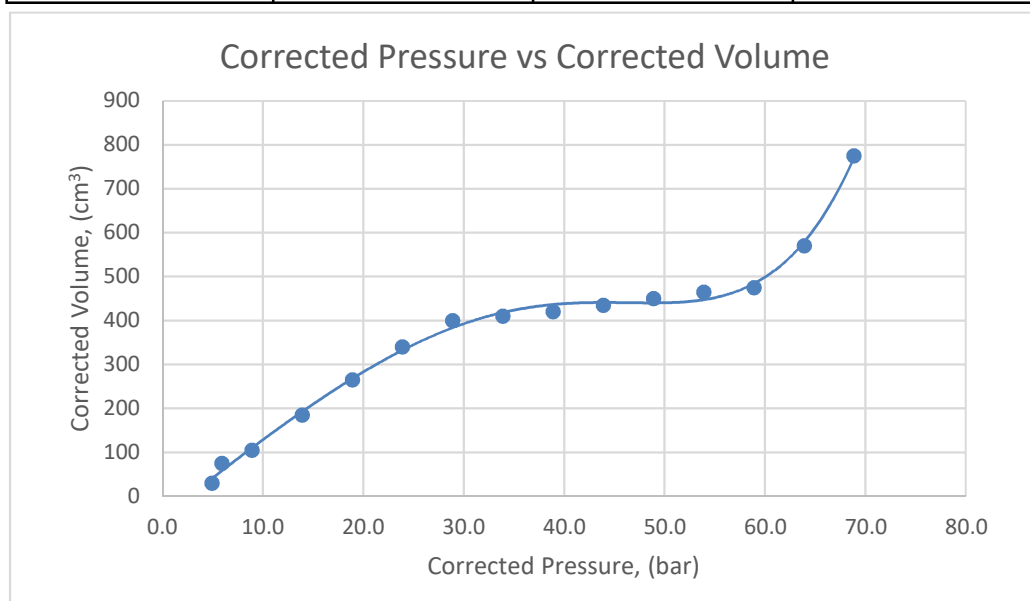


K.C.T Consultancy Services LLP			
Pressure meter Test - 04			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-15.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	85	4.9	85
2	140	5.9	140
5	170	8.9	170
10	225	13.9	225
15	275	18.9	275
20	315	23.9	315
25	375	28.9	375
30	390	33.9	390
35	400	38.9	400
40	415	43.9	415
45	425	48.9	425
50	505	53.9	505
55	675	58.9	675
60	810	63.9	810

Corrected Pressure vs Corrected Volume

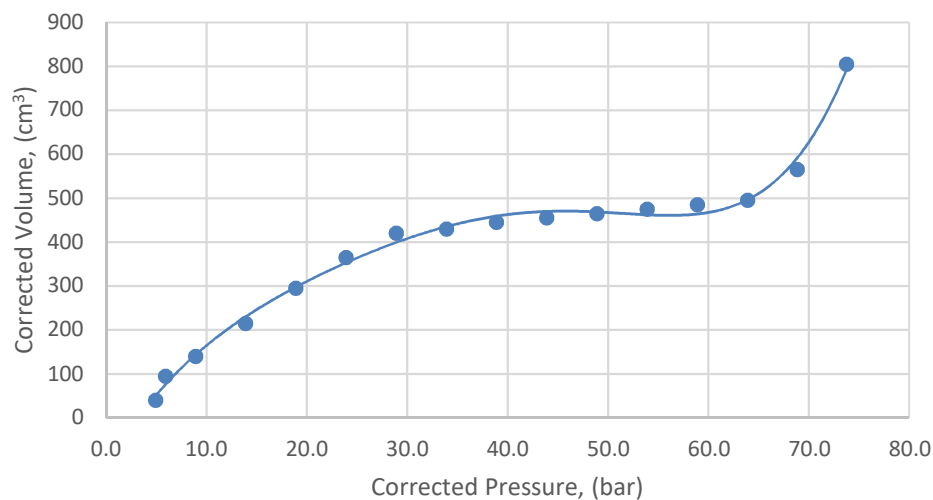


K.C.T Consultancy Services LLP			
Pressure meter Test - 04			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-18.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	30	4.9	30
2	75	5.9	75
5	105	8.9	105
10	185	13.9	185
15	265	18.9	265
20	340	23.9	340
25	400	28.9	400
30	410	33.9	410
35	420	38.9	420
40	435	43.9	435
45	450	48.9	450
50	465	53.9	465
55	475	58.9	475
60	570	63.9	570
65	775	68.8	775

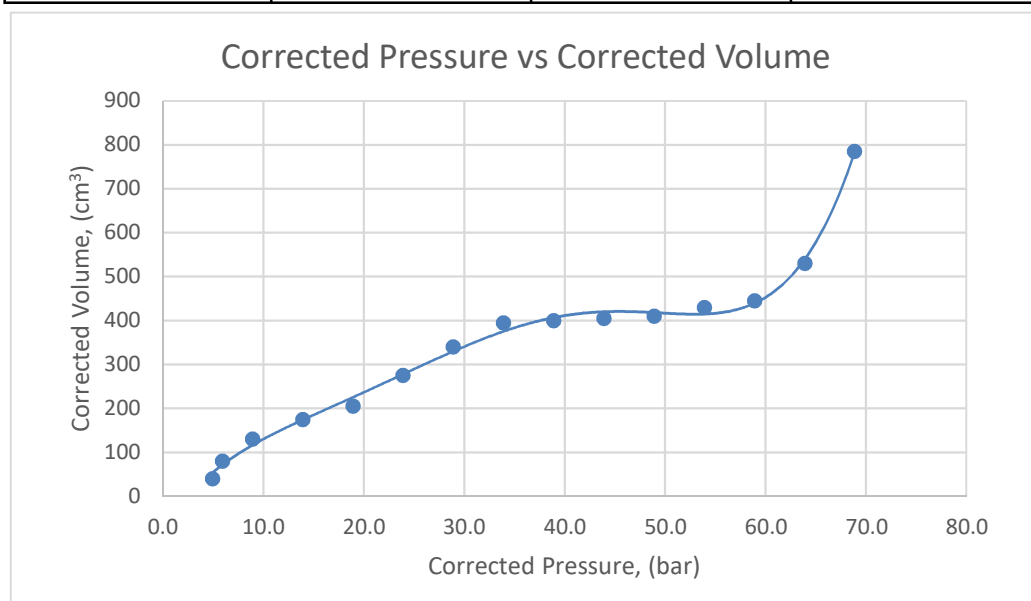


K.C.T Consultancy Services LLP			
Pressure meter Test - 04			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-21.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	40	4.9	40
2	95	5.9	95
5	140	8.9	140
10	215	13.9	215
15	295	18.9	295
20	365	23.9	365
25	420	28.9	420
30	430	33.9	430
35	445	38.9	445
40	455	43.9	455
45	465	48.9	465
50	475	53.9	475
55	485	58.9	485
60	495	63.9	495
65	565	68.8	565
70	805	73.8	805

Corrected Pressure vs Corrected Volume

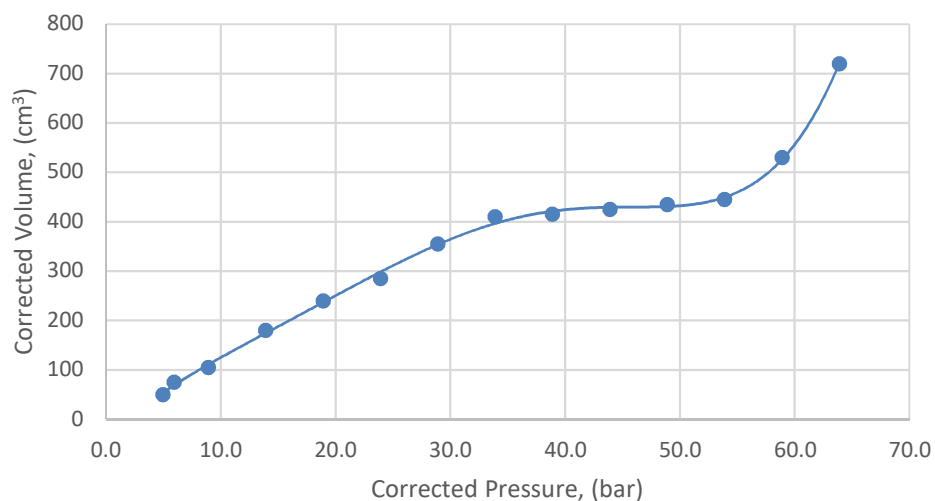


K.C.T Consultancy Services LLP			
Pressure meter Test - 04			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-24.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	40	4.9	40
2	80	5.9	80
5	130	8.9	130
10	175	13.9	175
15	205	18.9	205
20	275	23.9	275
25	340	28.9	340
30	395	33.9	395
35	400	38.9	400
40	405	43.9	405
45	410	48.9	410
50	430	53.9	430
55	445	58.9	445
60	530	63.9	530
65	785	68.8	785



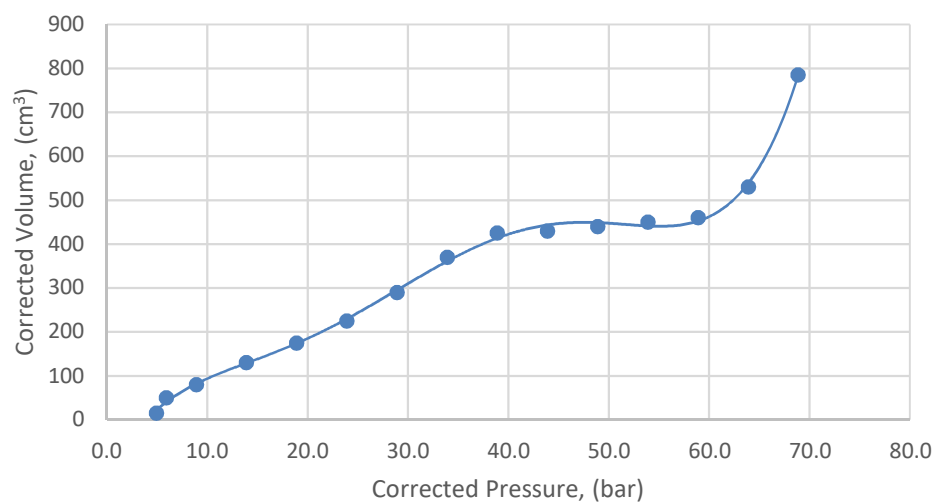
K.C.T Consultancy Services LLP			
Pressure meter Test - 04			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :- 27.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	50	4.9	50
2	75	5.9	75
5	105	8.9	105
10	180	13.9	180
15	240	18.9	240
20	285	23.9	285
25	355	28.9	355
30	410	33.9	410
35	415	38.9	415
40	425	43.9	425
45	435	48.9	435
50	445	53.9	445
55	530	58.9	530
60	720	63.9	720

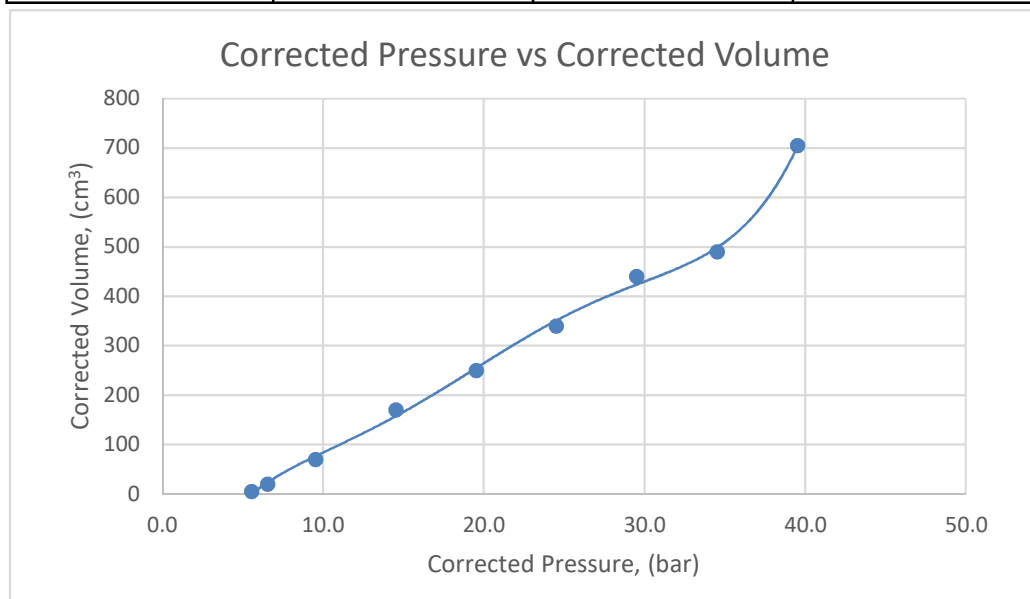
Corrected Pressure vs Corrected Volume



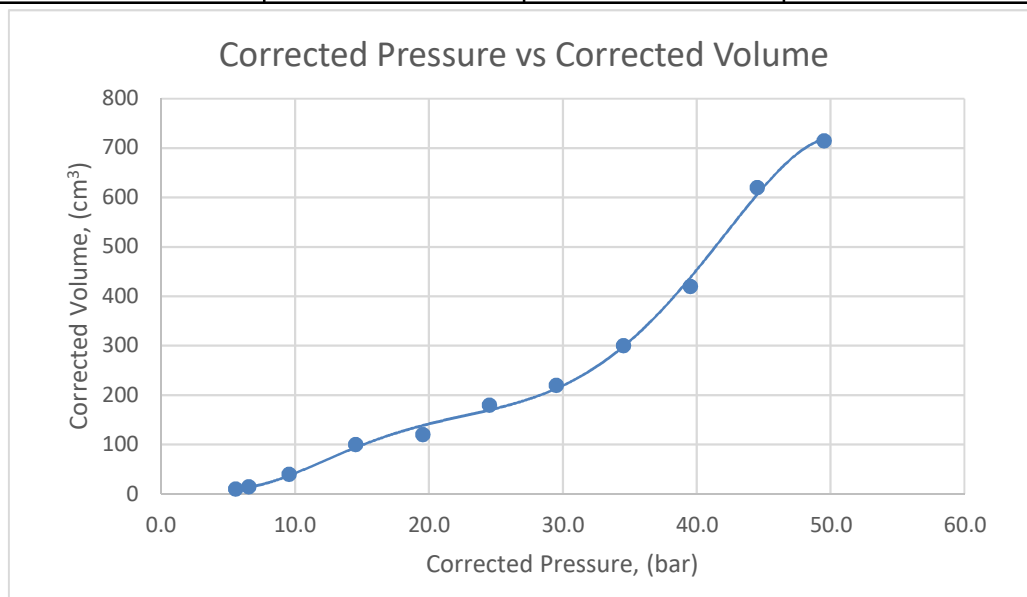
K.C.T Consultancy Services LLP			
Pressure meter Test - 04			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-30.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
bar	60 sec	bar	60 sec
	cc		cc
1	15	4.9	15
2	50	5.9	50
5	80	8.9	80
10	130	13.9	130
15	175	18.9	175
20	225	23.9	225
25	290	28.9	290
30	370	33.9	370
35	425	38.9	425
40	430	43.9	430
45	440	48.9	440
50	450	53.9	450
55	460	58.9	460
60	530	63.9	530
65	785	68.8	785

Corrected Pressure vs Corrected Volume

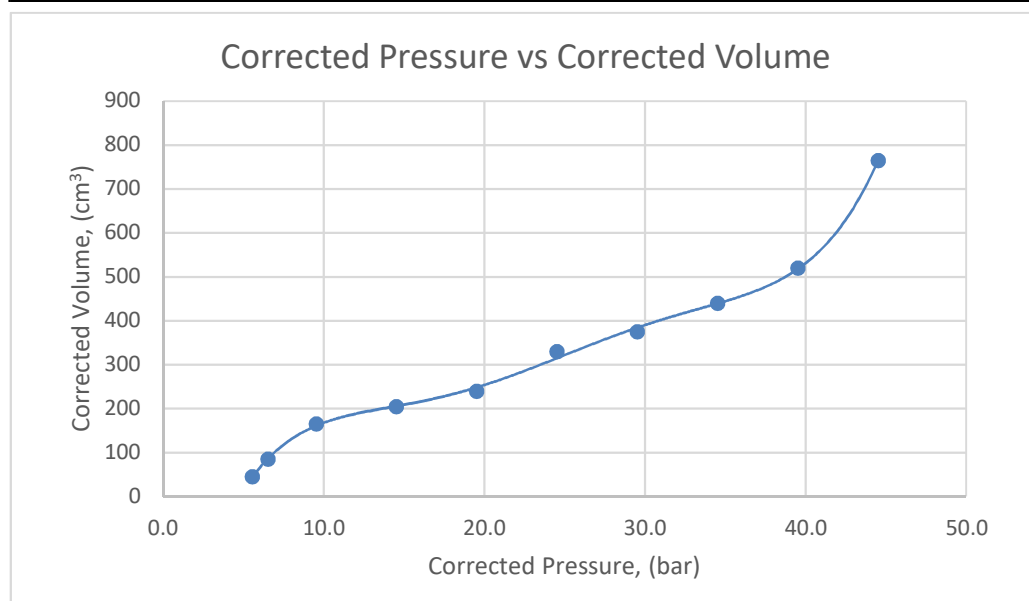


[illegible]

K.C.T Consultancy Services LLP			
Pressure meter Test - 05			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-4.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
bar	60 sec	bar	60 sec
	cc		cc
1	10	5.6	10
2	15	6.5	15
5	40	9.5	40
10	100	14.5	100
15	120	19.5	120
20	180	24.5	180
25	220	29.5	220
30	300	34.5	300
35	420	39.5	420
40	620	44.5	620
45	715	49.5	715

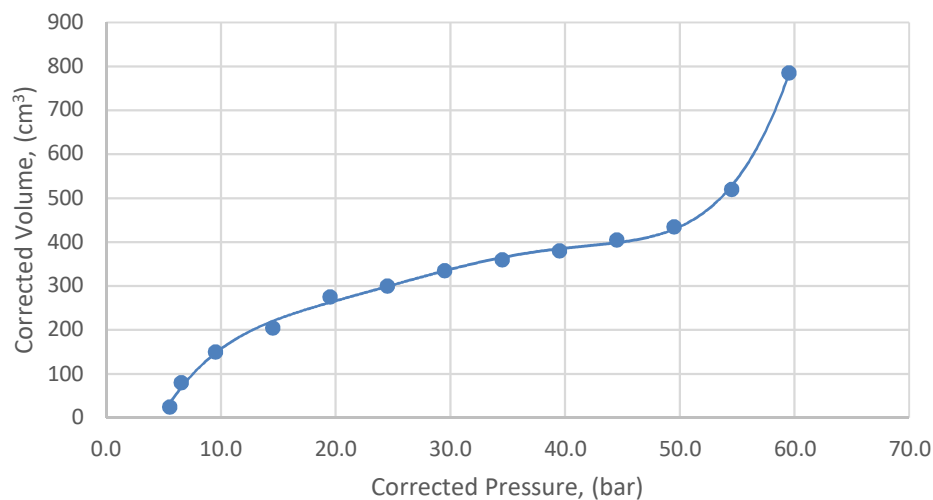


K.C.T Consultancy Services LLP			
Pressure meter Test - 05			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-6.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	45	5.6	45
2	85	6.5	85
5	165	9.5	165
10	205	14.5	205
15	240	19.5	240
20	330	24.5	330
25	375	29.5	375
30	440	34.5	440
35	520	39.5	520
40	765	44.5	765

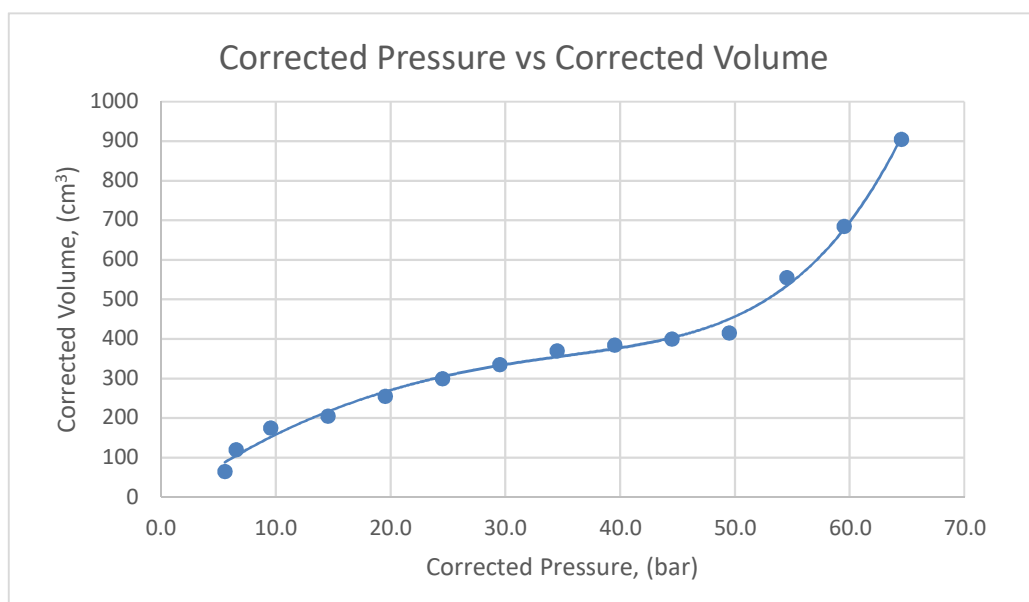


K.C.T Consultancy Services LLP			
Pressure meter Test - 05			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-8.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	25	5.6	25
2	80	6.5	80
5	150	9.5	150
10	205	14.5	205
15	275	19.5	275
20	300	24.5	300
25	335	29.5	335
30	360	34.5	360
35	380	39.5	380
40	405	44.5	405
45	435	49.5	435
50	520	54.5	520
55	785	59.5	785

Corrected Pressure vs Corrected Volume

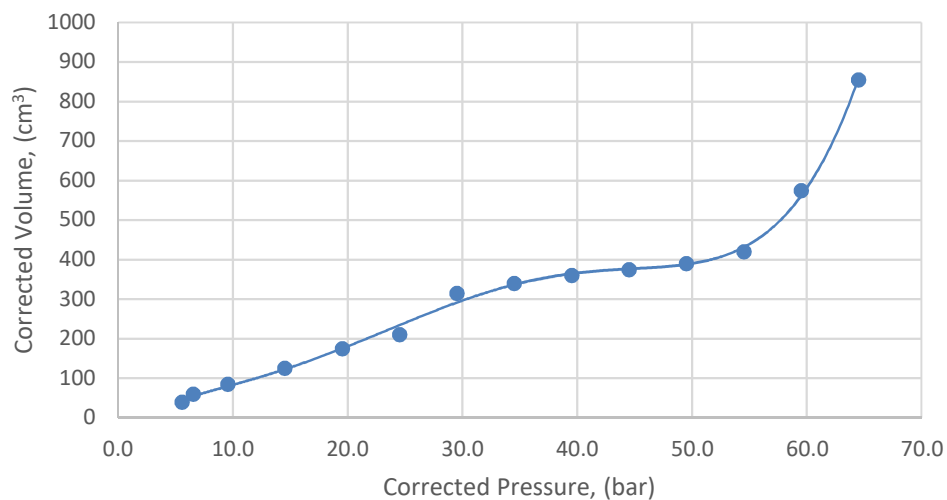


K.C.T Consultancy Services LLP			
Pressure meter Test - 05			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-10.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	65	5.6	65
2	120	6.5	120
5	175	9.5	175
10	205	14.5	205
15	255	19.5	255
20	300	24.5	300
25	335	29.5	335
30	370	34.5	370
35	385	39.5	385
40	400	44.5	400
45	415	49.5	415
50	555	54.5	555
55	685	59.5	685
60	905	64.5	905

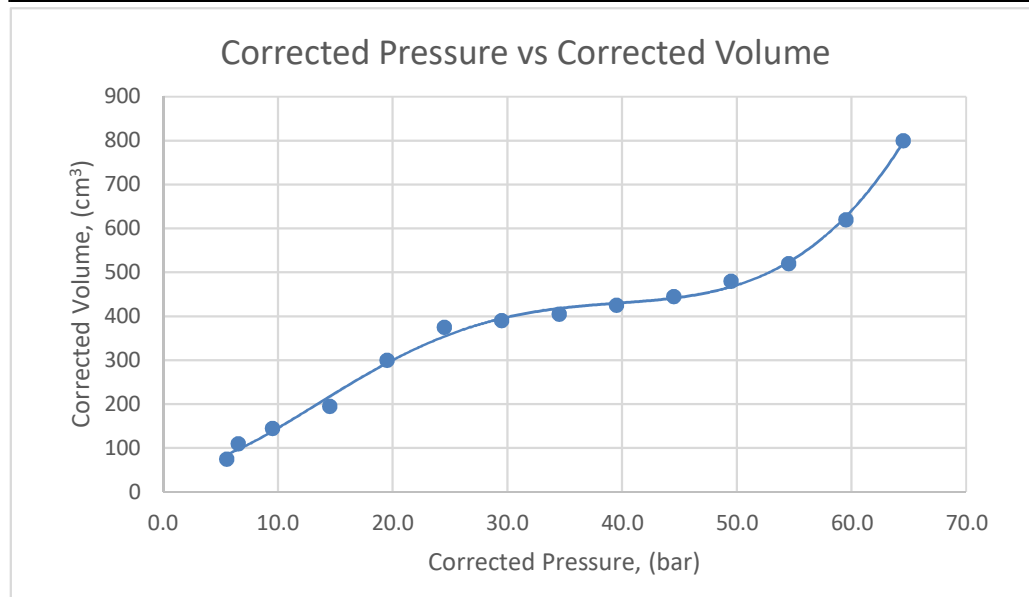


K.C.T Consultancy Services LLP			
Pressure meter Test - 05			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-12.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	40	5.6	40
2	60	6.5	60
5	85	9.5	85
10	125	14.5	125
15	175	19.5	175
20	210	24.5	210
25	315	29.5	315
30	340	34.5	340
35	360	39.5	360
40	375	44.5	375
45	390	49.5	390
50	420	54.5	420
55	575	59.5	575
60	855	64.5	855

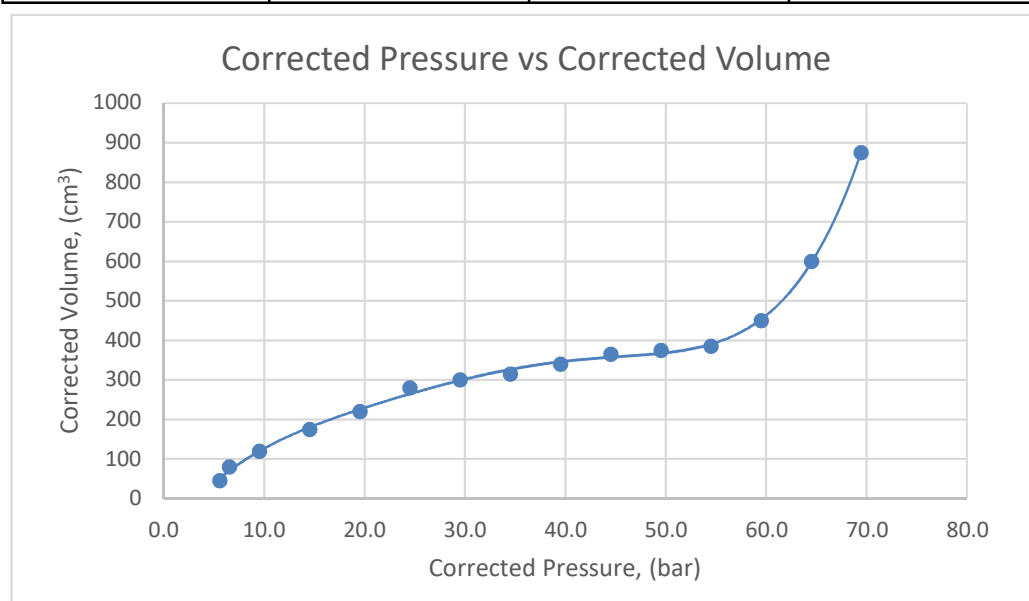
Corrected Pressure vs Corrected Volume



K.C.T Consultancy Services LLP			
Pressure meter Test - 05			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-15.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	75	5.6	75
2	110	6.5	110
5	145	9.5	145
10	195	14.5	195
15	300	19.5	300
20	375	24.5	375
25	390	29.5	390
30	405	34.5	405
35	425	39.5	425
40	445	44.5	445
45	480	49.5	480
50	520	54.5	520
55	620	59.5	620
60	800	64.5	800

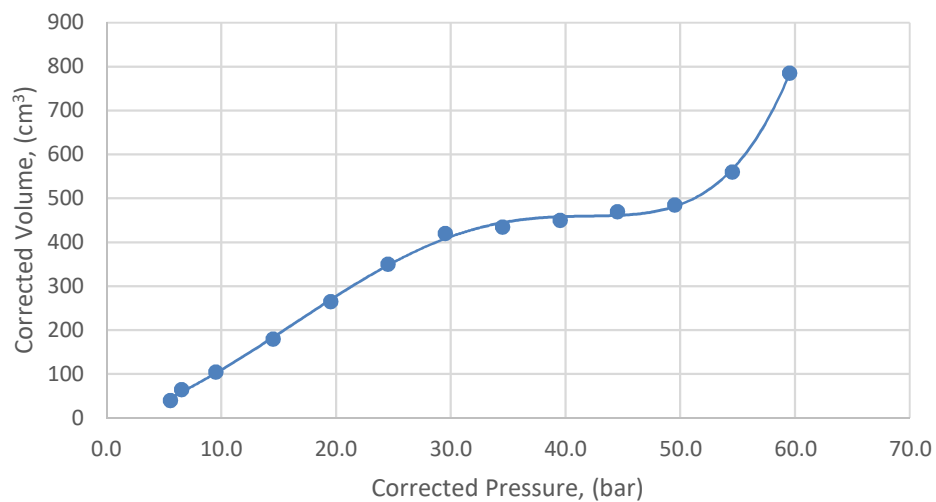


K.C.T Consultancy Services LLP			
Pressure meter Test - 05			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-18.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	45	5.6	45
2	80	6.5	80
5	120	9.5	120
10	175	14.5	175
15	220	19.5	220
20	280	24.5	280
25	300	29.5	300
30	315	34.5	315
35	340	39.5	340
40	365	44.5	365
45	375	49.5	375
50	385	54.5	385
55	450	59.5	450
60	600	64.5	600
65	875	69.5	875

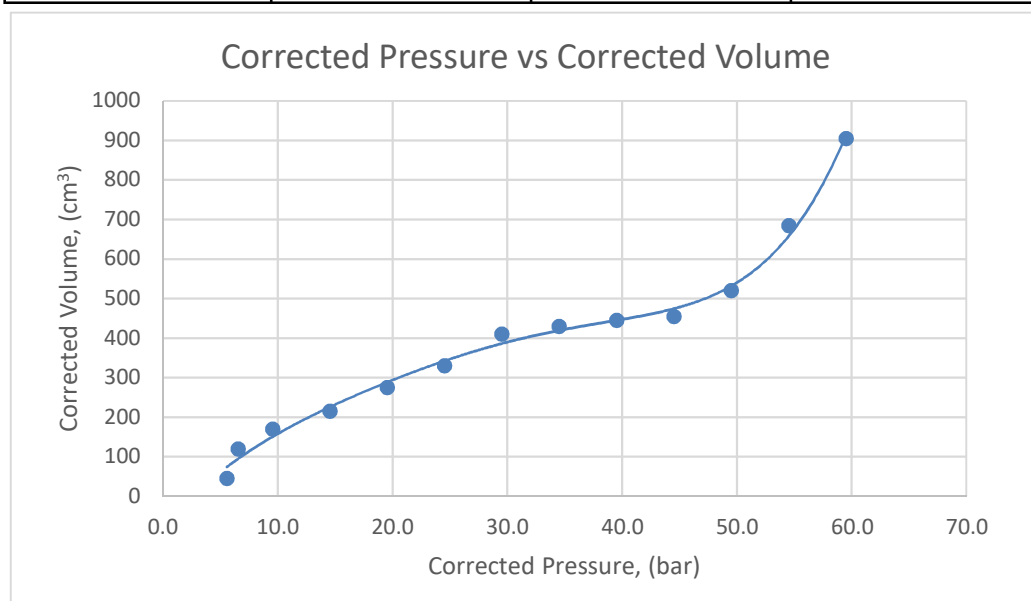


K.C.T Consultancy Services LLP			
Pressure meter Test - 05			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-21.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	40	5.6	40
2	65	6.5	65
5	105	9.5	105
10	180	14.5	180
15	265	19.5	265
20	350	24.5	350
25	420	29.5	420
30	435	34.5	435
35	450	39.5	450
40	470	44.5	470
45	485	49.5	485
50	560	54.5	560
55	785	59.5	785

Corrected Pressure vs Corrected Volume

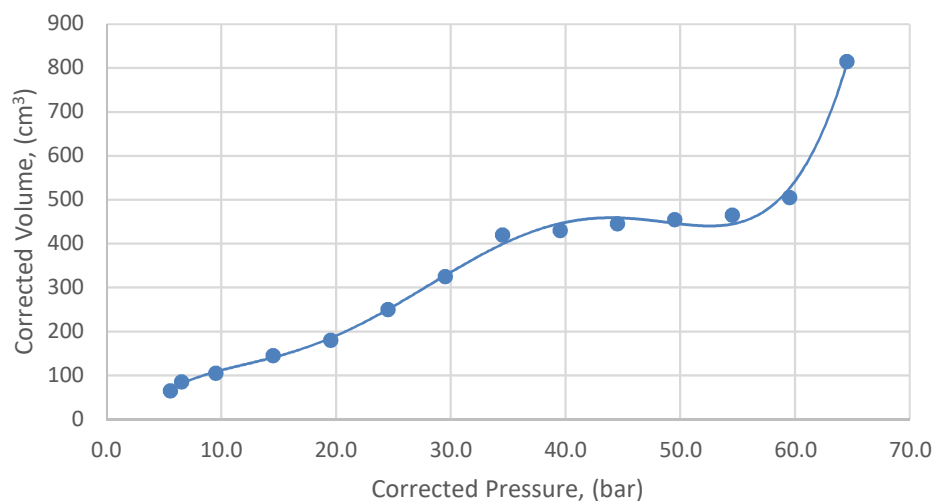


K.C.T Consultancy Services LLP			
Pressure meter Test - 05			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-24.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	45	5.6	45
2	120	6.5	120
5	170	9.5	170
10	215	14.5	215
15	275	19.5	275
20	330	24.5	330
25	410	29.5	410
30	430	34.5	430
35	445	39.5	445
40	455	44.5	455
45	520	49.5	520
50	685	54.5	685
55	905	59.5	905



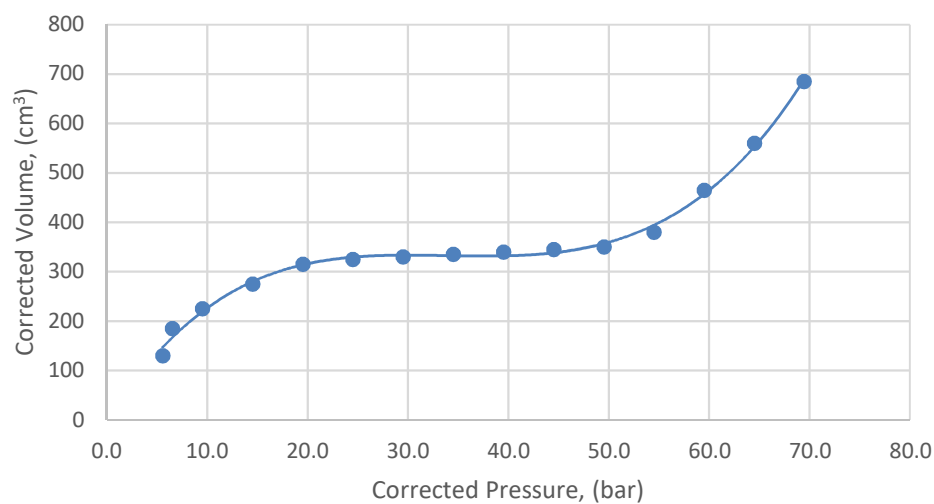
K.C.T Consultancy Services LLP			
Pressure meter Test - 05			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :- 27.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	65	5.6	65
2	85	6.5	85
5	105	9.5	105
10	145	14.5	145
15	180	19.5	180
20	250	24.5	250
25	325	29.5	325
30	420	34.5	420
35	430	39.5	430
40	445	44.5	445
45	455	49.5	455
50	465	54.5	465
55	505	59.5	505
60	815	64.5	815

Corrected Pressure vs Corrected Volume



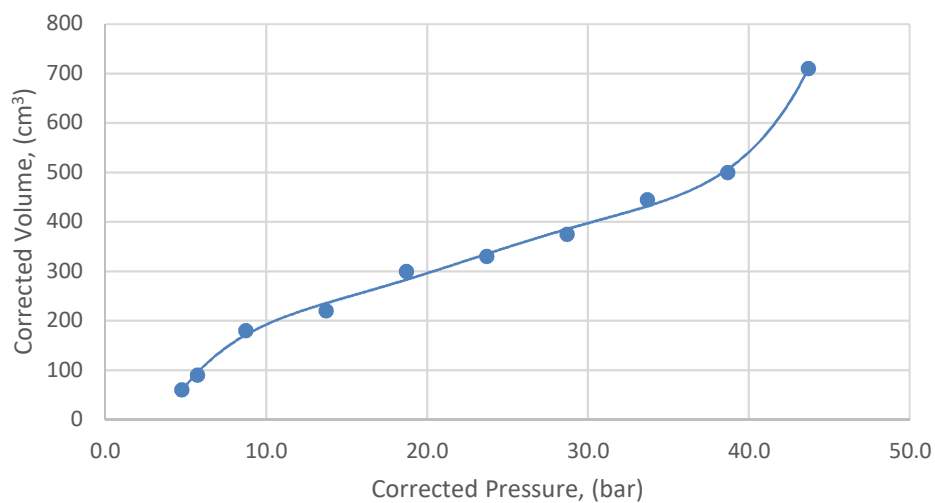
K.C.T Consultancy Services LLP			
Pressure meter Test - 05			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-30.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	130	5.6	130
2	185	6.5	185
5	225	9.5	225
10	275	14.5	275
15	315	19.5	315
20	325	24.5	325
25	330	29.5	330
30	335	34.5	335
35	340	39.5	340
40	345	44.5	345
45	350	49.5	350
50	380	54.5	380
55	465	59.5	465
60	560	64.5	560
65	685	69.5	685

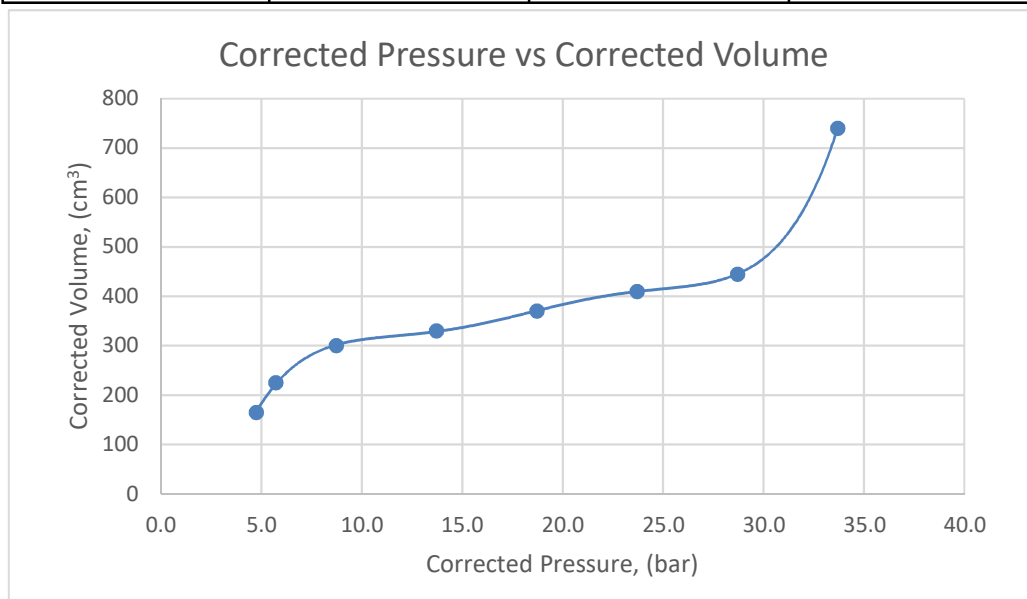
Corrected Pressure vs Corrected Volume



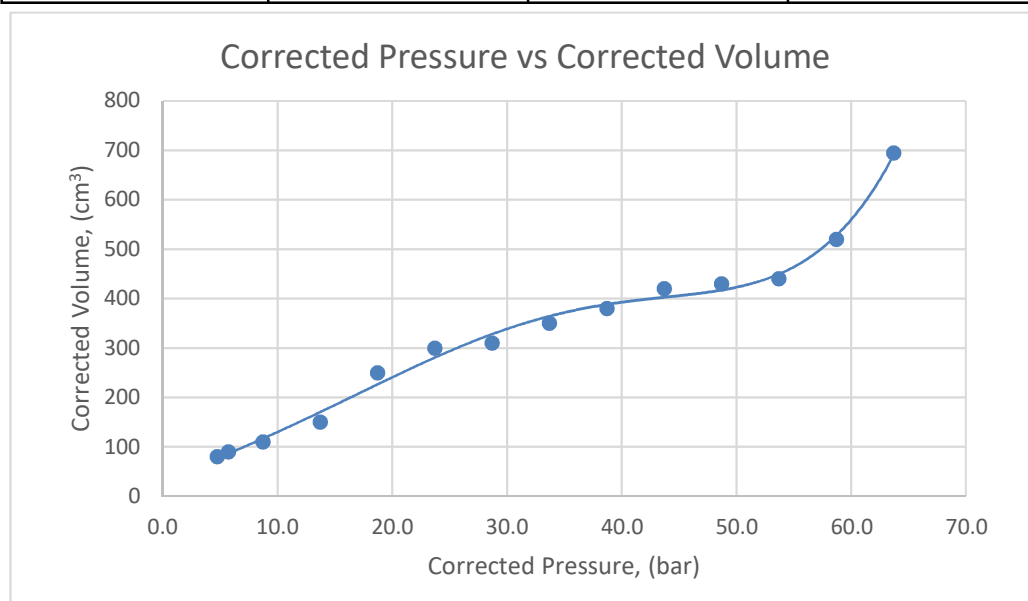
K.C.T Consultancy Services LLP			
Pressure meter Test - 06			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-6.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	60	4.7	60
2	90	5.7	90
5	180	8.7	180
10	220	13.7	220
15	300	18.7	300
20	330	23.7	330
25	375	28.7	375
30	445	33.7	445
35	500	38.7	500
40	710	43.7	710

Corrected Pressure vs Corrected Volume

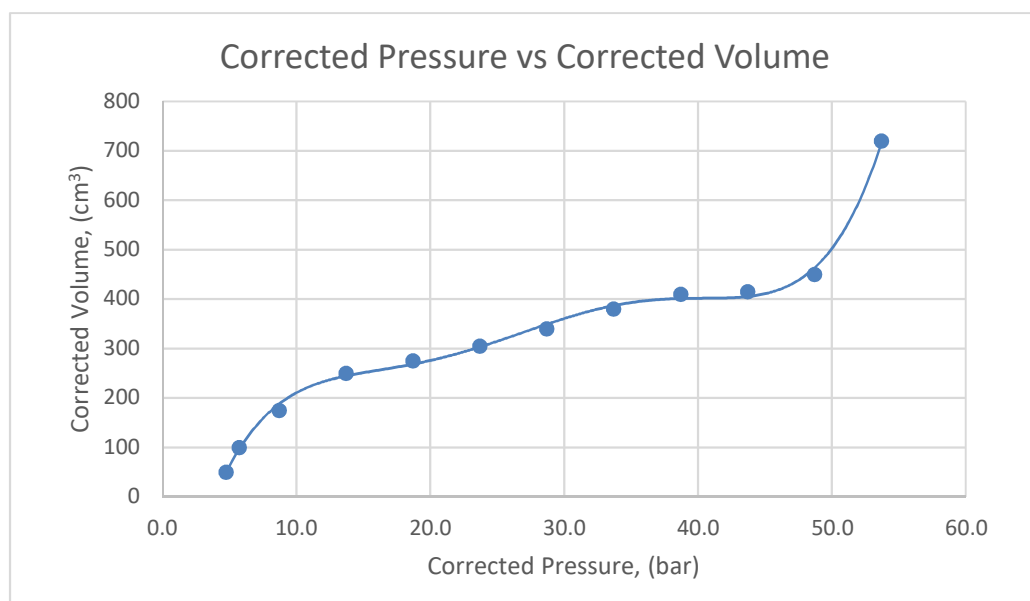


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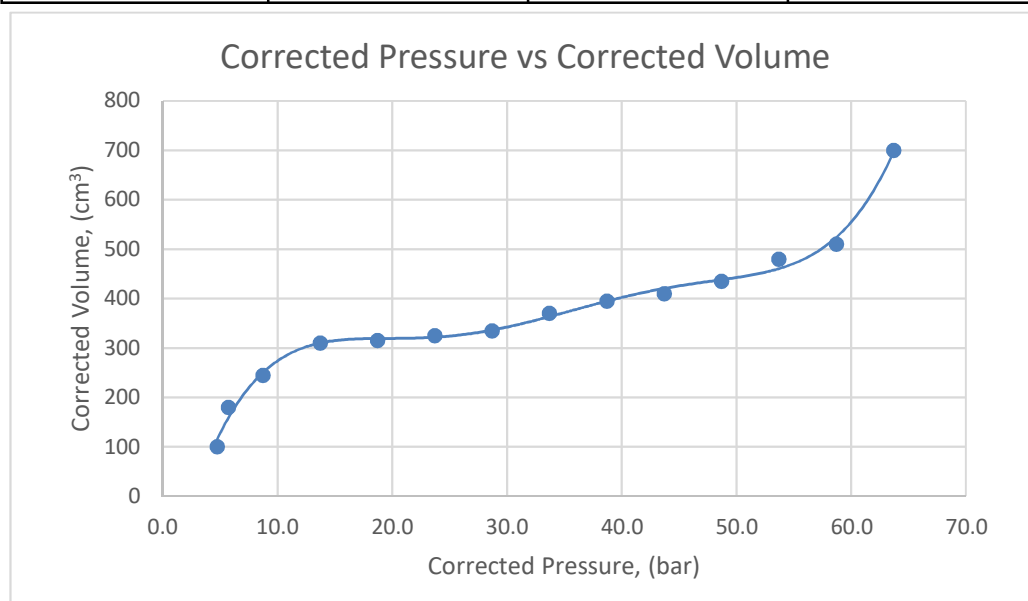
K.C.T Consultancy Services LLP			
Pressure meter Test - 06			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-10.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	80	4.7	80
2	90	5.7	90
5	110	8.7	110
10	150	13.7	150
15	250	18.7	250
20	300	23.7	300
25	310	28.7	310
30	350	33.7	350
35	380	38.7	380
40	420	43.7	420
45	430	48.7	430
50	440	53.7	440
55	520	58.7	520
60	695	63.7	695



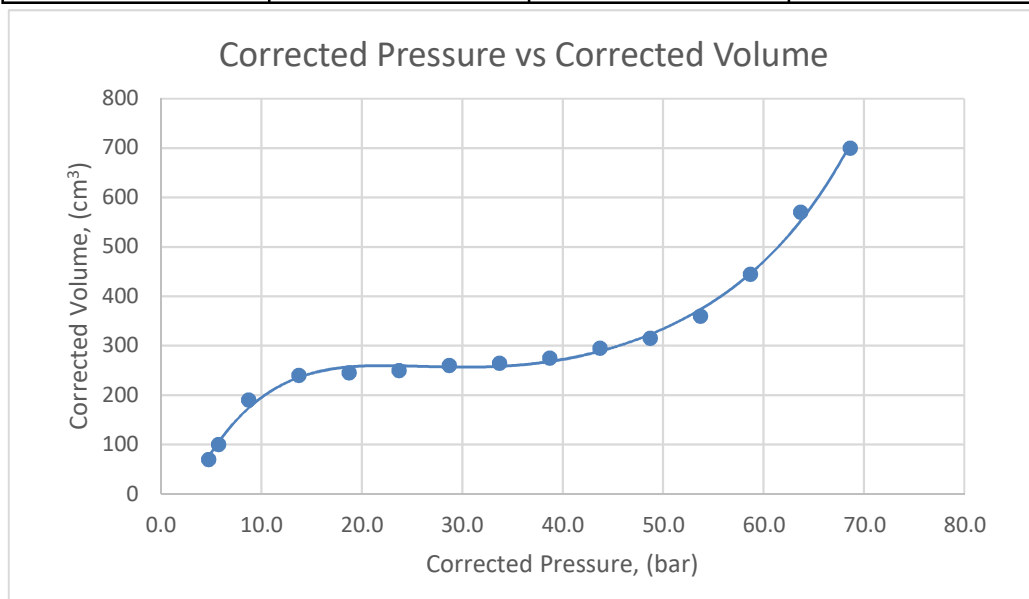
K.C.T Consultancy Services LLP			
Pressure meter Test - 06			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-12.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	50	4.7	50
2	100	5.7	100
5	175	8.7	175
10	250	13.7	250
15	275	18.7	275
20	305	23.7	305
25	340	28.7	340
30	380	33.7	380
35	410	38.7	410
40	415	43.7	415
45	450	48.7	450
50	720	53.7	720



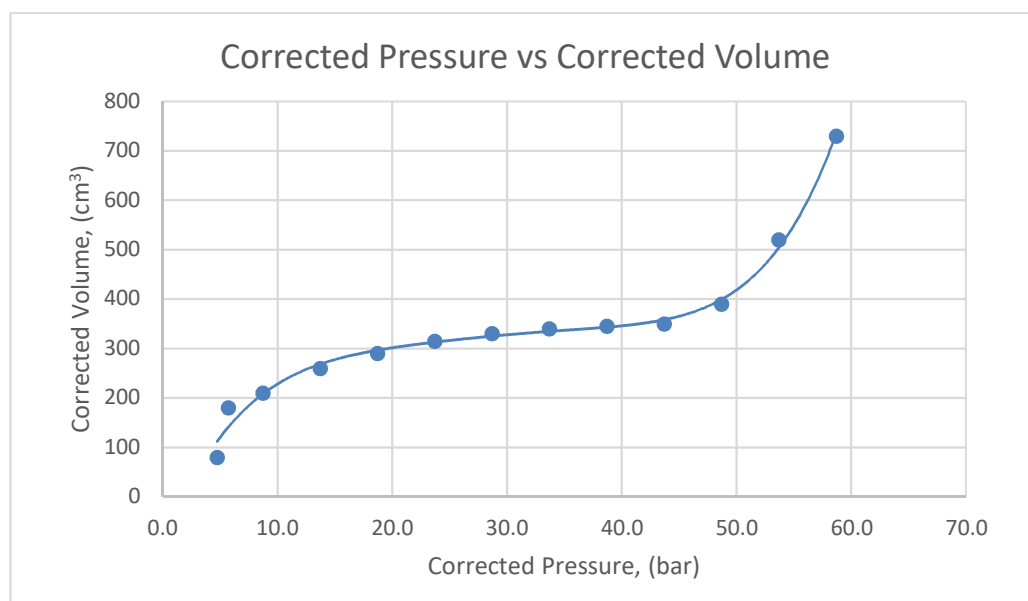
K.C.T Consultancy Services LLP			
Pressure meter Test - 06			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-15.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
bar	60 sec cc	bar	60 sec cc
1	100	4.7	100
2	180	5.7	180
5	245	8.7	245
10	310	13.7	310
15	315	18.7	315
20	325	23.7	325
25	335	28.7	335
30	370	33.7	370
35	395	38.7	395
40	410	43.7	410
45	435	48.7	435
50	480	53.7	480
55	510	58.7	510
60	700	63.7	700



K.C.T Consultancy Services LLP			
Pressure meter Test - 06			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-18.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	70	4.7	70
2	100	5.7	100
5	190	8.7	190
10	240	13.7	240
15	245	18.7	245
20	250	23.7	250
25	260	28.7	260
30	265	33.7	265
35	275	38.7	275
40	295	43.7	295
45	315	48.7	315
50	360	53.7	360
55	445	58.7	445
60	570	63.7	570
65	700	68.6	700

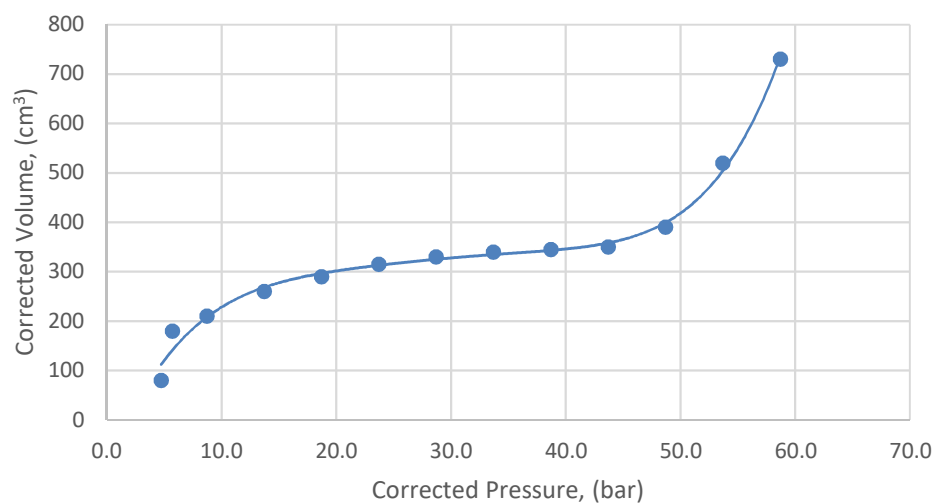


K.C.T Consultancy Services LLP			
Pressure meter Test - 06			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-21.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	80	4.7	80
2	180	5.7	180
5	210	8.7	210
10	260	13.7	260
15	290	18.7	290
20	315	23.7	315
25	330	28.7	330
30	340	33.7	340
35	345	38.7	345
40	350	43.7	350
45	390	48.7	390
50	520	53.7	520
55	730	58.7	730

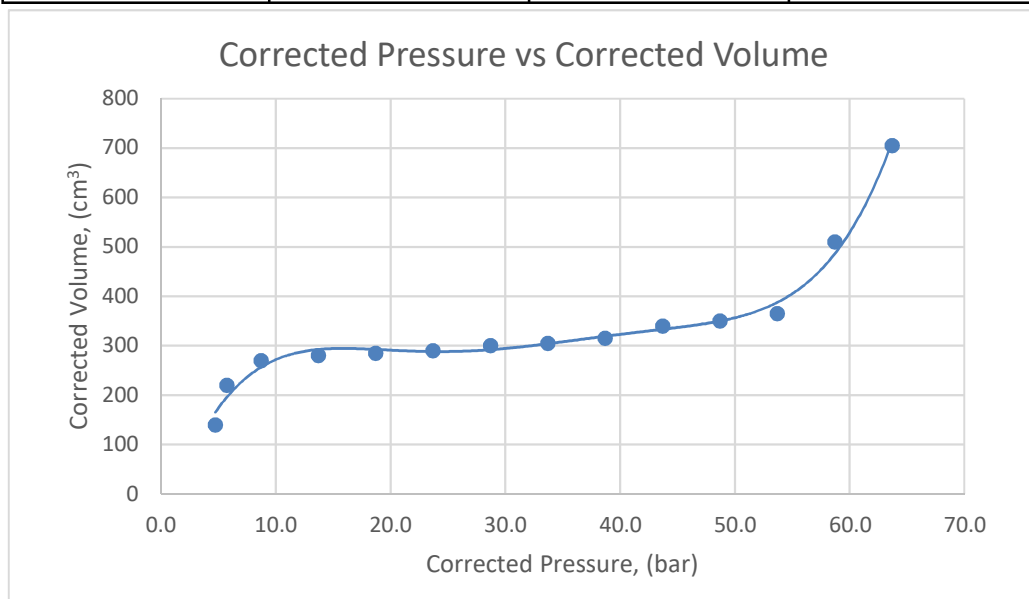


K.C.T Consultancy Services LLP			
Pressure meter Test - 06			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-24.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
	60 sec		60 sec
bar	cc	bar	cc
1	80	4.7	80
2	180	5.7	180
5	210	8.7	210
10	260	13.7	260
15	290	18.7	290
20	315	23.7	315
25	330	28.7	330
30	340	33.7	340
35	345	38.7	345
40	350	43.7	350
45	390	48.7	390
50	520	53.7	520
55	730	58.7	730

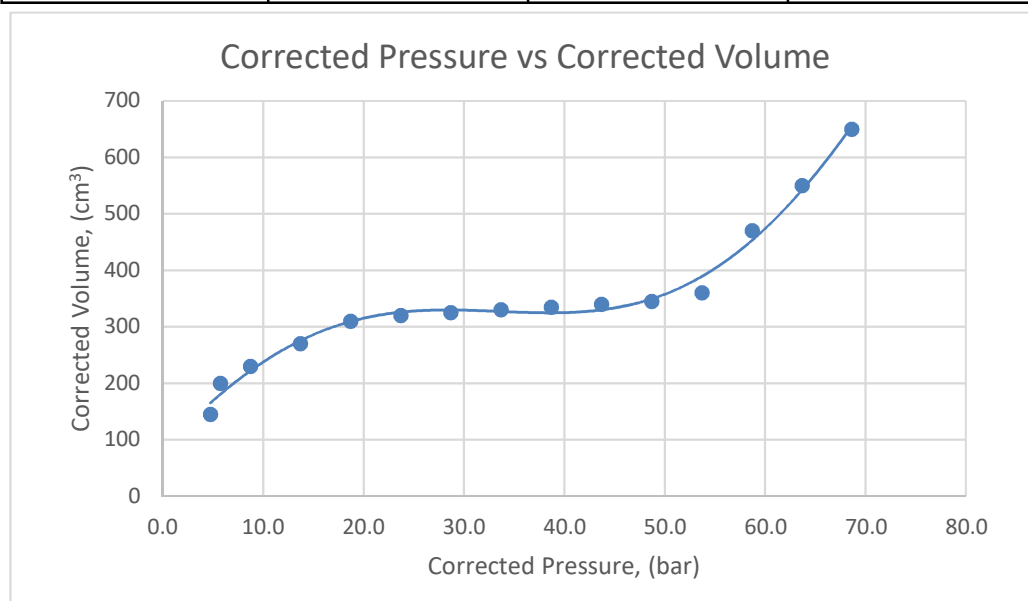
Corrected Pressure vs Corrected Volume



K.C.T Consultancy Services LLP			
Pressure meter Test - 06			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :- 27.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
bar	60 sec cc	bar	60 sec cc
1	140	4.7	140
2	220	5.7	220
5	270	8.7	270
10	280	13.7	280
15	285	18.7	285
20	290	23.7	290
25	300	28.7	300
30	305	33.7	305
35	315	38.7	315
40	340	43.7	340
45	350	48.7	350
50	365	53.7	365
55	510	58.7	510
60	705	63.7	705



K.C.T Consultancy Services LLP			
Pressure meter Test - 06			
Name of Project :- NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha			
Depth of Test :-30.00m			
Pressure observed	Observed Volume	Corrected Pressure	Final Volume
bar	60 sec cc	bar	60 sec cc
1	145	4.7	145
2	200	5.7	200
5	230	8.7	230
10	270	13.7	270
15	310	18.7	310
20	320	23.7	320
25	325	28.7	325
30	330	33.7	330
35	335	38.7	335
40	340	43.7	340
45	345	48.7	345
50	360	53.7	360
55	470	58.7	470
60	550	63.7	550
65	650	68.6	650



13. Percolation Test:

13.1 Field Investigation

Percolation Test was conducted as described below following the procedure as described in clause no. 13.2.2 of SP 35 – “Hand book on water supply and drainage was followed for the test”.

The bottom and sides of bore hole were carefully scratched in order to remove any smeared soil surface and thus to provide the natural soil interface in to which water may percolate. All loose material was removed. Water was poured in the borehole. Then, from a fix reference point, the drop was noted over a 30 minute period, this drop was used to calculate the percolation rate using the expression

$Q = 204 / t^{0.5}$ in L / m².day, where t = time in minutes required for water to fall 25 mm

13.2 Recommendations:

Based on investigations, the results were obtained. The findings are based on interpretation of results, analysis and computations as per relevant Indian standards.

Rate of percolation

Sr. No.	Drop in level in mm within last 30 minutes	Percolation Rate as per clause no. 6.13.2.2 of SP : 35, 1987	Max. rate of effluent application for std percolation rate
1	70	10.71 min / 25 mm	62.32 lit / sqmt day
2	78	9.62 min / 25 mm	65.79 lit / sqmt day

Observations of Percolation Test					
Pecolation Test No. 1					
Location: NTPP Hirma					
Co-ordinates: E 1929, N 2872					
Size of Pit: 300*300*300mm					
RL of EGL: 202.09m RL of Test Level:201.09m					
Date of test: 18-03-2025					
Depth of location: Conducted in pit of PLT-1 at 1.00m depth					
Sr. No.	Time Interval (minutes)	Drop in water level in mm	Drop in level in mm within last 30 minutes	Percolation Rate as per clause no. 6.13.2.2 of SP : 35, 1987	Max. rate of effluent application for std percolation rate
1	30	150	70	10.71 min / 25 mm	62.32 lit / sqmt day
2	60	300			
3	90	421			
4	120	513			
5	150	602			
6	180	683			
7	210	755			
8	240	825			
Type of Soil :- Reddish brown fine to medium grained clay with gravel and moorum					
Observations of Percolation Test					
Pecolation Test No. 2					
Location: NTPP Hirma					
Co-ordinates: E 892, N 1119					
Size of Pit: 300*300*300mm					
RL of EGL: 196.20m RL of Test Level:195.20m					
Date of test: 21-03-2025					
Depth of location: Conducted in pit of PLT-2 at 1.00m depth					
Sr. No.	Time Interval (minutes)	Drop in water level in mm	Drop in level in mm within last 30 minutes	Percolation Rate as per clause no. 6.13.2.2 of SP : 35, 1987	Max. rate of effluent application for std percolation rate
1	30	150	78	9.62 min / 25 mm	65.79 lit / sqmt day
2	60	300			
3	90	450			
4	120	591			
5	150	700			
6	180	785			
7	210	866			
8	240	944			
Type of Soil :- Fine grained silty sand					

14. Pump out type permeability Test:

Co-Ordinates: N 3000, E 1400 Location: Tranformer yard

14.1 Procedure:

The installation for pumping out test consists of fully or partially penetrating well and suitable number of piezometers arranged on 3 tiers preferably 120° to each other. A 400 mm bore hole should be drilled by using direct or reverse circulation methods of drilling (based on prevailing geo-hydrological conditions) extending to the bottom of the test section. Where the total saturated thickness of the aquifer is very large and drilling the hole to bottom of the aquifer is expensive, partially penetrating well may be used. The impervious boundary or bed rock should be ascertained by drilling.

The well consists of 250 mm dia GI pipe having maximum number of holes over the portion below the water table and having wire mesh fixed around this portion of the pipe. The aperture of the wire mesh shall depend upon the grading of the surrounding aquifer and should be taken as the diameter of 60 percent finer material. A conical shoe at the bottom and a blind pipe on the top, from water table to ground surface are provided. A 75 mm thick coarse sand and gravel filter should be placed all-round the screen to a height approximately 3 m above the top of the screen. During development of the well, there is a possibility of more intake of coarse sand due to large quantities of finer sands being pumped out. The shrouding should be continued till the well yields sand free water.

For carrying out the test, the well should be first pumped up to the depth for which the overall permeability is to be determined. The pump should be run at a constant rate of discharge continuously till the pumped well attains equilibrium conditions in the piezometer surface. This period varies from 10 h to 100 h depending upon the aquifer conditions, its thickness, permeability and slope. The observation in piezometers should be taken at suitable intervals of time. In the initial stages, say for the first 15 min, the observations may be taken at 30 s interval; for the next 30 min at 1 min interval; for the next 30 min at 2 min interval and for the next 2 h at 5 min interval. After this it may be increased to hourly and then to 5 hourly and 10 hourly intervals till equilibrium conditions are achieved. These intervals are only arbitrary and may be changed to suit the site conditions.

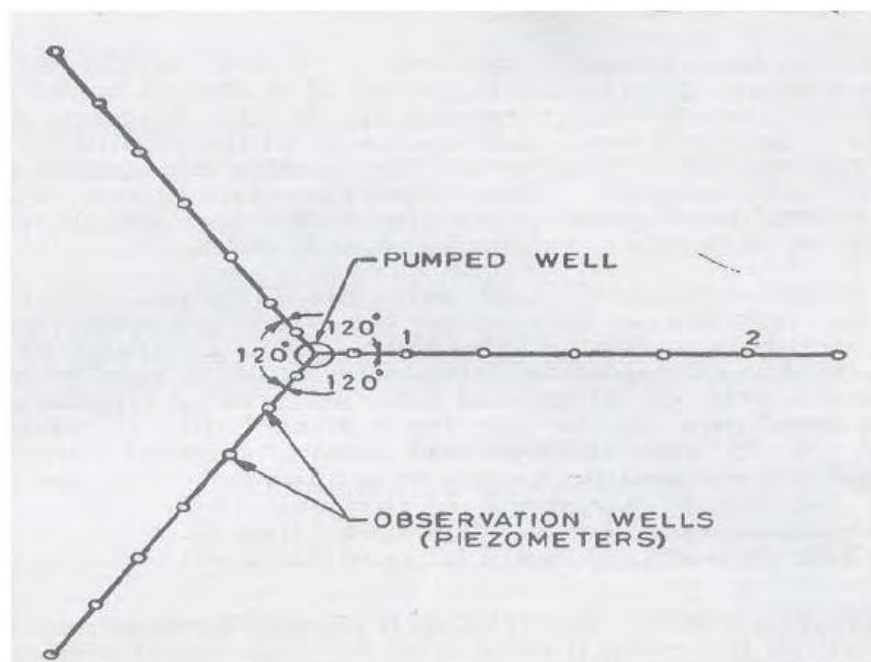


Figure 1 Plan show arrangement of pumping well and piezometers for pumping

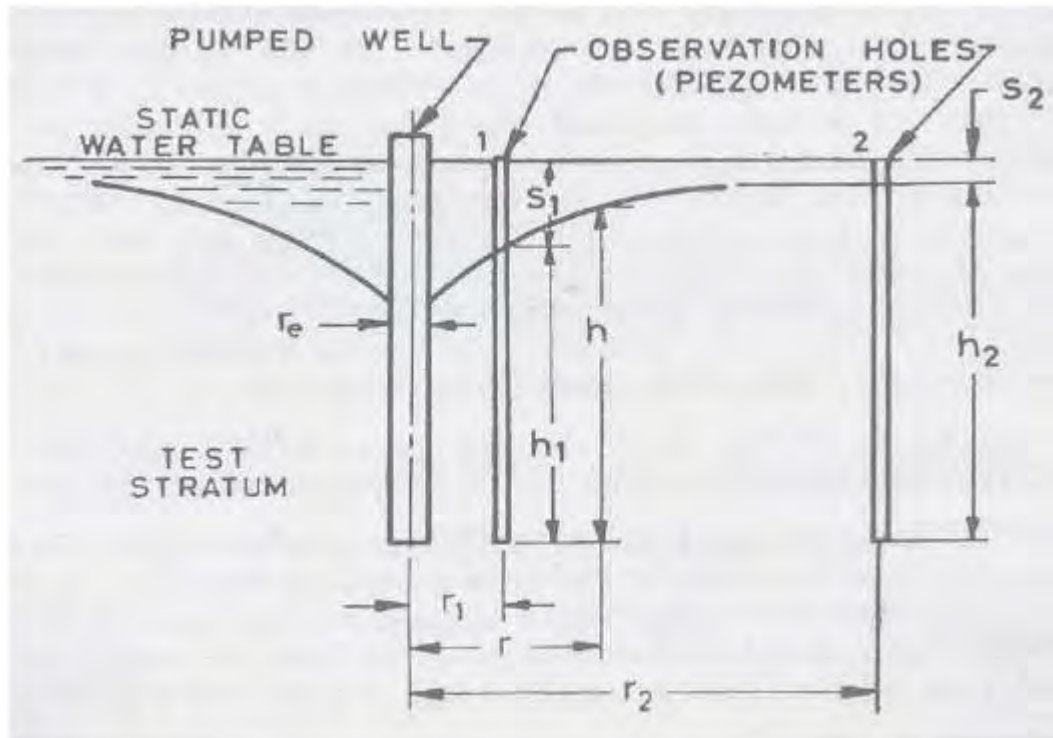


Figure 2 Typical arrangement for Pumping out test

14.3 Calculation of Coefficient of permeability:

$$k = \frac{2.30 q \log_{10} \left(\frac{r^2}{r_1^2} \right)}{2 \pi b (Z_2 - Z_1)}$$

Where,

r_1 = Radial distance of first well

r_2 = Radial distance of second well

z_1 = height of water level in observation well 1 at a radial distance r_1

z_2 = height of water level in observation well 2 at a radial distance r_2

b = Thickness of confined aquifer

q = discharge

$$k = \frac{2.30 * 8.06 * 10^{-4} * \log_{10} \left(\frac{6.0}{3.0} \right)}{2 \pi * 10.0 * (7.20 - 5.50)}$$

$$k = 1.20 \times 10^{-5} \text{ mm/sec}$$