

Corrigendum /Addendum No.1

Date: 02.12.2024

Reference: NIT No. WAP/CMU-III/2024-25/SMFPL/Agartala/09 dtd. 20.11.2024 for "Survey, Investigation, Planning, Designing and Construction of National Industrial Township at Agartala, Tripura on EPC Mode-I".

The following dates are revised/ modified as given below

	Narration	Earlier Dates	Revised dates
(m)	Last date & time for online submission of Technical & Financial Bid	04/12/2024 up to 15:00 hours	18/12/2024 up to 15:00 hours
(n)	Offline Submission of Technical document, Tender Fees, EMD etc. as detail in Tender for bidders.	04/12/2024 up to 17:00 hours in the office of The Chief Engineer (CMU-III), WAPCOS, Construction Management Unit-III at 1st Floor, NPCC Building, Plot No. 148, Sector- 44 Gurugram- 122003, Haryana	18/12/2024 up to 17:00 hours in the office of The Chief Engineer (CMU-III), WAPCOS, Construction Management Unit-III at 1st Floor, NPCC Building, Plot No. 148, Sector- 44 Gurugram- 122003, Haryana
(o)	Online opening of Technical Bid	05/12/2024 up to 16:00 hours	19/12/2024 up to 16:00 hours

Also, the Replies to the Pre-bid Queries of Bidders on 27-11-2024 is enclosed.



(Adarsh Kalhia)

Chief Engineer (CMU-III)

**SURVEY, INVESTIGATION, PLANNING, DESIGNING AND CONSTRUCTION OF
NATIONAL INDUSTRIAL TOWNSHIP AT AGARTALA,
TRIPURA ON EPC MODE-I**

NIT No. WAP/CMU-III/2024-25/SMFPL/Agartala/09 Date: 20-11-2024

Replies to the Pre-bid Queries of Bidders on 27-11-2024

S No.	Reference	Existing Clauses	Clarification Sought	Replies to Queries
Name of the Contractor - M/s Vishwa Samudra Engineering Private Limited				
1	Extension of Bid- Tendernotice_1- Notice Inviting Tender- Sr. No. m) – Page No 7	m) Last date & time for online submission of Technical & Financial Bid- 04-12-2024 up to 15:00 hours	The authority is requested to please provide two weeks of extension for preparation of a comprehensive and most competitive bid. Kindly consider.	Refer Corrigendum No. 1 for extension of date
2	Tendernotice_1- Notice Inviting Tender- Sr. No. m) & Sr. No. n) Page No 7	m) Last date & time for online submission of Technical & Financial Bid- 04-12-2024 up to 15:00 hours n) Offline Submission of Technical document, Tender Fees, EMD etc. as detail in Tender for bidders- 04-12-2024 up to 17:00 hours in the office of Chief Engineer (CMU-III)	The authority is requested to give at least one day time for Offline Submission of Technical document, Tender Fees and EMD etc. after online submission of Technical & Financial Bid. Kindly consider.	As per NIT.
3	Insurance Surety Bonds a) Tendernotice_1-Notice Inviting Tender (NIT)-Sr. No. g) Bid Security / EMD / Insurance Surety Bonds – PDF Page No 6 b) Tendernotice_1-Section-IV- General Conditions of Contract- 3.0 Clauses of Contract-Clause	Insurance Surety Bonds a) Rs. 3,46,00,000/- (Refundable) in the form of RTGS/ NEFT/ D.D./Banker's cheque/ Insurance Surety Bonds/ FDR in favor of 'WAPCOS Limited' payable at Gurugram, Haryana. b) This Guarantee shall be in the form of Insurance Surety	Format for the Insurance Surety Bonds is missing in the tender documents. The authority is requested to provide the Format of Insurance Surety Bonds for Bid Security & Performance Guarantee. Kindly Provide.	The bidders may submit the Insurance Surety Bonds from any of the Commercial Banks on the Bank's format.

S No.	Reference	Existing Clauses	Clarification Sought	Replies to Queries
	1: Performance Guarantee – PDF Page No 57	Bonds, Account Payee Demand Draft, Fixed Deposit Receipt or Bank Guarantee from any of the Commercial Banks.		
4	General – Utility Shifting	132KV Transmission Line- During the site visit we have observed that the transmission line is passing through the plot and as per the transmission board of Agartala division rerouting of the said line is not feasible also the construction cannot be done below the line and within the ROU of 8m.	Club House / Gymkhana & Electrical Sub-station needs to be planned at different location or orientation will be changed. Kindly Confirm.	The layout provided is tentative. The successful bidder may change orientation of the buildings with the approval of Engineer-In-Charge
5	CLAUSE 43: CONDITIONS SPECIFIC TO GREEN BUILDINGS PRACTICES CLAUSE 2. CONSTRUCTION PHASE AND WORKER FACILITIES 2.2 Preserve and Protect Landscape during Construction – b) Page No 104	The contractor shall take steps to protect trees or saplings identified for preservation within the construction site using tree guards of approved specification.	As the entire plot is covered with varying size of trees and bushes, during land development / formation of the plot during the construction the trees need to be cut & removed. The Authority is requested to obtain the necessary Environment Clearances such as Forest NoC, etc. from the appropriate authorities before handing over the site for construction. Kindly Consider.	Refer clause no. 6, page no. 181 of NIT
6. a	Tendernotice_1-Section VII-Terms of Reference-6.0 Scope of Work for Survey, Investigation, Planning, Designing and Construction of National Industrial Township at Agartala-Page No 181	HT Electrical Service connection from local supply agency to the HT energy meter in the premises of the building.	As per the GPRa guidelines the estimated power demand load will be 10MVA. We could not identify the nearest sub-station to provide the power connection for the proposed project. Kindly confirm the location & distance of permanent Source Sub-Station to the proposed township. Kindly Confirm.	An Electrical substation is located in Tripura Mega Food Park which will be the source of electric supply for the proposed Township. Tripura Mega Food Park is located adjacent to the proposed Township.

S No.	Reference	Existing Clauses	Clarification Sought	Replies to Queries
6. b	Source for permanent water supply	Not mentioned in the tender document	Kindly confirm the source of the permanent water supply. Whether the bore well is allowed for the same. Kindly Confirm.	The source of water is only the Ground Water. The successful bidder has to seek permission from the relevant authority for the construction of Bore Well.
6. c	Sewer Line Connection	Sewer Line- During site visit we could not assess the sewer line discharge point surrounding the plot.	Kindly confirm the nearest location for the same.	The successful bidders has to design the Sewerage System as Zero Discharge System. The treated effluent shall be used for the flushing, gardening and horticulture etc.
7	Power Backup System a) Tendemnotice_1-Section-VII- Terms of Reference-11.0 Project Execution-11.12 Domain Experts Requirements-24 x 7 x 365 Back-Up Power Generating System-PDF Page No 210 Tendemnotice_1-Section-VIII- Technical Specifications-15.0 Civil Works-15.1 Broad Technical Specifications of Buildings-Sr. No. 14-Power Backup-Emergency Power backup for common area lighting and one elevator per block; Provision for 1000W power back up for every flat 224	Power Backup System a) 24 x 7 x 365 Back-Up Power Generating System b) Emergency Power backup for common area lighting and one elevator per block; Provision for 1000W power back up for every flat	There is a discrepancy in the Back-Up Power Generating System. We are considering the requirement as specified in Technical Specifications 15.1 Broad Technical Specifications of Buildings-Sr. No. 14-Power Backup under section VIII. Kindly Confirm.	Clause no. 11.12 (a) on page no. 210 shall be followed in respect of Power Backup System
8	Tendemnotice_1-Section-II-Selection & Qualifying Criteria-1.0 Project-HVAC System-PDF Page No 18	HVAC System	The authority is requested to confirm scope of works of HVAC System for residential township. Please Confirm.	The successful bidders has to provide the HVAC in Gymkhana Type Five-Star Club facility only.
9	Tender Drawings	Pdf. available	Kindly provide the drawings in the Auto CAD form.	The Auto CAD drawings shall be shared with the Successful bidder only.

S No.	Reference	Existing Clauses	Clarification Sought	Replies to Queries
10	Tendernotice_1-Section VII-Terms of Reference- 2.0 Project Brief.PDF Page No 179	Sikaria Mega Food Park Private Limited (SMFPL) (A Special Purpose Vehicle (SPV) Under Ministry of Food Processing Industries, Union Government of India) has identified around 11.71 acres of land to develop approx. 28 Lakh sq. ft. area of Saleable carpet area / Built-up area in form of HIG / MIG Residential Township of G+22/24 multiple towers with 5-star club facilities, amenities and accompanying commercial facilities within the complex in the demise land, adjacent to Mega Food Park premises at Agartala city.	<u>Please Provide.</u> There is a discrepancy in the Plot Area to be developed. As per the tender document the proposed plot area is 11.71 Acres, however as the master layout the proposed plot area for the development is found to be approx. 12.74 Acres. Kindly confirm the actual plot area to be developed.	The proposed plot area is 11.71 Acres to develop approx. 28 Lakh sq. ft. area of Saleable carpet area / Built-up area in form of HIG / MIG Residential Township of G+22/24 multiple towers with 5-star club facilities, amenities and accompanying commercial facilities within the complex in the demise land, adjacent to Mega Food Park premises at Agartala city. However, additional 1.08 Acres of Land for the development of "Temple area with allied activities of National Industrial Township (NIT) like Mandir, Senior Citizens Park (Thakurda & Thakurmaa Park) and dedicated NIT Substation / Back-up Power Infrastructure, etc." Additional 0.19 Acres of land area for Common Effluent cum Sewerage Treatment Plant/ System, MLCP etc. Total Actual Plot/ Land Area = $11.71 + 1.08 + 0.19 = 12.98$ Acres and accordingly master layout of the proposed plot area for the development, is included in the Tender Document.

S No.	Reference	Existing Clauses	Clarification Sought	Replies to Queries
Name of the Contractor - M/s Renaatus Projects Pvt Ltd				
1	Similar Work	As per the Tender document page no. 21 for Similar work shall mean completed any Infrastructure Development Projects during last seven years is mentioned	Is Residential development also included or Only Infrastructure development	Residential Developments are also included in the Infrastructure Development Projects
2	General	Soil investigation report	Kindly provide Soil Investigation report	The Soil Investigation Report, is indicative only, is attached with the Corrigendum no. 1. The bidders shall confirm the results in the indicative Soil Investigation Report by their own. No extra claim shall be entertained by the WAPCOS for any variation in size / type of foundation proposed by the Successful Tenderer.
3	General	As per the NIT the Bid security is mentioned in form of Insurance Surety Bonds also	We kindly request you to provide the format for the Insurance Surety Bonds	The bidders may submit the Insurance Surety Bonds from any of the Commercial Banks on the Bank's format.
4	General	Tender Drawings are given in PDF Format	We request you to provide the Auto CADD Drawings for better Understanding.	The Auto CAD drawings shall be shared with the Successful bidder only.
5	General		We request you to provide available survey drawings if any.	Attached with the Corrigendum no. 1.
6	General		During site visit we found the project site to be a terrain with lot of elevation changes from about - 100 feet to +100 feet. Is cutting & filling allowed so that the project can be designed effectively.	The Successful bidders shall propose the methodology for the cutting & filling for the effective design.
7	General	All statutory Approvals are contractor scope	Will the employer pay for the statutory charges or the contractor has to consider for that also in the quote	The Successful bidders has to pay the statutory charges. Refer clause no. 6, page no, 181

S No.	Reference	Existing Clauses	Clarification Sought	Replies to Queries
8	General		Conceptual drawing is provided for Only one type of tower. Kindly provide other drawings also if available.	The Conceptual drawings are tentative only. The successful bidders has to provide the detailed tower wise drawings for approval to the WAPCOS.
9	General		Conceptual drawing required (Electrical, Fire Fighting, Plumbing)	In the scope of the Successful bidder.
10	General	Article 15.5 and Tender Drawings	In Specification of work, Type 2,3,4,5 is provided. But in conceptual drawings Type 1,2,4 & 6 is provided. Kindly clarify	Refer Annexure - I
11	General	It is mentioned to follow PAR - 2021 in Tender document	The latest PAR is 2023. Kindly clarify	As per NIT only
12	General	Estimated cost of the Project	The project development area is provided as 28 Lakh Sqft and the estimated cost is provided as 336 Cr. The overall sqft area comes around Rs. 1200/Sqft which is impossible to construct as per the specifications. Kindly consider revision of the Estimated cost to a reasonable price.	As per NIT only
13	General	Extension of Tender	We kindly request an extension of the Bid Due Date by at least 1 month to enable us to submit a more competitive Price	Refer Corrigendum No. 1 for extension of date
Name of the Contractor - M/s Avighnaa Contractors Pvt Ltd.				
1	Point h) Solvency Certificate	Rs. 134.40 Cr. in original from a Nationalized/ Scheduled Commercial Bank approved by Reserve Bank of India (RBI)	Request to consider the amount as 5 crs.	As per NIT Only
2	Point g) Completed Similar Work Criteria	Note: Similar work shall mean completed any Infrastructure Development Projects during last seven years	Kindly clarify if both Government/Semi-Government and Private works are taken under the category of Similar works	Refer clause no. (g) (i), page no. 21 & 22

S No.	Reference	Existing Clauses	Clarification Sought	Replies to Queries
3	Point g) Completed Similar Work Criteria i) iii)	i) One similar completed work costing not less than 80% of the estimated cost of work.	i) One similar completed work costing not less than 50% of the estimated cost of work.	As per NIT Only.
Name of the Contractor - M/s Renaatus Projects Pvt Ltd				
1	-	High Tension Electrical Line	We have observed a high -tension electrical line running through the site. Should the design be adapted to account for the line or there any plans to relocate the HT line. Kindly clarify	The HT line will not be relocated. The successful bidders has to plan according to the norms and obtain the approvals from the relevant local bodies for the execution.
2	As per Tender Document page no. 18, 320 & 322	The Area Coverage of 28 lakhs Sq. ft.	The area of 28 lakhs Sq. ft is inclusive of Residential building, amenities Blocks, Gymkhana Type Five Star Club facility, Temple, MLCP or Residential Building Saleable area only. Kindly confirm the scope of this area.	The built-up area of 28 lakhs Sq. ft is inclusive of Residential building, Amenities Blocks, Gymkhana Type Five Star Club facility, Temple, MLCP.
3	As per Tender Document page no. 18	The area of 28 lakhs Sq. ft. is mentioned as area of Saleable Carpet area / Built-up area	Kindly confirm whether this area of saleable refers to the carpet area / saleable area.	The area of 28 lakhs Sq. ft. is the Built-up area
4	As per Tender Document page no. 309 and 296	It mentions 8 types of model flats, but the number of units and which model corresponds to which tower is not specified.	Kindly provide the clarity on number of units for each model and the corresponding tower allocation	Refer Annexure-I
5	As per Tender Document page no. 296	As per tender document on page no. 296, they are type 1,2,4,6 is there for which block is for which type. There is no clarity	Kindly clarify the block and unity type allocation	Refer Annexure - I
6	As per Tender Document page no. 314	As per cross section drawing provided in tender document there are having 17 floors but they are so many type for which type having 17 floors. There is no clear clarity.	Kindly clarify which unit types are assigned to these buildings with 17 floors. And also provide floor for each type.	Refer Annexure - I
7	-	HVAC System Requirements	Kindly confirm which buildings (other than residential towers)	The successful bidders has to provide the HVAC in Gymkhana Type Five-Star Club facility only.

S No.	Reference	Existing Clauses	Clarification Sought	Replies to Queries
			require an HVAC, as per GPRA norms	
8	-	STP & WTP Design – Occupancy Details	Kindly provide the number of tenants per unit per tower to assist in designing the STP and WTP system	No. of Tenants shall be as per CPHEEO Manual. For units per tower refer Annexure-I
9	-	Date Extension	As several details are missing in the tender document, which are required for the tentative design, and we need to refer to the applicable norms and codes, we request a 1 months extension for submission of tender.	Refer Corrigendum no. 1

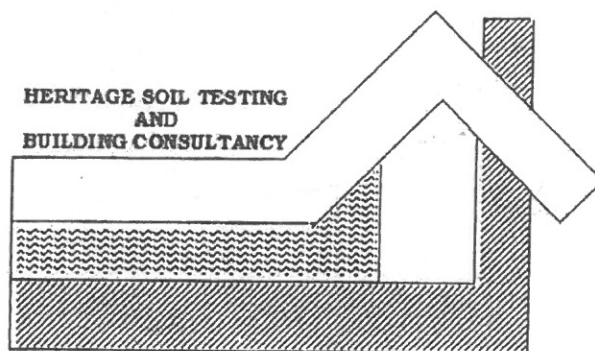
ANNEXURE – I

STATEMENT OF RESIDENTIAL QUARTERS						
Sl. No.	Particulars	2 BHK	2 BHK (S)	3 BHK	4 BHK	Total
1	CPWD Type Quarters	2	3	4 Spl	Spl	
2	Carpet Area of a flat (Sft.)	579.32	659.70	1104.51	1310.57	
3	Clauster No.	1	2	3	4	
4	Tower Nos.	1, 3, 4 & 5	2, 12, 13	9, 10 & 11	6, 7 & 8	
5	No. of Towers	4	3	3	3	13
6	No. of Floors per Tower	G+22	G+22	G+22	G+24	
7	No. of Flats per Floor	12	12	8	2	
8	Total No. of Flats	1056	792	528	144	2520

REPORT ON
GEOTECHNICAL INVESTIGATION OF PROPOSED (G+17) RESIDENTIAL
BUILDING/TOWER OF MEGA HOUSING PROJECT AT UTTAR
CHAMPAMURA AREA, UNDER MOUJA: UTTAR CHAMPAMURA,
TEHSHIL: UTTAR CHAMPAMURA, SUBDIVISION: JIRANIA, DISTRICT:
TRIPURA(W)

Work assigned by:

Sikaria Mega Food Park Pvt. Ltd.
Salt Lake City,
KOL-700064



HERITAGE SOIL TESTING AND BUILDING CONSULTANCY

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FEB-2022

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**REPORT ON
GEOTECHNICAL INVESTIGATION OF PROPOSED (G+17)
RESIDENTIAL BUILDING/TOWER OF MEGA HOUSING PROJECT
AT UTTAR CHAMPAMURA AREA, UNDER MOUJA: UTTAR
CHAMPAMURA, TEHSHIL: UTTAR CHAMPAMURA, SUBDIVISION:
JIRANIA, DISTRICT: TRIPURA(W)**

1. INTRODUCTION

1.1 GENERAL

Sikaria Mega Food Park Pvt. Ltd. Salt Lake City, KOL-700064 has been entrusted with the Geotechnical investigation of proposed (G+17) residential building/tower of Mega housing project at Uttar Champamura area, under Mouja: Uttar Champamura, Tehsil: Uttar Champamura, Subdivision: Jirania, District: Tripura(W). It was necessary to conduct a detailed Geotechnical Investigation work to designing of Foundation Structures coming under this project, and the job was awarded to Heritage Soil Testing and Building Consultancy, Agartala, Tripura (W). A detailed investigation including field and laboratory investigation was required for design of foundation of the structure.

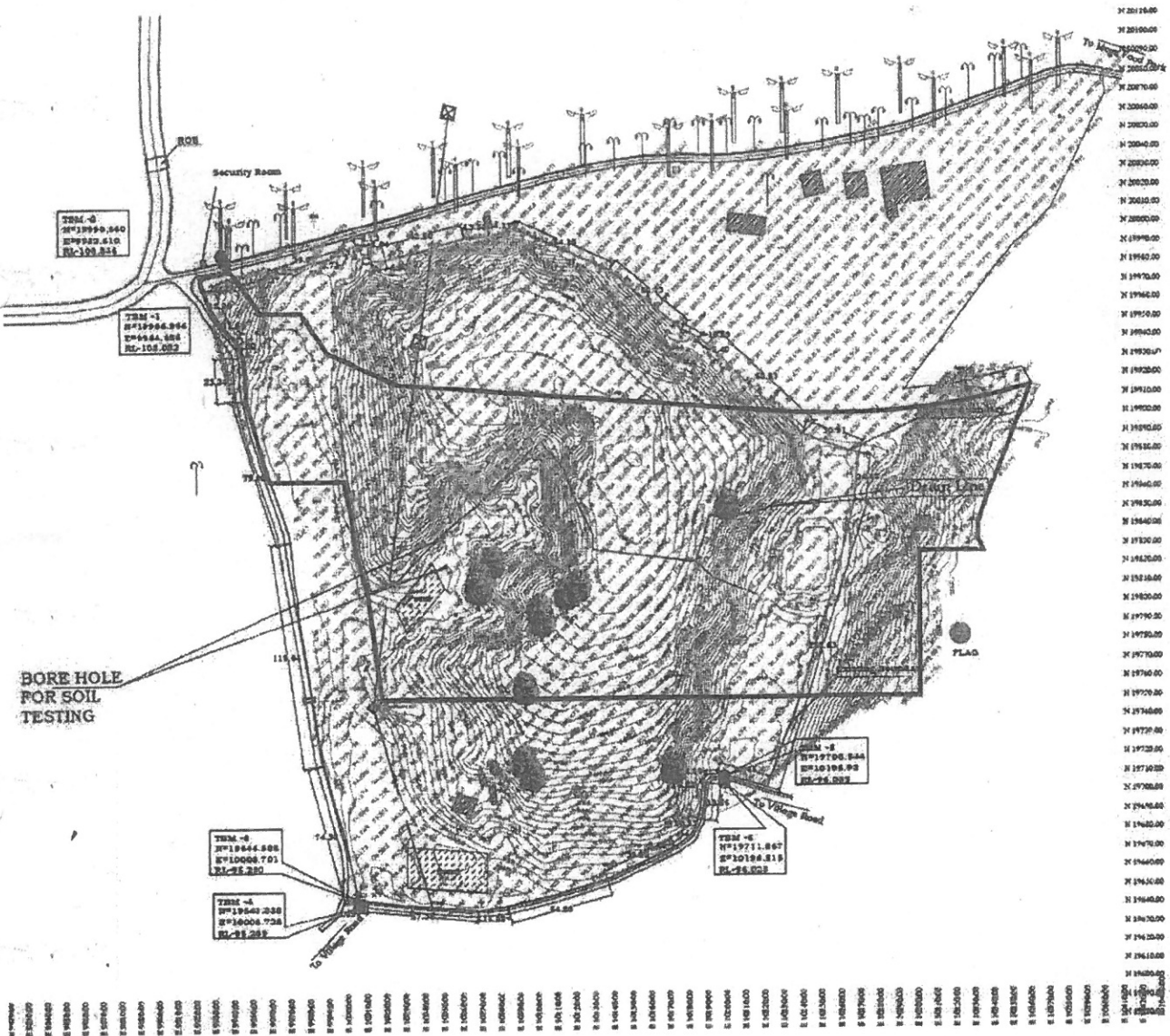
The works consist of sinking one bore holes in the location as shown in the site plan. Boreholes of 150 mm diameter were sunk by auger and wash boring method. The work also incorporated Standard Penetration Tests, collecting disturb soil sample at regular interval for visual inspection and identification of soil layers and collecting undisturbed soil sample at regular interval.

This soil report is prepared based on field and laboratory test results and based on those results; a suitable foundation type is suggested.

The subsoils are of medium quality. The sub soil consists of dark to light grey to yellowish silty-sand soil followed by dark to light grey to yellowish sandy-silt soil. After that a medium dense to dense dark to light grey to yellowish sandy soil is observed and that continued up to the terminating depth of the borehole.

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

1.2 BOREHOLE LOCATION AND SITE MAP



2. SOIL EXPLORATION PROGRAMS

2.1 GENERAL

The subsoils are of medium quality. The sub soil consists of dark to light grey to yellowish silty-sand soil from EGL to 3.0 M depth followed by dark to light grey to yellowish sandy-silt soil extended up to (11.0 – 13.5) M depth. After that a medium dense to dense dark to light grey to yellowish sandy soil is observed and that continued up to the terminating depth 30 M of the borehole. For the proper selection and design of foundation to transfer the superstructure load to the soil, geotechnical investigation was conducted. The whole geotechnical investigation was divided into two parts-

- a) **Field investigation:** Field investigations explore the change of subsurface characteristics with the change of depth.
- b) **Laboratory investigation:** Laboratory investigation helps to determine the physical and engineering properties of sub-surface soil. This investigation helps to determine the bearing capacity, settlement characteristics and foundation depth of the proposed structure.

2.2 FIELD WORK

2.2.1 Boring

Boring job was carried out by Auger and wash boring method to sink nominal 150mm diameter bore hole. Undisturbed soil samples were collected at suitable intervals and it also collect when the soil strata get change. Disturbed soil samples were also collected at regular interval for visual inspection and to recognise the change of strata. Despite of collecting the soil sample, SPT test was also conducted at regular interval.

2.2.2 Sampling

2.2.2.1 Collection of disturb soil sample

During the boring process, disturb soil samples are collected frequently. These disturb soil samples are the representative soil sample which shows the change of strata. Disturb soil samples are collected by using split spoon sampler of SPT apparatus, auger and cutting shoe of undisturbed sampling assembly and stored it in air tight vessels for farther laboratory assessment.

2.2.2.2 Collection of undisturbed soil sample

Undisturbed soil sample were collected at regular interval with 100 mm diameter and 450 mm long sampler. The sampling assembly was driven to its desire depth by means of a jarring link. After collecting the sample, the ends of the sampling tubes were sealed with wax and label and packed in air tight packets and taken to the laboratory.

2.2.3 Standard Penetration Tests

Standard Penetration Tests were conducted in the bore holes at appropriate intervals. Standard Penetration Test (SPT) involves driving a standard thick-walled split spoon sample tube having an outer diameter of 50.8 mm and Inner diameter of 35 mm into the ground at the bottom of a borehole by blows from a slide hammer with standard weight 63.5 kg and falling distance 75 cm. The sample tube is driven 150 mm into the ground and then the number of blows needed for the tube to penetrate each 150 mm up to a depth of 450 mm is recorded. The sum of the number of blows required for the second and third 150 mm of penetration is reported as SPT blow count value, commonly termed "standard penetration resistance" or the "N-value". After each count the split spoon sampler was opened and for the logging purpose, soil specimens were potted in polythene bags.

2.2.4 Measurement of Water Table

After 24 hours of removal of casing, standing water level was measured it is presented in the profile. The level of ground water is subjected to the climate change.

2.3 LABORATORY TESTS

Following laboratory tests are conducted on the soil samples which are collected from the field exploratory program.

1. Grain size analysis;
2. Determination of Specific Gravity;
3. Determination of Consistency limit;
4. Determination of Natural moisture Content;
5. Determination of Bulk & Dry Unit Weight;
6. Direct Shear Test; and
7. One-dimensional Consolidation Test

Detail descriptions of the laboratory experimental programs are presented in the following section.

3. LABORATORY TESTING

Laboratory experiments of the field samples are essential parts of the sub-soil investigation. All the laboratory investigation are conducted as per IS 2720 for proper classification and identification of the sub-soil deposits.

1. **Grain Size Analysis:** Grain size analysis is consisting of two separate test-
 - a) **Sieve analysis:** 75 μ sieve is used for wet sieve analysis to separate sand and above size particles from silt and clay size particles. After that a dry sieve analysis is conducted with retain particles on 75 μ sieve and identify the percentages of gravel and sand size particles.
 - b) **Hydrometer analysis:** Hydrometer analysis is conducted to determine the percentages of silt and clay size particles present in soil samples.
2. **Determination of Specific Gravity:** Specific gravity is defined as the ratio of weight of a given volume of dry soil solids to the weight of equal volume of distilled water at 27°C.
3. **Determination of Consistency limit:** The limiting water content when a soil mass passes from liquid to plastic state of consistency is termed as liquid limit, and the limiting water content when a soil mass passes from plastic to semi-solid state of consistency is termed as plastic limit. Fine grained cohesive soils are classified by liquid and plastic limit. From liquid limit and plastic limit, we can find flow index, toughness index and plasticity index.
4. **Determination of Natural moisture Content:** Natural moisture content is defined as the ratio of weight of water present to the weight of dry soil in a given in-situ soil mass. To determine the moisture content a thermostatically controlled dry oven, capable of maintaining temperature of 105 to 110°C.
5. **Determination of Bulk & Dry Unit Weight:** Bulk unit weight of soil is defined as its weight per unit volume. Dry unit weight of soil is defined as the weight of soil solids per unit of total volume of the soil mass.
6. **Direct Shear Test:** direct shear test is conducted to determine shear strength parameters of a soil sample at known unit weight and water content. The shear parameter C and ϕ are used for calculation of bearing capacity of soil-foundation system.

7. **One-dimensional Consolidation Test:** When load is applied on a saturated soil, pore water pressure develops. The expulsion of pore water pressure reduces the volume of soil. The reduction of volume of soil due to expulsion of pore water pressure is defined as consolidation. Soil data obtained from consolidation are useful for calculation of foundation settlement under a range of stresses at any given time.

4. STATE OF SUB-SOIL AND PROPERTIES

4.1 GENERAL

Detailed sub-soil condition is presented in this section. Sub-soil condition is explored by the results obtained from field experimental work and laboratory test results. A generalised soil profile is given in this section of the report, from where it is possible to identify the sub-soil stratification and properties of different layers of sub-soil.

4.2 SUB-SOIL CONDITIONS

The bore log report shown in the appendix is presented from the field logs after proper modifications in the light of the laboratory test results and observation of disturb and undisturbed soil samples. The general sub-soil profile obtained from the in-situ and laboratory test results are presented in appendix. The laboratory tests results data sheets as well as 'N' values are also presented in the appendix.

4.3 GNERALISED SOIL PROFILE

Generalised soil profile is shown in appendix. This soil profile gives description, consistency and colour of each stratum.

4.4 SUB-SOIL STRATIFICATION

Distinct three layers are observed from existing ground level to the maximum boring depth. The subsoils are of medium quality. The sub soil consists of dark to light grey to yellowish silty-sand soil from EGL to 3.0 M depth followed by dark to light grey to yellowish sandy-silt soil extended up to (11 – 13.5) M depth. After that a medium dense to dense dark to light grey to yellowish sandy soil is observed and that continued up to the terminating depth 30 M of the borehole.

4.4.1 Stratum – I [0.00 – 3.00 M]

In this layer of soil is extended up to 3.00 M from existing ground level. This layer is constituted of dark to light grey to yellowish silty-sand soil. The average corrected 'N' value of this layer is 2. The average soil properties of this layer are presented Table 4.1.

4.4.2 Stratum – II [3.00 – 13.50 M]

This soil layer is characterized by dark to light grey to yellowish sandy-silt soil. The average corrected 'N' value of this layer is 18. The average soil properties of this layer are presented Table 4.2.

4.4.3 Stratum – III [13.50 M – 30.00 M]

This soil layer is characterized by medium dense to dense dark to light grey to yellowish sandy soil. The average corrected 'N' value of this layer is 43. The average soil properties of this layer are presented Table 4.3.

Table 4.1 Basic soil properties of stratum – I (BH02)

In-situ Moisture Content (%)	21
Liquid Limit (%)	35
Plastic Limit (%)	21
Bulk unite weight, (t/m ³)	2.08
Specific Gravity	2.64
Void Ratio (e _o)	0.615
Grain Size	
Sand (%)	47
Silt (%)	43
Clay (%)	10
TRSH-UU	
C (kg/sqcm)	0.13
Φ	6°

Table 4.2 Basic soil properties of stratum – II (BH02)

In-situ Moisture Content (%)	28
Liquid Limit (%)	39
Plastic Limit (%)	24
Bulk unite weight, (t/m ³)	2.13
Specific Gravity	2.67
Void Ratio (e _o)	0.64
Grain Size	
Sand (%)	38
Silt (%)	49
clay (%)	13
TRSH-UU	
C (kg/sqcm)	0.45
Φ	5°

Table 4.3 Basic soil properties of stratum – III (BH02)

In-situ Moisture Content (%)	14.00
Liquid Limit (%)	-
Plastic Limit (%)	-
Bulk unite weight, (t/m ³)	-
Specific Gravity	2.60
Void Ratio (e _o)	0.41
Grain Size	
Sand (%)	84
Silt + clay (%)	16

4.5 VARIATION OF 'N' CORRESPONDING TO DEPTH

'N' values are used to determine the bearing capacity and density of soil. The General Soil Profile and bore log shown in appendix correspondingly presented the recorded 'N' values of different soil strata. The corrected 'N' values are given in the Table 4.3 and also presented in Appendix.

Table 4.3 Strata wise corrected 'N' value

Stratum No.	Corrected 'N' Value		
	Minimum	Maximum	Average
I (0.00 – 3.00) M	2	3	2
II (3.00 – 13.50) M	8	29	18
III (13.50–30.0) M	34	52	43

5. ANALYSIS AND DISCUSSIONS

5.1 GENERAL

Detail field tests and laboratory analysis of soil sample has been conducted. Based on the laboratory & field tests results, it has been observed that the sub-soil comprised of medium quality foundation soil up to 13.5 M depth and after that a good dense sand layer is observed.

Considering the subsoil condition and the type of structures to be constructed at the present site, it is suggested to go for deep foundation. Bearing capacity is calculated based on average strength parameters & layer stratification around BH-02 location. Safety of the proposed structure is checked based on shear strength and settlement criteria.

5.2. USE OF R.C BORED PILE

By considering the subsoil conditions which are assessed by field and laboratory tests results and the proposed structure to be constructed at the present site, deep foundation in form of piles should be used. Bored cast in-situ piles are preferred due to availability of construction agencies; ease of construction and less sound pollution. Such piles may be placed at 30.0 M below EGL.

While determining the pile capacity, the following considerations are made.

- i) Assumed Grade of Concrete = M25
- ii) Diameter of pile used = 600 mm, 750 mm & 1000 mm
- iii) Cut off level is considered = 2.50 M
- iv) Length of pile below cut-off Level = 27.50 M
- v) FOS of shaft resistance = 3.0
- vi) FOS for end bearing = 3.0

LOAD CARRYING CAPACITY:

PILES IN GRANULAR SOILS

The ultimate bearing capacity (Q_u) of piles in granular soils is given by the following formula:

$$Q_u = A_p(0.5D\gamma N_\gamma + P_D N_q) + \sum_{i=1}^n K \tan \delta P_{Di} A_{si}$$

Where,

A_p = Cross-sectional area of pile toe in cm^2 ;

D = Stem diameter in cm;

γ = Effective unit weight of soil at pile toe in kgf/cm^3 ;

P_D = Effective overburden pressure at pile toe in kgf/cm^2 ;

N_r and N_q = Bearing capacity factors depending upon the angle of internal friction ϕ at toe;

$\sum_{i=1}^n$ = Summation for n layers in which pile is installed;

K = Coefficient of earth pressure;

P_{Di} = Effective overburden pressure in kg/cm^2 for the i^{th} layer where i varies from 1 to n ;

δ = Angle of wall friction between pile and soil, in degrees (may be taken equal to ϕ); and

A_{si} = Surface area of pile stem in cm^2 in the i^{th} layer where i varies from 1 to n .

PILES IN COHESIVE SOIL

$$Q_u = A_p C_p N_c + \alpha C A_s$$

A_p = Cross sectional area of pile toe in cm^2 ,

N_c = Bearing capacity factor usually taken as 9,

C_p = average cohesion at pile tip in kg/cm^2 ,

Q = reduction factor,

C = Average cohesion throughout the length of pile in kg/cm^2 , and

A_s = Surface area of pile shaft in cm^2 .

5.3. DESIGN STRENGTH PARAMETERS

STRATUM – II:

Average N in this layer = 18

From Laboratory TRSH UU test results, average $C = 0.45 \text{ kg/sqcm}$ and use $\Phi = 0^\circ$

Total soil modulus, $E_s = 4.4 \times N = 79.2 \text{ kg/sqcm}$

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

Undrained Young's modulus, $E_u = K \times C = 400 \times 0.45 = 180.0 \text{ kg/sqcm}$

Again, $1/E_s = 1/E_u + 1/E_d$ giving drained young's modulus, $E_d = 141.42 \text{ kg/sqcm}$

Now, we have, $E_d = E_u/3 = 60.0 \text{ kg/sqcm}$

STRATUM – III:

Design corrected " N " in this layer = 43

Assuming fine particle content to be more than 5%.

For $N = 43$ corresponding Relative Density (D_r) = 78 %

Hence, Friction angle $\Phi_1 = 25 + 0.15 \times D_r = 25 + 0.15 \times 78.0 = 36.7^\circ$

For bored cast-in-situ piles the soil get loosened during boring.

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Poulos (1980) suggested that $\Phi = (\Phi_1 - 3) = (36.7 - 3) = 33.7 \approx 33^\circ$

So, let us use, $C = 0.00 \text{ kg/sqcm}$ & $\Phi = 33^\circ$.

Use $K_o = 1.00$

SAMPLE PILE CAPACITY CALCULATION

Bottom depth of pile below EGL = 30.0 M

Bottom depth of pile below cut-off level = 27.5 M

Cut-off length = 2.5 M

Diameter of pile = 600 mm

FOS of shaft resistance and End bearing = 3.0

Layer	Top depth (M)	Bottom depth (M)	Eff. Depth (M)	Cohesion (kg/sqcm)	ϕ (degree)	Adhesion (α)
I	2.5	3.0	0.50	0.13	0	1
II	3.0	13.5	10.50	0.45	0	1
III	13.5	30.0	16.50	0	33	1

For Skin friction:

Layer	Ultimate Shaft resistance (T)	Safe Shaft Resistance (T)
I	$\alpha \times C \times A_s = 1.22$	0.40
II	$\alpha \times C \times A_s = 89.02$	29.67
III	$K \times \tan \delta \times P_{Di} \times A_{si} = 259.04$	86.34
Total safe shaft resistance (T)		116.41

For end bearing:

Cohesion $C = 0 \text{ kg/sqcm}$

Frictional angle = 33°

$N_q = 27.34$

$N_\gamma = 37.77$

Effective overburden pressure $P_D = 12.84 \text{ t/sqm}$

Ultimate end bearing = $A_p (0.5 D_\gamma N_\gamma + P_D N_q)$

$$= \frac{\pi \times 0.6^2}{4} \{ (0.5 \times 0.6 \times 1.2 \times 37.77) + (12.84 \times 27.34) \}$$

$$= 103.10 \text{ T}$$

Safe end bearing = 34.36 T

Total Pile capacity = $(116.41 + 34.36) = 150.77 \text{ T}$

Recommended pile capacity = 142 T

5.4 DETERMINATION OF VERTICAL PILE CAPACITY

Based on the different strength parameters of different layers, the pile capacity values are calculated and presented below. Calculations are conducted as per IS: 2911 (Part 1 / Sec 2) - 2010 and a sample calculation is shown in separate sheet.

Borehole No.	Depth below maximum cut-off Level 2.5 (m)	Pile diameter (mm)	Recommended vertical pile capacity (Ton)
01	27.50	600	142
		750	220
		1000	400

Note: Pile load test should be conducted to determine the pile capacity as per IS: 2911, Part 4

5.5 HORIZONTAL PILE CAPACITY

Considering the subsoil condition and laboratory test data,

Use design $C = 0.29 \text{ kg/sqcm}$ with zero overhang for lateral pile capacity calculation.

Refer to IS: 2911 (Part I/Sec 2) - 2010, Appendix - C

Constant Factor, $k_1 = 1.08 \text{ kg/cucm}$ corresponding to Cohesion = 0.29 kg/sqcm

Now, $K = (k_1/1.5) \times (30/D)$ which is coming as 0.36 kg/cucm [D = Pile dia in cm]

Stiffness factor, $R = [EI/KD]^{1/4}$

Now, $I = 0.636 \times 10^8 \text{ cm}^4$ [for 600mm dia pile]

$E = 5000 \times (f_{ck})^{0.5} = 5000 \times (25)^{0.5} = 25000 \text{ N/sqmm} = 2.5 \times 10^5 \text{ kg/sqcm}$

Hence, $R = 292.91 \text{ cm}$

From Graph (Fig.4 of IS: 2911 (Part I/Sec 2) - 2010, Appendix - C),

$L_f = 1.95 \times R = 571.17 \text{ cm}$ [Assuming Fixed Head Piles]

Pile Head deflection, $Y = (H \times L_f^3) / (12EI) = 0.98 \text{ mm}$ for 1T load

So, for 5 mm horizontal deflection at cut-off level, $H = 5.10T$.

Now, Moment = $[H \times L_f/2] = [1 \times 5.71/2] = 2.85 \text{ t-m}$ per T of thrust

The Reduction Factor for computation of Maximum Moment in Pile, $m = 0.70$

So, the corrected actual moment, $M = 2.85 \times 0.70 = 1.99 \text{ t-m}$ per T of thrust

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5.6 CHEMICAL TESTS:

Chemical tests were performed on a soil sample for determining the pH value, Sulphate and Chloride content. The results are given below:

CHEMICAL TEST RESULTS ON SOIL SAMPLE:

BH No: BH02 UDS01

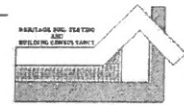
Depth (m): 2.0

pH : 6.10

Sulphate as SO₃ % : Below detection level (<0.05%)

Chloride as Cl % : 0.007

It is seen that the values are within permissible limits (as per IS 456). So, no special cement will be required for foundation concrete. Either Ordinary Portland cement or Portland slag cement or Portland Pozzolana cement can be used for the construction.



6. SUMMERY AND CONCLUSION

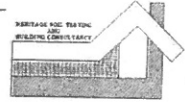
Based on the field and laboratory test results followings are summarised below:

1. Distinct three layers are observed from existing ground level to the maximum boring depth. The subsoils are of medium quality. The sub soil consists of dark to light grey to yellowish silty-sand soil from EGL to 3.0 M depth followed by dark to light grey to yellowish sandy-silt soil extended up to (11 – 13.5) M depth. After that a medium dense to dense dark to light grey to yellowish sandy soil is observed and that continued up to the terminating depth 30 M of the borehole.
2. The standing water table was observed at depth of 3.0 M below E.G.L. during the time of investigation.
3. By considering the subsoil conditions which are assessed by field and laboratory tests results, and the proposed structure to be constructed at the present site, deep foundation in form of piles (as per IS 2911, Part 1/Sec 2) is required for higher load caring capacity. Bored cast in-situ piles are preferred due to availability of construction agencies; ease of construction and less sound pollution. Such piles may be placed at 30.0 M below EGL. The vertical pile capacity has been determined in the previous section. However, the recommended pile capacity values for different pile diameter are presented below.
4. The options of foundation discussed above are strictly applicable corresponding to the allowable bearing capacity mentioned and it depend on the super structure load, which is liable to structural designer. Seismic force has not been taken under consideration in this report.

Depth below maximum cut-off Level 2.50 (m)	Pile diameter (mm)	Recommended pile capacity			
		Vertical pile capacity (Ton)	Lateral (H) (Ton)	Moment (t-m per T of thrust)	Length of fixity (L _f) (m)
27.5	600	142	5.10	1.99	5.71
	750	220	8.33	2.35	6.74
	1000	400	12.82	2.92	8.37

Note: Pile load test should be conducted to determine the pile capacity as per IS: 2911, Part 4

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5. Chemical tests were performed on few soil samples to determine the pH value, Sulphate and Chloride content. It is seen that the values are within permissible limits (as per IS 456). So, no special cement will be required for foundation concrete. Either Ordinary Portland Cement or Portland slag cement or Portland Pozzolana cement can be used for the purpose.

For Heritage Soil Testing and Building Consultancy

Prepared By

Approved By

Er. PRADIP DAS

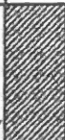
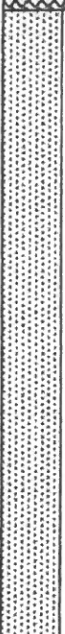
DR. ARPAN LASKAR

Mega housing project at Uttar Champamura area, under design
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APPENDICES

Mega housing project at Uttar Champamura area, under Mouja: Uttar Champamura,
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BORE LOG DATA SHEET

Created by: P. Das; Created on: 03-01-2022				DS means Disturb Sample; UDS means undisturb soil sample; N means SPT value; E.G.L means Existing Ground Level					
Site: Mega Food park, Nagicherra									
Depth from E.G.L.(M)	BH 01	Soil Description E.G.L	Thick-ness (m)	S.P.T. (N.Value)			N-Value	Depth (m)	Ref. No.
				0.0mm to 150 mm	150 mm to 300 mm	300 mm to 450 mm			
3.0 M		Dark to light grey to yellowish silty-sand soil	3	1	1	2	3	0.5	DS01
								1.0	DS02
		Dark to light grey to yellowish sand-silt soil	8.0					1.5	SPT01
							2.00 - 2.45	UDS01	
				1	1	2	3	3.0 - 3.60	SPT02
				3	3	5	8	4.5 - 5.10	SPT03
				12	12	15	27	6.0 - 6.60	SPT04
				13	16	22	38	7.5 - 8.10	SPT05
				20	20	28	48	9.0-9.60	SPT 06
				20	26	34	60	10.5-11.10	SPT 07
				27	35	42	77	12.0-12.6	SPT 08
				25	37	47	84	13.5-14.10	SPT 09
				28	40	52	92	15.0-15.60	SPT 10
				32	45	51	96	16.5-17.10	SPT 11
				28	38	54	92	18.0-18.6	SPT 12
				30	40	55	95	19.5-20.6	SPT 13
				25	39	59	98	21.0-21.6	SPT 14
				32	46	61	107	22.50-23.6	SPT 15
				40	52	60	112	24.0-24.60	SPT 16
				51	67	71	138	25.5-26.10	SPT 17
	46	71	87	158	27.0-27.60	SPT 18			
	40	69	89	158	28.5-29.10	SPT 19			
30.00 M		Dark to light grey to yellowish sandy soil	19.0	42	66	95	161	30.0-30.6	SPT 20

Mega housing project at Uttar Champamura
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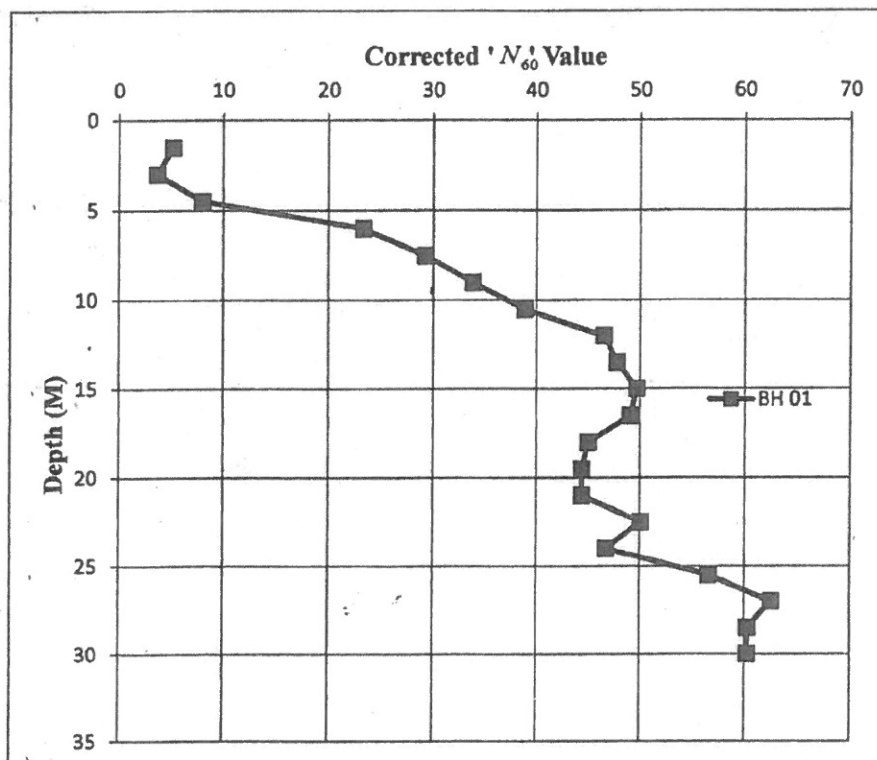
BORE LOG DATA SHEET

Created by: P. Das; Created on: 03-01-2022				DS means Disturb Sample; UDS means undisturb soil sample; N means SPT value; E.G.L means Existing Ground Level					
Site: Mega Food park, Nagicherra				S.P.T. (N.Value)					
Depth from E.G.L. (M)	BH 02	Soil Description E.G.L	Thick-ness (m)	0.0mm to 150 mm	150 mm to 300 mm	300 mm to 450 mm	N-Value	Depth (m)	Ref. No.
3.0 M		Dark to light grey to yellowish silty-sand soil	3	0	1	1	2	0.5	DS01
								1.0	DS02
								1.5	SPT01
13.5 M		Dark to light grey to yellowish sand-silt soil	8					2.00 - 2.45	UDS01
				1	1	1	2	3.0 - 3.60	SPT02
				3	3	5	8	4.5 - 5.10	SPT03
				12	12	15	27	6.0 - 6.60	SPT04
				6	11	16	27	7.5 - 8.10	SPT05
				11	14	21	35	9.0-9.60	SPT 06
				14	17	24	41	10.5-11.10	SPT 07
				18	20	27	47	12.0-12.6	SPT 08
				25	26	37	63	13.5-14.10	SPT 09
				28	28	40	68	15.0-15.60	SPT 10
				25	33	40	73	16.5-17.10	SPT 11
				30	37	42	79	18.0-18.6	SPT 12
				25	36	38	74	19.5-20.6	SPT 13
				25	35	40	75	21.0-21.6	SPT 14
				22	39	45	84	22.50-23.6	SPT 15
				26	42	56	98	24.0-24.60	SPT 16
30.00 M		Dark to light grey to yellowish sandy soil	19	34	59	68	127	25.5-26.10	SPT 17
				30	55	70	125	27.0-27.60	SPT 18
				35	64	77	141	28.5-29.10	SPT 19
				36	65	91	156	30.0-30.6	SPT 20

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CORRECTION FOR STANDARD PENETRATION TEST VALUES

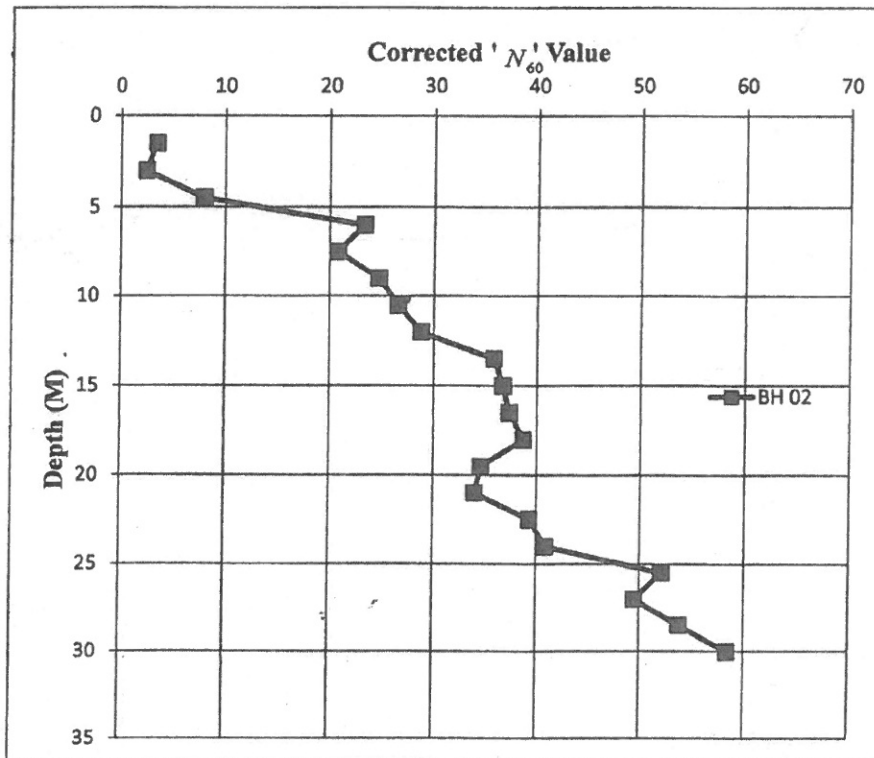
Bore Hole No	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Value	Corrected N_{60}	Stratum
BH01	1.5	3.0	1.5	3	5	I
BH01	3.0	4.5	1.5	3	4	I
BH01	4.5	6.0	1.5	8	8	II
BH01	6.0	7.5	1.5	27	23	II
BH01	7.5	9.0	1.5	38	29	II
BH01	9.0	10.5	1.5	48	34	II
BH01	10.5	12.0	1.5	60	39	II
BH01	12.0	13.5	1.5	77	47	III
BH01	13.5	15.0	1.5	84	48	III
BH01	15.0	16.5	1.5	92	50	III
BH01	16.5	18.0	1.5	96	49	III
BH01	18.0	19.5	1.5	92	45	III
BH01	19.5	21.0	1.5	95	44	III
BH01	21.0	22.5	1.5	98	44	III
BH01	22.5	24.0	1.5	107	50	III
BH01	24.0	25.5	1.5	112	47	III
BH01	25.5	27.0	1.5	138	57	III
BH01	27.0	28.5	1.5	158	63	III
BH01	28.5	30.0	1.5	158	60	III
BH01	30.0	31.5	1.5	161	60	III



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CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Value	Corrected N_{60}	Stratum
BH01	1.5	3.0	1.5	2	3	I
BH01	3.0	4.5	1.5	2	2	I
BH01	4.5	6.0	1.5	8	8	II
BH01	6.0	7.5	1.5	27	23	II
BH01	7.5	9.0	1.5	27	21	II
BH01	9.0	10.5	1.5	35	25	II
BH01	10.5	12.0	1.5	41	27	II
BH01	12.0	13.5	1.5	47	29	II
BH01	13.5	15.0	1.5	63	36	III
BH01	15.0	16.5	1.5	68	37	III
BH01	16.5	18.0	1.5	73	37	III
BH01	18.0	19.5	1.5	79	39	III
BH01	19.5	21.0	1.5	74	35	III
BH01	21.0	22.5	1.5	75	34	III
BH01	22.5	24.0	1.5	84	39	III
BH01	24.0	25.5	1.5	98	41	III
BH01	25.5	27.0	1.5	127	52	III
BH01	27.0	28.5	1.5	125	50	III
BH01	28.5	30.0	1.5	141	54	III
BH01	30.0	31.5	1.5	156	58	III



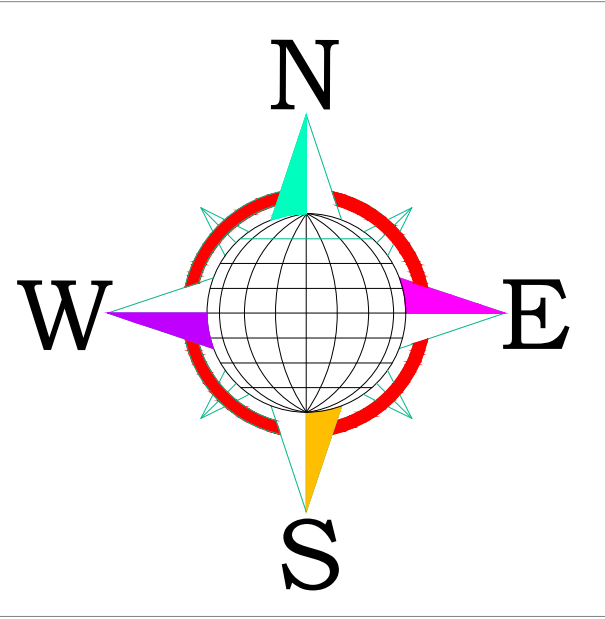
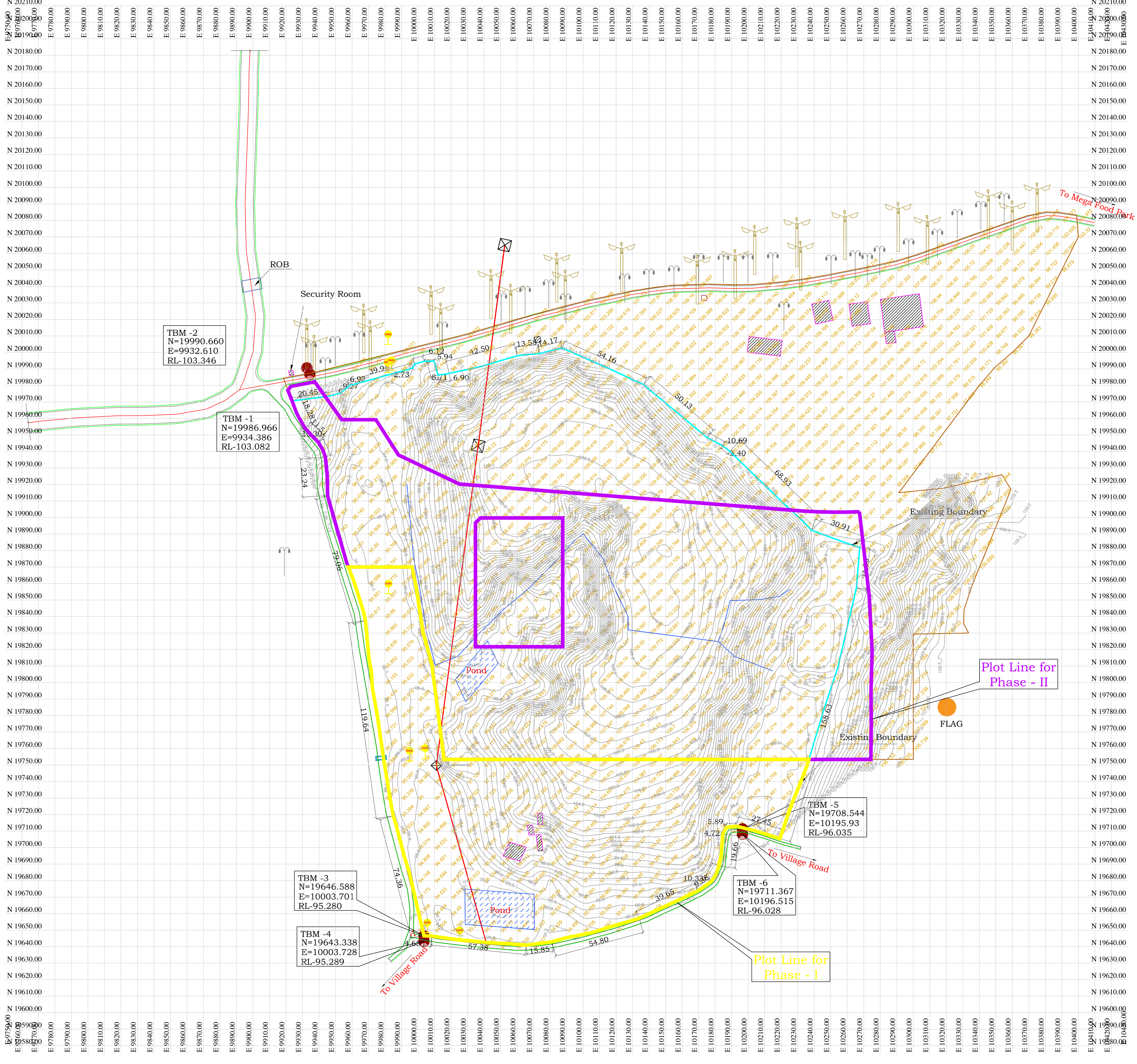


Job: Geotechnical investigation of proposed (G+17) residential building/tower of
Mega housing project at Uttar Champamura area under Mouja: Uttar Champamura,
Tehsil: Uttar Champamura, Subdivision: Jirania, District: Tripura(W)
Work Assigned by: Sikaria Mega Food Park Pvt. Ltd. Salt Lake City, KOL-700064
Job No: HSTBC/2022/P102

Laboratory Test Results

Bore Hole No	Sample Type no. Depth in mtr. Below G.L.,	Description of Strata	Physical Characteristics					Unconfined Comp. Test Cohesion 'C' (t/m ²)	Triaxial Shear Test		Composition		
			Natural Moisture Content (%)	Bulk Density (t/m ³)	Atterberg Limit (%)		Specific Gravity		Cohesion 'C' (kg/cm ²)	Friction ϕ	Sand (%)	Silt (%)	Clay (%)
					LL	PL							
02	UDS 01	Dark to light grey to- yellowish silty-sand soil	21.00	2.08	35.00	21.00	2.64	-	0.13	6	47.00	43	10.0
02	SPT 06	Dark to light grey to yellowish sand-silt soil	28.00	2.13	39.00	24.00	2.67	-	0.45	5	38.00	49.00	13.0
02	SPT 16	Dark to light grey to yellowish sandy soil	14.00	-	-	-	2.60	-	0	33	84.00	16.00	

Site : Mega Food park, Nagicheera



-: Note :-

1. ALL THE DIMENSIONS ARE IN 'M' UNLESS OTHERWISE SPECIFIED.
2. AREA AS PER SURVEY :- 31.867 ACRES.
3. THE GRID INTERVAL IS TAKEN AS 10.00 MTR.
4. THE CONTOUR INTERVAL IS TAKEN 0.50 MTR.
5. THE SPOT LEVEL IS TAKEN IS 10.00 MTR.

-: Project Title :-

Topographical & Contour Survey
of Mega Food Park Extention
Area at Nagicherra (West
Tripura).

-: Job Entrusted By :-

Sikaria Mega Food Park Pvt Ltd
(SPV), CF-9 SECT.-1 , Salt Lake
City , KOL-700064

-: Consultant By :-

Omega Consultancy Services
East site of Central Jail , Agartala ,
Tripura (West)

-: Legend :-

GAIL Row -	
Existing Boundary Line -	
TBM -	
Tree -	
Spot Level -	
Contour Line -	
Contour RI -	
Road -	
Culvert -	
HT Line -	
Gate -	
HUT -	
Sureved Boundary-	

SCALE -	1 : 1150
DATE -	30-11-2021
DRAWING BY -	R.DAS
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