

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/ SECTION 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

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				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	<p>Similar work shall mean works of:</p> <p>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.</p> <p>AND</p> <p>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.</p> <p>AND</p>	<p>Similar work shall mean works of:</p> <p>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.</p> <p>AND</p> <p>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.</p>

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			<p>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.</p>	<p>Or</p> <p>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.</p>
4.	Volume 3 SCC	Specific Conditions of Contract-Scope of Work 1.1 General Page no. 1-3	<p>For ease of understanding the scope of work, brief description is as given below:</p> <ul style="list-style-type: none"> • 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, 	<p>For ease of understanding the scope of work, brief description is as given below:</p> <ul style="list-style-type: none"> • 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,

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			Lighting Conductors, Telephone Conduits) <ul style="list-style-type: none"> • BMS • Streetlight, Landscape Light & Façade Light, Solar Street Light • Uninterrupted Power Supply • HVAC Plant Room, VRV, Split AC's • Solar Photo Voltaic Power Generation System • Solar Water Heating System • Solid Waste Management System • Fire Fighting System, Public Address System • Nurse Call System • Information Display System & Video Wall in OPD Lobby • CCTV System • LAN, Wi-Fi, IPBAX system • Access Control System • STP/ETP/WTP • Centralize RO System • Water Coolers with RO + UV Unit • Electric Geysers • Heat Pumps for Hospital Building 	Lighting Conductors, Telephone Conduits) <ul style="list-style-type: none"> • BMS • Streetlight, Landscape Light & Façade Light, Solar Street Light • Uninterrupted Power Supply • HVAC Plant Room, VRV, Split AC's • Solar Photo Voltaic Power Generation System • Solar Water Heating System • Solid Waste Management System • Fire Fighting System, Public Address System • Nurse Call System • Information Display System & Video Wall in OPD Lobby • CCTV System • LAN, Wi-Fi, IPBAX system • Access Control System • ETP/WTP• • Water Coolers with RO + UV Unit • Electric Geysers • 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
			<ul style="list-style-type: none"> • Pneumatic Tube based Fire Suppression 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 Auditorium • Master Antenna TV (MATV) System including LED Monitors • CSSD, MOT (16 Nos.), MGPS, PTTs, Minor OT & Integration • Boundary wall /fencing near Main Gates & Security Cabins as per drawing, • Internal Compound Wall with Gates & Porta Cabin as shown in Master Plan • Internal RCC Roads, Open Pathways /Cycle Track/ Building approach /drop off. • Covered Path ways, Surface Parking, Covered Parking. • Storm Water Drains • Cutting, Filling, &Leveling • Landscaping and Horticulture works • External Sewerage System, Water-Supply System, Drainage System, Rain Water Harvesting (R.W.H), Trenches for Services. 	<p>System for Main LT Panels and Gas Flooding Fire Suppression System for Data Rooms</p> <ul style="list-style-type: none"> • Master Antenna TV (MATV) System including LED Monitors • MGPS, Minor OT • Green Boundary wall • Internal RCC Roads, Open Pathways /Cycle Track/ Building approach /drop off. • Covered Path ways, Surface Parking, Covered Parking. • Storm Water Drains • Cutting, Filling, &Leveling • Landscaping and Horticulture works • External Sewerage System, Water-Supply System, Drainage System, Rain Water Harvesting (R.W.H), Trenches for Services. • Under Ground RCC Water & Firefighting Tanks, RCC Tanks for STP, ETP & WTP. • Bore wells • 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
			<ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • 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 Page no. 4	provided.	
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)

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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	<p>Similar work shall mean works of:</p> <p>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.</p> <p>AND</p> <p>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</p>	<p>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:</p> <p>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.</p> <p>AND</p> <p>b. Should have satisfactorily completed at least one completed work costing not less than amount equal to 40% of estimated cost put to</p>	<p>Refer Above Amendment 01</p>

S. No.	Tender Document/ Section No.	Clause/ Sub Clause	Existing Clause	Bidder's query	Amended Clause/Reply by HITES
			<p>be a part of the above given eligible works at 1.4.1 (a) above or as a separate work.</p> <p>AND</p> <p>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.</p>	<p>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.</p> <p>AND</p> <p>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.</p>	

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

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 Handling 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 be provided as per approved GFC and Shop Drawings as per project requirements.)

**SUB-SOIL INVESTIGATION FOR THE PROPOSED
CONSTRUCTION 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: geoglobeengineering@gmail.com

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

Sl. 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

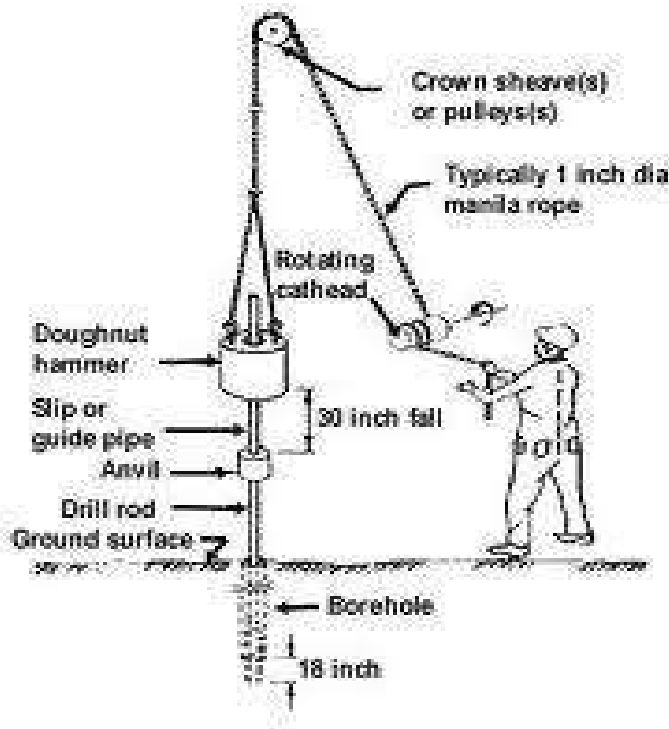


FIELD INVESTIGATION

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		

Undisturbed Soil Samples (UDS)

Undisturbed soil samples 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

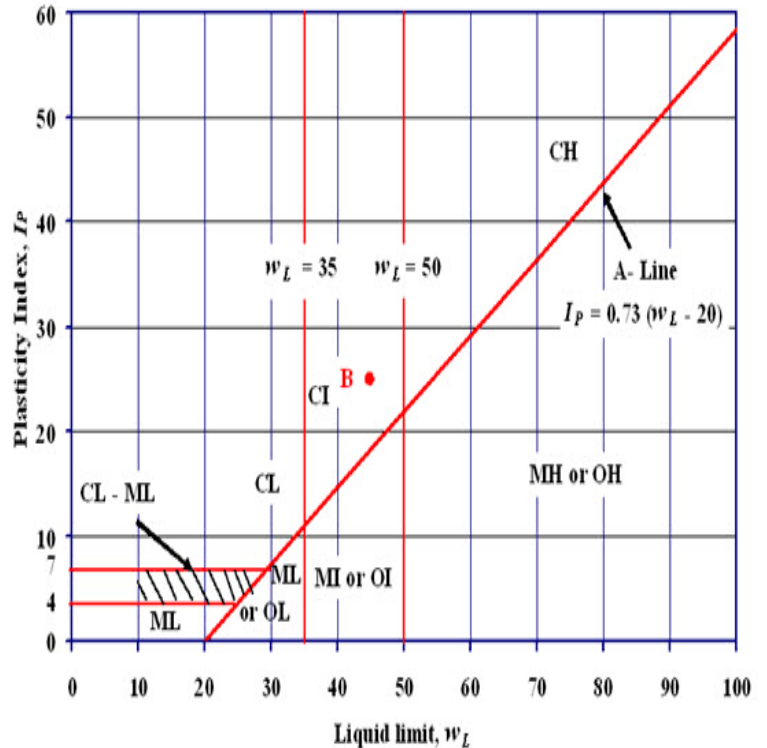
SPT Value	Consistency
0-2	Very Soft
2-4	Soft
4-8	Medium
8-15	Stiff
15-30	Very Stiff
>30	Hard

Density Condition of Granular Soils

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



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 'Cl' 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 bore-log 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

Bore Hole	Depth of Foundation below GL with 2.40 m Basement Floor level	Shape of Footing	Size of Footing		Net Safe Bearing Capacity	Settlement Produced	Gross Safe Bearing Capacity	MODULUS OF SUBGRADE REACTION
			Length	Width				
	(m)		(m)	(m)	Tonne/sqm	(mm)	Tonne/sqm	Kg/cm ³
1	4.50	SQUARE	3.00	3.00	15.86	39.91	20.36	5.96
	4.50	RECTANGULAR	4.00	3.00	14.14	39.86	18.64	
	5.00	SQUARE	3.00	3.00	16.41	38.65	20.91	
	5.00	RECTANGULAR	4.00	3.00	14.64	38.62	19.14	
2	4.50	SQUARE	3.00	3.00	16.74	41.19	21.24	5.90
	4.50	RECTANGULAR	4.00	3.00	14.93	41.14	19.43	
	5.00	SQUARE	3.00	3.00	17.32	39.90	21.82	
	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

NOTE: -

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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BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981

BOREHOLE 01		Depth of borehole		20.00 metre		Water table below borehole level (m)		11.00		Factor of safety		2.50																								
		Water table used for calculation (m)		10.00		Assumed post monsoon rise (m)		1.00																												
S. No.	Type of foundation	Depth of foundation below GL (m)	Length (m)	Width (m)	Diameter (m)	Input Parameters				Shearing Resistance Parameters										Ultimate Net Bearing Capacity			Net Safe Bearing Capacity kN/m ²													
						Density Above Foundation Level (gms/cc)	Density Including water effect (kN/m ³)	Density Below Foundation Level (gms/cc)	Density Including water effect (kN/m ³)	Cohesion (kg/cm ²)	Angle of Shearing Resistance (°)	Void Ratio (e)	Effective Surcharge (kN/m ²)	Bearing Capacity Factors			Shape Factors			Depth Factors				Inclination Factors	General shear	Local shear	Intermediate									
						c	φ	φ'	q	Nc	Nq	Ny	Nc'	Nq'	Ny'	Sc	Sq	Sy	Dc	Dq	Dy	Dc'	Dq'	Dy'	Ic	Iq	Iy	kN/m ²	kN/m ²	kN/m ²	kN/m ²					
1	SQUARE	4.50	3.00	3.00	-	1.98	19.42	1.98	19.42	19.42	0.40	4	2.68	0.642	87.38	6.19	1.43	0.34	5.81	1.27	0.21	1.30	1.20	0.80	1.32	1.00	1.00	1.00	1.00	1.00	1.00	1.00	470.16	293.27	388.79	155.52
2	RECTANGULAR	4.50	4.00	3.00	-	1.98	19.42	1.98	19.42	0.40	4	2.68	0.642	87.38	6.19	1.43	0.34	5.81	1.27	0.21	1.15	1.15	0.70	1.32	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	419.18	261.49	346.64	138.66
3	SQUARE	5.00	3.00	3.00	-	1.98	19.42	1.98	19.42	0.40	4	2.68	0.642	97.09	6.19	1.43	0.34	5.81	1.27	0.21	1.30	1.20	0.80	1.36	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	486.48	303.34	402.24	160.89
4	RECTANGULAR	5.00	4.00	3.00	-	1.98	19.42	1.98	19.42	0.40	4	2.68	0.642	97.09	6.19	1.43	0.34	5.81	1.27	0.21	1.15	1.15	0.70	1.36	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	433.98	270.63	358.84	143.54



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BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981

BOREHOLE 02		Depth of borehole		20.00 metre		Water table below borehole level (m)		11.00		Factor of safety		2.50																									
		20.00		metre		Water table used for calculation (m)		10.00		Assumed post monsoon rise (m)		1.00																									
		20.00		metre		10.00		10.00		1.00		1.00																									
S. No.	Type of foundation	Depth of foundation below GL (m)	Length (m)	Width (m)	Diameter (m)	Input Parameters						Shearing Resistance Parameters								Ultimate Net Bearing Capacity			Net Safe Bearing Capacity kN/m ²														
						Density Above Foundation Level (gms/cc)	Density Including water effect (kN/m ³)	Density Below Foundation Level (gms/cc)	Density Including water effect (kN/m ³)	Cohesion (kg/cm ²)	Angle of Shearing Resistance (°)	Void Ratio (e)	Effective Surcharge (kN/m ²)	Bearing Capacity Factors			Shape Factors			Depth Factors				Inclination Factors	General shear	Local shear	Intermediate										
						Bulk	Bulk	Bulk	Bulk	c	φ	e	q	Nc	Nq	Ny	Nc'	Nq'	Ny'	Sc	Sq	Sp	Dc	Dq	Dy	Dc'	Dq'	Dy'	Ic	Iq	Iy	kN/m ²	kN/m ²	kN/m ²	kN/m ²		
1	SQUARE	4.50	3.00	3.00	-	2.00	19.61	2.00	19.61	0.40	4	0.618	88.26	6.19	1.43	0.34	5.81	1.27	0.21	1.30	1.20	0.80	1.32	1.00	1.00	1.00	1.31	1.00	1.00	1.00	1.00	1.00	1.00	470.70	293.61	410.49	164.20
2	RECTANGULAR	4.50	4.00	3.00	-	2.00	19.61	2.00	19.61	0.40	4	0.618	88.26	6.19	1.43	0.34	5.81	1.27	0.21	1.15	1.15	0.70	1.32	1.00	1.00	1.00	1.31	1.00	1.00	1.00	1.00	1.00	1.00	419.69	261.81	366.01	146.40
3	SQUARE	5.00	3.00	3.00	-	2.00	19.61	2.00	19.61	0.40	4	0.618	98.07	6.19	1.43	0.34	5.81	1.27	0.21	1.30	1.20	0.80	1.36	1.00	1.00	1.00	1.35	1.00	1.00	1.00	1.00	1.00	1.00	487.07	303.71	424.73	169.89
4	RECTANGULAR	5.00	4.00	3.00	-	2.00	19.61	2.00	19.61	0.40	4	0.618	98.07	6.19	1.43	0.34	5.81	1.27	0.21	1.15	1.15	0.70	1.36	1.00	1.00	1.00	1.35	1.00	1.00	1.00	1.00	1.00	1.00	434.54	270.99	378.93	151.57



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BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981

BOREHOLE 01		Depth of borehole		Factor of safety																																
		20.00	metre	11.00	2.50																															
		Water table below borehole level (m)		Assumed post monsoon rise (m)																																
		10.00		1.00																																
		Water table used for calculation (m)																																		
Input Parameters																																				
S. No.	Type of foundation	Depth of foundation below GL (m)	Length (m)	Width (m)	Diameter (m)	Density Above Foundation Level (gms/cc)	Density Including water effect (kN/m ³)	Density Below Foundation Level (gms/cc)	Density Including water effect (kN/m ³)	Cohesion (kg/cm ²)	Angle of Shearing Resistance (°)	Void Ratio (e)	Effective Surcharge (q) (kN/m ²)	Shearing Resistance Parameters						Ultimate Net Bearing Capacity			Net Safe Bearing Capacity (kN/m ²)													
														Bearing Capacity Factors	Shape Factors	Depth Factors	Inclination Factors	General shear (kN/m ²)	Local shear (kN/m ²)	Intermediate																
														Nc	Nq	Nγ	Nc'	Nq'	Nγ'	Sc	Sq	Sγ	Dc	Dq	Dγ	Dc'	Dq'	Dγ'	Ic	Iq	Iγ					
1	RECTANGULAR	4.00	20.00	10.00	-	1.98	19.42	1.98	19.42	0.40	4	0.642	77.67	6.19	1.43	0.34	5.81	1.27	0.21	1.10	1.10	0.80	1.09	1.00	1.08	1.00	1.00	1.00	1.00	1.00	1.00	1.00	347.88	217.74	288.01	115.20



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BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981

BOREHOLE 02		Depth of borehole		20.00 metre		Water table below borehole level (m)		11.00		Factor of safety		2.50																										
		Water table used for calculation (m)		10.00		Assumed post monsoon rise (m)		1.00																														
BOREHOLE 02		Depth of borehole		20.00 metre		Water table below borehole level (m)		11.00		Factor of safety		2.50																										
		Water table used for calculation (m)		10.00		Assumed post monsoon rise (m)		1.00																														
BOREHOLE 02		Depth of borehole		20.00 metre		Water table below borehole level (m)		11.00		Factor of safety		2.50																										
		Water table used for calculation (m)		10.00		Assumed post monsoon rise (m)		1.00																														
S. No.	Type of foundation	Depth of foundation below GL (m)	Length (m)	Width (m)	Diameter (m)	Input Parameters			Shearing Resistance Parameters										Ultimate Net Bearing Capacity			Net Safe Bearing Capacity kN/m ²																
						Density Above Foundation Level (gms/cc)	Density Including water effect (kN/m ³)	Density Below Foundation Level (gms/cc)	Density Including water effect (kN/m ³)	Cohesion c (kg/cm ²)	Angle of Shearing Resistance ϕ' (°)	Void Ratio e	Effective Surcharge q (kN/m ²)	Bearing Capacity Factors			Shape Factors			Depth Factors			Inclination Factors	General shear kN/m ²	Local shear kN/m ²	Intermediate kN/m ²												
						Bulk		Bulk		c	ϕ'	e	q	Nc	Nq	N γ	Nc'	Nq'	N γ '	Sc	Sq	Sy	Dc	Dq	D γ	Dc'	Dq'	D γ '	Ic	Iq	I γ	kN/m ²	kN/m ²	kN/m ²	kN/m ²			
1	RECTANGULAR	4.00	20.00	10.00	-	2.00	19.61	2.00	19.61	0.40	4	0.618	78.46	6.19	1.43	0.34	5.81	1.27	0.21	1.10	1.10	0.80	1.09	1.00	1.00	1.00	1.08	1.00	1.00	1.00	1.00	1.00	1.00	1.00	348.46	218.10	304.14	121.66



SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	4.50	metre	Settlement effective zone depth		1.50	X Width (m) bgl	Depth factor		1.00	BOREHOLE 1
			Water Table depth for calculation	Applied Pressure at foundation base			Rigidity factor	0.80		
Length	3.00	metre			10.00					
Width	3.00	metre			155.52	kN/m ²				

S. No.	Layer No.	Type of Layer	Layer Start depth (m)	Layer End depth (m)	Layer Thickness (m)	Density (gms/cc)	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement (mm)	Immediate settlement (mm)	Total settlement (mm)
		CLAY					e	Cc	N"	P _o	ΔP	(mm)	W'	(mm)		
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)

Depth of foundation																
1	1	CLAY	0.00	4.50	4.50	1.98	-	-	-	131.29	50.78	-	-	49.882	-	39.91
2	2	CLAY	4.50	9.00	4.50	1.99	0.627	0.127	-	-	-	-	-	-	-	-



SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	4.50	metre	Settlement effective zone depth	1.50	X Width	Depth factor		Type of foundation	RECTANGULAR	BOREHOLE 1
						Rigidity factor				
						1.00	0.80			
Length	4.00	metre	Water Table depth for calculation	10.00	(m) bgl					
Width	3.00	metre	Applied Pressure at foundation base	138.66	kN/m ²					

S. No.	Layer No.	Type of Layer	Layer Start depth (m)	Layer End depth (m)	Layer Thickness (m)	Density (gms/cc)	Void Ratio	Compression Index	Corrected SPT	Effective stress (kN/m ²)	Increment stress (kN/m ²)	Settlement for Unit Pressure (mm)	Water Correction factor	Consolidation settlement (mm)	Immediate settlement (mm)	Total settlement (mm)
		CLAY					e	Cc	N''	P _o	ΔP	(mm)	W'	(mm)		
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)

Depth of foundation																
1	1	CLAY	0.00	4.50	4.50	1.98	-	-	-	131.29	50.71	-	-	49.821	-	39.86
2	2	CLAY	4.50	9.00	4.50	1.99	0.627	0.127	-							



SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	5.00	metre	Settlement effective zone depth		1.50	X Width (m) bgl kN/m ²	Depth factor		BOREHOLE 1				
			Water Table depth for calculation	Applied Pressure at foundation base			Rigidity factor	Type of foundation	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
			10.00	160.89			0.80	SQUARE					

3

S. No.	Layer No.	Type of Layer	Layer Start depth (m)	Layer End depth (m)	Layer Thickness (m)	Density (gms/cc)	Void Ratio	Compression index	Corrected SPT	Effective stress (kN/m ²)	Increment stress (kN/m ²)	Settlement for Unit Pressure (mm)	Water Correction factor	Consolidation settlement (mm)	Immediate settlement (mm)	Total settlement (mm)
		CLAY					e	Cc	N''	P _o	ΔP	(mm)	W'	(mm)		(mm)
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)		(mm)
1	1	CLAY	0.00	5.00	5.00	1.98	-	-	-	141.00	52.54	-	-	48.314	-	38.65
2	2	CLAY	5.00	9.50	4.50	1.99	0.627	0.127	-							
Depth of foundation																



SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	5.00	metre	Settlement effective zone depth		1.50	X Width (m) bgl	Depth factor		RECTANGULAR	BOREHOLE 1
			Water Table depth for calculation	Applied Pressure at foundation base			Rigidity factor	Type of foundation		
			4.00	3.00			10.00	143.54		

S. No.	Layer No.	Type of Layer	Layer Start depth (m)	Layer End depth (m)	Layer Thickness (m)	Density (gms/cc)	Void Ratio	Compression Index	Corrected SPT	Effective stress P_o kN/m^2	Increment stress ΔP kN/m^2	Settlement for Unit Pressure (mm)	Water Correction factor	Consolidation settlement (mm)	Immediate settlement (mm)	Total settlement (mm)
		CLAY					e	Cc	N''	P_o	ΔP	(mm)	W'	(mm)		
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m^2	kN/m^2	(mm)		(mm)	(mm)	(mm)

		Depth of foundation															
1	1	CLAY	0.00	5.00	5.00	1.98	-	-	-	-	-	-	-	-	-	-	38.62
2	2	CLAY	5.00	9.50	4.50	1.99	0.627	0.127	-	141.00	52.49	-	-	48.280	-	-	



SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1																
BOREHOLE 2												Total settlement (mm)				
Depth	4.50	metre	Settlement effective zone depth		1.50	X Width (m) bgl	Depth factor		1.00	Rigidity factor	Type of foundation	SQUARE				
			Water Table depth for calculation	Applied Pressure at foundation base			10.00	0.80								
Length	3.00	metre			164.20											
Width	3.00	metre														
S. No.	Layer No.	Type of Layer	Layer Start depth (m)	Layer End depth (m)	Layer Thickness (m)	Density (gms/cc)	Void Ratio	Compression Index	Corrected SPT	Effective stress P_o (kN/m ²)	Increment stress ΔP (kN/m ²)	Settlement for Unit Pressure (mm)	Water Correction factor	Consolidation settlement (mm)	Immediate settlement (mm)	Total settlement (mm)
		CLAY					e	Cc	N"	P_o	ΔP	(mm)	W'	(mm)	(mm)	(mm)
		SAND								kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	4.50	4.50	1.99	-	-	-	131.95	53.62	-	-	51.482	-	41.19
2	2	CLAY	4.50	9.00	4.50	2.00	0.618	0.125	-	-	-	-	-	-	-	-
Depth of foundation																



SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	4.50	metre	Settlement effective zone depth		1.50	X Width (m) bgl	Depth factor		1.00	BOREHOLE 2	
			Water Table depth for calculation	Applied Pressure at foundation base			Rigidity factor	Type of foundation		0.80	RECTANGULAR
			4.00	3.00			metre	metre			
Length	4.00	metre			10.00						
Width	3.00	metre			146.40						

S. No.	Layer No.	Type of Layer	Layer Start depth (m)	Layer End depth (m)	Layer Thickness (m)	Density (gms/cc)	Void Ratio	Compression Index	Corrected SPT	Effective stress (kN/m ²)	Increment stress (kN/m ²)	Settlement for Unit Pressure (mm)	Water Correction factor	Consolidation settlement (mm)	Immediate settlement (mm)	Total settlement (mm)
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)

		Depth of foundation										41.14				
1	2	CLAY	0.00	4.50	4.50	1.99	-	-	-	131.95	53.54	-	-	51.422	-	
1	1	CLAY	0.00	4.50	4.50	1.99	-	-	-	131.95	53.54	-	-	51.422	-	
2	2	CLAY	4.50	9.00	4.50	2.00	0.618	0.125	-							



SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	5.00	metre	Settlement effective zone depth		1.50	X Width (m) bgl	Depth factor		BOREHOLE 2	
			Water Table depth for calculation	10.00			Rigidity factor	1.00	SQUARE	
			Applied Pressure at foundation base	169.89			Type of foundation	0.80		

3

S. No.	Layer No.	Type of Layer	Layer Start depth (m)	Layer End depth (m)	Layer Thickness (m)	Density (gms/cc)	Void Ratio	Compression Index	Corrected SPT	Effective stress (kN/m ²)	Increment stress (kN/m ²)	Settlement for Unit Pressure (mm)	Water Correction factor	Consolidation settlement (mm)	Immediate settlement (mm)	Total settlement (mm)
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)

		Depth of foundation														
1	1	CLAY	0.00	5.00	5.00	1.99	-	-	-	141.71	55.47	-	-	49.878	-	39.90
2	2	CLAY	5.00	9.50	4.50	2.00	0.618	0.125	-							



SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	5.00	metre	Settlement effective zone depth		1.50	X Width (m) bgl	Depth factor		1.00	BOREHOLE 2	
			Water Table depth for calculation	Rigidity factor			Type of foundation				
			Applied Pressure at foundation base	0.80				RECTANGULAR			
Length	4.00	metre		10.00							
Width	3.00	metre		151.57							

S. No.	Layer No.	Type of Layer	Layer Start depth (m)	Layer End depth (m)	Layer Thickness (m)	Density (gms/cc)	Void Ratio	Compression Index	Corrected SPT	Effective stress (kN/m ²)	Increment stress (kN/m ²)	Settlement for Unit Pressure (mm)	Water Correction factor	Consolidation settlement (mm)	Immediate settlement (mm)	Total settlement (mm)
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)

		Depth of foundation														
1	1	CLAY	0.00	5.00	5.00	1.99	-	-	-	141.71	55.43	-	-	49.846	-	39.88
2	2	CLAY	5.00	9.50	4.50	2.00	0.618	0.125	-							



SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 5																
												BOREHOLE 1				
Depth	4.00	metre	Settlement effective zone depth		1.50	X Width (m) bgl	Depth factor		1.00	RECTANGULAR			Total settlement (mm)			
			Water Table depth for calculation	Applied Pressure at foundation base			Rigidity factor	Type of foundation		Settlement for Unit Pressure	Water Correction factor	Consolidation settlement		Immediate settlement		
Length	20.00	metre			10.00				0.80							
Width	10.00	metre			115.20											
S. No.	Layer No.	Type of Layer	Layer Start depth (m)	Layer End depth (m)	Layer Thickness (m)	Density (gms/cc)	Void Ratio	Compression Index	Corrected SPT	Effective stress kN/m ²	Increment stress kN/m ²	Settlement for Unit Pressure (mm)	Water Correction factor	Consolidation settlement (mm)	Immediate settlement (mm)	Total settlement (mm)
		CLAY				e	Cc	N"	P _o	ΔP	W'					
		SAND							kN/m ²	kN/m ²		(mm)		(mm)	(mm)	(mm)
Depth of foundation																
1	1	CLAY	0.00	4.00	4.00	1.98	-	-	-	164.67	59.84	-	-	63.235	-	59.01
2	2	CLAY	4.00	14.50	10.50	2.00	0.596	-	-	274.61	30.92	0.170	0.500	-	10.522	
3	3	SAND	14.50	19.00	4.50	2.04	-	20.11								

SETTLEMENT CALCULATION

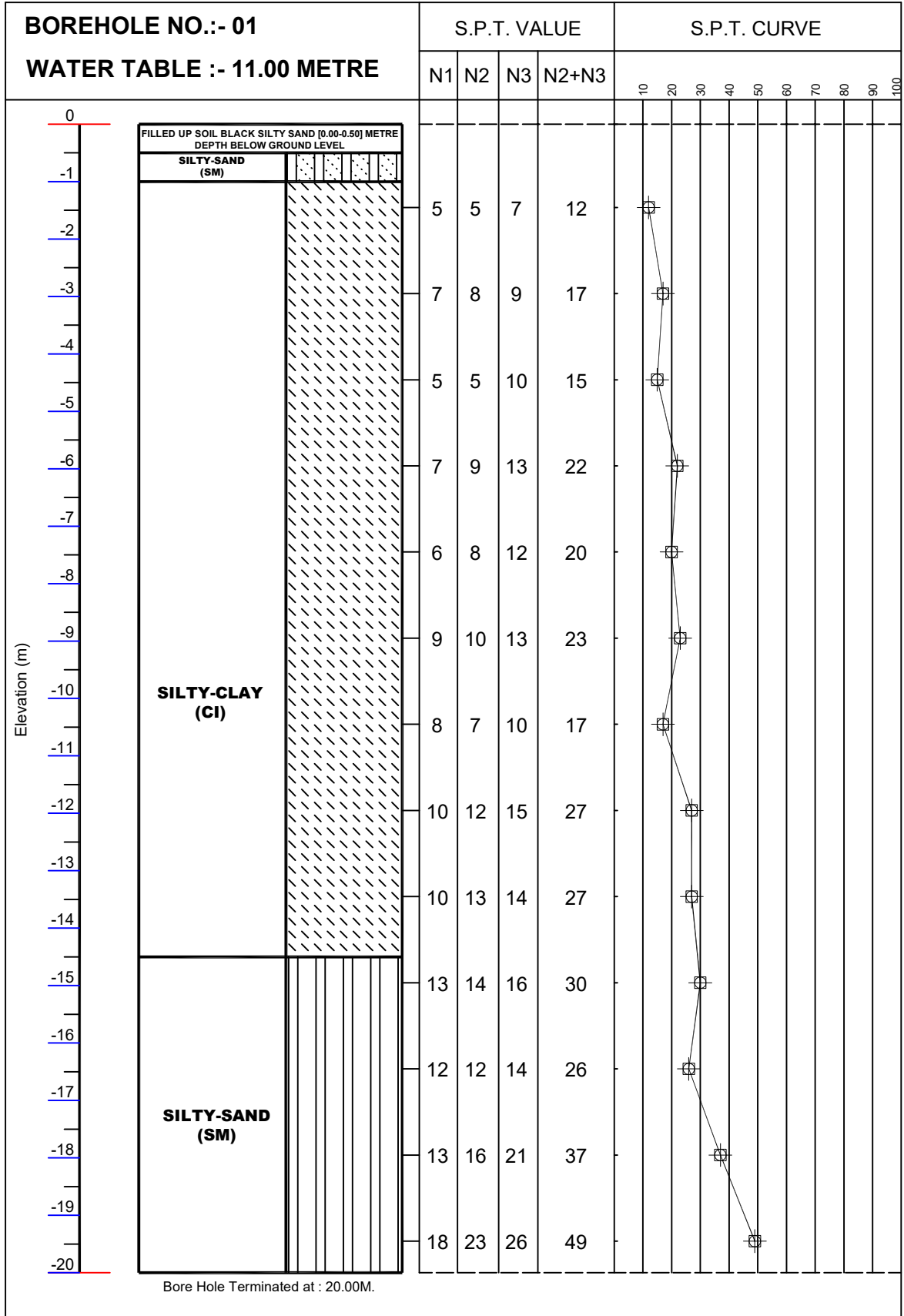
SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 5																
												BOREHOLE 2				
Depth	4.00	metre	Settlement effective zone depth			1.50	X Width (m) bgl	Depth factor		1.00	Type of foundation		RECTANGULAR			
			metre	metre	metre			Rigidity factor	0.80							
Length	20.00	metre	Water Table depth for calculation			10.00										
Width	10.00	metre	Applied Pressure at foundation base			121.66										
S. No.	Layer No.	Type of Layer	Layer Start depth (m)	Layer End depth (m)	Layer Thickness (m)	Density (gms/cc)	Void Ratio	Compression Index	Corrected SPT	Effective stress kN/m ²	Increment stress kN/m ²	Settlement for Unit Pressure (mm)	Water Correction factor	Consolidation settlement (mm)	Immediate settlement (mm)	Total settlement (mm)
		CLAY				e	Cc	N''	P _o	ΔP	W'					
		SAND	(m)	(m)	(m)	(gms/cc)			kN/m ²	kN/m ²	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)
1	1	CLAY	0.00	4.00	4.00	1.99	-	-	-	165.06	63.19	-	-	72.021	-	66.30
2	2	CLAY	4.00	14.50	10.50	2.00	0.609	-	-	275.44	32.66	0.166	0.500	-	10.858	
3	3	SAND	14.50	19.00	4.50	2.06	-	20.51								
Depth of foundation																

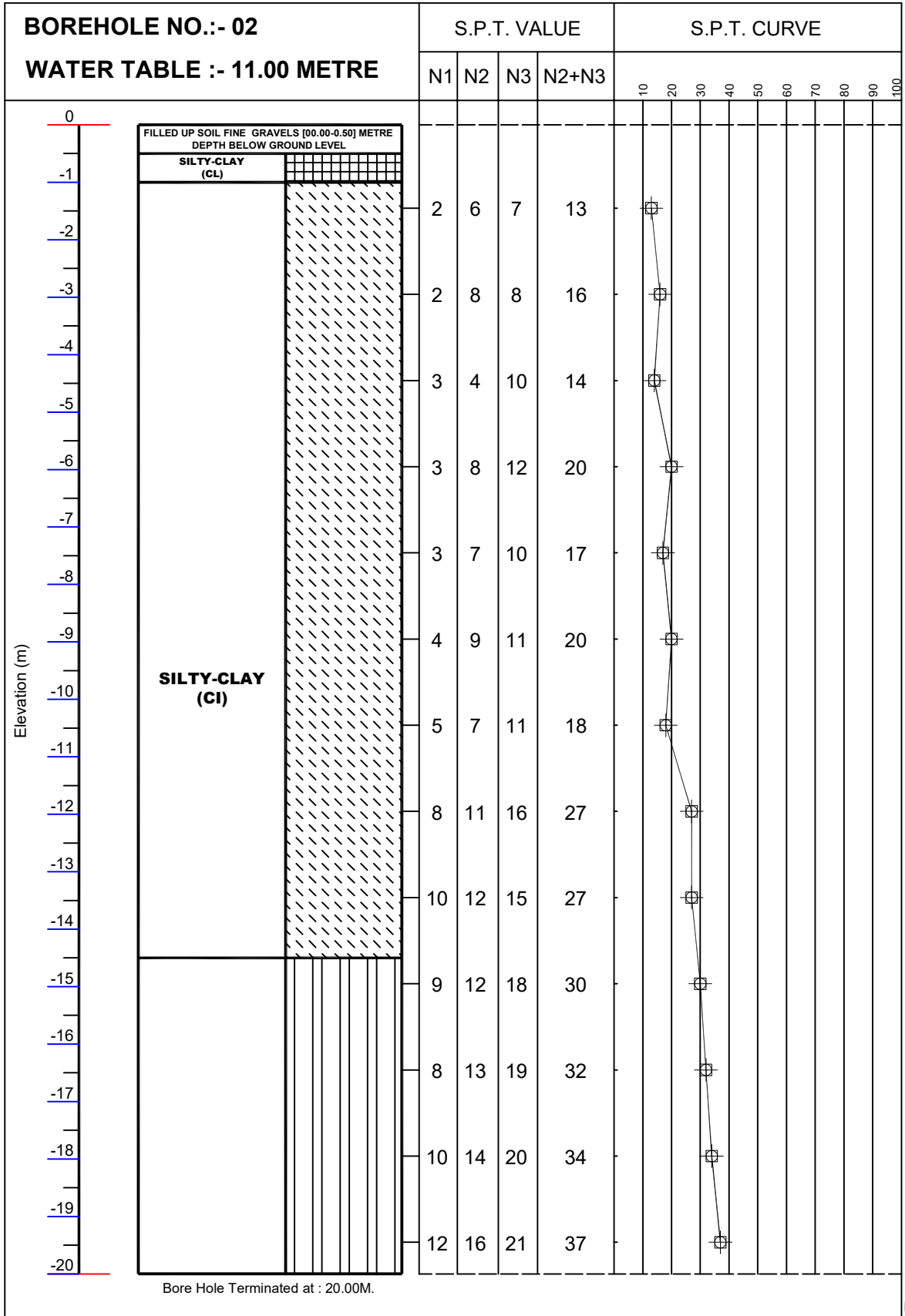
16.00 - 16.45	84.000 - 83.550	UD	-	-	-	-	96	95	94	28	-	-	-	-	-	-	-	-	-	-	-
16.45 - 16.90	83.550 - 83.100	SPT	32	26.03	20.52																
17.50 - 17.95	82.500 - 82.050	UD	-	-	-	98	97	96	26												
17.95 - 18.40	82.050 - 81.600	SPT	34	26.69	20.85																
19.00 - 19.45	81.000 - 80.550	UD	-	-	-	97	96	95	27												
19.45 - 19.90	80.550 - 80.100	SPT	37	28.08	21.54																
19.90 - 20.00	80.100 - 80.000	DS	-	-	-	98	97	96	28												



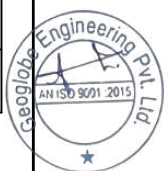
BORE-LOG CHART

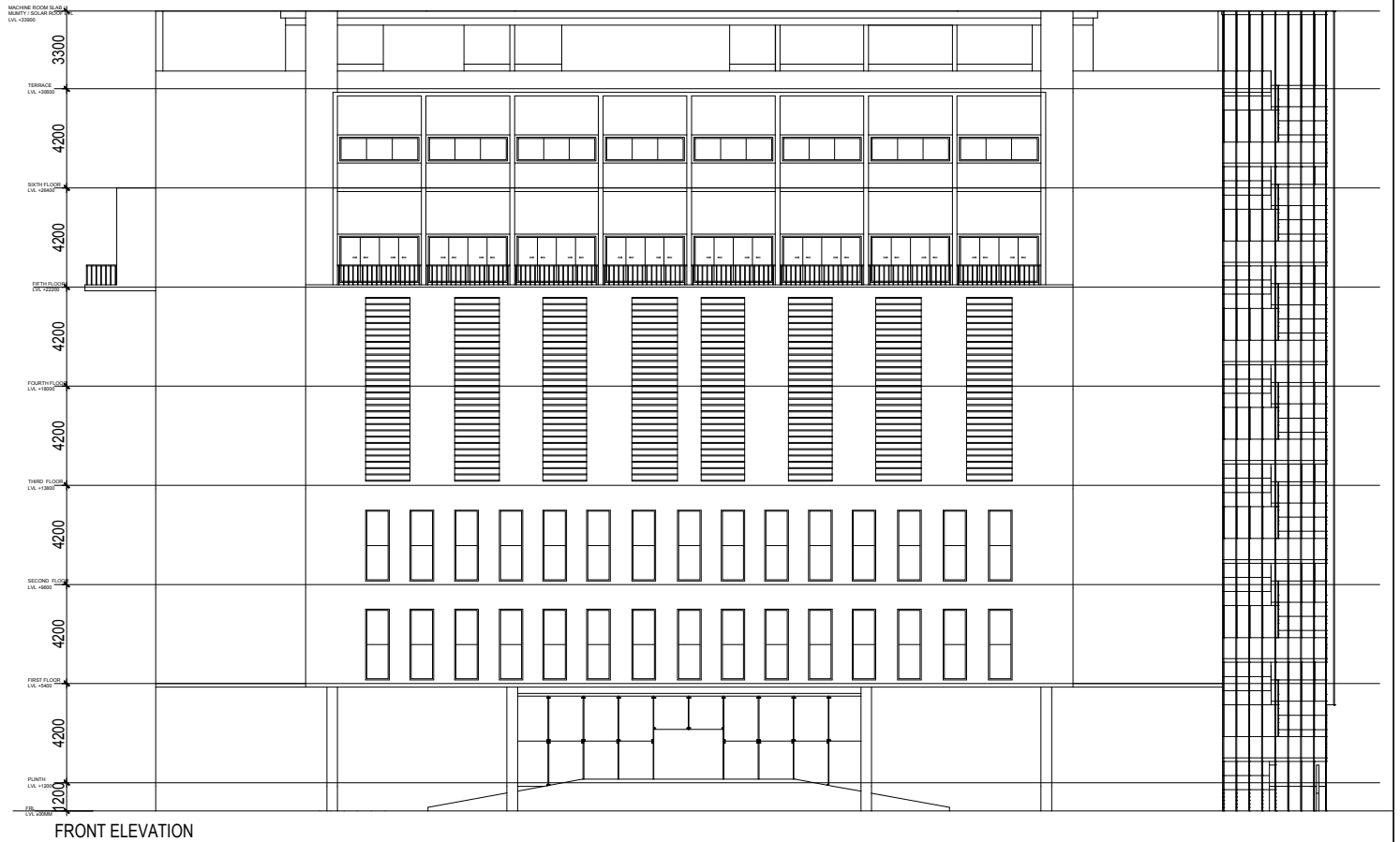
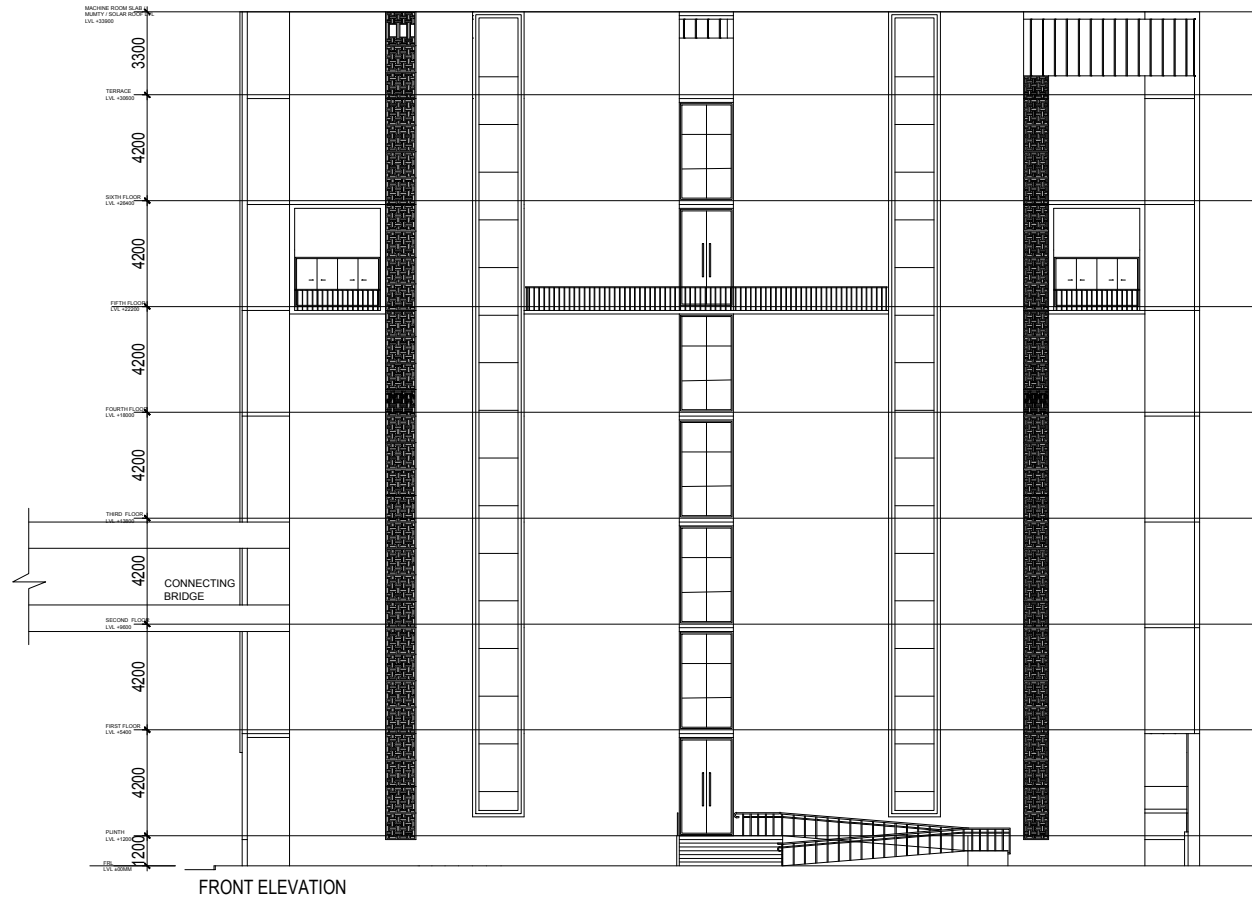


BORE-LOG CHART



END OF REPORT





DATE	REV.	REV. BY	DESCRIPTION	DATE	NOS.	ISSUED TO

REVISIONS

ARCHITECT
SURESH GOEL AND ASSOCIATES
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DWG ISSUED ON 08.10.2023 AT NEW DELHI

PROJECT CODE	NAME :	PJ	NAME :	AS	NAME :	VS
2023B	SIG		SIG		SIG	

BUILDING CODE	ORIGINATED BY	CHECKED BY	VALIDATED BY
HO	ARCHITECT	ARCHITECT	ARCHITECT

PROJECT:
CENTRE FOR AGEING
AT BANARAS HINDU UNIVERSITY
VARANASI

CLIENT :

DRAWING TITLE
FRONT & SIDE ELEVATION
DRAWING NUMBER
2023B-S1-HO-AE-110

SCALE : 1:75	SHEET SIZE : A1	SHEET NO : 01
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