

**TELANGANA STATE GENERATION
CORPORATION LIMITED (TSGENCO)**

**1x800 MW KOTHAGUDEM THERMAL POWER STATION
STAGE-VII, UNIT#12**

**CONSULTANT: DEVELOPMENT CONSULTANTS
PRIVATE LIMITED**

GEOTECHNICAL INVESTIGATION REPORT

DOCUMENT NO. PE-DC-410-602-C001



**BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT
NOIDA-201301**

Job No: 3421

**REPORT ON
GEOTECHNICAL INVESTIGATION WORK FOR
1 x 800MW KOTHAGUDAM THERMAL POWER STATION
STAGE VII, UNIT-12 AT KHAMMAM DISTRICT,
TELANGANA STATE**

**VOLUME 1
(Main Report with Conclusions)**

Client:

**M M/s. Bharat Heavy Electricals Limited
Power Sector – Southern Region
690, Annasalai, Nandanam, Chennai - 600035**

Foundation Consultants:

C. E. Testing Company Pvt. Limited
An ISO 9001, 14001& OHSAS 18001 Certified Company
NABL Accredited Laboratory
124A, N.S.C. Bose Road : Kolkata - 700 092
Phones: 2428-6221/6222/6223 Fax: (033) 2428-6220
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**April – 2015
(Revised in May'2015)**

REPORT ON

GEOTECHNICAL INVESTIGATION WORK FOR

1 x 800MW KOTHAGUDAM THERMAL POWER STATION

STAGE VII, UNIT-12 AT KHAMMAM DISTRICT,

TELANGANA STATE

1. INTRODUCTION

The **Telangana State Generation Corporation Limited** has proposed 1 x 800MW Kothagudam Thermal Power Station, Stage – VII, Unit - 12 & the job was awarded to **M/s. Bharat Heavy Electricals Limited**. For designing of Foundation Structures coming under this project, it was necessary to conduct a Detailed Geotechnical Investigation Work and **M/s Bharat Heavy Electricals Limited**, in turn awarded the job to **M/s. C. E. Testing Company Pvt. Ltd., Kolkata**.

The scope of the work comprised of sinking 68 nos. bore holes. The scope also includes PLT (Plate Load Tests – 5Nos.), CPLT (Cyclic Plate Load Tests – 5Nos.), TP (Trial Pit – 10Nos.), ERT (Electrical Resistivity Tests – 20Nos.), CST (Cross Hole Shear Tests – 4Nos.), PMT (Pressure meter Test – 3Nos.), BVT (Block Vibration Test – 2Nos.), SCPT (Static Cone Penetration Tests – 5Nos.), DCPT (Dynamic Cone Penetration Tests – 10Nos.), Field Permeability – 2Nos., Field CBR – 4Nos.

The boreholes of 150 mm diameter were advanced by Shell and Auger/rotary mud circulation method in soil. In rock, rotary core drilling of “NX” size was adopted. The scope also included conducting Standard Penetration Tests, collecting disturbed samples at regular intervals for identification and logging purposes, collecting undisturbed tube samples at suitable intervals or at change of strata whichever is earlier and testing these in the laboratory.

Based on the above, this report presents the Bore Logs, Soil Profile, laboratory and field Test Results. On the basis of field tests and laboratory test results and their analysis thereof, the most suitable type of foundation is suggested. The field profile is sometimes changed in the light of laboratory test results.

The subsoil is characterised by stiff to very stiff clayey silt / silty clay followed by a layer of

Project: Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.

Job No. : 3421**Sheet No.**

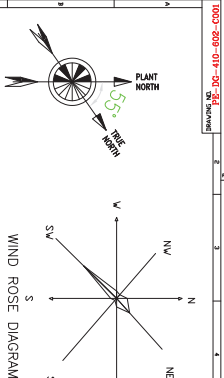
hard clayey silt / silty clay or very dense silty sand layer. After that weathered rock layer was struck and continues upto the terminating depth of all the boreholes.

Considering the nature of the subsoil as revealed from field tests, shallow foundation is recommended. However, this is discussed in details later.

The Geotechnical report has been divided into two parts (volumes). The first volume deals with subsoil condition and foundation recommendations, the second volume contains the borelog data sheets, field and laboratory test results.

- **Volume – 1:– Main Report with Recommendations.**
- **Volume – 2:– Borelogs, Field & Laboratory Test Results.**

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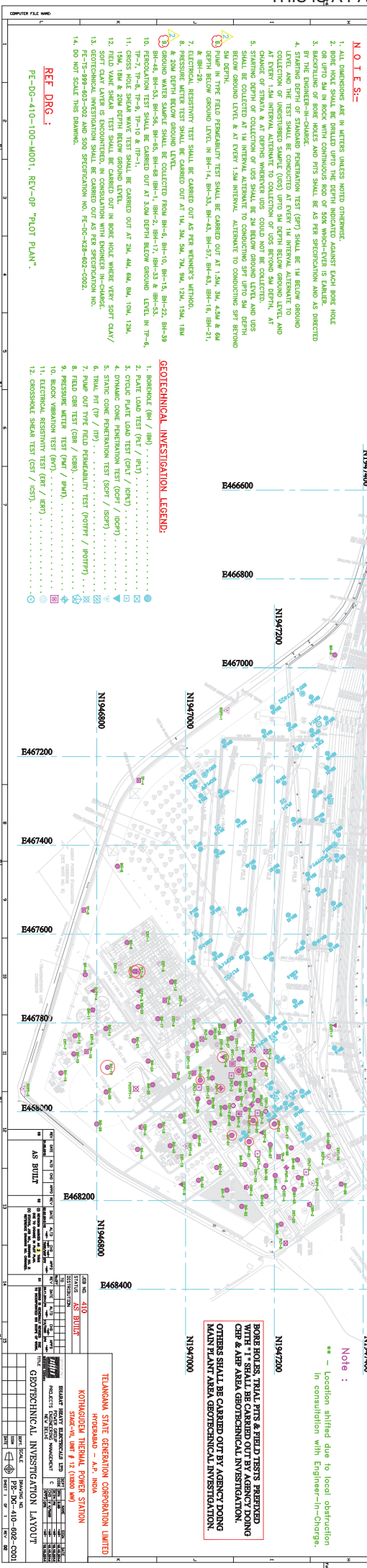
MARKING	DESCRIPTION	SCOPE
1	PLATE LOAD TEST (PLT)	PLT-1
2	CROSSHOLE SHEAR TEST (CHS)	CHS-1
3	ELECTRIC RESISTIVITY TEST (ERT)	ERT-1
4	BORE HOLE TEST (BHT)	BHT-1
5	FIELD CBR TEST (FCR)	FCR-1
6	PLATE LOAD TEST (PLT)	PLT-2
7	CROSSHOLE SHEAR TEST (CHS)	CHS-2
8	ELECTRIC RESISTIVITY TEST (ERT)	ERT-2
9	BORE HOLE TEST (BHT)	BHT-2
10	FIELD CBR TEST (FCR)	FCR-2
11	PLATE LOAD TEST (PLT)	PLT-3
12	CROSSHOLE SHEAR TEST (CHS)	CHS-3
13	ELECTRIC RESISTIVITY TEST (ERT)	ERT-3
14	BORE HOLE TEST (BHT)	BHT-3
15	FIELD CBR TEST (FCR)	FCR-3
16	PLATE LOAD TEST (PLT)	PLT-4
17	CROSSHOLE SHEAR TEST (CHS)	CHS-4
18	ELECTRIC RESISTIVITY TEST (ERT)	ERT-4
19	BORE HOLE TEST (BHT)	BHT-4
20	FIELD CBR TEST (FCR)	FCR-4
21	PLATE LOAD TEST (PLT)	PLT-5
22	CROSSHOLE SHEAR TEST (CHS)	CHS-5
23	ELECTRIC RESISTIVITY TEST (ERT)	ERT-5
24	BORE HOLE TEST (BHT)	BHT-5
25	FIELD CBR TEST (FCR)	FCR-5
26	PLATE LOAD TEST (PLT)	PLT-6
27	CROSSHOLE SHEAR TEST (CHS)	CHS-6
28	ELECTRIC RESISTIVITY TEST (ERT)	ERT-6
29	BORE HOLE TEST (BHT)	BHT-6
30	FIELD CBR TEST (FCR)	FCR-6
31	PLATE LOAD TEST (PLT)	PLT-7
32	CROSSHOLE SHEAR TEST (CHS)	CHS-7
33	ELECTRIC RESISTIVITY TEST (ERT)	ERT-7
34	BORE HOLE TEST (BHT)	BHT-7
35	FIELD CBR TEST (FCR)	FCR-7
36	PLATE LOAD TEST (PLT)	PLT-8
37	CROSSHOLE SHEAR TEST (CHS)	CHS-8
38	ELECTRIC RESISTIVITY TEST (ERT)	ERT-8
39	BORE HOLE TEST (BHT)	BHT-8
40	FIELD CBR TEST (FCR)	FCR-8
41	PLATE LOAD TEST (PLT)	PLT-9
42	CROSSHOLE SHEAR TEST (CHS)	CHS-9
43	ELECTRIC RESISTIVITY TEST (ERT)	ERT-9
44	BORE HOLE TEST (BHT)	BHT-9
45	FIELD CBR TEST (FCR)	FCR-9
46	PLATE LOAD TEST (PLT)	PLT-10
47	CROSSHOLE SHEAR TEST (CHS)	CHS-10
48	ELECTRIC RESISTIVITY TEST (ERT)	ERT-10
49	BORE HOLE TEST (BHT)	BHT-10
50	FIELD CBR TEST (FCR)	FCR-10

NOTE:-

1. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
2. BORE HOLE SHALL BE DRILLED UP TO THE DEPTH INDICATED AGAINST EACH BORE HOLE ON UP TO 5M IN ROCK WITH CONTINUOUS ROD OF 50% WHICH-EVER IS EQUAL.
3. BY THE ENGINEER-IN-CHARGE.
4. STARTING DEPTH OF STANDARD PENETRATION TEST (SPT) SHALL BE 1M BELOW GROUND LEVEL AND THE TEST SHALL BE CONDUCTED AT EVERY 1M INTERVAL ALTERNATE TO COLLECTION OF UNDISTURBED SAMPLE (UDS) UP TO 5M DEPTH BELOW GROUND LEVEL.
5. STARTING DEPTH OF COLLECTION OF UDS SHALL BE 2M BELOW GROUND LEVEL AND UDS SHALL BE COLLECTED AT 1M INTERVAL ALTERNATE TO CONDUCTING SPT UP TO 5M DEPTH BELOW GROUND LEVEL. & AT EVERY 1.5M INTERVAL ALTERNATE TO CONDUCTING SPT BEYOND 5M DEPTH.
6. PUMP IN THE FIELD PERMEABILITY TEST SHALL BE CARRIED OUT AT 1.5M, 3M, 4.5M & 6M DEPTH BELOW GROUND LEVEL. IN BH-14, BH-15, BH-33, BH-43, BH-53, BH-16, BH-21, & BH-24.
7. PRESSURE METER TEST SHALL BE CARRIED OUT AT 1M, 2M, 3M, 4M, 5M, 6M, 7M, 8M, 9M, 10M, 11M, 12M, 13M, 14M, 15M, 16M, 17M, 18M, 19M, 20M, 21M, 22M, 23M, 24M, 25M, 26M, 27M, 28M, 29M, 30M, 31M, 32M, 33M, 34M, 35M, 36M, 37M, 38M, 39M, 40M, 41M, 42M, 43M, 44M, 45M, 46M, 47M, 48M, 49M, 50M.
8. PRESSURE METER TEST SHALL BE CARRIED OUT AT 1M, 2M, 3M, 4M, 5M, 6M, 7M, 8M, 9M, 10M, 11M, 12M, 13M, 14M, 15M, 16M, 17M, 18M, 19M, 20M, 21M, 22M, 23M, 24M, 25M, 26M, 27M, 28M, 29M, 30M, 31M, 32M, 33M, 34M, 35M, 36M, 37M, 38M, 39M, 40M, 41M, 42M, 43M, 44M, 45M, 46M, 47M, 48M, 49M, 50M.
9. GROUND WATER SAMPLE SHALL BE COLLECTED FROM BH-5, BH-10, BH-15, BH-22, BH-38, BH-43, BH-53, BH-16, BH-21, & BH-24.
10. PERCOLATION TEST SHALL BE CARRIED OUT AT 3.0M DEPTH BELOW GROUND LEVEL. IN TP-4, TP-7, TP-8, TP-9, TP-10 & TP-11.
11. CROSS HOLE SHEAR TEST SHALL BE CARRIED OUT AT 2M, 4M, 6M, 8M, 10M, 12M, 14M, 16M, 18M, 20M, 22M, 24M, 26M, 28M, 30M, 32M, 34M, 36M, 38M, 40M, 42M, 44M, 46M, 48M, 50M.
12. PLATE LOAD TEST SHALL BE CARRIED OUT AT 2M, 4M, 6M, 8M, 10M, 12M, 14M, 16M, 18M, 20M, 22M, 24M, 26M, 28M, 30M, 32M, 34M, 36M, 38M, 40M, 42M, 44M, 46M, 48M, 50M.
13. GEOTECHNICAL INVESTIGATION SHALL BE CARRIED OUT BY THE ENGINEER-IN-CHARGE.
14. DO NOT SCALE THIS DRAWING.

REF. DRG.:

PE-DO-410-100-M001, REV-0P "PILOT PLAN".



GEOTECHNICAL INVESTIGATION LEGEND:

1. BOREHOLE (BH / BH)
2. PLATE LOAD TEST (PLT / PLT)
3. CROSS HOLE SHEAR TEST (CHS / CHS)
4. DYNAMIC CONE PENETRATION TEST (DCPT / DCPT)
5. STATIC CONE PENETRATION TEST (SCPT / SCPT)
6. TRIAXIAL TEST (TP / TP)
7. PUMP OUT THE FIELD PERMEABILITY TEST (PROPT / PROPT)
8. PRESSURE METER TEST (PMT / PMT)
9. FIELD CBR TEST (FCR / FCR)
10. ELECTRIC RESISTIVITY TEST (ERT / ERT)
11. ELECTRIC RESISTIVITY TEST (ERT / ERT)
12. CROSSHOLE SHEAR TEST (CHS / CHS)

MARKING	DESCRIPTION	SCOPE
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TELANGANA STATE GENERATION CORPORATION LIMITED
KOTHAAGODI THERMAL POWER STATION
PROJECT NO. KOTHAAGODI THERMAL POWER STATION
GEOTECHNICAL INVESTIGATION LAYOUT
SCALE: 1:1000
DATE: 10/05/2021
BY: [Signature]
CHECKED: [Signature]
APPROVED: [Signature]

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2. FIELD INVESTIGATION

2.1. GENERAL:

In an attempt for finalisation in the design of foundation for these proposed structures to be constructed at this site, Geotechnical Investigation was envisaged. The entire Investigation programme had been divided mainly into two parts, I) Field works & II) Laboratory tests.

- I) Field works unfold the sub-surface deposit types and their characteristics and
- II) Laboratory tests part would help determining the relevant physical and geotechnical properties of the sub-surface deposits leading to finalisation of foundation depths of the structures and the bearing capacity with particular reference to the sub-surface types and their strength parameters and settlement potentials at the site.

A list of the bore holes with the reduced level and standing water level are presented in a tabular form below:

Name of Structure	Bore Hole No.	Co-ordinate, (M)		G.L. (M)	Terminating Depth (m)	Standing Water Level (m)	Depth of Top of Rock (m)
		Easting	Northing				
Raw Water Storage Reservoir	BH-01	466078	1948555	96.729	15	4.10	2.70
	BH-02	466214	1948533	95.001	15	3.80	2.50
	BH-03	466124	1948465	97.230	15	3.70	2.90
	BH-04	466077	1948318	101.437	15	2.90	2.70
Watch Tower	BH-05	466971	1947336	111.035	15	3.90	2.50
	BH-06	467447	1946847	104.525	15	2.50	4.00
Proposed Area for Outdoor Storage	BH-07	468177	1947093	99.471	20	1.40	3.80
Thickener	BH-08	467691	1946774	104.524	15	2.70	3.90
400 KV Switch Yard & Switch Yard Control Room	BH-09	467619	1946868	103.827	20	2.40	4.20
	BH-10	467684	1946885	103.259	20	2.90	4.00
Clarifiers	BH-11	467771	1946791	103.090	20	2.80	3.60
Chemical House	BH-12	467829	1946751	102.188	15	2.40	3.90
400 KV Switch Yard & Switch Yard Control Room	BH-13	467708	1946969	102.072	25	3.20	4.20
Clarified Water Tank	BH-14	467813	1946821	101.792	20	2.80	1.60
Centralised Sewage Treatment System	BH-15	467870	1946749	101.976	20	3.00	2.80
C.M.B. Waster Treatment System	BH-16	467913	1946720	103.490	15	3.00	3.00
400 KV Switch Yard & Switch Yard Control Room	BH-17	467790	1946938	102.037	20	3.10	4.40
Fire Water Storage Tank & Pump House	BH-18	468032	1946943	100.143	20	2.60	2.00
NDCT	BH-19	467900.081	1946824.434	100.967	25	3.60	4.18

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Name of Structure	Bore Hole No.	Co-ordinate, (M)		G.L. (M)	Terminating Depth (m)	Standing Water Level (m)	Depth of Top of Rock (m)
		Eastings	Northing				
400 KV Switch Yard & Switch Yard Control Room	BH-20	467764	1946893	103.078	20	3.00	4.20
CW Treatment Area	BH-21	467840	1946884	101.298	15	2.60	3.00
Transformer Yard	BH-22	467822	1947058	98.965	20	1.80	3.00
	BH-23	467851	1947016	100.226	20	2.70	3.10
Side Stream Filtration Area	BH-24	467886	1946916	100.45	20	2.70	2.60
NDCT	BH-25	467956	1946821	101.631	30	4.40	4.99
	BH-26	468028	1946800	102.499	25	5.50	4.00
Transformer Yard	BH-27	467835	1947104	98.786	20	1.30	3.00
	BH-28	467807	1947085	98.868	20	2.30	3.00
Cooling water Pump House	BH-29	467939	1946926	99.959	20	2.00	4.00
Power house building including electrical bay	BH-30	467881	1947121	98.421	20	1.10	2.50
	BH-31	467924	1947060	98.192	20	1.90	4.00
ESP	BH-32	468067.299	1947143.217	97.997	15	1.30	4.50
Power house building including electrical bay	BH-33	467907.679	1947119.916	98.288	20	1.40	2.60
	BH-34	467928.848	1947032.886	98.945	30	2.10	4.80
Service Building	BH-35	467971	1947027	99.034	20	2.25	4.00
CPU Regeneration Area	BH-36	468010	1946989	99.917	15	2.50	1.90
Power house building including electrical bay	BH-37	467894.003	1947174.015	99.003	20	1.90	3.50
	BH-38	467936	1947114	98.025	20	2.10	3.00
	BH-39	467980	1947053	98.578	20	2.80	3.50
Boiler & Mill-Bunker Bay Area	BH-40	467950	1947146	98.713	20	1.90	3.50
	BH-41	467970	1947118	98.162	20	1.30	4.30
	BH-42	467990	1947089	98.545	20	1.50	4.90
DM Plant	BH-43	468077	1946966	99.056	15	2.50	4.50
DG & Compressor House	BH-44	468025	1947065	98.856	20	2.40	4.40
Condensate Storage Tank & Pump House	BH-45	468056	1947021	99.500	20	2.30	4.50
Chemical Lab	BH-46	468085	1946892	101.858	20	2.40	2.55
Boiler & Mill-Bunker Bay Area	BH-47	467975	1947163	98.718	20	1.35	4.00
	BH-48	467995	1947135	97.977	20	0.60	4.80
	BH-49	468015	1947106	98.420	20	1.45	4.25
	BH-50	468019.860	1947152.171	97.758	25	1.40	4.00
	BH-51	468053.308	1947104.078	98.537	15	1.42	4.00
Proposed Area for Outdoor Storage	BH-52	468213	1947127	98.716	15	1.80	4.50
ESP	BH-53	468027.710	1947200.038	97.811	20	2.90	3.00

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Sheet No.

Name of Structure	Bore Hole No.	Co-ordinate, (M)		G.L. (M)	Terminating Depth (m)	Standing Water Level (m)	Depth of Top of Rock (m)
		Easting	Northing				
Canteen	BH-54	468126	1947070	100.112	20	1.40	4.30
Indoor Store	BH-55	468154	1947029	100.838	20	1.40	4.40
ESP Control Room	BH-56	468119	1947133	98.578	20	1.57	4.50
ESP	BH-57	468074	1947191	97.212	25	0.90	3.40
	BH-58	468122	1947181	97.738	20	2.40	4.30
HFO & LDO Storage Tank Dyke Area	BH-59	468079	1947322	99.198	20	2.70	3.45
ID Fan	BH-60	468108	1947252	97.332	20	1.80	4.50
	BH-61	468143	1947201	97.584	20	1.80	4.50
Chimney	BH-62	468147.467	1947259.15	96.743	30	1.30	4.40
	BH-63	468159	1947239	96.568	20	1.40	4.30
Near Fire Station	BH-64	468190	1947181	97.777	20	1.52	4.00
Administrative Building	BH-65	468253	1947215	97.751	20	1.30	3.00
ESP	BH-66	468081	1947238	97.324	20	0.80	3.50
Raw Water Pump House	BH-67	466223	1948367	99.214	15	3.50	4.50
HFO & LDO Unloading & Forwarding Pump House	BH-68	468163	1947350	97.452	20	1.60	3.75

2.2. BORING:

Boring was carried out by Shell and Auger / rotary mud circulation method to sink nominal 150mm diameter bore holes to depths envisaged by using a mechanical winch. Undisturbed soil samples were collected at suitable intervals or at change of strata whichever is earlier by open drive sampling method since it was intended to ascertain the sub-soil characteristics.

2.3. SAMPLING:

Nominal 100 mm diameter undisturbed samples were recovered. The sampling equipment used consists of a two-tier assembly of sample tubes 450 mm in length fitted at its lower end. The sampling assembly was driven by means of a jarring link to its full length or as far down as was found practicable. As the soil is very stiff to hard and contains sand mixtures / calcareous nodules, cutting shoe was used with a area ratio < 20%. After withdrawal the ends of the tubes were sealed with wax and capped before onward transmission to the laboratory. At close intervals in depth disturbed samples were collected for identification and logging purpose. These were tagged and packed in polythene packets and transported to the laboratory.

Project: Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.



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2.4. STANDARD PENETRATION TESTS:

Standard Penetration Tests were conducted in the bore holes at intervals of 1.5M to 3.0M depth or at change of strata whichever is earlier using a split spoon sampler. The split spoon sampler used is of a Standard design having an outer diameter of 50.8 mm and inner diameter of 35 mm, driven with a monkey weighing 63.5 kgs, falling freely through 75cms. A record of the number of blows required to penetrate every 7.5cms to a maximum depth of 45cms was made. The first 15cm of drive are considered to be seating drive and are neglected. The total blows required for third, forth, fifth & sixth 7.50cm of penetration is counted and termed as penetration resistance "N". On completion of a test, the split spoon sampler was opened and soil specimens were preserved in polythene bags for logging purpose.

All the boreholes were sunk with winch. However, raising of hammer for SP Tests were done manually. Hence there will not be any inertia loss and the efficiency of hammer blows should be considered as 100%.

2.5. MEASUREMENT OF WATER TABLE:

Standing water level after 24 hours of removal of casing was also noted and shown in the profile.

2.6. ROTARY CORE DRILLING:

This drilling technique is regarded as the most satisfactory method of assessing the character of rock formations, which lie at depth below the ground surface. Specimens of rock in the form of cylindrical cores are recovered from the drill holes by means of a core barrel. Double barrel technique is adopted according to field condition. The core barrel is provided at its lower end with a detachable shoe or core bit, which is of diamond. All rotary core bits were of NX (73mm) size.

2.7. TRIAL PITS:

10 nos. Trial Pits were excavated for physical verification of subsoil with depth. The co-ordinates of the Trial Pit locations are presented below.

Trial Pit No.	Co-ordinate (M)			Depth (M)	Standing Water Level (M)
	Easting	Northing	G.L.		
TP – 1	466214	1948420	95.734	4.00	3.60
TP – 2	466130	1948124	102.101	4.00	Not found
TP – 3	466578	1947475	113.413	4.00	Not found

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Trial Pit No.	Co-ordinate (M)			Depth (M)	Standing Water Level (M)
	Easting	Northing	G.L.		
TP – 4	467256.341	1946893.857	104.396	4.00	Not found
TP – 5	467546	1946771	105.071	4.00	Not found
TP – 6	467749	1946953	102.023	4.00	3.70
TP – 7	467913	1947019	99.155	4.00	2.80
TP – 8	467919	1946975	99.575	4.00	3.90
TP – 9	468101	1947210	97.154	4.00	2.60
TP – 10	467864	1946777	101.890	4.00	Not found

2.8. FIELD PERMEABILITY TEST:

20 Nos. Field Permeability Tests are conducted as per IS: 5529 (Part 1) in five (5) locations using falling head method. The test locations are presented below.

Test Locations	Co-ordinates (M)			Type of Test	Depth of Test (M)
	Easting	Northing	G.L.		
BH-14	467813	1946821	101.792	Falling Head	0.90 - 1.70
				Falling Head	2.70 - 3.50
				Falling Head	4.20 - 5.00
				Falling Head	5.70 - 6.50
BH-33	467907.679	1947119.916	98.288	Falling Head	1.30 - 2.00
				Falling Head	2.70 - 3.50
				Falling Head	4.30 - 5.00
				Falling Head	5.70 - 6.50
BH-43	468077	1946966	99.056	Falling Head	1.20 - 2.00
				Falling Head	2.80 - 3.50
				Falling Head	4.50 - 5.20
				Falling Head	5.70 - 6.50
BH-57	468074	1947191	97.212	Falling Head	1.20 - 2.00
				Falling Head	2.70 - 3.40
				Falling Head	4.20 - 5.00
				Falling Head	5.70 - 6.50
BH-63	468159	1947239	96.568	Falling Head	1.20 - 2.00
				Falling Head	2.70 - 3.40
				Falling Head	4.20 - 5.00
				Falling Head	5.70 - 6.50

2.9. PERCOLATION TESTS:

Percolation tests in the trial pits were conducted as per with IS : 2470 (Part-I), Appendix-A. Three (3) nos. Field Percolation Tests were conducted in three (3) trial pits. The test locations are presented below.

Percolation No.	Co-ordinate (M)			Depth (M)
	E	N	G.L.	
1 near TP-06	467749	1946953	102.023	4.00

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Percolation No.	Co-ordinate (M)			Depth (M)
	E	N	G.L.	
2 near TP-08	468101	1947210	97.154	4.00
3 near TP-10	467864	1946777	101.890	4.00

2.10. FIELD CBR TEST:

The tests were carried out in accordance with IS 2720 (Part 31): 1969 (and Amendment 1).

Apparatus used: Jacks, proving ring of capacity 500kg with a dial gauge to read to an accuracy of 0.002mm, metal penetration piston, extension rods, MS truss, connector, surcharge weight etc.

Test Procedure & Loading Arrangement: A pit was excavated of a suitable size upto the desired depth. A truss, used for providing reaction for loading was suitably anchored. The loading arrangement was made with sand bags. The sand bags were loaded on the truss suitably. The equipment used to provide load reaction was located at the centre of the truss against which the loading jack worked. The proving ring was connected to the bottom end of the jack and the piston connector to the bottom of the proving ring. Then the piston was connected using extension rods. The dial gauge was fitted suitably. It was ensured that the entire assembly was plumbed and the loading jack should be clamped in position. The surcharge weight of 10 kg was kept in position on the test surface. The penetration piston was seated with the smallest possible load. Then the load was applied on the penetration piston to penetrate approximately 1.25mm / minute. Then the load reading was recorded at penetration of 0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 4.0, 5.0, 7.5, 10.0 & 12.5mm. Then the set up was dismantled. In this manner the test was conducted in unsoaked & soaked condition.

Total 4nos. Field C.B.R. Test (soaked & unsoaked) was conducted. The co-ordinates of the test locations are presented below. The test results & curves are presented at the end of the report.

FCBR No.	Co-ordinate (M)			Depth (M)
	E	N	G.L.	
CBR-01	467796	1947121	99.119	0.50
CBR-02	468209	1947279	97.020	0.50
CBR-03	468170	1947137	99.242	0.50
CBR-04	468035	1946900	100.503	0.50

2.11. DYNAMIC CONE PENETRATION TEST:

Total 10 nos. Dynamic Cone Penetration Tests were conducted at the following locations.

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The co-ordinates at each DCPT locations are presented below. The DCPT values vs. depth plots are presented in Volume-2.

DCPT No.	Co-ordinate (M)		
	E	N	G.L.
1	466161	1947925	107.781
2	466324	1947564	112.748
3	466784	1947411	113.408
4	467728	1946791	104.109
5	467729	1946895	103.287
6	467877	1947084	98.638
7	467806	1947336	104.879
8	468047	1947172	97.680
9	468163	1946990	100.984
10	468114	1947462	100.554

2.12. STATIC CONE PENETRATION TEST (SCPT):

The test was carried out in 5 locations as per IS-4968 (Part-III) 1976. Among the field sounding tests, this test is the best for recording the in-situ variation of soil properties. The results are useful to determine the bearing capacity of shallow footings. It is most widely used to determine the frictional resistance of piles and also the required termination depth. Both cone and frictional resistance were measured at an interval of 200mm. The tests were carried out till the desired depth wherever possible otherwise till it struck refusal (i.e. the soft disintegrated rock). At site both cone resistance and frictional resistance are measured. In the Appendix, cone resistance, q_c , frictional resistance f_s and friction ratio f_r are shown for the five test locations. From a plot of ' f_r ' Vs ' q_c ', the attribute (it shows the granulometry of soil) at each point is determined. Based on the attribute and q_c the average profiles are drawn.

SCPT No.	Co-ordinate (M)			Depth of Test (M)
	Easting	Northing	G.L.	
SCPT-1	467096	1947094	98.925	3.60
SCPT-2	467948	1946634	104.263	3.70
SCPT-3	468077	1947001	99.230	2.60
SCPT-4	468102	1947321	97.463	3.40
SCPT-5	468161	1947285	97.459	3.00

2.13. PLATE LOAD TESTS:

Plate Load Tests were conducted using a **600mm** square plate. Test is continued upto a maximum desired loading intensity or specified plate settlement which ever is earlier. The load is applied through a hydraulic jack. The reaction for applying the load on the plate is obtained by a loading platform with sandbags. After applying the load increments, settlement

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records are made at intervals of 1, 2.25, 4, 6.25, 9, 16, 25 & 60 minutes and thereafter at an interval of an hour. When the rate of plate settlement reduced to 0.02 mm per minute, the final readings of the dial gauges is recorded. The coordinate of test locations are given below.

PLT No.	Type of Tests	Plate size (mm x mm)	Co-ordinates(M)		Ground Level (M)	Depth (M)
			E	N		
PLT-01	Routine Type	600 x 600	466245	1947743	111.742	3.00
PLT-02	Routine Type	600 x 600	467684	1946893.085	103.022	3.00
PLT-03	Routine Type	600 x 600	467836	1947037	99.370	3.00
PLT-04	Routine Type	600 x 600	467864	1947181	100.412	3.00
PLT-05	Routine Type	600 x 600	468212	1947206	97.520	3.00
CPLT-01	Cyclic Type	600 x 600	467945	1947030	98.902	3.00
CPLT-02	Cyclic Type	600 x 600	467919	1947103	99.385	3.00
CPLT-03	Cyclic Type	600 x 600	468003	1947162	98.239	3.00
CPLT-04	Cyclic Type	600 x 600	468095	1947162	98.012	3.00
CPLT-05	Cyclic Type	600 x 600	468136	1947271	97.209	3.00

2.14. ELECTRICAL RESISTIVITY TESTS:

Twenty (20) nos. Electrical Resistivity Tests were carried out at the following locations. The test procedure and results are presented under Section-8.

ERT No.	Co-ordinate (M)		G.L. in metre	ERT No.	Co-ordinate (M)		G.L. in metre
	E	N			E	N	
1	467598	1946905	102.784	11	467829	1947120	98.745
2	467668	1946852	104.138	12	467888	1947148	98.815
3	467666	1946940	102.035	13	467949	1947059	98.263
4	467749	1946997	100.641	14	467966	1947136	98.431
5	467790	1946982	100.842	15	468023	1947133	98.235
6	467826	1946800	101.800	16	468101	1946883	101.789
7	467838	1946738	102.234	17	468054	1947219	98.077
8	467793	1947029	101.357	18	468097	1947336	98.567
9	467849	1947071	98.968	19	468139	1947149	98.573
10	467868	1947005	100.280	20	468239	1947235	97.640

2.15. CROSS HOLE SHEAR TEST:

Four (4) nos. Cross Hole Shear Test were carried out to determine the dynamic properties of the layer for the construction of machine foundations at the following locations. The test procedure and results are presented and discussed under Section-9.

CHT No.	Co-ordinates (M)		Ground Level (M)
	E	N	
CST -1	467915	1947144	98.212

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CHT No.	Co-ordinates (M)		Ground Level (M)
	E	N	
CST -2	467986	1947107	96.443
CST -3	467999	1947180	98.379
CST -4	468171	1947221	98.379

2.16. PRESSURE METER TESTS:

Total 3nos. Pressure Meter Tests were conducted. The test procedure and results are presented in Section-10.

PMT No.	Co-ordinates (M)		Ground Level (M)
	E	N	
PMT - 1	467947.354	1947079.124	99.435
PMT - 2	467984	1947149	97.738
PMT - 3	468126	1947227	97.023

2.17. BLOCK VIBRATION TESTS:

Total 2nos. Block Vibration Tests were conducted. The test procedure and results are presented in Section-11.

BVT No.	Co-ordinates (M)		Ground Level (M)
	E	N	
BVT - 1	467892	1947105	3.00
BVT - 2	468004	1947120	3.00

3. LABORATORY TESTING

For proper identification and classification of the sub-soil deposits and for deriving adequate information regarding its relevant physical and geotechnical properties at the site under investigation, the following laboratory tests were conducted on the soil / rock samples collected from the exploratory bore holes:

On Soil Samples:

1. Grain size analysis (Sieve as well as Hydrometer).
2. Determination of Liquid Limit, Plastic Limit and Shrinkage Limit.
3. Determination of Natural Moisture Content.
4. Determination of Specific Gravity.
5. Determination of Bulk & Dry Unit Weight.
6. Strength determination by Triaxial Unconsolidated Undrained Test (UU).
7. Strength Determination of Unconfined Compression Test on "UDS" (UNCONFD).
8. Strength Determination of Unconfined Compression Test on REMOULDED samples.
9. Strength determination by Consolidated Undrained Test (CU).
10. One-dimensional Consolidation Test for determining settlement potentiality.
11. Determination of Free Swelling Index & Swelling Pressure.
12. Conducting Standard Compaction Test to determine Optimum Moisture Content (OMC) and Maximum Dry Density (MDD).
13. Conducting CBR test (soaked) on sample prepared at MDD.
14. Chemical tests on soil and water samples to determine pH value, Sulphate, Chloride content etc.

On Rock Samples:

1. Determination of Bulk Density, Water Content, Specific Gravity & Porosity of Rock.
2. Determination of Unconfined Compressive Strength of Rock samples (Saturated & In-situ State)
3. Determination of Point Load Strength Index.
4. Determination of Slake Durability Index of Rock.
5. Determination of Hardness & Soundness of Rock.
6. Determination of Deformability (Young's Modulus)

Laboratory test results are presented in a tabular form in Volume - 2. The results are self explanatory except that of consolidation tests. The compressibility for a pressure range has been separated into 2 components through the compression ratio. As a first step dial gauge reading is plotted against square root of time and by extrapolation dial reading at zero time, is obtained. The compression ratio is given as

$$r = (d_i - d_s) / (d_i - d_f), \text{ where}$$

d_i = Initial reading of dial before load application

d_s = Dial reading corresponding to theoretical zero time

d_f = Final dial reading after 24 hrs.

Now we write $m_{vc} = (1 - r) \times m_v$

All the tests were conducted as per relevant Indian Standard Specifications.

4. SUBSOIL CONDITION, STRATIFICATION AND PROPERTIES

4.1. SUB-SOIL CONDITIONS:

The boring records showing the various soils met with are enclosed in Volume-2. These are prepared from field logs after proper modifications in the light of the laboratory test results and observation of disturbed and penetrometer soil samples. The results of the Standard Penetration Tests are given as 'N' values in these boring records. The sub-soil profiles (as obtained from field and Laboratory test results) across the bore holes are shown under Figs. 2.01 to 2.36 giving description, consistency and colour of each strata. The "N" values are shown in the profiles as well as presented in the borelogs in Volume-2. The laboratory test results and the back up sheets are also presented there.

4.2. SUB-SOIL STRATIFICATIONS:

The subsoil is characterised by stiff to very stiff clayey silt / silty clay followed by a layer of hard clayey silt / silty clay or very dense silty sand layer. After that weathered rock layer was struck and continues upto the terminating depth of all the boreholes. The description of each layer is presented below.

4.2.1. TOPSOIL/FILL:

Topsoil consists of light brownish grey / grayish brown silty clay with calcareous nodules, brick particle, surkhi mixture.

4.2.2. STRATUM - I:

This layer is present only around BH-30 location and the soil in this layer consists of medium, dark grey silty clay. The properties of this layer are presented below.

Liquid limit %	41
Plastic Limit %	14

4.2.3. STRATUM - II:

The soil in this layer consists of stiff to very stiff, brownish grey to deep grey / grayish brown silty clay / clayey silt with sand mixture. Traces of calcareous nodules, kankar, gravel have also been observed in this layer. The average properties of this layer are presented below.

Bulk Density, gms/cc	1.93	Specific gravity	2.68
Dry Density, gms/cc	1.60	Void Ratio	0.651



FIG. 2.01 : GENERALISED SOIL PROFILE

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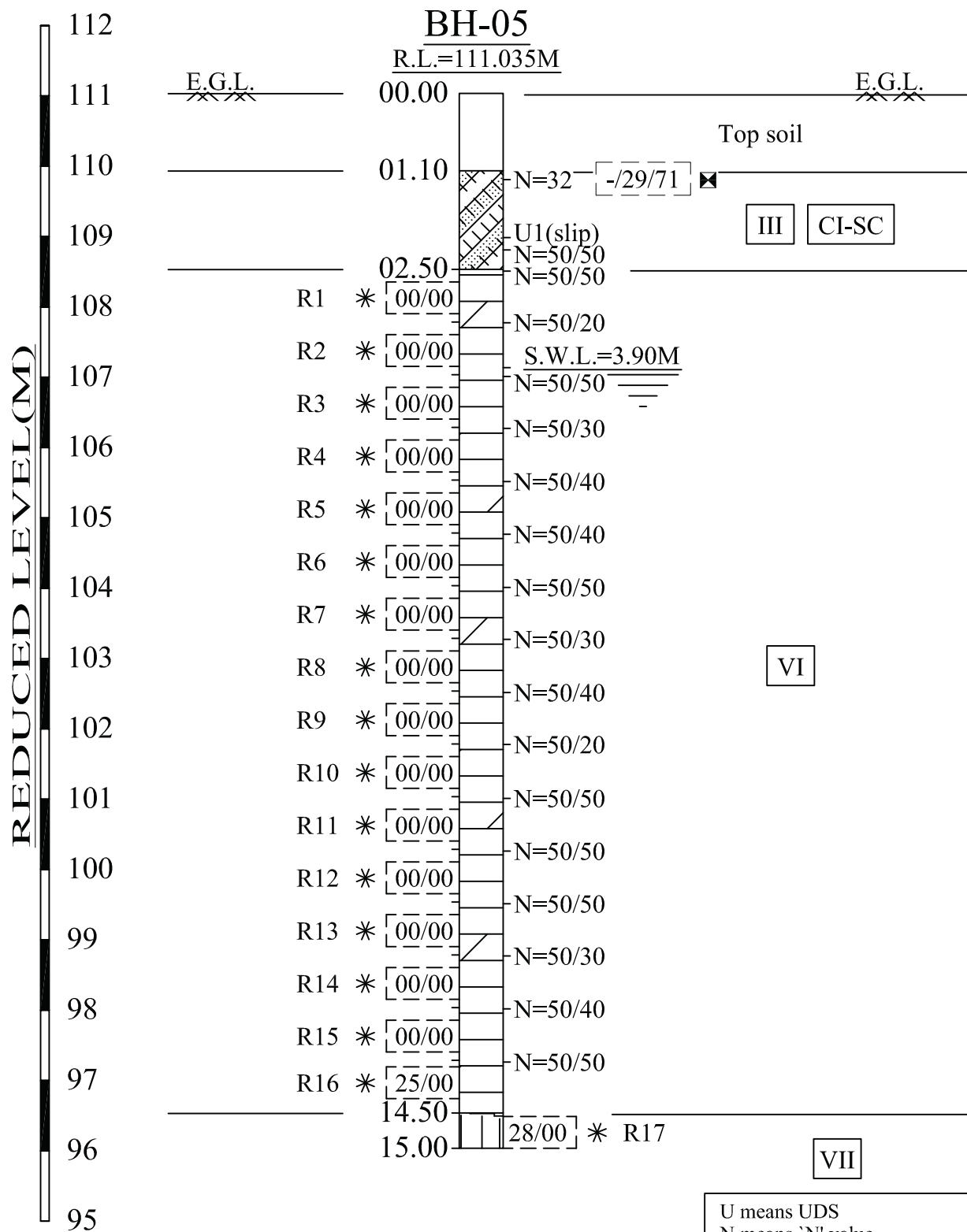
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Created on : 21 / 03 / 2015

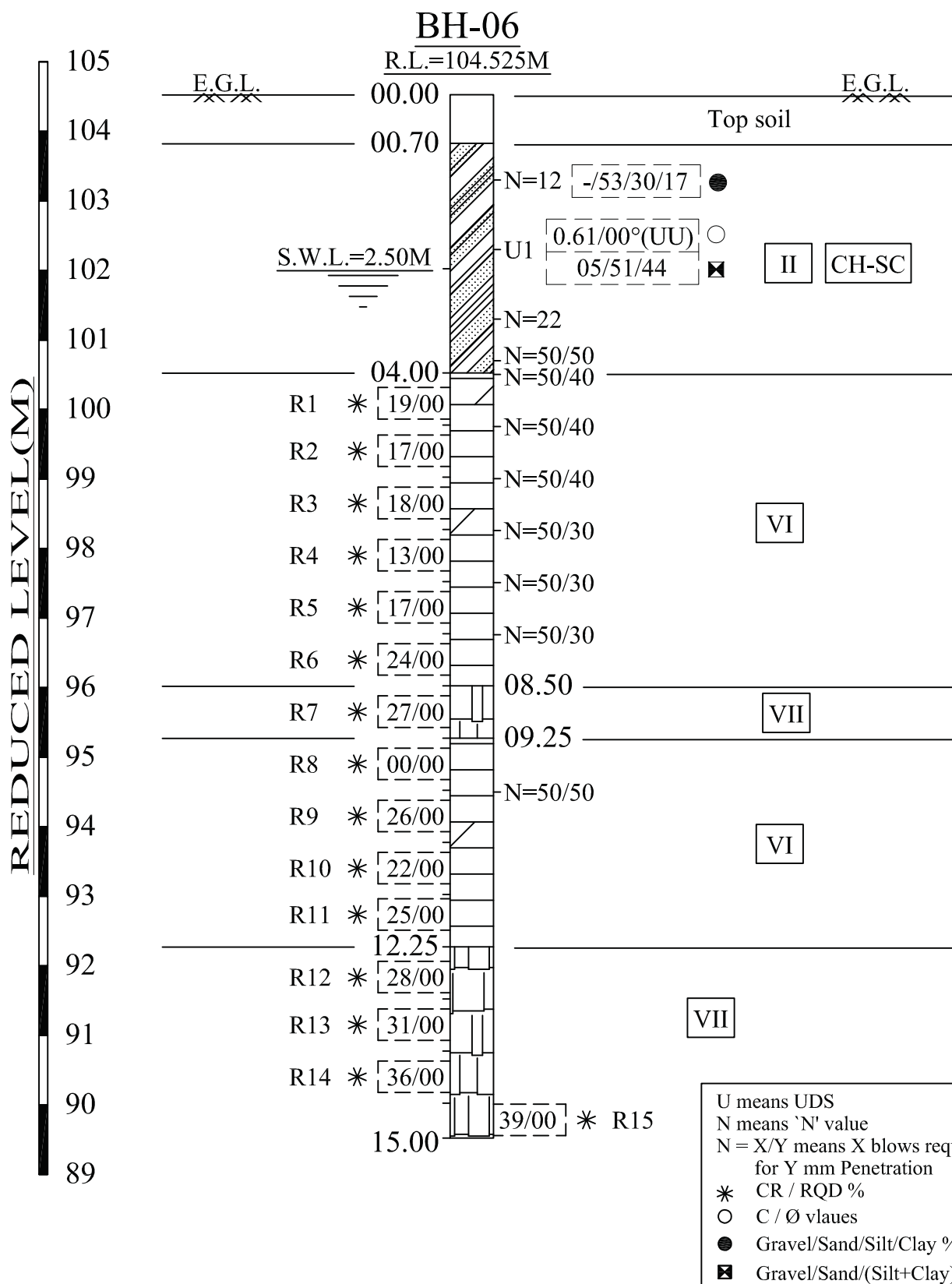
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(WATCH TOWER)

FIG. 2.02 : GENERALISED SOIL PROFILE

U means UDS
N means 'N' value
N = X/Y means X blows required
for Y mm Penetration
* CR / RQD %
Gravel/Sand/(Silt+Clay) %

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(WATCH TOWER)

FIG. 2.03 : GENERALISED SOIL PROFILE

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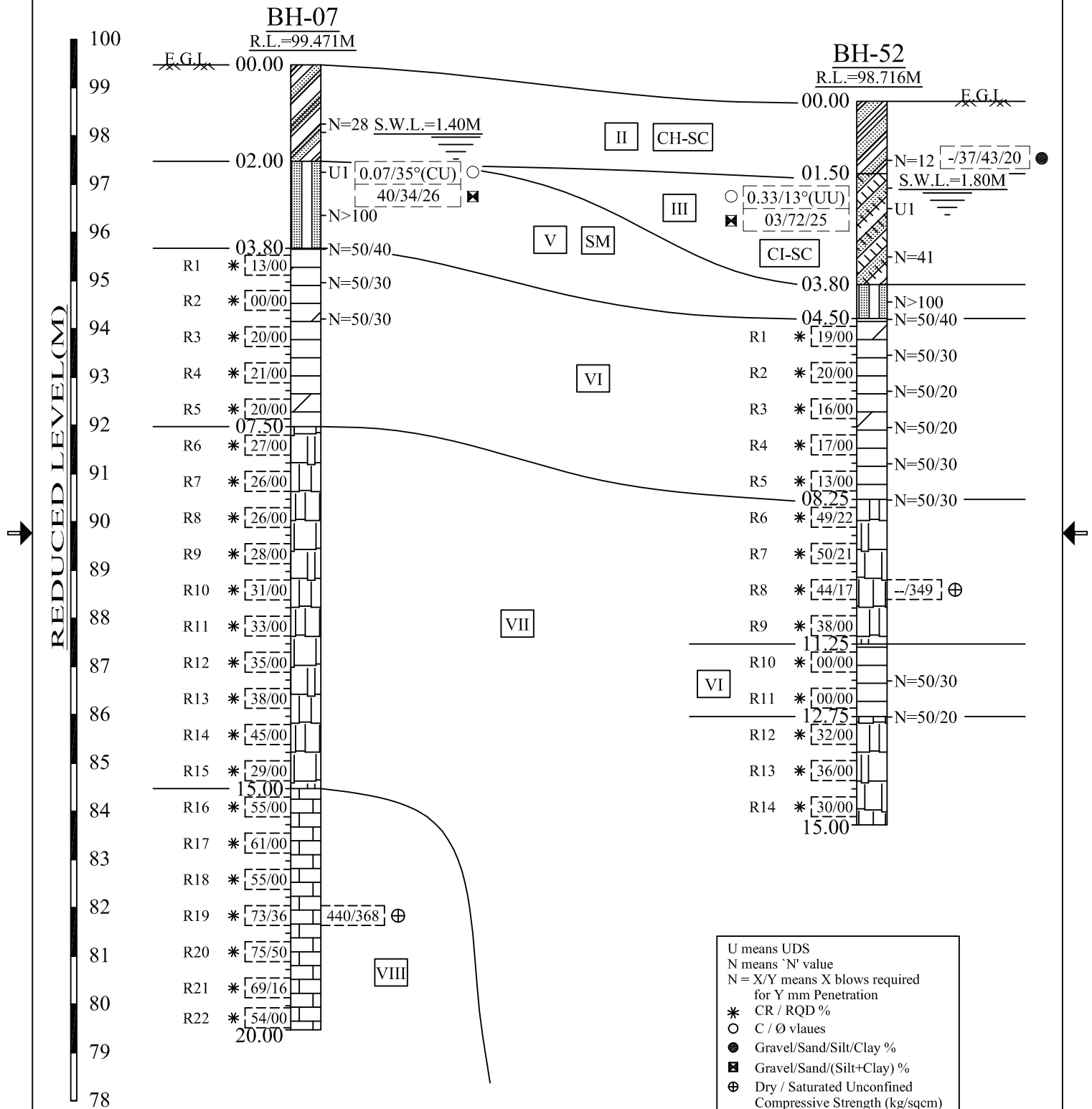
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(Proposed Area for Outdoor Storage)

FIG. 2.04 : GENERALISED SOIL PROFILE

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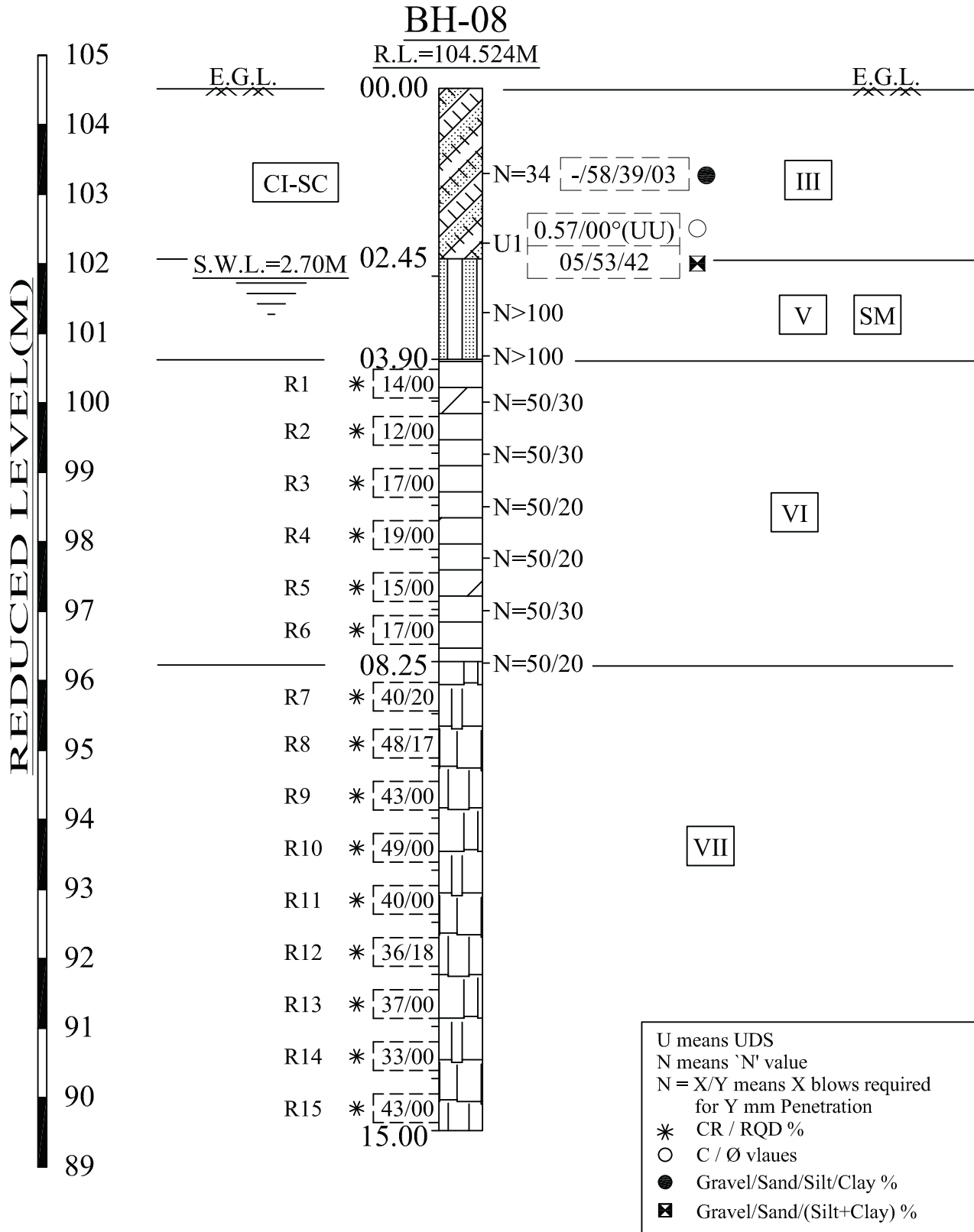
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(Thickener)

FIG. 2.05 : GENERALISED SOIL PROFILE

Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.

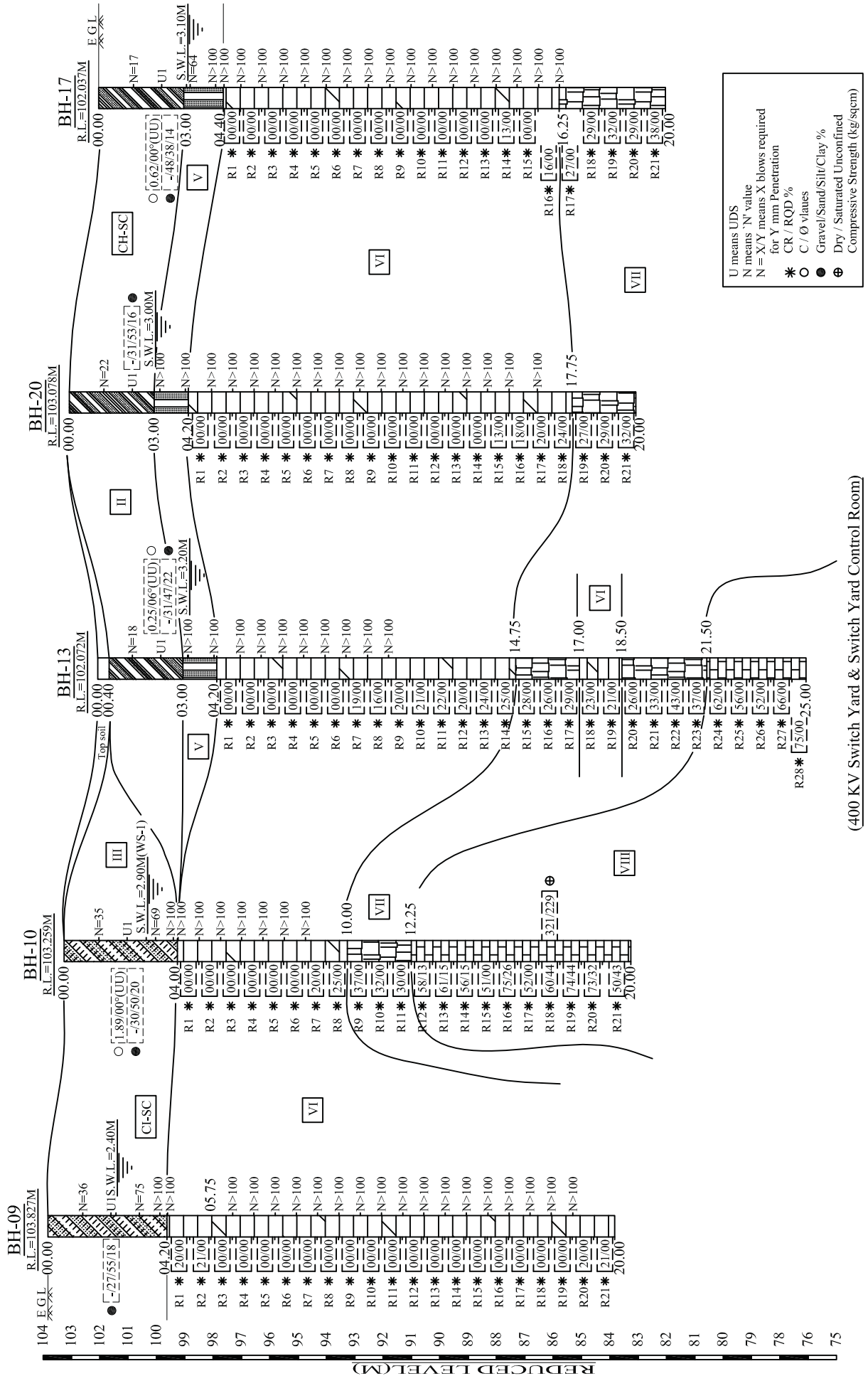
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(400 KV Switch Yard & Switch Yard Control Room)

FIG. 2.06 : GENERALISED SOIL PROFILE

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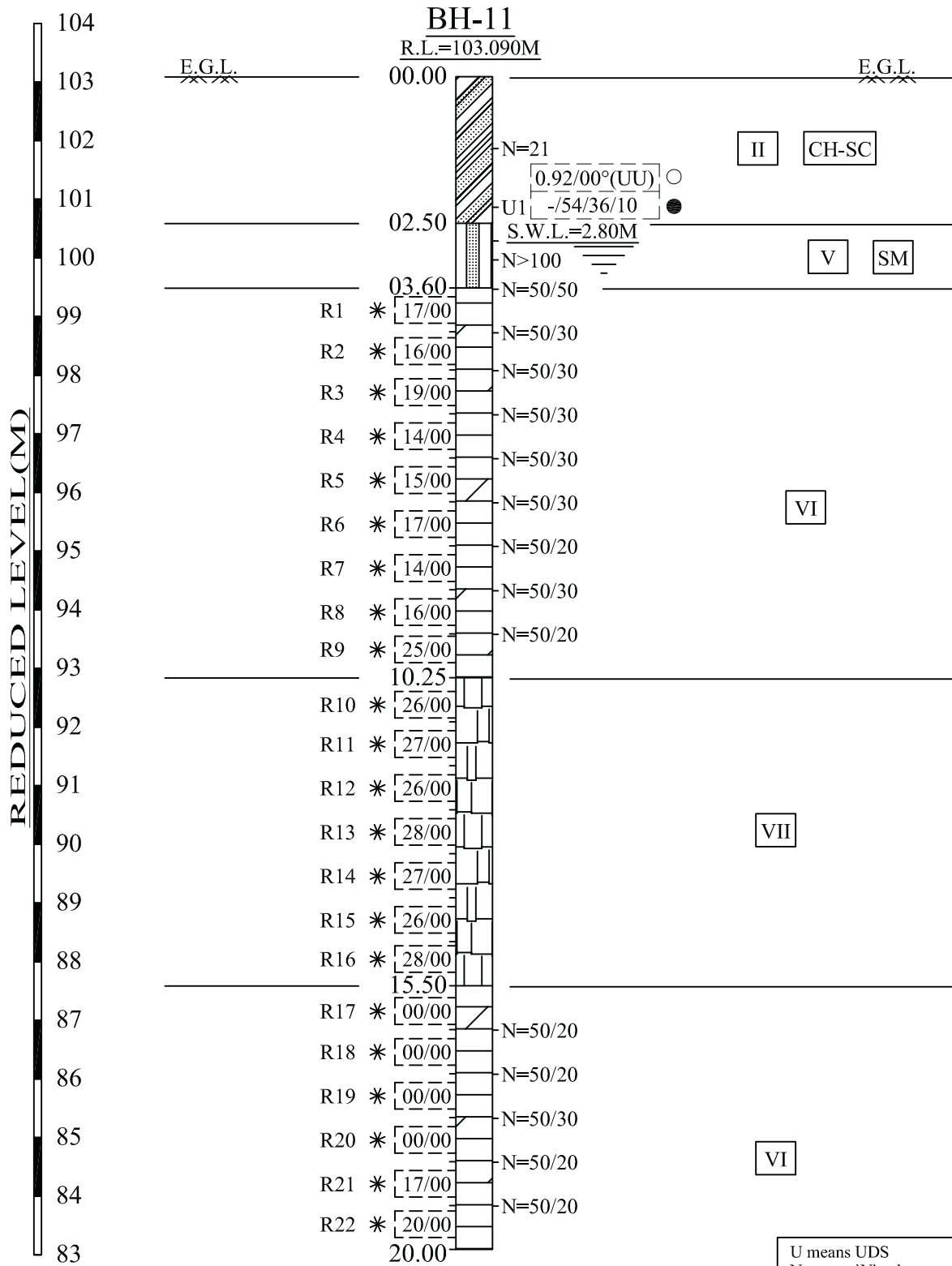
CETEST

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Sheet No:



(Clarifiers)

FIG. 2.07 : GENERALISED SOIL PROFILE

U means UDS
N means 'N' value
N = X/Y means X blows required
for Y mm Penetration
* CR / RQD %
○ C / Ø values
● Gravel/Sand/Silt/Clay %

Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.

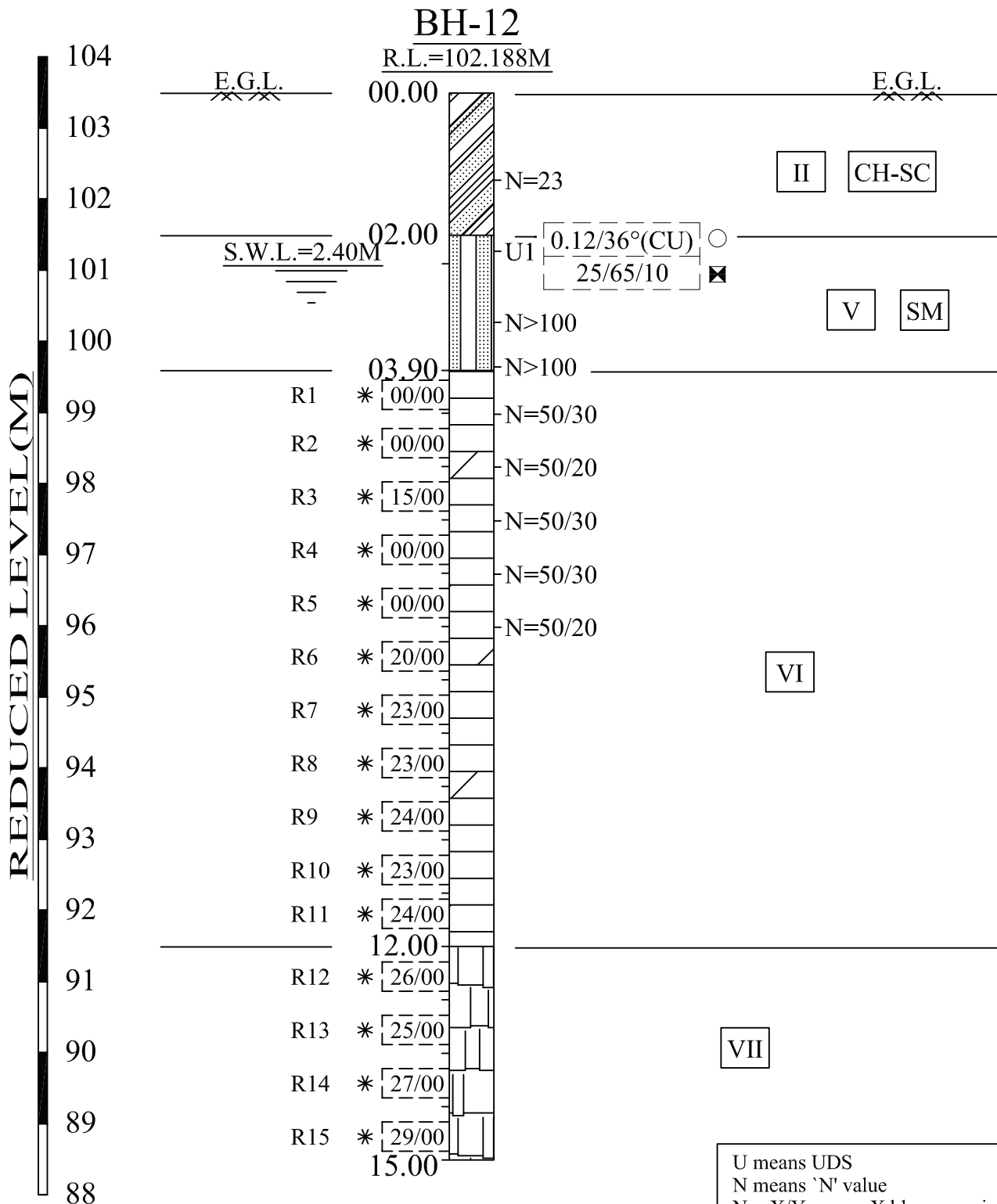
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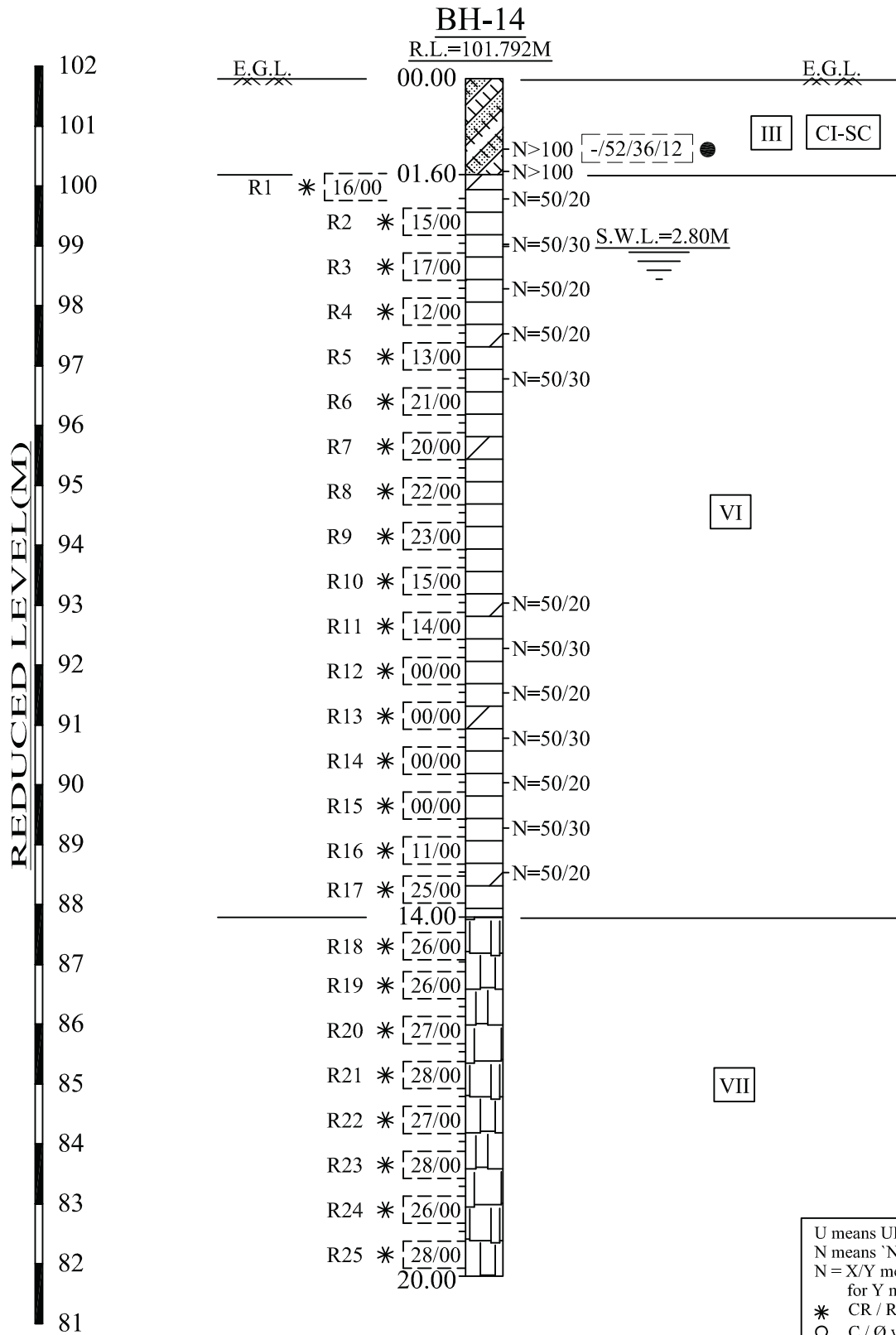
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(Clarified Water Tank)

FIG. 2.09 : GENERALISED SOIL PROFILE

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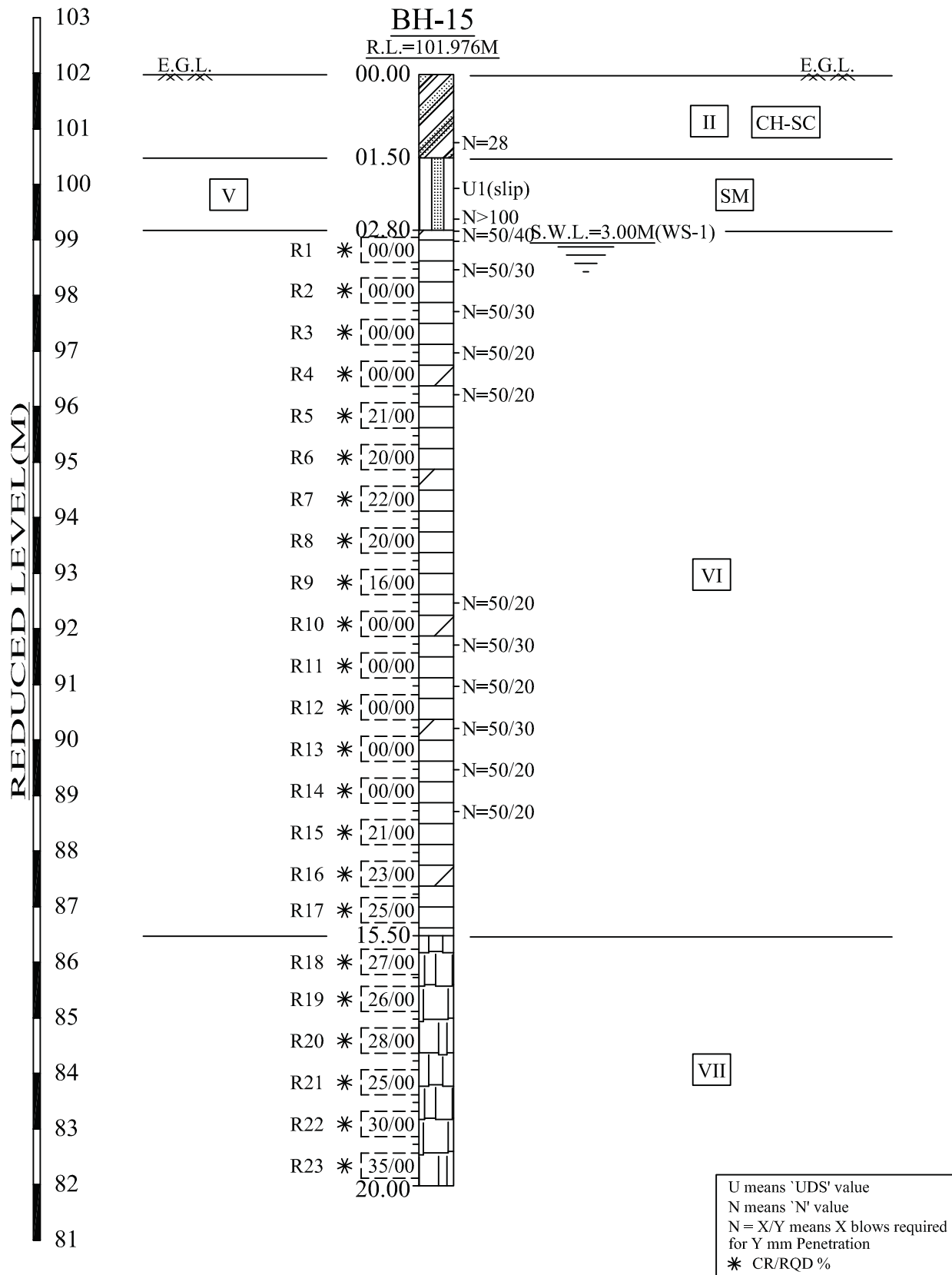
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(Centralised Sewage Treatment System)

FIG. 2.10 : GENERALISED SOIL PROFILE

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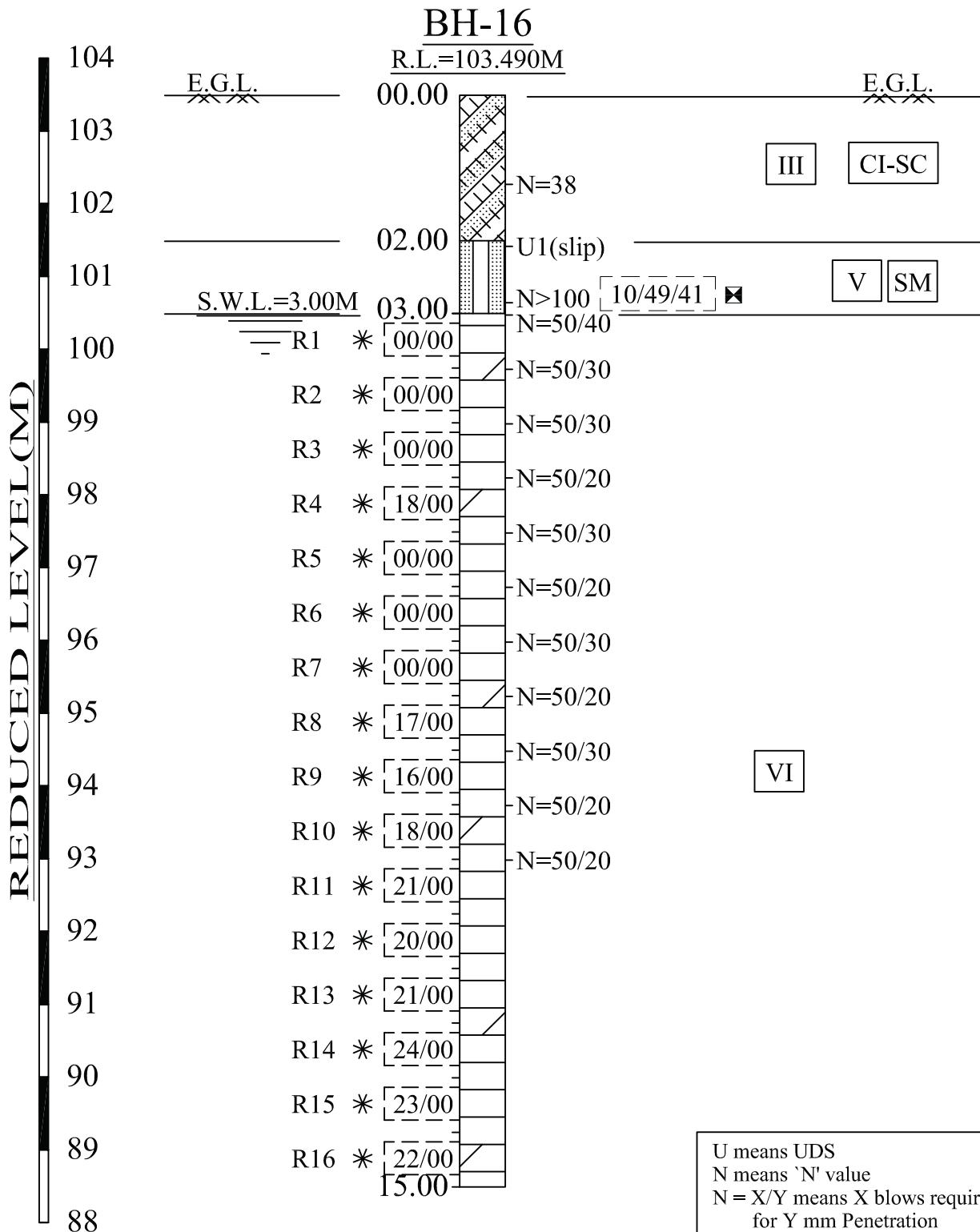
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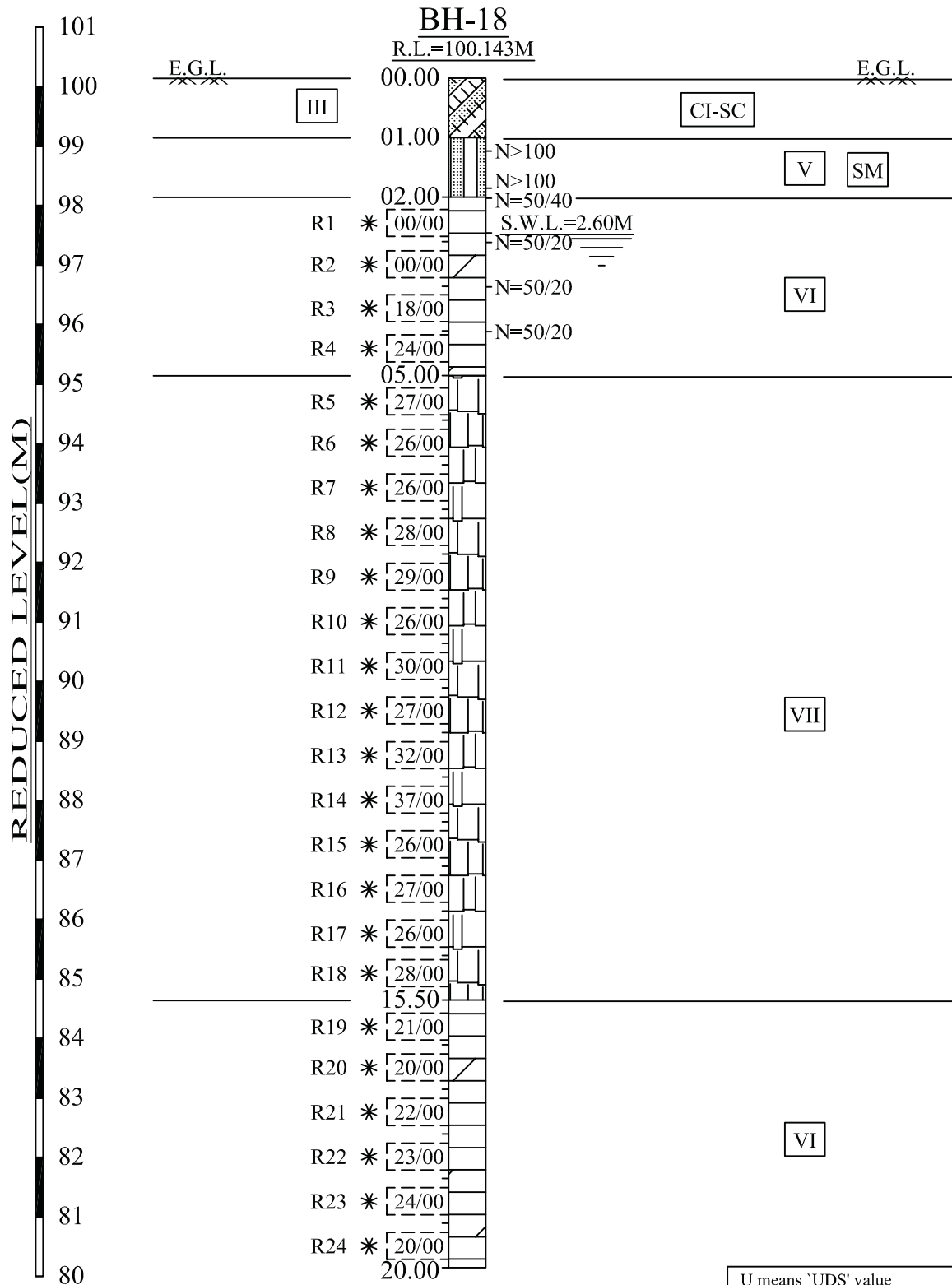
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(C.M.B. Waster Treatment System)

FIG. 2.11 : GENERALISED SOIL PROFILE

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U means 'UDS' value
 N means 'N' value
 N = X/Y means X blows required
 for Y mm Penetration
 * CR/RQD %

(Fire Water Storage Tank & Pump House)

FIG. 2.12 : GENERALISED SOIL PROFILE

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Job No : 3 4 2 1

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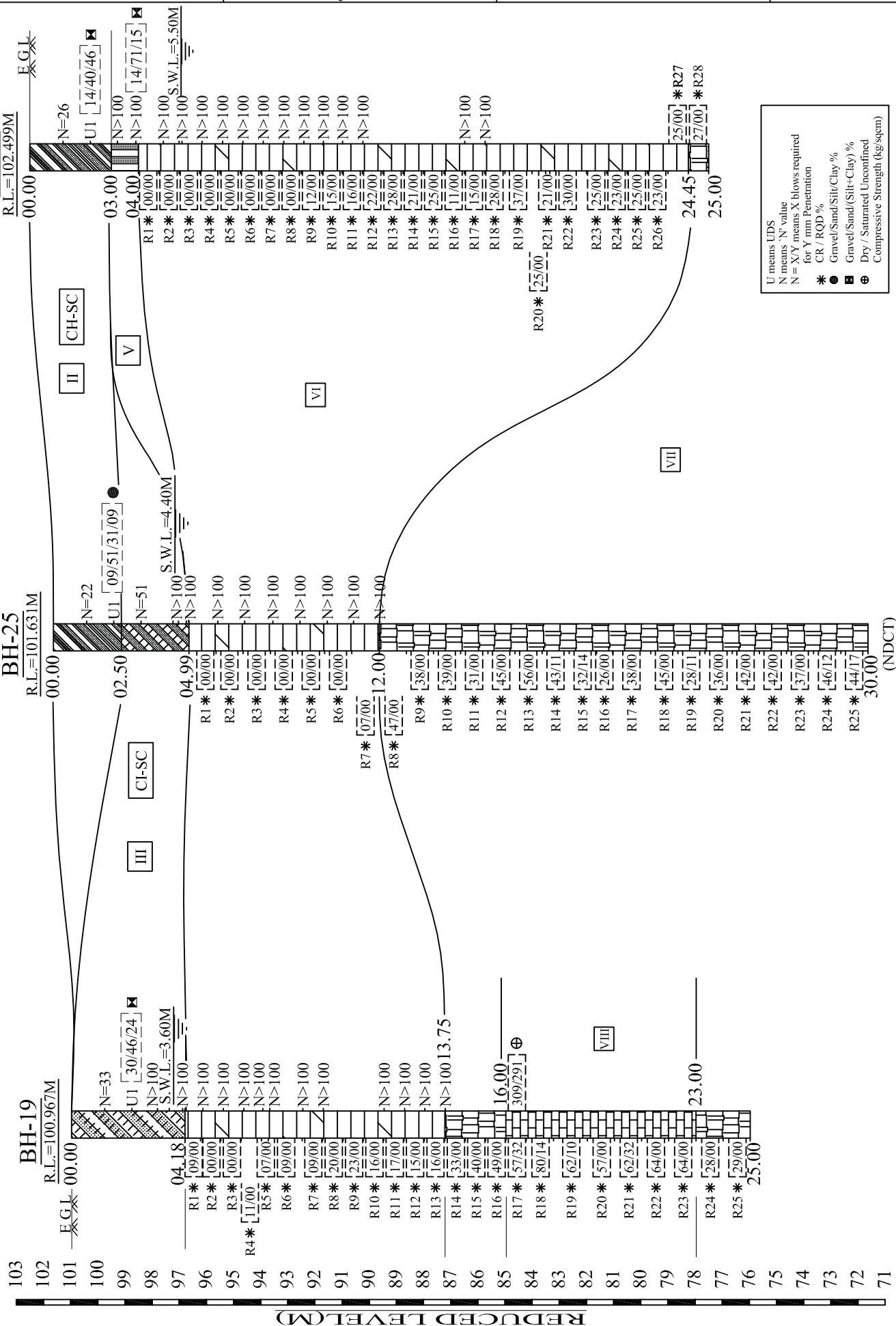


FIG. 2.13 : GENERALISED SOIL PROFILE (NDCT)

Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.

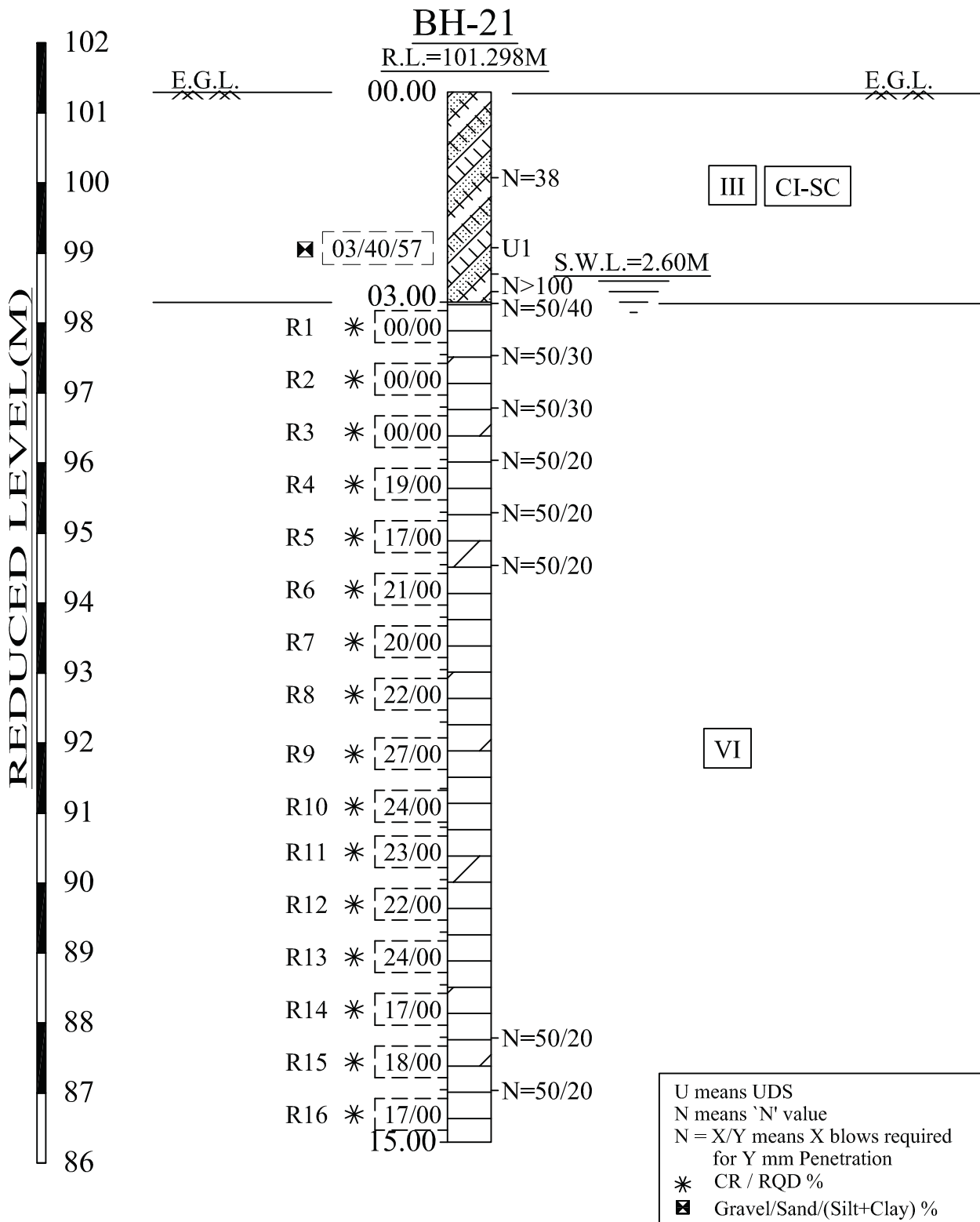
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Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.

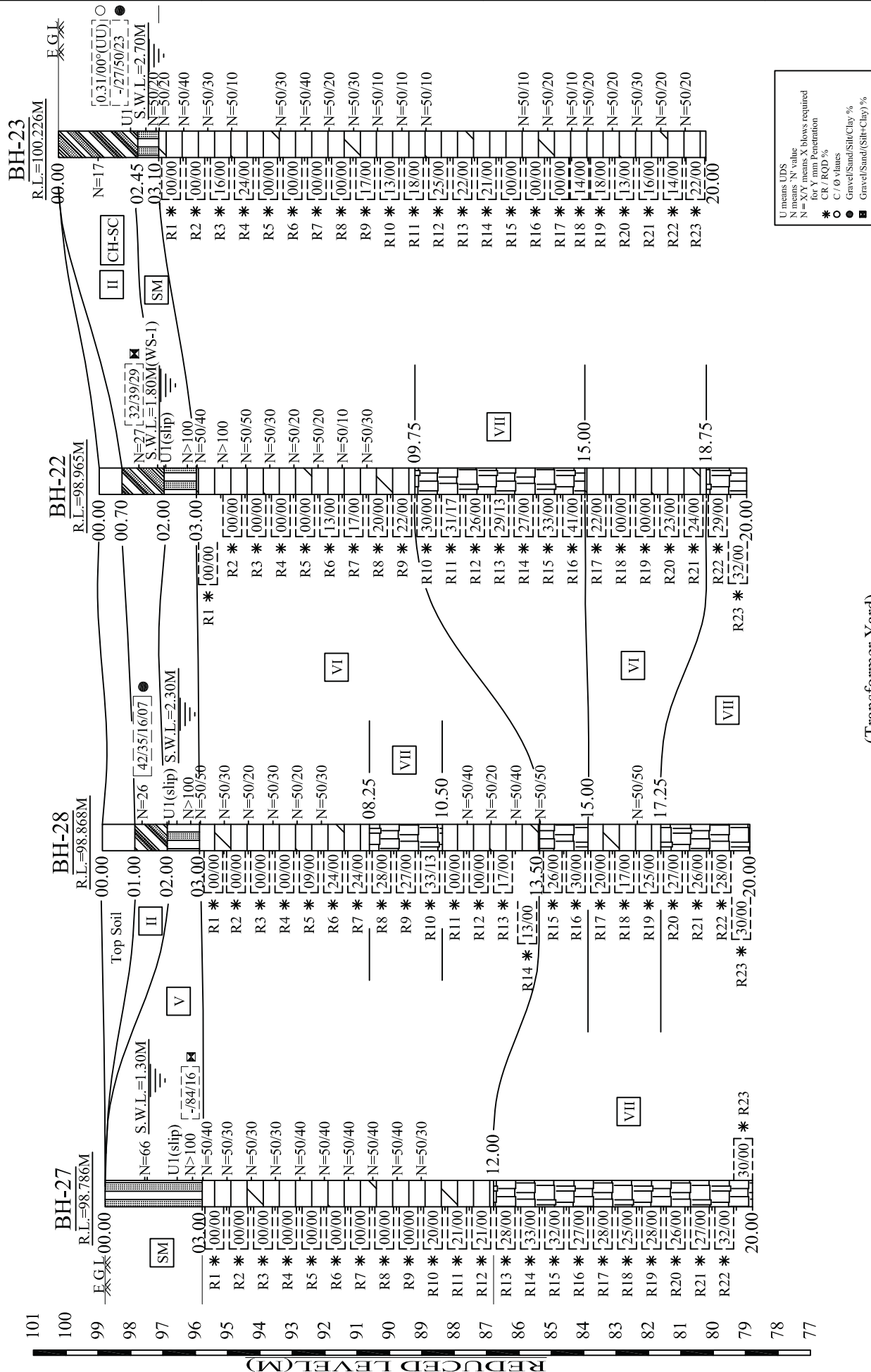
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Created on : 21/03/2015

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(Transformer Yard)

FIG. 2.15 : GENERALISED SOIL PROFILE

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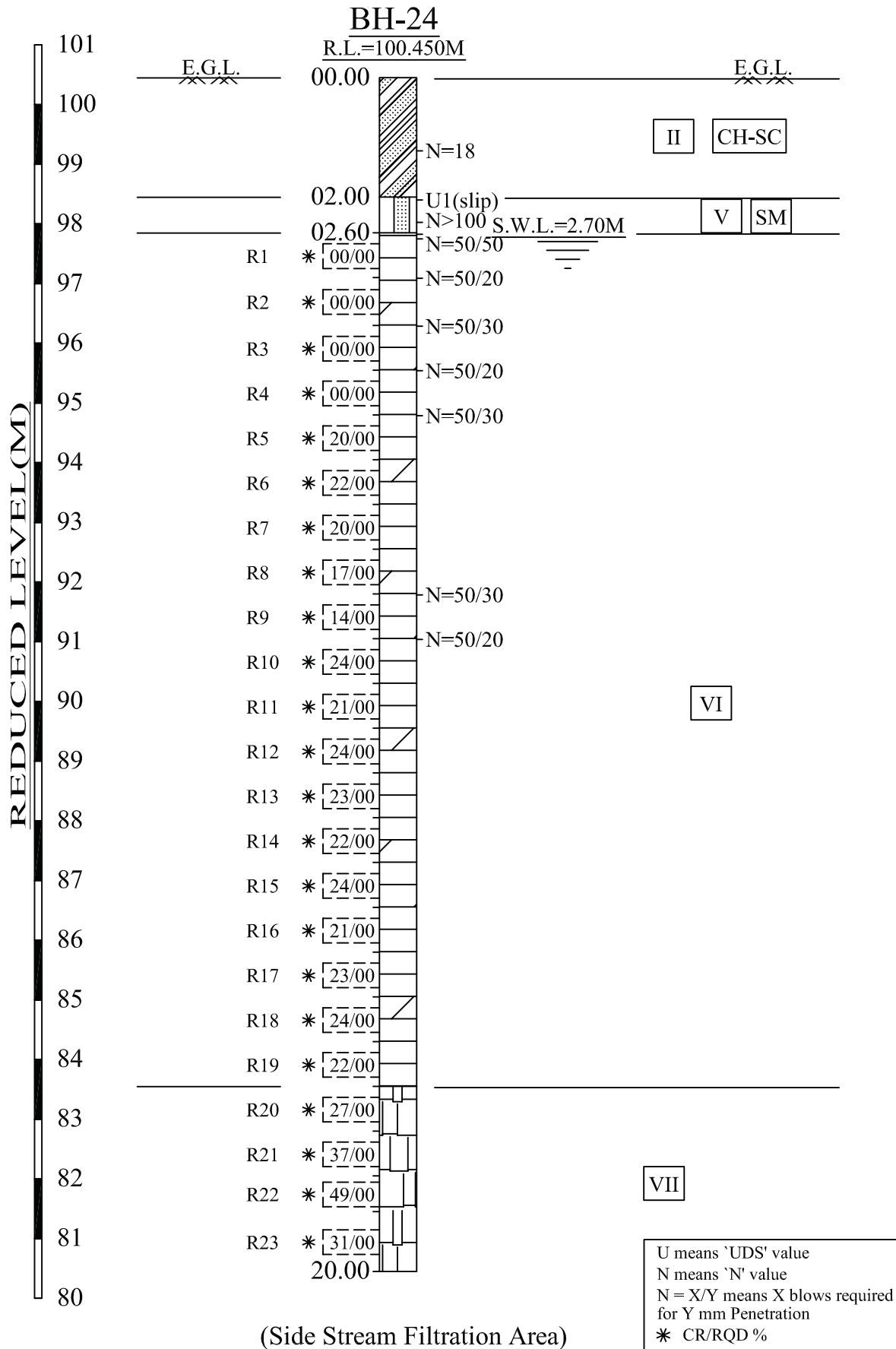


FIG. 2.16 : GENERALISED SOIL PROFILE

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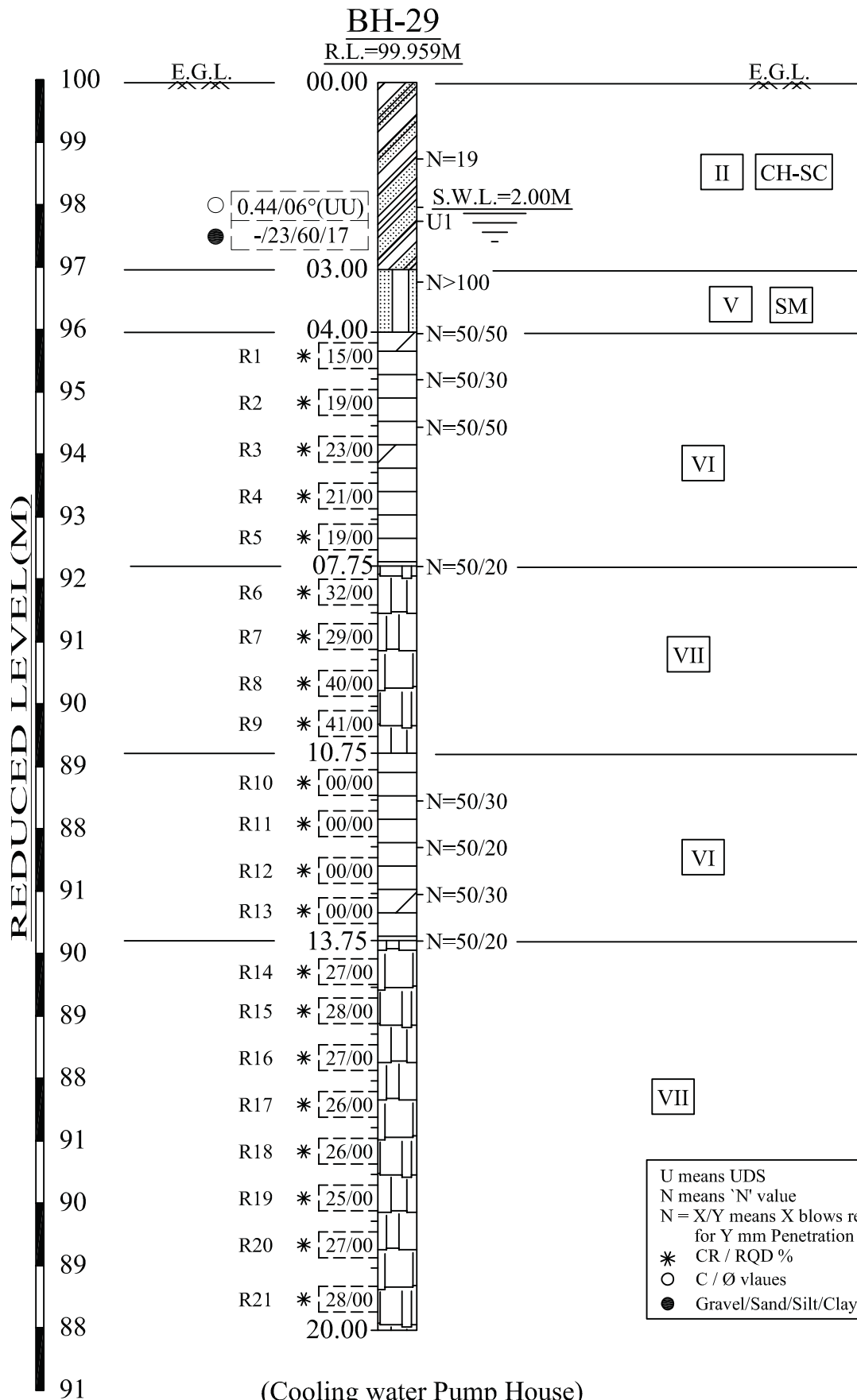
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Job No : 3 4 2 1

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Created on : 21 / 03 / 2015

Sheet No:



Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.

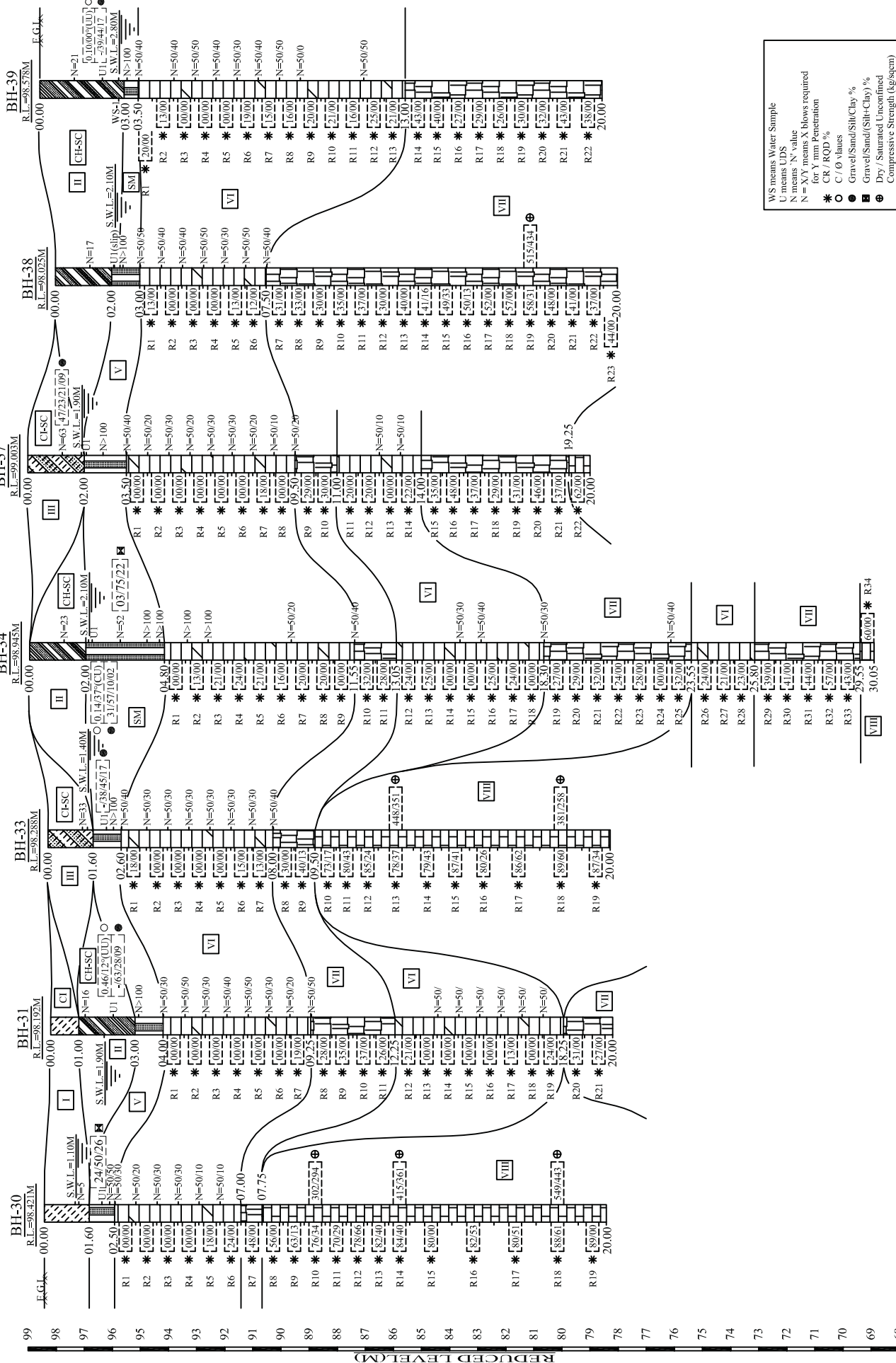
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(Power house building including electrical bay)

FIG. 2.18 : GENERALISED SOIL PROFILE.

Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.

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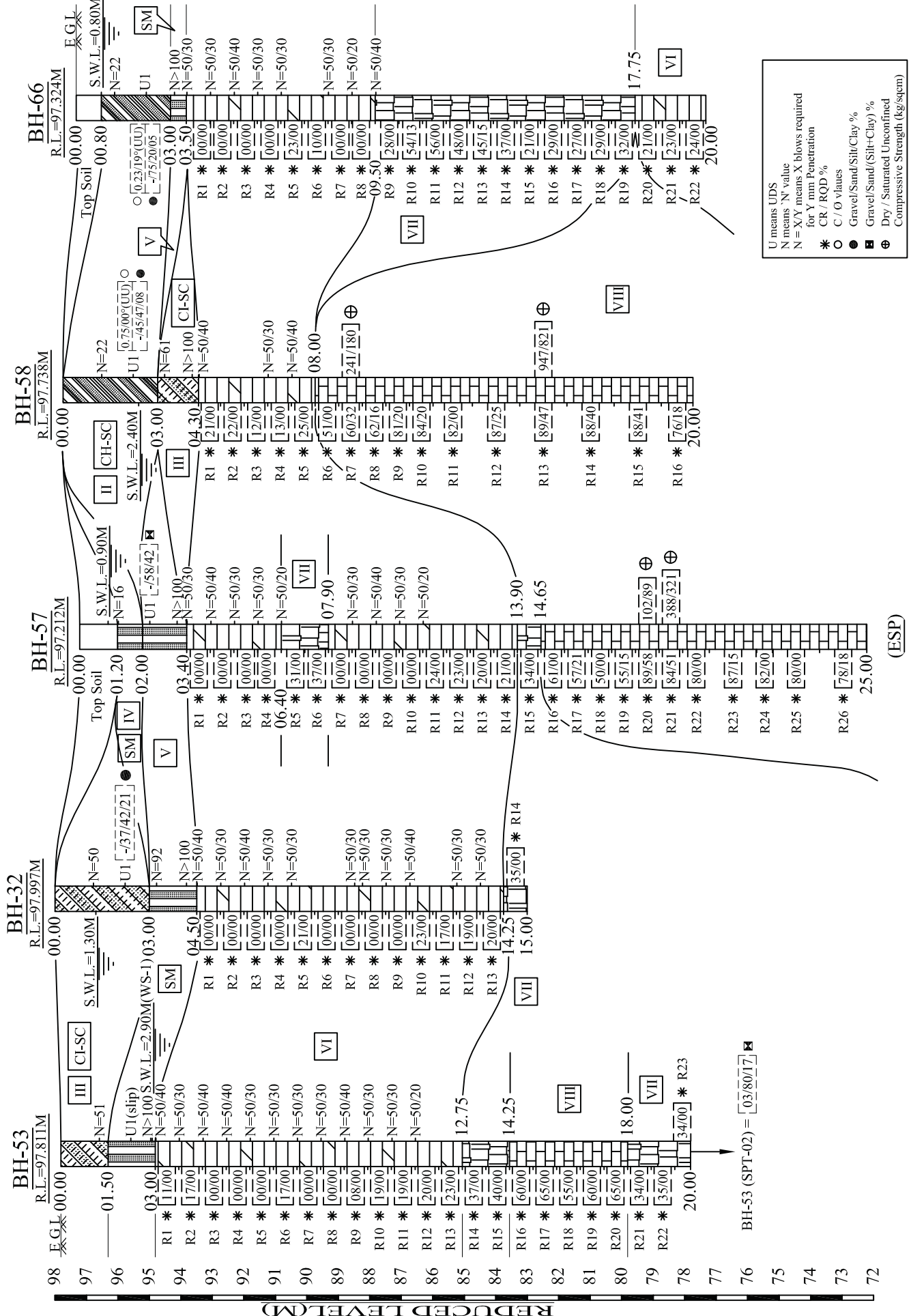


FIG. 2.19 : GENERALISED SOIL PROFILE

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CETEST

Job No : 3 4 2 1

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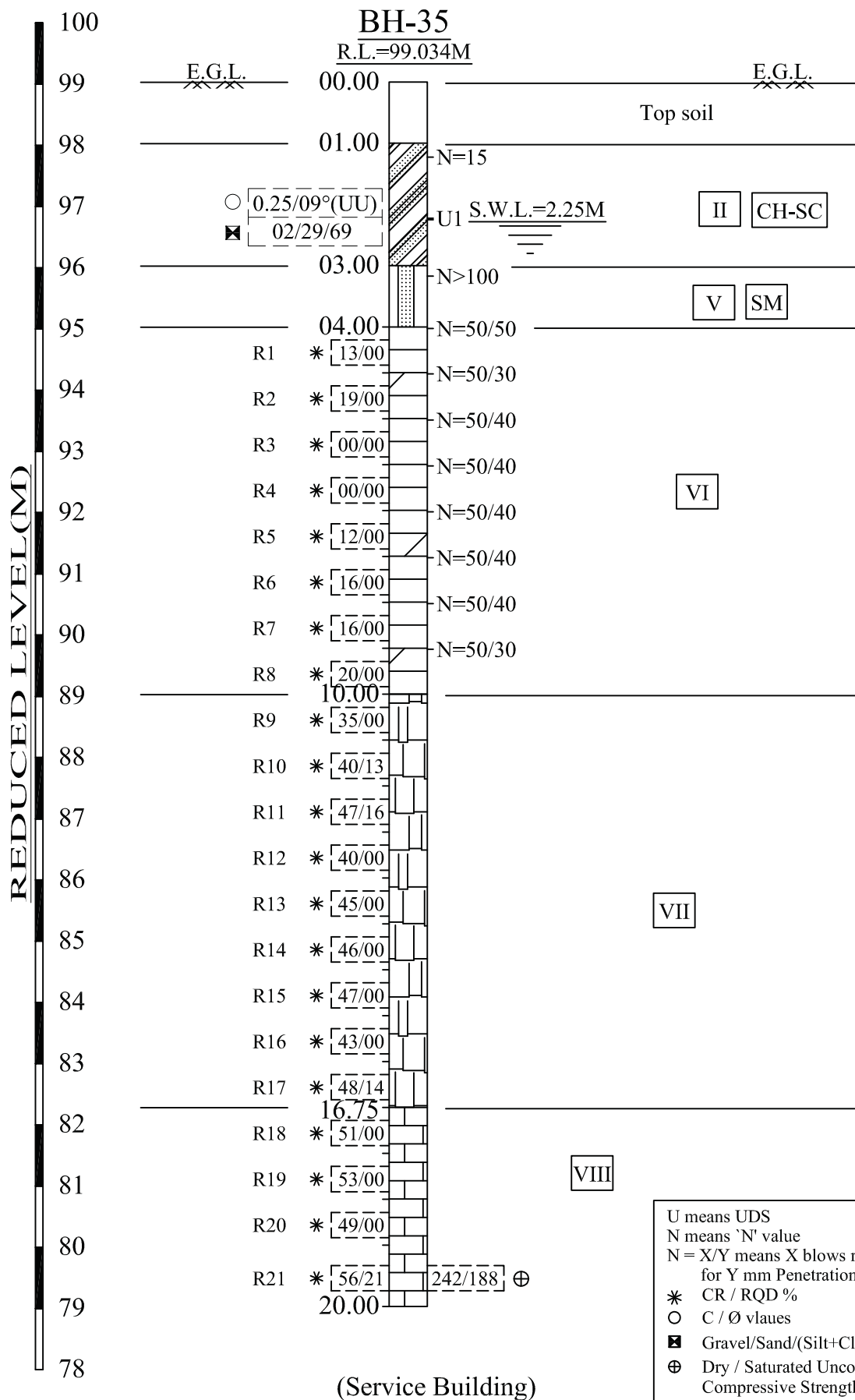


FIG. 2.20 : GENERALISED SOIL PROFILE

Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.

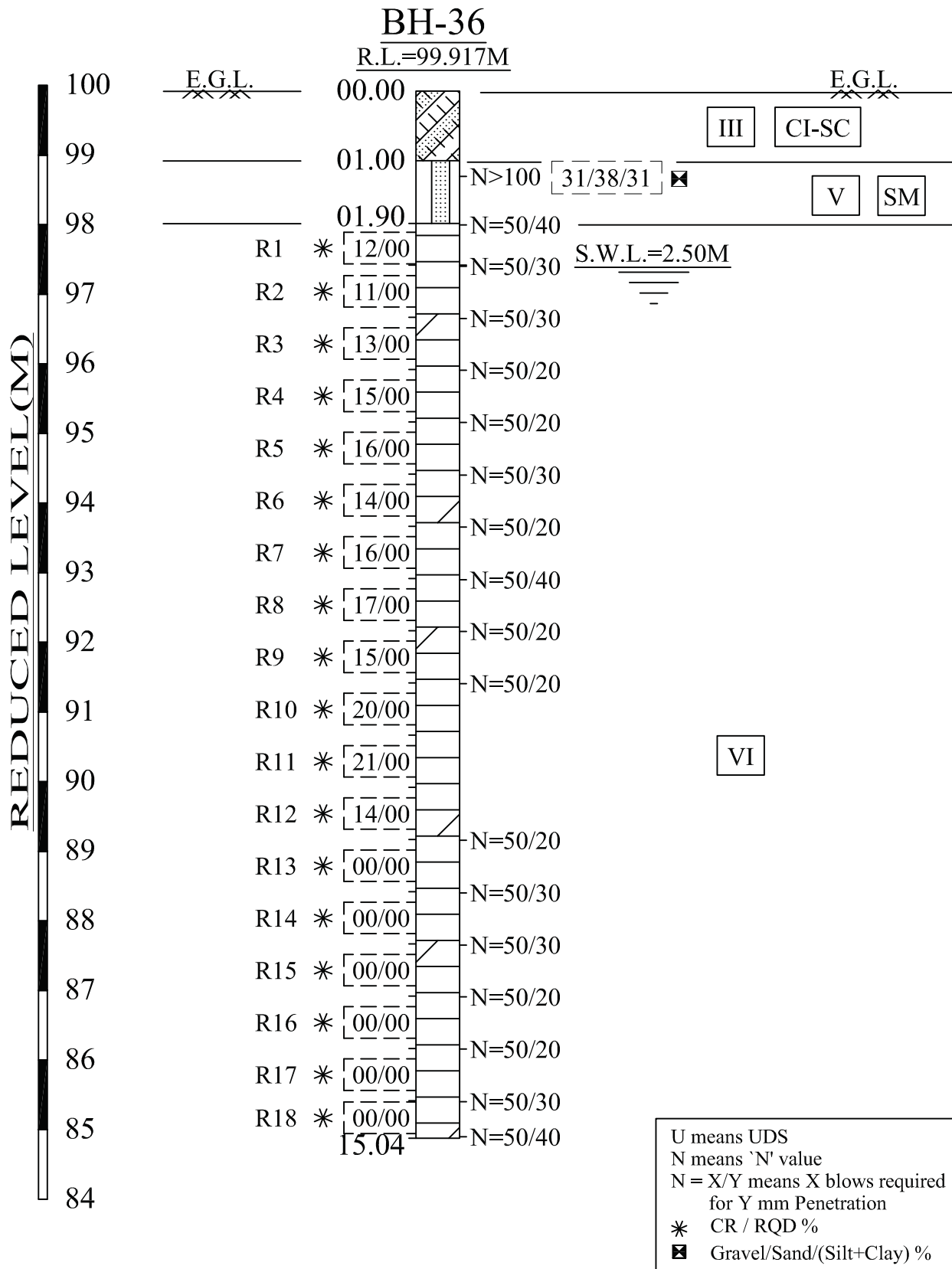
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Sheet No:



(CPU Regeneration Area)

FIG. 2.21 : GENERALISED SOIL PROFILE

Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.

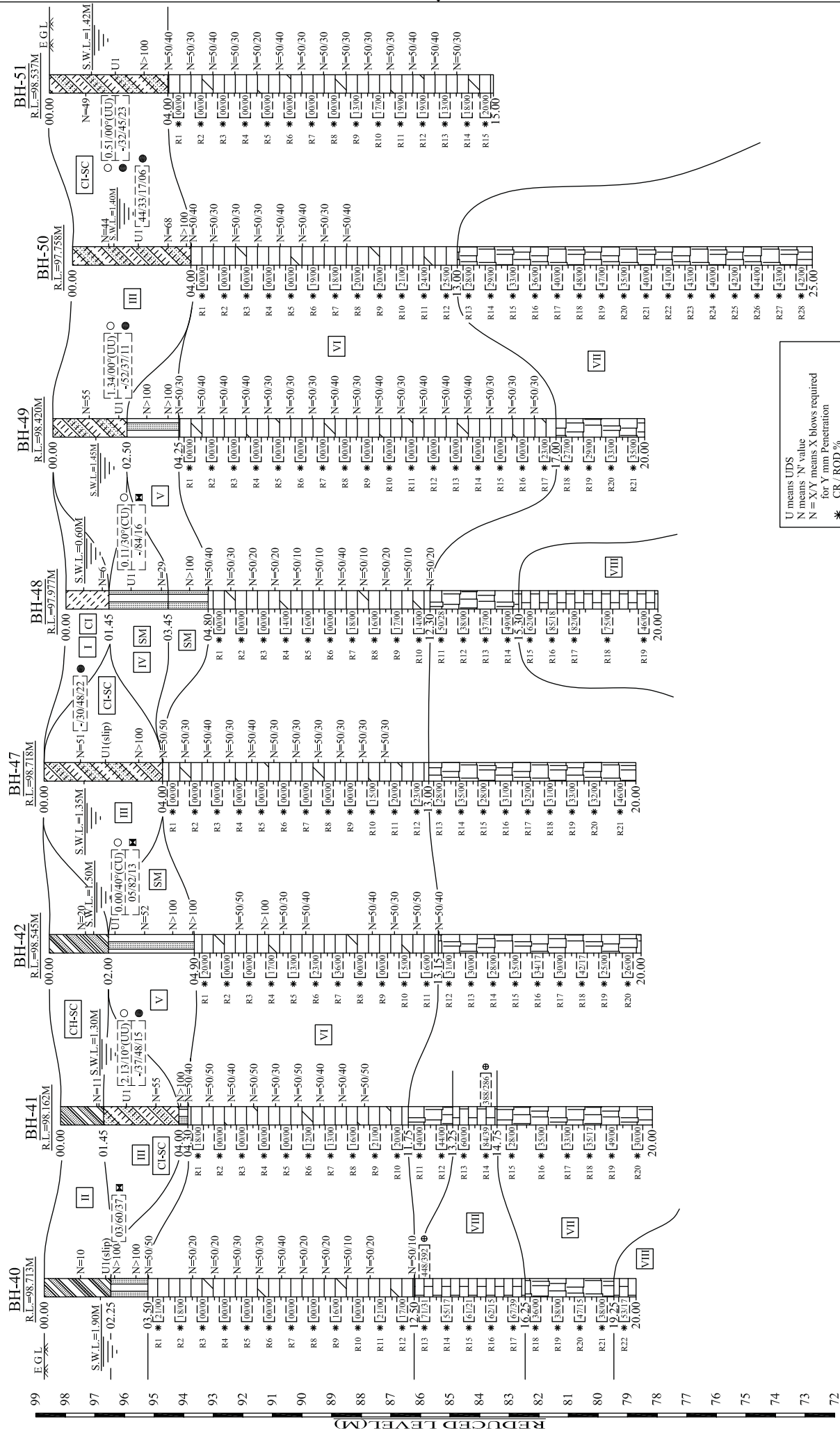
CETEST

Job No : 3 4 2 1

Created by : CHANDRANI

Created on : 26 / 12 / 2014

Sheet No:



(Boiler & Mill-Bunker Bay Area%)

FIG. 2.22 : GENERALISED SOIL PROFILE

Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.

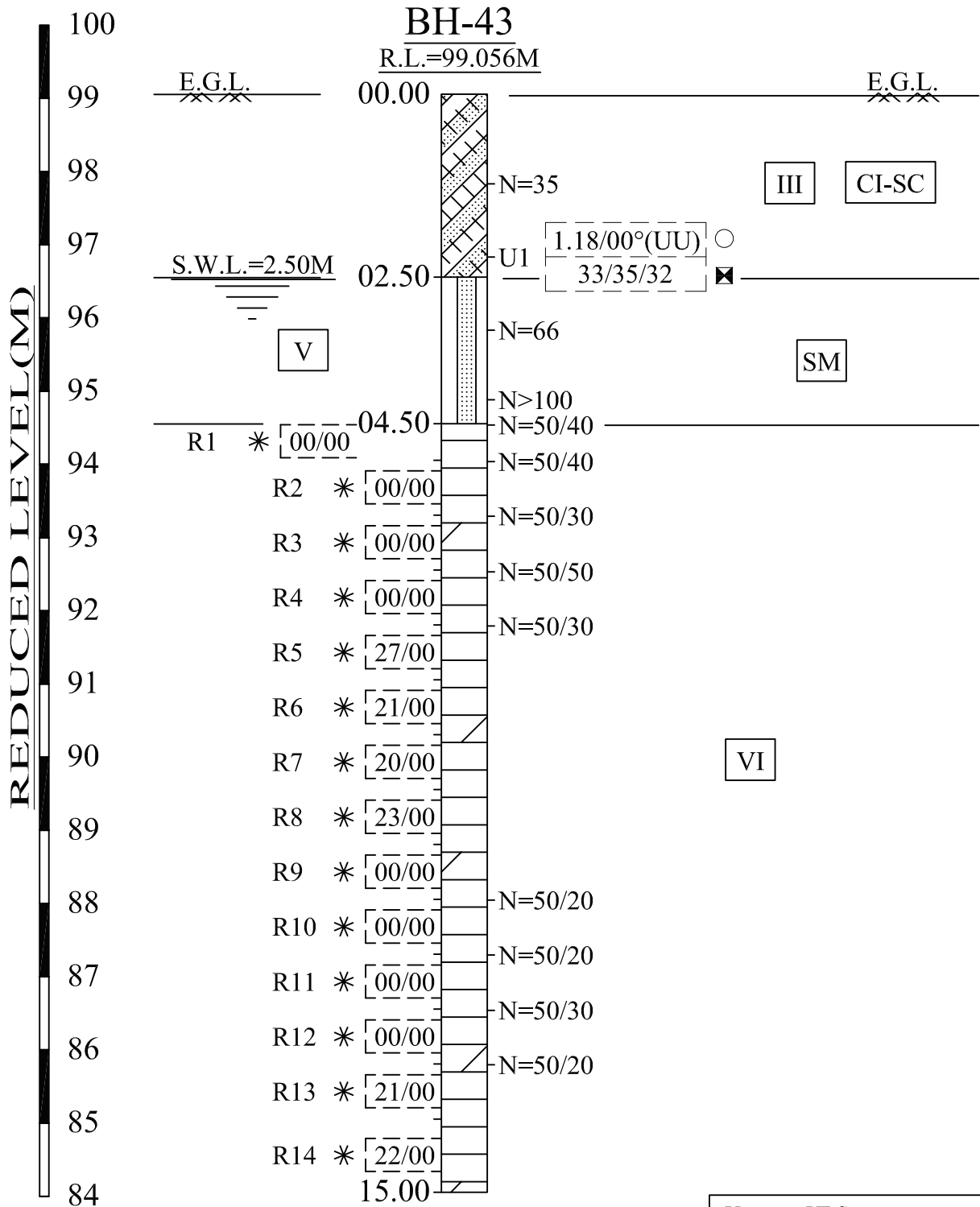
CETEST

Job No : 3 4 2 1

Created by : CHANDRANI

Created on : 21 / 03 / 2015

Sheet No:



(DM Plant)

FIG. 2.23 : GENERALISED SOIL PROFILE

Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.

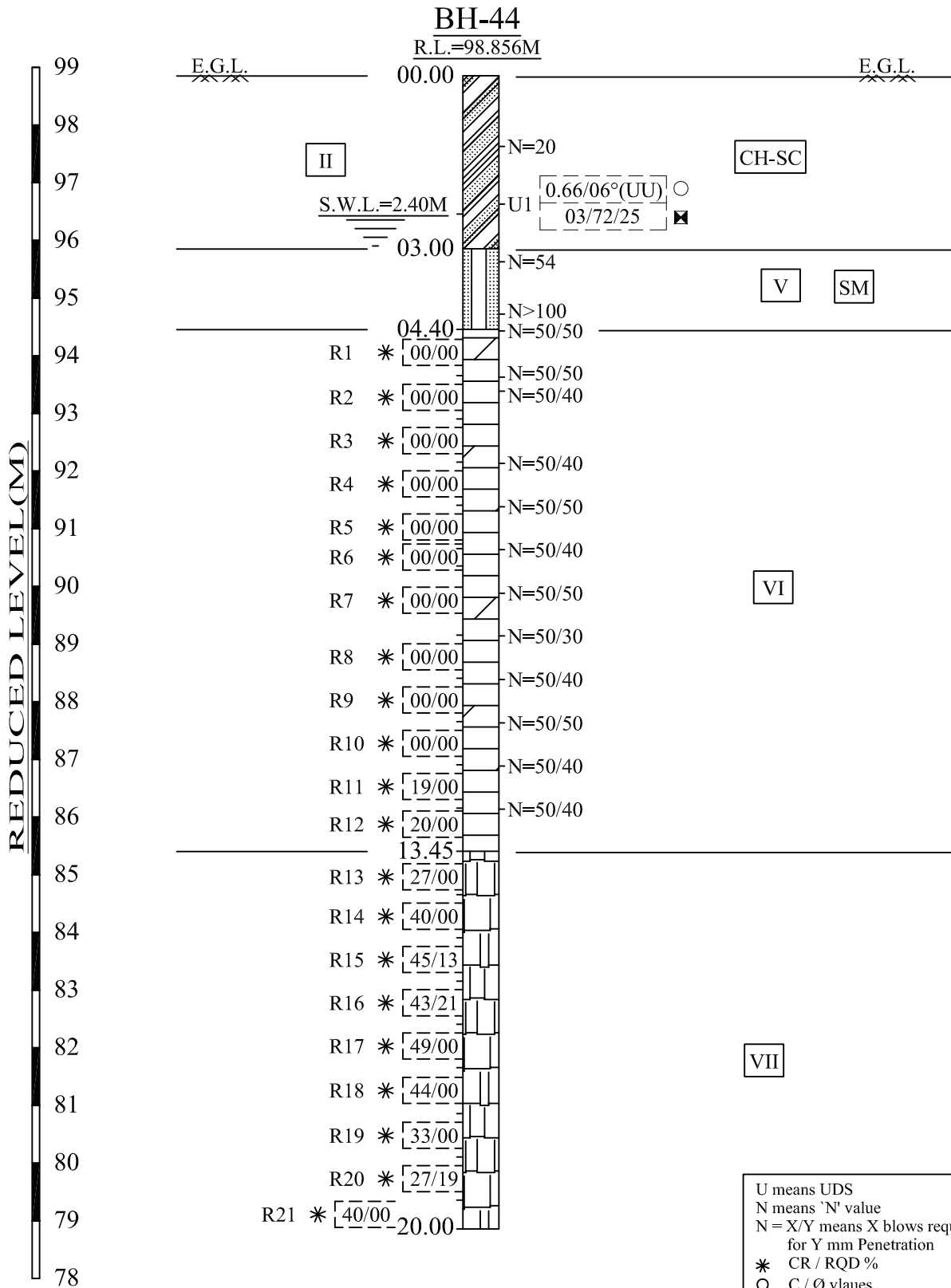
CETEST

Job No : 3 4 2 1

Created by : CHANDRANI

Created on : 21 / 03 / 2015

Sheet No:



(DG & Compressor House)

FIG. 2.24 : GENERALISED SOIL PROFILE

Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.

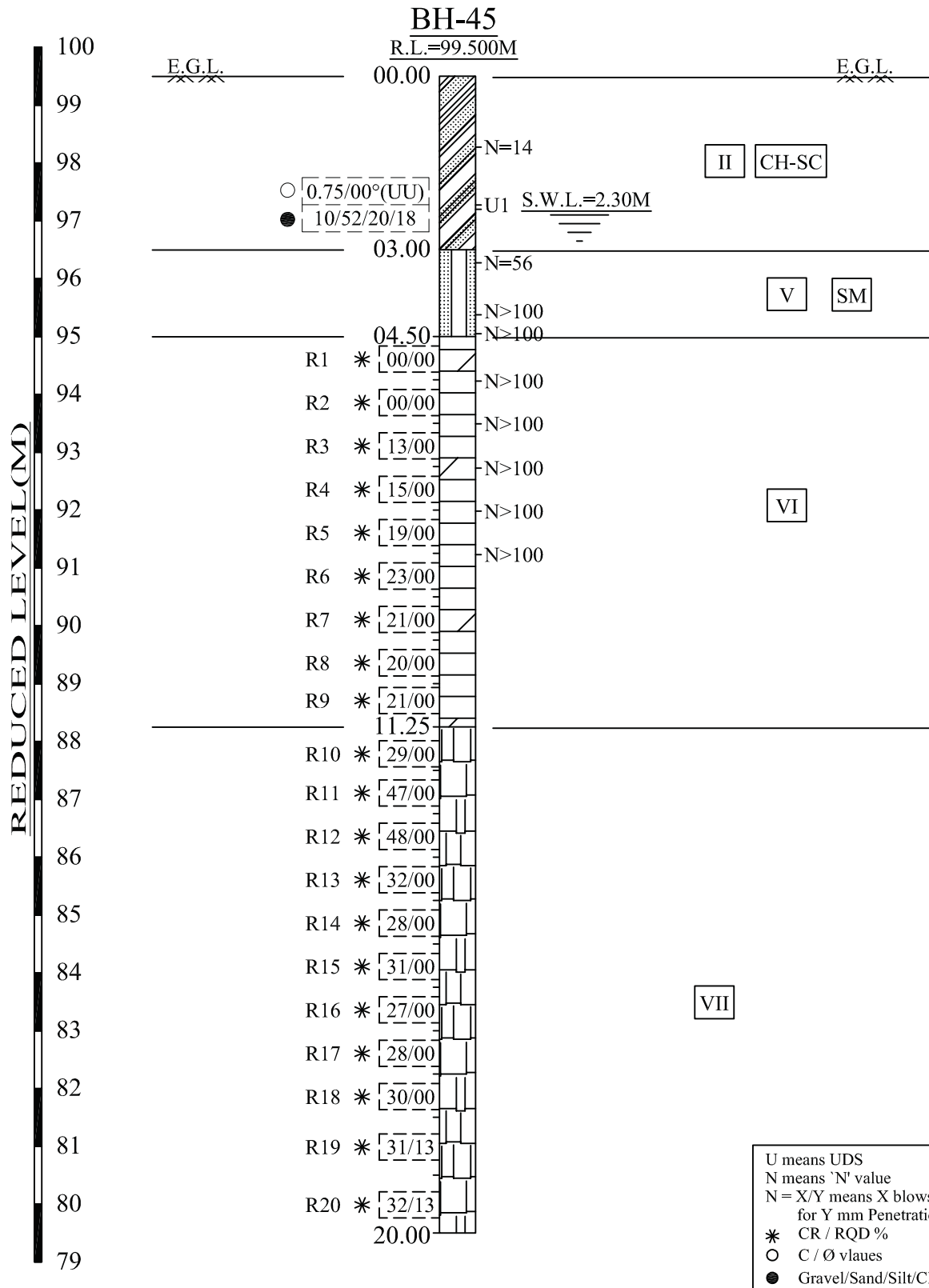
CETEST

Job No : 3 4 2 1

Created by : CHANDRANI

Created on : 21 / 03 / 2015

Sheet No:



(Condensate Storage Tank & Pump House)

FIG. 2.25 : GENERALISED SOIL PROFILE

CETEST

Sheet No:



CETEST

Sheet No:



FIG. 2.27 : GENERALISED SOIL PROFILE

Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.

CETEST

Job No : 3 4 2 1

Created by : CHANDRANI

Created on : 21 / 03 / 2015

Sheet No:

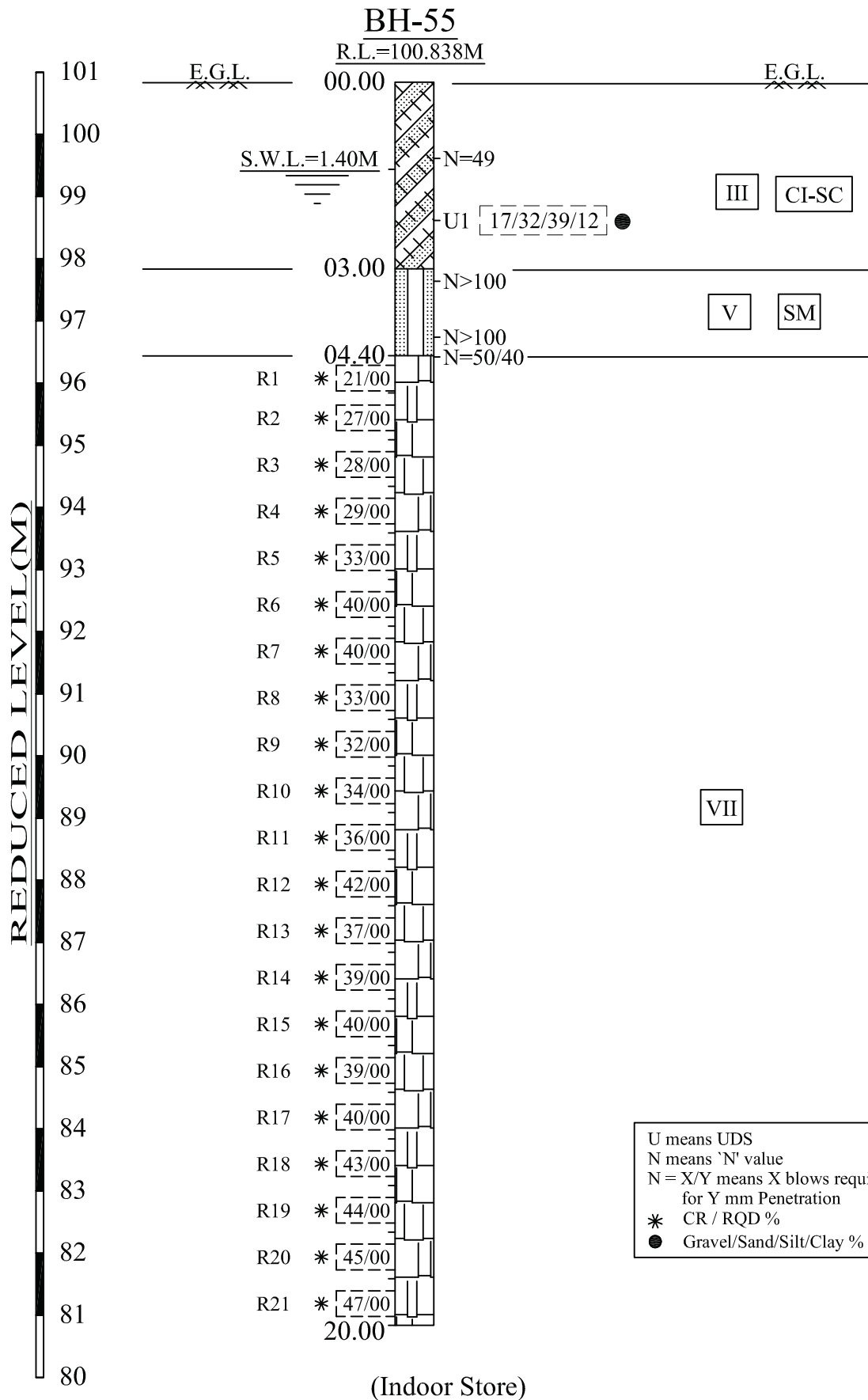


FIG. 2.28 : GENERALISED SOIL PROFILE

Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.

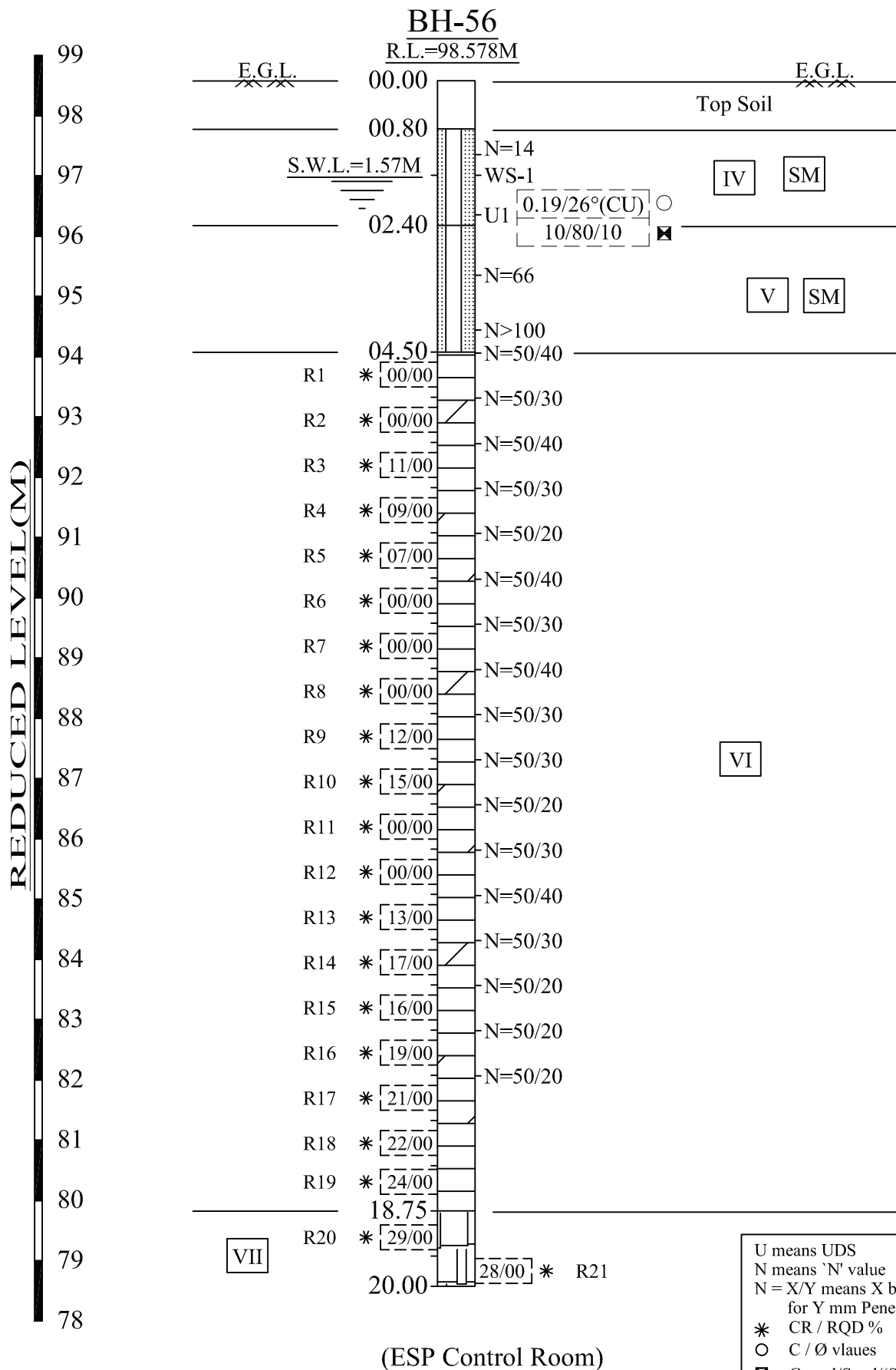
CETEST

Job No : 3 4 2 1

Created by : CHANDRANI

Created on : 21 / 03 / 2015

Sheet No:



Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.

CETEST

Job No : 3 4 2 1

Created by : CHANDRANI

Created on : 21 / 03 / 2015

Sheet No:

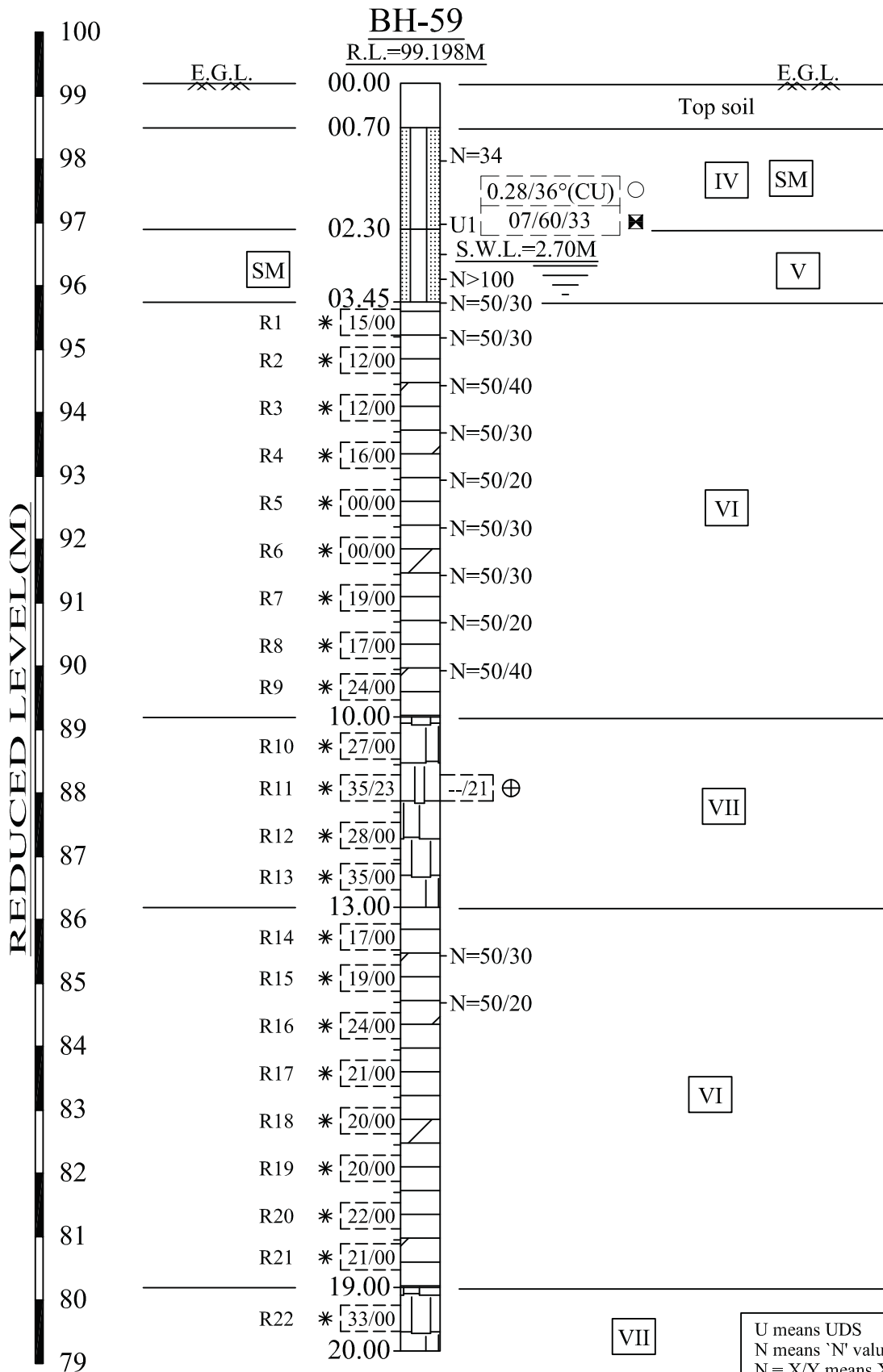


FIG. 2.30 : GENERALISED SOIL PROFILE

U means UDS
N means 'N' value
N = X/Y means X blows required for Y mm Penetration
* CR / RQD %
○ C / Ø values
■ Gravel/Sand/(Silt+Clay) %

Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.

CETEST

Job No : 3 4 2 1

Created by : CHANDRANI

Created on : 24 / 09 / 2014

Sheet No:

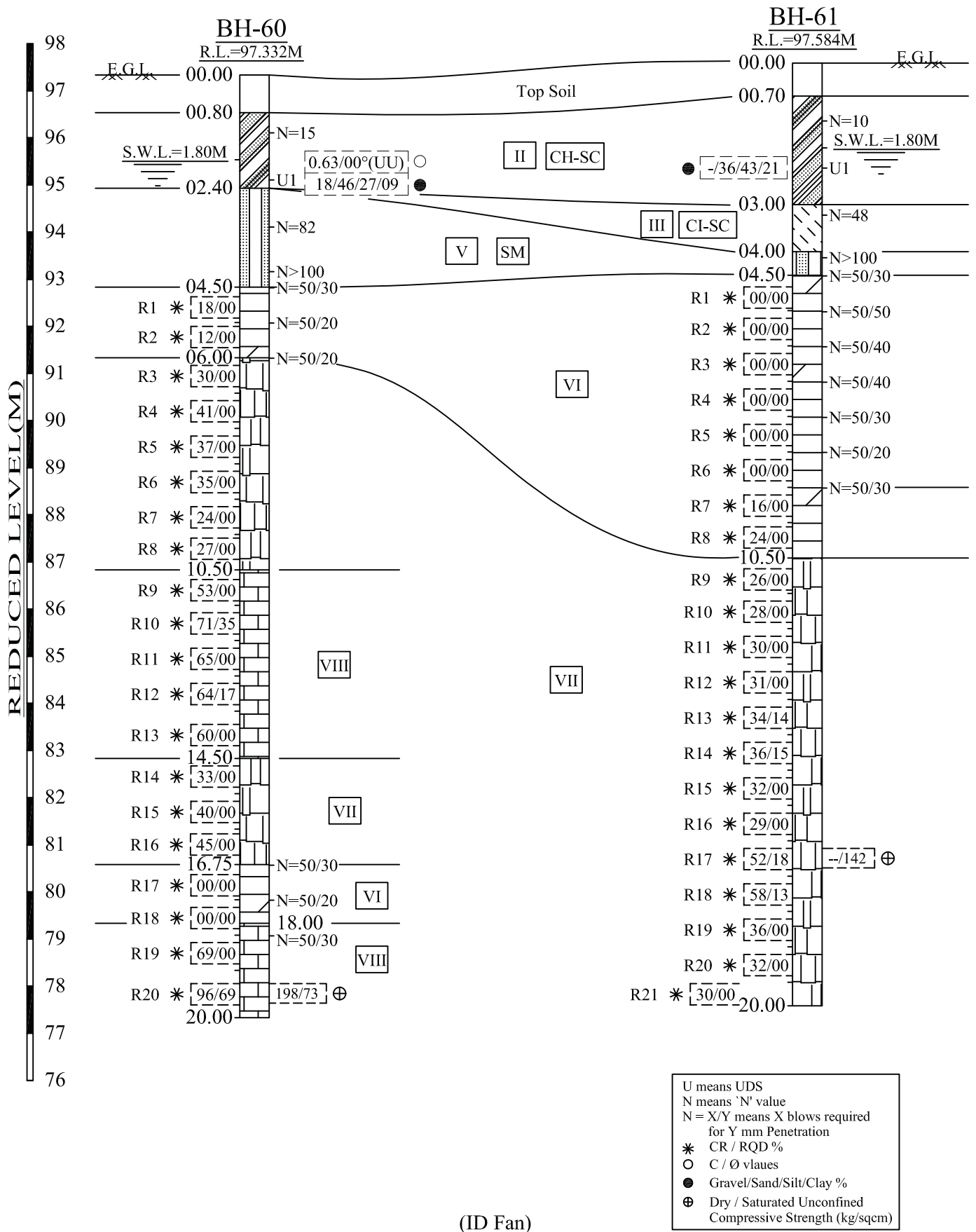


FIG. 2.31 : GENERALISED SOIL PROFILE

CETEST

Sheet No:



Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.

CETEST

Job No : 3 4 2 1

Created by : CHANDRANI

Created on : 21 / 03 / 2015

Sheet No:

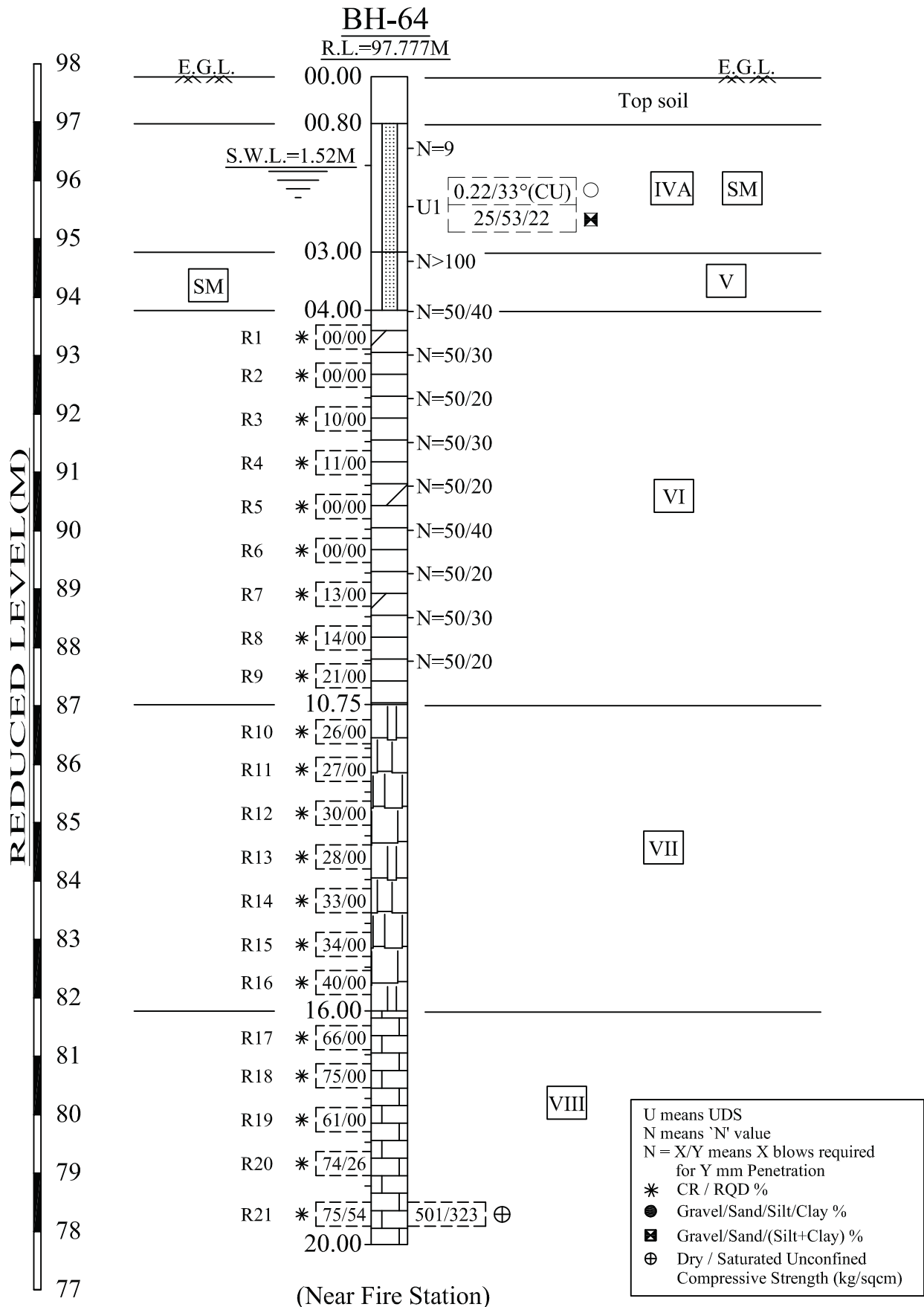


FIG. 2.33 : GENERALISED SOIL PROFILE

Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.

CETEST

Job No : 3 4 2 1

Created by : CHANDRANI

Created on : 21 / 03 / 2015

Sheet No:

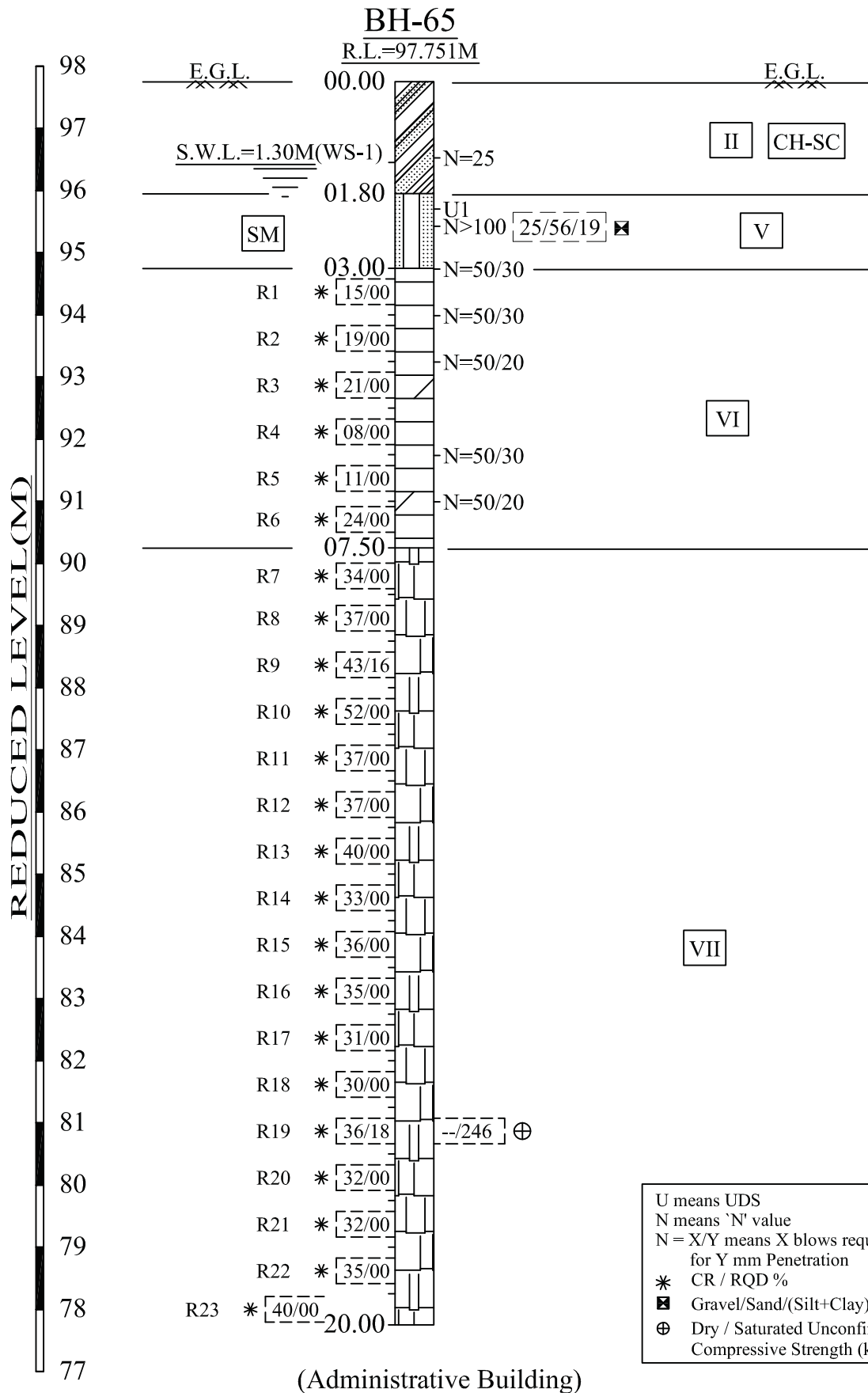


FIG. 2.34 : GENERALISED SOIL PROFILE

Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.

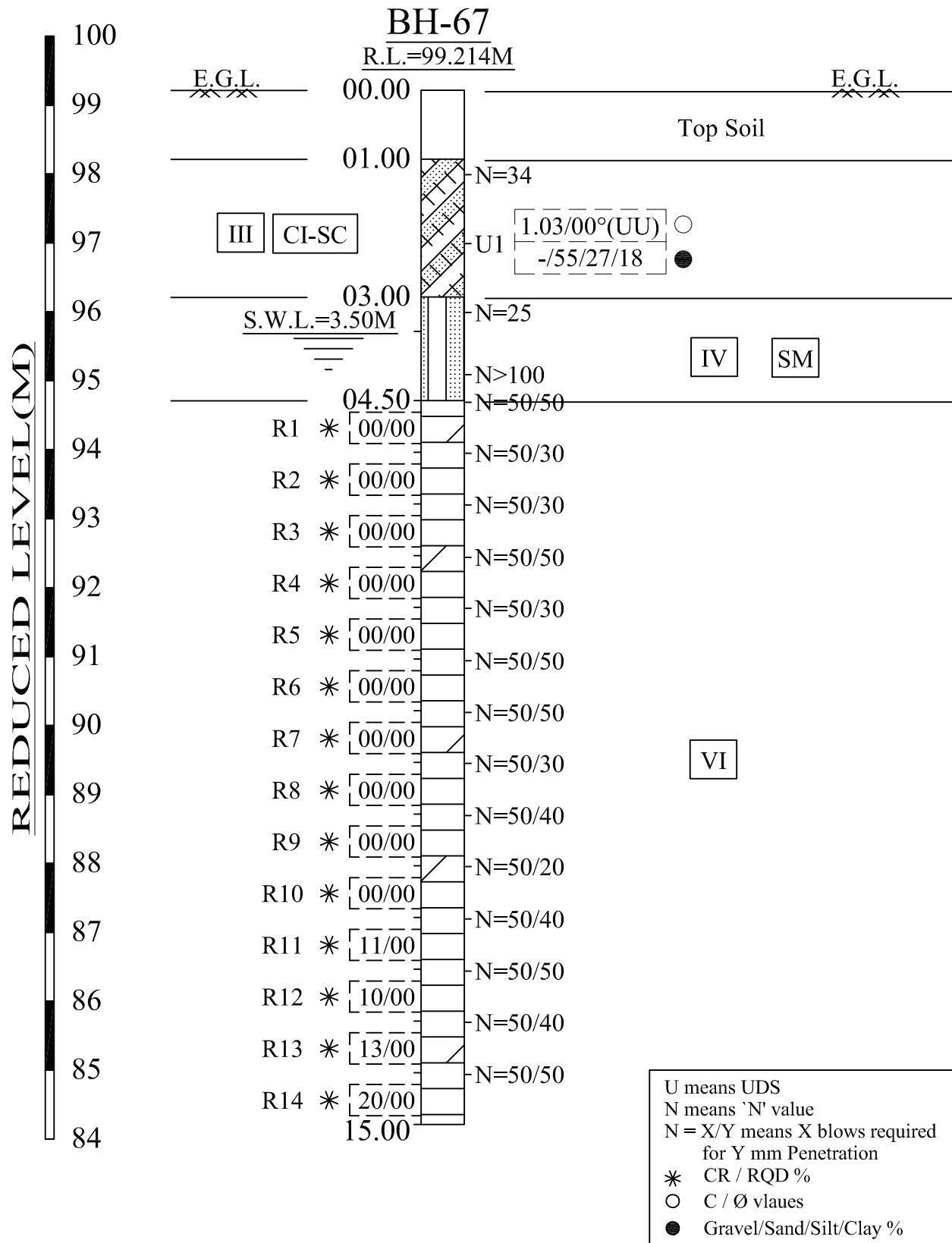
CETEST

Job No : 3 4 2 1

Created by : CHANDRANI

Created on : 21 / 03 / 2015

Sheet No:



(Raw Water Pump House)

FIG. 2.35 : GENERALISED SOIL PROFILE

Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.

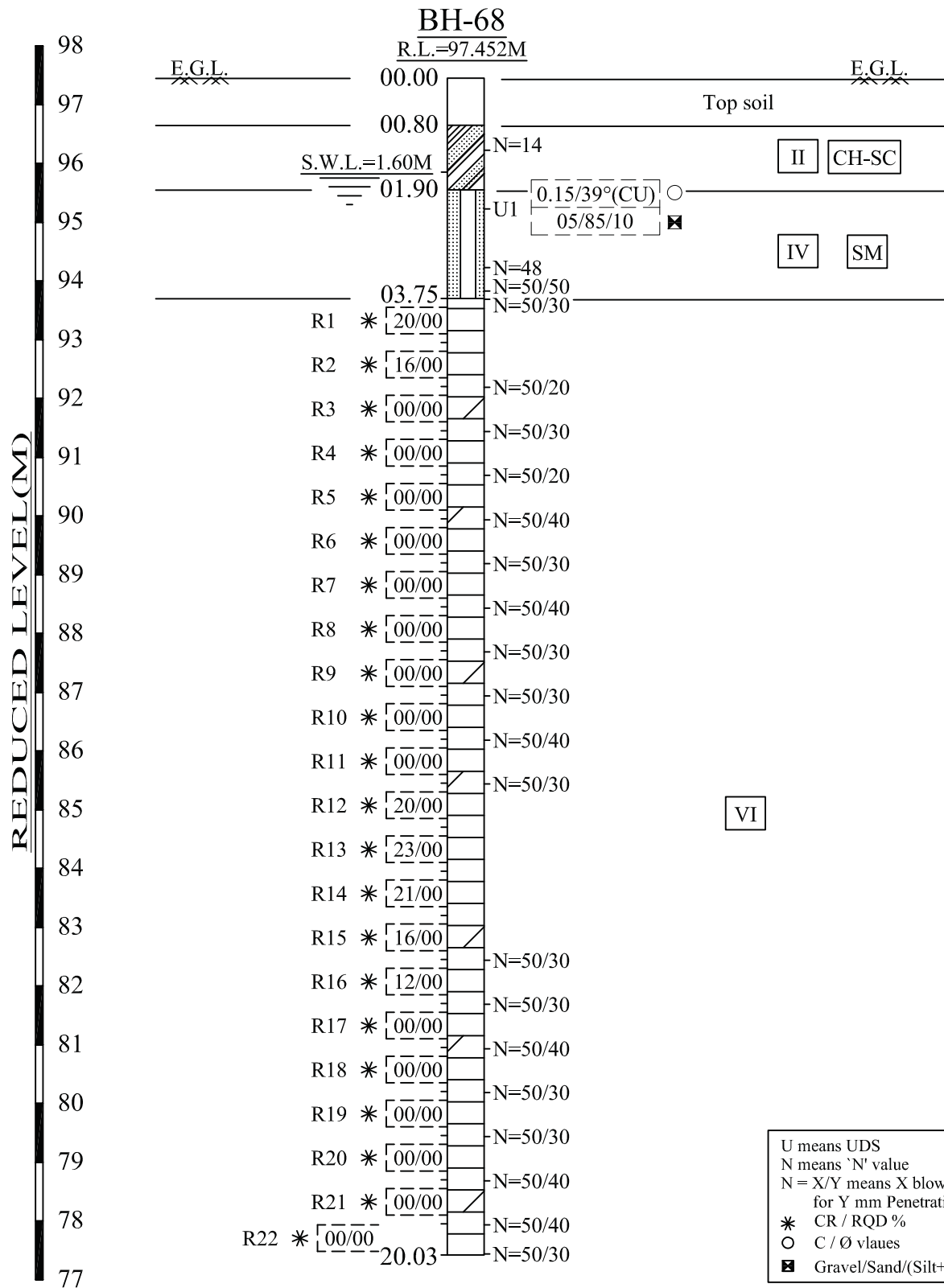
CETEST

Job No : 3 4 2 1

Created by : CHANDRANI

Created on : 21 / 03 / 2015

Sheet No:



(HFO & LDO Unloading & Forwarding Pump House)

FIG. 2.36 : GENERALISED SOIL PROFILE

Project: Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.



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Natural Water Content %	20	Liquid limit %	50
TRSH-UU:		Plastic Limit %	18
Cohesion kg/sqcm	0.50	Shrinkage Limit %	14
Friction angle °	4°	GRAIN SIZE	
Unconfined cohesion, kg/sqcm	0.55	Gravel %	05
Remoulded cohesion, kg/sqcm	0.40	Sand %	44
SENSITIVITY, S_t	1.37	(Silt + Clay) %	51

4.2.4. STRATUM - III:

This layer consists of hard, deep grey to brownish grey / yellowish brown silty clay / clayey silt with sand mixture, calcareous nodules, kankar & decomposed rock. The average properties of this layer are presented below.

Bulk Density, gms/cc	1.94	Specific gravity	2.65
Dry Density, gms/cc	1.59	Void Ratio	0.704
Natural Water Content %	22	Liquid limit %	47
TRSH-UU:		Plastic Limit %	18
Cohesion kg/sqcm	1.13	Shrinkage Limit %	10
Friction angle °	3°	GRAIN SIZE	
Unconfined cohesion, kg/sqcm	1.30	Gravel %	08
Remoulded cohesion, kg/sqcm	1.03	Sand %	42
SENSITIVITY, S_t	1.27	(Silt + Clay) %	49

4.2.5. STRATUM - IVA:

This layer is present only around BH-64 location and this layer consists of loose brownish grey silty sand with clay binder & gravel. The only UDS that could be collected from this layer show the following properties.

Bulk Density, gms/cc	1.78	Natural Water Content	7
Dry Density, gms/cc	1.66	GRAIN SIZE	
DRSH-CQ:		Gravel %	25
Cohesion kg/sqcm	0.22	Sand %	53
Friction angle °	33°	(Silt + Clay) %	22

4.2.6. STRATUM - IV:

This layer consists of medium dense to dense brownish grey silty sand with clay binder & decomposed rock. The only UDS that could be collected from this layer shows the following properties.

Bulk Density, gms/cc	1.77	Natural Water Content	11
Dry Density, gms/cc	1.59	GRAIN SIZE	
DRSH-CQ:		Gravel %	04
Cohesion kg/sqcm	0.18	Sand %	76
Friction angle °	35°	(Silt + Clay) %	20

Project: Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.



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4.2.7. STRATUM - V:

The soil in this layer consists of very dense, brownish grey / yellowish brown silty sand with moorum, decomposed rock. Calcareous nodules have also been observed in this layer. The average properties of this layer are presented below.

Bulk Density, gms/cc	1.79	Specific gravity	2.66
Dry Density, gms/cc	1.64		
Natural Water Content %	9	GRAIN SIZE	
DRSH-CQ:		Gravel %	14
Cohesion kg/sqcm	0.12	Sand %	62
Friction angle °	37°	(Silt + Clay) %	22

4.2.8. STRATUM - VI:

This is a rock layer and this layer consists of completely to highly weathered, light grey / brownish grey, fine to medium grained, highly to moderately fractured gneissic rock. The core recovery of this layer ranges from 0% to 25% with nil RQD.

Only one type of test was carried out on the rock samples viz.

1. Determination of Point Load Strength Index.

The average properties of this layer as revealed from the routine laboratory test are as follows.

Bulk Density, gms/cc	2.507
Dry Density, gms/cc	2.483
Water Content %	0.963
Specific Gravity	2.545
Porosity %	2.284
Point Load Strength Index, kg/sqcm	7.85
Slake Durability Index, %	88.94

4.2.9. STRATUM - V:

This is also a rock layer, consists of highly to moderately weathered, light grey / brownish grey, fine to medium grained, highly to moderately fractured gneissic rock. The core recovery of this layer varies from 26% to 50% and RQD varies from 0% to 23%..

The following tests were carried out on the rock samples viz.

1. Unconfined Compressive Strength determination of the rock samples after 24 hours full submergence and thereafter air drying before testing (i.e. saturated condition).
2. Determination of Point Load Strength Index.

Project: Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.



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The average properties of this layer as revealed from the routine laboratory test are as follows.

Bulk Density, gms/cc	2.726	UCS (saturated water content), kg/sqcm	205
Dry Density, gms/cc	2.705	Point Load Strength Index, kg/sqcm	11.91
Water Content %	0.778	Slake Durability Index, %	87.62
Specific Gravity	2.780		
Porosity %	2.128	E, kg/sqcm	2293

4.2.10. STRATUM - VI:

This is also a rock layer and continues upto the terminating depth of few boreholes, consists of moderately to slightly weathered / fresh, light grey / brownish grey, fine to medium grained, highly to moderately fractured gneissic rock. The core recovery of this layer varies from 51% to 89% and RQD varies from 0% to 58%.

The average properties of this layer as revealed from the routine laboratory test are as follows.

Bulk Density, gms/cc	2.843	UCS (insitu water content), kg/sqcm	407
Dry Density, gms/cc	2.826	UCS (saturated water content), kg/sqcm	317
Water Content %	0.602	Co-efficient of Softening	0.779
Specific Gravity	2.883	Point Load Strength Index, kg/sqcm	33.81
Porosity %	1.702	Slake Durability Index, %	93.81
		E, kg/sqcm	7846

4.3. GRAPHICAL PRESENTATION:

The detailed Laboratory Test Results in tabular form are given in Volume-2. The back up sheets are also presented there as given in below:

1. *Strength envelopes from Triaxial Tests.*
2. *Normal Stress vs. Shear Stress from Direct Shear Tests.*
3. *Standard Proctor Compaction Curves.*
4. *CBR Curves.*
5. *e-log p curves from consolidation tests.*
6. *Grain size distribution curves for sieve and hydrometer tests.*

The consolidation test results are analysed by numerical methods and only the final output in a tabular form is given. The m_{vc} indicates the time dependent component of m_v and c_v is the co-efficient of consolidation.

5. DISCUSSION

5.1. PLATE LOAD TEST:

Total 5 nos. Plate Load Tests were conducted in the site (three nos. are of routine type & the two nos. are of cyclic type) in this zone at specified depths using 600mm square plate. Load (Vs.) settlement plots is made in arithmetic as well as log-log scale to calculate Allowable Bearing Capacity, Young's modulus. The calculations are presented below separately.

DETERMINATION OF SAFE BEARING CAPACITY:

Settlement is below 25mm, so as per Cl. 4.7 of IS:1888, ultimate Load = 80.77 t/sqm, applying a factor of safety of 2.00, safe bearing capacity = $80.77/2.00 = 40.39$ t/sqm.

The summarised test results are given below.

Test No.	Depth (M)	Safe Bearing Capacity, T/M ²
PLT - 01	3.00	40
PLT - 02	3.00	40
PLT - 03	3.00	40
PLT - 04	3.00	40
PLT - 05	3.00	24

SUBGRADE MODULUS:

Subgrade Modulus is obtained from Plate Load Tests as $K = P/S$. Where P = Plate Load corresponding to settlement S under working load. The final results values are presented in a tabular form below.

Test No.	Depth (M)	Subgrade Modulus for Plate as per IS 9214, Kg/cm ³	Subgrade Modulus for Plate, correcting as per IS 9214 Kg/cm ³
PLT - 01	3.00	5.57	4.51
PLT - 02	3.00	4.24	3.72
PLT - 03	3.00	8.80	6.35
PLT - 04	3.00	6.20	4.87
PLT - 05	3.00	1.92	1.50
CPLT - 01	3.00	9.74	6.88
CPLT - 02	3.00	1.93	1.51
CPLT - 03	3.00	2.50	1.95
CPLT - 04	3.00	6.62	5.11
CPLT - 05	3.00	5.24	4.32

Project: Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.

CETEST

Job No. : 3421

Sheet No.

PLATE LOAD TEST NO. 01

Commenced on: 04/03/2015
 Completed on: 05/03/2015
 Pit size: 3.00mX3.00mX3.00m(depth)
 Load on pr.guage/divn.=10Kg/sq.cm
 Load on jack/divn. = 1.42t
 Plate size: 0.60mX0.60m
 Load on plate/divn. = 3.94t/sq.m.

Test Type: Routine PLT

Co-ordinates:
 E = 466245.000M.
 N = 1947743.000M.
 RL = 111.742M.

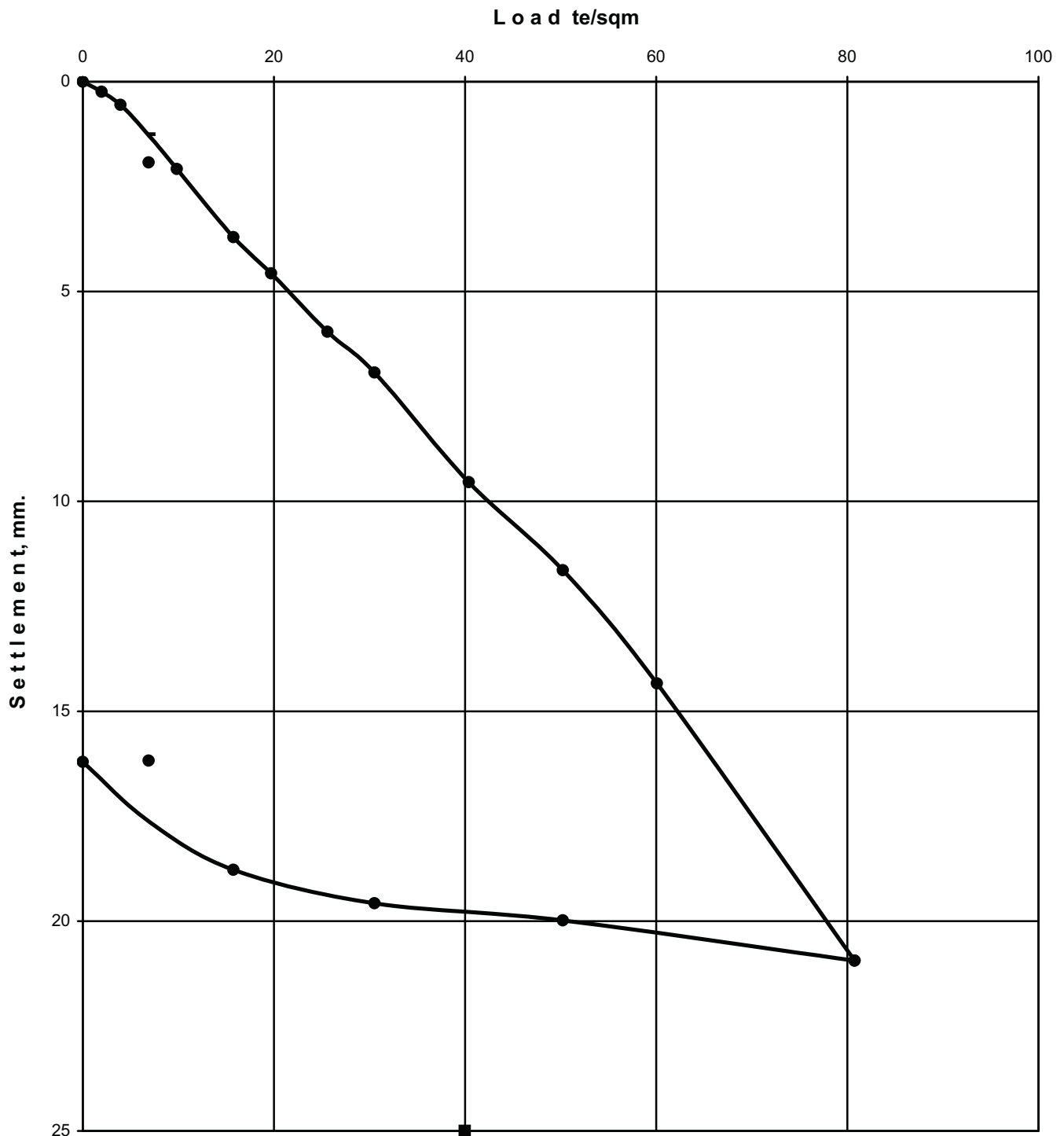
S.W.L.= Not found.

Description of Soil :-

(EGL - 0.30)m:- Top soil consists of clayey silt. Obs. moorum & boulder.

(0.30 - 1.50)m:- Light grey, sandy silt with decomposed rock.

(1.50 - 3.00)m:- Reddish brown, moorum. Obs. boulder & decomposed rock.

**FIG. 3.1. LOAD VS SETTLEMENT GRAPH FOR PLT - 01**

Project: Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana**CETEST****Job No. : 3421****Sheet No.****PLATE LOAD TEST NO. 02**

Commenced on: 05/03/2015
 Completed on: 05/03/2015
 Pit size: 3.00mX3.00mX3.00m(depth)
 Load on pr.guage/divn.=20Kg/sq.cm
 Load on jack/divn. = 1.42t
 Plate size: 0.60mX0.60m
 Load on plate/divn. = 3.94t/sq.m.

Test Type: Routine PLT

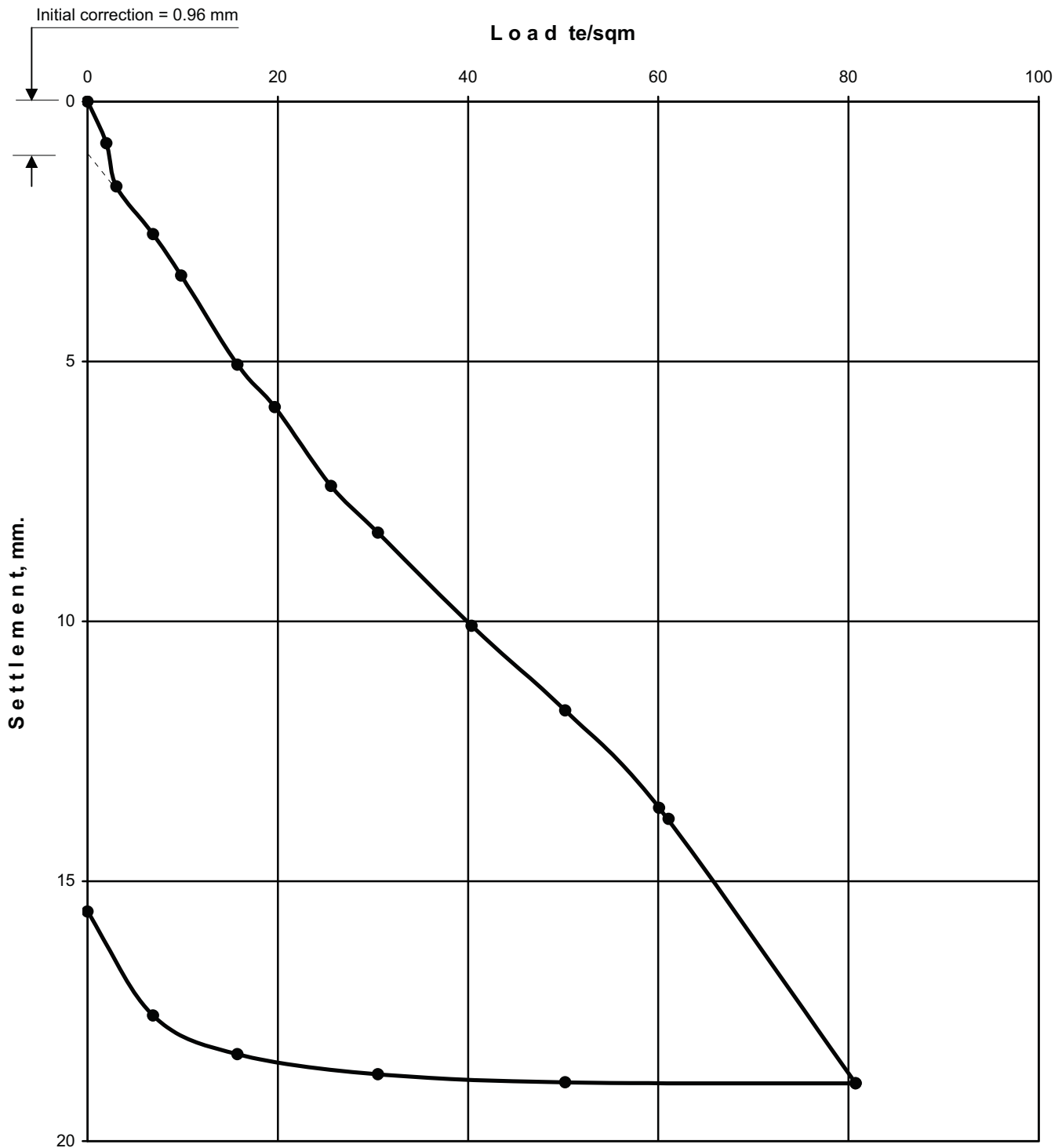
Co-ordinates:
 E = 467684.000M.
 N = 1946893.085M.
 RL = 103.022M.

S.W.L.= Not found.

Description of Soil :-

(EGL-1.40)m:- Blackish grey, silty clay with gravels. Obs. calcareous nodules.

(1.40-3.00)m:- Light grey, silty sand with decomposed rock & boulders.

**FIG. 3.2. LOAD VS SETTLEMENT GRAPH FOR PLT - 02**

Project: Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.

CETEST

Job No. : 3421

Sheet No.

PLATE LOAD TEST NO. 03

Commenced on: 26/02/2015
 Completed on: 27/02/2015
 Pit size: 3.00mX3.00mX3.00m(depth)
 Load on pr.guage/divn.=20Kg/sq.cm
 Load on jack/divn. = 1.42t
 Plate size: 0.60mX0.60m
 Load on plate/divn. = 3.94t/sq.m.

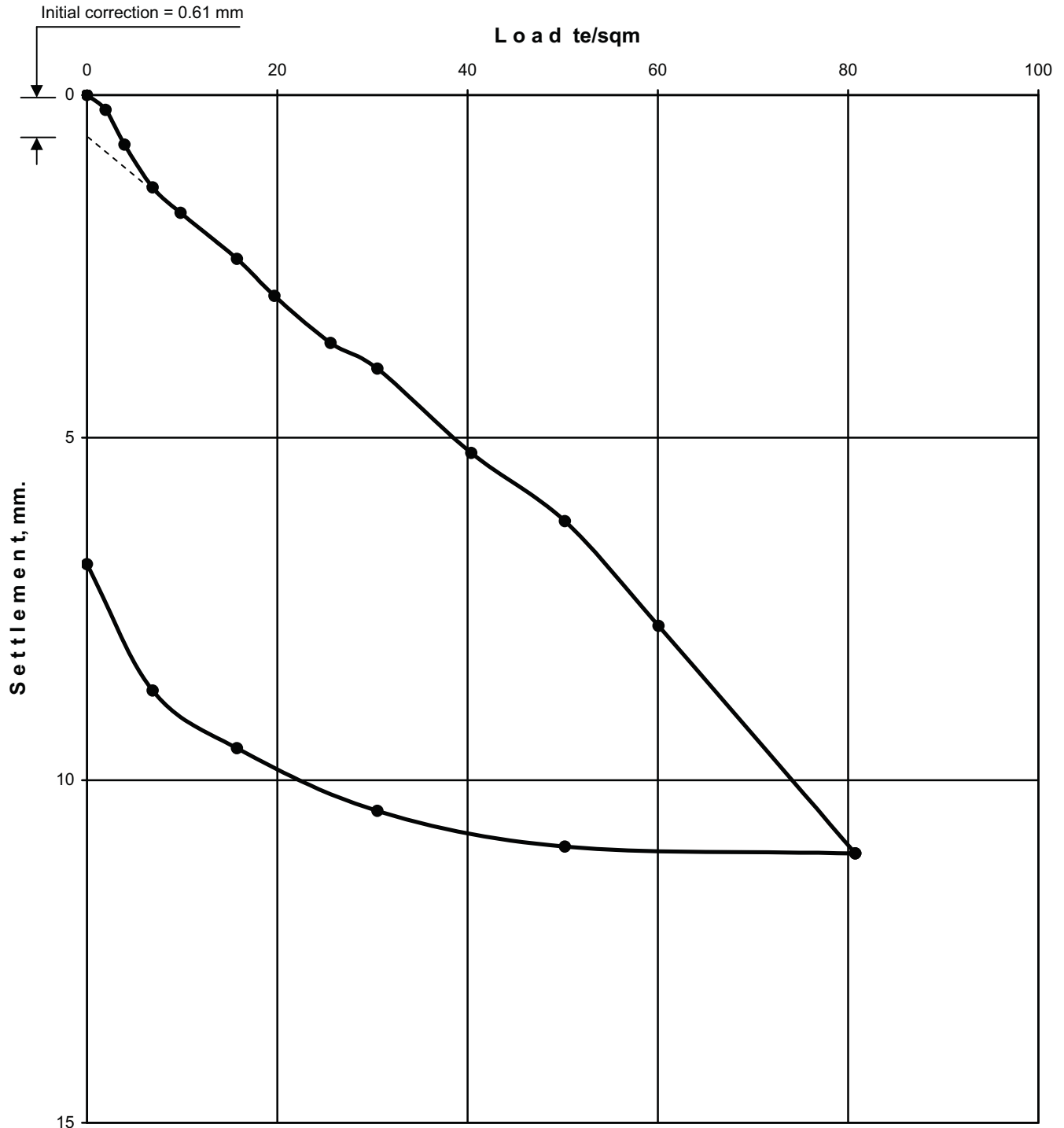
Test Type: Routine PLT

Co-ordinates:
 E = 467836.000M.
 N = 1947037.000M.
 RL = M.

S.W.L.= 2.70 m.

Description of Soil :-

(EGL-0.60)m:- Deep grey, silty clay with sand mixture. Obs. calcareous nodules & gravels.
 (0.60-1.80)m:- Brownish grey to whitish grey, clayey silty sand with high % of calcareous nodules. Obs. gravels.
 (1.80-3.00)m:- Light grey to brownish grey, silty sand with decomposed rock.

**FIG. 3.3. LOAD VS SETTLEMENT GRAPH FOR PLT - 03**

Project: Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.

CETEST

Job No. : 3421

Sheet No.

PLATE LOAD TEST NO. 04

Commenced on: 18/02/2015
 Completed on: 19/02/2015
 Pit size: 3.00mX3.00mX3.00m(depth)
 Load on pr.guage/divn.=20Kg/sq.cm
 Load on jack/divn. = 1.42t
 Plate size: 0.60mX0.60m
 Load on plate/divn. = 3.94t/sq.m.

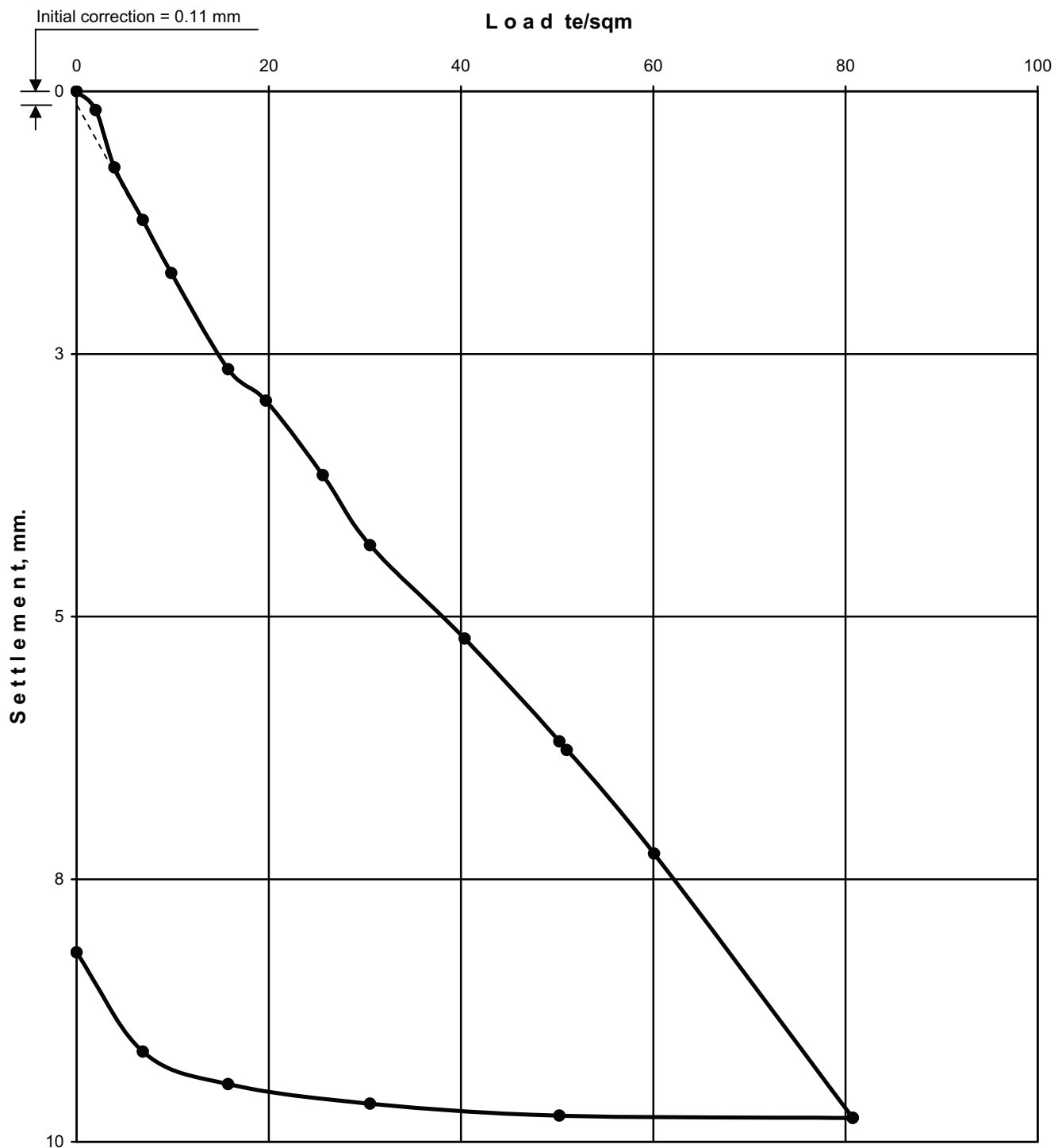
Test Type: Routine PLT

Co-ordinates:
 E = 467864.000M.
 N = 1947181.000M.
 RL = 100.412M.

S.W.L. = 2.60 m..

Description of Soil :-

(EGL-0.30)m:- Deep grey, silty clay with gravels. Obs. boulder.
 (0.30-2.10)m:- Light grey, moorum with boulder. Obs. calcareous nodules.
 (2.10-3.00)m:- Light grey , decomposed rock with boulder.

**FIG. 3.4. LOAD VS SETTLEMENT GRAPH FOR PLT - 04**

Project: Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.

CETEST

Job No. : 3421

Sheet No.

PLATE LOAD TEST NO. 05

Commenced on: 31/03/2015
 Completed on: 01/04/2015
 Pit size: 3.00mX3.00mX3.00m(depth)
 Load on pr.guage/divn.=10Kg/sq.cm
 Load on jack/divn. = 1.42t
 Plate size: 0.60mX0.60m
 Load on plate/divn. = 1.97t/sq.m.

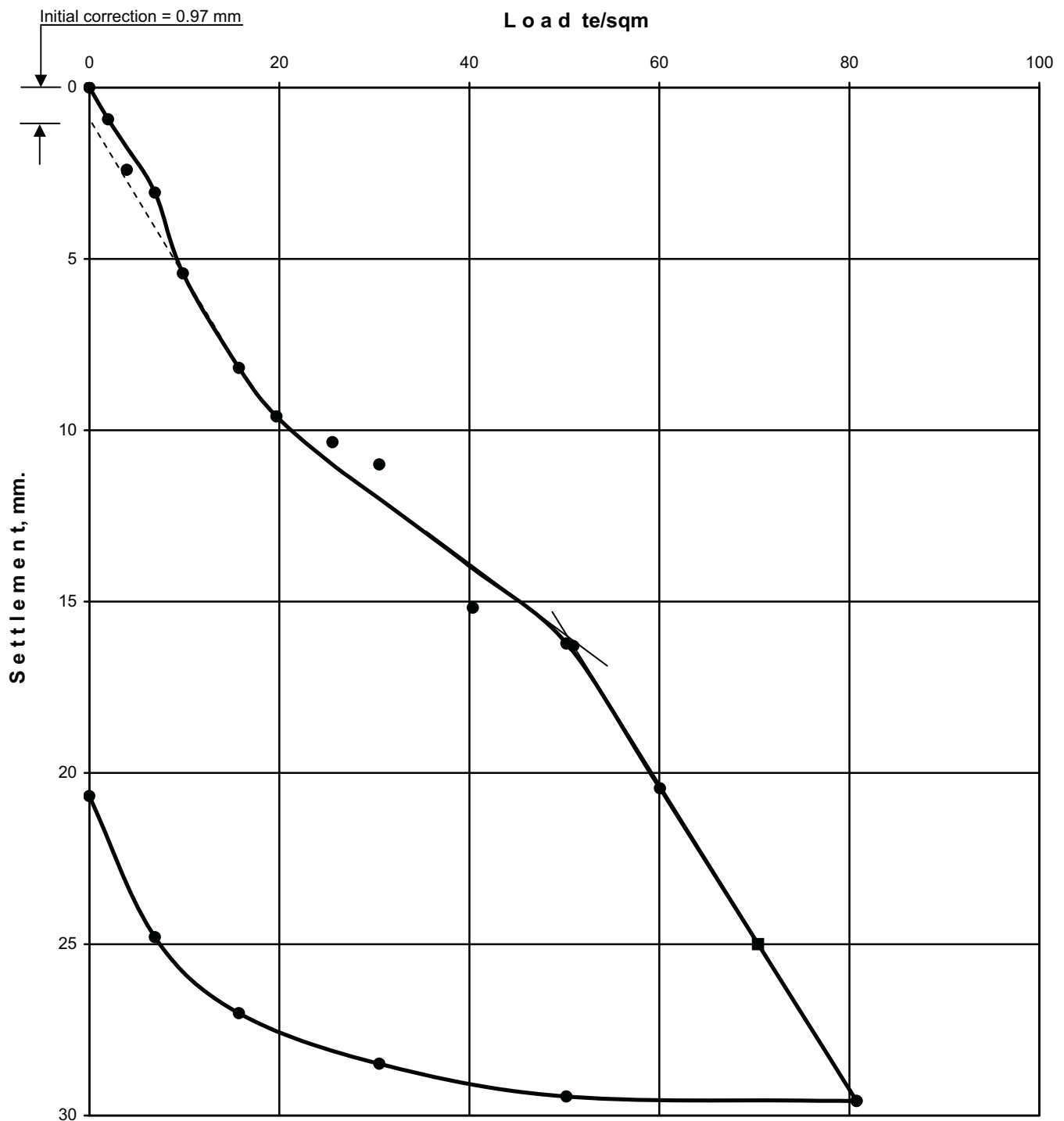
Test Type: Routine PLT

Co-ordinates:
 E = 468212.000M.
 N = 1947206.000M.
 RL = 97.520M.

S.W.L.= Not found.

Description of Soil :-

(EGL - 1.80)m:- Deep grey, silty clay with kankars.
 (1.80 - 2.40)m:- Yellowish brown, moorum with clacareous nodules.
 (2.40 - 3.00)m:- Light grey, decomposed rock. Obs. clay binder.

**FIG. 3.5. LOAD VS SETTLEMENT GRAPH FOR PLT - 05**

Project: Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.

CETEST

Job No. : 3421

Sheet No.

CYCLIC PLATE LOAD TEST NO. 01

Commenced on: 25/03/2015
 Completed on: 26/03/2015
 Pit size: 3.00mX3.00mX3.00m(depth)
 Load on pr.guage/divn. = 20Kg/sq.cm
 Load on jack/divn. = 14.2t
 Plate size: 0.60mX0.60m
 Load on plate/divn. = 3.94t/sq.m.

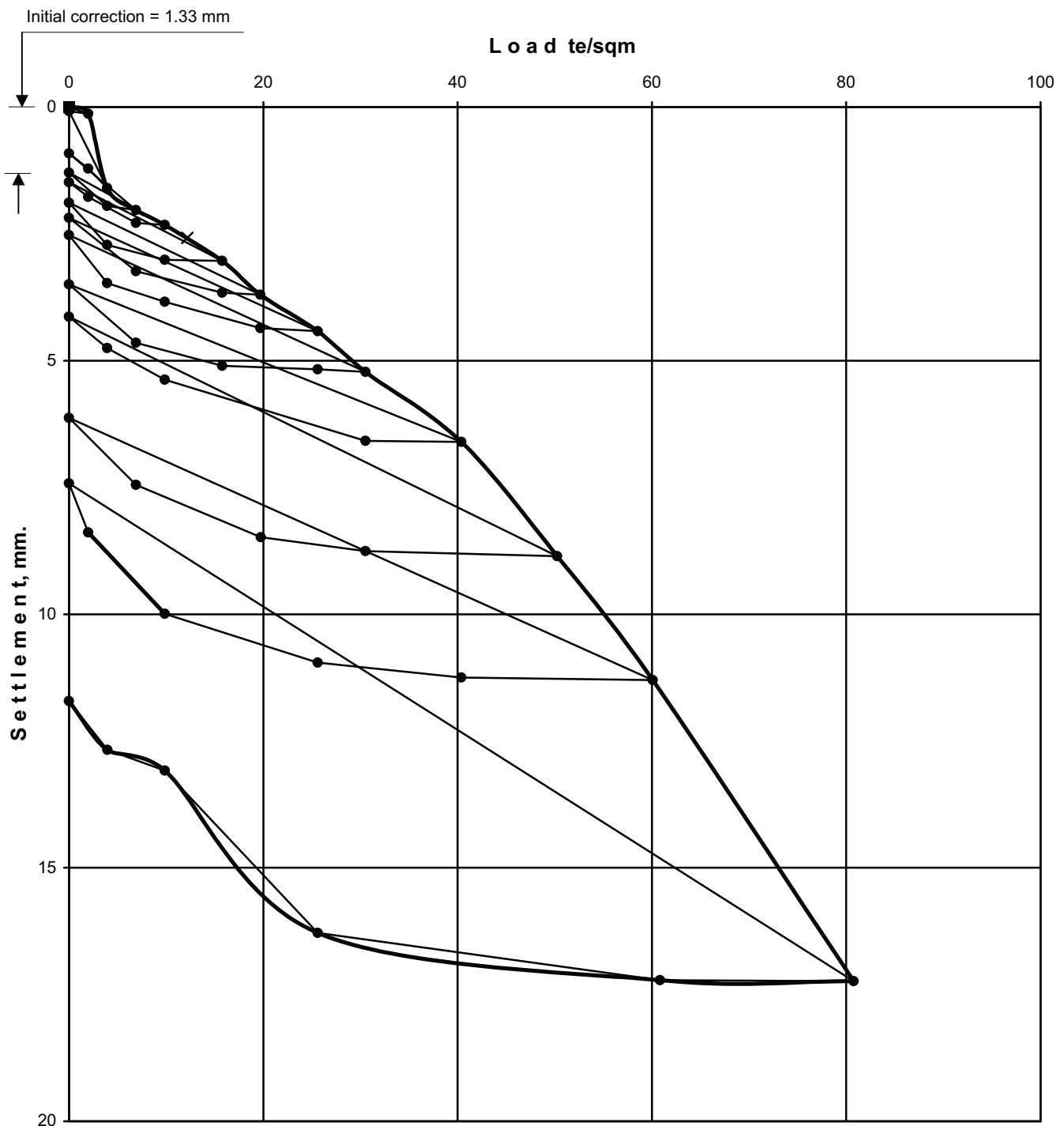
Test Type: Cyclic PLT

Co-ordinates:
 E = 467945.000m.
 N = 1947030.000m.
 RL = 98.902m.

S.W.L. = Not found

Description of Soil :-

(EGL - 0.80)m:- Deep grey, silty clay with sand mixture.
 Obs. calcareous nodules.
 (0.80 - 2.30)m:- Brownish grey, clayey silty sand. Obs.
 calcareous nodules & residual soil.
 (2.30 - 3.00)m:- Light grey, silty sand with decomposed
 rock.

**FIG.3.6. LOAD VS SETTLEMENT GRAPH FOR CPLT - 01**

Project: Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.

CETEST

Job No. : 3421

Sheet No.

CYCLIC PLATE LOAD TEST NO. 02

Commenced on: 10/03/2015
 Completed on: 11/03/2015
 Pit size: 3.00mX3.00mX3.00m(depth)
 Load on pr.guage/divn. = 20Kg/sq.cm
 Load on jack/divn. = 14.2t
 Plate size: 0.60mX0.60m
 Load on plate/divn. = 3.94t/sq.m.

Test Type: Cyclic PLT

Co-ordinates:
 E = 467919.000m.
 N = 1947103.000m.
 RL = 99.385m.

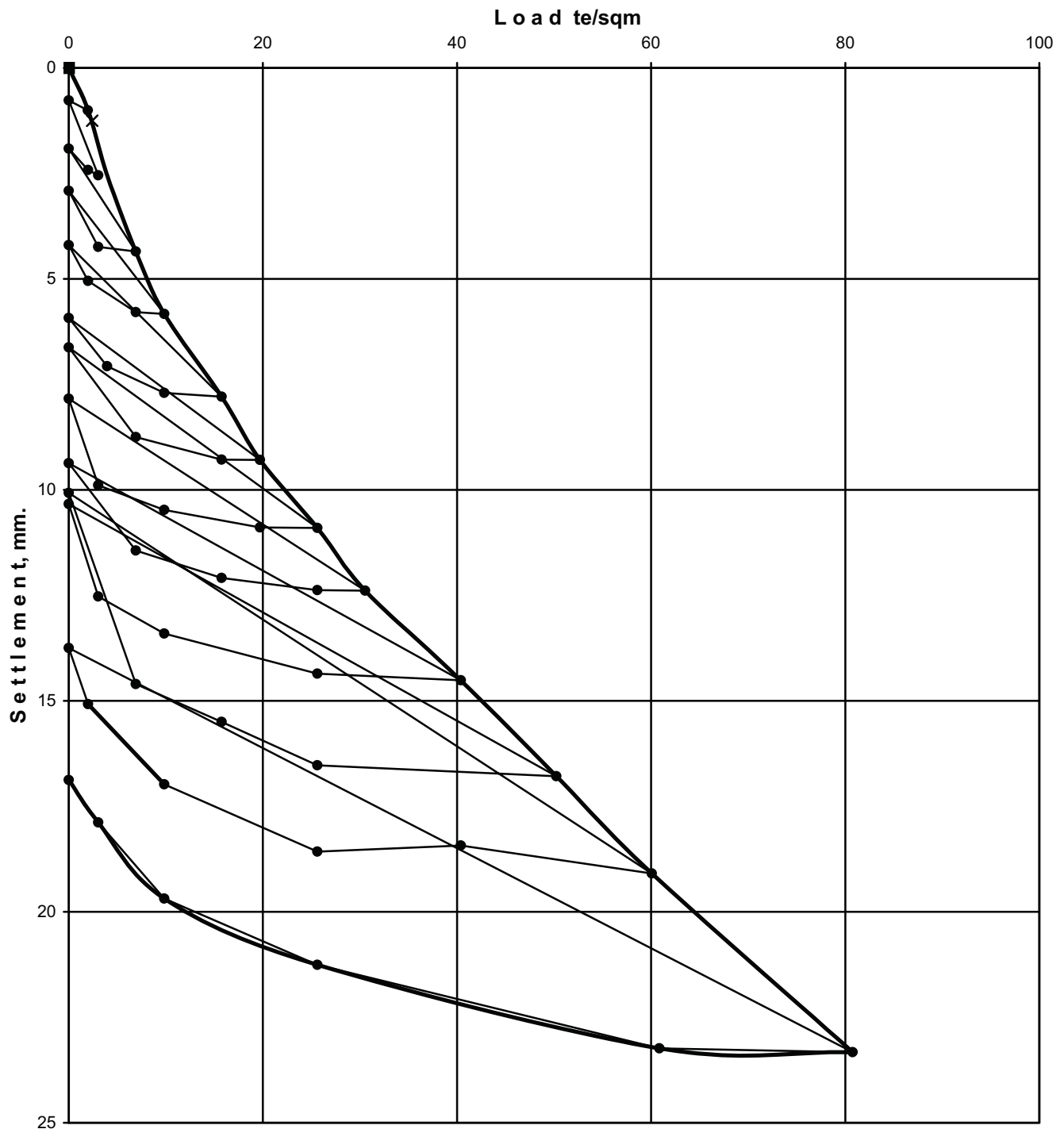
S.W.L. = Not found

Description of Soil :-

(EGL - 1.20)m:- Deep grey, silty clay. Obs. gravels & calcareous nodules.

(1.20 - 2.00)m:- Light grey, clayey silty sand with decomposed rock & calcareous nodules.

(2.00 - 3.00)m:- Light grey, silty sand with decomposed rock

**FIG.3.7. LOAD VS SETTLEMENT GRAPH FOR CPLT - 02**

Project: Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.

CETEST

Job No. : 3421

Sheet No.

CYCLIC PLATE LOAD TEST NO. 03

Commenced on: 14/03/2015
 Completed on: 15/03/2015
 Pit size: 3.00mX3.00mX3.00m(depth)
 Load on pr.guage/divn. = 20Kg/sq.cm
 Load on jack/divn. = 14.2t
 Plate size: 0.60mX0.60m
 Load on plate/divn. = 3.94t/sq.m.

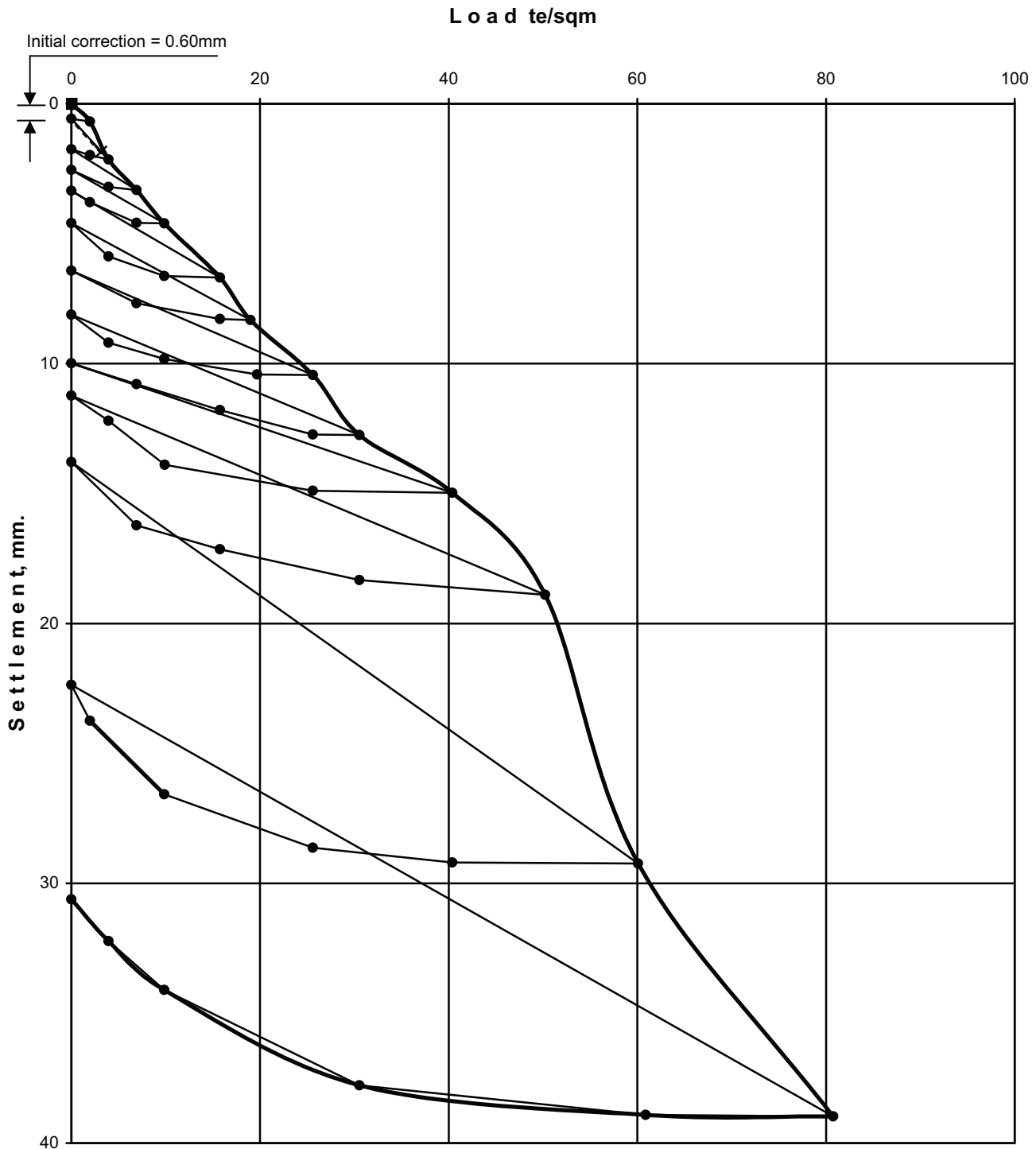
Test Type: Cyclic PLT

Co-ordinates:
 E = 468003.000m.
 N = 1947162.000m.
 RL = 98.239m.

S.W.L. = Not found

Description of Soil :-

(EGL - 1.30)m:- Deep grey silty clay with sand mixture.
 (1.30 - 2.40)m - Brownish grey to whitish grey clayey silt with sand mixture & calcareous nodules. Obs. gravles.
 (2.40 - 3.00)m - Brownish grey silty sand with decomposed rock.

**FIG.3.8. LOAD VS SETTLEMENT GRAPH FOR CPLT - 03**

Project: Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana.

CETEST

Job No. : 3421

Sheet No.

CYCLIC PLATE LOAD TEST NO. 04

Commenced on: 16/03/2015
 Completed on: 17/03/2015
 Pit size: 3.00mX3.00mX3.00m(depth)
 Load on pr.guage/divn. = 20Kg/sq.cm
 Load on jack/divn. = 14.2t
 Plate size: 0.60mX0.60m
 Load on plate/divn. = 3.94t/sq.m.

Test Type: Cyclic PLT

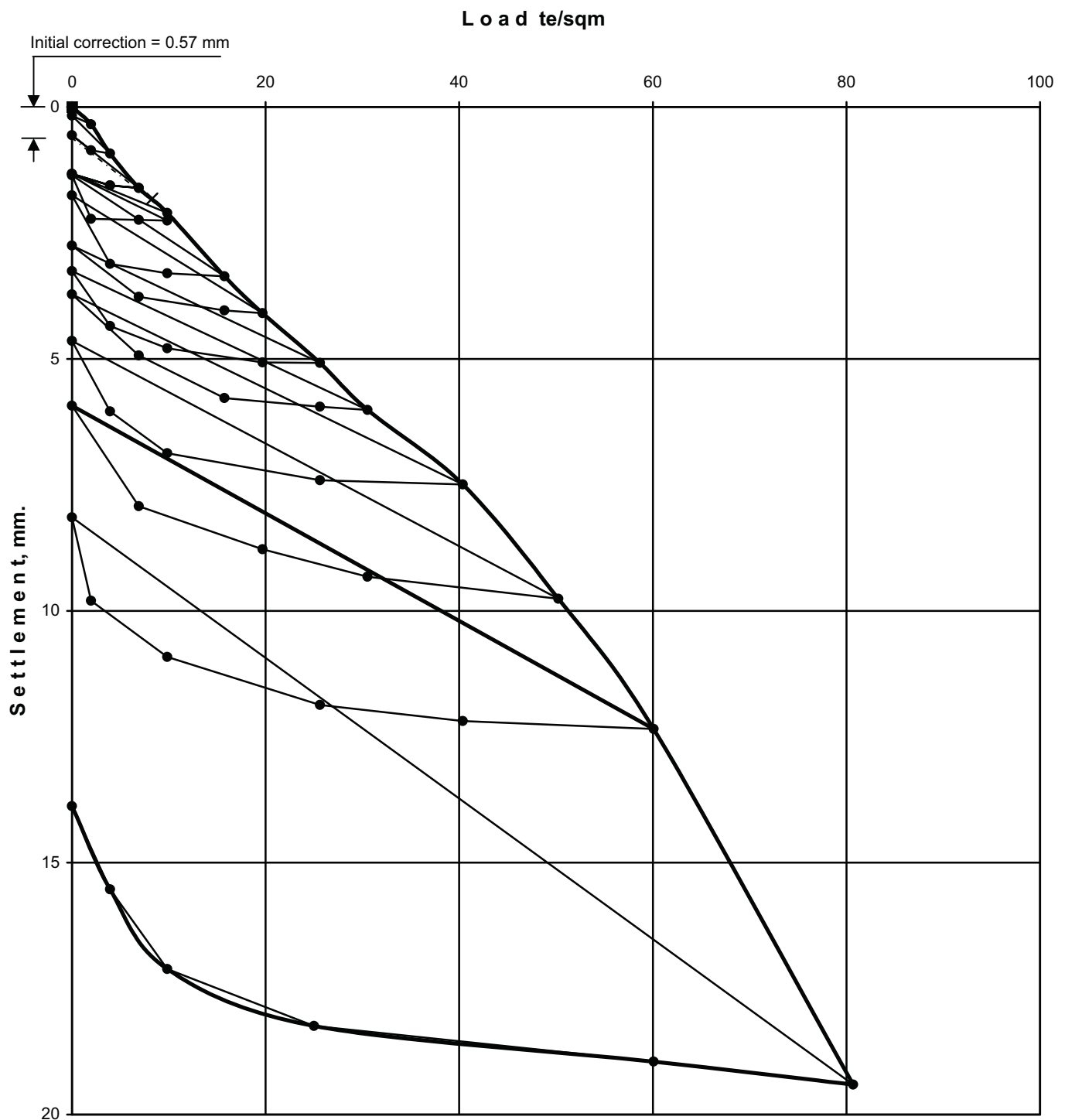
Co-ordinates:
 E = 468094.000m.
 N = 1947162.000m.
 RL = 98.012m.

S.W.L. = 2.70m

Description of Soil :-

(EGL - 1.50)m:- Deep grey, silty clay with sand mixture.
 Obs. calcareous nodules.

(1.50 - 3.00)m:- Brownish grey with white patches, clayey silty sand with decomposed rock.

**FIG. 3.9. LOAD VS SETTLEMENT GRAPH FOR CPLT - 04**

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CYCLIC PLATE LOAD TEST NO. 05

Commenced on: 21/03/2015
 Completed on: 22/03/2015
 Pit size: 3.00mX3.00mX3.00m(depth)
 Load on pr. gauge/divn. = 20Kg/sq.cm
 Load on jack/divn. = 14.2t
 Plate size: 0.60mX0.60m
 Load on plate/divn. = 3.94t/sq.m.

Test Type: Cyclic PLT

Co-ordinates:
 E = 468136.000m.
 N = 1947271.000m.
 RL = 97.209m.

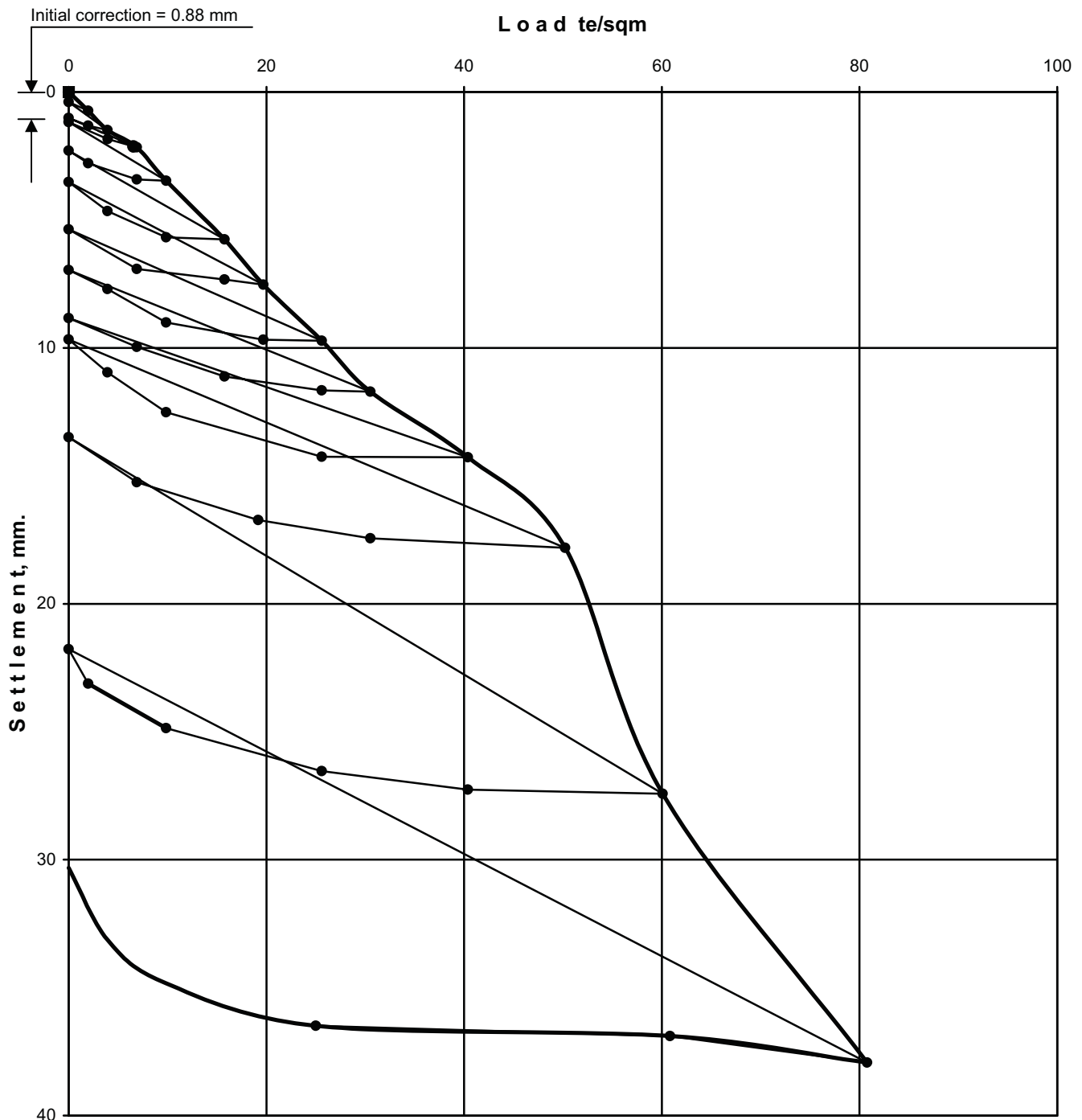
S.W.L. = Not found

Description of Soil :-

(EGL - 2.30)m:- Deep grey, silty clay with calcareous nodules.

(2.30 - 2.60)m:- Whitish grey, clayey silt with calcareous nodules & decomposed rock.

(2.60 - 3.00)m:- Light grey, clayey silty sand with decomposed rock.

**FIG.3.10 LOAD VS SETTLEMENT GRAPH FOR CPLT - 05**

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The Subgrade modulus value is inversely proportional to the square root of the foundation area up to a base area of 10 sqm and then remains constant. The calculated subgrade modulus values for different foundation areas are presented below.

Test No.	Depth (M)	Subgrade Modulus, (kg/cucm)			
		Foundation Area = 1 sqm	Foundation Area = 4 sqm	Foundation Area = 5 sqm	Foundation Area = 10 sqm or above
PLT - 01	3.00	2.71	1.35	1.21	0.86
PLT - 02	3.00	2.23	1.12	1.00	0.71
PLT - 03	3.00	3.81	1.91	1.70	1.20
PLT - 04	3.00	2.92	1.46	1.31	0.92
PLT - 05	3.00	0.90	0.45	0.40	0.28
CPLT - 01	3.00	4.13	2.06	1.85	1.31
CPLT - 02	3.00	0.91	0.45	0.41	0.29
CPLT - 03	3.00	1.17	0.59	0.52	0.37
CPLT - 04	3.00	3.07	1.53	1.37	0.97
CPLT - 05	3.00	2.59	1.30	1.16	0.82

Sample Calculation of Subgrade Modulus for foundation area 5 Sq.m of PLT-03

For Plate

Safe Load, corresponding to 1.25mm settlement = 11.00 t/sqm

Subgrade Modulus for Plate, $K = P/S = 11.00/1.25 = 8.80 \text{ Kg/cm}^3$

Since the test was conducted on 600mm square plate (i.e. smaller than 75cm dia.), corrected Subgrade Modulus as per Clause 5.1.1 & Fig.3 of IS:9214 = $8.80 / 1.28 = 6.88 \text{ Kg/cm}^3$

Again applying correction for plate bending, as per Clause 5.1.3 & Fig.5 of IS:9214, corrected Subgrade Modulus = 6.35 Kg/cm^3

For Foundation

Corrected Subgrade Modulus of plate = 6.35 Kg/cm^3

Area of plate = $60 \times 60 \text{ sq.cm} = 0.60 \times 0.60 \text{ sq.m}$

Area of footing = 5 sq.m

Subgrade Modulus of foundation = $6.35 \times \sqrt{(0.60 \times 0.60)/5} \text{ Kg/cm}^3 = 1.70 \text{ Kg/cm}^3$

ELASTIC COMPRESSION:

For Cyclic Plate Load Tests, after application of each load increment and full stabilisation of plate settlement, the applied load was reduced to zero and the settlement records were noted till full stabilisation. Thereafter, the next load increment was applied.

The elastic rebounds at these load intensities are calculated from the field data and are graphically presented in graph (Ref. fig. no. 3.11 – 3.15). The coefficient of elastic uniform compression, C_u is obtained as $C_u = P / S_e \text{ kg/cucm}$

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CPLT- 01:

From the load vs elastic rebound plot, the slope of the trend line = $C_u = (30-10)/(1.946-0.642) = 15.34 \text{ kg/cucm}$

Now, for a foundation size of 10 sqm (3m x 3.33m, say), the corresponding value will be,

$$C_{u10\text{sqm}} = 15.34 \times \sqrt{[(0.600 \times 0.600) / 10]} = 2.91 \text{ kg/cucm}$$

CPLT- 02:

From the load vs elastic rebound plot, the slope of the trend line = $C_u = (30-10)/(3.01-1.01) = 10.00 \text{ kg/cucm}$

Now, for a foundation size of 10 sqm (3m x 3.33m, say), the corresponding value will be,

$$C_{u10\text{sqm}} = 10.00 \times \sqrt{[(0.600 \times 0.600) / 10]} = 1.89 \text{ kg/cucm}$$

CPLT- 03:

From the load vs elastic rebound plot, the slope of the trend line = $C_u = (30-10)/(3.11-1.06) = 9.74 \text{ kg/cucm}$

Now, for a foundation size of 10 sqm (3m x 3.33m, say), the corresponding value will be,

$$C_{u10\text{sqm}} = 9.74 \times \sqrt{[(0.600 \times 0.600) / 10]} = 1.84 \text{ kg/cucm}$$

CPLT- 04:

From the load vs elastic rebound plot, the slope of the trend line = $C_u = (30-10)/(2.111-0.705) = 14.22 \text{ kg/cucm}$

Now, for a foundation size of 10 sqm (3m x 3.33m, say), the corresponding value will be,

$$C_{u10\text{sqm}} = 14.22 \times \sqrt{[(0.600 \times 0.600) / 10]} = 2.69 \text{ kg/cucm}$$

CPLT- 05:

From the load vs elastic rebound plot, the slope of the trend line = $C_u = (30-10)/(2.908-0.969) = 10.31 \text{ kg/cucm}$

Now, for a foundation size of 10 sqm (3m x 3.33m, say), the corresponding value will be,

$$C_{u10\text{sqm}} = 10.31 \times \sqrt{[(0.600 \times 0.600) / 10]} = 1.96 \text{ kg/cucm}$$

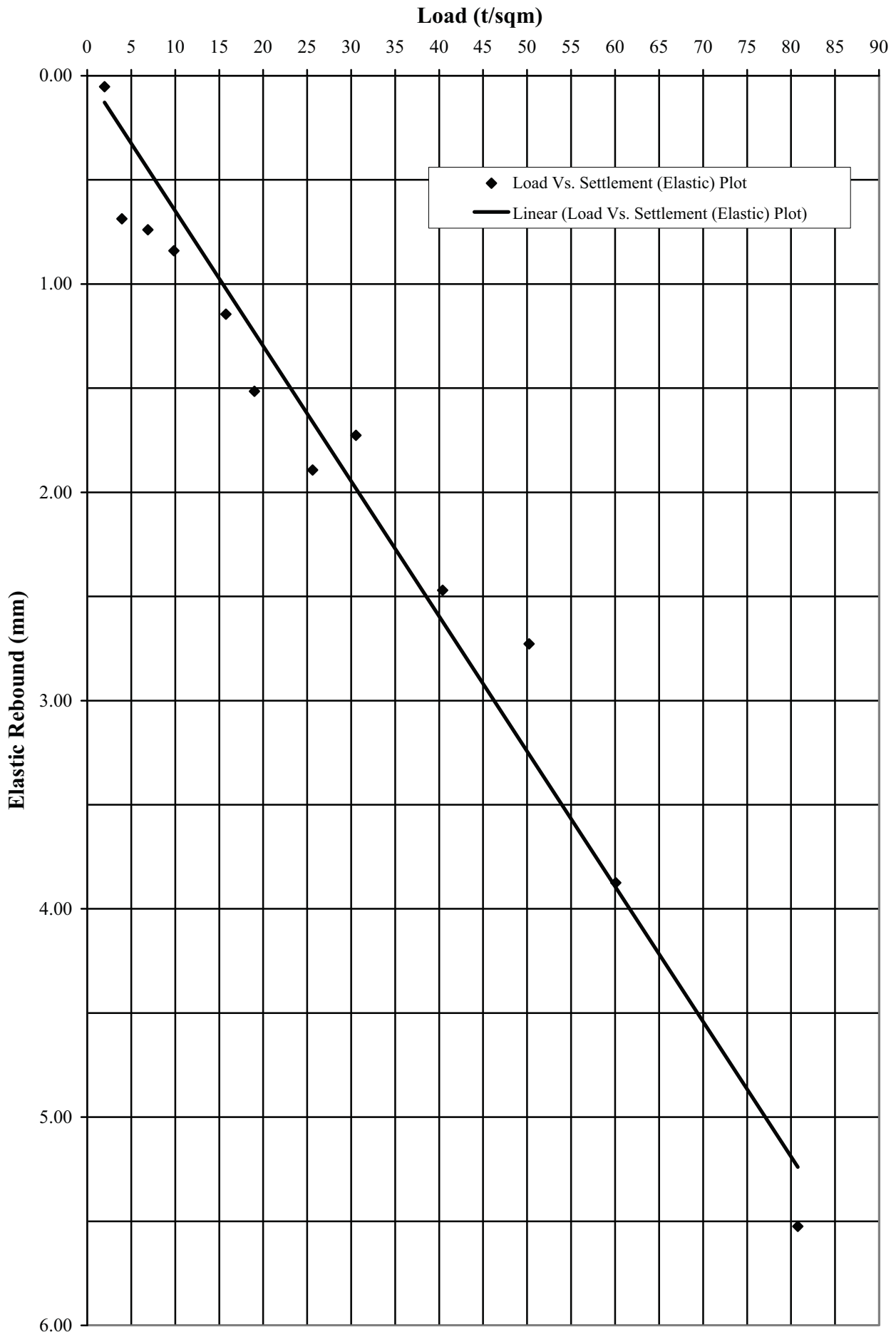
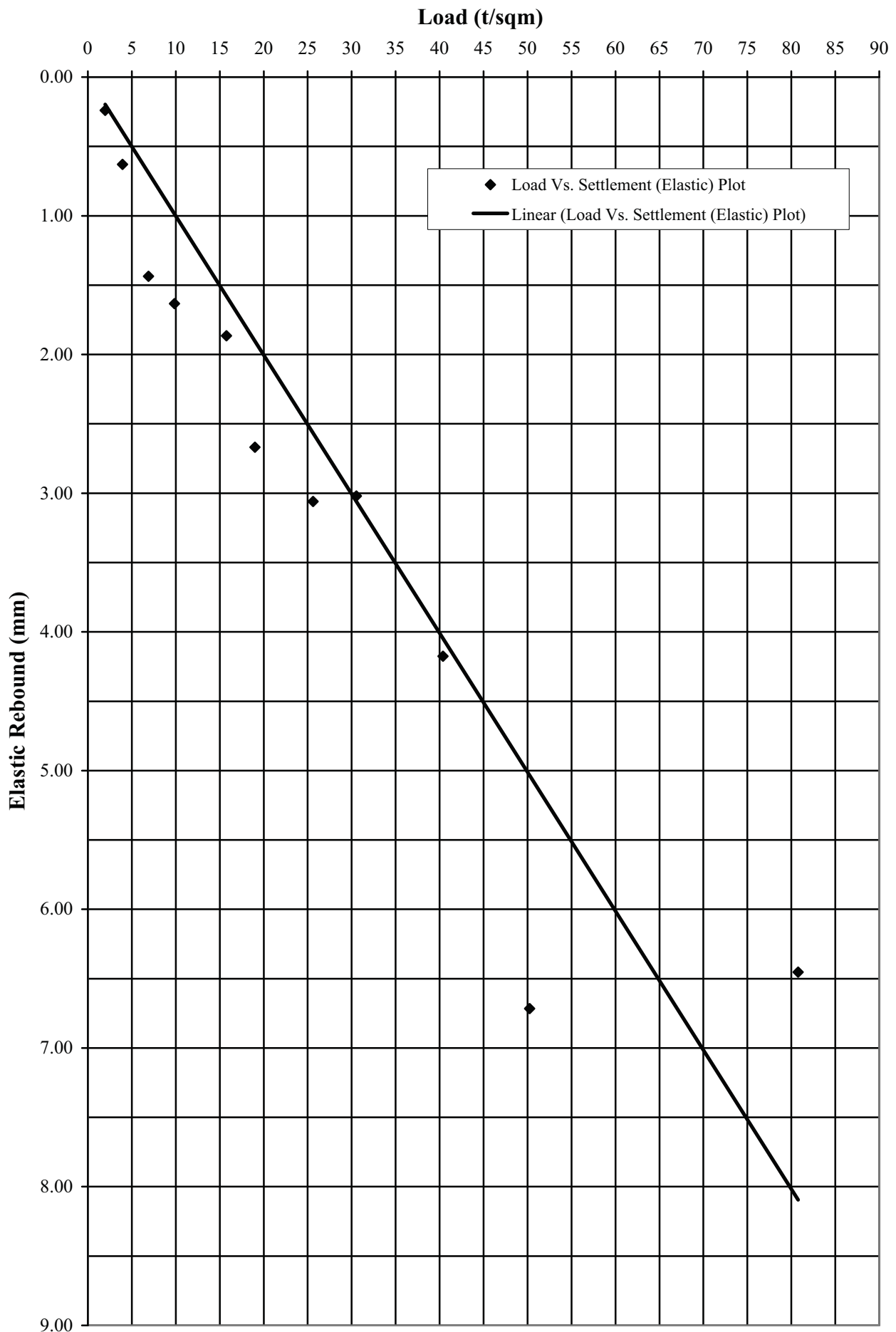
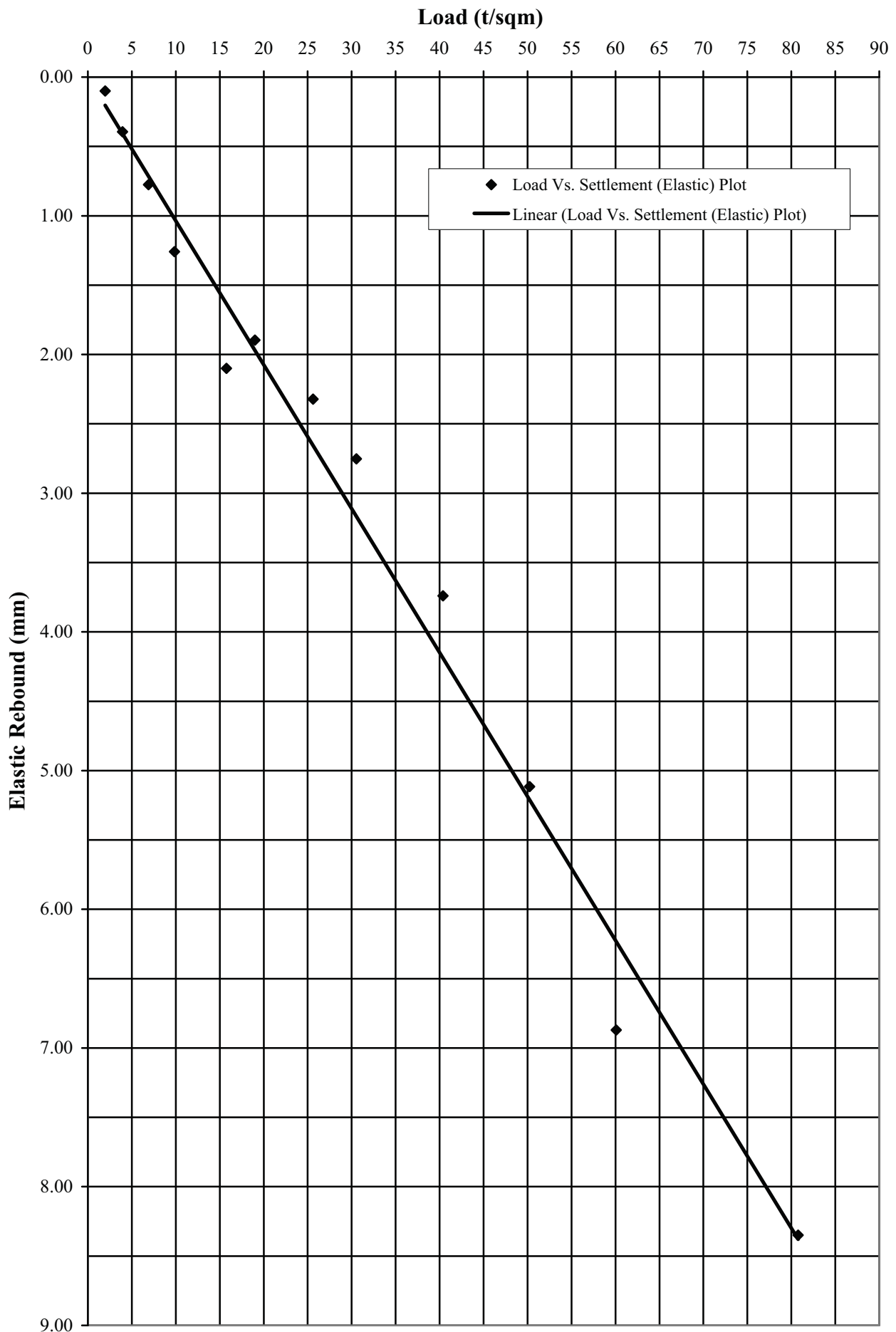


Fig. 3.11. Load vs. Elastic Rebound Plot (CPLT-01)

as per IS 5249 : 1992, Pg - 6

**Fig. 3.12. Load vs. Elastic Rebound Plot (CPLT-02)**

as per IS 5249 : 1992, Pg - 6

**Fig. 3.13. Load vs. Elastic Rebound Plot (CPLT-03)**

as per IS 5249 : 1992, Pg - 6

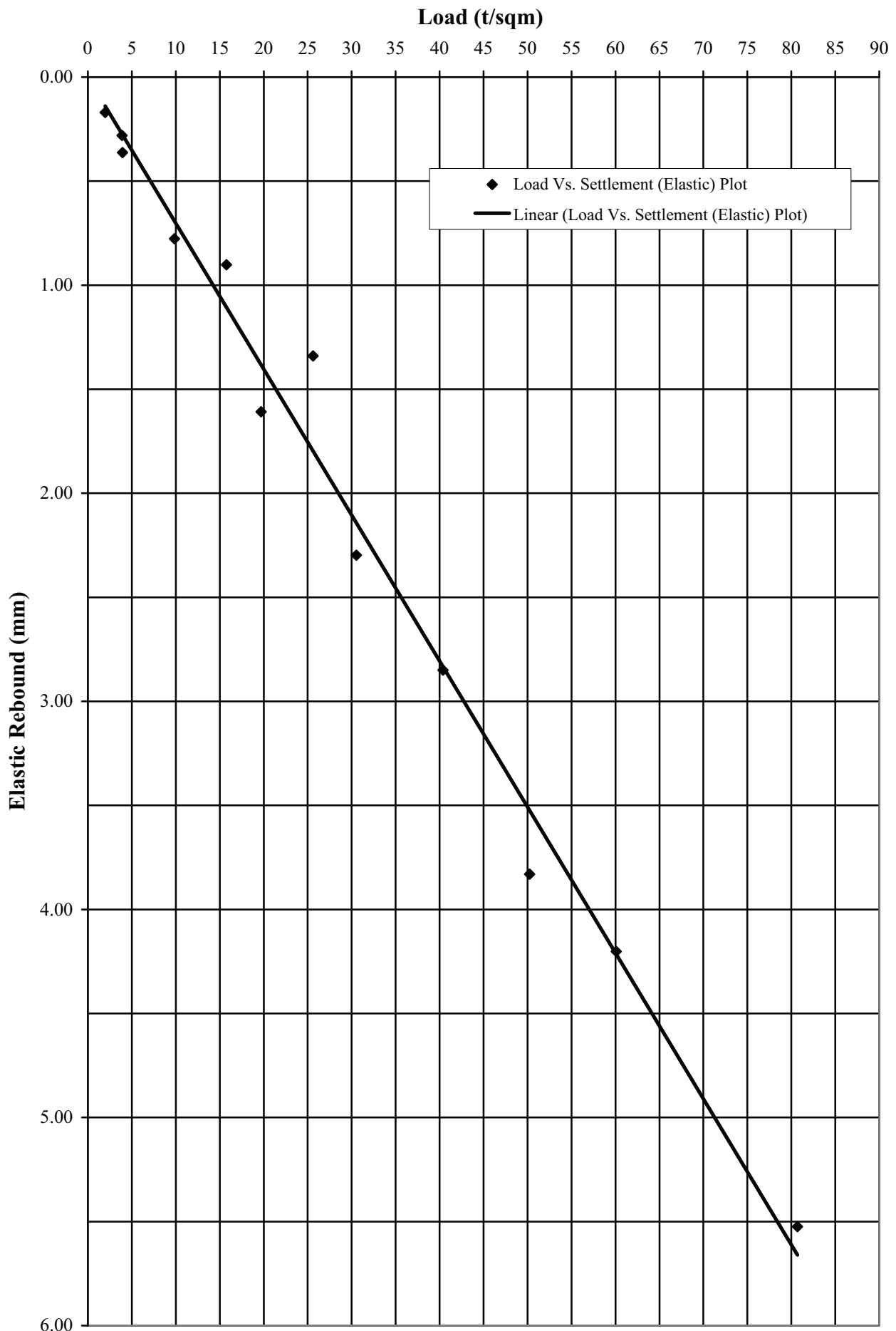
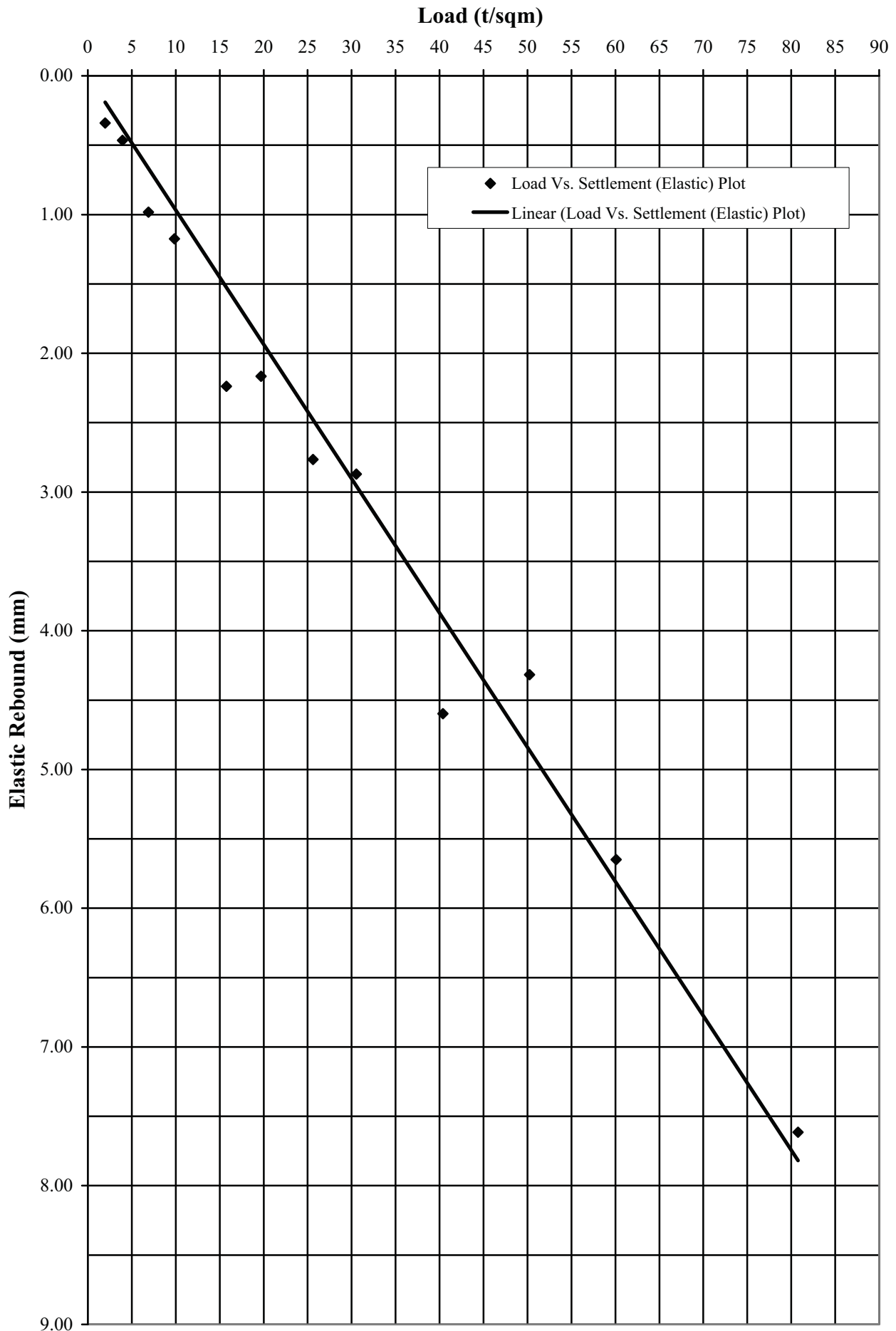


Fig. 3.14. Load vs. Elastic Rebound Plot (CPLT-04)

as per IS 5249 : 1992, Pg - 6

**Fig. 3.15. Load vs. Elastic Rebound Plot (CPLT-05)**

as per IS 5249 : 1992, Pg - 6

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5.2. DETAILS OF STRUCTURES:

The subsoil quality, thickness of each layer varies widely within the zone of investigation. Again, the type of structures to be constructed is different with different requirement. Considering all these aspect, the entire area is subdivided in to the following.

Sl. No.	Structure Name	Bore Hole Points	Reference Figure No.
1	Raw Water Storage Reservoir	BH-01 to 04	2.01
2	Watch Tower	BH-05	2.02
3	Watch Tower	BH-06	2.03
4	Proposed Area for Outdoor Storage	BH-07 & 52	2.04
5	Thickener	BH-08	2.05
6	400 KV Switch Yard & Switch Yard Control Room	BH-09, 10, 13, 17, 20	2.06
7	Clarifiers	BH-11	2.07
8	Chemical House	BH-12	2.08
9	Clarified Water Tank	BH-14	2.09
10	Centrilised Sewage Treatment System	BH-15	2.10
11	C.M.B. Waster Treatment System	BH-16	2.11
12	Fire Water Storage Tank & Pump House	BH-18	2.12
13	NDCT	BH-19, 25, 26	2.13
14	CW Treatment Area	BH-21	2.14
15	Transformer Yard	BH-22, 23, 27, 28	2.15
16	Side Stream Filtration Area	BH-24	2.16
17	Cooling Water Pump House	BH-29	2.17
18	Power house building including electrical bay	BH-30, 31, 33, 34, 37, 38, 39	2.18
19	ESP	BH-32, 53, 57, 58, 66	2.19
20	Service Building	BH-35	2.20
21	CPU Regeneration Area	BH-36	2.21
22	Boiler & Mill-Bunker Bay Area	BH-40, 41, 42, 47, 48, 49, 50, 51	2.22
23	DM Plant	BH-43	2.23
24	DG & Compressor House	BH-44	2.24
25	Condensate Storage Tank & Pump House	BH-45	2.25
26	Chemical Lab	BH-46	2.26
27	Canteen	BH-54	2.27
28	Indoor Store	BH-55	2.28
29	ESP Control Room	BH-56	2.29
30	HFO & LDO Storage Tank Dyke Area	BH-59	2.30
31	ID Fan	BH-60, 61	2.31
32	Chimney	BH-62, 63	2.32
33	Near Fire Station	BH-64	2.33
34	Administrative Building	BH-65	2.34
35	Raw Water Pump House	BH-67	2.35
36	HFO & LDO Unloading & Forwarding Pump House	BH-68	2.36

5.3. CHOICE OF FOUNDATION AND FOUNDING LEVEL:

Considering the nature of the subsoil and the type of structures to be constructed at the present site, it is suggested to go for open foundation. Such foundations should be placed at 1.00m or more below EGL depending on requirement. The determination of bearing capacity is presented below.

5.4. DETERMINATION OF BEARING CAPACITY AT COOLING TOWER LOCATION

Let us consider BH-19.

Let us place the foundation at 1.50m below FGL (FGL= 101.500M).

The founding level falls inside hard clay layer.

Design $N = 33$, So, estimated cohesion from "N" value = 1.22 kg/sqcm

From laboratory test results, Use $C = 1.10$ kg/sqcm & $\Phi = 4^\circ$.

Therefore average $C = 1.16$ kg/sqcm & $\Phi = 2^\circ$.

Use $C = C = 1.10$ kg/sqcm & $\Phi = 0^\circ$.

Evaluation of Strength & Deformation Parameters:

FOR STRATUM III

Total soil modulus, $E_s = 4.4 \times N = 145.2$ kg/sqcm

[Ref. to "History of Soil penetration testing" by B. B. Broms & N. Flodin in "Penetration Testing 1988", ISPOT-1: vol.1, p – 185]

Undrained Young's modulus, $E_u = K \times C = 500 \times 1.10 = 550$ kg/sqcm

Again, $1/E_s = 1/E_u + 1/E_d$ giving drained young's modulus, $E_d = 197.28$ kg/sqcm

Now, we have, $E_d = E_u/3 = 183.33$ kg/sqcm

[Refer to "Cone Penetration Testing" by A.C.Meigh, pp. No. – 53]

Considering the above, let us use $E_d = 190$ kg/sqcm

From E_d , $m_{vc} = 1/G.E_d = 0.0088$ sqcm/kg [Geological Factor, $G = 0.60$ & $\mu = 0.35$]

Again from SPT "N", $m_{vc} = 1/5N = 0.0061$ sqcm/kg

[Refer to "Standard Penetration Test, State-of-the-art-Report" by Ivan K. Nixon in

"Penetration testing 1" Edited by A.Verrujit, F.L.beringen & E.H.De Leeuw, pp. No. 11]

Therefore, average $m_{vc} = [0.0088 + 0.0061]/2 = 0.0075$ sqcm/kg

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Rock layer (Layer VI, VII & VIII)**Approach-1:**

The 'E' value for fissured and jointed rock varies from a minimum of 1500 kg/sqcm to a maximum of 30000 kg/sqcm whereas for sound rock the same is 30000 kg/sqcm or more.

[Refer to "Soil Mechanics and Foundation Engineering" 4th Edition by Prof. V. N. S. Murthy, pp – 271]

Approach-2:

Based on Pressuremeter test results, average Menard's Young's Modulus is 1208kg/sqcm for layer-VI.

Hence, young's modulus for layer VI = $1208/0.67 = 1803\text{kg/sqcm}$

Approach-3:

Again, from saturated UCS tests on rock samples, it is seen that the average E value of rock is about 2293kg/sqcm for layer VII & 7792 kg/sqcm for layer VIII respectively. However, these are for intact rock core pieces. However the overall design E value of a certain layer will be much lower due to presence of fracture, joints etc.

Based on the above three approaches, use the following design young's modulus values for further calculation.

For layer-VI, Young's modulus = 1000 kg/sqcm

For layer-VII, Young's modulus = 2000 kg/sqcm

For layer-VIII, Young's modulus = 4000 kg/sqcm

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Calculation of Safe Bearing Capacity:Use depth of foundation = 1.50M below FGL

The Net Ultimate Bearing Capacity is given as:

$$q_{nu} = C.N_c.S_c.D_c + q.N_q.S_q.D_q + 0.5\gamma.B.N_\gamma.S_\gamma.D_\gamma - q$$

Where,

 N_c , N_q and N_γ are bearing capacity factors, S_c , S_q and S_γ are shape factors, D_c , D_q and D_γ are depth factors,

And

C = Cohesion

q = Effective Overburden pressure,

B = Width of foundation,

 γ = Effective density below foundation.**For 4m x 6m Isolated Footing**

Cohesion, C = 11.00 t/sqm

Using $\phi = 0$ degree, the bearing capacity factors are:

$$N_c = 5.14$$

$$N_q = 1.00$$

$$N_\gamma = 0.00$$

Use,

Depth of Foundation = $D_f = 1.5$ M below FGL

Width of Foundation = B = 4 M

Length of Foundation = L = 6 M

Overburden Pressure = $q = 1.500$ (Depth) x 0.90 (Submerged density) = 1.35 t/sqm (assuming water table is flushing with the ground)

The Shape factors are [IS:6403 - 1981]

$$S_c = 1.13$$

$$S_q = 1.13$$

$$S_\gamma = 0.73$$

The Depth factors are [IS:6403 - 1981]

$$D_c = 1.08$$

$$D_q = 1.00$$

$$D_\gamma = 1.00$$

Computed Net Ultimate Bearing Capacity = 69.12 t/sqm

Using a factor of safety of 2.5, Net Safe Bearing Capacity = 27.65 t/sqm**For 10m x 15m Isolated Footing**

Computed Net Ultimate Bearing Capacity = 66.23 t/sqm

Using a factor of safety of 2.5, Net Safe Bearing Capacity = 26.49 t/sqm

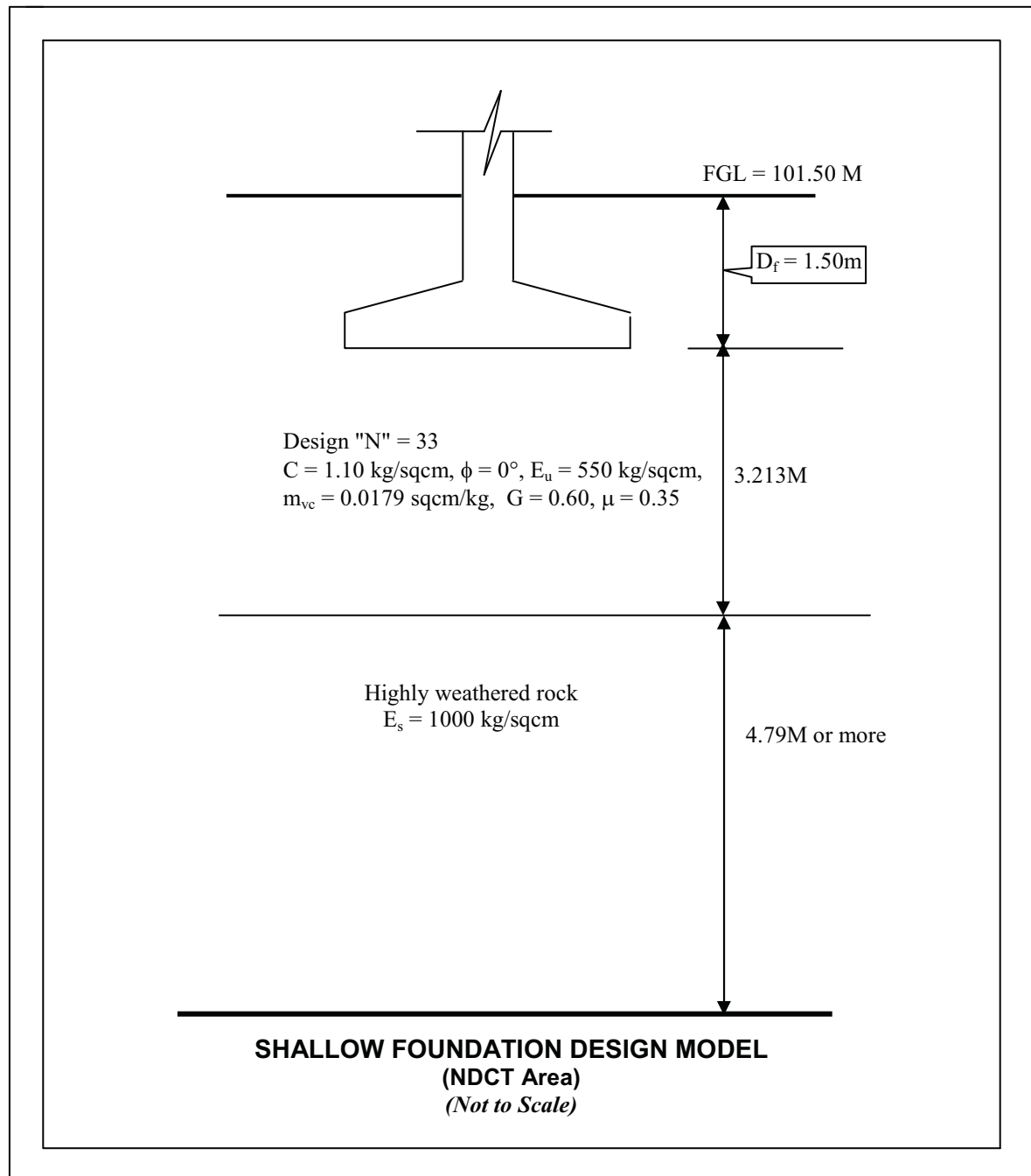
The above bearing capacity should be checked against settlement criteria. This is shown below.

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SETTLEMENT CALCULATION**Settlement Analysis for 4m x 6m foundation****A) General Data:**

Width of foundation =	4.0	m
Length of foundation =	6.0	m
Depth of foundation =	1.5	m
Net Base Pressure =	2.4	kg/sqcm

B) Subsoil Properties:**Layer - III**

Young's Modulus =	550	kg/sqcm
Poisson Ratio, μ =	0.35	
Top of Stratum =	1.50	m
End of Stratum =	4.71	m
Geological factor, G =	0.60	
m_{vc} =	0.0075	sqcm/kg

Layer - V

Young's Modulus =	1000	kg/sqcm
Poisson Ratio, μ =	0.25	
Top of Stratum =	4.71	m
End of Stratum =	9.50	m
Geological factor, G =	1.00	
m_{vc} =	0.0000	sqcm/kg

C) Calculation of Immediate Settlement:*Settlement at center*

$M = L' / B' =$	1.500	
$N = H / B' =$	1.607	
$I_1 =$	0.237	
$I_2 =$	0.094	
$I_s = I_1 + \{(1-2\mu) / (1-\mu)\} I_2 =$	0.281	
Immediate settlement $S_i =$	0.859	cm
$[q_o \times B' \times (1-\mu^2) \times m \times I_s] / E_s$		

Settlement at center

$M = L' / B' =$	1.277	
$N = H / B' =$	1.327	
$I_1 =$	0.195	
$I_2 =$	0.091	
$I_s = I_1 + \{(1-2\mu) / (1-\mu)\} I_2 =$	0.255	
Immediate settlement $S_i =$	0.299	cm
$[q_o \times B' \times (1-\mu^2) \times m \times I_s] / E_s$		

Settlement at corner

$M = L' / B' =$	1.50	
$N = H / B' =$	0.803	
$I_1 =$	0.095122	
$I_2 =$	0.096872	
$I_s = I_1 + \{(1-2\mu) / (1-\mu)\} I_2 =$	0.140	
Immediate settlement $S_i =$	0.214	cm

Settlement at corner

$M = L' / B' =$	1.28	
$N = H / B' =$	0.664	
$I_1 =$	0.073	
$I_2 =$	0.088	
$I_s = I_1 + \{(1-2\mu) / (1-\mu)\} I_2 =$	0.132	
Immediate settlement $S_i =$	0.077	cm

Average S_i for Stratum III = 5.37 mmAverage S_i for Stratum V = 1.88 mm

Total immediate settlement = 7.25 mm

(for both the layer)

D) Calculation of Consolidation Settlement:

Strata	From (M)	To (M)	Thickness (M)	Mid depth (M)	ΔP (kg/sqcm)	m_{vc} sqcm/kg	G	S_c (cm)
Layer - III	1.50	3.11	1.61	0.80	1.76	0.0075	0.60	1.27
	3.11	4.71	1.61	2.41	1.07	0.0075	0.60	0.77
Layer - V	4.71	7.11	2.39	4.41	0.66	0.0000	1.00	0.00
	7.11	9.50	2.39	6.80	0.42	0.0000	1.00	0.00

Hence, Total Consolidation Settlement = 20.47 mm

So, total settlement = 27.72mm

Foxe's Depth correction Factor = 0.92

Corrected Total Settlement = 27.72 x 0.92 = 25.50mm

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With reference to the above and considering the subsoil condition around each bore hole, the following bearing capacity values may be used.

Name of Structure	Foundation Location	Depth of Foundation below FGL (m)	Net Allowable Bearing Capacity (t/sqm)	
			Isolated / Strip	Raft
Watch Tower (FGL = 104.00M)	BH-05	1.50	45	45
Watch Tower (FGL = 100.50M)	BH-06	1.50	45	45
400KV Switch Yard & SW Control Room (FGL = 100.50M)	BH-9, 10, 13, 17, 20	1.00	18	18
		2.00	40	40
		3.50	45	45
Proposed Area for Outdoor Storage (FGL = 99M)	BH-07 & 52	1.50	10	10
		3.00	35	35
		5.50	45	45
Transformer Yard (FGL = 99.00M)	BH-22, 23, 27, 28	2.00	20	20
		3.00	40	40
		4.00	45	45
Power House (FGL = 99.00M)	BH-30, 31, 33, 34, 37, 38, 39	2.50	16	15
		3.50	30	30
		4.00	40	40
		5.50	45	45
ESP (FGL = 99.00M)	BH-32, 53, 57, 58, 66	3.50	16	15
		4.00	30	30
		5.00	40	40
		6.00	45	45
Service Building (FGL = 99.00M)	BH-35	1.50	14	12
		2.50	16	15
		3.50	40	40
		4.50	45	45
Boiler & Mill Bunker Bay Area (FGL = 99.00M)	BH-40, 41, 42, 47, 48, 49, 50, 51	2.00	8	6
		3.00	20	20
		4.00	30	30
		5.50	40	40
		6.00	45	45
DG & Compressor House (FGL = 99.00M)	BH-44	1.50	16	15
		3.50	40	40
		5.00	45	45
Canteen (FGL = 99.00M)	BH-54	1.50	40	40
		4.00	45	45
Indoor Store (FGL = 99.00M)	BH-55	1.50	40	40
		3.50	45	45
ESP Control Room (FGL = 99.00M)	BH-56	2.50	10	8
		3.50	40	40
		5.50	45	45
HFO & LDO Storage Tank Dyke Area (FGL = 99.00M)	BH-59	1.50	25	25
		2.50	40	40
		4.00	45	45
ID Fan (FGL = 99.00M)	BH-60, 61	3.00	12	10
		5.00	35	35

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Name of Structure	Foundation Location	Depth of Foundation below FGL (m)	Net Allowable Bearing Capacity (t/sqm)	
			Isolated / Strip	Raft
ID Fan (FGL = 99.00M)	BH-60, 61	6.00	40	40
		6.50	45	45
Chimney (FGL = 99.00M)	BH-62 & 63	4.00	15	12
		5.00	18	16
		6.00	40	40
		7.00	45	45
Near Fire Station (FGL = 99.00M)	BH-64	5.00	40	40
		6.00	45	45
Administrative Building (FGL = 99.00M)	BH-65	2.50	20	20
		3.50	40	40
		5.00	45	45
HFO & LDO Unloading & Forwarding Pump House (FGL = 99.00M)	BH-68	3.00	12	10
		4.00	30	30
		5.00	40	40
		6.00	45	45
Thickener (FGL = 101.50M)	BH-08	1.50	45	45
Clarifiers (FGL = 101.50M)	BH-11	1.50	40	40
		2.50	45	45
Chemical House (FGL = 101.50M)	BH-12	1.00	20	20
		2.00	40	40
		4.00	45	45
Clarified Water Tank (FGL = 101.50M)	BH-14	1.00	30	30
		2.00	45	45
Centrilised Sewage Treatment System (FGL = 101.50M)	BH-15	1.00	20	20
		1.50	40	40
		3.00	45	45
C.M.B. Waster Treatment System (FGL = 101.50M)	BH-16	1.00	30	30
		2.00	45	45
Fire Water Storage Tank & Pump House (FGL = 101.50M)	BH-18	3.00	40	40
		4.00	45	45
NDCT (FGL = 101.50M)	BH-19, 25, 26	1.50	24	22
		4.00	40	40
		5.50	45	45
CW Treatment Area (FGL = 101.50M)	BH-21	1.50	30	30
		3.00	40	40
		4.00	45	45
Side Stream Filtration Area (FGL = 101.50M)	BH-24	2.00	18	18
		3.50	40	40
		4.50	45	45
Cooling Water Pump House (FGL = 101.50M)	BH-29	3.00	18	18
		5.00	40	40
		6.00	45	45

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Name of Structure	Foundation Location	Depth of Foundation below FGL (m)	Net Allowable Bearing Capacity (t/sqm)	
			Isolated / Strip	Raft
CPU Regeneration Area (FGL = 101.50M)	BH-36	3.00	40	40
		4.00	45	45
DM Plant (FGL = 101.50M)	BH-43	4.00	30	30
		6.00	40	40
		7.50	45	45
Condensate Storage Tank & Pump House (FGL = 101.50M)	BH-45	3.00	10	8
		4.00	12	10
		6.00	40	40
		7.00	45	45
Chemical Lab (FGL = 101.50M)	BH-46	1.50	20	18
		3.00	45	45
Raw Water Storage Reservoir (FGL = EGL)	BH-01 to 04	1.50	22	20
		2.50	40	40
		3.50	45	45
Raw Water Pump House (FGL = EGL)	BH-67	1.50	25	25
		2.50	30	30
		4.00	40	40
		5.00	45	45

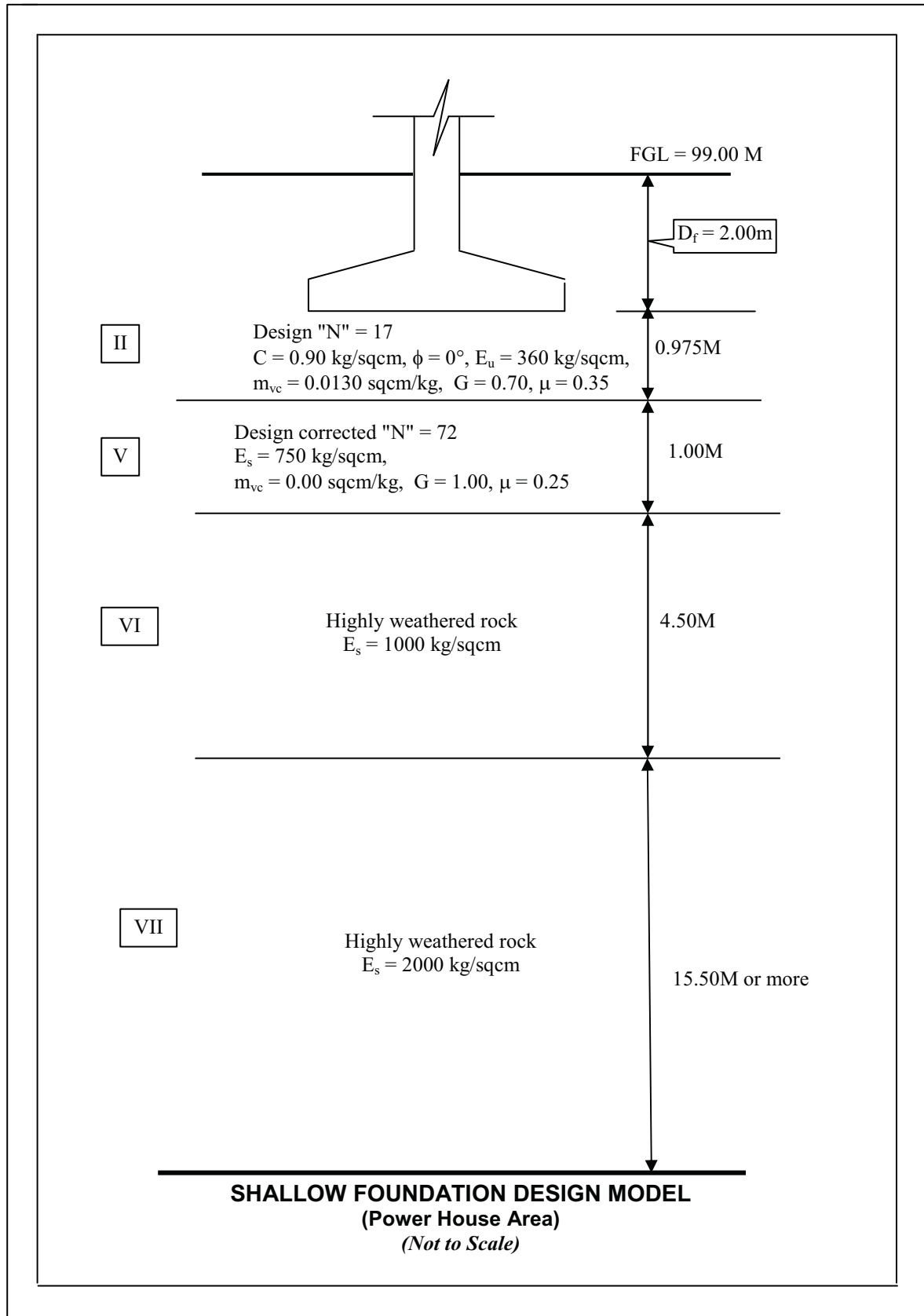
- Note:**
- 1) Limiting settlement in soil is considered as 25mm for Isolated / Strip and 40mm for Raft foundation.
 - 2) Limiting settlement in rock is considered as 12mm for irrespective type of foundation.
 - 3) For Minor structures (which are not sensitive to settlement) foundation may be placed on the filled up soil. The minimum depth of foundation shall be 1m below EGL and use a net allowable bearing capacity of 5t/sqm
 - 4) For Isolated / strip foundation, bearing capacity is considered upto 6m width and for raft foundation bearing capacity is considered for >6m width.

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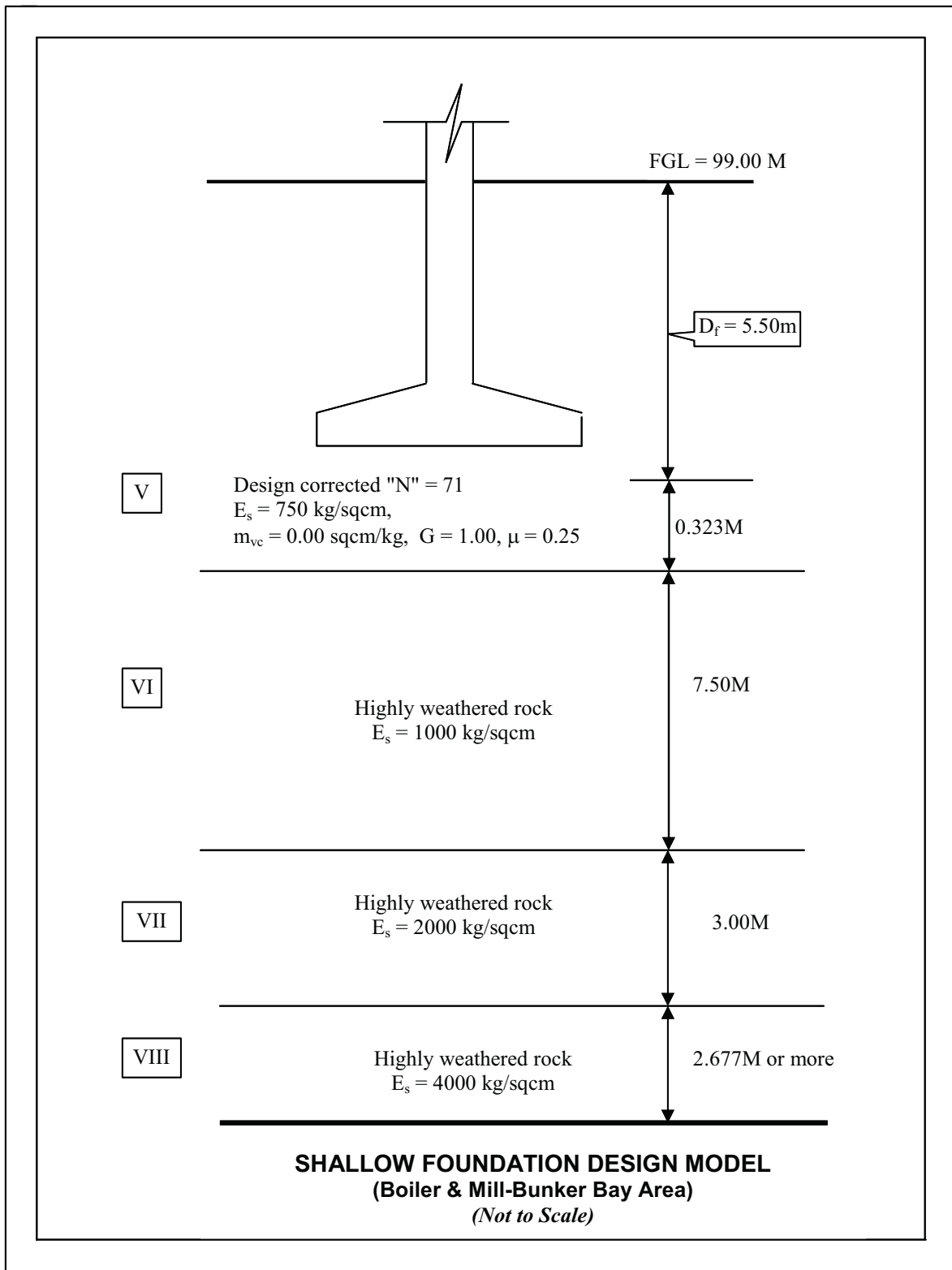


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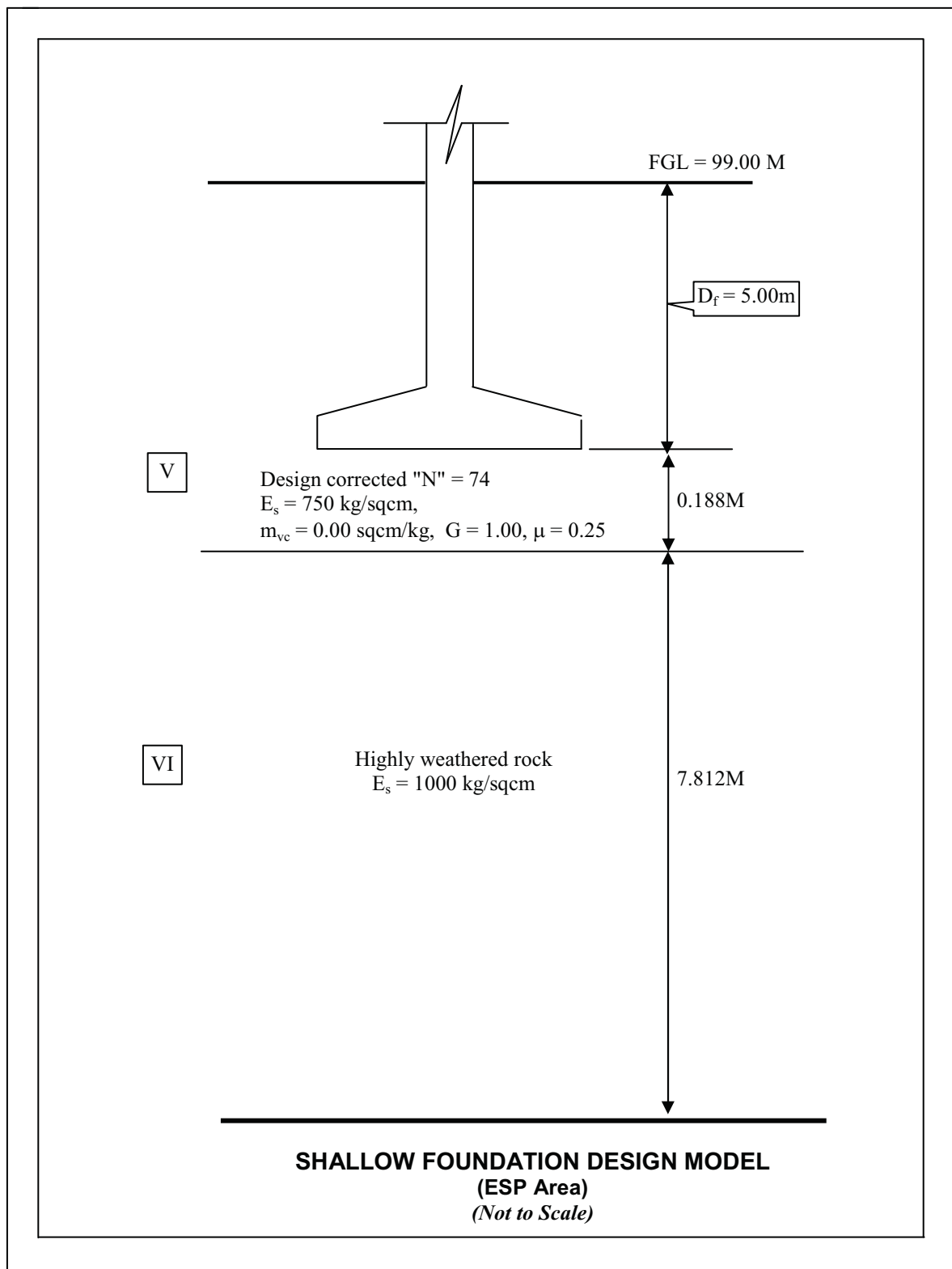


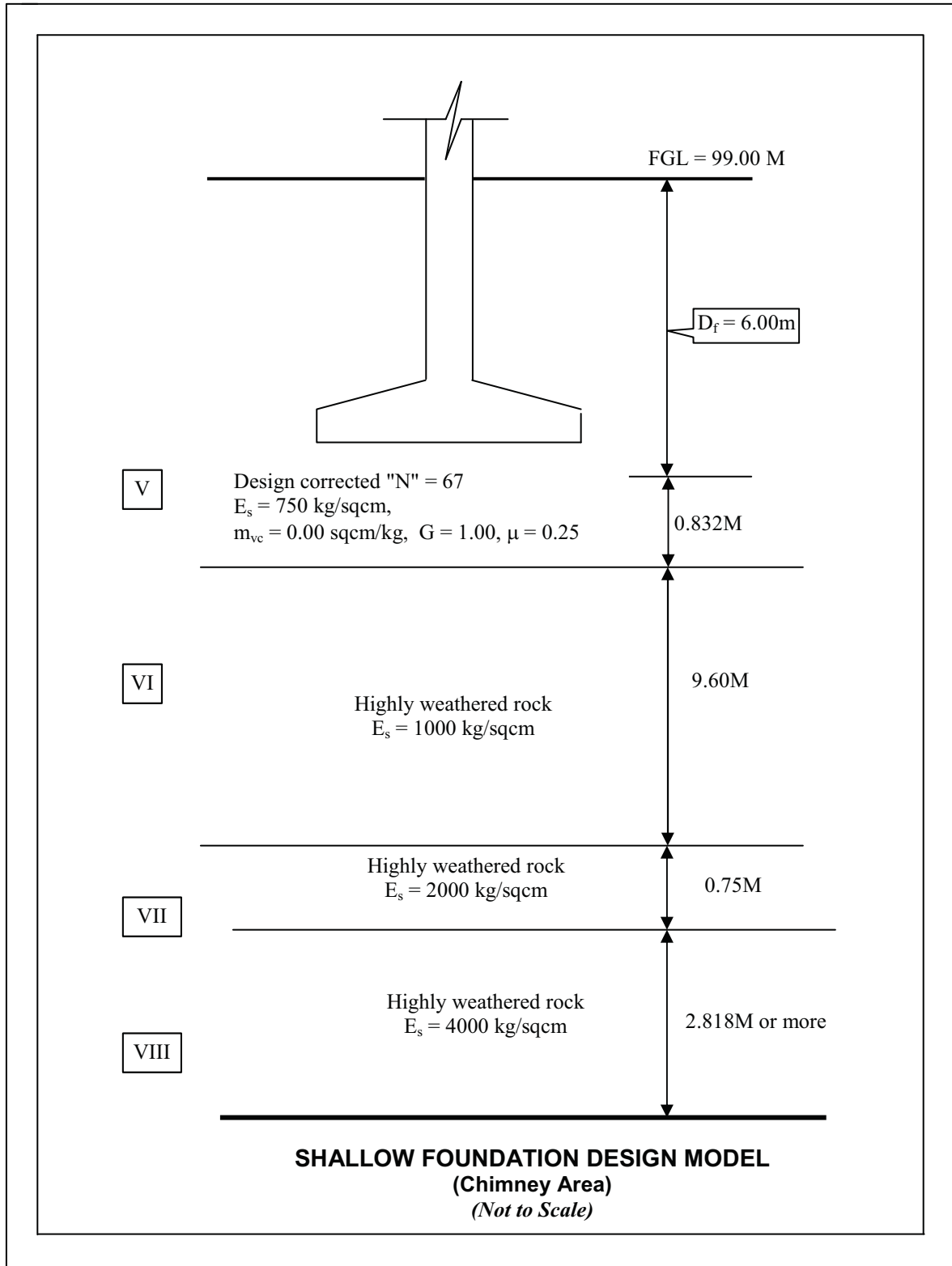
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5.5. SWELLING CHARACTERISTICS:

The swelling pressure and Free Swell Index tests were performed on few samples and the test results are presented at the end of Volume-2. The average swelling pressure and Free Swell Index as found from the tests are 0.426kg/sqcm and 32.01% respectively. It is seen that the subsoil has low to medium swelling characteristics. So, no problem with respect to the swelling of the subsoil is anticipated.

5.6. FIELD PERMEABILITY TEST RESULTS:

20Nos. Field permeability test was conducted at different depths in five bore holes by falling head method and the test results are presented below. A sample calculation is also enclosed at the end of Volume-2.

Test Locations	Depth of Test (M)	Permeability (cm/sec)
BH-14	0.90 - 1.70	8.899×10^{-6}
	2.70 - 3.50	5.638×10^{-5}
	4.20 - 5.00	7.328×10^{-5}
	5.70 - 6.50	5.206×10^{-5}
BH-33	1.30 - 2.00	1.683×10^{-6}
	2.70 - 3.50	7.818×10^{-7}
	4.30 - 5.00	4.324×10^{-5}
	5.70 - 6.50	1.012×10^{-5}
BH-43	1.20 - 2.00	5.439×10^{-6}
	2.80 - 3.50	6.966×10^{-6}
	4.50 - 5.20	5.944×10^{-5}
	5.70 - 6.50	1.089×10^{-5}
BH-57	1.20 - 2.00	3.071×10^{-5}
	2.70 - 3.40	1.643×10^{-5}
	4.20 - 5.00	4.155×10^{-5}
	5.70 - 6.50	4.106×10^{-5}
BH-63	1.30 - 2.00	4.716×10^{-6}
	2.70 - 3.50	1.774×10^{-4}
	4.30 - 5.10	9.792×10^{-5}
	5.70 - 6.50	6.525×10^{-5}

5.7. PERCOLATION TEST RESULTS:

3 Nos. percolation test was conducted by falling head method and the test results are presented below.

Percolation No.	Depth (M)	Permeability (cm/sec)
1 near TP-06	4.00	1.038×10^{-6}

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Percolation No.	Depth (M)	Permeability (cm/sec)
2 near TP-08	4.00	1.434×10^{-6}
3 near TP-10	4.00	7.002×10^{-7}

5.8. FIELD CBR TEST RESULTS:

Both soaked & unsoaked field CBR test were conducted at site and the test results are presented below.

Sl No.	Test Location	Depth of Test (m)	Soaked			Un Soaked		
			2.50mm Penetration	5.00mm Penetration	Average	2.50mm Penetration	5.00mm Penetration	Average
1	FCBR-01	0.50	4.29	3.65	5.08	3.03	2.86	7.04
			3.79	3.51		11.05	9.15	
			7.16	6.31		7.05	7.06	
2	FCBR-02	0.50	4.49	3.64	2.77	10.77	9.64	12.66
			1.24	1.59		14.53	11.39	
			2.59	2.52		12.68	13.95	
3	FCBR-03	0.50	16.07	14.81	10.49	28.60	21.93	16.43
			13.61	14.43		8.17	8.64	
			1.59	2.23		12.51	14.70	
4	FCBR-04	0.50	1.87	3.90	2.93	17.1	15.08	12.28
			1.85	2.30		6.26	7.99	
			1.83	2.59		8.43	13.76	

5.9. CHEMICAL TESTS:

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

CHEMICAL TEST RESULTS ON SOIL SAMPLES:

BH/Sample No.	Depth (m)	pH value	Sulphate as SO_3 (%)	Chloride as Cl (%)	Carbonate as CO_3 (%)	Organic Matter (%)
BH-06 / UDS-01	2.00	8.05	0.05	0.0242	0.22	0.80
BH-13 / UDS-01	2.00	8.69	0.05	0.0284	0.20	0.97
BH-20 / UDS-01	2.00	8.14	0.05	0.0213	0.30	1.04
BH-25 / UDS-01	2.00	8.38	0.15	0.0910	0.44	0.95
BH-32 / UDS-01	2.00	7.87	0.10	0.0228	0.36	1.41
BH-40 / SPT-01	1.00	8.34	0.05	0.0256	0.22	0.93
BH-50 / UDS-01	2.00	8.55	0.05	0.0213	0.28	0.90
BH-55 / UDS-01	2.00	8.28	0.05	0.0199	0.36	1.23
BH-57 / UDS-01	2.00	8.37	0.10	0.0384	0.28	0.66
BH-66 / UDS-01	2.00	9.69	0.05	0.0242	0.44	0.09

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CHEMICAL TEST RESULTS ON WATER SAMPLES: -

BH/Sample No.	Depth (M)	pH value	Sulphate as (mg/litre)	Chloride as (mg/litre)	Carbonate as (mg/litre)	Nitrate as (mg/litre)	Organic Matter (mg/litre)
06	2.50	8.01	120	104.32	18	0.12	13.20
10	2.90	8.56	360	497.12	20	0.08	9.35
15	3.00	8.08	180	105.26	18	0.06	14.96
22	1.80	8.38	360	511.32	16	0.07	11.22
39	2.80	7.96	180	119.49	22	0.12	14.96
46	2.40	7.97	120	71.12	20	0.10	13.09
53	2.90	8.27	120	65.43	14	0.12	13.08
56	1.57	8.40	360	511.32	16	0.14	11.22
65	1.30	8.41	360	504.22	20	0.16	11.22
68	1.60	7.82	120	92.46	16	0.10	14.12

BDL = Below Detection Limit (i.e. below 0.050%)

It is seen that the values are within permissible limits (as per IS:456-2000) and so no special cement will be required for foundation concrete. **Either Ordinary Portland cement or Portland slag cement or Portland Pozzolana cement can be used for concreting.**

5.10. STANDARD PROCTOR COMPACTION & CBR TEST:

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

SL No	Test No.	Sample No	Depth (M)	Description	Standard Proctor Compaction Test		CBR (%)		Recommended CBR
							Soaked Condition		Value (%)
					OMC (%)	MDD (gm/cc)	2.50mm Penetration	5.00mm Penetration	Soaked Condition
1	TP01	DS01	0.50	Whitish grey sandy silt with moorum.	13.45	1.649	--	--	--
2	TP03	DS02	1.50	Whitish grey sandy silt with moorum.	15.88	1.717	6.80	5.49	6
3	TP05	DS02	1.50	Deep grey silty clay. Obs. kankar.	18.38	1.612	--	--	--
4	TP06	DS02	1.50	Light grey moorum.	18.67	1.581	5.49	5.21	5
5	TP08	DS04	3.50	Light grey sandy silt with decomposed rock.	13.55	1.805	--	--	--
6	TP10	DS02	1.50	Light grey sandy silt with decomposed rock.	14.02	1.584	7.60	6.87	7
7	PLT-03	DS01	1.00	Light grey moorum with boulders.	11.65	1.877	8.22	8.02	8
8	PLT-05	DS01	1.00	Deep grey silty clay with kankar.	18.31	1.607	--	--	--
9	CPLT-02	DS02	2.00	Light grey clayey silty sand with decomposed rock	14.70	1.801	--	--	--
10	CPLT-04	DS01	1.00	Deep grey silty clay with sand mixture.	19.70	1.646	5.23	4.07	5

□

5.11. SUITABILITY OF EXISTING SOIL FOR FILLING AND BACK-FILLING:

In general the top 1 to 1.5m thick blackish / deep greyish soil is CH type of high compressibility possessing expansive characteristics and hence the same shall not be used

for filling / backfilling purposes. The sub-soil below blackish / deep greyish soil is CI/SM/SC type with low swelling / non-swelling characteristics and can be used for filling and backfilling purposes.

5.12. SUITABILITY OF SOIL FOR CONSTRUCTION OF ROADS & PAVEMENT:

Being the top 1 to 1.5m blackish/deep greyish soil is CH type of high compressibility with expansive characteristics, in case roads / pavements are to be rested on the top soil then at least 1m deep blackish / deep greyish soil shall be removed and backfilled with non-expansive good earth to be filled in layers and compacted/rolled to require degree of compaction.

5.13. EXCAVATION:

For excavation in virgin soil (stratum-I, II, III, IV, IVA, V), a slope of 1(H):2(V) may be used. For excavation in stratum-VI, VII & VIII (i.e. rock layer), vertical or almost vertical slope may be used. However, to be in the safer side, a nominal side slope of 1(H):4(V) for stratum-VI & VII and 1(H):6(V) for stratum-VIII should be provided.

It is also suggested to provide a Berm of at least 1m wide after each 3m to 4m of excavation. Excavation in stratum-I, II, III, IV, IVA & V can be made with shovels and pick-axe. For layer – VI, VII & VIII, pneumatic / jack hammer will be more efficient. Alternatively controlled blasting may be required at places.

5.14. FOUNDATION LEVEL PREPARATION IN ROCK:

The desired foundation level should be reached by excavating with jack hammer / pneumatic hammer. Controlled blasting, if required may be used.

After thorough scrutiny of the surface so obtained, the nature should be checked by using a hand hammer or otherwise. In case loose rock / decomposed rock pockets are obtained, manual excavation upto the bottom of such loose pocket should be done and soft patches should be removed. The voids between founding level and bottom of excavation level should be filled up with lean concrete of 1:3:6. Thereafter, leveling course of 75-100mm of Grade M15 may be placed. Normal construction can proceed thereafter.

6. SUMMARY & CONCLUSIONS

Based on the field and laboratory tests and the foregoing discussion the following are summarised.

1. The subsoil is characterised by stiff to very stiff clayey silt / silty clay followed by a layer of hard clayey silt / silty clay or very dense silty sand layer. After that weathered rock layer was struck and continues upto the terminating depth of all the boreholes.
2. The standing water level was found from 0.60m to a maximum depth of 5.50m during the time of investigation. So, construction of open foundation, placed at a depth of 1.50m or more, may create a problem. However, ordinary surface operated pump will be able to tackle the situation for dewatering.
3. Using the elastic rebound as we obtain from CPLT, the dynamic properties are calculated and presented below.

Test No.	Depth (M)	C _u (10sqm fdn.size) (kg/cucm)
CPLT - 01	3.00	2.91
CPLT - 02	3.00	1.89
CPLT- 03	3.00	1.84
CPLT - 04	3.00	2.69
CPLT - 05	3.00	1.96

4. Considering Subsoil condition it is suggested to go for open foundation depending on requirement.
5. The determination of bearing capacity is discussed in the previous section. However, this is further presented below.

Name of Structure	Foundation Location	Depth of Foundation below FGL (m)	Net Allowable Bearing Capacity (t/sqm)	
			Isolated / Strip	Raft
Watch Tower (FGL = 104.00M)	BH-05	1.50	45	45
Watch Tower (FGL = 100.50M)	BH-06	1.50	45	45
400KV Switch Yard & SW Control Room (FGL = 100.50M)	BH-9, 10, 13, 17, 20	1.00	18	18
		2.00	40	40
		3.50	45	45
Proposed Area for Outdoor Storage (FGL = 99M)	BH-07 & 52	1.50	10	10
		3.00	35	35
		5.50	45	45
Transformer Yard (FGL = 99.00M)	BH-22, 23, 27, 28	2.00	20	20
		3.00	40	40
		4.00	45	45
Power House (FGL = 99.00M)	BH-30, 31, 33, 34, 37, 38, 39	2.50	16	15
		3.50	30	30

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Name of Structure	Foundation Location	Depth of Foundation below FGL (m)	Net Allowable Bearing Capacity (t/sqm)	
			Isolated / Strip	Raft
Power House (FGL = 99.00M)	BH-30, 31, 33, 34, 37, 38, 39	4.00	40	40
		5.50	45	45
ESP (FGL = 99.00M)	BH-32, 53, 57, 58, 66	3.50	16	15
		4.00	30	30
		5.00	40	40
		6.00	45	45
Service Building (FGL = 99.00M)	BH-35	1.50	14	12
		2.50	16	15
		3.50	40	40
		4.50	45	45
Boiler & Mill Bunker Bay Area (FGL = 99.00M)	BH-40, 41, 42, 47, 48, 49, 50, 51	2.00	8	6
		3.00	20	20
		4.00	30	30
		5.50	40	40
DG & Compressor House (FGL = 99.00M)	BH-44	1.50	16	15
		3.50	40	40
		5.00	45	45
Canteen (FGL = 99.00M)	BH-54	1.50	40	40
		4.00	45	45
Indoor Store (FGL = 99.00M)	BH-55	1.50	40	40
		3.50	45	45
ESP Control Room (FGL = 99.00M)	BH-56	2.50	10	8
		3.50	40	40
		5.50	45	45
HFO & LDO Storage Tank Dyke Area (FGL = 99.00M)	BH-59	1.50	25	25
		2.50	40	40
		4.00	45	45
ID Fan (FGL = 99.00M)	BH-60, 61	3.00	12	10
		5.00	35	35
		6.00	40	40
		6.50	45	45
Chimney (FGL = 99.00M)	BH-62 & 63	4.00	15	12
		5.00	18	16
		6.00	40	40
		7.00	45	45
Near Fire Station (FGL = 99.00M)	BH-64	5.00	40	40
		6.00	45	45
Administrative Building (FGL = 99.00M)	BH-65	2.50	20	20
		3.50	40	40
		5.00	45	45
HFO & LDO Unloading & Forwarding Pump House (FGL = 99.00M)	BH-68	3.00	12	10
		4.00	30	30
		5.00	40	40
		6.00	45	45
Thickener (FGL = 101.50M)	BH-08	1.50	45	45
Clarifiers (FGL = 101.50M)	BH-11	1.50	40	40
		2.50	45	45

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Name of Structure	Foundation Location	Depth of Foundation below FGL (m)	Net Allowable Bearing Capacity (t/sqm)	
			Isolated / Strip	Raft
Chemical House (FGL = 101.50M)	BH-12	1.00	20	20
		2.00	40	40
		4.00	45	45
Clarified Water Tank (FGL = 101.50M)	BH-14	1.00	30	30
		2.00	45	45
Centrilised Sewage Treatment System (FGL = 101.50M)	BH-15	1.00	20	20
		1.50	40	40
		3.00	45	45
C.M.B. Waster Treatment System (FGL = 101.50M)	BH-16	1.00	30	30
		2.00	45	45
Fire Water Storage Tank & Pump House (FGL = 101.50M)	BH-18	3.00	40	40
		4.00	45	45
NDCT (FGL = 101.50M)	BH-19, 25, 26	1.50	24	22
		4.00	40	40
		5.50	45	45
CW Treatment Area (FGL = 101.50M)	BH-21	1.50	30	30
		3.00	40	40
		4.00	45	45
Side Stream Filtration Area (FGL = 101.50M)	BH-24	2.00	18	18
		3.50	40	40
		4.50	45	45
Cooling Water Pump House (FGL = 101.50M)	BH-29	3.00	18	18
		5.00	40	40
		6.00	45	45
CPU Regeneration Area (FGL = 101.50M)	BH-36	3.00	40	40
		4.00	45	45
DM Plant (FGL = 101.50M)	BH-43	4.00	30	30
		6.00	40	40
		7.50	45	45
Condensate Storage Tank & Pump House (FGL = 101.50M)	BH-45	3.00	10	8
		4.00	12	10
		6.00	40	40
		7.00	45	45
Chemical Lab (FGL = 101.50M)	BH-46	1.50	20	18
		3.00	45	45
Raw Water Storage Reservoir (FGL = EGL)	BH-01 to 04	1.50	22	20
		2.50	40	40
		3.50	45	45
Raw Water Pump House (FGL = EGL)	BH-67	1.50	25	25
		2.50	30	30
		4.00	40	40
		5.00	45	45

Note: 1) Limiting settlement in soil is considered as 25mm for Isolated / Strip and 40mm for Raft foundation.

2) Limiting settlement in rock is considered as 12mm for irrespective type of foundation

3) For Minor structures (which are not sensitive to settlement) foundation may be placed on the filled up soil. The minimum depth of foundation shall be 1m below EGL and use a net allowable bearing capacity of 5t/sqm

4) For Isolated / strip foundation, bearing capacity is considered upto 6m width and for raft foundation bearing capacity is considered for >6m width.

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6. The discussion on swelling characteristics is given in Section 5.5.
7. It is seen that the values are within permissible limits (as per IS:456-2000). So, **Either Ordinary Portland cement or Portland slag cement or Portland Pozzolana cement can be used for concreting.**
8. Standard Proctor Compaction tests were carried out in the laboratory to determine the Optimum Moisture Content (OMC) and Maximum Dry Density (MDD). Thereafter, CBR (soaked) tests were also carried out on the samples prepared at MDD. The summarised test results and the graphs are presented in Volume 2.
9. The geological logging is presented under Section 7.
10. 20 (twenty seven) nos. ERT were performed at the site and the test results are discussed and presented in Section - 8.
11. 4 (Four) nos. Cross Hole Shear Tests were performed at the site and the test results are discussed and presented in Section - 9. For dynamic properties of subsoil strata, Cross Hole Shear test results shall be referred.
12. 3 (Three) nos. Pressure meter Tests were performed at the site and the test results are discussed and presented in Section - 10.
13. 2 (Two) nos. Block Vibration Tests were performed at the site and the test results are discussed and presented in Section – 11.

For C. E. Testing Company Private Limited,

Prepared By

Checked By

Approved By

 (S. SARKAR)

 (S. NATH)

 (DR. M. NAYAK)

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7. GEOLOGICAL LOGGING

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BH No. 01

- 00.00 – 02.70m : O. B.
- 02.70 – 09.25m : Completely weathered, decomposed and disintegrated rock particles collected as sludge with remnants of highly weathered, soft and weak fractured pieces of **Hornblende Gneiss** (at 03.25-06.25m).
- 09.25 – 15.00m Highly weathered, gneissic, light greenish grey, medium to fine grained, moderately compacted, moderately hard and moderately strong **Hornblende Gneiss**.

Discontinuous cores recovered and are thinly spaced (>15 nos./m) dominantly base parallel and randomly oriented fractured. Fracture surfaces are apparently planar, slightly rough and altered. Recovered core pieces are small sizes mixed with angular fragmented pieces. Rock quality is very poor.

BH No. 02

- 00.00 – 02.50m : O. B.
- 02.50 – 03.75m : Completely weathered, decomposed and disintegrated rock particles collected as sludge.
- 14.25 – 15.00m Highly to moderately weathered, gneissic, light grey, medium to fine grained, moderately compacted, moderately hard and moderately strong **Hornblende Gneiss**.
- 03.75 – 15.00m

Discontinuous cores recovered and are thinly spaced (>15 nos./m) dominantly base parallel and randomly oriented with locally inclined fractured. Fracture surfaces are apparently planar, slightly rough and altered. Recovered core pieces are small sizes mixed with angular fragmented pieces. Rock quality is very poor.

BH No. 03

- 00.00 – 02.90m : O. B.
- 02.90 – 11.75m : Completely weathered, decomposed and disintegrated rock particles collected as sludge with remnants of highly weathered, soft and weak fractured pieces of **Hornblende Gneiss** (at 08.00-09.50m).
- 11.75 – 15.00m Highly to moderately weathered, gneissic, light grey, medium to fine grained, moderately compacted, moderately hard and moderately strong **Hornblende Gneiss**.

Discontinuous cores recovered and are thinly spaced (>15 nos./m) dominantly base parallel and randomly oriented with locally inclined fractured. Fracture surfaces are apparently planar, slightly rough and altered. Recovered core pieces are small sizes mixed with angular fragmented pieces. Rock quality is very poor.

BH No. 04

- 00.00 – 02.70m : O. B.
- 02.70 – 05.00m : Completely weathered, decomposed and disintegrated rock particles collected as sludge.
- 05.00 – 15.00m Highly to moderately weathered, gneissic, light grey, medium to fine grained, moderately compacted, moderately hard and moderately strong **Hornblende Gneiss**.

Discontinuous cores recovered and are thinly spaced (>15 nos./m) dominantly

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base parallel with locally inclined fractured. Fracture surfaces are apparently planar, slightly rough and altered. Recovered core pieces are small sizes mixed with angular fragmented pieces. Rock quality is very poor.

BH No. 05

- 00.00 – 02.50m : Overburden.
 02.50 – 13.75m : Completely weathered, decomposed and disintegrated rock particles collected as sludge.
 13.75 – 15.00m : Moderately weathered, gneissic, light grey, medium to fine grained, moderately compacted, medium hard and moderately strong **Gneiss**.

Discontinuous core recovered and are thinly spaced (>15 nos./m) dominantly base parallel along with random fractures cores at places. Fracture surfaces are planar, smooth and slightly altered. Recovered core dominated with small size pieces mixed with completely broken angular rock fragments. Rock quality is very poor (upto 14.5m depth) followed by poor quality.

BH. No: 06

- 00.00 – 04.00m : Overburden.
 04.00 – 15.00m : Highly weathered, light grey and dark grey bands, medium to fine grains are loose to moderately compacted, well developed gneissic structure observed, moderately hard and weak **Hornblende Gneiss** having mica along the weak planes throughout the depth.
 Completely weathered, decomposed and disintegrated rock fragments collected as sludge at 09.25 – 10.00m.
 Isolated rounded gravel and dominantly boulders of Quartzite at 06.25 – 07.75m depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures (>15 nos/m). Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces with rare partial size pieces at places. Open fractured surfaces are rough, wavy and altered. Rock quality is very poor to poor.

BH No. 07

- 00.00 – 03.80m : Overburden.
 03.80 – 20.00m : Moderate (upto 9.75m depth) to slightly weathered, gneissic, light grey, medium to fine grained, densely compacted, hard and strong **Gneiss**.

Discontinuous (upto 15.75m depth) followed by continuous core recovered and are thinly spaced (>15 nos./m) dominantly base parallel along with random and rare inclined (45° dip) fractures. Fracture surfaces are planar, slightly rough and slightly altered. Fractured cores are mainly small sizes pieces mixed with completely fragmented pieces and locally medium size pieces. Rock quality is very poor (upto 7.50m depth) followed by poor (upto 15.0m depth) to fair quality.

BH No. 08

- 00.00 – 03.90m : Overburden.
 03.90 – 15.00m : Moderate (upto 8.25m depth) to slightly weathered, gneissic, light grey, medium to fine grained, densely compacted, hard and strong **Gneiss**.

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Discontinuous cores recovered and are thinly spaced (>15 nos./m) dominantly base parallel along with random and rare inclined (45° dip) fractures. Fracture surfaces are planar, slightly rough and slightly altered. Recovered core are small sizes pieces mixed with completely fragmented pieces and locally medium size pieces. Rock quality is very poor (upto 8.25m depth) to poor.

BH. No: 09

00.00 – 04.20m : Overburden.

04.20 – 20.00m : Throughout the depth completely weathered, decomposed and disintegrated strata with remnants of highly weathered, dark grey with greenish patch, medium to fine grains are loosely compacted, well developed gneissic structure observed, soft and weak **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Completely weathered, decomposed and disintegrated rock fragments collected as sludge at 05.75 – 18.50m depth.

Discontinuous core recovery, and are very thinly to thinly spaced (>15 nos/m), dominantly randomly oriented fractures. Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces. Open fractured surfaces are rough, wavy and altered. Rock quality is very poor.

BH No. 10

00.00 – 04.00m : Overburden.

04.00 – 08.50m : Completely weathered, decomposed and disintegrated rock particles collected as sludge.

08.50 – 20.00m : Slightly weathered, gneissic, light grey, medium to fine grained, densely compacted, hard and strong **Gneiss**.

Discontinuous (upto 12.25m depth) followed by continuous core recovered and are thinly spaced (>15 nos./m) dominantly base parallel along with random fractures and rare inclined (45°dip) fractured cores. Fracture surfaces are planar, slightly rough and slightly altered / or stain. Recovered core dominated with small and less frequently medium size pieces. Rock quality is very poor (upto 10.0m depth) followed by poor (upto 12.25m depth) to fair.

BH No. 11

00.00 – 02.50m : Overburden.

02.50 – 10.50m : Calc silicate.

10.50 – 20.00m : High (upto 14.0m depth) to moderately weathered, gneissic, light greenish grey, medium to fine grained, moderately compacted, medium hard and moderately strong hornblende **Gneiss** with sludge of disintegrated rock particles from 15.50-18.50m depth.

Discontinuous core recovered and are thinly spaced (>15 nos./m) dominantly base parallel, few inclined (45° dip) and randomly fractured. Fracture surfaces are planar, slightly rough and slightly altered. Recovered core dominated with small size pieces and angular broken rock fragments. Rock quality in general is very poor.

BH No. 12

00.00 – 03.00m : Overburden.

03.00 – 07.50m : Completely weathered, decomposed and disintegrated rock particles collected

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- as sludge.
- 07.50 – 15.00m : Moderately weathered, gneissic, light grey, medium to fine grained, medium compacted, medium hard and moderately strong **Gneiss**.

Discontinuous cores recovered and are thinly spaced (>15 nos./m) dominantly base parallel along with rare inclined (45° dip) and random fracture cores. Fracture surfaces are planar, slightly rough and slightly altered. Recovered core are small sizes pieces mixed with completely fragmented pieces. Rock quality is very poor (upto 12.0m depth) to poor.

BH. No: 13

- 00.00 – 04.20m : Overburden.
- 04.20 – 08.00m : Completely weathered, decomposed and disintegrated rock fragments collected as sludge.
- 08.00 – 25.00m : High (upto 14.75m depth) to moderately weathered, light grey with blackish patch (occasionally brown shades at 11.00 – 13.25m depth), medium to fine grains are densely compacted, well developed gneissic structure observed, moderately hard to hard and moderately strong to strong **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures upto 20.75m depth. Thereafter cores are continuous and are medium to thickly spaced base parallel fractures (15-8 nos/m). Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces upto 21.50m depth. Followed by small and partial sizes mixed with few sub-angular to sub-rounded pieces at places. Open fractured surfaces are rough, wavy and altered. Open inclined (45°-55° dip) fracture surfaces are non-planar, smooth and altered. Rock quality is poor (upto 21.50m) to fair.

BH No. 14

- 00.00 – 01.60m : Overburden.
- 01.60 – 06.50m : Calc silicate rock.
- 06.50 – 20.00m : Highly weathered, schistose, light grey (upto 11.50m depth) to blackish grey, medium to fine grained, loose, soft and weak (upto 11.50m depth) to medium compacted, medium hard and moderately strong **hornblende schist**.

Discontinuous cores recovered and are thinly spaced (>15 nos./m) dominantly base parallel along with rare inclined (45° dip) fractured. Fracture surfaces are planar, slightly smooth and altered or stain. Recovered core pieces are small sizes mixed with fragmented pieces. Rock quality is very poor. Completely weathered, decomposed and disintegrated rock particles collected as sludge.

BH No. 15

- 00.00 – 02.80m : Overburden.
- 02.80 – 13.25m : Completely weathered, decomposed and disintegrated rock particles collected as sludge with remnants of round to sub rounded Hornblende Gneiss at several depths. Fresh, light colored, compacted hard and strong **Quartzite** observed from 5.25-6.0m depths.
- 13.25 – 20.00m : Moderately weathered, gneissic, light grey, medium to fine grained, medium compacted, medium hard and moderately strong **Hornblende Gneiss**.

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Discontinuous cores recovered and are thinly spaced (>15 nos./m) dominantly base parallel and random, locally inclined (45° dip) (from 15.50-16.50m depth) fractured. Fracture surfaces are planar, smooth and altered. Recovered core are isolated small sizes pieces mixed with angular to sub rounded rock fragments. Rock quality is very poor.

BH No. 16

- 00.00 – 03.00m : Overburden.
- 03.00 – 08.25m : Completely weathered, decomposed and disintegrated rock particles collected as sludge.
- 08.25 – 11.00m : Calc silicate rock.
- 11.00 – 12.00m : Fresh, light colored, mosaic, compacted, very hard and strong **Quartzite**.
- 12.00 – 15.00m : Moderately weathered, gneissic, light grey, medium to fine grained, medium compacted, medium hard and moderately strong **Hornblende Gneiss**.

Discontinuous cores recovered and are thinly spaced (>15 nos./m) dominantly base parallel along with rare inclined (45° dip) (from 12.75-13.50m depth) and vertically fractured (from 11.25-12.0m depth). Fracture surfaces are planar, smooth and slightly altered. Recovered core are isolated small sizes pieces. Rock quality is very poor.

BH. No: 17

- 00.00 – 04.40m : Overburden.
- 04.40 – 14.00m : Completely weathered, decomposed and disintegrated rock fragments along with mica collected as sludge.
- 14.00 – 20.00m : Highly weathered, dark grey with greenish patch, medium to fine grains are moderately to densely compacted, well developed gneissic structure observed, moderately hard and moderately strong **Hornblende Gneiss** having mica along the weak planes throughout the depth.
Pockets of highly weathered, fine grained, whitish grey with brown shades, loosely compacted, moderately soft and weak Calc-silicate at 17.00 – 18.50m depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures, with locally inclined (45°-55° dip) fractures. Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces throughout the depth. Open fractured surfaces are rough, wavy and altered. Open inclined fracture surfaces are non-planar, smooth and altered. Rock quality is very poor to poor.

BH No. 18

- 00.00 – 02.00m : Overburden.
- 02.00 – 03.50m : Completely weathered, decomposed and disintegrated rock particles collected as sludge.
- 03.50 – 20.00m : Moderately weathered, schistose, light grey, medium to fine grained, medium compacted, medium hard and moderately strong **Hornblende schist**.

Discontinuous cores recovered and are thinly spaced (>15 nos./m) dominantly base parallel and locally random and inclined (45°dip) fractured. Vertical fracture observed from 12.50-13.25m depth. Fracture surfaces are slightly wavy, rough and altered. Recovered core pieces are dominated with small sizes pieces mixed with fragmented angular pieces along with medium size

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pieces at few depths. Rock quality is in general very poor to poor.

BH. No: 19

- 00.00 – 04.18m : Overburden.
 04.18 – 13.75m : Complete to highly weathered and decomposed, medium grained, loosely compacted and crushed, moderately soft and weak **Hornblende Gneiss**. Sludge collected from 04.75 – 06.25m depth.
 13.75 – 25.00m : Moderately weathered, light grey and blackish grey bands, medium to fine grains are moderately to densely compacted, well developed gneissic structure observed, moderately hard to hard and moderately strong to strong **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures upto 13.75m depth. Thereafter cores are continuous and are medium to thickly spaced base parallel fractures (15-8 nos/m). Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces upto 13.75m depth. Followed by massive and partial sizes mixed with few small size pieces at places. Open fractured surfaces are rough, wavy and altered. Rock quality is poor (upto 14.00m) to fair.

BH. No: 20

- 00.00 – 04.20m : Overburden.
 04.20 – 14.75m : Completely weathered, decomposed and disintegrated rock fragments along with mica collected as sludge.
 14.75 – 20.00m : Highly weathered, light grey with blackish patch and bands, medium to fine grains are moderately to densely compacted, well developed gneissic structure observed, moderately hard and moderately strong **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures, with locally inclined (45°-55° dip) fractures. Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces throughout the depth. Open fractured surfaces are rough, wavy and altered. Open inclined fracture surfaces are non-planar, smooth and altered. Rock quality is very poor to poor.

BH. No: 21

- 00.00 – 03.00m : Overburden.
 03.00 – 05.25m : Completely weathered, decomposed and disintegrated rock fragments along with mica collected as sludge.
 05.25 – 15.00m : Highly weathered, dark grey and light grey bands with brown shades, medium to fine grains are moderately compacted, well developed gneissic structure observed, moderately hard and weak **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures. Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces throughout the depth. Open fractured surfaces are rough, wavy and altered. Rock quality is very poor to poor.

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BH. No: 22

- 00.00 – 03.00m : Overburden.
- 03.00 – 06.75m : Completely weathered, decomposed and disintegrated rock fragments along with mica collected as sludge.
- 06.75 – 20.00m : Dominantly high with locally moderately (at 09.75 – 12.75m depth) weathered, dark grey and light grey bands with brown shades, medium to fine grains are moderately to densely compacted, well developed gneissic structure observed, moderately hard and weak to moderately strong (at 09.75 – 12.75m) **Hornblende Gneiss** having mica along the weak planes throughout the depth.
Locally completely weathered, decomposed and disintegrated rock fragments collected as sludge at 15.75 – 17.25m depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures, with locally inclined (45°-55° dip) fractures. Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces throughout the depth, locally massive and partial size at 09.75 – 12.75m depth. Open fractured surfaces are rough, wavy and altered. Open inclined fracture surfaces are non-planar, smooth and altered. Rock quality is very poor to poor.

BH. No: 23

- 00.00 – 03.10m : Overburden.
- 03.10 – 09.10m : Completely weathered, decomposed and disintegrated rock fragments collected as sludge, with remnants of highly weathered, decomposed, fine grained, soft and weak **Calc-silicate** at 04.60 – 06.10m depth.
- 09.10 – 20.00m : Highly to moderately weathered, dark grey with blackish patch and bands, medium to fine grains are moderately compacted, well developed gneissic structure observed, moderately hard and weak **Hornblende Gneiss** having mica along the weak planes throughout the depth.
Locally completely weathered, decomposed and disintegrated rock fragments collected as sludge at 13.60 – 15.85m depth.

Discontinuous with locally continuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures. Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces throughout the depth. Open fractured surfaces are rough, wavy and altered. Rock quality is very poor to poor.

BH. No: 24

- 00.00 – 02.60m : Overburden.
- 02.60 – 05.65m : Completely weathered, decomposed and disintegrated rock fragments along with mica collected as sludge.
- 05.65 – 07.15m : Different shaped gravels and boulders of quartzite and granite.
- 07.15 – 20.00m : Highly weathered, dark grey and light grey bands, medium to fine grains are moderately to densely compacted, well developed gneissic structure observed, moderately hard and moderately strong **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Discontinuous with locally continuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures. Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces throughout the depth. Open fractured surfaces are rough,

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wavy and altered. Rock quality is very poor to poor.

BH. No: 25

00.00 – 04.99m : Overburden.

04.99 – 12.00m : Completely weathered, decomposed and disintegrated rock fragments collected as sludge, with remnants of highly weathered, decomposed, fine grained, soft and weak **Hornblende Gneiss** at 10.99 – 12.00m depth.

12.00 – 30.00m : High to moderately weathered, light grey with blackish patch and bands, medium to fine grains are moderately to densely compacted, well developed gneissic structure observed, moderately hard and moderately strong **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures upto 16.00m depth. Thereafter cores are continuous and are medium spaced base parallel fractures (15-8 nos/m). Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces upto 16.00m depth. Followed by intact partial and small size pieces. Open fractured surfaces are rough, wavy and altered. Rock quality is very poor to poor.

BH. No: 26

00.00 – 04.40m : Overburden.

04.40 – 10.00m : Completely weathered, decomposed and disintegrated rock fragments collected as sludge.

10.00 – 25.00m : Highly weathered, light grey with blackish patch and bands, medium to fine grains are moderately compacted, well developed gneissic structure observed, moderately hard and weak **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Discontinuous with locally continuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures. Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces with rare partial size pieces at certain depth. Open fractured surfaces are rough, wavy and altered. Rock quality is very poor to poor.

BH. No: 27

00.00 – 03.00m : Overburden.

03.00 – 09.75m : Completely weathered, decomposed and disintegrated rock fragments collected as sludge.

09.75 – 20.00m : Highly weathered, dark grey and light grey bands with brownish shades, medium to fine grains are moderately compacted, well developed gneissic structure observed, moderately hard and weak to strong **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures upto 11.00m depth. Thereafter cores are continuous and are medium spaced base parallel fractures (15-8 nos/m). Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces, mixed with few partial size pieces upto 11.00m depth. Followed by intact partial and small size pieces. Open fractured surfaces are rough, wavy and altered. Rock quality is very poor to poor.

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BH No. 28

- 00.00 – 03.00m : Overburden.
 03.00 – 06.00m : Completely weathered, decomposed and disintegrated rock particles collected as sludge.
 06.00 – 20.00m : Moderately weathered, gneissic, whitish grey, medium to fine grained, medium compacted, medium hard and moderately strong **Gneiss** with sludge of disintegrated rock particles from 10.50-12.00m depth.

Discontinuous cores recovered and are thinly spaced (>15 nos./m) dominantly base parallel along with rare inclined (45° dip) and random fracture cores. Fracture surfaces are planar, slightly rough and slightly altered. Recovered core are isolated small sizes pieces mixed with completely fragmented pieces. Rock quality is very poor (upto 8.25m depth) to poor, locally very poor.

BH No. 29

- 00.00 – 04.00m : Overburden.
 04.00 – 20.00m : Moderately weathered, gneissic, light grey, medium to fine grained, medium compacted, medium hard and moderately strong **Gneiss** with sludge of disintegrated rock particles from 10.75-13.75m depth.

Discontinuous cores recovered and are thinly spaced (>15 nos./m) dominantly base parallel along with rare inclined (45° dip) and random fractures. Fracture surfaces are planar, smooth and altered. Recovered core pieces are small sizes mixed with fragmented pieces. Rock quality is very poor (upto 7.75m depth) to poor.

BH. No: 30

- 00.00 – 02.50m : Overburden.
 02.50 – 05.50m : Completely weathered, decomposed and disintegrated rock fragments collected as sludge.
 05.50 – 20.00m : Highly to moderately (07.75 – 20.00m) weathered, dark grey with blackish patch and bands, medium to fine grains are moderately to densely compacted, well developed gneissic structure observed, moderately hard and moderately strong to strong **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures upto 07.75m depth. Thereafter cores are continuous and are medium spaced base parallel fractures (15-8 to 8-5 nos/m). Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces, mixed with few partial size pieces upto 07.75m depth. Followed by intact partial and massive size pieces. Open fractured surfaces are rough, wavy and altered. Rock quality is poor to fair (from 08.00m depth).

BH. No: 31

- 00.00 – 04.00m : Overburden.
 04.00 – 08.50m : Completely weathered, decomposed and disintegrated rock fragments collected as sludge.
 08.50 – 20.00m : Highly to completely weathered, light grey and dark grey bands / stripes, medium to fine grains are loosely to moderately compacted, well developed gneissic structure observed, moderately hard and weak **Hornblende Gneiss**

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having mica along the weak planes throughout the depth.

Completely weathered, decomposed and disintegrated rock fragments collected as sludge at 13.00 – 16.00m, 16.75 – 17.50m depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures. Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces with few partial sizes pieces at places. Open fractured surfaces are rough, wavy and altered. Rock quality is very poor to poor.

BH. No: 32

00.00 – 04.50m : Overburden.

04.50 – 11.25m : Completely weathered, decomposed and disintegrated rock fragments collected as sludge, with remnants of highly weathered, decomposed, fine grained, soft and weak **Hornblende Gneiss** at 07.50 – 08.25m.

11.25 – 15.00m : Highly weathered, dark grey and light grey bands with brownish shades, medium to fine grains are moderately compacted, well developed gneissic structure observed, moderately hard and weak **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures. Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces, mixed with rare partial size pieces. Open fractured surfaces are rough, wavy and altered. Rock quality is very poor to poor.

BH. No: 33

00.00 – 02.60m : Overburden.

02.60 – 06.50m : Completely weathered, decomposed and disintegrated rock fragments collected as sludge, with remnants of highly weathered, decomposed, fine grained, soft and weak **Hornblende Gneiss** at 02.60 – 03.50m.

06.50 – 20.00m : Highly to moderately (09.50 – 20.00m) weathered, dark grey with blackish patch and bands, medium to fine grains are moderately to densely compacted, well developed gneissic structure observed, moderately hard and moderately strong to strong **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures upto 09.50m depth. Thereafter cores are continuous and are medium spaced base parallel fractures (15-8 nos/m). Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces, mixed with few partial size pieces upto 09.50m depth. Followed by intact partial and massive size pieces. Open fractured surfaces are rough, wavy and altered. Rock quality is poor to fair (from 09.50m depth).

BH. No: 34

00.00 – 04.80m : Overburden.

04.80 – 30.05m : Dominantly high with locally completely (upto 27.00m depth), followed by moderately weathered, light grey with brown shades, medium to fine grains are loosely to moderately compacted, well developed gneissic structure observed, moderately hard and weak to moderately strong (from 27.00m) **Hornblende Gneiss** having mica along the weak planes throughout the depth. Locally completely weathered, decomposed and disintegrated rock fragments

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collected as sludge at 04.80 – 05.55m, 10.80 – 11.55m, 14.55 – 16.05m, 17.55 – 18.30m, 22.05 – 22.80m depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures upto 27.30m depth. Thereafter cores are continuous and are medium spaced base parallel fractures (15-8 nos/m). Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces. Followed by intact partial and small size pieces. Open fractured surfaces are rough, wavy and altered. Rock quality is very poor to poor.

BH. No: 35

00.00 – 04.00m : Overburden.

04.00 – 20.00m : Highly (upto 11.50m) to moderately weathered, light grey and dark grey bands, medium to fine grains are moderately (upto 12.00m) to densely compacted, well developed gneissic structure observed, moderately hard and weak (upto 12.00m) to strong **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Completely weathered, decomposed and disintegrated rock fragments collected as sludge at 05.50 – 07.00m.

Isolated rounded gravel and dominantly boulders of Quartzite at 07.00 – 08.50m depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures upto 10.75m depth. Thereafter cores are continuous and are medium to thickly spaced base parallel fractures (15-8 to 8-5 nos/m). Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces upto 10.75m depth. Followed by small and partial sizes mixed with few massive size pieces. Open fractured surfaces are rough, wavy and altered. Rock quality is poor (upto 11.00m) to fair.

BH No. 36

00.00 – 01.90m : Overburden.

01.90 – 10.75m : Highly weathered, light greenish grey, schistose, medium to fine grained, loosely compacted, soft and weak **Hornblende Schist**.

Discontinuous cores are thinly spaced random and few base parallel fractured (>15 nos./m). Fracture surfaces are non planar, rough and deeply altered. Recovered core pieces are isolated small sizes mixed with sub rounded to angular fragmented pieces. Rock quality is very poor.

10.75 – 15.00m : Completely weathered, decomposed and disintegrated rock particles collected as sludge.

BH. No: 37

00.00 – 03.50m : Overburden.

03.50 – 13.75m : Completely weathered, decomposed and disintegrated rock fragments collected as sludge, with remnants of highly weathered, decomposed, fine grained, soft and weak **Calc-silicate** at 08.00 – 08.75m, 09.50 – 12.50m depth.

13.75 – 20.00m : Highly to moderately weathered, dark grey with blackish patch and bands, medium to fine grains are moderately to densely compacted, well developed gneissic structure observed, moderately hard and moderately strong **Hornblende Gneiss** having mica along the weak planes throughout the depth.

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Discontinuous with locally continuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures, with locally inclined (45°-55° dip) fractures. Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces throughout the depth. Open fractured surfaces are rough, wavy and altered. Open inclined fracture surfaces are non-planar, smooth and altered. Rock quality is very poor to poor.

BH. No: 38

00.00 – 03.00m : Overburden.

03.00 – 06.00m : Completely weathered, decomposed and disintegrated rock fragments collected as sludge, with remnants of highly weathered, decomposed, fine grained, soft and weak **Hornblende Gneiss** at 03.00 – 03.75m depth.06.00 – 20.00m : Highly weathered, light grey and blackish grey bands, medium to fine grains are densely compacted, well developed gneissic structure observed, moderately hard to hard and weak to strong **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures upto 09.75m depth. Thereafter cores are continuous and are medium to thickly spaced base parallel fractures (15-8 nos/m). Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces upto 09.75m depth. Followed by small and partial sizes mixed with few massive size pieces at 12.75 – 15.00m depth. Open fractured surfaces are rough, wavy and altered. Open inclined (45°-55° dip) fracture surfaces are non-planar, smooth and altered. Rock quality is very poor to poor.

BH. No: 39

00.00 – 03.50m : Overburden.

03.50 – 08.50m : Completely weathered, decomposed and disintegrated rock fragments collected as sludge, with remnants of highly weathered, decomposed, fine grained, soft and weak **Calc-silicate** at 03.50 – 04.75m, 07.00 – 08.50m depth.08.50 – 20.00m : Highly to moderately weathered, dark grey with blackish patch and bands, medium to fine grains are moderately compacted, well developed gneissic structure observed, moderately hard and weak **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Discontinuous with locally continuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures. Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces throughout the depth. Open fractured surfaces are rough, wavy and altered. Rock quality is very poor to poor.

BH. No: 40

00.00 – 03.50m : Overburden.

03.50 – 11.00m : Completely weathered, decomposed and disintegrated rock fragments collected as sludge with gravels and boulders of Quartzite at 03.50 – 05.00m, 09.50 – 11.00m depth.

11.00 – 20.00m : High (upto 12.50m depth) to moderately weathered, light grey with blackish patch (occasionally brown shades upto 15.00m depth), medium to fine grains are densely compacted, well developed gneissic structure observed,

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moderately hard to hard and moderately strong to strong **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures upto 12.50m depth. Thereafter cores are continuous and are medium to thickly spaced base parallel fractures (15-8 nos/m). Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces upto 12.50m depth. Followed by small and partial sizes mixed with few massive size pieces at places. Open fractured surfaces are rough, wavy and altered. Open inclined (45°-55° dip) fracture surfaces are non-planar, smooth and altered. Rock quality is poor (upto 13.00m) to fair.

BH. No: 41

00.00 – 04.30m : Overburden.

04.30 – 08.00m : Completely weathered, decomposed and disintegrated rock fragments collected as sludge, with remnants of highly weathered, decomposed, fine grained, soft and weak **Hornblende Gneiss** at 04.30 – 05.00m.

08.00 – 20.00m : Dominantly high with locally moderately (at 13.25 – 14.75m depth) weathered, dark grey and light grey bands with brown shades, medium to fine grains are moderately to densely compacted, well developed gneissic structure observed, moderately hard and weak to moderately strong (at 13.25 – 14.75m) **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Discontinuous to continuous core recovery, and are thinly to locally medium spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures. Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces throughout the depth, locally massive and partial size at 13.25 – 14.75m depth. Open fractured surfaces are rough, wavy and altered. Open inclined (45°-55° dip) fracture surfaces are non-planar, smooth and altered. Rock quality is very poor to poor, locally fair (13.00 – 15.00m depth).

BH. No: 42

00.00 – 04.90m : Overburden.

04.90 – 20.00m : Highly to completely weathered, light grey and dark grey bands / stripes, medium to fine grains are loosely to moderately compacted, well developed gneissic structure observed, moderately hard and weak **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Completely weathered, decomposed and disintegrated rock fragments collected as sludge at 05.65 – 07.15m, 10.15 – 11.65m depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures. Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces with few partial and massive size pieces at 16.15 – 18.40m depth. Open fractured surfaces are rough, wavy and altered. Rock quality is very poor to poor.

BH No. 43

00.00 – 04.50m : Overburden.

04.50 – 07.25m : Completely weathered, decomposed and disintegrated rock particles collected as sludge.

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- 07.25 – 15.00m : Moderately weathered, gneissic, greenish grey, medium to fine grained, medium compacted, medium hard and moderately strong **Hornblende Gneiss** with sludge of disintegrated rock particles from 10.25-13.25m depth.

Discontinuous cores recovered and are thinly spaced (>15 nos./m) dominantly base parallel along with rare inclined (45° dip) fractured. Fracture surfaces are planar, slightly smooth and altered or stain. Recovered core pieces are small sizes mixed with fragmented pieces. Rock quality is very poor.

BH. No: 44

- 00.00 – 04.40m : Overburden.
 04.40 – 11.95m : Completely weathered, decomposed and disintegrated rock fragments collected as sludge.
 11.95 – 20.00m : Highly to moderately weathered, dark grey with blackish patch and bands, medium to fine grains are moderately compacted, well developed gneissic structure observed, moderately hard and weak **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Discontinuous with locally continuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures. Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces with rare partial size pieces at certain depth. Open fractured surfaces are rough, wavy and altered. Rock quality is very poor to poor.

BH No. 45

- 00.00 – 04.50m : O. B.
 04.50 – 06.00m : Completely weathered, decomposed and disintegrated rock particles collected as sludge.
 06.00 – 20.00m : Moderate (upto 11.25m depth) to slightly weathered, gneissic, greenish grey, medium to fine grained, densely compacted, hard and strong **Hornblende Gneiss**.

Discontinuous cores recovered and are thinly spaced (>15 nos./m) dominantly base parallel along with locally inclined (45° dip) and heavily and random fractured. Fracture surfaces are planar, slightly smooth and altered. Recovered core pieces are small sizes mixed with fragmented pieces at few depths. Rock quality is very poor (upto 12.0m depth to poor).

BH. No: 46

- 00.00 – 02.55m : Overburden.
 02.55 – 10.00m : Completely weathered, decomposed and disintegrated rock fragments along with mica collected as sludge.
 10.00 – 20.00m : Highly weathered, dark grey and light grey bands with brown shades, medium to fine grains are moderately compacted, well developed gneissic structure observed, moderately hard and weak **Hornblende Gneiss** having mica along the weak planes throughout the depth.
 Locally completely weathered, decomposed and disintegrated rock fragments along with mica collected as sludge at 16.75 – 20.00m depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures. Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces throughout the

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depth. Open fractured surfaces are rough, wavy and altered. Rock quality is very poor to poor.

BH. No: 47

- 00.00 – 04.00m : Overburden.
 04.00 – 10.75m : Completely weathered, decomposed and disintegrated rock fragments collected as sludge.
 10.75 – 20.00m : Highly weathered, dark grey and brownish grey bands, medium grains are moderately to densely compacted, well developed gneissic structure observed, moderately hard and weak to moderately strong **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Discontinuous to continuous core recovery, and are thinly to locally medium spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures. Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces throughout the depth. Open fractured surfaces are rough, wavy and altered. Rock quality is very poor to poor.

BH. No: 48

- 00.00 – 04.80m : Overburden.
 04.80 – 09.30m : Completely weathered, decomposed and disintegrated rock fragments collected as sludge, with remnants of highly weathered, decomposed, fine grained, soft and weak **Hornblende Gneiss** at 07.80 – 08.55m depth.
 09.30 – 20.00m : High (upto 12.30m depth) to moderately weathered, light grey and blackish grey bands / stripes, medium to fine grains are densely compacted, well developed gneissic structure observed, moderately hard to hard and moderately strong to strong **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures upto 12.30m depth. Thereafter cores are continuous and are medium to thickly spaced base parallel fractures (15-8 nos/m). Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces upto 12.30m depth. Followed by small and partial sizes mixed with few massive size pieces at places. Open fractured surfaces are rough, wavy and altered. Open inclined (45°-55° dip) fracture surfaces are non-planar, smooth and altered. Rock quality is poor (upto 12.30m) to fair.

BH. No: 49

- 00.00 – 04.25m : Overburden.
 04.25 – 16.25m : Completely weathered, decomposed and disintegrated rock fragments collected as sludge.
 16.25 – 20.00m : Highly weathered, light grey and dark grey bands / stripes, medium to fine grains are moderately compacted, well developed gneissic structure observed, moderately hard and weak **Hornblende Gneiss** having mica along the weak planes throughout the depth.
 Locally boulders and gravels of **Quartzite** found at 16.25 – 17.00m depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures. Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces with few partial sizes pieces at places. Open fractured surfaces are rough, wavy and altered.

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Rock quality is very poor to poor.

BH. No: 50

- 00.00 – 04.00m : Overburden.
 04.00 – 07.75m : Completely weathered, decomposed and disintegrated rock fragments collected as sludge.
 07.75 – 25.00m : High (upto 16.00m depth) to moderately weathered, light grey and blackish grey bands / stripes, medium to fine grains are densely compacted, well developed gneissic structure observed, moderately hard to hard and moderately strong to strong **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures upto 21.00m depth. Thereafter cores are continuous and are medium spaced base parallel fractures (15-8 nos/m). Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces upto 21.00m depth. Followed by small and partial sizes pieces. Open fractured surfaces are rough, wavy and altered. Rock quality is very poor to poor.

BH. No: 51

- 00.00 – 04.00m : Overburden.
 04.00 – 10.00m : Completely weathered, decomposed and disintegrated rock fragments collected as sludge.
 10.00 – 15.00m : Highly weathered, dark grey and light grey bands with brownish shades, medium to fine grains are moderately compacted, well developed gneissic structure observed, moderately hard and weak **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures. Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces, mixed with rare partial size pieces. Open fractured surfaces are rough, wavy and altered. Rock quality is very poor to poor.

BH. No: 52

- 00.00 – 04.50m : Overburden.
 04.50 – 15.00m : Dominantly high with locally moderately (at 08.25 – 10.50m depth) weathered, dark grey and light grey bands with brown shades, medium to fine grains are moderately to densely (08.25 – 10.50m) compacted, well developed gneissic structure observed, moderately hard and weak to moderately strong (at 08.25 – 10.50m) **Hornblende Gneiss** having mica along the weak planes throughout the depth.
 Locally completely weathered, decomposed and disintegrated rock fragments collected as sludge at 11.25 – 12.75m depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures, with locally inclined (45°-55° dip) fractures. Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces throughout the depth, locally massive and partial size at 08.25 – 10.50m depth. Open fractured surfaces are rough, wavy and altered. Open inclined fracture surfaces are non-planar, smooth and altered. Rock quality is very poor to poor, locally fair (08.25 – 10.50m depth).

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BH. No: 53

- 00.00 – 03.00m : Overburden.
- 03.00 – 09.75m : Completely weathered, decomposed and disintegrated rock fragments collected as sludge.
- 09.75 – 20.00m : Highly to moderately weathered, dark grey with blackish patch and bands, medium to fine grains are moderately compacted, well developed gneissic structure observed, moderately hard and weak **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Pockets of Quartzite gravels and boulders at 09.75 – 10.50m depth.

Discontinuous with locally continuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures. Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces throughout the depth. Open fractured surfaces are rough, wavy and altered. Rock quality is very poor to poor.

BH. No: 54

- 00.00 – 04.30m : Overburden.
- 04.30 – 13.25m : Almost completely weathered and decomposed, fine to medium grained, loosely compacted and crushed, soft and weak **Hornblende Gneiss**.
- 13.25 – 20.00m : Highly weathered, light grey and dark grey bands, medium to fine grains are moderately compacted, well developed gneissic structure observed, moderately hard and weak **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Discontinuous with locally continuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures. Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces throughout the depth. Open fractured surfaces are rough, wavy and altered. Rock quality is very poor to poor.

BH. No: 55

- 00.00 – 04.40m : Overburden.
- 04.40 – 10.25m : Almost completely weathered and decomposed, fine to medium grained, loosely compacted and crushed, soft and weak **Hornblende Gneiss**.
- 10.25 – 20.00m : Dominantly high with locally moderately (at 14.00 – 15.00m depth) weathered, dark grey and light grey bands with brown shades, medium to fine grains are moderately to densely (14.00 – 15.00m) compacted, well developed gneissic structure observed, moderately hard and weak to moderately strong (at 14.00 – 15.00m) **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures, with locally inclined (45°-55° dip) fractures. Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces throughout the depth, locally massive and partial size at 14.00 – 15.00m depth. Open fractured surfaces are rough, wavy and altered. Open inclined fracture surfaces are non-planar, smooth and altered. Rock quality is very poor to poor, locally fair (14.00 – 15.00m depth).

BH. No: 56

- 00.00 – 04.50m : Overburden.

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- 04.50 – 13.50m : Completely weathered, decomposed and disintegrated rock fragments collected as sludge, with remnants of highly weathered, decomposed, fine grained, soft and weak **Calc-silicate** at 06.00 – 08.25m, 10.50 – 12.00m depth.
- 13.50 – 20.00m : Highly weathered, dark grey to light grey, medium to fine grains are moderately compacted, well developed gneissic structure observed, moderately hard and moderately strong **Hornblende Gneiss** having mica along the weak planes throughout the depth.
Pocket layer of Cal-silicate rock observed at 16.50 – 18.75m depth.

Discontinuous with locally continuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures. Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces throughout the depth. Open fractured surfaces are rough, wavy and altered. Rock quality is very poor to poor.

BH. No: 57

- 00.00 – 03.40m : Overburden.
- 03.40 – 10.90m : Completely weathered, decomposed and disintegrated rock fragments collected as sludge, with remnants of **Quartzite** gravels and boulders at 06.40 – 07.90m depth.
- 10.90 – 13.15m : Different shaped gravels and boulders of **Quartzite**.
- 13.15 – 25.00m : Highly (upto 14.65m) to moderately weathered, light grey and dark grey bands / stripes, medium to fine grains are moderately (upto 14.65m) to densely compacted, well developed gneissic structure observed, moderately hard and weak (upto 15.00m) to strong **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures upto 14.65m depth. Thereafter cores are continuous and are medium to thickly spaced base parallel fractures (15-8 to 8-5 nos/m). Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces upto 14.65m depth. Followed by small and partial sizes mixed with few massive size pieces. Open fractured surfaces are rough, wavy and altered. Rock quality is poor (upto 14.65m) to fair.

BH. No: 58

- 00.00 – 04.30m : Overburden.
- 04.30 – 20.00m : High (upto 08.00m depth) to moderately (08.00 – 10.25m), followed by slightly weathered, light grey and blackish grey bands, medium to fine grains are moderately (upto 10.25m) to densely compacted, well developed gneissic structure observed, moderately hard to hard and moderately strong to strong **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures upto 08.00m depth. Thereafter cores are continuous and are medium to thickly spaced base parallel fractures (15-8 to 8-5 nos/m). Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces upto 08.00m depth. Followed by massive and partial sizes mixed with few small size pieces at places. Open fractured surfaces are rough, wavy and altered. Rock quality is poor (upto 08.00m) to fair (08.00 – 10.25m), followed by good.

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BH. No: 59

00.00 – 03.45m : Overburden.

03.45 – 20.00m : Highly weathered, dark grey and light grey bands, medium to fine grains are moderately compacted, well developed gneissic structure observed, moderately hard and weak to moderately strong **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Pocket layer of highly weathered Cal-silicate rock observed at 10.00 – 11.50m depth.

Completely weathered, decomposed and disintegrated rock fragments collected as sludge at 06.25 – 07.75m depth.

Discontinuous with locally continuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures. Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces throughout the depth. Open fractured surfaces are rough, wavy and altered. Rock quality is very poor to poor.

BH. No: 60

00.00 – 04.50m : Overburden.

04.50 – 20.00m : High (upto 10.50m depth) to moderately (10.50 – 19.00m), followed by slightly weathered, light grey and blackish grey bands, medium to fine grains are moderately (upto 19.00m) to densely compacted, well developed gneissic structure observed, moderately hard to hard and moderately strong to strong **Hornblende Gneiss** having mica along the weak planes throughout the depth. Locally of completely weathered, decomposed and disintegrated rock fragments collected as sludge at 16.75 – 18.25m depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures upto 10.50m depth. Thereafter cores are continuous and are medium to thickly spaced base parallel fractures (15-8 nos/m). Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces upto 19.00m depth. Followed by massive and partial size pieces. Open fractured surfaces are rough, wavy and altered. Rock quality is poor (upto 10.50m) to fair (10.50 – 19.00m), followed by good.

BH. No: 61

00.00 – 04.50m : Overburden.

04.50 – 09.00m : Completely weathered, decomposed and disintegrated rock fragments collected as sludge.

09.00 – 20.00m : Dominantly high with locally moderately (at 16.50 – 18.00m depth) weathered, dark grey and light grey bands with brown shades, medium to fine grains are moderately to densely (16.50 – 18.00m) compacted, well developed gneissic structure observed, moderately hard and weak to moderately strong (at 16.50 – 18.00m) **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures, with locally inclined (45°-55° dip) fractures. Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces throughout the depth, locally massive and partial size at 16.50 – 18.00m depth. Open fractured surfaces are rough, wavy and altered. Open inclined fracture surfaces are non-planar, smooth and altered. Rock quality is very poor to poor with locally fair (16.50 – 18.00m

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depth).

BH. No: 62

- 00.00 – 04.40m : Overburden.
 04.40 – 30.00m : High (upto 14.00m depth) to moderately (14.00 – 17.00m), followed by slightly weathered, light grey and blackish grey bands, medium to fine grains are moderately (upto 17.00m) to densely compacted, well developed gneissic structure observed, moderately hard to hard and moderately strong to strong **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures upto 14.00m depth. Thereafter cores are continuous and are medium to thickly spaced base parallel fractures (15-8 to 8-5 nos/m). Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces upto 14.00m depth. Followed by massive and partial sizes mixed with few small size pieces at places. Open fractured surfaces are rough, wavy and altered. Rock quality is poor (upto 14.00m) to fair (14.00 – 17.00m), followed by good.

BH. No: 63

- 00.00 – 04.30m : Overburden.
 04.30 – 06.50m : Completely weathered, decomposed and disintegrated rock fragments collected as sludge.
 06.50 – 20.00m : Highly (upto 10.25m) to moderately weathered, dark grey and light grey bands, medium to fine grains are moderately compacted, well developed gneissic structure observed, moderately hard and weak (upto 10.25m) to strong **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures upto 11.00m depth. Thereafter cores are continuous and are medium spaced base parallel fractures (15-8 nos/m). Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces, mixed with few partial size pieces upto 11.00m depth. Followed by intact partial and small size pieces. Open fractured surfaces are rough, wavy and altered. Rock quality is very poor to poor.

BH. No: 64

- 00.00 – 04.00m : Overburden.
 04.00 – 08.50m : Completely weathered, decomposed and disintegrated rock fragments collected as sludge, with remnants of highly weathered, decomposed, fine grained, soft and weak **Hornblende Gneiss** at 05.50 – 07.00m depth.
 08.50 – 20.00m : Highly (upto 15.25m) to moderately weathered, light grey to dark grey, medium to fine grains are moderately (upto 15.25m) to densely compacted, well developed gneissic structure observed, moderately hard and weak (upto 15.25m) to strong **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures upto 15.25m depth. Thereafter cores are continuous and are medium to thickly spaced base parallel fractures (15-8 to 8-5 nos/m). Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces upto 15.25m depth. Followed by small and

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partial sizes mixed with few massive size pieces. Open fractured surfaces are rough, wavy and altered. Open inclined (45°-55° dip) fracture surfaces are non-planar, smooth and altered. Rock quality is poor (upto 15.25m) to fair.

BH. No: 65

00.00 – 03.00m : Overburden.

03.00 – 20.00m : Highly to moderately weathered, dark grey (upto 11.25m) to light grey with blackish bands, medium to fine grains are moderately compacted, well developed gneissic structure observed, moderately hard and weak (upto 12.00m) to strong **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures upto 09.00m depth. Thereafter cores are continuous and are medium to thickly spaced base parallel fractures (15-8 nos/m). Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces, mixed with few massive and partial size pieces at 04.50 – 05.25m, 09.00 – 10.50m, 15.75 – 17.25m depth. Open fractured surfaces are rough, wavy and altered. Rock quality is poor (upto 09.00m) to fair.

BH. No: 66

00.00 – 03.50m : Overburden.

03.50 – 09.50m : Completely weathered, decomposed and disintegrated rock fragments collected as sludge, with remnants of **Quartzite** gravels and boulders at 06.50 – 08.0m depth.

09.50 – 20.00m : Highly weathered, light grey and dark grey bands / stripes, medium to fine grains are moderately to densely compacted, well developed gneissic structure observed, moderately hard and weak to strong **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Discontinuous core recovery, and are thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures. Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces with few partial sizes pieces at places. Open fractured surfaces are rough, wavy and altered. Rock quality is very poor to poor.

BH No. 67

00.00 – 04.50m : O. B.

04.50 – 12.00m : Completely weathered, decomposed and disintegrated rock particles collected as sludge.

12.00 – 15.00m : Moderate (upto 11.25m depth) to slightly weathered, gneissic, light greenish grey, medium to fine grained, moderately compacted, medium hard and moderately strong **Hornblende Gneiss**.

Discontinuous cores recovered and are thinly spaced (>15 nos./m) dominantly base parallel along with locally inclined (45° dip) and heavily and random fractured. Vertically fractured cores from 13.50-14.25m depth. Fracture surfaces are planar, slightly rough and altered. Recovered core pieces are small sizes mixed with angular fragmented pieces. Rock quality is very poor.

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00.00 – 03.75m : Overburden.

03.75 – 20.00m : Highly weathered, dark grey and light grey bands, medium to fine grains are moderately compacted, well developed gneissic structure observed, moderately hard and weak to moderately strong **Hornblende Gneiss** having mica along the weak planes throughout the depth.

Completely weathered, decomposed and disintegrated rock fragments collected as sludge at 05.25 – 12.00m and 15.75-20.00m depth.

Discontinuous core recovery, and are very thinly spaced (>15 nos/m), dominantly base parallel with randomly oriented fractures. Isolated segmented pieces are core shaped small with sub-angular to sub-rounded pieces throughout the depth. Open fractured surfaces are rough, wavy and altered. Rock quality is very poor.

For C. E. Testing Company private limited,

(Dr. A. Seth, Geologist)

(Mr. S.Paramanik, Geologist)

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8. ELECTRICAL RESISTIVITY TEST

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REPORT ON
ELECTRICAL RESISTIVITY TEST (ERT) FOR
1 x 800MW KOTHAGUDAM THERMAL POWER STATION
STAGE VII, UNIT-12 AT KHAMMAM DISTRICT,
TELANGANA STATE

INTRODUCTION:

Electrical Resistivity Test was carried out for proposed 1x800 MW Kothagudam Thermal Power Station, Stage VII, Unit-12 at Khammam district, Telangana State from 14.02.2015 to 19.02.2015 using resistivity meter (model DDR2, IGIS) and following Indian standard at twenty (20) locations.

METHODOLOGY:

The Soil Resistivity Survey is a method to find out the Electrical Resistivity (Specific Resistance) of a medium. It is the resistance offered by a unit cube of a particular medium (so called strata below the ground level) when a unit current passes perpendicular to the surface of a cross-sectional area A. The relation is given by Ohm's Law is –

$$\rho = R \frac{A}{L} \text{ ohm --- } = \text{ohm - m where}$$

ρ = Resistivity, R = resistance offered by the medium of length L and Cross-sectional area A.

In electrical resistivity survey a known current I (direct current or low frequency alternating current) is sent into the ground through a pair of current electrodes A & B and the potential difference (ΔV) created in the medium is measured between another pair of electrodes M & N. The resistivity of the formation is then given

$$\rho = K \frac{\Delta V}{I} \text{ where } \rho \text{ is the apparent resistivity, K is the geometric factor.}$$

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In the Earth Resistivity Test, the Wenner configuration was followed. In this configuration two potential electrodes M & N are placed in a line with the current electrodes A & B, all four being situated equidistance from one to another and disposed symmetrically with respect to a central point such that $AM=MN=NB=a$. The outer two electrodes A & B were used for sending current (I) and inner two M & N were used for measuring the potential differences (ΔV). The distance between each consecutive electrode (a) was kept constant and was progressively increased to reach the depth at which resistivity information are wanted. Suitable electrode spacing determines the conductivity of the top soil as well as the various subsurface layers occurring in the area under study. At each location, 4 sets of observations were taken for each of the electrode spacing (a) in eight directions (N-S, E-W, NE-SW and NW-SE) and in seven different electrode spacing viz.: a = 0.50m, 1.0m, 2.0m, 3.0m, 4.0m, 5.0m and 10.0m were used to know the nature of change of resistivity.

The apparent resistivity was determined by the formula –

$$\rho = 6.28 a \frac{\Delta V}{I} \text{ where 'a' is the distance between the two consecutive}$$

Electrodes and $\frac{\Delta V}{I}$ is R which is the observed resistance for measuring resistivity.

The mean value of the resistivity estimated was taken as the representative one.

The depth of investigation in an isotropic and homogeneous formation can be approximated to the distance between the consecutive two electrodes (a).

INTERPRETATION:

ERT observations were taken on 20 (Twenty) locations distributed over the different building and structure positions as given in the work schedule of the Client and for direction of observations also followed the same work schedule.

The summarized result of the resistivity measurements along with the co-ordinates and the RL at different locations are given in the table annexed hereto.

All the ERT curves are plotted as “a” (m) vs. ρ (ohm-m) and are exhibited in the form plates annexed hereto.

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

The area is having different localised soil characteristics. Around some location there exists filling material almost up to 5-6 mts. Below this filling material there is presence of highly weathered hard rock turned into soil extending down below up to the depth 12 mts, then starts sandy zones within our limit of observation. At certain location the top soil is the original soil with rock fragments and extends up to 2 mts., then starts a sandy clay patch up to a depth 5 to 6 mts, there after starts the weathered rock. At the places where it is covered with coal dusts, the resistivity is exhibiting extremely low order, first it is decreasing with depth up to 6 mts or so and then it is increasing with depth further down below. Whereas at other places, in general, all the ERT curves exhibit a nature of H-type and Q-type curves which are indicative of the fact that the resistivity gradually decreases with depth and again increases with depth from that point of depth with the lower order of resistivity values. At places there are A-type curves also which indicates that resistivity increases with depth.

CONCLUSION:

The first criteria for earthing purpose is that, the zones of high resistivity are to be avoided and discarded and should hunt for the zone of steady resistivity of so called UNIFORM LAYER. The average apparent resistivity of uniform soil should be considered as correct computation of resistivity to be used in design calculation. It is not the average of all the apparent resistivity values revealed from top to bottom layers. It is only the average of apparent resistivity of so called uniform soil occurring at a particular depth below the ground level at a particular depth when for few consecutive electrodes spacing (with the gradual increase of electrode spacing) the resistivity variations are within 20 to 30 percent, the soil, at that depth, in the vicinity of the test location is to be considered as uniform one. When the electrode spacing is increased gradually from low values, at a stage, it may be found that the resistivity readings are more or less constant (variations are within 20 to 30 %) irrespective of the increase in the electrode spacing. Such type of uniform soil, the corresponding average apparent resistivity and the corresponding average depth are of prime

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importance for design purpose. Keeping in view of the necessity of detection of Uniform Soil, one should give a keen and close look in the tables to discern where the apparent resistivity readings for different electrode spacing in a direction is within 20 to 30 percent and the soil at that level will have to be considered as uniform. Such type of Uniform Soil was envisaged and corresponding average resistivities of that particular layer were deciphered and tabulated below. It can be concluded that the mean apparent resistivity of the uniform soil for different ERT locations are as hereunder:—

APPARENT RESISTIVITY VALUES

Sl. No.	ERT Location	Overall Mean Resistivity (Ohm – m)	Sl. No.	ERT Location	Overall Mean Resistivity (Ohm – m)
1.	ERT- 01	16.32	11.	ERT- 11	13.54
2.	ERT-02	10.62	12.	ERT- 12	22.00
3.	ERT-03	19.43	13.	ERT- 13	9.14
4.	ERT-04	32.90	14.	ERT-14	12.80
5.	ERT-05	29.40	15.	ERT-15	23.54
6.	ERT- 06	27.69	16.	ERT-16	20.05
7.	ERT- 07	9.73	17.	ERT-17	17.89
8.	ERT-08	39.06	18.	ERT-18	20.03
9.	ERT- 09	27.32	19.	ERT-19	20.47
10.	ERT- 10	15.00	20.	ERT-20	17.77

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SI No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				Mean
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	
1	0.5	53.38	33.60	37.74	37.11	40.46
2	1.0	13.33	16.35	14.84	22.90	16.86
3	2.0	10.59	10.81	10.81	11.06	10.82
4	3.0	8.68	11.69	12.07	12.82	11.32
5	4.0	11.06	12.07	11.06	9.55	10.94
6	5.0	12.57	11.31	10.06	8.80	10.69
7	10.0	15.09	13.83	12.57	11.31	13.20

Mean Resistivity at ERT-01 is 16.32 Ohm - m.**ERT No. 02**

SI No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				Mean
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	
1	0.50	16.64	20.10	16.33	17.27	17.59
2	1.0	6.92	6.29	11.95	7.55	8.18
3	2.0	6.29	7.54	7.54	8.80	7.54
4	3.0	7.54	7.54	9.43	9.43	8.49
5	4.0	15.08	10.06	10.06	10.06	11.32
6	5.0	9.43	9.43	9.43	6.29	8.65
7	10.0	18.86	12.57	12.57	6.29	12.57

Mean Resistivity at ERT-02 is 10.62 Ohm - m.**ERT No. 03**

SI No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				Mean
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	
1	0.50	39.44	16.33	34.85	28.34	29.74
2	1.0	16.98	12.71	15.10	13.71	14.63
3	2.0	13.83	14.08	16.34	15.34	14.90
4	3.0	14.71	17.73	15.47	16.97	16.22
5	4.0	17.60	18.10	18.60	18.10	18.10
6	5.0	17.60	20.12	19.49	20.74	19.49
7	10.0	20.12	22.63	23.89	25.14	22.95

Mean Resistivity at ERT-03 is 19.43 Ohm - m.**ERT No. 04**

SI No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				Mean
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	
1	0.50	120.70	107.39	92.94	95.46	104.12
2	1.0	24.15	23.52	24.15	25.03	24.21
3	2.0	15.34	15.59	16.09	16.34	15.84
4	3.0	20.37	15.84	20.75	16.60	18.39
5	4.0	21.62	19.11	20.11	19.61	20.11
6	5.0	23.26	22.00	20.74	21.37	21.84
7	10.0	26.40	27.66	23.89	25.14	25.77

Mean Resistivity at ERT-04 is 32.90 Ohm - m.

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SI No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				Mean
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	
1	0.50	17.71	26.38	22.29	21.98	22.09
2	1.0	31.83	28.18	22.64	19.62	25.57
3	2.0	27.40	38.21	27.15	30.17	30.73
4	3.0	27.91	29.80	28.29	28.67	28.67
5	4.0	30.67	31.17	31.68	26.65	30.04
6	5.0	35.83	26.40	30.17	31.43	30.96
7	10.0	36.46	30.17	41.49	42.74	37.72

Mean Resistivity at ERT-05 is 29.40 Ohm - m.**ERT No. 06**

SI No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				Mean
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	
1	0.50	29.89	26.63	26.69	27.63	27.71
2	1.0	34.22	28.56	27.68	35.35	31.45
3	2.0	30.92	29.41	29.92	28.41	29.67
4	3.0	24.90	25.27	24.14	26.03	25.09
5	4.0	23.13	24.13	22.63	24.64	23.63
6	5.0	21.37	22.00	20.74	21.37	21.37
7	10.0	38.97	32.69	36.46	31.43	34.89

Mean Resistivity at ERT-06 is 27.69 Ohm - m.**ERT No. 07**

SI No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				Mean
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	
1	0.50	14.07	17.58	15.70	14.70	15.51
2	1.0	9.31	12.71	12.45	10.69	11.29
3	2.0	4.78	5.53	5.78	5.28	5.34
4	3.0	8.30	5.28	6.41	6.04	6.51
5	4.0	7.54	6.54	7.54	7.04	7.17
6	5.0	8.17	8.17	8.17	8.17	8.17
7	10.0	13.83	15.09	15.09	12.57	14.15

Mean Resistivity at ERT-07 is 9.73 Ohm - m.**ERT No. 08**

SI No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				Mean
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	
1	0.50	52.56	70.02	85.35	76.30	71.06
2	1.0	45.16	40.00	33.21	40.26	39.66
3	2.0	37.21	35.95	33.18	38.21	36.14
4	3.0	27.91	29.80	31.31	30.18	29.80
5	4.0	24.13	31.17	26.15	31.68	28.28
6	5.0	25.14	30.80	26.40	28.29	27.66
7	10.0	41.49	45.26	36.45	40.23	40.86

Mean Resistivity at ERT-08 is 39.06 Ohm - m.

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SI No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				Mean
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	
1	0.50	25.25	22.29	33.91	21.48	25.73
2	1.0	32.20	28.56	24.15	29.56	28.62
3	2.0	21.87	26.90	19.61	25.64	23.51
4	3.0	21.50	25.27	21.50	25.65	23.48
5	4.0	22.63	25.64	23.13	26.65	24.51
6	5.0	25.77	26.40	25.14	27.03	26.09
7	10.0	37.72	40.23	36.46	42.74	39.29

Mean Resistivity at ERT-09 is 27.32 Ohm - m.**ERT No. 10**

SI No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				Mean
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	
1	0.50	9.55	14.57	17.58	15.70	14.35
2	1.0	10.06	9.44	7.42	9.81	9.18
3	2.0	13.32	10.06	12.07	10.81	11.57
4	3.0	12.82	13.20	13.96	14.33	13.58
5	4.0	13.58	16.09	17.60	17.10	16.09
6	5.0	15.09	14.46	16.34	15.74	15.41
7	10.0	22.63	23.89	25.14	27.66	24.83

Mean Resistivity at ERT-10 is 15.00 Ohm - m.**ERT No. 11**

SI No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				Mean
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	
1	0.50	4.90	6.66	6.22	6.78	6.14
2	1.0	5.41	6.79	7.04	6.29	6.38
3	2.0	8.04	8.30	8.80	8.55	8.42
4	3.0	12.45	11.69	12.45	12.07	12.17
5	4.0	16.09	16.09	15.08	14.58	15.46
6	5.0	19.49	17.60	16.97	18.86	18.23
7	10.0	32.69	28.92	23.89	26.40	27.98

Mean Resistivity at ERT-11 is 13.54 Ohm - m.**ERT No. 12**

SI No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				Mean
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	
1	0.50	7.72	7.98	8.16	7.85	7.93
2	1.0	9.69	12.83	10.82	11.57	11.23
3	2.0	14.83	14.08	15.84	20.87	16.41
4	3.0	21.88	19.24	19.99	21.50	20.65
5	4.0	25.14	26.65	24.13	26.15	25.52
6	5.0	26.40	28.29	27.03	30.17	27.97
7	10.0	38.97	50.29	41.49	46.52	44.32

Mean Resistivity at ERT-12 is 22.00 Ohm - m.

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SI No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				Mean
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	
1	0.50	2.64	2.89	4.08	3.14	3.19
2	1.0	4.91	4.78	5.16	5.28	5.03
3	2.0	7.29	6.03	6.54	6.79	6.66
4	3.0	8.68	6.79	9.43	9.05	8.49
5	4.0	11.06	8.04	11.56	10.56	10.31
6	5.0	12.57	9.43	13.20	11.94	11.79
7	10.0	20.12	16.34	18.86	18.86	18.55

Mean Resistivity at ERT-13 is 9.45 Ohm - m.**ERT No. 14**

SI No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				Mean
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	
1	0.50	31.09	35.17	31.71	29.83	31.95
2	1.0	3.15	8.18	12.58	11.32	8.81
3	2.0	2.51	11.31	13.83	12.57	10.06
4	3.0	5.66	11.32	11.32	9.43	9.43
5	4.0	7.54	10.06	7.54	7.54	8.17
6	5.0	6.29	9.43	6.29	6.29	7.08
7	10.0	12.57	18.86	12.57	12.57	14.14

Mean Resistivity at ERT-14 is 12.80 Ohm - m.**ERT No. 15**

SI No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				Mean
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	
1	0.50	15.20	21.23	18.78	16.14	17.84
2	1.0	21.39	20.51	23.90	24.53	22.58
3	2.0	38.21	25.89	37.71	38.21	35.01
4	3.0	19.24	18.11	16.97	15.47	17.45
5	4.0	16.09	20.11	16.59	16.09	17.22
6	5.0	16.34	17.60	16.97	14.46	16.34
7	10.0	38.97	37.72	40.23	36.46	38.35

Mean Resistivity at ERT-15 is 23.54 Ohm - m.**ERT No. 16**

SI No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				Mean
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	
1	0.50	13.75	13.82	13.63	8.10	12.33
2	1.0	15.98	15.22	14.84	14.47	15.13
3	2.0	20.87	15.08	20.61	20.61	19.29
4	3.0	21.12	19.99	21.50	20.37	20.75
5	4.0	20.61	24.64	22.63	23.63	22.88
6	5.0	20.74	25.77	23.26	24.52	23.57
7	10.0	23.89	28.92	26.40	26.40	26.40

Mean Resistivity at ERT-16 is 20.05 Ohm - m.

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SI No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				Mean
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	
1	0.50	15.57	15.39	16.58	15.70	15.81
2	1.0	13.59	12.83	13.84	13.21	13.37
3	2.0	15.08	15.08	14.83	14.58	14.89
4	3.0	16.97	16.97	17.35	17.35	17.16
5	4.0	18.60	22.12	16.62	20.11	19.36
6	5.0	19.49	20.12	20.74	21.37	20.43
7	10.0	21.34	25.14	23.89	26.40	24.19

Mean Resistivity at ERT-17 is 17.89 Ohm - m.**ERT No. 18**

SI No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				Mean
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	
1	0.50	10.55	13.50	13.19	13.50	12.69
2	1.0	16.61	13.46	15.72	13.71	14.88
3	2.0	13.58	12.32	26.65	12.57	16.28
4	3.0	16.97	16.97	37.72	16.60	22.07
5	4.0	25.14	21.62	31.68	19.61	24.51
6	5.0	29.54	25.14	16.97	24.52	24.04
7	10.0	32.69	23.89	20.12	26.40	25.78

Mean Resistivity at ERT-18 is 20.03 Ohm - m.**ERT No. 19**

SI No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				Mean
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	
1	0.50	35.48	34.23	22.61	25.12	29.36
2	1.0	23.27	18.87	11.32	12.58	16.51
3	2.0	15.08	13.83	8.80	12.57	12.57
4	3.0	24.52	22.63	7.54	13.20	16.97
5	4.0	7.54	12.57	12.57	12.57	11.31
6	5.0	15.72	18.86	12.57	15.72	15.72
7	10.0	37.72	44.00	44.00	37.72	40.86

Mean Resistivity at ERT-19 is 20.47 Ohm - m.**ERT No. 20**

SI No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				Mean
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	
1	0.50	8.98	9.42	7.66	9.61	8.92
2	1.0	9.94	9.69	7.80	10.06	9.37
3	2.0	14.58	16.09	12.07	15.08	14.46
4	3.0	16.97	17.73	18.86	16.97	17.63
5	4.0	22.12	21.62	22.12	21.62	21.87
6	5.0	24.52	20.74	26.40	25.14	24.20
7	10.0	25.14	28.92	30.17	27.66	27.97

Mean Resistivity at ERT-20 is 17.77 Ohm - m.

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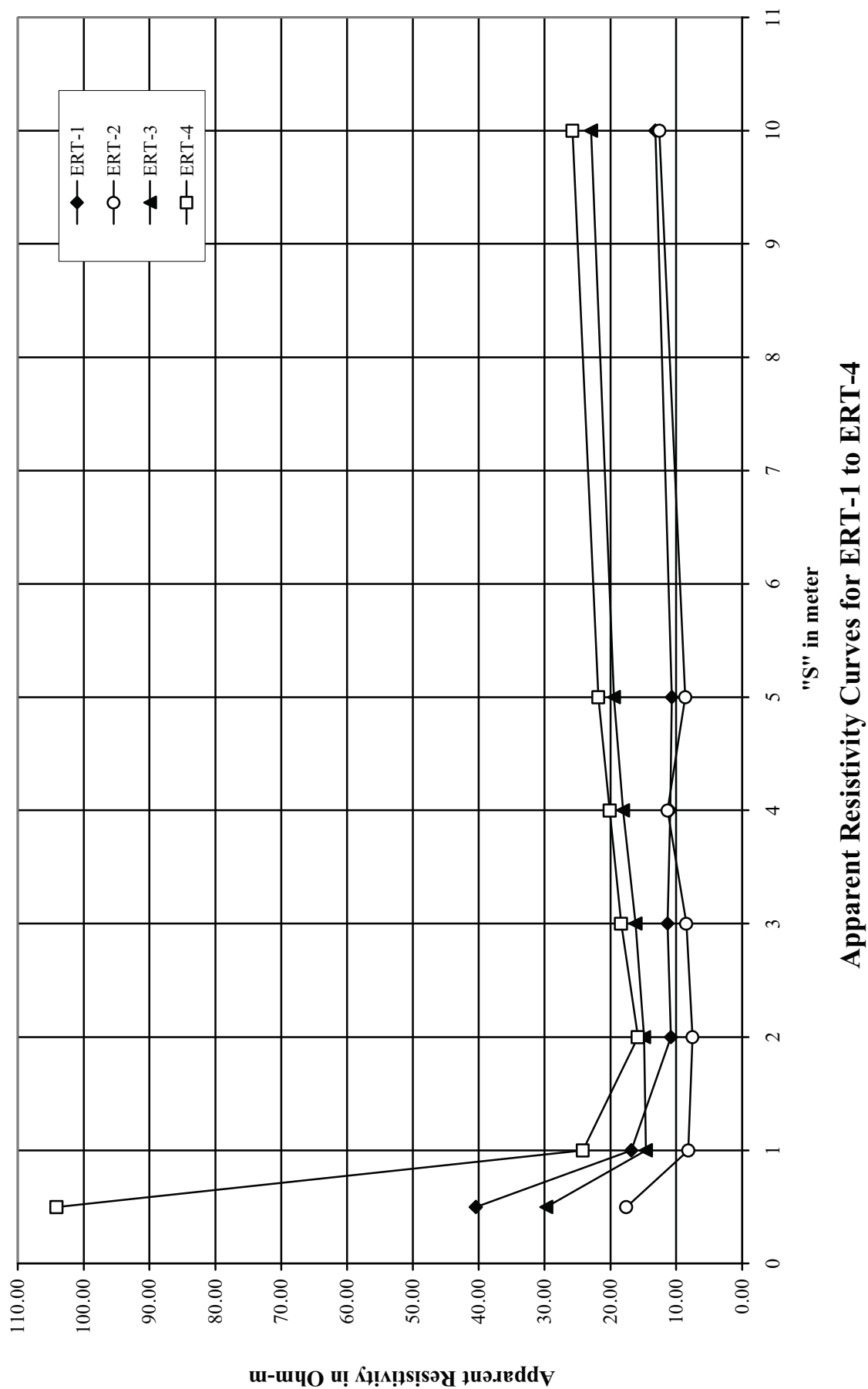
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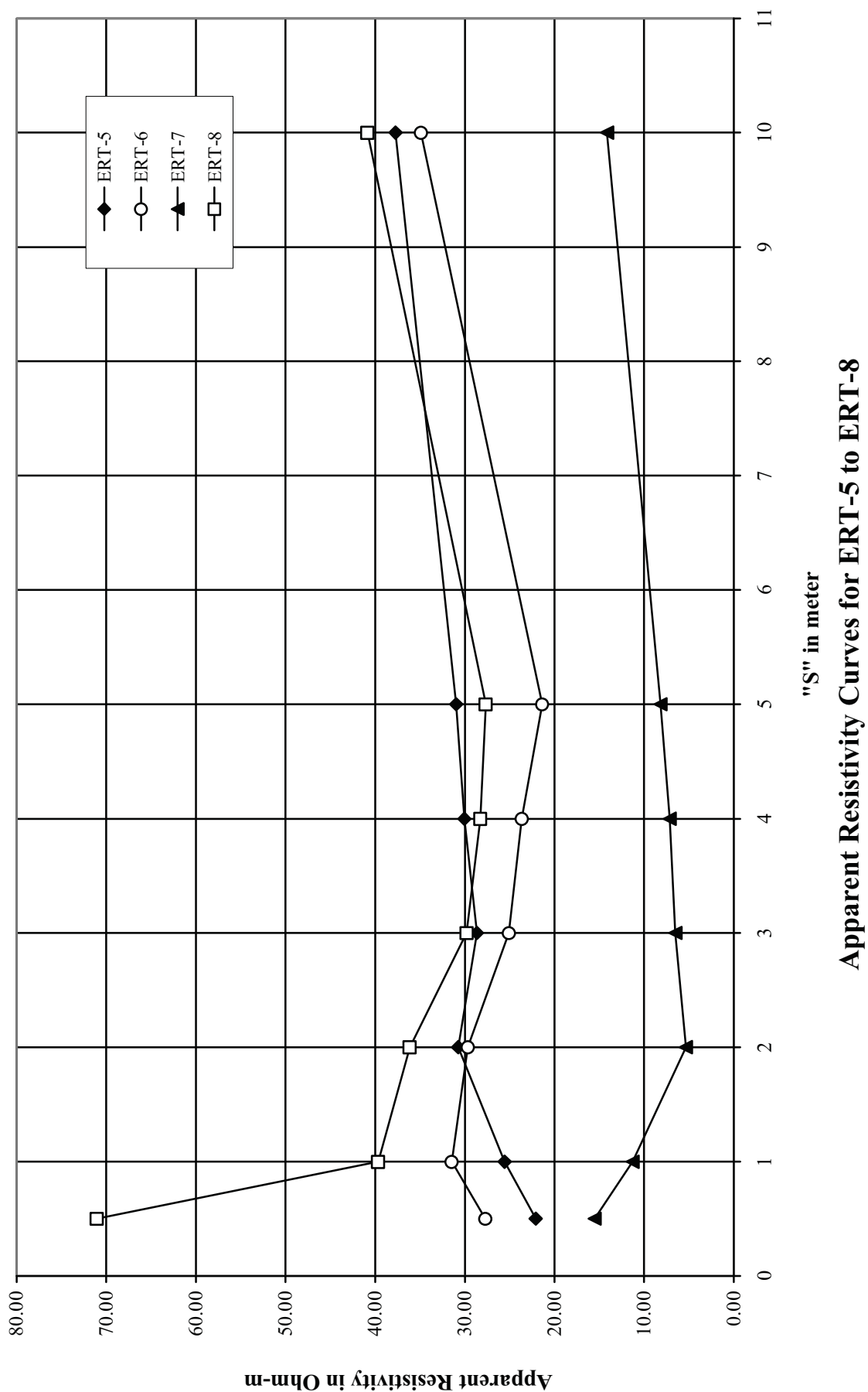
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Sheet No.



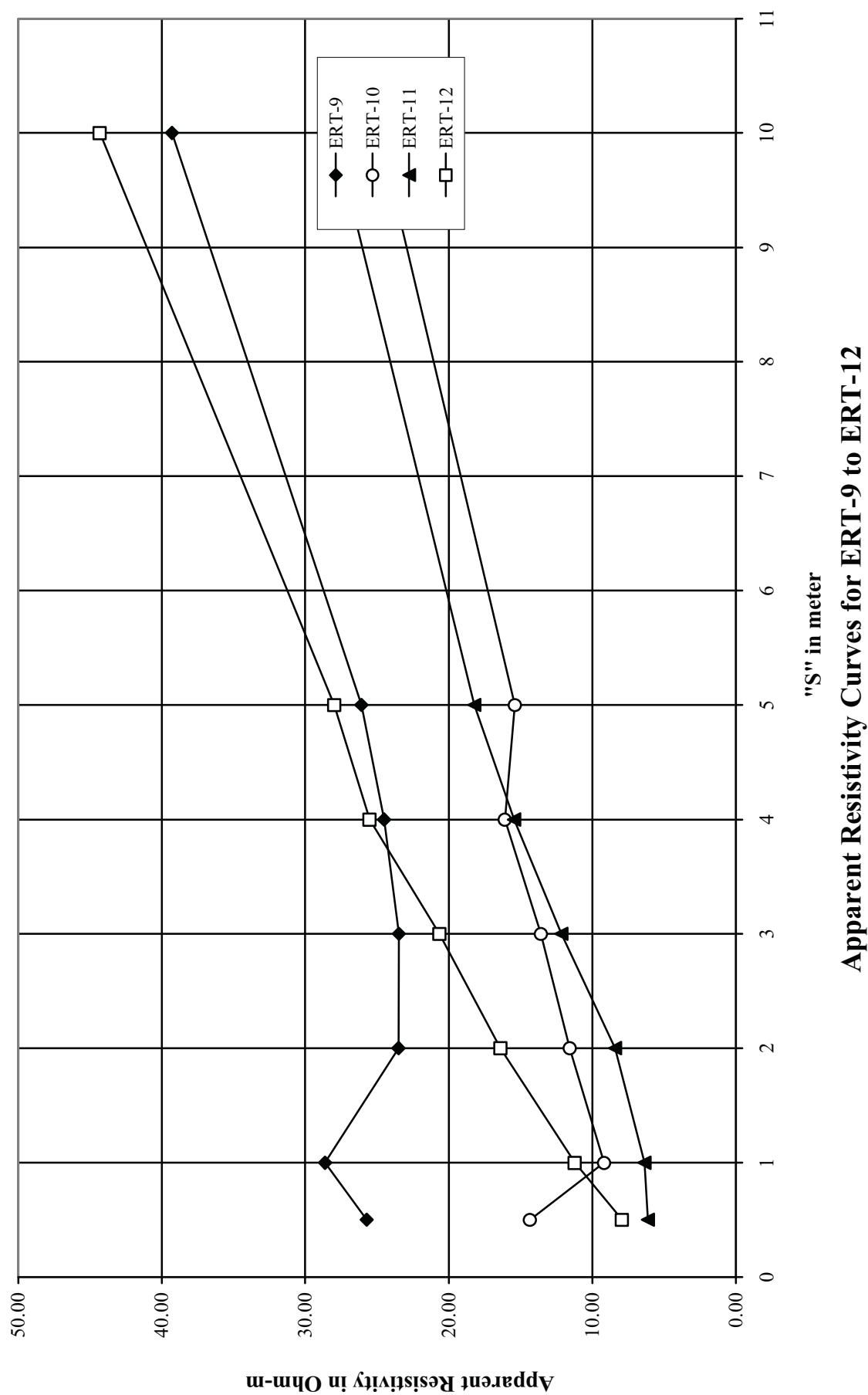


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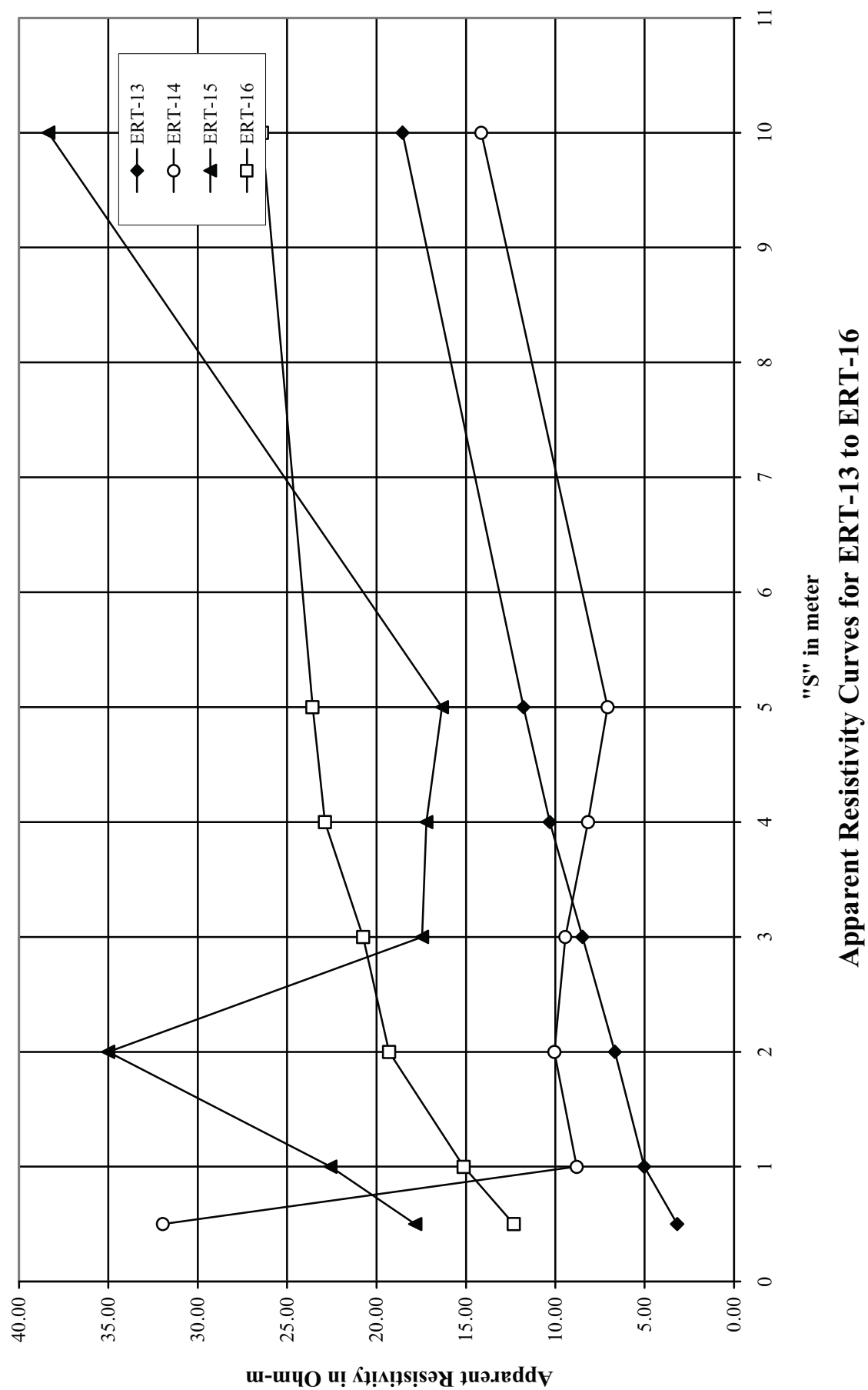


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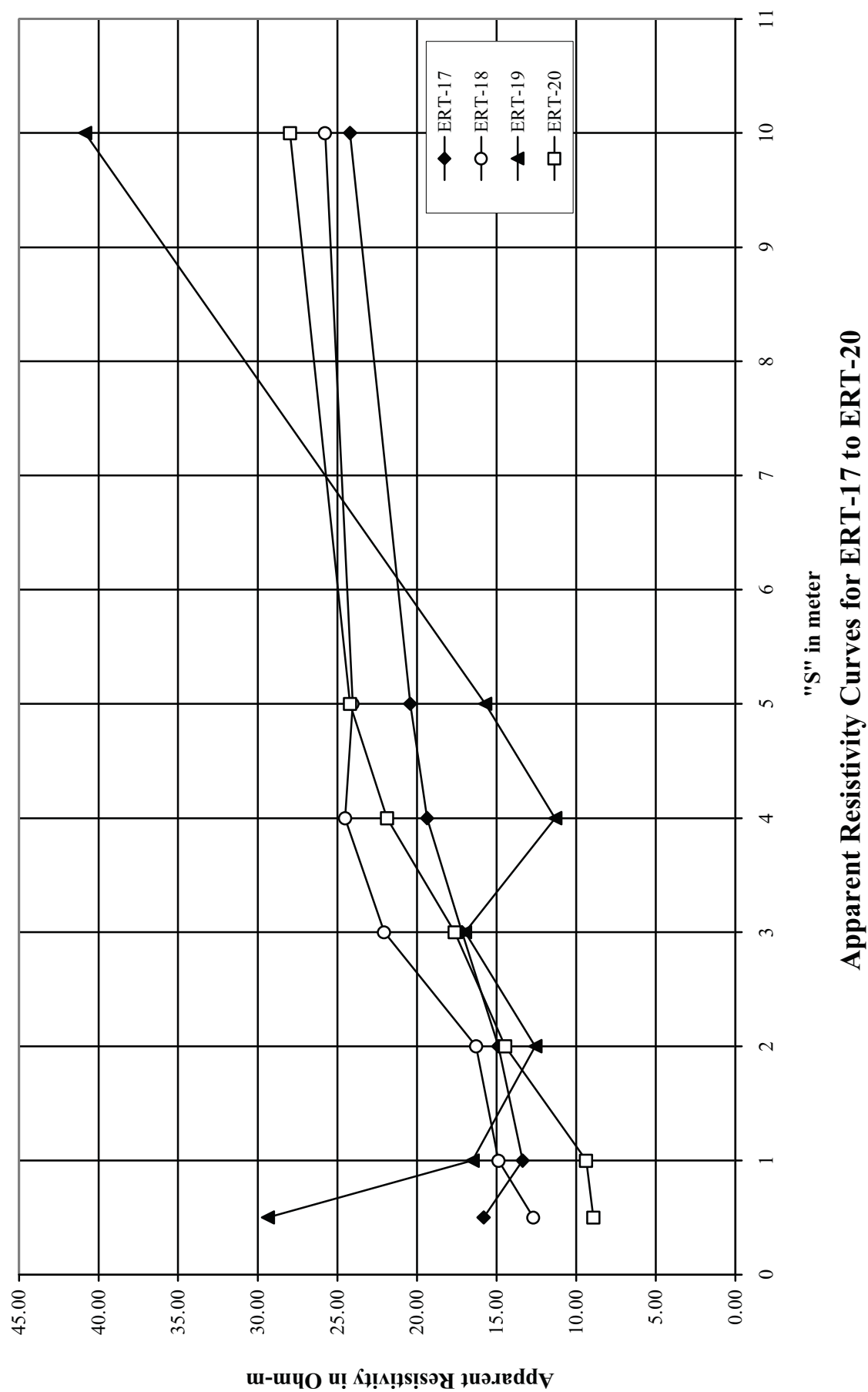


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9. CROSS HOLE SHEAR TESTS

Project: Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana**Job No. : 3421****Sheet No.**

REPORT ON CROSS HOLE SHEAR TEST FOR 1x800MW KOTHAGUDAM TPS STAGE VII, UNIT-12 AT KHAMMAM DISTRICT, TELANGANA STATE

1. INTRODUCTION

The **Telangana State Generation Corporation Limited** has proposed 1 x 800MW Kothagudam Thermal Power Station, Stage – VII, Unit - 12 and the job of civil work was awarded to **M/s. Bharat Heavy Electrical Limited**. For designing of various Foundation Structures coming under this project, it was necessary to conduct a Geotechnical Investigation Work to obtain the engineering properties of the underlying soil and **M/s. BHEL**, in turn, the job was awarded to **M/s. C. E. Testing Company Pvt. Ltd., Kolkata**. This present report presents the findings of Cross Hole Shear Tests (conducted during the month of January' 2015)

2. SCOPE OF WORK

The Cross Hole Tests were conducted at four (04) locations down to a depth of about 20 meters. One source hole and two Receiver holes at a distance of 3 meter were used.

3. PURPOSE OF INVESTIGATIONS

The aim of the investigation was to determine the soil parameters. The Seismic Cross Hole Tests were conducted to determine dynamic soil properties.

4. GENERAL SITE DESCRIPTION

The test was conducted between one Source and two Receiver holes. The holes were drilled down to a depth of maximum 21 meter.

5. CROSS HOLE SEISMIC TEST

5.1. LOCATION

Four cross hole tests were conducted. The test locations are given below.

CHST No.	Co-ordinates		GL (M)
	Easting	Northing	
CST-1	467915	1947144	98.212
CST-2	467986	1947107	96.443
CST-3	467999	1947180	98.379
CST-4	468171	1947221	98.379

5.2. EQUIPMENT AND ACCESSORIES

Following equipment and accessories were used:

- | | |
|------------------|---|
| 1. Seismograph : | PASI model 16S24-U
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, 10m spacing, water proof joints, made in Italy |
| 4. Software : | WinSism 14 |

5.2.1. 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.



5.2.2. Down Hole Sensors:

Orthogonal down hole sensors were used to receive the waves in two Receiver holes. The sensors have two Horizontal components 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 Hammer in the Source hole, and tube attached to them was inflated so as to make them fixed with the borehole wall.

5.2.3. Seismograph:

PASI 16S 24-U 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. The seismic waves detected by each geophone are displayed simultaneously on the screen.



5.3 SEISMIC CROSS HOLE TEST

The Seismic Cross Hole 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 one or two nearby boreholes (Receiver holes).

5.4 CROSS HOLE SHEAR TEST DATA INTERPRETATION

5.4.1. DATA PROCESSING

The data is stored in the hard disk of the Seismograph at the time of data acquisition. The data was 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.

5.4.2. 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 is used to determine the velocities of P & Shear waves, as distance between the boreholes is known.

5.4.3. VELOCITY CALCULATION

Velocity calculation was done using the time derives as above and the distance between the two Receiver holes from the Source hole.

5.5. 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).

The Poisson's Ratio is determined directly from the compressional (P) wave and shear (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:

$$E = \rho V_p^2 (1 + \sigma) (1 - 2\sigma) / (1 - \sigma)$$

The shear Modulus G is the stress-strain ratio for simple shear. Its dynamic value is obtained by the following:

$$G = E / 2 (1 + \sigma) = \rho V_s^2$$

Where ρ is mass density in $\text{kN.s}^2/\text{m}^4$, σ is Poisson's ratio and V_p is P-wave velocity in m/sec, **E & G** are in kN/m^2 .

The test results are presented afterwards in a tabular form.

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TEST RESULTS

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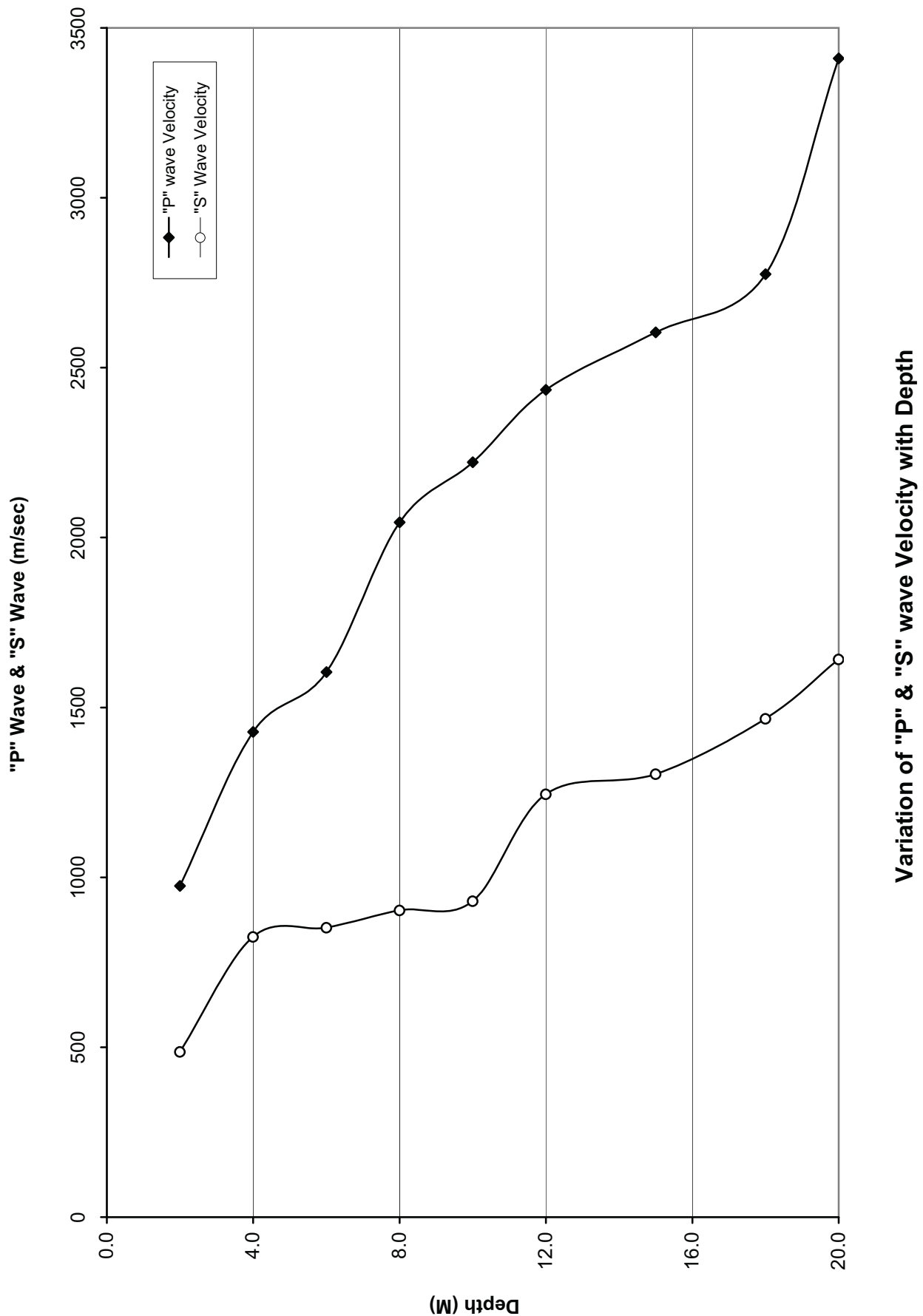


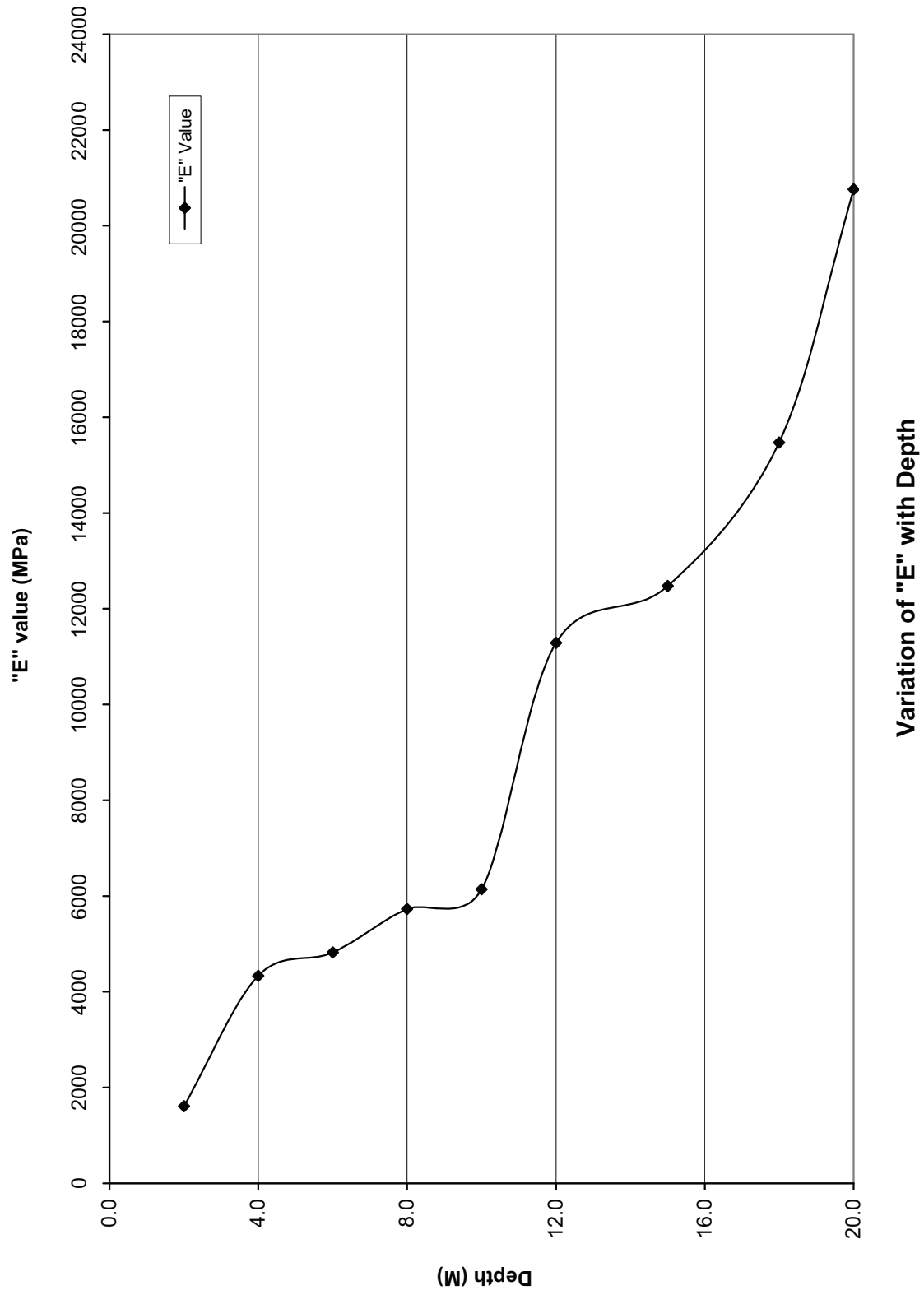
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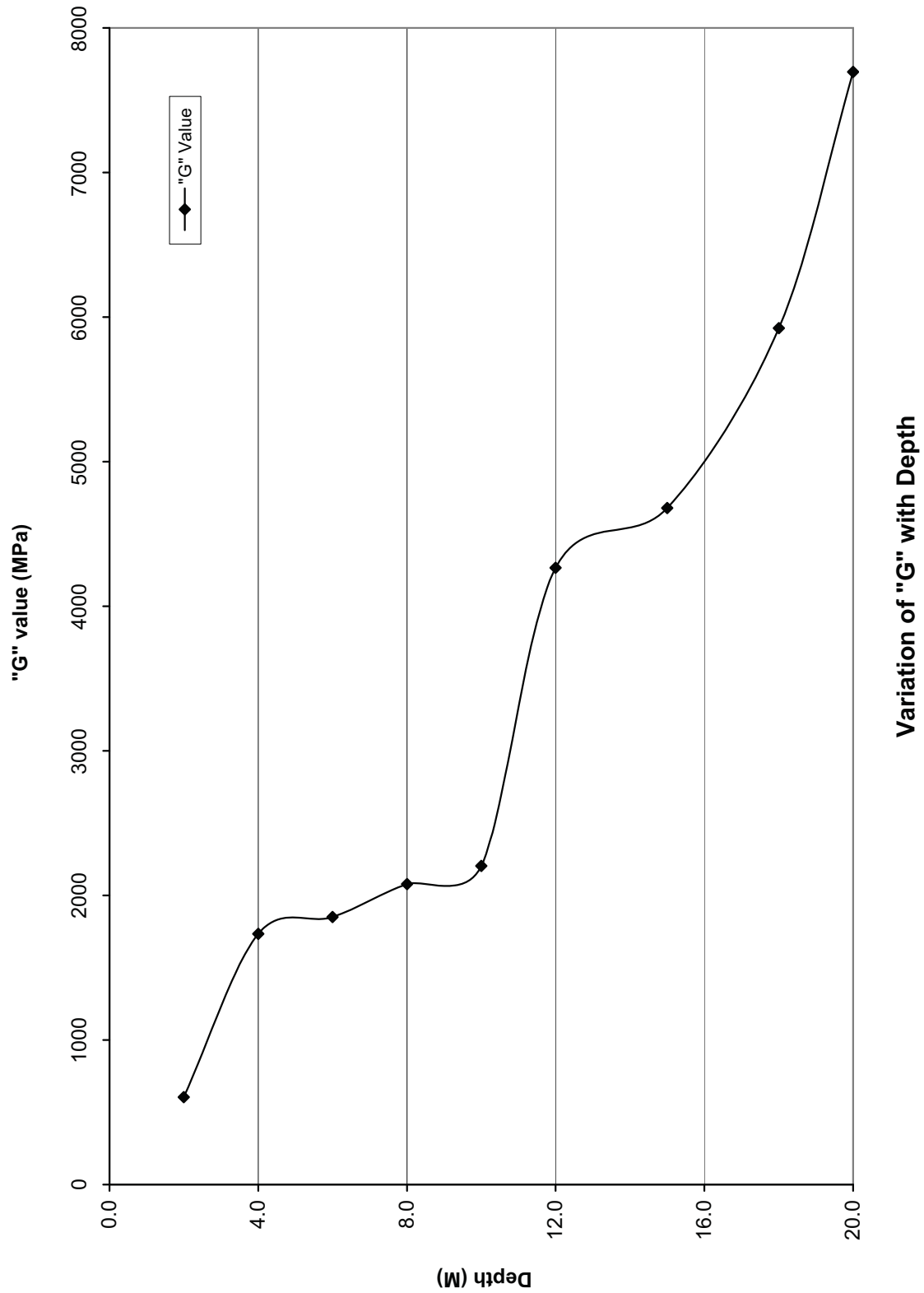
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Cross Hole Shear Test Results - 1
Calculated Values of Dynamic Parameters

Depth (M) BGL	Vp (m/s)	Vs (m/s)	Mass Density ($\text{kN.s}^2/\text{m}^4$)	m = V_p/V_s	Poisson Ratio, σ	Young's Modulus (kN/m^2)	Young's Modulus (MPa)	Shear Modulus (kN/m^2)	Shear Modulus (MPa)
2.0	975	487	2.55	2.00	0.334	1612300	1612.30	604406	604.41
4.0	1428	825	2.55	1.73	0.250	4334578	4334.58	1734518	1734.52
6.0	1604	852	2.55	1.88	0.303	4822643	4822.64	1849908	1849.91
8.0	2045	903	2.55	2.26	0.379	5730712	5730.71	2078005	2078.00
10.0	2222	930	2.55	2.39	0.394	6144269	6144.27	2204128	2204.13
12.0	2435	1245	2.75	1.96	0.323	11288370	11288.37	4266124	4266.12
15.0	2604	1304	2.75	2.00	0.333	12473716	12473.72	4680044	4680.04
18.0	2775	1467	2.75	1.89	0.306	15472141	15472.14	5923181	5923.18
20.0	3410	1642	2.85	2.08	0.349	20763490	20763.49	7695473	7695.47



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Cross Hole Shear Test Results - 2
Calculated Values of Dynamic Parameters

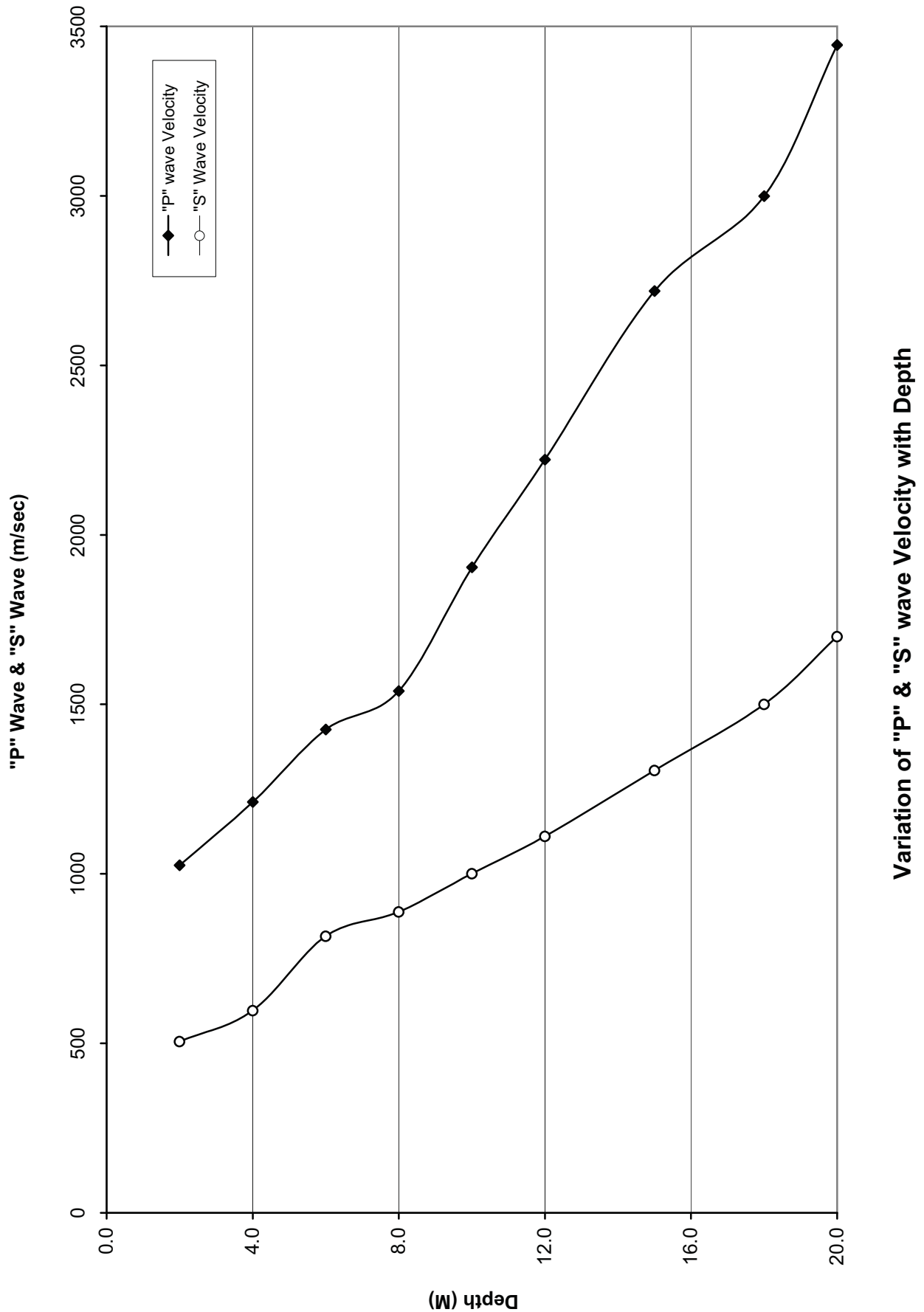
Depth (M) BGL	Vp (m/s)	Vs (m/s)	Mass Density ($\text{kN}\cdot\text{s}^2/\text{m}^4$)	m $= V_p/V_s$	Poisson Ratio, σ	Young's Modulus (kN/m^2)	Young's Modulus (MPa)	Shear Modulus (kN/m^2)	Shear Modulus (MPa)
2.0	1025	506	1.73	2.03	0.339	1188106	1188.11	443691	443.69
4.0	1212	597	2.55	2.03	0.340	2433865	2433.87	908280	908.28
6.0	1426	816	2.55	1.75	0.257	4264478	4264.48	1696881	1696.88
8.0	1539	888	2.55	1.73	0.250	5025690	5025.69	2009541	2009.54
10.0	1904	1001	2.75	1.90	0.309	7219993	7219.99	2757801	2757.80
12.0	2222	1111	2.75	2.00	0.333	9059237	9059.24	3397214	3397.21
15.0	2719	1305	2.85	2.08	0.350	13127609	13127.61	4860826	4860.83
18.0	2999	1500	2.85	2.00	0.333	17123478	17123.48	6422018	6422.02
20.0	3445	1700	2.85	2.03	0.339	22090937	22090.94	8248726	8248.73

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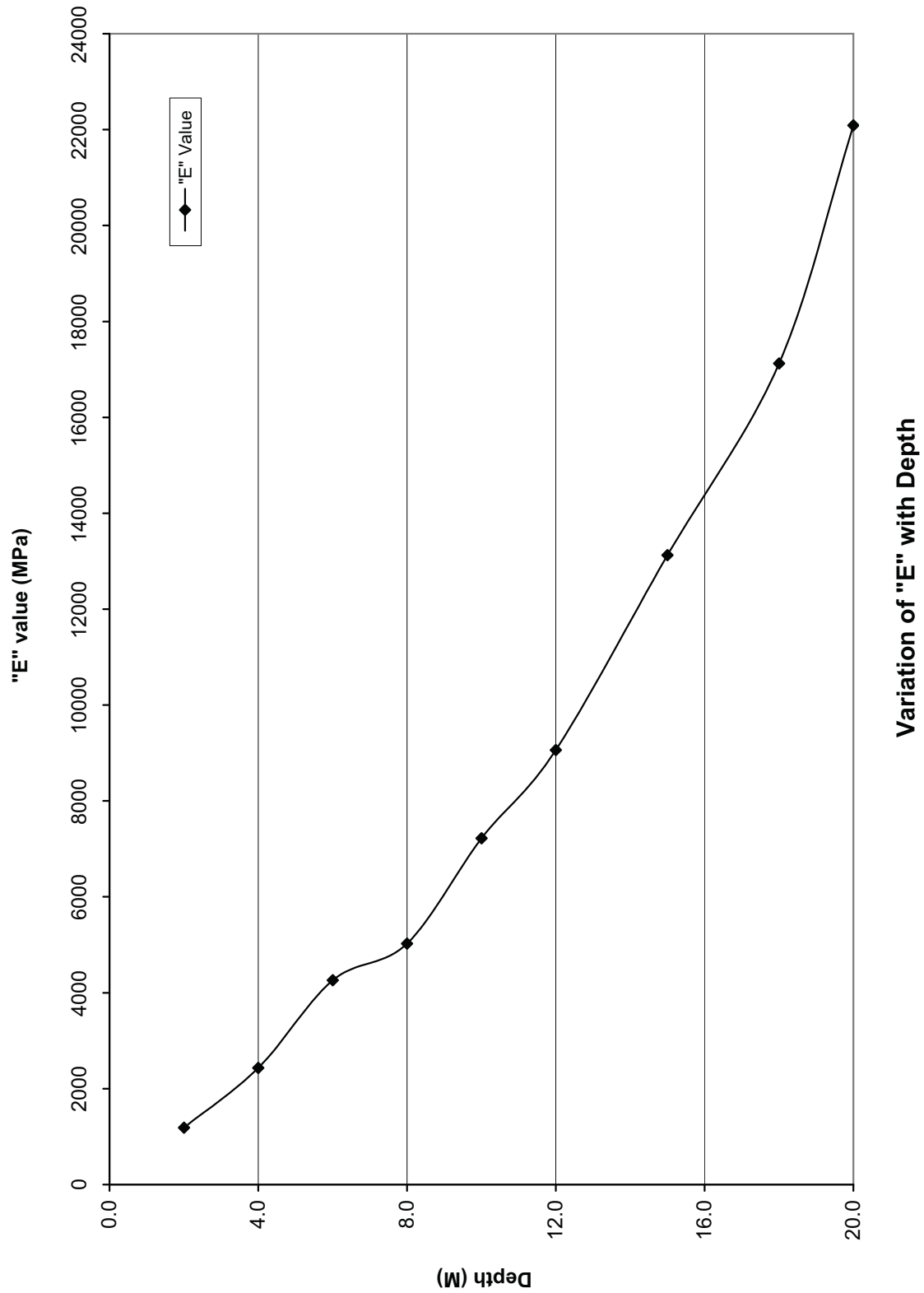


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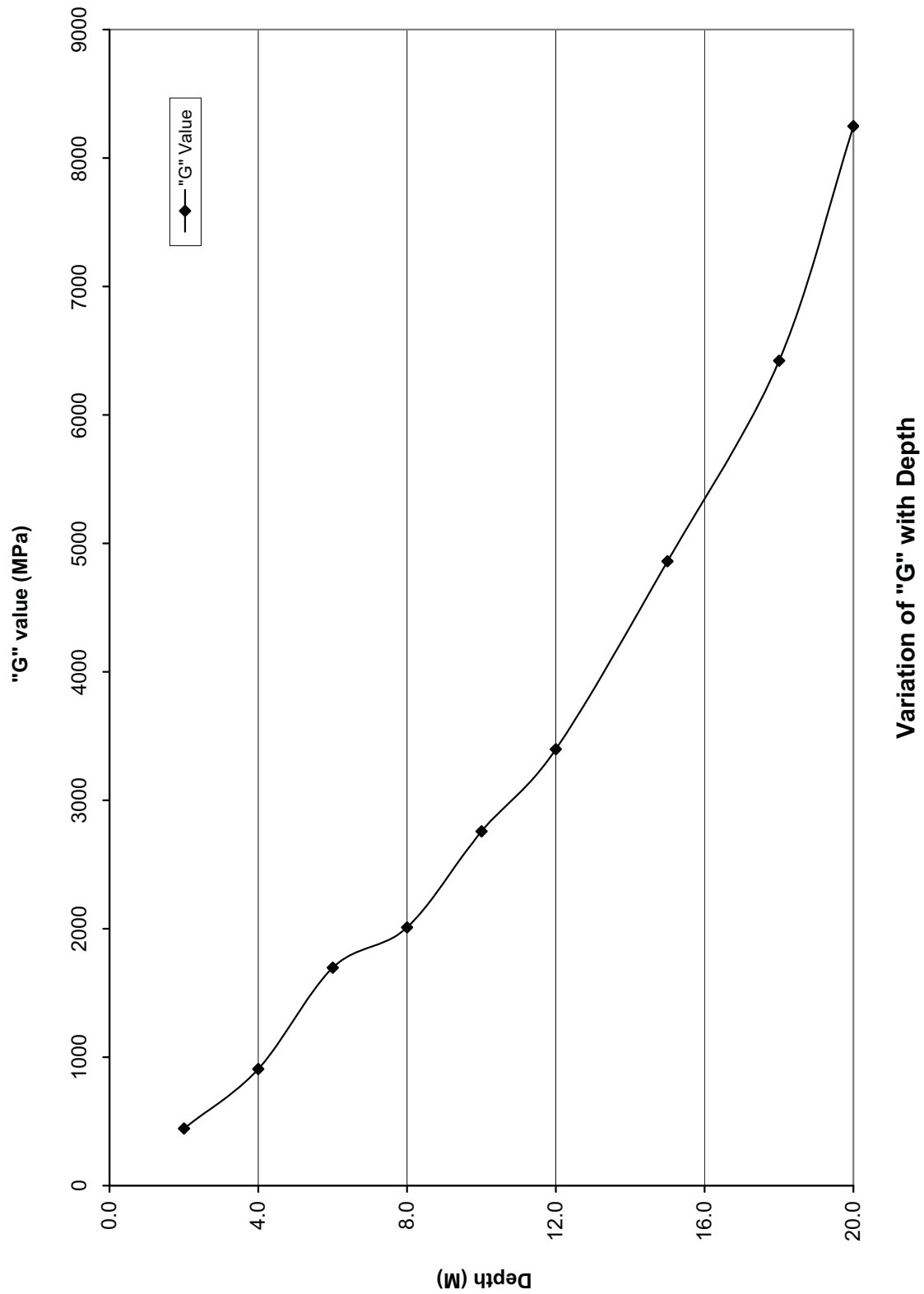


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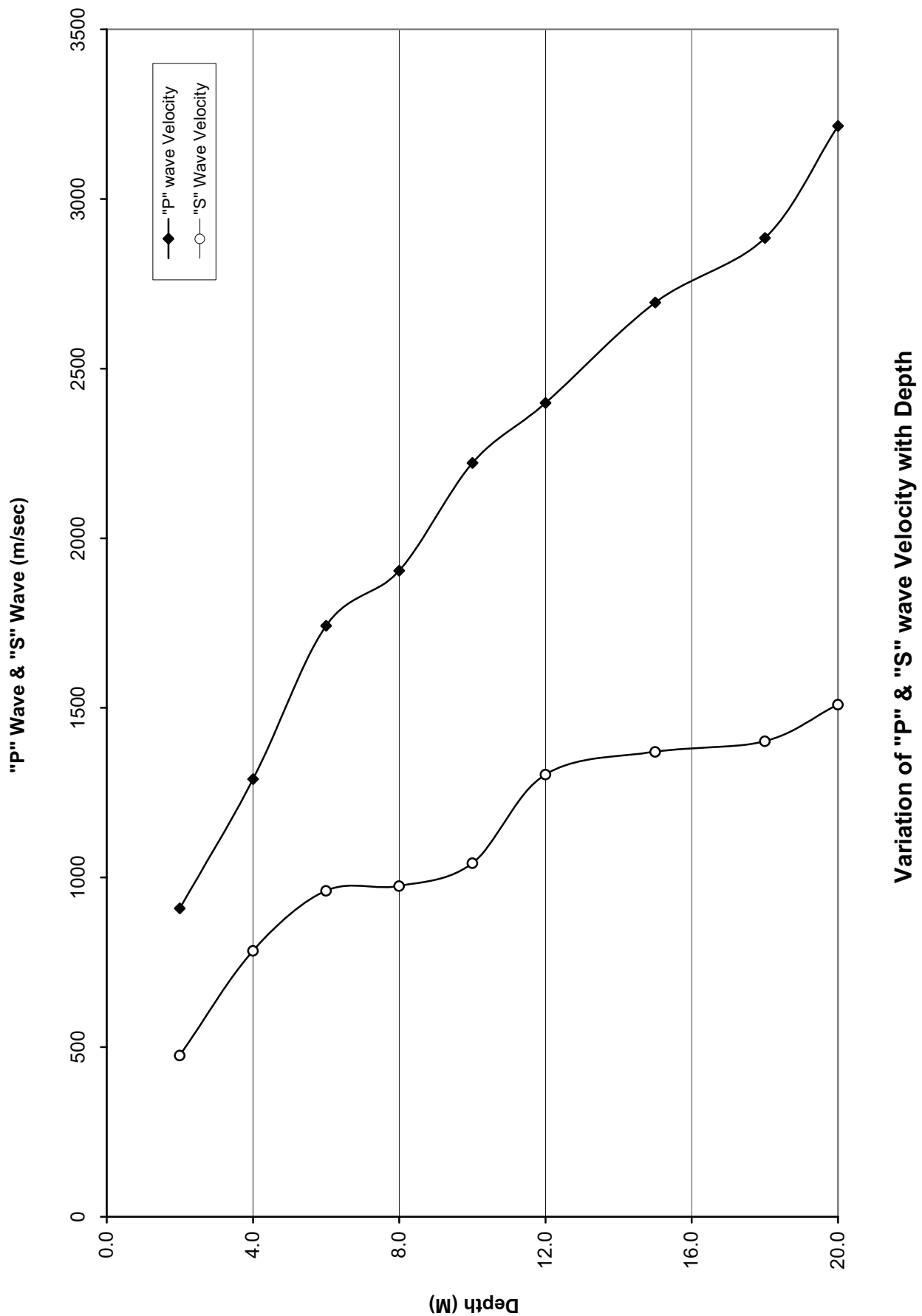


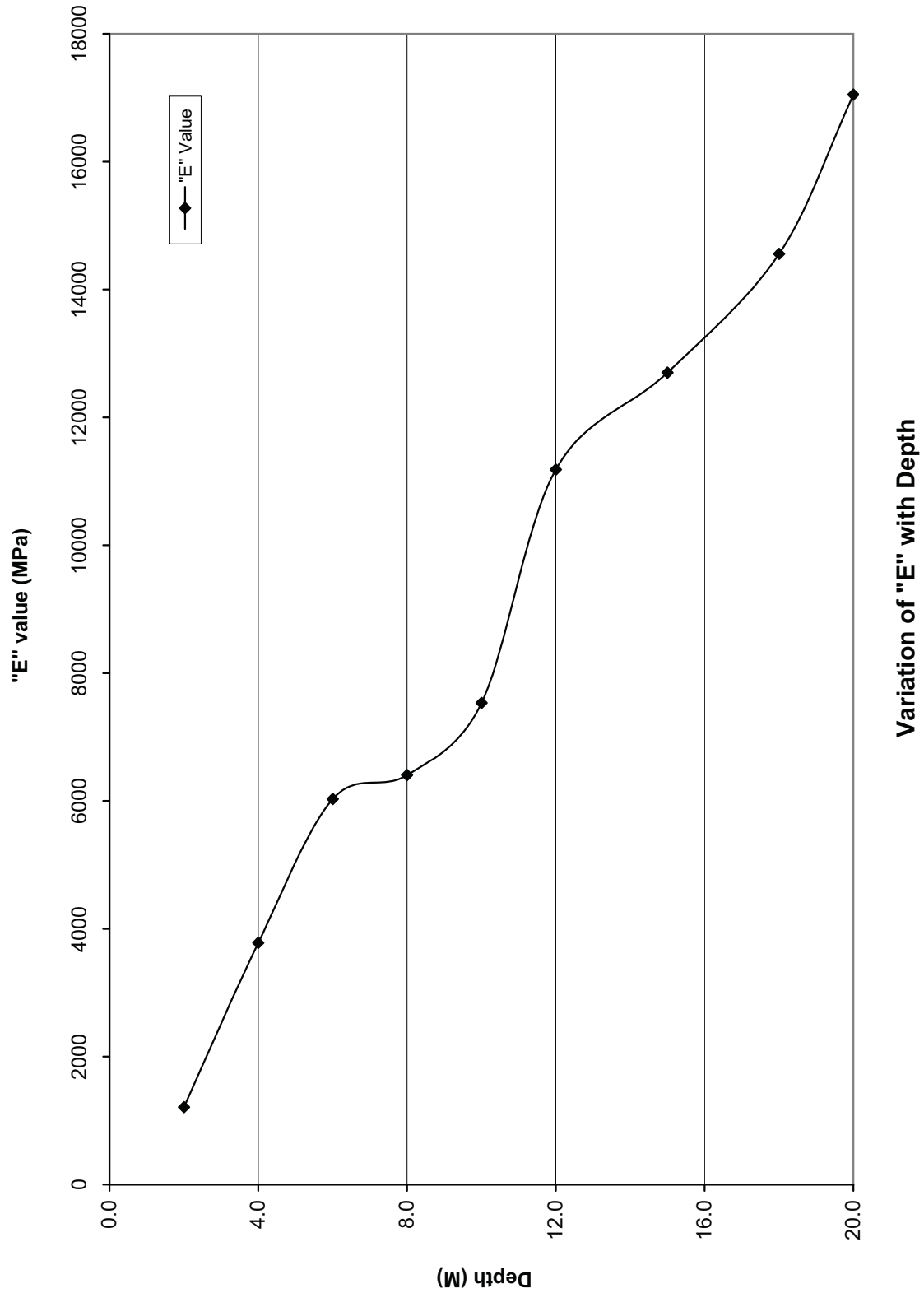
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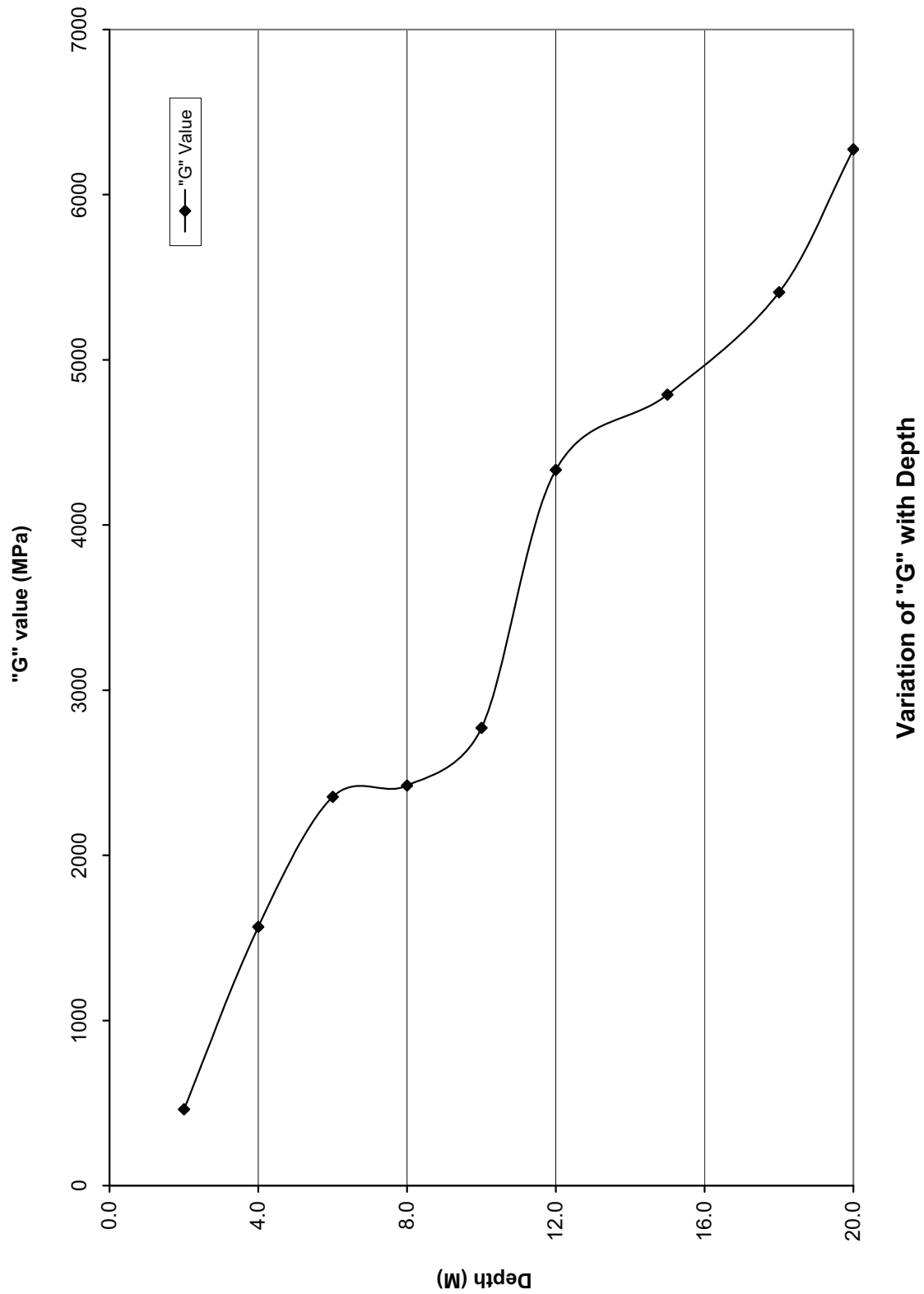
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Cross Hole Shear Test Results - 3
Calculated Values of Dynamic Parameters

Depth (M) BGL	Vp (m/s)	Vs (m/s)	Mass Density ($\text{kN.s}^2/\text{m}^4$)	m = V_p/V_s	Poisson Ratio, σ	Young's Modulus (kN/m^2)	Young's Modulus (MPa)	Shear Modulus (kN/m^2)	Shear Modulus (MPa)
2.0	909	476	2.04	1.91	0.311	1211264	1211.26	461929	461.93
4.0	1290	784	2.55	1.65	0.207	3781768	3781.77	1566402	1566.40
6.0	1742	961	2.55	1.81	0.281	6030961	6030.96	2353519	2353.52
8.0	1904	975	2.55	1.95	0.322	6406718	6406.72	2422592	2422.59
10.0	2222	1043	2.55	2.13	0.359	7533438	7533.44	2772296	2772.30
12.0	2399	1304	2.55	1.84	0.290	11182877	11182.88	4333374	4333.37
15.0	2695	1371	2.55	1.97	0.325	12697847	12697.85	4790115	4790.11
18.0	2885	1402	2.75	2.06	0.345	14557157	14557.16	5409919	5409.92
20.0	3215	1510	2.75	2.13	0.358	17050377	17050.38	6275505	6275.50



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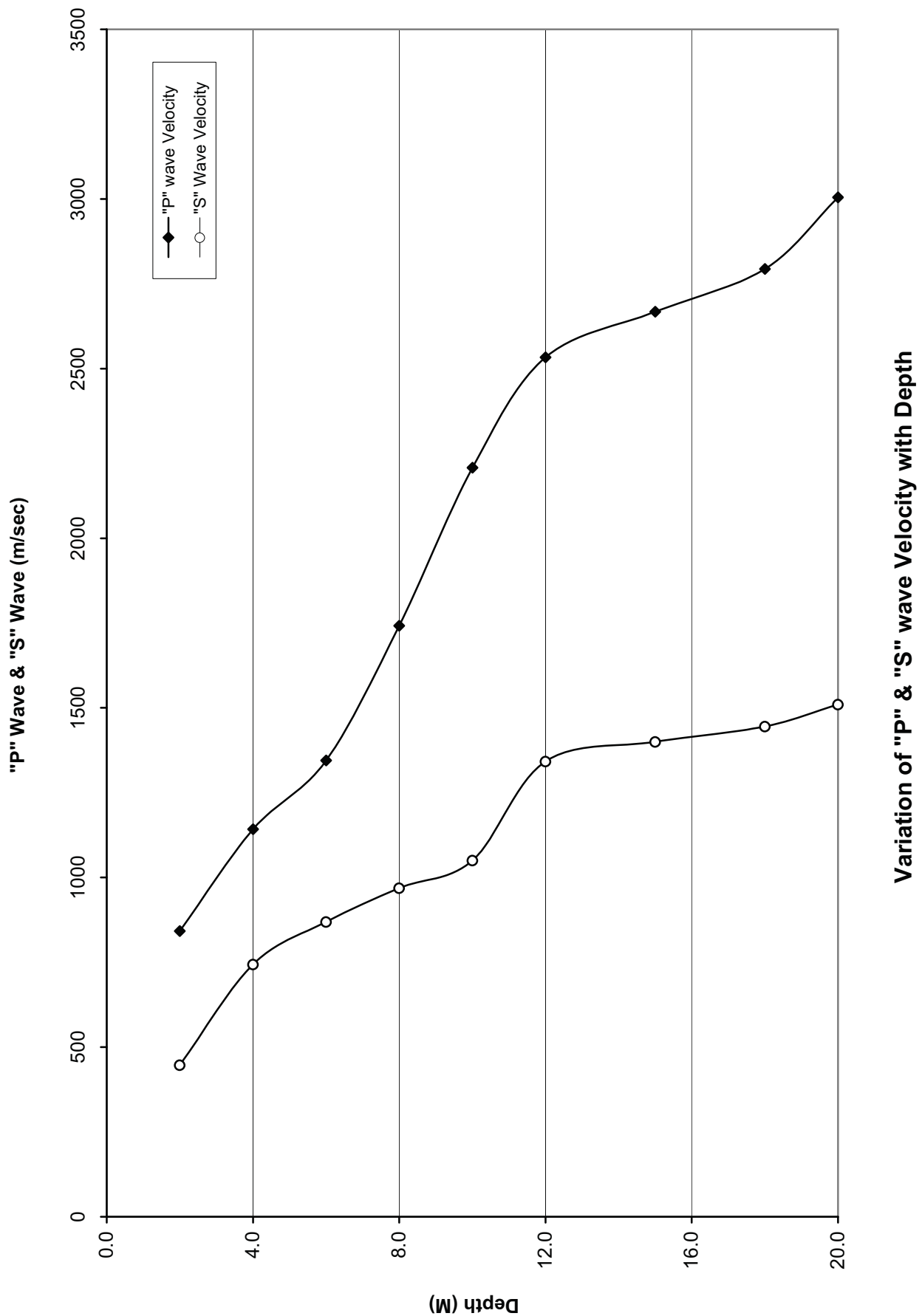
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Cross Hole Shear Test Results - 4
Calculated Values of Dynamic Parameters

Depth (M) BGL	Vp (m/s)	Vs (m/s)	Mass Density ($\text{kN.s}^2/\text{m}^4$)	m = V_p/V_s	Poisson Ratio, σ	Young's Modulus (kN/m^2)	Young's Modulus (MPa)	Shear Modulus (kN/m^2)	Shear Modulus (MPa)
2.0	842	447	2.04	1.88	0.304	1062213	1062.21	407358	407.36
4.0	1142	744	2.55	1.53	0.131	3191676	3191.68	1410642	1410.64
6.0	1345	869	2.55	1.55	0.142	4394398	4394.40	1924467	1924.47
8.0	1742	969	2.55	1.80	0.276	6106447	6106.45	2392867	2392.87
10.0	2208	1050	2.55	2.10	0.354	7607851	7607.85	2809633	2809.63
12.0	2533	1342	2.55	1.89	0.305	11977830	11977.83	4589613	4589.61
15.0	2668	1400	2.55	1.91	0.310	13086767	13086.77	4994903	4994.90
18.0	2794	1445	2.55	1.93	0.317	14020520	14020.52	5321165	5321.16
20.0	3005	1510	2.55	1.99	0.331	15469140	15469.14	5810652	5810.65

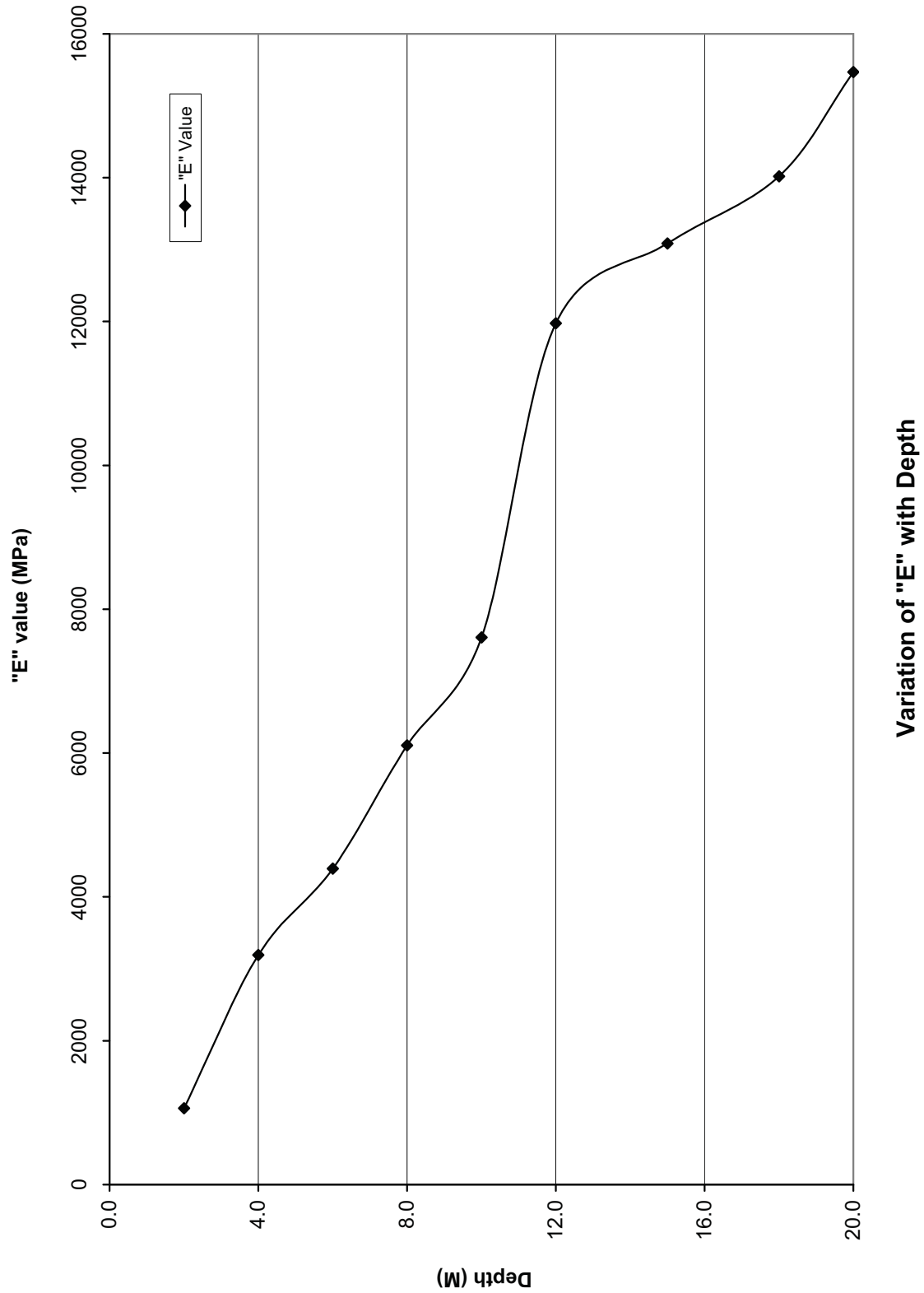


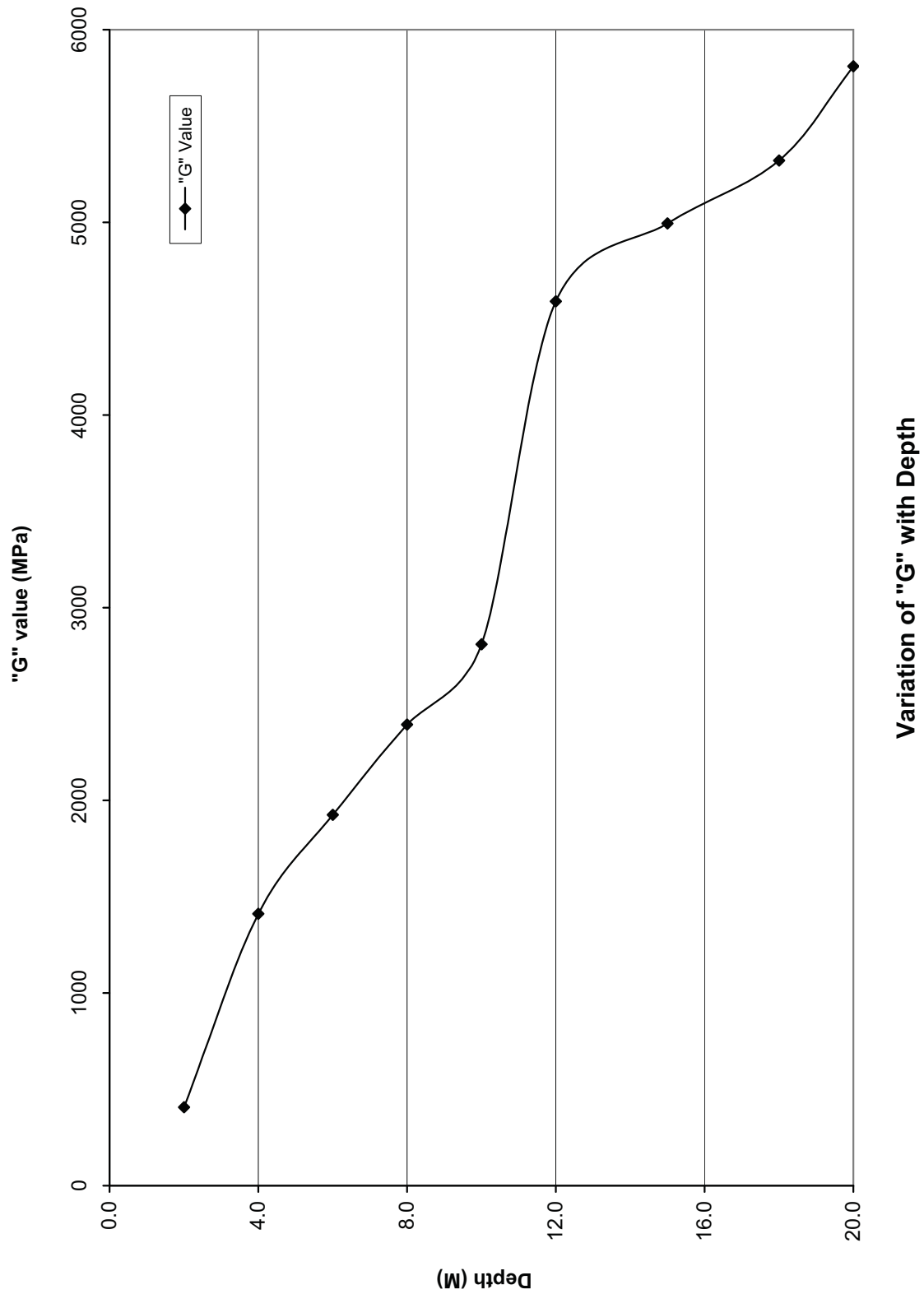
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10. PRESSUREMETER TEST

PRESSUREMETER TEST**1. INTRODUCTION :**

The Pressure meter equipment (Ref. Fig.1) consists of mainly of three components, namely the probe, the control panel and the tubing. The probe consists of rubber membranes stretched over a core. Only the central portion known as the measuring cell is used for measurement. The two end portions known as guard cells serve merely to avoid end convergence over the measured portion. The control panel consists of a water reservoir for the measuring cell which is connected by means of a hole. A coaxial outlet with quick release nipples for connecting to the water and gas outlets meant for measuring cell and guard cells respectively is connected to the water and gas outlets meant for measuring cell and guard cells respectively is connected to the one end of a coaxial tubing. Pressure is applied to the water through pneumatic control equipment and resulting soil deformations are indicated by volume changes which one read on a sight tube.

2. FIELD INVESTIGATIONS & ANALYSIS OF TEST RESULTS :

Total twenty seven nos. Pressuremeter test was conducted at nine different depth in three bore holes [i.e. PMT-01 to PMT-03] at depths varying from about 1.00m to a maximum of 20m below the existing ground surface. The details of bore hole locations are as under:

Test No.	Co-ordinates (m)		GL (m)
	E	N	
PMT-01	467947.354	1947079.124	99.435
PMT-02	467984	1947149	97.738
PMT-03	468126	1947227	97.023

All the tests were carried out in the bore hole of required size compatible to that of Nx probe of Pressuremeter as per instructions of Engineer-in-Charge. Before starting

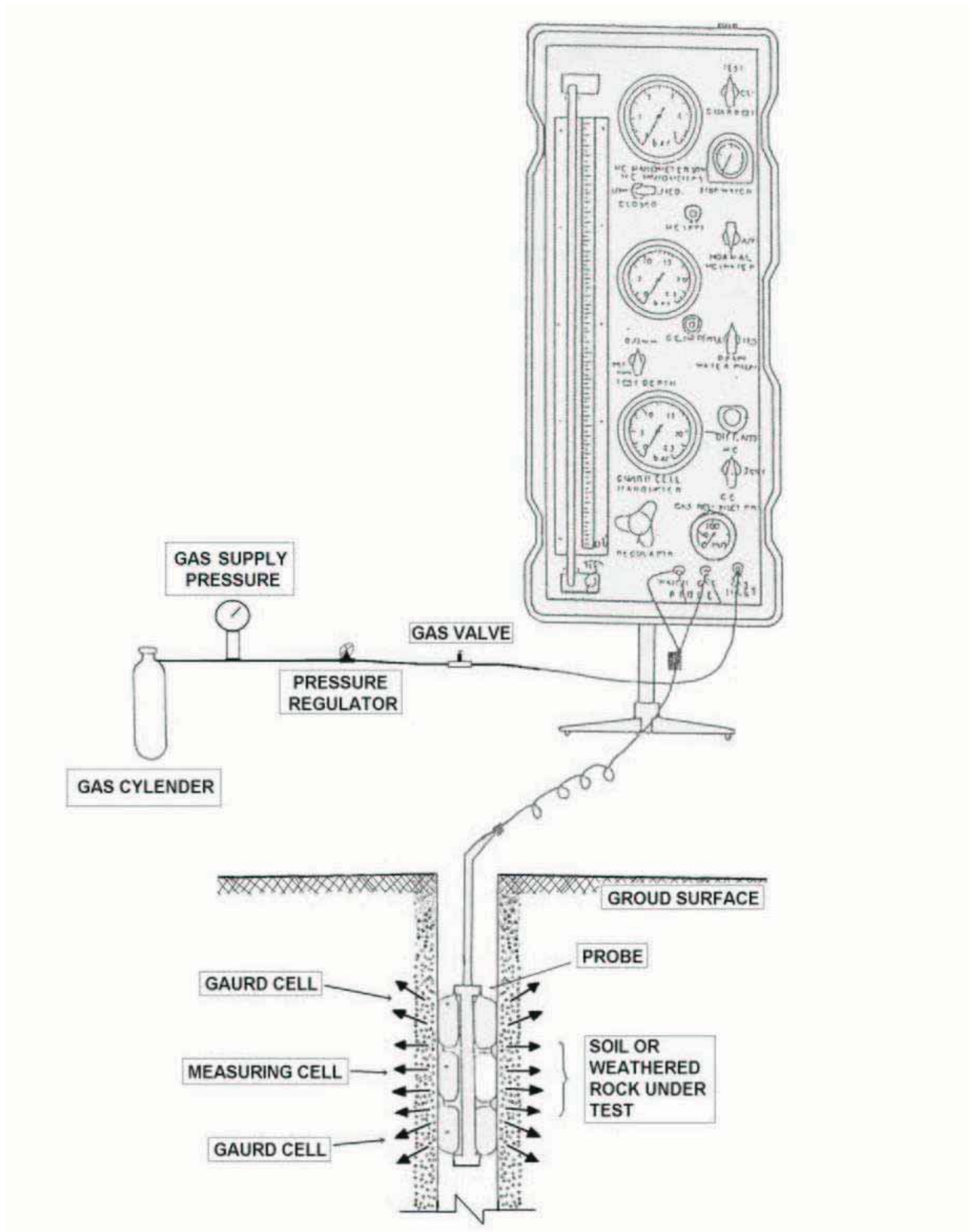


FIG. 1. SCHEMATIC REPRESENTATION OF PRESSUREMETER

use of new Nx size probe air calibration was done. For conducting Pressuremeter tests each bore hole of Nx size was made upto the required depth by rotary drilling machine. The probe was attached to the drill rod, lowered into the bore hole and held at test depth. All valves were opened enabling the system to attain equilibrium under atmospheric pressure. Water table of the measuring cell reservoir was noted. The instruments was set ready for test by closing or opening the relevant valves. Then from a compressed gas cylinder a little amount of pressure was let into the system. This pressure caused the probe to expand and consequently the water level to fall. The pressure was maintained constant for that step and the measuring cell voltmeter readings were noted at 30 and 60 seconds. After that next pressure was let in and observations continued as before. This way the test was carried out upto the failure of the soil. Then the pressure was released. Probe was allowed to contract to its original size and withdrawn to the ground level. This constituted one test at a given depth.

For the Pressuremeter test conducted at different depths at the specified location the plots of applied pressure and volumetric deformation are shown in figures (2) to (36). From these plots the values of pressure at rest (P_o), limit pressure (P_l) & Creep pressure (P_f) were read. These values were corrected for probe air calibration pressure at corresponding volume & head due to water column.

A typical plot between applied pressure against volumetric deformation is shown in figure (4), (16) & (28). The graph clearly shows three different parts. Part AB represents the expansion of the probe in the initial air gap. Part BC, which is a straight line, represents the stress deformation relationship of the soil. Part CD represents the progress of failure of the soil. At D the soil is completely failed. P_o represents the 'natural stress' in the soil. P_f and P_l are called 'Creep Pressure' and 'Limit pressure' respectively.

The Menard's modulus of deformation ' E_m ' of the soil is calculated from the following relationship:

$$E_m = 2.66 \times \{V_c + (V_0 + V_f)/2\} \times (P_f - P_0) / (V_f - V_0)$$

Where

- E_m = Menard's Modulus of deformation in kg/cm^2 .
 P_0 = At rest pressure in kg/cm^2 .
 P_f = Creep pressure in kg/cm^2 .
 V_c = Volume of probe before test under deflated condition in c.c.
 V_0 = Volume corresponding to pressure P_0 in c.c.
 V_f = Volume corresponding to pressure P_f in c.c.

By putting all the relevant values in the above relationship from the plot between applied pressure against volumetric deformation (Refer figures 2 to 36), the following values of limit pressure & Menard's modulus of deformation have been arrived at : -

Sl. No.	Test Location No.	Test No.	Test depth below existing ground surface (m)	Corrected Limit pressure (Kg/cm^2)	Menard's Modulus of Deformation, E_m (Kg/cm^2)
1	PMT-01	PMT-01/1	1.00	2.70	21.87
2		PMT-01/2	3.00	5.40	66.97
3		PMT-01/3	5.00	10.35	78.14
4		PMT-01/4	7.00	14.05	126.2
5		PMT-01/5	9.00	14.70	168.9
6		PMT-01/6	12.00	21.75	251.26
7		PMT-01/7	15.00	41.55	856.25
8		PMT-01/8	18.00	31.85	313.36
9		PMT-01/9	20.00	42.05	482.36
10	PMT-02	PMT-02/1	1.00	0.35	3.59
11		PMT-02/2	3.00	4.30	34.86
12		PMT-02/3	5.00	13.30	121.87
13		PMT-02/4	7.00	35.50	569.40
14		PMT-02/5	9.00	59.70	765.83
15		PMT-02/6	12.00	57.00	2276.11
16		PMT-02/7	15.00	57.30	1680.04
17		PMT-02/8	18.00	62.65	3752.60
18		PMT-02/9	20.00	62.85	2782.29
19	PMT-03	PMT-03/1	1.00	2.15	13.84
20		PMT-03/2	3.00	4.10	38.39
21		PMT-03/3	5.00	12.30	161.28
22		PMT-03/4	7.00	49.50	1915.64
23		PMT-03/5	9.00	56.70	3583.46

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Sl. No.	Test Location No.	Test No.	Test depth below existing ground surface (m)	Corrected Limit pressure (Kg/cm ²)	Menard's Modulus of Deformation, E _m (Kg/cm ²)
24	PMT-03	PMT-03/6	12.00	55.20	1877.69
25		PMT-03/7	15.00	60.50	1303.37
26		PMT-03/8	18.00	55.45	1633.77
27		PMT-03/9	20.00	54.15	1743.97

SAMPLE CALCULATION:**Test Location = PMT01 / 4**

Test depth = 7.00 m

Refer Figure No. = 7

Head due to water column = 0.80 kg/cm²

Probe air calibration pressure corresponding to volume at limit pressure (P_l)
= 1.25 kg/cm²

Probe air calibration pressure corresponding to volume at Pressure at rest (P_o)
= 0.30 kg/cm²

Probe air calibration pressure corresponding to volume at Creep pressure (P_f)
= 0.75 kg/cm²

Volume of probe before test under deflated condition (V_c) = 670 ccLimit pressure (P_l) = 14.50 kg/cm²Pressure at rest (P_o) = 1.00 kg/cm²Creep Pressure (P_f) = 11.00 kg/cm²V_o = 380 cm³V_f = 615 cm³So, corrected limit pressure (P_l) = 14.50 – 1.25 + 0.80 = 14.50 kg/cm²Corrected pressure at rest (P_o) = 1.00 – 0.30 + 0.80 = 1.50 kg/cm²Corrected creep pressure (P_f) = 11.00 – 0.75 + 0.80 = 11.05 kg/cm²

By substituting all the values in the equation as above, we get

$$E_m = 2.66 \{670 + (380+615)/2\} \times (11.05 - 1.50)/(615 - 380) = 126.20 \text{ kg/cm}^2$$

Thus, the two parameters obtained at 7.00m depth below the existing ground surface at the location of PMT-01 are: -

- (i) Limit pressure, P_l = 14.05 kg/cm²
- (ii) Menard's Modulus of deformation, E_m = 126.20 kg/cm²

3. CONCLUSIONS:

1. Twenty seven nos. Pressuremeter test was carried out at depths varying from 1.00m to 20m below the existing ground surface & shown in figures (2) to (36).
2. It is revealed that the limit pressure ranged from 0.35 to 62.85 kg/cm² & Menard's modulus of deformation ranged from 3.59 to 3752.60 kg/cm².

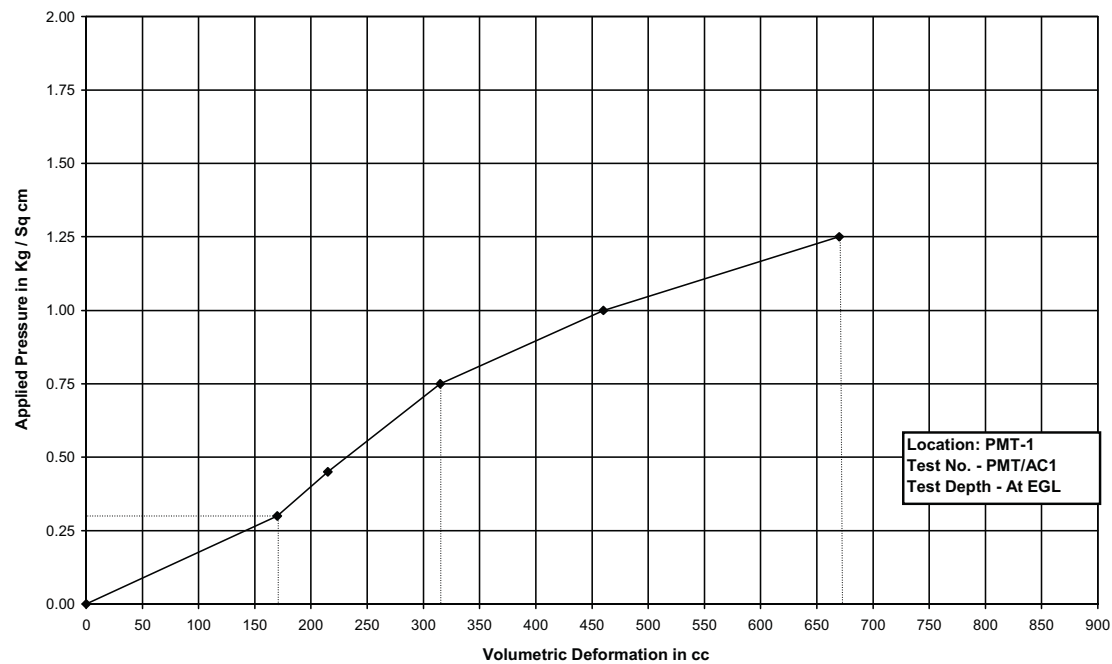


FIG. 2. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

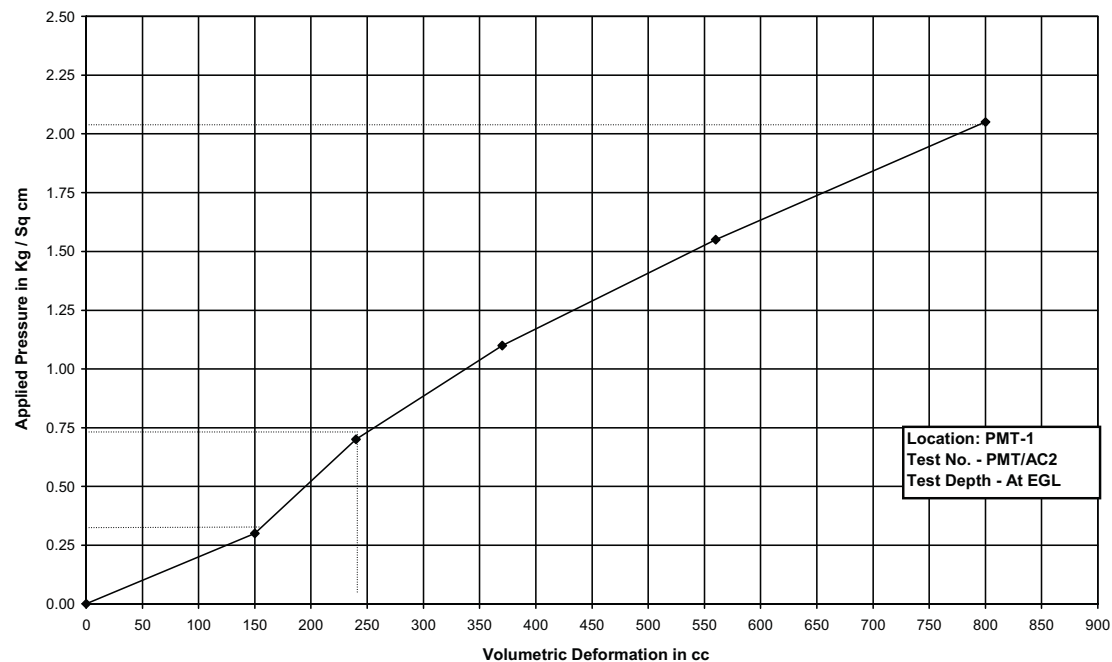


FIG. 3. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

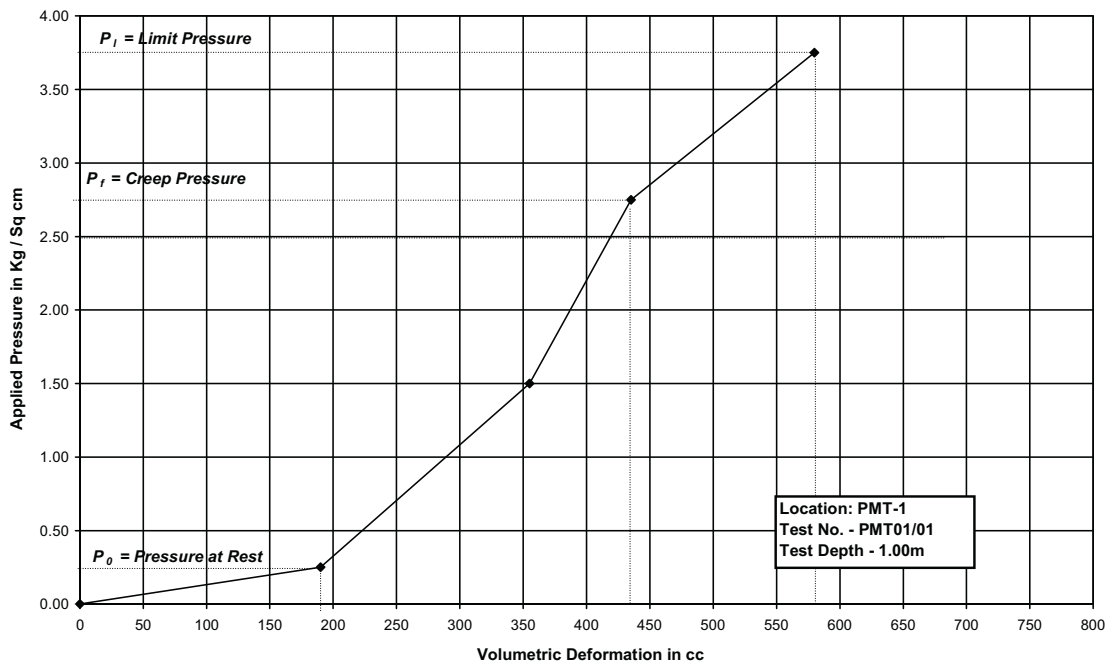


FIG. 4. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

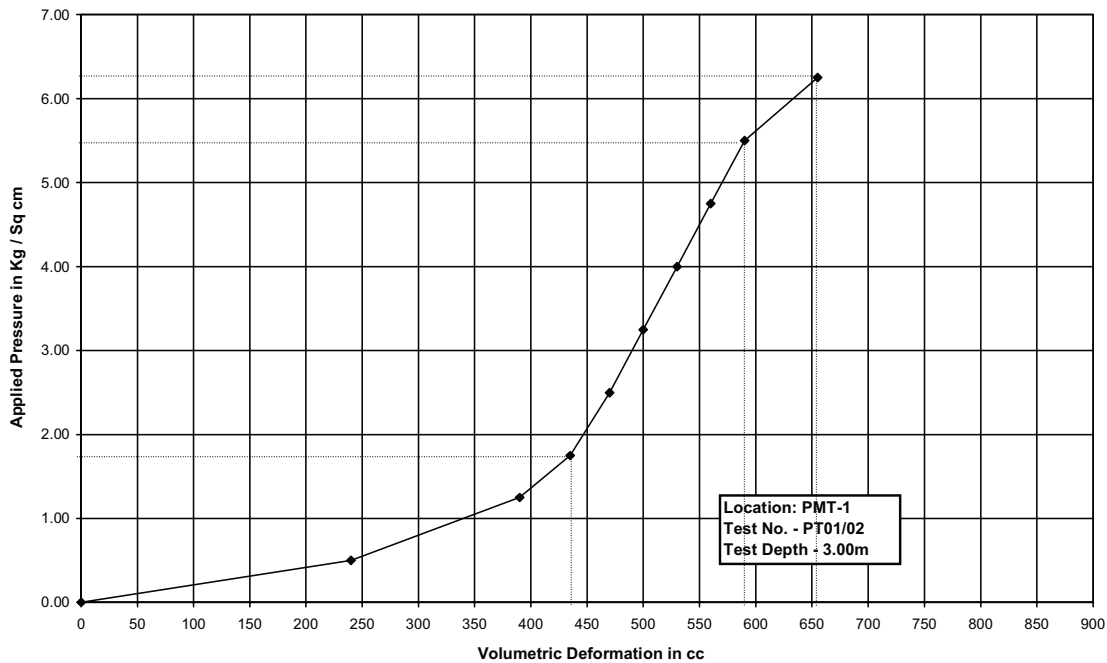


FIG. 5. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

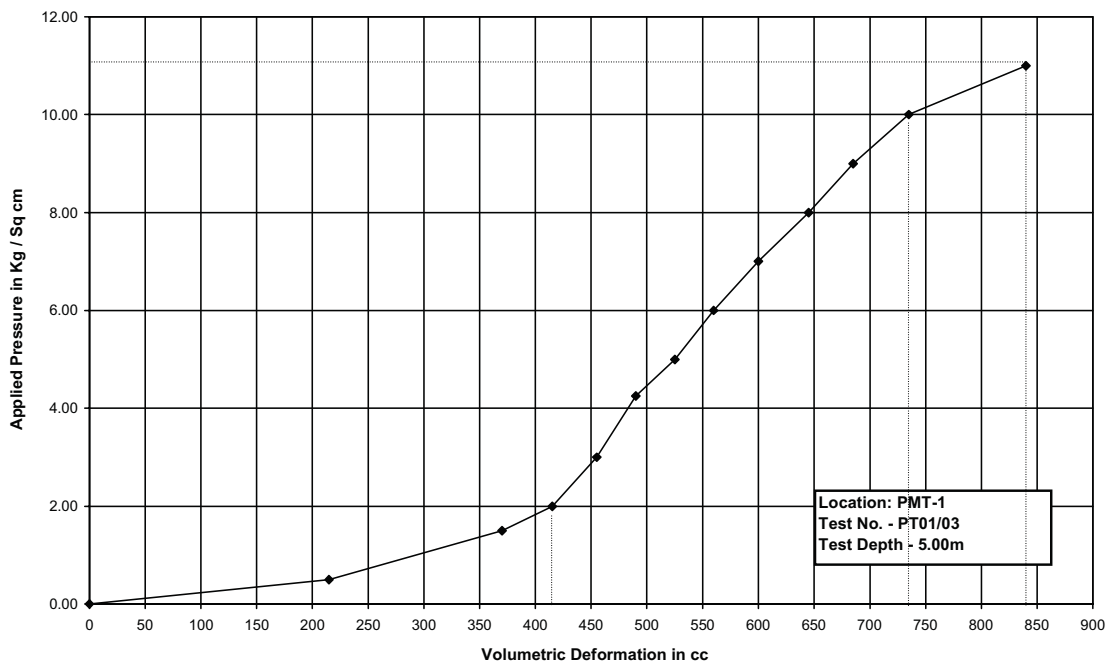


FIG. 6. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

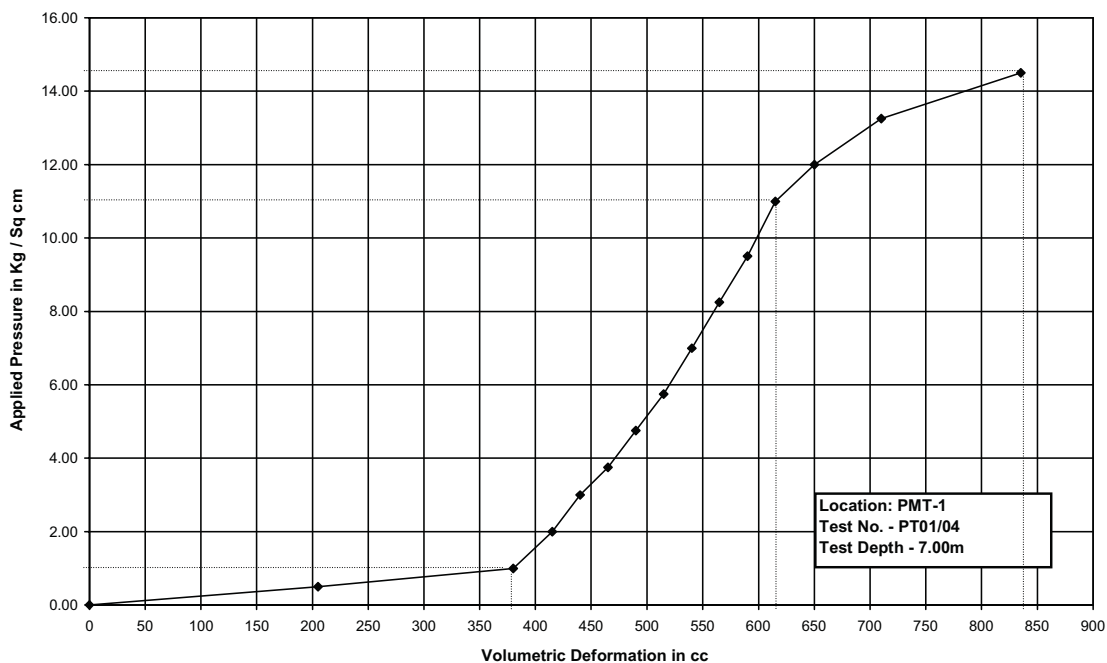


FIG. 7. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

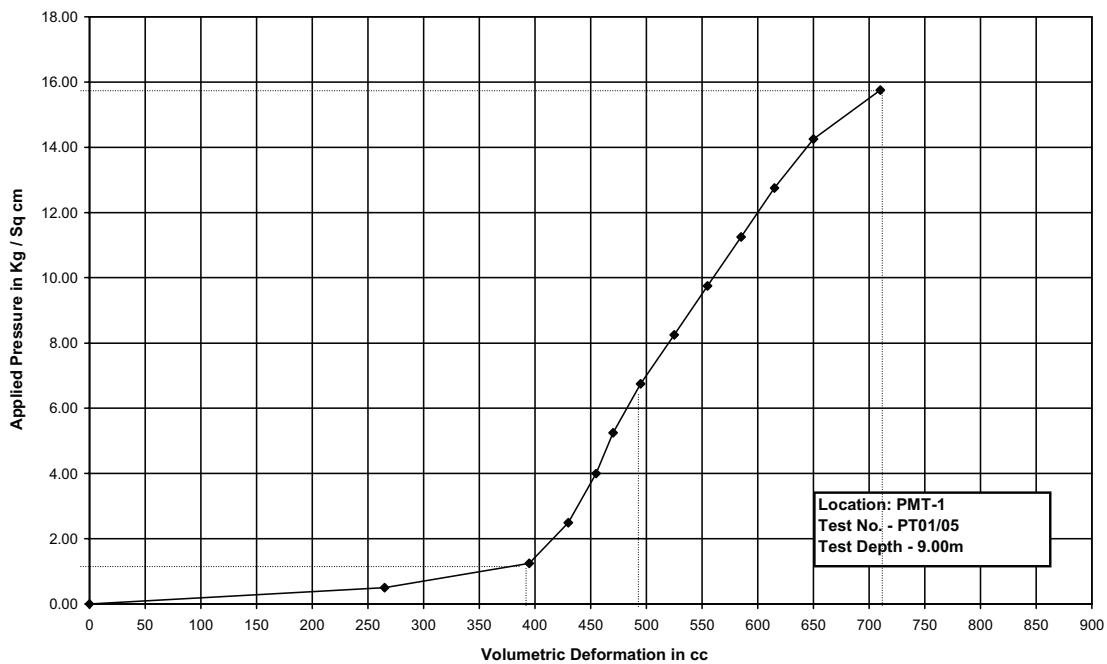


FIG. 8. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

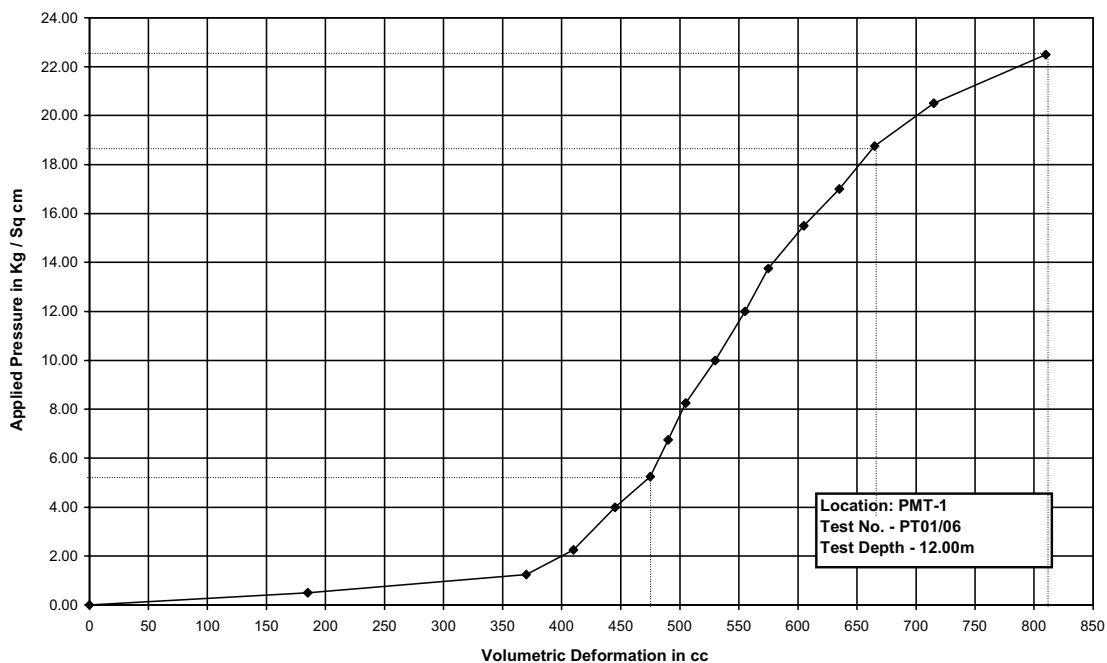


FIG. 9. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

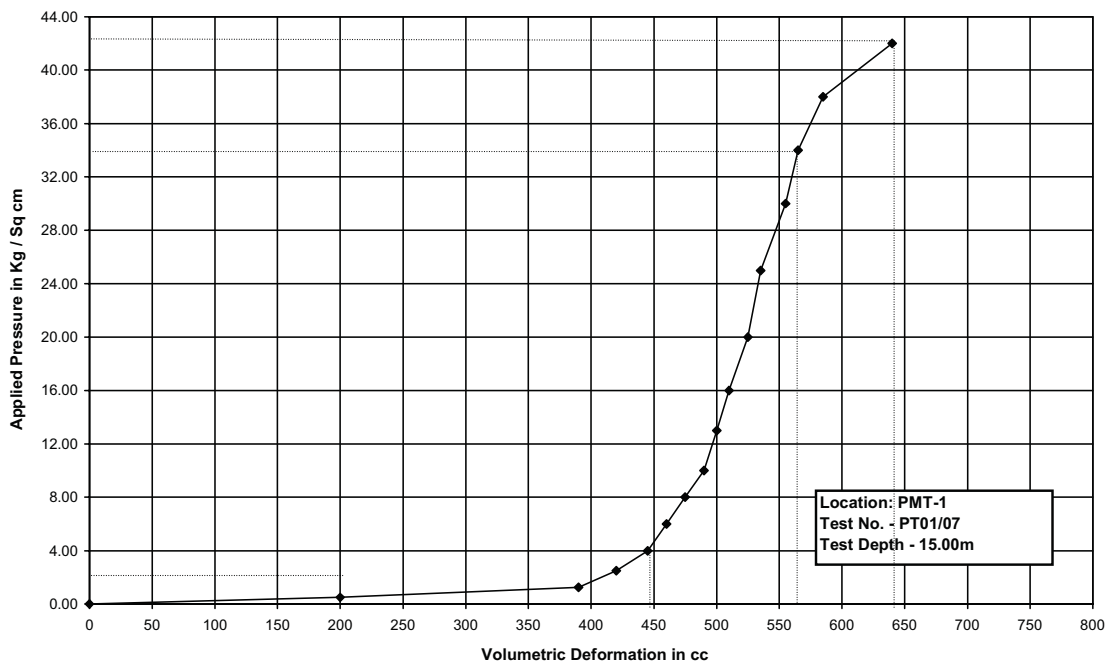


FIG. 10. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

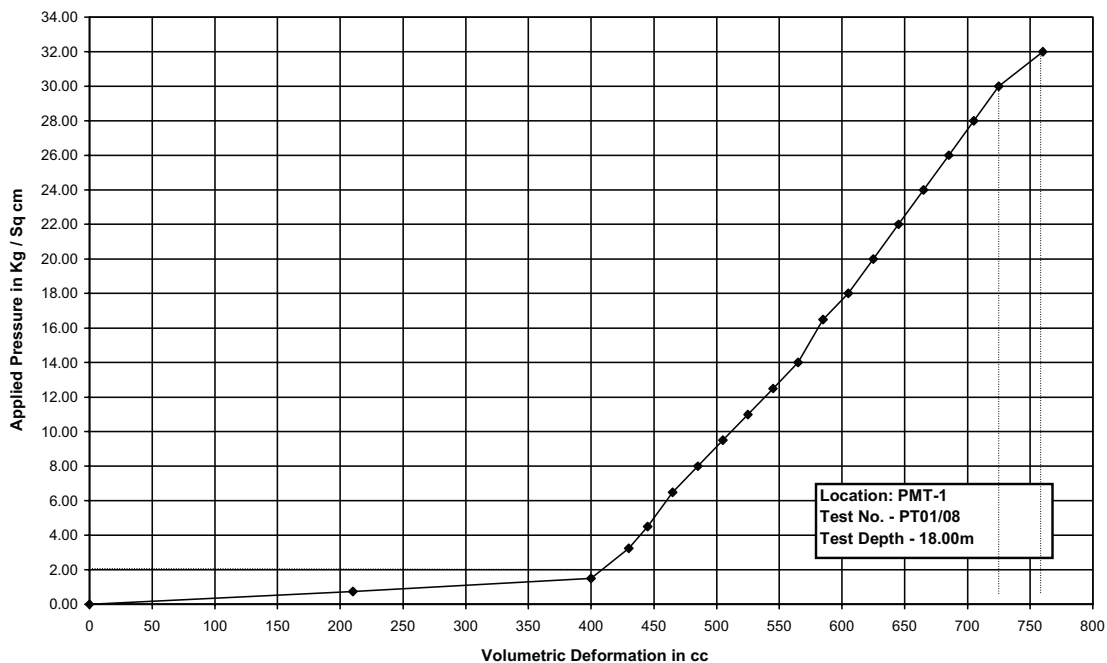


FIG. 11. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

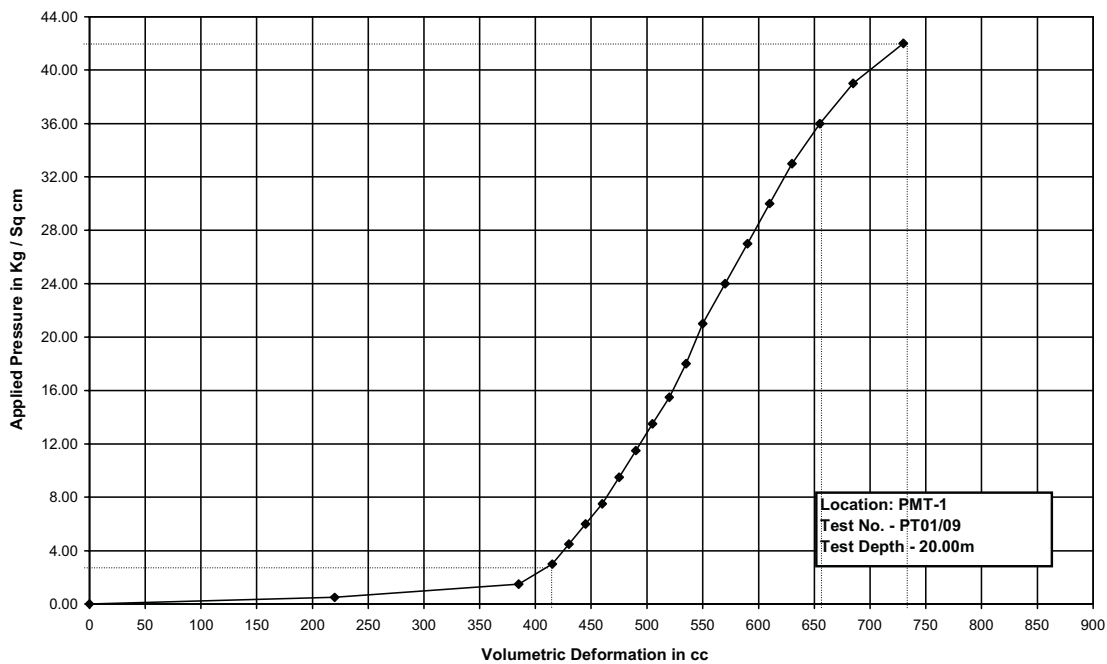


FIG. 12. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

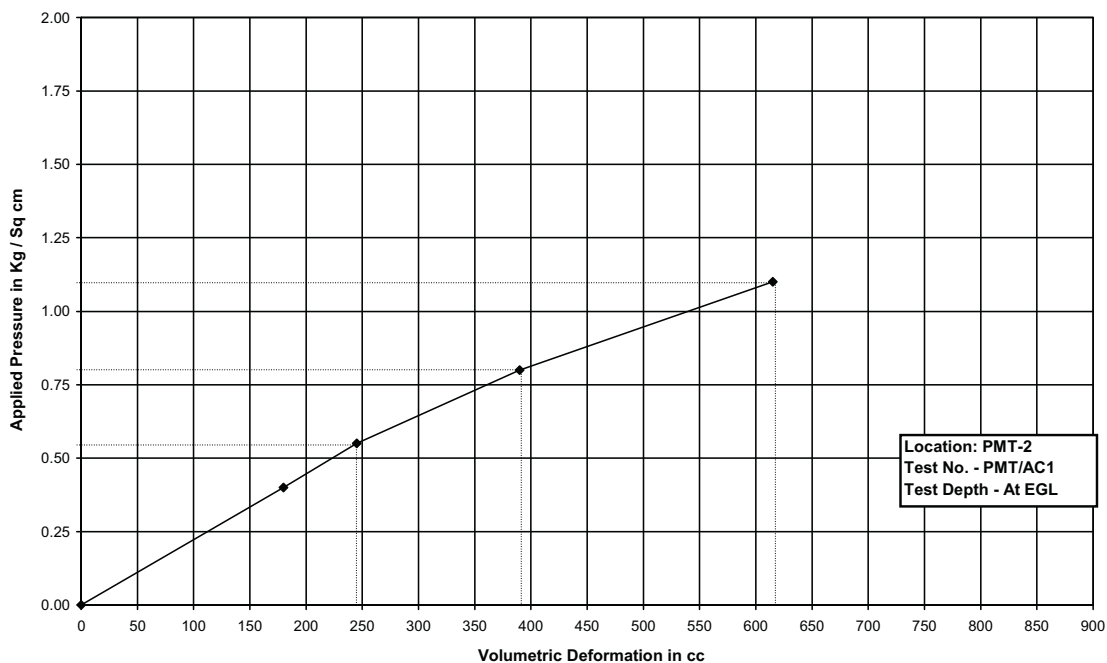


FIG. 13. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

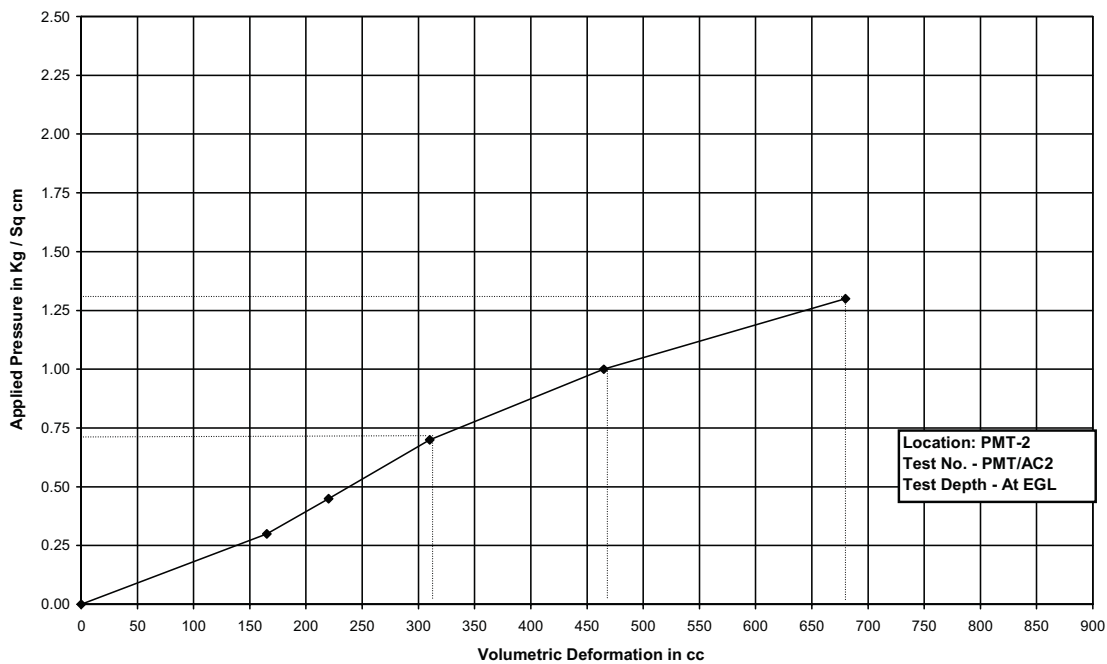


FIG. 14. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

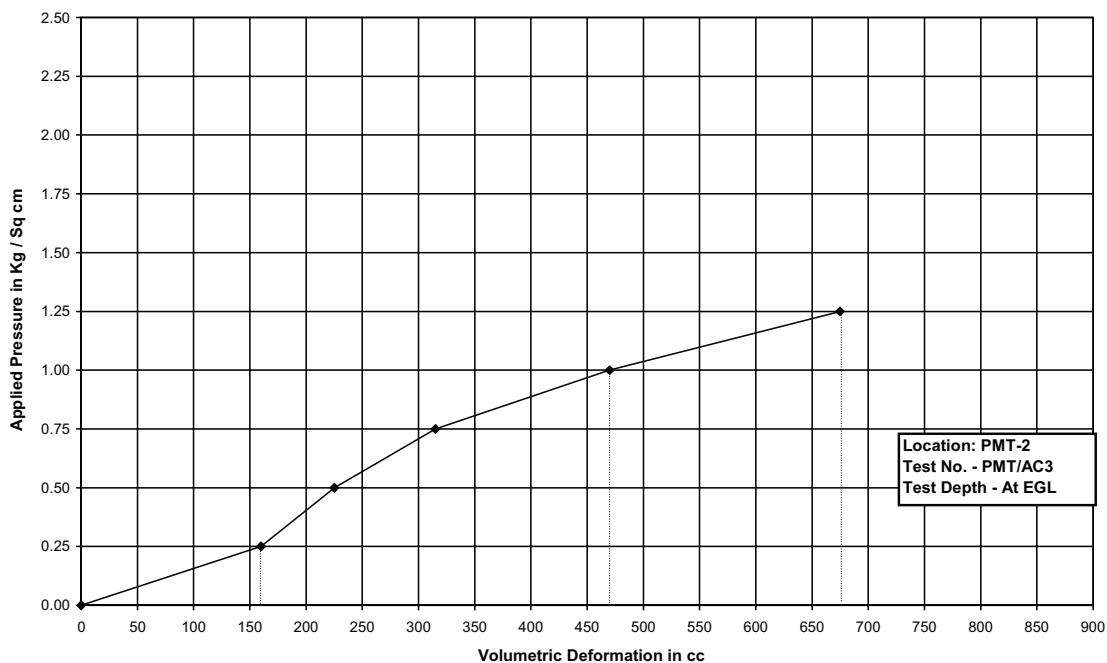


FIG. 15. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

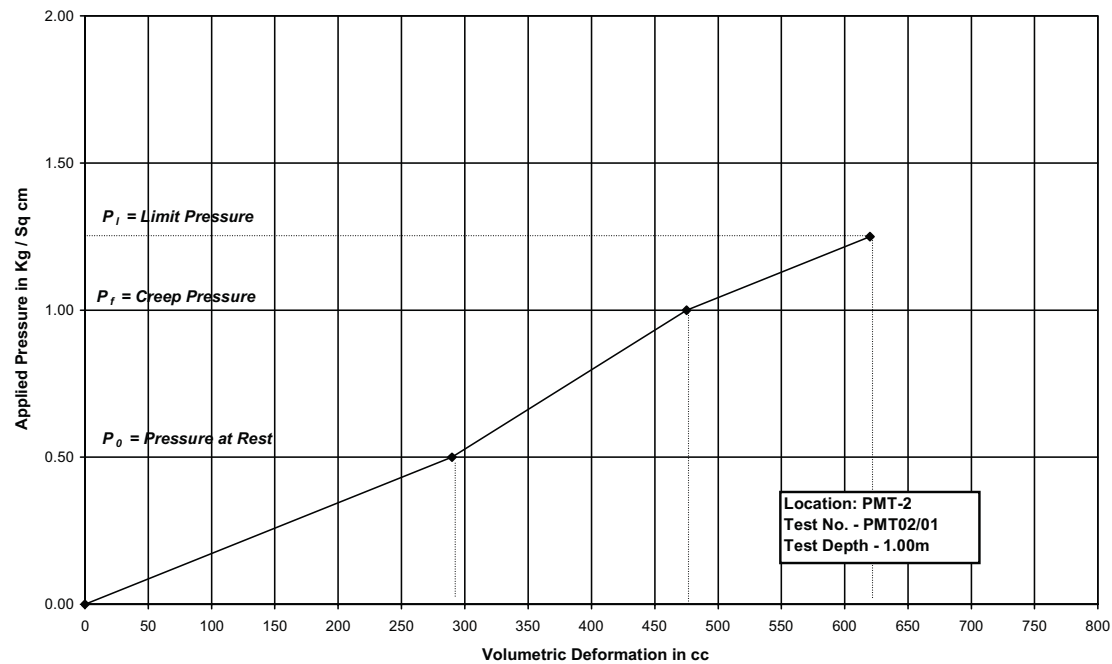


FIG. 16. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

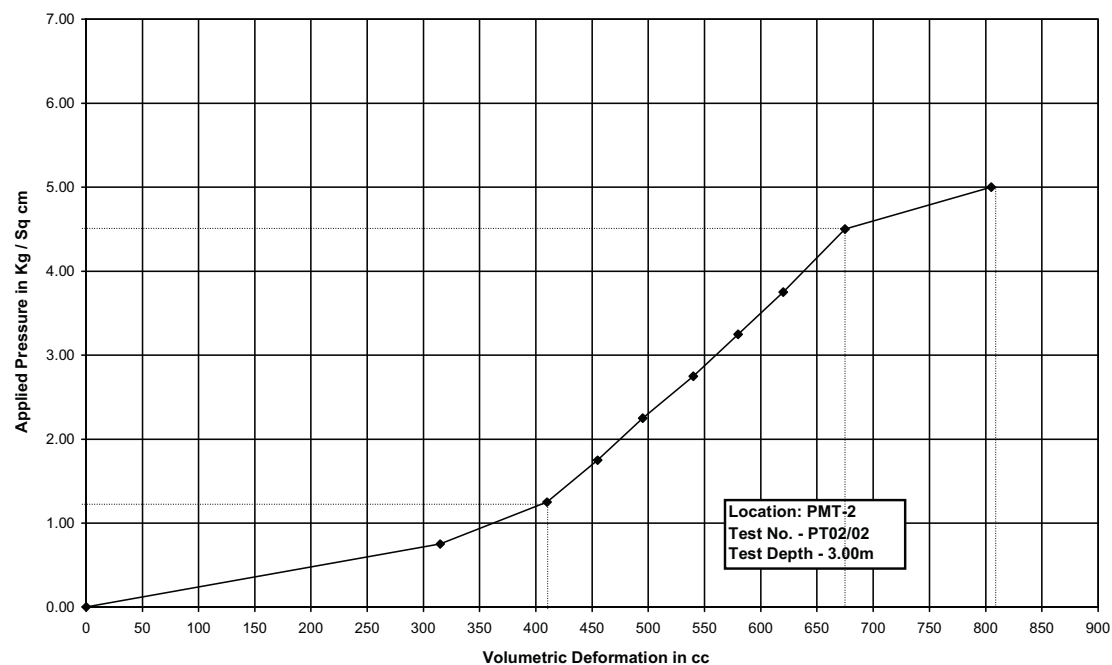


FIG. 17. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

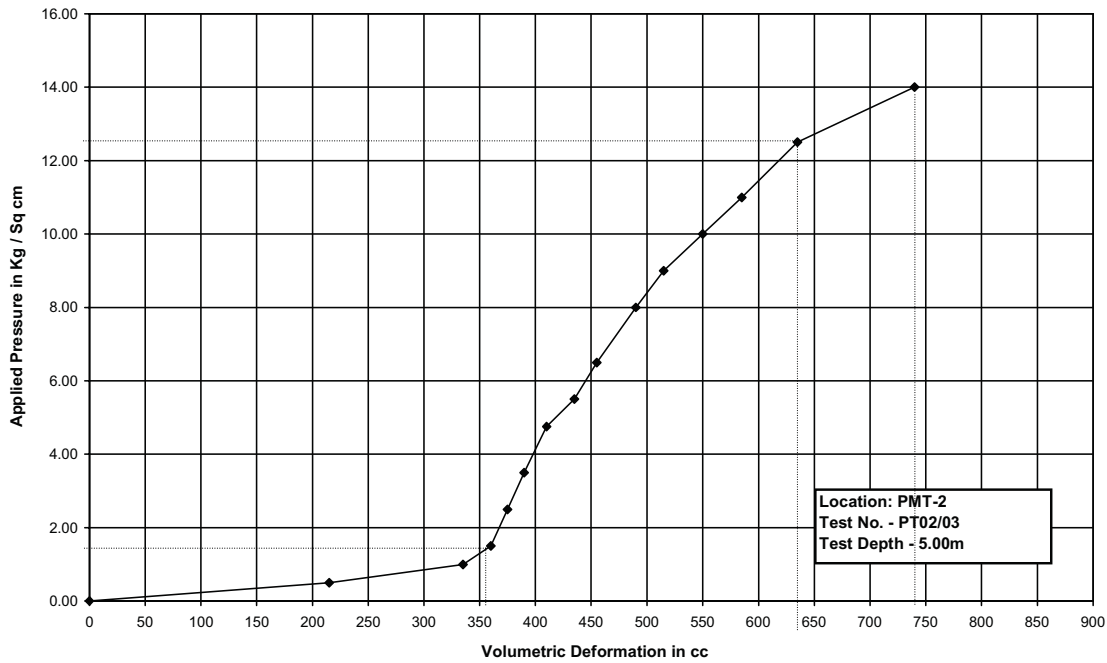


FIG. 18. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

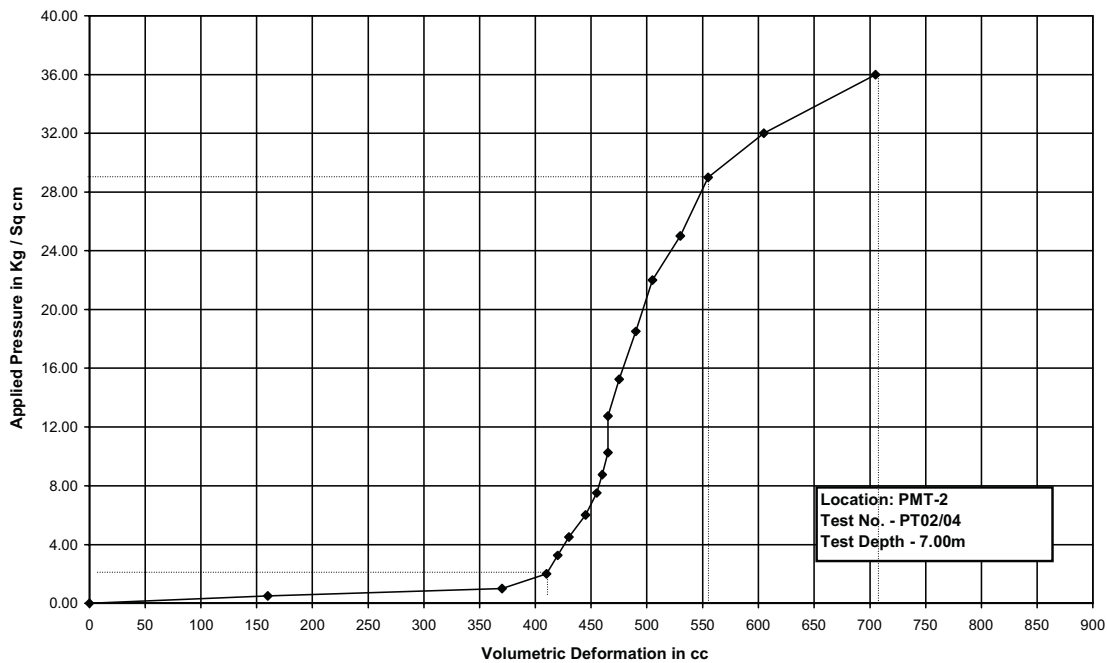


FIG. 19. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

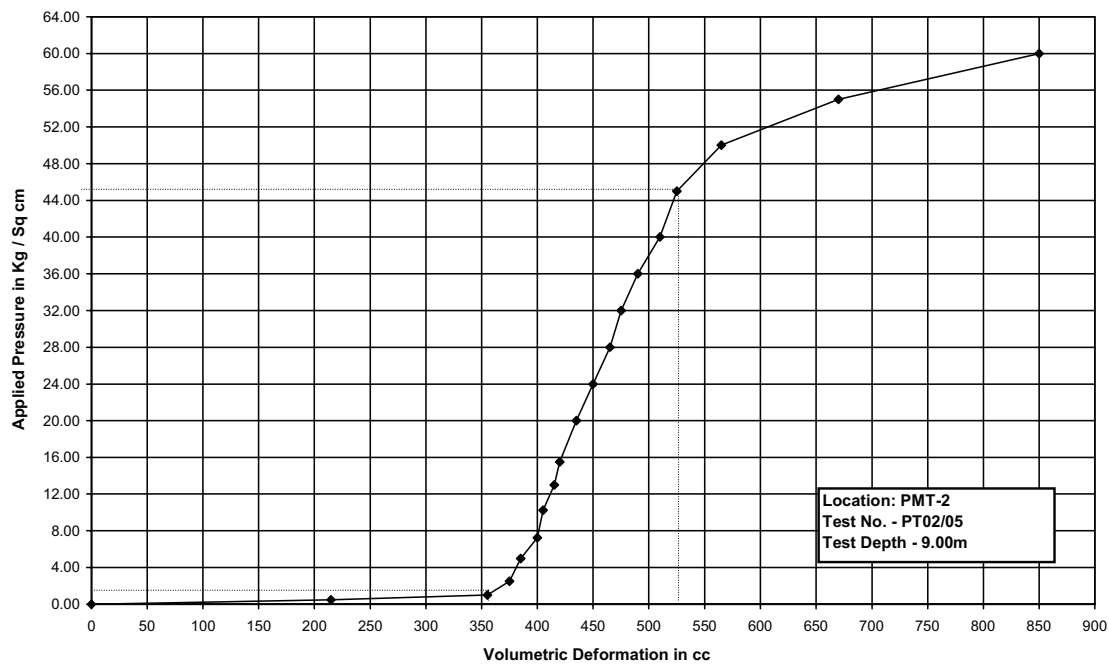


FIG. 20. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

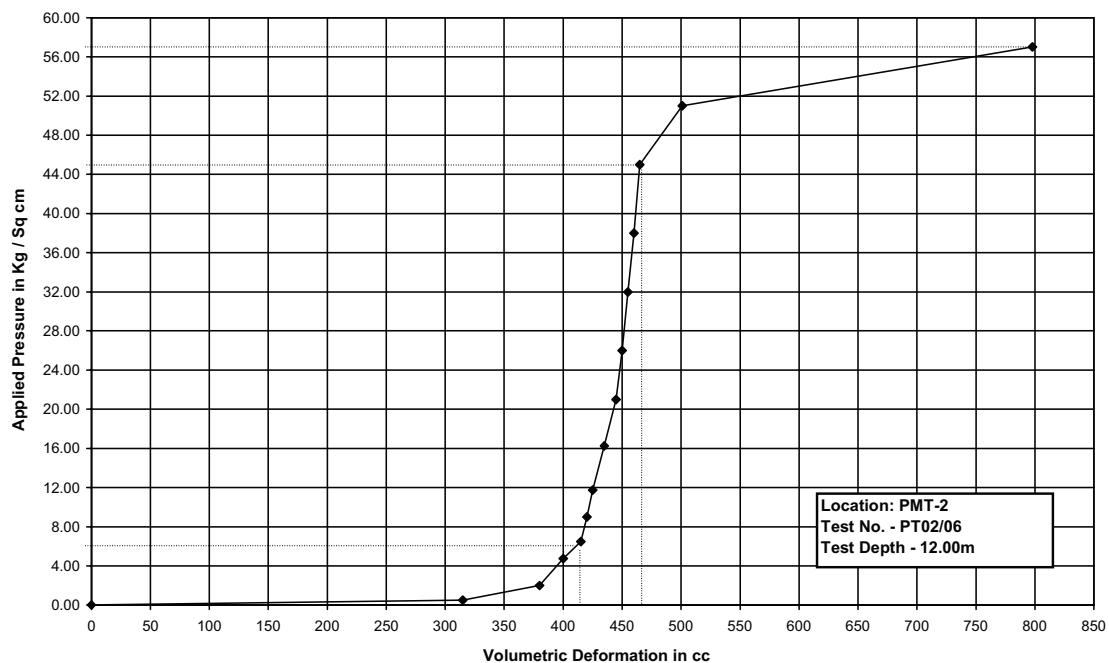


FIG. 21. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

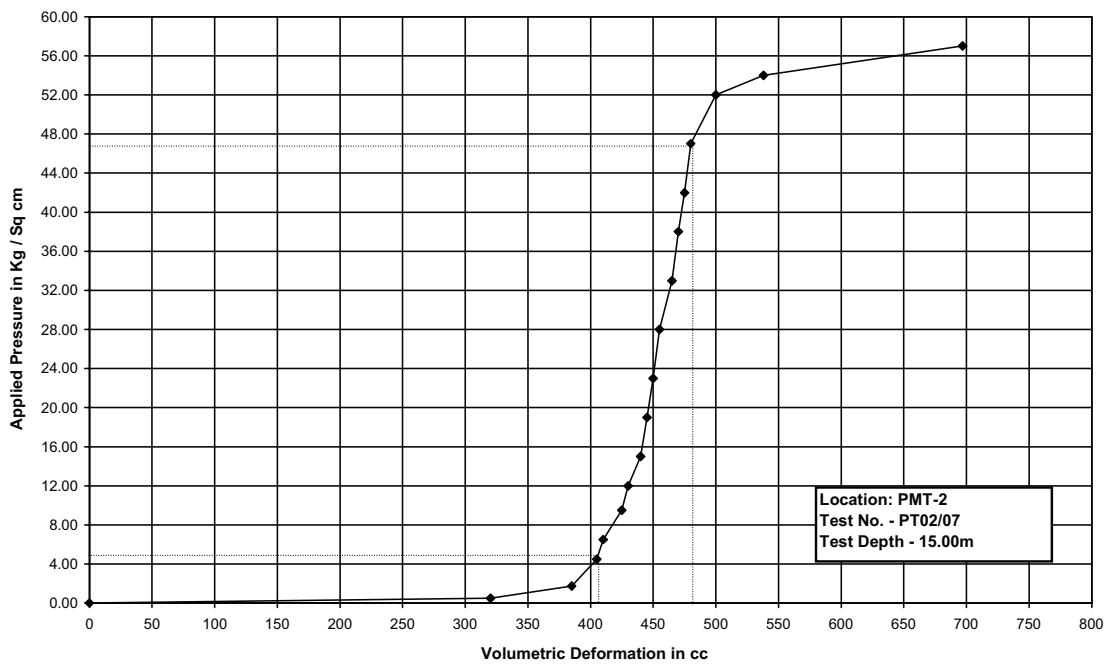


FIG. 22. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

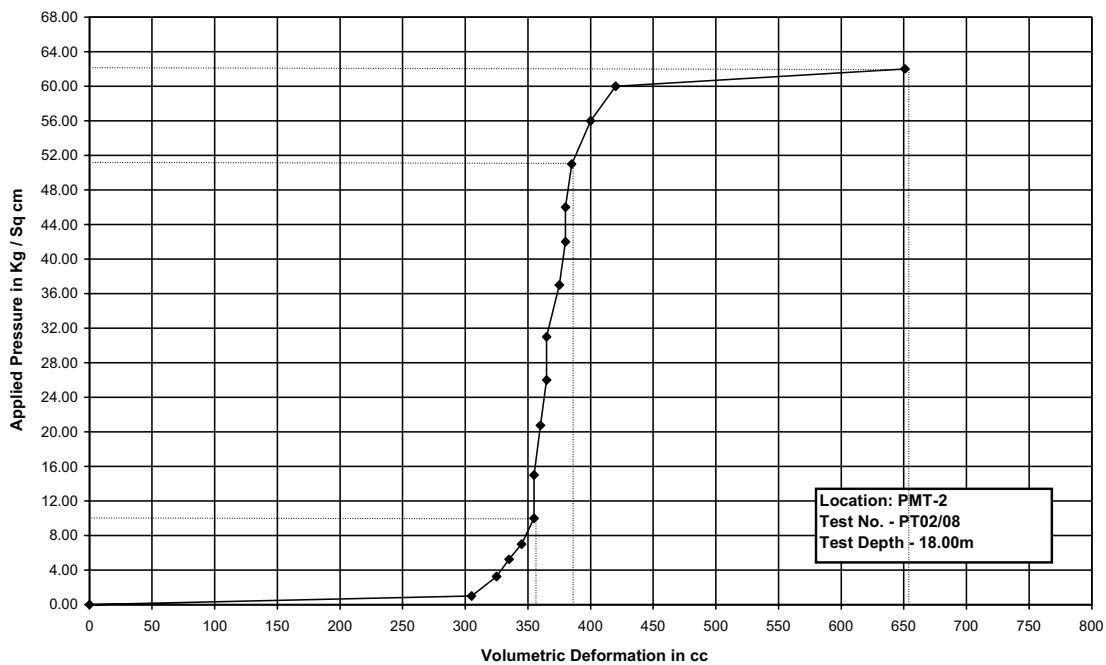


FIG. 23. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

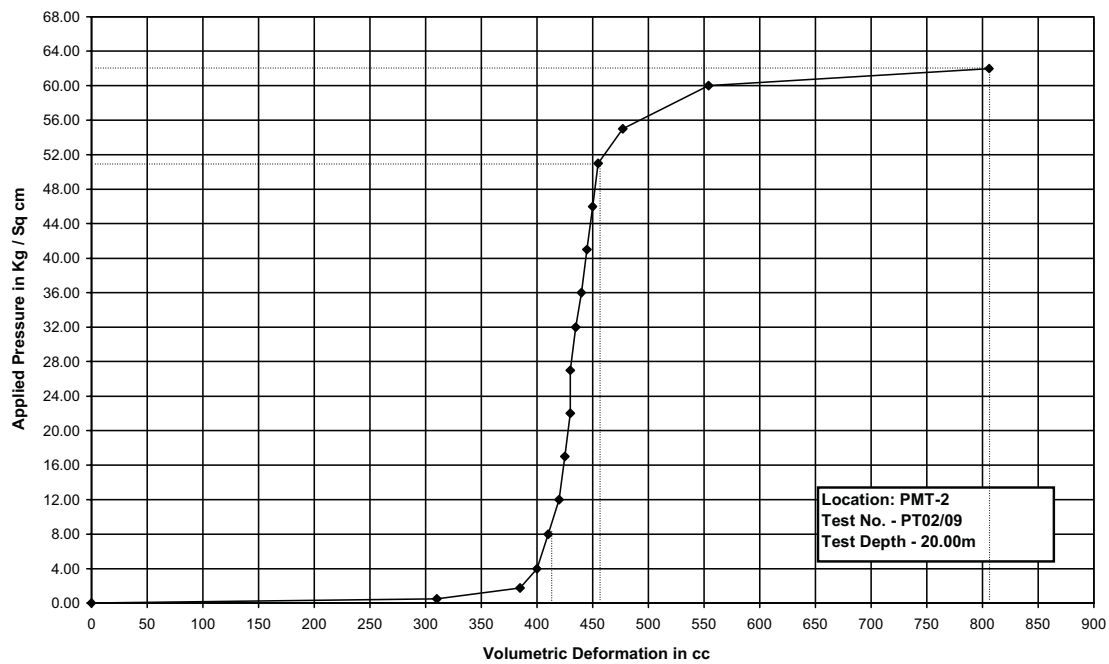


FIG. 24. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

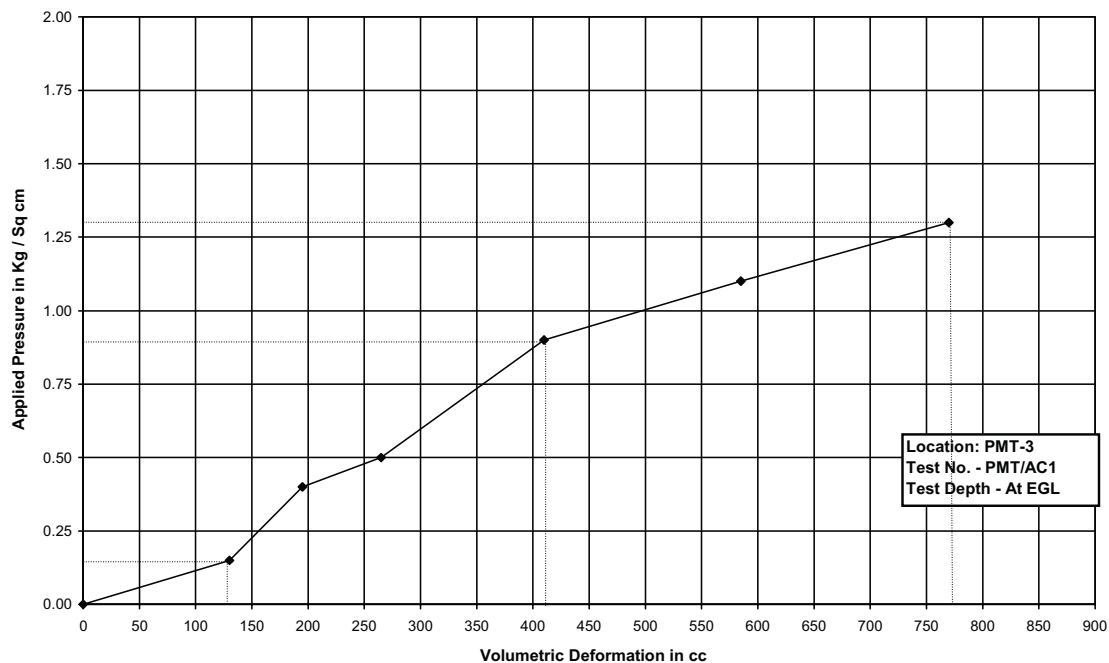


FIG. 25. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

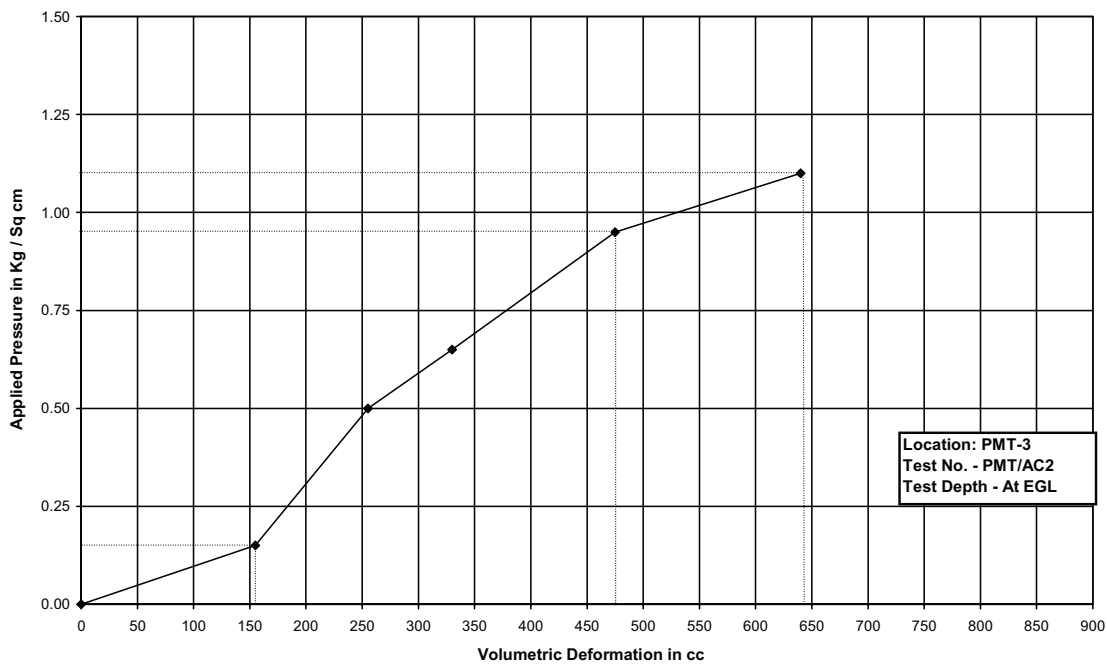


FIG. 26. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

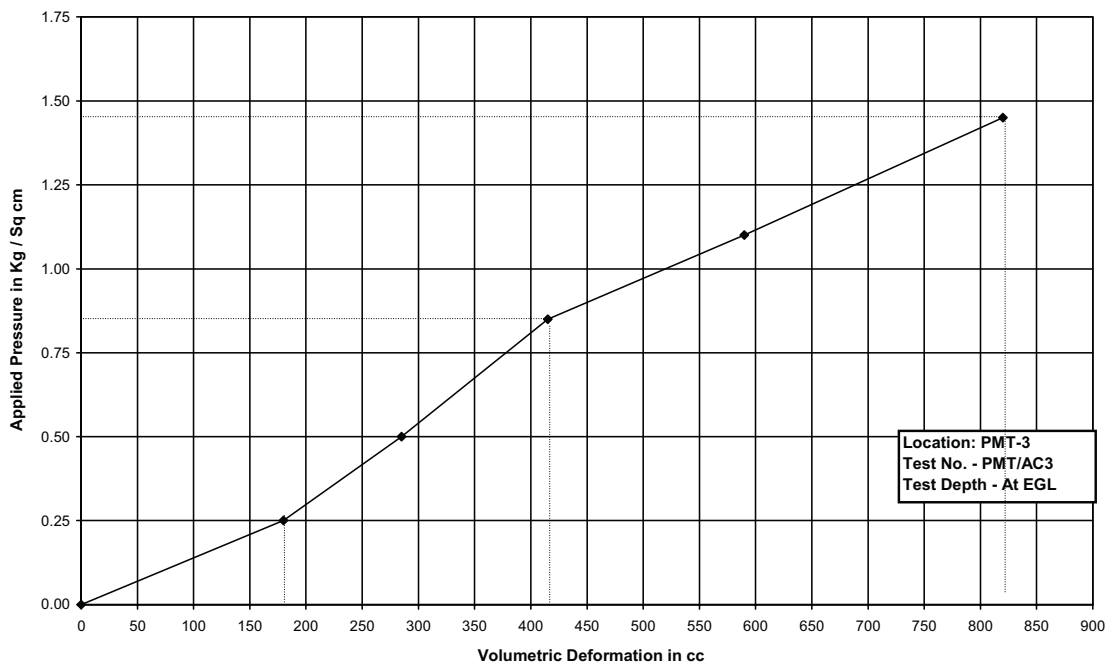


FIG. 27. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

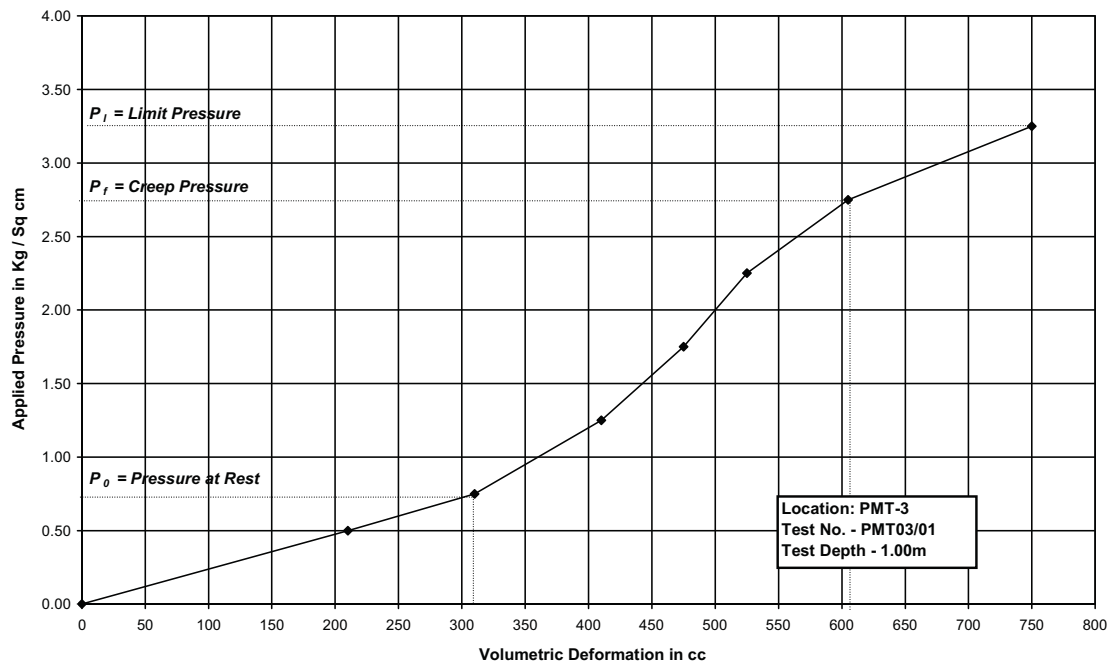


FIG. 28. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

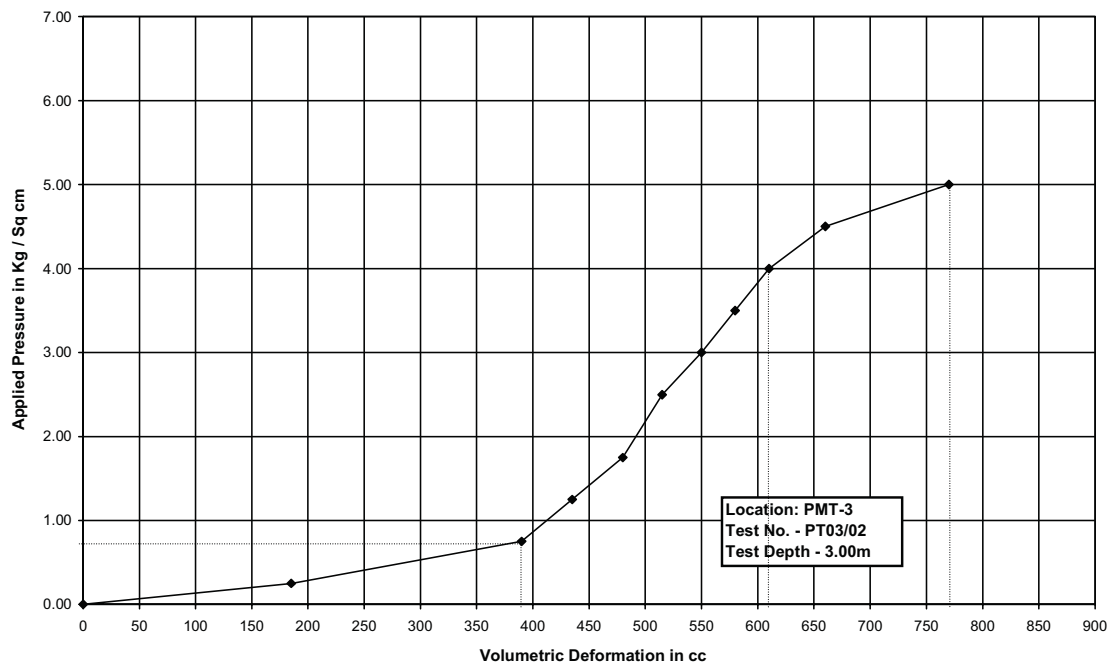


FIG. 29. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

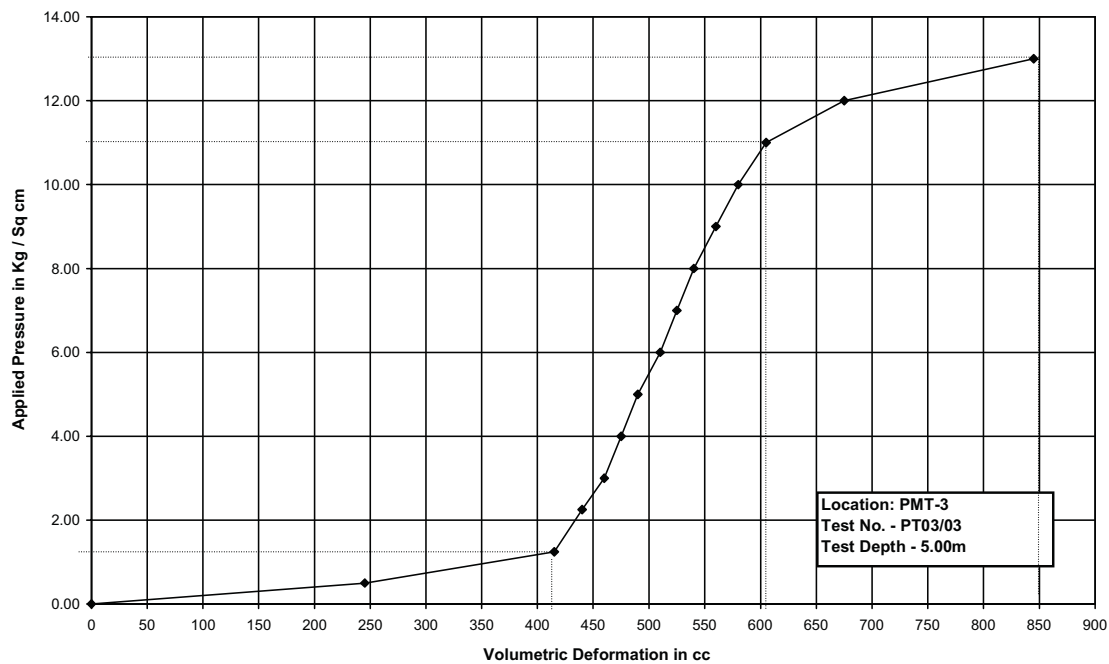


FIG. 30. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

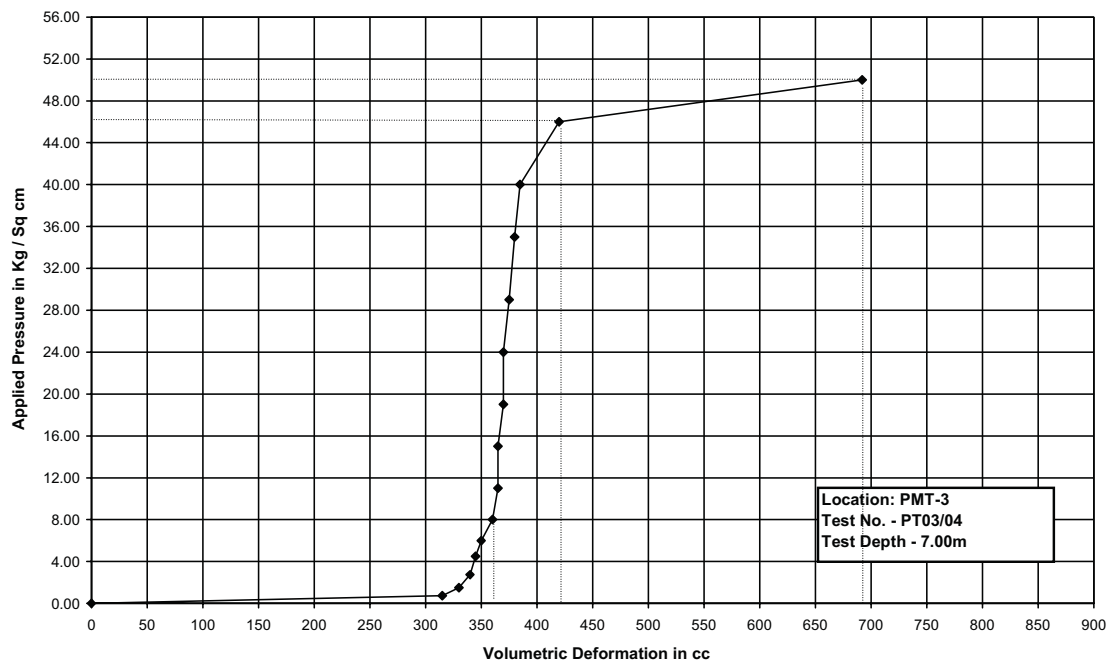


FIG. 31. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

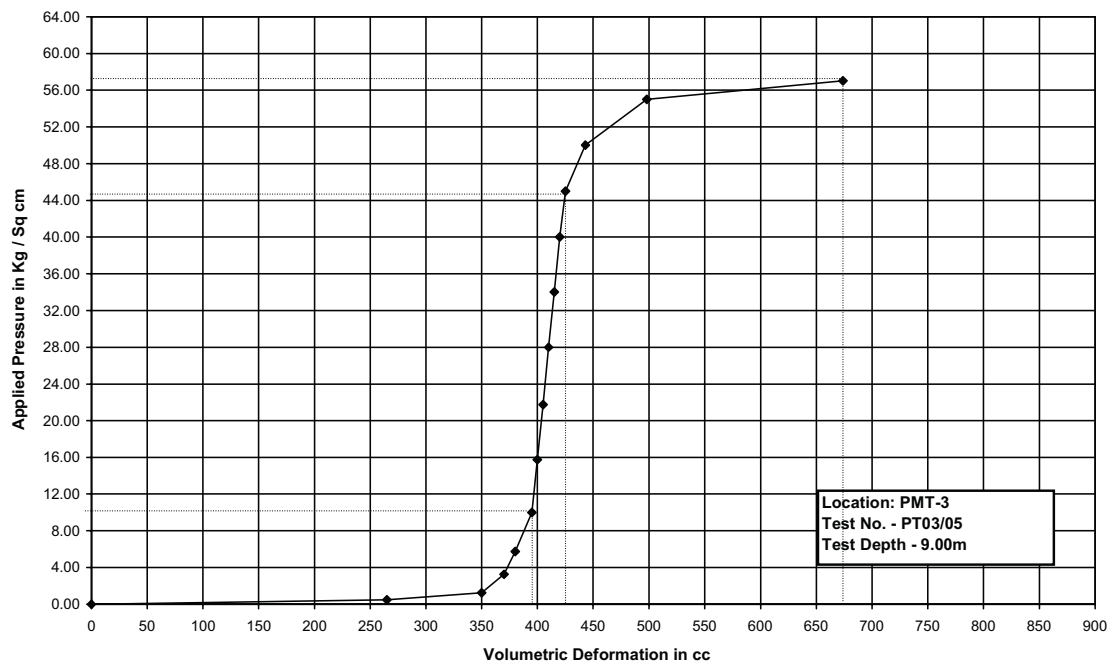


FIG. 32. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

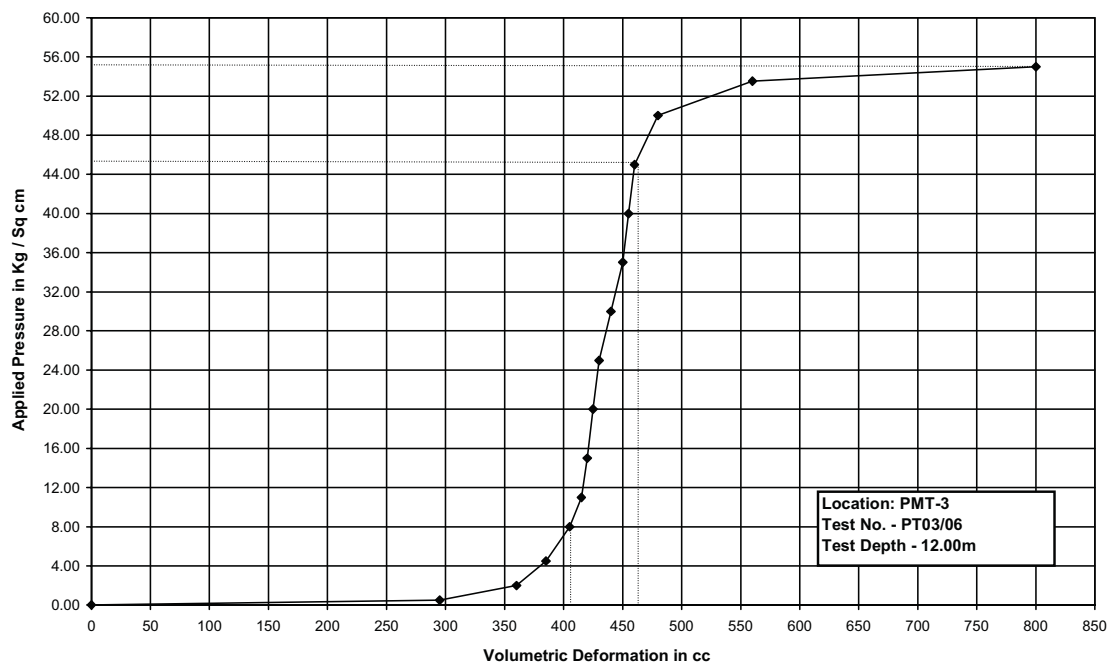


FIG. 33. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

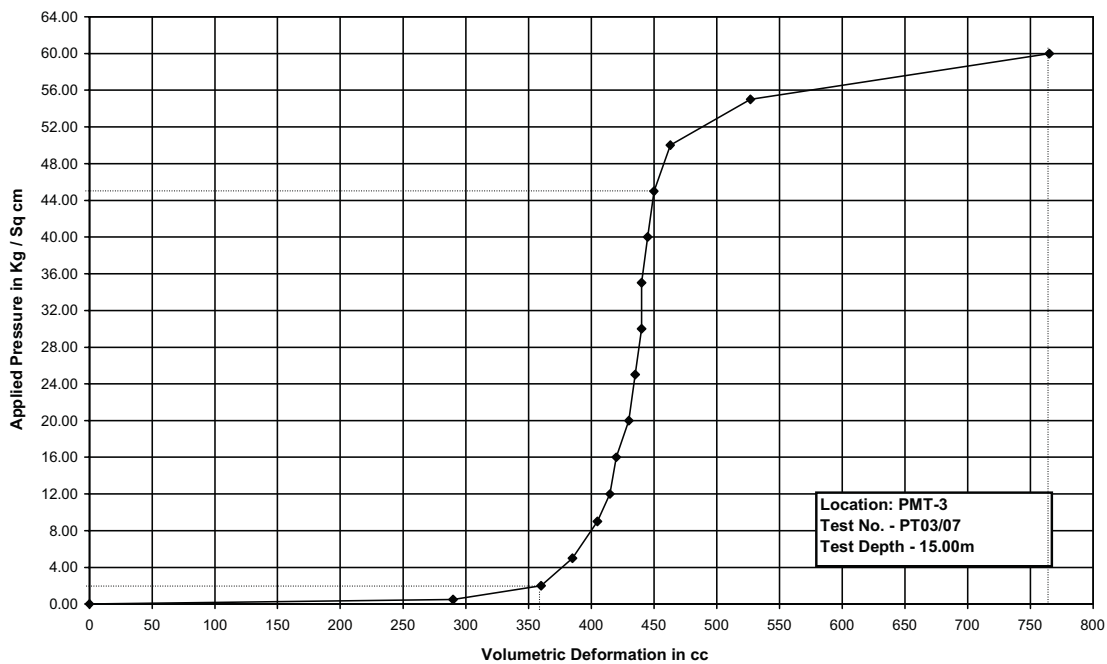


FIG. 34. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

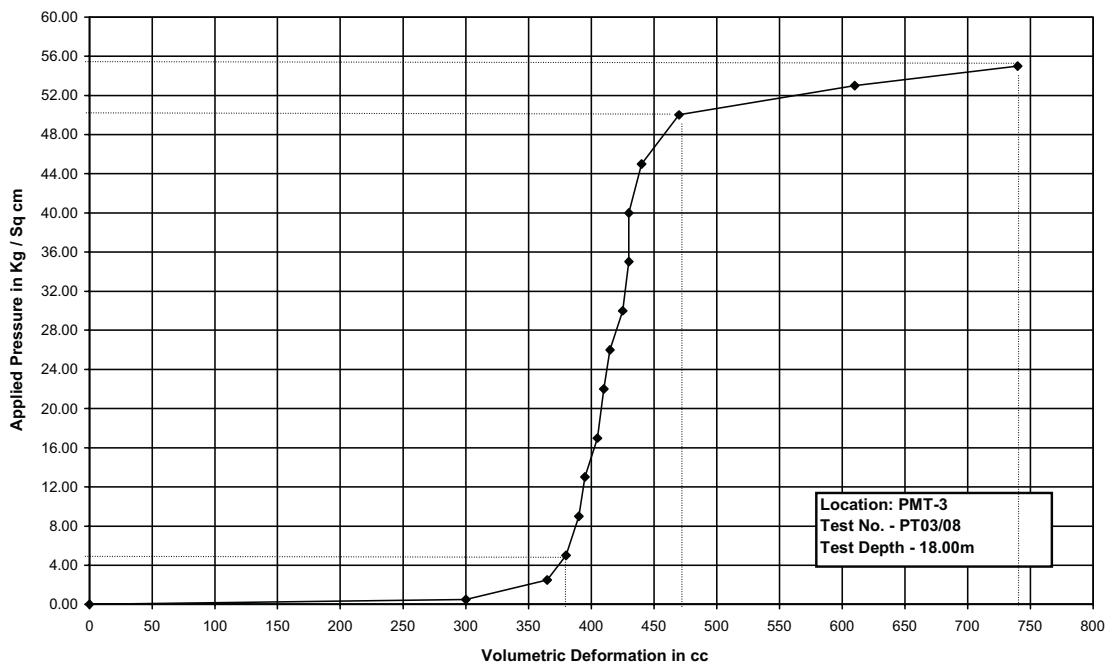


FIG. 35. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

Project: Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana

CETEST

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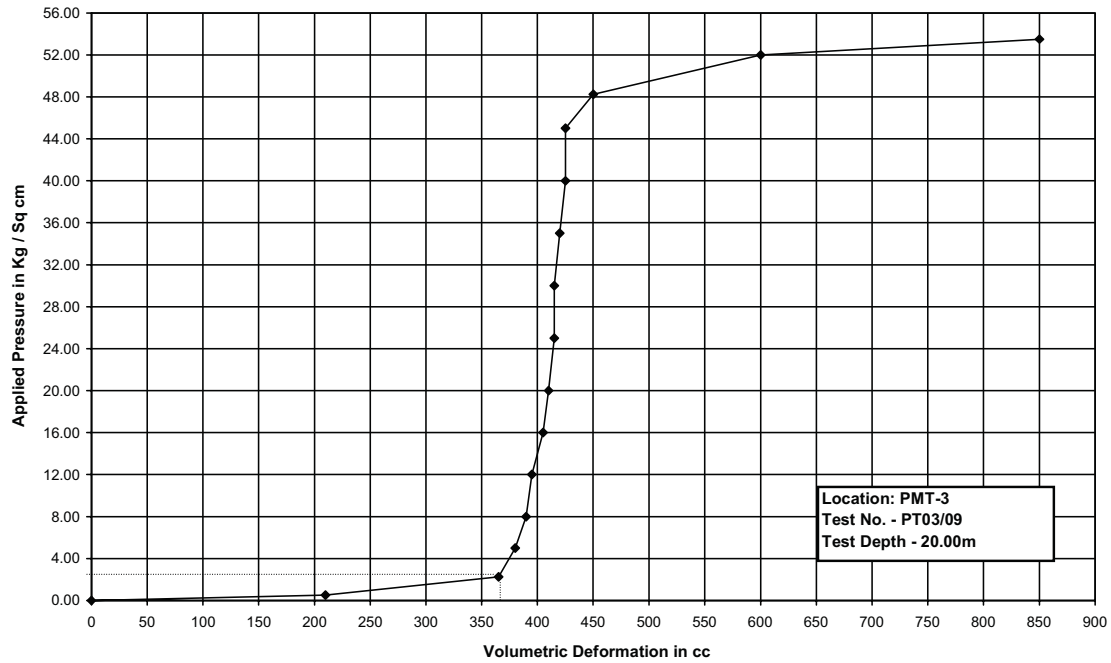


FIG. 36. APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

Project: Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana 

Job No. : 3421

Sheet No.

11. BLOCK VIBRATION TESTS

Project: Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana**Job No. : 3421****Sheet No.**

BLOCK VIBRATION REPORT

FOR 1 x 800MW KOTHAGUDAM THERMAL POWER STATION

STAGE VII, UNIT-12 AT KHAMMAM DISTRICT,

TELANGANA STATE

1. INTRODUCTION

The **Telangana State Generation Corporation Limited** has proposed 1 x 800MW Kothagudam Thermal Power Station, Stage – VII, Unit - 12 & the job was awarded to **M/s. Bharat Heavy Electricals Limited**. For designing of Foundation Structures coming under this project, it was necessary to conduct a Detailed Geotechnical Investigation Work and **M/s Bharat Heavy Electricals Limited**, in turn awarded the job to **M/s. C. E. Testing Company Pvt. Ltd., Kolkata**.

As per the scope of work, 2 nos. Block Vibration Tests were conducted.

2. SITE CONDITION:

The soil at the test level is grayish brown, sandy silt. Only two (2) nos. BVT were carried out to determine the dynamic properties of the layer for the construction of machine foundations. The RL & depth of test is given below in a tabular form.

BVT No.	Co-ordinate (M)			Depth (M)
	E	N	R.L	
1	467892	1947105	98.897	3.00
2	468004	1947120	97.849	3.00

3. PURPOSE OF TEST:

The dynamic tests were performed for studying the behavior of sub-soil under vibration and for determining the various dynamic properties of soil as obtained by exciting a concrete block mechanically. The tests were performed according to I.S. 5249.

4. EQUIPMENTS USED:

Description of various equipment which were used during the tests are given below:

1. Oscillator:

Mechanical Oscillator type SEA-350 (A) was used. Maximum force that can be generated by this oscillator is 1200 Kg, and maximum frequency is 60 c.p.s.

Eccentricity range is 0° - 140° . The oscillator was mounted on the base plate, which was in turn fitted with the block by holding down bolts. The oscillator can be fitted with the base plate both for vertical vibration and horizontal vibration. The eccentricity is adjusted by adjustor circle on oscillator. One complete clockwise rotation increases the eccentricity by 4° . The tachometer is fixed internally in the equipment having two visible terminals, which were connected to the phase meter. The oscillator, which is filled with standard engine oil SEA-40, is connected by V-belt with the electric D.C. motor.

2. D.C. Motor:

Variable Speed Motor Type SEA-351 (A) was used. This 3 H.P. single phase D.C. Motor was fitted on the frame by the side of the oscillator. Supply from main was given through speed control unit, which controls the speed of the motor. The motor was connected to the oscillator by a V-belt.

3. Speed Control Unit:

Speed Control Unit Type SEA-352(A) was used. The maximum voltage for the armature is 250 V and maximum current is 12 Amp. For the fields, the maximum voltage is 28 V and maximum current is 8 Amp. The main function of the speed control unit is to control the speed of the motor as required. Higher speed of the motor gives higher frequency of the oscillator. The main knob of the speed control unit is turned in the anticlockwise direction till the minimum speed indicator light glows with a 'click' sound and then the knob is turned in the clockwise direction for increasing the speed as required. Maximum indicator light indicates the overloading of the motor.

4. Three-in-one Phase Meter:

Phase Meter Type SEA-550 was used for recording the frequency and amplitude. The instrument is powered by two 9 Volt batteries provided in the cabinet body of the units. For vertical vibration test, one acceleration pick up was fitted on top of the block and was connected to the remaining input of the meter. By turning the switch to "AMPLITUDE", the amplitude of the block is recorded. The second knob is meant for choosing properly the multiplier for recording higher amplitudes.

5. Acceleration Pick up:

The acceleration pick-ups are used to record the amplitude of vibration during vertical and horizontal block resonance test.

5. DESCRIPTION OF TESTS PERFORMED:

Forced vibration test was performed on a concrete block of size 1.50M x 0.75M x 0.70M (height) as per IS-5249. The detailed description of the test is given below:

Vertical Vibration Test: The acceleration pick up is fixed on the top of the concrete block such that it senses vertical motion of the block. The mechanical oscillator is mounted on the block such that it generates purely vertical sinusoidal vibrations and line of action of the vibrating force passes through the center of gravity of the block. After choosing a suitable value of angle of setting of eccentric masses, the oscillator is made to run at a constant frequency. With the help of the speed control unit, the speed of the motor is regulated and the frequency of the oscillator is increased in steps of small values upto the resonant frequency and two or three more readings of amplitude are taken beyond the resonant frequency. The same procedure is repeated for various values of angle of setting of eccentric masses. At any eccentricity and frequency, the dynamic force should not exceed 20 percent of the total mass of the block and motor-oscillator assembly. The frequency and amplitude are recorded through meter.

6. CALCULATION:

6.1. COEFFICIENT OF ELASTIC UNIFORM COMPRESSION, C_u

The coefficient of elastic uniform compression, C_u , is calculated from the natural frequency as follows.

$$C_u = 4 \cdot \pi^2 \cdot f_{nz}^2 \cdot M/A$$

Where, f_{nz} = Natural frequency as obtained from forced vibration tests.

M = Mass of concrete block with Oscillator etc.

A = Base area of block.

Now we have, $A = 150 \times 75 = 11250 \text{ cm}^2$.

Weight of block = $1.50 \times 0.75 \times 0.70 \times 2400 = 1890 \text{ kg}$

Weight of motor + Oscillator = 169 kg.

Total weight = 2059 kg.

$M = 2059 / 981 = 2.10 \text{ kg} \cdot \text{Sec}^2/\text{cm}$, $M/A = 1.86 \times 10^{-4} \text{ kg sec}^2\text{cm}^{-3}$

The natural frequencies are presented in Column-3 of Table-1 for vertical vibration for each level of Dynamic force. For example **for BVT-1, eccentricity = 8°**, $f_{nz} = 869 \text{ rpm} = 869/60 = 14.48 \text{ c.p.s.}$

$$\begin{aligned} C_u &= [4 \times \pi^2 \times 1.86 \times 10^{-4}] f_{nz}^2 = 4 \times \pi^2 \times 1.86 \times 10^{-4} \times 14.48^2 \\ &= 1.55 \text{ kg/cucm} \end{aligned}$$

Project: Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana**Job No. : 3421****Sheet No.****6.2. DAMPING CONSTANTS:**

The damping constants, ξ is given as $\xi = ([f_2 \cdot f_1] / [2 \cdot f_{nx}])$

Where, f_1 and f_2 are the frequencies at which the amplitude is 0.707 times the amplitude at natural frequency.

Considering Vertical Vibration test: **For BVT-01 & 8° eccentric angle:**

$f_{nx} = 869 \text{ rpm}$, $f_1 = 506 \text{ rpm}$, $f_2 = 1213 \text{ rpm}$ from graph.

Therefore $\xi = (1213 - 506) / (2 \times 869) = 0.407$

Table- 1 : Summarised Results for Damping Constant

BVT No.	Type of Test	Eccentric angle (degree)	Natural frequency, f_{nx} (rpm)	Damping constant (ξ)	Avg. ξ
01	Vertical	8°	869	0.407	0.314
		16°	951	0.347	
		24°	1136	0.276	
		36°	710	0.227	
02	Vertical	8°	833	0.605	0.403
		16°	922	0.386	
		24°	1225	0.249	
		36°	1208	0.372	

6.3. DYNAMIC SHEAR AND YOUNG'S MODULUS:**DYNAMIC YOUNG'S MODULUS: -**

The co-efficient of elastic uniform compression, C_u is related to dynamic Young's Modulus, E_d as $C_u = 1.09 E_d / [(1 - \mu^2) \sqrt{A}]$, Therefore $E_d = [\sqrt{A} C_u (1 - \mu^2)] / 1.09$

Using $\mu = 0.30$ and $A = 150 \times 75 = 11250 \text{ sqcm}$.

Substituting the values, E_d is given as $88.55 C_u$.

For $C_u = 1.55 \text{ kg/cucm}$, $E_d = 136.81 \text{ kg/sqcm}$

THE SHEAR MODULUS, G: -

Shear modulus is related to Young's Modulus by

$$E_d = 2G (1 + \mu) = 2.60 G$$

Therefore, $G = E_d / 2.60$ giving **52.62 kg/sqcm**.

Table:- 2: Summarised results for 1.50M x 0.75M foundation size.

Test No	Eccentricity	Co-efficient of Uniform compression C_u (kg/cu cm)	Dynamic Young's Modulus (kg/sq cm)	Shear Modulus (G) (kg/sq cm)	Damping constant (ξ)
BVT-01	8°	1.55	136.81	52.62	0.407
	16°	1.85	163.85	63.02	0.347
	24°	2.64	233.8	89.92	0.276
	36°	1.03	91.33	35.13	0.227
	Average	1.77	156.45	60.17	0.314
BVT-02	8°	1.42	129.51	51.80	0.605
	16°	1.74	158.66	63.47	0.386
	24°	3.07	280.08	112.03	0.249
	36°	2.99	272.36	108.94	0.372
	Average	2.31	210.15	84.06	0.403

6.4. CORRECTIONS FOR AREA & OVERBURDEN PRESSURE ON VALUES OF C_u & C_τ

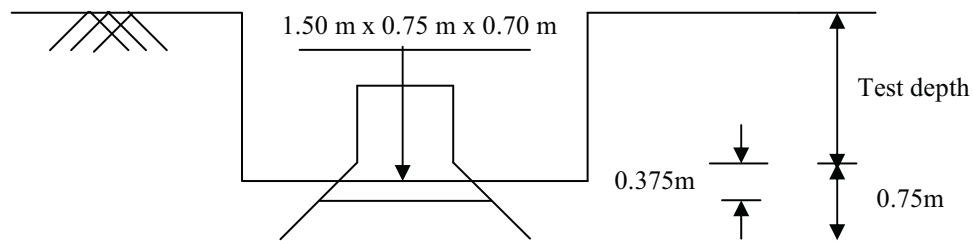
We know that, $C_u \propto 1/\sqrt{A}$ and $C_u \propto \sqrt{P_v}$

So, we can write, $C_u \propto \sqrt{(P_v/A)}$

Hence we can write, $(C_u)_{\text{block}} / (C_u)_{\text{foundation}} = [\sqrt{(P_v/A)}]_{\text{block}} / [\sqrt{(P_v/A)}]_{\text{foundation}}$

$$(C_u)_{\text{foundation}} = (C_u)_{\text{block}} \times [\sqrt{(A/P_v)}]_{\text{block}} \times [\sqrt{(P_v/A)}]_{\text{foundation}}$$

It is standard practice to deduce the values for 10sqm foundation with vertical stress of 10t/sqm.

**6.5. CALCULATION OF $(C_u)_{\text{Foundation}}$ & $(E_d)_{\text{Foundation}}$**

Weight of block = 2.059 t

Load at the base of foundation = $2.059 / (1.5 \times 0.75) = 1.83$ t/sqm

Zone of influence = B = 0.75m below the block.

Hence pressure intensity at B/2 = $(1.83 \times 1.50 \times 0.75) / ((1.50 + 0.375) \times (0.75 + 0.375))$
 $= 0.976$ t/sqm

Overburden of 0.375m (submerged) soil = 0.338 t/sqm

Project: Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana**Job No. : 3421****Sheet No.**

Hence total Pressure = $(0.976 + 0.338) = 1.314 \text{ t/sqm}$

Area of block = $1.5 \times 0.75 = 1.125 \text{ sqm}$

Hence $\sqrt{(A/P_v)_{\text{block}}} = \sqrt{(1.125/1.314)} = 0.925$

Let us consider one actual footing of base area = $10 \text{ sqm} = 3.162\text{m} \times 3.162\text{m}$

Vertical stress at centre of influence zone = 10 t/sqm (assumed)

Hence $\sqrt{(P_v/A)_{\text{foundation}}} = \sqrt{(10/10)} = 1$

Therefore, $(C_u)_{\text{foundation}} = (C_u)_{\text{block}} \times 1 \times 0.925 = 0.925 \times (C_u)_{\text{block}}$

The Young's modulus will vary as $E \propto \sqrt{P_v}$

Hence $E_{\text{foundation}} = E_{\text{block}} \times \sqrt{(10/1.314)} = 2.759 \times E_{\text{block}}$

The shear modulus will follow the same rule.

On the basis of the above, in Table – 3, the dynamic properties for 10 sqm foundation with vertical pressure intensity of 10 t/sqm is presented.

TABLE - 3: RECOMMENDED VALUES OF DYNAMIC PROPERTIES:-

Foundation size = 10 sqm , $P_v = 10 \text{ t/sqm}$

Test No	Eccentricity	Corrected C_u (kg/cu cm)	Corrected Modulus of Elasticity (Kg/sq cm) (E)	Corrected Shear Modulus (kg/sq cm) (G)	Damping constant (ξ)
BVT-01	8°	1.434	377.50	145.20	0.407
	16°	1.711	452.10	173.90	0.347
	24°	2.442	645.10	248.10	0.276
	36°	0.953	252.00	96.92	0.227
	Average	1.635	431.675	166.030	0.314
BVT-02	8°	1.314	357.30	142.90	0.605
	16°	1.610	437.80	175.10	0.386
	24°	2.840	772.80	309.10	0.249
	36°	2.766	751.50	300.60	0.372
	Average	2.132	579.85	231.93	0.403

Note: Following relations are to be used to calculate the coefficient of non uniform compression & shear.

Coefficient of elastic uniform shear, $C_\tau = 0.50C_u$

Co-efficient of elastic non-uniform compression = $3.46C_\tau$

Coefficient of elastic non-uniform shear = $1.50C_\tau$

Project: Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana**CETEST****Job No. : 3421****Sheet No.****7. CONCLUDING REMARKS:**

1. Two (2) nos. Routine Block Vibration Tests has been conducted on 1.50m x 0.75m x 0.70m block.
2. The observed natural frequencies for the test are already given in the preceding clause.
3. The computed C_u values for the test are already given. However, this is further presented below.

Test No	Eccentricity	Co-efficient of Uniform compression C_u (kg/cucm)	Dynamic Young's Modulus (kg/sqcm)	Shear Modulus (kg/sqcm (G))	Damping constant (ξ)
BVT-01	8°	1.55	136.81	52.62	0.407
	16°	1.85	163.85	63.02	0.347
	24°	2.64	233.8	89.92	0.276
	36°	1.03	91.33	35.13	0.227
	Average	1.77	156.45	60.17	0.314
BVT-02	8°	1.42	129.51	51.8	0.605
	16°	1.74	158.66	63.47	0.386
	24°	3.07	280.08	112.03	0.249
	36°	2.99	272.36	108.94	0.372
	Average	2.31	210.15	84.06	0.403

4. On the basis of experimental test results, dynamic values are recommended for a **10sqm footing** with an average vertical pressure intensity of **10t/sqm** are calculated and supplied in the previous clause. However, the corrected values are presented below.

Test No	Eccentricity	Corrected C_u (kg/cucm)	Corrected Modulus of Elasticity (Kg/sqcm) (E)	Corrected Shear Modulus (kg/sqcm) (G)	Damping constant (ξ)
BVT-01	8°	1.434	377.50	145.20	0.407
	16°	1.711	452.10	173.90	0.347
	24°	2.442	645.10	248.10	0.276
	36°	0.953	252.00	96.92	0.227
	Average	1.635	431.675	166.030	0.314
BVT-02	8°	1.314	357.30	142.90	0.605
	16°	1.610	437.80	175.10	0.386
	24°	2.840	772.80	309.10	0.249
	36°	2.766	751.50	300.60	0.372
	Average	2.132	579.85	231.93	0.403

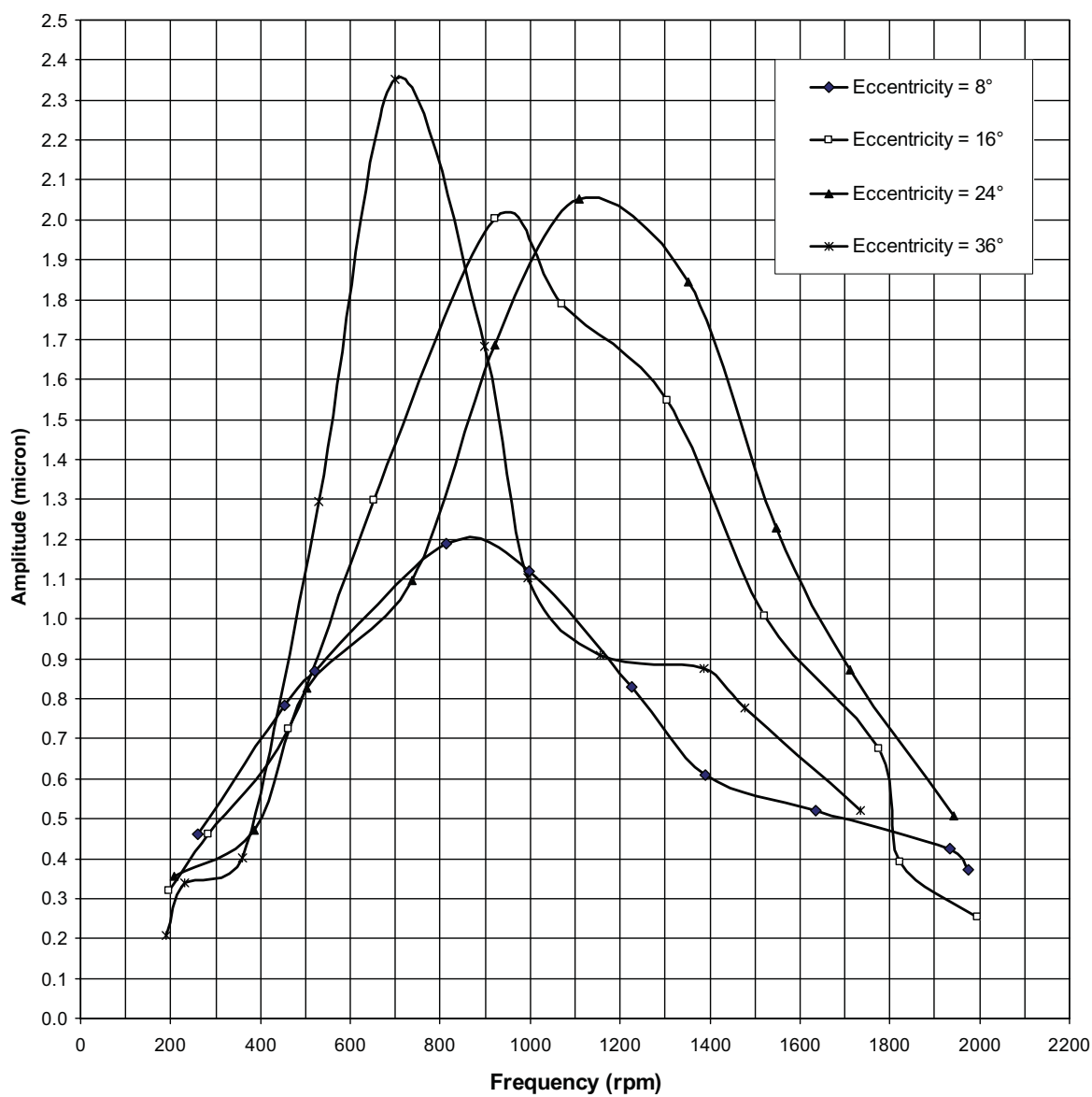
5. For different foundation size & vertical stress, the recommended dynamic properties should be computed by using the principles illustrated.

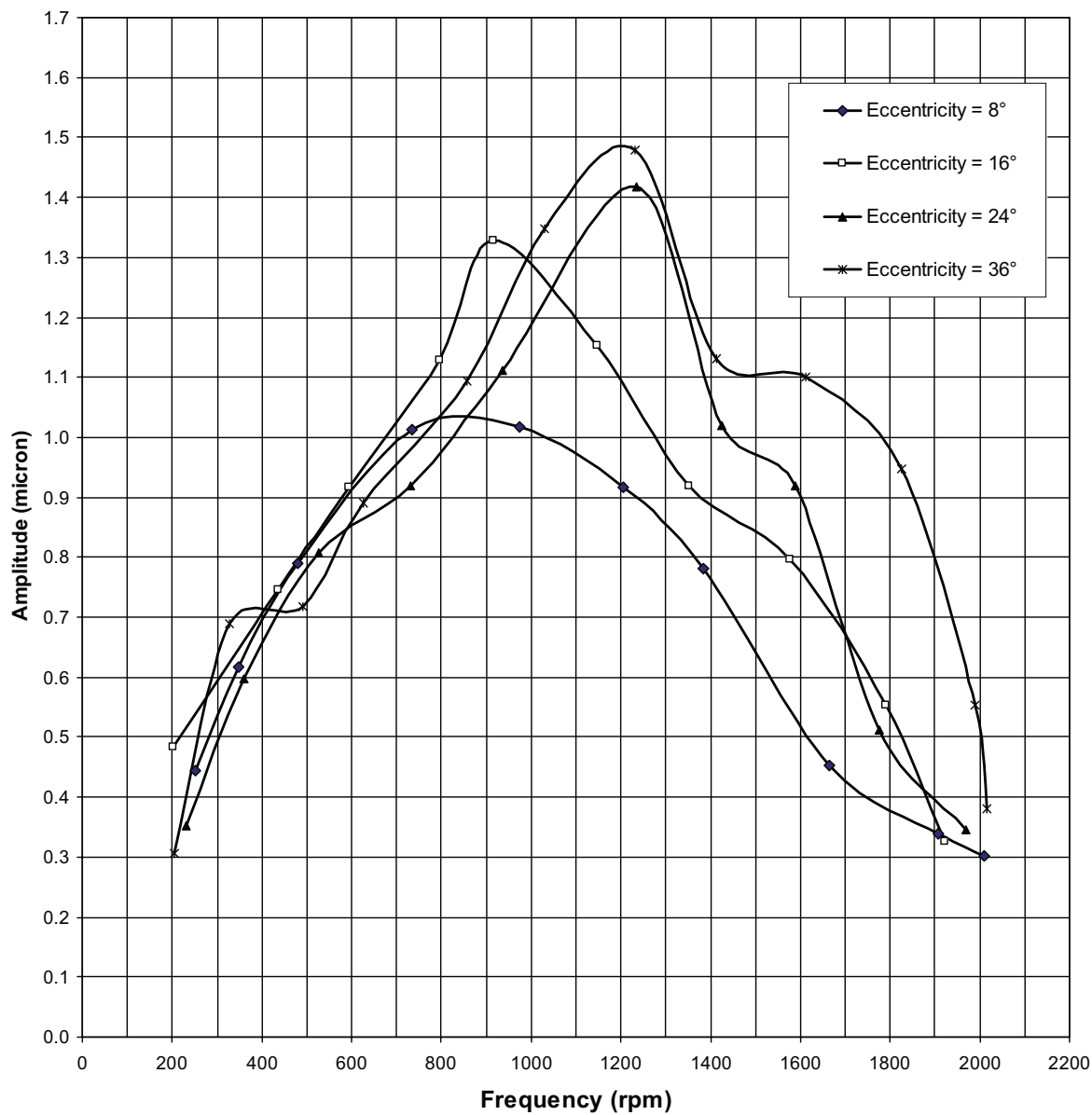
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CETEST

Job No. : 3421

Sheet No.

Vertical Block Vibration Test graphs for BVT-01

Vertical Block Vibration Test graphs for BVT-02

Job No: 3421

REPORT ON
GEOTECHNICAL INVESTIGATION WORK FOR
1 x 800MW KOTHAGUDAM THERMAL POWER STATION
STAGE VII, UNIT-12 AT KHAMMAM DISTRICT,
TELANGANA STATE

VOLUME 2
(Borelogs, Field & Laboratory Test Results, Graphs, Charts etc.)

Client:

M/s. Bharat Heavy Electricals Limited
Power Sector – Southern Region
690, Annasalai, Nandanam, Chennai - 600035

Foundation Consultants:

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April – 2015
(Revised in May'2015)

Project: Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana



Job No. : 3421

Sheet No.

PART I: ALL FIELD TESTS RESULTS



Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 04/04/2015 Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO. 1

Co-ordinates E=466078.000
N=1948555.000

Field Test	Nos	Samples	Nos	Commencement Date : 24/03/15
Penetrometer (SPT)	19	Undisturbed (UDS)	1	Completion Date : 25/03/15
Cone (Pc)		Penetrometer (SPT)	19	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 96.729 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 4.1 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
0.00m									
Filled up soil consists of light grey fly ash.								DS-1	0.50
1.00m									
Hard, light yellowish grey, silty clay. Obs. gravel & kankars.		5	5	6	8	10	11	SPT-1	1.00-1.45
2.00m									
Very dense, whitish grey, sandy silt. Obs moorum.								*UDS-1	2.00-2.10
2.70m								SPT-2	2.30-2.55
		11	19	35	50				
								*SPT-3	2.70-2.75 2.70
		56						R1	CR=NIL RQD=NIL
								*SPT-4	3.25-3.28 3.25
		52						R2	CR=11% RQD=NIL
								*SPT-5	4.00-4.05 4.00
		50						R3	CR=13% RQD=NIL
								*SPT-6	4.75-4.78 4.75
		50						R4	CR=11% RQD=NIL
								*SPT-7	5.50-5.55 5.50
		50						R5	CR=10% RQD=NIL
								*SPT-8	6.25-6.28 6.25
		51						R6	CR=NIL RQD=NIL
								*SPT-9	7.00-7.05 7.00
		50						R7	CR=NIL RQD=NIL
								*SPT-10	7.75-7.78 7.75
		52						R8	CR=NIL RQD=NIL
								*SPT-11	8.50-8.55 8.50
		50						R9	CR=NIL RQD=NIL
								*SPT-12	9.25-9.28 9.25
		50						R10	CR=12% RQD=NIL
9.25m									
Highly weathered, light yellowish grey, medium grained, highly fractured rock.									
10.00m									



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Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 04/04/2015 Sheet No:

BORE LOG DATA SHEET **BORE HOLE NO. 1** Co-ordinates E=466078.000 N=1948555.000

Field Test	Nos	Samples	Nos	Commencement Date : 24/03/15
Penetrometer (SPT)	19	Undisturbed (UDS)	1	Completion Date : 25/03/15
Cone (Pc)		Penetrometer (SPT)	19	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 96.729 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 4.1 m.

DESCRIPTION	SYMBOL	N-VALUE			SAMPLES	
		EACH DIVN. = 7.5cm.			Ref. No	Depth (m)
Highly weathered, light yellowish grey, medium grained, highly fractured rock.	10.00m	50	Refusal		*SPT-13	10.00-10.05 10.00
			5.0 cm Penth.		R11	CR=11% RQD=NIL
		51	Refusal		*SPT-14	10.75-10.77 10.75
			2.0 cm Penth.		R12	CR=13% RQD=NIL
		50	Refusal		*SPT-15	11.50-11.54 11.50
			4.0 cm Penth.		R13	CR=13% RQD=NIL
		50	Refusal		*SPT-16	12.25-12.30 12.25
			5.0 cm Penth.		R14	CR=10% RQD=NIL
		51	Refusal		*SPT-17	13.00-13.04 13.00
			4.0 cm Penth.		R15	CR=14% RQD=NIL
Highly weathered, light yellowish grey, medium grained, highly fractured rock.	14.50m	50	Refusal		*SPT-18	13.75-13.80 13.75
			5.0 cm Penth.		R16	CR=16% RQD=NIL
	15.00m	52	Refusal		*SPT-19	14.50-14.55 14.50
			5.0 cm Penth.		R17	CR=32% RQD=NIL

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



BH-1/Sheet-2

BH-2/Sheet-1



Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 04/04/2015 Sheet No:

BORE LOG DATA SHEET **BORE HOLE NO. 2** Co-ordinates E=466214.000
N=1948533.000

Field Test	Nos	Samples	Nos	Commencement Date : 27/03/15
Penetrometer (SPT)	8	Undisturbed (UDS)	1	Completion Date : 28/03/15
Cone (Pc)		Penetrometer (SPT)	8	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 95.001 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 3.8 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
10.00m								R11	CR=20% RQD=NIL
									10.50
								R12	CR=23% RQD=NIL
									11.25
Highly weathered, light grey, medium grained, moderately fractured rock.								R13	CR=21% RQD=NIL
									12.00
								R14	CR=24% RQD=NIL
									12.75
12.75m								R15	CR=33% RQD=NIL
									13.50
Highly weathered, light grey, medium grained, moderately fractured rock.								R16	CR=38% RQD=NIL
									14.25
14.25m								R17	CR=NIL RQD=NIL
									15.00
Completely weathered, light grey, medium grained, decomposed & disintegrated rock particle collected as sludge.									
15.00m									

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





Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 01/04/2015 Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO. 3

Co-ordinates E=466124.000
N=1948465.000

Field Test	Nos	Samples	Nos	Commencement Date : 22/03/15
Penetrometer (SPT)	17	Undisturbed (UDS)	1	Completion Date : 23/03/15
Cone (Pc)		Penetrometer (SPT)	17	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 97.23 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 3.7 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
0.00m									
Very stiff, light grey, silty clay with kankars.								DS-1	0.50
1.50m								SPT-1	1.00-1.45
Very dense, yellowish grey, sandy silt with decomposed rock.								*UDS-1	2.00-2.45
2.90m								SPT-2	2.50-2.75
								*SPT-3	2.90-2.95 2.90
								R1	CR=NIL RQD=NIL
								*SPT-4	3.50-3.55 3.50
								R2	CR=NIL RQD=NIL
								*SPT-5	4.25-4.27 4.25
								R3	CR=NIL RQD=NIL
								*SPT-6	5.00-5.04 5.00
								R4	CR=NIL RQD=NIL
								*SPT-7	5.75-5.78 5.75
								R5	CR=NIL RQD=NIL
								*SPT-8	6.50-6.55 6.50
								R6	CR=NIL RQD=NIL
								*SPT-9	7.25-7.27 7.25
								R7	CR=NIL RQD=NIL
								*SPT-10	8.00-8.05 8.00
								R8	CR=09% RQD=NIL
								*SPT-11	8.75-8.80 8.75
								R9	CR=10% RQD=NIL
								*SPT-12	9.50-9.54 9.50
								R10	CR=NIL RQD=NIL
10.00m									

BH-3/Sheet-1



Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 01/04/2015 Sheet No:

BORE LOG DATA SHEET **BORE HOLE NO. 3** Co-ordinates E=466124.000
N=1948465.000

Field Test	Nos	Samples	Nos	Commencement Date : 22/03/15
Penetrometer (SPT)	17	Undisturbed (UDS)	1	Completion Date : 23/03/15
Cone (Pc)		Penetrometer (SPT)	17	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 97.23 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 3.7 m.

DESCRIPTION	SYMBOL	N-VALUE				SAMPLES	
		EACH DIVN. = 7.5cm.				Ref. No	Depth (m)
10.00m							
Completely weathered, light grey, medium grained, decomposed & disintegrated particle collected as sludge.				Refusal		*SPT-13	10.25-10.28 10.25
		50		3.0 cm Penth.		R11	CR=NIL RQD=NIL
				Refusal		*SPT-14	11.00-11.03 11.00
		50		3.0 cm Penth.		R12	CR=NIL RQD=NIL
				Refusal		*SPT-15	11.75-11.80 11.75
		51		5.0 cm Penth.		R13	CR=14% RQD=NIL
				Refusal		*SPT-16	12.50-12.55 12.50
		50		5.0 cm Penth.		R14	CR=20% RQD=NIL
				Refusal		R15	CR=15% RQD=NIL
		50		5.0 cm Penth.		*SPT-17	14.00-14.05 14.00
				Refusal		R16	CR=21% RQD=NIL
11.75m							
Highly weathered, light grey to whitish grey, medium grained, highly fractured rock							
15.00m							

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





Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 01/04/2015 Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO. 4

Co-ordinates E=466077.000
N=1948318.000

Field Test	Nos	Samples	Nos	Commencement Date : 20/03/15
Penetrometer (SPT)	7	Undisturbed (UDS)	1	Completion Date : 21/03/15
Cone (Pc)		Penetrometer (SPT)	7	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 101.437 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 2.9 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
0.00m Top soil consists of light grey, silty clay with kankars. Obs. moorum.								DS-1	0.50
1.00m Very stiff, deep grey, silty clay with kankars.		4	4	5	5	25	7	SPT-1	1.00-1.45
2.40m Very dense, whitish grey, sandy silt with decomposed rock.		15	36	50		>100		*UDS-1	2.00-2.15
2.70m		58				5.0 cm Penth.		SPT-2	2.40-2.60
						Refusal		*SPT-3	2.70-2.75 2.70
						5.0 cm Penth.		R1	CR=NIL RQD=NIL
						Refusal		*SPT-4	3.50-3.55 3.50
						5.0 cm Penth.		R2	CR=NIL RQD=NIL
						Refusal		*SPT-5	4.25-4.28 4.25
						3.0 cm Penth.		R3	CR=NIL RQD=NIL
						Refusal		*SPT-6	5.00-5.04 5.00
						4.0 cm Penth.		R4	CR=20% RQD=NIL
						NX rotary drilling from 2.70m to 15.00m			5.75
						Refusal		R5	CR=17% RQD=NIL
						5.0 cm Penth.		*SPT-7	6.50-6.55 6.50
								R6	CR=20% RQD=NIL
									7.25
								R7	CR=21% RQD=NIL
									8.00
								R8	CR=23% RQD=NIL
									8.75
								R9	CR=24% RQD=NIL
									9.50
9.50m Highly weathered, light yellowish grey, medium to fine grained, highly fractured rock.								R10	CR=26% RQD=13%
10.00m									



Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 01/04/2015 Sheet No:

BORE LOG DATA SHEET **BORE HOLE NO. 4** Co-ordinates E=466077.000
N=1948318.000

Field Test	Nos	Samples	Nos	Commencement Date : 20/03/15
Penetrometer (SPT)	7	Undisturbed (UDS)	1	Completion Date : 21/03/15
Cone (Pc)		Penetrometer (SPT)	7	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 101.437 m.
		Water Sample (WS)	0	Water Struck At : Standing Water Level : 2.9 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
Highly weathered, light yellowish grey, medium to fine grained, highly fractured rock.	10.00m								10.25
								R11	CR=25% RQD=NIL
									11.00
								R12	CR=29% RQD=NIL
									11.75
								R13	CR=25% RQD=NIL
									12.50
								R14	CR=31% RQD=NIL
									13.25
								R15	CR=26% RQD=13%
									14.00
								R16	CR=39% RQD=NIL
									15.00
	15.00m								

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







Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. CETEST

Job No : 3421 Created by : Chandrani Created on : 20/03/2015 Sheet No:

BORE LOG DATA SHEET BORE HOLE NO. 5 Co-ordinates E=466971.000 N=1947336.000

Field Test	Nos	Samples	Nos	Commencement Date : 10/03/15
Penetrometer (SPT)	18	Undisturbed (UDS)	1	Completion Date : 12/03/15
Cone (Pc)		Penetrometer (SPT)	18	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 111.035 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 3.90 m.

DESCRIPTION	SYMBOL	N-VALUE				SAMPLES	
		EACH DIVN. = 7.5cm.				Ref. No	Depth (m)
10.50m Completely weathered, brownish grey, medium grained, decomposed & disintegrated rock particle collected as sludge.		50	Refusal			*SPT-14	10.75-10.80 10.75
			5.0 cm Pentn.			R12	CR=NIL RQD=NIL
		51	Refusal			*SPT-15	11.50-11.55 11.50
			5.0 cm Pentn.			R13	CR=NIL RQD=NIL
		50	Refusal			*SPT-16	12.25-12.28 12.25
			3.0 cm Pentn.			R14	CR=NIL RQD=NIL
10.75m Completely to highly weathered, light grey, medium grained, highly fractured rock. Obs. decomposed & disintegrated rock particle collected as sludge on R12, R13, R14 & R15.		50	Refusal			*SPT-17	13.00-13.04 13.00
			4.0 cm Pentn.			R15	CR=NIL RQD=NIL
		51	Refusal			*SPT-18	13.75-13.80 13.75
			5.0 cm Pentn.			R16	CR=25% RQD=NIL
14.50m Highly weathered, light grey, medium grained, highly fractured rock.						R17	CR=28% RQD=NIL
15.00m							14.50 15.00

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







Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. CETEST

Job No : 3421 Created by : Chandrani Created on : 21/03/2015 Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO. 6

Co-ordinates E=467447.000
N=1946847.000

Field Test	Nos	Samples	Nos	Commencement Date : 25/02/15
Penetrometer (SPT)	10	Undisturbed (UDS)	1	Completion Date : 26/02/15
Cone (Pc)		Penetrometer (SPT)	10	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 104.525 m.
		Water Sample (WS)	1	Water Struck At :
				Standing Water Level : 2.50 m.

DESCRIPTION	SYMBOL	N-VALUE					SAMPLES	
		EACH DIVN. = 7.5cm.					Ref. No	Depth (m)
10.00m		50					*SPT-10	10.00-10.0510.00
Highly weathered, light greenish grey, fine grained, highly fractured rock. Obs. decomposed & disintegrated rock sample collected as sludge on R8.							R9	CR=26% RQD=NIL
							R10	CR=22% RQD=NIL
							R11	CR=25% RQD=NIL
12.00m								10.75
Highly weathered, light brownish grey, fine grained, highly fractured rock.								11.50
12.25m								12.25
Highly weathered, light brownish grey, fine grained, highly to moderately fractured rock.							R12	CR=28% RQD=NIL
							R13	CR=31% RQD=NIL
13.75m								13.00
Highly weathered, light blackish grey, fine grained, medium fractured rock.							R14	CR=36% RQD=NIL
							R15	CR=39% RQD=NIL
15.00m								13.75
								14.50
								15.00

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





Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 09/03/2015 Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO. 7

Co-ordinates E=468177.000
N=1947093.000

Field Test	Nos	Samples	Nos	Commencement Date : 25/02/15
Penetrometer (SPT)	5	Undisturbed (UDS)	1	Completion Date : 27/02/15
Cone (Pc)		Penetrometer (SPT)	5	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 99.471 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 1.4 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
0.00m									
Very stiff, deep grey, silty clay with calcareous nodules, kankars.								DS-1	0.50
		3	5	6	7	28	8	SPT-1	1.00-1.45
2.00m									
Very dense, yellowish brown, silty sand with moorum & decomposed rock.								UDS-1	2.00-2.45
		4	4	30	50	>100		SPT-2	3.00-3.24
						1.5 cm Penth.			
3.80m		50				Refusal		*SPT-3	3.80-3.84 3.80
						4.0 cm Penth.		R1	CR=13% RQD=NIL
		50				Refusal		*SPT-4	4.50-4.53 4.50
						3.0 cm Penth.		R2	CR=NIL RQD=NIL
Completely to highly weathered, light greyish brown to whitish grey, highly to moderately fractured rock. Obs. decomposed & disintegrated rock particle collected as sludge on R2.		50				Refusal		*SPT-5	5.25-5.28 5.25
						3.0 cm Penth.		R3	CR=20% RQD=NIL
									6.00
								R4	CR=21% RQD=NIL
									6.75
								R5	CR=20% RQD=NIL
									7.50
7.50m								R6	CR=27% RQD=NIL
									8.25
								R7	CR=26% RQD=NIL
									9.00
								R8	CR=26% RQD=NIL
									9.75
								R9	CR=28% RQD=NIL
									10.50
10.50m									

NX rotary drilling from 3.80m to 20.00m



BH-7/Sheet-1



Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. CETEST

Job No : 3421 Created by : Chandrani Created on : 09/03/2015 Sheet No:

BORE LOG DATA SHEET BORE HOLE NO. 7 Co-ordinates E=468177.000 N=1947093.000

Field Test	Nos	Samples	Nos	Commencement Date : 25/02/15
Penetrometer (SPT)	5	Undisturbed (UDS)	1	Completion Date : 27/02/15
Cone (Pc)		Penetrometer (SPT)	5	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 99.471 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 1.4 m.

DESCRIPTION	SYMBOL	N-VALUE							SAMPLES	
		EACH DIVN. = 7.5cm.							Ref. No	Depth (m)
Highly weathered, light greyish brown to whitish grey, highly to moderately fractured rock.	10.50m								R10	CR=31% RQD=NIL
	11.25m								R11	CR=33% RQD=NIL
									R12	CR=35% RQD=NIL
									R13	CR=38% RQD=NIL
Highly to moderately weathered, light brownish grey, medium to fine grained, fractured rock.									R14	CR=45% RQD=NIL
									R15	CR=29% RQD=NIL
	15.00m								R16	CR=55% RQD=NIL
									R17	CR=61% RQD=NIL
Moderately weathered, light brownish grey, medium to fine grained, fractured rock.									R18	CR=55% RQD=NIL
	17.25m								R19	CR=73% RQD=36%
									R20	CR=75% RQD=50%
Moderately weathered, light grey, medium grained, moderately fractured rock.									R21	CR=69% RQD=16%
	20.00m								R22	CR=54% RQD=NIL
N.B. - '*' means sample could not be recovered.										




Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. CETEST
Job No : 3421 Created by : Chandrani Created on : 21/03/2015 Sheet No:
BORE LOG DATA SHEET BORE HOLE NO. 8 Co-ordinates E=467691.000 N=1946774.000

Field Test	Nos	Samples	Nos	Commencement Date : 27/02/15
Penetrometer (SPT)	9	Undisturbed (UDS)	1	Completion Date : 28/02/15
Cone (Pc)		Penetrometer (SPT)	9	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 104.524 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 2.7 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
0.00m Deep grey. silty clay. Obs. calcareous nodules.								DS-1	0.50
1.00m Hard, yellowish brown, silty clay with calcareous nodules.		2	3	7	9	34	8	SPT-1	1.00-1.45
2.45m Very dense, brownish grey, silty sand with decomposed rock.								UDS-1	2.00-2.45
3.90m		12	15	17	20	31	42	SPT-2	3.00-3.45
								SPT-3	3.80-3.90
		57	50					R1	3.90
								*SPT-4	4.50
								R2	4.50
								*SPT-5	5.25
								R3	5.25
								*SPT-6	6.00
								R4	6.00
								*SPT-7	6.75
								R5	6.75
								*SPT-8	7.50
								R6	7.50
								*SPT-9	8.25
								R7	8.25
8.25m Highly weathered, light grey, medium grained, highly fractured rock.								R8	9.00
									9.75
10.00m Highly to moderately weathered, yellowish brown, medium grained, highly fractured rock.									

NX rotary drilling from 3.90m to 15.00m



Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 21/03/2015 Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO. 8

Co-ordinates E=467691.000
N=1946774.000

Field Test	Nos	Samples	Nos	Commencement Date : 27/02/15
Penetrometer (SPT)	9	Undisturbed (UDS)	1	Completion Date : 28/02/15
Cone (Pc)		Penetrometer (SPT)	9	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 104.524 m.
		Water Sample (WS)	0	Water Struck At : Standing Water Level : 2.7 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
Highly to moderately weathered, yellowish brown, medium grained, highly fractured rock.	10.00m							R9	CR=43% RQD=NIL
								R10	CR=49% RQD=NIL
								R11	CR=40% RQD=NIL
								R12	CR=36% RQD=18%
								R13	CR=37% RQD=NIL
								R14	CR=33% RQD=NIL
								R15	CR=43% RQD=NIL
	15.00m								

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



BH-9/Sheet-1



Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 12/03/2015 Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO. 9

Co-ordinates E=467619.000
N=1946868.000

Field Test	Nos	Samples	Nos	Commencement Date : 27/02/15
Penetrometer (SPT)	21	Undisturbed (UDS)	1	Completion Date : 28/02/15
Cone (Pc)		Penetrometer (SPT)	21	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 103.827 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 2.4 m.

DESCRIPTION	SYMBOL	N-VALUE				SAMPLES	
		EACH DIVN. = 7.5cm.				Ref. No	Depth (m)
10.50m						R9	CR=NIL RQD=NIL
						*SPT-11	11.00-11.0411.00
						R10	CR=NIL RQD=NIL
						*SPT-12	11.75-11.7811.75
						R11	CR=NIL RQD=NIL
						*SPT-13	12.50-12.5412.50
						R12	CR=NIL RQD=NIL
						*SPT-14	13.25-13.2813.25
						R13	CR=NIL RQD=NIL
						*SPT-15	14.00-14.0414.00
						R14	CR=NIL RQD=NIL
						*SPT-16	14.75-14.7814.75
						R15	CR=NIL RQD=NIL
						*SPT-17	15.50-15.5515.50
						R16	CR=NIL RQD=NIL
						*SPT-18	16.25-16.2916.25
						R17	CR=NIL RQD=NIL
						SPT-19	17.00-17.0217.00
						R18	CR=NIL RQD=NIL
						*SPT-20	17.75-17.7717.75
						R19	CR=NIL RQD=NIL
						*SPT-21	18.50-18.5518.50
						R20	CR=20% RQD=NIL
							19.25
						R21	CR=21% RQD=NIL
							20.00
18.50m							
20.00m							

Completely weathered, light grey, medium grained, decomposed & disintegrated rock particle collected as sludge.

Highly weathered, light grey, medium grained, highly fractured rock.

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





Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 09/03/2015 Sheet No:

BORE LOG DATA SHEET **BORE HOLE NO. 10** Co-ordinates E=467684.000
N=1946885.000

Field Test	Nos	Samples	Nos	Commencement Date : 27/02/15
Penetrometer (SPT)	10	Undisturbed (UDS)	1	Completion Date : 01/03/15
Cone (Pc)		Penetrometer (SPT)	10	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 103.259 m.
		Water Sample (WS)	1	Water Struck At :
				Standing Water Level : 2.9 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
0.00m									
Hard, deep grey, silty clay with calcareous nodules. Obs. kankars.								DS-1	0.50
		3	5	7	7	35	9	SPT-1	1.00-1.45
2.00m									
Hard, brownish grey, silty clay with kankars & decomposed rock.						69		UDS-1	2.00-2.45
		10	12	14	16	18	21	WS-1	2.90
								SPT-2	3.00-3.45
						>100			
4.00m		39	50			2.5 cm Pentn.		SPT-3	3.80-3.90
Completely weathered, brownish grey, medium grained, decomposed & disintegrated rock particle collected as sludge.		50				Refusal		*SPT-4	4.00-4.04 4.00
						4.0 cm Pentn.		R1	CR=NIL RQD=NIL
						Refusal		*SPT-5	4.75-4.78 4.75
		50				3.0 cm Pentn.		R2	CR=NIL RQD=NIL
						Refusal		*SPT-6	5.50-5.54 5.50
		50				4.0 cm Pentn.		R3	CR=NIL RQD=NIL
						Refusal		*SPT-7	6.25-6.28 6.25
		50				3.0 cm Pentn.		R4	CR=NIL RQD=NIL
						Refusal		*SPT-8	7.00-7.04 7.00
		50				4.0 cm Pentn.		R5	CR=NIL RQD=NIL
						Refusal		*SPT-9	7.75-7.79 7.75
8.50m		50				4.0 cm Pentn.		R6	CR=NIL RQD=NIL
Highly weathered, light brownish grey, medium grained, highly fractured rock.						Refusal		*SPT-10	8.50-8.54 8.50
						4.0 cm Pentn.		R7	CR=20% RQD=NIL
						NX rotary drilling from 4.00m to 20.00m			9.25
								R8	CR=25% RQD=NIL
10.00m									10.00
Highly weathered, light brownish grey, medium grained, highly fractured rock.								R9	CR=37% RQD=NIL
10.50m									





Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 09/03/2015 Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO. 10

Co-ordinates E=467684.000
N=1946885.000

Field Test	Nos	Samples	Nos	Commencement Date : 27/02/15
Penetrometer (SPT)	10	Undisturbed (UDS)	1	Completion Date : 01/03/15
Cone (Pc)		Penetrometer (SPT)	10	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 103.259 m.
		Water Sample (WS)	1	Water Struck At : Standing Water Level : 2.9 m.

DESCRIPTION	SYMBOL	N-VALUE							SAMPLES	
		EACH DIVN. = 7.5cm.							Ref. No	Depth (m)
10.50m										10.75
Highly weathered, light brownish grey, medium grained, highly fractured rock.									R10	CR=32% RQD=NIL
										11.50
									R11	CR=30% RQD=NIL
										12.25
									R12	CR=58% RQD=13%
										13.00
									R13	CR=61% RQD=15%
										13.75
									R14	CR=56% RQD=15%
										14.50
Moderately weathered, light brownish grey, medium grained, fractured rock.									R15	CR=51% RQD=NIL
										15.25
									R16	CR=75% RQD=26%
										16.00
									R17	CR=52% RQD=NIL
										16.75
									R18	CR=60% RQD=44%
										17.50
									R19	CR=74% RQD=44%
										18.25
Moderately weathered, light grey, medium grained, fractured rock.									R20	CR=73% RQD=32%
										19.00
									R21	CR=50% RQD=43%
20.00m										20.00

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





Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 20/03/2015 Sheet No:

BORE LOG DATA SHEET **BORE HOLE NO. 11** Co-ordinates E=467771.000 N=1946791.000

Field Test	Nos	Samples	Nos	Commencement Date : 01/03/15
Penetrometer (SPT)	16	Undisturbed (UDS)	1	Completion Date : 03/03/15
Cone (Pc)		Penetrometer (SPT)	16	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 103.09 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 2.8 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
10.50m								R10	CR=26% RQD=NIL
									11.00
								R11	CR=27% RQD=NIL
									11.75
Highly weathered, yellowish brown, medium grained, highly to moderately fractured rock.								R12	CR=26% RQD=NIL
									12.50
								R13	CR=28% RQD=NIL
									13.25
								R14	CR=27% RQD=NIL
									14.00
14.00m								R15	CR=26% RQD=NIL
									14.75
Highly weathered, light grey, medium grained, highly fractured rock.								R16	CR=28% RQD=NIL
									15.50
15.50m								R17	CR=NIL RQD=NIL
								*SPT-12	16.25-16.27
									16.25
								R18	CR=NIL RQD=NIL
								*SPT-13	17.00-17.02
									17.00
								R19	CR=NIL RQD=NIL
								*SPT-14	17.75-17.78
									17.75
								R20	CR=NIL RQD=NIL
								*SPT-15	18.50-18.52
									18.50
18.50m								R21	CR=17% RQD=NIL
								*SPT-16	19.25-19.27
									19.25
Highly weathered, medium grained, highly fractured rock.								R22	CR=20% RQD=NIL
20.00m									20.00

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





Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 21/03/2015 Sheet No:

BORE LOG DATA SHEET **BORE HOLE NO. 12** Co-ordinates E=467829.000 N=1946751.000

Field Test	Nos	Samples	Nos	Commencement Date : 27/02/15
Penetrometer (SPT)	8	Undisturbed (UDS)	1	Completion Date : 01/03/15
Cone (Pc)		Penetrometer (SPT)	8	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 102.188 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 2.4 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
0.00m									
Very stiff, deep grey, silty clay with kankars.								DS-1	0.50
		2	3	4	5	23	7	SPT-1	1.00-1.45
2.00m								UDS-1	2.00-2.45
Very dense, yellowish brown, silty sand with calcareous nodules & decomposed rock.									
		9	11	18	25	>100	38	SPT-2	3.00-3.45
3.90m		42	50			>100		SPT-3	3.80-3.90
Completely to highly weathered, light grey, medium grained, highly fractured rock. Obs. decomposed & disintegrated rock particle collected as sludge on R1, R2, R4 & R5.						2.5 cm Penth.		R1	CR=NIL RQD=NIL
						Refusal		*SPT-4	4.50-4.53
		50				3.0 cm Penth.		R2	CR=NIL RQD=NIL
						Refusal		*SPT-5	5.25-5.27
		50				2.0 cm Penth.		R3	CR=NIL RQD=NIL
						Refusal		*SPT-6	6.00-6.03
		50				3.0 cm Penth.		R4	CR=NIL RQD=NIL
						Refusal		*SPT-7	6.75-6.78
		50				3.0 cm Penth.		R5	CR=NIL RQD=NIL
						Refusal		*SPT-8	7.50-7.52
7.50m		50				2.0 cm Penth.		R6	CR=20% RQD=NIL
Completely to highly weathered, light grey, medium grained, moderately fractured rock.									
								R7	CR=23% RQD=NIL
								R8	CR=23% RQD=NIL
10.00m									

NX rotary drilling from 3.90m to 15.00m



Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 21/03/2015 Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO. 12

Co-ordinates E=467829.000
N=1946751.000

Field Test	Nos	Samples	Nos	Commencement Date : 27/02/15
Penetrometer (SPT)	8	Undisturbed (UDS)	1	Completion Date : 01/03/15
Cone (Pc)		Penetrometer (SPT)	8	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 102.188 m.
		Water Sample (WS)	0	Water Struck At : Standing Water Level : 2.4 m.

DESCRIPTION	SYMBOL	N-VALUE							SAMPLES	
		EACH DIVN. = 7.5cm.							Ref. No	Depth (m)
10.00m									R9	CR=24% RQD=NIL
Completely to highly weathered, light grey, medium grained, moderately fractured rock.									R10	CR=23% RQD=NIL
									R11	CR=24% RQD=NIL
									R12	CR=26% RQD=NIL
									R13	CR=25% RQD=NIL
12.00m									R14	CR=27% RQD=NIL
Highly weathered, light grey, medium grained, moderately fractured rock.									R15	CR=29% RQD=NIL
15.00m										

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





Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 09/03/2015 Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO. 13

Co-ordinates E=467708.000
N=1946969.000

Field Test	Nos	Samples	Nos	Commencement Date : 23/02/15
Penetrometer (SPT)	11	Undisturbed (UDS)	1	Completion Date : 26/02/15
Cone (Pc)		Penetrometer (SPT)	11	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 102.072 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 3.2 m.

DESCRIPTION	SYMBOL	N-VALUE					SAMPLES	
		EACH DIVN. = 7.5cm.					Ref. No	Depth (m)
Top soil consists of deep grey, silty clay with kankars.	0.00m 0.40m						DS-1	0.50
Very stiff, yellowish brown, silty clay. Obs. calcareous nodules.		5	7	5	4	18 4 5	SPT-1	1.00-1.45
							UDS-1	2.00-2.45
Very dense, brownish grey to whitish grey, clayey sandy silt with calcareous nodules.	3.00m	4	8	25	31	50 5.0 cm Penth.	SPT-2	3.00-3.35
						50 5.0 cm Penth.	SPT-3	4.00-4.20
Completely weathered, light brownish grey, medium grained, decomposed & disintegrated rock particle collected as sludge.	4.20m	25	30	50		50 5.0 cm Penth.	R1	4.20 CR=NIL RQD=NIL
						Refusal	*SPT-4	5.00-5.05 5.00
		50				5.0 cm Penth.	R2	CR=NIL RQD=NIL
						Refusal	*SPT-5	5.75-5.79 5.75
		50				4.0 cm Penth.	R3	CR=NIL RQD=NIL
						Refusal	*SPT-6	6.50-6.55 6.50
		50				5.0 cm Penth.	R4	CR=NIL RQD=NIL
						Refusal	*SPT-7	7.25-7.28 7.25
		50				3.0 cm Penth.	R5	CR=NIL RQD=NIL
						Refusal	*SPT-8	8.00-8.04 8.00
Completely to highly weathered, light brownish grey, medium grained, highly fractured rock with mica.	8.00m	50				4.0 cm Penth.	R6	CR=NIL RQD=NIL
						Refusal	*SPT-9	8.75-8.78 8.75
		50				3.0 cm Penth.	R7	CR=19% RQD=NIL
						Refusal	*SPT-10	9.50-9.55 9.50
		50				5.0 cm Penth.	R8	CR=16% RQD=NIL
						Refusal	*SPT-11	10.25-10.27 10.25
		50				2.0 cm Penth.	R9	CR=20% RQD=NIL
							R10	CR=21% RQD=NIL
							R11	CR=22% RQD=NIL
								11.00
								11.75
								12.50

NX rotary drilling from 4.20m to 25.00m


Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. CETEST
Job No : 3421 Created by : Chandrani Created on : 09/03/2015 Sheet No:
BORE LOG DATA SHEET BORE HOLE NO. 13 Co-ordinates E=467708.000 N=1946969.000

Field Test	Nos	Samples	Nos	Commencement Date : 23/02/15
Penetrometer (SPT)	11	Undisturbed (UDS)	1	Completion Date : 26/02/15
Cone (Pc)		Penetrometer (SPT)	11	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 102.072 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 3.2 m.

DESCRIPTION	SYMBOL	N-VALUE							SAMPLES	
		EACH DIVN. = 7.5cm.							Ref. No	Depth (m)
12.75m									R12	CR=20% RQD=NIL
Completely to highly weatherd, light brownish grey, medium grained, highly fractured rock with mica.									R13	CR=24% RQD=NIL
									R14	CR=25% RQD=NIL
									R15	CR=28% RQD=NIL
14.75m									R16	CR=26% RQD=NIL
Highly weathered, light grey, medium grained, highly fractured rock with mica.									R17	CR=29% RQD=NIL
									R18	CR=23% RQD=NIL
									R19	CR=21% RQD=NIL
17.00m									R20	CR=26% RQD=NIL
Highly weathered, light grey, medium grained, highly fractured rock with mica.									R21	CR=33% RQD=NIL
									R22	CR=43% RQD=NIL
									R23	CR=37% RQD=NIL
18.50m									R24	CR=62% RQD=NIL
Highly to moderately weathered, light grey with blackish patches, medium grained, highly fractured rock.									R25	CR=56% RQD=NIL
									R26	CR=52% RQD=NIL
									R27	CR=66% RQD=NIL
21.50m									R28	CR=75% RQD=NIL
Moderately weathered, light grey with blackish patches, medium grained, highly fractured rock.										23.00
										23.75
										24.50
25.00m										25.00

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





Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 20/03/2015 Sheet No:

BORE LOG DATA SHEET **BORE HOLE NO. 14** Co-ordinates E=467813.000 N=1946821.000

Field Test	Nos	Samples	Nos	Commencement Date : 03/03/15
Penetrometer (SPT)	14	Undisturbed (UDS)	0	Completion Date : 05/03/15
Cone (Pc)		Penetrometer (SPT)	14	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 101.792 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 2.8 m.

DESCRIPTION	SYMBOL	N-VALUE					SAMPLES	
		EACH DIVN. = 7.5cm.					Ref. No	Depth (m)
0.00m								
Hard, deep grey, silty clay with calcareous nodules & decomposed rock.		8	9	17	29	50	DS-1	0.50
		5.0	cm	Penth.			SPT-1	1.00-1.35
1.60m		49	50				SPT-2	1.50-1.60
							R1	CR=16% RQD=NIL
		52					*SPT-3	2.00-2.02
							R2	CR=15% RQD=NIL
		50					*SPT-4	2.75-2.78
							R3	CR=17% RQD=NIL
		52					*SPT-5	3.50-3.52
							R4	CR=12% RQD=NIL
		50					*SPT-6	4.25-4.27
							R5	CR=13% RQD=NIL
		50					*SPT-7	5.00-5.03
							R6	CR=21% RQD=NIL
6.50m								5.75
							R7	CR=20% RQD=NIL
								6.50
							R8	CR=22% RQD=NIL
								7.25
							R9	CR=23% RQD=NIL
								8.00
							R10	CR=15% RQD=NIL
		50					*SPT-8	8.75-8.77
							R11	CR=14% RQD=NIL
9.50m		52					*SPT-9	9.50-9.53
							R12	CR=NIL RQD=NIL
		50					*SPT-10	10.25-10.27
10.50m								10.25



BH-14/Sheet-1



Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 20/03/2015 Sheet No:

BORE LOG DATA SHEET **BORE HOLE NO. 14** Co-ordinates E=467813.000 N=1946821.000

Field Test	Nos	Samples	Nos	Commencement Date : 03/03/15
Penetrometer (SPT)	14	Undisturbed (UDS)	0	Completion Date : 05/03/15
Cone (Pc)		Penetrometer (SPT)	14	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 101.792 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 2.8 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
10.50m								R13	CR=NIL RQD=NIL
Completely weathered, light grey, medium grained, decomposed & disintegrated rock particle collected as sludge.		50	3.0 cm	Penth.				*SPT-11	11.00-11.03 11.00
								R14	CR=NIL RQD=NIL
		52	2.0 cm	Penth.				*SPT-12	11.75-11.77 11.75
								R15	CR=NIL RQD=NIL
12.50m		52	3.0 cm	Penth.				*SPT-13	12.50-12.53 12.50
Highly weathered, yellowish brown, medium grained, moderately fractured rock.								R16	CR=11% RQD=NIL
		50	2.0 cm	Penth.				*SPT-14	13.25-13.27 13.25
								R17	CR=25% RQD=NIL
								R18	CR=26% RQD=NIL
14.00m									14.00
Highly weathered, yellowish brown, medium grained, moderately fractured rock.									14.75
								R19	CR=26% RQD=NIL
									15.50
								R20	CR=27% RQD=NIL
									16.25
								R21	CR=28% RQD=NIL
									17.00
								R22	CR=27% RQD=NIL
17.75m									17.75
Highly weathered, light grey, medium grained, moderately fractured rock.								R23	CR=28% RQD=NIL
									18.50
								R24	CR=26% RQD=NIL
									19.25
20.00m								R25	CR=28% RQD=NIL
									20.00

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





Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 12/03/2015 Sheet No:

BORE LOG DATA SHEET **BORE HOLE NO. 15** Co-ordinates E=467870.000 N=1946749.000

Field Test	Nos	Samples	Nos	Commencement Date : 01/03/15
Penetrometer (SPT)	13	Undisturbed (UDS)	1	Completion Date : 03/03/15
Cone (Pc)		Penetrometer (SPT)	13	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 101.976 m.
		Water Sample (WS)	1	Water Struck At :
				Standing Water Level : 3.0 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
0.00m									
Very stiff, deep grey, silty clay with kankars & boulder.								DS-1	0.50
		4	5	6	7	28	8	SPT-1	1.00-1.45
1.50m									
Very dense, yellowish brown, silty sand with decomposed rock.								*UDS-1	2.00-2.10
		34	44	50		>100		SPT-2	2.50-2.70
						5.0 cm Penth.			
2.80m		50				Refusal		*SPT-3	2.80-2.84 2.80
						4.0 cm Penth.		R1	CR=NIL
						Refusal		WS-1	RQD=NIL 3.00
		50						*SPT-4	3.50-3.53 3.50
						3.0 cm Penth.		R2	CR=NIL
						Refusal			RQD=NIL
		50						*SPT-5	4.25-4.28 4.25
						3.0 cm Penth.		R3	CR=NIL
						Refusal			RQD=NIL
		52						*SPT-6	5.00-5.02 5.00
						2.0 cm Penth.		R4	CR=NIL
						Refusal			RQD=NIL
		52						*SPT-7	5.75-5.77 5.75
Completely to highly weathered, light grey, medium grained, highly fractured rock.						2.0 cm Penth.		R5	CR=21% RQD=NIL
									6.50
								R6	CR=20% RQD=NIL
									7.25
								R7	CR=22% RQD=NIL
									8.00
								R8	CR=20% RQD=NIL
									8.75
								R9	CR=16% RQD=NIL
						Refusal			
9.50m		52						*SPT-8	9.50-9.52 9.50
Completely weathered, yellowish brown, medium grained, decomposed & disintegrated rock particle collected as sludge.						2.0 cm Penth.		R10	CR=NIL
						Refusal			RQD=NIL
		50						*SPT-9	10.25-10.28 10.25
10.50m						3.0 cm Penth.			

NX rotary drilling from 2.80m to 20.00m



Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 12/03/2015 Sheet No:

BORE LOG DATA SHEET **BORE HOLE NO. 15** Co-ordinates E=467870.000
N=1946749.000

Field Test	Nos	Samples	Nos	Commencement Date : 01/03/15
Penetrometer (SPT)	13	Undisturbed (UDS)	1	Completion Date : 03/03/15
Cone (Pc)		Penetrometer (SPT)	13	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 101.976 m.
		Water Sample (WS)	1	Water Struck At :
				Standing Water Level : 3.0 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
10.50m								R11	CR=NIL RQD=NIL
								*SPT-10	11.00-11.02 11.00
		50						R12	CR=NIL RQD=NIL
								*SPT-11	11.75-11.78 11.75
Completely weathered, yellowish brown, medium grained, decomposed & disintegrated rock particle collected as sludge.		50						R13	CR=NIL RQD=NIL
								*SPT-12	12.50-12.52 12.50
		50						R14	CR=NIL RQD=NIL
								*SPT-13	13.25-13.28 13.25
13.25m		52						R15	CR=21% RQD=NIL
									14.00
Highly weathered, light grey, medium grained, moderately fractured rock.								R16	CR=23% RQD=NIL
									14.75
								R17	CR=25% RQD=NIL
									15.50
15.50m								R18	CR=27% RQD=NIL
									16.25
								R19	CR=26% RQD=NIL
									17.00
								R20	CR=28% RQD=NIL
									17.75
Highly weathered, light grey, medium grained, moderately fractured rock								R21	CR=25% RQD=NIL
									18.50
								R22	CR=30% RQD=NIL
									19.25
								R23	CR=35% RQD=NIL
20.00m									20.00 20.00

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





Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 20/03/2015 Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO. 16

Co-ordinates E=467913.000
N=1946720.000

Field Test	Nos	Samples	Nos	Commencement Date : 04/03/15
Penetrometer (SPT)	13	Undisturbed (UDS)	1	Completion Date : 05/03/15
Cone (Pc)		Penetrometer (SPT)	13	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 103.49 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 3.0 m.

DESCRIPTION	SYMBOL	N-VALUE					SAMPLES	
		EACH DIVN. = 7.5cm.					Ref. No	Depth (m)
0.00m		NX rotary drilling from 3.00m to 15.00m					DS-1	0.50
Hard, deep grey, silty clay with kankars & calcareous nodules.		4	3	7	6	38	SPT-1	1.00-1.45
2.00m		44	50			>100	*UDS-1	2.00-2.15
Very dense, yellowish brown, silty sand with decomposed rock.		50				2.5 cm Pentn. Refusal	SPT-2	2.80-2.90
3.00m		50				4.0 cm Pentn. Refusal	*SPT-3	3.00-3.04 3.00
		50				3.0 cm Pentn. Refusal	R1	CR=NIL RQD=NIL
		50				3.0 cm Pentn. Refusal	*SPT-4	3.75-3.78 3.75
		50				3.0 cm Pentn. Refusal	R2	CR=NIL RQD=NIL
		50				3.0 cm Pentn. Refusal	*SPT-5	4.50-4.53 4.50
		50				2.0 cm Pentn. Refusal	R3	CR=NIL RQD=NIL
Completely weathered, yellowish brown, medium grained, decomposed & disintegrated rock particle collected as sludge.		50				2.0 cm Pentn. Refusal	*SPT-6	5.25-5.27 5.25
		50				3.0 cm Pentn. Refusal	R4	CR=18% RQD=NIL
		50				3.0 cm Pentn. Refusal	*SPT-7	6.00-6.03 6.00
		50				2.0 cm Pentn. Refusal	R5	CR=NIL RQD=NIL
		50				2.0 cm Pentn. Refusal	*SPT-8	6.75-6.77 6.75
		50				3.0 cm Pentn. Refusal	R6	CR=NIL RQD=NIL
		50				3.0 cm Pentn. Refusal	*SPT-9	7.50-7.53 7.50
		50				2.0 cm Pentn. Refusal	R7	CR=NIL RQD=NIL
8.25m		50				2.0 cm Pentn. Refusal	*SPT-10	8.25-8.27 8.25
Highly weathered, whitish grey, medium grained, highly to moderately fractured rock.		50				3.0 cm Pentn. Refusal	R8	CR=17% RQD=NIL
		50				3.0 cm Pentn. Refusal	*SPT-11	9.00-9.03 9.00
		52				2.0 cm Pentn.	R9	CR=16% RQD=NIL
10.00m							*SPT-12	9.75-9.77 9.75



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Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 20/03/2015 Sheet No:

BORE LOG DATA SHEET **BORE HOLE NO. 16** Co-ordinates E=467913.000
N=1946720.000

Field Test	Nos	Samples	Nos	Commencement Date : 04/03/15
Penetrometer (SPT)	13	Undisturbed (UDS)	1	Completion Date : 05/03/15
Cone (Pc)		Penetrometer (SPT)	13	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 103.49 m.
		Water Sample (WS)	0	Water Struck At : Standing Water Level : 3.0 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
10.00m								R10	CR=18% RQD=NIL
								*SPT-13	10.50-10.52 10.50
Highly weathered, whitish grey, medium grained, highly to moderately fractured rock.								R11	CR=21% RQD=NIL
								R12	CR=20% RQD=NIL
								R13	CR=21% RQD=NIL
12.00m								R14	CR=24% RQD=NIL
								R15	CR=23% RQD=NIL
Highly weathered, medium grained, moderately fractured rock.								R16	CR=22% RQD=NIL
15.00m									

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





Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 09/03/2015 Sheet No:

BORE LOG DATA SHEET **BORE HOLE NO. 17** Co-ordinates E=467790.000 N=1946938.000

Field Test	Nos	Samples	Nos	Commencement Date : 23/02/15
Penetrometer (SPT)	20	Undisturbed (UDS)	1	Completion Date : 24/02/15
Cone (Pc)		Penetrometer (SPT)	20	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 102.037 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 3.1 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
0.00m		NX rotary drilling from 4.40m to 20.00m						DS-1	0.50
Very stiff, deep grey, silty clay with calcareous nodules.		2	3	3	4	17	3	SPT-1	1.00-1.45
2.00m								UDS-1	2.00-2.45
Brownish grey, silty clay with kankars.									
3.00m		4	8	12	15	64	20	SPT-2	3.00-3.45
Very dense, light yellowish brown, clayey silty sand.		12	30	37	50	>100		SPT-3	4.00-4.25
4.40m		50				2.5 cm Penth.		*SPT-4	4.40-4.45
		50				Refusal		R1	CR=NIL RQD=NIL
		50				5.0 cm Penth.		*SPT-5	5.00-5.04
		50				Refusal		R2	CR=NIL RQD=NIL
		50				4.0 cm Penth.		*SPT-6	5.75-5.78
		50				Refusal		R3	CR=NIL RQD=NIL
		50				3.0 cm Penth.		*SPT-7	6.50-6.55
		50				Refusal		R4	CR=NIL RQD=NIL
		50				5.0 cm Penth.		*SPT-8	7.25-7.29
		50				Refusal		R5	CR=NIL RQD=NIL
		50				4.0 cm Penth.		*SPT-9	8.00-8.05
		50				Refusal		R6	CR=NIL RQD=NIL
		50				5.0 cm Penth.		*SPT-10	8.75-8.79
		50				Refusal		R7	CR=NIL RQD=NIL
		50				4.0 cm Penth.		*SPT-11	9.50-9.54
		50				Refusal		R8	CR=NIL RQD=NIL
		50				5.0 cm Penth.		*SPT-12	10.25-10.30
10.50m		50				Refusal			10.25



BH-17/Sheet-1



Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 09/03/2015 Sheet No:

BORE LOG DATA SHEET **BORE HOLE NO. 17** Co-ordinates E=467790.000 N=1946938.000

Field Test	Nos	Samples	Nos	Commencement Date : 23/02/15
Penetrometer (SPT)	20	Undisturbed (UDS)	1	Completion Date : 24/02/15
Cone (Pc)		Penetrometer (SPT)	20	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 102.037 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 3.1 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
10.50m								R9	CR=NIL RQD=NIL
								*SPT-13	11.00-11.04 11.00
		50						R10	CR=NIL RQD=NIL
								*SPT-14	11.75-11.80 11.75
		50						R11	CR=NIL RQD=NIL
Completely weathered, light grey, medium grained, decomposed & disintegrated rock particle collected as sludge.								*SPT-15	12.50-12.54 12.50
		50						R12	CR=NIL RQD=NIL
								*SPT-16	13.25-13.27 13.25
		50						R13	CR=NIL RQD=NIL
								*SPT-17	14.00-14.05 14.00
14.00m		50						R14	CR=13% RQD=NIL
								*SPT-18	14.75-14.78 14.75
		51						R15	CR=NIL RQD=NIL
Completely to highly weathered, whitish grey, medium grained, highly fractured rock. Obs. decomposed & disintegrated rock particle collected as sludge on R15.								*SPT-19	15.50-15.55 15.50
		50						R16	CR=16% RQD=NIL
								*SPT-20	16.25-16.27 16.25
16.25m		50						R17	CR=27% RQD=NIL
									17.00
Highly weathered, whitish grey, medium grained, highly fractured rock.								R18	CR=29% RQD=NIL
									17.75
17.75m								R19	CR=32% RQD=NIL
									18.50
Highly weathered, light grey, medium grained, highly fractured rock with mica.								R20	CR=29% RQD=NIL
									19.25
								R21	CR=38% RQD=NIL
									20.00
20.00m									

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





Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 20/03/2015 Sheet No:

BORE LOG DATA SHEET **BORE HOLE NO. 18** Co-ordinates E=468032.000 N=1946943.000

Field Test	Nos	Samples	Nos	Commencement Date : 06/03/15
Penetrometer (SPT)	6	Undisturbed (UDS)	0	Completion Date : 07/03/15
Cone (Pc)		Penetrometer (SPT)	6	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 100.143 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 2.6 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
0.00m									
Deep grey, silty clay with calcareous nodules.								DS-1	0.50
1.00m								SPT-1	1.00-1.45
Very dense, yellowish brown, silty sand with decomposed rock.								SPT-2	1.80-1.90
2.00m								*SPT-3	2.00-2.04 2.00
Completely weathered, light grey, medium grained, decomposed & disintegrated rock particle collected as sludge.								R1	CR=NIL RQD=NIL
3.50m								*SPT-4	2.75-2.77 2.75
Highly weathered, light grey, medium grained, highly fractured rock.								R2	CR=NIL RQD=NIL
5.00m								*SPT-5	3.50-3.52 3.50
								R3	CR=18% RQD=NIL
								*SPT-6	4.25-4.27 4.25
								R4	CR=24% RQD=NIL
									5.00
								R5	CR=27% RQD=NIL
									5.75
								R6	CR=26% RQD=NIL
									6.50
								R7	CR=26% RQD=NIL
									7.25
								R8	CR=28% RQD=NIL
									8.00
								R9	CR=29% RQD=NIL
									8.75
								R10	CR=26% RQD=NIL
									9.50
								R11	CR=30% RQD=NIL
									10.25
10.50m									

NX rotary drilling from 2.00m to 20.00m


Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. CETEST
Job No : 3421 Created by : Chandrani Created on : 20/03/2015 Sheet No:
BORE LOG DATA SHEET BORE HOLE NO. 18 Co-ordinates E=468032.000 N=1946943.000

Field Test	Nos	Samples	Nos	Commencement Date : 06/03/15
Penetrometer (SPT)	6	Undisturbed (UDS)	0	Completion Date : 07/03/15
Cone (Pc)		Penetrometer (SPT)	6	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 100.143 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 2.6 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
10.50m								R12	CR=27% RQD=NIL 11.00
Highly weathered, light grey, medium grained, moderately fractured rock.								R13	CR=32% RQD=NIL 11.75
								R14	CR=37% RQD=NIL 12.50
								R15	CR=26% RQD=NIL 13.25
								R16	CR=27% RQD=NIL 14.00
12.50m								R17	CR=26% RQD=NIL 14.75
Highly weathered, yellowish brown, medium grained, moderately fractured rock.								R18	CR=28% RQD=NIL 15.50
								R19	CR=21% RQD=NIL 16.25
								R20	CR=20% RQD=NIL 17.00
								R21	CR=22% RQD=NIL 17.75
15.50m								R22	CR=23% RQD=NIL 18.50
Highly weathered, light grey, medium grained, moderately fractured rock.								R23	CR=24% RQD=NIL 19.25
								R24	CR=20% RQD=NIL 20.00
20.00m									

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





Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 12/02/2015 Sheet No:

BORE LOG DATA SHEET **BORE HOLE NO. 19** Co-ordinates E=467900.081
N=1946824.434

Field Test	Nos	Samples	Nos	Commencement Date : 24/01/15
Penetrometer (SPT)	14	Undisturbed (UDS)	1	Completion Date : 29/01/15
Cone (Pc)		Penetrometer (SPT)	14	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 100.967 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 3.6 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
0.00m									
								DS-1	0.50
								SPT-1	1.00-1.45
								UDS-1	2.00-2.45
								SPT-2	3.00-3.34
								SPT-3	4.00-4.18
								R1	4.18
								SPT-4	4.75-4.94
								R2	4.75
								SPT-5	5.50-5.68
								R3	5.50
								SPT-6	6.25-6.44
								R4	6.25
								SPT-7	7.00-7.10
								R5	7.00
								SPT-8	7.25-7.36
								R6	7.25
								SPT-9	8.50-8.54
								R7	8.50
								SPT-10	9.25-9.30
								R8	9.25
								R9	10.00
								R10	10.75
								SPT-11	11.50-11.53
								R11	11.50
								SPT-12	12.25-12.29
								R12	12.25
									13.00





Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 12/02/2015 Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO. 19

Co-ordinates E=467900.081
N=1946824.434

Field Test	Nos	Samples	Nos	Commencement Date : 24/01/15
Penetrometer (SPT)	14	Undisturbed (UDS)	1	Completion Date : 29/01/15
Cone (Pc)		Penetrometer (SPT)	14	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	2	Level Of Ground : 100.967 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 3.6 m.

DESCRIPTION	SYMBOL	N-VALUE					SAMPLES	
		EACH DIVN. = 7.5cm.					Ref. No	Depth (m)
13.00m Highly weathered, light grey, medium grained, highly fractured rock.		50	Refusal				SPT-13	13.00-13.03 13.00
			3.0 cm Pentn.				R13	CR=16% RQD=NIL
13.75m		50	Refusal				SPT-14	13.75-13.79 13.75
			4.0 cm Pentn.				R14	CR=33% RQD=NIL
Highly to moderately weathered, steel grey, medium grained, highly to moderately fractured rock.							R15	14.50 CR=40% RQD=NIL
							R16	15.25 CR=49% RQD=NIL
16.00m							R17	16.00 CR=57% RQD=32%
							R18	16.75 CR=80% RQD=14%
							R19	17.75 CR=62% RQD=10%
							R20	19.00 CR=57% RQD=NIL
Moderately weathered, steel grey, medium grained, moderately fractured rock.							R21	20.00 CR=62% RQD=32%
							R22	21.00 CR=64% RQD=NIL
							R23	22.00 CR=64% RQD=NIL
23.00m							R24	23.00 CR=28% RQD=NIL
							R25	24.00 CR=29% RQD=NIL
Highly weathered, steel grey, medium grained, highly fractured rock.								25.00
25.00m								





Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 09/03/2015 Sheet No:

BORE LOG DATA SHEET **BORE HOLE NO. 20** Co-ordinates E=467764.000
N=1946893.000

Field Test	Nos	Samples	Nos	Commencement Date : 25/02/15
Penetrometer (SPT)	19	Undisturbed (UDS)	1	Completion Date : 26/02/15
Cone (Pc)		Penetrometer (SPT)	19	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 103.078 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 3.0 m.

DESCRIPTION	SYMBOL	N-VALUE					SAMPLES		
		EACH DIVN. = 7.5cm.					Ref. No	Depth (m)	
10.50m Completely weathered, light yellowish grey, medium grained, decomposed & disintegrated rock particle collected as sludge.		50	3.0	cm	Penth.	Refusal	R9	CR=NIL RQD=NIL	
							*SPT-12	11.00-11.03	11.00
							R10	CR=NIL RQD=NIL	
							*SPT-13	11.75-11.80	11.75
							R11	CR=NIL RQD=NIL	
							*SPT-14	12.50-12.54	12.50
							R12	CR=NIL RQD=NIL	
							*SPT-15	13.25-13.29	13.25
							R13	CR=NIL RQD=NIL	
							*SPT-16	14.00-14.05	14.00
14.75m Completely to highly weathered, light grey, medium grained, highly fractured rock.		50	3.0	cm	Penth.	Refusal	R14	CR=NIL RQD=NIL	
							*SPT-17	14.75-14.78	14.75
							R15	CR=13% RQD=NIL	
							*SPT-18	15.50-15.55	15.50
							R16	CR=18% RQD=NIL	
							*SPT-19	16.25-16.29	16.25
							R17	CR=20% RQD=NIL	
									17.00
							R18	CR=24% RQD=NIL	
									17.75
17.75m Highly weathered, light grey, medium grained, highly fractured rock.		50	5.0	cm	Penth.	Refusal	R19	CR=27% RQD=NIL	
									18.50
							R20	CR=29% RQD=NIL	
									19.25
							R21	CR=32% RQD=NIL	
20.00m								20.00	
N.B. - '*' means sample could not be recovered.									





Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 09/03/2015 Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO. 22

Co-ordinates E=467822.000
N=1947058.000

Field Test	Nos	Samples	Nos	Commencement Date : 21/02/15
Penetrometer (SPT)	10	Undisturbed (UDS)	1	Completion Date : 23/02/15
Cone (Pc)		Penetrometer (SPT)	12	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 98.965 m.
		Water Sample (WS)	1	Water Struck At :
				Standing Water Level : 1.8 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
0.00m Top soil consists of deep grey, clayey silt / silty clay. Obs. calcareous nodules.								DS-1	0.50
0.70m Very stiff, light grey, clayey silt with calcareous nodules, traces of sand mixture.		3	4	4	6	27	10	SPT-1	1.00-1.45
2.00m Very dense, brownish grey, silty sand with decomposed rock.								WS-1 *UDS-1	1.80 2.00-2.10
3.00m		18	29	38	52	>100		SPT-2	2.60-2.84
		53				1.5 cm Penth.		*SPT-3	3.00-3.04 3.00
						Refusal		R1	CR=NIL RQD=NIL
						4.0 cm Penth.		SPT-4	3.75-3.86 3.75
		28	52			Refusal		R2	CR=NIL RQD=NIL
						3.5 cm Penth.		*SPT-5	4.50-4.55 4.50
		53				Refusal		R3	CR=NIL RQD=NIL
						5.0 cm Penth.		*SPT-6	5.25-5.28 5.25
		56				Refusal		R4	CR=NIL RQD=NIL
						3.0 cm Penth.		*SPT-7	6.00-6.02 6.00
		53				Refusal		R5	CR=NIL RQD=NIL
						2.0 cm Penth.		*SPT-8	6.75-6.77 6.75
		51				Refusal		R6	CR=13% RQD=NIL
						2.0 cm Penth.		*SPT-9	7.50-7.51 7.50
		51				Refusal		R7	CR=17% RQD=NIL
						1.0 cm Penth.		*SPT-10	8.25-8.28 8.25
		50				Refusal		R8	CR=20% RQD=NIL
						3.0 cm Penth.		R9	CR=22% RQD=NIL
									9.00
									9.75
									10.50
9.75m Highly to moderately weathered, dark grey, medium grained, highly to moderately fractured rock.								R10	CR=30% RQD=NIL
10.50m									

NX rotary drilling from
3.00m to 20.00m



Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 09/03/2015 Sheet No:

BORE LOG DATA SHEET **BORE HOLE NO. 22** Co-ordinates E=467822.000 N=1947058.000

Field Test	Nos	Samples	Nos	Commencement Date : 21/02/15
Penetrometer (SPT)	10	Undisturbed (UDS)	1	Completion Date : 23/02/15
Cone (Pc)		Penetrometer (SPT)	12	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 98.965 m.
		Water Sample (WS)	1	Water Struck At :
				Standing Water Level : 1.8 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
Highly to moderately weathered, dark grey, medium grained, highly to moderately fractured rock.	10.50m							R11	CR=31% RQD=17% 11.25
								R12	CR=26% RQD=NIL 12.00
								R13	CR=29% RQD=13% 12.75
								R14	CR=27% RQD=NIL 13.50
								R15	CR=33% RQD=NIL 14.25
								R16	CR=41% RQD=NIL 15.00
Completely to highly weathered, dark grey, medium grained, highly to moderately fractured rock. Obs. decomposed & disintegrated rock particle collected as sludge on R18 & R19.	15.00m							R17	CR=22% RQD=NIL 15.75
								R18	CR=NIL RQD=NIL 16.50
								*SPT-11	16.50-16.5316.50
								R19	CR=NIL RQD=NIL 17.25
								*SPT-12	17.25-17.2817.25
								R20	CR=23% RQD=NIL 18.00
Highly weathered, dark grey, medium grained, highly to moderately fractured rock.	18.75m							R21	CR=24% RQD=NIL 18.75
								R22	CR=29% RQD=NIL 19.50
	20.00m							R23	CR=32% RQD=NIL 20.00

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



BH-22/Sheet-2



Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 09/03/2015 Sheet No:

BORE LOG DATA SHEET **BORE HOLE NO. 23** Co-ordinates E=467851.000 N=1947016.000

Field Test	Nos	Samples	Nos	Commencement Date : 17/02/15
Penetrometer (SPT)	21	Undisturbed (UDS)	1	Completion Date : 20/02/15
Cone (Pc)		Penetrometer (SPT)	21	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 100.226 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 2.7 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
0.00m								DS-1	0.50
Very stiff, dark grey, silty clay. Obs gravels.		3	4	4	3	17	7	SPT-1	1.00-1.45
2.45m								UDS-1	2.00-2.45
Very dense, silty sand with decomposed rock. Obs. mica.		50				Refusal		*SPT-2	3.00-3.02
3.10m		51				Refusal		*SPT-3	3.10-3.12 3.10
Completely weathered, brownish grey, medium grained, decomposed & disintegrated rock particle collected as sludge.						Refusal		R1	CR=NIL RQD=NIL
4.60m		50				Refusal		*SPT-4	3.85-3.89 3.85
Highly weathered, whitish brown, medium grained, highly fractured rock.						Refusal		R2	CR=NIL RQD=NIL
6.10m		50				Refusal		*SPT-5	4.60-4.63 4.60
Completely weathered, brownish grey, medium to fine grained, decomposed & disintegrated rock particle collected as sludge.						Refusal		R3	CR=16% RQD=NIL
9.10m		50				Refusal		*SPT-6	5.35-5.36 5.35
Highly weathered, brownish grey, medium grained, highly fractured rock.						Refusal		R4	CR=24% RQD=NIL
10.50m		50				Refusal		*SPT-7	6.85-6.88 6.85
						Refusal		R5	CR=NIL RQD=NIL
						Refusal		*SPT-8	7.60-7.64 7.60
						Refusal		R6	CR=NIL RQD=NIL
						Refusal		*SPT-9	8.35-8.37 8.35
						Refusal		R7	CR=NIL RQD=NIL
						Refusal		*SPT-10	9.10-9.13 9.10
						Refusal		R8	CR=NIL RQD=NIL
						Refusal		*SPT-11	9.85-9.86 9.85
						Refusal		R9	CR=17% RQD=NIL
						Refusal		R10	CR=13% RQD=NIL




Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. CETEST
Job No : 3421 Created by : Chandrani Created on : 09/03/2015 Sheet No:
BORE LOG DATA SHEET BORE HOLE NO. 23 Co-ordinates E=467851.000 N=1947016.000

Field Test	Nos	Samples	Nos	Commencement Date : 17/02/15
Penetrometer (SPT)	21	Undisturbed (UDS)	1	Completion Date : 20/02/15
Cone (Pc)		Penetrometer (SPT)	21	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 100.226 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 2.7 m.

DESCRIPTION	SYMBOL	N-VALUE				SAMPLES	
		EACH DIVN. = 7.5cm.				Ref. No	Depth (m)
10.50m		50	Refusal			*SPT-12	10.60-10.61 10.60
Highly weathered, brownish grey, medium grained, highly fractured rock.			1.0 cm Penth.			R11	CR=18% RQD=NIL
		50	Refusal			*SPT-13	11.35-11.36 11.35
			1.0 cm Penth.			R12	CR=25% RQD=NIL
							12.10
12.10m						R13	CR=22% RQD=NIL
Highly weathered, dark grey, medium grained, highly fractured rock.							12.85
						R14	CR=21% RQD=NIL
							13.60
						R15	CR=NIL RQD=NIL
13.60m		52	Refusal			*SPT-14	14.35-14.36 14.35
Completely weathered, brownish grey, medium grained, decomposed & disintegrated rock particle collected as sludge.			1.0 cm Penth.			R16	CR=NIL RQD=NIL
		50	Refusal			*SPT-15	15.10-15.12 15.10
			2.0 cm Penth.			R17	CR=NIL RQD=NIL
							15.85
15.85m		50	Refusal			*SPT-16	15.85-15.86 15.85
Highly weathered, light blackish grey, medium grained, highly fractured rock			1.0 cm Penth.			R18	CR=14% RQD=NIL
		52	Refusal			*SPT-17	16.35-16.37 16.35
			2.0 cm Penth.			R19	CR=18% RQD=NIL
							17.10
		50	Refusal			*SPT-18	17.10-17.12 17.10
			2.0 cm Penth.			R20	CR=13% RQD=NIL
							17.85
		52	Refusal			*SPT-19	17.85-17.88 17.85
			3.0 cm Penth.			R21	CR=16% RQD=NIL
							18.60
		55	Refusal			*SPT-20	18.60-18.62 18.60
			2.0 cm Penth.			R22	CR=14% RQD=NIL
							19.35
		51	Refusal			*SPT-21	19.35-19.37 19.35
			2.0 cm Penth.			R23	CR=22% RQD=NIL
20.00m							20.00

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





Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 21/03/2015 Sheet No:

BORE LOG DATA SHEET **BORE HOLE NO. 24** Co-ordinates E=467886.000 N=1946916.000

Field Test	Nos	Samples	Nos	Commencement Date : 23/02/15
Penetrometer (SPT)	9	Undisturbed (UDS)	1	Completion Date : 26/02/15
Cone (Pc)		Penetrometer (SPT)	9	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 100.45 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 2.7 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
0.00m								DS-1	0.50
Very stiff, deep grey, silty clay. Obs. calcareous nodules.		2	3	3	4	18	7	SPT-1	1.00-1.45
2.00m						>100		*UDS-1	2.00-2.10
Very dense, brownish grey, sandy silt with decomposed rock. Obs. mica.		10	30	38	50	2.5 cm Penth.		SPT-2	2.30-2.55
2.60m		50				Refusal		*SPT-3	2.60-2.65 2.60
						5.0 cm Penth.		R1	CR=NIL RQD=NIL
						Refusal		*SPT-4	3.35-3.37 3.35
		52				2.0 cm Penth.		R2	CR=NIL RQD=NIL
Completely weathered, brownish grey, medium grained, decomposed & disintegrated rock particle collected as sludge.						Refusal		*SPT-5	4.15-4.18 4.15
		52				3.0 cm Penth.		R3	CR=NIL RQD=NIL
						Refusal		*SPT-6	4.90-4.92 4.90
		52				2.0 cm Penth.		R4	CR=NIL RQD=NIL
						Refusal		*SPT-7	5.65-5.68 5.65
5.65m		53				3.0 cm Penth.		R5	CR=20% RQD=NIL
Highly weathered, whitish brown, medium grained, highly fractured rock.								R6	CR=22% RQD=NIL
								R7	CR=20% RQD=NIL
7.15m									7.15
									7.90
Highly weathered, brownish grey, medium grained, highly fractured rock.								R8	CR=17% RQD=NIL
		50				Refusal		*SPT-8	8.65-8.68 8.65
						3.0 cm Penth.		R9	CR=14% RQD=NIL
						Refusal		*SPT-9	9.40-9.42 9.40
9.40m		50				2.0 cm Penth.		R10	CR=24% RQD=NIL
Highly weathered, dark grey, medium grained, highly fractured rock.									
10.00m									

NX rotary drilling from 2.60m to 20.00m



BH-24/Sheet-1



Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 21/03/2015 Sheet No:

BORE LOG DATA SHEET **BORE HOLE NO. 24** Co-ordinates E=467886.000 N=1946916.000

Field Test	Nos	Samples	Nos	Commencement Date : 23/02/15
Penetrometer (SPT)	9	Undisturbed (UDS)	1	Completion Date : 26/02/15
Cone (Pc)		Penetrometer (SPT)	9	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 100.45 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 2.7 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
10.00m									10.15
Highly weathered, dark grey, medium grained, highly fractured rock.								R11	CR=21% RQD=NIL
									10.90
								R12	CR=24% RQD=NIL
									11.65
								R13	CR=23% RQD=NIL
									12.40
								R14	CR=22% RQD=NIL
									13.15
								R15	CR=24% RQD=NIL
									13.90
15.40m								R16	CR=21% RQD=NIL
									14.65
								R17	CR=23% RQD=NIL
									15.40
16.90m								R18	CR=24% RQD=NIL
									16.15
								R19	CR=22% RQD=NIL
									16.90
Highly to moderately weathered, light grey, medium grained, highly fractured rock.								R20	CR=27% RQD=NIL
									17.65
								R21	CR=37% RQD=NIL
									18.40
								R22	CR=49% RQD=NIL
									19.00
N.B. - '*' means sample could not be recovered.								R23	CR=31% RQD=NIL
									20.00



BH-24/Sheet-2



Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 12/02/2015 Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO. 25

Co-ordinates E=467956.000
N=1946821.000

Field Test	Nos	Samples	Nos	Commencement Date : 11/01/15
Penetrometer (SPT)	11	Undisturbed (UDS)	1	Completion Date : 02/02/15
Cone (Pc)		Penetrometer (SPT)	11	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 101.631 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 4.4 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
0.00m								DS-1	0.50
Very stiff, deep yellowish brown, silty clay with kankars & calcareous nodules.		5	5	5	5	22	6	SPT-1	1.00-1.45
								UDS-1	2.00-2.45
2.50m		6	5	6	9	51	18	SPT-2	3.00-3.45
Hard, deep yellowish brown, silty clay with kankars & calcareous nodules.								SPT-3	4.50-4.70
		24	38	50	5.0	cm Pentn.		SPT-4	4.80-4.99
4.99m		29	52	50		>100		R1	CR=NIL RQD=NIL
					4.0	cm Pentn.		SPT-5	5.99-6.11
Completely weathered, whitish grey, medium grained, decomposed & disintegrated rock particle collected as sludge.		54	50			>100		R2	CR=NIL RQD=NIL
					4.5	cm Pentn.		SPT-6	6.99-7.10
		50	50			>100		R3	CR=NIL RQD=NIL
					3.5	cm Pentn.		SPT-7	7.99-8.18
7.99m		17	45	50		>100		R4	CR=NIL RQD=NIL
					4.0	cm Pentn.		SPT-8	8.99-9.17
Completely weathered, whitish grey with blackish spot, medium grained, decomposed & disintegrated rock particle collected as sludge.		23	39	50		>100		R5	CR=NIL RQD=NIL
					3.0	cm Pentn.		SPT-9	9.99-10.18
		37	42	50		>100		R6	CR=NIL RQD=NIL
					4.0	cm Pentn.		SPT-10	10.99-11.11
		50	50			>100		R7	CR=07% RQD=NIL
12.00m						Refusal		SPT-11	12.00-12.04
						4.0	cm Pentn.	R8	CR=47% RQD=NIL
Highly to moderately weathered, light grey with whitish spot, medium grained, highly fractured rock.								R9	CR=38% RQD=NIL
								R10	CR=39% RQD=NIL
								R11	CR=31% RQD=NIL
16.00m									16.00

NX rotary drilling from 4.99m to 30.00m




Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. CETEST
Job No : 3421 Created by : Chandrani Created on : 12/02/2015 Sheet No:
BORE LOG DATA SHEET BORE HOLE NO. 25 Co-ordinates E=467956.000 N=1946821.000

Field Test	Nos	Samples	Nos	Commencement Date : 11/01/15
Penetrometer (SPT)	11	Undisturbed (UDS)	1	Completion Date : 02/02/15
Cone (Pc)		Penetrometer (SPT)	11	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	2	Level Of Ground : 101.631 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 4.4 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
Highly to moderately weathered, light grey with whitish spot, medium grained, highly fractured rock.	16.00m							R12	CR=45% RQD=NIL
	17.00m							R13	CR=56% RQD=NIL
								R14	CR=43% RQD=11%
								R15	CR=32% RQD=14%
								R16	CR=26% RQD=NIL
								R17	CR=38% RQD=NIL
								R18	CR=45% RQD=NIL
								R19	CR=28% RQD=11%
								R20	CR=36% RQD=NIL
								R21	CR=42% RQD=NIL
								R22	CR=42% RQD=NIL
								R23	CR=37% RQD=NIL
								R24	CR=46% RQD=12%
								R25	CR=44% RQD=17%
	30.00m								





Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 12/02/2015 Sheet No:

BORE LOG DATA SHEET **BORE HOLE NO. 26** Co-ordinates E=468028.000 N=1946800.000

Field Test	Nos	Samples	Nos	Commencement Date : 20/01/15
Penetrometer (SPT)	16	Undisturbed (UDS)	1	Completion Date : 23/01/15
Cone (Pc)		Penetrometer (SPT)	16	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 102.499 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 5.5 m.

DESCRIPTION	SYMBOL	N-VALUE					SAMPLES	
		EACH DIVN. = 7.5cm.					Ref. No	Depth (m)
0.00m							DS-1	0.50
Very stiff, brownish grey to whitish brown, silty clay with calcareous nodules. Obs. gravels.		5	7	4	4	26 8 10	SPT-1	1.00-1.45
							UDS-1	2.00-2.45
3.00m						>100	SPT-2	3.00-3.45
Very dense, light grey, sandy silt / silty sand with decomposed rock. Obs. calcareous nodules.		19	16	18	21	30 35		
						>100	SPT-3	3.80-4.00
4.00m		21	16	50			R1	CR=NIL RQD=NIL
						5.0 cm Pentn.		4.00
						>100	SPT-4	4.75-5.09
		21	18	16	31	50	R2	CR=NIL RQD=NIL
						4.0 cm Pentn.		4.75
						>100	SPT-5	5.50-5.70
		27	31	50			R3	CR=NIL RQD=NIL
						5.0 cm Pentn.		5.50
						>100	SPT-6	6.25-6.44
		26	34	50			R4	CR=NIL RQD=NIL
						4.0 cm Pentn.		6.25
Completely weathered, light grey, medium grained, decomposed & disintegrated rock particle collected as sludge.						>100	SPT-7	7.00-7.20
		27	35	50			R5	CR=NIL RQD=NIL
						5.0 cm Pentn.		7.00
						>100	SPT-8	7.75-7.94
		21	31	50			R6	CR=NIL RQD=NIL
						4.0 cm Pentn.		7.75
						>100	SPT-9	8.50-8.69
		22	33	50			R7	CR=NIL RQD=NIL
						4.0 cm Pentn.		8.50
						>100	SPT-10	9.25-9.45
		24	37	50			R8	CR=NIL RQD=NIL
						5.0 cm Pentn.		9.25
10.00m						>100	SPT-11	10.00-10.18
		25	35	50			R9	CR=12% RQD=NIL
						3.0 cm Pentn.		10.00
						>100	SPT-12	10.75-10.87
Highly weathered, light grey with whitish spot, medium grained highly fractured rock.		87	50				R10	CR=15% RQD=NIL
						4.5 cm Pentn.		10.75
						Refusal	*SPT-13	11.50-11.53
		50					R11	CR=16% RQD=NIL
						3.0 cm Pentn.		11.50
						Refusal	*SPT-14	12.25-12.29
12.25m		50					R12	CR=22% RQD=NIL
Highly weathered, light grey, with whitish spot, medium grained highly fractured rock.						4.0 cm Pentn.		12.25
13.00m						NX rotary drilling from 4.00m to 25.00m		13.00




Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. CETEST
Job No : 3421 Created by : Chandrani Created on : 12/02/2015 Sheet No:
BORE LOG DATA SHEET BORE HOLE NO. 26 Co-ordinates E=468028.000 N=1946800.000

Field Test	Nos	Samples	Nos	Commencement Date : 20/01/15
Penetrometer (SPT)	16	Undisturbed (UDS)	1	Completion Date : 23/01/15
Cone (Pc)		Penetrometer (SPT)	16	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	2	Level Of Ground : 102.499 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 5.5 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
13.00m								R13	CR=28% RQD=NIL
								R14	CR=21% RQD=NIL
								R15	CR=25% RQD=NIL
								R16	CR=11% RQD=NIL
Highly weathered, light grey, with whitish spot, medium grained highly fractured rock.								*SPT-15	16.00-16.03
								R17	CR=15% RQD=NIL
16.75m								*SPT-16	16.75-16.78
								R18	CR=28% RQD=NIL
								R19	CR=37% RQD=NIL
								R20	CR=25% RQD=NIL
								R21	CR=21% RQD=NIL
								R22	CR=30% RQD=NIL
								R23	CR=25% RQD=NIL
								R24	CR=23% RQD=NIL
								R25	CR=25% RQD=NIL
								R26	CR=23% RQD=NIL
								R27	CR=25% RQD=NIL
24.25m								R28	CR=27% RQD=NIL
25.00m									
N.B. - '*' means sample could not be recovered.									




Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. CETEST
Job No : 3421 Created by : Chandrani Created on : 09/03/2015 Sheet No:
BORE LOG DATA SHEET BORE HOLE NO. 27 Co-ordinates E=467835.000 N=1947104.000

Field Test	Nos	Samples	Nos	Commencement Date : 23/02/15
Penetrometer (SPT)	12	Undisturbed (UDS)	1	Completion Date : 24/02/15
Cone (Pc)		Penetrometer (SPT)	12	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 98.786 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 1.3 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
0.00m									
Very dense, deep grey, silty sand with gravels.								DS-1	0.50
1.50m								SPT-1	1.00-1.45
Very dense, light brownish grey, silty sand with decomposed rock.								*UDS-1	2.00-2.45
3.00m								SPT-2	2.60-2.80
								*SPT-3	3.00-3.04 3.00
								R1	CR=NIL RQD=NIL
								*SPT-4	3.75-3.78 3.75
								R2	CR=NIL RQD=NIL
								*SPT-5	4.50-4.53 4.50
								R3	CR=NIL RQD=NIL
								*SPT-6	5.25-5.28 5.25
								R4	CR=NIL RQD=NIL
								*SPT-7	6.00-6.04 6.00
								R5	CR=NIL RQD=NIL
								*SPT-8	6.75-6.79 6.75
								R6	CR=NIL RQD=NIL
								*SPT-9	7.50-7.54 7.50
								R7	CR=NIL RQD=NIL
								*SPT-10	8.25-8.29 8.25
								R8	CR=NIL RQD=NIL
								*SPT-11	9.00-9.04 9.00
								R9	CR=NIL RQD=NIL
								*SPT-12	9.75-9.78 9.75
								R10	CR=20% RQD=NIL
9.75m									
Completely to highly weatherd, whitish grey, medium grained, moderately fractured rock.									
10.50m									



BH-27/Sheet-1



Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 09/03/2015 Sheet No:

BORE LOG DATA SHEET **BORE HOLE NO. 27** Co-ordinates E=467835.000
N=1947104.000

Field Test	Nos	Samples	Nos	Commencement Date : 23/02/15
Penetrometer (SPT)	12	Undisturbed (UDS)	1	Completion Date : 24/02/15
Cone (Pc)		Penetrometer (SPT)	12	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 98.786 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 1.3 m.

DESCRIPTION	SYMBOL	N-VALUE							SAMPLES	
		EACH DIVN. = 7.5cm.							Ref. No	Depth (m)
10.50m										
Completely to highly weatherd, whitish grey, medium grained, moderately fractured rock.									R11	CR=21% RQD=NIL
										11.25
									R12	CR=21% RQD=NIL
										12.00
12.00m										
Highly weatherd, whitish grey, medium grained, moderately fractured rock.									R13	CR=28% RQD=NIL
										12.75
									R14	CR=33% RQD=NIL
										13.50
									R15	CR=32% RQD=NIL
										14.25
									R16	CR=27% RQD=NIL
										15.00
15.75m										
Highly weathered, light grey, medium grained, moderately fractured rock.									R17	CR=28% RQD=NIL
										15.75
									R18	CR=25% RQD=NIL
										16.50
									R19	CR=28% RQD=NIL
										17.25
									R20	CR=26% RQD=NIL
										18.00
									R21	CR=27% RQD=NIL
										18.75
									R22	CR=32% RQD=NIL
										19.50
20.00m									R23	CR=30% RQD=NIL
										20.00

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



BH-27/Sheet-2


Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. CETEST
Job No : 3421 Created by : Chandrani Created on : 09/03/2015 Sheet No:
BORE LOG DATA SHEET BORE HOLE NO. 28 Co-ordinates E=467807.000 N=1947085.000

Field Test	Nos	Samples	Nos	Commencement Date : 25/02/15
Penetrometer (SPT)	13	Undisturbed (UDS)	1	Completion Date : 27/02/15
Cone (Pc)		Penetrometer (SPT)	13	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 98.868 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 2.3 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
0.00m									
Top soil consists of deep grey, clayey silt.								DS-1	0.50
1.00m									
Very stiff, light grey, silty clay. Obs. gravels.		3	4	4	6	26	7	SPT-1	1.00-1.45
2.00m									
Very dense, brownish grey, silty sand with decomposed rock.								*UDS-1	2.00-2.10
3.00m									
		17	28	39	52	>100		SPT-2	2.60-2.85
						2.5 cm Penth.			
		52				Refusal		*SPT-3	3.00-3.05 3.00
						5.0 cm Penth.		R1	CR=NIL RQD=NIL
						Refusal		*SPT-4	3.75-3.78 3.75
		52				3.0 cm Penth.		R2	CR=NIL RQD=NIL
Completely weathered, brownish grey, fine to medium grained, decomposed & disintegrated rock particle collected as sludge.						Refusal		*SPT-5	4.50-4.52 4.50
		50				2.0 cm Penth.		R3	CR=NIL RQD=NIL
						Refusal		*SPT-6	5.25-5.28 5.25
		52				3.0 cm Penth.		R4	CR=NIL RQD=NIL
						Refusal		*SPT-7	6.00-6.02 6.00
		50				2.0 cm Penth.		R5	CR=09% RQD=NIL
						Refusal		*SPT-8	6.75-6.78 6.75
		52				3.0 cm Penth.		R6	CR=24% RQD=NIL
Highly weathered, whitish grey to light grey, medium grained, highly fractured rock.									7.50
								R7	CR=24% RQD=NIL
									8.25
								R8	CR=28% RQD=NIL
									9.00
								R9	CR=27% RQD=NIL
									9.75
								R10	CR=33% RQD=13%
									10.50
8.25m									
Highly weathered, whitish grey to light grey, medium grained, highly fractured rock.									
10.50m									

NX rotary drilling from 3.00m to 20.00m



Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. CETEST

Job No : 3421 Created by : Chandrani Created on : 09/03/2015 Sheet No:

BORE LOG DATA SHEET BORE HOLE NO. 28 Co-ordinates E=467807.000 N=1947085.000

Field Test	Nos	Samples	Nos	Commencement Date : 25/02/15
Penetrometer (SPT)	13	Undisturbed (UDS)	1	Completion Date : 27/02/15
Cone (Pc)		Penetrometer (SPT)	13	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 98.868 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 2.3 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
10.50m								R11	CR=NIL RQD=NIL
Completely weathered, whitish grey to light grey, medium grained, decomposed & disintegrated rock particle collected as sludge.								*SPT-9	11.25-11.29 11.25
								R12	CR=NIL RQD=NIL
								*SPT-10	12.00-12.02 12.00
12.00m								R13	CR=17% RQD=NIL
Highly weathered, whitish grey, medium grained, highly fractured rock.								*SPT-11	12.75-12.79 12.75
								R14	CR=13% RQD=NIL
								*SPT-12	13.50-13.55 13.50
13.50m								R15	CR=26% RQD=NIL
Highly weathered, whitish grey, medium grained, highly fractured rock.								R16	CR=30% RQD=NIL
									14.25
									15.00
15.00m								R17	CR=20% RQD=NIL
									15.75
								R18	CR=17% RQD=NIL
								*SPT-13	16.50-16.55 16.50
17.25m								R19	CR=25% RQD=NIL
Highly weathered, light grey, medium grained, highly fractured rock.								R20	CR=27% RQD=NIL
									17.25
								R21	CR=26% RQD=NIL
									18.00
								R22	CR=28% RQD=NIL
									18.75
								R23	CR=30% RQD=NIL
									19.50
									20.00
20.00m									
N.B. - '*' means sample could not be recovered.									





Project : Geotech. Inv. Work for 1x800MW KTPS at Khammam Dist. Telangana. **CETEST**

Job No : 3421 Created by : Chandrani Created on : 21/03/2015 Sheet No:

BORE LOG DATA SHEET **BORE HOLE NO. 29** Co-ordinates E=467939.000 N=1946926.000

Field Test	Nos	Samples	Nos	Commencement Date : 26/02/15
Penetrometer (SPT)	10	Undisturbed (UDS)	1	Completion Date : 28/02/15
Cone (Pc)		Penetrometer (SPT)	10	Bore Hole Diameter : 150 mm. / N.X.
Vane (V)		Disturbed (DS)	1	Level Of Ground : 99.959 m.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 2.0 m.

DESCRIPTION	SYMBOL	N-VALUE						SAMPLES	
		EACH DIVN. = 7.5cm.						Ref. No	Depth (m)
0.00m									
Very stiff, deep grey, silty clay with calcareous nodules.		3	3	3	4	19	7	DS-1	0.50
								SPT-1	1.00-1.45
								UDS-1	2.00-2.45
3.00m		7	8	16	22	32	50	SPT-2	3.00-3.40
Very dense, light brownish grey, sandy silt with decomposed rock.						≥100	2.5 cm Pentn.		
4.00m		50						*SPT-3	4.00-4.05 4.00
							5.0 cm Pentn.	R1	CR=15% RQD=NIL
		50						*SPT-4	4.75-4.78 4.75
Highly weathered, yellowish brown, medium grained, highly fractured rock.							3.0 cm Pentn.	R2	CR=19% RQD=NIL
		51						*SPT-5	5.50-5.55 5.50
							5.0 cm Pentn.	R3	CR=23% RQD=NIL
6.25m								R4	CR=21% RQD=NIL
Highly weathered, light grey, medium grained, highly to moderately fractured rock.								R5	CR=19% RQD=NIL
								*SPT-6	7.75-7.77 7.75
7.75m		50						R6	CR=32% RQD=NIL
							2.0 cm Pentn.	R7	CR=29% RQD=NIL
Highly to moderately weathered, light grey, medium grained, highly to moderately fractured rock.								R8	CR=40% RQD=NIL
10.00m									10.00



