

PROJECT	SUBJECT	DOCUMENT NO.	REV.	SECTION
NLC India Limited NLC Talabira Thermal Power Project- 3x800 MW Jharsuguda, Odisha	Geotechnical Investigation Report Part-5 (CHP & AHP Area)	PE-DC-511-602-C001D	2	
				SHEET NO.
				1



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

**GEOTECHNICAL INVESTIGATION REPORT
PART-5 (CHP & AHP AREA)**

BHEL DOCUMENT NO. PE-DC-511-602-C001D

(REVISION R2)

**BHARAT HEAVY ELECTRICALS LIMITED
NEW DELHI**



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

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

This is Geotechnical Investigation Report, Part-5 (CHP & AHP Area)



3 X 800 MW NLC Talabira Thermal Power Project
EPC Package



COMMENT RESOLUTION SHEET

DOC TITLE		Geotechnical Investigation Report Part - 5			
BHEL DOC NO.		PE-DC-511-602-C001D			
BHEL UNIT		PEM- NOIDA			
Sl. No.	Dwg Ref	NLCIL/DCPL Comments: (Rev No. 00)	BHEL reply dated 30.07.2025	NLCIL/DCPL Comments: (Rev No. 01)	BHEL reply dated 06.04.2026
		Date: 02.06.2025		Date: 21.08.2025	
		Approval Category : 3		Approval Category : 2	
1	General	In the Geotechnical Investigation report Part-5 for CHP & AHP area, presently 52 boreholes are listed. BHEL shall confirm the total number of boreholes envisaged in this volume.	There are total 63 bore holes (IBH-1 to 55, BH-8,42,45,48,52,77,96,114) in Part-5 report. Out of total 63 bore holes, 62 bore holes are completed and included in R1 report. Balance bore hole i.e. IBH-47 related to HCSD slurry pipe corridor could not be completed due to hinderances at site. The same shall be included in the report after completion at site.	Noted. However, IBH-47 to be included after completion.	IBH-47 completed at site and the same is included in revised report R2.
2	General	As Geotechnical Investigation report Part-5 is exclusively for CHP and AHP area, BH-45 corresponding to CHP MCC-2 and BH-42 corresponding to AHP compressor house shall be shifted to Part-5 report. In addition, BHEL to check and add any CHP and AHP related Boreholes in this volume.	Noted and incorporated in revised report.	Noted. Point closed.	-
3	General	Boreholes corresponding to Biomass Handling system BH-8 is listed in Geotechnical investigation report Part-4 and IBH-27 & IBH-28 is listed in Part-5. BHEL is requested to maintain all boreholes and recommendations of Biomass Handling system in a single part to avoid confusion.	Noted and incorporated in revised report.	Noted. Point closed.	-
4	General	Boreholes corresponding to Limestone Handling and Gypsum handling are listed in Geotechnical investigation report Part-4 and Part-5. BHEL is requested to maintain all boreholes and recommendations of Limestone Handling and Gypsum handling systems in a single part to avoid confusion.	Boreholes corresponding to Limestone Handling and Gypsum handling are incorporated in this revised report.	Noted. Point closed.	-
5	Layout	BHEL has requested for relocation of IBH-12 & IBH-27 due to site issues. However, final location of these boreholes is same as approved investigation layout. BHEL shall reconfirm the actual locations of Boreholes executed at NTPP site to avoid any erroneous recommendations.	Revised co-ordinates of IBH-12 & IBH-27 executed at site are incorporated in revised report.	Noted. Point closed.	-
6	Report	BHEL shall include detailed sample calculation for obtaining bearing capacities of one open foundation instead of tabulation.	Noted and incorporated in revised report.	Noted. Point closed.	-
7	Report	As per clause 2.00.00, Section-II, Volume-II-G1, Bearing capacities of open foundations and Pile capacities based on contractor's soil investigation shall be compared with recommendations of nearest boreholes as per Owner's soil report and design shall be based on conservative values. Accordingly, BHEL shall check and revise the recommendations for SBC of Open foundations, pile capacities for piles socketed in rocks and pile capacities of piles terminating in soils.	Only BH-23,24 & 25 mentioned in the Owner's soil report are pertaining to CHP & AHP area Part-5 report. SBC of open foundations and pile capacities of BH-23,24 & 25 of owner's soil report is already compared with present structures nearby to these bore holes.	Noted. Point closed.	-
8	Report	For open foundation, depth of footing shall be not less than 1.0m below virgin soil. Accordingly, in SBC recommendation table for open foundations, Lowest NGL shall be mentioned instead of average NGL for each group. For example, In coal stockpile area, NGL as per IBH-8 is 200.65M. Average NGL is 206.70m. Recommendation levels shall be checked for lowest NGL.	Noted and incorporated in revised report.	Noted. Point closed.	-



3 X 800 MW NLC Talabira Thermal Power Project
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		Date: 02.06.2025		Date: 21.08.2025	
		Approval Category : 3		Approval Category : 2	
9	Report	For SBC recommendations of open foundations, Depth of foundation below FGL shall be rounded off. For example, Receiving Tower area IBH-20 recommendation is for 13.54m, 14.04m & 14.54m below FGL.	Noted and incorporated in revised report.	Noted. Point closed.	-
10	Report	For open foundations, BHEL shall check the sufficiency of recommendation based on depth of footing and its SBC values for each area/structure.	Checked and incorporated in revised report.	Noted. Point closed.	-
11	Report	For some areas like HCSD Slurry Pipe corridor, SBC recommendations are available only at Clays of High Plasticity (CH soil). BHEL to check the suitability of construction of foundations in all CH soils.	CH soils are known to have two different zones i.e. by depth volume change zone up to 2.0m from exposed surface and equilibrium zone below 2.0m. Expansive clays do not change in volume below 2.0m depth onwards due to the Newtonian weight of the soil in overburden coupled with the clay bonds therefore when foundation is kept below 2.0m even in the expansive soils may not have any detrimental effect as a consequence of swelling and shrinking. Additionally at all location where the foundation is below the ground water table may not experience the consequences of swelling and shrinking as the moisture variation may not occur below water table. Similarly any foundation placed within overburden more than 2.0m filling over it to match with the FGL will also not experiences consequence of swelling potential. In the present site and in majority of areas filling is planned to raise the FGL. In those locations there is no hazard expected due to expansive nature of soil and no specific measures are required. In the areas, where cutting is planned to match the FGL, where the foundation is placed below 2.0m recommended from FGL will not have any consequences of swelling and shrinking potential even when foundation is placed directly on clays of high plasticity without any specific measures.	Noted. Point closed.	-
12	Report	In calculations for open foundations in filling areas, overburden pressure of filling soil upto FGL is considered in calculations. In general, SBC calculations are as per present soil conditions. However, BHEL has taken the effect for filling works which are yet to be carried out at site. BHEL shall clarify.	Effect of overburden pressure of the depth of filling has not been considered in revised calculations incorporated in revised report.	Noted. Point closed.	-
13	Report	BHEL shall confirm whether open foundations works shall be carried out after completion of site grading works or prior to completion.	Open foundations coming in filling area shall be constructed before site gardening works.	Noted. Point closed.	-
14	Report	In pile capacity calculations for piles terminating in soils, depth of pile is varying from structure to structure. BHEL shall clarify the criteria for fixing termination depth of pile.	Safe pile capacity in vertical compression for Pile terminating in soil strata is 75 MT. Hence length of pile is varying depending on soil strata.	Noted. Point closed.	-
15	Report	For piles in rocks, pile capacity is ensured by using 3D socketing in rocks. BHEL shall clarify how the same is ensured in piles terminating in soil. BHEL shall confirm the termination criteria for piles terminating in soils for site execution.	Safe pile capacity in vertical compression for Pile terminating in soil strata is 75 MT. Hence length of pile is varying depending on soil strata. The safe pile capacity of pile terminating in soil strata shall be confirmed by initial pile load test and routine pile load tests.	Noted. Types and number of Initial pile load tests and Routine pile load tests to be decided during detail engineering, based on the usage of piles terminating in soil.	-

Bharat Heavy Electricals Limited (B H E L)

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

Part - 5

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Table of Contents

SR No.	Contents	Page No.
1	Introduction	1
2	Field Investigation	1
3	Laboratory investigation	4
4	General geology of site	5
5	Subsurface Soil Conditions	5
6	Site condition	5
7	Computation of safe bearing capacity	5
8	Conclusions	6
9	Limitation	7
10	Recommendations for RCC Bored cast-in-situ Pile Capacity for piles socketed inside rock & Soil	8
11	Summary for RCC Bored cast-in-situ Pile Capacity for piles socketed inside rock & Soil	10
12	Summary of Open foundation	12
13	Summary of design parameter	21
14	Sample calculations of Allowable bearing pressure from shear & settlement criteria	51
15	Appendix -1 to 30	54
16	Results of chemical analysis	509
17	Notations	515
18	References	516
19	Results of laboratory tests	517
20	Investigation Layout Plan	578
21	Bore log data sheets	579

Report on Geotechnical Investigation for Proposed Structures in Phase 1 of 3 x 800 MW of NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

1.0 Introduction

This report is presented based on limited numbers of geotechnical investigation locations. The detailed scope of work for entire of investigation work was decided by officials of BHEL. A complete geotechnical investigation was undertaken by us to obtain the required subsurface information to study and to indicate the nature and behavior of soil/rock under the application of load of proposed Structures in Phase 1 of 3 x 800 MW of NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha.

For foundation analysis of the structure on the site, it is necessary to determine the soil/rock profile of the site and to know physical properties and strength characteristics of soil/rock at various depths. For this purpose, BHEL entrusted the geotechnical investigation to us.

A report was required to be submitted as per the instructions of the client's officials. This report contains following,

1. Details of 63 Nos. of exploratory bore holes.
2. Details of standard penetration tests at regular interval of 1 m and even closer.
3. Results of tests on disturbed samples and undisturbed samples collected at regular intervals in soils and continuous sampling in rock.
4. Physical properties and strength characteristics of undisturbed and disturbed samples.
5. Interpretation of results, analysis and Conclusions
6. Locating ground water table

Based on the above points the detailed Geotechnical Investigation Program included the following:

(A) Field Investigation

1. Drilling of exploratory bore holes.
2. Collection of soil/rock samples (Disturbed and Undisturbed)
3. Conducting Standard Penetration Test.

(B) Laboratory Investigation

1. Bulk Density and moisture content of soil and rock
2. Grain size analysis and Index properties in soil
3. Shear tests (Triaxial shear test) in soil
4. Consolidation tests in cohesive soil
5. Uniaxial Compressive Test in rock
6. Point load Index in rock

(C) Recommendations

Based on above investigations, the results were obtained. The findings are based on interpretation of results, analysis and computations as per relevant Indian standards.

2.0 Field Investigation

2.1 Exploratory drilling

The exploratory boreholes of 150mm diameter in soils and 76mm diameter (Nx size) in rocks were drilled by rotary drilling method with mud circulation. Drilling was carried out using hydraulic feed drilling machine fitted with soil saw tooth and NX size bit. The locations of boreholes were dictated by client. The bore holes were terminated following the tender specifications and instruction of clients EIC. The details of the exploratory bore holes are as under:

Group No.	Sr. No.	Bore hole nos.	Co-ordinates		NGL (m)	FGL (m)	(-)Cutting/filling(+)	Depth Planned to investigate	Depth Investigated from ground level	Reasoned for early termination	Building/area
			E	N							
1	1	IBH-1	1338	3767	202.33	202.50	0.17	25.00	21.50	*	Crushed coat stock pile, Stacker reclaimers, Wind barrier
	2	IBH-2	1646	3767	207.74	202.50	-5.24	25.00	25.00	-	
	3	IBH-3	1342	3622	204.39	202.50	-1.89	25.00	25.00	-	
	4	IBH-4	1634	3623	210.12	202.50	-7.62	25.00	25.00	-	
	5	IBH-5	1482	3788	203.90	202.50	-1.40	25.00	25.00	-	
	6	IBH-6	1504	3672	207.25	202.50	-4.75	25.00	25.00	-	
	7	IBH-7	1469	3607	206.70	202.50	-4.20	25.00	21.50	*	
	8	IBH-8	1402	3826	200.65	202.50	1.85	25.00	25.00	-	
	9	IBH-9	1594	3825	206.15	202.50	-3.65	25.00	25.00	-	
	10	IBH-10	1715	3565	210.40	202.50	-7.90	25.00	25.00	-	
	11	IBH-11	1811	3767	209.85	202.50	-7.35	25.00	25.00	-	
	12	IBH-12	1824	3599	210.70	202.50	-8.20	25.00	25.00	-	
2	13	IBH-54	815	3178	197.12	202.50	5.38	25.00	16.50	*	Gypsum storage shed
	14	IBH-55	815	3297	196.75	202.50	5.75	25.00	18.00	*	
	15	BH-77	816	3128	197.21	202.50	5.29	20.00	20.00	-	
3	16	IBH-14	1122	3767	198.77	202.50	3.73	25.00	25.00	-	Coal Conveyor BC-2A/B, weigh bridge
4	17	IBH-15	1221	3716	200.95	202.50	1.55	25.00	25.00	-	Coal conveyor BC-3A/B, Pipe rack
5	18	IBH-16	1218	3531	200.47	202.50	2.03	25.00	25.00	-	Coal Conveyor BC-4A/B
	19	IBH-17	1219	3423	200.70	202.50	1.80	25.00	25.00	-	
6	20	IBH-18	1218	3266	200.34	202.50	2.16	25.00	25.00	-	Coal Conveyor BC-5A/B in BTG area
	21	IBH-19	1218	2964	200.35	202.50	2.15	25.00	18.00	*	
7	22	IBH-20	745	3722	193.46	202.50	9.04	25.00	16.50	*	Receiving Tower
8	23	IBH-21	987	3766	194.99	202.50	7.51	25.00	25.00	-	Crusher House
9	24	IBH-22	1201	3766	200.61	202.50	1.89	25.00	25.00	-	Junction Tower JT-1
10	25	IBH-23	1194	3618	200.45	202.50	2.05	25.00	25.00	-	Junction Tower JT-2
11	26	IBH-24	1194	3334	199.65	202.50	2.85	25.00	25.00	-	Junction Tower JT-3 CHP MCC-2
12	27	IBH-25	1042	3715	198.30	202.50	4.20	25.00	22.00	*	CHP MCC-1
13	28	IBH-26	1569	3519	208.20	202.50	-5.70	25.00	25.00	-	CHP maintenance shop
14	29	IBH-27	1154	3588	200.28	202.50	2.22	25.00	22.00	*	Bio mass handling system
	30	IBH-28	1137	3607	199.71	202.50	2.79	25.00	25.00	-	
	31	BH-8	1136	3661	199.63	202.50	2.87	20.00	20.00	-	
15	32	IBH-29	1254	3809	200.10	202.50	2.40	25.00	25.00	-	Coal pile run off pond

Group No.	Sr. No.	Bore hole nos.	Co-ordinates		NGL (m)	FGL (m)	(-)Cutting/filling(+)	Depth Planned to investigate	Depth Investigated from ground level	Reasoned for early termination	Building/area
			E	N							
16	33	IBH-30	752	3479	197.78	202.50	4.72	25.00	15.50	*	Dry fly ash silo & Dewatering bin
	34	IBH-31	830	3466	196.60	202.50	5.90	25.00	21.50	*	
	35	IBH-32	794	3534	196.50	202.50	6.00	25.00	18.50	*	
	36	IBH-38	867	3431	194.67	202.50	7.83	25.00	23.00	*	
17	37	IBH-33	1026	3326	197.00	202.50	5.50	25.00	19.50	*	AHP MCC-1 cum control room AHP COMPRESSOR BLDG
18	38	IBH-34	1131	3266	198.51	202.50	3.99	25.00	25.00	-	SLURRY PH CUM AHP MCCs Pipe rack in BTG area
	39	IBH-35	1132	3102	198.78	202.50	3.72	25.00	23.50	*	
	40	IBH-36	1132	2951	200.53	202.50	1.97	25.00	17.50	*	
19	41	IBH-37	787	3401	197.57	202.50	4.93	25.00	18.00	*	Silo utility building cum HCSD pump house
20	42	IBH-39	914	3293	195.45	202.50	7.05	25.00	17.50	*	ASH WATER PH Pipe rack
	43	BH-52	908	3261	196.05	202.50	6.45	30.00	20.00	*	
21	44	IBH-40	839	3591	193.60	202.50	8.90	25.00	15.00	*	Ash water transfer pump house, Settling cum surge tank
22	45	IBH-41	700	3329	197.65	201.00	3.35	25.00	21.50	*	HCSD slurry pipe corridor
	46	IBH-42	718	2730	197.76	201.00	3.24	25.00	25.00	-	
	47	IBH-43	798	2397	198.48	201.00	2.52	25.00	25.00	-	
	48	IBH-44	915	1955	199.30	201.00	1.70	25.00	25.00	-	
	49	IBH-45	795	1564	194.80	201.00	6.20	25.00	20.00	*	
	50	IBH-46	1155	1098	196.61	201.00	4.39	25.00	25.00	-	
	51	IBH-48	1574	242	196.10	202.50	6.40	25.00	25.00	-	
	52	IBH-49	1899	351	197.20	202.50	5.30	25.00	25.00	-	
23	53	IBH-50	797	2975	197.35	202.50	5.15	25.00	15.00	*	Limestone handling system
	54	IBH-51	776	3035	197.51	202.50	4.99	25.00	17.00	*	
	55	IBH-52	775	3126	197.57	202.50	4.93	25.00	16.50	*	
	56	IBH-53	776	3228	197.60	202.50	4.90	25.00	19.50	*	
24	57	BH-45	1160	3318	198.85	202.50	3.65	25.00	25.00	-	CHP MCC-2 & AAQMS
25	58	BH-42	958	3319	195.39	202.50	7.11	25.00	23.50	*	AHP compressor house
26	59	BH-114	814	2918	197.18	202.50	5.32	30.00	16.50	*	Common limestone unloading house
27	60	BH-96	831	3034	197.34	202.50	5.16	25.00	17.00	*	Weigh bridge control room
28	61	IBH-13	843	3741	193.54	202.50	8.96	25.00	18.50	*	Coal conveyor BC-1 A/B
29	62	BH-48	1219	3291	200.63	202.50	1.87	25.00	25.00	-	Coal Conveyor near unit-1
30	63	IBH-47	1304	700	196.30	201.00	4.70	25.00	20.50	*	Ash Pipe Line Corridor

* As per the note no 2 of approved drawing vide no. PE-DG-511-602-C001, borehole shall be drilled up to the depth indicated against each borehole or up to the depth where more than 75% core recovery is encountered, whichever is earlier.

2.2 Sampling

2.2.1 Disturbed samples

Disturbed samples were collected during boring and from split spoon samplers in SPT. The samples recovered were logged, labeled and placed in polyethylene bags and sent to laboratory for testing.

2.2.2 Undisturbed samples

Undisturbed soil samples were collected in thin walled Shelby tubes as per IS 2132 in overburden. The samples thus collected were sealed with wax, labeled and transported with utmost care.

In rocky stratum, undisturbed samples were collected in rock core form. Sampling was carried out to get continuous samples. The rock core samples from different depths were numbered chronologically and marked with direction of drilling and were stored in core boxes. All this samples were labeled and transported to our laboratory at Gota, Ahmedabad for testing at the earliest.

2.2.3 Standard penetration test

The standard penetration tests is conducted in accordance with IS:2131-1981. The test results show N Value, the blow counts of last 30 cm penetration of split spoon sampler with 63.5 kg hammer falling from 76 cm height. Tests were carried out using the auto-hammer fitted on each drilling rig. The ER (energy ratio) has been maintained at 60 % to get N60. The numbers of blows / minute was maintained as 25 to 30 blows / minute. This test is the most appropriate in sandy soils. In clays the same indicates the consistency. While SPT is one of the important tests in soils, in rock the same is not of much significance as the N values are more than 100 i.e. refusal. In soft and laminated rock SPT was conducted to be utilized for analysis of the deep foundations.

2.2.4 Rock Quality designation

From the cores samples recovered, % core recovery and Rock quality designation RQD were determined on cores having length more than 10cm. Based on the RQD; the rock can be classified from stand point of spacing of discontinuities.

RQD (%)	Rock Classification
100-90	Very good
90-75	Good
75-50	Medium
50-25	Poor
25-0	Very poor

3.0 Laboratory investigation

The following laboratory tests were conducted on undisturbed and disturbed soil samples collected from various depths to find physical properties and strength characteristics.

Tests	Recommended procedure	Type Samples
1. Sample Preparation	IS 2720 Pt 1	DS / UDS
2. Moisture Content	IS 2720 Pt 2	DS / UDS
3. Dry Unit Weight	IS 2720 Pt 29	UDS
4. Specific Gravity	IS 2720 Pt 3	DS
5. Atterberg's Limit	IS 2720 Pt 5	DS
6. Grain Size Analysis	IS 2720 Pt 4	DS
7. Soil Classification	IS 1498	DS / UDS
8. Consolidation	IS 2720 Pt 15	UDS
9. Unconfined Compression Strength	IS 2720 Pt 10	UDS
10. Triaxial Compression Test	IS 2720 Pt 11	UDS
11. Direct Shear Test	IS 2720 Pt 13	

The following tests were conducted on rock sample

Tests	Recommended procedure	Type Samples
1. Sample Preparation	IS 4464	Rock Core
2. Moisture Content	IS 2720 Pt 2	Rock Core
3. Bulk and Dry Unit Weight	IS 13030	Rock Core
4. Specific Gravity	IS 2720 Pt 3	Rock Core
5. Uniaxial Compressive Strength	IS 9143	Rock Core
6. Point load index test	IS 10785	Rock Core
7. Water absorption test	IS 1124	Rock Core

4.0 General Geology of Site

The Sambalpur district houses a wide variety of rock types of different ages. They can broadly be classified into Eastern Ghat Supergroup, Bonai Group, Gangpur Group, Chattisgarh Group, intrusive nepheline syenite, Gondwana Supergroup and Quaternary sediment. The rocks belonging to Gondwana Supergroup are hosted in the fault bounded basins occupying the central portion of the district with a NW-SE trend. They are represented by Talchir Formation, Barakar Formation and Mahadeva Formation.

Quaternary sediments are sporadically distributed in district. They occur as 5-20 m thick medium- to fine-grained soil/alluvium in the pediplains and flood plains followed by Barakar formation shale and sandstone which alternate with one another within individual bodies.

5.0 Subsurface Soil Conditions

At this stage of investigation exact sub soil profiling may not be narrated correctly based on only few borehole results especially in a very vast project site area as in present case. However it can be said that there exists four characterized strata up to the depth investigated i.e. 20 m from NGL.

A superficial clayey sandy soil layer exists up to around 1 m from NGL. Underlying layer comprises of fully saturated silty Clay of intermediate plasticity of stiff to very stiff and even hard consistency. This layer was observed to extend up to 2.5 to 4 m. A very fine grained fully saturated, very stiff to hard clays of high plasticity exists under the second layer and extends up to 3.5 to 8.5 m in different land parcels. Below that clays, a thick layer of fully saturated, dense sandy soils are encountered. Again this layer also varies in depth between 9.5 to 14.5 m. below all these layers, very weak, laminated and foliated shale is encountered.

5.1 Groundwater Conditions

Ground water table was encountered on an average at 1.50 to 5.30m depth from NGL. The ground water can rise up to GL immediately post monsoon. Practically the GWT shall be considered at FGL for all designs.

5.2 Strong Ground Motion

The site is located within a seismically active region (Zone 3; *ref IS 1893*). Liquefaction is unlikely owing to the cohesive soils of stiff to very stiff and hard consistency and dense sandy soils. Hence, soil is not likely to undergo shear strength loss in seismic event.

6.0 Computation of Safe Bearing Capacity

It is proposed to fill up the entire plot premises up to 201.0/202.5 m RL. The filling would on an average about 1.0 to 9.0m. At this stage character of soil for filling is not known. Again, foundation for all important structures may not be kept in filling. Shallow depth of water table from NGL would be another constraint for taking down foundation below NGL. So from all such considerations pile foundations shall be necessary for all important plant structures.

In this report, safe load on piles is calculated which would be the primary foundation option and allowable bearing pressure of open foundation is also calculated. In situations where overburden offering low bearing pressure is followed by rock at relatively shallower depths, end bearing piles is the suitable foundation option. Piles in rocks and weathered rocks of varying degree of weathering derive their capacity by end bearing and socket side resistance.

In situations, where, rock strata comprises of highly fragmented rock, as in present case, where RQD is nil or

$(CR+RQD)/2$ is less than 30 % or when the crushing strength is less than 10 MPa, the appropriate approach would be of that suggested by Cole & Stroud. In present site overburden soils overlay fractured / laminated / foliated weak shale. The founding stratum having highly fragmented rock with nil RQD and $(CR+RQD)/2$ to be less than 30 %, the approach suggested by Cole and Stroud as per Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 Pa/S2 has been used for safe load calculations.

Allowable bearing capacity and safe load on end bearing piles in compression, uplift and lateral direction is calculated area wise and appended in Appendix 1 to 30 for different areas represented by the boreholes covered in BOP area portion.

7.0 Conclusions

- 1) General stratifications are as described in section 5.0 and as shown in respective borelogs. An open foundation is recommended for the areas below depth 1.0m from NGL.
- 2) Ground water table was encountered on an average at 1.50 to 5.30 m depth from NGL. The ground water can rise up to GL immediately post monsoon. Practically the GWT shall be considered at FGL for all designs.
- 3) Based on the test results the soil can be classified in class-1 as per Table-4 of IS 456: 2000. Therefore, from the standpoint of sulphite (SO_3) and Chlorides content specific precautions are not required.
- 4) The site is located within a seismically region (Zone 3). Shear strength loss (liquefaction) is unlikely based on screening criteria.
- 5) The filling for raising FGL will be a controlled fill assuming that the soil used for raising the EGL to FGL are from local sources and of similar character than the soil would be mostly cohesive in nature and after 95% compaction have very stiff consistency as well. Not with standing very stiff consistency, the safe bearing capacity may safely be assume to be 5 t/m^2 as suggested in presumptive safe bearing capacity of soil in various credible documents. For the ready reference the document suggesting 5 t/m^2 published by Indian railway standard “Code of practice for the design of sub-structures and foundations of bridges”, second revision 2013 may be referred which is also attached in Appendix as ready reference. From that table, we have considered the minimum presumptive safe bearing capacity among all types of soil, which is 5 t/m^2 .
- 6) Considering chemical analysis test results of sub soil samples, existing soil is suitable for filling/backfilling purposes.

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9.0 Limitations

We have prepared this report for the exclusive use of clients and as per the scope and specification instructed by them verbally or in writing. No other use is anticipated or authorized by clients. The report shall be used only by the client for the project and purposes described herein at the locations shown by him and explored by us. The finding and recommendations are valid when the onsite and offsite conditions affecting the structures in project are not changed due to the actions of man or nature.

Professional judgments presented in this report are based on evaluations of the technical information gathered, understanding of the proposed construction, and general experience in the geotechnical field. We have performed according to generally accepted geotechnical engineering practices followed in the project area at the time the services were provided. No warranty is expressed or implied. The report is issued with the understanding that the owner and client choose the risk they decide to incur by the expenditures involved in the engineering and construction.

The findings and recommendations presented in this report are based upon soil conditions inferred from site explorations, interpolation of the soil conditions between exploration locations, and extrapolation of these conditions throughout the proposed site area. The extent of investigation as well as specific exploration locations were dictated by the clients. The findings and recommendations are further based on the assumption that the subsurface conditions do not deviate appreciably from those reported and those assumed. The potential for encountering conditions different from those assumed can never be discounted.

If different subsurface conditions are encountered if any, must be brought to our attention before execution & in a timely manner so that the need for revised recommendations can be evaluated. In the event of changes in design loads or structural characteristics or in location of the structure, clients should review its design based on our recommendation and their applicability to the revision he made in a timely manner.

Recommendation for RCC Bored cast-in-situ piles socketed inside rock as per technical specification

Sr No	Building/ Structure/ Area	Applicable bore hole nos.	Average EGL in RL (m)	FGL in RL (m)	Pile cut off level below FGL (in m)	Diameter of pile (in m)	Safe pile capacity (in T)			Remarks
							Vertical compression	Lateral (in fixed head condition)	Uplift	
1	Crushed coat stock pile, Stacker reclaimer, Wind barrier	IBH- 1,2,3,4,5,6,7,8,9,10, 11,12	206.7	202.5	1.00m or below	0.60	150.00	7.50	37.50	Pile length includes 3D socketing inside rock
						0.76	250.00	12.50	62.50	
2	Coal Conveyor BC-2A/B, weigh bridge	IBH-14	198.8	202.5	4.00m or below	0.60	150.00	7.50	37.50	
						0.76	250.00	12.50	62.50	
3	Coal conveyor BC-3A/B, Pipe rack	IBH-15	201.0	202.5	2.00m or below	0.60	150.00	7.50	37.50	
						0.76	250.00	12.50	62.50	
4	Coal Conveyor BC-4A/B	IBH-16,17	200.59	202.5	2.00m or below	0.60	150.00	7.50	37.50	
						0.76	250.00	12.50	62.50	
5	Coal Conveyor BC-5A/B in BTG area	IBH-18,19	200.35	202.5	3.00m or below	0.60	150.00	7.50	37.50	
						0.76	250.00	12.50	62.50	
6	Receiving Tower	IBH-20	193.46	202.5	9.00m or below	0.60	150.00	7.50	37.50	
						0.76	250.00	12.50	62.50	
7	Crusher House	IBH-21	194.99	202.5	8.00m or below	0.60	150.00	7.50	37.50	
						0.76	250.00	12.50	62.50	
8	Junction Tower JT-1	IBH-22	200.61	202.5	2.00m or below	0.60	150.00	7.50	37.50	
						0.76	250.00	12.50	62.50	
9	Junction Tower JT-2	IBH-23	200.45	202.5	2.00m or below	0.60	150.00	7.50	37.50	
						0.76	250.00	12.50	62.50	
10	Junction Tower JT-3 CHP MCC-2	IBH-24	199.65	202.5	3.00m or below	0.60	150.00	7.50	37.50	
						0.76	250.00	12.50	62.50	
11	Bio mass handling system	IBH-27&28	200.00	202.5	3.00m or below	0.60	150.00	7.50	37.50	
						0.76	250.00	12.50	62.50	
12	Dry fly ash silo & Dewatering bin	IBH-30,31,32,38	196.39	202.5	6.00m or below	0.60	150.00	7.50	37.50	
						0.76	250.00	12.50	62.50	
13	AHP MCC-1 cum control room AHP COMPRESSOR BLDG	IBH-33	197	202.5	6.00m or below	0.60	150.00	7.50	37.50	
						0.76	250.00	12.50	62.50	
14	SLURRY PH CUM AHP MCCs Pipe rack in BTG area	IBH-34,35,36	199.27	202.5	4.00m or below	0.60	150.00	7.50	37.50	
						0.76	250.00	12.50	62.50	
15	Silo utility building cum HCSD pump house	IBH-37	197.57	202.5	5.00m or below	0.60	150.00	7.50	37.50	
						0.76	250.00	12.50	62.50	
16	ASH WATER PH Pipe rack	IBH-39	195.45	202.5	6.00m or below	0.60	150.00	7.50	37.50	
						0.76	250.00	12.50	62.50	
17	Ash water transfer pump house, Settling cum surge tank	IBH-40	193.6	202.5	9.00m or below	0.60	150.00	7.50	37.50	
						0.76	250.00	12.50	62.50	
18	Limestone handling system	IBH-50,51,52,53	197.51	202.5	5.00m or below	0.60	150.00	7.50	37.50	
						0.76	250.00	12.50	62.50	
19	Gypsum storage shed	IBH-54,55 BH-77	196.94	202.5	6.00m or below	0.60	150.00	7.50	37.50	
						0.76	250.00	12.50	62.50	
20	Common limestone unloading house	BH-114	197.18	202.5	6.00m or below	0.60	150.00	7.50	37.50	
						0.76	250.00	12.50	62.50	
21	Coal Conveyor BC-1 A/B	IBH-13	193.54	202.5	9.00m or below	0.60	150.00	7.50	37.50	
						0.76	250.00	12.50	62.50	
22	Coal conveyor near unit-1	BH-48	200.63	202.5	2.00m or below	0.60	150.00	7.50	37.50	
						0.76	250.00	12.50	62.50	

Summary of RCC Bored cast-in-situ Pile Capacity for piles socketed inside rock

Sr No	Building/ Structure/ Area	Applicable bore hole nos.	Average EGL in RL (m)	FGL in RL (m)	Pile cut off level below FGL (in m)	Diameter of pile (in m)	*Length of pile below cut off level (in m)	Safe pile capacity (in T)				Remarks
								Vertical compression	Lateral (in free head condition)	Lateral (in fixed head condition)	Uplift	
1	Crushed coat stock pile, Stacker reclaimers, Wind barrier	IBH-1,2,3,4,5,6,7,8,9,10,11,12	206.7	202.5	1.00m or below	0.60	14.80	176.00	3.00	10.00	153.00	Pile length includes 3D socketing inside rock
						0.76	15.28	283.00	5.00	15.00	219.00	
2	Coal Conveyor BC-2A/B, weigh bridge	IBH-14	198.8	202.5	4.00m or below	0.60	20.00	176.00	4.00	12.00	167.00	
						0.76	20.50	283.00	6.00	17.00	237.00	
3	Coal conveyor BC-3A/B, Pipe rack	IBH-15	201.0	202.5	2.00m or below	0.60	20.00	176.00	3.00	9.00	193.00	
						0.76	20.50	283.00	5.00	13.00	270.00	
4	Coal Conveyor BC-4A/B	IBH-16,17	200.59	202.5	2.00m or below	0.60	19.00	176.00	9.00	24.00	158.00	
						0.76	19.50	283.00	13.00	35.00	226.00	
5	Coal Conveyor BC-5A/B in BTG area	IBH-18,19	200.35	202.5	3.00m or below	0.60	15.00	176.00	9.00	24.00	120.00	
						0.76	15.50	283.00	13.00	35.00	176.00	
6	Receiving Tower	IBH-20	193.46	202.5	9.00m or below	0.60	9.50	176.00	5.00	15.00	98.00	
						0.76	10.00	283.00	8.00	21.00	148.00	
7	Crusher House	IBH-21	194.99	202.5	8.00m or below	0.60	16.00	176.00	3.00	9.00	170.00	
						0.76	16.50	283.00	5.00	14.00	241.00	
8	Junction Tower JT-1	IBH-22	200.61	202.5	2.00m or below	0.60	20.00	176.00	3.00	8.00	185.00	
						0.76	20.50	283.00	4.00	12.00	260.00	
9	Junction Tower JT-2	IBH-23	200.45	202.5	2.00m or below	0.60	16.50	176.00	3.00	9.00	118.00	
						0.76	17.00	283.00	5.00	13.00	175.00	
10	Junction Tower JT-3 CHP MCC-2	IBH-24	199.65	202.5	3.00m or below	0.60	16.00	176.00	10.00	26.00	126.00	
						0.76	16.50	283.00	14.00	38.00	184.00	
11	Bio mass handling system	IBH-27&28	200.00	202.5	3.00m or below	0.60	19.00	176.00	3.00	9.00	188.00	
						0.76	19.50	283.00	5.00	13.00	263.00	
12	Dry fly ash silo & Dewatering bin	IBH-30,31,32,38	196.39	202.5	6.00m or below	0.60	16.00	176.00	5.00	15.00	117.00	
						0.76	16.50	283.00	8.00	21.00	173.00	
13	AHP MCC-1 cum control room AHP COMPRESSOR BLDG	IBH-33	197	202.5	6.00m or below	0.60	8.50	176.00	9.00	25.00	85.00	
						0.76	9.00	283.00	14.00	37.00	132.00	
14	SLURRY PH CUM AHP MCCs Pipe rack in BTG area	IBH-34,35,36	199.27	202.5	4.00m or below	0.60	14.00	176.00	5.00	15.00	116.00	
						0.76	14.50	283.00	8.00	21.00	172.00	
15	Silo utility building cum HCSD pump house	IBH-37	197.57	202.5	5.00m or below	0.60	9.00	176.00	6.00	16.00	99.00	
						0.76	9.50	283.00	9.00	24.00	150.00	
16	ASH WATER PH Pipe rack	IBH-39	195.45	202.5	6.00m or below	0.60	9.50	176.00	8.00	22.00	95.00	
						0.76	10.00	283.00	12.00	33.00	144.00	
17	Ash water transfer pump house, Settling cum surge tank	IBH-40	193.6	202.5	9.00m or below	0.60	8.00	176.00	6.00	16.00	97.00	
						0.76	8.50	283.00	9.00	24.00	147.00	
18	Limestone handling system	IBH-50,51,52,53	197.51	202.5	5.00m or below	0.60	9.50	176.00	5.00	14.00	98.00	
						0.76	10.00	283.00	7.00	20.00	149.00	
19	Gypsum storage shed	IBH-54,55	196.94	202.5	6.00m or below	0.60	8.00	176.00	6.00	16.00	102.00	
						0.76	8.50	283.00	9.00	24.00	153.00	
20	Common limestone unloading house	BH-114	197.18	202.5	6.00m or below	0.60	12.50	176.00	3.00	8.00	114.00	
						0.76	13.00	283.00	4.00	12.00	169.00	
21	Coal Conveyor BC-1 A/B	IBH-13	193.54	202.5	9.00m or below	0.60	11.00	176.00	9.00	25.00	141.00	
						0.76	11.50	283.00	14.00	37.00	203.00	
22	Coal conveyor near unit-1	BH-48	200.63	202.5	2.00m or below	0.60	11.00	176.00	3.00	8.00	134.00	
						0.76	11.50	283.00	4.00	13.00	196.00	

*Note: Since rock level is varying, pile lengths will also vary as 3D socketing inside rock is to be ensured for each pile

Recommendations for RCC Bored cast-in-situ Pile Terminating in Soil Strata as per technical specification

Sr No	Building/ Structure/ Area	Applicable bore hole nos.	Average EGL in RL (m)	FGL in RL (m)	Pile cut off level below FGL (in m)	Diameter of pile (in m)	Length of pile below cut off level (in m)	Safe pile capacity (in T)		
								Vertical compression	Lateral (in fixed head condition)	Uplift
1	Crushed coal stock pile, Stacker reclaimers, Wind barrier	IBH-1,2,3,4,5,6,7,8,9,10,11,12	206.7	202.5	3.00m or below	0.60	9.00	75.00	3.75	18.75
2	Coal pile run off pond	IBH-29	200.1	202.5	3.00m or below	0.60	11.00	75.00	3.75	18.75
3	Dry fly ash silo & Dewatering bin	IBH-30,31,32,38	196.4	202.5	6.00m or below	0.60	12.00	75.00	3.75	18.75
4	SLURRY PH CUM AHP MCCs Pipe rack in BTG area	IBH-34,35,36	199.3	202.5	4.00m or below	0.60	11.00	75.00	3.75	18.75
5	CHP MCC-2	BH-45	198.85	202.5	4.0m or below	0.60	12.00	75.00	3.75	18.75
6	Weigh bridge control room	BH-96	197.3	202.5	6.0m or below	0.60	9.00	75.00	3.75	18.75
7	Coal conveyor near unit-1	BH-48	200.6	202.5	2.0m or below	0.60	10.00	75.00	3.75	18.75

Summary for RCC Bored cast-in-situ Pile Capacity for Piles Terminating in Soil Strata

Sr No	Building/ Structure/ Area	Applicable bore hole nos.	Average EGL in RL (m)	FGL in RL (m)	Pile cut off level below FGL (in m)	Diameter of pile (in m)	Length of pile below cut off level (in m)	Safe pile capacity (in T)			
								Vertical compression	Lateral (in free head condition)	Lateral (in fixed head condition)	Uplift
1	Crushed coal stock pile, Stacker reclaimer, Wind barrier	IBH- 1,2,3,4,5,6,7,8,9,10, 11,12	206.7	202.5	3.00m or below	0.60	9.00	85.00	3.90	10.30	37.00
2	Coal pile run off pond	IBH-29	200.1	202.5	3.00m or below	0.60	11.00	80.00	3.00	10.00	38.00
3	Dry fly ash silo & Dewatering bin	IBH-30,31,32,38	196.4	202.5	6.00m or below	0.60	12.00	88.00	5.00	15.00	45.00
4	SLURRY PH CUM AHP MCCs Pipe rack in BTG area	IBH-34,35,36	199.3	202.5	4.00m or below	0.60	11.00	77.00	5.00	15.00	34.00
5	CHP MCC-2	BH-45	198.85	202.5	4.0m or below	0.60	12.00	78.00	3.60	9.60	36.00
6	Weigh bridge control room	BH-96	197.3	202.5	6.0m or below	0.60	9.00	75.00	4.00	11.00	34.00
7	Coal conveyor near unit-1	BH-48	200.6	202.5	2.0m or below	0.60	10.00	76.00	3.00	8.00	32.00

Summary of Allowable Bearing Pressure for Various Structures

SR.No.	Building/Structure/Area	Applicable bore hole nos.	Lowest EGL in RL (m)	FGL in RL (m)	Depth of foundation below FGL (in m)	Width of foundation (in m)	Allowable Bearing Pressure (in T/m ²) for given below permissible settlement	
							25 mm	40 mm
1	Crushed coal stock pile, stacker reclaimer, wind barrier	IBH-1,2,3,4,5,6,7,8,9,10,11,12	200.65	202.50	1.00	1.5 m	19.00	-
						>1.5 to ≤ 3 m	19.00	-
						>3 to ≤ 6 m	15.00	-
						>6 to ≤ 10 m	9.00	-
					1.50	1.5 m	23.00	-
						Up to 3 m	23.00	-
						>3 to ≤ 6 m	15.00	-
						>6 to ≤ 10 m	9.00	-
					2.00	1.5 m	28.00	-
						Up to 3 m	28.00	-
						>3 to ≤ 6 m	15.00	-
						>6 to ≤ 10 m	9.00	-
					2.50	1.5 m	33.00	-
						Up to 3 m	30.00	-
						>3 to ≤ 6 m	15.00	-
						>6 to ≤ 10 m	9.00	-
					3.00	1.5 m	38.00	-
						Up to 3 m	30.00	-
						>3 to ≤ 6 m	15.00	-
						>6 to ≤ 10 m	9.00	-
					3.50	1.5 m	43.00	-
						Up to 3 m	30.00	-
						>3 to ≤ 6 m	15.00	-
						>6 to ≤ 10 m	9.00	-
2	Gypsum storage shed	IBH-54,55 BH-77	196.75	202.50	6.50	1.5 m	9.00	-
						>1.5 to ≤ 3 m	7.00	-
						>3 to ≤ 6 m	4.00	-
						>6 to ≤ 10 m	3.00	-
					7.50	1.5 m	10.00	-
						Up to 3 m	8.00	-
						>3 to ≤ 6 m	4.00	-
						>6 to ≤ 10 m	3.00	-
					8.50	1.5 m	11.00	-
						Up to 3 m	8.00	-
						>3 to ≤ 6 m	4.00	-
						>6 to ≤ 10 m	3.00	-
					9.50	1.5 m	38.00	-
						Up to 3 m	25.00	-
						>3 to ≤ 6 m	14.00	-
						>6 to ≤ 10 m	10.00	-
					10.50	1.5 m	42.00	-
						Up to 3 m	27.00	-
						>3 to ≤ 6 m	16.00	-
						>6 to ≤ 10 m	11.00	-
					11.50	1.5 m	45.00	-
						Up to 3 m	31.00	-
						>3 to ≤ 6 m	20.00	-
						>6 to ≤ 10 m	13.00	-
3	Coal conveyor BC-2A/B, Weigh bridge	IBH-14	198.77	202.50	5.00	1.5 m	23.00	-
						>1.5 to ≤ 3 m	27.00	-
						>3 to ≤ 6 m	22.00	-
						>6 to ≤ 10 m	13.00	-
					5.50	1.5 m	29.00	-
						Up to 3 m	31.00	-
						>3 to ≤ 6 m	22.00	-
						>6 to ≤ 10 m	13.00	-
					6.00	1.5 m	35.00	-
						Up to 3 m	36.00	-
						>3 to ≤ 6 m	22.00	-
						>6 to ≤ 10 m	13.00	-

Summary of Allowable Bearing Pressure for Various Structures

SR.No.	Building/Structure/Area	Applicable bore hole nos.	Lowest EGL in RL (m)	FGL in RL (m)	Depth of foundation below FGL (in m)	Width of foundation (in m)	Allowable Bearing Pressure (in T/m ²) for given below permissible settlement	
							25 mm	40 mm
4	Receiving tower	IBH-20	193.46	202.50	10.00	1.5 m	5.00	-
						Up to 3 m	5.00	-
						>3 to ≤ 6 m	5.00	-
						>6 to ≤ 10 m	3.00	-
					11.00	1.5 m	7.00	-
						Up to 3 m	7.00	-
						>3 to ≤ 6 m	5.00	-
						>6 to ≤ 10 m	3.00	-
					12.00	1.5 m	10.00	-
						Up to 3 m	10.00	-
						>3 to ≤ 6 m	5.00	-
						>6 to ≤ 10 m	3.00	-
					13.00	1.5 m	21.00	-
						>1.5 to ≤ 3 m	19.00	-
						>3 to ≤ 6 m	18.00	-
						>6 to ≤ 10 m	11.00	-
					14.00	1.5 m	26.00	-
						Up to 3 m	22.00	-
						>3 to ≤ 6 m	18.00	-
						>6 to ≤ 10 m	11.00	-
					15.00	1.5 m	31.00	-
						Up to 3 m	26.00	-
						>3 to ≤ 6 m	18.00	-
						>6 to ≤ 10 m	11.00	-
5	Crusher house	IBH-21	194.99	202.50	8.50	1.5 m	14.00	-
						Up to 3 m	14.00	-
						>3 to ≤ 6 m	10.00	-
						>6 to ≤ 10 m	6.00	-
					9.00	1.5 m	17.00	-
						Up to 3 m	18.00	-
						>3 to ≤ 6 m	10.00	-
						>6 to ≤ 10 m	6.00	-
					9.50	1.5 m	21.00	-
						Up to 3 m	19.00	-
						>3 to ≤ 6 m	10.00	-
						>6 to ≤ 10 m	6.00	-
					10.50	1.5 m	29.00	-
						>1.5 to ≤ 3 m	27.00	-
						>3 to ≤ 6 m	28.00	-
						>6 to ≤ 10 m	17.00	-
					11.00	1.5 m	33.00	-
						Up to 3 m	31.00	-
						>3 to ≤ 6 m	28.00	-
						>6 to ≤ 10 m	17.00	-
					11.50	1.5 m	37.00	-
						Up to 3 m	34.00	-
						>3 to ≤ 6 m	28.00	-
						>6 to ≤ 10 m	17.00	-
6	Junction Tower JT-1	IBH-22	200.61	202.50	3.00	1.5 m	13.00	-
						Up to 3 m	14.00	-
						>3 to ≤ 6 m	15.00	-
						>6 to ≤ 10 m	11.00	-
					3.50	1.5 m	16.00	-
						Up to 3 m	16.00	-
						>3 to ≤ 6 m	18.00	-
						>6 to ≤ 10 m	11.00	-
					4.00	1.5 m	19.00	-
						Up to 3 m	19.00	-
						>3 to ≤ 6 m	19.00	-
						>6 to ≤ 10 m	11.00	-
					5.00	1.5 m	39.00	-
						>1.5 to ≤ 3 m	38.00	-
						>3 to ≤ 6 m	26.00	-
						>6 to ≤ 10 m	16.00	-
					5.50	1.5 m	44.00	-
						Up to 3 m	42.00	-
						>3 to ≤ 6 m	26.00	-
						>6 to ≤ 10 m	16.00	-
					6.00	1.5 m	50.00	-
						Up to 3 m	47.00	-
						>3 to ≤ 6 m	26.00	-
						>6 to ≤ 10 m	16.00	-

Summary of Allowable Bearing Pressure for Various Structures

SR.No.	Building/Structure/Area	Applicable bore hole nos.	Lowest EGL in RL (m)	FGL in RL (m)	Depth of foundation below FGL (in m)	Width of foundation (in m)	Allowable Bearing Pressure (in T/m ²) for given below permissible settlement	
							25 mm	40 mm
7	Junction Tower JT-2	IBH-23	200.45	202.50	3.00	1.5 m	12.00	-
						>1.5 to ≤ 3 m	13.00	-
						>3 to ≤ 6 m	13.00	-
						>6 to ≤ 10 m	8.00	-
					4.00	1.5 m	20.00	-
						Up to 3 m	20.00	-
						>3 to ≤ 6 m	13.00	-
						>6 to ≤ 10 m	8.00	-
					5.00	1.5 m	28.00	-
						Up to 3 m	27.00	-
						>3 to ≤ 6 m	13.00	-
						>6 to ≤ 10 m	8.00	-
8	CHP MCC-1	IBH-25	198.30	202.50	5.50	1.5 m	6.00	-
						>1.5 to ≤ 3 m	6.00	-
						>3 to ≤ 6 m	7.00	-
						>6 to ≤ 10 m	5.00	-
					6.50	1.5 m	9.00	-
						Up to 3 m	8.00	-
						>3 to ≤ 6 m	8.00	-
						>6 to ≤ 10 m	5.00	-
					7.50	1.5 m	12.00	-
						Up to 3 m	11.00	-
						>3 to ≤ 6 m	8.00	-
						>6 to ≤ 10 m	5.00	-
9	CHP maintenance shop	IBH-26	208.20	202.50	1.00	1.5 m	10.00	-
						>1.5 to ≤ 3 m	11.00	-
						>3 to ≤ 6 m	12.00	-
						>6 to ≤ 10 m	11.00	-
					2.00	1.5 m	15.00	-
						Up to 3 m	15.00	-
						>3 to ≤ 6 m	16.00	-
						>6 to ≤ 10 m	11.00	-
					3.00	1.5 m	21.00	-
						Up to 3 m	20.00	-
						>3 to ≤ 6 m	19.00	-
						>6 to ≤ 10 m	11.00	-

Summary of Allowable Bearing Pressure for Various Structures

SR.No.	Building/Structure/Area	Applicable bore hole nos.	Lowest EGL in RL (m)	FGL in RL (m)	Depth of foundation below FGL (in m)	Width of foundation (in m)	Allowable Bearing Pressure (in T/m ²) for given below permissible settlement	
							25 mm	40 mm
10	Bio mass handling system	IBH-27&28 BH-8	199.71	202.50	4.00	1.5 m	7.00	-
						>1.5 to ≤ 3 m	8.00	-
						>3 to ≤ 6 m	7.00	-
						>6 to ≤ 10 m	4.00	-
					5.00	1.5 m	11.00	-
						>1.5 to ≤ 3 m	11.00	-
						>3 to ≤ 6 m	7.00	-
						>6 to ≤ 10 m	4.00	-
					6.00	1.5 m	14.00	-
						>1.5 to ≤ 3 m	14.00	-
						>3 to ≤ 6 m	7.00	-
						>6 to ≤ 10 m	4.00	-
11	Coal pile run off pond	IBH-29	200.10	202.50	3.50	1.5 m	14.00	-
						>1.5 to ≤ 3 m	16.00	-
						>3 to ≤ 6 m	16.00	-
						>6 to ≤ 10 m	10.00	-
					4.00	1.5 m	19.00	-
						Up to 3 m	20.00	-
						>3 to ≤ 6 m	16.00	-
						>6 to ≤ 10 m	10.00	-
					4.50	1.5 m	24.00	-
						Up to 3 m	25.00	-
						>3 to ≤ 6 m	16.00	-
						>6 to ≤ 10 m	10.00	-
12	Dry fly ash silo & dewatering bin	IBH-30,31,32,38	194.67	202.50	7.00	1.5 m	13.00	-
						Up to 3 m	13.00	-
						>3 to ≤ 6 m	9.00	-
						>6 to ≤ 10 m	6.00	-
					8.00	1.5 m	15.00	-
						Up to 3 m	13.00	-
						>3 to ≤ 6 m	9.00	-
						>6 to ≤ 10 m	6.00	-
					9.00	1.5 m	17.00	-
						Up to 3 m	14.00	-
						>3 to ≤ 6 m	10.00	-
						>6 to ≤ 10 m	6.00	-
					10.00	1.5 m	22.00	-
						>1.5 to ≤ 3 m	21.00	-
						>3 to ≤ 6 m	21.00	-
						>6 to ≤ 10 m	17.00	-
					11.00	1.5 m	28.00	-
						Up to 3 m	25.00	-
						>3 to ≤ 6 m	24.00	-
						>6 to ≤ 10 m	17.00	-
					12.00	1.5 m	34.00	-
						Up to 3 m	29.00	-
						>3 to ≤ 6 m	28.00	-
						>6 to ≤ 10 m	17.00	-

Summary of Allowable Bearing Pressure for Various Structures

SR.No.	Building/Structure/Area	Applicable bore hole nos.	Lowest EGL in RL (m)	FGL in RL (m)	Depth of foundation below FGL (in m)	Width of foundation (in m)	Allowable Bearing Pressure (in T/m ²) for given below permissible settlement	
							25 mm	40 mm
13	AHP MCC-1 cum control room AHP compressor bldg	IBH-33	197.00	202.50	6.50	1.5 m	16.00	-
						Up to 3 m	14.00	-
						>3 to ≤ 6 m	8.00	-
						>6 to ≤ 10 m	5.00	-
					7.50	1.5 m	18.00	-
						Up to 3 m	15.00	-
						>3 to ≤ 6 m	8.00	-
						>6 to ≤ 10 m	6.00	-
					8.50	1.5 m	20.00	-
						Up to 3 m	17.00	-
						>3 to ≤ 6 m	10.00	-
						>6 to ≤ 10 m	6.00	-
					9.00	1.5 m	54.00	-
						>1.5 to ≤ 3 m	45.00	-
						>3 to ≤ 6 m	27.00	-
						>6 to ≤ 10 m	18.00	-
					9.50	1.5 m	56.00	-
						Up to 3 m	46.00	-
						>3 to ≤ 6 m	30.00	-
						>6 to ≤ 10 m	20.00	-
					10.00	1.5 m	59.00	-
						Up to 3 m	48.00	-
						>3 to ≤ 6 m	33.00	-
						>6 to ≤ 10 m	22.00	-
14	Slurry PH cum AHP MCC's pipe rack in BTG area	IBH-34,35,36	198.51	202.50	5.00	1.5 m	9.00	-
						Up to 3 m	8.00	-
						>3 to ≤ 6 m	4.00	-
						>6 to ≤ 10 m	2.00	-
					6.00	1.5 m	11.00	-
						Up to 3 m	9.00	-
						>3 to ≤ 6 m	4.00	-
						>6 to ≤ 10 m	3.00	-
					7.00	1.5 m	12.00	-
						Up to 3 m	10.00	-
						>3 to ≤ 6 m	4.00	-
						>6 to ≤ 10 m	3.00	-
					8.00	1.5 m	18.00	-
						>1.5 to ≤ 3 m	15.00	-
						>3 to ≤ 6 m	7.00	-
						>6 to ≤ 10 m	5.00	-
					9.00	1.5 m	20.00	-
						Up to 3 m	16.00	-
						>3 to ≤ 6 m	8.00	-
						>6 to ≤ 10 m	5.00	-
					10.00	1.5 m	22.00	-
						Up to 3 m	16.00	-
						>3 to ≤ 6 m	8.00	-
						>6 to ≤ 10 m	5.00	-
15	Silo utility building cum HCSD pump house	IBH-37	197.57	202.50	6.00	1.5 m	9.00	-
						Up to 3 m	8.00	-
						>3 to ≤ 6 m	4.00	-
						>6 to ≤ 10 m	3.00	-
					7.00	1.5 m	10.00	-
						Up to 3 m	9.00	-
						>3 to ≤ 6 m	5.00	-
						>6 to ≤ 10 m	3.00	-
					8.00	1.5 m	11.00	-
						Up to 3 m	10.00	-
						>3 to ≤ 6 m	5.00	-
						>6 to ≤ 10 m	3.00	-
					9.00	1.5 m	17.00	-
						>1.5 to ≤ 3 m	14.00	-
						>3 to ≤ 6 m	8.00	-
						>6 to ≤ 10 m	6.00	-
					10.00	1.5 m	19.00	-
						Up to 3 m	16.00	-
						>3 to ≤ 6 m	10.00	-
						>6 to ≤ 10 m	7.00	-
					11.00	1.5 m	21.00	-
						Up to 3 m	16.00	-
						>3 to ≤ 6 m	12.00	-
						>6 to ≤ 10 m	8.00	-

Summary of Allowable Bearing Pressure for Various Structures

SR.No.	Building/Structure/Area	Applicable bore hole nos.	Lowest EGL in RL (m)	FGL in RL (m)	Depth of foundation below FGL (in m)	Width of foundation (in m)	Allowable Bearing Pressure (in T/m2) for given below permissible settlement	
							25 mm	40 mm
16	ASH water PH pipe rack	IBH-39	195.45	202.50	8.00	1.5 m	6.00	-
						Up to 3 m	6.00	-
						>3 to ≤ 6 m	4.00	-
						>6 to ≤ 10 m	3.00	-
					9.00	1.5 m	9.00	-
						Up to 3 m	8.00	-
						>3 to ≤ 6 m	4.00	-
						>6 to ≤ 10 m	3.00	-
					10.00	1.5 m	12.00	-
						Up to 3 m	8.00	-
						>3 to ≤ 6 m	4.00	-
						>6 to ≤ 10 m	3.00	-
					12.50	1.5 m	44.00	-
						>1.5 to ≤ 3 m	40.00	-
						>3 to ≤ 6 m	31.00	-
						>6 to ≤ 10 m	19.00	-
					13.00	1.5 m	49.00	-
						Up to 3 m	43.00	-
						>3 to ≤ 6 m	31.00	-
						>6 to ≤ 10 m	19.00	-
					13.50	1.5 m	54.00	-
						Up to 3 m	47.00	-
						>3 to ≤ 6 m	31.00	-
						>6 to ≤ 10 m	19.00	-
17	ASH water transfer pump house, settling cum surge tank	IBH-40	193.60	202.50	10.00	1.5 m	10.00	-
						Up to 3 m	9.00	-
						>3 to ≤ 6 m	4.00	-
						>6 to ≤ 10 m	3.00	-
					11.00	1.5 m	11.00	-
						Up to 3 m	10.00	-
						>3 to ≤ 6 m	5.00	-
						>6 to ≤ 10 m	3.00	-
					12.00	1.5 m	13.00	-
						Up to 3 m	10.00	-
						>3 to ≤ 6 m	5.00	-
						>6 to ≤ 10 m	4.00	-
					13.50	1.5 m	59.00	-
						>1.5 to ≤ 3 m	48.00	-
						>3 to ≤ 6 m	42.00	-
						>6 to ≤ 10 m	26.00	-
					14.00	1.5 m	62.00	-
						Up to 3 m	49.00	-
						>3 to ≤ 6 m	43.00	-
						>6 to ≤ 10 m	27.00	-
					14.50	1.5 m	65.00	-
						Up to 3 m	51.00	-
						>3 to ≤ 6 m	44.00	-
						>6 to ≤ 10 m	28.00	-
18	HCSD slurry pipe corridor	IBH-41,42,43,44,45,46,48,49	194.80	201.00	3.50	1.5 m	6.00	-
						>1.5 to ≤ 3 m	6.00	-
						>3 to ≤ 6 m	3.00	-
						>6 to ≤ 10 m	2.00	-
					4.50	1.5 m	7.00	-
						Up to 3 m	6.00	-
						>3 to ≤ 6 m	3.00	-
						>6 to ≤ 10 m	2.00	-
					5.50	1.5 m	7.00	-
						Up to 3 m	6.00	-
						>3 to ≤ 6 m	3.00	-
						>6 to ≤ 10 m	2.00	-
					6.50	1.5 m	8.00	-
						Up to 3 m	7.00	-
						>3 to ≤ 6 m	3.00	-
						>6 to ≤ 10 m	2.00	-
					7.50	1.5 m	9.00	-
						Up to 3 m	7.00	-
						>3 to ≤ 6 m	3.00	-
						>6 to ≤ 10 m	2.00	-
					8.50	1.5 m	10.00	-
						Up to 3 m	7.00	-
						>3 to ≤ 6 m	3.00	-
						>6 to ≤ 10 m	2.00	-
					9.50	1.5 m	20.00	-
						Up to 3 m	13.00	-
						>3 to ≤ 6 m	7.00	-
						>6 to ≤ 10 m	4.00	-
					10.00	1.5 m	21.00	-
						Up to 3 m	13.00	-
						>3 to ≤ 6 m	7.00	-
						>6 to ≤ 10 m	5.00	-
					10.50	1.5 m	22.00	-
						Up to 3 m	13.00	-
						>3 to ≤ 6 m	7.00	-
						>6 to ≤ 10 m	5.00	-

Summary of Allowable Bearing Pressure for Various Structures

SR.No.	Building/Structure/Area	Applicable bore hole nos.	Lowest EGL in RL (m)	FGL in RL (m)	Depth of foundation below FGL (in m)	Width of foundation (in m)	Allowable Bearing Pressure (in T/m ²) for given below permissible settlement	
							25 mm	40 mm
19	Limestone handling system	IBH-50,51,52,53	197.35	202.50	6.00	1.5 m	4.00	-
						Up to 3 m	3.00	-
						>3 to ≤ 6 m	2.00	-
						>6 to ≤ 10 m	1.00	-
					7.00	1.5 m	4.00	-
						Up to 3 m	4.00	-
						>3 to ≤ 6 m	2.00	-
						>6 to ≤ 10 m	1.00	-
					8.00	1.5 m	5.00	-
						Up to 3 m	4.00	-
						>3 to ≤ 6 m	2.00	-
						>6 to ≤ 10 m	1.00	-
					9.00	1.5 m	13.00	-
						Up to 3 m	8.00	-
						>3 to ≤ 6 m	4.00	-
						>6 to ≤ 10 m	3.00	-
					10.00	1.5 m	14.00	-
						Up to 3 m	8.00	-
						>3 to ≤ 6 m	4.00	-
						>6 to ≤ 10 m	3.00	-
					11.00	1.5 m	15.00	-
						Up to 3 m	8.00	-
						>3 to ≤ 6 m	5.00	-
						>6 to ≤ 10 m	3.00	-
					12.00	1.5 m	62.00	-
						>1.5 to ≤ 3 m	47.00	-
						>3 to ≤ 6 m	28.00	-
						>6 to ≤ 10 m	17.00	-
					12.50	1.5 m	65.00	-
						Up to 3 m	48.00	-
						>3 to ≤ 6 m	28.00	-
						>6 to ≤ 10 m	18.00	-
					13.00	1.5 m	67.00	-
						Up to 3 m	50.00	-
						>3 to ≤ 6 m	29.00	-
						>6 to ≤ 10 m	18.00	-
20	CHP MCC-2& AAQMS	BH-45	198.85	202.50	5.00	1.5 m	11.00	-
						>1.5 to ≤ 3 m	11.00	-
						>3 to ≤ 6 m	7.00	-
						>6 to ≤ 10 m	4.00	-
					6.00	1.5 m	13.00	-
						Up to 3 m	11.00	-
						>3 to ≤ 6 m	7.00	-
						>6 to ≤ 10 m	4.00	-
					7.00	1.5 m	14.00	-
						Up to 3 m	12.00	-
						>3 to ≤ 6 m	7.00	-
						>6 to ≤ 10 m	4.00	-
21	AHP compressor house	BH-42	195.39	202.50	8.50	1.5 m	15.00	-
						>1.5 to ≤ 3 m	14.00	-
						>3 to ≤ 6 m	14.00	-
						>6 to ≤ 10 m	10.00	-
					9.50	1.5 m	17.00	-
						Up to 3 m	15.00	-
						>3 to ≤ 6 m	14.00	-
						>6 to ≤ 10 m	11.00	-
					10.50	1.5 m	18.00	-
						Up to 3 m	16.00	-
						>3 to ≤ 6 m	14.00	-
						>6 to ≤ 10 m	14.00	-

Summary of Allowable Bearing Pressure for Various Structures

SR.No.	Building/Structure/Area	Applicable bore hole nos.	Lowest EGL in RL (m)	FGL in RL (m)	Depth of foundation below FGL (in m)	Width of foundation (in m)	Allowable Bearing Prssure (in T/m2) for given below permissible settlement	
							25 mm	40 mm
22	Weigh bridge control room	BH-96	197.34	202.50	6.50	1.5 m	4.00	-
						Up to 3 m	4.00	-
						>3 to ≤ 6 m	4.00	-
						>6 to ≤ 10 m	3.00	-
					7.50	1.5 m	5.00	-
						Up to 3 m	4.00	-
						>3 to ≤ 6 m	4.00	-
						>6 to ≤ 10 m	3.00	-
					8.50	1.5 m	5.00	-
						Up to 3 m	4.00	-
						>3 to ≤ 6 m	4.00	-
						>6 to ≤ 10 m	3.00	-
					9.00	1.5 m	14.00	-
						>1.5 to ≤ 3 m	11.00	-
						>3 to ≤ 6 m	6.00	-
						>6 to ≤ 10 m	4.00	-
					9.50	1.5 m	15.00	-
						Up to 3 m	11.00	-
						>3 to ≤ 6 m	6.00	-
						>6 to ≤ 10 m	4.00	-
					10.00	1.5 m	15.00	-
						Up to 3 m	11.00	-
						>3 to ≤ 6 m	6.00	-
						>6 to ≤ 10 m	4.00	-
23	Coal conveyor near unit-1	BH-48	200.63	202.50	3.00	1.5 m	13.00	-
						Up to 3 m	12.00	-
						>3 to ≤ 6 m	10.00	-
						>6 to ≤ 10 m	6.00	-
					4.00	1.5 m	15.00	-
						Up to 3 m	13.00	-
						>3 to ≤ 6 m	10.00	-
						>6 to ≤ 10 m	6.00	-
					4.50	1.5 m	15.00	-
						Up to 3 m	13.00	-
						>3 to ≤ 6 m	10.00	-
						>6 to ≤ 10 m	6.00	-
					5.00	1.5 m	16.00	-
						Up to 3 m	14.00	-
						>3 to ≤ 6 m	11.00	-
						>6 to ≤ 10 m	6.00	-

Summary of Allowable Bearing Pressure for Various Structures

SR.No.	Building/Structure/Area	Applicable bore hole nos.	Lowest EGL in RL (m)	FGL in RL (m)	Depth of foundation below FGL (in m)	Width of foundation (in m)	Allowable Bearing Prssure (in T/m2) for given below permissible settlement	
							25 mm	40 mm
24	Ash pipe line corridor	IBH-47	196.30	201.00	5.70	1.5 m	8.00	-
						Up to 3 m	7.00	-
						>3 to ≤ 6 m	3.00	-
						>6 to ≤ 10 m	2.00	-
					6.70	1.5 m	9.00	-
						Up to 3 m	8.00	-
						>3 to ≤ 6 m	4.00	-
						>6 to ≤ 10 m	2.00	-
					7.70	1.5 m	10.00	-
						Up to 3 m	8.00	-
						>3 to ≤ 6 m	4.00	-
						>6 to ≤ 10 m	2.00	-
					8.70	1.5 m	14.00	-
						Up to 3 m	12.00	-
						>3 to ≤ 6 m	6.00	-
						>6 to ≤ 10 m	3.00	-
					9.70	1.5 m	16.00	-
						Up to 3 m	12.00	-
						>3 to ≤ 6 m	6.00	-
						>6 to ≤ 10 m	3.00	-
					10.70	1.5 m	17.00	-
						Up to 3 m	12.00	-
						>3 to ≤ 6 m	6.00	-
						>6 to ≤ 10 m	4.00	-

Note: The fill material proposed for raising the Finished Ground Level (FGL) shall consist of controlled engineered fill, sourced locally and assumed to be predominantly cohesive in nature. Upon achieving a minimum compaction of 95% of Maximum Dry Density (MDD), the fill is expected to attain a very stiff consistency. Notwithstanding the improved stiffness characteristics, a conservative Safe Bearing Capacity (SBC) of 5 t/m² has been adopted based on the minimum presumptive values recommended in Indian Railway Standard Code of Practice for Design of Substructures and Foundations of Bridges, ensuring a safe and conservative design basis. Accordingly, for this structure where the required SBC is up to 5 t/m², foundations may be safely placed over the compacted fill material.

Design Parameter

Design Parameter for Group 1 Applicable structure: Crushed coat stock pile, Stacker reclaimer, Wind barrier Representative Borehole: IBH-10							
Depth in m from NGL	Soil Classification	Depth in m from FGL	Cohesion in kg/cm ²	Angle of Internal Friction	Bulk Density in gm/cc	SPT N Value	shear strength qc kN/m ²
-	Filled up soil	Up to 7.90m depth from FGL soil in cutting	-	-	-	-	-
0.00-0.60	Dark yellowish brown, fine to medium grained, clayey sand (SC)		-	-	-	-	
0.60-2.30	Reddish yellowish brown, fine to medium grained, clayey sand (SC)		-	-	-	15-42	
2.30-3.90	Dark reddish brown, fine to medium grained, silty sand (SM)		0	30	1.71	32	
3.90-4.40	Yellowish brown, fine to medium grained, clayey sand (SC)		-	-	-	38	
4.40-5.45	Yellowish brown, fine to medium grained, sandy clays of low plasticity (CL)		0.76	6	1.79	29	
5.45-7.90	Yellowish brown, fine to medium grained, clayey sand (SC)		0.08	28	1.98	42-61	
7.90-9.60	Yellowish brown, fine to medium grained, clayey sand (SC)	0.00-1.70	0.09	26	2.08	41- >100	
9.60-11.60	Yellowish brown, fine to very fine grained, silty clayey sand with little to some gravels (SM-SC)	1.70-3.70	-	-	-	>100	
11.60-14.60	Yellowish brown, fine to medium grained, clayey sand with little to some gravels (SC)	3.70-6.70	-	-	-	>100	
14.60-17.30	Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL)	6.70-9.40	-	-	-	>100	
17.30-20.40	Yellowish brown, fine to medium grained, clayey sand (SC)	9.40-12.50	-	-	-	>100	
20.40-21.20	Yellowish brown, fine to medium grained, silty clayey sand (SM-SC)	12.50-13.30	-	-	-	>100	
21.20-21.90	Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL)	13.30-14.00	-	-	-	>100	
21.90-23.10	Highly weathered, very weak, completely fractured, dark brownish yellow, fine to coarse grained, rock	14.00-15.20	-	-	-	>100	-
23.10-25.00	Highly weathered, weak, dark brownish yellow, fine to coarse grained, very thinly laminated rock	15.20-17.10	-	-	2.53	-	146.3

Design Parameter for Group 2 Applicable structure: Gypsum storage shed Representative Borehole: IBH-54							
Depth in m from NGL	Soil Classification	Depth in m from FGL	Cohesion in kg/cm ²	Angle of Internal Friction	Bulk Density in gm/cc	SPT N Value	shear strength qc kN/m ²
-	Filled up soil	FGL- 5.38	-	-	-	-	-
0.00-2.75	Brownish, very fine grained, silty clays of intermediate plasticity with occasional gravels (CI)	5.38-8.13	0.38	3	1.93	6-7	
2.75-4.90	Yellowish brown, very fine grained, silty clays of intermediate plasticity with occasional gravels (CI)	8.13-10.28	0.50	5	1.97	9-10	
4.90-7.10	Reddish yellow, fine to very fine grained, silty clays of intermediate plasticity (CI)	10.28-12.48	-	-	-	29- >100	
7.10-10.00	Highly weathered, weak, dark brownish, fine to medium grained, fractured rock	12.48-15.38	2.17	-	-	>100	
10.00-13.00	Moderately weathered, moderately weak, brownish, fine to medium grained, fractured rock	15.38-18.38	2.30	-	-	-	
13.00-16.00	Highly weathered, moderately weak, brownish, fine to medium grained, rock with closely spaced discontinuities	18.38-21.38	2.44	-	-	-	186.3

Design Parameter for Group 3 Applicable structure: Coal Conveyor BC-2A/B, weigh bridge Representative Borehole: IBH-14							
Depth in m from NGL	Soil Classification	Depth in m from FGL	Cohesion in kg/cm ²	Angle of Internal Friction	Bulk Density in gm/cc	SPT N Value	shear strength qc kN/m ²
-	Filled up soil	FGL- 3.73	-	-	-	-	-
0.00-1.60	Yellowish brown, fine to medium grained, clayey sand with much to some gravels (SC)	3.73-5.33	-	-	-	45	
1.60-2.60	Yellowish brown, fine to medium grained, silty clayey sand with much gravels (SM-SC)	5.33-6.33	-	-	-	38-49	
2.60-5.00	Yellowish brown, fine to medium grained, silty sand with little to some gravels (SM)	6.33-8.73	-	-	-	>100	
5.00-8.70	Yellowish brown, fine to medium grained, clayey sand with little gravels (SC)	8.73-12.43	0.10	28	2.19	25- >100	
8.70-10.20	Yellowish brown, fine to medium grained, silty clayey sand with much gravels (SM-SC)	12.43-13.93	-	-	-	25-33	
10.20-17.20	Yellowish brown, fine to medium grained, clayey sand with much to some gravels (SC)	13.93-20.93	-	-	-	45- >100	
17.20-18.80	Yellowish brown, fine to medium grained, silty sand (SM)	20.93-22.53	-	-	-	>100	84.5
18.80-25.00	Boulderous formation of highly weathered, weak and friable, dark brownish yellow, fine to coarse grained, gravels, pebbles, cobbles size fractured rock fragments with infilled dark brownish, fine to coarse grained, sand	22.53-28.73	-	-	2.45	>100	

Design Parameter for Group 4 Applicable structure: Coal conveyor BC-3A/B, Pipe rack Representative Borehole: IBH-15							
Depth in m from NGL	Soil Classification	Depth in m from FGL	Cohesion in kg/cm ²	Angle of Internal Friction	Bulk Density in gm/cc	SPT N Value	shear strength qc kN/m2
-	Filled up soil	FGL- 1.55	-	-	-	-	-
0.00-0.80	Reddish brown, fine to medium grained, silty sand with little plastic fines and occasional gravels (SM)	1.55-2.35	-	-	-	-	-
0.80-5.30	Dark reddish yellow to yellowish brown, fine to medium grained, clayey sand with little too much gravels (SC)	2.35-6.85	0.06	27	1.97	18-55	-
5.30-6.40	Yellowish brown, fine to coarse grained, silty clayey sand with little gravels (SM-SC)	6.85-7.95	0.03	29	2.08	61	-
6.40-11.60	Yellowish brown, fine to medium grained, cemented clayey sand with occasional too much gravels (SC)	7.95-13.15	-	-	-	74- >100	-
11.60-13.50	Brownish, fine to medium grained, cemented, silty clayey sand (SM-SC)	13.15-15.05	-	-	-	>100	-
13.50-19.15	Yellowish brown, fine to medium grained, cemented clayey sand (SC)	15.05-20.70	-	-	-	>100	-
19.15-23.00	Highly weathered, weak, yellowish brown, fine to coarse grained, fractured rock	20.70-24.55	2.34	-	-	-	99.8
23.00-24.00	Highly weathered, moderately weak, light brownish, fine to medium grained, fractured rock	24.55-25.55	2.28	-	-	-	111.6
24.00-25.00	Highly weathered, moderately strong, brownish, fine to coarse grained, fractured rock	25.55-26.55	2.52	-	-	-	202.3

Design Parameter for Group 5 Applicable structure: Coal Conveyor BC-4A/B Representative Borehole: IBH-17							
Depth in m from NGL	Soil Classification	Depth in m from FGL	Cohesion in kg/cm ²	Angle of Internal Friction	Bulk Density in gm/cc	SPT N Value	shear strength qc kN/m2
-	Filled up soil	FGL- 1.80	-	-	-	-	-
0.00-0.60	Yellowish brown, fine to medium grained, clayey sand (SC)	1.80-2.40	-	-	-	-	
0.60-2.30	Dark yellowish brown, fine to medium grained, sandy clays of low plasticity (CL)	2.40-4.10	-	-	-	11-14	
2.30-3.40	Reddish yellowish brown, fine to medium grained, clayey sand (SC)	4.10-5.20	0.07	25	1.82	15	
3.40-4.60	Yellowish brown, fine to very fine grained, sandy clays of intermediate plasticity (CI)	5.20-6.40	0.78	7	1.97	12-23	
4.60-5.70	Yellowish brown, fine to very fine grained, sandy clays of high plasticity (CH)	6.40-7.50	-	-	-	22	
5.70-6.30	Yellowish brown, fine to medium grained, sandy clays of intermediate plasticity (CI)	7.50-8.10	-	-	-	25	
6.30-7.80	Yellowish brown, fine to medium grained, clayey sand with occasional gravels (SC)	8.10-9.60	0.08	27	2.00	20	
7.80-9.50	Yellowish brown, very fine grained, clays of high plasticity (CH)	9.60-11.30	-	-	-	22-26	
9.50-11.40	Light yellowish brown, fine to very fine grained, sandy clays of intermediate plasticity (CI)	11.30-13.20	1.30	6	2.08	29	
11.40-14.40	Yellowish brown, fine to very fine grained, clayey sand with little to occasional gravels (SC)	13.20-16.20	-	-	-	20-33	
14.40-16.10	Yellowish brown, fine to very fine grained, silty sand (SM)	16.20-17.90	-	-	-	28- >100	-
16.10-17.60	Brownish, fine to medium grained, clayey sand with little too much gravels (SC)	17.90-19.40	-	-	-	>100	
17.60-20.50	Highly weathered, completely fractured and disintegration, dark brownish black, fine to coarse grained, gravels, pebbles and cobbles size fractured rock fragments with infilled sandy clays	19.40-22.30	-	-	-	>100	
20.50-22.50	Moderately weathered, moderately strong, dark brownish, fine to medium grained, rock with wide spacing of discontinuities	22.30-24.30	-	-	-	-	
22.50-23.50	Moderately weathered, moderately strong, dark brownish, fine to medium grained, rock with close spacing of discontinuities	24.30-25.30	-	-	-	-	
23.50-25.00	Fresh, strong, dark brownish, fine to medium grained, massive rock	25.30-26.80	-	-	-	-	350.4

Design Parameter for Group 6 Applicable structure: Coal Conveyor BC-5A/B in BTG area Representative Borehole: IBH-18							
Depth in m from NGL	Soil Classification	Depth in m from FGL	Cohesion in kg/cm ²	Angle of Internal Friction	Bulk Density in gm/cc	SPT N Value	shear strength qc kN/m ²
-	Filled up soil	FGL- 2.16	-	-	-	-	-
0.00-0.50	Brownish, fine to very fine grained, clayey sand with occasional gravels(SC)	2.16-2.66	-	-	-	-	-
0.50-3.70	Pinkish yellow, fine to very fine grained, sandy clays of intermediate plasticity with occasional gravels(CI)	2.66-5.86	0.90	5	1.97	11-17	-
3.70-8.50	Brownish yellow, very fine grained, clays of high plasticity with little gravels (CH)	5.86-10.66	1.12	3	2.00	19-24	-
8.50-9.50	Brownish yellow, fine to very fine grained, sandy clays of low plasticity (CL)	10.66-11.66	0.96	8	2.00	21	-
9.50-10.50	Light brownish yellow and greyish, fine to medium grained, clayey sand with little plastic fines (SC)	11.66-12.66	0.09	27	2.02	22	-
10.50-14.20	Light brownish yellow and greyish, fine to medium grained, silty sand with little plastic fines (SM)	12.66-16.36	0	29	2.05	18-22	-
14.20-16.00	Highly weathered, very weak, dark greenish grey, very fine grained, very weak, very thinly laminated, foliated SHALE	16.36-18.16	-	-	-	>100	-
16.00-19.00	Highly weathered, dark greenish grey, very fine grained, very weak, very thinly laminated, foliated SHALE	18.16-21.16	-	-	2.17	-	30.4
19.00-20.50	Moderately weathered, dark greenish grey, very fine grained, very weak, very thinly laminated, foliated SHALE	21.16-22.66	-	-	2.21	-	29.6
20.50-25.00	Slightly weathered, dark greenish grey, very fine grained, very weak, very thinly laminated foliated SHALE	22.66-27.16	-	-	2.29	-	39.4

Design Parameter for Group 7 Applicable structure: Receiving Tower Representative Borehole: IBH-20							
Depth in m from NGL	Soil Classification	Depth in m from FGL	Cohesion in kg/cm ²	Angle of Internal Friction	Bulk Density in gm/cc	SPT N Value	shear strength qc kN/m ²
-	Filled up soil	FGL- 9.04	-	-	-	-	-
0.00-0.90	Brownish, fine to medium grained, sandy clays of intermediate plasticity (CI)	9.04-9.94	-	-	-	-	
0.90-7.40	Yellowish brown to reddish yellow, fine to medium grained, clayey sand with some too much gravels (SC)	9.94- 16.44	0.11	24	1.96	5-32	
7.40-7.90	Greyish brown, very fine grained, indurated, clays of intermediate plasticity with gravels Mud stone	16.44- 16.94	-	-	-	>100	
7.90-13.50	Highly weathered, weak to moderately weak, dark greyish brown, fine to very fine grained, very thinly bedded rock	16.94- 22.54	-	-	2.26	>100	-
13.50-15.00	Moderately weathered, weak, dark greyish black, fine to very fine grained, moderately thinly bedded rock	22.54- 24.05	-	-	2.40	-	86.4
15.00-16.00	Moderately weathered, moderately weak, dark greyish black, fine to very fine grained, moderately thickly bedded rock	24.04- 25.04	-	-	2.47	-	150.2
16.00-16.50	Slightly weathered, moderately weak, dark greyish black, fine to very fine grained, moderately thickly bedded rock	25.04- 25.54	-	-	2.47	-	171.5

Design Parameter for Group 8 Applicable structure: Crusher House Representative Borehole: IBH-21							
Depth in m from NGL	Soil Classification	Depth in m from FGL	Cohesion in kg/cm ²	Angle of Internal Friction	Bulk Density in gm/cc	SPT N Value	shear strength qc kN/m ²
-	Filled up soil	FGL- 7.51	-	-	-	-	-
0.00-0.30	Yellowish brown, fine to medium grained, sandy clays of low plasticity with occasional gravels (CL)	7.51-7.81	-	-	-	-	
0.30-2.40	Yellowish brown, fine to medium grained, clayey sand with little gravels (SC)	7.81-9.91	-	-	-	13-16	
2.40-6.30	Dark brownish, fine to medium grained, cemented clayey sand with much gravels (SC)	9.91-13.81	-	-	-	60-92	
6.30-9.30	Yellowish brown, fine to medium grained, cemented silty clayey sand with much gravels (SM-SC)	13.81-16.81	-	-	-	>100	
9.300-10.50	Brownish, fine to medium grained, cemented silty sand with little plastic fines (SM)	16.81-18.01	-	-	-	>100	
10.50-11.70	Yellowish brown, fine to medium grained, cemented clayey sand (SC)	18.01-19.21	-	-	-	>100	
11.70-14.70	Yellowish brown, fine to medium grained, cemented silty sand (SM)	19.21-22.21	-	-	-	>100	-
14.70-17.50	Moderately weathered, moderately weak, dark brownish, fine to medium grained, rock with close spacing of discontinuities	22.21-25.01	-	-	2.51	>100	199.7
17.50-21.00	Highly weathered, moderately weak, dark brownish, fine to coarse grained, fractured rock	25.01-28.51	-	-	2.54	-	216.8
21.00-25.00	Moderately weathered, moderately strong, dark brownish, fine to coarse grained, fractured rock	28.51-32.51	-	-	2.58	-	230.5

Design Parameter for Group 9 Applicable structure: Junction Tower JT-1 Representative Borehole: IBH-22							
Depth in m from NGL	Soil Classification	Depth in m from FGL	Cohesion in kg/cm ²	Angle of Internal Friction	Bulk Density in gm/cc	SPT N Value	shear strength qc kN/m ²
-	Filled up soil	FGL- 1.89	-	-	-	-	-
0.00-0.30	Dark reddish brown, fine to coarse grained, silty sand with little plastic fines and some gravels (SM)	1.89-2.19	-	-	-	-	
0.30-6.30	Light reddish yellow and reddish yellow, fine to medium grained, clayey sand with occasional gravels (SC)	2.19-8.19	0.08	29	1.82	13- >100	
6.30-9.50	Boulderous formation of highly weathered, weak, dark brownish, fine to coarse grained, fractured and friable rock with little cemented sand	8.19- 11.39	0	33	2.33		
9.50-12.50	Boulderous formation of highly weathered, moderately weak, dark brownish, fine to coarse grained, fractured and friable rock with cemented sand	11.39- 14.39	0	34	2.33		
12.50-17.30	Yellowish brown, fine to medium grained, cemented silty sand with very weak and friable fragments of rock	14.39- 19.19	-	-	-	>100	
17.30-18.50	Yellowish brown and slightly greyish, fine to coarse grained, cemented silty sand with little plastic fines and with very weak and friable fragments of rock	19.19- 20.39	-	-	-	>100	
18.50-20.50	Highly weathered, weak, completely fractured, yellowish brown, fine to medium grained, rock mix with yellowish brown, fine to medium grained, cemented sand	20.39- 22.39	-	-	-	>100	-
20.50-23.00	Highly weathered, very weak, yellowish brown, fine to coarse grained, fractured and friable rock	22.39- 24.89	2.28	-	-	>100	
23.00-25.00	Highly weathered, weak, yellowish brown, fine to coarse grained, rock with close spacing of discontinuities	24.89- 26.89	2.39	-	-	-	

Design Parameter for Group 10 Applicable structure: Junction Tower JT-2 Representative Borehole: IBH-23							
Depth in m from NGL	Soil Classification	Depth in m from FGL	Cohesion in kg/cm ²	Angle of Internal Friction	Bulk Density in gm/cc	SPT N Value	shear strength qc kN/m ²
-	Filled up soil	FGL- 2.05	-	-	-	-	-
0.00-4.70	Yellowish brown, fine to medium grained, clayey sand with little too much gravels (SC)	2.05-6.75	0.04	29	1.88	13-36	
4.70-6.20	Yellowish brown, fine to medium grained, silty clayey sand with little gravels (SM-SC)	6.75-8.25	-	-	-	31-36	
6.20-8.50	Yellowish brown, fine to medium grained, poorly graded sand and silty sand with some gravels (SP-SM)	8.25-10.55	0	29	2.05	18- >100	
8.50-14.70	Yellowish brown, fine to medium grained, clayey sand with much gravels (SC)	10.55-14.75	0.13	28	2.14	>100	
14.70-21.50	Highly weathered, very weak, dark brownish, fine to coarse grained, fractured rock	14.75-23.55	2.36	-	-	>100	38.7
21.50-23.00	Highly weathered, moderately weak, dark brownish, fine to coarse grained, rock with very closely spaced discontinuities	23.55-25.05	-	-	2.51	>100	124.8
23.00-25.00	Highly weathered, very weak, brownish, fine to coarse grained, rock with closely spaced discontinuities	25.05-27.05	-	-	-	-	-

Design Parameter for Group 11 Applicable structure: Junction Tower JT-3 CHP MCC-2 Representative Borehole: IBH-24							
Depth in m from NGL	Soil Classification	Depth in m from FGL	Cohesion in kg/cm ²	Angle of Internal Friction	Bulk Density in gm/cc	SPT N Value	shear strength qc kN/m2
-	Filled up soil	FGL- 2.85	-	-	-	-	-
0.00-0.20	Yellowish brown, fine to very fine grained, clayey sand (SC)	2.85-3.05	-	-	-	-	
0.20-1.50	Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL)	3.05-4.35	-	-	-	18	
1.50-4.70	Yellowish brown, fine to very fine grained, sandy clays of intermediate plasticity (CI)	4.35-7.55	0.97	6	2.00	15-22	
4.70-5.60	Yellowish brown, fine to very fine grained, clays of high plasticity (CH) 4.70 to 5.60m	7.55-8.45	1.29	5	2.02	24	
5.60-7.30	Yellowish brown, fine to medium grained, clayey sand (SC)	8.45-10.15	0.08	26	2.04	26-34	
7.30-9.60	Yellowish brown, fine to very fine grained, clays of high plasticity (CH)	10.15-12.45	1.26	2	1.99	19-23	
9.60-11.30	Yellowish brown, fine to medium grained, clayey sand (SC)	12.45-14.15	-	-	-	16-19	
11.30-14.60	Yellowish brown, fine to medium grained, silty sand (SM)	14.15-17.45	-	-	-	20-36	99.5
14.60-20.00	Highly weathered, weak, brownish grey, very fine grained, thinly laminated rock	17.45-22.85	-	-	2.35	>100	
20.00-21.50	Moderately weathered, weak, brownish grey, very fine grained, thinly bedded rock	22.85-24.35	-	-	2.43	-	
21.50-23.50	Moderately weathered, weak, dark black, very fine grained, thickly bedded rock	24.35-26.35	-	-	2.51	-	
23.50-25.00	Slightly weathered, weak, dark black, very fine grained, massive rock	26.35-27.85	-	-	2.46	-	

Design Parameter for Group 12 Applicable structure: CHP MCC-1 Representative Borehole: IBH-25							
Depth in m from NGL	Soil Classification	Depth in m from FGL	Cohesion in kg/cm ²	Angle of Internal Friction	Bulk Density in gm/cc	SPT N Value	shear strength qc kN/m ²
-	Filled up soil	FGL- 4.20	-	-	-	-	-
0.00-2.60	Yellowish brown, fine to medium grained, clayey sand (SC)	4.20-6.80	0.07	24	1.88	8-14	
2.60-4.70	Light yellowish brown, fine to very fine grained, clayey sand (SC)	6.80-8.90	0.06	25	1.93	10- >100	
4.70-11.70	Yellowish brown, fine to medium grained, clayey sand (SC)	8.90- 15.90	-	-	-	32- >100	
11.70-13.50	Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL)	15.90- 17.70	-	-	-	>100	
13.50-17.20	Yellowish brown, fine to medium grained, clayey sand (SC)	17.70- 21.40	-	-	-	>100	
17.20-19.00	Highly weathered, completely fractured and disintegrated, brownish yellow, fine to coarse grained, rock	21.40- 23.20	-	-	2.16	>100	-
19.00-20.50	Highly weathered, dark brownish grey, very fine grained, very thinly laminated rock	23.20- 24.70	-	-	-	>100	-
20.50-22.00	Highly weathered, weak, dark brownish yellow, fine to coarse grained, fractured rock	24.70- 26.20	-	-	2.21	-	-

Design Parameter for Group 13 Applicable structure: CHP maintenance shop Representative Borehole: IBH-26							
Depth in m from NGL	Soil Classification	Depth in m from FGL	Cohesion in kg/cm ²	Angle of Internal Friction	Bulk Density in gm/cc	SPT N Value	shear strength qc kN/m2
0.00-0.80	Dark brownish red, fine to very fine grained, sandy clays of low plasticity (CL)	Up to 5.70m depth from FGL soil in cutting	-	-	-	-	-
0.80-3.60	Dark brownish red, fine to coarse grained, clayey sand with much gravels (SC)		0.07	27	1.71	13-73	
3.60-4.80	Reddish brown, fine to coarse grained, cemented silty sand with some gravels (SM)		-	-	-	>100	
4.80-5.70	Yellowish brown, fine to medium grained, clayey sand with occasional gravels (SC)		-	-	-	44-81	
5.70-6.30	Yellowish brown, fine to medium grained, clayey sand with occasional gravels (SC)	0.00-0.60	-	-	-	54	
6.30-7.70	Light yellowish brown, fine to medium grained, cemented silty clayey sand (SM-SC)	0.60-2.00	-	-	-	>100	
7.70-9.50	Dark brownish, fine to medium grained, cemented sand with much gravels and rock fragments	2.00-3.80	0	33	2.08	>100	
9.50-19.00	Highly weathered, very weak, brownish, fine to medium grained, fractured and friable rock	3.80-13.30	-	-	2.25	>100	-
19.00-22.00	Highly weathered, moderately weak, dark brownish, fine to coarse grained, fractured rock	13.30-16.30	-	-	2.39	-	-
22.00-25.00	Highly weathered, moderately strong, dark blackish grey, fine to coarse grained, fractured rock	16.30-19.30	-	-	2.57	-	-

Design Parameter for Group 14 Applicable structure: Bio mass handling system Representative Borehole: IBH-28							
Depth in m from NGL	Soil Classification	Depth in m from FGL	Cohesion in kg/cm ²	Angle of Internal Friction	Bulk Density in gm/cc	SPT N Value	shear strength qc kN/m ²
-	Filled up soil	FGL- 2.79	-	-	-	-	-
0.00-0.50	Brownish, fine to medium grained, clayey sand (SC)	2.79-3.29	-	-	-	-	
0.50-3.95	Yellowish brown to dark brownish, fine to medium grained, clayey sand with occasional gravels (SC)	3.29-6.74	0.07	26	1.66	4-22	
3.95-4.90	Dark brownish, fine to medium grained, silty sand with little plastic fines (SM)	6.74-7.69	0	30	2.04	38	
4.90-5.80	Yellowish brown, fine to medium grained, cemented silty sand with much gravels (SM)	7.69-8.59	-	-	-	>100	
5.80-6.40	Light brownish yellow, fine to medium grained, cemented clayey sand (SC)	8.59-9.19	-	-	-	>100	
6.40-9.60	Yellowish brown, fine to medium grained, cemented silty sand with little plastic fines occasional gravels (SM)	9.19- 12.39	-	-	-	>100	
9.60-15.20	Dark brownish, fine to medium grained, cemented clayey sand with occasional to some gravels (SC)	12.39- 17.99	-	-	-	>100	
15.20-17.50	Yellowish brown, fine to medium grained, silty clayey sand with little to some gravels (SM-SC)	17.99- 20.29	-	-	-	>100	-
17.50-21.00	Highly weathered, very weak, yellowish brown, fine to coarse grained, friable and fractured rock	20.29- 23.79	-	-	2.26	>100	
21.00-25.00	Highly weathered, weak, reddish brown, fine to coarse grained, fractured rock	23.79- 27.79	-	-	2.32	-	

Design Parameter for Group 15 Applicable structure: Coal pile run off pond Representative Borehole: IBH-29							
Depth in m from NGL	Soil Classification	Depth in m from FGL	Cohesion in kg/cm ²	Angle of Internal Friction	Bulk Density in gm/cc	SPT N Value	shear strength qc kN/m2
-	Filled up soil	FGL- 2.40	-	-	-	-	-
0.00-0.30	Reddish brown, fine to medium grained, silty clayey sand with much gravels (SM-SC)	2.40-2.70	-	-	-	-	
0.30-2.80	Yellowish brown, fine to coarse grained, silty clayey sand with some to little gravels (SM-SC)	2.70-5.20	0.02	30	1.83	19-34	
2.80-3.70	Yellowish brown, fine to medium grained, silty sand with little plastic fines (SM)	5.20-6.10	0	30	1.79	58	
3.70-5.30	Brownish yellow, fine to medium grained, silty clayey sand (SM-SC)	6.10-7.70	0.06	29	2.04	26	
5.30-6.70	Yellowish brown, fine to medium grained, cemented micaceous clayey sand (SC)	7.70-9.10	-	-	-	70- >100	
6.70-8.30	Greyish brown, fine to medium grained, cemented silty sand with occasional gravels (SM)	9.10-10.70	-	-	-	>100	
8.30-11.30	Dark brownish, fine to medium grained, cemented micaceous clayey sand with occasional gravels (SC)	10.70-13.70	-	-	-	>100	
11.30-13.10	Brownish, fine to medium grained, cemented silty sand with occasional gravels (SM)	13.70-15.50	-	-	-	>100	
13.10-14.20	Yellowish brown, fine to coarse grained, cemented sand with much gravels	15.50-16.60	-	-	-	>100	
14.20-19.00	Highly weathered, very weak, yellowish brown, fine to coarse grained, fractured and friable rock	16.60-21.40	-	-	2.29	>100	-
19.00-20.50	Highly weathered, very weak, dark brownish, fine to coarse grained, fractured and friable rock	21.40-22.40	-	-	2.21	-	64.8
20.50-24.00	Highly weathered, weak, brownish, fine to coarse grained, rock with very close spacing of discontinuities	22.40-26.40	-	-	2.32	-	-
24.00-25.00	Highly weathered, brownish, weak, fine to coarse grained, fractured rock	26.40-27.40	-	-	2.33	-	-

Design Parameter for Group 16 Applicable structure: Dry fly ash silo & Dewatering bin Representative Borehole: IBH-32							
Depth in m from NGL	Soil Classification	Depth in m from FGL	Cohesion in kg/cm ²	Angle of Internal Friction	Bulk Density in gm/cc	SPT N Value	shear strength qc kN/m ²
-	Filled up soil	FGL- 6.00	-	-	-	-	-
0.00-0.80	Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL)	6.00-6.80	-	-	-	-	
0.80-2.80	Yellowish brown, very fine grained, clays of high plasticity (CH)	6.80-8.80	-	-	-	5-20	
2.80-3.60	Yellowish brown, fine to very fine grained, sandy clays of intermediate plasticity (CI)	8.80-9.60	1.03	8	1.98	23	
3.60-11.60	Brownish yellow, fine to very fine grained, clayey sand (SC)	9.60-17.60	0.07	27	1.98	16- >100	
11.60-14.70	Brownish grey, fine to very fine grained, clayey sand with some too much gravels (SC)	17.60-20.70	-	-	-	>100	
14.70-17.00	Moderately weathered, very weak, light brownish grey, fine to very fine grained, rock with moderately wide spacing of discontinuities	20.70-23.00	-	-	2.21	-	109.2
17.00-18.00	Highly weathered, very weak, light brownish grey, fine to very fine grained, close spacing of discontinuities	23.00-24.00	-	-	2.29	-	128.7
18.00-18.50	Slightly weathered, weak, dark brownish grey, fine to medium grained, massive rock	24.00-24.50	-	-	2.42	-	193.4

Design Parameter for Group 17 Applicable structure: AHP MCC-1 cum control room AHP COMPRESSOR BLDG Representative Borehole: IBH-33							
Depth in m from NGL	Soil Classification	Depth in m from FGL	Cohesion in kg/cm ²	Angle of Internal Friction	Bulk Density in gm/cc	SPT N Value	shear strength qc kN/m2
-	Filled up soil	FGL- 5.50	-	-	-	-	-
0.00-0.60	Yellowish brown, fine to very fine grained, sandy clays of high plasticity (CH)	5.50-6.10	-	-	-	-	
0.60-3.70	Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL)	6.10-9.20	0.91	8	1.98	12-17	
3.70-5.10	Yellowish brown, very fine grained, clays of intermediate plasticity (CI)	9.20-10.60	1.84	2	2.03	32-61	
5.10-7.50	Highly weathered, completely fractured and disintegrated, yellowish brown, very fine grained, mud rock	10.60-13.00	-	-	-	73- >100	
7.50-13.50	Highly weathered, very weak, light brownish yellow, fine to medium grained, thinly laminated rock	13.00-19.00	-	-	-	72- >100	
13.50-15.00	Highly weathered, weak, dark brownish grey, very fine grained, fractured rock	19.00-20.50	-	-	-	-	-
15.00-16.50	Highly weathered, brownish grey, very fine grained, thickly bedded rock	20.50-22.00	-	-	-	-	-
16.50-18.00	Slightly weathered, very weak, dark greyish, fine to very fine grained, massive rock	22.00-23.50	-	-	-	-	-
18.00-19.00	Highly weathered, moderately weak, dark greyish brown, fine to very fine grained, thinly bedded rock	23.50-24.50	-	-	2.49	-	147.5
19.00-20.00	Highly weathered, weak, dark brownish grey, very fine grained, massive rock	24.50-25.50	-	-	2.26	-	68.4

Design Parameter for Group 18 Applicable structure: SLURRY PH CUM AHP MCCs Pipe rack in BTG area Representative Borehole: IBH-35							
Depth in m from NGL	Soil Classification	Depth in m from FGL	Cohesion in kg/cm ²	Angle of Internal Friction	Bulk Density in gm/cc	SPT N Value	shear strength qc kN/m2
-	Filled up soil	FGL- 3.72	-	-	-	-	-
0.00-0.80	Yellowish brown, fine to medium grained, clayey sand (SC)	3.72-4.52	-	-	-	-	
0.80-4.60	Yellowish brown to brownish yellow, fine to medium grained, sandy clays of intermediate plasticity with occasional gravels (CI)	4.52-8.32	0.40	7	1.97	5-17	
4.60-6.70	Brownish yellow, fine to very fine grained, clays of intermediate plasticity (CI)	8.32-10.42	1.23	6	1.99	23-30	
6.70-8.45	Brownish yellow, fine to very fine grained, clayey sand (SC)	10.42-12.17	-	-	-	13-17	
8.45-12.20	Light yellowish brown, fine to very fine grained, silty sand (SM)	12.17-15.92	-	-	-	14-23	
12.20-12.80	Dark brownish grey, fine to very fine grained, indurated clays of intermediate plasticity mud stone	15.92-16.52	-	-	-	91	
12.80-14.50	Highly weathered, very weak, thinly laminated friable dark brownish, fine to very fine grained, mud stone	16.52-18.22	-	-	2.29	-	-
14.50-16.00	Highly weathered, weak, dark brownish grey, fine to very fine grained, fractured rock	18.22-19.72	-	-	2.30	-	-
16.00-18.00	Moderately weathered, weak, dark brownish, fine to very fine grained, rock with close spacing of discontinuities	19.72-21.72	-	-	2.33	-	110.6
18.00-20.50	Slightly weathered, moderately strong, greyish black, fine to medium grained, rock with wide spacing of discontinuities	21.72-24.22	-	-	2.64	-	526.3
20.50-22.00	Moderately weathered, weak, dark brownish, fine to very fine grained, rock with moderately close spacing of discontinuities	24.22-25.72	-	-	2.68	-	436.1
22.00-23.50	Fresh, strong, dark brownish, fine to medium grained, massive rock	25.72-27.22	-	-	2.51	-	146.2

Design Parameter for Group 19 Applicable structure: Silo utility building cum HCSD pump house Representative Borehole: IBH-37							
Depth in m from NGL	Soil Classification	Depth in m from FGL	Cohesion in kg/cm ²	Angle of Internal Friction	Bulk Density in gm/cc	SPT N Value	shear strength qc kN/m2
-	Filled up soil	FGL-4.93	-	-	-	-	-
0.00-2.60	Yellowish brown, fine to very fine grained, clays of intermediate plasticity (CI)	4.93-7.53	0.38	4	1.92	6-7	
2.60-4.70	Brownish yellow, fine to very fine grained, sandy clays of intermediate plasticity with occasional gravels (CI)	7.53-9.63	0.50	7	1.94	9-10	
4.70-7.30	Brownish yellow, fine to very fine grained, cemented clayey sand with occasional to some gravels (SC)	9.63-12.23	0.12	27	2.00	20->100	
7.30-9.00	Highly weathered, weak, brownish, fine to medium grained, friable rock	12.23-13.93	-	-	2.29	-	-
9.00-10.50	Moderately weathered, moderately weak, brownish grey, fine to medium grained, rock with closely spaced discontinuities	13.93-15.43	-	-	2.33	-	62.5
10.50-12.00	Slightly weathered, moderately weak, greyish, fine to medium grained, rock with closely spaced discontinuities	15.43-16.93	-	-	2.41	-	116.7
12.00-13.50	Slightly weathered, moderately weak, greyish, fine to medium grained, rock with moderately widely spaced discontinuities	16.93-18.43	-	-	2.40	-	159.4
13.50-15.00	Moderately weathered, moderately weak, greyish, fine to medium grained, friable rock	18.43-19.93	-	-	2.38	-	-
15.00-16.50	Moderately weathered, weak, yellowish brown, fine to medium grained, massive rock	19.93-21.43	-	-	2.40	-	166.2
16.50-18.00	Fresh, moderately weak, yellowish brown, fine to medium grained, rock with very widely spaced discontinuities	21.43-22.93	-	-	2.34	-	82.6

Design Parameter for Group 20 Applicable structure: ASH WATER PH Pipe rack Representative Borehole: IBH-39							
Depth in m from NGL	Soil Classification	Depth in m from FGL	Cohesion in kg/cm ²	Angle of Internal Friction	Bulk Density in gm/cc	SPT N Value	shear strength qc kN/m ²
-	Filled up soil	FGL- 7.05	-	-	-	-	-
0.00-0.50	Yellowish brown, fine to medium grained, clayey sand with little gravels (SC)	7.05-7.55	-	-	-	-	
0.50-1.70	Brownish yellow, very fine grained, clays of intermediate plasticity (CI)	7.55-8.75	-	-	-	10	
1.70-5.80	Yellowish brown, fine to medium grained, clayey sand (SC)	8.75-12.85	0.05	27	1.97	7-10	
5.80-6.80	Yellowish brown, fine to very fine grained, cemented clayey sand (SC)	12.85-13.85	-	-	-	>100	
6.80-10.00	Moderately weathered, moderately weak, yellowish brown, fine to medium grained, fractured rock	13.85-17.05	-	-	2.37	-	-
10.00-11.50	Highly weathered, weak, blackish grey, fine to medium grained, fractured rock	17.05-18.55	-	-	2.34	-	-
11.50-13.00	Highly weathered, weak, blackish grey, fine to medium grained, fractured rock	18.55-20.05	-	-	2.28	-	-
13.00-14.50	Moderately weathered, moderately weak, brownish black, fine to medium grained, rock with close spacing of discontinuities	20.05-21.55	-	-	2.29	-	79.8
14.50-16.00	Slightly weathered, moderately weak, brownish black, fine to medium grained, rock with moderately close spacing of discontinuities	21.55-23.05	-	-	2.40	-	165.6
16.00-17.50	Slightly weathered, moderately weak, brownish black, fine to medium grained, rock with wide spacing of discontinuities	23.05-24.55	-	-	2.42	-	117.3

Design Parameter for Group 21 Applicable structure: Ash water transfer pump house, Settling cum surge tank Representative Borehole: IBH-40							
Depth in m from NGL	Soil Classification	Depth in m from FGL	Cohesion in kg/cm ²	Angle of Internal Friction	Bulk Density in gm/cc	SPT N Value	shear strength qc kN/m ²
-	Filled up soil	FGL- 8.90	-	-	-	-	-
0.00-2.60	Yellowish brown, fine to medium grained, sandy clays of intermediate plasticity (CI)	8.90- 11.50	0.35	8	1.95	6-7	
2.60-4.90	Brownish yellow, very fine grained, clays of intermediate plasticity (CI)	11.50- 13.80	1.16	9	2.00	18-24	
4.90-5.70	Yellowish brown, very fine grained, cemented silty clays of intermediate plasticity (CI)	13.80- 14.60	-	-	-	>100	
5.70-6.30	Brownish yellow, very fine grained, cemented silty clays of intermediate plasticity (CI)	14.60- 15.60	-	-	-	>100	
6.30-10.50	Highly weathered, weak, dark yellowish brown, fine to very fine grained, fractured rock	15.60- 19.40	-	-	2.29	-	-
10.50-12.00	Highly weathered, very weak, dark brownish, fine to very fine grained, fractured rock	19.40- 20.90	-	-	2.31	-	-
12.00-13.50	Highly weathered, blackish brown, fine to medium grained, rock with close spacing of discontinuities	20.90- 22.40	-	-	2.13	-	46.1
13.50-15.00	Slightly weathered, moderately weak, dark brownish black, fine to very fine grained, massive rock	22.40- 23.90	-	-	2.25	-	155.3

Design Parameter for Group 22 Applicable structure: HCSD slurry pipe corridor Representative Borehole: IBH-43							
Depth in m from NGL	Soil Classification	Depth in m from FGL	Cohesion in kg/cm ²	Angle of Internal Friction	Bulk Density in gm/cc	SPT N Value	shear strength qc kN/m ²
-	Filled up soil	FGL- 2.52	-	-	-	-	-
0.00-0.80	Brownish, fine to very fine grained, silty clays of low plasticity with occasional gravels (CL)	2.52-3.32	-	-	-	-	-
0.80-3.40	Light Brownish, very fine grained, clays of high plasticity (CH)	3.32-5.92	0.27	2	1.68	4-7	-
3.40-7.70	Yellowish brown, very fine grained, clays of high plasticity (CH)	5.92-10.22	0.45	5	1.93	6-9	-
7.70-8.85	Yellowish brown, fine to coarse grained, clayey sand with some gravels (SC)	10.22-11.37	0.13	26	1.99	20	-
8.85-10.60	Light whitish yellow, fine to medium grained, clayey sand (SC)	11.37-13.12	0.08	27	2.06	34-36	-
10.60-14.30	Yellowish brown, fine to medium grained, silty sand with much gravels (SM)	13.12-16.82	0	30	2.09	23-45	-
14.30-14.90	Yellowish brown, fine to medium grained, clayey sand (SC)	16.82-17.42	-	-	-	>100	-
14.90-25.00	Light whitish yellow to Light greyish, fine to medium grained, cemented clayey sand with much to some gravels (SC)	17.42-27.52	-	-	-	69- >100	-

Design Parameter for Group 23 Applicable structure: Limestone handling system Representative Borehole: IBH-52							
Depth in m from NGL	Soil Classification	Depth in m from FGL	Cohesion in kg/cm ²	Angle of Internal Friction	Bulk Density in gm/cc	SPT N Value	shear strength qc kN/m ²
-	Filled up soil	FGL-4.93	-	-	-	-	-
0.00-0.50	Light brownish, fine to very fine grained, sandy clays of low plasticity (CL)	4.93-5.43	-	-	-	-	-
0.50-4.20	Light brownish and dark brownish, very fine grained, silty clays of intermediate plasticity (CI)	5.43-9.13	0.26	2	1.87	2-7	
4.20-5.00	Yellowish brown, fine to medium grained, clayey sand (SC)	9.13-9.93				15	
5.00-6.00	Yellowish brown, fine to medium grained, sandy clays of low plasticity (CL)	9.93-10.93				11-13	
6.00-6.70	Yellowish brown, very fine grained, clays of intermediate plasticity (CI)	10.93-11.63				19-24	
6.70-8.00	Yellowish brown, very fine grained, silty clays of low plasticity (CL)	11.63-12.93				>100	
8.00-10.00	Highly weathered, weak, yellowish brown, fine to very fine grained, rock with moderately close spaced discontinuities	12.93-14.93			2.38		44.3
10.00-10.80	Slightly weathered, weak, dark brownish, fine to very fine grained, rock with moderately closely spaced discontinuities	14.93-15.73			2.39		56.7
10.80-13.00	Slightly weathered, moderately weak, yellowish brown, fine to medium grained, rock with moderately closely spaced discontinuities	15.73-17.93			2.48		116.3
13.00-16.50	Slightly weathered, weak, yellowish brown, fine to very fine grained, rock with moderately wide to very widely spaced discontinuities	17.93-21.43			2.41		58.7

Design Parameter for Group 24 Applicable structure: CHP MCC-2 & AAQMS Representative Borehole: BH-45							
Depth in m from NGL	Soil Classification	Depth in m from FGL	Cohesion in kg/cm ²	Angle of Internal Friction	Bulk Density in gm/cc	SPT N Value	shear strength qc kN/m ²
-	Filled up soil	FGL- 3.65	-	-	-	-	-
0.00-2.60	Reddish yellowish brown, fine to medium grained, sandy clays of intermediate plasticity (CI)	3.65-6.25	.046	5	1.95	6-9	
2.60- 4.30	Yellowish brown, fine to very fine grained, sandy clays of high plasticity (CH)	6.25-7.95	0.75	4	1.97	14-20	
4.30-5.60	Yellowish brown, fine to very fine grained, clays of high plasticity (CH)	7.95-9.25	0.95	5	2.02	18-35	
5.60-6.70	Yellowish brown, fine to medium grained, clayey sand (SC)	9.25-10.35	0.08	24	1.97	27	
6.70-8.40	Yellowish brown, very fine grained, clays of high plasticity (CH)	10.35-12.05	0.55	1	1.98	10-15	
8.40-10.70	Yellowish brown, fine to medium grained, clayey sand (SC)	12.05-14.35	.10	25	1.96	7-13	-
10.70-12.90	Yellowish brown, fine to medium grained, silty sand (SM)	14.35-16.55	-	-	-	29-38	-
12.90-14.30	Dark greyish brown, fine to very fine grained, sandy clays of intermediate plasticity with little gravels (CI)	16.55-17.95	-	-	-	54- >100	-
14.30-18.50	Highly weathered, moderately weak, dark blackish grey, very fine grained, thinly bedded rock	17.95-22.15	-	-	2.36	>100	88.7
18.50-20.50	Moderately weathered, weak, dark blackish grey, very fine grained, thinly bedded rock	22.15-24.15	-	-	2.31	-	97.2
20.50-21.50	Slightly weathered, weak, dark blackish grey, very fine grained, moderately thickly bedded rock	24.15-25.15	-	-	2.27	-	89.7
21.50-25.00	Slightly weathered, moderately weak, dark brownish grey, very fine grained, massive rock	25.15-28.65	-	-	2.42	-	132.4

Design Parameter for Group 25 Applicable structure: AHP compressor house Representative Borehole: BH-42							
Depth in m from NGL	Soil Classification	Depth in m from FGL	Cohesion in kg/cm ²	Angle of Internal Friction	Bulk Density in gm/cc	SPT N Value	shear strength qc kN/m ²
-	Filled up soil	FGL-7.11	-	-	-	-	NA
0.00-0.40	Brownish, fine to very fine grained, sandy clays of low plasticity with occasional gravels (CL)	7.11-7.51	-	-	-	-	
0.40-1.60	Reddish brown, fine to coarse grained, clayey sand with much gravels (SC)	7.51-8.71	-	-	-	11	
1.60-2.90	Light yellowish brown, fine to very fine grained, silty clays of intermediate plasticity with occasional gravels (CI)	8.71-10.01	-	-	-	14-11	
2.90-4.80	Dark brownish, fine to very fine grained, silty clays of intermediate plasticity with occasional gravels (CI)	10.01-11.91	-	-	-	17- >100	
4.80-8.10	Yellowish brown, fine to very fine grained, cemented clayey sand with little gravels (SC)	11.91-15.21	-	-	-	>100	
8.10-14.50	Highly weathered, weak, yellowish brown, fine to medium grained, fractured rock	15.21-21.61	-	-	-	-	45.50
14.50-17.50	Highly weathered, moderately weak, grayish black, fine to medium grained, rock with close spacing of discontinuities	21.61-24.61	-	-	-	-	129.80
17.50-19.00	Moderately weathered, moderately weak, dark brownish, fine to medium grained, fractured rock	24.61-26.11	-	-	-	-	135.60
19.00-20.50	Highly weathered, moderately weak, grayish black, fine to medium grained, rock with close spacing of discontinuities	26.11-27.61	-	-	-	-	135.60
20.50-22.00	Highly weathered, moderately weak, dark blackish brown, fine to medium grained, rock with close spacing of discontinuities	27.61-29.11	-	-	-	-	152.70
22.00-23.00	Moderately weathered, moderately weak, dark brownish, fine to medium grained, rock with moderately wide spacing of discontinuities	29.11-30.11	-	-	-	-	189.90
23.00-24.00	Moderately weathered, moderately weak, dark brownish, fine to medium grained, rmassive rock	30.11-31.11	-	-	-	-	246.50

Design Parameter for Group 26 Applicable structure: Common limestone unloading house Representative Borehole: BH-114							
Depth in m from NGL	Soil Classification	Depth in m from FGL	Cohesion in kg/cm ²	Angle of Internal Friction	Bulk Density in gm/cc	SPT N Value	shear strength qc kN/m ²
-	Filled up soil	FGL- 5.32	-	-	-	-	-
0.00-2.60	Yellowish brown, very fine grained, clays of high plasticity (CH)	5.32-7.92	0.64	3	1.91	3-5	
2.60-3.50	Yellowish brown, fine to very fine grained, sandy clays of intermediate plasticity (CI)	7.92-8.82	0.86	4	1.95	19	
3.50-5.60	Yellowish brown, very fine grained, clays of high plasticity (CH)	8.82-10.92	0.87	1	1.94	14-18	
5.60-6.70	Yellowish brown, fine to medium grained, clayey sand (SC)	10.92-12.02	-	-	-	15-19	
6.70-7.50	Yellowish brown, fine to very fine grained, sandy clays of intermediate plasticity (CI)	12.02-12.82	-	-	-	15- >100	
7.50-9.00	Yellowish brown, fine to medium grained, clayey sand with some to occasional gravels (SC)	12.82-14.32	-	-	-	40-54	-
9.00-10.00	Light yellowish brown, fine to very fine grained, clays of high plasticity (CH)	14.32-15.32	-	-	-	40-46	-
10.00-11.10	Yellowish brown, fine to medium grained, clayey sand with some gravels (SC)	15.32-16.42	-	-	-	>100	-
11.00-13.50	Slightly weathered, moderately weak, dark blackish brown, fine to very fine grained, massive rock	16.42-18.82	-	-	2.38	-	129.1
13.50-16.50	Slightly weathered, moderately weak, dark blackish brown, fine to very fine grained, moderately thickly bedded rock	18.82-21.82	-	-	2.38	-	146.7

Design Parameter for Group 27 Applicable structure: Weigh bridge control room Representative Borehole: BH-96							
Depth in m from NGL	Soil Classification	Depth in m from FGL	Cohesion in kg/cm ²	Angle of Internal Friction	Bulk density in gm/cc	SPT N Value	shear strength qc kN/m ²
-	Filled up soil	FGL- 5.16	-	-	-	-	-
0.00-4.30	Yellowish brown, very fine grained, clays of high plasticity (CH)	5.16-9.46	0.49	2	1.89	3-12	
4.30-6.80	Yellowish brown, fine to medium grained, clayey sand (SC)	9.46-11.96	-	-	-	8-11	
6.80-8.60	Yellowish brown, fine to medium grained, silty sand (SM)	11.96-13.76	-	-	-	14-29	
8.60-9.70	Yellowish brown, fine to very fine grained, clays of intermediate plasticity (CI)	13.76-14.86	-	-	-	>100	
9.70-10.50	Yellowish brown, fine to coarse grained, silty sand with much gravels (SM)	14.86-15.66	-	-	-	>100	
10.50-12.50	Highly weathered, weak, brownish grey, fine to very fine grained, very thinly laminated rock	15.66-17.66	-	-	2.31	-	-
12.50-15.00	Highly weathered, moderately weak, brownish grey, fine to very fine grained, very thinly laminated rock	17.66-20.16	-	-	2.34	-	-
15.00-16.00	Moderately weathered, moderately weak, dark brownish grey, fine to medium grained, thickly bedded rock	20.16-21.16	-	-	2.41	-	156.8
16.00-7.00	Moderately weathered, moderately weak, dark brownish grey, fine to medium grained, massive rock	21.16-22.16	-	-	2.44	-	115.7

Design Parameter for Group 28 Applicable structure: Coal Conveyor BC-1 A/B Representative Borehole: IBH-13							
Depth in m from NGL	Soil Classification	Depth in m from FGL	Cohesion in kg/cm ²	Angle of Internal Friction	Bulk Density in gm/cc	SPT N Value	shear strength qc kN/m ²
-	Filled up soil	FGL- 8.96	-	-	-	-	-
0.00-0.40	Brownish, fine to medium grained, sandy clays of intermediate plasticity (CI) 0.00 to 0.40m	8.96-9.36	-	-	-	-	
0.40-2.30	Yellowish brown, fine to medium grained, sandy clays of low plasticity with much gravels (CL) 0.40 to 2.30m	9.36-11.26	-	-	-	12-14	
2.30-3.40	Dark brownish, fine to coarse grained, silty gravels and clayey gravels (GM-GC) 2.30 to 3.40m	11.26-12.36	-	-	-	25-24	
3.40-5.80	Reddish yellow, fine to coarse grained, clayey sand with much gravels (SC) 3.40 to 5.80m	12.36-14.76	-	-	-	26->100	
5.80-7.00	Dark yellowish, very fine grained, indurated clays of high plasticity mud rock 5.80 to 7.00m	14.76-15.96	-	-	-	>100	
7.00-9.00	Greyish brown, fine to medium grained, sandy clay of intermediate plasticity with much gravels mud rock 7.00 to 9.00m	15.96-17.96	-	-	-	>100	54.10
9.00-11.00	Highly weathered, weak, light brownish grey, fine to very fine grained, fractured rock 9.00 to 11.00m	17.96-19.96	-	-	-	-	
11.00-14.00	Highly weathered, moderately weak, yellowish brown, fine to very fine grained, fractured rock 11.00 to 14.00m	19.96-22.96	-	-	-	-	
14.00-17.50	Highly weathered, moderately weak, dark greyish black, fine to very fine grained, fractured rock 14.00 to 17.50m	22.96-26.46	-	-	-	-	
17.50 - 18.50	Slightly weathered, weak, dark greyish black, fine to very fine grained, massive rock	26.46-27.46	-	-	-	-	

Design Parameter for Group 29 Applicable structure: Coal conveyor near unit-1 Representative Borehole: BH-48							
Depth in m from NGL	Soil Classification	Depth in m from FGL	Cohesion in kg/cm ²	Angle of Internal Friction	Bulk Density in gm/cc	SPT N Value	shear strength qc kN/m2
-	Filled up soil	FGL- 1.87	-	-	-	-	-
0.00-0.60	Dark brownish, fine to medium grained, clayey sand with little gravels (SC)	1.87-2.47	-	-	-	-	
0.60-3.70	Reddish yellow, very fine grained, silty clays of intermediate plasticity with occasional gravels (CI)	2.47-5.57	1.02	4	1.97	8-21	
3.70-8.50	Light brownish yellow, very fine grained, clays of high plasticity (CH)	5.57-10.37	1.56	4	2.04	22-34	
8.50-9.70	Light brownish yellow, very fine grained, sandy clays of low plasticity (CL)	10.37-11.57	0.92	8	2.00	15	
11.00-14.8	Light greyish yellow and slightly greenish fine to medium grained, silty sand with little plastic fines (SM)	11.57-16.67	0	29	2.00	19-24	
14.80-15.70	Highly weathered, very weak, very thin laminated/foliated, dark greenish grey, very fine grained, SHALE mixed with greenish grey, fine to very fine grained, clays of intermediate plasticity	6.67-17.57	-	-	-	48- >100	-
15.70-20.00	Highly weathered, very weak, dark greenish grey, very fine grained, very thinly bedded , foliated SHALE	17.57-21.87	-	-	2.19	>100	74.90
20.00-22.00	Moderately weathered, weak, dark greenish grey, very fine grained, very thinly bedded , foliated SHALE	21.87-23.87	-	-	-	-	106.6
22.00-25.00	Slightly weathered, weak, dark greenish grey, very fine grained, very thinly bedded , foliated SHALE	23.87-26.87	-	-	-	-	104.3

Design Parameter for Group 30 Applicable structure: Ash pipe line corridor Representative Borehole: IBH-47							
Depth in m from NGL	Soil Classification	Depth in m from FGL	Cohesion in kg/cm ²	Angle of Internal Friction	Bulk Density in gm/cc	SPT N Value	shear strength qc kN/m ²
-	Filled up soil	FGL-4.70	-	-	-	-	-
0.00-0.40	Brownish, fine to very fine grained, clayey sand (SC)	4.70-5.10	-	-	-	-	
0.40-1.60	Brownish, fine to very fine grained, sandy clays of intermediate plasticity (CI)	5.10-6.30	-	-	-	5	
1.60-3.40	Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL)	6.30-8.10	0.29	8	1.69	5-6	
3.40-5.30	Yellowish brown, fine to very fine grained, clays of intermediate plasticity (CI)	8.10-10.00	0.31	2	1.78	7-8	
5.30-7.40	Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL)	10.00-12.10	0.40	7	1.94	8-10	
7.40-8.80	Yellowish brown, fine to very fine grained, clayey sand (SC)	12.10-13.50	0.06	24	1.96	11	
8.80-11.40	Yellowish brown, fine to very fine grained, clays of high plasticity (CH)	13.50-16.10	0.74	5	1.99	14-31	
11.40-11.80	Yellowish brown, fine to medium grained, clayey sand with some gravels (SC)	16.10-16.50	-	-	-	36	
11.80-14.40	Yellowish brown, fine to medium grained, silty sand with little too much gravels (SM)	16.50-19.10	-	-	-	39-49	
14.40-17.30	Yellowish brown, medium to coarse grained, poorly graded sand and silty sand with occasional gravels (SP-SM)	19.10-22.00	-	-	-	53->100	
17.30-19.00	Yellowish brown, fine to very fine grained, clayey sand (SC)	22.00-23.70	-	-	-	>100	
19.00-20.50	Moderately weathered, weak, yellowish brown, fine to medium grained, rock with wide spacing of discontinuities	23.70-25.20	-	-	-	-	81.60

Calculation of Allowable Bearing Pressure from Shear & Settlement Criteria.

Project: Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Structure: IBH-10

➤ **For Square Isolated Foundations:**

Depth of foundation considered from FGL, $D_f = 1.00$ m (202.50 R.L.)

Width of foundation considered, $B_f = 1.50$ m

Length of foundation considered, $L_f = 1.50$ m

Bulk Density $\gamma_b = 2.08$ gm/cm³

Water Table at depth = Considered at F.G.L. for analysis.

Factor of Safety = 2.50

Type of Failure Considered = Mixed shear failure, as $e > 0.55$ & $e < 0.75$

(Ref: Soil mechanics and foundation engineering by DR.K.R.Arora attached in Appendix)

$$q_{nu} = \left[\left(\frac{2}{3} \right) * c N_c d_c S_c i_c + \gamma_d (N_q - 1) S_q d_q i_q W + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma \right],$$

Ref: - (IS 6403, Cl-5.1.2a)

Shear Parameters, $c = 0.09$ kg/cm², $\phi = 26^\circ$, $e = 0.53$

Bearing Capacity Factors:

$N_c = 23.27$, $N_q = 12.58$, i.e. $N_q - 1 = 11.58$, $N_\gamma = 13.48$

Shape Factors: (for square footings)

(IS 6403, Table 2)

$S_c = 1.30$, $S_q = 1.20$, $S_\gamma = 0.80$

Depth Factors:

$d_c = 1.18$, $d_q = d_\gamma = 1.09$

(IS 6403, CL-5.1.2.2)

$d_c = 1 + 0.2 D_f/B * \sqrt{N_\phi}$

$d_q = d_\gamma = 1 + 0.1 D_f/B * \sqrt{N_\phi}$ for $\Phi > 10^\circ$

Inclination Factors: (for vertical loading)

$i_c = i_q = i_\gamma = 1.00$

(IS 6403, CL-5.1.2.3)

$i_c = i_q = \left(1 - \frac{\alpha}{90} \right)^2$

$i_\gamma = \left(1 - \frac{\alpha}{\phi} \right)^2$

α = inclination of load to vertical in degrees = 0

Water Table Correction: (W.T at F.G.L.)

W_q , $W_\gamma = 0.5$ & 0.5 respectively,

(IS 6403, CL-5.1.2.4)

Substituting, the values for determination of net ultimate bearing capacity from shear criteria,

$$q_{nu} = \left[\left(\frac{2}{3} \right) * c N_c d_c S_c i_c + \gamma_d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma \right]$$

$$\begin{aligned}
 q_{nu} &= \left[\left(\frac{2}{3} \right) * (0.09 * 10) * 23.27 * 1.18 * 1.30 * 1.09 * 1.00 \right. \\
 &\quad + (2.08 * (1.00))(12.58 - 1.00) * 1.20 * 1.00 * 1.09 * 0.50 + 0.5 \\
 &\quad \left. * 2.08 * 1.50 * 13.48 * 0.80 * 1.09 * 1.00 * 0.50 \right] \\
 &= \mathbf{48.27 \text{ T / m}^2}
 \end{aligned}$$

$$q_{\text{net safe}} = q_{nu} / \text{FS (i.e.2.5)} = 19.31 \text{ T /m}^2$$

$$q_{\text{net safe}} = \mathbf{19.00 \text{ T /m}^2} = \mathbf{190.00 \text{ kN/m}^2}$$

Calculation of Allowable Bearing Pressure from Settlement Criteria.

Project: Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Structure: IBH-10

$$S_i = \frac{Cd q_{net} B (1-\mu^2)}{(E)}$$

Where,

S = Settlement of 40mm Considered

Q_{net} = Safe Bearing pressure

Factor Cd

E = Modulus of Elasticity

mv = Co-efficient of Volume Compressibility

μ = Poisson's Ratio

B, L = Width & Length of Foundation respectively

R_f = Rigidity Factor

D_f = Depth factor

λ = Factor Related to Pore Pressure

Code of Reference – IS 8009 P-1

For Isolated Foundations:

- Safe Bearing Pressure for 40mm Settlement.
- Depth of foundation considered from EGL, D_f = 1.00 m (202.50m R.L.)
- Width of foundation, considered, B_f = 1.50 m
- Length of foundation, considered, L_f = 1.50 m
- Poisson's ratio, μ = 0.35 (Ref: "Foundation analysis and design" by Joseoh E. Bowles given in Appendix)
- Modulus of Elasticity, E = (500(N+15))/100 = 5(41+15) = 280 kg/cm²
(Ref: "Foundation analysis and design" by Joseoh E. Bowles given in Appendix)
- Rigidity Factor = 0.80
- Factor Cd = 1.12 **Ref: - Table-2, IS 8009, P-I,**

$$\text{Net S.B.P} = 40 / ((100 * 1.12 * 1.50 * (1 - 0.35^2) * 0.80) / 280.0)$$

$$= 94.97 \text{ T/m}^2$$

$$= \mathbf{95.00 \text{ T/m}^2}$$

So, Allowable Safe Bearing Pressure Considering Immediate Settlement is 95.00 T/m².

So, Allowable Bearing Pressure = lower of both the cases, i.e. shear and settlement criteria

$$= \mathbf{\text{Minimum of } 19.00 \text{ T/m}^2 \text{ \& } 95.00 \text{ T/m}^2}$$

$$= \mathbf{19.00 \text{ T/m}^2 = 190.00 \text{ kN/m}^2}.$$

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APPENDIX - 1 (For IBH-1,2,3,4,5,6,7,8,9,10,11,12 (Crushed coal stock pile, stacker reclaimer, wind barrier))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Depth of Foundation from FGL (RL:202.5 m)	RL of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 1.1)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 1.2)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
					For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	201.50	1.50	1.50	19	59	95	19	19
1.00	201.50	2.00	2.00	19	45	71	19	19
1.00	201.50	2.50	2.50	20	36	57	20	20
1.00	201.50	3.00	3.00	21	30	47	21	21
1.50	201.00	1.50	1.50	23	59	95	23	23
1.50	201.00	2.00	2.00	23	45	71	23	23
1.50	201.00	2.50	2.50	24	36	57	24	24
1.50	201.00	3.00	3.00	25	30	47	25	25
2.00	200.50	1.50	1.50	28	59	95	28	28
2.00	200.50	2.00	2.00	28	45	71	28	28
2.00	200.50	2.50	2.50	28	36	57	28	28
2.00	200.50	3.00	3.00	29	30	47	29	29

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 202.50m.
- 3) Calculations are considering the effect of water table at FGL.

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APPENDIX - 1.1 (For IBH-1,2,3,4,5,6,7,8,9,10,11,12 (Crushed coal stock pile, stacker reclaimer, wind barrier))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

For Square Isolated Foundation

Sr. No.	Size of Foundation		Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width			C	ϕ													γ	0.5γ			
	m	m			Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	1.00	201.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.18	1.09	1.09	1.00	1.00	1.00	2.08	1.04	0.50	0.50	19
2	2.00	2.00	1.00	201.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	2.08	1.04	0.50	0.50	19
3	2.50	2.50	1.00	201.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.11	1.06	1.06	1.00	1.00	1.00	2.08	1.04	0.50	0.50	20
4	3.00	3.00	1.00	201.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.09	1.05	1.05	1.00	1.00	1.00	2.08	1.04	0.50	0.50	21
5	1.50	1.50	1.50	201.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.28	1.14	1.14	1.00	1.00	1.00	2.08	1.04	0.50	0.50	23
6	2.00	2.00	1.50	201.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.21	1.10	1.10	1.00	1.00	1.00	2.08	1.04	0.50	0.50	23
7	2.50	2.50	1.50	201.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.17	1.08	1.08	1.00	1.00	1.00	2.08	1.04	0.50	0.50	24
8	3.00	3.00	1.50	201.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	2.08	1.04	0.50	0.50	25
9	1.50	1.50	2.00	200.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.37	1.18	1.18	1.00	1.00	1.00	2.08	1.04	0.50	0.50	28
10	2.00	2.00	2.00	200.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.28	1.14	1.14	1.00	1.00	1.00	2.08	1.04	0.50	0.50	28
11	2.50	2.50	2.00	200.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.22	1.11	1.11	1.00	1.00	1.00	2.08	1.04	0.50	0.50	28
12	3.00	3.00	2.00	200.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.18	1.09	1.09	1.00	1.00	1.00	2.08	1.04	0.50	0.50	29

Note :-

1) The factor of safety of 2.5 is considered.

2) The depth of foundation is considered from RL 202.50m.

3) Calculations are considering the effect of water table at FGL.

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APPENDIX - 1.2 (For IBH-1,2,3,4,5,6,7,8,9,10,11,12 (Crushed coal stock pile, stacker reclaimer, wind barrier))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_i = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D m	RL of Foundation m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
								For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	201.50	1.50	1.12	0.35	280	0.80	59	95
2	1.00	201.50	2.00	1.12	0.35	280	0.80	45	71
3	1.00	201.50	2.50	1.12	0.35	280	0.80	36	57
4	1.00	201.50	3.00	1.12	0.35	280	0.80	30	47
5	1.50	201.00	1.50	1.12	0.35	280	0.80	59	95
6	1.50	201.00	2.00	1.12	0.35	280	0.80	45	71
7	1.50	201.00	2.50	1.12	0.35	280	0.80	36	57
8	1.50	201.00	3.00	1.12	0.35	280	0.80	30	47
9	2.00	200.50	1.50	1.12	0.35	280	0.80	59	95
10	2.00	200.50	2.00	1.12	0.35	280	0.80	45	71
11	2.00	200.50	2.50	1.12	0.35	280	0.80	36	57
12	2.00	200.50	3.00	1.12	0.35	280	0.80	30	47

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APPENDIX - 1.3 (For IBH-1,2,3,4,5,6,7,8,9,10,11,12 (Crushed coal stock pile, stacker reclaimer, wind barrier))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Depth of Foundation from FGL (RL:202.5 m)	RL of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 1.4)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 1.5)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
					For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	201.50	3.50	3.50	22	25	41	22	22
1.00	201.50	4.00	4.00	23	22	36	22	23
1.00	201.50	5.00	5.00	25	18	28	18	25
1.00	201.50	6.00	6.00	27	15	24	15	24
1.50	201.00	3.50	3.50	26	25	41	25	26
1.50	201.00	4.00	4.00	27	22	36	22	27
1.50	201.00	5.00	5.00	29	18	28	18	28
1.50	201.00	6.00	6.00	31	15	24	15	24
2.00	200.50	3.50	3.50	29	25	41	25	29
2.00	200.50	4.00	4.00	30	22	36	22	30
2.00	200.50	5.00	5.00	32	18	28	18	28
2.00	200.50	6.00	6.00	34	15	24	15	24

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 202.50m.
- 3) Calculations are considering the effect of water table at FGL.

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APPENDIX - 1.4 (For IBH-1,2,3,4,5,6,7,8,9,10,11,12 (Crushed coal stock pile, stacker reclaimer, wind barrier))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width			C	ϕ													γ	0.5 γ			
	m	m			Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	1.00	201.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	2.08	1.04	0.50	0.50	22
2	4.00	4.00	1.00	201.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.07	1.03	1.03	1.00	1.00	1.00	2.08	1.04	0.50	0.50	23
3	5.00	5.00	1.00	201.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	2.08	1.04	0.50	0.50	25
4	6.00	6.00	1.00	201.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.05	1.02	1.02	1.00	1.00	1.00	2.08	1.04	0.50	0.50	27
5	3.50	3.50	1.50	201.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.12	1.06	1.06	1.00	1.00	1.00	2.08	1.04	0.50	0.50	26
6	4.00	4.00	1.50	201.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.10	1.05	1.05	1.00	1.00	1.00	2.08	1.04	0.50	0.50	27
7	5.00	5.00	1.50	201.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	2.08	1.04	0.50	0.50	29
8	6.00	6.00	1.50	201.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.07	1.03	1.03	1.00	1.00	1.00	2.08	1.04	0.50	0.50	31
9	3.50	3.50	2.00	200.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.16	1.08	1.08	1.00	1.00	1.00	2.08	1.04	0.50	0.50	29
10	4.00	4.00	2.00	200.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	2.08	1.04	0.50	0.50	30
11	5.00	5.00	2.00	200.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.11	1.06	1.06	1.00	1.00	1.00	2.08	1.04	0.50	0.50	32
12	6.00	6.00	2.00	200.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.09	1.05	1.05	1.00	1.00	1.00	2.08	1.04	0.50	0.50	34

Note :-

1) The factor of safety of 2.5 is considered.

2) The depth of foundation is considered from RL 202.50m.

3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 1.5 (For IBH-1,2,3,4,5,6,7,8,9,10,11,12 (Crushed coal stock pile, stacker reclaimer, wind barrier))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_i = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D m	RL of Foundation m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
								For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	201.50	3.50	1.12	0.35	280	0.80	25	41
2	1.00	201.50	4.00	1.12	0.35	280	0.80	22	36
3	1.00	201.50	5.00	1.12	0.35	280	0.80	18	28
4	1.00	201.50	6.00	1.12	0.35	280	0.80	15	24
5	1.50	201.00	3.50	1.12	0.35	280	0.80	25	41
6	1.50	201.00	4.00	1.12	0.35	280	0.80	22	36
7	1.50	201.00	5.00	1.12	0.35	280	0.80	18	28
8	1.50	201.00	6.00	1.12	0.35	280	0.80	15	24
9	2.00	200.50	3.50	1.12	0.35	280	0.80	25	41
10	2.00	200.50	4.00	1.12	0.35	280	0.80	22	36
11	2.00	200.50	5.00	1.12	0.35	280	0.80	18	28
12	2.00	200.50	6.00	1.12	0.35	280	0.80	15	24

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 1.6 (For IBH-1,2,3,4,5,6,7,8,9,10,11,12 (Crushed coal stock pile, stacker reclaimer, wind barrier))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Depth of Foundation from FGL (RL:202.5 m)	RL of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 1.7)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 1.8)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
					For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	201.50	7.00	7.00	29	13	20	13	20
1.00	201.50	8.00	8.00	32	11	18	11	18
1.00	201.50	9.00	9.00	34	10	16	10	16
1.00	201.50	10.00	10.00	36	9	14	9	14
1.50	201.00	7.00	7.00	33	13	20	13	20
1.50	201.00	8.00	8.00	35	11	18	11	18
1.50	201.00	9.00	9.00	37	10	16	10	16
1.50	201.00	10.00	10.00	39	9	14	9	14
2.00	200.50	7.00	7.00	36	13	20	13	20
2.00	200.50	8.00	8.00	38	11	18	11	18
2.00	200.50	9.00	9.00	40	10	16	10	16
2.00	200.50	10.00	10.00	43	9	14	9	14

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 202.50m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 1.7 (For IBH-1,2,3,4,5,6,7,8,9,10,11,12 (Crushed coal stock pile, stacker reclaimer, wind barrier))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width			C	ϕ													γ	0.5γ			
	m	m			Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	1.00	201.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.04	1.02	1.02	1.00	1.00	1.00	2.08	1.04	0.50	0.50	29
2	8.00	8.00	1.00	201.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.03	1.02	1.02	1.00	1.00	1.00	2.08	1.04	0.50	0.50	32
3	9.00	9.00	1.00	201.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.03	1.02	1.02	1.00	1.00	1.00	2.08	1.04	0.50	0.50	34
4	10.00	10.00	1.00	201.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.03	1.01	1.01	1.00	1.00	1.00	2.08	1.04	0.50	0.50	36
5	7.00	7.00	1.50	201.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	2.08	1.04	0.50	0.50	33
6	8.00	8.00	1.50	201.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.05	1.03	1.03	1.00	1.00	1.00	2.08	1.04	0.50	0.50	35
7	9.00	9.00	1.50	201.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.05	1.02	1.02	1.00	1.00	1.00	2.08	1.04	0.50	0.50	37
8	10.00	10.00	1.50	201.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.04	1.02	1.02	1.00	1.00	1.00	2.08	1.04	0.50	0.50	39
9	7.00	7.00	2.00	200.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	2.08	1.04	0.50	0.50	36
10	8.00	8.00	2.00	200.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.07	1.03	1.03	1.00	1.00	1.00	2.08	1.04	0.50	0.50	38
11	9.00	9.00	2.00	200.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	2.08	1.04	0.50	0.50	40
12	10.00	10.00	2.00	200.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	2.08	1.04	0.50	0.50	43

Note :-**1) The factor of safety of 2.5 is considered.****2) The depth of foundation is considered from RL 202.50m.****3) Calculations are considering the effect of water table at FGL.**

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 1.8 (For IBH-1,2,3,4,5,6,7,8,9,10,11,12 (Crushed coal stock pile, stacker reclaimer, wind barrier))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_i = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D m	RL of Foundation m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
								For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	201.50	7.00	1.12	0.35	280	0.80	13	20
2	1.00	201.50	8.00	1.12	0.35	280	0.80	11	18
3	1.00	201.50	9.00	1.12	0.35	280	0.80	10	16
4	1.00	201.50	10.00	1.12	0.35	280	0.80	9	14
5	1.50	201.00	7.00	1.12	0.35	280	0.80	13	20
6	1.50	201.00	8.00	1.12	0.35	280	0.80	11	18
7	1.50	201.00	9.00	1.12	0.35	280	0.80	10	16
8	1.50	201.00	10.00	1.12	0.35	280	0.80	9	14
9	2.00	200.50	7.00	1.12	0.35	280	0.80	13	20
10	2.00	200.50	8.00	1.12	0.35	280	0.80	11	18
11	2.00	200.50	9.00	1.12	0.35	280	0.80	10	16
12	2.00	200.50	10.00	1.12	0.35	280	0.80	9	14

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 1.9 (For IBH-1,2,3,4,5,6,7,8,9,10,11,12 (Crushed coal stock pile, stacker reclaimer, wind barrier))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Depth of Foundation from FGL (RL:202.5 m)	RL of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
					For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
2.50	200.00	1.50	1.50	33	59	95	33	33
2.50	200.00	2.00	2.00	32	45	71	32	32
2.50	200.00	2.50	2.50	32	36	57	32	32
2.50	200.00	3.00	3.00	33	30	47	30	33
3.00	199.50	1.50	1.50	38	59	95	38	38
3.00	199.50	2.00	2.00	37	45	71	37	37
3.00	199.50	2.50	2.50	36	36	57	36	36
3.00	199.50	3.00	3.00	37	30	47	30	37
3.50	199.00	1.50	1.50	43	59	95	43	43
3.50	199.00	2.00	2.00	41	45	71	41	41
3.50	199.00	2.50	2.50	41	36	57	36	41
3.50	199.00	3.00	3.00	41	30	47	30	41

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 202.50m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-1.10 (For IBH-1,2,3,4,5,6,7,8,9,10,11,12 (Crushed coal stock pile, stacker reclaimer, wind barrier))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width			C	ϕ													γ	0.5 γ			
	m	m			Kg/cm ²	degree	N _c	N _q - 1	N _γ	S _c	S _q	S _γ	d _c	d _q	d _γ	i _c	i _q	i _γ	gm/cc		W _q	W _γ	
1	1.50	1.50	2.50	200.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.46	1.23	1.23	1.00	1.00	1.00	2.08	1.04	0.50	0.50	33
2	2.00	2.00	2.50	200.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.34	1.17	1.17	1.00	1.00	1.00	2.08	1.04	0.50	0.50	32
3	2.50	2.50	2.50	200.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.28	1.14	1.14	1.00	1.00	1.00	2.08	1.04	0.50	0.50	32
4	3.00	3.00	2.50	200.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.23	1.11	1.11	1.00	1.00	1.00	2.08	1.04	0.50	0.50	33
5	1.50	1.50	3.00	199.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.55	1.28	1.28	1.00	1.00	1.00	2.08	1.04	0.50	0.50	38
6	2.00	2.00	3.00	199.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.41	1.21	1.21	1.00	1.00	1.00	2.08	1.04	0.50	0.50	37
7	2.50	2.50	3.00	199.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.33	1.17	1.17	1.00	1.00	1.00	2.08	1.04	0.50	0.50	36
8	3.00	3.00	3.00	199.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.28	1.14	1.14	1.00	1.00	1.00	2.08	1.04	0.50	0.50	37
9	1.50	1.50	3.50	199.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.64	1.32	1.32	1.00	1.00	1.00	2.08	1.04	0.50	0.50	43
10	2.00	2.00	3.50	199.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.48	1.24	1.24	1.00	1.00	1.00	2.08	1.04	0.50	0.50	41
11	2.50	2.50	3.50	199.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.39	1.19	1.19	1.00	1.00	1.00	2.08	1.04	0.50	0.50	41
12	3.00	3.00	3.50	199.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.32	1.16	1.16	1.00	1.00	1.00	2.08	1.04	0.50	0.50	41

Note :-**1) The factor of safety of 2.5 is considered.****2) The depth of foundation is considered from RL 202.50m.****3) Calculations are considering the effect of water table at FGL.**

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-1.11 (For IBH-1,2,3,4,5,6,7,8,9,10,11,12 (Crushed coal stock pile, stacker reclaimer, wind barrier))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_i = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D m	RL of Foundation m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
								For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	2.50	200.00	1.50	1.12	0.35	280	0.80	59	95
2	2.50	200.00	2.00	1.12	0.35	280	0.80	45	71
3	2.50	200.00	2.50	1.12	0.35	280	0.80	36	57
4	2.50	200.00	3.00	1.12	0.35	280	0.80	30	47
5	3.00	199.50	1.50	1.12	0.35	280	0.80	59	95
6	3.00	199.50	2.00	1.12	0.35	280	0.80	45	71
7	3.00	199.50	2.50	1.12	0.35	280	0.80	36	57
8	3.00	199.50	3.00	1.12	0.35	280	0.80	30	47
9	3.50	199.00	1.50	1.12	0.35	280	0.80	59	95
10	3.50	199.00	2.00	1.12	0.35	280	0.80	45	71
11	3.50	199.00	2.50	1.12	0.35	280	0.80	36	57
12	3.50	199.00	3.00	1.12	0.35	280	0.80	30	47

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 1.12 (For IBH-1,2,3,4,5,6,7,8,9,10,11,12 (Crushed coal stock pile, stacker reclaimer, wind barrier))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Depth of Foundation from FGL (RL:202.5 m)	RL of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
					For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
2.50	200.00	3.50	3.50	33	25	41	25	33
2.50	200.00	4.00	4.00	34	22	36	22	34
2.50	200.00	5.00	5.00	36	18	28	18	28
2.50	200.00	6.00	6.00	38	15	24	15	24
3.00	199.50	3.50	3.50	37	25	41	25	37
3.00	199.50	4.00	4.00	38	22	36	22	36
3.00	199.50	5.00	5.00	39	18	28	18	28
3.00	199.50	6.00	6.00	41	15	24	15	24
3.50	199.00	3.50	3.50	41	25	41	25	41
3.50	199.00	4.00	4.00	42	22	36	22	36
3.50	199.00	5.00	5.00	43	18	28	18	28
3.50	199.00	6.00	6.00	45	15	24	15	24

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 202.50m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-1.13 (For IBH-1,2,3,4,5,6,7,8,9,10,11,12 (Crushed coal stock pile, stacker reclaimer, wind barrier))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width			C	ϕ													γ	0.5 γ			
	m	m			Kg/cm ²	degree	N _c	N _q - 1	N _γ	S _c	S _q	S _γ	d _c	d _q	d _γ	i _c	i _q	i _γ	gm/cc		W _q	W _γ	
1	3.50	3.50	2.50	200.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.20	1.10	1.10	1.00	1.00	1.00	2.08	1.04	0.50	0.50	33
2	4.00	4.00	2.50	200.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.17	1.09	1.09	1.00	1.00	1.00	2.08	1.04	0.50	0.50	34
3	5.00	5.00	2.50	200.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	2.08	1.04	0.50	0.50	36
4	6.00	6.00	2.50	200.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.11	1.06	1.06	1.00	1.00	1.00	2.08	1.04	0.50	0.50	38
5	3.50	3.50	3.00	199.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.24	1.12	1.12	1.00	1.00	1.00	2.08	1.04	0.50	0.50	37
6	4.00	4.00	3.00	199.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.21	1.10	1.10	1.00	1.00	1.00	2.08	1.04	0.50	0.50	38
7	5.00	5.00	3.00	199.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.17	1.08	1.08	1.00	1.00	1.00	2.08	1.04	0.50	0.50	39
8	6.00	6.00	3.00	199.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	2.08	1.04	0.50	0.50	41
9	3.50	3.50	3.50	199.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.28	1.14	1.14	1.00	1.00	1.00	2.08	1.04	0.50	0.50	41
10	4.00	4.00	3.50	199.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.24	1.12	1.12	1.00	1.00	1.00	2.08	1.04	0.50	0.50	42
11	5.00	5.00	3.50	199.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.19	1.10	1.10	1.00	1.00	1.00	2.08	1.04	0.50	0.50	43
12	6.00	6.00	3.50	199.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.16	1.08	1.08	1.00	1.00	1.00	2.08	1.04	0.50	0.50	45

Note :-**1) The factor of safety of 2.5 is considered.****2) The depth of foundation is considered from RL 202.50m.****3) Calculations are considering the effect of water table at FGL.**

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APPENDIX-1.14 (For IBH-1,2,3,4,5,6,7,8,9,10,11,12 (Crushed coal stock pile, stacker reclaimer, wind barrier))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_i = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D m	RL of Foundation m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
								For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	2.50	200.00	3.50	1.12	0.35	280	0.80	25	41
2	2.50	200.00	4.00	1.12	0.35	280	0.80	22	36
3	2.50	200.00	5.00	1.12	0.35	280	0.80	18	28
4	2.50	200.00	6.00	1.12	0.35	280	0.80	15	24
5	3.00	199.50	3.50	1.12	0.35	280	0.80	25	41
6	3.00	199.50	4.00	1.12	0.35	280	0.80	22	36
7	3.00	199.50	5.00	1.12	0.35	280	0.80	18	28
8	3.00	199.50	6.00	1.12	0.35	280	0.80	15	24
9	3.50	199.00	3.50	1.12	0.35	280	0.80	25	41
10	3.50	199.00	4.00	1.12	0.35	280	0.80	22	36
11	3.50	199.00	5.00	1.12	0.35	280	0.80	18	28
12	3.50	199.00	6.00	1.12	0.35	280	0.80	15	24

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APPENDIX - 1.15 (For IBH-1,2,3,4,5,6,7,8,9,10,11,12 (Crushed coal stock pile, stacker reclaimer, wind barrier))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Depth of Foundation from FGL (RL:202.5 m)	RL of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
					For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
2.50	200.00	7.00	7.00	40	13	20	13	20
2.50	200.00	8.00	8.00	42	11	18	11	18
2.50	200.00	9.00	9.00	44	10	16	10	16
2.50	200.00	10.00	10.00	46	9	14	9	14
3.00	199.50	7.00	7.00	43	13	20	13	20
3.00	199.50	8.00	8.00	45	11	18	11	18
3.00	199.50	9.00	9.00	47	10	16	10	16
3.00	199.50	10.00	10.00	49	9	14	9	14
3.50	199.00	7.00	7.00	47	13	20	13	20
3.50	199.00	8.00	8.00	49	11	18	11	18
3.50	199.00	9.00	9.00	51	10	16	10	16
3.50	199.00	10.00	10.00	53	9	14	9	14

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 202.50m.
- 3) Calculations are considering the effect of water table at FGL.

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APPENDIX-1.16 (For IBH-1,2,3,4,5,6,7,8,9,10,11,12 (Crushed coal stock pile, stacker reclaimer, wind barrier))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length m	Width m			C Kg/cm ²	ϕ degree	N _c	N _q - 1	N _γ	S _c	S _q	S _γ	d _c	d _q	d _γ	i _c	i _q	i _γ	γ gm/cc	0.5 γ			
																					W _q	W _γ	
1	7.00	7.00	2.50	200.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.10	1.05	1.05	1.00	1.00	1.00	2.08	1.04	0.50	0.50	40
2	8.00	8.00	2.50	200.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.09	1.04	1.04	1.00	1.00	1.00	2.08	1.04	0.50	0.50	42
3	9.00	9.00	2.50	200.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	2.08	1.04	0.50	0.50	44
4	10.00	10.00	2.50	200.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.07	1.03	1.03	1.00	1.00	1.00	2.08	1.04	0.50	0.50	46
5	7.00	7.00	3.00	199.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.12	1.06	1.06	1.00	1.00	1.00	2.08	1.04	0.50	0.50	43
6	8.00	8.00	3.00	199.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.10	1.05	1.05	1.00	1.00	1.00	2.08	1.04	0.50	0.50	45
7	9.00	9.00	3.00	199.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.09	1.05	1.05	1.00	1.00	1.00	2.08	1.04	0.50	0.50	47
8	10.00	10.00	3.00	199.50	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	2.08	1.04	0.50	0.50	49
9	7.00	7.00	3.50	199.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	2.08	1.04	0.50	0.50	47
10	8.00	8.00	3.50	199.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.12	1.06	1.06	1.00	1.00	1.00	2.08	1.04	0.50	0.50	49
11	9.00	9.00	3.50	199.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.11	1.05	1.05	1.00	1.00	1.00	2.08	1.04	0.50	0.50	51
12	10.00	10.00	3.50	199.00	0.09	26	23.27	11.58	13.48	1.30	1.20	0.80	1.10	1.05	1.05	1.00	1.00	1.00	2.08	1.04	0.50	0.50	53

Note :-**1) The factor of safety of 2.5 is considered.****2) The depth of foundation is considered from RL 202.50m.****3) Calculations are considering the effect of water table at FGL.**

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-1.17 (For IBH-1,2,3,4,5,6,7,8,9,10,11,12 (Crushed coal stock pile, stacker reclaimer, wind barrier))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_i = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D m	RL of Foundation m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
								For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	2.50	200.00	7.00	1.12	0.35	280	0.80	13	20
2	2.50	200.00	8.00	1.12	0.35	280	0.80	11	18
3	2.50	200.00	9.00	1.12	0.35	280	0.80	10	16
4	2.50	200.00	10.00	1.12	0.35	280	0.80	9	14
5	3.00	199.50	7.00	1.12	0.35	280	0.80	13	20
6	3.00	199.50	8.00	1.12	0.35	280	0.80	11	18
7	3.00	199.50	9.00	1.12	0.35	280	0.80	10	16
8	3.00	199.50	10.00	1.12	0.35	280	0.80	9	14
9	3.50	199.00	7.00	1.12	0.35	280	0.80	13	20
10	3.50	199.00	8.00	1.12	0.35	280	0.80	11	18
11	3.50	199.00	9.00	1.12	0.35	280	0.80	10	16
12	3.50	199.00	10.00	1.12	0.35	280	0.80	9	14

Appendix – 1A

Calculation of Safe Load carrying capacity of piles socketed inside rock (Near IBH 1,2,3,4,5,6,7,8,9,10,11,12) (Crushed coal stock pile, stacker reclaimer, wind barrier)

Project Name: - Proposed structures of thermal power project of NTTTP at Hirma, Talabira

1.0 Introduction

In situations where overburden offering low bearing pressure is followed by rock at relatively shallower depths, end bearing piles is the suitable foundation option. Piles in rocks and weathered rocks of varying degree of weathering derive their capacity by end bearing and socket side resistance.

In situations, where, rock strata comprises of highly fragmented rock, as in present case, where RQD is nil or $(CR+RQD)/2$ is less than 30 % or when the crushing strength is less than 10 MPa, the appropriate approach would be of that suggested by Cole & Stroud.

In present site overburden soils overlay fractured / laminated / foliated rock. The founding stratum having highly fragmented rock with nil RQD and $(CR+RQD)/2$ to be less than 30 %, the approach suggested by Cole and Stroud as per Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 P1/S2 has been used for safe load calculations.

An illustrative calculation of safe load on pile and summary of pile capacities is as follows,

2.0 Sub soil strata Characterization

General stratification at the location of boreholes IBH 32 show primarily two characterized layers,

1. Overburden comprising of fine to medium grained, clayey sand and silty sand and fine to medium grained, sandy clays of low plasticity upto 21.90m (i.e. RL 188.50m).
2. Second characterized layer below the overburden soils comprises of Highly weathered, very weak, completely fractured, dark brownish yellow, fine to coarse grained, rock followed by Highly weathered, weak, dark brownish yellow, fine to coarse grained, very thinly laminated rock upto 25.00m (i.e. RL 185.40m).

3.0 Design Considerations

1. Length of socket considered 3D from depth of rock encountered.
2. The pile is considered to have socket length below 21.90 m below NGL (i.e. RL 188.50 m) depth.
3. For present case of pile terminating in highly weathered rock. SPT at depths between 21.90 to 25.00m (between RL 188.50 to 185.40 m) is > 100 with just 5.0 cm penetration in 70 blows. SPT can be extrapolated for 30 cm i.e. $70 * 30 / 5.00 = 420$.

Based on recommendation of fig no. 3 in B 8 in Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 P1/S2, average shear strength q_c corresponding to assumed SPT of 200 may be taken as 1300 kN/m²

4. Allowable Capacity of pile socketed into rock $Q_a = R_e + R_{sf} = C_{u1} N_c \pi B^2 / 4 (F_s = 3) + \alpha C_{u2} \pi BL / (F_s = 6)$

4.0 Safe Load on Pile in Compression

Where,

End bearing component, $R_e = C_{u1} N_c \pi B^2 / 4 F_s$,

C_{u1} = Shear strength below base of pile = 1300 kN/m²

B = diameter of the pile = d

F_s = Factor of Safety = 3

$N_c = 9$

Therefore, **$R_e = 3061.5 d^2$**

Skin friction component of socketed length of pile, $R_{sf} = \alpha C_{u2} \pi BL / F_s$

$\alpha = 0.9$ (recommended value in IS 2911 P1/S2)

L = length of the socket = $3 D$

C_{u2} = Ultimate shear strength along socket length which shall be restricted to shear capacity of concrete of the pile = 1300 kN/m^2

F_s = Factor of Safety = 6

Therefore, $R_{sf} = 1836.9 d^2$

Thus,

$$Q_a = c_{u1} N_c \cdot \frac{\pi B^2}{4 F_s} + \alpha c_{u2} \cdot \frac{\pi B L}{F_s}$$

$$= 3061.5 d^2 + 1836.9 d^2 = 4898.4 d^2$$

Substituting the values of various diameters and socket lengths equal to 3 times diameter, allowable load on single pile can be summarized as follows,

Summary of the Safe load calculation in Compression

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	15.80	16.28	16.70
Termination level RL in m	186.70	186.22	185.80
End Bearing Component in kN	1102.1	1768.3	2479.8
Friction Component in kN	661.3	1060.9	1487.9
Safe load in Compression in kN	1763.4	2829.3	3967.7
Safe load in Compression in T	176	283	397

5.0 Safe Load on Pile in uplift

At 1.00m FGL

The overburden soils, though, will not contribute in compression capacity would offer resistance in uplift capacity. The parameters of IBH 10 are considered for calculation of uplift resistance as summarized below,

Depth in m from RL 202.5 m	Cohesion in kg/cm ²	Angle of Internal Friction ϕ	Submerged density in gm/cc γ_{sub}	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
FGL to 1.00	Cut off level						
1.00 to 1.70	0.08(ignored)	27	1.00	NA	1.00	27	41-69
1.70 to 6.70	0.00	34	1.08	NA	1.50	34	>100
6.70 to 9.40	4.00	0	1.08	0.28	NA	NA	>100
9.40 to 14.00	0.00	34	1.08	NA	1.50	34	>100
14.00 to 17.10	Rock strata – Resistance would be as per skin friction capacity in socket as already calculated in compression capacity						

Ultimate load in skin friction,

$$Q_{uf} = \alpha_i C_{ai} A_{si} + K_i P D_i \tan \delta_i A_{si}$$

First Layer – Cut off level

$$\text{Second Layer – } K_2 P D_2 \tan \delta_2 A_{s2} = 1.00 * 1.15 * \tan 27 * \pi d * 0.70 = 1.29 d$$

$$\text{Third Layer – } K_3 P D_3 \tan \delta_3 A_{s3} = 1.50 * 4.20 * \tan 34 * \pi d * 5.00 = 66.75 d$$

$$\text{Fourth Layer – } \alpha_4 C_{a4} A_{s4} = 0.28 * 40.00 * \pi d * 2.70 = 95.00 d$$

$$\text{Fifth Layer – } K_5 P D_5 \tan \delta_5 A_{s5} = 1.50 * 11.98 * \tan 34 * \pi d * 4.60 = 175.16 d$$

Sixth Layer – $1836.90 d^2$ in rock socket

$$\text{Substituting, ultimate load } q_{uf} = 3382.00 d + 1836.9 d^2$$

The safe load in uplift is worked out (considering the safety factor of 2.50 for overburden soils) and summarized below,

Safe Load on Piles in Uplift (in Ton)

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	15.80	16.28	16.70
Termination level RL in m	186.70	186.22	185.80
Safe load in Uplift in kN	1472.96	2089.12	2705.41
Self-weight of pile in kN	62.74	103.92	149.74
Safe load in Uplift in T (Considering self-weight of pile)	153.57	219.30	285.52

6.0 Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60	0.76	0.90
Subgrade reaction in MN/m ³		3.85	3.85	3.85
Stiffness factor T in m		2.15	2.60	2.98
Depth of fixity in m	Free Head	4.10	4.90	5.70
	Fixed Head	4.70	5.70	6.50
Allowable Horizontal Force in T	Free Head	3.90	5.70	7.50
	Fixed Head	10.30	15.10	19.70
Allowable Moment capacity in Tm	Free Head	5.58	9.84	14.76
	Fixed Head	19.85	35.01	52.53

7.0 Notes

1. Pile shall be terminated after socketing 3D inside rock.
2. Initial and routine pile load test is required to verify the actual carrying capacity of pile in compression, uplift and lateral loads.
3. For design and construction, specification of IS: 2911, P1/S2, IS: 456, 2000 shall strictly be followed.

(Dr. K. K. Thaker)

Appendix – 1B

Calculation of Safe Load on Uniform Diameter Bored Cast in situ Pile. (Near IBH 1,2,3,4,5,6,7,8,9,10,11,12) (Crushed coal stock pile, stacker reclaimer, wind barrier)

The safe load is calculated as follows,

1) Design Stipulations

- | | |
|---|---|
| 1. Type of pile | - Bored cast in situ uniform diameter pile. |
| 2. Pile diameter considered | - 0.60m |
| 3. Termination depth of pile considered | - 10.00m from FGL. |
| 4. Cut off Level | - At 1.00m from FGL. |
| 5. Factor of Safety | - 2.50 |
| 6. Depth of Water table | - Considered at FGL. |
| 7. Ref | - IS 2911 P-I, Sec-II, 2021. |

2) Test Data

The parameters are based on IBH 10. For evaluation of safe load on piles following characterized layers are considered as described in table below,

Depth in m from RL 202.5 m	Cohesion in kg/cm ²	Angle of Internal Friction ϕ	Submerged density in gm/cc γ_{sub}	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
FGL to 1.00	Cutoff level						
1.00 to 1.70	0.08(ignored)	27	1.00	NA	1.00	27	41-69
1.70 to 6.70	0.00	34 ^{\$}	1.08 ^{\$}	NA	1.50	34	>100
6.70 to 9.40	4.00 ^{\$}	0	1.08 ^{\$}	0.28	NA	NA	>100
9.40 to 14.00	0.00	34 ^{\$}	1.08 ^{\$}	NA	1.50	34	>100

Notes: - Layers are characterized based on classification and the state of soil in that stratum.

* - In cohesive soils the contribution of the angle of internal friction being insignificant is ignored.

Shear parameters are the most representative for the layer. NA means not applicable. Characterized N values are considered for each layer.

- Weighted Average of the parameters falling in the same layer has been considered

\$-Parameters are correlated based on SPT value N.

3) Ultimate Load in Compression

3.1) Ultimate load in Compression by Bearing

Ultimate load on pile in end bearing,

$$q_{ub} = A_p (0.5 \cdot D \cdot \gamma \cdot N_\gamma + P D N_q)$$

$$A_p = \text{Cross section area of Pile stem at toe} = \pi d^2 / 4$$

$$D = \text{Diameter of pile} = d \text{ in m}$$

$$N_\gamma = 42.90$$

$$N_q = 40.00$$

$$q_{ub} = 0.785d^2 (0.5 \cdot d \cdot 1.08 \cdot 42.90 + 9.58 \cdot 40.00) = 18.19d^3 + 300.81d^2$$

(For Pile terminating at 10.00m from F.G.L.)

Note: As the pile terminating just above rock level, we have considered parameter for end bearing component based on rock strata.

3.2) Ultimate Load in Compression by Skin Friction

Ultimate load in skin friction,

$$q_{uf} = \alpha_i C_{ai} + K_i P D_i \tan \delta_i A_{si}$$

First Layer – No contribution considered due to cut off level

$$\text{Second Layer} - K_2 P D_2 \tan \delta_2 A_{s2} = 1.00 \cdot 0.35 \cdot \tan 27^\circ \cdot \pi \cdot d \cdot 0.70 = 0.39 d$$

$$\text{Third Layer} - K_3 P D_3 \tan \delta_3 A_{s3} = 1.50 \cdot 3.40 \cdot \tan 34^\circ \cdot \pi \cdot d \cdot 5.00 = 54.04 d$$

$$\text{Fourth Layer} - \alpha_4 C_{a4} A_{s4} = 0.28 \cdot 40.00 \cdot \pi \cdot d \cdot 2.70 = 95.00 d$$

$$\text{Fifth Layer} - K_5 P D_5 \tan \delta_5 A_{s5} = 1.50 \cdot 3.40 \cdot \tan 34^\circ \cdot \pi \cdot d \cdot (\ell - 9.40) = 10.81 d (\ell - 9.40)$$

Substituting, ultimate load

$$q_{uf} = 149.43d + 10.81d(\ell - 9.40) \text{ (For Pile terminating at 10.00m from F.G.L.)}$$

Where, ℓ is the pile length and d is diameter of piles, substituting

Ultimate load by both bearing and friction can be as follows for various lengths of piles,

$$q_{uc} = q_{ub} + q_{uf}$$

$$q_{uc} = 18.19d^3 + 300.81d^2 + 72.24d + 35.19d(\ell - 9.40)$$

(For Pile terminating at 10.00m from F.G.L.)

By substituting various diameters of piles having various lengths, the safe load is worked out considering the safety factor of 2.50 and are given in table below,

Safe Load on Piles in Compression (in Ton)

Termination Depth of Pile in m, from FGL	Termination Depth of Pile in m, from cut-off	Diameter of Pile in, m
		0.60
10.00	9.00	85.39

3.3) Ultimate Load in Uplift

Considering skin friction for determination of uplift

Safe Load on Piles in Uplift (in Ton)

Termination Depth of Pile in m, from FGL	Termination Depth of Pile in m, from cut-off	Diameter of Pile in, m
		0.60
10.00	9.00	37.25

Note: Self weight of pile is considered in calculation of ultimate load in uplift.

Self weight of Pile (in Ton)

Termination Depth of Pile in m, from FGL	Termination Depth of Pile in m, from cut-off	Diameter of Pile in, m
		0.60
10.00	9.00	3.82

3.4) Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60
Subgrade reaction in MN/m ³		3.85
Stiffness factor T in m		2.15
Depth of fixity in m	Free Head	4.10
	Fixed Head	4.70
Allowable Horizontal Force in T	Free Head	3.90
	Fixed Head	10.30
Allowable Moment capacity in Tm	Free Head	5.58
	Fixed Head	19.85

4) Notes:

1) Initial and Routine pile load tests shall be carried out as per IS 2911, P-4 on the piles to confirm the capacity of pile worked out theoretically. For design and construction, specifications of IS 2911, P-I, S-2, shall strictly be followed. Termination depth of pile shall be from FGL.

Dr. K. K. Thaker

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 2 (For IBH-54,55 BH-77 (Gypsum storage shed))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:197.12m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 2.1)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 2.2)		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	196.12	6.38	1.50	1.50	9	16	25	9	9
1.00	196.12	6.38	2.00	2.00	8	11	18	8	8
1.00	196.12	6.38	2.50	2.50	8	9	14	8	8
1.00	196.12	6.38	3.00	3.00	8	7	12	7	8
2.00	195.12	7.38	1.50	1.50	10	17	27	10	10
2.00	195.12	7.38	2.00	2.00	9	13	20	9	9
2.00	195.12	7.38	2.50	2.50	9	10	16	9	9
2.00	195.12	7.38	3.00	3.00	9	8	13	8	9
3.00	194.12	8.38	1.50	1.50	11	17	27	11	11
3.00	194.12	8.38	2.00	2.00	10	13	20	10	10
3.00	194.12	8.38	2.50	2.50	10	10	16	10	10
3.00	194.12	8.38	3.00	3.00	9	8	14	8	9

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.12m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 2.1 (For IBH-54,55 BH-77 (Gypsum storage shed))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	1.00	6.38	196.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.14	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	9
2	2.00	2.00	1.00	6.38	196.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	8
3	2.50	2.50	1.00	6.38	196.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	8
4	3.00	3.00	1.00	6.38	196.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	8
5	1.50	1.50	2.00	7.38	195.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.28	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	10
6	2.00	2.00	2.00	7.38	195.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.21	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	9
7	2.50	2.50	2.00	7.38	195.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.17	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	9
8	3.00	3.00	2.00	7.38	195.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.14	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	9
9	1.50	1.50	3.00	8.38	194.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.41	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	11
10	2.00	2.00	3.00	8.38	194.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.31	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	10
11	2.50	2.50	3.00	8.38	194.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.25	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	10
12	3.00	3.00	3.00	8.38	194.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.21	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	9

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.12m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 2.2 (For IBH-54,55 BH-77 (Gypsum storage shed))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ²	T / m ²
1	1.00	196.12	6.38	1.50	1.50	0.40	190	1.12	0.80	0.0292	3.00	0.70	0.80	0.80	16	25
2	1.00	196.12	6.38	2.00	2.00	0.40	190	1.12	0.80	0.0292	4.00	0.70	0.85	0.80	11	18
3	1.00	196.12	6.38	2.50	2.50	0.40	190	1.12	0.80	0.0292	5.00	0.70	0.88	0.80	9	14
4	1.00	196.12	6.38	3.00	3.00	0.40	190	1.12	0.80	0.0292	6.00	0.70	0.91	0.80	7	12
5	2.00	195.12	7.38	1.50	1.50	0.40	190	1.12	0.80	0.0292	3.00	0.70	0.73	0.80	17	27
6	2.00	195.12	7.38	2.00	2.00	0.40	190	1.12	0.80	0.0292	4.00	0.70	0.73	0.80	13	20
7	2.00	195.12	7.38	2.50	2.50	0.40	190	1.12	0.80	0.0292	5.00	0.70	0.76	0.80	10	16
8	2.00	195.12	7.38	3.00	3.00	0.40	190	1.12	0.80	0.0292	5.50	0.70	0.80	0.80	8	13
9	3.00	194.12	8.38	1.50	1.50	0.40	190	1.12	0.80	0.0292	3.00	0.70	0.73	0.80	17	27
10	3.00	194.12	8.38	2.00	2.00	0.40	190	1.12	0.80	0.0292	4.00	0.70	0.73	0.80	13	20
11	3.00	194.12	8.38	2.50	2.50	0.40	190	1.12	0.80	0.0292	4.50	0.70	0.73	0.80	10	16
12	3.00	194.12	8.38	3.00	3.00	0.40	190	1.12	0.80	0.0292	4.50	0.70	0.73	0.80	8	14

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 2.3 (For IBH-54,55 BH-77 (Gypsum storage shed))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:197.12m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 2.4)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 2.5)		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	196.12	6.38	3.50	3.50	8	6	10	6	8
1.00	196.12	6.38	4.00	4.00	8	5	9	5	8
1.00	196.12	6.38	5.00	5.00	8	4	7	4	7
1.00	196.12	6.38	6.00	6.00	8	4	6	4	6
2.00	195.12	7.38	3.50	3.50	9	7	11	7	9
2.00	195.12	7.38	4.00	4.00	9	6	9	6	9
2.00	195.12	7.38	5.00	5.00	8	5	8	5	8
2.00	195.12	7.38	6.00	6.00	8	4	6	4	6
3.00	194.12	8.38	3.50	3.50	9	7	12	7	9
3.00	194.12	8.38	4.00	4.00	9	6	10	6	9
3.00	194.12	8.38	5.00	5.00	9	5	8	5	8
3.00	194.12	8.38	6.00	6.00	9	4	7	4	7

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.12m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 2.4 (For IBH-54,55 BH-77 (Gypsum storage shed))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	1.00	6.38	196.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	8
2	4.00	4.00	1.00	6.38	196.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	8
3	5.00	5.00	1.00	6.38	196.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	8
4	6.00	6.00	1.00	6.38	196.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	8
5	3.50	3.50	2.00	7.38	195.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	9
6	4.00	4.00	2.00	7.38	195.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	9
7	5.00	5.00	2.00	7.38	195.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	8
8	6.00	6.00	2.00	7.38	195.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	8
9	3.50	3.50	3.00	8.38	194.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.18	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	9
10	4.00	4.00	3.00	8.38	194.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.16	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	9
11	5.00	5.00	3.00	8.38	194.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	9
12	6.00	6.00	3.00	8.38	194.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	9

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.12m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 2.5 (For IBH-54,55 BH-77 (Gypsum storage shed))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ²	T / m ²
1	1.00	196.12	6.38	3.50	3.50	0.40	190	1.12	0.80	0.0292	6.50	0.70	0.92	0.80	6	10
2	1.00	196.12	6.38	4.00	4.00	0.40	190	1.12	0.80	0.0292	6.50	0.70	0.93	0.80	5	9
3	1.00	196.12	6.38	5.00	5.00	0.40	190	1.12	0.80	0.0292	6.50	0.70	0.95	0.80	4	7
4	1.00	196.12	6.38	6.00	6.00	0.40	190	1.12	0.80	0.0292	6.50	0.70	0.96	0.80	4	6
5	2.00	195.12	7.38	3.50	3.50	0.40	190	1.12	0.80	0.0292	5.50	0.70	0.83	0.80	7	11
6	2.00	195.12	7.38	4.00	4.00	0.40	190	1.12	0.80	0.0292	5.50	0.70	0.85	0.80	6	9
7	2.00	195.12	7.38	5.00	5.00	0.40	190	1.12	0.80	0.0292	5.50	0.70	0.88	0.80	5	8
8	2.00	195.12	7.38	6.00	6.00	0.40	190	1.12	0.80	0.0292	5.50	0.70	0.91	0.80	4	6
9	3.00	194.12	8.38	3.50	3.50	0.40	190	1.12	0.80	0.0292	4.50	0.70	0.75	0.80	7	12
10	3.00	194.12	8.38	4.00	4.00	0.40	190	1.12	0.80	0.0292	4.50	0.70	0.77	0.80	6	10
11	3.00	194.12	8.38	5.00	5.00	0.40	190	1.12	0.80	0.0292	4.50	0.70	0.82	0.80	5	8
12	3.00	194.12	8.38	6.00	6.00	0.40	190	1.12	0.80	0.0292	4.50	0.70	0.85	0.80	4	7

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 2.6 (For IBH-54,55 BH-77 (Gypsum storage shed))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:197.12m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 2.7)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 2.8)		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	196.12	6.38	7.00	7.00	8	3	5	3	5
1.00	196.12	6.38	8.00	8.00	8	3	5	3	5
1.00	196.12	6.38	9.00	9.00	8	3	4	3	4
1.00	196.12	6.38	10.00	10.00	8	3	4	3	4
2.00	195.12	7.38	7.00	7.00	8	4	6	4	6
2.00	195.12	7.38	8.00	8.00	8	3	5	3	5
2.00	195.12	7.38	9.00	9.00	8	3	5	3	5
2.00	195.12	7.38	10.00	10.00	8	3	4	3	4
3.00	194.12	8.38	7.00	7.00	9	4	6	4	6
3.00	194.12	8.38	8.00	8.00	9	3	6	3	6
3.00	194.12	8.38	9.00	9.00	8	3	5	3	5
3.00	194.12	8.38	10.00	10.00	8	3	5	3	5

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.12m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 2.7 (For IBH-54,55 BH-77 (Gypsum storage shed))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	1.00	6.38	196.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	8
2	8.00	8.00	1.00	6.38	196.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	8
3	9.00	9.00	1.00	6.38	196.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.02	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	8
4	10.00	10.00	1.00	6.38	196.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.02	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	8
5	7.00	7.00	2.00	7.38	195.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	8
6	8.00	8.00	2.00	7.38	195.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	8
7	9.00	9.00	2.00	7.38	195.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	8
8	10.00	10.00	2.00	7.38	195.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	8
9	7.00	7.00	3.00	8.38	194.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	9
10	8.00	8.00	3.00	8.38	194.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	9
11	9.00	9.00	3.00	8.38	194.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	8
12	10.00	10.00	3.00	8.38	194.12	0.38	3	5.64	0.20	0.16	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	8

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.12m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 2.8 (For IBH-54,55 BH-77 (Gypsum storage shed))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ²	T / m ²
1	1.00	196.12	6.38	7.00	7.00	0.40	190	1.12	0.80	0.0292	6.50	0.70	0.97	0.80	3	5
2	1.00	196.12	6.38	8.00	8.00	0.40	190	1.12	0.80	0.0292	6.50	0.70	0.97	0.80	3	5
3	1.00	196.12	6.38	9.00	9.00	0.40	190	1.12	0.80	0.0292	6.50	0.70	0.97	0.80	3	4
4	1.00	196.12	6.38	10.00	10.00	0.40	190	1.12	0.80	0.0292	6.50	0.70	0.98	0.80	3	4
5	2.00	195.12	7.38	7.00	7.00	0.40	190	1.12	0.80	0.0292	5.50	0.70	0.92	0.80	4	6
6	2.00	195.12	7.38	8.00	8.00	0.40	190	1.12	0.80	0.0292	5.50	0.70	0.93	0.80	3	5
7	2.00	195.12	7.38	9.00	9.00	0.40	190	1.12	0.80	0.0292	5.50	0.70	0.94	0.80	3	5
8	2.00	195.12	7.38	10.00	10.00	0.40	190	1.12	0.80	0.0292	5.50	0.70	0.95	0.80	3	4
9	3.00	194.12	8.38	7.00	7.00	0.40	190	1.12	0.80	0.0292	4.50	0.70	0.87	0.80	4	6
10	3.00	194.12	8.38	8.00	8.00	0.40	190	1.12	0.80	0.0292	4.50	0.70	0.89	0.80	3	6
11	3.00	194.12	8.38	9.00	9.00	0.40	190	1.12	0.80	0.0292	4.50	0.70	0.91	0.80	3	5
12	3.00	194.12	8.38	10.00	10.00	0.40	190	1.12	0.80	0.0292	4.50	0.70	0.92	0.80	3	5

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 2.9 (For IBH-54,55 BH-77 (Gypsum storage shed))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:197.12m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
4.00	193.12	9.38	1.50	1.50	38	48	77	38	38
4.00	193.12	9.38	2.00	2.00	35	36	58	35	35
4.00	193.12	9.38	2.50	2.50	33	29	47	29	33
4.00	193.12	9.38	3.00	3.00	32	25	40	25	32
5.00	192.12	10.38	1.50	1.50	42	48	77	42	42
5.00	192.12	10.38	2.00	2.00	38	37	60	37	38
5.00	192.12	10.38	2.50	2.50	35	31	50	31	35
5.00	192.12	10.38	3.00	3.00	34	27	43	27	34
6.00	191.12	11.38	1.50	1.50	45	52	84	45	45
6.00	191.12	11.38	2.00	2.00	40	41	66	40	40
6.00	191.12	11.38	2.50	2.50	37	35	57	35	37
6.00	191.12	11.38	3.00	3.00	35	31	50	31	35

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.12m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-2.10 (For IBH-54,55 BH-77 (Gypsum storage shed))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	4.00	9.38	193.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.55	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	38
2	2.00	2.00	4.00	9.38	193.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.41	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	35
3	2.50	2.50	4.00	9.38	193.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.33	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	33
4	3.00	3.00	4.00	9.38	193.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.28	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	32
5	1.50	1.50	5.00	10.38	192.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.69	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	42
6	2.00	2.00	5.00	10.38	192.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.52	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	38
7	2.50	2.50	5.00	10.38	192.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.41	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	35
8	3.00	3.00	5.00	10.38	192.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.35	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	34
9	1.50	1.50	6.00	11.38	191.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.83	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	45
10	2.00	2.00	6.00	11.38	191.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.62	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	40
11	2.50	2.50	6.00	11.38	191.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.50	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	37
12	3.00	3.00	6.00	11.38	191.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.41	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	35

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.12m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-2.11 (For IBH-54,55 BH-77 (Gypsum storage shed))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ²	T / m ²
1	4.00	193.12	9.38	1.50	1.50	0.40	610	1.12	0.80	0.0110	3.00	0.70	0.73	0.80	48	77
2	4.00	193.12	9.38	2.00	2.00	0.40	610	1.12	0.80	0.0110	3.50	0.70	0.73	0.80	36	58
3	4.00	193.12	9.38	2.50	2.50	0.40	610	1.12	0.80	0.0110	3.50	0.70	0.73	0.80	29	47
4	4.00	193.12	9.38	3.00	3.00	0.40	610	1.12	0.80	0.0110	3.50	0.70	0.73	0.80	25	40
5	5.00	192.12	10.38	1.50	1.50	0.40	610	1.12	0.80	0.0110	2.50	0.70	0.73	0.80	48	77
6	5.00	192.12	10.38	2.00	2.00	0.40	610	1.12	0.80	0.0110	2.50	0.70	0.73	0.80	37	60
7	5.00	192.12	10.38	2.50	2.50	0.40	610	1.12	0.80	0.0110	2.50	0.70	0.73	0.80	31	50
8	5.00	192.12	10.38	3.00	3.00	0.40	610	1.12	0.80	0.0110	2.50	0.70	0.73	0.80	27	43
9	6.00	191.12	11.38	1.50	1.50	0.40	610	1.12	0.80	0.0110	1.50	0.70	0.71	0.80	52	84
10	6.00	191.12	11.38	2.00	2.00	0.40	610	1.12	0.80	0.0110	1.50	0.70	0.73	0.80	41	66
11	6.00	191.12	11.38	2.50	2.50	0.40	610	1.12	0.80	0.0110	1.50	0.70	0.73	0.80	35	57
12	6.00	191.12	11.38	3.00	3.00	0.40	610	1.12	0.80	0.0110	1.50	0.70	0.73	0.80	31	50

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 2.12 (For IBH-54,55 BH-77 (Gypsum storage shed))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:197.12m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
4.00	193.12	9.38	3.50	3.50	31	22	35	22	31
4.00	193.12	9.38	4.00	4.00	30	20	32	20	30
4.00	193.12	9.38	5.00	5.00	29	16	26	16	26
4.00	193.12	9.38	6.00	6.00	28	14	23	14	23
5.00	192.12	10.38	3.50	3.50	32	24	38	24	32
5.00	192.12	10.38	4.00	4.00	31	22	35	22	31
5.00	192.12	10.38	5.00	5.00	30	19	30	19	30
5.00	192.12	10.38	6.00	6.00	29	16	26	16	26
6.00	191.12	11.38	3.50	3.50	34	28	45	28	34
6.00	191.12	11.38	4.00	4.00	33	26	41	26	33
6.00	191.12	11.38	5.00	5.00	31	22	36	22	31
6.00	191.12	11.38	6.00	6.00	30	20	31	20	30

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.12m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-2.13 (For IBH-54,55 BH-77 (Gypsum storage shed))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	4.00	9.38	193.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.24	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	31
2	4.00	4.00	4.00	9.38	193.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.21	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	30
3	5.00	5.00	4.00	9.38	193.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.17	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	29
4	6.00	6.00	4.00	9.38	193.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.14	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	28
5	3.50	3.50	5.00	10.38	192.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.30	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	32
6	4.00	4.00	5.00	10.38	192.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.26	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	31
7	5.00	5.00	5.00	10.38	192.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.21	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	30
8	6.00	6.00	5.00	10.38	192.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.17	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	29
9	3.50	3.50	6.00	11.38	191.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.36	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	34
10	4.00	4.00	6.00	11.38	191.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.31	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	33
11	5.00	5.00	6.00	11.38	191.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.25	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	31
12	6.00	6.00	6.00	11.38	191.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.21	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	30

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.12m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-2.14 (For IBH-54,55 BH-77 (Gypsum storage shed))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ²	T / m ²
1	4.00	193.12	9.38	3.50	3.50	0.40	610	1.12	0.80	0.0110	3.50	0.70	0.73	0.80	22	35
2	4.00	193.12	9.38	4.00	4.00	0.40	610	1.12	0.80	0.0110	3.50	0.70	0.73	0.80	20	32
3	4.00	193.12	9.38	5.00	5.00	0.40	610	1.12	0.80	0.0110	3.50	0.70	0.76	0.80	16	26
4	4.00	193.12	9.38	6.00	6.00	0.40	610	1.12	0.80	0.0110	3.50	0.70	0.80	0.80	14	23
5	5.00	192.12	10.38	3.50	3.50	0.40	610	1.12	0.80	0.0110	2.50	0.70	0.73	0.80	24	38
6	5.00	192.12	10.38	4.00	4.00	0.40	610	1.12	0.80	0.0110	2.50	0.70	0.73	0.80	22	35
7	5.00	192.12	10.38	5.00	5.00	0.40	610	1.12	0.80	0.0110	2.50	0.70	0.73	0.80	19	30
8	5.00	192.12	10.38	6.00	6.00	0.40	610	1.12	0.80	0.0110	2.50	0.70	0.75	0.80	16	26
9	6.00	191.12	11.38	3.50	3.50	0.40	610	1.12	0.80	0.0110	1.50	0.70	0.73	0.80	28	45
10	6.00	191.12	11.38	4.00	4.00	0.40	610	1.12	0.80	0.0110	1.50	0.70	0.73	0.80	26	41
11	6.00	191.12	11.38	5.00	5.00	0.40	610	1.12	0.80	0.0110	1.50	0.70	0.73	0.80	22	36
12	6.00	191.12	11.38	6.00	6.00	0.40	610	1.12	0.80	0.0110	1.50	0.70	0.73	0.80	20	31

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APPENDIX - 2.15 (For IBH-54,55 BH-77 (Gypsum storage shed))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:197.12m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
4.00	193.12	9.38	7.00	7.00	28	12	20	12	20
4.00	193.12	9.38	8.00	8.00	28	11	18	11	18
4.00	193.12	9.38	9.00	9.00	27	10	17	10	17
4.00	193.12	9.38	10.00	10.00	27	10	15	10	15
5.00	192.12	10.38	7.00	7.00	29	14	23	14	23
5.00	192.12	10.38	8.00	8.00	28	13	21	13	21
5.00	192.12	10.38	9.00	9.00	28	12	19	12	19
5.00	192.12	10.38	10.00	10.00	28	11	18	11	18
6.00	191.12	11.38	7.00	7.00	30	17	28	17	28
6.00	191.12	11.38	8.00	8.00	29	16	25	16	25
6.00	191.12	11.38	9.00	9.00	29	14	23	14	23
6.00	191.12	11.38	10.00	10.00	28	13	21	13	21

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.12m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-2.16 (For IBH-54,55 BH-77 (Gypsum storage shed))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	4.00	9.38	193.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	28
2	8.00	8.00	4.00	9.38	193.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	28
3	9.00	9.00	4.00	9.38	193.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	27
4	10.00	10.00	4.00	9.38	193.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	27
5	7.00	7.00	5.00	10.38	192.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.15	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	29
6	8.00	8.00	5.00	10.38	192.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	28
7	9.00	9.00	5.00	10.38	192.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	28
8	10.00	10.00	5.00	10.38	192.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	28
9	7.00	7.00	6.00	11.38	191.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.18	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	30
10	8.00	8.00	6.00	11.38	191.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.16	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	29
11	9.00	9.00	6.00	11.38	191.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.14	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	29
12	10.00	10.00	6.00	11.38	191.12	1.22	3	5.74	0.24	0.19	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	1.99	1.00	0.50	0.50	28

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.12m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-2.17 (For IBH-54,55 BH-77 (Gypsum storage shed))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ²	T / m ²
1	4.00	193.12	9.38	7.00	7.00	0.40	610	1.12	0.80	0.0110	3.50	0.70	0.83	0.80	12	20
2	4.00	193.12	9.38	8.00	8.00	0.40	610	1.12	0.80	0.0110	3.50	0.70	0.85	0.80	11	18
3	4.00	193.12	9.38	9.00	9.00	0.40	610	1.12	0.80	0.0110	3.50	0.70	0.87	0.80	10	17
4	4.00	193.12	9.38	10.00	10.00	0.40	610	1.12	0.80	0.0110	3.50	0.70	0.88	0.80	10	15
5	5.00	192.12	10.38	7.00	7.00	0.40	610	1.12	0.80	0.0110	2.50	0.70	0.78	0.80	14	23
6	5.00	192.12	10.38	8.00	8.00	0.40	610	1.12	0.80	0.0110	2.50	0.70	0.81	0.80	13	21
7	5.00	192.12	10.38	9.00	9.00	0.40	610	1.12	0.80	0.0110	2.50	0.70	0.83	0.80	12	19
8	5.00	192.12	10.38	10.00	10.00	0.40	610	1.12	0.80	0.0110	2.50	0.70	0.85	0.80	11	18
9	6.00	191.12	11.38	7.00	7.00	0.40	610	1.12	0.80	0.0110	1.50	0.70	0.75	0.80	17	28
10	6.00	191.12	11.38	8.00	8.00	0.40	610	1.12	0.80	0.0110	1.50	0.70	0.77	0.80	16	25
11	6.00	191.12	11.38	9.00	9.00	0.40	610	1.12	0.80	0.0110	1.50	0.70	0.80	0.80	14	23
12	6.00	191.12	11.38	10.00	10.00	0.40	610	1.12	0.80	0.0110	1.50	0.70	0.82	0.80	13	21

Appendix – 2A

Calculation of Safe Load carrying capacity of piles socketed inside rock (Near IBH 54,55) (Gypsum storage shed)

Project Name: - Proposed structures of thermal power project of NTTTP at Hirma, Talabira

1.0 Introduction

In situations where overburden offering low bearing pressure is followed by rock at relatively shallower depths, end bearing piles is the suitable foundation option. Piles in rocks and weathered rocks of varying degree of weathering derive their capacity by end bearing and socket side resistance.

In situations, where, rock strata comprises of highly fragmented rock, as in present case, where RQD is nil or $(CR+RQD)/2$ is less than 30 % or when the crushing strength is less than 10 MPa, the appropriate approach would be of that suggested by Cole & Stroud.

In present site overburden soils overlay fractured / laminated / foliated rock. The founding stratum having highly fragmented rock with nil RQD and $(CR+RQD)/2$ to be less than 30 %, the approach suggested by Cole and Stroud as per Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 Pa/S2 has been used for safe load calculations.

An illustrative calculation of safe load on pile and summary of pile capacities is as follows,

2.0 Sub soil strata Characterization

General stratification at the location of boreholes IBH 54 show primarily two characterized layers,

1. Overburden comprising of very fine grained, silty clays of intermediate plasticity with occasional gravels upto 7.10m (i.e. RL 190.02 m).
2. Second characterized layer below the overburden soils comprises of Highly weathered, weak, dark brownish, fine to medium grained, fractured rock upto 10.00m (i.e. RL 187.12 m).

3.0 Design Considerations

1. Length of socket considered 3D from depth of rock encountered.
2. The pile is considered to have socket length below 7.10 m below NGL (i.e. RL 190.02 m) depth.
3. For present case of pile terminating in highly weathered rock. SPT at depths between 7.10 to 10.00m (between RL 190.02 to 187.12 m) is > 100 with just 3.0 cm penetration in 50 blows. SPT can be extrapolated for 30 cm i.e. $50 * 30 / 3.00 = 500$.
Based on recommendation of fig no. 3 in B 8 in Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 P1/S2, average shear strength q_c corresponding to assumed SPT of 200 may be taken as 1300 kN/m²
4. Allowable Capacity of pile socketed into rock $Q_a = R_e + R_{sf} = C_{u1} N_c \pi B^2 / 4 (F_s = 3) + \alpha C_{u2} \pi BL / (F_s = 6)$

4.0 Safe Load on Pile in Compression

Where,

End bearing component, $R_e = C_{u1} N_c \pi B^2 / 4 F_s$,

C_{u1} = Shear strength below base of pile = 1300 kN/m²

B = diameter of the pile = d

F_s = Factor of Safety = 3

$N_c = 9$

Therefore, **$R_e = 3061.5 d^2$**

Skin friction component of socketed length of pile, $R_{sf} = \alpha C_{u2} \pi BL / F_s$

$\alpha = 0.9$ (recommended value in IS 2911 P1/S2)

L = length of the socket = $3 D$

C_{u2} = Ultimate shear strength along socket length which shall be restricted to shear capacity of concrete of the pile = 1300 kN/m^2

F_s = Factor of Safety = 6

Therefore, $R_{sf} = 1836.9 \text{ d}^2$

Thus,

$$Q_a = c_{u1} N_c \cdot \frac{\pi B^2}{4 F_s} + \alpha c_{u2} \cdot \frac{\pi B L}{F_s}$$

$$= 3061.5 \text{ d}^2 + 1836.9 \text{ d}^2 = 4898.4 \text{ d}^2$$

Substituting the values of various diameters and socket lengths equal to 3 times diameter, allowable load on single pile can be summarized as follows,

Summary of the Safe load calculation in Compression

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	14.28	14.76	15.18
Termination level RL in m	188.22	187.74	187.32
End Bearing Component in kN	1102.1	1768.3	2479.8
Friction Component in kN	661.3	1060.9	1487.9
Safe load in Compression in kN	1763.4	2829.3	3967.7
Safe load in Compression in T	176	283	397

5.0 Safe Load on Pile in uplift

For 6.00m cutoff from FGL

The overburden soils, though, will not contribute in compression capacity would offer resistance in uplift capacity. The parameters of IBH 54 are considered for calculation of uplift resistance as summarized below,

Depth in m from RL 202.5 m	Cohesion in kg/cm^2	Angle of Internal Friction ϕ	Submerged density in $\text{gm/cc } \gamma_{\text{sub}}$	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 6.00	Pile cutoff level – No pile						
6.00 to 10.28	0.46	4(ignored)	0.96	0.94	NA	NA	6-29
10.28 to 12.48	4.00	0	0.99	0.28	NA	NA	>100
12.48 to 21.88	Rock strata – Resistance would be as per skin friction capacity in socket as already calculated in compression capacity						

Ultimate load in skin friction,

$$Q_{uf} = \alpha_i C_{ai} A_{si} + K_i P D_i \tan \delta_i A_{si}$$

First Layer – No contribution considered – (Within Cutoff Level).

$$\text{Second Layer} - \alpha_2 C_{a2} A_{s2} = 0.94 * 4.60 * \pi * d * 4.28 = \mathbf{58.14d}$$

$$\text{Third Layer} - \alpha_3 C_{a3} A_{s3} = 0.28 * 40.00 * \pi * d * 2.20 = \mathbf{77.41d}$$

Fourth Layer – 1836.90 d^2 in rock socket

$$\text{Substituting, ultimate load } q_{uf} = \mathbf{1355.49 \text{ d} + 1836.9 \text{ d}^2}$$

The safe load in uplift is worked out (considering the safety factor of 2.50 for overburden soils) and summarized below,

Safe Load on Piles in Uplift (in Ton)

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	14.28	14.76	15.18
Termination level RL in m	188.22	187.74	187.32
Safe load in Uplift in kN	986.60	1473.06	1975.87
Self-weight of pile in kN	35.10	59.58	87.56
Safe load in Uplift in T (Considering self-weight of pile)	102.17	153.26	206.34

6.0 Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60	0.76	0.90
Subgrade reaction in MN/m^3		8.64	8.64	8.64
Stiffness factor T in m		1.83	2.21	2.53
Depth of fixity in m	Free Head	3.50	4.20	4.80
	Fixed Head	4.00	4.80	5.50
Allowable Horizontal Force in T	Free Head	6.30	9.20	12.10
	Fixed Head	16.80	24.50	32.10
Allowable Moment capacity in Tm	Free Head	7.71	13.59	20.39
	Fixed Head	27.43	48.38	72.59

7.0 Notes

1. Pile shall be terminated after socketing 3D inside rock.
2. Initial and routine pile load test is required to verify the actual carrying capacity of pile in compression, uplift and lateral loads.
3. For design and construction, specification of IS: 2911, P1/S2, IS: 456, 2000 shall strictly be followed.

(Dr. K. K. Thaker)

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APPENDIX - 3 (For IBH-14 (Coal conveyor BC-2A/B, Weigh bridge))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Depth of Foundation from NGL (RL:198.77m)	Depth of Foundation from FGL (RL:202.50m)	RL of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 3.1)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 3.2)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	4.73	197.77	1.50	1.50	23	87	139	23	23
1.00	4.73	197.77	2.00	2.00	24	65	104	24	24
1.00	4.73	197.77	2.50	2.50	25	52	83	25	25
1.00	4.73	197.77	3.00	3.00	27	43	69	27	27
1.50	5.23	197.27	1.50	1.50	29	87	139	29	29
1.50	5.23	197.27	2.00	2.00	29	65	104	29	29
1.50	5.23	197.27	2.50	2.50	30	52	83	30	30
1.50	5.23	197.27	3.00	3.00	31	43	69	31	31
2.00	5.73	196.77	1.50	1.50	35	87	139	35	35
2.00	5.73	196.77	2.00	2.00	35	65	104	35	35
2.00	5.73	196.77	2.50	2.50	35	52	83	35	35
2.00	5.73	196.77	3.00	3.00	36	43	69	36	36

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 198.77m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 3.1 (For IBH-14 (Coal conveyor BC-2A/B, Weigh bridge))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from NGL m	Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5 γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	1.00	4.73	197.77	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.19	1.09	1.09	1.00	1.00	1.00	2.19	1.10	0.50	0.50	23
2	2.00	2.00	1.00	4.73	197.77	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	2.19	1.10	0.50	0.50	24
3	2.50	2.50	1.00	4.73	197.77	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.11	1.06	1.06	1.00	1.00	1.00	2.19	1.10	0.50	0.50	25
4	3.00	3.00	1.00	4.73	197.77	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.09	1.05	1.05	1.00	1.00	1.00	2.19	1.10	0.50	0.50	27
5	1.50	1.50	1.50	5.23	197.27	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.28	1.14	1.14	1.00	1.00	1.00	2.19	1.10	0.50	0.50	29
6	2.00	2.00	1.50	5.23	197.27	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.21	1.11	1.11	1.00	1.00	1.00	2.19	1.10	0.50	0.50	29
7	2.50	2.50	1.50	5.23	197.27	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.17	1.08	1.08	1.00	1.00	1.00	2.19	1.10	0.50	0.50	30
8	3.00	3.00	1.50	5.23	197.27	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	2.19	1.10	0.50	0.50	31
9	1.50	1.50	2.00	5.73	196.77	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.38	1.19	1.19	1.00	1.00	1.00	2.19	1.10	0.50	0.50	35
10	2.00	2.00	2.00	5.73	196.77	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.28	1.14	1.14	1.00	1.00	1.00	2.19	1.10	0.50	0.50	35
11	2.50	2.50	2.00	5.73	196.77	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.23	1.11	1.11	1.00	1.00	1.00	2.19	1.10	0.50	0.50	35
12	3.00	3.00	2.00	5.73	196.77	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.19	1.09	1.09	1.00	1.00	1.00	2.19	1.10	0.50	0.50	36

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 198.77m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 3.2 (For IBH-14 (Coal conveyor BC-2A/B, Weigh bridge))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_i = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D m	Depth of foundation from FGL m	RL of Foundation m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	4.73	197.77	1.50	1.12	0.35	409	0.80	87	139
2	1.00	4.73	197.77	2.00	1.12	0.35	409	0.80	65	104
3	1.00	4.73	197.77	2.50	1.12	0.35	409	0.80	52	83
4	1.00	4.73	197.77	3.00	1.12	0.35	409	0.80	43	69
5	1.50	5.23	197.27	1.50	1.12	0.35	409	0.80	87	139
6	1.50	5.23	197.27	2.00	1.12	0.35	409	0.80	65	104
7	1.50	5.23	197.27	2.50	1.12	0.35	409	0.80	52	83
8	1.50	5.23	197.27	3.00	1.12	0.35	409	0.80	43	69
9	2.00	5.73	196.77	1.50	1.12	0.35	409	0.80	87	139
10	2.00	5.73	196.77	2.00	1.12	0.35	409	0.80	65	104
11	2.00	5.73	196.77	2.50	1.12	0.35	409	0.80	52	83
12	2.00	5.73	196.77	3.00	1.12	0.35	409	0.80	43	69

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 3.3 (For IBH-14 (Coal conveyor BC-2A/B, Weigh bridge))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTP) at village- Hirma, Talabira, Odisha

Depth of Foundation from NGL (RL:198.77m)	Depth of Foundation from FGL (RL:202.50m)	RL of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 3.4)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 3.5)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	4.73	197.77	3.50	3.50	28	37	59	28	28
1.00	4.73	197.77	4.00	4.00	29	33	52	29	29
1.00	4.73	197.77	5.00	5.00	32	26	42	26	32
1.00	4.73	197.77	6.00	6.00	35	22	35	22	35
1.50	5.23	197.27	3.50	3.50	32	37	59	32	32
1.50	5.23	197.27	4.00	4.00	34	33	52	33	34
1.50	5.23	197.27	5.00	5.00	36	26	42	26	36
1.50	5.23	197.27	6.00	6.00	39	22	35	22	35
2.00	5.73	196.77	3.50	3.50	37	37	59	37	37
2.00	5.73	196.77	4.00	4.00	38	33	52	33	38
2.00	5.73	196.77	5.00	5.00	41	26	42	26	41
2.00	5.73	196.77	6.00	6.00	43	22	35	22	35

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 198.77m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 3.4 (For IBH-14 (Coal conveyor BC-2A/B, Weigh bridge))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from NGL m	Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5 γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	1.00	4.73	197.77	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	2.19	1.10	0.50	0.50	28
2	4.00	4.00	1.00	4.73	197.77	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.07	1.04	1.04	1.00	1.00	1.00	2.19	1.10	0.50	0.50	29
3	5.00	5.00	1.00	4.73	197.77	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	2.19	1.10	0.50	0.50	32
4	6.00	6.00	1.00	4.73	197.77	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.05	1.02	1.02	1.00	1.00	1.00	2.19	1.10	0.50	0.50	35
5	3.50	3.50	1.50	5.23	197.27	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.12	1.06	1.06	1.00	1.00	1.00	2.19	1.10	0.50	0.50	32
6	4.00	4.00	1.50	5.23	197.27	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.11	1.05	1.05	1.00	1.00	1.00	2.19	1.10	0.50	0.50	34
7	5.00	5.00	1.50	5.23	197.27	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	2.19	1.10	0.50	0.50	36
8	6.00	6.00	1.50	5.23	197.27	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.07	1.04	1.04	1.00	1.00	1.00	2.19	1.10	0.50	0.50	39
9	3.50	3.50	2.00	5.73	196.77	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.16	1.08	1.08	1.00	1.00	1.00	2.19	1.10	0.50	0.50	37
10	4.00	4.00	2.00	5.73	196.77	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	2.19	1.10	0.50	0.50	38
11	5.00	5.00	2.00	5.73	196.77	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.11	1.06	1.06	1.00	1.00	1.00	2.19	1.10	0.50	0.50	41
12	6.00	6.00	2.00	5.73	196.77	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.09	1.05	1.05	1.00	1.00	1.00	2.19	1.10	0.50	0.50	43

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 198.77m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 3.5 (For IBH-14 (Coal conveyor BC-2A/B, Weigh bridge))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_i = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D m	Depth of foundation from FGL m	RL of Foundation m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	4.73	197.77	3.50	1.12	0.35	409	0.80	37	59
2	1.00	4.73	197.77	4.00	1.12	0.35	409	0.80	33	52
3	1.00	4.73	197.77	5.00	1.12	0.35	409	0.80	26	42
4	1.00	4.73	197.77	6.00	1.12	0.35	409	0.80	22	35
5	1.50	5.23	197.27	3.50	1.12	0.35	409	0.80	37	59
6	1.50	5.23	197.27	4.00	1.12	0.35	409	0.80	33	52
7	1.50	5.23	197.27	5.00	1.12	0.35	409	0.80	26	42
8	1.50	5.23	197.27	6.00	1.12	0.35	409	0.80	22	35
9	2.00	5.73	196.77	3.50	1.12	0.35	409	0.80	37	59
10	2.00	5.73	196.77	4.00	1.12	0.35	409	0.80	33	52
11	2.00	5.73	196.77	5.00	1.12	0.35	409	0.80	26	42
12	2.00	5.73	196.77	6.00	1.12	0.35	409	0.80	22	35

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 3.6 (For IBH-14 (Coal conveyor BC-2A/B, Weigh bridge))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTP) at village- Hirma, Talabira, Odisha

Depth of Foundation from NGL (RL:198.77m)	Depth of Foundation from FGL (RL:202.50m)	RL of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 3.7)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 3.8)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	4.73	197.77	7.00	7.00	38	19	30	19	30
1.00	4.73	197.77	8.00	8.00	40	16	26	16	26
1.00	4.73	197.77	9.00	9.00	43	14	23	14	23
1.00	4.73	197.77	10.00	10.00	46	13	21	13	21
1.50	5.23	197.27	7.00	7.00	42	19	30	19	30
1.50	5.23	197.27	8.00	8.00	45	16	26	16	26
1.50	5.23	197.27	9.00	9.00	47	14	23	14	23
1.50	5.23	197.27	10.00	10.00	50	13	21	13	21
2.00	5.73	196.77	7.00	7.00	46	19	30	19	30
2.00	5.73	196.77	8.00	8.00	49	16	26	16	26
2.00	5.73	196.77	9.00	9.00	52	14	23	14	23
2.00	5.73	196.77	10.00	10.00	54	13	21	13	21

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 198.77m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 3.7 (For IBH-14 (Coal conveyor BC-2A/B, Weigh bridge))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from NGL m	Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5 γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	1.00	4.73	197.77	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.04	1.02	1.02	1.00	1.00	1.00	2.19	1.10	0.50	0.50	38
2	8.00	8.00	1.00	4.73	197.77	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.04	1.02	1.02	1.00	1.00	1.00	2.19	1.10	0.50	0.50	40
3	9.00	9.00	1.00	4.73	197.77	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.03	1.02	1.02	1.00	1.00	1.00	2.19	1.10	0.50	0.50	43
4	10.00	10.00	1.00	4.73	197.77	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.03	1.01	1.01	1.00	1.00	1.00	2.19	1.10	0.50	0.50	46
5	7.00	7.00	1.50	5.23	197.27	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	2.19	1.10	0.50	0.50	42
6	8.00	8.00	1.50	5.23	197.27	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.05	1.03	1.03	1.00	1.00	1.00	2.19	1.10	0.50	0.50	45
7	9.00	9.00	1.50	5.23	197.27	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.05	1.02	1.02	1.00	1.00	1.00	2.19	1.10	0.50	0.50	47
8	10.00	10.00	1.50	5.23	197.27	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.04	1.02	1.02	1.00	1.00	1.00	2.19	1.10	0.50	0.50	50
9	7.00	7.00	2.00	5.73	196.77	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	2.19	1.10	0.50	0.50	46
10	8.00	8.00	2.00	5.73	196.77	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.07	1.04	1.04	1.00	1.00	1.00	2.19	1.10	0.50	0.50	49
11	9.00	9.00	2.00	5.73	196.77	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	2.19	1.10	0.50	0.50	52
12	10.00	10.00	2.00	5.73	196.77	0.10	28	25.80	13.72	16.72	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	2.19	1.10	0.50	0.50	54

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 198.77m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 3.8 (For IBH-14 (Coal conveyor BC-2A/B, Weigh bridge))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_i = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D m	Depth of foundation from FGL m	RL of Foundation m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	4.73	197.77	7.00	1.12	0.35	409	0.80	19	30
2	1.00	4.73	197.77	8.00	1.12	0.35	409	0.80	16	26
3	1.00	4.73	197.77	9.00	1.12	0.35	409	0.80	14	23
4	1.00	4.73	197.77	10.00	1.12	0.35	409	0.80	13	21
5	1.50	5.23	197.27	7.00	1.12	0.35	409	0.80	19	30
6	1.50	5.23	197.27	8.00	1.12	0.35	409	0.80	16	26
7	1.50	5.23	197.27	9.00	1.12	0.35	409	0.80	14	23
8	1.50	5.23	197.27	10.00	1.12	0.35	409	0.80	13	21
9	2.00	5.73	196.77	7.00	1.12	0.35	409	0.80	19	30
10	2.00	5.73	196.77	8.00	1.12	0.35	409	0.80	16	26
11	2.00	5.73	196.77	9.00	1.12	0.35	409	0.80	14	23
12	2.00	5.73	196.77	10.00	1.12	0.35	409	0.80	13	21

Appendix – 3A

Calculation of Safe Load carrying capacity of piles socketed inside rock

(Near IBH 14)

(Coal Conveyor BC-2A/B, Weigh bridge)

Project Name: - Proposed structures of thermal power project of NTTTP at Hirma, Talabira

1.0 Introduction

In situations where overburden offering low bearing pressure is followed by rock at relatively shallower depths, end bearing piles is the suitable foundation option. Piles in rocks and weathered rocks of varying degree of weathering derive their capacity by end bearing and socket side resistance.

In situations, where, rock strata comprises of highly fragmented rock, as in present case, where RQD is nil or $(CR+RQD)/2$ is less than 30 % or when the crushing strength is less than 10 MPa, the appropriate approach would be of that suggested by Cole & Stroud.

In present site overburden soils overlay fractured / laminated / foliated rock. The founding stratum having highly fragmented rock with nil RQD and $(CR+RQD)/2$ to be less than 30 %, the approach suggested by Cole and Stroud as per Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 Pa/S2 has been used for safe load calculations.

An illustrative calculation of safe load on pile and summary of pile capacities is as follows,

2.0 Sub soil strata Characterization

General stratification at the location of boreholes IBH14 show primarily two characterized layers,

1. Overburden comprising of Yellowish brown, fine to medium grained, clayey sand and silty sand with much to some gravels upto 18.80m (i.e. RL 179.97 m).
2. Second characterized layer below the overburden soils comprises of Boulderous formation of highly weathered, weak and friable, dark brownish yellow, fine to coarse grained, gravels, pebbles, cobbles size fractured rock fragments with infilled dark brownish, fine to coarse grained, sand upto 25.00m (i.e. RL 173.77m).

3.0 Design Considerations

1. Length of socket considered 3D from depth of rock encountered.
2. The pile is considered to have socket length below 18.80 m below NGL (i.e. RL 179.97 m) depth.
3. For present case of pile terminating in highly weathered rock. SPT at depths between 18.80 to 25.00m (between RL 179.97 to 173.77 m) is > 100 with just 5.0 cm (Average) penetration in 50 blows. SPT can be extrapolated for 30 cm i.e. $50 * 30 / 5.00 = 300$.
Based on recommendation of fig no. 3 in B 8 in Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 P1/S2, average shear strength q_c corresponding to assumed SPT of 200 may be taken as 1300 kN/m²
4. Allowable Capacity of pile socketed into rock $Q_a = R_e + R_{sf} = C_{u1} N_c \pi B^2 / 4 (F_s = 3) + \alpha C_{u2} \pi BL / (F_s = 6)$

4.0 Safe Load on Pile in Compression

Where,

End bearing component, $R_e = C_{u1} N_c \pi B^2 / 4 F_s$,

C_{u1} = Shear strength below base of pile = 1300 kN/m²

B = diameter of the pile = d

F_s = Factor of Safety = 3

$N_c = 9$

Therefore, **$R_e = 3061.5 d^2$**

Skin friction component of socketed length of pile, $R_{sf} = \alpha C_{u2} \pi BL / F_s$

$\alpha = 0.9$ (recommended value in IS 2911 P1/S2)

L = length of the socket = $3 D$

C_{u2} = Ultimate shear strength along socket length which shall be restricted to shear capacity of concrete of the pile = 1300 kN/m^2

F_s = Factor of Safety = 6

Therefore, $R_{sf} = 1836.9 d^2$

Thus,

$$Q_a = c_{u1} N_c \cdot \frac{\pi B^2}{4 F_s} + \alpha c_{u2} \cdot \frac{\pi B L}{F_s}$$

$$= 3061.5 d^2 + 1836.9 d^2 = 4898.4 d^2$$

Substituting the values of various diameters and socket lengths equal to 3 times diameter, allowable load on single pile can be summarized as follows,

Summary of the Safe load calculation in Compression

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	24.33	24.81	25.23
Termination level RL in m	178.17	177.69	177.27
End Bearing Component in kN	1102.1	1768.3	2479.8
Friction Component in kN	661.3	1060.9	1487.9
Safe load in Compression in kN	1763.4	2829.3	3967.7
Safe load in Compression in T	176	283	397

5.0 Safe Load on Pile in uplift

For 4.00m cutoff from FGL

The overburden soils, though, will not contribute in compression capacity would offer resistance in uplift capacity. The parameters of IBH 14 are considered for calculation of uplift resistance as summarized below,

Depth in m from RL 202.5 m	Cohesion in kg/cm^2	Angle of Internal Friction ϕ	Submerged density in $\text{gm/cc } \gamma_{\text{sub}}$	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 4.00	Pile cutoff level – No pile						
4.00 to 6.33	0.10(ignored)	28	1.19	NA	1.00	28	39-48
6.33 to 22.53	0.05(ignored)	31	1.19	NA	1.00	31	25->100
22.53 to 28.73	Rock strata – Resistance would be as per skin friction capacity in socket as already calculated in compression capacity						

Note - \$ Weighted average data considered. NA means not applicable.

B Ultimate load in skin friction,

$$Q_{uf} = \alpha_i C_{ai} A_{si} + K_i P D_i \tan \delta_i A_{si}$$

First Layer – No contribution considered – (Within Cutoff Level).

$$\text{Second Layer} - K_2 P D_2 \tan \delta_2 A_{s2} = 1.00 * 4.59 * \tan 28 * \pi d * 2.33 = 17.86 d$$

$$\text{Third Layer} - K_4 P D_4 \tan \delta_4 A_{s4} = 1.00 * 12.01 * \tan 31 * \pi d * 16.20 = 367.27 d$$

Fourth Layer – $1836.90 d^2$ in rock socket

$$\text{Substituting, ultimate load } q_{uf} = 3851.3 d + 1836.9 d^2$$

The safe load in uplift is worked out (considering the safety factor of 2.50 for overburden soils) and summarized below,

Safe Load on Piles in Uplift (in Ton)

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	24.33	24.81	25.23
Termination level RL in m	178.17	177.69	177.27
Safe load in Uplift in kN	1585.60	2231.79	2874.36
Self-weight of pile in kN	86.18	141.53	202.49
Safe load in Uplift in T (Considering self-weight of pile)	167.18	237.33	307.69

6.0 Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60	0.76	0.90
Subgrade reaction in MN/m^3		5.00	5.00	5.00
Stiffness factor T in m		2.04	2.47	2.83
Depth of fixity in m	Free Head	3.90	4.70	5.40
	Fixed Head	4.50	5.40	6.20
Allowable Horizontal Force in T	Free Head	4.60	6.70	8.70
	Fixed Head	12.10	17.60	23.10
Allowable Moment capacity in Tm	Free Head	6.19	10.92	16.39
	Fixed Head	22.04	38.87	58.32

7.0 Notes

1. Pile shall be terminated after socketing 3D inside rock.
2. Initial and routine pile load test is required to verify the actual carrying capacity of pile in compression, uplift and lateral loads.
3. For design and construction, specification of IS: 2911, P1/S2, IS: 456, 2000 shall strictly be followed.

(Dr. K. K. Thaker)

Appendix – 4A
Calculation of Safe Load carrying capacity of piles socketed inside rock
(Near IBH 15)
(Coal Conveyor BC-3A/B, Pipe rack)

Project Name: - Proposed structures of thermal power project of NTTTP at Hirma, Talabira

1.0 Introduction

In situations where overburden offering low bearing pressure is followed by rock at relatively shallower depths, end bearing piles is the suitable foundation option. Piles in rocks and weathered rocks of varying degree of weathering derive their capacity by end bearing and socket side resistance.

In situations, where, rock strata comprises of highly fragmented rock, as in present case, where RQD is nil or $(CR+RQD)/2$ is less than 30 % or when the crushing strength is less than 10 MPa, the appropriate approach would be of that suggested by Cole & Stroud.

In present site overburden soils overlay fractured / laminated / foliated rock. The founding stratum having highly fragmented rock with nil RQD and $(CR+RQD)/2$ to be less than 30 %, the approach suggested by Cole and Stroud as per Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 Pa/S2 has been used for safe load calculations.

An illustrative calculation of safe load on pile and summary of pile capacities is as follows,

2.0 Sub soil strata Characterization

General stratification at the location of boreholes IBH 15 show primarily two characterized layers,

1. Overburden comprising of fine to medium grained, silty sand and clayey sand with little plastic fines and occasional gravels upto 19.15m (i.e. RL 181.80 m).
2. Second characterized layer below the overburden soils comprises of Highly weathered, weak, yellowish brown, fine to coarse grained, fractured rock upto 23.00m (i.e. RL 177.95m).

3.0 Design Considerations

1. Length of socket considered 3D from depth of rock encountered.
2. The pile is considered to have socket length below 19.15 m below NGL (i.e. RL 181.80 m) depth.
3. For present case of pile terminating in highly weathered rock. SPT at depths between 19.15 to 23.00m (between RL 181.80 to 177.95 m) is > 100 with just 6.50 cm (Average) penetration in 52 blows. SPT can be extrapolated for 30 cm i.e. $52 * 30 / 6.50 = 240$.
Based on recommendation of fig no. 3 in B 8 in Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 P1/S2, average shear strength q_c corresponding to assumed SPT of 200 may be taken as 1300 kN/m²
4. Allowable Capacity of pile socketed into rock $Q_a = R_e + R_{sf} = C_{u1} N_c \pi B^2 / 4 (F_s = 3) + \alpha C_{u2} \pi BL / (F_s = 6)$

4.0 Safe Load on Pile in Compression

Where,

End bearing component, $R_e = C_{u1} N_c \pi B^2 / 4 F_s$,

C_{u1} = Shear strength below base of pile = 1300 kN/m²

B = diameter of the pile = d

F_s = Factor of Safety = 3

$N_c = 9$

Therefore, **$R_e = 3061.5 d^2$**

Skin friction component of socketed length of pile, $R_{sf} = \alpha C_{u2} \pi BL / F_s$

$\alpha = 0.9$ (recommended value in IS 2911 P1/S2)

L = length of the socket = 3 D

C_{u2} = Ultimate shear strength along socket length which shall be restricted to shear capacity of concrete of the pile = 1300 kN/m²

F_s = Factor of Safety = 6

Therefore, $R_{sf} = 1836.9 \text{ d}^2$

Thus,

$$Q_a = c_{u1} N_c \cdot \frac{\pi B^2}{4 F_s} + \alpha c_{u2} \cdot \frac{\pi B L}{F_s}$$

$$= 3061.5 \text{ d}^2 + 1836.9 \text{ d}^2 = 4898.4 \text{ d}^2$$

Substituting the values of various diameters and socket lengths equal to 3 times diameter, allowable load on single pile can be summarized as follows,

Summary of the Safe load calculation in Compression

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	22.50	22.98	23.40
Termination level RL in m	180.00	179.52	179.10
End Bearing Component in kN	1102.1	1768.3	2479.8
Friction Component in kN	661.3	1060.9	1487.9
Safe load in Compression in kN	1763.4	2829.3	3967.7
Safe load in Compression in T	176	283	397

5.0 Safe Load on Pile in uplift

For 2.00m cutoff from FGL

The overburden soils, though, will not contribute in compression capacity would offer resistance in uplift capacity. The parameters of IBH 15 are considered for calculation of uplift resistance as summarized below,

Depth in m from RL 202.5 m	Cohesion in kg/cm ²	Angle of Internal Friction ϕ	Submerged density in gm/cc γ_{sub}	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 2.00	Pile cutoff level – No pile						
2.00 to 7.95	0.06(ignored)	28	0.97	NA	1.00	28	18-61
7.95 to 20.70	0.00	34	1.08	NA	1.50	34	>100
20.70 to 26.55	Rock strata – Resistance would be as per skin friction capacity in socket as already calculated in compression capacity						

Note - \$ Weighted average data considered. NA means not applicable.

Ultimate load in skin friction,

$$Q_{uf} = \alpha_i C_{ai} A_{si} + K_i P D_i \tan \delta_i A_{si}$$

First Layer – No contribution considered – (Within Cutoff Level).

$$\text{Second Layer} - K_2 P D_2 \tan \delta_2 A_{s2} = 1.00 * 4.49 * \tan 28^\circ * \pi d * 5.95 = 44.63 \text{ d}$$

$$\text{Third Layer} - K_3 P D_3 \tan \delta_3 A_{s3} = 1.50 * 11.10 * \tan 34^\circ * \pi d * 12.75 = 449.84 \text{ d}$$

Fourth Layer – 1836.90 d² in rock socket

$$\text{Substituting, ultimate load } q_{uf} = 4944.74 \text{ d} + 1836.9 \text{ d}^2$$

The safe load in uplift is worked out (considering the safety factor of 2.50 for overburden soils) and summarized below,

Safe Load on Piles in Uplift (in Ton)

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	22.50	22.98	23.40
Termination level RL in m	180.00	179.52	179.10
Safe load in Uplift in kN	1848.02	2564.19	3268.00
Self-weight of pile in kN	86.90	142.69	204.11
Safe load in Uplift in T (Considering self-weight of pile)	193.49	270.69	347.21

6.0 Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60	0.76	0.90
Subgrade reaction in MN/m^3		3.13	3.13	3.13
Stiffness factor T in m		2.24	2.71	3.10
Depth of fixity in m	Free Head	4.30	5.10	5.90
	Fixed Head	4.90	5.90	6.80
Allowable Horizontal Force in T	Free Head	3.40	5.00	6.60
	Fixed Head	9.10	13.30	17.40
Allowable Moment capacity in Tm	Free Head	5.13	9.05	13.59
	Fixed Head	18.28	32.23	48.36

7.0 Notes

1. Pile shall be terminated after socketing 3D inside rock.
2. Initial and routine pile load test is required to verify the actual carrying capacity of pile in compression, uplift and lateral loads.
3. For design and construction, specification of IS: 2911, P1/S2, IS: 456, 2000 shall strictly be followed.

(Dr. K. K. Thaker)

Appendix – 5A

Calculation of Safe Load carrying capacity of piles socketed inside rock

(Near IBH 16 & 17)

(Coal conveyor BC-4A/B)

Project Name: - Proposed structures of thermal power project of NTTTP at Hirma, Talabira

1.0 Introduction

In situations where overburden offering low bearing pressure is followed by rock at relatively shallower depths, end bearing piles is the suitable foundation option. Piles in rocks and weathered rocks of varying degree of weathering derive their capacity by end bearing and socket side resistance.

In situations, where, rock strata comprises of highly fragmented rock, as in present case, where RQD is nil or $(CR+RQD)/2$ is less than 30 % or when the crushing strength is less than 10 MPa, the appropriate approach would be of that suggested by Cole & Stroud.

In present site overburden soils overlay fractured / laminated / foliated rock. The founding stratum having highly fragmented rock with nil RQD and $(CR+RQD)/2$ to be less than 30 %, the approach suggested by Cole and Stroud as per Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 Pa/S2 has been used for safe load calculations.

An illustrative calculation of safe load on pile and summary of pile capacities is as follows,

2.0 Sub soil strata Characterization

General stratification at the location of boreholes IBH 17 show primarily two characterized layers,

1. Overburden comprising of fine to medium grained, sandy clays of low, intermediate, high plasticity and fine to very fine grained, clayey sand and silty sand with little to occasional gravels upto 17.60m (i.e. RL 183.10 m).
2. Second characterized layer below the overburden soils comprises of Highly weathered, completely fractured and disintegration, dark brownish black, fine to coarse grained, gravels, pebbles and cobbles size fractured rock fragments with infilled sandy clays upto 20.50m (i.e. RL 180.20m).

3.0 Design Considerations

1. Length of socket considered 3D from depth of rock encountered.
2. The pile is considered to have socket length below 17.60 m below NGL (i.e. RL 183.10 m) depth.
3. For present case of pile terminating in highly weathered rock. SPT at depths between 17.60 to 20.50m (between RL 183.10 to 180.20 m) is > 100 with just 7.50 cm (Average) penetration in 51 blows. SPT can be extrapolated for 30 cm i.e. $51 * 30 / 7.50 = 204$.
Based on recommendation of fig no. 3 in B 8 in Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 P1/S2, average shear strength q_c corresponding to assumed SPT of 200 may be taken as 1300 kN/m²
4. Allowable Capacity of pile socketed into rock $Q_a = R_e + R_{sf} = C_{u1} N_c \pi B^2 / 4 (F_s = 3) + \alpha C_{u2} \pi BL / (F_s = 6)$

4.0 Safe Load on Pile in Compression

Where,

End bearing component, $R_e = C_{u1} N_c \pi B^2 / 4 F_s$,

C_{u1} = Shear strength below base of pile = 1300 kN/m²

B = diameter of the pile = d

F_s = Factor of Safety = 3

$N_c = 9$

Therefore, **$R_e = 3061.5 d^2$**

Skin friction component of socketed length of pile, $R_{sf} = \alpha C_{u2} \pi BL / F_s$

$\alpha = 0.9$ (recommended value in IS 2911 P1/S2)

L = length of the socket = $3 D$

C_{u2} = Ultimate shear strength along socket length which shall be restricted to shear capacity of concrete of the pile = 1300 kN/m^2

F_s = Factor of Safety = 6

Therefore, $R_{sf} = 1836.9 d^2$

Thus,

$$Q_a = c_{u1} N_c \cdot \frac{\pi B^2}{4 F_s} + \alpha c_{u2} \cdot \frac{\pi B L}{F_s}$$

$$= 3061.5 d^2 + 1836.9 d^2 = 4898.4 d^2$$

Substituting the values of various diameters and socket lengths equal to 3 times diameter, allowable load on single pile can be summarized as follows,

Summary of the Safe load calculation in Compression

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	21.20	21.68	22.10
Termination level RL in m	181.30	180.82	180.40
End Bearing Component in kN	1102.1	1768.3	2479.8
Friction Component in kN	661.3	1060.9	1487.9
Safe load in Compression in kN	1763.4	2829.3	3967.7
Safe load in Compression in T	176	283	397

5.0 Safe Load on Pile in uplift

For 2.00m cutoff from FGL

The overburden soils, though, will not contribute in compression capacity would offer resistance in uplift capacity. The parameters of IBH 17 are considered for calculation of uplift resistance as summarized below,

Depth in m from RL 202.5 m	Cohesion in kg/cm ²	Angle of Internal Friction ϕ	Submerged density in gm/cc γ_{sub}	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 2.00	Pile cutoff level – No pile						
2.00 to 4.10	0.44	0	0.82	0.97	NA	NA	11-14
4.10 to 5.20	0.07(ignored)	25	0.82	NA	1.00	25	15
5.20 to 8.10	0.78	7(ignored)	0.97	0.59	NA	NA	12-25
8.10 to 9.60	0.08(ignored)	27	1.00	NA	1.00	27	20
9.60 to 13.20	1.30	6(ignored)	1.08	0.34	NA	NA	23-30
13.20 to 19.40	0.00	34	1.10	NA	1.50	34	20->100
19.40 to 26.80	Rock strata – Resistance would be as per skin friction capacity in socket as already calculated in compression capacity						

Ultimate load in skin friction,

$$Q_{uf} = \alpha_i C_{ai} A_{si} + K_i P D_i \tan \delta_i A_{si}$$

First Layer – No contribution considered – (Within Cutoff Level).

$$\text{Second Layer} - \alpha_2 C_{a2} A_{s2} = 0.97 * 4.40 * \pi d * 2.10 = 28.16d$$

$$\text{Third Layer} - K_3 P D_3 \tan \delta_3 A_{s3} = 1.00 * 3.77 * \tan 25^\circ * \pi d * 1.10 = 6.08 d$$

$$\text{Fourth Layer} - \alpha_4 C_{a4} A_{s4} = 0.59 * 7.80 * \pi d * 2.90 = 41.93d$$

$$\text{Fifth Layer} - K_5 P D_5 \tan \delta_5 A_{s5} = 1.00 * 7.79 * \tan 27^\circ * \pi d * 1.50 = 18.70 d$$

$$\text{Sixth Layer} - \alpha_6 C_{a6} A_{s6} = 0.34 * 13.00 * \pi d * 3.60 = 49.99d$$

$$\text{Seventh Layer} - K_7 P D_7 \tan \delta_7 A_{s7} = 1.50 * 10.48 * \tan 34^\circ * \pi d * 6.20 = 206.53 d$$

$$\text{Eighth Layer} - 1836.90 d^2 \text{ in rock socket}$$

Substituting, ultimate load $q_{uf} = 3513.90 d + 1836.90 d^2$

The safe load in uplift is worked out (considering the safety factor of 2.50 for overburden soils) and summarized below,

Safe Load on Piles in Uplift (in Ton)

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	21.20	21.68	22.10
Termination level RL in m	181.30	180.82	180.40
Safe load in Uplift in kN	1504.62	2129.22	2752.89
Self-weight of pile in kN	81.39	133.85	191.71
Safe load in Uplift in T (Considering self-weight of pile)	158.60	226.61	294.46

6.0 Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60	0.76	0.90
Subgrade reaction in MN/m ³		15.84	15.84	15.84
Stiffness factor T in m		1.62	1.96	2.24
Depth of fixity in m	Free Head	3.10	3.70	4.30
	Fixed Head	3.50	4.30	4.90
Allowable Horizontal Force in T	Free Head	9.10	13.30	17.40
	Fixed Head	24.10	35.20	46.10
Allowable Moment capacity in Tm	Free Head	9.82	17.32	25.99
	Fixed Head	34.96	61.65	92.50

7.0 Notes

1. Pile shall be terminated after socketing 3D inside rock.
2. Initial and routine pile load test is required to verify the actual carrying capacity of pile in compression, uplift and lateral loads.
3. For design and construction, specification of IS: 2911, P1/S2, IS: 456, 2000 shall strictly be followed.

(Dr. K. K. Thaker)

Appendix – 6A

Calculation of Safe Load carrying capacity of piles socketed inside rock (Near IBH 18,19) (Coal Conveyor BC-5A/B IN BTG area)

Project Name: - Proposed structures of thermal power project of NTTTP at Hirma, Talabira

1.0 Introduction

In situations where overburden offering low bearing pressure is followed by rock at relatively shallower depths, end bearing piles is the suitable foundation option. Piles in rocks and weathered rocks of varying degree of weathering derive their capacity by end bearing and socket side resistance.

In situations, where, rock strata comprises of highly fragmented rock, as in present case, where RQD is nil or $(CR+RQD)/2$ is less than 30 % or when the crushing strength is less than 10 MPa, the appropriate approach would be of that suggested by Cole & Stroud.

In present site overburden soils overlay fractured / laminated / foliated rock. The founding stratum having highly fragmented rock with nil RQD and $(CR+RQD)/2$ to be less than 30 %, the approach suggested by Cole and Stroud as per Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 Pa/S2 has been used for safe load calculations.

An illustrative calculation of safe load on pile and summary of pile capacities is as follows,

2.0 Sub soil strata Characterization

General stratification at the location of boreholes IBH 18 show primarily two characterized layers,

1. Overburden comprising of fine to very fine grained, sandy clays of intermediate to high plasticity with occasional gravels and fine to medium grained, clayey and silty sand with little plastic fines up to 14.20 m (i.e. RL 186.14 m).
2. Second characterized layer below the overburden soils comprises of Highly weathered, very weak, dark greenish grey, very fine grained, very weak, very thinly laminated, foliated SHALE upto 16.00m (i.e. RL 184.34 m).

3.0 Design Considerations

1. Length of socket considered 3D from depth of rock encountered.
2. The pile is considered to have socket length below 14.20 m below NGL (i.e. RL 186.14 m) depth.
3. For present case of pile terminating in highly weathered rock. SPT at depths between 14.20 to 16.00m (between RL 186.14 to 184.34 m) is > 200.
Based on recommendation of fig no. 3 in B 8 in Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 P1/S2, average shear strength q_c corresponding to assumed SPT of 200 may be taken as 1300 kN/m²
4. Allowable Capacity of pile socketed into rock $Q_a = R_e + R_{sf} = C_{u1} N_c \pi B^2 / 4 (F_s = 3) + \alpha C_{u2} \pi BL / (F_s = 6)$

4.0 Safe Load on Pile in Compression

Where,

End bearing component, $R_e = C_{u1} N_c \pi B^2 / 4 F_s$,

C_{u1} = Shear strength below base of pile = 1300 kN/m²

B = diameter of the pile = d

F_s = Factor of Safety = 3

$N_c = 9$

Therefore, **$R_e = 3061.5 d^2$**

Skin friction component of socketed length of pile, $R_{sf} = \alpha C_{u2} \pi BL / F_s$

$\alpha = 0.9$ (recommended value in IS 2911 P1/S2)

L = length of the socket = $3 D$

C_{u2} = Ultimate shear strength along socket length which shall be restricted to shear capacity of concrete of the pile = 1300 kN/m^2

F_s = Factor of Safety = 6

Therefore, $R_{sf} = 1836.9 \text{ d}^2$

Thus,

$$Q_a = c_{u1} N_c \cdot \frac{\pi B^2}{4 F_s} + \alpha c_{u2} \cdot \frac{\pi B L}{F_s}$$

$$= 3061.5 \text{ d}^2 + 1836.9 \text{ d}^2 = 4898.4 \text{ d}^2$$

Substituting the values of various diameters and socket lengths equal to 3 times diameter, allowable load on single pile can be summarized as follows,

Summary of the Safe load calculation in Compression

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	18.16	18.64	19.06
Termination level RL in m	184.34	183.86	183.44
End Bearing Component in kN	1102.1	1768.3	2479.8
Friction Component in kN	661.3	1060.9	1487.9
Safe load in Compression in kN	1763.4	2829.3	3967.7
Safe load in Compression in T	176	283	397

5.0 Safe Load on Pile in uplift

For 3.00m cutoff from FGL

The overburden soils, though, will not contribute in compression capacity would offer resistance in uplift capacity. The parameters of IBH 18 are considered for calculation of uplift resistance as summarized below,

Depth in m from RL 202.5 m	Cohesion in kg/cm^2	Angle of Internal Friction ϕ	Submerged density in $\text{gm/cc } \gamma_{\text{sub}}$	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 3.00	Pile cutoff level – No pile						
3.00 to 11.66	1.00	4(ignored)	0.98	0.42	NA	NA	11-24
11.66 to 16.36	0.05(ignored)	28	1.04	NA	1.00	28	18->100
16.36 to 27.16	Rock strata – Resistance would be as per skin friction capacity in socket as already calculated in compression capacity						

Ultimate load in skin friction,

$$Q_{uf} = \alpha_i C_{ai} A_{si} + K_i P D_i \tan \delta_i A_{si}$$

First Layer – No contribution considered – (Within Cutoff Level).

$$\text{Second Layer} - \alpha_2 C_{a2} A_{s2} = 0.42 * 10.00 * \pi * d * 8.66 = 114.27d$$

$$\text{Third Layer} - K_3 P D_3 \tan \delta_3 A_{s3} = 1.00 * 10.63 * \tan 28 * \pi * d * 4.70 = 83.46 d$$

Fourth Layer – 1836.90 d^2 in rock socket

Substituting, ultimate load $q_{uf} = 1977.26 d + 1836.9 \text{ d}^2$

The safe load in uplift is worked out (considering the safety factor of 2.50 for overburden soils) and summarized below,

Safe Load on Piles in Uplift (in Ton)

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	18.16	18.64	19.06
Termination level RL in m	184.34	183.86	183.44
Safe load in Uplift in kN	1135.83	1662.08	2199.70
Self-weight of pile in kN	64.26	106.37	153.18
Safe load in Uplift in T (Considering self-weight of pile)	120.00	176.85	235.29

6.0 Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60	0.76	0.90
Subgrade reaction in MN/m^3		15.84	15.84	15.84
Stiffness factor T in m		1.62	1.96	2.24
Depth of fixity in m	Free Head	3.10	3.70	4.30
	Fixed Head	3.50	4.30	4.90
Allowable Horizontal Force in T	Free Head	9.10	13.30	17.40
	Fixed Head	24.10	35.20	46.10
Allowable Moment capacity in Tm	Free Head	9.82	17.32	25.99
	Fixed Head	34.96	61.65	92.50

7.0 Notes

1. Pile shall be terminated after socketing 3D inside rock.
2. Initial and routine pile load test is required to verify the actual carrying capacity of pile in compression, uplift and lateral loads.
3. For design and construction, specification of IS: 2911, P1/S2, IS: 456, 2000 shall strictly be followed.

(Dr. K. K. Thaker)

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 7 (For IBH-20 (Receiving Tower))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:193.46m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
4.00	189.46	13.04	1.50	1.50	21	71	113	21	21
4.00	189.46	13.04	2.00	2.00	20	53	85	20	20
4.00	189.46	13.04	2.50	2.50	19	42	68	19	19
4.00	189.46	13.04	3.00	3.00	19	35	57	19	19
5.00	188.46	14.04	1.50	1.50	26	71	113	26	26
5.00	188.46	14.04	2.00	2.00	24	53	85	24	24
5.00	188.46	14.04	2.50	2.50	23	42	68	23	23
5.00	188.46	14.04	3.00	3.00	22	35	57	22	22
6.00	187.46	15.04	1.50	1.50	31	71	113	31	31
6.00	187.46	15.04	2.00	2.00	28	53	85	28	28
6.00	187.46	15.04	2.50	2.50	27	42	68	27	27
6.00	187.46	15.04	3.00	3.00	26	35	57	26	26

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 193.46m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX 7.1 (For IBH-20 (Receiving Tower))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	4.00	13.04	189.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.71	1.36	1.36	1.00	1.00	1.00	1.96	0.98	0.50	0.50	21
2	2.00	2.00	4.00	13.04	189.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.54	1.27	1.27	1.00	1.00	1.00	1.96	0.98	0.50	0.50	20
3	2.50	2.50	4.00	13.04	189.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.43	1.21	1.21	1.00	1.00	1.00	1.96	0.98	0.50	0.50	19
4	3.00	3.00	4.00	13.04	189.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.36	1.18	1.18	1.00	1.00	1.00	1.96	0.98	0.50	0.50	19
5	1.50	1.50	5.00	14.04	188.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.89	1.45	1.45	1.00	1.00	1.00	1.96	0.98	0.50	0.50	26
6	2.00	2.00	5.00	14.04	188.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.67	1.33	1.33	1.00	1.00	1.00	1.96	0.98	0.50	0.50	24
7	2.50	2.50	5.00	14.04	188.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.54	1.27	1.27	1.00	1.00	1.00	1.96	0.98	0.50	0.50	23
8	3.00	3.00	5.00	14.04	188.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.45	1.22	1.22	1.00	1.00	1.00	1.96	0.98	0.50	0.50	22
9	1.50	1.50	6.00	15.04	187.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	2.07	1.54	1.54	1.00	1.00	1.00	1.96	0.98	0.50	0.50	31
10	2.00	2.00	6.00	15.04	187.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.80	1.40	1.40	1.00	1.00	1.00	1.96	0.98	0.50	0.50	28
11	2.50	2.50	6.00	15.04	187.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.64	1.32	1.32	1.00	1.00	1.00	1.96	0.98	0.50	0.50	27
12	3.00	3.00	6.00	15.04	187.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.54	1.27	1.27	1.00	1.00	1.00	1.96	0.98	0.50	0.50	26

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 193.46m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX 7.2 (For IBH-20 (Receiving Tower))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_1 = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D from NGL m	RL of foundation m	Depth of foundation from FGL m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	4.00	189.46	13.04	1.50	1.12	0.35	334	0.80	71	113
2	4.00	189.46	13.04	2.00	1.12	0.35	334	0.80	53	85
3	4.00	189.46	13.04	2.50	1.12	0.35	334	0.80	42	68
4	4.00	189.46	13.04	3.00	1.12	0.35	334	0.80	35	57
5	5.00	188.46	14.04	1.50	1.12	0.35	334	0.80	71	113
6	5.00	188.46	14.04	2.00	1.12	0.35	334	0.80	53	85
7	5.00	188.46	14.04	2.50	1.12	0.35	334	0.80	42	68
8	5.00	188.46	14.04	3.00	1.12	0.35	334	0.80	35	57
9	6.00	187.46	15.04	1.50	1.12	0.35	334	0.80	71	113
10	6.00	187.46	15.04	2.00	1.12	0.35	334	0.80	53	85
11	6.00	187.46	15.04	2.50	1.12	0.35	334	0.80	42	68
12	6.00	187.46	15.04	3.00	1.12	0.35	334	0.80	35	57

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 7.3 (For IBH-20 (Receiving Tower))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:193.46m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
4.00	189.46	13.04	3.50	3.50	19	30	49	19	19
4.00	189.46	13.04	4.00	4.00	19	27	42	19	19
4.00	189.46	13.04	5.00	5.00	19	21	34	19	19
4.00	189.46	13.04	6.00	6.00	19	18	28	18	19
5.00	188.46	14.04	3.50	3.50	22	30	49	22	22
5.00	188.46	14.04	4.00	4.00	22	27	42	22	22
5.00	188.46	14.04	5.00	5.00	22	21	34	21	22
5.00	188.46	14.04	6.00	6.00	22	18	28	18	22
6.00	187.46	15.04	3.50	3.50	25	30	49	25	25
6.00	187.46	15.04	4.00	4.00	25	27	42	25	25
6.00	187.46	15.04	5.00	5.00	25	21	34	21	25
6.00	187.46	15.04	6.00	6.00	25	18	28	18	25

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 193.46m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX 7.4 (For IBH-20 (Receiving Tower))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	4.00	13.04	189.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.31	1.15	1.15	1.00	1.00	1.00	1.96	0.98	0.50	0.50	19
2	4.00	4.00	4.00	13.04	189.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.27	1.13	1.13	1.00	1.00	1.00	1.96	0.98	0.50	0.50	19
3	5.00	5.00	4.00	13.04	189.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.21	1.11	1.11	1.00	1.00	1.00	1.96	0.98	0.50	0.50	19
4	6.00	6.00	4.00	13.04	189.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.18	1.09	1.09	1.00	1.00	1.00	1.96	0.98	0.50	0.50	19
5	3.50	3.50	5.00	14.04	188.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.38	1.19	1.19	1.00	1.00	1.00	1.96	0.98	0.50	0.50	22
6	4.00	4.00	5.00	14.04	188.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.33	1.17	1.17	1.00	1.00	1.00	1.96	0.98	0.50	0.50	22
7	5.00	5.00	5.00	14.04	188.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.27	1.13	1.13	1.00	1.00	1.00	1.96	0.98	0.50	0.50	22
8	6.00	6.00	5.00	14.04	188.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.22	1.11	1.11	1.00	1.00	1.00	1.96	0.98	0.50	0.50	22
9	3.50	3.50	6.00	15.04	187.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.46	1.23	1.23	1.00	1.00	1.00	1.96	0.98	0.50	0.50	25
10	4.00	4.00	6.00	15.04	187.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.40	1.20	1.20	1.00	1.00	1.00	1.96	0.98	0.50	0.50	25
11	5.00	5.00	6.00	15.04	187.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.32	1.16	1.16	1.00	1.00	1.00	1.96	0.98	0.50	0.50	25
12	6.00	6.00	6.00	15.04	187.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.27	1.13	1.13	1.00	1.00	1.00	1.96	0.98	0.50	0.50	25

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 193.46m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX 7.5 (For IBH-20 (Receiving Tower))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_1 = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D from NGL m	RL of foundation m	Depth of foundation from FGL m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	4.00	189.46	13.04	3.50	1.12	0.35	334	0.80	30	49
2	4.00	189.46	13.04	4.00	1.12	0.35	334	0.80	27	42
3	4.00	189.46	13.04	5.00	1.12	0.35	334	0.80	21	34
4	4.00	189.46	13.04	6.00	1.12	0.35	334	0.80	18	28
5	5.00	188.46	14.04	3.50	1.12	0.35	334	0.80	30	49
6	5.00	188.46	14.04	4.00	1.12	0.35	334	0.80	27	42
7	5.00	188.46	14.04	5.00	1.12	0.35	334	0.80	21	34
8	5.00	188.46	14.04	6.00	1.12	0.35	334	0.80	18	28
9	6.00	187.46	15.04	3.50	1.12	0.35	334	0.80	30	49
10	6.00	187.46	15.04	4.00	1.12	0.35	334	0.80	27	42
11	6.00	187.46	15.04	5.00	1.12	0.35	334	0.80	21	34
12	6.00	187.46	15.04	6.00	1.12	0.35	334	0.80	18	28

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 7.6 (For IBH-20 (Receiving Tower))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:193.46m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
4.00	189.46	13.04	7.00	7.00	20	15	24	15	20
4.00	189.46	13.04	8.00	8.00	20	13	21	13	20
4.00	189.46	13.04	9.00	9.00	21	12	19	12	19
4.00	189.46	13.04	10.00	10.00	21	11	17	11	17
5.00	188.46	14.04	7.00	7.00	22	15	24	15	22
5.00	188.46	14.04	8.00	8.00	23	13	21	13	21
5.00	188.46	14.04	9.00	9.00	23	12	19	12	19
5.00	188.46	14.04	10.00	10.00	24	11	17	11	17
6.00	187.46	15.04	7.00	7.00	25	15	24	15	24
6.00	187.46	15.04	8.00	8.00	25	13	21	13	21
6.00	187.46	15.04	9.00	9.00	26	12	19	12	19
6.00	187.46	15.04	10.00	10.00	26	11	17	11	17

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 193.46m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX 7.7 (For IBH-20 (Receiving Tower))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ																	
	m	m				Kg/cm ²	degree	N _c	N _q - 1	N _γ	S _c	S _q	S _γ	d _c	d _q	d _γ	i _c	i _q	i _γ	γ gm/cc	0.5 γ	W _q	W _γ	
1	7.00	7.00	4.00	13.04	189.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.15	1.08	1.08	1.00	1.00	1.00	1.96	0.98	0.50	0.50	20
2	8.00	8.00	4.00	13.04	189.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.13	1.07	1.07	1.00	1.00	1.00	1.96	0.98	0.50	0.50	20
3	9.00	9.00	4.00	13.04	189.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.12	1.06	1.06	1.00	1.00	1.00	1.96	0.98	0.50	0.50	21
4	10.00	10.00	4.00	13.04	189.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.11	1.05	1.05	1.00	1.00	1.00	1.96	0.98	0.50	0.50	21
5	7.00	7.00	5.00	14.04	188.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.19	1.10	1.10	1.00	1.00	1.00	1.96	0.98	0.50	0.50	22
6	8.00	8.00	5.00	14.04	188.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.17	1.08	1.08	1.00	1.00	1.00	1.96	0.98	0.50	0.50	23
7	9.00	9.00	5.00	14.04	188.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.15	1.07	1.07	1.00	1.00	1.00	1.96	0.98	0.50	0.50	23
8	10.00	10.00	5.00	14.04	188.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.13	1.07	1.07	1.00	1.00	1.00	1.96	0.98	0.50	0.50	24
9	7.00	7.00	6.00	15.04	187.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.23	1.11	1.11	1.00	1.00	1.00	1.96	0.98	0.50	0.50	25
10	8.00	8.00	6.00	15.04	187.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.20	1.10	1.10	1.00	1.00	1.00	1.96	0.98	0.50	0.50	25
11	9.00	9.00	6.00	15.04	187.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.18	1.09	1.09	1.00	1.00	1.00	1.96	0.98	0.50	0.50	26
12	10.00	10.00	6.00	15.04	187.46	0.11	24	13.15	4.35	4.26	1.30	1.20	0.80	1.16	1.08	1.08	1.00	1.00	1.00	1.96	0.98	0.50	0.50	26

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 193.46m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX 7.8 (For IBH-20 (Receiving Tower))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_1 = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D from NGL m	RL of foundation m	Depth of foundation from FGL m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	4.00	189.46	13.04	7.00	1.12	0.35	334	0.80	15	24
2	4.00	189.46	13.04	8.00	1.12	0.35	334	0.80	13	21
3	4.00	189.46	13.04	9.00	1.12	0.35	334	0.80	12	19
4	4.00	189.46	13.04	10.00	1.12	0.35	334	0.80	11	17
5	5.00	188.46	14.04	7.00	1.12	0.35	334	0.80	15	24
6	5.00	188.46	14.04	8.00	1.12	0.35	334	0.80	13	21
7	5.00	188.46	14.04	9.00	1.12	0.35	334	0.80	12	19
8	5.00	188.46	14.04	10.00	1.12	0.35	334	0.80	11	17
9	6.00	187.46	15.04	7.00	1.12	0.35	334	0.80	15	24
10	6.00	187.46	15.04	8.00	1.12	0.35	334	0.80	13	21
11	6.00	187.46	15.04	9.00	1.12	0.35	334	0.80	12	19
12	6.00	187.46	15.04	10.00	1.12	0.35	334	0.80	11	17

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 7.9 (For IBH-20 (Receiving Tower))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:193.46m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	192.46	10.04	1.50	1.50	5	20	32	5	5
1.00	192.46	10.04	2.00	2.00	5	15	24	5	5
1.00	192.46	10.04	2.50	2.50	5	12	19	5	5
1.00	192.46	10.04	3.00	3.00	5	10	16	5	5
2.00	191.46	11.04	1.50	1.50	7	20	32	7	7
2.00	191.46	11.04	2.00	2.00	7	15	24	7	7
2.00	191.46	11.04	2.50	2.50	7	12	19	7	7
2.00	191.46	11.04	3.00	3.00	8	10	16	8	8
3.00	190.46	12.04	1.50	1.50	10	20	32	10	10
3.00	190.46	12.04	2.00	2.00	10	15	24	10	10
3.00	190.46	12.04	2.50	2.50	10	12	19	10	10
3.00	190.46	12.04	3.00	3.00	10	10	16	10	10

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 193.46m.
- 3) Calculations are considering the effect of water table at FGL.
- 4) Shear parameters are correlated based on SPT N value.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX 7.10 (For IBH-20 (Receiving Tower))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	1.00	10.04	192.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.18	1.09	1.09	1.00	1.00	1.00	1.96	0.98	0.50	0.50	5
2	2.00	2.00	1.00	10.04	192.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.13	1.07	1.07	1.00	1.00	1.00	1.96	0.98	0.50	0.50	5
3	2.50	2.50	1.00	10.04	192.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.11	1.05	1.05	1.00	1.00	1.00	1.96	0.98	0.50	0.50	5
4	3.00	3.00	1.00	10.04	192.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.09	1.04	1.04	1.00	1.00	1.00	1.96	0.98	0.50	0.50	5
5	1.50	1.50	2.00	11.04	191.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.35	1.18	1.18	1.00	1.00	1.00	1.96	0.98	0.50	0.50	7
6	2.00	2.00	2.00	11.04	191.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.26	1.13	1.13	1.00	1.00	1.00	1.96	0.98	0.50	0.50	7
7	2.50	2.50	2.00	11.04	191.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.21	1.11	1.11	1.00	1.00	1.00	1.96	0.98	0.50	0.50	7
8	3.00	3.00	2.00	11.04	191.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.18	1.09	1.09	1.00	1.00	1.00	1.96	0.98	0.50	0.50	8
9	1.50	1.50	3.00	12.04	190.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.53	1.26	1.26	1.00	1.00	1.00	1.96	0.98	0.50	0.50	10
10	2.00	2.00	3.00	12.04	190.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.40	1.20	1.20	1.00	1.00	1.00	1.96	0.98	0.50	0.50	10
11	2.50	2.50	3.00	12.04	190.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.32	1.16	1.16	1.00	1.00	1.00	1.96	0.98	0.50	0.50	10
12	3.00	3.00	3.00	12.04	190.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.26	1.13	1.13	1.00	1.00	1.00	1.96	0.98	0.50	0.50	10

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 193.46m.
- 3) Calculations are considering the effect of water table at FGL.
- 4) Shear parameters are correlated based on SPT N value.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX 7.11 (For IBH-20 (Receiving Tower))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_1 = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D from NGL m	RL of foundation m	Depth of foundation from FGL m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	192.46	10.04	1.50	1.12	0.35	95	0.80	20	32
2	1.00	192.46	10.04	2.00	1.12	0.35	95	0.80	15	24
3	1.00	192.46	10.04	2.50	1.12	0.35	95	0.80	12	19
4	1.00	192.46	10.04	3.00	1.12	0.35	95	0.80	10	16
5	2.00	191.46	11.04	1.50	1.12	0.35	95	0.80	20	32
6	2.00	191.46	11.04	2.00	1.12	0.35	95	0.80	15	24
7	2.00	191.46	11.04	2.50	1.12	0.35	95	0.80	12	19
8	2.00	191.46	11.04	3.00	1.12	0.35	95	0.80	10	16
9	3.00	190.46	12.04	1.50	1.12	0.35	95	0.80	20	32
10	3.00	190.46	12.04	2.00	1.12	0.35	95	0.80	15	24
11	3.00	190.46	12.04	2.50	1.12	0.35	95	0.80	12	19
12	3.00	190.46	12.04	3.00	1.12	0.35	95	0.80	10	16

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 7.12 (For IBH-20 (Receiving Tower))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:193.46m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	192.46	10.04	3.50	3.50	5	9	14	5	5
1.00	192.46	10.04	4.00	4.00	6	8	12	6	6
1.00	192.46	10.04	5.00	5.00	6	6	10	6	6
1.00	192.46	10.04	6.00	6.00	7	5	8	5	7
2.00	191.46	11.04	3.50	3.50	8	9	14	8	8
2.00	191.46	11.04	4.00	4.00	8	8	12	8	8
2.00	191.46	11.04	5.00	5.00	8	6	10	6	8
2.00	191.46	11.04	6.00	6.00	9	5	8	5	8
3.00	190.46	12.04	3.50	3.50	10	9	14	9	10
3.00	190.46	12.04	4.00	4.00	10	8	12	8	10
3.00	190.46	12.04	5.00	5.00	11	6	10	6	10
3.00	190.46	12.04	6.00	6.00	11	5	8	5	8

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 193.46m.
- 3) Calculations are considering the effect of water table at FGL.
- 4) Shear parameters are correlated based on SPT N value.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX 7.13 (For IBH-20 (Receiving Tower))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	1.00	10.04	192.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	1.96	0.98	0.50	0.50	5
2	4.00	4.00	1.00	10.04	192.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.07	1.03	1.03	1.00	1.00	1.00	1.96	0.98	0.50	0.50	6
3	5.00	5.00	1.00	10.04	192.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.05	1.03	1.03	1.00	1.00	1.00	1.96	0.98	0.50	0.50	6
4	6.00	6.00	1.00	10.04	192.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.04	1.02	1.02	1.00	1.00	1.00	1.96	0.98	0.50	0.50	7
5	3.50	3.50	2.00	11.04	191.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.15	1.08	1.08	1.00	1.00	1.00	1.96	0.98	0.50	0.50	8
6	4.00	4.00	2.00	11.04	191.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.13	1.07	1.07	1.00	1.00	1.00	1.96	0.98	0.50	0.50	8
7	5.00	5.00	2.00	11.04	191.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.11	1.05	1.05	1.00	1.00	1.00	1.96	0.98	0.50	0.50	8
8	6.00	6.00	2.00	11.04	191.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.09	1.04	1.04	1.00	1.00	1.00	1.96	0.98	0.50	0.50	9
9	3.50	3.50	3.00	12.04	190.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.23	1.11	1.11	1.00	1.00	1.00	1.96	0.98	0.50	0.50	10
10	4.00	4.00	3.00	12.04	190.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.20	1.10	1.10	1.00	1.00	1.00	1.96	0.98	0.50	0.50	10
11	5.00	5.00	3.00	12.04	190.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.16	1.08	1.08	1.00	1.00	1.00	1.96	0.98	0.50	0.50	11
12	6.00	6.00	3.00	12.04	190.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.13	1.07	1.07	1.00	1.00	1.00	1.96	0.98	0.50	0.50	11

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 193.46m.
- 3) Calculations are considering the effect of water table at FGL.
- 4) Shear parameters are correlated based on SPT N value.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX 7.14 (For IBH-20 (Receiving Tower))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_1 = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D from NGL m	RL of foundation m	Depth of foundation from FGL m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	192.46	10.04	3.50	1.12	0.35	95	0.80	9	14
2	1.00	192.46	10.04	4.00	1.12	0.35	95	0.80	8	12
3	1.00	192.46	10.04	5.00	1.12	0.35	95	0.80	6	10
4	1.00	192.46	10.04	6.00	1.12	0.35	95	0.80	5	8
5	2.00	191.46	11.04	3.50	1.12	0.35	95	0.80	9	14
6	2.00	191.46	11.04	4.00	1.12	0.35	95	0.80	8	12
7	2.00	191.46	11.04	5.00	1.12	0.35	95	0.80	6	10
8	2.00	191.46	11.04	6.00	1.12	0.35	95	0.80	5	8
9	3.00	190.46	12.04	3.50	1.12	0.35	95	0.80	9	14
10	3.00	190.46	12.04	4.00	1.12	0.35	95	0.80	8	12
11	3.00	190.46	12.04	5.00	1.12	0.35	95	0.80	6	10
12	3.00	190.46	12.04	6.00	1.12	0.35	95	0.80	5	8

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 7.15 (For IBH-20 (Receiving Tower))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:193.46m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	192.46	10.04	7.00	7.00	7	4	7	4	7
1.00	192.46	10.04	8.00	8.00	8	4	6	4	6
1.00	192.46	10.04	9.00	9.00	9	3	5	3	5
1.00	192.46	10.04	10.00	10.00	9	3	5	3	5
2.00	191.46	11.04	7.00	7.00	10	4	7	4	7
2.00	191.46	11.04	8.00	8.00	10	4	6	4	6
2.00	191.46	11.04	9.00	9.00	11	3	5	3	5
2.00	191.46	11.04	10.00	10.00	11	3	5	3	5
3.00	190.46	12.04	7.00	7.00	12	4	7	4	7
3.00	190.46	12.04	8.00	8.00	12	4	6	4	6
3.00	190.46	12.04	9.00	9.00	13	3	5	3	5
3.00	190.46	12.04	10.00	10.00	13	3	5	3	5

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 193.46m.
- 3) Calculations are considering the effect of water table at FGL.
- 4) Shear parameters are correlated based on SPT N value.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX 7.16 (For IBH-20 (Receiving Tower))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	1.00	10.04	192.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.04	1.02	1.02	1.00	1.00	1.00	1.96	0.98	0.50	0.50	7
2	8.00	8.00	1.00	10.04	192.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.03	1.02	1.02	1.00	1.00	1.00	1.96	0.98	0.50	0.50	8
3	9.00	9.00	1.00	10.04	192.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.03	1.01	1.01	1.00	1.00	1.00	1.96	0.98	0.50	0.50	9
4	10.00	10.00	1.00	10.04	192.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.03	1.01	1.01	1.00	1.00	1.00	1.96	0.98	0.50	0.50	9
5	7.00	7.00	2.00	11.04	191.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	1.96	0.98	0.50	0.50	10
6	8.00	8.00	2.00	11.04	191.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.07	1.03	1.03	1.00	1.00	1.00	1.96	0.98	0.50	0.50	10
7	9.00	9.00	2.00	11.04	191.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	1.96	0.98	0.50	0.50	11
8	10.00	10.00	2.00	11.04	191.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.05	1.03	1.03	1.00	1.00	1.00	1.96	0.98	0.50	0.50	11
9	7.00	7.00	3.00	12.04	190.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.11	1.06	1.06	1.00	1.00	1.00	1.96	0.98	0.50	0.50	12
10	8.00	8.00	3.00	12.04	190.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.10	1.05	1.05	1.00	1.00	1.00	1.96	0.98	0.50	0.50	12
11	9.00	9.00	3.00	12.04	190.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.09	1.04	1.04	1.00	1.00	1.00	1.96	0.98	0.50	0.50	13
12	10.00	10.00	3.00	12.04	190.46	0.03	23	12.52	3.94	3.79	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	1.96	0.98	0.50	0.50	13

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 193.46m.
- 3) Calculations are considering the effect of water table at FGL.
- 4) Shear parameters are correlated based on SPT N value.

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APPENDIX 7.17 (For IBH-20 (Receiving Tower))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_1 = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D from NGL m	RL of foundation m	Depth of foundation from FGL m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	192.46	10.04	7.00	1.12	0.35	95	0.80	4	7
2	1.00	192.46	10.04	8.00	1.12	0.35	95	0.80	4	6
3	1.00	192.46	10.04	9.00	1.12	0.35	95	0.80	3	5
4	1.00	192.46	10.04	10.00	1.12	0.35	95	0.80	3	5
5	2.00	191.46	11.04	7.00	1.12	0.35	95	0.80	4	7
6	2.00	191.46	11.04	8.00	1.12	0.35	95	0.80	4	6
7	2.00	191.46	11.04	9.00	1.12	0.35	95	0.80	3	5
8	2.00	191.46	11.04	10.00	1.12	0.35	95	0.80	3	5
9	3.00	190.46	12.04	7.00	1.12	0.35	95	0.80	4	7
10	3.00	190.46	12.04	8.00	1.12	0.35	95	0.80	4	6
11	3.00	190.46	12.04	9.00	1.12	0.35	95	0.80	3	5
12	3.00	190.46	12.04	10.00	1.12	0.35	95	0.80	3	5

Appendix – 7A

Calculation of Safe Load carrying capacity of piles socketed inside rock

(Near IBH 20)

(Receiving tower)

Project Name: - Proposed structures of thermal power project of NTTTP at Hirma, Talabira

1.0 Introduction

In situations where overburden offering low bearing pressure is followed by rock at relatively shallower depths, end bearing piles is the suitable foundation option. Piles in rocks and weathered rocks of varying degree of weathering derive their capacity by end bearing and socket side resistance.

In situations, where, rock strata comprises of highly fragmented rock, as in present case, where RQD is nil or $(CR+RQD)/2$ is less than 30 % or when the crushing strength is less than 10 MPa, the appropriate approach would be of that suggested by Cole & Stroud.

In present site overburden soils overlay fractured / laminated / foliated rock. The founding stratum having highly fragmented rock with nil RQD and $(CR+RQD)/2$ to be less than 30 %, the approach suggested by Cole and Stroud as per Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 Pa/S2 has been used for safe load calculations.

An illustrative calculation of safe load on pile and summary of pile capacities is as follows,

2.0 Sub soil strata Characterization

General stratification at the location of boreholes IBH 20 show primarily two characterized layers,

1. Overburden comprising of Brownish, fine to medium grained, sandy clays of intermediate plasticity and fine to medium grained, clayey sand with some to much gravels followed by Greyish brown, very fine grained, indurated, clays of intermediate plasticity with gravels Mud stone upto 7.90m (i.e. RL 185.56 m).
2. Second characterized layer below the overburden soils comprises of Highly weathered, weak to moderately weak, dark greyish brown, fine to very fine grained, very thinly bedded rock upto 13.50m (i.e. RL 179.96m).

3.0 Design Considerations

1. Length of socket considered 3D from depth of rock encountered.
2. The pile is considered to have socket length below 7.90 m below NGL (i.e. RL 185.56 m) depth.
3. For present case of pile terminating in highly weathered rock. SPT at depths between 7.90 to 13.50m (between RL 185.56 to 179.96 m) is > 100 with just 5.0 cm (Average) penetration in 50 blows. SPT can be extrapolated for 30 cm i.e. $50 * 30 / 5.00 = 300$.

Based on recommendation of fig no. 3 in B 8 in Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 P1/S2, average shear strength q_c corresponding to assumed SPT of 200 may be taken as 1300 kN/m^2

4. Allowable Capacity of pile socketed into rock $Q_a = R_e + R_{sf} = C_{u1} N_c \pi B^2 / 4 (F_s = 3) + \alpha C_{u2} \pi BL / (F_s = 6)$

4.0 Safe Load on Pile in Compression

Where,

End bearing component, $R_e = C_{u1} N_c \pi B^2 / 4 F_s$,

C_{u1} = Shear strength below base of pile = 1300 kN/m^2

B = diameter of the pile = d

F_s = Factor of Safety = 3

$N_c = 9$

Therefore, **$R_e = 3061.5 d^2$**

Skin friction component of socketed length of pile, $R_{sf} = \alpha C_{u2} \pi BL / F_s$

$\alpha = 0.9$ (recommended value in IS 2911 P1/S2)

L = length of the socket = $3 D$

C_{u2} = Ultimate shear strength along socket length which shall be restricted to shear capacity of concrete of the pile = 1300 kN/m^2

F_s = Factor of Safety = 6

Therefore, $R_{sf} = 1836.9 d^2$

Thus,

$$Q_a = c_{u1} N_c \cdot \frac{\pi B^2}{4 F_s} + \alpha c_{u2} \cdot \frac{\pi B L}{F_s}$$

$$= 3061.5 d^2 + 1836.9 d^2 = 4898.4 d^2$$

Substituting the values of various diameters and socket lengths equal to 3 times diameter, allowable load on single pile can be summarized as follows,

Summary of the Safe load calculation in Compression

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	18.74	19.22	19.64
Termination level RL in m	183.76	183.28	182.86
End Bearing Component in kN	1102.1	1768.3	2479.8
Friction Component in kN	661.3	1060.9	1487.9
Safe load in Compression in kN	1763.4	2829.3	3967.7
Safe load in Compression in T	176	283	397

5.0 Safe Load on Pile in uplift

For 9.00m cutoff from FGL

The overburden soils, though, will not contribute in compression capacity would offer resistance in uplift capacity. The parameters of IBH 20 are considered for calculation of uplift resistance as summarized below,

Depth in m from RL 202.5 m	Cohesion in kg/cm^2	Angle of Internal Friction ϕ	Submerged density in $\text{gm/cc } \gamma_{\text{sub}}$	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 9.00	Pile cutoff level – No pile						
9.00 to 16.44	0.11(ignored)	24	0.96	NA	1.00	24	5-32
16.44 to 16.94	4.00	0	0.96	0.28	NA	NA	>100
16.94 to 25.54	Rock strata – Resistance would be as per skin friction capacity in socket as already calculated in compression capacity						

Ultimate load in skin friction,

$$Q_{uf} = \alpha_i C_{ai} A_{si} + K_i P D_i \tan \delta_i A_{si}$$

First Layer – No contribution considered – (Within Cutoff Level).

$$\text{Second Layer} - K_2 P D_2 \tan \delta_2 A_{s2} = 1.00 * 9.50 * \tan 24 * \pi d * 7.44 = 98.86 d$$

$$\text{Third Layer} - \alpha_3 C_{a3} A_{s3} = 0.28 * 40.00 * \pi d * 0.50 = 17.59 d$$

Fourth Layer – $1836.90 d^2$ in rock socket

$$\text{Substituting, ultimate load } Q_{uf} = 1164.53 d + 1836.9 d^2$$

The safe load in uplift is worked out (considering the safety factor of 2.50 for overburden soils) and summarized below,

Safe Load on Piles in Uplift (in Ton)

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	18.74	19.22	19.64
Termination level RL in m	183.76	183.28	182.86
Safe load in Uplift in kN	940.77	1415.01	1907.12
Self-weight of pile in kN	41.29	69.51	101.48
Safe load in Uplift in T (Considering self-weight of pile)	98.21	148.45	200.86

6.0 Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60	0.76	0.90
Subgrade reaction in MN/m^3		7.20	7.20	7.20
Stiffness factor T in m		1.90	2.29	2.63
Depth of fixity in m	Free Head	3.60	4.40	5.00
	Fixed Head	4.10	5.00	5.70
Allowable Horizontal Force in T	Free Head	5.70	8.30	10.90
	Fixed Head	15.00	21.90	28.80
Allowable Moment capacity in Tm	Free Head	7.16	12.64	18.96
	Fixed Head	25.50	44.97	67.48

7.0 Notes

1. Pile shall be terminated after socketing 3D inside rock.
2. Initial and routine pile load test is required to verify the actual carrying capacity of pile in compression, uplift and lateral loads.
3. For design and construction, specification of IS: 2911, P1/S2, IS: 456, 2000 shall strictly be followed.

(Dr. K. K. Thaker)

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 8 (For IBH-21 (Crusher house))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:194.99m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
3.00	191.99	10.51	1.50	1.50	29	110	177	29	29
3.00	191.99	10.51	2.00	2.00	28	83	133	28	28
3.00	191.99	10.51	2.50	2.50	27	66	106	27	27
3.00	191.99	10.51	3.00	3.00	28	55	88	28	28
3.50	191.49	11.01	1.50	1.50	33	110	177	33	33
3.50	191.49	11.01	2.00	2.00	31	83	133	31	31
3.50	191.49	11.01	2.50	2.50	31	66	106	31	31
3.50	191.49	11.01	3.00	3.00	31	55	88	31	31
4.00	190.99	11.51	1.50	1.50	37	110	177	37	37
4.00	190.99	11.51	2.00	2.00	35	83	133	35	35
4.00	190.99	11.51	2.50	2.50	34	66	106	34	34
4.00	190.99	11.51	3.00	3.00	34	55	88	34	34

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 194.99m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-8.1 (For IBH-21 (Crusher house))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	3.00	10.51	191.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.57	1.29	1.29	1.00	1.00	1.00	2.00	1.00	0.50	0.50	29
2	2.00	2.00	3.00	10.51	191.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.43	1.22	1.22	1.00	1.00	1.00	2.00	1.00	0.50	0.50	28
3	2.50	2.50	3.00	10.51	191.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.34	1.17	1.17	1.00	1.00	1.00	2.00	1.00	0.50	0.50	27
4	3.00	3.00	3.00	10.51	191.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.29	1.14	1.14	1.00	1.00	1.00	2.00	1.00	0.50	0.50	28
5	1.50	1.50	3.50	11.01	191.49	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.67	1.33	1.33	1.00	1.00	1.00	2.00	1.00	0.50	0.50	33
6	2.00	2.00	3.50	11.01	191.49	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.50	1.25	1.25	1.00	1.00	1.00	2.00	1.00	0.50	0.50	31
7	2.50	2.50	3.50	11.01	191.49	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.40	1.20	1.20	1.00	1.00	1.00	2.00	1.00	0.50	0.50	31
8	3.00	3.00	3.50	11.01	191.49	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.33	1.17	1.17	1.00	1.00	1.00	2.00	1.00	0.50	0.50	31
9	1.50	1.50	4.00	11.51	190.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.77	1.38	1.38	1.00	1.00	1.00	2.00	1.00	0.50	0.50	37
10	2.00	2.00	4.00	11.51	190.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.57	1.29	1.29	1.00	1.00	1.00	2.00	1.00	0.50	0.50	35
11	2.50	2.50	4.00	11.51	190.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.46	1.23	1.23	1.00	1.00	1.00	2.00	1.00	0.50	0.50	34
12	3.00	3.00	4.00	11.51	190.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.38	1.19	1.19	1.00	1.00	1.00	2.00	1.00	0.50	0.50	34

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 194.99m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-8.2 (For IBH-21 (Crusher house))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_1 = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D from NGL m	RL of foundation m	Depth of foundation from FGL m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	3.00	191.99	10.51	1.50	1.12	0.35	521	0.80	110	177
2	3.00	191.99	10.51	2.00	1.12	0.35	521	0.80	83	133
3	3.00	191.99	10.51	2.50	1.12	0.35	521	0.80	66	106
4	3.00	191.99	10.51	3.00	1.12	0.35	521	0.80	55	88
5	3.50	191.49	11.01	1.50	1.12	0.35	521	0.80	110	177
6	3.50	191.49	11.01	2.00	1.12	0.35	521	0.80	83	133
7	3.50	191.49	11.01	2.50	1.12	0.35	521	0.80	66	106
8	3.50	191.49	11.01	3.00	1.12	0.35	521	0.80	55	88
9	4.00	190.99	11.51	1.50	1.12	0.35	521	0.80	110	177
10	4.00	190.99	11.51	2.00	1.12	0.35	521	0.80	83	133
11	4.00	190.99	11.51	2.50	1.12	0.35	521	0.80	66	106
12	4.00	190.99	11.51	3.00	1.12	0.35	521	0.80	55	88

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APPENDIX - 8.3 (For IBH-21 (Crusher house))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:194.99m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
3.00	191.99	10.51	3.50	3.50	28	47	76	28	28
3.00	191.99	10.51	4.00	4.00	28	41	66	28	28
3.00	191.99	10.51	5.00	5.00	30	33	53	30	30
3.00	191.99	10.51	6.00	6.00	31	28	44	28	31
3.50	191.49	11.01	3.50	3.50	31	47	76	31	31
3.50	191.49	11.01	4.00	4.00	31	41	66	31	31
3.50	191.49	11.01	5.00	5.00	32	33	53	32	32
3.50	191.49	11.01	6.00	6.00	34	28	44	28	34
4.00	190.99	11.51	3.50	3.50	34	47	76	34	34
4.00	190.99	11.51	4.00	4.00	34	41	66	34	34
4.00	190.99	11.51	5.00	5.00	35	33	53	33	35
4.00	190.99	11.51	6.00	6.00	36	28	44	28	36

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 194.99m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-8.4 (For IBH-21 (Crusher house))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	3.00	10.51	191.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.25	1.12	1.12	1.00	1.00	1.00	2.00	1.00	0.50	0.50	28
2	4.00	4.00	3.00	10.51	191.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.22	1.11	1.11	1.00	1.00	1.00	2.00	1.00	0.50	0.50	28
3	5.00	5.00	3.00	10.51	191.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.17	1.09	1.09	1.00	1.00	1.00	2.00	1.00	0.50	0.50	30
4	6.00	6.00	3.00	10.51	191.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	2.00	1.00	0.50	0.50	31
5	3.50	3.50	3.50	11.01	191.49	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.29	1.14	1.14	1.00	1.00	1.00	2.00	1.00	0.50	0.50	31
6	4.00	4.00	3.50	11.01	191.49	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.25	1.13	1.13	1.00	1.00	1.00	2.00	1.00	0.50	0.50	31
7	5.00	5.00	3.50	11.01	191.49	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.20	1.10	1.10	1.00	1.00	1.00	2.00	1.00	0.50	0.50	32
8	6.00	6.00	3.50	11.01	191.49	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.17	1.08	1.08	1.00	1.00	1.00	2.00	1.00	0.50	0.50	34
9	3.50	3.50	4.00	11.51	190.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.33	1.16	1.16	1.00	1.00	1.00	2.00	1.00	0.50	0.50	34
10	4.00	4.00	4.00	11.51	190.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.29	1.14	1.14	1.00	1.00	1.00	2.00	1.00	0.50	0.50	34
11	5.00	5.00	4.00	11.51	190.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.23	1.11	1.11	1.00	1.00	1.00	2.00	1.00	0.50	0.50	35
12	6.00	6.00	4.00	11.51	190.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.19	1.10	1.10	1.00	1.00	1.00	2.00	1.00	0.50	0.50	36

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 194.99m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-8.5 (For IBH-21 (Crusher house))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_1 = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D from NGL m	RL of foundation m	Depth of foundation from FGL m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	3.00	191.99	10.51	3.50	1.12	0.35	521	0.80	47	76
2	3.00	191.99	10.51	4.00	1.12	0.35	521	0.80	41	66
3	3.00	191.99	10.51	5.00	1.12	0.35	521	0.80	33	53
4	3.00	191.99	10.51	6.00	1.12	0.35	521	0.80	28	44
5	3.50	191.49	11.01	3.50	1.12	0.35	521	0.80	47	76
6	3.50	191.49	11.01	4.00	1.12	0.35	521	0.80	41	66
7	3.50	191.49	11.01	5.00	1.12	0.35	521	0.80	33	53
8	3.50	191.49	11.01	6.00	1.12	0.35	521	0.80	28	44
9	4.00	190.99	11.51	3.50	1.12	0.35	521	0.80	47	76
10	4.00	190.99	11.51	4.00	1.12	0.35	521	0.80	41	66
11	4.00	190.99	11.51	5.00	1.12	0.35	521	0.80	33	53
12	4.00	190.99	11.51	6.00	1.12	0.35	521	0.80	28	44

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 8.6 (For IBH-21 (Crusher house))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:194.99m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
3.00	191.99	10.51	7.00	7.00	32	24	38	24	32
3.00	191.99	10.51	8.00	8.00	34	21	33	21	33
3.00	191.99	10.51	9.00	9.00	35	18	29	18	29
3.00	191.99	10.51	10.00	10.00	37	17	27	17	27
3.50	191.49	11.01	7.00	7.00	35	24	38	24	35
3.50	191.49	11.01	8.00	8.00	36	21	33	21	33
3.50	191.49	11.01	9.00	9.00	38	18	29	18	29
3.50	191.49	11.01	10.00	10.00	39	17	27	17	27
4.00	190.99	11.51	7.00	7.00	38	24	38	24	38
4.00	190.99	11.51	8.00	8.00	39	21	33	21	33
4.00	190.99	11.51	9.00	9.00	41	18	29	18	29
4.00	190.99	11.51	10.00	10.00	42	17	27	17	27

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 194.99m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-8.7 (For IBH-21 (Crusher house))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	3.00	10.51	191.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.12	1.06	1.06	1.00	1.00	1.00	2.00	1.00	0.50	0.50	32
2	8.00	8.00	3.00	10.51	191.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.11	1.05	1.05	1.00	1.00	1.00	2.00	1.00	0.50	0.50	34
3	9.00	9.00	3.00	10.51	191.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.10	1.05	1.05	1.00	1.00	1.00	2.00	1.00	0.50	0.50	35
4	10.00	10.00	3.00	10.51	191.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.09	1.04	1.04	1.00	1.00	1.00	2.00	1.00	0.50	0.50	37
5	7.00	7.00	3.50	11.01	191.49	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	2.00	1.00	0.50	0.50	35
6	8.00	8.00	3.50	11.01	191.49	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.13	1.06	1.06	1.00	1.00	1.00	2.00	1.00	0.50	0.50	36
7	9.00	9.00	3.50	11.01	191.49	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.11	1.06	1.06	1.00	1.00	1.00	2.00	1.00	0.50	0.50	38
8	10.00	10.00	3.50	11.01	191.49	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.10	1.05	1.05	1.00	1.00	1.00	2.00	1.00	0.50	0.50	39
9	7.00	7.00	4.00	11.51	190.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.16	1.08	1.08	1.00	1.00	1.00	2.00	1.00	0.50	0.50	38
10	8.00	8.00	4.00	11.51	190.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	2.00	1.00	0.50	0.50	39
11	9.00	9.00	4.00	11.51	190.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.13	1.06	1.06	1.00	1.00	1.00	2.00	1.00	0.50	0.50	41
12	10.00	10.00	4.00	11.51	190.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.11	1.06	1.06	1.00	1.00	1.00	2.00	1.00	0.50	0.50	42

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 194.99m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-8.8 (For IBH-21 (Crusher house))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_1 = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D from NGL m	RL of foundation m	Depth of foundation from FGL m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	3.00	191.99	10.51	7.00	1.12	0.35	521	0.80	24	38
2	3.00	191.99	10.51	8.00	1.12	0.35	521	0.80	21	33
3	3.00	191.99	10.51	9.00	1.12	0.35	521	0.80	18	29
4	3.00	191.99	10.51	10.00	1.12	0.35	521	0.80	17	27
5	3.50	191.49	11.01	7.00	1.12	0.35	521	0.80	24	38
6	3.50	191.49	11.01	8.00	1.12	0.35	521	0.80	21	33
7	3.50	191.49	11.01	9.00	1.12	0.35	521	0.80	18	29
8	3.50	191.49	11.01	10.00	1.12	0.35	521	0.80	17	27
9	4.00	190.99	11.51	7.00	1.12	0.35	521	0.80	24	38
10	4.00	190.99	11.51	8.00	1.12	0.35	521	0.80	21	33
11	4.00	190.99	11.51	9.00	1.12	0.35	521	0.80	18	29
12	4.00	190.99	11.51	10.00	1.12	0.35	521	0.80	17	27

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 8.9 (For IBH-21 (Crusher house))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:194.99m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	193.99	8.51	1.50	1.50	14	38	62	14	14
1.00	193.99	8.51	2.00	2.00	14	29	46	14	14
1.00	193.99	8.51	2.50	2.50	15	23	37	15	15
1.00	193.99	8.51	3.00	3.00	16	19	31	16	16
1.50	193.49	9.01	1.50	1.50	17	38	62	17	17
1.50	193.49	9.01	2.00	2.00	18	29	46	18	18
1.50	193.49	9.01	2.50	2.50	18	23	37	18	18
1.50	193.49	9.01	3.00	3.00	19	19	31	19	19
2.00	192.99	9.51	1.50	1.50	21	38	62	21	21
2.00	192.99	9.51	2.00	2.00	21	29	46	21	21
2.00	192.99	9.51	2.50	2.50	21	23	37	21	21
2.00	192.99	9.51	3.00	3.00	21	19	31	19	21

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 194.99m.
- 3) Calculations are considering the effect of water table at FGL.
- 4) Shear Parameters is correlated based on SPT N value.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-8.10 (For IBH-21 (Crusher house))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	1.00	8.51	193.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.19	1.10	1.10	1.00	1.00	1.00	2.00	1.00	0.50	0.50	14
2	2.00	2.00	1.00	8.51	193.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	2.00	1.00	0.50	0.50	14
3	2.50	2.50	1.00	8.51	193.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.11	1.06	1.06	1.00	1.00	1.00	2.00	1.00	0.50	0.50	15
4	3.00	3.00	1.00	8.51	193.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.10	1.05	1.05	1.00	1.00	1.00	2.00	1.00	0.50	0.50	16
5	1.50	1.50	1.50	9.01	193.49	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.29	1.14	1.14	1.00	1.00	1.00	2.00	1.00	0.50	0.50	17
6	2.00	2.00	1.50	9.01	193.49	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.22	1.11	1.11	1.00	1.00	1.00	2.00	1.00	0.50	0.50	18
7	2.50	2.50	1.50	9.01	193.49	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.17	1.09	1.09	1.00	1.00	1.00	2.00	1.00	0.50	0.50	18
8	3.00	3.00	1.50	9.01	193.49	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	2.00	1.00	0.50	0.50	19
9	1.50	1.50	2.00	9.51	192.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.38	1.19	1.19	1.00	1.00	1.00	2.00	1.00	0.50	0.50	21
10	2.00	2.00	2.00	9.51	192.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.29	1.14	1.14	1.00	1.00	1.00	2.00	1.00	0.50	0.50	21
11	2.50	2.50	2.00	9.51	192.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.23	1.11	1.11	1.00	1.00	1.00	2.00	1.00	0.50	0.50	21
12	3.00	3.00	2.00	9.51	192.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.19	1.10	1.10	1.00	1.00	1.00	2.00	1.00	0.50	0.50	21

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 194.99m.
- 3) Calculations are considering the effect of water table at FGL.
- 4) Shear Parameters is correlated based on SPT N value.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-8.11 (For IBH-21 (Crusher house))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_1 = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D from NGL m	RL of foundation m	Depth of foundation from FGL m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	193.99	8.51	1.50	1.12	0.35	182	0.80	38	62
2	1.00	193.99	8.51	2.00	1.12	0.35	182	0.80	29	46
3	1.00	193.99	8.51	2.50	1.12	0.35	182	0.80	23	37
4	1.00	193.99	8.51	3.00	1.12	0.35	182	0.80	19	31
5	1.50	193.49	9.01	1.50	1.12	0.35	182	0.80	38	62
6	1.50	193.49	9.01	2.00	1.12	0.35	182	0.80	29	46
7	1.50	193.49	9.01	2.50	1.12	0.35	182	0.80	23	37
8	1.50	193.49	9.01	3.00	1.12	0.35	182	0.80	19	31
9	2.00	192.99	9.51	1.50	1.12	0.35	182	0.80	38	62
10	2.00	192.99	9.51	2.00	1.12	0.35	182	0.80	29	46
11	2.00	192.99	9.51	2.50	1.12	0.35	182	0.80	23	37
12	2.00	192.99	9.51	3.00	1.12	0.35	182	0.80	19	31

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 8.12 (For IBH-21 (Crusher house))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:194.99m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	193.99	8.51	3.50	3.50	16	16	26	16	16
1.00	193.99	8.51	4.00	4.00	17	14	23	14	17
1.00	193.99	8.51	5.00	5.00	19	12	18	12	18
1.00	193.99	8.51	6.00	6.00	20	10	15	10	15
1.50	193.49	9.01	3.50	3.50	19	16	26	16	19
1.50	193.49	9.01	4.00	4.00	20	14	23	14	20
1.50	193.49	9.01	5.00	5.00	21	12	18	12	18
1.50	193.49	9.01	6.00	6.00	23	10	15	10	15
2.00	192.99	9.51	3.50	3.50	22	16	26	16	22
2.00	192.99	9.51	4.00	4.00	23	14	23	14	23
2.00	192.99	9.51	5.00	5.00	24	12	18	12	18
2.00	192.99	9.51	6.00	6.00	26	10	15	10	15

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 194.99m.
- 3) Calculations are considering the effect of water table at FGL.
- 4) Shear Parameters is correlated based on SPT N value.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-8.13 (For IBH-21 (Crusher house))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	1.00	8.51	193.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	2.00	1.00	0.50	0.50	16
2	4.00	4.00	1.00	8.51	193.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.07	1.04	1.04	1.00	1.00	1.00	2.00	1.00	0.50	0.50	17
3	5.00	5.00	1.00	8.51	193.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	2.00	1.00	0.50	0.50	19
4	6.00	6.00	1.00	8.51	193.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.05	1.02	1.02	1.00	1.00	1.00	2.00	1.00	0.50	0.50	20
5	3.50	3.50	1.50	9.01	193.49	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.12	1.06	1.06	1.00	1.00	1.00	2.00	1.00	0.50	0.50	19
6	4.00	4.00	1.50	9.01	193.49	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.11	1.05	1.05	1.00	1.00	1.00	2.00	1.00	0.50	0.50	20
7	5.00	5.00	1.50	9.01	193.49	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.09	1.04	1.04	1.00	1.00	1.00	2.00	1.00	0.50	0.50	21
8	6.00	6.00	1.50	9.01	193.49	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.07	1.04	1.04	1.00	1.00	1.00	2.00	1.00	0.50	0.50	23
9	3.50	3.50	2.00	9.51	192.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.16	1.08	1.08	1.00	1.00	1.00	2.00	1.00	0.50	0.50	22
10	4.00	4.00	2.00	9.51	192.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	2.00	1.00	0.50	0.50	23
11	5.00	5.00	2.00	9.51	192.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.11	1.06	1.06	1.00	1.00	1.00	2.00	1.00	0.50	0.50	24
12	6.00	6.00	2.00	9.51	192.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.10	1.05	1.05	1.00	1.00	1.00	2.00	1.00	0.50	0.50	26

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 194.99m.
- 3) Calculations are considering the effect of water table at FGL.
- 4) Shear Parameters is correlated based on SPT N value.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-8.14 (For IBH-21 (Crusher house))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_1 = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D from NGL m	RL of foundation m	Depth of foundation from FGL m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	193.99	8.51	3.50	1.12	0.35	182	0.80	16	26
2	1.00	193.99	8.51	4.00	1.12	0.35	182	0.80	14	23
3	1.00	193.99	8.51	5.00	1.12	0.35	182	0.80	12	18
4	1.00	193.99	8.51	6.00	1.12	0.35	182	0.80	10	15
5	1.50	193.49	9.01	3.50	1.12	0.35	182	0.80	16	26
6	1.50	193.49	9.01	4.00	1.12	0.35	182	0.80	14	23
7	1.50	193.49	9.01	5.00	1.12	0.35	182	0.80	12	18
8	1.50	193.49	9.01	6.00	1.12	0.35	182	0.80	10	15
9	2.00	192.99	9.51	3.50	1.12	0.35	182	0.80	16	26
10	2.00	192.99	9.51	4.00	1.12	0.35	182	0.80	14	23
11	2.00	192.99	9.51	5.00	1.12	0.35	182	0.80	12	18
12	2.00	192.99	9.51	6.00	1.12	0.35	182	0.80	10	15

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 8.15 (For IBH-21 (Crusher house))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:194.99m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	193.99	8.51	7.00	7.00	22	8	13	8	13
1.00	193.99	8.51	8.00	8.00	24	7	12	7	12
1.00	193.99	8.51	9.00	9.00	25	6	10	6	10
1.00	193.99	8.51	10.00	10.00	27	6	9	6	9
1.50	193.49	9.01	7.00	7.00	25	8	13	8	13
1.50	193.49	9.01	8.00	8.00	26	7	12	7	12
1.50	193.49	9.01	9.00	9.00	28	6	10	6	10
1.50	193.49	9.01	10.00	10.00	29	6	9	6	9
2.00	192.99	9.51	7.00	7.00	27	8	13	8	13
2.00	192.99	9.51	8.00	8.00	29	7	12	7	12
2.00	192.99	9.51	9.00	9.00	30	6	10	6	10
2.00	192.99	9.51	10.00	10.00	32	6	9	6	9

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 194.99m.
- 3) Calculations are considering the effect of water table at FGL.
- 4) Shear Parameters is correlated based on SPT N value.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-8.16 (For IBH-21 (Crusher house))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	1.00	8.51	193.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.04	1.02	1.02	1.00	1.00	1.00	2.00	1.00	0.50	0.50	22
2	8.00	8.00	1.00	8.51	193.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.04	1.02	1.02	1.00	1.00	1.00	2.00	1.00	0.50	0.50	24
3	9.00	9.00	1.00	8.51	193.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.03	1.02	1.02	1.00	1.00	1.00	2.00	1.00	0.50	0.50	25
4	10.00	10.00	1.00	8.51	193.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.03	1.01	1.01	1.00	1.00	1.00	2.00	1.00	0.50	0.50	27
5	7.00	7.00	1.50	9.01	193.49	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	2.00	1.00	0.50	0.50	25
6	8.00	8.00	1.50	9.01	193.49	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.05	1.03	1.03	1.00	1.00	1.00	2.00	1.00	0.50	0.50	26
7	9.00	9.00	1.50	9.01	193.49	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.05	1.02	1.02	1.00	1.00	1.00	2.00	1.00	0.50	0.50	28
8	10.00	10.00	1.50	9.01	193.49	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.04	1.02	1.02	1.00	1.00	1.00	2.00	1.00	0.50	0.50	29
9	7.00	7.00	2.00	9.51	192.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	2.00	1.00	0.50	0.50	27
10	8.00	8.00	2.00	9.51	192.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.07	1.04	1.04	1.00	1.00	1.00	2.00	1.00	0.50	0.50	29
11	9.00	9.00	2.00	9.51	192.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	2.00	1.00	0.50	0.50	30
12	10.00	10.00	2.00	9.51	192.99	0.08	29	19.57	9.03	10.41	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	2.00	1.00	0.50	0.50	32

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 194.99m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-8.17 (For IBH-21 (Crusher house))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_1 = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D from NGL m	RL of foundation m	Depth of foundation from FGL m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	193.99	8.51	7.00	1.12	0.35	182	0.80	8	13
2	1.00	193.99	8.51	8.00	1.12	0.35	182	0.80	7	12
3	1.00	193.99	8.51	9.00	1.12	0.35	182	0.80	6	10
4	1.00	193.99	8.51	10.00	1.12	0.35	182	0.80	6	9
5	1.50	193.49	9.01	7.00	1.12	0.35	182	0.80	8	13
6	1.50	193.49	9.01	8.00	1.12	0.35	182	0.80	7	12
7	1.50	193.49	9.01	9.00	1.12	0.35	182	0.80	6	10
8	1.50	193.49	9.01	10.00	1.12	0.35	182	0.80	6	9
9	2.00	192.99	9.51	7.00	1.12	0.35	182	0.80	8	13
10	2.00	192.99	9.51	8.00	1.12	0.35	182	0.80	7	12
11	2.00	192.99	9.51	9.00	1.12	0.35	182	0.80	6	10
12	2.00	192.99	9.51	10.00	1.12	0.35	182	0.80	6	9

Appendix – 8A

Calculation of Safe Load carrying capacity of piles socketed inside rock (Near IBH 21) (Crusher House)

Project Name: - Proposed structures of thermal power project of NTTTP at Hirma, Talabira

1.0 Introduction

In situations where overburden offering low bearing pressure is followed by rock at relatively shallower depths, end bearing piles is the suitable foundation option. Piles in rocks and weathered rocks of varying degree of weathering derive their capacity by end bearing and socket side resistance.

In situations, where, rock strata comprises of highly fragmented rock, as in present case, where RQD is nil or $(CR+RQD)/2$ is less than 30 % or when the crushing strength is less than 10 MPa, the appropriate approach would be of that suggested by Cole & Stroud.

In present site overburden soils overlay fractured / laminated / foliated rock. The founding stratum having highly fragmented rock with nil RQD and $(CR+RQD)/2$ to be less than 30 %, the approach suggested by Cole and Stroud as per Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 Pa/S2 has been used for safe load calculations.

An illustrative calculation of safe load on pile and summary of pile capacities is as follows,

2.0 Sub soil strata Characterization

General stratification at the location of boreholes IBH 21 show primarily two characterized layers,

1. Overburden comprising of Yellowish brown, fine to medium grained, sandy clays of low plasticity with occasional gravels followed by Yellowish brown, fine to medium grained, cemented silty clayey sand with much gravels upto 14.70m (i.e. RL 180.29 m).
2. Second characterized layer below the overburden soils comprises of Moderately weathered, moderately weak, dark brownish, fine to medium grained, rock with close spacing of discontinuities followed by Highly weathered, moderately weak, dark brownish, fine to coarse grained, fractured rock followed by Moderately weathered, moderately strong, dark brownish, fine to coarse grained, fractured rock upto 25.00m (i.e. RL 169.99 m).

3.0 Design Considerations

1. Length of socket considered 3D from depth of rock encountered.
2. The pile is considered to have socket length below 14.70 m below NGL (i.e. RL 180.29 m) depth.
3. For present case of pile terminating in highly weathered rock. SPT at depths between 14.70 to 17.50m (between RL 180.29 to 177.49 m) is > 100 with just 3.0 cm penetration in 50 blows. SPT can be extrapolated for 30 cm i.e. $50 * 30 / 3.00 = 500$.
Based on recommendation of fig no. 3 in B 8 in Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 P1/S2, average shear strength q_c corresponding to assumed SPT of 200 may be taken as 1300 kN/m²
4. Allowable Capacity of pile socketed into rock $Q_a = R_e + R_{sf} = C_{u1} N_c \pi B^2 / 4 (F_s = 3) + \alpha C_{u2} \pi BL / (F_s = 6)$

4.0 Safe Load on Pile in Compression

Where,

End bearing component, $R_e = C_{u1} N_c \pi B^2 / 4 F_s$,

C_{u1} = Shear strength below base of pile = 1300 kN/m²

B = diameter of the pile = d

F_s = Factor of Safety = 3

$N_c = 9$

Therefore, **$R_e = 3061.5 d^2$**

Skin friction component of socketed length of pile, $R_{sf} = \alpha C_{u2} \pi BL / F_s$

$\alpha = 0.9$ (recommended value in IS 2911 P1/S2)

L = length of the socket = $3 D$

C_{u2} = Ultimate shear strength along socket length which shall be restricted to shear capacity of concrete of the pile = 1300 kN/m^2

F_s = Factor of Safety = 6

Therefore, $R_{sf} = 1836.9 \text{ d}^2$

Thus,

$$Q_a = c_{u1} N_c \cdot \frac{\pi B^2}{4 F_s} + \alpha c_{u2} \cdot \frac{\pi B L}{F_s}$$

$$= 3061.5 \text{ d}^2 + 1836.9 \text{ d}^2 = 4898.4 \text{ d}^2$$

Substituting the values of various diameters and socket lengths equal to 3 times diameter, allowable load on single pile can be summarized as follows,

Summary of the Safe load calculation in Compression

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	24.01	24.49	24.91
Termination level RL in m	178.49	178.01	177.59
End Bearing Component in kN	1102.1	1768.3	2479.8
Friction Component in kN	661.3	1060.9	1487.9
Safe load in Compression in kN	1763.4	2829.3	3967.7
Safe load in Compression in T	176	283	397

5.0 Safe Load on Pile in uplift

For 8.00m cutoff from FGL

The overburden soils, though, will not contribute in compression capacity would offer resistance in uplift capacity. The parameters of IBH 21 are considered for calculation of uplift resistance as summarized below,

Depth in m from RL 202.5 m	Cohesion in kg/cm^2	Angle of Internal Friction ϕ	Submerged density in $\text{gm/cc } \gamma_{\text{sub}}$	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 8.00	Pile cutoff level – No pile						
8.00 to 9.91	0.08(ignored)	29	1.00	NA	1.00	28	13-16
9.91 to 22.21	0.00	34	1.00	NA	1.50	34	60->100
22.21 to 32.51	Rock strata – Resistance would be as per skin friction capacity in socket as already calculated in compression capacity						

Ultimate load in skin friction,

$$Q_{uf} = \alpha_i C_{ai} A_{si} + K_i P D_i \tan \delta_i A_{si}$$

First Layer – No contribution considered – (Within Cutoff Level).

$$\text{Second Layer} - K_2 P D_2 \tan \delta_2 A_{s2} = 1.00 * 7.36 * \tan 29 * \pi d * 1.91 = 24.48 \text{ d}$$

$$\text{Third Layer} - K_3 P D_3 \tan \delta_3 A_{s3} = 1.50 * 9.80 * \tan 34 * \pi d * 12.30 = 383.14 \text{ d}$$

Fourth Layer – 1836.90 d^2 in rock socket

$$\text{Substituting, ultimate load } q_{uf} = 4076.22 \text{ d} + 1836.9 \text{ d}^2$$

The safe load in uplift is worked out (considering the safety factor of 2.50 for overburden soils) and summarized below,

Safe Load on Piles in Uplift (in Ton)

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	24.01	24.49	24.91
Termination level RL in m	178.49	178.01	177.59
Safe load in Uplift in kN	1639.58	2300.16	2955.33
Self-weight of pile in kN	67.87	112.15	161.28
Safe load in Uplift in T (Considering self-weight of pile)	170.75	241.23	311.66

6.0 Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60	0.76	0.90
Subgrade reaction in MN/m^3		3.56	3.56	3.56
Stiffness factor T in m		2.19	2.64	3.02
Depth of fixity in m	Free Head	4.20	5.00	5.70
	Fixed Head	4.80	5.80	6.60
Allowable Horizontal Force in T	Free Head	3.70	5.40	7.10
	Fixed Head	9.80	14.40	18.80
Allowable Moment capacity in Tm	Free Head	5.41	9.53	14.30
	Fixed Head	19.24	33.93	50.91

7.0 Notes

1. Pile shall be terminated after socketing 3D inside rock.
2. Initial and routine pile load test is required to verify the actual carrying capacity of pile in compression, uplift and lateral loads.
3. For design and construction, specification of IS: 2911, P1/S2, IS: 456, 2000 shall strictly be followed.

(Dr. K. K. Thaker)

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 9 (For IBH-22 (Junction Tower JT-1))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:200.61m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 9.1)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 9.2)		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
3.00	197.61	4.89	1.50	1.50	39	105	168	39	39
3.00	197.61	4.89	2.00	2.00	38	79	126	38	38
3.00	197.61	4.89	2.50	2.50	38	63	101	38	38
3.00	197.61	4.89	3.00	3.00	38	52	84	38	38
3.50	197.11	5.39	1.50	1.50	44	105	168	44	44
3.50	197.11	5.39	2.00	2.00	43	79	126	43	43
3.50	197.11	5.39	2.50	2.50	42	63	101	42	42
3.50	197.11	5.39	3.00	3.00	42	52	84	42	42
4.00	196.61	5.89	1.50	1.50	50	105	168	50	50
4.00	196.61	5.89	2.00	2.00	48	79	126	48	48
4.00	196.61	5.89	2.50	2.50	47	63	101	47	47
4.00	196.61	5.89	3.00	3.00	47	52	84	47	47

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 200.61m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 9.1 (For IBH-22 (Junction Tower JT-1))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree	N _c	N _q - 1	N _γ	S _c	S _q	S _γ	d _c	d _q	d _γ	i _c	i _q	i _γ	gm/cc		W _q	W _γ	
1	1.50	1.50	3.00	4.89	197.61	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.57	1.29	1.29	1.00	1.00	1.00	1.85	0.93	0.50	0.50	39
2	2.00	2.00	3.00	4.89	197.61	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.43	1.22	1.22	1.00	1.00	1.00	1.85	0.93	0.50	0.50	38
3	2.50	2.50	3.00	4.89	197.61	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.34	1.17	1.17	1.00	1.00	1.00	1.85	0.93	0.50	0.50	38
4	3.00	3.00	3.00	4.89	197.61	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.29	1.14	1.14	1.00	1.00	1.00	1.85	0.93	0.50	0.50	38
5	1.50	1.50	3.50	5.39	197.11	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.67	1.33	1.33	1.00	1.00	1.00	1.85	0.93	0.50	0.50	44
6	2.00	2.00	3.50	5.39	197.11	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.50	1.25	1.25	1.00	1.00	1.00	1.85	0.93	0.50	0.50	43
7	2.50	2.50	3.50	5.39	197.11	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.40	1.20	1.20	1.00	1.00	1.00	1.85	0.93	0.50	0.50	42
8	3.00	3.00	3.50	5.39	197.11	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.33	1.17	1.17	1.00	1.00	1.00	1.85	0.93	0.50	0.50	42
9	1.50	1.50	4.00	5.89	196.61	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.77	1.38	1.38	1.00	1.00	1.00	1.85	0.93	0.50	0.50	50
10	2.00	2.00	4.00	5.89	196.61	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.57	1.29	1.29	1.00	1.00	1.00	1.85	0.93	0.50	0.50	48
11	2.50	2.50	4.00	5.89	196.61	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.46	1.23	1.23	1.00	1.00	1.00	1.85	0.93	0.50	0.50	47
12	3.00	3.00	4.00	5.89	196.61	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.38	1.19	1.19	1.00	1.00	1.00	1.85	0.93	0.50	0.50	47

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 200.61m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 9.2 (For IBH-22 (Junction Tower JT-1))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_1 = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D from NGL m	RL of foundation m	Depth of foundation from FGL m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	3.00	197.61	4.89	1.50	1.12	0.35	494	0.80	105	168
2	3.00	197.61	4.89	2.00	1.12	0.35	494	0.80	79	126
3	3.00	197.61	4.89	2.50	1.12	0.35	494	0.80	63	101
4	3.00	197.61	4.89	3.00	1.12	0.35	494	0.80	52	84
5	3.50	197.11	5.39	1.50	1.12	0.35	494	0.80	105	168
6	3.50	197.11	5.39	2.00	1.12	0.35	494	0.80	79	126
7	3.50	197.11	5.39	2.50	1.12	0.35	494	0.80	63	101
8	3.50	197.11	5.39	3.00	1.12	0.35	494	0.80	52	84
9	4.00	196.61	5.89	1.50	1.12	0.35	494	0.80	105	168
10	4.00	196.61	5.89	2.00	1.12	0.35	494	0.80	79	126
11	4.00	196.61	5.89	2.50	1.12	0.35	494	0.80	63	101
12	4.00	196.61	5.89	3.00	1.12	0.35	494	0.80	52	84

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 9.3 (For IBH-22 (Junction Tower JT-1))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:200.61m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 9.4)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 9.5)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
3.00	197.61	4.89	3.50	3.50	38	45	72	38	38
3.00	197.61	4.89	4.00	4.00	39	39	63	39	39
3.00	197.61	4.89	5.00	5.00	41	31	50	31	41
3.00	197.61	4.89	6.00	6.00	43	26	42	26	42
3.50	197.11	5.39	3.50	3.50	43	45	72	43	43
3.50	197.11	5.39	4.00	4.00	43	39	63	39	43
3.50	197.11	5.39	5.00	5.00	45	31	50	31	45
3.50	197.11	5.39	6.00	6.00	47	26	42	26	42
4.00	196.61	5.89	3.50	3.50	47	45	72	45	47
4.00	196.61	5.89	4.00	4.00	47	39	63	39	47
4.00	196.61	5.89	5.00	5.00	49	31	50	31	49
4.00	196.61	5.89	6.00	6.00	50	26	42	26	42

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 200.61m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 9.4 (For IBH-22 (Junction Tower JT-1))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree	N _c	N _q - 1	N _γ	S _c	S _q	S _γ	d _c	d _q	d _γ	i _c	i _q	i _γ	gm/cc		W _q	W _γ	
1	3.50	3.50	3.00	4.89	197.61	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.25	1.12	1.12	1.00	1.00	1.00	1.85	0.93	0.50	0.50	38
2	4.00	4.00	3.00	4.89	197.61	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.22	1.11	1.11	1.00	1.00	1.00	1.85	0.93	0.50	0.50	39
3	5.00	5.00	3.00	4.89	197.61	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.17	1.09	1.09	1.00	1.00	1.00	1.85	0.93	0.50	0.50	41
4	6.00	6.00	3.00	4.89	197.61	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	1.85	0.93	0.50	0.50	43
5	3.50	3.50	3.50	5.39	197.11	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.29	1.14	1.14	1.00	1.00	1.00	1.85	0.93	0.50	0.50	43
6	4.00	4.00	3.50	5.39	197.11	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.25	1.13	1.13	1.00	1.00	1.00	1.85	0.93	0.50	0.50	43
7	5.00	5.00	3.50	5.39	197.11	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.20	1.10	1.10	1.00	1.00	1.00	1.85	0.93	0.50	0.50	45
8	6.00	6.00	3.50	5.39	197.11	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.17	1.08	1.08	1.00	1.00	1.00	1.85	0.93	0.50	0.50	47
9	3.50	3.50	4.00	5.89	196.61	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.33	1.16	1.16	1.00	1.00	1.00	1.85	0.93	0.50	0.50	47
10	4.00	4.00	4.00	5.89	196.61	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.29	1.14	1.14	1.00	1.00	1.00	1.85	0.93	0.50	0.50	47
11	5.00	5.00	4.00	5.89	196.61	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.23	1.11	1.11	1.00	1.00	1.00	1.85	0.93	0.50	0.50	49
12	6.00	6.00	4.00	5.89	196.61	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.19	1.10	1.10	1.00	1.00	1.00	1.85	0.93	0.50	0.50	50

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 200.61m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 9.5 (For IBH-22 (Junction Tower JT-1))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_1 = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D from NGL m	RL of foundation m	Depth of foundation from FGL m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	3.00	197.61	4.89	3.50	1.12	0.35	494	0.80	45	72
2	3.00	197.61	4.89	4.00	1.12	0.35	494	0.80	39	63
3	3.00	197.61	4.89	5.00	1.12	0.35	494	0.80	31	50
4	3.00	197.61	4.89	6.00	1.12	0.35	494	0.80	26	42
5	3.50	197.11	5.39	3.50	1.12	0.35	494	0.80	45	72
6	3.50	197.11	5.39	4.00	1.12	0.35	494	0.80	39	63
7	3.50	197.11	5.39	5.00	1.12	0.35	494	0.80	31	50
8	3.50	197.11	5.39	6.00	1.12	0.35	494	0.80	26	42
9	4.00	196.61	5.89	3.50	1.12	0.35	494	0.80	45	72
10	4.00	196.61	5.89	4.00	1.12	0.35	494	0.80	39	63
11	4.00	196.61	5.89	5.00	1.12	0.35	494	0.80	31	50
12	4.00	196.61	5.89	6.00	1.12	0.35	494	0.80	26	42

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 9.6 (For IBH-22 (Junction Tower JT-1))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:200.61m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 9.7)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 9.8)		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
3.00	197.61	4.89	7.00	7.00	45	22	36	22	36
3.00	197.61	4.89	8.00	8.00	47	20	31	20	31
3.00	197.61	4.89	9.00	9.00	49	17	28	17	28
3.00	197.61	4.89	10.00	10.00	52	16	25	16	25
3.50	197.11	5.39	7.00	7.00	49	22	36	22	36
3.50	197.11	5.39	8.00	8.00	51	20	31	20	31
3.50	197.11	5.39	9.00	9.00	53	17	28	17	28
3.50	197.11	5.39	10.00	10.00	55	16	25	16	25
4.00	196.61	5.89	7.00	7.00	52	22	36	22	36
4.00	196.61	5.89	8.00	8.00	54	20	31	20	31
4.00	196.61	5.89	9.00	9.00	57	17	28	17	28
4.00	196.61	5.89	10.00	10.00	59	16	25	16	25

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 200.61m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 9.7 (For IBH-22 (Junction Tower JT-1))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree	N _c	N _q - 1	N _γ	S _c	S _q	S _γ	d _c	d _q	d _γ	i _c	i _q	i _γ	gm/cc		W _q	W _γ	
1	7.00	7.00	3.00	4.89	197.61	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.12	1.06	1.06	1.00	1.00	1.00	1.85	0.93	0.50	0.50	45
2	8.00	8.00	3.00	4.89	197.61	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.11	1.05	1.05	1.00	1.00	1.00	1.85	0.93	0.50	0.50	47
3	9.00	9.00	3.00	4.89	197.61	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.10	1.05	1.05	1.00	1.00	1.00	1.85	0.93	0.50	0.50	49
4	10.00	10.00	3.00	4.89	197.61	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.09	1.04	1.04	1.00	1.00	1.00	1.85	0.93	0.50	0.50	52
5	7.00	7.00	3.50	5.39	197.11	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	1.85	0.93	0.50	0.50	49
6	8.00	8.00	3.50	5.39	197.11	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.13	1.06	1.06	1.00	1.00	1.00	1.85	0.93	0.50	0.50	51
7	9.00	9.00	3.50	5.39	197.11	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.11	1.06	1.06	1.00	1.00	1.00	1.85	0.93	0.50	0.50	53
8	10.00	10.00	3.50	5.39	197.11	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.10	1.05	1.05	1.00	1.00	1.00	1.85	0.93	0.50	0.50	55
9	7.00	7.00	4.00	5.89	196.61	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.16	1.08	1.08	1.00	1.00	1.00	1.85	0.93	0.50	0.50	52
10	8.00	8.00	4.00	5.89	196.61	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	1.85	0.93	0.50	0.50	54
11	9.00	9.00	4.00	5.89	196.61	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.13	1.06	1.06	1.00	1.00	1.00	1.85	0.93	0.50	0.50	57
12	10.00	10.00	4.00	5.89	196.61	0.08	29	25.22	13.40	16.49	1.30	1.20	0.80	1.11	1.06	1.06	1.00	1.00	1.00	1.85	0.93	0.50	0.50	59

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 200.61m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 9.8 (For IBH-22 (Junction Tower JT-1))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_1 = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D from NGL m	RL of foundation m	Depth of foundation from FGL m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	3.00	197.61	4.89	7.00	1.12	0.35	494	0.80	22	36
2	3.00	197.61	4.89	8.00	1.12	0.35	494	0.80	20	31
3	3.00	197.61	4.89	9.00	1.12	0.35	494	0.80	17	28
4	3.00	197.61	4.89	10.00	1.12	0.35	494	0.80	16	25
5	3.50	197.11	5.39	7.00	1.12	0.35	494	0.80	22	36
6	3.50	197.11	5.39	8.00	1.12	0.35	494	0.80	20	31
7	3.50	197.11	5.39	9.00	1.12	0.35	494	0.80	17	28
8	3.50	197.11	5.39	10.00	1.12	0.35	494	0.80	16	25
9	4.00	196.61	5.89	7.00	1.12	0.35	494	0.80	22	36
10	4.00	196.61	5.89	8.00	1.12	0.35	494	0.80	20	31
11	4.00	196.61	5.89	9.00	1.12	0.35	494	0.80	17	28
12	4.00	196.61	5.89	10.00	1.12	0.35	494	0.80	16	25

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 9.9 (For IBH-22 (Junction Tower JT-1))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:200.61m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	199.61	2.89	1.50	1.50	13	74	119	13	13
1.00	199.61	2.89	2.00	2.00	14	56	89	14	14
1.00	199.61	2.89	2.50	2.50	14	45	71	14	14
1.00	199.61	2.89	3.00	3.00	15	37	59	15	15
1.50	199.11	3.39	1.50	1.50	16	74	119	16	16
1.50	199.11	3.39	2.00	2.00	16	56	89	16	16
1.50	199.11	3.39	2.50	2.50	17	45	71	17	17
1.50	199.11	3.39	3.00	3.00	17	37	59	17	17
2.00	198.61	3.89	1.50	1.50	19	74	119	19	19
2.00	198.61	3.89	2.00	2.00	19	56	89	19	19
2.00	198.61	3.89	2.50	2.50	20	45	71	20	20
2.00	198.61	3.89	3.00	3.00	20	37	59	20	20

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 200.61m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX 9.10 (For IBH-22 (Junction Tower JT-1))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree	N _c	N _q - 1	N _γ	S _c	S _q	S _γ	d _c	d _q	d _γ	i _c	i _q	i _γ	gm/cc		W _q	W _γ	
1	1.50	1.50	1.00	2.89	199.61	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.19	1.09	1.09	1.00	1.00	1.00	1.78	0.89	0.50	0.50	13
2	2.00	2.00	1.00	2.89	199.61	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	1.78	0.89	0.50	0.50	14
3	2.50	2.50	1.00	2.89	199.61	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.11	1.06	1.06	1.00	1.00	1.00	1.78	0.89	0.50	0.50	14
4	3.00	3.00	1.00	2.89	199.61	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.09	1.05	1.05	1.00	1.00	1.00	1.78	0.89	0.50	0.50	15
5	1.50	1.50	1.50	3.39	199.11	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.28	1.14	1.14	1.00	1.00	1.00	1.78	0.89	0.50	0.50	16
6	2.00	2.00	1.50	3.39	199.11	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.21	1.11	1.11	1.00	1.00	1.00	1.78	0.89	0.50	0.50	16
7	2.50	2.50	1.50	3.39	199.11	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.17	1.08	1.08	1.00	1.00	1.00	1.78	0.89	0.50	0.50	17
8	3.00	3.00	1.50	3.39	199.11	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	1.78	0.89	0.50	0.50	17
9	1.50	1.50	2.00	3.89	198.61	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.38	1.19	1.19	1.00	1.00	1.00	1.78	0.89	0.50	0.50	19
10	2.00	2.00	2.00	3.89	198.61	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.28	1.14	1.14	1.00	1.00	1.00	1.78	0.89	0.50	0.50	19
11	2.50	2.50	2.00	3.89	198.61	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.23	1.11	1.11	1.00	1.00	1.00	1.78	0.89	0.50	0.50	20
12	3.00	3.00	2.00	3.89	198.61	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.19	1.09	1.09	1.00	1.00	1.00	1.78	0.89	0.50	0.50	20

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 200.61m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-9.11 (For IBH-22 (Junction Tower JT-1))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_1 = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D from NGL m	RL of foundation m	Depth of foundation from FGL m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	199.61	2.89	1.50	1.12	0.35	350	0.80	74	119
2	1.00	199.61	2.89	2.00	1.12	0.35	350	0.80	56	89
3	1.00	199.61	2.89	2.50	1.12	0.35	350	0.80	45	71
4	1.00	199.61	2.89	3.00	1.12	0.35	350	0.80	37	59
5	1.50	199.11	3.39	1.50	1.12	0.35	350	0.80	74	119
6	1.50	199.11	3.39	2.00	1.12	0.35	350	0.80	56	89
7	1.50	199.11	3.39	2.50	1.12	0.35	350	0.80	45	71
8	1.50	199.11	3.39	3.00	1.12	0.35	350	0.80	37	59
9	2.00	198.61	3.89	1.50	1.12	0.35	350	0.80	74	119
10	2.00	198.61	3.89	2.00	1.12	0.35	350	0.80	56	89
11	2.00	198.61	3.89	2.50	1.12	0.35	350	0.80	45	71
12	2.00	198.61	3.89	3.00	1.12	0.35	350	0.80	37	59

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 9.12 (For IBH-22 (Junction Tower JT-1))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:200.61m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	199.61	2.89	3.50	3.50	15	32	51	15	15
1.00	199.61	2.89	4.00	4.00	16	28	45	16	16
1.00	199.61	2.89	5.00	5.00	18	22	36	18	18
1.00	199.61	2.89	6.00	6.00	19	19	30	19	19
1.50	199.11	3.39	3.50	3.50	18	32	51	18	18
1.50	199.11	3.39	4.00	4.00	19	28	45	19	19
1.50	199.11	3.39	5.00	5.00	20	22	36	20	20
1.50	199.11	3.39	6.00	6.00	22	19	30	19	22
2.00	198.61	3.89	3.50	3.50	21	32	51	21	21
2.00	198.61	3.89	4.00	4.00	21	28	45	21	21
2.00	198.61	3.89	5.00	5.00	23	22	36	22	23
2.00	198.61	3.89	6.00	6.00	24	19	30	19	24

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 200.61m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX 9.13 (For IBH-22 (Junction Tower JT-1))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree	N _c	N _q - 1	N _γ	S _c	S _q	S _γ	d _c	d _q	d _γ	i _c	i _q	i _γ	gm/cc		W _q	W _γ	
1	3.50	3.50	1.00	2.89	199.61	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	1.78	0.89	0.50	0.50	15
2	4.00	4.00	1.00	2.89	199.61	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.07	1.04	1.04	1.00	1.00	1.00	1.78	0.89	0.50	0.50	16
3	5.00	5.00	1.00	2.89	199.61	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	1.78	0.89	0.50	0.50	18
4	6.00	6.00	1.00	2.89	199.61	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.05	1.02	1.02	1.00	1.00	1.00	1.78	0.89	0.50	0.50	19
5	3.50	3.50	1.50	3.39	199.11	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.12	1.06	1.06	1.00	1.00	1.00	1.78	0.89	0.50	0.50	18
6	4.00	4.00	1.50	3.39	199.11	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.11	1.05	1.05	1.00	1.00	1.00	1.78	0.89	0.50	0.50	19
7	5.00	5.00	1.50	3.39	199.11	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	1.78	0.89	0.50	0.50	20
8	6.00	6.00	1.50	3.39	199.11	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.07	1.04	1.04	1.00	1.00	1.00	1.78	0.89	0.50	0.50	22
9	3.50	3.50	2.00	3.89	198.61	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.16	1.08	1.08	1.00	1.00	1.00	1.78	0.89	0.50	0.50	21
10	4.00	4.00	2.00	3.89	198.61	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	1.78	0.89	0.50	0.50	21
11	5.00	5.00	2.00	3.89	198.61	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.11	1.06	1.06	1.00	1.00	1.00	1.78	0.89	0.50	0.50	23
12	6.00	6.00	2.00	3.89	198.61	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.09	1.05	1.05	1.00	1.00	1.00	1.78	0.89	0.50	0.50	24

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 200.61m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-9.14 (For IBH-22 (Junction Tower JT-1))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_1 = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D from NGL m	RL of foundation m	Depth of foundation from FGL m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	199.61	2.89	3.50	1.12	0.35	350	0.80	32	51
2	1.00	199.61	2.89	4.00	1.12	0.35	350	0.80	28	45
3	1.00	199.61	2.89	5.00	1.12	0.35	350	0.80	22	36
4	1.00	199.61	2.89	6.00	1.12	0.35	350	0.80	19	30
5	1.50	199.11	3.39	3.50	1.12	0.35	350	0.80	32	51
6	1.50	199.11	3.39	4.00	1.12	0.35	350	0.80	28	45
7	1.50	199.11	3.39	5.00	1.12	0.35	350	0.80	22	36
8	1.50	199.11	3.39	6.00	1.12	0.35	350	0.80	19	30
9	2.00	198.61	3.89	3.50	1.12	0.35	350	0.80	32	51
10	2.00	198.61	3.89	4.00	1.12	0.35	350	0.80	28	45
11	2.00	198.61	3.89	5.00	1.12	0.35	350	0.80	22	36
12	2.00	198.61	3.89	6.00	1.12	0.35	350	0.80	19	30

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 9.15 (For IBH-22 (Junction Tower JT-1))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:200.61m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	199.61	2.89	7.00	7.00	21	16	25	16	21
1.00	199.61	2.89	8.00	8.00	22	14	22	14	22
1.00	199.61	2.89	9.00	9.00	24	12	20	12	20
1.00	199.61	2.89	10.00	10.00	25	11	18	11	18
1.50	199.11	3.39	7.00	7.00	23	16	25	16	23
1.50	199.11	3.39	8.00	8.00	25	14	22	14	22
1.50	199.11	3.39	9.00	9.00	26	12	20	12	20
1.50	199.11	3.39	10.00	10.00	28	11	18	11	18
2.00	198.61	3.89	7.00	7.00	26	16	25	16	25
2.00	198.61	3.89	8.00	8.00	27	14	22	14	22
2.00	198.61	3.89	9.00	9.00	29	12	20	12	20
2.00	198.61	3.89	10.00	10.00	30	11	18	11	18

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 200.61m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-9.16 (For IBH-22 (Junction Tower JT-1))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree	N _c	N _q - 1	N _γ	S _c	S _q	S _γ	d _c	d _q	d _γ	i _c	i _q	i _γ	gm/cc		W _q	W _γ	
1	7.00	7.00	1.00	2.89	199.61	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.04	1.02	1.02	1.00	1.00	1.00	1.78	0.89	0.50	0.50	21
2	8.00	8.00	1.00	2.89	199.61	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.04	1.02	1.02	1.00	1.00	1.00	1.78	0.89	0.50	0.50	22
3	9.00	9.00	1.00	2.89	199.61	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.03	1.02	1.02	1.00	1.00	1.00	1.78	0.89	0.50	0.50	24
4	10.00	10.00	1.00	2.89	199.61	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.03	1.01	1.01	1.00	1.00	1.00	1.78	0.89	0.50	0.50	25
5	7.00	7.00	1.50	3.39	199.11	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	1.78	0.89	0.50	0.50	23
6	8.00	8.00	1.50	3.39	199.11	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.05	1.03	1.03	1.00	1.00	1.00	1.78	0.89	0.50	0.50	25
7	9.00	9.00	1.50	3.39	199.11	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.05	1.02	1.02	1.00	1.00	1.00	1.78	0.89	0.50	0.50	26
8	10.00	10.00	1.50	3.39	199.11	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.04	1.02	1.02	1.00	1.00	1.00	1.78	0.89	0.50	0.50	28
9	7.00	7.00	2.00	3.89	198.61	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	1.78	0.89	0.50	0.50	26
10	8.00	8.00	2.00	3.89	198.61	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.07	1.04	1.04	1.00	1.00	1.00	1.78	0.89	0.50	0.50	27
11	9.00	9.00	2.00	3.89	198.61	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	1.78	0.89	0.50	0.50	29
12	10.00	10.00	2.00	3.89	198.61	0.07	28	20.41	9.64	11.19	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	1.78	0.89	0.50	0.50	30

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 200.61m.
- 3) Calculations are considering the effect of water table at FGL.

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APPENDIX-9.17 (For IBH-22 (Junction Tower JT-1))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_1 = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D from NGL m	RL of foundation m	Depth of foundation from FGL m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	199.61	2.89	7.00	1.12	0.35	350	0.80	16	25
2	1.00	199.61	2.89	8.00	1.12	0.35	350	0.80	14	22
3	1.00	199.61	2.89	9.00	1.12	0.35	350	0.80	12	20
4	1.00	199.61	2.89	10.00	1.12	0.35	350	0.80	11	18
5	1.50	199.11	3.39	7.00	1.12	0.35	350	0.80	16	25
6	1.50	199.11	3.39	8.00	1.12	0.35	350	0.80	14	22
7	1.50	199.11	3.39	9.00	1.12	0.35	350	0.80	12	20
8	1.50	199.11	3.39	10.00	1.12	0.35	350	0.80	11	18
9	2.00	198.61	3.89	7.00	1.12	0.35	350	0.80	16	25
10	2.00	198.61	3.89	8.00	1.12	0.35	350	0.80	14	22
11	2.00	198.61	3.89	9.00	1.12	0.35	350	0.80	12	20
12	2.00	198.61	3.89	10.00	1.12	0.35	350	0.80	11	18

Appendix – 9A

Calculation of Safe Load carrying capacity of piles socketed inside rock (Near IBH 22) (Junction Tower JT-1)

Project Name: - Proposed structures of thermal power project of NTTTP at Hirma, Talabira

1.0 Introduction

In situations where overburden offering low bearing pressure is followed by rock at relatively shallower depths, end bearing piles is the suitable foundation option. Piles in rocks and weathered rocks of varying degree of weathering derive their capacity by end bearing and socket side resistance.

In situations, where, rock strata comprises of highly fragmented rock, as in present case, where RQD is nil or $(CR+RQD)/2$ is less than 30 % or when the crushing strength is less than 10 MPa, the appropriate approach would be of that suggested by Cole & Stroud.

In present site overburden soils overlay fractured / laminated / foliated rock. The founding stratum having highly fragmented rock with nil RQD and $(CR+RQD)/2$ to be less than 30 %, the approach suggested by Cole and Stroud as per Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 Pa/S2 has been used for safe load calculations.

An illustrative calculation of safe load on pile and summary of pile capacities is as follows,

2.0 Sub soil strata Characterization

General stratification at the location of boreholes IBH 22 show primarily two characterized layers,

1. Overburden comprising of Dark reddish brown, fine to coarse grained, silty sand with little plastic fines and some followed by Light reddish yellow and reddish yellow, fine to medium grained, clayey sand with occasional gravels upto 6.30m (i.e. RL 194.31 m) followed by Boulderous formation of highly weathered, weak, dark brownish, fine to coarse grained, fractured and friable rock with little cemented sand upto 9.50m (i.e. RL 191.11 m) followed by Boulderous formation of highly weathered, moderately weak, dark brownish, fine to coarse grained, fractured and friable rock with cemented sand upto 12.50m (i.e. RL 188.11 m) followed by Yellowish brown, fine to medium grained, cemented silty sand with very weak and friable fragments of rock upto 17.30m (i.e. RL 183.31 m) followed by Yellowish brown and slightly greyish, fine to coarse grained, cemented silty sand with little plastic fines and with very weak and friable fragments of rock upto 18.50m (i.e. RL 182.11 m).
2. Second characterized layer below the overburden soils comprises of Highly weathered, weak, completely fractured, yellowish brown, fine to medium grained, rock mix with yellowish brown, fine to medium grained, cemented sand followed by Highly weathered, very weak, yellowish brown, fine to coarse grained, fractured and friable rock upto 25.00m (i.e. RL 175.61 m).

3.0 Design Considerations

1. Length of socket considered 3D from depth of rock encountered.
2. The pile is considered to have socket length below 18.50 m below NGL (i.e. RL 182.11 m) depth.
3. For present case of pile terminating in highly weathered rock. SPT at depths between 18.50 to 25.00m (between RL 182.11 to 175.61 m) is > 100 with just 3.0 cm penetration in 51 blows. SPT can be extrapolated for 30 cm i.e. $51 * 30 / 3.00 = 510$.
Based on recommendation of fig no. 3 in B 8 in Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 P1/S2, average shear strength q_c corresponding to assumed SPT of 200 may be taken as 1300 kN/m^2
4. Allowable Capacity of pile socketed into rock $Q_a = R_e + R_{sf} = C_{u1} N_c \pi B^2 / 4(F_s=3) + \alpha C_{u2} \pi BL / (F_s=6)$

4.0 Safe Load on Pile in Compression

Where,

End bearing component, $R_e = C_{u1} N_c \pi B^2 / 4F_s$,

C_{u1} = Shear strength below base of pile = 1300 kN/m^2

B = diameter of the pile = d

F_s = Factor of Safety = 3

$N_c = 9$

Therefore, **$R_e = 3061.5 d^2$**

Skin friction component of socketed length of pile, $R_{sf} = \alpha C_{u2} \pi BL / F_s$

$\alpha = 0.9$ (recommended value in IS 2911 P1/S2)

L = length of the socket = 3 D

C_{u2} = Ultimate shear strength along socket length which shall be restricted to shear capacity of concrete of the pile = 1300 kN/m²

F_s = Factor of Safety = 6

Therefore, $R_{sf} = 1836.9 \text{ d}^2$

Thus,

$$Q_a = c_{u1} N_c \cdot \frac{\pi B^2}{4 F_s} + \alpha c_{u2} \cdot \frac{\pi B L}{F_s}$$

$$= 3061.5 \text{ d}^2 + 1836.9 \text{ d}^2 = 4898.4 \text{ d}^2$$

Substituting the values of various diameters and socket lengths equal to 3 times diameter, allowable load on single pile can be summarized as follows,

Summary of the Safe load calculation in Compression

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	22.19	22.67	23.09
Termination level RL in m	180.31	179.83	179.41
End Bearing Component in kN	1102.1	1768.3	2479.8
Friction Component in kN	661.3	1060.9	1487.9
Safe load in Compression in kN	1763.4	2829.3	3967.7
Safe load in Compression in T	176	283	397

5.0 Safe Load on Pile in uplift

For 2.00m cutoff from FGL

The overburden soils, though, will not contribute in compression capacity would offer resistance in uplift capacity. The parameters of IBH 22 are considered for calculation of uplift resistance as summarized below,

Depth in m from RL 202.5 m	Cohesion in kg/cm ²	Angle of Internal Friction ϕ	Submerged density in gm/cc γ_{sub}	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 2.00	Pile cutoff level – No pile						
2.00 to 8.19	0.08	29	0.82	NA	1.00	29	13-43
8.19 to 20.39	0.00	34	1.27	NA	1.50	34	>100
20.39 to 26.89	Rock strata – Resistance would be as per skin friction capacity in socket as already calculated in compression capacity						

5) Soil type 1 shall be considered for seismic analysis as per table 2 of IS 1893-2016.

Ultimate load in skin friction,

$$Q_{uf} = \alpha_i C_{ai} A_{si} + K_i P D_i \tan \delta_i A_{si}$$

First Layer – No contribution considered – (Within Cutoff Level).

$$\text{Second Layer} - K_2 P D_2 \tan \delta_2 A_{s2} = 1.00 * 4.14 * \tan 29 * \pi d * 6.19 = 44.60 \text{ d}$$

$$\text{Third Layer} - K_3 P D_3 \tan \delta_3 A_{s3} = 1.50 * 10.75 * \tan 34 * \pi d * 12.20 = 416.87 \text{ d}$$

Fourth Layer – 1836.90 d² in rock socket

$$\text{Substituting, ultimate load } q_{uf} = 4614.66 \text{ d} + 1836.9 \text{ d}^2$$

The safe load in uplift is worked out (considering the safety factor of 2.50 for overburden soils) and summarized below,

Safe Load on Piles in Uplift (in Ton)

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	22.19	22.67	23.09
Termination level RL in m	180.31	179.83	179.41
Safe load in Uplift in kN	1768.80	2463.85	3149.17
Self-weight of pile in kN	85.59	140.58	201.15
Safe load in Uplift in T (Considering self-weight of pile)	185.44	260.44	335.03

6.0 Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60	0.76	0.90
Subgrade reaction in MN/m^3		2.84	2.84	2.84
Stiffness factor T in m		2.29	2.76	3.16
Depth of fixity in m	Free Head	4.30	5.20	6.00
	Fixed Head	5.00	6.00	6.90
Allowable Horizontal Force in T	Free Head	3.20	4.70	6.20
	Fixed Head	8.60	12.60	16.50
Allowable Moment capacity in Tm	Free Head	4.94	8.71	13.07
	Fixed Head	17.58	31.00	46.51

7.0 Notes

1. Pile shall be terminated after socketing 3D inside rock.
2. Initial and routine pile load test is required to verify the actual carrying capacity of pile in compression, uplift and lateral loads.
3. For design and construction, specification of IS: 2911, P1/S2, IS: 456, 2000 shall strictly be followed.

(Dr. K. K. Thaker)

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 10 (For IBH-23 (Junction Tower JT-2))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:200.45m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 10.1) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 10.2)		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
1.00	199.45	3.05	1.50	1.50	12	53	85	12	12
1.00	199.45	3.05	2.00	2.00	13	40	64	13	13
1.00	199.45	3.05	2.50	2.50	14	32	51	14	14
1.00	199.45	3.05	3.00	3.00	15	27	43	15	15
2.00	198.45	4.05	1.50	1.50	20	53	85	20	20
2.00	198.45	4.05	2.00	2.00	20	40	64	20	20
2.00	198.45	4.05	2.50	2.50	20	32	51	20	20
2.00	198.45	4.05	3.00	3.00	21	27	43	21	21
3.00	197.45	5.05	1.50	1.50	28	53	85	28	28
3.00	197.45	5.05	2.00	2.00	27	40	64	27	27
3.00	197.45	5.05	2.50	2.50	27	32	51	27	27
3.00	197.45	5.05	3.00	3.00	28	27	43	27	28

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 200.45m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 10.1 (For IBH-23 (Junction Tower JT-2))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	1.00	3.05	199.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.19	1.10	1.10	1.00	1.00	1.00	1.86	0.93	0.50	0.50	12
2	2.00	2.00	1.00	3.05	199.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	1.86	0.93	0.50	0.50	13
3	2.50	2.50	1.00	3.05	199.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.11	1.06	1.06	1.00	1.00	1.00	1.86	0.93	0.50	0.50	14
4	3.00	3.00	1.00	3.05	199.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.10	1.05	1.05	1.00	1.00	1.00	1.86	0.93	0.50	0.50	15
5	1.50	1.50	2.00	4.05	198.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.38	1.19	1.19	1.00	1.00	1.00	1.86	0.93	0.50	0.50	20
6	2.00	2.00	2.00	4.05	198.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.29	1.14	1.14	1.00	1.00	1.00	1.86	0.93	0.50	0.50	20
7	2.50	2.50	2.00	4.05	198.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.23	1.11	1.11	1.00	1.00	1.00	1.86	0.93	0.50	0.50	20
8	3.00	3.00	2.00	4.05	198.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.19	1.10	1.10	1.00	1.00	1.00	1.86	0.93	0.50	0.50	21
9	1.50	1.50	3.00	5.05	197.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.57	1.29	1.29	1.00	1.00	1.00	1.86	0.93	0.50	0.50	28
10	2.00	2.00	3.00	5.05	197.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.43	1.22	1.22	1.00	1.00	1.00	1.86	0.93	0.50	0.50	27
11	2.50	2.50	3.00	5.05	197.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.34	1.17	1.17	1.00	1.00	1.00	1.86	0.93	0.50	0.50	27
12	3.00	3.00	3.00	5.05	197.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.29	1.14	1.14	1.00	1.00	1.00	1.86	0.93	0.50	0.50	28

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 200.45m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 10.2 (For IBH-23 (Junction Tower JT-2))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_1 = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D from NGL m	RL of foundation m	Depth of foundation from FGL m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	199.45	3.05	1.50	1.12	0.35	251	0.80	53	85
2	1.00	199.45	3.05	2.00	1.12	0.35	251	0.80	40	64
3	1.00	199.45	3.05	2.50	1.12	0.35	251	0.80	32	51
4	1.00	199.45	3.05	3.00	1.12	0.35	251	0.80	27	43
5	2.00	198.45	4.05	1.50	1.12	0.35	251	0.80	53	85
6	2.00	198.45	4.05	2.00	1.12	0.35	251	0.80	40	64
7	2.00	198.45	4.05	2.50	1.12	0.35	251	0.80	32	51
8	2.00	198.45	4.05	3.00	1.12	0.35	251	0.80	27	43
9	3.00	197.45	5.05	1.50	1.12	0.35	251	0.80	53	85
10	3.00	197.45	5.05	2.00	1.12	0.35	251	0.80	40	64
11	3.00	197.45	5.05	2.50	1.12	0.35	251	0.80	32	51
12	3.00	197.45	5.05	3.00	1.12	0.35	251	0.80	27	43

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APPENDIX - 10.3 (For IBH-23 (Junction Tower JT-2))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:200.45m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 10.4) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 10.5)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
1.00	199.45	3.05	3.50	3.50	16	23	36	16	16
1.00	199.45	3.05	4.00	4.00	17	20	32	17	17
1.00	199.45	3.05	5.00	5.00	19	16	26	16	19
1.00	199.45	3.05	6.00	6.00	20	13	21	13	20
2.00	198.45	4.05	3.50	3.50	22	23	36	22	22
2.00	198.45	4.05	4.00	4.00	23	20	32	20	23
2.00	198.45	4.05	5.00	5.00	24	16	26	16	24
2.00	198.45	4.05	6.00	6.00	26	13	21	13	21
3.00	197.45	5.05	3.50	3.50	28	23	36	23	28
3.00	197.45	5.05	4.00	4.00	29	20	32	20	29
3.00	197.45	5.05	5.00	5.00	30	16	26	16	26
3.00	197.45	5.05	6.00	6.00	32	13	21	13	21

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 200.45m.
- 3) Calculations are considering the effect of water table at FGL.

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APPENDIX - 10.4 (For IBH-23 (Junction Tower JT-2))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	1.00	3.05	199.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	1.86	0.93	0.50	0.50	16
2	4.00	4.00	1.00	3.05	199.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.07	1.04	1.04	1.00	1.00	1.00	1.86	0.93	0.50	0.50	17
3	5.00	5.00	1.00	3.05	199.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	1.86	0.93	0.50	0.50	19
4	6.00	6.00	1.00	3.05	199.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.05	1.02	1.02	1.00	1.00	1.00	1.86	0.93	0.50	0.50	20
5	3.50	3.50	2.00	4.05	198.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.16	1.08	1.08	1.00	1.00	1.00	1.86	0.93	0.50	0.50	22
6	4.00	4.00	2.00	4.05	198.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	1.86	0.93	0.50	0.50	23
7	5.00	5.00	2.00	4.05	198.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.11	1.06	1.06	1.00	1.00	1.00	1.86	0.93	0.50	0.50	24
8	6.00	6.00	2.00	4.05	198.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.10	1.05	1.05	1.00	1.00	1.00	1.86	0.93	0.50	0.50	26
9	3.50	3.50	3.00	5.05	197.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.25	1.12	1.12	1.00	1.00	1.00	1.86	0.93	0.50	0.50	28
10	4.00	4.00	3.00	5.05	197.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.22	1.11	1.11	1.00	1.00	1.00	1.86	0.93	0.50	0.50	29
11	5.00	5.00	3.00	5.05	197.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.17	1.09	1.09	1.00	1.00	1.00	1.86	0.93	0.50	0.50	30
12	6.00	6.00	3.00	5.05	197.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	1.86	0.93	0.50	0.50	32

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 200.45m.
- 3) Calculations are considering the effect of water table at FGL.

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APPENDIX - 10.5 (For IBH-23 (Junction Tower JT-2))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_1 = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D from NGL m	RL of foundation m	Depth of foundation from FGL m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	199.45	3.05	3.50	1.12	0.35	251	0.80	23	36
2	1.00	199.45	3.05	4.00	1.12	0.35	251	0.80	20	32
3	1.00	199.45	3.05	5.00	1.12	0.35	251	0.80	16	26
4	1.00	199.45	3.05	6.00	1.12	0.35	251	0.80	13	21
5	2.00	198.45	4.05	3.50	1.12	0.35	251	0.80	23	36
6	2.00	198.45	4.05	4.00	1.12	0.35	251	0.80	20	32
7	2.00	198.45	4.05	5.00	1.12	0.35	251	0.80	16	26
8	2.00	198.45	4.05	6.00	1.12	0.35	251	0.80	13	21
9	3.00	197.45	5.05	3.50	1.12	0.35	251	0.80	23	36
10	3.00	197.45	5.05	4.00	1.12	0.35	251	0.80	20	32
11	3.00	197.45	5.05	5.00	1.12	0.35	251	0.80	16	26
12	3.00	197.45	5.05	6.00	1.12	0.35	251	0.80	13	21

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APPENDIX - 10.6 (For IBH-23 (Junction Tower JT-2))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:200.45m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 10.7) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 10.8)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
1.00	199.45	3.05	7.00	7.00	22	11	18	11	18
1.00	199.45	3.05	8.00	8.00	24	10	16	10	16
1.00	199.45	3.05	9.00	9.00	26	9	14	9	14
1.00	199.45	3.05	10.00	10.00	28	8	13	8	13
2.00	198.45	4.05	7.00	7.00	28	11	18	11	18
2.00	198.45	4.05	8.00	8.00	30	10	16	10	16
2.00	198.45	4.05	9.00	9.00	32	9	14	9	14
2.00	198.45	4.05	10.00	10.00	34	8	13	8	13
3.00	197.45	5.05	7.00	7.00	34	11	18	11	18
3.00	197.45	5.05	8.00	8.00	36	10	16	10	16
3.00	197.45	5.05	9.00	9.00	38	9	14	9	14
3.00	197.45	5.05	10.00	10.00	39	8	13	8	13

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 200.45m.
- 3) Calculations are considering the effect of water table at FGL.

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APPENDIX - 10.7 (For IBH-23 (Junction Tower JT-2))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	1.00	3.05	199.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.04	1.02	1.02	1.00	1.00	1.00	1.86	0.93	0.50	0.50	22
2	8.00	8.00	1.00	3.05	199.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.04	1.02	1.02	1.00	1.00	1.00	1.86	0.93	0.50	0.50	24
3	9.00	9.00	1.00	3.05	199.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.03	1.02	1.02	1.00	1.00	1.00	1.86	0.93	0.50	0.50	26
4	10.00	10.00	1.00	3.05	199.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.03	1.01	1.01	1.00	1.00	1.00	1.86	0.93	0.50	0.50	28
5	7.00	7.00	2.00	4.05	198.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	1.86	0.93	0.50	0.50	28
6	8.00	8.00	2.00	4.05	198.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.07	1.04	1.04	1.00	1.00	1.00	1.86	0.93	0.50	0.50	30
7	9.00	9.00	2.00	4.05	198.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	1.86	0.93	0.50	0.50	32
8	10.00	10.00	2.00	4.05	198.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	1.86	0.93	0.50	0.50	34
9	7.00	7.00	3.00	5.05	197.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.12	1.06	1.06	1.00	1.00	1.00	1.86	0.93	0.50	0.50	34
10	8.00	8.00	3.00	5.05	197.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.11	1.05	1.05	1.00	1.00	1.00	1.86	0.93	0.50	0.50	36
11	9.00	9.00	3.00	5.05	197.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.10	1.05	1.05	1.00	1.00	1.00	1.86	0.93	0.50	0.50	38
12	10.00	10.00	3.00	5.05	197.45	0.04	29	22.22	11.08	13.26	1.30	1.20	0.80	1.09	1.04	1.04	1.00	1.00	1.00	1.86	0.93	0.50	0.50	39

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 200.45m.
- 3) Calculations are considering the effect of water table at FGL.

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APPENDIX - 10.8 (For IBH-23 (Junction Tower JT-2))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_1 = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D from NGL m	RL of foundation m	Depth of foundation from FGL m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	199.45	3.05	7.00	1.12	0.35	251	0.80	11	18
2	1.00	199.45	3.05	8.00	1.12	0.35	251	0.80	10	16
3	1.00	199.45	3.05	9.00	1.12	0.35	251	0.80	9	14
4	1.00	199.45	3.05	10.00	1.12	0.35	251	0.80	8	13
5	2.00	198.45	4.05	7.00	1.12	0.35	251	0.80	11	18
6	2.00	198.45	4.05	8.00	1.12	0.35	251	0.80	10	16
7	2.00	198.45	4.05	9.00	1.12	0.35	251	0.80	9	14
8	2.00	198.45	4.05	10.00	1.12	0.35	251	0.80	8	13
9	3.00	197.45	5.05	7.00	1.12	0.35	251	0.80	11	18
10	3.00	197.45	5.05	8.00	1.12	0.35	251	0.80	10	16
11	3.00	197.45	5.05	9.00	1.12	0.35	251	0.80	9	14
12	3.00	197.45	5.05	10.00	1.12	0.35	251	0.80	8	13

Appendix – 10A

Calculation of Safe Load carrying capacity of piles socketed inside rock (Near IBH 23) (Junction Tower JT-2)

Project Name: - Proposed structures of thermal power project of NTTTP at Hirma, Talabira

1.0 Introduction

In situations where overburden offering low bearing pressure is followed by rock at relatively shallower depths, end bearing piles is the suitable foundation option. Piles in rocks and weathered rocks of varying degree of weathering derive their capacity by end bearing and socket side resistance.

In situations, where, rock strata comprises of highly fragmented rock, as in present case, where RQD is nil or $(CR+RQD)/2$ is less than 30 % or when the crushing strength is less than 10 MPa, the appropriate approach would be of that suggested by Cole & Stroud.

In present site overburden soils overlay fractured / laminated / foliated rock. The founding stratum having highly fragmented rock with nil RQD and $(CR+RQD)/2$ to be less than 30 %, the approach suggested by Cole and Stroud as per Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 Pa/S2 has been used for safe load calculations.

An illustrative calculation of safe load on pile and summary of pile capacities is as follows,

2.0 Sub soil strata Characterization

General stratification at the location of boreholes IBH 23 show primarily two characterized layers,

1. Overburden comprising of Yellowish brown, fine to medium grained, clayey sand with little to much gravels followed by Yellowish brown, fine to medium grained, poorly graded sand and silty sand with some gravels upto 14.70m (i.e. RL 185.75 m)
2. Second characterized layer below the overburden soils comprises of Highly weathered, very weak, dark brownish, fine to coarse grained, fractured rock upto 21.50m (i.e. RL 178.95 m).

3.0 Design Considerations

1. Length of socket considered 3D from depth of rock encountered.
2. The pile is considered to have socket length below 14.70 m below NGL (i.e. RL 185.75 m) depth.
3. For present case of pile terminating in highly weathered rock. SPT at depths between 14.70 to 21.50m (between RL 185.75 to 178.95 m) is > 100 with just 4.0 cm penetration in 51 blows. SPT can be extrapolated for 30 cm i.e. $51 * 30 / 4.00 = 382$.
Based on recommendation of fig no. 3 in B 8 in Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 P1/S2, average shear strength q_c corresponding to assumed SPT of 200 may be taken as 1300 kN/m²
4. Allowable Capacity of pile socketed into rock $Q_a = R_e + R_{sf} = C_{u1} N_c \pi B^2 / 4 (F_s = 3) + \alpha C_{u2} \pi BL / (F_s = 6)$

4.0 Safe Load on Pile in Compression

Where,

End bearing component, $R_e = C_{u1} N_c \pi B^2 / 4 F_s$,

C_{u1} = Shear strength below base of pile = 1300 kN/m²

B = diameter of the pile = d

F_s = Factor of Safety = 3

$N_c = 9$

Therefore, **$R_e = 3061.5 d^2$**

Skin friction component of socketed length of pile, $R_{sf} = \alpha C_{u2} \pi BL / F_s$

$\alpha = 0.9$ (recommended value in IS 2911 P1/S2)

L = length of the socket = $3 D$

C_{u2} = Ultimate shear strength along socket length which shall be restricted to shear capacity of concrete of the pile = 1300 kN/m^2

F_s = Factor of Safety = 6

Therefore, $R_{sf} = 1836.9 \text{ d}^2$

Thus,

$$Q_a = c_{u1} N_c \cdot \frac{\pi B^2}{4 F_s} + \alpha c_{u2} \cdot \frac{\pi B L}{F_s}$$

$$= 3061.5 \text{ d}^2 + 1836.9 \text{ d}^2 = 4898.4 \text{ d}^2$$

Substituting the values of various diameters and socket lengths equal to 3 times diameter, allowable load on single pile can be summarized as follows,

Summary of the Safe load calculation in Compression

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	18.55	19.03	19.45
Termination level RL in m	183.95	183.47	183.05
End Bearing Component in kN	1102.1	1768.3	2479.8
Friction Component in kN	661.3	1060.9	1487.9
Safe load in Compression in kN	1763.4	2829.3	3967.7
Safe load in Compression in T	176	283	397

5.0 Safe Load on Pile in uplift

For 2.00m cutoff from FGL

The overburden soils, though, will not contribute in compression capacity would offer resistance in uplift capacity. The parameters of IBH 23 are considered for calculation of uplift resistance as summarized below,

Depth in m from RL 202.5 m	Cohesion in kg/cm^2	Angle of Internal Friction ϕ	Submerged density in $\text{gm/cc } \gamma_{\text{sub}}$	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 2.00	Pile cutoff level – No pile						
2.00 to 10.55	0.04(ignored)	29	0.92	NA	1.00	29	13-36
10.55 to 16.75	0.13(ignored)	28	1.14	NA	1.00	28	>100
20.39 to 26.89	Rock strata – Resistance would be as per skin friction capacity in socket as already calculated in compression capacity						

Ultimate load in skin friction,

$$Q_{uf} = \alpha_i C_{ai} A_{si} + K_i P D_i \tan \delta_i A_{si}$$

First Layer – No contribution considered – (Within Cutoff Level).

$$\text{Second Layer} - K_2 P D_2 \tan \delta_2 A_{s2} = 1.00 * 5.53 * \tan 29 * \pi d * 8.55 = 82.34 \text{ d}$$

$$\text{Third Layer} - K_3 P D_3 \tan \delta_3 A_{s3} = 1.00 * 10.44 * \tan 28 * \pi d * 6.20 = 108.12 \text{ d}$$

Fourth Layer – 1836.90 d^2 in rock socket

$$\text{Substituting, ultimate load } q_{uf} = 1904.63 \text{ d} + 1836.9 \text{ d}^2$$

The safe load in uplift is worked out (considering the safety factor of 2.50 for overburden soils) and summarized below,

Safe Load on Piles in Uplift (in Ton)

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	18.55	19.03	19.45
Termination level RL in m	183.95	183.47	183.05
Safe load in Uplift in kN	1118.40	1640.00	2173.56
Self-weight of pile in kN	70.16	115.83	166.43
Safe load in Uplift in T (Considering self-weight of pile)	118.86	175.58	234.00

6.0 Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60	0.76	0.90
Subgrade reaction in MN/m^3		3.13	3.13	3.13
Stiffness factor T in m		2.24	2.71	3.10
Depth of fixity in m	Free Head	4.30	5.10	5.90
	Fixed Head	4.90	5.90	6.80
Allowable Horizontal Force in T	Free Head	3.40	5.00	6.60
	Fixed Head	9.10	13.30	17.40
Allowable Moment capacity in Tm	Free Head	5.13	9.05	13.59
	Fixed Head	18.28	32.23	48.36

7.0 Notes

1. Pile shall be terminated after socketing 3D inside rock.
2. Initial and routine pile load test is required to verify the actual carrying capacity of pile in compression, uplift and lateral loads.
3. For design and construction, specification of IS: 2911, P1/S2, IS: 456, 2000 shall strictly be followed.

(Dr. K. K. Thaker)

Appendix – 11A

Calculation of Safe Load carrying capacity of piles socketed inside rock (Near IBH 24) (Junction Tower JT-3 CHP MCC-2)

Project Name: - Proposed structures of thermal power project of NTTTP at Hirma, Talabira

1.0 Introduction

In situations where overburden offering low bearing pressure is followed by rock at relatively shallower depths, end bearing piles is the suitable foundation option. Piles in rocks and weathered rocks of varying degree of weathering derive their capacity by end bearing and socket side resistance.

In situations, where, rock strata comprises of highly fragmented rock, as in present case, where RQD is nil or $(CR+RQD)/2$ is less than 30 % or when the crushing strength is less than 10 MPa, the appropriate approach would be of that suggested by Cole & Stroud.

In present site overburden soils overlay fractured / laminated / foliated rock. The founding stratum having highly fragmented rock with nil RQD and $(CR+RQD)/2$ to be less than 30 %, the approach suggested by Cole and Stroud as per Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 Pa/S2 has been used for safe load calculations.

An illustrative calculation of safe load on pile and summary of pile capacities is as follows,

2.0 Sub soil strata Characterization

General stratification at the location of boreholes IBH 24 show primarily two characterized layers,

1. Overburden comprising of Yellowish brown, fine to very fine grained, clayey sand and Yellowish brown, fine to very fine grained, sandy clays of low plasticity upto 14.60m (i.e. RL 185.05m)
2. Second characterized layer below the overburden soils comprises of Highly weathered, weak, brownish grey, very fine grained, thinly laminated rock upto 20.00m (i.e. RL 179.65 m).

3.0 Design Considerations

1. Length of socket considered 3D from depth of rock encountered.
2. The pile is considered to have socket length below 14.60 m below NGL (i.e. RL 185.05 m) depth.
3. For present case of pile terminating in highly weathered rock. SPT at depths between 14.60 to 20.00m (between RL 185.05 to 179.65 m) is > 100 with just 7.0 cm penetration in 51 blows. SPT can be extrapolated for 30 cm i.e. $51 * 30 / 7.00 = 219$.
Based on recommendation of fig no. 3 in B 8 in Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 P1/S2, average shear strength q_c corresponding to assumed SPT of 200 may be taken as 1300 kN/m²
4. Allowable Capacity of pile socketed into rock $Q_a = R_e + R_{sf} = C_{u1} N_c \pi B^2 / 4 (F_s = 3) + \alpha C_{u2} \pi BL / (F_s = 6)$

4.0 Safe Load on Pile in Compression

Where,

End bearing component, $R_e = C_{u1} N_c \pi B^2 / 4 F_s$,

C_{u1} = Shear strength below base of pile = 1300 kN/m²

B = diameter of the pile = d

F_s = Factor of Safety = 3

$N_c = 9$

Therefore, **$R_e = 3061.5 d^2$**

Skin friction component of socketed length of pile, $R_{sf} = \alpha C_{u2} \pi BL / F_s$

$\alpha = 0.9$ (recommended value in IS 2911 P1/S2)

L = length of the socket = $3 D$

C_{u2} = Ultimate shear strength along socket length which shall be restricted to shear capacity of concrete of the pile = 1300 kN/m^2

F_s = Factor of Safety = 6

Therefore, $R_{sf} = 1836.9 \text{ d}^2$

Thus,

$$Q_a = c_{u1} N_c \cdot \frac{\pi B^2}{4 F_s} + \alpha c_{u2} \cdot \frac{\pi B L}{F_s}$$

$$= 3061.5 \text{ d}^2 + 1836.9 \text{ d}^2 = 4898.4 \text{ d}^2$$

Substituting the values of various diameters and socket lengths equal to 3 times diameter, allowable load on single pile can be summarized as follows,

Summary of the Safe load calculation in Compression

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	19.25	19.73	20.15
Termination level RL in m	183.25	182.77	182.35
End Bearing Component in kN	1102.1	1768.3	2479.8
Friction Component in kN	661.3	1060.9	1487.9
Safe load in Compression in kN	1763.4	2829.3	3967.7
Safe load in Compression in T	176	283	397

5.0 Safe Load on Pile in uplift

For 3.00m cutoff from FGL

The overburden soils, though, will not contribute in compression capacity would offer resistance in uplift capacity. The parameters of IBH 24 are considered for calculation of uplift resistance as summarized below,

Depth in m from RL 202.5 m	Cohesion in kg/cm^2	Angle of Internal Friction ϕ	Submerged density in $\text{gm/cc } \gamma_{\text{sub}}$	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 3.00	Pile cutoff level – No pile						
3.00 to 8.45	1.05	6(ignored)	1.00	0.41	NA	NA	13-24
8.45 to 10.15	0.08(ignored)	28	1.04	NA	1.00	28	26-34
10.15 to 12.45	1.26	2(ignored)	0.99	0.36	NA	NA	19-23
12.45 to 17.45	0.00	34	1.00	NA	1.00	34	16-36
17.45 to 27.85	Rock strata – Resistance would be as per skin friction capacity in socket as already calculated in compression capacity						

Ultimate load in skin friction,

$$Q_{uf} = \alpha_i C_{ai} A_{si} + K_i P D_i \tan \delta_i A_{si}$$

First Layer – No contribution considered – (Within Cutoff Level).

$$\text{Second Layer} - \alpha_2 C_{a2} A_{s2} = 0.41 * 10.50 * \pi * d * 5.45 = \mathbf{73.71d}$$

$$\text{Third Layer} - K_3 P D_3 \tan \delta_3 A_{s3} = 1.00 * 8.73 * \tan 28 * \pi * d * 1.70 = \mathbf{24.79 d}$$

$$\text{Fourth Layer} - \alpha_4 C_{a4} A_{s4} = 0.36 * 12.60 * \pi * d * 2.30 = \mathbf{32.78d}$$

$$\text{Fifth Layer} - K_5 P D_5 \tan \delta_5 A_{s5} = 1.00 * 10.86 * \tan 28 * \pi * d * 5.00 = \mathbf{90.70 d}$$

Sixth Layer – 1836.90 d^2 in rock socket

$$\text{Substituting, ultimate load } q_{uf} = \mathbf{2219.84 d + 1836.9 d^2}$$

The safe load in uplift is worked out (considering the safety factor of 2.50 for overburden soils) and summarized below,

Safe Load on Piles in Uplift (in Ton)

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	19.25	19.73	20.15
Termination level RL in m	183.25	182.77	182.35
Safe load in Uplift in kN	1194.05	1735.83	2287.03
Self-weight of pile in kN	68.88	113.78	163.57
Safe load in Uplift in T (Considering self-weight of pile)	126.29	184.96	245.06

6.0 Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60	0.76	0.90
Subgrade reaction in MN/m^3		18.72	18.72	18.72
Stiffness factor T in m		1.57	1.90	2.17
Depth of fixity in m	Free Head	3.00	3.60	4.10
	Fixed Head	3.40	4.10	4.70
Allowable Horizontal Force in T	Free Head	10.10	14.70	19.30
	Fixed Head	26.70	38.90	51.00
Allowable Moment capacity in Tm	Free Head	10.50	18.52	27.79
	Fixed Head	37.37	65.91	98.90

7.0 Notes

1. Pile shall be terminated after socketing 3D inside rock.
2. Initial and routine pile load test is required to verify the actual carrying capacity of pile in compression, uplift and lateral loads.
3. For design and construction, specification of IS: 2911, P1/S2, IS: 456, 2000 shall strictly be followed.

(Dr. K. K. Thaker)

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 12 (For IBH-25 (CHP MCC-1))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Depth of Foundation from NGL (RL:198.30m)	Depth of Foundation from FGL (RL:202.50m)	RL of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 12.1)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 12.2)		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	5.20	197.30	1.50	1.50	6	31	49	6	6
1.00	5.20	197.30	2.00	2.00	6	23	37	6	6
1.00	5.20	197.30	2.50	2.50	6	18	30	6	6
1.00	5.20	197.30	3.00	3.00	6	15	25	6	6
2.00	6.20	196.30	1.50	1.50	9	31	49	9	9
2.00	6.20	196.30	2.00	2.00	8	23	37	8	8
2.00	6.20	196.30	2.50	2.50	8	18	30	8	8
2.00	6.20	196.30	3.00	3.00	9	15	25	9	9
3.00	7.20	195.30	1.50	1.50	12	31	49	12	12
3.00	7.20	195.30	2.00	2.00	11	23	37	11	11
3.00	7.20	195.30	2.50	2.50	11	18	30	11	11
3.00	7.20	195.30	3.00	3.00	11	15	25	11	11

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 198.30m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 12.1 (For IBH-25 (CHP MCC-1))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from NGL m	Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ	N _c	N _q - 1	N _γ	S _c	S _q	S _γ	d _c	d _q	d _γ	i _c	i _q	i _γ	γ	0.5 γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _γ	
1	1.50	1.50	1.00	5.20	197.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.18	1.09	1.09	1.00	1.00	1.00	1.88	0.94	0.50	0.50	6
2	2.00	2.00	1.00	5.20	197.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.13	1.07	1.07	1.00	1.00	1.00	1.88	0.94	0.50	0.50	6
3	2.50	2.50	1.00	5.20	197.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.11	1.05	1.05	1.00	1.00	1.00	1.88	0.94	0.50	0.50	6
4	3.00	3.00	1.00	5.20	197.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.09	1.04	1.04	1.00	1.00	1.00	1.88	0.94	0.50	0.50	6
5	1.50	1.50	2.00	6.20	196.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.36	1.18	1.18	1.00	1.00	1.00	1.88	0.94	0.50	0.50	9
6	2.00	2.00	2.00	6.20	196.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.27	1.13	1.13	1.00	1.00	1.00	1.88	0.94	0.50	0.50	8
7	2.50	2.50	2.00	6.20	196.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.21	1.11	1.11	1.00	1.00	1.00	1.88	0.94	0.50	0.50	8
8	3.00	3.00	2.00	6.20	196.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.18	1.09	1.09	1.00	1.00	1.00	1.88	0.94	0.50	0.50	9
9	1.50	1.50	3.00	7.20	195.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.54	1.27	1.27	1.00	1.00	1.00	1.88	0.94	0.50	0.50	12
10	2.00	2.00	3.00	7.20	195.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.40	1.20	1.20	1.00	1.00	1.00	1.88	0.94	0.50	0.50	11
11	2.50	2.50	3.00	7.20	195.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.32	1.16	1.16	1.00	1.00	1.00	1.88	0.94	0.50	0.50	11
12	3.00	3.00	3.00	7.20	195.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.27	1.13	1.13	1.00	1.00	1.00	1.88	0.94	0.50	0.50	11

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 198.30m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 12.2 (For IBH-25 (CHP MCC-1))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_i = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D m	Depth of foundation from FGL m	RL of Foundation m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	5.20	197.30	1.50	1.12	0.35	145	0.80	31	49
2	1.00	5.20	197.30	2.00	1.12	0.35	145	0.80	23	37
3	1.00	5.20	197.30	2.50	1.12	0.35	145	0.80	18	30
4	1.00	5.20	197.30	3.00	1.12	0.35	145	0.80	15	25
5	2.00	6.20	196.30	1.50	1.12	0.35	145	0.80	31	49
6	2.00	6.20	196.30	2.00	1.12	0.35	145	0.80	23	37
7	2.00	6.20	196.30	2.50	1.12	0.35	145	0.80	18	30
8	2.00	6.20	196.30	3.00	1.12	0.35	145	0.80	15	25
9	3.00	7.20	195.30	1.50	1.12	0.35	145	0.80	31	49
10	3.00	7.20	195.30	2.00	1.12	0.35	145	0.80	23	37
11	3.00	7.20	195.30	2.50	1.12	0.35	145	0.80	18	30
12	3.00	7.20	195.30	3.00	1.12	0.35	145	0.80	15	25

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 12.3 (For IBH-25 (CHP MCC-1))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Depth of Foundation from NGL (RL:198.30m) (m)	Depth of Foundation from FGL (RL:202.50m) (m)	RL of Foundation (m)	Length of Foundation (m)	Width of Foundation (m)	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 12.4) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 12.5)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
1.00	5.20	197.30	3.50	3.50	7	13	21	7	7
1.00	5.20	197.30	4.00	4.00	7	12	18	7	7
1.00	5.20	197.30	5.00	5.00	7	9	15	7	7
1.00	5.20	197.30	6.00	6.00	8	8	12	8	8
2.00	6.20	196.30	3.50	3.50	9	13	21	9	9
2.00	6.20	196.30	4.00	4.00	9	12	18	9	9
2.00	6.20	196.30	5.00	5.00	9	9	15	9	9
2.00	6.20	196.30	6.00	6.00	10	8	12	8	10
3.00	7.20	195.30	3.50	3.50	11	13	21	11	11
3.00	7.20	195.30	4.00	4.00	11	12	18	11	11
3.00	7.20	195.30	5.00	5.00	11	9	15	9	11
3.00	7.20	195.30	6.00	6.00	12	8	12	8	12

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 198.30m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 12.4 (For IBH-25 (CHP MCC-1))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from NGL m	Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5 γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	1.00	5.20	197.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	1.88	0.94	0.50	0.50	7
2	4.00	4.00	1.00	5.20	197.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.07	1.03	1.03	1.00	1.00	1.00	1.88	0.94	0.50	0.50	7
3	5.00	5.00	1.00	5.20	197.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.05	1.03	1.03	1.00	1.00	1.00	1.88	0.94	0.50	0.50	7
4	6.00	6.00	1.00	5.20	197.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.04	1.02	1.02	1.00	1.00	1.00	1.88	0.94	0.50	0.50	8
5	3.50	3.50	2.00	6.20	196.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.15	1.08	1.08	1.00	1.00	1.00	1.88	0.94	0.50	0.50	9
6	4.00	4.00	2.00	6.20	196.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.13	1.07	1.07	1.00	1.00	1.00	1.88	0.94	0.50	0.50	9
7	5.00	5.00	2.00	6.20	196.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.11	1.05	1.05	1.00	1.00	1.00	1.88	0.94	0.50	0.50	9
8	6.00	6.00	2.00	6.20	196.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.09	1.04	1.04	1.00	1.00	1.00	1.88	0.94	0.50	0.50	10
9	3.50	3.50	3.00	7.20	195.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.23	1.11	1.11	1.00	1.00	1.00	1.88	0.94	0.50	0.50	11
10	4.00	4.00	3.00	7.20	195.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.20	1.10	1.10	1.00	1.00	1.00	1.88	0.94	0.50	0.50	11
11	5.00	5.00	3.00	7.20	195.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.16	1.08	1.08	1.00	1.00	1.00	1.88	0.94	0.50	0.50	11
12	6.00	6.00	3.00	7.20	195.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.13	1.07	1.07	1.00	1.00	1.00	1.88	0.94	0.50	0.50	12

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 198.30m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 12.5 (For IBH-25 (CHP MCC-1))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_i = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D m	Depth of foundation from FGL m	RL of Foundation m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	5.20	197.30	3.50	1.12	0.35	145	0.80	13	21
2	1.00	5.20	197.30	4.00	1.12	0.35	145	0.80	12	18
3	1.00	5.20	197.30	5.00	1.12	0.35	145	0.80	9	15
4	1.00	5.20	197.30	6.00	1.12	0.35	145	0.80	8	12
5	2.00	6.20	196.30	3.50	1.12	0.35	145	0.80	13	21
6	2.00	6.20	196.30	4.00	1.12	0.35	145	0.80	12	18
7	2.00	6.20	196.30	5.00	1.12	0.35	145	0.80	9	15
8	2.00	6.20	196.30	6.00	1.12	0.35	145	0.80	8	12
9	3.00	7.20	195.30	3.50	1.12	0.35	145	0.80	13	21
10	3.00	7.20	195.30	4.00	1.12	0.35	145	0.80	12	18
11	3.00	7.20	195.30	5.00	1.12	0.35	145	0.80	9	15
12	3.00	7.20	195.30	6.00	1.12	0.35	145	0.80	8	12

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 12.6 (For IBH-25 (CHP MCC-1))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTP) at village- Hirma, Talabira, Odisha

Depth of Foundation from NGL (RL:198.30m)	Depth of Foundation from FGL (RL:202.50m)	RL of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 12.7)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 12.8)		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	5.20	197.30	7.00	7.00	8	7	11	7	8
1.00	5.20	197.30	8.00	8.00	9	6	9	6	9
1.00	5.20	197.30	9.00	9.00	9	5	8	5	8
1.00	5.20	197.30	10.00	10.00	10	5	7	5	7
2.00	6.20	196.30	7.00	7.00	10	7	11	7	10
2.00	6.20	196.30	8.00	8.00	11	6	9	6	9
2.00	6.20	196.30	9.00	9.00	11	5	8	5	8
2.00	6.20	196.30	10.00	10.00	11	5	7	5	7
3.00	7.20	195.30	7.00	7.00	12	7	11	7	11
3.00	7.20	195.30	8.00	8.00	12	6	9	6	9
3.00	7.20	195.30	9.00	9.00	13	5	8	5	8
3.00	7.20	195.30	10.00	10.00	13	5	7	5	7

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 198.30m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 12.7 (For IBH-25 (CHP MCC-1))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from NGL m	Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5 γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	1.00	5.20	197.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.04	1.02	1.02	1.00	1.00	1.00	1.88	0.94	0.50	0.50	8
2	8.00	8.00	1.00	5.20	197.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.03	1.02	1.02	1.00	1.00	1.00	1.88	0.94	0.50	0.50	9
3	9.00	9.00	1.00	5.20	197.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.03	1.01	1.01	1.00	1.00	1.00	1.88	0.94	0.50	0.50	9
4	10.00	10.00	1.00	5.20	197.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.03	1.01	1.01	1.00	1.00	1.00	1.88	0.94	0.50	0.50	10
5	7.00	7.00	2.00	6.20	196.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	1.88	0.94	0.50	0.50	10
6	8.00	8.00	2.00	6.20	196.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.07	1.03	1.03	1.00	1.00	1.00	1.88	0.94	0.50	0.50	11
7	9.00	9.00	2.00	6.20	196.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	1.88	0.94	0.50	0.50	11
8	10.00	10.00	2.00	6.20	196.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.05	1.03	1.03	1.00	1.00	1.00	1.88	0.94	0.50	0.50	11
9	7.00	7.00	3.00	7.20	195.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.11	1.06	1.06	1.00	1.00	1.00	1.88	0.94	0.50	0.50	12
10	8.00	8.00	3.00	7.20	195.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.10	1.05	1.05	1.00	1.00	1.00	1.88	0.94	0.50	0.50	12
11	9.00	9.00	3.00	7.20	195.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.09	1.04	1.04	1.00	1.00	1.00	1.88	0.94	0.50	0.50	13
12	10.00	10.00	3.00	7.20	195.30	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	1.88	0.94	0.50	0.50	13

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 198.30m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 12.8 (For IBH-25 (CHP MCC-1))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_i = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D m	Depth of foundation from FGL m	RL of Foundation m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	5.20	197.30	7.00	1.12	0.35	145	0.80	7	11
2	1.00	5.20	197.30	8.00	1.12	0.35	145	0.80	6	9
3	1.00	5.20	197.30	9.00	1.12	0.35	145	0.80	5	8
4	1.00	5.20	197.30	10.00	1.12	0.35	145	0.80	5	7
5	2.00	6.20	196.30	7.00	1.12	0.35	145	0.80	7	11
6	2.00	6.20	196.30	8.00	1.12	0.35	145	0.80	6	9
7	2.00	6.20	196.30	9.00	1.12	0.35	145	0.80	5	8
8	2.00	6.20	196.30	10.00	1.12	0.35	145	0.80	5	7
9	3.00	7.20	195.30	7.00	1.12	0.35	145	0.80	7	11
10	3.00	7.20	195.30	8.00	1.12	0.35	145	0.80	6	9
11	3.00	7.20	195.30	9.00	1.12	0.35	145	0.80	5	8
12	3.00	7.20	195.30	10.00	1.12	0.35	145	0.80	5	7

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 13 (For IBH-26 (CHP maintenance shop))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Depth of Foundation from FGL (RL:202.5 m)	RL of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 13.1)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 13.2)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
					For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	201.50	1.50	1.50	10	74	119	10	10
1.00	201.50	2.00	2.00	11	56	89	11	11
1.00	201.50	2.50	2.50	11	45	71	11	11
1.00	201.50	3.00	3.00	12	37	59	12	12
2.00	200.50	1.50	1.50	15	74	119	15	15
2.00	200.50	2.00	2.00	15	56	89	15	15
2.00	200.50	2.50	2.50	15	45	71	15	15
2.00	200.50	3.00	3.00	16	37	59	16	16
3.00	199.50	1.50	1.50	21	74	119	21	21
3.00	199.50	2.00	2.00	20	56	89	20	20
3.00	199.50	2.50	2.50	20	45	71	20	20
3.00	199.50	3.00	3.00	20	37	59	20	20

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 202.50m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 13.1 (For IBH-26 (CHP maintenance shop))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTTP) at village- Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width			C	ϕ	N _c	N _q - 1	N _γ	S _c	S _q	S _γ	d _c	d _q	d _γ	i _c	i _q	i _γ	γ	0.5 γ			
	m	m			Kg/cm ²	degree													gm/cc		W _q	W _γ	
1	1.50	1.50	1.00	201.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.19	1.09	1.09	1.00	1.00	1.00	1.71	0.86	0.50	0.50	10
2	2.00	2.00	1.00	201.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	1.71	0.86	0.50	0.50	11
3	2.50	2.50	1.00	201.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.11	1.06	1.06	1.00	1.00	1.00	1.71	0.86	0.50	0.50	11
4	3.00	3.00	1.00	201.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.09	1.05	1.05	1.00	1.00	1.00	1.71	0.86	0.50	0.50	12
5	1.50	1.50	2.00	200.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.37	1.19	1.19	1.00	1.00	1.00	1.71	0.86	0.50	0.50	15
6	2.00	2.00	2.00	200.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.28	1.14	1.14	1.00	1.00	1.00	1.71	0.86	0.50	0.50	15
7	2.50	2.50	2.00	200.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.22	1.11	1.11	1.00	1.00	1.00	1.71	0.86	0.50	0.50	15
8	3.00	3.00	2.00	200.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.19	1.09	1.09	1.00	1.00	1.00	1.71	0.86	0.50	0.50	16
9	1.50	1.50	3.00	199.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.56	1.28	1.28	1.00	1.00	1.00	1.71	0.86	0.50	0.50	21
10	2.00	2.00	3.00	199.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.42	1.21	1.21	1.00	1.00	1.00	1.71	0.86	0.50	0.50	20
11	2.50	2.50	3.00	199.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.33	1.17	1.17	1.00	1.00	1.00	1.71	0.86	0.50	0.50	20
12	3.00	3.00	3.00	199.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.28	1.14	1.14	1.00	1.00	1.00	1.71	0.86	0.50	0.50	20

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 202.50m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 13.2 (For IBH-26 (CHP maintenance shop))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_i = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D m	RL of Foundation m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
								For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	201.50	1.50	1.12	0.35	350	0.80	74	119
2	1.00	201.50	2.00	1.12	0.35	350	0.80	56	89
3	1.00	201.50	2.50	1.12	0.35	350	0.80	45	71
4	1.00	201.50	3.00	1.12	0.35	350	0.80	37	59
5	2.00	200.50	1.50	1.12	0.35	350	0.80	74	119
6	2.00	200.50	2.00	1.12	0.35	350	0.80	56	89
7	2.00	200.50	2.50	1.12	0.35	350	0.80	45	71
8	2.00	200.50	3.00	1.12	0.35	350	0.80	37	59
9	3.00	199.50	1.50	1.12	0.35	350	0.80	74	119
10	3.00	199.50	2.00	1.12	0.35	350	0.80	56	89
11	3.00	199.50	2.50	1.12	0.35	350	0.80	45	71
12	3.00	199.50	3.00	1.12	0.35	350	0.80	37	59

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 13.3 (For IBH-26 (CHP maintenance shop))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Depth of Foundation from FGL (RL:202.5 m)	RL of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 13.4)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 13.5)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
					For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	201.50	3.50	3.50	12	32	51	12	12
1.00	201.50	4.00	4.00	13	28	45	13	13
1.00	201.50	5.00	5.00	14	22	36	14	14
1.00	201.50	6.00	6.00	15	19	30	15	15
2.00	200.50	3.50	3.50	16	32	51	16	16
2.00	200.50	4.00	4.00	17	28	45	17	17
2.00	200.50	5.00	5.00	17	22	36	17	17
2.00	200.50	6.00	6.00	18	19	30	18	18
3.00	199.50	3.50	3.50	20	32	51	20	20
3.00	199.50	4.00	4.00	21	28	45	21	21
3.00	199.50	5.00	5.00	21	22	36	21	21
3.00	199.50	6.00	6.00	22	19	30	19	22

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 202.50m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 13.4 (For IBH-26 (CHP maintenance shop))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width			C	ϕ	N _c	N _q - 1	N _γ	S _c	S _q	S _γ	d _c	d _q	d _γ	i _c	i _q	i _γ	γ	0.5 γ			
	m	m			Kg/cm ²	degree													gm/cc		W _q	W _γ	
1	3.50	3.50	1.00	201.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	1.71	0.86	0.50	0.50	12
2	4.00	4.00	1.00	201.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.07	1.03	1.03	1.00	1.00	1.00	1.71	0.86	0.50	0.50	13
3	5.00	5.00	1.00	201.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	1.71	0.86	0.50	0.50	14
4	6.00	6.00	1.00	201.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.05	1.02	1.02	1.00	1.00	1.00	1.71	0.86	0.50	0.50	15
5	3.50	3.50	2.00	200.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.16	1.08	1.08	1.00	1.00	1.00	1.71	0.86	0.50	0.50	16
6	4.00	4.00	2.00	200.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	1.71	0.86	0.50	0.50	17
7	5.00	5.00	2.00	200.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.11	1.06	1.06	1.00	1.00	1.00	1.71	0.86	0.50	0.50	17
8	6.00	6.00	2.00	200.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.09	1.05	1.05	1.00	1.00	1.00	1.71	0.86	0.50	0.50	18
9	3.50	3.50	3.00	199.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.24	1.12	1.12	1.00	1.00	1.00	1.71	0.86	0.50	0.50	20
10	4.00	4.00	3.00	199.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.21	1.10	1.10	1.00	1.00	1.00	1.71	0.86	0.50	0.50	21
11	5.00	5.00	3.00	199.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.17	1.08	1.08	1.00	1.00	1.00	1.71	0.86	0.50	0.50	21
12	6.00	6.00	3.00	199.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	1.71	0.86	0.50	0.50	22

Note :-**1) The factor of safety of 2.5 is considered.****2) The depth of foundation is considered from RL 202.50m.****3) Calculations are considering the effect of water table at FGL.**

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 13.5 (For IBH-26 (CHP maintenance shop))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_i = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D m	RL of Foundation m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
								For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	201.50	3.50	1.12	0.35	350	0.80	32	51
2	1.00	201.50	4.00	1.12	0.35	350	0.80	28	45
3	1.00	201.50	5.00	1.12	0.35	350	0.80	22	36
4	1.00	201.50	6.00	1.12	0.35	350	0.80	19	30
5	2.00	200.50	3.50	1.12	0.35	350	0.80	32	51
6	2.00	200.50	4.00	1.12	0.35	350	0.80	28	45
7	2.00	200.50	5.00	1.12	0.35	350	0.80	22	36
8	2.00	200.50	6.00	1.12	0.35	350	0.80	19	30
9	3.00	199.50	3.50	1.12	0.35	350	0.80	32	51
10	3.00	199.50	4.00	1.12	0.35	350	0.80	28	45
11	3.00	199.50	5.00	1.12	0.35	350	0.80	22	36
12	3.00	199.50	6.00	1.12	0.35	350	0.80	19	30

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 13.6 (For IBH-26 (CHP maintenance shop))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Depth of Foundation from FGL (RL:202.5 m)	RL of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 13.7)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 13.8)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
					For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	201.50	7.00	7.00	16	16	25	16	16
1.00	201.50	8.00	8.00	17	14	22	14	17
1.00	201.50	9.00	9.00	18	12	20	12	18
1.00	201.50	10.00	10.00	19	11	18	11	18
2.00	200.50	7.00	7.00	20	16	25	16	20
2.00	200.50	8.00	8.00	21	14	22	14	21
2.00	200.50	9.00	9.00	22	12	20	12	20
2.00	200.50	10.00	10.00	23	11	18	11	18
3.00	199.50	7.00	7.00	23	16	25	16	23
3.00	199.50	8.00	8.00	24	14	22	14	22
3.00	199.50	9.00	9.00	25	12	20	12	20
3.00	199.50	10.00	10.00	26	11	18	11	18

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 202.50m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 13.7 (For IBH-26 (CHP maintenance shop))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTTP) at village- Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width			C	ϕ	N _c	N _q - 1	N _γ	S _c	S _q	S _γ	d _c	d _q	d _γ	i _c	i _q	i _γ	γ	0.5 γ			
	m	m			Kg/cm ²	degree													gm/cc		W _q	W _γ	
1	7.00	7.00	1.00	201.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.04	1.02	1.02	1.00	1.00	1.00	1.71	0.86	0.50	0.50	16
2	8.00	8.00	1.00	201.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.03	1.02	1.02	1.00	1.00	1.00	1.71	0.86	0.50	0.50	17
3	9.00	9.00	1.00	201.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.03	1.02	1.02	1.00	1.00	1.00	1.71	0.86	0.50	0.50	18
4	10.00	10.00	1.00	201.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.03	1.01	1.01	1.00	1.00	1.00	1.71	0.86	0.50	0.50	19
5	7.00	7.00	2.00	200.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	1.71	0.86	0.50	0.50	20
6	8.00	8.00	2.00	200.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.07	1.03	1.03	1.00	1.00	1.00	1.71	0.86	0.50	0.50	21
7	9.00	9.00	2.00	200.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	1.71	0.86	0.50	0.50	22
8	10.00	10.00	2.00	200.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	1.71	0.86	0.50	0.50	23
9	7.00	7.00	3.00	199.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.12	1.06	1.06	1.00	1.00	1.00	1.71	0.86	0.50	0.50	23
10	8.00	8.00	3.00	199.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.10	1.05	1.05	1.00	1.00	1.00	1.71	0.86	0.50	0.50	24
11	9.00	9.00	3.00	199.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.09	1.05	1.05	1.00	1.00	1.00	1.71	0.86	0.50	0.50	25
12	10.00	10.00	3.00	199.50	0.07	27	17.71	7.60	8.40	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	1.71	0.86	0.50	0.50	26

Note :-**1) The factor of safety of 2.5 is considered.****2) The depth of foundation is considered from RL 202.50m.****3) Calculations are considering the effect of water table at FGL.**

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 13.8 (For IBH-26 (CHP maintenance shop))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_i = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D m	RL of Foundation m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
								For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	201.50	7.00	1.12	0.35	350	0.80	16	25
2	1.00	201.50	8.00	1.12	0.35	350	0.80	14	22
3	1.00	201.50	9.00	1.12	0.35	350	0.80	12	20
4	1.00	201.50	10.00	1.12	0.35	350	0.80	11	18
5	2.00	200.50	7.00	1.12	0.35	350	0.80	16	25
6	2.00	200.50	8.00	1.12	0.35	350	0.80	14	22
7	2.00	200.50	9.00	1.12	0.35	350	0.80	12	20
8	2.00	200.50	10.00	1.12	0.35	350	0.80	11	18
9	3.00	199.50	7.00	1.12	0.35	350	0.80	16	25
10	3.00	199.50	8.00	1.12	0.35	350	0.80	14	22
11	3.00	199.50	9.00	1.12	0.35	350	0.80	12	20
12	3.00	199.50	10.00	1.12	0.35	350	0.80	11	18

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 14 (For IBH-27&28 BH-8 (Bio mass handling system))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Depth of Foundation from NGL (RL:199.71m)	Depth of Foundation from FGL (RL:202.50m)	RL of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 14.1) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 14.2)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
1.00	3.79	198.71	1.50	1.50	7	30	48	7	7
1.00	3.79	198.71	2.00	2.00	8	22	36	8	8
1.00	3.79	198.71	2.50	2.50	8	18	29	8	8
1.00	3.79	198.71	3.00	3.00	8	15	24	8	8
2.00	4.79	197.71	1.50	1.50	11	30	48	11	11
2.00	4.79	197.71	2.00	2.00	11	22	36	11	11
2.00	4.79	197.71	2.50	2.50	11	18	29	11	11
2.00	4.79	197.71	3.00	3.00	11	15	24	11	11
3.00	5.79	196.71	1.50	1.50	14	30	48	14	14
3.00	5.79	196.71	2.00	2.00	14	22	36	14	14
3.00	5.79	196.71	2.50	2.50	14	18	29	14	14
3.00	5.79	196.71	3.00	3.00	14	15	24	14	14

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 199.71m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 14.1 (For IBH-27&28 BH-8 (Bio mass handling system))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from NGL m	Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5 γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	1.00	3.79	198.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.18	1.09	1.09	1.00	1.00	1.00	1.66	0.83	0.50	0.50	7
2	2.00	2.00	1.00	3.79	198.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	1.66	0.83	0.50	0.50	8
3	2.50	2.50	1.00	3.79	198.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.11	1.06	1.06	1.00	1.00	1.00	1.66	0.83	0.50	0.50	8
4	3.00	3.00	1.00	3.79	198.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.09	1.05	1.05	1.00	1.00	1.00	1.66	0.83	0.50	0.50	8
5	1.50	1.50	2.00	4.79	197.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.37	1.18	1.18	1.00	1.00	1.00	1.66	0.83	0.50	0.50	11
6	2.00	2.00	2.00	4.79	197.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.28	1.14	1.14	1.00	1.00	1.00	1.66	0.83	0.50	0.50	11
7	2.50	2.50	2.00	4.79	197.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.22	1.11	1.11	1.00	1.00	1.00	1.66	0.83	0.50	0.50	11
8	3.00	3.00	2.00	4.79	197.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.18	1.09	1.09	1.00	1.00	1.00	1.66	0.83	0.50	0.50	11
9	1.50	1.50	3.00	5.79	196.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.55	1.28	1.28	1.00	1.00	1.00	1.66	0.83	0.50	0.50	14
10	2.00	2.00	3.00	5.79	196.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.41	1.21	1.21	1.00	1.00	1.00	1.66	0.83	0.50	0.50	14
11	2.50	2.50	3.00	5.79	196.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.33	1.17	1.17	1.00	1.00	1.00	1.66	0.83	0.50	0.50	14
12	3.00	3.00	3.00	5.79	196.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.28	1.14	1.14	1.00	1.00	1.00	1.66	0.83	0.50	0.50	14

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 199.71m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 14.2 (For IBH-27&28 BH-8 (Bio mass handling system))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_i = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D m	Depth of foundation from FGL m	RL of Foundation m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	3.79	198.71	1.50	1.12	0.35	141	0.80	30	48
2	1.00	3.79	198.71	2.00	1.12	0.35	141	0.80	22	36
3	1.00	3.79	198.71	2.50	1.12	0.35	141	0.80	18	29
4	1.00	3.79	198.71	3.00	1.12	0.35	141	0.80	15	24
5	2.00	4.79	197.71	1.50	1.12	0.35	141	0.80	30	48
6	2.00	4.79	197.71	2.00	1.12	0.35	141	0.80	22	36
7	2.00	4.79	197.71	2.50	1.12	0.35	141	0.80	18	29
8	2.00	4.79	197.71	3.00	1.12	0.35	141	0.80	15	24
9	3.00	5.79	196.71	1.50	1.12	0.35	141	0.80	30	48
10	3.00	5.79	196.71	2.00	1.12	0.35	141	0.80	22	36
11	3.00	5.79	196.71	2.50	1.12	0.35	141	0.80	18	29
12	3.00	5.79	196.71	3.00	1.12	0.35	141	0.80	15	24

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 14.3 (For IBH-27&28 BH-8 (Bio mass handling system))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTP) at village- Hirma, Talabira, Odisha

Depth of Foundation from NGL (RL:199.71m)	Depth of Foundation from FGL (RL:202.50m)	RL of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 14.4)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 14.5)		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	3.79	198.71	3.50	3.50	8	13	21	8	8
1.00	3.79	198.71	4.00	4.00	9	11	18	9	9
1.00	3.79	198.71	5.00	5.00	9	9	14	9	9
1.00	3.79	198.71	6.00	6.00	10	7	12	7	10
2.00	4.79	197.71	3.50	3.50	11	13	21	11	11
2.00	4.79	197.71	4.00	4.00	11	11	18	11	11
2.00	4.79	197.71	5.00	5.00	12	9	14	9	12
2.00	4.79	197.71	6.00	6.00	12	7	12	7	12
3.00	5.79	196.71	3.50	3.50	14	13	21	13	14
3.00	5.79	196.71	4.00	4.00	14	11	18	11	14
3.00	5.79	196.71	5.00	5.00	14	9	14	9	14
3.00	5.79	196.71	6.00	6.00	15	7	12	7	12

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 199.71m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 14.4 (For IBH-27&28 BH-8 (Bio mass handling system))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from NGL m	Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ																	
	m	m				Kg/cm ²	degree	N _c	N _q - 1	N _γ	S _c	S _q	S _γ	d _c	d _q	d _γ	i _c	i _q	i _γ	γ gm/cc	0.5 γ	W _q	W _γ	
1	3.50	3.50	1.00	3.79	198.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	1.66	0.83	0.50	0.50	8
2	4.00	4.00	1.00	3.79	198.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.07	1.03	1.03	1.00	1.00	1.00	1.66	0.83	0.50	0.50	9
3	5.00	5.00	1.00	3.79	198.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	1.66	0.83	0.50	0.50	9
4	6.00	6.00	1.00	3.79	198.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.05	1.02	1.02	1.00	1.00	1.00	1.66	0.83	0.50	0.50	10
5	3.50	3.50	2.00	4.79	197.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.16	1.08	1.08	1.00	1.00	1.00	1.66	0.83	0.50	0.50	11
6	4.00	4.00	2.00	4.79	197.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	1.66	0.83	0.50	0.50	11
7	5.00	5.00	2.00	4.79	197.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.11	1.06	1.06	1.00	1.00	1.00	1.66	0.83	0.50	0.50	12
8	6.00	6.00	2.00	4.79	197.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.09	1.05	1.05	1.00	1.00	1.00	1.66	0.83	0.50	0.50	12
9	3.50	3.50	3.00	5.79	196.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.24	1.12	1.12	1.00	1.00	1.00	1.66	0.83	0.50	0.50	14
10	4.00	4.00	3.00	5.79	196.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.21	1.10	1.10	1.00	1.00	1.00	1.66	0.83	0.50	0.50	14
11	5.00	5.00	3.00	5.79	196.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.17	1.08	1.08	1.00	1.00	1.00	1.66	0.83	0.50	0.50	14
12	6.00	6.00	3.00	5.79	196.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	1.66	0.83	0.50	0.50	15

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 199.71m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 14.5 (For IBH-27&28 BH-8 (Bio mass handling system))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_i = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D m	Depth of foundation from FGL m	RL of Foundation m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	3.79	198.71	3.50	1.12	0.35	141	0.80	13	21
2	1.00	3.79	198.71	4.00	1.12	0.35	141	0.80	11	18
3	1.00	3.79	198.71	5.00	1.12	0.35	141	0.80	9	14
4	1.00	3.79	198.71	6.00	1.12	0.35	141	0.80	7	12
5	2.00	4.79	197.71	3.50	1.12	0.35	141	0.80	13	21
6	2.00	4.79	197.71	4.00	1.12	0.35	141	0.80	11	18
7	2.00	4.79	197.71	5.00	1.12	0.35	141	0.80	9	14
8	2.00	4.79	197.71	6.00	1.12	0.35	141	0.80	7	12
9	3.00	5.79	196.71	3.50	1.12	0.35	141	0.80	13	21
10	3.00	5.79	196.71	4.00	1.12	0.35	141	0.80	11	18
11	3.00	5.79	196.71	5.00	1.12	0.35	141	0.80	9	14
12	3.00	5.79	196.71	6.00	1.12	0.35	141	0.80	7	12

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 14.6 (For IBH-27&28 BH-8 (Bio mass handling system))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Depth of Foundation from NGL (RL:199.71m)	Depth of Foundation from FGL (RL:202.50m)	RL of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 14.7)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 14.8)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	3.79	198.71	7.00	7.00	11	6	10	6	10
1.00	3.79	198.71	8.00	8.00	11	6	9	6	9
1.00	3.79	198.71	9.00	9.00	12	5	8	5	8
1.00	3.79	198.71	10.00	10.00	13	4	7	4	7
2.00	4.79	197.71	7.00	7.00	13	6	10	6	10
2.00	4.79	197.71	8.00	8.00	14	6	9	6	9
2.00	4.79	197.71	9.00	9.00	14	5	8	5	8
2.00	4.79	197.71	10.00	10.00	15	4	7	4	7
3.00	5.79	196.71	7.00	7.00	15	6	10	6	10
3.00	5.79	196.71	8.00	8.00	16	6	9	6	9
3.00	5.79	196.71	9.00	9.00	17	5	8	5	8
3.00	5.79	196.71	10.00	10.00	17	4	7	4	7

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 199.71m.
- 3) Calculations are considering the effect of water table at FGL.

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APPENDIX - 14.7 (For IBH-27&28 BH-8 (Bio mass handling system))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from NGL m	Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	1.00	3.79	198.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.04	1.02	1.02	1.00	1.00	1.00	1.66	0.83	0.50	0.50	11
2	8.00	8.00	1.00	3.79	198.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.03	1.02	1.02	1.00	1.00	1.00	1.66	0.83	0.50	0.50	11
3	9.00	9.00	1.00	3.79	198.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.03	1.02	1.02	1.00	1.00	1.00	1.66	0.83	0.50	0.50	12
4	10.00	10.00	1.00	3.79	198.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.03	1.01	1.01	1.00	1.00	1.00	1.66	0.83	0.50	0.50	13
5	7.00	7.00	2.00	4.79	197.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	1.66	0.83	0.50	0.50	13
6	8.00	8.00	2.00	4.79	197.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.07	1.03	1.03	1.00	1.00	1.00	1.66	0.83	0.50	0.50	14
7	9.00	9.00	2.00	4.79	197.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	1.66	0.83	0.50	0.50	14
8	10.00	10.00	2.00	4.79	197.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	1.66	0.83	0.50	0.50	15
9	7.00	7.00	3.00	5.79	196.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.12	1.06	1.06	1.00	1.00	1.00	1.66	0.83	0.50	0.50	15
10	8.00	8.00	3.00	5.79	196.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.10	1.05	1.05	1.00	1.00	1.00	1.66	0.83	0.50	0.50	16
11	9.00	9.00	3.00	5.79	196.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.09	1.05	1.05	1.00	1.00	1.00	1.66	0.83	0.50	0.50	17
12	10.00	10.00	3.00	5.79	196.71	0.07	26	14.25	5.09	5.13	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	1.66	0.83	0.50	0.50	17

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 199.71m.
- 3) Calculations are considering the effect of water table at FGL.

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APPENDIX - 14.8 (For IBH-27&28 BH-8 (Bio mass handling system))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_i = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D m	Depth of foundation from FGL m	RL of Foundation m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	3.79	198.71	7.00	1.12	0.35	141	0.80	6	10
2	1.00	3.79	198.71	8.00	1.12	0.35	141	0.80	6	9
3	1.00	3.79	198.71	9.00	1.12	0.35	141	0.80	5	8
4	1.00	3.79	198.71	10.00	1.12	0.35	141	0.80	4	7
5	2.00	4.79	197.71	7.00	1.12	0.35	141	0.80	6	10
6	2.00	4.79	197.71	8.00	1.12	0.35	141	0.80	6	9
7	2.00	4.79	197.71	9.00	1.12	0.35	141	0.80	5	8
8	2.00	4.79	197.71	10.00	1.12	0.35	141	0.80	4	7
9	3.00	5.79	196.71	7.00	1.12	0.35	141	0.80	6	10
10	3.00	5.79	196.71	8.00	1.12	0.35	141	0.80	6	9
11	3.00	5.79	196.71	9.00	1.12	0.35	141	0.80	5	8
12	3.00	5.79	196.71	10.00	1.12	0.35	141	0.80	4	7

Appendix – 14A

Calculation of Safe Load carrying capacity of piles socketed inside rock (Near IBH 27&28 & BH-8) (Bio mass handling system)

Project Name: - Proposed structures of thermal power project of NTTTP at Hirma, Talabira

1.0 Introduction

In situations where overburden offering low bearing pressure is followed by rock at relatively shallower depths, end bearing piles is the suitable foundation option. Piles in rocks and weathered rocks of varying degree of weathering derive their capacity by end bearing and socket side resistance.

In situations, where, rock strata comprises of highly fragmented rock, as in present case, where RQD is nil or $(CR+RQD)/2$ is less than 30 % or when the crushing strength is less than 10 MPa, the appropriate approach would be of that suggested by Cole & Stroud.

In present site overburden soils overlay fractured / laminated / foliated rock. The founding stratum having highly fragmented rock with nil RQD and $(CR+RQD)/2$ to be less than 30 %, the approach suggested by Cole and Stroud as per Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 Pa/S2 has been used for safe load calculations.

An illustrative calculation of safe load on pile and summary of pile capacities is as follows,

2.0 Sub soil strata Characterization

General stratification at the location of boreholes IBH 28 show primarily two characterized layers,

1. Overburden comprising of Yellowish brown, fine to medium grained, silty clayey sand with little to some gravels upto 17.50m (i.e. RL 182.21m)
2. Second characterized layer below the overburden soils comprises of Highly weathered, very weak, yellowish brown, fine to coarse grained, friable and fractured rock upto 21.00m (i.e. RL 178.71 m).

3.0 Design Considerations

1. Length of socket considered 3D from depth of rock encountered.
2. The pile is considered to have socket length below 17.50 m below NGL (i.e. RL 182.21 m) depth.
3. For present case of pile terminating in highly weathered rock. SPT at depths between 17.50 to 21.00m (between RL 182.21 to 178.71 m) is > 100 with just 6.0 cm penetration in 50 blows. SPT can be extrapolated for 30 cm i.e. $50 * 30 / 6.00 = 250$.
Based on recommendation of fig no. 3 in B 8 in Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 P1/S2, average shear strength q_c corresponding to assumed SPT of 200 may be taken as 1300 kN/m²
4. Allowable Capacity of pile socketed into rock $Q_a = R_e + R_{sf} = C_{u1} N_c \pi B^2 / 4 (F_s = 3) + \alpha C_{u2} \pi BL / (F_s = 6)$

4.0 Safe Load on Pile in Compression

Where,

End bearing component, $R_e = C_{u1} N_c \pi B^2 / 4 F_s$,

C_{u1} = Shear strength below base of pile = 1300 kN/m²

B = diameter of the pile = d

F_s = Factor of Safety = 3

$N_c = 9$

Therefore, **$R_e = 3061.5 d^2$**

Skin friction component of socketed length of pile, $R_{sf} = \alpha C_{u2} \pi BL / F_s$

$\alpha = 0.9$ (recommended value in IS 2911 P1/S2)

L = length of the socket = $3 D$

C_{u2} = Ultimate shear strength along socket length which shall be restricted to shear capacity of concrete of the pile = 1300 kN/m^2

F_s = Factor of Safety = 6

Therefore, $R_{sf} = 1836.9 \text{ d}^2$

Thus,

$$Q_a = c_{u1} N_c \cdot \frac{\pi B^2}{4 F_s} + \alpha c_{u2} \cdot \frac{\pi B L}{F_s}$$

$$= 3061.5 \text{ d}^2 + 1836.9 \text{ d}^2 = 4898.4 \text{ d}^2$$

Substituting the values of various diameters and socket lengths equal to 3 times diameter, allowable load on single pile can be summarized as follows,

Summary of the Safe load calculation in Compression

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	22.09	22.57	22.99
Termination level RL in m	180.41	179.93	179.51
End Bearing Component in kN	1102.1	1768.3	2479.8
Friction Component in kN	661.3	1060.9	1487.9
Safe load in Compression in kN	1763.4	2829.3	3967.7
Safe load in Compression in T	176	283	397

5.0 Safe Load on Pile in uplift

For 3.00m cutoff from FGL

The overburden soils, though, will not contribute in compression capacity would offer resistance in uplift capacity. The parameters of IBH 28 are considered for calculation of uplift resistance as summarized below,

Depth in m from RL 202.5 m	Cohesion in kg/cm^2	Angle of Internal Friction ϕ	Submerged density in $\text{gm/cc } \gamma_{\text{sub}}$	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 3.00	Pile cutoff level – No pile						
3.00 to 6.74	0.04(ignored)	28	0.85	NA	1.00	28	4-38
6.74 to 20.29	0.00	34	1.04	NA	1.50	34	>100
20.29 to 27.79	Rock strata – Resistance would be as per skin friction capacity in socket as already calculated in compression capacity						

Ultimate load in skin friction,

$$Q_{uf} = \alpha_i C_{ai} A_{si} + K_i P D_i \tan \delta_i A_{si}$$

First Layer – No contribution considered – (Within Cutoff Level).

$$\text{Second Layer} - K_2 P D_2 \tan \delta_2 A_{s2} = 1.00 * 3.99 * \tan 28 * \pi d * 3.74 = \mathbf{24.93 \text{ d}}$$

$$\text{Third Layer} - K_3 P D_3 \tan \delta_3 A_{s3} = 1.50 * 10.43 * \tan 34 * \pi d * 13.55 = \mathbf{449.21 \text{ d}}$$

Fourth Layer – 1836.90 d^2 in rock socket

$$\text{Substituting, ultimate load } q_{uf} = \mathbf{4741.43 \text{ d} + 1836.9 \text{ d}^2}$$

The safe load in uplift is worked out (considering the safety factor of 2.50 for overburden soils) and summarized below,

Safe Load on Piles in Uplift (in Ton)

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	22.09	22.57	22.99
Termination level RL in m	180.41	179.93	179.51
Safe load in Uplift in kN	1799.23	2502.39	3194.80
Self-weight of pile in kN	80.92	133.10	190.66
Safe load in Uplift in T (Considering self-weight of pile)	188.02	263.55	338.55

6.0 Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60	0.76	0.90
Subgrade reaction in MN/m^3		3.13	3.13	3.13
Stiffness factor T in m		2.24	2.71	3.10
Depth of fixity in m	Free Head	4.30	5.10	5.90
	Fixed Head	4.90	5.90	6.80
Allowable Horizontal Force in T	Free Head	3.40	5.00	6.60
	Fixed Head	9.10	13.30	17.40
Allowable Moment capacity in Tm	Free Head	5.13	9.05	13.59
	Fixed Head	18.2	32.23	48.36

7.0 Notes

1. Pile shall be terminated after socketing 3D inside rock.
2. Initial and routine pile load test is required to verify the actual carrying capacity of pile in compression, uplift and lateral loads.
3. For design and construction, specification of IS: 2911, P1/S2, IS: 456, 2000 shall strictly be followed.

(Dr. K. K. Thaker)

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 15 (For IBH-29 (Coal pile run off pond))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Depth of Foundation from NGL (RL:200.10m)	Depth of Foundation from FGL (RL:202.50m)	RL of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 15.1)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 15.2)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	3.40	199.10	1.50	1.50	14	64	103	14	14
1.00	3.40	199.10	2.00	2.00	16	48	77	16	16
1.00	3.40	199.10	2.50	2.50	17	38	62	17	17
1.00	3.40	199.10	3.00	3.00	18	32	51	18	18
1.50	3.90	198.60	1.50	1.50	19	64	103	19	19
1.50	3.90	198.60	2.00	2.00	20	48	77	20	20
1.50	3.90	198.60	2.50	2.50	21	38	62	21	21
1.50	3.90	198.60	3.00	3.00	22	32	51	22	22
2.00	4.40	198.10	1.50	1.50	24	64	103	24	24
2.00	4.40	198.10	2.00	2.00	25	48	77	25	25
2.00	4.40	198.10	2.50	2.50	26	38	62	26	26
2.00	4.40	198.10	3.00	3.00	27	32	51	27	27

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 200.10m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 15.1 (For IBH-29 (Coal pile run off pond))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from NGL m	Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ	N _c	N _q - 1	N _γ	S _c	S _q	S _γ	d _c	d _q	d _γ	i _c	i _q	i _γ	γ	0.5 γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _γ	
1	1.50	1.50	1.00	3.40	199.10	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.19	1.10	1.10	1.00	1.00	1.00	1.83	0.92	0.50	0.50	14
2	2.00	2.00	1.00	3.40	199.10	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.15	1.07	1.07	1.00	1.00	1.00	1.83	0.92	0.50	0.50	16
3	2.50	2.50	1.00	3.40	199.10	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.12	1.06	1.06	1.00	1.00	1.00	1.83	0.92	0.50	0.50	17
4	3.00	3.00	1.00	3.40	199.10	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.10	1.05	1.05	1.00	1.00	1.00	1.83	0.92	0.50	0.50	18
5	1.50	1.50	1.50	3.90	198.60	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.29	1.15	1.15	1.00	1.00	1.00	1.83	0.92	0.50	0.50	19
6	2.00	2.00	1.50	3.90	198.60	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.22	1.11	1.11	1.00	1.00	1.00	1.83	0.92	0.50	0.50	20
7	2.50	2.50	1.50	3.90	198.60	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.17	1.09	1.09	1.00	1.00	1.00	1.83	0.92	0.50	0.50	21
8	3.00	3.00	1.50	3.90	198.60	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.15	1.07	1.07	1.00	1.00	1.00	1.83	0.92	0.50	0.50	22
9	1.50	1.50	2.00	4.40	198.10	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.39	1.19	1.19	1.00	1.00	1.00	1.83	0.92	0.50	0.50	24
10	2.00	2.00	2.00	4.40	198.10	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.29	1.15	1.15	1.00	1.00	1.00	1.83	0.92	0.50	0.50	25
11	2.50	2.50	2.00	4.40	198.10	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.23	1.12	1.12	1.00	1.00	1.00	1.83	0.92	0.50	0.50	26
12	3.00	3.00	2.00	4.40	198.10	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.19	1.10	1.10	1.00	1.00	1.00	1.83	0.92	0.50	0.50	27

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 200.10m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 15.2 (For IBH-29 (Coal pile run off pond))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_i = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D m	Depth of foundation from FGL m	RL of Foundation m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	3.40	199.10	1.50	1.12	0.35	303	0.80	64	103
2	1.00	3.40	199.10	2.00	1.12	0.35	303	0.80	48	77
3	1.00	3.40	199.10	2.50	1.12	0.35	303	0.80	38	62
4	1.00	3.40	199.10	3.00	1.12	0.35	303	0.80	32	51
5	1.50	3.90	198.60	1.50	1.12	0.35	303	0.80	64	103
6	1.50	3.90	198.60	2.00	1.12	0.35	303	0.80	48	77
7	1.50	3.90	198.60	2.50	1.12	0.35	303	0.80	38	62
8	1.50	3.90	198.60	3.00	1.12	0.35	303	0.80	32	51
9	2.00	4.40	198.10	1.50	1.12	0.35	303	0.80	64	103
10	2.00	4.40	198.10	2.00	1.12	0.35	303	0.80	48	77
11	2.00	4.40	198.10	2.50	1.12	0.35	303	0.80	38	62
12	2.00	4.40	198.10	3.00	1.12	0.35	303	0.80	32	51

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APPENDIX - 15.3 (For IBH-29 (Coal pile run off pond))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Depth of Foundation from NGL (RL:200.10m)	Depth of Foundation from FGL (RL:202.50m)	RL of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 15.4) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 15.5)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
1.00	3.40	199.10	3.50	3.50	20	27	44	20	20
1.00	3.40	199.10	4.00	4.00	21	24	38	21	21
1.00	3.40	199.10	5.00	5.00	24	19	31	19	24
1.00	3.40	199.10	6.00	6.00	27	16	26	16	26
1.50	3.90	198.60	3.50	3.50	24	27	44	24	24
1.50	3.90	198.60	4.00	4.00	25	24	38	24	25
1.50	3.90	198.60	5.00	5.00	28	19	31	19	28
1.50	3.90	198.60	6.00	6.00	30	16	26	16	26
2.00	4.40	198.10	3.50	3.50	28	27	44	27	28
2.00	4.40	198.10	4.00	4.00	29	24	38	24	29
2.00	4.40	198.10	5.00	5.00	32	19	31	19	31
2.00	4.40	198.10	6.00	6.00	34	16	26	16	26

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 200.10m.
- 3) Calculations are considering the effect of water table at FGL.

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APPENDIX - 15.4 (For IBH-29 (Coal pile run off pond))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from NGL m	Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5 γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	1.00	3.40	199.10	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	1.83	0.92	0.50	0.50	20
2	4.00	4.00	1.00	3.40	199.10	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.07	1.04	1.04	1.00	1.00	1.00	1.83	0.92	0.50	0.50	21
3	5.00	5.00	1.00	3.40	199.10	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	1.83	0.92	0.50	0.50	24
4	6.00	6.00	1.00	3.40	199.10	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.05	1.02	1.02	1.00	1.00	1.00	1.83	0.92	0.50	0.50	27
5	3.50	3.50	1.50	3.90	198.60	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.12	1.06	1.06	1.00	1.00	1.00	1.83	0.92	0.50	0.50	24
6	4.00	4.00	1.50	3.90	198.60	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.11	1.05	1.05	1.00	1.00	1.00	1.83	0.92	0.50	0.50	25
7	5.00	5.00	1.50	3.90	198.60	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.09	1.04	1.04	1.00	1.00	1.00	1.83	0.92	0.50	0.50	28
8	6.00	6.00	1.50	3.90	198.60	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.07	1.04	1.04	1.00	1.00	1.00	1.83	0.92	0.50	0.50	30
9	3.50	3.50	2.00	4.40	198.10	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.17	1.08	1.08	1.00	1.00	1.00	1.83	0.92	0.50	0.50	28
10	4.00	4.00	2.00	4.40	198.10	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.15	1.07	1.07	1.00	1.00	1.00	1.83	0.92	0.50	0.50	29
11	5.00	5.00	2.00	4.40	198.10	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.12	1.06	1.06	1.00	1.00	1.00	1.83	0.92	0.50	0.50	32
12	6.00	6.00	2.00	4.40	198.10	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.10	1.05	1.05	1.00	1.00	1.00	1.83	0.92	0.50	0.50	34

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 200.10m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 15.5 (For IBH-29 (Coal pile run off pond))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_i = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D m	Depth of foundation from FGL m	RL of Foundation m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	3.40	199.10	3.50	1.12	0.35	303	0.80	27	44
2	1.00	3.40	199.10	4.00	1.12	0.35	303	0.80	24	38
3	1.00	3.40	199.10	5.00	1.12	0.35	303	0.80	19	31
4	1.00	3.40	199.10	6.00	1.12	0.35	303	0.80	16	26
5	1.50	3.90	198.60	3.50	1.12	0.35	303	0.80	27	44
6	1.50	3.90	198.60	4.00	1.12	0.35	303	0.80	24	38
7	1.50	3.90	198.60	5.00	1.12	0.35	303	0.80	19	31
8	1.50	3.90	198.60	6.00	1.12	0.35	303	0.80	16	26
9	2.00	4.40	198.10	3.50	1.12	0.35	303	0.80	27	44
10	2.00	4.40	198.10	4.00	1.12	0.35	303	0.80	24	38
11	2.00	4.40	198.10	5.00	1.12	0.35	303	0.80	19	31
12	2.00	4.40	198.10	6.00	1.12	0.35	303	0.80	16	26

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APPENDIX - 15.6 (For IBH-29 (Coal pile run off pond))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Depth of Foundation from NGL (RL:200.10m)	Depth of Foundation from FGL (RL:202.50m)	RL of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 15.7) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 15.8)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
1.00	3.40	199.10	7.00	7.00	29	14	22	14	22
1.00	3.40	199.10	8.00	8.00	32	12	19	12	19
1.00	3.40	199.10	9.00	9.00	35	11	17	11	17
1.00	3.40	199.10	10.00	10.00	38	10	15	10	15
1.50	3.90	198.60	7.00	7.00	33	14	22	14	22
1.50	3.90	198.60	8.00	8.00	36	12	19	12	19
1.50	3.90	198.60	9.00	9.00	39	11	17	11	17
1.50	3.90	198.60	10.00	10.00	42	10	15	10	15
2.00	4.40	198.10	7.00	7.00	37	14	22	14	22
2.00	4.40	198.10	8.00	8.00	40	12	19	12	19
2.00	4.40	198.10	9.00	9.00	43	11	17	11	17
2.00	4.40	198.10	10.00	10.00	46	10	15	10	15

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 200.10m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 15.7 (For IBH-29 (Coal pile run off pond))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from NGL m	Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	1.00	3.40	199.10	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.04	1.02	1.02	1.00	1.00	1.00	1.83	0.92	0.50	0.50	29
2	8.00	8.00	1.00	3.40	199.10	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.04	1.02	1.02	1.00	1.00	1.00	1.83	0.92	0.50	0.50	32
3	9.00	9.00	1.00	3.40	199.10	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.03	1.02	1.02	1.00	1.00	1.00	1.83	0.92	0.50	0.50	35
4	10.00	10.00	1.00	3.40	199.10	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.03	1.01	1.01	1.00	1.00	1.00	1.83	0.92	0.50	0.50	38
5	7.00	7.00	1.50	3.90	198.60	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	1.83	0.92	0.50	0.50	33
6	8.00	8.00	1.50	3.90	198.60	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.05	1.03	1.03	1.00	1.00	1.00	1.83	0.92	0.50	0.50	36
7	9.00	9.00	1.50	3.90	198.60	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.05	1.02	1.02	1.00	1.00	1.00	1.83	0.92	0.50	0.50	39
8	10.00	10.00	1.50	3.90	198.60	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.04	1.02	1.02	1.00	1.00	1.00	1.83	0.92	0.50	0.50	42
9	7.00	7.00	2.00	4.40	198.10	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	1.83	0.92	0.50	0.50	37
10	8.00	8.00	2.00	4.40	198.10	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.07	1.04	1.04	1.00	1.00	1.00	1.83	0.92	0.50	0.50	40
11	9.00	9.00	2.00	4.40	198.10	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	1.83	0.92	0.50	0.50	43
12	10.00	10.00	2.00	4.40	198.10	0.02	30	27.67	15.45	19.60	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	1.83	0.92	0.50	0.50	46

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 200.10m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 15.8 (For IBH-29 (Coal pile run off pond))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_i = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D m	Depth of foundation from FGL m	RL of Foundation m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	3.40	199.10	7.00	1.12	0.35	303	0.80	14	22
2	1.00	3.40	199.10	8.00	1.12	0.35	303	0.80	12	19
3	1.00	3.40	199.10	9.00	1.12	0.35	303	0.80	11	17
4	1.00	3.40	199.10	10.00	1.12	0.35	303	0.80	10	15
5	1.50	3.90	198.60	7.00	1.12	0.35	303	0.80	14	22
6	1.50	3.90	198.60	8.00	1.12	0.35	303	0.80	12	19
7	1.50	3.90	198.60	9.00	1.12	0.35	303	0.80	11	17
8	1.50	3.90	198.60	10.00	1.12	0.35	303	0.80	10	15
9	2.00	4.40	198.10	7.00	1.12	0.35	303	0.80	14	22
10	2.00	4.40	198.10	8.00	1.12	0.35	303	0.80	12	19
11	2.00	4.40	198.10	9.00	1.12	0.35	303	0.80	11	17
12	2.00	4.40	198.10	10.00	1.12	0.35	303	0.80	10	15

Appendix – 15A

Calculation of Safe Load carrying capacity of piles socketed inside rock (Near IBH 29) (Coal pile run off pond)

Project Name: - Proposed structures of thermal power project of NTTTP at Hirma, Talabira

1.0 Introduction

In situations where overburden offering low bearing pressure is followed by rock at relatively shallower depths, end bearing piles is the suitable foundation option. Piles in rocks and weathered rocks of varying degree of weathering derive their capacity by end bearing and socket side resistance.

In situations, where, rock strata comprises of highly fragmented rock, as in present case, where RQD is nil or $(CR+RQD)/2$ is less than 30 % or when the crushing strength is less than 10 MPa, the appropriate approach would be of that suggested by Cole & Stroud.

In present site overburden soils overlay fractured / laminated / foliated rock. The founding stratum having highly fragmented rock with nil RQD and $(CR+RQD)/2$ to be less than 30 %, the approach suggested by Cole and Stroud as per Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 Pa/S2 has been used for safe load calculations.

An illustrative calculation of safe load on pile and summary of pile capacities is as follows,

2.0 Sub soil strata Characterization

General stratification at the location of boreholes IBH 29 show primarily two characterized layers,

1. Overburden comprising of Reddish brown, fine to medium grained, silty clayey sand with much gravels upto 14.20m (i.e. RL 185.90m)
2. Second characterized layer below the overburden soils comprises of Highly weathered, very weak, yellowish brown, fine to coarse grained, fractured and friable rock upto 19.00m (i.e. RL 181.10 m).

3.0 Design Considerations

1. Length of socket considered 3D from depth of rock encountered.
2. The pile is considered to have socket length below 14.20 m below NGL (i.e. RL 185.90 m) depth.
3. For present case of pile terminating in highly weathered rock. SPT at depths between 14.20 to 19.00m (between RL 185.90 to 181.10 m) is > 100 with just 4.0 cm penetration in 53 blows. SPT can be extrapolated for 30 cm i.e. $53 * 30 / 4.00 = 397$.
Based on recommendation of fig no. 3 in B 8 in Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 P1/S2, average shear strength q_c corresponding to assumed SPT of 200 may be taken as 1300 kN/m²
4. Allowable Capacity of pile socketed into rock $Q_a = R_e + R_{sf} = C_{u1} N_c \pi B^2 / 4 (F_s = 3) + \alpha C_{u2} \pi BL / (F_s = 6)$

4.0 Safe Load on Pile in Compression

Where,

End bearing component, $R_e = C_{u1} N_c \pi B^2 / 4 F_s$,

C_{u1} = Shear strength below base of pile = 1300 kN/m²

B = diameter of the pile = d

F_s = Factor of Safety = 3

$N_c = 9$

Therefore, **$R_e = 3061.5 d^2$**

Skin friction component of socketed length of pile, $R_{sf} = \alpha C_{u2} \pi BL / F_s$

$\alpha = 0.9$ (recommended value in IS 2911 P1/S2)

L = length of the socket = 3 D

C_{u2} = Ultimate shear strength along socket length which shall be restricted to shear capacity of concrete of the pile = 1300 kN/m²

F_s = Factor of Safety = 6

Therefore, $R_{sf} = 1836.9 \text{ d}^2$

Thus,

$$Q_a = c_{u1} N_c \cdot \frac{\pi B^2}{4 F_s} + \alpha c_{u2} \cdot \frac{\pi B L}{F_s}$$

$$= 3061.5 \text{ d}^2 + 1836.9 \text{ d}^2 = 4898.4 \text{ d}^2$$

Substituting the values of various diameters and socket lengths equal to 3 times diameter, allowable load on single pile can be summarized as follows,

Summary of the Safe load calculation in Compression

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	18.40	18.88	19.30
Termination level RL in m	184.10	183.62	183.20
End Bearing Component in kN	1102.1	1768.3	2479.8
Friction Component in kN	661.3	1060.9	1487.9
Safe load in Compression in kN	1763.4	2829.3	3967.7
Safe load in Compression in T	176	283	397

5.0 Safe Load on Pile in uplift

For 3.00m cutoff from FGL

The overburden soils, though, will not contribute in compression capacity would offer resistance in uplift capacity. The parameters of IBH 29 are considered for calculation of uplift resistance as summarized below,

Depth in m from RL 202.5 m	Cohesion in kg/cm ²	Angle of Internal Friction ϕ	Submerged density in gm/cc γ_{sub}	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 3.00	Pile cutoff level – No pile						
3.00 to 7.70	0.03(ignored)	30	0.89	NA	1.00	30	19-58
7.70 to 16.60	0.00	34	1.04	NA	1.50	34	70->100
16.60 to 27.40	Rock strata – Resistance would be as per skin friction capacity in socket as already calculated in compression capacity						

Ultimate load in skin friction,

$$Q_{uf} = \alpha_i C_{ai} A_{si} + K_i P D_i \tan \delta_i A_{si}$$

First Layer – No contribution considered – (Within Cutoff Level).

$$\text{Second Layer} - K_2 P D_2 \tan \delta_2 A_{s2} = 1.00 * 4.49 * \tan 28 * \pi d * 4.70 = 35.25 \text{ d}$$

$$\text{Third Layer} - K_3 P D_3 \tan \delta_3 A_{s3} = 1.50 * 10.43 * \tan 28 * \pi d * 8.90 = 232.59 \text{ d}$$

Fourth Layer – 1836.90 d² in rock socket

$$\text{Substituting, ultimate load } q_{uf} = 2648.4 \text{ d} + 1836.9 \text{ d}^2$$

The safe load in uplift is worked out (considering the safety factor of 2.50 for overburden soils) and summarized below,

Safe Load on Piles in Uplift (in Ton)

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	18.40	18.88	19.30
Termination level RL in m	184.10	183.62	183.20
Safe load in Uplift in kN	1296.90	1866.11	2441.31
Self-weight of pile in kN	65.28	108.00	155.47
Safe load in Uplift in T (Considering self-weight of pile)	136.22	197.41	259.68

6.0 Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60	0.76	0.90
Subgrade reaction in MN/m^3		3.70	3.70	3.70
Stiffness factor T in m		2.17	2.62	3.00
Depth of fixity in m	Free Head	4.10	5.00	5.70
	Fixed Head	4.70	5.70	6.50
Allowable Horizontal Force in T	Free Head	3.80	5.60	7.30
	Fixed Head	10.10	14.70	19.30
Allowable Moment capacity in Tm	Free Head	5.49	9.68	14.53
	Fixed Head	19.54	34.46	51.71

7.0 Notes

1. Pile shall be terminated after socketing 3D inside rock.
2. Initial and routine pile load test is required to verify the actual carrying capacity of pile in compression, uplift and lateral loads.
3. For design and construction, specification of IS: 2911, P1/S2, IS: 456, 2000 shall strictly be followed.

(Dr. K. K. Thaker)

Appendix – 15B

Calculation of Safe Load on Uniform Diameter Bored Cast in situ Pile. (Near IBH 29) (Coal pile run off pond)

The safe load is calculated as follows,

1) Design Stipulations

- | | |
|---|---|
| 1. Type of pile | - Bored cast in situ uniform diameter pile. |
| 2. Pile diameter considered | - 0.60m |
| 3. Termination depth of pile considered | - 14.00m from FGL. |
| 4. Cut off Level | - 3.00m from FGL. |
| 5. Factor of Safety | - 2.50 |
| 6. Depth of Water table | - Considered at FGL. |
| 7. Ref | - IS 2911 P-I, Sec-II, 2021. |

2) Test Data

The parameters are based on IBH 29. For evaluation of safe load on piles following characterized layers are considered as described in table below,

Depth in m from RL 202.5 m	Cohesion in kg/cm ²	Angle of Internal Friction ϕ	Submerged density in gm/cc γ_{sub}	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 3.00	Pile cutoff level – No pile						
3.00 to 7.70	0.03(ignored)	30	0.89	NA	1.0	30	19-58
7.70 to 16.60	0.00	34	1.04	NA	1.5	34	70->100

Notes: - Layers are characterized based on classification and the state of soil in that stratum.

* - In cohesive soils the contribution of the angle of internal friction being insignificant is ignored.

Shear parameters are the most representative for the layer. NA means not applicable. Characterized N values are considered for each layer.

- Weighted Average of the parameters falling in the same layer has been considered

\$-Parameters are correlated based on SPT value N.

3) Ultimate Load in Compression

3.1) Ultimate load in Compression by Bearing

Ultimate load on pile in end bearing,

$$q_{ub} = A_p (0.5 \cdot D \cdot \gamma N_v + PDN_q)$$

$$A_p = \text{Cross section area of Pile stem at toe} = \pi d^2/4$$

$$D = \text{Diameter of pile} = d \text{ in m}$$

$$N_v = 42.90$$

$$N_q = 40.00$$

$$q_{ub} = 0.785d^2 (0.5 \cdot d \cdot 1.04 \cdot 42.90 + 8.66 \cdot 40.00) = 17.51d^3 + 271.92d^2$$

(For Pile terminating at 14.00m from F.G.L.)

Note: As the pile terminating just above rock level, we have considered parameter for end bearing component based on rock strata.

3.2) Ultimate Load in Compression by Skin Friction

Ultimate load in skin friction,

$$q_{uf} = \alpha_i C_{ai} + K_i P D_i \tan \delta_i A_{si}$$

First Layer – No contribution considered – (Within Cutoff Level).

$$\text{Second Layer} - K_2 P D_2 \tan \delta_2 A_{s2} = 1.00 \cdot 2.09 \cdot \tan 30^\circ \cdot \pi \cdot d \cdot 4.70 = 17.82 d$$

$$\text{Third Layer} - K_3 P D_3 \tan \delta_3 A_{s3} = 1.50 \cdot 7.46 \cdot \tan 34^\circ \cdot \pi \cdot d \cdot (\ell - 7.70) = 23.71 d (\ell - 7.70)$$

Substituting, ultimate load

$$q_{uf} = 17.82d + 23.71d (\ell - 7.70) \text{ (For Pile terminating at 14.00m from F.G.L.)}$$

Where, ℓ is the pile length and d is diameter of piles, substituting

Ultimate load by both bearing and friction can be as follows for various lengths of piles,

$$q_{uc} = q_{ub} + q_{uf}$$

$$q_{uc} = 17.51d^3 + 271.92d^2 + 17.82d + 23.71d (\ell - 7.70)$$

(For Pile terminating at 14.00m from F.G.L.).

By substituting various diameters of piles having various lengths, the safe load is worked out considering the safety factor of 2.50 and are given in table below,

Safe Load on Piles in Compression (in Ton)

Termination Depth of Pile in m, from FGL	Termination Depth of Pile in m, from cut-off	Diameter of Pile in, m
		0.60
14.00	11.00	80.75

3.3) Ultimate Load in Uplift

Considering skin friction for determination of uplift

Safe Load on Piles in Uplift (in Ton)

Termination Depth of Pile in m, from FGL	Termination Depth of Pile in m, from cut-off	Diameter of Pile in, m
		0.60
14.00	11.00	38.09

Note: Self weight of pile is considered in calculation of ultimate load in uplift.

Self weight of Pile (in Ton)

Termination Depth of Pile in m, from FGL	Termination Depth of Pile in m, from cut-off	Diameter of Pile in, m
		0.60
14.00	11.00	4.67

3.4) Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60
Subgrade reaction in MN/m ³		3.70
Stiffness factor T in m		2.17
Depth of fixity in m	Free Head	4.10
	Fixed Head	4.70
Allowable Horizontal Force in T	Free Head	3.80
	Fixed Head	10.10
Allowable Moment capacity in Tm	Free Head	5.49
	Fixed Head	19.54

4) Notes:

1) Initial and Routine pile load tests shall be carried out as per IS 2911, P-4 on the piles to confirm the capacity of pile worked out theoretically. For design and construction, specifications of IS 2911, P-I, S-2, shall strictly be followed. Termination depth of pile shall be from FGL.

Dr. K. K. Thaker

Appendix – 16A

Calculation of Safe Load carrying capacity of piles socketed inside rock (Near IBH 30,31,32,38) (Dry fly ash silo & dewatering bin)

Project Name: - Proposed structures of thermal power project of NTTTP at Hirma, Talabira

1.0 Introduction

In situations where overburden offering low bearing pressure is followed by rock at relatively shallower depths, end bearing piles is the suitable foundation option. Piles in rocks and weathered rocks of varying degree of weathering derive their capacity by end bearing and socket side resistance.

In situations, where, rock strata comprises of highly fragmented rock, as in present case, where RQD is nil or $(CR+RQD)/2$ is less than 30 % or when the crushing strength is less than 10 MPa, the appropriate approach would be of that suggested by Cole & Stroud.

In present site overburden soils overlay fractured / laminated / foliated rock. The founding stratum having highly fragmented rock with nil RQD and $(CR+RQD)/2$ to be less than 30 %, the approach suggested by Cole and Stroud as per Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 Pa/S2 has been used for safe load calculations.

An illustrative calculation of safe load on pile and summary of pile capacities is as follows,

2.0 Sub soil strata Characterization

General stratification at the location of boreholes IBH 32 show primarily two characterized layers,

1. Overburden comprising of fine to very fine grained, sandy clays of low, intermediate, high plasticity and fine to very fine grained, clayey sand upto 14.70m (i.e. RL 181.80m).
2. Second characterized layer below the overburden soils comprises of Moderately weathered, very weak, light brownish grey, fine to very fine grained, rock with moderately wide spacing of discontinuities followed by Highly weathered, very weak, light brownish grey, fine to very fine grained, close spacing of discontinuities upto 18.00m (i.e. RL 178.50m).

3.0 Design Considerations

1. Length of socket considered 3D from depth of rock encountered.
2. The pile is considered to have socket length below 14.70 m below NGL (i.e. RL 181.80 m) depth.
3. For present case of pile terminating in highly weathered rock. SPT at depths between 14.70 to 18.00m (between RL 181.80 to 178.50 m) is > 200.
Based on recommendation of fig no. 3 in B 8 in Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 P1/S2, average shear strength q_c corresponding to assumed SPT of 200 may be taken as 1300 kN/m²
4. Allowable Capacity of pile socketed into rock $Q_a = R_e + R_{sf} = C_{u1} N_c \pi B^2 / 4(F_s = 3) + \alpha C_{u2} \pi BL / (F_s = 6)$

4.0 Safe Load on Pile in Compression

Where,

End bearing component, $R_e = C_{u1} N_c \pi B^2 / 4F_s$,

C_{u1} = Shear strength below base of pile = 1300 kN/m²

B = diameter of the pile = d

F_s = Factor of Safety = 3

$N_c = 9$

Therefore, **$R_e = 3061.5 d^2$**

Skin friction component of socketed length of pile, $R_{sf} = \alpha C_{u2} \pi BL / F_s$

$\alpha = 0.9$ (recommended value in IS 2911 P1/S2)

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APPENDIX - 16 (For IBH-30,31,32,38 (Dry fly ash silo & dewatering bin))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:196.50m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 16.1) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 16.2)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
4.00	192.50	10.00	1.50	1.50	22	112	179	22	22
4.00	192.50	10.00	2.00	2.00	21	84	134	21	21
4.00	192.50	10.00	2.50	2.50	21	67	107	21	21
4.00	192.50	10.00	3.00	3.00	21	56	89	21	21
5.00	191.50	11.00	1.50	1.50	28	112	179	28	28
5.00	191.50	11.00	2.00	2.00	26	84	134	26	26
5.00	191.50	11.00	2.50	2.50	25	67	107	25	25
5.00	191.50	11.00	3.00	3.00	25	56	89	25	25
6.00	190.50	12.00	1.50	1.50	34	112	179	34	34
6.00	190.50	12.00	2.00	2.00	31	84	134	31	31
6.00	190.50	12.00	2.50	2.50	30	67	107	30	30
6.00	190.50	12.00	3.00	3.00	29	56	89	29	29

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 196.50m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 16.1 (For IBH-30,31,32,38 (Dry fly ash silo & dewatering bin))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	4.00	10.00	192.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.73	1.37	1.37	1.00	1.00	1.00	1.97	0.99	0.50	0.50	22
2	2.00	2.00	4.00	10.00	192.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.55	1.28	1.28	1.00	1.00	1.00	1.97	0.99	0.50	0.50	21
3	2.50	2.50	4.00	10.00	192.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.44	1.22	1.22	1.00	1.00	1.00	1.97	0.99	0.50	0.50	21
4	3.00	3.00	4.00	10.00	192.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.37	1.18	1.18	1.00	1.00	1.00	1.97	0.99	0.50	0.50	21
5	1.50	1.50	5.00	11.00	191.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.92	1.46	1.46	1.00	1.00	1.00	1.97	0.99	0.50	0.50	28
6	2.00	2.00	5.00	11.00	191.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.69	1.34	1.34	1.00	1.00	1.00	1.97	0.99	0.50	0.50	26
7	2.50	2.50	5.00	11.00	191.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.55	1.28	1.28	1.00	1.00	1.00	1.97	0.99	0.50	0.50	25
8	3.00	3.00	5.00	11.00	191.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.46	1.23	1.23	1.00	1.00	1.00	1.97	0.99	0.50	0.50	25
9	1.50	1.50	6.00	12.00	190.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	2.10	1.55	1.55	1.00	1.00	1.00	1.97	0.99	0.50	0.50	34
10	2.00	2.00	6.00	12.00	190.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.83	1.41	1.41	1.00	1.00	1.00	1.97	0.99	0.50	0.50	31
11	2.50	2.50	6.00	12.00	190.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.66	1.33	1.33	1.00	1.00	1.00	1.97	0.99	0.50	0.50	30
12	3.00	3.00	6.00	12.00	190.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.55	1.28	1.28	1.00	1.00	1.00	1.97	0.99	0.50	0.50	29

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 196.50m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 16.2 (For IBH-30,31,32,38 (Dry fly ash silo & dewatering bin))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_1 = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D from NGL m	RL of foundation m	Depth of foundation from FGL m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	4.00	192.50	10.00	1.50	1.12	0.35	528	0.80	112	179
2	4.00	192.50	10.00	2.00	1.12	0.35	528	0.80	84	134
3	4.00	192.50	10.00	2.50	1.12	0.35	528	0.80	67	107
4	4.00	192.50	10.00	3.00	1.12	0.35	528	0.80	56	89
5	5.00	191.50	11.00	1.50	1.12	0.35	528	0.80	112	179
6	5.00	191.50	11.00	2.00	1.12	0.35	528	0.80	84	134
7	5.00	191.50	11.00	2.50	1.12	0.35	528	0.80	67	107
8	5.00	191.50	11.00	3.00	1.12	0.35	528	0.80	56	89
9	6.00	190.50	12.00	1.50	1.12	0.35	528	0.80	112	179
10	6.00	190.50	12.00	2.00	1.12	0.35	528	0.80	84	134
11	6.00	190.50	12.00	2.50	1.12	0.35	528	0.80	67	107
12	6.00	190.50	12.00	3.00	1.12	0.35	528	0.80	56	89

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 16.3 (For IBH-30,31,32,38 (Dry fly ash silo & dewatering bin))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:196.50m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 16.4) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 16.5)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
4.00	192.50	10.00	3.50	3.50	21	48	77	21	21
4.00	192.50	10.00	4.00	4.00	21	42	67	21	21
4.00	192.50	10.00	5.00	5.00	21	34	54	21	21
4.00	192.50	10.00	6.00	6.00	22	28	45	22	22
5.00	191.50	11.00	3.50	3.50	24	48	77	24	24
5.00	191.50	11.00	4.00	4.00	24	42	67	24	24
5.00	191.50	11.00	5.00	5.00	25	34	54	25	25
5.00	191.50	11.00	6.00	6.00	25	28	45	25	25
6.00	190.50	12.00	3.50	3.50	29	48	77	29	29
6.00	190.50	12.00	4.00	4.00	28	42	67	28	28
6.00	190.50	12.00	5.00	5.00	28	34	54	28	28
6.00	190.50	12.00	6.00	6.00	29	28	45	28	29

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 196.50m.
- 3) Calculations are considering the effect of water table at FGL.

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APPENDIX - 16.4 (For IBH-30,31,32,38 (Dry fly ash silo & dewatering bin))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	4.00	10.00	192.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.31	1.16	1.16	1.00	1.00	1.00	1.97	0.99	0.50	0.50	21
2	4.00	4.00	4.00	10.00	192.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.28	1.14	1.14	1.00	1.00	1.00	1.97	0.99	0.50	0.50	21
3	5.00	5.00	4.00	10.00	192.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.22	1.11	1.11	1.00	1.00	1.00	1.97	0.99	0.50	0.50	21
4	6.00	6.00	4.00	10.00	192.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.18	1.09	1.09	1.00	1.00	1.00	1.97	0.99	0.50	0.50	22
5	3.50	3.50	5.00	11.00	191.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.39	1.20	1.20	1.00	1.00	1.00	1.97	0.99	0.50	0.50	24
6	4.00	4.00	5.00	11.00	191.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.34	1.17	1.17	1.00	1.00	1.00	1.97	0.99	0.50	0.50	24
7	5.00	5.00	5.00	11.00	191.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.28	1.14	1.14	1.00	1.00	1.00	1.97	0.99	0.50	0.50	25
8	6.00	6.00	5.00	11.00	191.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.23	1.11	1.11	1.00	1.00	1.00	1.97	0.99	0.50	0.50	25
9	3.50	3.50	6.00	12.00	190.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.47	1.24	1.24	1.00	1.00	1.00	1.97	0.99	0.50	0.50	29
10	4.00	4.00	6.00	12.00	190.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.41	1.21	1.21	1.00	1.00	1.00	1.97	0.99	0.50	0.50	28
11	5.00	5.00	6.00	12.00	190.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.33	1.17	1.17	1.00	1.00	1.00	1.97	0.99	0.50	0.50	28
12	6.00	6.00	6.00	12.00	190.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.28	1.14	1.14	1.00	1.00	1.00	1.97	0.99	0.50	0.50	29

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 196.50m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 16.5 (For IBH-30,31,32,38 (Dry fly ash silo & dewatering bin))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_1 = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D from NGL m	RL of foundation m	Depth of foundation from FGL m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	4.00	192.50	10.00	3.50	1.12	0.35	528	0.80	48	77
2	4.00	192.50	10.00	4.00	1.12	0.35	528	0.80	42	67
3	4.00	192.50	10.00	5.00	1.12	0.35	528	0.80	34	54
4	4.00	192.50	10.00	6.00	1.12	0.35	528	0.80	28	45
5	5.00	191.50	11.00	3.50	1.12	0.35	528	0.80	48	77
6	5.00	191.50	11.00	4.00	1.12	0.35	528	0.80	42	67
7	5.00	191.50	11.00	5.00	1.12	0.35	528	0.80	34	54
8	5.00	191.50	11.00	6.00	1.12	0.35	528	0.80	28	45
9	6.00	190.50	12.00	3.50	1.12	0.35	528	0.80	48	77
10	6.00	190.50	12.00	4.00	1.12	0.35	528	0.80	42	67
11	6.00	190.50	12.00	5.00	1.12	0.35	528	0.80	34	54
12	6.00	190.50	12.00	6.00	1.12	0.35	528	0.80	28	45

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 16.6 (For IBH-30,31,32,38 (Dry fly ash silo & dewatering bin))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:196.50m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 16.7) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 16.8)		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
4.00	192.50	10.00	7.00	7.00	22	24	38	22	22
4.00	192.50	10.00	8.00	8.00	23	21	34	21	23
4.00	192.50	10.00	9.00	9.00	24	19	30	19	24
4.00	192.50	10.00	10.00	10.00	25	17	27	17	25
5.00	191.50	11.00	7.00	7.00	26	24	38	24	26
5.00	191.50	11.00	8.00	8.00	26	21	34	21	26
5.00	191.50	11.00	9.00	9.00	27	19	30	19	27
5.00	191.50	11.00	10.00	10.00	28	17	27	17	27
6.00	190.50	12.00	7.00	7.00	29	24	38	24	29
6.00	190.50	12.00	8.00	8.00	30	21	34	21	30
6.00	190.50	12.00	9.00	9.00	30	19	30	19	30
6.00	190.50	12.00	10.00	10.00	31	17	27	17	27

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 196.50m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 16.7 (For IBH-30,31,32,38 (Dry fly ash silo & dewatering bin))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	4.00	10.00	192.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.16	1.08	1.08	1.00	1.00	1.00	1.97	0.99	0.50	0.50	22
2	8.00	8.00	4.00	10.00	192.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	1.97	0.99	0.50	0.50	23
3	9.00	9.00	4.00	10.00	192.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.12	1.06	1.06	1.00	1.00	1.00	1.97	0.99	0.50	0.50	24
4	10.00	10.00	4.00	10.00	192.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.11	1.06	1.06	1.00	1.00	1.00	1.97	0.99	0.50	0.50	25
5	7.00	7.00	5.00	11.00	191.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.20	1.10	1.10	1.00	1.00	1.00	1.97	0.99	0.50	0.50	26
6	8.00	8.00	5.00	11.00	191.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.17	1.09	1.09	1.00	1.00	1.00	1.97	0.99	0.50	0.50	26
7	9.00	9.00	5.00	11.00	191.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.15	1.08	1.08	1.00	1.00	1.00	1.97	0.99	0.50	0.50	27
8	10.00	10.00	5.00	11.00	191.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	1.97	0.99	0.50	0.50	28
9	7.00	7.00	6.00	12.00	190.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.24	1.12	1.12	1.00	1.00	1.00	1.97	0.99	0.50	0.50	29
10	8.00	8.00	6.00	12.00	190.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.21	1.10	1.10	1.00	1.00	1.00	1.97	0.99	0.50	0.50	30
11	9.00	9.00	6.00	12.00	190.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.18	1.09	1.09	1.00	1.00	1.00	1.97	0.99	0.50	0.50	30
12	10.00	10.00	6.00	12.00	190.50	0.07	26	14.88	5.54	5.71	1.30	1.20	0.80	1.17	1.08	1.08	1.00	1.00	1.00	1.97	0.99	0.50	0.50	31

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 196.50m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 16.8 (For IBH-30,31,32,38 (Dry fly ash silo & dewatering bin))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_1 = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D from NGL m	RL of foundation m	Depth of foundation from FGL m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	4.00	192.50	10.00	7.00	1.12	0.35	528	0.80	24	38
2	4.00	192.50	10.00	8.00	1.12	0.35	528	0.80	21	34
3	4.00	192.50	10.00	9.00	1.12	0.35	528	0.80	19	30
4	4.00	192.50	10.00	10.00	1.12	0.35	528	0.80	17	27
5	5.00	191.50	11.00	7.00	1.12	0.35	528	0.80	24	38
6	5.00	191.50	11.00	8.00	1.12	0.35	528	0.80	21	34
7	5.00	191.50	11.00	9.00	1.12	0.35	528	0.80	19	30
8	5.00	191.50	11.00	10.00	1.12	0.35	528	0.80	17	27
9	6.00	190.50	12.00	7.00	1.12	0.35	528	0.80	24	38
10	6.00	190.50	12.00	8.00	1.12	0.35	528	0.80	21	34
11	6.00	190.50	12.00	9.00	1.12	0.35	528	0.80	19	30
12	6.00	190.50	12.00	10.00	1.12	0.35	528	0.80	17	27

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 16.9 (For IBH-30,31,32,38 (Dry fly ash silo & dewatering bin))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:196.50m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	195.50	7.00	1.50	1.50	13	34	55	13	13
1.00	195.50	7.00	2.00	2.00	13	25	40	13	13
1.00	195.50	7.00	2.50	2.50	13	20	32	13	13
1.00	195.50	7.00	3.00	3.00	13	16	26	13	13
2.00	194.50	8.00	1.50	1.50	15	36	57	15	15
2.00	194.50	8.00	2.00	2.00	14	27	43	14	14
2.00	194.50	8.00	2.50	2.50	14	21	34	14	14
2.00	194.50	8.00	3.00	3.00	13	17	28	13	13
3.00	193.50	9.00	1.50	1.50	17	36	57	17	17
3.00	193.50	9.00	2.00	2.00	15	27	43	15	15
3.00	193.50	9.00	2.50	2.50	15	22	35	15	15
3.00	193.50	9.00	3.00	3.00	14	19	30	14	14

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 196.50m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-16.10 (For IBH-30,31,32,38 (Dry fly ash silo & dewatering bin))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	1.00	7.00	195.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	13
2	2.00	2.00	1.00	7.00	195.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	13
3	2.50	2.50	1.00	7.00	195.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	13
4	3.00	3.00	1.00	7.00	195.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	13
5	1.50	1.50	2.00	8.00	194.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.27	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	15
6	2.00	2.00	2.00	8.00	194.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.20	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	14
7	2.50	2.50	2.00	8.00	194.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.16	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	14
8	3.00	3.00	2.00	8.00	194.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	13
9	1.50	1.50	3.00	9.00	193.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.40	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	17
10	2.00	2.00	3.00	9.00	193.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.30	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	15
11	2.50	2.50	3.00	9.00	193.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.24	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	15
12	3.00	3.00	3.00	9.00	193.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.20	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	14

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 196.50m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-16.11 (For IBH-30,31,32,38 (Dry fly ash silo & dewatering bin))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	1.00	195.50	7.00	1.50	1.50	0.40	258	1.12	0.80	0.0086	3.00	0.70	0.80	0.80	34	55
2	1.00	195.50	7.00	2.00	2.00	0.40	258	1.12	0.80	0.0086	4.00	0.70	0.85	0.80	25	40
3	1.00	195.50	7.00	2.50	2.50	0.40	258	1.12	0.80	0.0086	5.00	0.70	0.88	0.80	20	32
4	1.00	195.50	7.00	3.00	3.00	0.40	258	1.12	0.80	0.0086	5.00	0.70	0.91	0.80	16	26
5	2.00	194.50	8.00	1.50	1.50	0.40	258	1.12	0.80	0.0086	3.00	0.70	0.73	0.80	36	57
6	2.00	194.50	8.00	2.00	2.00	0.40	258	1.12	0.80	0.0086	4.00	0.70	0.73	0.80	27	43
7	2.00	194.50	8.00	2.50	2.50	0.40	258	1.12	0.80	0.0086	4.00	0.70	0.76	0.80	21	34
8	2.00	194.50	8.00	3.00	3.00	0.40	258	1.12	0.80	0.0086	4.00	0.70	0.80	0.80	17	28
9	3.00	193.50	9.00	1.50	1.50	0.40	258	1.12	0.80	0.0086	3.00	0.70	0.73	0.80	36	57
10	3.00	193.50	9.00	2.00	2.00	0.40	258	1.12	0.80	0.0086	3.00	0.70	0.73	0.80	27	43
11	3.00	193.50	9.00	2.50	2.50	0.40	258	1.12	0.80	0.0086	3.00	0.70	0.73	0.80	22	35
12	3.00	193.50	9.00	3.00	3.00	0.40	258	1.12	0.80	0.0086	3.00	0.70	0.73	0.80	19	30

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 16.12 (For IBH-30,31,32,38 (Dry fly ash silo & dewatering bin))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:196.50m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	195.50	7.00	3.50	3.50	12	14	22	12	12
1.00	195.50	7.00	4.00	4.00	12	12	20	12	12
1.00	195.50	7.00	5.00	5.00	12	10	16	10	12
1.00	195.50	7.00	6.00	6.00	12	9	14	9	12
2.00	194.50	8.00	3.50	3.50	13	15	24	13	13
2.00	194.50	8.00	4.00	4.00	13	13	21	13	13
2.00	194.50	8.00	5.00	5.00	13	11	17	11	13
2.00	194.50	8.00	6.00	6.00	13	9	15	9	13
3.00	193.50	9.00	3.50	3.50	14	16	26	14	14
3.00	193.50	9.00	4.00	4.00	14	14	23	14	14
3.00	193.50	9.00	5.00	5.00	13	12	19	12	13
3.00	193.50	9.00	6.00	6.00	13	10	16	10	13

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 196.50m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-16.13 (For IBH-30,31,32,38 (Dry fly ash silo & dewatering bin))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5 γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	1.00	7.00	195.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	12
2	4.00	4.00	1.00	7.00	195.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	12
3	5.00	5.00	1.00	7.00	195.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	12
4	6.00	6.00	1.00	7.00	195.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	12
5	3.50	3.50	2.00	8.00	194.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.11	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	13
6	4.00	4.00	2.00	8.00	194.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	13
7	5.00	5.00	2.00	8.00	194.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	13
8	6.00	6.00	2.00	8.00	194.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	13
9	3.50	3.50	3.00	9.00	193.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.17	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	14
10	4.00	4.00	3.00	9.00	193.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.15	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	14
11	5.00	5.00	3.00	9.00	193.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	13
12	6.00	6.00	3.00	9.00	193.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	13

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 196.50m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-16.14 (For IBH-30,31,32,38 (Dry fly ash silo & dewatering bin))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	1.00	195.50	7.00	3.50	3.50	0.40	258	1.12	0.80	0.0086	5.00	0.70	0.92	0.80	14	22
2	1.00	195.50	7.00	4.00	4.00	0.40	258	1.12	0.80	0.0086	5.00	0.70	0.93	0.80	12	20
3	1.00	195.50	7.00	5.00	5.00	0.40	258	1.12	0.80	0.0086	5.00	0.70	0.95	0.80	10	16
4	1.00	195.50	7.00	6.00	6.00	0.40	258	1.12	0.80	0.0086	5.00	0.70	0.96	0.80	9	14
5	2.00	194.50	8.00	3.50	3.50	0.40	258	1.12	0.80	0.0086	4.00	0.70	0.83	0.80	15	24
6	2.00	194.50	8.00	4.00	4.00	0.40	258	1.12	0.80	0.0086	4.00	0.70	0.85	0.80	13	21
7	2.00	194.50	8.00	5.00	5.00	0.40	258	1.12	0.80	0.0086	4.00	0.70	0.88	0.80	11	17
8	2.00	194.50	8.00	6.00	6.00	0.40	258	1.12	0.80	0.0086	4.00	0.70	0.91	0.80	9	15
9	3.00	193.50	9.00	3.50	3.50	0.40	258	1.12	0.80	0.0086	3.00	0.70	0.75	0.80	16	26
10	3.00	193.50	9.00	4.00	4.00	0.40	258	1.12	0.80	0.0086	3.00	0.70	0.77	0.80	14	23
11	3.00	193.50	9.00	5.00	5.00	0.40	258	1.12	0.80	0.0086	3.00	0.70	0.82	0.80	12	19
12	3.00	193.50	9.00	6.00	6.00	0.40	258	1.12	0.80	0.0086	3.00	0.70	0.85	0.80	10	16

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APPENDIX - 16.15 (For IBH-30,31,32,38 (Dry fly ash silo & dewatering bin))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:196.50m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	195.50	7.00	7.00	7.00	12	8	12	8	12
1.00	195.50	7.00	8.00	8.00	12	7	11	7	11
1.00	195.50	7.00	9.00	9.00	12	6	10	6	10
1.00	195.50	7.00	10.00	10.00	12	6	9	6	9
2.00	194.50	8.00	7.00	7.00	12	8	13	8	12
2.00	194.50	8.00	8.00	8.00	12	7	11	7	11
2.00	194.50	8.00	9.00	9.00	12	7	10	7	10
2.00	194.50	8.00	10.00	10.00	12	6	10	6	10
3.00	193.50	9.00	7.00	7.00	13	9	14	9	13
3.00	193.50	9.00	8.00	8.00	13	8	12	8	12
3.00	193.50	9.00	9.00	9.00	13	7	11	7	11
3.00	193.50	9.00	10.00	10.00	13	6	10	6	10

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 196.50m.
- 3) Calculations are considering the effect of water table at FGL.

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APPENDIX-16.16 (For IBH-30,31,32,38 (Dry fly ash silo & dewatering bin))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5 γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	1.00	7.00	195.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	12
2	8.00	8.00	1.00	7.00	195.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	12
3	9.00	9.00	1.00	7.00	195.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.02	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	12
4	10.00	10.00	1.00	7.00	195.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.02	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	12
5	7.00	7.00	2.00	8.00	194.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	12
6	8.00	8.00	2.00	8.00	194.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	12
7	9.00	9.00	2.00	8.00	194.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	12
8	10.00	10.00	2.00	8.00	194.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	12
9	7.00	7.00	3.00	9.00	193.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	13
10	8.00	8.00	3.00	9.00	193.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	13
11	9.00	9.00	3.00	9.00	193.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	13
12	10.00	10.00	3.00	9.00	193.50	0.66	0	5.14	0.00	0.00	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	13

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 196.50m.
- 3) Calculations are considering the effect of water table at FGL.

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APPENDIX-16.17 (For IBH-30,31,32,38 (Dry fly ash silo & dewatering bin))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	1.00	195.50	7.00	7.00	7.00	0.40	258	1.12	0.80	0.0086	5.00	0.70	0.97	0.80	8	12
2	1.00	195.50	7.00	8.00	8.00	0.40	258	1.12	0.80	0.0086	5.00	0.70	0.97	0.80	7	11
3	1.00	195.50	7.00	9.00	9.00	0.40	258	1.12	0.80	0.0086	5.00	0.70	0.97	0.80	6	10
4	1.00	195.50	7.00	10.00	10.00	0.40	258	1.12	0.80	0.0086	5.00	0.70	0.98	0.80	6	9
5	2.00	194.50	8.00	7.00	7.00	0.40	258	1.12	0.80	0.0086	4.00	0.70	0.92	0.80	8	13
6	2.00	194.50	8.00	8.00	8.00	0.40	258	1.12	0.80	0.0086	4.00	0.70	0.93	0.80	7	11
7	2.00	194.50	8.00	9.00	9.00	0.40	258	1.12	0.80	0.0086	4.00	0.70	0.94	0.80	7	10
8	2.00	194.50	8.00	10.00	10.00	0.40	258	1.12	0.80	0.0086	4.00	0.70	0.95	0.80	6	10
9	3.00	193.50	9.00	7.00	7.00	0.40	258	1.12	0.80	0.0086	3.00	0.70	0.87	0.80	9	14
10	3.00	193.50	9.00	8.00	8.00	0.40	258	1.12	0.80	0.0086	3.00	0.70	0.89	0.80	8	12
11	3.00	193.50	9.00	9.00	9.00	0.40	258	1.12	0.80	0.0086	3.00	0.70	0.91	0.80	7	11
12	3.00	193.50	9.00	10.00	10.00	0.40	258	1.12	0.80	0.0086	3.00	0.70	0.92	0.80	6	10

Appendix – 16A

Calculation of Safe Load carrying capacity of piles socketed inside rock (Near IBH 30,31,32,38) (Dry fly ash silo & dewatering bin)

Project Name: - Proposed structures of thermal power project of NTTTP at Hirma, Talabira

1.0 Introduction

In situations where overburden offering low bearing pressure is followed by rock at relatively shallower depths, end bearing piles is the suitable foundation option. Piles in rocks and weathered rocks of varying degree of weathering derive their capacity by end bearing and socket side resistance.

In situations, where, rock strata comprises of highly fragmented rock, as in present case, where RQD is nil or $(CR+RQD)/2$ is less than 30 % or when the crushing strength is less than 10 MPa, the appropriate approach would be of that suggested by Cole & Stroud.

In present site overburden soils overlay fractured / laminated / foliated rock. The founding stratum having highly fragmented rock with nil RQD and $(CR+RQD)/2$ to be less than 30 %, the approach suggested by Cole and Stroud as per Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 Pa/S2 has been used for safe load calculations.

An illustrative calculation of safe load on pile and summary of pile capacities is as follows,

2.0 Sub soil strata Characterization

General stratification at the location of boreholes IBH 32 show primarily two characterized layers,

1. Overburden comprising of fine to very fine grained, sandy clays of low, intermediate, high plasticity and fine to very fine grained, clayey sand upto 14.70m (i.e. RL 181.80m).
2. Second characterized layer below the overburden soils comprises of Moderately weathered, very weak, light brownish grey, fine to very fine grained, rock with moderately wide spacing of discontinuities followed by Highly weathered, very weak, light brownish grey, fine to very fine grained, close spacing of discontinuities upto 18.00m (i.e. RL 178.50m).

3.0 Design Considerations

1. Length of socket considered 3D from depth of rock encountered.
2. The pile is considered to have socket length below 14.70 m below NGL (i.e. RL 181.80 m) depth.
3. For present case of pile terminating in highly weathered rock. SPT at depths between 14.70 to 18.00m (between RL 181.80 to 178.50 m) is > 200.
Based on recommendation of fig no. 3 in B 8 in Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 P1/S2, average shear strength q_c corresponding to assumed SPT of 200 may be taken as 1300 kN/m²
4. Allowable Capacity of pile socketed into rock $Q_a = R_e + R_{sf} = C_{u1} N_c \pi B^2 / 4(F_s = 3) + \alpha C_{u2} \pi BL / (F_s = 6)$

4.0 Safe Load on Pile in Compression

Where,

End bearing component, $R_e = C_{u1} N_c \pi B^2 / 4F_s$,

C_{u1} = Shear strength below base of pile = 1300 kN/m²

B = diameter of the pile = d

F_s = Factor of Safety = 3

$N_c = 9$

Therefore, **$R_e = 3061.5 d^2$**

Skin friction component of socketed length of pile, $R_{sf} = \alpha C_{u2} \pi BL / F_s$

$\alpha = 0.9$ (recommended value in IS 2911 P1/S2)

L = length of the socket = $3 D$

C_{u2} = Ultimate shear strength along socket length which shall be restricted to shear capacity of concrete of the pile = 1300 kN/m^2

F_s = Factor of Safety = 6

Therefore, $R_{sf} = 1836.9 d^2$

Thus,

$$Q_a = c_{u1} N_c \cdot \frac{\pi B^2}{4 F_s} + \alpha c_{u2} \cdot \frac{\pi B L}{F_s}$$

$$= 3061.5 d^2 + 1836.9 d^2 = 4898.4 d^2$$

Substituting the values of various diameters and socket lengths equal to 3 times diameter, allowable load on single pile can be summarized as follows,

Summary of the Safe load calculation in Compression

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	22.50	22.98	23.40
Termination level RL in m	180.00	179.52	179.10
End Bearing Component in kN	1102.1	1768.3	2479.8
Friction Component in kN	661.3	1060.9	1487.9
Safe load in Compression in kN	1763.4	2829.3	3967.7
Safe load in Compression in T	176	283	397

5.0 Safe Load on Pile in uplift

For 6.00m cutoff from FGL

The overburden soils, though, will not contribute in compression capacity would offer resistance in uplift capacity. The parameters of IBH 32 are considered for calculation of uplift resistance as summarized below,

Depth in m from RL 202.5 m	Cohesion in kg/cm ²	Angle of Internal Friction ϕ	Submerged density in gm/cc γ_{sub}	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 6.00	Pile cutoff level – No pile						
6.00 to 8.80	0.20	0	0.80	1.00	NA	NA	5-20
8.80 to 9.60	1.03	8(ignored)	0.98	0.41	NA	NA	23
9.60 to 12.00	0.07(ignored)	27	0.98	NA	1.00	27	16-28
12.00 to 20.70	0.00	34	0.99	NA	1.50	34	>100
20.70 to 24.50	Rock strata – Resistance would be as per skin friction capacity in socket as already calculated in compression capacity						

Ultimate load in skin friction,

$$Q_{uf} = \alpha_i C_{ai} A_{si} + K_i P D_i \tan \delta_i A_{si}$$

First Layer – No contribution considered – (Within Cutoff Level).

$$\text{Second Layer} - \alpha_2 C_{a2} A_{s2} = 1.00 * 2.00 * \pi d * 2.80 = 17.59d$$

$$\text{Third Layer} - \alpha_3 C_{a3} A_{s3} = 0.41 * 10.30 * \pi d * 0.80 = 10.61d$$

$$\text{Fourth Layer} - K_4 P D_4 \tan \delta_4 A_{s4} = 1.00 * 9.00 * \tan 27^\circ * \pi d * 2.40 = 34.58 d$$

$$\text{Fifth Layer} - K_5 P D_5 \tan \delta_5 A_{s5} = 1.00 * 9.59 * \tan 34^\circ * \pi d * 6.00 = 121.93 d$$

Sixth Layer – $1836.90 d^2$ in rock socket

$$\text{Substituting, ultimate load } q_{uf} = 1847.10 d + 1836.9 d^2$$

The safe load in uplift is worked out (considering the safety factor of 2.50 for overburden soils) and summarized below,

Safe Load on Piles in Uplift (in Ton)

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	22.50	22.98	23.40
Termination level RL in m	180.00	179.52	179.10
Safe load in Uplift in kN	1104.59	1622.51	2152.85
Self-weight of pile in kN	69.94	115.49	165.96
Safe load in Uplift in T (Considering self-weight of pile)	117.45	173.80	231.88

6.0 Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60	0.76	0.90
Subgrade reaction in MN/m^3		7.20	7.20	7.20
Stiffness factor T in m		1.90	2.29	2.63
Depth of fixity in m	Free Head	3.60	4.40	5.00
	Fixed Head	4.10	5.00	5.70
Allowable Horizontal Force in T	Free Head	5.70	8.30	10.90
	Fixed Head	15.00	21.90	28.80
Allowable Moment capacity in Tm	Free Head	7.16	12.64	18.96
	Fixed Head	25.50	44.97	67.48

7.0 Notes

1. Pile shall be terminated after socketing 3D inside rock.
2. Initial and routine pile load test is required to verify the actual carrying capacity of pile in compression, uplift and lateral loads.
3. For design and construction, specification of IS: 2911, P1/S2, IS: 456, 2000 shall strictly be followed.

(Dr. K. K. Thaker)

Appendix – 16B

Calculation of Safe Load on Uniform Diameter Bored Cast in situ Pile. (Near IBH 30,31,32,38) (Dry fly ash silo & dewatering bin)

The safe load is calculated as follows,

1) Design Stipulations

- | | |
|---|---|
| 1. Type of pile | - Bored cast in situ uniform diameter pile. |
| 2. Pile diameter considered | - 0.60m |
| 3. Termination depth of pile considered | - 18.00m from FGL. |
| 4. Cut off Level | - 6.00m from FGL. |
| 5. Factor of Safety | - 2.50 |
| 6. Depth of Water table | - Considered at FGL. |
| 7. Ref | - IS 2911 P-I, Sec-II, 2021. |

2) Test Data

The parameters are based on IBH 32. For evaluation of safe load on piles following characterized layers are considered as described in table below,

Depth in m from RL 202.5 m	Cohesion in kg/cm ²	Angle of Internal Friction ϕ	Submerged density in gm/cc γ_{sub}	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 6.00	Pile cutoff level – No pile						
6.00 to 8.80	0.20	0	0.80	1.00	NA	NA	5-20
8.80 to 9.60	1.03	8(ignored)	0.98	0.41	NA	NA	23
9.60 to 12.00	0.07(ignored)	27	0.98	NA	1.00	27	16-28
12.00 to 20.70	0.00	34	0.99	NA	1.50	34	>100

Notes: - Layers are characterized based on classification and the state of soil in that stratum.

* - In cohesive soils the contribution of the angle of internal friction being insignificant is ignored.

Shear parameters are the most representative for the layer. NA means not applicable. Characterized N values are considered for each layer.

- Weighted Average of the parameters falling in the same layer has been considered

\$-Parameters are correlated based on SPT value N.

3) Ultimate Load in Compression

3.1) Ultimate load in Compression by Bearing

Ultimate load on pile in end bearing,

$$q_{ub} = A_p (0.5 \cdot D \cdot \gamma \cdot N_v + P D N_q)$$

$$A_p = \text{Cross section area of Pile stem at toe} = \pi d^2 / 4$$

$$D = \text{Diameter of pile} = d \text{ in m}$$

$$N_v = 42.90$$

$$N_q = 40.00$$

$$q_{ub} = 0.785d^2 (0.5 \cdot d \cdot 0.99 \cdot 42.90 + 8.35 \cdot 40.00) = 16.67d^3 + 262.19d^2$$

(For Pile terminating at 18.00m from F.G.L.)

Note: As the pile terminating just above rock level, we have considered parameter for end bearing component based on rock strata.

3.2) Ultimate Load in Compression by Skin Friction

Ultimate load in skin friction,

$$q_{uf} = \alpha_i C_{ai} A_i + K_i P D_i \tan \delta_i A_{si}$$

First Layer – No contribution considered – (Within Cutoff Level).

$$\text{Second Layer} - \alpha_2 C_{a2} A_{s2} = 1.00 \cdot 2.00 \cdot \pi \cdot d \cdot 2.80 = 17.59d$$

$$\text{Third Layer} - \alpha_3 C_{a3} A_{s3} = 0.41 \cdot 10.30 \cdot \pi \cdot d \cdot 0.80 = 10.61d$$

$$\text{Fourth Layer} - K_4 P D_4 \tan \delta_4 A_{s4} = 1.00 \cdot 4.20 \cdot \tan 27^\circ \cdot \pi \cdot d \cdot 2.40 = 16.14d$$

$$\text{Fifth Layer} - K_5 P D_5 \tan \delta_5 A_{s5} = 1.50 \cdot 8.35 \cdot \tan 34^\circ \cdot \pi \cdot d \cdot (\ell - 12.00) = 26.54d (\ell - 12.00)$$

Substituting, ultimate load

$$q_{uf} = 44.34d + 26.54d(\ell - 12.00) \text{ (For Pile terminating at 18.00m from F.G.L.)}$$

Where, ℓ is the pile length and d is diameter of piles, substituting

Ultimate load by both bearing and friction can be as follows for various lengths of piles,

$$q_{uc} = q_{ub} + q_{uf}$$

$$q_{uc} = 16.67d^3 + 262.19d^2 + 44.34d + 26.54d(\ell - 12.00)$$

(For Pile terminating at 18.00m from F.G.L.)

By substituting various diameters of piles having various lengths, the safe load is worked out considering the safety factor of 2.50 and are given in table below,

Safe Load on Piles in Compression (in Ton)

Termination Depth of Pile in m, from FGL	Termination Depth of Pile in m, from cut-off	Diameter of Pile in, m
		0.60
18.00	12.00	88.02

3.3) Ultimate Load in Uplift

Considering skin friction for determination of uplift

Safe Load on Piles in Uplift (in Ton)

Termination Depth of Pile in m, from FGL	Termination Depth of Pile in m, from cut-off	Diameter of Pile in, m
		0.60
18.00	12.00	45.79

Note: Self weight of pile is considered in calculation of ultimate load in uplift.

Self weight of Pile (in Ton)

Termination Depth of Pile in m, from FGL	Termination Depth of Pile in m, from cut-off	Diameter of Pile in, m
		0.60
18.00	12.00	5.09

3.4) Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60
Subgrade reaction in MN/m^3		7.20
Stiffness factor T in m		1.90
Depth of fixity in m	Free Head	3.60
	Fixed Head	4.10
Allowable Horizontal Force in T	Free Head	5.70
	Fixed Head	15.00
Allowable Moment capacity in Tm	Free Head	7.16
	Fixed Head	25.50

4) Notes:

1) Initial and Routine pile load tests shall be carried out as per IS 2911, P-4 on the piles to confirm the capacity of pile worked out theoretically. For design and construction, specifications of IS 2911, P-I, S-2, shall strictly be followed. Termination depth of pile shall be from FGL.

Dr. K. K. Thaker

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 17 (For IBH-33 (AHP MCC-1 cum control room AHP compressor bldg))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:197.00m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 17.1) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 17.2)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
3.50	193.50	9.00	1.50	1.50	54	84	134	54	54
3.50	193.50	9.00	2.00	2.00	49	66	105	49	49
3.50	193.50	9.00	2.50	2.50	47	55	88	47	47
3.50	193.50	9.00	3.00	3.00	45	48	76	45	45
4.00	193.00	9.50	1.50	1.50	56	87	140	56	56
4.00	193.00	9.50	2.00	2.00	51	69	111	51	51
4.00	193.00	9.50	2.50	2.50	48	59	94	48	48
4.00	193.00	9.50	3.00	3.00	46	51	82	46	46
4.50	192.50	10.00	1.50	1.50	59	95	152	59	59
4.50	192.50	10.00	2.00	2.00	53	77	123	53	53
4.50	192.50	10.00	2.50	2.50	50	65	104	50	50
4.50	192.50	10.00	3.00	3.00	48	57	91	48	48

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.00m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 17.1 (For IBH-33 (AHP MCC-1 cum control room AHP compressor bldg))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	3.50	9.00	193.50	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.48	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	54
2	2.00	2.00	3.50	9.00	193.50	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.36	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	49
3	2.50	2.50	3.50	9.00	193.50	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.29	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	47
4	3.00	3.00	3.50	9.00	193.50	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.24	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	45
5	1.50	1.50	4.00	9.50	193.00	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.55	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	56
6	2.00	2.00	4.00	9.50	193.00	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.41	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	51
7	2.50	2.50	4.00	9.50	193.00	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.33	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	48
8	3.00	3.00	4.00	9.50	193.00	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.27	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	46
9	1.50	1.50	4.50	10.00	192.50	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.61	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	59
10	2.00	2.00	4.50	10.00	192.50	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.46	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	53
11	2.50	2.50	4.50	10.00	192.50	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.37	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	50
12	3.00	3.00	4.50	10.00	192.50	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.31	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	48

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.00m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 17.2 (For IBH-33 (AHP MCC-1 cum control room AHP compressor bldg))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	3.50	193.50	9.00	1.50	1.50	0.40	828	1.12	0.80	0.0055	2.00	0.70	0.73	0.80	84	134
2	3.50	193.50	9.00	2.00	2.00	0.40	828	1.12	0.80	0.0055	2.00	0.70	0.73	0.80	66	105
3	3.50	193.50	9.00	2.50	2.50	0.40	828	1.12	0.80	0.0055	2.00	0.70	0.73	0.80	55	88
4	3.50	193.50	9.00	3.00	3.00	0.40	828	1.12	0.80	0.0055	2.00	0.70	0.73	0.80	48	76
5	4.00	193.00	9.50	1.50	1.50	0.40	828	1.12	0.80	0.0055	1.50	0.70	0.73	0.80	87	140
6	4.00	193.00	9.50	2.00	2.00	0.40	828	1.12	0.80	0.0055	1.50	0.70	0.73	0.80	69	111
7	4.00	193.00	9.50	2.50	2.50	0.40	828	1.12	0.80	0.0055	1.50	0.70	0.73	0.80	59	94
8	4.00	193.00	9.50	3.00	3.00	0.40	828	1.12	0.80	0.0055	1.50	0.70	0.73	0.80	51	82
9	4.50	192.50	10.00	1.50	1.50	0.40	828	1.12	0.80	0.0055	1.00	0.70	0.73	0.80	95	152
10	4.50	192.50	10.00	2.00	2.00	0.40	828	1.12	0.80	0.0055	1.00	0.70	0.73	0.80	77	123
11	4.50	192.50	10.00	2.50	2.50	0.40	828	1.12	0.80	0.0055	1.00	0.70	0.73	0.80	65	104
12	4.50	192.50	10.00	3.00	3.00	0.40	828	1.12	0.80	0.0055	1.00	0.70	0.73	0.80	57	91

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 17.3 (For IBH-33 (AHP MCC-1 cum control room AHP compressor bldg))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:197.00m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 17.4) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 17.5)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
3.50	193.50	9.00	3.50	3.50	44	42	68	42	44
3.50	193.50	9.00	4.00	4.00	43	38	61	38	43
3.50	193.50	9.00	5.00	5.00	42	32	51	32	42
3.50	193.50	9.00	6.00	6.00	41	27	44	27	41
4.00	193.00	9.50	3.50	3.50	45	46	73	45	45
4.00	193.00	9.50	4.00	4.00	44	41	66	41	44
4.00	193.00	9.50	5.00	5.00	42	35	56	35	42
4.00	193.00	9.50	6.00	6.00	41	30	48	30	41
4.50	192.50	10.00	3.50	3.50	46	51	82	46	46
4.50	192.50	10.00	4.00	4.00	45	46	74	45	45
4.50	192.50	10.00	5.00	5.00	43	39	62	39	43
4.50	192.50	10.00	6.00	6.00	42	33	53	33	42

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.00m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 17.4 (For IBH-33 (AHP MCC-1 cum control room AHP compressor bldg))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5 γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	3.50	9.00	193.50	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.20	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	44
2	4.00	4.00	3.50	9.00	193.50	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.18	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	43
3	5.00	5.00	3.50	9.00	193.50	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.14	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	42
4	6.00	6.00	3.50	9.00	193.50	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	41
5	3.50	3.50	4.00	9.50	193.00	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.23	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	45
6	4.00	4.00	4.00	9.50	193.00	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.20	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	44
7	5.00	5.00	4.00	9.50	193.00	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.16	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	42
8	6.00	6.00	4.00	9.50	193.00	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.14	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	41
9	3.50	3.50	4.50	10.00	192.50	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.26	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	46
10	4.00	4.00	4.50	10.00	192.50	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.23	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	45
11	5.00	5.00	4.50	10.00	192.50	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.18	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	43
12	6.00	6.00	4.50	10.00	192.50	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.15	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	42

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.00m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 17.5 (For IBH-33 (AHP MCC-1 cum control room AHP compressor bldg))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	3.50	193.50	9.00	3.50	3.50	0.40	828	1.12	0.80	0.0055	2.00	0.70	0.73	0.80	42	68
2	3.50	193.50	9.00	4.00	4.00	0.40	828	1.12	0.80	0.0055	2.00	0.70	0.75	0.80	38	61
3	3.50	193.50	9.00	5.00	5.00	0.40	828	1.12	0.80	0.0055	2.00	0.70	0.79	0.80	32	51
4	3.50	193.50	9.00	6.00	6.00	0.40	828	1.12	0.80	0.0055	2.00	0.70	0.82	0.80	27	44
5	4.00	193.00	9.50	3.50	3.50	0.40	828	1.12	0.80	0.0055	1.50	0.70	0.73	0.80	46	73
6	4.00	193.00	9.50	4.00	4.00	0.40	828	1.12	0.80	0.0055	1.50	0.70	0.73	0.80	41	66
7	4.00	193.00	9.50	5.00	5.00	0.40	828	1.12	0.80	0.0055	1.50	0.70	0.76	0.80	35	56
8	4.00	193.00	9.50	6.00	6.00	0.40	828	1.12	0.80	0.0055	1.50	0.70	0.80	0.80	30	48
9	4.50	192.50	10.00	3.50	3.50	0.40	828	1.12	0.80	0.0055	1.00	0.70	0.73	0.80	51	82
10	4.50	192.50	10.00	4.00	4.00	0.40	828	1.12	0.80	0.0055	1.00	0.70	0.73	0.80	46	74
11	4.50	192.50	10.00	5.00	5.00	0.40	828	1.12	0.80	0.0055	1.00	0.70	0.74	0.80	39	62
12	4.50	192.50	10.00	6.00	6.00	0.40	828	1.12	0.80	0.0055	1.00	0.70	0.77	0.80	33	53

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 17.6 (For IBH-33 (AHP MCC-1 cum control room AHP compressor bldg))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:197.00m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 17.7) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 17.8)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
3.50	193.50	9.00	7.00	7.00	40	24	39	24	39
3.50	193.50	9.00	8.00	8.00	40	22	35	22	35
3.50	193.50	9.00	9.00	9.00	39	20	32	20	32
3.50	193.50	9.00	10.00	10.00	39	18	29	18	29
4.00	193.00	9.50	7.00	7.00	41	26	42	26	41
4.00	193.00	9.50	8.00	8.00	40	24	38	24	38
4.00	193.00	9.50	9.00	9.00	40	22	34	22	34
4.00	193.00	9.50	10.00	10.00	40	20	32	20	32
4.50	192.50	10.00	7.00	7.00	41	29	47	29	41
4.50	192.50	10.00	8.00	8.00	41	26	42	26	41
4.50	192.50	10.00	9.00	9.00	40	24	38	24	38
4.50	192.50	10.00	10.00	10.00	40	22	35	22	35

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.00m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 17.7 (For IBH-33 (AHP MCC-1 cum control room AHP compressor bldg))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	3.50	9.00	193.50	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	40
2	8.00	8.00	3.50	9.00	193.50	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	40
3	9.00	9.00	3.50	9.00	193.50	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	39
4	10.00	10.00	3.50	9.00	193.50	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	39
5	7.00	7.00	4.00	9.50	193.00	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	41
6	8.00	8.00	4.00	9.50	193.00	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	40
7	9.00	9.00	4.00	9.50	193.00	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	40
8	10.00	10.00	4.00	9.50	193.00	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	40
9	7.00	7.00	4.50	10.00	192.50	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	41
10	8.00	8.00	4.50	10.00	192.50	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	41
11	9.00	9.00	4.50	10.00	192.50	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	40
12	10.00	10.00	4.50	10.00	192.50	1.84	2	5.62	0.19	0.15	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	40

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.00m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 17.8 (For IBH-33 (AHP MCC-1 cum control room AHP compressor bldg))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	3.50	193.50	9.00	7.00	7.00	0.40	828	1.12	0.80	0.0055	2.00	0.70	0.85	0.80	24	39
2	3.50	193.50	9.00	8.00	8.00	0.40	828	1.12	0.80	0.0055	2.00	0.70	0.87	0.80	22	35
3	3.50	193.50	9.00	9.00	9.00	0.40	828	1.12	0.80	0.0055	2.00	0.70	0.89	0.80	20	32
4	3.50	193.50	9.00	10.00	10.00	0.40	828	1.12	0.80	0.0055	2.00	0.70	0.90	0.80	18	29
5	4.00	193.00	9.50	7.00	7.00	0.40	828	1.12	0.80	0.0055	1.50	0.70	0.83	0.80	26	42
6	4.00	193.00	9.50	8.00	8.00	0.40	828	1.12	0.80	0.0055	1.50	0.70	0.85	0.80	24	38
7	4.00	193.00	9.50	9.00	9.00	0.40	828	1.12	0.80	0.0055	1.50	0.70	0.87	0.80	22	34
8	4.00	193.00	9.50	10.00	10.00	0.40	828	1.12	0.80	0.0055	1.50	0.70	0.88	0.80	20	32
9	4.50	192.50	10.00	7.00	7.00	0.40	828	1.12	0.80	0.0055	1.00	0.70	0.80	0.80	29	47
10	4.50	192.50	10.00	8.00	8.00	0.40	828	1.12	0.80	0.0055	1.00	0.70	0.83	0.80	26	42
11	4.50	192.50	10.00	9.00	9.00	0.40	828	1.12	0.80	0.0055	1.00	0.70	0.85	0.80	24	38
12	4.50	192.50	10.00	10.00	10.00	0.40	828	1.12	0.80	0.0055	1.00	0.70	0.87	0.80	22	35

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 17.9 (For IBH-33 (AHP MCC-1 cum control room AHP compressor bldg))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:197.00m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	196.00	6.50	1.50	1.50	16	30	47	16	16
1.00	196.00	6.50	2.00	2.00	16	21	34	16	16
1.00	196.00	6.50	2.50	2.50	15	17	27	15	15
1.00	196.00	6.50	3.00	3.00	15	14	22	14	15
2.00	195.00	7.50	1.50	1.50	18	31	50	18	18
2.00	195.00	7.50	2.00	2.00	17	23	37	17	17
2.00	195.00	7.50	2.50	2.50	17	19	30	17	17
2.00	195.00	7.50	3.00	3.00	16	15	25	15	16
3.00	194.00	8.50	1.50	1.50	20	31	50	20	20
3.00	194.00	8.50	2.00	2.00	19	24	38	19	19
3.00	194.00	8.50	2.50	2.50	18	20	32	18	18
3.00	194.00	8.50	3.00	3.00	17	17	27	17	17

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.00m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-17.10 (For IBH-33 (AHP MCC-1 cum control room AHP compressor bldg))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	1.00	6.50	196.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	16
2	2.00	2.00	1.00	6.50	196.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	16
3	2.50	2.50	1.00	6.50	196.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	15
4	3.00	3.00	1.00	6.50	196.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	15
5	1.50	1.50	2.00	7.50	195.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.27	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	18
6	2.00	2.00	2.00	7.50	195.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.20	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	17
7	2.50	2.50	2.00	7.50	195.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.16	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	17
8	3.00	3.00	2.00	7.50	195.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	16
9	1.50	1.50	3.00	8.50	194.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.40	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	20
10	2.00	2.00	3.00	8.50	194.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.30	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	19
11	2.50	2.50	3.00	8.50	194.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.24	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	18
12	3.00	3.00	3.00	8.50	194.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.20	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	17

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.00m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-17.11 (For IBH-33 (AHP MCC-1 cum control room AHP compressor bldg))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	1.00	196.00	6.50	1.50	1.50	0.40	311	1.12	0.80	0.0144	3.00	0.70	0.80	0.80	30	47
2	1.00	196.00	6.50	2.00	2.00	0.40	311	1.12	0.80	0.0144	4.00	0.70	0.85	0.80	21	34
3	1.00	196.00	6.50	2.50	2.50	0.40	311	1.12	0.80	0.0144	4.50	0.70	0.88	0.80	17	27
4	1.00	196.00	6.50	3.00	3.00	0.40	311	1.12	0.80	0.0144	4.50	0.70	0.91	0.80	14	22
5	2.00	195.00	7.50	1.50	1.50	0.40	311	1.12	0.80	0.0144	3.00	0.70	0.73	0.80	31	50
6	2.00	195.00	7.50	2.00	2.00	0.40	311	1.12	0.80	0.0144	3.50	0.70	0.73	0.80	23	37
7	2.00	195.00	7.50	2.50	2.50	0.40	311	1.12	0.80	0.0144	3.50	0.70	0.76	0.80	19	30
8	2.00	195.00	7.50	3.00	3.00	0.40	311	1.12	0.80	0.0144	3.50	0.70	0.80	0.80	15	25
9	3.00	194.00	8.50	1.50	1.50	0.40	311	1.12	0.80	0.0144	2.50	0.70	0.73	0.80	31	50
10	3.00	194.00	8.50	2.00	2.00	0.40	311	1.12	0.80	0.0144	2.50	0.70	0.73	0.80	24	38
11	3.00	194.00	8.50	2.50	2.50	0.40	311	1.12	0.80	0.0144	2.50	0.70	0.73	0.80	20	32
12	3.00	194.00	8.50	3.00	3.00	0.40	311	1.12	0.80	0.0144	2.50	0.70	0.73	0.80	17	27

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 17.12 (For IBH-33 (AHP MCC-1 cum control room AHP compressor bldg))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:197.00m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	196.00	6.50	3.50	3.50	15	12	19	12	15
1.00	196.00	6.50	4.00	4.00	15	11	17	11	15
1.00	196.00	6.50	5.00	5.00	15	9	14	9	14
1.00	196.00	6.50	6.00	6.00	15	8	12	8	12
2.00	195.00	7.50	3.50	3.50	16	13	21	13	16
2.00	195.00	7.50	4.00	4.00	16	12	19	12	16
2.00	195.00	7.50	5.00	5.00	15	10	16	10	15
2.00	195.00	7.50	6.00	6.00	15	8	13	8	13
3.00	194.00	8.50	3.50	3.50	17	15	24	15	17
3.00	194.00	8.50	4.00	4.00	16	13	21	13	16
3.00	194.00	8.50	5.00	5.00	16	11	18	11	16
3.00	194.00	8.50	6.00	6.00	16	10	15	10	15

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.00m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-17.13 (For IBH-33 (AHP MCC-1 cum control room AHP compressor bldg))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5 γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	1.00	6.50	196.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	15
2	4.00	4.00	1.00	6.50	196.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	15
3	5.00	5.00	1.00	6.50	196.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	15
4	6.00	6.00	1.00	6.50	196.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	15
5	3.50	3.50	2.00	7.50	195.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.11	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	16
6	4.00	4.00	2.00	7.50	195.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	16
7	5.00	5.00	2.00	7.50	195.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	15
8	6.00	6.00	2.00	7.50	195.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	15
9	3.50	3.50	3.00	8.50	194.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.17	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	17
10	4.00	4.00	3.00	8.50	194.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.15	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	16
11	5.00	5.00	3.00	8.50	194.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	16
12	6.00	6.00	3.00	8.50	194.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	16

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.00m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-17.14 (For IBH-33 (AHP MCC-1 cum control room AHP compressor bldg))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	1.00	196.00	6.50	3.50	3.50	0.40	311	1.12	0.80	0.0144	4.50	0.70	0.92	0.80	12	19
2	1.00	196.00	6.50	4.00	4.00	0.40	311	1.12	0.80	0.0144	4.50	0.70	0.93	0.80	11	17
3	1.00	196.00	6.50	5.00	5.00	0.40	311	1.12	0.80	0.0144	4.50	0.70	0.95	0.80	9	14
4	1.00	196.00	6.50	6.00	6.00	0.40	311	1.12	0.80	0.0144	4.50	0.70	0.96	0.80	8	12
5	2.00	195.00	7.50	3.50	3.50	0.40	311	1.12	0.80	0.0144	3.50	0.70	0.83	0.80	13	21
6	2.00	195.00	7.50	4.00	4.00	0.40	311	1.12	0.80	0.0144	3.50	0.70	0.85	0.80	12	19
7	2.00	195.00	7.50	5.00	5.00	0.40	311	1.12	0.80	0.0144	3.50	0.70	0.88	0.80	10	16
8	2.00	195.00	7.50	6.00	6.00	0.40	311	1.12	0.80	0.0144	3.50	0.70	0.91	0.80	8	13
9	3.00	194.00	8.50	3.50	3.50	0.40	311	1.12	0.80	0.0144	2.50	0.70	0.75	0.80	15	24
10	3.00	194.00	8.50	4.00	4.00	0.40	311	1.12	0.80	0.0144	2.50	0.70	0.77	0.80	13	21
11	3.00	194.00	8.50	5.00	5.00	0.40	311	1.12	0.80	0.0144	2.50	0.70	0.82	0.80	11	18
12	3.00	194.00	8.50	6.00	6.00	0.40	311	1.12	0.80	0.0144	2.50	0.70	0.85	0.80	10	15

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APPENDIX - 17.15 (For IBH-33 (AHP MCC-1 cum control room AHP compressor bldg))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:197.00m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	196.00	6.50	7.00	7.00	15	7	11	7	11
1.00	196.00	6.50	8.00	8.00	15	6	10	6	10
1.00	196.00	6.50	9.00	9.00	15	6	9	6	9
1.00	196.00	6.50	10.00	10.00	15	5	8	5	8
2.00	195.00	7.50	7.00	7.00	15	7	12	7	12
2.00	195.00	7.50	8.00	8.00	15	7	11	7	11
2.00	195.00	7.50	9.00	9.00	15	6	10	6	10
2.00	195.00	7.50	10.00	10.00	15	6	9	6	9
3.00	194.00	8.50	7.00	7.00	16	8	13	8	13
3.00	194.00	8.50	8.00	8.00	15	8	12	8	12
3.00	194.00	8.50	9.00	9.00	15	7	11	7	11
3.00	194.00	8.50	10.00	10.00	15	6	10	6	10

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.00m.
- 3) Calculations are considering the effect of water table at FGL.

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APPENDIX-17.16 (For IBH-33 (AHP MCC-1 cum control room AHP compressor bldg))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5 γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	1.00	6.50	196.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	15
2	8.00	8.00	1.00	6.50	196.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	15
3	9.00	9.00	1.00	6.50	196.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.02	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	15
4	10.00	10.00	1.00	6.50	196.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.02	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	15
5	7.00	7.00	2.00	7.50	195.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	15
6	8.00	8.00	2.00	7.50	195.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	15
7	9.00	9.00	2.00	7.50	195.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	15
8	10.00	10.00	2.00	7.50	195.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	15
9	7.00	7.00	3.00	8.50	194.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	16
10	8.00	8.00	3.00	8.50	194.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	15
11	9.00	9.00	3.00	8.50	194.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	15
12	10.00	10.00	3.00	8.50	194.00	0.80	0	5.14	0.00	0.00	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	15

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.00m.
- 3) Calculations are considering the effect of water table at FGL.

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APPENDIX-17.17 (For IBH-33 (AHP MCC-1 cum control room AHP compressor bldg))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	1.00	196.00	6.50	7.00	7.00	0.40	311	1.12	0.80	0.0144	4.50	0.70	0.97	0.80	7	11
2	1.00	196.00	6.50	8.00	8.00	0.40	311	1.12	0.80	0.0144	4.50	0.70	0.97	0.80	6	10
3	1.00	196.00	6.50	9.00	9.00	0.40	311	1.12	0.80	0.0144	4.50	0.70	0.97	0.80	6	9
4	1.00	196.00	6.50	10.00	10.00	0.40	311	1.12	0.80	0.0144	4.50	0.70	0.98	0.80	5	8
5	2.00	195.00	7.50	7.00	7.00	0.40	311	1.12	0.80	0.0144	3.50	0.70	0.92	0.80	7	12
6	2.00	195.00	7.50	8.00	8.00	0.40	311	1.12	0.80	0.0144	3.50	0.70	0.93	0.80	7	11
7	2.00	195.00	7.50	9.00	9.00	0.40	311	1.12	0.80	0.0144	3.50	0.70	0.94	0.80	6	10
8	2.00	195.00	7.50	10.00	10.00	0.40	311	1.12	0.80	0.0144	3.50	0.70	0.95	0.80	6	9
9	3.00	194.00	8.50	7.00	7.00	0.40	311	1.12	0.80	0.0144	2.50	0.70	0.87	0.80	8	13
10	3.00	194.00	8.50	8.00	8.00	0.40	311	1.12	0.80	0.0144	2.50	0.70	0.89	0.80	8	12
11	3.00	194.00	8.50	9.00	9.00	0.40	311	1.12	0.80	0.0144	2.50	0.70	0.91	0.80	7	11
12	3.00	194.00	8.50	10.00	10.00	0.40	311	1.12	0.80	0.0144	2.50	0.70	0.92	0.80	6	10

Appendix – 17A
Calculation of Safe Load carrying capacity of piles socketed inside rock
(Near IBH 33)
(AHP MCC-1 cum control room AHP compressor BLDG)

Project Name: - Proposed structures of thermal power project of NTTTP at Hirma, Talabira

1.0 Introduction

In situations where overburden offering low bearing pressure is followed by rock at relatively shallower depths, end bearing piles is the suitable foundation option. Piles in rocks and weathered rocks of varying degree of weathering derive their capacity by end bearing and socket side resistance.

In situations, where, rock strata comprises of highly fragmented rock, as in present case, where RQD is nil or $(CR+RQD)/2$ is less than 30 % or when the crushing strength is less than 10 MPa, the appropriate approach would be of that suggested by Cole & Stroud.

In present site overburden soils overlay fractured / laminated / foliated rock. The founding stratum having highly fragmented rock with nil RQD and $(CR+RQD)/2$ to be less than 30 %, the approach suggested by Cole and Stroud as per Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 Pa/S2 has been used for safe load calculations.

An illustrative calculation of safe load on pile and summary of pile capacities is as follows,

2.0 Sub soil strata Characterization

General stratification at the location of boreholes IBH 33 show primarily two characterized layers,

1. Overburden comprising of Yellowish brown, fine to very fine grained, sandy clays of low, intermediate and high plasticity upto 5.10m (i.e. RL 191.90m) followed by Highly weathered, completely fractured and disintegrated, yellowish brown, very fine grained, mud rock upto 7.50m (i.e. RL 189.50m).
2. Second characterized layer below the overburden soils comprises of highly weathered, very weak, light brownish yellow, fine to medium grained, thinly laminated rock upto 13.50m (i.e. RL 183.50m).

3.0 Design Considerations

1. Length of socket considered 3D from depth of rock encountered.
2. The pile is considered to have socket length below 7.50 m below NGL (i.e. RL 189.50 m) depth.
3. For present case of pile terminating in highly weathered rock. SPT at depths between 7.50 to 13.50m (between RL 189.50 to 183.50 m) is > 200.
Based on recommendation of fig no. 3 in B 8 in Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 P1/S2, average shear strength q_c corresponding to assumed SPT of 200 may be taken as 1300 kN/m²
4. Allowable Capacity of pile socketed into rock $Q_a = R_e + R_{sf} = C_{u1} N_c \pi B^2 / 4 (F_s = 3) + \alpha C_{u2} \pi BL / (F_s = 6)$

4.0 Safe Load on Pile in Compression

Where,

End bearing component, $R_e = C_{u1} N_c \pi B^2 / 4 F_s$,

C_{u1} = Shear strength below base of pile = 1300 kN/m²

B = diameter of the pile = d

F_s = Factor of Safety = 3

$N_c = 9$

Therefore, **$R_e = 3061.5 d^2$**

Skin friction component of socketed length of pile, $R_{sf} = \alpha C_{u2} \pi BL / F_s$

$\alpha = 0.9$ (recommended value in IS 2911 P1/S2)

L = length of the socket = $3 D$

C_{u2} = Ultimate shear strength along socket length which shall be restricted to shear capacity of concrete of the pile = 1300 kN/m^2

F_s = Factor of Safety = 6

Therefore, $R_{sf} = 1836.9 d^2$

Thus,

$$Q_a = c_{u1} N_c \cdot \frac{\pi B^2}{4 F_s} + \alpha c_{u2} \cdot \frac{\pi B L}{F_s}$$

$$= 3061.5 d^2 + 1836.9 d^2 = 4898.4 d^2$$

Substituting the values of various diameters and socket lengths equal to 3 times diameter, allowable load on single pile can be summarized as follows,

Summary of the Safe load calculation in Compression

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	14.80	15.28	15.70
Termination level RL in m	187.70	187.22	186.80
End Bearing Component in kN	1102.1	1768.3	2479.8
Friction Component in kN	661.3	1060.9	1487.9
Safe load in Compression in kN	1763.4	2829.3	3967.7
Safe load in Compression in T	176	283	397

5.0 Safe Load on Pile in uplift

For 6.00m cutoff from FGL

The overburden soils, though, will not contribute in compression capacity would offer resistance in uplift capacity. The parameters of IBH 33 are considered for calculation of uplift resistance as summarized below,

Depth in m from RL 202.5 m	Cohesion in kg/cm ²	Angle of Internal Friction ϕ	Submerged density in gm/cc γ_{sub}	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 6.00	Pile cutoff level – No pile						
6.00 to 10.60	1.22	6(ignored)	0.99	0.37	NA	NA	12-61
10.60 to 25.00	Rock strata – Resistance would be as per skin friction capacity in socket as already calculated in compression capacity						

Ultimate load in skin friction,

$$Q_{uf} = \alpha_i C_{ai} A_{si} + K_i P D_i \tan \delta_i A_{si}$$

First Layer – No contribution considered – (Within Cutoff Level).

$$\text{Second Layer} - \alpha_2 C_{a2} A_{s2} = 0.37 * 12.20 * \pi d * 4.60 = 65.23d$$

Third Layer – $1836.90 d^2$ in rock socket

$$\text{Substituting, ultimate load } q_{uf} = 652.30 d + 1836.9 d^2$$

The safe load in uplift is worked out (considering the safety factor of 2.50 for overburden soils) and summarized below,

Safe Load on Piles in Uplift (in Ton)

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	14.8	15.28	15.70
Termination level RL in m	187.70	187.22	186.80
Safe load in Uplift in kN	817.84	1259.29	1722.72
Self-weight of pile in kN	37.30	63.12	92.52
Safe load in Uplift in T (Considering self-weight of pile)	85.51	132.24	181.52

6.0 Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60	0.76	0.90
Subgrade reaction in MN/m ³		17.28	17.28	17.28
Stiffness factor T in m		1.59	1.93	2.20
Depth of fixity in m	Free Head	3.00	3.70	4.20
	Fixed Head	3.50	4.20	4.80
Allowable Horizontal Force in T	Free Head	9.60	14.00	18.40
	Fixed Head	25.40	37.10	48.60
Allowable Moment capacity in Tm	Free Head	10.17	17.93	26.91
	Fixed Head	36.20	63.83	95.78

7.0 Notes

1. Pile shall be terminated after socketing 3D inside rock.
2. Initial and routine pile load test is required to verify the actual carrying capacity of pile in compression, uplift and lateral loads.
3. For design and construction, specification of IS: 2911, P1/S2, IS: 456, 2000 shall strictly be followed.

(Dr. K. K. Thaker)

Appendix – 18A

Calculation of Safe Load carrying capacity of piles socketed inside rock (Near IBH 34,35,36) (Slurry PH cum AHP MCCs pipe rack in BTG area)

Project Name: - Proposed structures of thermal power project of NTTTP at Hirma, Talabira

1.0 Introduction

In situations where overburden offering low bearing pressure is followed by rock at relatively shallower depths, end bearing piles is the suitable foundation option. Piles in rocks and weathered rocks of varying degree of weathering derive their capacity by end bearing and socket side resistance.

In situations, where, rock strata comprises of highly fragmented rock, as in present case, where RQD is nil or $(CR+RQD)/2$ is less than 30 % or when the crushing strength is less than 10 MPa, the appropriate approach would be of that suggested by Cole & Stroud.

In present site overburden soils overlay fractured / laminated / foliated rock. The founding stratum having highly fragmented rock with nil RQD and $(CR+RQD)/2$ to be less than 30 %, the approach suggested by Cole and Stroud as per Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 Pa/S2 has been used for safe load calculations.

An illustrative calculation of safe load on pile and summary of pile capacities is as follows,

2.0 Sub soil strata Characterization

General stratification at the location of boreholes IBH 35 show primarily two characterized layers,

1. Overburden comprising of fine to medium grained, sandy clays of intermediate plasticity with occasional gravels and fine to very fine grained, clayey and silty sand upto 12.80m (i.e. RL 185.98m).
2. Second characterized layer below the overburden soils comprises of Highly weathered, very weak, thinly laminated friable dark brownish, fine to very fine grained, mud stone followed by Highly weathered, weak, dark brownish grey, fine to very fine grained, fractured rock upto 16.00m (i.e. RL 182.78m).

3.0 Design Considerations

1. Length of socket considered 3D from depth of rock encountered.
2. The pile is considered to have socket length below 12.80 m below NGL (i.e. RL 185.98 m) depth.
3. For present case of pile terminating in highly weathered rock. SPT at depths between 12.80 to 16.00m (between RL 185.98 to 182.78 m) is > 200 .
Based on recommendation of fig no. 3 in B 8 in Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 P1/S2, average shear strength q_c corresponding to assumed SPT of 200 may be taken as 1300 kN/m^2
4. Allowable Capacity of pile socketed into rock $Q_a = R_e + R_{sf} = C_{u1} N_c \pi B^2 / 4 (F_s = 3) + \alpha C_{u2} \pi BL / (F_s = 6)$

4.0 Safe Load on Pile in Compression

Where,

End bearing component, $R_e = C_{u1} N_c \pi B^2 / 4 F_s$,

C_{u1} = Shear strength below base of pile = 1300 kN/m^2

B = diameter of the pile = d

F_s = Factor of Safety = 3

$N_c = 9$

Therefore, **$R_e = 3061.5 d^2$**

Skin friction component of socketed length of pile, $R_{sf} = \alpha C_{u2} \pi BL / F_s$

$\alpha = 0.9$ (recommended value in IS 2911 P1/S2)

L = length of the socket = $3 D$

C_{u2} = Ultimate shear strength along socket length which shall be restricted to shear capacity of concrete of the pile = 1300 kN/m^2

F_s = Factor of Safety = 6

Therefore, $R_{sf} = 1836.9 d^2$

Thus,

$$Q_a = c_{u1} N_c \cdot \frac{\pi B^2}{4 F_s} + \alpha c_{u2} \cdot \frac{\pi B L}{F_s}$$

$$= 3061.5 d^2 + 1836.9 d^2 = 4898.4 d^2$$

Substituting the values of various diameters and socket lengths equal to 3 times diameter, allowable load on single pile can be summarized as follows,

Summary of the Safe load calculation in Compression

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	18.32	18.80	19.22
Termination level RL in m	184.18	183.70	183.28
End Bearing Component in kN	1102.1	1768.3	2479.8
Friction Component in kN	661.3	1060.9	1487.9
Safe load in Compression in kN	1763.4	2829.3	3967.7
Safe load in Compression in T	176	283	397

5.0 Safe Load on Pile in uplift

For 4.00m cutoff from FGL

The overburden soils, though, will not contribute in compression capacity would offer resistance in uplift capacity. The parameters of IBH 35 are considered for calculation of uplift resistance as summarized below,

Depth in m from RL 202.5 m	Cohesion in kg/cm^2	Angle of Internal Friction ϕ	Submerged density in $\text{gm/cc } \gamma_{\text{sub}}$	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 4.00	Pile cutoff level – No pile						
4.00 to 10.42	0.68	7(ignored)	0.98	0.65	NA	NA	5-30
10.42 to 15.92	0.09	27	0.99	NA	1.00	27	13-23
15.92 to 16.52	3.64	0	0.99	0.28	NA	NA	91
16.52 to 27.22	Rock strata – Resistance would be as per skin friction capacity in socket as already calculated in compression capacity						

Ultimate load in skin friction,

$$Q_{uf} = \alpha_i C_{ai} A_{si} + K_i P D_i \tan \delta_i A_{si}$$

First Layer – No contribution considered – (Within Cutoff Level).

Second Layer – $\alpha_2 C_{a2} A_{s2} = 0.65 * 6.80 * \pi d * 6.42 = 89.15d$

Third Layer – $K_3 P D_3 \tan \delta_3 A_{s3} = 1.00 * 10.46 * \tan 27 * \pi d * 4.58 = 76.69 d$

Fourth Layer – $\alpha_4 C_{a4} A_{s4} = 0.28 * 36.40 * \pi d * 0.60 = 19.21d$

Fifth Layer – $1836.90 d^2$ in rock socket

Substituting, ultimate load **q_{uf} = 1850.50 d + 1836.9 d²**

The safe load in uplift is worked out (considering the safety factor of 2.50 for overburden soils) and summarized below,

Safe Load on Piles in Uplift (in Ton)

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	18.32	18.80	19.22
Termination level RL in m	184.18	183.70	183.28
Safe load in Uplift in kN	1105.40	1623.55	2154.07
Self-weight of pile in kN	60.70	100.66	145.16
Safe load in Uplift in T (Considering self-weight of pile)	116.61	172.42	229.92

6.0 Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60	0.76	0.90
Subgrade reaction in MN/m^3		7.20	7.20	7.20
Stiffness factor T in m		1.90	2.29	2.63
Depth of fixity in m	Free Head	3.60	4.40	5.00
	Fixed Head	4.10	5.00	5.70
Allowable Horizontal Force in T	Free Head	5.70	8.30	10.90
	Fixed Head	15.00	21.90	28.80
Allowable Moment capacity in Tm	Free Head	7.16	12.64	18.96
	Fixed Head	25.50	44.97	67.48

7.0 Notes

1. Pile shall be terminated after socketing 3D inside rock.
2. Initial and routine pile load test is required to verify the actual carrying capacity of pile in compression, uplift and lateral loads.
3. For design and construction, specification of IS: 2911, P1/S2, IS: 456, 2000 shall strictly be followed.

(Dr. K. K. Thaker)

Appendix – 18B

Calculation of Safe Load on Uniform Diameter Bored Cast in situ Pile. (Near IBH 34,35,36) (Slurry PH cum AHP MCCs pipe rack in BTG area)

The safe load is calculated as follows,

1) Design Stipulations

- | | |
|---|---|
| 1. Type of pile | - Bored cast in situ uniform diameter pile. |
| 2. Pile diameter considered | - 0.60m |
| 3. Termination depth of pile considered | - 15.00m from FGL. |
| 4. Cut off Level | - 4.00m from FGL. |
| 5. Factor of Safety | - 2.50 |
| 6. Depth of Water table | - Considered at FGL. |
| 7. Ref | - IS 2911 P-I, Sec-II, 2021. |

2) Test Data

The parameters are based on IBH 35. For evaluation of safe load on piles following characterized layers are considered as described in table below,

Depth in m from RL 202.5 m	Cohesion in kg/cm ²	Angle of Internal Friction ϕ	Submerged density in gm/cc γ_{sub}	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 4.00	Pile cutoff level – No pile						
4.00 to 10.42	0.68 [#]	7 [#] (ignored)	0.98 [#]	0.65	NA	NA	5-30
10.42 to 15.92	0.09 ^{\$}	27 ^{\$}	0.99	NA	1.00	27	13-23
15.92 to 16.52	3.64 ^{\$}	0	0.99	0.28	NA	NA	91
16.52 to 27.22	0	34 ^{\$}	0.99	NA	1.50	34	>100

Notes: - Layers are characterized based on classification and the state of soil in that stratum.

* - In cohesive soils the contribution of the angle of internal friction being insignificant is ignored.

Shear parameters are the most representative for the layer. NA means not applicable. Characterized N values are considered for each layer.

- Weighted Average of the parameters falling in the same layer has been considered

\$-Parameters are correlated based on SPT value N.

3) Ultimate Load in Compression

3.1) Ultimate load in Compression by Bearing

Ultimate load on pile in end bearing,

$$q_{ub} = A_p (0.5 \cdot D \cdot \gamma \cdot N_v + PDN_q)$$

$$A_p = \text{Cross section area of Pile stem at toe} = \pi d^2/4$$

$$D = \text{Diameter of pile} = d \text{ in m}$$

$$N_v = 42.90$$

$$N_q = 40.00$$

$$q_{ub} = 0.785d^2 (0.5 \cdot d \cdot 0.99 \cdot 42.90 + 8.85 \cdot 40.00) = 16.67d^3 + 277.89d^2$$

(For Pile terminating at 15.00m from F.G.L.)

Note: As the pile terminating just above rock level, we have considered parameter for end bearing component based on rock strata.

3.2) Ultimate Load in Compression by Skin Friction

Ultimate load in skin friction,

$$q_{uf} = \alpha_i C_{ai} + K_i P D_i \tan \delta_i A_{si}$$

First Layer – No contribution considered – (Within Cutoff Level).

$$\text{Second Layer} - \alpha_2 C_{a2} A_{s2} = 0.65 \cdot 6.80 \cdot \pi \cdot d \cdot 6.42 = 89.15d$$

$$\text{Third Layer} - K_3 PD_3 \tan \delta_3 A_{s3} = 1.00 \cdot 8.56 \cdot \tan 27^\circ \cdot \pi \cdot d \cdot (\ell - 10.42) = 13.70 d (\ell - 10.42)$$

Substituting, ultimate load

$$q_{uf} = 89.15d + 13.70d (\ell - 10.42) \text{ (For Pile terminating at 15.00m from F.G.L.)}$$

Where, ℓ is the pile length and d is diameter of piles, substituting

Ultimate load by both bearing and friction can be as follows for various lengths of piles,
 $q_{uc} = q_{ub} + q_{uf}$

$$q_{uc} = 16.67d^3 + 277.89d^2 + 89.15d + 13.70d (\ell - 10.42)$$

(For Pile terminating at 15.00m from F.G.L.).

By substituting various diameters of piles having various lengths, the safe load is worked out considering the safety factor of 2.50 and are given in table below,

Safe Load on Piles in Compression (in Ton)

Termination Depth of Pile in m, from FGL	Termination Depth of Pile in m, from cut-off	Diameter of Pile in, m
		0.60
15.00	11.00	77.74

3.3) Ultimate Load in Uplift

Considering skin friction for determination of uplift

Safe Load on Piles in Uplift (in Ton)

Termination Depth of Pile in m, from FGL	Termination Depth of Pile in m, from cut-off	Diameter of Pile in, m
		0.60
15.00	11.00	34.92

Note: Self weight of pile is considered in calculation of ultimate load in uplift.

Self weight of Pile (in Ton)

Termination Depth of Pile in m, from FGL	Termination Depth of Pile in m, from cut-off	Diameter of Pile in, m
		0.60
15.00	11.00	4.67

3.4) Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60
Subgrade reaction in MN/m^3		7.20
Stiffness factor T in m		1.90
Depth of fixity in m	Free Head	3.60
	Fixed Head	4.10
Allowable Horizontal Force in T	Free Head	5.70
	Fixed Head	15.00
Allowable Moment capacity in Tm	Free Head	7.16
	Fixed Head	25.50

4) Notes:

1) Initial and Routine pile load tests shall be carried out as per IS 2911, P-4 on the piles to confirm the capacity of pile worked out theoretically. For design and construction, specifications of IS 2911, P-I, S-2, shall strictly be followed. Termination depth of pile shall be from FGL.

Dr. K. K. Thaker

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 18 (For IBH-34,35,36 (Slurry PH Cum AHP MCCs pipe rack in BTG area))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:198.78m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 18.1) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 18.2)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
4.00	194.78	7.72	1.50	1.50	18	31	50	18	18
4.00	194.78	7.72	2.00	2.00	17	23	37	17	17
4.00	194.78	7.72	2.50	2.50	16	19	30	16	16
4.00	194.78	7.72	3.00	3.00	15	16	25	15	15
5.00	193.78	8.72	1.50	1.50	20	31	50	20	20
5.00	193.78	8.72	2.00	2.00	18	23	37	18	18
5.00	193.78	8.72	2.50	2.50	17	19	30	17	17
5.00	193.78	8.72	3.00	3.00	16	16	25	16	16
6.00	192.78	9.72	1.50	1.50	22	32	51	22	22
6.00	192.78	9.72	2.00	2.00	20	23	37	20	20
6.00	192.78	9.72	2.50	2.50	18	19	30	18	18
6.00	192.78	9.72	3.00	3.00	18	16	25	16	18

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.78m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 18.1 (For IBH-34,35,36 (Slurry PH Cum AHP MCCs pipe rack in BTG area))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	4.00	7.72	194.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.59	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	18
2	2.00	2.00	4.00	7.72	194.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.44	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	17
3	2.50	2.50	4.00	7.72	194.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.35	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	16
4	3.00	3.00	4.00	7.72	194.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.29	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	15
5	1.50	1.50	5.00	8.72	193.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.73	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	20
6	2.00	2.00	5.00	8.72	193.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.55	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	18
7	2.50	2.50	5.00	8.72	193.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.44	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	17
8	3.00	3.00	5.00	8.72	193.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.37	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	16
9	1.50	1.50	6.00	9.72	192.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.88	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	22
10	2.00	2.00	6.00	9.72	192.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.66	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	20
11	2.50	2.50	6.00	9.72	192.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.53	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	18
12	3.00	3.00	6.00	9.72	192.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.44	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	18

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.78m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 18.2 (For IBH-34,35,36 (Slurry PH Cum AHP MCCs pipe rack in BTG area))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	4.00	194.78	7.72	1.50	1.50	0.40	330	1.12	0.80	0.0150	3.00	0.70	0.73	0.80	31	50
2	4.00	194.78	7.72	2.00	2.00	0.40	330	1.12	0.80	0.0150	4.00	0.70	0.73	0.80	23	37
3	4.00	194.78	7.72	2.50	2.50	0.40	330	1.12	0.80	0.0150	5.00	0.70	0.73	0.80	19	30
4	4.00	194.78	7.72	3.00	3.00	0.40	330	1.12	0.80	0.0150	6.00	0.70	0.73	0.80	16	25
5	5.00	193.78	8.72	1.50	1.50	0.40	330	1.12	0.80	0.0150	3.00	0.70	0.73	0.80	31	50
6	5.00	193.78	8.72	2.00	2.00	0.40	330	1.12	0.80	0.0150	4.00	0.70	0.73	0.80	23	37
7	5.00	193.78	8.72	2.50	2.50	0.40	330	1.12	0.80	0.0150	5.00	0.70	0.73	0.80	19	30
8	5.00	193.78	8.72	3.00	3.00	0.40	330	1.12	0.80	0.0150	6.00	0.70	0.73	0.80	16	25
9	6.00	192.78	9.72	1.50	1.50	0.40	330	1.12	0.80	0.0150	3.00	0.70	0.71	0.80	32	51
10	6.00	192.78	9.72	2.00	2.00	0.40	330	1.12	0.80	0.0150	4.00	0.70	0.73	0.80	23	37
11	6.00	192.78	9.72	2.50	2.50	0.40	330	1.12	0.80	0.0150	5.00	0.70	0.73	0.80	19	30
12	6.00	192.78	9.72	3.00	3.00	0.40	330	1.12	0.80	0.0150	6.00	0.70	0.73	0.80	16	25

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 18.3 (For IBH-34,35,36 (Slurry PH Cum AHP MCCs pipe rack in BTG area))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:198.78m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 18.4) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 18.5)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
4.00	194.78	7.72	3.50	3.50	15	13	21	13	15
4.00	194.78	7.72	4.00	4.00	15	12	19	12	15
4.00	194.78	7.72	5.00	5.00	14	9	15	9	14
4.00	194.78	7.72	6.00	6.00	14	7	12	7	12
5.00	193.78	8.72	3.50	3.50	16	13	21	13	16
5.00	193.78	8.72	4.00	4.00	16	12	19	12	16
5.00	193.78	8.72	5.00	5.00	15	9	15	9	15
5.00	193.78	8.72	6.00	6.00	15	8	13	8	13
6.00	192.78	9.72	3.50	3.50	17	13	21	13	17
6.00	192.78	9.72	4.00	4.00	16	12	19	12	16
6.00	192.78	9.72	5.00	5.00	16	10	15	10	15
6.00	192.78	9.72	6.00	6.00	16	8	13	8	13

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.78m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 18.4 (For IBH-34,35,36 (Slurry PH Cum AHP MCCs pipe rack in BTG area))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	4.00	7.72	194.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.25	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	15
2	4.00	4.00	4.00	7.72	194.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.22	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	15
3	5.00	5.00	4.00	7.72	194.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.18	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	14
4	6.00	6.00	4.00	7.72	194.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.15	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	14
5	3.50	3.50	5.00	8.72	193.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.31	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	16
6	4.00	4.00	5.00	8.72	193.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.27	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	16
7	5.00	5.00	5.00	8.72	193.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.22	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	15
8	6.00	6.00	5.00	8.72	193.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.18	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	15
9	3.50	3.50	6.00	9.72	192.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.38	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	17
10	4.00	4.00	6.00	9.72	192.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.33	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	16
11	5.00	5.00	6.00	9.72	192.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.26	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	16
12	6.00	6.00	6.00	9.72	192.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.22	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	16

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.78m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 18.5 (For IBH-34,35,36 (Slurry PH Cum AHP MCCs pipe rack in BTG area))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	4.00	194.78	7.72	3.50	3.50	0.40	330	1.12	0.80	0.0150	7.00	0.70	0.73	0.80	13	21
2	4.00	194.78	7.72	4.00	4.00	0.40	330	1.12	0.80	0.0150	8.00	0.70	0.73	0.80	12	19
3	4.00	194.78	7.72	5.00	5.00	0.40	330	1.12	0.80	0.0150	9.00	0.70	0.76	0.80	9	15
4	4.00	194.78	7.72	6.00	6.00	0.40	330	1.12	0.80	0.0150	9.00	0.70	0.80	0.80	7	12
5	5.00	193.78	8.72	3.50	3.50	0.40	330	1.12	0.80	0.0150	7.00	0.70	0.73	0.80	13	21
6	5.00	193.78	8.72	4.00	4.00	0.40	330	1.12	0.80	0.0150	8.00	0.70	0.73	0.80	12	19
7	5.00	193.78	8.72	5.00	5.00	0.40	330	1.12	0.80	0.0150	8.00	0.70	0.73	0.80	9	15
8	5.00	193.78	8.72	6.00	6.00	0.40	330	1.12	0.80	0.0150	8.00	0.70	0.75	0.80	8	13
9	6.00	192.78	9.72	3.50	3.50	0.40	330	1.12	0.80	0.0150	7.00	0.70	0.73	0.80	13	21
10	6.00	192.78	9.72	4.00	4.00	0.40	330	1.12	0.80	0.0150	7.00	0.70	0.73	0.80	12	19
11	6.00	192.78	9.72	5.00	5.00	0.40	330	1.12	0.80	0.0150	7.00	0.70	0.73	0.80	10	15
12	6.00	192.78	9.72	6.00	6.00	0.40	330	1.12	0.80	0.0150	7.00	0.70	0.73	0.80	8	13

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 18.6 (For IBH-34,35,36 (Slurry PH Cum AHP MCCs pipe rack in BTG area))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:198.78m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 18.7) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 18.8)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
4.00	194.78	7.72	7.00	7.00	14	6	10	6	10
4.00	194.78	7.72	8.00	8.00	14	6	9	6	9
4.00	194.78	7.72	9.00	9.00	14	5	8	5	8
4.00	194.78	7.72	10.00	10.00	14	5	7	5	7
5.00	193.78	8.72	7.00	7.00	15	7	11	7	11
5.00	193.78	8.72	8.00	8.00	14	6	9	6	9
5.00	193.78	8.72	9.00	9.00	14	5	8	5	8
5.00	193.78	8.72	10.00	10.00	14	5	8	5	8
6.00	192.78	9.72	7.00	7.00	15	7	11	7	11
6.00	192.78	9.72	8.00	8.00	15	6	10	6	10
6.00	192.78	9.72	9.00	9.00	15	6	9	6	9
6.00	192.78	9.72	10.00	10.00	15	5	8	5	8

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.78m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 18.7 (For IBH-34,35,36 (Slurry PH Cum AHP MCCs pipe rack in BTG area))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	4.00	7.72	194.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	14
2	8.00	8.00	4.00	7.72	194.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.11	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	14
3	9.00	9.00	4.00	7.72	194.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	14
4	10.00	10.00	4.00	7.72	194.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	14
5	7.00	7.00	5.00	8.72	193.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.16	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	15
6	8.00	8.00	5.00	8.72	193.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.14	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	14
7	9.00	9.00	5.00	8.72	193.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	14
8	10.00	10.00	5.00	8.72	193.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.11	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	14
9	7.00	7.00	6.00	9.72	192.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.19	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	15
10	8.00	8.00	6.00	9.72	192.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.16	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	15
11	9.00	9.00	6.00	9.72	192.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.15	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	15
12	10.00	10.00	6.00	9.72	192.78	0.44	8	6.86	0.74	0.59	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	1.98	0.99	0.50	0.50	15

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.78m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 18.8 (For IBH-34,35,36 (Slurry PH Cum AHP MCCs pipe rack in BTG area))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	4.00	194.78	7.72	7.00	7.00	0.40	330	1.12	0.80	0.0150	9.00	0.70	0.83	0.80	6	10
2	4.00	194.78	7.72	8.00	8.00	0.40	330	1.12	0.80	0.0150	9.00	0.70	0.85	0.80	6	9
3	4.00	194.78	7.72	9.00	9.00	0.40	330	1.12	0.80	0.0150	9.00	0.70	0.87	0.80	5	8
4	4.00	194.78	7.72	10.00	10.00	0.40	330	1.12	0.80	0.0150	9.00	0.70	0.88	0.80	5	7
5	5.00	193.78	8.72	7.00	7.00	0.40	330	1.12	0.80	0.0150	8.00	0.70	0.78	0.80	7	11
6	5.00	193.78	8.72	8.00	8.00	0.40	330	1.12	0.80	0.0150	8.00	0.70	0.81	0.80	6	9
7	5.00	193.78	8.72	9.00	9.00	0.40	330	1.12	0.80	0.0150	8.00	0.70	0.83	0.80	5	8
8	5.00	193.78	8.72	10.00	10.00	0.40	330	1.12	0.80	0.0150	8.00	0.70	0.85	0.80	5	8
9	6.00	192.78	9.72	7.00	7.00	0.40	330	1.12	0.80	0.0150	7.00	0.70	0.75	0.80	7	11
10	6.00	192.78	9.72	8.00	8.00	0.40	330	1.12	0.80	0.0150	7.00	0.70	0.77	0.80	6	10
11	6.00	192.78	9.72	9.00	9.00	0.40	330	1.12	0.80	0.0150	7.00	0.70	0.80	0.80	6	9
12	6.00	192.78	9.72	10.00	10.00	0.40	330	1.12	0.80	0.0150	7.00	0.70	0.82	0.80	5	8

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 18.9 (For IBH-34,35,36 (Slurry PH Cum AHP MCCs pipe rack in BTG area))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:198.78m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	197.78	4.72	1.50	1.50	9	18	29	9	9
1.00	197.78	4.72	2.00	2.00	9	13	21	9	9
1.00	197.78	4.72	2.50	2.50	9	10	16	9	9
1.00	197.78	4.72	3.00	3.00	9	8	13	8	9
2.00	196.78	5.72	1.50	1.50	11	19	31	11	11
2.00	196.78	5.72	2.00	2.00	10	15	23	10	10
2.00	196.78	5.72	2.50	2.50	10	11	18	10	10
2.00	196.78	5.72	3.00	3.00	10	9	15	9	10
3.00	195.78	6.72	1.50	1.50	12	19	31	12	12
3.00	195.78	6.72	2.00	2.00	11	15	23	11	11
3.00	195.78	6.72	2.50	2.50	11	12	19	11	11
3.00	195.78	6.72	3.00	3.00	10	10	16	10	10

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.78m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-18.10 (For IBH-34,35,36 (Slurry PH Cum AHP MCCs pipe rack in BTG area))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	1.00	4.72	197.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.14	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	9
2	2.00	2.00	1.00	4.72	197.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.11	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	9
3	2.50	2.50	1.00	4.72	197.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	9
4	3.00	3.00	1.00	4.72	197.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	9
5	1.50	1.50	2.00	5.72	196.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.29	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	11
6	2.00	2.00	2.00	5.72	196.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.21	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	10
7	2.50	2.50	2.00	5.72	196.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.17	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	10
8	3.00	3.00	2.00	5.72	196.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.14	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	10
9	1.50	1.50	3.00	6.72	195.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.43	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	12
10	2.00	2.00	3.00	6.72	195.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.32	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	11
11	2.50	2.50	3.00	6.72	195.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.26	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	11
12	3.00	3.00	3.00	6.72	195.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.21	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	10

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.78m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-18.11 (For IBH-34,35,36 (Slurry PH Cum AHP MCCs pipe rack in BTG area))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	1.00	197.78	4.72	1.50	1.50	0.40	300	1.12	0.80	0.0298	3.00	0.70	0.80	0.80	18	29
2	1.00	197.78	4.72	2.00	2.00	0.40	300	1.12	0.80	0.0298	4.00	0.70	0.85	0.80	13	21
3	1.00	197.78	4.72	2.50	2.50	0.40	300	1.12	0.80	0.0298	5.00	0.70	0.88	0.80	10	16
4	1.00	197.78	4.72	3.00	3.00	0.40	300	1.12	0.80	0.0298	6.00	0.70	0.91	0.80	8	13
5	2.00	196.78	5.72	1.50	1.50	0.40	300	1.12	0.80	0.0298	3.00	0.70	0.73	0.80	19	31
6	2.00	196.78	5.72	2.00	2.00	0.40	300	1.12	0.80	0.0298	4.00	0.70	0.73	0.80	15	23
7	2.00	196.78	5.72	2.50	2.50	0.40	300	1.12	0.80	0.0298	5.00	0.70	0.76	0.80	11	18
8	2.00	196.78	5.72	3.00	3.00	0.40	300	1.12	0.80	0.0298	6.00	0.70	0.80	0.80	9	15
9	3.00	195.78	6.72	1.50	1.50	0.40	300	1.12	0.80	0.0298	3.00	0.70	0.73	0.80	19	31
10	3.00	195.78	6.72	2.00	2.00	0.40	300	1.12	0.80	0.0298	4.00	0.70	0.73	0.80	15	23
11	3.00	195.78	6.72	2.50	2.50	0.40	300	1.12	0.80	0.0298	5.00	0.70	0.73	0.80	12	19
12	3.00	195.78	6.72	3.00	3.00	0.40	300	1.12	0.80	0.0298	6.00	0.70	0.73	0.80	10	16

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 18.12 (For IBH-34,35,36 (Slurry PH Cum AHP MCCs pipe rack in BTG area))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:198.78m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	197.78	4.72	3.50	3.50	9	7	11	7	9
1.00	197.78	4.72	4.00	4.00	9	6	10	6	9
1.00	197.78	4.72	5.00	5.00	9	5	8	5	8
1.00	197.78	4.72	6.00	6.00	9	4	6	4	6
2.00	196.78	5.72	3.50	3.50	10	8	12	8	10
2.00	196.78	5.72	4.00	4.00	9	7	10	7	9
2.00	196.78	5.72	5.00	5.00	9	5	8	5	8
2.00	196.78	5.72	6.00	6.00	9	4	7	4	7
3.00	195.78	6.72	3.50	3.50	10	8	13	8	10
3.00	195.78	6.72	4.00	4.00	10	7	11	7	10
3.00	195.78	6.72	5.00	5.00	10	5	9	5	9
3.00	195.78	6.72	6.00	6.00	10	4	7	4	7

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.78m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-18.13 (For IBH-34,35,36 (Slurry PH Cum AHP MCCs pipe rack in BTG area))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	1.00	4.72	197.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	9
2	4.00	4.00	1.00	4.72	197.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	9
3	5.00	5.00	1.00	4.72	197.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	9
4	6.00	6.00	1.00	4.72	197.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	9
5	3.50	3.50	2.00	5.72	196.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	10
6	4.00	4.00	2.00	5.72	196.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.11	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	9
7	5.00	5.00	2.00	5.72	196.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	9
8	6.00	6.00	2.00	5.72	196.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	9
9	3.50	3.50	3.00	6.72	195.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.18	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	10
10	4.00	4.00	3.00	6.72	195.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.16	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	10
11	5.00	5.00	3.00	6.72	195.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	10
12	6.00	6.00	3.00	6.72	195.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.11	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	10

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.78m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-18.14 (For IBH-34,35,36 (Slurry PH Cum AHP MCCs pipe rack in BTG area))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	1.00	197.78	4.72	3.50	3.50	0.40	300	1.12	0.80	0.0298	7.00	0.70	0.92	0.80	7	11
2	1.00	197.78	4.72	4.00	4.00	0.40	300	1.12	0.80	0.0298	8.00	0.70	0.93	0.80	6	10
3	1.00	197.78	4.72	5.00	5.00	0.40	300	1.12	0.80	0.0298	10.00	0.70	0.95	0.80	5	8
4	1.00	197.78	4.72	6.00	6.00	0.40	300	1.12	0.80	0.0298	12.00	0.70	0.96	0.80	4	6
5	2.00	196.78	5.72	3.50	3.50	0.40	300	1.12	0.80	0.0298	7.00	0.70	0.83	0.80	8	12
6	2.00	196.78	5.72	4.00	4.00	0.40	300	1.12	0.80	0.0298	8.00	0.70	0.85	0.80	7	10
7	2.00	196.78	5.72	5.00	5.00	0.40	300	1.12	0.80	0.0298	10.00	0.70	0.88	0.80	5	8
8	2.00	196.78	5.72	6.00	6.00	0.40	300	1.12	0.80	0.0298	11.00	0.70	0.91	0.80	4	7
9	3.00	195.78	6.72	3.50	3.50	0.40	300	1.12	0.80	0.0298	7.00	0.70	0.75	0.80	8	13
10	3.00	195.78	6.72	4.00	4.00	0.40	300	1.12	0.80	0.0298	8.00	0.70	0.77	0.80	7	11
11	3.00	195.78	6.72	5.00	5.00	0.40	300	1.12	0.80	0.0298	10.00	0.70	0.82	0.80	5	9
12	3.00	195.78	6.72	6.00	6.00	0.40	300	1.12	0.80	0.0298	10.00	0.70	0.85	0.80	4	7

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 18.15 (For IBH-34,35,36 (Slurry PH Cum AHP MCCs pipe rack in BTG area))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:198.78m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	197.78	4.72	7.00	7.00	9	3	5	3	5
1.00	197.78	4.72	8.00	8.00	9	3	5	3	5
1.00	197.78	4.72	9.00	9.00	9	3	4	3	4
1.00	197.78	4.72	10.00	10.00	9	2	4	2	4
2.00	196.78	5.72	7.00	7.00	9	4	6	4	6
2.00	196.78	5.72	8.00	8.00	9	3	5	3	5
2.00	196.78	5.72	9.00	9.00	9	3	4	3	4
2.00	196.78	5.72	10.00	10.00	9	3	4	3	4
3.00	195.78	6.72	7.00	7.00	10	4	6	4	6
3.00	195.78	6.72	8.00	8.00	10	3	5	3	5
3.00	195.78	6.72	9.00	9.00	10	3	5	3	5
3.00	195.78	6.72	10.00	10.00	10	3	4	3	4

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.78m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-18.16 (For IBH-34,35,36 (Slurry PH Cum AHP MCCs pipe rack in BTG area))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	1.00	4.72	197.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	9
2	8.00	8.00	1.00	4.72	197.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	9
3	9.00	9.00	1.00	4.72	197.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.02	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	9
4	10.00	10.00	1.00	4.72	197.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.02	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	9
5	7.00	7.00	2.00	5.72	196.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	9
6	8.00	8.00	2.00	5.72	196.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	9
7	9.00	9.00	2.00	5.72	196.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	9
8	10.00	10.00	2.00	5.72	196.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	9
9	7.00	7.00	3.00	6.72	195.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	10
10	8.00	8.00	3.00	6.72	195.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	10
11	9.00	9.00	3.00	6.72	195.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	10
12	10.00	10.00	3.00	6.72	195.78	0.36	6	6.29	0.48	0.38	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	10

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.78m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-18.17 (For IBH-34,35,36 (Slurry PH Cum AHP MCCs pipe rack in BTG area))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	1.00	197.78	4.72	7.00	7.00	0.40	300	1.12	0.80	0.0298	12.00	0.70	0.97	0.80	3	5
2	1.00	197.78	4.72	8.00	8.00	0.40	300	1.12	0.80	0.0298	12.00	0.70	0.97	0.80	3	5
3	1.00	197.78	4.72	9.00	9.00	0.40	300	1.12	0.80	0.0298	12.00	0.70	0.97	0.80	3	4
4	1.00	197.78	4.72	10.00	10.00	0.40	300	1.12	0.80	0.0298	12.00	0.70	0.98	0.80	2	4
5	2.00	196.78	5.72	7.00	7.00	0.40	300	1.12	0.80	0.0298	11.00	0.70	0.92	0.80	4	6
6	2.00	196.78	5.72	8.00	8.00	0.40	300	1.12	0.80	0.0298	11.00	0.70	0.93	0.80	3	5
7	2.00	196.78	5.72	9.00	9.00	0.40	300	1.12	0.80	0.0298	11.00	0.70	0.94	0.80	3	4
8	2.00	196.78	5.72	10.00	10.00	0.40	300	1.12	0.80	0.0298	11.00	0.70	0.95	0.80	3	4
9	3.00	195.78	6.72	7.00	7.00	0.40	300	1.12	0.80	0.0298	10.00	0.70	0.87	0.80	4	6
10	3.00	195.78	6.72	8.00	8.00	0.40	300	1.12	0.80	0.0298	10.00	0.70	0.89	0.80	3	5
11	3.00	195.78	6.72	9.00	9.00	0.40	300	1.12	0.80	0.0298	10.00	0.70	0.91	0.80	3	5
12	3.00	195.78	6.72	10.00	10.00	0.40	300	1.12	0.80	0.0298	10.00	0.70	0.92	0.80	3	4

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 19 (For IBH-37 (Silo utility building cum HCSD pump house))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:197.57m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 19.1) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 19.2)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
4.00	193.57	8.93	1.50	1.50	17	27	44	17	17
4.00	193.57	8.93	2.00	2.00	16	21	33	16	16
4.00	193.57	8.93	2.50	2.50	15	17	27	15	15
4.00	193.57	8.93	3.00	3.00	15	14	23	14	15
5.00	192.57	9.93	1.50	1.50	19	27	44	19	19
5.00	192.57	9.93	2.00	2.00	17	21	34	17	17
5.00	192.57	9.93	2.50	2.50	16	18	28	16	16
5.00	192.57	9.93	3.00	3.00	16	16	25	16	16
6.00	191.57	10.93	1.50	1.50	21	30	48	21	21
6.00	191.57	10.93	2.00	2.00	19	24	38	19	19
6.00	191.57	10.93	2.50	2.50	17	21	33	17	17
6.00	191.57	10.93	3.00	3.00	16	18	29	16	16

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.57m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 19.1 (For IBH-37 (Silo utility building cum HCSD pump house))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	4.00	8.93	193.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.57	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	17
2	2.00	2.00	4.00	8.93	193.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.43	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	16
3	2.50	2.50	4.00	8.93	193.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.34	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	15
4	3.00	3.00	4.00	8.93	193.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.29	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	15
5	1.50	1.50	5.00	9.93	192.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.72	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	19
6	2.00	2.00	5.00	9.93	192.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.54	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	17
7	2.50	2.50	5.00	9.93	192.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.43	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	16
8	3.00	3.00	5.00	9.93	192.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.36	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	16
9	1.50	1.50	6.00	10.93	191.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.86	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	21
10	2.00	2.00	6.00	10.93	191.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.64	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	19
11	2.50	2.50	6.00	10.93	191.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.51	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	17
12	3.00	3.00	6.00	10.93	191.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.43	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	16

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.57m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 19.2 (For IBH-37 (Silo utility building cum HCSD pump house))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	4.00	193.57	8.93	1.50	1.50	0.40	435	1.12	0.80	0.0214	3.00	0.70	0.73	0.80	27	44
2	4.00	193.57	8.93	2.00	2.00	0.40	435	1.12	0.80	0.0214	3.50	0.70	0.73	0.80	21	33
3	4.00	193.57	8.93	2.50	2.50	0.40	435	1.12	0.80	0.0214	3.50	0.70	0.73	0.80	17	27
4	4.00	193.57	8.93	3.00	3.00	0.40	435	1.12	0.80	0.0214	3.50	0.70	0.73	0.80	14	23
5	5.00	192.57	9.93	1.50	1.50	0.40	435	1.12	0.80	0.0214	2.50	0.70	0.73	0.80	27	44
6	5.00	192.57	9.93	2.00	2.00	0.40	435	1.12	0.80	0.0214	2.50	0.70	0.73	0.80	21	34
7	5.00	192.57	9.93	2.50	2.50	0.40	435	1.12	0.80	0.0214	2.50	0.70	0.73	0.80	18	28
8	5.00	192.57	9.93	3.00	3.00	0.40	435	1.12	0.80	0.0214	2.50	0.70	0.73	0.80	16	25
9	6.00	191.57	10.93	1.50	1.50	0.40	435	1.12	0.80	0.0214	1.50	0.70	0.71	0.80	30	48
10	6.00	191.57	10.93	2.00	2.00	0.40	435	1.12	0.80	0.0214	1.50	0.70	0.73	0.80	24	38
11	6.00	191.57	10.93	2.50	2.50	0.40	435	1.12	0.80	0.0214	1.50	0.70	0.73	0.80	21	33
12	6.00	191.57	10.93	3.00	3.00	0.40	435	1.12	0.80	0.0214	1.50	0.70	0.73	0.80	18	29

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 19.3 (For IBH-37 (Silo utility building cum HCSD pump house))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:197.57m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 19.4) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 19.5)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
4.00	193.57	8.93	3.50	3.50	14	13	20	13	14
4.00	193.57	8.93	4.00	4.00	14	12	18	12	14
4.00	193.57	8.93	5.00	5.00	13	10	15	10	13
4.00	193.57	8.93	6.00	6.00	13	8	13	8	13
5.00	192.57	9.93	3.50	3.50	15	14	22	14	15
5.00	192.57	9.93	4.00	4.00	15	13	20	13	15
5.00	192.57	9.93	5.00	5.00	14	11	18	11	14
5.00	192.57	9.93	6.00	6.00	14	10	15	10	14
6.00	191.57	10.93	3.50	3.50	16	17	27	16	16
6.00	191.57	10.93	4.00	4.00	15	15	25	15	15
6.00	191.57	10.93	5.00	5.00	15	13	22	13	15
6.00	191.57	10.93	6.00	6.00	14	12	19	12	14

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.57m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 19.4 (For IBH-37 (Silo utility building cum HCSD pump house))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	4.00	8.93	193.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.25	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	14
2	4.00	4.00	4.00	8.93	193.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.21	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	14
3	5.00	5.00	4.00	8.93	193.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.17	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	13
4	6.00	6.00	4.00	8.93	193.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.14	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	13
5	3.50	3.50	5.00	9.93	192.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.31	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	15
6	4.00	4.00	5.00	9.93	192.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.27	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	15
7	5.00	5.00	5.00	9.93	192.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.21	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	14
8	6.00	6.00	5.00	9.93	192.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.18	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	14
9	3.50	3.50	6.00	10.93	191.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.37	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	16
10	4.00	4.00	6.00	10.93	191.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.32	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	15
11	5.00	5.00	6.00	10.93	191.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.26	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	15
12	6.00	6.00	6.00	10.93	191.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.21	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	14

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.57m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 19.5 (For IBH-37 (Silo utility building cum HCSD pump house))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	4.00	193.57	8.93	3.50	3.50	0.40	435	1.12	0.80	0.0214	3.50	0.70	0.73	0.80	13	20
2	4.00	193.57	8.93	4.00	4.00	0.40	435	1.12	0.80	0.0214	3.50	0.70	0.73	0.80	12	18
3	4.00	193.57	8.93	5.00	5.00	0.40	435	1.12	0.80	0.0214	3.50	0.70	0.76	0.80	10	15
4	4.00	193.57	8.93	6.00	6.00	0.40	435	1.12	0.80	0.0214	3.50	0.70	0.80	0.80	8	13
5	5.00	192.57	9.93	3.50	3.50	0.40	435	1.12	0.80	0.0214	2.50	0.70	0.73	0.80	14	22
6	5.00	192.57	9.93	4.00	4.00	0.40	435	1.12	0.80	0.0214	2.50	0.70	0.73	0.80	13	20
7	5.00	192.57	9.93	5.00	5.00	0.40	435	1.12	0.80	0.0214	2.50	0.70	0.73	0.80	11	18
8	5.00	192.57	9.93	6.00	6.00	0.40	435	1.12	0.80	0.0214	2.50	0.70	0.75	0.80	10	15
9	6.00	191.57	10.93	3.50	3.50	0.40	435	1.12	0.80	0.0214	1.50	0.70	0.73	0.80	17	27
10	6.00	191.57	10.93	4.00	4.00	0.40	435	1.12	0.80	0.0214	1.50	0.70	0.73	0.80	15	25
11	6.00	191.57	10.93	5.00	5.00	0.40	435	1.12	0.80	0.0214	1.50	0.70	0.73	0.80	13	22
12	6.00	191.57	10.93	6.00	6.00	0.40	435	1.12	0.80	0.0214	1.50	0.70	0.73	0.80	12	19

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 19.6 (For IBH-37 (Silo utility building cum HCSD pump house))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:197.57m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 19.7) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 19.8)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
4.00	193.57	8.93	7.00	7.00	13	7	12	7	12
4.00	193.57	8.93	8.00	8.00	13	7	11	7	11
4.00	193.57	8.93	9.00	9.00	13	6	10	6	10
4.00	193.57	8.93	10.00	10.00	13	6	9	6	9
5.00	192.57	9.93	7.00	7.00	14	9	14	9	14
5.00	192.57	9.93	8.00	8.00	13	8	13	8	13
5.00	192.57	9.93	9.00	9.00	13	7	12	7	12
5.00	192.57	9.93	10.00	10.00	13	7	11	7	11
6.00	191.57	10.93	7.00	7.00	14	11	17	11	14
6.00	191.57	10.93	8.00	8.00	14	10	16	10	14
6.00	191.57	10.93	9.00	9.00	14	9	14	9	14
6.00	191.57	10.93	10.00	10.00	14	8	13	8	13

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.57m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 19.7 (For IBH-37 (Silo utility building cum HCSD pump house))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	4.00	8.93	193.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	13
2	8.00	8.00	4.00	8.93	193.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.11	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	13
3	9.00	9.00	4.00	8.93	193.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	13
4	10.00	10.00	4.00	8.93	193.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	13
5	7.00	7.00	5.00	9.93	192.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.15	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	14
6	8.00	8.00	5.00	9.93	192.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	13
7	9.00	9.00	5.00	9.93	192.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	13
8	10.00	10.00	5.00	9.93	192.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.11	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	13
9	7.00	7.00	6.00	10.93	191.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.18	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	14
10	8.00	8.00	6.00	10.93	191.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.16	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	14
11	9.00	9.00	6.00	10.93	191.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.14	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	14
12	10.00	10.00	6.00	10.93	191.57	0.48	6	6.27	0.47	0.37	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	14

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.57m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 19.8 (For IBH-37 (Silo utility building cum HCSD pump house))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	4.00	193.57	8.93	7.00	7.00	0.40	435	1.12	0.80	0.0214	3.50	0.70	0.83	0.80	7	12
2	4.00	193.57	8.93	8.00	8.00	0.40	435	1.12	0.80	0.0214	3.50	0.70	0.85	0.80	7	11
3	4.00	193.57	8.93	9.00	9.00	0.40	435	1.12	0.80	0.0214	3.50	0.70	0.87	0.80	6	10
4	4.00	193.57	8.93	10.00	10.00	0.40	435	1.12	0.80	0.0214	3.50	0.70	0.88	0.80	6	9
5	5.00	192.57	9.93	7.00	7.00	0.40	435	1.12	0.80	0.0214	2.50	0.70	0.78	0.80	9	14
6	5.00	192.57	9.93	8.00	8.00	0.40	435	1.12	0.80	0.0214	2.50	0.70	0.81	0.80	8	13
7	5.00	192.57	9.93	9.00	9.00	0.40	435	1.12	0.80	0.0214	2.50	0.70	0.83	0.80	7	12
8	5.00	192.57	9.93	10.00	10.00	0.40	435	1.12	0.80	0.0214	2.50	0.70	0.85	0.80	7	11
9	6.00	191.57	10.93	7.00	7.00	0.40	435	1.12	0.80	0.0214	1.50	0.70	0.75	0.80	11	17
10	6.00	191.57	10.93	8.00	8.00	0.40	435	1.12	0.80	0.0214	1.50	0.70	0.77	0.80	10	16
11	6.00	191.57	10.93	9.00	9.00	0.40	435	1.12	0.80	0.0214	1.50	0.70	0.80	0.80	9	14
12	6.00	191.57	10.93	10.00	10.00	0.40	435	1.12	0.80	0.0214	1.50	0.70	0.82	0.80	8	13

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 19.9 (For IBH-37 (Silo utility building cum HCSD pump house))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:197.57m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	196.57	5.93	1.50	1.50	9	18	29	9	9
1.00	196.57	5.93	2.00	2.00	9	13	21	9	9
1.00	196.57	5.93	2.50	2.50	9	10	16	9	9
1.00	196.57	5.93	3.00	3.00	8	8	13	8	8
2.00	195.57	6.93	1.50	1.50	10	19	31	10	10
2.00	195.57	6.93	2.00	2.00	10	14	23	10	10
2.00	195.57	6.93	2.50	2.50	9	11	18	9	9
2.00	195.57	6.93	3.00	3.00	9	9	14	9	9
3.00	194.57	7.93	1.50	1.50	11	19	31	11	11
3.00	194.57	7.93	2.00	2.00	11	14	23	11	11
3.00	194.57	7.93	2.50	2.50	10	11	18	10	10
3.00	194.57	7.93	3.00	3.00	10	10	15	10	10

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.57m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-19.10 (For IBH-37 (Silo utility building cum HCSD pump house))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	1.00	5.93	196.57	0.38	4	5.81	0.27	0.21	1.30	1.20	0.80	1.14	1.00	1.00	1.00	1.00	1.00	1.92	0.96	0.50	0.50	9
2	2.00	2.00	1.00	5.93	196.57	0.38	4	5.81	0.27	0.21	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.92	0.96	0.50	0.50	9
3	2.50	2.50	1.00	5.93	196.57	0.38	4	5.81	0.27	0.21	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.92	0.96	0.50	0.50	9
4	3.00	3.00	1.00	5.93	196.57	0.38	4	5.81	0.27	0.21	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.92	0.96	0.50	0.50	8
5	1.50	1.50	2.00	6.93	195.57	0.38	4	5.81	0.27	0.21	1.30	1.20	0.80	1.28	1.00	1.00	1.00	1.00	1.00	1.92	0.96	0.50	0.50	10
6	2.00	2.00	2.00	6.93	195.57	0.38	4	5.81	0.27	0.21	1.30	1.20	0.80	1.21	1.00	1.00	1.00	1.00	1.00	1.92	0.96	0.50	0.50	10
7	2.50	2.50	2.00	6.93	195.57	0.38	4	5.81	0.27	0.21	1.30	1.20	0.80	1.17	1.00	1.00	1.00	1.00	1.00	1.92	0.96	0.50	0.50	9
8	3.00	3.00	2.00	6.93	195.57	0.38	4	5.81	0.27	0.21	1.30	1.20	0.80	1.14	1.00	1.00	1.00	1.00	1.00	1.92	0.96	0.50	0.50	9
9	1.50	1.50	3.00	7.93	194.57	0.38	4	5.81	0.27	0.21	1.30	1.20	0.80	1.42	1.00	1.00	1.00	1.00	1.00	1.92	0.96	0.50	0.50	11
10	2.00	2.00	3.00	7.93	194.57	0.38	4	5.81	0.27	0.21	1.30	1.20	0.80	1.31	1.00	1.00	1.00	1.00	1.00	1.92	0.96	0.50	0.50	11
11	2.50	2.50	3.00	7.93	194.57	0.38	4	5.81	0.27	0.21	1.30	1.20	0.80	1.25	1.00	1.00	1.00	1.00	1.00	1.92	0.96	0.50	0.50	10
12	3.00	3.00	3.00	7.93	194.57	0.38	4	5.81	0.27	0.21	1.30	1.20	0.80	1.21	1.00	1.00	1.00	1.00	1.00	1.92	0.96	0.50	0.50	10

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.57m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-19.11 (For IBH-37 (Silo utility building cum HCSD pump house))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	1.00	196.57	5.93	1.50	1.50	0.40	260	1.12	0.80	0.0286	3.00	0.70	0.80	0.80	18	29
2	1.00	196.57	5.93	2.00	2.00	0.40	260	1.12	0.80	0.0286	4.00	0.70	0.85	0.80	13	21
3	1.00	196.57	5.93	2.50	2.50	0.40	260	1.12	0.80	0.0286	5.00	0.70	0.88	0.80	10	16
4	1.00	196.57	5.93	3.00	3.00	0.40	260	1.12	0.80	0.0286	6.00	0.70	0.91	0.80	8	13
5	2.00	195.57	6.93	1.50	1.50	0.40	260	1.12	0.80	0.0286	3.00	0.70	0.73	0.80	19	31
6	2.00	195.57	6.93	2.00	2.00	0.40	260	1.12	0.80	0.0286	4.00	0.70	0.73	0.80	14	23
7	2.00	195.57	6.93	2.50	2.50	0.40	260	1.12	0.80	0.0286	5.00	0.70	0.76	0.80	11	18
8	2.00	195.57	6.93	3.00	3.00	0.40	260	1.12	0.80	0.0286	5.50	0.70	0.80	0.80	9	14
9	3.00	194.57	7.93	1.50	1.50	0.40	260	1.12	0.80	0.0286	3.00	0.70	0.73	0.80	19	31
10	3.00	194.57	7.93	2.00	2.00	0.40	260	1.12	0.80	0.0286	4.00	0.70	0.73	0.80	14	23
11	3.00	194.57	7.93	2.50	2.50	0.40	260	1.12	0.80	0.0286	4.50	0.70	0.73	0.80	11	18
12	3.00	194.57	7.93	3.00	3.00	0.40	260	1.12	0.80	0.0286	4.50	0.70	0.73	0.80	10	15

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 19.12 (For IBH-37 (Silo utility building cum HCSD pump house))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:197.57m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	196.57	5.93	3.50	3.50	8	7	11	7	8
1.00	196.57	5.93	4.00	4.00	8	6	10	6	8
1.00	196.57	5.93	5.00	5.00	8	5	8	5	8
1.00	196.57	5.93	6.00	6.00	8	4	7	4	7
2.00	195.57	6.93	3.50	3.50	9	8	12	8	9
2.00	195.57	6.93	4.00	4.00	9	7	11	7	9
2.00	195.57	6.93	5.00	5.00	9	5	9	5	9
2.00	195.57	6.93	6.00	6.00	9	5	7	5	7
3.00	194.57	7.93	3.50	3.50	10	8	13	8	10
3.00	194.57	7.93	4.00	4.00	9	7	12	7	9
3.00	194.57	7.93	5.00	5.00	9	6	9	6	9
3.00	194.57	7.93	6.00	6.00	9	5	8	5	8

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.57m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-19.14 (For IBH-37 (Silo utility building cum HCSD pump house))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	1.00	196.57	5.93	3.50	3.50	0.40	260	1.12	0.80	0.0286	6.50	0.70	0.92	0.80	7	11
2	1.00	196.57	5.93	4.00	4.00	0.40	260	1.12	0.80	0.0286	6.50	0.70	0.93	0.80	6	10
3	1.00	196.57	5.93	5.00	5.00	0.40	260	1.12	0.80	0.0286	6.50	0.70	0.95	0.80	5	8
4	1.00	196.57	5.93	6.00	6.00	0.40	260	1.12	0.80	0.0286	6.50	0.70	0.96	0.80	4	7
5	2.00	195.57	6.93	3.50	3.50	0.40	260	1.12	0.80	0.0286	5.50	0.70	0.83	0.80	8	12
6	2.00	195.57	6.93	4.00	4.00	0.40	260	1.12	0.80	0.0286	5.50	0.70	0.85	0.80	7	11
7	2.00	195.57	6.93	5.00	5.00	0.40	260	1.12	0.80	0.0286	5.50	0.70	0.88	0.80	5	9
8	2.00	195.57	6.93	6.00	6.00	0.40	260	1.12	0.80	0.0286	5.50	0.70	0.91	0.80	5	7
9	3.00	194.57	7.93	3.50	3.50	0.40	260	1.12	0.80	0.0286	4.50	0.70	0.75	0.80	8	13
10	3.00	194.57	7.93	4.00	4.00	0.40	260	1.12	0.80	0.0286	4.50	0.70	0.77	0.80	7	12
11	3.00	194.57	7.93	5.00	5.00	0.40	260	1.12	0.80	0.0286	4.50	0.70	0.82	0.80	6	9
12	3.00	194.57	7.93	6.00	6.00	0.40	260	1.12	0.80	0.0286	4.50	0.70	0.85	0.80	5	8

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 19.15 (For IBH-37 (Silo utility building cum HCSD pump house))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:197.57m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	196.57	5.93	7.00	7.00	8	4	6	4	6
1.00	196.57	5.93	8.00	8.00	8	3	5	3	5
1.00	196.57	5.93	9.00	9.00	8	3	5	3	5
1.00	196.57	5.93	10.00	10.00	8	3	5	3	5
2.00	195.57	6.93	7.00	7.00	9	4	6	4	6
2.00	195.57	6.93	8.00	8.00	9	4	6	4	6
2.00	195.57	6.93	9.00	9.00	9	3	5	3	5
2.00	195.57	6.93	10.00	10.00	9	3	5	3	5
3.00	194.57	7.93	7.00	7.00	9	4	7	4	7
3.00	194.57	7.93	8.00	8.00	9	4	6	4	6
3.00	194.57	7.93	9.00	9.00	9	4	6	4	6
3.00	194.57	7.93	10.00	10.00	9	3	5	3	5

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.57m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-19.16 (For IBH-37 (Silo utility building cum HCSD pump house))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5 γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	1.00	5.93	196.57	0.38	4	5.81	0.27	0.21	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.92	0.96	0.50	0.50	8
2	8.00	8.00	1.00	5.93	196.57	0.38	4	5.81	0.27	0.21	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.92	0.96	0.50	0.50	8
3	9.00	9.00	1.00	5.93	196.57	0.38	4	5.81	0.27	0.21	1.30	1.20	0.80	1.02	1.00	1.00	1.00	1.00	1.00	1.92	0.96	0.50	0.50	8
4	10.00	10.00	1.00	5.93	196.57	0.38	4	5.81	0.27	0.21	1.30	1.20	0.80	1.02	1.00	1.00	1.00	1.00	1.00	1.92	0.96	0.50	0.50	8
5	7.00	7.00	2.00	6.93	195.57	0.38	4	5.81	0.27	0.21	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.92	0.96	0.50	0.50	9
6	8.00	8.00	2.00	6.93	195.57	0.38	4	5.81	0.27	0.21	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.92	0.96	0.50	0.50	9
7	9.00	9.00	2.00	6.93	195.57	0.38	4	5.81	0.27	0.21	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.92	0.96	0.50	0.50	9
8	10.00	10.00	2.00	6.93	195.57	0.38	4	5.81	0.27	0.21	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.92	0.96	0.50	0.50	9
9	7.00	7.00	3.00	7.93	194.57	0.38	4	5.81	0.27	0.21	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	1.92	0.96	0.50	0.50	9
10	8.00	8.00	3.00	7.93	194.57	0.38	4	5.81	0.27	0.21	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.92	0.96	0.50	0.50	9
11	9.00	9.00	3.00	7.93	194.57	0.38	4	5.81	0.27	0.21	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.92	0.96	0.50	0.50	9
12	10.00	10.00	3.00	7.93	194.57	0.38	4	5.81	0.27	0.21	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.92	0.96	0.50	0.50	9

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.57m.
- 3) Calculations are considering the effect of water table at FGL.

Appendix – 19A

Calculation of Safe Load carrying capacity of piles socketed inside rock (Near IBH 37) (Silo utility building cum HCSD pump house)

Project Name: - Proposed structures of thermal power project of NTTTP at Hirma, Talabira

1.0 Introduction

In situations where overburden offering low bearing pressure is followed by rock at relatively shallower depths, end bearing piles is the suitable foundation option. Piles in rocks and weathered rocks of varying degree of weathering derive their capacity by end bearing and socket side resistance.

In situations, where, rock strata comprises of highly fragmented rock, as in present case, where RQD is nil or $(CR+RQD)/2$ is less than 30 % or when the crushing strength is less than 10 MPa, the appropriate approach would be of that suggested by Cole & Stroud.

In present site overburden soils overlay fractured / laminated / foliated rock. The founding stratum having highly fragmented rock with nil RQD and $(CR+RQD)/2$ to be less than 30 %, the approach suggested by Cole and Stroud as per Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 Pa/S2 has been used for safe load calculations.

An illustrative calculation of safe load on pile and summary of pile capacities is as follows,

2.0 Sub soil strata Characterization

General stratification at the location of boreholes IBH 37 show primarily two characterized layers,

1. Overburden comprising of fine to very fine grained, clays of intermediate plasticity and fine to very fine grained, cemented clayey sand with occasional to some gravels upto 7.30m (i.e. RL 190.27m)
2. Second characterized layer below the overburden soils comprises of Highly weathered, weak, brownish, fine to medium grained, friable rock and Moderately weathered, moderately weak, brownish grey, fine to medium grained, rock with closely spaced discontinuities upto 10.50m (i.e. RL 187.07m).

3.0 Design Considerations

1. Length of socket considered 3D from depth of rock encountered.
2. The pile is considered to have socket length below 7.30 m below NGL (i.e. RL 182.21 m) depth.
3. For present case of pile terminating in highly weathered rock. SPT at depths between 7.30 to 10.50m (between RL 190.27 to 187.07 m) is > 100 with just 9.0 (average) cm penetration in 60 blows. SPT can be extrapolated for 30 cm i.e. $60 * 30 / 9.00 = 200$.
Based on recommendation of fig no. 3 in B 8 in Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 P1/S2, average shear strength q_c corresponding to assumed SPT of 200 may be taken as 1300 kN/m^2
4. Allowable Capacity of pile socketed into rock $Q_a = R_e + R_{sf} = C_{u1} N_c \pi B^2 / 4(F_s=3) + \alpha C_{u2} \pi BL / (F_s=6)$

4.0 Safe Load on Pile in Compression

Where,

End bearing component, $R_e = C_{u1} N_c \pi B^2 / 4F_s$,

C_{u1} = Shear strength below base of pile = 1300 kN/m^2

B = diameter of the pile = d

F_s = Factor of Safety = 3

$N_c = 9$

Therefore, $R_e = 3061.5 d^2$

Skin friction component of socketed length of pile, $R_{sf} = \alpha C_{u2} \pi BL / F_s$

$\alpha = 0.9$ (recommended value in IS 2911 P1/S2)

L = length of the socket = 3 D

C_{u2} = Ultimate shear strength along socket length which shall be restricted to shear capacity of concrete of the pile = 1300 kN/m²

F_s = Factor of Safety = 6

Therefore, $R_{sf} = 1836.9 d^2$

Thus,

$$Q_a = c_{u1} N_c \cdot \frac{\pi B^2}{4 F_s} + \alpha c_{u2} \cdot \frac{\pi B L}{F_s}$$

$$= 3061.5 d^2 + 1836.9 d^2 = 4898.4 d^2$$

Substituting the values of various diameters and socket lengths equal to 3 times diameter, allowable load on single pile can be summarized as follows,

Summary of the Safe load calculation in Compression

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	14.03	14.51	14.93
Termination level RL in m	188.47	187.99	187.57
End Bearing Component in kN	1102.1	1768.3	2479.8
Friction Component in kN	661.3	1060.9	1487.9
Safe load in Compression in kN	1763.4	2829.3	3967.7
Safe load in Compression in T	176	283	397

5.0 Safe Load on Pile in uplift

For 5.00m cutoff from FGL

The overburden soils, though, will not contribute in compression capacity would offer resistance in uplift capacity. The parameters of IBH 37 are considered for calculation of uplift resistance as summarized below,

Depth in m from RL 202.5 m	Cohesion in kg/cm ²	Angle of Internal Friction ϕ	Submerged density in gm/cc γ_{sub}	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 5.00	Pile cutoff level – No pile						
5.00 to 9.63	0.46	5(ignored)	0.93	0.94	NA	NA	6-10
9.63 to 10.93	0.12(ignored)	27	1.00	NA	1.00	27	20
10.93 to 12.23	0.00	34	1.00	NA	1.50	34	>100
12.23 to 22.93	Rock strata – Resistance would be as per skin friction capacity in socket as already calculated in compression capacity						

Ultimate load in skin friction,

$$Q_{uf} = \alpha_i C_{ai} A_{si} + K_i P D_i \tan \delta_i A_{si}$$

First Layer – No contribution considered – (Within Cutoff Level).

$$\text{Second Layer} - \alpha_2 C_{a2} A_{s2} = 0.94 * 4.60 * \pi * d * 4.63 = 62.90d$$

$$\text{Third Layer} - K_3 P D_3 \tan \delta_3 A_{s3} = 1.00 * 8.96 * \tan 27 * \pi * d * 1.30 = 18.65 d$$

$$\text{Fourth Layer} - K_4 P D_4 \tan \delta_4 A_{s4} = 1.50 * 10.08 * \tan 34 * \pi * d * 1.30 = 41.65 d$$

Fifth Layer – 1836.90 d² in rock socket

$$\text{Substituting, ultimate load } q_{uf} = 1232.02 d + 1836.9 d^2$$

The safe load in uplift is worked out (considering the safety factor of 2.50 for overburden soils) and summarized below,

Safe Load on Piles in Uplift (in Ton)

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	14.03	14.51	14.93
Termination level RL in m	188.47	187.99	187.57
Safe load in Uplift in kN	956.97	1435.53	1931.42
Self-weight of pile in kN	38.28	64.68	94.71
Safe load in Uplift in T (Considering self-weight of pile)	99.53	150.02	202.61

6.0 Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60	0.76	0.90
Subgrade reaction in MN/m^3		8.64	8.64	8.64
Stiffness factor T in m		1.83	2.21	2.53
Depth of fixity in m	Free Head	3.50	4.20	4.80
	Fixed Head	4.00	4.80	5.50
Allowable Horizontal Force in T	Free Head	6.30	9.20	12.10
	Fixed Head	16.80	24.50	32.10
Allowable Moment capacity in Tm	Free Head	7.71	13.59	20.39
	Fixed Head	27.43	48.38	72.59

7.0 Notes

1. Pile shall be terminated after socketing 3D inside rock.
2. Initial and routine pile load test is required to verify the actual carrying capacity of pile in compression, uplift and lateral loads.
3. For design and construction, specification of IS: 2911, P1/S2, IS: 456, 2000 shall strictly be followed.

(Dr. K. K. Thaker)

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 20 (For IBH-39 (ASH Water PH Pipe rack))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:195.45m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 20.1) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 20.2)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
5.50	189.95	12.55	1.50	1.50	44	126	201	44	44
5.50	189.95	12.55	2.00	2.00	42	94	151	42	42
5.50	189.95	12.55	2.50	2.50	40	75	121	40	40
5.50	189.95	12.55	3.00	3.00	40	63	100	40	40
6.00	189.45	13.05	1.50	1.50	49	126	201	49	49
6.00	189.45	13.05	2.00	2.00	46	94	151	46	46
6.00	189.45	13.05	2.50	2.50	44	75	121	44	44
6.00	189.45	13.05	3.00	3.00	43	63	100	43	43
6.50	188.95	13.55	1.50	1.50	54	126	201	54	54
6.50	188.95	13.55	2.00	2.00	50	94	151	50	50
6.50	188.95	13.55	2.50	2.50	48	75	121	48	48
6.50	188.95	13.55	3.00	3.00	47	63	100	47	47

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 195.45m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 20.1 (For IBH-39 (ASH Water PH Pipe rack))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree	N _c	N _q - 1	N _γ	S _c	S _q	S _γ	d _c	d _q	d _γ	i _c	i _q	i _γ	gm/cc		W _q	W _γ	
1	1.50	1.50	5.50	12.55	189.95	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	2.04	1.52	1.52	1.00	1.00	1.00	1.99	1.00	0.50	0.50	44
2	2.00	2.00	5.50	12.55	189.95	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.78	1.39	1.39	1.00	1.00	1.00	1.99	1.00	0.50	0.50	42
3	2.50	2.50	5.50	12.55	189.95	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.62	1.31	1.31	1.00	1.00	1.00	1.99	1.00	0.50	0.50	40
4	3.00	3.00	5.50	12.55	189.95	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.52	1.26	1.26	1.00	1.00	1.00	1.99	1.00	0.50	0.50	40
5	1.50	1.50	6.00	13.05	189.45	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	2.13	1.57	1.57	1.00	1.00	1.00	1.99	1.00	0.50	0.50	49
6	2.00	2.00	6.00	13.05	189.45	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.85	1.42	1.42	1.00	1.00	1.00	1.99	1.00	0.50	0.50	46
7	2.50	2.50	6.00	13.05	189.45	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.68	1.34	1.34	1.00	1.00	1.00	1.99	1.00	0.50	0.50	44
8	3.00	3.00	6.00	13.05	189.45	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.57	1.28	1.28	1.00	1.00	1.00	1.99	1.00	0.50	0.50	43
9	1.50	1.50	6.50	13.55	188.95	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	2.23	1.61	1.61	1.00	1.00	1.00	1.99	1.00	0.50	0.50	54
10	2.00	2.00	6.50	13.55	188.95	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.92	1.46	1.46	1.00	1.00	1.00	1.99	1.00	0.50	0.50	50
11	2.50	2.50	6.50	13.55	188.95	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.74	1.37	1.37	1.00	1.00	1.00	1.99	1.00	0.50	0.50	48
12	3.00	3.00	6.50	13.55	188.95	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.61	1.31	1.31	1.00	1.00	1.00	1.99	1.00	0.50	0.50	47

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 195.45m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 20.2 (For IBH-39 (ASH Water PH Pipe rack))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_1 = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D from NGL m	RL of foundation m	Depth of foundation from FGL m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	5.50	189.95	12.55	1.50	1.12	0.35	593	0.80	126	201
2	5.50	189.95	12.55	2.00	1.12	0.35	593	0.80	94	151
3	5.50	189.95	12.55	2.50	1.12	0.35	593	0.80	75	121
4	5.50	189.95	12.55	3.00	1.12	0.35	593	0.80	63	100
5	6.00	189.45	13.05	1.50	1.12	0.35	593	0.80	126	201
6	6.00	189.45	13.05	2.00	1.12	0.35	593	0.80	94	151
7	6.00	189.45	13.05	2.50	1.12	0.35	593	0.80	75	121
8	6.00	189.45	13.05	3.00	1.12	0.35	593	0.80	63	100
9	6.50	188.95	13.55	1.50	1.12	0.35	593	0.80	126	201
10	6.50	188.95	13.55	2.00	1.12	0.35	593	0.80	94	151
11	6.50	188.95	13.55	2.50	1.12	0.35	593	0.80	75	121
12	6.50	188.95	13.55	3.00	1.12	0.35	593	0.80	63	100

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 20.3 (For IBH-39 (ASH Water PH Pipe rack))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:195.45m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 20.4) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 20.5)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
5.50	189.95	12.55	3.50	3.50	39	54	86	39	39
5.50	189.95	12.55	4.00	4.00	39	47	75	39	39
5.50	189.95	12.55	5.00	5.00	40	38	60	38	40
5.50	189.95	12.55	6.00	6.00	41	31	50	31	41
6.00	189.45	13.05	3.50	3.50	43	54	86	43	43
6.00	189.45	13.05	4.00	4.00	43	47	75	43	43
6.00	189.45	13.05	5.00	5.00	43	38	60	38	43
6.00	189.45	13.05	6.00	6.00	44	31	50	31	44
6.50	188.95	13.55	3.50	3.50	46	54	86	46	46
6.50	188.95	13.55	4.00	4.00	46	47	75	46	46
6.50	188.95	13.55	5.00	5.00	46	38	60	38	46
6.50	188.95	13.55	6.00	6.00	47	31	50	31	47

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 195.45m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 20.4 (For IBH-39 (ASH Water PH Pipe rack))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree	N _c	N _q - 1	N _γ	S _c	S _q	S _γ	d _c	d _q	d _γ	i _c	i _q	i _γ	gm/cc		W _q	W _γ	
1	3.50	3.50	5.50	12.55	189.95	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.44	1.22	1.22	1.00	1.00	1.00	1.99	1.00	0.50	0.50	39
2	4.00	4.00	5.50	12.55	189.95	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.39	1.19	1.19	1.00	1.00	1.00	1.99	1.00	0.50	0.50	39
3	5.00	5.00	5.50	12.55	189.95	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.31	1.16	1.16	1.00	1.00	1.00	1.99	1.00	0.50	0.50	40
4	6.00	6.00	5.50	12.55	189.95	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.26	1.13	1.13	1.00	1.00	1.00	1.99	1.00	0.50	0.50	41
5	3.50	3.50	6.00	13.05	189.45	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.49	1.24	1.24	1.00	1.00	1.00	1.99	1.00	0.50	0.50	43
6	4.00	4.00	6.00	13.05	189.45	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.42	1.21	1.21	1.00	1.00	1.00	1.99	1.00	0.50	0.50	43
7	5.00	5.00	6.00	13.05	189.45	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.34	1.17	1.17	1.00	1.00	1.00	1.99	1.00	0.50	0.50	43
8	6.00	6.00	6.00	13.05	189.45	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.28	1.14	1.14	1.00	1.00	1.00	1.99	1.00	0.50	0.50	44
9	3.50	3.50	6.50	13.55	188.95	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.53	1.26	1.26	1.00	1.00	1.00	1.99	1.00	0.50	0.50	46
10	4.00	4.00	6.50	13.55	188.95	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.46	1.23	1.23	1.00	1.00	1.00	1.99	1.00	0.50	0.50	46
11	5.00	5.00	6.50	13.55	188.95	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.37	1.18	1.18	1.00	1.00	1.00	1.99	1.00	0.50	0.50	46
12	6.00	6.00	6.50	13.55	188.95	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.31	1.15	1.15	1.00	1.00	1.00	1.99	1.00	0.50	0.50	47

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 195.45m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 20.5 (For IBH-39 (ASH Water PH Pipe rack))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_1 = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D from NGL m	RL of foundation m	Depth of foundation from FGL m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	5.50	189.95	12.55	3.50	1.12	0.35	593	0.80	54	86
2	5.50	189.95	12.55	4.00	1.12	0.35	593	0.80	47	75
3	5.50	189.95	12.55	5.00	1.12	0.35	593	0.80	38	60
4	5.50	189.95	12.55	6.00	1.12	0.35	593	0.80	31	50
5	6.00	189.45	13.05	3.50	1.12	0.35	593	0.80	54	86
6	6.00	189.45	13.05	4.00	1.12	0.35	593	0.80	47	75
7	6.00	189.45	13.05	5.00	1.12	0.35	593	0.80	38	60
8	6.00	189.45	13.05	6.00	1.12	0.35	593	0.80	31	50
9	6.50	188.95	13.55	3.50	1.12	0.35	593	0.80	54	86
10	6.50	188.95	13.55	4.00	1.12	0.35	593	0.80	47	75
11	6.50	188.95	13.55	5.00	1.12	0.35	593	0.80	38	60
12	6.50	188.95	13.55	6.00	1.12	0.35	593	0.80	31	50

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 20.6 (For IBH-39 (ASH Water PH Pipe rack))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:195.45m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 20.7) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 20.8)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
5.50	189.95	12.55	7.00	7.00	42	27	43	27	42
5.50	189.95	12.55	8.00	8.00	43	24	38	24	38
5.50	189.95	12.55	9.00	9.00	45	21	33	21	33
5.50	189.95	12.55	10.00	10.00	46	19	30	19	30
6.00	189.45	13.05	7.00	7.00	45	27	43	27	43
6.00	189.45	13.05	8.00	8.00	46	24	38	24	38
6.00	189.45	13.05	9.00	9.00	48	21	33	21	33
6.00	189.45	13.05	10.00	10.00	49	19	30	19	30
6.50	188.95	13.55	7.00	7.00	48	27	43	27	43
6.50	188.95	13.55	8.00	8.00	49	24	38	24	38
6.50	188.95	13.55	9.00	9.00	50	21	33	21	33
6.50	188.95	13.55	10.00	10.00	52	19	30	19	30

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 195.45m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 20.7 (For IBH-39 (ASH Water PH Pipe rack))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5 γ			
	m	m				Kg/cm ²	degree	N _c	N _q - 1	N _γ	S _c	S _q	S _γ	d _c	d _q	d _γ	i _c	i _q	i _γ	gm/cc		W _q	W _γ	
1	7.00	7.00	5.50	12.55	189.95	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.22	1.11	1.11	1.00	1.00	1.00	1.99	1.00	0.50	0.50	42
2	8.00	8.00	5.50	12.55	189.95	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.19	1.10	1.10	1.00	1.00	1.00	1.99	1.00	0.50	0.50	43
3	9.00	9.00	5.50	12.55	189.95	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.17	1.09	1.09	1.00	1.00	1.00	1.99	1.00	0.50	0.50	45
4	10.00	10.00	5.50	12.55	189.95	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.16	1.08	1.08	1.00	1.00	1.00	1.99	1.00	0.50	0.50	46
5	7.00	7.00	6.00	13.05	189.45	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.24	1.12	1.12	1.00	1.00	1.00	1.99	1.00	0.50	0.50	45
6	8.00	8.00	6.00	13.05	189.45	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.21	1.11	1.11	1.00	1.00	1.00	1.99	1.00	0.50	0.50	46
7	9.00	9.00	6.00	13.05	189.45	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.19	1.09	1.09	1.00	1.00	1.00	1.99	1.00	0.50	0.50	48
8	10.00	10.00	6.00	13.05	189.45	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.17	1.08	1.08	1.00	1.00	1.00	1.99	1.00	0.50	0.50	49
9	7.00	7.00	6.50	13.55	188.95	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.26	1.13	1.13	1.00	1.00	1.00	1.99	1.00	0.50	0.50	48
10	8.00	8.00	6.50	13.55	188.95	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.23	1.12	1.12	1.00	1.00	1.00	1.99	1.00	0.50	0.50	49
11	9.00	9.00	6.50	13.55	188.95	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.20	1.10	1.10	1.00	1.00	1.00	1.99	1.00	0.50	0.50	50
12	10.00	10.00	6.50	13.55	188.95	0.03	28	19.72	9.13	10.49	1.30	1.20	0.80	1.18	1.09	1.09	1.00	1.00	1.00	1.99	1.00	0.50	0.50	52

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 195.45m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 20.8 (For IBH-39 (ASH Water PH Pipe rack))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_1 = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D from NGL m	RL of foundation m	Depth of foundation from FGL m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	5.50	189.95	12.55	7.00	1.12	0.35	593	0.80	27	43
2	5.50	189.95	12.55	8.00	1.12	0.35	593	0.80	24	38
3	5.50	189.95	12.55	9.00	1.12	0.35	593	0.80	21	33
4	5.50	189.95	12.55	10.00	1.12	0.35	593	0.80	19	30
5	6.00	189.45	13.05	7.00	1.12	0.35	593	0.80	27	43
6	6.00	189.45	13.05	8.00	1.12	0.35	593	0.80	24	38
7	6.00	189.45	13.05	9.00	1.12	0.35	593	0.80	21	33
8	6.00	189.45	13.05	10.00	1.12	0.35	593	0.80	19	30
9	6.50	188.95	13.55	7.00	1.12	0.35	593	0.80	27	43
10	6.50	188.95	13.55	8.00	1.12	0.35	593	0.80	24	38
11	6.50	188.95	13.55	9.00	1.12	0.35	593	0.80	21	33
12	6.50	188.95	13.55	10.00	1.12	0.35	593	0.80	19	30

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 20.9 (For IBH-39 (ASH Water PH Pipe rack))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:195.45m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	194.45	8.05	1.50	1.50	6	17	27	6	6
1.00	194.45	8.05	2.00	2.00	6	13	20	6	6
1.00	194.45	8.05	2.50	2.50	6	10	16	6	6
1.00	194.45	8.05	3.00	3.00	7	8	14	7	7
2.00	193.45	9.05	1.50	1.50	9	17	27	9	9
2.00	193.45	9.05	2.00	2.00	9	13	20	9	9
2.00	193.45	9.05	2.50	2.50	9	10	16	9	9
2.00	193.45	9.05	3.00	3.00	9	8	14	8	9
3.00	192.45	10.05	1.50	1.50	12	17	27	12	12
3.00	192.45	10.05	2.00	2.00	12	13	20	12	12
3.00	192.45	10.05	2.50	2.50	11	10	16	10	11
3.00	192.45	10.05	3.00	3.00	11	8	14	8	11

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 195.45m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-20.10 (For IBH-39 (ASH Water PH Pipe rack))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ	N _c	N _q - 1	N _γ	S _c	S _q	S _γ	d _c	d _q	d _γ	i _c	i _q	i _γ	γ	0.5 γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _γ	
1	1.50	1.50	1.00	8.05	194.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.18	1.09	1.09	1.00	1.00	1.00	1.95	0.98	0.50	0.50	6
2	2.00	2.00	1.00	8.05	194.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.13	1.07	1.07	1.00	1.00	1.00	1.95	0.98	0.50	0.50	6
3	2.50	2.50	1.00	8.05	194.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.11	1.05	1.05	1.00	1.00	1.00	1.95	0.98	0.50	0.50	6
4	3.00	3.00	1.00	8.05	194.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.09	1.04	1.04	1.00	1.00	1.00	1.95	0.98	0.50	0.50	7
5	1.50	1.50	2.00	9.05	193.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.36	1.18	1.18	1.00	1.00	1.00	1.95	0.98	0.50	0.50	9
6	2.00	2.00	2.00	9.05	193.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.27	1.13	1.13	1.00	1.00	1.00	1.95	0.98	0.50	0.50	9
7	2.50	2.50	2.00	9.05	193.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.21	1.11	1.11	1.00	1.00	1.00	1.95	0.98	0.50	0.50	9
8	3.00	3.00	2.00	9.05	193.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.18	1.09	1.09	1.00	1.00	1.00	1.95	0.98	0.50	0.50	9
9	1.50	1.50	3.00	10.05	192.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.54	1.27	1.27	1.00	1.00	1.00	1.95	0.98	0.50	0.50	12
10	2.00	2.00	3.00	10.05	192.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.40	1.20	1.20	1.00	1.00	1.00	1.95	0.98	0.50	0.50	12
11	2.50	2.50	3.00	10.05	192.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.32	1.16	1.16	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11
12	3.00	3.00	3.00	10.05	192.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.27	1.13	1.13	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 195.45m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-20.11 (For IBH-39 (ASH Water PH Pipe rack))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_1 = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D from NGL m	RL of foundation m	Depth of foundation from FGL m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	194.45	8.05	1.50	1.12	0.35	80	0.80	17	27
2	1.00	194.45	8.05	2.00	1.12	0.35	80	0.80	13	20
3	1.00	194.45	8.05	2.50	1.12	0.35	80	0.80	10	16
4	1.00	194.45	8.05	3.00	1.12	0.35	80	0.80	8	14
5	2.00	193.45	9.05	1.50	1.12	0.35	80	0.80	17	27
6	2.00	193.45	9.05	2.00	1.12	0.35	80	0.80	13	20
7	2.00	193.45	9.05	2.50	1.12	0.35	80	0.80	10	16
8	2.00	193.45	9.05	3.00	1.12	0.35	80	0.80	8	14
9	3.00	192.45	10.05	1.50	1.12	0.35	80	0.80	17	27
10	3.00	192.45	10.05	2.00	1.12	0.35	80	0.80	13	20
11	3.00	192.45	10.05	2.50	1.12	0.35	80	0.80	10	16
12	3.00	192.45	10.05	3.00	1.12	0.35	80	0.80	8	14

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 20.12 (For IBH-39 (ASH Water PH Pipe rack))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:195.45m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	194.45	8.05	3.50	3.50	7	7	12	7	7
1.00	194.45	8.05	4.00	4.00	7	6	10	6	7
1.00	194.45	8.05	5.00	5.00	8	5	8	5	8
1.00	194.45	8.05	6.00	6.00	8	4	7	4	7
2.00	193.45	9.05	3.50	3.50	9	7	12	7	9
2.00	193.45	9.05	4.00	4.00	9	6	10	6	9
2.00	193.45	9.05	5.00	5.00	10	5	8	5	8
2.00	193.45	9.05	6.00	6.00	10	4	7	4	7
3.00	192.45	10.05	3.50	3.50	12	7	12	7	12
3.00	192.45	10.05	4.00	4.00	12	6	10	6	10
3.00	192.45	10.05	5.00	5.00	12	5	8	5	8
3.00	192.45	10.05	6.00	6.00	12	4	7	4	7

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 195.45m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-20.13 (For IBH-39 (ASH Water PH Pipe rack))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	1.00	8.05	194.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	1.95	0.98	0.50	0.50	7
2	4.00	4.00	1.00	8.05	194.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.07	1.03	1.03	1.00	1.00	1.00	1.95	0.98	0.50	0.50	7
3	5.00	5.00	1.00	8.05	194.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.05	1.03	1.03	1.00	1.00	1.00	1.95	0.98	0.50	0.50	8
4	6.00	6.00	1.00	8.05	194.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.04	1.02	1.02	1.00	1.00	1.00	1.95	0.98	0.50	0.50	8
5	3.50	3.50	2.00	9.05	193.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.15	1.08	1.08	1.00	1.00	1.00	1.95	0.98	0.50	0.50	9
6	4.00	4.00	2.00	9.05	193.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.13	1.07	1.07	1.00	1.00	1.00	1.95	0.98	0.50	0.50	9
7	5.00	5.00	2.00	9.05	193.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.11	1.05	1.05	1.00	1.00	1.00	1.95	0.98	0.50	0.50	10
8	6.00	6.00	2.00	9.05	193.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.09	1.04	1.04	1.00	1.00	1.00	1.95	0.98	0.50	0.50	10
9	3.50	3.50	3.00	10.05	192.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.23	1.11	1.11	1.00	1.00	1.00	1.95	0.98	0.50	0.50	12
10	4.00	4.00	3.00	10.05	192.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.20	1.10	1.10	1.00	1.00	1.00	1.95	0.98	0.50	0.50	12
11	5.00	5.00	3.00	10.05	192.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.16	1.08	1.08	1.00	1.00	1.00	1.95	0.98	0.50	0.50	12
12	6.00	6.00	3.00	10.05	192.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.13	1.07	1.07	1.00	1.00	1.00	1.95	0.98	0.50	0.50	12

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 195.45m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-20.14 (For IBH-39 (ASH Water PH Pipe rack))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_1 = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D from NGL m	RL of foundation m	Depth of foundation from FGL m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	194.45	8.05	3.50	1.12	0.35	80	0.80	7	12
2	1.00	194.45	8.05	4.00	1.12	0.35	80	0.80	6	10
3	1.00	194.45	8.05	5.00	1.12	0.35	80	0.80	5	8
4	1.00	194.45	8.05	6.00	1.12	0.35	80	0.80	4	7
5	2.00	193.45	9.05	3.50	1.12	0.35	80	0.80	7	12
6	2.00	193.45	9.05	4.00	1.12	0.35	80	0.80	6	10
7	2.00	193.45	9.05	5.00	1.12	0.35	80	0.80	5	8
8	2.00	193.45	9.05	6.00	1.12	0.35	80	0.80	4	7
9	3.00	192.45	10.05	3.50	1.12	0.35	80	0.80	7	12
10	3.00	192.45	10.05	4.00	1.12	0.35	80	0.80	6	10
11	3.00	192.45	10.05	5.00	1.12	0.35	80	0.80	5	8
12	3.00	192.45	10.05	6.00	1.12	0.35	80	0.80	4	7

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 20.15 (For IBH-39 (ASH Water PH Pipe rack))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:195.45m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	194.45	8.05	7.00	7.00	9	4	6	4	6
1.00	194.45	8.05	8.00	8.00	9	3	5	3	5
1.00	194.45	8.05	9.00	9.00	10	3	5	3	5
1.00	194.45	8.05	10.00	10.00	10	3	4	3	4
2.00	193.45	9.05	7.00	7.00	11	4	6	4	6
2.00	193.45	9.05	8.00	8.00	11	3	5	3	5
2.00	193.45	9.05	9.00	9.00	12	3	5	3	5
2.00	193.45	9.05	10.00	10.00	12	3	4	3	4
3.00	192.45	10.05	7.00	7.00	13	4	6	4	6
3.00	192.45	10.05	8.00	8.00	13	3	5	3	5
3.00	192.45	10.05	9.00	9.00	14	3	5	3	5
3.00	192.45	10.05	10.00	10.00	15	3	4	3	4

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 195.45m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-20.16 (For IBH-39 (ASH Water PH Pipe rack))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5 γ			
	m	m				Kg/cm ²	degree	N _c	N _q - 1	N _γ	S _c	S _q	S _γ	d _c	d _q	d _γ	i _c	i _q	i _γ	gm/cc		W _q	W _γ	
1	7.00	7.00	1.00	8.05	194.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.04	1.02	1.02	1.00	1.00	1.00	1.95	0.98	0.50	0.50	9
2	8.00	8.00	1.00	8.05	194.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.03	1.02	1.02	1.00	1.00	1.00	1.95	0.98	0.50	0.50	9
3	9.00	9.00	1.00	8.05	194.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.03	1.01	1.01	1.00	1.00	1.00	1.95	0.98	0.50	0.50	10
4	10.00	10.00	1.00	8.05	194.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.03	1.01	1.01	1.00	1.00	1.00	1.95	0.98	0.50	0.50	10
5	7.00	7.00	2.00	9.05	193.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11
6	8.00	8.00	2.00	9.05	193.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.07	1.03	1.03	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11
7	9.00	9.00	2.00	9.05	193.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.06	1.03	1.03	1.00	1.00	1.00	1.95	0.98	0.50	0.50	12
8	10.00	10.00	2.00	9.05	193.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.05	1.03	1.03	1.00	1.00	1.00	1.95	0.98	0.50	0.50	12
9	7.00	7.00	3.00	10.05	192.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.11	1.06	1.06	1.00	1.00	1.00	1.95	0.98	0.50	0.50	13
10	8.00	8.00	3.00	10.05	192.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.10	1.05	1.05	1.00	1.00	1.00	1.95	0.98	0.50	0.50	13
11	9.00	9.00	3.00	10.05	192.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.09	1.04	1.04	1.00	1.00	1.00	1.95	0.98	0.50	0.50	14
12	10.00	10.00	3.00	10.05	192.45	0.06	24	12.48	3.89	3.70	1.30	1.20	0.80	1.08	1.04	1.04	1.00	1.00	1.00	1.95	0.98	0.50	0.50	15

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 195.45m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-20.17 (For IBH-39 (ASH Water PH Pipe rack))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

$$S_1 = C_d q_{net} B \{ (1 - \mu^2) / E \}$$

Project:- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Depth of Foundation D from NGL m	RL of foundation m	Depth of foundation from FGL m	Width of Foundation B m	Shape & Rigid factor Cd	Poisson's Ratio μ	Modulus of Elasticity of Soil E Kg / cm ²	Rigidity Factor	Safe Bearing Pressure	
									For 25 mm Settlement T / m ²	For 40 mm Settlement T / m ²
1	1.00	194.45	8.05	7.00	1.12	0.35	80	0.80	4	6
2	1.00	194.45	8.05	8.00	1.12	0.35	80	0.80	3	5
3	1.00	194.45	8.05	9.00	1.12	0.35	80	0.80	3	5
4	1.00	194.45	8.05	10.00	1.12	0.35	80	0.80	3	4
5	2.00	193.45	9.05	7.00	1.12	0.35	80	0.80	4	6
6	2.00	193.45	9.05	8.00	1.12	0.35	80	0.80	3	5
7	2.00	193.45	9.05	9.00	1.12	0.35	80	0.80	3	5
8	2.00	193.45	9.05	10.00	1.12	0.35	80	0.80	3	4
9	3.00	192.45	10.05	7.00	1.12	0.35	80	0.80	4	6
10	3.00	192.45	10.05	8.00	1.12	0.35	80	0.80	3	5
11	3.00	192.45	10.05	9.00	1.12	0.35	80	0.80	3	5
12	3.00	192.45	10.05	10.00	1.12	0.35	80	0.80	3	4

Appendix – 20A

Calculation of Safe Load carrying capacity of piles socketed inside rock (Near IBH 39, BH-52) (ASH Water PH Pipe rack)

Project Name: - Proposed structures of thermal power project of NTTTP at Hirma, Talabira

1.0 Introduction

In situations where overburden offering low bearing pressure is followed by rock at relatively shallower depths, end bearing piles is the suitable foundation option. Piles in rocks and weathered rocks of varying degree of weathering derive their capacity by end bearing and socket side resistance.

In situations, where, rock strata comprises of highly fragmented rock, as in present case, where RQD is nil or $(CR+RQD)/2$ is less than 30 % or when the crushing strength is less than 10 MPa, the appropriate approach would be of that suggested by Cole & Stroud.

In present site overburden soils overlay fractured / laminated / foliated rock. The founding stratum having highly fragmented rock with nil RQD and $(CR+RQD)/2$ to be less than 30 %, the approach suggested by Cole and Stroud as per Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 P1/S2 has been used for safe load calculations.

An illustrative calculation of safe load on pile and summary of pile capacities is as follows,

2.0 Sub soil strata Characterization

General stratification at the location of boreholes IBH 39 show primarily two characterized layers,

1. Overburden comprising of Yellowish brown, fine to medium grained, clayey sand with little gravels and Brownish yellow, very fine grained, clays of intermediate plasticity upto 6.80m (i.e. RL 188.65m)
2. Second characterized layer below the overburden soils comprises of Moderately weathered, moderately weak, yellowish brown, fine to medium grained, fractured rock upto 10.00m (i.e. RL 185.45m).

3.0 Design Considerations

1. Length of socket considered 3D from depth of rock encountered.
2. The pile is considered to have socket length below 6.80 m below NGL (i.e. RL 188.65 m) depth.
3. For present case of pile terminating in highly weathered rock. SPT at depths between 6.80 to 10.00m (between RL 188.65 to 185.45 m) is > 100 with just 4.0 cm penetration in 50 blows. SPT can be extrapolated for 30 cm i.e. $50 * 30 / 4.00 = 375$.
Based on recommendation of fig no. 3 in B 8 in Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 P1/S2, average shear strength q_c corresponding to assumed SPT of 200 may be taken as 1300 kN/m²
4. Allowable Capacity of pile socketed into rock $Q_a = R_e + R_{sf} = C_{u1} N_c \pi B^2 / 4(F_s=3) + \alpha C_{u2} \pi BL / (F_s=6)$

4.0 Safe Load on Pile in Compression

Where,

End bearing component, $R_e = C_{u1} N_c \pi B^2 / 4F_s$,

C_{u1} = Shear strength below base of pile = 1300 kN/m²

B = diameter of the pile = d

F_s = Factor of Safety = 3

$N_c = 9$

Therefore, **$R_e = 3061.5 d^2$**

Skin friction component of socketed length of pile, $R_{sf} = \alpha C_{u2} \pi BL / F_s$

$\alpha = 0.9$ (recommended value in IS 2911 P1/S2)

L = length of the socket = $3 D$

C_{u2} = Ultimate shear strength along socket length which shall be restricted to shear capacity of concrete of the pile = 1300 kN/m^2

F_s = Factor of Safety = 6

Therefore, $R_{sf} = 1836.9 d^2$

Thus,

$$Q_a = c_{u1} N_c \cdot \frac{\pi B^2}{4 F_s} + \alpha c_{u2} \cdot \frac{\pi B L}{F_s}$$

$$= 3061.5 d^2 + 1836.9 d^2 = 4898.4 d^2$$

Substituting the values of various diameters and socket lengths equal to 3 times diameter, allowable load on single pile can be summarized as follows,

Summary of the Safe load calculation in Compression

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	15.65	16.13	16.55
Termination level RL in m	186.85	186.37	185.95
End Bearing Component in kN	1102.1	1768.3	2479.8
Friction Component in kN	661.3	1060.9	1487.9
Safe load in Compression in kN	1763.4	2829.3	3967.7
Safe load in Compression in T	176	283	397

5.0 Safe Load on Pile in uplift

For 6.00m cutoff from FGL

The overburden soils, though, will not contribute in compression capacity would offer resistance in uplift capacity. The parameters of IBH 39 are considered for calculation of uplift resistance as summarized below,

Depth in m from RL 202.5 m	Cohesion in kg/cm ²	Angle of Internal Friction ϕ	Submerged density in gm/cc γ_{sub}	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 7.00	Pile cutoff level – No pile						
7.00 to 8.75	0.40	0	0.95	1.00	NA	NA	10
8.75 to 12.85	0.05(ignored)	26	0.97	NA	1.00	26	7-10
12.85 to 13.85	0	34	0.99	NA	1.50	34	>100
13.85 to 24.55	Rock strata – Resistance would be as per skin friction capacity in socket as already calculated in compression capacity						

Ultimate load in skin friction,

$$Q_{uf} = \alpha_i C_{ai} A_{si} + K_i P D_i \tan \delta_i A_{si}$$

First Layer – No contribution considered – (Within Cutoff Level).

$$\text{Second Layer} - \alpha_2 C_{a2} A_{s2} = 1.00 * 4.00 * \pi d * 1.75 = 21.99d$$

$$\text{Third Layer} - K_3 P D_3 \tan \delta_3 A_{s3} = 1.00 * 8.44 * \tan 26 * \pi d * 4.10 = 53.02 d$$

$$\text{Fourth Layer} - K_4 P D_4 \tan \delta_4 A_{s4} = 1.50 * 9.87 * \tan 34 * \pi d * 1.00 = 31.37 d$$

Fifth Layer – $1836.90 d^2$ in rock socket

$$\text{Substituting, ultimate load } q_{uf} = 1063.80 d + 1836.9 d^2$$

The safe load in uplift is worked out (considering the safety factor of 2.50 for overburden soils) and summarized below,

Safe Load on Piles in Uplift (in Ton)

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	15.65	16.13	16.55
Termination level RL in m	186.85	186.37	185.95
Safe load in Uplift in kN	916.60	1384.39	1870.86
Self-weight of pile in kN	36.67	62.10	91.09
Safe load in Uplift in T (Considering self-weight of pile)	95.33	144.65	196.20

6.0 Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60	0.76	0.90
Subgrade reaction in MN/m ³		14.40	14.40	14.40
Stiffness factor T in m		1.65	2.00	2.29
Depth of fixity in m	Free Head	3.10	3.80	4.30
	Fixed Head	3.60	4.40	5.00
Allowable Horizontal Force in T	Free Head	8.60	12.60	16.50
	Fixed Head	22.80	33.30	43.60
Allowable Moment capacity in Tm	Free Head	9.45	16.67	25.02
	Fixed Head	33.65	59.34	89.04

7.0 Notes

1. Pile shall be terminated after socketing 3D inside rock.
2. Initial and routine pile load test is required to verify the actual carrying capacity of pile in compression, uplift and lateral loads.
3. For design and construction, specification of IS: 2911, P1/S2, IS: 456, 2000 shall strictly be followed.

(Dr. K. K. Thaker)

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 21 (For IBH-40 (Ash water transfer pump house, settling cum surge tank))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:193.60m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 21.1) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 21.2)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
4.50	189.10	13.40	1.50	1.50	59	149	239	59	59
4.50	189.10	13.40	2.00	2.00	54	113	180	54	54
4.50	189.10	13.40	2.50	2.50	50	91	146	50	50
4.50	189.10	13.40	3.00	3.00	48	77	124	48	48
5.00	188.60	13.90	1.50	1.50	62	150	239	62	62
5.00	188.60	13.90	2.00	2.00	56	114	182	56	56
5.00	188.60	13.90	2.50	2.50	52	93	149	52	52
5.00	188.60	13.90	3.00	3.00	49	79	126	49	49
5.50	188.10	14.40	1.50	1.50	65	152	243	65	65
5.50	188.10	14.40	2.00	2.00	58	116	186	58	58
5.50	188.10	14.40	2.50	2.50	54	95	153	54	54
5.50	188.10	14.40	3.00	3.00	51	81	130	51	51

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 193.60m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 21.1 (For IBH-40 (Ash water transfer pump house, settling cum surge tank))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	4.50	13.40	189.10	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.66	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	59
2	2.00	2.00	4.50	13.40	189.10	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.49	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	54
3	2.50	2.50	4.50	13.40	189.10	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.40	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	50
4	3.00	3.00	4.50	13.40	189.10	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.33	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	48
5	1.50	1.50	5.00	13.90	188.60	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.73	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	62
6	2.00	2.00	5.00	13.90	188.60	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.55	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	56
7	2.50	2.50	5.00	13.90	188.60	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.44	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	52
8	3.00	3.00	5.00	13.90	188.60	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.37	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	49
9	1.50	1.50	5.50	14.40	188.10	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.81	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	65
10	2.00	2.00	5.50	14.40	188.10	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.60	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	58
11	2.50	2.50	5.50	14.40	188.10	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.48	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	54
12	3.00	3.00	5.50	14.40	188.10	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.40	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	51

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 193.60m.
- 3) Calculations are considering the effect of water table at FGL.

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APPENDIX - 21.2 (For IBH-40 (Ash water transfer pump house, settling cum surge tank))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	4.50	189.10	13.40	1.50	1.50	0.40	1005	1.12	0.80	0.0018	3.00	0.70	0.73	0.80	149	239
2	4.50	189.10	13.40	2.00	2.00	0.40	1005	1.12	0.80	0.0018	3.00	0.70	0.73	0.80	113	180
3	4.50	189.10	13.40	2.50	2.50	0.40	1005	1.12	0.80	0.0018	3.00	0.70	0.73	0.80	91	146
4	4.50	189.10	13.40	3.00	3.00	0.40	1005	1.12	0.80	0.0018	3.00	0.70	0.73	0.80	77	124
5	5.00	188.60	13.90	1.50	1.50	0.40	1005	1.12	0.80	0.0018	2.50	0.70	0.73	0.80	150	239
6	5.00	188.60	13.90	2.00	2.00	0.40	1005	1.12	0.80	0.0018	2.50	0.70	0.73	0.80	114	182
7	5.00	188.60	13.90	2.50	2.50	0.40	1005	1.12	0.80	0.0018	2.50	0.70	0.73	0.80	93	149
8	5.00	188.60	13.90	3.00	3.00	0.40	1005	1.12	0.80	0.0018	2.50	0.70	0.73	0.80	79	126
9	5.50	188.10	14.40	1.50	1.50	0.40	1005	1.12	0.80	0.0018	2.00	0.70	0.72	0.80	152	243
10	5.50	188.10	14.40	2.00	2.00	0.40	1005	1.12	0.80	0.0018	2.00	0.70	0.73	0.80	116	186
11	5.50	188.10	14.40	2.50	2.50	0.40	1005	1.12	0.80	0.0018	2.00	0.70	0.73	0.80	95	153
12	5.50	188.10	14.40	3.00	3.00	0.40	1005	1.12	0.80	0.0018	2.00	0.70	0.73	0.80	81	130

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APPENDIX - 21.3 (For IBH-40 (Ash water transfer pump house, settling cum surge tank))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:193.60m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 21.4) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 21.5)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
4.50	189.10	13.40	3.50	3.50	46	68	108	46	46
4.50	189.10	13.40	4.00	4.00	45	60	96	45	45
4.50	189.10	13.40	5.00	5.00	44	49	79	44	44
4.50	189.10	13.40	6.00	6.00	43	42	67	42	43
5.00	188.60	13.90	3.50	3.50	48	69	111	48	48
5.00	188.60	13.90	4.00	4.00	46	62	98	46	46
5.00	188.60	13.90	5.00	5.00	45	51	81	45	45
5.00	188.60	13.90	6.00	6.00	44	43	69	43	44
5.50	188.10	14.40	3.50	3.50	49	71	114	49	49
5.50	188.10	14.40	4.00	4.00	48	64	102	48	48
5.50	188.10	14.40	5.00	5.00	46	52	84	46	46
5.50	188.10	14.40	6.00	6.00	44	45	72	44	44

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 193.60m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 21.4 (For IBH-40 (Ash water transfer pump house, settling cum surge tank))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	4.50	13.40	189.10	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.28	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	46
2	4.00	4.00	4.50	13.40	189.10	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.25	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	45
3	5.00	5.00	4.50	13.40	189.10	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.20	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	44
4	6.00	6.00	4.50	13.40	189.10	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.16	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	43
5	3.50	3.50	5.00	13.90	188.60	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.31	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	48
6	4.00	4.00	5.00	13.90	188.60	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.27	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	46
7	5.00	5.00	5.00	13.90	188.60	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.22	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	45
8	6.00	6.00	5.00	13.90	188.60	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.18	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	44
9	3.50	3.50	5.50	14.40	188.10	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.35	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	49
10	4.00	4.00	5.50	14.40	188.10	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.30	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	48
11	5.00	5.00	5.50	14.40	188.10	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.24	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	46
12	6.00	6.00	5.50	14.40	188.10	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.20	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	44

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 193.60m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 21.5 (For IBH-40 (Ash water transfer pump house, settling cum surge tank))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	4.50	189.10	13.40	3.50	3.50	0.40	1005	1.12	0.80	0.0018	3.00	0.70	0.73	0.80	68	108
2	4.50	189.10	13.40	4.00	4.00	0.40	1005	1.12	0.80	0.0018	3.00	0.70	0.73	0.80	60	96
3	4.50	189.10	13.40	5.00	5.00	0.40	1005	1.12	0.80	0.0018	3.00	0.70	0.74	0.80	49	79
4	4.50	189.10	13.40	6.00	6.00	0.40	1005	1.12	0.80	0.0018	3.00	0.70	0.77	0.80	42	67
5	5.00	188.60	13.90	3.50	3.50	0.40	1005	1.12	0.80	0.0018	2.50	0.70	0.73	0.80	69	111
6	5.00	188.60	13.90	4.00	4.00	0.40	1005	1.12	0.80	0.0018	2.50	0.70	0.73	0.80	62	98
7	5.00	188.60	13.90	5.00	5.00	0.40	1005	1.12	0.80	0.0018	2.50	0.70	0.73	0.80	51	81
8	5.00	188.60	13.90	6.00	6.00	0.40	1005	1.12	0.80	0.0018	2.50	0.70	0.75	0.80	43	69
9	5.50	188.10	14.40	3.50	3.50	0.40	1005	1.12	0.80	0.0018	2.00	0.70	0.73	0.80	71	114
10	5.50	188.10	14.40	4.00	4.00	0.40	1005	1.12	0.80	0.0018	2.00	0.70	0.73	0.80	64	102
11	5.50	188.10	14.40	5.00	5.00	0.40	1005	1.12	0.80	0.0018	2.00	0.70	0.73	0.80	52	84
12	5.50	188.10	14.40	6.00	6.00	0.40	1005	1.12	0.80	0.0018	2.00	0.70	0.74	0.80	45	72

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 21.6 (For IBH-40 (Ash water transfer pump house, settling cum surge tank))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:193.60m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 21.7) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 21.8)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
4.50	189.10	13.40	7.00	7.00	42	36	58	36	42
4.50	189.10	13.40	8.00	8.00	42	32	51	32	42
4.50	189.10	13.40	9.00	9.00	41	29	46	29	41
4.50	189.10	13.40	10.00	10.00	41	26	42	26	41
5.00	188.60	13.90	7.00	7.00	43	38	60	38	43
5.00	188.60	13.90	8.00	8.00	42	33	53	33	42
5.00	188.60	13.90	9.00	9.00	42	30	48	30	42
5.00	188.60	13.90	10.00	10.00	42	27	44	27	42
5.50	188.10	14.40	7.00	7.00	44	39	62	39	44
5.50	188.10	14.40	8.00	8.00	43	34	55	34	43
5.50	188.10	14.40	9.00	9.00	43	31	50	31	43
5.50	188.10	14.40	10.00	10.00	42	28	45	28	42

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 193.60m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 21.7 (For IBH-40 (Ash water transfer pump house, settling cum surge tank))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	4.50	13.40	189.10	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.14	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	42
2	8.00	8.00	4.50	13.40	189.10	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	42
3	9.00	9.00	4.50	13.40	189.10	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.11	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	41
4	10.00	10.00	4.50	13.40	189.10	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	41
5	7.00	7.00	5.00	13.90	188.60	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.16	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	43
6	8.00	8.00	5.00	13.90	188.60	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.14	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	42
7	9.00	9.00	5.00	13.90	188.60	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	42
8	10.00	10.00	5.00	13.90	188.60	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.11	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	42
9	7.00	7.00	5.50	14.40	188.10	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.17	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	44
10	8.00	8.00	5.50	14.40	188.10	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.15	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	43
11	9.00	9.00	5.50	14.40	188.10	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	43
12	10.00	10.00	5.50	14.40	188.10	1.34	8	7.33	0.97	0.78	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	2.03	1.02	0.50	0.50	42

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 193.60m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 21.8 (For IBH-40 (Ash water transfer pump house, settling cum surge tank))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	4.50	189.10	13.40	7.00	7.00	0.40	1005	1.12	0.80	0.0018	3.00	0.70	0.80	0.80	36	58
2	4.50	189.10	13.40	8.00	8.00	0.40	1005	1.12	0.80	0.0018	3.00	0.70	0.83	0.80	32	51
3	4.50	189.10	13.40	9.00	9.00	0.40	1005	1.12	0.80	0.0018	3.00	0.70	0.85	0.80	29	46
4	4.50	189.10	13.40	10.00	10.00	0.40	1005	1.12	0.80	0.0018	3.00	0.70	0.87	0.80	26	42
5	5.00	188.60	13.90	7.00	7.00	0.40	1005	1.12	0.80	0.0018	2.50	0.70	0.78	0.80	38	60
6	5.00	188.60	13.90	8.00	8.00	0.40	1005	1.12	0.80	0.0018	2.50	0.70	0.81	0.80	33	53
7	5.00	188.60	13.90	9.00	9.00	0.40	1005	1.12	0.80	0.0018	2.50	0.70	0.83	0.80	30	48
8	5.00	188.60	13.90	10.00	10.00	0.40	1005	1.12	0.80	0.0018	2.50	0.70	0.85	0.80	27	44
9	5.50	188.10	14.40	7.00	7.00	0.40	1005	1.12	0.80	0.0018	2.00	0.70	0.76	0.80	39	62
10	5.50	188.10	14.40	8.00	8.00	0.40	1005	1.12	0.80	0.0018	2.00	0.70	0.79	0.80	34	55
11	5.50	188.10	14.40	9.00	9.00	0.40	1005	1.12	0.80	0.0018	2.00	0.70	0.81	0.80	31	50
12	5.50	188.10	14.40	10.00	10.00	0.40	1005	1.12	0.80	0.0018	2.00	0.70	0.83	0.80	28	45

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 21.9 (For IBH-40 (Ash water transfer pump house, settling cum surge tank))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:193.60m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	192.60	9.90	1.50	1.50	10	19	30	10	10
1.00	192.60	9.90	2.00	2.00	9	14	22	9	9
1.00	192.60	9.90	2.50	2.50	9	11	17	9	9
1.00	192.60	9.90	3.00	3.00	9	9	14	9	9
2.00	191.60	10.90	1.50	1.50	11	20	32	11	11
2.00	191.60	10.90	2.00	2.00	11	15	24	11	11
2.00	191.60	10.90	2.50	2.50	10	12	19	10	10
2.00	191.60	10.90	3.00	3.00	10	10	15	10	10
3.00	190.60	11.90	1.50	1.50	13	20	32	13	13
3.00	190.60	11.90	2.00	2.00	12	15	24	12	12
3.00	190.60	11.90	2.50	2.50	11	12	19	11	11
3.00	190.60	11.90	3.00	3.00	11	10	16	10	11

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 193.60m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-21.10 (For IBH-40 (Ash water transfer pump house, settling cum surge tank))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree	N _c	N _q - 1	N _{γ}	S _c	S _q	S _{γ}	d _c	d _q	d _{γ}	i _c	i _q	i _{γ}	gm/cc		W _q	W _{γ}	
1	1.50	1.50	1.00	9.90	192.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.15	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	10
2	2.00	2.00	1.00	9.90	192.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.11	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	9
3	2.50	2.50	1.00	9.90	192.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	9
4	3.00	3.00	1.00	9.90	192.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	9
5	1.50	1.50	2.00	10.90	191.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.29	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11
6	2.00	2.00	2.00	10.90	191.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.22	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11
7	2.50	2.50	2.00	10.90	191.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.18	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	10
8	3.00	3.00	2.00	10.90	191.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.15	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	10
9	1.50	1.50	3.00	11.90	190.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.44	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	13
10	2.00	2.00	3.00	11.90	190.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.33	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	12
11	2.50	2.50	3.00	11.90	190.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.26	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11
12	3.00	3.00	3.00	11.90	190.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.22	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 193.60m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-21.11 (For IBH-40 (Ash water transfer pump house, settling cum surge tank))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	1.00	192.60	9.90	1.50	1.50	0.40	263	1.12	0.80	0.0265	3.00	0.70	0.80	0.80	19	30
2	1.00	192.60	9.90	2.00	2.00	0.40	263	1.12	0.80	0.0265	4.00	0.70	0.85	0.80	14	22
3	1.00	192.60	9.90	2.50	2.50	0.40	263	1.12	0.80	0.0265	5.00	0.70	0.88	0.80	11	17
4	1.00	192.60	9.90	3.00	3.00	0.40	263	1.12	0.80	0.0265	6.00	0.70	0.91	0.80	9	14
5	2.00	191.60	10.90	1.50	1.50	0.40	263	1.12	0.80	0.0265	3.00	0.70	0.73	0.80	20	32
6	2.00	191.60	10.90	2.00	2.00	0.40	263	1.12	0.80	0.0265	4.00	0.70	0.73	0.80	15	24
7	2.00	191.60	10.90	2.50	2.50	0.40	263	1.12	0.80	0.0265	5.00	0.70	0.76	0.80	12	19
8	2.00	191.60	10.90	3.00	3.00	0.40	263	1.12	0.80	0.0265	5.50	0.70	0.80	0.80	10	15
9	3.00	190.60	11.90	1.50	1.50	0.40	263	1.12	0.80	0.0265	3.00	0.70	0.73	0.80	20	32
10	3.00	190.60	11.90	2.00	2.00	0.40	263	1.12	0.80	0.0265	4.00	0.70	0.73	0.80	15	24
11	3.00	190.60	11.90	2.50	2.50	0.40	263	1.12	0.80	0.0265	4.50	0.70	0.73	0.80	12	19
12	3.00	190.60	11.90	3.00	3.00	0.40	263	1.12	0.80	0.0265	4.50	0.70	0.73	0.80	10	16

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 21.12 (For IBH-40 (Ash water transfer pump house, settling cum surge tank))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:193.60m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	192.60	9.90	3.50	3.50	9	7	12	7	9
1.00	192.60	9.90	4.00	4.00	9	6	10	6	9
1.00	192.60	9.90	5.00	5.00	9	5	8	5	8
1.00	192.60	9.90	6.00	6.00	9	4	7	4	7
2.00	191.60	10.90	3.50	3.50	10	8	13	8	10
2.00	191.60	10.90	4.00	4.00	10	7	11	7	10
2.00	191.60	10.90	5.00	5.00	10	6	9	6	9
2.00	191.60	10.90	6.00	6.00	10	5	8	5	8
3.00	190.60	11.90	3.50	3.50	11	9	14	9	11
3.00	190.60	11.90	4.00	4.00	11	8	12	8	11
3.00	190.60	11.90	5.00	5.00	11	6	10	6	10
3.00	190.60	11.90	6.00	6.00	10	5	8	5	8

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 193.60m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-21.13 (For IBH-40 (Ash water transfer pump house, settling cum surge tank))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5 γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	1.00	9.90	192.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	9
2	4.00	4.00	1.00	9.90	192.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	9
3	5.00	5.00	1.00	9.90	192.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	9
4	6.00	6.00	1.00	9.90	192.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	9
5	3.50	3.50	2.00	10.90	191.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	10
6	4.00	4.00	2.00	10.90	191.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.11	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	10
7	5.00	5.00	2.00	10.90	191.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	10
8	6.00	6.00	2.00	10.90	191.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	10
9	3.50	3.50	3.00	11.90	190.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.19	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11
10	4.00	4.00	3.00	11.90	190.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.16	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11
11	5.00	5.00	3.00	11.90	190.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11
12	6.00	6.00	3.00	11.90	190.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.11	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	10

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 193.60m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-21.14 (For IBH-40 (Ash water transfer pump house, settling cum surge tank))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	1.00	192.60	9.90	3.50	3.50	0.40	263	1.12	0.80	0.0265	6.50	0.70	0.92	0.80	7	12
2	1.00	192.60	9.90	4.00	4.00	0.40	263	1.12	0.80	0.0265	6.50	0.70	0.93	0.80	6	10
3	1.00	192.60	9.90	5.00	5.00	0.40	263	1.12	0.80	0.0265	6.50	0.70	0.95	0.80	5	8
4	1.00	192.60	9.90	6.00	6.00	0.40	263	1.12	0.80	0.0265	6.50	0.70	0.96	0.80	4	7
5	2.00	191.60	10.90	3.50	3.50	0.40	263	1.12	0.80	0.0265	5.50	0.70	0.83	0.80	8	13
6	2.00	191.60	10.90	4.00	4.00	0.40	263	1.12	0.80	0.0265	5.50	0.70	0.85	0.80	7	11
7	2.00	191.60	10.90	5.00	5.00	0.40	263	1.12	0.80	0.0265	5.50	0.70	0.88	0.80	6	9
8	2.00	191.60	10.90	6.00	6.00	0.40	263	1.12	0.80	0.0265	5.50	0.70	0.91	0.80	5	8
9	3.00	190.60	11.90	3.50	3.50	0.40	263	1.12	0.80	0.0265	4.50	0.70	0.75	0.80	9	14
10	3.00	190.60	11.90	4.00	4.00	0.40	263	1.12	0.80	0.0265	4.50	0.70	0.77	0.80	8	12
11	3.00	190.60	11.90	5.00	5.00	0.40	263	1.12	0.80	0.0265	4.50	0.70	0.82	0.80	6	10
12	3.00	190.60	11.90	6.00	6.00	0.40	263	1.12	0.80	0.0265	4.50	0.70	0.85	0.80	5	8

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 21.15 (For IBH-40 (Ash water transfer pump house, settling cum surge tank))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:193.60m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	192.60	9.90	7.00	7.00	9	4	6	4	6
1.00	192.60	9.90	8.00	8.00	9	4	6	4	6
1.00	192.60	9.90	9.00	9.00	9	3	5	3	5
1.00	192.60	9.90	10.00	10.00	9	3	5	3	5
2.00	191.60	10.90	7.00	7.00	10	4	7	4	7
2.00	191.60	10.90	8.00	8.00	10	4	6	4	6
2.00	191.60	10.90	9.00	9.00	10	4	6	4	6
2.00	191.60	10.90	10.00	10.00	10	3	5	3	5
3.00	190.60	11.90	7.00	7.00	10	5	7	5	7
3.00	190.60	11.90	8.00	8.00	10	4	7	4	7
3.00	190.60	11.90	9.00	9.00	10	4	6	4	6
3.00	190.60	11.90	10.00	10.00	10	4	6	4	6

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 193.60m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-21.16 (For IBH-40 (Ash water transfer pump house, settling cum surge tank))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	1.00	9.90	192.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	9
2	8.00	8.00	1.00	9.90	192.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	9
3	9.00	9.00	1.00	9.90	192.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.02	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	9
4	10.00	10.00	1.00	9.90	192.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.02	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	9
5	7.00	7.00	2.00	10.90	191.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	10
6	8.00	8.00	2.00	10.90	191.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	10
7	9.00	9.00	2.00	10.90	191.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	10
8	10.00	10.00	2.00	10.90	191.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	10
9	7.00	7.00	3.00	11.90	190.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	10
10	8.00	8.00	3.00	11.90	190.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	10
11	9.00	9.00	3.00	11.90	190.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	10
12	10.00	10.00	3.00	11.90	190.60	0.35	8	6.66	0.65	0.51	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	10

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 193.60m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-21.17 (For IBH-40 (Ash water transfer pump house, settling cum surge tank))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	1.00	192.60	9.90	7.00	7.00	0.40	263	1.12	0.80	0.0265	6.50	0.70	0.97	0.80	4	6
2	1.00	192.60	9.90	8.00	8.00	0.40	263	1.12	0.80	0.0265	6.50	0.70	0.97	0.80	4	6
3	1.00	192.60	9.90	9.00	9.00	0.40	263	1.12	0.80	0.0265	6.50	0.70	0.97	0.80	3	5
4	1.00	192.60	9.90	10.00	10.00	0.40	263	1.12	0.80	0.0265	6.50	0.70	0.98	0.80	3	5
5	2.00	191.60	10.90	7.00	7.00	0.40	263	1.12	0.80	0.0265	5.50	0.70	0.92	0.80	4	7
6	2.00	191.60	10.90	8.00	8.00	0.40	263	1.12	0.80	0.0265	5.50	0.70	0.93	0.80	4	6
7	2.00	191.60	10.90	9.00	9.00	0.40	263	1.12	0.80	0.0265	5.50	0.70	0.94	0.80	4	6
8	2.00	191.60	10.90	10.00	10.00	0.40	263	1.12	0.80	0.0265	5.50	0.70	0.95	0.80	3	5
9	3.00	190.60	11.90	7.00	7.00	0.40	263	1.12	0.80	0.0265	4.50	0.70	0.87	0.80	5	7
10	3.00	190.60	11.90	8.00	8.00	0.40	263	1.12	0.80	0.0265	4.50	0.70	0.89	0.80	4	7
11	3.00	190.60	11.90	9.00	9.00	0.40	263	1.12	0.80	0.0265	4.50	0.70	0.91	0.80	4	6
12	3.00	190.60	11.90	10.00	10.00	0.40	263	1.12	0.80	0.0265	4.50	0.70	0.92	0.80	4	6

Appendix – 21A

Calculation of Safe Load carrying capacity of piles socketed inside rock (Near IBH 40) (Ash water transfer pump house, settling cum surge tank)

Project Name: - Proposed structures of thermal power project of NTTTP at Hirma, Talabira

1.0 Introduction

In situations where overburden offering low bearing pressure is followed by rock at relatively shallower depths, end bearing piles is the suitable foundation option. Piles in rocks and weathered rocks of varying degree of weathering derive their capacity by end bearing and socket side resistance.

In situations, where, rock strata comprises of highly fragmented rock, as in present case, where RQD is nil or $(CR+RQD)/2$ is less than 30 % or when the crushing strength is less than 10 MPa, the appropriate approach would be of that suggested by Cole & Stroud.

In present site overburden soils overlay fractured / laminated / foliated rock. The founding stratum having highly fragmented rock with nil RQD and $(CR+RQD)/2$ to be less than 30 %, the approach suggested by Cole and Stroud as per Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 P1/S2 has been used for safe load calculations.

An illustrative calculation of safe load on pile and summary of pile capacities is as follows,

2.0 Sub soil strata Characterization

General stratification at the location of boreholes IBH 40 show primarily two characterized layers,

1. Overburden comprising of fine to medium grained, sandy clays of intermediate plasticity upto 6.30m (i.e. RL 187.30m)
2. Second characterized layer below the overburden soils comprises of Highly weathered, weak, dark yellowish brown, fine to very fine grained, fractured rock upto 10.50m (i.e. RL 183.10m).

3.0 Design Considerations

1. Length of socket considered 3D from depth of rock encountered.
2. The pile is considered to have socket length below 6.30 m below NGL (i.e. RL 187.30 m) depth.
3. For present case of pile terminating in highly weathered rock. SPT at depths between 6.30m to 10.50m (between RL 187.30 to 183.10 m) is > 200.
Based on recommendation of fig no. 3 in B 8 in Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 P1/S2, average shear strength q_c corresponding to assumed SPT of 200 may be taken as 1300 kN/m²
4. Allowable Capacity of pile socketed into rock $Q_a = R_e + R_{sf} = C_{u1} N_c \pi B^2 / 4 (F_s = 3) + \alpha C_{u2} \pi BL / (F_s = 6)$

4.0 Safe Load on Pile in Compression

Where,

End bearing component, $R_e = C_{u1} N_c \pi B^2 / 4 F_s$,

C_{u1} = Shear strength below base of pile = 1300 kN/m²

B = diameter of the pile = d

F_s = Factor of Safety = 3

$N_c = 9$

Therefore, **$R_e = 3061.5 d^2$**

Skin friction component of socketed length of pile, $R_{sf} = \alpha C_{u2} \pi BL / F_s$

$\alpha = 0.9$ (recommended value in IS 2911 P1/S2)

L = length of the socket = $3 D$

C_{u2} = Ultimate shear strength along socket length which shall be restricted to shear capacity of concrete of the pile = 1300 kN/m^2

F_s = Factor of Safety = 6

Therefore, $R_{sf} = 1836.9 d^2$

Thus,

$$Q_a = c_{u1} N_c \cdot \frac{\pi B^2}{4 F_s} + \alpha c_{u2} \cdot \frac{\pi B L}{F_s}$$

$$= 3061.5 d^2 + 1836.9 d^2 = 4898.4 d^2$$

Substituting the values of various diameters and socket lengths equal to 3 times diameter, allowable load on single pile can be summarized as follows,

Summary of the Safe load calculation in Compression

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	17.00	17.48	17.90
Termination level RL in m	185.50	185.02	184.60
End Bearing Component in kN	1102.1	1768.3	2479.8
Friction Component in kN	661.3	1060.9	1487.9
Safe load in Compression in kN	1763.4	2829.3	3967.7
Safe load in Compression in T	176	283	397

5.0 Safe Load on Pile in uplift

For 9.00m cutoff from FGL

The overburden soils, though, will not contribute in compression capacity would offer resistance in uplift capacity. The parameters of IBH 40 are considered for calculation of uplift resistance as summarized below,

Depth in m from RL 202.5 m	Cohesion in kg/cm^2	Angle of Internal Friction ϕ	Submerged density in $\text{gm/cc } \gamma_{\text{sub}}$	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 9.00	Pile cutoff level – No pile						
9.00 to 13.80	0.89	8(ignored)	0.98	0.51	NA	NA	6-24
13.80 to 15.20	4.00	0	1.03	0.28	NA	NA	>100
15.20 to 23.90	Rock strata – Resistance would be as per skin friction capacity in socket as already calculated in compression capacity						

Ultimate load in skin friction,

$$Q_{uf} = \alpha_i C_{ai} A_{si} + K_i P D_i \tan \delta_i A_{si}$$

First Layer – No contribution considered – (Within Cutoff Level).

$$\text{Second Layer} - \alpha_2 C_{a2} A_{s2} = 0.51 * 8.90 * \pi d * 4.80 = 68.45d$$

$$\text{Third Layer} - \alpha_3 C_{a3} A_{s3} = 0.28 * 40.00 * \pi d * 1.40 = 49.26d$$

Fourth Layer – $1836.90 d^2$ in rock socket

$$\text{Substituting, ultimate load } q_{uf} = 1177.10 d + 1836.9 d^2$$

The safe load in uplift is worked out (considering the safety factor of 2.50 for overburden soils) and summarized below,

Safe Load on Piles in Uplift (in Ton)

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	17.00	17.48	17.90
Termination level RL in m	185.50	185.02	184.60
Safe load in Uplift in kN	943.79	1418.83	1911.65
Self-weight of pile in kN	33.91	57.67	84.89
Safe load in Uplift in T (Considering self-weight of pile)	97.78	147.65	199.65

6.0 Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60	0.76	0.90
Subgrade reaction in MN/m ³		8.64	8.64	8.64
Stiffness factor T in m		1.83	2.21	2.53
Depth of fixity in m	Free Head	3.50	4.20	4.80
	Fixed Head	4.00	4.80	5.50
Allowable Horizontal Force in T	Free Head	6.30	9.20	12.10
	Fixed Head	16.80	24.50	32.10
Allowable Moment capacity in Tm	Free Head	7.71	13.59	20.39
	Fixed Head	27.43	48.38	72.59

7.0 Notes

1. Pile shall be terminated after socketing 3D inside rock.
2. Initial and routine pile load test is required to verify the actual carrying capacity of pile in compression, uplift and lateral loads.
3. For design and construction, specification of IS: 2911, P1/S2, IS: 456, 2000 shall strictly be followed.

(Dr. K. K. Thaker)

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 22 (For IBH-41,42,43,44,45,46, 47, 48 - (HCSD slurry pipe corridor))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:198.48m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 22.1) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 22.2)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
1.00	197.48	3.52	1.50	1.50	6	13	20	6	6
1.00	197.48	3.52	2.00	2.00	6	9	15	6	6
1.00	197.48	3.52	2.50	2.50	6	7	11	6	6
1.00	197.48	3.52	3.00	3.00	6	6	9	6	6
2.00	196.48	4.52	1.50	1.50	7	14	22	7	7
2.00	196.48	4.52	2.00	2.00	6	10	16	6	6
2.00	196.48	4.52	2.50	2.50	6	8	13	6	6
2.00	196.48	4.52	3.00	3.00	6	6	10	6	6
3.00	195.48	5.52	1.50	1.50	7	14	22	7	7
3.00	195.48	5.52	2.00	2.00	7	10	16	7	7
3.00	195.48	5.52	2.50	2.50	7	8	13	7	7
3.00	195.48	5.52	3.00	3.00	6	7	11	6	6

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.48m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 22.1 (For IBH-41,42,43,44,45,46, 47, 48 - (HCSD slurry pipe corridor))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	1.00	3.52	197.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.14	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
2	2.00	2.00	1.00	3.52	197.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
3	2.50	2.50	1.00	3.52	197.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
4	3.00	3.00	1.00	3.52	197.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
5	1.50	1.50	2.00	4.52	196.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.27	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	7
6	2.00	2.00	2.00	4.52	196.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.20	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
7	2.50	2.50	2.00	4.52	196.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.16	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
8	3.00	3.00	2.00	4.52	196.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.14	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
9	1.50	1.50	3.00	5.52	195.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.41	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	7
10	2.00	2.00	3.00	5.52	195.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.31	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	7
11	2.50	2.50	3.00	5.52	195.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.25	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	7
12	3.00	3.00	3.00	5.52	195.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.20	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.48m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 22.2 (For IBH-41,42,43,44,45,46, 47, 48 - (HCSD slurry pipe corridor))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	1.00	197.48	3.52	1.50	1.50	0.40	203	1.12	0.80	0.0417	3.00	0.70	0.80	0.80	13	20
2	1.00	197.48	3.52	2.00	2.00	0.40	203	1.12	0.80	0.0417	4.00	0.70	0.85	0.80	9	15
3	1.00	197.48	3.52	2.50	2.50	0.40	203	1.12	0.80	0.0417	5.00	0.70	0.88	0.80	7	11
4	1.00	197.48	3.52	3.00	3.00	0.40	203	1.12	0.80	0.0417	6.00	0.70	0.91	0.80	6	9
5	2.00	196.48	4.52	1.50	1.50	0.40	203	1.12	0.80	0.0417	3.00	0.70	0.73	0.80	14	22
6	2.00	196.48	4.52	2.00	2.00	0.40	203	1.12	0.80	0.0417	4.00	0.70	0.73	0.80	10	16
7	2.00	196.48	4.52	2.50	2.50	0.40	203	1.12	0.80	0.0417	5.00	0.70	0.76	0.80	8	13
8	2.00	196.48	4.52	3.00	3.00	0.40	203	1.12	0.80	0.0417	6.00	0.70	0.80	0.80	6	10
9	3.00	195.48	5.52	1.50	1.50	0.40	203	1.12	0.80	0.0417	3.00	0.70	0.73	0.80	14	22
10	3.00	195.48	5.52	2.00	2.00	0.40	203	1.12	0.80	0.0417	4.00	0.70	0.73	0.80	10	16
11	3.00	195.48	5.52	2.50	2.50	0.40	203	1.12	0.80	0.0417	5.00	0.70	0.73	0.80	8	13
12	3.00	195.48	5.52	3.00	3.00	0.40	203	1.12	0.80	0.0417	6.00	0.70	0.73	0.80	7	11

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 22.3 (For IBH-41,42,43,44,45,46, ~~47~~, ~~48~~ - (HCSD slurry pipe corridor))**SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION****Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:198.48m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 22.4) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 22.5)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	197.48	3.52	3.50	3.50	6	5	8	5	6
1.00	197.48	3.52	4.00	4.00	6	4	7	4	6
1.00	197.48	3.52	5.00	5.00	5	3	5	3	5
1.00	197.48	3.52	6.00	6.00	5	3	4	3	4
2.00	196.48	4.52	3.50	3.50	6	5	9	5	6
2.00	196.48	4.52	4.00	4.00	6	5	7	5	6
2.00	196.48	4.52	5.00	5.00	6	4	6	4	6
2.00	196.48	4.52	6.00	6.00	6	3	5	3	5
3.00	195.48	5.52	3.50	3.50	6	6	9	6	6
3.00	195.48	5.52	4.00	4.00	6	5	8	5	6
3.00	195.48	5.52	5.00	5.00	6	4	6	4	6
3.00	195.48	5.52	6.00	6.00	6	3	5	3	5

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.48m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 22.4 (For IBH-41,42,43,44,45,46, 47, 48 - (HCSD slurry pipe corridor))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	1.00	3.52	197.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
2	4.00	4.00	1.00	3.52	197.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
3	5.00	5.00	1.00	3.52	197.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	5
4	6.00	6.00	1.00	3.52	197.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	5
5	3.50	3.50	2.00	4.52	196.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
6	4.00	4.00	2.00	4.52	196.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
7	5.00	5.00	2.00	4.52	196.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
8	6.00	6.00	2.00	4.52	196.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
9	3.50	3.50	3.00	5.52	195.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.18	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
10	4.00	4.00	3.00	5.52	195.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.15	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
11	5.00	5.00	3.00	5.52	195.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
12	6.00	6.00	3.00	5.52	195.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.48m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 22.5 (For IBH-41,42,43,44,45,46, 47, 48 - (HCSD slurry pipe corridor))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	1.00	197.48	3.52	3.50	3.50	0.40	203	1.12	0.80	0.0417	7.00	0.70	0.92	0.80	5	8
2	1.00	197.48	3.52	4.00	4.00	0.40	203	1.12	0.80	0.0417	8.00	0.70	0.93	0.80	4	7
3	1.00	197.48	3.52	5.00	5.00	0.40	203	1.12	0.80	0.0417	10.00	0.70	0.95	0.80	3	5
4	1.00	197.48	3.52	6.00	6.00	0.40	203	1.12	0.80	0.0417	12.00	0.70	0.96	0.80	3	4
5	2.00	196.48	4.52	3.50	3.50	0.40	203	1.12	0.80	0.0417	7.00	0.70	0.83	0.80	5	9
6	2.00	196.48	4.52	4.00	4.00	0.40	203	1.12	0.80	0.0417	8.00	0.70	0.85	0.80	5	7
7	2.00	196.48	4.52	5.00	5.00	0.40	203	1.12	0.80	0.0417	10.00	0.70	0.88	0.80	4	6
8	2.00	196.48	4.52	6.00	6.00	0.40	203	1.12	0.80	0.0417	12.00	0.70	0.91	0.80	3	5
9	3.00	195.48	5.52	3.50	3.50	0.40	203	1.12	0.80	0.0417	7.00	0.70	0.75	0.80	6	9
10	3.00	195.48	5.52	4.00	4.00	0.40	203	1.12	0.80	0.0417	8.00	0.70	0.77	0.80	5	8
11	3.00	195.48	5.52	5.00	5.00	0.40	203	1.12	0.80	0.0417	10.00	0.70	0.82	0.80	4	6
12	3.00	195.48	5.52	6.00	6.00	0.40	203	1.12	0.80	0.0417	11.50	0.70	0.85	0.80	3	5

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 22.6 (For IBH-41,42,43,44,45,46, ~~47~~, ~~48~~ - (HCSD slurry pipe corridor))**SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION****Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:198.48m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 22.7) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 22.8)		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
1.00	197.48	3.52	7.00	7.00	5	2	4	2	4
1.00	197.48	3.52	8.00	8.00	5	2	3	2	3
1.00	197.48	3.52	9.00	9.00	5	2	3	2	3
1.00	197.48	3.52	10.00	10.00	5	2	3	2	3
2.00	196.48	4.52	7.00	7.00	6	2	4	2	4
2.00	196.48	4.52	8.00	8.00	6	2	3	2	3
2.00	196.48	4.52	9.00	9.00	6	2	3	2	3
2.00	196.48	4.52	10.00	10.00	6	2	3	2	3
3.00	195.48	5.52	7.00	7.00	6	3	4	3	4
3.00	195.48	5.52	8.00	8.00	6	2	4	2	4
3.00	195.48	5.52	9.00	9.00	6	2	3	2	3
3.00	195.48	5.52	10.00	10.00	6	2	3	2	3

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.48m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 22.7 (For IBH-41,42,43,44,45,46, 22.7 - (HCSD slurry pipe corridor))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	1.00	3.52	197.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	5
2	8.00	8.00	1.00	3.52	197.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	5
3	9.00	9.00	1.00	3.52	197.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.02	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	5
4	10.00	10.00	1.00	3.52	197.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.02	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	5
5	7.00	7.00	2.00	4.52	196.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
6	8.00	8.00	2.00	4.52	196.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
7	9.00	9.00	2.00	4.52	196.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
8	10.00	10.00	2.00	4.52	196.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
9	7.00	7.00	3.00	5.52	195.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
10	8.00	8.00	3.00	5.52	195.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
11	9.00	9.00	3.00	5.52	195.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
12	10.00	10.00	3.00	5.52	195.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.48m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 22.8 (For IBH-41,42,43,44,45,46, 47, 48 - (HCSD slurry pipe corridor))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	1.00	197.48	3.52	7.00	7.00	0.40	203	1.12	0.80	0.0417	13.50	0.70	0.97	0.80	2	4
2	1.00	197.48	3.52	8.00	8.00	0.40	203	1.12	0.80	0.0417	13.50	0.70	0.97	0.80	2	3
3	1.00	197.48	3.52	9.00	9.00	0.40	203	1.12	0.80	0.0417	13.50	0.70	0.97	0.80	2	3
4	1.00	197.48	3.52	10.00	10.00	0.40	203	1.12	0.80	0.0417	13.50	0.70	0.98	0.80	2	3
5	2.00	196.48	4.52	7.00	7.00	0.40	203	1.12	0.80	0.0417	12.50	0.70	0.92	0.80	2	4
6	2.00	196.48	4.52	8.00	8.00	0.40	203	1.12	0.80	0.0417	12.50	0.70	0.93	0.80	2	3
7	2.00	196.48	4.52	9.00	9.00	0.40	203	1.12	0.80	0.0417	12.50	0.70	0.94	0.80	2	3
8	2.00	196.48	4.52	10.00	10.00	0.40	203	1.12	0.80	0.0417	12.50	0.70	0.95	0.80	2	3
9	3.00	195.48	5.52	7.00	7.00	0.40	203	1.12	0.80	0.0417	11.50	0.70	0.87	0.80	3	4
10	3.00	195.48	5.52	8.00	8.00	0.40	203	1.12	0.80	0.0417	11.50	0.70	0.89	0.80	2	4
11	3.00	195.48	5.52	9.00	9.00	0.40	203	1.12	0.80	0.0417	11.50	0.70	0.91	0.80	2	3
12	3.00	195.48	5.52	10.00	10.00	0.40	203	1.12	0.80	0.0417	11.50	0.70	0.92	0.80	2	3

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 22.9 (For IBH-41,42,43,44,45,46, ~~47~~, ~~48~~ - (HCSD slurry pipe corridor))**SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION****Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:198.48m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
4.00	194.48	6.52	1.50	1.50	8	14	22	8	8
4.00	194.48	6.52	2.00	2.00	7	10	16	7	7
4.00	194.48	6.52	2.50	2.50	7	8	13	7	7
4.00	194.48	6.52	3.00	3.00	7	7	11	7	7
5.00	193.48	7.52	1.50	1.50	9	14	22	9	9
5.00	193.48	7.52	2.00	2.00	8	10	16	8	8
5.00	193.48	7.52	2.50	2.50	8	8	13	8	8
5.00	193.48	7.52	3.00	3.00	7	7	11	7	7
6.00	192.48	8.52	1.50	1.50	10	14	22	10	10
6.00	192.48	8.52	2.00	2.00	9	10	16	9	9
6.00	192.48	8.52	2.50	2.50	8	8	13	8	8
6.00	192.48	8.52	3.00	3.00	8	7	11	7	8

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.48m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-22.10 (For IBH-41,42,43,44,45,46, 47, 48 - (HCSD slurry pipe corridor))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	4.00	6.52	194.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.55	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	8
2	2.00	2.00	4.00	6.52	194.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.41	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	7
3	2.50	2.50	4.00	6.52	194.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.33	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	7
4	3.00	3.00	4.00	6.52	194.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.27	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	7
5	1.50	1.50	5.00	7.52	193.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.68	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	9
6	2.00	2.00	5.00	7.52	193.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.51	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	8
7	2.50	2.50	5.00	7.52	193.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.41	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	8
8	3.00	3.00	5.00	7.52	193.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.34	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	7
9	1.50	1.50	6.00	8.52	192.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.82	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	10
10	2.00	2.00	6.00	8.52	192.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.61	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	9
11	2.50	2.50	6.00	8.52	192.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.49	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	8
12	3.00	3.00	6.00	8.52	192.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.41	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	8

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.48m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-22.11 (For IBH-41,42,43,44,45,46, 47, 48 - (HCSD slurry pipe corridor))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	4.00	194.48	6.52	1.50	1.50	0.40	203	1.12	0.80	0.0417	3.00	0.70	0.73	0.80	14	22
2	4.00	194.48	6.52	2.00	2.00	0.40	203	1.12	0.80	0.0417	4.00	0.70	0.73	0.80	10	16
3	4.00	194.48	6.52	2.50	2.50	0.40	203	1.12	0.80	0.0417	5.00	0.70	0.73	0.80	8	13
4	4.00	194.48	6.52	3.00	3.00	0.40	203	1.12	0.80	0.0417	6.00	0.70	0.73	0.80	7	11
5	5.00	193.48	7.52	1.50	1.50	0.40	203	1.12	0.80	0.0417	3.00	0.70	0.73	0.80	14	22
6	5.00	193.48	7.52	2.00	2.00	0.40	203	1.12	0.80	0.0417	4.00	0.70	0.73	0.80	10	16
7	5.00	193.48	7.52	2.50	2.50	0.40	203	1.12	0.80	0.0417	5.00	0.70	0.73	0.80	8	13
8	5.00	193.48	7.52	3.00	3.00	0.40	203	1.12	0.80	0.0417	6.00	0.70	0.73	0.80	7	11
9	6.00	192.48	8.52	1.50	1.50	0.40	203	1.12	0.80	0.0417	3.00	0.70	0.71	0.80	14	22
10	6.00	192.48	8.52	2.00	2.00	0.40	203	1.12	0.80	0.0417	4.00	0.70	0.73	0.80	10	16
11	6.00	192.48	8.52	2.50	2.50	0.40	203	1.12	0.80	0.0417	5.00	0.70	0.73	0.80	8	13
12	6.00	192.48	8.52	3.00	3.00	0.40	203	1.12	0.80	0.0417	6.00	0.70	0.73	0.80	7	11

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 22.12 (For IBH-41,42,43,44,45,46, 47, 48 - (HCSD slurry pipe corridor))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:198.48m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
4.00	194.48	6.52	3.50	3.50	7	6	9	6	7
4.00	194.48	6.52	4.00	4.00	6	5	8	5	6
4.00	194.48	6.52	5.00	5.00	6	4	6	4	6
4.00	194.48	6.52	6.00	6.00	6	3	5	3	5
5.00	193.48	7.52	3.50	3.50	7	6	9	6	7
5.00	193.48	7.52	4.00	4.00	7	5	8	5	7
5.00	193.48	7.52	5.00	5.00	7	4	7	4	7
5.00	193.48	7.52	6.00	6.00	6	3	5	3	5
6.00	192.48	8.52	3.50	3.50	7	6	9	6	7
6.00	192.48	8.52	4.00	4.00	7	5	8	5	7
6.00	192.48	8.52	5.00	5.00	7	4	7	4	7
6.00	192.48	8.52	6.00	6.00	7	3	6	3	6

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.48m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-22.13 (For IBH-41,42,43,44,45,46, ~~47~~, ~~48~~ - (HCSD slurry pipe corridor))**Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ**

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	4.00	6.52	194.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.23	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	7
2	4.00	4.00	4.00	6.52	194.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.20	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
3	5.00	5.00	4.00	6.52	194.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.16	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
4	6.00	6.00	4.00	6.52	194.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.14	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
5	3.50	3.50	5.00	7.52	193.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.29	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	7
6	4.00	4.00	5.00	7.52	193.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.26	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	7
7	5.00	5.00	5.00	7.52	193.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.20	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	7
8	6.00	6.00	5.00	7.52	193.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.17	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
9	3.50	3.50	6.00	8.52	192.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.35	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	7
10	4.00	4.00	6.00	8.52	192.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.31	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	7
11	5.00	5.00	6.00	8.52	192.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.25	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	7
12	6.00	6.00	6.00	8.52	192.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.20	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	7

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.48m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-22.14 (For IBH-41,42,43,44,45,46, 47, 48 - (HCSD slurry pipe corridor))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	4.00	194.48	6.52	3.50	3.50	0.40	203	1.12	0.80	0.0417	7.00	0.70	0.73	0.80	6	9
2	4.00	194.48	6.52	4.00	4.00	0.40	203	1.12	0.80	0.0417	8.00	0.70	0.73	0.80	5	8
3	4.00	194.48	6.52	5.00	5.00	0.40	203	1.12	0.80	0.0417	10.00	0.70	0.76	0.80	4	6
4	4.00	194.48	6.52	6.00	6.00	0.40	203	1.12	0.80	0.0417	10.50	0.70	0.80	0.80	3	5
5	5.00	193.48	7.52	3.50	3.50	0.40	203	1.12	0.80	0.0417	7.00	0.70	0.73	0.80	6	9
6	5.00	193.48	7.52	4.00	4.00	0.40	203	1.12	0.80	0.0417	8.00	0.70	0.73	0.80	5	8
7	5.00	193.48	7.52	5.00	5.00	0.40	203	1.12	0.80	0.0417	9.50	0.70	0.73	0.80	4	7
8	5.00	193.48	7.52	6.00	6.00	0.40	203	1.12	0.80	0.0417	9.50	0.70	0.75	0.80	3	5
9	6.00	192.48	8.52	3.50	3.50	0.40	203	1.12	0.80	0.0417	7.00	0.70	0.73	0.80	6	9
10	6.00	192.48	8.52	4.00	4.00	0.40	203	1.12	0.80	0.0417	8.00	0.70	0.73	0.80	5	8
11	6.00	192.48	8.52	5.00	5.00	0.40	203	1.12	0.80	0.0417	8.50	0.70	0.73	0.80	4	7
12	6.00	192.48	8.52	6.00	6.00	0.40	203	1.12	0.80	0.0417	8.50	0.70	0.73	0.80	3	6

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 22.15 (For IBH-41,42,43,44,45,46, 47, 48 - (HCSD slurry pipe corridor))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:198.48m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
4.00	194.48	6.52	7.00	7.00	6	3	4	3	4
4.00	194.48	6.52	8.00	8.00	6	2	4	2	4
4.00	194.48	6.52	9.00	9.00	6	2	3	2	3
4.00	194.48	6.52	10.00	10.00	6	2	3	2	3
5.00	193.48	7.52	7.00	7.00	6	3	5	3	5
5.00	193.48	7.52	8.00	8.00	6	2	4	2	4
5.00	193.48	7.52	9.00	9.00	6	2	4	2	4
5.00	193.48	7.52	10.00	10.00	6	2	3	2	3
6.00	192.48	8.52	7.00	7.00	6	3	5	3	5
6.00	192.48	8.52	8.00	8.00	6	3	4	3	4
6.00	192.48	8.52	9.00	9.00	6	2	4	2	4
6.00	192.48	8.52	10.00	10.00	6	2	3	2	3

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.48m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-22.16 (For IBH-41,42,43,44,45,46, ~~47~~, ~~48~~ - (HCSD slurry pipe corridor))**Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ**

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	4.00	6.52	194.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
2	8.00	8.00	4.00	6.52	194.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
3	9.00	9.00	4.00	6.52	194.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
4	10.00	10.00	4.00	6.52	194.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
5	7.00	7.00	5.00	7.52	193.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.15	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
6	8.00	8.00	5.00	7.52	193.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
7	9.00	9.00	5.00	7.52	193.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.11	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
8	10.00	10.00	5.00	7.52	193.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
9	7.00	7.00	6.00	8.52	192.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.18	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
10	8.00	8.00	6.00	8.52	192.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.15	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
11	9.00	9.00	6.00	8.52	192.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.14	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6
12	10.00	10.00	6.00	8.52	192.48	0.27	2	5.46	0.13	0.10	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	1.68	0.84	0.50	0.50	6

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.48m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-22.17 (For IBH-41,42,43,44,45,46, 47, 48 - (HCSD slurry pipe corridor))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	4.00	194.48	6.52	7.00	7.00	0.40	203	1.12	0.80	0.0417	10.50	0.70	0.83	0.80	3	4
2	4.00	194.48	6.52	8.00	8.00	0.40	203	1.12	0.80	0.0417	10.50	0.70	0.85	0.80	2	4
3	4.00	194.48	6.52	9.00	9.00	0.40	203	1.12	0.80	0.0417	10.50	0.70	0.87	0.80	2	3
4	4.00	194.48	6.52	10.00	10.00	0.40	203	1.12	0.80	0.0417	10.50	0.70	0.88	0.80	2	3
5	5.00	193.48	7.52	7.00	7.00	0.40	203	1.12	0.80	0.0417	9.50	0.70	0.78	0.80	3	5
6	5.00	193.48	7.52	8.00	8.00	0.40	203	1.12	0.80	0.0417	9.50	0.70	0.81	0.80	2	4
7	5.00	193.48	7.52	9.00	9.00	0.40	203	1.12	0.80	0.0417	9.50	0.70	0.83	0.80	2	4
8	5.00	193.48	7.52	10.00	10.00	0.40	203	1.12	0.80	0.0417	9.50	0.70	0.85	0.80	2	3
9	6.00	192.48	8.52	7.00	7.00	0.40	203	1.12	0.80	0.0417	8.50	0.70	0.75	0.80	3	5
10	6.00	192.48	8.52	8.00	8.00	0.40	203	1.12	0.80	0.0417	8.50	0.70	0.77	0.80	3	4
11	6.00	192.48	8.52	9.00	9.00	0.40	203	1.12	0.80	0.0417	8.50	0.70	0.80	0.80	2	4
12	6.00	192.48	8.52	10.00	10.00	0.40	203	1.12	0.80	0.0417	8.50	0.70	0.82	0.80	2	3

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-22.18 (For IBH-41,42,43,44,45,46, ~~47~~, ~~48~~ - (HCSD slurry pipe corridor))**Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ**

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	7.00	9.52	191.48	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.99	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	20
2	2.00	2.00	7.00	9.52	191.48	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.74	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	18
3	2.50	2.50	7.00	9.52	191.48	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.59	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	17
4	3.00	3.00	7.00	9.52	191.48	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.49	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	16
5	1.50	1.50	7.50	10.02	190.98	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	2.06	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	21
6	2.00	2.00	7.50	10.02	190.98	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.80	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	19
7	2.50	2.50	7.50	10.02	190.98	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.64	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	17
8	3.00	3.00	7.50	10.02	190.98	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.53	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	16
9	1.50	1.50	8.00	10.52	190.48	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	2.13	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	22
10	2.00	2.00	8.00	10.52	190.48	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.85	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	19
11	2.50	2.50	8.00	10.52	190.48	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.68	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	18
12	3.00	3.00	8.00	10.52	190.48	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.57	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	16

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.48m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-22.19 (For IBH-41,42,43,44,45,46, 47, 48 - (HCSD slurry pipe corridor))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	7.00	191.48	9.52	1.50	1.50	0.40	455	1.12	0.80	0.0231	3.00	0.70	0.69	0.80	27	43
2	7.00	191.48	9.52	2.00	2.00	0.40	455	1.12	0.80	0.0231	4.00	0.70	0.73	0.80	20	31
3	7.00	191.48	9.52	2.50	2.50	0.40	455	1.12	0.80	0.0231	5.00	0.70	0.73	0.80	16	25
4	7.00	191.48	9.52	3.00	3.00	0.40	455	1.12	0.80	0.0231	6.00	0.70	0.73	0.80	13	21
5	7.50	190.98	10.02	1.50	1.50	0.40	455	1.12	0.80	0.0231	3.00	0.70	0.69	0.80	27	44
6	7.50	190.98	10.02	2.00	2.00	0.40	455	1.12	0.80	0.0231	4.00	0.70	0.73	0.80	20	31
7	7.50	190.98	10.02	2.50	2.50	0.40	455	1.12	0.80	0.0231	5.00	0.70	0.73	0.80	16	25
8	7.50	190.98	10.02	3.00	3.00	0.40	455	1.12	0.80	0.0231	6.00	0.70	0.73	0.80	13	21
9	8.00	190.48	10.52	1.50	1.50	0.40	455	1.12	0.80	0.0231	3.00	0.70	0.68	0.80	28	44
10	8.00	190.48	10.52	2.00	2.00	0.40	455	1.12	0.80	0.0231	4.00	0.70	0.73	0.80	20	31
11	8.00	190.48	10.52	2.50	2.50	0.40	455	1.12	0.80	0.0231	5.00	0.70	0.73	0.80	16	25
12	8.00	190.48	10.52	3.00	3.00	0.40	455	1.12	0.80	0.0231	6.00	0.70	0.73	0.80	13	21

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-22.20 (For IBH-41,42,43,44,45,46, ~~47~~, ~~48~~ - (HCSD slurry pipe corridor))**SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION****Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:198.48m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
7.00	191.48	9.52	3.50	3.50	15	11	18	11	15
7.00	191.48	9.52	4.00	4.00	14	10	16	10	14
7.00	191.48	9.52	5.00	5.00	14	8	13	8	13
7.00	191.48	9.52	6.00	6.00	13	7	11	7	11
7.50	190.98	10.02	3.50	3.50	15	11	18	11	15
7.50	190.98	10.02	4.00	4.00	15	10	16	10	15
7.50	190.98	10.02	5.00	5.00	14	8	13	8	13
7.50	190.98	10.02	6.00	6.00	14	7	11	7	11
8.00	190.48	10.52	3.50	3.50	16	11	18	11	16
8.00	190.48	10.52	4.00	4.00	15	10	16	10	15
8.00	190.48	10.52	5.00	5.00	14	8	13	8	13
8.00	190.48	10.52	6.00	6.00	14	7	11	7	11

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.48m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-22.21 (For IBH-41,42,43,44,45,46, 47, 48 - (HCSD slurry pipe corridor))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	7.00	9.52	191.48	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.42	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	15
2	4.00	4.00	7.00	9.52	191.48	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.37	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	14
3	5.00	5.00	7.00	9.52	191.48	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.30	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	14
4	6.00	6.00	7.00	9.52	191.48	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.25	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	13
5	3.50	3.50	7.50	10.02	190.98	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.45	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	15
6	4.00	4.00	7.50	10.02	190.98	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.40	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	15
7	5.00	5.00	7.50	10.02	190.98	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.32	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	14
8	6.00	6.00	7.50	10.02	190.98	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.27	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	14
9	3.50	3.50	8.00	10.52	190.48	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.48	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	16
10	4.00	4.00	8.00	10.52	190.48	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.42	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	15
11	5.00	5.00	8.00	10.52	190.48	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.34	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	14
12	6.00	6.00	8.00	10.52	190.48	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.28	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	14

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.48m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-22.22 (For IBH-41,42,43,44,45,46, 47, 48 - (HCSD slurry pipe corridor))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	7.00	191.48	9.52	3.50	3.50	0.40	455	1.12	0.80	0.0231	7.00	0.70	0.73	0.80	11	18
2	7.00	191.48	9.52	4.00	4.00	0.40	455	1.12	0.80	0.0231	7.50	0.70	0.73	0.80	10	16
3	7.00	191.48	9.52	5.00	5.00	0.40	455	1.12	0.80	0.0231	7.50	0.70	0.73	0.80	8	13
4	7.00	191.48	9.52	6.00	6.00	0.40	455	1.12	0.80	0.0231	7.50	0.70	0.73	0.80	7	11
5	7.50	190.98	10.02	3.50	3.50	0.40	455	1.12	0.80	0.0231	7.00	0.70	0.73	0.80	11	18
6	7.50	190.98	10.02	4.00	4.00	0.40	455	1.12	0.80	0.0231	7.00	0.70	0.73	0.80	10	16
7	7.50	190.98	10.02	5.00	5.00	0.40	455	1.12	0.80	0.0231	7.00	0.70	0.73	0.80	8	13
8	7.50	190.98	10.02	6.00	6.00	0.40	455	1.12	0.80	0.0231	7.00	0.70	0.73	0.80	7	11
9	8.00	190.48	10.52	3.50	3.50	0.40	455	1.12	0.80	0.0231	6.50	0.70	0.73	0.80	11	18
10	8.00	190.48	10.52	4.00	4.00	0.40	455	1.12	0.80	0.0231	6.50	0.70	0.73	0.80	10	16
11	8.00	190.48	10.52	5.00	5.00	0.40	455	1.12	0.80	0.0231	6.50	0.70	0.73	0.80	8	13
12	8.00	190.48	10.52	6.00	6.00	0.40	455	1.12	0.80	0.0231	6.50	0.70	0.73	0.80	7	11

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-22.23 (For IBH-41,42,43,44,45,46, ~~47~~, ~~48~~ - (HCSD slurry pipe corridor))**SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION****Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:198.48m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
7.00	191.48	9.52	7.00	7.00	13	6	10	6	10
7.00	191.48	9.52	8.00	8.00	13	5	9	5	9
7.00	191.48	9.52	9.00	9.00	13	5	8	5	8
7.00	191.48	9.52	10.00	10.00	13	4	7	4	7
7.50	190.98	10.02	7.00	7.00	13	6	10	6	10
7.50	190.98	10.02	8.00	8.00	13	5	9	5	9
7.50	190.98	10.02	9.00	9.00	13	5	8	5	8
7.50	190.98	10.02	10.00	10.00	13	5	7	5	7
8.00	190.48	10.52	7.00	7.00	14	6	10	6	10
8.00	190.48	10.52	8.00	8.00	13	6	9	6	9
8.00	190.48	10.52	9.00	9.00	13	5	8	5	8
8.00	190.48	10.52	10.00	10.00	13	5	8	5	8

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.48m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-22.24 (For IBH-41,42,43,44,45,46, 47, 48 - (HCSD slurry pipe corridor))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	7.00	9.52	191.48	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.21	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	13
2	8.00	8.00	7.00	9.52	191.48	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.19	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	13
3	9.00	9.00	7.00	9.52	191.48	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.16	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	13
4	10.00	10.00	7.00	9.52	191.48	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.15	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	13
5	7.00	7.00	7.50	10.02	190.98	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.23	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	13
6	8.00	8.00	7.50	10.02	190.98	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.20	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	13
7	9.00	9.00	7.50	10.02	190.98	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.18	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	13
8	10.00	10.00	7.50	10.02	190.98	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.16	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	13
9	7.00	7.00	8.00	10.52	190.48	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.24	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	14
10	8.00	8.00	8.00	10.52	190.48	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.21	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	13
11	9.00	9.00	8.00	10.52	190.48	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.19	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	13
12	10.00	10.00	8.00	10.52	190.48	0.46	5	5.99	0.35	0.27	1.30	1.20	0.80	1.17	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	13

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.48m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-22.25 (For IBH-41,42,43,44,45,46, 47, 48 - (HCSD slurry pipe corridor))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	7.00	191.48	9.52	7.00	7.00	0.40	455	1.12	0.80	0.0231	7.50	0.70	0.73	0.80	6	10
2	7.00	191.48	9.52	8.00	8.00	0.40	455	1.12	0.80	0.0231	7.50	0.70	0.75	0.80	5	9
3	7.00	191.48	9.52	9.00	9.00	0.40	455	1.12	0.80	0.0231	7.50	0.70	0.77	0.80	5	8
4	7.00	191.48	9.52	10.00	10.00	0.40	455	1.12	0.80	0.0231	7.50	0.70	0.79	0.80	4	7
5	7.50	190.98	10.02	7.00	7.00	0.40	455	1.12	0.80	0.0231	7.00	0.70	0.73	0.80	6	10
6	7.50	190.98	10.02	8.00	8.00	0.40	455	1.12	0.80	0.0231	7.00	0.70	0.74	0.80	5	9
7	7.50	190.98	10.02	9.00	9.00	0.40	455	1.12	0.80	0.0231	7.00	0.70	0.75	0.80	5	8
8	7.50	190.98	10.02	10.00	10.00	0.40	455	1.12	0.80	0.0231	7.00	0.70	0.77	0.80	5	7
9	8.00	190.48	10.52	7.00	7.00	0.40	455	1.12	0.80	0.0231	6.50	0.70	0.73	0.80	6	10
10	8.00	190.48	10.52	8.00	8.00	0.40	455	1.12	0.80	0.0231	6.50	0.70	0.73	0.80	6	9
11	8.00	190.48	10.52	9.00	9.00	0.40	455	1.12	0.80	0.0231	6.50	0.70	0.74	0.80	5	8
12	8.00	190.48	10.52	10.00	10.00	0.40	455	1.12	0.80	0.0231	6.50	0.70	0.76	0.80	5	8

Appendix – 22B

Calculation of Safe Load on Uniform Diameter Bored Cast in situ Pile. (Near IBH41,42,43,44,45,46,48,49) (HCSD Slurry pipe corridor)

The safe load is calculated as follows,

1) Design Stipulations

- | | |
|---|---|
| 1. Type of pile | - Bored cast in situ uniform diameter pile. |
| 2. Pile diameter considered | - 0.60m |
| 3. Termination depth of pile considered | - 16.00m from FGL. |
| 4. Cut off Level | - 3.00m from FGL. |
| 5. Factor of Safety | - 2.50 |
| 6. Depth of Water table | - Considered at FGL. |
| 7. Ref | - IS 2911 P-I, Sec-II, 2021. |

2) Test Data

The parameters are based on IBH 43. For evaluation of safe load on piles following characterized layers are considered as described in table below,

Depth in m from RL 201.00 m	Cohesion in kg/cm ²	Angle of Internal Friction ϕ	Submerged density in gm/cc γ_{sub}	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 3.00	Pile cutoff level – No pile						
3.00 to 10.22	0.39 [#]	4 [#] ~0*	0.84 [#]	1.00	NA	NA	4-9
10.22 to 16.82	0.05 [#] ~0.00*	28 [#]	1.06 [#]	NA	1.00	28	20-36
16.82 to 27.52	0.00	34 ^{\$}	1.10	NA	1.50	34	>100

Notes: - Layers are characterized based on classification and the state of soil in that stratum.

* - In cohesive soils the contribution of the angle of internal friction being insignificant is ignored.

Shear parameters are the most representative for the layer. NA means not applicable. Characterized N values are considered for each layer.

- Weighted Average of the parameters falling in the same layer has been considered

\$-Parameters are correlated based on SPT value N.

3) Ultimate Load in Compression

3.1) Ultimate load in Compression by Bearing

Ultimate load on pile in end bearing,

$$q_{ub} = A_p (0.5 \cdot D \cdot \gamma \cdot N_\gamma + P D N_q)$$

$$A_p = \text{Cross section area of Pile stem at toe} = \pi d^2 / 4$$

$$D = \text{Diameter of pile} = d \text{ in m}$$

$$N_\gamma = 42.90$$

$$N_q = 40.00$$

$$q_{ub} = 0.785d^2 (0.5 \cdot d \cdot 1.10 \cdot 42.90 + 7.95 \cdot 40.00) = 18.52d^3 + 249.63d^2$$

(For Pile terminating at 16.00m from F.G.L.)

Note: As the pile terminating just above rock level, we have considered parameter for end bearing component based on rock strata.

3.2) Ultimate Load in Compression by Skin Friction

Ultimate load in skin friction,

$$q_{uf} = \alpha_i C_{ai} A_i + K_i P D_i \tan \delta_i A_{si}$$

First Layer – No contribution considered – (Within Cutoff Level).

$$\text{Second Layer} - \alpha_2 C_{a2} A_{s2} = 1.00 \cdot 3.90 \cdot \pi \cdot d \cdot 7.22 = 88.46d$$

$$\text{Third Layer} - K_3 P D_3 \tan \delta_3 A_{s3} = 1.00 \cdot 7.95 \cdot \tan 28^\circ \cdot \pi \cdot d \cdot (\ell - 10.22) = 13.28 d (\ell - 10.22)$$

Substituting, ultimate load

$$q_{uf} = 88.46d + 13.28d (\ell - 10.22) \text{ (For Pile terminating at 16.00m from F.G.L.)}$$

Where, ℓ is the pile length and d is diameter of piles, substituting

Ultimate load by both bearing and friction can be as follows for various lengths of piles,
 $q_{uc} = q_{ub} + q_{uf}$

$$q_{uc} = 18.52d^3 + 249.63d^2 + 88.46d + 13.28d (\ell - 10.22)$$

(For Pile terminating at 16.00m from F.G.L.).

By substituting various diameters of piles having various lengths, the safe load is worked out considering the safety factor of 2.50 and are given in table below,

Safe Load on Piles in Compression (in Ton)

Termination Depth of Pile in m, from FGL	Termination Depth of Pile in m, from cut-off	Diameter of Pile in, m
		0.60
16.00	13.00	77.18

3.3) Ultimate Load in Uplift

Considering skin friction for determination of uplift

Safe Load on Piles in Uplift (in Ton)

Termination Depth of Pile in m, from FGL	Termination Depth of Pile in m, from cut-off	Diameter of Pile in, m
		0.60
16.00	13.00	38.54

Note: Self weight of pile is considered in calculation of ultimate load in uplift.

Self weight of Pile (in Ton)

Termination Depth of Pile in m, from FGL	Termination Depth of Pile in m, from cut-off	Diameter of Pile in, m
		0.60
16.00	13.00	5.51

3.4) Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60
Subgrade reaction in MN/m^3		5.76
Stiffness factor T in m		1.99
Depth of fixity in m	Free Head	3.80
	Fixed Head	4.30
Allowable Horizontal Force in T	Free Head	5.00
	Fixed Head	13.10
Allowable Moment capacity in Tm	Free Head	6.55
	Fixed Head	23.32

4) Notes:

1) Initial and Routine pile load tests shall be carried out as per IS 2911, P-4 on the piles to confirm the capacity of pile worked out theoretically. For design and construction, specifications of IS 2911, P-I, S-2, shall strictly be followed. Termination depth of pile shall be from FGL.

Dr. K. K. Thaker

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APPENDIX - 23 (For IBH-50,51,52,53 (Limestone handling system))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:197.57m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 23.1) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 23.2)		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
7.00	190.57	11.93	1.50	1.50	62	103	164	62	62
7.00	190.57	11.93	2.00	2.00	55	77	124	55	55
7.00	190.57	11.93	2.50	2.50	50	63	100	50	50
7.00	190.57	11.93	3.00	3.00	47	53	85	47	47
7.50	190.07	12.43	1.50	1.50	65	104	167	65	65
7.50	190.07	12.43	2.00	2.00	56	79	126	56	56
7.50	190.07	12.43	2.50	2.50	52	64	102	52	52
7.50	190.07	12.43	3.00	3.00	48	54	87	48	48
8.00	189.57	12.93	1.50	1.50	67	107	171	67	67
8.00	189.57	12.93	2.00	2.00	58	81	130	58	58
8.00	189.57	12.93	2.50	2.50	53	66	106	53	53
8.00	189.57	12.93	3.00	3.00	50	56	89	50	50

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.57m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 23.1 (For IBH-50,51,52,53 (Limestone handling system))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	7.00	11.93	190.57	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.97	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	62
2	2.00	2.00	7.00	11.93	190.57	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.72	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	55
3	2.50	2.50	7.00	11.93	190.57	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.58	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	50
4	3.00	3.00	7.00	11.93	190.57	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.48	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	47
5	1.50	1.50	7.50	12.43	190.07	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	2.04	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	65
6	2.00	2.00	7.50	12.43	190.07	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.78	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	56
7	2.50	2.50	7.50	12.43	190.07	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.62	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	52
8	3.00	3.00	7.50	12.43	190.07	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.52	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	48
9	1.50	1.50	8.00	12.93	189.57	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	2.10	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	67
10	2.00	2.00	8.00	12.93	189.57	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.83	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	58
11	2.50	2.50	8.00	12.93	189.57	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.66	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	53
12	3.00	3.00	8.00	12.93	189.57	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.55	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	50

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.57m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 23.2 (For IBH-50,51,52,53 (Limestone handling system))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	7.00	190.57	11.93	1.50	1.50	0.40	560	1.12	0.80	0.0015	2.00	0.70	0.69	0.80	103	164
2	7.00	190.57	11.93	2.00	2.00	0.40	560	1.12	0.80	0.0015	2.00	0.70	0.73	0.80	77	124
3	7.00	190.57	11.93	2.50	2.50	0.40	560	1.12	0.80	0.0015	2.00	0.70	0.73	0.80	63	100
4	7.00	190.57	11.93	3.00	3.00	0.40	560	1.12	0.80	0.0015	2.00	0.70	0.73	0.80	53	85
5	7.50	190.07	12.43	1.50	1.50	0.40	560	1.12	0.80	0.0015	1.50	0.70	0.69	0.80	104	167
6	7.50	190.07	12.43	2.00	2.00	0.40	560	1.12	0.80	0.0015	1.50	0.70	0.73	0.80	79	126
7	7.50	190.07	12.43	2.50	2.50	0.40	560	1.12	0.80	0.0015	1.50	0.70	0.73	0.80	64	102
8	7.50	190.07	12.43	3.00	3.00	0.40	560	1.12	0.80	0.0015	1.50	0.70	0.73	0.80	54	87
9	8.00	189.57	12.93	1.50	1.50	0.40	560	1.12	0.80	0.0015	1.00	0.70	0.68	0.80	107	171
10	8.00	189.57	12.93	2.00	2.00	0.40	560	1.12	0.80	0.0015	1.00	0.70	0.73	0.80	81	130
11	8.00	189.57	12.93	2.50	2.50	0.40	560	1.12	0.80	0.0015	1.00	0.70	0.73	0.80	66	106
12	8.00	189.57	12.93	3.00	3.00	0.40	560	1.12	0.80	0.0015	1.00	0.70	0.73	0.80	56	89

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 23.3 (For IBH-50,51,52,53 (Limestone handling system))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:197.57m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 23.4) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 23.5)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
7.00	190.57	11.93	3.50	3.50	45	46	73	45	45
7.00	190.57	11.93	4.00	4.00	43	41	65	41	43
7.00	190.57	11.93	5.00	5.00	41	33	53	33	41
7.00	190.57	11.93	6.00	6.00	40	28	45	28	40
7.50	190.07	12.43	3.50	3.50	46	47	75	46	46
7.50	190.07	12.43	4.00	4.00	44	41	66	41	44
7.50	190.07	12.43	5.00	5.00	42	34	54	34	42
7.50	190.07	12.43	6.00	6.00	40	28	46	28	40
8.00	189.57	12.93	3.50	3.50	47	48	77	47	47
8.00	189.57	12.93	4.00	4.00	45	43	68	43	45
8.00	189.57	12.93	5.00	5.00	43	35	55	35	43
8.00	189.57	12.93	6.00	6.00	41	29	47	29	41

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.57m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 23.4 (For IBH-50,51,52,53 (Limestone handling system))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	7.00	11.93	190.57	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.41	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	45
2	4.00	4.00	7.00	11.93	190.57	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.36	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	43
3	5.00	5.00	7.00	11.93	190.57	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.29	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	41
4	6.00	6.00	7.00	11.93	190.57	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.24	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	40
5	3.50	3.50	7.50	12.43	190.07	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.44	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	46
6	4.00	4.00	7.50	12.43	190.07	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.39	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	44
7	5.00	5.00	7.50	12.43	190.07	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.31	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	42
8	6.00	6.00	7.50	12.43	190.07	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.26	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	40
9	3.50	3.50	8.00	12.93	189.57	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.47	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	47
10	4.00	4.00	8.00	12.93	189.57	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.41	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	45
11	5.00	5.00	8.00	12.93	189.57	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.33	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	43
12	6.00	6.00	8.00	12.93	189.57	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.28	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	41

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.57m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 23.5 (For IBH-50,51,52,53 (Limestone handling system))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	7.00	190.57	11.93	3.50	3.50	0.40	560	1.12	0.80	0.0015	2.00	0.70	0.73	0.80	46	73
2	7.00	190.57	11.93	4.00	4.00	0.40	560	1.12	0.80	0.0015	2.00	0.70	0.73	0.80	41	65
3	7.00	190.57	11.93	5.00	5.00	0.40	560	1.12	0.80	0.0015	2.00	0.70	0.73	0.80	33	53
4	7.00	190.57	11.93	6.00	6.00	0.40	560	1.12	0.80	0.0015	2.00	0.70	0.73	0.80	28	45
5	7.50	190.07	12.43	3.50	3.50	0.40	560	1.12	0.80	0.0015	1.50	0.70	0.73	0.80	47	75
6	7.50	190.07	12.43	4.00	4.00	0.40	560	1.12	0.80	0.0015	1.50	0.70	0.73	0.80	41	66
7	7.50	190.07	12.43	5.00	5.00	0.40	560	1.12	0.80	0.0015	1.50	0.70	0.73	0.80	34	54
8	7.50	190.07	12.43	6.00	6.00	0.40	560	1.12	0.80	0.0015	1.50	0.70	0.73	0.80	28	46
9	8.00	189.57	12.93	3.50	3.50	0.40	560	1.12	0.80	0.0015	1.00	0.70	0.73	0.80	48	77
10	8.00	189.57	12.93	4.00	4.00	0.40	560	1.12	0.80	0.0015	1.00	0.70	0.73	0.80	43	68
11	8.00	189.57	12.93	5.00	5.00	0.40	560	1.12	0.80	0.0015	1.00	0.70	0.73	0.80	35	55
12	8.00	189.57	12.93	6.00	6.00	0.40	560	1.12	0.80	0.0015	1.00	0.70	0.73	0.80	29	47

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 23.6 (For IBH-50,51,52,53 (Limestone handling system))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:197.57m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 23.7) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 23.8)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
7.00	190.57	11.93	7.00	7.00	39	24	39	24	39
7.00	190.57	11.93	8.00	8.00	38	21	34	21	34
7.00	190.57	11.93	9.00	9.00	37	19	30	19	30
7.00	190.57	11.93	10.00	10.00	37	17	28	17	28
7.50	190.07	12.43	7.00	7.00	39	25	39	25	39
7.50	190.07	12.43	8.00	8.00	38	22	35	22	35
7.50	190.07	12.43	9.00	9.00	38	19	31	19	31
7.50	190.07	12.43	10.00	10.00	37	18	28	18	28
8.00	189.57	12.93	7.00	7.00	40	25	40	25	40
8.00	189.57	12.93	8.00	8.00	39	22	35	22	35
8.00	189.57	12.93	9.00	9.00	38	20	32	20	32
8.00	189.57	12.93	10.00	10.00	38	18	29	18	29

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.57m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 23.7 (For IBH-50,51,52,53 (Limestone handling system))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	7.00	11.93	190.57	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.21	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	39
2	8.00	8.00	7.00	11.93	190.57	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.18	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	38
3	9.00	9.00	7.00	11.93	190.57	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.16	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	37
4	10.00	10.00	7.00	11.93	190.57	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.14	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	37
5	7.00	7.00	7.50	12.43	190.07	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.22	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	39
6	8.00	8.00	7.50	12.43	190.07	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.19	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	38
7	9.00	9.00	7.50	12.43	190.07	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.17	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	38
8	10.00	10.00	7.50	12.43	190.07	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.16	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	37
9	7.00	7.00	8.00	12.93	189.57	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.24	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	40
10	8.00	8.00	8.00	12.93	189.57	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.21	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	39
11	9.00	9.00	8.00	12.93	189.57	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.18	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	38
12	10.00	10.00	8.00	12.93	189.57	1.60	3	5.63	0.20	0.15	1.30	1.20	0.80	1.17	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	38

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.57m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 23.8 (For IBH-50,51,52,53 (Limestone handling system))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	7.00	190.57	11.93	7.00	7.00	0.40	560	1.12	0.80	0.0015	2.00	0.70	0.73	0.80	24	39
2	7.00	190.57	11.93	8.00	8.00	0.40	560	1.12	0.80	0.0015	2.00	0.70	0.75	0.80	21	34
3	7.00	190.57	11.93	9.00	9.00	0.40	560	1.12	0.80	0.0015	2.00	0.70	0.77	0.80	19	30
4	7.00	190.57	11.93	10.00	10.00	0.40	560	1.12	0.80	0.0015	2.00	0.70	0.79	0.80	17	28
5	7.50	190.07	12.43	7.00	7.00	0.40	560	1.12	0.80	0.0015	1.50	0.70	0.73	0.80	25	39
6	7.50	190.07	12.43	8.00	8.00	0.40	560	1.12	0.80	0.0015	1.50	0.70	0.74	0.80	22	35
7	7.50	190.07	12.43	9.00	9.00	0.40	560	1.12	0.80	0.0015	1.50	0.70	0.75	0.80	19	31
8	7.50	190.07	12.43	10.00	10.00	0.40	560	1.12	0.80	0.0015	1.50	0.70	0.77	0.80	18	28
9	8.00	189.57	12.93	7.00	7.00	0.40	560	1.12	0.80	0.0015	1.00	0.70	0.73	0.80	25	40
10	8.00	189.57	12.93	8.00	8.00	0.40	560	1.12	0.80	0.0015	1.00	0.70	0.73	0.80	22	35
11	8.00	189.57	12.93	9.00	9.00	0.40	560	1.12	0.80	0.0015	1.00	0.70	0.74	0.80	20	32
12	8.00	189.57	12.93	10.00	10.00	0.40	560	1.12	0.80	0.0015	1.00	0.70	0.76	0.80	18	29

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 23.9 (For IBH-50,51,52,53 (Limestone handling system))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:197.57m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	196.57	5.93	1.50	1.50	4	7	11	4	4
1.00	196.57	5.93	2.00	2.00	4	5	8	4	4
1.00	196.57	5.93	2.50	2.50	4	4	7	4	4
1.00	196.57	5.93	3.00	3.00	4	3	5	3	4
2.00	195.57	6.93	1.50	1.50	4	7	12	4	4
2.00	195.57	6.93	2.00	2.00	4	6	9	4	4
2.00	195.57	6.93	2.50	2.50	4	4	7	4	4
2.00	195.57	6.93	3.00	3.00	4	4	6	4	4
3.00	194.57	7.93	1.50	1.50	5	7	12	5	5
3.00	194.57	7.93	2.00	2.00	4	6	9	4	4
3.00	194.57	7.93	2.50	2.50	4	4	7	4	4
3.00	194.57	7.93	3.00	3.00	4	4	6	4	4

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.57m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-23.10 (For IBH-50,51,52,53 (Limestone handling system))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	1.00	5.93	196.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4
2	2.00	2.00	1.00	5.93	196.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4
3	2.50	2.50	1.00	5.93	196.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4
4	3.00	3.00	1.00	5.93	196.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4
5	1.50	1.50	2.00	6.93	195.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.27	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4
6	2.00	2.00	2.00	6.93	195.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.20	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4
7	2.50	2.50	2.00	6.93	195.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.16	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4
8	3.00	3.00	2.00	6.93	195.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4
9	1.50	1.50	3.00	7.93	194.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.40	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	5
10	2.00	2.00	3.00	7.93	194.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.30	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4
11	2.50	2.50	3.00	7.93	194.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.24	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4
12	3.00	3.00	3.00	7.93	194.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.20	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.57m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-23.11 (For IBH-50,51,52,53 (Limestone handling system))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	1.00	196.57	5.93	1.50	1.50	0.40	63	1.12	0.80	0.0510	3.00	0.70	0.80	0.80	7	11
2	1.00	196.57	5.93	2.00	2.00	0.40	63	1.12	0.80	0.0510	4.00	0.70	0.85	0.80	5	8
3	1.00	196.57	5.93	2.50	2.50	0.40	63	1.12	0.80	0.0510	5.00	0.70	0.88	0.80	4	7
4	1.00	196.57	5.93	3.00	3.00	0.40	63	1.12	0.80	0.0510	6.00	0.70	0.91	0.80	3	5
5	2.00	195.57	6.93	1.50	1.50	0.40	63	1.12	0.80	0.0510	3.00	0.70	0.73	0.80	7	12
6	2.00	195.57	6.93	2.00	2.00	0.40	63	1.12	0.80	0.0510	4.00	0.70	0.73	0.80	6	9
7	2.00	195.57	6.93	2.50	2.50	0.40	63	1.12	0.80	0.0510	5.00	0.70	0.76	0.80	4	7
8	2.00	195.57	6.93	3.00	3.00	0.40	63	1.12	0.80	0.0510	6.00	0.70	0.80	0.80	4	6
9	3.00	194.57	7.93	1.50	1.50	0.40	63	1.12	0.80	0.0510	3.00	0.70	0.73	0.80	7	12
10	3.00	194.57	7.93	2.00	2.00	0.40	63	1.12	0.80	0.0510	4.00	0.70	0.73	0.80	6	9
11	3.00	194.57	7.93	2.50	2.50	0.40	63	1.12	0.80	0.0510	5.00	0.70	0.73	0.80	4	7
12	3.00	194.57	7.93	3.00	3.00	0.40	63	1.12	0.80	0.0510	6.00	0.70	0.73	0.80	4	6

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 23.12 (For IBH-50,51,52,53 (Limestone handling system))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:197.57m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	196.57	5.93	3.50	3.50	4	3	5	3	4
1.00	196.57	5.93	4.00	4.00	4	2	4	2	4
1.00	196.57	5.93	5.00	5.00	4	2	3	2	3
1.00	196.57	5.93	6.00	6.00	4	2	3	2	3
2.00	195.57	6.93	3.50	3.50	4	3	5	3	4
2.00	195.57	6.93	4.00	4.00	4	3	4	3	4
2.00	195.57	6.93	5.00	5.00	4	2	3	2	3
2.00	195.57	6.93	6.00	6.00	4	2	3	2	3
3.00	194.57	7.93	3.50	3.50	4	3	5	3	4
3.00	194.57	7.93	4.00	4.00	4	3	4	3	4
3.00	194.57	7.93	5.00	5.00	4	2	3	2	3
3.00	194.57	7.93	6.00	6.00	4	2	3	2	3

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.57m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-23.13 (For IBH-50,51,52,53 (Limestone handling system))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	1.00	5.93	196.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4
2	4.00	4.00	1.00	5.93	196.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4
3	5.00	5.00	1.00	5.93	196.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4
4	6.00	6.00	1.00	5.93	196.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4
5	3.50	3.50	2.00	6.93	195.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4
6	4.00	4.00	2.00	6.93	195.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4
7	5.00	5.00	2.00	6.93	195.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4
8	6.00	6.00	2.00	6.93	195.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4
9	3.50	3.50	3.00	7.93	194.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.17	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4
10	4.00	4.00	3.00	7.93	194.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.15	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4
11	5.00	5.00	3.00	7.93	194.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4
12	6.00	6.00	3.00	7.93	194.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.57m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-23.14 (For IBH-50,51,52,53 (Limestone handling system))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	1.00	196.57	5.93	3.50	3.50	0.40	63	1.12	0.80	0.0510	7.00	0.70	0.92	0.80	3	5
2	1.00	196.57	5.93	4.00	4.00	0.40	63	1.12	0.80	0.0510	8.00	0.70	0.93	0.80	2	4
3	1.00	196.57	5.93	5.00	5.00	0.40	63	1.12	0.80	0.0510	8.00	0.70	0.95	0.80	2	3
4	1.00	196.57	5.93	6.00	6.00	0.40	63	1.12	0.80	0.0510	8.00	0.70	0.96	0.80	2	3
5	2.00	195.57	6.93	3.50	3.50	0.40	63	1.12	0.80	0.0510	7.00	0.70	0.83	0.80	3	5
6	2.00	195.57	6.93	4.00	4.00	0.40	63	1.12	0.80	0.0510	7.00	0.70	0.85	0.80	3	4
7	2.00	195.57	6.93	5.00	5.00	0.40	63	1.12	0.80	0.0510	7.00	0.70	0.88	0.80	2	3
8	2.00	195.57	6.93	6.00	6.00	0.40	63	1.12	0.80	0.0510	7.00	0.70	0.91	0.80	2	3
9	3.00	194.57	7.93	3.50	3.50	0.40	63	1.12	0.80	0.0510	6.00	0.70	0.75	0.80	3	5
10	3.00	194.57	7.93	4.00	4.00	0.40	63	1.12	0.80	0.0510	6.00	0.70	0.77	0.80	3	4
11	3.00	194.57	7.93	5.00	5.00	0.40	63	1.12	0.80	0.0510	6.00	0.70	0.82	0.80	2	3
12	3.00	194.57	7.93	6.00	6.00	0.40	63	1.12	0.80	0.0510	6.00	0.70	0.85	0.80	2	3

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 23.15 (For IBH-50,51,52,53 (Limestone handling system))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:197.57m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	196.57	5.93	7.00	7.00	3	1	2	1	2
1.00	196.57	5.93	8.00	8.00	3	1	2	1	2
1.00	196.57	5.93	9.00	9.00	3	1	2	1	2
1.00	196.57	5.93	10.00	10.00	3	1	2	1	2
2.00	195.57	6.93	7.00	7.00	4	2	2	2	2
2.00	195.57	6.93	8.00	8.00	4	1	2	1	2
2.00	195.57	6.93	9.00	9.00	4	1	2	1	2
2.00	195.57	6.93	10.00	10.00	4	1	2	1	2
3.00	194.57	7.93	7.00	7.00	4	2	3	2	3
3.00	194.57	7.93	8.00	8.00	4	1	2	1	2
3.00	194.57	7.93	9.00	9.00	4	1	2	1	2
3.00	194.57	7.93	10.00	10.00	4	1	2	1	2

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.57m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-23.16 (For IBH-50,51,52,53 (Limestone handling system))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	1.00	5.93	196.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	3
2	8.00	8.00	1.00	5.93	196.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	3
3	9.00	9.00	1.00	5.93	196.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.02	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	3
4	10.00	10.00	1.00	5.93	196.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.02	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	3
5	7.00	7.00	2.00	6.93	195.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4
6	8.00	8.00	2.00	6.93	195.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4
7	9.00	9.00	2.00	6.93	195.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4
8	10.00	10.00	2.00	6.93	195.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4
9	7.00	7.00	3.00	7.93	194.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4
10	8.00	8.00	3.00	7.93	194.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4
11	9.00	9.00	3.00	7.93	194.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4
12	10.00	10.00	3.00	7.93	194.57	0.18	1	5.30	0.06	0.05	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.85	0.93	0.50	0.50	4

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.57m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-23.17 (For IBH-50,51,52,53 (Limestone handling system))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	1.00	196.57	5.93	7.00	7.00	0.40	63	1.12	0.80	0.0510	8.00	0.70	0.97	0.80	1	2
2	1.00	196.57	5.93	8.00	8.00	0.40	63	1.12	0.80	0.0510	8.00	0.70	0.97	0.80	1	2
3	1.00	196.57	5.93	9.00	9.00	0.40	63	1.12	0.80	0.0510	8.00	0.70	0.97	0.80	1	2
4	1.00	196.57	5.93	10.00	10.00	0.40	63	1.12	0.80	0.0510	8.00	0.70	0.98	0.80	1	2
5	2.00	195.57	6.93	7.00	7.00	0.40	63	1.12	0.80	0.0510	7.00	0.70	0.92	0.80	2	2
6	2.00	195.57	6.93	8.00	8.00	0.40	63	1.12	0.80	0.0510	7.00	0.70	0.93	0.80	1	2
7	2.00	195.57	6.93	9.00	9.00	0.40	63	1.12	0.80	0.0510	7.00	0.70	0.94	0.80	1	2
8	2.00	195.57	6.93	10.00	10.00	0.40	63	1.12	0.80	0.0510	7.00	0.70	0.95	0.80	1	2
9	3.00	194.57	7.93	7.00	7.00	0.40	63	1.12	0.80	0.0510	6.00	0.70	0.87	0.80	2	3
10	3.00	194.57	7.93	8.00	8.00	0.40	63	1.12	0.80	0.0510	6.00	0.70	0.89	0.80	1	2
11	3.00	194.57	7.93	9.00	9.00	0.40	63	1.12	0.80	0.0510	6.00	0.70	0.91	0.80	1	2
12	3.00	194.57	7.93	10.00	10.00	0.40	63	1.12	0.80	0.0510	6.00	0.70	0.92	0.80	1	2

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 23.18 (For IBH-50,51,52,53 (Limestone handling system))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:197.57m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
4.00	193.57	8.93	1.50	1.50	13	15	24	13	13
4.00	193.57	8.93	2.00	2.00	12	11	18	11	12
4.00	193.57	8.93	2.50	2.50	11	9	15	9	11
4.00	193.57	8.93	3.00	3.00	11	8	12	8	11
5.00	192.57	9.93	1.50	1.50	14	15	24	14	14
5.00	192.57	9.93	2.00	2.00	13	11	18	11	13
5.00	192.57	9.93	2.50	2.50	12	9	15	9	12
5.00	192.57	9.93	3.00	3.00	11	8	12	8	11
6.00	191.57	10.93	1.50	1.50	15	15	25	15	15
6.00	191.57	10.93	2.00	2.00	13	12	18	12	13
6.00	191.57	10.93	2.50	2.50	12	9	15	9	12
6.00	191.57	10.93	3.00	3.00	12	8	13	8	12

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.57m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-23.19 (For IBH-50,51,52,53 (Limestone handling system))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5 γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	4.00	8.93	193.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.53	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	13
2	2.00	2.00	4.00	8.93	193.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.40	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	12
3	2.50	2.50	4.00	8.93	193.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.32	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	11
4	3.00	3.00	4.00	8.93	193.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.27	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	11
5	1.50	1.50	5.00	9.93	192.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.67	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	14
6	2.00	2.00	5.00	9.93	192.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.50	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	13
7	2.50	2.50	5.00	9.93	192.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.40	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	12
8	3.00	3.00	5.00	9.93	192.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.33	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	11
9	1.50	1.50	6.00	10.93	191.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.80	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	15
10	2.00	2.00	6.00	10.93	191.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.60	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	13
11	2.50	2.50	6.00	10.93	191.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.48	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	12
12	3.00	3.00	6.00	10.93	191.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.40	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	12

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.57m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-23.20 (For IBH-50,51,52,53 (Limestone handling system))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	4.00	193.57	8.93	1.50	1.50	0.40	165	1.12	0.80	0.0314	3.00	0.70	0.73	0.80	15	24
2	4.00	193.57	8.93	2.00	2.00	0.40	165	1.12	0.80	0.0314	4.00	0.70	0.73	0.80	11	18
3	4.00	193.57	8.93	2.50	2.50	0.40	165	1.12	0.80	0.0314	5.00	0.70	0.73	0.80	9	15
4	4.00	193.57	8.93	3.00	3.00	0.40	165	1.12	0.80	0.0314	5.00	0.70	0.73	0.80	8	12
5	5.00	192.57	9.93	1.50	1.50	0.40	165	1.12	0.80	0.0314	3.00	0.70	0.73	0.80	15	24
6	5.00	192.57	9.93	2.00	2.00	0.40	165	1.12	0.80	0.0314	4.00	0.70	0.73	0.80	11	18
7	5.00	192.57	9.93	2.50	2.50	0.40	165	1.12	0.80	0.0314	4.00	0.70	0.73	0.80	9	15
8	5.00	192.57	9.93	3.00	3.00	0.40	165	1.12	0.80	0.0314	4.00	0.70	0.73	0.80	8	12
9	6.00	191.57	10.93	1.50	1.50	0.40	165	1.12	0.80	0.0314	3.00	0.70	0.71	0.80	15	25
10	6.00	191.57	10.93	2.00	2.00	0.40	165	1.12	0.80	0.0314	3.00	0.70	0.73	0.80	12	18
11	6.00	191.57	10.93	2.50	2.50	0.40	165	1.12	0.80	0.0314	3.00	0.70	0.73	0.80	9	15
12	6.00	191.57	10.93	3.00	3.00	0.40	165	1.12	0.80	0.0314	3.00	0.70	0.73	0.80	8	13

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 23.21 (For IBH-50,51,52,53 (Limestone handling system))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:197.57m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
4.00	193.57	8.93	3.50	3.50	10	7	11	7	10
4.00	193.57	8.93	4.00	4.00	10	6	9	6	9
4.00	193.57	8.93	5.00	5.00	10	5	8	5	8
4.00	193.57	8.93	6.00	6.00	10	4	6	4	6
5.00	192.57	9.93	3.50	3.50	11	7	11	7	11
5.00	192.57	9.93	4.00	4.00	11	6	10	6	10
5.00	192.57	9.93	5.00	5.00	10	5	8	5	8
5.00	192.57	9.93	6.00	6.00	10	4	7	4	7
6.00	191.57	10.93	3.50	3.50	11	7	11	7	11
6.00	191.57	10.93	4.00	4.00	11	6	10	6	10
6.00	191.57	10.93	5.00	5.00	10	5	9	5	9
6.00	191.57	10.93	6.00	6.00	10	5	8	5	8

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.57m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-23.22 (For IBH-50,51,52,53 (Limestone handling system))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	4.00	8.93	193.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.23	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	10
2	4.00	4.00	4.00	8.93	193.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.20	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	10
3	5.00	5.00	4.00	8.93	193.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.16	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	10
4	6.00	6.00	4.00	8.93	193.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	10
5	3.50	3.50	5.00	9.93	192.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.29	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	11
6	4.00	4.00	5.00	9.93	192.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.25	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	11
7	5.00	5.00	5.00	9.93	192.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.20	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	10
8	6.00	6.00	5.00	9.93	192.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.17	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	10
9	3.50	3.50	6.00	10.93	191.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.34	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	11
10	4.00	4.00	6.00	10.93	191.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.30	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	11
11	5.00	5.00	6.00	10.93	191.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.24	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	10
12	6.00	6.00	6.00	10.93	191.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.20	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	10

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.57m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-23.23 (For IBH-50,51,52,53 (Limestone handling system))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	4.00	193.57	8.93	3.50	3.50	0.40	165	1.12	0.80	0.0314	5.00	0.70	0.73	0.80	7	11
2	4.00	193.57	8.93	4.00	4.00	0.40	165	1.12	0.80	0.0314	5.00	0.70	0.73	0.80	6	9
3	4.00	193.57	8.93	5.00	5.00	0.40	165	1.12	0.80	0.0314	5.00	0.70	0.76	0.80	5	8
4	4.00	193.57	8.93	6.00	6.00	0.40	165	1.12	0.80	0.0314	5.00	0.70	0.80	0.80	4	6
5	5.00	192.57	9.93	3.50	3.50	0.40	165	1.12	0.80	0.0314	4.00	0.70	0.73	0.80	7	11
6	5.00	192.57	9.93	4.00	4.00	0.40	165	1.12	0.80	0.0314	4.00	0.70	0.73	0.80	6	10
7	5.00	192.57	9.93	5.00	5.00	0.40	165	1.12	0.80	0.0314	4.00	0.70	0.73	0.80	5	8
8	5.00	192.57	9.93	6.00	6.00	0.40	165	1.12	0.80	0.0314	4.00	0.70	0.75	0.80	4	7
9	6.00	191.57	10.93	3.50	3.50	0.40	165	1.12	0.80	0.0314	3.00	0.70	0.73	0.80	7	11
10	6.00	191.57	10.93	4.00	4.00	0.40	165	1.12	0.80	0.0314	3.00	0.70	0.73	0.80	6	10
11	6.00	191.57	10.93	5.00	5.00	0.40	165	1.12	0.80	0.0314	3.00	0.70	0.73	0.80	5	9
12	6.00	191.57	10.93	6.00	6.00	0.40	165	1.12	0.80	0.0314	3.00	0.70	0.73	0.80	5	8

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APPENDIX - 23.24 (For IBH-50,51,52,53 (Limestone handling system))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:197.57m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
4.00	193.57	8.93	7.00	7.00	9	3	6	3	6
4.00	193.57	8.93	8.00	8.00	9	3	5	3	5
4.00	193.57	8.93	9.00	9.00	9	3	5	3	5
4.00	193.57	8.93	10.00	10.00	9	3	4	3	4
5.00	192.57	9.93	7.00	7.00	10	4	6	4	6
5.00	192.57	9.93	8.00	8.00	9	3	5	3	5
5.00	192.57	9.93	9.00	9.00	9	3	5	3	5
5.00	192.57	9.93	10.00	10.00	9	3	5	3	5
6.00	191.57	10.93	7.00	7.00	10	4	7	4	7
6.00	191.57	10.93	8.00	8.00	10	4	6	4	6
6.00	191.57	10.93	9.00	9.00	10	3	6	3	6
6.00	191.57	10.93	10.00	10.00	9	3	5	3	5

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.57m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-23.25 (For IBH-50,51,52,53 (Limestone handling system))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	4.00	8.93	193.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.11	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	9
2	8.00	8.00	4.00	8.93	193.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	9
3	9.00	9.00	4.00	8.93	193.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	9
4	10.00	10.00	4.00	8.93	193.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	9
5	7.00	7.00	5.00	9.93	192.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.14	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	10
6	8.00	8.00	5.00	9.93	192.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	9
7	9.00	9.00	5.00	9.93	192.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.11	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	9
8	10.00	10.00	5.00	9.93	192.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	9
9	7.00	7.00	6.00	10.93	191.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.17	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	10
10	8.00	8.00	6.00	10.93	191.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.15	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	10
11	9.00	9.00	6.00	10.93	191.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	10
12	10.00	10.00	6.00	10.93	191.57	0.47	0	5.14	0.00	0.00	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	1.88	0.94	0.50	0.50	9

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.57m.
- 3) Calculations are considering the effect of water table at FGL.

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APPENDIX-23.26 (For IBH-50,51,52,53 (Limestone handling system))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	4.00	193.57	8.93	7.00	7.00	0.40	165	1.12	0.80	0.0314	5.00	0.70	0.83	0.80	3	6
2	4.00	193.57	8.93	8.00	8.00	0.40	165	1.12	0.80	0.0314	5.00	0.70	0.85	0.80	3	5
3	4.00	193.57	8.93	9.00	9.00	0.40	165	1.12	0.80	0.0314	5.00	0.70	0.87	0.80	3	5
4	4.00	193.57	8.93	10.00	10.00	0.40	165	1.12	0.80	0.0314	5.00	0.70	0.88	0.80	3	4
5	5.00	192.57	9.93	7.00	7.00	0.40	165	1.12	0.80	0.0314	4.00	0.70	0.78	0.80	4	6
6	5.00	192.57	9.93	8.00	8.00	0.40	165	1.12	0.80	0.0314	4.00	0.70	0.81	0.80	3	5
7	5.00	192.57	9.93	9.00	9.00	0.40	165	1.12	0.80	0.0314	4.00	0.70	0.83	0.80	3	5
8	5.00	192.57	9.93	10.00	10.00	0.40	165	1.12	0.80	0.0314	4.00	0.70	0.85	0.80	3	5
9	6.00	191.57	10.93	7.00	7.00	0.40	165	1.12	0.80	0.0314	3.00	0.70	0.75	0.80	4	7
10	6.00	191.57	10.93	8.00	8.00	0.40	165	1.12	0.80	0.0314	3.00	0.70	0.77	0.80	4	6
11	6.00	191.57	10.93	9.00	9.00	0.40	165	1.12	0.80	0.0314	3.00	0.70	0.80	0.80	3	6
12	6.00	191.57	10.93	10.00	10.00	0.40	165	1.12	0.80	0.0314	3.00	0.70	0.82	0.80	3	5

Appendix – 23A

Calculation of Safe Load carrying capacity of piles socketed inside rock (Near IBH 50,51,52,53) (Limestone handling system)

Project Name: - Proposed structures of thermal power project of NTTTP at Hirma, Talabira

1.0 Introduction

In situations where overburden offering low bearing pressure is followed by rock at relatively shallower depths, end bearing piles is the suitable foundation option. Piles in rocks and weathered rocks of varying degree of weathering derive their capacity by end bearing and socket side resistance.

In situations, where, rock strata comprises of highly fragmented rock, as in present case, where RQD is nil or $(CR+RQD)/2$ is less than 30 % or when the crushing strength is less than 10 MPa, the appropriate approach would be of that suggested by Cole & Stroud.

In present site overburden soils overlay fractured / laminated / foliated rock. The founding stratum having highly fragmented rock with nil RQD and $(CR+RQD)/2$ to be less than 30 %, the approach suggested by Cole and Stroud as per Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 Pa/S2 has been used for safe load calculations.

An illustrative calculation of safe load on pile and summary of pile capacities is as follows,

2.0 Sub soil strata Characterization

General stratification at the location of boreholes IBH 52 show primarily two characterized layers,

1. Overburden comprising of, very fine grained, silty clays of low and intermediate plasticity and fine to medium grained, clayey sand upto 8.00m (i.e. RL 189.57 m).
2. Second characterized layer below the overburden soils comprises of Highly weathered, weak, yellowish brown, fine to very fine grained, rock with moderately close spaced discontinuities followed by lightly weathered, weak, dark brownish, fine to very fine grained, rock with moderately closely spaced discontinuities upto 10.80m (i.e. RL 186.77 m).

3.0 Design Considerations

1. Length of socket considered 3D from depth of rock encountered.
2. The pile is considered to have socket length below 8.00 m below NGL (i.e. RL 189.57 m) depth.
3. For present case of pile terminating in highly weathered rock. SPT at depths between 8.00 to 10.80m (between RL 189.57 to 186.77 m) is > 200 .
Based on recommendation of fig no. 3 in B 8 in Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 P1/S2, average shear strength q_c corresponding to assumed SPT of 200 may be taken as 1300 kN/m^2
4. Allowable Capacity of pile socketed into rock $Q_a = R_e + R_{sf} = C_{u1} N_c \pi B^2 / 4(F_s=3) + \alpha C_{u2} \pi BL / (F_s=6)$

4.0 Safe Load on Pile in Compression

Where,

End bearing component, $R_e = C_{u1} N_c \pi B^2 / 4F_s$,

C_{u1} = Shear strength below base of pile = 1300 kN/m^2

B = diameter of the pile = d

F_s = Factor of Safety = 3

$N_c = 9$

Therefore, **$R_e = 3061.5 d^2$**

Skin friction component of socketed length of pile, $R_{sf} = \alpha C_{u2} \pi BL / F_s$

$\alpha = 0.9$ (recommended value in IS 2911 P1/S2)

L = length of the socket = $3 D$

C_{u2} = Ultimate shear strength along socket length which shall be restricted to shear capacity of concrete of the pile = 1300 kN/m^2

F_s = Factor of Safety = 6

Therefore, $R_{sf} = 1836.9 d^2$

Thus,

$$Q_a = c_{u1} N_c \cdot \frac{\pi B^2}{4 F_s} + \alpha c_{u2} \cdot \frac{\pi B L}{F_s}$$

$$= 3061.5 d^2 + 1836.9 d^2 = 4898.4 d^2$$

Substituting the values of various diameters and socket lengths equal to 3 times diameter, allowable load on single pile can be summarized as follows,

Summary of the Safe load calculation in Compression

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	14.73	15.21	15.63
Termination level RL in m	187.77	187.29	186.87
End Bearing Component in kN	1102.1	1768.3	2479.8
Friction Component in kN	661.3	1060.9	1487.9
Safe load in Compression in kN	1763.4	2829.3	3967.7
Safe load in Compression in T	176	283	397

5.0 Safe Load on Pile in uplift

For 5.00m cutoff from FGL

The overburden soils, though, will not contribute in compression capacity would offer resistance in uplift capacity. The parameters of IBH 52 are considered for calculation of uplift resistance as summarized below,

Depth in m from RL 202.5 m	Cohesion in kg/cm^2	Angle of Internal Friction ϕ	Submerged density in $\text{gm/cc } \gamma_{\text{sub}}$	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 5.00	Pile cutoff level – No pile						
5.00 to 9.13	0.26	2(ignored)	0.87	1.00	NA	NA	2-7
9.13 to 9.93	0	28	0.88	NA	1.00	28	15
9.93 to 11.63	0.44	0	0.88	0.97	NA	NA	11-24
11.63 to 12.93	4.00	0	0.88	0.28	NA	NA	>100
12.93 to 21.43	Rock strata – Resistance would be as per skin friction capacity in socket as already calculated in compression capacity						

Ultimate load in skin friction,

$$Q_{uf} = \alpha_i C_{ai} A_{si} + K_i P D_i \tan \delta_i A_{si}$$

First Layer – No contribution considered – (Within Cutoff Level).

$$\text{Second Layer} - \alpha_2 C_{a2} A_{s2} = 1.00 * 2.60 * \pi d * 4.13 = 33.73d$$

$$\text{Third Layer} - K_3 P D_3 \tan \delta_3 A_{s3} = 1.00 * 7.95 * \tan 28 * \pi d * 0.80 = 10.62 d$$

$$\text{Fourth Layer} - \alpha_4 C_{a4} A_{s4} = 0.97 * 4.40 * \pi d * 1.70 = 22.79d$$

$$\text{Fifth Layer} - \alpha_5 C_{a5} A_{s5} = 0.28 * 40.00 * \pi d * 1.30 = 45.74d$$

Sixth Layer – $1836.90 d^2$ in rock socket

$$\text{Substituting, ultimate load } q_{uf} = 1128.80 d + 1836.9 d^2$$

The safe load in uplift is worked out (considering the safety factor of 2.50 for overburden soils) and summarized below,

Safe Load on Piles in Uplift (in Ton)

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	14.73	15.21	15.63
Termination level RL in m	187.77	187.29	186.87
Safe load in Uplift in kN	932.20	1404.15	1894.26
Self-weight of pile in kN	55.78	92.77	134.10
Safe load in Uplift in T (Considering self-weight of pile)	98.80	149.69	202.84

6.0 Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60	0.76	0.90
Subgrade reaction in MN/m^3		6.48	6.48	6.48
Stiffness factor T in m		1.94	2.34	2.68
Depth of fixity in m	Free Head	3.70	4.50	5.10
	Fixed Head	4.20	5.10	5.80
Allowable Horizontal Force in T	Free Head	5.30	7.80	10.20
	Fixed Head	14.10	20.60	27.00
Allowable Moment capacity in Tm	Free Head	6.87	12.11	18.18
	Fixed Head	24.45	43.12	64.70

7.0 Notes

1. Pile shall be terminated after socketing 3D inside rock.
2. Initial and routine pile load test is required to verify the actual carrying capacity of pile in compression, uplift and lateral loads.
3. For design and construction, specification of IS: 2911, P1/S2, IS: 456, 2000 shall strictly be followed.

(Dr. K. K. Thaker)

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 24 (For BH-45 (CHP MCC-2 & AAQMS))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation from NGL (R.L. 198.85m)	Depth of foundation from FGL	RL of Foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 24.1)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 24.2)		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	4.65	199.99	1.50	1.50	11	30	48	11	11
1.00	4.65	199.99	2.00	2.00	11	22	35	11	11
1.00	4.65	199.99	2.50	2.50	11	17	27	11	11
1.00	4.65	199.99	3.00	3.00	11	14	22	11	11
2.00	5.65	198.99	1.50	1.50	13	32	51	13	13
2.00	5.65	198.99	2.00	2.00	12	24	38	12	12
2.00	5.65	198.99	2.50	2.50	12	19	30	12	12
2.00	5.65	198.99	3.00	3.00	11	15	24	11	11
3.00	6.65	197.99	1.50	1.50	14	32	51	14	14
3.00	6.65	197.99	2.00	2.00	13	24	38	13	13
3.00	6.65	197.99	2.50	2.50	13	19	31	13	13
3.00	6.65	197.99	3.00	3.00	12	16	26	12	12

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.85m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 24.1 (For BH-45 (CHP MCC-2 & AAQMS))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from NGL m	Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	1.00	4.65	199.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.14	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11
2	2.00	2.00	1.00	4.65	199.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.11	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11
3	2.50	2.50	1.00	4.65	199.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11
4	3.00	3.00	1.00	4.65	199.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11
5	1.50	1.50	2.00	5.65	198.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.28	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	13
6	2.00	2.00	2.00	5.65	198.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.21	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	12
7	2.50	2.50	2.00	5.65	198.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.17	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	12
8	3.00	3.00	2.00	5.65	198.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.14	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11
9	1.50	1.50	3.00	6.65	197.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.42	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	14
10	2.00	2.00	3.00	6.65	197.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.32	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	13
11	2.50	2.50	3.00	6.65	197.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.25	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	13
12	3.00	3.00	3.00	6.65	197.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.21	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	12

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.85m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 24.2 (For BH-45 (CHP MCC-2 & AAQMS))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :-

Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	1.00	197.99	6.65	1.50	1.50	0.40	458	1.12	0.80	0.0174	3.00	0.70	0.80	0.80	30	48
2	1.00	197.99	6.65	2.00	2.00	0.40	458	1.12	0.80	0.0174	4.00	0.70	0.85	0.80	22	35
3	1.00	197.99	6.65	2.50	2.50	0.40	458	1.12	0.80	0.0174	5.00	0.70	0.88	0.80	17	27
4	1.00	197.99	6.65	3.00	3.00	0.40	458	1.12	0.80	0.0174	6.00	0.70	0.91	0.80	14	22
5	2.00	197.49	7.15	1.50	1.50	0.40	458	1.12	0.80	0.0174	3.00	0.70	0.73	0.80	32	51
6	2.00	197.49	7.15	2.00	2.00	0.40	458	1.12	0.80	0.0174	4.00	0.70	0.73	0.80	24	38
7	2.00	197.49	7.15	2.50	2.50	0.40	458	1.12	0.80	0.0174	5.00	0.70	0.76	0.80	19	30
8	2.00	197.49	7.15	3.00	3.00	0.40	458	1.12	0.80	0.0174	6.00	0.70	0.80	0.80	15	24
9	3.00	196.99	7.65	1.50	1.50	0.40	458	1.12	0.80	0.0174	3.00	0.70	0.73	0.80	32	51
10	3.00	196.99	7.65	2.00	2.00	0.40	458	1.12	0.80	0.0174	4.00	0.70	0.73	0.80	24	38
11	3.00	196.99	7.65	2.50	2.50	0.40	458	1.12	0.80	0.0174	5.00	0.70	0.73	0.80	19	31
12	3.00	196.99	7.65	3.00	3.00	0.40	458	1.12	0.80	0.0174	6.00	0.70	0.73	0.80	16	26

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 24.3 (For BH-45 (CHP MCC-2 & AAQMS))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation from NGL (R.L. 198.85m)	Depth of foundation from FGL	RL of Foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 24.4)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 24.5)		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	4.65	199.99	3.50	3.50	11	12	19	11	11
1.00	4.65	199.99	4.00	4.00	11	10	16	10	11
1.00	4.65	199.99	5.00	5.00	10	8	13	8	10
1.00	4.65	199.99	6.00	6.00	10	7	11	7	10
2.00	5.65	198.99	3.50	3.50	11	13	20	11	11
2.00	5.65	198.99	4.00	4.00	11	11	17	11	11
2.00	5.65	198.99	5.00	5.00	11	8	13	8	11
2.00	5.65	198.99	6.00	6.00	11	7	11	7	11
3.00	6.65	197.99	3.50	3.50	12	13	22	12	12
3.00	6.65	197.99	4.00	4.00	12	12	18	12	12
3.00	6.65	197.99	5.00	5.00	12	9	14	9	12
3.00	6.65	197.99	6.00	6.00	11	7	12	7	11

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.85m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 24.4 (For BH-45 (CHP MCC-2 & AAQMS))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from NGL m	Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	1.00	4.65	199.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11
2	4.00	4.00	1.00	4.65	199.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11
3	5.00	5.00	1.00	4.65	199.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	10
4	6.00	6.00	1.00	4.65	199.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	10
5	3.50	3.50	2.00	5.65	198.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11
6	4.00	4.00	2.00	5.65	198.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.11	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11
7	5.00	5.00	2.00	5.65	198.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11
8	6.00	6.00	2.00	5.65	198.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11
9	3.50	3.50	3.00	6.65	197.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.18	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	12
10	4.00	4.00	3.00	6.65	197.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.16	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	12
11	5.00	5.00	3.00	6.65	197.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	12
12	6.00	6.00	3.00	6.65	197.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.11	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.85m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 24.5 (For BH-45 (CHP MCC-2 & AAQMS))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :-

Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	1.00	197.99	6.65	3.50	3.50	0.40	458	1.12	0.80	0.0174	7.00	0.70	0.92	0.80	12	19
2	1.00	197.99	6.65	4.00	4.00	0.40	458	1.12	0.80	0.0174	8.00	0.70	0.93	0.80	10	16
3	1.00	197.99	6.65	5.00	5.00	0.40	458	1.12	0.80	0.0174	10.00	0.70	0.95	0.80	8	13
4	1.00	197.99	6.65	6.00	6.00	0.40	458	1.12	0.80	0.0174	12.00	0.70	0.96	0.80	7	11
5	2.00	197.49	7.15	3.50	3.50	0.40	458	1.12	0.80	0.0174	7.00	0.70	0.83	0.80	13	20
6	2.00	197.49	7.15	4.00	4.00	0.40	458	1.12	0.80	0.0174	8.00	0.70	0.85	0.80	11	17
7	2.00	197.49	7.15	5.00	5.00	0.40	458	1.12	0.80	0.0174	10.00	0.70	0.88	0.80	8	13
8	2.00	197.49	7.15	6.00	6.00	0.40	458	1.12	0.80	0.0174	12.00	0.70	0.91	0.80	7	11
9	3.00	196.99	7.65	3.50	3.50	0.40	458	1.12	0.80	0.0174	7.00	0.70	0.75	0.80	13	22
10	3.00	196.99	7.65	4.00	4.00	0.40	458	1.12	0.80	0.0174	8.00	0.70	0.77	0.80	12	18
11	3.00	196.99	7.65	5.00	5.00	0.40	458	1.12	0.80	0.0174	10.00	0.70	0.82	0.80	9	14
12	3.00	196.99	7.65	6.00	6.00	0.40	458	1.12	0.80	0.0174	11.00	0.70	0.85	0.80	7	12

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 24.6 (For BH-45 (CHP MCC-2 & AAQMS))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation from NGL (R.L. 198.85m)	Depth of foundation from FGL	RL of Foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 24.7) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 24.8)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
1.00	4.65	199.99	7.00	7.00	10	6	9	6	9
1.00	4.65	199.99	8.00	8.00	10	5	8	5	8
1.00	4.65	199.99	9.00	9.00	10	4	7	4	7
1.00	4.65	199.99	10.00	10.00	10	4	6	4	6
2.00	5.65	198.99	7.00	7.00	11	6	9	6	9
2.00	5.65	198.99	8.00	8.00	11	5	8	5	8
2.00	5.65	198.99	9.00	9.00	11	5	7	5	7
2.00	5.65	198.99	10.00	10.00	11	4	7	4	7
3.00	6.65	197.99	7.00	7.00	11	6	10	6	10
3.00	6.65	197.99	8.00	8.00	11	5	9	5	9
3.00	6.65	197.99	9.00	9.00	11	5	8	5	8
3.00	6.65	197.99	10.00	10.00	11	4	7	4	7

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.85m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 24.7 (For BH-45 (CHP MCC-2 & AAQMS))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from NGL m	Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	1.00	4.65	199.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	10
2	8.00	8.00	1.00	4.65	199.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	10
3	9.00	9.00	1.00	4.65	199.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.02	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	10
4	10.00	10.00	1.00	4.65	199.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.02	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	10
5	7.00	7.00	2.00	5.65	198.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11
6	8.00	8.00	2.00	5.65	198.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11
7	9.00	9.00	2.00	5.65	198.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11
8	10.00	10.00	2.00	5.65	198.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11
9	7.00	7.00	3.00	6.65	197.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11
10	8.00	8.00	3.00	6.65	197.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11
11	9.00	9.00	3.00	6.65	197.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11
12	10.00	10.00	3.00	6.65	197.99	0.46	5	6.03	0.36	0.29	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 198.85m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 24.8 (For BH-45 (CHP MCC-2 & AAQMS))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :-

Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	1.00	197.99	6.65	7.00	7.00	0.40	458	1.12	0.80	0.0174	13.00	0.70	0.97	0.80	6	9
2	1.00	197.99	6.65	8.00	8.00	0.40	458	1.12	0.80	0.0174	13.00	0.70	0.97	0.80	5	8
3	1.00	197.99	6.65	9.00	9.00	0.40	458	1.12	0.80	0.0174	13.00	0.70	0.97	0.80	4	7
4	1.00	197.99	6.65	10.00	10.00	0.40	458	1.12	0.80	0.0174	13.00	0.70	0.98	0.80	4	6
5	2.00	197.49	7.15	7.00	7.00	0.40	458	1.12	0.80	0.0174	12.00	0.70	0.92	0.80	6	9
6	2.00	197.49	7.15	8.00	8.00	0.40	458	1.12	0.80	0.0174	12.00	0.70	0.93	0.80	5	8
7	2.00	197.49	7.15	9.00	9.00	0.40	458	1.12	0.80	0.0174	12.00	0.70	0.94	0.80	5	7
8	2.00	197.49	7.15	10.00	10.00	0.40	458	1.12	0.80	0.0174	12.00	0.70	0.95	0.80	4	7
9	3.00	196.99	7.65	7.00	7.00	0.40	458	1.12	0.80	0.0174	11.00	0.70	0.87	0.80	6	10
10	3.00	196.99	7.65	8.00	8.00	0.40	458	1.12	0.80	0.0174	11.00	0.70	0.89	0.80	5	9
11	3.00	196.99	7.65	9.00	9.00	0.40	458	1.12	0.80	0.0174	11.00	0.70	0.91	0.80	5	8
12	3.00	196.99	7.65	10.00	10.00	0.40	458	1.12	0.80	0.0174	11.00	0.70	0.92	0.80	4	7

Appendix – 24B

Calculation of Safe Load on Uniform Diameter Bored Cast in situ Pile. (Near BH 45) (CHP MCC-2)

The safe load is calculated as follows,

1) Design Stipulations

- | | |
|---|---|
| 1. Type of pile | - Bored cast in situ uniform diameter pile. |
| 2. Pile diameter considered | - 0.60m |
| 3. Termination depth of pile considered | - 16.00m from FGL. |
| 4. Cut off Level | - 4.00m from FGL. |
| 5. Factor of Safety | - 2.50 |
| 6. Depth of Water table | - Considered at FGL. |
| 7. Ref | - IS 2911 P-I, Sec-II, 2021. |

2) Test Data

The parameters are based on BH 45. For evaluation of safe load on piles following characterized layers are considered as described in table below,

Depth in m from RL 202.5 m	Cohesion in kg/cm ²	Angle of Internal Friction ϕ	Submerged density in gm/cc γ_{sub}	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 4.00	Pile cutoff level – No pile						
4.00 to 9.25	0.72	5~0(Ignored)	0.98	0.61	NA	NA	6-35
9.25 to 10.35	0.08(Ignored)	24	0.97	NA	1.00	24	27
10.35 to 12.05	0.55	1	0.98	0.81	NA	NA	10-15
12.05 to 16.55	0.10(Ignored)	25	0.96	NA	1.00	25	7-38
16.55 to 17.95	3.60	0	1.02	0.28	NA	NA	54->100
17.95 to 28.65	0	34\$	1.02	NA	1.50	34	>100

Notes: - Layers are characterized based on classification and the state of soil in that stratum.

* - In cohesive soils the contribution of the angle of internal friction being insignificant is ignored.

Shear parameters are the most representative for the layer. NA means not applicable. Characterized N values are considered for each layer.

- Weighted Average of the parameters falling in the same layer has been considered

\$-Parameters are correlated based on SPT value N.

3) Ultimate Load in Compression

3.1) Ultimate load in Compression by Bearing

Ultimate load on pile in end bearing,

$$q_{ub} = A_p (0.5 \cdot D \cdot \gamma \cdot N_v + P D N_q)$$

$$A_p = \text{Cross section area of Pile stem at toe} = \pi d^2 / 4$$

$$D = \text{Diameter of pile} = d \text{ in m}$$

$$N_v = 42.90$$

$$N_q = 40.00$$

$$q_{ub} = 0.785d^2 (0.5 \cdot d \cdot 1.02 \cdot 42.90 + 8.79 \cdot 40.00) = 17.18d^3 + 276.01d^2$$

(For Pile terminating at 16.00m from F.G.L.)

Note: As the pile terminating just above rock level, we have considered parameter for end bearing component based on rock strata.

3.2) Ultimate Load in Compression by Skin Friction

Ultimate load in skin friction,

$$q_{uf} = \alpha_i C_{ai} A_i + K_i P D_i \tan \delta_i A_{si}$$

First Layer – No contribution considered – (Within Cutoff Level).

$$\text{Second Layer} - \alpha_2 C_{a2} A_{s2} = 0.61 \cdot 7.20 \cdot \pi d \cdot 5.25 = 72.44 d$$

$$\text{Third Layer} - K_3 P D_3 \tan \delta_3 A_{s3} = 1.00 \cdot 5.68 \cdot \tan 24^\circ \cdot \pi d \cdot 1.10 = 8.74 d$$

$$\text{Fourth Layer} - \alpha_4 C_{a4} A_{s4} = 0.81 \cdot 5.50 \cdot \pi d \cdot 1.70 = 23.79 d$$

Fifth Layer – $K5PD5 \tan \delta_5 A_{s5} = 1.00 \times 8.79 \times \tan 25^\circ \pi d (\ell - 12.05) = 12.88 d (\ell - 12.05)$

Substituting, ultimate load

$q_{uf} = 104.97d + 12.88d (\ell - 12.05)$ (For Pile terminating at 16.00m from F.G.L.).

Where, ℓ is the pile length and d is diameter of piles, substituting

Ultimate load by both bearing and friction can be as follows for various lengths of piles,

$q_{uc} = q_{ub} + q_{uf}$

$q_{uc} = 17.18d^3 + 276.01d^2 + 104.97d + 12.88d (\ell - 12.05)$

(For Pile terminating at 16.00m from F.G.L.).

By substituting various diameters of piles having various lengths, the safe load is worked out considering the safety factor of 2.50 and are given in table below,

Safe Load on Piles in Compression (in Ton)

Termination Depth of Pile in m, from FGL	Termination Depth of Pile in m, from cut-off	Diameter of Pile in, m
		0.60
16.00	12.00	78.68

3.3) Ultimate Load in Uplift

Considering skin friction for determination of uplift

Safe Load on Piles in Uplift (in Ton)

Termination Depth of Pile in m, from FGL	Termination Depth of Pile in m, from cut-off	Diameter of Pile in, m
		0.60
16.00	12.00	36.30

Note: Self weight of pile is considered in calculation of ultimate load in uplift.

Self weight of Pile (in Ton)

Termination Depth of Pile in m, from FGL	Termination Depth of Pile in m, from cut-off	Diameter of Pile in, m
		0.60
16.00	12.00	5.09

3.4) Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60
Subgrade reaction in MN/m^3		3.40
Stiffness factor T in m		2.21
Depth of fixity in m	Free Head	4.20
	Fixed Head	4.80
Allowable Horizontal Force in T	Free Head	3.60
	Fixed Head	9.60
Allowable Moment capacity in Tm	Free Head	5.31
	Fixed Head	18.89

4) Notes:

1) Initial and Routine pile load tests shall be carried out as per IS 2911, P-4 on the piles to confirm the capacity of pile worked out theoretically. For design and construction, specifications of IS 2911, P-I, S-2, shall strictly be followed. Termination depth of pile shall be from FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 25 (For BH- 42 (AHP compressor house))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTP) at village- Hirma, Talabira, Odisha

Depth of Foundation from FGL (R.L. 195.39m)	Depth of Foundation from FGL (R.L. 202.50m)	RL of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 25.1) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 25.2)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
1.00	8.11	194.39	1.50	1.50	15	48	78	15	15
1.00	8.11	194.39	2.00	2.00	14	35	56	14	14
1.00	8.11	194.39	2.50	2.50	14	28	44	14	14
1.00	8.11	194.39	3.00	3.00	14	23	37	14	14
2.00	9.11	193.39	1.50	1.50	17	52	83	17	17
2.00	9.11	193.39	2.00	2.00	16	40	64	16	16
2.00	9.11	193.39	2.50	2.50	15	32	52	15	15
2.00	9.11	193.39	3.00	3.00	15	27	44	15	15
3.00	10.11	192.39	1.50	1.50	18	55	88	18	18
3.00	10.11	192.39	2.00	2.00	17	44	71	17	17
3.00	10.11	192.39	2.50	2.50	16	38	61	16	16
3.00	10.11	192.39	3.00	3.00	16	33	53	16	16

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 195.39m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 25.1 (For BH- 42 (AHP compressor house))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from NGL m	Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5 γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	1.00	8.11	194.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	15
2	2.00	2.00	1.00	8.11	194.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	14
3	2.50	2.50	1.00	8.11	194.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	14
4	3.00	3.00	1.00	8.11	194.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	14
5	1.50	1.50	2.00	9.11	193.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.27	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	17
6	2.00	2.00	2.00	9.11	193.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.20	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	16
7	2.50	2.50	2.00	9.11	193.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.16	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	15
8	3.00	3.00	2.00	9.11	193.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	15
9	1.50	1.50	3.00	10.11	192.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.40	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	18
10	2.00	2.00	3.00	10.11	192.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.30	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	17
11	2.50	2.50	3.00	10.11	192.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.24	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	16
12	3.00	3.00	3.00	10.11	192.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.20	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	16

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 195.39m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 25.2 (For BH- 42 (AHP compressor house))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D from NGL	Depth D from FGL	RL of Foundation	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	1.00	8.11	194.39	1.50	1.50	0.40	648	1.12	0.80	0.0102	3.00	0.70	0.80	0.80	48	78
2	1.00	8.11	194.39	2.00	2.00	0.40	648	1.12	0.80	0.0102	3.50	0.70	0.85	0.80	35	56
3	1.00	8.11	194.39	2.50	2.50	0.40	648	1.12	0.80	0.0102	3.50	0.70	0.88	0.80	28	44
4	1.00	8.11	194.39	3.00	3.00	0.40	648	1.12	0.80	0.0102	3.50	0.70	0.91	0.80	23	37
5	2.00	9.11	193.39	1.50	1.50	0.40	648	1.12	0.80	0.0102	2.50	0.70	0.73	0.80	52	83
6	2.00	9.11	193.39	2.00	2.00	0.40	648	1.12	0.80	0.0102	2.50	0.70	0.73	0.80	40	64
7	2.00	9.11	193.39	2.50	2.50	0.40	648	1.12	0.80	0.0102	2.50	0.70	0.76	0.80	32	52
8	2.00	9.11	193.39	3.00	3.00	0.40	648	1.12	0.80	0.0102	2.50	0.70	0.80	0.80	27	44
9	3.00	10.11	192.39	1.50	1.50	0.40	648	1.12	0.80	0.0102	1.50	0.70	0.73	0.80	55	88
10	3.00	10.11	192.39	2.00	2.00	0.40	648	1.12	0.80	0.0102	1.50	0.70	0.73	0.80	44	71
11	3.00	10.11	192.39	2.50	2.50	0.40	648	1.12	0.80	0.0102	1.50	0.70	0.73	0.80	38	61
12	3.00	10.11	192.39	3.00	3.00	0.40	648	1.12	0.80	0.0102	1.50	0.70	0.73	0.80	33	53

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 25.3 (For BH- 42 (AHP compressor house))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Depth of Foundation from FGL (R.L. 195.39m)	Depth of Foundation from FGL (R.L. 202.50m)	RL of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 25.4) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 25.5)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
1.00	8.11	194.39	3.50	3.50	14	20	33	14	14
1.00	8.11	194.39	4.00	4.00	14	18	29	14	14
1.00	8.11	194.39	5.00	5.00	14	15	25	14	14
1.00	8.11	194.39	6.00	6.00	14	14	22	14	14
2.00	9.11	193.39	3.50	3.50	15	24	38	15	15
2.00	9.11	193.39	4.00	4.00	14	21	34	14	14
2.00	9.11	193.39	5.00	5.00	14	18	29	14	14
2.00	9.11	193.39	6.00	6.00	14	16	25	14	14
3.00	10.11	192.39	3.50	3.50	15	30	47	15	15
3.00	10.11	192.39	4.00	4.00	15	27	43	15	15
3.00	10.11	192.39	5.00	5.00	15	23	36	15	15
3.00	10.11	192.39	6.00	6.00	14	20	31	14	14

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 195.39m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 25.4 (For BH- 42 (AHP compressor house))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from NGL m	Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5 γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	1.00	8.11	194.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	14
2	4.00	4.00	1.00	8.11	194.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	14
3	5.00	5.00	1.00	8.11	194.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	14
4	6.00	6.00	1.00	8.11	194.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	14
5	3.50	3.50	2.00	9.11	193.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.11	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	15
6	4.00	4.00	2.00	9.11	193.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	14
7	5.00	5.00	2.00	9.11	193.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	14
8	6.00	6.00	2.00	9.11	193.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	14
9	3.50	3.50	3.00	10.11	192.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.17	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	15
10	4.00	4.00	3.00	10.11	192.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.15	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	15
11	5.00	5.00	3.00	10.11	192.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	15
12	6.00	6.00	3.00	10.11	192.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	14

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 195.39m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 25.5 (For BH- 42 (AHP compressor house))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D from NGL	Depth D from FGL	RL of Foundation	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	1.00	8.11	194.39	3.50	3.50	0.40	648	1.12	0.80	0.0102	3.50	0.70	0.92	0.80	20	33
2	1.00	8.11	194.39	4.00	4.00	0.40	648	1.12	0.80	0.0102	3.50	0.70	0.93	0.80	18	29
3	1.00	8.11	194.39	5.00	5.00	0.40	648	1.12	0.80	0.0102	3.50	0.70	0.95	0.80	15	25
4	1.00	8.11	194.39	6.00	6.00	0.40	648	1.12	0.80	0.0102	3.50	0.70	0.96	0.80	14	22
5	2.00	9.11	193.39	3.50	3.50	0.40	648	1.12	0.80	0.0102	2.50	0.70	0.83	0.80	24	38
6	2.00	9.11	193.39	4.00	4.00	0.40	648	1.12	0.80	0.0102	2.50	0.70	0.85	0.80	21	34
7	2.00	9.11	193.39	5.00	5.00	0.40	648	1.12	0.80	0.0102	2.50	0.70	0.88	0.80	18	29
8	2.00	9.11	193.39	6.00	6.00	0.40	648	1.12	0.80	0.0102	2.50	0.70	0.91	0.80	16	25
9	3.00	10.11	192.39	3.50	3.50	0.40	648	1.12	0.80	0.0102	1.50	0.70	0.75	0.80	30	47
10	3.00	10.11	192.39	4.00	4.00	0.40	648	1.12	0.80	0.0102	1.50	0.70	0.77	0.80	27	43
11	3.00	10.11	192.39	5.00	5.00	0.40	648	1.12	0.80	0.0102	1.50	0.70	0.82	0.80	23	36
12	3.00	10.11	192.39	6.00	6.00	0.40	648	1.12	0.80	0.0102	1.50	0.70	0.85	0.80	20	31

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APPENDIX - 25.6 (For BH- 42 (AHP compressor house))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Depth of Foundation from FGL (R.L. 195.39m)	Depth of Foundation from FGL (R.L. 202.50m)	RL of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 25.7) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 25.8)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
1.00	8.11	194.39	7.00	7.00	13	12	20	12	13
1.00	8.11	194.39	8.00	8.00	13	11	18	11	13
1.00	8.11	194.39	9.00	9.00	13	10	17	10	13
1.00	8.11	194.39	10.00	10.00	13	10	16	10	13
2.00	9.11	193.39	7.00	7.00	14	14	23	14	14
2.00	9.11	193.39	8.00	8.00	14	13	21	13	14
2.00	9.11	193.39	9.00	9.00	14	12	19	12	14
2.00	9.11	193.39	10.00	10.00	14	11	18	11	14
3.00	10.11	192.39	7.00	7.00	14	18	28	14	14
3.00	10.11	192.39	8.00	8.00	14	16	26	14	14
3.00	10.11	192.39	9.00	9.00	14	15	23	14	14
3.00	10.11	192.39	10.00	10.00	14	14	22	14	14

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 195.39m.
- 3) Calculations are considering the effect of water table at FGL.

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APPENDIX - 25.7 (For BH- 42 (AHP compressor house))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from NGL m	Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5 γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	1.00	8.11	194.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	13
2	8.00	8.00	1.00	8.11	194.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	13
3	9.00	9.00	1.00	8.11	194.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.02	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	13
4	10.00	10.00	1.00	8.11	194.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.02	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	13
5	7.00	7.00	2.00	9.11	193.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	14
6	8.00	8.00	2.00	9.11	193.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	14
7	9.00	9.00	2.00	9.11	193.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	14
8	10.00	10.00	2.00	9.11	193.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	14
9	7.00	7.00	3.00	10.11	192.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	14
10	8.00	8.00	3.00	10.11	192.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	14
11	9.00	9.00	3.00	10.11	192.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	14
12	10.00	10.00	3.00	10.11	192.39	0.73	0	5.14	0.00	0.00	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.80	0.90	0.50	0.50	14

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 195.39m.
- 3) Calculations are considering the effect of water table at FGL.

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APPENDIX - 25.8 (For BH- 42 (AHP compressor house))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D from NGL	Depth D from FGL	RL of Foundation	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	1.00	8.11	194.39	7.00	7.00	0.40	648	1.12	0.80	0.0102	3.50	0.70	0.97	0.80	12	20
2	1.00	8.11	194.39	8.00	8.00	0.40	648	1.12	0.80	0.0102	3.50	0.70	0.97	0.80	11	18
3	1.00	8.11	194.39	9.00	9.00	0.40	648	1.12	0.80	0.0102	3.50	0.70	0.97	0.80	10	17
4	1.00	8.11	194.39	10.00	10.00	0.40	648	1.12	0.80	0.0102	3.50	0.70	0.98	0.80	10	16
5	2.00	9.11	193.39	7.00	7.00	0.40	648	1.12	0.80	0.0102	2.50	0.70	0.92	0.80	14	23
6	2.00	9.11	193.39	8.00	8.00	0.40	648	1.12	0.80	0.0102	2.50	0.70	0.93	0.80	13	21
7	2.00	9.11	193.39	9.00	9.00	0.40	648	1.12	0.80	0.0102	2.50	0.70	0.94	0.80	12	19
8	2.00	9.11	193.39	10.00	10.00	0.40	648	1.12	0.80	0.0102	2.50	0.70	0.95	0.80	11	18
9	3.00	10.11	192.39	7.00	7.00	0.40	648	1.12	0.80	0.0102	1.50	0.70	0.87	0.80	18	28
10	3.00	10.11	192.39	8.00	8.00	0.40	648	1.12	0.80	0.0102	1.50	0.70	0.89	0.80	16	26
11	3.00	10.11	192.39	9.00	9.00	0.40	648	1.12	0.80	0.0102	1.50	0.70	0.91	0.80	15	23
12	3.00	10.11	192.39	10.00	10.00	0.40	648	1.12	0.80	0.0102	1.50	0.70	0.92	0.80	14	22

Appendix – 26A
Calculation of Safe Load carrying capacity of piles socketed inside rock
(Near BH 114)
(Common limestone unloading house)

Project Name: - Proposed structures of thermal power project of NTTTP at Hirma, Talabira

1.0 Introduction

In situations where overburden offering low bearing pressure is followed by rock at relatively shallower depths, end bearing piles is the suitable foundation option. Piles in rocks and weathered rocks of varying degree of weathering derive their capacity by end bearing and socket side resistance.

In situations, where, rock strata comprises of highly fragmented rock, as in present case, where RQD is nil or $(CR+RQD)/2$ is less than 30 % or when the crushing strength is less than 10 MPa, the appropriate approach would be of that suggested by Cole & Stroud.

In present site overburden soils overlay fractured / laminated / foliated rock. The founding stratum having highly fragmented rock with nil RQD and $(CR+RQD)/2$ to be less than 30 %, the approach suggested by Cole and Stroud as per Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 P1/S2 has been used for safe load calculations.

An illustrative calculation of safe load on pile and summary of pile capacities is as follows,

2.0 Sub soil strata Characterization

General stratification at the location of boreholes 114 show primarily two characterized layers,

1. Overburden comprising of Yellowish brown, very fine grained, clays of high and intermediate plasticity upto 5.60m (i.e. RL 191.58m) followed by Yellowish brown, fine to medium grained, clayey sand upto 6.70m (i.e. RL 190.48m) followed by Yellowish brown, fine to very fine grained, sandy clays of intermediate plasticity upto 7.50m (i.e. RL 189.68m) Yellowish brown, fine to medium grained, clayey sand with some to occasional gravels upto 9.00m (i.e. RL 188.18m) followed by Light yellowish brown, fine to very fine grained, clays of high plasticity upto 10.00m (i.e. RL 187.18m) followed by Yellowish brown, fine to medium grained, clayey sand with some gravels upto 11.10m (i.e. RL 186.08m).
2. Second characterized layer below the overburden soils Slightly weathered, moderately weak, dark blackish brown, fine to very fine grained, massive rock upto 13.50m (i.e. RL 183.68m).

3.0 Design Considerations

1. Length of socket considered 3D from depth of rock encountered.
2. The pile is considered to have socket length below 11.10 m below NGL (i.e. RL 186.08 m) depth.
3. For present case of pile terminating in highly weathered rock. SPT at depths between 11.10 to 13.50m (between RL 186.08 to 183.68 m) is > 100 with just 5.0 cm penetration in 50 blows. SPT can be extrapolated for 30 cm i.e. $50 * 30 / 5.00 = 300$.
Based on recommendation of fig no. 3 in B 8 in Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 P1/S2, average shear strength q_c corresponding to assumed SPT of 200 may be taken as 1300 kN/m²
4. Allowable Capacity of pile socketed into rock $Q_a = R_e + R_{sf} = C_{u1} N_c \pi B^2 / 4 (F_s = 3) + \alpha C_{u2} \pi BL / (F_s = 6)$

4.0 Safe Load on Pile in Compression

Where,

End bearing component, $R_e = C_{u1} N_c \pi B^2 / 4 F_s$,

C_{u1} = Shear strength below base of pile = 1300 kN/m²

B = diameter of the pile = d

F_s = Factor of Safety = 3

$N_c = 9$

Therefore, **$R_e = 3061.5 d^2$**

Skin friction component of socketed length of pile, $R_{sf} = \alpha C_{u2} \pi BL / F_s$

$\alpha = 0.9$ (recommended value in IS 2911 P1/S2)

L = length of the socket = 3 D

C_{u2} = Ultimate shear strength along socket length which shall be restricted to shear capacity of concrete of the pile = 1300 kN/m²

F_s = Factor of Safety = 6

Therefore, $R_{sf} = 1836.9 \text{ d}^2$

Thus,

$$Q_a = c_{u1} N_c \cdot \frac{\pi B^2}{4 F_s} + \alpha c_{u2} \cdot \frac{\pi B L}{F_s}$$

$$= 3061.5 \text{ d}^2 + 1836.9 \text{ d}^2 = 4898.4 \text{ d}^2$$

Substituting the values of various diameters and socket lengths equal to 3 times diameter, allowable load on single pile can be summarized as follows,

Summary of the Safe load calculation in Compression

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	18.20	18.70	19.12
Termination level RL in m	184.30	183.80	183.38
End Bearing Component in kN	1102.1	1768.3	2479.8
Friction Component in kN	661.3	1060.9	1487.9
Safe load in Compression in kN	1763.4	2829.3	3967.7
Safe load in Compression in T	176	283	397

5.0 Safe Load on Pile in uplift

For 6.00m cutoff from FGL

The overburden soils, though, will not contribute in compression capacity would offer resistance in uplift capacity. The parameters of BH 114 are considered for calculation of uplift resistance as summarized below,

Depth in m from RL 202.0 m	Cohesion in kg/cm ²	Angle of Internal Friction ϕ	Submerged density in gm/cc γ_{sub}	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 6.00	Pile cutoff level – No pile						
6.00 to 10.92	0.79	2(ignored)	0.93	0.58	NA	NA	3-19
10.92 to 14.32	0.07(ignored)	30	0.94	NA	1.00	30	18->100
14.32 to 15.32	1.60	0	0.94	0.28	NA	NA	40-54
15.32 to 16.42	0	34	0.94	NA	1.50	34	46->100
16.42 to 21.82	Rock strata – Resistance would be as per skin friction capacity in socket as already calculated in compression capacity						

Note - \$ Weighted average data considered. NA means not applicable.

Ultimate load in skin friction,

$$Q_{uf} = \alpha_i C_{ai} A_{si} + K_i P D_i \tan \delta_i A_{si}$$

First Layer – No contribution considered – (Within Cutoff Level).

$$\text{Second Layer} - \alpha_2 C_{a2} A_{s2} = 0.58 * 7.90 * \pi d * 4.92 = 70.82 \text{ d}$$

$$\text{Third Layer} - K_3 P D_3 \tan \delta_3 A_{s3} = 1.00 * 9.83 * \tan 30 * \pi d * 3.40 = 60.62 \text{ d}$$

$$\text{Fourth Layer} - \alpha_4 C_{a4} A_{s4} = 0.28 * 16.00 * \pi d * 1.00 = 14.07 \text{ d}$$

$$\text{Fifth Layer} - K_5 P D_5 \tan \delta_5 A_{s5} = 1.50 * 9.83 * \tan 34 * \pi d * 1.10 = 34.37 \text{ d}$$

Sixth Layer – 1836.90 d² in rock socket

$$\text{Substituting, ultimate load } q_{uf} = 1798.80 \text{ d} + 1836.9 \text{ d}^2$$

The safe load in uplift is worked out (considering the safety factor of 2.50 for overburden soils) and summarized below,

Safe Load on Piles in Uplift (in Ton)

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	18.20	18.70	19.12
Termination level RL in m	184.30	183.80	183.38
Safe load in Uplift in kN	1093.00	1607.83	2135.46
Self-weight of pile in kN	51.72	86.38	125.13
Safe load in Uplift in T (Considering self-weight of pile)	114.47	169.42	226.06

6.0 Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60	0.76	0.90
Subgrade reaction in MN/m^3		2.70	2.70	2.70
Stiffness factor T in m		2.31	2.79	3.20
Depth of fixity in m	Free Head	4.40	5.30	6.10
	Fixed Head	5.00	6.10	7.00
Allowable Horizontal Force in T	Free Head	3.20	4.60	6.00
	Fixed Head	8.30	12.20	16.00
Allowable Moment capacity in Tm	Free Head	4.84	8.54	12.80
	Fixed Head	17.23	30.38	45.58

7.0 Notes

1. Pile shall be terminated after socketing 3D inside rock.
2. Initial and routine pile load test is required to verify the actual carrying capacity of pile in compression, uplift and lateral loads.
3. For design and construction, specification of IS: 2911, P1/S2, IS: 456, 2000 shall strictly be followed.

(Dr. K. K. Thaker)

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 27 (For BH-96 (Weigh bridge control room))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation from NGL (R.L. 197.34m)	Depth of foundation from FGL	RL of Foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 27.1) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 27.2)		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
3.50	8.66	193.84	1.50	1.50	14	22	36	14	14
3.50	8.66	193.84	2.00	2.00	13	17	27	13	13
3.50	8.66	193.84	2.50	2.50	12	13	21	12	12
3.50	8.66	193.84	3.00	3.00	12	11	18	11	12
4.00	9.16	193.34	1.50	1.50	15	22	36	15	15
4.00	9.16	193.34	2.00	2.00	13	17	27	13	13
4.00	9.16	193.34	2.50	2.50	13	13	21	13	13
4.00	9.16	193.34	3.00	3.00	12	11	18	11	12
4.50	9.66	192.84	1.50	1.50	15	22	36	15	15
4.50	9.66	192.84	2.00	2.00	14	17	27	14	14
4.50	9.66	192.84	2.50	2.50	13	13	21	13	13
4.50	9.66	192.84	3.00	3.00	12	11	18	11	12

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.34m.
- 3) Calculations are considering the effect of water table at FGL.

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APPENDIX - 27.1 (For BH-96 (Weigh bridge control room))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from NGL m	Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ	N _c	N _q - 1	N _γ	S _c	S _q	S _γ	d _c	d _q	d _γ	i _c	i _q	i _γ	γ	0.5 γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _γ	
1	1.50	1.50	3.50	8.66	193.84	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.48	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	14
2	2.00	2.00	3.50	8.66	193.84	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.36	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	13
3	2.50	2.50	3.50	8.66	193.84	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.29	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	12
4	3.00	3.00	3.50	8.66	193.84	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.24	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	12
5	1.50	1.50	4.00	9.16	193.34	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.55	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	15
6	2.00	2.00	4.00	9.16	193.34	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.41	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	13
7	2.50	2.50	4.00	9.16	193.34	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.33	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	13
8	3.00	3.00	4.00	9.16	193.34	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.27	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	12
9	1.50	1.50	4.50	9.66	192.84	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.61	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	15
10	2.00	2.00	4.50	9.66	192.84	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.46	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	14
11	2.50	2.50	4.50	9.66	192.84	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.37	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	13
12	3.00	3.00	4.50	9.66	192.84	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.31	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	12

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.34m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 27.2 (For BH-96 (Weigh bridge control room))
Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	3.50	193.84	8.66	1.50	1.50	0.40	285	1.12	0.80	0.0236	3.00	0.70	0.73	0.80	22	36
2	3.50	193.84	8.66	2.00	2.00	0.40	285	1.12	0.80	0.0236	4.00	0.70	0.73	0.80	17	27
3	3.50	193.84	8.66	2.50	2.50	0.40	285	1.12	0.80	0.0236	5.00	0.70	0.73	0.80	13	21
4	3.50	193.84	8.66	3.00	3.00	0.40	285	1.12	0.80	0.0236	5.50	0.70	0.73	0.80	11	18
5	4.00	193.34	9.16	1.50	1.50	0.40	285	1.12	0.80	0.0236	3.00	0.70	0.73	0.80	22	36
6	4.00	193.34	9.16	2.00	2.00	0.40	285	1.12	0.80	0.0236	4.00	0.70	0.73	0.80	17	27
7	4.00	193.34	9.16	2.50	2.50	0.40	285	1.12	0.80	0.0236	5.00	0.70	0.73	0.80	13	21
8	4.00	193.34	9.16	3.00	3.00	0.40	285	1.12	0.80	0.0236	5.00	0.70	0.73	0.80	11	18
9	4.50	192.84	9.66	1.50	1.50	0.40	285	1.12	0.80	0.0236	3.00	0.70	0.73	0.80	22	36
10	4.50	192.84	9.66	2.00	2.00	0.40	285	1.12	0.80	0.0236	4.00	0.70	0.73	0.80	17	27
11	4.50	192.84	9.66	2.50	2.50	0.40	285	1.12	0.80	0.0236	4.50	0.70	0.73	0.80	13	21
12	4.50	192.84	9.66	3.00	3.00	0.40	285	1.12	0.80	0.0236	4.50	0.70	0.73	0.80	11	18

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 27.3 (For BH-96 (Weigh bridge control room))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation from NGL (R.L. 197.34m)	Depth of foundation from FGL	RL of Foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 27.4)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 27.5)		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
3.50	8.66	193.84	3.50	3.50	11	10	15	10	11
3.50	8.66	193.84	4.00	4.00	11	8	14	8	11
3.50	8.66	193.84	5.00	5.00	11	7	11	7	11
3.50	8.66	193.84	6.00	6.00	11	6	9	6	9
4.00	9.16	193.34	3.50	3.50	12	10	16	10	12
4.00	9.16	193.34	4.00	4.00	12	9	14	9	12
4.00	9.16	193.34	5.00	5.00	11	7	11	7	11
4.00	9.16	193.34	6.00	6.00	11	6	10	6	10
4.50	9.66	192.84	3.50	3.50	12	10	16	10	12
4.50	9.66	192.84	4.00	4.00	12	9	14	9	12
4.50	9.66	192.84	5.00	5.00	11	7	12	7	11
4.50	9.66	192.84	6.00	6.00	11	6	10	6	10

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.34m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 27.4 (For BH-96 (Weigh bridge control room))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from NGL m	Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ																	
	m	m				Kg/cm ²	degree	N _c	N _q - 1	N _γ	S _c	S _q	S _γ	d _c	d _q	d _γ	i _c	i _q	i _γ	γ gm/cc	0.5 γ	W _q	W _γ	
1	3.50	3.50	3.50	8.66	193.84	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.20	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	11
2	4.00	4.00	3.50	8.66	193.84	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.18	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	11
3	5.00	5.00	3.50	8.66	193.84	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.14	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	11
4	6.00	6.00	3.50	8.66	193.84	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	11
5	3.50	3.50	4.00	9.16	193.34	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.23	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	12
6	4.00	4.00	4.00	9.16	193.34	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.20	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	12
7	5.00	5.00	4.00	9.16	193.34	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.16	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	11
8	6.00	6.00	4.00	9.16	193.34	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.14	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	11
9	3.50	3.50	4.50	9.66	192.84	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.26	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	12
10	4.00	4.00	4.50	9.66	192.84	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.23	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	12
11	5.00	5.00	4.50	9.66	192.84	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.18	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	11
12	6.00	6.00	4.50	9.66	192.84	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.15	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	11

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.34m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 27.5 (For BH-96 (Weigh bridge control room))
Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	3.50	193.84	8.66	3.50	3.50	0.40	285	1.12	0.80	0.0236	5.50	0.70	0.73	0.80	10	15
2	3.50	193.84	8.66	4.00	4.00	0.40	285	1.12	0.80	0.0236	5.50	0.70	0.75	0.80	8	14
3	3.50	193.84	8.66	5.00	5.00	0.40	285	1.12	0.80	0.0236	5.50	0.70	0.79	0.80	7	11
4	3.50	193.84	8.66	6.00	6.00	0.40	285	1.12	0.80	0.0236	5.50	0.70	0.82	0.80	6	9
5	4.00	193.34	9.16	3.50	3.50	0.40	285	1.12	0.80	0.0236	5.00	0.70	0.73	0.80	10	16
6	4.00	193.34	9.16	4.00	4.00	0.40	285	1.12	0.80	0.0236	5.00	0.70	0.73	0.80	9	14
7	4.00	193.34	9.16	5.00	5.00	0.40	285	1.12	0.80	0.0236	5.00	0.70	0.76	0.80	7	11
8	4.00	193.34	9.16	6.00	6.00	0.40	285	1.12	0.80	0.0236	5.00	0.70	0.80	0.80	6	10
9	4.50	192.84	9.66	3.50	3.50	0.40	285	1.12	0.80	0.0236	4.50	0.70	0.73	0.80	10	16
10	4.50	192.84	9.66	4.00	4.00	0.40	285	1.12	0.80	0.0236	4.50	0.70	0.73	0.80	9	14
11	4.50	192.84	9.66	5.00	5.00	0.40	285	1.12	0.80	0.0236	4.50	0.70	0.74	0.80	7	12
12	4.50	192.84	9.66	6.00	6.00	0.40	285	1.12	0.80	0.0236	4.50	0.70	0.77	0.80	6	10

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 27.6 (For BH-96 (Weigh bridge control room))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation from NGL (R.L. 197.34m)	Depth of foundation from FGL	RL of Foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 27.7)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 27.8)		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
3.50	8.66	193.84	7.00	7.00	11	5	8	5	8
3.50	8.66	193.84	8.00	8.00	10	4	7	4	7
3.50	8.66	193.84	9.00	9.00	10	4	6	4	6
3.50	8.66	193.84	10.00	10.00	10	4	6	4	6
4.00	9.16	193.34	7.00	7.00	11	5	8	5	8
4.00	9.16	193.34	8.00	8.00	11	5	7	5	7
4.00	9.16	193.34	9.00	9.00	11	4	7	4	7
4.00	9.16	193.34	10.00	10.00	10	4	6	4	6
4.50	9.66	192.84	7.00	7.00	11	5	9	5	9
4.50	9.66	192.84	8.00	8.00	11	5	8	5	8
4.50	9.66	192.84	9.00	9.00	11	4	7	4	7
4.50	9.66	192.84	10.00	10.00	11	4	7	4	7

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.34m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 27.7 (For BH-96 (Weigh bridge control room))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from NGL m	Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ	N _c	N _q - 1	N _γ	S _c	S _q	S _γ	d _c	d _q	d _γ	i _c	i _q	i _γ	γ	0.5 γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _γ	
1	7.00	7.00	3.50	8.66	193.84	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	11
2	8.00	8.00	3.50	8.66	193.84	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	10
3	9.00	9.00	3.50	8.66	193.84	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	10
4	10.00	10.00	3.50	8.66	193.84	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	10
5	7.00	7.00	4.00	9.16	193.34	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	11
6	8.00	8.00	4.00	9.16	193.34	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	11
7	9.00	9.00	4.00	9.16	193.34	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	11
8	10.00	10.00	4.00	9.16	193.34	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	10
9	7.00	7.00	4.50	9.66	192.84	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	11
10	8.00	8.00	4.50	9.66	192.84	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	11
11	9.00	9.00	4.50	9.66	192.84	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	11
12	10.00	10.00	4.50	9.66	192.84	0.49	2	5.46	0.13	0.10	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	11

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.34m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 27.8 (For BH-96 (Weigh bridge control room))
Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	3.50	193.84	8.66	7.00	7.00	0.40	285	1.12	0.80	0.0236	5.50	0.70	0.85	0.80	5	8
2	3.50	193.84	8.66	8.00	8.00	0.40	285	1.12	0.80	0.0236	5.50	0.70	0.87	0.80	4	7
3	3.50	193.84	8.66	9.00	9.00	0.40	285	1.12	0.80	0.0236	5.50	0.70	0.89	0.80	4	6
4	3.50	193.84	8.66	10.00	10.00	0.40	285	1.12	0.80	0.0236	5.50	0.70	0.90	0.80	4	6
5	4.00	193.34	9.16	7.00	7.00	0.40	285	1.12	0.80	0.0236	5.00	0.70	0.83	0.80	5	8
6	4.00	193.34	9.16	8.00	8.00	0.40	285	1.12	0.80	0.0236	5.00	0.70	0.85	0.80	5	7
7	4.00	193.34	9.16	9.00	9.00	0.40	285	1.12	0.80	0.0236	5.00	0.70	0.87	0.80	4	7
8	4.00	193.34	9.16	10.00	10.00	0.40	285	1.12	0.80	0.0236	5.00	0.70	0.88	0.80	4	6
9	4.50	192.84	9.66	7.00	7.00	0.40	285	1.12	0.80	0.0236	4.50	0.70	0.80	0.80	5	9
10	4.50	192.84	9.66	8.00	8.00	0.40	285	1.12	0.80	0.0236	4.50	0.70	0.83	0.80	5	8
11	4.50	192.84	9.66	9.00	9.00	0.40	285	1.12	0.80	0.0236	4.50	0.70	0.85	0.80	4	7
12	4.50	192.84	9.66	10.00	10.00	0.40	285	1.12	0.80	0.0236	4.50	0.70	0.87	0.80	4	7

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 27.9 (For BH-96 (Weigh bridge control room))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation from NGL (R.L. 197.34m)	Depth of foundation from FGL	RL of Foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	6.16	196.34	1.50	1.50	4	20	31	4	4
1.00	6.16	196.34	2.00	2.00	4	14	23	4	4
1.00	6.16	196.34	2.50	2.50	4	11	18	4	4
1.00	6.16	196.34	3.00	3.00	4	9	14	4	4
2.00	7.16	195.34	1.50	1.50	5	21	33	5	5
2.00	7.16	195.34	2.00	2.00	4	16	25	4	4
2.00	7.16	195.34	2.50	2.50	4	12	19	4	4
2.00	7.16	195.34	3.00	3.00	4	10	16	4	4
3.00	8.16	194.34	1.50	1.50	5	21	33	5	5
3.00	8.16	194.34	2.00	2.00	5	16	25	5	5
3.00	8.16	194.34	2.50	2.50	4	12	20	4	4
3.00	8.16	194.34	3.00	3.00	4	10	17	4	4

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.34m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-27.10 For BH-96 (Weigh bridge control room))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from NGL m	Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	1.00	6.16	196.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4
2	2.00	2.00	1.00	6.16	196.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4
3	2.50	2.50	1.00	6.16	196.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4
4	3.00	3.00	1.00	6.16	196.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4
5	1.50	1.50	2.00	7.16	195.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.27	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	5
6	2.00	2.00	2.00	7.16	195.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.20	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4
7	2.50	2.50	2.00	7.16	195.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.16	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4
8	3.00	3.00	2.00	7.16	195.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4
9	1.50	1.50	3.00	8.16	194.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.40	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	5
10	2.00	2.00	3.00	8.16	194.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.30	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	5
11	2.50	2.50	3.00	8.16	194.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.24	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4
12	3.00	3.00	3.00	8.16	194.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.20	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.34m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-27.11 (For BH-96 (Weigh bridge control room))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :-

Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	1.00	196.34	6.16	1.50	1.50	0.40	234	1.12	0.80	0.0236	3.00	0.70	0.80	0.80	20	31
2	1.00	196.34	6.16	2.00	2.00	0.40	234	1.12	0.80	0.0236	4.00	0.70	0.85	0.80	14	23
3	1.00	196.34	6.16	2.50	2.50	0.40	234	1.12	0.80	0.0236	5.00	0.70	0.88	0.80	11	18
4	1.00	196.34	6.16	3.00	3.00	0.40	234	1.12	0.80	0.0236	6.00	0.70	0.91	0.80	9	14
5	2.00	195.34	7.16	1.50	1.50	0.40	234	1.12	0.80	0.0236	3.00	0.70	0.73	0.80	21	33
6	2.00	195.34	7.16	2.00	2.00	0.40	234	1.12	0.80	0.0236	4.00	0.70	0.73	0.80	16	25
7	2.00	195.34	7.16	2.50	2.50	0.40	234	1.12	0.80	0.0236	5.00	0.70	0.76	0.80	12	19
8	2.00	195.34	7.16	3.00	3.00	0.40	234	1.12	0.80	0.0236	6.00	0.70	0.80	0.80	10	16
9	3.00	194.34	8.16	1.50	1.50	0.40	234	1.12	0.80	0.0236	3.00	0.70	0.73	0.80	21	33
10	3.00	194.34	8.16	2.00	2.00	0.40	234	1.12	0.80	0.0236	4.00	0.70	0.73	0.80	16	25
11	3.00	194.34	8.16	2.50	2.50	0.40	234	1.12	0.80	0.0236	5.00	0.70	0.73	0.80	12	20
12	3.00	194.34	8.16	3.00	3.00	0.40	234	1.12	0.80	0.0236	6.00	0.70	0.73	0.80	10	17

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 27.12 (For BH-96 (Weigh bridge control room))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation from NGL (R.L. 197.34m)	Depth of foundation from FGL	RL of Foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	6.16	196.34	3.50	3.50	4	8	12	4	4
1.00	6.16	196.34	4.00	4.00	4	7	11	4	4
1.00	6.16	196.34	5.00	5.00	4	5	9	4	4
1.00	6.16	196.34	6.00	6.00	4	4	7	4	4
2.00	7.16	195.34	3.50	3.50	4	8	13	4	4
2.00	7.16	195.34	4.00	4.00	4	7	11	4	4
2.00	7.16	195.34	5.00	5.00	4	6	9	4	4
2.00	7.16	195.34	6.00	6.00	4	5	8	4	4
3.00	8.16	194.34	3.50	3.50	4	9	14	4	4
3.00	8.16	194.34	4.00	4.00	4	8	12	4	4
3.00	8.16	194.34	5.00	5.00	4	6	10	4	4
3.00	8.16	194.34	6.00	6.00	4	5	8	4	4

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.34m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-27.13 For BH-96 (Weigh bridge control room))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from NGL m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	1.00	6.16	196.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4
2	4.00	4.00	1.00	6.16	196.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4
3	5.00	5.00	1.00	6.16	196.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4
4	6.00	6.00	1.00	6.16	196.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4
5	3.50	3.50	2.00	7.16	195.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.11	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4
6	4.00	4.00	2.00	7.16	195.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4
7	5.00	5.00	2.00	7.16	195.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4
8	6.00	6.00	2.00	7.16	195.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4
9	3.50	3.50	3.00	8.16	194.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.17	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4
10	4.00	4.00	3.00	8.16	194.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.15	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4
11	5.00	5.00	3.00	8.16	194.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4
12	6.00	6.00	3.00	8.16	194.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.34m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-27.14 (For BH-96 (Weigh bridge control room))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :-

Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	1.00	196.34	6.16	3.50	3.50	0.40	234	1.12	0.80	0.0236	7.00	0.70	0.92	0.80	8	12
2	1.00	196.34	6.16	4.00	4.00	0.40	234	1.12	0.80	0.0236	8.00	0.70	0.93	0.80	7	11
3	1.00	196.34	6.16	5.00	5.00	0.40	234	1.12	0.80	0.0236	8.00	0.70	0.95	0.80	5	9
4	1.00	196.34	6.16	6.00	6.00	0.40	234	1.12	0.80	0.0236	8.00	0.70	0.96	0.80	4	7
5	2.00	195.34	7.16	3.50	3.50	0.40	234	1.12	0.80	0.0236	7.00	0.70	0.83	0.80	8	13
6	2.00	195.34	7.16	4.00	4.00	0.40	234	1.12	0.80	0.0236	7.00	0.70	0.85	0.80	7	11
7	2.00	195.34	7.16	5.00	5.00	0.40	234	1.12	0.80	0.0236	7.00	0.70	0.88	0.80	6	9
8	2.00	195.34	7.16	6.00	6.00	0.40	234	1.12	0.80	0.0236	7.00	0.70	0.91	0.80	5	8
9	3.00	194.34	8.16	3.50	3.50	0.40	234	1.12	0.80	0.0236	6.00	0.70	0.75	0.80	9	14
10	3.00	194.34	8.16	4.00	4.00	0.40	234	1.12	0.80	0.0236	6.00	0.70	0.77	0.80	8	12
11	3.00	194.34	8.16	5.00	5.00	0.40	234	1.12	0.80	0.0236	6.00	0.70	0.82	0.80	6	10
12	3.00	194.34	8.16	6.00	6.00	0.40	234	1.12	0.80	0.0236	6.00	0.70	0.85	0.80	5	8

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 27.15 (For BH-96 (Weigh bridge control room))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation from NGL (R.L. 197.34m)	Depth of foundation from FGL	RL of Foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria	Safe Bearing Pressures calculated based on Settlement Criteria		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	6.16	196.34	7.00	7.00	4	4	6	4	4
1.00	6.16	196.34	8.00	8.00	4	4	6	4	4
1.00	6.16	196.34	9.00	9.00	4	3	5	3	4
1.00	6.16	196.34	10.00	10.00	4	3	5	3	4
2.00	7.16	195.34	7.00	7.00	4	4	7	4	4
2.00	7.16	195.34	8.00	8.00	4	4	6	4	4
2.00	7.16	195.34	9.00	9.00	4	3	5	3	4
2.00	7.16	195.34	10.00	10.00	4	3	5	3	4
3.00	8.16	194.34	7.00	7.00	4	4	7	4	4
3.00	8.16	194.34	8.00	8.00	4	4	6	4	4
3.00	8.16	194.34	9.00	9.00	4	4	6	4	4
3.00	8.16	194.34	10.00	10.00	4	3	5	3	4

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.34m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-27.16 For BH-96 (Weigh bridge control room))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation from NGL m	Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	1.00	6.16	196.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4
2	8.00	8.00	1.00	6.16	196.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4
3	9.00	9.00	1.00	6.16	196.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.02	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4
4	10.00	10.00	1.00	6.16	196.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.02	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4
5	7.00	7.00	2.00	7.16	195.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4
6	8.00	8.00	2.00	7.16	195.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4
7	9.00	9.00	2.00	7.16	195.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4
8	10.00	10.00	2.00	7.16	195.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4
9	7.00	7.00	3.00	8.16	194.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4
10	8.00	8.00	3.00	8.16	194.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4
11	9.00	9.00	3.00	8.16	194.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4
12	10.00	10.00	3.00	8.16	194.34	0.20	0	5.14	0.00	0.00	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.89	0.95	0.50	0.50	4

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 197.34m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX-27.17 (For BH-96 (Weigh bridge control room))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :-

Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	1.00	196.34	6.16	7.00	7.00	0.40	234	1.12	0.80	0.0236	8.00	0.70	0.97	0.80	4	6
2	1.00	196.34	6.16	8.00	8.00	0.40	234	1.12	0.80	0.0236	8.00	0.70	0.97	0.80	4	6
3	1.00	196.34	6.16	9.00	9.00	0.40	234	1.12	0.80	0.0236	8.00	0.70	0.97	0.80	3	5
4	1.00	196.34	6.16	10.00	10.00	0.40	234	1.12	0.80	0.0236	8.00	0.70	0.98	0.80	3	5
5	2.00	195.34	7.16	7.00	7.00	0.40	234	1.12	0.80	0.0236	7.00	0.70	0.92	0.80	4	7
6	2.00	195.34	7.16	8.00	8.00	0.40	234	1.12	0.80	0.0236	7.00	0.70	0.93	0.80	4	6
7	2.00	195.34	7.16	9.00	9.00	0.40	234	1.12	0.80	0.0236	7.00	0.70	0.94	0.80	3	5
8	2.00	195.34	7.16	10.00	10.00	0.40	234	1.12	0.80	0.0236	7.00	0.70	0.95	0.80	3	5
9	3.00	194.34	8.16	7.00	7.00	0.40	234	1.12	0.80	0.0236	6.00	0.70	0.87	0.80	4	7
10	3.00	194.34	8.16	8.00	8.00	0.40	234	1.12	0.80	0.0236	6.00	0.70	0.89	0.80	4	6
11	3.00	194.34	8.16	9.00	9.00	0.40	234	1.12	0.80	0.0236	6.00	0.70	0.91	0.80	4	6
12	3.00	194.34	8.16	10.00	10.00	0.40	234	1.12	0.80	0.0236	6.00	0.70	0.92	0.80	3	5

Appendix – 27B

Calculation of Safe Load on Uniform Diameter Bored Cast in situ Pile. (Near BH 96)

(Weigh bridge control room)

The safe load is calculated as follows,

1) Design Stipulations

- | | |
|---|---|
| 1. Type of pile | - Bored cast in situ uniform diameter pile. |
| 2. Pile diameter considered | - 0.60m |
| 3. Termination depth of pile considered | - 15.00m from FGL. |
| 4. Cut off Level | - 6.00m from FGL. |
| 5. Factor of Safety | - 2.50 |
| 6. Depth of Water table | - Considered at FGL. |
| 7. Ref | - IS 2911 P-I, Sec-II, 2021. |

2) Test Data

The parameters are based on BH 96. For evaluation of safe load on piles following characterized layers are considered as described in table below,

Depth in m from RL 202.5 m	Cohesion in kg/cm ²	Angle of Internal Friction ϕ	Submerged density in gm/cc γ_{sub}	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
FGL to 6.00	No contribution- Cutoff level						
6.00 to 9.46	0.49	2(ignored)	0.89	0.89	NA	NA	3-12
9.46 to 13.76	0.05(ignored)	30	0.89	NA	NA	30	8-29
13.76 to 14.86	6.67	0	1.00	0.28	NA	NA	>100
14.86 to 15.66	0	34	1.00	NA	1.50	34	>100

Notes: - Layers are characterized based on classification and the state of soil in that stratum.

* - In cohesive soils the contribution of the angle of internal friction being insignificant is ignored.

Shear parameters are the most representative for the layer. NA means not applicable. Characterized N values are considered for each layer.

- Weighted Average of the parameters falling in the same layer has been considered

\$-Parameters are correlated based on SPT value N.

3) Ultimate Load in Compression

3.1) Ultimate load in Compression by Bearing

Ultimate load on pile in end bearing,

$$q_{ub} = A_p (0.5 \cdot D \cdot \gamma \cdot N_\gamma + P D N_q)$$

$$A_p = \text{Cross section area of Pile stem at toe} = \pi d^2 / 4$$

$$D = \text{Diameter of pile} = d \text{ in m}$$

$$N_\gamma = 42.90$$

$$N_q = 40.00$$

$$q_{ub} = 0.785d^2 (0.5 \cdot d \cdot 1.00 \cdot 42.90 + 8.15 \cdot 40.00) = 16.84d^3 + 255.91d^2$$

(For Pile terminating at 15.00m from F.G.L.)

Note: As the pile terminating just above rock level, we have considered parameter for end bearing component based on rock strata.

3.2) Ultimate Load in Compression by Skin Friction

Ultimate load in skin friction,

$$q_{uf} = \alpha_i C_{ai} A_i + K_i P D_i \tan \delta_i A_{si}$$

First Layer – No contribution considered – Due to cutoff

$$\text{Second Layer} - \alpha_2 C_{a2} A_{s2} = 0.89 \cdot 4.90 \cdot \pi \cdot d \cdot 3.46 = 47.40 d$$

$$\text{Third Layer} - K_3 P D_3 \tan \delta_3 A_{s3} = 1.00 \cdot 4.99 \cdot \tan 30^\circ \cdot \pi \cdot d \cdot 4.30 = 38.92 d$$

$$\text{Fourth Layer} - \alpha_4 C_{a4} A_{s4} = 0.28 \cdot 66.70 \cdot \pi \cdot d \cdot 1.10 = 64.54 d$$

$$\text{Fifth Layer} - K_5 P D_5 \tan \delta_5 A_{s5} = 1.50 \cdot 8.08 \cdot \tan 34^\circ \cdot \pi \cdot d \cdot (\ell - 14.86) = 25.68 d (\ell - 14.86)$$

Substituting, ultimate load

$$q_{uf} = 150.86d + 25.68d (\ell - 14.86) \text{ (For Pile terminating at 15.00m from F.G.L.)}$$

Where, ℓ is the pile length and d is diameter of piles, substituting

Ultimate load by both bearing and friction can be as follows for various lengths of piles,

$$q_{uc} = q_{ub} + q_{uf}$$

$$q_{uc} = 16.84d^3 + 255.91d^2 + 150.86d + 25.68d(\ell - 14.86)$$

(For Pile terminating at 15.00m from F.G.L.).

By substituting various diameters of piles having various lengths, the safe load is worked out considering the safety factor of 2.50 and are given in table below,

Safe Load on Piles in Compression (in Ton)

Termination Depth of Pile in m, from FGL	Termination Depth of Pile in m, from cut-off	Diameter of Pile in, m
		0.60
15.00	9.00	75.19

3.3) Ultimate Load in Uplift

Considering skin friction for determination of uplift

Safe Load on Piles in Uplift (in Ton)

Termination Depth of Pile in m, from FGL	Termination Depth of Pile in m, from cut-off	Diameter of Pile in, m
		0.60
15.00	9.00	34.71

Note: Self weight of pile is considered in calculation of ultimate load in uplift.

Self-weight of Pile (in Ton)

Termination Depth of Pile in m, from FGL	Termination Depth of Pile in m, from cut-off	Diameter of Pile in, m
		0.60
15.00	9.00	3.82

3.4) Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60
Subgrade reaction in MN/m^3		4.50
Stiffness factor T in m		2.09
Depth of fixity in m	Free Head	4.00
	Fixed Head	4.50
Allowable Horizontal Force in T	Free Head	4.30
	Fixed Head	11.30
Allowable Moment capacity in Tm	Free Head	5.94
	Fixed Head	21.13

4) Notes:

1) Initial and Routine pile load tests shall be carried out as per IS 2911, P-4 on the piles to confirm the capacity of pile worked out theoretically. For design and construction, specifications of IS 2911, P-I, S-2, shall strictly be followed. Termination depth of pile shall be from FGL.

Dr. K. K. Thaker

Appendix – 28A
Calculation of Safe Load carrying capacity of piles socketed inside rock
(Near IBH 13)
(Coal Conveyor BC-1 A/B)

Project Name: - Proposed structures of thermal power project of NTTTP at Hirma, Talabira

1.0 Introduction

In situations where overburden offering low bearing pressure is followed by rock at relatively shallower depths, end bearing piles is the suitable foundation option. Piles in rocks and weathered rocks of varying degree of weathering derive their capacity by end bearing and socket side resistance.

In situations, where, rock strata comprises of highly fragmented rock, as in present case, where RQD is nil or $(CR+RQD)/2$ is less than 30 % or when the crushing strength is less than 10 MPa, the appropriate approach would be of that suggested by Cole & Stroud.

In present site overburden soils overlay fractured / laminated / foliated rock. The founding stratum having highly fragmented rock with nil RQD and $(CR+RQD)/2$ to be less than 30 %, the approach suggested by Cole and Stroud as per Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 Pa/S2 has been used for safe load calculations.

An illustrative calculation of safe load on pile and summary of pile capacities is as follows,

2.0 Sub soil strata Characterization

General stratification at the location of boreholes IBH 13 show primarily two characterized layers,

1. Overburden comprising of Brownish, fine to medium grained, sandy clays of intermediate plasticity followed by Dark brownish, fine to coarse grained, silty gravels and clayey gravels followed by Reddish yellow, fine to coarse grained, clayey sand with much gravels followed by Reddish yellow, fine to coarse grained, clayey sand with much gravels followed by Greyish brown, fine to medium grained, sandy clay of intermediate plasticity with much gravels mud rock upto 9.00m (i.e. RL 184.54 m).
2. Second characterized layer below the overburden soils comprises of Highly weathered, weak, light brownish grey, fine to very fine grained, fractured rock followed by Highly weathered, moderately weak, yellowish brown, fine to very fine grained, fractured rock upto 14.00m (i.e. RL 179.54m).

3.0 Design Considerations

1. Length of socket considered 3D from depth of rock encountered.
2. The pile is considered to have socket length below 9.00 m below NGL (i.e. RL 184.54 m) depth.
3. For present case of pile terminating in highly weathered rock. SPT at depths between 9.00 to 14.00m (between RL 181.80 to 177.95 m) is > 100 with just 9.00 cm (Average) penetration in 71 blows. SPT can be extrapolated for 30 cm i.e. $71 * 30 / 9.00 = 237$.
Based on recommendation of fig no. 3 in B 8 in Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 P1/S2, average shear strength q_c corresponding to assumed SPT of 200 may be taken as 1300 kN/m^2
4. Allowable Capacity of pile socketed into rock $Q_a = R_e + R_{sf} = C_{u1} N_c \pi B^2 / 4 (F_s = 3) + \alpha C_{u2} \pi BL / (F_s = 6)$

4.0 Safe Load on Pile in Compression

Where,

End bearing component, $R_e = C_{u1} N_c \pi B^2 / 4 F_s$,

C_{u1} = Shear strength below base of pile = 1300 kN/m^2

B = diameter of the pile = d

F_s = Factor of Safety = 3

$N_c = 9$

Therefore, **$R_e = 3061.5 d^2$**

Skin friction component of socketed length of pile, $R_{sf} = \alpha C_{u2} \pi BL / F_s$

$\alpha = 0.9$ (recommended value in IS 2911 P1/S2)

L = length of the socket = $3 D$

C_{u2} = Ultimate shear strength along socket length which shall be restricted to shear capacity of concrete of the pile = 1300 kN/m^2

F_s = Factor of Safety = 6

Therefore, $R_{sf} = 1836.9 d^2$

Thus,

$$Q_a = c_{u1} N_c \cdot \frac{\pi B^2}{4 F_s} + \alpha c_{u2} \cdot \frac{\pi B L}{F_s}$$

$$= 3061.5 d^2 + 1836.9 d^2 = 4898.4 d^2$$

Substituting the values of various diameters and socket lengths equal to 3 times diameter, allowable load on single pile can be summarized as follows,

Summary of the Safe load calculation in Compression

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	19.76	20.24	20.66
Termination level RL in m	182.74	182.26	181.84
End Bearing Component in kN	1102.1	1768.3	2479.8
Friction Component in kN	661.3	1060.9	1487.9
Safe load in Compression in kN	1763.4	2829.3	3967.7
Safe load in Compression in T	176	283	397

5.0 Safe Load on Pile in uplift

For 2.00m cutoff from FGL

The overburden soils, though, will not contribute in compression capacity would offer resistance in uplift capacity. The parameters of IBH 13 are considered for calculation of uplift resistance as summarized below,

Depth in m from RL 202.5 m	Cohesion in kg/cm^2	Angle of Internal Friction ϕ	Submerged density in $\text{gm/cc } \gamma_{\text{sub}}$	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 9.00	Pile cutoff level – No pile						
9.00 to 11.26	0.80	0	0.97	0.58	NA	NA	12-14
11.26 to 14.76	0.10(ignored)	28	1.00	NA	1.00	28	15-65
14.76 to 17.96	6.67	0	1.02	0.28	NA	NA	>100
17.96 to 27.46	Rock strata – Resistance would be as per skin friction capacity in socket as already calculated in compression capacity						

Note - \$ Weighted average data considered. NA means not applicable.

Ultimate load in skin friction,

$$Q_{uf} = \alpha_i C_{ai} A_{si} + K_i P D_i \tan \delta_i A_{si}$$

First Layer – No contribution considered – (Within Cutoff Level).

$$\text{Second Layer} - \alpha_2 C_{a2} A_{s2} = 0.58 * 8.00 * \pi d * 2.26 = 32.94d$$

$$\text{Third Layer} - K_3 P D_3 \tan \delta_3 A_{s3} = 1.00 * 9.53 * \tan 28 * \pi d * 3.50 = 55.72 d$$

$$\text{Fourth Layer} - \alpha_4 C_{a4} A_{s4} = 0.28 * 66.70 * \pi d * 3.20 = 205.35d$$

Fifth Layer – $1836.90 d^2$ in rock socket

$$\text{Substituting, ultimate load } q_{uf} = 2940.1 d + 1836.9 d^2$$

The safe load in uplift is worked out (considering the safety factor of 2.50 for overburden soils) and summarized below,

Safe Load on Piles in Uplift (in Ton)

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	19.76	20.24	20.66
Termination level RL in m	182.74	182.26	181.84
Safe load in Uplift in kN	1366.91	1954.78	2546.33
Self-weight of pile in kN	45.61	76.45	111.21
Safe load in Uplift in T (Considering self-weight of pile)	141.25	203.12	265.75

6.0 Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60	0.76	0.90
Subgrade reaction in MN/m^3		17.28	17.28	17.28
Stiffness factor T in m		1.59	1.93	2.20
Depth of fixity in m	Free Head	3.00	3.70	4.20
	Fixed Head	3.50	4.20	4.80
Allowable Horizontal Force in T	Free Head	9.60	14.00	18.40
	Fixed Head	25.40	37.10	48.60
Allowable Moment capacity in Tm	Free Head	10.17	17.93	26.91
	Fixed Head	36.20	63.83	95.78

7.0 Notes

1. Pile shall be terminated after socketing 3D inside rock.
2. Initial and routine pile load test is required to verify the actual carrying capacity of pile in compression, uplift and lateral loads.
3. For design and construction, specification of IS: 2911, P1/S2, IS: 456, 2000 shall strictly be followed.

(Dr. K. K. Thaker)

KCT Consultancy Services LLP, Ahmedabad**APPENDIX - &- (For BH- 48(Coal conveyor near unit-1))****SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION****Project :** Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Depth of Foundation from NGL (R.L. 200.63m)	Depth of Foundation from FGL (R.L. 202.50m)	RL of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria Á (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria Á		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
2.00	3.87	198.63	1.50	1.50	15	46	74	15	15
2.00	3.87	198.63	2.00	2.00	14	35	56	14	14
2.00	3.87	198.63	2.50	2.50	13	27	43	13	13
2.00	3.87	198.63	3.00	3.00	13	22	35	13	13
2.50	4.37	198.13	1.50	1.50	15	46	74	15	15
2.50	4.37	198.13	2.00	2.00	14	35	56	14	14
2.50	4.37	198.13	2.50	2.50	14	28	45	14	14
2.50	4.37	198.13	3.00	3.00	13	23	36	13	13
3.00	4.87	197.63	1.50	1.50	16	46	74	16	16
3.00	4.87	197.63	2.00	2.00	15	35	56	15	15
3.00	4.87	197.63	2.50	2.50	14	28	45	14	14
3.00	4.87	197.63	3.00	3.00	14	23	37	14	1

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 202.50m.
- 3) Calculations are considering the effect of water table at FGL.
- 4) Shear Parameters are correlated based on SPT N value.

KCT Consultancy Services LLP, Ahmedabad**APPENDIX - &- .1 (For BH- 48(Coal conveyor near unit-1))****Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ**

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

For Square Isolated Foundation

Sr. No.	Size of Foundation		Depth of Foundation from NGL m	Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ	N _c	N _q - 1	N _γ	S _c	S _q	S _γ	d _c	d _q	d _γ	i _c	i _q	i _γ	γ	0.5 γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _γ	
1	1.50	1.50	2.00	3.87	198.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.27	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	15
2	2.00	2.00	2.00	3.87	198.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.20	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	14
3	2.50	2.50	2.00	3.87	198.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.16	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	13
4	3.00	3.00	2.00	3.87	198.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	13
5	1.50	1.50	2.50	4.37	198.13	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.33	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	15
6	2.00	2.00	2.50	4.37	198.13	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.25	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	14
7	2.50	2.50	2.50	4.37	198.13	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.20	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	14
8	3.00	3.00	2.50	4.37	198.13	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.17	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	13
9	1.50	1.50	3.00	4.87	197.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.40	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	16
10	2.00	2.00	3.00	4.87	197.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.30	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	15
11	2.50	2.50	3.00	4.87	197.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.24	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	14
12	3.00	3.00	3.00	4.87	197.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.20	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	14

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 202.50m.
- 3) Calculations are considering the effect of water table at FGL.
- 4) Shear Parameters are correlated based on SPT N value.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - &- .2 (For BH- 48(Coal conveyor near unit-1))
Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D from NGL	Depth D from FGL	RL of Foundation	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	2.00	3.87	198.63	1.50	1.50	0.40	479	1.12	0.80	0.0099	3.00	0.70	0.73	0.80	46	74
2	2.00	3.87	198.63	2.00	2.00	0.40	479	1.12	0.80	0.0099	4.00	0.70	0.73	0.80	35	56
3	2.00	3.87	198.63	2.50	2.50	0.40	479	1.12	0.80	0.0099	5.00	0.70	0.76	0.80	27	43
4	2.00	3.87	198.63	3.00	3.00	0.40	479	1.12	0.80	0.0099	6.00	0.70	0.80	0.80	22	35
5	2.50	4.37	198.13	1.50	1.50	0.40	479	1.12	0.80	0.0099	3.00	0.70	0.73	0.80	46	74
6	2.50	4.37	198.13	2.00	2.00	0.40	479	1.12	0.80	0.0099	4.00	0.70	0.73	0.80	35	56
7	2.50	4.37	198.13	2.50	2.50	0.40	479	1.12	0.80	0.0099	5.00	0.70	0.73	0.80	28	45
8	2.50	4.37	198.13	3.00	3.00	0.40	479	1.12	0.80	0.0099	6.00	0.70	0.75	0.80	23	36
9	3.00	4.87	197.63	1.50	1.50	0.40	479	1.12	0.80	0.0099	3.00	0.70	0.73	0.80	46	74
10	3.00	4.87	197.63	2.00	2.00	0.40	479	1.12	0.80	0.0099	4.00	0.70	0.73	0.80	35	56
11	3.00	4.87	197.63	2.50	2.50	0.40	479	1.12	0.80	0.0099	5.00	0.70	0.73	0.80	28	45
12	3.00	4.87	197.63	3.00	3.00	0.40	479	1.12	0.80	0.0099	6.00	0.70	0.73	0.80	23	37

KCT Consultancy Services LLP, Ahmedabad**APPENDIX - & .3 (For BH- 48(Coal conveyor near unit-1))****SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION****Project :** Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Depth of Foundation from NGL (R.L. 200.63m)	Depth of Foundation from FGL (R.L. 202.50m)	RL of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria Á (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria Á		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)	(m)					
2.00	3.87	198.63	3.50	3.50	13	19	30	13	13
2.00	3.87	198.63	4.00	4.00	13	16	25	13	13
2.00	3.87	198.63	5.00	5.00	12	12	20	12	12
2.00	3.87	198.63	6.00	6.00	12	10	16	10	12
2.50	4.37	198.13	3.50	3.50	13	19	31	13	13
2.50	4.37	198.13	4.00	4.00	13	16	26	13	13
2.50	4.37	198.13	5.00	5.00	13	13	20	13	13
2.50	4.37	198.13	6.00	6.00	12	10	17	10	12
3.00	4.87	197.63	3.50	3.50	13	20	31	13	13
3.00	4.87	197.63	4.00	4.00	13	17	27	13	13
3.00	4.87	197.63	5.00	5.00	13	13	21	13	13
3.00	4.87	197.63	6.00	6.00	13	11	17	11	13

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 202.50m.
- 3) Calculations are considering the effect of water table at FGL.
- 4) Shear Parameters are correlated based on SPT N value.

KCT Consultancy Services LLP, Ahmedabad**APPENDIX - &- .4 (For BH- 48(Coal conveyor near unit-1))****Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ**

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

For Square Isolated Foundation

Sr. No.	Size of Foundation		Depth of Foundation from NGL m	Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5 γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	2.00	3.87	198.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.11	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	13
2	4.00	4.00	2.00	3.87	198.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	13
3	5.00	5.00	2.00	3.87	198.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	12
4	6.00	6.00	2.00	3.87	198.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	12
5	3.50	3.50	2.50	4.37	198.13	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.14	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	13
6	4.00	4.00	2.50	4.37	198.13	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	13
7	5.00	5.00	2.50	4.37	198.13	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	13
8	6.00	6.00	2.50	4.37	198.13	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	12
9	3.50	3.50	3.00	4.87	197.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.17	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	13
10	4.00	4.00	3.00	4.87	197.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.15	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	13
11	5.00	5.00	3.00	4.87	197.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	13
12	6.00	6.00	3.00	4.87	197.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	13

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 202.50m.
- 3) Calculations are considering the effect of water table at FGL.
- 4) Shear Parameters are correlated based on SPT N value.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - &- .5 (For BH- 48(Coal conveyor near unit-1))
Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D from NGL	Depth D from FGL	RL of Foundation	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	2.00	3.87	198.63	3.50	3.50	0.40	479	1.12	0.80	0.0099	7.00	0.70	0.83	0.80	19	30
2	2.00	3.87	198.63	4.00	4.00	0.40	479	1.12	0.80	0.0099	8.00	0.70	0.85	0.80	16	25
3	2.00	3.87	198.63	5.00	5.00	0.40	479	1.12	0.80	0.0099	10.00	0.70	0.88	0.80	12	20
4	2.00	3.87	198.63	6.00	6.00	0.40	479	1.12	0.80	0.0099	12.00	0.70	0.91	0.80	10	16
5	2.50	4.37	198.13	3.50	3.50	0.40	479	1.12	0.80	0.0099	7.00	0.70	0.78	0.80	19	31
6	2.50	4.37	198.13	4.00	4.00	0.40	479	1.12	0.80	0.0099	8.00	0.70	0.81	0.80	16	26
7	2.50	4.37	198.13	5.00	5.00	0.40	479	1.12	0.80	0.0099	10.00	0.70	0.85	0.80	13	20
8	2.50	4.37	198.13	6.00	6.00	0.40	479	1.12	0.80	0.0099	12.00	0.70	0.88	0.80	10	17
9	3.00	4.87	197.63	3.50	3.50	0.40	479	1.12	0.80	0.0099	7.00	0.70	0.75	0.80	20	31
10	3.00	4.87	197.63	4.00	4.00	0.40	479	1.12	0.80	0.0099	8.00	0.70	0.77	0.80	17	27
11	3.00	4.87	197.63	5.00	5.00	0.40	479	1.12	0.80	0.0099	10.00	0.70	0.82	0.80	13	21
12	3.00	4.87	197.63	6.00	6.00	0.40	479	1.12	0.80	0.0099	12.00	0.70	0.85	0.80	11	17

KCT Consultancy Services LLP, Ahmedabad**APPENDIX - & .6 (For BH- 48(Coal conveyor near unit-1))****SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION****Project :** Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Depth of Foundation from NGL (R.L. 200.63m)	Depth of Foundation from FGL (R.L. 202.50m)	RL of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria Á (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria Á		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)	(m)					
2.00	3.87	198.63	7.00	7.00	12	9	14	9	12
2.00	3.87	198.63	8.00	8.00	12	8	12	8	12
2.00	3.87	198.63	9.00	9.00	12	7	11	7	11
2.00	3.87	198.63	10.00	10.00	12	6	10	6	10
2.50	4.37	198.13	7.00	7.00	12	9	14	9	12
2.50	4.37	198.13	8.00	8.00	12	8	12	8	12
2.50	4.37	198.13	9.00	9.00	12	7	11	7	11
2.50	4.37	198.13	10.00	10.00	12	6	10	6	10
3.00	4.87	197.63	7.00	7.00	12	9	14	9	12
3.00	4.87	197.63	8.00	8.00	12	8	12	8	12
3.00	4.87	197.63	9.00	9.00	12	7	11	7	11
3.00	4.87	197.63	10.00	10.00	12	6	10	6	10

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 202.50m.
- 3) Calculations are considering the effect of water table at FGL.
- 4) Shear Parameters are correlated based on SPT N value.

KCT Consultancy Services LLP, Ahmedabad**APPENDIX - &- .7 (For BH- 48(Coal conveyor near unit-1))****Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ**

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

For Square Isolated Foundation

Sr. No.	Size of Foundation		Depth of Foundation from NGL m	Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5 γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	2.00	3.87	198.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	12
2	8.00	8.00	2.00	3.87	198.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	12
3	9.00	9.00	2.00	3.87	198.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	12
4	10.00	10.00	2.00	3.87	198.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	12
5	7.00	7.00	2.50	4.37	198.13	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	12
6	8.00	8.00	2.50	4.37	198.13	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	12
7	9.00	9.00	2.50	4.37	198.13	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	12
8	10.00	10.00	2.50	4.37	198.13	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	12
9	7.00	7.00	3.00	4.87	197.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	12
10	8.00	8.00	3.00	4.87	197.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	12
11	9.00	9.00	3.00	4.87	197.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	12
12	10.00	10.00	3.00	4.87	197.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	12

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 202.50m.
- 3) Calculations are considering the effect of water table at FGL.
- 4) Shear Parameters are correlated based on SPT N value.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - &- .8 (For BH- 48(Coal conveyor near unit-1))
Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D from NGL	Depth D from FGL	RL of Foundation	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	2.00	3.87	198.63	7.00	7.00	0.40	479	1.12	0.80	0.0099	13.50	0.70	0.92	0.80	9	14
2	2.00	3.87	198.63	8.00	8.00	0.40	479	1.12	0.80	0.0099	13.50	0.70	0.93	0.80	8	12
3	2.00	3.87	198.63	9.00	9.00	0.40	479	1.12	0.80	0.0099	13.50	0.70	0.94	0.80	7	11
4	2.00	3.87	198.63	10.00	10.00	0.40	479	1.12	0.80	0.0099	13.50	0.70	0.95	0.80	6	10
5	2.50	4.37	198.13	7.00	7.00	0.40	479	1.12	0.80	0.0099	13.00	0.70	0.90	0.80	9	14
6	2.50	4.37	198.13	8.00	8.00	0.40	479	1.12	0.80	0.0099	13.00	0.70	0.91	0.80	8	12
7	2.50	4.37	198.13	9.00	9.00	0.40	479	1.12	0.80	0.0099	13.00	0.70	0.92	0.80	7	11
8	2.50	4.37	198.13	10.00	10.00	0.40	479	1.12	0.80	0.0099	13.00	0.70	0.93	0.80	6	10
9	3.00	4.87	197.63	7.00	7.00	0.40	479	1.12	0.80	0.0099	12.50	0.70	0.87	0.80	9	14
10	3.00	4.87	197.63	8.00	8.00	0.40	479	1.12	0.80	0.0099	12.50	0.70	0.89	0.80	8	12
11	3.00	4.87	197.63	9.00	9.00	0.40	479	1.12	0.80	0.0099	12.50	0.70	0.91	0.80	7	11
12	3.00	4.87	197.63	10.00	10.00	0.40	479	1.12	0.80	0.0099	12.50	0.70	0.92	0.80	6	10

KCT Consultancy Services LLP, Ahmedabad**APPENDIX - & .9 (For BH- 48(Coal conveyor near unit-1))****SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION****Project :** Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Depth of Foundation from NGL (R.L. 200.63m)	Depth of Foundation from FGL (R.L. 202.50m)	RL of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria Á (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria Á		Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
1.00	2.87	199.63	1.50	1.50	13	44	71	13	13
1.00	2.87	199.63	2.00	2.00	13	32	51	13	13
1.00	2.87	199.63	2.50	2.50	12	25	40	12	12
1.00	2.87	199.63	3.00	3.00	12	20	33	12	12
1.00	2.87	199.63	3.50	3.50	12	17	28	12	12
1.00	2.87	199.63	4.00	4.00	12	15	24	12	12
1.00	2.87	199.63	5.00	5.00	12	12	19	12	12
1.00	2.87	199.63	6.00	6.00	12	10	16	10	12
1.00	2.87	199.63	7.00	7.00	12	8	13	8	12
1.00	2.87	199.63	8.00	8.00	12	7	12	7	12
1.00	2.87	199.63	9.00	9.00	12	7	10	7	10
1.00	2.87	199.63	10.00	10.00	12	6	10	6	10

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 202.50m.
- 3) Calculations are considering the effect of water table at FGL.
- 4) Shear Parameters are correlated based on SPT N value.

KCT Consultancy Services LLP, Ahmedabad**APPENDIX - &- .10 (For BH- 48(Coal conveyor near unit-1))****Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ**

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

For Square Isolated Foundation

Sr. No.	Size of Foundation		Depth of Foundation from NGL m	Depth of Foundation from FGL m	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5 γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	1.00	2.87	199.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	13
2	2.00	2.00	1.00	2.87	199.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	13
3	2.50	2.50	1.00	2.87	199.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	12
4	3.00	3.00	1.00	2.87	199.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	12
5	3.50	3.50	1.00	2.87	199.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	12
6	4.00	4.00	1.00	2.87	199.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	12
7	5.00	5.00	1.00	2.87	199.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	12
8	6.00	6.00	1.00	2.87	199.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	12
9	7.00	7.00	1.00	2.87	199.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	12
10	8.00	8.00	1.00	2.87	199.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	12
11	9.00	9.00	1.00	2.87	199.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.02	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	12
12	10.00	10.00	1.00	2.87	199.63	0.64	0	5.14	0.00	0.00	1.30	1.20	0.80	1.02	1.00	1.00	1.00	1.00	1.00	1.97	0.99	0.50	0.50	12

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from RL 202.50m.
- 3) Calculations are considering the effect of water table at FGL.
- 4) Shear Parameters are correlated based on SPT N value.

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APPENDIX - &- .11 (For BH- 48(Coal conveyor near unit-1))
Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed Structures in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D from NGL	Depth D from FGL	RL of Foundation	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³	T / m ²
1	1.00	2.87	199.63	1.50	1.50	0.40	479	1.12	0.80	0.0099	3.00	0.70	0.80	0.80	44	71
2	1.00	2.87	199.63	2.00	2.00	0.40	479	1.12	0.80	0.0099	4.00	0.70	0.85	0.80	32	51
3	1.00	2.87	199.63	2.50	2.50	0.40	479	1.12	0.80	0.0099	5.00	0.70	0.88	0.80	25	40
4	1.00	2.87	199.63	3.00	3.00	0.40	479	1.12	0.80	0.0099	6.00	0.70	0.91	0.80	20	33
5	1.00	2.87	199.63	3.50	3.50	0.40	479	1.12	0.80	0.0099	7.00	0.70	0.92	0.80	17	28
6	1.00	2.87	199.63	4.00	4.00	0.40	479	1.12	0.80	0.0099	8.00	0.70	0.93	0.80	15	24
7	1.00	2.87	199.63	5.00	5.00	0.40	479	1.12	0.80	0.0099	10.00	0.70	0.95	0.80	12	19
8	1.00	2.87	199.63	6.00	6.00	0.40	479	1.12	0.80	0.0099	12.00	0.70	0.96	0.80	10	16
9	1.00	2.87	199.63	7.00	7.00	0.40	479	1.12	0.80	0.0099	14.00	0.70	0.97	0.80	8	13
10	1.00	2.87	199.63	8.00	8.00	0.40	479	1.12	0.80	0.0099	14.50	0.70	0.97	0.80	7	12
11	1.00	2.87	199.63	9.00	9.00	0.40	479	1.12	0.80	0.0099	14.50	0.70	0.97	0.80	7	10
12	1.00	2.87	199.63	10.00	10.00	0.40	479	1.12	0.80	0.0099	14.50	0.70	0.98	0.80	6	10

Appendix – 29A

Calculation of Safe Load carrying capacity of piles socketed inside rock

(Near BH 48)

(Coal conveyor near unit-1)

Project Name: - Proposed structures of thermal power project of NTTTP at Hirma, Talabira

1.0 Introduction

In situations where overburden offering low bearing pressure is followed by rock at relatively shallower depths, end bearing piles is the suitable foundation option. Piles in rocks and weathered rocks of varying degree of weathering derive their capacity by end bearing and socket side resistance.

In situations, where, rock strata comprises of highly fragmented rock, as in present case, where RQD is nil or $(CR+RQD)/2$ is less than 30 % or when the crushing strength is less than 10 MPa, the appropriate approach would be of that suggested by Cole & Stroud.

In present site overburden soils overlay fractured / laminated / foliated rock. The founding stratum having highly fragmented rock with nil RQD and $(CR+RQD)/2$ to be less than 30 %, the approach suggested by Cole and Stroud as per Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 P1/S2 has been used for safe load calculations.

An illustrative calculation of safe load on pile and summary of pile capacities is as follows,

2.0 Sub soil strata Characterization

General stratification at the location of boreholes 48 show primarily three characterized layers,

1. Overburden comprising of Reddish yellow, very fine grained, silty clays of intermediate plasticity with occasional gravels and Light greyish yellow and slightly greenish fine to medium grained, silty sand with little plastic fines upto 14.80m (i.e. RL 185.83 m). The RL of NGL is 200.63 m.
2. Second characterized layer below the overburden soils Highly weathered, very weak, very thinly laminated/foliated, dark greenish grey, very fine grained, SHALE mixed with greenish grey, fine to very fine grained, clays of intermediate plasticity up to 15.70m (i.e. RL 184.93m) followed by Highly weathered, very weak, dark greenish grey, very fine grained, very thinly bedded, foliated SHALE upto 20.00 (i.e. RL 180.63m). Though, rock is not very sound but can be considered for socketing if the pile capacity obtained thereby is adequate against imposed loads.

3.0 Design Considerations

1. Length of socket considered 3D from depth of rock encountered.
2. The pile is considered to have socket length below 15.70 m below NGL (i.e. RL 184.93m) depth.
3. For present case of pile terminating in highly weathered rock. SPT at depths between 15.70 to 20.00 m (between RL 184.93 to 180.63 m) is > 100 with just 6.00cm penetration (average) in 50 blows. SPT can be extrapolated for 30 cm i.e. $50 * 30 / 6.00 = 250$.

Based on recommendation of fig no. 3 in B 8 in Annex B under clause 6.3.1.1 and 6.3.2 of IS 2911 P1/S2, average shear strength q_c corresponding to assumed SPT of 200 may be taken as 1300 kN/m^2

4. Allowable Capacity of pile socketed into rock $Q_a = R_e + R_{sf} = C_{u1} N_c \pi B^2 / 4 (F_s = 3) + \alpha C_{u2} \pi BL / (F_s = 6)$

4.0 Safe Load on Pile in Compression

Where,

End bearing component, $R_e = C_{u1} N_c \pi B^2 / 4 F_s$,

C_{u1} = Shear strength below base of pile = 1300 kN/m^2

B = diameter of the pile = d

F_s = Factor of Safety = 3

$N_c = 9$

Therefore, $R_e = 3061.5 d^2$

Skin friction component of socketed length of pile, $R_{sf} = \alpha C_{u2} \pi BL / F_s$

$\alpha = 0.9$ (recommended value in IS 2911 P1/S2)

L = length of the socket = $3 D$

C_{u2} = Ultimate shear strength along socket length which shall be restricted to shear capacity of concrete of the pile = 1300 kN/m^2

F_s = Factor of Safety = 6

Therefore, $R_{sf} = 1836.9 d^2$

Thus,

$$Q_a = c_{u1} N_c \cdot \frac{\pi B^2}{4 F_s} + \alpha c_{u2} \cdot \frac{\pi B L}{F_s}$$

$$= 3061.5 d^2 + 1836.9 d^2 = 4898.4 d^2$$

Substituting the values of various diameters and socket lengths equal to 3 times diameter, allowable load on single pile can be summarized as follows,

Summary of the Safe load calculation in Compression

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	19.37	19.85	20.27
Termination level RL in m	183.13	182.65	182.23
End Bearing Component in kN	1102.1	1768.3	2479.8
Friction Component in kN	661.3	1060.9	1487.9
Safe load in Compression in kN	1763.4	2829.3	3967.7
Safe load in Compression in T	176	283	397

5.0 Safe Load on Pile in uplift

Cutoff level considered at 2.00m from FGL

The overburden soils, though, will not contribute in compression capacity would offer resistance in uplift capacity. The parameters of BH 48 are considered for calculation of uplift resistance as summarized below,

Depth in m from RL 202.5 m	Cohesion in kg/cm ²	Angle of Internal Friction ϕ	Submerged density in gm/cc γ_{sub}	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
FGL to 2.00	No contribution considered – Due to cutoff						
2.00 to 11.57	1.26	5(ignored)	1.01	0.36	NA	NA	8-34
11.57 to 16.67	0.00	29	1.00	1.00	NA	29	19-24
16.67 to 17.57	0.00	34	1.00	NA	1.00	34	>100
17.57 to 26.87	Rock strata – Resistance would be as per skin friction capacity in socket as already calculated in compression capacity						

Note - & data is assumed for filling soils used for raising the FGL from EGL.

\$ Weighted average data considered. NA means not applicable.

Ultimate load in skin friction,

$$Q_{uf} = \alpha_i C_{ai} A_{si}$$

First Layer – No contribution considered – Due to cutoff

$$\text{Second Layer} - \alpha_2 C_{a2} A_{s2} = 0.36 * 12.60 * \pi d * 9.57 = 136.38 d$$

$$\text{Third Layer} - K_3 P D_3 \tan \delta_3 A_{s3} = 1.00 * 11.09 * \tan 29 * \pi d * 5.10 = 98.49 d$$

$$\text{Fourth Layer} - K_4 P D_3 \tan \delta_3 A_{s3} = 1.00 * 11.09 * \tan 34 * \pi d * 0.90 = 21.15 d$$

Fifth Layer – $1836.9 d^2$ in rock socket

$$\text{Substituting, ultimate load } q_{uf} = 2560.20 d + 1836.9 d^2$$

The safe load in uplift is worked out (considering the safety factor of 2.50 for overburden soils) and summarized below,

Safe Load on Piles in Uplift (in Ton)

Pile Diameter in, m	0.60	0.76	0.90
Socketing Length in, m (3 Times Diameter of Pile)	1.80	2.28	2.70
Termination depth of pile below the FGL (i.e. RL 202.50 m)	19.37	19.85	20.27
Termination level RL in m	183.13	182.65	182.23
Safe load in Uplift in kN	1275.73	1839.29	2409.56
Self-weight of pile in kN	73.63	121.40	174.25
Safe load in Uplift in T (Considering self-weight of pile)	134.94	196.07	258.38

6.0 Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60	0.76	0.90
Subgrade reaction in MN/m^3		3.00	3.00	3.00
Stiffness factor T in m		2.26	2.73	3.13
Depth of fixity in m	Free Head	4.30	5.20	5.90
	Fixed Head	4.90	6.00	6.80
Allowable Horizontal Force in T	Free Head	3.40	4.90	6.40
	Fixed Head	8.90	13.00	17.00
Allowable Moment capacity in Tm	Free Head	5.05	8.90	13.36
	Fixed Head	17.97	31.69	47.55

7.0 Notes

1. Pile shall be terminated after socketing 3D inside rock.
2. Initial and routine pile load test is required to verify the actual carrying capacity of pile in compression, uplift and lateral loads.
3. For design and construction, specification of IS: 2911, P1/S2, IS: 456, 2000 shall strictly be followed.

(Dr. K. K. Thaker)

Appendix – 29B

Calculation of Safe Load on Uniform Diameter Bored Cast in situ Pile. (Near BH 48) (Coal conveyor near unit-1)

The safe load is calculated as follows,

1) Design Stipulations

- | | |
|---|---|
| 1. Type of pile | - Bored cast in situ uniform diameter pile. |
| 2. Pile diameter considered | - 0.60m |
| 3. Termination depth of pile considered | - 12.00m from FGL. |
| 4. Cut off Level | - 2.00m from FGL. |
| 5. Factor of Safety | - 2.50 |
| 6. Depth of Water table | - Considered at FGL. |
| 7. Ref | - IS 2911 P-I, Sec-II, 2021. |

2) Test Data

The parameters are based on BH 48. For evaluation of safe load on piles following characterized layers are considered as described in table below,

Depth in m from RL 202.5 m	Cohesion in kg/cm ²	Angle of Internal Friction ϕ	Submerged density in gm/cc γ_{sub}	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
FGL to 2.00	No contribution considered – Due to cutoff						
2.00 to 11.57	1.26	5(ignored)	1.01	0.36	NA	NA	8-34
11.57 to 16.67	0.00	29	1.00	1.00	NA	29	19-24
16.67 to 17.57	0.00	34	1.00	NA	1.00	34	>100
17.57 to 26.87	Rock strata – Resistance would be as per skin friction capacity in socket as already calculated in compression capacity						

Notes: - Layers are characterized based on classification and the state of soil in that stratum.

* - In cohesive soils the contribution of the angle of internal friction being insignificant is ignored.

Shear parameters are the most representative for the layer. NA means not applicable. Characterized N values are considered for each layer.

- Weighted Average of the parameters falling in the same layer has been considered

\$-Parameters are correlated based on SPT value N.

3) Ultimate Load in Compression

3.1) Ultimate load in Compression by Bearing

Ultimate load on pile in end bearing,

$$q_{ub} = A_p (0.5 \cdot D \cdot \gamma \cdot N_\gamma + P D N_q)$$

A_p = Cross section area of Pile stem at toe = $\pi d^2/4$

D = Diameter of pile = d in m

$N_\gamma = 42.90$

$N_q = 40.00$

$$q_{ub} = 0.785d^2 (0.5 \cdot d \cdot 1.00 \cdot 42.90 + 9.10 \cdot 40.00) = 16.84d^3 + 285.74d^2$$

(For Pile terminating at 12.00m from F.G.L.)

Note: As the pile terminating just above rock level, we have considered parameter for end bearing component based on rock strata.

3.2) Ultimate Load in Compression by Skin Friction

Ultimate load in skin friction,

$$q_{uf} = \alpha_i C_{ai} + K_i P D_i \tan \delta_i A_{si}$$

First Layer – No contribution considered – (Within Cutoff Level).

Second Layer – $\alpha_2 C_{a2} A_{s2} = 0.36 \cdot 12.60 \cdot \pi d \cdot 9.57 = 136.38 d$

Third Layer – $K_3 P D_3 \tan \delta_3 A_{s3} = 1.00 \cdot 9.10 \cdot \tan 29^\circ \cdot \pi d \cdot (\ell - 11.57) = 15.85 d (\ell - 11.57)$

Substituting, ultimate load

$$q_{uf} = 136.38d + 15.85d (\ell - 11.57) \text{ (For Pile terminating at 12.00m from F.G.L.)}$$

Where, ℓ is the pile length and d is diameter of piles, substituting

Ultimate load by both bearing and friction can be as follows for various lengths of piles,

$$q_{uc} = q_{ub} + q_{uf}$$

$$q_{uc} = 16.84d^3 + 285.74d^2 + 136.38d + 15.85d(\ell - 11.57)$$

(For Pile terminating at 12.00m from F.G.L.).

By substituting various diameters of piles having various lengths, the safe load is worked out considering the safety factor of 2.50 and are given in table below,

Safe Load on Piles in Compression (in Ton)

Termination Depth of Pile in m, from FGL	Termination Depth of Pile in m, from cut-off	Diameter of Pile in, m
		0.60
12.00	10.00	76.57

3.3) Ultimate Load in Uplift

Considering skin friction for determination of uplift

Safe Load on Piles in Uplift (in Ton)

Termination Depth of Pile in m, from FGL	Termination Depth of Pile in m, from cut-off	Diameter of Pile in, m
		0.60
12.00	10.00	32.56

Note: Self weight of pile is considered in calculation of ultimate load in uplift.

Self-weight of Pile (in Ton)

Termination Depth of Pile in m, from FGL	Termination Depth of Pile in m, from cut-off	Diameter of Pile in, m
		0.60
12.00	10.00	4.24

3.4) Lateral Pile Capacity

Pile would be long and elastic (i.e. $L > 4T$). For a prescribed deflection of 5mm and with M 30 grade of concrete, the lateral load and moment were worked out as follows,

Diameters in m		0.60
Subgrade reaction in MN/m^3		3.00
Stiffness factor T in m		2.26
Depth of fixity in m	Free Head	4.30
	Fixed Head	4.90
Allowable Horizontal Force in T	Free Head	3.40
	Fixed Head	8.90
Allowable Moment capacity in Tm	Free Head	5.05
	Fixed Head	17.97

4) Notes:

1) Initial and Routine pile load tests shall be carried out as per IS 2911, P-4 on the piles to confirm the capacity of pile worked out theoretically. For design and construction, specifications of IS 2911, P-I, S-2, shall strictly be followed. Termination depth of pile shall be from FGL.

Dr. K. K. Thaker

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APPENDIX - 30.0 (For IBH-47 (Ash pipe line corridor))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:196.30m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 30.1) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 30.2)		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
1.00	195.30	5.70	1.50	1.50	8	15	25	8	8
1.00	195.30	5.70	2.00	2.00	8	11	18	8	8
1.00	195.30	5.70	2.50	2.50	8	9	14	8	8
1.00	195.30	5.70	3.00	3.00	8	7	12	7	8
2.00	194.30	6.70	1.50	1.50	9	16	26	9	9
2.00	194.30	6.70	2.00	2.00	9	12	19	9	9
2.00	194.30	6.70	2.50	2.50	9	9	15	9	9
2.00	194.30	6.70	3.00	3.00	8	8	12	8	8
3.00	193.30	7.70	1.50	1.50	10	16	26	10	10
3.00	193.30	7.70	2.00	2.00	10	12	19	10	10
3.00	193.30	7.70	2.50	2.50	9	10	15	9	9
3.00	193.30	7.70	3.00	3.00	9	8	13	8	9

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 196.30m.
- 3) Calculations are considering the effect of water table at FGL.

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APPENDIX - 30.1 (For IBH-47 (Ash pipe line corridor))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	1.00	5.70	195.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.15	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	8
2	2.00	2.00	1.00	5.70	195.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.11	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	8
3	2.50	2.50	1.00	5.70	195.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	8
4	3.00	3.00	1.00	5.70	195.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	8
5	1.50	1.50	2.00	6.70	194.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.29	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	9
6	2.00	2.00	2.00	6.70	194.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.22	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	9
7	2.50	2.50	2.00	6.70	194.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.18	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	9
8	3.00	3.00	2.00	6.70	194.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.15	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	8
9	1.50	1.50	3.00	7.70	193.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.44	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	10
10	2.00	2.00	3.00	7.70	193.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.33	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	10
11	2.50	2.50	3.00	7.70	193.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.26	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	9
12	3.00	3.00	3.00	7.70	193.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.22	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	9

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 196.30m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 30.2 (For IBH-47 (Ash pipe line corridor))
Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ²	T / m ²
1	1.00	195.30	5.70	1.50	1.50	0.40	145	1.12	0.80	0.0252	3.00	0.70	0.80	0.80	15	25
2	1.00	195.30	5.70	2.00	2.00	0.40	145	1.12	0.80	0.0252	4.00	0.70	0.85	0.80	11	18
3	1.00	195.30	5.70	2.50	2.50	0.40	145	1.12	0.80	0.0252	5.00	0.70	0.88	0.80	9	14
4	1.00	195.30	5.70	3.00	3.00	0.40	145	1.12	0.80	0.0252	6.00	0.70	0.91	0.80	7	12
5	2.00	194.30	6.70	1.50	1.50	0.40	145	1.12	0.80	0.0252	3.00	0.70	0.73	0.80	16	26
6	2.00	194.30	6.70	2.00	2.00	0.40	145	1.12	0.80	0.0252	4.00	0.70	0.73	0.80	12	19
7	2.00	194.30	6.70	2.50	2.50	0.40	145	1.12	0.80	0.0252	5.00	0.70	0.76	0.80	9	15
8	2.00	194.30	6.70	3.00	3.00	0.40	145	1.12	0.80	0.0252	6.00	0.70	0.80	0.80	8	12
9	3.00	193.30	7.70	1.50	1.50	0.40	145	1.12	0.80	0.0252	3.00	0.70	0.73	0.80	16	26
10	3.00	193.30	7.70	2.00	2.00	0.40	145	1.12	0.80	0.0252	4.00	0.70	0.73	0.80	12	19
11	3.00	193.30	7.70	2.50	2.50	0.40	145	1.12	0.80	0.0252	5.00	0.70	0.73	0.80	10	15
12	3.00	193.30	7.70	3.00	3.00	0.40	145	1.12	0.80	0.0252	6.00	0.70	0.73	0.80	8	13

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 30.3 (For IBH-47 (Ash pipe line corridor))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:196.30m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 30.4) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 30.5)		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
1.00	195.30	5.70	3.50	3.50	8	6	10	6	8
1.00	195.30	5.70	4.00	4.00	8	5	8	5	8
1.00	195.30	5.70	5.00	5.00	8	4	7	4	7
1.00	195.30	5.70	6.00	6.00	8	3	6	3	6
2.00	194.30	6.70	3.50	3.50	8	6	10	6	8
2.00	194.30	6.70	4.00	4.00	8	6	9	6	8
2.00	194.30	6.70	5.00	5.00	8	4	7	4	7
2.00	194.30	6.70	6.00	6.00	8	4	6	4	6
3.00	193.30	7.70	3.50	3.50	9	7	11	7	9
3.00	193.30	7.70	4.00	4.00	9	6	9	6	9
3.00	193.30	7.70	5.00	5.00	9	5	7	5	7
3.00	193.30	7.70	6.00	6.00	9	4	6	4	6

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 196.30m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 30.4 (For IBH-47 (Ash pipe line corridor))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	1.00	5.70	195.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	8
2	4.00	4.00	1.00	5.70	195.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	8
3	5.00	5.00	1.00	5.70	195.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	8
4	6.00	6.00	1.00	5.70	195.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	8
5	3.50	3.50	2.00	6.70	194.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	8
6	4.00	4.00	2.00	6.70	194.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.11	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	8
7	5.00	5.00	2.00	6.70	194.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	8
8	6.00	6.00	2.00	6.70	194.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	8
9	3.50	3.50	3.00	7.70	193.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.19	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	9
10	4.00	4.00	3.00	7.70	193.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.16	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	9
11	5.00	5.00	3.00	7.70	193.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	9
12	6.00	6.00	3.00	7.70	193.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.11	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	9

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 196.30m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 30.5 (For IBH-47 (Ash pipe line corridor))
Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ²	T / m ²
1	1.00	195.30	5.70	3.50	3.50	0.40	145	1.12	0.80	0.0252	7.00	0.70	0.92	0.80	6	10
2	1.00	195.30	5.70	4.00	4.00	0.40	145	1.12	0.80	0.0252	8.00	0.70	0.93	0.80	5	8
3	1.00	195.30	5.70	5.00	5.00	0.40	145	1.12	0.80	0.0252	10.00	0.70	0.95	0.80	4	7
4	1.00	195.30	5.70	6.00	6.00	0.40	145	1.12	0.80	0.0252	12.00	0.70	0.96	0.80	3	6
5	2.00	194.30	6.70	3.50	3.50	0.40	145	1.12	0.80	0.0252	7.00	0.70	0.83	0.80	6	10
6	2.00	194.30	6.70	4.00	4.00	0.40	145	1.12	0.80	0.0252	8.00	0.70	0.85	0.80	6	9
7	2.00	194.30	6.70	5.00	5.00	0.40	145	1.12	0.80	0.0252	10.00	0.70	0.88	0.80	4	7
8	2.00	194.30	6.70	6.00	6.00	0.40	145	1.12	0.80	0.0252	12.00	0.70	0.91	0.80	4	6
9	3.00	193.30	7.70	3.50	3.50	0.40	145	1.12	0.80	0.0252	7.00	0.70	0.75	0.80	7	11
10	3.00	193.30	7.70	4.00	4.00	0.40	145	1.12	0.80	0.0252	8.00	0.70	0.77	0.80	6	9
11	3.00	193.30	7.70	5.00	5.00	0.40	145	1.12	0.80	0.0252	10.00	0.70	0.82	0.80	5	7
12	3.00	193.30	7.70	6.00	6.00	0.40	145	1.12	0.80	0.0252	12.00	0.70	0.85	0.80	4	6

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 30.6 (For IBH-47 (Ash pipe line corridor))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:196.30m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 30.7) (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 30.8)		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)	For 25 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
1.00	195.30	5.70	7.00	7.00	8	3	5	3	5
1.00	195.30	5.70	8.00	8.00	8	3	4	3	4
1.00	195.30	5.70	9.00	9.00	8	2	4	2	4
1.00	195.30	5.70	10.00	10.00	8	2	3	2	3
2.00	194.30	6.70	7.00	7.00	8	3	5	3	5
2.00	194.30	6.70	8.00	8.00	8	3	4	3	4
2.00	194.30	6.70	9.00	9.00	8	2	4	2	4
2.00	194.30	6.70	10.00	10.00	8	2	3	2	3
3.00	193.30	7.70	7.00	7.00	9	3	5	3	5
3.00	193.30	7.70	8.00	8.00	9	3	4	3	4
3.00	193.30	7.70	9.00	9.00	9	2	4	2	4
3.00	193.30	7.70	10.00	10.00	9	2	4	2	4

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 196.30m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 30.7 (For IBH-47 (Ash pipe line corridor))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	1.00	5.70	195.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	8
2	8.00	8.00	1.00	5.70	195.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.03	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	8
3	9.00	9.00	1.00	5.70	195.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.02	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	8
4	10.00	10.00	1.00	5.70	195.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.02	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	8
5	7.00	7.00	2.00	6.70	194.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.06	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	8
6	8.00	8.00	2.00	6.70	194.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	8
7	9.00	9.00	2.00	6.70	194.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.05	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	8
8	10.00	10.00	2.00	6.70	194.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.04	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	8
9	7.00	7.00	3.00	7.70	193.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	9
10	8.00	8.00	3.00	7.70	193.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.08	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	9
11	9.00	9.00	3.00	7.70	193.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	9
12	10.00	10.00	3.00	7.70	193.30	0.29	8	6.60	0.62	0.49	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.69	0.85	0.50	0.50	9

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 196.30m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 30.8 (For IBH-47 (Ash pipe line corridor))
Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ²	T / m ²
1	1.00	195.30	5.70	7.00	7.00	0.40	145	1.12	0.80	0.0252	14.00	0.70	0.97	0.80	3	5
2	1.00	195.30	5.70	8.00	8.00	0.40	145	1.12	0.80	0.0252	14.50	0.70	0.97	0.80	3	4
3	1.00	195.30	5.70	9.00	9.00	0.40	145	1.12	0.80	0.0252	14.50	0.70	0.97	0.80	2	4
4	1.00	195.30	5.70	10.00	10.00	0.40	145	1.12	0.80	0.0252	14.50	0.70	0.98	0.80	2	3
5	2.00	194.30	6.70	7.00	7.00	0.40	145	1.12	0.80	0.0252	13.50	0.70	0.92	0.80	3	5
6	2.00	194.30	6.70	8.00	8.00	0.40	145	1.12	0.80	0.0252	13.50	0.70	0.93	0.80	3	4
7	2.00	194.30	6.70	9.00	9.00	0.40	145	1.12	0.80	0.0252	13.50	0.70	0.94	0.80	2	4
8	2.00	194.30	6.70	10.00	10.00	0.40	145	1.12	0.80	0.0252	13.50	0.70	0.95	0.80	2	3
9	3.00	193.30	7.70	7.00	7.00	0.40	145	1.12	0.80	0.0252	12.50	0.70	0.87	0.80	3	5
10	3.00	193.30	7.70	8.00	8.00	0.40	145	1.12	0.80	0.0252	12.50	0.70	0.89	0.80	3	4
11	3.00	193.30	7.70	9.00	9.00	0.40	145	1.12	0.80	0.0252	12.50	0.70	0.91	0.80	2	4
12	3.00	193.30	7.70	10.00	10.00	0.40	145	1.12	0.80	0.0252	12.50	0.70	0.92	0.80	2	4

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 30.9 (For IBH-47 (Ash pipe line corridor))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:196.30m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 30.10)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 30.11)		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
4.00	192.30	8.70	1.50	1.50	14	24	38	14	14
4.00	192.30	8.70	2.00	2.00	13	18	28	13	13
4.00	192.30	8.70	2.50	2.50	13	14	23	13	13
4.00	192.30	8.70	3.00	3.00	12	12	19	12	12
5.00	191.30	9.70	1.50	1.50	16	24	38	16	16
5.00	191.30	9.70	2.00	2.00	14	18	28	14	14
5.00	191.30	9.70	2.50	2.50	14	14	23	14	14
5.00	191.30	9.70	3.00	3.00	13	12	19	12	13
6.00	190.30	10.70	1.50	1.50	17	24	38	17	17
6.00	190.30	10.70	2.00	2.00	16	18	28	16	16
6.00	190.30	10.70	2.50	2.50	14	14	23	14	14
6.00	190.30	10.70	3.00	3.00	14	12	19	12	14

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 196.30m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 30.10 (For IBH-47 (Ash pipe line corridor))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	1.50	1.50	4.00	8.70	192.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.58	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	14
2	2.00	2.00	4.00	8.70	192.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.43	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	13
3	2.50	2.50	4.00	8.70	192.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.35	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	13
4	3.00	3.00	4.00	8.70	192.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.29	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	12
5	1.50	1.50	5.00	9.70	191.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.72	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	16
6	2.00	2.00	5.00	9.70	191.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.54	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	14
7	2.50	2.50	5.00	9.70	191.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.43	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	14
8	3.00	3.00	5.00	9.70	191.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.36	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	13
9	1.50	1.50	6.00	10.70	190.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.87	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	17
10	2.00	2.00	6.00	10.70	190.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.65	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	16
11	2.50	2.50	6.00	10.70	190.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.52	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	14
12	3.00	3.00	6.00	10.70	190.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.43	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	14

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 196.30m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 30.11 (For IBH-47 (Ash pipe line corridor))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ²	T / m ²
1	4.00	192.30	8.70	1.50	1.50	0.40	190	1.12	0.80	0.0151	3.00	0.70	0.73	0.80	24	38
2	4.00	192.30	8.70	2.00	2.00	0.40	190	1.12	0.80	0.0151	4.00	0.70	0.73	0.80	18	28
3	4.00	192.30	8.70	2.50	2.50	0.40	190	1.12	0.80	0.0151	5.00	0.70	0.73	0.80	14	23
4	4.00	192.30	8.70	3.00	3.00	0.40	190	1.12	0.80	0.0151	6.00	0.70	0.73	0.80	12	19
5	5.00	191.30	9.70	1.50	1.50	0.40	190	1.12	0.80	0.0151	3.00	0.70	0.73	0.80	24	38
6	5.00	191.30	9.70	2.00	2.00	0.40	190	1.12	0.80	0.0151	4.00	0.70	0.73	0.80	18	28
7	5.00	191.30	9.70	2.50	2.50	0.40	190	1.12	0.80	0.0151	5.00	0.70	0.73	0.80	14	23
8	5.00	191.30	9.70	3.00	3.00	0.40	190	1.12	0.80	0.0151	6.00	0.70	0.73	0.80	12	19
9	6.00	190.30	10.70	1.50	1.50	0.40	190	1.12	0.80	0.0151	3.00	0.70	0.71	0.80	24	38
10	6.00	190.30	10.70	2.00	2.00	0.40	190	1.12	0.80	0.0151	4.00	0.70	0.73	0.80	18	28
11	6.00	190.30	10.70	2.50	2.50	0.40	190	1.12	0.80	0.0151	5.00	0.70	0.73	0.80	14	23
12	6.00	190.30	10.70	3.00	3.00	0.40	190	1.12	0.80	0.0151	6.00	0.70	0.73	0.80	12	19

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 30.12 (For IBH-47 (Ash pipe line corridor))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:196.30m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 30.13)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 30.14)		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
4.00	192.30	8.70	3.50	3.50	12	10	16	10	12
4.00	192.30	8.70	4.00	4.00	12	9	14	9	12
4.00	192.30	8.70	5.00	5.00	11	7	11	7	11
4.00	192.30	8.70	6.00	6.00	11	6	9	6	9
5.00	191.30	9.70	3.50	3.50	13	10	16	10	13
5.00	191.30	9.70	4.00	4.00	12	9	14	9	12
5.00	191.30	9.70	5.00	5.00	12	7	11	7	11
5.00	191.30	9.70	6.00	6.00	12	6	9	6	9
6.00	190.30	10.70	3.50	3.50	13	10	16	10	13
6.00	190.30	10.70	4.00	4.00	13	9	14	9	13
6.00	190.30	10.70	5.00	5.00	12	7	11	7	11
6.00	190.30	10.70	6.00	6.00	12	6	10	6	10

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 196.30m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 30.13 (For IBH-47 (Ash pipe line corridor))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	3.50	3.50	4.00	8.70	192.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.25	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	12
2	4.00	4.00	4.00	8.70	192.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.22	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	12
3	5.00	5.00	4.00	8.70	192.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.17	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	11
4	6.00	6.00	4.00	8.70	192.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.14	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	11
5	3.50	3.50	5.00	9.70	191.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.31	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	13
6	4.00	4.00	5.00	9.70	191.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.27	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	12
7	5.00	5.00	5.00	9.70	191.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.22	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	12
8	6.00	6.00	5.00	9.70	191.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.18	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	12
9	3.50	3.50	6.00	10.70	190.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.37	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	13
10	4.00	4.00	6.00	10.70	190.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.33	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	13
11	5.00	5.00	6.00	10.70	190.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.26	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	12
12	6.00	6.00	6.00	10.70	190.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.22	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	12

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 196.30m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 30.14 (For IBH-47 (Ash pipe line corridor))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ²	T / m ²
1	4.00	192.30	8.70	3.50	3.50	0.40	190	1.12	0.80	0.0151	7.00	0.70	0.73	0.80	10	16
2	4.00	192.30	8.70	4.00	4.00	0.40	190	1.12	0.80	0.0151	8.00	0.70	0.73	0.80	9	14
3	4.00	192.30	8.70	5.00	5.00	0.40	190	1.12	0.80	0.0151	10.00	0.70	0.76	0.80	7	11
4	4.00	192.30	8.70	6.00	6.00	0.40	190	1.12	0.80	0.0151	11.50	0.70	0.80	0.80	6	9
5	5.00	191.30	9.70	3.50	3.50	0.40	190	1.12	0.80	0.0151	7.00	0.70	0.73	0.80	10	16
6	5.00	191.30	9.70	4.00	4.00	0.40	190	1.12	0.80	0.0151	8.00	0.70	0.73	0.80	9	14
7	5.00	191.30	9.70	5.00	5.00	0.40	190	1.12	0.80	0.0151	10.00	0.70	0.73	0.80	7	11
8	5.00	191.30	9.70	6.00	6.00	0.40	190	1.12	0.80	0.0151	10.50	0.70	0.75	0.80	6	9
9	6.00	190.30	10.70	3.50	3.50	0.40	190	1.12	0.80	0.0151	7.00	0.70	0.73	0.80	10	16
10	6.00	190.30	10.70	4.00	4.00	0.40	190	1.12	0.80	0.0151	8.00	0.70	0.73	0.80	9	14
11	6.00	190.30	10.70	5.00	5.00	0.40	190	1.12	0.80	0.0151	9.50	0.70	0.73	0.80	7	11
12	6.00	190.30	10.70	6.00	6.00	0.40	190	1.12	0.80	0.0151	9.50	0.70	0.73	0.80	6	10

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 30.15 (For IBH-47 (Ash pipe line corridor))

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Depth of Foundation (From NGL:196.30m)	RL of Foundation	Depth of foundation from FGL	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria (See Appendix 30.16)	Safe Bearing Pressures calculated based on Settlement Criteria (See Appendix 30.17)		Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)	
						For 25 mm Settlement	For 40 mm Settlement	For 25 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)	(t / m ²)
4.00	192.30	8.70	7.00	7.00	11	5	8	5	8
4.00	192.30	8.70	8.00	8.00	11	4	7	4	7
4.00	192.30	8.70	9.00	9.00	11	4	6	4	6
4.00	192.30	8.70	10.00	10.00	11	3	5	3	5
5.00	191.30	9.70	7.00	7.00	11	5	8	5	8
5.00	191.30	9.70	8.00	8.00	11	4	7	4	7
5.00	191.30	9.70	9.00	9.00	11	4	6	4	6
5.00	191.30	9.70	10.00	10.00	11	3	6	3	6
6.00	190.30	10.70	7.00	7.00	12	5	8	5	8
6.00	190.30	10.70	8.00	8.00	12	4	7	4	7
6.00	190.30	10.70	9.00	9.00	12	4	6	4	6
6.00	190.30	10.70	10.00	10.00	12	4	6	4	6

Notes :

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 196.30m.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 30.16 (For IBH-47 (Ash pipe line corridor))

Calculation of Net Safe Bearing Capacity Based on Shear Parameters C - ϕ

$$q_u = 1 / FS [2 / 3 C N_c d_c S_c i_c + \gamma d (N_q - 1) S_q d_q i_q W_q + 0.5 \gamma B N_\gamma S_\gamma d_\gamma i_\gamma W_\gamma]$$

Project : Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha**For Square Isolated Foundation**

Sr. No.	Size of Foundation		Depth of Foundation m	Depth of Foundation from FGL	RL of Foundation m	Shear Parameter		Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors			Unit Weight		Water Table Correction		Safe Bearing Capacity t / m ²
	Length	Width				C	ϕ													γ	0.5γ			
	m	m				Kg/cm ²	degree													gm/cc		W _q	W _{γ}	
1	7.00	7.00	4.00	8.70	192.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	11
2	8.00	8.00	4.00	8.70	192.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.11	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	11
3	9.00	9.00	4.00	8.70	192.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.10	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	11
4	10.00	10.00	4.00	8.70	192.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.09	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	11
5	7.00	7.00	5.00	9.70	191.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.16	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	11
6	8.00	8.00	5.00	9.70	191.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.14	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	11
7	9.00	9.00	5.00	9.70	191.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.12	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	11
8	10.00	10.00	5.00	9.70	191.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.11	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	11
9	7.00	7.00	6.00	10.70	190.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.19	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	12
10	8.00	8.00	6.00	10.70	190.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.16	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	12
11	9.00	9.00	6.00	10.70	190.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.14	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	12
12	10.00	10.00	6.00	10.70	190.30	0.38	7	6.39	0.52	0.41	1.30	1.20	0.80	1.13	1.00	1.00	1.00	1.00	1.00	1.93	0.97	0.50	0.50	12

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the RL 196.30m.
- 3) Calculations are considering the effect of water table at FGL.

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APPENDIX - 30.17 (For IBH-47 (Ash pipe line corridor))

Calculation of Safe Bearing Pressure for Settlement of 25 and 40 mm

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

Sr. No.	Foundation Details					Immediate Settlement				Consolidation Settlement					Safe Bearing Pressure	
	Depth D	RL of Foundation	Depth of foundation from FGL	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 25 mm Settlement	For 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ²	T / m ²
1	4.00	192.30	8.70	7.00	7.00	0.40	190	1.12	0.80	0.0151	11.50	0.70	0.83	0.80	5	8
2	4.00	192.30	8.70	8.00	8.00	0.40	190	1.12	0.80	0.0151	11.50	0.70	0.85	0.80	4	7
3	4.00	192.30	8.70	9.00	9.00	0.40	190	1.12	0.80	0.0151	11.50	0.70	0.87	0.80	4	6
4	4.00	192.30	8.70	10.00	10.00	0.40	190	1.12	0.80	0.0151	11.50	0.70	0.88	0.80	3	5
5	5.00	191.30	9.70	7.00	7.00	0.40	190	1.12	0.80	0.0151	10.50	0.70	0.78	0.80	5	8
6	5.00	191.30	9.70	8.00	8.00	0.40	190	1.12	0.80	0.0151	10.50	0.70	0.81	0.80	4	7
7	5.00	191.30	9.70	9.00	9.00	0.40	190	1.12	0.80	0.0151	10.50	0.70	0.83	0.80	4	6
8	5.00	191.30	9.70	10.00	10.00	0.40	190	1.12	0.80	0.0151	10.50	0.70	0.85	0.80	3	6
9	6.00	190.30	10.70	7.00	7.00	0.40	190	1.12	0.80	0.0151	9.50	0.70	0.75	0.80	5	8
10	6.00	190.30	10.70	8.00	8.00	0.40	190	1.12	0.80	0.0151	9.50	0.70	0.77	0.80	4	7
11	6.00	190.30	10.70	9.00	9.00	0.40	190	1.12	0.80	0.0151	9.50	0.70	0.80	0.80	4	6
12	6.00	190.30	10.70	10.00	10.00	0.40	190	1.12	0.80	0.0151	9.50	0.70	0.82	0.80	4	6

RESULTS OF CHEMICAL ANALYSIS OF WATER

Sr. No.	Borehole no.	Result			
		pH	Total Dissolved Solids	Sulphate (SO ₃) (mg/l)	Chloride (mg/l)
			Inorganic		
1	IBH-4	7.76	325	163	175
2	IBH-21	7.43	452	266	201
3	IBH-52	7.87	501	211	225

RESULTS OF CHEMICAL ANALYSIS OF SOIL

Sr. No.	Borehole no.	Depth (m)	Result		
			pH	Sulphate (SO ₃) (%)	Chloride (mg/l)
1	IBH-4	2.50	7.87	0.18	155
2	IBH-21	5.50	7.56	0.15	195
3	IBH-52	3.00	7.37	0.17	179

Reference - 1

Soil Mechanics And Foundation Engineering by Dr.K.R.Arora
(For Mixed shear failure reference)

SOIL MECHANICS AND FOUNDATION ENGINEERING

600

and

$$N_c = 57.8, N_q = 41.4 \text{ and } N_\gamma = 42.4$$

$$N'_c = 25.2, N'_q = 12.6 \text{ and } N'_\gamma = 10.1$$

Difference $(N_c)_d = 32.6, (N_q)_d = 28.8 \text{ and } (N_\gamma)_d = 32.3$.

As the actual value of ϕ' is 35° which is 6° more than the value of ϕ' corresponding to local shear failure (viz. 29°), the proportional difference to be added to the values of N'_c, N'_q and N'_γ is $6/7$ times the total difference. Thus, the required values are

$$N_c = 25.2 + 6/7 \times 32.6 = 53.14$$

$$N_q = 12.6 + 6/7 \times 28.8 = 37.29$$

$$N_\gamma = 10.1 + 6/7 \times 32.3 = 37.79$$

(2) If the failure of the specimen of the soil occurs at a relatively small strain, say less than 5%, the failure of the footing would be by general shear failure. If the stress-strain curve does not show a peak and is a continuously rising curve even upto a strain of 10 to 20%, local shear failure would occur in the footing.

(3) If the relative density (D_r) is greater than about 70%, general shear failure would occur. If it is less than 35%, local shear failure is more likely.

(4) If the standard penetration test (SPT) value is more than 30, the general shear failure would occur. However, if it is less than 5, the local shear failure is more likely.

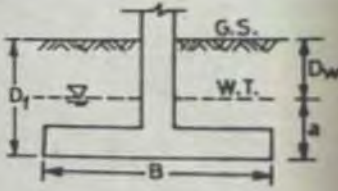
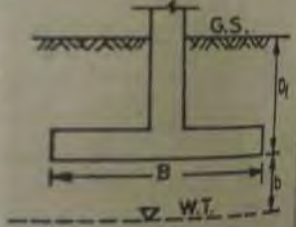
(5) If e is less than 0.55, the general shear failure occurs. If e is greater than 0.75, the local shear failure occurs.

23.10. EFFECT OF WATER TABLE ON BEARING CAPACITY

Eq. 23.25 for the ultimate bearing capacity has been developed based on the assumption that the water table is located at a great depth. If the water table is located close to the foundation, the bearing capacity equation needs modification, as explained below.

Case I Water table located above the base of footing [Fig. 23.11 (a)]

The effective surcharge is reduced as the effective weight below the water table is equal to the submerged unit weight. Therefore,

(a) (b)

Fig. 23.11.

$$q = D_w \gamma + a \gamma' \quad \dots(23.29)$$

where D_w = depth of water table below the ground surface,
 a = height of water table above the base of footing.

Alternatively, Eq. 23.30 can be written as, substituting $a = D_f - D_w$,

$$q = \gamma' D_f + (\gamma - \gamma') D_w \quad \dots(23.30)$$

Moreover, the unit weight in the third term of Eq. 23.25 is equal to the submerged unit weight. Thus Eq. 23.25 becomes

$$q_u = c' N_c + [\gamma' D_f + (\gamma - \gamma') D_w] N_q + 0.5 \gamma' B N_\gamma \quad \dots(23.31)$$

If $D_w = 0$ (i.e. $a = D_f$),

$$q_u = c' N_c + \gamma' D_f N_q + 0.5 \gamma' B N_\gamma \quad \dots(23.32)$$

If $a = 0$ (i.e. $D_f = D_w$),

$$q_u = c' N_c + \gamma D_f N_q + 0.5 \gamma' B N_\gamma \quad \dots(23.33)$$

Reference - 2

Soil Mechanics And Foundation Engineering by V.N.S. Murthy (For Modulus of Elasticity reference)

676

Chapter 16

tests in 900 mm diameter bored holes in London clay. Marsland found that the average moduli determined from the loading tests were between 1.8 to 4.8 times those obtained from undrained triaxial tests. A suggestion to obtain the more realistic value for E_v is,

1. Undisturbed samples obtained from the field must be reconsolidated under a stress system equal to that in the field (K_0 -condition).
2. Samples must be reconsolidated isotropically to a stress equal to $1/2$ to $2/3$ of the *in-situ* vertical stress.

It may be noted here that reconsolidation of disturbed sensitive clays would lead to significant change in the water content and hence a stiffer structure which would lead to a very high E_v .

Because of the many difficulties faced in selecting a modulus value from the results of laboratory tests, it has been suggested that a correlation between the modulus of elasticity of soil and the undrained shear strength may provide a basis for settlement calculation. The modulus E_v may be expressed as

$$E_v = Ac_u \quad (18.51)$$

where the value of A for inorganic stiff clay varies from about 500 to 1500 (Bjerrum, 1972) and c_u is the undrained cohesion. It may generally be assumed that highly plastic clays give lower values for A , and low plasticity give higher values for A . For organic or soft clays the value of A may vary from 100 to 500. The undrained cohesion c_u can be obtained from any one of the field tests mentioned below and also discussed in Chapter 17.

Field methods

Field methods are increasingly used to determine the soil strength parameters. They have been found to be more reliable than the ones obtained from laboratory tests. The field tests that are normally used for this purpose are

1. Plate load tests (PLT)
2. Standard penetration test (SPT)
3. Static cone penetration test (CPT)
4. Pressuremeter test (PMT)
5. Flat dilatometer test (DMT)

TABLE 18.7

Equations for computing E_v by making use of SPT and CPT values (in kPa)

Soil	SPT	CPT
Sand (normally consolidated)	$500 (N_{60} + 15)$ $(35000 \text{ to } 50000) \log N_{60}$ (U.S.S.R. Practice)	$2 (\sigma' + q_c)$ $(1 + D^2) q_c$
Sand (saturated)	$250 (N_{60} + 15)$	
Sand (overconsolidated)	—	$6 \text{ to } 30 q_c$
Gravelly sand and gravel	$1200 (N_{60} + 6)$	
Clayey sand	$320 (N_{60} + 15)$	$3 \text{ to } 6 q_c$
Silty sand	$300 (N_{60} + 6)$	$1 \text{ to } 2 q_c$
Soft clay	—	$3 \text{ to } 8 q_c$

Reference - 3

Soil Mechanics And Foundation Engineering by V.N.S. Murthy
(For Poisson's Ratio reference)

678

Chapter 18

corresponding value of E_s has to be determined. Table 18.8 gives typical values for μ as suggested by Bowles (1996).

I_f is a function of the L/B ratio of the foundation, and the thickness H of the compressible layer. Terzaghi has given a method of calculating I_f from curves derived by Steinbrenner (1934),

for Poisson's ratio of 0.5, $I_f = F_1$,

for Poisson's ratio of zero, $I_f = F_1 + F_2$,

where F_1 and F_2 are factors which depend upon the ratios of H/B and L/B .

For intermediate values of μ , the value of I_f can be computed by means of interpolation or by the equation

$$I_f = \left[F_1 + \frac{(1-\mu-2\mu^2)F_2}{1-\mu^2} \right] \quad (18.52b)$$

The values of F_1 and F_2 are given in Fig. 18.19a. The elastic settlement at any point N (Fig. 18.19b) is given by

$$S_e \text{ at point } N = \frac{q_n(1-\mu^2)}{E_s} [I_{f1}B_1 + I_{f2}B_2 + I_{f3}B_3 + I_{f4}B_4] \quad (18.52c)$$

To obtain the settlement at the center of the loaded area, the principle of superposition is followed. In such a case N in Fig. 18.19b will be at the center of the area when $B_1 = B_4 = L_2 = B_3$ and $B_2 = L_1$. Then the settlement at the centre is equal to four times the settlement at any one corner. The curves in Fig. 18.19a are based on the assumption that the modulus of deformation is constant with depth.

In the case of a rigid foundation, the immediate settlement at the center is approximately 0.8 times that obtained for a flexible foundation at the center. A correction factor is applied to the immediate settlement to allow for the depth of foundation by means of the depth factor d_f . Fig. 18.20

gives Fox's (1948) correction curve for depth factor. The final elastic settlement is

$$S_{ef} = C_e d_f S_e \quad (18.53)$$

where, S_{ef} = final elastic settlement

TABLE 18.8

Typical range of values for Poisson's ratio (Bowles, 1996)

Type of soil	μ
Clay, saturated	0.4-0.5
Clay, unsaturated	0.1-0.3
Sandy clay	0.2-0.3
Silt	0.3-0.35
Sand (dense)	0.2-0.4
Coarse (void ratio = 0.4 to 0.7)	0.15
Fine grained (void ratio = 0.4 to 0.7)	0.25
Rock	0.1-0.4

Reference - 4

(For Modulus of Volume Compressibility, Angle of Internal friction and Cohesion reference)

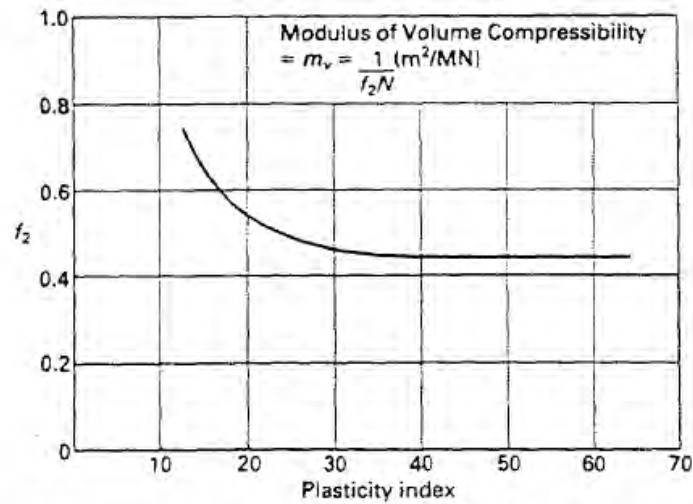


Figure 8. Relationship between Mass Shear Strength, Modulus of Volume Compressibility, Plasticity Index, and SPT-N values (after Stroud, 1975)

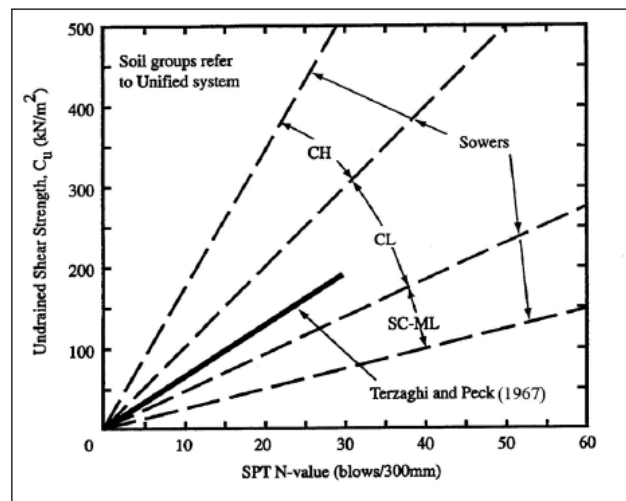


Figure 9. Approximate Correlation between Undrained Shear Strength and SPT-N values (After Sowers, 1979)

Hatanaka and Uchida (1996); $\phi' = \sqrt{20N} + 20^\circ$

$$\phi' = \sqrt{12N_{45}} + 20^\circ$$

A lower bound for the above equation is given as;

$$\phi' = \sqrt{12N_{45}} + 15^\circ$$

Reference - 5

TABLE 6
PRESUMPTIVE SAFE BEARING CAPACITY OF SOIL

Sr. No	Types of Rocks/Soils	Safe bearing capacity KN/m ² /t/ m ²	Remarks
(1)	(2)	(3)	(4)
	(a) Rocks		
1.	Rocks (hard) without lamination and defects, for example , granite, trap and diorite	3,240 (330.39)	..
2.	Laminated rocks, for example, stone and lime stone in sound condition	1,620 (165.19)	..
3.	Residual deposits of shattered and broken bed rock and hard shale cemented material	880 (89.73)	..
4.	Soft Rock	440 (44.87)	..
	(b) Non-cohesive soils:		..
5.	Gravel, sand and gravel, compact and offering high resistance to penetration when excavated by tools	440 (44.87)	(See Note 2)
6.	Coarse sand, compact and dry	440 (44.87)	Dry means that the ground water level is at a depth not less than the width of foundation below the base of the foundation
7.	Medium sand, compact and dry	245 (24.98)	..
8.	Fine sand, silt (dry lumps easily pulverized by the fingers).	150 (15.30)	..
9.	Loose gravel or sand gravel mixture loose coarse to medium sand, dry	245 (24.98)	(See Note 2)
10	Fine sand, loose and dry.	100 (10.20)	
	(c) Cohesive soils:		
11.	Soft shale, hard or stiff clay in deep bed, dry	440 (44.87)	This group is susceptible to long term consolidation settlement
12.	Medium clay, readily indented with a thumb nail	245 (24.98)	..
13	Moist clay and sand clay mixture which can be indented with strong thumb pressure	150 (15.30)	..
14	Soft clay indented with moderate thumb pressure	100 (10.20)	..
15.	Very soft clay which can be penetrated several centimeters with the thumb	50 (5.10)	..
16.	Black cotton soil or other shrinkable or expansive clay in dry condition (50 percent saturation)	..	See Note 3. To be determined after investigation
	(d) Peat:		
17.	Peat	..	See Note 3 and Note 4. To be determined after investigation
	(e) Made-up Ground:		
18.	Fills or made-up ground	..	See Note 2 and Note 4. To be determined after investigation

Note: 1- Value listed in the Table are from shear consideration only

Note:2- Values are very much rough due to the following reasons:

- (a) Effect of characteristics of foundations (that is, effect of depth, width, shape, roughness, etc.) has not been considered.
- (b) Effect of range of soil properties (that is, angle of frictional resistance, cohesion, water table, density, etc) has not been considered.
- (c) Effect of eccentricity and indication of loads has not been considered.

Note:3 – For non-cohesive soils, the values listed in the Table shall be reduced by 50% if the water table is above or near the base of footing

Note 4: Compactness of non-cohesive soils may be determined by driving the cone of 65 mm dia and 60 apex angle by a hammer of 65 kg falling from 75 cm. If corrected number of blows (N) for 30 cm penetration are less than 10, the soil is called loose, if N lies between 10 and 30, it is medium, if more than 30, the soils is called as dense.

NOTATIONS

C	Cohesion
ϕ	Angle of internal friction of soil
DS	Disturbed Sample
UDS	Undisturbed Sample
NMC	Natural Moisture Content
NP	Non Plastic Soils
G	Specific Gravity
G	Gravel Content
M	Silt Content
S	Sand Content
C	Clay Content
LL	Liquid Limit
PL	Plastic Limit
PI	Plasticity Index
Cc	Compression Index
K	Coefficient of Permeability
UCS	Unconfined Compression
N	SPT Value
BH	Bore Hole
Suffix	The Number of Bore Holes
Nc, Nq, N γ	Bearing Capacity Factor
Sc, Sq, S γ	Shape Factors
γ	Density of Soil
D	Depth of foundation
FS	Factor of Safety
mv	Coefficient of volume compressibility
UU	Unconsolidated undrained triaxial test
CU	Consolidated undrained triaxial test
CD	Consolidated drained triaxial test
GC	Clayey Gravels
GM	Silty Gravels
GP	Poorly Graded Gravels
GW	Well Graded Gravels
SC	Clayey Sand
SM	Silty Sand
SW	Well Graded Sand
SP	Poorly Graded Sand
CH	Clays of High Plasticity
CI	Clays of Intermediate Plasticity
CL	Clays of Low Plasticity
MH	Silts of High Plasticity
MI	Silts of Intermediate Plasticity
ML	Silts of Low Plasticity

Reference

Indian Standards

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IS 1498,

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RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 1

Co-Ordinate :- E - 1338, N - 3767

Reduced Level :- 202.33m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility m _v cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	38	50	12	33	16	17	-	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	24	47	29	40	21	19	-	-	-	-	SC	-	-	-	-	-	-	-	-	9	-	-	-
3	2.00	SPT	-	-	-	-	0	76	24	43	23	20	-	-	-	-	SC	-	-	-	-	-	-	-	-	14	-	-	-
4	2.50	UDS	1.76	1.57	12.34	2.66	1	70	29	44	21	23	-	-	-	-	SC	0.07	25	-	-	DSU	-	-	-	-	-	0.70	41.1
5	3.00	SPT	-	-	-	-	2	81	17	37	23	14	-	-	-	-	SC	-	-	-	-	-	-	-	-	24	-	-	-
6	3.50	UDS	2.00	1.60	24.81	2.66	2	76	22	39	21	18	-	-	-	-	SC	0.05	28	-	-	DSU	-	-	-	-	-	0.66	39.8
7	4.00	SPT	-	-	-	-	0	64	36	44	20	24	-	-	-	-	SC	-	-	-	-	-	-	-	-	39	-	-	-
8	4.50	Remoulded	2.10	1.76	19.41	2.67	1	90	9	NP	NP	NP	-	-	-	-	SP-SM	0.00	32	-	-	DSU	-	-	-	-	-	0.52	34.1
9	5.00	SPT	-	-	-	-	2	81	17	29	16	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
10	5.50	SPT	-	-	-	-	10	68	22	33	18	15	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
11	6.00	SPT	-	-	-	-	2	81	17	28	18	10	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
12	6.50	SPT	-	-	-	-	2	70	28	34	20	14	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
13	7.00	SPT	-	-	-	-	20	64	16	26	16	10	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
14	7.50	SPT	-	-	-	-	4	77	19	28	15	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
15	8.00	SPT	-	-	-	-	4	65	31	36	21	15	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
16	8.50	SPT	-	-	-	-	4	71	25	35	22	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
17	9.00	SPT	-	-	-	-	2	66	32	29	17	12	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
18	9.50	SPT	-	-	-	-	14	73	13	26	16	10	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
19	10.00	SPT	-	-	-	-	4	72	24	33	17	16	-	-	-	-	SC	-	-	-	-	-	-	-	-	70	-	-	-
20	11.00	SPT	-	-	-	-	0	74	26	30	19	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
21	11.50	SPT	-	-	-	-	0	75	25	26	17	9	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
22	12.50	SPT	-	-	-	-	0	74	26	27	15	12	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
23	13.00	SPT	-	-	-	-	0	79	21	25	16	9	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
24	14.00	SPT	-	-	-	-	2	70	28	29	18	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
25	14.50	SPT	-	-	-	-	4	67	29	30	16	14	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
26	15.50	SPT	-	-	-	-	0	62	38	32	15	17	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
27	16.00	SPT	-	-	-	-	0	81	19	26	16	10	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
28	17.00	UDS	2.39	2.21	8.26	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	106.5	UCS	-	-	-	-	-	0.22	18.2
29	17.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
30	18.50	UDS	2.43	2.26	7.46	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	151.8	-	UCS	-	-	-	-	6.66	0.20	16.9
31	18.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
32	20.00	UDS	2.68	2.62	2.35	2.79	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	364.2	UCS	-	-	-	-	-	0.07	6.1
33	20.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
34	21.50	UDS	2.71	2.67	1.47	2.78	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	360.8	UCS	-	-	-	-	-	0.04	3.9
35	21.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 2

Co-Ordinate :- E - 1646, N - 3767

Reduced Level :- 207.74m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility m _v cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	20	26	26	28	46	21	25	-	-	-	CI	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	27	58	15		27	16	11	-	-	-	SC	-	-	-	-	-	-	-	-	20	-	-	-
3	2.00	SPT	-	-	-	-	3	72	25		29	15	14	-	-	-	SC	-	-	-	-	-	-	-	-	16	-	-	-
4	2.50	UDS	1.73	1.57	10.34	2.67	3	83	14		26	17	9	-	-	-	SC	0.04	26	-	-	DSU	-	-	-	-	-	0.70	41.3
5	3.00	SPT	-	-	-	-	0	82	18		25	18	7	-	-	-	SM-SC	-	-	-	-	-	-	-	-	21	-	-	-
6	3.50	UDS	1.75	1.63	7.39	2.68	0	83	17		23	17	6	-	-	-	SM-SC	0.01	28	-	-	DSU	-	-	-	-	-	0.64	39.2
7	4.00	SPT	-	-	-	-	32	53	15		21	15	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	19	-	-	-
8	4.50	UDS	1.78	1.62	9.75	2.66	4	71	25		26	19	7	-	-	-	SM-SC	0.04	28	-	-	DSU	-	-	-	-	-	0.64	39.0
9	5.00	SPT	-	-	-	-	14	72	14		23	17	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	69	-	-	-
10	5.50	UDS	2.00	1.85	8.02	2.67	5	82	13		22	16	6	-	-	-	SM-SC	0.02	30	-	-	DSU	-	-	-	-	-	0.44	30.7
11	6.00	SPT	-	-	-	-	2	69	29		24	17	7	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
12	6.50	SPT	-	-	-	-	8	67	25		20	16	4	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
13	7.00	SPT	-	-	-	-	4	72	24		19	15	4	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
14	7.50	SPT	-	-	-	-	10	85	5		NP	NP	NP	-	-	-	SP	-	-	-	-	-	-	-	-	>100	-	-	-
15	8.00	SPT	-	-	-	-	0	83	17		29	16	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
16	8.50	SPT	-	-	-	-	0	85	15		27	15	12	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
17	9.00	SPT	-	-	-	-	0	69	31		28	15	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
18	9.50	SPT	-	-	-	-	0	84	16		26	16	10	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
19	10.00	SPT	-	-	-	-	0	87	13		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
20	11.00	SPT	-	-	-	-	0	88	12		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
21	11.50	SPT	-	-	-	-	0	86	14		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
22	12.50	SPT	-	-	-	-	0	88	12		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
23	13.00	SPT	-	-	-	-	0	85	15		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
24	14.00	SPT	-	-	-	-	0	69	31		29	25	4	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
25	14.50	SPT	-	-	-	-	3	75	22		25	21	4	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
26	15.50	SPT	-	-	-	-	0	87	13		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
27	16.00	SPT	-	-	-	-	0	86	14		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
28	17.00	SPT	-	-	-	-	0	84	16		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
29	17.50	SPT	-	-	-	-	0	88	12		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
30	18.50	SPT	-	-	-	-	0	87	13		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
31	19.00	SPT	-	-	-	-	0	77	23		24	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
32	20.00	SPT	-	-	-	-	0	79	21		23	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
33	20.50	SPT	-	-	-	-	0	84	16		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
34	21.50	SPT	-	-	-	-	0	76	24		24	20	4	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
35	22.00	UDS	2.29	2.05	11.53	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	86.3	UCS	-	-	-	-	-	0.31	23.7
36	23.50	UDS	2.51	2.38	5.34	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	191.6	-	UCS	-	-	-	-	6.66	0.15	12.7
37	25.00	UDS	2.56	2.46	4.21	2.74	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	243.5	-	UCS	-	-	-	-	14.22	0.12	10.3

UDS - Undisturbed Sample
DS - Disturbed Sample
SPT - Standard Penetration Tests

Page No 518 of 639
NP - Non Plastic
UCS - Unconfined Compression Strength

TUU - Triaxial Unconsolidated Undrained
TCU - Triaxial Consolidated Undrained
DSU - Direct Shear Test

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 03

Co-Ordinate :- E - 1342, N 3622

Reduced Level :- 204.39 m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %	
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²						
1	0.00	DS	-	-	-	-	0	67	33	28	16	12	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	60	40	33	15	18	-	-	-	SC	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
3	2.00	SPT	-	-	-	-	0	70	30	27	17	10	-	-	-	SC	-	-	-	-	-	-	-	-	-	35	-	-	-	-
4	2.50	UDS	1.76	1.60	10.16	2.65	19	61	20	34	18	16	-	-	-	SC	0.08	27	-	-	DSU	-	-	-	-	-	-	-	0.66	39.7
5	3.00	SPT	-	-	-	-	0	68	32	29	19	10	-	-	-	SC	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
6	3.50	UDS	1.92	1.76	9.30	2.66	8	72	20	21	17	4	-	-	-	SM	0.00	31	-	-	DSU	-	-	-	-	-	-	-	0.51	34.0
7	4.00	SPT	-	-	-	-	4	81	15	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
8	4.50	UDS	2.01	1.62	24.19	2.66	6	80	14	20	16	4	-	-	-	SM	0.00	30	-	-	DSU	-	-	-	-	-	-	-	0.64	39.2
9	5.00	SPT	-	-	-	-	5	83	12	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	-	52	-	-	-	-
10	5.50	UDS	2.00	1.60	25.09	2.67	5	81	14	NP	NP	NP	-	-	-	SM	0.00	30	-	-	DSU	-	-	-	-	-	-	-	0.67	40.1
11	6.00	SPT	-	-	-	-	5	78	17	18	14	4	-	-	-	SM	-	-	-	-	-	-	-	-	-	84	-	-	-	-
12	6.50	DS	-	-	-	-	0	91	9	NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	7.00	SPT	-	-	-	-	3	89	8	NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
14	7.50	DS	-	-	-	-	4	90	6	NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	8.00	SPT	-	-	-	-	0	66	34	30	17	13	-	-	-	SC	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
16	8.50	SPT	-	-	-	-	0	63	37	33	16	17	-	-	-	SC	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
17	9.00	SPT	-	-	-	-	0	68	32	29	18	11	-	-	-	SC	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
18	9.50	SPT	-	-	-	-	0	64	36	32	17	15	-	-	-	SC	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
19	10.00	SPT	-	-	-	-	3	90	7	NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
20	11.00	SPT	-	-	-	-	6	88	6	NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
21	11.50	SPT	-	-	-	-	0	89	11	NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
22	12.50	SPT	-	-	-	-	0	92	8	NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
23	13.00	SPT	-	-	-	-	4	90	6	NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
24	14.00	SPT	-	-	-	-	6	87	7	NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
25	14.50	SPT	-	-	-	-	5	86	9	NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
26	15.50	SPT	-	-	-	-	3	89	8	NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
27	16.00	SPT	-	-	-	-	0	64	36	29	22	7	-	-	-	SM-SC	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
28	17.00	SPT	-	-	-	-	0	70	30	25	19	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
29	17.50	SPT	-	-	-	-	0	66	34	28	21	7	-	-	-	SM-SC	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
30	18.50	SPT	-	-	-	-	0	62	38	31	24	7	-	-	-	SM-SC	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
31	19.00	SPT	-	-	-	-	0	68	32	29	23	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
32	20.00	SPT	-	-	-	-	0	82	18	19	15	4	-	-	-	SM	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
33	20.50	SPT	-	-	-	-	0	79	21	23	19	4	-	-	-	SM	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
34	21.50	SPT	-	-	-	-	0	86	14	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
35	22.50	SPT	-	-	-	-	0	88	12	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
36	23.00	SPT	-	-	-	-	0	87	13	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
37	23.50	SPT	-	-	-	-	0	85	15	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
38	24.50	SPT	-	-	-	-	0	82	18	19	15	4	-	-	-	SM	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
39	25.00	SPT	-	-	-	-	0	88	12	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	-	>100	-	-	-	-

KCT Consultancy Services LLP, Ahmedabad

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 4

Co-Ordinate :- E 1634, N 3623

Reduced Level :- 210.12m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	5	30	37	28	44	19	25	-	-	-	CI	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	4	34	39	23	41	20	21	-	-	-	CI	-	-	-	-	-	-	-	-	13	-	-	-
3	2.00	SPT	-	-	-	-	8	61	31		28	16	12	-	-	-	SC	-	-	-	-	-	-	-	-	15	-	-	-
4	2.50	UDS	1.78	1.55	14.63	2.65	6	59	35		31	15	16	-	-	-	SC	0.05	25	-	-	DSU	-	-	-	-	-	0.71	41.4
5	3.00	SPT	-	-	-	-	9	68	23		27	17	10	-	-	-	SC	-	-	-	-	-	-	-	-	71	-	-	-
6	3.50	UDS	1.86	1.60	16.09	2.66	3	61	36		30	15	15	-	-	-	SC	0.08	28	-	-	DSU	-	-	-	-	-	0.66	39.8
7	4.00	SPT	-	-	-	-	15	67	18		19	15	4	-	-	-	SM	-	-	-	-	-	-	-	-	17	-	-	-
8	4.50	SPT	-	-	-	-	9	64	27		25	21	4	-	-	-	SM	-	-	-	-	-	-	-	-	54	-	-	-
9	5.00	SPT	-	-	-	-	23	62	15		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	91	-	-	-
10	5.50	SPT	-	-	-	-	21	59	20		19	15	4	-	-	-	SM	-	-	-	-	-	-	-	-	82	-	-	-
11	6.00	SPT	-	-	-	-	18	57	25		23	18	5	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
12	6.50	UDS	2.10	1.76	19.41	2.67	0	77	23		21	17	4	-	-	-	SM	0.00	31	-	-	DSU	-	-	-	-	-	0.52	34.1
13	7.00	SPT	-	-	-	-	0	79	21		20	16	4	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
14	7.50	SPT	-	-	-	-	0	66	34		25	19	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
15	8.00	SPT	-	-	-	-	0	62	38		28	21	7	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
16	8.50	SPT	-	-	-	-	0	69	31		23	17	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
17	9.00	SPT	-	-	-	-	3	58	39		28	18	10	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
18	9.50	SPT	-	-	-	-	1	52	47		31	17	14	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
19	10.00	SPT	-	-	-	-	3	63	34		26	19	7	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
20	11.00	SPT	-	-	-	-	0	66	34		25	18	7	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
21	11.50	SPT	-	-	-	-	4	67	29		23	17	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
22	12.50	SPT	-	-	-	-	7	65	28		22	16	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
23	13.00	SPT	-	-	-	-	13	71	16		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
24	14.00	SPT	-	-	-	-	17	70	13		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
25	14.50	SPT	-	-	-	-	59	21	20		22	16	6	-	-	-	GM-GC	-	-	-	-	-	-	-	-	>100	-	-	-
26	15.50	SPT	-	-	-	-	18	28	33	21	43	24	19	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-
27	16.00	SPT	-	-	-	-	0	89	11		NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	-	>100	-	-	-
28	17.00	SPT	-	-	-	-	8	57	35		31	16	15	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
29	17.50	SPT	-	-	-	-	10	58	32		29	17	12	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
30	19.00	UDS	2.34	2.13	9.71	2.69	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	84.6	UCS	-	-	-	-	-	0.26	20.7
31	19.00	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
32	20.50	UDS	2.43	2.26	7.46	2.72	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	72.0	UCS	-	-	-	-	-	0.20	16.9
33	20.50	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
34	22.00	UDS	2.38	2.19	8.59	2.70	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	98.3	UCS	-	-	-	-	-	0.23	18.8
35	22.00	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
36	23.50	UDS	2.31	2.08	11.03	2.70	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	81.7	UCS	-	-	-	-	-	0.30	22.9
37	23.50	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
38	25.00	UDS	2.36	2.15	9.97	2.73	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	91.6	UCS	-	-	-	-	-	0.27	21.4
39	25.00	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 06

Co-Ordinate :- E - 1504, N - 3672

Reduced Level :- 207.25 m

Sr No	Depth of Sample	Type of Sample	Field Bulk Density	Field Dry Density	Natural Moisture Content	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit	Swelling Pressure	Free Swell Index	Soil Classification	Shear Parameter		Unconfined Compression Test	UCS by Point Load Index in rock	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation	Void Ratio	Porosity
							Gravel	Sand	Silt	Clay	Liquid Limit	Plastic Limit	Plasticity Index					Cohesion C	Angle of Internal Friction ϕ				Compression Index C _c	Coefficient of Volume Compressibility m _v	Pre-consolidation Pressure				
1	0.00	DS	-	-	-	-	0	66	34	29	16	13	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	32	46	22	24	15	9	-	-	-	SC	-	-	-	-	-	-	-	-	12	-	-	-	-
3	2.00	SPT	-	-	-	-	0	55	45	33	17	16	-	-	-	SC	-	-	-	-	-	-	-	-	19	-	-	-	-
4	2.50	UDS	1.98	1.57	26.37	2.67	22	54	24	27	15	12	-	-	-	SC	0.08	29	-	-	DSU	-	-	-	-	-	-	0.70	41.3
5	3.00	SPT	-	-	-	-	4	76	20	26	16	10	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-	-
6	3.50	SPT	-	-	-	-	13	71	16	24	18	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
7	4.00	SPT	-	-	-	-	8	70	22	28	21	7	-	-	-	SM-SC	-	-	-	-	-	-	-	-	67	-	-	-	-
8	4.50	SPT	-	-	-	-	10	75	15	23	17	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	70	-	-	-	-
9	5.00	SPT	-	-	-	-	6	80	14	22	16	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	78	-	-	-	-
10	5.50	SPT	-	-	-	-	0	78	22	29	15	14	-	-	-	SC	-	-	-	-	-	-	-	-	86	-	-	-	-
11	6.00	SPT	-	-	-	-	8	61	31	34	17	17	-	-	-	SC	-	-	-	-	-	-	-	-	61	-	-	-	-
12	6.50	SPT	-	-	-	-	0	80	20	24	15	9	-	-	-	SC	-	-	-	-	-	-	-	-	49	-	-	-	-
13	7.00	SPT	-	-	-	-	0	70	30	32	14	18	-	-	-	SC	-	-	-	-	-	-	-	-	53	-	-	-	-
14	7.50	SPT	-	-	-	-	5	71	24	26	16	10	-	-	-	SC	-	-	-	-	-	-	-	-	85	-	-	-	-
15	8.00	SPT	-	-	-	-	0	77	23	23	14	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
16	8.50	SPT	-	-	-	-	0	86	14	21	13	8	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
17	9.00	SPT	-	-	-	-	0	84	16	23	14	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
18	9.50	SPT	-	-	-	-	0	84	16	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
19	10.00	SPT	-	-	-	-	6	82	12	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
20	11.00	SPT	-	-	-	-	2	80	18	23	17	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
21	11.50	SPT	-	-	-	-	8	78	14	26	16	10	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
22	12.50	SPT	-	-	-	-	0	75	25	28	15	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
23	13.00	SPT	-	-	-	-	4	76	20	26	17	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
24	14.00	SPT	-	-	-	-	7	75	18	24	16	8	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
25	14.50	SPT	-	-	-	-	0	84	16	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
26	15.50	SPT	-	-	-	-	0	87	13	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
27	16.00	SPT	-	-	-	-	0	64	36	25	20	5	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
28	17.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-
29	17.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-
30	18.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-
31	20.00	UDS	2.65	2.62	1.12	2.70	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	316.8	UCS	-	-	-	-	-	-	0.03	2.9
32	20.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-
33	21.50	UDS	2.71	2.66	1.88	2.80	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	374.6	UCS	-	-	-	-	-	-	0.05	5.0
34	21.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-
35	23.00	DS	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	-	-	-	-	-
36	23.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-
37	25.00	UDS	2.70	2.66	1.69	2.78	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	389.6	UCS	-	-	-	-	-	-	0.05	4.5
38	25.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-

KCT Consultancy Services LLP, Ahmedabad

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 07

Co-Ordinate :- E - 1469, N - 3607

Reduced Level :- 206.70 m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %	
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²						
1	0.00	DS	-	-	-	-	0	56	44	30	16	14	-	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	37	42	21	24	15	9	-	-	-	-	SC	-	-	-	-	-	-	-	42	-	-	-	-	-
3	2.00	SPT	-	-	-	-	31	51	18	23	14	9	-	-	-	-	SC	-	-	-	-	-	-	-	26	-	-	-	-	-
4	2.50	UDS	1.77	1.62	9.34	2.68	30	49	21	29	16	13	-	-	-	-	SC	0.05	31	-	-	DSU	-	-	-	-	-	0.66	39.6	-
5	3.00	SPT	-	-	-	-	12	64	24	30	15	15	-	-	-	-	SC	-	-	-	-	-	-	-	31	-	-	-	-	-
6	3.50	UDS	1.74	1.61	7.78	2.68	25	52	23	26	17	9	-	-	-	-	SC	0.08	30	-	-	DSU	-	-	-	-	-	0.66	39.8	-
7	4.00	SPT	-	-	-	-	21	63	16	23	15	8	-	-	-	-	SC	-	-	-	-	-	-	-	27	-	-	-	-	-
8	4.50	UDS	1.72	1.59	8.12	2.67	22	59	19	24	14	10	-	-	-	-	SC	0.03	30	-	-	DSU	-	-	-	-	-	0.68	40.4	-
9	5.00	SPT	-	-	-	-	4	73	23	27	15	12	-	-	-	-	SC	-	-	-	-	-	-	-	18	-	-	-	-	-
10	5.50	SPT	-	-	-	-	10	72	18	24	16	8	-	-	-	-	SC	-	-	-	-	-	-	-	28	-	-	-	-	-
11	6.00	SPT	-	-	-	-	5	82	13	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	29	-	-	-	-	-
12	6.50	SPT	-	-	-	-	27	65	8	NP	NP	NP	-	-	-	-	SP-SM	-	-	-	-	-	-	-	>100	-	-	-	-	-
13	7.00	SPT	-	-	-	-	21	72	7	NP	NP	NP	-	-	-	-	SP-SM	-	-	-	-	-	-	-	>100	-	-	-	-	-
14	7.50	SPT	-	-	-	-	2	73	25	27	16	11	-	-	-	-	SC	-	-	-	-	-	-	-	>100	-	-	-	-	-
15	8.00	SPT	-	-	-	-	10	68	22	24	15	9	-	-	-	-	SC	-	-	-	-	-	-	-	>100	-	-	-	-	-
16	8.50	SPT	-	-	-	-	6	78	16	23	13	10	-	-	-	-	SC	-	-	-	-	-	-	-	>100	-	-	-	-	-
17	9.00	SPT	-	-	-	-	3	73	24	28	16	12	-	-	-	-	SC	-	-	-	-	-	-	-	>100	-	-	-	-	-
18	9.50	SPT	-	-	-	-	29	58	13	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	>100	-	-	-	-	-
19	10.00	SPT	-	-	-	-	0	84	16	17	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	>100	-	-	-	-	-
20	11.00	SPT	-	-	-	-	2	85	13	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	>100	-	-	-	-	-
21	11.50	SPT	-	-	-	-	0	84	16	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	>100	-	-	-	-	-
22	12.50	SPT	-	-	-	-	0	88	12	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	>100	-	-	-	-	-
23	13.00	SPT	-	-	-	-	2	85	13	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	>100	-	-	-	-	-
24	14.00	SPT	-	-	-	-	3	71	26	28	16	12	-	-	-	-	SC	-	-	-	-	-	-	-	>100	-	-	-	-	-
25	14.50	SPT	-	-	-	-	0	79	21	24	15	9	-	-	-	-	SC	-	-	-	-	-	-	-	>100	-	-	-	-	-
26	15.50	SPT	-	-	-	-	0	74	26	27	17	10	-	-	-	-	SC	-	-	-	-	-	-	-	>100	-	-	-	-	-
27	16.00	SPT	-	-	-	-	4	83	13	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	>100	-	-	-	-	-
28	17.00	SPT	-	-	-	-	4	81	15	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	>100	-	-	-	-	-
29	17.50	SPT	-	-	-	-	0	80	20	24	18	6	-	-	-	-	SM-SC	-	-	-	-	-	-	-	>100	-	-	-	-	-
30	18.50	SPT	-	-	-	-	0	68	32	28	21	7	-	-	-	-	SM-SC	-	-	-	-	-	-	-	>100	-	-	-	-	-
31	19.00	SPT	-	-	-	-	0	86	14	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	>100	-	-	-	-	-
32	20.00	SPT	-	-	-	-	14	74	12	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	>100	-	-	-	-	-
33	20.50	SPT	-	-	-	-	0	85	15	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	>100	-	-	-	-	-
34	21.50	UDS	2.42	2.26	7.30	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	46.3	UCS	-	-	-	-	-	0.20	16.5	-
35	21.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	>100	-	-	-	-	-

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 08

Co-Ordinate :- E - 1402, N - 3826

Reduced Level :- 200.65m

Sr No	Depth of Sample	Type of Sample	Field Bulk Density	Field Dry Density	Natural Moisture Content	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit	Swelling Pressure	Free Swell Index	Soil Classification	Shear Parameter		Unconfined Compression Test	UCS by Point Load Index in rock	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation	Void Ratio	Porosity
							Gravel	Sand	Silt	Clay	Liquid Limit	Plastic Limit	Plasticity Index					Cohesion C	Angle of Internal Friction ϕ				Compression Index C _c	Coefficient of Volume Compressibility m _v	Pre-consolidation Pressure				
1	0.00	DS	-	-	-	-	2	65	33	27	14	13	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	4	70	26	24	13	11	-	-	-	SC	-	-	-	-	-	-	-	4	-	-	-	-	-
3	2.00	SPT	-	-	-	-	0	81	19	23	19	4	-	-	-	SM	-	-	-	-	-	-	-	30	-	-	-	-	-
4	2.50	UDS	2.04	1.66	22.69	2.67	6	80	14	26	22	4	-	-	-	SM	0.00	29	-	-	DSU	-	-	-	-	-	0.61	37.7	-
5	3.00	SPT	-	-	-	-	0	75	25	32	20	12	-	-	-	SC	-	-	-	-	-	-	-	>100	-	-	-	-	-
6	3.50	SPT	-	-	-	-	0	82	18	29	19	10	-	-	-	SC	-	-	-	-	-	-	-	>100	-	-	-	-	-
7	4.00	SPT	-	-	-	-	26	52	22	32	20	12	-	-	-	SC	-	-	-	-	-	-	-	>100	-	-	-	-	-
8	4.50	SPT	-	-	-	-	0	76	24	36	18	18	-	-	-	SC	-	-	-	-	-	-	-	>100	-	-	-	-	-
9	5.00	SPT	-	-	-	-	5	82	13	27	19	8	-	-	-	SC	-	-	-	-	-	-	-	41	-	-	-	-	-
10	5.50	SPT	-	-	-	-	0	85	15	31	23	8	-	-	-	SC	-	-	-	-	-	-	-	63	-	-	-	-	-
11	6.00	SPT	-	-	-	-	0	71	29	37	19	18	-	-	-	SC	-	-	-	-	-	-	-	>100	-	-	-	-	-
12	6.50	SPT	-	-	-	-	4	66	30	39	18	21	-	-	-	SC	-	-	-	-	-	-	-	40	-	-	-	-	-
13	7.00	SPT	-	-	-	-	0	68	32	40	21	19	-	-	-	SC	-	-	-	-	-	-	-	73	-	-	-	-	-
14	7.50	SPT	-	-	-	-	0	70	30	37	20	17	-	-	-	SC	-	-	-	-	-	-	-	42	-	-	-	-	-
15	8.00	SPT	-	-	-	-	0	63	37	38	18	20	-	-	-	SC	-	-	-	-	-	-	-	56	-	-	-	-	-
16	8.50	SPT	-	-	-	-	0	84	16	28	24	4	-	-	-	SM	-	-	-	-	-	-	-	>100	-	-	-	-	-
17	9.00	SPT	-	-	-	-	0	69	31	30	25	5	-	-	-	SM	-	-	-	-	-	-	-	>100	-	-	-	-	-
18	9.50	SPT	-	-	-	-	0	86	14	26	22	4	-	-	-	SM	-	-	-	-	-	-	-	>100	-	-	-	-	-
19	10.00	SPT	-	-	-	-	0	78	22	27	23	4	-	-	-	SM	-	-	-	-	-	-	-	>100	-	-	-	-	-
20	11.00	UDS	2.29	2.06	11.28	2.68	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	38.6	UCS	-	-	-	-	-	-	0.30	23.2
21	11.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	>100	-	-	-	-	-
22	12.50	UDS	2.28	2.05	11.41	2.67	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	53.4	-	UCS	-	-	-	-	6.66	0.30	23.4	-
23	12.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	>100	-	-	-	-	-
24	14.00	UDS	2.31	2.09	10.54	2.68	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	49.7	UCS	-	-	-	-	-	0.28	22.0	-
25	14.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	>100	-	-	-	-	-
26	15.50	UDS	2.29	2.05	11.77	2.70	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	61.3	UCS	-	-	-	-	-	0.32	24.1	-
27	17.00	UDS	2.36	2.16	9.50	2.71	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	156.1	UCS	-	-	-	-	-	0.26	20.5	-
28	18.50	UDS	2.68	2.59	3.55	2.85	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	392.2	UCS	-	-	-	-	-	0.10	9.2	-
29	20.00	UDS	2.71	2.63	3.07	2.86	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	408.4	UCS	-	-	-	-	-	0.09	8.1	-
30	21.50	UDS	2.66	2.56	3.82	2.84	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	387.9	-	UCS	-	-	-	-	6.66	0.11	9.8	-
31	21.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	>100	-	-	-	-	-
32	23.00	UDS	2.43	2.26	7.46	2.72	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	191.4	-	UCS	-	-	-	-	10.66	0.20	16.9	-
33	25.00	UDS	2.21	1.93	14.49	2.68	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	48.3	UCS	-	-	-	-	-	0.39	28.0	-

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 09

Co-Ordinate :- E - 1594, N - 3825

Reduced Level :- 206.15m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility m _v cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	0	65	35	27	20	7	-	-	-	-	SM-SC	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	12	61	27	32	16	16	-	-	-	-	SC	-	-	-	-	-	-	-	-	16	-	-	-
3	2.00	SPT	-	-	-	-	8	64	28	30	17	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	18	-	-	-
4	2.50	UDS	1.88	1.59	18.30	2.65	0	60	40	36	19	17	-	-	-	-	SC	0.11	26	-	-	DSU	-	-	-	-	-	0.67	40.0
5	3.00	SPT	-	-	-	-	0	76	24	38	17	21	-	-	-	-	SC	-	-	-	-	-	-	-	-	56	-	-	-
6	3.50	UDS	2.06	1.71	20.46	2.66	0	70	30	39	16	23	-	-	-	-	SC	0.08	29	-	-	DSU	-	-	-	-	-	0.56	35.7
7	4.00	SPT	-	-	-	-	0	75	25	31	18	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	60	-	-	-
8	4.50	SPT	-	-	-	-	10	68	22	29	17	12	-	-	-	-	SC	-	-	-	-	-	-	-	-	68	-	-	-
9	5.00	SPT	-	-	-	-	2	75	23	23	17	6	-	-	-	-	SM-SC	-	-	-	-	-	-	-	-	64	-	-	-
10	5.50	SPT	-	-	-	-	0	73	27	25	19	6	-	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
11	6.00	SPT	-	-	-	-	7	73	20	27	16	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
12	6.50	SPT	-	-	-	-	0	76	24	29	15	14	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
13	7.00	SPT	-	-	-	-	0	70	30	30	17	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
14	7.50	SPT	-	-	-	-	0	80	20	26	18	8	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
15	8.00	SPT	-	-	-	-	0	84	16	25	16	9	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
16	8.50	SPT	-	-	-	-	0	82	18	27	15	12	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
17	9.00	SPT	-	-	-	-	0	78	22	29	16	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
18	9.50	SPT	-	-	-	-	10	75	15	26	17	9	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
19	10.00	SPT	-	-	-	-	14	70	16	29	18	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
20	11.00	SPT	-	-	-	-	3	72	25	30	16	14	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
21	11.50	SPT	-	-	-	-	0	73	27	32	15	17	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
22	12.50	SPT	-	-	-	-	0	82	18	28	17	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
23	13.00	SPT	-	-	-	-	0	72	28	29	16	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
24	14.00	SPT	-	-	-	-	20	56	24	24	15	9	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
25	14.50	SPT	-	-	-	-	9	63	28	30	16	14	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
26	15.50	SPT	-	-	-	-	0	83	17	26	17	9	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
27	17.00	UDS	2.24	1.98	12.99	2.67	59	20	21	25	14	11	-	-	-	-	GC	0.04	32	-	-	DSU	-	-	-	-	-	0.35	25.7
28	18.50	UDS	2.46	2.30	7.00	2.74	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	164.3	UCS	-	-	-	-	-	0.19	16.1
29	20.00	UDS	2.28	2.04	11.91	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	72.8	UCS	-	-	-	-	-	0.32	24.3
30	21.50	UDS	2.42	2.24	8.00	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	158.3	-	UCS	-	-	-	-	20.66	0.22	17.9
31	23.00	UDS	2.53	2.42	4.57	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	136.4	-	UCS	-	-	-	-	16.66	0.12	11.0
32	25.00	UDS	2.58	2.48	4.13	2.76	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	176.8	-	UCS	-	-	-	-	35.00	0.11	10.2

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 10

Co-Ordinate :- E - 1811, N - 3767

Reduced Level :- 210.40m

Sr No	Depth of Sample	Type of Sample	Field Bulk Density	Field Dry Density	Natural Moisture Content	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit	Swelling Pressure	Free Swell Index	Soil Classification	Shear Parameter		Unconfined Compression Test	UCS by Point Load Index in rock	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation	Void Ratio	Porosity	
							Gravel	Sand	Silt	Clay	Liquid Limit	Plastic Limit	Plasticity Index					Cohesion C	Angle of Internal Friction ϕ				Compression Index C _c	Coefficient of Volume Compressibility m _v	Pre-consolidation Pressure					
																														%
1	0.00	DS	-	-	-	-	0	65	35	31	16	15	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	
2	1.00	SPT	-	-	-	-	0	69	31	28	18	10	-	-	-	SC	-	-	-	-	-	-	-	-	15	-	-	-	-	
3	2.00	SPT	-	-	-	-	0	71	29	27	16	11	-	-	-	SC	-	-	-	-	-	-	-	-	42	-	-	-	-	
4	2.50	UDS	1.72	1.64	5.16	2.67	0	82	18	NP	NP	NP	-	-	-	SM	0.00	30	-	-	DSU	-	-	-	-	-	0.63	38.7	-	
5	3.00	SPT	-	-	-	-	0	80	20	21	17	4	-	-	-	SM	-	-	-	-	-	-	-	-	32	-	-	-	-	
6	3.50	UDS	1.70	1.61	5.87	2.66	0	78	22	23	18	5	-	-	-	SM	0.00	29	-	-	DSU	-	-	-	-	-	0.66	39.6	-	
7	4.00	SPT	-	-	-	-	0	65	35	29	16	13	-	-	-	SC	-	-	-	-	-	-	-	-	38	-	-	-	-	
8	4.50	UDS	1.79	1.59	12.46	2.65	0	31	52	17	30	15	15	-	-	-	CL	0.76	6	-	-	TUU	0.12	0.0085	0.76	-	-	0.66	39.9	-
9	5.00	SPT	-	-	-	-	0	36	51	13	28	17	11	-	-	-	CL	-	-	-	-	-	-	-	29	-	-	-	-	
10	5.50	UDS	1.83	1.61	13.59	2.66	0	64	36	29	16	13	-	-	-	SC	0.09	27	-	-	DSU	-	-	-	-	-	0.65	39.4	-	
11	6.00	SPT	-	-	-	-	0	68	32	26	17	9	-	-	-	SC	-	-	-	-	-	-	-	-	61	-	-	-	-	
12	6.50	UDS	2.06	1.69	21.55	2.67	0	71	29	25	17	8	-	-	-	SC	0.06	28	-	-	DSU	-	-	-	-	-	0.58	36.5	-	
13	7.00	SPT	-	-	-	-	0	76	24	23	15	8	-	-	-	SC	-	-	-	-	-	-	-	-	42	-	-	-	-	
14	7.50	UDS	2.04	1.67	22.41	2.66	0	64	36	30	17	13	-	-	-	SC	0.08	27	-	-	DSU	-	-	-	-	-	0.60	37.3	-	
15	8.00	SPT	-	-	-	-	0	68	32	29	18	11	-	-	-	SC	-	-	-	-	-	-	-	-	41	-	-	-	-	
16	8.50	UDS	2.08	1.73	19.92	2.65	0	59	41	31	16	15	-	-	-	SC	0.09	26	-	-	DSU	-	-	-	-	-	0.53	34.5	-	
17	9.00	SPT	-	-	-	-	0	63	37	28	18	10	-	-	-	SC	-	-	-	-	-	-	-	-	69	-	-	-	-	
18	9.50	SPT	-	-	-	-	0	68	32	26	16	10	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-	
19	10.00	SPT	-	-	-	-	5	73	22	24	17	7	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-	-	
20	11.00	SPT	-	-	-	-	11	70	19	22	16	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-	-	
21	11.50	SPT	-	-	-	-	8	72	20	23	17	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-	-	
22	12.50	SPT	-	-	-	-	3	58	39	29	15	14	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-	
23	13.00	SPT	-	-	-	-	9	51	40	31	18	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-	
24	14.00	SPT	-	-	-	-	12	54	34	28	16	12	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-	
25	14.50	SPT	-	-	-	-	6	65	29	26	15	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-	
26	15.50	SPT	-	-	-	-	0	30	57	13	29	17	12	-	-	-	CL	-	-	-	-	-	-	-	>100	-	-	-	-	
27	16.00	SPT	-	-	-	-	0	33	58	9	27	19	8	-	-	-	CL	-	-	-	-	-	-	-	>100	-	-	-	-	
28	17.00	SPT	-	-	-	-	0	29	54	17	31	16	15	-	-	-	CL	-	-	-	-	-	-	-	>100	-	-	-	-	
29	17.50	SPT	-	-	-	-	0	62	38	29	18	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-	
30	18.50	SPT	-	-	-	-	0	68	32	26	15	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-	
31	19.00	SPT	-	-	-	-	0	69	31	25	16	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-	
32	20.00	SPT	-	-	-	-	0	64	36	28	15	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-	
33	20.50	SPT	-	-	-	-	0	74	26	24	18	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-	-	
34	21.50	SPT	-	-	-	-	0	34	51	15	29	16	13	-	-	-	CL	-	-	-	-	-	-	-	>100	-	-	-	-	
35	22.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	>100	-	-	-	-	
36	23.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	>100	-	-	-	-	
37	23.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	>100	-	-	-	-	
38	25.00	UDS	2.53	2.43	4.12	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	146.3	-	UCS	-	-	-	-	8.66	0.11	10.0	-

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 11

Co-Ordinate :- E - 1811, N - 3767

Reduced Level :- 209.85m

Sr No	Depth of Sample	Type of Sample	Field Bulk Density	Field Dry Density	Natural Moisture Content	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit	Swelling Pressure	Free Swell Index	Soil Classification	Shear Parameter		Unconfined Compression Test	UCS by Point Load Index in rock	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation	Void Ratio	Porosity
							Gravel	Sand	Silt	Clay	Liquid Limit	Plastic Limit	Plasticity Index					Cohesion C	Angle of Internal Friction ϕ				Compression Index C _c	Coefficient of Volume Compressibility m _v	Pre-consolidation Pressure				
1	0.00	DS	-	-	-	-	0	63	37	33	16	17	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	69	31	29	18	11	-	-	-	SC	-	-	-	-	-	-	-	-	13	-	-	-	-
3	2.00	SPT	-	-	-	-	0	73	27	26	16	10	-	-	-	SC	-	-	-	-	-	-	-	-	23	-	-	-	-
4	2.50	UDS	1.77	1.57	12.43	2.65	0	60	40	35	18	17	-	-	-	SC	0.10	25	-	-	DSU	-	-	-	-	-	-	0.68	40.6
5	3.00	SPT	-	-	-	-	0	68	32	28	17	11	-	-	-	SC	-	-	-	-	-	-	-	-	23	-	-	-	-
6	3.50	UDS	1.84	1.61	14.50	2.65	0	61	39	32	19	13	-	-	-	SC	0.08	29	-	-	DSU	-	-	-	-	-	-	0.65	39.4
7	4.00	SPT	-	-	-	-	0	73	27	26	15	11	-	-	-	SC	-	-	-	-	-	-	-	-	40	-	-	-	-
8	4.50	UDS	1.99	1.75	13.69	2.66	0	70	30	29	16	13	-	-	-	SC	0.06	28	-	-	DSU	-	-	-	-	-	-	0.52	34.2
9	5.00	SPT	-	-	-	-	0	82	18	17	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
10	5.50	SPT	-	-	-	-	0	81	19	20	16	4	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
11	6.00	SPT	-	-	-	-	0	86	14	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
12	6.50	SPT	-	-	-	-	0	85	15	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
13	7.00	SPT	-	-	-	-	0	88	12	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
14	7.50	SPT	-	-	-	-	0	79	21	20	16	4	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
15	8.00	SPT	-	-	-	-	0	59	41	34	16	18	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
16	8.50	SPT	-	-	-	-	0	68	32	28	15	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
17	9.00	SPT	-	-	-	-	0	58	42	35	20	15	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
18	9.50	SPT	-	-	-	-	0	69	31	27	16	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
19	10.00	SPT	-	-	-	-	0	82	18	19	15	4	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
20	11.00	SPT	-	-	-	-	0	83	17	16	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
21	11.50	SPT	-	-	-	-	0	79	21	23	19	4	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
22	12.50	SPT	-	-	-	-	0	68	32	28	21	7	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
23	13.00	SPT	-	-	-	-	0	69	31	27	21	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
24	14.00	SPT	-	-	-	-	0	73	27	25	19	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
25	14.50	SPT	-	-	-	-	0	61	39	29	16	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
26	15.50	SPT	-	-	-	-	0	58	42	33	18	15	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
27	16.00	SPT	-	-	-	-	0	63	37	32	19	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
28	17.00	SPT	-	-	-	-	0	70	30	29	16	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
29	17.50	SPT	-	-	-	-	0	68	32	31	15	16	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
30	18.50	SPT	-	-	-	-	0	87	13	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
31	19.00	SPT	-	-	-	-	0	88	12	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
32	20.00	SPT	-	-	-	-	0	82	18	20	16	4	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
33	21.50	SPT	-	-	-	-	5	63	32	29	18	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
34	23.00	UDS	2.34	2.13	9.95	2.70	-	-	-	-	-	-	-	-	-	Boulderous	-	-	-	94.3	UCS	-	-	-	-	-	-	0.27	21.2
35	24.50	UDS	2.25	1.99	13.09	2.69	-	-	-	-	-	-	-	-	-	Boulderous	-	-	-	82.4	UCS	-	-	-	-	-	-	0.35	26.0
36	25.00	UDS	2.36	2.15	9.97	2.73	-	-	-	-	-	-	-	-	-	Boulderous	-	-	-	186.4	UCS	-	-	-	-	-	-	0.27	21.4

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 12

Co-Ordinate :- E 1793, N 3622

Reduced Level :- 210.70m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility m _v cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	16	51	33	29	16	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	39	40	21	24	15	9	-	-	-	-	SC	-	-	-	-	-	-	-	-	25	-	-	-
3	2.00	SPT	-	-	-	-	6	69	25	26	18	8	-	-	-	-	SC	-	-	-	-	-	-	-	-	11	-	-	-
4	2.50	UDS	1.61	1.56	3.07	2.66	0	79	21	25	14	11	-	-	-	-	SC	0.03	26	-	-	DSU	-	-	-	-	-	0.70	41.3
5	3.00	SPT	-	-	-	-	0	73	27	29	16	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	19	-	-	-
6	3.50	UDS	1.66	1.59	4.59	2.65	0	77	23	26	15	11	-	-	-	-	SC	0.05	27	-	-	DSU	-	-	-	-	-	0.67	40.1
7	4.00	SPT	-	-	-	-	6	75	19	25	16	9	-	-	-	-	SC	-	-	-	-	-	-	-	-	23	-	-	-
8	4.50	UDS	1.67	1.64	2.14	2.65	4	73	23	28	17	11	-	-	-	-	SC	0.05	27	-	-	DSU	-	-	-	-	-	0.62	38.3
9	5.00	SPT	-	-	-	-	4	76	20	25	16	9	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
10	5.50	SPT	-	-	-	-	4	82	14	23	15	8	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
11	6.00	SPT	-	-	-	-	0	78	22	24	19	5	-	-	-	-	SM	-	-	-	-	-	-	-	-	67	-	-	-
12	6.50	SPT	-	-	-	-	3	76	21	22	18	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
13	7.00	SPT	-	-	-	-	0	85	15	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
14	7.50	SPT	-	-	-	-	0	82	18	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
15	8.00	SPT	-	-	-	-	2	78	20	19	15	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
16	8.50	SPT	-	-	-	-	0	80	20	25	20	5	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
17	9.00	SPT	-	-	-	-	6	78	16	23	19	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
18	9.50	SPT	-	-	-	-	8	64	28	29	16	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
19	10.00	SPT	-	-	-	-	7	77	16	22	16	6	-	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
20	11.00	SPT	-	-	-	-	6	76	18	27	21	6	-	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
21	11.50	SPT	-	-	-	-	4	81	15	26	20	6	-	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
22	12.50	SPT	-	-	-	-	0	76	24	29	17	12	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
23	13.00	SPT	-	-	-	-	0	82	18	27	16	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
24	14.00	SPT	-	-	-	-	0	78	22	33	18	15	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
25	14.50	SPT	-	-	-	-	12	76	12	26	17	9	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
26	15.50	UDS	2.29	2.04	12.25	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	83.4	UCS	-	-	-	-	-	0.33	25.0
27	15.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
28	16.50	UDS	2.36	2.16	9.26	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	90.2	UCS	-	-	-	-	-	0.25	20.0
29	16.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
30	18.00	UDS	2.34	2.12	10.19	2.71	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	93.9	UCS	-	-	-	-	-	0.28	21.6
31	18.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
32	19.50	UDS	2.29	2.04	12.25	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	82.5	UCS	-	-	-	-	-	0.33	25.0
33	21.00	UDS	2.46	2.29	7.22	2.75	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	154.6	-	UCS	-	-	-	-	15.33	0.20	16.6
34	22.50	UDS	2.33	2.11	10.30	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	120.5	UCS	-	-	-	-	-	0.28	21.8
35	24.00	UDS	2.39	2.19	8.96	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	138.7	-	UCS	-	-	-	-	8.00	0.24	19.7
36	25.50	UDS	2.30	2.06	11.40	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	115.0	UCS	-	-	-	-	-	0.31	23.5
37	25.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-

KCT Consultancy Services LLP, Ahmedabad

RESULTS OF LABORATORY TEST

Project :- Proposed structure in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 13

Co-Ordinate :- E 843, N 3741

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %	
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility m _v cm ² /kg	Pre-consolidation Pressure kg/cm ²					
1	0.00	DS	-	-	-	-	0	23	57	20	38	20	18	-	-	-	CI	-	-	-	-	-	-	-	-	-	-	-	-	
2	1.00	SPT	-	-	-	-	0	28	58	14	29	16	13	-	-	-	CL	-	-	-	-	-	-	-	-	14	-	-	-	
3	2.00	SPT	-	-	-	-	17	32	38	13	26	14	12	-	-	-	CL	-	-	-	-	-	-	-	-	12	-	-	-	
4	2.50	SPT	-	-	-	-	61	25	14		28	22	6	-	-	-	GM-GC	-	-	-	-	-	-	-	-	15	-	-	-	
5	3.00	SPT	-	-	-	-	49	24	27		30	23	7	-	-	-	GM-GC	-	-	-	-	-	-	-	-	24	-	-	-	
6	3.50	SPT	-	-	-	-	36	47	17		25	16	9	-	-	-	SC	-	-	-	-	-	-	-	-	33	-	-	-	
7	4.00	SPT	-	-	-	-	10	62	28		30	17	13	-	-	-	SC	-	-	-	-	-	-	-	-	26	-	-	-	
8	4.50	SPT	-	-	-	-	13	69	18		27	16	11	-	-	-	SC	-	-	-	-	-	-	-	-	49	-	-	-	
9	5.00	SPT	-	-	-	-	16	61	23		28	15	13	-	-	-	SC	-	-	-	-	-	-	-	-	57	-	-	-	
10	5.50	SPT	-	-	-	-	0	55	45		32	18	14	-	-	-	SC	-	-	-	-	-	-	-	-	65	-	-	-	
11	6.00	SPT	-	-	-	-	0	4	57	39	56	23	33	-	-	-	CH	-	-	-	-	-	-	-	-	>100	-	-	-	
12	6.50	SPT	-	-	-	-	0	3	64	33	55	26	29	-	-	-	CH	-	-	-	-	-	-	-	-	>100	-	-	-	
13	7.00	SPT	-	-	-	-	25	22	21	32	51	23	28	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-	
14	8.00	SPT	-	-	-	-	5	14	41	40	56	21	35	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-	
15	9.50	UDS	2.29	2.04	12.01	2.71	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	68.1	UCS	-	-	-	-	-	-	0.33	24.6
16	11.00	UDS	2.46	2.29	7.44	2.76	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	54.1	UCS	-	-	-	-	-	-	0.21	17.0
17	12.50	UDS	2.51	2.37	5.78	2.75	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	99.6	UCS	-	-	-	-	-	-	0.16	13.7
18	14.00	UDS	2.48	2.34	6.19	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	84.3	UCS	-	-	-	-	-	-	0.17	14.5
19	15.50	UDS	2.56	2.45	4.65	2.76	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	102.4	UCS	-	-	-	-	-	-	0.13	11.4
20	17.00	UDS	2.31	2.05	12.68	2.77	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	139.4	-	UCS	-	-	-	-	30.66	0.35	26.0	
21	18.50	UDS	2.38	2.18	9.06	2.72	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	186.2	-	UCS	-	-	-	-	75.33	0.25	19.8	

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 14

Co-Ordinate :- E - 1122, N - 3767

Reduced Level :- 198.77 m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %	
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²					
1	0.00	DS	-	-	-	-	18	48	34		31	16	15	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	33	47	20		26	15	11	-	-	-	SC	-	-	-	-	-	-	-	-	-	45	-	-	-
3	2.00	SPT	-	-	-	-	24	60	16		23	17	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	-	48	-	-	-
4	2.50	SPT	-	-	-	-	21	61	18		25	19	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	-	39	-	-	-
5	3.00	SPT	-	-	-	-	20	67	13		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	-	>100	-	-	-
6	3.50	SPT	-	-	-	-	11	75	14		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	-	>100	-	-	-
7	4.00	SPT	-	-	-	-	7	74	19		20	16	4	-	-	-	SM	-	-	-	-	-	-	-	-	-	>100	-	-	-
8	4.50	SPT	-	-	-	-	5	79	16		18	14	4	-	-	-	SM	-	-	-	-	-	-	-	-	-	>100	-	-	-
9	5.00	SPT	-	-	-	-	7	65	28		32	18	14	-	-	-	SC	-	-	-	-	-	-	-	-	-	62	-	-	-
10	5.50	SPT	-	-	-	-	6	77	17		28	17	11	-	-	-	SC	-	-	-	-	-	-	-	-	-	>100	-	-	-
11	6.00	SPT	-	-	-	-	7	78	15		26	16	10	-	-	-	SC	-	-	-	-	-	-	-	-	-	>100	-	-	-
12	6.50	SPT	-	-	-	-	0	80	20		29	18	11	-	-	-	SC	-	-	-	-	-	-	-	-	-	68	-	-	-
13	7.00	SPT	-	-	-	-	0	85	15		26	17	9	-	-	-	SC	-	-	-	-	-	-	-	-	-	54	-	-	-
14	7.50	UDS	2.19	1.91	14.85	2.66	11	61	28		34	20	14	-	-	-	SC	0.10	28	-	-	DSU	-	-	-	-	-	-	0.39	28.3
15	8.00	SPT	-	-	-	-	16	62	22		29	15	14	-	-	-	SC	-	-	-	-	-	-	-	-	-	29	-	-	-
16	8.50	SPT	-	-	-	-	9	75	16		28	16	12	-	-	-	SC	-	-	-	-	-	-	-	-	-	25	-	-	-
17	9.00	SPT	-	-	-	-	32	54	14		23	17	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	-	25	-	-	-
18	9.50	SPT	-	-	-	-	22	57	21		24	18	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	-	28	-	-	-
19	10.00	SPT	-	-	-	-	6	66	28		26	19	7	-	-	-	SM-SC	-	-	-	-	-	-	-	-	-	33	-	-	-
20	11.00	SPT	-	-	-	-	34	50	16		28	16	12	-	-	-	SC	-	-	-	-	-	-	-	-	-	>100	-	-	-
21	11.50	SPT	-	-	-	-	13	69	18		29	15	14	-	-	-	SC	-	-	-	-	-	-	-	-	-	45	-	-	-
22	12.50	SPT	-	-	-	-	22	56	22		31	18	13	-	-	-	SC	-	-	-	-	-	-	-	-	-	78	-	-	-
23	13.00	SPT	-	-	-	-	13	55	32		34	19	15	-	-	-	SC	-	-	-	-	-	-	-	-	-	>100	-	-	-
24	14.00	SPT	-	-	-	-	21	59	20		29	16	13	-	-	-	SC	-	-	-	-	-	-	-	-	-	>100	-	-	-
25	14.50	SPT	-	-	-	-	16	61	23		30	18	12	-	-	-	SC	-	-	-	-	-	-	-	-	-	>100	-	-	-
26	15.50	SPT	-	-	-	-	0	82	18		27	16	11	-	-	-	SC	-	-	-	-	-	-	-	-	-	>100	-	-	-
27	16.00	SPT	-	-	-	-	8	45	47		34	15	19	-	-	-	SC	-	-	-	-	-	-	-	-	-	>100	-	-	-
28	17.00	SPT	-	-	-	-	0	59	41		30	14	16	-	-	-	SC	-	-	-	-	-	-	-	-	-	>100	-	-	-
29	17.50	SPT	-	-	-	-	0	86	14		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	-	>100	-	-	-
30	18.50	SPT	-	-	-	-	0	88	12		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	-	>100	-	-	-
31	20.00	UDS	2.43	2.28	6.76	2.69	-	-	-		-	-	-	-	-	-	Boulders	-	-	-	84.5	UCS	-	-	-	-	-	-	0.18	15.4
32	20.00	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	Boulders	-	-	-	-	-	-	-	-	-	>100	-	-	-
33	21.50	DS	-	-	-	-	61	23	16		NP	NP	NP	-	-	-	Boulders	-	-	-	-	-	-	-	-	-	-	-	-	-
34	21.50	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	Boulders	-	-	-	-	-	-	-	-	-	>100	-	-	-
35	23.00	DS	-	-	-	-	59	24	17		NP	NP	NP	-	-	-	Boulders	-	-	-	-	-	-	-	-	-	-	-	-	-
36	23.00	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	Boulders	-	-	-	-	-	-	-	-	-	>100	-	-	-
37	25.00	UDS	2.47	2.32	6.48	2.73	-	-	-		-	-	-	-	-	-	Boulders	-	-	-	96.3	UCS	-	-	-	-	-	-	0.18	15.0
38	25.00	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	Boulders	-	-	-	-	-	-	-	-	-	>100	-	-	-

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 15

Co-Ordinate :- E - 1221, N - 3716

Reduced Level :- 200.95m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility m _v cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	2	81	17	22	18	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	16	56	28	30	16	14	-	-	-	-	SC	-	-	-	-	-	-	-	-	18	-	-	-
3	2.00	SPT	-	-	-	-	18	53	29	31	15	16	-	-	-	-	SC	-	-	-	-	-	-	-	-	26	-	-	-
4	2.50	UDS	1.76	1.61	9.45	2.65	6	66	28	34	18	16	-	-	-	-	SC	0.09	27	-	-	DSU	-	-	-	-	-	0.65	39.3
5	3.00	SPT	-	-	-	-	0	70	30	35	16	19	-	-	-	-	SC	-	-	-	-	-	-	-	-	20	-	-	-
6	3.50	UDS	2.00	1.60	24.81	2.66	8	68	24	34	19	15	-	-	-	-	SC	0.06	26	-	-	DSU	-	-	-	-	-	0.66	39.8
7	4.00	SPT	-	-	-	-	6	60	34	36	15	21	-	-	-	-	SC	-	-	-	-	-	-	-	-	25	-	-	-
8	4.50	UDS	2.03	1.65	23.27	2.67	6	78	16	35	20	15	-	-	-	-	SC	0.04	28	-	-	DSU	-	-	-	-	-	0.62	38.3
9	5.00	SPT	-	-	-	-	0	77	23	33	21	12	-	-	-	-	SC	-	-	-	-	-	-	-	-	55	-	-	-
10	5.50	UDS	2.08	1.73	20.46	2.67	10	69	21	26	20	6	-	-	-	-	SM-SC	0.03	29	-	-	DSU	-	-	-	-	-	0.55	35.3
11	6.00	SPT	-	-	-	-	4	70	26	28	21	7	-	-	-	-	SM-SC	-	-	-	-	-	-	-	-	61	-	-	-
12	6.50	SPT	-	-	-	-	2	82	16	28	19	9	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
13	7.00	SPT	-	-	-	-	4	75	21	30	16	14	-	-	-	-	SC	-	-	-	-	-	-	-	-	83	-	-	-
14	7.50	SPT	-	-	-	-	0	71	29	34	19	15	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
15	8.00	SPT	-	-	-	-	18	66	16	31	14	17	-	-	-	-	SC	-	-	-	-	-	-	-	-	74	-	-	-
16	8.50	SPT	-	-	-	-	0	80	20	37	22	15	-	-	-	-	SC	-	-	-	-	-	-	-	-	80	-	-	-
17	9.00	SPT	-	-	-	-	8	70	22	36	19	17	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
18	9.50	SPT	-	-	-	-	36	44	20	33	21	12	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
19	10.00	SPT	-	-	-	-	0	66	34	36	20	16	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
20	11.00	SPT	-	-	-	-	25	51	24	28	17	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
21	11.50	SPT	-	-	-	-	0	74	26	29	16	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
22	12.50	SPT	-	-	-	-	0	86	14	24	18	6	-	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
23	13.00	SPT	-	-	-	-	0	84	16	25	19	6	-	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
24	14.00	SPT	-	-	-	-	0	66	34	30	16	14	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
25	14.50	SPT	-	-	-	-	0	72	28	28	15	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
26	15.50	SPT	-	-	-	-	0	76	24	27	16	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
27	16.00	SPT	-	-	-	-	0	68	32	30	18	12	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
28	17.00	SPT	-	-	-	-	0	71	29	27	16	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
29	17.50	SPT	-	-	-	-	0	72	28	28	15	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
30	18.50	SPT	-	-	-	-	0	78	22	25	16	9	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
31	19.00	SPT	-	-	-	-	34	49	17	24	15	9	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
32	20.00	UDS	2.33	2.10	10.78	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	99.8	UCS	-	-	-	-	-	0.29	22.7
33	20.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
34	21.50	UDS	2.34	2.12	10.19	2.71	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	135.4	UCS	-	-	-	-	-	0.28	21.6
35	21.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
36	23.00	UDS	2.28	2.02	12.88	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	111.6	UCS	-	-	-	-	-	0.35	26.0
37	23.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
38	24.00	UDS	2.41	2.22	8.77	2.75	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	202.3	-	UCS	-	-	-	-	12.00	0.24	19.4
39	25.00	UDS	2.63	2.51	4.93	2.86	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	469.2	UCS	-	-	-	-	-	0.14	12.4

UDS - Undisturbed Sample
DS - Disturbed Sample
SPT - Standard Penetration Tests

NP - Non Plastic
UCS - Unconfined Compression Strength

TUU - Triaxial Unconsolidated Undrained
TCU - Triaxial Consolidated Undrained
DSU - Direct Shear Test

KCT Consultancy Services LLP, Ahmedabad

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 16

Co-Ordinate :- E - 1218, N - 3531

Reduced Level :- 200.47 m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	2	69	29		29	16	13	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	3	33	38	26	43	20	23	-	-	-	CI	-	-	-	-	-	-	-	-	8	-	-	-
3	2.00	SPT	-	-	-	-	7	47	46		35	18	17	-	-	-	SC	-	-	-	-	-	-	-	-	22	-	-	-
4	2.50	UDS	1.74	1.61	7.89	2.68	28	45	27		28	16	12	-	-	-	SC	0.07	28	-	-	DSU	-	-	-	-	-	0.66	39.8
5	3.00	SPT	-	-	-	-	14	56	30		32	17	15	-	-	-	SC	-	-	-	-	-	-	-	-	21	-	-	-
6	3.50	DS	-	-	-	-	2	85	13		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	-	-	-	-
7	4.00	SPT	-	-	-	-	12	73	15		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
8	4.50	DS	-	-	-	-	5	69	26		24	18	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	-	-	-	-
9	5.00	SPT	-	-	-	-	4	68	28		26	19	7	-	-	-	SM-SC	-	-	-	-	-	-	-	-	49	-	-	-
10	5.50	DS	-	-	-	-	0	63	37		29	22	7	-	-	-	SM-SC	-	-	-	-	-	-	-	-	-	-	-	-
11	6.00	SPT	-	-	-	-	4	70	26		27	17	10	-	-	-	SC	-	-	-	-	-	-	-	-	38	-	-	-
12	6.50	UDS	2.04	1.66	22.69	2.67	2	81	17		25	16	9	-	-	-	SC	0.03	29	-	-	DSU	-	-	-	-	-	0.61	37.7
13	7.00	SPT	-	-	-	-	0	74	26		28	14	14	-	-	-	SC	-	-	-	-	-	-	-	-	62	-	-	-
14	7.50	DS	-	-	-	-	0	85	15		24	15	9	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
15	8.00	SPT	-	-	-	-	8	65	27		29	17	12	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
16	8.50	SPT	-	-	-	-	15	68	17		25	19	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
17	9.00	SPT	-	-	-	-	14	65	21		27	20	7	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
18	9.50	SPT	-	-	-	-	7	74	19		26	20	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
19	10.00	SPT	-	-	-	-	3	79	18		24	18	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
20	11.00	SPT	-	-	-	-	3	81	16		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
21	11.50	SPT	-	-	-	-	5	82	13		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
22	12.50	SPT	-	-	-	-	9	77	14		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
23	13.00	SPT	-	-	-	-	14	73	13		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
24	14.00	SPT	-	-	-	-	14	74	12		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
25	14.50	SPT	-	-	-	-	28	59	13		NP	NP	NP	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
26	15.50	SPT	-	-	-	-	0	61	39		30	16	14	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
27	17.00	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
28	18.50	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
29	20.00	DS	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	-	-	-	-
30	20.00	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
31	21.50	DS	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	-	-	-	-
32	21.50	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
33	23.00	UDS	2.39	2.20	8.50	2.71	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	98.5	UCS	-	-	-	-	-	0.23	18.7
34	23.00	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
35	24.50	UDS	2.51	2.34	7.28	2.82	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	376.4	UCS	-	-	-	-	-	0.21	17.0
36	25.00	UDS	2.56	2.43	5.49	2.80	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	400.5	UCS	-	-	-	-	-	0.15	13.3

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 17

Co-Ordinate :- E - 1219, N - 3423

Reduced Level :- 200.70 m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility m _v cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	0	54	46		27	16	11	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	48	37	15	28	15	13	-	-	-	CL	-	-	-	-	-	-	-	-	14	-	-	-
3	2.00	SPT	-	-	-	-	0	44	42	14	29	17	12	-	-	-	CL	-	-	-	-	-	-	-	-	11	-	-	-
4	2.50	UDS	1.82	1.55	17.19	2.65	0	62	38		26	16	10	-	-	-	SC	0.07	25	-	-	DSU	-	-	-	-	-	0.71	41.4
5	3.00	SPT	-	-	-	-	9	47	44		28	14	14	-	-	-	SC	-	-	-	-	-	-	-	-	15	-	-	-
6	3.50	UDS	1.97	1.56	26.16	2.64	0	47	29	24	39	18	21	-	-	-	CI	0.78	7	-	-	TUU	0.14	0.0123	0.56	-	-	0.69	40.9
7	4.00	SPT	-	-	-	-	0	42	39	19	40	23	17	-	-	-	CI	-	-	-	-	-	-	-	-	12	-	-	-
8	4.50	SPT	-	-	-	-	3	37	35	25	42	20	22	-	-	-	CI	-	-	-	-	-	-	-	-	23	-	-	-
9	5.00	SPT	-	-	-	-	0	29	28	43	55	19	36	-	-	-	CH	-	-	-	-	-	-	-	-	22	-	-	-
10	5.50	SPT	-	-	-	-	0	30	37	33	52	24	28	-	-	-	CH	-	-	-	-	-	-	-	-	22	-	-	-
11	6.00	SPT	-	-	-	-	0	44	40	16	39	25	14	-	-	-	CI	-	-	-	-	-	-	-	-	25	-	-	-
12	6.50	DS	-	-	-	-	4	61	35		28	19	9	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
13	7.00	SPT	-	-	-	-	3	64	33		27	16	11	-	-	-	SC	-	-	-	-	-	-	-	-	20	-	-	-
14	7.50	UDS	2.00	1.61	24.53	2.65	2	65	33		25	15	10	-	-	-	SC	0.08	27	-	-	DSU	-	-	-	-	-	0.65	39.4
15	8.00	SPT	-	-	-	-	2	22	43	33	53	24	29	-	-	-	CH	-	-	-	-	-	-	-	-	23	-	-	-
16	8.50	SPT	-	-	-	-	0	17	46	37	55	23	32	-	-	-	CH	-	-	-	-	-	-	-	-	26	-	-	-
17	9.00	SPT	-	-	-	-	0	11	51	38	56	21	35	-	-	-	CH	-	-	-	-	-	-	-	-	22	-	-	-
18	9.50	UDS	2.05	1.70	20.72	2.62	0	17	55	28	47	23	24	-	-	-	CI	1.16	4	-	-	TUU	0.10	0.0091	3.54	-	-	0.54	35.2
19	10.00	SPT	-	-	-	-	0	33	47	20	39	22	17	-	-	-	CI	-	-	-	-	-	-	-	-	29	-	-	-
20	11.00	UDS	2.10	1.77	18.87	2.65	0	45	34	21	37	19	18	-	-	-	CI	1.43	8	-	-	TUU	0.09	0.0062	3.69	-	-	0.50	33.3
21	11.50	SPT	-	-	-	-	0	78	22		27	16	11	-	-	-	SC	-	-	-	-	-	-	-	-	30	-	-	-
22	12.50	SPT	-	-	-	-	0	67	33		29	15	14	-	-	-	SC	-	-	-	-	-	-	-	-	27	-	-	-
23	13.00	SPT	-	-	-	-	0	78	22		24	14	10	-	-	-	SC	-	-	-	-	-	-	-	-	20	-	-	-
24	14.00	SPT	-	-	-	-	0	83	17		23	15	8	-	-	-	SC	-	-	-	-	-	-	-	-	33	-	-	-
25	14.50	SPT	-	-	-	-	0	87	13		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	28	-	-	-
26	15.50	SPT	-	-	-	-	0	88	12		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
27	16.00	SPT	-	-	-	-	4	72	24		20	16	4	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
28	17.50	SPT	-	-	-	-	30	43	27		26	17	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
29	19.00	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
30	20.50	UDS	2.38	2.15	10.87	2.80	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	165.2	-	UCS	-	-	-	-	28.66	0.30	23.3
31	22.50	UDS	2.64	2.54	4.09	2.83	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	392.9	-	UCS	-	-	-	-	39.33	0.12	10.4
32	23.50	UDS	2.60	2.49	4.26	2.79	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	350.4	-	UCS	-	-	-	-	8.00	0.12	10.6
33	25.00	UDS	2.68	2.60	2.96	2.82	-	-	-		-	-	-	-	-	-	ROCK	-	-	587.6	-	UCS	-	-	-	-	50.00	0.08	7.7

KCT Consultancy Services LLP, Ahmedabad

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- BH-18

Co-Ordinate :- E 1218, N 3266

Reduced Level :- 200.340 m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	3	66	31		29	16	13	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	1	28	47	24	42	20	22	-	-	-	CI	-	-	-	-	-	-	-	-	11	-	-	-
3	2.00	SPT	-	-	-	-	6	23	44	27	44	21	23	-	-	-	CI	-	-	-	-	-	-	-	-	11	-	-	-
4	2.50	UDS	1.95	1.54	26.92	2.62	2	19	51	28	45	20	25	-	-	-	CI	0.75	3	-	-	TUU	0.15	0.0143	0.43	-	-	0.71	41.4
5	3.00	SPT	-	-	-	-	4	26	51	19	40	23	17	-	-	-	CI	-	-	-	-	-	-	-	-	17	-	-	-
6	3.50	UDS	1.98	1.58	25.51	2.64	0	30	54	16	37	22	15	-	-	-	CI	1.07	6	-	-	TUU	-	-	-	-	-	0.67	40.2
7	4.00	SPT	-	-	-	-	10	14	41	35	53	21	32	-	-	-	CH	-	-	-	-	-	-	-	-	22	-	-	-
8	4.50	SPT	-	-	-	-	4	9	46	41	57	19	38	-	-	-	CH	-	-	-	-	-	-	-	-	22	-	-	-
9	5.00	SPT	-	-	-	-	6	16	44	34	52	21	31	-	-	-	CH	-	-	-	-	-	-	-	-	24	-	-	-
10	5.50	UDS	2.00	1.61	23.95	2.63	2	18	49	31	51	24	27	-	-	-	CH	1.18	3	-	-	TUU	0.13	0.0093	1.93	-	-	0.63	38.7
11	6.00	SPT	-	-	-	-	5	10	47	38	56	23	33	-	-	-	CH	-	-	-	-	-	-	-	-	20	-	-	-
12	6.50	SPT	-	-	-	-	8	19	41	32	53	25	28	-	-	-	CH	-	-	-	-	-	-	-	-	21	-	-	-
13	7.00	SPT	-	-	-	-	2	21	46	31	52	26	26	-	-	-	CH	-	-	-	-	-	-	-	-	19	-	-	-
14	7.50	UDS	1.99	1.60	24.29	2.62	1	16	44	39	56	22	34	-	-	-	CH	1.06	2	-	-	TUU	-	-	-	-	-	0.64	38.9
15	8.00	SPT	-	-	-	-	6	24	33	37	54	21	33	-	-	-	CH	-	-	-	-	-	-	-	-	20	-	-	-
16	8.50	UDS	2.00	1.61	24.53	2.65	0	30	55	15	29	16	13	-	-	-	CL	0.96	8	-	-	TUU	0.12	0.0063	2.03	-	-	0.65	39.4
17	9.00	SPT	-	-	-	-	0	31	55	14	28	15	13	-	-	-	CL	-	-	-	-	-	-	-	-	21	-	-	-
18	9.50	UDS	2.02	1.63	23.59	2.66	0	64	36		27	17	10	-	-	-	SC	0.09	27	-	-	DSU	-	-	-	-	-	0.63	38.6
19	10.00	SPT	-	-	-	-	2	69	29		25	16	9	-	-	-	SC	-	-	-	-	-	-	-	-	22	-	-	-
20	11.00	Remoulded	2.05	1.68	21.84	2.66	0	77	23		18	14	4	-	-	-	SM	0.00	29	-	-	DSU	-	-	-	-	-	0.58	36.7
21	11.50	SPT	-	-	-	-	0	76	24		19	15	4	-	-	-	SM	-	-	-	-	-	-	-	-	18	-	-	-
22	13.00	SPT	-	-	-	-	0	82	18		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	20	-	-	-
23	14.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
24	16.00	UDS	2.18	1.88	16.07	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	30.4	-	UCS	-	-	-	-	12.00	0.43	30.2
25	17.50	UDS	2.16	1.85	16.99	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	-	0.46	31.4	
26	19.00	UDS	2.21	1.93	14.49	2.68	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	29.6	-	UCS	-	-	-	-	8.00	0.39	28.0
27	20.50	UDS	2.30	2.06	11.40	2.70	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	41.7	-	UCS	-	-	-	-	30.00	0.31	23.5
28	22.00	UDS	2.28	2.04	11.91	2.69	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	43.6	-	UCS	-	-	-	-	20.00	0.32	24.3
29	23.50	UDS	2.29	2.04	12.01	2.71	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	46.5	-	UCS	-	-	-	-	80.00	0.33	24.6
30	25.00	UDS	2.28	2.03	12.15	2.70	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	39.4	-	UCS	-	-	-	-	56.00	0.33	24.7

UDS - Undisturbed Sample
DS - Disturbed Sample
SPT - Standard Penetration Tests
NP - Non Plastic

TUU - Triaxial Unconsolidated Undrained
TCU - Triaxial Consolidated Undrained
DSU - Direct Shear Test
UCS - Unconfined Compression Strength

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RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 19

Co-Ordinate :- E 1218, N 2964

Reduced Level :- 200.35 m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %	
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²					
1	0.00	DS	-	-	-	-	0	29	45	26	44	20	24	-	-	-	CI	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	20	41	39	61	28	33	-	-	-	CH	-	-	-	-	-	-	-	-	-	25	-	-	-
3	2.00	SPT	-	-	-	-	0	11	45	44	64	25	39	-	-	-	CH	-	-	-	-	-	-	-	-	-	21	-	-	-
4	2.50	UDS	1.98	1.58	24.93	2.62	0	19	49	32	56	29	27	14	0.36	53	CH	0.65	3	-	-	TUU	0.10	0.0157	0.51	-	-	0.65	39.5	
5	3.00	SPT	-	-	-	-	0	23	27	50	68	25	43	-	-	-	CH	-	-	-	-	-	-	-	-	-	50	-	-	-
6	3.50	UDS	2.01	1.64	22.47	2.60	0	9	43	48	73	29	44	8	0.59	91	CH	2.69	1	-	-	TUU	0.08	0.0045	2.16	-	-	0.58	36.9	
7	4.00	SPT	-	-	-	-	0	34	45	21	38	20	18	-	-	-	CI	-	-	-	-	-	-	-	-	-	31	-	-	-
8	4.50	SPT	-	-	-	-	0	26	50	24	40	19	21	-	-	-	CI	-	-	-	-	-	-	-	-	-	>100	-	-	-
9	5.00	SPT	-	-	-	-	0	35	46	19	37	21	16	-	-	-	CI	-	-	-	-	-	-	-	-	-	>100	-	-	-
10	5.50	SPT	-	-	-	-	0	34	59	7	26	20	6	-	-	-	CL	-	-	-	-	-	-	-	-	-	>100	-	-	-
11	6.00	SPT	-	-	-	-	0	29	61	10	28	19	9	-	-	-	CL	-	-	-	-	-	-	-	-	-	>100	-	-	-
12	7.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	-	>100	-	-	-
13	9.00	UDS	2.29	2.04	12.01	2.71	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	82.7	-	UCS	-	-	-	-	-	18.50	0.33	24.6
14	10.50	UDS	2.23	1.96	13.90	2.69	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	51.6	-	UCS	-	-	-	-	-	42.60	0.37	27.2
15	12.00	UDS	2.21	1.93	14.49	2.68	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	52.2	UCS	-	-	-	-	-	0.39	28.0	
16	13.50	UDS	2.33	2.11	10.30	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	86.6	-	UCS	-	-	-	-	-	36.00	0.28	21.8
17	15.00	UDS	2.37	2.16	9.63	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	104.9	-	UCS	-	-	-	-	-	86.00	0.26	20.8
18	16.50	UDS	2.36	2.14	10.43	2.75	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	96.8	-	UCS	-	-	-	-	-	68.66	0.29	22.3
19	18.00	UDS	2.37	2.16	9.63	2.73	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	100.9	-	UCS	-	-	-	-	-	98.60	0.26	20.8

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 20

Co-Ordinate :- E - 745, N - 3722

Reduced Level :- 193.460m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility m _v cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	0	27	49	24	37	16	21	-	-	-	CI	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	53	47	41	19	22	-	-	-	-	SC	-	-	-	-	-	-	-	-	5	-	-	-
3	2.00	SPT	-	-	-	-	0	55	45	40	15	25	-	-	-	-	SC	-	-	-	-	-	-	-	-	5	-	-	-
4	2.50	UDS	1.96	1.54	27.12	2.65	2	51	47	33	16	17	-	-	-	-	SC	0.11	24	-	-	DSU	-	-	-	-	-	0.72	41.8
5	3.00	SPT	-	-	-	-	3	65	32	35	15	20	-	-	-	-	SC	-	-	-	-	-	-	-	-	14	-	-	-
6	3.50	SPT	-	-	-	-	12	61	27	29	17	12	-	-	-	-	SC	-	-	-	-	-	-	-	-	12	-	-	-
7	4.00	SPT	-	-	-	-	8	70	22	34	15	19	-	-	-	-	SC	-	-	-	-	-	-	-	-	13	-	-	-
8	4.50	SPT	-	-	-	-	38	48	14	24	14	10	-	-	-	-	SC	-	-	-	-	-	-	-	-	19	-	-	-
9	5.00	SPT	-	-	-	-	0	76	24	32	15	17	-	-	-	-	SC	-	-	-	-	-	-	-	-	24	-	-	-
10	5.50	SPT	-	-	-	-	0	77	23	40	17	23	-	-	-	-	SC	-	-	-	-	-	-	-	-	20	-	-	-
11	6.00	SPT	-	-	-	-	6	69	25	41	15	26	-	-	-	-	SC	-	-	-	-	-	-	-	-	25	-	-	-
12	6.50	SPT	-	-	-	-	16	61	23	34	17	17	-	-	-	-	SC	-	-	-	-	-	-	-	-	25	-	-	-
13	7.00	SPT	-	-	-	-	24	54	22	32	16	16	-	-	-	-	SC	-	-	-	-	-	-	-	-	32	-	-	-
14	7.50	SPT	-	-	-	-	12	12	51	25	42	20	22	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-
15	9.00	UDS	2.26	2.00	12.93	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	73.9	UCS	-	-	-	-	-	0.35	25.9
16	9.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
17	10.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
18	12.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
19	13.50	UDS	2.40	2.23	7.70	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	86.4	-	UCS	-	-	-	-	13.00	0.21	17.2
20	15.00	UDS	2.47	2.32	6.25	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	150.2	-	UCS	-	-	-	-	26.00	0.17	14.5
21	16.50	UDS	2.43	2.25	7.91	2.74	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	171.5	-	UCS	-	-	-	-	64.00	0.22	17.8

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 21

Co-Ordinate :- E - 987, N - 3766

Reduced Level :- 194.99m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility m _v cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	1	46	36	17	29	15	14	-	-	-	CL	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	6	80	14	25	17	8	-	-	-	-	SC	-	-	-	-	-	-	-	-	13	-	-	-
3	2.00	SPT	-	-	-	-	9	51	40	38	23	15	-	-	-	-	SC	-	-	-	-	-	-	-	-	16	-	-	-
4	2.50	UDS	2.00	1.60	25.37	2.68	20	60	20	32	19	13	-	-	-	-	SC	0.08	29	-	-	DSU	-	-	-	-	-	0.68	40.5
5	3.00	SPT	-	-	-	-	0	61	39	35	20	15	-	-	-	-	SC	-	-	-	-	-	-	-	-	76	-	-	-
6	3.50	SPT	-	-	-	-	0	70	30	34	21	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	60	-	-	-
7	4.00	SPT	-	-	-	-	12	67	21	28	19	9	-	-	-	-	SC	-	-	-	-	-	-	-	-	85	-	-	-
8	4.50	SPT	-	-	-	-	0	72	28	29	18	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	92	-	-	-
9	5.00	SPT	-	-	-	-	4	62	34	32	20	12	-	-	-	-	SC	-	-	-	-	-	-	-	-	85	-	-	-
10	5.50	SPT	-	-	-	-	0	53	47	39	23	16	-	-	-	-	SC	-	-	-	-	-	-	-	-	82	-	-	-
11	6.00	SPT	-	-	-	-	6	65	29	33	19	14	-	-	-	-	SC	-	-	-	-	-	-	-	-	89	-	-	-
12	6.50	SPT	-	-	-	-	0	62	38	34	27	7	-	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
13	7.00	SPT	-	-	-	-	10	60	30	32	26	6	-	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
14	7.50	SPT	-	-	-	-	2	77	21	25	19	6	-	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
15	8.00	SPT	-	-	-	-	4	68	28	27	20	7	-	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
16	8.50	SPT	-	-	-	-	0	60	40	30	23	7	-	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
17	9.00	SPT	-	-	-	-	3	66	31	29	23	6	-	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
18	9.50	SPT	-	-	-	-	0	78	22	21	17	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
19	10.00	SPT	-	-	-	-	17	64	19	20	16	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
20	11.00	SPT	-	-	-	-	3	63	34	28	15	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
21	11.50	SPT	-	-	-	-	0	78	22	25	14	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
22	12.50	SPT	-	-	-	-	0	80	20	22	18	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
23	13.00	SPT	-	-	-	-	0	82	18	19	15	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
24	14.00	SPT	-	-	-	-	0	86	14	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
25	14.50	SPT	-	-	-	-	0	87	13	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
26	15.50	UDS	2.53	2.40	5.45	2.76	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	199.7	-	UCS	-	-	-	-	16.60	0.15	13.1
27	17.00	UDS	2.49	2.33	7.00	2.78	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	152.4	UCS	-	-	-	-	-	0.19	16.3
28	17.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
29	18.50	UDS	2.51	2.37	6.00	2.76	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	216.8	UCS	-	-	-	-	-	0.17	14.2
30	20.00	UDS	2.56	2.43	5.28	2.79	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	255.6	UCS	-	-	-	-	-	0.15	12.8
31	21.50	UDS	2.50	2.32	7.57	2.82	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	230.5	UCS	-	-	-	-	-	0.21	17.6
32	23.00	UDS	2.61	2.49	4.83	2.83	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	336.4	UCS	-	-	-	-	-	0.14	12.0
33	25.00	UDS	2.63	2.52	4.34	2.83	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	357.1	UCS	-	-	-	-	-	0.12	10.9

KCT Consultancy Services LLP, Ahmedabad

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 22

Co-Ordinate :- E - 1201, N - 3766

Reduced Level :- 200.61m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	0	65	35	20	16	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	6	52	42	36	19	17	-	-	-	-	SC	-	-	-	-	-	-	-	-	13	-	-	-
3	2.00	SPT	-	-	-	-	2	50	48	37	16	21	-	-	-	-	SC	-	-	-	-	-	-	-	-	25	-	-	-
4	2.50	UDS	1.78	1.63	9.23	2.68	22	49	29	40	18	22	-	-	-	-	SC	0.07	28	-	-	DSU	-	-	-	-	-	0.64	39.2
5	3.00	SPT	-	-	-	-	10	48	42	36	20	16	-	-	-	-	SC	-	-	-	-	-	-	-	-	37	-	-	-
6	3.50	UDS	1.85	1.68	10.27	2.67	15	51	34	35	18	17	-	-	-	-	SC	0.08	29	-	-	DSU	-	-	-	-	-	0.59	37.2
7	4.00	SPT	-	-	-	-	8	55	37	36	17	19	-	-	-	-	SC	-	-	-	-	-	-	-	-	38	-	-	-
8	4.50	SPT	-	-	-	-	12	57	31	41	20	21	-	-	-	-	SC	-	-	-	-	-	-	-	-	33	-	-	-
9	5.00	SPT	-	-	-	-	0	72	28	34	19	15	-	-	-	-	SC	-	-	-	-	-	-	-	-	43	-	-	-
10	5.50	SPT	-	-	-	-	0	56	44	36	18	18	-	-	-	-	SC	-	-	-	-	-	-	-	-	42	-	-	-
11	6.00	SPT	-	-	-	-	6	70	24	33	20	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
12	6.50	UDS	2.41	2.24	7.62	2.70	56	20	24	29	24	5	-	-	-	-	Boulders	-	-	-	83.4	UCS	-	-	-	-	-	0.21	17.1
13	8.00	Remoulded	2.24	1.97	13.99	2.71	72	16	12	NP	NP	NP	-	-	-	-	Boulders	0.00	33	-	-	DSU	-	-	-	-	-	0.38	27.5
14	9.50	Remoulded	2.29	2.05	11.77	2.70	63	22	15	NP	NP	NP	-	-	-	-	Boulders	0.00	34	-	-	DSU	-	-	-	-	-	0.32	24.1
15	11.00	UDS	2.36	2.16	9.02	2.69	52	30	18	26	21	5	-	-	-	-	Boulders	-	-	-	79.6	UCS	-	-	-	-	-	0.24	19.5
16	12.50	SPT	-	-	-	-	63	23	14	NP	NP	NP	-	-	-	-	Boulders	-	-	-	-	-	-	-	-	-	-	-	-
17	13.00	SPT	-	-	-	-	0	72	28	25	20	5	-	-	-	-	SM	-	-	-	-	-	-	-	-	-	-	-	-
18	14.00	SPT	-	-	-	-	0	81	19	20	16	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	-	-	-	-
19	14.50	SPT	-	-	-	-	0	84	16	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	-	-	-	-
20	15.50	SPT	-	-	-	-	0	82	18	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	-	-	-	-
21	16.00	SPT	-	-	-	-	0	60	40	26	21	5	-	-	-	-	SM	-	-	-	-	-	-	-	-	-	-	-	-
22	17.00	SPT	-	-	-	-	0	70	30	28	24	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	-	-	-	-
23	17.50	SPT	-	-	-	-	29	54	17	19	15	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	-	-	-	-
24	18.50	SPT	-	-	-	-	16	63	21	26	21	5	-	-	-	-	SM	-	-	-	-	-	-	-	-	-	-	-	-
25	20.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	-	-	-	-
26	20.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	-	-	-	-
27	21.50	UDS	2.28	2.03	12.15	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	54.3	UCS	-	-	-	-	-	0.33	24.7
28	23.00	UDS	2.34	2.11	11.13	2.75	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	116.8	-	UCS	-	-	-	-	21.33	0.31	23.4
29	25.00	UDS	2.44	2.27	7.38	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	139.4	-	UCS	-	-	-	-	6.50	0.20	16.8

KCT Consultancy Services LLP, Ahmedabad

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 23

Co-Ordinate :- E - 1194, N - 3618

Reduced Level :- 200.45 m

Sr No	Depth of Sample	Type of Sample	Field Bulk Density	Field Dry Density	Natural Moisture Content	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit	Swelling Pressure	Free Swell Index	Soil Classification	Shear Parameter		Unconfined Compression Test	UCS by Point Load Index in rock	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation	Void Ratio	Porosity
							Gravel	Sand	Silt	Clay	Liquid Limit	Plastic Limit	Plasticity Index					Cohesion C	Angle of Internal Friction ϕ				Compression Index C _c	Coefficient of Volume Compressibility mv	Pre-consolidation Pressure				
1	0.00	DS	-	-	-	-	0	66	34	29	16	13	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	8	53	39	31	15	16	-	-	-	SC	-	-	-	-	-	-	-	-	13	-	-	-	-
3	2.00	SPT	-	-	-	-	25	48	27	26	17	9	-	-	-	SC	-	-	-	-	-	-	-	-	31	-	-	-	-
4	2.50	UDS	1.86	1.62	14.57	2.66	2	81	17	23	15	8	-	-	-	SC	0.04	29	-	-	DSU	-	-	-	-	-	0.64	39.0	-
5	3.00	SPT	-	-	-	-	1	76	23	28	16	12	-	-	-	SC	-	-	-	-	-	-	-	-	27	-	-	-	-
6	3.50	UDS	1.85	1.60	15.64	2.65	0	78	22	27	18	9	-	-	-	SC	0.07	28	-	-	DSU	-	-	-	-	-	0.66	39.6	-
7	4.00	SPT	-	-	-	-	4	75	21	25	15	10	-	-	-	SC	-	-	-	-	-	-	-	-	36	-	-	-	-
8	4.50	UDS	1.92	1.72	11.34	2.66	5	80	15	23	14	9	-	-	-	SC	0.03	30	-	-	DSU	-	-	-	-	-	0.54	35.2	-
9	5.00	SPT	-	-	-	-	0	84	16	24	18	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	31	-	-	-	-
10	5.50	DS	-	-	-	-	0	82	18	26	19	7	-	-	-	SM-SC	-	-	-	-	-	-	-	-	-	-	-	-	-
11	6.00	SPT	-	-	-	-	0	73	27	28	21	7	-	-	-	SM-SC	-	-	-	-	-	-	-	-	36	-	-	-	-
12	6.50	Remoulded	2.05	1.68	22.12	2.67	0	91	9	NP	NP	NP	-	-	-	SP-SM	0.00	29	-	-	DSU	-	-	-	-	-	0.59	37.1	-
13	7.00	SPT	-	-	-	-	0	92	8	NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	-	18	-	-	-	-
14	7.50	DS	-	-	-	-	12	78	10	NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	-	-	-	-	-	-
15	8.00	SPT	-	-	-	-	0	93	7	NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
16	8.50	UDS	2.14	1.83	17.15	2.66	1	74	25	27	14	13	-	-	-	SC	0.13	28	-	-	DSU	-	-	-	-	-	0.46	31.3	-
17	10.00	SPT	-	-	-	-	3	61	36	31	16	15	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
18	11.50	SPT	-	-	-	-	6	65	29	28	15	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
19	13.00	SPT	-	-	-	-	1	68	31	30	16	14	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
20	14.50	SPT	-	-	-	-	2	72	26	27	17	10	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
21	16.00	UDS	2.34	2.13	9.95	2.70	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	38.7	-	UCS	-	-	-	-	7.00	0.27	21.2	-
22	16.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-
23	17.50	UDS	2.33	2.11	10.54	2.71	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	45.1	UCS	-	-	-	-	-	0.29	22.2	-
24	17.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-
25	19.00	UDS	2.40	2.23	7.70	2.69	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	50.8	-	UCS	-	-	-	-	35.33	0.21	17.2	-
26	19.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-
27	20.50	UDS	2.37	2.17	9.16	2.71	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	49.9	-	UCS	-	-	-	-	7.33	0.25	19.9	-
28	20.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-
29	22.50	UDS	2.51	2.38	5.34	2.73	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	124.8	-	UCS	-	-	-	-	10.00	0.15	12.7	-
30	22.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-
31	23.50	UDS	2.32	2.10	10.66	2.70	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	41.7	-	UCS	-	-	-	-	14.66	0.29	22.4	-
32	23.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-
33	25.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-

KCT Consultancy Services LLP, Ahmedabad

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 24

Co-Ordinate :- E - 1194, N - 3334

Reduced Level :- 199.65m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	0	68	32	27	16	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	39	43	18	31	15	16	-	-	-	CL	-	-	-	-	-	-	-	-	13	-	-	-
3	2.00	SPT	-	-	-	-	0	42	35	23	38	18	20	-	-	-	CI	-	-	-	-	-	-	-	-	15	-	-	-
4	2.50	UDS	1.98	1.57	26.09	2.66	0	36	40	24	40	19	21	-	-	-	CI	0.80	7	-	-	TUU	0.14	0.0128	0.43	-	-	0.69	41.0
5	3.00	SPT	-	-	-	-	0	30	40	30	43	18	25	-	-	-	CI	-	-	-	-	-	-	-	-	17	-	-	-
6	3.50	UDS	2.00	1.61	24.53	2.65	0	31	45	24	42	21	21	-	-	-	CI	0.91	6	-	-	TUU	0.12	0.0109	0.57	-	-	0.65	39.4
7	4.00	SPT	-	-	-	-	0	37	43	20	40	23	17	-	-	-	CI	-	-	-	-	-	-	-	-	22	-	-	-
8	4.50	UDS	2.00	1.61	24.24	2.64	0	29	44	27	44	21	23	-	-	-	CI	1.19	4	-	-	TUU	-	-	-	-	-	0.64	39.0
9	5.00	SPT	-	-	-	-	0	14	51	35	54	22	32	-	-	-	CH	-	-	-	-	-	-	-	-	24	-	-	-
10	5.50	UDS	2.02	1.64	23.02	2.64	0	17	51	32	52	24	28	-	-	-	CH	1.29	5	-	-	TUU	0.11	0.0085	0.83	-	-	0.61	37.8
11	6.00	SPT	-	-	-	-	0	67	33	27	16	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	34	-	-	-
12	6.50	UDS	2.04	1.67	22.41	2.66	0	63	37	31	18	13	-	-	-	-	SC	0.08	28	-	-	DSU	-	-	-	-	-	0.60	37.3
13	7.00	SPT	-	-	-	-	0	64	36	29	19	10	-	-	-	-	SC	-	-	-	-	-	-	-	-	26	-	-	-
14	7.50	SPT	-	-	-	-	0	12	56	32	52	24	28	-	-	-	CH	-	-	-	-	-	-	-	-	19	-	-	-
15	8.00	SPT	-	-	-	-	0	10	53	37	55	22	33	-	-	-	CH	-	-	-	-	-	-	-	-	23	-	-	-
16	8.50	UDS	2.00	1.62	23.37	2.61	0	9	49	42	56	21	35	-	-	-	CH	1.28	1	-	-	TUU	0.11	0.0095	1.26	-	-	0.61	37.9
17	9.00	SPT	-	-	-	-	0	15	54	31	51	25	26	-	-	-	CH	-	-	-	-	-	-	-	-	22	-	-	-
18	9.50	UDS	1.98	1.58	25.22	2.63	0	14	55	31	52	24	28	-	-	-	CH	1.23	3	-	-	TUU	-	-	-	-	-	0.66	39.9
19	10.00	SPT	-	-	-	-	0	65	35	29	16	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	16	-	-	-
20	11.00	SPT	-	-	-	-	0	71	29	32	17	15	-	-	-	-	SC	-	-	-	-	-	-	-	-	19	-	-	-
21	11.50	SPT	-	-	-	-	0	83	17	21	17	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	20	-	-	-
22	12.50	SPT	-	-	-	-	0	81	19	23	18	5	-	-	-	-	SM	-	-	-	-	-	-	-	-	24	-	-	-
23	13.00	SPT	-	-	-	-	0	85	15	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	28	-	-	-
24	14.00	SPT	-	-	-	-	0	82	18	23	19	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	32	-	-	-
25	14.50	SPT	-	-	-	-	0	83	17	22	18	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	36	-	-	-
26	15.50	UDS	2.31	2.07	11.51	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	97.9	UCS	-	-	-	-	-	0.31	23.8
27	15.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
28	17.50	UDS	2.34	2.13	9.95	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	106.4	UCS	-	-	-	-	-	0.27	21.2
29	18.50	UDS	2.40	2.21	8.40	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	99.5	-	UCS	-	-	-	-	6.66	0.23	18.6
30	20.00	UDS	2.43	2.25	7.91	2.74	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	112.4	-	UCS	-	-	-	-	14.66	0.22	17.8
31	21.50	UDS	2.53	2.42	4.57	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	186.7	-	UCS	-	-	-	-	57.33	0.12	11.0
32	23.00	UDS	2.49	2.34	6.35	2.75	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	138.6	-	UCS	-	-	-	-	40.66	0.17	14.9
33	25.00	UDS	2.56	2.46	3.99	2.73	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	184.2	-	UCS	-	-	-	-	75.00	0.11	9.8

UDS - Undisturbed Sample
DS - Disturbed Sample
SPT - Standard Penetration Tests

KCT Consultancy Services LLP, Ahmedabad

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 25

Co-Ordinate :- E - 1042, N - 3715

Reduced Level :- 198.30m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	0	63	37		31	16	15	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	69	31		28	17	11	-	-	-	SC	-	-	-	-	-	-	-	-	14	-	-	-
3	2.00	SPT	-	-	-	-	0	72	28		25	15	10	-	-	-	SC	-	-	-	-	-	-	-	-	8	-	-	-
4	2.50	UDS	1.88	1.41	33.02	2.65	0	64	36		30	17	13	-	-	-	SC	0.07	24	-	-	DSU	-	-	-	-	-	0.88	46.7
5	3.00	SPT	-	-	-	-	0	78	22		24	15	9	-	-	-	SC	-	-	-	-	-	-	-	-	10	-	-	-
6	3.50	UDS	1.93	1.49	29.51	2.66	0	67	33		28	16	12	-	-	-	SC	0.06	25	-	-	DSU	-	-	-	-	-	0.78	44.0
7	4.00	SPT	-	-	-	-	0	81	19		23	14	9	-	-	-	SC	-	-	-	-	-	-	-	-	75	-	-	-
8	4.50	SPT	-	-	-	-	0	76	24		26	15	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
9	5.00	SPT	-	-	-	-	0	79	21		24	16	8	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
10	5.50	SPT	-	-	-	-	0	82	18		23	15	8	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
11	6.00	SPT	-	-	-	-	0	75	25		27	14	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
12	6.50	SPT	-	-	-	-	0	71	29		30	16	14	-	-	-	SC	-	-	-	-	-	-	-	-	32	-	-	-
13	7.00	SPT	-	-	-	-	0	78	22		24	15	9	-	-	-	SC	-	-	-	-	-	-	-	-	76	-	-	-
14	7.50	SPT	-	-	-	-	0	69	31		32	17	15	-	-	-	SC	-	-	-	-	-	-	-	-	72	-	-	-
15	8.00	SPT	-	-	-	-	0	75	25		28	18	10	-	-	-	SC	-	-	-	-	-	-	-	-	74	-	-	-
16	8.50	SPT	-	-	-	-	0	70	30		30	16	14	-	-	-	SC	-	-	-	-	-	-	-	-	77	-	-	-
17	9.00	SPT	-	-	-	-	0	67	33		32	15	17	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
18	9.50	SPT	-	-	-	-	0	82	18		26	17	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
19	10.00	SPT	-	-	-	-	0	76	24		28	16	12	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
20	11.00	SPT	-	-	-	-	0	80	20		27	17	10	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
21	11.50	SPT	-	-	-	-	0	84	16		24	15	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
22	12.50	SPT	-	-	-	-	0	39	46	15	29	15	14	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-
23	13.00	SPT	-	-	-	-	0	43	46	11	27	17	10	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-
24	14.00	SPT	-	-	-	-	0	67	33		26	15	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
25	14.50	SPT	-	-	-	-	0	76	24		24	16	8	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
26	15.50	SPT	-	-	-	-	0	78	22		23	14	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
27	16.00	SPT	-	-	-	-	0	72	28		25	13	12	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
28	17.50	UDS	2.16	1.85	16.99	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	39.4	UCS	-	-	-	-	-	0.46	31.4
29	17.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
30	19.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	-	-	-	-
31	19.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
32	20.50	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	-	-	-	-
33	20.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
34	22.00	UDS	2.21	1.92	15.00	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	69.4	UCS	-	-	-	-	-	0.40	28.8

KCT Consultancy Services LLP, Ahmedabad

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTTP) at village Hirma, Talabira, Odisha

BH No. :- IBH 26

Co-Ordinate :- E 1569, N 3519

Reduced Level :- 208.20m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	0	47	38	15	30	16	14	-	-	-	CL	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	20	54	26	32	18	14	-	-	-	-	SC	-	-	-	-	-	-	-	-	28	-	-	-
3	2.00	SPT	-	-	-	-	35	38	27	33	17	16	-	-	-	-	SC	-	-	-	-	-	-	-	-	13	-	-	-
4	2.50	UDS	1.71	1.60	7.09	2.67	17	53	30	35	16	19	-	-	-	-	SC	0.07	27	-	-	DSU	-	-	-	-	-	0.67	40.2
5	3.00	SPT	-	-	-	-	0	74	26	33	18	15	-	-	-	-	SC	-	-	-	-	-	-	-	-	51	-	-	-
6	3.50	SPT	-	-	-	-	4	72	24	29	19	10	-	-	-	-	SC	-	-	-	-	-	-	-	-	73	-	-	-
7	4.00	SPT	-	-	-	-	13	72	15	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
8	4.50	SPT	-	-	-	-	12	68	20	24	20	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
9	5.00	SPT	-	-	-	-	2	55	43	35	21	14	-	-	-	-	SC	-	-	-	-	-	-	-	-	44	-	-	-
10	5.50	SPT	-	-	-	-	2	75	23	31	20	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	81	-	-	-
11	6.00	SPT	-	-	-	-	0	74	26	30	16	14	-	-	-	-	SC	-	-	-	-	-	-	-	-	54	-	-	-
12	6.50	SPT	-	-	-	-	0	85	15	21	15	6	-	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
13	7.00	SPT	-	-	-	-	4	74	22	24	18	6	-	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
14	7.50	SPT	-	-	-	-	4	60	36	26	19	7	-	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
15	8.00	SPT	-	-	-	-	30	64	6	NP	NP	NP	-	-	-	-	SP-SM	-	-	-	-	-	-	-	-	>100	-	-	-
16	8.50	SPT	-	-	-	-	0	89	11	NP	NP	NP	-	-	-	-	SP-SM	-	-	-	-	-	-	-	-	>100	-	-	-
17	9.50	UDS	2.08	1.72	20.73	2.68	70	24	6	NP	NP	NP	-	-	-	-	SP-SM	0.00	33	-	-	DSU	-	-	-	-	-	0.56	35.7
18	9.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
19	11.00	UDS	2.19	1.89	16.12	2.71	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	56.3	-	UCS	-	-	-	-	8.00	0.44	30.4
20	11.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
21	12.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
22	13.00	UDS	2.18	1.88	16.07	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	62.6	UCS	-	-	-	-	-	0.43	30.2
23	14.50	UDS	2.26	2.01	12.44	2.68	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	81.1	UCS	-	-	-	-	-	0.33	25.0
24	16.00	UDS	2.32	2.10	10.66	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	96.3	UCS	-	-	-	-	-	0.29	22.4
25	17.50	UDS	2.29	2.05	11.53	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	70.5	UCS	-	-	-	-	-	0.31	23.7
26	19.00	UDS	2.23	1.96	13.90	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	87.8	UCS	-	-	-	-	-	0.37	27.2
27	20.50	UDS	2.34	2.11	11.13	2.75	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	115.3	UCS	-	-	-	-	-	0.31	23.4
28	22.00	UDS	2.37	2.14	10.54	2.77	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	138.9	UCS	-	-	-	-	-	0.29	22.6
29	23.50	UDS	2.66	2.58	3.01	2.80	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	416.5	UCS	-	-	-	-	-	0.08	7.8
30	25.00	UDS	2.69	2.62	2.53	2.81	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	476.9	UCS	-	-	-	-	-	0.07	6.6

KCT Consultancy Services LLP, Ahmedabad

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 27

Co-Ordinate :- E 1166, N 3589

Reduced Level :- 200.28 m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	0	66	34	24	13	11	-	-	-	-	Filled up Soil	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	54	46	43	19	24	-	-	-	-	SC	-	-	-	-	-	-	-	-	5	-	-	-
3	2.00	SPT	-	-	-	-	0	76	24	37	18	19	-	-	-	-	SC	-	-	-	-	-	-	-	-	10	-	-	-
4	2.50	UDS	1.93	1.49	29.51	2.66	10	52	38	39	16	23	-	-	-	-	SC	0.06	25	-	-	DSU	-	-	-	-	-	0.78	44.0
5	3.00	SPT	-	-	-	-	8	78	14	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	17	-	-	-
6	3.50	UDS	1.96	1.53	27.70	2.67	21	63	16	27	22	5	-	-	-	-	SM	0.00	30	-	-	DSU	-	-	-	-	-	0.74	42.5
7	4.00	SPT	-	-	-	-	6	76	18	NP	NP	23	-	-	-	-	SM	-	-	-	-	-	-	-	-	29	-	-	-
8	4.50	DS	-	-	-	-	0	84	16	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	-	-	-	-
9	5.00	SPT	-	-	-	-	0	86	14	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
10	5.50	SPT	-	-	-	-	5	78	17	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
11	6.00	SPT	-	-	-	-	0	82	18	19	15	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
12	6.50	SPT	-	-	-	-	0	79	21	20	16	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
13	7.00	SPT	-	-	-	-	0	72	28	27	20	7	-	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
14	7.50	SPT	-	-	-	-	2	76	22	25	19	6	-	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
15	8.00	SPT	-	-	-	-	0	68	32	25	20	5	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
16	8.50	SPT	-	-	-	-	0	87	13	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
17	9.00	SPT	-	-	-	-	10	74	16	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
18	9.50	SPT	-	-	-	-	8	64	28	23	18	5	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
19	10.00	SPT	-	-	-	-	3	79	18	20	16	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
20	11.00	SPT	-	-	-	-	0	80	20	21	17	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
21	11.50	SPT	-	-	-	-	5	79	16	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
22	12.50	SPT	-	-	-	-	6	85	9	NP	NP	NP	-	-	-	-	SP-SM	-	-	-	-	-	-	-	-	>100	-	-	-
23	13.00	SPT	-	-	-	-	0	94	6	NP	NP	NP	-	-	-	-	SP-SM	-	-	-	-	-	-	-	-	>100	-	-	-
24	14.00	SPT	-	-	-	-	67	20	13	NP	NP	NP	-	-	-	-	Boulderous	-	-	-	-	-	-	-	-	>100	-	-	-
25	14.50	Remoulded	2.09	1.73	20.46	2.69	58	19	23	21	17	4	-	-	-	-	Boulderous	0.00	33	-	-	DSU	-	-	-	-	22.00	0.55	35.5
26	14.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
27	15.50	DS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	-	-	-	-
28	15.50	SPT	-	-	-	-	7	73	20	29	16	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
29	16.00	SPT	-	-	-	-	9	68	23	34	15	19	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
30	17.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
31	17.50	UDS	2.21	1.93	14.75	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	38.4	UCS	-	-	-	-	-	0.40	28.4
32	18.50	UDS	2.26	2.00	12.93	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	86.7	UCS	-	-	-	-	-	0.35	25.9
33	19.00	UDS	2.51	2.38	5.56	2.74	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	129.4	-	UCS	-	-	-	-	22.00	0.15	13.2
34	20.50	UDS	2.47	2.33	6.02	2.71	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	100.7	-	UCS	-	-	-	-	8.00	0.16	14.0
35	22.00	UDS	2.57	2.46	4.60	2.77	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	120.5	-	UCS	-	-	-	-	21.33	0.13	11.3

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 28

Co-Ordinate :- E - 1137, N - 3607

Reduced Level :- 199.71m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility m _v cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	0	71	29	26	16	10	-	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	3	66	31	29	15	14	-	-	-	-	SC	-	-	-	-	-	-	-	-	4	-	-	-
3	2.00	SPT	-	-	-	-	0	61	39	30	14	16	-	-	-	-	SC	-	-	-	-	-	-	-	-	22	-	-	-
4	2.50	UDS	1.66	1.54	8.06	2.65	4	59	37	28	16	12	-	-	-	-	SC	0.07	26	-	-	DSU	-	-	-	-	-	0.73	42.0
5	3.00	SPT	-	-	-	-	6	63	31	25	17	8	-	-	-	-	SC	-	-	-	-	-	-	-	-	9	-	-	-
6	3.50	SPT	-	-	-	-	0	60	40	30	19	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	10	-	-	-
7	4.00	SPT	-	-	-	-	0	77	23	22	18	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	38	-	-	-
8	4.50	UDS	2.04	1.67	22.41	2.66	0	76	24	25	20	5	-	-	-	-	SM	0.00	30	-	-	DSU	-	-	-	-	-	0.60	37.3
9	5.00	SPT	-	-	-	-	17	61	22	20	16	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
10	5.50	SPT	-	-	-	-	20	63	17	16	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
11	6.00	SPT	-	-	-	-	0	67	33	29	16	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
12	6.50	SPT	-	-	-	-	3	82	15	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
13	7.00	SPT	-	-	-	-	5	71	24	20	16	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
14	7.50	SPT	-	-	-	-	1	78	21	19	15	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
15	8.00	SPT	-	-	-	-	5	70	25	22	17	5	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
16	8.50	SPT	-	-	-	-	2	69	29	25	20	5	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
17	9.00	SPT	-	-	-	-	0	76	24	24	20	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
18	9.50	SPT	-	-	-	-	3	75	22	21	17	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
19	10.00	SPT	-	-	-	-	6	57	37	29	16	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
20	11.00	SPT	-	-	-	-	12	61	27	26	15	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
21	11.50	SPT	-	-	-	-	5	56	39	30	17	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
22	12.50	SPT	-	-	-	-	9	58	33	26	16	10	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
23	13.00	SPT	-	-	-	-	11	53	36	29	15	14	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
24	14.00	SPT	-	-	-	-	2	59	39	30	14	16	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
25	14.50	SPT	-	-	-	-	8	60	32	26	16	10	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
26	15.50	SPT	-	-	-	-	8	70	22	24	18	6	-	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
27	16.00	SPT	-	-	-	-	9	68	23	22	15	7	-	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
28	17.00	SPT	-	-	-	-	13	67	20	21	15	6	-	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
29	17.50	SPT	-	-	-	-	10	65	25	26	20	6	-	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
30	19.00	UDS	2.25	1.99	13.09	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	43.1	UCS	-	-	-	-	-	0.35	26.0
31	20.50	UDS	2.27	2.00	13.27	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	89.6	UCS	-	-	-	-	-	0.36	26.6
32	22.00	UDS	2.31	2.07	11.51	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	91.0	UCS	-	-	-	-	-	0.31	23.8
33	23.50	UDS	2.34	2.11	10.89	2.74	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	105.6	UCS	-	-	-	-	-	0.30	23.0
34	25.00	UDS	2.30	2.04	12.59	2.75	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	98.2	UCS	-	-	-	-	-	0.35	25.7

KCT Consultancy Services LLP, Ahmedabad

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 29

Co-Ordinate :- E - 1254, N - 3809

Reduced Level :- 200.10m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	34	46	20		27	21	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	14	64	22		30	23	7	-	-	-	SM-SC	-	-	-	-	-	-	-	-	19	-	-	-
3	2.00	SPT	-	-	-	-	6	74	20		29	23	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	34	-	-	-
4	2.50	UDS	1.83	1.69	8.61	2.67	12	73	15		31	25	6	-	-	-	SM-SC	0.02	30	-	-	DSU	-	-	-	-	-	0.58	36.9
5	3.00	SPT	-	-	-	-	0	85	15		27	23	4	-	-	-	SM	-	-	-	-	-	-	-	-	58	-	-	-
6	3.50	UDS	1.79	1.66	7.98	2.66	0	72	28		29	25	4	-	-	-	SM	0.00	30	-	-	DSU	-	-	-	-	-	0.60	37.7
7	4.00	SPT	-	-	-	-	0	76	24		26	20	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	26	-	-	-
8	4.50	UDS	2.04	1.67	22.41	2.66	0	74	26		29	22	7	-	-	-	SM-SC	0.06	29	-	-	DSU	-	-	-	-	-	0.60	37.3
9	5.00	SPT	-	-	-	-	0	78	22		25	19	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	70	-	-	-
10	5.50	SPT	-	-	-	-	0	68	32		28	16	12	-	-	-	SC	-	-	-	-	-	-	-	-	70	-	-	-
11	6.00	SPT	-	-	-	-	14	68	18		25	17	8	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
12	6.50	SPT	-	-	-	-	0	84	16		24	15	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
13	7.00	SPT	-	-	-	-	4	82	14		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
14	7.50	SPT	-	-	-	-	0	84	16		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
15	8.00	SPT	-	-	-	-	14	68	18		19	15	4	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
16	8.50	SPT	-	-	-	-	3	72	25		24	14	10	-	-	-	SC	-	-	-	-	-	-	-	-	53	-	-	-
17	9.00	SPT	-	-	-	-	32	53	15		22	13	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
18	9.50	SPT	-	-	-	-	12	74	14		21	12	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
19	10.00	SPT	-	-	-	-	6	76	18		23	13	10	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
20	11.00	SPT	-	-	-	-	0	59	41		26	15	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
21	11.50	SPT	-	-	-	-	4	81	15		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
22	12.50	SPT	-	-	-	-	3	85	12		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
23	13.00	SPT	-	-	-	-	0	64	36		25	21	4	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
24	14.00	SPT	-	-	-	-	0	98	2		NP	NP	NP	-	-	-	SP	-	-	-	-	-	-	-	-	>100	-	-	-
25	14.50	UDS	2.26	2.00	12.93	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	39.6	UCS	-	-	-	-	-	0.35	25.9
26	14.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
27	16.00	UDS	2.33	2.11	10.54	2.71	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	60.1	UCS	-	-	-	-	-	0.29	22.2
28	17.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
29	19.00	UDS	2.29	2.04	12.49	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	55.6	UCS	-	-	-	-	-	0.34	25.4
30	20.50	UDS	2.21	1.90	16.23	2.75	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	64.8	-	UCS	-	-	-	-	8.00	0.45	30.9
31	22.00	UDS	2.31	2.08	11.27	2.71	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	76.8	UCS	-	-	-	-	-	0.31	23.4
32	23.50	UDS	2.30	2.05	12.12	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	95.1	UCS	-	-	-	-	-	0.33	24.9
33	25.00	UDS	2.33	2.11	10.30	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	80.3	UCS	-	-	-	-	-	0.28	21.8

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 30

Co-Ordinate :- E - 752, N - 3479

Reduced Level :- 197.78m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility m _v cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	0	23	55	22	38	18	20	-	-	-	CI	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	11	60	29	47	21	26	-	-	-	CI	-	-	-	-	-	-	-	-	7	-	-	-
3	2.00	SPT	-	-	-	-	0	12	57	31	45	17	28	-	-	-	CI	-	-	-	-	-	-	-	-	11	-	-	-
4	2.50	UDS	1.95	1.53	27.22	2.63	0	14	52	34	44	15	29	-	-	-	CI	0.56	5	-	-	TUU	0.15	0.0186	0.45	-	-	0.72	41.7
5	3.00	SPT	-	-	-	-	0	13	57	30	45	19	26	-	-	-	CI	-	-	-	-	-	-	-	-	14	-	-	-
6	3.50	UDS	1.94	1.52	27.31	2.61	0	11	58	31	45	17	28	-	-	-	CI	0.73	3	-	-	TUU	0.15	0.0143	0.52	-	-	0.71	41.6
7	4.00	SPT	-	-	-	-	0	30	46	24	37	16	21	-	-	-	CI	-	-	-	-	-	-	-	-	14	-	-	-
8	4.50	SPT	-	-	-	-	0	46	28	26	36	14	22	-	-	-	CI	-	-	-	-	-	-	-	-	21	-	-	-
9	5.00	SPT	-	-	-	-	0	78	22	26	15	11	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
10	5.50	SPT	-	-	-	-	0	69	31	29	17	12	12	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
11	6.00	SPT	-	-	-	-	0	76	24	27	16	11	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
12	6.50	SPT	-	-	-	-	0	69	31	28	15	13	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
13	7.00	SPT	-	-	-	-	0	72	28	26	17	9	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
14	7.50	SPT	-	-	-	-	4	71	25	24	16	8	8	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
15	8.00	SPT	-	-	-	-	15	56	29	28	15	13	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
16	8.50	SPT	-	-	-	-	2	52	46	29	17	12	12	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
17	9.00	SPT	-	-	-	-	24	34	42	28	20	8	8	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
18	9.50	UDS	2.48	2.35	5.73	2.71	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	126.6	-	UCS	-	-	-	-	20.00	0.16	13.5
19	11.00	UDS	2.46	2.32	6.09	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	117.2	-	UCS	-	-	-	-	16.00	0.16	14.1
20	12.50	UDS	2.48	2.34	6.19	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	211.1	-	UCS	-	-	-	-	27.33	0.17	14.5
21	14.00	UDS	2.53	2.40	5.45	2.76	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	363.9	-	UCS	-	-	-	-	12.66	0.15	13.1
22	15.50	UDS	2.46	2.31	6.55	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	161.8	-	UCS	-	-	-	-	56.00	0.18	15.1

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 31

Co-Ordinate :- E - 830, N - 3466

Reduced Level :- 196.60m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility m _v cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	0	27	51	22	40	21	19	-	-	-	CI	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	4	25	42	29	42	17	25	-	-	-	CI	-	-	-	-	-	-	-	-	8	-	-	-
3	2.00	SPT	-	-	-	-	0	24	51	25	43	22	21	-	-	-	CI	-	-	-	-	-	-	-	-	14	-	-	-
4	2.50	SPT	-	-	-	-	0	28	46	26	45	21	24	-	-	-	CI	-	-	-	-	-	-	-	-	13	-	-	-
5	3.00	SPT	-	-	-	-	8	41	27	24	41	20	21	-	-	-	CI	-	-	-	-	-	-	-	-	14	-	-	-
6	3.50	UDS	1.96	1.54	27.41	2.66	0	46	34	20	37	20	17	-	-	-	CI	0.73	8	-	-	TUU	0.15	0.0123	0.61	-	-	0.73	42.2
7	4.00	SPT	-	-	-	-	14	67	19	19	33	17	16	-	-	-	SC	-	-	-	-	-	-	-	-	12	-	-	-
8	4.50	UDS	1.99	1.59	25.44	2.66	8	45	47	43	20	23	23	-	-	-	SC	0.11	25	-	-	DSU	-	-	-	-	-	0.68	40.4
9	5.00	SPT	-	-	-	-	0	60	40	30	19	11	11	-	-	-	SC	-	-	-	-	-	-	-	-	23	-	-	-
10	5.50	UDS	2.02	1.64	23.31	2.65	0	47	35	18	38	22	16	-	-	-	CI	1.13	7	-	-	TUU	0.11	0.0072	0.89	-	-	0.62	38.2
11	6.00	SPT	-	-	-	-	0	6	73	21	42	24	18	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-
12	6.50	SPT	-	-	-	-	0	4	76	20	40	23	17	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-
13	7.00	SPT	-	-	-	-	0	8	69	23	45	24	21	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-
14	7.50	SPT	-	-	-	-	0	6	75	19	40	23	17	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-
15	8.00	SPT	-	-	-	-	0	11	66	23	48	24	24	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-
16	8.50	SPT	-	-	-	-	0	28	48	24	41	19	22	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-
17	9.00	SPT	-	-	-	-	0	32	39	29	45	20	25	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-
18	9.50	UDS	2.39	2.20	8.50	2.71	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	140.6	UCS	-	-	-	-	-	0.23	18.7
19	11.00	UDS	2.40	2.21	8.40	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	153.9	UCS	-	-	-	-	-	0.23	18.6
20	12.50	UDS	2.40	2.20	8.86	2.74	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	121.6	-	UCS	-	-	-	-	8.00	0.24	19.5
21	14.00	UDS	2.48	2.34	5.96	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	162.7	-	UCS	-	-	-	-	27.00	0.16	14.0
22	15.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
23	17.00	UDS	2.23	1.96	13.65	2.68	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	82.3	-	UCS	-	-	-	-	19.00	0.37	26.8
24	18.50	UDS	2.34	2.13	9.71	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	60.4	-	UCS	-	-	-	-	40.00	0.26	20.7
25	20.00	UDS	2.39	2.19	8.96	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	212.6	-	UCS	-	-	-	-	37.33	0.24	19.7
26	21.50	UDS	2.40	2.20	8.86	2.74	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	182.7	-	UCS	-	-	-	-	73.30	0.24	19.5

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 32

Co-Ordinate :- E - 794, N - 3534

Reduced Level :- 196.50m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility m _v cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	0	27	59	14	29	17	12	-	-	-	CL	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	7	53	40	54	20	34	13	-	58	CH	-	-	-	-	-	-	-	-	5	-	-	-
3	2.00	SPT	-	-	-	-	0	18	48	34	52	22	30	-	-	-	CH	-	-	-	-	-	-	-	-	16	-	-	-
4	2.50	SPT	-	-	-	-	0	22	41	37	51	19	32	14	-	55	CH	-	-	-	-	-	-	-	-	20	-	-	-
5	3.00	SPT	-	-	-	-	0	47	22	31	45	18	27	-	-	-	CI	-	-	-	-	-	-	-	-	23	-	-	-
6	3.50	UDS	1.98	1.57	25.80	2.65	0	43	38	19	37	20	17	20	0.11	31	CI	1.03	8	-	-	TUU	0.12	0.0086	0.63	-	-	0.68	40.6
7	4.00	SPT	-	-	-	-	3	61	36	3	34	15	19	-	-	-	SC	-	-	-	-	-	-	-	-	16	-	-	-
8	4.50	UDS	1.97	1.55	26.74	2.66	0	57	43	3	28	18	10	-	-	-	SC	0.07	26	-	-	DSU	-	-	-	-	-	0.71	41.6
9	5.00	SPT	-	-	-	-	0	64	36	3	27	15	12	-	-	-	SC	-	-	-	-	-	-	-	-	28	-	-	-
10	5.50	UDS	1.99	1.59	25.44	2.66	0	62	38	3	29	16	13	-	-	-	SC	0.06	27	-	-	DSU	-	-	-	-	-	0.68	40.4
11	6.00	SPT	-	-	-	-	0	58	42	3	30	19	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
12	6.50	SPT	-	-	-	-	0	60	40	3	28	18	10	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
13	7.00	SPT	-	-	-	-	0	66	34	3	29	19	10	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
14	7.50	SPT	-	-	-	-	0	71	29	3	26	15	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
15	8.00	SPT	-	-	-	-	0	74	26	3	24	16	8	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
16	8.50	SPT	-	-	-	-	0	75	25	3	28	19	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
17	9.00	SPT	-	-	-	-	0	78	22	3	29	18	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
18	9.50	SPT	-	-	-	-	0	70	30	3	31	19	12	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
19	10.00	SPT	-	-	-	-	0	72	28	3	26	16	10	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
20	11.00	SPT	-	-	-	-	0	76	24	3	25	16	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
21	11.50	SPT	-	-	-	-	0	77	23	3	22	14	8	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
22	12.50	SPT	-	-	-	-	13	54	33	3	29	16	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
23	13.00	SPT	-	-	-	-	11	45	44	3	30	15	15	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
24	14.50	SPT	-	-	-	-	15	46	39	3	27	16	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
25	15.50	UDS	2.21	1.92	15.00	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	109.2	-	UCS	-	-	-	-	44.00	0.40	28.8
26	17.00	UDS	2.29	2.04	12.01	2.71	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	128.7	-	UCS	-	-	-	-	22.66	0.33	24.6
27	18.50	UDS	2.42	2.24	8.22	2.74	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	193.4	-	UCS	-	-	-	-	67.00	0.23	18.4

KCT Consultancy Services LLP, Ahmedabad

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 33

Co-Ordinate :- E - 1026, N - 3326

Reduced Level :- 197.00 m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	0	31	33	36	52	21	31	-	-	-	CH	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	38	48	14	31	19	12	-	-	-	CL	-	-	-	-	-	-	-	-	13	-	-	-
3	2.00	SPT	-	-	-	-	0	46	42	12	29	18	11	-	-	-	CL	-	-	-	-	-	-	-	-	12	-	-	-
4	2.50	UDS	1.97	1.56	26.45	2.65	0	42	38	20	33	16	17	-	-	-	CL	0.69	9	-	-	TUU	0.14	0.0144	0.43	-	-	0.70	41.2
5	3.00	SPT	-	-	-	-	0	29	57	14	30	17	13	-	-	-	CL	-	-	-	-	-	-	-	-	17	-	-	-
6	3.50	UDS	1.98	1.58	24.93	2.62	0	25	65	10	28	19	9	-	-	-	CL	1.13	6	-	-	TUU	0.12	0.0058	0.57	-	-	0.65	39.5
7	4.00	SPT	-	-	-	-	0	19	60	21	40	22	18	-	-	-	CI	-	-	-	-	-	-	-	-	61	-	-	-
8	4.50	UDS	2.03	1.67	21.57	2.61	0	13	62	25	42	19	23	-	-	-	CI	1.84	2	-	-	TUU	0.11	0.0055	1.86	-	-	0.56	36.0
9	5.00	SPT	-	-	-	-	0	23	58	19	39	23	16	-	-	-	CI	-	-	-	-	-	-	-	-	32	-	-	-
10	5.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	73	-	-	-
11	6.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
12	6.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
13	7.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	72	-	-	-
14	9.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
15	10.50	DS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	-	-	-	-
16	12.00	DS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	-	-	-	-
17	13.50	DS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	-	-	-	-
18	15.00	DS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	-	-	-	-
19	16.50	DS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	-	-	-	-
20	18.00	UDS	2.49	2.35	5.90	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	147.5	-	UCS	-	-	-	-	6.66	0.16	13.9
21	19.50	UDS	2.26	2.00	13.18	2.71	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	68.4	-	UCS	-	-	-	-	81.00	0.36	26.3

KCT Consultancy Services LLP, Ahmedabad

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 34

Co-Ordinate :- E 1131, N 3266

Reduced Level :- 198.51 m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	0	31	55	14	28	15	13	-	-	-	CL	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	29	47	24	40	19	21	18	-	36	CI	-	-	-	-	-	-	-	-	9	-	-	-
3	2.00	SPT	-	-	-	-	0	28	47	25	42	20	22	-	-	-	CI	-	-	-	-	-	-	-	-	12	-	-	-
4	2.50	UDS	1.98	1.57	25.80	2.65	0	31	49	20	40	23	17	20	0.14	33	CI	0.66	7	-	-	TUU	0.14	0.0144	0.42	-	-	0.68	40.6
5	3.00	SPT	-	-	-	-	0	28	50	22	41	22	19	-	-	-	CI	-	-	-	-	-	-	-	-	27	-	-	-
6	3.50	DS	-	-	-	-	0	32	51	17	39	24	15	-	-	-	CI	-	-	-	-	-	-	-	-	-	-	-	-
7	4.00	SPT	-	-	-	-	0	19	53	28	52	27	25	-	-	-	CH	-	-	-	-	-	-	-	-	17	-	-	-
8	4.50	UDS	1.99	1.60	24.29	2.62	0	15	52	33	54	25	29	13	0.38	57	CH	0.93	1	-	-	TUU	0.12	0.0120	0.62	-	-	0.64	38.9
9	5.00	SPT	-	-	-	-	0	16	52	32	53	26	27	-	-	-	CH	-	-	-	-	-	-	-	-	30	-	-	-
10	5.50	UDS	2.07	1.73	19.90	2.63	0	20	53	27	51	27	24	-	-	-	CH	1.62	5	-	-	TUU	0.10	0.0067	1.64	-	-	0.52	34.4
11	6.00	SPT	-	-	-	-	0	18	51	31	54	26	28	-	-	-	CH	-	-	-	-	-	-	-	-	31	-	-	-
12	6.50	UDS	2.08	1.75	19.08	2.62	0	17	48	35	55	25	30	12	0.48	59	CH	1.61	4	-	-	TUU	0.09	0.0069	2.15	-	-	0.50	33.3
13	7.00	SPT	-	-	-	-	0	20	52	28	52	27	25	-	-	-	CH	-	-	-	-	-	-	-	-	30	-	-	-
14	7.50	UDS	2.05	1.68	21.84	2.66	0	71	29	28	16	12	-	-	-	-	SC	0.07	25	-	-	DSU	-	-	-	-	-	0.58	36.7
15	8.00	SPT	-	-	-	-	0	64	36	31	15	16	-	-	-	-	SC	-	-	-	-	-	-	-	-	13	-	-	-
16	8.50	UDS	2.03	1.65	22.71	2.65	0	66	34	30	16	14	-	-	-	-	SC	0.10	26	-	-	DSU	-	-	-	-	-	0.60	37.6
17	9.00	SPT	-	-	-	-	0	76	24	24	17	7	-	-	-	-	SM-SC	-	-	-	-	-	-	-	-	26	-	-	-
18	9.50	UDS	2.05	1.68	21.84	2.66	0	71	29	26	20	6	-	-	-	-	SM-SC	0.02	28	-	-	DSU	-	-	-	-	-	0.58	36.7
19	10.00	SPT	-	-	-	-	0	79	21	21	15	6	-	-	-	-	SM-SC	-	-	-	-	-	-	-	-	23	-	-	-
20	11.00	UDS	2.11	1.78	18.36	2.65	0	66	34	25	14	11	-	-	-	-	SC	0.08	26	-	-	DSU	-	-	-	-	-	0.49	32.7
21	11.50	SPT	-	-	-	-	0	65	35	26	13	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	34	-	-	-
22	12.50	DS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	-	-	-	-
23	13.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
24	14.50	DS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	-	-	-	-
25	14.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
26	16.00	UDS	2.19	1.90	15.36	2.68	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	56.3	UCS	-	-	-	-	-	0.41	29.2
27	17.50	UDS	2.24	1.97	13.49	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	51.7	UCS	-	-	-	-	-	0.36	26.6
28	19.00	UDS	2.25	1.99	13.33	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	38.9	-	UCS	-	-	-	-	17.33	0.36	26.5
29	20.50	UDS	2.20	1.91	15.18	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	34.1	-	UCS	-	-	-	-	13.33	0.41	29.0
30	22.00	UDS	2.18	1.87	16.57	2.71	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	62.9	-	UCS	-	-	-	-	62.00	0.45	31.0
31	23.50	UDS	2.39	2.20	8.73	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	116.8	-	UCS	-	-	-	-	48.00	0.24	19.2
32	25.00	UDS	2.23	1.94	14.89	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	61.3	-	UCS	-	-	-	-	24.00	0.41	28.9

UDS - Undisturbed Sample

DS - Disturbed Sample

SPT - Standard Penetration Tests

NP - Non Plastic

TUU - Triaxial Unconsolidated Undrained

TCU - Triaxial Consolidated Undrained

DSU - Direct Shear Test

UCS - Unconfined Compression Strength

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 35

Co-Ordinate :- E - 1132, N - 3102

Reduced Level :- 198.78m

Sr No	Depth of Sample	Type of Sample	Field Bulk Density	Field Dry Density	Natural Moisture Content	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit	Swelling Pressure	Free Swell Index	Soil Classification	Shear Parameter		Unconfined Compression Test	UCS by Point Load Index in rock	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation	Void Ratio	Porosity
							Gravel	Sand	Silt	Clay	Liquid Limit	Plastic Limit	Plasticity Index					Cohesion C	Angle of Internal Friction ϕ				Compression Index C _c	Coefficient of Volume Compressibility mv	Pre-consolidation Pressure				
1	0.00	DS	-	-	-	-	0	56	44	34	18	16	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	38	35	27	43	19	24	-	-	-	CI	-	-	-	-	-	-	-	-	5	-	-	-
3	2.00	SPT	-	-	-	-	0	37	32	31	45	17	28	-	-	-	CI	-	-	-	-	-	-	-	-	7	-	-	-
4	2.50	UDS	1.96	1.54	27.12	2.65	0	35	28	37	49	16	33	-	-	-	CI	0.36	6	-	-	TUU	0.15	0.0298	0.43	-	-	0.72	41.8
5	3.00	SPT	-	-	-	-	6	42	27	25	40	18	22	-	-	-	CI	-	-	-	-	-	-	-	-	9	-	-	-
6	3.50	UDS	1.98	1.57	26.09	2.66	2	40	32	26	48	24	24	-	-	-	CI	0.44	8	-	-	TUU	0.14	0.0214	0.56	-	-	0.69	41.0
7	4.00	SPT	-	-	-	-	4	43	31	22	46	26	20	-	-	-	CI	-	-	-	-	-	-	-	-	14	-	-	-
8	4.50	SPT	-	-	-	-	0	41	29	30	46	20	26	-	-	-	CI	-	-	-	-	-	-	-	-	17	-	-	-
9	5.00	SPT	-	-	-	-	0	18	45	37	48	16	32	-	-	-	CI	-	-	-	-	-	-	-	-	30	-	-	-
10	6.00	SPT	-	-	-	-	0	20	53	27	41	18	23	-	-	-	CI	-	-	-	-	-	-	-	-	23	-	-	-
11	6.50	UDS	1.99	1.59	25.16	2.65	0	31	44	25	47	25	22	-	-	-	CI	1.23	6	-	-	TUU	0.13	0.0081	1.38	-	-	0.67	40.0
12	7.50	SPT	-	-	-	-	0	68	32	33	21	12	-	-	-	SC	-	-	-	-	-	-	-	-	-	17	-	-	-
13	8.00	SPT	-	-	-	-	0	69	31	32	22	10	-	-	-	SC	-	-	-	-	-	-	-	-	-	13	-	-	-
14	8.50	SPT	-	-	-	-	0	84	16	21	15	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	-	14	-	-	-
15	9.00	SPT	-	-	-	-	0	81	19	26	19	7	-	-	-	SM-SC	-	-	-	-	-	-	-	-	-	17	-	-	-
16	9.50	SPT	-	-	-	-	0	82	18	25	19	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	-	16	-	-	-
17	10.00	SPT	-	-	-	-	0	79	21	27	20	7	-	-	-	SM-SC	-	-	-	-	-	-	-	-	-	20	-	-	-
18	11.00	SPT	-	-	-	-	0	80	20	25	19	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	-	23	-	-	-
19	11.50	SPT	-	-	-	-	0	84	16	23	17	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	-	20	-	-	-
20	12.50	SPT	-	-	-	-	0	22	55	23	39	18	21	-	-	-	CI	-	-	-	-	-	-	-	-	91	-	-	-
21	13.00	UDS	2.29	2.06	11.28	2.68	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	43.1	UCS	-	-	-	-	-	-	0.30	23.2
22	14.50	UDS	2.30	2.07	11.15	2.69	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	46.0	UCS	-	-	-	-	-	-	0.30	23.1
23	16.00	UDS	2.32	2.10	10.66	2.70	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	110.6	-	UCS	-	-	-	-	-	13.23	0.29	22.4
24	17.50	UDS	2.34	2.13	9.95	2.70	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	139.7	-	UCS	-	-	-	-	-	47.00	0.27	21.2
25	19.00	UDS	2.64	2.54	3.89	2.82	-	-	-	-	-	-	-	-	-	ROCK	-	-	526.3	-	UCS	-	-	-	-	-	22.00	0.11	9.9
26	20.50	UDS	2.68	2.59	3.35	2.84	-	-	-	-	-	-	-	-	-	ROCK	-	-	436.1	-	UCS	-	-	-	-	-	51.33	0.10	8.7
27	22.00	UDS	2.31	2.08	11.03	2.70	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	146.2	-	UCS	-	-	-	-	-	36.00	0.30	22.9
28	23.50	UDS	2.71	2.64	2.48	2.83	-	-	-	-	-	-	-	-	-	ROCK	-	-	552.8	-	UCS	-	-	-	-	-	94.66	0.07	6.6

KCT Consultancy Services LLP, Ahmedabad

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 36

Co-Ordinate :- E 1132, N 2951

Reduced Level :- 200.53 m

Sr No	Depth of Sample	Type of Sample	Field Bulk Density	Field Dry Density	Natural Moisture Content	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit	Swelling Pressure	Free Swell Index	Soil Classification	Shear Parameter		Unconfined Compression Test	UCS by Point Load Index in rock	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation	Void Ratio	Porosity	
							Gravel	Sand	Silt	Clay	Liquid Limit	Plastic Limit	Plasticity Index					Cohesion C	Angle of Internal Friction ϕ				Compression Index C _c	Coefficient of Volume Compressibility mv	Pre-consolidation Pressure					
																														%
1	0.00	DS	-	-	-	-	0	30	38	32	53	24	29	-	-	-	CH	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	32	40	28	51	25	26	-	-	-	CH	-	-	-	-	-	-	-	7	-	-	-	-	
3	2.00	SPT	-	-	-	-	0	19	47	34	58	27	31	-	-	-	CH	-	-	-	-	-	-	-	15	-	-	-	-	
4	2.50	SPT	-	-	-	-	0	12	45	43	66	29	37	-	-	-	CH	-	-	-	-	-	-	-	10	-	-	-	-	
5	3.00	SPT	-	-	-	-	0	10	43	47	68	28	40	-	-	-	CH	-	-	-	-	-	-	-	16	-	-	-	-	
6	3.50	UDS	1.96	1.56	25.94	2.61	0	13	44	43	65	29	36	-	-	-	CH	0.93	2	-	-	TUU	0.10	0.0128	0.67	-	-	0.68	40.4	
7	4.00	SPT	-	-	-	-	0	21	46	33	54	26	28	-	-	-	CH	-	-	-	-	-	-	-	18	-	-	-	-	
8	4.50	SPT	-	-	-	-	0	19	46	35	59	28	31	-	-	-	CH	-	-	-	-	-	-	-	25	-	-	-	-	
9	5.00	SPT	-	-	-	-	0	33	38	29	51	26	25	-	-	-	CH	-	-	-	-	-	-	-	22	-	-	-	-	
10	5.50	SPT	-	-	-	-	0	34	34	32	53	25	28	-	-	-	CH	-	-	-	-	-	-	-	21	-	-	-	-	
11	6.00	SPT	-	-	-	-	0	29	49	22	43	23	20	-	-	-	CI	-	-	-	-	-	-	-	22	-	-	-	-	
12	6.50	SPT	-	-	-	-	0	26	43	31	47	21	26	-	-	-	CI	-	-	-	-	-	-	-	25	-	-	-	-	
13	7.00	SPT	-	-	-	-	0	61	39		46	22	24	-	-	-	SC	-	-	-	-	-	-	-	26	-	-	-	-	
14	7.50	UDS	2.01	1.62	24.19	2.66	0	66	34		48	23	25	-	-	-	SC	0.11	26	-	-	DSU	-	-	-	-	-	0.64	39.2	
15	8.00	SPT	-	-	-	-	0	70	30		47	24	23	-	-	-	SC	-	-	-	-	-	-	-	22	-	-	-	-	
16	8.50	SPT	-	-	-	-	0	73	27		49	26	23	-	-	-	SC	-	-	-	-	-	-	-	21	-	-	-	-	
17	9.00	SPT	-	-	-	-	0	64	36		43	23	20	-	-	-	SC	-	-	-	-	-	-	-	18	-	-	-	-	
18	9.50	SPT	-	-	-	-	0	66	34		45	21	24	-	-	-	SC	-	-	-	-	-	-	-	17	-	-	-	-	
19	10.00	SPT	-	-	-	-	0	69	31		48	22	26	-	-	-	SC	-	-	-	-	-	-	-	25	-	-	-	-	
20	11.00	SPT	-	-	-	-	0	72	28		49	20	29	-	-	-	SC	-	-	-	-	-	-	-	35	-	-	-	-	
21	12.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	>100	-	-	-	-	
22	13.00	UDS	2.31	2.08	11.03	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	103.6	UCS	-	-	-	-	-	0.30	22.9	
23	14.50	UDS	2.29	2.04	12.01	2.71	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	94.0	-	UCS	-	-	-	-	30.00	0.33	24.6	
24	16.00	UDS	2.43	2.26	7.68	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	135.8	-	UCS	-	-	-	-	24.66	0.21	17.3	
25	17.50	UDS	2.48	2.35	5.73	2.71	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	97.6	-	UCS	-	-	-	-	77.33	0.16	13.5	

UDS - Undisturbed Sample
DS - Disturbed Sample
SPT - Standard Penetration Tests
NP - Non Plastic

TUU - Triaxial Unconsolidated Undrained
TCU - Triaxial Consolidated Undrained
DSU - Direct Shear Test
UCS - Unconfined Compression Strength

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 37

Co-Ordinate :- E - 787, N - 3401

Reduced Level :- 197.57m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	0	22	53	25	40	18	22	-	-	-	CI	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	12	60	28	42	16	26	-	-	-	CI	-	-	-	-	-	-	-	-	6	-	-	-
3	2.00	SPT	-	-	-	-	0	17	60	23	36	15	21	-	-	-	CI	-	-	-	-	-	-	-	-	7	-	-	-
4	2.50	UDS	1.92	1.49	29.04	2.62	10	8	50	32	47	19	28	-	-	-	CI	0.38	4	-	-	TUU	0.17	0.0286	0.42	-	-	0.76	43.2
5	3.00	SPT	-	-	-	-	0	31	45	24	37	17	20	-	-	-	CI	-	-	-	-	-	-	-	-	10	-	-	-
6	3.50	UDS	1.94	1.52	27.91	2.63	3	16	47	34	45	16	29	-	-	-	CI	0.52	6	-	-	TUU	0.16	0.0200	0.51	-	-	0.73	42.3
7	4.00	SPT	-	-	-	-	3	43	31	23	36	15	21	-	-	-	CI	-	-	-	-	-	-	-	-	9	-	-	-
8	4.50	UDS	1.94	1.52	27.61	2.62	8	21	44	27	39	16	23	-	-	-	CI	0.48	6	-	-	TUU	0.16	0.0214	0.65	-	-	0.72	42.0
9	5.00	SPT	-	-	-	-	0	74		26	23	14	9	-	-	-	SC	-	-	-	-	-	-	-	-	20	-	-	-
10	5.50	UDS	2.00	1.61	24.53	2.65	3	53		44	32	17	15	-	-	-	SC	0.12	27	-	-	DSU	-	-	-	-	-	0.65	39.4
11	6.00	SPT	-	-	-	-	6	63		31	30	16	14	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
12	6.50	SPT	-	-	-	-	10	52		38	32	15	17	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
13	7.00	SPT	-	-	-	-	31	50		19	28	17	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
14	7.50	UDS	2.29	2.06	11.28	2.68	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	71.1	UCS	-	-	-	-	-	0.30	23.2
15	9.00	UDS	2.33	2.12	10.06	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	62.5	-	UCS	-	-	-	-	14.00	0.27	21.3
16	10.50	UDS	2.41	2.23	7.85	2.71	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	116.7	-	UCS	-	-	-	-	7.33	0.21	17.5
17	12.00	UDS	2.40	2.21	8.63	2.73	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	159.4	-	UCS	-	-	-	-	31.33	0.24	19.1
18	13.50	UDS	2.38	2.17	9.52	2.74	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	-	124.7	UCS	-	-	-	-	-	0.26	20.7
19	15.00	UDS	2.40	2.21	8.40	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	166.2	-	UCS	-	-	-	-	63.33	0.23	18.6
20	16.50	UDS	2.28	2.03	12.15	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	82.6	-	UCS	-	-	-	-	59.33	0.33	24.7
21	18.00	UDS	2.40	2.21	8.63	2.73	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	159.8	-	UCS	-	-	-	-	55.33	0.24	19.1

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 38

Co-Ordinate :- E - 867, N - 3431

Reduced Level :- 194.67m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility m _v cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	0	31	45	24	41	20	21	-	-	-	CI	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	71	29		24	18	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	5	-	-	-
3	2.00	SPT	-	-	-	-	0	16	71	13	28	16	12	-	-	-	CL	-	-	-	-	-	-	-	-	8	-	-	-
4	2.50	UDS	1.97	1.56	26.45	2.65	2	59	39		29	18	11	-	-	-	SC	0.08	24	-	-	DSU	-	-	-	-	-	0.70	41.2
5	3.00	SPT	-	-	-	-	1	68	31		26	16	10	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
6	3.50	SPT	-	-	-	-	6	65	29		25	14	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
7	4.00	SPT	-	-	-	-	0	34	42	24	43	21	22	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-
8	4.50	SPT	-	-	-	-	0	40	44	16	36	22	14	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-
9	5.00	UDS	2.34	2.12	10.43	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	140.1	UCS	-	-	-	-	-	0.28	22.1
10	6.50	UDS	2.35	2.13	10.31	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	152.9	-	UCS	-	-	-	-	7.33	0.28	22.0
11	8.00	UDS	2.26	2.00	12.93	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	139.6	UCS	-	-	-	-	-	0.35	25.9
12	9.50	UDS	2.66	2.58	3.22	2.81	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	367.1	UCS	-	-	-	-	-	0.09	8.3
13	11.00	UDS	2.68	2.60	3.15	2.83	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	392.9	UCS	-	-	-	-	-	0.09	8.2
14	12.50	UDS	2.70	2.64	2.10	2.80	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	416.8	-	UCS	-	-	-	-	30.66	0.06	5.6
15	14.00	UDS	2.53	2.43	4.12	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	98.6	UCS	-	-	-	-	-	0.11	10.0
16	15.50	UDS	2.41	2.24	7.38	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	86.3	-	UCS	-	-	-	-	50.66	0.20	16.6
17	17.00	UDS	2.69	2.62	2.73	2.82	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	364.1	UCS	-	-	-	-	-	0.08	7.1
18	18.50	UDS	2.66	2.59	2.81	2.79	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	317.9	-	UCS	-	-	-	-	31.33	0.08	7.3
19	20.00	UDS	2.53	2.43	4.12	2.70	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	146.2	-	UCS	-	-	-	-	34.66	0.11	10.0
20	21.50	UDS	2.51	2.39	4.89	2.71	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	182.9	-	UCS	-	-	-	-	40.00	0.13	11.7
21	23.00	UDS	2.55	2.47	3.36	2.69	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	144.4	-	UCS	-	-	-	-	13.33	0.09	8.3

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 39

Co-Ordinate :- E - 914, N - 3293

Reduced Level :- 195.45m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility m _v cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	0	53	47		28	16	12	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	26	50	24	41	19	22	-	-	-	CI	-	-	-	-	-	-	-	-	10	-	-	-
3	2.00	SPT	-	-	-	-	0	70	30		28	18	10	-	-	-	SC	-	-	-	-	-	-	-	-	8	-	-	-
4	2.50	UDS	1.95	1.53	27.81	2.65	0	62	38		32	16	16	-	-	-	SC	0.06	24	-	-	DSU	-	-	-	-	-	0.74	42.4
5	3.00	SPT	-	-	-	-	0	66	34		30	18	12	-	-	-	SC	-	-	-	-	-	-	-	-	8	-	-	-
6	3.50	SPT	-	-	-	-	0	70	30		29	19	10	-	-	-	SC	-	-	-	-	-	-	-	-	7	-	-	-
7	4.00	SPT	-	-	-	-	0	63	37		33	17	16	-	-	-	SC	-	-	-	-	-	-	-	-	8	-	-	-
8	4.50	UDS	1.96	1.54	27.12	2.65	0	66	34		32	18	14	-	-	-	SC	0.05	25	-	-	DSU	-	-	-	-	-	0.72	41.8
9	5.00	SPT	-	-	-	-	2	69	29		28	16	12	-	-	-	SC	-	-	-	-	-	-	-	-	10	-	-	-
10	5.50	UDS	1.99	1.59	24.87	2.64	0	82	18		25	17	8	-	-	-	SC	0.03	28	-	-	DSU	-	-	-	-	-	0.66	39.6
11	6.00	SPT	-	-	-	-	0	70	30		29	16	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
12	6.50	SPT	-	-	-	-	0	76	24		27	17	10	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
13	7.00	UDS	2.35	2.13	10.08	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	134.1	UCS	-	-	-	-	-	0.27	21.5
14	8.50	UDS	2.38	2.18	9.29	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	158.6	UCS	-	-	-	-	-	0.25	20.2
15	10.00	UDS	2.34	2.13	9.95	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	136.2	UCS	-	-	-	-	-	0.27	21.2
16	11.50	UDS	2.28	2.02	12.64	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	100.6	UCS	-	-	-	-	-	0.34	25.6
17	13.00	UDS	2.29	2.04	12.49	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	79.8	-	UCS	-	-	-	-	17.33	0.34	25.4
18	14.50	UDS	2.40	2.20	9.09	2.75	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	165.6	-	UCS	-	-	-	-	27.33	0.25	20.0
19	16.00	UDS	2.43	2.26	7.68	2.73	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	156.9	-	UCS	-	-	-	-	44.00	0.21	17.3
20	17.50	UDS	2.42	2.24	8.22	2.74	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	117.3	-	UCS	-	-	-	-	37.00	0.23	18.4

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 40

Co-Ordinate :- E - 839, N - 3591

Reduced Level :- 193.60m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %	
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility m _v cm ² /kg	Pre-consolidation Pressure kg/cm ²					
1	0.00	DS	-	-	-	-	0	22	57	21	39	20	19	-	-	-	CI	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	26	46	28	38	13	25	-	-	-	CI	-	-	-	-	-	-	-	-	6	-	-	-	-
3	2.00	SPT	-	-	-	-	0	46	30	24	36	14	22	-	-	-	CI	-	-	-	-	-	-	-	-	7	-	-	-	-
4	2.50	UDS	1.95	1.53	27.81	2.65	2	45	29	24	35	15	20	-	-	-	CI	0.35	8	-	-	TUU	0.15	0.0265	0.43	-	-	0.74	42.4	-
5	3.00	SPT	-	-	-	-	0	16	59	25	40	18	22	-	-	-	CI	-	-	-	-	-	-	-	-	18	-	-	-	-
6	3.50	UDS	1.96	1.56	25.64	2.60	0	2	69	29	49	24	25	-	-	-	CI	0.98	9	-	-	TUU	0.12	0.0111	0.51	-	-	0.67	40.0	-
7	4.00	SPT	-	-	-	-	0	4	76	20	43	25	18	-	-	-	CI	-	-	-	-	-	-	-	-	24	-	-	-	-
8	4.50	UDS	2.03	1.66	22.43	2.64	3	12	62	23	45	24	21	-	-	-	CI	1.34	8	-	-	TUU	0.11	0.0079	2.31	-	-	0.59	37.2	-
9	5.00	SPT	-	-	-	-	0	4	77	19	41	25	16	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-	-
10	5.50	SPT	-	-	-	-	0	6	77	17	36	21	15	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-	-
11	6.00	SPT	-	-	-	-	0	8	73	19	40	23	17	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-	-
12	7.50	UDS	2.30	2.06	11.64	2.71	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	125.6	UCS	-	-	-	-	-	0.32	24.0	-
13	9.00	UDS	2.28	2.02	12.88	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	114.2	UCS	-	-	-	-	-	0.35	26.0	-
14	10.50	UDS	2.31	2.07	11.51	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	130.9	UCS	-	-	-	-	-	0.31	23.8	-
15	12.00	UDS	2.13	1.80	18.42	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	46.1	-	UCS	-	-	-	-	18.00	0.50	33.1	-
16	13.50	UDS	2.16	1.83	17.75	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	155.3	-	UCS	-	-	-	-	52.00	0.48	32.6	-
17	15.00	UDS	2.31	2.07	11.74	2.73	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	195.4	-	UCS	-	-	-	-	72.00	0.32	24.3	-

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 41

Co-Ordinate :- E - 700, N - 3329

Reduced Level :- 197.65m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility m _v cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	0	20	69	11	26	16	10	-	-	-	CL	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	32	9	24	35	54	24	30	13	-	56	CH	-	-	-	-	-	-	-	-	5	-	-	-
3	2.00	SPT	-	-	-	-	0	10	59	31	52	25	27	-	-	-	CH	-	-	-	-	-	-	-	-	7	-	-	-
4	2.50	UDS	1.92	1.50	28.43	2.60	2	6	55	37	55	22	33	12	0.25	59	CH	0.36	2	-	-	TUU	0.16	0.0292	2.05	-	-	0.74	42.5
5	3.00	SPT	-	-	-	-	0	10	59	31	51	24	27	-	-	-	CH	-	-	-	-	-	-	-	-	11	-	-	-
6	3.50	UDS	1.93	1.51	28.01	2.61	0	8	56	36	53	20	33	12	0.24	58	CH	0.59	3	-	-	TUU	0.15	0.0186	1.69	-	-	0.73	42.2
7	4.00	SPT	-	-	-	-	14	12	42	32	52	23	29	-	-	-	CH	-	-	-	-	-	-	-	-	12	-	-	-
8	4.50	UDS	1.97	1.57	25.87	2.63	6	12	48	34	51	20	31	13	0.22	54	CH	0.64	3	-	-	TUU	0.13	0.0170	2.10	-	-	0.68	40.5
9	5.00	SPT	-	-	-	-	0	20	55	25	42	19	23	-	-	-	CI	-	-	-	-	-	-	-	-	13	-	-	-
10	5.50	UDS	1.99	1.59	25.16	2.65	0	23	55	22	40	20	20	18	0.14	36	CI	0.68	5	-	-	TUU	0.12	0.0142	0.46	-	-	0.67	40.0
11	6.00	SPT	-	-	-	-	8	28	53	11	29	19	10	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-
12	6.50	SPT	-	-	-	-	0	28	59	13	28	16	12	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-
13	7.00	SPT	-	-	-	-	2	23	64	11	26	17	9	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-
14	7.50	SPT	-	-	-	-	0	17	66	17	30	15	15	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-
15	8.00	SPT	-	-	-	-	10	32	44	14	28	16	12	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-
16	8.50	SPT	-	-	-	-	2	26	57	15	30	16	14	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-
17	9.00	SPT	-	-	-	-	0	10	72	18	31	15	16	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-
18	9.50	SPT	-	-	-	-	0	12	67	21	41	22	19	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-
19	10.00	SPT	-	-	-	-	0	8	69	23	42	21	21	-	-	-	CI	-	-	-	-	-	-	-	-	92	-	-	-
20	11.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
21	11.50	UDS	2.43	2.27	6.99	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	164.3	UCS	-	-	-	-	-	0.19	15.9
22	11.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
23	12.50	UDS	2.34	2.11	10.66	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	146.2	-	UCS	-	-	-	-	33.00	0.29	22.5
24	14.00	UDS	2.46	2.31	6.55	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	176.3	-	UCS	-	-	-	-	26.00	0.18	15.1
25	15.50	UDS	2.23	1.95	14.65	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	52.0	-	UCS	-	-	-	-	41.33	0.40	28.5
26	17.00	UDS	2.27	2.02	12.29	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	49.9	-	UCS	-	-	-	-	38.00	0.33	24.9
27	18.50	UDS	2.29	2.05	11.77	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	62.1	-	UCS	-	-	-	-	38.00	0.32	24.1
28	20.00	UDS	2.37	2.17	9.39	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	146.3	-	UCS	-	-	-	-	16.66	0.26	20.3
29	21.50	UDS	2.69	2.61	2.93	2.83	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	298.6	-	UCS	-	-	-	-	73.33	0.08	7.7

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 42

Co-Ordinate :- E - 718, N - 2730

Reduced Level :- 197.76m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction φ Degree				Compression Index C _c	Coefficient of Volume Compressibility m _v cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	0	17	65	18	34	19	15	-	-	-	CL	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	10	59	31	51	23	28	14	-	53	CH	-	-	-	-	-	-	-	-	5	-	-	-
3	2.00	SPT	-	-	-	-	0	8	58	34	54	24	30	-	-	-	CH	-	-	-	-	-	-	-	-	5	-	-	-
4	2.50	UDS	1.79	1.54	16.25	2.61	0	7	65	28	52	26	26	15	0.33	56	CH	0.25	2	-	-	TUU	0.16	0.0400	0.44	-	-	0.70	41.0
5	3.00	SPT	-	-	-	-	0	9	63	28	51	27	24	-	-	-	CH	-	-	-	-	-	-	-	-	15	-	-	-
6	3.50	UDS	1.85	1.55	19.43	2.60	0	6	58	36	55	23	32	13	0.32	62	CH	0.79	4	-	-	TUU	0.15	0.0139	0.63	-	-	0.68	40.4
7	4.00	SPT	-	-	-	-	0	9	61	30	53	26	27	-	-	-	CH	-	-	-	-	-	-	-	-	10	-	-	-
8	4.50	UDS	1.97	1.56	26.16	2.64	0	10	62	28	52	27	25	15	0.24	53	CH	0.53	5	-	-	TUU	0.15	0.0200	0.78	-	-	0.69	40.9
9	5.00	SPT	-	-	-	-	0	14	64	22	41	21	20	-	-	-	CI	-	-	-	-	-	-	-	-	10	-	-	-
10	5.50	UDS	1.96	1.55	26.54	2.63	0	12	60	28	44	20	24	20	0.12	39	CI	0.54	3	-	-	TUU	0.14	0.0192	0.85	-	-	0.70	41.1
11	6.00	SPT	-	-	-	-	0	8	62	30	47	22	25	-	-	-	CI	-	-	-	-	-	-	-	-	10	-	-	-
12	6.50	UDS	1.93	1.51	28.01	2.61	0	7	66	27	48	24	24	-	-	-	CI	0.53	2	-	-	TUU	0.16	0.0196	0.91	-	-	0.73	42.2
13	7.00	SPT	-	-	-	-	0	4	63	33	53	23	30	-	-	-	CH	-	-	-	-	-	-	-	-	9	-	-	-
14	7.50	UDS	1.99	1.59	24.87	2.64	0	10	55	35	52	21	31	-	-	-	CH	0.48	1	-	-	TUU	0.13	0.0231	1.05	-	-	0.66	39.6
15	8.00	SPT	-	-	-	-	4	74	22	39	19	20	-	-	-	-	SC	-	-	-	-	-	-	-	-	22	-	-	-
16	8.50	SPT	-	-	-	-	12	68	20	32	17	15	-	-	-	-	SC	-	-	-	-	-	-	-	-	18	-	-	-
17	9.00	SPT	-	-	-	-	12	76	12	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	25	-	-	-
18	9.50	SPT	-	-	-	-	0	87	13	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	26	-	-	-
19	10.00	SPT	-	-	-	-	0	86	14	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	24	-	-	-
20	11.00	SPT	-	-	-	-	12	73	15	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	27	-	-	-
21	11.50	SPT	-	-	-	-	40	44	16	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	77	-	-	-
22	12.50	SPT	-	-	-	-	47	40	13	NP	NP	NP	-	-	-	-	GM	-	-	-	-	-	-	-	-	>100	-	-	-
23	13.00	SPT	-	-	-	-	64	19	17	NP	NP	NP	-	-	-	-	GM	-	-	-	-	-	-	-	-	>100	-	-	-
24	14.00	SPT	-	-	-	-	22	55	23	29	16	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
25	14.50	SPT	-	-	-	-	0	53	47	40	22	18	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
26	15.50	SPT	-	-	-	-	20	65	15	28	19	9	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
27	16.00	SPT	-	-	-	-	0	69	31	30	17	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
28	17.00	SPT	-	-	-	-	0	58	42	35	16	19	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
29	17.50	SPT	-	-	-	-	0	78	22	34	19	15	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
30	18.50	SPT	-	-	-	-	0	71	29	32	20	12	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
31	19.00	SPT	-	-	-	-	0	74	26	29	18	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
32	20.00	UDS	2.41	2.22	8.54	2.74	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	164.3	-	UCS	-	-	-	-	51.25	0.23	19.0
33	21.50	UDS	2.26	2.00	13.18	2.71	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	96.1	-	UCS	-	-	-	-	13.33	0.36	26.3
34	23.00	UDS	2.38	2.18	9.29	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	141.1	-	UCS	-	-	-	-	48.66	0.25	20.2
35	25.00	UDS	2.30	2.04	12.59	2.75	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	134.9	-	UCS	-	-	-	-	30.00	0.35	25.7

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 43

Co-Ordinate :- E - 798, N - 2397

Reduced Level :- 198.48m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility m _v cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	0	22	64	14	29	16	13	-	-	-	CL	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	10	58	32	53	25	28	-	-	-	CH	-	-	-	-	-	-	-	-	4	-	-	-
3	2.00	SPT	-	-	-	-	0	6	52	42	58	21	37	-	-	-	CH	-	-	-	-	-	-	-	-	5	-	-	-
4	2.50	UDS	1.68	1.48	13.14	2.62	0	12	53	35	56	25	31	-	-	-	CH	0.27	2	-	-	TUU	0.17	0.0417	0.41	-	-	0.76	43.3
5	3.00	SPT	-	-	-	-	0	9	53	38	57	24	33	-	-	-	CH	-	-	-	-	-	-	-	-	7	-	-	-
6	3.50	SPT	-	-	-	-	0	6	48	46	60	21	39	-	-	-	CH	-	-	-	-	-	-	-	-	7	-	-	-
7	4.00	SPT	-	-	-	-	0	8	62	30	53	26	27	-	-	-	CH	-	-	-	-	-	-	-	-	6	-	-	-
8	4.50	SPT	-	-	-	-	0	3	60	37	57	24	33	-	-	-	CH	-	-	-	-	-	-	-	-	8	-	-	-
9	5.00	SPT	-	-	-	-	0	2	56	42	58	23	35	-	-	-	CH	-	-	-	-	-	-	-	-	9	-	-	-
10	5.50	SPT	-	-	-	-	0	9	60	31	53	25	28	-	-	-	CH	-	-	-	-	-	-	-	-	8	-	-	-
11	6.00	SPT	-	-	-	-	0	2	68	30	54	27	27	-	-	-	CH	-	-	-	-	-	-	-	-	8	-	-	-
12	6.50	UDS	1.92	1.49	28.74	2.61	0	11	58	31	52	26	26	-	-	-	CH	0.43	4	-	-	TUU	0.16	0.0250	1.04	-	-	0.75	42.9
13	7.00	SPT	-	-	-	-	0	2	59	39	57	23	34	-	-	-	CH	-	-	-	-	-	-	-	-	9	-	-	-
14	7.50	UDS	1.93	1.50	28.62	2.63	0	14	54	32	53	26	27	-	-	-	CH	0.46	5	-	-	TUU	0.15	0.0231	1.20	-	-	0.75	42.9
15	8.00	SPT	-	-	-	-	26	36	38	36	29	18	11	-	-	-	SC	-	-	-	-	-	-	-	-	20	-	-	-
16	8.50	UDS	1.99	1.59	25.16	2.65	0	56	44	31	17	14	14	-	-	-	SC	0.13	26	-	-	DSU	-	-	-	-	-	0.67	40.0
17	9.00	SPT	-	-	-	-	0	52	48	33	18	15	15	-	-	-	SC	-	-	-	-	-	-	-	-	34	-	-	-
18	9.50	UDS	2.06	1.70	21.28	2.66	0	58	42	30	19	11	11	-	-	-	SC	0.08	27	-	-	DSU	-	-	-	-	-	0.57	36.1
19	10.00	SPT	-	-	-	-	0	60	40	28	16	12	12	-	-	-	SC	-	-	-	-	-	-	-	-	36	-	-	-
20	11.00	UDS	2.08	1.73	20.19	2.66	0	72	28	24	20	4	4	-	-	-	SM	0.00	29	-	-	DSU	-	-	-	-	-	0.54	34.9
21	11.50	SPT	-	-	-	-	10	75	15	NP	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	45	-	-	-
22	12.50	SPT	-	-	-	-	16	71	13	NP	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	23	-	-	-
23	13.00	SPT	-	-	-	-	17	61	22	20	16	4	4	-	-	-	SM	-	-	-	-	-	-	-	-	30	-	-	-
24	14.00	UDS	2.10	1.76	19.41	2.67	6	78	16	NP	NP	NP	NP	-	-	-	SM	0.00	30	-	-	DSU	-	-	-	-	-	0.52	34.1
25	14.50	SPT	-	-	-	-	28	34	38	29	17	12	12	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
26	15.50	SPT	-	-	-	-	0	73	27	25	16	9	9	-	-	-	SC	-	-	-	-	-	-	-	-	69	-	-	-
27	16.00	SPT	-	-	-	-	0	78	22	23	15	8	8	-	-	-	SC	-	-	-	-	-	-	-	-	73	-	-	-
28	17.00	SPT	-	-	-	-	0	80	20	22	14	8	8	-	-	-	SC	-	-	-	-	-	-	-	-	83	-	-	-
29	17.50	SPT	-	-	-	-	0	76	24	23	13	10	10	-	-	-	SC	-	-	-	-	-	-	-	-	70	-	-	-
30	18.50	SPT	-	-	-	-	0	75	25	27	14	13	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
31	19.00	SPT	-	-	-	-	0	77	23	22	13	9	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
32	20.00	SPT	-	-	-	-	0	74	26	28	16	12	12	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
33	20.50	SPT	-	-	-	-	0	76	24	26	17	9	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
34	21.50	SPT	-	-	-	-	0	77	23	25	15	10	10	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
35	22.00	SPT	-	-	-	-	20	56	24	27	16	11	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
36	23.00	SPT	-	-	-	-	0	84	16	23	15	8	8	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
37	23.50	SPT	-	-	-	-	2	74	24	26	14	12	12	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
38	24.50	SPT	-	-	-	-	0	78	22	25	16	9	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
39	25.00	SPT	-	-	-	-	13	55	32	29	17	12	12	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-

UDS - Undisturbed Sample
DS - Disturbed Sample
SPT - Standard Penetration Tests

NP - Non Plastic
UCS - Unconfined Compression Strength

TUU - Triaxial Unconsolidated Undrained
TCU - Triaxial Consolidated Undrained
DSU - Direct Shear Test

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 44

Co-Ordinate :- E 915, N 1955

Reduced Level :- 199.30m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	6	63	31		22	16	6	-	-	-	Filled up Soil	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	43	35	22	37	17	20	-	-	-	CI	-	-	-	-	-	-	-	-	3	-	-	-
3	2.00	SPT	-	-	-	-	0	47	33	20	36	19	17	-	-	-	CI	-	-	-	-	-	-	-	-	6	-	-	-
4	2.50	UDS	1.73	1.52	13.65	2.66	0	42	36	22	37	18	19	-	-	-	CI	0.30	8	-	-	TUU	0.17	0.0667	0.41	-	-	0.75	42.8
5	3.00	SPT	-	-	-	-	0	43	33	24	38	17	21	-	-	-	CI	-	-	-	-	-	-	-	-	7	-	-	-
6	3.50	UDS	1.95	1.53	27.81	2.65	0	36	41	23	36	16	20	-	-	-	CI	0.35	6	-	-	TUU	0.16	0.0265	0.53	-	-	0.74	42.4
7	4.00	SPT	-	-	-	-	0	47	32	21	35	17	18	-	-	-	CI	-	-	-	-	-	-	-	-	8	-	-	-
8	4.50	SPT	-	-	-	-	0	49	26	25	36	14	22	-	-	-	CI	-	-	-	-	-	-	-	-	9	-	-	-
9	5.00	SPT	-	-	-	-	0	62	38		34	16	18	-	-	-	SC	-	-	-	-	-	-	-	-	10	-	-	-
10	5.50	SPT	-	-	-	-	8	65	27		30	15	15	-	-	-	SC	-	-	-	-	-	-	-	-	12	-	-	-
11	6.00	SPT	-	-	-	-	6	63	31		34	16	18	-	-	-	SC	-	-	-	-	-	-	-	-	14	-	-	-
12	6.50	SPT	-	-	-	-	8	66	26		37	15	22	-	-	-	SC	-	-	-	-	-	-	-	-	21	-	-	-
13	7.00	SPT	-	-	-	-	10	64	26		32	17	15	-	-	-	SC	-	-	-	-	-	-	-	-	12	-	-	-
14	7.50	SPT	-	-	-	-	0	26	47	27	40	16	24	-	-	-	CI	-	-	-	-	-	-	-	-	16	-	-	-
15	8.00	SPT	-	-	-	-	0	27	48	25	39	16	23	-	-	-	CI	-	-	-	-	-	-	-	-	18	-	-	-
16	8.50	UDS	1.98	1.58	25.22	2.63	9	24	41	26	42	20	22	-	-	-	CI	0.95	5	-	-	TUU	0.13	0.0105	1.09	-	-	0.66	39.9
17	9.00	SPT	-	-	-	-	1	56	43		35	16	19	-	-	-	SC	-	-	-	-	-	-	-	-	16	-	-	-
18	9.50	SPT	-	-	-	-	2	68	30	29	18	11		-	-	-	SC	-	-	-	-	-	-	-	-	17	-	-	-
19	10.00	SPT	-	-	-	-	30	44	26		27	19	8	-	-	-	Boulders	-	-	-	-	-	-	-	-	32	-	-	-
20	11.00	SPT	-	-	-	-	16	56	28		28	16	12	-	-	-	Boulders	-	-	-	-	-	-	-	-	42	-	-	-
21	11.50	SPT	-	-	-	-	0	61	39		31	17	14	-	-	-	Boulders	-	-	-	-	-	-	-	-	39	-	-	-
22	12.50	SPT	-	-	-	-	9	63	28		26	15	11	-	-	-	Boulders	-	-	-	-	-	-	-	-	24	-	-	-
23	13.00	SPT	-	-	-	-	4	79	17		25	16	9	-	-	-	Boulders	-	-	-	-	-	-	-	-	44	-	-	-
24	14.00	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	52	-	-	-
25	14.50	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	55	-	-	-
26	15.50	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	47	-	-	-
27	16.00	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
28	17.00	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
29	17.50	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
30	18.50	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
31	19.00	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
32	19.00	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
33	20.00	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
34	20.50	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
35	21.50	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
36	22.00	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
37	23.00	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
38	23.50	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
39	24.50	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
40	25.00	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 45

Co-Ordinate :- E - 795, N - 1564

Reduced Level :- 194.80m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility m _v cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	0	38	41	21	40	21	19	-	-	-	CI	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	4	35	36	25	43	20	23	-	-	-	CI	-	-	-	-	-	-	-	-	2	-	-	-
3	2.00	SPT	-	-	-	-	3	41	36	20	39	21	18	-	-	-	CI	-	-	-	-	-	-	-	-	4	-	-	-
4	2.50	UDS	1.92	1.47	30.24	2.66	16	38	46		32	20	12	-	-	-	SC	0.06	22	-	-	DSU	-	-	-	-	-	0.80	44.6
5	3.00	SPT	-	-	-	-	1	53	46		33	19	14	-	-	-	SC	-	-	-	-	-	-	-	-	9	-	-	-
6	3.50	UDS	1.95	1.53	27.81	2.65	6	58	36		29	17	12	-	-	-	SC	0.04	24	-	-	DSU	-	-	-	-	-	0.74	42.4
7	4.00	SPT	-	-	-	-	14	48	38		33	19	14	-	-	-	SC	-	-	-	-	-	-	-	-	8	-	-	-
8	4.50	UDS	1.96	1.54	27.12	2.65	0	52	48		34	18	16	-	-	-	SC	0.08	24	-	-	DSU	-	-	-	-	-	0.72	41.8
9	5.00	SPT	-	-	-	-	14	57	29		28	16	12	-	-	-	SC	-	-	-	-	-	-	-	-	11	-	-	-
10	5.50	UDS	1.98	1.57	26.37	2.67	17	62	21		26	15	11	-	-	-	SC	0.05	27	-	-	DSU	-	-	-	-	-	0.70	41.3
11	6.00	SPT	-	-	-	-	6	66	28		29	17	12	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
12	6.50	SPT	-	-	-	-	39	44	17		25	16	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
13	7.00	SPT	-	-	-	-	7	72	21		19	15	4	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
14	7.50	SPT	-	-	-	-	41	47	12		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
15	8.00	SPT	-	-	-	-	6	81	13		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
16	8.50	SPT	-	-	-	-	0	83	17		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
17	9.00	SPT	-	-	-	-	0	8	56	36	55	22	33	-	-	-	CH	-	-	-	-	-	-	-	-	>100	-	-	-
18	9.50	SPT	-	-	-	-	0	9	59	32	52	24	28	-	-	-	CH	-	-	-	-	-	-	-	-	>100	-	-	-
19	10.00	SPT	-	-	-	-	0	2	60	38	58	23	35	-	-	-	CH	-	-	-	-	-	-	-	-	>100	-	-	-
20	11.00	SPT	-	-	-	-	0	4	58	38	55	22	33	-	-	-	CH	-	-	-	-	-	-	-	-	>100	-	-	-
21	11.50	SPT	-	-	-	-	0	5	64	31	53	25	28	-	-	-	CH	-	-	-	-	-	-	-	-	>100	-	-	-
22	12.50	UDS	2.67	2.60	2.78	2.80	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	398.6	UCS	-	-	-	-	-	0.08	7.2
23	12.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
24	14.00	UDS	2.69	2.62	2.73	2.82	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	406.1	-	UCS	-	-	-	-	29.33	0.08	7.1
25	15.50	UDS	2.32	2.09	10.90	2.71	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	94.3	-	UCS	-	-	-	-	45.33	0.30	22.8
26	17.00	UDS	2.18	1.88	15.81	2.68	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	38.4	-	UCS	-	-	-	-	21.33	0.42	29.8
27	18.50	UDS	2.19	1.89	15.62	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	46.3	-	UCS	-	-	-	-	44.00	0.42	29.6
28	20.00	UDS	2.35	2.14	9.60	2.70	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	103.8	-	UCS	-	-	-	-	54.66	0.26	20.6

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 46

Co-Ordinate :- E -1155, N 1098

Reduced Level :- 196.61 m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility m _v cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	13	62	25		21	15	6	-	-	-	Filled up Soil	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	24	50	26	40	18	22	-	-	-	CI	-	-	-	-	-	-	-	-	7	-	-	-
3	2.00	SPT	-	-	-	-	0	39	51	10	28	19	9	-	-	-	CL	-	-	-	-	-	-	-	-	13	-	-	-
4	2.50	UDS	1.84	1.57	16.90	2.63	0	26	58	16	30	16	14	-	-	-	CL	0.69	5	-	-	TUU	0.14	0.0110	0.45	-	-	0.67	40.2
5	3.00	SPT	-	-	-	-	0	38	49	13	26	15	11	-	-	-	CL	-	-	-	-	-	-	-	-	28	-	-	-
6	3.50	UDS	1.99	1.59	24.87	2.64	0	36	49	15	29	16	13	-	-	-	CL	1.51	7	-	-	TUU	0.13	0.0045	0.63	-	-	0.66	39.6
7	4.00	SPT	-	-	-	-	0	48	41	11	25	15	10	-	-	-	CL	-	-	-	-	-	-	-	-	16	-	-	-
8	4.50	UDS	1.99	1.59	25.16	2.65	0	67	33		27	20	7	-	-	-	SM-SC	0.06	25	-	-	DSU	-	-	-	-	-	0.67	40.0
9	5.00	SPT	-	-	-	-	0	76	24		24	18	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	19	-	-	-
10	5.50	SPT	-	-	-	-	0	69	31		26	20	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	24	-	-	-
11	6.00	SPT	-	-	-	-	0	70	30		27	20	7	-	-	-	SM-SC	-	-	-	-	-	-	-	-	13	-	-	-
12	6.50	SPT	-	-	-	-	0	78	22		24	18	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	8	-	-	-
13	7.00	SPT	-	-	-	-	0	20	58	22	42	22	20	-	-	-	CI	-	-	-	-	-	-	-	-	8	-	-	-
14	7.50	UDS	1.96	1.55	26.24	2.62	0	13	59	28	46	20	26	-	-	-	CI	0.43	3	-	-	TUU	0.14	0.0250	0.98	-	-	0.69	40.7
15	8.00	SPT	-	-	-	-	0	20	57	23	43	23	20	-	-	-	CI	-	-	-	-	-	-	-	-	16	-	-	-
16	8.50	UDS	2.01	1.63	23.63	2.64	0	44	31	25	39	16	23	-	-	-	CI	0.76	7	-	-	TUU	0.12	0.0120	1.11	-	-	0.62	38.4
17	9.00	SPT	-	-	-	-	0	72	28		25	20	5	-	-	-	SM	-	-	-	-	-	-	-	-	24	-	-	-
18	9.50	SPT	-	-	-	-	21	65	14		19	15	4	-	-	-	SM	-	-	-	-	-	-	-	-	23	-	-	-
19	10.00	SPT	-	-	-	-	10	74	16		21	16	5	-	-	-	SM	-	-	-	-	-	-	-	-	33	-	-	-
20	11.00	SPT	-	-	-	-	7	79	14		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	43	-	-	-
21	11.50	SPT	-	-	-	-	5	80	15		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	38	-	-	-
22	12.50	SPT	-	-	-	-	4	53	43		30	16	14	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
23	13.00	SPT	-	-	-	-	23	49	28		27	14	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
24	14.00	SPT	-	-	-	-	28	34	38		28	13	15	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
25	14.50	SPT	-	-	-	-	10	76	14		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
26	15.50	SPT	-	-	-	-	74	14	12		NP	NP	NP	-	-	-	GM	-	-	-	-	-	-	-	-	>100	-	-	-
27	16.00	SPT	-	-	-	-	60	22	18		20	16	4	-	-	-	GM	-	-	-	-	-	-	-	-	>100	-	-	-
28	17.00	SPT	-	-	-	-	64	23	13		NP	NP	NP	-	-	-	GM	-	-	-	-	-	-	-	-	>100	-	-	-
29	17.50	SPT	-	-	-	-	0	64	36		32	18	14	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
30	18.50	SPT	-	-	-	-	0	70	30		29	19	10	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
31	19.00	SPT	-	-	-	-	0	74	26		25	16	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
32	20.00	SPT	-	-	-	-	0	60	40		34	18	16	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
33	20.50	SPT	-	-	-	-	2	68	30		31	16	15	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
34	21.50	SPT	-	-	-	-	0	66	34		32	14	18	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
35	22.00	SPT	-	-	-	-	0	69	31		29	16	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
36	23.00	SPT	-	-	-	-	0	62	38		33	15	18	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
37	23.50	SPT	-	-	-	-	18	53	29		26	17	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
38	24.50	SPT	-	-	-	-	0	54	46		34	16	18	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
39	25.00	SPT	-	-	-	-	0	68	32		32	17	15	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-

KCT Consultancy Services LLP, Ahmedabad

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 47

Co-Ordinate :- E - 1304, N - 700

Reduced Level :- 196.30m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %	
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c cm ² /kg	Coefficient of Volume Compressibility m _v kg/cm ²	Pre-consolidation Pressure kg/cm ²					
1	0.00	DS	-	-	-	-	0	66	34	24	15	9	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	15	65	20	39	21	18	-	-	-	CI	-	-	-	-	-	-	-	-	5	-	-	-	-
3	2.00	SPT	-	-	-	-	0	41	40	19	32	15	17	-	-	-	CL	-	-	-	-	-	-	-	-	6	-	-	-	-
4	2.50	UDS	1.69	1.47	14.91	2.67	0	43	43	14	29	16	13	-	-	-	CL	0.29	8	-	-	TUU	0.16	0.0256	0.42	-	-	0.82	44.9	-
5	3.00	SPT	-	-	-	-	0	39	43	18	34	18	16	-	-	-	CL	-	-	-	-	-	-	-	-	5	-	-	-	-
6	3.50	UDS	1.76	1.42	24.03	2.66	2	14	61	23	41	20	21	-	-	-	CI	0.25	2	-	-	TUU	0.18	0.0308	0.62	-	-	0.87	46.7	-
7	4.00	SPT	-	-	-	-	0	19	51	30	42	17	25	-	-	-	CI	-	-	-	-	-	-	-	-	7	-	-	-	-
8	4.50	UDS	1.79	1.47	21.43	2.67	0	17	56	27	44	21	23	-	-	-	CI	0.36	1	-	-	TUU	-	-	-	-	-	0.81	44.8	-
9	5.00	SPT	-	-	-	-	0	19	58	23	39	18	21	-	-	-	CI	-	-	-	-	-	-	-	-	8	-	-	-	-
10	5.50	UDS	1.93	1.49	29.21	2.65	0	45	39	16	30	16	14	-	-	-	CL	0.38	7	-	-	TUU	0.15	0.0192	0.95	-	-	0.77	43.6	-
11	6.00	SPT	-	-	-	-	0	39	42	19	32	15	17	-	-	-	CL	-	-	-	-	-	-	-	-	8	-	-	-	-
12	6.50	UDS	1.94	1.51	28.80	2.66	0	33	44	23	34	14	20	-	-	-	CL	0.42	6	-	-	TUU	-	-	-	-	-	0.77	43.4	-
13	7.00	SPT	-	-	-	-	0	48	35	17	30	16	14	-	-	-	CL	-	-	-	-	-	-	-	-	10	-	-	-	-
14	7.50	UDS	1.96	1.53	27.70	2.67	0	53	47	32	17	15	-	-	-	SC	0.06	23	-	-	DSU	-	-	-	-	-	-	0.74	42.5	-
15	8.00	SPT	-	-	-	-	0	65	35	27	16	11	-	-	-	SC	-	-	-	-	-	-	-	-	-	11	-	-	-	-
16	8.50	UDS	1.95	1.52	28.39	2.67	0	59	41	40	21	19	-	-	-	SC	0.05	25	-	-	DSU	-	-	-	-	-	-	0.76	43.1	-
17	9.00	SPT	-	-	-	-	0	29	36	35	52	20	32	-	-	-	CH	-	-	-	-	-	-	-	-	14	-	-	-	-
18	9.50	UDS	1.99	1.59	25.44	2.66	0	17	41	42	55	19	36	-	-	-	CH	0.74	5	-	-	TUU	0.12	0.0110	5.88	-	-	0.68	40.4	-
19	10.00	SPT	-	-	-	-	0	13	43	44	56	19	37	-	-	-	CH	-	-	-	-	-	-	-	-	23	-	-	-	-
20	11.00	SPT	-	-	-	-	0	14	50	36	52	21	31	-	-	-	CH	-	-	-	-	-	-	-	-	31	-	-	-	-
21	11.50	SPT	-	-	-	-	18	57	25	29	16	13	-	-	-	SC	-	-	-	-	-	-	-	-	-	36	-	-	-	-
22	12.50	SPT	-	-	-	-	8	80	12	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	-	39	-	-	-	-
23	13.00	SPT	-	-	-	-	10	78	12	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	-	46	-	-	-	-
24	14.00	SPT	-	-	-	-	34	53	13	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	-	49	-	-	-	-
25	14.50	SPT	-	-	-	-	2	91	7	NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	-	-	53	-	-	-	-
26	15.50	SPT	-	-	-	-	2	92	6	NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
27	16.00	SPT	-	-	-	-	4	90	6	NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
28	17.00	SPT	-	-	-	-	2	89	9	NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
29	17.50	SPT	-	-	-	-	0	72	28	27	16	11	-	-	-	SC	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
30	18.50	SPT	-	-	-	-	0	69	31	29	15	14	-	-	-	SC	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
31	20.50	UDS	2.29	2.04	12.25	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	81.6	UCS	-	-	-	-	-	0.33	25.0	-

KCT Consultancy Services LLP, Ahmedabad

RESULTS OF LABORATORY TEST

Project :- Proposed structure in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 48

Co-Ordinate :- E - 1574, N - 242

Reduced Level :- 196.10m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	1	50	49		24	14	10	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	18	49	33	51	21	30	-	-	-	CH	-	-	-	-	-	-	-	-	9	-	-	-
3	2.00	SPT	-	-	-	-	0	27	46	27	42	19	23	-	-	-	CI	-	-	-	-	-	-	-	-	11	-	-	-
4	2.50	UDS	1.94	1.51	28.50	2.65	0	48	32	20	39	21	18	-	-	-	CI	0.54	8	-	-	TUU	0.16	0.0159	0.43	-	-	0.76	43.0
5	3.00	SPT	-	-	-	-	6	41	30	23	40	20	20	-	-	-	CI	-	-	-	-	-	-	-	-	9	-	-	-
6	3.50	UDS	1.96	1.54	27.12	2.65	7	40	26	27	42	19	23	-	-	-	CI	0.61	7	-	-	TUU	0.14	0.0145	0.52	-	-	0.72	41.8
7	4.00	SPT	-	-	-	-	8	41	29	22	41	22	19	-	-	-	CI	-	-	-	-	-	-	-	-	17	-	-	-
8	4.50	SPT	-	-	-	-	0	72	28		31	18	13	-	-	-	SC	-	-	-	-	-	-	-	-	35	-	-	-
9	5.00	SPT	-	-	-	-	4	66	30		33	17	16	-	-	-	SC	-	-	-	-	-	-	-	-	35	-	-	-
10	5.50	SPT	-	-	-	-	2	4	66	28	45	20	25	-	-	-	CI	-	-	-	-	-	-	-	-	30	-	-	-
11	6.00	SPT	-	-	-	-	0	2	71	27	46	23	23	-	-	-	CI	-	-	-	-	-	-	-	-	27	-	-	-
12	6.50	SPT	-	-	-	-	0	20	54	26	41	19	22	-	-	-	CI	-	-	-	-	-	-	-	-	41	-	-	-
13	7.00	SPT	-	-	-	-	0	66	34		36	21	15	-	-	-	SC	-	-	-	-	-	-	-	-	32	-	-	-
14	7.50	SPT	-	-	-	-	0	67	33		34	20	14	-	-	-	SC	-	-	-	-	-	-	-	-	55	-	-	-
15	8.00	SPT	-	-	-	-	0	58	42		39	21	18	-	-	-	SC	-	-	-	-	-	-	-	-	43	-	-	-
16	8.50	SPT	-	-	-	-	0	52	48		42	22	20	-	-	-	SC	-	-	-	-	-	-	-	-	53	-	-	-
17	9.00	SPT	-	-	-	-	0	63	37		39	24	15	-	-	-	SC	-	-	-	-	-	-	-	-	86	-	-	-
18	9.50	SPT	-	-	-	-	0	59	41		43	23	20	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
19	10.00	SPT	-	-	-	-	0	13	63	24	42	21	21	-	-	-	CI	-	-	-	-	-	-	-	-	64	-	-	-
20	11.00	SPT	-	-	-	-	0	2	67	31	46	20	26	-	-	-	CI	-	-	-	-	-	-	-	-	87	-	-	-
21	11.50	SPT	-	-	-	-	0	3	74	23	44	24	20	-	-	-	CI	-	-	-	-	-	-	-	-	94	-	-	-
22	12.50	SPT	-	-	-	-	0	5	75	20	41	23	18	-	-	-	CI	-	-	-	-	-	-	-	-	68	-	-	-
23	13.00	SPT	-	-	-	-	0	10	68	22	43	24	19	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-
24	14.00	SPT	-	-	-	-	0	3	73	24	45	25	20	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-
25	14.50	SPT	-	-	-	-	0	4	75	21	42	24	18	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-
26	15.50	SPT	-	-	-	-	0	68	32		32	23	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
27	16.00	SPT	-	-	-	-	0	67	33		33	22	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
28	17.00	SPT	-	-	-	-	0	51	49		35	23	12	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
29	17.50	SPT	-	-	-	-	0	42	33	25	39	18	21	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-
30	18.50	SPT	-	-	-	-	0	46	37	17	37	22	15	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-
31	19.00	SPT	-	-	-	-	0	48	33	19	36	20	16	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-
32	20.00	SPT	-	-	-	-	0	49	31	20	36	19	17	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-
33	20.50	SPT	-	-	-	-	0	45	34	21	39	21	18	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-
34	21.50	SPT	-	-	-	-	0	25	58	17	32	17	15	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-
35	22.00	SPT	-	-	-	-	0	46	39	15	29	16	13	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-
36	23.00	SPT	-	-	-	-	0	74	26		27	15	12	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
37	23.50	SPT	-	-	-	-	0	76	24		26	17	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
38	24.50	SPT	-	-	-	-	0	72	28		29	16	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
39	25.00	SPT	-	-	-	-	0	79	21		25	15	10	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-

UDS - Undisturbed Sample
DS - Disturbed Sample
SPT - Standard Penetration Tests
NP - Non Plastic

TUU - Triaxial Unconsolidated Undrained
TCU - Triaxial Consolidated Undrained
DSU - Direct Shear Test
UCS - Unconfined Compression Strength

KCT Consultancy Services LLP, Ahmedabad

RESULTS OF LABORATORY TEST

Project :- Proposed structure in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 49

Co-Ordinate :- E - 1899, N - 351

Reduced Level :- 197.20m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %	
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²						
1	0.00	DS	-	-	-	-	10	63	27	29	16	13	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	7	70	23	26	15	11	-	-	-	SC	-	-	-	-	-	-	-	-	14	-	-	-	-	-
3	2.00	SPT	-	-	-	-	0	73	27	31	17	14	-	-	-	SC	-	-	-	-	-	-	-	-	54	-	-	-	-	-
4	2.50	SPT	-	-	-	-	5	63	32	40	22	18	-	-	-	SC	-	-	-	-	-	-	-	-	72	-	-	-	-	-
5	3.00	SPT	-	-	-	-	0	62	38	42	21	21	-	-	-	SC	-	-	-	-	-	-	-	-	80	-	-	-	-	-
6	3.50	SPT	-	-	-	-	0	73	27	28	16	12	-	-	-	SC	-	-	-	-	-	-	-	-	61	-	-	-	-	-
7	4.00	SPT	-	-	-	-	0	75	25	26	15	11	-	-	-	SC	-	-	-	-	-	-	-	-	76	-	-	-	-	-
8	4.50	SPT	-	-	-	-	0	68	32	31	18	13	-	-	-	SC	-	-	-	-	-	-	-	-	87	-	-	-	-	-
9	5.00	SPT	-	-	-	-	13	53	34	36	19	17	-	-	-	SC	-	-	-	-	-	-	-	-	78	-	-	-	-	-
10	5.50	SPT	-	-	-	-	0	66	34	35	22	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-	-
11	6.00	SPT	-	-	-	-	0	68	32	33	23	10	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-	-
12	6.50	SPT	-	-	-	-	1	47	27	25	42	20	22	-	-	-	CI	-	-	-	-	-	-	-	>100	-	-	-	-	-
13	7.00	SPT	-	-	-	-	0	48	32	20	40	22	18	-	-	-	CI	-	-	-	-	-	-	-	>100	-	-	-	-	-
14	7.50	SPT	-	-	-	-	0	46	27	27	43	19	24	-	-	-	CI	-	-	-	-	-	-	-	>100	-	-	-	-	-
15	8.00	SPT	-	-	-	-	0	76	24	25	17	8	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-	-
16	8.50	SPT	-	-	-	-	0	76	24	27	16	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-	-
17	9.00	SPT	-	-	-	-	0	70	30	29	16	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-	-
18	9.50	SPT	-	-	-	-	0	54	46	33	18	15	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-	-
19	10.00	SPT	-	-	-	-	0	68	32	26	17	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-	-
20	11.00	SPT	-	-	-	-	0	65	35	28	16	12	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-	-
21	11.50	SPT	-	-	-	-	0	63	37	29	15	14	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-	-
22	12.50	SPT	-	-	-	-	0	62	38	31	18	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-	-
23	13.00	SPT	-	-	-	-	0	66	34	28	19	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-	-
24	14.00	SPT	-	-	-	-	0	68	32	27	17	10	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-	-
25	14.50	SPT	-	-	-	-	0	64	36	30	16	14	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-	-
26	15.50	SPT	-	-	-	-	0	65	35	29	17	12	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-	-
27	16.00	SPT	-	-	-	-	0	67	33	25	14	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-	-
28	17.50	UDS	2.10	1.76	19.14	2.66	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	16.3	UCS	-	-	-	-	-	-	0.51	33.7
29	17.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	>100	-	-	-	-	-
30	19.00	UDS	2.18	1.88	15.81	2.68	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	18.1	-	UCS	-	-	-	-	35.00	0.42	29.8	-
31	20.50	UDS	2.16	1.85	16.47	2.67	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	15.2	-	UCS	-	-	-	-	29.00	0.44	30.5	-
32	22.00	UDS	2.23	1.97	13.40	2.67	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	19.4	-	UCS	-	-	-	-	35.00	0.36	26.3	-
33	23.50	UDS	2.28	2.04	11.66	2.68	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	20.2	-	UCS	-	-	-	-	25.00	0.31	23.8	-
34	25.00	UDS	2.25	1.99	13.09	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	17.5	-	UCS	-	-	-	-	29.00	0.35	26.0	-

KCT Consultancy Services LLP, Ahmedabad

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTP) at village Hirma, Talabira, Odisha

BH No. :- IBH 50

Co-Ordinate :- E 797, N 2975

Reduced Level :- 197.35 m

Sr No	Depth of Sample	Type of Sample	Field Bulk Density	Field Dry Density	Natural Moisture Content	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit	Swelling Pressure	Free Swell Index	Soil Classification	Shear Parameter		Unconfined Compression Test	UCS by Point Load Index in rock	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation	Void Ratio	Porosity
							Gravel	Sand	Silt	Clay	Liquid Limit	Plastic Limit	Plasticity Index					Cohesion C	Angle of Internal Friction ϕ				Compression Index C _c	Coefficient of Volume Compressibility mv	Pre-consolidation Pressure				
1	0.00	DS	-	-	-	-	0	18	43	39	56	23	33	-	-	-	CH	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	15	39	46	59	20	39	-	-	-	CH	-	-	-	-	-	-	-	-	3	-	-	-
3	2.00	SPT	-	-	-	-	0	9	45	46	71	29	42	8	-	93	CH	-	-	-	-	-	-	-	-	4	-	-	-
4	2.50	SPT	-	-	-	-	0	8	41	51	73	27	46	-	-	-	CH	-	-	-	-	-	-	-	-	5	-	-	-
5	3.00	SPT	-	-	-	-	0	16	36	48	67	26	41	-	-	-	CH	-	-	-	-	-	-	-	-	12	-	-	-
6	3.50	UDS	1.95	1.54	26.62	2.61	0	10	45	45	68	29	39	8	0.48	81	CH	0.66	2	-	-	TUU	0.12	0.0181	0.62	-	-	0.69	41.0
7	4.00	SPT	-	-	-	-	0	24	44	32	57	30	27	-	-	-	CH	-	-	-	-	-	-	-	-	13	-	-	-
8	4.50	UDS	1.97	1.58	24.98	2.60	0	8	55	37	61	28	33	9	0.43	56	CH	0.71	1	-	-	TUU	0.10	0.0160	0.71	-	-	0.65	39.4
9	5.00	SPT	-	-	-	-	0	31	50	19	39	23	16	-	-	-	CI	-	-	-	-	-	-	-	-	14	-	-	-
10	5.50	UDS	2.01	1.62	24.19	2.66	0	60	40	46	24	22	-	-	-	-	SC	0.16	26	-	-	DSU	-	-	-	-	-	0.64	39.2
11	6.00	SPT	-	-	-	-	0	68	32	45	25	20	-	-	-	-	SC	-	-	-	-	-	-	-	-	21	-	-	-
12	6.50	SPT	-	-	-	-	0	66	34	49	26	23	-	-	-	-	SC	-	-	-	-	-	-	-	-	15	-	-	-
13	7.00	SPT	-	-	-	-	0	29	41	30	54	27	27	-	-	-	CH	-	-	-	-	-	-	-	-	18	-	-	-
14	7.50	SPT	-	-	-	-	0	27	42	31	55	26	29	-	-	-	CH	-	-	-	-	-	-	-	-	19	-	-	-
15	8.00	SPT	-	-	-	-	0	68	32	29	16	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	15	-	-	-
16	8.50	SPT	-	-	-	-	0	64	36	33	17	16	-	-	-	-	SC	-	-	-	-	-	-	-	-	39	-	-	-
17	9.00	SPT	-	-	-	-	0	65	35	31	16	15	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
18	10.50	UDS	2.41	2.24	7.62	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	128.2	-	UCS	-	-	-	-	38.00	0.21	17.1
19	12.00	UDS	2.39	2.20	8.50	2.71	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	141.6	-	UCS	-	-	-	-	6.00	0.23	18.7
20	13.50	UDS	2.47	2.33	6.02	2.71	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	132.7	-	UCS	-	-	-	-	10.00	0.16	14.0
21	15.00	UDS	2.48	2.35	5.51	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	146.2	-	UCS	-	-	-	-	73.00	0.15	12.9

UDS - Undisturbed Sample
DS - Disturbed Sample
SPT - Standard Penetration Tests
NP - Non Plastic

TUU - Triaxial Unconsolidated Undrained
TCU - Triaxial Consolidated Undrained
DSU - Direct Shear Test
UCS - Unconfined Compression Strength

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 51

Co-Ordinate :- E - 776, N - 3035

Reduced Level :- 197.51 m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility m _v cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	0	22	42	36	50	19	31	14	-	58	CH	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	6	55	39	53	20	33	-	-	-	CH	-	-	-	-	-	-	-	-	2	-	-	-
3	2.00	SPT	-	-	-	-	0	10	57	33	52	22	30	-	-	-	CH	-	-	-	-	-	-	-	-	5	-	-	-
4	2.50	UDS	1.92	1.48	29.64	2.64	0	16	46	38	51	19	32	13	0.33	55	CH	0.26	3	-	-	TUU	0.17	0.0408	0.42	-	-	0.78	43.9
5	3.00	SPT	-	-	-	-	0	18	49	33	50	20	30	-	-	-	CH	-	-	-	-	-	-	-	-	7	-	-	-
6	3.50	UDS	1.94	1.51	28.50	2.65	0	24	55	21	37	19	18	19	0.28	31	CI	0.36	5	-	-	TUU	0.16	0.0251	0.53	-	-	0.76	43.0
7	4.00	SPT	-	-	-	-	0	23	51	26	39	17	22	-	-	-	CI	-	-	-	-	-	-	-	-	8	-	-	-
8	4.50	UDS	1.99	1.58	25.73	2.67	0	48	34	18	36	21	15	20	0.28	29	CI	0.37	9	-	-	TUU	0.13	0.0202	0.66	-	-	0.69	40.7
9	5.00	SPT	-	-	-	-	0	74	26	27	16	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	13	-	-	-
10	5.50	UDS	2.02	1.63	24.14	2.68	8	65	27	29	15	14	-	-	-	-	SC	0.07	25	-	-	DSU	-	-	-	-	-	0.65	39.3
11	6.00	SPT	-	-	-	-	13	59	28	30	18	12	-	-	-	-	SC	-	-	-	-	-	-	-	-	28	-	-	-
12	6.50	SPT	-	-	-	-	34	52	14	25	16	9	-	-	-	-	SC	-	-	-	-	-	-	-	-	27	-	-	-
13	7.00	SPT	-	-	-	-	17	57	26	29	17	12	-	-	-	-	SC	-	-	-	-	-	-	-	-	14	-	-	-
14	7.50	SPT	-	-	-	-	2	72	26	27	16	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	25	-	-	-
15	8.00	SPT	-	-	-	-	0	73	27	28	18	10	-	-	-	-	SC	-	-	-	-	-	-	-	-	29	-	-	-
16	8.50	SPT	-	-	-	-	0	66	34	30	16	14	-	-	-	-	SC	-	-	-	-	-	-	-	-	32	-	-	-
17	9.00	SPT	-	-	-	-	30	34	36	31	15	16	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
18	9.50	SPT	-	-	-	-	12	47	41	33	18	15	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
19	10.00	SPT	-	-	-	-	18	28	40	14	31	19	12	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-
20	11.00	UDS	2.49	2.34	6.35	2.75	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	78.3	-	UCS	-	-	-	-	38.00	0.17	14.9
21	12.50	UDS	2.58	2.47	4.55	2.78	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	99.1	-	UCS	-	-	-	-	73.00	0.13	11.2
22	14.00	UDS	2.56	2.46	3.99	2.73	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	85.6	-	UCS	-	-	-	-	50.00	0.11	9.8
23	15.50	UDS	2.64	2.59	1.79	2.72	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	95.7	-	UCS	-	-	-	-	36.00	0.05	4.7
24	17.00	UDS	2.59	2.53	2.56	2.70	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	76.9	-	UCS	-	-	-	-	8.00	0.07	6.5

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RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 52

Co-Ordinate :- E - 775, N - 3126

Reduced Level :- 197.57 m

Sr No	Depth of Sample	Type of Sample	Field Bulk Density	Field Dry Density	Natural Moisture Content	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit	Swelling Pressure	Free Swell Index	Soil Classification	Shear Parameter		Unconfined Compression Test	UCS by Point Load Index in rock	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation	Void Ratio	Porosity		
							Gravel	Sand	Silt	Clay	Liquid Limit	Plastic Limit	Plasticity Index					Cohesion C	Angle of Internal Friction ϕ				Compression Index C _c	Coefficient of Volume Compressibility mv	Pre-consolidation Pressure						
																														%	%
1	0.00	DS	-	-	-	-	0	26	61	13	28	16	12	-	-	-	CL	-	-	-	-	-	-	-	-	-	-	-	-	-	
2	1.00	SPT	-	-	-	-	0	12	61	27	43	19	24	-	-	-	CI	-	-	-	-	-	-	-	-	2	-	-	-	-	
3	2.00	SPT	-	-	-	-	0	10	58	32	49	21	28	-	-	-	CI	-	-	-	-	-	-	-	-	3	-	-	-	-	
4	2.50	UDS	1.85	1.38	34.26	2.61	0	11	58	31	44	17	27	-	-	-	CI	0.18	1	-	-	TUU	0.23	0.0510	0.40	-	-	0.89	47.2	-	
5	3.00	SPT	-	-	-	-	0	12	58	30	46	20	26	-	-	-	CI	-	-	-	-	-	-	-	-	4	-	-	-	-	
6	3.50	UDS	1.88	1.42	32.71	2.64	0	17	59	24	39	18	21	-	-	-	CI	0.33	2	-	-	TUU	0.20	0.0314	0.49	-	-	0.86	46.3	-	
7	4.00	SPT	-	-	-	-	0	18	52	30	42	16	26	-	-	-	CI	-	-	-	-	-	-	-	-	7	-	-	-	-	
8	4.50	SPT	-	-	-	-	0	58	42		26	15	11	-	-	-	SC	-	-	-	-	-	-	-	-	15	-	-	-	-	
9	5.00	SPT	-	-	-	-	0	44	38	18	32	16	16	-	-	-	CL	-	-	-	-	-	-	-	-	13	-	-	-	-	
10	5.50	SPT	-	-	-	-	0	45	34	21	33	15	18	-	-	-	CL	-	-	-	-	-	-	-	-	11	-	-	-	-	
11	6.00	SPT	-	-	-	-	0	20	55	25	39	17	22	-	-	-	CI	-	-	-	-	-	-	-	-	19	-	-	-	-	
12	6.50	SPT	-	-	-	-	0	18	57	25	41	18	23	-	-	-	CI	-	-	-	-	-	-	-	-	24	-	-	-	-	
13	7.00	SPT	-	-	-	-	0	12	72	16	34	20	14	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-	-	
14	7.50	SPT	-	-	-	-	0	30	51	19	32	15	17	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-	-	
15	9.00	UDS	2.38	2.19	8.59	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	44.3	-	UCS	-	-	-	-	-	35.00	0.23	18.8	-
16	10.50	UDS	2.39	2.20	8.50	2.71	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	56.7	-	UCS	-	-	-	-	-	30.00	0.23	18.7	-
17	12.00	UDS	2.48	2.33	6.41	2.74	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	116.3	-	UCS	-	-	-	-	-	27.23	0.18	14.9	-
18	13.50	UDS	2.49	2.35	5.90	2.73	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	130.0	-	UCS	-	-	-	-	-	34.00	0.16	13.9	-
19	15.00	UDS	2.28	2.03	12.15	2.70	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	58.7	-	UCS	-	-	-	-	-	33.33	0.33	24.7	-
20	16.50	UDS	2.37	2.16	9.63	2.73	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	63.2	-	UCS	-	-	-	-	-	74.66	0.26	20.8	-

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 53

Co-Ordinate :- E - 776, N - 3228

Reduced Level :- 197.60m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility m _v cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	0	12	62	26	45	21	24	-	-	-	CI	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	16	10	42	32	52	23	29	14	-	57	CH	-	-	-	-	-	-	-	-	4	-	-	-
3	2.00	SPT	-	-	-	-	0	12	53	35	54	22	32	-	-	-	CH	-	-	-	-	-	-	-	-	6	-	-	-
4	2.50	UDS	1.91	1.47	29.78	2.62	0	4	56	40	56	20	36	12	0.29	69	CH	0.33	3	-	-	TUU	0.17	0.0347	0.41	-	-	0.78	43.8
5	3.00	SPT	-	-	-	-	0	12	56	32	51	24	27	-	-	-	CH	-	-	-	-	-	-	-	-	8	-	-	-
6	3.50	SPT	-	-	-	-	0	10	54	36	52	21	31	-	-	-	CH	-	-	-	-	-	-	-	-	9	-	-	-
7	4.00	SPT	-	-	-	-	0	24	53	23	40	19	21	-	-	-	CI	-	-	-	-	-	-	-	-	11	-	-	-
8	4.50	UDS	1.93	1.51	27.40	2.59	0	6	77	17	42	28	14	-	-	-	MI	0.54	4	-	-	TUU	0.14	0.0130	0.63	-	-	0.71	41.5
9	5.00	SPT	-	-	-	-	0	26	62	12	36	25	11	-	-	-	MI	-	-	-	-	-	-	-	-	58	-	-	-
10	5.50	UDS	2.03	1.67	21.28	2.60	0	10	76	14	39	26	13	-	-	-	MI	0.21	26	-	-	DSU	-	-	-	-	-	0.55	35.6
11	6.00	SPT	-	-	-	-	0	12	78	10	37	28	9	-	-	-	MI	-	-	-	-	-	-	-	-	>100	-	-	-
12	6.50	SPT	-	-	-	-	0	18	70	12	35	25	10	-	-	-	MI	-	-	-	-	-	-	-	-	>100	-	-	-
13	7.00	SPT	-	-	-	-	0	14	73	13	36	25	11	-	-	-	MI	-	-	-	-	-	-	-	-	>100	-	-	-
14	7.50	SPT	-	-	-	-	4	32	48	16	30	16	14	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-
15	9.00	UDS	2.40	2.21	8.63	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	141.6	-	UCS	-	-	-	-	17.14	0.24	19.1
16	10.50	UDS	2.42	2.24	8.22	2.74	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	168.9	-	UCS	-	-	-	-	10.66	0.23	18.4
17	12.00	UDS	2.16	1.85	16.99	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	53.4	-	UCS	-	-	-	-	27.33	0.46	31.4
18	13.50	UDS	2.33	2.11	10.54	2.71	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	89.7	-	UCS	-	-	-	-	10.00	0.29	22.2
19	15.00	UDS	2.68	2.61	2.55	2.80	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	419.3	-	UCS	-	-	-	-	9.33	0.07	6.7
20	16.50	UDS	2.18	1.88	16.07	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	58.0	-	UCS	-	-	-	-	34.00	0.43	30.2
21	18.00	UDS	2.29	2.05	11.77	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	115.6	-	UCS	-	-	-	-	8.00	0.32	24.1
22	19.50	UDS	2.31	2.08	11.03	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	128.7	-	UCS	-	-	-	-	64.00	0.30	22.9

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RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 54

Co-Ordinate :- E - 815, N - 3178

Reduced Level :- 197.12 m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	0	16	62	22	36	16	20	-	-	-	CI	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	5	13	59	23	40	20	20	-	-	-	CI	-	-	-	-	-	-	-	-	6	-	-	-
3	2.00	SPT	-	-	-	-	3	16	60	21	39	21	18	-	-	-	CI	-	-	-	-	-	-	-	-	7	-	-	-
4	2.50	UDS	1.93	1.50	28.32	2.62	2	13	56	29	46	20	26	16	0.16	45	CI	0.38	3	-	-	TUu	0.18	0.0292	0.44	-	-	0.74	42.6
5	3.00	SPT	-	-	-	-	0	12	59	29	47	21	26	-	-	-	CI	-	-	-	-	-	-	-	-	9	-	-	-
6	3.50	UDS	1.95	1.53	27.22	2.63	4	13	50	33	49	19	30	15	0.17	49	CI	0.48	4	-	-	TUU	0.16	0.0227	0.52	-	-	0.72	41.7
7	4.00	SPT	-	-	-	-	10	12	48	30	46	20	26	-	-	-	CI	-	-	-	-	-	-	-	-	10	-	-	-
8	4.50	UDS	1.99	1.59	25.16	2.65	4	36	35	25	38	16	22	16	0.13	34	CI	0.51	5	-	-	TUU	0.14	0.0192	0.65	-	-	0.67	40.0
9	5.00	SPT	-	-	-	-	0	40	44	16	36	22	14	-	-	-	CI	-	-	-	-	-	-	-	-	29	-	-	-
10	5.50	SPT	-	-	-	-	0	16	58	26	44	21	23	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-
11	6.00	SPT	-	-	-	-	0	26	53	21	41	23	18	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-
12	6.50	SPT	-	-	-	-	0	18	55	27	43	20	23	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-
13	7.00	SPT	-	-	-	-	0	20	55	25	42	21	21	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-
14	7.50	UDS	2.12	1.78	18.92	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	58.3	UCS	-	-	-	-	-	0.51	33.7
15	7.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
16	9.00	UDS	2.21	1.93	14.49	2.68	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	79.6	UCS	-	-	-	-	-	0.39	28.0
17	10.50	UDS	2.26	1.99	13.42	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	75.3	UCS	-	-	-	-	-	0.37	26.7
18	12.00	UDS	2.34	2.11	10.66	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	152.1	UCS	-	-	-	-	-	0.29	22.5
19	13.50	UDS	2.44	2.26	7.83	2.75	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	186.3	-	UCS	-	-	-	-	60.00	0.22	17.7
20	15.00	UDS	2.43	2.25	7.91	2.74	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	190.2	-	UCS	-	-	-	-	47.33	0.22	17.8
21	16.50	UDS	2.46	2.29	7.44	2.76	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	199.4	-	UCS	-	-	-	-	73.33	0.21	17.0

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- IBH 55

Co-Ordinate :- E - 815, N - 3297

Reduced Level :- 196.750 m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	0	20	57	23	41	20	21	-	-	-	CI	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	15	18	42	25	43	21	22	-	-	-	CI	-	-	-	-	-	-	-	-	8	-	-	-
3	2.00	SPT	-	-	-	-	8	17	47	28	49	24	25	-	-	-	CI	-	-	-	-	-	-	-	-	7	-	-	-
4	2.50	UDS	1.91	1.47	29.78	2.62	0	11	64	25	46	23	23	-	-	-	CI	0.37	4	-	-	TUU	0.16	0.0270	0.42	-	-	0.78	43.8
5	3.00	SPT	-	-	-	-	0	24	49	27	42	18	24	-	-	-	CI	-	-	-	-	-	-	-	-	7	-	-	-
6	3.50	UDS	1.97	1.55	27.03	2.67	18	39	43	41	20	21	-	-	-	-	SC	0.09	26	-	-	DSU	-	-	-	-	-	0.72	41.9
7	4.00	SPT	-	-	-	-	16	61	23	36	17	19	-	-	-	-	SC	-	-	-	-	-	-	-	-	7	-	-	-
8	4.50	UDS	1.98	1.56	26.65	2.68	23	38	39	39	16	23	-	-	-	-	SC	0.06	26	-	-	DSU	-	-	-	-	-	0.71	41.7
9	5.00	SPT	-	-	-	-	10	71	19	26	19	7	-	-	-	-	SM-SC	-	-	-	-	-	-	-	-	17	-	-	-
10	5.50	UDS	2.01	1.61	24.47	2.67	14	72	14	24	18	6	-	-	-	-	SM-SC	0.02	28	-	-	DSU	-	-	-	-	-	0.65	39.5
11	6.00	SPT	-	-	-	-	0	62	38	27	15	12	-	-	-	-	SC	-	-	-	-	-	-	-	-	33	-	-	-
12	6.50	UDS	2.08	1.73	20.19	2.66	10	59	31	26	16	10	-	-	-	-	SC	0.07	27	-	-	DSU	-	-	-	-	-	0.54	34.9
13	7.00	SPT	-	-	-	-	0	92	8	NP	NP	NP	-	-	-	-	SP-SM	-	-	-	-	-	-	-	-	>100	-	-	-
14	7.50	SPT	-	-	-	-	0	90	10	NP	NP	NP	-	-	-	-	SP-SM	-	-	-	-	-	-	-	-	>100	-	-	-
15	8.00	SPT	-	-	-	-	0	93	7	NP	NP	NP	-	-	-	-	SP-SM	-	-	-	-	-	-	-	-	>100	-	-	-
16	8.50	SPT	-	-	-	-	0	91	9	NP	NP	NP	-	-	-	-	SP-SM	-	-	-	-	-	-	-	-	>100	-	-	-
17	9.00	UDS	2.31	2.08	11.27	2.71	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	96.8	UCS	-	-	-	-	-	0.31	23.4
18	10.50	UDS	2.30	2.05	12.12	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	100.7	-	UCS	-	-	-	-	19.00	0.33	24.9
19	12.00	UDS	2.34	2.11	11.13	2.75	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	186.3	-	UCS	-	-	-	-	27.00	0.31	23.4
20	13.50	UDS	2.35	2.12	11.00	2.76	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	195.8	-	UCS	-	-	-	-	33.00	0.30	23.3
21	15.00	UDS	2.32	2.08	11.61	2.74	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	152.2	-	UCS	-	-	-	-	26.00	0.32	24.1
22	16.50	UDS	2.30	2.05	12.12	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	173.4	-	UCS	-	-	-	-	26.00	0.33	24.9
23	18.00	UDS	2.34	2.11	10.89	2.74	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	186.9	-	UCS	-	-	-	-	44.00	0.30	23.0

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- BH-52

Co-Ordinate :- E - 908, N - 3261

Reduced Level :- 196.05m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility m _v cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	0	67	33	33	16	17	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	4	33	36	27	43	20	23	-	-	-	CI	-	-	-	-	-	-	-	9	-	-	-	-
3	2.00	SPT	-	-	-	-	6	63	31		29	19	10	-	-	-	SC	-	-	-	-	-	-	-	24	-	-	-	-
4	2.50	UDS	2.04	1.66	22.69	2.67	3	59	38	36	20	16	-	-	-	SC	0.08	26	-	-	DSU	-	-	-	-	-	0.61	37.7	
5	3.00	SPT	-	-	-	-	4	68	28	26	16	10	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
6	3.50	SPT	-	-	-	-	3	64	33	29	15	14	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
7	4.00	SPT	-	-	-	-	0	78	22	24	17	7	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
8	4.50	SPT	-	-	-	-	0	79	21	22	16	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
9	5.00	SPT	-	-	-	-	0	68	32	29	22	7	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
10	5.50	SPT	-	-	-	-	0	75	25	26	20	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
11	6.00	SPT	-	-	-	-	0	83	17	24	18	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
12	6.50	UDS	2.36	2.16	9.50	2.71	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	131.4	UCS	-	-	-	-	-	-	0.26	20.5
13	8.00	UDS	2.32	2.08	11.38	2.73	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	116.8	UCS	-	-	-	-	-	-	0.31	23.7
14	9.50	UDS	2.30	2.06	11.88	2.72	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	106.9	UCS	-	-	-	-	-	-	0.32	24.4
15	11.00	UDS	2.23	1.95	14.15	2.70	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	80.1	UCS	-	-	-	-	-	-	0.38	27.6
16	12.50	UDS	2.06	1.69	21.82	2.68	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	65.9	UCS	-	-	-	-	-	-	0.58	36.9
17	14.00	UDS	2.08	1.73	20.46	2.67	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	72.4	UCS	-	-	-	-	-	-	0.55	35.3
18	15.50	UDS	2.03	1.64	23.82	2.69	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	54.3	UCS	-	-	-	-	-	-	0.64	39.1
19	17.00	UDS	2.46	2.29	7.22	2.75	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	130.2	UCS	-	-	-	-	-	-	0.20	16.6
20	18.50	UDS	2.51	2.37	6.00	2.76	-	-	-	-	-	-	-	-	-	ROCK	-	-	-	174.8	UCS	-	-	-	-	-	-	0.17	14.2
21	20.00	UDS	2.26	1.99	13.42	2.72	-	-	-	-	-	-	-	-	-	ROCK	-	-	96.5	-	UCS	-	-	-	-	22.66	0.37	26.7	

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- BH-8

Co-Ordinate :- E 1136, N 3661

Reduced Level :- 199.63 m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility m _v cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	3	58	39		30	15	15	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	20	54	26		29	16	13	-	-	-	SC	-	-	-	-	-	-	-	-	19	-	-	-
3	2.00	SPT	-	-	-	-	6	56	38		35	18	17	-	-	-	SC	-	-	-	-	-	-	-	-	21	-	-	-
4	2.50	UDS	1.87	1.59	17.64	2.66	2	64	34		31	16	15	-	-	-	SC	0.08	27	-	-	DSU	-	-	-	-	-	0.67	40.2
5	3.00	SPT	-	-	-	-	12	62	26		27	18	9	-	-	-	SC	-	-	-	-	-	-	-	-	14	-	-	-
6	3.50	UDS	1.95	1.53	27.51	2.64	0	52	48		40	20	20	-	-	-	SC	0.10	26	-	-	DSU	-	-	-	-	-	0.73	42.1
7	4.00	SPT	-	-	-	-	28	46	26		38	23	15	-	-	-	SC	-	-	-	-	-	-	-	-	15	-	-	-
8	4.50	UDS	1.97	1.55	26.74	2.66	3	83	14		23	14	9	-	-	-	SC	0.06	28	-	-	DSU	-	-	-	-	-	0.71	41.6
9	5.00	SPT	-	-	-	-	14	66	20		36	21	15	-	-	-	SC	-	-	-	-	-	-	-	-	19	-	-	-
10	5.50	Remoulded	2.00	1.60	25.09	2.67	14	74	12		NP	NP	NP	-	-	-	SM	0.00	30	-	-	DSU	-	-	-	-	-	0.67	40.1
11	6.00	SPT	-	-	-	-	6	81	13		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
12	6.50	SPT	-	-	-	-	2	86	12		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
13	7.00	SPT	-	-	-	-	0	86	14		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
14	7.50	SPT	-	-	-	-	5	80	15		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
15	8.00	DS	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	-	-	-	-
16	8.50	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
17	9.50	SPT	-	-	-	-	0	82	18		22	14	8	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
18	11.00	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
19	11.50	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
20	12.50	SPT	-	-	-	-	0	76	24		27	16	11	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
21	13.00	SPT	-	-	-	-	0	82	18		23	14	9	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
22	14.00	SPT	-	-	-	-	4	82	14		21	13	8	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
23	14.50	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
24	15.50	UDS	2.29	2.06	11.28	2.68	9	72	19		25	15	10	-	-	-	W.ROCK	-	-	-	46.3	UCS	-	-	-	-	-	0.30	23.2
25	15.50	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
26	17.00	UDS	2.32	2.10	10.42	2.69	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	88.7	UCS	-	-	-	-	-	0.28	21.9
27	17.00	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
28	18.50	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
29	20.00	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- BH-42

Co-Ordinate :- E - 958, N - 3319

Reduced Level :- 195.39 m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %	
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction φ Degree				Compression Index C _c	Coefficient of Volume Compressibility m _v cm ² /kg	Pre-consolidation Pressure kg/cm ²					
1	0.00	DS	-	-	-	-	4	36	47	13	28	17	11	-	-	-	CL	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	15	56	29		25	16	9	-	-	-	SC	-	-	-	-	-	-	-	-	11	-	-	-	-
3	2.00	SPT	-	-	-	-	3	20	57	20	39	21	18	-	-	-	CI	-	-	-	-	-	-	-	-	14	-	-	-	-
4	2.50	SPT	-	-	-	-	5	19	49	27	42	19	23	-	-	-	CI	-	-	-	-	-	-	-	-	11	-	-	-	-
5	3.00	SPT	-	-	-	-	4	20	55	21	40	22	18	-	-	-	CI	-	-	-	-	-	-	-	-	17	-	-	-	-
6	3.50	SPT	-	-	-	-	6	28	49	17	39	24	15	-	-	-	CI	-	-	-	-	-	-	-	-	25	-	-	-	-
7	4.00	SPT	-	-	-	-	4	30	50	16	37	23	14	-	-	-	CI	-	-	-	-	-	-	-	-	50	-	-	-	-
8	4.50	SPT	-	-	-	-	3	25	46	26	42	20	22	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-	-
9	5.00	SPT	-	-	-	-	5	61	34		29	18	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
10	5.50	SPT	-	-	-	-	6	59	35		31	17	14	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
11	6.00	SPT	-	-	-	-	4	66	30		26	16	10	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
12	6.50	SPT	-	-	-	-	6	63	31		28	15	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
13	7.00	SPT	-	-	-	-	5	57	38		31	16	15	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
14	7.50	SPT	-	-	-	-	7	63	30		29	18	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
15	8.00	SPT	-	-	-	-	5	59	36		32	19	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
16	8.50	UDS	2.26	2.00	12.93	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	46.2	UCS	-	-	-	-	-	-	0.35	25.9
17	8.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-
18	10.00	UDS	2.31	2.09	10.78	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	58.2	UCS	-	-	-	-	-	-	0.29	22.5
19	10.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-
20	11.50	UDS	2.30	2.06	11.40	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	49.4	UCS	-	-	-	-	-	-	0.31	23.5
21	13.00	UDS	2.29	2.06	11.28	2.68	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	45.5	UCS	-	-	-	-	-	-	0.30	23.2
22	14.50	UDS	2.35	2.14	9.60	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	150.1	-	UCS	-	-	-	-	-	7.33	0.26	20.6
23	16.00	UDS	2.44	2.27	7.60	2.74	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	131.7	-	UCS	-	-	-	-	-	13.33	0.21	17.2
24	17.50	UDS	2.41	2.22	8.77	2.75	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	129.8	UCS	-	-	-	-	-	-	0.24	19.4
25	19.00	UDS	2.39	2.19	9.19	2.74	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	135.6	-	UCS	-	-	-	-	-	15.33	0.25	20.1
26	20.50	UDS	2.42	2.25	7.54	2.71	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	152.7	-	UCS	-	-	-	-	-	20.66	0.20	17.0
27	22.00	UDS	2.44	2.26	7.83	2.75	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	189.9	-	UCS	-	-	-	-	-	33.33	0.22	17.7
28	23.50	UDS	2.45	2.27	7.75	2.76	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	246.5	-	UCS	-	-	-	-	-	63.33	0.21	17.6

KCT Consultancy Services LLP, Ahmedabad

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- BH-45

Co-Ordinate :- E 1160, N 3318

Reduced Level :- 198.85 m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	0	28	44	28	47	23	24	-	-	-	CI	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	31	44	25	42	20	22	-	-	-	CI	-	-	-	-	-	-	-	-	6	-	-	-
3	2.00	SPT	-	-	-	-	0	27	48	25	43	21	22	-	-	-	CI	-	-	-	-	-	-	-	-	9	-	-	-
4	2.50	UDS	1.95	1.53	27.81	2.65	0	36	41	23	41	20	21	19	0.13	36	CI	0.46	5	-	-	TUU	0.16	0.0174	0.43	-	-	0.74	42.4
5	3.00	SPT	-	-	-	-	0	29	37	34	59	29	30	-	-	-	CH	-	-	-	-	-	-	-	-	14	-	-	-
6	3.50	UDS	1.97	1.56	26.16	2.64	0	31	35	34	55	26	29	14	0.37	53	CH	0.75	4	-	-	TUU	0.14	0.0149	0.51	-	-	0.69	40.9
7	4.00	SPT	-	-	-	-	0	28	37	35	58	28	30	-	-	-	CH	-	-	-	-	-	-	-	-	20	-	-	-
8	4.50	SPT	-	-	-	-	0	27	32	41	61	26	35	-	-	-	CH	-	-	-	-	-	-	-	-	35	-	-	-
9	5.00	SPT	-	-	-	-	0	33	37	30	53	27	26	-	-	-	CH	-	-	-	-	-	-	-	-	18	-	-	-
10	5.50	UDS	2.02	1.64	23.31	2.65	0	34	31	35	56	25	31	12	0.41	61	CH	0.95	5	-	-	TUU	0.11	0.0116	0.70	-	-	0.62	38.2
11	6.00	SPT	-	-	-	-	0	67	33		27	16	11	-	-	-	SC	-	-	-	-	-	-	-	-	27	-	-	-
12	6.50	UDS	1.97	1.55	26.74	2.66	0	64	36		29	15	14	-	-	-	SC	0.08	24	-	-	DSU	-	-	-	-	-	0.71	41.6
13	7.00	SPT	-	-	-	-	0	15	47	38	58	26	32	-	-	-	CH	-	-	-	-	-	-	-	-	10	-	-	-
14	7.50	UDS	1.98	1.59	24.63	2.61	0	14	50	36	60	28	32	-	-	-	CH	0.55	1	-	-	TUU	0.12	0.0208	0.88	-	-	0.64	39.1
15	8.00	SPT	-	-	-	-	0	17	54	29	53	27	26	-	-	-	CH	-	-	-	-	-	-	-	-	15	-	-	-
16	8.50	UDS	1.96	1.54	27.12	2.65	0	61	39		33	16	17	-	-	-	SC	0.10	25	-	-	DSU	-	-	-	-	-	0.72	41.8
17	9.00	SPT	-	-	-	-	0	68	32		27	15	12	-	-	-	SC	-	-	-	-	-	-	-	-	7	-	-	-
18	9.50	SPT	-	-	-	-	0	69	31		26	16	10	-	-	-	SC	-	-	-	-	-	-	-	-	10	-	-	-
19	10.00	SPT	-	-	-	-	0	71	29		24	15	9	-	-	-	SC	-	-	-	-	-	-	-	-	13	-	-	-
20	11.00	SPT	-	-	-	-	0	79	21		20	15	5	-	-	-	SM	-	-	-	-	-	-	-	-	29	-	-	-
21	11.50	SPT	-	-	-	-	0	82	18		16	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	31	-	-	-
22	12.50	SPT	-	-	-	-	0	81	19		19	15	4	-	-	-	SM	-	-	-	-	-	-	-	-	38	-	-	-
23	13.00	SPT	-	-	-	-	6	29	43	22	40	21	19	-	-	-	CI	-	-	-	-	-	-	-	-	54	-	-	-
24	14.00	SPT	-	-	-	-	4	28	44	24	42	20	22	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-
25	15.50	UDS	2.41	2.23	8.08	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	113.8	-	UCS	-	-	-	-	8.00	0.22	18.0
26	17.00	UDS	2.40	2.22	8.17	2.71	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	148.8	-	UCS	-	-	-	-	11.33	0.22	18.1
27	18.50	UDS	2.28	2.02	12.88	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	88.7	-	UCS	-	-	-	-	39.33	0.35	26.0
28	20.00	UDS	2.31	2.08	11.03	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	97.2	-	UCS	-	-	-	-	44.66	0.30	22.9
29	21.50	UDS	2.27	2.02	12.29	2.69	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	89.7	-	UCS	-	-	-	-	70.00	0.33	24.9
30	23.00	UDS	2.44	2.28	7.15	2.72	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	132.4	-	UCS	-	-	-	-	72.00	0.19	16.3
31	24.50	UDS	2.43	2.26	7.46	2.72	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	159.3	-	UCS	-	-	-	-	62.00	0.20	16.9
32	25.00	UDS	2.39	2.20	8.50	2.71	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	152.9	-	UCS	-	-	-	-	37.00	0.23	18.7

UDS - Undisturbed Sample
DS - Disturbed Sample
SPT - Standard Penetration Tests
NP - Non Plastic

TUU - Triaxial Unconsolidated Undrained
TCU - Triaxial Consolidated Undrained
DSU - Direct Shear Test
UCS - Unconfined Compression Strength

KCT Consultancy Services LLP, Ahmedabad

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- BH-48

Co-Ordinate :- E 1219, N 3291

Reduced Level :- 200.630 m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	8	62	30		29	15	14	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	1	18	60	21	40	21	19	-	-	-	CI	-	-	-	-	-	-	-	-	8	-	-	-
3	2.00	SPT	-	-	-	-	0	13	60	27	43	20	23	-	-	-	CI	-	-	-	-	-	-	-	-	16	-	-	-
4	2.50	SPT	-	-	-	-	3	20	56	21	40	22	18	-	-	-	CI	-	-	-	-	-	-	-	-	21	-	-	-
5	3.00	SPT	-	-	-	-	2	21	58	19	39	23	16	-	-	-	CI	-	-	-	-	-	-	-	-	19	-	-	-
6	3.50	UDS	1.97	1.56	26.16	2.64	0	17	58	25	41	19	22	18	0.15	42	CI	1.02	4	-	-	TUU	0.14	0.0099	0.63	-	-	0.69	40.9
7	4.00	SPT	-	-	-	-	0	9	54	37	54	22	32	-	-	-	CH	-	-	-	-	-	-	-	-	22	-	-	-
8	4.50	SPT	-	-	-	-	0	7	52	41	57	21	36	-	-	-	CH	-	-	-	-	-	-	-	-	27	-	-	-
9	5.00	SPT	-	-	-	-	0	12	54	34	53	24	29	-	-	-	CH	-	-	-	-	-	-	-	-	32	-	-	-
10	5.50	UDS	2.07	1.73	19.62	2.62	0	14	57	29	52	26	26	12	0.32	56	CH	1.76	3	-	-	TUU	0.10	0.0063	2.59	-	-	0.51	34.0
11	6.00	SPT	-	-	-	-	0	23	48	29	51	27	24	-	-	-	CH	-	-	-	-	-	-	-	-	34	-	-	-
12	6.50	UDS	2.03	1.66	22.43	2.64	0	26	38	36	52	20	32	13	0.30	58	CH	1.80	7	-	-	TUU	0.11	0.0064	3.81	-	-	0.59	37.2
13	7.00	SPT	-	-	-	-	0	13	47	40	55	21	34	-	-	-	CH	-	-	-	-	-	-	-	-	21	-	-	-
14	7.50	UDS	2.02	1.65	22.74	2.63	0	19	48	33	53	23	30	13	0.30	60	CH	1.12	4	-	-	TUU	0.12	0.0095	4.76	-	-	0.60	37.4
15	8.00	SPT	-	-	-	-	0	17	45	38	54	20	34	-	-	-	CH	-	-	-	-	-	-	-	-	22	-	-	-
16	8.50	UDS	2.01	1.62	23.91	2.65	0	31	54	15	29	16	13	-	-	-	CL	1.13	8	-	-	TUU	0.10	0.0057	4.82	-	-	0.63	38.8
17	9.00	SPT	-	-	-	-	0	29	51	20	32	15	17	-	-	-	CL	-	-	-	-	-	-	-	-	15	-	-	-
18	9.50	UDS	1.98	1.57	25.80	2.65	0	33	52	15	31	17	14	-	-	-	CL	0.71	8	-	-	TUU	0.14	0.0095	4.83	-	-	0.68	40.6
19	10.00	SPT	-	-	-	-	4	67	29		28	19	9	-	-	-	SC	-	-	-	-	-	-	-	-	19	-	-	-
20	11.00	UDS	2.00	1.60	25.09	2.67	0	79	21		22	18	4	-	-	-	SM	0.00	29	-	-	DSU	-	-	-	-	-	0.67	40.1
21	11.50	SPT	-	-	-	-	0	83	17		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	19	-	-	-
22	12.50	SPT	-	-	-	-	0	74	26		25	20	5	-	-	-	SM	-	-	-	-	-	-	-	-	22	-	-	-
23	13.00	SPT	-	-	-	-	0	75	25		24	20	4	-	-	-	SM	-	-	-	-	-	-	-	-	21	-	-	-
24	14.00	SPT	-	-	-	-	0	83	17		21	17	4	-	-	-	SM	-	-	-	-	-	-	-	-	23	-	-	-
25	14.50	SPT	-	-	-	-	0	85	15		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	24	-	-	-
26	15.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
27	17.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
28	18.50	UDS	2.16	1.85	16.99	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	39.2	UCS	-	-	-	-	-	0.46	31.4
29	18.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
30	20.00	UDS	2.21	1.92	15.25	2.71	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	74.9	-	UCS	-	-	-	-	7.00	0.41	29.2
31	21.50	UDS	2.28	2.02	12.64	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	106.6	-	UCS	-	-	-	-	14.00	0.34	25.6
32	23.00	UDS	2.27	2.00	13.51	2.74	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	115.3	-	UCS	-	-	-	-	57.00	0.37	27.0
33	24.50	UDS	2.25	1.97	14.31	2.74	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	104.3	-	UCS	-	-	-	-	54.00	0.39	28.2
34	25.00	UDS	2.16	1.84	17.50	2.71	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	121.8	-	UCS	-	-	-	-	20.00	0.47	32.2

UDS - Undisturbed Sample
DS - Disturbed Sample
SPT - Standard Penetration Tests
NP - Non Plastic

TUU - Triaxial Unconsolidated Undrained
TCU - Triaxial Consolidated Undrained
DSU - Direct Shear Test
UCS - Unconfined Compression Strength

KCT Consultancy Services LLP, Ahmedabad

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- BH-96

Co-Ordinate :- E 831, N 3034

Reduced Level :- 197.34 m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	0	15	37	48	60	19	41	-	-	-	CH	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	17	42	41	58	22	36	12	-	60	CH	-	-	-	-	-	-	-	-	3	-	-	-
3	2.00	SPT	-	-	-	-	0	21	39	40	55	21	34	-	-	-	CH	-	-	-	-	-	-	-	-	7	-	-	-
4	2.50	UDS	1.89	1.44	31.00	2.61	0	10	42	48	62	20	42	9	0.38	76	CH	0.49	2	-	-	TUU	0.15	0.0236	0.43	-	-	0.81	44.7
5	3.00	SPT	-	-	-	-	0	21	42	37	57	25	32	-	-	-	CH	-	-	-	-	-	-	-	-	11	-	-	-
6	3.50	SPT	-	-	-	-	0	12	47	41	61	26	35	-	-	-	CH	-	-	-	-	-	-	-	-	10	-	-	-
7	4.00	SPT	-	-	-	-	0	11	44	45	64	25	39	-	-	-	CH	-	-	-	-	-	-	-	-	12	-	-	-
8	4.50	SPT	-	-	-	-	0	66	34	41	20	21	-	-	-	-	SC	-	-	-	-	-	-	-	-	11	-	-	-
9	5.00	SPT	-	-	-	-	0	71	29	46	23	23	-	-	-	-	SC	-	-	-	-	-	-	-	-	10	-	-	-
10	5.50	SPT	-	-	-	-	0	70	30	45	22	23	-	-	-	-	SC	-	-	-	-	-	-	-	-	8	-	-	-
11	6.00	SPT	-	-	-	-	0	68	32	43	24	19	-	-	-	-	SC	-	-	-	-	-	-	-	-	11	-	-	-
12	6.50	SPT	-	-	-	-	0	78	22	21	16	5	-	-	-	-	SM	-	-	-	-	-	-	-	-	8	-	-	-
13	7.00	SPT	-	-	-	-	0	82	18	19	15	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	14	-	-	-
14	7.50	SPT	-	-	-	-	0	79	21	22	18	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	16	-	-	-
15	8.00	SPT	-	-	-	-	0	81	19	21	16	5	-	-	-	-	SM	-	-	-	-	-	-	-	-	26	-	-	-
16	8.50	SPT	-	-	-	-	0	74	26	26	21	5	-	-	-	-	SM	-	-	-	-	-	-	-	-	29	-	-	-
17	9.00	SPT	-	-	-	-	0	16	60	24	43	21	22	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-
18	9.50	SPT	-	-	-	-	0	19	57	24	41	20	21	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-
19	10.00	SPT	-	-	-	-	16	61	23	21	17	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
20	11.00	UDS	2.29	2.05	11.77	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	86.4	UCS	-	-	-	-	-	0.32	24.1
21	12.50	UDS	2.32	2.09	10.90	2.71	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	138.7	UCS	-	-	-	-	-	0.30	22.8
22	14.00	UDS	2.34	2.11	10.66	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	141.4	UCS	-	-	-	-	-	0.29	22.5
23	15.50	UDS	2.41	2.23	8.31	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	156.8	-	UCS	-	-	-	-	52.00	0.23	18.5
24	17.00	UDS	2.44	2.27	7.60	2.74	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	115.7	-	UCS	-	-	-	-	89.00	0.21	17.2

UDS - Undisturbed Sample
DS - Disturbed Sample
SPT - Standard Penetration Tests
NP - Non Plastic

TUU - Triaxial Unconsolidated Undrained
TCU - Triaxial Consolidated Undrained
DSU - Direct Shear Test
UCS - Unconfined Compression Strength

KCT Consultancy Services LLP, Ahmedabad

RESULTS OF LABORATORY TEST

Project :- Proposed structures in Phase 1 of 3 x 800 MW NLC Talabira Thermal Power Project (NTTPP) at village Hirma, Talabira, Odisha

BH No. :- BH-114

Co-Ordinate :- E 814, N 2918

Reduced Level :- 197.18 m

Sr No	Depth of Sample	Type of Sample	Field Bulk Density	Field Dry Density	Natural Moisture Content	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit	Swelling Pressure	Free Swell Index	Soil Classification	Shear Parameter		Unconfined Compression Test	UCS by Point Load Index in rock	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation	Void Ratio	Porosity	
							Gravel	Sand	Silt	Clay	Liquid Limit	Plastic Limit	Plasticity Index					Cohesion C	Angle of Internal Friction ϕ				Compression Index C _c	Coefficient of Volume Compressibility mv	Pre-consolidation Pressure					
																														%
1	0.00	DS	-	-	-	-	0	20	39	41	63	28	35	-	-	-	CH	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	11	46	43	66	27	39	-	-	-	CH	-	-	-	-	-	-	-	-	3	-	-	-	-
3	2.00	SPT	-	-	-	-	0	13	44	43	65	28	37	-	-	-	CH	-	-	-	-	-	-	-	-	5	-	-	-	-
4	2.50	UDS	1.91	1.47	29.78	2.62	0	17	44	39	62	29	33	-	-	-	CH	0.64	3	-	-	TUU	0.17	0.0177	0.42	-	-	0.78	43.8	-
5	3.00	SPT	-	-	-	-	0	29	47	24	43	23	20	-	-	-	CI	-	-	-	-	-	-	-	-	19	-	-	-	-
6	3.50	UDS	1.95	1.53	27.22	2.63	0	20	45	35	61	29	32	-	-	-	CH	0.86	4	-	-	TUU	0.14	0.0128	0.55	-	-	0.72	41.7	-
7	4.00	SPT	-	-	-	-	0	23	42	35	59	29	30	-	-	-	CH	-	-	-	-	-	-	-	-	14	-	-	-	-
8	4.50	UDS	1.94	1.53	27.00	2.60	0	10	54	36	63	30	33	-	-	-	CH	0.87	1	-	-	TUU	0.14	0.0130	0.73	-	-	0.70	41.3	-
9	5.00	SPT	-	-	-	-	0	15	49	36	58	28	30	-	-	-	CH	-	-	-	-	-	-	-	-	17	-	-	-	-
10	5.50	SPT	-	-	-	-	0	19	48	33	55	26	29	-	-	-	CH	-	-	-	-	-	-	-	-	18	-	-	-	-
11	6.00	SPT	-	-	-	-	0	67	33		46	24	22	-	-	-	SC	-	-	-	-	-	-	-	-	19	-	-	-	-
12	6.50	SPT	-	-	-	-	0	63	37		48	25	23	-	-	-	SC	-	-	-	-	-	-	-	-	18	-	-	-	-
13	7.00	SPT	-	-	-	-	0	33	44	23	41	20	21	-	-	-	CI	-	-	-	-	-	-	-	-	15	-	-	-	-
14	7.50	SPT	-	-	-	-	4	56	40		44	22	22	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
15	8.00	SPT	-	-	-	-	12	59	29		41	24	17	-	-	-	SC	-	-	-	-	-	-	-	-	51	-	-	-	-
16	8.50	SPT	-	-	-	-	6	65	29		39	20	19	-	-	-	SC	-	-	-	-	-	-	-	-	40	-	-	-	-
17	9.00	SPT	-	-	-	-	0	24	45	31	56	29	27	-	-	-	CH	-	-	-	-	-	-	-	-	54	-	-	-	-
18	9.50	SPT	-	-	-	-	0	19	43	38	58	26	32	-	-	-	CH	-	-	-	-	-	-	-	-	40	-	-	-	-
19	10.00	SPT	-	-	-	-	11	57	32		29	16	13	-	-	-	SC	-	-	-	-	-	-	-	-	46	-	-	-	-
20	11.00	SPT	-	-	-	-	9	54	37		31	15	16	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
21	12.00	UDS	2.37	2.16	9.63	2.73	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	129.1	-	UCS	-	-	-	-	66.00	0.26	20.8	-
22	13.50	UDS	2.39	2.20	8.50	2.71	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	135.9	-	UCS	-	-	-	-	36.00	0.23	18.7	-
23	15.00	UDS	2.35	2.13	10.08	2.72	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	152.4	-	UCS	-	-	-	-	48.00	0.27	21.5	-
24	16.50	UDS	2.41	2.22	8.54	2.74	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	146.7	-	UCS	-	-	-	-	43.00	0.23	19.0	-

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TUU - Triaxial Unconsolidated Undrained
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UCS - Unconfined Compression Strength

1000-Z09-115-90-3D

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

GEOTECHNICAL INVESTIGATION LAYOUT

DEVELOPMENT CONSULTANTS PVT. LIMITED.

Reviewed only for general compliance with contract drawings and specifications. Contractor to be responsible for any errors and for fulfillment of detailed requirements of contract documents.

DISTRIBUTED BY: GN **DATE: 25.09.2025**

1 Approved **FOR INFORMATION ONLY**

2 Approved except as noted. **FOR INFORMATION ONLY**

3 Returned with Comments. **FOR INFORMATION ONLY**

4 For information only

LETTER REF. NO. DATE

MARKING	CO-ORDINATES	DEPTH (M)
BH-1	E 1430 N 5845	20.0
BH-2	E 957 N 5845	20.0
BH-3	E 2000 N 5843	20.0
BH-4	E 719 N 5759	20.0
BH-5	E 1669 N 5690	25.0
BH-6	E 1129 N 5563	25.0
BH-7	E 1963 N 5695	20.0
BH-8	E 1136 N 5661	20.0
BH-9	E 1046 N 5637	25.0
BH-10	E 814 N 5614	25.0
BH-11	E 714 N 5599	20.0
BH-12	E 1018 N 5561	25.0
BH-13	E 1058 N 5579	25.0
BH-14	E 940 N 5559	25.0
BH-15	E 1238 N 5510	25.0
BH-16	E 1151 N 5503	25.0
BH-17	E 837 N 5501	25.0
BH-18	E 1443 N 5456	20.0
BH-19	E 1049 N 5500	20.0
BH-20	E 956 N 5493	20.0
BH-21	E 1344 N 5488	25.0
BH-22	E 1264 N 5434	25.0
BH-23	E 1157 N 5471	25.0
BH-24	E 1176 N 5017	25.0
BH-25	E 1304 N 5435	25.0
BH-26	E 1350 N 5325	25.0
BH-27	E 928 N 5442	25.0
BH-28	E 1009 N 5416	20.0
BH-29	E 771 N 5417	25.0
BH-30	E 1248 N 5425	25.0
BH-31	E 1060 N 5388	25.0
BH-32	E 1670 N 5419	20.0
BH-33	E 1172 N 5393	25.0
BH-34	E 1457 N 5401	25.0
BH-35	E 1010 N 5360	20.0
BH-36	E 1819 N 5369	20.0
BH-37	E 955 N 5368	20.0
BH-38	E 1411 N 5308	20.0
BH-39	E 1619 N 5343	25.0
BH-40	E 898 N 5343	20.0
BH-41	E 1270 N 5322	20.0
BH-42	E 958 N 5319	25.0
BH-43	E 1416 N 5364	20.0
BH-44	E 1772 N 5384	25.0
BH-45	E 1616 N 5318	25.0
BH-46	E 1516 N 5323	25.0
BH-47	E 757 N 5328	25.0
BH-48	E 1219 N 5291	25.0
BH-49	E 1081 N 5296	25.0
BH-50	E 1281 N 5354	25.0
BH-51	E 1007 N 5246	25.0
BH-52	E 908 N 5261	30.0
BH-53	E 1171 N 5260	30.0
BH-54	E 1680 N 5346	25.0
BH-55	E 1314 N 5320	30.0
BH-56	E 1152 N 5231	30.0
BH-57	E 1077 N 5230	30.0
BH-58	E 1217 N 5229	30.0
BH-59	E 967 N 5209	30.0
BH-60	E 909 N 5227	30.0
BH-61	E 1265 N 5214	30.0
BH-62	E 1414 N 5223	30.0
BH-63	E 1178 N 5201	30.0
BH-64	E 1128 N 5195	30.0
BH-65	E 1335 N 5190	20.0
BH-66	E 1280 N 5169	30.0
BH-67	E 900 N 5182	25.0
BH-68	E 1050 N 5179	25.0
BH-69	E 1805 N 5156	30.0
BH-70	E 1216 N 5170	30.0
BH-71	E 1175 N 5163	20.0
BH-72	E 1598 N 5160	30.0
BH-73	E 986 N 5156	20.0
BH-74	E 1705 N 5142	30.0
BH-75	E 917 N 5123	25.0
BH-76	E 1204 N 5127	25.0
BH-77	E 816 N 5128	20.0
BH-78	E 1253 N 5105	30.0
BH-79	E 1172 N 5104	30.0
BH-80	E 2085 N 5091	25.0
BH-81	E 1430 N 5109	20.0
BH-82	E 1011 N 5100	20.0
BH-83	E 1306 N 5093	30.0
BH-84	E 1152 N 5073	30.0
BH-85	E 712 N 5086	30.0
BH-86	E 1217 N 5081	30.0
BH-87	E 902 N 5074	25.0
BH-88	E 1268 N 5062	25.0
BH-89	E 1551 N 5047	30.0
BH-90	E 884 N 5039	30.0
BH-91	E 978 N 5061	30.0
BH-92	E 1448 N 5047	30.0
BH-93	E 1122 N 5048	20.0
BH-94	E 1109 N 5047	25.0
BH-95	E 1678 N 5020	20.0
BH-96	E 831 N 5054	25.0
BH-97	E 1068 N 5033	25.0

MARKING	CO-ORDINATES	DEPTH (M)
BH-98	E 912 N 5024	30.0
BH-99	E 1753 N 5010	30.0
BH-100	E 1248 N 5017	20.0
BH-101	E 1047 N 5016	25.0
BH-102	E 1602 N 5097	30.0
BH-103	E 856 N 5094	25.0
BH-104	E 1082 N 5070	25.0
BH-105	E 916 N 5086	30.0
BH-106	E 888 N 5072	25.0
BH-107	E 1683 N 5075	25.0
BH-108	E 1278 N 5050	30.0
BH-109	E 1177 N 5043	25.0
BH-110	E 1422 N 5031	20.0
BH-111	E 1305 N 5030	20.0
BH-112	E 1004 N 5028	20.0
BH-113	E 908 N 5041	30.0
BH-114	E 814 N 5018	30.0
BH-115	E 1217 N 5018	25.0
BH-116	E 1154 N 5013	30.0
BH-117	E 1742 N 5010	20.0
BH-118	E 1609 N 5010	20.0
BH-119	E 1668 N 5008	25.0
BH-120	E 884 N 5020	20.0
BH-121	E 967 N 5097	30.0
BH-122	E 1906 N 5090	25.0
BH-123	E 1265 N 5098	30.0
BH-124	E 860 N 5085	25.0
BH-125	E 1557 N 5092	20.0
BH-126	E 1180 N 5081	30.0
BH-127	E 1349 N 5068	25.0
BH-128	E 1032 N 5062	30.0
BH-129	E 1128 N 5080	25.0
BH-130	E 1248 N 5055	30.0
BH-131	E 912 N 5046	25.0
BH-132	E 1886 N 5040	25.0
BH-133	E 825 N 5040	25.0
BH-134	E 1209 N 5039	30.0
BH-135	E 1150 N 5051	25.0
BH-136	E 1722 N 5039	25.0
BH-137	E 952 N 5025	25.0
BH-138	E 787 N 5040	25.0
BH-139	E 1337 N 5028	20.0
BH-140	E 1564 N 5019	25.0
BH-141	E 1425 N 5074	25.0
BH-142	E 1856 N 5071	20.0
BH-143	E 312 N 5074	25.0
BH-144	E 2408 N 5074	20.0
BH-145	E 2350 N 5077	20.0
BH-146	E 388 N 5076	25.0
BH-147	E 1712 N 5079	25.0
BH-148	E 1610 N 5081	25.0
BH-149	E 1423 N 5066	25.0
BH-150	E 771 N 5071	20.0
BH-151	E 1680 N 5054	25.0
BH-152	E 1497 N 5051	25.0
BH-153	E 1589 N 5047	25.0
BH-154	E 1501 N 5040	25.0
BH-155	E 1685 N 5038	25.0
BH-156	E 1462 N 5012	20.0
BH-157	E 1500 N 5048	25.0
BH-158	E 1684 N 5040	25.0
BH-159	E 865 N 5049	25.0
BH-160	E 1485 N 5043	25.0
BH-161	E 1576 N 5048	25.0
BH-162	E 1452 N 5099	25.0
BH-163	E 885 N 5039	25.0
BH-164	E 1047 N 5039	25.0
BH-165	E 1408 N 5091	20.0
BH-166	E 1541 N 5024	25.0
BH-167	E 881 N 5022	20.0
BH-168	E 1425 N 5019	20.0
BH-169	E 1188 N 5044	20.0
BH-170	E 1393 N 5038	25.0
BH-171	E 955 N 5038	25.0
BH-172	E 1185 N 5077	20.0
BH-173	E 1185 N 5050	20.0
BH-174	E 1185 N 5167	20.0
BH-175	E 1454 N 5106	20.0
BH-176	E 1464 N 5081	20.0
BH-177	E 1194 N 5053	25.0
BH-178	E 1100 N 5047	25.0
BH-179	E 1190 N 5040	20.0
BH-180	E 1085 N 5083	20.0
BH-181	E 937 N 5049	20.0
BH-182	E 1209 N 5164	25.0
BH-183	E 1335 N 5035	20.0
BH-184	E 970 N 5078	20.0
BH-185	E 1349 N 5018	25.0

MARKING	CO-ORDINATES	DEPTH (M)
BH-1	E 1338 N 5767	25.0
BH-2	E 1646 N 5767	25.0
BH-3	E 1342 N 5622	25.0
BH-4	E 1634 N 5623	25.0
BH-5	E 1482 N 5768	25.0
BH-6	E 1504 N 5672	25.0
BH-7	E 1469 N 5607	25.0
BH-8	E 1402 N 5826	25.0
BH-9	E 1594 N 5825	25.0
BH-10	E 1715 N 5845	25.0
BH-11	E 1811 N 5767	25.0
BH-12	E 1824 N 5599	25.0
BH-13	E 843 N 5741	25.0
BH-14	E 1122 N 5767	25.0
BH-15	E 1221 N 5716	25.0
BH-16	E 1218 N 5531	25.0
BH-17	E 1219 N 5423	25.0
BH-18	E 1218 N 5286	25.0
BH-19	E 1218 N 2994	25.0
BH-20	E 745 N 3722	25.0
BH-21	E 987 N 3766	25.0
BH-22	E 1201 N 3768	25.0
BH-23	E 1194 N 3618	25.0
BH-24	E 1194 N 3534	25.0
BH-25	E 1906 N 3715	25.0
BH-26	E 1569 N 3519	25.0
BH-27	E 1154 N 3588	25.0
BH-28	E 1137 N 3607	25.0
BH-29	E 1254 N 3609	25.0
BH-30	E 1349 N 3572	25.0
BH-31	E 830 N 3466	25.0
BH-32	E 794 N 3534	25.0
BH-33	E 1026 N 3326	25.0
BH-34	E 1133 N 3266	25.0
BH-35	E 1132 N 3102	25.0
BH-36	E 1132 N 2951	25.0
BH-37	E 787 N 3401	25.0
BH-38	E 867 N 3431	25.0
BH-39	E 914 N 3293	25.0
BH-40	E 839 N 3593	25.0
BH-41	E 700 N 5329	25.0
BH-42	E 718 N 2730	25.0
BH-43	E 796 N 2397	25.0
BH-44	E 915 N 1983	25.0
BH-45	E 795 N 1564	25.0
BH-46	E 1155 N 1098	25.0
BH-47	E 1304 N 700	25.0
BH-48	E 1574 N 242	25.0
BH-49	E 1899 N 351	25.0
BH-50	E 797 N 2975	25.0
BH-51	E 776 N 3035	25.0
BH-52	E 775 N 3126	25.0
BH-53	E 776 N 3228	25.0
BH-54	E 815 N 3280	25.0
BH-55	E 815 N 3297	25.0

MARKING	CO-ORDINATES	DEPTH (M)
ERT-1	E 970 N 3536	25.0
ERT-2	E 1085 N 3536	25.0
ERT-3	E 1145 N 3548	25.0
ERT-4	E 1012 N 3548	25.0
ERT-5	E 1169 N 3443	25.0
ERT-6	E 1313 N 3414	25.0
ERT-7	E 904 N 3504	25.0
ERT-8	E 976 N 3480	25.0
ERT-9	E 1346 N 3380	25.0
ERT-10	E 1442 N 3325	25.0
ERT-11	E 1356 N 3318	25.0
ERT-12	E 1050 N 3318	25.0
ERT-13	E 1258 N 3323	25.0
ERT-14	E 874 N 3203	25.0
ERT-15	E 1236 N 3239	25.0
ERT-16	E 805 N 3224	25.0
ERT-17	E 748 N 3206	25.0
ERT-18	E 739 N 3137	25.0
ERT-19	E 1329 N 2100	25.0
ERT-20	E 877 N 3078	25.0
ERT-21	E 1646 N 3077	25.0
ERT-22	E 1218 N 3022	25.0
ERT-23	E 1665 N 3165	25.0
ERT-24	E 1292 N 2983	25.0
ERT-25	E 1754 N 2896	25.0
ERT-26	E 1223 N 2869	25.0
ERT-27	E 1174 N 2847	25.0
ERT-28	E 1308 N 2844	25.0
ERT-29	E 2426 N 2781	25.0
ERT-30	E 337 N 2788	25.0
ERT-31	E 1817 N 2826	25.0
ERT-32	E 929 N 2555	25.0
ERT-33	E 1439 N 2565	25.0
ERT-34	E 1502 N 2503	25.0
ERT-35	E 872 N 2345	25.0
ERT-36	E 1664 N 2531	25.0
ERT-37	E 1510 N 2282	25.0

MARKING	CO-ORDINATES	DEPTH (M)
TP-1	E 1600 N 5843	2
TP-2	E 1327 N 5524	2
TP-3	E 1850 N 5522	2
TP-4	E 1980 N 5085	2
TP-5	E 1850 N 5072	2
TP-6	E 1761 N 2600	2
TP-7	E 1419 N 2080	2
TP-8	E 846 N 1842	2
TP-9	E 1427 N 1535	2

MARKING	CO-ORDINATES	DEPTH (M)
CP-1	E 1182 N 3315	2
CP-2	E 1196 N 3319	3
CP-3	E 951 N 2927	2
CP-4	E 1197 N 3564	2
CP-5	E 802 N 3361	2

MARKING	CO-ORDINATES	DEPTH (M)
BV-1		

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : IBH 01

Location : Hirma, Talabira

Depth of Termination : 21.5 M

Co-ordinates: E 1338, N 3767

Depth of Water Table : Encountered at 3.80 m depth during investigation

Date of Start: 29-07-2024

Date of Completion: 01-08-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 202.33 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks
						From m	To m		N ₁	N ₂	N ₃	N			
Rotary drilling method	0.00	Not Used		Reddish brown, fine to coarse grained, clayey sand with much gravels (SC) 0.00 to 0.50m	0.00	0.00	1.00	DS	-	-	-	-	-	-	
	0.50			Reddish yellow, fine to medium grained, clayey sand with much gravels (SC) 0.50 to 1.70m	1.00	1.00	2.00	SPT	3	4	5	9	-	-	
	1.00														
	1.50														
	2.00														
	2.50			Yellowish brown, fine to medium grained, clayey sand with occasional gravels (SC) 1.70 to 4.40m	2.00	2.00	2.50	SPT	4	6	8	14	-	-	
	3.00														
	3.50														
	4.00														
	4.50			Yellowish brown, fine to coarse grained, poorly graded sand and silty sand with occasional gravels (SP-SM) 4.40 to 4.90m	4.00	4.00	4.50	SPT	12	18	21	39	-	-	
	5.00														
	5.50														
	6.00														
	6.50			Light brownish, fine to medium grained, cemented micaceous clayey sand with occasional gravels (SC) 5.30 to 6.90m	5.00	5.00	5.50	SPT	55/14cm	-	-	>100	-	-	
	7.00														
	7.50														
	8.00														
	8.50			Light brownish, fine to medium grained, cemented clayey sand with much gravels (SC) 6.90 to 7.80m	5.50	5.50	6.00	SPT	55/13cm	-	-	>100	-	-	
	9.00														
	9.50														
	10.00														
	10.50			Yellowish brown, fine to medium grained, cemented clayey sand with occasional gravels (SC) 7.80 to 8.90m	6.00	6.00	6.50	SPT	50/14cm	-	-	>100	-	-	
	11.00														
	11.50														
	12.00														
	12.50			Light brownish yellow, fine to medium grained, cemented clayey sand with occasional gravels (SC) 8.90 to 10.20m	6.50	6.50	7.00	SPT	60/10cm	-	-	>100	-	-	
	13.00														
	13.50														
	14.00														
	14.50			Light brownish, fine to medium grained, cemented clayey sand with much gravels (SC) 6.90 to 7.80m	7.00	7.00	7.50	SPT	60/7cm	-	-	>100	-	-	
	15.00														
	15.50														
	16.00														
	16.50			Yellowish brown, fine to medium grained, cemented clayey sand with occasional gravels (SC) 7.80 to 8.90m	7.50	7.50	8.00	SPT	60/5cm	-	-	>100	-	-	
	17.00														
	17.50														
	18.00														
18.50	Yellowish brown, fine to medium grained, cemented clayey sand with occasional gravels (SC) 8.90 to 10.20m	8.00	8.00	8.50	SPT	64	40/4 cm	-	>100	-	-				
19.00															
19.50															
20.00															
20.50	Light brownish yellow, fine to medium grained, cemented clayey sand with occasional gravels (SC) 8.90 to 10.20m	8.50	8.50	9.00	SPT	60/14cm	-	-	>100	-	-				
21.00															
21.50															
22.00															
22.50	Light brownish yellow, fine to medium grained, cemented clayey sand with occasional gravels (SC) 8.90 to 10.20m	9.00	9.00	9.50	SPT	60/14cm	-	-	>100	-	-				
23.00															
23.50															
24.00															
24.50	Yellowish brown, fine to medium grained, cemented micaceous clayey sand with occasional gravels (SC) 10.20 to 12.20m	9.50	9.50	10.00	SPT	60/12cm	-	-	>100	-	-				
25.00															
25.50															
26.00															
26.50	Yellowish brown, fine to medium grained, cemented micaceous clayey sand with occasional gravels (SC) 10.20 to 12.20m	10.00	10.00	11.00	SPT	19	32	38	70	-	-				
27.00															
27.50															
28.00															
28.50	Dark brownish, fine to very fine grained, cemente micaceous clayey sand (SC) 12.20 to 16.20m	11.00	11.00	11.50	SPT	60/14cm	-	-	>100	-	-				
29.00															
29.50															
30.00															
30.50	Dark brownish, fine to very fine grained, cemente micaceous clayey sand (SC) 12.20 to 16.20m	11.50	11.50	12.50	SPT	60/9cm	-	-	>100	-	-				
31.00															
31.50															
32.00															
32.50	Dark brownish, fine to very fine grained, cemente micaceous clayey sand (SC) 12.20 to 16.20m	12.50	12.50	13.00	SPT	60/3cm	-	-	>100	-	-				
33.00															
33.50															
34.00															
34.50	Dark brownish, fine to very fine grained, cemente micaceous clayey sand (SC) 12.20 to 16.20m	13.00	13.00	14.00	SPT	60/6cm	-	-	>100	-	-				
35.00															
35.50															
36.00															
36.50	Dark brownish, fine to very fine grained, cemente micaceous clayey sand (SC) 12.20 to 16.20m	14.00	14.00	14.50	SPT	60/7cm	-	-	>100	-	-				
37.00															
37.50															
38.00															
38.50	Dark brownish, fine to very fine grained, cemente micaceous clayey sand (SC) 12.20 to 16.20m	14.50	14.50	15.50	SPT	60/6cm	-	-	>100	-	-				
39.00															
39.50															
40.00															
40.50	Dark brownish, fine to very fine grained, cemente micaceous clayey sand (SC) 12.20 to 16.20m	15.50	15.50	16.00	SPT	60/5cm	-	-	>100	-	-				
41.00															
41.50															
42.00															
42.50	Dark brownish, fine to very fine grained, cemente micaceous clayey sand (SC) 12.20 to 16.20m	16.00	16.00	16.05	SPT	60/5cm	-	-	>100	-	-				
43.00															
43.50															
44.00															
44.50	Highly weathered, weak, reddish brown, fine to medium grained, fractured and friable rock 16.20 to 18.50m	17.00	16.05	17.00	Core	-	-	-	-	16.25	-				
45.00															
45.50															
46.00															
46.50	Highly weathered, weak, reddish brown, fine to medium grained, fractured and friable rock 16.20 to 18.50m	17.00	17.00	17.03	SPT	50/3cm	-	-	>100	-	-				
47.00															
47.50															
48.00															
48.50	Highly weathered, moderately strong, yellowish brown, fine to coarse grained, rock with close spacing of discontinuities 18.50 to 20.00m	18.50	17.03	18.50	Core	-	-	-	-	16.66	6.66				
49.00															
49.50															
50.00															
50.50	Highly weathered, moderately strong, yellowish brown, fine to coarse grained, rock with close spacing of discontinuities 18.50 to 20.00m	18.50	18.50	18.52	SPT	50/2cm	-	-	>100	-	-				
51.00															
51.50															
52.00															
52.50	Highly weathered, moderately strong, yellowish brown, fine to coarse grained, fractured rock	20.00	18.52	20.00	Core	-	-	-	-	14.00	-				
53.00															
53.50															
54.00															
54.50	Highly weathered, moderately strong, yellowish brown, fine to coarse grained, fractured rock	20.00	20.00	20.03	SPT	50/3cm	-	-	>100	-	-				
55.00															
55.50															
56.00															
56.50	Highly weathered, moderately strong, yellowish brown, fine to coarse grained, fractured rock	21.50	20.03	21.50	Core	-	-	-	-	14.00	-				
57.00															
57.50															
58.00															
58.50	Highly weathered, moderately strong, yellowish brown, fine to coarse grained, fractured rock	21.50	21.50	21.52	SPT	50/2cm	-	-	>100	-	-				
59.00															
59.50															
60.00															
20.00 to 25.00m															

Project : BHEL

Bore Hole No. : IBH 2

Location : Hirma, Talabira

Depth of Termination : 25.0 M

Co-ordinates: E 1646, N 3767

Depth of Water Table : Encountered at 7.70m depth during investigation

Date of Start: 25-08-2024

Date of Completion: 29-08-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 207.74 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks	
						From m	To m		N ₁	N ₂	N ₃	N				
Rotary drilling method	0.00	Used		Reddish brown, fine to medium grained, sandy clays of intermediate plasticity (CI) 0.00 to 0.80m	0.00	0.00	1.00	DS	-	-	-	-	-	-		
	0.50															
	1.00				Reddish brown, fine to coarse grained, clayey sand with some gravels (SC) 0.80 to 2.90m	1.00	1.00	2.00	SPT	2	9	11	20	-	-	
	1.50															
	2.00															
	2.50															
	3.00				Light brownish, fine to medium grained, silty clayey sand (SM-SC) 2.90 to 5.00m	2.50	2.50	3.00	UDS	-	-	-	-	-	-	
	3.00															
	3.50															
	4.00															
	4.50				Yellowish brown, fine to medium grained, cemented silty clayey sand (SM-SC) 5.00 to 6.30m	4.00	4.00	4.50	SPT	6	7	11	19	-	-	
	4.50															
	5.00															
	5.50															
	6.00		Dark brownish, fine to medium grained, cemented silty sand (SM) 6.30 to 7.30m	5.00	5.00	5.50	SPT	22	33	36	69	-	-			
	5.50															
	6.00															
	6.50															
	7.00	Not used		Dark brownish, fine to medium grained, cemented sand 7.30 to 7.90m	6.50	6.50	7.00	SPT	50/12cm	-	-	>100	-	-		
	7.50															
	8.00															
	8.50				Dark brownish, fine to medium grained, cemented clayey sand (SC) 7.90 to 9.90m	7.00	7.00	7.50	SPT	50/14cm	-	-	>100	-	-	
	8.00															
	8.50															
	9.00															
	9.50															
	10.00				Brownish to dark brownish, fine to medium grained, cemented silty sand with occasional to some gravels (SM) 9.90 to 19.00m	9.50	9.50	10.00	SPT	38.00	62/8cm	-	>100	-	-	
	10.00															
	10.50															
	11.00															
	11.50															
	12.00															
	12.50															
	13.00															
	13.50															
	14.00															
14.50																
15.00		Blackish brown, fine to medium grained, cemented silty sand with some gravels (SM) 19.00 to 21.60m	14.00	14.00	14.50	SPT	50/14cm	-	-	>100	-	-				
14.50																
15.00																
15.50																
16.00																
16.50																
17.00																
17.50																
18.00																
18.50																
19.00																
19.50		Highly weak, dark brownish, fine to coarse grained, fractured rock 21.60 to 23.50m	19.00	19.00	20.00	SPT	50/12cm	-	-	>100	-	-				
20.00																
20.50																
21.00																
21.50		Highly weathered, moderately weak, yellowish brown, fine to coarse grained, rock with close spacing of discontinuities 23.50 to 24.00m	21.50	21.50	21.55	SPT	50/14cm	-	-	>100	-	-				
22.00																
22.50																
23.00																
23.50		Moderately weathered, moderately weak, yellowish brown, fine to coarse grained, rock with close spacing of discontinuities 24.00 to 25.00m	23.50	23.50	24.00	SPT	50/5cm	-	-	>100	-	-				
24.00																
24.50																
25.00																
				24.00 to 25.00m	25.00	23.50	25.00	Core	-	-	-	-	62.00	14.22		

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : IBH 03

Location : Hirma, Talabira

Depth of Termination : 25.0 M

Co-ordinates: E 1342, N 3622

Depth of Water Table : Encountered at 7.40m depth during investigation

Date of Start: 05-07-2024

Date of Completion: 08-07-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 204.39 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks
						From m	To m		N ₁	N ₂	N ₃	N			
Rotary drilling method	0.00				0.00	0.00	1.00	DS	-	-	-	-	-	-	
	0.50														
	1.00				1.00	1.00	2.00	SPT	12	45	55/12 cm	>100	-	-	
	1.50			Yellowish brown, fine to medium grained, clayey sand (SC) 0.00 to 3.40m											
	2.00				2.00	2.00	2.50	SPT	9	14	21	35	-	-	
	2.50				2.50	2.50	3.00	UDS	-	-	-	-	-	-	
	3.00				3.00	3.00	3.50	SPT	14	47	53/9 cm	>100	-	-	
	3.50				3.50	3.50	4.00	UDS	-	-	-	-	-	-	
	4.00				4.00	4.00	4.50	SPT	12	48	52/10 cm	>100	-	-	
	4.50			Yellowish brown, fine to medium grained, silty sand with little to occasional gravels (SM) 3.40 to 6.30m	4.50	4.50	5.00	UDS	-	-	-	-	-	-	
	5.00				5.00	5.00	5.50	SPT	30	25	27	52	-	-	
	5.50				5.50	5.50	6.00	UDS	-	-	-	-	-	-	
	6.00				6.00	6.00	6.50	SPT	6	30	45	84	-	-	
	6.50			Yellowish brown, fine to medium grained, poorly graded sand and silty sand with little to occasional gravels (SP-SM) 6.30 to 7.80m	6.50	6.50	7.00	DS	-	UDS attempted but not recovered					
	7.00				7.00	7.00	7.50	SPT	50/12 cm	-	-	>100	-	-	
	7.50				7.50	7.50	8.00	DS	-	UDS attempted but not recovered					
	8.00				8.00	8.00	8.50	SPT	36	50/10 cm	-	>100	-	-	
	8.50			Yellowish brown, fine to medium grained, clayey sand (SC) 7.80 to 9.60m	8.50	8.50	9.00	SPT	29	60/13 cm	-	>100	-	-	
	9.00				9.00	9.00	9.50	SPT	50/13 cm	-	-	>100	-	-	
	9.50				9.50	9.50	10.00	SPT	50/10 cm	-	-	>100	-	-	
	10.00				10.00	10.00	11.00	SPT	50/12 cm	-	-	>100	-	-	
	10.50														
	11.00				11.00	11.00	11.50	SPT	50/13 cm	-	-	>100	-	-	
	11.50				11.50	11.50	12.50	SPT	25	50/9 cm	-	>100	-	-	
	12.00			Yellowish brown, fine to medium grained, poorly graded sand and silty sand with little to occasional gravels (SP-SM) 9.60 to 15.80m	12.50	12.50	13.00	SPT	50/12 cm	-	-	>100	-	-	
	12.50				13.00	13.00	14.00	SPT	50/5 cm	-	-	>100	-	-	
	13.00														
	13.50														
	14.00				14.00	14.00	14.50	SPT	50/5 cm	-	-	>100	-	-	
	14.50				14.50	14.50	15.50	SPT	50/6 cm	-	-	>100	-	-	
	15.00														
	15.50				15.50	15.50	16.00	SPT	50/8 cm	-	-	>100	-	-	
	16.00				16.00	16.00	17.00	SPT	50/8cm	-	-	>100	-	-	
	16.50														
	17.00			Yellowish brown, fine to medium grained, silty clayey sand (SM-SC) 15.80 to 19.50m	17.00	17.00	17.50	SPT	50/9cm	-	-	>100	-	-	
	17.50				17.50	17.50	18.50	SPT	60/13 cm	-	-	>100	-	-	
	18.00														
	18.50				18.50	18.50	19.00	SPT	55/13 cm	-	-	>100	-	-	
	19.00				19.00	19.00	20.00	SPT	60/9 cm	-	-	>100	-	-	
	19.50														
	20.00				20.00	20.00	20.50	SPT	51/6 cm	-	-	>100	-	-	
	20.50				20.50	20.50	20.50	SPT	55/6 cm	-	-	>100	-	-	
	21.00														
	21.50				21.50	21.50	22.50	SPT	60/7 cm	-	-	>100	-	-	
	22.00			Yellowish brown, fine to medium grained, silty sand (SM)	22.50	22.50	23.00	SPT	50/9 cm	-	-	>100	-	-	
	22.50				23.00	23.00	23.50	SPT	60/6 cm	-	-	>100	-	-	
	23.00				23.50	23.50	24.50	SPT	55/4 cm	-	-	>100	-	-	
	23.50														
	24.00														
	24.50				24.50	24.50	25.00	SPT	60/10 cm	-	-	>100	-	-	
	25.00				25.00	25.00	24.45	SPT	13	15	30	45	-	-	
19.50 to 25.00m															

Project : BHEL

Bore Hole No. : IBH 4

Location : Hirma, Talabira

Depth of Termination : 25.0 M

Co-ordinates: E 1634, N 3623

Depth of Water Table : Encountered at 7.60m depth during investigation

Date of Start: 31-08-2024

Date of Completion: 05-09-2024

Diameter of Bore: 150mm and Nx size

Soil Surface Bit and NX Size

Reduced Level: 210.12m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks			
						From m	To m		N ₁	N ₂	N ₃	N						
Rotary drilling method	0.00	Used		Dark reddish, fine to medium grained, sandy clays of intermediate plasticity with occasional gravels (CI) 0.00 to 1.20m	0.00	0.00	1.00	DS	-	-	-	-	-	-				
	0.50																	
	1.00				Reddish yellow, fine to medium grained, clayey sand with little gravels (SC) 1.20 to 4.00m	1.00	1.00	2.00	SPT	5	6	7	13	-	-			
	1.50																	
	2.00					2.00	2.50	SPT	3	6	9	15	-	-				
	2.50					2.50	3.00	UDS	-	-	-	-	-	-	-			
	3.00					3.00	3.50	SPT	9	32	39	71	-	-				
	3.50			3.50	4.00	UDS	-	-	-	-	-	-	-					
	4.00				Reddish yellow, and Yellowish brown, fine to coarse grained, silty sand with little plastic fines and much gravels (SM) 4.00 to 6.50m	4.00	4.00	4.50	SPT	7	7	10	17	-	-			
	4.50					4.50	5.00	SPT	9	18	36	54	-	-				
	5.00					5.00	5.50	SPT	16	39	52	91	-	-				
	5.50					5.50	6.00	SPT	22	35	47	82	-	-				
	6.00					6.00	6.50	SPT	34	50/10cm	-	>100	-	-				
	6.50				Yellowish brown, fine to coarse grained, silty sand (SM) 6.50 to 7.50m	6.50	6.50	7.00	UDS	-	-	-	-	-	-			
	7.00					7.00	7.50	SPT	50/8cm	-	-	>100	-	-				
	7.50					7.50	8.00	SPT	37.00	50/3cm	-	>100	-	-				
	8.00					8.00	8.50	SPT	24.00	50/5cm	-	>100	-	-				
	8.50					8.50	9.00	SPT	50/9cm	-	-	>100	-	-				
	9.00				Yellowish brown, fine to medium grained, clayey sand with occasional gravels (SC) 9.00 to 10.00m	9.00	9.00	9.50	SPT	50/11cm	-	-	>100	-	-			
	9.50					9.50	10.00	SPT	50/7cm	-	-	>100	-	-				
	10.00					10.00	11.00	SPT	50/4cm	-	-	>100	-	-				
	10.50		Yellowish brown, fine to medium grained, silty and clayey sand with occasional gravels (SM-SC) 10.00 to 13.00m			11.00	11.00	11.50	SPT	50/5cm	-	-	>100	-	-			
	11.50					11.50	12.50	SPT	50/5cm	-	-	>100	-	-				
	12.00																	
	12.50			12.50	13.00	SPT	50/6cm	-	-	>100	-	-						
	13.00			13.00	14.00	SPT	50/8cm	-	-	>100	-	-						
	13.50		Yellowish brown, fine to coarse grained, silty sand with little plastic fines and occasional to much gravels (SM) 13.00 to 14.10m	14.00	14.00	14.50	SPT	50/7cm	-	-	>100	-	-					
	14.50			14.50	15.50	SPT	50/13cm	-	-	>100	-	-						
	15.00				Whitish yellow, fine to coarse grained, silty and clayey gravels (GM-GC) 14.10 to 15.50m	15.50	15.50	16.00	SPT	50/14cm	-	-	>100	-	-			
	16.00					16.00	17.00	SPT	50/2cm	-	-	>100	-	-				
	16.50						Whitish, fine to medium grained, sandy clays of intermediate plasticity with much gravels (CI) 15.50 to 16.00m	17.00	17.00	17.50	SPT	50/6cm	-	-	>100	-	-	
	17.50	17.50	17.57					SPT	50/7cm	-	-	>100	-	-				
	18.00		Highly weathered, weak, yellowish brown, fine to coarse grained, fractured rock 17.90 to 25.00m					19.00	17.57	19.00	Core	-	-	-	-	8.00	-	
	19.50			19.00	19.02			SPT	50/2cm	-	-	>100	-	-				
	20.00																	
	20.50			20.50	20.50	Core	-	-	-	-	10.00	-						
	21.00			20.50	20.50	SPT	50/2cm	-	-	>100	-	-						
	21.50																	
	22.00			22.00	20.52	22.00	Core	-	-	-	-	5.00	-					
	22.50			22.00	22.00	SPT	50/2cm	-	-	>100	-	-						
	23.00																	
	23.50			23.50	22.02	23.50	Core	-	-	-	-	2.00	-					
	24.00			23.50	23.50	SPT	50/2cm	-	-	>100	-	-						
	24.50																	
	25.00			25.00	23.52	25.00	Core	-	-	-	-	6.00	-					
				25.00	25.00	25.02	SPT	50/2cm	-	-	>100	-	-					
	17.90 to 25.00m																	

Project : BHEL

Bore Hole No. : IBH 6

Location : Hirma, Talabira

Depth of Termination : 25.0 M

Co-ordinates : E 1504, N 3672

Depth of Water Table : Encountered at 7.80m depth during investigation

Date of Start: 16-07-2024

Date of Completion: 18-07-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 207.25 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks	
						From m	To m		N ₁	N ₂	N ₃	N				
Rotary drilling method	0.00	Used		Reddish yellowish brown, fine to very fine graned, clayey sand (SC) 0.00 to 0.50m	0.00	0.00	1.00	DS	-	-	-	-	-	-		
	0.50															
	1.00			Yellowish brown, fine to very fine grained, clayey sand with occasional to much gravels (SC) 0.50 to 3.40m	1.00	1.00	2.00	SPT	4	5	7	12	-	-		
	1.50															
	2.00				2.00	2.00	2.50	SPT	5	9	10	19	-	-		
	2.50				2.50	2.50	3.00	UDS	-	-	-	-	-	-		
	3.00				3.00	3.00	3.50	SPT	9	22	54	76	-	-		
	3.50			Yellowish brown, fine to medium grained, silty clayey sand with little gravels (SM-SC) 3.40 to 5.50m	3.50	3.50	4.00	SPT	28.00	72/14 cm	-	>100	-	-		
	4.00				4.00	4.00	4.50	SPT	29	31	36	67	-	-		
	4.50				4.50	4.50	5.00	SPT	30	32	38	70	-	-		
	5.00				5.00	5.00	5.50	SPT	31	36	42	78	-	-		
	5.50				5.50	5.50	6.00	SPT	33	39	47	86	-	-		
	6.00			Yellowish brown, fine to medium grained, clayey sand with little gravels (SC) 5.50 to 9.30m	6.00	6.00	6.50	SPT	22	29	32	61	-	-		
	6.50				6.50	6.50	7.00	UDS	18	222	27	49	-	-		
	7.00				7.00	7.00	7.50	SPT	19	24	29	53	-	-		
	7.50				7.50	7.50	8.00	SPT	26	31	54	85	-	-		
	8.00				8.00	8.00	8.50	SPT	50/12 cm	-	-	>100	-	-		
	8.50			Yellowish brown, fine to medium grained, silty sand with little gravels (SM) 9.30 to 10.50m	8.50	8.50	9.00	SPT	50/10 cm	-	-	>100	-	-		
	9.00				9.00	9.00	9.50	SPT	50/14 cm	-	-	>100	-	-		
	9.50				9.50	9.50	10.00	SPT	20	50/5 cm	-	>100	-	-		
	10.00				10.00	10.00	11.00	SPT	18	50/7 cm	-	>100	-	-		
	10.50				Yellowish brown, fine to medium grained, silty clayey sand (SM-SC) 10.50 to 11.50m											
	11.00			11.00		11.00	11.50	SPT	50/9 cm	-	-	>100	-	-		
	11.50			11.50		11.50	12.50	SPT	50/8 cm	-	-	>100	-	-		
	12.00			Yellowish brown, fine to medium grained, clayey sand with little gravels (SC) 11.50 to 14.30m		12.50	12.50	13.00	SPT	50/7 cm	-	-	>100	-	-	
	12.50					13.00	13.00	14.00	SPT	50/9 cm	-	-	>100	-	-	
	13.00				13.50	13.50	14.00	SPT	50/9 cm	-	-	>100	-	-		
	13.50				14.00	14.00	14.50	SPT	50/12 cm	-	-	>100	-	-		
	14.00				14.50	14.50	14.60	SPT	50/10 cm	-	-	>100	-	-		
	14.50			Yellowish brown, fine to medium grained, silty sand with occasional gravels (SM) 14.30 to 16.10m	14.50	14.50	14.60	SPT	50/10 cm	-	-	>100	-	-		
	15.00				15.00	15.00	16.00	SPT	50/6 cm	-	-	>100	-	-		
	15.50				15.50	15.50	16.00	SPT	50/6 cm	-	-	>100	-	-		
	16.00				16.00	16.00	17.00	SPT	50/5 cm	-	-	>100	-	-		
16.50	Highly weathered, weak, dark brownish yellow, fine to coarse grained, fractured rock	16.50	16.50		17.00	SPT	50/5 cm	-	-	>100	-	-				
17.00		17.00	17.00	17.09	SPT	50/3 cm	-	-	>100	-	-					
17.50		17.50	17.00	17.50	SPT	50/3 cm	-	-	>100	-	-					
18.00		16.10 to 19.00m	18.00	18.00	18.50	SPT	50/4 cm	-	-	>100	-	-				
18.50			18.50	18.50	18.54	SPT	50/4 cm	-	-	>100	-	-				
19.00	Highly weathered, moderately strong, dark brownish yellow, fine to coarse grained, fractured rock		19.00	19.00	20.00	Core	-	-	-	-	12.00	-				
19.50			19.50	19.50	20.04	SPT	50/4 cm	-	-	>100	-	-				
20.00			20.00	20.00	20.04	SPT	50/4 cm	-	-	>100	-	-				
20.50		19.00 to 21.50m	21.00	21.00	21.50	Core	-	-	-	-	5.33	-				
21.50			21.50	21.50	21.53	SPT	50/3 cm	-	-	>100	-	-				
22.00	Highly weathered, very weak and friable brownish yellow, fine to coarse grained, fractured rock 21.50 to 23.00m		22.50	22.50	23.00	Core	-	-	-	-	4.00	-				
23.00			23.00	23.00	23.04	SPT	50/4 cm	-	-	>100	-	-				
23.50			Highly weathered, moderately strong, brownish yellow, fine to coarse grained, fraile rock	24.00	24.00	23.04	SPT	50/4 cm	-	-	>100	-	-			
24.50		24.50		24.50	23.04	SPT	50/4 cm	-	-	>100	-	-				
25.00		25.00		23.52	25.00	Core	-	-	-	-	16.00	-				
23.00 to 25.00m					25.00	25.00	25.03	SPT	50/3 cm	-	-	>100	-	-		

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : IBH 07

Location : Talabira

Depth of Termination : 21.50 M

Co-ordinates: E 1469, N 3607

Depth of Water Table : Encountered at 8.30m depth during investigation

Date of Start: 09-07-2024

Date of Completion: 13-07-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 206.7 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks	
						From m	To m		N ₁	N ₂	N ₃	N				
Rotary drilling method	0.00	Used		Reddish yellowish brown, fine to medium grained, clayey sand (SC) 0.00 to 0.80m	0.00	0.00	1.00	DS	-	-	-	-	-	-		
	0.50															
	1.00				1.00	1.00	2.00	SPT	10	20	22	42	-	-		
	1.50															
	2.00				2.00	2.00	2.50	SPT	8	13	13	26	-	-		
	2.50				2.50	2.50	3.00	UDS	-	-	-	-	-	-		
	3.00			Yellowish brown, fine to medium grained, clayey sand with some to much gravels (SC) 0.80 to 5.60m	3.00	3.00	3.50	SPT	9	14	17	31	-	-		
	3.50				3.50	4.00	UDS	-	-	-	-	-	-	-		
	4.00				4.00	4.50	SPT	7	12	15	27	-	-			
	4.50				4.50	5.00	UDS	-	-	-	-	-	-	-		
	5.00				5.00	5.50	SPT	8	9	10	19	-	-			
	5.50															
	6.00				Yellowish brown, fine to medium grained, silty sand with little gravels (SM) 5.60 to 6.30m	5.50	5.50	6.00	SPT	7	8	20	28	-	-	
	6.50					6.00	6.00	6.50	SPT	11	13	16	29	-	-	
	7.00			Yellowish brown, fine to medium grained, poorly graded sand and silty sand with little gravels (SP-SM) 6.30 to 7.30m	6.50	6.50	7.00	SPT	50/10 cm	-	-	>100	-	-		
	7.50				7.00	7.00	7.50	SPT	50/14 cm	-	-	>100	-	-		
	8.00			Yellowish brown, fine to medium grained, clayey sand with little to some gravels (SC) 7.30 to 9.30m	7.50	7.50	8.00	SPT	18	56	44/10 cm	>100	-	-		
	8.50				8.00	8.00	8.50	SPT	50/13 cm	-	-	>100	-	-		
	9.00				8.50	8.50	9.00	SPT	47	53/10 cm	-	>100	-	-		
	9.50				9.00	9.00	9.50	SPT	50/13 cm	-	-	>100	-	-		
	10.00				9.50	9.50	10.00	SPT	50/11 cm	-	-	>100	-	-		
	10.50				10.00	10.00	11.00	SPT	50/7 cm	-	-	>100	-	-		
	11.00			Yellowish brown, fine to medium grained, silty sand with little to occasional gravels (SM) 9.30 to 13.60m	11.00	11.00	11.50	SPT	50/7 cm	-	-	>100	-	-		
	11.50				11.50	11.50	12.50	SPT	50/8 cm	-	-	>100	-	-		
	12.00															
	12.50				12.50	12.50	13.00	SPT	48	52/9 cm	-	>100	-	-		
	13.00				13.00	13.00	14.00	SPT	25	65	35/8 cm	>100	-	-		
	13.50															
	14.00			Yellowish brown, fine to medium grained, clayey sand (SC) 13.60 to 15.60m	14.00	14.00	14.50	SPT	41	60/13 cm	-	>100	-	-		
	14.50				14.50	14.50	15.50	SPT	50/11 cm	-	-	>100	-	-		
	15.00															
	15.50				15.50	15.50	16.00	SPT	50/10cm	-	-	>100	-	-		
	16.00	Yellowish brown, fine to medium grained, silty sand with little to occasional gravels (SM) 15.60 to 17.30m	16.00	16.00	17.00	SPT	50/11cm	-	-	>100	-	-				
	16.50															
	17.00			17.00	17.00	17.50	SPT	50/8 cm	-	-	>100	-	-			
	17.50		Yellowish brown, fine to medium grained, silty clayey sand (SM-SC) 17.30 to 18.60m	17.50	17.50	18.50	SPT	50/7 cm	-	-	>100	-	-			
18.00																
18.50		18.50	18.50	19.00	SPT	50/8 cm	-	-	>100	-	-					
19.00	Yellowish brown, fine to medium grained, silty sand with some gravels (SM) 18.60 to 20.70m	19.00	19.00	20.00	SPT	50/8 cm	-	-	>100	-	-					
19.50																
20.00			20.00	20.00	20.50	SPT	51/6 cm	-	-	>100	-	-				
20.50			20.50	20.70	20.50	SPT	50/4 cm	-	-	>100	-	-				
21.00																
21.50			highly weathered, weak, brownish yellow, fine to coarse grained, completely fractured rock	21.50	20.70	21.50	Core	-	-	-	-	4.60	-			
				20.70 to 21.50m	21.50	21.50	21.53	SPT	50/3 cm	-	-	>100				

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : IBH 08

Location : Hirma, Talabira

Depth of Termination : 25.0 M

Co-ordinates: E 1402, N 3826

Depth of Water Table : Encountered at 1.20 m depth during investigation

Date of Start: 29-07-2024

Date of Completion: 30-07-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 200.65 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks
						From m	To m		N ₁	N ₂	N ₃	N			
Rotary drilling method	0.00			Light brownish to yellowish brown, fine to medium grained, clayey sand with occasional gravels (SC) 0.00 to 1.30m	0.00	0.00	1.00	DS	-	-	-	-	-	-	
	0.50														
	1.00				1.00	1.00	2.00	SPT	2	2	2	4	-	-	
	1.50			Brownish, fine to medium grained, silty sand with little plastic fines (SM) 1.30 to 2.60m	2.00	2.00	2.50	SPT	16	15	15	30	-	-	
	2.00				2.50	2.50	3.00	UDS	-	-	-	-	-	-	
	2.50				3.00	3.00	3.50	SPT	39	40	60/3cm	>100	-	-	
	3.00				3.50	3.50	4.00	SPT	50/10cm	-	-	>100	-	-	
	3.50				4.00	4.00	4.50	SPT	50/9cm	-	-	>100	-	-	
	4.00			Light yellowish brown, fine to medium grained, cemented clayey sand with occasional to much gravels (SC) 2.60 to 6.30m	4.50	4.50	5.00	SPT	50/9cm	-	-	>100	-	-	
	4.50				5.00	5.00	5.50	SPT	12	20	21	41	-	-	
	5.00				5.50	5.50	6.00	SPT	13	26	37	63	-	-	
	5.50				6.00	6.00	6.50	SPT	50/11cm	-	-	>100	-	-	
	6.00				6.50	6.50	7.00	SPT	14	15	25	40	-	-	
	6.50				7.00	7.00	7.50	SPT	23	35	38	73	-	-	
	7.00			Light brownish, fine to medium grained, cemented micaceous clayey sand 6.30 to 8.40m	7.50	7.50	8.00	SPT	13	20	22	42	-	-	
	7.50				8.00	8.00	8.50	SPT	19	26	30	56	-	-	
	8.00				8.50	8.50	9.00	SPT	27	50/9cm	-	>100	-	-	
	8.50				9.00	9.00	9.50	SPT	45	50/4cm	-	>100	-	-	
	9.00			Yellowish brown, fine to medium grained, cemented, micaceous silty sand (SM) 8.30 to 10.50m	9.50	9.50	10.00	SPT	50/5cm	-	-	>100	-	-	
	9.50				10.00	10.00	10.05	SPT	50/5cm	-	-	>100	-	-	
	10.00				10.50										
	10.50				11.00	10.05	11.00	Core	-	-	-	-	18.00	-	
	11.00			Highly weathered, very weak, yellowish brown, fine to medium grained, fractured rock 10.50 to 12.50m	11.00	11.00	11.04	SPT	50/4cm	-	-	>100	-	-	
	11.50				12.50	11.04	12.50	Core	-	-	-	-	19.33	6.66	
	12.00				12.50	12.50	12.53	SPT	50/3cm	-	-	>100	-	-	
	12.50			Highly weathered, very weak, yellowish brown, fine to medium grained, micaceous friable rock with close spacing of discontinuities 12.50 to 14.00m	14.00	12.53	14.00	Core	-	-	-	-	18.66	-	
	13.00				14.00	14.00	14.03	SPT	50/3cm	-	-	>100	-	-	
	13.50			Highly weathered, weak, blackish brown, fine to medium grained, fractured rock 14.00 to 15.50m	15.50	14.03	15.50	Core	-	-	-	-	24.00	-	
	14.00				17.00	15.50	17.00	Core	-	-	-	-	24.00	-	
	14.50			Highly weathered, moderately weak, blackish brown, fine to medium grained, fractured rock 15.50 to 17.00m	18.50	17.00	18.50	Core	-	-	-	-	24.66	-	
	15.00				20.00	18.50	20.00	Core	-	-	-	-	18.66	-	
	15.50				21.50	20.00	21.50	Core	-	-	-	-	19.33	6.66	
	16.00			Highly weathered, moderately weak, blackish brown, fine to medium grained, rock with close spacing of discontinuities 21.50 to 24.00m	21.50	21.50	21.52	SPT	50/2cm	-	-	>100	-	-	
	16.50				23.00	21.52	23.00	Core	-	-	-	-	22.66	10.66	
	17.00				24.00										
	17.50				24.50										
	18.00			Highly weathered, very weak, blackish grey, fine to medium grained, fractured rock	25.00	23.00	25.00	Core	-	-	-	-	23.00	-	
	18.50														
	19.00														
	19.50														
	20.00														
	20.50														
	21.00														
	21.50														
	22.00														
	22.50														
	23.00														
	23.50														
	24.00														
	24.50														
	25.00														
24.00 to 25.00m															

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : IBH 09

Location : Hirma, Talabira

Depth of Termination : 25.0 M

Co-ordinates: E 1594, N 3825

Depth of Water Table : Encountered at 5.60 m depth during investigation

Date of Start: 29-07-2024

Date of Completion: 03-08-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level:206.15 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recov- ery (%)	RQD (%)	Remarks
						From m	To m		N ₁	N ₂	N ₃	N			
Rotary drilling method	0.00	Used		Yellowish brown, fine to medium grained, silty clayey sand (SM-SC) 0.00 to 0.90m	0.00	0.00	1.00	DS	-	-	-	-	-	-	
	0.50														
	1.00				1.00	1.00	2.00	SPT	4	6	10	16	-	-	
	1.50														
	2.00			Yellowish brown, fine to medium grained, clayey sand with occasional to much gravels (SC) 0.90 to 3.40m	2.00	2.00	2.50	SPT	6	8	10	18	-	-	
	2.50				2.50	2.50	3.00	UDS	-	-	-	-			
	3.00				3.00	3.00	3.50	SPT	16	22	31	56	-	-	
	3.50			Brownish yellow, fine to medium grained, clayey sand with occasional gravels (SC) 3.40 to 4.60m	3.50	3.50	4.00	UDS	-	-	-	-	-	-	
	4.00				4.00	4.00	4.50	SPT	16.00	20	40.00	60	-	-	
	4.50			Yellowish brown, fine to medium grained, silty clayey sand with occasional gravels (SM-SC) 4.60 to 5.70m	4.50	4.50	5.00	SPT	18.00	24	42.00	68			
	5.00				5.00	5.00	5.50	SPT	17	24	40	64	-	-	
	5.50				5.50	5.50	6.00	SPT	32	60/2cm	-	>100	-	-	
	6.00				6.00	6.00	6.50	SPT	28	50/8cm	-	>100	-	-	
	6.50				6.50	6.50	7.00	SPT	32	50/6cm	-	>100	-	-	
	7.00				7.00	7.00	7.50	SPT	50/13cm	-	-	>100	-	-	
	7.50				7.50	7.50	8.00	SPT	50/13cm	-	-	>100	-	-	
	8.00				8.00	8.00	8.50	SPT	50/11cm	-	-	>100	-	-	
	8.50				8.50	8.50	9.00	SPT	50/11cm	-	-	>100			
	9.00				9.00	9.00	9.50	SPT	50/12cm	-	-	>100			
	9.50				9.50	9.50	10.00	SPT	50/10cm	-	-	>100	-	-	
	10.00				10.00	10.00	11.00	SPT	50/11cm	-	-	>100	-	-	
	10.50			Yellowish brown to dark brownish, fine to medium grained, cemented clayey sand 5.70 to 15.90m											
	11.00				11.00	11.00	11.50	SPT	50/11cm	-	-	>100	-	-	
	11.50				11.50	11.50	12.50	SPT	50/9cm	-	-	>100	-	-	
	12.00														
	12.50				12.50	12.50	13.00	SPT	50/8cm	-	-	>100	-	-	
	13.00				13.00	13.00	14.00	SPT	50/8cm	-	-	>100	-	-	
	13.50														
	14.00				14.00	14.00	14.50	SPT	50/9cm	-	-	>100	-	-	
	14.50				14.50	14.50	15.50	SPT	50/7cm	-	-	>100	-	-	
	15.00														
	15.50				15.50	15.50	15.56	SPT	50/6cm	-	-	>100	-	-	
	16.00	Not Used		Mixture of highly weathered, completely fractured and disintegrated, brownish yellow, fine to coarse grained, gravel, pebble size weak and friable fractured rock fragments with brownish yellow, fine to coarse grained, clayey sand 15.90 to 17.00m											
	16.50														
	17.00				17.00	15.56	17.00	Core	-	-	-	-	40.90	-	
	17.50														
	18.00			Highly weathered, weak to moderately weak, yellowish brown, fine to medium grained, fractured rock 17.00 to 20.00m	18.50	17.00	18.50	Core	-	-	-	-	39.33	-	
	18.50														
	19.00														
	19.50														
	20.00				20.00	18.50	20.00	Core	-	-	-	-	32.00	-	
	20.50														
	21.00														
	21.50				21.50	20.00	21.50	Core	-	-	-	-	38.00	20.66	
	22.00			Highly weathered, weak to moderately weak, yellowish brown, fine to medium grained, close to moderately close spacing of discontinuities											
	22.50				23.00	21.50	23.00	Core	-	-	-	-	33.33	16.66	
	23.00														
	23.50														
	24.00														
	24.50														
	25.00				25.00	23.00	25.00	Core	-	-	-	-	36.50	35.00	

20.00 to 25.00m

Project : BHEL

Bore Hole No. : IBH 10

Location : Hirma, Talabira

Depth of Termination : 25.0 M

Co-ordinates: E 1811, N 3767

Depth of Water Table : Encountered at 7.20m depth during investigation

Date of Start: 15-07-2024

Date of Completion: 17-07-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 210.40 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks
						From m	To m		N ₁	N ₂	N ₃	N			
Rotary drilling method	0.00	Used		Dark yellowish brown, fine to medium grained, clayey sand (SC) 0.00 to 0.60m	0.00	0.00	1.00	DS	-	-	-	-	-	-	
	0.50			Reddish yellowish brown, fine to medium grained, clayey sand (SC) 0.60 to 2.30m	1.00	1.00	2.00	SPT	5	7	8	15	-	-	
	1.00				2.00	2.00	2.50	SPT	9	18	24	42	-	-	
	1.50				2.50	2.50	3.00	UDS	-	-	-	-	-	-	
	2.00			Dark reddish brown, fine to medium grained, silty sand (SM) 2.30 to 3.90m	3.00	3.00	3.50	SPT	8	14	18	32	-	-	
	2.50				3.50	3.50	4.00	UDS	-	-	-	-	-	-	
	3.00				4.00	4.00	4.50	SPT	11	16	22	38	-	-	
	3.50			Yellowish brown, fine to medium grained, clayey sand (SC) 3.90 to 4.40m	4.50	4.50	5.00	UDS	-	-	-	-	-	-	
	4.00				5.00	5.00	5.50	SPT	8	12	17	29	-	-	
	4.50				5.50	5.50	6.00	UDS	-	-	-	-	-	-	
	5.00			Yellowish brown, fine to medium grained, sandy clays of low plasticity (CL) 4.40 to 5.45m	6.00	6.00	6.50	SPT	14	23	38	61	-	-	
	5.50				6.50	6.50	7.00	UDS	-	-	-	-	-	-	
	6.00				7.00	7.00	7.50	SPT	12	18	24	42	-	-	
	6.50			Yellowish brown, fine to medium grained, clayey sand (SC) 5.45 to 9.60m	7.50	7.50	8.00	UDS	-	-	-	-	-	-	
	7.00				8.00	8.00	8.50	SPT	13	19	22	41	-	-	
	7.50				8.50	8.50	9.00	UDS	-	-	-	-	-	-	
	8.00			Yellowish brown, fine to very fine grained, silty clayey sand with little to some gravels (SM-SC) 9.60 to 11.60m	9.00	9.00	9.50	SPT	16	32	37	69	-	-	
	8.50				9.50	9.50	10.00	SPT	39	62/14 cm	-	>100	-	-	
	9.00				10.00	10.00	11.00	SPT	42	60/7 cm	-	>100	-	-	
	9.50			Yellowish brown, fine to medium grained, clayey sand with little to some gravels (SC) 11.60 to 14.60m	11.00	11.00	11.50	SPT	52	48/5 cm	-	>100	-	-	
	10.00				11.50	11.50	12.50	SPT	60/7 cm	-	-	>100	-	-	
	10.50				12.50	12.50	13.00	SPT	65/9 cm	-	-	>100	-	-	
	11.00			Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL) 14.60 to 17.30m	13.00	13.00	14.00	SPT	38	55/12 cm	-	>100	-	-	
	11.50				14.00	14.00	14.50	SPT	60/10 cm	-	-	>100	-	-	
	12.00				14.50	14.50	14.60	SPT	65/8 cm	-	-	>100	-	-	
	12.50			Yellowish brown, fine to medium grained, clayey sand (SC) 17.30 to 20.40m	15.50	15.50	16.00	SPT	61	40/5 cm	-	>100	-	-	
	13.00				16.00	16.00	17.00	SPT	55/9 cm	-	-	>100	-	-	
	13.50				17.00	17.00	17.09	SPT	60/7 cm	-	-	>100	-	-	
	14.00			Yellowish brown, fine to medium grained, clayey sand (SC) 20.40 to 21.20m	17.50	17.00	17.50	SPT	60/6 cm	-	-	>100	-	-	
	14.50				18.50	18.50	18.06	SPT	60/6 cm	-	-	>100	-	-	
	15.00				19.00	19.00	20.00	SPT	60/6 cm	-	-	>100	-	-	
	15.50			Yellowish brown, fine to medium grained, silty clayey sand (SM-SC) 20.40 to 21.20m	20.00	20.00	20.50	SPT	60/6 cm	-	-	>100	-	-	
	16.00				20.50	20.50	20.56	SPT	60/6 cm	-	-	>100	-	-	
	16.50				21.00	21.00	21.90	SPT	65/6 cm	-	-	>100	-	-	
	17.00			Highly weathered, very weak, completely fractured, dark brownish yellow, fine to coarse grained, rock 21.90 to 23.10m	21.50	21.50	22.00	SPT	70/5 cm	-	-	>100	-	-	
	17.50				22.00	22.00	23.00	SPT	60/3 cm	-	-	>100	-	-	
	18.00				23.00	23.00	23.50	SPT	50/2 cm	-	-	>100	-	-	
	18.50			Highly weathered, weak, dark brownish yellow, fine to coarse grained, very thinly laminated rock	23.50	23.50	25.00	Core	-	-	-	-	23.66	8.66	
	19.00				24.00	24.00	24.50								
	19.50				24.50	24.50	25.00								
	20.00				25.00	25.00									

23.10 to 25.00m

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : IBH 11

Location : Hirma, Talabira

Depth of Termination : 25.0 M

Co-ordinates: E 1811, N 3767

Depth of Water Table : Encountered at 6.40m depth during investigation

Date of Start: 14-07-2024

Date of Completion: 16-07-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 209.85 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks
						From m	To m		N ₁	N ₂	N ₃	N			
Rotary drilling method	0.00				0.00	0.00	1.00	DS	-	-	-	-	-	-	
	0.50			Reddish yellowish brown, fine to medium grained, clayey sand (SC) 0.00 to 2.20m											
	1.00				1.00	1.00	2.00	SPT	4	5	8	13	-	-	
	1.50														
	2.00				2.00	2.00	2.50	SPT	7	9	14	23	-	-	
	2.50			Yellowish brown, fine to medium grained, clayey sand (SC) 2.20 to 4.70m	2.50	2.50	3.00	UDS	-	-	-	-	-	-	
	3.00				3.00	3.00	3.50	SPT	7	10	13	23	-	-	
	3.50				3.50	3.50	4.00	UDS	-	-	-	-	-	-	
	4.00				4.00	4.00	4.50	SPT	11	18	22	40	-	-	
	4.50				4.50	4.50	5.00	UDS	-	-	-	-	-	-	
	5.00				5.00	5.00	5.50	SPT	50/13 cm	-	-	>100	-	-	
	5.50				5.50	5.50	6.00	SPT	50/12 cm	-	-	>100	-	-	
	6.00			Yellowish brown, fine to medium grained, silty sand (SM) 4.70 to 7.80m	6.00	6.00	6.50	SPT	50/10 cm	-	-	>100	-	-	
	6.50				6.50	6.50	7.00	UDS	50/10 cm	-	-	>100	-	-	
	7.00				7.00	7.00	7.50	SPT	50/6 cm	-	-	>100	-	-	
	7.50				7.50	7.50	8.00	SPT	50/6 cm	-	-	>100	-	-	
	8.00			Yellowish brown, fine to medium grained, clayey sand (SC) 7.80 to 9.60m	8.00	8.00	8.50	SPT	50/5 cm	-	-	>100	-	-	
	8.50				8.50	8.50	9.00	SPT	50/4 cm	-	-	>100	-	-	
	9.00				9.00	9.00	9.50	SPT	50/6 cm	-	-	>100	-	-	
	9.50				9.50	9.50	10.00	SPT	50/7 cm	-	-	>100	-	-	
	10.00			Yellowish brown, fine to medium grained, silty sand (SM) 9.60 to 11.80m	10.00	10.00	11.00	SPT	50/4 cm	-	-	>100	-	-	
	10.50														
	11.00				11.00	11.00	11.50	SPT	50/5 cm	-	-	>100	-	-	
	11.50				11.50	11.50	12.50	SPT	50/5 cm	-	-	>100	-	-	
	12.00														
	12.50			Yellowish brown, fine to medium grained, silty clayey sand (SM-SC) 11.60 to 14.30m	12.50	12.50	13.00	SPT	50/10 cm	-	-	>100	-	-	
	+ 13.00				13.00	13.00	14.00	SPT	50/4 cm	-	-	>100	-	-	
	13.50														
	14.00				14.00	14.00	14.50	SPT	50/6 cm	-	-	>100	-	-	
	14.50				14.50	14.50	14.60	SPT	70/5 cm	-	-	>100	-	-	
	15.00														
	15.50			Yellowish brown, fine to medium grained, clayey sand (SC) 14.30 to 18.25m	15.50	15.50	16.00	SPT	70/6 cm	-	-	>100	-	-	
	16.00				16.00	16.00	17.00	SPT	70/5 cm	-	-	>100	-	-	
	16.50														
	17.00				17.00	17.00	17.50	SPT	70/6 cm	-	-	>100	-	-	
	17.50				17.50	17.50	18.50	SPT	70/4 cm	-	-	>100	-	-	
	18.00														
	18.50			Yellowish brown, fine to medium grained, silty sand (SM) 18.25 to 20.50m	18.50	18.50	19.00	SPT	60/5 cm	-	-	>100	-	-	
	19.00				19.00	19.00	20.00	SPT	50/7 cm	-	-	>100	-	-	
	19.50														
	20.00				20.00	18.54	20.50	SPT	50/7 cm	-	-	>100	-	-	
	20.50			Yellowish brown, fine to medium grained, clayey sand with little gravels (SC) 20.50 to 21.80m									-	-	
	21.00														
	21.50				21.50	20.50	21.50	SPT	50/4 cm	-	-	>100	-	-	
	22.00														
	22.50			Boulderous formation of highly weathered, moderately weak, dark brownish, fine to coarse grained, gravels, pebbles and cobbles size fractured rock fragments and dark blackish brown, fine to coarse graind, infilled sand											
	23.00				23.00	21.50	23.00	Core	-	-	-	-	6.66	-	
	23.50														
	24.00														
	24.50				24.50	23.00	24.50	Core	-	-	-	-	3.33	-	
	25.00				25.00	23.00	25.00	Core	-	-	-	-	24.00	-	

23.00 to 25.00m

Project : BHEL

Bore Hole No. : IBH 12

Location : Hirma, Talabira

Depth of Termination : 25.0 M

Co-ordinates: E 1793, N 3622

Depth of Water Table : Encountered at 7.80m depth during investigation

Date of Start: 16-11-2024

Date of Completion: 18-11-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 210.70 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks			
						From m	To m		N ₁	N ₂	N ₃	N						
Rotary drilling method	0.00			Dark brownish red to reddish yellow, fine to medium grained, clayey sand with occasional to much gravels (SC) 0.00 to 4.60m	0.00	0.00	1.00	DS	-	-	-	-	-	-				
	0.50																	
	1.00																	
	1.50							1.00	1.00	2.00	SPT	5	11	14		25	-	-
	2.00							2.00	2.00	2.50	SPT	5	5	6		11	-	-
	2.50							2.50	2.50	3.00	UDS	-	-	-		-		
	3.00							3.00	3.00	3.50	SPT	8	9	10		19	-	-
	3.50							3.50	3.50	4.00	UDS	-	-	-		-		
	4.00							4.00	4.00	4.50	SPT	6	9	14		23	-	-
	4.50							4.50	4.50	5.00	UDS	-	-	-		-	-	-
	5.00						Reddish yellow, fine to medium grained, cemented clayey sand (SC) 4.60 to 5.70m	5.00	5.00	5.50	SPT	32	50/6 cm	-		>100	-	-
	5.50							5.50	5.50	6.00	SPT	30	50/9 cm	-		>100	-	-
	6.00						Yellowish brown, fine to medium grained, silty sand with little plastic fines and occasional gravels (SM) 5.70 to 9.20m	6.00	6.00	6.50	SPT	19	30	37		67	-	-
	6.50							6.50	6.50	7.00	SPT	35	50/3 cm	-		>100		
	7.00							7.00	7.00	7.50	SPT	50/13 cm	-	-		>100	-	-
	7.50							7.50	7.50	8.00	SPT	50/14 cm	-	-		>100	-	-
	8.00							8.00	8.00	8.50	SPT	50/10 cm	-	-		>100	-	-
	8.50							8.50	8.50	8.55	SPT	50/14 cm	-	-		>100	-	-
	9.00			Yellowish brown, fine to medium grained, cemented clayey sand with little gravels (SC) 9.20 to 9.60m	9.00	9.00	9.00	SPT	37	50/4 cm	-	>100	-	-				
	9.50			Yellowish brown, fine to medium grained, cemented, silty clayey sand (SM-SC) 9.60 to 11.60m	9.50	9.50	9.56	SPT	50/6 cm	-	-	>100	-	-				
	10.00				10.00	10.00	10.00	SPT	50/8 cm	-	-	>100	-	-				
	10.50																	
	11.00				11.00	11.00	11.06	SPT	50/6 cm	-	-	>100	-	-				
	11.50				11.50	11.50	11.59	SPT	50/9 cm	-	-	>100	-	-				
	12.00																	
	12.50			Dark brownish to yellowish brown, fine to medium grained, cemented micaceous clayey sand (SC) 11.60 to 14.60m	12.50	11.50	12.50	SPT	42	50/6 cm	-	>100	-	-				
	13.00				13.00	12.50	13.00	SPT	50/11 cm	-	-	>100	-	-				
	13.50																	
	14.00				14.00	14.00	14.00	SPT	50/7 cm	-	-	>100						
	14.50				14.50	14.50	14.58	SPT	50/8 cm	-	-	>100	-	-				
	15.00																	
	15.50			Highly weathered, weak, yellowish brown, fine to coarse grained, friable and fractured rock 14.60 to 21.00m	15.50	14.58	15.50	Core	-	-	-	-	13.33					
	16.00				15.50	15.50	15.52	SPT	50/2 cm	-	-	>100						
16.50			16.50		15.52	18.00	Core	-	-	-	-	11.00						
17.00			16.50		16.50	16.52	SPT	50/3 cm	-	-	>100							
17.50																		
18.00			18.00		16.52	18.00	Core	-	-	-	-	7.33						
18.50			18.00		18.00	18.53	SPT	50/3 cm	-	-	>100							
19.00																		
19.50			19.50		18.53	19.50	Core	-	-	-	-	24						
20.00																		
20.50																		
21.00			Highly weathered, weak, yellowish brown, fine to coarse grained, rock with close spacing of discontinuities 21.00 to 23.00m	21.00	19.50	21.00	Core	-	-	-	-	26	15.33					
21.50																		
22.00																		
22.50				22.50	21.00	22.50	Core	-	-	-	-	24	-					
23.00			Highly weathered, weak, dark brownish, fine to coarse grained, rock with close spacing of discontinuities															
23.50																		
24.00				24.00	22.50	24.00	Core	-	-	-	-	23.33	8.00					
24.50																		
25.00				25.00	24.00	25.00	Core	-	-	-	-	7.00	-					
23.00 to 25.00m					25.00	25.00	25.02	SPT	50/2 cm	-	-	>100						

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : IBH 13

Location : Hirma, Talabira

Depth of Termination : 18.5

Co-ordinates: E 843, N 3741

Depth of Water Table : Encountered at 0.60 m depth during investigation

Date of Start: 22-04-2025

Date of Completion: 25-04-2025

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level:

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks
						From m	To m		N ₁	N ₂	N ₃	N			
Rotary drilling method	0.00	Not used		Brownish, fine to medium grained, sandy clays of intermediate plasticity (CI) 0.00 to 0.40m	0.00	0.00	1.00	DS	-	-	-	-	-	-	
	0.50														
	1.00			Yellowish brown, fine to medium grained, sandy clays of low plasticity with much gravels (CL) 0.40 to 2.30m	1.00	1.00	2.00	SPT	4	6	8	14	-	-	
	1.50														
	2.00				2.00	2.00	2.50	SPT	4	4	8	12	-	-	
	2.50														
	3.00			Dark brownish, fine to coarse grained, silty gravels and clayey gravels (GM-GC) 2.30 to 3.40m	2.50	2.50	3.00	SPT	6	6	9	15	-	-	
	3.50														
	4.00				3.00	3.00	3.50	SPT	7	11	13	24	-	-	
	4.50														
	5.00			Reddish yellow, fine to coarse grained, clayey sand with much gravels (SC) 3.40 to 5.80m	3.50	3.50	4.00	SPT	7.00	15	18.00	33	-	-	
	5.50														
	6.00				4.00	4.00	4.50	SPT	7	11	15	26	-	-	
	6.50														
	7.00			Dark yellowish, very fine grained, indurated clays of high plasticity mud rock 5.80 to 7.00m	4.50	4.50	5.00	SPT	12.00	21	28.00	49	-	-	
	7.50														
	8.00				5.00	5.00	5.50	SPT	15	26	31	57	-	-	
	8.50														
	9.00				5.50	5.50	6.00	SPT	21	30	35	65	-	-	
	9.50														
	10.00			Dark yellowish, very fine grained, indurated clays of high plasticity mud rock 5.80 to 7.00m	6.00	6.00	6.50	SPT	45	50/9 cm	-	>100	-	-	
	10.50														
	11.00				6.50	6.50	7.00	SPT	33	68/11 cm	-	>100	-	-	
	11.50														
	12.00			Greyish brown, fine to medium grained, sandy clas of intermediate plasticity with much gravels mud rock 7.00 to 9.00m	7.00	7.00	7.50	SPT	55/10 cm	-	-	>100	-	-	
	12.50														
	13.00				8.00	8.00	8.10	SPT	71/9 cm	-	-	>100	-	-	
	13.50														
	14.00			Highly weathered, weak, light brownish grey, fine to very fine grained, fractured rock 9.00 to 11.00m	8.50										
	14.50														
15.00			9.50	8.10	9.50	Core	-	-	-	-	8.57	-			
15.50															
16.00			11.00	10.50	11.00	Core	-	-	-	-	14.66	-			
16.50															
17.00		Highly weathered, moderately weak, yellowish brown, fine to very fine grained, fractured rock 11.00 to 14.00m	12.50	11.00	12.50	Core	-	-	-	-	28.00	-			
17.50															
18.00			14.00	12.53	14.00	Core	-	-	-	-	16.66	-			
18.50															
19.00		Highly weathered, moderately weak, dark greyish black, fine to very fine grained, fractured rock 14.00 to 17.50m	15.50	14.03	15.50	Core	-	-	-	-	29.33	-			
19.50															
20.00			17.00	15.52	17.00	Core	-	-	-	-	30.66	30.66			
20.50															
21.00		Slightly weathered, weak, dark greyish black, fine to very fine grained, massive rock													
21.50															
22.00			18.50	17.00	18.50	Core	-	-	-	-	78.66	75.33			
22.50															
17.50 to 18.50m															

Project : BHEL

Bore Hole No. : IBH 14

Location : Hirma, Talabira

Depth of Termination : 25.0 M

Co-ordinates : E 1122, N 3767

Depth of Water Table : Encountered at 5.00m epth during investigation

Date of Start: 08-07-2024

Date of Completion: 10-07-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 198.77 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks	
						From m	To m		N ₁	N ₂	N ₃	N				
Rotary drilling method	0.00	Used		Yellowish brown, fine to medium grained, clayey sand with much to some gravels (SC) 0.00 to 1.60m	0.00	0.00	1.00	DS	-	-	-	-	-	-		
	0.50															
	1.00															
	1.50															
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18.50																
19.00																
19.50																
20.00																
20.50																
21.00																
21.50																
22.00																
22.50																
23.00																
23.50																
24.00																
24.50																
25.00																
18.80 to 25.00m				25.00	25.00	25.05	SPT	50/5 cm	-	-	>100					

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : IBH 15

Location : Hirma, Talabira

Depth of Termination : 25.0 M

Co-ordinates: E 1221, N 3716

Depth of Water Table : Encountered at 3.50 m depth during investigation

Date of Start: 21-09-2024

Date of Completion: 24-09-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 200.95 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks
						From m	To m		N ₁	N ₂	N ₃	N			
Rotary drilling method	0.00	Used		Reddish brown, fine to medium grained, silty sand with little plastic fines and occasional gravels (SM) 0.00 to 0.80m	0.00	0.00	1.00	DS	-	-	-	-	-	-	
	0.50														
	1.00														
	1.50														
	2.00														
	2.50														
	3.00														
	3.50														
	4.00														
	4.50														
	5.00														
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	14.00														
	14.50														
	15.00														
	15.50														
	16.00														
16.50															
17.00															
17.50															
18.00															
18.50															
19.00															
19.50															
20.00		Not Used		Highly weathered, weak, yellowish brown, fine to coarse grained, fractured rock 19.15 to 23.00m	20.00	19.15	20.00	Core	-	-	-	-	14.11	-	
20.50															
21.00															
21.50															
22.00															
22.50															
23.00															
23.50															
24.00															
24.50															
25.00															
24.00 to 25.00m															

Project : BHEL

Bore Hole No. : IBH 16

Location : Hirma, Talabira

Depth of Termination : 25.0 M

Co-ordinates: E 1218, N 3531

Depth of Water Table : Encountered at 5.20m depth during investigation

Date of Start: 04-07-2024

Date of Completion: 07-07-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 200.47 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks	
						From m	To m		N ₁	N ₂	N ₃	N				
Rotary drilling method	0.00	Used		Brownish, fine to medium grained, clayey sand with occasional gravels (SC) 0.00 to 0.40m	0.00	0.00	1.00	DS	-	-	-	-	-	-		
	0.50			Brownish, fine to very fine grained, sandy clays of intermediate plasticity with occasional gravels (CI) 0.40 to 1.70m	1.00	1.00	2.00	SPT	4	3	3	6	-	-		
	1.00			Yellowish brown, fine to medium grained, clayey sand with much to some gravels (SC) 1.70 to 3.10m	2.00	2.00	2.50	SPT	9	10	12	22	-	-		
	1.50				2.50	2.50	3.00	UDS	-	-	-	-	-	-		
	2.00				3.00	3.00	3.50	SPT	7	10	11	21	-	-		
	2.50			Yellowish brown, fine to medium grained, silty sand with some gravels (SM) 3.10 to 4.20m	3.50	3.50	4.00	DS	-	UDS attempted but not recovered				-		
	3.00				4.00	4.00	4.50	SPT	17	50/14 cm	-	>100	-	-		
	3.50				4.50	4.50	5.00	DS	-	UDS attempted but not recovered				-		
	4.00			Yellowish brown, fine to medium grained, silty clayey sand with little to some gravels (SM-SC) 4.20 to 6.00m	5.00	5.00	5.50	SPT	16	20	29	49	-	-		
	4.50				5.50	5.50	6.00	DS	-	UDS attempted but not recovered				-		
	5.00				6.00	6.00	6.50	SPT	13	17	21	38	-	-		
	5.50			Yellowish brown, fine to medium grained, clayey sand with occasional gravels (SC) 6.00 to 8.20m	6.50	6.50	7.00	UDS	-	-	-	-	-	-	-	
	6.00				7.00	7.00	7.50	SPT	9	25	37	62	-	-		
	6.50				7.50	7.50	8.00	DS	-	UDS attempted but not recovered				-		
	7.00			Yellowish brown, fine to medium grained, silty clayey sand with little to occasional gravels (SM-SC) 8.20 to 10.50m	8.00	8.00	8.50	SPT	50/11 cm	-	-	-	>100	-	-	
	7.50				8.50	8.50	9.00	SPT	50/10 cm	-	-	-	>100	-	-	
	8.00				9.00	9.00	9.50	SPT	50/9 cm	-	-	-	>100	-	-	
	8.50			Yellowish brown, fine to medium grained, silty sand with little to some gravels (SM) 10.50 to 14.30mm	9.50	9.50	10.00	SPT	50/10 cm	-	-	-	>100	-	-	
	9.00				10.00	10.00	11.00	SPT	50/10 cm	-	-	-	>100	-	-	
	9.50				11.00	11.00	11.50	SPT	50/13 cm	-	-	-	>100	-	-	
	10.00			Yellowish brown, fine to medium grained, silty sand with little to some gravels (SM) 10.50 to 14.30mm	11.50	11.50	12.50	SPT	50/12 cm	-	-	-	>100	-	-	
	10.50				12.50	12.50	13.00	SPT	50/12 cm	-	-	-	>100	-	-	
	11.00				13.00	13.00	14.00	SPT	12	50/13 cm	-	-	>100	-	-	
	11.50			Yellowish brown, fine to medium grained, clayey sand with much gravels (SC) 14.30 to 15.70m	14.00	14.00	14.50	SPT	50/7 cm	-	-	-	>100	-	-	
	12.00				14.50	14.50	15.50	SPT	50/9 cm	-	-	-	>100	-	-	
	12.50				15.50	15.50	17.00	SPT	50/4 cm	-	-	-	>100	-	-	
	13.00			Highly weathered, completely fractured and disintegration, dark brownish black, fine to coarse grained, gravels, pebbles and cobbles size fractured rock fragments with infilled sandy clays 15.70 to 18.50m	17.00	17.00	18.50	SPT	50/9 cm	-	-	-	>100	-	-	
	13.50				18.50	18.50	18.54	SPT	50/4 cm	-	-	-	>100	-	-	
	14.00				20.00	18.54	20.00	Core	-	-	-	-	2.00	-	-	
	14.50			Highly weathered, very weak, dark blackish grey, very fine grained, thinly laminated rock 18.50 to 22.00m	20.00	20.00	20.02	SPT	50/2 cm	-	-	-	>100	-	-	
	15.00				21.50	20.02	21.50	Core	-	-	-	-	1.00	-	-	
	15.50				21.50	21.50	21.54	SPT	50/4 cm	-	-	-	>100	-	-	
	16.00			Highly weathered, weak, dark yellowish brown, fine to coarse grained, fractured rock 22.00 to 23.50m	23.00	21.54	23.00	Core	-	-	-	-	20.00	-	-	
	16.50				23.00	23.00	23.03	SPT	50/3 cm	-	-	-	>100	-	-	
	17.00				24.50	23.03	24.50	Core	-	-	-	-	24.00	-	-	
	17.50			Highly weathered, moderately strong, dark yellowish brown, fine to coarse grained, fractured rock	24.50	24.50	25.00	Core	-	-	-	-	28.00	-	-	
18.00		25.00	24.50		25.00	Core	-	-	-	-	28.00	-	-			
18.50		25.00	24.50		25.00	Core	-	-	-	-	28.00	-	-			
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19.50																
20.00																
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24.50																
25.00																

Project : BHEL
 Bore Hole No. : IBH 17
 Location : Hirma, Talabira
 Depth of Termination : 25.0 M
 Co-ordinates : E 1219, N 3423
 Depth of Water Table : Encountered at 2.80 m depth during investigation

Date of Start: 10-07-2024
 Date of Completion: 12-07-2024
 Diameter of Bore: 150mm and Nx size
 Bit Used: Soil Surface Bit and NX Size
 Reduced Level: 200.70

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks	
						From m	To m		N ₁	N ₂	N ₃	N				
Rotary drilling method	0.00	Used		Yellowish brown, fine to medium grained, clayey sand (SC) 0.00 to 0.60m	0.00	0.00	1.00	DS	-	-	-	-	-	-		
	0.50															
	1.00															
	1.50															
	2.00															
	2.50															
	3.00															
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25.00																

Page No 594 of 639

23.50 to 25.00m

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Project : BHEL

Bore Hole No. : IBH 18

Location : Hirma, Talabira

Depth of Termination : 25.0 M

Co-ordinates: E 1218, N 3266

Depth of Water Table : Encountered at 2.80 m depth during investigation

Date of Start: 20-06-2024

Date of Completion: 22-06-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced level: 200.340 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recov- ery (%)	RQD (%)	Remarks		
						From m	To m		N ₁	N ₂	N ₃	N					
Rotary drilling method with Hydraulic feed	0.00	Used		Brownish, fine to very fine grained, clayey sand with occational gravels(SC) 0.00 to 0.50m	0.00	0.00	1.50	DS	-	-	-	-	-	-			
	0.50																
	1.00			Pinkish yellow, fine to very fine grained, sandy clays of intermediate plasticity with occational gravels(CI)	1.00	1.00	2.00	SPT	6	5	6	11	-	-			
	1.50																
	2.00				2.00	2.00	2.50	SPT	5	5	6	11	-	-			
	2.50		0.50 to 3.70m	2.50	2.50	2.00	UDS	-	-	-	-	-	-				
	3.00			3.00	3.00	3.40	SPT	4	7	10	17	-	-				
	3.50			3.50	3.50	4.00	UDS	-	-	-	-	-	-				
	4.00			Brownish yellow, very fine grained, clays of high plasticity with little gravels (CH)	4.00	4.00	4.50	SPT	7	9	13	22	-	-			
	4.50				4.50	4.50	5.00	UDS	8	10	12	22	-	-			
	5.00				5.00	5.00	5.50	SPT	11	12	12	24	-	-			
	5.50				5.50	5.50	6.00	UDS	-	-	-	-	-	-			
	6.00				6.00	6.00	6.50	SPT	6	8	12	20	-	-			
	6.50				6.50	6.50	7.00	SPT	6	7	14	21	-	-			
	7.00				7.00	7.00	7.50	SPT	6	8	11	19	-	-			
	7.50				7.50	7.50	8.00	UDS	-	-	-	-	-	-			
	8.00				8.00	8.00	8.50	SPT	5	7	13	20	-	-			
	8.50			Brownish yellow, fine to very fine grained, sandy clays of low plasticity (CL) 8.50 to 9.50m	8.50	8.50	9.00	UDS	-	-	-	-	-	-			
	9.00				9.00	9.50	SPT	8	9	12	21	-	-				
	9.50				9.50	10.00	UDS	-	-	-	-	-	-	-			
	10.00		Light brownish yellow and greyish, fine to medium grained,clayey sand with little plastic fines (SC) 9.50 to 10.50m	10.00	10.00	11.00	SPT	6	9	13	22	-	-				
	10.50																
	11.00			11.00	11.00	11.50	UDS	-	-	-	-	-	-	-			
	11.50		Light brownish yellow and greyish, fine to medium grained,silty sand with little plastic fines (SM)	11.50	11.50	12.50	SPT	4	6	12	18	-	-				
	12.00																
	12.50																
	+ 13.00	Not used		10.50 to 14.20m	13.00	13.00	14.00	SPT	4	7	13	20	16.00	-			
	13.50																
	14.00																
	14.50			Highly weathered, very weak, dark greenish grey, very fine grained, very weak, very thinly laminated, foliated SHALE 14.20 to 16.00m	14.50	14.50	14.60	SPT	50/14 cm	-	-	>100	-	-			
	15.00																
	15.50																
	16.00				16.00	14.50	16.00	Core	-	-	-	-	26.00	12.00			
16.50																	
17.00																	
17.50	Highly weathered, dark greenish grey, very fine grained, very weak, very thinly laminated, foliated SHALE 16.00 to 19.00m			17.50	16.00	17.50	Core	-	-	-	-	30.00	-				
18.00																	
18.50																	
19.00				Moderately weathered, dark greenish grey, very fine grained, very weak, very thinly laminated, foliated SHALE 19.00 to 20.50m	19.00	17.50	19.00	Core	-	-	-	-	44.00	8.00			
19.50																	
20.00																	
20.50				20.50	19.00	20.50	Core	-	-	-	-	58.00	30.00				
21.00																	
21.50																	
22.00				22.00	20.50	22.00	Core	-	-	-	-	74.00	20.00				
22.50																	
23.00																	
23.50				23.50	22.00	23.50	Core	-	-	-	-	78.00	80.00				
24.00																	
24.50																	
25.00				25.00	23.50	25.00	Core	-	-	-	-	86.00	56.00				
20.50 to 25.00																	

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : IBH 19

Location : Hirma, Talabira

Depth of Termination : 18.00 M

Co-ordinates: E 1218, N 2964

Depth of Water Table : Encountered at 3.20m depth during investigation

Date of Start: 21-07-2024



















Date of Completion: 22-07-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 200.35m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks		
						From m	To m		N ₁	N ₂	N ₃	N					
Rotary drilling method	0.00	Not Used		Yellowish brown, very fine grained, sandy clays of interemdtate plasticity (CI) 0.00 to 0.70m	0.00	0.00	1.00	DS	-	-	-	-	-	-			
	0.50																
	1.00					1.00	1.00	2.00	SPT	10	12	14	26	-	-		
	1.50																
	2.00				Yellowish brown, fine to very fine grained, clays of high plasticity (CH) 0.70 to 2.80m	2.00	2.00	2.50	SPT	6	9	12	21	-	-		
	2.50																
	3.00				Yellowish brown, fine to very fine grained, sandy clays of high plasticity (CH) 2.80 to 3.70m	3.00	3.00	3.50	SPT	14	19	31	50	-	-		
	3.50																
	4.00				Yellowish brown, fine to very fine grained, sandy clays of intermediate plasticity (CI) 3.70 to 5.70m	4.00	4.00	4.50	SPT	7	13	18	31	-	-		
	4.50																
	5.00					5.00	5.00	5.50	SPT	50/3 cm	-	-	-	>100	-	-	
	5.50																
	6.00				Yellowish brown, fine to medium grained, clayey sand (SC) 5.50 to 6.65m	5.50	5.50	6.00	SPT	50/8 cm	-	-	-	>100	-	-	
	6.50																
	7.00																
	7.50					Highly weathered, completely fractured and disintegrated, yellowish brown, fine to medium grained, gravel, pebble size fragments of fractured rock with dark brownish red, fine to medium grained, clayey sand 6.65 to 8.30m	7.50	7.50	8.30	SPT	70/10 cm	-	-	-	>100		
	8.00																
	8.50					9.00	8.30	9.00	Core	-	-	-	-	60.00	19		
	9.50																
	10.00					10.50	9.08	10.50	Core	-	-	-	-	81.33	42.60		
	10.50																
	11.00					12.00	10.50	12.00	Core	-	-	-	-	46.00	-		
	11.50																
	12.00					13.50	12.00	13.50	Core	-	-	-	-	70.00	36.00		
	12.50																
	13.00					15.00	13.50	15.00	Core	-	-	-	-	59.00	86.00		
	13.50																
	14.00					16.50	15.00	16.50	Core					92.60	68.66		
14.50																	
15.00			18.00	16.50	18.00	Core					98.60	98.60					
15.50																	
16.00																	
16.50																	
17.00																	
17.50																	
18.00																	
16.50 to 18.00m																	

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : IBH 20

Location : Hirma, Talabira

Depth of Termination : 16.50 m

Co-ordinates: E 745, N 3722

Depth of Water Table : Encountered at 0.70m depth during investigation

Date of Start: 13-10-2024

Date of Completion: 15-10-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 193.46 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks	
						From m	To m		N ₁	N ₂	N ₃	N				
Rotary drilling method	0.00	Used		Brownish, fine to medium grained, sandy clays of intermediate plasticity (CI) 0.00 to 0.90m	0.00	0.00	1.00	DS	-	-	-	-	-	-		
	0.50															
	1.00				Yellowish brown to reddish yellow, fine to medium grained, clayey sand with some to much gravels (SC) 0.90 to 7.40m	1.00	1.00	2.00	SPT	2	2	3	5	-		-
	1.50															
	2.00					2.00	2.00	2.50	SPT	2	3	2	5	-		-
	2.50					2.50	2.50	3.00	UDS	-	-	-	-	-		-
	3.00					3.00	3.00	3.50	SPT	6	7	7	14	-		-
	3.50					3.50	3.50	4.00	SPT	3	5	7	12	-		-
	4.00					4.00	4.00	4.50	SPT	4	6	7	13	-		-
	4.50					4.50	4.50	5.00	SPT	6	9	10	19	-		-
	5.00					5.00	5.00	5.50	SPT	6	11	13	24	-		-
	5.50					5.50	5.50	6.00	SPT	7	9	11	20	-		-
	6.00				6.00	6.00	6.50	SPT	7	10	15	25	-	-		
	6.50				6.50	6.50	7.00	SPT	10	12	13	25	-	-		
	7.00				7.00	7.00	7.50	SPT	10	15	17	32	-	-		
	7.50				Greyish brown, very fine grained, indurated, clays of intermediate plasticity with gravels Mud stone 7.40 to 7.90m	7.50	7.50	7.90	SPT	50/12 cm	-	-	>100	-		-
	8.00															
	8.50			Not Used		Highly weathered, weak to moderately weak, dark greyish brown, fine to very fine grained, very thinly bedded rock 7.90 to 13.50m	9.00	7.90	9.00	Core	-	-	-	-		8.00
	9.50	9.00	9.00				9.07	SPT	50/7 cm	-	-	>100	-	-		
	10.00															
	10.50	10.50	10.50				12.00	SPT	50/5 cm	-	-	>100	-	-		
	11.00															
	11.50															
	12.00	12.00	12.00			12.03	SPT	50/3 cm	-	-	>100	-	-			
	12.50															
	13.00		Moderately weathered, weak, dark greyish black, fine to very fine grained, moderately thinly bedded rock 13.50 to 15.00m			13.50	12.03	13.50	Core	-	-	-	-	50.00		13
	14.00															
	14.50															
15.00		Moderately weathered, moderately weak, dark greyish black, fine to very fine grained, moderately thickly bedded rock 15.00 to 16.00m		15.00	13.50	15.00	Core	-	-	-	-	64.00	26			
15.50																
16.00			Slightly weathered, moderately weak, dark greyish black, fine to very fine grained, moderately thickly bedded rock													
16.50		16.50		15.00	16.50	Core	-	-	-	-	90.00	64				
16.00 to 16.50m																

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : IBH 21

Location : Hirma, Talabira

Depth of Termination : 25.0 M

Co-ordinates: E 987, N 3766

Depth of Water Table : Encountered at 3.80 m depth during investigation

Date of Start: 02-08-2024

Date of Completion: 06-08-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 194.99 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks	
						From m	To m		N ₁	N ₂	N ₃	N				
Rotary drilling method	0.00	Used		Yellowish brown, fine to medium grained, sandy clays of low plasticity with occasional gravels (CL) 0.00 to 0.30m	0.00	0.00	1.00	DS	-	-	-	-	-	-		
	0.50															
	1.00				Yellowish brown, fine to medium grained, clayey sand with little gravels (SC) 0.30 to 2.40m	1.00	1.00	2.00	SPT	4	6	7	13	-	-	
	1.50															
	2.00					2.00	2.00	2.50	SPT	2	7	9	16	-	-	
	2.50					2.50	2.50	3.00	UDS	-	-	-	-	-	-	
	3.00					3.00	3.00	3.50	SPT	4	26	50	76	-	-	
	3.50					3.50	3.50	4.00	SPT	7.00	28	32.00	60	-	-	
	4.00				Dark brownish, fine to medium grained, cemented clayey sand with much gravels (SC) 2.40 to 6.30m	4.00	4.00	4.50	SPT	11.00	36	49.00	85	-	-	
	4.50					4.50	4.50	5.00	SPT	11.00	42	50.00	92	-	-	
	5.00					5.00	5.00	5.50	SPT	14	27	48	85	-	-	
	5.50					5.50	5.50	6.00	SPT	17	32	50	82	-	-	
	6.00					6.00	6.00	6.50	SPT	18	34	55	89	-	-	
	6.50					6.50	6.50	7.00	SPT	50/13cm	-	-	>100	-	-	
	7.00					7.00	7.00	7.50	SPT	50/5cm	-	-	>100	-	-	
	7.50				Yellowish brown, fine to medium grained, cemented silty clayey sand with much gravels (SM-SC) 6.30 to 9.30m	7.50	7.50	8.00	SPT	50/9cm	-	-	>100	-	-	
	8.00					8.00	8.00	8.50	SPT	50/8cm	-	-	>100	-	-	
	8.50					8.50	8.50	9.00	SPT	50/9cm	-	-	>100	-	-	
	9.00					9.00	9.00	9.50	SPT	50/13cm	-	-	>100	-	-	
	9.50					9.50	9.50	10.00	SPT	50/12cm	-	-	>100	-	-	
	10.00					10.00	10.00	11.00	SPT	50/11cm	-	-	>100	-	-	
	10.50					10.50	10.50	11.00	SPT	50/11cm	-	-	>100	-	-	
	11.00				Yellowish brown, fine to medium grained, cemented clayey sand (SC) 10.50 to 11.70m	11.00	11.00	11.50	SPT	50/10cm	-	-	>100	-	-	
	11.50					11.50	11.50	12.50	SPT	50/11cm	-	-	>100	-	-	
	12.00					12.00	12.00	13.00	SPT	50/11cm	-	-	>100	-	-	
	12.50					12.50	12.50	13.00	SPT	50/8cm	-	-	>100	-	-	
	13.00				Yellowish brown, fine to medium grained, cemented silty sand (SM) 11.70 to 14.70m	13.00	13.00	14.00	SPT	50/8cm	-	-	>100	-	-	
	13.50					13.50	13.50	14.00	SPT	50/8cm	-	-	>100	-	-	
	14.00					14.00	14.00	14.50	SPT	50/8cm	-	-	>100	-	-	
	14.50					14.50	14.50	14.53	SPT	50/3cm	-	-	>100	-	-	
	15.00		Not Used		15.00	14.53	15.50	Core	-	-	-	-	45.00	16.60		
	15.50				15.50	15.50	17.00	Core	-	-	-	-	18.66	-		
	16.00				16.00	17.00	17.03	SPT	50/3cm	-	-	>100	-	-		
	16.50				16.50	17.00	17.03	SPT	50/3cm	-	-	>100	-	-		
	17.00				17.00	17.00	17.03	SPT	50/3cm	-	-	>100	-	-		
	17.50				17.50	17.00	17.03	SPT	50/3cm	-	-	>100	-	-		
18.00				18.00	17.00	17.03	SPT	50/3cm	-	-	>100	-	-			
18.50				18.50	17.03	18.50	Core	-	-	-	-	21.33	-			
19.00				19.00	17.03	18.50	Core	-	-	-	-	21.33	-			
19.50				19.50	17.03	18.50	Core	-	-	-	-	21.33	-			
20.00				20.00	18.50	20.00	Core	-	-	-	-	34.00	-			
20.50				20.50	18.50	20.00	Core	-	-	-	-	34.00	-			
21.00				21.00	20.00	21.50	Core	-	-	-	-	35.23	-			
21.50				21.50	20.00	21.50	Core	-	-	-	-	35.23	-			
22.00				22.00	20.00	21.50	Core	-	-	-	-	35.23	-			
22.50				22.50	20.00	21.50	Core	-	-	-	-	35.23	-			
23.00			23.00	21.50	23.00	Core	-	-	-	-	10.00	-				
23.50			23.50	21.50	23.00	Core	-	-	-	-	10.00	-				
24.00			24.00	21.50	23.00	Core	-	-	-	-	10.00	-				
24.50			24.50	21.50	23.00	Core	-	-	-	-	10.00	-				
25.00			25.00	25.00	23.00	25.00	Core	-	-	-	-	26.50	-			
21.00 to 25.00m																

21.00 to 25.00m

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : IBH 22

Location : Hirma, Talabira

Depth of Termination : 25.0 M

Co-ordinates: E 1201, N 3766

Depth of Water Table : Encountered at 4.20m depth during investigation

Date of Start: 30-07-2024

Date of Completion: 01-08-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 200.61 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks
						From m	To m		N ₁	N ₂	N ₃	N			
Rotary drilling method	0.00	Used		Dark reddish brown, fine to coarse grained, silty sand with little plastic fines and some gravels (SM) 0.00 to 0.30m	0.00	0.00	1.00	DS	-	-	-	-	-	-	
	0.50														
	1.00				1.00	1.00	2.00	SPT	5	6	7	13	-	-	
	1.50														
	2.00				2.00	2.00	2.50	SPT	7	10	15	25	-	-	
	2.50				2.50	2.50	3.00	UDS	-	-	-	-	-	-	
	3.00			Light reddish yellow and reddish yellow, fine to medium grained, clayey sand with occasional gravels (SC) 0.30 to 6.30m	3.00	3.00	3.50	SPT	12	16	21	37	-	-	
	3.50				3.50	3.50	4.00	UDS	-	-	-	-	-	-	
	4.00				4.00	4.00	4.50	SPT	13	16	22	38	-	-	
	4.50				4.50	4.50	5.00	SPT	9	15	18	33	-	-	
	5.00				5.00	5.00	5.50	SPT	12	18	25	43	-	-	
	5.50				5.50	5.50	6.00	SPT	13	19	23	42	-	-	
	6.00				6.00	6.00	6.06	SPT	51/6cm	-	-	>100	-	-	
	6.50				6.50	6.06	8.00	Core	-	-	-	-	22.00	-	
	7.00	Boulderous formation of highly weathered, weak, dark brownish, fine to coarse grained, fractured and friable rock with littled cemented sand 6.30 to 9.50m													
	7.50														
	8.00		8.00	8.00	9.50	Core	-	-	-	-	6.66	-			
	8.50														
	9.00														
	9.50		9.50	9.50	11.00	Core	-	-	-	-	6.00	-			
	10.00	Boulderous formation of highly weathered, moderately weak, dark brownish, fine to coarse grained, fractured and friable rock with cemented sand 9.50 to 12.50m													
	10.50														
	11.00		11.00	11.00	12.50	Core	-	-	-	-	7.33	-			
	11.50														
	12.00														
	12.50		12.50	12.50	13.00	SPT	51/3cm	-	-	>100	-	-			
	+ 13.00	Not Used		Yellowish brown, fine to medium grained, cemented silty sand with very weak and friable fragments of rock 12.50 to 17.30m	13.00	13.00	14.00	SPT	51/3cm	-	-	>100	-	-	
	13.50														
	14.00				14.00	14.00	14.50	SPT	51/4cm	-	-	>100	-	-	
	14.50				14.50	14.50	15.50	SPT	51/3cm	-	-	>100	-	-	
	15.00														
	15.50				15.50	15.50	16.00	SPT	51/3cm	-	-	>100	-	-	
16.00	16.00				16.00	17.00	SPT	51/3cm	-	-	>100	-	-		
16.50															
17.00	Yekkiwush brown and slightly greyish, fine to coarse grained, cemented silty sand with little plastic fines and with vey weak and friable fragments of rock 17.30 to 18.50m			17.00	17.00	17.50	SPT	51/4cm	-	-	>100	-	-		
17.50				17.50	17.50	18.50	SPT	51/4cm	-	-	>100	-	-		
18.00	Highly weathered, weak, completely fractured, yellowish brown, fine to medium grained, rock mix with yellowish brown, fine to medium grained, cemented sand 18.50 to 20.50m														
18.50				18.50	18.50	20.00	SPT	51/3cm	-	-	>100	-	-		
19.00															
19.50															
20.00		20.00	20.00	20.50	SPT	51/3cm	-	-	>100	-	-				
20.50		20.50	20.50	20.54	SPT	51/4cm	-	-	>100	-	-				
21.00	Highly weathered, very weak, yellowish brown, fine to coarse grained, fractured and friable rock 20.50 to 23.00m														
21.50		21.50	20.54	21.50	Core	-	-	-	-	22.00	-				
22.00															
22.50															
23.00	Not Used		Highly weathered, weak, yellowish brown, fine to coarse grained, rock with close spacing of discontinuities 20.50 to 25.00m	23.00	21.50	23.00	Core	-	-	-	-	21.33	21.33		
23.50															
24.00															
24.50															
25.00				25.00	23.00	25.00	Core	-	-	-	-	18.50	6.50		

20.50 to 25.00m

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : IBH 23

Location : Hirma, Talabira

Depth of Termination : 25.0 M

Co-ordinates: E 1194, N 3618

Depth of Water Table : Encountered at 8.70m depth during investigation

Date of Start: 04-07-2024

Date of Completion: 07-07-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 200.45

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks
						From m	To m		N ₁	N ₂	N ₃	N			
Rotary drilling method	0.00	Used		Yellowish brown, fine to medium grained, clayey sand with little to much gravels (SC) 0.00 to 4.70m	0.00	0.00	1.00	DS	-	-	-	-	-	-	
	0.50														
	1.00				1.00	1.00	2.00	SPT	4	6	7	13	-	-	
	1.50														
	2.00				2.00	2.00	2.50	SPT	9	15	16	31	-	-	
	2.50				2.50	2.50	3.00	UDS	-	-	-	-	-	-	
	3.00				3.00	3.00	3.50	SPT	9	12	15	27	-	-	
	3.50				3.50	3.50	4.00	UDS	-	-	-	-	-	-	
	4.00				4.00	4.00	4.50	SPT	9	16	20	36	-	-	
	4.50				4.50	4.50	5.00	UDS	-	-	-	-	-	-	
	5.00			Yellowish brown, fine to medium grained, silty clayey sand with little gravels (SM-SC) 4.70 to 6.20m	5.00	5.00	5.50	SPT	13	15	16	31	-	-	
	5.50				5.50	5.50	6.00	DS	-	UDS attempted but not recovered			-	-	
	6.00				6.00	6.00	6.50	SPT	14	16	20	36	-	-	
	6.50				6.50	6.50	7.00	DS	-	-	-	-	-	-	
	7.00				7.00	7.00	7.50	SPT	8	8	10	18	-	-	
	7.50				7.50	7.50	8.00	DS	-	UDS attempted but not recovered			-	-	
	8.00			Yellowish brown, fine to medium grained, poorly graded sand and silty sand with some gravels (SP-SM) 6.20 to 8.50m	8.00	8.00	8.50	SPT	50/6 cm	-	-	>100	-	-	
	8.50				8.50	10.00	UDS	-	-	-	-	-	-	-	
	9.00														
	9.50	Not used		Yellowish brown, fine to medium grained, clayey sand with much gravels (SC) 8.50 to 14.70m											
	10.00				10.00	10.00	11.50	SPT	51/5 cm	-	-	>100	-	-	
	10.50														
	11.00														
	11.50				11.50	11.50	13.00	SPT	55/7 cm	-	-	>100	-	-	
	12.00														
	12.50														
	+ 13.00				13.00	13.00	14.50	SPT	51/9 cm	-	-	>100	-	-	
	13.50														
	14.00														
	14.50			14.50	14.50	14.59	SPT	51/9 cm	-	-	>100	-	-		
	15.00														
	15.50														
	16.00			16.00	14.59	16.00	Core	-	-	-	-	9.33	7		
	16.50			16.00	16.00	16.03	SPT	51/3 cm	-	-	>100	-	-		
	17.00														
	17.50			Highly weathered, very weak, dark brownish, fine to coarse grained, fractured rock	17.50	16.03	17.50	Core	-	-	-	-	14.66	-	
	18.00				17.50	17.50	17.53	SPT	51/3 cm	-	-	>100	-	-	
	18.50														
	19.00	19.00	17.53		19.00	Core	-	-	-	-	40.00	35.33			
	19.50	14.70 to 21.50m	19.00	19.00	19.03	SPT	51/3 cm	-	-	>100	-	-			
20.00															
20.50	20.50		19.03	20.50	Core	-	-	-	-	19.33	7.33				
21.00	20.50		20.50	20.53	SPT	51/3 cm	-	-	>100	-	-				
21.50	Highly weathered, moderately weak, dark brownish, fine to coarse grained, rock with very closely spaced discontinuities 21.50 to 23.00m														
22.00															
22.50		22.50	20.53	22.50	Core	-	-	-	-	16.66	10.00				
23.00	Highly weathered, very weak, brownish, fine to coarse grained, rock with closely spaced discontinuities	22.50	22.50	22.53	SPT	51/3 cm	-	-	>100	-	-				
23.50		23.50	22.50	23.50	Core	-	-	-	-	22.66	14.66				
24.00		23.50	23.50	23.53	SPT	51/3 cm	-	-	>100	-	-				
24.50															
25.00															
23.00 to 25.00m															

Project : BHEL

Bore Hole No. : IBH 24

Location : Hirma, Talabira

Depth of Termination : 25.0 M

Co-ordinates: E 1194, N 3334

Depth of Water Table : Encountered at 2.20m depth during investigation

Date of Start: 11-07-2024

Date of Completion: 15-07-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 199.65 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks
						From m	To m		N ₁	N ₂	N ₃	N			
Rotary drilling method	0.00	Used		Yellowish brown, fine to very fine grained, clayey sand (SC) 0.00 to 0.20m	0.00	0.00	1.00	DS	-	-	-	-	-	-	
	0.50			Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL) 0.20 to 1.50m											
	1.00				1.00	1.00	2.00	SPT	5	6	7	13	-	-	
	1.50														
	2.00				2.00	2.00	2.50	SPT	5	6	9	15	-	-	
	2.50				2.50	2.50	3.00	UDS	-	-	-	-			
	3.00				3.00	3.00	3.50	SPT	9	9	8	17	-	-	
	3.50				3.50	3.50	4.00	UDS	-	-	-	-			
	4.00				4.00	4.00	4.50	SPT	8	10	12	22	-	-	
	4.50				4.50	4.50	5.00	UDS	-	-	-	-			
	5.00			Yellowish brown, fine to very fine grained, clays of high plasticity (CH) 4.70 to 5.60m	5.00	5.00	5.50	SPT	7	10	14	24	-	-	
	5.50				5.50	5.50	6.00	UDS	-	-	-	-			
	6.00				6.00	6.00	6.50	SPT	11	16	18	34	-	-	
	6.50			Yellowish brown, fine to medium grained, clayey sand (SC) 5.60 to 7.30m	6.50	6.50	7.00	UDS	-	-	-	-			
	7.00				7.00	7.00	7.50	SPT	16	12	14	26	-	-	
	7.50				7.50	7.50	8.00	SPT	6	8	11	19			
	8.00				8.00	8.00	8.50	SPT	7	11	17	23	-	-	
	8.50				8.50	8.50	9.00	UDS	-	-	-	-	-	-	
	9.00				9.00	9.00	9.50	SPT	7	9	13	22			
	9.50				9.50	9.50	10.00	UDS	-	-	-	-	-	-	
	10.00				10.00	10.00	11.00	SPT	5	7	9	16	-	-	
	10.50			Yellowish brown, fine to medium grained, clayey sand (SC) 9.60 to 11.30m											
	11.00				11.00	11.00	11.50	SPT	6	7	12	19			
	11.50				11.50	11.50	12.50	SPT	5	9	11	20	-	-	
	12.00														
	12.50				12.50	12.50	13.00	SPT	6	10	14	24			
	13.00				13.00	13.00	14.50	SPT	9	12	16	28	-	-	
	13.50														
	14.00				14.00	14.00	14.50	SPT	9	12	20	32			
	14.50				14.50	14.50	14.60	SPT	10	11	26	36	-	-	
	15.00				15.50	14.60	15.50	Core	-	-	-	-	6.00		
	15.50				15.50	15.50	15.57	SPT	51/7 cm	-	-	>100	-	-	
	16.00														
	16.50														
	17.00														
	17.50			Highly weathered, weak, brownish grey, very fine grained, thinly laminated rock 14.60 to 20.00m	17.50	15.57	17.50	Core	-	-	-	-	6.00	-	
	18.00														
	18.50				18.50	17.50	18.00	Core	-	-	-	-	18.00	6.66	
	19.00														
	19.50														
	20.00	Not used			20.00	18.00	20.00	Core	-	-	-	-	57.33	14.66	
	20.50														
	21.00														
	21.50				21.50	20.00	21.50	Core	-	-	-	-	72.00	57.33	
	22.00														
	22.50														
	23.00				23.00	21.50	23.00	Core	-	-	-	-	63.33	40.66	
	23.50														
	24.00														
	24.50														
	25.00				25.00	23.00	25.03	Core	-	-	-	-	79.00	75.00	

Project : BHEL

Bore Hole No. : IBH 25

Location : Hirma, Talabira

Depth of Termination : 25.0 M

Co-ordinates : E 1042, N 3715

Depth of Water Table : Encountered at 2.70m depth during investigation

Date of Start: 08-07-2024

Date of Completion: 11-07-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 198.30 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks		
						From m	To m		N ₁	N ₂	N ₃	N					
Rotary drilling method	0.00	Used		Yellowish brown, fine to medium grained, clayey sand (SC) 0.00 to 2.60m	0.00	0.00	1.00	DS	-	-	-	-	-	-			
	0.50																
	1.00				1.00	1.00	2.00	SPT	4	7	7	14	-	-			
	1.50																
	2.00				2.00	2.00	2.50	SPT	3	4	4	8	-	-			
	2.50				2.50	2.50	3.00	UDS	-	-	-	-	-	-			
	3.00				3.00	3.00	3.50	SPT	3	4	6	10	-	-			
	3.50				3.50	3.50	4.00	UDS	-	-	-	-	-	-			
	4.00				4.00	4.00	4.50	SPT	9	30	45	75	-	-			
	4.50				4.50	5.00	SPT	50/13 cm	-	-	>100	-	-				
	5.00				5.00	5.50	SPT	50/10 cm	-	-	>100	-	-				
	5.50				5.50	6.00	SPT	60/12 cm	-	-	>100	-	-				
	6.00				6.00	6.00	6.50	SPT	32	60/10 cm	-	>100	-	-			
	6.50				6.50	7.00	SPT	12	15	17	32	-	-				
	7.00				7.00	7.50	SPT	17	31	45	76	-	-				
	7.50				7.50	8.00	SPT	15	30	42	72	-	-				
	8.00				8.00	8.00	8.50	SPT	17	28	46	74	-	-			
	8.50				8.50	9.00	SPT	16	30	47	77	-	-				
	9.00				9.00	9.50	SPT	50/13 cm	-	-	>100	-	-				
	9.50				9.50	10.00	SPT	22	50/11 cm	-	>100	-	-				
	10.00				10.00	10.00	11.00	SPT	50/12 cm	-	-	>100	-	-			
	10.50																
	11.00				11.00	11.00	11.50	SPT	50/12 cm	-	-	>100	-	-			
	11.50				11.50	11.50	12.50	SPT	50/9 cm	-	-	>100	-	-			
	12.00				Not used	Highly weathered, completely fractured and disintegrated, brownish yellow, fien to coarse grained, rock 17.20 to 19.00m	12.00										
	12.50						12.50	12.50	13.00	SPT	50/12 cm	-	-	>100	-	-	
	13.00						13.00	13.00	14.00	SPT	50/13 cm	-	-	>100	-	-	
	13.50																
	14.00				Not used	Highly weathered, weak, dark brownish yellow, fine to coarse grained, fractured rock	14.00	14.00	14.50	SPT	50/12 cm	-	-	>100	-	-	
	14.50						14.50	14.50	14.60	SPT	15	50/10 cm	-	>100	-	-	
	15.00																
	15.50						15.50	15.50	16.00	SPT	50/11 cm	-	-	>100	-	-	
16.00		Not used	Highly weathered, completely fractured and disintegrated, brownish yellow, fien to coarse grained, rock 17.20 to 19.00m	16.00	16.00	17.00	SPT	50/10 cm	-	-	>100	-	-				
16.50																	
17.00																	
17.50				17.50	17.00	17.50	Core	-	-	-	-	10.00	-				
18.00		Not used	Highly weathered, completely fractured and disintegrated, brownish yellow, fien to coarse grained, rock 17.20 to 19.00m	17.50	17.50	17.62	SPT	50/12 cm	-	-	>100	-	-				
18.50																	
19.00				19.00	17.50	19.00	Core	-	-	-	-	1.30	-				
19.50				19.00	19.00	19.11	SPT	50/11 cm	-	-	>100	-	-				
20.00		Not used	Highly weathered, completely fractured and disintegrated, brownish yellow, fien to coarse grained, rock 17.20 to 19.00m	20.00													
20.50				20.50	19.00	20.50	Core	-	-	-	-	9.00	-				
21.00				20.50	20.50	20.57	SPT	50/7 cm	-	-	>100	-	-				
21.50																	
22.00		Not used	Highly weathered, completely fractured and disintegrated, brownish yellow, fien to coarse grained, rock 17.20 to 19.00m	22.00	20.57	22.00	Core	-	-	-	-	24.00	-				
20.50 to 22.00m																	

Project : BHEL

Bore Hole No. : IBH 26

Location : Hirma, Talabira

Depth of Termination : 25.0 M

Co-ordinates: E 1569, N 3519

Depth of Water Table : Encountered at 8.70m depth during investigation

Date of Start: 24-08-2024

Date of Completion: 28-08-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 208.20 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks	
						From m	To m		N ₁	N ₂	N ₃	N				
Rotary drilling method	0.00			Dark brownish red, fine to very fine grained, sandy clays of low plasticity (CL) 0.00 to 0.80m	0.00	0.00	1.00	DS	-	-	-	-	-	-		
	0.50															
	1.00				1.00	1.00	2.00	SPT	13	15	13	28	-	-		
	1.50															
	2.00			Dark brownish red, fine to coarse grained, clayey sand with much gravels (SC) 0.80 to 3.60m	2.00	2.00	2.50	SPT	4	6	7	13	-	-		
	2.50				2.50	2.50	3.00	UDS	-	-	-	-	-	-		
	3.00				3.00	3.00	3.50	SPT	12	17	34	51	-	-		
	3.50				3.50	3.50	4.00	SPT	10.00	29.00	44.00	73.00	-	-		
	4.00			Reddish brown, fine to coarse grained, cemented silty sand with some gravels (SM) 3.60 to 4.80m	4.00	4.00	4.50	SPT	23	50/6cm	-	>100	-	-		
	4.50				4.50	4.50	5.00	SPT	28	50/4cm	-	>100	-	-		
	5.00			Yellowish brown, fine to medium grained, clayey sand with occasional gravels (SC) 4.80 to 6.30m	5.00	5.00	5.50	SPT	7	15	29	44	-	-		
	5.50				5.50	5.50	6.00	SPT	17	38	43	81	-	-		
	6.00				6.00	6.00	6.50	SPT	10	28	26	54	-	-		
	6.50				6.50	6.50	7.00	SPT	50/13cm	-	-	>100	-	-		
	7.00			Light yellowish brown, fine to medium grained, cemented silty clayey sand (SM-SC) 6.30 to 7.70m	7.00	7.00	7.50	SPT	50/9cm	-	-	>100	-	-		
	7.50				7.50	7.50	8.00	SPT	50/6cm	-	-	>100	-	-		
	8.00			Dark brownish, fine to medium grained, cemented sand with much gravels and rock fragments 7.70 to 9.50m	8.00	8.00	8.50	SPT	50/8cm	-	-	>100	-	-		
	8.50				8.50	8.50	8.55	SPT	50/5cm	-	-	>100	-	-		
	9.00															
	9.50				9.50	8.55	9.50	Core	-	-	-	-	7.00	-		
	10.00				9.50	9.50	9.52	SPT	50/2cm	-	-	>100	-	-		
	10.50															
	11.00				11.00	9.52	11.00	Core	-	-	-	-	8.00	8.00		
	11.50				11.00	11.00	11.02	SPT	50/2cm	-	-	>100	-	-		
	12.00															
	12.50				12.50	11.02	12.50	SPT	50/4cm	-	-	>100	-	-		
	13.00				13.00	12.50	13.00	Core	-	-	-	-	18.00	-		
	13.50															
	14.00				Highly weathered, very weak, brownish, fine to medium grained, fractured and friable rock 9.50 to 19.00m											
	14.50					14.50	13.00	14.50	Core	-	-	-	-	15.00	-	
	15.00															
	15.50															
16.00					16.00	14.50	16.00	Core	-	-	-	-	8.00	-		
16.50																
17.00																
17.50					17.50	16.00	17.50	Core	-	-	-	-	7.00	-		
18.00																
18.50																
19.00					19.00	17.50	19.00	Core	-	-	-	-	7.00	-		
19.50																
20.00				Highly weathered, moderately weak, dark brownish, fine to coarse grained, fractured rock 19.00 to 22.00m												
20.50					20.50	19.00	20.50	Core	-	-	-	-	13.00	-		
21.00																
21.50																
22.00					22.00	20.50	22.00	Core	-	-	-	-	13.00	-		
22.50																
23.00				Highly weathered, moderately strong, dark blackish grey, fine to coarse grained, fractured rock												
23.50					23.50	22.00	23.50	Core	-	-	-	-	8.00	-		
24.00																
24.50																
25.00					25.00	23.50	25.00	Core	-	-	-	-	16.00	-		
22.00 to 25.00m																

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : IBH 27

Location : Hirma, Talabira

Depth of Termination : 22.00 M

Co-ordinates: E 1166, N 3589

Depth of Water Table : Encountered at 3.20m depth during investigation

Date of Start: 13-08-2024

Date of Completion: 17-08-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 200.28m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks		
						From m	To m		N ₁	N ₂	N ₃	N					
Rotary drilling method	0.00	Used		Yellowish brown, fine to medium grained, filled up clayey sand 0.00 to 0.70m	0.00	0.00	1.00	DS	-	-	-	-	-	-			
	0.50																
	1.00			Reddish yellow and yellowish brown, fine to medium grained, clayey sand with some gravels (SC)	1.00	1.00	2.00	SPT	1	2	3	5	-	-			
	1.50																
	2.00				2.00	2.00	2.50	SPT	3	4	6	10	-	-			
	2.50			0.70 to 2.80m	2.50	2.50	3.00	UDS	-	-	-	-	-	-			
	3.00			Reddish yellow, fine to coarse grained, silty sand with little to occasional gravels (SM)	3.00	3.00	3.50	SPT	7	9	8	17	-	-			
	3.50				3.50	4.00	UDS	-	-	-	-	-	-	-			
	4.00				4.00	4.50	SPT	8	12	17	29	-	-				
	4.50				4.50	5.00	DS	-	-	-	-	-	-	-			
	5.00				5.00	5.50	SPT	55/10cm	-	-	>100	-	-				
	5.50				5.50	6.00	SPT	60/7 cm	-	-	>100	-	-				
	6.00				6.00	6.50	SPT	60/5 cm	-	-	>100	-	-				
	6.50				2.80 to 7.00m	6.50	6.50	7.00	SPT	60/8 cm	-	-	>100	-	-		
	7.00				Brownish, fine to medium grained, silty and clayey sand with occasional gravesl (SM-SC) 7.00 to 8.00m	7.00	7.00	7.50	SPT	60/8 cm	-	-	>100	-	-		
	7.50					7.50	8.00	SPT	60/7 cm	-	-	>100	-	-			
	8.00			Brownish and yellowish brown, fine to medium grained, silty sand with little gravels (SM)	8.00	8.00	8.50	SPT	70/7 cm	-	-	>100	-	-			
	8.50				8.50	9.00	SPT	80/5 cm	-	-	>100	-	-				
	9.00				9.00	9.50	SPT	60/6 cm	-	-	>100	-	-				
	9.50				9.50	10.00	SPT	60/6 cm	-	-	>100	-	-				
	10.00				10.00	11.00	SPT	60/7 cm	-	-	>100	-	-				
	10.50																
	11.00			Not Used			11.00	11.00	11.50	SPT	60/6 cm	-	-	>100	-	-	
	11.50					11.50	12.50	SPT	60/7 cm	-	-	>100	-	-			
	12.00																
	12.50					Yellowish brown, fine to coarse grained, poorly graded and silty sand (SP-SM) 12.00 to 13.50m	12.50	12.50	13.00	SPT	60/5 cm	-	-	>100	-	-	
	+ 13.00						13.00	13.00	14.00	SPT	60/5 cm	-	-	>100	-	-	
	13.50					Mixture or highly weathered, completely fractured and disintegrated, yellowish brown, fine to coarse grained, very weak and friable, fractured rock with yellowish brown, fine to coarse grained, sand 13.50 to 14.50m											
	14.00						14.00	14.00	14.05	SPT	60/5 cm	-	-	>100	-	-	
	14.50					Highly weathered, moderately weak, yellowish brown, fine to coarse grained, rock with closely spaced discontinuities 14.50 to 15.50m	14.50	14.05	14.50	Core					22.00	22.00	
	15.00						14.50	14.50	14.55	SPT	60/5 cm	-	-	>100	-	-	
	15.50					Mixture of yellowish brown, fine to medium grained, clayey sand with highly weathered, weak, completely fractured and disintegrated, fractured rock fragments 15.50 to 16.50m	15.50	15.50	15.06	SPT	60/6 cm	-	-	>100	-	-	
16.00	Not Used			16.00	15.06	16.00	SPT	60/6 cm	-	-	>100	-	-				
16.50																	
17.00			Highly weathered, completely fractured and disintegrated, yellowish brown, fine to coarse grained, very weak and friable, fractured rock fragments 16.50 to 17.60m	17.00	16.00	17.00	SPT	60/7 cm	-	-	>100	-	-				
17.50				17.50	17.00	17.50	Core					14.00	-				
18.00																	
18.50				18.50	17.50	18.50	Core					21.00	-				
19.00				19.00	18.50	19.00	Core					34.00	22.00				
19.50																	
20.00			Highly weathered, moderately weak, dark brownish, fine to coarse grained, fractured rock with closely spaced discontinuities														
20.50					20.50	19.00	20.50	Core					13.33	8.00			
21.00																	
21.50																	
22.00		22.00		20.50	22.00	Core					85.33	21.33					
	17.60 to 22.00m																

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : IBH 28

Location : Hirma, Talabira

Depth of Termination : 25.0 M

Co-ordinates: E 1137, N 3607

Depth of Water Table : Encountered at 4.20m depth during investigation

Date of Start: 04-08-2024

Date of Completion: 13-08-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 199.71 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks	
						From m	To m		N ₁	N ₂	N ₃	N				
Rotary drilling method	0.00	Not Used		Brownish, fine to medium grained, clayey sand (SC) 0.00 to 0.50m	0.00	0.00	1.00	DS	-	-	-	-	-	-		
	0.50															
	1.00															
	1.50			Yellowish brown to dark brownish, fine to medium grained, clayey sand with occasional gravels (SC) 0.50 to 3.95m	1.00	1.00	2.00	SPT	1	2	2	4	-	-		
	2.00				2.00	2.50	SPT	6	10	12	22	-	-			
	2.50				2.50	3.00	UDS	-	-	-	-	-	-			
	3.00				3.00	3.50	SPT	3	4	5	9	-	-			
	3.50				3.50	4.00	SPT	4	5	5	10	-	-			
	4.00				Dark brownish, fine to medium grained, silty sand with little plastic fines (SM) 3.95 to 4.90m	4.00	4.00	4.50	SPT	12	17	21	38	-		-
	4.50					4.50	5.00	UDS	-	-	-	-	-	-		
	5.00				Yellowish brown, fine to medium grained, cemented silty sand with much gravels (SM) 4.90 to 5.80m	5.00	5.00	5.50	SPT	60/9 cm	-	-	>100	-		-
	5.50					5.50	6.00	SPT	60/8 cm	-	-	>100	-	-		
	6.00				Light brownish yellow, fine to medium grained, cemented clayey sand (SC) 5.80 to 6.40m	6.00	6.00	6.50	SPT	38	50/10 cm	-	>100	-		-
	6.50					6.50	7.00	SPT	55/12 cm	-	-	>100	-	-		
	7.00				Yellowish brown, fine to medium grained, cemented silty sand with little plastic fines occasional gravels (SM) 6.40 to 9.60m	7.00	7.00	7.50	SPT	56/11 cm	-	-	>100	-		-
	7.50					7.50	8.00	SPT	55/10 cm	-	-	>100	-	-		
	8.00					8.00	8.50	SPT	55/10 cm	-	-	>100	-	-		
	8.50					8.50	9.00	SPT	55/7 cm	-	-	>100	-	-		
	9.00					9.00	9.50	SPT	51/6 cm	-	-	>100	-	-		
	9.50					9.50	10.00	SPT	51/8 cm	-	-	>100	-	-		
	10.00					10.00	11.00	SPT	56/7 cm	-	-	>100	-	-		
	10.50				Dark brownish, fine to medium grained, cemented clayey sand with occasional to some gravels (SC) 9.60 to 15.20m	11.00	11.00	11.50	SPT	38	50/8 cm	-	>100	-		-
	11.50					11.50	12.50	SPT	55/6 cm	-	-	>100	-	-		
	12.00															
	12.50					12.50	13.00	SPT	55/6 cm	-	-	>100	-	-		
	+ 13.00					13.00	14.00	SPT	55/5 cm	-	-	>100	-	-		
	13.50															
	14.00					14.00	14.04	SPT	55/8 cm	-	-	>100	-	-		
	14.50			14.50	15.50	SPT	55/7 cm	-	-	>100	-	-				
	15.00				Yellowish brown, fine to medium grained, silty clayey sand with little to some gravels (SM-SC) 15.20 to 17.50m	15.50	15.50	16.09	SPT	55/9 cm	-	-	>100	-		-
	16.00					16.00	16.00	SPT	55/10 cm	-	-	-	-	-		
	16.50															
17.00		Highly weathered, very weak, yellowish brown, fine to coarse grained, friable and fractured rock 17.50 to 21.00m	17.00	17.00	17.50	SPT	55/9 cm	-	-	>100	-	-				
17.50			17.50	17.70	SPT	50/6 cm	-	-	>100	-	-					
18.00		Highly weathered, weak, reddish brown, fine to coarse grained, fractured rock														
18.50																
19.00			19.00	17.70	19.00	Core	-	-	-	-	31.25	-				
19.50																
20.00																
20.50			20.50	19.00	20.50	Core	-	-	-	-	25.33	-				
21.00																
21.50		Highly weathered, weak, reddish brown, fine to coarse grained, fractured rock														
22.00			22.00	20.50	22.00	Core	-	-	-	-	22.00	-				
22.50																
23.00																
23.50			23.50	22.00	23.50	Core	-	-	-	-	26.00	-				
24.00																
24.50																
25.00				25.00	23.00	25.00	Core	-	-	-	-	21.50	-			
21.00 to 25.00m																

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : IBH 29

Location : Hirma, Talabira

Depth of Termination : 25.0 M

Co-ordinates: E 1254, N 3809

Depth of Water Table : Encountered at 4.60m depth during investigation

Date of Start: 27-07-2024

Date of Completion: 31-07-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 200.10 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks
						From m	To m		N ₁	N ₂	N ₃	N			
Rotary drilling method	0.00			Reddish brown, fine to medium grained, silty clayey sand with much gravels (SM-SC) 0.00 to 0.30m	0.00	0.00	1.00	DS	-	-	-	-	-	-	
	0.50														
	1.00			Yellowish brown, fine to coarse grained, silty clayey sand with some to little gravels (SM-SC) 0.30 to 2.80m	1.00	1.00	2.00	SPT	5	6	13	19	-	-	
	1.50														
	2.00				2.00	2.00	2.50	SPT	9	11	23	34	-	-	
	2.50				2.50	2.50	3.00	UDS	-	-	-	-	-	-	
	3.00			Yellowish brown, fine to medium grained, silty sand with little plastic fines (SM) 2.80 to 3.70m	3.00	3.00	3.50	SPT	15	26	32	58	-	-	
	3.50				3.50	3.50	4.00	UDS	-	-	-	-	-	-	
	4.00			Brownish yellow, fine to medium grained, silty clayey sand (SM-SC) 3.70 to 5.30m	4.00	4.00	4.50	SPT	6	11	15	26	-	-	
	4.50				4.50	4.50	5.00	UDS	-	-	-	-	-	-	
	5.00				5.00	5.00	5.50	SPT	20	28	42	70	-	-	
	5.50			Yellowish brown, fine to medium grained, cemented micaceous clayey sand (SC) 5.30 to 6.70m	5.50	5.50	6.00	SPT	20	28	42	70	-	-	
	6.00				6.00	6.00	6.50	SPT	51/8cm	-	-	>100	-	-	
	6.50				6.50	6.50	7.00	SPT	51/7 cm	-	-	>100	-	-	
	7.00			Greyish brown, fine to medium grained, cemented silty sand with occasional gravels (SM) 6.70 to 8.30m	7.00	7.00	7.50	SPT	51/7 cm	-	-	>100	-	-	
	7.50				7.50	7.50	8.00	SPT	51/6 cm	-	-	>100	-	-	
	8.00				8.00	8.00	8.50	SPT	51/10 cm	-	-	>100	-	-	
	8.50				8.50	8.50	9.00	SPT	15	22	31	53	-	-	
	9.00				9.00	9.00	9.50	SPT	51/9 cm	-	-	>100	-	-	
	9.50			Dark brownish, fine to medium grained, cemented micaceous clayey sand with occasional gravels (SC) 8.30 to 11.30m	9.50	9.50	10.00	SPT	51/6 cm	-	-	>100	-	-	
	10.00				10.00	10.00	11.00	SPT	56/6 cm	-	-	>100	-	-	
	10.50														
	11.00				11.00	11.00	11.50	SPT	32	69/5cm	-	>100	-	-	
	11.50			Brownish, fine to medium grained, cemented silty sand with occasional gravels (SM) 11.30 to 13.10m	11.50	11.50	12.50	SPT	60/6 cm	-	-	>100	-	-	
	12.00				12.50	12.50	13.00	SPT	51/5 cm	-	-	>100	-	-	
	12.50				13.00	13.00	14.00	SPT	61/6 cm	-	-	>100	-	-	
	13.00			Yellowish brown, fine to coarse grained, cemented sand with much gravels 13.10 to 14.20m	13.00	13.00	14.00	SPT	61/6 cm	-	-	>100	-	-	
	13.50														
	14.00				14.00	14.00	14.04	SPT	55/4 cm	-	-	>100	-	-	
	14.50				14.50	14.04	14.50	Core	-	-	-	-	12.00	-	
	15.00				14.50	14.50	14.53	SPT	55/3 cm	-	-	>100	-	-	
	15.50														
16.00			Highly weathered, very weak, yellowish brown, fine to coarse grained, fractured and friable rock 14.20 to 19.00m	16.00	14.53	16.00	Core	-	-	-	-	13.33	-		
16.50															
17.00				17.50	16.00	17.50	SPT	51/4 cm	-	-	>100	-	-		
17.50															
18.00															
18.50															
19.00			Highly weathered, very weak, dark brownish, fine to coarse grained, fractured and friable rock 19.00 to 20.50m	19.00	17.50	19.00	Core	-	-	-	-	11.33	-		
19.50															
20.00				20.50	19.00	20.50	Core	-	-	-	-	16.00	8.00		
20.50															
21.00															
21.50			Highly weathered, weak, brownish, fine to coarse grained, rock with very close spacing of discontinuities 20.50 to 24.00m	22.00	20.50	22.00	Core	-	-	-	-	9.33	-		
22.00															
22.50				23.50	22.00	23.50	Core	-	-	-	-	8.66	-		
23.00															
23.50															
24.00															
24.50			Highly weathered, brownish, weak, fine to coarse grained, fractured rock												
25.00				25.00	23.00	25.00	Core	-	-	-	-	23.33	-		
24.00 to 25.00m															

Project : BHEL

Bore Hole No. : IBH 30

Location : Hirma, Talabira

Depth of Termination : 15.50 M

Co-ordinates: E 752, N 3479

Depth of Water Table : Encountered at 2.20m depth during investigation

Date of Start: 18-08-2024

Date of Completion: 20-08-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 198.780 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks			
						From m	To m		N ₁	N ₂	N ₃	N						
Rotary drilling method	0.00	Used		Yellowish brown, very fine grained, clays of intermediate plasticity (CI) 0.00 to 5.00m	0.00	0.00	1.00	DS	-	-	-	-	-	-				
	0.50																	
	1.00							1.00	1.00	2.00	SPT	2	3	4		7	-	-
	1.50																	
	2.00							2.00	2.00	2.50	SPT	4	5	6		11	-	-
	2.50							2.50	2.50	3.00	UDS	-	-	-		-	-	-
	3.00							3.00	3.00	3.50	SPT	5	6	8		14	-	-
	3.50							3.50	3.50	4.00	UDS	-	-	-		-	-	-
	4.00							4.00	4.00	4.50	SPT	5	6	8		14	-	-
	4.50							4.50	4.50	5.00	SPT	8	10	11		21	-	-
	5.00		Brownish yellow to greyish, fine to medium grained, weakly cemented clayey sand (SC) 5.00 to 9.10m	5.00	5.00	5.50	SPT	12	55/11 cm	-	>100	-	-					
	5.50			5.50	6.00	SPT	53/9 cm	-	-	>100	-	-						
	6.00			6.00	6.50	SPT	55/11 cm	-	-	>100	-	-						
	6.50			6.50	6.57	SPT	51/1 cm	-	-	>100	-	-						
	7.00			7.00	7.14	SPT	52/10 cm	-	-	>100	-	-						
	7.50			7.50	8.00	SPT	53	-	-	>100	-	-						
	8.00			8.00	9.00	SPT	51	-	-	>100	-	-						
	8.50			8.50	9.00	SPT	55	-	-	>100	-	-						
	9.00			9.00	9.05	SPT	51/9 cm	-	-	>100	-	-						
	9.50			9.50	9.50	Core	-	-	-	-	50.00	20.00						
	10.00		Moderately weathered, moderately weak, yellowish brown, fine to medium grained, rock with close spacing of discontinuities 9.10 to 12.50m															
	10.50																	
	11.00																	
	11.50																	
	12.00																	
	12.50		Moderately weathered, moderately strong, brownish grey, fine to medium grained, rock with moderately close spacing of discontinuities 12.50 to 14.50m	12.50	11.00	12.50	Core					44.00	27.33					
13.00																		
13.50												-						
14.00																		
14.50																		
15.00		Slightly weathered, moderately weak, brownish grey and blackish grey, rock with wide spacing of discontinuities																
15.50			15.50	14.00	15.50	Core	-	-	-	-	77.33	56.00						
14.50 to 15.00m																		

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : IBH 31

Location : Hirma, Talabira

Depth of Termination : 21.50 m

Co-ordinates: E 830, N 3466

Depth of Water Table : Encountered at 1.70m depth during investigation

Date of Start: 25-08-2024

Date of Completion: 27-08-2027

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 196.60 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks			
						From m	To m		N ₁	N ₂	N ₃	N						
Rotary drilling method	0.00	Not Used		Yellowish brown to brownish, fine to medium grained, sandy clays of intermediate plasticity with occasional gravels (CI) 0.00 to 3.60m	0.00	0.00	1.00	DS	-	-	-	-	-	-				
	0.50																	
	1.00																	
	1.50							1.00	1.00	2.00	SPT	2	3	5		8	-	-
	2.00							2.00	2.00	2.50	SPT	5	6	8		14	-	-
	2.50							2.50	2.50	3.00	SPT	4	6	7		13		
	3.00							3.00	3.00	3.50	SPT	4	5	9		14	-	-
	3.50							3.50	3.50	4.00	UDS	-	-	-		-		
	4.00						Yellowish brown, fine to coarse grained, clayey sand with some gravels (SC) 3.60 to 5.50m	4.00	4.00	4.50	SPT	4	5	7		12	-	-
	4.50							4.50	4.50	5.00	UDS	-	-	-		-		
	5.00						5.00	5.00	5.50	SPT	6	11	12	23		-	-	
	5.50						5.50	5.50	6.00	UDS	-	-	-	-				
	6.00						6.00	6.00	6.50	SPT	51/10 cm	-	-	>100		-	-	
	6.50						6.50	6.50	7.00	SPT	52/4 cm	-	-	>100				
	7.00						7.00	7.00	7.50	SPT	52/8 cm	-	-	>100		-	-	
	7.50						7.50	7.50	8.00	SPT	55/10 cm	-	-	>100				
	8.00						8.00	8.00	8.50	SPT	55/8 cm	-	-	>100		-	-	
	8.50						8.50	8.50	9.00	SPT	51/8 cm	-	-	>100		-	-	
	9.00						9.00	9.00	9.40	SPT	56/8 cm	-	-	>100				
	9.50						9.50	9.40	9.50	Core	-	-	-	-		56.00	-	
	10.00						Moderately weathered, moderately weak, dark brownish, fine to medium grained, fractured rock 9.50 to 11.00m											
	10.50																	
	11.00						Highly weathered, moderately weak, dark brownish, fine to medium grained, fractured rock 11.00 to 12.50m	11.00	9.50	11.00	Core	-	-	-		-	36.66	-
	11.50																	
	12.00																	
	12.50							12.50	11.00	12.50	Core	-	-	-		-	38.00	8
	+ 13.00																	
	13.50						Moderately weathered, moderately weak, blackish brown, fine to medium grained, rock with close spacing of discontinuities 12.50 to 15.50m	14.00	12.50	14.00	Core	-	-	-		-	58.00	27
	14.00																	
	14.50																	
	15.00																	
	15.50						Highly weathered, very weak, completely fractured and friable yellowish brown, fine to medium grained, fractured rock 15.50 to 17.00m	15.50	14.00	15.50	SPT	51/3 cm	-	-		>100	-	-
	16.00																	
	16.50																	
17.00				Highly weathered, weak, dark brownish, fine to medium grained, rock with close spacing of discontinuities 17.00 to 18.50m	17.00	15.50	17.00	Core	-	-	-	-	37.33	19				
17.50																		
18.00																		
18.50					18.50	17.00	18.50	Core	-	-	-	-	57.33	40.00				
19.00				Moderately weathered, moderately weak, brownish black, fine to medium grained, rock with wide spacing of discontinuities 18.50 to 21.00m	20.00	18.50	20.00	Core	-	-	-	-	45.33	37.33				
19.50																		
20.00																		
20.50																		
21.00				Slightly weathered, moderately weak, blackish brown, fine to medium grained, massive rock	21.50	20.00	21.50	Core	-	-	-	-	82.66	73.33				
21.50																		
21.00 to 21.50m																		

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : IBH 32

Location : Hirma, Talabira

Depth of Termination : 18.50 m

Co-ordinates: E 794, N 3534

Depth of Water Table : Encountered at 2.10 m depth during investigation

Date of Start: 14-08-2024




Date of Completion: 17-08-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 196.50 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks		
						From m	To m		N ₁	N ₂	N ₃	N					
Rotary drilling method	0.00	Used		Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL) 0.00 to 0.80m	0.00	0.00	1.00	DS	-	-	-	-	-	-			
	0.50																
	1.00			Yellowish brown, very fine grained, clays of high plasticity (CH) 0.80 to 2.80m	1.00	1.00	2.00	SPT	1	2	3	5	-	-			
	1.50																
	2.00																
	2.50																
	3.00	Not Used		Yellowish brown, fine to very fine grained, sandy clays of intermediate plasticity (CI) 2.80 to 3.60m	3.00	3.00	3.50	SPT	8	10	13	23	-	-			
	3.50																
	4.00																
	4.50																
	5.00																
	5.50																
	6.00																
	6.50																
	7.00				Brownish yellow, fine to very fine grained, clayey sand (SC) 3.60 to 11.60m	7.00	7.00	7.50	SPT	28	61/13 cm	-	-	>100	-	-	
	7.50																
	8.00																
	8.50																
	9.00																
	9.50																
	10.00																
	10.50																
	11.00																
	11.50																
	12.00																
	12.50				Brownish grey, fine to very fine grained, clayey sand with some to much gravels (SC) 11.60 to 14.70m	12.50	12.50	12.80	SPT	55/9 cm	-	-	-	>100	-	-	
	13.00																
	13.50																
	14.00																
	14.50																
	15.00				Moderately weathered, very weak, light brownish grey, fine to very fine grained, rock with moderately wide spacing of discontinuities 14.70 to 17.00m												
	15.50																
	16.00																
	16.50																
	17.00	Highly weathered, very weak, light brownish grey, fine to very fine grained, close spacing of discontinuities 17.00 to 18.00m															
	17.50																
	18.00	Slightly weathered, weak, dark brownish grey, fine to medium grained, massive rock															
	18.50																
17.00 to 18.50m																	

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks		
						From m	To m		N ₁	N ₂	N ₃	N					
Rotary drilling method	0.00	Used		Yellowish brown, fine to very fine grained, sandy clays of high plasticity (CH) 0.00 to 0.60m	0.00	0.00	1.00	DS	-	-	-	-	-	-			
	0.50			Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL) 0.60 to 3.70m	1.00	1.00	2.00	SPT	4	6	7	13	-	-			
	1.00				2.00	2.00	2.50	SPT	5	5	7	12	-	-			
	1.50				2.50	2.50	3.00	UDS	-	-	-	-	-	-			
	2.00				3.00	3.00	3.50	SPT	6	8	9	17	-	-			
	2.50				3.50	3.50	4.00	UDS	-	-	-	-	-	-			
	3.00			Yellowish brown, very fine grained, clays of intermediate plasticity (CI) 3.70 to 5.10m	4.00	4.00	4.50	SPT	16	28	33	61	-	-			
	3.50				4.50	4.50	5.00	UDS	-	-	-	-	-	-			
	4.00				5.00	5.00	5.50	SPT	11	13	19	32	-	-			
	4.50				5.50	5.50	6.00	SPT	20	25	48	73.00	-	-			
	5.00				6.00	6.00	6.50	SPT	51/3 CM	-	-	>100	-	-			
	5.50	Not used		Highly weathered, completely fractured and disintegrated, yellowish brown, very fine grained, mud rock 5.10 to 7.50m	6.50	6.50	7.00	SPT	51/3 cm	-	-	32	-	-			
	6.00				7.00	7.00	7.50	SPT	15	30	42	72	-	-			
	6.50				7.50	7.50	8.00	SPT	50/13 cm	-	-	>100	-	-			
	7.00				8.00	8.00	9.00	SPT	-	-	-	-	-	-			
	7.50				9.00	9.00	9.50	SPT	-	-	-	-	-	-			
	8.00					Highly weathered, very weak, light brownish yellow, fine to medium grained, thinly laminated rock 7.50 to 13.50m	9.50	9.50	10.00	DS	-	-	-	-	-	-	
	8.50						10.00	10.00	10.50	DS	-	-	-	-	-	-	
	9.00						10.50	10.50	11.00	DS	-	-	-	-	-	-	
	9.50						11.00	11.00	11.50	DS	-	-	-	-	-	-	
	10.00						11.50	11.50	12.00	DS	-	-	-	-	-	-	
	10.50						12.00	12.00	12.50	DS	-	-	-	-	-	-	
	11.00	12.50	12.50	13.00			DS	-	-	-	-	-	-				
	11.50	13.00	13.00	13.50			DS	-	-	-	-	-	-				
	12.00	13.50	13.50	14.00			DS	-	-	-	-	-	-				
	12.50	14.00	14.00	14.50			DS	-	-	-	-	-	-				
	13.00	14.50	14.50	15.00			DS	-	-	-	-	-	-				
	13.50		Highly weathered, weak, dark brownish grey, very fine grained, fractured rock 13.50 to 15.00m	15.00	15.00	15.50	DS	-	-	-	-	-	-				
	14.00			15.50	15.50	16.00	DS	-	-	-	-	-	-				
	14.50			16.00	16.00	16.50	DS	-	-	-	-	-	-				
15.00	16.50			16.50	17.00	DS	-	-	-	-	-	-					
15.50	17.00			17.00	17.50	DS	-	-	-	-	-	-					
16.00				Highly weathered, brownish grey, very fine grained, thickly bedded rock 15.00 to 16.50m	16.50	16.50	17.00	DS	-	-	-	-	-	-			
16.50					17.00	17.00	17.50	DS	-	-	-	-	-	-			
17.00					17.50	17.50	18.00	DS	-	-	-	-	-	-			
17.50					18.00	18.00	18.50	DS	-	-	-	-	-	-			
18.00					18.50	18.50	19.00	DS	-	-	-	-	-	-			
18.50					19.00	19.00	19.50	DS	-	-	-	-	-	-			
19.00		19.50	19.50		20.00	DS	-	-	-	-	-	-					
19.50		20.00	20.00		20.50	DS	-	-	-	-	-	-					
20.00		20.50	20.50		21.00	DS	-	-	-	-	-	-					
20.50		21.00	21.00		21.50	DS	-	-	-	-	-	-					
21.00		21.50	21.50		22.00	DS	-	-	-	-	-	-					
21.50		Slightly weathered, very weak, dark greyish, fine to very fine grained, massive rock 16.50 to 18.00m	22.00	22.00	22.50	DS	-	-	-	-	-	-					
22.50			22.50	23.00	DS	-	-	-	-	-	-	-					
23.00			23.00	23.50	DS	-	-	-	-	-	-	-					
23.50			23.50	24.00	DS	-	-	-	-	-	-	-					
24.00			24.00	24.50	DS	-	-	-	-	-	-	-					
24.50			24.50	25.00	DS	-	-	-	-	-	-	-					
25.00			25.00	25.50	DS	-	-	-	-	-	-	-					
25.50			25.50	26.00	DS	-	-	-	-	-	-	-					
26.00			26.00	26.50	DS	-	-	-	-	-	-	-					
26.50			26.50	27.00	DS	-	-	-	-	-	-	-					
27.00			27.00	27.50	DS	-	-	-	-	-	-	-					
27.50		Highly weathered, moderately weak, dark greyish brown, fine to very fine grained, thinly bedded rock 18.00 to 19.00m	28.00	28.00	28.50	Core	-	-	-	-	26.66	6.66					
28.50			28.50	29.00	Core	-	-	-	-	80.66	81						
29.00			29.00	29.50	Core	-	-	-	-	-	-						
29.50			29.50	30.00	Core	-	-	-	-	-	-						
30.00			30.00	30.50	Core	-	-	-	-	-	-						
30.50			30.50	31.00	Core	-	-	-	-	-	-						
31.00			31.00	31.50	Core	-	-	-	-	-	-						
31.50			31.50	32.00	Core	-	-	-	-	-	-						
32.00			32.00	32.50	Core	-	-	-	-	-	-						
32.50			32.50	33.00	Core	-	-	-	-	-	-						
33.00			33.00	33.50	Core	-	-	-	-	-	-						
33.50		Highly weathered, weak, dark brownish grey, very fine grained, massive rock 19.00 to 20.00m	34.00	34.00	34.50	Core	-	-	-	-	-	-					
34.50			34.50	35.00	Core	-	-	-	-	-	-	-					
35.00			35.00	35.50	Core	-	-	-	-	-	-	-					
35.50			35.50	36.00	Core	-	-	-	-	-	-	-					
36.00			36.00	36.50	Core	-	-	-	-	-	-	-					
36.50			36.50	37.00	Core	-	-	-	-	-	-	-					
37.00			37.00	37.50	Core	-	-	-	-	-	-	-					
37.50			37.50	38.00	Core	-	-	-	-	-	-	-					
38.00			38.00	38.50	Core	-	-	-	-	-	-	-					
38.50			38.50	39.00	Core	-	-	-	-	-	-	-					
39.00			39.00	39.50	Core	-	-	-	-	-	-	-					
39.50	39.50	40.00	Core	-	-	-	-	-	-	-							

Project : BHEL

Bore Hole No. : IBH 34

Location : Hirma, Talabira

Depth of Termination : 25.0 M

Co-ordinates: E 1131, N 3266

Depth of Water Table : Encountered at 2.30m depth during investigation

Date of Start: 21-06-2024

Date of Completion: 24-06-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 198.51 M

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT S.S.S	N Value/Penetration of				Core Recovery (%)	RQD (%)	Remarks
						From	To									
						m	m			N ₁	N ₂	N ₃	N			
Rotary drilling method	0.00			Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL) 0.00 to 0.60m	0.00	0.00	1.00	DS	-	-	-	-	-	-	-	
	0.50															
	1.00				1.00	1.00	2.00	SPT	4	4	5	9	-	-	-	
	1.50															
	2.00			Yellowish brown, fine to very fine grained, sandy clays of intermediate plasticity (CI) 0.60 to 3.60m	2.00	2.00	2.50	SPT	3	5	7	12	-	-	-	
	2.50				2.50	2.50	3.00	UDS	-	-	-	-	-	-	-	
	3.00				3.00	3.00	3.50	SPT	8	12	15	27	-	-	-	
	3.50				3.50	3.50	4.00	DS	-	UDS attempted but not recovered				-	-	
	4.00				4.00	4.00	4.50	SPT	7	8	9	17	-	-	-	
	4.50				4.50	4.50	5.00	UDS	-	-	-	-	-	-	-	
	5.00			Yellowish brown, fine to very fine grained, clays of high plasticity (CH) 3.60 to 7.10m	5.00	5.00	5.50	SPT	11	14	16	30	-	-	-	
	5.50				5.50	5.50	6.00	UDS	-	-	-	-	-	-	-	
	6.00				6.00	6.00	6.50	SPT	12	14	17	31	-	-	-	
	6.50				6.50	6.50	7.00	UDS	-	-	-	-	-	-	-	
	7.00				7.00	7.00	7.50	SPT	10	13	17	30	-	-	-	
	7.50				7.50	7.50	8.00	UDS	-	-	-	-	-	-	-	
	8.00			Yellowish brown, fine to very fine grained, clayey sand (SC) 7.10 to 8.70m	8.00	8.00	8.50	SPT	4	6	7	13	-	-	-	
	8.50				8.50	8.50	9.00	UDS	-	-	-	-	-	-	-	
	9.00				9.00	9.00	9.50	SPT	9	12	14	26	-	-	-	
	9.50			Yellowish brown, fine to medium grained, silty clayey sand (SM-SC) 8.70 to 10.20m	9.50	9.50	10.00	UDS	-	-	-	-	-	-	-	
	10.00				10.00	10.00	11.00	SPT	9	11	12	23	-	-	-	
	10.50															
	11.00				11.00	11.00	11.50	UDS	-	-	-	-	-	-	-	
	11.50			Yellowish brown, fine to medium grained, clayey sand (SC) 10.20 to 12.60m	11.50	11.50	12.50	SPT	14	16	18	34	-	-	-	
	12.00															
	12.50				12.50	12.50	13.00	DS	-	UDS attempted but not recovered				-	-	
	13.00				13.00	13.00	13.10	SPT	50	-	-	>100	-	-	-	
	13.50			Highly weathered, fractured, dark brownish grey, very fine grained, very thinly bedded rock					10cm							
	14.00				14.50	13.10	14.60	Core	-	-	-	-	7.14	-	-	
	14.50				14.50	14.50	14.52	SPT	50	-	-	>100	-	-	-	
	15.00			12.60 to 16.00m					2cm							
	15.50				16.00	14.52	16.00	Core	-	-	-	-	23.33	-	-	
	16.00															
	16.50															
	17.00				17.50	16.00	17.50	Core	-	-	-	-	21.33	-	-	
	17.50															
	18.00															
	18.50			Highly weathered, very weak, dark greyish black, very fine grained, thinly bedded rock												
	19.00				19.00	17.50	19.00	Core	-	-	-	-	49.33	17.33	-	
	19.50															
	20.00				20.50	19.00	20.50	Core	-	-	-	-	41.33	13.33	-	
	20.50															
	21.00															
	21.50			16.00 to 22.00m												
	22.00				22.00	20.50	22.00	Core	-	-	-	-	79.33	62.00	-	
	22.50			Slightly weathered, very weak, dark greyish black, very fine grained, thickly bedded rock 22.00 to 23.50m												
	23.00															
	23.50			Moderately weathered, moderately weak, dark brownish grey, very fine grained, moderately thickly bedded rock 23.50 to 24.00m	23.50	22.00	23.50	Core	-	-	-	-	59.33	48.00	-	
	24.00															
	24.50			Highly weathered, very weak, dark brownish black, fine grained, moderately thinly bedded rock												
	25.00				25.00	23.00	25.00	Core	-	-	-	-	31.33	24.00	-	
24.00 to 25.00m																

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : IBH 35

Location : Hirma, Talabira

Depth of Termination : 23.50 m

Co-ordinates: E 1132, N 3102

Depth of Water Table : Encountered at 1.00 m depth during investigation

Date of Start: 15-01-2025

Date of Completion: 17-01-2025

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 198.78 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks					
						From m	To m		N ₁	N ₂	N ₃	N								
Rotary drilling method	0.00	Used		Yellowish brown, fine to medium grained, clayey sand (SC) 0.00 to 0.80m	0.00	0.00	1.00	DS	-	-	-	-	-	-						
	0.50																			
	1.00				1.00	2.00	SPT	2	2	3	5	-	-							
	1.50																			
	2.00			Yellowish brown to brownish yellow, fine to medium grained, sandy clays of intermediate plasticity with occasional gravels (CI) 0.80 to 4.60m	2.00	2.00	2.50	SPT	2	3	4	7	-	-						
	2.50				2.50	3.00	UDS	-	-	-	-	-	-							
	3.00				3.00	3.50	SPT	3	4	5	9	-	-							
	3.50				3.50	4.00	UDS	-	-	-	-	-	-							
	4.00				4.00	4.50	SPT	5	6	8	14	-	-							
	4.50				4.50	4.60	SPT	5	8	9	17	-	-							
	5.00				5.00	5.50	SPT	8	14	16	30	-	-							
	5.50			Brownish yellow, fine to very fine grained, clays of intermediate plasticity (CI) 4.60 to 6.70m																
	6.00				6.00	6.50	SPT	6	10	13	23	-	-							
	6.50				6.50	7.00	UDS	-	-	-	-	-	-							
	7.00			Not Used		Brownish yellow, fine to very fine grained, clayey sand (SC) 6.70 to 8.45m	7.50	7.50	8.00	SPT	6	7	10	17						
	8.00						8.00	8.50	SPT	4	5	8	13							
	8.50						8.50	9.00	SPT	5	6	8	14							
	9.00						9.00	9.50	SPT	4	8	9	17							
	9.50	9.50	10.00				SPT	5	7	9	16									
	10.00	10.00	11.00				SPT	5	8	12	20									
	10.50																			
	11.00	11.00	11.50				SPT	5	8	15	23									
	11.50	11.50	12.50				SPT	6	9	11	20									
	12.00	Dark brownish grey, fine to very fine grained, indurated clays of intermediate plasticity mud stone 12.20 to 12.80m					Dark brownish grey, fine to very fine grained, indurated clays of intermediate plasticity mud stone 12.20 to 12.80m	12.50	12.50	12.80	SPT	20	31	60	91	-	-			
	13.00							Highly weathered, very weak, thinly laminated fraible dark brownish, fine to very fine grained, mud stone 12.80 to 14.50m												
	13.50								13.00	12.80	13.00	Core					70.00			
	14.00																25.33			
	14.50							Highly weathered, weak, dark brownish grey, fine to very fine grained, fractured rock 14.50 to 16.00m		Highly weathered, weak, dark brownish grey, fine to very fine grained, fractured rock 14.50 to 16.00m	14.50	13.00	14.50	Core						
	15.00																			
	15.50																			
	16.00			Moderately weathered, weak, dark brownish, fine to very fine grained, rock with close spacing of discontinuities 16.00 to 18.00m		Moderately weathered, weak, dark brownish, fine to very fine grained, rock with close spacing of discontinuities 16.00 to 18.00m		16.00	14.50	16.00	Core					52.00	13.33			
	16.50																			
	17.00																			
17.50	Slightly weathered, moderately strong, greyish black, fine to medium grained, rock with wide spacing of discontinuities 18.00 to 20.50m				Slightly weathered, moderately strong, greyish black, fine to medium grained, rock with wide spacing of discontinuities 18.00 to 20.50m	17.50		16.00	17.50	Core					69.33	47				
18.00																				
18.50																				
19.00	Moderately weathered, weak, dark brownish, fine to very fine grained, rock with moderately close spacing of discontinuities 20.50 to 22.00m		Moderately weathered, weak, dark brownish, fine to very fine grained, rock with moderately close spacing of discontinuities 20.50 to 22.00m	19.00	17.50	19.00	Core					47.33	22.00							
19.50																				
20.00																				
20.50	Fresh, strong, dark brownish, fine to medium grained, massive rock		Fresh, strong, dark brownish, fine to medium grained, massive rock	20.50	19.00	20.50	Core					55.33	51.33							
21.00																				
21.50																				
22.00	22.00 to 23.50m			22.00	20.50	22.00	Core					60.00	36.00							
22.50																				
23.00																				
23.50				23.50	22.00	23.50	Core					97.33	94.66							

Project : BHEL

Bore Hole No. : IBH 36

Location : Hirma, Talabira

Depth of Termination : 17.5 M

Co-ordinates: E 1132, N 2951

Depth of Water Table : Encountered at 3.15m depth during investigation

Date of Start: 22-07-2024


Date of Completion: 25-07-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 200.53 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type Sample of	SPT N Value/Penetration of S.S.S				Core Recov- ery (%)	RQD (%)	Remarks	
						From m	To m		N ₁	N ₂	N ₃	N				
Rotary drilling method	0.00	Not Used		Yellowiwh brown, fine to very fine grained, sandy clays of high plasticity (CH) 0.00 to 1.30m	0.00	0.00	1.00	DS	-	-	-	-	-	-		
	0.50															
	1.00															
	1.50															
	2.00															
	2.50			Yellowish brown, very fine grained, clays of high plasticity (CH) 1.30 to 4.95m	2.50	2.50	2.50	SPT	5	7	8	15	-	-		
	3.00				3.00	3.00	3.50	SPT	3	4	6	10				
	3.50				3.50	3.50	4.00	SPT	7	8	8	16	-	-		
	4.00				4.00	4.00	4.50	UDS	-	-	-	-				
	4.50															
	5.00			Yellowish brown, fine to medium grained, sandy clays of high plasticity (CH) 4.95 to 5.70m	5.00	5.00	5.00	SPT	5	9	9	18	-	-		
	5.50				5.50	5.50	6.00	SPT	7	11	14	25				
	6.00				6.00	6.00	6.50	SPT	7	10	12	22	-	-		
	6.50				6.50	6.50	7.00	SPT	8	9	12	21				
	7.00			Yellowish brown, fine to medium grained, sandy clays of intermediate plasticity (CI) 5.70 to 7.90m	7.00	7.00	7.50	SPT	9	10	12	22	-	-		
	7.50				7.50	7.50	8.00	SPT	10	12	13	25				
	8.00				8.00	8.00	8.50	SPT	9	13	13	26	-	-		
	8.50				8.50	8.50	9.00	UDS	-	-	-	-				
	9.00			Yellowish brown, fine to very fine grained, clayey sand (SC) 7.90 to 11.30m	9.00	9.00	9.50	SPT	8	10	12	22	-	-		
	9.50				9.50	9.50	10.00	SPT	7	10	11	21	-	-		
	10.00				10.00	10.00	11.00	SPT	7	9	9	18				
	10.50				10.50	10.50	11.50	SPT	7	7	10	17	-	-		
	11.00				11.00	11.00	12.50	SPT	9	11	14	25	-	-		
	11.50															
	12.00															
	12.50															
	13.00															
	13.50															
	14.00															
	14.50															
	15.00															
	15.50															
	16.00															
	16.50															
	17.00															
	17.50															
17.00 to 17.50m																

Project : BHEL

Bore Hole No. : IBH 37

Location : Hirma, Talabira

Depth of Termination : 18.00 M

Co-ordinates: E 787, N 3401

Depth of Water Table : Encountered at 2.20m depth during investigation

Date of Start: 18-08-2024

Date of Completion: 19-08-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 197.570 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks	
						From m	To m		N ₁	N ₂	N ₃	N				
Rotary drilling method	0.00	Used		Yellowish brown, fine to very fine grained, clays of intermediate plasticity (CI)	0.00	0.00	1.00	DS	-	-	-	-	-	-		
	0.50															
	1.00															
	1.50															
	2.00															
	2.50															
	3.00															
	3.50															
	4.00															
	4.50															
	5.00															
	5.50															
	6.00															
	6.50															
	7.00															
	7.50															
	8.00															
	8.50															
	9.00															
	9.50															
	10.00															
	10.50															
	11.00															
	11.50															
	12.00															
	12.50															
	13.00															
	13.50															
	14.00															
	14.50															
	15.00															
	15.50															
	16.00															
	16.50															
	17.00															
	17.50															
	18.00															
17.00 to 18.00m																

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Project : BHEL

Bore Hole No. : IBH 38

Location : Hirma, Talabira

Depth of Termination : 23.0 m

Co-ordinates: E 867, N 3431

Depth of Water Table : Encountered at 0.80 m depth during investigation

Date of Start: 04-01-2025



















Date of Completion: 05-01-2025

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 194.67 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks	
						From m	To m		N ₁	N ₂	N ₃	N				
Rotary drilling method	0.00	Used		Brownish, fine to medium grained, sandy clays of intermediate plasticity (CI) 0.00 to 0.80m	0.00	0.00	1.00	DS	-	-	-	-	-	-		
	0.50															
	1.00				Brownish yellow, fine to medium grained, silty clayey sand (SM-SC) 0.80 to 1.70m	1.00	1.00	2.00	SPT	2	2	3	5	-	-	
	1.50				Brownish, yellow, very fine grained, silty clays of low plasticity (CL) 1.70 to 2.40m	2.00	2.00	2.50	SPT	2	3	5	8	-	-	
	2.00				2.50	2.50	3.00	UDS	-	-	-	-	-	-	-	
	3.00				3.00	3.50	SPT	50/12 cm	-	-	>100	-	-	-	-	
	3.50				3.50	4.00	SPT	50/13 cm	-	-	>100	-	-	-	-	
	4.00				Brownish grey, fine to very fine grained, indurated sandy clays of intermediate plasticity (CI) 3.80 to 4.60m	4.00	4.00	4.50	SPT	50/11 cm	-	-	>100	-	-	
	4.50				5.00	4.50	4.60	SPT	50/10 cm	-	-	>100	-	-	-	
	5.00				4.60	5.00	Core	-	-	-	-	47.50	-	-	-	
	5.50															
	6.00				6.50	5.00	6.50	Core	-	-	-	-	32.00	7.33	-	
	6.50															
	7.00															
	7.50				8.00	6.50	8.00	Core	-	-	-	-	60.66	-	-	
	8.50															
	9.00															
	9.50				10.00	8.00	9.50	Core	-	-	-	-	55.33	-	-	
	10.50															
	11.00															
	11.50				12.00	9.50	11.00	Core	-	-	-	-	57.33	-	-	
	12.50															
	13.00															
	13.50				14.00	11.00	12.50	Core	-	-	-	-	56.00	30.66	-	
	14.50															
	15.00															
	15.50				16.00	12.50	14.00	Core	-	-	-	-	25.33	-	-	
	16.50															
	17.00															
	17.50				18.00	14.00	15.50	Core	-	-	-	-	60.66	50.66	-	
18.50																
19.00																
19.50		20.00	15.50	17.00	Core	-	-	-	-	59.33	-	-				
20.50																
21.00																
21.50		22.00	17.00	18.50	Core	-	-	-	-	72.66	31.33	-				
22.50																
23.00																
23.00		24.00	18.50	20.00	Core	-	-	-	-	61.33	34.66	-				
24.50																
25.00																
25.50		26.00	20.00	21.50	Core	-	-	-	-	45.33	40.00	-				
26.50																
27.00																
27.50		28.00	21.50	23.00	Core	-	-	-	-	84.00	13.33	-				
28.50																
29.00																
21.50 to 23.00m																

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : IBH 39

Location : Hirma, Talabira

Depth of Termination : 17.5

Co-ordinates: E 914, N 3293

Depth of Water Table : Encountered at 0.45 m depth during investigation

Date of Start: 31-12-2024

Date of Completion: 02-01-2025

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 195.45 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks	
						From m	To m		N ₁	N ₂	N ₃	N				
Rotary drilling method	0.00	Used		Yellowish brown, fine to medium grained, clayey sand with little gravels (SC) 0.00 to 0.50m	0.00	0.00	1.00	DS	-	-	-	-	-	-		
	0.50															
	1.00			Brownish yellow, very fine grained, clays of intermediate plasticity (CI) 0.50 to 1.70m	1.00	1.00	2.00	SPT	3	5	5	10	-	-		
	1.50															
	2.00					2.00	2.00	2.50	SPT	3	3	5	8	-	-	
	2.50					2.50	2.50	3.00	UDS	-	-	-	-	-	-	
	3.00					3.00	3.00	3.50	SPT	3	4	4	8	-	-	
	3.50															
	4.00			Yellowish brown, fine to medium grained, clayey sand (SC) 1.70 to 5.80m	3.50	3.50	4.00	SPT	2	3	4	7	-	-		
	4.50				4.00	4.00	4.50	SPT	3	4	4	8	-	-		
	5.00					4.50	4.50	5.00	UDS	-	-	-	-	-	-	
	5.50					5.00	5.00	5.50	SPT	3	4	6	10	-	-	
	6.00					5.50	5.00	6.00	UDS	-	-	-	-	-	-	
	6.50				Yellowish brown, fine to very fine grained, cemented clayey sand (SC) 5.80 to 6.80m	6.00	6.00	6.50	SPT	31	50/12 cm	-	>100	-	-	
	7.00					6.50	6.50	6.80	SPT	38	50/4 cm	-	>100	-	-	
	7.50					7.00	6.80	7.00	Core	-	-	-	-	30.00	-	
	8.00		Not Used													
	8.50			Moderately weathered, moderately weak, yellowish brown, fine to medium grained, fractured rock 6.80 to 10.00m	8.50	7.00	8.50	Core	-	-	-	-	42.66			
	9.00															
	9.50															
	10.00				Highly weatherd, weak, blackish grey, fine to medium grained, fractured rock 10.00 to 11.50m	10.00	8.50	10.00	Core	-	-	-	-	24.00		
	10.50															
	11.00															
	11.50				Highly weathered, weak, blackish grey, fine to medium grained, fractured rock 11.50 to 13.00m	11.50	10.00	11.50	Core	-	-	-	-	44.00		
	12.00															
	12.50															
	13.00				Moderately weathered, moderately weak, brownish black, fine to medium grained, rock with close spacing of discontinuities 13.00 to 14.50m	13.00	11.50	13.00	Core	-	-	-	-	65.33	17.33	
	13.50															
	14.00															
	14.50					14.50	13.00	14.50	Core	-	-	-	-	64.00	27.33	
	15.00				Slightly weathered, moderately weak, brownish black, fine to medium grained, rock with moderately close spacing of discontinuities 14.50 to 16.00m											
	15.50															
	16.00				16.00	15.50	16.00	Core	-	-	-	-	58.66	44.00		
	16.50			Slightly weathered, moderately weak, brownish black, fine to medium grained, rock with wide spacing of discontinuities												
	17.00															
	17.50				17.50	16.00	17.50	Core	-	-	-	-	83.33	37		
16.00 to 17.50m																

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : IBH 40

Location : Hirma, Talabira

Depth of Termination : 15.0 m

Co-ordinates: E 839, N 3591

Depth of Water Table : Encountered at 0.75m depth during investigation

Date of Start: 06-10-2024

Date of Completion: 07-10-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 193.60 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks
						From m	To m		N ₁	N ₂	N ₃	N			
Rotary drilling method	0.00	Used		Yellowish brown, fine to medium grained, sandy clays of intermediate plasticity (CI) 0.00 to 2.60m	0.00	0.00	1.00	DS	-	-	-	-	-	-	
	0.50				1.00	1.00	2.00	SPT	2	3	3	6	-	-	
	1.00														
	1.50														
	2.00			Brownish yellow, very fine grained, clays of intermediate plasticity (CI) 2.60 to 4.90m	2.00	2.00	2.50	SPT	2	3	4	7	-	-	
	2.50				2.50	2.50	3.00	UDS	-	-	-	-	-	-	
	3.00				3.00	3.00	3.50	SPT	7	8	10	18	-	-	
	3.50				3.50	3.50	4.00	UDS	-	-	-	-	-	-	
	4.00			Yellowish brown, very fine grained, cemented silty clays of intermediate plasticity (CI) 4.90 to 5.70m	4.00	4.00	4.50	SPT	10	11	13	24	-	-	
	4.50				4.50	4.50	5.00	UDS	-	-	-	-	-	-	
	5.00				5.00	5.00	5.50	SPT	20	42	53/14 cm	>100	-	-	
	5.50				5.50	5.50	6.00	SPT	40	50/13 cm	-	>100	-	-	
	6.00			Brownish yellow, very fine grained, cemented silty clays of intermediate plasticity (CI) 5.70 to 6.30m	6.00	6.00	6.30	SPT	55	-	-	>100	-	-	
	6.50	Not Used		Highly weathered, weak, dark yellowish brown, fine to very fine grained, fractured rock 6.30 to 10.50m	7.50	6.30	7.50	Core	-	-	-	-	23	-	
	7.00														
	7.50														
	8.00														
	8.50			Highly weathered, very weak, dark brownish, fine to very fine grained, fractured rock 10.50 to 12.00m	9.00	7.90	9.00	Core	-	-	-	-	33	-	
	9.00														
	9.50														
	10.00														
	10.50			Highly weathered, blackish brown, fine to medium grained, rock with close spacing of discontinuities 12.00 to 13.50m	10.50	10.50	12.00	Core	-	-	-	-	23	-	
	11.00														
	11.50														
	12.00			Slightly weathered, moderately weak, dark brownish black, fine to very fine grained, massive rock	12.00	12.00	12.03	Core	-	-	-	-	39	18	
	12.50														
	13.00														
	13.50														
14.00	13.50	12.03	13.50	Core	-	-	-	-	73	52					
14.50															
15.00															
13.50 to 15.00m															

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Project : BHEL

Bore Hole No. : IBH 41

Location : Hirma, Talabira

Depth of Termination : 21.5 M

Co-ordinates: E 700, N 3329

Depth of Water Table : Encountered at 2.30m depth during investigation

Date of Start: 20-08-2024


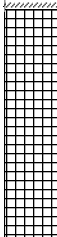







Date of Completion: 23-08-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 197.65 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks			
						From m	To m		N ₁	N ₂	N ₃	N						
Rotary drilling method	0.00	Used		Yellowish brown, fine to very fine grained, clays of low plasticity (CL) 0.00 to 0.80m	0.00	0.00	1.00	DS	-	-	-	-	-	-				
	0.50																	
	1.00				Yellowish brown to brownish, very fine grained, clays of high plasticity (CH) 0.80 to 3.60m	1.00	1.00	2.00	SPT	2	2	3	5	-	-			
	1.50																	
	2.00						2.00	2.00	2.50	SPT	2	3	4	7	-	-		
	2.50						2.50	3.00	UDS	-	-	-	-	-	-	-		
	3.00						3.00	3.50	SPT	3	5	6	11	-	-			
	3.50						3.50	4.00	UDS	-	-	-	-	-	-	-		
	4.00						4.00	4.00	4.50	SPT	3	4	8	12	-	-		
	4.50						4.50	5.00	UDS	-	-	-	-	-	-	-		
	5.00						5.00	5.50	SPT	4	6	7	13	-	-			
	5.50						5.50	6.00	UDS	-	-	-	-	-	-	-		
	6.00				Yellowish brown, very fine grained, clays of intermediate plasticity (CI) 4.70 to 5.60m	6.00	6.00	6.50	SPT	51/9cm	-	-	>100	-	-			
	6.50					6.50	7.00	SPT	55/9cm	-	-	>100	-	-				
	7.00					7.00	7.50	SPT	61/8cm	-	-	>100	-	-				
	7.50					7.50	8.00	SPT	61/9cm	-	-	>100	-	-				
	8.00					8.00	8.50	SPT	51/7cm	-	-	>100	-	-				
	8.50					8.50	9.00	SPT	51/7cm	-	-	>100	-	-				
	9.00					9.00	9.50	SPT	51/9cm	-	-	>100	-	-				
	9.50					9.50	10.00	SPT	25	76/9cm	-	>100	-	-				
	10.00	10.00	10.07			SPT	25	31	61	92	-	-						
	10.50		Blackish brown, very fine grained, silty clays of intermediate plasticity (CI) 9.30 to 10.50m			11.00	10.07	11.00	SPT	51/3cm	-	-	>100	8.00	-			
	11.50			11.00	11.50	Core	-	-	-	-	10.00	-						
	12.00			11.50	11.57	SPT	51/7 cm	-	-	>100	-	-						
	12.50			11.00	12.50	Core	-	-	-	-	51.00	33.00						
	+ 13.00				Highly weathered, weak, yellowish brown, fine to medium grained, fractured rock 10.50 to 12.50m	14.00	12.50	14.00	Core	-	-	-	-	45.33	26.00			
	14.50																	
	15.00					15.50	14.00	15.50	Core	-	-	-	-	43.33	41.33			
	16.00						Highly weathered, very weak, yellowish brown, fine to medium grained, rock with moderately wide spacing of discontinuities 15.50 to 18.50m	17.00	15.50	17.00	Core	-	-	-	-	45.33	38.00	
	16.50																	
	17.00																	
	17.50																	
18.00		Moderately weathered, weak, blackish brown, fine to medium grained, rock with moderately wide spacing of discontinuities 18.50 to 20.00m	18.50			17.00	18.50	Core	-	-	-	-	50.66	38.00				
18.50																		
19.00																		
19.50																		
20.00		Slightly weathered, moderately strong, dark brownish grey, fine to medium grained, massive rock	20.00	18.50	20.00	Core	-	-	-	-	70.00	16.66						
20.50																		
21.00																		
21.50																		
						21.50	20.00	21.50	Core	-	-	-	-	98.00	73.33			
20.00 to 21.50m																		

Project : BHEL

Bore Hole No. : IBH 42

Location : Hirma, Talabira

Depth of Termination : 25.0 M

Co-ordinates : E 718, N 2730

Depth of Water Table : Encountered at 5.20m depth during investigation

Date of Start: 20-12-2024

Date of Completion: 23-12-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 197.76 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks
						From m	To m		N ₁	N ₂	N ₃	N			
Rotary drilling method	0.00	Used		Light brownish, fine to very fine grained, silty clays of low plasticity (CL) 0.00 to 0.90m	0.00	0.00	1.00	DS	-	-	-	-	-	-	
	0.50														
	1.00			Light brownish, very fine grained, silty clays of high plasticity (CH) 0.90 to 2.90m	1.00	1.00	2.00	SPT	1	2	3	5	-	-	
	1.50														
	2.00				2.00	2.00	2.50	SPT	2	2	3	5	-	-	
	2.50				2.50	2.50	3.00	UDS	-	-	-	-	-	-	
	3.00				3.00	3.00	3.50	SPT	5	7	8	15	-	-	
	3.50				3.50	3.50	4.00	UDS	-	-	-	-	-	-	
	4.00				4.00	4.00	4.50	SPT	3	4	6	10	-	-	
	4.50				4.50	4.50	5.00	UDS	-	-	-	-	-	-	
	5.00			Reddish brown, very fine grained, clays of intermediate plasticity (CI) 4.60 to 6.90m	5.00	5.00	5.50	SPT	3	4	6	10	-	-	
	5.50				5.50	5.50	6.00	UDS	-	-	-	-	-	-	
	6.00				6.00	6.00	6.50	SPT	4	4	6	10	-	-	
	6.50				6.50	6.50	7.00	UDS	-	-	-	-	-	-	
	7.00			Reddish yellow, very fine grained, clays of high plasticity (CH) 6.90 to 7.90m	7.00	7.00	7.50	SPT	3	4	5	9	-	-	
	7.50				7.50	7.50	8.00	UDS	-	-	-	-	-	-	
	8.00			Yellowish brown, fine to coarse grained, clayey sand with occasional gravels (SC) 7.90 to 8.95m	8.00	8.00	8.50	SPT	7	10	12	22	-	-	
	8.50				8.50	8.50	8.55	SPT	5	8	10	18	-	-	
	9.00			Yellowish brown, fine to coarse grained, silty sand with little plastic fines and some gravels (SM) 8.95 to 9.45m	9.00	9.00	9.00	SPT	7	11	14	25	-	-	
	9.50				9.50	9.50	9.56	SPT	8	12	14	26	-	-	
	10.00			Yellowish brown, fine to coarse grained, silty sand with little plastic fines and some gravels (SM) 9.45 to 12.20m	10.00	10.00	10.00	SPT	8	11	13	24	-	-	
	10.50														
	11.00				11.00	11.00	11.06	SPT	9	12.00	15	27	-	-	
	11.50				11.50	11.50	11.59	SPT	26	34	43	77	-	-	
	12.00														
	12.50				12.50	11.50	12.50	SPT	31	50/11 cm	-	>100	-	-	
	13.00				13.00	12.50	13.00	SPT	60/8 cm	-	-	>100	-	-	
	13.50	Not used		Light greyish brown to whitish grey, fine to medium grained, cemented clayey sand with occasional to much gravels (SC) 13.30 to 17.40m	14.00	14.00	14.00	SPT	38	55/13 cm	-	>100	-	-	
	14.50				14.50	14.50	14.58	SPT	36	55/12 cm	-	>100	-	-	
	15.00														
	15.50				15.50	15.50	16.00	SPT	39	50/11 cm	-	>100	-	-	
	16.00				16.00	16.00	17.00	SPT	60/14 cm	-	-	>100	-	-	
	16.50				17.00	17.00	17.50	SPT	36.00	50/10 cm	-	>100	-	-	
	17.00			Blackish brown, fine to very fine grained, cemented clayey sand (SC) 17.40 to 18.40m	17.50	17.50	18.5	SPT	32	60/14 cm	-	>100	-	-	
	17.50														
	18.00			Whitish grey, fine to very fine grained, cemented clayey sand with occasional gravels (SC) 18.40 to 19.20m	18.50	18.50	19.00	SPT	31	50/19 cm	-	>100	-	-	
	18.50														
	19.00			Moderately weathered, weak, light yellowish grey, fine to medium grained, rock with very wide spacing of discontinuities 19.20 to 21.50m	19.50	19.00	19.20	SPT	60/14 cm	-	-	>100	51.25	51.25	
	19.50				20.00	19.20	20.00	Core	-	-	-	-			
	20.00				20.50										
	20.50				21.00										
	21.00			Moderately weathered, weak, light yellowish grey, fine to medium grained, rock with close spacing of discontinuities 21.50 to 24.00m	21.50	20.00	21.50	Core	-	-	-	-	42	13.33	
	21.50				22.00										
	22.00				22.50										
	22.50				23.00	21.50	23.00	Core	-	-	-	-	50.00	48.66	
	23.00			Moderately weathered, weak, light brownish grey, fine to medium grained, rock with moderately wide spacing of discontinuities	23.50										
	23.50				24.00										
	24.00				24.50										
	24.50				25.00	24.00	25.00	Core	-	-	-	-	44.50	30.00	
	25.00														

24.00 to 25.00m

Project : BHEL

Bore Hole No. : IBH 43

Location : Hirma, Talabira

Depth of Termination : 25.0 M

Co-ordinates : E 798, N 2397

Depth of Water Table : Encountered at 5.10m depth during investigation

Date of Start: 10-01-2025

Date of Completion: 12-01-2025

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 198.48 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks	
						From m	To m		N ₁	N ₂	N ₃	N				
Rotary drilling method	0.00			Brownish, fine to very fine grained, silty clays of low plasticity with occasional gravels (CL) 0.00 to 0.80m	0.00	0.00	1.00	DS	-	-	-	-	-	-		
	0.50															
	1.00				Light Brownish, very fine grained, clays of high plasticity (CH) 0.80 to 3.40m	1.00	1.00	2.00	SPT	2	2	2	4	-	-	
	1.50															
	2.00			2.00		2.00	2.50	SPT	2	2	3	5	-	-		
	2.50			2.50		2.50	3.00	UDS	-	-	-	-	-	-		
	3.00			Yellowish brown, very fine grained, clays of high plasticity (CH) 3.40 to 7.70m	3.00	3.00	3.50	SPT	2	3	4	7	-	-		
	3.50				3.50	3.50	4.00	SPT	2	3	4	7	-	-		
	4.00				4.00	4.00	4.50	SPT	2	3	3	6	-	-		
	4.50				4.50	4.50	5.00	SPT	3	4	4	8	-	-		
	5.00			Yellowish brown, fine to coarse grained, clayey sand with some gravels (SC) 7.70 to 8.85m	5.00	5.00	5.50	SPT	3	4	5	9	-	-		
	5.50				5.50	5.50	6.00	SPT	4	4	4	8	-	-		
	6.00				6.00	6.00	6.50	SPT	3	3	5	8	-	-		
	6.50				6.50	6.50	7.00	UDS	-	-	-	-	-	-		
	7.00			Light whitish yellow, fine to medium grained, clayey sand (SC) 8.85 to 10.60m	7.00	7.00	7.50	SPT	4	5	6	9	-	-		
	7.50				7.50	7.50	8.00	UDS	-	-	-	-	-	-		
	8.00				8.00	8.00	8.50	SPT	7	8	12	20	-	-		
	8.50				8.50	8.50	9.00	UDS	-	-	-	-	-	-		
	9.00			Yellowish brown, fine to medium grained, silty sand with much gravels (SM) 10.60 to 14.30m	9.00	9.00	9.50	SPT	15	19	18	34	-	-		
	9.50				9.50	9.50	10.00	UDS	-	-	-	-	-	-		
	10.00				10.00	10.00	11.00	SPT	16	17	19	36	-	-		
	10.50															
	11.00			Yellowish brown, fine to medium grained, silty sand with much gravels (SM) 10.60 to 14.30m	11.00	11.00	11.50	UDS	-	-	-	-	-	-		
	11.50				11.50	11.50	12.50	SPT	12	15	30	45	-	-		
	12.00				12.50	12.50	13.00	SPT	8	10	13	23	-	-		
	12.50				13.00	13.00	14.00	SPT	8	12	18	30	-	-		
	13.00			Yellowish brown, fine to medium grained, clayey sand (SC) 14.30 to 14.90m	13.50											
	14.00				14.00	14.00	14.50	UDS	-	-	-	-	-	-		
	14.50				14.50	14.50	15.50	SPT	22	50/10 cm	-	>100	-	-		
	15.00															
	15.50			Light whitish yellow to Light greyish, fine to medium grained, cemented clayey sand with much to some gravels (SC)	15.50	15.50	16.00	SPT	23	27	42	69	-	-		
	16.00				16.00	16.00	17.00	SPT	21	37	39	73	-	-		
	16.50															
	17.00				17.00	17.00	17.50	SPT	21	35	48	83	-	-		
	17.50				17.50	17.50	18.50	SPT	25	30	40	70	-	-		
	18.00															
	18.50				18.50	18.50	19.00	SPT	28	55/11 cm	-	>100	-	-		
	19.00				19.00	19.00	20.00	SPT	29	50/12 cm	-	>100	-	-		
	19.50															
	20.00				20.00	20.00	20.50	SPT	32	50/10 cm	-	>100	-	-		
20.50			20.50		20.50	21.50	SPT	33	50/11 cm	-	>100	-	-			
21.00																
21.50			21.50		21.50	22.00	SPT	30	50/9 cm	-	>100	-	-			
22.00			22.00		22.00	23.00	SPT	50/11 cm	-	-	-	>100	-	-		
22.50																
23.00			23.00		23.00	23.50	SPT	50/12 cm	-	-	-	>100	-	-		
23.50			23.50	23.50	24.50	SPT	50/13 cm	-	-	-	>100	-	-			
24.00																
24.50			24.50	24.50	25.00	SPT	50/12 cm	-	-	-	>100	-	-			
25.00			25.00	25.00	25.11	SPT	50/11 cm	-	-	-	>100	-	-			
14.90 to 25.00m																

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : IBH 44

Location : Hirma, Talabira

Depth of Termination : 25.0 M

Co-ordinates: E 915, N 1955

Depth of Water Table : Encountered at 3.20 m depth during investigation

Date of Start: 03-09-2024

Date of Completion: 09-09-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 199.30 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks		
						From m	To m		N ₁	N ₂	N ₃	N					
Rotary drilling method	0.00	Used		Dark brownish, fo medium grained, filled up silty clayey sand with little gravels 0.00 to 0.40m	0.00	0.00	1.00	DS	-	-	-	-	-	-			
	0.50			Yellowish brown to reddish brown, fine to medium grained, sandy clays of intermediate plasticity with little gravels (CI) 0.40 to 4.80m	1.00	1.00	2.00	SPT	1	1	2	3	-	-			
	1.00				2.00	2.00	2.50	SPT	2	3	3	6	-	-			
	1.50				2.50	2.50	3.00	UDS	-	-	-	-	-	-			
	2.00				3.00	3.00	3.50	SPT	3	3	4	7	-	-			
	2.50				3.50	3.50	4.00	UDS	-	-	-	-	-	-			
	3.00				4.00	4.00	4.50	SPT	3	4	4	8	-	-			
	3.50				4.50	4.50	5.00	SPT	3	4	5	9	-	-			
	4.00				5.00	5.00	5.50	SPT	4	5	5	10	-	-			
	4.50				5.50	5.50	6.00	SPT	4	6	6	12	-	-			
	5.00				6.00	6.00	6.50	SPT	4	7	7	14	-	-			
	5.50		6.50	6.50	7.00	SPT	8	10	11	21	-	-					
	6.00		7.00	7.00	7.50	SPT	4	5	7	12	-	-					
	6.50			Light brownish yellow, fine to very fine grained, sandy clays of intermediate plasticity with little gravels (CI) 7.30 to 9.00m	7.50	7.50	8.00	SPT	5	7	9	16	-	-			
	8.00				8.00	8.50	SPT	6	7	11	18	-	-				
	8.50				8.50	9.00	UDS	-	-	-	-	-	-	-			
	9.00			Brownish yellow, fine to medium grained, clayey sand with occasional gravels (SC) 9.00 to 9.90m	9.00	9.00	9.50	SPT	5	7	9	16	-	-			
	9.50				9.50	10.00	SPT	5	8	9	17	-	-				
	10.00					Mixture of highly weathered, completely fractured and disintegrated, brownish yellow, fine to coarse grained, gravel, pebble size angular fractured rock with brownish yellow, fine to medium grained, clayey sand 9.90 to 11.40m	10.00	10.00	11.00	SPT	9	12	20	32	-	-	
	10.50		11.00	11.00			11.50	SPT	9	20	22	42	-	-			
	11.00		11.50	11.50			12.50	SPT	10	18	21	39	-	-			
	11.50		Light brownish yellow, fine to very fine grained, very weak, friable fractured rock with infilling of brownish yellow, fine to very fine grained, clayey sand 11.40 to 13.00m	12.00			12.50	13.00	SPT	6	12	12	24	-	-		
	12.50			13.00			13.00	14.00	SPT	12	20	24	44	-	-		
	13.00			14.00			14.00	14.50	SPT	15	25	27	52	-	-		
	13.50			14.50			14.50	15.50	SPT	14	27	28	55	-	-		
	14.00		Not Used	Highly weathered, completely fractured and disintegrated, brownish yellow, fine to coarse grained, very weak and friable fractured rock			15.00	15.50	16.00	SPT	20	22	25	47	-	-	
	15.50						16.00	16.00	17.00	SPT	25	52/13 cm	-	>100	-	-	
	16.00						17.00	17.00	17.50	SPT	29	50/12 cm	-	>100	-	-	
	16.50				17.50	17.50	18.50	SPT	52/13 cm	-	-	>100	-	-			
	17.00				18.50	18.50	19.00	SPT	50/10 cm	-	-	>100	-	-			
	17.50				19.00	19.00	20.00	SPT	50/12 cm	-	-	>100	-	-			
	18.00				20.00	20.00	20.50	SPT	55/10 cm	-	-	>100	-	-			
	18.50				20.50	20.50	21.50	SPT	55/12 cm	-	-	>100	-	-			
	19.00				21.50	21.50	22.00	SPT	53/13 cm	-	-	>100	-	-			
	19.50				22.00	22.00	23.00	SPT	57/9 cm	-	-	>100	-	-			
	20.00				23.00	23.00	23.50	SPT	54/10 cm	-	-	>100	-	-			
20.50	23.50	23.50			24.50	SPT	50/8 cm	-	-	>100	-	-					
21.00	24.50	24.50			25.00	SPT	53/9 cm	-	-	>100	-	-					
21.50	25.00	25.00			25.00	SPT	50/7 cm	-	-	>100	-	-					

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : IBH 45

Location : Hirma, Talabira

Depth of Termination : 20

Co-ordinates: E 795, N 1564

Depth of Water Table : Encountered at 1.90 m depth during investigation

Date of Start: 29-12-2024

Date of Completion: 29-12-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 194.80 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks
						From m	To m		N ₁	N ₂	N ₃	N			
Rotary drilling method	0.00				0.00	0.00	1.00	DS	-	-	-	-	-	-	
	0.50														
	1.00				1.00	1.00	2.00	SPT	1	1	1	2	-	-	
	1.50			Yellowish brown, fine to medium grained, sandy clays of intermediate plasticity with occasional gravels (CI) 0.00 to 2.40m											
	2.00				2.00	2.00	2.50	SPT	1	2	2	4	-	-	
	2.50				2.50	2.50	3.00	UDS	-	-	-	-	-	-	
	3.00				3.00	3.00	3.50	SPT	3	4	5	9	-	-	
	3.50				3.50	3.50	4.00	UDS	-	-	-	-	-	-	
	4.00			Yellowish brown to reddish yellow, fine to medium grained, clayey sand with little to some gravels (SC) 2.40 to 5.70m	4.00	4.00	4.50	SPT	3	3	5	8	-	-	
	4.50				4.50	4.50	5.00	UDS	-	-	-	-	-	-	
	5.00				5.00	5.00	5.50	SPT	3	5	6	11	-	-	
	5.50				5.50	5.50	6.00	UDS	-	-	-	-	-	-	
	6.00			Yellowish brown, fine to medium grained, cemented clayey sand with little gravels (SC) 5.70 to 6.70m	6.00	6.00	6.50	SPT	50/10 cm	-	-	>100	-	-	
	6.50				6.50	6.50	7.00	SPT	50/12 cm	-	-	>100	-	-	
	7.00				7.00	7.00	7.50	SPT	50/11 cm	-	-	>100	-	-	
	7.50			Yellowish brown, fine to coarse grained, cemented silty sand with occasional gravels (SM) 6.70 to 8.60m	7.50	7.50	8.00	SPT	50/12 cm	-	-	>100	-	-	
	8.00				8.00	8.00	8.50	SPT	50/5 cm	-	-	>100	-	-	
	8.50				8.50	8.50	9.00	SPT	37	50/3 cm	-	>100	-	-	
	9.00				9.00	9.00	9.50	SPT	32	50/9 cm	-	>100	-	-	
	9.50				9.50	9.50	10.00	SPT	32	50/12 cm	-	>100	-	-	
	10.00			Reddish brown to dark brownish, very fine grained, indurated clays of high plasticity (CH) mud stone 8.60 to 12.30m	10.00	10.00	11.00	SPT	35	50/10 cm	-	>100	-	-	
	10.50														
	11.00				11.00	11.00	11.50	SPT	50/15 cm	-	-	>100	-	-	
	11.50				11.50	11.50	11.80	SPT	50/14 cm	-	-	>100	-	-	
	12.00														
	12.50			Highly weathered, moderately strong, light whitish yellow, fine to medium grained, fractured rock 12.30 to 14.00m	12.50	11.80	12.50	Core	-	-	-	-	12.86	-	
	13.00				12.50	12.50	12.52	SPT	50/2 cm	-	-	>101	-	-	
	13.50														
	14.00			Highly weathered, weak, dark brownish, fine to very fine grained, rock with close spacing of discontinuities 14.00 to 15.50m	14.00	12.52	14.50	Core	-	-	-	-	40.00	29.33	
	14.50														
	15.00														
	15.50			Highly weathered, very weak, whitish, fine to medium grained, rock with close spacing of discontinuities 15.50 to 17.50m	15.50	14.50	15.50	Core	-	-	-	-	45.33	45.33	
	16.00														
	16.50														
	17.00				17.00	15.50	17.00	Core	-	-	-	-	41.33	21.33	
	17.50			Highly weathered, very weak, whitish, fine to medium grained, rock with moderately wide spacing of discontinuities 17.50 to 18.50m											
	18.00														
	18.50			Highly weathered, weak, dark brownish black, fine to medium grained, rock with wide spacing of discontinuities 18.50 to 19.00m	18.50	17.00	18.50	Core	-	-	-	-	44.00	44.00	
	19.00														
	19.50			Slightly weathered, weak, dark brownish black, fine to medium grained, rock with wide spacing of discontinuities											
	20.00				20.00	18.50	20.00	Core	-	-	-	-	84.66	54.66	
19.00 to 20.00m															

Project : BHEL

Bore Hole No. : IBH 46

Location : Hirma, Talabira

Depth of Termination : 25.0 M

Co-ordinates: E 1155, N 1098

Depth of Water Table : Encountered at 3.70m depth during investigation

Date of Start: 09-09-2024

Date of Completion: 11-09-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 196.61 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks
						From m	To m		N ₁	N ₂	N ₃	N			
Rotary drilling method	0.00			Brownish, fine to medium grained, filled up silty clayey sand with debris 0.00 to 0.80m	0.00	0.00	1.00	DS	-	-	-	-	-	-	
	0.50														
	1.00			Yellowish brown, fine to very fine grained, sandy clays of intermediate plasticity (CI) 0.80 to 1.60m	1.00	1.00	2.00	SPT	3	2	5	7	-	-	
	1.50														
	2.00				2.00	2.00	2.50	SPT	4	5	8	13	-	-	
	2.50				2.50	2.50	3.00	UDS	-	-	-	-	-	-	
	3.00				3.00	3.00	3.50	SPT	9	10	18	28	-	-	
	3.50				3.50	3.50	4.00	UDS	-	-	-	-	-	-	
	4.00				4.00	4.00	4.50	SPT	4	7	9	16	-	-	
	4.50				4.50	4.50	5.00	UDS	-	-	-	-	-	-	
	5.00				5.00	5.00	5.50	SPT	5	7	12	19	-	-	
	5.50				5.50	5.50	6.00	SPT	7	10	14	24	-	-	
	6.00				6.00	6.00	6.50	SPT	6	5	8	13	-	-	
	6.50				6.50	6.50	7.00	SPT	4.00	3.00	5.00	8.00	-	-	
	7.00				7.00	7.00	7.50	SPT	3.00	4.00	4.00	8.00	-	-	
	7.50				7.50	7.50	8.00	UDS	-	-	-	-	-	-	
	8.00				8.00	8.00	8.50	SPT	6.00	7.00	9.00	16.00	-	-	
	8.50				8.50	8.50	9.00	UDS	-	-	-	-	-	-	
	9.00				9.00	9.00	9.50	SPT	8.00	9.00	15.00	24.00	-	-	
	9.50				9.50	9.50	10.00	SPT	7	11.00	12	23	-	-	
	10.00				10.00	10.00	11.00	SPT	13.00	15.00	18.00	33.00	-	-	
	10.50														
	11.00				11.00	11.00	11.50	SPT	16	20.00	23	43	-	-	
	11.50				11.50	11.50	12.50	SPT	9.00	13.00	25.00	38.00	-	-	
	12.00														
	12.50				12.50	12.50	13.00	SPT	50/13cm	-	-	>100	-	-	
	13.00				13.00	13.00	14.00	SPT	50/9cm	-	-	>100	-	-	
	13.50														
	14.00				14.00	14.00	14.50	SPT	50/5cm	-	-	>100	-	-	
	14.50				14.50	14.50	15.50	SPT	50/7cm	-	-	>100	-	-	
	15.00														
	15.50				15.50	15.50	16.00	SPT	50/4cm	-	-	>100	-	-	
16.00				16.00	16.00	17.00	SPT	50/4cm	-	-	>100	-	-		
16.50															
17.00				17.00	17.00	17.50	SPT	50/6cm	-	-	>100	-	-		
17.50				17.50	17.50	18.50	SPT	50/9cm	-	-	>100	-	-		
18.00															
18.50				18.50	18.50	19.00	SPT	50/11cm	-	-	>100	-	-		
19.00				19.00	19.00	20.00	SPT	50/14cm	-	-	>100	-	-		
19.50															
20.00				20.00	20.00	20.50	SPT	50/7cm	-	-	>100	-	-		
20.50				20.50	20.50	21.50	SPT	50/9cm	-	-	>100	-	-		
21.00															
21.50				21.50	21.50	22.00	SPT	50/8cm	-	-	>100	-	-		
22.00				22.00	22.00	23.00	SPT	50/7cm	-	-	>100	-	-		
22.50															
23.00				23.00	23.00	23.50	SPT	50/5cm	-	-	>100	-	-		
23.50				23.50	23.50	24.50	SPT	50/7cm	-	-	>100	-	-		
24.00															
24.50				24.50	24.50	24.58	SPT	50/8cm	-	-	>100	-	-		
25.00				25.00	24.58	25.00	SPT	50/3cm	-	-	>100	16.00	-		

21.60 to 25.00m

Project : BHEL

Bore Hole No. : IBH 47

Location : Hirma, Talabira

Depth of Termination : 20.50 m

Co-ordinates: E FHE , N 700

Depth of Water Table : Encountered at 5.10m depth during investigation

Date of Start: 10-01-2025

Date of Completion: 12-01-2025

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 196.30m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks
						From m	To m		N ₁	N ₂	N ₃	N			
Rotary drilling method	0.00	<div>Used</div>		Brownish, fine to very fine grained, clayey sand (SC) 0.00 to 0.40m	0.00	0.00	1.00	DS	-	-	-	-	-	-	
	0.50			Brownish, fine to very fine grained, sandy clays of intermediate plasticity (CI) 0.40 to 1.60m	1.00	1.00	2.00	SPT	2	2	3	5	-	-	
	1.00			Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL) 1.60 to 3.40m	2.00	2.00	2.50	SPT	2	3	3	6	-	-	
	1.50				2.50	2.50	3.00	UDS	-	-	-	-	-	-	
	2.00				3.00	3.00	3.50	SPT	2	2	3	5	-	-	
	2.50				3.50	3.50	4.00	UDS	-	-	-	-	-	-	
	3.00			Yellowish brown, fine to very fine grained, clays of intermediate plasticity (CI) 3.40 to 5.30m	4.00	4.00	4.50	SPT	3	3	4	7	-	-	
	3.50				4.50	4.50	5.00	UDS	-	-	-	-	-	-	
	4.00				5.00	5.00	5.50	SPT	3	3	5	8	-	-	
	4.50				5.50	5.50	6.00	UDS	-	-	-	-	-	-	
	5.00			Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL) 5.30 to 7.40m	6.00	6.00	6.50	SPT	2	3	5	8	-	-	
	5.50				6.50	6.50	7.00	UDS	-	-	-	-	-	-	
	6.00				7.00	7.00	7.50	SPT	3	4	6	10	-	-	
	6.50				7.50	7.50	8.00	UDS	-	-	-	-	-	-	
	7.00			Yellowish brown, fine to very fine grained, clayey sand (SC) 7.40 to 8.80m	8.00	8.00	8.50	SPT	3	5	6	11	-	-	
	7.50				8.50	8.50	9.00	UDS	-	-	-	-	-	-	
	8.00				9.00	9.00	9.50	SPT	4	5	9	14	-	-	
	8.50				9.50	9.50	10.00	UDS	-	-	-	-	-	-	
	9.00			Yellowish brown, fine to very fine grained, clays of high plasticity (CH) 8.80 to 11.40m	10.00	10.00	11.00	SPT	7	10	13	23	-	-	
	9.50				11.00	11.00	11.50	SPT	8	12	19	31	-	-	
	10.00				11.50	11.50	12.50	SPT	10	15	21	36	-	-	
	10.50				12.50	12.50	13.00	SPT	9	14	25	39	-	-	
	11.00			Yellowish brown, fine to medium grained, silty sand with little to much gravels (SM) 11.80 to 14.40m	13.00	13.00	14.00	SPT	11	20	26	46	-	-	
	11.50				14.00	14.00	14.50	SPT	13	19	30	49	-	-	
	12.00				14.50	14.50	15.50	SPT	15	21	32	53	-	-	
	12.50				15.50	15.50	16.00	SPT	17	50/7 cm	-	>100	-	-	
	13.00			Yellowish brown, medium to coarse grained, poorly graded sand and silty sand with occasional gravels (SP-SM) 14.40 to 17.30m	16.00	16.00	17.00	SPT	30	50/3 cm	-	>100	-	-	
	13.50				17.00	17.00	17.50	SPT	36	50/5 cm	-	>100	-	-	
	14.00				17.50	17.50	18.50	SPT	30	50/5 cm	-	>100	-	-	
	14.50				18.50	18.50	19.00	SPT	35	50/3 cm	-	>100	-	-	
	15.00			Yellowish brown, fine to very fine grained, clayey sand (SC) 17.30 to 19.00m	19.00	19.00	20.00	SPT	-	-	-	-	78.00	56.66	
	15.50				20.00	20.00	21.50	Core	-	-	-	-	-	-	
16.00		21.50	21.50		22.50	Core	-	-	-	-	-	-			
16.50		22.50	22.50		23.50	Core	-	-	-	-	-	-			
17.00		Not used		Moderately weathered, weak, yellowish brown, fine to medium grained, rock with wide spacing of discontinuities	23.50	23.50	24.50	Core	-	-	-	-	-	-	
17.50			24.50	24.50	25.50	Core	-	-	-	-	-	-			
18.00			25.50	25.50	26.50	Core	-	-	-	-	-	-			
18.50			26.50	26.50	27.50	Core	-	-	-	-	-	-			
19.00			27.50	27.50	28.50	Core	-	-	-	-	-	-			
19.00 to 20.50m															

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : IBH 48

Location : Hirma, Talabira

Depth of Termination : 25.0 M

Co-ordinates: E 1574, N 242

Depth of Water Table : Encountered at 2.30m depth during investigation

Date of Start: 23-06-2025

Date of Completion: 25-06-2025

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 196.3

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth Sample m	Drill Run		Type Sample	SPT N Value/Penetration of S.S.S				Core Recov- ery (%)	RQD (%)	Remarks	
						From m	To m		N ₁	N ₂	N ₃	N				
Rotary drilling method	0.00	Not Used		Brownish, fine to medium grained, clayey sand with little gravels (SC) 0.00 to 0.80m	0.00	0.00	1.00	DS	-	-	-	-	-	-		
	0.50															
	1.00			Brownish, fine to very fine grained, indurated sandy clays of intermediate plasticity (CI) 0.80 to 1.70m	1.00	1.00	2.00	SPT	3	4	5	9	-	-		
	1.50															
	2.00				2.00	2.00	2.50	SPT	4	5	6	11	-	-		
	2.50															
	3.00			Yellowish brown, fine to medium grained, sandy clays of intermediate plasticity with little gravels (CI) 1.70 to 4.40m	2.50	2.50	3.00	UDS	-	-	-	-	-	-		
	3.50															
	4.00				3.50	3.50	4.00	UDS	-	-	-	-	-	-	-	
	4.50															
	5.00			Yellowish brown, fine to medium grained, clayey sand (SC) 4.40 to 5.40m	4.50	4.50	5.00	SPT	10	15	20	35	-	-		
	5.50															
	6.00			Brownish, fine to very fine grained, silty clays of intermediate plasticity (CI) 5.40 to 6.90m	5.50	5.50	6.00	SPT	10	14	16	30				
	6.50															
	7.00				6.00	6.00	6.50	SPT	8	12	15	27	-	-		
	7.50															
	8.00			Brownish, fine to very fine grained, clayey sand (SC) 6.90 to 8.70m	7.00	7.00	7.50	SPT	8	12	20	32	-	-		
	8.50															
	9.00				7.50	7.50	8.00	SPT	18	25	30	55	-	-		
	9.50															
	10.00				8.00	8.00	8.50	SPT	10	15	28	43	-	-		
	10.50															
	11.00				8.50	8.50	9.00	SPT	8	19	34	53	-	-		
	11.50															
	12.00			Light reddish brwon and whitish yellow, fine to very fine grained, cemented clayey sand weak and friable sand rock 8.70 to 9.90m	9.00	9.00	9.50	SPT	20	38	48	86				
	12.50															
	13.00				9.50	9.50	10.00	SPT	21	50/14 cm	-	>100	-	-		
	13.50															
	14.00				10.00	10.00	11.00	SPT	14	24	40	64	-	-		
	14.50															
	15.00				11.00	11.00	11.50	SPT	21	42	45	87				
	15.50															
	16.00				11.50	11.50	12.50	SPT	35	44	50	94				
	16.50															
	17.00				12.50	12.50	13.00	SPT	30	32	36	68				
	17.50															
	18.00				13.00	13.00	14.00	SPT	40	50/13 cm	-	>100	-	-		
	18.50															
	19.00				14.00	14.00	14.04	SPT	42	50/11 cm	-	>100	-	-		
	19.50															
20.00			14.50	14.50	15.50	SPT	45	50/14 cm	-	>100	-	-				
20.50																
21.00			15.50	15.50	16.09	SPT	40	52	-	>100	-	-				
21.50																
22.00			16.00	14.53	16.00	SPT	60	-	-	>100	-	-				
22.50																
23.00			17.00	17.00	17.50	SPT	65	-	-	>100	-	-				
23.50																
24.00			17.50	17.50	18.50	SPT	62	-	-	>100	-	-				
24.50																
25.00			18.50	18.50	19.00	SPT	52	50/10 cm	-	>100	-	-				
25.50																
26.00			19.00	19.00	20.00	SPT	55	-	-	>100	-	-				
26.50																
27.00			19.50	20.00	20.50	SPT	50/14 cm	-	-	>100	-	-				
27.50																
28.00			20.50	20.50	21.50	SPT	59	-	-	>100	-	-				
28.50																
29.00			21.50	21.50	22.00	SPT	50/12 cm	-	-	>100	-	-				
29.50																
30.00			22.00	20.50	22.00	SPT	50/13 cm	-	-	>100	-	-				
30.50																
31.00			23.00	23.00	2.50	SPT	50/14 cm	-	-	>100	-	-				
31.50																
32.00			23.50	23.50	24.50	SPT	50/13 cm	-	-	>100	-	-				
32.50																
33.00			24.50	24.50	25.00	SPT	60/12 cm	-	-	>100	-	-				
33.50																
34.00			25.00	25.00	25.10	SPT	70	-	-	>100	-	-				
34.50																
22.60 to 25.00m																

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : IBH 49

Location : Hirma, Talabira

Depth of Termination : 25.0 M

Co-ordinates: E 1899, N 351

Depth of Water Table : Encountered at 2.50m depth during investigation

Date of Start: 26-06-2025

Date of Completion: 27-06-2025

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 197.20 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks	
						From m	To m		N ₁	N ₂	N ₃	N				
Rotary drilling method	0.00	Not Used		Brownish, fine to very fine grained, clayey sand with occasional gravels (SC) 0.00 to 1.70m	0.00	0.00	1.00	DS	-	-	-	-	-	-		
	0.50															
	1.00				1.00	2.00	SPT	4	5	9	14	-	-			
	1.50															
	2.00				Reddish brown, fine to medium grained, cemented clayey sand sand rock 1.70 to 6.30m	2.00	2.00	2.50	SPT	20	24	30	54	-	-	
	2.50					2.50	3.00	SPT	21	32	40	72	-	-		
	3.00					3.00	3.50	SPT	20	35	45	80	-	-		
	3.50					3.50	4.00	SPT	18	28	33	61	-	-		
	4.00					4.00	4.50	SPT	12	21	55	76	-	-		
	4.50					4.50	5.00	SPT	14	25	62	87	-	-		
	5.00			5.00		5.50	SPT	15	28	50	78	-	-			
	5.50			5.50		6.00	SPT	55	-	-	>100	-	-			
	6.00			6.00		6.50	SPT	60	-	-	>100	-	-			
	6.50			6.50		7.00	SPT	62	-	-	>100	-	-			
	7.00			Dark reddish brown, fine to very fine grained, indurated clays of intermediate plasticity mud rock (CI) 6.30 to 7.90m	7.00	7.00	7.50	SPT	40	50/1 cm	-	>100	-	-		
	7.50				7.50	8.00	SPT	55/14 cm	-	-	>100	-	-			
	8.00				8.00	8.50	SPT	50/13 cm	-	-	>100	-	-			
	8.50				8.50	9.00	SPT	60	-	-	>100	-	-			
	9.00			Yellowish brown to light brownish red, fine to medium grained, cemented clayey sand sand rock 7.90 to 17.00m	9.00	9.00	9.50	SPT	65	-	-	>100	-	-		
	9.50				9.50	10.00	SPT	50/14 cm	-	-	>100	-	-			
	10.00				10.00	11.00	SPT	50/13 cm	-	-	>100	-	-			
	10.50															
	11.00				11.00	11.50	SPT	50/12 cm	-	-	>100	-	-			
	11.50				11.50	12.50	SPT	50/13 cm	-	-	>100	-	-			
	12.00				12.50	13.00	SPT	50/14 cm	-	-	>100	-	-			
	12.50				13.00	14.00	SPT	50/13 cm	-	-	>100	-	-			
	13.00															
	13.50															
	14.00				14.00	14.04	SPT	50/10 cm	-	-	>100	-	-			
	14.50				14.50	15.50	SPT	50/10 cm	-	-	>100	-	-			
	15.00															
	15.50				15.50	16.09	SPT	50/9 cm	-	-	>100	-	-			
	16.00				16.00	17.50	SPT	50/8 cm	-	-	>100	-	-			
16.50																
17.00	Highly weathered, very weak, yellowish brown, fine to medium grained, friable fractured sand rock 17.00 to 19.00m	17.50	16.00	17.50	Core	-	-	-	-	4.00						
17.50		17.50	17.55	SPT	50/5 cm	-	-	>100	-	-						
18.50																
19.00	Moderately weathered, very weak and friable, yellowish brown, fine to medium grained, moderately thickly bedded sand rock	19.00	17.55	19.00	Core	-	-	-	-	41.00	35.00					
19.50																
20.00																
20.50		20.50	19.00	205.00	Core	-	-	-	-	47.00	29.00					
21.00																
21.50																
22.00		22.00	20.50	22.00	Core	-	-	-	-	53.00	35.00					
22.50																
23.00																
23.50		23.50	22.50	23.50	Core	-	-	-	-	47.00	25.00					
24.00																
24.50																
25.00		25.00	23.50	25.10	Core	-	-	-	-	42.00	29.00					
19.00 to 25.00m																

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : IBH 50

Location : Hirma, Talabira

Depth of Termination : 15.0 M

Co-ordinates: E 797, N 2975

Depth of Water Table : Encountered at 3.00m depth during investigation

Date of Start: 01-08-2024

Date of Completion: 02-08-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 197.35 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks	
						From m	To m		N ₁	N ₂	N ₃	N				
Rotary drilling method	0.00	Used		Yellowish brown, very fine grained, clays of high plasticity (CH) 0.00 to 4.50m	0.00	0.00	1.00	DS	-	-	-	-	-	-		
	0.50															
	1.00				1.00	2.00	SPT	1	1	2	3	-	-			
	1.50															
	2.00				2.00	2.50	SPT	1	2	2	4	-	-			
	2.50				2.50	3.00	SPT	1	2	3	5					
	3.00				3.00	3.50	SPT	3	5	7	12	-	-			
	3.50				3.50	4.00	UDS	-	-	-	-					
	4.00				4.00	4.50	SPT	3	5	8	13	-	-			
	4.50				4.50	5.00	UDS	-	-	-	-					
	5.00				5.00	5.50	SPT	7	7	7	14	-	-			
	5.50			Yellowish brown, fine to medium grained, clayey sand (SC) 5.50 to 6.65m	5.50	5.50	6.00	UDS	-	-	-	-				
	6.00				6.00	6.50	SPT	4	9	12	21	-	-			
	6.50				Yellowish brown, fine to very fine grained, sandy clays of high plasticity (CH) 6.65 to 7.60m	6.50	6.50	7.00	SPT	5	6	9	15			
	7.00					7.00	7.50	SPT	5	7	11	18				
	7.50					7.50	8.00	SPT	5	7	12	19				
	8.00					8.00	8.50	SPT	5	6	9	15				
	8.50				Reddish yellowish brown, fine to very fine grained, clayey sand (SC) 7.60 to 10.50m	8.50	8.50	9.00	SPT	6	14	25	39			
	9.00					9.00	9.08	SPT	50/8cm	-	-	>100				
	9.50															
	10.00															
	10.50	Not Used		Moderately weathered, moderately weak, dark greyish brown, fine to medium grained, thickly bedded rock 10.50 to 12.00m	10.50	9.08	10.50	Core	-	-	-	-	72.00	38.00		
	11.00															
	11.50				Moderately weathered, moderately weak, dark greyish brown, fine to medium grained, thinly bedded rock 12.00 to 14.00m	12.00	10.50	12.00	Core	-	-	-	-	62.00		6.00
	12.00															
	12.50															
	+ 13.00															
	13.50			Slightly weathered, moderately weak, dark brownish grey, fine to medium grained, massive rock	13.50	12.00	13.50	Core	-	-	-	-	74.00	10.00		
14.00																
14.50																
15.00																
14.00 to 15.00m																

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : IBH 51

Location : Hirma, Talabira

Depth of Termination : 17.0 M

Co-ordinates: E 776, N 3035

Depth of Water Table : Encountered at 1.50m depth during investigation

Date of Start: 05-08-2024

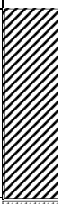

Date of Completion: 07-08-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level:197.51 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks
						From m	To m		N ₁	N ₂	N ₃	N			
Rotary drilling method	0.00	Used		Yellowish brown, very fine grained, clays of high plasticity with occasional gravels (CH) 0.00 to 3.10m	0.00	0.00	1.00	DS	-	-	-	-	-	-	
	0.50														
	1.00				1.00	2.00	SPT	1	1	1	2	-	-		
	1.50														
	2.00				2.00	2.50	SPT	2	2	3	5	-	-		
	2.50				2.50	3.00	UDS	-	-	-	-	-	-		
	3.00			Yellowish brown, fine to medium grained, sandy clays of intermediate plasticity (CI) 3.10 to 5.00m	3.00	3.00	3.50	SPT	2	3	4	7	-	-	
	3.50				3.50	4.00	UDS	-	-	-	-	-	-		
	4.00				4.00	4.50	SPT	3	4	4	8	-	-		
	4.50				4.50	5.00	UDS	-	-	-	-	-	-		
	5.00			Reddish brown to yellowish brown, fine to medium grained, clayey sand with little gravels (SC) 5.00 to 8.60m	5.00	5.00	5.50	SPT	4	6	7	13	-	-	
	5.50				5.50	6.00	UDS	-	-	-	-	-	-		
	6.00				6.00	6.50	SPT	12	16	12	28	-	-		
	6.50				6.50	7.00	SPT	10	12	15	27	-	-		
	7.00				7.00	7.50	SPT	4	5	9	14	-	-		
	7.50				7.50	8.00	SPT	7	10	15	25	-	-		
	8.00				8.00	8.50	SPT	9	12	17	29	-	-		
	8.50				8.50	9.00	SPT	9	14	18	32	-	-		
	9.00				9.00	9.50	SPT	37	50/2cm	-	>100	-	-		
	9.50				9.50	10.00	SPT	50/7cm	-	-	>100	-	-		
	10.00			Reddish yellow, fine to very fine grained, sandy clays of low plasticity with some gravels (CL) Mud stone 9.60 to 10.50m	10.00	10.00	10.07	SPT	50/7cm	-	-	>100	-	-	
	10.50														
	11.00	Not Used		Slightly weathered, weak, dark brownish, fine to medium grained, rock with moderately wide spacing of discontinuities 10.50 to 12.50m	11.00	10.07	11.00	Core	-	-	-	-	71.00	38.00	
	11.50														
	12.00			Slightly weathered, weak, dark brownish, fine to very fine grained, massive rock 12.50 to 14.00m	12.50	11.00	12.50	Core	-	-	-	-	74.00	73.00	
	12.50														
	+ 13.00			Slightly weathered, weak, dark brownish, fine to very fine grained, rock with wide spacing of discontinuities 14.00 to 16.00m	14.00	12.50	14.00	Core	-	-	-	-	72.00	50.00	
	13.50														
	14.00			Slightly weathered, weak, dark greyish black, fine to very fine grained, rock with close spacing of discontinuities	15.50	14.00	15.50	Core	-	-	-	-	70.00	36.00	
	14.50														
	15.00														
	15.50														
	16.00														
	16.50														
	17.00				17.00	15.50	17.00	Core	-	-	-	-	90.00	8.00	
16.00 to 17.00m															

Project : BHEL

Bore Hole No. : IBH 52

Location : Hirma, Talabira

Depth of Termination : 16.50 M

Co-ordinates: E -775, N 3126

Depth of Water Table : Encountered at 2.20m depth during investigation

Date of Start: 14-08-2024



























Date of Completion: 17-08-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 197.57 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks
						From m	To m		N ₁	N ₂	N ₃	N			
	0.00	Used		Light brownish, fine to very fine grained, sandy clays of low plasticity (CL) 0.00 to 0.50m	0.00	0.00	1.00	DS	-	-	-	-	-	-	
	0.50			Light brownish and dark brownish,very fine grained, silty clays of intermediate plasticity (CI) 0.50 to 4.20m	1.00	1.00	2.00	SPT	1	1	1	2	-	-	
	1.00				2.00	2.00	2.50	SPT	1	1	2	3	-	-	
	1.50				2.50	2.50	3.00	UDS	-	-	-	-	-	-	
	2.00				3.00	3.00	3.50	SPT	1	2	2	4	-	-	
	2.50				3.50	3.50	4.00	UDS	-	-	-	-	-	-	
	3.00				4.00	4.00	4.50	SPT	2	3	4	7	-	-	
	3.50				4.50	4.50	5.00	SPT	4	6	9	15	-	-	
	4.00				5.00	5.00	5.50	SPT	3	4	9	13	-	-	
	4.50				5.50	5.50	6.00	SPT	3	3	8	11	-	-	
	5.00				6.00	6.00	6.50	SPT	5	7	12	19			
	5.50			6.50	6.50	7.00	SPT	6	9	15	24				
	6.00			7.00	7.00	7.50	SPT	50/13cm	-	-	>100				
	6.50			7.50	7.50	7.64	SPT	50/14cm	-	-	>100				
	7.00			8.00	8.00	9.00	Core	-	-	-	-	46.00	35.00		
	7.50			9.00	9.00	9.50									
	8.00	Not used		Highly weatherd, weak, yellowish brown, fine to very fine grained, rock with moderately close spaced discontinuities 8.00 to 10.00m	7.50	7.50	7.64	SPT	-	-	-	-			
	8.50			10.00	10.00	10.50	Core	-	-	-	-	70.00	30.00		
	9.00			11.00	11.00	12.00	Core	-	-	-	-	68.66	27.23		
	9.50			12.00	12.00	12.50									
	10.00			13.00	13.00	13.50	Core	-	-	-	-	74.00	34.00		
	10.50			14.00	14.00	15.00	Core	-	-	-	-	60.00	33.33		
	11.00			15.00	15.00	16.00									
	11.50			16.00	16.00	16.50	Core	-	-	-	-	91.33	74.66		
	12.00			16.50	16.50										
	12.50														
13.00 to 16.50m															

Project : BHEL

Bore Hole No. : IBH 53

Location : Hirma, Talabira

Depth of Termination : 19.50 M

Co-ordinates : E 776, N 3228

Depth of Water Table : Encountered at 1.70m depth during investigation

Date of Start: 18-08-2024




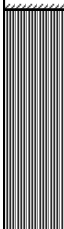


Date of Completion: 29-08-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 197.60m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recov-ery (%)	RQD (%)	Remarks		
						From m	To m		N ₁	N ₂	N ₃	N					
Rotary drilling method	0.00	Used		Yellowish brown, very fine grained, silty clays of intermediate plasticity (CI) 0.00 to 0.80m	0.00	0.00	1.00	DS	-	-	-	-	-	-			
	0.50																
	1.00					1.00	1.00	2.00	SPT	1	2	2	4	-	-		
	1.50																
	2.00						2.00	2.00	2.50	SPT	2	3	3	6	-	-	
	2.50						2.50	2.50	3.00	UDS	-	-	-	-	-	-	
	3.00						3.00	3.00	3.50	SPT	3	3	5	8	-	-	
	3.50						3.50	3.50	4.00	SPT	3	3	6	9	-	-	
	4.00			Brownish yellow, fine to very fine grained, sandy clays of intermediate plasticity (CI) 3.80 to 4.40m	4.00	4.00	4.50	SPT	4	5	6	11	-	-			
	4.50				4.50	4.50	5.00	UDS	-	-	-	-	-	-	-		
	5.00				5.00	5.00	5.50	SPT	16	27	31	58	-	-	-		
	5.50					5.50	5.50	6.00	UDS	-	-	-	-	-	-	-	
	6.00					6.00	6.00	6.50	SPT	50/13cm	-	-	-	>100	-	-	
	6.50					6.50	6.50	7.00	SPT	50/12cm	-	-	-	>100	-	-	
	7.00					7.00	7.00	7.50	SPT	52/10cm	-	-	-	>100	-	-	
	7.50			Light brownish, fine to very fine grained, sandy clays of low plasticity (CL) 7.30 to 8.20m	7.50	7.50	7.57	SPT	50/7cm	-	-	-	>100	-	-		
	8.00		Not used														
	8.50																
	9.00				Highly weathered, moderately weak, light brownish, fine to medium grained, rock with close spacing of discontinuties 8.20 to 10.50m	9.00	7.57	9.00	Core	-	-	-	-	27.85	17.14		
	9.50																
	10.00																
	10.50				Highly weathered, very weak, yellowish brown, fine to medium grained, very weak and friable rock with close spacing of discontinuties 10.50 to 12.00m	10.50	9.00	10.50	Core	-	-	-	-	34.00	10.66		
	11.00																
	11.50																
	12.00				Highly weathered, weak, light brownish, fine to very fine grained, rock with moderately close spacing of discontinuties 12.00 to 13.50m	12.00	10.50	12.00	Core	-	-	-	-	37.33	27.33		
	12.50																
	13.00																
	13.50				Highly weathered, moderately strong, brownish, fine to very fine grained, rock with close spacing of discontinuties 13.50 to 15.00m	13.50	12.00	13.50	Core	-	-	-	-	32.00	10.00		
	14.00																
	14.50																
15.00		Highly weathered, very weak and friable, brownish yellow, fine to very fine grained, rock with close spacing of discontinuties 15.00 to 16.50m	15.00	13.50	15.00	Core	-	-	-	-	36.00	9.33					
15.50																	
16.00																	
16.50		Highly weathered, weak, brownish yellow, fine to medium grained, rock with moderately wide spacing of discontinuties 16.50 to 18.00m	16.50	15.00	16.50	Core	-	-	-	-	55.33	34.00					
17.00																	
17.50																	
18.00		Highly weathered, weak, brownish yellow, fine to medium grained, rock with close spacing of discontinuties 18.00 to 19.00m	18.00	16.50	18.00	Core	-	-	-	-	24.00	8.00					
18.50																	
19.00		Highly weathered, weak, brownish yellow, fine to medium grained, massive rock	19.50	18.00	19.50	Core	-	-	-	-	94.00	64.00					
19.50																	
19.00 to 20.00m																	

Project : BHEL

Bore Hole No. : IBH 54

Location : Hirma, Talabira

Depth of Termination : 16.50 M

Co-ordinates: E 815, N 3178

Depth of Water Table : Encountered at 2.15m depth during investigation

Date of Start: 14-08-2024




Date of Completion: 17-08-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 197.12 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks			
						From m	To m		N ₁	N ₂	N ₃	N						
	0.00	Used		Brownish, very fine grained, silty clays of intermediate plasticity with occasional gravels (CI)	0.00	0.00	1.00	DS	-	-	-	-	-	-				
	0.50																	
	1.00																	
	1.50																	
	2.00																	
	2.50					0.00 to 2.75m	2.00	2.00	2.50	SPT	3	3	4	7		-	-	
	3.00					Yellowish brown, very fine grained, silty clays of intermediate plasticity with occasional gravels (CI)	2.50	2.50	3.00	UDS	-	-	-	-		-	-	
	3.50							3.00	3.00	3.50	SPT	2	3	6		9	-	-
	4.00							3.50	3.50	4.00	UDS	-	-	-		-	-	-
	4.50							4.00	4.00	4.50	SPT	3	4	6		10	-	-
	5.00							4.50	4.50	5.00	UDS	-	-	-		-	-	-
	5.50					Reddish yellow, fine to very fine grained, silty clays of intermediate plasticity (CI)	5.00	5.00	5.50	SPT	8	13	16	29		-	-	
	6.00							5.50	5.50	6.00	SPT	50/12cm	-	-		>100	-	-
	6.50							6.00	6.00	6.50	SPT	56/11cm	-	-		>100	-	-
	7.00							6.50	6.50	7.00	SPT	50/13cm	-	-		>100	-	-
	7.50				7.00		7.00	7.07	SPT	50/7cm	-	-	>100	-	-			
	8.00	Not used		Highly weathered, weak, dark brownish, fine to medium grained, fractured rock	7.50	7.07	7.50	Core	-	-	-	-	17.50	-				
	8.50							7.50	7.50	7.53	SPT	50/3cm	-	-	>100	-	-	
	9.00																	
	9.50							9.00	7.53	9.00	Core	-	-	-	-	23.33	-	
	10.00																	
	10.50					Moderately weathered, moderately weak, brownish, fine to medium grained, fractured rock	10.50	9.00	10.50	Core	-	-	-	-	31.33	-		
	11.00																	
	11.50																	
	12.00							12.00	10.50	12.00	Core	-	-	-	-	54.66	-	
	12.50																	
	13.00			Highly weathered, moderately weak, brownish, fine to medium grained, rock with closely spaced discontinuities	13.50	12.00	13.50	Core	-	-	-	-	71.33	60.00				
	14.00																	
	14.50																	
	15.00							15.00	13.50	15.00	Core	-	-	-	-	71.33	47.33	
	15.50																	
	16.00																	
	16.50				16.50	15.00	16.50	Core	-	-	-	-	95.33	73.33				
13.00 to 16.50m																		

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Project : BHEL

Bore Hole No. : IBH 55

Location : Hirma, Talabira

Depth of Termination : 18.0 m

Co-ordinates: E 815, N 3297

Depth of Water Table : Encountered at 1.60m depth during investigation

Date of Start: 25-08-2024

Date of Completion: 26-08-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 196.750m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks	
						From m	To m		N ₁	N ₂	N ₃	N				
Rotary drilling method	0.00	Used		Yellowish brown, fine to very fine grained, clays of intermediate plasticity with occasional gravels (CI) 0.00 to 2.80m	0.00	0.00	1.00	DS	-	-	-	-	-	-		
	0.50															
	1.00				1.00	2.00	SPT	2	3	3	8	-	-			
	1.50				2.00	2.50	SPT	3	3	4	7	-	-			
	2.00				2.50	3.00	UDS	-	-	-	-					
	2.50															
	3.00			3.00	3.50	SPT	2	3	4	7	-	-				
	3.50			Yellowish brown, fine to very fine grained, sandy clays of intermediate plasticity (CI) 2.80 to 3.40m	3.50	3.50	4.00	UDS	-	-	-	-				
	4.00				4.00	4.50	SPT	2	3	4	7	-	-			
	4.50				4.50	5.00	UDS	-	-	-	-					
	5.00					5.00	5.00	5.50	SPT	6	8	9	17	-		-
	5.50					5.50	6.00	UDS	-	-	-	-				
	6.00						6.00	6.00	6.50	SPT	13	14	17	33		-
	6.50			6.50			7.00	UDS	-	-	-	-				
	7.00				7.00		7.00	7.50	SPT	50/10 cm	-	-	>100	-		-
	7.50				7.50		8.00	SPT	56/6cm	-	-	>100				
	8.00				8.00	8.50	SPT	50/5 cm	-	-	>100	-	-			
	8.50				8.50	8.70	SPT	55/6 cm	-	-	>100	-	-			
	9.00	Not use	9.00		8.70	9.00	Core	-	-	-	-	30.00	-			
	9.50															
	10.00															
	10.50															
	11.00			10.50	9.00	10.50	Core	-	-	-	-	60.00	19			
	11.50															
	12.00				12.00	10.50	12.00	Core	-	-	-	-	56.00	27		
	12.50															
	+ 13.00															
	13.50				13.50	12.00	13.50	Core	-	-	-	-	64.66	33		
14.00																
14.50																
15.00		15.00		13.50	15.00	Core	-	-	-	-	61.33	26				
15.50																
16.00																
16.50																
17.00			16.50	15.00	16.50	Core					62.66	26				
17.50																
18.00																
17.00 to 18.00m																

Project : BHEL

Bore Hole No. : OP52

Location : Hirma, Talabira

Depth of Termination : 20

Co-ordinates: E 908, N 3261

Depth of Water Table : Encountered at 1.60 m depth during investigation

Date of Start: 11-12-2024


Date of Completion: 13-12-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced level: 196.05 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks
						From m	To m		N ₁	N ₂	N ₃	N			
Rotary drilling method	0.00	Not used		Yellowish brown, fine to medium grained, clayey sand (SC) 0.00 to 1.00m	0.00	0.00	1.00	DS	-	-	-	-	-	-	
	0.50														
	1.00			Light yellowish brown, fine to medium grained, sandy clays of intermediate plasticity with occasional gravels (CI) 1.00 to 2.00m	1.00	1.00	2.00	SPT	3	4	5	9			
	1.50														
	2.00			Yellowish brown, fine to very fine grained, clayey sand with occasional gravels (SC) 2.00 to 3.60m	2.00	2.00	2.50	SPT	7	9	15	24			
	2.50														
	3.00														
	3.50														
	4.00			Reddish yellow, fine to medium grained, cementitious silty and clayey sand (SM-SC) 3.60 to 6.10m	4.00	4.00	4.50	SPT	32	50/6 cm	-	>100			
	4.50														
	5.00														
	5.50														
	6.00														
	6.50														
	7.00														
	7.50														
	8.00			Highly weathered, weak, light whitish yellow, fine to medium grained, thinly bedded laminated rock 6.10 to 11.50m	8.00	6.50	8.00	Core	-	-	-	-	34.00	-	
	8.50														
	9.00														
	9.50														
	10.00														
	10.50														
	11.00														
	11.50														
	12.00			Highly weathered, very weak and fraible, fine to medium grained, thinly bedded laminated rock 11.50 to 15.65m	12.50	11.00	12.50	Core	-	-	-	-	30.00	-	
	12.50														
	13.00														
	13.50														
	14.00														
	14.50														
	15.00														
15.50															
16.00	Highly weathered, moderately weak, dark greyish, fine to very fine grained, fractured rock 15.65 to 18.50m	15.50	14.00	15.50	Core	-	-	-	-	39.33					
16.50															
17.00															
17.50															
18.00															
18.50															
19.00	Slightly weathered, weak, light greyish, fine to medium grained, rock with closely spaced discontinuities 18.50 to 20.00m	18.50	17.00	18.50	Core	-	-	-	-	74.00					
19.50															
20.00															
18.50 to 20.00m															

Project : BHEL

Bore Hole No. : OPB

Location : Hirma, Talabira

Depth of Termination : 20.0 m

Co-ordinates: E 1136, N 3661

Depth of Water Table : Encountered at 3.80 m depth during investigation

Date of Start: 01-08-2024


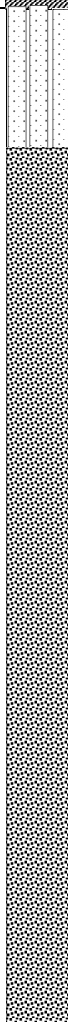
Date of Completion: 05-08-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced level:199.63

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks			
						From m	To m		N ₁	N ₂	N ₃	N						
Rotary drilling method	0.00	Used		Yellowish brown, fine to medium grained, clayey sand with occasional to much gravels (SC) 0.00 to 5.50m	0.00	0.00	1.00	DS	-	-	-	-	-	-				
	0.50																	
	1.00				1.00	2.00	SPT	8	9	10	19							
	1.50																	
	2.00				2.00	2.00	2.50	SPT	9	10	11	21						
	2.50				2.50	2.50	3.00	UDS	-	-	-	-	-	-				
	3.00				3.00	3.00	3.50	SPT	6	6	8	14	-	-				
	3.50				3.50	3.50	4.00	UDS	-	-	-	-						
	4.00				4.00	4.00	4.50	SPT	6	7	8	15						
	4.50				4.50	4.50	5.00	UDS	-	-	-	-	-	-				
	5.00				5.00	5.00	5.50	SPT	9	8	11	19						
	5.50	Not USED		Yellowish brown, fine to medium grained, silty sand with occasional gravels (SM) 5.50 to 7.60m	5.50	5.50	6.00	UDS	-	-	-	-	-	-				
	6.00				6.00	6.50	SPT	53/6 cm	-	-	-	>100	-	-				
	6.50				6.50	7.00	SPT	51/7 cm	-	-	-	>100	-	-				
	7.00				7.00	7.50	SPT	51/13cm	-	-	-	>100						
	7.50				7.50	8.00	UDS	53/13cm	-	-	-	>100	-	-				
	8.00			Yellowish brown, fine to very fine grained, Cemented clayey sand with friable fragments of rock 7.60 to 17.00m	8.00	8.00	8.50	DS	-	-	-	-	-	-				
	8.50				8.50	9.50	SPT	50/2 cm	-	-	-	>100						
	9.00																	
	9.50				9.50	9.50	11.00	SPT	66/13cm	-	-	-	>100					
	10.00																	
	10.50																	
	11.00				11.00	11.00	11.50	SPT	61/12cm	-	-	-	>100	-		-		
	11.50				11.50	11.50	12.50	SPT	55/7 cm	-	-	-	>100	-		-		
	12.00																	
	12.50				12.50	12.50	13.00	SPT	53/7 cm	-	-	-	>100	-		-		
	13.00				13.00	13.00	14.00	SPT	52/3 cm	-	-	-	>100	-		-		
	13.50																	
	14.00				14.00	14.00	14.50	SPT	51/7 cm	-	-	-	>100	-		-		
	14.50				14.50	14.50	14.54	SPT	51/4 cm	-	-	-	>100					
	15.00																	
	15.50	15.50	14.54	15.50	Core	-	-	-	-	3.33	-	-						
16.00	15.50	15.50	15.53	SPT	51/3 cm	-	-	-	>100	-	-							
16.50																		
17.00	Highly weathered, weak, reddish yellow, fine to coarse grained, very weak and friable fractured rock	17.00	15.53	17.00	Core	-	-	-	-	8.00	-	-						
17.50		17.00	17.00	17.03	SPT	51/3 cm	-	-	-	>100	-	-						
18.00																		
18.50		18.50	17.03	18.50	SPT	51/4 cm	-	-	-	>100	-	-						
19.00																		
19.50																		
20.00		20.00	18.50	20.00	Core	-	-	-	-	14.00	-	-						
17.00 to 20.00m																		

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : OPB2

Location : Hirma, Talabira

Depth of Termination : 23.5

Co-ordinates: E 958, N 3319

Depth of Water Table : Encountered at 0.80m depth during investigation

Date of Start: 27-12-2024

Date of Completion: 30-12-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced level: 195.29 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks	
						From m	To m		N ₁	N ₂	N ₃	N				
Rotary drilling method with Hydraulic feed	0.00	Used		Brownish, fine to very fine grained, sandy clays of low plasticity with occasional gravels (CL) 0.00 to 0.40m	0.00	0.00	1.50	DS	-	-	-	-	-	-		
			Reddish brown, fine to coarse grained, clayey sand with much gravels (SC) 0.40 to 1.60m	1.00	1.00	2.00	SPT	4	5	6	11					
	0.50															
	1.00															
	1.50															
	2.00				Light yellowish brown, fine to very fine grained, silty clays of intermediate plasticity with occasional gravels (CI) 1.60 to 2.90m	2.00	2.00	2.50	SPT	5	6	8	14	-	-	
	2.50					2.50	2.50	2.00	SPT	4	5	6	11			
	3.00					3.00	3.00	3.50	SPT	5	7	10	17	-	-	
	3.50				Dark brownish, fine to very fine grained, silty clays of intermediate plasticity with occasional gravels (CI) 2.90 to 4.80m	3.50	3.50	4.00	SPT	13	16	19	25			
	4.00					4.00	4.00	4.50	SPT	19	23	27	50			
	4.50					4.50	4.50	5.00	SPT	27	50/11 cm	-	>100			
	5.00					5.00	5.00	5.50	SPT	33	50/11 cm	-	>100			
	5.50					5.50	5.50	6.00	SPT	30	50/10 cm	-	>100			
	6.00				Yellowish brown, fine to very fine grained, cemented clayey sand with little gravels (SC) 4.80 to 8.10m	6.00	6.00	6.50	SPT	50/13 cm	-	-	>100	-	-	
	6.50					6.50	6.50	7.00	SPT	50/12 cm	-	-	>100		-	
	7.00					7.00	7.00	7.50	SPT	50/11 cm	-	-	>100			
	7.50					7.50	7.50	8.00	SPT	50/13 cm	-	-	>100			
	8.00					8.00	8.00	8.09	SPT	50/9 cm	-	-	>100			
	8.50					8.50	8.09	8.50	Core	-	-	-	-	13.50		
	9.00					8.50	8.50	8.53	SPT	50/3 cm	-	-	>100			
	9.50															
	10.00					10.00	8.53	10.00	Core	-	-	-	-	9.33		
	10.50					10.00	10.00	10.04	SPT	50/4 cm	-	-	>100			
	11.00															
	11.50					11.50	10.04	11.50	Core	-	-	-	-	30.66		-
	12.00															
	12.50															
	+ 13.00					13.00	11.50	13.00	Core	-	-	-	-	26.00		
	13.50															
	14.00															
	14.50				14.50	13.00	14.50	Core	-	-	-	-	36.00	7.33		
	15.00		Not used		Highly weathered, moderately weak, greyish black, fine to medium grained, rock with close spacing of discontinuities 14.50 to 17.50m	16.00	14.50	16.00	Core	-	-	-	-	58.00	13.33	
	15.50															
	16.00															
	16.50															
	17.00															
	17.50				Moderately weathered, moderately weak, dark brownish, fine to medium grained, fractured rock 17.50 to 19.00m	17.50	16.00	17.50	Core	-	-	-	-	53.33	-	
	18.00															
	18.50															
	19.00				Highly weathered, moderately weak, greyish black, fine to medium grained, rock with close spacing of discontinuities 19.00 to 20.50m	19.00	17.50	19.00	Core	-	-	-	-	31.33	15.33	
	19.50															
	20.00															
	20.50				Highly weathered, moderately weak, dark blackish brown, fine to medium grained, rock with close spacing of discontinuities 20.50 to 22.00m	20.50	19.00	20.50	Core	-	-	-	-	31.33	20.66	
	21.00															
	21.50															
	22.00				Moderately weathered, moderately weak, dark brownish, fine to medium grained, rock with moderately wide spacing of discontinuities 22.00 to 23.00m	22.00	20.50	22.00	Core	-	-	-	-	64.66	33.33	
	22.50															
	23.00				Moderately weathered, moderately weak, dark brownish, fine to medium grained, massive rock	23.50	22.00	23.50	Core	-	-	-	-	88.66	63.33	
23.50																
23.00 to 24.00m																

Project : BHEL
 Bore Hole No. : OPB5
 Location : Hirma, Talabira
 Depth of Termination : 25
 Co-ordinates : E 1160, N 3318
 Depth of Water Table : Encountered at 3.30m depth during investigation

Date of Start: 11-07-2024
 Date of Completion: 16-07-2024
 Diameter of Bore: 150mm and Nx size
 Bit Used: Soil Surface Bit and NX Size
 Reduced level: 198.85 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks	
						From m	To m		N ₁	N ₂	N ₃	N				
Rotary drilling method	0.00	Used		Reddish yellowish brown, fine to medium grained, sandy clays of intermediate plasticity (CI) 0.00 to 2.60m	0.00	0.00	1.50	DS	-	-	-	-	-	-		
	0.50				1.00	1.00	2.00	SPT	3	3	3	6	-	-		
	1.00															
	1.50															
	2.00															
	2.50			Yellowish brown, fine to very fine grained, sandy clays of high plasticity (CH) 2.60 to 4.30m	2.50	2.50	2.00	UDS	-	-	-	-	-	-		
	3.00				3.00	3.40	SPT	5	7	7	14	-	-			
	3.50				3.50	4.00	UDS	-	-	-	-	-	-			
	4.00				4.00	4.50	SPT	6	8	12	20	-	-			
	4.50				4.50	5.00	SPT	8	14	21	35	-	-			
	5.00			Yellowish brown, fine to very fine grained, clays of high plasticity (CH) 4.30 to 5.60m	5.00	5.00	5.50	SPT	6	7	11	18	-	-		
	5.50				5.50	6.00	UDS	-	-	-	-	-	-			
	6.00				6.00	6.50	SPT	8	10	17	27	-	-			
	6.50				6.50	7.00	UDS	-	-	-	-	-	-			
	7.00				Yellowish brown, very fine grained, clays of high plasticity (CH) 6.70 to 8.40m	7.00	7.00	7.50	SPT	3	4	6	10	-		-
	7.50			7.50		8.00	UDS	-	-	-	-	-	-			
	8.00			8.00		8.50	SPT	4	5	10	15	-	-			
	8.50			8.50		9.00	UDS	-	-	-	-	-	-			
	9.00			Yellowish brown, fine to medium grained, clayey sand (SC) 8.40 to 10.70m		9.00	9.00	9.50	SPT	3	3	4	7	-		-
	9.50				9.50	10.00	SPT	4	5	5	10	-	-			
	10.00				10.00	11.00	SPT	5	6	7	13	-	-			
	10.50				Yellowish brown, fine to medium grained, silty sand (SM) 10.70 to 12.90m	11.00	11.00	11.50	SPT	7	13	16	29	-		-
	11.50					11.50	12.50	SPT	11	14	17	31	-	-		
	12.00			12.00		13.00	SPT	10	16	22	38	-	-			
	12.50			12.50		13.00	SPT	10	16	22	38	-	-			
	13.00			Dark greyish brown, fine to very fine grained, sandy clays of intermediate plasticity with little gravels (CI) 12.90 to 14.30m		13.00	13.00	14.00	SPT	12	17	37	54	-		-
	13.50				13.50	14.00	SPT	12	17	37	54	-	-			
	14.00				14.00	14.45	SPT	31	50/8 cm	-	>100	-	-			
	14.50				Highly weathered, moderately weak, dark blackish grey, very fine grained, thinly bedded rock 14.30 to 18.50m	15.00	14.45	15.50	Core	-	-	-	-	28.66		8.00
	15.50					15.50	17.00	Core	-	-	-	-	62.00	11.33		
	16.00			17.00		15.50	17.00	Core	-	-	-	-	62.00	-		
	16.50			17.50		15.50	17.00	Core	-	-	-	-	62.00	-		
17.00	Moderately weathered, weak, dark blackish grey, very fine grained, thinly bedded rock 18.50 to 20.50m	18.50	17.00	18.50		Core	-	-	-	-	52.00	39.33				
17.50		18.50	17.00	18.50	Core	-	-	-	-	52.00	39.33					
18.00		19.00	18.50	20.00	Core	-	-	-	-	72.66	44.66					
18.50		19.50	18.50	20.00	Core	-	-	-	-	72.66	44.66					
19.00		Slightly weathered, weak, dark blackish grey, very fine grained, moderately thickly bedded rock 20.50 to 21.50m	20.00	18.50	20.00	Core	-	-	-	-	72.66	44.66				
19.50	20.50		20.00	21.50	Core	-	-	-	-	84.00	70.00					
20.00	21.00		20.00	21.50	Core	-	-	-	-	84.00	70.00					
20.50	21.50		20.00	21.50	Core	-	-	-	-	84.00	70.00					
21.00	Slightly weathered, moderately weak, dark brownish grey, very fine grained, massive rock		21.50	20.00	21.50	Core	-	-	-	-	84.00	70.00				
21.50		22.00	21.50	23.00	Core	-	-	-	-	88.00	72.00					
22.00		22.50	21.50	23.00	Core	-	-	-	-	88.00	72.00					
22.50		23.00	21.50	23.00	Core	-	-	-	-	88.00	72.00					
23.00		23.50	21.50	23.00	Core	-	-	-	-	88.00	72.00					
23.50	Slightly weathered, moderately weak, dark brownish grey, very fine grained, massive rock	24.00	23.00	24.50	Core	-	-	-	-	72.66	62.00					
24.00		24.50	23.00	24.50	Core	-	-	-	-	72.66	62.00					
24.50		25.00	24.50	25.00	Core	-	-	-	-	88.00	37.00					
25.00		25.00	24.50	25.00	Core	-	-	-	-	88.00	37.00					
25.00		25.00	24.50	25.00	Core	-	-	-	-	88.00	37.00					
21.50 to 25.00m																

21.50 to 25.00m

Project : BHEL

Bore Hole No. : BH 48

Location : Hirma, Talabira

Depth of Termination : 25.0 M

Co-ordinates: E 1219, N 3291

Depth of Water Table : Encountered at 4.10 m depth during investigation

Date of Start: 20-06-2024

Date of Completion: 22-06-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced level: 200.630 m

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks
						From	To		N ₁	N ₂	N ₃	N			
						m	m								
Rotary drilling method	0.00	Used		Dark brownish, fine to medium grained, clayey sand with little gravels (SC) 0.00 to 0.60m	0.00	0.00	1.50	DS	-	-	-	-	-	-	
	0.50			Reddish yellow, very fine grained, silty clays of intermediate plasticity with occational gravels (CI) 0.60 to 3.70m	1.00	1.00	2.00	SPT	3	3	5	8	-	-	
	1.00				2.00	2.00	2.50	SPT	5	7	9	16	-	-	
	1.50				2.50	2.50	2.00	SPT	5	8	13	21	-	-	
	2.00				3.00	3.00	3.40	SPT	5	7	12	19	-	-	
	2.50				3.50	3.50	4.00	UDS	-	-	-	-	-	-	
	3.00			Light brownish yellow, very fine grained, clays of high plasticity (CH) 3.70 to 8.50m	4.00	4.00	4.50	SPT	8	10	12	22	-	-	
	3.50				4.50	4.50	5.00	SPT	9	12	15	27	-	-	
	4.00				5.00	5.00	5.50	SPT	-	-	-	-	-	-	
	4.50				5.50	5.50	6.00	UDS	-	-	-	-	-	-	
	5.00				6.00	6.00	6.50	SPT	-	-	-	-	-	-	
	5.50				6.50	6.50	7.00	UDS	-	-	-	-	-	-	
	6.00				7.00	7.00	7.50	SPT	5	9	12	21	-	-	
	6.50				7.50	7.50	8.00	UDS	-	-	-	-	-	-	
	7.00			Light brownish yellow, very fine grained, sandy clays of low plasticity (CL) 8.50m to 9.70m	8.00	8.00	8.50	SPT	7	8	14	22	-	-	
	7.50				8.50	8.50	9.00	UDS	-	-	-	-	-	-	
	8.00			Reddish yellow, fine to very fine grained, clayey sand with occational gravels (SC) 9.70 to 11.00m	9.00	9.00	9.50	SPT	6	6	9	15	-	-	
	8.50				9.50	9.50	10.00	UDS	-	-	-	-	-	-	
	9.00				10.00	10.00	11.00	SPT	5	8	11	19	-	-	
	9.50			Light greyish yellow and slightly greenish fine to medium grained, silty sand with little plastic fines (SM) 11.00 to 14.80m	11.00	11.00	11.50	UDS	-	-	-	-	-	-	
	10.00				11.50	11.50	12.50	SPT	4	7	12	19	-	-	
	10.50				12.50	12.50	13.00	SPT	7	9	13	22	-	-	
	11.00				13.00	13.00	14.00	SPT	7	8	13	21	-	-	
	11.50			Highly weathered, very weak, very thinly laminated/foliated, dark greenish grey, very fine grained, SHALE mixed with greenish grey, fine to very fine grained, clays of intermediate plasticity 14.80 to 15.70m	14.00	14.00	14.50	SPT	9	11	12	23	-	-	
	12.00				14.50	14.50	15.50	SPT	8	9	15	24	-	-	
	12.50				15.50	15.50	17.00	SPT	50/12 cm	-	-	>100	-	-	
	13.00			Highly weathered, very weak, dark greenish grey, very fine grained, very thinly bedded, foliated SHALE 15.70 to 20.00m	17.00	17.00	17.03	SPT	50/3 cm	-	-	>100	-	-	
	13.50				18.50	17.03	18.50	Core	-	-	-	-	12.00	-	
	14.00				18.50	18.50	18.54	SPT	50/4 cm	-	-	>100	-	-	
	14.50				20.00	18.54	20.00	Core	-	-	-	-	32.00	7.00	
	15.00	Not used	Moderately weathered, weak, dark greenish grey, very fine grained, very thinly bedded, foliated SHALE 20.00 to 22.00m	21.00	20.00	21.50	Core	-	-	-	-	58.00	14.00		
	15.50			22.00	21.50	23.00	Core	-	-	-	-	77.00	57.00		
	16.00		Slightly weathered, weak, dark greenish grey, very fine grained, very thinly bedded, foliated SHALE	23.00	21.50	23.00	Core	-	-	-	-	77.00	57.00		
16.50	23.50			21.50	24.50	Core	-	-	-	-	75.00	54.00			
17.00	24.00			23.00	24.50	Core	-	-	-	-	58.00	20.00			
17.50	24.50			23.00	24.50	Core	-	-	-	-	58.00	20.00			
18.00	22.00 to 25.00m		25.00	24.50	25.00	Core	-	-	-	-	58.00	20.00			
18.50			25.00	24.50	25.00	Core	-	-	-	-	58.00	20.00			
19.00			25.00	24.50	25.00	Core	-	-	-	-	58.00	20.00			
19.50			25.00	24.50	25.00	Core	-	-	-	-	58.00	20.00			
20.00			25.00	24.50	25.00	Core	-	-	-	-	58.00	20.00			

Project : BHEL

Bore Hole No. : OPB6

Location : Talabira

Depth of Termination : 17.0 M

Co-ordinates: E 831, N 3034

Depth of Water Table : Encountered at 2.60m depth during investigation

Date of Start: 04-08-2024

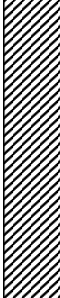
Date of Completion: 05-08-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 197.34 M

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks
						From m	To m		N ₁	N ₂	N ₃	N			
Rotary drilling method	0.00	Not used		Yellowish brown, very fine grained, clays of high plasticity (CH) 0.00 to 4.30m	0.00	0.00	1.00	DS	-	-	-	-	-	-	
	0.50														
	1.00														
	1.50														
	2.00														
	2.50														
	3.00														
	3.50														
	4.00														
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	15.00														
	15.50														
	16.00														
	16.50														
	17.00														
16.00 to 17.00m															

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Project : BHEL

Bore Hole No. : OPB 14

Location : Talabira

Depth of Termination : 16.5 M

Co-ordinates: E 814, N 2918

Depth of Water Table : Encountered at 2.60m depth during investigation

Date of Start: 30-07-2024

Date of Completion: 31-07-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 197.18

BORE LOG DATA SHEET

Method of Boring	Depth m	Casing	Notation	Soil Description	Depth of Sample m	Drill Run		Type of Sample	SPT N Value/Penetration of S.S.S				Core Recovery (%)	RQD (%)	Remarks
						From m	To m		N ₁	N ₂	N ₃	N			
Rotary drilling method	0.00	used		Yellowish brown, very fine grained, clays of high plasticity (CH)	0.00	0.00	1.00	DS	-	-	-	-	-	-	
	0.50				1.00 to 2.60m	1.00	2.00	SPT	1	1	2	3	-	-	
	1.00														
	1.50														
	2.00														
	2.50														
	Yellowish brown, fine to very fine grained, sandy clays of intermediate plasticity (CI) 2.60 to 3.50m		2.50	2.50	3.00	UDS	-	-	-	-	-	-	-		
			3.00	3.00	3.50	SPT	6	8	11	19	-	-			
			3.50	3.50	4.00	UDS	-	-	-	-	-	-			
			4.00	4.00	4.50	SPT	5	7	7	14	-	-			
			4.50	4.50	5.00	UDS	-	-	-	-	-	-			
	Yellowish brown, very fine grained, clays of high plasticity (CH) 3.50 to 5.60m		5.00	5.00	5.50	SPT	5	8	9	17	-	-			
			5.50	5.50	6.00	SPT	6	7	11	18	-	-			
			6.00	6.00	6.50	SPT	6	8	11	19	-	-			
			6.50	6.50	7.00	SPT	7	8	10	18	-	-			
			7.00	7.00	7.50	SPT	5	6	9	15	-	-			
	Yellowish brown, fine to medium grained, clayey sand (SC) 5.60 to 6.70m		7.50	7.50	8.00	SPT	27	50/7cm	-	>100	-	-			
			8.00	8.00	8.50	SPT	15	22	29	51	-	-			
			8.50	8.50	9.00	SPT	9	13	27	40	-	-			
			9.00	9.00	9.50	SPT	26	20	34	54	-	-			
			9.50	9.50	10.00	SPT	9	18	22	40	-	-			
	Not used	10.00		Yellowish brown, fine to medium grained, clayey sand with some gravels (SC) 10.00 to 11.10m	10.00	10.00	11.00	SPT	5	19	27	46	-	-	
		10.50													
		11.00													
		Slightly weathered, moderately weak, dark blackish brown, fine to very fine grained, massive rock 11.10 to 13.50m		11.50	11.00	11.00	11.05	SPT	50/5cm	-	-	>100	-	-	
				12.00	12.00	11.05	12.00	Core	-	-	-	-	73.00	66.00	
				12.50											
13.00				13.50	12.00	13.50	Core	-	-	-	-	68.00	36.00		
13.50															
14.00															
14.50															
15.00				15.00	13.50	15.00	Core	-	-	-	-	68.00	48.00		
15.50															
16.00															
16.50	16.50	15.00	16.50	Core	-	-	-	-	86.00	43.00					
13.50 to 16.50m															