2x660MW IB THERMAL POWER STATION UNIT-3 & 4, OPGCL, BANHARPALLI, DIST. – JHARSUGUDA, ODISHA.

GEOTECHNICAL INVESTIGATION REPORT

VOLUME-I FOR BTG AREA

GID-208-CV-DOC-3015

BGR ENERGY SYSTEMS LIMITED

POWER PROJECTS DIVISION

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DATE	REVISIONS	PREPARED BY	CHECKED BY	APPROVED BY
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GEOTECHNICAL INVESTIGATION REPORT - VOLUME-I

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CLIENT: **BGR ENERGY SYSTEM LTD, CHENNAI**

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1.0 INTRODUCTION

M/s BGR Energy Systems Limited has awarded the work of Soil Investigation works for the proposed 2X660 MW Unit # 3 & 4 – IB Thermal Power Project, Odisha to M/s Soil Engineering Consultants, New Delhi. This Volume I report presents the details of Geotechnical investigations carried out at BTG Area and data obtained from various field and laboratory tests, their presentation in graphical form, their computation, compilation, analysis and suitable recommendation made as regards to type of foundations to be adopted for the Main Plant structures based on BH 1 to BH 14, BH 16, BH 32 and BH 34.

2.0 SCOPE OF WORK

a) Drilling bore holes upto the maximum depth of 25.0 m by Shell and auger method or up to refusal. Beyond refusal strata drilling using Hydraulic Feed Drilling Machine with double tube core barrel and Nx size diamond drilling bits upto specified depth as per IS code of practice and as per the direction of the Engineer-in-Charge.

b) Conducting Standard Penetration tests in the bore holes at regular intervals of 1.50m or change of strata as per IS Code of Practice.

c) Collecting Disturbed / Undisturbed soil samples from the bore holes at regular intervals or change of strata as per IS Code of Practice.

d) Recording of water table level in the bore holes after completion of borehole.

e) Conducting all the necessary laboratory tests on the samples collected.

f) Preparation of report summarizing the details of soil classification, analysis of test data, type of foundation etc.

3.0 FIELD WORK

3.1 Boring

Bore holes of 150 mm dia. were drilled by Shell and auger method upto the refusal depth as per IS code of practice and the directions of the Engineer in charge. Refusal was obtained in all the boreholes at varying depths. In refusal strata rotary drilling was resorted by using Hydraulic feed drilling machine with double tube core barrel and Nx size diamond bits as per IS code of practice. The details about the depth of bore holes, co ordinates and RL's are given in Table 1 and also in borelogs.

3.2 Standard Penetration Test (SPT)

Standard Penetration tests were conducted at every 1.50m intervals and every change of strata or wherever possible. The tests were performed by driving into the soil (bore holes cleaned of any loose material) a standard split spoon sampler with the help of a standard hammer with a free fall of 75 cms on a driving head as described in IS: 2131. This head was attached to "A" drill rod to the other end of which the sampler was fitted. The number of blows needed to penetrate the first, second and third stages (each of 15 cms) depth of the sampler length, were noted. The number of blows (N- value) as given in the bore hole data sheets is the numerical sum of blows counted during the second & third stage only i.e. for a depth of 30 cms.

3.3 Collection of Samples

Both Disturbed and Undisturbed soil samples, Rock Core Samples were collected from the bore holes.

3.4 Recording of water table

Water table was met in all boreholes at varying depths at the time of Soil investigation. The details are given in the respective bore logs and also at **Table 1** below.

Location	BH No.	Depth of BH (m)	RL (m)	Co-ordinates		water table (m)
				East	South	
Transformer Yard	1	15.0	203.000	1394	1316	2.60
	2	15.0	201.800	1495	1316	2.80
	34	15.0	199.500	1432	1196	0.40
Power House Block	3	25.0	202.800	1450	1369	2.40
	4	25.0	201.128	1315	1369	0.40
	5	25.0	199.744	1237	1369	0.40
Boiler	6	25.0	200.125	1275	1422	0.50
	7	25.0	202.100	1375	1422	2.45
	8	25.0	202.440	1453	1447	2.80
	9	25.0	201.900	1480	1497	2.65
	11	25.0	199.631	1275	1497	1.10
Switch Yard	32	15.0	199.436	1358	1072	0.80
Storage Tank & P/H	10	25.0	200.200	1385	1497	0.90
ESP	12	20.0	199.400	1295	1552	0.75
	13	20.0	199.50	1434	1639	1.10
	14	20.0	199.700	1468	1556	0.60
Chimney	16	25.0	199.700	1396	1711	1.20

4.0 LABORATORY TESTS

A visual and discrete examination of all the soil / rock samples collected was carried out for deciding the number and type of tests to be tested from each bore hole. Based on the strata met at site the following tests were conducted on samples to classify them and to evaluate their index and Engineering properties.

SOIL SAMPLES

a) Grain size distribution as per IS: 2720(Part IV).
b) Hydrometer Analysis as per IS: 2720(Part IV).
c) Liquid and plastic limits as per IS: 2720(Part V).
d) Specific gravity as per IS : 2720(Part III).
e) Bulk density and dry density as per IS : 2720(Part II).
f) Moisture content as per IS : 2720(Part II).
g) Direct shear test as per IS : 2720(Part XIII)
h) Consolidated Undrained Shear Test as per IS : 2720(Part XII)
i) Consolidation as per IS : 2720(Part XV)

ROCK SAMPLES

The rock samples on saturation were dissolved. Only Density tests were performed on the samples. The results are given at Annexure I.

5.0 SOIL & ROCK CHARACTERISTICS

Transformer Yard

At this location Three Boreholes (BH 1,BH 2 and BH 34) were drilled upto 15m depth. The Boreholes were advanced by Shell and auger method upto the refusal depth. While advancing the bore holes SPT tests were conducted at regular intervals of 1.5m depth and representative samples were collected and analyzed for soil classification. From the soil classification it revealed that the strata consists of Filled up soil upto varying depths of 0.40m to 1.20 depth followed by Silty clay of High Plasticity (CH) upto the rocky strata depth. Rocky strata was obtained at varying depths of 4.50m to 5.0m depth. In rocky strata the boreholes were

advanced by Hydraulic feed rotary drilling machine using Nx size Diamond Core bit upto the specified depth. From the samples of the core recovery, drill log, representative samples, wash samples and return of drilled water from bore holes the refusal strata is classified as highly weathered disintegrated rock / Highly weathered and fractured rock. The details of classification, Core recovery and RQD are as given below:

BH 1

Rocky strata was observed from 4.50m depth. The overburden strata is classified as Filled up soil upto 1.20m depth followed by Silty clay of High Plasticity (CH). The rocky strata is classified as Highly weathered and highly fractured yellowish color Sandstone/siltstone upto 6.0m depth followed by highly weathered disintegrated rock upto 7.50m depth. Below 7.50m depth the strata is classified as Highly weathered and fractured Shale upto the depth drilled. The Core recovery is around 15% upto 6.0m depth. From 6.0m to 7.50m depth the core recovery is Nil. Below 7.50m depth the core recovery is varying from 40% to 85%. RQD is Nil upto 7.50m depth and from 12.0m to 13.50m depth. At other depths RQd is varying from 34% to 67%.

BH 2

Rocky strata was observed from 5.00m depth. The overburden strata is classified as Filled up soil upto 0.40m depth followed by Silty clay of High Plasticity (CH). The rocky strata is classified as Highly weathered and highly fractured yellowish color Sandstone/siltstone upto 10.50m depth followed by highly weathered and fractured grayish color Shale upto the depth drilled. Core recovery is varying from 35% to 72%. RQD is varying from 8% to 59% upto 13.50m depth. Below 13.50m depth RQD is Nil upto the depth drilled.

BH 34

Rocky strata was observed from 7.00m depth. The overburden strata is classified as Filled up soil upto 1.50m depth followed by non-plastic Silty sand with gravel (SM) upto 3.0m depth. Below 3.0m depth the strata consists of Silty clay mixed with Sand (CI-CH) upto the rocky strata depth. In rocky strata the borehole was advanced by Hydraulic feed rotary

drilling machine using Nx size Diamond Core bit upto the specified depth. From the samples of the core recovery, drill log, representative samples, wash samples and return of drilled water from bore holes the refusal strata is classified as Highly weathered and fractured Silt Stone (Core recovery 20% to 40%). RQD is varying from 9% to 16% except from 7.0m to 7.50m depth, from 10.50m to 12.0m depth and from 13.50m to 15.0m depth wherein RQD is Nil.

Power House Block

At this location Three Boreholes (BH 3 to BH 5) were drilled upto 25m depth. The Boreholes were advanced by Shell and auger method upto the refusal depth. While advancing the bore holes SPT tests were conducted at regular intervals of 1.5m depth and representative samples were collected and analyzed for soil classification. From the soil classification it revealed that the strata consists of Filled up soil upto varying depth of 0.40m to 0.70m depth followed by non-plastic Silty sand with gravel (SM)/ Silty clay of Medium Plasticity (CI) upto the rocky strata depth. Rocky strata was obtained at varying depths of 4.50m to 8.0m depth. In rocky strata the boreholes were advanced by Hydraulic feed rotary drilling machine using Nx size Diamond Core bit upto the specified depth. From the samples of the core recovery, drill log, representative samples, wash samples and return of drilled water from bore holes the refusal strata is classified as highly weathered disintegrated rock / Highly weathered and fractured rock. The details of classification, Core recovery and RQD are as given below:

BH 3

Rocky strata was observed from 4.50m depth. The overburden strata is classified as Filled up soil upto 0.70m depth followed by non-plastic Silty sand with gravel (SM)/ Silty clay of Medium Plasticity (CI). The rocky strata is classified as Highly weathered and highly fractured / fractured yellowish color Sandstone/siltstone upto the depth drilled with core recovery varying from 10% to 80% except from 15.0m to 19.50m depth wherein the strata is classified as Highly weathered disintegrated rock with no core recovery.

RQD is Nil upto 7.50m depth, from 15.0m to 21.0m depth and from 24.0m to 25.0m depth. From 7.50m to 15.50m depth RQD is varying from 8% to 40%. From 21.0m to 24.0m depth RQD is varying from 7% to 25%.

BH 4

Rocky strata was observed from 6.00m depth. The overburden strata is classified as Filled up soil upto 0.50m depth followed by non-plastic Silty Sand with Gravel/Silty sand with gravel (SM). The rocky strata is classified as Highly weathered disintegrated rock with no core recovery upto 21.0m depth except from 6.0m to 7.50m depth and from 12.0m to 13.50m depth wherein the strata is classified as Highly weathered and highly fractured yellowish color Sandstone/siltstone with core recovery around 3%. Below 21.0m depth the strata is classified as Moderately weathered and fractured yellowish to grayish color Sand stone with Core recovery varying from 74% to 90%. RQD is Nil upto 21.0m depth and below 21.0m depth RQD is varying from 62% to 78% upto the depth drilled.

BH 5

Rocky strata was observed from 8.00m depth. The overburden strata is classified as Filled up soil upto 0.50m depth followed by non-plastic Silty sand with gravel (SM). The rocky strata is classified as Highly weathered disintegrated rock with no core recovery upto 21.0m depth except from 6.0m to 7.50m depth and from 12.0m to 13.50m depth wherein the strata is classified as Highly weathered and highly fractured yellowish color Sandstone/siltstone with core recovery around 3%. Below 21.0m depth the strata is classified as Moderately weathered and fractured yellowish to grayish color Sand stone with Core recovery varying from 74% to 90%. RQD is Nil upto 21.0m depth and below 21.0m depth RQD is varying from 62% to 78% upto the depth drilled.

Boiler Area

Five bore holes (BH6, BH 7, BH 8, BH 9 and BH 11) were drilled at the proposed Boiler Area upto 25m depth. The Boreholes were advanced by Shell and auger method upto the refusal depth. While advancing the bore holes SPT tests were conducted at regular intervals of 1.5m depth and

representative samples were collected and analyzed for soil classification. From the soil classification it revealed that the strata consists of filled up soil upto varying depths of 0.30m to 0.70m followed by non-plastic yellowish color Sandy Silt with gravel/Silty sand with gravel (SM) and Silty clay mixed with Sand (CI). Rocky strata was obtained at varying depths of 3.50m to 8.50m. In rocky strata the boreholes were advanced by Hydraulic feed rotary drilling machine using Nx size Diamond Core bit upto the specified depth. From the samples of the core recovery, drill log, representative samples, wash samples and return of drilled water from bore holes the refusal strata is classified as highly weathered disintegrated rock followed by highly weathered fractured rock. The details of each bore hole are as given below:

BH 6

Rocky strata was obtained at a depth of 8.50m below ground surface. The overburden strata is classified as Filled up soil upto 0.40m depth followed by Sandy silt with gravel(sSM-ML)/Silty sand with Gravel (SM). From the samples of the core recovery, drill log, representative samples, wash samples and return of drilled water from bore hole the refusal strata is classified as highly weathered and fractured Sand stone upto 12.0m depth and from 21m to 24.0m depth. From 12.0m to 21.0m depth the strata is classified as highly weathered disintegrated rock with no core recovery and RQD. From 24.0m to 25m depth the strata is classified as highly weathered and highly fractured Shale. From 8.50m to 12.0m depth the Core recovery is varying from 23% to 34%. From 12.0m to 21m depth the core recovery is Nil. From 21.0m to 25.0m depth the core recovery is varying from 42% to 46%. RQD is Nil except from 9.0m to 12.0m depth wherein RQD is around 23% and from 21.0m to 24.0m depth wherein RQD is varying from 10% to 18%.

BH 7

Rocky strata was obtained at a depth of 4.50m below ground surface. The overburden strata is classified as Filled up soil upto 0.50m depth followed by Silty Clay mixed with Sand (CI). From the samples of the core recovery,

drill log, representative samples, wash samples and return of drilled water from bore hole the refusal strata is classified as highly weathered and highly fractured Sand stone upto 15.0m depth and from 18.0m to 21.0m depth. From 15.0m to 18.0m depth the strata is classified as highly weathered disintegrated rock with no core recovery and RQD. From 21.0m to 25m depth the strata is classified as highly weathered and fractured Sand stone. The core recovery is varying from 8% to 71% except from 15.0m to 18.0m depth wherein the core recovery is Nil. RQD is Nil except from 4.50m to 6.0m (RQD around 9%) , from 18.0m to 21.m (RQD varying from 14% to 19% and from 21.0m to 25m depth (RQD varying from 45% to 69%.)

BH 8

Rocky strata was obtained at a depth of 3.50m below ground surface. The overburden strata is classified as filled up soil upto 0.70m depth followed by Silty Clay mixed with Sand (CI). From the samples of the core recovery, drill log, representative samples, wash samples and return of drilled water from bore hole the refusal strata is classified as alternate layers of highly weathered and highly fractured Sand stone (Core recovery varying from 10% to 41%) and Highly weathered disintegrated rock (Nil Core recovery) upto 13.50m depth. From 13.50m to 18.0m depth and from 21.0m to 25.0m depth the strata is classified as highly weathered and fractured Sandstone/siltstone. From 18.0m to 21.0m depth the strata is classified as Highly weathered and fractured Shale. Below 13.50m depth the core recovery is varying from 22% to 74% and RQD is varying from 10% to 61%.

BH 9

Rocky strata was obtained at a depth of 6.00m below ground surface. The overburden strata is classified as filled up soil upto0.50m depth followed by Sandy silt with gravel(SM-ML)/Silty Clay of medium Plasticity(CI). From the samples of the core recovery, drill log, representative samples, wash samples and return of drilled water from bore hole the refusal strata is classified as Highly weathered disintegrated rock (Nil Core recovery) upto 10.50m depth followed by highly weathered and fractured

Sandstone/siltstone upto 22.50m depth. Below 22.50m depth the strata is classified as Highly weathered fractured Shale upto the depth drilled. The core recovery is varying from 10% to 72%. RQD is Nil upto 19.50m depth and below 19.50m depth RQD is varying from 12% to 55%.

BH 11

Rocky strata was obtained at a depth of 3.50m below ground surface. The overburden strata is classified as filled up soil upto 0.30m depth followed by Silty clay of Medium Plasticity (CI). From the samples of the core recovery, drill log, representative samples, wash samples and return of drilled water from bore hole the refusal strata is classified as highly weathered and fractured Sand stone upto 16.50m depth and from 19.50m to 22.50m depth. From 16.50m to 19.50m depth the strata is classified as highly weathered disintegrated rock with no core recovery and RQD. From 22.50m to 25m depth the strata is classified as highly weathered and highly fractured Shale. Core recovery is varying from 12% to 69% except from 16.5m to 19.50m depth wherein the core recovery is Nil. RQD is varying from 7% to 35% except from 3.50m to 6.0m and from 16.50m to 21.0m depth wherein RQD is Nil.

The rock samples on saturation were dissolved. Only Density tests were performed on the samples.

Storage Tank & Pump House

At this location One Borehole (BH 10) was drilled upto 25m depth. The Borehole was advanced by Shell and auger method upto the refusal depth. While advancing the bore hole SPT tests were conducted at regular intervals of 1.5m depth and representative samples were collected and analyzed for soil classification. From the soil classification it revealed that the strata consists of Filled up soil upto 0.75m depth followed by Silty clay mixed with Sand (CI) upto 4.0m depth. Below 4.0m depth the strata consists of non-plastic Silty sand with gravel (SM) upto the rocky strata depth. Rocky strata was obtained at 6.50m depth. In rocky strata the borehole was advanced by Hydraulic feed rotary drilling machine using Nx size Diamond Core bit upto the specified depth. From the samples of the

core recovery, drill log, representative samples, wash samples and return of drilled water from bore holes the refusal strata is classified as alternate layers highly weathered disintegrated rock (Core recovery Nil) and Highly weathered and fractured Sand Stone (Core recovery 10% to 29%) of varying thickness. RQD is Nil except from 15.0m to 16.50m depth wherein RQD is around 23%.

ESP

At this location Three Boreholes (BH 12 to BH 14) were drilled upto 20m depth. The Boreholes were advanced by Shell and auger method upto the refusal depth. While advancing the bore holes SPT tests were conducted at regular intervals of 1.5m depth and representative samples were collected and analyzed for soil classification. From the soil classification it revealed that the strata consists of Filled up soil upto varying depth of 0.50m to 3.0m depth followed by Silty clay of Medium Plasticity (CI) upto the rocky strata depth. Rocky strata was obtained at varying depths of 3.50m to 6.0m depth. In rocky strata the boreholes were advanced by Hydraulic feed rotary drilling machine using Nx size Diamond Core bit upto the specified depth. From the samples of the core recovery, drill log, representative samples, wash samples and return of drilled water from bore holes the refusal strata is classified as highly weathered and fractured sand stone / Silt stone. The details of classification, Core recovery and RQD are as given below:

BH 12

Rocky strata was observed from 3.50m depth. The overburden strata is classified as Filled up soil upto 0.50m depth followed by Silty clay of Medium Plasticity (CI). The rocky strata is classified as Highly weathered and highly fractured / fractured yellowish color Sandstone/ Silt Stone upto the depth drilled with core recovery varying from 30% to 54%. RQD is varying from 7% to 54% except from 3.50m to 4.50m depth and from 12.0m to 13.50m depth.

BH 13

Rocky strata was observed from 6.00m depth. The rocky strata is classified as Highly weathered and fractured yellowish color Sandstone/ Silt Stone upto 12.0m depth followed by Highly weathered disintegrated silt stone upto the depth drilled. Core recovery is varying from 34% to 61% upto 12.0m depth and below 12.0m depth the core recovery is Nil. RQD is varying from 10% to 33% upto 12.0m depth and below 12.0m depth RQD is Nil upto the depth drilled.

BH 14

Rocky strata was observed from 4.50m depth. The overburden strata is classified as Filled up soil upto 3.0m depth followed by Silty clay of Medium Plasticity (CI). The rocky strata is classified as Highly weathered and highly fractured / fractured yellowish color Sandstone/ Silt Stone upto the depth drilled with core recovery varying from 15% to 57%. RQD is varying from 18% to 53% except from 4.50m to 9.0m depth and from 12.0m to 13.50m depth.

Chimney

At this location One Borehole (BH 16) was drilled upto 25m depth. The Borehole was advanced by Shell and auger method upto the refusal depth. While advancing the bore hole SPT tests were conducted at regular intervals of 1.5m depth and representative samples were collected and analyzed for soil classification. From the soil classification it revealed that the strata consists of Filled up soil upto 3.0m depth followed by Silty clay of Medium Plasticity (CI) upto 8.50m depth. Below 8.50m depth the strata consists of Sandy Silt (SM-ML) upto the rocky strata depth. Rocky strata was obtained at 9.50m depth. In rocky strata the borehole was advanced by Hydraulic feed rotary drilling machine using Nx size Diamond Core bit upto the specified depth. From the samples of the core recovery, drill log, representative samples, wash samples and return of drilled water from bore holes the refusal strata is classified as Highly weathered and fractured Silt Stone / Sand stone / Highly weathered disintegrated rock. Core recovery is varying from 10% to 22% except from 10.50m to 13.50m depth,

and 21.0m to 22.50m depth wherein the Core recovery is Nil. RQD is Nil except from 13.50m to 15.0m depth and from 16.50m to 18.0m depth wherein the RQD is around 17% to18%.

Switch Yard

At this location One Borehole (BH 32) was drilled upto 15m depth. The Boreholes were advanced by Shell and auger method upto the refusal depth. While advancing the bore holes SPT tests were conducted at regular intervals of 1.5m depth and representative samples were collected and analyzed for soil classification. From the soil classification it revealed that the strata consists of Filled up soil upto 1.30m depth followed by Silty Clay mixed with Sand (CH) upto the rocky strata depth. Rocky strata was obtained at varying depths of 4.50m depth. In rocky strata the boreholes were advanced by Hydraulic feed rotary drilling machine using Nx size Diamond Core bit upto the specified depth. From the samples of the core recovery, drill log, representative samples, wash samples and return of drilled water from bore holes the refusal strata is classified as highly weathered and fractured Sand Stone. Core recovery is varying from 17% to 92%. RQD is varying from 12% to 83% except from 7.50m to 9.0m depth wherein RQD is Nil.

6.0 DESIGN CRITERIA

As the refusal stratum has been encountered at shallow depths footing foundation has been analysed. The analysis is based on SPT & ϕ values as there is no core recovery or core recovery is less.

The water table was encountered at shallow depths. The water table was considered at ground level and accordingly correction factor has been considered as 0.50 for design purpose.

An allowable settlements of 25mm and 40mm has been considered for the analysis of footing foundation and raft foundation respectively.

6.1.1 Foundation resting on Non Plastic strata (Based on SPT & ϕ.)

a) Shear failure criteria

The safe bearing pressure from Shear failure criteria can be obtained, using the equation given below as per IS 6403- 1981.

$Qu = q (N_q - 1) S_q D_q I_q + 0.5 B \gamma N_\gamma S_\gamma D_\gamma I_\gamma W$

Where,

B = Width of the footing in m

D_q, D_γ = Depth factors

S_q, S_γ = Shape factors

I_q, I_γ = Inclination factors

N_q, N_γ = Bearing capacity factor

q = Effective overburden pressure at foundation, in t/m^2

W' = Water table correction factor

γ = Bulk unit wt. of foundation soil, in t/m^3

General Shear Failure:

When $\phi > 36$

Local Shear Failure:

When $\phi < 28$

The values obtained are falling in between General Shear and Local Shear hence the values have interpolated between the above two as per IS 6403- 1981.

b) Settlements:

a) Soil profiles are given for each borehole. The soil profile, which is likely to cause greater settlements, is to be considered for calculations.

b) The imposed load at the foundation level is likely to compress the soil up to a depth of approximately equal to 1.5B below the foundations.

c) The settlements can be calculated using Fig No 9 of IS: 8009 Part 1 & 2, 1976.

7.0 COMPUTATION

BH 1 & BH 2 (TRANSFORMER YARD)

Footing Foundation

Considering formation Level @ RL 199.50

Shear Failure Criteria

Case I

Df @ 196.50 **B = 2.00m**

ϕ = 34, (As per Fig 1 of IS 6403)

ϕ' = 24, average ϕ = 28 F.O.S = 2.5

N_q= 14.72, N_r = 16.72 , S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\ (N_q-1)\ s_q\ d_q\ i_q + 0.5\ B\ \gamma\ N_\gamma\ s_\gamma\ d_\gamma\ i_\gamma\ W'$

Substituting the data in the equation given, we get

Q_{ult} = 39.608 t/m^2 Q_{safe} = 15.84 t/m^2

Case II

Df @ 196.50 **B = 3.00m**

ϕ = 34, (As per Fig 1 of IS 6403)

ϕ' = 24, average ϕ = 28 F.O.S = 2.5

N_q= 14.72, N_r = 16.72 , S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\ (N_q-1)\ s_q\ d_q\ i_q + 0.5\ B\ \gamma\ N_\gamma\ s_\gamma\ d_\gamma\ i_\gamma\ W'$

Substituting the data in the equation given, we get

Q_{ult} = 43.24 t/m^2 Q_{safe} = 17.29 t/m^2

Case III

Df @ 196.50 **B = 4.00m**

ϕ = 34, (As per Fig 1 of IS 6403)

ϕ' = 24, average ϕ = 28 F.O.S = 2.5

N_q= 14.72, N_r = 16.72 , S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\ (N_q-1)\ s_q\ d_q\ i_q + 0.5\ B\ \gamma\ N_\gamma\ s_\gamma\ d_\gamma\ i_\gamma\ W'$

Substituting the data in the equation given, we get

Q_{ult} = 46.296 t/m^2 Q_{safe} = 18.51 t/m^2

Case IV

Df @ 195.50 **B = 2.00m**

ϕ = 34, (As per Fig 1 of IS 6403)

ϕ' = 24, average ϕ = 28 F.O.S = 2.5

N_q= 14.72, N_r = 16.72 , S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\ (N_q\text{-}1)\ s_q\ d_q\ i_q + 0.5\ B\ \gamma\ N_\gamma\ s_\gamma\ d_\gamma\ i_\gamma\ W'$

Substituting the data in the equation given, we get

Q_{ult} = 56.06 t/m^2

Q_{safe} = 22.42 t/m^2

Case V

Df @ 195.50 **B = 3.00m**

ϕ = 34, (As per Fig 1 of IS 6403)

ϕ' = 24, average ϕ = 28 F.O.S = 2.5

N_q= 14.72, N_r = 16.72 , S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\ (N_q\text{-}1)\ s_q\ d_q\ i_q + 0.5\ B\ \gamma\ N_\gamma\ s_\gamma\ d_\gamma\ i_\gamma\ W'$

Substituting the data in the equation given, we get

Q_{ult} = 59.70t/m^2

Q_{safe} = 23.88 t/m^2

Case VI

Df @ 195.50 **B = 4.00m**

ϕ = 34, (As per Fig 1 of IS 6403)

ϕ' = 24, average ϕ = 28 F.O.S = 2.5

N_q= 14.72, N_r = 16.72 , S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\ (N_q\text{-}1)\ s_q\ d_q\ i_q + 0.5\ B\ \gamma\ N_\gamma\ s_\gamma\ d_\gamma\ i_\gamma\ W'$

Substituting the data in the equation given, we get

Q_{ult} = 62.756 t/m^2

Q_{safe} = 25.10 t/m^2

Settlement Criteria

Df (RL of Foundation depth in m)	@ RL 196.50			@ RL 195.50		
B (Width of foundation in m)	2	3	4	2	3	4
Settlement under footing with a load intensity of 10 t/m^2 in dry condition (mm)	5	5	5	5	5	5
Settlement under footing with a load intensity of 10 t/m^2 with water table correction(mm)	10	10	10	10	10	10
Settlement under footing with a load intensity of 10 t/m^2 with water table and depth correction(mm)	8	8	9	7	8	8
Net safe bearing pressure for allowable settlement of 25 mm (t/m^2)	31.25	31.25	27.77	35.71	31.25	31.25

BH 3 to BH 5 (Power House Block)

Footing Foundation

Considering formation Level @ RL 199.500

Shear Failure Criteria

Case I

Df @ 194.50 **B = 3.00m**

ϕ = 36, (As per Fig 1 of IS 6403)

ϕ' = 26, average ϕ = 31 F.O.S = 2.5

N_q= 20.63, N_r = 30.22, S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\,(N_q-1)\,s_q\,d_q\,i_q + 0.5\,B\,\gamma\,N_\gamma\,s_\gamma\,d_\gamma\,i_\gamma\,W'$

Substituting the data in the equation given, we get

Q_{ult} = 135.91 t/m^2

Q_{safe} = 54.36 t/m^2

Case II

Df @ 194.50 **B = 5.00m**

ϕ = 36, (As per Fig 1 of IS 6403)

ϕ' = 26, average ϕ = 31 F.O.S = 2.5

N_q= 20.63, N_r = 30.22, S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\ (N_q-1)\ s_q\ d_q\ i_q + 0.5\ B\ \gamma\ N_\gamma\ s_\gamma\ d_\gamma\ i_\gamma\ W'$

Substituting the data in the equation given, we get

Q_{ult} = 147.996 t/m^2

Q_{safe} = 59.19 t/m^2

Case III

Df @ 193.50 B = 3.00m

ϕ = 36, (As per Fig 1 of IS 6403)

ϕ' = 26, average ϕ = 31 F.O.S = 2.5

N_q= 20.63, N_r = 30.22, S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\ (N_q-1)\ s_q\ d_q\ i_q + 0.5\ B\ \gamma\ N_\gamma\ s_\gamma\ d_\gamma\ i_\gamma\ W'$

Substituting the data in the equation given, we get

Q_{ult} = 159.466 t/m^2

Q_{safe} = 63.78 t/m^2

Case IV

Df @ 193.50 B = 5.00m

ϕ = 36, (As per Fig 1 of IS 6403)

ϕ' = 26, average ϕ = 31 F.O.S = 2.5

N_q= 20.63, N_r = 30.22, S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\ (N_q-1)\ s_q\ d_q\ i_q + 0.5\ B\ \gamma\ N_\gamma\ s_\gamma\ d_\gamma\ i_\gamma\ W'$

Substituting the data in the equation given, we get

Q_{ult} = 171.546 t/m^2

Q_{safe} = 68.61 t/m^2

Settlement Criteria

Df (RL of Foundation depth in m)	Df @ RL 194.50		Df @ RL 193.50	
B (Width of foundation in m)	**3.0m**	**5.0m**	**3.0m**	**5.0m**
Settlement under footing with a load intensity of 10 t/m^2 in dry condition	4.3mm	4.5mm	4.3mm	4.5mm
Settlement under footing with a load intensity of 10 t/m^2 with water table correction	9mm	9mm	9mm	9mm
Settlement under footing with a load intensity of 10 t/m^2 with water table and depth correction	6mm	7mm	5.7mm	6.5mm
Net safe bearing pressure for allowable settlement of 25 mm (t/m^2)	41.66	35.71	43.88	38.46

Alternatively Raft Foundation

Shear Failure Criteria

Case I

Df @ 194.50 **B >6.00m**

ϕ = 36, (As per Fig 1 of IS 6403)

ϕ' = 26, average ϕ = 31 F.O.S = 2.5

N_q= 20.63, N_r = 30.22, S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\ (N_q-1)\ s_q\ d_q\ i_q + 0.5\ B\ \gamma\ N_\gamma\ s_\gamma\ d_\gamma\ i_\gamma\ W'$

Substituting the data in the equation given, we get

Q_{ult} = 154.04t/m^2 `Q_{safe} = 61.61 t/m^2

Case II

Df @ 193.50 **B >6.00m**

ϕ = 36, (As per Fig 1 of IS 6403)

ϕ' = 26, average ϕ = 31 F.O.S = 2.5

N_q= 20.63, N_r = 30.22, S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\ (N_q\text{-}1)\ s_q\ d_q\ i_q + 0.5\ B\ \gamma\ N_\gamma\ s_\gamma\ d_\gamma\ i_\gamma\ W'$

Substituting the data in the equation given, we get

Q_{ult} = 177.59 t/m² ` Q_{safe} = 71.03 t/m²

Settlement Criteria

Df (RL of Foundation depth in m)	Df@ RL 194.50	Df@ RL 193.50
Settlement under footing with a load intensity of 10 t/m² in dry condition	5mm	5mm
Settlement under footing with a load intensity of 10 t/m² with water table correction	10mm	10mm
Settlement under footing with a load intensity of 10 t/m² with water table, depth and rigidity correction	8mm	8mm
Net safe bearing pressure for allowable settlement of 40 mm (t/m²)	50	50

BH 6 to BH 9 & BH 11 (Boiler)

Footing Foundation

Considering formation Level @ RL 199.500

Shear Failure Criteria

Case I

Df @ 194.50 **B = 3.00m**

ϕ = 36, (As per Fig 1 of IS 6403)

ϕ' = 26, average ϕ = 31 F.O.S = 2.5

N_q= 20.63, N_r = 30.22, S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\ (N_q\text{-}1)\ s_q\ d_q\ i_q + 0.5\ B\ \gamma\ N_\gamma\ s_\gamma\ d_\gamma\ i_\gamma\ W'$

Substituting the data in the equation given, we get

Q_{ult} = 135.91t/m² ` Q_{safe} = 54.36 t/m²

Case II

Df @ 194.50 **B = 5.00m**

ϕ = 36, (As per Fig 1 of IS 6403)

ϕ' = 26, average ϕ = 31 F.O.S = 2.5

N_q= 20.63, N_r = 30.22, S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\ (N_q\text{-}1)\ s_q\ d_q\ i_q + 0.5\ B\ \gamma\ N_\gamma\ s_\gamma\ d_\gamma\ i_\gamma\ W'$

Substituting the data in the equation given, we get

Q_{ult} = 147.9 t/m^2 Q_{safe} = 59.20 t/m^2

Case III

Df @ 193.50 B = 3.00m

ϕ = 36, (As per Fig 1 of IS 6403)

ϕ' = 26, average ϕ = 31 F.O.S = 2.5

N_q= 20.63, N_r = 30.22, S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\ (N_q\text{-}1)\ s_q\ d_q\ i_q + 0.5\ B\ \gamma\ N_\gamma\ s_\gamma\ d_\gamma\ i_\gamma\ W'$

Substituting the data in the equation given, we get

Q_{ult} = 159.466 t/m^2 Q_{safe} = 63.78 t/m^2

Case IV

Df @ 193.50 B = 5.00m

ϕ = 36, (As per Fig 1 of IS 6403)

ϕ' = 26, average ϕ = 31 F.O.S = 2.5

N_q= 20.63, N_r = 30.22, S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\ (N_q\text{-}1)\ s_q\ d_q\ i_q + 0.5\ B\ \gamma\ N_\gamma\ s_\gamma\ d_\gamma\ i_\gamma\ W'$

Substituting the data in the equation given, we get

Q_{ult} = 171.546 t/m^2 Q_{safe} = 68.61 t/m^2

Settlement Criteria

Df (RL of Foundation depth in m)	Df @ RL 194.50		Df @ RL 193.50	
B (Width of foundation in m)	**3.0m**	**5.0m**	**3.0m**	**5.0m**
Settlement under footing with a load intensity of 10 t/m^2 in dry condition	4.3mm	4.5mm	4.3mm	4.5mm
Settlement under footing with a load intensity of 10 t/m^2 with water table correction	9mm	9mm	9mm	9mm
Settlement under footing with a load intensity of 10 t/m^2 with water table and depth correction	6mm	7mm	5.7mm	6.5mm
Net safe bearing pressure for allowable settlement of 25 mm (t/m^2)	41.66	35.71	43.88	38.46

Alternatively Raft Foundation

Shear Failure Criteria

Case I

Df @ 194.50 **B >6.00m**

ϕ = 36, (As per Fig 1 of IS 6403)

ϕ' = 26, average ϕ = 31 F.O.S = 2.5

N_q= 20.63, N_r = 30.22, S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\ (N_q-1)\ s_q\ d_q\ i_q + 0.5\ B\ \gamma\ N_\gamma\ s_\gamma\ d_\gamma\ i_\gamma\ W'$

Substituting the data in the equation given, we get

Q_{ult} = 154.04t/m^2 Q_{safe} = 61.61 t/m^2

Case II

Df @ 193.50 **B >6.00m**

ϕ = 36, (As per Fig 1 of IS 6403)

ϕ' = 26, average ϕ = 31 F.O.S = 2.5

N_q= 20.63, N_r = 30.22, S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\ (N_q-1)\ s_q\ d_q\ i_q + 0.5\ B\ \gamma\ N_\gamma\ s_\gamma\ d_\gamma\ i_\gamma\ W'$

Substituting the data in the equation given, we get

Q_{ult} = 177.59 t/m^2

Q_{safe} = 71.03 t/m^2

Settlement Criteria

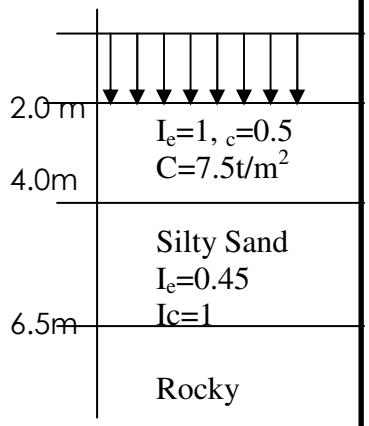
	Df@ RL 194.50	Df@ RL 193.50
Settlement under footing with a load intensity of 10 t/m^2 in dry condition	5mm	5mm
Settlement under footing with a load intensity of 10 t/m^2 with water table correction	10mm	10mm
Settlement under footing with a load intensity of 10 t/m^2 with water table, depth and rigidity correction	8mm	8mm
Net safe bearing pressure for allowable settlement of 40 mm (t/m^2)	50	50

Storage Tank (BH 10)

Considering formation Level @ RL 199.500

Df=197.50 Considering Dia of Tank 15.0m

Pad Foundation



Shear Failure Criteria

Average cohesion, c = 7.50 t/m^2

N_c = 5.14, s_c = 1.30; d_c = i_c = 1

Using the equation

$Q_{ult} = cN_cs_cd_ci_cN$

Substituting the data in the equation given, we get

Q_{ult} = 7.50 X 5.14 X 1.3 = 50.115 t/m^2

Q_{safe} =20.04t/m^2

Settlement Criteria **Considering 16.0t/m²**

Settlement at Center

Settlement below the foundation can be obtained using the following equation,

S_{t1} = {H /C_r x Log (P+ δP / P)

Using equation

Substituting the data we get.

S_{t1} = 200/40 X Log {(3.0+16)/3.0}= 40.07 mm

S_{t2} = 250/190 X Log {(5.25+16)/5.25}= 7.99 mm

S_{t3} = 1000/250 X Log {(11.50+5.60)/11.50}= 6.879 mm

S_{t3}= S_{t1}+ S_{t2}+ S_{t3}=54.95 ≈ 55mm

Settlement at the edge

Settlement below the foundation can be obtained using the following equation,

S_{t1} = {H /C_r x Log (P+ δP / P)

Using equation

Substituting the data we get.

S_{t1} = 200/40 X Log {(3.0+8)/3.0}= 28.21 mm

S_{t2} = 250/190 X Log {(5.25+7.20)/5.25}= 4.934 mm

S_{t3} = 1000/250 X Log {(11.50+3.20)/11.50}= 4.26 mm

S_{t3}= S_{t1}+ S_{t2}+ S_{t3}=37.90≈ 38mm

While Hydro testing the tank, tank shall be loaded in stages. At each stage of loading settlement shall be stabilised.

BH 12 & BH 14 (ESP)

Footing Foundation

Considering formation Level @ RL 199.500

Shear Failure Criteria

Case I

Df @ 195.00 **B = 3.00m**

ϕ = 35, (As per Fig 1 of IS 6403)

ϕ' = 25, average ϕ = 30 F.O.S = 2.5

N_q= 18.40, N_r =22.40, S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\,(N_q-1)\,s_q\,d_q\,i_q + 0.5\,B\,\gamma\,N_\gamma\,s_\gamma\,d_\gamma\,i_\gamma\,W'$

Substituting the data in the equation given, we get

Q_{ult} = 96.96t/m^2

Q_{safe} = 38.78 t/m^2

Case II

Df @ 195.00 **B = 5.00m**

ϕ = 35, (As per Fig 1 of IS 6403)

ϕ' = 25, average ϕ = 30 F.O.S = 2.5

N_q= 18.40, N_r =22.40, S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\,(N_q-1)\,s_q\,d_q\,i_q + 0.5\,B\,\gamma\,N_\gamma\,s_\gamma\,d_\gamma\,i_\gamma\,W'$

Substituting the data in the equation given, we get

Q_{ult} = 110.40 t/m^2

Q_{safe} = 44.16 t/m^2

Case III

Df @ 193.50 **B = 3.00m**

ϕ = 35, (As per Fig 1 of IS 6403)

ϕ' = 25, average ϕ = 30 F.O.S = 2.5

N_q= 18.40, N_r =22.40, S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\,(N_q-1)\,s_q\,d_q\,i_q + 0.5\,B\,\gamma\,N_\gamma\,s_\gamma\,d_\gamma\,i_\gamma\,W'$

Substituting the data in the equation given, we get

Q_{ult} = 117.84 t/m^2

Q_{safe} = 47.13 t/m^2

Case IV

Df @ 193.50 **B = 5.00m**

ϕ = 35, (As per Fig 1 of IS 6403)

ϕ' = 25, average ϕ = 30 F.O.S = 2.5

N_q= 18.40, N_r =22.40, S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\ (N_q\text{-}1)\ s_q\ d_q\ i_q + 0.5\ B\ \gamma\ N_\gamma\ s_\gamma\ d_\gamma\ i_\gamma\ W'$

Substituting the data in the equation given, we get

Q_{ult} = 126.80t/m^2

Q_{safe} = 50.72 t/m^2

Settlement Criteria

Df (RL of Foundation depth in m)	**Df@ RL 195**		**Df@ RL 193.50**	
B (Width of foundation in m)	**B=3.0**	**B=5.0**	**B=3.0**	**B=5.0**
Settlement under footing with a load intensity of 10 t/m^2 in dry condition	5mm	5mm	5mm	5mm
Settlement under footing with a load intensity of 10 t/m^2 with water table correction	10mm	10mm	10mm	10mm
Settlement under footing with a load intensity of 10 t/m^2 with water table and depth correction	7mm	8mm	7mm	8mm
Net safe bearing pressure for allowable settlement of 25 mm (t/m^2)	35.71	31.25	35.71	31.25

BH 13 (ESP)

Footing Foundation

Considering formation Level @ RL 199.500

Shear Failure Criteria

Case I

Df @ 193.50 **B = 3.00m**

ϕ = 35, (As per Fig 1 of IS 6403)

ϕ' = 25, average ϕ = 30 F.O.S = 2.5

N_q= 18.40, N_r =22.40, S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\,(N_q-1)\,s_q\,d_q\,i_q + 0.5\,B\,\gamma\,N_\gamma\,s_\gamma\,d_\gamma\,i_\gamma\,W'$

Substituting the data in the equation given, we get

Q_{ult} = 117.84 t/m^2

Q_{safe} = 47.13 t/m^2

Case II

Df @ 193.50 **B = 5.00m**

ϕ = 35, (As per Fig 1 of IS 6403)

ϕ' = 25, average ϕ = 30 F.O.S = 2.5

N_q= 18.40, N_r =22.40, S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\,(N_q-1)\,s_q\,d_q\,i_q + 0.5\,B\,\gamma\,N_\gamma\,s_\gamma\,d_\gamma\,i_\gamma\,W'$

Substituting the data in the equation given, we get

Q_{ult} = 126.80t/m^2

Q_{safe} = 50.72 t/m^2

Settlement Criteria

Df (RL of Foundation depth in m)	Df@ RL 193.50	
B (Width of foundation in m)	B=3.0	B=5.0
Settlement under footing with a load intensity of 10 t/m^2 in dry condition	5mm	5mm
Settlement under footing with a load intensity of 10 t/m^2 with water table correction	10mm	10mm
Settlement under footing with a load intensity of 10 t/m^2 with water table and depth correction	7mm	8mm
Net safe bearing pressure for allowable settlement of 25 mm (t/m^2)	35.71	31.25

Alternatively Raft Foundation

BH 12 & BH 14 (ESP)

Shear Failure Criteria

Case I

Df @ 195.00 **B >6.00m**

ϕ = 35, (As per Fig 1 of IS 6403)

ϕ' = 25, average ϕ = 30 F.O.S = 2.5

N_q= 18.40, N_r =22.40, S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\ (N_q-1)\ s_q\ d_q\ i_q + 0.5\ B\ \gamma\ N_\gamma\ s_\gamma\ d_\gamma\ i_\gamma\ W'$

Substituting the data in the equation given, we get

Q_{ult} = 110.40t/m^2 Q_{safe} = 44.16 t/m^2

Case II

Df @ 193.50 **B >6.00m**

ϕ = 35, (As per Fig 1 of IS 6403)

ϕ' = 25, average ϕ = 30 F.O.S = 2.5

N_q= 18.40, N_r =22.40, S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\ (N_q\text{-}1)\ s_q\ d_q\ i_q + 0.5\ B\ \gamma\ N_\gamma\ s_\gamma\ d_\gamma\ i_\gamma\ W'$

Substituting the data in the equation given, we get

Q_{ult} = 131.28 t/m^2 Q_{safe} = 52.51 t/m^2

Settlement Criteria

Df = RL 195 to 193.50	
Settlement under footing with a load intensity of 10 t/m^2 in dry condition	5mm
Settlement under footing with a load intensity of 10 t/m^2 with water table correction	10mm
Settlement under footing with a load intensity of 10 t/m^2 with water table, depth and rigidity correction	8mm
Net safe bearing pressure for allowable settlement of 40 mm (t/m^2)	50

BH 13 (ESP)

Shear Failure Criteria

Case I

Df @ 193.50 **B >6.00m**

ϕ = 35, (As per Fig 1 of IS 6403)

ϕ' = 25, average ϕ = 30 F.O.S = 2.5

N_q= 18.40, N_r =22.40, S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\ (N_q\text{-}1)\ s_q\ d_q\ i_q + 0.5\ B\ \gamma\ N_\gamma\ s_\gamma\ d_\gamma\ i_\gamma\ W'$

Substituting the data in the equation given, we get

Q_{ult} = 131.28 t/m^2 Q_{safe} = 52.51 t/m^2

Settlement Criteria

Df = RL 193.50	
Settlement under footing with a load intensity of 10 t/m^2 in dry condition	5mm
Settlement under footing with a load intensity of 10 t/m^2 with water table correction	10mm
Settlement under footing with a load intensity of 10 t/m^2 with water table, depth and rigidity correction	8mm
Net safe bearing pressure for allowable settlement of 40 mm (t/m^2)	50

BH 16 (Chimney)

Raft Foundation

Considering formation Level @ RL 199.500

Shear Failure Criteria

Case I

Df @ 190.00 **B = 16.60m**

ϕ = 36, (As per Fig 1 of IS 6403)

ϕ' = 26, average ϕ = 31 F.O.S = 2.5

N_q= 20.63, N_r = 30.22, S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\ (N_q-1)\ s_q\ d_q\ i_q + 0.5\ B\ \gamma\ N_\gamma\ s_\gamma\ d_\gamma\ i_\gamma\ W'$

Substituting the data in the equation given, we get

Q_{ult} = 304.91 t/m^2

Q_{safe} = 128.132 t/m^2

Settlement Criteria

Df 190.00	B=16.60 m
Settlement under footing with a load intensity of 10 t/m^2 in dry condition	5mm
Settlement under footing with a load intensity of 10 t/m^2 with water table correction	10mm
Settlement under footing with a load intensity of 10 t/m^2 with water table, depth and rigidity correction	8mm
Net safe bearing pressure for allowable settlement of 40 mm (t/m^2)	50

BH 32 (Switch Yard)

Considering formation Level @ RL199.500

Footing Foundation

Case I

Df @ RL 196.00

Shear Failure Criteria

Average cohesion, c = 4.50 t/m^2

N_c = 5.14, s_c = 1.30; d_c = i_c = 1

Using the equation

$Q_{ult} = cN_cs_cd_ci_cN$

Substituting the data in the equation given, we get

Q_{ult} = 4.50X 5.14 X 1.3 =30.069 t/m^2

Q_{safe} =12.02 t/m^2

Settlement Criteria

Considering 12.0t/m^2 **B= 2 to 4 m**

e_0= 0.82 C_c=0.063 C_r=150

Settlement below the foundation can be obtained using the following equation,

$S_{t1} = \{H /(1+e_o)\} x C_c x Log (P+ \delta P / P)$

$S_{t2} = \{H /C_r\} x Log (P+ \delta P / P)$

Using equation

Substituting the data we get.

S_{t1} = {(100/1.82)x0.063Log {((3.5+12)/3.50)}= 22.36mm

S_{t2} = {(200/150)xLog {((4.5+5.4)/4.50)}= 0.45mm

After depth correction < 25.0mm

Case II

Df @ 195.0 B = 2.00m

ϕ = 34, (As per Fig 1 of IS 6403)

ϕ' = 24, average ϕ = 28 F.O.S = 2.5

N_q= 14.72, N_r = 16.72 , S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\ (N_q-1)\ s_q\ d_q\ i_q + 0.5\ B\ \gamma\ N_\gamma\ s_\gamma\ d_\gamma\ i_\gamma\ W'$

Substituting the data in the equation given, we get

Q_{ult} = 64.30 t/m^2 ` Q_{safe} = 25.72 t/m^2

Case III

Df @ 195.00 B = 3.00m

ϕ = 34, (As per Fig 1 of IS 6403)

ϕ' = 24, average ϕ = 28 F.O.S = 2.5

N_q= 14.72, N_r = 16.72 , S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\ (N_q-1)\ s_q\ d_q\ i_q + 0.5\ B\ \gamma\ N_\gamma\ s_\gamma\ d_\gamma\ i_\gamma\ W'$

Substituting the data in the equation given, we get

Q_{ult} = 67.65 t/m^2 ` Q_{safe} = 27.06 t/m^2

Case IV

Df @ 195.00 B = 4.00m

ϕ = 34, (As per Fig 1 of IS 6403)

ϕ' = 24, average ϕ = 28 F.O.S = 2.5

N_q= 14.72, N_r = 16.72 , S_q =1.20, S_r = 0.80, W' = 0.50

Using the equation

$Q_{ult} = q\ (N_q-1)\ s_q\ d_q\ i_q + 0.5\ B\ \gamma\ N_\gamma\ s_\gamma\ d_\gamma\ i_\gamma\ W'$

Substituting the data in the equation given, we get

Q_{ult} = 70.976 t/m^2 ` Q_{safe} = 28.40 t/m^2

Settlement Criteria

Df 195.00	B=2 to 4
Settlement under footing with a load intensity of 10 t/m^2 in dry condition	5mm
Settlement under footing with a load intensity of 10 t/m^2 with water table correction	10mm
Settlement under footing with a load intensity of 10 t/m^2 with water table and depth correction	8mm
Net safe bearing pressure for allowable settlement of 25 mm (t/m^2)	31.00

BH 34 (Transformer Yard)

Considering formation Level @ RL199.500

Footing Foundation

Case I

Df @ RL 196.50

Shear Failure Criteria

Average cohesion, c = 20.0 t/m^2

N_c = 5.14, s_c = 1.30; d_c = i_c = 1

Using the equation

$Q_{ult} = cN_cs_cd_ci_cN$

Substituting the data in the equation given, we get

Q_{ult} = 20.0 X 5.14 X 1.3 = 133.64 t/m^2

Q_{safe} =53.45 t/m^2

Settlement Criteria

Case I

Considering 18.0t/m^2 B= 2 m

C_r=70

Settlement below the foundation can be obtained using the following equation,

S_{t1} = {H /Cr x Log (P+ δP / P)

Using equation

Substituting the data we get.

S_{t1} = {(300/70)Log {((4.50+9)/4.50)}= 20.45mm

After depth correction < 25.0mm

Case II

Considering 18.0t/m^2 B= 3 m

C_r=70

Settlement below the foundation can be obtained using the following equation,

S_{t1} = {H /Cr x Log (P+ δP / P)

Using equation

Substituting the data we get.

S_{t1} = {(450/70)Log {((5.25+9)/5.25)}= 27.88mm

After depth correction < 25.0mm

Case III

Considering 18.0t/m^2 B= 4 m

C_r=70

Settlement below the foundation can be obtained using the following equation,

S_{t1} = {H /Cr x Log (P+ δP / P)

Using equation

Substituting the data we get.

S_{t1} = {(600/70)Log {((6.00+8.50)/6.00)}=32.85mm

After depth correction < 25.0mm

Case II

Df @ RL 195.50

Shear Failure Criteria

Average cohesion, c = 20.0 t/m^2

N_c = 5.14, s_c = 1.30; d_c = i_c = 1

Using the equation

$Q_{ult} = cN_cs_cd_ci_cN$

Substituting the data in the equation given, we get

Q_{ult} = 20.0 X 5.14 X 1.3 = 133.64 t/m^2

Q_{safe} =53.45 t/m^2

Settlement Criteria

Case I

Considering 20.0t/m^2 B= 2 m C_r=70

Settlement below the foundation can be obtained using the following equation,

S_{t1} = {H /Cr x Log (P+ δP / P)

Using equation

Substituting the data we get.

S_{t1} = {(300/70)Log {((5.50+9)/5.50)}= 18.04mm

After depth correction < 25.0mm

Case II

Considering 20.0t/m^2 B= 3 m C_r=70

Settlement below the foundation can be obtained using the following equation,

S_{t1} = {H /Cr x Log (P+ δP / P)

Using equation

Substituting the data we get.

S_{t1} = {(450/70)Log {((6.25+9)/6.25)}=24.90mm

After depth correction < 25.0mm

Case III

Considering 20.0t/m^2 B= 4 m

C_r=70

Settlement below the foundation can be obtained using the following equation,

S_{t1} = {H /Cr x Log (P+ δP / P)

Using equation

Substituting the data we get.

S_{t1} = {(600/70)Log {((7.000+9.0)/7.00)}=30.76mm

After depth correction < 25.0mm

7.0 RECOMMENDATIONS

Transformer Yard

Footing Foundation is recommended. The depth of foundation, width of foundation and the safe bearing pressure are as given below:

BH	Df @ RL	Width of Fdn (m)	Safe Bearing pressure (t/m^2)
BH 1, BH 2 & BH 34	196.50	2	15
		3	17
		4	18
	195.50	2	20
		3	20
		4	20

Power House Block

Footing Foundation is recommended. The depth of foundation, width of foundation and the safe bearing pressure are as given below:

BH	Df @ RL	Width of Fdn (m)	Safe Bearing pressure (t/m^2)
BH 3 to BH 5	194.500	3.00	40
		5.00	35
	193.500	3.00	40
		5.00	38

Alternatively, Raft Foundation is recommended. The depth of foundation, width of foundation and the safe bearing pressure are as given below:

BH	Df @ RL	Width of Fdn (m)	Safe Bearing pressure (t/m^2)
BH 3 to BH 5	194.500	>6	50
	193.500	>6	50

Boiler

Footing Foundation is recommended. The depth of foundation, width of foundation and the safe bearing pressure are as given below:

BH	Df @ RL	Width of Fdn (m)	Net Safe Bearing pressure (t/m²)
BH 6 to 9 & BH 11	194.500	3.00	40
		5.00	35
	193.500	3.00	40
		5.00	38

Alternatively, Raft Foundation is recommended. The depth of foundation, width of foundation and the safe bearing pressure are as given below:

BH	Df @ RL	Width of Fdn (m)	Net Safe Bearing pressure (t/m²)
BH 6 to 9 & BH 11	194.500	>6	50
	193.500	>6	50

ESP

Footing Foundation is recommended. The depth of foundation, width of foundation and the safe bearing pressure are as given below:

BH	Df @ RL	Width of Fdn (m)	Net Safe Bearing pressure (t/m²)
BH 12 & BH 14	195.00 to 193.50	3	30
		5	31
BH 13	193.50	3	30
		5	31

Alternatively, Raft Foundation is recommended. The depth of foundation, width of foundation and the safe bearing pressure are as given below:

BH	Df @ RL	Width of Fdn (m)	Net Safe Bearing pressure (t/m²)
BH 12 & BH 14	193.50 to 195	>6	50
BH 13	193.50	>6	50

Switch Yard

Footing Foundation is recommended. The depth of foundation, width of foundation and the safe bearing pressure are as given below:

BH	Df @ RL	Width of Fdn (m)	Net Safe Bearing pressure (t/m²)
32	196	2 to 4	12
	195	2	25
		3	27
		4	28

Storage Tank (BH 10)

Pad foundation is recommended @ RL 197.50. A Net safe bearing pressure of 16 t/m^2 can be taken for the design of 10.0m dia pad Foundation. While hydro testing the tanks, loading can be done at eight stages. At each stage of load increment, the settlements shall be stabilised.

Chimney (BH 16)

Raft Foundation is recommended at RL 190.00.A net Safe bearing pressure of 50 t/m^2 can be taken for the design of Raft foundation for an allowable settlement of 40mm.

For all Structures

In case of any change in width of foundation and depth of foundation other than given above, recommendation for the changed sizes shall be provided as and when required.

For Soil Engineering Consultants

(AVS Ranga Rao)
Consultant

Annexure I

ROCK TEST RESULT

S.No	Area	BH	Depth (m)		Density (t/m^3)
			From	To	
1	Transformer Yard	1	7.50	9.00	2.09
2			9.00	10.50	2.02
3			10.50	12.00	2.14
4			12.00	13.50	2.07
5			13.50	15.00	2.09
6		2	5.00	6.00	2.15
7			6.00	7.50	2.14
8			7.50	9.00	2.07
9			9.00	10.50	2.26
10			10.50	12.00	2.24
11			12.00	13.50	2.23
12			13.50	15.00	2.12
13	Power Block	3	6.00	7.50	2.14
14			7.50	9.00	2.04
15			9.00	10.50	2.14
16			10.50	12.00	2.40
17			12.00	13.50	2.11
18			13.50	15.00	2.08
19			19.50	21.00	2.09
20			21.00	22.50	2.15
21			22.50	24.00	2.18
22			24.00	25.00	2.22
23		4	21.00	22.50	2.23
24			22.50	24.00	2.22
25			24.00	25.00	2.37
26		5	8.00	9.00	2.00
27			9.00	10.50	2.17
28	Boiler	6	8.00	9.50	2.13
29			9.50	10.50	2.15
30			10.50	12.00	2.15
31			21.00	22.50	2.21
32			22.50	24.00	2.23
33			24.00	25.00	2.32

S.No	Area	BH	Depth (m)		Density(t/m^3)
			From	To	
34	Boiler	7	4.50	6.00	2.23
35			6.00	7.50	2.27
36			7.50	9.00	2.12
37			9.00	10.50	2.28
38			10.50	12.00	2.25
39			12.00	13.50	2.23
40			18.00	19.50	2.16
41			19.50	21.00	2.29
42			21.00	22.50	2.14
43			22.50	24.00	2.12
44			24.00	25.00	2.25
45	Boiler	8	4.50	6.00	2.09
46			6.00	7.50	2.00
47			9.00	10.00	2.15
48			13.50	15.00	2.08
49			15.00	16.50	2.08
50			16.50	18.00	2.26
51			18.00	19.50	2.20
52			19.50	21.00	2.12
53			21.00	22.50	2.42
54			22.50	24.00	2.44
55			24.00	25.00	2.11
56		9	18.00	19.50	2.18
57			19.50	21.00	2.20
58			21.00	22.50	2.14
59			22.50	24.00	2.19
60			24.00	25.00	2.12
61		11	3.50	4.50	2.19
62			4.50	6.00	2.17
63			6.00	7.50	2.04
64			7.50	9.00	2.00
65			9.00	10.50	2.23
66			10.50	12.00	2.04
67			12.00	13.50	2.12
68			13.50	15.00	2.07
69			15.00	16.50	2.22
70			19.50	19.50	2.00
71			21.00	21.00	2.17
72			22.50	22.50	2.18
73			24.00	25.00	2.17

S.No	Area	BH	Depth(m)		Density(t/m^3)
			From	To	
74	Switch Yard	32	6.00	7.50	2.15
75			7.50	9.00	2.15
76			9.00	10.50	2.22
77			10.50	12.00	2.19
78			12.00	13.50	2.25
79			13.50	15.00	2.31

Annexure II

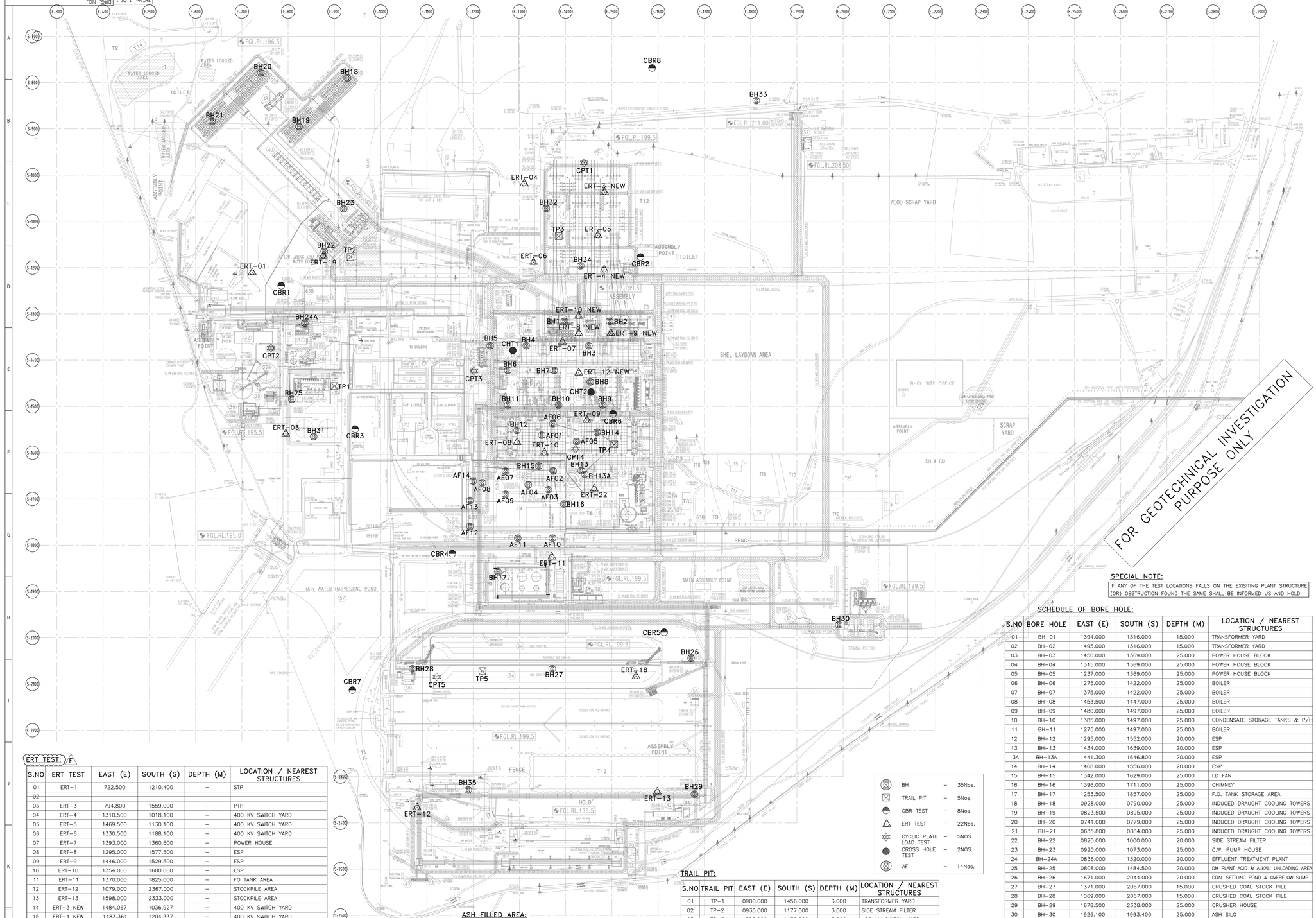
FREE SWELL INDEX

S.No	BH No	Depth	Free Swell Index (%)
1	1	1.8	0
2		3.3	0
3	2	1.8	0
4		3.3	0
5	3	3	0
6	7	1.8	0
7		3.3	0
8	8	3.3	0
9	9	3.3	0
10		4.8	0
11	11	1.8	0
12	32	1.8	0
13		3.3	0

BOREHOLE LOCATION PLAN

FIRST ANGLE PROJECTION

SHT No. 1 OF 1 DRG. NO. GID-208-CV-DWG-3002



S.NO	DESCRIPTION
55	SEPTIC TANK
54	STP COMMON COLLECTION SUMP
53	DM PLANT NEUTRALIZATION PIT
52	AHP VACUUM PUMP HOUSE
51	PTP COMMON SLUDGE SUMP
50	COAL SETTLING POND & OVERFLOW SUMP
49	IDCT MCC ROOM
48	DM PLANT ACID & ALKALI UNLOADING AREA
47	ETP RO-CONCENTRATE TANK
46	ETP RO-PERMEATE TANK
45	AHP CLARIFIER
44	CHP OFFICE BUILDING
43	TRACK HOPPER CONTROL ROOM
42	MAIN CHP CONTROL ROOM
41	CRUSHER HOUSE
40	SIDE STREAM FILTER
39	CHEMICAL HOUSE
38	CPU NUTRALISATION PIT
37	WEIGH BRIDGE
36	WAGON LOADING CONTROL & REMOTE SILO UTILITY BUILDING
35	HCSD PUMP & ART TANK
34	ASH SILO
33	EFFLUENT TREATMENT PLANT
32	CLARIFIED WATER RESERVOIR & PUMP HOUSE
31	NOT USED
30	C.W. PUMP HOUSE
29	INDUCED DRAUGHT COOLING TOWERS
28	PRE-TREATMENT AREA
27	CENTRAL MONITORING BASIN
26	RAW WATER PUMP HOUSE (EXISTING)
25	UNIDIRECTIONAL STACKER CUM RECLAIMER
24	CRUSHED COAL STOCK PILE
23	CPU REGENERATION BUILDING
22	ASH WATER PUMP HOUSE
21	COMPRESSOR HOUSE
20	HYDROGEN GEN. PLANT & STORAGE AREA
19	C.W. TREATMENT CUM CHLORINATION BUILDING
18	F.O. PRESSURISING PUMP HOUSE
17	F.O. TANK FIRM AREA
16	SPACE FOR FGD
15	FIRE WATER TANKS AND PUMPS
14	ASH SLURRY PUMP HOUSE
13	AHP/MILL REJECT SYS. COMPRESSOR HOUSE
12	I.D FAN
11	MILL BAY
10	CONDENSATE STORAGE TANKS & P/H
09	DIESEL GENERATOR BUILDING
08	TRANSFORMER YARD
07	CHIMNEY
06	ESP CONTROL ROOM
05	ESP
04	BOILER
03	POWER HOUSE BLOCK
02	SWITCH YARD CONTROL ROOM
01	400 KV SWITCH YARD

NOTES:

1. ALL DIMENSIONS, LEVELS AND CO-ORDINATES ARE IN METRES.
2. THE ENTIRE PLOT IS ON SAME GRADE LEVEL WHICH IS AROUND 199.5 M ABOVE MEAN SEA LEVEL (MSL).
3. TOP OF FINISHED GROUND FLOOR LEVEL OF POWER HOUSE BUILDING IS AT EL.(±)0.00 WHICH CORRESPONDS TO RL. 200 M.
4. ALL DIMENSIONS AND LOCATION FOR THE NEW BUILDING/PREMISES ARE INDICATIVE ONLY.

SPECIAL NOTE:

IF ANY OF THE TEST LOCATIONS FALLS ON THE EXISITING PLANT STRUCTURE (OR) OBSTRUCTION FOUND THE SAME SHALL BE INFORMED US AND HOLD

LEGENDS:

- ▨ – DENOTES ROADS TO BE CONSTRUCTED FOR THE PROPOSED UNITS.
- ▭ – DENOTES EXISTING ROADS FOR UNITS #1 & #2.
- ▭ – DENOTES PIPE RACK TO BE CONSTRUCTED FOR THE PROPOSED UNITS.
- ——— – BURIED PIPE.
- ⊗ – BORE HOLE

SCHEDULE OF BORE HOLE:

S.NO	BORE HOLE	EAST (E)	SOUTH (S)	DEPTH (M)	LOCATION / NEAREST STRUCTURES
01	BH-01	1394.000	1316.000	15.000	TRANSFORMER YARD
02	BH-02	1495.000	1316.000	15.000	TRANSFORMER YARD
03	BH-03	1450.000	1369.000	25.000	POWER HOUSE BLOCK
04	BH-04	1315.000	1369.000	25.000	POWER HOUSE BLOCK
05	BH-05	1237.000	1369.000	25.000	POWER HOUSE BLOCK
06	BH-06	1275.000	1422.000	25.000	BOILER
07	BH-07	1375.000	1422.000	25.000	BOILER
08	BH-08	1453.500	1447.000	25.000	BOILER
09	BH-09	1480.000	1497.000	25.000	BOILER
10	BH-10	1385.000	1497.000	25.000	CONDENSATE STORAGE TANKS & P/H
11	BH-11	1275.000	1497.000	25.000	BOILER
12	BH-12	1295.000	1552.000	20.000	ESP
13	BH-13	1434.000	1639.000	20.000	ESP
13A	BH-13A	1441.300	1646.800	20.000	ESP
14	BH-14	1468.000	1556.000	20.000	ESP
15	BH-15	1342.000	1629.000	25.000	I.D FAN
16	BH-16	1396.000	1711.000	25.000	CHIMNEY
17	BH-17	1253.500	1857.000	25.000	F.O. TANK STORAGE AREA
18	BH-18	0928.000	0790.000	25.000	INDUCED DRAUGHT COOLING TOWERS
19	BH-19	0823.500	0895.000	25.000	INDUCED DRAUGHT COOLING TOWERS
20	BH-20	0741.000	0779.000	25.000	INDUCED DRAUGHT COOLING TOWERS
21	BH-21	0635.800	0884.000	25.000	INDUCED DRAUGHT COOLING TOWERS
22	BH-22	0820.000	1000.000	20.000	SIDE STREAM FILTER
23	BH-23	0920.000	1073.000	25.000	C.W. PUMP HOUSE
24	BH-24A	0836.000	1320.000	20.000	EFFLUENT TREATMENT PLANT
25	BH-25	0808.000	1484.500	20.000	DM PLANT ACID & ALKALI UNLOADING AREA
26	BH-26	1671.000	2044.000	20.000	COAL SETTLING POND & OVERFLOW SUMP
27	BH-27	1371.000	2067.000	15.000	CRUSHED COAL STOCK PILE
28	BH-28	1069.000	2067.000	15.000	CRUSHED COAL STOCK PILE
29	BH-29	1678.500	2338.000	25.000	CRUSHER HOUSE
30	BH-30	1926.100	1993.400	25.000	ASH SILO
31	BH-31	0855.000	1565.500	20.000	DM PLANT NEUTRALIZATION PIT
32	BH-32	1358.000	1072.000	15.000	400 KV SWITCH YARD
33	BH-33	1812.000	0839.000	15.000	–
34	BH-34	1432.500	1196.000	15.000	TRANSFORMER YARD
35	BH-35	1189.500	2329.000	15.000	CRUSHED COAL STOCK PILE

CBR TEST:

S.NO	CBR TEST	EAST (E)	SOUTH (S)	DEPTH (M)	LOCATION / NEAREST STRUCTURES
01	CBR-1	0785.000	1239.000	0.500	CPU REGENERATION BUILDING
02	CBR-2	1562.000	1177.000	0.500	400 KV SWITCH YARD
03	CBR-3	0945.000	1549.000	0.500	–
04	CBR-4	1155.000	1818.000	0.500	–
05	CBR-5	1613.000	1988.000	0.500	–
06	CBR-6	1502.500	1516.000	0.500	ESP
07	CBR-7	0939.000	2113.000	0.500	–
08	CBR-8	1587.000	0768.500	0.500	–

ERT TEST: / F

S.NO	ERT TEST	EAST (E)	SOUTH (S)	DEPTH (M)	LOCATION / NEAREST STRUCTURES
01	ERT-1	722.500	1210.400	–	STP
02					
03	ERT-3	794.800	1559.000	–	PTP
04	ERT-4	1310.500	1018.100	–	400 KV SWITCH YARD
05	ERT-5	1469.500	1130.100	–	400 KV SWITCH YARD
06	ERT-6	1330.500	1188.100	–	400 KV SWITCH YARD
07	ERT-7	1393.000	1360.600	–	POWER HOUSE
08	ERT-8	1295.000	1577.500	–	ESP
09	ERT-9	1446.000	1529.500	–	ESP
10	ERT-10	1354.000	1600.000	–	ESP
11	ERT-11	1370.000	1825.000	–	FO TANK AREA
12	ERT-12	1079.000	2367.000	–	STOCKPILE AREA
13	ERT-13	1598.000	2333.000	–	STOCKPILE AREA
14	ERT-3 NEW	1484.067	1036.927	–	400 KV SWITCH YARD
15	ERT-4 NEW	1483.361	1204.337	–	400 KV SWITCH YARD
16	ERT-8 NEW	1428.944	1342.160	–	TRANSFORMER YARD
17	ERT-9 NEW	1497.703	1341.898	–	TRANSFORMER YARD
18	ERT-10 NEW	1427.909	1304.756	–	TRANSFORMER YARD
19	ERT-12 NEW	1428.305	1427.353	–	BOILER
20	ERT-18	1552.055	2083.572	–	CHP
21	ERT-19	876.000	1174.600	–	CWPH
22	ERT-22	1461.716	1678.005	–	AHP

CYCLIC PLATE LOAD TEST:

S.NO	CPL TEST	EAST (E)	SOUTH (S)	DEPTH (M)	LOCATION / NEAREST STRUCTURES
01	CPT-1	1440.000	0973.500	1.000/2.000	400 KV SWITCH YARD
02	CPT-2	0763.000	1373.500	1.000/2.000	CLARIFIED WATER RESERVOIR & PUMP HOUSE
03	CPT-3	1201.500	1423.500	1.000/2.000	BOILER
04	CPT-4	1421.500	1592.500	1.000/2.000	ESP
05	CPT-5	1121.500	2084.500	1.000/2.000	CRUSHED COAL STOCK PILE

ASH FILLED AREA:

S.NO	ASH FILL	EAST (E)	SOUTH (S)	DEPTH (M)	LOCATION / NEAREST STRUCTURES
1	AF-01	1348.376	1562.168	0.500	ESP AREA
2	AF-02	1373.222	1639.393	4.500	ID FAN
3	AF-03	1362.656	1679.783	5.000	ID FAN
4	AF-04	1319.085	1669.333	4.500	ID FAN
5	AF-05	1423.640	1575.600	2.500	ESP AREA
6	AF-06	1372.100	1536.500	0.500	ESP AREA
7	AF-07	1270.000	1640.000	1.500	AUXILIARY BUILDING
8	AF-08	1220.000	1665.000	2.500	NEAR AUXILIARY BUILDING
9	AF-09	1270.000	1690.000	3.000	NEAR AUXILIARY BUILDING
10	AF-10	1371.700	1784.700	2.800	RE-ROUTED PIPE RACK
11	AF-11	1296.400	1784.700	3.000	RE-ROUTED PIPE RACK
12	AF-12	1193.200	1759.500	4.500	RE-ROUTED PIPE RACK
13	AF-13	1193.000	1703.200	2.500	RE-ROUTED PIPE RACK
14	AF-14	1200.200	1661.300	1.500	RE-ROUTED PIPE RACK

BH	– 35Nos.
TRAIL PIT	– 5Nos.
CBR TEST	– 8Nos.
ERT TEST	– 22Nos.
CYCLIC PLATE LOAD TEST	– 5NOS.
CROSS HOLE TEST	– 2NOS.
AF	– 14Nos.

TRAIL PIT:

S.NO	TRAIL PIT	EAST (E)	SOUTH (S)	DEPTH (M)	LOCATION / NEAREST STRUCTURES
01	TP-1	0900.000	1456.000	3.000	TRANSFORMER YARD
02	TP-2	0935.000	1177.000	3.000	SIDE STREAM FILTER
03	TP-3	1385.000	1132.000	3.000	400 KV SWITCH YARD
04	TP-4	1505.000	1582.000	3.000	ESP
05	TP-5	1220.000	2072.000	3.000	CRUSHED COAL STOCK PILE

CROSS HOLE TEST:

S.NO	TRAIL PIT	EAST (E)	SOUTH (S)	DEPTH (M)	LOCATION / NEAREST STRUCTURES
01	CHT-1	1286.000	1379.000	15.000	POWER HOUSE BLOCK
02	CHT-2	1455.000	1469.000	15.000	POWER HOUSE BLOCK

LEGEND (NOISE MAPPING)

LOCATION	NEARBY VILLAGE	LATITUDE	LONGITUDE	REMARKS
A	BANAHARPALI	21°41'8.6778" N	83°52'19.5486" E	
B	PLANT ENTRY GATE	21°41'43.8498" N	83°51'45.4818" E	
C	BARGARH	21°41'31.902" N	83°51'18.0318" E	
D	BINKA	21°40'51.50" N	83°51'41.25" E	

ZONE	REV	DESCRIPTION	DATE	CIVIL	MECH.	ELEC.	HPCE
	F	REVISED AS MARKED AS EXECUTED	08.09.15				
	E	REVISED BASED ON OPGCL/DCPL COMMENTS ISSUED VIDE LETTER NO. OPGC/BOP/0321 DATED. 13.02.14	02.05.14	-Sd-	-Sd-	-Sd-	-Sd-
	D	REVISED BASED ON DCPL COMMENTS VIDE EMAIL DATED: 11.02.14	21.02.14	-Sd-	-Sd-	-Sd-	-Sd-
	C	REVISED AS PER LATEST PLOT PLAN DATED: 21.12.13	22.01.14	-Sd-	-Sd-	-Sd-	-Sd-
	B	REVISED FOR NEW ERT LOCATIONS AS PER 2013.09.05 BGRE-S-MOM.	07.09.13	-Sd-	-Sd-	-Sd-	-Sd-
	A	ISSUED FOR APPROVAL	22.07.13	-Sd-	-Sd-	-Sd-	-Sd-

REVISIONS APPROVED

DO NOT SCALE THE DRAWING

POWER PROJECTS DIVISION

OWNER

ORISSA POWER GENERATION CORPORATION LIMITED

PROJECT

IB THERMAL POWER STATION, BANHARPALI

2 X 660 MW UNITS 3 & 4

OWNER'S CONSULTANT

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA . MUMBAI . CHENNAI . NEW DELHI

BOP CONTRACTOR

BGR ENERGY SYSTEMS LIMITED
CHENNAI - INDIA

	NAME	SIGN	DATE	SHEET	NO.OF VAR.
DRN.	NK/MMR	-Sd-	22.07.13	A0	N.A.
PRP.	GM	-Sd-	22.07.13		
CHD.	SPR	-Sd-	22.07.13		
APPD.	JV/TVBSSM	-Sd-	22.07.13		
DEPT.	UNTOL. DIMS. ± X/M/F	SCALE 1:3000	WEIGHT (KG) N.A.	REF. TO ASSY. DRG. N.A.	ITEM NO. N.A.	NO.OF ITEMS N.A.
CODE.						

TITLE: LAYOUT PLAN FOR BORE HOLES & OTHER FIELD TESTS LOCATION.

CARD CODE -NA-

DRAWING NO. GID-208-CV-DWG-3002

REV. F

SHT. No. 1 OF 1

FILE NAME:- GID-208-CV-DWG-3002

BORE LOGS

BORE LOG

SOIL ENGINEERING CONSULTANTS

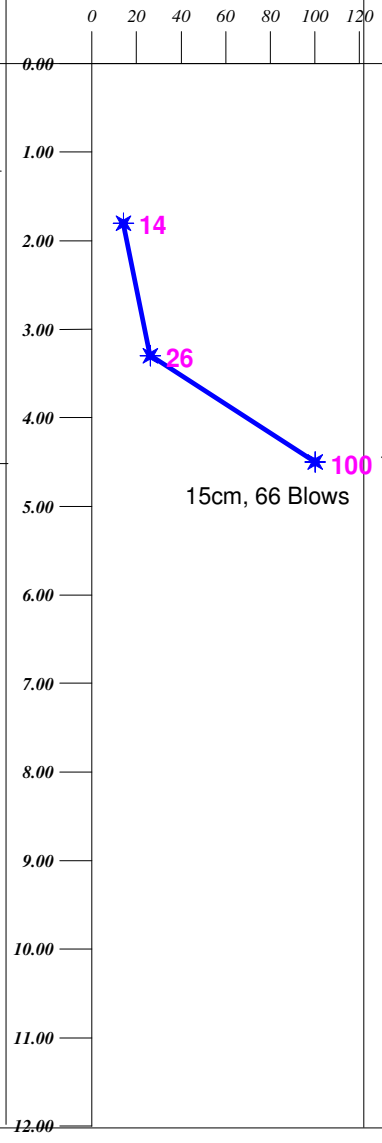
PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Coordinate: 1394 E, 1316 S **RL: 203.000** Project No: 1988

Location: Transformer Yard BH No. : 1 DEPTH : 15.00m Depth of Water Table : 2.60m Date of Start : 28/09/2013 Date of Finish : 30/09/2013

Reduced Level (m)	Depth (m)	Type of sample	Soil Classification	Gravel	Sand	Silt/Clay	r(wet)	r(dry)	W(%)	L.L	P . L	Sp.Gr	Shear Parameters: Type of test	Shear Parameters: C(kg/sq.cm)	Shear Parameters: phi(degrees)	Cc
203.000	0.00		Filledup Soil (Soil Mixed with Building Material)													
201.200	1.80	SPT		1	14	63/22				48	26					
200.500	2.50	UDS	Silty Clay of medium to High Plasticity (CH)				1.84	1.51	21.83			2.75	UU	0.83	2	0.059
199.700	3.30	SPT		2	24	57/17				51	26					
198.500	4.50	SPT	Refusal Strata	12	57	31				Non Plastic						

S.P.T Plot



BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Coordinate: 1394 E, 1316 S **RL: 203.000** Project No: 1988

Location: Transformer Yard BH No. : 1 DEPTH : 15.00m Depth of Water Table : 2.60m

Date of Start : 28/09/2013 Date of Finish : 30/09/2013

REDUCED LEVEL (m)	DEPTH (m)	LITHOLOGY: DESCRIPTION	LOG	Size of core pieces: < 10 mm size / 10 to 25 mm / 25 to 75 mm / 75 to 150 mm / > 150 mm	STRUCTURAL CONDITIONS: DESCRIPTION	PERCENT CORE RECOVERY (0 20 40 60 80 100)	RQD (0 20 40 60 80 100)	SIZE OF HOLE	GROUT	CASING: OTHER SIZES (mmNX BX AX)	DEPTH OF WATER LEVEL	WATER LOSS: NO / PARTIAL / COMPLETE (0 20 40 60 80 100)	PERCOLATION TEST: TEST SECTION	BY APPLIED PRESSURE METHOD: PRESSURE (kg/sq.cm) / LOSS(l/m)	BY FALLING HEAD METHOD: DEPTH OF WATER LEVEL / TIME INTERVAL	PERMEABILITY	REMARKS
198.500	4.50	Highly weathered highly fractured yellowish color Sandstone/Siltstone						NX									CR(CM)=22 CR(%)=15 RQD(%)=Nil N>100
197.000	6.00	Highly weathered disintegrated Rock															CR(CM)=Nil,CR(%)=Nil RQD(%)=Nil N>100 Penetration 10 cm 68 Blows
195.500	7.50	Highly weathered and fractured greyish color Shale															CR(CM)=76 CR(%)=51 RQD(%)=37
194.000	9.00							NX									CR(CM)=128 CR(%)=85 RQD(%)=67
192.500	10.50																CR(CM)=101 CR(%)=67 RQD(%)=34
191.000	12.00	Highly weathered highly fractured greyish color Shale						NX									CR(CM)=60 CR(%)=40 RQD(%)=Nil
189.500	13.50	Highly weathered and fractured greyish color Shale															CR(CM)=102 CR(%)=67 RQD(%)=41
188.000	15.00																

BORE LOG

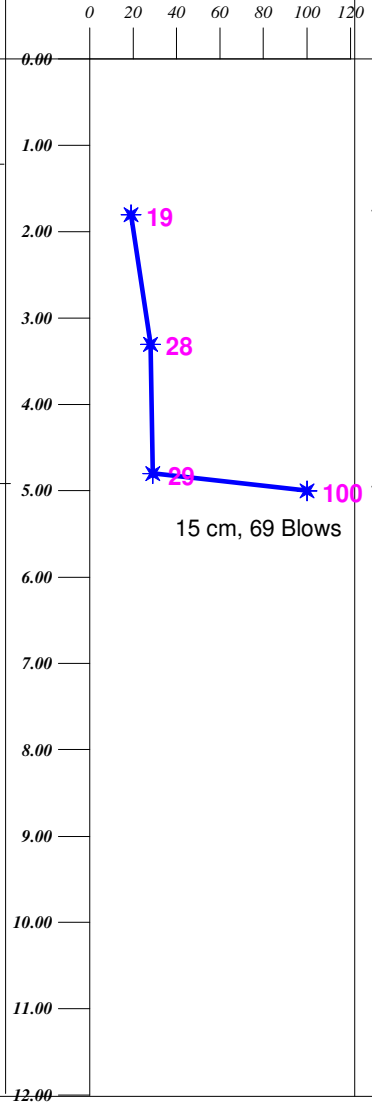
PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Coordinate: 1495 E, 1316 S RL: 201.800 Project No: 1988

Location: Transformer Yard BH No. :2 DEPTH : 15.00m Depth of Water Table : 2.80m Date of Start : 01/10/2013 Date of Finish : 03/10/2013

Reduced Level (m)	Depth (m)	Type of sample	Soil Classification	Grain size (%) Gravel	Sand	Silt/Clay	Density (gm/cc) r(wet)	r(dry)	W/C W(%)	Limits (%) L.L	P . L	Sp.Gr	Shear Parameters Type of test	C(kg/sq.cm)	phi(degrees)	Cc
201.800	0.00		Filledup Soil (Soil Mixed with Leaves etc)													
200.000	1.80	SPT		17	19	43/21				46	28					
199.300	2.50	UDS	Silty Clay of medium to High Plasticity (CI-CH)				1.86	1.52	22.18			2.78	UU	0.94	2	0.059
198.500	3.30	SPT		2	16	67/15				54	31					
197.000	4.80	SPT		1	15	70/14										
196.800	5.00	SPT	Refusal Strata	15	44	41										

S.P.T Plot



BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Coordinate: 1495 E, 1316 S RL: 201.800 Project No: 1988

Location: Transformer Yard BH No. :2 DEPTH : 15.00m Depth of Water Table : 2.80m

Date of Start : 01/10/2013 Date of Finish : 03/10/2013

REDUCED LEVEL (m)	DEPTH (m)	LITHOLOGY: DESCRIPTION	LOG	Size of core pieces: < 10 mm size / 10 to 25 mm / 25 to 75 mm / 75 to 150 mm / > 150 mm	STRUCTURAL CONDITIONS: DESCRIPTION	PERCENT CORE RECOVERY (0 20 40 60 80 100)	RQD (0 20 40 60 80 100)	SIZE OF HOLE	GROUT	CASING: OTHER SIZES (mmNX BX AX)	DEPTH OF WATER LEVEL	WATER LOSS: NO / PARTIAL / COMPLETE (0 20 40 60 80 100)	PERCOLATION TEST: TEST SECTION	BY APPLIED PRESSURE METHOD: PRESSURE (kg/sq.cm) / LOSS(l/m)	BY FALLING HEAD METHOD: DEPTH OF WATER LEVEL / TIME INTERVAL	PERMEABILITY	REMARKS
196.800	5.00	Highly weathered and fractured yellowish color Sandstone/ Siltstone						NX									CR(CM)=39 CR(%)=39 RQD(%)=39
195.800	6.00																CR(CM)=88 CR(%)=59 RQD(%)=21
194.300	7.50																CR(CM)=101 CR(%)=67 RQD(%)=40
192.800	9.00							NX									CR(CM)=86 CR(%)=57 RQD(%)=35
191.300	10.50	Highly weathered and fractured greyish color Shale															CR(CM)=52 CR(%)=35 RQD(%)=8
189.800	12.00							NX									CR(CM)=108 CR(%)=72 RQD(%)=59
188.300	13.50	Highly weathered highly fractured greyish color Shale															CR(CM)=85 CR(%)=57 RQD(%)=Nil
186.800	15.00																

BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Coordinate: 1450 E, 1369 S RL: 202.800 Project No : 1988

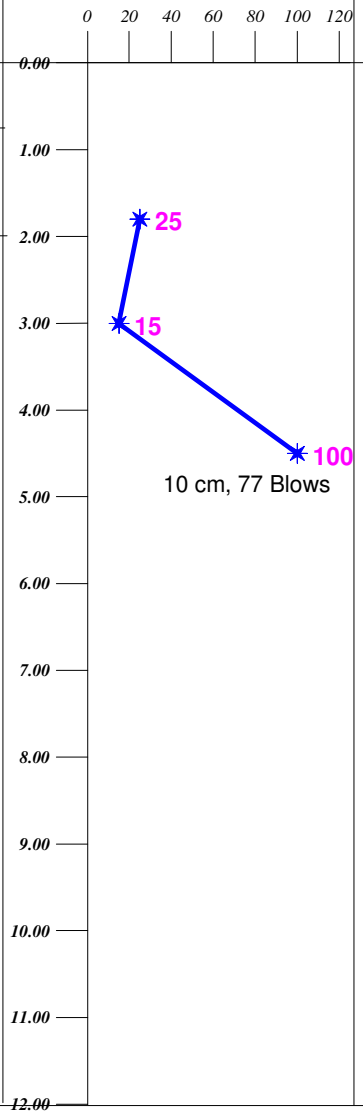
Location: Power House Block BH No. : 3 DEPTH : 25.00m Depth of Water Table :2.40 m

Date of Start : 01/09/2013 Date of Finish : 20/09/2013

Reduced Level (m)	Depth (m)	Type of sample	Soil Classification	Gravel	Sand	Silt/Clay	r(wet)	r(dry)	W(%)	L.L	P . L	Sp.Gr	Shear Parameters: Type of test	Shear Parameters: C(kg/sq.cm)	Shear Parameters: phi(degrees)	Cc
202.800	0.00		Filledup Soil (Soil)													
			Sandy Silt with Gravel (SM-ML)													
201.000	1.80	SPT		13	34	53				Non Plastic						
200.300	2.50	UDS					1.85	1.52	21.89			2.76	UU	0.83	3	0.061
199.800	3.00	SPT	Silty Clay of medium Plasticity (CI)	10	9	61/20				43	25					
198.300	4.50	SPT		0	39	39/22										
			Refusal Strata													

S.P.T Plot

Observed



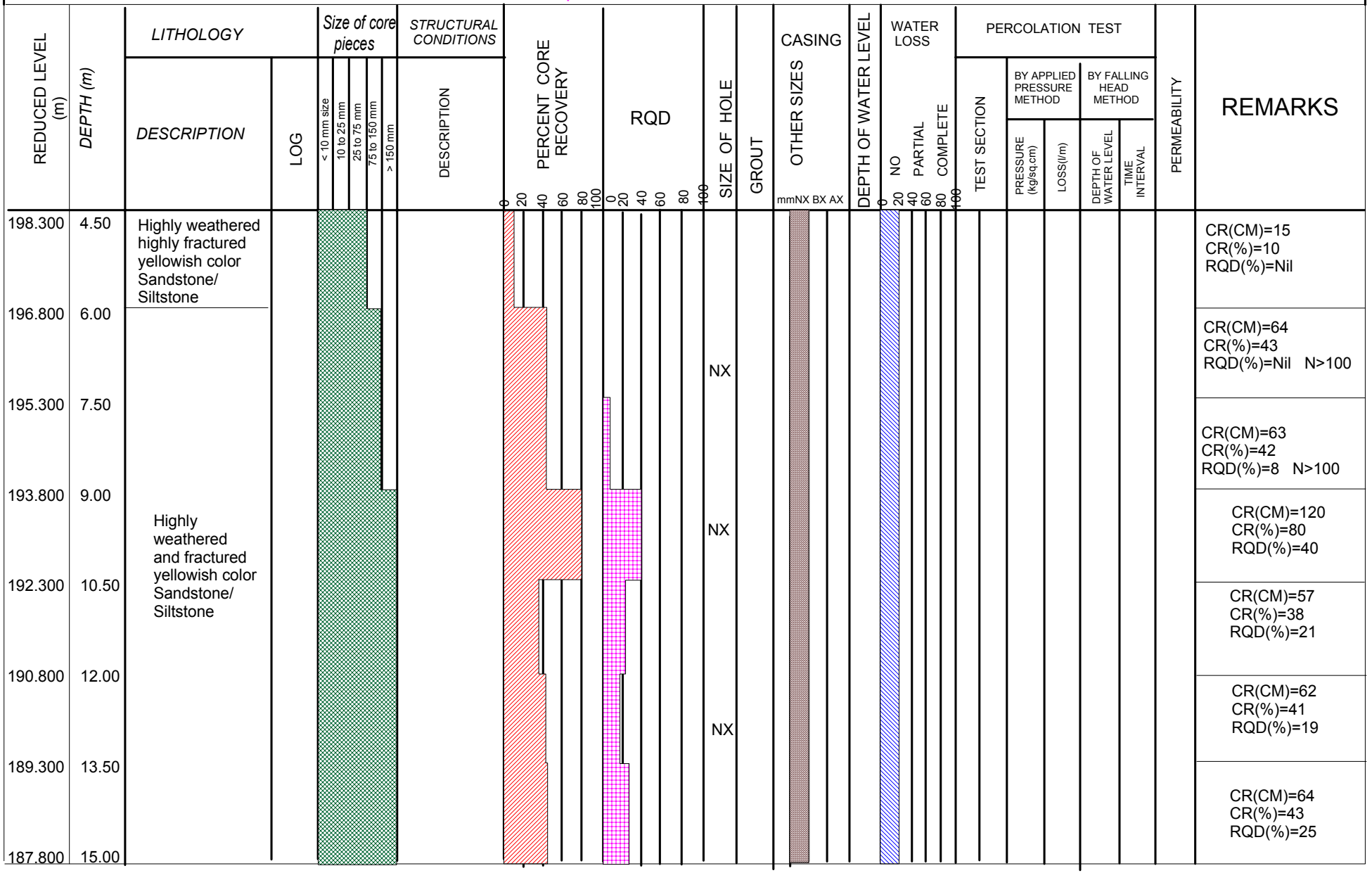
BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Coordinate: 1450 E, 1369 S RL: 202.800 Project No : 1988

Location: Power House Block BH No. : 3 DEPTH : 25.00m Depth of Water Table :2.40 m

Date of Start : 01/09/2013 Date of Finish : 20/09/2013



BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Coordinate: 1450 E, 1369 S RL: 202.800 Project No : 1988

Location: Power House Block BH No. : 3 DEPTH : 25.00m Depth of Water Table :2.40m

Date of Start : 01/09/2013 Date of Finish : 20/09/2013

REDUCED LEVEL (m)	DEPTH (m)	LITHOLOGY: DESCRIPTION	LOG	Size of core pieces: < 10 mm size / 10 to 25 mm / 25 to 75 mm / 75 to 150 mm / > 150 mm	STRUCTURAL CONDITIONS: DESCRIPTION	PERCENT CORE RECOVERY (0 20 40 60 80 100)	RQD (0 20 40 60 80 100)	SIZE OF HOLE	GROUT	CASING: OTHER SIZES (mmNX BX AX)	DEPTH OF WATER LEVEL	WATER LOSS: NO / PARTIAL / COMPLETE (0 20 40 60 80 100)	PERCOLATION TEST: TEST SECTION	BY APPLIED PRESSURE METHOD: PRESSURE (kg/sq.cm) / LOSS(l/m)	BY FALLING HEAD METHOD: DEPTH OF WATER LEVEL / TIME INTERVAL	PERMEABILITY	REMARKS
187.800	15.00	Highly weathered disintegrated Rock						NX									CR(CM)=Nil, CR(%)=Nil RQD(%)=Nil N>100 Penetration 5 cm 70 Blows
186.300	16.50																CR(CM)=Nil,CR(%)=Nil RQD(%)=Nil N>100 Penetration 4 cm 70 Blows
184.800	18.00																CR(CM)=Nil,CR(%)=Nil RQD(%)=Nil N>100 Penetration 4cm 75 Blows
183.300	19.50	Highly weathered highly fractured yellowish color Sandstone/ Siltstone						NX									CR(CM)=27 CR(%)=18 RQD(%)=Nil
181.800	21.00	Highly weathered and fractured yellowish color Sandstone/ Siltstone															CR(CM)=79 CR(%)=53 RQD(%)=25
180.300	22.50							NX									CR(CM)=45 CR(%)=30 RQD(%)=7
178.800	24.00	Highly weathered highly fractured yellowish color Sandstone/Siltstone															CR(CM)=10 CR(%)=10 RQD(%)=Nil
177.800	25.00																

BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Coordinate: 1315 E, 1369 S RL: 201.128 Project No : 1988

Location: Power House Block BH No. : 4 DEPTH : 25.00m Depth of Water Table : 0.40m

Date of Start : 21/09/2013 Date of Finish : 24/09/2013

Reduced Level (m)	Depth (m)	Type of sample	Soil Classification	S.P.T Plot (Observed)	Grain size (%) Gravel	Sand	Silt/Clay	Density (gm/cc) r(wet)	r(dry)	W/C W(%)	Limits (%) L.L	P . L	Sp.Gr	Shear Parameters Type of test	C(kg/sq.cm)	phi(degrees)	Cc
201.128	0.00		Filledup Soil(Soil)														
199.328	1.80	SPT	Sandy Silt with Gravel (SM-ML)	92	0	35	65					Non Plastic					
198.628	2.50	UDS						2.03	1.68	21.11			2.64	DST	0.12	33	
198.128	3.00	SPT	Silty Sand with Gravel (SM)	15cm, 85 Blows 100	0	58	42					Non Plastic					
196.628	4.50	SPT		15 cm, 74 Blows 100	0	54	46					Non Plastic					
195.128	6.00	SPT	Sandy Silt with Gravel (SM-ML) / Refusal Strata	10 cm, 77 Blows 100	0	28	72					Non Plastic					

S.P.T Plot: Observed; 0 20 40 60 80 100 120; 0.00 1.00 2.00 3.00 4.00 5.00 6.00 7.00 8.00 9.00 10.00 11.00 12.00

BORE LOG

SOIL ENGINEERING CONSULTANTS

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Coordinate: 1315 E, 1369 S RL: 201.128 Project No : 1988

Location: Power House Block BH No. : 4 DEPTH : 25.00m Depth of Water Table : 0.40m

Date of Start : 21/09/2013 Date of Finish : 24/09/2013

REDUCED LEVEL (m)	DEPTH (m)	LITHOLOGY: DESCRIPTION	LOG	Size of core pieces: < 10 mm size	10 to 25 mm	25 to 75 mm	75 to 150 mm	> 150 mm	STRUCTURAL CONDITIONS: DESCRIPTION	PERCENT CORE RECOVERY	RQD	SIZE OF HOLE	GROUT	CASING: OTHER SIZES	DEPTH OF WATER LEVEL	WATER LOSS: NO / PARTIAL / COMPLETE	PERCOLATION TEST: TEST SECTION	BY APPLIED PRESSURE METHOD: PRESSURE (kg/sq.cm)	LOSS(l/m)	BY FALLING HEAD METHOD: DEPTH OF WATER LEVEL	TIME INTERVAL	PERMEABILITY	REMARKS
195.128	6.00	Highly weathered Highly fractured yellowish color Sandstone/ Siltstone												mmNX BX AX									CR(CM)=5 CR(%)=3 RQD(%)=Nil N>100 Penetration 11 cm 77 Blows
193.628	7.50											NX											CR(CM)=Nil,CR(%)=Nil RQD(%)=Nil N>100 Penetration 8cm 68 Blows
192.128	9.00	Highly weathered disintegrated Rock																					CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 Penetration 9cm 70 Blows
190.628	10.50											NX											CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 Penetration 6cm 65 Blows
189.128	12.00	Highly weathered Highly fractured yellowish color Sandstone/siltstone																					CR(CM)=5 CR(%)=3 RQD(%)=Nil N>100 Penetration 5Cm 63 Blows
187.628	13.50	Highly weathered disintegrated Rock										NX											CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 Penetration 6cm 71 Blows
186.128	15.00																						

BORE LOG

SOIL ENGINEERING CONSULTANTS

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Coordinate: 1315 E, 1369 S RL: 201.128 Project No : 1988

Location: Power House Block BH No. : 4 DEPTH : 25.00m Depth of Water Table : 0.40m

Date of Start : 21/09/2013 Date of Finish : 24/09/2013

REDUCED LEVEL (m)	DEPTH (m)	LITHOLOGY DESCRIPTION	LOG	Size of core pieces	STRUCTURAL CONDITIONS DESCRIPTION	PERCENT CORE RECOVERY	RQD	SIZE OF HOLE	GROUT	CASING OTHER SIZES	DEPTH OF WATER LEVEL	WATER LOSS	PERCOLATION TEST	PERMEABILITY	REMARKS
186.128	15.00	Highly weathered disintegrated Rock						NX							CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 Penetration 7cm 75 Blows
184.628	16.50														CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 Penetration 9cm 78 Blows
183.128	18.00														CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 Penetration 9cm 71 Blows
181.628	19.50							NX							CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 Penetration 5cm 66 Blows
180.128	21.00	Moderately weathered and fractured yellowish to greyish color Sandstone/ Siltstone													CR(CM)=135 CR(%)=90 RQD(%)=78
178.628	22.50							NX							CR(CM)=113 CR(%)=74 RQD(%)=62
177.128	24.00														CR(CM)=75 CR(%)=75 RQD(%)=68
176.128	25.00														

PERCENT CORE RECOVERY: 0 20 40 60 80 100

RQD: 0 20 40 60 80 100

CASING OTHER SIZES: mmNX BX AX

WATER LOSS: NO PARTIAL COMPLETE; 0 20 40 60 80 100

PERCOLATION TEST: TEST SECTION; BY APPLIED PRESSURE METHOD (PRESSURE (kg/sq.cm), LOSS(l/m)); BY FALLING HEAD METHOD (DEPTH OF WATER LEVEL, TIME INTERVAL)

Size of core pieces: < 10 mm size; 10 to 25 mm; 25 to 75 mm; 75 to 150 mm; > 150 mm

BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Coordinate: 1237 E, 1369 S RL: 199.744 Project No : 1988

Location: Power House Block BH No. : 5 DEPTH : 25.00m Depth of Water Table : 0.40m

Date of Start : 01/09/2013 Date of Finish : 20/09/2013

Reduced Level (m)	Depth (m)	Type of sample	Soil Classification	S.P.T Plot (Observed)	Grain size (%) Gravel	Sand	Silt/Clay	Density (gm/cc) r(wet)	r(dry)	W/C W(%)	Limits (%) L.L	P . L	Sp.Gr	Shear Parameters Type of test	C(kg/sq.cm)	phi(degrees)	Cc
199.744	0.00		Filledup Soil (Soil)														
197.944	1.80	SPT		91	1	50	49				Non	Plastic					
196.744	3.00	SPT		15cm, 79 Blows 100	2	64	34				Non	Plastic					
195.244	4.50	SPT	Silty Sand with Gravel (SM)	10cm, 86 Blows 100	1	64	35				Non	Plastic					
193.744	6.00	SPT		15cm, 91 Blows 100	1	65	34				Non	Plastic					
192.244	7.50	SPT		12cm, 88 Blows 100	1	74	25				Non	Plastic					
191.744	8.00	SPT		15cm, 96 Blows 100	12	64	24				Non	Plastic					
			Refusal Strata														

BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Coordinate: 1237 E, 1369 S RL: 199.744 Project No : 1988

Location: Power House Block BH No. : 5 DEPTH : 25.00m Depth of Water Table : 0.40m

Date of Start : 01/09/2013 Date of Finish : 20/09/2013

REDUCED LEVEL (m)	DEPTH (m)	LITHOLOGY: DESCRIPTION	LOG	Size of core pieces: < 10 mm size / 10 to 25 mm / 25 to 75 mm / 75 to 150 mm / > 150 mm	STRUCTURAL CONDITIONS: DESCRIPTION	PERCENT CORE RECOVERY	RQD	SIZE OF HOLE	GROUT	CASING: OTHER SIZES	DEPTH OF WATER LEVEL	WATER LOSS: NO / PARTIAL / COMPLETE	PERCOLATION TEST: TEST SECTION	BY APPLIED PRESSURE METHOD: PRESSURE (kg/sq.cm) / LOSS(l/m)	BY FALLING HEAD METHOD: DEPTH OF WATER LEVEL / TIME INTERVAL	PERMEABILITY	REMARKS
191.744	8.00	Highly weathered and fractured yellowish color Sandstone/ Siltstone						NX		mmNX BX AX							CR(CM)=20 CR(%)=20 RQD(%)=Nil
190.744	9.00																CR(CM)=31 CR(%)=21 RQD(%)=Nil
189.244	10.50																CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 Penetration15cm 57 Blows
187.744	12.00							NX									CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 Penetration 15cm 80 Blows
186.244	13.50	Highly weathered disintegrated Rock															CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 Penetration 7cm 70 Blows
184.744	15.00							NX									CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 Penetration 5cm 60 Blows
183.244	16.50																

BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Coordinate: 1237 E, 1369 S RL: 199.744 Project No : 1988

Location: Power House Block BH No. : 5 DEPTH : 25.00m Depth of Water Table : 0.40m

Date of Start : 01/09/2013 Date of Finish : 20/09/2013

REDUCED LEVEL (m)	DEPTH (m)	LITHOLOGY: DESCRIPTION	LOG	Size of core pieces: < 10 mm size	10 to 25 mm	25 to 75 mm	75 to 150 mm	> 150 mm	STRUCTURAL CONDITIONS: DESCRIPTION	PERCENT CORE RECOVERY	RQD	SIZE OF HOLE	GROUT	CASING: OTHER SIZES	DEPTH OF WATER LEVEL	WATER LOSS	PERCOLATION TEST: TEST SECTION	BY APPLIED PRESSURE METHOD: PRESSURE (kg/sq.cm)	LOSS(l/m)	BY FALLING HEAD METHOD: DEPTH OF WATER LEVEL	TIME INTERVAL	PERMEABILITY	REMARKS
183.244	16.50	Highly weathered disintegrated Rock										NX											CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 penetration 7cm 74 Blows
181.744	18.00																						CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 penetration 5cm 75 Blows
180.244	19.50	Highly weathered and fractured yellowish color Sandstone/ Siltstone										NX											CR(CM)=12,CR(%)=8, RQD(%)=Nil N>100 Penetration 4 Cm 68 Blows
178.744	21.00																						CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 penetration 6cm 62 Blows
177.244	22.50	Highly weathered disintegrated Rock										NX											CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 penetration 4cm 70 Blows
175.744	24.00																						CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 penetration 4cm 75 Blows
174.744	25.00																						

PERCENT CORE RECOVERY: 0 20 40 60 80 100 | RQD: 0 20 40 60 80 100 | CASING: mm NX BX AX | WATER LOSS: NO PARTIAL COMPLETE | PERCOLATION TEST: 0 20 40 60 80 100

BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha

Coordinates: 1275 E, 1422 S RL: 200.125 Project No: 1988

Location: Boiler BH No. : 6 DEPTH : 25.00m Depth of Water Table : 0.50m

Date of Start : 31/08/2013 Date of Finish : 18/09/2013

Reduced Level (m)	Depth (m)	Type of sample	Soil Classification	S.P.T Plot (Observed)	Gravel	Sand	Silt/Clay	Density (gm/cc) r(wet)	Density (gm/cc) r(dry)	W/C W(%)	Limits (%) L.L	Limits (%) P.L	Sp.Gr	Shear Parameters Type of test	Shear Parameters C(kg/sq.cm)	Shear Parameters phi(degrees)	Cc
200.125	0.00		Filledup Soil (Soil)														
198.325	1.80	SPT	Sandy Silt with Gravel (SM-ML)	56	3	36	61					Non Plastic					
196.825	3.30	SPT		78	5	21	74					Non Plastic					
195.375	4.75	SPT		15 cm, 80 Blows 100	3	13	84					Non Plastic					
194.025	6.10	SPT	Silty Sand with Gravel (SM)	10 cm, 80 Blows 100	1	64	35					Non Plastic					
192.535	7.59	SPT		9 cm, 92 Blows 100	1	63	36					Non Plastic					
191.625	8.50	SPT	Refusal Strata	10 cm, 85 Blows 100	18	70	12					Non Plastic					

BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha

RL: 200.125 Project No: 1988

Location: Boiler BH No. : 6 DEPTH : 25.00m Depth of Water Table : 0.50m

Date of Start : 31/08/2013 Date of Finish : 18/09/2013

REDUCED LEVEL (m)	DEPTH	LITHOLOGY: DESCRIPTION	LOG	Size of core pieces: < 10 mm size	10 to 25 mm	25 to 75 mm	75 to 150 mm	> 150 mm	STRUCTURAL CONDITIONS: DESCRIPTION	PERCENT CORE RECOVERY	RQD	SIZE OF HOLE	GROUT	CASING: OTHER SIZES	DEPTH OF WATER LEVEL	WATER LOSS: NO / PARTIAL / COMPLETE	PERCOLATION TEST: TEST SECTION	BY APPLIED PRESSURE METHOD: PRESSURE (kg/sq.cm)	LOSS(l/m)	BY FALLING HEAD METHOD: DEPTH OF WATER LEVEL	TIME INTERVAL	PERMEABILITY	REMARKS
191.625	8.50																						CR(CM)=17,CR(%)=34 RQD(%)=Nil
191.125	9.00	Highly weathered and fractured yellowish color Sandstone/ Siltstone																					CR(CM)=68 CR(%)=45 RQD(%)=23 N>100
189.625	10.50											NX											CR(CM)=35 CR(%)=23 RQD(%)=23 N>100
188.125	12.00											NX											CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 Penetration 9cm Blows 78
186.625	13.50	Highly weathered disintegrated Rock																					CR(%)=Nil RQD(%)=Nil N>100 Penetration 7cm Blows 69
185.125	15.00											NX											CR(%)=Nil RQD(%)=Nil N>100 Penetration 69cm Blows 57
183.625	16.50																						

SOIL ENGINEERING CONSULTANTS

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha

Coordinates: 1275 E, 1422 S **RL: 200.125** Projrct No: 1988

Location: Boiler BH No. : 6 DEPTH : 25.00m Depth of Water Table : 0.50m

Date of Start : 31/08/2013 Date of Finish : 18/09/2013

REDUCED LEVEL (m)	DEPTH (m)	LITHOLOGY: DESCRIPTION	LOG	Size of core pieces: < 10 mm size / 10 to 25 mm / 25 to 75 mm / 75 to 150 mm / > 150 mm	STRUCTURAL CONDITIONS: DESCRIPTION	PERCENT CORE RECOVERY (0 20 40 60 80 100)	RQD (0 20 40 60 80 100)	SIZE OF HOLE	GROUT	CASING: OTHER SIZES (mmNX BX AX)	DEPTH OF WATER LEVEL	WATER LOSS: NO / PARTIAL / COMPLETE (0 20 40 60 80 100)	PERCOLATION TEST: TEST SECTION	BY APPLIED PRESSURE METHOD: PRESSURE (kg/sq.cm) / LOSS(l/m)	BY FALLING HEAD METHOD: DEPTH OF WATER LEVEL / TIME INTERVAL	PERMEABILITY	REMARKS
183.625	16.50																
182.125	18.00	Highly weathered disintegrated Rock						NX									CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100
180.625	19.50																
179.125	21.00	Highly weathered and fractured yellowish color Sandstone						NX									CR(CM)=69 CR(%)=46 RQD(%)=18 N>100
177.625	22.50																CR(CM)=67 CR(%)=45 RQD(%)=10 N>100
176.125	24.00	Highly weathered Highly fractured Greyish color Shale						NX									CR(CM)=42 CR(%)=42 RQD(%)=Nil N>100
175.125	25.00																

BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha

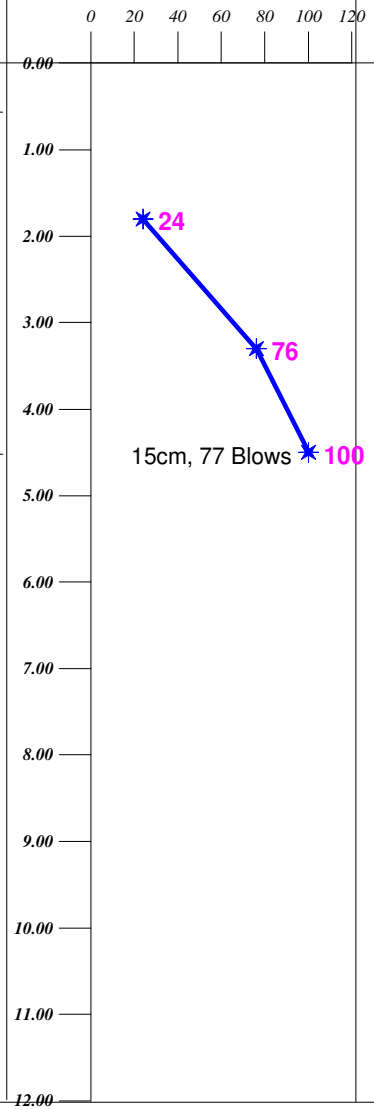
Coordinate: 1275 E, 1422 S RL: 202.100 Project No: 1988

Location: Boiler BH No. : 7 DEPTH : 25.00m Depth of Water Table : 2.45 m

Date of Start : 26/09/2013 Date of Finish : 30/09/2013

Reduced Level (m)	Depth (m)	Type of sample	Soil Classification	Grain size (%) Gravel	Sand	Silt/Clay	Density (gm/cc) r(wet)	r(dry)	W/C W(%)	Limits (%) L.L	P . L	Sp.Gr	Shear Parameters Type of test	C(kg/sq.cm)	phi(degrees)	Cc
202.100	0.00		Filledup Soil(Soil)													
200.300	1.80	SPT	Silty Clay mixed with Sand (CI)	1	20	56/23				39	20					
199.600	2.50	UDS					1.89	1.51	25.13			2.76	UU	1.46	3	0.058
198.800	3.30	SPT		1	35	44/20										
197.600	4.50	SPT	Refusal Strata	1	22	61/16										

S.P.T Plot



BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Coordinate: 1275 E, 1422 S **RL: 202.100** Project No: 1988

Location: Boiler BH No. : 7 DEPTH : 25.00m Depth of Water Table : 2.45 m

Date of Start : 26/09/2013 Date of Finish : 30/09/2013

REDUCED LEVEL (m)	DEPTH (m)	LITHOLOGY: DESCRIPTION	LOG	Size of core pieces: < 10 mm size	10 to 25 mm	25 to 75 mm	75 to 150 mm	> 150 mm	STRUCTURAL CONDITIONS: DESCRIPTION	PERCENT CORE RECOVERY	RQD	SIZE OF HOLE	GROUT	CASING: OTHER SIZES	DEPTH OF WATER LEVEL	WATER LOSS: NO	PARTIAL	COMPLETE	PERCOLATION TEST: TEST SECTION	BY APPLIED PRESSURE METHOD: PRESSURE (kg/sq.cm)	LOSS(l/m)	BY FALLING HEAD METHOD: DEPTH OF WATER LEVEL	TIME INTERVAL	PERMEABILITY	REMARKS
197.600	4.50	Highly weathered Highly fractured yellowish color Sandstone/ Siltstone										NX		mmNX BX AX											CR(CM)=31 CR(%)=21 RQD(%)=9 N>100
196.100	6.00																								CR(CM)=27 CR(%)=18 RQD(%)=Nil N>100
194.600	7.50																								CR(CM)=33 CR(%)=22 RQD(%)=Nil N>100
193.100	9.00											NX													CR(CM)=17 CR(%)=11 RQD(%)=Nil N>100 Penetration 6cm Blows 59
191.600	10.50																								CR(CM)=13 CR(%)=9 RQD(%)=Nil N>100 Penetration 5cm 55 Blows
190.100	12.00																								CR(CM)=12 CR(%)=8 RQD(%)=Nil N>100 Penetration 9cm 72 Blows
188.600	13.50											NX													CR(CM)=12 CR(%)=8 RQD(%)=Nil N>100
187.100	15.00																								

BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha

Coordinate: 1275 E, 1422 S RL: 202.100 Project No: 1988

Location: Boiler BH No. : 7 DEPTH : 25.00m Depth of Water Table : 2.45 m

Date of Start : 26/09/2013 Date of Finish : 30/09/2013

REDUCED LEVEL (m)	DEPTH (m)	LITHOLOGY DESCRIPTION	LOG	Size of core pieces	STRUCTURAL CONDITIONS DESCRIPTION	PERCENT CORE RECOVERY	RQD	SIZE OF HOLE	GROUT	CASING OTHER SIZES	DEPTH OF WATER LEVEL	WATER LOSS	PERCOLATION TEST: TEST SECTION	PERCOLATION TEST: BY APPLIED PRESSURE METHOD: PRESSURE (kg/sq.cm)	PERCOLATION TEST: BY APPLIED PRESSURE METHOD: LOSS(l/m)	PERCOLATION TEST: BY FALLING HEAD METHOD: DEPTH OF WATER LEVEL	PERCOLATION TEST: BY FALLING HEAD METHOD: TIME INTERVAL	PERMEABILITY	REMARKS
187.100	15.00																		
		Highly weathered disintegrated Rock		Nil		Ni	Ni	NX											CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 Penetration 8cm 72 Blows
185.600	16.50																		
																			CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 Penetration 5cm 68 Blows
184.100	18.00																		
		Highly weathered and fractured yellowish color Sandstone/ Siltstone																	CR(CM)=40 CR(%)=27 RQD(%)=19
182.600	19.50							NX											
																			CR(CM)=67 CR(%)=45 RQD(%)=14
181.100	21.00																		
																			CR(CM)=107 CR(%)=71 RQD(%)=69
179.600	22.50							NX											
		Highly weathered and fractured Greyish color Shale																	CR(CM)=96 CR(%)=64 RQD(%)=50
178.100	24.00																		
																			CR(CM)=60 CR(%)=60 RQD(%)=45
177.100	25.00																		

BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha

Coordinate: 1453 E, 1447 S RL: 202.440 Project No: 1988

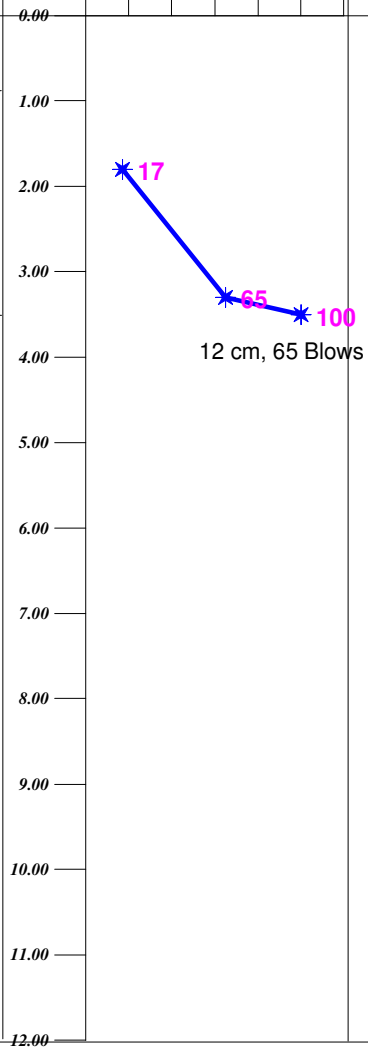
Location: Boiler BH No. : 8 DEPTH : 25.00m Depth of Water Table : 2.80 m

Date of Start : 26/09/2013 Date of Finish : 29/09/2013

Reduced Level (m)	Depth (m)	Type of sample	Soil Classification	Gravel	Sand	Silt/Clay	r(wet)	r(dry)	W(%)	L.L	P . L	Sp.Gr	Shear Parameters: Type of test	Shear Parameters: C(kg/sq.cm)	Shear Parameters: phi(degrees)	Cc
202.440	0.00		Filledup Soil (Soil mixed with Road Material)													
200.640	1.80	SPT	Silty Clay mixed with Sand (Cl)	0	24	54/22										
199.940	2.50	UDS					1.85	1.50	23.64			2.76	UU	0.94	3	0.061
199.140	3.30	SPT		1	39	40/20				42	25					
198.940	3.50	SPT	Refusal Strata	0	35	65										

S.P.T Plot

Observed



BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha

Coordinate: 1453 E, 1447 S RL: 202.440 Project No: 1988

Location: Boiler BH No. : 8 DEPTH : 25.00m Depth of Water Table : 2.80 m

Date of Start : 26/09/2013 Date of Finish : 29/09/2013

REDUCED LEVEL (m)	DEPTH (m)	LITHOLOGY: DESCRIPTION	LOG	Size of core pieces: < 10 mm size / 10 to 25 mm / 25 to 75 mm / 75 to 150 mm / > 150 mm	STRUCTURAL CONDITIONS: DESCRIPTION	PERCENT CORE RECOVERY	RQD	SIZE OF HOLE	GROUT	CASING: OTHER SIZES	DEPTH OF WATER LEVEL	WATER LOSS: NO / PARTIAL / COMPLETE	PERCOLATION TEST: TEST SECTION	BY APPLIED PRESSURE METHOD: PRESSURE (kg/sq.cm) / LOSS(l/m)	BY FALLING HEAD METHOD: DEPTH OF WATER LEVEL / TIME INTERVAL	PERMEABILITY	REMARKS
198.940	3.50	Highly weathered Highly fractured yellowish color Sandstone/ Siltstone						NX		mmNX BX AX							CR(CM)=35 CR(%)=35 RQD(%)=Nil
197.940	4.50																CR(CM)=61 CR(%)=41 RQD(%)=7
196.440	6.00																CR(CM)=54 CR(%)=36 RQD(%)=Nil
194.940	7.50	Highly weathered disintegrated Rock						NX									CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 Penetration 5cm 50 Blows
193.440	9.00	Highly weathered Highly fractured yellowish color Sandstone															CR(CM)=15 CR(%)=10 RQD(%)=Nil
191.940	10.50																CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 Penetration 4cm 61 Blows
190.440	12.00	Highly weathered disintegrated Rock						NX									CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 Penetration 5cm 65 Blows
188.940	13.50																

BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha

Coordinate : 1468 E, 1447 S RL: 202.440 Job No: 1988

Location: Boiler BH No. : 8 DEPTH : 25.00m Depth of Water Table : 2.80 m

Date of Start : 26/09/2013 Date of Finish : 29/09/2013

REDUCED LEVEL	DEPTH	LITHOLOGY: DESCRIPTION	LOG	Size of core pieces: <10 mm size	10 to 25 mm	25 to 75 mm	75 to 150 mm	>150 mm	STRUCTURAL CONDITIONS: DESCRIPTION	PERCENT CORE RECOVERY	RQD	SIZE OF HOLE	GROUT	CASING: OTHER SIZES	DEPTH OF WATER LEVEL	WATER LOSS: NO	PARTIAL	COMPLETE	PERCOLATION TEST: TEST SECTION	BY APPLIED PRESSURE METHOD: PRESSURE (kg/sq.cm)	LOSS(l/m)	BY FALLING HEAD METHOD: DEPTH OF WATER LEVEL	TIME INTERVAL	PERMEABILITY	REMARKS
188.940	13.50	Highly weathered and fractured yellowish color Sandstone										NX													CR(CM)=33 CR(%)=22 RQD(%)=10
187.440	15.00																								CR(CM)=60 CR(%)=40 RQD(%)=34
185.940	16.50																								CR(CM)=73 CR(%)=49 RQD(%)=43
184.440	18.00	Highly weathered and fractured greyish color Shale										NX													CR(CM)=101 CR(%)=67 RQD(%)=47
182.940	19.50																								CR(CM)=125 CR(%)=33 RQD(%)=61
181.440	21.00																								CR(CM)=111 CR(%)=74 RQD(%)=29
179.940	22.50	Highly weathered and fractured yellowish color Sandstone										NX													CR(CM)=94 CR(%)=62 RQD(%)=28
178.440	24.00																								CR(CM)=58 CR(%)=58 RQD(%)=53
177.440	25.00																								

BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha

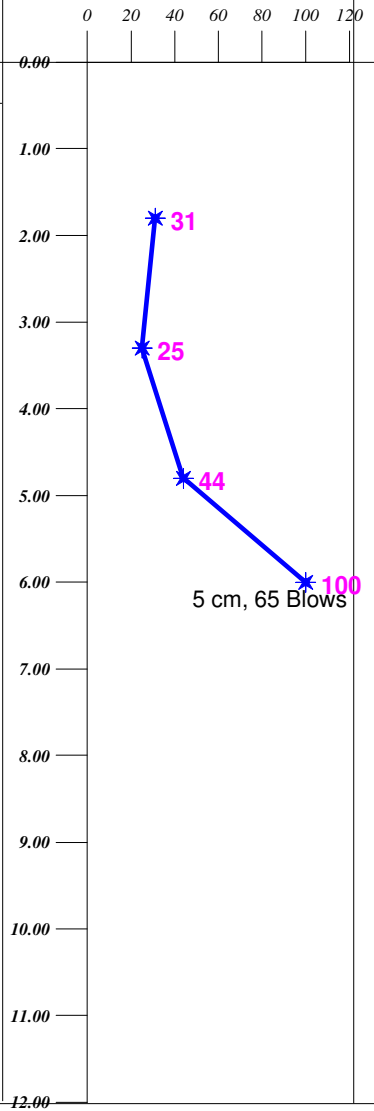
Coordinate: 1480 E, 1497 S RL: 201.900 Project No: 1988

Location: Boiler BH No. : 9 DEPTH : 25.00m Depth of Water Table : 2.65m

Date of Start : 03/10/2013 Date of Finish : 04/10/2013

Reduced Level (m)	Depth (m)	Type of sample	Soil Classification	Gravel	Sand	Silt/Clay	r(wet)	r(dry)	W(%)	L.L	P . L	Sp.Gr	Shear Parameters: Type of test	Shear Parameters: C(kg/sq.cm)	Shear Parameters: phi(degrees)	Cc
201.900	0.00		Filledup Soil(Soil)													
200.100	1.80	SPT	Sandy Silt with Gravel (SM-ML)	2	31	67				Non Plastic						
199.400	2.50	UDS					1.86	1.53	21.93			2.64	DST	0.13	31	
198.600	3.30	SPT		4	31	65				Non Plastic						
197.100	4.80	SPT	Silty Clay of medium Plasticity (CI)	2	5	70/23				46	22					
195.900	6.00	SPT	Refusal Strata	1	23	58/18										

S.P.T Plot



BORE LOG

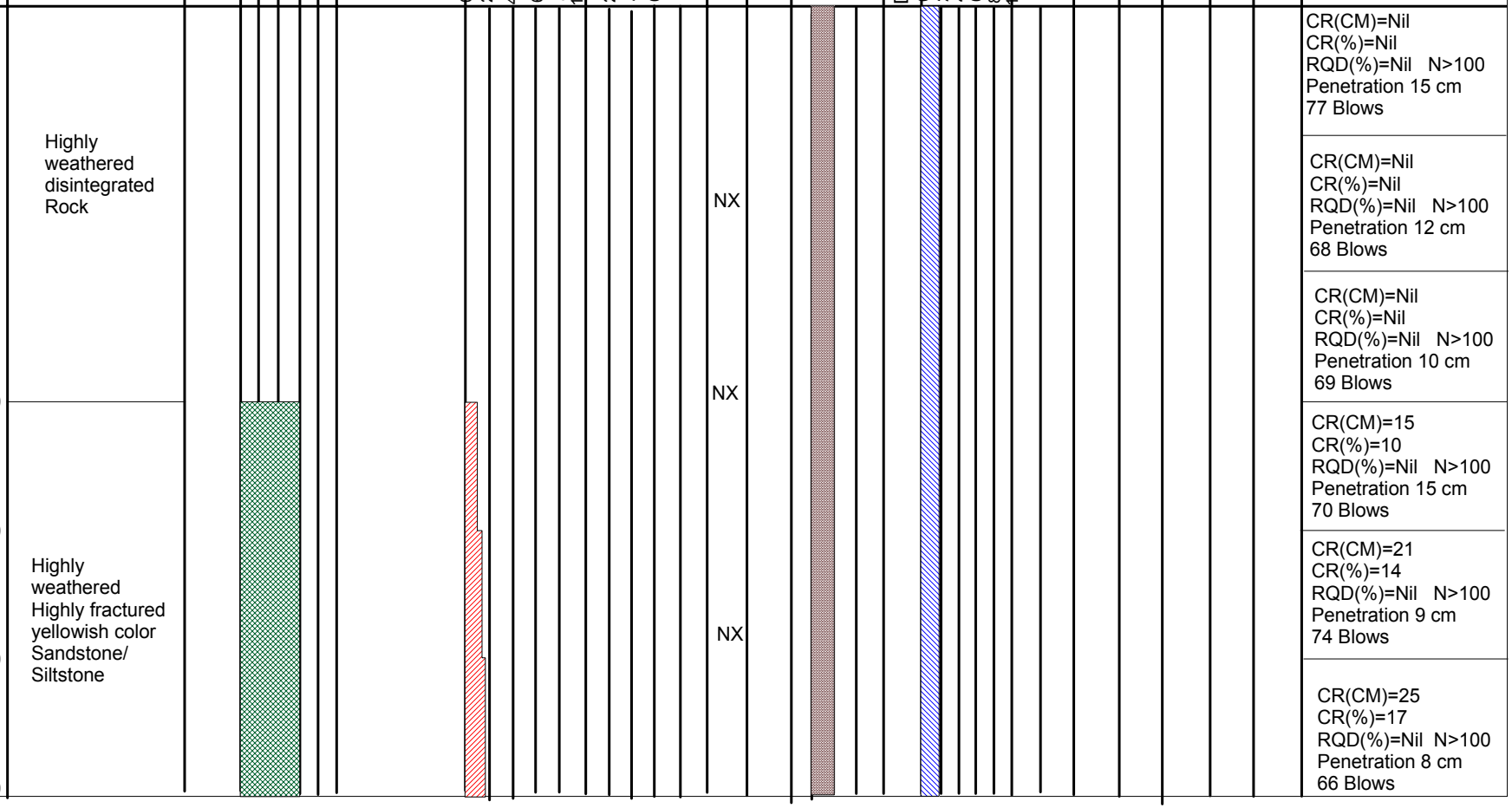
PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha

Coordinate: 1480 E, 1497 S RL: 201.900 Project No: 1988

Location: Boiler BH No. : 9 DEPTH : 25.00m Depth of Water Table : 2.65m

Date of Start : 03/10/2013 Date of Finish : 04/10/2013

REDUCED LEVEL (m)	DEPTH (m)	LITHOLOGY DESCRIPTION	LOG	Size of core pieces (< 10 mm size / 10 to 25 mm / 25 to 75 mm / 75 to 150 mm / > 150 mm)	STRUCTURAL CONDITIONS DESCRIPTION	PERCENT CORE RECOVERY	RQD	SIZE OF HOLE	GROUT	CASING OTHER SIZES	DEPTH OF WATER LEVEL	WATER LOSS (NO / PARTIAL / COMPLETE)	PERCOLATION TEST: TEST SECTION	PERCOLATION TEST: BY APPLIED PRESSURE METHOD (PRESSURE (kg/sq.cm) / LOSS(l/m))	PERCOLATION TEST: BY FALLING HEAD METHOD (DEPTH OF WATER LEVEL / TIME INTERVAL)	PERMEABILITY	REMARKS
195.900	6.00	Highly weathered disintegrated Rock						NX									CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 Penetration 15 cm 77 Blows
194.400	7.50																CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 Penetration 12 cm 68 Blows
192.900	9.00																CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 Penetration 10 cm 69 Blows
191.400	10.50							NX									CR(CM)=15 CR(%)=10 RQD(%)=Nil N>100 Penetration 15 cm 70 Blows
189.900	12.00	Highly weathered Highly fractured yellowish color Sandstone/ Siltstone															CR(CM)=21 CR(%)=14 RQD(%)=Nil N>100 Penetration 9 cm 74 Blows
188.400	13.50							NX									CR(CM)=25 CR(%)=17 RQD(%)=Nil N>100 Penetration 8 cm 66 Blows
186.900	15.00																



BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha

Coordinate: 1480 E, 1497 S RL: 201.900 Project No: 1988

Location: Boiler BH No. : 9 DEPTH : 25.00m Depth of Water Table : 2.65m

Date of Start : 03/10/2013 Date of Finish : 04/10/2013

REDUCED LEVEL (m)	DEPTH (m)	LITHOLOGY: DESCRIPTION	LOG	Size of core pieces: < 10 mm size / 10 to 25 mm / 25 to 75 mm / 75 to 150 mm / > 150 mm	STRUCTURAL CONDITIONS: DESCRIPTION	PERCENT CORE RECOVERY (0 20 40 60 80 100)	RQD (0 20 40 60 80 100)	SIZE OF HOLE	GROUT	CASING: OTHER SIZES (mmNX BX AX)	DEPTH OF WATER LEVEL	WATER LOSS (NO / PARTIAL / COMPLETE; 0 20 40 60 80 100)	PERCOLATION TEST: TEST SECTION	BY APPLIED PRESSURE METHOD: PRESSURE (kg/sq.cm) / LOSS(l/m)	BY FALLING HEAD METHOD: DEPTH OF WATER LEVEL / TIME INTERVAL	PERMEABILITY	REMARKS
186.900	15.00	Highly weathered Highly fractured yellowish color Sandstone/ Siltstone															CR(CM)=20 CR(%)=13 RQD(%)=Nil N>100 Penetration 7 cm 72 Blows
185.400	16.50							NX									CR(CM)=18 CR(%)=12 RQD(%)=Nil N>100 Penetration 4 cm 60 Blows
183.900	18.00																CR(CM)=36 CR(%)=24 RQD(%)=Nil
182.400	19.50	Highly weathered and fractured yellowish color Sandstone/ Siltstone						NX									CR(CM)=51 CR(%)=34 RQD(%)=27
180.900	21.00																CR(CM)=63 CR(%)=42 RQD(%)=12
179.400	22.50	Highly weathered and fractured greyish color Shale						NX									CR(CM)=44 CR(%)=29 RQD(%)=16
177.900	24.00																CR(CM)=72 CR(%)=72 RQD(%)=55
176.900	25.00																

BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

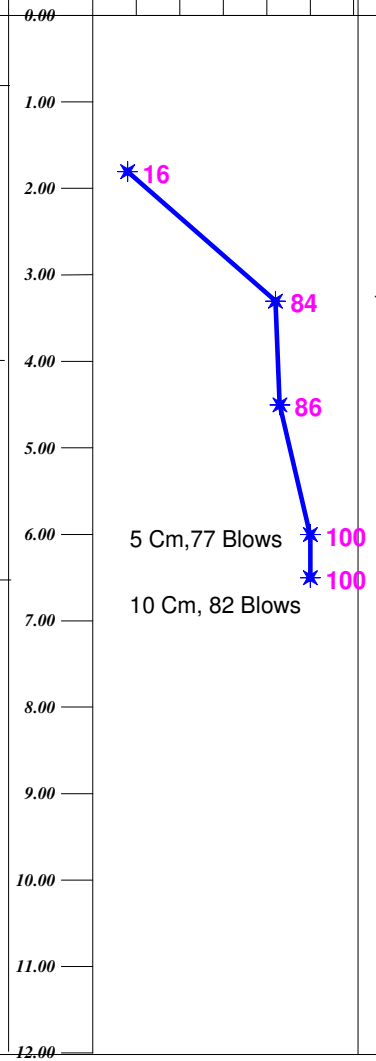
Coordinate: 1385 E, 1497 S RL: 200.200 Project No: 1988

Location: Storage Tank & P/H BH No. : 10 DEPTH : 25.00m Depth of Water Table 0.90m

Date of Start : 08/10/2013 Date of Finish : 10/10/2013

Reduced Level (m)	Depth (m)	Type of sample	Soil Classification	Gravel	Sand	Silt/Clay	r(wet)	r(dry)	W(%)	L.L	P . L	Sp.Gr	Shear Parameters: Type of test	C(kg/sq.cm)	phi(degrees)	Cc
200.000	0.00		Filledup Soil (Soil, Low Lying Area)													
198.400	1.80	SPT	Silty Clay mixed with Sand (Cl)	1	28	71				36	19					
197.700	2.50	UDS					1.85	1.51	22.64			2.7	UU	0.76	2	
196.900	3.30	SPT		10	33	57										
195.700	4.50	SPT	Silty Sand with Gravel (SM)	0	75	25				Non Plastic						
194.200	6.00	SPT		2	79	19				Non Plastic						
193.700	6.50	SPT	Refusal Strata							Non Plastic						

S.P.T Plot



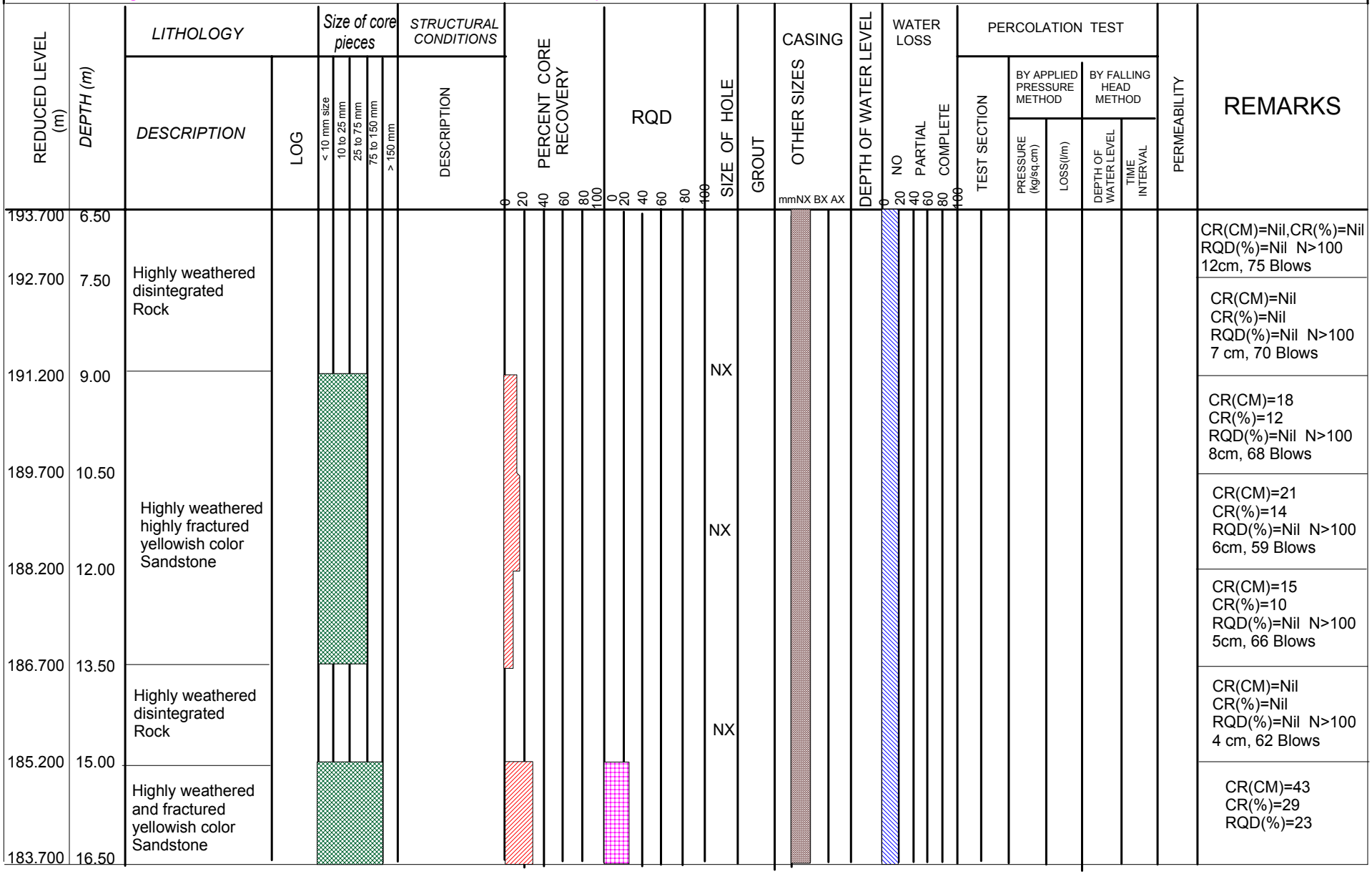
BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Coordinate: 1385 E, 1497 S RL: 200.200 Project No: 1988

Location: Storage Tank & P/H BH No. : 10 DEPTH : 25.00m Depth of Water Table 0.90m

Date of Start : 08/10/2013 Date of Finish : 10/10/2013



PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Coordinate: 1385 E, 1497 S RL:200.200 Project No: 1988

Location: Storage Tank & P/H BH No. : 10 DEPTH : 25.00m Depth of Water Table 0.90m

Date of Start : 08/10/2013 Date of Finish : 10/10/2013

REDUCED LEVEL (m)	DEPTH (m)	LITHOLOGY: DESCRIPTION	LOG	Size of core pieces	STRUCTURAL CONDITIONS: DESCRIPTION	PERCENT CORE RECOVERY	RQD	SIZE OF HOLE	GROUT	CASING: OTHER SIZES	DEPTH OF WATER LEVEL	WATER LOSS	PERCOLATION TEST: TEST SECTION	BY APPLIED PRESSURE METHOD: PRESSURE (kg/sq.cm)	BY APPLIED PRESSURE METHOD: LOSS(l/m)	BY FALLING HEAD METHOD: DEPTH OF WATER LEVEL	BY FALLING HEAD METHOD: TIME INTERVAL	PERMEABILITY	REMARKS
183.700	16.50	Highly weathered highly fractured yellowish color Sandstone/ Siltstone		< 10 mm size, 10 to 25 mm, 25 to 75 mm, 75 to 150 mm, > 150 mm		0 20 40 60 80 100	0 20 40 60 80 100			mmNX BX AX		NO PARTIAL COMPLETE 0 20 40 60 80 100							CR(CM)=29 CR(%)=19 RQD(%)=Nil
182.200	18.00	Highly weathered disintegrated Rock						NX											CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 5cm, 65 Blows
180.700	19.50																		CR(CM)=24 CR(%)=16 RQD(%)=Nil
179.200	21.00							NX											CR(CM)=20 CR(%)=13 RQD(%)=Nil N>100 4cm, 59 Blows
177.700	22.50	Highly weathered highly fractured yellowish color Sandstone/ Siltstone						NX											CR(CM)=19 CR(%)=13 RQD(%)=Nil N>100 5 cm, 62 Blows
176.200	24.00																		CR(CM)=21 CR(%)=21 RQD(%)=Nil
175.200	25.00																		

BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Coordinate: 1275 E, 1497 S **RL: 199.631** Project No: 1988

Location: Boiler BH No. : 11 DEPTH : 25.00m Depth of Water Table : 1.10 m

Date of Start : 03/09/2013 Date of Finish : 21/09/2013

Reduced Level (m)	Depth (m)	Type of sample	Soil Classification	S.P.T Plot (Observed)	Gravel	Sand	Silt/Clay	Density (gm/cc) r(wet)	Density (gm/cc) r(dry)	W/C W(%)	Limits (%) L.L	Limits (%) P . L	Sp.Gr	Shear Parameters Type of test	Shear Parameters C(kg/sq.cm)	Shear Parameters phi(degrees)	Cc
199.631	0.00		Filledup Soil(Soil)														
197.831	1.80	SPT	Silty Clay of medium Plasticity (CI)	11	2	38	52/8				39	20					
197.131	2.50	UDS						1.82	1.46	24.78			2.78	UU	0.82	3	0.061
196.331	3.30	SPT		28	1	66	30/0				Non Plastic						
196.131	3.50	SPT	Refusal Strata	100 6 cm, 70 Blows							Non Plastic						

BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Coordinate: 1275 E, 1497 S RL: 199.631 Project No: 1988

Location: Boiler BH No. : 11 DEPTH : 25.00m Depth of Water Table : 1.10 m

Date of Start : 03/09/2013 Date of Finish : 21/09/2013

REDUCED LEVEL (m)	DEPTH (m)	LITHOLOGY DESCRIPTION	LOG	Size of core pieces	STRUCTURAL CONDITIONS DESCRIPTION	PERCENT CORE RECOVERY	RQD	SIZE OF HOLE	GROUT	CASING OTHER SIZES	DEPTH OF WATER LEVEL	WATER LOSS	PERCOLATION TEST	PERMEABILITY	REMARKS
196.131	3.50	Highly weathered Highly fractured yellowish color Sandstone/ Siltstone													CR(CM)=47 CR(%)=47 RQD(%)=Nil
195.131	4.50														CR(CM)=60 CR(%)=40 RQD(%)=Nil
193.631	6.00							NX							CR(CM)=89 CR(%)=59 RQD(%)=13
192.131	7.50														CR(CM)=94 CR(%)=63 RQD(%)=20
190.631	9.00							NX							CR(CM)=75 CR(%)=50 RQD(%)=16
189.131	10.50	Highly weathered and fractured yellowish color Sandstone/ Siltstone													CR(CM)=103 CR(%)=69 RQD(%)=18
187.631	12.00							NX							CR(CM)=73 CR(%)=49 RQD(%)=19
186.131	13.50														CR(CM)=61 CR(%)=41 RQD(%)=17
184.631	15.00														

BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Coordinate: 1275 E, 1497 S RL: 199.631 Project No: 1988

Location: Boiler BH No. : 11 DEPTH : 25.00m Depth of Water Table : 1.10 m

Date of Start : 03/09/2013 Date of Finish : 21/09/2013

REDUCED LEVEL (m)	DEPTH (m)	LITHOLOGY: DESCRIPTION	LOG	Size of core pieces: < 10 mm size / 10 to 25 mm / 25 to 75 mm / 75 to 150 mm / > 150 mm	STRUCTURAL CONDITIONS: DESCRIPTION	PERCENT CORE RECOVERY	RQD	SIZE OF HOLE	GROUT	CASING: OTHER SIZES (mmNX BX AX)	DEPTH OF WATER LEVEL	WATER LOSS: NO / PARTIAL / COMPLETE	PERCOLATION TEST: TEST SECTION	BY APPLIED PRESSURE METHOD: PRESSURE (kg/sq.cm) / LOSS(l/m)	BY FALLING HEAD METHOD: DEPTH OF WATER LEVEL / TIME INTERVAL	PERMEABILITY	REMARKS
184.631	15.00	Highly weathered and fractured yellowish color Sandstone/ Siltstone															CR(CM)=94 CR(%)=63 RQD(%)=26
183.131	16.50	Highly weathered disintegrated Rock						NX									CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 Penetration 5 cm 63 Blows
181.631	18.00																CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 Penetration 6 cm 71 Blows
180.131	19.50	Highly weathered and fractured yellowish color Sandstone/ Siltstone						NX									CR(CM)=18 CR(%)=12 RQD(%)=Nil
178.631	21.00																CR(CM)=22 CR(%)=15 RQD(%)=7
177.131	22.50	Highly weathered and fractured Greyish color Shale						NX									CR(CM)=70 CR(%)=47 RQD(%)=35
175.631	24.00																CR(CM)=56 CR(%)=56 RQD(%)=34
174.631	25.00																

BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

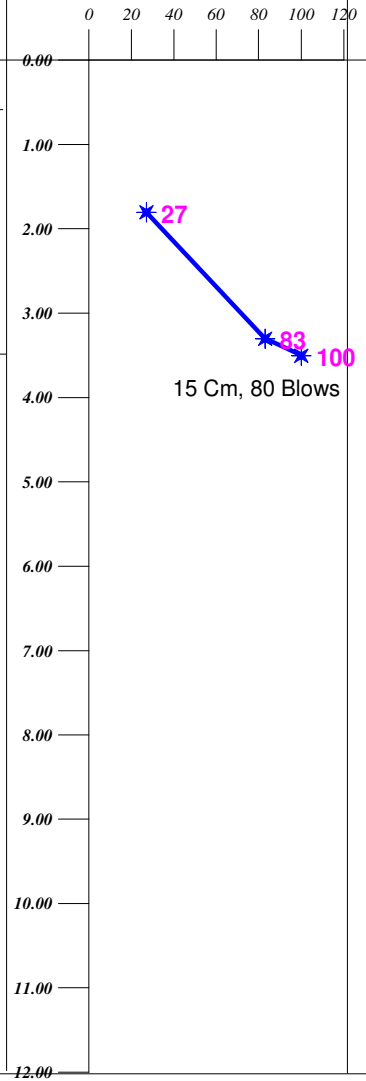
Coordinate: 1295 E, 1552 S RL: 199.400 Project No: 1988

Location: ESP BH No. : 12 DEPTH : 20.00m Depth of Water Table :0.75m

Date of Start : 05/10/2013 Date of Finish : 06/10/2013

Reduced Level (m)	Depth (m)	Type of sample	Soil Classification	Gravel	Sand	Silt/Clay	r(wet)	r(dry)	W(%)	L.L	P . L	Sp.Gr	Type of test	C(kg/sq.cm)	phi(degrees)	Cc
199.400	0.00		Filledup Soil (Soil)													
197.600	1.80	SPT	Silty Clay mixed with sand (Cl)	1	34	65				42	23					
196.900	2.50	UDS					1.88	1.52	23.28			2.76	UU	1.26	3	
196.100	3.30	SPT		1	25	74				43	23					
195.900	3.50	SPT	Refusal Strata													

S.P.T Plot



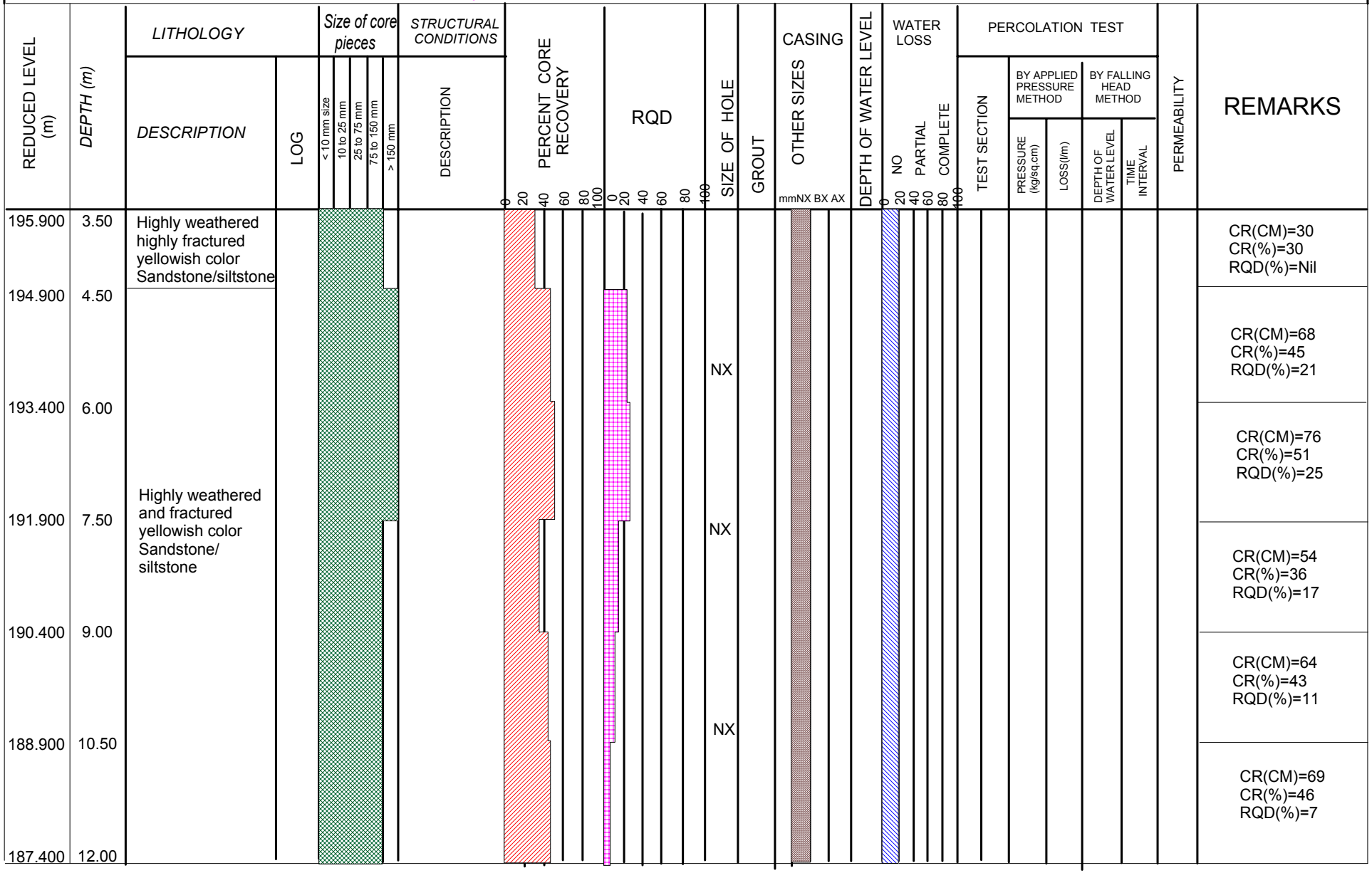
BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Coordinate: 1295 E, 1552 S RL: 199.400 Project No: 1988

Location: ESP BH No. : 12 DEPTH : 20.00m Depth of Water Table :0.75m

Date of Start : 05/10/2013 Date of Finish : 06/10/2013



BORE LOG

SOIL ENGINEERING CONSULTANTS

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Coordinate: 1295 E, 1552 S RL: 199.400 Project No: 1988

Location: ESP BH No. : 12 DEPTH : 20.00m Depth of Water Table :0.75m

Date of Start : 05/10/2013 Date of Finish : 06/10/2013

REDUCED LEVEL (m)	DEPTH (m)	LITHOLOGY DESCRIPTION	LOG	Size of core pieces (< 10 mm size / 10 to 25 mm / 25 to 75 mm / 75 to 150 mm / > 150 mm)	STRUCTURAL CONDITIONS DESCRIPTION	PERCENT CORE RECOVERY (0 20 40 60 80 100)	RQD (0 20 40 60 80 100)	SIZE OF HOLE	GROUT	CASING OTHER SIZES (mmNX BX AX)	DEPTH OF WATER LEVEL	WATER LOSS (NO / PARTIAL / COMPLETE; 0 20 40 60 80 100)	PERCOLATION TEST: TEST SECTION	BY APPLIED PRESSURE METHOD: PRESSURE (kg/sq.cm)	BY APPLIED PRESSURE METHOD: LOSS(l/m)	BY FALLING HEAD METHOD: DEPTH OF WATER LEVEL	BY FALLING HEAD METHOD: TIME INTERVAL	PERMEABILITY	REMARKS
187.400	12.00	Highly weathered highly fractured yellowish color Sandstone/ siltstone																	CR(CM)=74 CR(%)=49 RQD(%)=Nil
185.900	13.50	Highly weathered and fractured yellowish color Sandstone/ siltstone						NX											CR(CM)=71 CR(%)=47 RQD(%)=10
184.400	15.00							NX											CR(CM)=83 CR(%)=55 RQD(%)=38
182.900	16.50																		CR(CM)=69 CR(%)=46 RQD(%)=43
181.400	18.00							NX											CR(CM)=58 CR(%)=39 RQD(%)=17
179.900	19.50																		CR(CM)=27,CR(%)=54 RQD(%)=54
179.400	20.00																		

B12-3/3

BORE LOG

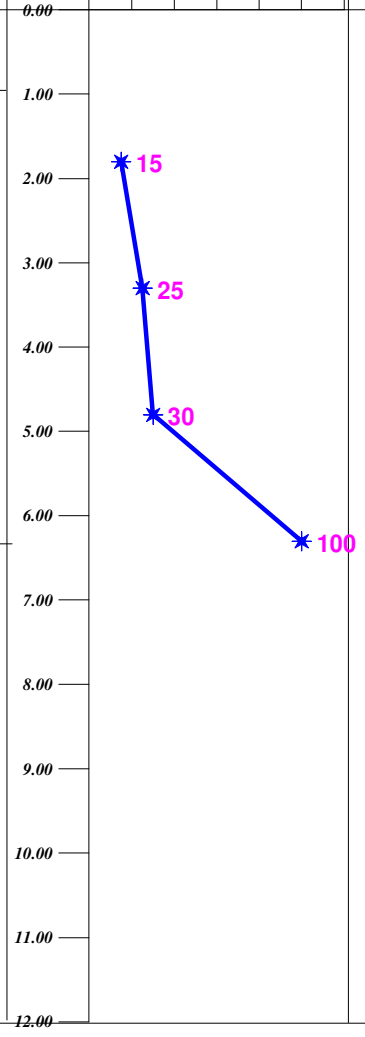
PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Co ordinates : 1434E, 1639S RL 199.50 Project No: 1988

Location: ESP BH No. : 13 DEPTH : 20.00m Depth of Water Table 1.10m

Date of Start : 14/10/2013 Date of Finish : 17/10/2013

Reduced Level (m)	Depth (m)	Type of sample	Soil Classification	S.P.T Plot (Observed)	Grain size (%) Gravel	Sand	Silt/Clay	Density (gm/cc) r(wet)	r(dry)	W/C W(%)	Limits (%) L.L	P. L	Sp.Gr	Shear Parameters Type of test	C(kg/sq.cm)	phi(degrees)	Cc
199.500	0.00		Filledup Soil (Road Material)														
197.700	1.80	SPT		15	2	32	64				44	23					
197.000	2.50	UDS						1.85	1.49	23.97			2.76	UU	0.89	3	
196.200	3.30	SPT	Silty Clay mixed with sand (Cl)	25	1	28	71				39	21					
194.700	4.80	SPT		30	2	29	69				38	22					
193.200	6.30	SPT		100													
			Refusal Strata														



PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Co ordinates : 1434E, 1639S RL 199.50 Project No: 1988

Location: ESP BH No. : 13 DEPTH : 20.00m Depth of Water Table 1.10m

Date of Start : 14/10/2013 Date of Finish : 17/10/2013

REDUCED LEVEL (m)	DEPTH (m)	LITHOLOGY: DESCRIPTION	LITHOLOGY: LOG	Size of core pieces: < 10 mm size / 10 to 25 mm / 25 to 75 mm / 75 to 150 mm / > 150 mm	STRUCTURAL CONDITIONS: DESCRIPTION	PERCENT CORE RECOVERY (0 20 40 60 80 100)	RQD (0 20 40 60 80 100)	SIZE OF HOLE	GROUT	CASING: OTHER SIZES (mm NX BX AX)	DEPTH OF WATER LEVEL	WATER LOSS (0 20 40 60 80 100): NO / PARTIAL / COMPLETE	PERCOLATION TEST: TEST SECTION	BY APPLIED PRESSURE METHOD: PRESSURE (kg/sq.cm)	BY APPLIED PRESSURE METHOD: LOSS(l/m)	BY FALLING HEAD METHOD: DEPTH OF WATER LEVEL	BY FALLING HEAD METHOD: TIME INTERVAL	PERMEABILITY	REMARKS
193.50	6.00	Highly weathered and fractured yellowish color Sandstone/ Siltstone						NX											CR(CM)=92, CR(%)=61 RQD(%)=21
192.00	7.50																		CR(CM)=50 CR(%)=34 RQD(%)=10
190.50	9.00							NX											CR(CM)=63 CR(%)=42 RQD(%)=33
189.00	10.50							NX											CR(CM)=78 CR(%)=52 RQD(%)=18
187.50	12.00																		

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Co ordinates : 1434E, 1639S RL 199.50 Project No: 1988

Location: ESP BH No. : 13 DEPTH : 20.00m Depth of Water Table 1.10m

Date of Start : 14/10/2013 Date of Finish : 17/10/2013

REDUCED LEVEL (m)	DEPTH (m)	LITHOLOGY DESCRIPTION	LOG	Size of core pieces: < 10 mm size / 10 to 25 mm / 25 to 75 mm / 75 to 150 mm / > 150 mm	STRUCTURAL CONDITIONS DESCRIPTION	PERCENT CORE RECOVERY (0 20 40 60 80 100)	RQD (0 20 40 60 80 100)	SIZE OF HOLE	GROUT	CASING OTHER SIZES (mmNX BX AX)	DEPTH OF WATER LEVEL	WATER LOSS NO / PARTIAL / COMPLETE (0 20 40 60 80 100)	PERCOLATION TEST: TEST SECTION / BY APPLIED PRESSURE METHOD: PRESSURE (kg/sq.cm), LOSS(l/m) / BY FALLING HEAD METHOD: DEPTH OF WATER LEVEL, TIME INTERVAL	PERMEABILITY	REMARKS
187.50	12.00	Highly weathered Disintegrated Siltstone													CR(CM)=Nil, CR(%)=Nil RQD(%)=Nil N>100 Penetration 5 cm 70 Blows
186.00	13.50							NX							CR(CM)=Nil, CR(%)=Nil RQD(%)=Nil N>100 Penetration 4 cm 78 Blows
184.50	15.00														CR(CM)=Nil, CR(%)=Nil RQD(%)=Nil N>100 Penetration 6 cm 75 Blows
183.00	16.50							NX							CR(CM)=Nil, CR(%)=Nil RQD(%)=Nil N>100 Penetration 6 cm 70 Blows
181.50	18.00														CR(CM)=Nil, CR(%)=Nil RQD(%)=Nil N>100 Penetration 4 cm 55 Blows
180.00	19.50							NX							CR(%)=Nil RQD(%)=Nil N=60 Blows for 4 cm
179.50	20.00														

BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Coordinate: 1468 E, 1556 S RL: 199.700 Project No: 1988

Location: ESP BH No. : 14 DEPTH : 20.00m Depth of Water Table :0.60m

Date of Start : 08/10/2013 Date of Finish : 10/10/2013

Reduced Level (m)	Depth (m)	Type of sample	Soil Classification	S.P.T Plot (Observed)	Gravel	Sand	Silt/Clay	Density (gm/cc) r(wet)	Density (gm/cc) r(dry)	W/C W(%)	Limits (%) L.L	Limits (%) P . L	Sp.Gr	Shear Parameters Type of test	Shear Parameters C(kg/sq.cm)	Shear Parameters phi(degrees)	Cc
199.700	0.00		Filledup Soil (Soil Material)														
196.400	3.30	SPT	Silty Clay of medium Plasticity (CI)	34	0	30	70				38	19					
195.200	4.50	SPT	Refusal Strata	100 (15 Cm, 67 Blows)	1	8	91										

BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Coordinate: 1468 E, 1556 S RL: 199.700 Project No: 1988

Location: ESP BH No. : 14 DEPTH : 20.00m Depth of Water Table :0.60m

Date of Start : 08/10/2013 Date of Finish : 10/10/2013

REDUCED LEVEL (m)	DEPTH (m)	LITHOLOGY: DESCRIPTION	LOG	Size of core pieces: < 10 mm size	10 to 25 mm	25 to 75 mm	75 to 150 mm	> 150 mm	STRUCTURAL CONDITIONS: DESCRIPTION	PERCENT CORE RECOVERY	RQD	SIZE OF HOLE	GROUT	CASING: OTHER SIZES	DEPTH OF WATER LEVEL	WATER LOSS: NO	PARTIAL	COMPLETE	PERCOLATION TEST: TEST SECTION	BY APPLIED PRESSURE METHOD: PRESSURE (kg/sq.cm)	LOSS(l/m)	BY FALLING HEAD METHOD: DEPTH OF WATER LEVEL	TIME INTERVAL	PERMEABILITY	REMARKS
195.200	4.50																								CR(CM)=22 CR(%)=15 RQD(%)=Nil
193.700	6.00	Highly weathered highly fractured greyish to yellowish color Sandstone/ Siltstone										NX													CR(CM)=21 CR(%)=14 RQD(%)=Nil
192.200	7.50											NX													CR(CM)=30 CR(%)=20 RQD(%)=Nil
190.700	9.00																								CR(CM)=41 CR(%)=27 RQD(%)=18
189.200	10.50	Highly weathered and fractured brpwnish to yellowish color Sandstone/ Siltstone										NX													CR(CM)=56 CR(%)=37 RQD(%)=37
187.700	12.00																								

PERCENT CORE RECOVERY: 0 20 40 60 80 100

RQD: 0 20 40 60 80 100

CASING: OTHER SIZES: mmNX BX AX

WATER LOSS: NO 0 20 40 60 80 100; PARTIAL; COMPLETE

B14-2/3

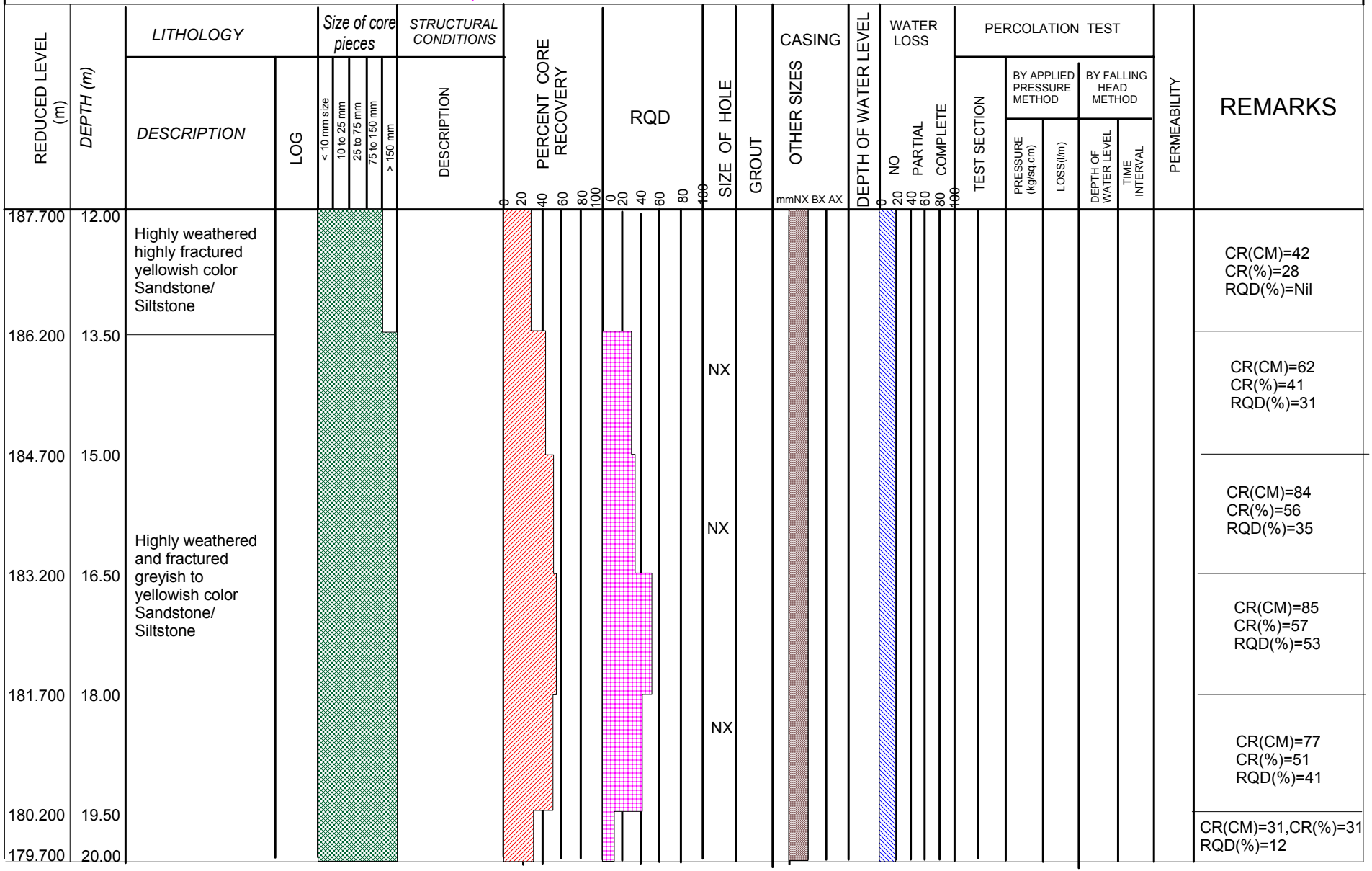
BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Coordinate: 1468 E, 1556 S RL: 199.700 Project No: 1988

Location: ESP BH No. : 14 DEPTH : 20.00m Depth of Water Table :0.60m

Date of Start : 08/10/2013 Date of Finish : 10/10/2013



B14-3/3

BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Coordinate: 1396 E, 1711S RL: 199.700 Project No: 1988

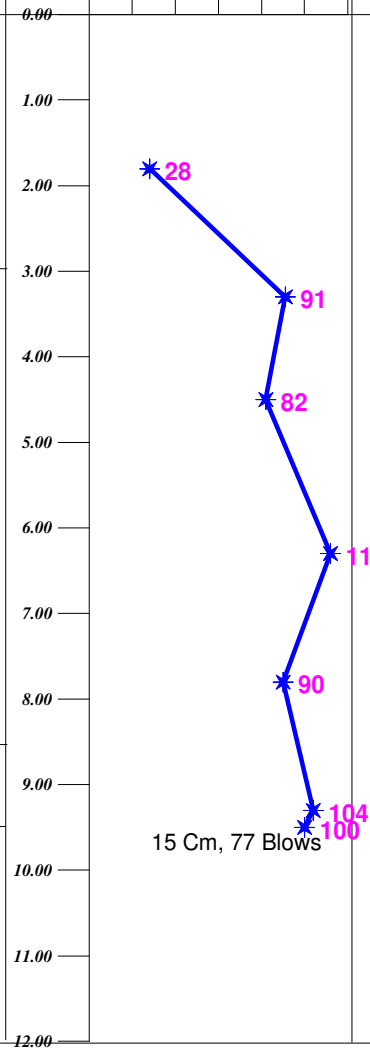
Location: Chimney BH No. : 16 DEPTH : 25.00m Depth of Water Table 1.20m

Date of Start : 05/10/2013 Date of Finish : 06/10/2013

Reduced Level (m)	Depth (m)	Type of sample	Soil Classification	Gravel	Sand	Silt/Clay	r(wet)	r(dry)	W(%)	L.L	P . L	Sp.Gr	Type of test	C(kg/sq.cm)	phi(degrees)	Cc
199.700	0.00															
197.900	1.80	SPT	Filledup Soil (Road Material mixed with soil)							Non Plastic						
196.400	3.30	SPT		0	4	96				49	27					
195.200	4.50	SPT		0	3	97										
193.400	6.30	SPT	Silty Clay of medium Plasticity (CI)	0	6	94				44	23					
191.900	7.80	SPT		1	8	91										
190.400	9.30	SPT	Sandy Silt (SM-ML)	0	30	70				Non Plastic						
190.200	9.50	SPT	Refusal Strata							Non Plastic						

S.P.T Plot

Observed



BORE LOG

SOIL ENGINEERING CONSULTANTS

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Coordinate: 1396 E, 1711S RL: 199.700 Project No: 1988

Location: Chimney BH No. : 16 DEPTH : 25.00m Depth of Water Table 1.20m

Date of Start : 05/10/2013 Date of Finish : 06/10/2013

REDUCED LEVEL (m)	DEPTH (m)	LITHOLOGY: DESCRIPTION	LOG	Size of core pieces: < 10 mm size / 10 to 25 mm / 25 to 75 mm / 75 to 150 mm / > 150 mm	STRUCTURAL CONDITIONS: DESCRIPTION	PERCENT CORE RECOVERY (0 20 40 60 80 100)	RQD (0 20 40 60 80 100)	SIZE OF HOLE	GROUT	CASING: OTHER SIZES (mmNX BX AX)	DEPTH OF WATER LEVEL	WATER LOSS: NO / PARTIAL / COMPLETE (0 20 40 60 80 100)	PERCOLATION TEST: TEST SECTION	BY APPLIED PRESSURE METHOD: PRESSURE (kg/sq.cm) / LOSS(l/m)	BY FALLING HEAD METHOD: DEPTH OF WATER LEVEL / TIME INTERVAL	PERMEABILITY	REMARKS
190.200	9.50	Highly weathered highly fractured yellowish color Sandstone/Siltstone															CR(CM)=15 CR(%)=10 RQD(%)=Nil N>100 10cm, 75 Blows
189.200	10.50	Highly weathered disintegrated Rock						NX									CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 7 cm, 70 Blows
187.700	12.00																CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 5cm, 65 Blows
186.200	13.50	Highly weathered and fractured yellowish color Sandstone/Siltstone						NX									CR(CM)=27 CR(%)=18 RQD(%)=18
184.700	15.00	Highly weathered highly fractured yellowish color Sandstone/Siltstone						NX									CR(CM)=21 CR(%)=14 RQD(%)=Nil N>100 5cm, 71 Blows
183.200	16.50	Highly weathered and fractured yellowish color Sandstone/Siltstone															CR(CM)=25 CR(%)=17 RQD(%)=17
181.700	18.00																

BORE LOG

SOIL ENGINEERING CONSULTANTS

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Coordinate: 1396 E, 1711S RL: 199.700 Project No: 1988

Location: Chimney BH No. : 16 DEPTH : 25.00m Depth of Water Table 1.20m

Date of Start : 05/10/2013 Date of Finish : 06/10/2013

REDUCED LEVEL (m)	DEPTH (m)	LITHOLOGY: DESCRIPTION	LOG	Size of core pieces: < 10 mm size	10 to 25 mm	25 to 75 mm	75 to 150 mm	> 150 mm	STRUCTURAL CONDITIONS: DESCRIPTION	PERCENT CORE RECOVERY	RQD	SIZE OF HOLE	GROUT	CASING: OTHER SIZES	DEPTH OF WATER LEVEL	WATER LOSS: NO	PARTIAL	COMPLETE	PERCOLATION TEST: TEST SECTION	BY APPLIED PRESSURE METHOD: PRESSURE (kg/sq.cm)	LOSS(l/m)	BY FALLING HEAD METHOD: DEPTH OF WATER LEVEL	TIME INTERVAL	PERMEABILITY	REMARKS
181.700	18.00	Highly weathered highly fractured yellowish color Sandstone/ Siltstone										NX													CR(CM)=18 CR(%)=12 RQD(%)=Nil N>100 4cm, 65 Blows
180.200	19.50																								CR(CM)=13 CR(%)=9 RQD(%)=Nil N>100 5cm, 70 Blows
178.700	21.00	Highly weathered disintegrated Rock										NX													CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 7 cm, 77 Blows
177.200	22.50	Highly weathered highly fractured yellowish color Sandstone/Siltstone										NX													CR(CM)=32 CR(%)=21 RQD(%)=Nil
175.700	24.00																								CR(CM)=22 CR(%)=22 RQD(%)=Nil
174.700	25.00																								

mmNX BX AX

BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Coordinate: 1358 E, 1072 S RL: 199.436 Project No: 1988

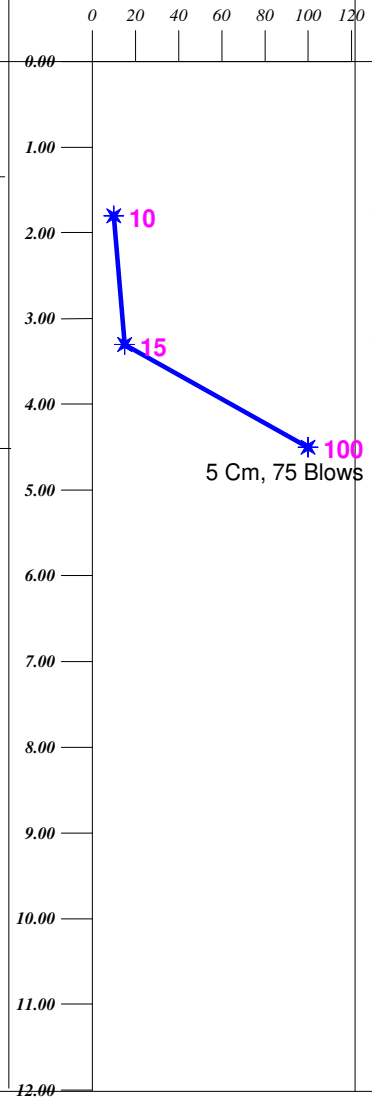
Location: Switch Yard BH No. : 32 DEPTH : 15.00m Depth of Water Table : 0.80 m

Date of Start : 23/09/2013 Date of Finish : 24/09/2013

Reduced Level (m)	Depth (m)	Type of sample	Soil Classification	Grain size (%) Gravel	Sand	Silt/Clay	Density (gm/cc) r(wet)	r(dry)	W/C W(%)	Limits (%) L.L	P . L	Sp.Gr	Shear Parameters Type of test	C(kg/sq.cm)	phi(degrees)	Cc
199.436	0.00		Filledup Soil (Soil with Ash)													
197.636	1.80	SPT	Silty Clay mixed with sand (CI)	13	34	33/20				36	19					
196.936	2.50	UDS					1.81	1.45	24.89			2.76	UU	0.48	2	0.063
196.136	3.30	SPT		10	9	63/18										
194.936	4.50	SPT	Refusal Strata	0	39	39/22										

S.P.T Plot

Observed



BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Coordinate: 1358 E, 1072 S RL: 199.436 Project No: 1988

Location: Switch Yard BH No. : 32 DEPTH : 15.00m Depth of Water Table : 0.80 m

Date of Start : 23/09/2013 Date of Finish : 24/09/2013

REDUCED LEVEL (m)	DEPTH (m)	LITHOLOGY: DESCRIPTION	LOG	Size of core pieces: < 10 mm size	10 to 25 mm	25 to 75 mm	75 to 150 mm	> 150 mm	STRUCTURAL CONDITIONS: DESCRIPTION	PERCENT CORE RECOVERY	RQD	SIZE OF HOLE	GROUT	CASING: OTHER SIZES	DEPTH OF WATER LEVEL	WATER LOSS: NO	PARTIAL	COMPLETE	PERCOLATION TEST: TEST SECTION	BY APPLIED PRESSURE METHOD: PRESSURE (kg/sq.cm)	LOSS(l/m)	BY FALLING HEAD METHOD: DEPTH OF WATER LEVEL	TIME INTERVAL	PERMEABILITY	REMARKS
194.936	4.50	Highly weathered highly fractured yellowish color Sandstone										NX		mmNX BX AX											CR(CM)=26 CR(%)=17 RQD(%)=12
193.436	6.00																								CR(CM)=78 CR(%)=52 RQD(%)=30
191.936	7.50	Highly weathered highly fractured yellowish color Sandstone																							CR(CM)=64 CR(%)=43 RQD(%)=Nil
190.436	9.00											NX													CR(CM)=95 CR(%)=63 RQD(%)=27
188.936	10.50																								CR(CM)=83 CR(%)=55 RQD(%)=39
187.436	12.00	Highly to moderately weathered fractured yellowish color Sandstone										NX													CR(CM)=112 CR(%)=75 RQD(%)=51
185.936	13.50																								CR(CM)=138 CR(%)=92 RQD(%)=83
184.436	15.00																								

BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Coordinate: 1432.500 E, 1196.00 S RL: 199.500 Project No: 1988

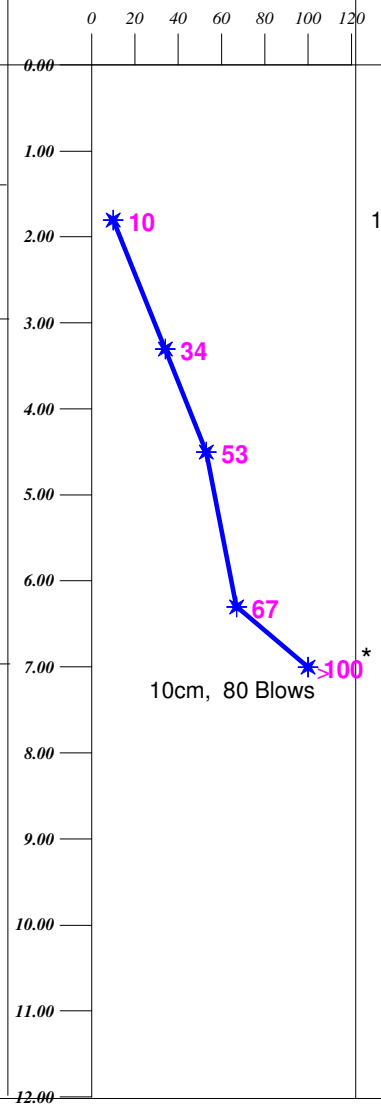
Location: Transformer Yard BH No. :34 DEPTH : 15.00m Depth of Water Table :0.40m

Date of Start : 06/10/2013 Date of Finish : 07/10/2013

Reduced Level (m)	Depth (m)	Type of sample	Soil Classification	Gravel	Sand	Silt/Clay	r(wet)	r(dry)	W(%)	L.L	P . L	Sp.Gr	Shear Parameters: Type of test	Shear Parameters: C(kg/sq.cm)	Shear Parameters: phi(degrees)	Cc
199.500	0.00		Filledup Soil (Soil mixed with Ash)													
197.700	1.80	SPT	Silty Sand with Gravel (SM)	16	42	42					Non Plastic					
197.000	2.50	UDS					1.81	1.46	24.28			2.65	DST		29	
196.200	3.30	SPT	Silty Clay mixed with Sand (CI-CH)	1	30	69				42	22					
195.000	4.50	SPT		4	34	62										
193.200	6.30	SPT		0	4	96				52	27					
192.500	7.00	SPT	Refusal Strata													

S.P.T Plot

Observed



BORE LOG

PROJECT: Geotechnical Investigation work for 2x660MW IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

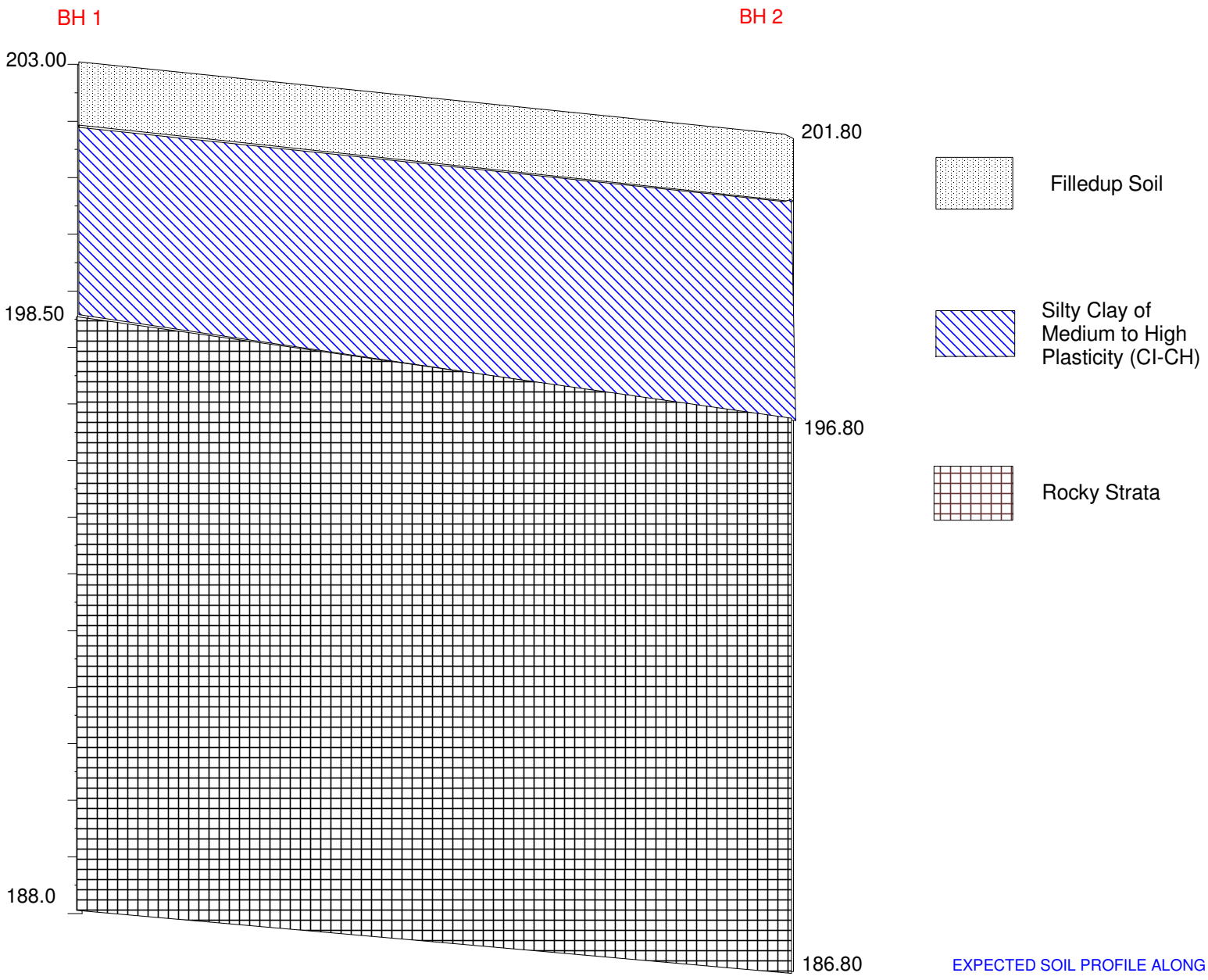
Coordinate: 1432.500 E, 1196.00 S RL: 199.500 Project No: 1988

Location: Transformer Yard BH No. :34 DEPTH : 15.00m Depth of Water Table :0.40m

Date of Start : 06/10/2013 Date of Finish : 07/10/2013

REDUCED LEVEL (m)	DEPTH (M)	LITHOLOGY: DESCRIPTION	LOG	Size of core pieces: < 10 mm size / 10 to 25 mm / 25 to 75 mm / 75 to 150 mm / > 150 mm	STRUCTURAL CONDITIONS: DESCRIPTION	PERCENT CORE RECOVERY (0 20 40 60 80 100)	RQD (0 20 40 60 80 100)	SIZE OF HOLE	GROUT	CASING: OTHER SIZES (mmNX BX AX)	DEPTH OF WATER LEVEL	WATER LOSS: NO / PARTIAL / COMPLETE (0 20 40 60 80 100)	PERCOLATION TEST: TEST SECTION	BY APPLIED PRESSURE METHOD: PRESSURE (kg/sq.cm) / LOSS(l/m)	BY FALLING HEAD METHOD: DEPTH OF WATER LEVEL / TIME INTERVAL	PERMEABILITY	REMARKS
192.500	7.00																CR(CM)=18,CR(%)=36 RQD(%)=Nil
192.000	7.50	Highly weathered and fractured yellowish color Sandstone/ Siltstone						NX									CR(CM)=54 CR(%)=36 RQD(%)=9
190.500	9.00																CR(CM)=60 CR(%)=40 RQD(%)=15
189.000	10.50	Highly weathered highlt fractured yellowish color Sandstone/ Siltstone						NX									CR(CM)=30 CR(%)=20 RQD(%)=Nil
187.500	12.00	Highly weathered and fractured yellowish color Sandstone/ Siltstone															CR(CM)=60 CR(%)=40 RQD(%)=16
186.000	13.50	Highly weathered highly fractured yellowish color Sandstone/ Siltstone						NX									CR(CM)=53 CR(%)=35 RQD(%)=Nil
184.500	15.00																

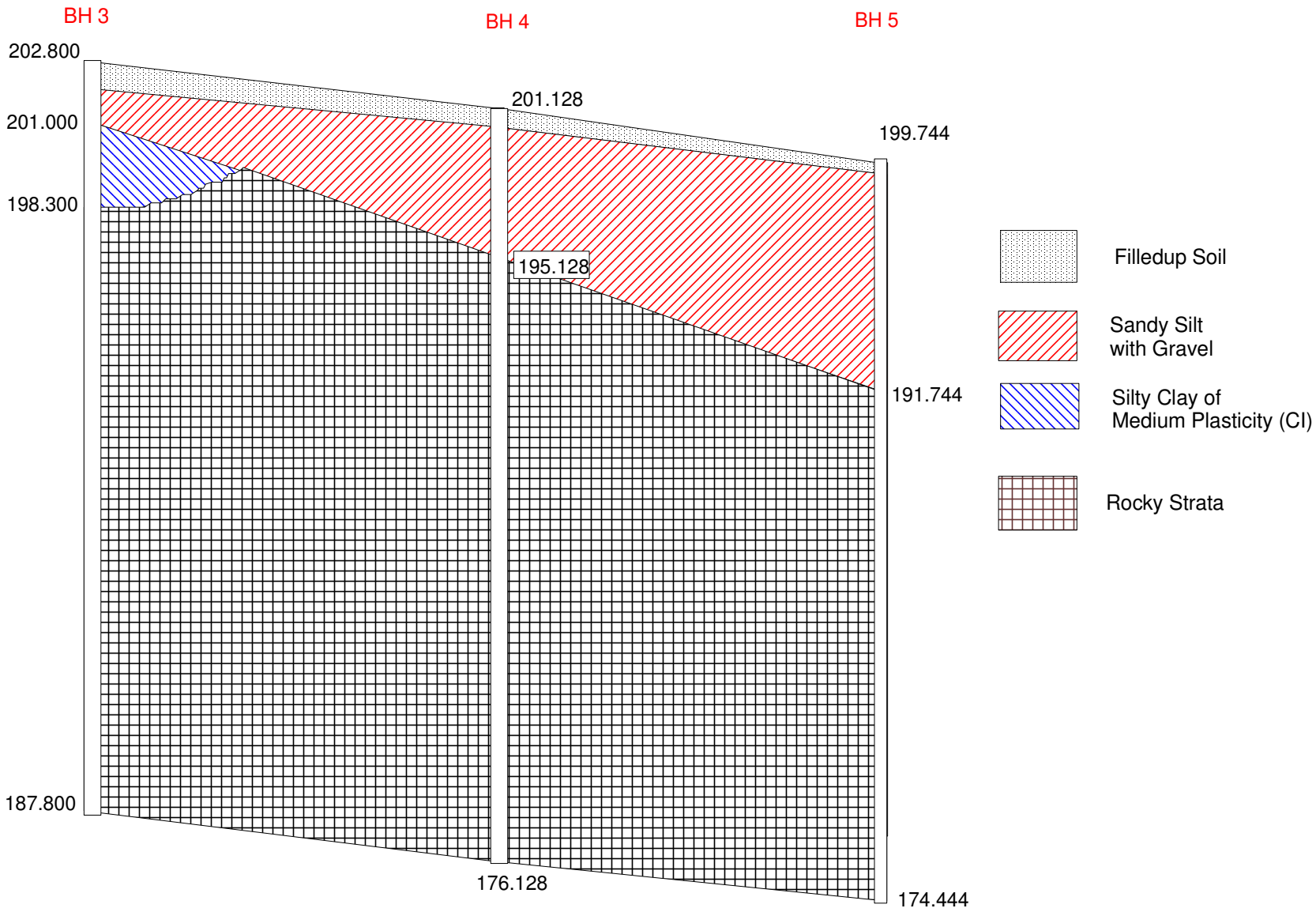
SOIL PROFILE



EXPECTED SOIL PROFILE ALONG BH 1 & BH 2

PROJECT: Geotechnical Investigation work for proposed Structure at 2x660MW
IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha

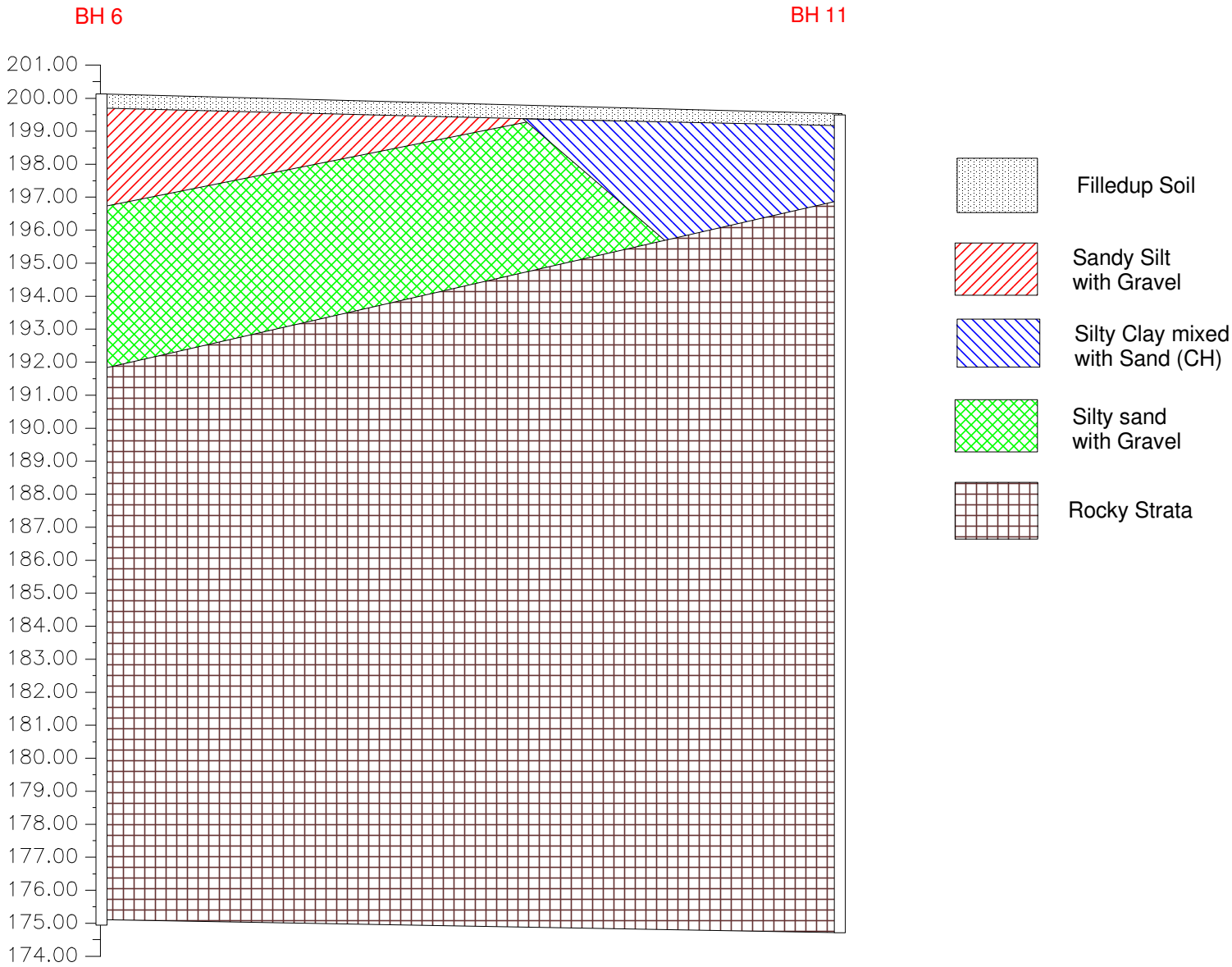
Figure : Soilpro A



EXPECTED SOIL PROFILE ALONG BH 3 to BH 5

PROJECT: Geotechnical Investigation work for proposed Structure at 2x660MW
IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha

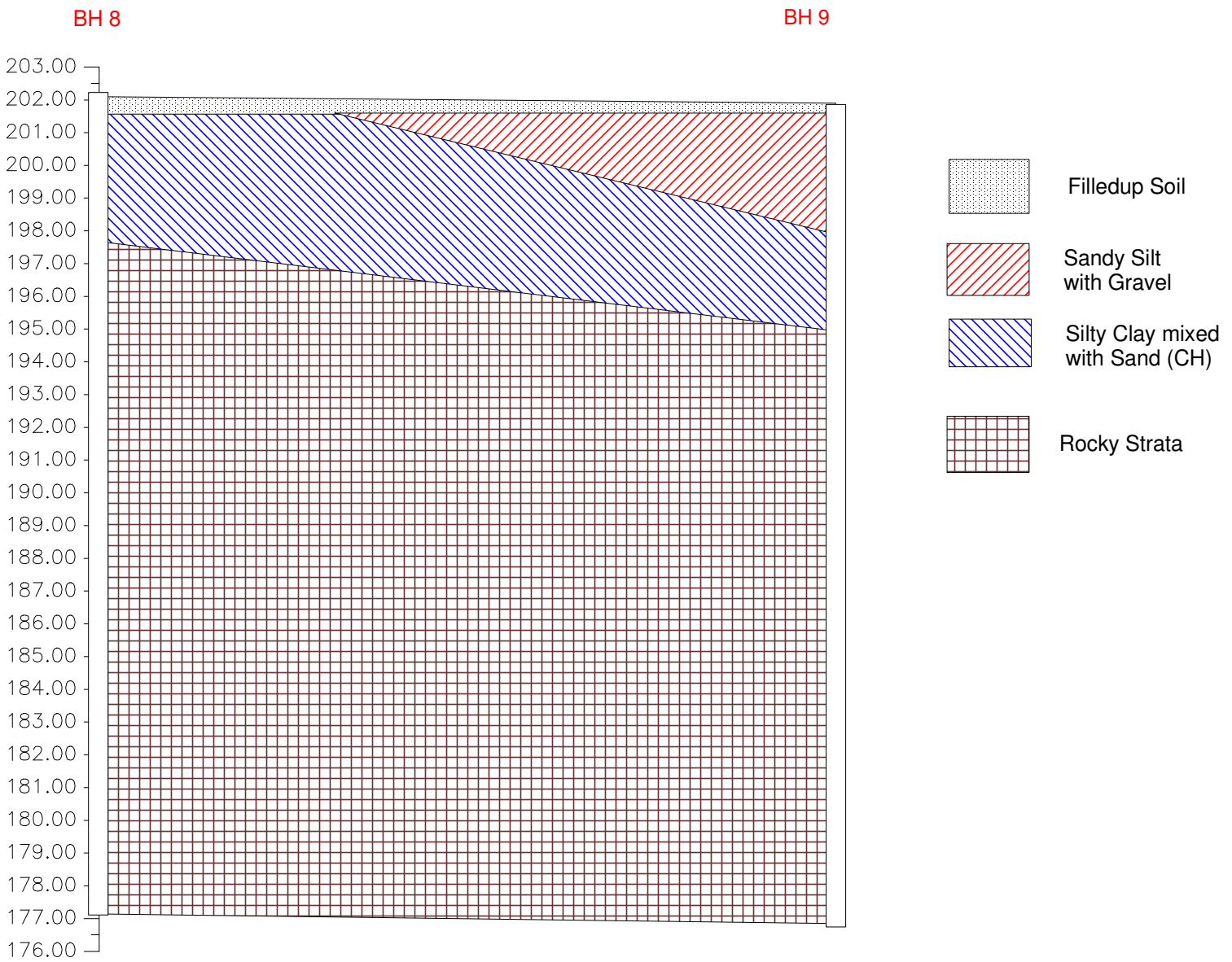
Figure : Soilpro B



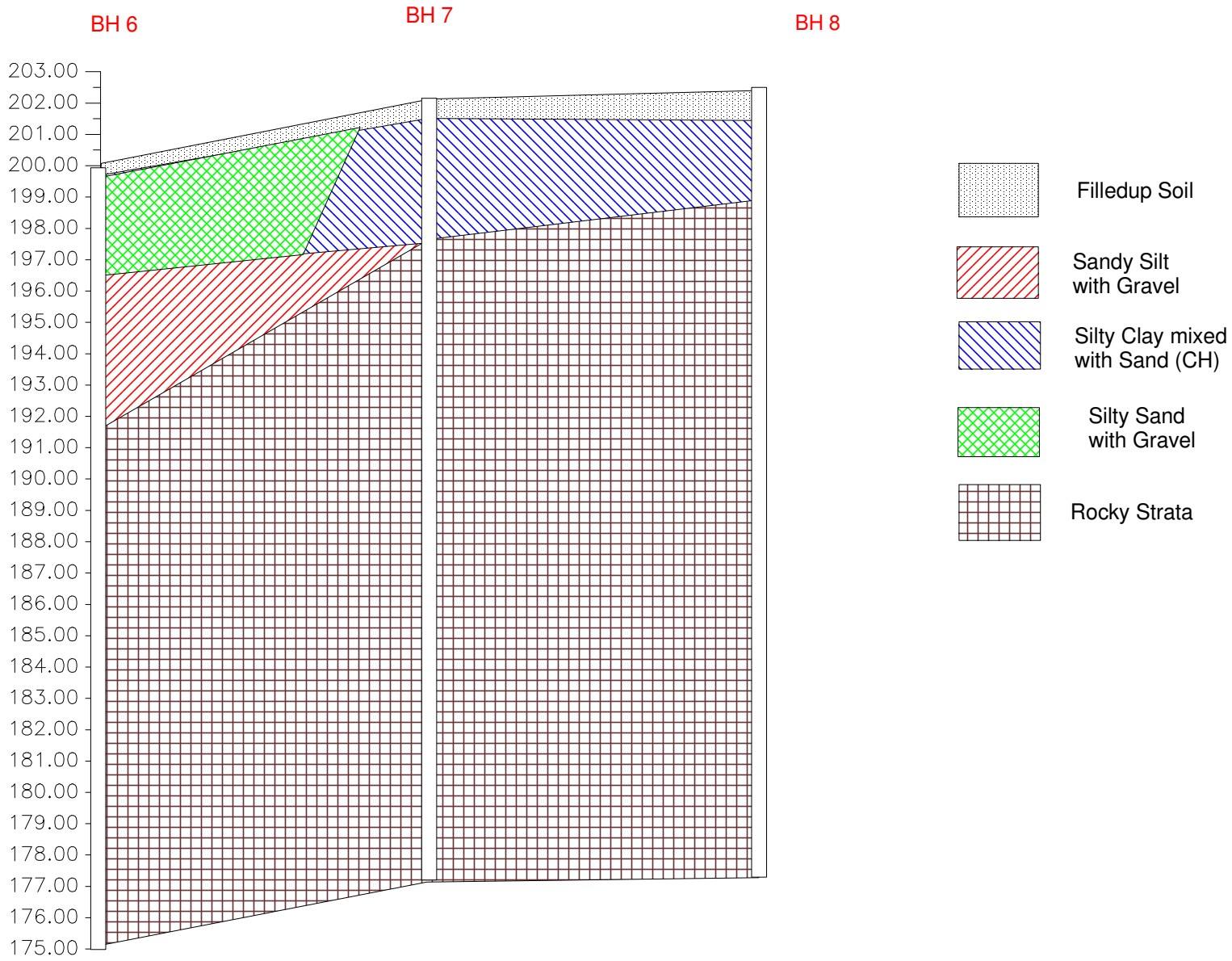
EXPECTED SOIL PROFILE ALONG BH 6 & BH 11

PROJECT: Geotechnical Investigation work for proposed Structure at 2x660MW
IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha

Figure : Soilpro C



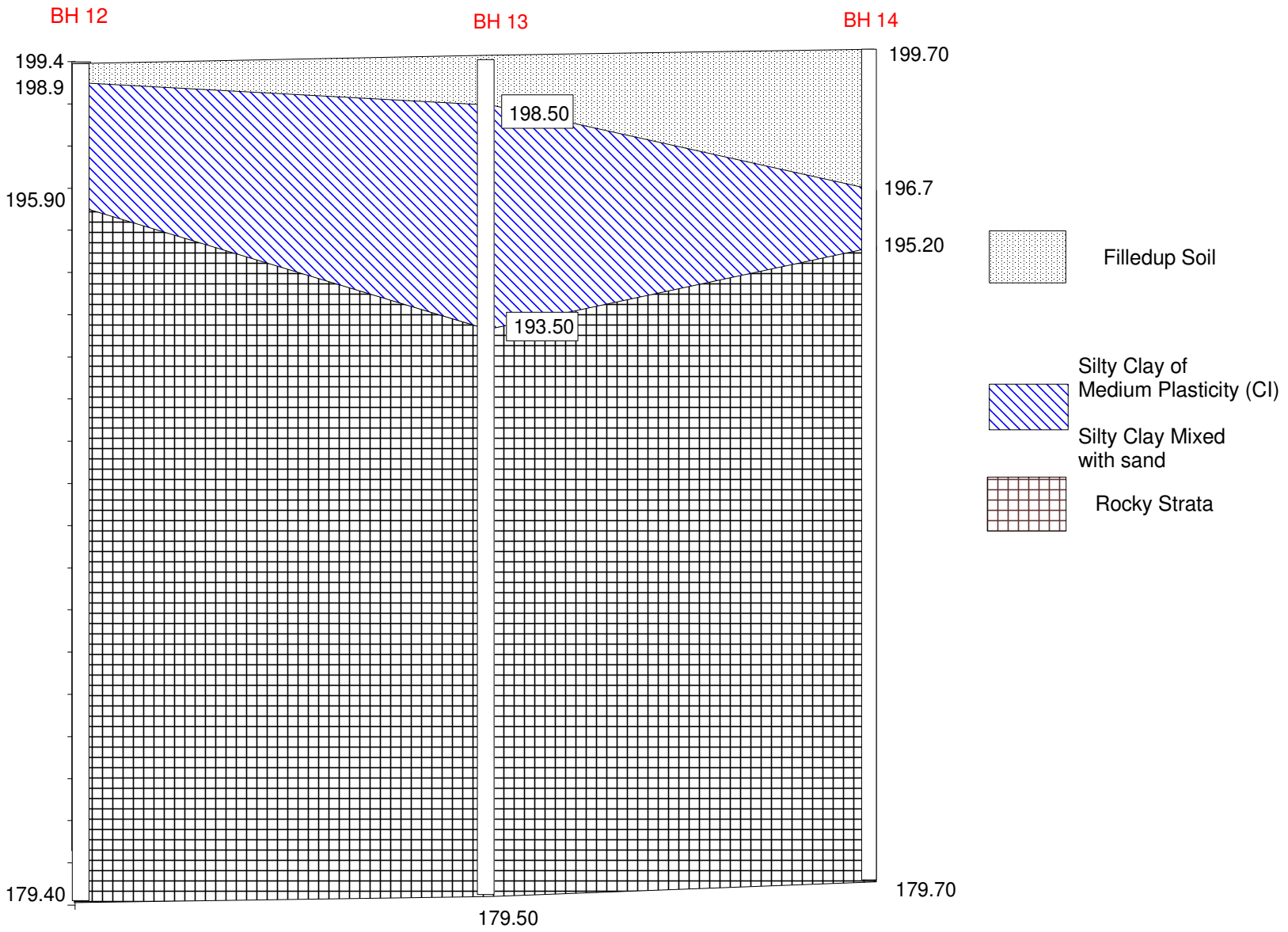
EXPECTED SOIL PROFILE ALONG BH 8 & BH 9



EXPECTED SOIL PROFILE ALONG BH 6 to BH 8

PROJECT: Geotechnical Investigation work for proposed Structure at 2x660MW
IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha

Figure : Soilpro E



EXPECTED SOIL PROFILE ALONG BH 12 TO BH 14

GRAIN SIEVE ANALYSIS

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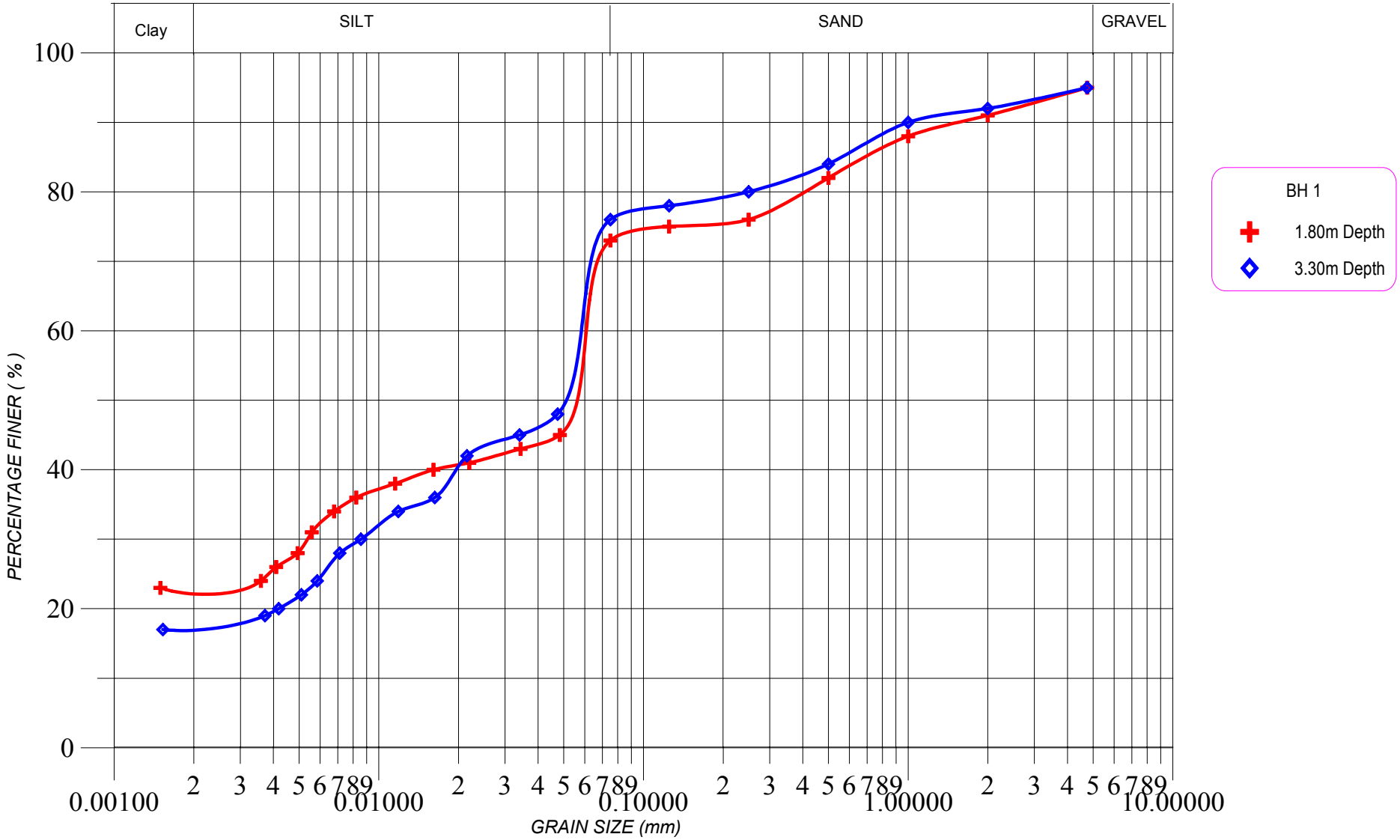
GRAIN SIZE DRISTRIBUTION CURVE



PROJECT: Geotechnical Investigation work for proposed Structure at 2x660MW
IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha

Fig : GSD-1

GRAIN SIZE DRISTRIBUTION CURVE

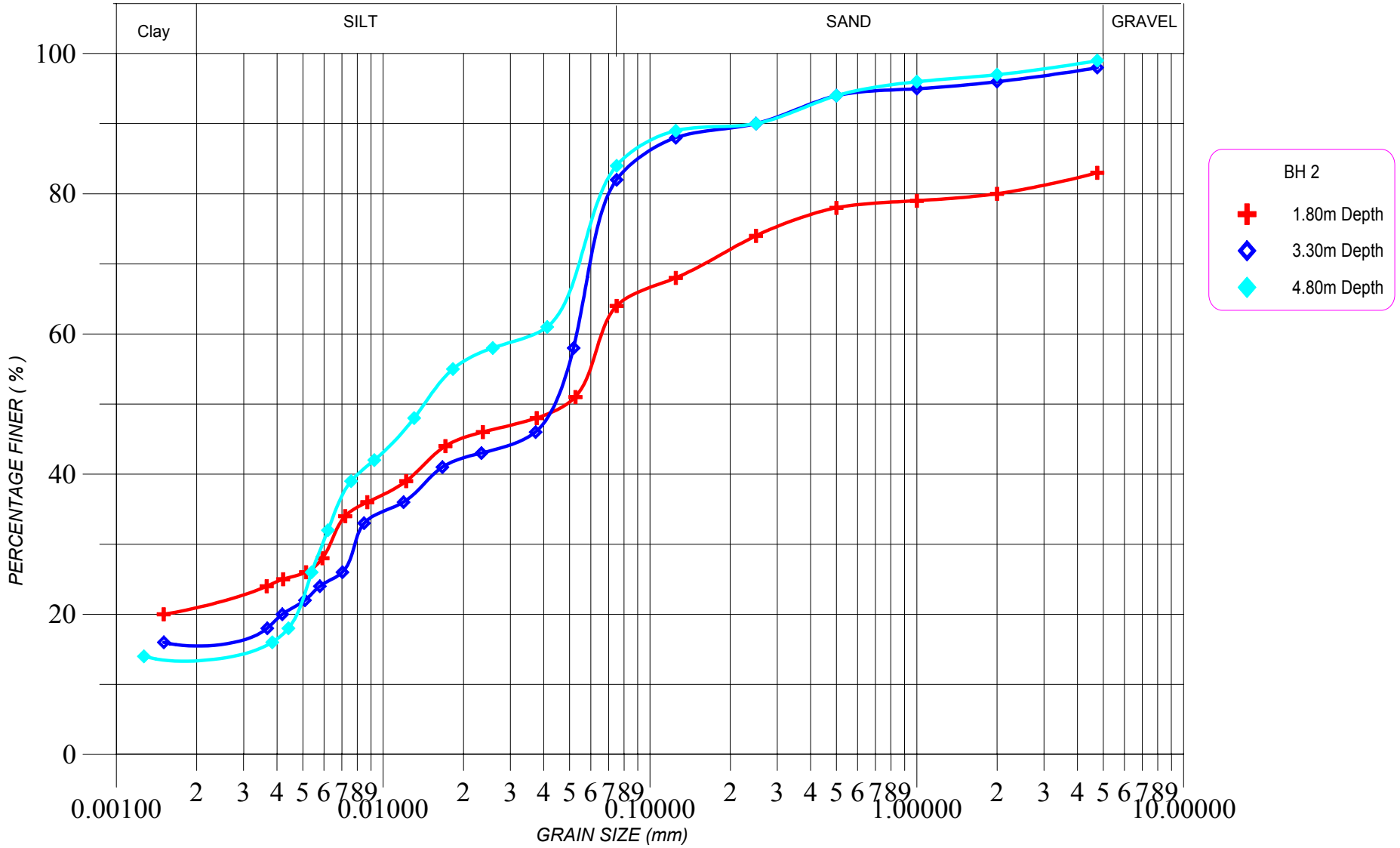


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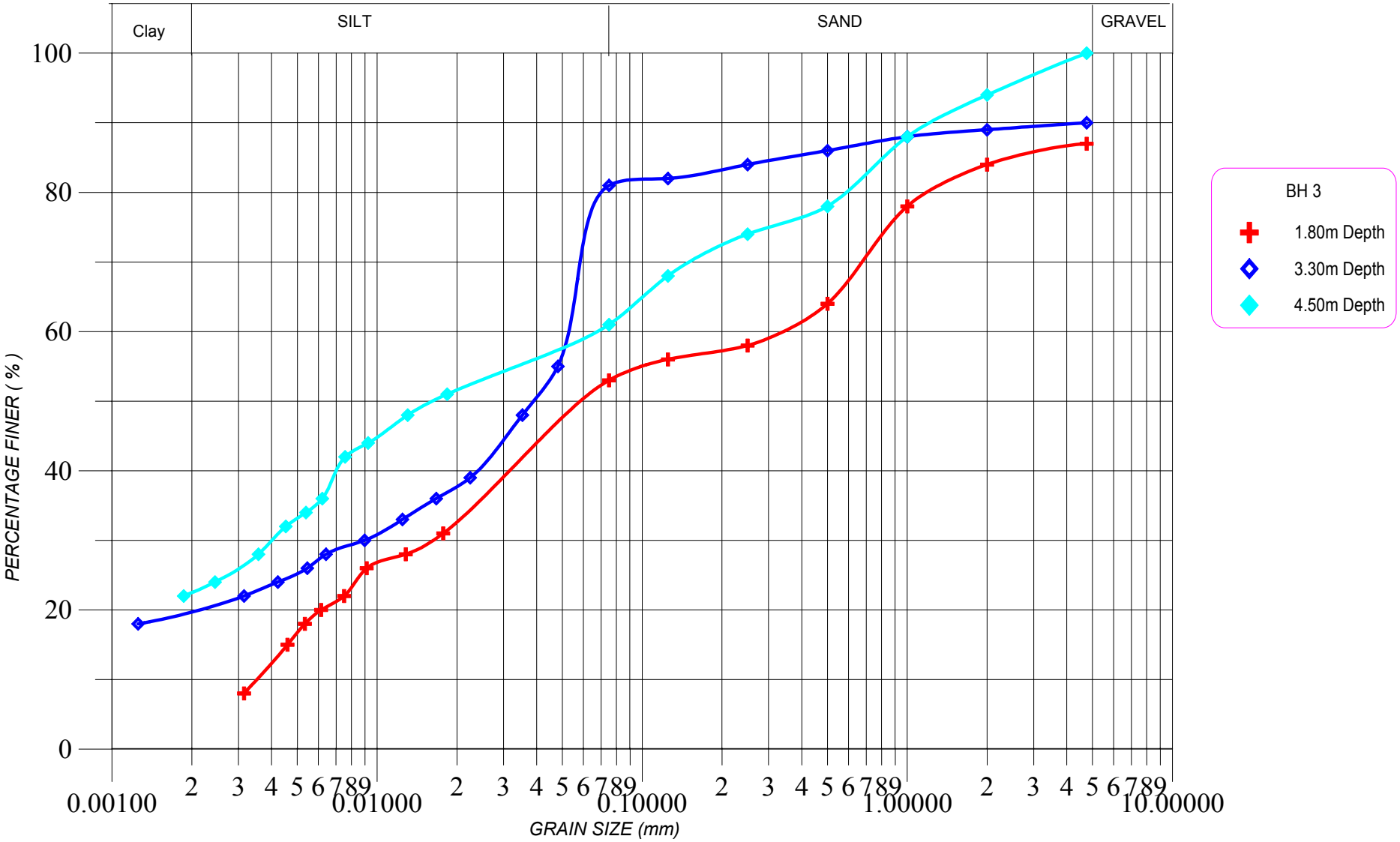
Fig : GSD 2

Soil Engineering Consultants

Job: 1988

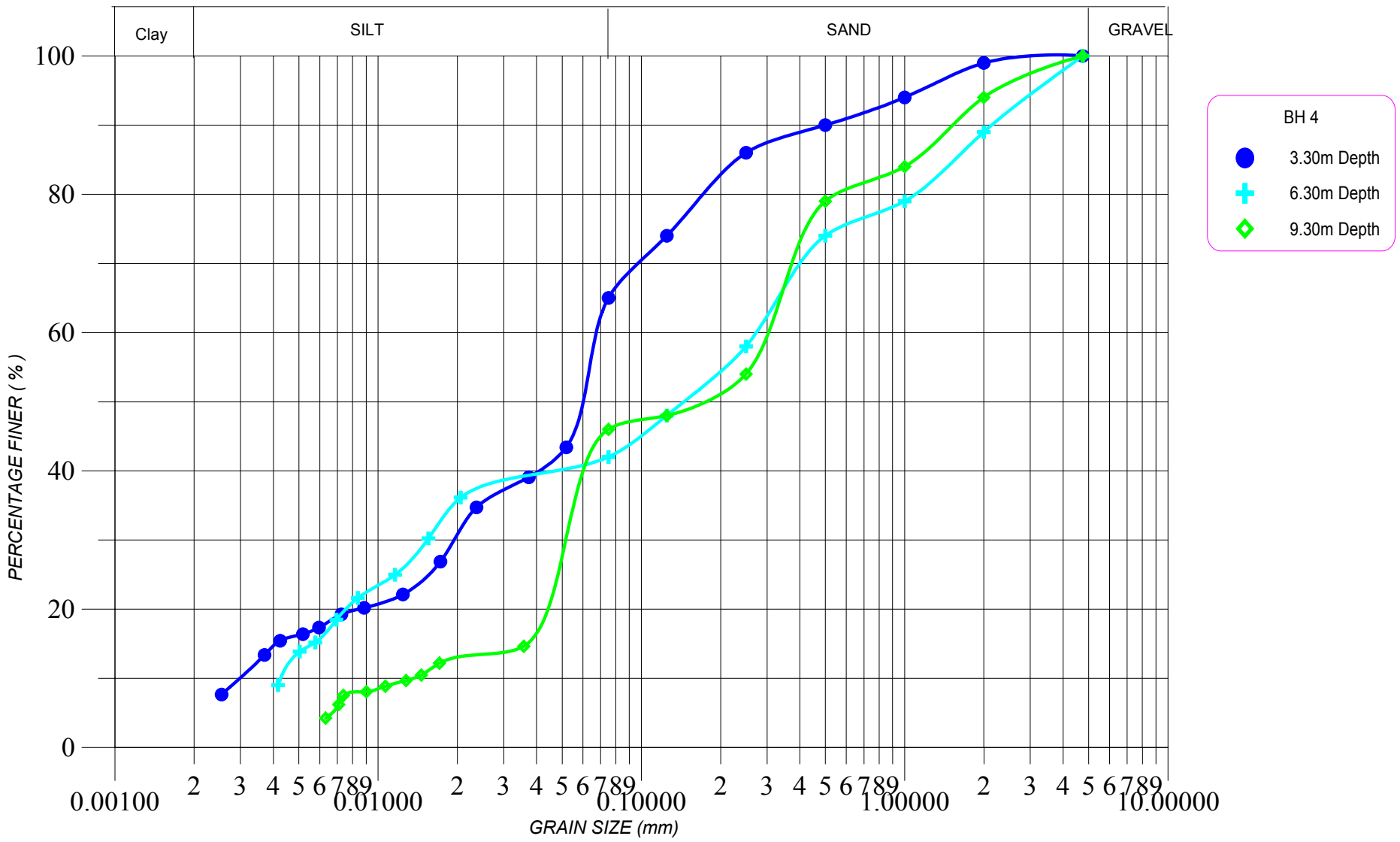
GRAIN SIZE DRISTRIBUTION CURVE



PROJECT: Geotechnical Investigation work for proposed Structure at 2x660MW
IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha

Fig : GSD-3

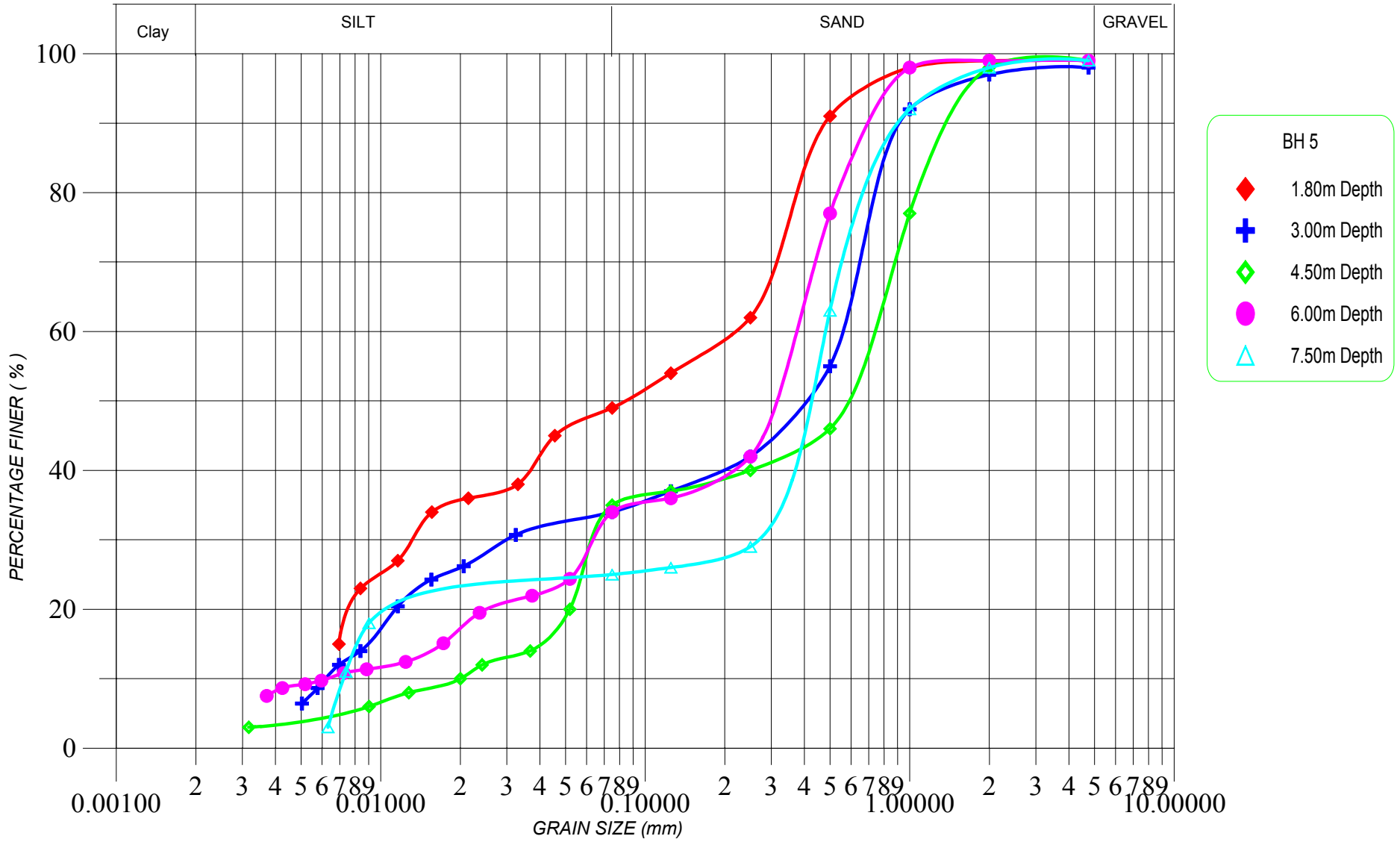
GRAIN SIZE DRISTRIBUTION CURVE



PROJECT: Geotechnical Investigation work for proposed Structure at 2x660MW
IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha

Fig : GSD-4

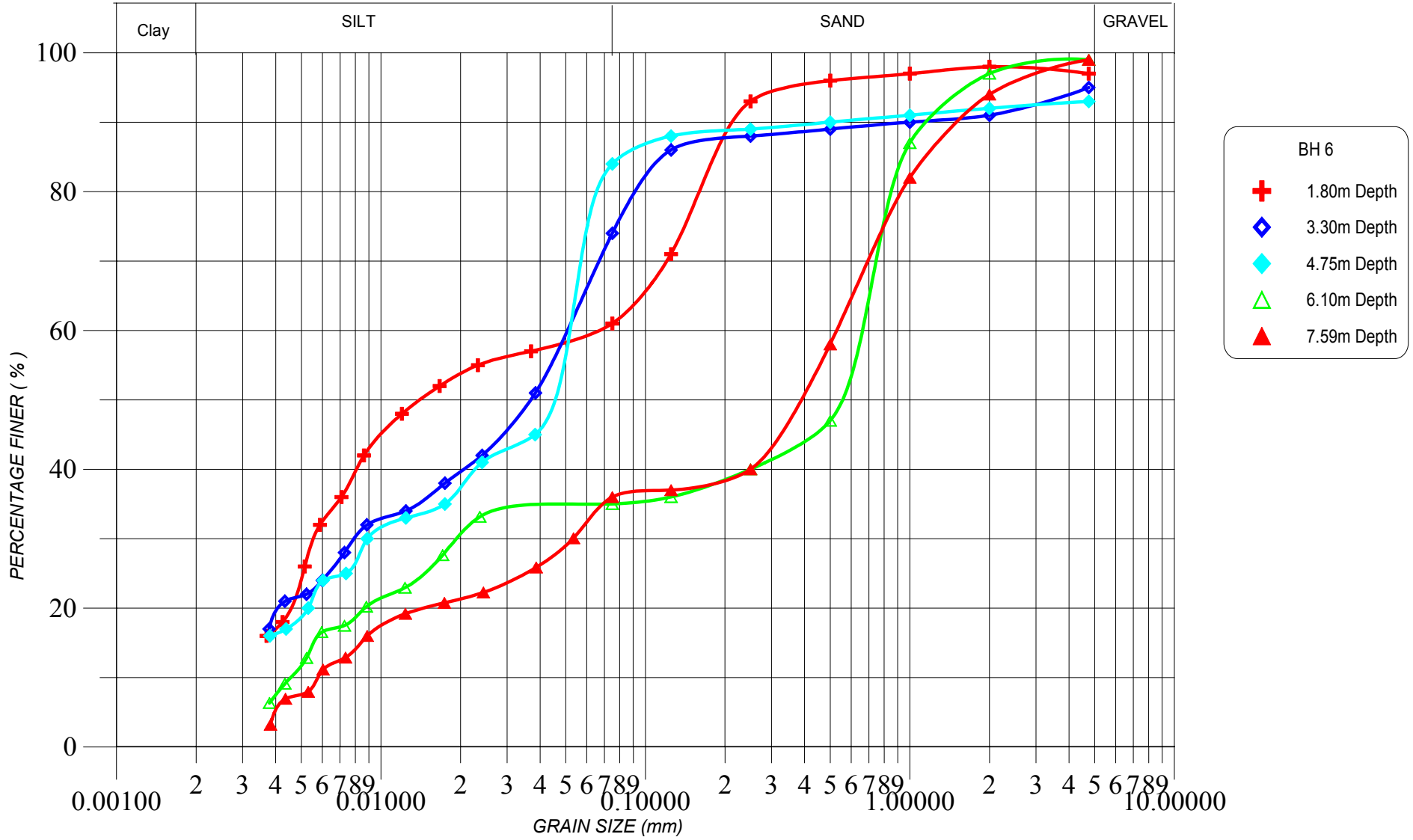
GRAIN SIZE DRISTRIBUTION CURVE



PROJECT: Geotechnical Investigation work for proposed Structure at 2x660MW
IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha

Fig : GSD-5

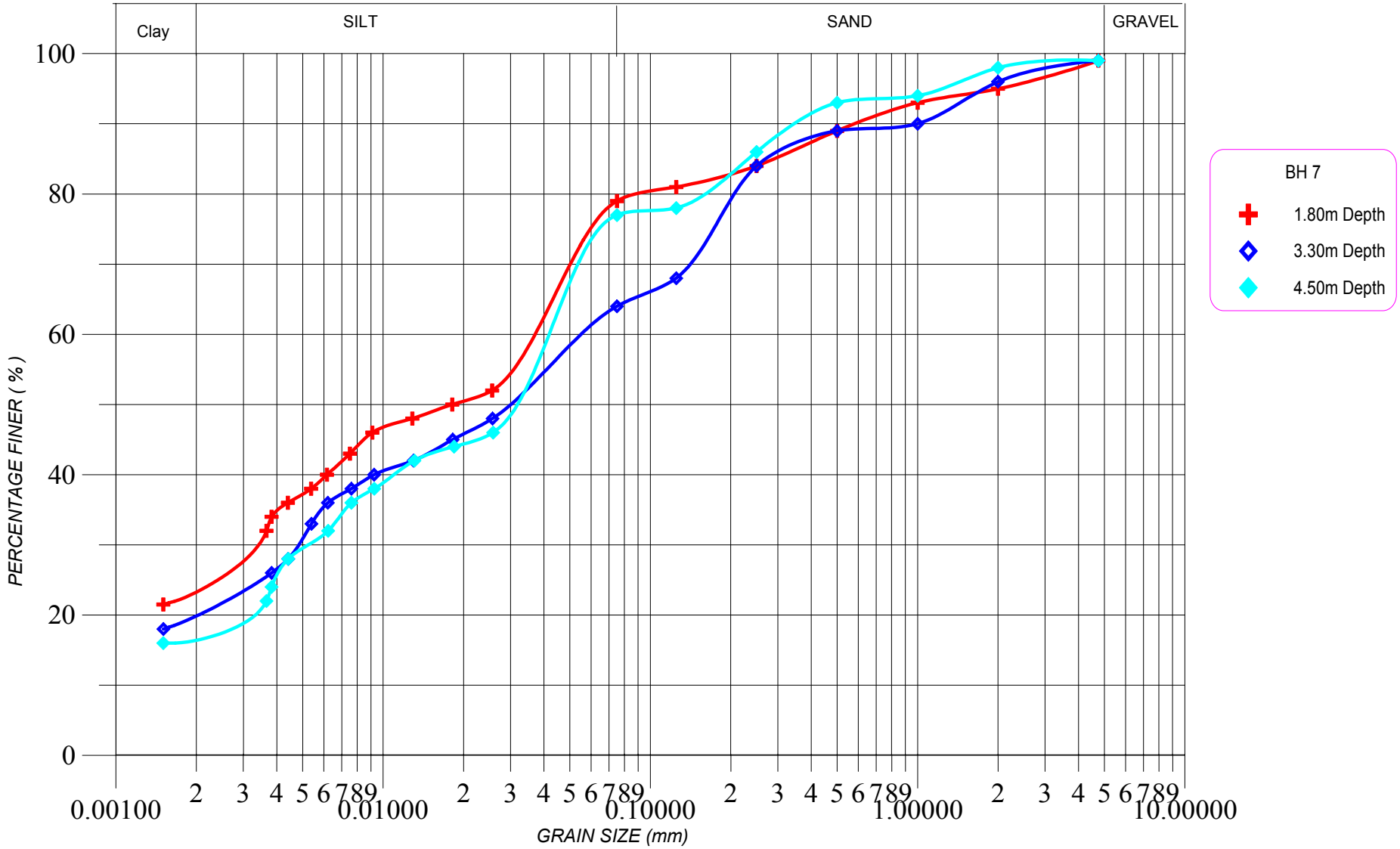
GRAIN SIZE DRISTRIBUTION CURVE



PROJECT: Geotechnical Investigation work for proposed Structure at 2x660MW
IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha

Fig : GSD-6

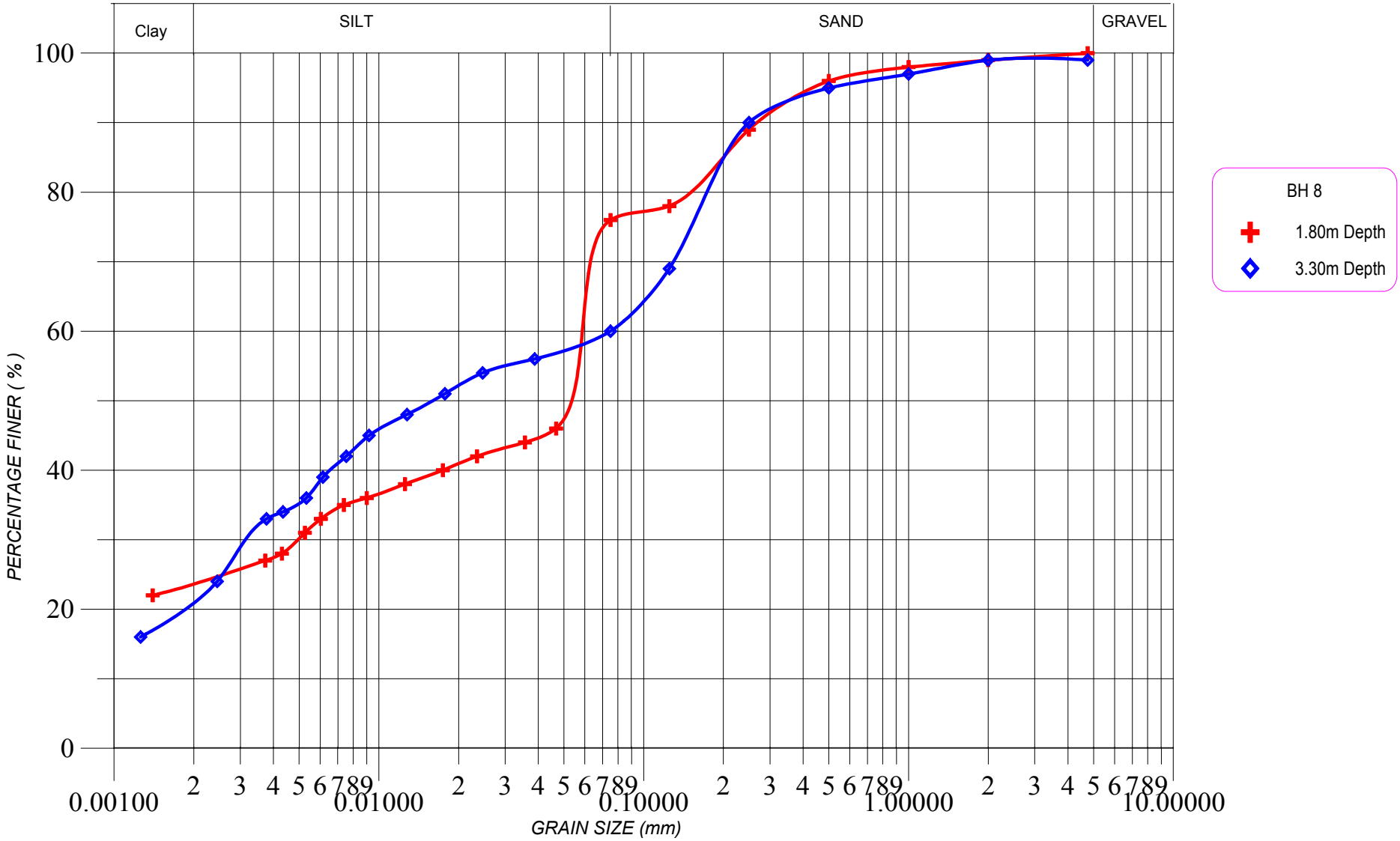
GRAIN SIZE DRISTRIBUTION CURVE



PROJECT: Geotechnical Investigation work for proposed Structure at 2x660MW
IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha

Fig : GSD 7

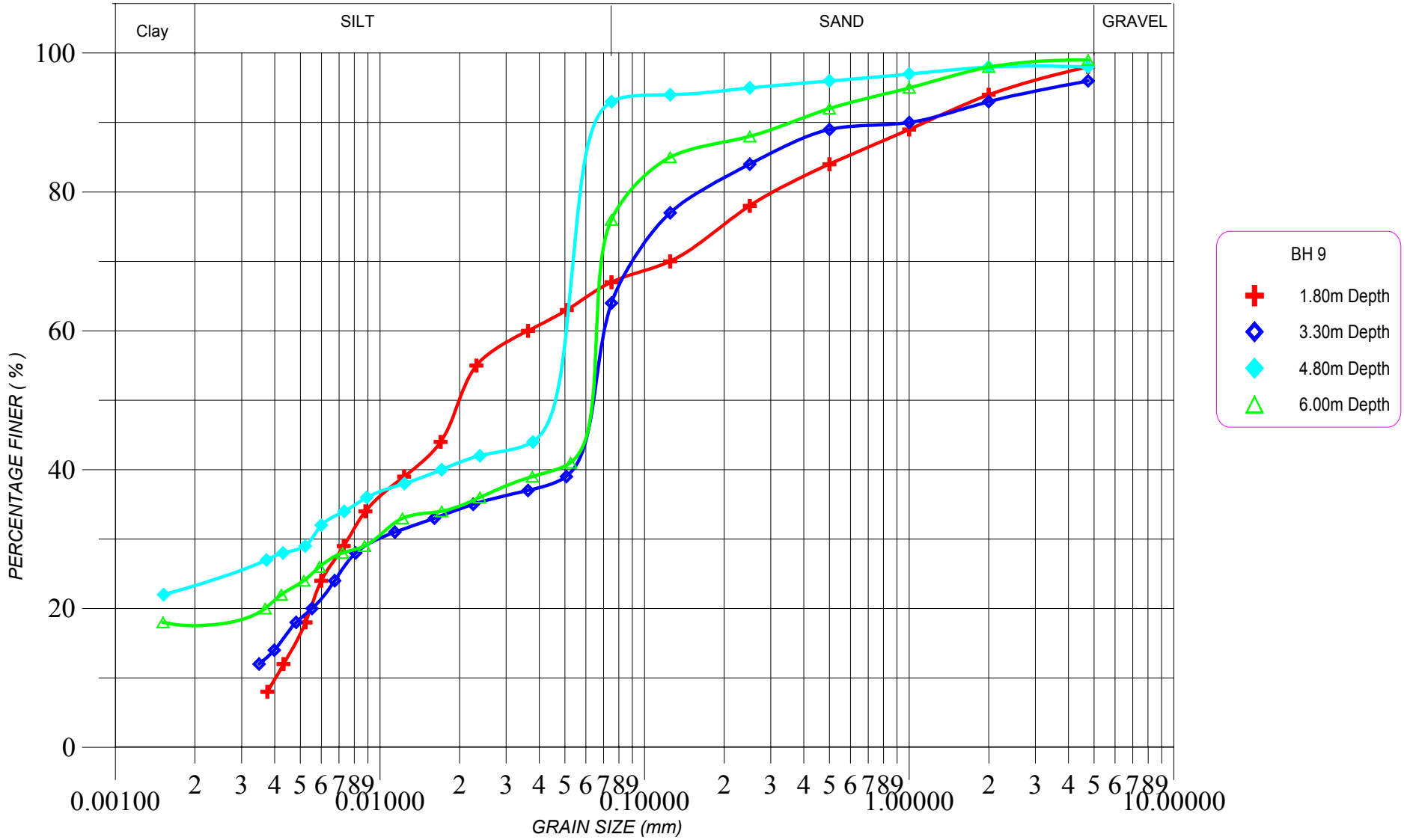
GRAIN SIZE DRISTRIBUTION CURVE



PROJECT: Geotechnical Investigation work for proposed Structure at 2x660MW
IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha

Fig : GSD8

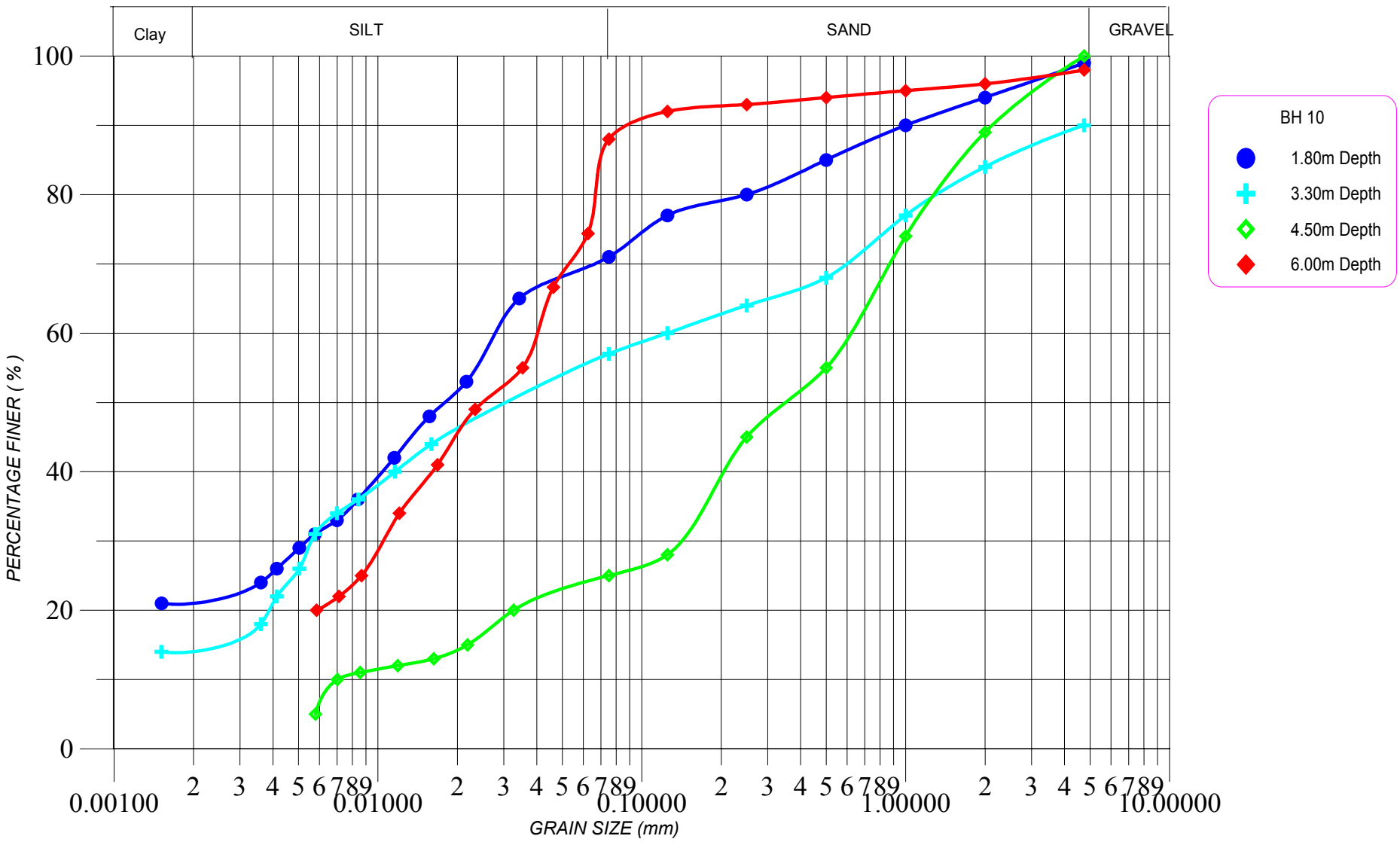
GRAIN SIZE DRISTRIBUTION CURVE



PROJECT: Geotechnical Investigation work for proposed Structure at 2x660MW
IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha

Fig : GSD-9

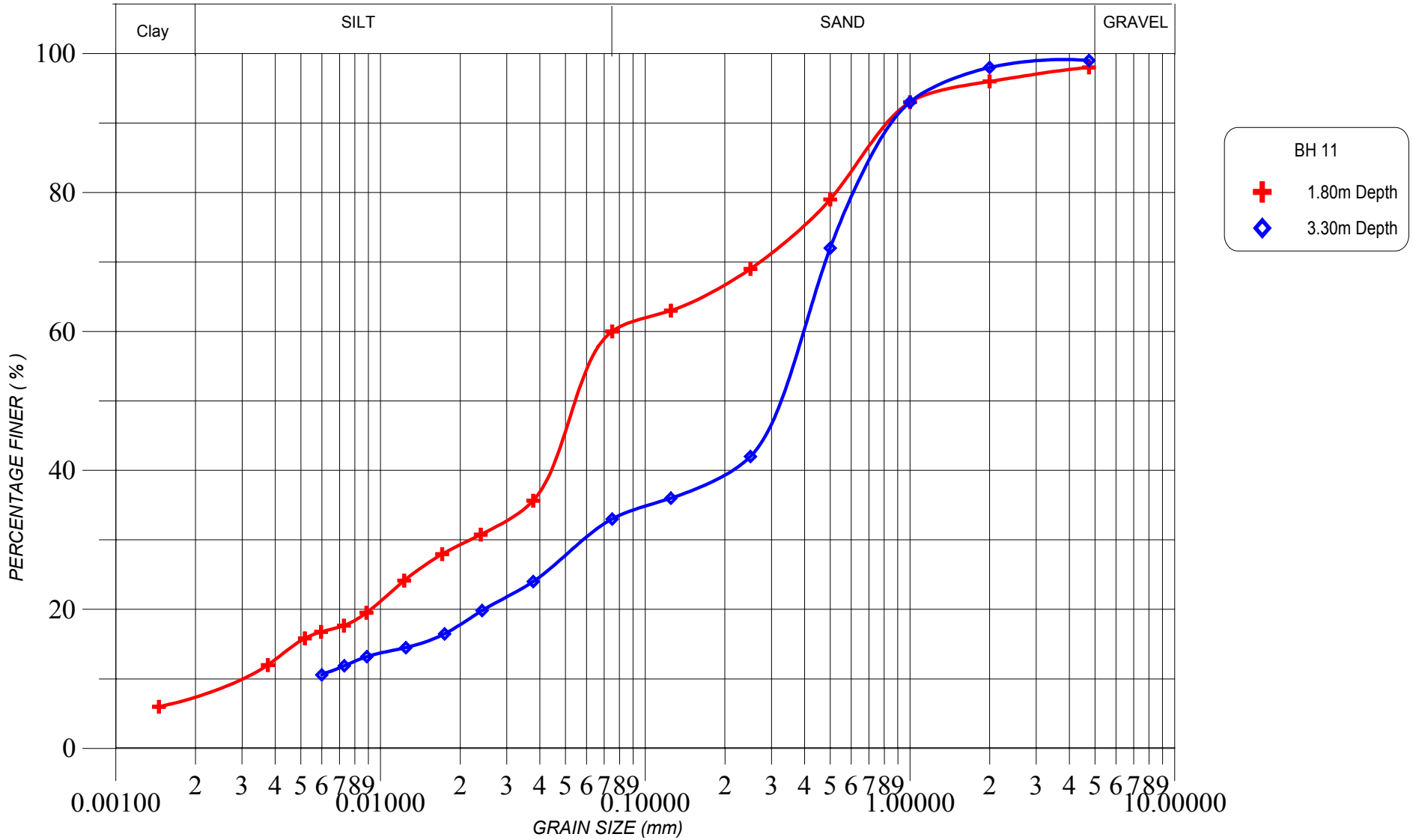
GRAIN SIZE DRISTRIBUTION CURVE



PROJECT: Geotechnical Investigation work for proposed Structure at 2x660MW
IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha

Fig : GSD-10

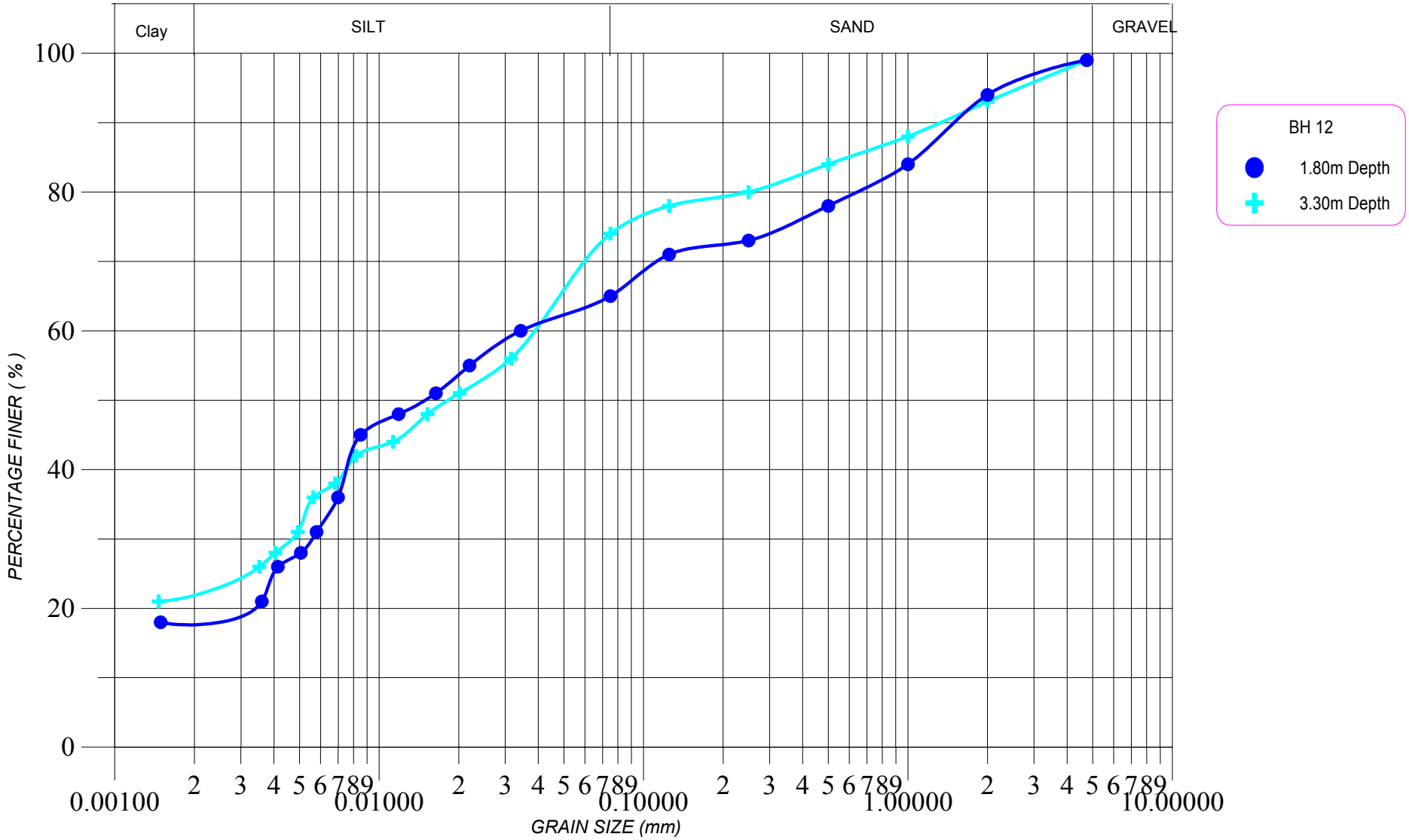
GRAIN SIZE DRISTRIBUTION CURVE



PROJECT: Geotechnical Investigation work for proposed Structure at 2x660MW
IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha

Fig : GSD-11

GRAIN SIZE DRISTRIBUTION CURVE



PROJECT: Geotechnical Investigation work for proposed Structure at 2x660MW
IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Fig : GSD-12

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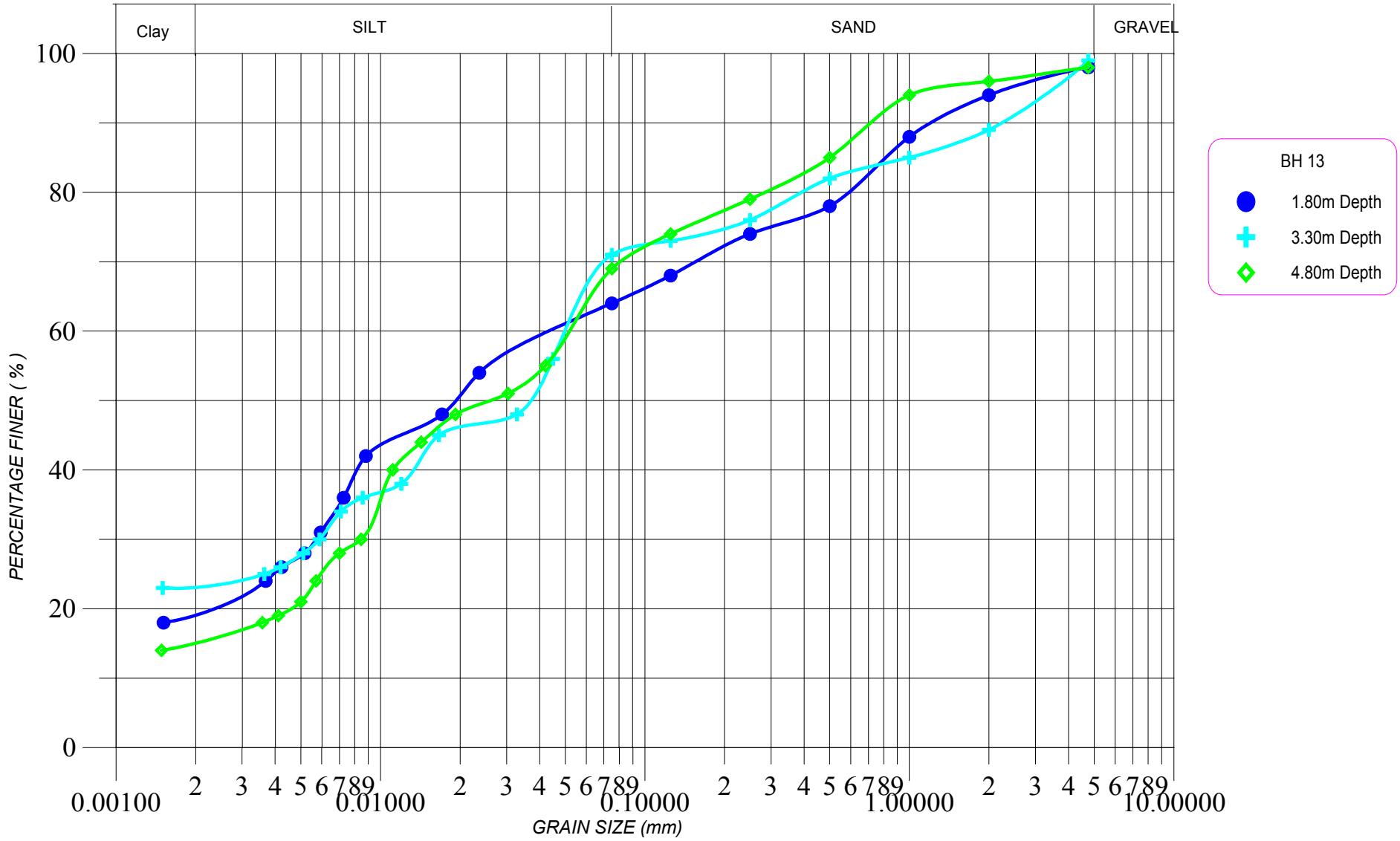
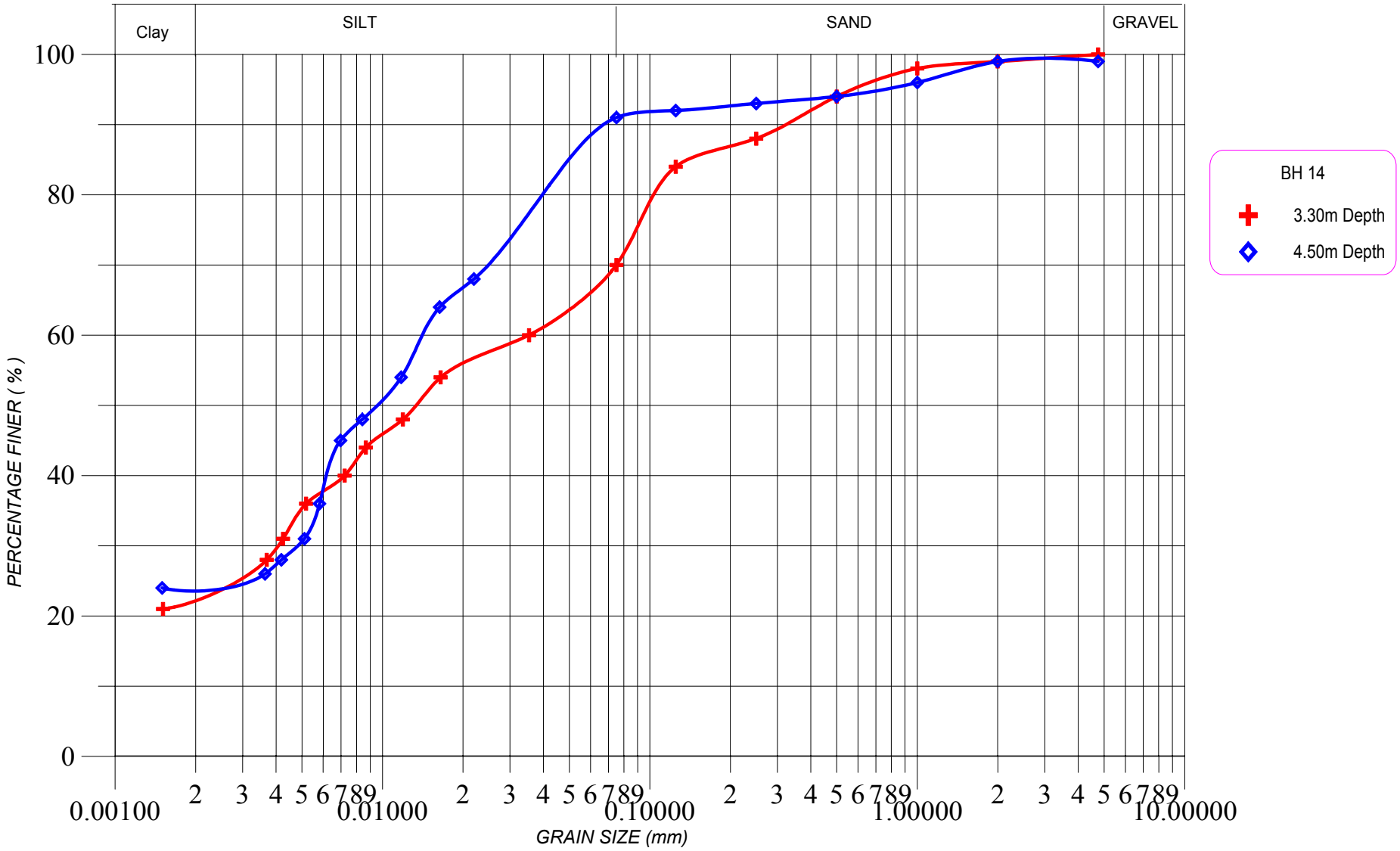
GRAIN SIZE DRISTRIBUTION CURVE



PROJECT: Geotechnical Investigation work for proposed Structure at 2x660MW
IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Fig : GSD-13

GRAIN SIZE DRISTRIBUTION CURVE



PROJECT: Geotechnical Investigation work for proposed Structure at 2x660MW
IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Fig : GSD-14

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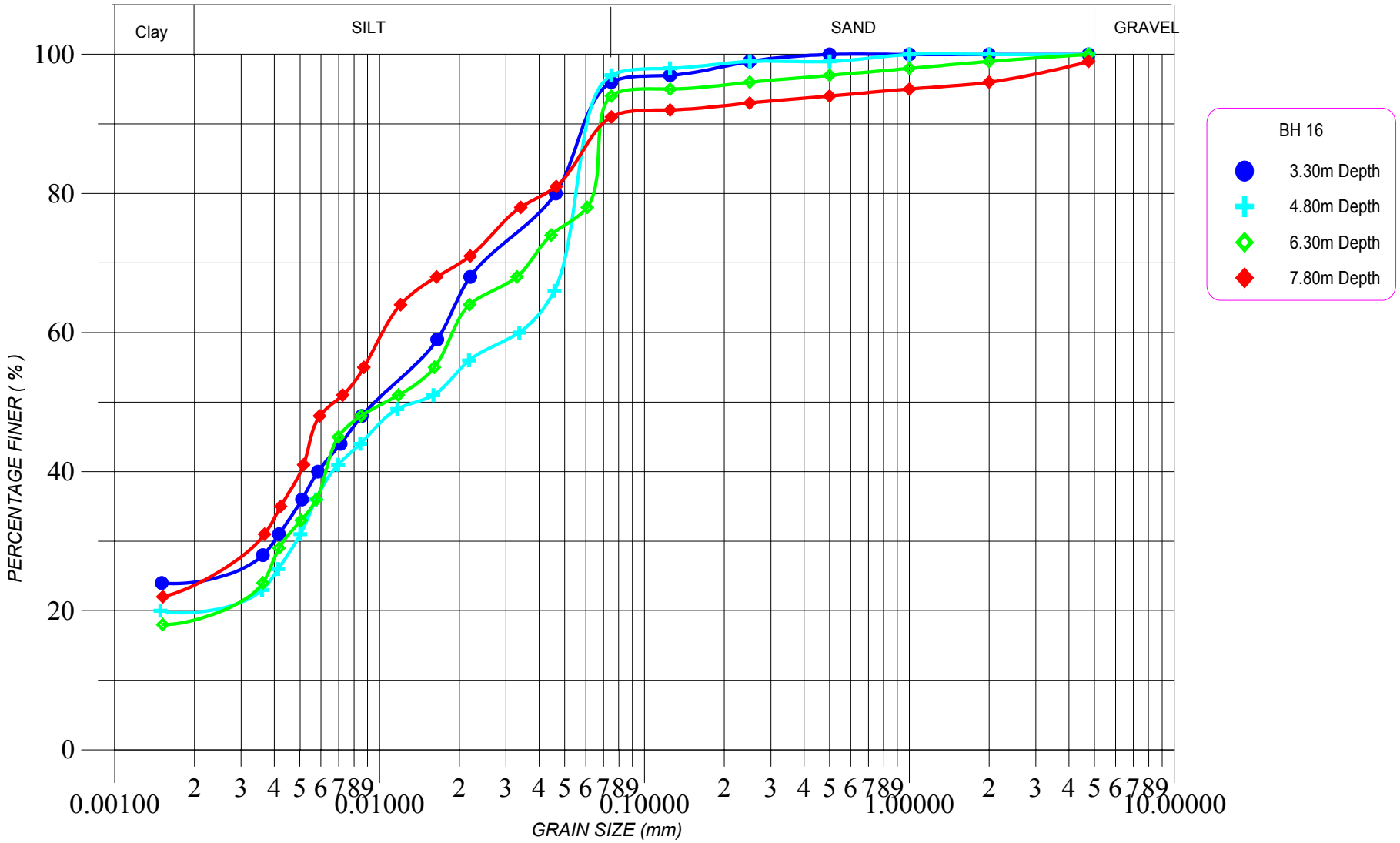
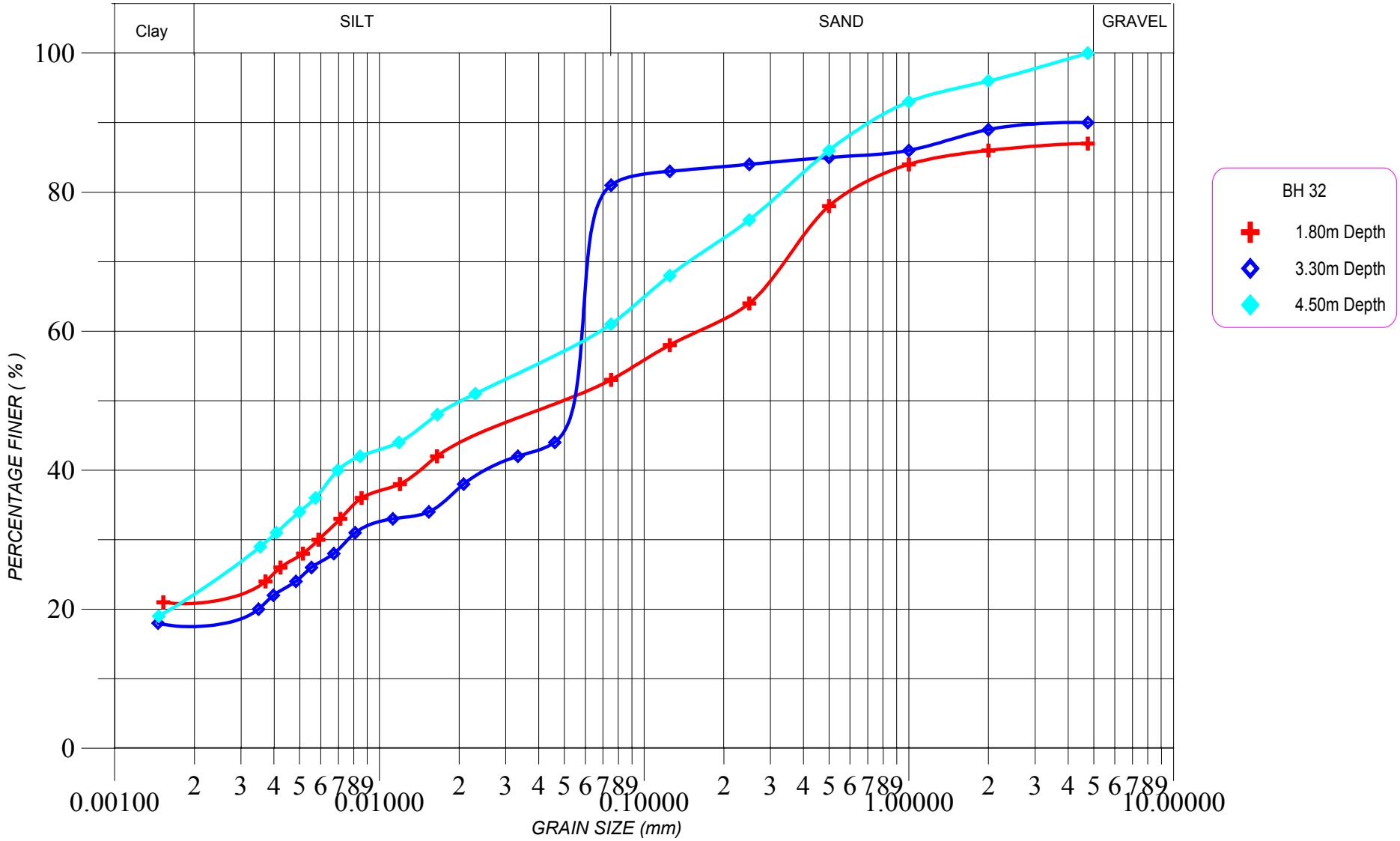
GRAIN SIZE DRISTRIBUTION CURVE



PROJECT: Geotechnical Investigation work for proposed Structure at 2x660MW
IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

Fig : GSD-16

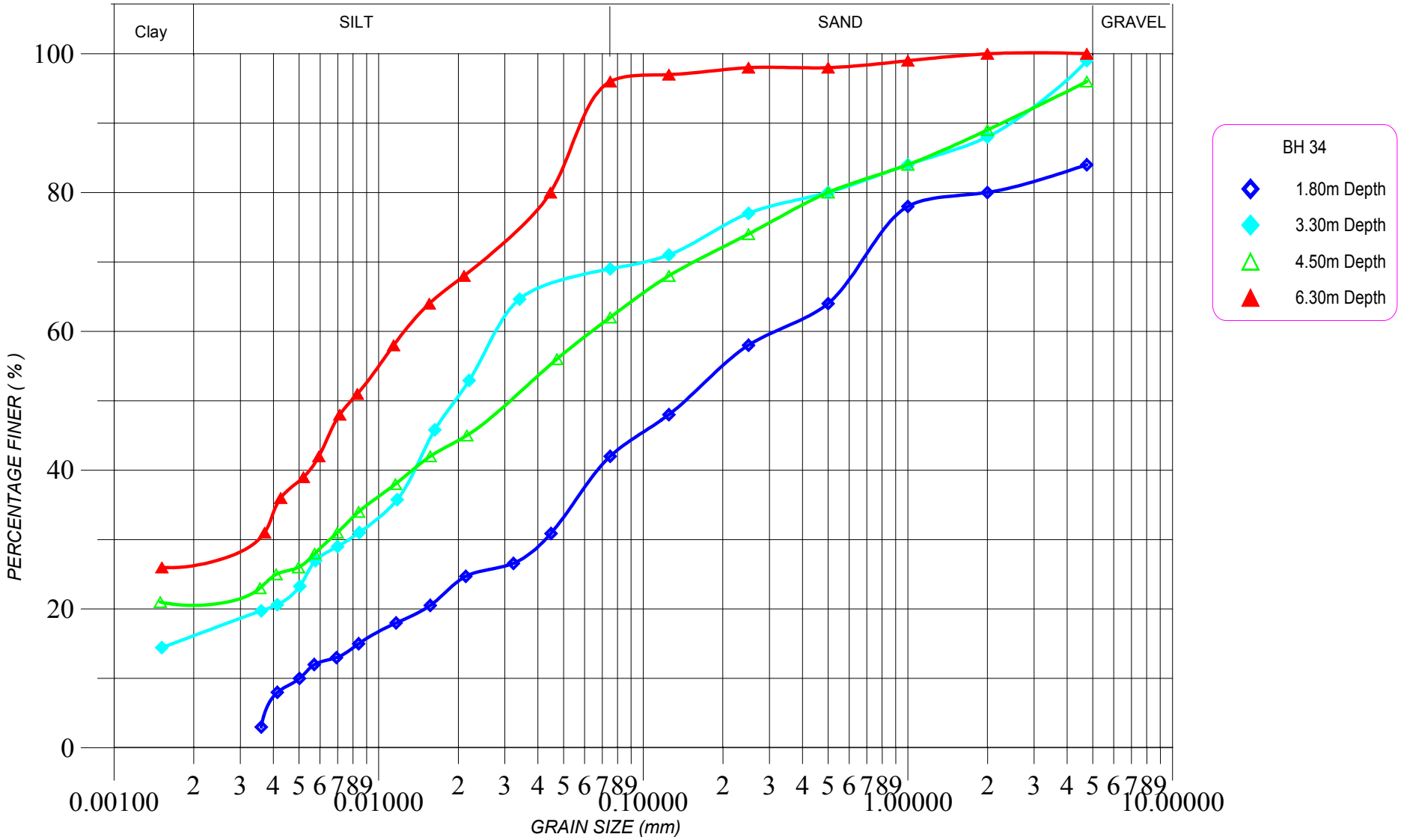
GRAIN SIZE DRISTRIBUTION CURVE



PROJECT: Geotechnical Investigation work for proposed Structure at 2x660MW
IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha

Fig : GSD-32

GRAIN SIZE DRISTRIBUTION CURVE

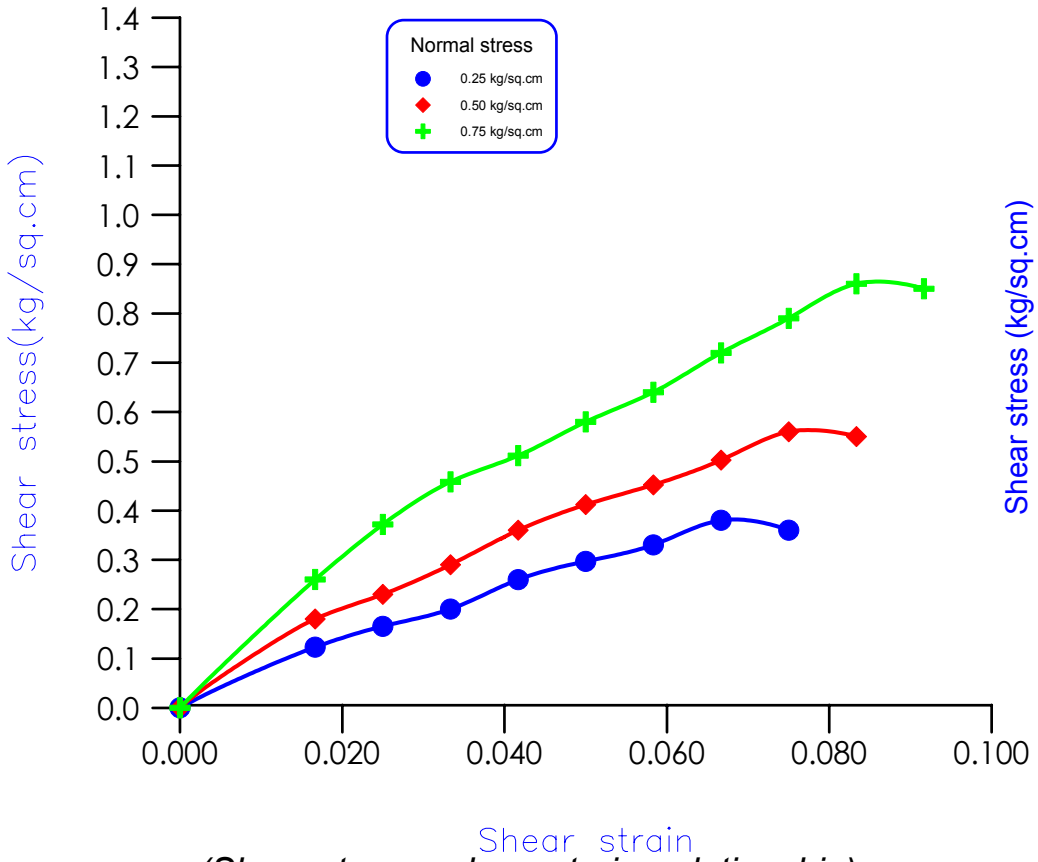


PROJECT: Geotechnical Investigation work for proposed Structure at 2x660MW
IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha.

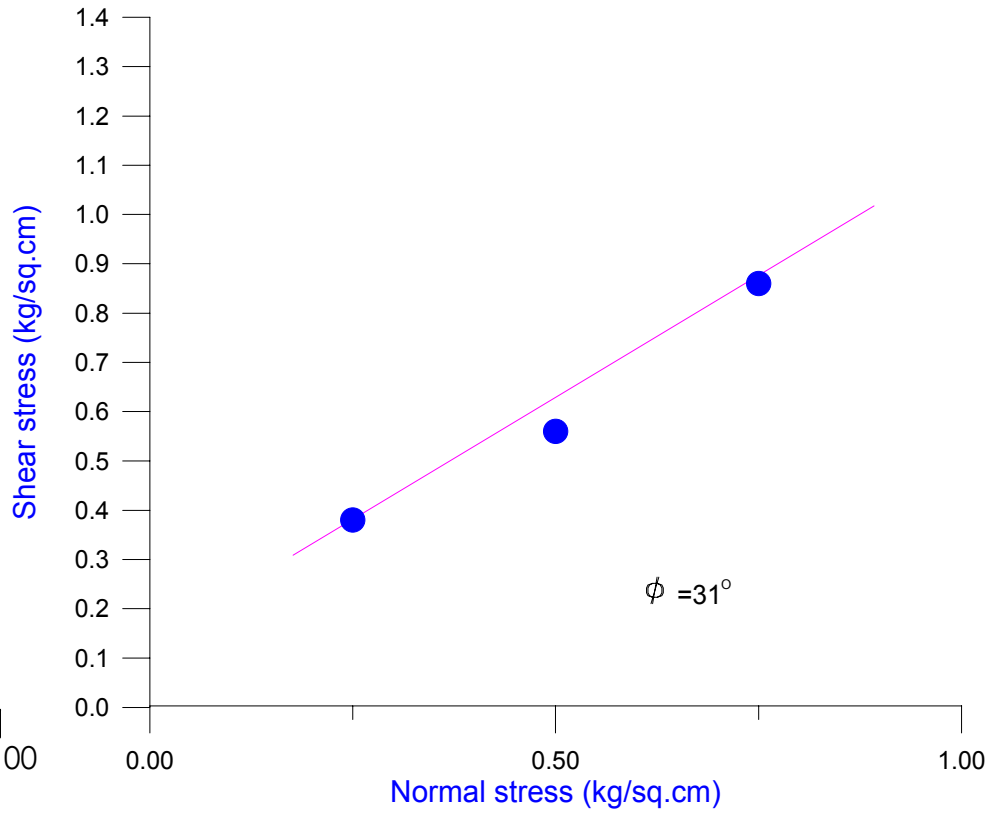
Fig : GSD-34

DIRECT SHEAR TEST

BH-9
DEPTH = 2.50 m.



(Shear stress - shear strain relationship)

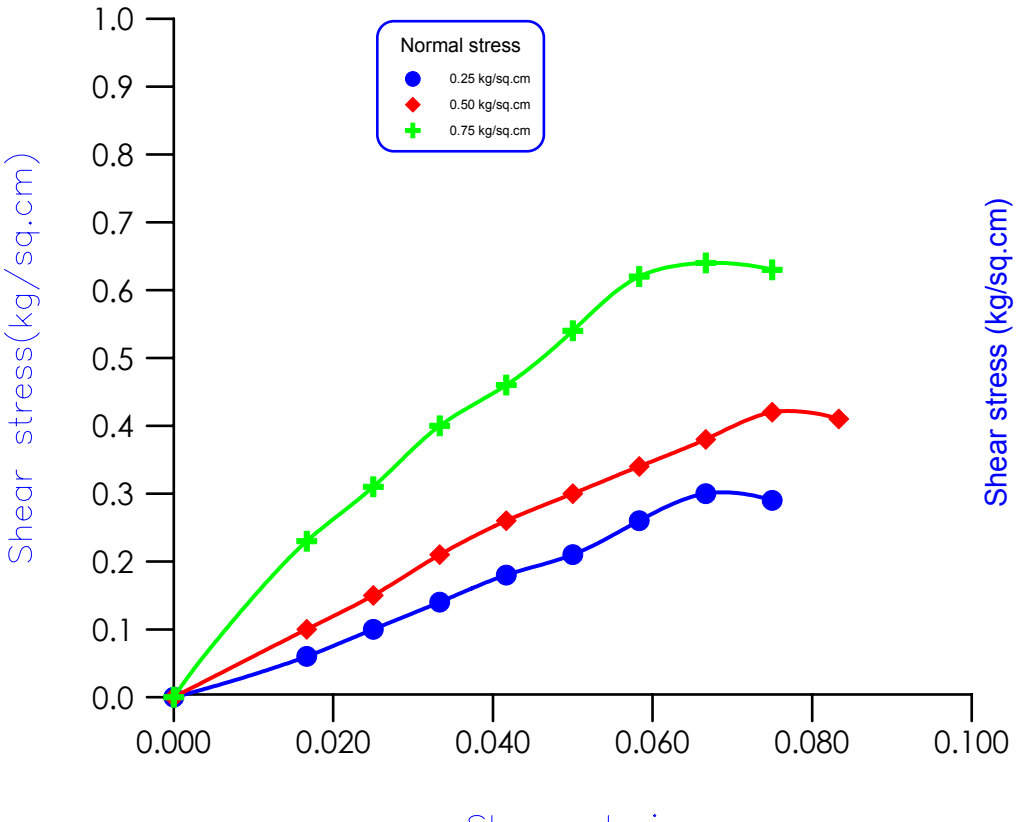


(Shear stress - Normal stress relationship)

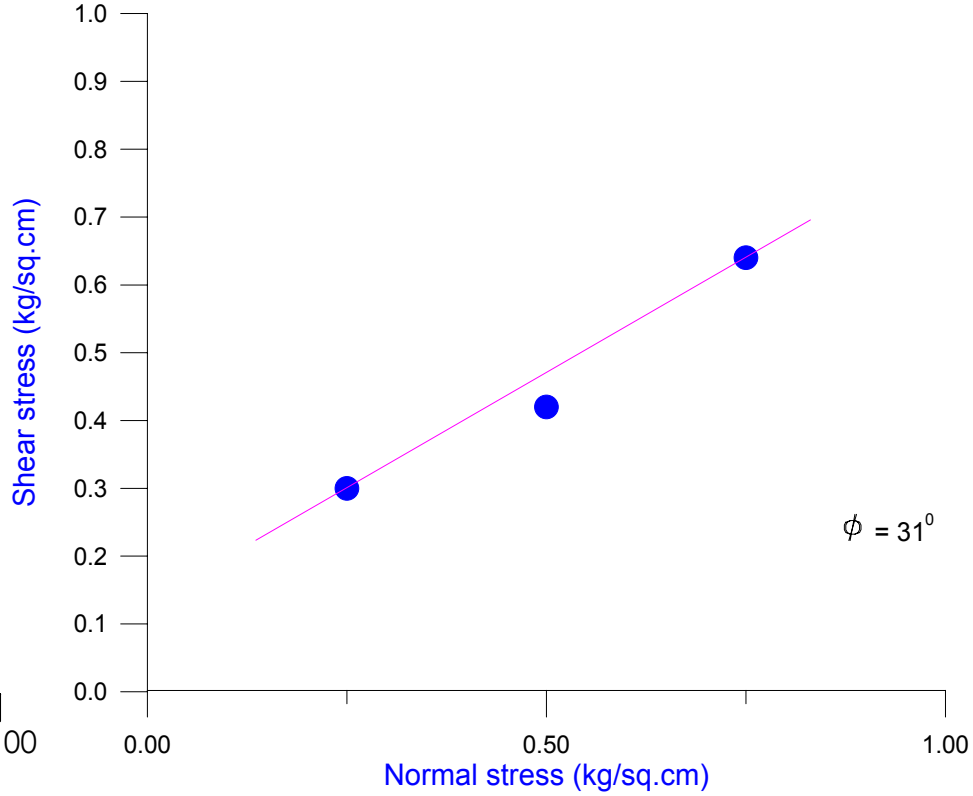
PROJECT: Geotechnical Investigation work for proposed Structure at 2x660MW
IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha

FIG- DS 1

BH - 4
DEPTH = 2.50 m.



(Shear stress - shear strain relationship)



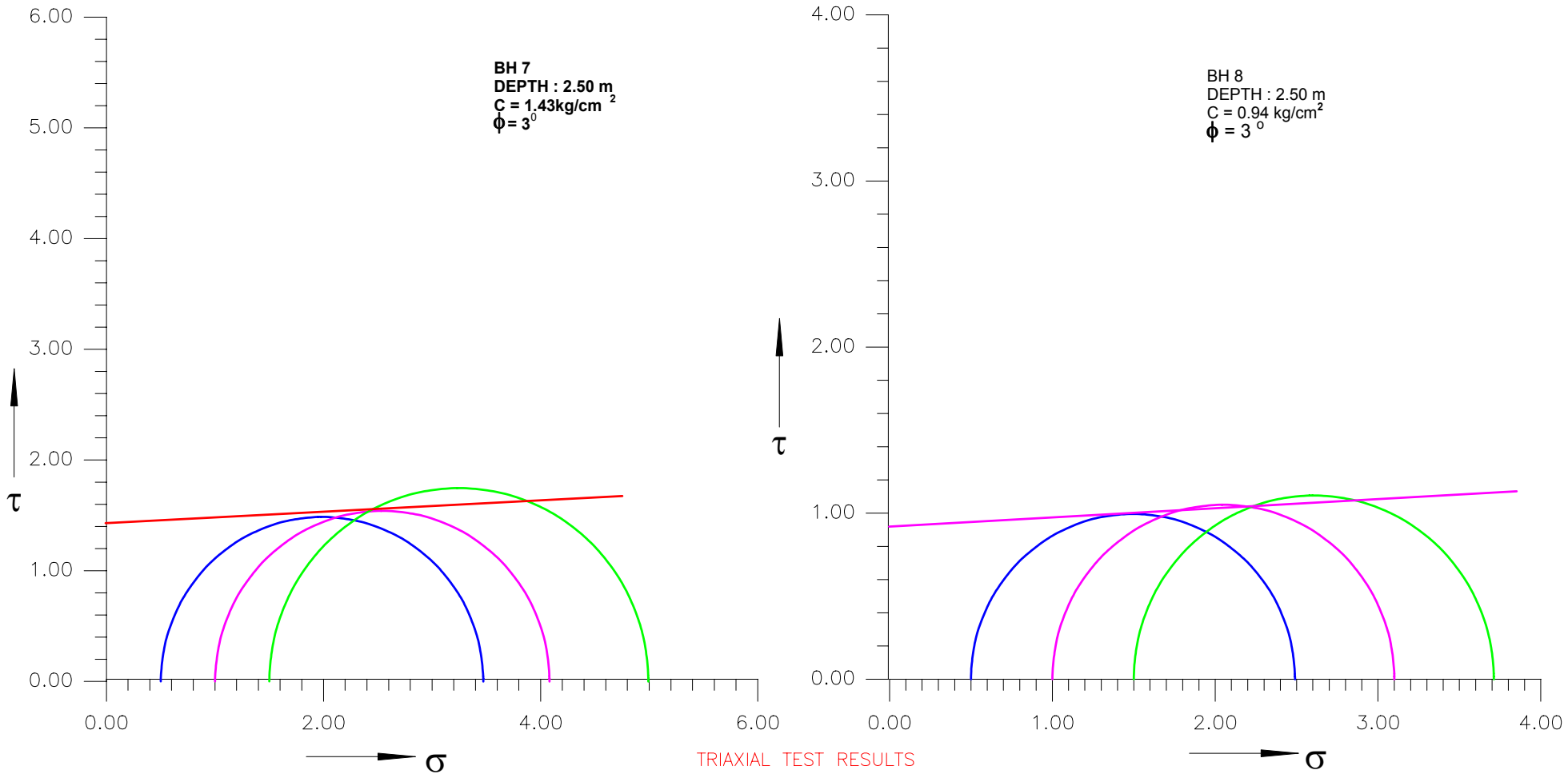
(Shear stress - Normal stress relationship)

TRI-AXIAL TEST

SOIL ENGINEERING CONSULTANTS

BOILER

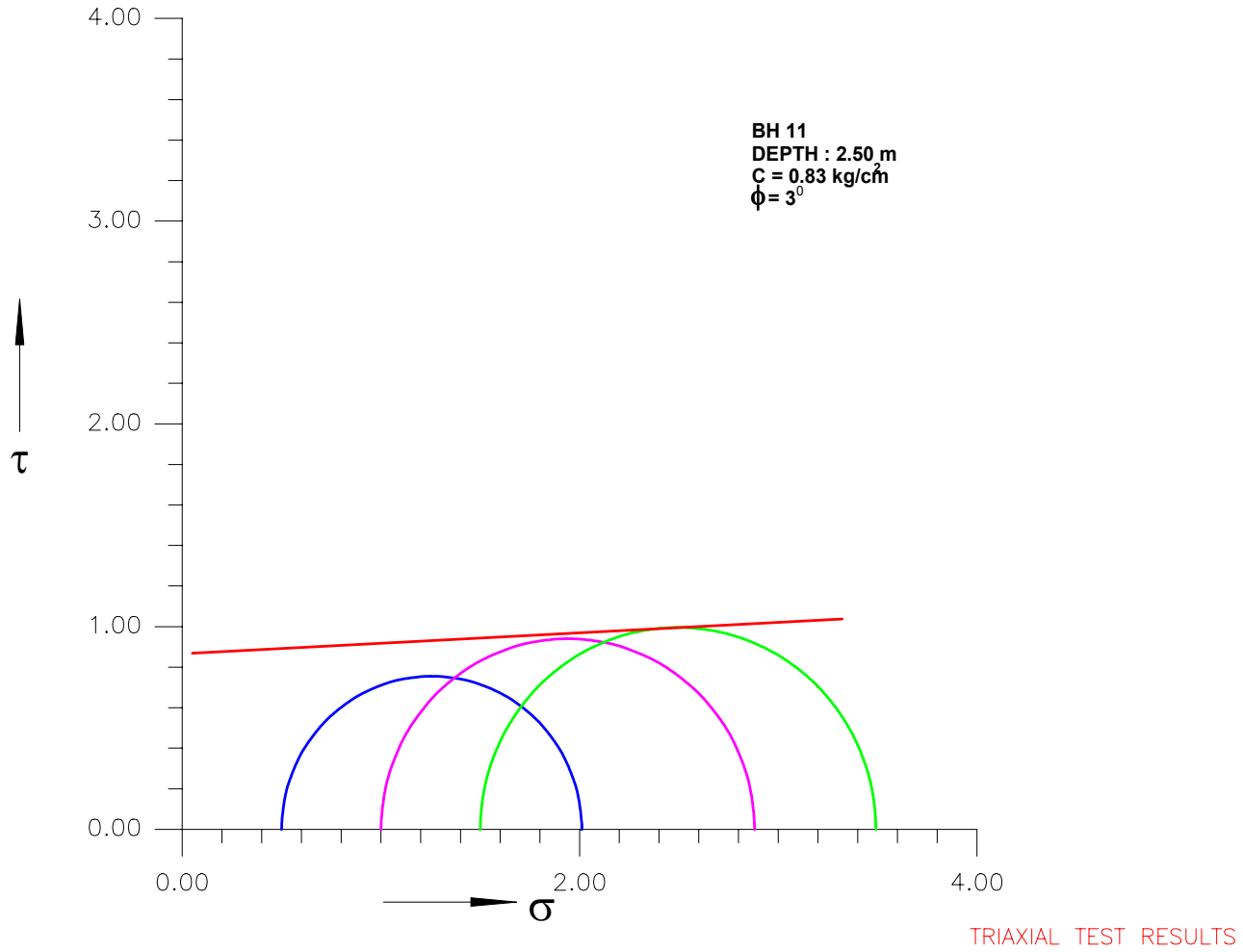
Job No: 1988



TRIAXIAL TEST RESULTS

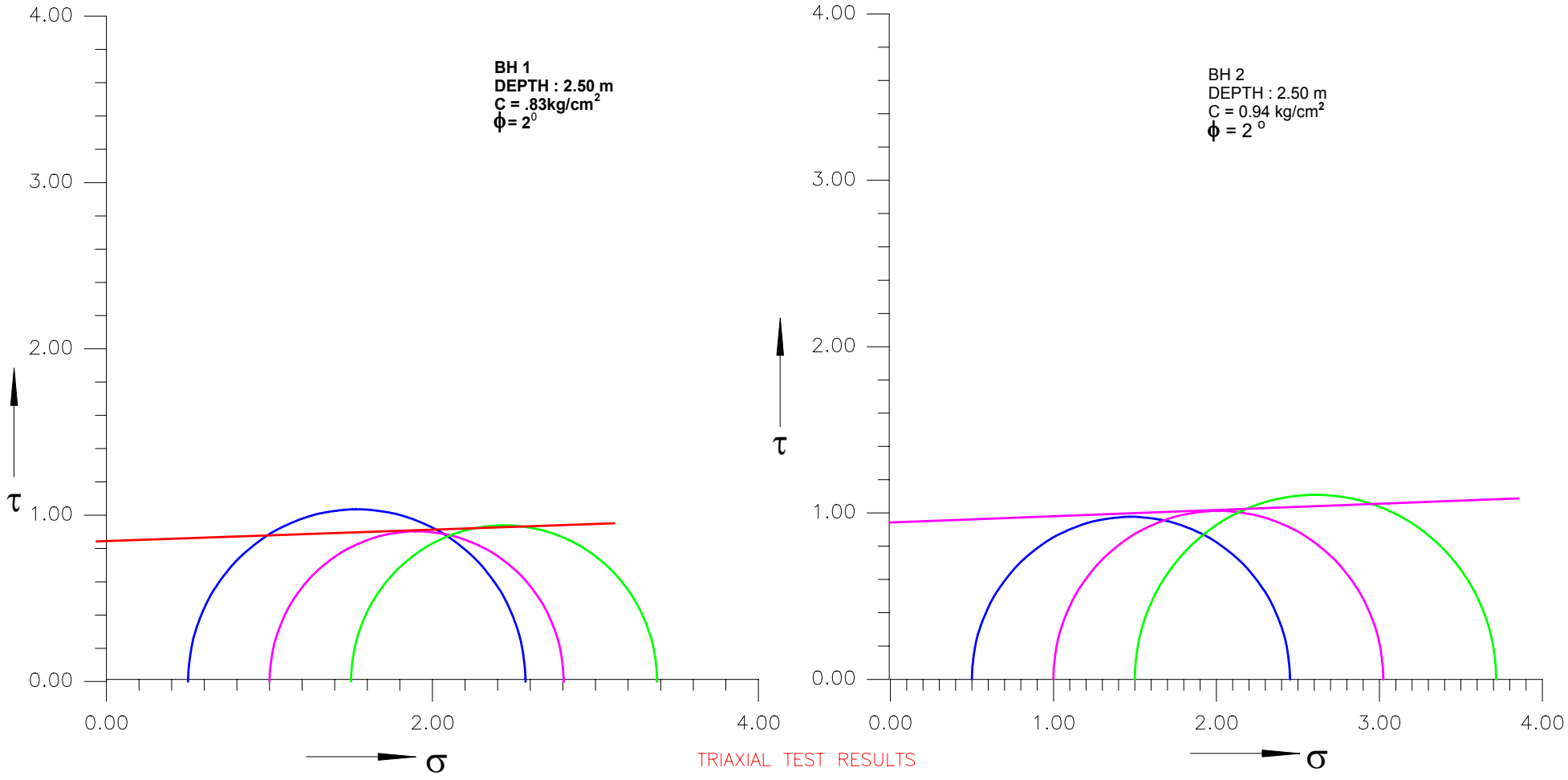
PROJECT: Geotechnical Investigation work for proposed Structure at 2x660MW
IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha

Figure : T1

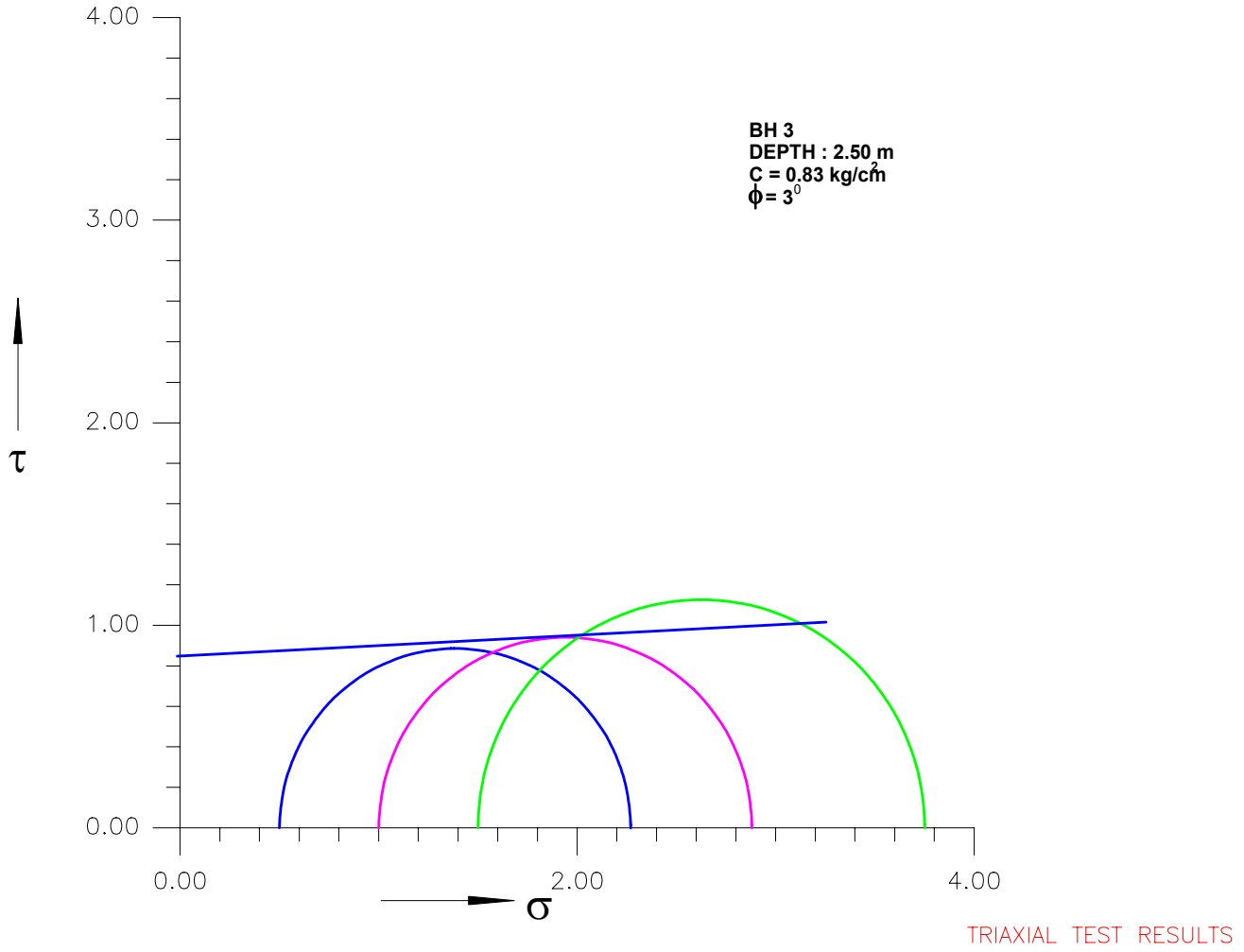


PROJECT: Geotechnical Investigation work for proposed Structure at 2x660MW
IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha

Figure : T1A

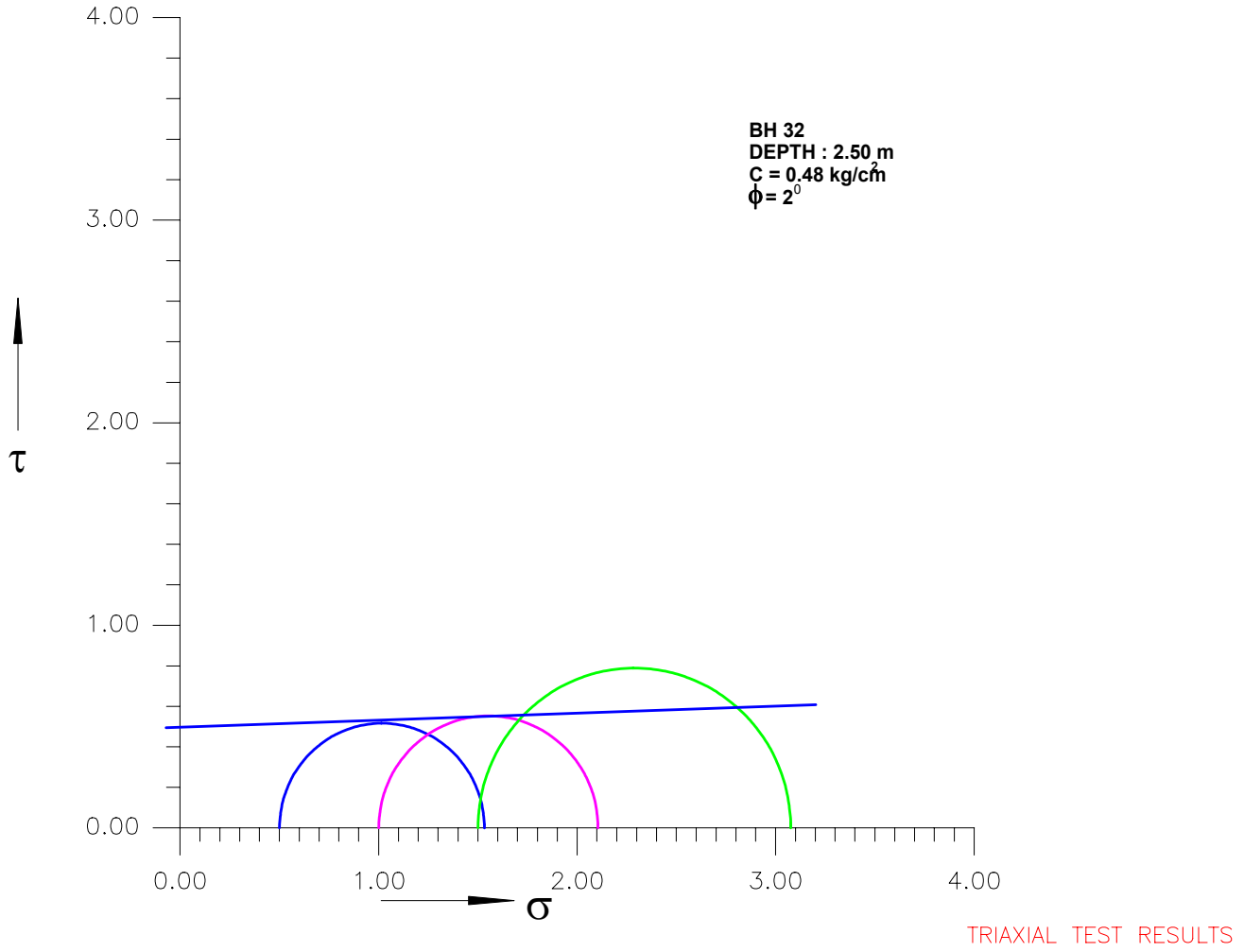


TRIAXIAL TEST RESULTS



PROJECT: Geotechnical Investigation work for proposed Structure at 2x660MW
IB Thermal Power Station, Unit-3 & 4, Banharpalli, Dist-Jharsugura, Odisha

Figure : T3


4.00
3.00
2.00
1.00
0.00
τ
0.00
1.00
2.00
3.00
4.00
σ
BH 32
DEPTH : 2.50 m
C = 0.48 kg/cm2
ϕ = 2°
TRIAXIAL TEST RESULTS