M/s HLL Infra Tech Services Ltd. (HITES) (Subsidiary of HLL Lifecare Ltd, A Government of India Enterprise)

HITES/IDN/NCA-BHU/EPC/Amendment-01/

16.12.2023

 Name of the work:
 Construction of National Centre of Ageing at IMS, BHU, Varanasi, INDIA on Design, Engineering, Procurement and Construction on (EPC) basis.

 Ref:
 Tender No. HITES/IDN/NCA-BHU/EPC/2023 dated 09.12.2023

The Reply to Pre-Bid Queries and Amendment shall be treated as part of e-tender to be uploaded online duly signed and stamped along with e-tender:

A. Amendment -01 to Existing e-Tender Clauses:

S. No.	Tender Document/ Section No.	Clause/ Sub Clause/Page no.	Existing Clause/Tender Provision	Amended Clause/Provision
1.	NOTICE INVITING E-TENDER/ ECTION I NOTICE INVITING BIDS	/1.2.8 Page no. 1, 2 & 11	Bid Security amount Rs.111.12 Lakhs The bidder shall remit 100% of EMD in approved format	Bid Security amount Rs.135.57 Lakhs The bidder shall remit 100% of EMD in approved format
2.	NOTICE INVITING E-TENDER SECTION-II INSTRUCTIONS TO BIDDERS (ITB)	2.3.20 Award of Contract Page 31	i. Award Criteria: HITES will declare the Bidder ranked L1 as Successful Bidder and proceed to issue Letter of Acceptance (LOA) as per the procedure mentioned in the Bid Document and terms and conditions set out in this Bid document.	i. Award Criteria: HITES will declare the bidder ranked L1 as successful Bidder considering the total bid comprising of Part-A & Part-B. HITES reserves the right to proceed and award the work for Part-A & Part-B together or Part-A & Part-B separately and issue Letter of Award (LOA) on these bases as per the Bid Document and terms and conditions set out in this Bid document. In case, the HITES award the work under Part-A initially and Part-B separately at a subsequent date, then the Part-B of the contract

S. No.	Tender Document/ Section No.	Clause/ Sub Clause/Page no.	Existing Clause/Tender Provision	Amended Clause/Provision
				shall be executed through a supplementary agreement with client at appropriate stage.
3.	NOTICE INVITING E-TENDER , SECTION I NOTICE INVITING BIDS	1.4. Eligibility Criteria Page 13-14	 Similar work shall mean works of: Work consisting of Construction of Minimum Five storied Hospital Building including specialized Electrical and mechanical services i.e., Heat Ventilation and Air Conditioning (HVAC), Fire fighting and Fire Alarm System & Building Management system). Work of specialized E&M services, etc., if executed under a separate contract may also be considered for the purpose of assessing the technical competence only without adding its monetary value for determining the eligibility criteria. AND b. Should have satisfactorily completed at least one completed work costing not less than amount equal to 40% of estimated cost put to tender executed with the RCC Framed Structure in EPC mode during the last 7 years ending last day of the month previous to the one in which tenders are invited. This work may be a part of the above given eligible works at 1.4.1 (a) above or as a separate work. 	Similar work shall mean works of: Work consisting of Construction of Minimum Five storied Hospital Building/Medical College including specialized Electrical and mechanical services i.e., Heat Ventilation and Air Conditioning (HVAC), Fire fighting and Fire Alarm System & Building Management system). Work of specialized E&M services, etc., if executed under a separate contract may also be considered for the purpose of assessing the technical competence only without adding its monetary value for determining the eligibility criteria. AND b. Should have satisfactorily completed at least one completed work costing not less than amount equal to 20% of estimated cost put to tender executed with the any building of RCC Framed Structure in EPC mode during the last 7 years ending last day of the month previous to the one in which tenders are invited. This work may be a part of the above given eligible works at 1.4.1 (a) above or as a separate work.

S. No.	Tender Document/ Section No.	Clause/ Sub Clause/Page no.	Existing Clause/Tender Provision	Amended Clause/Provision
			c. Should have satisfactorily completed at least one completed work of Multistoried RCC framed structure Hospital Building three or more storeys including Finishing Works, Sanitary & Plumbing, Electrical, HVAC, Fire Fighting, Fire Alarm & PA System, CCTV, Lift, DG Sets, Substation, BMS, ETP/STP,WTP including external development work all composite executed under one agreement. This work may be a part of the above given eligible works at 1.4.1 (a) above or as a separate work. Work of specialized E&M and Medical services, etc., if executed under a separate contract may also be considered for the purpose of assessing the technical competence only without adding its monetary value for determining the eligibility criteria.	Or b: The bidder shall associate with a contractor having experience of construction of any building of RCC Framed Structure in EPC Mode. Bidder has to submit MoU with such associate contractor along with his tender and the associate contractor must satisfy the eligibility criteria of having successful completed one work of costing not less than 20% of the estimated cost put to tender with RCC frame structure during the last seven years handing last day of previous month to the one in which tender is invited.
4.	Volume 3 SCC	Specific Conditions of Contract-Scope of Work 1.1 General Page no. 1-3	 For ease of understanding the scope of work, brief description is as given below: Site Survey, Soil Investigation Design &Detailed working drawings for Architecture, Structure, Fire Fighting & FA-PA System, MEP Services, External Development, Landscaping, Tree / Plantation etc. Planning & Design of all E&M equipment. Substation Equipment's Diesel Generating Sets Internal Electrical (Power Wiring & Plugs, 	 System, MEP Services, External Development, Landscaping, Tree / Plantation etc. Planning & Design of all E&M equipment. Substation Equipment's Diesel Generating Sets

S. No.	Tender Document/ Section No.	Clause/ Sub Clause/Page no.	Existing Clause/Tender Provision	Amended Clause/Provision
			Lighting Conductors, Telephone Conduits)	Lighting Conductors, Telephone Conduits)
			• BMS	• BMS
			 Streetlight, Landscape Light & Façade Light, Solar Street Light 	 Streetlight, Landscape Light & Façade Light, Solar Street Light
			Uninterrupted Power Supply	Uninterrupted Power Supply
			HVAC Plant Room, VRV, Split AC's	HVAC Plant Room, VRV, Split AC's
			 Solar Photo Voltaic Power Generation System 	 Solar Photo Voltaic Power Generation System
			Solar Water Heating System	Solar Water Heating System
			Solid Waste Management System	Solid Waste Management System
			 Fire Fighting System, Public Address System 	 Fire Fighting System, Public Address System
			Nurse Call System	Nurse Call System
			 Information Display System & Video Wall in OPD Lobby 	 Information Display System & Video Wall in OPD Lobby
			CCTV System	CCTV System
			LAN, Wi-Fi, IPBAX system	LAN, Wi-Fi, IPBAX system
			Access Control System	Access Control System
			STP/ETP/WTP	• ETP/WTP•
			Centralize RO System	Water Coolers with RO + UV Unit
			Water Coolers with RO + UV Unit	Electric Geysers
			Electric Geysers	Heat Pumps for Hospital Building
			Heat Pumps for Hospital Building	Pneumatic Tube based Fire Suppression

S. No.	Tender Document/ Section No.	Clause/ Sub Clause/Page no.	Existing Clause/Tender Provision	Amended Clause/Provision
			Pneumatic Tube based Fire Suppression System for Main LT Panels and Gas Flooding Fire Suppression System for Data Rooms	System for Main LT Panels and Gas Flooding Fire Suppression System for Data Rooms
			 Electrical Vehicle Charging Stations, DC Fast Charger & accessories Audio Visual System & Stage Lighting for 	 Master Antenna TV (MATV) System including LED Monitors
			 Audito Visual System & Stage Lighting for Auditorium Master Antenna TV (MATV) System 	MGPS, Minor OT
			 including LED Monitors CSSD, MOT (16 Nos.), MGPS, PTTS, Minor OT & Integration Boundary wall /fencing near Main Gates & Security Cabins as per drawing, 	 Green Boundary wall Internal RCC Roads, Open Pathways /Cycle Track/ Building approach /drop off. Covered Path ways, Surface Parking, Covered Path ways, Surface Parking,
			 Internal Compound Wall with Gates &Porta Cabin as shown in Master Plan 	Covered Parking.Storm Water Drains
			 Internal RCC Roads, Open Pathways /Cycle Track/ Building approach /drop off. Covered Path ways, Surface Parking, Covered Parking. 	 Cutting, Filling, &Leveling Landscaping and Horticulture works External Sewerage System, Water- Supply System, Drainage System, Rain Water
			 Storm Water Drains Cutting, Filling, &Leveling 	 Harvesting (R.W.H), Trenches for Services. Under Ground RCC Water & Firefighting
			Landscaping and Horticulture works	 Tanks, RCC Tanks for STP, ETP & WTP. Bore wells
			 External Sewerage System, Water- Supply System, Drainage System, Rain Water Harvesting (R.W.H), Trenches for Services. 	 Signages (Internal & External) Lifts (Passengers & Bed Lifts)

S. No.	Tender Document/ Section No.	Clause/ Sub Clause/Page no.	Existing Clause/Tender Provision	Amended Clause/Provision
			 Under Ground RCC Water & Firefighting Tanks, RCC Tanks for STP, ETP & WTP. Bore wells Signages (Internal & External) Lifts (Passengers & Bed Lifts) Construction and commissioning of building(s) complete along with the above- mentioned services. Items which are not mentioned above but are essential considering functional requirements and according to Medical College & Hospital building must be executed by the Contractor. Obtaining mandatory approvals (Pre & Post Construction) from all local bodies/ State & Central authorities/ Municipal Corporation, EIA (Environmental Impact Assessment) clearance, fire clearance, forest clearance etc. 	 Construction and commissioning of building(s) complete along with the above- mentioned services. Items which are not mentioned above but are essential considering functional requirements and according to Medical College & Hospital building must be executed by the Contractor. Obtaining mandatory approvals (Pre & Post Construction) from all local bodies/ State & Central authorities/ Municipal Corporation, EIA (Environmental Impact Assessment) clearance, fire clearance, forest clearance etc.
5.	Volume 3 SCC	Specific Conditions of Contract-Scope of Work 1.1 General xiii Page no. 3	xiii. The Contractor has to design and construct RCC Box Culvert drain of suitable size as per requirement and also to cater load of the earth and fire tender movement etc. (drain as per location shown in the master plan). All expenditure towards the same to be included in quoted price and nothing extra will be payable.	xiii. The Contractor has to design and construct RCC Box Culvert drain of suitable size as per requirement and also to cater MGPS Copper pipeline, load of the earth and fire tender movement etc. All expenditure towards the same to be included in quoted price and nothing extra will be payable.
6.	Volume 3 SCC	Specific Conditions of Contract-Scope of Work 1.1	xiv. In addition to above Buildings Fire Station and Solid Waste Management Building along with Organic Waste Composter is also to be	Deleted

S. No.	Tender Document/ Section No.	Clause/ Sub Clause/Page no.	Existing Clause/Tender Provision	Amended Clause/Provision		
		General xiv	provided.			
		Page no. 4				
7.	Volume 4 DBR	10. Scale of Amenities (civil)- Hospital block: 2.1 Page no. 12	Water proofing Treatment Raft of Building	Water proofing Treatment Raft of Building and Basement RCC Wall		
8.	Volume 4 DBR	Index: 13.Building Management System Page No. 2	Building Management System	Details attached as Annexure-B		
9.	Volume 4 DBR	10. Scale of Amenities (civil)- Hospital block: 4 Page no. 11	Item of Works	Add: All Aluminum Door and Windows should have Sub-frame/Base Frame		
10.	Volume 6	Tender Drawings	Volume 6 Tender Drawings	Volume 6 Tender Drawings 12. 2023B-S1-HO-AE-110-FRONT AND SIDE ELEVATION (not uploaded Earlier)		

S. No.	Tender Document/ Section No.	Clause/ Sub Clause/Page no.	Existing Clause/Tender Provision	Amended Clause/Provision
11.		General	Soil Investigation Report	Tentative Soil Investigation Report attached as Annexure-C. However, EPC contractor must have carried out proper soil investigation prior to bid.

B. Reply to Bidders' Queries:

S. No.	Tender Document/ Section No.	Clause/ Sub Clause	Existing Clause	Bidder's query	Amended Clause/Reply by HITES
1.	SECTION I NOTICE INVITING BIDS	1.4. Eligibility Criteria	Similar work shall mean works of: Work consisting of Construction of Minimum Five storied Hospital Building including specialized Electrical and mechanical services i.e., Heat Ventilation and Air Conditioning (HVAC), Fire fighting and Fire Alarm System & Building Management system). Work of specialized E&M services, etc., if executed under a separate contract may also be considered for the purpose of assessing the technical competence only without adding its monetary value for determining the eligibility criteria. AND	We request the authority to review the similar works requirements as mentioned herein and for facilitating healthy competition so that more bidder can participate in the bid, please amend the clause as requested below: Construction of Minimum Five storied Hospital Building/Institutional Building including specialized Electrical and mechanical services i.e., Heat Ventilation and Air Conditioning (HVAC), Fire fighting and Fire Alarm System & Building Management system). Work of specialized E&M services, etc., if executed under a separate contract may also be considered for the purpose of assessing the technical competence only without adding its monetary value for determining the eligibility criteria.	Refer Above Amendment 01
			b. Should have satisfactorily completed at least one completed work costing not less than amount equal to 40% of estimated cost put to tender executed with the RCC Framed Structure in EPC mode during the last 7 years ending last day of the month previous to the one in which tenders are invited. This work may	AND b. Should have satisfactorily completed at least one completed work costing not less than amount equal to 40% of estimated cost put to	

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S. No.	Tender Document/ Section No.	Clause/ Sub Clause	Existing Clause	Bidder's query	Amended Clause/Reply by HITES
			be a part of the above given eligible works at 1.4.1 (a) above or as a separate work. AND c. Should have satisfactorily completed at least one completed work of Multistoried RCC framed structure Hospital Building three or more storeys including Finishing Works, Sanitary & Plumbing, Electrical, HVAC, Fire Fighting, Fire Alarm & PA System, CCTV, Lift, DG Sets, Substation, BMS, ETP/STP,WTP including external development work all composite executed under one agreement. This work may be a part of the above given eligible works at 1.4.1 (a) above or as a separate work. Work of specialized E&M and Medical services, etc., if executed under a separate contract may also be considered for the purpose of assessing the technical competence only without adding its monetary value for determining the eligibility criteria.	tender executed with the RCC Framed Structure in EPC mode/Item Rate during the last 7 years ending last day of the month previous to the one in which tenders are invited. This work may be a part of the above given eligible works at 1.4.1 (a) above or as a separate work. AND c. Should have satisfactorily completed at least one completed work of Multistoried RCC framed structure Hospital Building/Institutional Building three or more storeys including Finishing Works, Sanitary & Plumbing, Electrical, HVAC, Fire Fighting, Fire Alarm & PA System, CCTV, Lift, DG Sets, Substation, BMS, ETP/STP,WTP including external development work all composite executed under one agreement. This work may be a part of the above given eligible works at 1.4.1 (a) above or as a separate work. Work of specialized E&M and Medical services, etc., if executed under a separate contract may also be considered for the purpose of assessing the technical competence only without adding its monetary value for determining the eligibility criteria.	

S. No.	Tender Document/ Section No.	Clause/ Sub Clause	Existing Clause	Bidder's query	Amended Clause/Reply by HITES
2.	General	1.2.12	Last date to fill/ upload the bid through e- tendering: 01.01.2024 up to 15:00 Hrs	We are keenly interested to participate in the above bid, but looking into the clarity required for participation in bid as requested above and looking into the size and complexity of project, we request the authority to please extend the bid due date of the project by one month from date of reply from your end for submitting a comprehensive bid.	Terms and Conditions of E- tender Prevails
3.	SECTION I NOTICE INVITING BIDS	1.4. Eligibility Criteria	Construction of Minimum Five storied Hospital Building including specialized Electrical and mechanical services i.e., Heat Ventilation and Air Conditioning (HVAC), Fire fighting and Fire Alarm System & Building Management system). Work of specialized E&M services, etc., if executed under a separate contract may also be considered for the purpose of assessing the technical competence only without adding its monetary value for determining the eligibility criteria.	Since We have executed (G+7) RCC Framed structure Medical College at Karnataka Institute of Medical Science for Government of Karnataka , Karwar we hereby request you to kindly consider this medical college work in Lieu of hospital work.	Refer Above Amendment 01
4.	Section I Notice Inviting Bids	1.4. Eligibility Criteria		Since we have not executed work on EPC Mode basis however, we are align for the same work with consultants & architects for various works done at Government sectors. And we are also fully equipped with associate architect consultant in this type of work so, instead of EPC Mode may be allowed to consider Pre-Tender Tie up with Experience architects and consultants in this field.	Refer Above Amendment 01

S. No.	Tender Document/ Section No.	Clause/ Sub Clause	Existing Clause	Bidder's query	Amended Clause/Reply by HITES
5.	Section I Notice Inviting BIDS	Clause 1.4 of NIT of Tender	Bidders who fulfill the eligibility requirements prescribed in this bid document shall be eligible to apply. Joint ventures are not accepted:	Joint Ventures should be allowed in the Tender, so that specialized agencies could be able to participate in Tender with the most-economical costs which would be beneficial for Project.	Terms and conditions of e- tender prevail
6.	SECTION I NOTICE INVITING BIDS	Clause 1.4 of NIT of Tender		In reference to Clause 1.4.1 of NIT of Tender Document, the definition of 'Similar Work' as should not be confined only to 'Hospital Building', as the Scope of works in this Project are similar to the Industrial and Commercial Projects. Hence, any bidder who has executed similar kind of Five storied building with similar scope of work should also be allowed to participate in the Tender.	Refer Above Amendment 01

Important Note:

- 1. The above Amendment -01 shall form part of the Tender Document and is to be submitted duly signed by the applicants along with their Application.
- 2. All other terms & condition of Tender document remains unchanged.
- 3. For Corrigendum/amendments etc. please refer websites www.hllhites.com, e-Procurement System at NIC's (CPP Portal) https://etenders.gov.in. regularly, separate advertisement will not be made for the same.

Vice President (ID) M/s HLL Infra Tech Services Ltd. (HITES),

END OF AMENDMENT -01

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14. BUILDING MANAGEMENT SYSTEM

1. General

The EPC Contractor shall carry out Engineering, Supply, Installation; Testing & Commissioning of IP based BMS Works as per I/O Summary given below.

BMS Room of adequate size complete with all hardware equipment and software etc. shall be provided in HVAC Plant Room. Chiller Plant Manager will be hooked up/ integrated with BMS System. In addition, 'Display Only' of BMS System shall be provided in Fire Control Room located in Hospital Building with suitable size display monitor.

Complete system shall be hooked on to BMS system; each building shall be controlled individually with additional central controller in plant room. The different buildings shall be interconnected on LAN infrastructure. Proposed BMS system shall be logically structured into three distinctive levels, which are Management Level, Automation Level and Field Level. Each level shall be autonomous from the other. Peer to peer communication shall be possible on all system levels and the system design shall be modular in structure to allow straight forward extensions.

Necessary hardware/software required for hooking up /hand shake of BMS system shall be provided.

State of art Building Management System (BMS) will integrate multiple building functions including equipment supervision and control, alarm management, energy management, information management and historical data collection and archiving. The system shall be modular in nature and shall permit expansion of both capacity and functionality through the addition of field devices / programming. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

2. Scope of Work

The BMS System shall be provided to control and monitor following system as per I-O summary given: -

- HVAC System
- Fire Alarm System
- CCTV
- Access control
- Lifts
- Any other system as per I-O summary but not mentioned above

The BMS system will consist of the following:

Central control station for monitoring, control and Alarm through operator interface station (OIS). Software for Building Management System and energy management system. System integration unit consisting of gateways, interface units etc. Portable operator terminals, Sensors and field devices consisting of but not limited to the following:

- Immersion type temperature sensors
- Duct type temperature sensors
- Outside air and humidity sensors

- ➢ Water flow meter
- Differential pressure switch across the AHU
- > Level switches for indicating water level in cooling towers, tanks etc.
- Water flow switches
- pH Sensor
- TDS Sensor
- Differential pressure transmitters
- Current transducers
- Voltage transducers
- Any other field devices as required.

Stand-alone intelligent 32 bit Direct Digital Controller (DDC), Line/Field Devices etc. for but not limited to the following:

- ➢ HVAC system
- ➢ Fire Alarm system
- Fire Alarm Integration
- CCTV System
- Access Control System
- > HT and LT Panels energy consumption parameters
- DG Sets
- > Air Handing unit & Forced cooling unit
- Lifts/ Elevators

Facility will Commit to provide the annual total building energy consumption data to GRIHA. The plant will operate automatically as per programmed schedule the controllers will estimate the actual requirement on any particular day depending on outside temperature and accordingly decide the lead time required to achieve design inside conditions, in all areas, at the start of offices.

The BMS system shall consists of computer system with LED monitor, printer, mouse, switches, software, system integration units, field instruments, cabling etc. All shall be of latest version.

All standby pumps can be rotated to provide equal wear and tear and reduce fatigue.

The water supply system is controlled and operated as per requirement without any wastage.

All other services are monitored as per requirement. Comprehensive I/O summary with relevant A/I, A/O, D/I, D/O details for all equipment and systems covered under BMS shall be prepared during detailed engineering by the consultant & as per directions of E-I-C.

3.AHU & Fire Damper Integration Control Sequence.

- 1. Smoke detector installed in respective zone after sensing smoke will give signal to Fire Alarm Panel.
- 2. Fire Alarm Panel will give signal to Fire Zone Control Module.
- 3. Fire Zone Control Module will enable the safety interlock in AHU starter panel to trip the

Starter & in turn close the fire damper also.

4. There will be a seamless integration between BMS & Fire System. Parallel the status of the Fire system will enable a soft point in BMS controller which in turn will disable all the start command of the AHUS within the same zone

3. I/O Summary / final quantities shall beprovided as per approved GFC and Shop Drawings as per project requirements.)

SUB-SOIL INVESTIGATION FOR THE PROPOSED CONTRUCTION OF CENTER FOR AGEING AT BANARAS HINDU UNIVERSITY

SUBMITTED TO :

HLL INFRA TECH SERVICE LTD



GEOGLOBAL ENGINEERING PVT. LTD.

D2/106 Om tower, near R.K. Timber, Vibhuti Khand, Gomti Nagar, Lucknow, Uttar Pradesh Mobile: 9415469828,6307534080 E-mail: <u>geoglobleengineering@gmail.com</u>



INTRODUCTION

The Client / Owner have awarded the work to "**HLL INFRA TECH SERVICE LTD**" It was decided to conduct the Geo-technical investigation at the proposed structures.

Fieldwork including Drilling of bore holes and sample collection was carried out. Laboratory tests were conducted on selected soil samples to determine the design parameters, confirming to relevant IS / IRC specifications and the guidelines received from time to time. The report includes the field investigation, laboratory testing, analysis and interpretations of the test results by Geo-technical expert with assessment and recommendations for the properties essential to the design of foundations.

The report includes the field investigation, laboratory testing, analysis and interpretations of the test results by Geo-technical expert with assessment and recommendations for the properties essential to the design of foundations.

The field investigation work at this site was carried out. The following investigation work was carried out 2 boreholes of diameter 150 mm were made within the proposed layout of the structure. The borehole was progressed using manually operated augers and further advanced by use of manually operated shell casing to the desired depth. The boreholes is up to the depth of 20.00 meter.

Scope of This Report

This report contains the following information;

- References
- Planning of geotechnical Investigation
- Standard Penetration test
- Laboratory test
- Data Interpretation
- Bearing Capacity Calculation
- Recommendation





References

SI. No.	Particulars of Properties	Ref: IS Code
1.	Sieve Analysis / Hydrometer	IS: 2720 (Part IV)
2.	Natural Moisture Content / Bulk / Dry Density	IS: 2720 (Part II)
3.	Specific Gravity	IS: 2720 (Part III)
4.	Liquid Limit/Plastic Limit/ Plasticity Index	IS: 2720 (Part V)
5.	Direct Shear Test (for non-cohesive soils / mixed soils / Dry Soils)	IS: 2720 (Part XIII)
6.	Unconfined Compressive Strength Test (for cohesive soils)	IS: 2720 (Part X)
7.	Unconsolidated Un-drained Tri-axial Test (for cohesive soils)	IS: 2720 (Part XI)
8.	Free Swell / Swell Pressure (if swelling is critical)	IS: 2720 (Part XL & XLI)
9.	Consolidation Tests (Cohesive soils below water table and if requirement of foundation design)	IS: 2720 (Part XV)
10.	Chemical Analysis on Soil Samples / water samples	IS: 2720 & IS 3025
11.	Field work including existent ground water table	IS: 1892-1974
12.	Sampling in Undisturbed and Disturbed form	IS: 2132-1986
13.	Standard Penetration Test	IS: 2131-1981
14.	Determination of Bearing Capacity	IS: 6403-1981
15.	Calculation of settlement of foundations	IS: 8009(Part I)- 1976
16.	permissible maximum settlement, differential settlement and angular distortion	IS: 1904-1986





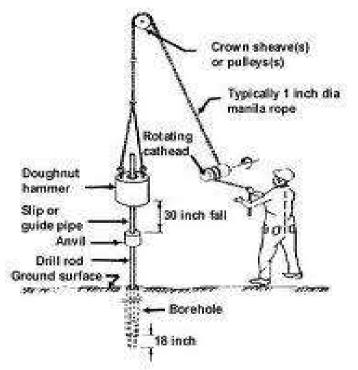
FIELD INVESTIGATION

STANDARD PENETRATION TESTS (SPT)

Standard Penetration Tests (SPT) was conducted as per IS specifications. SPT split spoon sampler of standard dimensions was driven into the soil from the borehole bottom

using 63.5 kg Hammer falling from 75 cm height. The SPT weight was mechanically lifted to the specified height and allowed to fall freely on the anvil with the use of cat-head winch with one to one and half turn of the drum. Blow counts for the penetration of every 15 cm were recorded and the N is reported as the blow counts for 30 cm penetration of the sampler leaving the first 15 cm penetration as seating drive.

When the number of blows exceeded 50 to penetrate the first or second 15 cms length of the sampler, the SPT N is regarded as more than 100. The test is terminated in such case and a record of penetration of the sampler under 50 blows or more is made. SPT refusal is recorded when there is no penetration of the sampler at any stage and also when a rebound of the sounding system is recorded.



CORRELATION FOR	CLAY/PLASTIC SILT	CORRELATION FOR SAND/NON-PLASTIC SILT				
Consistency	Penetration Value	Relative Density	Penetration Value			
Very Soft	0 to 2 Blows	Very loose	0 to 4 Blows			
Soft	3 to 4 Blows	Loose	5 to 10 Blows			
Medium Stiff	5 to 8 Blows	Medium	11 to 30 Blows			
Stiff	9 to 16 Blows	Dense	31 to 50 Blows			
Very Stiff	17 to 32 Blows	Very Dense	Above 50			
Hard	Above 32					

D2/106 Om tower, near R.K. Timber, Vibhuti Khand, Gomti Nagar, Lucknow, Uttar Pradesh Mobile: 9415469828,6307534080 E-mail: geoglobleengineering@gmail.com





Undisturbed Soil Samples (UDS)

Undisturbed soil sample were collected from the boreholes at every 1.50 m interval & change of strata as per sampling specifications, in thin walled sampling tubes of 100 mm dia. and 450 mm length. These sampling tubes after retrieval from the boreholes were properly waxed and sealed at both ends. These were carefully labeled and transported to the laboratory for testing. UDS wherever slipped during lifting, were duly marked in the bore logs as well in the soil profile.

LABORATORY TESTS:

- Natural moisture contents were determined by oven drying method as per IS 2720 (Part II)-1973. The results have been reported in result sheet attached.
- Dry and Bulk density of soil strata were obtained using Shelby tubes in accordance with IS 2720 (Part XXIX)-1975. The results have been reported in result sheet attached.
- Particle size analysis test by hydrometer method were performed in accordance with IS 2720 (Part IV) 1965 on the part of soil samples obtained after the sieve analysis. The results have been reported in result sheet attached.
- Atterberg Limits' tests were performed in accordance with IS 2720 (Part V) 1985 and results have been reported in result sheet attached.
- Specific gravity tests were performed in accordance with IS 2720 (Part III Section1) -1980 and the results have been reported in result sheet attached.
- Tri-axial Compression Test under Unconsolidated Un-drained (UU) condition as per IS: 2720 (Part-XI)-2011 were performed on the undisturbed soil samples obtained during the field investigation. The results have been reported in result sheet attached.
- Direct shear tests were performed as per IS 2720 (Part XIII)-2015, on the undisturbed soil samples obtained during the field investigation. The results and the density of samples have been reported in result sheet attached.
- Consolidation tests were performed as per IS 2720 (Part XV)-1986, on the undisturbed soil samples obtained during the field investigation. The result in the form of compression index (Cc) is reported in result sheet attached.





CONSISTENCY / RELATIVE DENSITY OF SOIL WITH SPT VALUES AS PER IRC: 75-2015

Consistency of Cohesive Soils

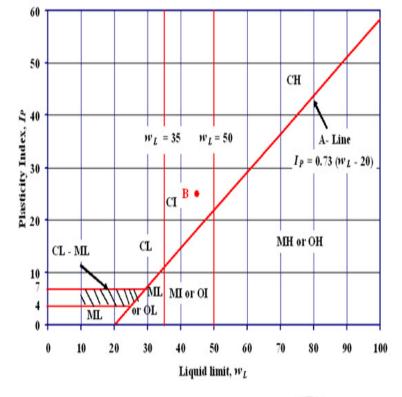
Density Condition of Granular Soils

SPT Value	Consistency
0-2	Very Soft
2-4	Soft
4-8	Medium
8-15	Stiff
15-30	Very Stiff
>30	Hard

SPT Value	Density Descriptor
0-4	Very Loose
4-10	Loose
10-30	Medium Dense
30-50	Dense
>50	Very Dense

Plastic Limit

Plasticity	Liquid Limit
Low Plastic	<35
Medium Plastic	35 to 50
High Plastic	>50





D2/106 Om tower, near R.K. Timber, Vibhuti Khand, Gomti Nagar, Lucknow, Uttar Pradesh Mobile: 9415469828,6307534080 E-mail: <u>geoglobleengineering@gmail.com</u>



Bearing Capacity for Open Foundations in Soil

Bearing capacity for shallow foundations in soil has been analyzed in accordance with IS: 6403-1981, which is based on, modified Terzaghi's classical approach. A factor of safety of 2.5 is selected based on clause 706.3.1.1.1 of IRC 78-2000 to estimate the net safe bearing capacity from ultimate net bearing capacity.

Standard Penetration Test (SPT) results are also used to determine the safe bearing capacity of shallow foundation in accordance with IS: 6403-1981 for non-cohesive soil, hard clay. While using this approach, the N value was corrected, adopted boring procedure, dilation for submerged Silty fine sands /fine sands as well as that due to the overburden pressure (Reference: IS: 2131-1981, "Foundation Analysis and Design" by J.E.Bowles).

Settlement for Open Foundations

Soil deform under the load of foundation structure. Moreover, The magnitude of settlement, when foundation loads are applied, depends upon the compressibility of the underlying strata and rigidity of the substructure. In cohesive deposition, the post construction settlement is caused by dissipation of pore pressures and hence is time dependent so that consolidation settlement is computed for such soils using Terzaghi's consolidation theory. The immediate settlements in cohesion-less soil are estimated using elastic theory as mentioned above or using SPT value as per IS: 8009 (Part 1/2).

DATA INTERPRETATION

The cohesive type soil comprises of either silty clay soil of low and medium plasticity and compressibility or clayey silt soil of low plasticity and compressibility belonging to 'CI' group of IS classification and having 87 to 99 percent material finer than 75 micron.

However, the non-cohesive type soil is found to comprise of either silty sand 'SM' type soil group of IS classification and having 17 to 28 percent fines.

S.P.T. VALUES

The S.P.T. values obtained in the respective clayey layer region present as per bore-log charts enclosed are found to range from 12 to 27 indicating 'Medium' to 'Stiff' consistency.

However, the S.P.T. values obtained in the respective sandy layer region present as per borelog charts enclosed are found to range from 30 to 49 indicating 'Medium' to 'Dense' relative density.





RECOMMENDATIONS

NET SAFE BEARING CAPACITY/SAFE BEARING CAPACITY/GROSS SAFE BEARING

CAPACITY

	Depth of Foundation		Size of	Footing				MODULUS				
Bore Hole	below GL with 2.40 m Basement Floor level	Shape of Footing	Length	Width	Net Safe Bearing Capacity	Settlement Produced	Gross Safe Bearing Capacity	OF SUBGRADE REACTION				
	(m)		(m) (m) Tonne/sqm (mm) Tonne/sqm		Kg/cm3							
	4.50	SQUARE	3.00	3.00	15.86	39.91	20.36					
1	4.50	RECTANGULAR	4.00	3.00	14.14	39.86	18.64	5.96				
_ _	5.00	SQUARE	3.00	3.00	16.41	38.65	20.91	5.90				
	5.00	RECTANGULAR	4.00	3.00	14.64	38.62	19.14					
	4.50	SQUARE	3.00	3.00	16.74	41.19	21.24					
2	4.50	RECTANGULAR	4.00	3.00	14.93	41.14	19.43	5.90				
	5.00	SQUARE	3.00	3.00	17.32	39.90	21.82	5.90				
	5.00	RECTANGULAR	4.00	3.00	15.46	39.88	19.96					
	FOR RAFT											
1	4.00	RECTANGULAR	20.00	10.00	11.75	59.01	16.25	5.96				
2	4.00	RECTANGULAR	20.00	10.00	12.41	66.30	16.91	5.90				

<u>NOTE:</u> -

The above recommendations are based on the field investigation data results and the laboratory tests results of the samples collected from the test locations and our experience in this regard. If the actual sub-soil conditions during excavation for the foundations differ from that has been reported, a reference should be made to us for suggestions.

Further, the recommendations are based on the assumptions as mentioned in the Report and the designer of the Structure should take into consideration all the factors required as per codes. The recommendations should be taken as guidelines for the designer.



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			of Cafe	Bearing Capacity		kN/m2	155.52	138.66	160.89	143.54	
			3earing /	Intermediate		kN/m2	388.79	346.64	402.24	358.84	
			Ultimate Net Bearing Capacity	Local shear		kN/m2	293.27	261.49	303.34	270.63	
	2.50	1.00	Ultin	General shear		kN/m2	470.16	419.18	486.48	433.98	
		se		uo s	2		1.00	1.00	1.00	1.00	
		Assumed post monsoon rise (m)		Inclination Factors	₫		1.00	1.00	1.00	1.00	
		monse		<u> </u>	2		1.00	1.00 1.00	1.00	1.00	
	Factor of safety	post			È		1.00		1.00	1.00	
	tor of	nmed	6	ors	ā		1 1.00	1.31 1.00	5 1.00	1.00	
	Fac	Ass (m)	eters	Depth Factors	č		0 1.3:	0 1.30	0 1.35	0 1.35	
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Ē	Water table below borehole level (m)	table u		Bearing Capacity Factors	- v		5.81 1.27	5.81 1	5.81 1	5.81 1.27	
HE	Water tal level (m)	Water 1 (m)			۸			0.34	0.34		
N N	>	>=		aring	ъ		1.43	1.43	1.43	1.43	
TIC				Be	ž		6.19 1.43 0.34	6.19	6.19	6.19 1.43 0.34	
Y CALCULATION SHEET AS PER IS: 6403-1981				Effective Surcharge	σ	kN/m2	87.38	87.38	97.09	97.09	
Y CA				Void Ratio	e		0.642	0.642	0.642	0.642	
CIT				Angle of Shearing Resistance	ō	۰	2.68	2.68	2.68	2.68	
APA					ø	0	4	4	4	4	
BEARING CAPACIT	metre			Cohesion	v	Kg/cm2	0.40	0.40	0.40	0.40	
BEARI	20.00			Density Including water effect		(kN/m3)	19.42	19.42	19.42	19.42	
	ehole			Density Below Foundation Level	Bulk	(gms/cc)	1.98	1.98	1.98	1.98	
	Depth of borehole		eters	Density Including on water effect) (kN/m3)	19.42	19.42	19.42	19.42	
	Del		Input Parameters	Density Above Foundation Level	Bulk	(gms/cc)	1.98	1.98	1.98	1.98	
			Input	Depth of Length Width Diameter below GL		(E)	-	- 0	,	-	
				Width		Ē	3.00	3.00	3.00	3.00	
	5	Е 01		on Length		٤ ٤	3.00	4.00	3.00	4.00	
) E	4.50	4.50	5.00	5.00	
	BOREHOLE 01			Type of foundation			SQUARE	RECTANGULAR	SQUARE	RECTANGULAR	
				No. S			7	2	m	4	



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IFICIAL CAPACITY CALCULATION SHEFT AS PER IS: 6403-1931 A material below bortion. A material below bor				ate Net B Capacity	Local shear		kN/m2	293.61	261.81	303.71	270.99											
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BEARING CAPACITY CAL Depth of borehole 20.00 metre Input Parameters 20.00 metre Input Parameters 20.00 metre Input Parameters 20.00 metre Input Parameters Angle of boneity beneity beneit	PEF	v bore	for ca	Shea		۰. ۸		0.21						
BEARING CAPACITY CAL Depth of borehole 20.00 metre Input Parameters 20.00 metre Input Parameters 20.00 metre Input Parameters 20.00 metre Input Parameters Angle of boneity beneity beneit	EET AS PI	belov	nsed		actors			1.27						
BEARING CAPACITY CAL Depth of borehole 20.00 metre Input Parameters 20.00 metre Input Parameters 20.00 metre Input Parameters 20.00 metre Input Parameters Angle of boneity beneity beneit		m) (m)	. table		icity Fi	- Z		5.81						
BEARING CAPACITY CAL Depth of borehole 20.00 metre Input Parameters 20.00 metre Input Parameters 20.00 metre Input Parameters 20.00 metre Input Parameters Angle of boneity beneity beneit	HE	Water 1 level (n	Water (m)		J Capa	ź		0.34						
BEARING CAPACITY CAL Depth of borehole 20.00 metre Input Parameters 20.00 metre Input Parameters 20.00 metre Input Parameters 20.00 metre Input Parameters Angle of boneity beneity beneit	S N				Bearin	ď		1.43						
BEARING CAPACITY CAL Depth of borehole 20.00 metre Input Parameters 20.00 metre Input Parameters 20.00 metre Input Parameters 20.00 metre Input Parameters Angle of boneity beneity beneit	UTIO					ÿ		6.19						
Depth of borehole Depth of borehole Input Parameters Input Parameters Pensity bensity bensit bensit bensity bensity bensity bensit bensity bensit bensity be	-CULA				Effective Surcharge	σ	kN/m2							
Depth of borehole Depth of borehole Input Parameters Input Parameters Pensity bensity bensit bensit bensity bensity bensity bensit bensity bensit bensity be	Y CAL										e		3 0.642	
Depth of borehole Depth of borehole Input Parameters Input Parameters Pensity bensity bensit bensit bensity bensity bensity bensit bensity bensit bensity be	CIT				gle of aring stance	ō	٥	2.68						
Depth of borehole Depth of borehole Input Parameters Input Parameters Pensity bensity bensit bensit bensity bensity bensity bensit bensity bensit bensity be	٨A					ø	٥	4						
Depth of borehole Depth of borehole Input Parameters Input Parameters Pensity bensity bensit bensit bensity bensity bensity bensit bensity bensit bensity be	NG C/	metre			L Cohesio n	U	Kg/cm2	0.40						
Depth of borehole Depth of borehole Input Parameters Input Parameters Pensity bensity bensit bensit bensity bensity bensity bensit bensity bensit bensity be	EARII	20.00			Density Including n water effect									
Dep Input Paramet Model Width Density Move Level Immeter Level <td< td=""><td>8</td><td>ehole</td><td></td><td></td><td>Density Below Foundatio Level</td><td>Bulk</td><td></td><td></td><td></td></td<>	8	ehole			Density Below Foundatio Level	Bulk								
Width Diameter Found to (gms 10.00 - 11.6		pth of boı		eters	Density Including n water effect		(kN/m3)							
10.00 (m) Width		De		Parame	Density Above Foundatio Level	Bulk		1.98						
				Input	Diameter									
REHOLE 01 Desthor I connection Length Length (m) (m)								10.0						
EHOL foundation below GL (m) 4,00		č	5		r Length		(m)							
					Depth of foundation below GL		(m)	4.00						
					Depth of toundation foundation foundation Length below GL			RECTANGULAR						
v, õ, v					s. No.			-						



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					Net Safe Bearing Capacity		kN/m2	 121.66											
				Bearing Y	Intermediate		kN/m2	304.14											
				Ultimate Net Bearing Capacity	Local shear		kN/m2	218.10											
	2.50	1.00		Ultin	General shear		kN/m2	348.46											
		se			ion s	2		1.00											
		Assumed post monsoon rise (m)			Inclination Factors	Þ		1.00											
	Å	mons			=	2		0 1.00											
	Factor of safety	d post				`A		0 1.00											
	ctor of	sumed		ş	tors	- bQ		38 1.0											
	Fac	Ass (m)		leter	Depth Factors	DV Dc'		00 1.0											
-				aram	Dept	Da Da		00 1.0											
198	•	•		ce P;		D DC		09 1.											
F03-	11.00	10.00		Shearing Resistance Parameters	S	sy D		6.19 1.43 0.34 5.81 1.27 0.21 1.10 0.80 1.09 1.00 <td< td=""><td>\vdash</td></td<>	\vdash										
: 64				Resi	Shape Factors	s sa		.10 0.											
s IS	hole	lculati		ring	Shape	Sc		.10 1											
PE	Water table below borehole level (m)	for ca		Shea		,Λ		0.21											
AS	below	Water table used for calculation (m)			actors	'pN		1.27 0											
ET	table m)				city Fa	, s		5.81											
SHEE	Water tal level (m)	Water (m)			Capa	ý		0.34											
N					Bearing Capacity Factors	Ŋ		1.43											
ATIC						Nc		6.19											
BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981					Effective Surcharge	a	kN/m2	78.46											
Y CA															Void Ratio	e		0.618	
ACIT						Angle of Shearing Resistance	ø	۰	2.68										
AP/					Ang She Resi	ø	۰	4											
NG C	metre				Density Including water effect	c	Kg/cm2	0.40											
BEAR	20.00				Density Including n water effect		(gms/cc) (kN/m3) Kg/cm2	19.61											
-	rehole				Density Below Foundation Level	Bulk		2.00											
	Depth of borehole			leters	Density Including on water effect) (kN/m3)	19.61											
	De			Input Parameters	Density C Above In Foundation Level	Bulk	(gms/cc)	2.00											
				Input	h Diamete		(m)	- 0											
					Widt		(Ľ	20.00 10.00											
	Ę				Length		<u>٤</u>	20.00											
		BOREHOLE 02			Depth of Length Width Diameter below GL		(m)	4.00											
		DORE			Type of foundation			RECTANGULAR											
					s. No.			1											



SETTLEMENT CALCULATION

					. در					1						
CALCULATION SHEET 1					Total settlement		(mm)	10.00	та.ес							
CALCULA		IOLE 1			Immediate settlement		(mm)									
		BOREHOLE 1			Consolidation settlement		(mm)	c	49.882							
			SQUARE		Water Correction factor	Ņ		Depth of foundation	I							
9	1.00	0.80	DS .		Settlement for Unit Pressure		(mm)	Depth	1							
(T 1) : 197	Depth factor	Rigidity factor	Type of foundation		Increment stress	ΔP	kN/m2		50.78							
(009 (PAR	Depth	Rigidit	Type of fo		Effective stress	å	kN/m2		131.29							
S PER IS 8					Corrected SPT	:z		 I								
SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976	X Width	(m) bgl	kN/m2		Compression Corrected Index SPT	ദ		·	0.127							
NT CALCL	1.50	10.00	155.52 k		Void Raito	a		ı	0.627							
ETTLEME	pth	tion	ı base	-	-	-		Density		(gms/cc)	1.98	1.99				
S	Settlement effective zone depth	Water Table depth for calculation	Applied Pressure at foundation base				Layer Thickness		(m)	 4.50	4.50					
	ttlement effe	iter Table dep	ied Pressure											Layer Start Layer End depth depth		(m)
	Se	Wa	Appl		Layer Start depth		(m)	0.00	4.50							
	metre	metre	metre		Type of Layer	CLAY	SAND	CLAY	CLAY							
	4.50	3.00	3.00		Layer No.			Ч	2							
	Depth	Length	Width		S. No.			Ч	2							



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	N SHEET 2				Total settle ment		(mm)	20 00	00.60
	CALCULATION SHEET 2								
	G		BOREHOLE 1		Immediate settle ment		(mm)		
			BOREH		Consolidation settle ment		(mm)	c	49.821
				RECTANGULAR	Water Correction factor	.ν		Depth of foundation	
6		1.00	0.80	RECT/	Settlement for Unit Pressure		(mm)	Depth	'
(T 1) : 197		Depth factor	Rigidity factor	Type of foundation	Increment stress	ΔP	kN/m2		50.71
009 (PAR		Depth	Rigidit	Type of f	Effective stress	å	kN/m2		131.29
S PER IS 8					Corrected SPT	z		I	ı
SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976		X Width	(m) bgl	kN/m2	Compression Index	ა		ı	0.127
NT CALCL		1.50	10.00	138.66	Void Raito	e		ı	0.627
ETTLEMEI		pth	tion	base	Density		(gms/cc)	1.98	1.99
S		Settlement effective zone depth	Water Table depth for calculation	Applied Pressure at foundation base	Layer Thickness		(m)	4.50	4.50
		ttlement effe	ter Table dep	ied Pressure	Layer End depth		(m)	4.50	00.6
		Sei	Wa	Appl	Layer Start Layer End depth depth		(m)	0.00	4.50
		metre	metre	metre	Type of Layer	CLAY	SAND	CLAY	CLAY
		4.50	4.00	3.00	Layer No.			Ч	2
		Depth	Length	Width	S. No.			H	2



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	CALCULATION SHEET 3					Total settle ment		(mm)	30 GG	CO.00	
	CALCULAT		OLE 1			Immediate settlement		(mm)		,	
			BOREHOLE 1			Consolidation settlement		(mm)	-	48.314	
				SQUARE		Water Correction factor	Ņ		Depth of foundation	ı	
9		1.00	0.80	SQ		Settlement for Unit Pressure		(mm)	Depth	I	
T 1) : 197		Depth factor	Rigidity factor	Type of foundation		Increment stress	ΔP	kN/m2		52.54	
009 (PAR		Depth	Rigidity	Type of fo		Effective stress	Ъ°	kN/m2		141.00	
SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976						Corrected SPT	:z		I	ı	
ILATION A		X Width	(m) bgl	kN/m2	£	Compression Index	ខ			0.127	
NT CALCL		1.50	10.00	160.89		Void Raito	a		I	0.627	
ETTLEME		pth	ition	ו base		Density		(gms/cc)	1.98	1.99	
S		Settlement effective zone depth	Water Table depth for calculation	Applied Pressure at foundation base		Layer Thickness		(m)	5.00	4.50	
		ttlement effe	ater Table dep	lied Pressure		Layer Start Layer End depth depth		(m)	5.00	9.50	
		Se	Ŵ	App		Layer Start depth		(m)	0.00	5.00	
		metre	metre	metre		Type of Layer	CLAY	SAND	CLAY	СГАҮ	
		5.00	3.00	3.00		Layer No.			1	2	
		Depth	Length	Width		S. No.			1	2	



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CALCULATION SHEET 4			Total settlement		(mm)		20 EJ	20.00
CALCULA	BOREHOLE 1		Immediate settle ment		(mm)			
	BOREH		Consolidation settle ment		(mm)		L	48.280
			Water Correction factor	"M			Depth of foundation	I
1.00	0.80 RECTA		Settlement for Unit Pressure		(mm)		Depth	I
(PART 1) : 197 Depth factor	Rigidity factor		Increment stress	ΔP	kN/m2			52.49
009 (PAR	Rigidity Type of fo	:	Effective stress	°d	kN/m2			141.00
S PER IS 8			Corrected SPT	N			ı	T
SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976 Jepth 1.50 x Width Depth factor Depth factor	(m) bgl		Compression Index	3			-	0.127
NT CALCL	10.00 142 EA		Void Raito	e			-	0.627
ETTLEME	tion		Density		(gms/cc)		1.98	1.99
SET Settlement effective zone depth	Water Table depth for calculation		Layer Thickness		(m)		5.00	4.50
ttlement effe	iter Table dep ind Pressure		Layer End depth		(m)		5.00	9.50
Se l	Wa	:	Layer Start Layer End depth depth		(m)		00.0	5.00
metre	metre		Type of Layer	CLAY	SAND		CLAY	СГАҮ
5.00	4.00		Layer No.				1	2
Depth	Length		S. No.				1	2



SETTLEMENT CALCULATION

SETTI EMENT CALCIII ATION AS PER IS 8009 (PART 1) · 1976	1.50 X Width Depth factor 1.00	IO.00 (m) bgl Rigidity factor 0.80 BOREHOLE 2	64.20 kN/m2 Type of foundation SQUARE	id Raito Compression Corrected Effective Increment for Unit Correction Immediate Total Settlement for Unit Correction settlement settlement settlement settlement	e Cc N" Ρ° ΔΡ W'	kN/m2 kN/m2 (mm) (mm) (mm) (mm)	Depth of foundation	0.125 - 131.95 53.62 - 51.482 -	
VT CALCULATION	1.50 X Width	10.00 (m) bgl	164.20 kN/m2				ı	0.618 0.125	
				laito					
SETTI EM	e zone depth	or calculation	undation base	Layer Thickness		(m) (gms/cc)	4.50 1.99	4.50 2.00	
	Settlement effective zone depth	Water Table depth for calculation	Applied Pressure at foundation base			(m)	4.50	, 00.6	+
	Sett	Wat	Applik	Layer Start Layer End depth		(m)	0.00	4.50	
	metre	metre	metre	Type of Layer	CLAY	SAND	CLAY	СГАУ	
	4.50	3.00	3.00	Layer No.			4	2	
	Depth	Length	Width	S. No.			Ч	2	



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STRIEMENT CALCULATION AS PER IS 8009 (PART 1): 1375 Applied Pressue et foundation is a point of model is a press of foundation in the etailer of the press of foundation in the etailer of the press of the		2						1			
SetTEMENT CALCULATION AS PER IS 8009 (PART 1) : 1376 SetTEMENT CALCULATION AS PER IS 8009 (PART 1) : 1376 Asom metre SetTement effective zone depth 1.50 Number 1.50 Number 1.50 SetTement effective zone depth I SetTement effective zone depth 1.50 Number 1.50 Num 1.50 Num 1.50<		VTION SHEET					Total settlement		(mm)	7 7 7 7	4
SETTLEMENT CALCULATION AS PER IS 8009 (PART 1): 1376 430 metre settlement effective zone depth 1.50 X width Depth factor 100 4.00 metre Settlement effective zone depth 1.50 X width Depth factor 100 4.00 metre Value Depth factor 1.00 Job metre Settlement effective zone depth 1.50 X width Type of foundation Rigidity factor 1.00 Job metre Settlement effective zone depth Settlement factor 1.00 Job metre Settlement effective zone depth Settlement factor Job metre Job metre Settlement depth for calculation Job metre Settlement Settlement Settlement Job metre Settlement Settlement Settlement Settlement Settlement Settlement Settlement		CALCULA		IOLE 2			Immediate settle ment		(mm)		
SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976 SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976 4.50 metre Settlement effective zone depth 1.50 Kwidth Depth factor 1 3.00 metre Vater Table depth for calculation 10.00 (m) bgi Rigidity factor 0 3.00 metre Vater Table depth for calculation 10.00 (m) bgi Rigidity factor 0 3.00 metre Vape of layer Start Layer End Layer Start Start Start Start Start Start 1 CLAY (m) (m) (m) C N'''' N'''' M Cit Vi''' Start Star				BOREH			Consolidation settlement		(mm)	Ē	51.422
SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976 SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976 4.50 metre Settlement effective zone depth 1.50 Kwidth Depth factor 1 3.00 metre Vater Table depth for calculation 10.00 (m) bgi Rigidity factor 0 3.00 metre Vater Table depth for calculation 10.00 (m) bgi Rigidity factor 0 3.00 metre Vape of layer Start Layer End Layer Start Start Start Start Start Start 1 CLAY (m) (m) (m) C N'''' N'''' M Cit Vi''' Start Star					NGULAR		Water Correction factor	Ņ		of foundatio	ı
4.50 metre Settlement effective zone 4.00 metre Vater Table depth for calculation 3.00 metre Maplied Pressure at foundation 3.00 metre Applied Pressure at foundation Jayer No. Layer Start Layer End Layer Layer No. Layer Monol Layer Start Layer End Layer 1 CLAY (m) (m) (m) 4.50 2 CLAY 4.50 9.00 4.50	9		1.00	0.80	RECTA		Settlement for Unit Pressure		(mm)	Depth	1
4.50 metre Settlement effective zone 4.00 metre Vater Table depth for calculation 3.00 metre Maplied Pressure at foundation 3.00 metre Applied Pressure at foundation Jayer No. Layer Start Layer End Layer Layer No. Layer Monol Layer Start Layer End Layer 1 CLAY (m) (m) (m) 4.50 2 CLAY 4.50 9.00 4.50	(T 1) : 197		factor	y factor	oundation		Increment stress	ΔP	kN/m2		53.54
4.50 metre Settlement effective zone 4.00 metre Vater Table depth for calculation 3.00 metre Maplied Pressure at foundation 3.00 metre Applied Pressure at foundation Jayer No. Layer Start Layer End Layer Layer No. Layer Monol Layer Start Layer End Layer 1 CLAY (m) (m) (m) 4.50 2 CLAY 4.50 9.00 4.50	009 (PAR		Depth	Rigidity	Type of fo		Effective stress	Å	kN/m2		131.95
4.50 metre Settlement effective zone 4.00 metre Vater Table depth for calculation 3.00 metre Maplied Pressure at foundation 3.00 metre Applied Pressure at foundation Jayer No. Layer Start Layer End Layer Layer No. Layer Monol Layer Start Layer End Layer 1 CLAY (m) (m) (m) 4.50 2 CLAY 4.50 9.00 4.50	S PER IS 8							z		I	
4.50 metre Settlement effective zone 4.00 metre Vater Table depth for calculation 3.00 metre Maplied Pressure at foundation 3.00 metre Applied Pressure at foundation Jayer No. Layer Start Layer End Layer Layer No. Layer Monol Layer Start Layer End Layer 1 CLAY (m) (m) (m) 4.50 2 CLAY 4.50 9.00 4.50	JLATION A		X Width	(m) bgl	kN/m2		Compression Index	3		ı	0.125
4.50 metre Settlement effective zone 4.00 metre Vater Table depth for calculation 3.00 metre Maplied Pressure at foundation 3.00 metre Applied Pressure at foundation Jayer No. Layer Start Layer End Layer Layer No. Layer Monol Layer Start Layer End Layer 1 CLAY (m) (m) (m) 4.50 2 CLAY 4.50 9.00 4.50	NT CALCL			10.00		~	Void Raito	a		ı	0.618
4.50 metre Settlement effective zone 4.00 metre Vater Table depth for calculation 3.00 metre Maplied Pressure at foundation 3.00 metre Applied Pressure at foundation Jayer No. Layer Start Layer End Layer Layer No. Layer Monol Layer Start Layer End Layer 1 CLAY (m) (m) (m) 4.50 2 CLAY 4.50 9.00 4.50	ETTLEME		pth	tion	ı base		Density		(gms/cc)	1.99	2.00
4.50 metre 4.50 metre 3.00 metre 3.00 metre Jayer No. Layer S Layer No. Layer S 1 CLAY 0.0 Modent 2 CLAY 4.5 A.5	S		ctive zone de	oth for calcula	at foundation		Layer Thickness		(m)	4.50	4.50
4.50 metre 4.50 metre 3.00 metre 3.00 metre Jayer No. Layer S Layer No. Layer S 1 CLAY 0.0 Modent 2 CLAY 4.5 A.5			ttlement effe	ter Table dep	ied Pressure		Layer End depth		(m)	4.50	00.6
2 1 1 Faver No.			Se	Wa	Appl		Layer Start depth		(m)	0.00	4.50
			metre	metre	metre		Type of Layer	CLAY	SAND	CLAY	СГАУ
2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2			4.50	4.00	3.00		Layer No.			Ч	2
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	IN SHEET 3					Total settlement		(mm)		06.60	
	SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976 calculation sheet 3		OLE 2			Immediate settlement so		(mm)		I	
			BOREHOLE 2			Consolidation settlement		(mm)	۲	49.878	
				SQUARE		Water Correction factor	, M		Depth of foundation	I	
ي		1.00	0.80	sc		Settlement for Unit Pressure		(mm)	Depth	-	
T 1) · 197		Depth factor	Rigidity factor	Type of foundation		Increment stress	ΔP	kN/m2		55.47	
DO9 (PAR		Depth	Rigidity	Type of fo		Effective stress	°ď	kN/m2		141.71	
S PER IS 8						Corrected SPT	N		ı	-	
		X Width	(m) bgl	kN/m2	e	Compression Index	3		ı	0.125	
NT CALC		1.50	10.00	169.89		Void Raito	Ð		I	0.618	
ETTI EME		pth	tion	ı base		Density		(gms/cc)	1.99	2.00	
		Settlement effective zone depth	Water Table depth for calculation	Applied Pressure at foundation base		Layer Thickness		(m)	5.00	4.50	
		ttlement effe	iter Table dep	ied Pressure		Layer End depth		(m)	5.00	9.50	
		Se	Wa	Appl		Layer Start depth		(m)	0.00	5.00	
		metre	metre	metre		Type of Layer	CLAY	SAND	CLAY	CLAY	
		5.00	3.00	3.00		Layer No.			Ч	2	
		Depth	Length	Width		S. No.			1	2	



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	CALCULATION SHEET 4				Total settlement		(mm)	00 DC	00.60
	CALCUL		BOREHOLE 2		Immediate settlement		(mm)		ı
			BOREH		Consolidation settlement		(mm)	r	49.846
				RECTANGULAR	Water Correction factor	w'		Depth of foundation	ı
6		1.00	0.80	RECTA	Settlement for Unit Pressure		(աա)	Depth	I
(Т 1) : 197		Depth factor	Rigidity factor	Type of foundation	Increment stress	ΔΡ	kN/m2		55.43
009 (PAR		Depth	Rigidit	Type of f	Effective stress	å	kN/m2		141.71
S PER IS 8					Corrected SPT	"N		I	1
SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976		X Width	lgd (m)	kN/m2	Compression Index	3		ı	0.125
NT CALCL		1.50	10.00	151.57	Void Raito	e		ı	0.618
ETTLEME		pth	tion	ı base	Density		(gms/cc)	1.99	2.00
S		Settlement effective zone depth	Water Table depth for calculation	Applied Pressure at foundation base	Layer Thickness		(m)	5.00	4.50
		ttlement effe	iter Table dep	lied Pressure	Layer Start Layer End depth depth		(m)	5.00	9.50
		Se	Ma	Appl	Layer Start depth		(m)	0.00	5.00
		metre	metre	metre	Type of Layer	CLAY	SAND	CLAY	СГАУ
		5.00	4.00	3.00	Layer No.			1	2
		Depth	Length	Width	S. No.			1	2



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	CALCULATION SHEET 5				Total settlement		(mm)			59.01		
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	CAI		HOLE 1		Immediate settlement		(mm)			I	10.522	
			BOREHOLE 1		Consolidation settlement		(mm)		Ľ	63.235	I	
				RECTANGULAR	Water Correction factor	.Μ			Depth of foundation	I	0.500	
6		1.00	0.80	RECT	Settlement for Unit Pressure		(mm)		Depth	I	0.170	
(T 1) : 197		Depth factor	Rigidity factor	Type of foundation	Increment stress	ΔP	kN/m2			59.84	30.92	
009 (PAR		Depth	Rigidit	Type of fo	Effective stress	°d	kN/m2			164.67	274.61	
S PER IS 8					Corrected SPT	N			I	I	20.11	
SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976		X Width	(m) bgl	kN/m2	Compression Index	ട				0.071	ı	
NT CALCL		1.50	10.00	115.20	Void Raito	ə			-	0.596	-	
ETTLEME		pth	tion	base	Density		(gms/cc)		1.98	2.00	2.04	
S		Settlement effective zone depth	Water Table depth for calculation	Applied Pressure at foundation base	Layer Thickness		(m)		4.00	10.50	4.50	
		ttlement effe	ter Table dep	ied Pressure	Layer End depth		(m)		4.00	14.50	19.00	
		Set	Wa	Appl	Layer Start depth		(m)		0.00	4.00	14.50	
		metre	metre	metre	Type of Layer	CLAY	SAND		CLAY	CLAY	SAND	
		4.00	20.00	10.00	Layer No.				1	2	8	
		Depth	Length	Width	S. No.				1	2	3	



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	CALCULATION SHEET 5				Total settlement		(mm)		66.30		
	CALCUL		BOREHOLE 2		Immediate settlement		(mm)		ı	10.858	
			BOREH		Consolidation settle ment		(mm)	E	72.021		
				RECTANGULAR	Water Correction factor	'W		Depth of foundation		0.500	
ور		1.00	0.80	RECT/	Settlement for Unit Pressure		(mm)	Depth	I	0.166	
(T 1) : 197		Depth factor	Rigidity factor	Type of foundation	Increment stress	ΔP	kN/m2		63.19	32.66	
009 (PAR		Depth	Rigidit	Type of f	Effective stress	å	kN/m2		165.06	275.44	
S PER IS 8					Corrected SPT	: Z		ı	I	20.51	
SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976		X Width	(m) bgl	kN/m2	Compression Index	പ്പ		I	0.078	ı	
NT CALCU		1.50	10.00	121.66	Void Raito	Ð		ı	0.609	ı	
ETTLEME		pth	ition	ו base	Density		(gms/cc)	1.99	2.00	2.06	
S S		Settlement effective zone depth	Water Table depth for calculation	Applied Pressure at foundation base	Layer Thickness		(m)	4.00	10.50	4.50	
		ttlement effe	iter Table dep	ied Pressure	Layer End depth		(m)	4.00	14.50	19.00	
		Se	Wa	Appl	Layer Start depth		(m)	0.00	4.00	14.50	
		metre	metre	metre	Type of Layer	CLAY	SAND	CLAY	CLAY	SAND	
		4.00	20.00	10.00	Layer No.			1	2	ε	
		Depth	Length	Width	S. No.			1	2	Υ	



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				Compress Compress	(Cc)	23				0.130										U. 123									0.080				
	Ш Т		ar erisitics	Angle of Internal Friction	Ø	22		•		¢									ů	0							•		å		ů	205	
	RESULT SHEET	, , 	Shear Characterisitics	noisədoJ	(Kg/sqcm)	21	IND LEVE			0.35										0.40		ı					•		0.50		-	5	
)	oi	tsЯ bioV	(e)	20	W GROU			0.642	,					•		,		710.N							•		0.580		101 0	1.504	
ĺ	Ŷ		ų tive	Specific Gr	Θ	19	H BELO	•		2.66		,			•		,		00 C	2.00							•		2.67		0.00	2.09	
			Vtisu	Dry Bulk De	(gms/cc)	18	E DEPTI			1.62		1.63							10	00.							•		1.69		110	2/.1	
00			isture	oM IsniginO	%	17	O METR			21.85		21.40								21.30		ı							20.12		10.01	10.01	
11.00			λisne	Wet Bulk De	(gms/cc)	16	FILLED UP SOIL BLACK SILTY SAND [0.00-0.50] METRE DEPTH BELOW GROUND LEVEI			1.97		1.98								Z-UU									2.03		2	2.04	
n bgl)			lodm	lS group sγ		15	LY SANE	SM		ō		Ū			ō		Ū		ā	5		Ū		Ū		i	5		ō		- NC	NN	
Depth of Water Level (m bgl)	ed on	d on	imits	ā	%	4	CK SIL	STIC		14		14			14		15		L T	0		15		15		!	12	T	15				
ater L	Commenced on	Completed on	Atterberg Limits	PL	%	13	BLAC	NON-PLASTIC	4	22		22			22		22		ç	77		22		22			23		23				
of W	Com	Con	Atte	F	%	7		NON	1.00M	36		36			ဗ္တ		37		5	ò		37		37			8	\perp	38				
Depth			or	Silt Fact		1	LLED UI	•	START FROM	•		.	•		•	•		·							•		•	•	•			•	•
28	28	_	ing	970.0	(mm)	10	≣	48	TART	95		94			93		96		2	33		92		93			94		93		00	07	
605877.28	2825077.28	100.000	% Material Passing IS Sieve	0.425	(mm)	6		84	CLAY S	96		95			95		97		2	94		94		94			сĥ		94		2	94	
90	28	•	lateria IS S	2.000	(mm)	8		86	0	97		96			97		98		Ľ	с Р		95		95			96		95		L C	сĥ	
ng	ing	tion	۷%	097.4	(mm)	~		6		86 86		67			88		100		5	2		96		96		ļ	9/		96		5	۶	
Easting	Northing	Elevation		SPT Value con table to dilat	:. Z	9						.															•						20.19
	ate			SPT Value con due to overb	.z	5					,					•		,		•		1	,				•			,		- L	25.38
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				Level ed)				99.500		98.550	98.100	97.050	96.600		95.550	95.100	94.050	93.600		000.28	92.100	91.050	90.600	89.550	89.100		0009 20	000.10	86.550	86.100	OF OF O	000.08	84.600
٢	00.00	10.04		Reduced Level (Assumed)	metre	7		- 000		- 000	550 -	- 005			- 000	550 -	- 009			- 000	550 -	- 009	50 -	- 000	550 -				- 000	550 -			- 090
				СC С				100.000			98.550	97.500		+	_	95.550	94.500	-		+	92.550	91.500	91.050	000.06	89.550		88.500		87.000	86.550			85.050
No.	h of	(u)		Bore				0.50		1.45	1.90	2.95	3.40		4.45	4.90	5.95	6.40		(1:0	7.90	8.95	9.40	10.45	10.90		11.95	14.40	13.45	13.90	14.05	14.95	15.40
Bore Hole No.	Total depth of	Bore Hole (m)		Depth of Bore Hole	metre	-		0.00		1.00 -	1.45 -	2.50 -			4.00 -	4.45 -	5.50 -			- nn./	7.45 -	8.50 -	8.95 -	10.00 -	10.45 -		11.50 -	-	13.00 -	13.45 -			14.95 -

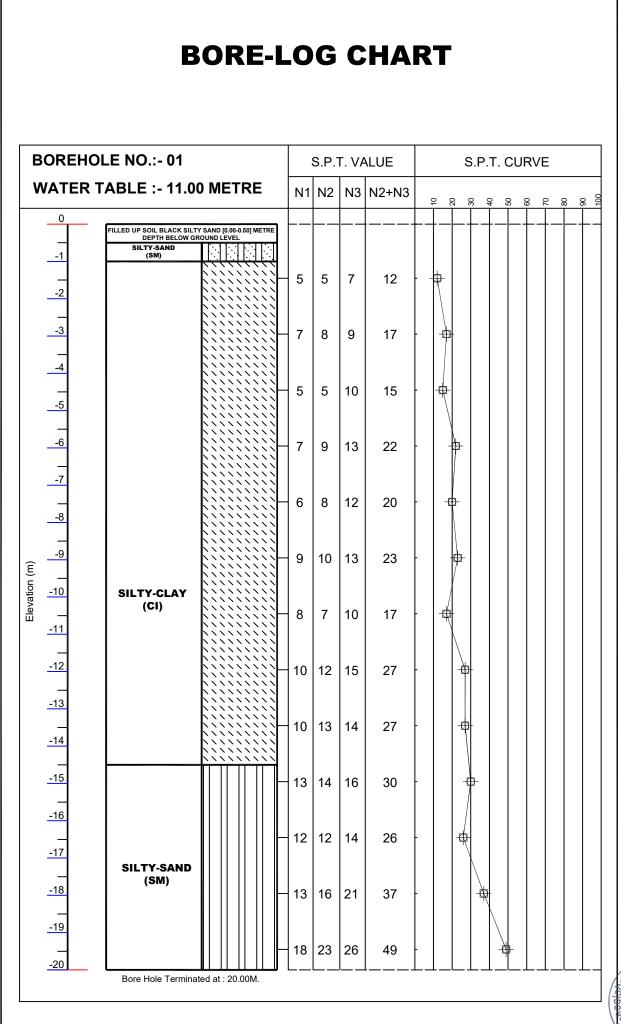
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27			29			30		28	
96			95			96		95	
26			96			26		96	
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an	SPT		ДŊ	SPT		an	SPT	DS	
<u>1</u> 6.00 - 16.45 84.000 - 83.550	- 83.100 SPT		- 82.050	17.95 - 18.40 82.050 - 81.600 SPT		19.00 - 19.45 81.000 - 80.550	80.550 - 80.100	80.100 - 80.000	
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				seandmoD Compress	(Cc)	23		,	101	0.127		0.123							0.123						0 100					
	Ш Т		ar erisitics	Angle of Internal Friction	(Ø	22		,	ŝ	4		5°							5°						7°				30°	
		,	Shear Characterisitics	noisədoD	(Kg/sqcm)	21	D LEVEL	,	L C C	00		0.35							0.40						0.50				0	
	RESULT SHEET)	oi	tsЯ bioV	(e)	20	GROUN	,		- 2007		0.618	,						0.618					,	0.589				0.564	ı
	2		γtive.	Specific Gr	(j)	19	BELOW	•		7.00		2.67			•		1		2.67						2.67				2.69	
			(tisue	Dry Bulk De	(gms/cc)	18	DEPTH	•	5	<u>8</u> .		1.65			•		'		1.65						1 68				1.72	
00			ərute	oM IsniginO	%	17] METRE	•		DC.12		21.10			•				20.80						20.01				19.70	
11.00			λisne	Wet Bulk De	(gms/cc)	16	GRAVELS [00.00-0.50] METRE DEPTH BELOW GROUND LEVE!	•	0	02.1		2.00							1.99						2.02				2.06	
n bgl)			lodm	lS group sy		15	AVELS [0	С	2	5		ō		ī	5		ō		0		0		Ū		0	;	ō		SM	
Depth of Water Level (m bgl)	Commenced on	Completed on	Atterberg Limits	Б	%	14		12	-	<u>+</u>		14		-	<u>+</u>		14		14		15		15		15	2	15		NON-PLASTIC	
ater	menc	nplet	rberg	Γ	%	13		20	ć	7		22		ç	1		22		22		22		22		23		22		<u>-PL</u>	
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Depth			or	Silt Fact		11	FILLED UP SOIL FINE								. .									•						
92	.10	0	sing	970.0	(mm)	10		90	Ľ	68		94		90	20		95		95		94		95		93		93		25	
605856.92	2825009.10	100.000	% Material Passing IS Sieve	0.425	(mm)	6		92	ç	90		95		ġ	202		67		96		95		96		94		94		95	
ğ	28		Materia IS S	2.000	(mm)	∞		93	1	28		96		_			100		97		96		97		95	8	95		96	
ng	ing	tion	N %	4.750	(mm)	~		94	2	ဂ္ဂ		97		0	3		100		8		97		8		90	3	96		97	
Easting	Northing	Elevation		SPT Value con balle to dilat	"z	9		•												20.17
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				Level ed)				99.500	01100	96.300 98.100		97.050	96.600		95.000		94.050	93.600	92.550	92.100	91.050	90.600	89.550	89.100	88 050	87.600	86.550	86.100	85.050	84.600
2	00.00			Reduced Level (Assumed)	metre	7		100.000 -		99.000 - 98.550 -		97.500 -	97.050 -		95.550 -		94.500 -	94.050 -	93.000 -		91.500 -	91.050 -	- 000.06	89.550 -	88.500 -		87.000 -		85.500 -	85.050 -
										_		_	_	_		+	_		_											
ole No.	spth of	ole (m)		Depth of Bore Hole	metre	-		- 0.50				- 2.95	- 3.40		- 4.40		- 5.95	- 6.40	- 7.45	- 7.90	- 8.95	- 9.40	- 10.45	- 10.90	- 11.95		- 13.45		- 14.95	- 15.4
Bore Hole No.	Total depth of	Bore Hole (m)		Depth H	2			0.00	00 1	1.45		2.50	2.95		4.00		5.50	5.95	7.00	7.45	8.50	8.95	10.00	10.45	11.50	11.95	13.00	13.45	14.50	14.95

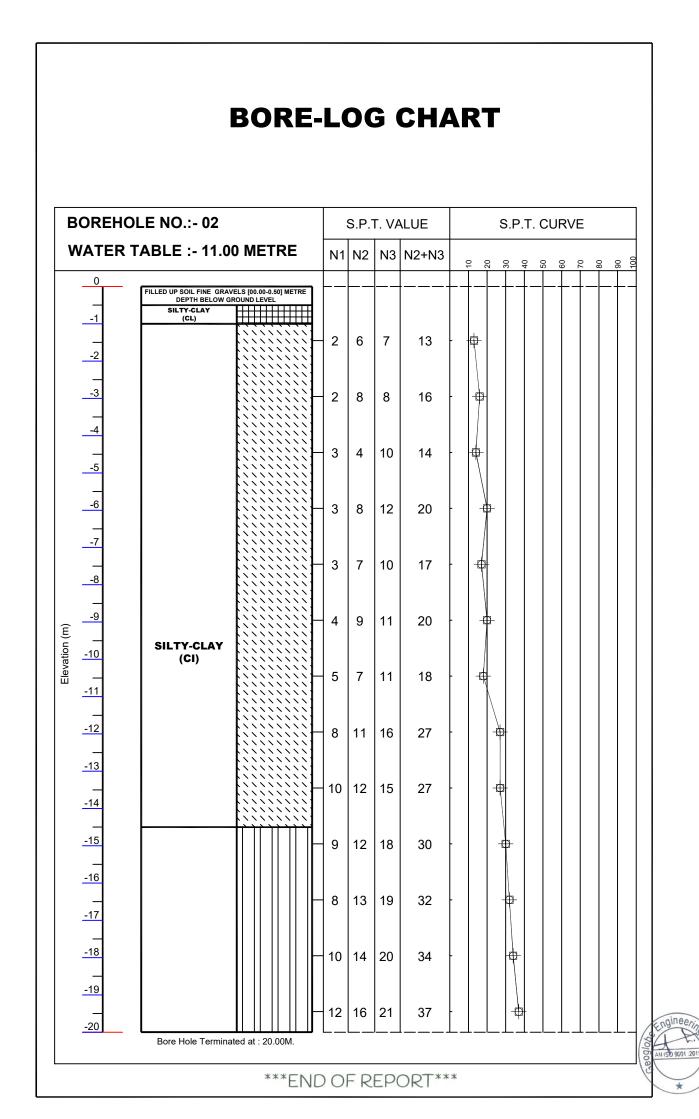
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96		86		26		86	
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84.000 - 83.550	83.550 -	17.50 - 17.95 82.500 -	82.050 -	81.000 - 80.550	80.550 -	80.100 - 80.000	
16.00 - 16.45	16.45 - 16.90	17.95	17.95 - 18.40	19.00 - 19.45	19.45 - 19.90	20.00	
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16.00	16.45	17.50	17.95	19.00	19.45	19.90 -	

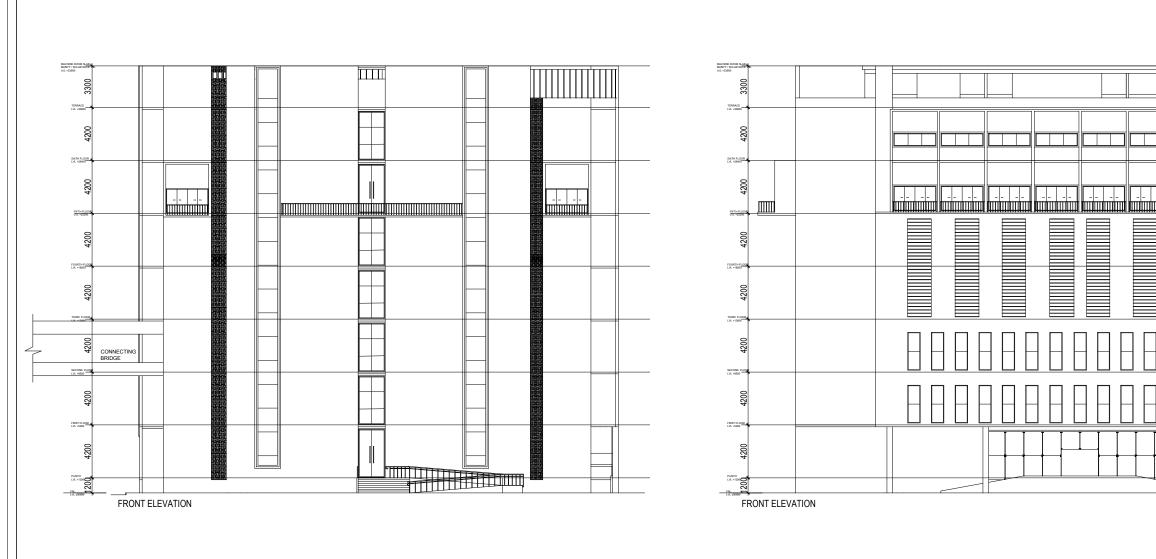




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DATE BEY. REVISIONS ARCHITEC SURESH ARCHITEC C-85, SHIVALIK DWG ISSUED PROJECT CODE 2023B BUILDING CODE HO PROJECT: CENTRE AT BAN/ VARANA CLIENT : SCALE : 1:	T GOE TS. E TS. E TS. E TS. E TS. E Sig ON 08.11 NAME SIG ORIG ARASI	ATECT	CKED BN HITECT NIVE	AT NEW DELHI NAME : VS SIG VALIDATED BY ARCHITECT ERSITY