

PROJECT	SUBJECT	DOCUMENT NO.	REV.	SECTION
NLC India Limited NLC Talabira Thermal Power Project- 3x800 MW Jharsuguda, Odisha	Geotechnical Investigation Report Part-2 (Compound Wall Area)	PE-DC-511-602-C001A	4	
				SHEET NO.
				1



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

**GEOTECHNICAL INVESTIGATION REPORT
PART-2 (COMPOUND WALL AREA)**

BHEL DOCUMENT NO. PE-DC-511-602-C001A

(REVISION R4)

**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-2	Compound wall Area
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-2 (Compound Wall Area)



3 X 800 MW NLC Talabira Thermal Power Project
EPC Package



COMMENT RESOLUTION SHEET									
DOC TITLE		Geotechnical Investigation Report Part - 2							
BHEL DOC NO.		PE-DC-511-602-C001							
BHEL UNIT		PEM- NOIDA							
Sl. No.	Dwg Ref	NLCIL/DCPL Comments: (Rev No. 00) Date: 04.12.2024 Approval Category : - 3	BHEL Reply dated 18.12.2024	NLCIL Comments: (Rev No. 01) Date: 28.12.2024 Approval Category : - 3	BHEL Reply dated 10.01.2025	NLCIL Comments: (Rev No. 02) Date: 18.01.2025 Approval Category : - 3	BHEL Reply dated 21.01.2025	NLCIL Comments: (Rev No. 03) Date: 22.01.2025 Approval Category : - 2	BHEL Rteply dated 22.11.2025
Section-B Comments									
1	General	BHEL have submitted Geotechnical investigation report Part-2 with the same document number as part-1. It is not possible to maintain two separate documents with same number. BHEL shall correct document number.	Geotechnical Investigation report for this project has been divided in different parts and mentioned in the revised report R1.		Point closed		Point closed		-
2	General	BHEL shall mention the details of proposed number of parts/volumes for Soil investigation report including detailed list of tests / list of areas being covered in each Soil report part/volume. Accordingly, for the recommendations with respect to particular area corresponding Soil report part/volume shall be referred.	Geotechnical Investigation report for this project has been divided in different parts and mentuioned in the revised report R1.		Point closed		Point closed		-
3	General	BHEL shall include Summary of bearing capacity recommendations for Open foundations and Summary of pile capacity recommendations subsequent to Limitations in page 8 as maintained in part-1 report.	Incorporated in revised report R1.		Point closed		Point closed		-
4	General	Table of contents with page numbers shall be included for easy reference.	Incorporated in revised report R1.		Point closed		Point closed		-
5	General	If boreholes in Section-A related area are to be used for works related to Section-B Buildings/structres, Lab test results, borelog and other details shall be repeated in Section-B related volume also. Bearing capacity and pile capacity calculations as per that borehole shall be conducted in line with terms and conditions as per Section-B works. For example, please refer BH-169 in this report.	Noted,		Point closed		Point closed		-
6	General	Any general updates being performed in Part-1 report based on NLCIL/DCPL comments shall be incorporated in Part-2 report also.	Noted.		Point closed		Point closed		-
Section-A Comments									
7	Report	It is noted that out of 24 boreholes & 4 trial pits for Compound wall, only 14 boreholes are covered in Part 2 Soil report. M/s BHEL may name the report as Part 2A and submit remaining borehole & 4 trail pit details for compound wall as Part 2B	Incorporated in revised report R1.	---	Point closed	-----	Point closed	-----	-
8	Report	It is noted that recommendation for 4 boreholes located on N-W side is pile foundation due to depth of filling > 3 m. In the report it is stated that as the properties of fill material is not known,SPT value of 22 is assumed in finding out pile capacity. a) M/s BHEL to list methods to ensure SPT value of fill >=22. b) Further as per 9(1) of report. Initial and routine pile load tests shall be carried out on the piles at site as per IS: 2911 Part 4. It is understood that pile will be tested to find out initial pile capacity after completion of site grading along compound wall.	In revised report R1, pile foundation is considered where ever filling with respect to FGL is more than 1.5 m. a) Propertiees of fill material are deleted from this report. B) Noted.	---	Point closed	-----	Point closed	-----	-
9	Report	As per SBC calculation based on settlement criteria, equation mentioned in Page 53 of 144, $S_i+S_c = C_d \cdot q_{net} \cdot B \cdot (1-u_2)/E + mvHP$. Where B represents width of foundation. In sample calculation, width of foundation is 3 m. However, while substituting and making calculation, 3.00/2 is used as B instead of 3 in page 54. To be reviewed and corrected. Accordingly, SBC calculation based on settlement criteria for BH 169,171,1 where B/2 is used in annexures may be reviewed and corrected.	The settlement at the center of the foundation was computed, which is why the value of B has been taken as B/2. Reference: "Foundation Analysis and Design," Fifth Edition, Joseph E. Bowles.	For settlement calculations at the centre of footing, Width of Footing B shall be adopted instead of B/2.M/s BHEL may review the same.	Incorporated in the revised report	-----	Point closed	-----	-
10	Report	It is further noted that Immediate settlement and consolidation settlement is used for calculation of safe bearing pressure for Boreholes, BH 169, 171, 1. However, Immediate settlement alone is used for calculating safe bearing pressure for BH 97, 99,69,3, 7, 5, 36. It is understood that, consolidation settlement is predominant in cohesive soil. However, It may be reviewed if whether Si and Sc need be considered for all the boreholes while arriving at Safe bearing pressure.	Reviewed and it is order.	Settlement shall be calculated based on the type of soil	It is to be noted that cohesionless strata as well as cohesive soil strata is encountered in the influence depth below founding level for BH-1 & 3. Hence, immediate as well as consolidation settlement has been considered for BH-1&3. While only cohesionless strata is encountered in the influence depth below foundation level in other boreholes therefore only immediate settlement is considered.	-----	Point closed	-----	-
11	Report	As per table 5 of IS 2911, Part 1, Sec 2, 2010, Pile behaviour is considered as short rigid pile when $L \leq 2T$, However, in Cl. 3.4 of Appendix 9 and 10, pile is considered as short pile mentioning $L < 4T$. To be reviewed and corrected. Further calculation for stiffness factor as per IS 2911 part-1 section-2 may be added.	In the revised report, all the piles are classified as long piles, i.e., $L > 4T$. Additionally, the calculation for the stiffness factor, as per IS 2911 Part-1, Section-2, has been included in the revised report.	---	Point closed	-----	Point closed	-----	-
12	Report	Further in Cl. 3.4 of Appendix 9 and 10, grade of concrete for pile is mentioned as M30. The same shall be ensured in compound wall drawing.	Grade of concrete for pile is M30. It shall be mentioned in the compound wall drawing.	---	Point closed	-----	Point closed	-----	-
13	Report	Further, in Cl. 3.4 of Appendix 9 and 10, lateral capacity may be summarized using available software. Name of software and relevant software out put files may be enclosed for reference. In case of short pile, possibility of using Brom's method to calculate pile capacity may be explored.	In the revised report, all the piles are classified as long piles, i.e., $L > 4T$. Therefore, the use of Brom's method is not required.	---	Point closed	-----	Point closed	-----	-
14	Report	As per recommendations presented in page 5, BH 10,2,85 and 11 are pile foundation. However, Annexure 9 and 10 covers only BH 2 and 85. BH 10 and 11 may be also be included in report.	Incorporated in revised report R1.	Not valid.Report revised.	Point closed	-----	Point closed	-----	-
15	Report	It is suggested a layout covering boreholes mentioned in report for compound wall area alone for better understanding of report.	Incorporated in revised report R1.	---	Point closed	-----	Point closed	-----	-
16	Report	All borelogs to be witnessed by NLCIL executives at site. NLCIL team authenticated borelogs may be enclosed in report.	Signature of NPCIL executives at site are pending from NPCIL end. The same shall be incorporated after receipt of the same.	Noted,(NPCIL typo to be corrected as NLCIL)	Point closed	-----	Point closed	-----	-
17	Report	Table of Contents (TOC) with sl no,description and page number for all sections and annexures shall be added.	Incorporated in revised report R1.	---	Point closed	-----	Point closed	-----	-
18	Report	It is noted that Swelling pressure and free swell index is not tested. M/s BHEL to find out whether the soil is expansive nature by testing swelling pressure and free swell index. Recommendations w.r.t swelling nature of soil to be added in Conclusion.	Test results of swelling pressure and free swell index shall be incorporated after completion of the same.	Not enclosed.	Point closed	-----	Point closed	-----	-
19	Report	Chemical analysis of soil sample may be added in report.	Incorporated in revised report R1.	---	Point closed	-----	Point closed	-----	-
20	Report	In page 113, BH-37 manual log sheets are enclosed,which is not relevant to the report.May be checked and deleted	Deleted in revised report R1.	---	Point closed	-----	Point closed	-----	-
21	Report	In page 121 to 126, BH-87 manual log sheets are enclosed,which is not relevant to the report.May be checked and deleted	Deleted in revised report R1.	---	Point closed	-----	Point closed	-----	-
22	Report	It is suggested that open foundation can be adopted for Cutting area and Pile foundation for Filling area in line with Cl. 3, Table covered in Part II, Ch II, Vol IB (Section A). Accordingly recommendation for BH 169,171,1 to be reviewed and corrected.	In revised report R1, pile foundation is considered where ever filling with respect to FGL is more than 1.5 m.	---	Point closed	-----	Point closed	-----	-
23				Pg 11-clause 6.3-it is mentioned that "From preliminary screening criteria, soil is not likely to undergo shear strength loss in seismic event, though on completion of other confirmatory tests, liquefaction analysis shall be performed". The details of other tests shall be furnished	Suitably corrected in the revised report.	-----	Point closed	-----	-
24				Pg 11-clause 7: It is mentioned that "Open foundations are suitable in areas with soil cuts or where filling depth is less than 3.0 meters." To be reviewed and corrected as 1.5m.	Incorporated into the revised report.	-----	Point closed	-----	-
25				Pg 11-clause 7: It is mentioned that "The safe load capacities of end-bearing piles, including compression, uplift, and lateral capacities, are calculated for as shown in the table No. and detailed in the appendices for different zones." The wording end bearing shall be checked and corrected. Also, the table No: shall be included in the report.	Incorporated into the revised report.	-----	Point closed	-----	-
26				Pg 11-clause 7: It is mentioned that "The characteristic of soil in filling for raising FGL is not known at this stage. For lateral load capacity calculations the SPT N value has been considered as 10. It is therefore necessary that the filled up soils between FGL and NGL shows SPT N value of at least 10 failing which the lateral load capacity suggested in point 6.0 above shall have to be reviewed.". The wording "lateral load capacity suggested in point 6.0" shall be checked and point no: shall be updated.	Suitably corrected in the revised report.	-----	Point closed	-----	-
27				Under Pg 14 --" Recommendation for RCC Bored cast-in-situ Pile Capacity as per technical specification" and under Pg 15 "Summary for RCC Bored cast-in-situ Pile Capacity" are furnished respectively. Clarification on difference in the pile capacities given under pg 14 and 15 may be given in details and also the final recommended SBC shall be furnished inline with technical specifications along with reference clauses.	The pile capacity provided on page 15 represents the actual capacity obtained from calculations, while the pile capacity mentioned in the page no 14 is the restricted value as per reference: Clause 3.02.00 Vol. 2-G2/ Part-A/ Section-V Bored Cast in Situ Concrete Pile. Hence the same is in order.	-----	Point closed	-----	-

28				<p>Pg 18-Under summary of allowable bearing pressure based on shear and settlement criteria, the RL of the foundation shall be included in the report at locations as mentioned below:</p> <p>I. Pg18-For BH-5,7,99</p> <p>II. Pg19-For BH-3</p> <p>III. Pg20-For BH-69</p> <p>IV. Pg21-For BH-36</p>	Incorporated into the revised report.	-----	Point closed	-----	-
29				<p>Pg 22-The design parameters of BH 171,99,5 shall also be included in the report.</p>	Since the mentioned boreholes are not being used for the design calculation of safe bearing capacity and pile capacity, design parameters for those boreholes are not mentioned.	-----	Point closed	-----	-
30				<p>Pg 24 under design paraments for BH 2 the filling height is mentioned as 8.35m. However, as per pg 12, the filling height under BH 2 is mentioned as 7.8m. To be reviewed and corrected.</p>	Incorporated into the revised report.	-----	Point closed	-----	-
31				<p>Pg 27-Appendix 1-The following shall be checked and corrected:</p> <p>I.Wherever, Rectangular isolated footing shall be corrected as Square footing.</p> <p>II.Type of failure considered as General shear failure shall be corrected as Local shear failure.</p> <p>III.The factor N_c, N_q, N_r shall be calculated for the effective ϕ value.</p>	As per IS 6403, mixed shear failure is considered for calculation of SBP and reference of the same is included in Appendix-14	-----	Point closed	-----	-
32				<p>The following shall be checked and corrected in case of Immediate settlement (Si):</p> <p>I. Pg 29- Appendix 1-The classification of soil at 3m depth for BH-1 is SM- SC. However, the settlement calculations are based considering soil as cohesive soil. However, the predominant soil is cohesionless less. This shall be reviewed.</p> <p>II.Wherever, 50mm mentioned shall be corrected as 40mm.</p> <p>III. Pg 30-The value of Cd at the centre of the square footing as per Table 2 of IS 8009 Part 1 is 1.12.However, the same has been considered different for BH-1(pg 35), BH-97(pg 37), BH-5,7,99(pg 39), BH-3(pg 41), BH-69(pg 43), BH-36(pg 45).</p> <p>IV. For BH-1, Pg 28-For immediate settlement calculation, the width of footing is taken as B/2.This shall be checked and corrected as B in line with calculation of SBC for 40mm settlement adopted BH-5,7,99(pg 39), BH-3(pg 41), BH-69(pg 43), BH-36(pg 45).</p> <p>V. References shall be included for E, Poisson ratio adopted in the calculation.</p>	<p>I. It is to be noted that cohesionless strata as well as cohesive soil strata is encountered in the influence depth below founding level for BH-1 & 3. Hence, immediate as well as consolidation settlement has been considered for BH-1&3. While only cohesionless strata is encountered in the influence depth below foundation level in other boreholes therefore only immediate settlement is considered.</p> <p>II. This has been incorporated into the revised report.</p> <p>III. Calculations are revised based on the IS 8009 Part-1.</p> <p>IV. Calculations are revised based on the IS 8009 Part-1..</p> <p>V. The reference has been added in the revised report in Appendix-15 &16.</p>	-----	Point closed	-----	-
33				<p>The following shall be checked and corrected in case of consolidation settlement (Sc):</p> <p>I. Pg 29- Appendix 1-The classification of soil at 3m depth for BH-1 is SM-SC. However, the settlement calculations are based considering soil as cohesive soil. However, the predominant soil is cohesionless less. This shall be reviewed.</p> <p>II. Pg 29-It is observed that for BH-1, influence depth of compressible stratum is taken as 2*width of footing. However for BH 97(37), it is observed that the same is not considered as 2*width of footing. Hence, the reference for consideration of influence depth shall be included in the report</p>	<p>I. It is to be noted that cohesionless strata as well as cohesive soil strata is encountered in the influence depth below founding level for BH-1 & 3. Hence, immediate as well as consolidation settlement has been considered for BH-1&3. While only cohesionless strata is encountered in the influence depth below foundation level in other boreholes therefore only immediate settlement is considered.</p> <p>II. in the revised report, only immediate settlement has been calculated for BH-97.</p>	-----	Point closed	-----	-
34				<p>Pg 31-The following Typo mistakes shall be corrected:</p> <p>I. Where ever, IS 2911(Part 1/sec 3) shall be corrected as sec 2.</p> <p>II. Length of pile mentioned as 10.5m shall be reviewed.</p> <p>III. The reference table for modulus of sub grade reaction for granular/Normally consolidated soil mentioned as table 4 shall be corrected as Table 3.</p>	Corrected in the revised report.	-----	Point closed	-----	-
35				<p>Pg 32-Fig 3 mentioned shall be corrected as fig 4(Depth of fixity).</p>	Corrected in the revised report.	-----	Point closed	-----	-
36				<p>Pg 32-The lateral capacity of pile furnished corresponds to only free head(Typo error). The same shall be reviewed and corrected for both free and fixed head.</p>	Corrected in the revised report.	-----	Point closed	-----	-
37				<p>Pg 33- Fig 4A&4B mentioned shall be corrected as fig 5A&5B</p>	Corrected in the revised report.	-----	Point closed	-----	-
38				<p>Pg 33-For free head pile the moment reduction factor mentioned as 0.35 shall be corrected to 0.4.</p>	Corrected in the revised report.	-----	Point closed	-----	-
39				<p>Pg 34-Under Appendix for open foundations:</p> <p>I. The RL of the foundation shall be mentioned for BH's 5,7,99 (pg 38&39),3 (pg 40&41),69 (pg 42&43),36 (pg 44&45), under both shear and settlement.</p> <p>II. The soil properties mentioned under design parameters and appendix are different for BH'S- 5,7,99, 3, 69, 36. To be checked and corrected.</p> <p>III. For BH-97(pg 37)-mv value is considered as 0.0087cm²/kg .However, the same is not available in the lab report of respective BH(Pg 69).</p> <p>IV. The recommended depth of SBC shall match with the foundation depth assumed in the compound wall drawing.</p> <p>V. It is observed that ssc calculations based on settlement criteria are considered based on cohesive soil. (immediate+consolidation). However, the soil is predominantly cohesionless soil-SC(Clayey sand). This shall be reviewed</p>	<p>I. This has been incorporated into the revised report.</p> <p>II. In the absence of shear parameters within the influence depth, we have considered correlated parameters. Soil properties, such as cohesion and the angle of internal friction, are inferred from the SPT N-value, while the design parameters listed for shear are derived from the tested values of undisturbed (UDS) samples.</p> <p>III. In the revised report we have considered only immediate settlement for BH-97.</p> <p>IV. This has been incorporated into the revised report.</p> <p>V. It is to be noted that cohesionless strata as well as cohesive soil strata is encountered in the influence depth below founding level for BH-1 & 3. Hence, immediate as well as consolidation settlement has been considered for BH-1&3. While only cohesionless strata is encountered in the influence depth below foundation level in other boreholes therefore only immediate settlement is considered.</p>	<p>Under Appendix for open foundations:</p> <p>I. The RL of the foundation shall be mentioned for BH 3 (pg 42),under settlement.</p> <p>2.It is observed that for BH-5,7,99,3,69,36 the angle of internal friction is assumed as 30degrees with varying bearing capacity factors. However, as per appendix 1, the bearing capacity factors shall remain constant for a given angle of internal friction. Hence, the recommended open foundation SBC based on shear shall be checked and corrected inline with Table 1 of IS 6403.</p> <p>Also, as mentioned earlier, the soil properties mentioned under design parameters and appendix are different for BH'S- 5,7,99, 3, 69, 36. To be checked and corrected.</p> <p>3.-----</p> <p>4.-----</p>	<p>1. Incorporated in the revised report.</p> <p>2. In our analysis, both general and local shear failure were evaluated based on the void ratio (reference provided in Appendix-14). Additionally, the bearing capacity factors were interpolated for mixed shear failure (as per table-3 depending on void ratio) by IS 6403 based on the angle of internal friction. Hence, the same is in order.</p>	-----	-
40				<p>Under appendix pg 34, it is observed that the recommendation of SBC is combined for BH 5,7,99 for open foundation and BH-169 and 171 for pile foundation. The reason for the combined recommendations of the above BH'S shall be brought in the report. Also, the basis of soil properties used for the calculation of SBC shall be brought in the report.</p>	Since the strata encountered at the foundation depth are same and the SPT N values are also similar, we have merged those boreholes.	-----	Point closed	-----	-
41				<p>Appendix 9(Pg 46) to Appendix 13(54)-The following shall be checked and corrected:</p> <p>I. For ultimate load in uplift the FOS considered shall be mentioned in the report.</p> <p>II. Under notes Where ever EGL mentioned shall be corrected as FGL.</p>	Incorporated into the revised report.	-----	Point closed	-----	-
42				<p>Pg 46,48,52,54-BH-2,10,85,169-For both ultimate load in compression by bearing and skin friction the value of PD has been considered as 5.4/5.64/5.22m. This shall be checked and corrected and detailed calculations shall be submitted separately for end bearing and skin friction for the respective layers including any critical depth assumed for calculation.</p>	Calculation of effective over burden pressure PD is given in Appendix-9 for your reference.	-----	Point closed	-----	-
43				<p>Pg 46-BH-2- Ultimate load in compression by skin friction for fourth layer "(L-11.02)" mentioned shall be corrected as "(L-10.45)".</p>	Incorporated into the revised report.	To be reviewed and corrected.(Typo error)	Incorporated in the revised report.	-----	-
44				<p>Pg 51-For BH-11 it shall be clarified if sand/Normally consolidated clay category is applicable (or) preloaded clay category is applicable for the lateral pile capacity calculation.</p>	Sand/normally consolidated clay category has been considered for fill portion for lateral pile capacity calculation.	-----	Point closed	-----	-
45				<p>Pg 52-For BH-85, the angle of internal friction is considered as 31 for layer with depth ranging from 11.3 to 14.8m from FGL. However, from laboratory reports for BH-85(Pg 68), the value of internal friction is 27 degrees at 6.5m from NGL. This shall be checked and corrected.</p>	In the absence of shear parameters within influence depth zone, we have considered correlated parameters. Soil properties, such as cohesion and the angle of internal friction, are inferred from the SPT N-value.	For BH -85 with filling depth of 4.8m, Depth of 11.3m from FGL is same as 6.5m from NGL.Hence, it is suggested to revise the pile capacity calculation for 27 degrees	Incorporated in the revised report.	-----	-
46				<p>Pg 54-for BH-169-under Test data, reduction factor for last layer shall be mentioned in the report.</p>	Incorporated into the revised report.	-----	Point closed	-----	-
47				<p>The design parameters for BH 169 mentioned under pg 22 and pg 54 are different. This shall be checked and corrected.</p>	Incorporated into the revised report.	-----	Point closed	-----	-
48				<p>Pg 74-Location of BH-10 is missing. To be checked and corrected.</p>	Incorporated into the revised report.	-----	Point closed	-----	-
49				<p>Pg 76-It shall be clarified if the SPT N Values mentioned under bore log data sheets requires dilatancy and overburden correction factors?</p>	The SPT N values provided in the borehole log data sheets are field SPT values.	-----	Point closed	-----	-
50				<p>In general, it is observed that in the absence of laboratory test results for pile capacity calculations soil properties such as cohesion and angle of internal friction are inferred based on the SPT N value. The reference for the same shall be furnished for the checking the soil properties assumed in the calculation.</p>	For calculation of angle of internal friction, correlation given by Hatanaka Uchida (1996) is used and for calculation of cohesion correlation given by Terzaghi and Peck (1967) is used for pile capacity calculations.	-----	Point closed	-----	-
51				<p>In general, it is observed that in R1 revision, the SBC values based on only 40mm is furnished instead of both 25mm and 40mm.The reason for the same may be explained in detail along with Technical specifications references.</p>	As per Clause 5.03.00, Vol-2 G1/ Section-2, Specific design requirements, for all non-plant buildings maximum allowable total settlement should be restricted to 40mm for all foundations. Hence 40 mm permissible settlement has been considered in the revised report.	-----	Point closed	-----	-
52				<p>Pg 79- bore log data sheet of BH 4 data is mentioned. This shall be checked and removed.</p>	Bore log data of BH-4 removed in revised report.	-----	Point closed	-----	-
53								After completion of boreholes in part 2B area, Geotechnical Investigation for part 2A and 2B shall be submitted for approval.	All bore holes of Compound wall area has been completed and updated report, Part-2, Rev 4 is being submitted.

Bharat Heavy Electricals Limited (B H E L)

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

Part 2

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Table of Contents

SR No.	Contents	Page No.
1	Introduction	1
2	Field Investigation	1
3	Laboratory investigation	3
4	General Geology of site	3
5	Subsurface Soil Conditions	4
6	Geologic Hazards	4
7	Computation of safe bearing capacity	4
8	Conclusions	5
9	Limitation	6
10	Recommendation and Summary for RCC Bored cast-in-situ Pile Capacity	7
11	Recommended Allowable bearing capacity for open foundation	11
12	Design Parameters	23
13	Appendix- 1 Sample calculation for allowable bearing pressure	36
14	Appendix- 2 Sample calculation for Lateral capacity of pile	64
15	Appendix- 3 to 21 (Calculation of allowable bearing pressure and Calculation of safe load on pile in soil strata)	47
16	Appendix – 22 to 25 (Reference)	87
17	Notations	8;
18	References	; 2
19	Result of Chemical analysis	; 3
20	Results of laboratory tests	; 4
21	Investigation Layout Plan	118
22	Bore log data sheets	11:
23	Filed photographs	164

Report on Geotechnical Investigation of Compound Wall 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

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 24 Nos. of exploratory bore holes for compound wall area
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:

Sr No.	Borehole No	Structure	R.L. of borehole	FGL	Co-Ordinate	Depth Investigated from ground level	Depth Planned to investigate	Reasoned for early termination
1	BH 169	COMPOUND WALL	199.13	202.00	E 1188 N 1944	20.00	20.00	-
2	BH 171		200.03	202.00	E 955 N 1938	25.00	25.00	-
3	BH 1		202.05	202.50	E 1430 N 3845	20.00	20.00	-
4	BH 97		204.10	202.50	E 1868 N 3033	25.00	25.00	-

Sr No.	Borehole No	Structure	R.L. of borehole	FGL	Co-Ordinate	Depth Investigated from ground level	Depth Planne d to investi gate	Reasone d for early terminat ion
5	BH 99	COMPOUND WALL	206.50	202.50	E 1753 N 3010	30.00	30.00	-
6	BH 69		206.25	202.50	E 1805 N 3156	30.00	30.00	-
7	BH 3		206.03	202.50	E 2000 N 3843	20.00	20.00	-
8	BH 7		207.90	202.50	E 1963 N 3695	20.00	20.00	-
9	BH 5		210.30	202.50	E 1869 N 3690	25.00	25.00	-
10	BH 36		208.65	202.50	E 1819 N 3369	20.00	20.00	-
11	BH 10		193.65	202.50	E 914 N 3614	16.00	25.00	*
12	BH 2		194.75	202.50	E 957 N 3845	20.00	20.00	-
13	BH 85		197.70	202.50	E 712 N 3086	18.00	30.00	*
14	BH 11		197.30	202.50	E 714 N 3599	20.00	20.00	-
15	BH 4		192.85	202.50	E 719 N 3759	18.50	20.00	-
16	BH 29		197.88	202.50	E 711 N 3417	25.00	25.00	-
17	BH 80		201.32	202.50	E 2085 N 3091	25.00	25.00	-
18	BH 132		202.30	202.00	E 1886 N 2840	25.00	25.00	-
19	BH 142		201.38	202.00	E 1856 N 2771	20.00	20.00	-
20	BH 150		197.47	202.50	E 771 N 2671	20.00	20.00	-
21	BH 166		202.73	202.00	E 1541 N 2204	25.00	25.00	-
22	BH 167		198.57	202.00	E 881 N 2212	20.00	20.00	-
23	BH 170		200.56	202.00	E 1393 N 1938	25.00	25.00	-
24	BH 158		202.96	202.00	E 1694 N 2444	25.00	25.00	-
* - 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	UDS

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. 25 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. These soils are adjudged to be expensive in nature. Below expansive 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 2.00 to 2.50m 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.

6.0 Site Condition

6.1 General

Water logging with present topographical levels is imminent and rising of GL shall be required. All other identified geologic hazards are considered less significant.

6.2 Sub soil conditions

Expansive soils are fine-grained soils (generally high plasticity clays) that can undergo a significant increase in volume with an increase in water content and a significant decrease in volume with a decrease in water content. Changes in the water content of a highly expansive soil can result in severe distress to structures constructed on or against the soil.

At site such expansive clays are not encountered in shallow depths. When such soils are below 2m from GL especially when below permanent water table, the soil does not swell or shrink and thus may not cause any distress to structure build against it.

Corrosive soils are materials that have the potential to adversely impact buried metallic pipes, concrete, and other underground structures due to their chemical markup. Factors that influence soil corrosivity include pH, electrical resistivity, and chemical constituents (chloride, sulfate, etc.).

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 view of sulphite (SO_3) content specific precautions are not required. From the considerations of chlorides, it can be said that the soil slightly corrosive to uncoated steel and very slightly corrosive to embedded steel in concrete. The concrete in foundation structure may be designed for moderate exposure condition as per Table 3 of IS 456-2000. The concrete shall have minimum of 300 kg/m³ cement content and water cement ratio shall not exceed 0.50.

6.3 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. From preliminary screening criteria, soil is not likely to undergo shear strength loss in seismic event, though on completion of other confirmatory tests, liquefaction analysis shall be performed. .

7.0 Computation of Safe Bearing Capacity

The proposed Finished Ground Level (FGL) for the entire compound wall is set as 202.0 and 202.5 meters R.L. Given these FGL requirements, soil cutting and filling will be necessary in various areas on-site. The filling will vary in depth from 2.00 meters to 8.90 meters, while soil cutting will range from 1.60 meters to 7.80 meters. Based on this scenario, pile foundations and open foundations is recommended. Open foundations are suitable in areas with soil cuts or where filling depth is less than 3.0 meters. The Safe Bearing Capacity (SBC) values for the open foundation are provided in Appendix Nos. 1-8, 14-18, 21.

Pile foundation is suggested in area where filling of soil occurs greater than the 1.50m. Pile foundations will be terminated in the soil, pile capacities calculated in accordance with IS 2911 Part 1, Section 2: 2010. The safe load capacities of end-bearing piles, including compression, uplift, and lateral capacities, are detailed in the appendices 9 to 13 for different zones.

The characteristic of soil in filling for raising FGL is not known at this stage. For lateral load capacity calculations the SPT N value has been considered as 10. Based on this, initial pile load test is to be performed at site and lateral capacity will be established accordingly.

8.0 Conclusions

- 1) General stratifications are as described in section 6.0 and as shown in respective borelogs.

In situations where filling of soil greater than the 1.50m pile foundation is recommended. Safe load on piles in compression, uplift and lateral direction is calculated and appended in Appendix 9 to 13, 19 and 20. Initial and routine pile load tests shall be carried out on the piles at site as per IS: 2911 Part 4. For design and construction, specification of IS: 2911, P1/S2, IS: 456, 2000 and IS: 14593 shall strictly be followed. An open foundation is recommended for the compound wall in areas where soil cutting is required, or where soil fill depth is less than 1.50 meters. Type of foundation is summarized as below.

Sr. No.	Bore hole No.	EGL in RL (m)	FGL in RL (m)	FGL - EGL (m)	Filling/cutting w.r.t FGL	Type of foundation	Remarks
1	BH-3	206.0	202.5	-3.5	Cutting	Open	Wherever filling is more than 1.5 m with respect to FGL, pile foundation is considered.
2	BH-1	202.1	202.5	0.4	Filling	Open	
3	BH-2	194.8	202.5	7.8	Filling	Pile	
4	BH-10	193.6	202.5	8.9	Filling	Pile	
5	BH-11	197.3	202.5	5.2	Filling	Pile	
6	BH-85	197.7	202.5	4.8	Filling	Pile	
7	BH-171	200.0	202.0	2.0	Filling	Pile	
8	BH-169	199.1	202.0	2.9	Filling	Pile	
9	BH-97	204.1	202.5	-1.6	Cutting	Open	
10	BH-99	206.5	202.5	-4.0	Cutting	Open	
11	BH-69	206.3	202.5	-3.8	Cutting	Open	
12	BH-36	208.7	202.5	-6.2	Cutting	Open	
13	BH-5	210.3	202.5	-7.8	Cutting	Open	
14	BH-7	207.9	202.5	-5.4	Cutting	Open	
15	BH-4	192.85	202.5	9.65	Filling	Pile	
16	BH-29	197.88	202.5	4.62	Filling	Pile	
17	BH-80	201.32	202.5	1.18	Filling	Open	
18	BH-132	202.3	202.0	-0.3	Cutting	Open	
19	BH-142	201.38	202.0	0.62	Filling	Open	
20	BH-150	197.47	202.5	5.03	Filling	Pile	
21	BH-166	202.73	202.0	-0.73	Cutting	Open	
22	BH-167	198.57	202.0	3.43	Filling	Pile	
23	BH-170	200.56	202.0	1.44	Filling	Open	
24	BH-158	202.96	202	-0.96	Cutting	Open	

- 2) Ground water table was encountered on an average at 2.00 to 2.50 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 (SO₃) 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) Considering chemical analysis test results of sub soil samples, existing soil is suitable for filling/backfilling purposes.

Dr. K. K. Thaker

Ph.D. (Geotech); M.B.A (Finance)

Prof. (Dr.) K. C. Thaker

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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 Pile Capacity as per technical specification

Building/ Structure/ Area	Applicable bore hole nos.	Average EGL in RL (m)	FGL in RL (m)	Pile cut off level below FGL (in m)	Length of pile below cut off level (in m)	Diameter of pile (in m)	Safe pile capacity (in T)			
							Vertical compression	Lateral (in free head condition)	Lateral (in fixed head condition)	Uplift
Compound wall	11	197.3	202.5	1	11.00	0.45	25.0	1.3	1.3	6.25
	85	197.70	202.5	1	13.00	0.45	25.00	1.3	1.3	6.25
	2	194.75	202.5	1	14.00	0.45	25.00	1.3	1.3	6.25
	169,171	199.58	202.0	1	13.00	0.45	25.00	1.3	1.3	6.25
	10	193.65	202.5	1	14.00	0.45	25.00	1.3	1.3	6.25

Reference: Clause 3.02.00 Vol. 2-G2/ Part-A/ Section-V Bored Cast in Situ Concrete Pile

Recommendation for RCC Bored cast-in-situ Pile Capacity as per technical specification

Building/ Structure/ Area	Applicable bore hole nos.	Average EGL in RL (m)	FGL in RL (m)	Pile cut off level below FGL (in m)	Length of pile below cut off level (in m)	Diameter of pile (in m)	Safe pile capacity (in T)			
							Vertical compression	Lateral (in free head condition)	Lateral (in fixed head condition)	Uplift
Compound wall	4,29	195.37	202.5	1	14.00	0.45	25.00	1.30	1.30	6.25
	150	197.47	202.5	1	13.00	0.45	25.00	1.30	1.30	6.25
	167	198.57	202	1	11.50	0.45	25.00	1.3	1.3	6.25

Reference: Clause 3.02.00 Vol. 2-G2/ Part-A/ Section-V Bored Cast in Situ Concrete Pile

Summary for RCC Bored cast-in-situ Pile Capacity										
Building/ Structure/ Area	Applicable bore hole nos.	Average EGL in RL (m)	FGL in RL (m)	Pile cut off level below FGL (in m)	Length of pile below cut off level (in m)	Diameter of pile (in m)	Safe pile capacity (in T)			
							Vertical compressi on	Lateral (in free head	Lateral (in fixed head	Uplift
Compound wall	11	197.30	202.5	1	11.00	0.45	26.7	1.3	3.6	14.46
	85	197.70	202.5	1	13.00	0.45	25.84	1.30	3.60	17.17
	2	194.75	202.5	1	14.00	0.45	29.27	1.30	3.60	12.53
	169,171	199.58	202.0	1	13.00	0.45	27.74	1.30	3.60	18.81
	10	193.65	202.5	1	14.00	0.45	27.68	1.30	3.60	12.82

Summary for RCC Bored cast-in-situ Pile Capacity

Building/ Structure/ Area	Applicable bore hole nos.	Average EGL in RL (m)	FGL in RL (m)	Pile cut off level below FGL (in m)	Length of pile below cut off level (in m)	Diameter of pile (in m)	Safe pile capacity (in T)			
							Vertical compression	Lateral (in free head condition)	Lateral (in fixed head condition)	Uplift
Compound wall	4,29	195.37	202.5	1	14.00	0.45	26.36	1.30	3.60	14.01
	150	197.47	202.5	1	13.00	0.45	25.29	1.30	3.60	16.93
	167	198.57	202	1	11.50	0.45	25.27	1.30	3.60	15.81

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the FGL at the time of exploration.
- 3) Calculations are considering the effect of water table at FGL (R.L. 202.5m)

KCT Consultancy Services LLP, Ahmedabad

For BH-97

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 F.G.L.	R.L. of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria \bar{A} (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria	Allowable Bearing Pressure suggested (Min. of <u>Shear and Settlement Criterion</u>)
					For 40 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)			
1.00	201.50	1.00	1.00	6	46	6
1.00	201.50	2.00	2.00	6	23	6
1.00	201.50	3.00	3.00	6	15	6
1.00	201.50	4.00	4.00	7	11	7
2.00	200.50	1.00	1.00	9	46	9
2.00	200.50	2.00	2.00	9	23	9
2.00	200.50	3.00	3.00	9	15	9
2.00	200.50	4.00	4.00	9	11	9
3.00	199.50	1.00	1.00	13	46	13
3.00	199.50	2.00	2.00	11	23	11
3.00	199.50	3.00	3.00	11	15	11
3.00	199.50	4.00	4.00	11	11	11

Notes :

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

KCT Consultancy Services LLP, Ahmedabad

For BH 5,7,99

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

Depth of Foundation (m)	R.L. of Foundation (m)	Length of Foundation (m)	Width of Foundation (m)	Safe Bearing Capacities calculated based on Shear Criteria \bar{A} (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria \bar{A}	Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)
					For 40 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
1.00	201.50	1.00	1.00	34	68	34
1.00	201.50	2.00	2.00	33	34	33
1.00	201.50	3.00	3.00	34	23	23
1.00	201.50	4.00	4.00	35	17	17
1.50	201.00	1.00	1.00	41	68	41
1.50	201.00	2.00	2.00	37	34	34
1.50	201.00	3.00	3.00	38	23	23
1.50	201.00	4.00	4.00	39	17	17
2.00	200.50	1.00	1.00	48	68	48
2.00	200.50	2.00	2.00	42	34	34
2.00	200.50	3.00	3.00	42	23	23
2.00	200.50	4.00	4.00	43	17	17

Notes :

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

KCT Consultancy Services LLP, Ahmedabad						
For BH 3						
SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION						
Project : Proposed structure in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha						
Depth of Foundation	R.L. 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)
(m)	(m)	(m)	(m)	Å (t / m ²)	For 40 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
1.00	201.50	1.00	1.00	19	48	19
1.00	201.50	2.00	2.00	18	23	18
1.00	201.50	3.00	3.00	19	15	15
1.00	201.50	4.00	4.00	20	11	11
1.50	201.00	1.00	1.00	23	49	23
1.50	201.00	2.00	2.00	22	24	22
1.50	201.00	3.00	3.00	22	16	16
1.50	201.00	4.00	4.00	23	12	12
2.00	200.50	1.00	1.00	27	49	27
2.00	200.50	2.00	2.00	25	24	24
2.00	200.50	3.00	3.00	25	16	16
2.00	200.50	4.00	4.00	25	12	12

Notes :

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

KCT Consultancy Services LLP, Ahmedabad						
For BH 69						
SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION						
Project : Proposed structure in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha						
Depth of Foundation	R.L. 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)
(m)	(m)	(m)	(m)	Å (t / m ²)	Å For 40 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
1.00	201.50	1.00	1.00	20	99	20
1.00	201.50	2.00	2.00	20	50	20
1.00	201.50	3.00	3.00	21	33	21
1.00	201.50	4.00	4.00	23	25	23
1.50	201.00	1.00	1.00	25	99	25
1.50	201.00	2.00	2.00	24	50	24
1.50	201.00	3.00	3.00	25	33	25
1.50	201.00	4.00	4.00	26	25	25
2.00	200.50	1.00	1.00	30	99	30
2.00	200.50	2.00	2.00	28	50	28
2.00	200.50	3.00	3.00	28	33	28
2.00	200.50	4.00	4.00	29	25	25

Notes :

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

KCT Consultancy Services LLP, Ahmedabad						
For BH 36						
SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION						
Project : Proposed structure in Phase 1 of 3 x 800 MW NLC Talabira, Thermal Power Project (NTTPP) at village- Hirma, Talabira, Odisha						
Depth of Foundation	R.L. 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)
(m)	(m)	(m)	(m)	Å (t / m ²)	Å For 40 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
1.00	201.50	1.00	1.00	20	76	20
1.00	201.50	2.00	2.00	20	38	20
1.00	201.50	3.00	3.00	22	25	22
1.00	201.50	4.00	4.00	24	19	19
1.50	201.00	1.00	1.00	25	76	25
1.50	201.00	2.00	2.00	24	38	24
1.50	201.00	3.00	3.00	25	25	25
1.50	201.00	4.00	4.00	27	19	19
2.00	200.50	1.00	1.00	30	76	30
2.00	200.50	2.00	2.00	28	38	28
2.00	200.50	3.00	3.00	29	25	25
2.00	200.50	4.00	4.00	30	19	19

Notes :

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

KCT Consultancy Services LLP, Ahmedabad

(BH-80)

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	Depth of Foundation from FGL	R.L. of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria A	Safe Bearing Pressures calculated based on Settlement Criteria A	Allowable Bearing Pressure suggested (<u>Min. of Shear and Settlement Criterion</u>)
(m)	(m)	(m)	(m)	(m)	(t / m ²)	For 40 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
1.32	2.50	200.00	1.00	1.00	19	51	19
1.32	2.50	200.00	2.00	2.00	20	25	20
1.32	2.50	200.00	3.00	3.00	22	17	17
1.32	2.50	200.00	4.00	4.00	24	13	13
2.32	3.50	199.00	1.00	1.00	30	50	30
2.32	3.50	199.00	2.00	2.00	28	25	25
2.32	3.50	199.00	3.00	3.00	29	17	17
2.32	3.50	199.00	4.00	4.00	31	13	13
3.32	4.50	198.00	1.00	1.00	42	50	42
3.32	4.50	198.00	2.00	2.00	37	25	25
3.32	4.50	198.00	3.00	3.00	37	17	17
3.32	4.50	198.00	4.00	4.00	38	13	13

Notes :

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

KCT Consultancy Services LLP, Ahmedabad

(For BH-166)

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structure 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. of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria Å (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria Å	Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)
					For 40 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)			
1.00	201.00	1.00	1.00	6	54	6
1.00	201.00	2.00	2.00	7	27	7
1.00	201.00	3.00	3.00	8	18	8
1.00	201.00	4.00	4.00	9	14	9
2.00	200.00	1.00	1.00	11	54	11
2.00	200.00	2.00	2.00	11	27	11
2.00	200.00	3.00	3.00	11	18	11
2.00	200.00	4.00	4.00	12	14	12
3.00	199.00	1.00	1.00	16	54	16
3.00	199.00	2.00	2.00	15	27	15
3.00	199.00	3.00	3.00	15	18	15
3.00	199.00	4.00	4.00	16	14	14

Notes :

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

KCT Consultancy Services LLP, Ahmedabad

(For BH-170)

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	Depth of Foundation from FGL	R.L. 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 (<u>Min. of Shear and Settlement Criterion</u>)
						For 40 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)	(m)			
1.06	2.50	199.50	2.00	2.00	10	26	10
1.06	2.50	199.50	2.50	2.50	10	21	10
1.06	2.50	199.50	3.00	3.00	10	17	10
1.06	2.50	199.50	3.50	3.50	10	14	10
2.06	3.50	198.50	2.00	2.00	11	28	11
2.06	3.50	198.50	2.50	2.50	11	22	11
2.06	3.50	198.50	3.00	3.00	11	18	11
2.06	3.50	198.50	3.50	3.50	11	15	11
3.06	4.50	197.50	2.00	2.00	12	28	12
3.06	4.50	197.50	2.50	2.50	12	23	12
3.06	4.50	197.50	3.00	3.00	12	19	12
3.06	4.50	197.50	3.50	3.50	11	16	11

Notes :

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

KCT Consultancy Services LLP, Ahmedabad

fl: cf'6<!% &L**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. of Foundation	Length of Foundation	Width of Foundation	Safe Bearing Capacities calculated based on Shear Criteria Å (t / m ²)	Safe Bearing Pressures calculated based on Settlement Criteria Å	Allowable Bearing Pressure suggested (Min. of Shear and Settlement Criterion)
					For 40 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)			
1.00	201.00	1.00	1.00	14	55	14
1.00	201.00	2.00	2.00	15	27	15
1.00	201.00	3.00	3.00	17	18	17
1.00	201.00	4.00	4.00	19	14	14
2.00	200.00	1.00	1.00	23	55	23
2.00	200.00	2.00	2.00	22	27	22
2.00	200.00	3.00	3.00	23	18	18
2.00	200.00	4.00	4.00	25	14	14
3.00	199.00	1.00	1.00	34	55	34
3.00	199.00	2.00	2.00	30	27	27
3.00	199.00	3.00	3.00	30	18	18
3.00	199.00	4.00	4.00	31	14	14

Notes :

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

KCT Consultancy Services LLP, Ahmedabad

(For BH-142)

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	Depth of Foundation from FGL	R.L. 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 (<u>Min. of Shear and Settlement Criterion</u>)
						For 40 mm Settlement (t / m ²)	For 40 mm Settlement (t / m ²)
(m)	(m)	(m)	(m)	(m)			
1.38	2.00	200.00	1.00	1.00	10	55	10
1.38	2.00	200.00	2.00	2.00	9	25	9
1.38	2.00	200.00	3.00	3.00	9	16	9
1.38	2.00	200.00	4.00	4.00	9	12	9
2.38	3.00	199.00	1.00	1.00	12	60	12
2.38	3.00	199.00	2.00	2.00	10	26	10
2.38	3.00	199.00	3.00	3.00	10	17	10
2.38	3.00	199.00	4.00	4.00	9	13	9
3.38	4.00	198.00	1.00	1.00	14	57	14
3.38	4.00	198.00	2.00	2.00	11	27	11
3.38	4.00	198.00	3.00	3.00	10	18	10
3.38	4.00	198.00	4.00	4.00	10	14	10

Notes :

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

KCT Consultancy Services LLP, Ahmedabad

ffor BH-158)

SUMMARY OF ALLOWABLE BEARING PRESSURE BASED ON SHEAR AND SETTLEMENT CRITERION**Project :** Proposed structure 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. 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)
				Å	For 40 mm Settlement	For 40 mm Settlement
(m)	(m)	(m)	(m)	(t / m ²)	(t / m ²)	(t / m ²)
1.00	201.00	1.00	1.00	17	62	17
1.00	201.00	2.00	2.00	19	31	19
1.00	201.00	3.00	3.00	22	21	21
1.00	201.00	4.00	4.00	25	15	15
2.00	200.00	1.00	1.00	29	62	29
2.00	200.00	2.00	2.00	29	31	29
2.00	200.00	3.00	3.00	31	21	21
2.00	200.00	4.00	4.00	33	15	15
3.00	199.00	1.00	1.00	43	62	43
3.00	199.00	2.00	2.00	40	31	31
3.00	199.00	3.00	3.00	41	21	21
3.00	199.00	4.00	4.00	43	15	15

Notes :

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

Design Parameter"

BH-169								
Structure	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
Compound Wall	-	Filled up soil	FGL-2.8	-	-	-	-	NA
	0.0 - 1.5	Dark reddish brown, fine to medium grained, clayey sand (SC)	2.8 - 4.3	-	-	-	2	
	1.5 - 3.6	Yellowish brown, fine to very fine grained, sandy clays of intermediate plasticity (CI)	4.3 - 6.4	0.76	3	1.70	20	
	3.6 - 13.1	Yellowish brown, fine to medium grained, clayey sand (SC)	6.4 - 15.9	0.07	26	1.94	19	
	13.1 - 18.6	Yellowish brown, fine to medium grained, poorly graded sand and silty sand with occasional gravels (SP-SM)	15.9 - 21.4	-	-	-	36	
	18.6 - 20.0	Yellowish brown, fine to very fine grained, clayey sand (SC)	21.4 - 22.8	-	-	-	>100	

BH - 1								
Structure	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
Compound Wall	-	Filled up soil	FGL- 0.5	-	-	-	-	NA
	0.0 - 3.4	Yellowish brown, fine to medium grained, silty clayey sand (SM-SC)	0.5 - 3.9	0.05	25	1.95	17	
	3.4 - 4.3	Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL)	3.9 - 4.8	0.86	6	1.96	17	
	4.3 - 8.6	Yellowish brown, fine to medium grained, clayey sand (SC)	4.8 - 9.1	0.06	26	2.02	33	
	8.6 - 9.4	Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL)	9.1 - 9.9	-	-	-	>100	
	9.4 - 12.0	Light yellowish brown, fine to medium grained, clayey sand (SC)	9.9 - 12.5	-	-	-	>100	
	12.0 - 20.0	Highly weathered, moderately strong, dark brownish, fine to coarse grained, rock	12.5 - 20.5	-	-	-	>100	315.7

BH - 97								
Structure	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
Compound Wall	0.0 - 1.4	Reddish brown, fine to medium grained, clayey sand with some gravels (SC)	Up to 1.6m depth from FGL soil in cutting	-	-	-	4	NA
	1.4 - 2.5	Brownish red, fine to medium grained, sandy clays of intermediate plasticity with little gravels (CI)	FGL - 0.9	-	-	-	4	
	2.5 - 6.5	Reddish brown and yellowish brown, fine to medium grained, clayey sand with some to occasional gravels (SC)	0.9 - 4.9	0.07	24	1.92	18	
	6.5 - 10.6	Yellowish brown fine to medium grained, silty and clayey sand (SM-SC)	4.9 - 9.0	0.05	25	1.99	90	
	10.6 - 17.0	Highly weathered, moderately strong, dark greyish, fine to coarse grained, fractured rock	9.0 - 15.4	-	-	-	>100	
	17.0 - 21.0	Highly weathered, moderately weak, dark brownish grey, fine to coarse grained, rock with closely spaced discontinuities	15.4 - 19.4	-	-	-	-	124.6
	21.0 - 25.0	Highly weathered, moderately weak, dark brownish grey, fine to coarse grained, rock with closely spaced discontinuities	19.4 - 23.4	-	-	-	-	56.4

BH - 3

Structure	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
Compound Wall	0.0 – 1.2	Yellowish brown, fine to medium grained, sandy clays of low plasticity (CL)	Up to 3.5m depth from FGL soil in cutting	-	-	-	14	NA
	1.2 – 4.7	Yellowish brown, fine to medium grained, clayey sand (SC)	FGL – 1.1	0.06	26	1.96	22	
	4.7 – 5.6	Yellowish brown, fine to medium grained, sandy clays of intermediate plasticity (CI)	1.1 – 2.1	-	-	-	24	
	5.6 – 12.3	Yellowish brown, fine to medium grained, clayey sand (SC)	2.1 – 8.8	-	-	-	70	
	12.3 – 20.0	Yellowish brown, fine to medium grained, silty sand with little gravels (SM)	8.8 – 16.5	-	-	-	>100	

BH - 7

Structure	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
Compound Wall	0.0 -3.3	Yellowish brown, fine to medium grained, clayey sand (SC)	Up to 5.4m depth from FGL soil in cutting	0.05	26	1.78	20	NA
	3.3 – 4.7	Yellowish brown, fine to medium grained, silty sand with occasional to some gravels (SM)		0.0	28	1.75	45	
	4.7 – 5.8	Yellowish brown, fine to medium grained, clayey sand (SC)	FGL – 0.4	0.0	29	1.70	16	
	5.8 – 6.6	Yellowish brown, fine to medium grained, silty sand (SM)	0.4 – 1.2	0.07	25	1.78	>100	
	6.6 - 11.7	Yellowish brown, fine to very fine grained, clayey sand (SC)	1.2 – 6.3	-	-	-	>100	
	11.7 – 13.6	Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL)	6.3 – 8.2	-	-	-	>100	
	13.6 -20.0	Yellowish brown, fine to medium grained, clayey sand with little gravels (SC)	8.2 – 14.6	-	-	-	>100	

BH - 36

Structure	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
Compound Wall	0.0 – 3.7	Yellowish brown to dark brownish, fine to medium grained, clayey sand (SC)	Up to 6.2m depth from FGL soil in cutting	0.06	27	1.85	16	NA
	3.7 – 5.7	Yellowish brown, fine to medium grained, silty sand with little gravels (SM)		-	-	-	33	
	5.7 – 8.6	Yellowish brown, fine to medium grained, clayey sand (SC)	FGL – 2.4	0.06	27	1.85	31	
	8.6 – 9.6	Yellowish brown, fine to medium grained, silty sand with little gravels (SM)	2.4 – 3.4	-	-	-	>100	
	9.6 – 12.6	Yellowish brown, fine to medium grained, clayey sand (SC)	3.4 – 6.4	-	-	-	>100	
	12.6 – 20.0	Yellowish brown, fine to medium grained, clayey sand (SC) and Yellowish brown, fine to medium grained, silty sand (SM)	6.4 – 13.8	-	-	-	>100	

BH - 10

Structure	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
Compound Wall	-	Filled up soil	FGL- 8.85	-	-	-	-	NA
	0.00-0.70	Brownish, fine to very fine grained, clayey sand with occasional gravels (SC)	8.85-9.55	-	-	-	-	
	0.70-2.20	Yellowish brown, fine to very fine grained, sandy clays of intermediate plasticity (CI)	9.55-11.05	-	-	-	6-11	
	2.20-3.90	Brownish yellow, very fine grained, clays of high plasticity (CH)	11.05-12.75	0.61	7	1.96	11	
	3.90-4.50	Yellowish brown, fine to medium grained, clayey sand (SC)	12.75-13.35	-	-	-	13	
	4.50-6.00	Reddish yellow, fine to medium grained, silty sand with little plastic fines (SM)	13.35-14.85	0.00	30	1.99	14	
	6.00-9.40	Reddish yellow, fine to medium grained, poorly grained sand and silty and (SP-SM)	14.85-18.25	0.00	32	2.04	19-43	
	9.40-10.20	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	18.25-19.05	-	-	-	-	-
	10.20-14.50	Highly weathered, very weak, dark greyish, very fine grained, laminated/foliated SHALE	19.05-23.35	-	-	-	-	66.80
	14.50-15.00	Moderately weathered, moderately weak, dark greyish black, fine grained, thinly laminated SHALE	23.35-23.85	-	-	-	-	151.40
	15.00-16.00	Fresh, moderately weathered, dark black, fine grained, massive SHALE	23.85-24.85	-	-	-	-	553.30

BH - 2

Structure	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
Compound Wall	-	Filled up soil	FGL- 7.75	-	-	-	-	NA
	0.00-0.30	Yellowish brown, fine to medium grained, clayey sand (SC)	7.75-8.05	-	-	-	-	
	0.30-2.70	Yellowish brown, fine to medium grained, silty clayey sand (SM-SC)	8.05-10.45	-	-	-	11-85	
	2.70-7.80	Yellowish brown, fine to medium grained, clayey sand (SC)	10.45-15.55	-	-	-	31- >100	
	7.80-8.70	Yellowish brown, fine to medium grained, poorly graded sand and silty sand (SP-SM)	15.55-16.45	-	-	-	>100	
	8.70-9.60	Yellowish brown, fine to medium grained, clayey sand with occasional gravels (SC)	16.45-17.35	-	-	-	>100	
	9.60-13.40	Yellowish brown, fine to medium grained, poorly graded sand and silty sand (SP-SM)	17.35-21.15	-	-	-	>100	
	13.40-14.80	Yellowish brown, fine to medium grained, clayey sand (SC)	21.15-22.55	-	-	-	>100	
	14.80-16.30	Yellowish brown, fine to medium grained, poorly graded sand and silty sand (SP-SM)	22.55-24.05	-	-	-	>100	
	16.30-18.60	Yellowish brown, fine to medium grained, silty sand (SM)	24.05-26.35	-	-	-	>100	
	18.60-20.00	Highly weathered, moderately weak, dark brownish yellowish, fine to coarse grained, fractured rock	26.35-27.75	-	-	-	-	202.40

BH- 85

Structure	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
Compound Wall	-	Filled up soil	FGL- 5.00	-	-	-	-	NA
	0.00-0.60	Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL)	5.00-5.40	-	-	-	-	
	0.60-3.00	Light brownish, very fine grained, silty clays of intermediate plasticity (CI)	5.40-7.80	0.43	1	1.66	2-8	
	3.00-6.50	Yellowish brown, fine to medium grained, sandy clays of intermediate plasticity with occasional gravels (CI)	7.80-11.30	0.71	4	1.95	9-17	
	6.50-7.00	Yellowish brown, fine to medium grained, clayey sand with some gravels (SC)	11.30-11.80	0.06	27	1.96	-	
	7.00-7.50	Light yellowish brown and greyish, fine to very fine grained, sandy clays of intermediate plasticity with occasional gravels (CI)	11.80-12.30	-	-	-	15	
	7.50-10.00	Light brownish yellow and reddish yellow, fine to very fine grained, clayey sand (SC)	12.30-14.80	-	-	-	20- >100	
	10.00-11.00	Reddish yellow, fine to very fine grained, sandy clays of low plasticity (CL)	14.80-15.80	-	-	-	>100	
	11.00-11.75	Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL)	15.80-16.55	-	-	-	>100	
	11.75-18.00	Moderately weathered, moderately weak, dark brownish grey, fine to very fine grained, rock with closely spaced discontinuities	16.55-22.80	-	-	-	-	120.70

BH- 11

Structure	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
Compound Wall	-	Filled up soil	FGL- 5.20	-	-	-	-	NA
	0.00-0.50	Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL)	5.20-5.70	-	-	-	-	
	0.50-2.90	Yellowish brown, very fine grained, clays of high plasticity (CH)	5.70-8.10	0.46	2	1.70	7-9	
	2.90-3.90	Yellowish brown, fine to very fine grained, sandy clays of intermediate plasticity (CI)	8.10-9.10	0.53	6	1.74	10	
	3.90-4.45	Yellowish brown, fine to very fine grained, clayey sand (SC)	9.10-9.65	-	-	-	14	
	4.45-5.40	Yellowish brown, fine to very fine grained, sandy clays of intermediate plasticity (CI)	9.65-10.60	-	-	-	41	
	5.40-9.40	Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL)	10.60-14.60	-	-	-	>100	
	9.40-10.30	Yellowish brown, fine to very fine grained, sandy clays of intermediate plasticity (CI)	14.60-15.50	-	-	-	>100	
	10.30-15.60	Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL)	15.50-20.80	-	-	-	>100	
	15.60-18.00	Moderately weathered, moderately weak, greyish black, fine to medium grained, moderately thickly bedded rock	20.80-23.20	-	-	-	-	165.60
	18.00-19.00	Slightly weathered, moderately weak, dark greyish black, fine to medium grained, thinly bedded rock	23.20-24.20	-	-	-	-	141.70
	19.00-20.00	Slightly weathered, weak, dark greyish black, fine to very fine grained, massive rock	24.20-25.20	-	-	-	-	204.50

BH - 69

Structure	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
Compound Wall	0.00-0.40	Reddish yellowish brown, fine to medium grained, clayey sand (SC)	Up to 3.75m depth from FGL soil in cutting	-	-	-	-	NA
	0.40-3.75	Yellowish brown, fine to medium grained, clayey sand with much gravels (SC)		0.06	28	1.79	25-32	
	3.75-5.00	Yellowish brown, fine to medium grained, clayey sand with much gravels (SC)	FGL-1.25	0.07	28	1.86	15	
	5.00-6.30	Yellowish brown, fine to medium grained, silty sand (SM)	1.25-2.55	0.00	30	2.01	31- >100	
	6.30-8.10	Yellowish brown, fine to medium grained, clayey sand (SC)	2.55-4.35	-	-	-	36- >100	
	8.10-13.00	Yellowish brown, fine to medium grained, Poorly graded sand and silty sand with little gravels (SP-SM)	4.35-9.25	-	-	-	>100	
	13.00-23.00	Yellowish brown, fine to medium grained, clayey sand with little gravels (SC)	9.25-19.25	-	-	-	>100	
	23.00-23.80	Highly weathered, completely fractured and disintegrated, dark brownish yellow, fine to coarse grained, gravels, pebbles and cobbles size angular interlocking fragments of fractured rock	19.25-20.05	-	-	-	>100	
	23.80-26.00	Highly weathered, moderately weathered, dark yellowish brown, fine to coarse grained, rock with closely spaced discontinuities	20.05-22.25	-	-	-	-	128.60
	26.00-30.00	Highly weathered, moderately strong, dark yellowish brown, fine to coarse grained, rock with closely spaced discontinuities	22.25-26.25	-	-	-	-	317.90

BH-80							
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
0.0 – 0.10	Reddish yellow, fine to medium grained, clayey sand with occasional gravels (SC)	Up to 0.32m depth from FGL soil in cutting	-	-	-	-	NA
0.10-0.32	Yellowish brown, fine to coarse grained, clayey sand with little gravels (SC)		-	-	-	-	
0.32-2.80	Yellowish brown, fine to coarse grained, clayey sand with little gravels (SC)	FGL-2.48	0.07	26	2.00	16-23	
2.80-4.10	Light greyish, fine to medium grained, silty sand with little plastic fines and occasional gravels (SM)	2.48-3.78	-	-	-	32-65	
4.10-5.70	Yellowish brown, fine to medium grained, clayey sand with little to some gravels (SC)	3.78-5.38	-	-	-	46-51	
5.70-7.60	Dark greyish, fine to very fine grained, weakly cemented micascist - (SC)	5.38-7.28	-	-	-	>100	
7.60-11.00	Mixture of brownish, fine to medium grained, cemented micascist clayey sand with very weak and friable fragments of fractured rock	7.28-10.68	-	-	-	>100	64.20
11.00-14.00	Highly weathered, weak, dark greyish brown, fine to medium grained, fractured rock	10.68-13.68	-	-	-	-	
14.00-22.00	Highly weathered, moderately strong to weak, blackish brown, fine to coarse grained, fractured rock	13.68-21.68	-	-	-	-	
22.00-25.00	Moderately weathered, moderately strong, dark brownish to whitish grey, fine to medium grained, rock with close spacing of discontinuities	21.68-24.68	-	-	-	-	

BH-132							
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
0.0 – 0.30	Yellowish brown, fine to medium grained, clayey sand with occasional gravels (SC)	Up to 0.30m depth from FGL soil in cutting	-	-	-	-	NA
0.30-0.80	Yellowish brown, fine to medium grained, clayey sand with occasional gravels (SC)	FGL-0.50	-	-	-	-	
0.80-3.40	Dark reddish brown, fine to coarse grained, clayey sand with little to some gravels (SC)	0.50-3.10	0.07	30	1.99	19-39	
3.40-4.30	Brownish, fine to coarse grained, clayey sand with much gravels (SC)	3.10-4.00	-	-	-	30-79	
4.30-12.60	Dark brownish, fine to coarse grained, weakly cemented clayey sand (SC)	4.00-12.30	-	-	-	>100	
12.60-17.50	Highly weathered, moderately weak, dark brownish, fine to coarse grained, fractured rock	12.30-17.20	-	-	-	-	99.50
17.50-23.50	Highly weathered, moderately strong, dark brownish, fine to coarse grained, rock with close spacing of discontinuities	17.20-23.20	-	-	-	-	116.50
23.50-25.00	Moderately weathered, moderately strong, reddish brown, fine to coarse grained, rock with moderately close spacing of discontinuities	23.20-24.70	-	-	-	-	334.90

BH-166							
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
0.00-1.73	Yellowish brown, fine to coarse grained, clayey sand with some gravels (SC)	Up to 1.73m depth from FGL soil in cutting	-	-	-	-	NA
1.73-4.70	Yellowish brown, fine to coarse grained, clayey sand with some gravels (SC)	1.73-2.97	0.04	26	1.96	7-28	
4.70-5.70	Yellowish brown, fine to coarse grained, silty sand with little plastic fines (SM)	2.97-3.97	-	-	-	34-38	
5.70-6.60	Brownish, fine to medium grained, silty clayey sand (SM-SC)	3.97-4.87	-	-	-	30-35	
6.60-7.60	Whitish yellow and slightly greyish, fine to medium grained, clayey sand with some gravels (SC)	4.87-5.87	-	-	-	29-35	
7.60-9.10	Yellowish brown, fine to medium grained, cemented silty sand with some gravels (SM)	5.87-7.37	-	-	-	>100	
9.10-9.60	Yellowish brown, fine to very fine grained, cemented clayey sand with little gravels (SC)	7.37-7.87	-	-	-	>100	
9.60-14.40	Brownish yellow, fine to medium grained, cemented silty sand with little plastic fines and some gravels (SM)	7.87-12.67	-	-	-	>100	
14.40-21.00	Highly weathered, weak, dark reddish brown, fine to medium grained, rock with close spacing of discontinuities	12.67-19.27	-	-	-	-	82.90
21.00-23.00	Highly weathered, moderately weak, greyish red, fine to medium grained, rock with moderately close spacing of discontinuities	19.27-21.27	-	-	-	-	38.70
23.00-24.00	Highly weathered, very weak, greyish red, fine to medium grained, fractured rock	21.27-22.27	-	-	-	-	-
24.00-25.00	Highly weathered, moderately weak, greyish red, fine to medium grained, rock with close spacing of discontinuities	22.27-23.27	-	-	-	-	146.30

BH-4							
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-9.65	-	-	-	-	NA
0.00-0.90	Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL)	9.65-10.55	-	-	-	-	
0.90-6.90	Yellowish brown, fine to medium grained, clayey sand with occasional to little gravels (SC)	10.55-16.55	0.09	24	1.94	9-19	
6.90-7.80	Yellowish brown, very fine grained, clays of intermediate plasticity with little to occasional gravels (CI)	16.55-17.75	-	-	-	25->100	
7.80-8.30	Dark brownish grey, fine to medium grained, clays of intermediate plasticity with much gravels and pebble size fragments of fractured rock	17.45-17.95	-	-	-	-	
8.30-9.10	Mixture of highly weathered, completely fractured and disintegrated, brownish grey, fine to very fine grained, gravel, pebble size fractured rock fragments with dark brownish, fine to very fine grained, sandy clays of intermediate plasticity	17.95-18.75	-	-	-	-	
9.10-14.00	Highly weathered, weak, dark grey, fine to very fine grained, fractured rock	18.75-23.65	-	-	-	-	65.40
14.00-17.00	Highly weathered, weak, greyish, fine to very fine grained, rock with close spacing of discontinuities	23.65-26.65	-	-	-	-	55.30
17.00-18.50	Moderately weathered, weak, greyish, fine to very fine grained, rock with wide spacing of discontinuities	26.65-28.15	-	-	-	-	80.60

BH-142							
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- 0.62	-	-	-	-	NA
0.00-0.80	Yellowish brown, fine to medium grained, clayey sand with occasional gravels (SC)	0.62-1.42	-	-	-	-	
0.80-2.90	Reddish yellow, fine to medium grained, sandy clays of intermediate plasticity with little gravels (CI)	1.42-3.52	0.53	6	1.94	6-9	
2.90-3.60	Yellowish brown, fine to coarse grained, sandy clays of intermediate plasticity (CI)	3.52-4.22	0.86	7	1.98	15	
3.60-4.90	Yellowish brown and greyish, fine to coarse grained, clayey sand with much gravels (SC)	4.22-5.52	0.08	30	2.05	33	
4.90-10.30	Light brownish, fine to medium grained, weakly cemented silty sand (SM)	5.52-10.92	-	-	-	84- >100	
10.30-12.50	Highly weathered, very weak, fractured, reddish brown, fine to coarse grained, pebble, cobble size angular fractured rock with infilled reddish yellow, fine to medium grained, sand	10.92-13.12	-	-	-	-	31.60
12.50-14.00	Highly weathered, very weak, light yellowish brown, fine to medium grained, rock with very close spacing of discontinuities	13.12-14.62	-	-	-	-	50.60
14.00-15.50	Highly weathered, weak, light yellowish and whitish brown, fine to coarse grained, fractured rock	14.62-16.12	-	-	-	-	59.90
15.50-17.00	Moderately weathered, moderately strong, brownish black, fine to coarse grained, rock with very close spacing of discontinuities	16.12-17.62	-	-	-	-	78.40
17.00-18.50	Highly weathered, very weak, light greyish, fine to coarse grained, fractured rock	17.62-19.12	-	-	-	-	46.20
18.50-20.00	Highly weathered, very weak, blackish brown, fine to coarse grained, rock with close spacing of discontinuities	19.12-20.62	-	-	-	-	66.70

BH-150							
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- 3.53	-	-	-	-	
0.00-0.20	Yellowish brown, fine to very fine grained, silty clays of intermediate plasticity with little gravels (CI)	3.53-3.73	-	-	-	-	
0.20-4.70	Reddish brown to yellowish brown, very fine grained, silty clays of high plasticity (CH)	3.73-8.23	0.47	4	1.93	4-10	
4.70-5.80	Reddish yellow, very fine grained, silty clays of intermediate plasticity with some gravels (CI)	8.23-9.33	0.79	5	1.98	18	
5.80-8.60	Reddish brown, fine to medium grained, clayey sand with some gravels (SC)	9.33-12.13	0.05	25	1.98	11-13	
8.60-9.40	Reddish brown, fine to very fine grained, sandy clays of intermediate plasticity with some gravels (CI)	12.13-12.93	-	-	-	13	
9.40-13.60	Reddish brown, fine to coarse grained, silty sand with little plastic fines and some gravels (SM)	12.93-17.13	0.00	30	2.00	22- >100	
13.60-15.60	Reddish yellow, fine to medium grained, cemented silty sand with some gravels (SM)	17.13-19.13	-	-	-	26- >100	
15.60-17.00	Highly weathered, completely fractured and disintegrated, light yellowish white, fine to very fine grained, very weak and friable fractured rock	19.13-20.53	-	-	-	-	
17.00-20.00	Highly weathered, very weak, light brownish, fine to medium grained, rock with close spacing of discontinuities	20.53-23.53	-	-	-	-	42.60

BH-170							
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- 0.44	-	-	-	-	NA
0.00-0.40	Yellowish brown, fine to medium grained, clayey sand with little gravels (SC)	0.44-0.84	-	-	-	-	
0.40-3.60	Dark reddish, fine to very fine grained, sandy clays of intermediate plasticity with little gravels (CI)	0.84-4.04	0.74	7	1.98	7-15	
3.60-7.40	Dark brownish red, fine to medium grained, clayey sand with little to some gravels (SC)	4.04-7.84	0.06	28	2.02	13->100	
7.40-9.30	Yellowish brown, fine to very fine grained, cemented clayey sand with little gravels (SC)	7.84-9.74	-	-	-	>100	
9.30-14.20	Yellowish brown, fine to very fine grained, cemented silty sand with little plastic fines and little to some gravels (SM)	9.74-14.64	-	-	-	>100	
14.20-17.00	Highly weathered, very weak and friable yellowish brown, fine to medium grained, fractured rock	14.64-17.44	-	-	-	-	36.20
17.00-18.50	Moderately weathered, weak, yellowish brown, fine to medium grained, rock with moderately wide spacing of discontinuities	17.44-18.94	-	-	-	-	55.60
18.50-21.00	Moderately weathered, weak, greyish, fine to medium grained, rock with wide spacing of discontinuities	18.94-21.44	-	-	-	-	62.90
21.00-25.00	Moderately weathered, weak, light brownish grey, fine to medium grained, rock with very close spacing of discontinuities	21.44-25.44	-	-	-	-	105.50

BH - 158								
Structure	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
Compound Wall	0.00-0.20	Dark brownish, fine to medium grained, silty sand with little plastic fines and occasional gravels (SM)	Up to 1.96m depth from FGL soil in cutting	-	-	-	-	NA
	0.20-1.80	Yellowish brown, fine to medium grained, clayey sand with occasional gravels (SC)		-	-	-	23	
	1.80-1.96	Reddish yellow, fine to coarse grained, clayey sand with much gravels (SC)		-	-	-	-	
	1.96-3.60	Reddish yellow, fine to coarse grained, clayey sand with much gravels (SC)	FGL-1.64	0.07	29	1.87	24-43	
	3.60-4.30	Yellowish brown, fine to medium grained, silty clayey sand with occasional gravels (SM-SC)	1.64-2.34	-	-	-	37	
	4.30-5.60	Light brownish, fine to medium grained, clayey sand with much gravels (SC)	2.34-3.64	0.07	30	1.94	38-75	
	5.60-8.70	Yellowish brown to brownish, fine to medium grained, cemented clayey sand with occasional gravels (SC)	3.64-6.74	-	-	-	>100	
	8.70-10.40	Yellowish brown, fine to coarse grained, cemented friable sand	6.74-8.44	-	-	-	>100	
	10.40-14.40	Yellowish white, fine to coarse grained, cemented sand/mud rock with gravel, pebble size fractured rock fragments	8.44-12.44	-	-	-	>100	
	14.40-17.60	Brownish, fine to very fine grained, cemented clayey sand/ mud rock	12.44-15.64	-	-	-	>100	
	17.60-25.00	Highly weathered, completely fractured and disintegrated, gravel, pebble, cobble size angular interlocking fragments of fractured rock with yellowish brown, fine to coarse grained, clayey sand	15.64-23.04	-	-	-	-	98.40

BH - 167

Structure	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
Compo und Wall	-	Filled up soil	FGL- 3.43	-	-	-	-	NA
	0.00 to 0.60	Yellowish brown, fine to very fine grained, sandy clays of intermediate plasticity (CI)	3.43-4.03	-	-	-	-	
	0.60 to 4.90	Yellowish brown, very fine grained, clays of high plasticity (CH)	4.03-8.33	0.41	2	1.83	4-10	
	4.90 to 6.80	Reddish yellow, fine to medium grained, clayey sand (SC)	8.33-10.23	0.12	25	1.98	13	
	6.80 to 8.60	Brownish yellow, fine to very fine grained, sandy clays of intermediate plasticity (CI)	10.23-12.03	1.10	5	2.01	20-30	
	8.60 to 11.40	Yellowish brown, fine to medium grained, clayey sand (SC)	12.03-14.83	0.12	29	2.08	31-37	
	11.40 to 12.20	Brownish yellow, fine to medium grained, silty sand with little plastic fines and much gravels (SM)	14.83-15.63	-	-	-	59	
	12.20 to 20.00	Light brownish yellow, fine to medium grained, clayey sand with occasional gravels (SC)	15.63-23.43	-	-	-	86- >100	

Appendix-1"

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: Compound Wall (BH-1)

➤ **For Isolated Foundations:**

Depth of foundation considered from FGL, $D_f = 1.50$ m (201.00 R.L.)

Width of foundation considered, $B_f = 1.00$ m

Length of foundation considered, $L_f = 1.00$ m

Bulk Density $\gamma_b = 1.95$ gm/cm³

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

Factor of Safety = 2.50

Type of Failure Considered = General shear Failure.

*Tgh<Uqkl'O gej cplku'Cpf 'Hqwpf c'kqp 'Gpi kpggtlpi 'd{ 'F T O M T C t q t c 'c w c e j g f 'k p 'C r r g p f k z / 36 +

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

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

Shear Parameters, $c = 0.05$ kg/cm², $\phi = 25^\circ$, $e = 0.74$

(Considered as average between all the boreholes)

Bearing Capacity Factors:

"

$N_c = 13.07$, $N_q = 5.28$, i.e. $N_q - 1 = 4.28$, $N_\gamma = 4.14$

Bearing capacity factors are interpolated based on void ratio for mixed shear failure (Reference given in Appendix-14) considering $\Phi = 25^\circ$ (for General shear failure) and $\Phi' = 17.27^\circ$ (for Local shear failure) as per Table No.1 of IS 6403.

Shape Factors: (for rectangular footings)

(IS 6403, Table 2)

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

Depth Factors:

$d_c = 1.41$, $d_q = d_\gamma = 1.20$

(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.)

$W_q, W_\gamma = 0.5 \text{ \& } 0.5$ respectively,

(IS 6403, CL-5.1.2.4)

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

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

$$\begin{aligned} q_u &= \left[\left(\frac{2}{3} \right) * (0.05 * 10) * 13.07 * 1.41 * 1.30 * 1.00 + 1.95 * (1.50)(5.28 - 1.00) \right. \\ &\quad * 1.20 * 1.20 * 1.00 * 0.50 + 0.5 * 1.95 * 1.50 * 4.14 * 0.80 * 1.20 \\ &\quad \left. * 1.00 * 0.50 \right] \\ &= \mathbf{19.91 \text{ T / m}^2} \end{aligned}$$

$$q_{\text{net safe}} = q_u / \text{FS (i.e. 2.5)} = 7.96 \text{ T / m}^2$$

$$q_{\text{net safe}} = \mathbf{8.0 \text{ T / m}^2 = 80.00 \text{ kN/m}^2}$$

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: Compound Wall (BH-1)

$$S_i + S_c = \frac{C_d q_{net} B (1 - \mu^2)}{(E)} + m_v H \Delta P$$

Where,

S = Settlement of 40mm Considered

Q_{net} = Safe Bearing pressure

Factor C_d

E = Modulus of Elasticity (Ref: "Foundation analysis and design" by Joseoh E. Bowles' I kgp'lp'Cr r gpf kz/37)

m_v = Co-efficient of Volume Compressibility

μ = Poisson's Ratio (Ref: "Foundation analysis and design" by Joseoh E. Bowles' I kgp'lp'Cr r gpf kz/38)

B, L = Width & Length of Foundation respectively

R_f = Rigidity Factor

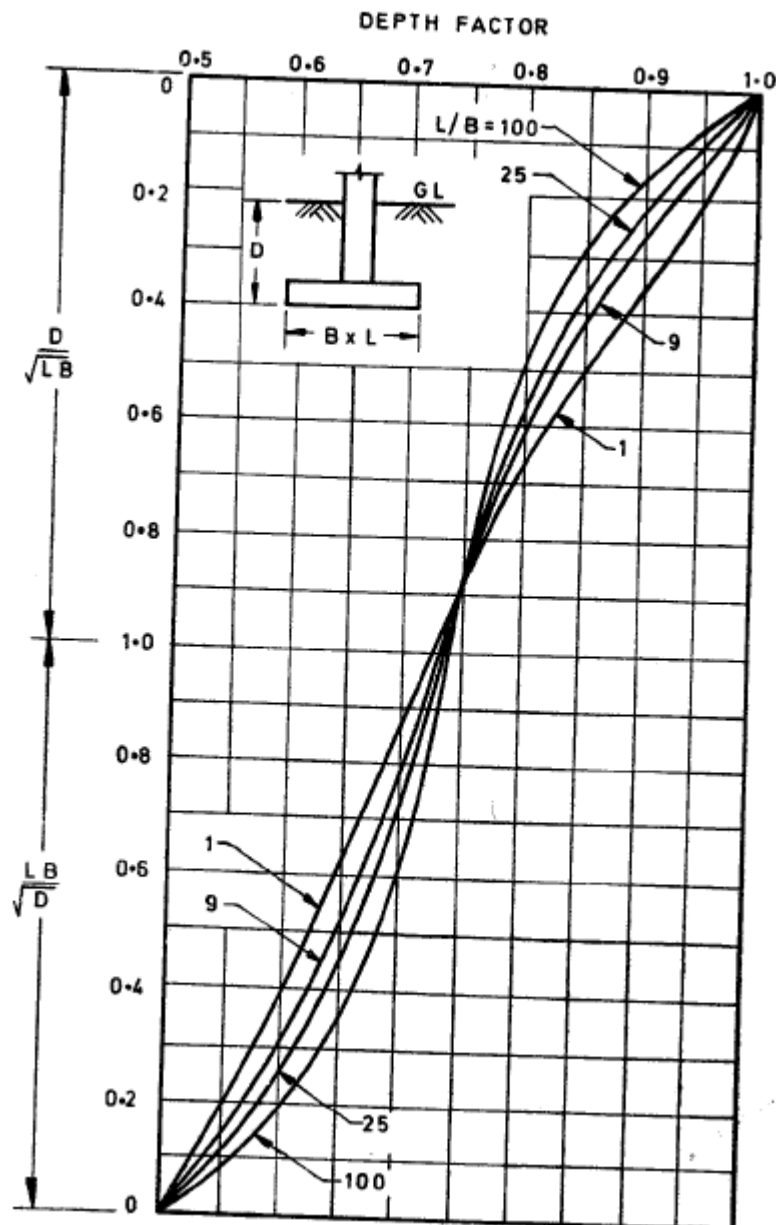
D_f = Depth factor

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 FGL, D_f = 1.50 m (201.00 R.L.)
- Width of foundation, considered, B_f = 1.00 m
- Length of foundation, considered, L_f = 1.00 m
- Poisson's ratio, μ = 0.35 (Ref : Foundation Analysis and Design by JE Bowles)
- Co-efficient of Volume Compressibility = 0.0108 cm²/kg,
- Modulus of Elasticity, E = 99 kg/cm²
- Depth of Compressible Stratum, H = 2.0 m
- Rigidity Factor = 0.80
- Dispersion 1:2 – Factor = ((H/2)+B)²/ B² = ((2.00/2)+1.00)²/1.00² = 4.0, (Utilized in calculations)
- Factor Related to Pore Pressure, λ = 0.7 **Ref: - Table – 1, IS 8009, P-1**
- Depth Correction Factor = 0.69 **Ref: - From Fig-12, IS 8009, P-1**
- **L/B = 1.00, D/(sqrt (L*B)) = (1.50/sqrt(1.00*1.00)) = 1.50**



- Factor $C_d = 1.12$ Ref: - Table-2, IS 8009, P-I,

$$\text{Net S.B.P} = 40 / (((100 * 1.12 * 1.00 * (1 - 0.35^2) * 0.80) / 99.0) + (100 * 0.0108 * 2.00 * 0.7 * 0.69 * 0.80 / 4.0))$$

$$= 40.05 \text{ T/m}^2$$

$$= 40.00 \text{ T/m}^2$$

So, Allowable Safe Bearing Pressure Considering Immediate and Consolidation Settlement is 40.00 T/m^2 .

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

$$= \text{Minimum of } 8.00 \text{ T/m}^2 \text{ \& } 40.00 \text{ T/m}^2$$

$$= 8.00 \text{ T/m}^2 = 80.00 \text{ kN/m}^2.$$

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: Compound Wall (BH-132)

➤ **For Square Isolated Foundations:**

Depth of foundation considered from FGL, $D_f = 1.00$ m (201.00 R.L.)

Width of foundation considered, $B_f = 1.00$ m

Length of foundation considered, $L_f = 1.00$ m

Bulk Density $\gamma_b = 1.99$ 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-;)

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

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

Shear Parameters, $c = 0.07$ kg/cm², $\phi = 30^\circ$, $e = 0.68$

Bearing Capacity Factors:

$N_c = 21.10$, $N_q = 11.24$, i.e. $N_q - 1 = 10.24$, $N_\gamma = 12.16$

Bearing capacity factors are interpolated based on void ratio for mixed shear failure (Reference given in Appendix-;) considering $\Phi = 30^\circ$ (for general shear failure) and $\Phi' = 21.15^\circ$ (for local shear failure) as per Table No 1 of IS 6403.

Shape Factors: (for rectangular footings)

(IS 6403, Table 2)

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

Depth Factors:

$d_c = 1.29$, $d_q = d_\gamma = 1.15$

(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 ultimate bearing capacity from shear criteria,

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

$$q_u = \left[\left(\frac{2}{3} \right) * (0.07 * 10) * 21.10 * 1.29 * 1.30 * 1.00 + 1.99 * (1.00)(11.24 - 1.00) \right. \\ \left. * 1.15 * 1.20 * 1.00 * 0.50 + 0.5 * 1.99 * 1.00 * 12.16 * 0.80 * 1.15 \right. \\ \left. * 1.00 * 0.50 \right] \\ = 36.14 \text{ T / m}^2$$

$$q_{\text{net safe}} = q_u / \text{FS (i.e. 2.5)} = 14.45 \text{ T / m}^2$$

$$q_{\text{net safe}} = 14.0 \text{ T / m}^2 = 140.00 \text{ kN/m}^2$$

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: Compound Wall (BH-132)

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

Where,

S = Settlement of 40mm Considered

Q_{net} = Safe Bearing pressure

Factor C_d

E = Modulus of Elasticity (Ref: "Foundation analysis and design" by Joseoh E. Bowles given in Appendix-12)

μ = Poisson's Ratio (Ref: "Foundation analysis and design" by Joseoh E. Bowles given in Appendix-13)

B, L = Width & Length of Foundation respectively

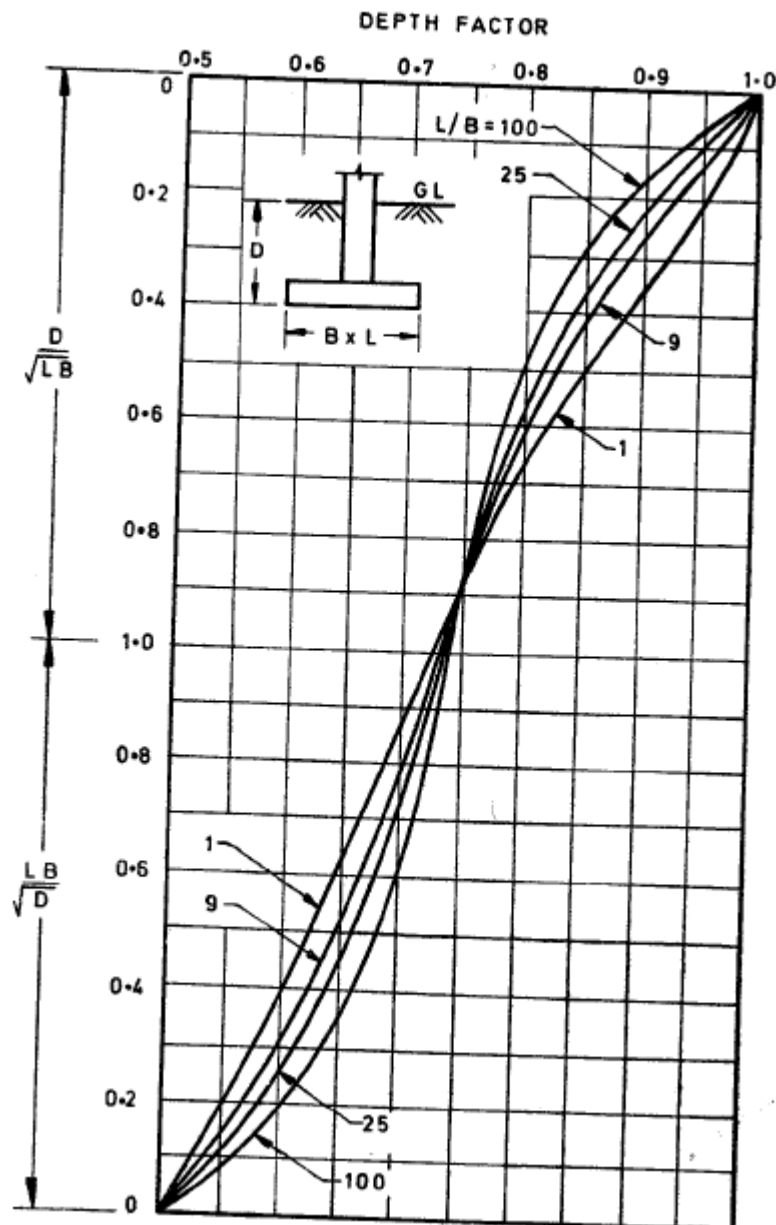
R_f = Rigidity Factor

D_f = Depth factor

Code of Reference – IS 8009 P-1

For Isolated Foundations:

- Safe Bearing Pressure for 40mm Settlement.
- Depth of foundation considered from FGL, D_f = 1.00 m (201.00 R.L.)
- Width of foundation, considered, B_f = 1.00 m
- Length of foundation, considered, L_f = 1.00 m
- Poisson's ratio, μ = 0.35 (Ref : Foundation Analysis and Design by JE Bowles)
- Modulus of Elasticity, E = 99 kg/cm² For SC soil,
E = 320(15+19) = 320(15+19) = 10880 kPa
- Rigidity Factor = 0.80



- Factor $C_d = 1.12$ Ref: - Table-2, IS 8009, P-I,

$$\text{Net S.B.P} = 40 / (((100 * 1.12 * 1.00 * (1 - 0.35^2) * 0.80) / 108.0))$$

$$= 54.95 \text{ T/m}^2$$

$$= 55.00 \text{ T/m}^2$$

So, Allowable Safe Bearing Pressure Considering Immediate Settlement is 55.00 T/m^2 .

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

$$= \text{Minimum of } 14.00 \text{ T/m}^2 \text{ \& } 55.00 \text{ T/m}^2$$

$$= 14.00 \text{ T/m}^2 = 140.00 \text{ kN/m}^2.$$

.....Cr r gpf k/4"

Sample Calculation for Pile Lateral Capacity

1.0 As per the IS 2911 (Part 1/ Sec 4): 2010 (reaffirmed 2020)

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

Structure: Compound wall

Cut-off of pile: 1.0 m from F.G.L. (R.L.-202.50 m)

Diameter of Pile: 0.450 m

Length of Pile: 17.02 m from F.G.L.

Here, pile would be long and elastic (i.e. $L > 4T$) therefore lateral capacity of pile calculated as per the IS 2911 (Part 1/ Sec 4): 2010 (reaffirmed 2020). Lateral pile capacity is calculated corresponding to 5 mm deflection.

Lateral Capacity for free head pile,

$$y = \frac{H (e+zf)^3}{3EI} \dots\dots\dots \text{Eq.1.}$$

Lateral Capacity for fix head pile,

$$y = \frac{H (e+zf)^3}{12EI} \dots\dots\dots \text{Eq.2.}$$

y = Deflection of Pile Head, in mm

H = lateral load, in tones

e = cantilever length above ground/bed to the point of load application, in m.

Here, e = 0m

E = Young's Modulus of pile material in kg/cm²

M30 Grade of concrete is considered for the calculation,

$$E = 5000 * (f_{ck})^{1/2} * 10^3 = 279261.80 \text{ kg/cm}^2$$

I = moment of inertia of the pile cross-section, in cm⁴

$$\begin{aligned} I &= \frac{\pi}{64} * d^4 \\ &= \frac{\pi}{64} * 45^4 \\ &= 201288.96 \text{ cm}^4 \end{aligned}$$

T = Stiffness Factor in cm,

$n_h = 1.40 \text{ MN/m}^3$ From Table 5.0 of IS 2911 (Part 1/ Sec 4): 2010 (reaffirmed 2020)

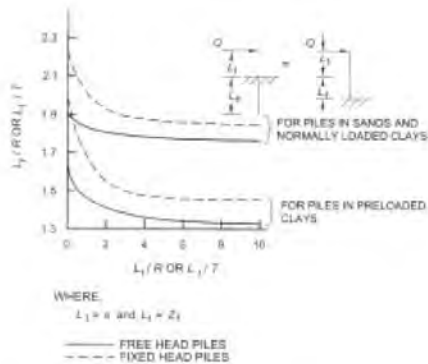
$$T = \sqrt[5]{\frac{EI}{n_h}}$$

$$T = \sqrt[5]{\frac{(279261.80 \times 201186.90)}{0.14}}$$

$$T = 209.27 \text{ cm}$$

$$T = 2.09 \text{ m}$$

z_f = depth to point of fixity, in m



As per the Fig.6 of IS 2911 (Part 1/ Sec 4): 2010 (reaffirmed 2020) for Free Head Pile,

$$\frac{z_f}{T} = 1.9$$

$$Z_f = 1.9 \times 209.27$$

$$Z_f = 397.61 \text{ cm}$$

As per the Fig.6 of IS 2911 (Part 1/ Sec 4): 2010 (reaffirmed 2020) for Fix Head Pile,

$$\frac{z_f}{T} = 2.18$$

$$Z_f = 2.18 \times 209.27$$

$$Z_f = 456.21 \text{ cm}$$

Substituting above value in Eq. 1. For Allowable Horizontal Force in free head condition,

$$0.5 = \frac{H (0+397.61)^3}{3 \times 279261.80 \times 201186.90}$$

$$H = 1340.70 \text{ kg}$$

$$H = 1.34 \text{ Tones}$$

$$H = 1.30 \text{ Tones}$$

Substituting above value in Eq. 2. For Allowable Horizontal Force in flzgf head condition,

$$0.5 = \frac{H (0+456.21)^3}{12 \times 279261.80 \times 201186.90}$$

$$H = 3550.32 \text{ kg}$$

$$H = 3.60 \text{ Tones}$$

Sample Calculation for Allowable Moment in pile

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

Diameter of Pile: 0.450 m

Allowable moment in pile calculated as per the IS 2911 (Part 1/ Sec 4): 2010 (reaffirmed 2020). Sample calculation is as given below.

For Free Head Pile

$$M_F = H * (e + Z_f)$$

$$= 1.30 * (0 + 3.97) \text{ tonne m}$$

$$= \mathbf{5.161 \text{ Tm}}$$

For actual moment acting on the pile reduction factor applied to the above moment. Reduction factor derived from the Fig. 7A is 0.62.

$$M = R_f * M_F$$

$$= 0.40 * 5.16$$

$$= \mathbf{2.06 \text{ Tm}}$$

For Fix Head Pile

$$M_F = \frac{H * (e + Z_f)}{2}$$

$$= \frac{3.60 * (0 + 4.56)}{2}$$

$$= \mathbf{8.208 \text{ Tm}}$$

For actual moment acting on the pile reduction factor applied to the above moment. Reduction factor derived from the Fig. 7B is 0.82.

$$M = R_f * M_F$$

$$= 0.82 * 8.208$$

$$= \mathbf{6.73 \text{ Tm}}$$

So, Allowable moment in the free head pile is 2.06 Tm and for fix head pile is 6.73 Tm.

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APPENDIX - 3.1 **Calculation of Net Safe Bearing Capacity****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 structure 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 m	R.L. 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																					
	m	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	1.00	1.00	1.50	201.00	0.05	25	13.07	4.28	4.14	1.30	1.20	0.80	1.41	1.20	1.20	1.00	1.00	1.00	1.95	0.98	0.50	0.50	8
2	2.00	2.00	1.50	201.00	0.05	25	13.07	4.28	4.14	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	7
3	3.00	3.00	1.50	201.00	0.05	25	13.07	4.28	4.14	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	1.95	0.98	0.50	0.50	8
4	4.00	4.00	1.50	201.00	0.05	25	13.07	4.28	4.14	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	8
5	1.00	1.00	2.50	200.00	0.05	25	13.07	4.28	4.14	1.30	1.20	0.80	1.68	1.34	1.34	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11
6	2.00	2.00	2.50	200.00	0.05	25	13.07	4.28	4.14	1.30	1.20	0.80	1.34	1.17	1.17	1.00	1.00	1.00	1.95	0.98	0.50	0.50	10
7	3.00	3.00	2.50	200.00	0.05	25	13.07	4.28	4.14	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	11
8	4.00	4.00	2.50	200.00	0.05	25	13.07	4.28	4.14	1.30	1.20	0.80	1.17	1.08	1.08	1.00	1.00	1.00	1.95	0.98	0.50	0.50	11
9	1.00	1.00	3.50	199.00	0.05	25	13.07	4.28	4.14	1.30	1.20	0.80	1.95	1.48	1.48	1.00	1.00	1.00	1.95	0.98	0.50	0.50	16
10	2.00	2.00	3.50	199.00	0.05	25	13.07	4.28	4.14	1.30	1.20	0.80	1.48	1.24	1.24	1.00	1.00	1.00	1.95	0.98	0.50	0.50	14
11	3.00	3.00	3.50	199.00	0.05	25	13.07	4.28	4.14	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	13
12	4.00	4.00	3.50	199.00	0.05	25	13.07	4.28	4.14	1.30	1.20	0.80	1.24	1.12	1.12	1.00	1.00	1.00	1.95	0.98	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 FGL at the time of exploration.
- 3) Calculations are considering the effect of water table at FGL (R.L. 202.5m)

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APPENDIX - 3.2 ~~of 6~~ ~~19~~Calculation of Safe Bearing Pressure for Settlement of ~~19~~ and 40 mm

Project :- Proposed structure 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	R.L. 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 40 mm Settlement
	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ²
1	1.50	201.00	1.00	1.00	0.35	99	1.12	0.80	0.0108	2.00	0.70	0.69	0.80	40
2	1.50	201.00	2.00	2.00	0.35	99	1.12	0.80	0.0108	4.00	0.70	0.77	0.80	19
3	1.50	201.00	3.00	3.00	0.35	99	1.12	0.80	0.0108	6.00	0.70	0.85	0.80	13
4	1.50	201.00	4.00	4.00	0.35	99	1.12	0.80	0.0108	8.00	0.70	0.89	0.80	9
5	2.50	200.00	1.00	1.00	0.35	99	1.12	0.80	0.0108	2.00	0.70	0.65	0.80	40
6	2.50	200.00	2.00	2.00	0.35	99	1.12	0.80	0.0108	4.00	0.70	0.73	0.80	20
7	2.50	200.00	3.00	3.00	0.35	99	1.12	0.80	0.0108	6.00	0.70	0.75	0.80	13
8	2.50	200.00	4.00	4.00	0.35	99	1.12	0.80	0.0108	7.50	0.70	0.81	0.80	10
9	3.50	199.00	1.00	1.00	0.35	99	1.12	0.80	0.0108	2.00	0.70	0.63	0.80	41
10	3.50	199.00	2.00	2.00	0.35	99	1.12	0.80	0.0108	4.00	0.70	0.73	0.80	20
11	3.50	199.00	3.00	3.00	0.35	99	1.12	0.80	0.0108	6.00	0.70	0.73	0.80	13
12	3.50	199.00	4.00	4.00	0.35	99	1.12	0.80	0.0108	6.50	0.70	0.75	0.80	10

Note: - Coefficient of volume compressibility has been taken by weighted average of the values within the compressible layer.

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APPENDIX - 4.1 (For BH-97)

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	R.L. 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	1.00	1.00	1.00	201.50	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	1.92	0.96	0.50	0.50	6
2	2.00	2.00	1.00	201.50	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	1.92	0.96	0.50	0.50	6
3	3.00	3.00	1.00	201.50	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	1.92	0.96	0.50	0.50	6
4	4.00	4.00	1.00	201.50	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	1.92	0.96	0.50	0.50	7
5	1.00	1.00	2.00	200.50	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	1.92	0.96	0.50	0.50	9
6	2.00	2.00	2.00	200.50	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	1.92	0.96	0.50	0.50	9
7	3.00	3.00	2.00	200.5	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	1.92	0.96	0.50	0.50	9
8	4.00	4.00	2.00	200.5	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	1.92	0.96	0.50	0.50	9
9	1.00	1.00	3.00	199.5	0.07	24	12.00	3.56	3.30	1.30	1.20	0.80	1.80	1.40	1.40	1.00	1.00	1.00	1.92	0.96	0.50	0.50	13
10	2.00	2.00	3.00	199.5	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	1.92	0.96	0.50	0.50	11
11	3.00	3.00	3.00	199.5	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	1.92	0.96	0.50	0.50	11
12	4.00	4.00	3.00	199.5	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	1.92	0.96	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 FGL (R.L. 202.50m).****3) Calculations are considering the effect of water table at F.G.L.**

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APPENDIX - 4.2 (For BH-97)

Calculation of Safe Bearing Pressure for Settlement of 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 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 40 mm Settlement T / m ²
1	1.00	201.50	1.00	1.12	0.35	90	0.80	46
2	1.00	201.50	2.00	1.12	0.35	90	0.80	23
3	1.00	201.50	3.00	1.12	0.35	90	0.80	15
4	1.00	201.50	4.00	1.12	0.35	90	0.80	11
5	2.00	200.50	1.00	1.12	0.35	90	0.80	46
6	2.00	200.50	2.00	1.12	0.35	90	0.80	23
7	2.00	200.50	3.00	1.12	0.35	90	0.80	15
8	2.00	200.50	4.00	1.12	0.35	90	0.80	11
9	3.00	199.50	1.00	1.12	0.35	90	0.80	46
10	3.00	199.50	2.00	1.12	0.35	90	0.80	23
11	3.00	199.50	3.00	1.12	0.35	90	0.80	15
12	3.00	199.50	4.00	1.12	0.35	90	0.80	11

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APPENDIX - 5.1 (For BH 5,7,99)

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 structure 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	R.L. 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	1.00	1.00	1.00	201.50	0.25	33	22.89	11.71	14.40	1.30	1.20	0.80	1.30	1.15	1.15	1.00	1.00	1.00	1.78	0.89	0.50	0.50	34
2	2.00	2.00	1.00	201.50	0.25	33	22.89	11.71	14.40	1.30	1.20	0.80	1.15	1.08	1.08	1.00	1.00	1.00	1.78	0.89	0.50	0.50	33
3	3.00	3.00	1.00	201.50	0.25	33	22.89	11.71	14.40	1.30	1.20	0.80	1.10	1.05	1.05	1.00	1.00	1.00	1.78	0.89	0.50	0.50	34
4	4.00	4.00	1.00	201.50	0.25	33	22.89	11.71	14.40	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	35
5	1.00	1.00	1.50	201.00	0.25	33	22.89	11.71	14.40	1.30	1.20	0.80	1.46	1.23	1.23	1.00	1.00	1.00	1.78	0.89	0.50	0.50	41
6	2.00	2.00	1.50	201.00	0.25	33	22.89	11.71	14.40	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	37
7	3.00	3.00	1.50	201.00	0.25	33	22.89	11.71	14.40	1.30	1.20	0.80	1.15	1.08	1.08	1.00	1.00	1.00	1.78	0.89	0.50	0.50	38
8	4.00	4.00	1.50	201.00	0.25	33	22.89	11.71	14.40	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	39
9	1.00	1.00	2.00	200.50	0.25	33	22.89	11.71	14.40	1.30	1.20	0.80	1.61	1.30	1.30	1.00	1.00	1.00	1.78	0.89	0.50	0.50	48
10	2.00	2.00	2.00	200.50	0.25	33	22.89	11.71	14.40	1.30	1.20	0.80	1.30	1.15	1.15	1.00	1.00	1.00	1.78	0.89	0.50	0.50	42
11	3.00	3.00	2.00	200.50	0.25	33	22.89	11.71	14.40	1.30	1.20	0.80	1.20	1.10	1.10	1.00	1.00	1.00	1.78	0.89	0.50	0.50	42
12	4.00	4.00	2.00	200.50	0.25	33	22.89	11.71	14.40	1.30	1.20	0.80	1.15	1.08	1.08	1.00	1.00	1.00	1.78	0.89	0.50	0.50	43

Note :-

- 1) The factor of safety of 2.5 is considered.
- 2) The depth of foundation is considered from the FGL at the time of exploration.
- 3) Calculations are considering the effect of water table at F.G.L (RL 202.50m).
- 4) Shear parameter is considered based on correlation given by Sowers, 1979 & Hatanaka Uchida.

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APPENDIX - 5.2 (For BH 5,7,99)

Calculation of Safe Bearing Pressure for Settlement of 40 mm

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

Project:- Proposed structure 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	R.L. 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 40 mm Settlement T / m ²
1	1.00	201.50	1.00	1.12	0.35	134	0.80	68
2	1.00	201.50	2.00	1.12	0.35	134	0.80	34
3	1.00	201.50	3.00	1.12	0.35	134	0.80	23
4	1.00	201.50	4.00	1.12	0.35	134	0.80	17
5	1.50	201.00	1.00	1.12	0.35	134	0.80	68
6	1.50	201.00	2.00	1.12	0.35	134	0.80	34
7	1.50	201.00	3.00	1.12	0.35	134	0.80	23
8	1.50	201.00	4.00	1.12	0.35	134	0.80	17
9	2.00	200.50	1.00	1.12	0.35	134	0.80	68
10	2.00	200.50	2.00	1.12	0.35	134	0.80	34
11	2.00	200.50	3.00	1.12	0.35	134	0.80	23
12	2.00	200.50	4.00	1.12	0.35	134	0.80	17

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APPENDIX - 6.1 (For BH 3)

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 structure 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	R.L. 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	1.00	1.00	1.00	201.50	0.16	30	18.10	7.87	8.77	1.30	1.20	0.80	1.29	1.15	1.15	1.00	1.00	1.00	1.96	0.98	0.50	0.50	19
2	2.00	2.00	1.00	201.50	0.16	30	18.10	7.87	8.77	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	18
3	3.00	3.00	1.00	201.50	0.16	30	18.10	7.87	8.77	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	19
4	4.00	4.00	1.00	201.50	0.16	30	18.10	7.87	8.77	1.30	1.20	0.80	1.07	1.04	1.04	1.00	1.00	1.00	1.96	0.98	0.50	0.50	20
5	1.00	1.00	1.50	201.00	0.16	30	18.10	7.87	8.77	1.30	1.20	0.80	1.44	1.22	1.22	1.00	1.00	1.00	1.96	0.98	0.50	0.50	23
6	2.00	2.00	1.50	201.00	0.16	30	18.10	7.87	8.77	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
7	3.00	3.00	1.50	201.00	0.16	30	18.10	7.87	8.77	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	22
8	4.00	4.00	1.50	201.00	0.16	30	18.10	7.87	8.77	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	23
9	1.00	1.00	2.00	200.50	0.16	30	18.10	7.87	8.77	1.30	1.20	0.80	1.58	1.29	1.29	1.00	1.00	1.00	1.96	0.98	0.50	0.50	27
10	2.00	2.00	2.00	200.50	0.16	30	18.10	7.87	8.77	1.30	1.20	0.80	1.29	1.15	1.15	1.00	1.00	1.00	1.96	0.98	0.50	0.50	25
11	3.00	3.00	2.00	200.50	0.16	30	18.10	7.87	8.77	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	25
12	4.00	4.00	2.00	200.50	0.16	30	18.10	7.87	8.77	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	25

Note :-

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

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 6.2 (For BH 3)

Calculation of Safe Bearing Pressure for Settlement of 40 mm

Project :- Proposed structure 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	Width B	Length L	Poissons ratio μ	Modulus of Elasticity E	Factor Cd	Rigidity Factor $\frac{d}{r}$	Coefficient of Volume Compressibility	Depth of Compressible Stratum H	λ factor related to pore pressure parameter	Depth Factor df	Rigidity Factor	For 40 mm Settlement
	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ²
1	1.00	201.50	1.00	1.00	0.35	118	1.12	0.80	0.0079	2.00	0.70	0.73	0.80	48
2	1.00	201.50	2.00	2.00	0.35	118	1.12	0.80	0.0079	4.00	0.70	0.85	0.80	23
3	1.00	201.50	3.00	3.00	0.35	118	1.12	0.80	0.0079	6.00	0.70	0.91	0.80	15
4	1.00	201.50	4.00	4.00	0.35	118	1.12	0.80	0.0079	8.00	0.70	0.93	0.80	11
5	1.50	201.00	1.00	1.00	0.35	118	1.12	0.80	0.0079	2.00	0.70	0.69	0.80	49
6	1.50	201.00	2.00	2.00	0.35	118	1.12	0.80	0.0079	4.00	0.70	0.77	0.80	24
7	1.50	201.00	3.00	3.00	0.35	118	1.12	0.80	0.0079	6.00	0.70	0.85	0.80	16
8	1.50	201.00	4.00	4.00	0.35	118	1.12	0.80	0.0079	8.00	0.70	0.89	0.80	12
9	2.00	200.50	1.00	1.00	0.35	118	1.12	0.80	0.0079	2.00	0.70	0.66	0.80	49
10	2.00	200.50	2.00	2.00	0.35	118	1.12	0.80	0.0079	4.00	0.70	0.73	0.80	24
11	2.00	200.50	3.00	3.00	0.35	118	1.12	0.80	0.0079	6.00	0.70	0.80	0.80	16
12	2.00	200.50	4.00	4.00	0.35	118	1.12	0.80	0.0079	8.00	0.70	0.85	0.80	12

Note: - Coefficient of volume compressibility has been taken by weighted average of the values within the compressible layer.

*Coefficient of volume compressibility is taken from Reference attached in Appendix-17

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APPENDIX - 7.1 (For BH 69)

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 structure 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	R.L. 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	1.00	1.00	1.00	201.50	0.14	30	20.37	9.67	11.34	1.30	1.20	0.80	1.29	1.15	1.15	1.00	1.00	1.00	1.99	1.00	0.50	0.50	20
2	2.00	2.00	1.00	201.50	0.14	30	20.37	9.67	11.34	1.30	1.20	0.80	1.15	1.07	1.07	1.00	1.00	1.00	1.99	1.00	0.50	0.50	20
3	3.00	3.00	1.00	201.50	0.14	30	20.37	9.67	11.34	1.30	1.20	0.80	1.10	1.05	1.05	1.00	1.00	1.00	1.99	1.00	0.50	0.50	21
4	4.00	4.00	1.00	201.50	0.14	30	20.37	9.67	11.34	1.30	1.20	0.80	1.07	1.04	1.04	1.00	1.00	1.00	1.99	1.00	0.50	0.50	23
5	1.00	1.00	1.50	201.00	0.14	30	20.37	9.67	11.34	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	25
6	2.00	2.00	1.50	201.00	0.14	30	20.37	9.67	11.34	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	24
7	3.00	3.00	1.50	201.00	0.14	30	20.37	9.67	11.34	1.30	1.20	0.80	1.15	1.07	1.07	1.00	1.00	1.00	1.99	1.00	0.50	0.50	25
8	4.00	4.00	1.50	201.00	0.14	30	20.37	9.67	11.34	1.30	1.20	0.80	1.11	1.05	1.05	1.00	1.00	1.00	1.99	1.00	0.50	0.50	26
9	1.00	1.00	2.00	200.50	0.14	30	20.37	9.67	11.34	1.30	1.20	0.80	1.58	1.29	1.29	1.00	1.00	1.00	1.99	1.00	0.50	0.50	30
10	2.00	2.00	2.00	200.50	0.14	30	20.37	9.67	11.34	1.30	1.20	0.80	1.29	1.15	1.15	1.00	1.00	1.00	1.99	1.00	0.50	0.50	28
11	3.00	3.00	2.00	200.50	0.14	30	20.37	9.67	11.34	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	28
12	4.00	4.00	2.00	200.50	0.14	30	20.37	9.67	11.34	1.30	1.20	0.80	1.15	1.07	1.07	1.00	1.00	1.00	1.99	1.00	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 FGL at the time of exploration.
- 3) Calculations are considering the effect of water table at F.G.L (RL 202.50m).

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 7.2 (For BH 69)

Calculation of Safe Bearing Pressure for Settlement of 40 mm

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

Project:- Proposed structure 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	R.L. 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 40 mm Settlement T / m ²
1	1.00	201.50	1.00	1.12	0.35	195	0.80	99
2	1.00	201.50	2.00	1.12	0.35	195	0.80	50
3	1.00	201.50	3.00	1.12	0.35	195	0.80	33
4	1.00	201.50	4.00	1.12	0.35	195	0.80	25
5	1.50	201.00	1.00	1.12	0.35	195	0.80	99
6	1.50	201.00	2.00	1.12	0.35	195	0.80	50
7	1.50	201.00	3.00	1.12	0.35	195	0.80	33
8	1.50	201.00	4.00	1.12	0.35	195	0.80	25
9	2.00	200.50	1.00	1.12	0.35	195	0.80	99
10	2.00	200.50	2.00	1.12	0.35	195	0.80	50
11	2.00	200.50	3.00	1.12	0.35	195	0.80	33
12	2.00	200.50	4.00	1.12	0.35	195	0.80	25

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 8.1 (For BH 36)

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 structure 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	R.L. 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	1.00	1.00	1.00	201.50	0.11	30	23.03	11.78	14.35	1.30	1.20	0.80	1.29	1.15	1.15	1.00	1.00	1.00	1.85	0.93	0.50	0.50	20
2	2.00	2.00	1.00	201.50	0.11	30	23.03	11.78	14.35	1.30	1.20	0.80	1.15	1.07	1.07	1.00	1.00	1.00	1.85	0.93	0.50	0.50	20
3	3.00	3.00	1.00	201.50	0.11	30	23.03	11.78	14.35	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	22
4	4.00	4.00	1.00	201.50	0.11	30	23.03	11.78	14.35	1.30	1.20	0.80	1.07	1.04	1.04	1.00	1.00	1.00	1.85	0.93	0.50	0.50	24
5	1.00	1.00	1.50	201.00	0.11	30	23.03	11.78	14.35	1.30	1.20	0.80	1.44	1.22	1.22	1.00	1.00	1.00	1.85	0.93	0.50	0.50	25
6	2.00	2.00	1.50	201.00	0.11	30	23.03	11.78	14.35	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	24
7	3.00	3.00	1.50	201.00	0.11	30	23.03	11.78	14.35	1.30	1.20	0.80	1.15	1.07	1.07	1.00	1.00	1.00	1.85	0.93	0.50	0.50	25
8	4.00	4.00	1.50	201.00	0.11	30	23.03	11.78	14.35	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	27
9	1.00	1.00	2.00	200.50	0.11	30	23.03	11.78	14.35	1.30	1.20	0.80	1.58	1.29	1.29	1.00	1.00	1.00	1.85	0.93	0.50	0.50	30
10	2.00	2.00	2.00	200.50	0.11	30	23.03	11.78	14.35	1.30	1.20	0.80	1.29	1.15	1.15	1.00	1.00	1.00	1.85	0.93	0.50	0.50	28
11	3.00	3.00	2.00	200.50	0.11	30	23.03	11.78	14.35	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	29
12	4.00	4.00	2.00	200.50	0.11	30	23.03	11.78	14.35	1.30	1.20	0.80	1.15	1.07	1.07	1.00	1.00	1.00	1.85	0.93	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 FGL at the time of exploration.
- 3) Calculations are considering the effect of water table at F.G.L (RL 202.50m).

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 8.2 (For BH 36)

Calculation of Safe Bearing Pressure for Settlement of 40 mm

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

Project:- Proposed structure 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	R.L. 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 40 mm Settlement T / m ²
1	1.00	201.50	1.00	1.12	0.35	150	0.80	76
2	1.00	201.50	2.00	1.12	0.35	150	0.80	38
3	1.00	201.50	3.00	1.12	0.35	150	0.80	25
4	1.00	201.50	4.00	1.12	0.35	150	0.80	19
5	1.50	201.00	1.00	1.12	0.35	150	0.80	76
6	1.50	201.00	2.00	1.12	0.35	150	0.80	38
7	1.50	201.00	3.00	1.12	0.35	150	0.80	25
8	1.50	201.00	4.00	1.12	0.35	150	0.80	19
9	2.00	200.50	1.00	1.12	0.35	150	0.80	76
10	2.00	200.50	2.00	1.12	0.35	150	0.80	38
11	2.00	200.50	3.00	1.12	0.35	150	0.80	25
12	2.00	200.50	4.00	1.12	0.35	150	0.80	19

Appendix – 9

Calculation of Safe Load on Uniform Diameter Bored Cast in situ Pile.

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

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 | - 0.45m. |
| 3. Termination depth of pile considered | - 15.00m (From FGL) |
| 4. Cut off Level | - 1.00 m from FGL. |
| 5. Factor of Safety | - 2.50 |
| 6. Depth of Water table | - Encountered at 1.80m depth but considered at FGL. |
| 7. Ref | - IS 2911 P-I, Sec-II, 2021. |

2) Test Data

The parameters are based on BH-2. 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 kg/cm ²	Angle of Internal Friction ϕ	Bulk / Submerged Density gm/cc γ_b / γ_{sub}	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 1.00	Pile cutoff level – No pile						
1.00 to 7.75	0.67 ^{&}	0 ^{&}	1.80 ^{&} / 0.80	0.66	NA	NA	10 ^{&}
7.75 to 10.45	0.0	26 ^{\$}	1.80 / 0.80	NA	1.00	26	11
10.45 to 26.35	0.00	33 ^{\$}	1.80/0.80	NA	1.15	33	>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.

- \$ 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,

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

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

D = Diameter of pile = d in m

$$N_\gamma = 37.78$$

$$N_q = 35$$

$$q_{ub} = 0.785d^2 (0.5 \cdot d \cdot 0.80 \cdot 37.78 + 6.20 \cdot 35) = 11.86d^3 + 170.35d^2$$

(For Pile terminating at 15.00m from F.G.L.).

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 – No contribution considered – Due to filled up soil.

$$\text{Third Layer} - K_3 P D_3 \tan \delta_3 A_{s3} = 1.00 \cdot 6.20 \cdot \tan 26^\circ \cdot \pi \cdot d \cdot 2.70 = 25.65d$$

$$\text{Fourth Layer} - K_4 P D_4 \tan \delta_4 A_{s4} = 1.15 \cdot 6.20 \cdot \tan 33^\circ \cdot \pi \cdot d \cdot (\ell - 12.067) = 14.55d (\ell - 12.067)$$

(For Pile terminating at 15.00m from F.G.L.)

As per IS 2911 part 1 section 2, Critical depth is considered fifteen times diameter of pile. Overburden is calculated at center of particular layer for skin friction calculation.

$$\text{In this case critical depth} = (15 \cdot 0.45) + 1.0(\text{cutoff level}) = 6.75 + 1.0(\text{cutoff level}) = 7.75$$

$$\text{As 7.5 falls in second layer i.e. between 1.00 to 7.75m, therefore } PD = 7.75 \cdot 0.80 = 6.20 \text{ T/m}^2$$

$$q_{uf} = 25.65d + 14.55 d (\ell - 12067) \text{ (For Piles terminating at 15.00m from F.G.L.)}$$

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,

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

$$q_{uc} = 11.86d^3 + 170.35d^2 + 25.65d + 14.55 d (\ell - 12067) \text{ (For Piles terminating at 15.00m from F.G.L.)}$$

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
		0.45
15.00	14.00	29.27

3.3) Ultimate Load in Uplift

Considering skin friction for determination of uplift and safety factor 3.0,

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
		0.45
15.00	14.00	12.53

Note: Self weight of pile is not considered in calculation of ultimate load in uplift.

3.4) Lateral Pile Capacity

The lateral capacity of long and elastic to intermediate piles with M 30 grade of concrete and having no free length may be summarized by using the codal provisions of IS 2911, P-1, S-2 as follows,

Diameter in, m		0.45
Subgrade Reaction in MN/m ³		1.40
Stiffness Factor T, in m		2.09
Depth of Fixity in, m	Free Head	4.00
	Fixed Head	4.60
Allowable Horizontal Force in, T	Free Head	1.30
	Fixed Head	3.60
Allowable Moment Capacity in, Tm	Free Head	2.13
	Fixed Head	6.64

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 – 32

Calculation of Safe Load on Uniform Diameter Bored Cast in situ Pile.

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

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 | - 0.45m. |
| 3. Termination depth of pile considered | - 15.00m (From FGL) |
| 4. Cut off Level | - 1.00 m from FGL. |
| 5. Factor of Safety | - 2.50 |
| 6. Depth of Water table | - Encountered at 1.30m depth but considered at FGL. |
| 7. Ref | - IS 2911 P-I, Sec-II, 2021. |

2) Test Data

The parameters are based on BH-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 kg/cm ²	Angle of Internal Friction ϕ	Bulk / Submerged Density gm/cc γ_b / γ_{sub}	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 1.00	Pile cutoff level – No pile						
1.00 to 8.85	0.67 ^{&}	0 ^{&}	1.80 ^{&} / 0.80	0.66	NA	NA	10 ^{&}
8.85 to 12.75	0.61	7~0*	1.96 / 0.96	0.74	NA	NA	6-11
12.75 to 18.25	0.00	32	2.01/1.01	NA	1.10	32	13-43

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.

3) Ultimate Load in Compression

3.1) Ultimate load in Compression by Bearing

Ultimate load on pile in end bearing,

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

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

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

$$N_\gamma = 32.65$$

$$N_q = 30$$

$$q_{ub} = 0.785d^2 (0.5 \cdot d \cdot 1.01 \cdot 32.65 + 8042 \cdot 30) = 12.94d^3 + 16803d^2$$

(For Pile terminating at 15.00m from F.G.L.).

3.2) Ultimate Load in Compression by Skin Friction

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 – No contribution considered – Due to filled up soil.

$$\text{Third Layer} - \alpha_3 C_{a3} A_{s3} = 0.74 \cdot 6.10 \cdot \pi \cdot d \cdot 3.90 = 55.31d$$

$$\text{Fourth Layer} - K_4 P D_4 \tan \delta_4 A_{s4} = 1.10 \cdot 8042 \cdot \tan 32^\circ \cdot \pi \cdot d \cdot (\ell - 12.75) = 1505; d (\ell - 12.75)$$

(For Pile terminating at 15.00m from F.G.L.)

$$q_{uf} = 55.31d + 1505; d (\ell - 12.75) \text{ (For Piles terminating at 15.00m from F.G.L.)}$$

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,

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

$$q_{uc} = 12.94d^3 + 16803d^2 + 55.31d + 1505; d (\ell - 12.75) \text{ (For Piles terminating at 15.00m from F.G.L.)}$$

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
		0.45
15.00	14.00	2908:

3.3) Ultimate Load in Uplift

Considering skin friction for determination of uplift load.

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
		0.45
15.00	14.00	12.4

Note: Self weight of pile is not considered in calculation of ultimate load in uplift.

3.4) Lateral Pile Capacity

The lateral capacity of long and elastic to intermediate piles with M 30 grade of concrete and having no free length may be summarized by using the codal provisions of IS 2911, P-1, S-2 as follows,

Diameter in, m		0.45
Subgrade Reaction in MN/m ³		1.40
Stiffness Factor T, in m		2.09
Depth of Fixity in, m	Free Head	4.00
	Fixed Head	4.60
Allowable Horizontal Force in, T	Free Head	1.30
	Fixed Head	3.60
Allowable Moment Capacity in, Tm	Free Head	2.13
	Fixed Head	6.64

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 HGL.

Dr. K. K. Thaker

Appendix – 33

Calculation of Safe Load on Uniform Diameter Bored Cast in situ Pile.

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

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 | - 0.45m. |
| 3. Termination depth of pile considered | - 12.00m (From FGL) |
| 4. Cut off Level | - 1.00 m from FGL. |
| 5. Factor of Safety | - 2.50 |
| 6. Depth of Water table | - Encountered at 3.80m depth but considered at FGL. |
| 7. Ref | - IS 2911 P-I, Sec-II, 2021. |

2) Test Data

The parameters are based on BH-11. 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 kg/cm ²	Angle of Internal Friction ϕ	Bulk / Submerged Density gm/cc γ_b / γ_{sub}	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 1.00	Pile cutoff level – No pile						
1.00 to 5.20	No contribution Considered – Due to filled up soil						
5.20 to 10.70	0.58 [#]	4 [#] ~0*	1.81 [#] / 0.81	0.78	NA	NA	7-41
10.70 to 20.70	1.64	0	1.98 / 0.98	0.28	NA	NA	>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.

3) Ultimate Load in Compression

3.1) Ultimate load in Compression by Bearing

Ultimate load on pile in end bearing,

$$q_{ub} = A_p * N_c * C_p$$

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

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

$$N_c = 9$$

$$C_p = \text{Cohesion at Pile Tip} = 1.64 \text{ kg/cm}^2$$

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

$$q_{ub} = 0.785 d^2 * 9 * 16.40 = 115.87d^2$$

(For Pile terminating at 12.00m from F.G.L.)

3.2) Ultimate Load in Compression by Skin Friction

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 – No contribution considered – Within filled up soil.

$$\text{Third Layer} - \alpha_3 C_{a3} A_{s3} = 0.78 * 5.80 * \pi d * 5.50 = 78.17d$$

$$\text{Fourth Layer} - \alpha_4 C_{a4} A_{s4} = 0.28 * 16.40 * \pi d * (\ell - 10.70) = 14.43d (\ell - 10.70)$$

(For Pile terminating at 12.00m from F.G.L.)

$$q_{uf} = 78.17d + 14.43d (\ell - 10.70) \text{ (For Piles terminating at 12.00m from F.G.L.)}$$

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,

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

$q_{uc} = 115.87d^2 + 78.17d + 14.43d(l - 10.70)$ (For Piles 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
		0.45
12.00	11.00	26.73

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 EGL	Termination Depth of Pile in m, from cut-off	Diameter of Pile in, m
		0.45
12.00	11.00	14.46

Note: Self weight of pile is not considered in calculation of ultimate load in uplift.

3.4) Lateral Pile Capacity

The lateral capacity of long and elastic to intermediate piles with M 30 grade of concrete and having no free length may be summarized by using the codal provisions of IS 2911, P-1, S-2 as follows,

Diameter in, m		0.45
Subgrade Reaction in MN/m ³		1.40
Stiffness Factor T, in m		2.09
Depth of Fixity in, m	Free Head	4.00
	Fixed Head	4.60
Allowable Horizontal Force in, T	Free Head	1.30
	Fixed Head	3.60
Allowable Moment Capacity in, Tm	Free Head	2.13
	Fixed Head	6.64

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 HGL.

Dr. K. K. Thaker

Appendix – 12

Calculation of Safe Load on Uniform Diameter Bored Cast in situ Pile.

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

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 | - 0.45m. |
| 3. Termination depth of pile considered | - 14.00m (From FGL) |
| 4. Cut off Level | - 1.00 m from FGL. |
| 5. Factor of Safety | - 2.50 |
| 6. Depth of Water table | - Encountered at 3.80m depth but considered at FGL. |
| 7. Ref | - IS 2911 P-I, Sec-II, 2021. |

2) Test Data

The parameters are based on BH-85. 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 kg/cm ²	Angle of Internal Friction ϕ	Bulk / Submerged Density gm/cc γ_b / γ_{sub}	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 1.00	Pile cutoff level – No pile						
1.00 to 4.80	No contribution Considered – Due to filled up soil						
4.80 to 11.30	0.67 [#]	4 [#] ~0*	1.88 [#] / 0.88	0.66	NA	NA	2-17
11.30 to 14.80	0.00	27	1.96 [#] / 0.96	NA	1.00	27	20

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.

3) Ultimate Load in Compression

3.1) Ultimate load in Compression by Bearing

Ultimate load on pile in end bearing,

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

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

D = Diameter of pile = d in m

$N_\gamma = 15.49$

$N_q = 14$

$$q_{ub} = 0.785d^2 (0.5 \cdot d \cdot 0.96 \cdot 15.49 + 5.64 \cdot 14) = 5.84d^3 + 61.98d^2$$

(For Pile terminating at 14.00m from F.G.L.).

3.2) Ultimate Load in Compression by Skin Friction

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 – No contribution considered – Within filled up soil.

Third Layer – $\alpha_3 C_{a3} A_{s3} = 0.66 \cdot 6.70 \cdot \pi \cdot d \cdot 6.50 = 90.30d$

Fourth Layer – $K_4 P D_4 \tan \delta_4 A_{s4} = 1.00 \cdot 5.64 \cdot \tan 27^\circ \cdot \pi \cdot d \cdot (\ell - 11.30) = 9.03d (\ell - 11.30)$

(For Pile terminating at 14.00m from F.G.L.)

$$q_{uf} = 90.30d + 9.03d (\ell - 11.30) \text{ (For Piles terminating at 14.00m from F.G.L.)}$$

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,

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

$q_{uc} = 5.84 d^3 + 61.98d^2 + 90.30d + 9.03d(l - 11.30)$ (For Piles 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
		0.45
14.00	13.00	25.84

3.3) Ultimate Load in Uplift

Considering skin friction for determination of uplift safety factor 3.00,

Safe Load on Piles in Uplift (in Ton)

Termination Depth of Pile in m, from EGL	Termination Depth of Pile in m, from cut-off	Diameter of Pile in, m
		0.45
14.00	13.00	17.17

Note: Self weight of pile is not considered in calculation of ultimate load in uplift.

3.4) Lateral Pile Capacity

The lateral capacity of long and elastic to intermediate piles with M 30 grade of concrete and having no free length may be summarized by using the codal provisions of IS 2911, P-1, S-2 as follows,

Diameter in, m		0.45
Subgrade Reaction in MN/m ³		1.40
Stiffness Factor T, in m		2.09
Depth of Fixity in, m	Free Head	4.00
	Fixed Head	4.60
Allowable Horizontal Force in, T	Free Head	1.30
	Fixed Head	3.60
Allowable Moment Capacity in, Tm	Free Head	2.13
	Fixed Head	6.64

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 – 15

Calculation of Safe Load on Uniform Diameter Bored Cast in situ Pile.

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

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 | - 0.45m. |
| 3. Termination depth of pile considered | - 14.00m (From FGL) |
| 4. Cut off Level | - 1.00 m from FGL. |
| 5. Factor of Safety | - 2.50 |
| 6. Depth of Water table | - Encountered at 5.20m depth but considered at FGL. |
| 7. Ref | - IS 2911 P-I, Sec-II, 2021. |

2) Test Data

The parameters are based on BH-169 (weakest from BH-169 & BH-171). For evaluation of safe load on piles following characterized layers are considered as described in table below,

Depth in m from RL 202.0 m	Cohesion kg/cm ²	Angle of Internal Friction ϕ	Bulk / Submerged Density gm/cc γ_b / γ_{sub}	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 1.00	Pile cutoff level – No pile						
1.00 to 2.42	No contribution considered – Due to filled up soil						
2.42 to 3.92	0.00	20°	1.66 / 0.66	NA	1.00	1.00	2
3.92 to 6.02	0.76	3~0°	1.70 / 0.70	0.60	NA	NA	9
6.02 to 15.52	0.07 [#]	26°	1.94 [#] /0.94	3Ø2	1.00	1.00	15

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.

3) Ultimate Load in Compression

3.1) Ultimate load in Compression by Bearing

Ultimate load on pile in end bearing,

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

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

D = Diameter of pile = d in m

$$N_v = 13.18$$

$$N_q = 12$$

$$N_c = 9$$

C_p = Cohesion at Pile Tip = 0.07 kg/cm²

$$q_{ub} = 0.785d^2 (0.5 \cdot d \cdot 0.94 \cdot 13.18 + 8 \cdot 0.07 \cdot 12) + 0.785 d^2 \cdot 9 \cdot 0.70 = 4.86d^3 + 7803d^2 + 4.95d^2$$

(For Pile terminating at 14.00m from F.G.L.).

3.2) Ultimate Load in Compression by Skin Friction

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 – No contribution considered – Due to filled up soil

Third Layer – $K_3 P D_3 \tan \delta_3 A_{s3} = 1.00 \cdot 4 \cdot 0.65 \cdot \tan 20^\circ \cdot \pi \cdot d \cdot 1.50 = 6089d$

Fourth Layer – $\alpha_4 C_{a4} A_{s4} = 0.60 \cdot 7.60 \cdot \pi \cdot d \cdot 2.10 = 30.08d$

Fifth Layer – $\alpha_5 C_{a5} A_{s5} + K_5 P D_5 \tan \delta_5 A_{s5} = 1.00 \cdot 0.70 \cdot \pi \cdot d \cdot (\ell - 6.02) + 1.00 \cdot 8 \cdot 0.24 \cdot \tan 26^\circ \cdot \pi \cdot d \cdot (\ell - 6.02)$
 $= 13064d \cdot (\ell - 6.02)$

(For Pile terminating at 14.00m from F.G.L.)

$$q_{uf} = 3607 + 13064d(l - 6.02) \text{ (For Piles terminating at 14.00m from F.G.L.)}$$

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,

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

$$q_{uc} = 4.86d^3 + 8308d^2 + 3607d + 13064d(l - 6.02) \text{ (For Piles terminating at 14.00m from F.G.L.)}$$

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
		0.45
14.00	13.00	2906

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 EGL	Termination Depth of Pile in m, from cut-off	Diameter of Pile in, m
		0.45
14.00	13.00	1: 0 3

Note: Self weight of pile is not considered in calculation of ultimate load in uplift.

3.4) Lateral Pile Capacity

The lateral capacity of long and elastic to intermediate piles with M 30 grade of concrete and having no free length may be summarized by using the codal provisions of IS 2911, P-1, S-2 as follows,

Diameter in, m		0.45
Subgrade Reaction in MN/m ³		1.40
Stiffness Factor T, in m		2.09
Depth of Fixity in, m	Free Head	4.00
	Fixed Head	4.60
Allowable Horizontal Force in, T	Free Head	1.30
	Fixed Head	3.60
Allowable Moment Capacity in, Tm	Free Head	2.13
	Fixed Head	6.64

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 HGL.

Dr. K. K. Thaker

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 14.1 (BH-80)

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	Depth of Foundation from NGL m	R.L. 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	Sc	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	1.00	1.00	2.50	1.32	200.00	0.07	30	23.00	11.75	14.32	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	19
2	2.00	2.00	2.50	1.32	200.00	0.07	30	23.00	11.75	14.32	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	20
3	3.00	3.00	2.50	1.32	200.00	0.07	30	23.00	11.75	14.32	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	22
4	4.00	4.00	2.50	1.32	200.00	0.07	30	23.00	11.75	14.32	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	24
5	1.00	1.00	3.50	2.32	199.00	0.07	30	23.00	11.75	14.32	1.30	1.20	0.80	1.68	1.34	1.34	1.00	1.00	1.00	2.00	1.00	0.50	0.50	30
6	2.00	2.00	3.50	2.32	199.00	0.07	30	23.00	11.75	14.32	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	28
7	3.00	3.00	3.50	2.32	199.00	0.07	30	23.00	11.75	14.32	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	29
8	4.00	4.00	3.50	2.32	199.00	0.07	30	23.00	11.75	14.32	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	31
9	1.00	1.00	4.50	3.32	198.00	0.07	30	23.00	11.75	14.32	1.30	1.20	0.80	1.97	1.48	1.48	1.00	1.00	1.00	2.00	1.00	0.50	0.50	42
10	2.00	2.00	4.50	3.32	198.00	0.07	30	23.00	11.75	14.32	1.30	1.20	0.80	1.48	1.24	1.24	1.00	1.00	1.00	2.00	1.00	0.50	0.50	37
11	3.00	3.00	4.50	3.32	198.00	0.07	30	23.00	11.75	14.32	1.30	1.20	0.80	1.32	1.16	1.16	1.00	1.00	1.00	2.00	1.00	0.50	0.50	37
12	4.00	4.00	4.50	3.32	198.00	0.07	30	23.00	11.75	14.32	1.30	1.20	0.80	1.24	1.12	1.12	1.00	1.00	1.00	2.00	1.00	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 NGL at the time of exploration.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 14.2 (BH-80)

Calculation of Safe Bearing Pressure for Settlement of 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	Depth of Foundation D from FGL m	R.L. 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 40 mm Settlement T / m ²
1	1.32	2.50	200.00	1.00	1.10	0.35	99	0.80	51
2	1.32	2.50	200.00	2.00	1.12	0.35	99	0.80	25
3	1.32	2.50	200.00	3.00	1.12	0.35	99	0.80	17
4	1.32	2.50	200.00	4.00	1.12	0.35	99	0.80	13
5	2.32	3.50	199.00	1.00	1.12	0.35	99	0.80	50
6	2.32	3.50	199.00	2.00	1.12	0.35	99	0.80	25
7	2.32	3.50	199.00	3.00	1.12	0.35	99	0.80	17
8	2.32	3.50	199.00	4.00	1.12	0.35	99	0.80	13
9	3.32	4.50	198.00	1.00	1.12	0.35	99	0.80	50
10	3.32	4.50	198.00	2.00	1.12	0.35	99	0.80	25
11	3.32	4.50	198.00	3.00	1.12	0.35	99	0.80	17
12	3.32	4.50	198.00	4.00	1.12	0.35	99	0.80	13

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 15.1 (For BH-166)

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 structure 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	R.L. 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	1.00	1.00	1.00	201.00	0.03	28	15.51	5.94	6.18	1.30	1.20	0.80	1.28	1.14	1.14	1.00	1.00	1.00	1.96	0.98	0.50	0.50	6
2	2.00	2.00	1.00	201.00	0.03	28	15.51	5.94	6.18	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	1.96	0.98	0.50	0.50	7
3	3.00	3.00	1.00	201.00	0.03	28	15.51	5.94	6.18	1.30	1.20	0.80	1.09	1.05	1.05	1.00	1.00	1.00	1.96	0.98	0.50	0.50	8
4	4.00	4.00	1.00	201.00	0.03	28	15.51	5.94	6.18	1.30	1.20	0.80	1.07	1.04	1.04	1.00	1.00	1.00	1.96	0.98	0.50	0.50	9
5	1.00	1.00	2.00	200.00	0.03	28	15.51	5.94	6.18	1.30	1.20	0.80	1.57	1.28	1.28	1.00	1.00	1.00	1.96	0.98	0.50	0.50	11
6	2.00	2.00	2.00	200.00	0.03	28	15.51	5.94	6.18	1.30	1.20	0.80	1.28	1.14	1.14	1.00	1.00	1.00	1.96	0.98	0.50	0.50	11
7	3.00	3.00	2.00	200.00	0.03	28	15.51	5.94	6.18	1.30	1.20	0.80	1.19	1.09	1.09	1.00	1.00	1.00	1.96	0.98	0.50	0.50	11
8	4.00	4.00	2.00	200.00	0.03	28	15.51	5.94	6.18	1.30	1.20	0.80	1.14	1.07	1.07	1.00	1.00	1.00	1.96	0.98	0.50	0.50	12
9	1.00	1.00	3.00	199.00	0.03	28	15.51	5.94	6.18	1.30	1.20	0.80	1.85	1.42	1.42	1.00	1.00	1.00	1.96	0.98	0.50	0.50	16
10	2.00	2.00	3.00	199.00	0.03	28	15.51	5.94	6.18	1.30	1.20	0.80	1.42	1.21	1.21	1.00	1.00	1.00	1.96	0.98	0.50	0.50	15
11	3.00	3.00	3.00	199.00	0.03	28	15.51	5.94	6.18	1.30	1.20	0.80	1.28	1.14	1.14	1.00	1.00	1.00	1.96	0.98	0.50	0.50	15
12	4.00	4.00	3.00	199.00	0.03	28	15.51	5.94	6.18	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	16

Note :-

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

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 15.2 (For BH-166)

Calculation of Safe Bearing Pressure for Settlement of 40`mm

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

Project:- Proposed structure 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 FGL m	R.L. of Foondation 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 40 mm Settlement T / m ²
1	1.00	201.00	1.00	1.12	0.35	107	0.80	54
2	1.00	201.00	2.00	1.12	0.35	107	0.80	27
3	1.00	201.00	3.00	1.12	0.35	107	0.80	18
4	1.00	201.00	4.00	1.12	0.35	107	0.80	14
5	2.00	200.00	1.00	1.12	0.35	107	0.80	54
6	2.00	200.00	2.00	1.12	0.35	107	0.80	27
7	2.00	200.00	3.00	1.12	0.35	107	0.80	18
8	2.00	200.00	4.00	1.12	0.35	107	0.80	14
9	3.00	199.00	1.00	1.12	0.35	107	0.80	54
10	3.00	199.00	2.00	1.12	0.35	107	0.80	27
11	3.00	199.00	3.00	1.12	0.35	107	0.80	18
12	3.00	199.00	4.00	1.12	0.35	107	0.80	14

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 16.1 (For BH-170)

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	R.L. 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	2.00	2.00	1.06	2.50	199.50	0.42	5	6.10	0.40	0.31	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
2	2.50	2.50	1.06	2.50	199.50	0.42	5	6.10	0.40	0.31	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
3	3.00	3.00	1.06	2.50	199.50	0.42	5	6.10	0.40	0.31	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
4	3.50	3.50	1.06	2.50	199.50	0.42	5	6.10	0.40	0.31	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
5	2.00	2.00	2.06	3.50	198.50	0.42	5	6.10	0.40	0.31	1.30	1.20	0.80	1.22	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	11
6	2.50	2.50	2.06	3.50	198.50	0.42	5	6.10	0.40	0.31	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	11
7	3.00	3.00	2.06	3.50	198.50	0.42	5	6.10	0.40	0.31	1.30	1.20	0.80	1.15	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	11
8	3.50	3.50	2.06	3.50	198.50	0.42	5	6.10	0.40	0.31	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	11
9	2.00	2.00	3.06	4.50	197.50	0.42	5	6.10	0.40	0.31	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	12
10	2.50	2.50	3.06	4.50	197.50	0.42	5	6.10	0.40	0.31	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	12
11	3.00	3.00	3.06	4.50	197.50	0.42	5	6.10	0.40	0.31	1.30	1.20	0.80	1.22	1.00	1.00	1.00	1.00	1.00	1.96	0.98	0.50	0.50	12
12	3.50	3.50	3.06	4.50	197.50	0.42	5	6.10	0.40	0.31	1.30	1.20	0.80	1.19	1.00	1.00	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 NGL at the time of exploration.
- 3) Calculations are considering the effect of water table at FGL.

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 16.2 (For BH-170)

Calculation of Safe Bearing Pressure for Settlement of 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	R.L. 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 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³
1	1.06	2.50	199.50	2.00	2.00	0.40	105	1.12	0.80	0.0172	4.00	0.70	0.84	0.80	26
2	1.06	2.50	199.50	2.50	2.50	0.40	105	1.12	0.80	0.0172	5.00	0.70	0.88	0.80	21
3	1.06	2.50	199.50	3.00	3.00	0.40	105	1.12	0.80	0.0172	6.00	0.70	0.90	0.80	17
4	1.06	2.50	199.50	3.50	3.50	0.40	105	1.12	0.80	0.0172	7.00	0.70	0.92	0.80	14
5	2.06	3.50	198.50	2.00	2.00	0.40	105	1.12	0.80	0.0172	4.00	0.70	0.73	0.80	28
6	2.06	3.50	198.50	2.50	2.50	0.40	105	1.12	0.80	0.0172	5.00	0.70	0.76	0.80	22
7	2.06	3.50	198.50	3.00	3.00	0.40	105	1.12	0.80	0.0172	6.00	0.70	0.79	0.80	18
8	2.06	3.50	198.50	3.50	3.50	0.40	105	1.12	0.80	0.0172	6.44	0.70	0.82	0.80	15
9	3.06	4.50	197.50	2.00	2.00	0.40	105	1.12	0.80	0.0172	4.00	0.70	0.73	0.80	28
10	3.06	4.50	197.50	2.50	2.50	0.40	105	1.12	0.80	0.0172	5.00	0.70	0.73	0.80	23
11	3.06	4.50	197.50	3.00	3.00	0.40	105	1.12	0.80	0.0172	5.44	0.70	0.73	0.80	19
12	3.06	4.50	197.50	3.50	3.50	0.40	105	1.09	0.80	0.0172	5.44	0.70	0.75	0.80	16

KCT Consultancy Services LLP, Ahmedabad

APPENDIX - 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 FGL m	R.L. 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	1.00	1.00	1.00	201.00	0.07	30	21.10	10.24	12.16	1.30	1.20	0.80	1.29	1.15	1.15	1.00	1.00	1.00	1.99	1.00	0.50	0.50	14
2	2.00	2.00	1.00	201.00	0.07	30	21.10	10.24	12.16	1.30	1.20	0.80	1.15	1.07	1.07	1.00	1.00	1.00	1.99	1.00	0.50	0.50	15
3	3.00	3.00	1.00	201.00	0.07	30	21.10	10.24	12.16	1.30	1.20	0.80	1.10	1.05	1.05	1.00	1.00	1.00	1.99	1.00	0.50	0.50	17
4	4.00	4.00	1.00	201.00	0.07	30	21.10	10.24	12.16	1.30	1.20	0.80	1.07	1.04	1.04	1.00	1.00	1.00	1.99	1.00	0.50	0.50	19
5	1.00	1.00	2.00	200.00	0.07	30	21.10	10.24	12.16	1.30	1.20	0.80	1.58	1.29	1.29	1.00	1.00	1.00	1.99	1.00	0.50	0.50	23
6	2.00	2.00	2.00	200.00	0.07	30	21.10	10.24	12.16	1.30	1.20	0.80	1.29	1.15	1.15	1.00	1.00	1.00	1.99	1.00	0.50	0.50	22
7	3.00	3.00	2.00	200.00	0.07	30	21.10	10.24	12.16	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	23
8	4.00	4.00	2.00	200.00	0.07	30	21.10	10.24	12.16	1.30	1.20	0.80	1.15	1.07	1.07	1.00	1.00	1.00	1.99	1.00	0.50	0.50	25
9	1.00	1.00	3.00	199.00	0.07	30	21.10	10.24	12.16	1.30	1.20	0.80	1.87	1.44	1.44	1.00	1.00	1.00	1.99	1.00	0.50	0.50	34
10	2.00	2.00	3.00	199.00	0.07	30	21.10	10.24	12.16	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	30
11	3.00	3.00	3.00	199.00	0.07	30	21.10	10.24	12.16	1.30	1.20	0.80	1.29	1.15	1.15	1.00	1.00	1.00	1.99	1.00	0.50	0.50	30
12	4.00	4.00	3.00	199.00	0.07	30	21.10	10.24	12.16	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	31

Note :-

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

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APPENDIX - 2

Calculation of Safe Bearing Pressure for Settlement of 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	R.L. 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 40 mm Settlement T / m ²
1	1.00	201.00	1.00	1.12	0.35	108	0.80	55
2	1.00	201.00	2.00	1.12	0.35	108	0.80	27
3	1.00	201.00	3.00	1.12	0.35	108	0.80	18
4	1.00	201.00	4.00	1.12	0.35	108	0.80	14
5	2.00	200.00	1.00	1.12	0.35	108	0.80	55
6	2.00	200.00	2.00	1.12	0.35	108	0.80	27
7	2.00	200.00	3.00	1.12	0.35	108	0.80	18
8	2.00	200.00	4.00	1.12	0.35	108	0.80	14
9	3.00	199.00	1.00	1.12	0.35	108	0.80	55
10	3.00	199.00	2.00	1.12	0.35	108	0.80	27
11	3.00	199.00	3.00	1.12	0.35	108	0.80	18
12	3.00	199.00	4.00	1.12	0.35	108	0.80	14

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APPENDIX - % .1 (For BH-142)

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	R.L. 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	1.00	1.00	1.38	2.00	200.00	0.39	4	5.84	0.28	0.22	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	10
2	2.00	2.00	1.38	2.00	200.00	0.39	4	5.84	0.28	0.22	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	9
3	3.00	3.00	1.38	2.00	200.00	0.39	4	5.84	0.28	0.22	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	9
4	4.00	4.00	1.38	2.00	200.00	0.39	4	5.84	0.28	0.22	1.30	1.20	0.80	1.07	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	9
5	1.00	1.00	2.38	3.00	199.00	0.39	4	5.84	0.28	0.22	1.30	1.20	0.80	1.50	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	12
6	2.00	2.00	2.38	3.00	199.00	0.39	4	5.84	0.28	0.22	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	10
7	3.00	3.00	2.38	3.00	199.00	0.39	4	5.84	0.28	0.22	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	10
8	4.00	4.00	2.38	3.00	199.00	0.39	4	5.84	0.28	0.22	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	9
9	1.00	1.00	3.38	4.00	198.00	0.39	4	5.84	0.28	0.22	1.30	1.20	0.80	1.71	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	14
10	2.00	2.00	3.38	4.00	198.00	0.39	4	5.84	0.28	0.22	1.30	1.20	0.80	1.35	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	11
11	3.00	3.00	3.38	4.00	198.00	0.39	4	5.84	0.28	0.22	1.30	1.20	0.80	1.24	1.00	1.00	1.00	1.00	1.00	1.94	0.97	0.50	0.50	10
12	4.00	4.00	3.38	4.00	198.00	0.39	4	5.84	0.28	0.22	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	10

Note :-

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

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APPENDIX - % .2 (For BH-142)

Calculation of Safe Bearing Pressure for Settlement of 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	R.L. 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 40 mm Settlement
	m	m	m	m	m		kg/cm ²			cm ² /kg	m				T / m ³
1	1.38	2.00	200.00	1.00	1.00	0.40	97	1.09	0.80	0.0182	2.00	0.70	0.69	0.80	55
2	1.38	2.00	200.00	2.00	2.00	0.40	97	1.12	0.80	0.0182	4.00	0.70	0.79	0.80	25
3	1.38	2.00	200.00	3.00	3.00	0.40	97	1.12	0.80	0.0182	6.00	0.70	0.86	0.80	16
4	1.38	2.00	200.00	4.00	4.00	0.40	97	1.12	0.80	0.0182	7.12	0.70	0.90	0.80	12
5	2.38	3.00	199.00	1.00	1.00	0.40	97	0.98	0.80	0.0182	2.00	0.70	0.65	0.80	60
6	2.38	3.00	199.00	2.00	2.00	0.40	97	1.12	0.80	0.0182	4.00	0.70	0.73	0.80	26
7	2.38	3.00	199.00	3.00	3.00	0.40	97	1.12	0.80	0.0182	6.00	0.70	0.76	0.80	17
8	2.38	3.00	199.00	4.00	4.00	0.40	97	1.12	0.80	0.0182	6.12	0.70	0.82	0.80	13
9	3.38	4.00	198.00	1.00	1.00	0.40	97	1.12	0.80	0.0182	2.00	0.70	0.63	0.80	57
10	3.38	4.00	198.00	2.00	2.00	0.40	97	1.04	0.80	0.0182	4.00	0.70	0.73	0.80	27
11	3.38	4.00	198.00	3.00	3.00	0.40	97	1.08	0.80	0.0182	5.12	0.70	0.73	0.80	18
12	3.38	4.00	198.00	4.00	4.00	0.40	97	1.01	0.80	0.0182	5.12	0.70	0.75	0.80	14

Appendix – 3;

Calculation of Safe Load on Uniform Diameter Bored Cast in situ Pile.

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

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 | - 0.45m. |
| 3. Termination depth of pile considered | - 15.00m (From FGL) |
| 4. Cut off Level | - 1.00 m from FGL. |
| 5. Factor of Safety | - 2.50 |
| 6. Depth of Water table | - Encountered at 3.60m depth but considered at FGL. |
| 7. Ref | - IS 2911 P-I, Sec-II, 2021. |

2) Test Data

The parameters are based on BH-4. 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 kg/cm ²	Angle of Internal Friction ϕ	Bulk / Submerged Density gm/cc γ_b / γ_{sub}	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 1.00	Pile cutoff level – No pile						
1.00 to 7.13	No contribution Considered – Due to filled up soil						
7.13 to 8.03	0.36 ^{\$}	0	1.80 / 0.80	1.00	NA	NA	9
8.03 to 14.03	0.09	24	1.94 / 0.94	NA	1.00	24	9-19
14.03 to 15.00	1.67 ^{\$}	0	1.94 / 0.94	0.28	NA	NA	25->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 of this layer is correlated based on SPT N value.

3) Ultimate Load in Compression

3.1) Ultimate load in Compression by Bearing

Ultimate load on pile in end bearing,

$$q_{ub} = A_p * N_c * C_p$$

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

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

$$N_c = 9$$

$$C_p = \text{Cohesion at Pile Tip} = 1.67 \text{ kg/cm}^2$$

$$q_{ub} = 0.785 d^2 * 9 * 16.70 = 117.99 d^2 \text{ (For Piles terminating at 15.00m from G.L.)}$$

3.2) Ultimate Load in Compression by Skin Friction

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 – No contribution considered – Within filled up soil.

$$\text{Third Layer} - \alpha_3 C_{a3} A_{s3} = 1.00 * 3.60 * \pi d * 0.90 = 10.18d$$

$$\text{Fourth Layer} - \alpha_3 C_{a3} A_{s3} + K_4 P D_4 \tan \delta_4 A_{s4} = 1.00 * 0.90 * \pi d * 6.00 + 1.00 * 6.20 * \tan 24^\circ * \pi d * 6.00 = 69.00d$$

$$\text{Fifth Layer} - \alpha_5 C_{a5} A_{s5} = 0.28 * 16.70 * \pi d * (\ell - 14.03) = 14.69d (\ell - 14.03)$$

(For Pile terminating at 15.00m from F.G.L)

$$q_{uf} = 79.18d + 14.69d (\ell - 14.03) \text{ (For Piles terminating at 15.00m from F.G.L.)}$$

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,

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

$$q_{uc} = 117.99d^2 + 79.18d + 14.69d(l - 14.03) \text{ (For Piles terminating at 15.00m from F.G.L.)}$$

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
		0.45
15.00	14.00	26.36

3.3) Ultimate Load in Uplift

Considering skin friction for determination of uplift safety factor 3.00,

Safe Load on Piles in Uplift (in Ton)

Termination Depth of Pile in m, from EGL	Termination Depth of Pile in m, from cut-off	Diameter of Pile in, m
		0.45
15.00	14.00	14.01

Note: Self weight of pile is not considered in calculation of ultimate load in uplift.

3.4) Lateral Pile Capacity

The lateral capacity of long and elastic to intermediate piles with M 30 grade of concrete and having no free length may be summarized by using the codal provisions of IS 2911, P-1, S-2 as follows,

Diameter in, m		0.45
Subgrade Reaction in MN/m ³		1.40
Stiffness Factor T, in m		2.09
Depth of Fixity in, m	Free Head	4.00
	Fixed Head	4.60
Allowable Horizontal Force in, T	Free Head	1.30
	Fixed Head	3.60
Allowable Moment Capacity in, Tm	Free Head	2.13
	Fixed Head	6.64

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 – 20

Calculation of Safe Load on Uniform Diameter Bored Cast in situ Pile.

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

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 | - 0.45m. |
| 3. Termination depth of pile considered | - 14.00m (From FGL) |
| 4. Cut off Level | - 1.00 m from FGL. |
| 5. Factor of Safety | - 2.50 |
| 6. Depth of Water table | - Encountered at 2.10m depth but considered at FGL. |
| 7. Ref | - IS 2911 P-I, Sec-II, 2021. |

2) Test Data

The parameters are based on BH-150. For evaluation of safe load on piles following characterized layers are considered as described in table below,

Depth in m from RL 201.0 m	Cohesion kg/cm ²	Angle of Internal Friction ϕ	Bulk / Submerged Density gm/cc γ_b / γ_{sub}	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 1.00	Pile cutoff level – No pile						
1.00 to 5.03	No contribution Considered – Due to filled up soil						
5.03 to 10.83	0.55 [#]	5 [#] ~0*	1.94 [#] / 0.94	0.81	NA	NA	4-18
10.83 to 13.63	0.05 [#] ~0.00*	25	1.98 [#] / 0.98	NA	1.00	25	11-13
13.63 to 14.43	0.87 ^s	0	1.98 / 0.98	0.52	NA	NA	13
14.43 to 20.63	0.00	30	2.00 / 1.00	NA	1.00	23	22->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.

3) Ultimate Load in Compression

3.1) Ultimate load in Compression by Bearing

Ultimate load on pile in end bearing,

$$q_{ub} = A_p * N_c * C_p$$

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

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

$$N_c = 9$$

$$C_p = \text{Cohesion at Pile Tip} = 0.87 \text{ kg/cm}^2$$

$$q_{ub} = 0.785 d^2 * 9 * 8.70 = \mathbf{61.47 d^2} \text{ (For Piles terminating at 14.00m from G.L.)}$$

3.2) Ultimate Load in Compression by Skin Friction

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 – No contribution considered – Within filled up soil.

$$\text{Third Layer} - \alpha_3 C_{a3} A_{s3} = 0.81 * 5.50 * \pi d * 5.80 = \mathbf{81.18d}$$

$$\text{Fourth Layer} - K_4 P D_4 \tan \delta_4 A_{s4} = 1.00 * 6.38 * \tan 25 * \pi d * 2.80 = \mathbf{26.17d}$$

$$\text{Fifth Layer} - \alpha_5 C_{a5} A_{s5} = 0.52 * 8.70 * \pi d * (\ell - 13.63) = \mathbf{14.21d (\ell - 13.63)}$$

(For Pile terminating at 14.00m from F.G.L)

$$q_{uf} = \mathbf{107.35d + 14.21d (\ell - 13.63)} \text{ (For Piles terminating at 14.00m from F.G.L.)}$$

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

Ultimate load by both bearing and friction can be as follows for various lengths of piles,
 $q_{uc} = q_{ub} + q_{uf}$

$q_{uc} = 61.47d^2 + 107.35d + 14.21d(l - 13.63)$ (For Piles 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
		0.45
14.00	13.00	25.29

3.3) Ultimate Load in Uplift

Considering skin friction for determination of uplift safety factor 3.00,

Safe Load on Piles in Uplift (in Ton)

Termination Depth of Pile in m, from EGL	Termination Depth of Pile in m, from cut-off	Diameter of Pile in, m
		0.45
13.50	12.50	16.93

Note: Self weight of pile is not considered in calculation of ultimate load in uplift.

3.4) Lateral Pile Capacity

The lateral capacity of long and elastic to intermediate piles with M 30 grade of concrete and having no free length may be summarized by using the codal provisions of IS 2911, P-1, S-2 as follows,

Diameter in, m		0.45
Subgrade Reaction in MN/m ³		1.40
Stiffness Factor T, in m		2.09
Depth of Fixity in, m	Free Head	4.00
	Fixed Head	4.60
Allowable Horizontal Force in, T	Free Head	1.30
	Fixed Head	3.60
Allowable Moment Capacity in, Tm	Free Head	2.13
	Fixed Head	6.64

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 - 21.1 (For BH-158)

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 structure 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	R.L. 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	1.00	1.00	1.00	201.00	0.04	30	28.71	16.27	20.78	1.30	1.20	0.80	1.29	1.15	1.15	1.00	1.00	1.00	1.85	0.93	0.50	0.50	17
2	2.00	2.00	1.00	201.00	0.04	30	28.71	16.27	20.78	1.30	1.20	0.80	1.15	1.07	1.07	1.00	1.00	1.00	1.85	0.93	0.50	0.50	19
3	3.00	3.00	1.00	201.00	0.04	30	28.71	16.27	20.78	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	22
4	4.00	4.00	1.00	201.00	0.04	30	28.71	16.27	20.78	1.30	1.20	0.80	1.07	1.04	1.04	1.00	1.00	1.00	1.85	0.93	0.50	0.50	25
5	1.00	1.00	2.00	200.00	0.04	30	28.71	16.27	20.78	1.30	1.20	0.80	1.58	1.29	1.29	1.00	1.00	1.00	1.85	0.93	0.50	0.50	29
6	2.00	2.00	2.00	200.00	0.04	30	28.71	16.27	20.78	1.30	1.20	0.80	1.29	1.15	1.15	1.00	1.00	1.00	1.85	0.93	0.50	0.50	29
7	3.00	3.00	2.00	200.00	0.04	30	28.71	16.27	20.78	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	31
8	4.00	4.00	2.00	200.00	0.04	30	28.71	16.27	20.78	1.30	1.20	0.80	1.15	1.07	1.07	1.00	1.00	1.00	1.85	0.93	0.50	0.50	33
9	1.00	1.00	3.00	199.00	0.04	30	28.71	16.27	20.78	1.30	1.20	0.80	1.87	1.44	1.44	1.00	1.00	1.00	1.85	0.93	0.50	0.50	43
10	2.00	2.00	3.00	199.00	0.04	30	28.71	16.27	20.78	1.30	1.20	0.80	1.44	1.22	1.22	1.00	1.00	1.00	1.85	0.93	0.50	0.50	40
11	3.00	3.00	3.00	199.00	0.04	30	28.71	16.27	20.78	1.30	1.20	0.80	1.29	1.15	1.15	1.00	1.00	1.00	1.85	0.93	0.50	0.50	41
12	4.00	4.00	3.00	199.00	0.04	30	28.71	16.27	20.78	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	43

Note :-

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

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APPENDIX - 21.2 (For BH-158)

Calculation of Safe Bearing Pressure for Settlement of 40 mm

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

Project:- Proposed structure 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 FGL m	R.L. of Foondation 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 40 mm Settlement T / m ²
1	1.00	201.00	1.00	1.12	0.35	122	0.80	62
2	1.00	201.00	2.00	1.12	0.35	122	0.80	31
3	1.00	201.00	3.00	1.12	0.35	122	0.80	21
4	1.00	201.00	4.00	1.12	0.35	122	0.80	15
5	2.00	200.00	1.00	1.12	0.35	122	0.80	62
6	2.00	200.00	2.00	1.12	0.35	122	0.80	31
7	2.00	200.00	3.00	1.12	0.35	122	0.80	21
8	2.00	200.00	4.00	1.12	0.35	122	0.80	15
9	3.00	199.00	1.00	1.12	0.35	122	0.80	62
10	3.00	199.00	2.00	1.12	0.35	122	0.80	31
11	3.00	199.00	3.00	1.12	0.35	122	0.80	21
12	3.00	199.00	4.00	1.12	0.35	122	0.80	15

Appendix – 22

Calculation of Safe Load on Uniform Diameter Bored Cast in situ Pile.

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

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 | - 0.45m. |
| 3. Termination depth of pile considered | - 12.50m (From FGL) |
| 4. Cut off Level | - 1.00 m from FGL. |
| 5. Factor of Safety | - 2.50 |
| 6. Depth of Water table | - Encountered at 2.80m depth but considered at FGL. |
| 7. Ref | - IS 2911 P-I, Sec-II, 2021. |

2) Test Data

The parameters are based on BH-167. For evaluation of safe load on piles following characterized layers are considered as described in table below,

Depth in m from RL 201.0 m	Cohesion kg/cm ²	Angle of Internal Friction ϕ	Bulk / Submerged Density gm/cc γ_b / γ_{sub}	Reduction Factor α	Earth pressure coefficient K	Angle of wall friction $\delta = \phi$	SPT N Value
0.00 to 1.00	Pile cutoff level – No pile						
1.00 to 3.43	No contribution Considered – Due to filled up soil						
3.43 to 8.33	0.41 [#]	2 [#] ~0*	1.83 [#] / 0.83	1.00	NA	NA	4-10
8.33 to 10.23	0.12 [#] ~0.00*	25	1.99 [#] / 0.99	NA	1.00	25	13
10.23 to 12.03	1.10 [#]	4~0*	2.01 [#] / 1.01	0.40	NA	NA	20-30
12.03 to 23.43	0.12~0.00*	29	2.08 / 1.08	NA	1.00	23	31->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.

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

3) Ultimate Load in Compression

3.1) Ultimate load in Compression by Bearing

Ultimate load on pile in end bearing,

$$q_{ub} = A_p * N_c * C_p$$

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

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

$$N_c = 9$$

$$C_p = \text{Cohesion at Pile Tip} = 1.10 \text{ kg/cm}^2$$

$$q_{ub} = 0.785 d^2 * 9 * 11.00 = \mathbf{77.72 d^2} \text{ (For Piles terminating at 12.50 from G.L.).}$$

3.2) Ultimate Load in Compression by Skin Friction

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 – No contribution considered – Within filled up soil.

$$\textbf{Third Layer} - \alpha_3 C_{a3} A_{s3} = 1.00 * 4.10 * \pi d * 4.90 = \mathbf{63.11d}$$

$$\textbf{Fourth Layer} - K_4 P D_4 \tan \delta_4 A_{s4} = 1.00 * 5.01 * \tan 25^\circ * \pi d * 1.90 = \mathbf{13.94d}$$

$$\textbf{Fifth Layer} - \alpha_5 C_{a5} A_{s5} = 0.40 * 11.00 * \pi d * 1.80 = \mathbf{24.88d}$$

$$\textbf{Sixth Layer} - K_6 P D_6 \tan \delta_6 A_{s6} = 1.00 * 5.90 * \tan 22^\circ * \pi d * (\ell - 12.03) = \mathbf{7.49d (\ell - 12.03)}$$

(For Pile terminating at 12.50m from F.G.L)

$$q_{uf} = 101.93d + 7.49d (\ell - 12.03) \text{ (For Piles terminating at 12.50m from F.G.L.)}$$

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,

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

$$q_{uc} = 77.72d^2 + 101.93d + 7.49d(\ell - 12.03) \text{ (For Piles terminating at 12.50m from F.G.L.)}$$

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
		0.45
12.50	11.50	25.27

3.3) Ultimate Load in Uplift

Considering skin friction for determination of uplift safety factor 3.00,

Safe Load on Piles in Uplift (in Ton)

Termination Depth of Pile in m, from EGL	Termination Depth of Pile in m, from cut-off	Diameter of Pile in, m
		0.45
12.50	11.50	15.81

Note: Self weight of pile is not considered in calculation of ultimate load in uplift.

3.4) Lateral Pile Capacity

The lateral capacity of long and elastic to intermediate piles with M 30 grade of concrete and having no free length may be summarized by using the codal provisions of IS 2911, P-1, S-2 as follows,

Diameter in, m		0.45
Subgrade Reaction in MN/m ³		1.40
Stiffness Factor T, in m		2.09
Depth of Fixity in, m	Free Head	4.00
	Fixed Head	4.60
Allowable Horizontal Force in, T	Free Head	1.30
	Fixed Head	3.60
Allowable Moment Capacity in, Tm	Free Head	2.13
	Fixed Head	6.64

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-45

Soil Mechanics And Foundation Engineering by Dr.K.R.Arora
(For Mixed shear failure reference)

SOIL MECHANICS AND FOUNDATION ENGINEERING

600

$N_c = 57.8, N_q = 41.4 \text{ and } N_\gamma = 42.4$
 $N'_c = 25.2, N'_q = 12.6 \text{ and } N'_\gamma = 10.1$

and
 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.

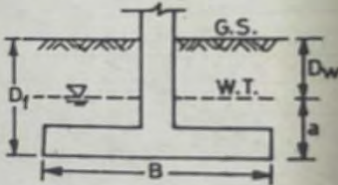
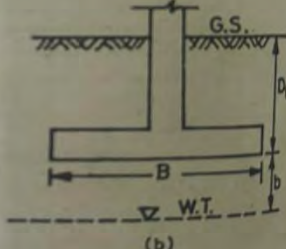
(5) If e is less than 0.55, the general shear failure occurs. If e is greater than 0.75, the local shear failure occurs.

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. Therefore,

(a) (b)

Fig. 23.11.

$$q = D_w \gamma + a \gamma' \quad \dots(23.30)$$

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 $a = D_f - D_w$,

$$q = \gamma' D_f + (\gamma - \gamma') D_w \quad \dots(23.31)$$

Moreover, the unit weight in the third term of Eq. 23.25 is equal to the submerged unit weight. Thus Eq. 23.25 becomes

$$q_u = c' N_c + [\gamma' D_f + (\gamma - \gamma') D_w] N_q + 0.5 \gamma' B N_\gamma \quad \dots(23.32)$$

If $D_w = 0$ (i.e. $a = D_f$),

$$q_u = c' N_c + \gamma' D_f N_q + 0.5 \gamma' B N_\gamma \quad \dots(23.33a)$$

If $a = 0$ (i.e. $D_f = D_w$),

$$q_u = c' N_c + \gamma D_f N_q + 0.5 \gamma' B N_\gamma \quad \dots(23.33b)$$

Appendix-46

Soil Mechanics And Foundation Engineering by V.N.S. Murthy (For Modulus of Elasticity reference)

676

Chapter 18

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_s 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_s .

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_s may be expressed as

$$E_s = Ac_u \quad (18.51)$$

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_s by making use of SPT and CPT values (in kPa)

Soil	SPT	CPT
Sand (normally consolidated)	$500 (N_{cor} + 15)$ $(35000 \text{ to } 50000) \log N_{cor}$ (U.S.S.R. Practice)	2 to 4 q_c $(1 + D_r^2) q_c$
Sand (saturated)	$250 (N_{cor} + 15)$	
Sand (overconsolidated)	—	6 to 30 q_c
Gravelly sand and gravel	$1200 (N_{cor} + 6)$	
Clayey sand	$320 (N_{cor} + 15)$	3 to 6 q_c
Silty sand	$300 (N_{cor} + 6)$	1 to 2 q_c
Soft clay	—	3 to 8 q_c

Appendix-47

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

$$S_{ef} = C_r d_f S_e \quad (18.53)$$

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

Appendix-48

(For Modulus of Volume Compressibility, Angle of Internal friction and Cohesion reference)

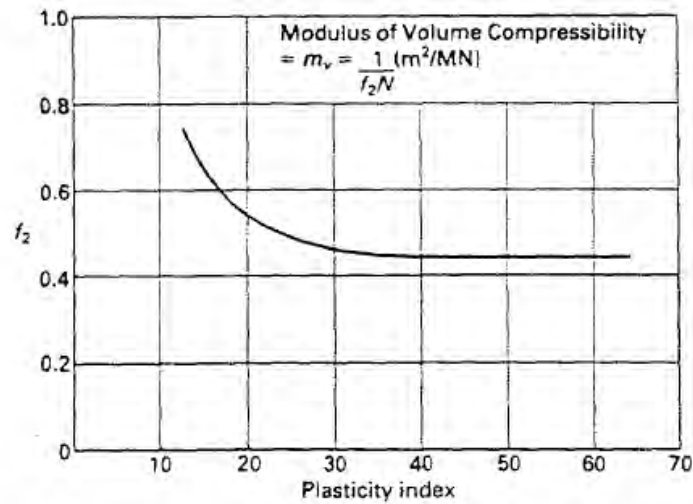


Figure 8. Relationship between Mass Shear Strength, Modulus of Volume Compressibility, Plasticity Index, and SPT-N values (after Stroud, 1975)

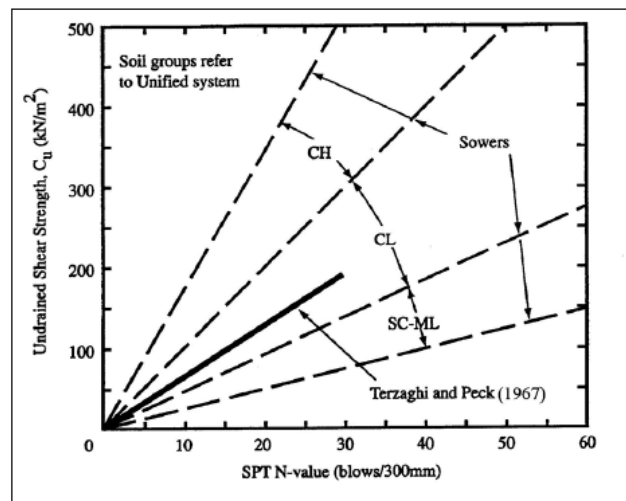


Figure 9. Approximate Correlation between Undrained Shear Strength and SPT-N values (After Sowers, 1979)

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;

$$\phi' = \sqrt{12N_{45}} + 15^\circ$$

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

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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	BH-5	7.76	273	163	136
2	BH-11	7.43	452	266	150

RESULTS OF CHEMICAL ANALYSIS OF SOIL

Sr. No.	Borehole no.	Result			
		Depth(m)	pH	SO ₃ in %	Chloride (mg/l)
1	BH-36	3.50	7.63	0.10	172
2	BH-99	1.00	7.73	0.13	161

Note: Based on SO₃ Content the soil can be classified in Class 1 as per table no. 4 of IS: 456, 2000

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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. :- 1

Co-Ordinate :- E 1430, N 3845

Reduced Level :- 202.05 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	-	-	-	-	16	51	33	32	15	17	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	73	27	25	19	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	16	-	-	-	-
3	2.00	SPT	-	-	-	-	0	70	30	28	19	9	-	-	-	SM-SC	-	-	-	-	-	-	-	-	18	-	-	-	-
4	2.50	UDS	1.95	1.53	27.81	2.65	0	64	36	33	21	12	-	-	-	SC	0.05	25	-	-	DSU	-	-	-	-	-	0.74	42.4	
5	3.00	SPT	-	-	-	-	0	69	31	29	16	13	-	-	-	SC	-	-	-	-	-	-	-	-	16	-	-	-	-
6	3.50	UDS	1.96	1.55	26.54	2.63	0	29	52	32	15	17	-	-	-	CL	0.86	6	-	-	TUU	0.13	0.0108	0.51	-	-	0.70	41.1	
7	4.00	SPT	-	-	-	-	0	31	56	28	17	11	-	-	-	CL	-	-	-	-	-	-	-	-	17	-	-	-	-
8	4.50	UDS	1.98	1.57	25.80	2.65	0	64	36	26	16	10	-	-	-	SC	0.07	26	-	-	DSU	-	-	-	-	-	0.68	40.6	
9	5.00	SPT	-	-	-	-	0	61	39	29	18	11	-	-	-	SC	-	-	-	-	-	-	-	-	36	-	-	-	-
10	5.50	UDS	2.02	1.64	23.02	2.64	0	57	43	30	16	14	-	-	-	SC	0.08	25	-	-	DSU	-	-	-	-	-	0.61	37.8	
11	6.00	SPT	-	-	-	-	0	68	32	27	15	12	-	-	-	SC	-	-	-	-	-	-	-	-	38	-	-	-	-
12	6.50	UDS	2.04	1.67	22.41	2.66	0	71	29	26	14	12	-	-	-	SC	0.03	28	-	-	DSU	-	-	-	-	-	0.60	37.3	
13	7.00	SPT	-	-	-	-	0	69	31	30	16	14	-	-	-	SC	-	-	-	-	-	-	-	-	41	-	-	-	-
14	7.50	UDS	2.05	1.69	21.56	2.65	0	64	36	32	15	17	-	-	-	SC	0.08	27	-	-	DSU	-	-	-	-	-	0.57	36.4	
15	8.00	SPT	-	-	-	-	0	70	30	28	17	11	-	-	-	SC	-	-	-	-	-	-	-	-	40	-	-	-	-
16	8.50	SPT	-	-	-	-	0	67	33	29	16	13	-	-	-	SC	-	-	-	-	-	-	-	-	41	-	-	-	-
17	9.00	SPT	-	-	-	-	0	37	49	30	18	12	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-	-
18	9.50	SPT	-	-	-	-	0	60	40	27	16	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
19	10.00	SPT	-	-	-	-	0	72	28	25	17	8	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
20	11.00	SPT	-	-	-	-	0	70	30	26	15	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
21	11.50	SPT	-	-	-	-	0	78	22	23	14	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
22	13.50	UDS	2.60	2.50	4.05	2.78	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	390.1	-	UCS	-	-	-	-	-	8.66	0.11	10.1
23	15.00	UDS	2.63	2.54	3.52	2.79	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	346.2	-	UCS	-	-	-	-	-	10.66	0.10	8.9
24	15.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-
25	16.50	UDS	2.31	2.08	11.27	2.71	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	90.8	UCS	-	-	-	-	-	0.31	23.4	
26	16.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-
27	18.00	UDS	2.69	2.63	2.12	2.79	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	315.7	-	UCS	-	-	-	-	-	36.00	0.06	5.6
28	20.00	UDS	2.70	2.64	2.10	2.80	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	338.6	-	UCS	-	-	-	-	-	18.00	0.06	5.6

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. :- 2

Co-Ordinate :- E 957, N 3845

Reduced Level :- 194.75 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	-	-	-	-	17	49	34	27	16	11	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	3	59	38	30	23	7	-	-	-	SM-SC	-	-	-	-	-	-	-	-	11	-	-	-	-
3	2.00	SPT	-	-	-	-	5	61	34	26	20	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	85	-	-	-	-
4	2.50	SPT	-	-	-	-	1	77	22	23	17	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
5	3.00	SPT	-	-	-	-	4	66	30	28	19	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
6	3.50	SPT	-	-	-	-	19	54	27	25	17	8	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
7	4.00	SPT	-	-	-	-	20	52	28	27	15	12	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
8	4.50	SPT	-	-	-	-	5	59	36	29	16	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
9	5.00	SPT	-	-	-	-	9	58	33	26	17	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
10	5.50	SPT	-	-	-	-	6	53	41	30	16	14	-	-	-	SC	-	-	-	-	-	-	-	-	31	-	-	-	-
11	6.00	SPT	-	-	-	-	17	49	34	28	15	13	-	-	-	SC	-	-	-	-	-	-	-	-	49	-	-	-	-
12	6.50	SPT	-	-	-	-	19	56	25	26	16	10	-	-	-	SC	-	-	-	-	-	-	-	-	58	-	-	-	-
13	7.00	SPT	-	-	-	-	8	60	32	29	18	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
14	7.50	SPT	-	-	-	-	4	61	35	31	16	15	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
15	8.00	SPT	-	-	-	-	0	91	9	NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
16	8.50	SPT	-	-	-	-	0	93	7	NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
17	9.00	SPT	-	-	-	-	5	60	35	28	16	12	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
18	9.50	SPT	-	-	-	-	2	65	33	26	15	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
19	10.00	SPT	-	-	-	-	0	92	8	NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
20	11.00	SPT	-	-	-	-	0	94	6	NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
21	11.50	SPT	-	-	-	-	0	91	9	NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
22	13.00	SPT	-	-	-	-	0	90	10	NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
23	14.00	SPT	-	-	-	-	0	67	33	29	16	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
24	14.50	SPT	-	-	-	-	0	70	30	26	15	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
25	15.50	SPT	-	-	-	-	0	94	6	NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
26	16.00	SPT	-	-	-	-	0	90	10	NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
27	17.00	SPT	-	-	-	-	0	84	16	18	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
28	18.50	SPT	-	-	-	-	0	86	14	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
29	20.00	UDS	2.34	2.14	9.47	2.68	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	202.4	UCS	-	-	-	-	-	-	0.25	20.2

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. :- 3

Co-Ordinate :- E 2000, N 3843

Reduced Level :- 206.03 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	31	54	15	29	16	13	-	-	-	CL	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	25	58	17	30	15	15	-	-	-	CL	-	-	-	-	-	-	-	-	14	-	-	-
3	2.00	SPT	-	-	-	-	0	67	33		28	18	10	-	-	-	SC	-	-	-	-	-	-	-	-	18	-	-	-
4	2.50	UDS	1.96	1.54	27.12	2.65	0	61	39		30	17	13	-	-	-	SC	0.06	26	-	-	DSU	-	-	-	-	-	0.72	41.8
5	3.00	SPT	-	-	-	-	0	69	31		28	16	12	-	-	-	SC	-	-	-	-	-	-	-	-	18	-	-	-
6	3.50	SPT	-	-	-	-	0	73	27		26	18	8	-	-	-	SC	-	-	-	-	-	-	-	-	25	-	-	-
7	4.00	SPT	-	-	-	-	0	77	23		22	14	8	-	-	-	SC	-	-	-	-	-	-	-	-	22	-	-	-
8	4.50	SPT	-	-	-	-	0	61	39		31	16	15	-	-	-	SC	-	-	-	-	-	-	-	-	25	-	-	-
9	5.00	SPT	-	-	-	-	0	31	46	23	40	21	19	-	-	-	CI	-	-	-	-	-	-	-	-	26	-	-	-
10	5.50	SPT	-	-	-	-	0	29	45	26	43	20	23	-	-	-	CI	-	-	-	-	-	-	-	-	23	-	-	-
11	6.00	SPT	-	-	-	-	0	66	34		29	16	13	-	-	-	SC	-	-	-	-	-	-	-	-	34	-	-	-
12	6.50	SPT	-	-	-	-	0	69	31		28	17	11	-	-	-	SC	-	-	-	-	-	-	-	-	67	-	-	-
13	7.00	SPT	-	-	-	-	0	64	36		31	16	15	-	-	-	SC	-	-	-	-	-	-	-	-	42	-	-	-
14	7.50	SPT	-	-	-	-	0	65	35		28	18	10	-	-	-	SC	-	-	-	-	-	-	-	-	29	-	-	-
15	8.00	SPT	-	-	-	-	0	60	40		38	21	17	-	-	-	SC	-	-	-	-	-	-	-	-	35	-	-	-
16	8.50	SPT	-	-	-	-	0	59	41		40	20	20	-	-	-	SC	-	-	-	-	-	-	-	-	46	-	-	-
17	9.00	SPT	-	-	-	-	0	67	33		28	18	10	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
18	9.50	SPT	-	-	-	-	0	69	31		26	16	10	-	-	-	SC	-	-	-	-	-	-	-	-	56	-	-	-
19	10.00	SPT	-	-	-	-	0	65	35		29	17	12	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
20	11.00	SPT	-	-	-	-	0	66	34		26	15	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
21	11.50	SPT	-	-	-	-	0	69	31		24	14	10	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
22	12.50	SPT	-	-	-	-	5	78	17		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
23	13.00	SPT	-	-	-	-	3	81	16		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
24	14.00	SPT	-	-	-	-	7	76	17		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
25	14.50	SPT	-	-	-	-	5	72	23		19	15	4	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
26	15.50	SPT	-	-	-	-	0	61	39		29	16	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
27	16.00	SPT	-	-	-	-	0	66	34		26	14	12	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
28	17.00	SPT	-	-	-	-	0	70	30		25	16	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
29	17.50	SPT	-	-	-	-	0	66	34		29	15	14	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
30	18.50	SPT	-	-	-	-	0	64	36		30	17	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
31	19.00	SPT	-	-	-	-	0	65	35		27	16	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
32	20.00	SPT	-	-	-	-	0	79	21		19	15	4	-	-	-	SM	-	-	-	-	-	-	-	-	>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 (NTTTP) at village Hirma, Talabira, Odisha

BH No. :- 4

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	24	60	16	32	17	15	-	-	-	CL	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	8	49		43	44	20	24	-	-	-	SC	-	-	-	-	-	-	-	-	9	-	-	-	-
3	2.00	SPT	-	-	-	-	6	68		26	41	21	20	-	-	-	SC	-	-	-	-	-	-	-	-	10	-	-	-	-
4	2.50	UDS	1.94	1.71	13.72	2.65	6	66		28	42	20	22	-	-	-	SC	0.09	24	-	-	DSU	-	-	-	-	-	0.55	35.6	-
5	3.00	SPT	-	-	-	-	0	70		30	36	22	14	-	-	-	SC	-	-	-	-	-	-	-	-	15	-	-	-	-
6	3.50	SPT	-	-	-	-	0	72		28	29	15	14	-	-	-	SC	-	-	-	-	-	-	-	-	17	-	-	-	-
7	4.00	SPT	-	-	-	-	3	66		31	32	17	15	-	-	-	SC	-	-	-	-	-	-	-	-	14	-	-	-	-
8	4.50	SPT	-	-	-	-	5	65		30	47	20	27	-	-	-	SC	-	-	-	-	-	-	-	-	18	-	-	-	-
9	5.00	SPT	-	-	-	-	0	68		32	37	18	19	-	-	-	SC	-	-	-	-	-	-	-	-	19	-	-	-	-
10	5.50	SPT	-	-	-	-	0	76		24	45	19	26	-	-	-	SC	-	-	-	-	-	-	-	-	16	-	-	-	-
11	6.00	SPT	-	-	-	-	4	74		22	44	21	23	-	-	-	SC	-	-	-	-	-	-	-	-	18	-	-	-	-
12	6.50	SPT	-	-	-	-	26	50		24	46	22	24	-	-	-	SC	-	-	-	-	-	-	-	-	19	-	-	-	-
13	7.00	SPT	-	-	-	-	4	18	48	30	47	20	27	-	-	-	CI	-	-	-	-	-	-	-	-	25	-	-	-	-
14	7.50	SPT	-	-	-	-	9	7	48	36	49	19	30	-	-	-	CI	-	-	-	-	-	-	-	-	38	-	-	-	-
15	8.00	SPT	-	-	-	-	13	16	45	26	46	23	23	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-	-
16	8.50	DS	-	-	-	-	49	28		23	29	16	13	-	-	-	GC	-	-	-	-	-	-	-	-	-	-	-	-	-
17	9.50	DS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	-	-	-	-	-
18	9.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-
19	11.00	UDS	2.29	2.05	11.53	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	66.9	UCS	-	-	-	-	-	-	0.31	23.7
20	11.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-
21	12.50	UDS	2.43	2.27	7.23	2.71	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	65.4	-	UCS	-	-	-	-	-	9.00	0.20	16.4
22	14.00	UDS	2.51	2.38	5.34	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	81.3	-	UCS	-	-	-	-	-	26.00	0.15	12.7
23	15.50	UDS	2.54	2.43	4.74	2.74	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	72.6	-	UCS	-	-	-	-	-	34.00	0.13	11.5
24	17.00	UDS	2.50	2.38	4.94	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	55.3	-	UCS	-	-	-	-	-	12.00	0.13	11.8
25	18.50	UDS	2.57	2.47	3.95	2.74	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	80.6	-	UCS	-	-	-	-	-	46.00	0.11	9.8

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 (NTTP) at village Hirma, Talabira, Odisha

BH No. :- 5

Co-Ordinate :- E 1869, N 3690

Reduced Level :- 210.30m

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	15	14	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	
2	1.00	SPT	-	-	-	-	0	72	28	25	18	7	-	-	-	SM-SC	-	-	-	-	-	-	-	-	16	-	-	-	-	
3	2.00	SPT	-	-	-	-	0	76	24	22	16	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	19	-	-	-	-	
4	2.50	UDS	1.99	1.58	25.73	2.67	0	69	31	26	19	7	-	-	-	SM-SC	0.01	28	-	-	-	DSU	-	-	-	-	-	0.69	40.7	
5	3.00	SPT	-	-	-	-	0	62	38	35	20	15	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	39	-	-	-
6	3.50	SPT	-	-	-	-	0	63	37	33	22	11	-	-	-	SC	-	-	-	-	-	-	-	-	-	33	-	-	-	-
7	4.00	SPT	-	-	-	-	0	69	31	30	19	11	-	-	-	SC	-	-	-	-	-	-	-	-	-	27	-	-	-	-
8	4.50	SPT	-	-	-	-	0	71	29	27	18	9	-	-	-	SC	-	-	-	-	-	-	-	-	-	33	-	-	-	-
9	5.00	SPT	-	-	-	-	0	65	35	32	20	12	-	-	-	SC	-	-	-	-	-	-	-	-	-	35	-	-	-	-
10	5.50	SPT	-	-	-	-	0	70	30	28	18	10	-	-	-	SC	-	-	-	-	-	-	-	-	-	42	-	-	-	-
11	6.00	SPT	-	-	-	-	0	61	39	30	17	13	-	-	-	SC	-	-	-	-	-	-	-	-	-	35	-	-	-	-
12	6.50	SPT	-	-	-	-	0	64	36	26	14	12	-	-	-	SC	-	-	-	-	-	-	-	-	-	34	-	-	-	-
13	7.00	SPT	-	-	-	-	0	66	34	25	15	10	-	-	-	SC	-	-	-	-	-	-	-	-	-	72	-	-	-	-
14	7.50	SPT	-	-	-	-	0	68	32	23	14	9	-	-	-	SC	-	-	-	-	-	-	-	-	-	69	-	-	-	-
15	8.00	SPT	-	-	-	-	0	59	41	29	17	12	-	-	-	SC	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
16	8.50	SPT	-	-	-	-	0	64	36	26	16	10	-	-	-	SC	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
17	9.00	SPT	-	-	-	-	0	63	37	27	15	12	-	-	-	SC	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
18	9.50	SPT	-	-	-	-	0	72	28	24	13	11	-	-	-	SC	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
19	10.00	SPT	-	-	-	-	0	76	24	22	14	8	-	-	-	SC	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
20	11.00	SPT	-	-	-	-	0	64	36	26	15	11	-	-	-	SC	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
21	11.50	SPT	-	-	-	-	0	67	33	23	14	9	-	-	-	SC	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
22	12.50	SPT	-	-	-	-	0	80	20	18	14	4	-	-	-	SM	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
23	13.00	SPT	-	-	-	-	0	84	16	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
24	14.00	SPT	-	-	-	-	0	85	15	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
25	15.50	Remoulded	2.09	1.74	20.20	2.68	40	37	23	24	15	9	-	-	-	Boulderos	0.04	30	-	-	-	DSU	-	-	-	-	-	0.54	35.1	-
26	15.50	SPT	-	-	-	-	53	31	16	22	14	8	-	-	-	Boulderos	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
27	17.00	Remoulded	2.12	1.78	18.92	2.69	61	20	19	23	14	9	-	-	-	Boulderos	0.05	30	-	-	-	DSU	-	-	-	-	-	0.51	33.7	-
28	17.00	SPT	-	-	-	-	42	34	24	28	16	12	-	-	-	Boulderos	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
29	18.50	UDS	2.15	1.83	17.46	2.69	38	29	33	31	17	14	-	-	-	Boulderos	0.09	29	-	-	-	DSU	-	-	-	-	-	0.47	32.0	-
30	18.50	SPT	-	-	-	-	48	34	18	25	13	12	-	-	-	Boulderos	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
31	20.00	SPT	-	-	-	-	0	79	21	20	15	5	-	-	-	SM	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
32	22.00	SPT	-	-	-	-	0	86	14	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
33	23.00	SPT	-	-	-	-	0	81	19	18	14	4	-	-	-	SM	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
34	23.50	SPT	-	-	-	-	0	85	15	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
35	24.50	SPT	-	-	-	-	0	64	36	27	16	11	-	-	-	SC	-	-	-	-	-	-	-	-	-	>100	-	-	-	-
36	25.00	SPT	-	-	-	-	0	61	39	30	17	13	-	-	-	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. :- 7

Co-Ordinate :- E 1963, N 3695

Reduced Level :- 207.9 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	67	33		31	16	15	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	65	35		28	15	13	-	-	-	SC	-	-	-	-	-	-	-	-	47	-	-	-
3	2.00	SPT	-	-	-	-	0	64	36		37	17	20	-	-	-	SC	-	-	-	-	-	-	-	-	20	-	-	-
4	2.50	UDS	1.78	1.57	13.41	2.65	0	68	32		29	16	13	-	-	-	SC	0.05	26	-	-	DSU	-	-	-	-	-	0.69	40.8
5	3.00	SPT	-	-	-	-	0	70	30		27	15	12	-	-	-	SC	-	-	-	-	-	-	-	-	22	-	-	-
6	3.50	UDS	1.75	1.59	9.85	2.66	4	78	18		16	NP	NP	-	-	-	SM	0.00	28	-	-	DSU	-	-	-	-	-	0.67	40.1
7	4.00	SPT	-	-	-	-	11	67	22		21	17	4	-	-	-	SM	-	-	-	-	-	-	-	-	69	-	-	-
8	4.50	UDS	1.70	1.54	10.46	2.66	6	75	19		18	14	4	-	-	-	SM	0.00	29	-	-	DSU	-	-	-	-	-	0.73	42.1
9	5.00	SPT	-	-	-	-	0	66	34		29	17	12	-	-	-	SC	-	-	-	-	-	-	-	-	16	-	-	-
10	5.50	UDS	1.78	1.55	14.65	2.65	0	64	36		30	16	14	-	-	-	SC	0.07	25	-	-	DSU	-	-	-	-	-	0.71	41.4
11	6.00	SPT	-	-	-	-	0	78	22		20	15	5	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
12	6.50	DS	-	-	-	-	0	80	20		18	14	4	-	-	-	SM	-	-	-	-	-	-	-	-	-	-	-	-
13	7.00	SPT	-	-	-	-	0	63	37		30	19	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
14	7.50	SPT	-	-	-	-	0	66	34		27	17	10	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
15	8.00	SPT	-	-	-	-	0	72	28		25	16	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
16	8.50	SPT	-	-	-	-	0	61	39		29	15	14	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
17	9.00	SPT	-	-	-	-	0	65	35		28	17	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
18	9.50	SPT	-	-	-	-	0	73	27		25	15	10	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
19	10.00	SPT	-	-	-	-	0	68	32		29	14	15	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
20	11.00	SPT	-	-	-	-	0	64	36		31	18	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
21	11.50	SPT	-	-	-	-	0	61	39		33	16	17	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
22	12.50	SPT	-	-	-	-	0	38	49	13	28	17	11	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-
23	12.50	SPT	-	-	-	-	0	34	51	15	29	16	13	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-
24	14.00	SPT	-	-	-	-	6	69	25		26	18	8	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
25	14.50	SPT	-	-	-	-	8	72	20		23	15	8	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
26	15.50	SPT	-	-	-	-	4	63	33		28	18	10	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
27	16.00	SPT	-	-	-	-	5	61	34		29	16	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
28	17.00	SPT	-	-	-	-	3	59	38		32	17	15	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
29	18.50	SPT	-	-	-	-	5	70	25		26	18	8	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
30	20.00	SPT	-	-	-	-	8	68	24		25	16	9	-	-	-	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. :- 10

Co-Ordinate :- E 914, N 3614

Reduced Level :- 193.650 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	59	41	30	17	13	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	29	50	21	41	23	18	-	-	-	CI	-	-	-	-	-	-	-	6	-	-	-	-
3	2.00	SPT	-	-	-	-	0	36	42	22	42	22	20	-	-	-	CI	-	-	-	-	-	-	-	11	-	-	-	-
4	2.50	UDS	1.95	1.53	27.81	2.65	0	14	50	36	52	20	32	-	-	-	CH	0.59	6	-	-	TUU	0.15	0.0186	0.43	-	-	0.74	42.4
5	3.00	SPT	-	-	-	-	0	9	48	43	55	19	36	-	-	-	CH	-	-	-	-	-	-	-	11	-	-	-	-
6	3.50	UDS	1.97	1.55	26.74	2.66	0	20	47	33	51	22	29	-	-	-	CH	0.63	7	-	-	TUU	0.14	0.0170	0.56	-	-	0.71	41.6
7	4.00	SPT	-	-	-	-	0	64	36		37	19	18	-	-	-	SC	-	-	-	-	-	-	-	13	-	-	-	-
8	4.50	UDS	1.98	1.57	26.09	2.66	0	76	24		23	18	5	-	-	-	SM	0.00	29	-	-	DSU	-	-	-	-	-	0.69	41.0
9	5.00	SPT	-	-	-	-	0	71	29		27	22	5	-	-	-	SM	-	-	-	-	-	-	-	14	-	-	-	-
10	5.50	Remoulded	2.00	1.60	25.09	2.67	0	78	22		21	17	4	-	-	-	SM	0.00	30	-	-	DSU	-	-	-	-	-	0.67	40.1
11	6.00	SPT	-	-	-	-	0	89	11		NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	19	-	-	-	-
12	6.50	Remoulded	2.04	1.66	22.69	2.67	0	90	10		NP	NP	NP	-	-	-	SP-SM	0.00	32	-	-	DSU	-	-	-	-	-	0.61	37.7
13	7.00	SPT	-	-	-	-	0	94	6		NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	24	-	-	-	-
14	7.50	DS	-	-	-	-	0	91	9		NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	-	-	-	-	-
15	8.00	SPT	-	-	-	-	0	90	10		NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	26	-	-	-	-
16	8.50	DS	-	-	-	-	0	93	7		NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	-	-	-	-	-
17	9.00	SPT	-	-	-	-	0	92	8		NP	NP	NP	-	-	-	SP-SM	-	-	-	-	-	-	-	43	-	-	-	-
18	9.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	>100	-	-	-	-
19	10.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	>100	-	-	-	-
20	11.50	UDS	2.31	2.09	10.78	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	66.8	UCS	-	-	-	-	-	0.29	22.5
21	11.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	>100	-	-	-	-
22	13.00	UDS	2.29	2.05	11.53	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	53.9	UCS	-	-	-	-	-	0.31	23.7
23	13.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	>100	-	-	-	-
24	14.50	UDS	2.43	2.26	7.46	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	151.4	-	UCS	-	-	-	-	16.00	0.20	16.9
25	16.00	UDS	2.97	2.95	0.84	3.02	-	-	-	-	-	-	-	-	-	-	ROCK	-	-	553.3	-	UCS	-	-	-	-	77.00	0.03	2.5

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. :- 11

Co-Ordinate :- E 714, N 3599

Reduced Level :- 197.3 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				Coefficient of Volume Compressibility mv	Pre-consolidation Pressure						
																									%					%
1	0.00	DS	-	-	-	-	0	29	58	13	28	17	11	-	-	-	CL	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	13	51	36	54	22	32	-	-	-	CH	-	-	-	-	-	-	-	-	7	-	-	-	-
3	2.00	SPT	-	-	-	-	0	10	46	44	59	21	38	-	-	-	CH	-	-	-	-	-	-	-	-	9	-	-	-	-
4	2.50	UDS	1.70	1.49	14.16	2.62	0	14	49	37	55	23	32	-	-	-	CH	0.46	2	-	-	TUU	0.16	0.0231	0.41	-	-	0.76	43.2	-
5	3.00	SPT	-	-	-	-	0	27	50	23	40	19	21	-	-	-	CI	-	-	-	-	-	-	-	-	10	-	-	-	-
6	3.50	UDS	1.74	1.53	13.56	2.66	0	29	51	20	39	21	18	-	-	-	CI	0.53	6	-	-	TUU	0.15	0.0179	0.59	-	-	0.74	42.4	-
7	4.00	SPT	-	-	-	-	0	66	34		28	16	12	-	-	-	SC	-	-	-	-	-	-	-	-	14	-	-	-	-
8	4.50	UDS	1.98	1.57	25.80	2.65	0	26	49	25	42	20	22	-	-	-	CI	0.74	5	-	-	TUU	0.12	0.0135	0.68	-	-	0.68	40.6	-
9	5.00	SPT	-	-	-	-	0	28	51	21	40	21	19	-	-	-	CI	-	-	-	-	-	-	-	-	41	-	-	-	-
10	5.50	SPT	-	-	-	-	0	31	54	15	31	18	13	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-	-
11	6.00	SPT	-	-	-	-	0	40	49	11	29	19	10	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-	-
12	6.50	SPT	-	-	-	-	0	32	52	16	30	16	14	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-	-
13	7.00	SPT	-	-	-	-	0	29	55	16	32	17	15	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-	-
14	7.50	SPT	-	-	-	-	0	35	53	12	29	19	10	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-	-
15	8.00	SPT	-	-	-	-	0	36	54	10	27	18	9	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-	-
16	8.50	SPT	-	-	-	-	0	37	48	15	28	15	13	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-	-
17	9.00	SPT	-	-	-	-	0	40	48	12	26	16	10	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-	-
18	9.50	SPT	-	-	-	-	0	29	44	27	43	20	23	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-	-
19	10.00	SPT	-	-	-	-	0	28	43	29	45	19	26	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-	-
20	11.00	SPT	-	-	-	-	0	40	46	14	29	16	13	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-	-
21	11.50	SPT	-	-	-	-	0	36	46	18	31	15	16	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-	-
22	12.50	SPT	-	-	-	-	0	39	47	14	30	17	13	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-	-
23	13.00	SPT	-	-	-	-	0	41	48	11	28	18	10	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-	-
24	14.00	SPT	-	-	-	-	0	35	50	15	29	16	13	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-	-
25	14.50	SPT	-	-	-	-	0	34	49	17	31	15	16	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-	-
26	15.50	SPT	-	-	-	-	0	39	49	12	28	18	10	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-	-
27	17.00	UDS	2.43	2.25	7.91	2.74	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	165.6	-	UCS	-	-	-	-	37.85	0.22	17.8	-
28	18.50	UDS	2.41	2.21	8.99	2.76	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	141.7	-	UCS	-	-	-	-	56.66	0.25	19.9	-
29	20.00	UDS	2.52	2.38	5.94	2.77	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	204.5	-	UCS	-	-	-	-	69.33	0.16	14.1	-

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. :- 29

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	30	60	10	24	15	9	-	-	-	CL	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	11	58	31	51	24	27	-	-	-	CH	-	-	-	-	-	-	-	-	4	-	-	-
3	2.00	SPT	-	-	-	-	0	12	49	39	56	21	35	-	-	-	CH	-	-	-	-	-	-	-	-	7	-	-	-
4	2.50	UDS	1.78	1.47	21.01	2.61	0	10	53	37	53	19	34	-	-	-	CH	0.35	2	-	-	TUU	0.17	0.0311	0.43	-	-	0.77	43.6
5	3.00	SPT	-	-	-	-	0	13	54	33	51	23	28	-	-	-	CH	-	-	-	-	-	-	-	-	7	-	-	-
6	3.50	SPT	-	-	-	-	0	43	31	26	45	22	23	-	-	-	CI	-	-	-	-	-	-	-	-	11	-	-	-
7	4.00	SPT	-	-	-	-	0	12	56	32	48	20	28	-	-	-	CI	-	-	-	-	-	-	-	-	10	-	-	-
8	4.50	UDS	1.95	1.54	26.32	2.60	0	10	66	24	44	22	22	-	-	-	CI	0.51	1	-	-	TUU	0.14	0.0192	0.75	-	-	0.68	40.6
9	5.00	SPT	-	-	-	-	0	47	28	25	37	16	21	-	-	-	CI	-	-	-	-	-	-	-	-	14	-	-	-
10	5.50	UDS	1.99	1.59	24.87	2.64	0	38	38	24	39	19	20	-	-	-	CI	0.66	6	-	-	TUU	0.12	0.0132	0.89	-	-	0.66	39.6
11	6.00	SPT	-	-	-	-	0	61	39	32	24	8	-	-	-	-	SC	-	-	-	-	-	-	-	-	29	-	-	-
12	6.50	SPT	-	-	-	-	0	72	28	27	17	10	-	-	-	-	SC	-	-	-	-	-	-	-	-	82	-	-	-
13	7.00	SPT	-	-	-	-	0	79	21	30	18	12	-	-	-	-	SC	-	-	-	-	-	-	-	-	48	-	-	-
14	7.50	SPT	-	-	-	-	0	70	30	26	17	9	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
15	8.00	SPT	-	-	-	-	0	53	47	28	18	10	-	-	-	-	SC	-	-	-	-	-	-	-	-	44	-	-	-
16	8.50	SPT	-	-	-	-	0	76	24	26	15	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
17	9.00	SPT	-	-	-	-	10	46	44	30	18	12	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
18	9.50	SPT	-	-	-	-	20	27	30	23	36	16	20	-	-	-	CI	-	-	-	-	-	-	-	-	>100	-	-	-
19	10.00	SPT	-	-	-	-	0	83	17	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
20	11.00	SPT	-	-	-	-	64	21	15	23	15	8	-	-	-	-	GC	-	-	-	-	-	-	-	-	>100	-	-	-
21	11.50	SPT	-	-	-	-	78	9	13	NP	NP	NP	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
22	12.50	UDS	2.39	2.21	8.26	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	51.9	UCS	-	-	-	-	-	0.22	18.2
23	14.00	UDS	2.26	2.01	12.44	2.68	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	38.1	UCS	-	-	-	-	-	0.33	25.0
24	15.50	UDS	2.27	2.02	12.29	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	34.6	UCS	-	-	-	-	-	0.33	24.9
25	17.00	UDS	2.34	2.13	9.71	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	58.0	-	UCS	-	-	-	-	6.66	0.26	20.7
26	18.50	UDS	2.38	2.19	8.59	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	67.6	-	UCS	-	-	-	-	36.00	0.23	18.8
27	20.00	UDS	2.41	2.23	8.31	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	101.8	-	UCS	-	-	-	-	52.66	0.23	18.5
28	21.50	UDS	2.48	2.33	6.63	2.75	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	100.6	-	UCS	-	-	-	-	58.66	0.18	15.4
29	23.00	UDS	2.37	2.17	9.39	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	104.1	-	UCS	-	-	-	-	48.00	0.26	20.3
30	25.00	UDS	2.35	2.14	9.60	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	96.8	-	UCS	-	-	-	-	19.50	0.26	20.6

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. :- 36

Co-Ordinate :- E 1819, N 3369

Reduced Level :- 208.65 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	68	32	26	16	10	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	64	36	27	14	13	-	-	-	SC	-	-	-	-	-	-	-	-	8	-	-	-	-
3	2.00	SPT	-	-	-	-	0	59	41	29	15	14	-	-	-	SC	-	-	-	-	-	-	-	-	16	-	-	-	-
4	2.50	UDS	1.77	1.57	12.65	2.65	0	57	43	30	18	12	-	-	-	SC	0.08	25	-	-	DSU	-	-	-	-	-	-	0.69	40.7
5	3.00	SPT	-	-	-	-	0	69	31	28	19	9	-	-	-	SC	-	-	-	-	-	-	-	-	23	-	-	-	-
6	3.50	UDS	1.85	1.61	14.73	2.66	0	64	36	29	17	12	-	-	-	SC	0.06	27	-	-	DSU	-	-	-	-	-	-	0.65	39.4
7	4.00	SPT	-	-	-	-	5	80	15	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	34	-	-	-	-
8	4.50	SPT	-	-	-	-	3	75	22	21	17	4	-	-	-	SM	-	-	-	-	-	-	-	-	40	-	-	-	-
9	5.00	SPT	-	-	-	-	7	73	20	19	15	4	-	-	-	SM	-	-	-	-	-	-	-	-	32	-	-	-	-
10	5.50	SPT	-	-	-	-	4	79	17	17	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	28	-	-	-	-
11	6.00	SPT	-	-	-	-	0	64	36	33	21	12	-	-	-	SC	-	-	-	-	-	-	-	-	26	-	-	-	-
12	6.50	SPT	-	-	-	-	0	69	31	29	19	10	-	-	-	SC	-	-	-	-	-	-	-	-	16	-	-	-	-
13	7.00	SPT	-	-	-	-	0	66	34	30	17	13	-	-	-	SC	-	-	-	-	-	-	-	-	21	-	-	-	-
14	7.50	SPT	-	-	-	-	0	67	33	28	19	9	-	-	-	SC	-	-	-	-	-	-	-	-	33	-	-	-	-
15	8.00	SPT	-	-	-	-	0	72	28	26	18	8	-	-	-	SC	-	-	-	-	-	-	-	-	59	-	-	-	-
16	8.50	SPT	-	-	-	-	0	69	31	32	17	15	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
17	9.00	SPT	-	-	-	-	5	78	17	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
18	9.50	SPT	-	-	-	-	9	79	12	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
19	10.00	SPT	-	-	-	-	0	67	33	28	16	12	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
20	11.00	SPT	-	-	-	-	0	58	42	31	15	16	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
21	11.50	SPT	-	-	-	-	0	63	37	30	18	12	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
22	12.50	SPT	-	-	-	-	0	72	28	26	17	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
23	13.00	SPT	-	-	-	-	0	82	18	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
24	14.00	SPT	-	-	-	-	0	81	19	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
25	14.50	SPT	-	-	-	-	0	56	44	34	18	16	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
26	15.50	SPT	-	-	-	-	0	59	41	31	17	14	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
27	16.00	SPT	-	-	-	-	0	83	17	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
28	17.00	SPT	-	-	-	-	0	86	14	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
29	17.50	SPT	-	-	-	-	0	60	40	35	18	17	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
30	18.50	SPT	-	-	-	-	0	73	27	26	16	10	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
31	19.00	SPT	-	-	-	-	0	84	16	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
32	20.00	SPT	-	-	-	-	0	83	17	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>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. :- 69

Co-Ordinate :- E 1805, N 3156

Reduced Level :- 206.25 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	68	32	30	16	14	-	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	11	57	32	33	15	18	-	-	-	-	SC	-	-	-	-	-	-	-	-	32	-	-	-
3	2.00	SPT	-	-	-	-	18	49	33	34	17	17	-	-	-	-	SC	-	-	-	-	-	-	-	-	25	-	-	-
4	2.50	UDS	1.79	1.62	10.67	2.68	16	48	36	36	16	20	-	-	-	-	SC	0.06	28	-	-	DSU	-	-	-	-	-	0.66	39.6
5	3.00	SPT	-	-	-	-	0	59	41	38	15	23	-	-	-	-	SC	-	-	-	-	-	-	-	-	26	-	-	-
6	3.50	UDS	1.73	1.59	9.10	2.67	3	58	39	33	19	14	-	-	-	-	SC	0.08	27	-	-	DSU	-	-	-	-	-	0.68	40.6
7	4.00	SPT	-	-	-	-	15	47	38	34	18	16	-	-	-	-	SC	-	-	-	-	-	-	-	-	15	-	-	-
8	4.50	UDS	1.99	1.58	25.73	2.67	9	60	31	36	17	19	-	-	-	-	SC	0.05	28	-	-	DSU	-	-	-	-	-	0.69	40.7
9	5.00	SPT	-	-	-	-	0	79	21	19	15	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	31	-	-	-
10	5.50	UDS	2.01	1.61	24.75	2.68	0	74	26	25	20	5	-	-	-	-	SM	0.00	30	-	-	DSU	-	-	-	-	-	0.66	39.9
11	6.00	SPT	-	-	-	-	0	73	27	26	21	5	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
12	6.50	SPT	-	-	-	-	0	62	38	33	18	15	-	-	-	-	SC	-	-	-	-	-	-	-	-	36	-	-	-
13	7.00	SPT	-	-	-	-	0	64	36	30	17	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
14	7.50	SPT	-	-	-	-	0	59	41	35	18	17	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
15	8.00	SPT	-	-	-	-	0	63	37	30	19	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
16	8.50	SPT	-	-	-	-	5	89	6	NP	NP	NP	-	-	-	-	SP-SM	-	-	-	-	-	-	-	-	>100	-	-	-
17	9.00	SPT	-	-	-	-	0	91	9	NP	NP	NP	-	-	-	-	SP-SM	-	-	-	-	-	-	-	-	>100	-	-	-
18	9.50	SPT	-	-	-	-	3	87	10	NP	NP	NP	-	-	-	-	SP-SM	-	-	-	-	-	-	-	-	>100	-	-	-
19	10.00	SPT	-	-	-	-	4	88	8	NP	NP	NP	-	-	-	-	SP-SM	-	-	-	-	-	-	-	-	>100	-	-	-
20	11.00	SPT	-	-	-	-	8	85	7	NP	NP	NP	-	-	-	-	SP-SM	-	-	-	-	-	-	-	-	>100	-	-	-
21	11.50	SPT	-	-	-	-	2	87	11	NP	NP	NP	-	-	-	-	SP-SM	-	-	-	-	-	-	-	-	>100	-	-	-
22	12.50	SPT	-	-	-	-	4	86	10	NP	NP	NP	-	-	-	-	SP-SM	-	-	-	-	-	-	-	-	>100	-	-	-
23	13.00	SPT	-	-	-	-	0	64	36	32	17	15	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
24	14.00	SPT	-	-	-	-	4	70	26	29	18	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
25	14.50	SPT	-	-	-	-	12	53	35	31	17	14	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
26	15.50	SPT	-	-	-	-	0	64	36	34	16	18	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
27	17.00	SPT	-	-	-	-	0	68	32	30	19	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
28	17.50	SPT	-	-	-	-	3	70	27	28	18	10	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
29	18.50	SPT	-	-	-	-	6	62	32	29	16	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
30	19.00	SPT	-	-	-	-	5	58	37	33	15	18	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
31	20.00	SPT	-	-	-	-	0	67	33	31	17	14	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
32	21.50	SPT	-	-	-	-	6	70	24	26	18	8	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
33	22.00	SPT	-	-	-	-	4	65	31	30	19	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
34	23.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
35	23.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
36	25.00	UDS	2.43	2.26	7.68	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	128.6	-	UCS	-	-	-	-	17.50	0.21	17.3
37	26.50	UDS	2.60	2.49	4.26	2.79	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	317.9	-	UCS	-	-	-	-	12.00	0.12	10.6
38	28.00	UDS	2.62	2.52	3.97	2.80	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	367.4	-	UCS	-	-	-	-	14.00	0.11	10.0
39	29.50	UDS	2.64	2.56	3.28	2.79	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	388.2	-	UCS	-	-	-	-	6.60	0.09	8.4
40	30.00	UDS	2.59	2.47	4.72	2.80	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	359.1	UCS	-	-	-	-	-	0.13	11.7

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. :- 80

Co-Ordinate :- E - 2085, N - 3091

Reduced Level :- 201.32m

Sr No	Depth of Sample m	Type of Sample	Field Bulk Density gm / cc	Field Dry Density gm / cc	Natural Moisture Content %	Specific Gravity	Grain Size Analysis				Consistency limits			Shrinkage Limit %	Swelling Pressure Kg/cm ²	Free Swell Index %	Soil Classification	Shear Parameter		Unconfined Compression Test Kg/cm ²	UCS by Point Load Index in rock Kg/cm ²	Type of Shear Test	Consolidation Parameters			SPT N Value	Rock Quality Designation %	Void Ratio	Porosity %
							Gravel %	Sand %	Silt %	Clay %	Liquid Limit %	Plastic Limit %	Plasticity Index %					Cohesion C Kg/cm ²	Angle of Internal Friction ϕ Degree				Compression Index C _c	Coefficient of Volume Compressibility mv cm ² /kg	Pre-consolidation Pressure kg/cm ²				
1	0.00	DS	-	-	-	-	4	62	34		28	16	12	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	6	59	35		29	15	14	-	-	-	SC	-	-	-	-	-	-	-	-	16	-	-	-
3	2.00	SPT	-	-	-	-	4	73	23		25	16	9	-	-	-	SC	-	-	-	-	-	-	-	-	23	-	-	-
4	2.50	UDS	2.00	1.61	24.53	2.65	2	60	38		30	14	16	-	-	-	SC	0.07	26	-	-	DSU	-	-	-	-	-	0.65	39.4
5	3.00	SPT	-	-	-	-	6	81	13		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	34	-	-	-
6	3.50	SPT	-	-	-	-	5	76	19		18	14	4	-	-	-	SM	-	-	-	-	-	-	-	-	62	-	-	-
7	4.00	SPT	-	-	-	-	1	75	24		21	16	5	-	-	-	SM	-	-	-	-	-	-	-	-	32	-	-	-
8	4.50	SPT	-	-	-	-	4	60	36		28	19	9	-	-	-	SC	-	-	-	-	-	-	-	-	46	-	-	-
9	5.00	SPT	-	-	-	-	8	56	36		29	17	12	-	-	-	SC	-	-	-	-	-	-	-	-	51	-	-	-
10	5.50	SPT	-	-	-	-	13	59	28		25	16	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
11	6.00	SPT	-	-	-	-	6	56	38		30	18	12	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
12	6.50	SPT	-	-	-	-	0	67	33		26	16	10	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
13	7.00	SPT	-	-	-	-	0	70	30		24	15	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
14	7.50	SPT	-	-	-	-	4	61	35		28	14	14	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
15	8.00	SPT	-	-	-	-	59	20	21		24	15	9	-	-	-	GC	-	-	-	-	-	-	-	-	>100	-	-	-
16	8.50	SPT	-	-	-	-	63	21	16		21	13	8	-	-	-	GC	-	-	-	-	-	-	-	-	>100	-	-	-
17	9.00	SPT	-	-	-	-	49	30	21		25	16	9	-	-	-	GC	-	-	-	-	-	-	-	-	>100	-	-	-
18	9.50	SPT	-	-	-	-	53	24	23		26	15	11	-	-	-	GC	-	-	-	-	-	-	-	-	>100	-	-	-
19	10.00	SPT	-	-	-	-	49	29	22		25	16	9	-	-	-	GC	-	-	-	-	-	-	-	-	>100	-	-	-
20	11.00	UDS	2.29	2.05	11.53	2.69	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	74.6	UCS	-	-	-	-	-	0.31	23.7
21	11.00	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
22	12.50	UDS	2.26	2.01	12.44	2.68	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	64.2	UCS	-	-	-	-	-	0.33	25.0
23	12.50	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
24	14.00	UDS	2.34	2.12	10.43	2.72	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	89.6	UCS	-	-	-	-	-	0.28	22.1
25	14.00	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
26	15.50	UDS	2.56	2.44	4.86	2.77	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	326.4	UCS	-	-	-	-	-	0.13	11.9
27	15.50	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
28	17.00	UDS	2.41	2.23	8.31	2.73	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	152.4	UCS	-	-	-	-	-	0.23	18.5
29	17.00	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
30	18.50	UDS	2.59	2.50	3.66	2.75	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	316.8	UCS	-	-	-	-	-	0.10	9.1
31	18.50	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
32	20.00	UDS	2.60	2.49	4.26	2.79	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	327.6	-	UCS	-	-	-	-	18.00	0.12	10.6
33	21.50	UDS	2.62	2.54	3.34	2.77	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	130.4	UCS	-	-	-	-	-	0.09	8.5
34	23.00	UDS	2.60	2.51	3.62	2.76	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	346.5	UCS	-	-	-	-	-	0.10	9.1
35	25.00	UDS	2.64	2.56	3.07	2.78	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	310.9	UCS	-	-	-	-	-	0.09	7.9

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. :- 85

Co-Ordinate :- E 712, N 3086

Reduced Level :- 197.7 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	31	58	11	24	14	10	-	-	-	CL	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	17	60	23	41	20	21	-	-	-	CI	-	-	-	-	-	-	-	-	2	-	-	-	-
3	2.00	SPT	-	-	-	-	0	20	61	19	39	22	17	-	-	-	CI	-	-	-	-	-	-	-	-	8	-	-	-	-
4	2.50	UDS	1.66	1.50	10.46	2.61	0	12	61	27	43	19	24	-	-	-	CI	0.43	1	-	-	TUU	0.16	0.0245	0.41	-	-	0.74	42.4	-
5	3.00	SPT	-	-	-	-	5	27	46	22	41	21	20	-	-	-	CI	-	-	-	-	-	-	-	-	9	-	-	-	-
6	3.50	UDS	1.94	1.52	27.91	2.63	4	29	46	21	39	20	19	-	-	-	CI	0.48	3	-	-	TUU	0.16	0.0195	0.53	-	-	0.73	42.3	-
7	4.00	SPT	-	-	-	-	5	31	46	18	37	21	16	-	-	-	CI	-	-	-	-	-	-	-	-	16	-	-	-	-
8	4.50	UDS	1.96	1.55	26.83	2.64	3	34	48	15	36	23	13	-	-	-	CI	0.85	6	-	-	TUU	-	-	-	-	-	0.71	41.5	-
9	5.00	SPT	-	-	-	-	6	18	52	24	40	19	21	-	-	-	CI	-	-	-	-	-	-	-	-	17	-	-	-	-
10	5.50	UDS	1.95	1.54	26.92	2.62	2	21	58	19	39	22	17	-	-	-	CI	0.91	4	-	-	TUU	0.15	0.0103	0.72	-	-	0.71	41.4	-
11	6.00	SPT	-	-	-	-	4	32	46	18	36	20	16	-	-	-	CI	-	-	-	-	-	-	-	-	14	-	-	-	-
12	6.50	UDS	1.96	1.54	27.41	2.66	12	53	35	31	16	15	-	-	-	-	SC	0.06	27	-	-	DSU	-	-	-	-	-	0.73	42.2	-
13	7.00	SPT	-	-	-	-	3	31	44	22	42	22	20	-	-	-	CI	-	-	-	-	-	-	-	-	15	-	-	-	-
14	7.50	SPT	-	-	-	-	0	65	35	28	16	12	-	-	-	-	SC	-	-	-	-	-	-	-	-	26	-	-	-	-
15	8.00	SPT	-	-	-	-	0	59	41	38	18	20	-	-	-	-	SC	-	-	-	-	-	-	-	-	21	-	-	-	-
16	8.50	SPT	-	-	-	-	0	66	34	27	17	10	-	-	-	-	SC	-	-	-	-	-	-	-	-	20	-	-	-	-
17	9.00	SPT	-	-	-	-	0	68	32	26	15	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	35	-	-	-	-
18	9.50	SPT	-	-	-	-	0	63	37	29	17	12	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
19	10.00	SPT	-	-	-	-	0	31	59	10	28	19	9	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-	-
20	11.00	SPT	-	-	-	-	0	28	58	14	31	18	13	-	-	-	CL	-	-	-	-	-	-	-	-	>100	-	-	-	-
21	12.00	UDS	2.38	2.18	9.06	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	149.7	-	UCS	-	-	-	-	11.00	0.25	19.8	-
22	13.50	UDS	2.36	2.16	9.26	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	123.6	UCS	-	-	-	-	-	0.25	20.0	-
23	15.00	UDS	2.51	2.38	5.56	2.74	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	155.9	-	UCS	-	-	-	-	69.00	0.15	13.2	-
24	16.50	UDS	2.43	2.28	6.76	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	120.7	-	UCS	-	-	-	-	57.00	0.18	15.4	-
25	18.00	UDS	2.45	2.28	7.52	2.75	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	177.1	-	UCS	-	-	-	-	67.00	0.21	17.1	-

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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. :- 97

Co-Ordinate :- E 1868, N 3033

Reduced Level :- 204.1 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											
																							kg/cm ³	kg/cm ³	%					%
			gm / cc	gm / cc	%		%	%	%	%	%	%	%	kg/cm ²	%			kg/cm ²	kg/cm ²			kg/cm ²	cm ² /kg	kg/cm ²		%		%		
1	0.00	DS	-	-	-	-	12	56	32		26	16	10	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-	
2	1.00	SPT	-	-	-	-	8	58	34		29	15	14	-	-	-	SC	-	-	-	-	-	-	-	4	-	-	-	-	
3	2.00	SPT	-	-	-	-	4	19	53	24	40	19	21	-	-	-	CI	-	-	-	-	-	-	-	4	-	-	-	-	
4	2.50	UDS	1.92	1.47	30.24	2.66	10	53	37		33	18	15	-	-	-	SC	0.07	24	-	-	DSU	-	-	-	-	0.80	44.6	-	
5	3.00	SPT	-	-	-	-	4	64	32		29	16	13	-	-	-	SC	-	-	-	-	-	-	-	13	-	-	-	-	
6	3.50	SPT	-	-	-	-	5	62	33		30	15	15	-	-	-	SC	-	-	-	-	-	-	-	15	-	-	-	-	
7	4.00	SPT	-	-	-	-	0	59	41		35	17	18	-	-	-	SC	-	-	-	-	-	-	-	25	-	-	-	-	
8	4.50	UDS	1.99	1.59	25.16	2.65	4	61	35		28	18	10	-	-	-	SC	0.05	26	-	-	DSU	-	-	-	-	0.67	40.0	-	
9	5.00	SPT	-	-	-	-	9	54	37		29	16	13	-	-	-	SC	-	-	-	-	-	-	-	>100	-	-	-	-	
10	5.50	SPT	-	-	-	-	6	63	31		28	17	11	-	-	-	SC	-	-	-	-	-	-	-	>100	-	-	-	-	
11	6.00	SPT	-	-	-	-	10	59	31		30	19	11	-	-	-	SC	-	-	-	-	-	-	-	72	-	-	-	-	
12	6.50	SPT	-	-	-	-	0	71	29		29	20	9	-	-	-	SM-SC	-	-	-	-	-	-	-	>100	-	-	-	-	
13	7.00	SPT	-	-	-	-	0	68	32		30	17	13	-	-	-	SM-SC	-	-	-	-	-	-	-	>100	-	-	-	-	
14	7.50	SPT	-	-	-	-	0	73	27		26	16	10	-	-	-	SM-SC	-	-	-	-	-	-	-	>100	-	-	-	-	
15	8.00	SPT	-	-	-	-	0	74	26		24	15	9	-	-	-	SM-SC	-	-	-	-	-	-	-	>100	-	-	-	-	
16	8.50	SPT	-	-	-	-	3	68	29		28	16	12	-	-	-	SM-SC	-	-	-	-	-	-	-	>100	-	-	-	-	
17	9.00	SPT	-	-	-	-	6	70	24		23	14	9	-	-	-	SM-SC	-	-	-	-	-	-	-	>100	-	-	-	-	
18	9.50	SPT	-	-	-	-	0	69	31		29	18	11	-	-	-	SM-SC	-	-	-	-	-	-	-	>100	-	-	-	-	
19	10.00	SPT	-	-	-	-	5	75	20		22	14	8	-	-	-	SM-SC	-	-	-	-	-	-	-	>100	-	-	-	-	
20	11.00	UDS	2.64	2.55	3.69	2.81	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	361.9	UCS	-	-	-	-	0.10	9.4	-	
21	11.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	>100	-	-	-	-	
22	12.50	UDS	2.28	2.03	12.15	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	84.2	UCS	-	-	-	-	0.33	24.7	-	
23	12.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	>100	-	-	-	-	
24	14.00	UDS	2.31	2.09	10.78	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	90.7	UCS	-	-	-	-	0.29	22.5	-	
25	14.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	>100	-	-	-	-	
26	15.50	UDS	2.26	1.99	13.42	2.72	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	71.8	UCS	-	-	-	-	0.37	26.7	-	
27	15.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	>100	-	-	-	-	
28	17.00	UDS	2.46	2.30	7.00	2.74	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	124.6	-	UCS	-	-	-	-	8.00	0.19	16.1	-
29	18.50	UDS	2.41	2.23	8.31	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	130.7	UCS	-	-	-	-	0.23	18.5	-	
30	20.00	UDS	2.47	2.32	6.48	2.73	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	125.3	-	UCS	-	-	-	-	6.60	0.18	15.0	-
31	21.50	UDS	2.28	2.03	12.15	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	44.2	UCS	-	-	-	-	0.33	24.7	-	
32	23.00	UDS	2.29	2.06	11.28	2.68	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	56.4	-	UCS	-	-	-	-	8.66	0.30	23.2	-
33	25.00	UDS	2.31	2.09	10.78	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	55.9	-	UCS	-	-	-	-	6.00	0.29	22.5	-

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. :- 99

Co-Ordinate :- E 175' , N 30%

Reduced Level :- 206.5 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	65	35		30	16	14	-	-	-	Filled up Soil	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	5	61	34		28	17	11	-	-	-	SC	-	-	-	-	-	-	-	-	13	-	-	-
3	2.00	SPT	-	-	-	-	12	55	33		26	16	10	-	-	-	SC	-	-	-	-	-	-	-	-	16	-	-	-
4	2.50	UDS	1.96	1.54	27.12	2.65	9	56	35		29	17	12	-	-	-	SC	0.07	26	-	-	DSU	-	-	-	-	-	0.72	41.8
5	3.00	SPT	-	-	-	-	0	64	36		30	16	14	-	-	-	SC	-	-	-	-	-	-	-	-	12	-	-	-
6	3.50	UDS	1.96	1.54	27.41	2.66	0	67	33		24	15	9	-	-	-	SC	0.02	25	-	-	DSU	-	-	-	-	-	0.73	42.2
7	4.00	SPT	-	-	-	-	0	65	35		26	14	12	-	-	-	SC	-	-	-	-	-	-	-	-	12	-	-	-
8	4.50	SPT	-	-	-	-	0	60	40		29	15	14	-	-	-	SC	-	-	-	-	-	-	-	-	42	-	-	-
9	5.00	SPT	-	-	-	-	9	74	17		22	16	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
10	5.50	SPT	-	-	-	-	12	68	20		25	19	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
11	6.00	SPT	-	-	-	-	4	71	25		28	21	7	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
12	6.50	SPT	-	-	-	-	6	68	26		27	20	7	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
13	7.00	SPT	-	-	-	-	11	72	17		25	19	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	>100	-	-	-
14	7.50	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
15	9.00	Remoulded	2.32	2.10	10.42	2.69	-	-	-		-	-	-	-	-	-	W.ROCK	0.00	32	-	-	DSU	-	-	-	-	-	0.28	21.9
16	9.00	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
17	10.50	DS	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	-	-	-	-
18	10.50	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
19	12.00	Remoulded	2.35	2.14	9.60	2.70	-	-	-		-	-	-	-	-	-	W.ROCK	0.00	33	-	-	DSU	-	-	-	-	-	0.26	20.6
20	12.00	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
21	13.50	DS	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	-	-	-	-
22	13.50	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
23	15.00	Remoulded	2.25	1.99	13.09	2.69	53	24	23		29	16	13	-	-	-	Bouldorous	0.05	34	-	-	DSU	-	-	-	-	-	0.35	26.0
24	15.00	SPT	-	-	-	-	68	18	14		25	15	10	-	-	-	Bouldorous	-	-	-	-	-	-	-	-	>100	-	-	-
25	16.50	DS	-	-	-	-	61	20	19		28	17	11	-	-	-	Bouldorous	0.02	35	-	-	DSU	-	-	-	-	-	-	-
26	16.50	SPT	-	-	-	-	58	17	25		31	16	15	-	-	-	Bouldorous	-	-	-	-	-	-	-	-	>100	-	-	-
27	18.00	UDS	2.39	2.19	8.96	2.73	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	157.4	UCS	-	-	-	-	-	0.24	19.7
28	18.00	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
29	19.50	UDS	2.42	2.24	8.22	2.74	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	130.6	UCS	-	-	-	-	-	0.23	18.4
30	19.50	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
31	21.00	UDS	2.55	2.43	5.12	2.77	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	350.6	UCS	-	-	-	-	-	0.14	12.4
32	21.00	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
33	22.50	UDS	2.53	2.40	5.45	2.76	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	379.8	-	UCS	-	-	-	-	14.00	0.15	13.1
34	22.50	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
35	24.00	UDS	2.50	2.34	6.71	2.78	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	298.1	-	UCS	-	-	-	-	6.66	0.19	15.7
36	25.50	UDS	2.38	2.19	8.82	2.71	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	136.4	-	UCS	-	-	-	-	18.00	0.24	19.3
37	27.00	UDS	2.39	2.20	8.73	2.72	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	126.6	UCS	-	-	-	-	-	0.24	19.2
38	27.00	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
39	28.50	UDS	2.44	2.29	6.69	2.70	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	119.8	UCS	-	-	-	-	-	0.18	15.3
40	28.50	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
41	30.00	UDS	2.46	2.31	6.55	2.72	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	172.1	UCS	-	-	-	-	-	0.18	15.1

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. :- 132

Co-Ordinate :- E -18, * , N - 284\$

Reduced Level :- 202.30m

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	-	-	-	-	2	63	35	34	17	17	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	9	59	32	29	16	13	-	-	-	SC	-	-	-	-	-	-	-	-	39	-	-	-	-
3	2.00	SPT	-	-	-	-	11	52	37	35	19	16	-	-	-	SC	-	-	-	-	-	-	-	-	19	-	-	-	-
4	2.50	UDS	1.99	1.59	25.44	2.66	8	69	23	26	16	10	-	-	-	SC	0.07	30	-	-	DSU	-	-	-	-	-	0.68	40.4	-
5	3.00	SPT	-	-	-	-	10	71	19	24	15	9	-	-	-	SC	-	-	-	-	-	-	-	-	21	-	-	-	-
6	3.50	SPT	-	-	-	-	19	60	21	28	16	12	-	-	-	SC	-	-	-	-	-	-	-	-	30	-	-	-	-
7	4.00	SPT	-	-	-	-	20	67	13	24	14	10	-	-	-	SC	-	-	-	-	-	-	-	-	79	-	-	-	-
8	4.50	SPT	-	-	-	-	8	76	16	26	15	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
9	5.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
10	5.50	SPT	-	-	-	-	0	84	16	25	16	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
11	6.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
12	6.50	SPT	-	-	-	-	0	81	19	28	15	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
13	7.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
14	7.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
15	8.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
16	8.50	SPT	-	-	-	-	0	83	17	27	16	11	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
17	9.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
18	9.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
19	10.00	SPT	-	-	-	-	0	76	24	32	17	15	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
20	11.00	SPT	-	-	-	-	0	79	21	26	16	10	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
21	11.50	SPT	-	-	-	-	0	81	19	24	15	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
22	12.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
23	13.00	UDS	2.44	2.27	7.60	2.74	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	157.3	UCS	-	-	-	-	-	-	0.21	17.2
24	14.50	UDS	2.32	2.09	11.14	2.72	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	99.5	UCS	-	-	-	-	-	-	0.30	23.3
25	14.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-
26	16.00	UDS	2.40	2.21	8.40	2.72	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	132.1	UCS	-	-	-	-	-	-	0.23	18.6
27	17.50	UDS	2.39	2.19	9.19	2.74	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	116.5	-	UCS	-	-	-	-	6.66	0.25	20.1	-
28	19.00	UDS	2.53	2.39	5.66	2.77	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	364.6	-	UCS	-	-	-	-	24.66	0.16	13.6	-
29	20.50	UDS	2.55	2.43	4.91	2.76	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	386.3	-	UCS	-	-	-	-	14.66	0.14	11.9	-
30	22.00	UDS	2.58	2.48	4.13	2.76	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	316.6	-	UCS	-	-	-	-	8.00	0.11	10.2	-
31	23.50	UDS	2.52	2.38	5.94	2.77	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	370.1	-	UCS	-	-	-	-	17.33	0.16	14.1	-
32	25.00	UDS	2.50	2.35	6.28	2.76	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	334.9	-	UCS	-	-	-	-	6.66	0.17	14.8	-

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. :- 142

Co-Ordinate :- E - 1856, N - 2771

Reduced Level :- 201.38m

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	-	-	-	-	3	61	36	24	16	8	-	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	4	34	35	27	44	21	23	-	-	-	CI	-	-	-	-	-	-	-	-	6	-	-	-	-
3	2.00	SPT	-	-	-	-	4	38	37	21	42	23	19	-	-	-	CI	-	-	-	-	-	-	-	-	9	-	-	-	-
4	2.50	UDS	1.94	1.52	27.91	2.63	7	29	33	31	48	21	27	-	-	-	CI	0.53	6	-	-	TUU	0.14	0.0182	0.43	-	-	0.73	42.3	-
5	3.00	SPT	-	-	-	-	0	27	39	34	49	20	29	-	-	-	CI	-	-	-	-	-	-	-	-	15	-	-	-	-
6	3.50	UDS	1.98	1.58	25.51	2.64	0	34	45	21	41	23	18	-	-	-	CI	0.86	7	-	-	TUU	0.11	0.0103	0.54	-	-	0.67	40.2	-
7	4.00	SPT	-	-	-	-	19	53	28	29	16	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	33	-	-	-	-
8	4.50	UDS	2.05	1.68	22.12	2.67	17	59	24	26	15	11	-	-	-	-	SC	0.08	30	-	-	DSU	-	-	-	-	-	0.59	37.1	-
9	5.00	SPT	-	-	-	-	0	78	22	21	17	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
10	5.50	SPT	-	-	-	-	0	80	20	18	14	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
11	6.00	SPT	-	-	-	-	0	76	24	22	17	5	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
12	6.50	SPT	-	-	-	-	0	82	18	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
13	7.00	SPT	-	-	-	-	0	81	19	16	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
14	7.50	SPT	-	-	-	-	0	80	20	19	15	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	84	-	-	-	-
15	8.00	SPT	-	-	-	-	0	75	25	22	17	5	-	-	-	-	SM	-	-	-	-	-	-	-	-	94	-	-	-	-
16	8.50	SPT	-	-	-	-	0	76	24	21	17	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
17	9.00	SPT	-	-	-	-	0	83	17	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
18	9.50	SPT	-	-	-	-	0	79	21	19	15	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
19	10.00	SPT	-	-	-	-	0	76	24	23	19	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
20	11.00	UDS	2.25	1.99	13.09	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	31.6	UCS	-	-	-	-	-	0.35	26.0	-
21	12.50	UDS	2.29	2.06	11.28	2.68	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	50.6	-	UCS	-	-	-	-	13.33	0.30	23.2	-
22	12.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-
23	14.00	UDS	2.24	1.97	13.49	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	59.9	UCS	-	-	-	-	-	0.36	26.6	-
24	14.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-
25	15.50	UDS	2.30	2.06	11.40	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	78.4	-	UCS	-	-	-	-	6.66	0.31	23.5	-
26	17.00	UDS	2.63	2.54	3.52	2.79	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	313.4	UCS	-	-	-	-	-	0.10	8.9	-
27	17.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-
28	18.50	UDS	2.14	1.81	17.94	2.69	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	46.2	-	UCS	-	-	-	-	9.33	0.48	32.5	-
29	20.00	UDS	2.10	1.75	20.20	2.70	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	66.7	-	UCS	-	-	-	-	12.66	0.55	35.3	-

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. :- 150

Co-Ordinate :- E - 771, N - 2671

Reduced Level :- 197.47m

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	23	51	21	39	20	19	-	-	-	CI	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	14	52	34	56	27	29	-	-	-	CH	-	-	-	-	-	-	-	-	4	-	-	-
3	2.00	SPT	-	-	-	-	0	16	55	29	54	28	26	-	-	-	CH	-	-	-	-	-	-	-	-	4	-	-	-
4	2.50	UDS	1.91	1.47	30.08	2.63	0	21	46	33	53	23	30	-	-	-	CH	0.31	4	-	-	TUU	0.16	0.0340	0.41	-	-	0.79	44.2
5	3.00	SPT	-	-	-	-	0	13	49	38	57	22	35	-	-	-	CH	-	-	-	-	-	-	-	-	7	-	-	-
6	3.50	UDS	1.93	1.50	28.32	2.62	0	20	47	33	54	26	28	-	-	-	CH	0.42	5	-	-	TUU	0.15	0.0250	0.51	-	-	0.74	42.6
7	4.00	SPT	-	-	-	-	0	18	50	32	56	27	29	-	-	-	CH	-	-	-	-	-	-	-	-	10	-	-	-
8	4.50	UDS	1.94	1.52	27.31	2.61	0	16	45	39	57	24	33	-	-	-	CH	0.68	4	-	-	TUU	0.13	0.0157	1.58	-	-	0.71	41.6
9	5.00	SPT	-	-	-	-	12	22	40	26	41	19	22	-	-	-	CI	-	-	-	-	-	-	-	-	18	-	-	-
10	5.50	UDS	1.98	1.58	25.22	2.63	8	21	43	28	43	18	25	-	-	-	CI	0.79	5	-	-	TUU	0.12	0.0133	1.77	-	-	0.66	39.9
11	6.00	SPT	-	-	-	-	6	63	31		28	16	12	-	-	-	SC	-	-	-	-	-	-	-	-	13	-	-	-
12	6.50	UDS	1.99	1.59	25.16	2.65	10	52	38		30	17	13	-	-	-	SC	0.06	25	-	-	DSU	-	-	-	-	-	0.67	40.0
13	7.00	SPT	-	-	-	-	0	67	33		29	19	10	-	-	-	SC	-	-	-	-	-	-	-	-	13	-	-	-
14	7.50	UDS	1.97	1.56	26.45	2.65	9	59	32		27	18	9	-	-	-	SC	0.05	24	-	-	DSU	-	-	-	-	-	0.70	41.2
15	8.00	SPT	-	-	-	-	12	53	35		29	16	13	-	-	-	SC	-	-	-	-	-	-	-	-	11	-	-	-
16	8.50	UDS	1.98	1.57	26.09	2.66	5	67	28		26	15	11	-	-	-	SC	0.04	25	-	-	DSU	-	-	-	-	-	0.69	41.0
17	9.00	SPT	-	-	-	-	11	32	35	22	41	21	20	-	-	-	CI	-	-	-	-	-	-	-	-	13	-	-	-
18	9.50	UDS	2.00	1.60	24.81	2.66	9	73	18		NP	NP	NP	-	-	-	SM	0.00	30	-	-	DSU	-	-	-	-	-	0.66	39.8
19	10.00	SPT	-	-	-	-	17	62	21		20	16	4	-	-	-	SM	-	-	-	-	-	-	-	-	22	-	-	-
20	11.00	SPT	-	-	-	-	11	73	16		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	27	-	-	-
21	11.50	SPT	-	-	-	-	0	79	21		19	15	4	-	-	-	SM	-	-	-	-	-	-	-	-	37	-	-	-
22	12.50	SPT	-	-	-	-	0	84	16		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	27	-	-	-
23	13.00	SPT	-	-	-	-	9	72	19		18	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
24	14.00	SPT	-	-	-	-	16	64	20		20	16	4	-	-	-	SM	-	-	-	-	-	-	-	-	26	-	-	-
25	14.50	SPT	-	-	-	-	11	65	24		21	17	4	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
26	15.50	SPT	-	-	-	-	3	78	19		NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
27	16.50	SPT	-	-	-	-	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-
28	17.50	UDS	2.25	1.99	13.09	2.69	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	42.6	-	UCS	-	-	-	-	26.00	0.35	26.0
29	19.00	UDS	2.28	2.03	12.15	2.70	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	48.1	-	UCS	-	-	-	-	16.00	0.33	24.7
30	20.00	UDS	2.29	2.04	12.01	2.71	-	-	-		-	-	-	-	-	-	W.ROCK	-	-	63.5	-	UCS	-	-	-	-	33.00	0.33	24.6

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. :- 158

Co-Ordinate :- E - % - 4, N - 24(4

Reduced Level :- 202.96 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	78	18	19	15	4	-	-	-	SM	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	4	53	43	39	18	21	-	-	-	SC	-	-	-	-	-	-	-	-	23	-	-	-	-
3	2.00	SPT	-	-	-	-	35	43	22	28	19	9	-	-	-	SC	-	-	-	-	-	-	-	-	43	-	-	-	-
4	2.50	UDS	1.85	1.71	8.38	2.68	31	51	18	27	17	10	-	-	-	SC	0.04	30	-	-	DSU	-	-	-	-	-	0.57	36.3	-
5	3.00	SPT	-	-	-	-	25	50	25	42	19	23	-	-	-	SC	-	-	-	-	-	-	-	-	24	-	-	-	-
6	3.50	UDS	1.88	1.66	13.59	2.66	15	52	33	48	21	27	-	-	-	SC	0.09	28	-	-	DSU	-	-	-	-	-	0.61	37.8	-
7	4.00	SPT	-	-	-	-	2	84	14	23	17	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	37	-	-	-	-
8	4.50	UDS	1.94	1.75	11.14	2.68	28	51	21	36	18	18	-	-	-	SC	0.07	30	-	-	DSU	-	-	-	-	-	0.54	34.9	-
9	5.00	SPT	-	-	-	-	23	59	18	33	16	17	-	-	-	SC	-	-	-	-	-	-	-	-	75	-	-	-	-
10	5.50	SPT	-	-	-	-	1	71	28	39	19	20	-	-	-	SC	-	-	-	-	-	-	-	-	38	-	-	-	-
11	6.00	SPT	-	-	-	-	0	68	32	28	16	12	-	-	-	Cemented SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
12	6.50	SPT	-	-	-	-	2	63	35	29	15	14	-	-	-		-	-	-	-	-	-	-	-	>100	-	-	-	-
13	7.00	SPT	-	-	-	-	0	80	20	26	16	10	-	-	-		-	-	-	-	-	-	-	-	>100	-	-	-	-
14	7.50	SPT	-	-	-	-	7	72	21	28	15	13	-	-	-		-	-	-	-	-	-	-	-	>100	-	-	-	-
15	8.00	SPT	-	-	-	-	0	52	48	42	24	18	-	-	-		-	-	-	-	-	-	-	-	>100	-	-	-	-
16	8.50	SPT	-	-	-	-	3	54	43	40	23	17	-	-	-		-	-	-	-	-	-	-	-	>100	-	-	-	-
17	9.00	SPT	-	-	-	-	0	84	16	NP	NP	NP	-	-	-	Cemented SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
18	9.50	SPT	-	-	-	-	5	73	22	NP	NP	NP	-	-	-		-	-	-	-	-	-	-	-	>100	-	-	-	-
19	10.00	SPT	-	-	-	-	5	74	21	NP	NP	NP	-	-	-		-	-	-	-	-	-	-	-	>100	-	-	-	-
20	11.00	SPT	-	-	-	-	16	66	18	NP	NP	NP	-	-	-		-	-	-	-	-	-	-	-	>100	-	-	-	-
21	11.50	SPT	-	-	-	-	18	62	20	NP	NP	NP	-	-	-		-	-	-	-	-	-	-	-	>100	-	-	-	-
22	12.50	SPT	-	-	-	-	16	56	28	23	19	4	-	-	-		-	-	-	-	-	-	-	-	>100	-	-	-	-
23	13.00	SPT	-	-	-	-	7	60	33	25	20	5	-	-	-	Cemented SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
24	14.00	SPT	-	-	-	-	4	65	31	26	21	5	-	-	-		-	-	-	-	-	-	-	-	>100	-	-	-	-
25	14.50	SPT	-	-	-	-	2	72	26	24	16	8	-	-	-		-	-	-	-	-	-	-	-	>100	-	-	-	-
26	15.50	SPT	-	-	-	-	5	69	26	26	15	11	-	-	-		-	-	-	-	-	-	-	-	>100	-	-	-	-
27	16.00	SPT	-	-	-	-	6	72	22	23	13	10	-	-	-		-	-	-	-	-	-	-	-	>100	-	-	-	-
28	17.00	SPT	-	-	-	-	4	68	28	28	15	13	-	-	-		-	-	-	-	-	-	-	-	>100	-	-	-	-
29	17.50	SPT	-	-	-	-	21	60	19	26	16	10	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-
30	18.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	>100	-	-	-	-
31	20.00	UDS	2.39	2.21	8.02	2.69	-	-	-	-	-	-	-	-	-		-	-	-	98.4	UCS	-	-	-	-	-	-	0.22	17.8
32	20.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	>100	-	-	-	-
33	21.50	UDS	2.51	2.39	5.11	2.72	-	-	-	-	-	-	-	-	-		-	-	-	134.5	-	UCS	-	-	-	-	8.00	0.14	12.2
34	23.00	UDS	2.56	2.46	4.21	2.74	-	-	-	-	-	-	-	-	-		-	-	-	163.7	-	UCS	-	-	-	-	10.00	0.12	10.3
35	25.00	UDS	2.58	2.51	2.81	2.70	-	-	-	-	-	-	-	-	-		-	-	-	128.7	-	UCS	-	-	-	-	5.00	0.08	7.1

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. :- 166

Co-Ordinate :- E - 1541, N - 2204

Reduced Level :- 202.73m

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	-	-	-	-	4	58	38	30	16	14	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	5	64	31	26	15	11	-	-	-	SC	-	-	-	-	-	-	-	-	9	-	-	-	-
3	2.00	SPT	-	-	-	-	11	53	36	29	17	12	-	-	-	SC	-	-	-	-	-	-	-	-	21	-	-	-	-
4	2.50	UDS	1.97	1.55	27.03	2.67	12	62	26	25	16	9	-	-	-	SC	0.03	27	-	-	DSU	-	-	-	-	-	-	0.72	41.9
5	3.00	SPT	-	-	-	-	9	52	39	30	15	15	-	-	-	SC	-	-	-	-	-	-	-	-	16	-	-	-	-
6	3.50	UDS	1.94	1.51	28.80	2.66	0	70	30	27	17	10	-	-	-	SC	0.05	25	-	-	DSU	-	-	-	-	-	-	0.77	43.4
7	4.00	SPT	-	-	-	-	5	64	31	28	16	12	-	-	-	SC	-	-	-	-	-	-	-	-	7	-	-	-	-
8	4.50	SPT	-	-	-	-	9	57	34	30	15	15	-	-	-	SC	-	-	-	-	-	-	-	-	28	-	-	-	-
9	5.00	SPT	-	-	-	-	0	84	16	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	38	-	-	-	-
10	5.50	SPT	-	-	-	-	0	82	18	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	34	-	-	-	-
11	6.00	SPT	-	-	-	-	0	79	21	22	16	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	35	-	-	-	-
12	6.50	SPT	-	-	-	-	0	81	19	20	14	6	-	-	-	SM-SC	-	-	-	-	-	-	-	-	30	-	-	-	-
13	7.00	SPT	-	-	-	-	11	52	37	32	18	14	-	-	-	SC	-	-	-	-	-	-	-	-	29	-	-	-	-
14	7.50	SPT	-	-	-	-	6	59	35	30	19	11	-	-	-	SC	-	-	-	-	-	-	-	-	35	-	-	-	-
15	8.00	SPT	-	-	-	-	5	78	17	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
16	8.50	SPT	-	-	-	-	12	69	19	20	16	4	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
17	9.00	SPT	-	-	-	-	10	67	23	21	17	4	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
18	9.50	SPT	-	-	-	-	6	57	37	29	15	14	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
19	10.00	SPT	-	-	-	-	9	74	17	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
20	11.00	SPT	-	-	-	-	10	69	21	20	16	4	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
21	11.50	SPT	-	-	-	-	4	76	20	19	15	4	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
22	12.50	SPT	-	-	-	-	14	69	17	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
23	13.00	SPT	-	-	-	-	10	63	27	21	17	4	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
24	14.00	SPT	-	-	-	-	3	74	23	20	16	4	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
25	15.50	UDS	2.21	1.93	14.75	2.69	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	82.9	UCS	-	-	-	-	-	-	0.40	28.4
26	15.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-
27	17.00	UDS	2.20	1.91	15.43	2.70	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	67.4	UCS	-	-	-	-	-	-	0.42	29.4
28	17.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-
29	18.50	UDS	2.31	2.08	11.03	2.70	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	95.3	UCS	-	-	-	-	-	-	0.30	22.9
30	18.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-
31	20.00	UDS	2.18	1.88	16.07	2.69	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	89.3	UCS	-	-	-	-	-	-	0.43	30.2
32	20.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-
33	21.50	UDS	2.39	2.19	8.96	2.73	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	154.7	UCS	-	-	-	-	-	-	0.24	19.7
34	23.00	UDS	2.14	1.81	17.94	2.69	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	38.7	UCS	-	-	-	-	-	-	0.48	32.5
35	23.00	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-
36	25.00	UDS	2.38	2.18	9.06	2.72	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	146.3	UCS	-	-	-	-	-	-	0.25	19.8

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 (NTTTP) at village Hirma, Talabira, Odisha

BH No. :- 167

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	27	53	20	36	19	17	-	-	-	CI	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	16	56	28	53	28	25	14	-	52	CH	-	-	-	-	-	-	-	-	4	-	-	-
3	2.00	SPT	-	-	-	-	0	10	60	30	54	27	27	-	-	-	CH	-	-	-	-	-	-	-	-	7	-	-	-
4	2.50	UDS	1.62	1.48	9.34	2.60	0	4	58	38	56	24	32	11	0.51	59	CH	0.36	2	-	-	TUU	0.16	0.0298	0.40	-	-	0.75	43.0
5	3.00	SPT	-	-	-	-	0	12	48	40	57	23	34	-	-	-	CH	-	-	-	-	-	-	-	-	8	-	-	-
6	3.50	UDS	1.94	1.52	27.91	2.63	0	19	50	31	52	24	28	14	0.17	53	CH	0.40	3	-	-	TUU	0.15	0.0255	0.52	-	-	0.73	42.3
7	4.00	SPT	-	-	-	-	0	14	55	31	53	26	27	-	-	-	CH	-	-	-	-	-	-	-	-	10	-	-	-
8	4.50	UDS	1.93	1.51	27.71	2.60	0	7	57	36	56	23	33	13	0.18	55	CH	0.48	1	-	-	TUU	0.15	0.0217	0.65	-	-	0.72	41.9
9	5.00	SPT	-	-	-	-	0	55	45	40	18	22	-	-	-	-	SC	-	-	-	-	-	-	-	-	13	-	-	-
10	5.50	UDS	1.98	1.57	25.80	2.65	0	63	37	39	19	20	-	-	-	-	SC	0.11	25	-	-	DSU	-	-	-	-	-	0.68	40.6
11	6.00	SPT	-	-	-	-	0	61	39	33	20	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	13	-	-	-
12	6.50	UDS	1.99	1.59	25.16	2.65	0	60	40	34	17	17	-	-	-	-	SC	0.13	25	-	-	DSU	-	-	-	-	-	0.67	40.0
13	7.00	SPT	-	-	-	-	0	39	41	20	37	20	17	-	-	-	CI	-	-	-	-	-	-	-	-	30	-	-	-
14	7.50	UDS	2.01	1.63	23.05	2.62	0	25	48	27	42	18	24	-	-	-	CI	1.31	5	-	-	TUU	0.10	0.0067	1.19	-	-	0.60	37.7
15	8.00	SPT	-	-	-	-	0	20	53	27	44	19	25	-	-	-	CI	-	-	-	-	-	-	-	-	20	-	-	-
16	8.50	UDS	2.00	1.62	23.37	2.61	0	24	55	21	40	21	19	-	-	-	CI	0.89	4	-	-	TUU	0.10	0.0091	1.22	-	-	0.61	37.9
17	9.00	SPT	-	-	-	-	0	56	44	34	16	18	-	-	-	-	SC	-	-	-	-	-	-	-	-	31	-	-	-
18	9.50	UDS	2.06	1.70	21.00	2.65	0	65	35	29	18	11	-	-	-	-	SC	0.13	28	-	-	DSU	-	-	-	-	-	0.56	35.8
19	10.00	SPT	-	-	-	-	0	54	46	32	16	16	-	-	-	-	SC	-	-	-	-	-	-	-	-	37	-	-	-
20	11.00	UDS	2.10	1.76	19.14	2.66	0	70	30	26	17	9	-	-	-	-	SC	0.11	30	-	-	DSU	-	-	-	-	-	0.51	33.7
21	11.50	SPT	-	-	-	-	20	66	14	22	18	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	59	-	-	-
22	12.50	SPT	-	-	-	-	1	61	38	31	19	12	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
23	13.00	SPT	-	-	-	-	3	59	38	30	20	10	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
24	14.00	DS	-	-	-	-	1	64	35	33	17	16	-	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
25	14.50	SPT	-	-	-	-	0	52	48	39	20	19	-	-	-	-	SC	-	-	-	-	-	-	-	-	86	-	-	-
26	15.50	SPT	-	-	-	-	0	70	30	28	16	12	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
27	17.00	SPT	-	-	-	-	0	79	21	25	15	10	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
28	17.50	SPT	-	-	-	-	2	64	34	32	18	14	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
29	18.50	SPT	-	-	-	-	0	63	37	34	19	15	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
30	19.00	SPT	-	-	-	-	0	72	28	30	16	14	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
31	20.00	SPT	-	-	-	-	3	77	20	28	17	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	>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. :- 169

Co-Ordinate :- E 1188, N 1944

Reduced Level :- 199.132 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	71	29	27	16	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	63	37	29	15	14	-	-	-	-	SC	-	-	-	-	-	-	-	-	2	-	-	-
3	2.00	SPT	-	-	-	-	0	26	51	23	41	21	20	-	-	-	CI	-	-	-	-	-	-	-	-	9	-	-	-
4	2.50	UDS	1.66	1.52	9.34	2.62	0	22	51	27	46	22	24	-	-	-	CI	0.68	2	-	-	TUU	0.15	0.0151	0.43	-	-	0.73	42.1
5	3.00	SPT	-	-	-	-	0	30	51	19	40	23	17	-	-	-	CI	-	-	-	-	-	-	-	-	20	-	-	-
6	3.50	UDS	1.73	1.56	11.14	2.64	0	28	45	27	44	19	25	-	-	-	CI	0.84	4	-	-	TUU	0.13	0.0125	0.55	-	-	0.70	41.0
7	4.00	SPT	-	-	-	-	0	70	30	28	16	12	-	-	-	-	SC	-	-	-	-	-	-	-	-	15	-	-	-
8	4.50	UDS	1.74	1.57	10.58	2.66	0	61	39	33	17	16	-	-	-	-	SC	0.08	26	-	-	DSU	-	-	-	-	-	0.69	40.8
9	5.00	SPT	-	-	-	-	0	66	34	29	19	10	-	-	-	-	SC	-	-	-	-	-	-	-	-	20	-	-	-
10	5.50	UDS	1.99	1.59	25.16	2.65	0	64	36	30	16	14	-	-	-	-	SC	0.07	25	-	-	DSU	-	-	-	-	-	0.67	40.0
11	6.00	SPT	-	-	-	-	0	72	28	26	15	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	19	-	-	-
12	6.50	UDS	2.00	1.60	24.81	2.66	0	69	31	30	18	12	-	-	-	-	SC	0.05	26	-	-	DSU	-	-	-	-	-	0.66	39.8
13	7.00	SPT	-	-	-	-	0	71	29	27	16	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	20	-	-	-
14	7.50	DS	-	-	-	-	0	75	25	23	14	9	-	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
15	8.00	SPT	-	-	-	-	0	68	32	28	15	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	13	-	-	-
16	8.50	UDS	1.98	1.58	25.51	2.64	0	58	42	30	16	14	-	-	-	-	SC	0.07	25	-	-	DSU	-	-	-	-	-	0.67	40.2
17	9.00	SPT	-	-	-	-	0	56	44	31	15	16	-	-	-	-	SC	-	-	-	-	-	-	-	-	19	-	-	-
18	9.50	DS	-	-	-	-	0	63	37	27	16	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
19	10.00	SPT	-	-	-	-	0	67	33	26	18	8	-	-	-	-	SC	-	-	-	-	-	-	-	-	16	-	-	-
20	11.00	UDS	1.98	1.57	25.80	2.65	0	59	41	32	16	16	-	-	-	-	SC	0.06	26	-	-	DSU	-	-	-	-	-	0.68	40.6
21	11.50	SPT	-	-	-	-	0	62	38	29	15	14	-	-	-	-	SC	-	-	-	-	-	-	-	-	17	-	-	-
22	12.50	DS	-	-	-	-	0	70	30	27	14	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
23	13.00	SPT	-	-	-	-	0	73	27	25	16	9	-	-	-	-	SC	-	-	-	-	-	-	-	-	23	-	-	-
24	14.00	DS	-	-	-	-	3	89	8	NP	NP	NP	-	-	-	-	SP-SM	-	-	-	-	-	-	-	-	-	-	-	-
25	14.50	SPT	-	-	-	-	6	85	9	NP	NP	NP	-	-	-	-	SP-SM	-	-	-	-	-	-	-	-	30	-	-	-
26	15.50	DS	-	-	-	-	3	89	8	NP	NP	NP	-	-	-	-	SP-SM	-	-	-	-	-	-	-	-	-	-	-	-
27	16.00	SPT	-	-	-	-	0	94	6	NP	NP	NP	-	-	-	-	SP-SM	-	-	-	-	-	-	-	-	36	-	-	-
28	17.00	DS	-	-	-	-	5	86	9	NP	NP	NP	-	-	-	-	SP-SM	-	-	-	-	-	-	-	-	-	-	-	-
29	17.50	SPT	-	-	-	-	8	82	10	NP	NP	NP	-	-	-	-	SP-SM	-	-	-	-	-	-	-	-	39	-	-	-
30	18.50	DS	-	-	-	-	4	89	7	NP	NP	NP	-	-	-	-	SP-SM	-	-	-	-	-	-	-	-	-	-	-	-
31	19.00	SPT	-	-	-	-	0	72	28	29	16	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-
32	20.00	SPT	-	-	-	-	0	79	21	26	15	11	-	-	-	-	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. :- 170

Co-Ordinate :- E - 1393, N - 1938

Reduced Level :- 200.56m

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	-	-	-	-	6	61	33	29	16	13	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	29	44	27	42	18	24	-	-	-	CI	-	-	-	-	-	-	-	7	-	-	-	-
3	2.00	SPT	-	-	-	-	4	38	37	21	39	20	19	-	-	-	CI	-	-	-	-	-	-	-	9	-	-	-	-
4	2.50	UDS	1.96	1.55	26.83	2.64	10	30	36	24	41	19	22	-	-	-	CI	0.56	8	-	-	TUU	0.13	0.0172	0.43	-	-	0.71	41.5
5	3.00	SPT	-	-	-	-	4	37	27	32	46	18	28	-	-	-	CI	-	-	-	-	-	-	-	15	-	-	-	-
6	3.50	UDS	2.00	1.61	24.53	2.65	9	39	26	26	45	22	23	-	-	-	CI	0.91	7	-	-	TUU	0.11	0.0115	0.53	-	-	0.65	39.4
7	4.00	SPT	-	-	-	-	6	59	35	30	20	10	-	-	-	SC	-	-	-	-	-	-	-	-	16	-	-	-	-
8	4.50	UDS	2.01	1.62	24.19	2.66	10	60	30	28	19	9	-	-	-	SC	0.07	27	-	-	DSU	-	-	-	-	-	0.64	39.2	
9	5.00	SPT	-	-	-	-	0	68	32	29	16	13	-	-	-	SC	-	-	-	-	-	-	-	-	15	-	-	-	-
10	5.50	UDS	2.03	1.65	22.99	2.66	12	59	29	26	17	9	-	-	-	SC	0.05	29	-	-	DSU	-	-	-	-	-	0.61	38.0	
11	6.00	SPT	-	-	-	-	19	49	32	28	16	12	-	-	-	SC	-	-	-	-	-	-	-	-	17	-	-	-	-
12	6.50	UDS	2.00	1.60	24.81	2.66	8	62	30	27	18	9	-	-	-	SC	0.07	27	-	-	DSU	-	-	-	-	-	0.66	39.8	
13	7.00	SPT	-	-	-	-	9	67	24	25	17	8	-	-	-	SC	-	-	-	-	-	-	-	-	13	-	-	-	-
14	7.50	SPT	-	-	-	-	4	59	37	29	15	14	-	-	-	SC	-	-	-	-	-	-	-	-	95	-	-	-	-
15	8.00	SPT	-	-	-	-	0	68	32	28	16	12	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
16	8.50	SPT	-	-	-	-	6	62	32	26	17	9	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
17	9.00	SPT	-	-	-	-	5	61	34	29	16	13	-	-	-	SC	-	-	-	-	-	-	-	-	>100	-	-	-	-
18	9.50	SPT	-	-	-	-	4	78	18	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
19	10.00	SPT	-	-	-	-	10	72	18	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
20	11.00	SPT	-	-	-	-	5	73	22	20	16	4	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
21	12.50	SPT	-	-	-	-	12	71	17	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
22	12.50	SPT	-	-	-	-	8	70	22	21	17	4	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
23	14.00	SPT	-	-	-	-	0	82	18	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
24	14.00	SPT	-	-	-	-	4	79	17	NP	NP	NP	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-	-
25	15.50	UDS	2.19	1.90	15.36	2.68	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	36.2	UCS	-	-	-	-	-	-	0.41	29.2
26	15.50	SPT	-	-	-	-	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	-	-	-	-	-	>100	-	-	-	-
27	17.00	UDS	2.30	2.06	11.40	2.70	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	55.6	-	UCS	-	-	-	-	56.66	0.31	23.5	
28	18.50	UDS	2.31	2.07	11.51	2.72	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	62.9	-	UCS	-	-	-	-	64.00	0.31	23.8	
29	20.00	UDS	2.28	2.03	12.40	2.71	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	83.9	UCS	-	-	-	-	-	0.34	25.1	
30	21.50	UDS	2.26	2.00	12.93	2.70	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	-	105.5	UCS	-	-	-	-	-	0.35	25.9	
31	22.00	UDS	2.30	2.06	11.88	2.72	-	-	-	-	-	-	-	-	-	W.ROCK	-	-	109.4	-	UCS	-	-	-	-	53.50	0.32	24.4	

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. :- 171

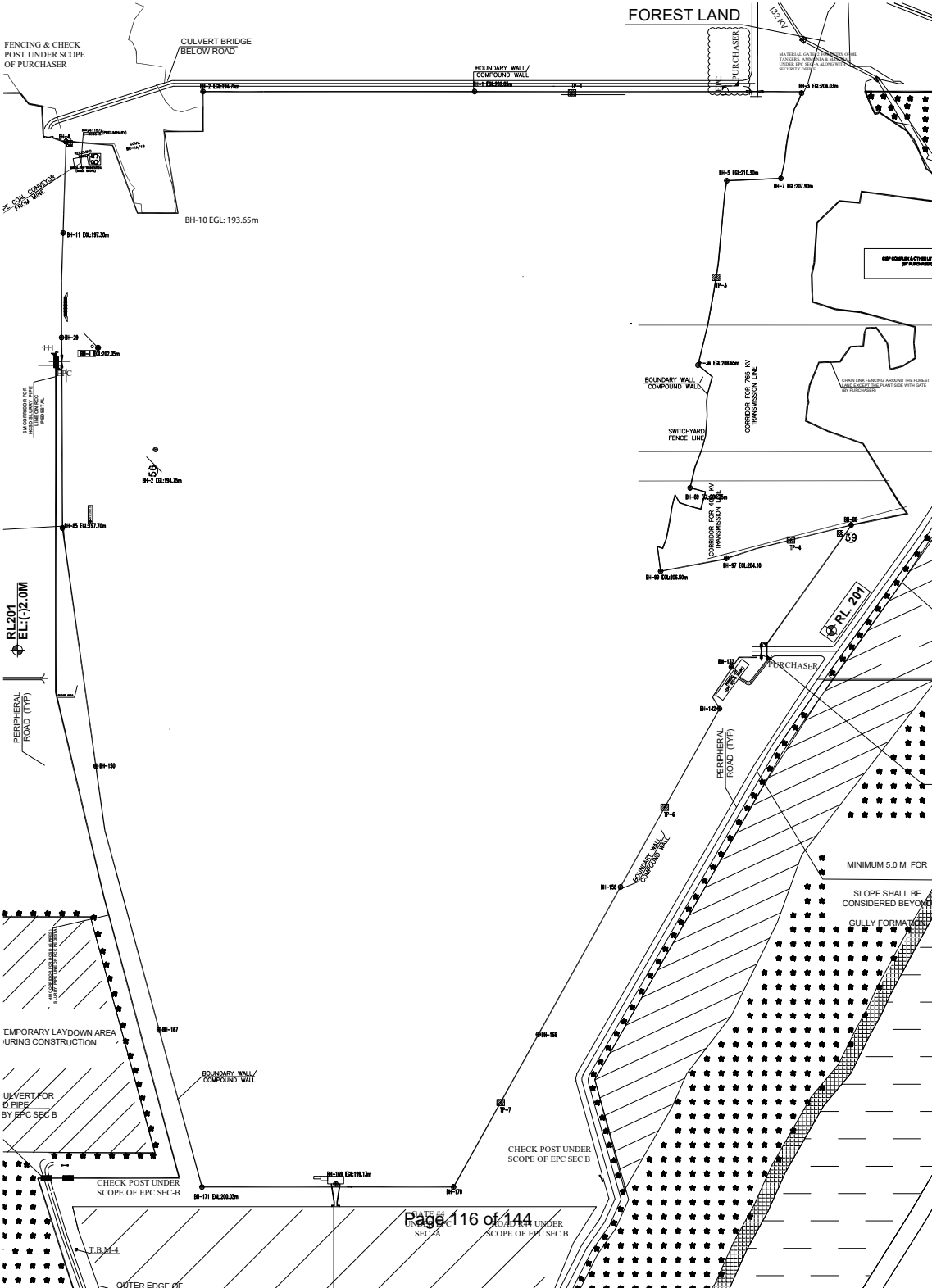
Co-Ordinate :- E 955, N 1938

Reduced Level :- 200.03 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	67	33	27	16	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	SPT	-	-	-	-	0	29	55	16	32	18	14	-	-	-	CL	-	-	-	-	-	-	-	-	15	-	-	-
3	2.00	SPT	-	-	-	-	0	32	54	14	28	16	12	-	-	-	CL	-	-	-	-	-	-	-	-	25	-	-	-
4	2.50	UDS	1.78	1.60	11.34	2.64	0	28	56	16	33	19	14	-	-	-	CL	1.31	5	-	-	TUU	0.11	0.0057	0.44	-	-	0.65	39.4
5	3.00	SPT	-	-	-	-	0	30	56	14	29	17	12	-	-	-	CL	-	-	-	-	-	-	-	-	56	-	-	-
6	3.50	DS	-	-	-	-	0	29	57	14	31	18	13	-	-	-	CL	-	-	-	-	-	-	-	-	-	-	-	-
7	4.00	SPT	-	-	-	-	0	34	57	9	27	19	8	-	-	-	CL	-	-	-	-	-	-	-	-	31	-	-	-
8	4.50	UDS	1.79	1.63	9.85	2.65	6	61	33	32	17	15	-	-	-	-	SC	0.06	28	-	-	DSU	-	-	-	-	-	0.63	38.5
9	5.00	SPT	-	-	-	-	3	65	32	30	19	11	-	-	-	-	SC	-	-	-	-	-	-	-	-	34	-	-	-
10	5.50	UDS	2.02	1.64	23.31	2.65	4	55	41	36	20	16	-	-	-	-	SC	0.08	27	-	-	DSU	-	-	-	-	-	0.62	38.2
11	6.00	SPT	-	-	-	-	5	62	33	31	19	12	-	-	-	-	SC	-	-	-	-	-	-	-	-	38	-	-	-
12	6.50	UDS	2.00	1.60	24.81	2.66	0	67	33	29	18	11	-	-	-	-	SC	0.05	27	-	-	DSU	-	-	-	-	-	0.66	39.8
13	7.00	SPT	-	-	-	-	0	73	27	26	16	10	-	-	-	-	SC	-	-	-	-	-	-	-	-	13	-	-	-
14	7.50	DS	-	-	-	-	5	59	36	30	17	13	-	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
15	8.00	SPT	-	-	-	-	2	57	41	32	18	14	-	-	-	-	SC	-	-	-	-	-	-	-	-	34	-	-	-
16	8.50	DS	-	-	-	-	0	68	32	26	16	10	-	-	-	-	SC	-	-	-	-	-	-	-	-	-	-	-	-
17	9.00	SPT	-	-	-	-	0	63	37	27	15	12	-	-	-	-	SC	-	-	-	-	-	-	-	-	15	-	-	-
18	9.50	UDS	1.97	1.56	26.45	2.65	0	57	43	31	17	14	-	-	-	-	SC	0.09	25	-	-	DSU	-	-	-	-	-	0.70	41.2
19	10.00	SPT	-	-	-	-	0	79	21	20	16	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	23	-	-	-
20	11.00	DS	-	-	-	-	0	86	14	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	-	-	-	-
21	11.50	SPT	-	-	-	-	19	59	22	22	17	5	-	-	-	-	SM	-	-	-	-	-	-	-	-	20	-	-	-
22	12.50	SPT	-	-	-	-	11	73	16	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	27	-	-	-
23	13.00	SPT	-	-	-	-	0	85	15	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	85	-	-	-
24	14.00	DS	-	-	-	-	0	81	19	20	16	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	-	-	-	-
25	14.50	SPT	-	-	-	-	15	63	22	24	20	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	90	-	-	-
26	15.50	SPT	-	-	-	-	6	79	15	NP	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
27	16.00	SPT	-	-	-	-	19	61	20	18	14	4	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
28	17.00	SPT	-	-	-	-	0	81	19	17	NP	NP	-	-	-	-	SM	-	-	-	-	-	-	-	-	>100	-	-	-
29	17.50	SPT	-	-	-	-	16	80	4	NP	NP	NP	-	-	-	-	SP	-	-	-	-	-	-	-	-	>100	-	-	-
30	18.50	SPT	-	-	-	-	18	79	3	NP	NP	NP	-	-	-	-	SP	-	-	-	-	-	-	-	-	>100	-	-	-
31	19.00	SPT	-	-	-	-	20	77	3	NP	NP	NP	-	-	-	-	SP	-	-	-	-	-	-	-	-	>100	-	-	-
32	20.00	SPT	-	-	-	-	4	86	10	NP	NP	NP	-	-	-	-	SP-SM	-	-	-	-	-	-	-	-	>100	-	-	-
33	20.50	SPT	-	-	-	-	0	92	8	NP	NP	NP	-	-	-	-	SP-SM	-	-	-	-	-	-	-	-	>100	-	-	-
34	21.50	SPT	-	-	-	-	15	79	6	NP	NP	NP	-	-	-	-	SP-SM	-	-	-	-	-	-	-	-	>100	-	-	-
35	22.00	SPT	-	-	-	-	17	80	3	NP	NP	NP	-	-	-	-	SP	-	-	-	-	-	-	-	-	>100	-	-	-
36	23.00	SPT	-	-	-	-	3	93	4	NP	NP	NP	-	-	-	-	SP	-	-	-	-	-	-	-	-	62	-	-	-
37	23.50	SPT	-	-	-	-	8	90	2	NP	NP	NP	-	-	-	-	SP	-	-	-	-	-	-	-	-	70	-	-	-
38	24.50	SPT	-	-	-	-	3	92	5	NP	NP	NP	-	-	-	-	SP	-	-	-	-	-	-	-	-	>100	-	-	-
39	25.00	SPT	-	-	-	-	15	83	2	NP	NP	NP	-	-	-	-	SP	-	-	-	-	-	-	-	-	>100	-	-	-

Boundary wall layout along with Boreholes

ST/25/02/19560



Project : BHEL

Bore Hole No. : BH 1

Location : Hirma, Talabira

Depth of Termination : 20.0 m

Co-ordinates : E 1430, N 3845

Depth of Water Table : Encountered at 1.80 m depth during investigation

Date of Start: 10-07-2024

Date of Completion: 11-08-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced level: 202.05 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 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, clayey sand with much gravels (SC) 0.00 to 0.50m	0.00	0.00	1.50	DS	-	-	-	-	-	-	
	0.50														
	1.00		Yellowish brown, fine to medium grained, silty clayey sand (SM-SC) 0.50 to 2.30m	1.00	1.00	2.00	SPT	5	7	9	16	-	-		
	1.50														
	2.00														
	2.50		Yellowish brown, fine to medium grained, clayey sand (SC) 2.30 to 3.40m	2.00	2.00	2.50	SPT	5	9	9	18				
	2.50														
	3.00														
	3.50		Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL) 3.40 to 4.30m	3.00	3.00	3.40	SPT	4	7	9	16	-	-		
	3.50														
	4.00														
	4.50		Yellowish brown, fine to medium grained, clayey sand (SC) 4.30 to 8.60m	4.00	4.00	4.50	SPT	7	7	10	17				
	4.50														
	5.00														
	5.50														
	6.00														
	6.50														
	7.00														
	7.50														
	8.00														
	8.50		Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL) 8.60 to 9.40m	8.00	8.00	8.50	SPT	13	18	22	40				
	8.50														
	9.00														
	9.50														
	10.00		Light yellowish brown, fine to medium grained, clayey sand (SC) 9.40 to 12.00m	9.50	9.50	10.00	SPT	35	50/8 cm	-	>100	-	-		
	10.50														
	11.00														
	11.50														
	12.00														
	12.50		Highly weathered, moderately strong, dark brownish, fine to coarse grained, rock												
	13.00														
	13.50														
	14.00														
	14.50														
	15.00		Not used												
	15.50			Highly weathered, weak, dark brownish and yellowish brown, fine to coarse grained, fractured rock	15.00	13.50	15.00	Core					15.33	10.66	
16.00															
16.50															
17.00															
17.50	Moderately weathered, moderately strong, brownish yellow, fine to coarse grained, rock with moderately wide spacing of discontinuities 18.00 to 19.00m	16.50		15.00	16.50	Core					16.00	-			
18.00															
18.50															
19.00															
19.50	Highly weathered, moderately strong, dark brownish yellow, fine to coarse grained, rock with moderately widely spaced discontinuities														
20.00															
19.00 to 20.00m															

Project : BHEL

Bore Hole No. : 2

Location : Hirma, Talabira

Depth of Termination : 20.0 m

Co-ordinates: E 957 N 3845

Depth of Water Table : Encountered at 1.80 m depth during investigation

Date of Start: 11-07-2024

Date of Completion: 13-07-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced level: 194.75

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		Yellowish brown, fine to medium grained, clayey sand with much gravels (SC) 0.00 to 0.30m	0.00	0.00	1.50	DS	-	-	-	-	-	-		
	0.50															
	1.00			Yellowish brown, fine to medium grained, silty clayey sand with little to occasional gravels (SM-SC) 0.30 to 2.70m	1.00	1.00	2.00	SPT	4	5	6	11	-	-		
	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			Yellowish brown, fine to medium grained, poorly graded sand and silty sand (SP-SM) 7.80 to 8.70m	8.00	8.00	8.50	SPT	60/5 cm	-	-	>100				
	8.50															
	9.00				Yellowish brown, fine to medium grained, clayey sand with occasional gravels (SC) 8.70 to 9.60m	8.50	8.50	9.00	SPT	50/7 cm	-	-	>100			
	9.50															
	10.00															
	10.50															
	11.00				Yellowish brown, fine to medium grained, poorly graded sand and silty sand (SP-SM) 9.60 to 13.40m	11.00	11.00	11.50	SPT	50/4 cm	-	-	>100	-	-	
	11.50															
	12.00															
	12.50															
	13.00															
	13.50	Yellowish brown, fine to medium grained, clayey sand (SC) 13.40 to 14.80m	13.00	13.00	14.00	SPT	50/4 cm	-	-	>100						
	14.00															
	14.50															
	15.00	Not used		Yellowish brown, fine to medium grained, poorly graded sand and silty sand (SP-SM) 14.80 to 16.30m	15.00	15.00	15.03	SPT	50/6 cm	-	-	>100				
	15.50															
	16.00															
16.50																
17.00	Yellowish brown, fine to medium grained, silty sand (SM) 16.30 to 18.60m				16.50	16.50	16.52	SPT	50/5 cm	-	-	>100				
17.50																
18.00																
18.50																
19.00	Highly weathered, moderately weak, dark brownish yellowish, fine to coarse grained, fractured rock				18.50	18.50	18.54	SPT	50/4 cm	-	-	>100				
19.50																
20.00																
					Page 19 of 144	18.34	20.00	Core								
18.60 to 20.00m																

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : 3

Location : Talabira

Depth of Termination : 20.0 m

Co-ordinates: E 2000, N 3843

Depth of Water Table : Encountered at 7.30 m depth during investigation

Date of Start: 19-07-2024

Date of Completion: 21-07-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 206.03 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			Yellowish brown, fine to medium grained, sandy clays of low plasticity (CL) 0.00 to 1.20m	0.00	0.00	1.00	DS	-	-	-	-	-	-	
	0.50														
	1.00				1.00	1.00	2.00	SPT	5	7	7	14	-	-	
	1.50														
	2.00			Yellowish brown, fine to medium grained, clayey sand (SC) 1.20 to 4.70m	2.00	2.00	2.50	SPT	5	8	10	18	-	-	
	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	SPT	15	12	13	25	-	-	
	4.00				4.00	4.00	4.50	SPT	10	12	10	22	-	-	
	4.50														
	5.00			Yellowish brown, fine to medium grained, sandy clays of intermediate plasticity (CI) 4.70 to 5.60m	4.50	4.50	5.00	SPT	7	10	15	25	-	-	
	5.50				5.00	5.00	5.50	SPT	5	9	17	26	-	-	
	6.00				5.50	5.50	6.00	SPT	3	9	14	23	-	-	
	6.50				6.00	6.00	6.50	SPT	7	15	19	34	-	-	
	7.00				6.50	6.50	7.00	SPT	11	25	42	67	-	-	
	7.50				7.00	7.00	7.50	SPT	13	19	23	42	-	-	
	8.00				7.50	7.50	8.00	SPT	14	15	14	29	-	-	
	8.50				8.00	8.00	8.50	SPT	7	8	27	35	-	-	
	9.00			Yellowish brown, fine to medium grained, clayey sand (SC) 5.60 to 12.30m	8.50	8.50	9.00	SPT	9	13	33	46	-	-	
	9.50				9.00	9.00	9.50	SPT	50/14 cm	-	-	>100	-	-	
	10.00				9.50	9.50	10.00	SPT	22	25	31	56	-	-	
	10.50				10.00	10.00	11.00	SPT	27	50/6 cm	-	>100	-	-	
	11.00														
	11.50					11.00	11.00	11.50	SPT	50/14 cm	-	-	>100	-	-
	12.00				11.50	11.50	12.50	SPT	50/9 cm	-	-	>100	-	-	
	12.50														
	13.00			Yellowish brown, fine to medium grained, silty sand with little gravels (SM) 12.30 to 15.00m	12.50	12.50	13.00	SPT	50/8 cm	-	-	>100	-	-	
	13.50				13.00	13.00	14.00	SPT	50/12 cm	-	-	>100	-	-	
	14.00				14.00	14.00	14.50	SPT	50/10 cm	-	-	>100	-	-	
	14.50				14.50	14.50	15.50	SPT	50/11 cm	-	-	>100	-	-	
	15.00														
	15.50			Yellowish brown, fine to medium grained, clayey sand (SC) 15.00 to 19.10m	15.50	15.50	16.00	SPT	50/9 cm	-	-	>100	-	-	
	16.00				16.00	16.00	17.00	SPT	50/12 cm	-	-	>100	-	-	
16.50															
17.00			17.00		17.00	17.50	SPT	50/10 cm	-	-	>100	-	-		
17.50			17.50		17.50	18.50	SPT	50/12 cm	-	-	>100	-	-		
18.00															
18.50				18.50	18.50	19.00	SPT	50/7 cm	-	-	>100	-	-		
19.00				19.00	19.00	20.00	SPT	50/10 cm	-	-	>100	-	-		
19.50			Yellowish brown, fine to medium grained, silty sand (SM)												
20.00				20.00	20.00	20.07	SPT	50/7 cm	-	-	>100	-	-		
19.10 to 20.00m															

Project : BHEL

Bore Hole No. : 4

Location : Hirma, Talabira

Depth of Termination : 18.50 m

Co-ordinates: E 719, N 3759

Depth of Water Table : Encountered at 3.60m depth during investigation

Date of Start: 09-10-2024

Date of Completion: 11-10-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced level: 192.85 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		Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL) 0.00 to 0.90m	0.00	0.00	1.00	DS	-	-	-	-	-	-			
	0.50																
	1.00					1.00	1.00	2.00	SPT	2	4	5	9	-	-		
	1.50																
	2.00					2.00	2.00	2.50	SPT	4	4	6	10	-	-		
	2.50					2.50	2.50	3.00	UDS	-	-	-	-	-	-		
	3.00					3.00	3.00	3.50	SPT	6	7	8	15	-	-		
	3.50				Yellowish brown, fine to medium grained, clayey sand with occasional to little gravels (SC) 0.90 to 6.90m	3.50	3.50	4.00	SPT	7	8	9	17	-	-		
	4.00					4.00	4.00	4.50	SPT	6	6	8	14	-	-		
	4.50					4.50	4.50	5.00	SPT	7	8	10	18	-	-		
	5.00					5.00	5.00	5.50	SPT	7	9	10	19	-	-		
	5.50					5.50	5.50	6.00	SPT	7	8	8	16	-	-		
	6.00					6.00	6.00	6.50	SPT	8	9	9	18	-	-		
	6.50					6.50	6.50	7.00	SPT	7	9	10	19	-	-		
	7.00				Yellowish brown, very fine grained, clays of intermediate plasticity with little to occasional gravels (CI) 6.90 to 7.80m	7.00	7.00	7.50	SPT	8	10	15	25	-	-		
	7.50					7.50	7.50	8.00	SPT	12	17	21	38	-	-		
	8.00				Dark brownish grey, fine to medium grained, clays of intermediate plasticity with much gravels and pebble size fragments of fractured rock 7.80 to 8.30m	8.00	8.00	8.30	SPT	30	47	69/10 cm	>100	-	-		
	8.50				Mixture of highly weathered, completely fractured and disintegrated, brownish grey, fine to very fine grained, gravel, pebble size fractured rock fragments with dark brownish, fine to very fine grained, sandy clays of intermediate plasticity 8.30 to 9.10m	8.50	8.30	9.10	DS	-	-	-	-	-	-		
	9.00			Not USED													
	9.50						9.50	8.30	9.50	Core	-	-	-	-	5	-	
	10.00						9.50	9.50	9.60	SPT	50/10 cm	-	-	>101	-	-	
	10.50																
	11.00					Highly weathered, weak, dark grey, fine to very fine grained, fractured rock 9.10 to 14.00m	11.00	9.60	11.00	Core	-	-	-	-	14.00	-	
	11.50						11.00	11.00	11.10	SPT	50/10 cm	-	-	>100	-	-	
	12.00																
	12.50						12.50	11.10	12.50	Core	-	-	-	-	50.00	9.00	
	13.00																
	13.50																
	14.00						14.00	14.00	14.50	Core	-	-	-	-	54.00	26.00	
	14.50																
15.00			Highly weathered, weak, greyish, fine to very fine grained, rock with close spacing of discontinuities 14.00 to 17.00m		15.50	14.50	15.50	Core	-	-	-	-	60.00	34.00			
15.50																	
16.00																	
16.50																	
17.00				17.00	15.50	17.00	Core	-	-	-	-	63.00	12.00				
17.50			Moerately weathered, weak, greyish, fine to very fine grained, rock with wide spacing of discontinuities										-				
18.00																	
18.50					18.50	17.00	18.50	Core	-	-	-	-	92.00	46.00			
17.00 to 18.50m																	

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Project : BHEL

Bore Hole No. : 5

Location : Talabira

Depth of Termination : 25.0 M

Co-ordinates: E 1869, N 3690

Depth of Water Table : Encountered at 5.60m depth during investigation

Date of Start: 15-07-2024

Date of Completion: 18-07-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 210.3 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 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			Dark yellowish brown, fine to medium grained, silty clayey sand (SM-SC) 0.60 to 2.60m	1.00	1.00	2.00	SPT	5	7	9	16	-	-	
	1.50														
	2.00				2.00	2.00	2.50	SPT	5	8	11	19	-	-	
	2.50				2.50	2.50	3.00	UDS	-	-	-	-	-	-	
	3.00				3.00	3.00	3.50	SPT	7	14	25	39	-	-	
	3.50				3.50	3.50	4.00	SPT	7	13	20	33	-	-	
	4.00				4.00	4.00	4.50	SPT	9	10	17	27	-	-	
	4.50				4.50	4.50	5.00	SPT	8	14	19	33	-	-	
	5.00				5.00	5.00	5.50	SPT	8	14	21	35	-	-	
	5.50				5.50	5.50	6.00	SPT	8	15	27	42	-	-	
	6.00				6.00	6.00	6.50	SPT	9	12	23	35	-	-	
	6.50			Yellowish brown, fine to medium grained, clayey sand (SC) 2.60 to 11.60m	6.50	6.50	7.00	UDS	4	16	18	34	-	-	
	7.00				7.00	7.00	7.50	SPT	27	35	37	72	-	-	
	7.50				7.50	7.50	8.00	SPT	24	32	37	69	-	-	
	8.00				8.00	8.00	8.50	SPT	26	50/6 cm	-	>100	-	-	
	8.50				8.50	8.50	9.00	SPT	30	50/2 cm	-	>100	-	-	
	9.00				9.00	9.00	9.50	SPT	50/2 cm	-	-	>100	-	-	
	9.50				9.50	9.50	10.00	SPT	50/3 cm	-	-	>100	-	-	
	10.00				10.00	10.00	11.00	SPT	50/3 cm	-	-	>100	-	-	
	10.50														
	11.00				11.00	11.00	11.50	SPT	50/2 cm	-	-	>100	-	-	
	11.50				11.50	11.50	12.50	SPT	50/4 cm	-	-	>100	-	-	
	12.00														
	12.50			Yellowish brown, fine to medium grained, silty sand (SM) 11.60 to 14.10m	12.50	12.50	13.00	SPT	50/5 cm	-	-	>100	-	-	
	13.00				13.00	13.00	14.00	SPT	50/2 cm	-	-	>100	-	-	
	13.50														
	14.00				14.00	14.00	14.10	SPT	50/2 cm	-	-	>100	-	-	
	14.50														
	15.00														
	15.50				15.50	14.10	17.00	Core	-	-	-	-	16.0	-	
	16.00			Boulders formation of highly weathered, moderately strong, yellowish brown, fine to coarse grained, fractured rock with infilled sand	15.50	15.50	15.02	SPT	50/2 cm	-	-	>100	-	-	
	16.50														
	17.00				17.00	15.02	17.00	Core	-	-	-	-	8.0	-	
	17.50				17.00	17.00	17.02	SPT	50/2 cm	-	-	>100	-	-	
	18.00														
	18.50				18.50	17.02	18.50	Core	-	-	-	-	2.0	-	
	19.00				18.50	18.50	18.52	SPT	50/2 cm	-	-	>100	-	-	
	19.50														
	20.00			14.10 to 20.00m											
	20.50				20.00	20.00	20.50	SPT	50/2 cm	-	-	>100	-	-	
	21.00														
	21.50			Yellowish brown, fine to medium grained, silty sand (SM) 20.00 to 23.80m											
	22.00				22.00	22.00	23.00	SPT	50/2 cm	-	-	>100	-	-	
	22.50														
	23.00				23.00	23.00	23.50	SPT	50/1 cm	-	-	>100	-	-	
	23.50				23.50	23.50	24.50	SPT	50/2 cm	-	-	>100	-	-	
	24.00														
	24.50			Yellowish brown, fine to medium grained, clayey sand (SC)	24.50	24.50	24.56	SPT	50/2 cm	-	-	>100	-	-	
	25.00				24.50	24.50	25.00	SPT	50/2 cm	-	-	>100	-	-	

Project : BHEL

Bore Hole No. : 7

Location : Hirma, Talabira

Depth of Termination : 20.0 m

Co-ordinates : E 1963, N 3695

Depth of Water Table : Encountered at 7.10 m 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: 207.90 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 3.30m	0.00	0.00	1.00	DS	-	-	-	-	-	-			
	0.50																
	1.00				1.00	1.00	2.00	SPT	17	25	22	47	-	-			
	1.50															-	-
	2.00				2.00	2.00	2.50	SPT	7	9	11	20	-	-			
	2.50				2.50	2.50	3.00	UDS	-	-	-	-	-	-			
	3.00			3.00	3.00	3.50	SPT	5	10	12	22	-	-				
	3.50					Yellowish brown, fine to medium grained, silty and with occasional to some gravels (SM) 3.30 to 4.70m	3.50	3.50	4.00	UDS	-	-	-	-		-	-
	4.00						4.00	4.50	SPT	24	31	39	69	-		-	
	4.50						4.50	5.00	UDS	-	-	-	-	-		-	
	5.00						5.00	5.50	SPT	7	8	8	16	-		-	
	5.50					Yellowish brown, fine to medium grained, clayey sand (SC) 4.70 to 5.80m	5.50	5.50	6.00	UDS	-	-	-	-		-	-
	6.00						6.00	6.50	SPT	50/13 cm	-	-	>100	-		-	
	6.50			Not USED		Yellowish brown, fine to medium grained, silty sand (SM) 5.80 to 6.60m	6.50	6.50	7.00	DS	-	UDS attempted but not recovered					
	7.00	7.00	7.50				SPT	50/4 cm	-	-	>100	-	-				
	7.50	7.50	8.00				UDS	50/6 cm	-	-	>100	-	-				
	8.00	8.00	8.50				SPT	50/2 cm	-	-	>100	-	-				
	8.50	8.50	9.00				SPT	50/2 cm	-	-	>100	-	-				
	9.00	9.00	9.50				SPT	50/5 cm	-	-	>100	-	-				
	9.50	9.50	10.00				SPT	50/7 cm	-	-	>100	-	-				
	10.00	10.00	11.00				SPT	50/4 cm	-	-	>100	-	-				
	10.50																
	11.00	11.00	11.50				SPT	50/2 cm	-	-	>100	-	-				
	11.50	11.50	11.58			SPT	50/3 cm	-	-	>100	-	-					
	12.00					Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL) 11.70 to 13.60m	12.00	11.58	12.50	SPT	50/1 cm	-	-	>100		-	-
	12.50						12.50	12.53	SPT	50/2 cm	-	-	>100	-		-	
	13.00																
	13.50																
	14.00						14.00	14.50	SPT	50/1 cm	-	-	>100	-		-	
	14.50						14.50	15.50	SPT	50/3 cm	-	-	>100	-		-	
	15.00																
	15.50			15.50	16.00		SPT	50/3 cm	-	-	>100	-	-				
	16.00	16.00	17.00	SPT	50/4 cm	-	-	>100	-	-							
16.50			Yellowish brown, fine to medium grained, clayey sand with little gravels(SC)	16.50													
17.00				17.00	17.50	SPT	50/3 cm	-	-	>100	-	-					
17.50																	
18.00																	
18.50				18.50	19.00	SPT	50/9 cm	-	-	>100	-	-					
19.00																	
19.50																	
20.00				20.00	20.02	SPT	50/2 cm	-	-	>100	-	-					
13.60 to 20.00m																	

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Project : BHEL

Bore Hole No. : 10

Location : Hirma, Talabira

Depth of Termination : 16.0 m

Co-ordinates: E 914, N 3614

Depth of Water Table : Encountered at 1.30 m depth during investigation

Date of Start: 17-06-2024

Date of Completion: 19-06-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced level: 193.650 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, clayey sand with occasional gravels (SC) 0.00 to 0.70m	0.00	0.00	1.50	DS	-	-	-	-	-	-	
	0.50														
	1.00			Yellowish brown, fine to very fine grained, sandy clays of intermediate plasticity (CI) 0.70 to 2.20m	1.00	1.00	2.00	SPT	2	3	3	6	-	-	
	1.50														
	2.00			Brownish yellow, very fine grained, clays of high plasticity (CH) 2.20 to 3.50m	2.00	2.00	2.50	SPT	4	5	6	11	-	-	
	2.50					2.50	2.50	2.00	UDS	-	-	-	-	-	
	3.00				3.00	3.00	3.40	SPT	3	4	7	11	-	-	
	3.50														
	4.00			Light brownish yellow and greyish, fine to very fine grained, sandy clays of high plasticity (CH) 3.50 to 3.90m	3.50	3.50	4.00	UDS	-	-	-	-	-	-	
	4.50														
	5.00			Yellowish brown, fine to medium grained, clayey sand (SC) 3.90 to 4.50m	4.00	4.00	4.50	SPT	3	5	8	13	-	-	
	5.50					4.50	4.50	5.00	UDS	-	-	-	-	-	
	6.00			Reddish yellow, fine to medium grained, silty sand with little plastic fines (SM) 4.50 to 6.00m	5.00	5.00	5.50	SPT	4	6	8	14	-	-	
	6.50					5.50	5.50	6.00	UDS	-	-	-	-	-	
	7.00				6.00	6.00	6.50	SPT	7	9	10	19	-	-	
	7.50					6.50	6.50	7.00	UDS	-	-	-	-	-	
	8.00			Reddish yellow, fine to medium grained, poorly grained sand and silty and (SP-SM) 6.00 to 9.40m	7.00	7.00	7.50	SPT	8	11	13	24	-	-	
	8.50					7.50	7.50	8.00	DS	-	UDS attempted but not recovered				
	9.00				8.00	8.00	8.50	SPT	9	12	14	26	-	-	
	9.50					8.50	8.50	9.00	DS	-	UDS attempted but not recovered				
	10.00				9.00	9.00	9.50	SPT	10	15	28	43	-	-	
	10.50														
	11.00			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 9.40 to 10.20m	9.50	9.50	10.00	SPT	50/14 cm	-	-	>100	-	-	
	11.50					10.00	10.00	10.20	SPT	60	-	-	>100	-	
	12.00	Not used		Highly weathered, very weak, dark greyish, very fine grained, laminated/foliated SHALE 10.20 to 14.50m	11.50	11.50	11.53	SPT	50/8cm	-	-	>100	37.00	-	
	12.50														
	13.00				13.00	11.53	13.00	Core	-	-	-	-	16.00	-	
	13.50					13.00	13.00	13.05	SPT	50/5 cm	-	-	>100	-	
	14.00														
	14.50														
	15.00			Moderately weathered, moderately weak, dark greyish black, fine grained, thinly laminated SHALE 14.50 to 15.00m	14.50	13.05	14.50	Core	-	-	-	-	48.00	16.00	
	15.50														
	16.00			Fresh, moderately weathered, dark black, fine grained, massive SHALE											
15.00 to 16.00m															

Project : BHEL

Bore Hole No. : 11

Location : Hirma, Talabira

Depth of Termination : 20.0 m

Co-ordinates: E 714, N 3599

Depth of Water Table : Encountered at 3.90 m depth during investigation

Date of Start: 26-07-2024

Date of Completion: 28-07-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced level: 197.30 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			Yellowish brown, 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			Yellowish brown, very fine grained, clays of high plasticity (CH) 0.50 to 2.90m	1.00	1.00	2.00	SPT	2	3	4	7	-	-	
	1.00				2.00	2.00	2.50	SPT	3	4	5	9	-	-	
	1.50				2.50	2.50	3.00	UDS	-	-	-	-	-	-	
	2.00				3.00	3.00	3.50	SPT	3	4	6	10	-	-	
	2.50				3.50	3.50	4.00	UDS	-	-	-	-	-	-	
	3.00			Yellowish brown, fine to very fine grained, sandy clays of intermediate plasticity (CI) 2.90 to 3.90m	3.00	3.00	3.50	SPT	3	4	6	10	-	-	
	3.50				3.50	3.50	4.00	UDS	-	-	-	-	-	-	
	4.00			Yellowish brown, fine to very fine grained, clayey sand (SC) 3.90 to 4.45m	4.00	4.00	4.50	SPT	4	6	8	14	-	-	
	4.50				4.50	4.50	5.00	UDS	-	-	-	-	-	-	
	5.00			Yellowish brown, fine to very fine grained, sandy clays of intermediate plasticity (CI) 4.45 to 5.40m	5.00	5.00	5.50	SPT	12	17	24	41	-	-	
	5.50				5.50	5.50	6.00	SPT	60/14 cm	-	-	>100	-	-	
	6.00			Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL) 5.40 to 6.40m	6.00	6.00	6.50	SPT	60/11 cm	-	-	>100	-	-	
	6.50				6.50	6.50	7.00	SPT	60/6 cm	-	-	>100	-	-	
	7.00			Brownish, fine to very fine grained, sandy clays of low plasticity (CL) 6.40 to 9.40m	7.00	7.00	7.50	SPT	60/5 cm	-	-	>100	-	-	
	7.50				7.50	7.50	8.00	SPT	60/5 cm	-	-	>100	-	-	
	8.00				8.00	8.00	8.50	SPT	60/4 cm	-	-	>100	-	-	
	8.50				8.50	8.50	9.00	SPT	60/5 cm	-	-	>100	-	-	
	9.00				9.00	9.00	9.50	SPT	60/13 cm	-	-	>100	-	-	
	9.50				9.50	9.50	10.00	SPT	60/6 cm	-	-	>100	-	-	
	10.00				10.00	10.00	11.00	SPT	60/4 cm	-	-	>100	-	-	
	10.50				11.00	11.00	11.50	SPT	60/4 cm	-	-	>100	-	-	
	11.00			Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL) 10.30 to 15.60m	11.50	11.50	11.58	SPT	60/8 cm	-	-	>100	-	-	
	11.50				12.00	12.00									
	12.00				12.50	12.50	13.00	SPT	60/4 cm	-	-	>100	-	-	
	12.50				13.00	13.00	14.00	SPT	60/4 cm	-	-	>100	-	-	
	13.00				14.00	14.00	14.50	SPT	60/4 cm	-	-	>100	-	-	
	13.50				14.50	14.50	15.50	SPT	60/4 cm	-	-	>100	-	-	
	14.00				15.00	15.00									
	14.50				15.50	15.50	15.53	SPT	60/3 cm	-	-	>100	-	-	
	15.00			Moderately weathered, moderately weak, greyish black, fine to medium grained, moderately thickly bedded rock 15.60 to 18.00m	16.00										
	15.50				16.50										
16.00			17.00		17.00	15.53	17.00	Core	-	-	-	-	63.57	37.85	
16.50			17.50												
17.00			Slightly weathered, moderately weak, dark greyish black, fine to medium grained, thinly bedded rock 18.00 to 19.00m	18.00											
17.50				18.50	18.50	17.00	18.50	Core	-	-	-	-	68.00	56.66	
18.00				19.00											
18.50				19.50											
19.00			Slightly weathered, weak, dark greyish black, fine to very fine grained, massive rock	19.50											
19.50				20.00											
20.00				20.00	20.00	18.50	20.00	Core	-	-	-	-	77.33	69.33	

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : 29

Location : Talabira

Depth of Termination : 25.0 M

Co-ordinates: E 711, N 34Fī

Depth of Water Table : Encountered at 3.80m 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: 197.88 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 0.60m	0.00	0.00	1.00	DS	-	-	-	-	-	-												
	0.50			Brownish, very fine grained, clays of high plasticity (CH) 0.60 to 3.40m	1.00	1.00	2.00	SPT	1	2	2	4	-	-												
	1.00				2.00	2.00	2.50	SPT	2	3	4	7	-	-												
	1.50				2.50	2.50	3.00	UDS	-	-	-	-	-	-												
	2.00				3.00	3.00	3.50	SPT	2	3	4	7	-	-												
	2.50				3.50	3.50	4.00	SPT	3	5	6	11	-	-												
	3.00				4.00	4.00	4.50	SPT	3	4	6	10	-	-												
	3.50				4.50	4.50	5.00	UDS	-	-	-	-	-	-												
	4.00				5.00	5.00	5.50	SPT	4	6	8	14	-	-												
	4.50				5.50	5.50	6.00	UDS	-	-	-	-	-	-												
	5.00				6.00	6.00	6.50	SPT	8	13	16	29	-	-												
	5.50		6.50	6.50	7.00	SPT	20.00	34	48.00	82	-	-														
	6.00			Yellowish brown to brownish yellow, fine to very fine grained, clayey sand (SC) 5.90 to 9.30m	7.00	7.00	7.50	SPT	14	20	28	48	-	-												
	7.50				7.50	8.00	SPT	25	40.00	50/9cm	>100	-	-													
	8.00				8.00	8.50	SPT	16	20.00	24	44.00	-	-													
	8.50				8.50	9.00	SPT	60/13cm	-	-	>100	-	-													
	9.00				9.00	9.50	SPT	60/13cm	-	-	>100	-	-													
	9.50				9.50	10.00	SPT	60/6cm	-	-	>100	-	-													
	10.00				10.00	11.00	SPT	60/5cm	-	-	>100	-	-													
	10.50		Not used		Mixture of highly weathered, completely fractured and disintegrated, brownish grey, fine to medium grained, gravel, pebble size fractured rock fragments with dark brownish grey, fine to medium grained, clayey sand 10.80 to 12.50m	11.00	11.00	11.50	SPT	60/3cm	-	-	>100	-	-											
	11.50					11.50	12.50	SPT	60/2cm	-	-	>100	-	-												
	12.00					Highly weathered, weak, dark reddish brown, fine to medium grained, fractured rock 12.50 to 17.00m	12.50	12.50	13.00	Core	-	-	-	-	36.00	-										
	13.00	14.00					14.00	14.50	Core	-	-	-	-	36.66	-											
	13.50																									
	14.00																									
	14.50																									
	15.00						Highly weathered, weak, dark brownish grey, fine to medium grained, rock with very close spacing of discontinuities 17.00 to 18.50m	15.50	15.50	16.00	Core	-	-	-	-	60.00	-									
	16.00							17.00	17.00	17.50	Core	-	-	-	-	50.66	6.66									
	16.50																									
	17.00																									
	17.50																									
	18.00																									
18.50	Moderately weathered, moderately weak, dark brownish grey, fine to medium grained, rock with wide spacing of discontinuities			18.50	17.59	18.50		Core	-	-	-	-	67.33	36.00												
19.00				20.00	18.50	20.00		Core	-	-	-	-	66.00	52.66												
19.50																										
20.00																										
20.50																										
21.00																										
21.50																										
22.00																										
22.50																										
23.00	23.00	21.50	23.00	Core	-	-	-	-	64.00	48.00																
23.50																										
24.00																										
24.50																										
25.00																										
18.50 to 25.00m																										

Project : BHEL

Bore Hole No. : 36

Location : Hirma, Talabira

Depth of Termination : 20.0 m

Co-ordinates: E 1819, n 3369

Depth of Water Table : Encountered at 8.00 m 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: 208.65

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		Yellowish brown to dark brownish, fine to medium grained, clayey sand (SC) 0.00 to 3.70m	0.00	0.00	1.00	DS	-	-	-	-	-	-	
	0.50														
	1.00				1.00	1.00	2.00	SPT	4	4	4	8			
	1.50														
	2.00				2.00	2.00	2.50	SPT	4	6	10	16			
	2.50				2.50	2.50	3.00	UDS	-	-	-	-			
	3.00				3.00	3.00	3.50	SPT	5	7	16	23	-	-	
	3.50				3.50	3.50	4.00	UDS	-	-	-	-			
	4.00		Yellowish brown, fine to medium grained, silty sand with little gravels (SM) 3.70 to 5.70m	4.00	4.00	4.50	SPT	7	15	19	34				
	4.50			4.50	4.50	5.00	SPT	7	17	23	40	-	-		
	5.00			5.00	5.00	5.50	SPT	8	13	19	32				
	5.50			5.50	5.50	6.00	SPT	8	10	18	28	-	-		
	6.00			6.00	6.00	6.50	SPT	7	12	14	26	-	-		
	6.50		Yellowish brown, fine to medium grained, clayey sand (SC) 5.70 to 8.60m	6.50	6.50	7.00	SPT	7	7	9	16	-	-		
	7.00			7.00	7.00	7.50	SPT	6	9	12	21				
	7.50			7.50	7.50	8.00	SPT	9	13	18	33	-	-		
	8.00			8.00	8.00	8.50	SPT	12	27	32	59				
	8.50														
	9.00		Yellowish brown, fine to medium grained, silty sand with little gravels (SM) 8.60 to 9.60m	8.50	8.50	9.00	SPT	50/9 cm	-	-	>100				
	9.50			9.00	9.00	9.50	SPT	50/10 cm	-	-	>100	-	-		
	10.00			9.50	9.50	10.00	SPT	50/8 cm	-	-	>100				
	10.50			10.00	10.00	11.00	SPT	50/12 cm	-	-	>100				
	11.00		Yellowish brown, fine to medium grained, clayey sand (SC) 9.60 to 12.60m	11.00	11.00	11.50	SPT	50/14 cm	-	-	>100	-	-		
	11.50			11.50	11.50	11.58	SPT	34	50/3 cm	-	>100	-	-		
	12.00														
	12.50			12.50	12.50	13.00	SPT	50/12 cm	-	-	>100	-	-		
	13.00		Yellowish brown, fine to medium grained, silty sand (SM) 12.60 to 14.30m	13.00	13.00	14.00	SPT	50/2 cm	-	-	>100				
	13.50														
	14.00			14.00	14.00	14.50	SPT	50/2 cm	-	-	>100	-	-		
	14.50			14.50	14.50	15.50	SPT	50/4 cm	-	-	>100				
	15.00		Not Used			15.50	15.50	16.00	SPT	50/7 cm	-	-	>100	-	-
16.00	16.00	16.00				17.00	SPT	50/2 cm	-	-	>100				
16.50															
17.00	17.00	17.00				17.50	SPT	50/2 cm	-	-	>100	-	-		
17.50	Yellowish brown, fine to medium grained, clayey sand (SC) 17.30 to 18.60m	17.50		17.50	18.50	SPT	50/3 cm	-	-	>100					
18.00															
18.50		18.50	18.50	19.00	SPT	50/8 cm	-	-	>100	-	-				
19.00		19.00	19.00	20.00	SPT	50/2 cm	-	-	>100						
19.50	Yellowish brown, fine to medium grained, silty sand (SM)														
20.00		20.00	18.50	20.00	SPT	50/2 cm	-	-	>100	-	-				
14.30 to 20.00m															

Project : BHEL
 Bore Hole No. : 69
 Location : Hirma, Talabira
 Depth of Termination : 30
 Co-ordinates: E 1805, N 3156
 Depth of Water Table : Encountered at 3.70m depth during investigation

Date of Start: 17-07-2024
 Date of Completion: 20-07-2024
 Diameter of Bore: 150mm and Nx size
 Bit Used: Soil Surface Bit and NX Size
 Reduced level: 206.25 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 medium grained, clayey sand (SC) 0.00 to 0.40m	0.00	0.00	1.50	DS	-	-	-	-	-	-	
	0.50			Yellowish brown, fine to medium grained, clayey sand with much gravels (SC) 0.40 to 5.00m	1.00	1.00	2.00	SPT	10	15	17	32	-	-	
	1.00				2.00	2.00	2.50	SPT	10	12	13	25			
	1.50				2.50	2.50	2.00	UDS	-	-	-	-			
	2.00				3.00	3.00	3.40	SPT	12	13	13	26	-	-	
	2.50				3.50	3.50	4.00	UDS	-	-	-	-			
	3.00				4.00	4.00	4.50	SPT	10	6	9	15			
	3.50				4.50	4.50	5.00	UDS	-	-	-	-	-	-	
	4.00				5.00	5.00	5.50	SPT	16	17	14	31			
	4.50				5.50	5.50	6.00	UDS	-	-	-	-			
	5.00				6.00	6.00	6.50	SPT	32	50/7 cm	-	>100	-	-	
	5.50			Yellowish brown, fine to medium grained, silty sand (SM) 5.00 to 6.30m	6.50	6.50	7.00	SPT	13	17	19	36	-	-	
	6.00				7.00	7.00	7.50	SPT	30	50/6 cm	-	>100			
	6.50	7.50	7.50		8.00	SPT	34	60/9 cm	-	>100					
	7.00	8.00	8.00		8.50	SPT	60/12 cm	-	-	>100					
	7.50	8.50	8.50		9.00	SPT	50/11 cm	-	-	>100					
	8.00	9.00	9.00		9.50	SPT	50/12 cm	-	-	>100	-	-			
	8.50	9.50	9.50		10.00	SPT	50/11 cm	-	-	>100					
	9.00	10.00	10.00		11.00	SPT	50/10 cm	-	-	>100					
	9.50	11.00	11.00		11.50	SPT	50/9 cm	-	-	>100	-	-			
	10.00	11.50	11.50		12.50	SPT	50/11 cm	-	-	>100	-	-			
	10.50	Yellowish brown, fine to medium grained, Poorly graded sand and silty sand with little gravels (SP-SM) 8.10 to 13.00m	12.50	12.50	13.00	SPT	50/5 cm	-	-	>100					
	11.00		13.00	13.00	14.00	SPT	50/12 cm	-	-	>100	-	-			
	11.50		14.00	14.00	14.50	SPT	50/6 cm	-	-	>100					
	12.00		14.50	14.50	15.50	SPT	50/5 cm	-	-	>100	-	-			
	12.50		15.50	15.50	17.00	SPT	50/7 cm	-	-	>100					
	13.00		17.00	17.00	17.50	SPT	50/12 cm	-	-	>100					
	13.50		17.50	17.50	18.50	SPT	50/13 cm	-	-	>100	-	-			
	14.00		18.50	17.03	18.50	SPT	50/11 cm	-	-	>100	-	-			
	14.50		19.00	19.00	20.00	SPT	50/7cm			>100	-	-			
	15.00		20.00	20.00	21.50	SPT	50/09cm	-	-	>100	-	-			
	15.50	Yellowish brown, fine to medium grained, clayey sand with little gravels (SC) 13.00 to 23.00m	21.50	21.50	22.00	SPT	50/07cm	-	-	>100	-	-			
	16.00		22.00	22.00	23.00	SPT	50/06cm			>100					
	16.50		23.00	23.00	23.50	SPT	50/06cm	-	-	>100	-	-			
	17.00		23.50	23.50	25.00	SPT	50/08cm			>100					
	17.50		25.00	25.00	26.50	Core	-	-	-	-	19.16	17.50			
	18.00		Highly weathered, moderately weathered, dark yellowish brown, fine to coarse grained, rock with closely spaced discontinuities 23.80 to 26.00m	26.50	26.50	28.00	Core	-	-	-	-	31.30	12.00		
	18.50			28.00	28.00	29.50	Core	-	-	-	-	32.00	14.00		
	19.00			29.50	29.50		Core	-	-	-	-	28.00	6.60		
	19.50			30.00			Core	-	-	-	-	30.00	0.00		
20.00	Highly weathered, completely fractured and disintegrated, dark brownish yellow, fine to coarse grained, gravels, pebbles and cobbles size angular interlocking fragments of fractured rock 23.00 to 23.80m			23.00	23.00	23.50	SPT	50/06cm	-	-	>100	-	-		
20.50		23.50		23.50	25.00	SPT	50/08cm			>100					
21.00		Highly weathered, moderately strong, dark yellowish brown, fine to coarse grained, rock with closely spaced discontinuities		28.00	28.00	29.50	Core	-	-	-	-	32.00	14.00		
21.50				29.50	29.50		Core	-	-	-	-	28.00	6.60		
22.00				30.00			Core	-	-	-	-	30.00	0.00		
22.50				Highly weathered, completely fractured and disintegrated, dark brownish yellow, fine to coarse grained, gravels, pebbles and cobbles size angular interlocking fragments of fractured rock 23.00 to 23.80m	23.00	23.00	23.50	SPT	50/06cm	-	-	>100	-	-	
23.00	23.50		23.50		25.00	SPT	50/08cm			>100					
23.50	Highly weathered, moderately strong, dark yellowish brown, fine to coarse grained, rock with closely spaced discontinuities	28.00	28.00		29.50	Core	-	-	-	-	32.00	14.00			
24.00		29.50	29.50			Core	-	-	-	-	28.00	6.60			
24.50		30.00				Core	-	-	-	-	30.00	0.00			
25.00		Highly weathered, completely fractured and disintegrated, dark brownish yellow, fine to coarse grained, gravels, pebbles and cobbles size angular interlocking fragments of fractured rock 23.00 to 23.80m	23.00	23.00	23.50	SPT	50/06cm	-	-	>100	-	-			
25.50			23.50	23.50	25.00	SPT	50/08cm			>100					
26.00	Highly weathered, moderately strong, dark yellowish brown, fine to coarse grained, rock with closely spaced discontinuities		28.00	28.00	29.50	Core	-	-	-	-	32.00	14.00			
26.50			29.50	29.50		Core	-	-	-	-	28.00	6.60			
27.00			30.00			Core	-	-	-	-	30.00	0.00			
27.50		Highly weathered, completely fractured and disintegrated, dark brownish yellow, fine to coarse grained, gravels, pebbles and cobbles size angular interlocking fragments of fractured rock 23.00 to 23.80m	23.00	23.00	23.50	SPT	50/06cm	-	-	>100	-	-			
28.00			23.50	23.50	25.00	SPT	50/08cm			>100					
28.50	Highly weathered, moderately strong, dark yellowish brown, fine to coarse grained, rock with closely spaced discontinuities		28.00	28.00	29.50	Core	-	-	-	-	32.00	14.00			
29.00			29.50	29.50		Core	-	-	-	-	28.00	6.60			
29.50			30.00			Core	-	-	-	-	30.00	0.00			
30.00		Highly weathered, completely fractured and disintegrated, dark brownish yellow, fine to coarse grained, gravels, pebbles and cobbles size angular interlocking fragments of fractured rock 23.00 to 23.80m	23.00	23.00	23.50	SPT	50/06cm	-	-	>100	-	-			
30.50			23.50	23.50	25.00	SPT	50/08cm			>100					
31.00	Highly weathered, moderately strong, dark yellowish brown, fine to coarse grained, rock with closely spaced discontinuities		28.00	28.00	29.50	Core	-	-	-	-	32.00	14.00			
31.50			29.50	29.50		Core	-	-	-	-	28.00	6.60			
32.00			30.00			Core	-	-	-	-	30.00	0.00			
32.50		Highly weathered, completely fractured and disintegrated, dark brownish yellow, fine to coarse grained, gravels, pebbles and cobbles size angular interlocking fragments of fractured rock 23.00 to 23.80m	23.00	23.00	23.50	SPT	50/06cm	-	-	>100	-	-			
33.00			23.50	23.50	25.00	SPT	50/08cm			>100					
33.50	Highly weathered, moderately strong, dark yellowish brown, fine to coarse grained, rock with closely spaced discontinuities		28.00	28.00	29.50	Core	-	-	-	-	32.00	14.00			
34.00			29.50	29.50		Core	-	-	-	-	28.00	6.60			
34.50			30.00			Core	-	-	-	-	30.00	0.00			
35.00		Highly weathered, completely fractured and disintegrated, dark brownish yellow, fine to coarse grained, gravels, pebbles and cobbles size angular interlocking fragments of fractured rock 23.00 to 23.80m	23.00	23.00	23.50	SPT	50/06cm	-	-	>100	-	-			
35.50			23.50	23.50	25.00	SPT	50/08cm			>100					
36.00	Highly weathered, moderately strong, dark yellowish brown, fine to coarse grained, rock with closely spaced discontinuities		28.00	28.00	29.50	Core	-	-	-	-	32.00	14.00			
36.50			29.50	29.50		Core	-	-	-	-	28.00	6.60			
37.00			30.00			Core	-	-	-	-	30.00	0.00			
37.50		Highly weathered, completely fractured and disintegrated, dark brownish yellow, fine to coarse grained, gravels, pebbles and cobbles size angular interlocking fragments of fractured rock 23.00 to 23.80m	23.00	23.00	23.50	SPT	50/06cm	-	-	>100	-	-			
38.00			23.50	23.50	25.00	SPT	50/08cm			>100					
38.50	Highly weathered, moderately strong, dark yellowish brown, fine to coarse grained, rock with closely spaced discontinuities		28.00	28.00	29.50	Core	-	-	-	-	32.00	14.00			
39.00			29.50	29.50		Core	-	-	-	-	28.00	6.60			
39.50			30.00			Core	-	-	-	-	30.00	0.00			
40.00		Highly weathered, completely fractured and disintegrated, dark brownish yellow, fine to coarse grained, gravels, pebbles and cobbles size angular interlocking fragments of fractured rock 23.00 to 23.80m	23.00	23.00	23.50	SPT	50/06cm	-	-	>100	-	-			
40.50			23.50	23.50	25.00	SPT	50/08cm			>100					
41.00	Highly weathered, moderately strong, dark yellowish brown, fine to coarse grained, rock with closely spaced discontinuities		28.00	28.00	29.50	Core	-	-	-	-	32.00	14.00			
41.50			29.50	29.50		Core	-	-	-	-	28.00	6.60			
42.00			30.00			Core	-	-	-	-	30.00	0.00			
42.50		Highly weathered, completely fractured and disintegrated, dark brownish yellow, fine to coarse grained, gravels, pebbles and cobbles size angular interlocking fragments of fractured rock 23.00 to 23.80m	23.00	23.00	23.50	SPT	50/06cm	-	-	>100	-	-			
43.00			23.50	23.50	25.00	SPT	50/08cm			>100					
43.50	Highly weathered, moderately strong, dark yellowish brown, fine to coarse grained, rock with closely spaced discontinuities		28.00	28.00	29.50	Core	-	-	-	-	32.00	14.00			
44.00			29.50	29.50		Core	-	-	-	-	28.00	6.60			
44.50			30.00			Core	-	-	-	-	30.00	0.00			
45.00		Highly weathered, completely fractured and disintegrated, dark brownish yellow, fine to coarse grained, gravels, pebbles and cobbles size angular interlocking fragments of fractured rock 23.00 to 23.80m	23.00	23.00	23.50	SPT	50/06cm	-	-	>100	-	-			
45.50			23.50	23.50	25.00	SPT	50/08cm			>100					
46.00	Highly weathered, moderately strong, dark yellowish brown, fine to coarse grained, rock with closely spaced discontinuities		28.00	28.00	29.50	Core	-	-	-	-	32.00	14.00			
46.50			29.50	29.50		Core	-	-	-	-	28.00	6.60			
47.00			30.00			Core	-	-	-	-	30.00	0.00			
47.50		Highly weathered, completely fractured and disintegrated, dark brownish yellow, fine to coarse grained, gravels, pebbles and cobbles size angular interlocking fragments of fractured rock 23.00 to 23.80m	23.00	23.00	23.50	SPT	50/06cm	-	-	>100	-	-			
48.00			23.50	23.50	25.00	SPT	50/08cm			>100					
48.50	Highly weathered, moderately strong, dark yellowish brown, fine to coarse grained, rock with closely spaced discontinuities		28.00	28.00	29.50	Core	-	-	-	-	32.00	14.00			
49.00			29.50	29.50		Core	-	-	-	-	28.00	6.60			
49.50			30.00			Core	-	-	-	-	30.00	0.00			
50.00		Highly weathered, completely fractured and disintegrated, dark brownish yellow, fine to coarse grained, gravels, pebbles and cobbles size angular interlocking fragments of fractured rock 23.00 to 23.80m	23.00	23.00	23.50	SPT	50/06cm	-	-	>100	-	-			
50.50			23.50	23.50	25.00	SPT	50/08cm			>100					
51.00	Highly weathered, moderately strong, dark yellowish brown, fine to coarse grained, rock with closely spaced discontinuities		28.00	28.00	29.50	Core	-	-	-	-	32.00	14.00			
51.50			29.50	29.50		Core	-	-	-	-	28.00	6.60			
52.00			30.00			Core	-	-	-	-	30.00	0.00			
52.50		Highly weathered, completely fractured and disintegrated, dark brownish yellow, fine to coarse grained, gravels, pebbles and cobbles size angular interlocking fragments of fractured rock 23.00 to 23.80m	23.00	23.00	23.50	SPT	50/06cm	-	-	>100	-	-			
53.00			23.50	23.50	25.00	SPT	50/08cm			>100					
53.50	Highly weathered, moderately strong, dark yellowish brown, fine to coarse grained, rock with closely spaced discontinuities		28.00	28.00	29.50	Core	-	-	-	-	32.00	14.00			
54.00			29.50	29.50		Core	-	-	-	-	28.00	6.60			
54.50			30.00			Core	-	-	-	-	30.00	0.00			
55.00		Highly weathered, completely fractured and disintegrated, dark brownish yellow, fine to coarse grained, gravels, pebbles and cobbles size angular interlocking fragments of fractured rock 23.00 to 23.80m	23.00	23.00	23.50	SPT	50/06cm	-	-	>100	-	-			
55.50			23.50	23.50	25.00	SPT	50/08cm			>100					
56.00	Highly weathered, moderately strong, dark yellowish brown, fine to coarse grained, rock with closely spaced discontinuities		28.00	28.00	29.50	Core	-	-	-	-	32.00	14.00			
56.50			29.50	29.50		Core	-	-	-	-	28.00	6.60			
57.00			3												

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : 80

Location : Hirma, Talabira

Depth of Termination : 25.0 m

Co-ordinates: E2085 N 3091

Depth of Water Table : Encountered at 2.20m depth during investigation

Date of Start: 28-11-2024

Date of Completion: 02-12-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced level: 207.328 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		Reddish yellow, fine to medium grained, clayey sand with occasional gravels (SC) 0.00 to 0.10m	0.00	0.00	1.50	DS	-	-	-	-	-	-		
	0.50															
	1.00															
	1.50			Yellowish brown, fine to coarse grained, clayey sand with little gravels (SC) 0.10 to 2.80m	1.00	1.00	2.00	SPT	5	7	9	16	-	-		
	2.00				2.00	2.00	2.50	SPT	5	7	14	23				
	2.50				2.50	2.50	2.00	UDS	-	-	-	-				
	3.00			Light greyish, fine to medium grained, silty sand with little plastic fines and occasional gravels (SM) 2.80 to 4.10m	3.00	3.00	3.40	SPT	27	15	19	34	-	-		
	3.50				3.50	3.50	4.00	SPT	21	29	33	62				
	4.00				4.00	4.00	4.50	SPT	10	14	18	32				
	4.50			Yellowish brown, fine to medium grained, clayey sand with little to some gravels (SC) 4.10 to 5.70m	4.50	4.50	5.00	SPT	17	21	25	46				
	5.00				5.00	5.00	5.50	SPT	19	21	30	51				
	5.50				5.50	5.50	6.00	SPT	27	50/10 cm	-	>100				
	6.00				6.00	6.00	6.50	SPT	50/14 cm	-	-	>100	-	-		
	6.50			Dark greyish, fine to very fine grained, weakly cemented micascist - (SC) 5.70 to 7.60m	6.50	6.50	7.00	SPT	32	50/4 cm	-	>100	-	-		
	7.00				7.00	7.00	7.50	SPT	50/14 cm	-	-	>100				
	7.50				7.50	7.50	8.00	SPT	50/12 cm	-	-	>100				
	8.00		8.00	8.00	8.50	SPT	50/8 cm	-	-	>100						
	8.50		8.50	8.50	9.00	SPT	50/5 cm	-	-	>100						
	9.00	Mixture of brownish, fine to medium grained, cemented micascist clayey sand with very weak and friable fragments of fractured rock 7.60 to 11.00m	9.00	9.00	9.50	SPT	50/6 cm	-	-	>100	-	-				
	9.50		9.50	9.50	10.00	SPT	50/5 cm	-	-	>100	-	-				
	10.00		10.00	10.00	10.04	SPT	50/4 cm	-	-	>100						
	10.50															
	11.00		Not used			11.00	10.04	11.00	Core	-	-	-	-	15.71	-	
	11.50				11.00	11.00	11.02	SPT	50/2 cm	-	-	>100	-	-		
	12.00	Highly weathered, weak, dark greyish brown, fine to medium grained, fractured rock 11.00 to 14.00m			12.50	11.02	12.50	Core	-	-	-	-	12.00	-		
	12.50				12.50	12.50	12.52	SPT	50/2 cm	-	-	>100	-	-		
	13.00															
	13.50				14.00	12.52	14.00	Core	-	-	-	-	13.33			
	14.00				14.00	14.00	14.02	SPT	50/2 cm	-	-	>100	-	-		
	14.50															
	15.00				15.50	14.02	15.50	Core	-	-	-	-	16.00			
	15.50				15.50	15.50	15.02	SPT	50/2 cm	-	-	>100	-	-		
16.00																
16.50		17.00			15.02	17.00	Core	-	-	-	-	11.33				
17.00		17.00			17.00	17.02	SPT	50/2 cm	-	-	>100	-	-			
17.50	Highly weathered, moderately strong to weak, blackish brown, fine to coarse grained, fractured rock 14.00 to 22.00m	18.50			17.02	18.50	Core	-	-	-	-	15.33				
18.00		18.50			18.50	18.52	SPT	50/2 cm	-	-	>100	-	-			
18.50																
19.00		20.00	18.52	20.00	Core	-	-	-	-	58.66	18.00					
19.50																
20.00		21.50	20.00	21.50	Core	-	-	-	-	56.00	-					
20.50																
21.00																
21.50																
22.00																
22.50																
23.00	Moderately weathered, moderately strong, dark brownish to whitish grey, fine to medium grained, rock with close spacing of discontinuities			23.00	21.50	23.00	Core	-	-	-	-	32.00	-			
23.50																
24.00																
24.50																
25.00				25.00	23.00	25.00	Core	-	-	-	-	47.50	-			

Page 129 of 144

KT Consultancy Services., 22.00 to 25.00m

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : 85

Location : Hirma, Talabira

Depth of Termination : 18.0m

Co-ordinates: E 712, N 3086

Depth of Water Table : Encountered at 3.80m depth during investigation

Date of Start: 10-08-2024

Date of Completion: 11-08-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced level: 197.70 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 Recovery (%)	RQD (%)	Remarks
						From m	To m		N ₁	N ₂	N ₃	N			
Rotary drilling method with Hydraulic feed	0.00	Used		Yellowish brown, fine to very fine grained, sandy clays of low plasticity (CL) 0.00 to 0.60m	0.00	0.00	1.50	DS	-	-	-	-	-	-	
	0.50			Light brownish, very fine grained, silty clays of intermediate plasticity (CI)	1.00	1.00	2.00	SPT	1	1	1	2			
	1.00				2.00	SPT	2	3	5	8					
	1.50				2.50	UDS	-	-	-	-					
	2.00				3.00	SPT	3	4	5	9	-	-			
	2.50			3.50	UDS	-	-	-	-						
	3.00			4.00	SPT	6	7	9	16						
	3.50			4.50	UDS	-	-	-	-						
	4.00			5.00	SPT	6	8	9	17						
	4.50			5.50	UDS	-	-	-	-						
	5.00			6.00	SPT	4	7	7	14	-	-				
	5.50			6.50	SPT										
	6.00			7.00	UDS	-	-	-	-						
	6.50			7.50	SPT	3	6	9	15						
	7.00			7.50	SPT	9	12	14	26						
	7.50			8.00	SPT	7	10	11	21						
	8.00			8.50	SPT	8	9	11	20						
	8.50			9.00	SPT	12	15	20	35						
	9.00			9.50	SPT	35	50/3cm	-	>100						
	9.50			10.00	SPT	50/8cm	-	-	>100						
	10.00			10.50	SPT	50/9cm	-	-	>100						
	10.50			11.00	SPT										
	11.00			11.50	SPT										
	11.50			12.00	Core										
	12.00	12.50		Core											
	12.50	13.00	Core												
	13.00	13.50	Core												
	13.50	14.00	Core												
	14.00	14.50	Core												
	14.50	15.00	Core												
	15.00	15.50	Core												
	15.50	16.00	Core												
	16.00	16.50	Core												
	16.50	17.00	Core												
	17.00	17.50	Core												
	17.50	18.00	Core												
	11.75 to 18.00m														

K.C.T. Consultancy Services®

Project : BHEL
 Bore Hole No. : 97
 Location : Hirma, Talabira
 Depth of Termination : 25.0m
 Co-ordinates : E 1868, N 3033
 Depth of Water Table : Encountered at 2.00m depth during investigation

Date of Start: 19-08-2024
 Date of Completion: 23-08-2024
 Diameter of Bore: 150mm and Nx size
 Bit Used: Soil Surface Bit and NX Size
 Reduced level: 204.10 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 with Hydraulic feed	0.00	Used		Reddish brown, fine to medium grained, clayey sand with some gravels (SC) 0.00 to 1.40m	0.00	0.00	1.50	DS	-	-	-	-	-	-			
	0.50																
	1.00				Brownish red, fine to medium grained, sandy clays of intermediate plasticity with little gravels (CI) 1.40 to 2.50m	1.00	1.00	2.00	SPT	1	2	2	4	-	-		
	1.50																
	2.00				Reddish brown and yellowish brown, fine to medium grained, clayey sand with some to occational gravels (SC)	2.00	2.00	2.50	SPT	2	2	2	4	-	-		
	2.50																
	3.00																
	3.50																
	4.00																
	4.50																
	5.00																
	5.50																
	6.00																
	6.50																
	7.00				Yellowish brown, fine to medium grained, silty and clayey sand (SM-SC)	6.50	6.50	7.00	SPT	50/9cm	-	-	-	>100	-	-	
	7.50																
	8.00																
	8.50																
	9.00																
	9.50																
	10.00																
	10.50																
	11.00		Highly weathered, moderately strong, dark greyish, fine to coarse grained, fractured rock 10.60 to 12.00m			11.00	10.04	11.00	Core	-	-	-	-	12.50	-		
	11.50																
	12.00																
	12.50																
	13.00																
	13.50																
	14.00				Highly weathered, weak, dark brownish, fine to coarse grained, fractured rock	14.00	12.53	14.00	Core	-	-	-	-	10.00	-		
	14.50																
	15.00																
	15.50																
	16.00																
	16.50																
	17.00																
	17.50																
18.00		Highly weathered, moderately weak, dark brownish grey, fine to coarse grained, rock with closely spaced discontinuities	18.50			17.00	18.50	Core	-	-	-	-	24.00	-			
18.50																	
19.00																	
19.50																	
20.00																	
20.50																	
21.00																	
21.50				Highly weathered, very weak, dark brownish grey, fine to very fine grained, fractured rock	21.50	20.00	21.50	Core	-	-	-	-	36.00	-			
22.00																	
22.50																	
23.00																	
23.50																	
24.00																	
24.50																	
25.00																	
					23.00 to 25.00m	23.00	23.00	25.00	Core	-	-	-	-	51.50	6.00		

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : 99

Location : Hirma, Talabira

Depth of Termination : 30.0m

Co-ordinates: E 1753, N 30#"

Depth of Water Table : Encountered at 1.90m 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: 206.5

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		Dark yellowish red, fine to medium grained, silty clayey sand 0.00 to 0.30m	0.00	0.00	1.50	DS	-	-	-	-	-	-	
	0.50			Dark reddish brown, fine to medium grained, clayey sand with some to occasional gravels (SC)	1.00	1.00	2.00	SPT	8	7	6	13	-	-	
	1.00				2.00	2.00	2.50	SPT	12	9	7	16	-	-	
	1.50				2.50	2.50	2.00	UDS	-	-	-	-	-	-	
	2.00				3.00	3.00	3.50	SPT	5	6	6	12	-	-	
	2.50				3.50	3.50	4.00	UDS	-	-	-	-	-	-	
	3.00			Brownish yellow, fine to medium grained, clayey sand (SC) 2.90 to 4.90m	4.00	4.00	4.50	SPT	6	6	6	12	-	-	
	3.50				4.50	4.50	5.00	SPT	6	12	30	42	-	-	
	4.00				5.00	5.00	5.50	SPT	39	61/13cm	-	>100	-	-	
	4.50				5.50	5.50	6.00	SPT	50/15cm	-	-	>100	-	-	
	5.00				6.00	6.00	6.50	SPT	44	56/13cm	-	>100	-	-	
	5.50			Yellowish brown, fine to medium grained, silty and clayey sand with some gravels (SM-SC)	6.50	6.50	7.00	SPT	38	62/12cm	-	>100	-	-	
	6.00				7.00	7.00	7.50	SPT	50/14cm	-	-	>100	-	-	
	6.50				7.50	7.50	7.54	SPT	50/4cm	-	-	>100	-	-	
	7.00				9.00	7.54	9.00	Core	-	-	-	-	6.66	-	
	7.50				9.00	9.00	9.03	SPT	50/3cm	-	-	>100	-	-	
	8.00	Not used		10.50	9.03	10.50	Core	-	-	-	-	9.33	-		
	10.50			10.50	10.54	SPT	50/4cm	-	-	>100	-	-			
	11.00			12.00	10.54	12.00	Core	-	-	-	-	3.33	-		
	11.50			12.00	12.00	12.06	SPT	50/6cm	-	-	>100	-	-		
	12.00			13.50	12.06	13.50	Core	-	-	-	-	8.00	-		
	12.50			13.50	13.50	13.53	SPT	50/3cm	-	-	>100	-	-		
	13.00			15.00	13.53	15.00	Core	-	-	-	-	-	-		
	13.50			15.00	15.00	15.14	SPT	50/14cm	-	-	>100	-	-		
	14.00			16.50	15.14	16.50	Core	-	-	-	-	4.00	-		
	14.50			16.50	16.50	16.58	SPT	50/8cm	-	-	>100	-	-		
	15.00			18.00	16.58	18.00	Core	-	-	-	-	10.00	-		
	15.50			18.00	18.00	18.03	SPT	50/3cm	-	-	>100	-	-		
	16.00			19.50	18.03	19.50	Core	-	-	-	-	3.33	-		
	16.50			19.50	19.50	19.54	SPT	50/4cm	-	-	>100	-	-		
	17.00			21.00	19.54	21.00	Core	-	-	-	-	14.00	-		
	17.50	21.00	21.00	21.02	SPT	50/2cm	-	-	>100	-	-				
	18.00	22.50	21.02	22.50	Core	-	-	-	-	16.66	14.00				
	18.50	22.50	22.50	22.52	SPT	50/2cm	-	-	>100	-	-				
	19.00	24.00	22.52	24.00	Core	-	-	-	-	32.66	6.66				
	19.50	25.50	24.00	25.50	Core	-	-	-	-	23.66	18.00				
	20.00	27.00	25.50	27.03	Core	-	-	-	-	12.00	-				
	20.50	27.00	27.00	27.03	SPT	50/3cm	-	-	>100	-	-				
	21.00	28.50	27.03	28.52	Core	-	-	-	-	18.00	-				
	21.50	28.50	27.03	28.52	SPT	50/2cm	-	-	>100	-	-				
	22.00	30.00	28.52	30.00	Core	-	-	-	-	22.00	-				
	22.50	30.00	28.52	30.00	Core	-	-	-	-	22.00	-				

Page 132 of 144

27.00 to 30.00m

Page 132 of 144

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : 132

Location : Talabira

Depth of Termination : 25.0 m

Co-ordinates: E 1886 N 2840

Depth of Water Table : Encountered at 3.30m depth during investigation

Date of Start: 11-12-2024

Date of Completion: 15-12-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 202.30m

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	Used		Yellowish brown, fine to medium grained, clayey sand with occasional gravels (SC)	0.00	0.00	1.00	DS	-	-	-	-	-	-	
	0.50			0.00 to 0.80m											
	1.00			Dark reddish brown, fine to coarse grained, clayey sand with little to some gravels (SC)	1.00	1.00	2.00	SPT	11	17	22	39	-	-	
	1.50														
	2.00				2.00	2.00	2.50	SPT	7	8	11	19	-	-	
	2.50				2.50	2.50	3.00	UDS	-	-	-	-			
	3.00			Brownish, fine to coarse grained, clayey sand with much gravels (SC) 3.40 to 4.30m	3.00	3.00	3.50	SPT	6	10	11	21	-	-	
	3.50				3.50	3.50	4.00	SPT	9	12	18	30	-	-	
	4.00				4.00	4.00	4.50	SPT	11	20	49	79	-	-	
	4.50				4.50	4.50	5.00	SPT	15	48	50/11 cm	>100	-	-	
	5.00			Dark brownish, fine to coarse grained, weakly cemented clayey sand (SC) 4.30 to 12.60m	5.00	5.00	5.50	SPT	23	45	50/8 cm	>100	-	-	
	5.50				5.50	5.50	6.00	SPT	50/11 cm	-	-	>100	-	-	
	6.00				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	50/10 cm	-	-	>100	-	-	
	7.50				7.50	7.50	8.00	SPT	50/9 cm	-	-	>100	-	-	
	8.00				8.00	8.00	8.50	SPT	50/11cm	-	-	>100	-	-	
	8.50				8.50	8.50	9.00	SPT	50/13 cm	-	-	>100	-	-	
	9.00				9.00	9.00	9.50	SPT	50/9 cm	-	-	>100	-	-	
	9.50				9.50	9.50	10.00	SPT	50/8 cm	-	-	>100	-	-	
	10.00				10.00	10.00	11.00	SPT	50/10 cm	-	-	>100	-	-	
	11.00				11.00	11.00	11.50	SPT	42	54/11 cm	-	>100	-	-	
	11.50				11.50	11.50	12.50	SPT	50/11 cm	-	-	>100	-	-	
	12.50				12.50	12.50	12.60	SPT	50/10 cm	-	-	>100	-	-	
	13.00				13.00	12.60	13.00	Core	-	-	-	-	20.00	-	
	14.00	Not used		Highly weathered, moderately weak, dark brownish, fine to coarse grained, fractured rock 12.60 to 17.50m	14.50	13.00	14.50	Core	-	-	-	-	7.33		
	14.50				14.50	14.50	14.54	SPT	50/4 cm	-	-	>100			
	15.00														
	15.50														
	16.00			Highly weathered, moderately strong, dark brownish, fine to coarse grained, rock with close spacing of discontinuities 17.50 to 23.50m	16.00	14.54	16.00	Core	-	-	-	-	8.00	-	
	16.50														
	17.00														
	17.50				17.50	16.00	17.50	Core					42.66	6.66	
	18.00														
	18.50														
	19.00				19.00	17.50	19.00	Core					46.66	24.66	
	19.50														
	20.00														
	20.50				20.50	19.00	20.50	Core					46.66	14.66	
	21.00														
	21.50														
	22.00				22.00	20.50	22.00	Core	-	-	-	-	55.33	8.00	
	22.50														
	23.00														
	23.50				23.50	22.00	23.50	Core	-	-	-	-	32.66	17.33	
	24.00			Moderately weathered, moderately strong, reddish brown, fine to coarse grained, rock with moderately close spacing of discontinuities											
	24.50														
	25.00				25.00	23.50	25.00	Core	-	-	-	-	33.33	6.66	

Project : BHEL

Bore Hole No. : 142

Location : Hirma, Talabira

Depth of Termination : 20.0 m

Co-ordinates: E 1856, N 2771

Depth of Water Table : Encountered at 3.25 m depth during investigation

Date of Start: 10-12-2024

Date of Completion: 15-12-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced level: 201.38m

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			Yellowish brown, fine to medium grained, clayey sand with occasional gravels (SC) 0.00 to 0.80m	0.00	0.00	1.00	DS	-	-	-	-	-	-		
	0.50															
	1.00				1.00	1.00	2.00	SPT	2	3	3	6				
	1.50			Reddish yellow, fine to medium grained, sandy clays of intermediate plasticity with little gravels (CI) 0.80 to 2.90m	2.00	2.00	2.50	SPT	3	4	5	9	-	-		
	2.00				2.50	2.50	3.00	UDS	-	-	-	-				
	2.50				3.00	3.00	3.50	SPT	5	7	8	15	-	-		
	3.00			Yellowish brown, fine to coarse grained, sandy clays of intermediate plasticity (CI) 2.90 to 3.60m	3.50	3.50	4.00	UDS	-	-	-	-				
	3.50				4.00	4.00	4.50	SPT	10	14	19	33				
	4.00			Yellowish brown and greyish, fine to coarse grained, clayey sand with much gravels (SC) 3.60 to 4.90m	4.50	4.50	5.00	UDS	-	-	-	-	-	-		
	4.50				5.00	5.00	5.50	SPT	12	41	50/8 cm	>100				
	5.00				5.50	5.50	6.00	SPT	30	50/11 cm	-	>100	-			
	5.50				6.00	6.00	6.50	SPT	41	50/10 cm	-	>100	-	-		
	6.00				6.50	6.50	7.00	SPT	50/13 cm	-	-	>100	-	-		
	6.50				7.00	7.00	7.50	SPT	50/12 cm	-	-	>100				
	7.00			Light brownish, fine to medium grained, weakly cemented silty sand (SM) 4.90 to 10.30m	7.50	7.50	8.00	SPT	31	38	46	84				
	7.50				8.00	8.00	8.50	SPT	32	45	49	94				
	8.00				8.50	8.50	9.00	SPT	52/11 cm	-	-	>100				
	8.50				9.00	9.00	9.50	SPT	50/10 cm	-	-	>100				
	9.00				9.50	9.50	10.00	SPT	50/11 cm	-	-	>100				
	9.50				10.00	10.00	10.30	SPT	50/9 cm	-	-	>100				
	10.00															
	10.50				Highly weathered, very weak, fractured, reddish brown, fine to coarse grained, pebble, cobble size angular fractured rock with infilled reddish yellow, fine to medium grained, sand 10.30 to 12.50m	11.00	10.30	11.00	Core	-	-	-	-	21.42		
	11.00															
	11.50															
	12.00															
	12.50				Highly weathered, very weak, light yellowish brown, fine to medium grained, rock with very close spacing of discontinuities 12.50 to 14.00m	12.50	12.50	12.53	SPT	50/3 cm	-	-	>100	18.66	13.33	
	13.00															
	13.50															
	14.00				Highly weathered, weak, light yellowish and whitish brown, fine to coarse grained, fractured rock 14.00 to 15.50m	14.00	12.53	14.00	Core	-	-	-	-	16.00	-	
	14.50					14.00	14.00	14.04	SPT	50/4 cm	-	-	>100			
	15.00															
	15.50				Moderately weathered, moderately strong, brownish black, fine to coarse grained, rock with very close spacing of discontinuities 15.50 to 17.00m	15.50	14.04	15.50	Core	-	-	-	-	32.66	6.66	
16.00																
16.50																
17.00				Highly weathered, very weak, light greyish, fine to coarse grained, fractured rock 17.00 to 18.50m	17.00	15.50	17.00	Core	-	-	-	-	9.33	-		
17.50					17.00	17.00	17.05	SPT	50/5 cm	-	-	>100				
18.00																
18.50					18.50	17.00	18.50	Core	-	-	-	-	21.33	9.33		
19.00				Highly weathered, very weak, blackish brown, fine to coarse grained, rock with close spacing of discontinuities												
19.50																
20.00					20.00	18.50	20.00	Core	-	-	-	-	20.66	12.66		

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : 150

Location : Talabira

Depth of Termination : 20.0 M

Co-ordinates: E 771, N 2671

Depth of Water Table : Encountered at 2.10m depth during investigation

Date of Start: 08-11-2024

Date of Completion: 13-11-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 197.47 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			Yellowish brown, fine to very fine grained, silty clays of intermediate plasticity with little gravels (CI) 0.00 to 0.20m	0.00	0.00	1.00	DS	-	-	-	-	-	-	
	0.50			Reddish brown to yellowish brown, very fine grained, silty clays of high plasticity (CH) 0.20 to 4.70m	1.00	1.00	2.00	SPT	1	2	2	4	-	-	
	1.00				2.00	2.00	2.50	SPT	2	2	2	4	-	-	
	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	6	10	-	-	
	3.50				4.50	4.50	5.00	UDS	-	-	-	-	-	-	
	4.00			Reddish yellow, very fine grained, silty clays of intermediate plasticity with some gravels (CI) 4.70 to 5.80m	5.00	5.00	5.50	SPT	8	9	9	18	-	-	
	4.50				5.50	5.50	6.00	UDS	-	-	-	-	-	-	
	5.00				6.00	6.00	6.50	SPT	4	5	8	13	-	-	
	5.50			Reddish brown, fine to medium grained, clayey sand with some gravels (SC) 5.80 to 8.60m	6.50	6.50	7.00	UDS	-	-	-	-	-	-	
	6.00				7.00	7.00	7.50	SPT	6	6	7	13	-	-	
	6.50				7.50	7.50	8.00	UDS	-	-	-	-	-	-	
	7.00				8.00	8.00	8.50	SPT	4	5	6	11	-	-	
	7.50			Reddish brown, fine to very fine grained, sandy clays of intermediate plasticity with some gravels (CI) 8.60 to 9.40m	8.50	8.50	9.00	UDS	-	-	-	-	-	-	
	8.00				9.00	9.00	9.50	SPT	5	6	7	13	-	-	
	8.50				9.50	9.50	10.00	UDS	-	-	-	-	-	-	
	9.00			Reddish brown, fine to coarse grained, silty sand with little plastic fines and some gravels (SM) 9.40 to 13.60m	10.00	10.00	11.00	SPT	8	9	13	22	-	-	
	9.50				11.00	11.00	11.50	SPT	8	10	17	27	-	-	
	10.00				11.50	11.50	12.50	SPT	9	16	21	37	-	-	
	10.50				12.50	12.50	13.00	SPT	6	10	17	27	-	-	
	11.00				13.00	13.00	14.00	SPT	25	50/13 cm	-	>100	-	-	
	11.50				14.00	14.00	14.50	SPT	10	11	15	26	-	-	
	12.00				14.50	14.50	15.50	SPT	50/4 cm	50/12 cm	-	>100	-	-	
	12.50			Highly weathered, completely fractured and disintegrated, light yellowish white, fine to very fine grained, very weak and friable fractured rock 15.60 to 17.00m	15.50	15.50	16.50	SPT	50/5 cm	-	-	>100	-	-	
	13.00				16.50	16.50	16.53	SPT	50/3 cm	-	-	>100	-	-	
	13.50				17.50	16.53	17.50	Core	-	-	-	-	37.33	26.00	
	14.00			Highly weathered, very weak, light brownish, fine to medium grained, rock with close spacing of discontinuities	18.00	17.50	19.00	Core	-	-	-	-	24.66	16.00	
	14.50				19.00	17.50	19.00	Core	-	-	-	-	24.66	16.00	
	15.00				19.50	17.50	19.00	Core	-	-	-	-	24.66	16.00	
	15.50				20.00	19.00	20.00	Core	-	-	-	-	33.00	33.00	
	16.00				20.00	19.00	20.00	Core	-	-	-	-	33.00	33.00	
	16.50				20.00	19.00	20.00	Core	-	-	-	-	33.00	33.00	

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : 158

Location : Talabira

Depth of Termination : 25.0 M

Co-ordinates: E F I J I , N 24 I I

Depth of Water Table : Encountered at 4.50m depth during investigation

Date of Start: 29-06-2025

Date of Completion: 30-06-2025

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 202.960 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, fine to medium grained, silty sand with little plastic fines and occasional gravels (SM) 0.00 to 0.20m	0.00	0.00	1.00	DS	-	-	-	-	-	-	
	0.50			Yellowish brown, fine to medium grained, clayey sand with occasional gravels (SC) 0.20 to 1.80m	1.00	1.00	2.00	SPT	9	11	12	23	-	-	
	1.00														
	1.50														
	2.00			Reddish yellow, fine to coarse grained, clayey sand with much gravels (SC) 1.80 to 3.60m	2.00	2.00	2.50	SPT	10	15	28	43	-	-	
	2.50				2.50	2.50	3.00	UDS	-	-	-	-	-	-	
	3.00				3.00	3.00	3.50	SPT	7	11	13	24	-	-	
	3.50				3.50	3.50	4.00	UDS	-	-	-	-	-	-	
	4.00			Yellowish brown, fine to medium grained, silty clayey sand with occasional gravels (SM-SC) 3.60 to 4.30m	4.00	4.00	4.50	SPT	14	17	20	37	-	-	
	4.50			Light brownish, fine to medium graned, clayey sand with much gravels (SC) 4.30 to 5.60m	4.50	4.50	5.00	UDS	-	-	-	-	-	-	
	5.00	Not used			5.00	5.00	5.50	SPT	22	35	40	75	-	-	
	5.50				5.50	5.50	6.00	SPT	13	18	20	38	-	-	
	6.00				6.00	6.00	6.50	SPT	30	50/14 cm	-	>100	-	-	
	6.50			Yellowish brown to brownish, fine to medium grained, cemented clayey sand with occasional gravels (SC) 5.60 to 8.70m	6.50	6.50	7.00	SPT	38	50/13 cm	-	>100	-	-	
	7.00				7.00	7.00	7.50	SPT	40	50/14 cm	-	>100	-	-	
	7.50				7.50	7.50	8.00	SPT	45	50/12 cm	-	>100	-	-	
	8.00				8.00	8.00	8.50	SPT	42	50/12 cm	-	>100	-	-	
	8.50				8.50	8.50	9.00	SPT	38	50/14 cm	-	>100	-	-	
	9.00			Yellowish brown, fine to coarse grained, cemented friable sand 8.70 to 10.40m	9.00	9.00	9.50	SPT	35	50/13 cm	-	>100	-	-	
	9.50				9.50	9.50	10.00	SPT	40	50/12 cm	-	>100	-	-	
	10.00				10.00	10.00	11.00	SPT	45	50/13 cm	-	>100	-	-	
	10.50	Not used													
	11.00				11.00	11.00	11.50	SPT	50/14 cm	-	-	>100	-	-	
	11.50			Yellowish white, fine to coarse grained, cemented sand/mud rock with gravel, pebble size fractured rock fragments 10.40 to 14.40m	11.50	11.50	12.50	SPT	50/13 cm	-	-	>100	-	-	
	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				14.00	14.00	14.50	SPT	50/12 cm	-	-	>100	-	-	
	14.50				14.50	14.50	15.50	SPT	50/14 cm	-	-	>100	-	-	
	15.00														
15.50	Not used		Brownish, fine to very fine grained, cemented clayey sand/ mud rock 14.40 to 17.60m	15.50	15.50	16.00	SPT	50/13 cm	-	-	>100	-	-		
16.00				16.00	16.00	17.00	SPT	50/14 cm	-	-	>100	-	-		
16.50															
17.00				17.00	17.00	17.50	SPT	50/12 cm	-	-	>100	-	-		
17.50				17.50	17.50	18.50	SPT	50/14 cm	-	-	>100	-	-		
18.00															
18.50				18.50	18.50	18.55	SPT	50/5 cm	-	-	>100	-	-		
19.00															
19.50															
20.00				20.00	18.55	20.00	Core	-	-	-	-	9.00	-		
20.50			Highly weathered, completely fractured and disintegrated, gravel, pebble, cobble size angular interlocking fragments of fractured rock with yellowish brown, fine to coarse grained, clayey sand	20.00	20.00	20.05	SPT	50/5 cm	-	-	>100	-	-		
21.00	Not used														
21.50				21.50	20.05	21.50	Core	-	-	-	-	27.00	8		
22.00															
22.50															
23.00				23.00	21.50	23.00	Core	-	-	-	-	35.00	10		
23.50															
24.00															
24.50															
25.00				25.00	23.00	25.00	Core	-	-	-	-	30.00	5		
17.60 to 25.00m															

K.C.T. Consultancy Services®

Project : BHEL
 Bore Hole No. : 166
 Location : Talabira
 Depth of Termination : 25.0 m
 Co-ordinates : E 1541, N 2204
 Depth of Water Table : Encountered at 4.90m depth during investigation

Date of Start: 22-11-2024
 Date of Completion: 24-11-2024
 Diameter of Bore: 150mm and Nx size
 Bit Used: Soil Surface Bit and NX Size
 Reduced Level: 202.73 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	4	4	5	9	-	-	
	1.50														
	2.00			Yellowish brown, fine to coarse grained, clayey sand with some gravels (SC) 0.00 to 4.70m	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	10	7	9	16	-	-	
	3.50				3.50	3.50	4.00	UDS	-	-	-	-	-	-	
	4.00				4.00	4.00	4.50	SPT	3	3	4	7	-	-	
	4.50				4.50	4.50	5.00	SPT	7	9	19	28			
	5.00			Yellowish brown, fine to coarse grained, silty sand with little plastic fines (SM) 4.70 to 5.70m	5.00	5.00	5.50	SPT	14	18	20	38	-	-	
	5.50				5.50	5.50	6.00	SPT	16	15	19	34	-	-	
	6.00			Brownish, fine to medium grained, silty clayey sand (SM-SC) 5.70 to 6.60m	6.00	6.00	6.50	SPT	10	15	20	35	-	-	
	6.50			Whitish yellow and slightly greyish, fine to medium grained, clayey sand with some gravels (SC) 6.60 to 7.60m	6.50	6.50	7.00	SPT	13	14	16	30	-	-	
	7.00				7.00	7.00	7.50	SPT	7	16	23	29	-	-	
	7.50			Yellowish brown, fine to medium grained, cemented silty sand with some gravels (SM) 7.60 to 9.10m	7.50	7.50	8.00	SPT	15	17	15	35	-	-	
	8.00				8.00	8.00	8.50	SPT	19	50/9 cm	-	>100	-	-	
	8.50				8.50	8.50	9.00	SPT	50/12 cm	-	-	>100	-	-	
	9.00			Yellowish brown, fine to very fine grained, cemented clayey sand with little gravels (SC) 9.10 to 9.60m	9.00	9.00	9.50	SPT	50/14 cm	-	-	>100	-	-	
	9.50				9.50	9.50	10.00	SPT	43	50/4 cm	-	>100	-	-	
	10.00				10.00	10.00	11.00	SPT	37	50/7 cm	-	>100	-	-	
	10.50														
	11.00				11.00	11.00	11.50	SPT	50/14 cm	-	-	>100	-	-	
	11.50			Brownish yellow, fine to medium grained, cemented silty sand with little plastic fines and some gravels (SM) 9.60 to 14.40m	11.50	11.50	12.50	SPT	32	50/5 cm	-	>100	-	-	
	12.00				12.50	12.50	13.00	SPT	39	50/6 cm	-	>100	-	-	
	12.50				13.00	13.00	14.00	SPT	50/13 cm	-	-	>100	-	-	
	13.00														
	13.50														
	14.00				14.00	14.00	14.50	SPT	50/13 cm	-	-	>100	-	-	
	14.50														
	15.00				15.50	14.50	15.50	Core	-	-	-	-	19.00	10.00	
	15.50				15.50	15.50	15.52	SPT	50/2 cm	-	-	>100			
	16.00														
	16.50														
	17.00			Highly weathered, weak, dark reddish brown, fine to medium grained, rock with close spacing of discontinuities 14.40 to 21.00m	17.00	15.52	17.00	Core	-	-	-	-	17.33	12.00	
	17.50				17.00	17.00	18.50	SPT	50/3 cm	-	-	>100	-	-	
	18.00				18.50	17.00	18.50	Core	-	-	-	-	14.00	-	
	18.50				18.50	18.50	18.52	SPT	50/2 cm	-	-	>100	-	-	
	19.00														
	19.50														
	20.00				20.00	18.52	20.00	Core	-	-	-	-	4.00	-	
	20.50				20.00	20.00	20.02	SPT	40/3 cm	-	-	>100	-	-	
	21.00			Highly weathered, moderately weak, greyish red, fine to medium grained, rock with moderately close spacing of discontinuities 21.00 to 23.00m	21.50	20.02	21.50	Core	-	-	-	-	33.33	24.66	
	21.50														
	22.00														
	22.50														
	23.00			Highly weathered, very weak, greyish red, fine to medium grained, fractured rock 23.00 to 24.00m	23.00	21.50	23.00	Core	-	-	-	-	12.00	-	
	23.50				23.00	23.00	23.03	SPT	50/3 cm	-	-	>100			
	24.00														
	24.50			Highly weathered, moderately weak, greyish red, fine to medium grained, rock with close spacing of discontinuities 24.00 to 25.00m	25.00	23.03	25.00	Core	-	-	-	-	30.50	20.00	

Project : BHEL

Bore Hole No. : 167

Location : Hirma, Talabira

Depth of Termination : 20.0 m

Co-ordinates: E 881, N 2212

Depth of Water Table : Encountered at 2.80m depth during investigation

Date of Start: 23-09-2024

Date of Completion: 26-09-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced level: 198.570 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	Not used		Yellowish brown, fine to very fine grained, sandy clays of intermediate plasticity (CI) 0.00 to 0.60m	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	1	2	5	7	-	-				
	2.50						2.50	2.50	3.00	UDS	-	-	-	-	-	-				
	3.00						3.00	3.00	3.50	SPT	2	4	4	8	-	-				
	3.50						3.50	3.50	4.00	UDS	-	-	-	-	-	-				
	4.00						4.00	4.00	4.50	SPT	4	4	6	10	-	-				
	4.50						4.50	4.50	5.00	UDS	-	-	-	-	-	-				
	5.00						5.00	5.00	5.50	SPT	4	6	7	13	-	-				
	5.50						5.50	5.50	6.00	UDS	-	-	-	-	-	-				
	6.00						6.00	6.00	6.50	SPT	4	5	8	13	-	-				
	6.50						6.50	6.50	7.00	UDS	-	-	-	-	-	-				
	7.00									7.00	7.00	7.50	SPT	6	8	22	30	-	-	
	7.50									7.50	7.50	8.00	UDS	-	-	-	-	-	-	
	8.00									8.00	8.00	8.50	SPT	7	9	11	20	-	-	
	8.50									8.50	8.50	9.00	UDS	-	-	-	-	-	-	
	9.00						9.00	9.00	9.50	SPT	12	15	16	31	-	-				
	9.50						9.50	9.50	10.00	UDS	-	-	-	-	-	-				
	10.00						10.00	10.00	11.00	SPT	15	18	19	37	-	-				
	10.50																			
	11.00						11.00	11.00	11.50	UDS	-	-	-	-	-	-				
	11.50						used			11.50	11.50	12.50	SPT	21	27	32	59	-	-	
	12.00																			
	12.50	12.50	12.50	13.00	SPT	50/9 cm				-	-	>100	-	-						
	13.00	13.00	13.00	14.00	SPT	50/6 cm				-	-	>100	-	-						
	13.50																			
	14.00	14.00	14.00	14.50																
	14.50	14.50	14.50	14.50	SPT	25				37	49	86	-	-						
	15.00																			
	15.50	15.50	15.00	16.00	SPT	37				50/13 cm	-	>100	-	-						
	16.00																			
	16.50																			
	17.00	17.00	17.00	17.50	SPT	46				50/10 cm	-	>100	-	-						
	17.50	17.50	17.50	18.50	SPT	50/13 cm	-	-	>100	-	-									
18.00																				
18.50	18.50	18.50	19.00	SPT	42	58/10 cm	-	>100	-	-										
19.00	19.00	19.00	20.00	SPT	50/14 cm	-	-	>100	-	-										
19.50																				
20.00	20.00	20.00	20.14	SPT	50/14 cm	-	-	-	51.00	-										
12.20 to 20.00m																				

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : 169

Location : Talabira

Depth of Termination : 20.0 M

Co-ordinates: E 1188, N 1944

Depth of Water Table : Encountered at 5.20m depth during investigation

Date of Start: 26-06-2024

Date of Completion: 03-07-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 199.13 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		Dark reddish brown, fine to medium grained, clayey sand (SC) 0.00 to 1.50m	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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17.00															
17.50															
18.00															
18.50															
19.00															
19.50															
20.00															
18.60 to 20.00m															

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : 170

Location : Talabira

Depth of Termination : 22.0 m

Co-ordinates: E 1393, N 1938

Depth of Water Table : Encountered at 5.30m depth during investigation

Date of Start: 24-11-2024

Date of Completion: 27-11-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 204.90 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			Yellowish brown, fine to medium grained, clayey sand with little gravels (SC) 0.00 to 0.40m	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			Dark reddish, fine to very fine grained, sandy clays of intermediate plasticity with little gravels (CI) 0.40 to 3.70m	2.00	2.00	2.50	SPT	3	4	5	9	-	-	
	2.50				2.50	2.50	3.00	UDS	-	-	-	-	-	-	
	3.00				3.00	3.00	3.50	SPT	6	7	8	15	-	-	
	3.50				3.50	3.50	4.00	UDS	-	-	-	-	-	-	
	4.00				4.00	4.00	4.50	SPT	5	7	9	16	-	-	
	4.50				4.50	4.50	5.00	UDS	-	-	-	-	-	-	
	5.00			Dark brownish red, fine to medium grained, clayey sand with little to some gravels (SC) 3.60 to 7.40m	5.00	5.00	5.50	SPT	6	7	8	15	-	-	
	5.50				5.50	5.50	6.00	UDS	-	-	-	-	-	-	
	6.00				6.00	6.00	6.50	SPT	6	8	9	17	-	-	
	6.50				6.50	6.50	7.00	UDS	-	-	-	-	-	-	
	7.00				7.00	7.00	7.50	SPT	6	6	7	13	-	-	
	7.50				7.50	7.50	8.00	SPT	20	40	55	95	-	-	
	8.00			Yellowish brown, fine to very fine grained, cemented clayey sand with little gravels (SC) 7.40 to 9.30m	8.00	8.00	8.50	SPT	45	50/10 cm	-	>100	-	-	
	8.50				8.50	8.50	9.00	SPT	59	-	-	>100	-	-	
	9.00				9.00	9.00	9.50	SPT	65	-	-	>100	-	-	
	9.50				9.50	9.50	10.00	SPT	70	-	-	>100	-	-	
	10.00				10.00	10.00	11.00	SPT	60/10 cm	-	-	>100	-	-	
	10.50														
	11.00			Yellowish brown, fine to very fine grained, cemented silty sand with little plastic fines and little to some gravels (SM) 9.30 to 14.20m	11.00	11.00	11.50	SPT	65/10 cm	-	-	>100	-	-	
	11.50				11.50	11.50	12.50	SPT	70/8 cm	-	-	>100	-	-	
	12.00														
	12.50				12.50	12.50	13.00	SPT	50/5 cm	-	-	>100	-	-	
	13.00				13.00	13.00	14.00	SPT	61/7 cm	-	-	>100	-	-	
	13.50														
	14.00				14.00	14.00	14.06	SPT	50/6 cm	-	-	>100	-	-	
	14.50														
	15.00			Highly weathered, very weak and friable yellowish brown, fine to medium grained, fractured rock 14.20 to 17.00m	15.50	14.06	15.50	Core	-	-	-	-	16.15	-	
	15.50				15.50	15.50	15.52	SPT	50/2 cm	-	-	>100	-	-	
	16.00														
	16.50														
	17.00			Moderately weathered, weak, yellowish brown, fine to medium grained, rock with moderately wide spacing of discontinuities 17.00 to 18.50m	17.00	15.52	17.00	Core	-	-	-	-	74.66	56.66	
	17.50														
	18.00														
	18.50				18.50	17.00	18.50	Core	-	-	-	-	74.66	64.00	
	19.00														
	19.50			Moderately weathered, weak, greyish, fine to medium grained, rock with wide spacing of discontinuities 18.50 to 21.00m	20.00	18.50	20.00	Core	-	-	-	-	86.00	-	
	20.00														
	20.50														
	21.00			Moderately weathered, weak, light brownish grey, fine to medium grained, rock with very close spacing of discontinuities	21.50	20.00	21.50	Core	-	-	-	-	-	-	
	21.50														
	22.00				22.00	21.50	22.00	Core	-	-	-	-	92.50	53.50	

21.00 to 22.00m

Page 140 of 144

K.C.T. Consultancy Services®

Project : BHEL

Bore Hole No. : 171

Location : Talabira

Depth of Termination : 25.0 M

Co-ordinates: E 955, N 1938

Depth of Water Table : Encountered at 5.60m depth during investigation

Date of Start: 26-06-2024

Date of Completion: 05-07-2024

Diameter of Bore: 150mm and Nx size

Bit Used: Soil Surface Bit and NX Size

Reduced Level: 200.03 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			Yellowish brown, fine to medium grained, clayey sand (SC) 0.00 to 0.30m	0.00	0.00	1.00	DS	-	-	-	-	-	-	
	0.50														
	1.00				1.00	1.00	2.00	SPT	4	6	9	15	-	-	
	1.50														
	2.00			Dark reddish brown, fine to very fine grained, sandy clays of low plasticity (CL) 0.30 to 4.30m	2.00	2.00	2.50	SPT	8	12	13	25	-	-	
	2.50				2.50	2.50	3.00	UDS	-	-	-	-	-	-	
	3.00				3.00	3.00	3.50	SPT	17	24	32	56	-	-	
	3.50				3.50	3.50	4.00	DS	-	UDS attempted but not recovered				-	-
	4.00				4.00	4.00	4.50	SPT	9	14	17	31	-	-	
	4.50			Dark reddish brown, fine to medium grained, clayey sand with little gravels (SC) 4.30 to 8.80m	4.50	4.50	5.00	UDS	-	-	-	-	-	-	
	5.00				5.00	5.00	5.50	SPT	13	16	18	34	-	-	
	5.50				5.50	5.50	6.00	UDS	-	-	-	-	-	-	
	6.00				6.00	6.00	6.50	SPT	15	18	20	38	-	-	
	6.50				6.50	6.50	7.00	UDS	-	-	-	-	-	-	
	7.00				7.00	7.00	7.50	SPT	8	7	6	13	-	-	
	7.50				7.50	7.50	8.00	DS	-	UDS attempted but not recovered				-	-
	8.00				8.00	8.00	8.50	SPT	11	15	19	34	-	-	
	8.50				8.50	8.50	9.00	DS	-	UDS attempted but not recovered				-	-
	9.00				Yellowish brown, fine to very fine grained, clayey sand (SC) 8.80 to 9.70m	9.00	9.00	9.50	SPT	4	6	9	15	-	-
	9.50			9.50		9.50	10.00	UDS	-	-	-	-	-	-	
	10.00			Yellowish brown, fine to medium grained, silty sand (SM) 9.70 to 11.30m	10.00	10.00	11.00	SPT	3	11	12	23	-	-	
	10.50														
	11.00														
	11.50				11.00	11.00	11.50	DS	-	UDS attempted but not recovered				-	-
	12.00			Yellowish brown, medium to coarse grained, silty sand with much gravels (SM) 11.30 to 17.30m	11.50	11.50	12.50	SPT	4	9	11	20	-	-	
	12.50				12.50	12.50	13.00	SPT	4	10	17	27	-	-	
	13.00				13.00	13.00	14.00	SPT	11	25	60	85	-	-	
	13.50														
	14.00				14.00	14.00	14.50	DS	-	UDS attempted but not recovered				-	-
	14.50				14.50	14.50	15.50	SPT	14	30	60	90	-	-	
	15.00				15.50	15.50	16.00	SPT	35	60	-	>100	-	-	
	15.50				16.00	16.00	17.00	SPT	60	-	-	>100	-	-	
	16.50														
	17.00				17.00	17.00	17.50	SPT	55/10cm	-	-	>100	-	-	
	17.50			Yellowish brown, fine to medium grained, poorly graded sand with little to much gravels (SP) 17.30 to 19.50m	17.50	17.50	18.50	SPT	60/12cm	-	-	>100	-	-	
	18.00				18.50	18.50	19.00	SPT	58	-	-	>100	-	-	
18.50			19.00		19.00	20.00	SPT	60/9cm	-	-	>100	-	-		
19.50															
20.00			Yellowish brown, fine to medium grained, poorly graded sand and silty sand with occasional to much gravels (SP-SM) 19.50 to 21.60m	20.00	20.00	20.50	SPT	60/10cm	-	-	>100	-	-		
20.50				20.50	20.50	21.50	SPT	50	-	-	>100	-	-		
21.00															
21.50				21.50	21.50	22.00	SPT	30	60/12cm	-	>100	-	-		
22.00			Yellowish brown, fine to medium grained, poorly graded sand with little to much gravels (SP)	22.00	22.00	23.00	SPT	24	55/10cm	-	>100	-	-		
22.50															
23.00				23.00	23.00	23.50	SPT	14	17	45	62	-	-		
23.50				23.50	23.50	24.50	SPT	18	21	49	70	-	-		
24.00															
24.50				24.50	24.50	24.56	SPT	19	50/6cm	-	>100	-	-		
25.00				25.00	25.00	25.00	SPT	15	50/9cm	-	>100	-	-		
Page 141 of 144															

Site Photographs





