REQUEST FOR QUOTATION

PROJECT MANAGEMENT CONSULTANT (FACILITY, EQUIPMENT & SOFT COMPONENTS) FOR ASSAM HEALTH SYSTEM STRENGTHENING PROJECT (SUPPORTED BY JAPAN INTERNATIONAL COORPORATION AGENCY)

BY

RITES LTD-MUKESH & ASSOCIATES-JV

(PMC-AHSSP)

OFFICE ADDRESS

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INVITES QUOTATIONS TO CARRY OUT GEO-TECHNICAL INVESTIGATION FOR THE PROPOSED CONSTRUCTION OF SUPERSPECIALITY HOSPITAL AT JORHAT, DIPHU AND CONSTRUCTION OF CIVIL HOSPITAL AT HALFLONG & MANGALDOI PACKAGE NO-A2

ISSUE DATE– 14/09/2023

Table A: Important Dates

Sr. No.	Event	Date and time
1	Date of issue of RFQ	**14/09/2023 – 11.00AM(IST)**
2	Last date for submission of Quotation along with Qualification Documents **(Physical Submission)**	**25/09/2023 – 3.00PM(IST)**
3	Bid Opening & Venue	**OPENING DATE & TIME: 25/09/2023 – 3.30PM (IST)** **VENUE: NAYANTARA COMPLEX (4TH FLOOR) SIXMILE,** **DIST.: KAMRUP (METRO), ASSAM, INDIA.**
4	Validity	Offers shall be valid for a period of Ninety (90) days from last date of bid submission.

Note: The above-mentioned dates are subject to amendment, in which case the amendments shall be uploaded in the https://ahidms.assam.gov.in

IMPORTANT NOTE:

No Quotation shall be accepted in any case after the Last date of submission, irrespective of delay due to postal services or any other reasons and PMC does not assume any responsibility for late receipt of the Tender.

1. All interested parties are requested to understand this RFQ in detail in order to comply with PMC's requirements including but not limited to the deadlines, selection criteria, selection methodology, scope of work, and minimum technical standards. They shall strictly abide by ALL terms prescribed in this Tender and provide accurate information to the best of their knowledge without misleading the PMC to be considered for participation in this Project.

2. **Quotation along with qualification document and all the pages signed and sealed RFQ document** to be submitted mandatorily in Original at the address mentioned below.

3. All the envelopes shall be addressed to: **RITES LTD-MUKESH& ASSOCIATES - JV NAYANTARA COMPLEX (4TH FLOOR) SIXMILE, Dist.: KAMRUP(METRO), Assam, India**

AUTHORITY:

The Team Leader, PMC-AHSSP, RITES Ltd. in JV with Mukesh & Associates

INSTRUCTION TO BIDDERS (ITB)

1) Bidders need to ensure that in the event the work is awarded to it, and during execution of the work, it shall not seek to alter any agreed contractual terms, conditions and specifications.
2) The specification provided with this RFQ (Request for Quotation) outlines the functional requirement.
3) The PMC reserves the right, to accept or reject any quotation and to annul the process and reject all quotation at any time prior to award of the contract, without assigning any reason thereof and without thereby incurring any liability to the affected Bidder(s).
4) The entire site for the work shall be made available along with work order
5) All rates shall be quoted in the proper form and understanding.
6) The PMC does not bind itself to accept the lowest Bid and reserves to itself the right to accept the whole or any part of the Quotation and the Bidder shall be bound to perform the same at the rate quoted in this Tender.

Pre-Qualifying Requirements (PQRs)/ Eligibility Conditions:

Technical Criteria:

a) The Bidder should be in business for at least last 7 years from the last date of submission of the Quotations. Submit Registration Certificate as supporting document along with Quotation.

b) The Bidder should have completed at least 5 similar Geo-Technical Investigation works with cumulative boring of minimum 150m each for government agencies/PSU in last 3 years from the last date of submission of the Quotations. Submit Completion Certificate as supporting document along with Quotation.

c) The Bidder should have the following manpower on its regular payroll for minimum one-year period reckoned as last date of notified for receipt of bid.

- At least one (1) qualified geotechnical engineer with M.Tech/ M.S. degree in Geotechnical Engineering/Civil Engineering and having minimum Three (3) years work experience in the area of geotechnical investigation. Submit CV along with Educational Qualification Document of the same as supporting document along with Quotation.

d) The Bidder should own the following equipment/test setup/facility:

- Wash boring rigs- Three (3) Nos.
- Electrical Resistivity Test setup- Three (3) No.
- 7.5 Horsepower Winch machine
- Laboratory set up equipped for testing the physical, engineering and chemical properties of soil and rock.

Note:

- Submit ownership proof / Valid Rental agreement for above equipment's as supporting document.

Financial Criteria:

a) The average annual turnover of the Bidder in the preceding three (3) financial years as on the last date of submission of quotation should not be less than Rs. 15.00 Lakhs.

b) Net worth should be at least 10% of average turnover of previous 3 years

c) Bidder shall submit documentary evidence like IT Returns/account statement/annual reports duly certified by qualified CA/CMA or annual reports for FYs 2019-2020, 2020-21,2021-22 certified by qualified CA/CMA.

d) Notwithstanding anything stated above, the PMC reserves the right to assess the capabilities and capacity of the Bidder to perform the contract, should be circumstances warrant such assessment in the overall interest of the PMC.

Other Criteria for Qualification:

a) The QUOTATION of only those Bidders will be considered who will produce documentary proofs self-attested to meet the following requirements:

b) The Bidders should have GST registration, PAN No. etc.

- The agency should have valid licenses under The Contract Labour (Regulation & Abolition) Act, 1970 & The Contract Labour (P & R) (ASSAM) Rules 1972 and amendment from time to time or should give an undertaking that he will get himself registered within one week if work is awarded to him and if applicable as per prevailing labour laws.
- The experience list shall include only works executed by Bidder himself as a turnkey contractor which shall include entire work of Geotechnical Investigations and detailed reports.

- The Bidder shall ensure that all the information, facts & figures, data provided in the bid are accurate and correct. PMC reserves the right to confirm / verify any data or information through their own sources.

c) The Bidder shall furnish documentary evidence by way of copies of Contract / Purchase Order or any other equivalent document, Audited Balance Sheet and Profit & Loss Account etc., along with the Bid to establish experience / track record and financial capabilities meeting Bid Evaluation Criteria.

- PMC also reserves right to reject or disqualify any bidder at any stage considering its overall performance in past project (s) executed for AHIDMS/PMC based on reasonable grounds/ reasons for such rejection/disqualification. PMC shall be under no obligation to inform the affected Applicants of the rejection and / or ground for rejection.
- The Bidder should meet all the above eligibility criteria as on the bid due date. The quotation of only those bidders, who meet the all the above Eligibility Criteria, will be considered for further evaluation.

Local Conditions:

1) The Bidder is advised to visit and examine the site conditions, location, surroundings, climate, availability of local labour, local working conditions, accommodation, availability of power, water and other utilities for performance of work, access to site, communication, transport, right of way, handling and storage of materials, weather data, applicable laws and regulations, and obtain for itself on its own responsibility all information that may be necessary for preparing the Bid and entering into the Contract. The costs of visiting the Site shall be at Bidder's own expense.
2) The Bidder and any of its personnel or agents shall be granted permission by the AHIDMS/PMC to enter upon it’s premises and lands for the purpose of such inspection, but only upon the express condition that the Bidder, its personnel or agents, shall release and indemnify the AHIDMS/PMC and its personnel and agents

from and against all liability in respect thereof and shall be responsible for personal injury (whether fatal or otherwise), loss of or damage to property and any other loss, damage, costs and expenses however caused, which, but for the exercise of such permission would not have arisen.

3) Failure to visit the Site shall in no way relieve the successful Bidder from furnishing any material or performing any work in accordance with the RFQ document.

4) In no case the date of Time for Completion of the project shall be extended, due to the failure of the Bidder to visit the site and it shall be in line with the timeline of PMC

5) The Bidder must conduct its own inspection of the proposed project site, access to the Project Site and surroundings at its own cost in order to make a proper estimate of the works to be performed under consideration of site-specific constraints.

6) It shall be deemed that by submitting a quotation, the Bidder has:
   a) made a complete and careful examination of the all the 5 (Five) Site location
   b) received all relevant information requested from the PMC;

7) The PMC shall not be liable for any omission, mistake or error on the part of the Bidder in respect of any of the above or on account of any matter or thing arising out of or concerning or relating to the RFP document or the Bidding Process, including any error or mistake therein or in any information or data given by the Company.

Right to accept or reject any or all Quotation:

1) Notwithstanding anything contained in this Tender, the PMC reserves the right to accept or reject any quotation and to annul the bidding process and reject all quotation at any time without any liability or any obligation for such acceptance, rejection or annulment, and without assigning any reasons thereof.

2) Such misrepresentation/ improper response shall lead to the disqualification of the Bidder. If such disqualification / rejection occurs after the Quotations have been opened and the Successful Bidder gets disqualified / rejected, then the PMC reserves the right to:
   a. select the next Bidder with the Lowest Quoted Value as the Successful Bidder; <or>
   b. Take any such measure as may be deemed fit in the sole discretion of the PMC, including annulment of the bidding process.

3) In case it is found during the evaluation or at any time before issuance of Work order or after its execution and during the period of subsistence thereof, that one or more of

the pre-qualification conditions have not been met by the Bidder or the Bidder has made material misrepresentation or has given any materially incorrect or false information, the Bidder shall be disqualified forthwith, if not yet appointed as the Contractor either by issue of the LOA or Work Order, and if the Successful Bidder has already been issued the LOA or Work Order, as the case may be, the same shall, notwithstanding anything to the contrary contained therein or in this Tender, be liable to be terminated, by a communication in writing by the PMC to the Contractor, without the PMC being liable in any manner whatsoever to the Bidder or Contractor, as the case may be. In such an event, the PMC shall forfeit and appropriate the bank guarantees without prejudice to any other right or remedy that may be available to the PMC.

4) The PMC reserves the right to verify all statements, information and documents submitted by the Bidder in response to the RFQ. Failure of the PMC to undertake such verification shall not relieve the Bidder of its obligations or liabilities hereunder nor will it affect any rights of the PMC there under.

SCOPE OF WORK FOR GEOTECHNICAL INVESTIGATION WORK

The Entire scope of Geo-Technical Investigation has to be carried out for the following site locations within Site boundary area:

Sl.No.	Site Locations	Site Area
1	Jorhat Medical College and Hospital,Jorhat	12000 Sq.m
2	Diphu Medical College and Hospital, Diphu	8775 Sq.m
3	Mangoldai Civil Hospital, Darrang.	7057 Sq.m
4	Haflong Civil Hospital,Dima Hasao	3277.24 sq.m

Note:

(i) ***Actual Bore hole Locations shall be informed to the successful bidder along with the issue of work order.***

(ii) ***Existing Site Plan is enclosed as Annexure-A to this RFQ.***

The scope of work for the Geotechnical work to be carried out for the Hospital Building.

1) Drilling of Bore Holes and carrying out SPT test at regular intervals along with standard field and laboratory tests for a depth of preferably minimum 20.0m/maximum 30.0m depth(or) up to refusal strata whichever is earlier.
2) Soil report covering the above particulars along with SBC at various depth and recommend type of foundations Pile/ Raft/ Open foundation.
3) Required tests related to Black Cotton soil including free swell test and recommendation for soil improvement / treatment if any.
4) Natural Moisture Content, Bulk and Dry Density, Sieve Analysis, Hydrometer Analysis, Liquid Limit, Plastic Limit & Shrinkage Limit, Triaxial Shear Test (Unconsolidated Undrained), Direct Shear Test, Specific Gravity, Consolidation Test, Free Swell Index, Swelling pressure.
5) Density, Unconfined Compressive Strength.
6) Copy of bore log along with SPT values on a regular basis after completion of field work.
7) The additional boreholes if required shall be carried out with approved rates.
8) If any other soil test or clarification with respect to SBC, soil improvement if required at present or during execution shall be clarified without any extra cost.
9) Boring of 150 mm dia. holes in all kinds of soil up to a maximum depth of 30.0m or up to refusal (N:100) whichever is met earlier including collection of undisturbed samples (from cohesive soil only) at 3.0m interval and conducting Standard Penetration Test at 1.5m intervals (6 BH x 30 m).

10) Nx size drilling using diamond bit in hard strata (N>100)/ rock formation in continuation of boring as per item no.1 including collection of cores in core boxes, determination of core recovery and RQD where applicable (6 BH x 30 m).

The above works includes the following necessary laboratory tests as relevant on selected soil and water samples:

<u>On Soil Samples collected from Bore Holes:</u>

- Liquid Limit & Plastic Limit.
- Natural Moisture Content
- Bulk Density
- Dry Density
- Specific Gravity
- Grain Size Analysis
- Silt factor for scour depth
- Particle Size Distribution
- Unconfined Compression Test
- Direct Shear Test and
- Consolidation Test
- Free Swell Index
- Swell Pressure
- Chemical Analysis of the soil etc.

<u>On Rock Samples collected from Bore Holes:</u>

- Water Absorption
- Density of Rock and
- Uniaxial Compression Test

Compilation of field and laboratory test results and submission of the same in the form of a report including necessary **recommendation for minimum depth and type of foundation, minimum safe bearing capacity of soil.**

<u>Notes:</u>

1. All bore hole investigation shall start from existing ground level only
2. Company Representative will mark the exact location of bore holes before commencement of work at site

3. Soil Samples shall be packed in Polythene cover for further reference purpose.
4. Work shall be executed only in the presence of company representative.
5. Geo Technical investigation shall be carried out as per IS 1892

CODES AND STANDARDS:

(i) All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions.
(ii) In case of conflict between this specification and those (IS codes, Standards etc.) referred to herein, the former shall prevail.
(iii) All work shall be carried out as per the following Indian Standards and Codes:

IS:1080	Code of practice for design and construction of simple spread foundations.
IS:1498	Classification and Identification of Soils for general Engineering Purposes.
IS:1888	Method of Load test on Soils.
IS:1892	Code of practice for Subsurface Investigation for Foundation.
IS:1904	Code of practice for design and construction of foundations in Soils: General Requirements.
IS:2131	Method of Standard Penetration Test for Soils.
IS:2132	Code of practice for Thin-Walled Tube Sampling of Soils.
IS:2470 (Part-I)	Code of practice for design and construction of Septic Tanks.
IS:2720	Method of Test for Soils (Relevant Parts).
IS:2809	Glossary of terms and symbols relating to Soil Engineering.
IS:2810	Glossary of terms relating to Soil Dynamics.
IS:2911	Code of practice for designs and construction of Pile foundations (Relevant Parts).
IS:2950 (Part-I)	Code of practice for designs and construction of Raft foundation.
IS:3025	Methods of Sampling and Testing (Physical and Chemical) for Water used in Industry.
IS:3043	Code of practice for Earthling.
IS:4078	Code of practice for Indexing and Storage of Drill Cores.
IS:4434	Code of practice for In-situ Vane Shear Test for Soils.
IS:4453	Code of practice for Exploration by pits, Trenches, Drifts and Shafts.

IS:4464	Code of practice for presentation of Drilling information and Core description of Foundation investigation.
IS:4968 (Part-II)	Method for subsurface Sounding for Soils – Dynamic method using Cone and Bentonite slurry.
IS:4968 (Part-III)	Method for subsurface Sounding for Soils- Static Cone Penetration Test.
IS : 5313	Guide for Core Drilling Observations.
IS : 5529 (Part-I)	Code of practice for in-situ permeability Test-Test in Over burden.
IS : 5529 (Part-II)	Code of practice for in-situ permeability Test- Test in Bed rock.
IS : 6065	Recommendation for the preparation of Geological and Geotechnical maps for River Valley Project.
IS : 6403	Code of practice for determination of Allowable Bearing Pressure on Shallow foundation.
IS : 6926	Code of practice for Diamond Core Drilling for Site Investigation for River Valley Projects.
IS : 6935	Method of determination of Water level in a Bore-Hole.
IS : 6955	Code of practice of subsurface exploration for Earth and Rock fill dams.
IS : 7422	Symbols and Abbreviations for use in Geological maps, sections and subsurface exploratory logs (Relevant parts).
IS: 8009	Code of practice for calculation of settlement of foundation subjected to symmetrical vertical loads
(Part –I)	– Shallow foundations
(Part – II)	— Deep foundations.
IS : 8763	Guide for Undisturbed Sampling of Sands.
IS : 8764	Method for determination of point load strength index of Rocks.
IS : 9143	Method for the determination of unconfined compressive strength of Rock Materials.
IS : 9179	Method for preparation of Rock Specimen for Laboratory testing.
IS : 9198	Compaction Rammer for Soil Testing.
IS : 9214	Determination of Modulus of subgrade reaction in field.
IS : 9259	Specification for Liquid Limit apparatus.
IS : 9640	Specification for Split Spoon Sampler.
IS : 9669	Specification for CBR Mould and its accessories.
IS : 10050	Method for determination of Slake Durability Index of Rocks.
IS : 10060	Code of practice for subsurface investigations for Power House Sites.

IS : 10074	Specification for compaction mould assembly for Light and Heavy Compaction.
IS : 10108	Code of practice for sampling by thin wall sampler with Stationary piston.
IS : 10589	Equipment for determination of subsurface sounding of Soils.
IS : 10837	Specification of moulds for determination of Relative density and its accessories.
IS : 11229	Specification for Shear Box testing of soils.
IS : 11315 (Part-II)	Description of Discontinuities in Rock Mass – Core Recovery and Rock Quality.
IS : 12070	Code of practicefor design and construction of shallow foundations on rocks.
IS: 13372	Part-I & II: Code of Practice - Seismic Testing of Rock Mass

CALIBRATION OF EQUIPMENT:

The contractor shall ensure that all the equipment's/instruments are properly calibrated at the start of the work to reflect factual values. If demanded by the PMC, the contractor shall have the instruments tested at an approved laboratory at his cost and the test reports shall be submitted at the earliest to PMC. If the PMC desires to witness such tests, the contractor shall arrange for the same at the field.

INVESTIGATIONS IN SOIL:

(i) GENERAL

The contractor shall have on site all required survey instruments to carry out the work accurately according to specifications and drawings. All the specified locations for boreholes and field tests shall be set out at site by the contractor from two established reference grid lines which will be shown to him by the PMC, or as indicated in the drawing. If required, the contractor shall set out the base lines and the locations of boreholes and field tests with reference to the property line as indicated by the PMC or as indicated on the drawing. At each location of boreholes, plate load tests and other field tests, the contractor shall establish the ground prior to commencing of the operations. The ground level shall be related to an established bench mark or to a GTS bench mark or as directed by the PMC or indicated on the Drawing.

If the area, where the field tests are located, is likely to be inundated by tidal waters, the field work shall include provision for temporary fill, erection and removal of platforms, making good the ground, access, etc., as necessary for carrying out the work in this area and no extra claims will be entertained on this account.

The CONTRACTOR shall submit with his bid the list of equipment/apparatus he would mobilise to site, if work is awarded to him. If necessary, to complete the work within the stipulated time, the CONTRACTOR shall mobilise additional equipment without additional cost to the PMC unless specifically agreed earlier.

(ii) Boring:

General requirements:

a) Bore holes shall be taken at specified locations to obtain information about the sub-soil profile, its nature and strength and to collect soil samples for strata identification and conducting laboratory tests. The diameter of the borehole shall be such as to permit collection of undisturbed samples of 90 mm to 100 mm diameter. However, the diameter shall be 150mm as per relevant IS code. The minimum diameter of the bore shall be 150 mm and boring shall be carried out in accordance with the provisions of IS: 1892 as per this specification.

b) All bore holes shall be extending up to depths shown on the construction drawings or as directed by the PMC. If the strata with Standard Penetration Test (SPT) Value greater than 100 with characteristics of rock is met with, prior to the specified depth, the bore hole shall be advanced further by chiselling. Chiselling shall be continued for a maximum depth of 20 cm or up to 2 hours whichever is earlier. During chiselling rock fragments shall be collected. Identification of rock strata shall be on the basis of visual examination of SPT sample and rock fragments. After it is established that rock is met with, borehole shall be advanced further by drilling in rock as specified in tender clause and core shall be collected. When the bore hole is terminated in soil strata, an additional Standard Penetration Test shall be carried out at the termination depth.

c) Casing pipe shall be used in the bore hole to support its sides when a side fall is suspected to occur inside the bore hole. When casing pipe is used, it shall be ensured that its bottom end is at all times less than 15 cm above the bottom of the bore hole and not below the level at which the test has to be conducted or sampling has to be done. In case of cohesion less soils the advancement of the casing pipe shall be such that it does not disturb the soil to be tested or sampled. The casing shall be advanced by slowly turning the casing pipe and not by driving.

d) If any obstruction to normal boring is encountered in any borehole, this obstruction shall be overcome by drilling and/or by chiselling. Chiselling will normally be paid at the contract rate for boring in soil at appropriate depths, unless a separate rate has been provided for in the contract.

e) In-situ tests shall be conducted or undisturbed samples (UDS) shall be collected in the bore holes at regular intervals and at change of strata or as decided by the Engineer. Representative disturbed samples shall be preserved for conducting various identification tests in the laboratory. Water table in the bore hole shall be carefully recorded and reported. No water/drilling mud shall be added while boring above ground water table. For cohesion less soil below water table, the water level in the bore hole shall at all times be maintained slightly above the water table.

f) The bore hole shall be cleaned using suitable tools up to the depth of testing or sampling, ensuring that there is minimum disturbance of the soil at the bottom of the bore hole. The process of jetting through an open tube sampler shall not be permitted. In cohesive soils, the bore hole may be cleaned using a bailer with a flap valve. Gentle circulation of drilling fluid shall be done when rotary mud circulation boring is adopted.

g) On completion of the bore hole, including the borehole in which special tests are conducted, the Contractor shall backfill all the bore hole as directed by the PMC.

(iii) Boring:

Boring by Shell Sinker Bar 150mm SX casing up to terminate depth, using 7.5 Horsepower Winch machine.

(iv) Percussion boring (Chiselling):

This method can be adopted in soil with gravel and boulders when the boring has to be done at a fast rate. This method consists of breaking of the strata by repeated blows from a chisel or drilling bit and bailing out the debris at intervals by adding water into the bore hole. This method is not permitted unless otherwise specified.

(v) Rotary Mud Circulation Boring:

This method can be used in all types of soil below water table. In this method boring shall be done by rotating the bit fixed at the bottom of the drill rod. Proper care shall be taken to keep firm contact between the bit and the bottom of the bore hole. Bentonite mud shall be used as the drilling fluid to prevent caving in of the bore hole sides. Use of percussion tool shall be permitted in hard clays and dense sandy deposits.

(vi) Standard Penetration Test (SPT):

This test shall be conducted in all types of soil deposits met within a bore hole, to find the variation in the soil stratification by correlating with the number of blows required for unit penetration of standard penetrometer. This test shall be conducted

at 3.0 m intervals and every change of strata to the satisfaction of the PMC. The starting depth of performing SPT shall be between 0.5 M depth below ground level. This depth shall be staggered in alternate boreholes. The depth interval between the top levels of Standard penetration test and next undisturbed sampling shall not be less than 1.0 m. The specifications for the equipment's and other accessories, procedure for conducting the test, presentation of test results and collection of the disturbed soil samples shall conform to IS: 2131.

For conducting the test, the bottom of borehole shall be cleaned properly and the spoon shall be properly and centrally seated in position in the borehole. It is necessary to ensure that drive hammer is of specified weight and has a specified free fall. It shall be ensured that energy of the falling weight is not reduced by friction between the drive weight and guides or between rope and winch drum. Only BIS recommended standard connecting rods shall be used for the test.

This test shall be carried out by driving a standard split spoon sampler in the bore hole by means of a 650 N hammer having a free fall of 0.75 m. The sampler shall be driven using the hammer and for 450 mm. While driving the number of blows for every 150 mm penetration and the penetration for every 50 blows shall be recorded. The number of blows for the last 300 mm drive shall be reported as N value. This test shall be discontinued when the blow count is equal to 100 and the penetration shall be recorded. Refusal shall be considered to be met with when the blow count is equal to or greater than 100. At the location where the test is discontinued the penetration and the number of blows shall also be reported. Sufficient quantity of disturbed soil samples shall be collected from the split spoon sampler for identification and laboratory testing. The sample shall be visually classified and recorded at the site and shall be properly preserved and labelled for future identification.

Sampling:

i. General

a) Sufficient number of soil samples shall be collected for reliable estimation of soil properties. The samples collected shall be either disturbed or undisturbed. Disturbed soil samples shall be collected for field identification and conducting tests such as sieve analysis, index properties, specific gravity, chemical analysis, etc. Undisturbed samples shall be collected to estimate the strength and settlement properties of the soil.

b) All the accessories required for sampling and the method of sampling shall conform to IS: 2132. All the disturbed and undisturbed samples collected in the field shall be classified at the site as per IS: 1498.

c) All the samples shall be identified with date, bore hole or trial pit number, depth of sampling, etc. It is also essential to mark an arrow pointing towards the top surface of the sample. Care shall be taken to keep the undisturbed soil samples and box samples vertically with the arrow directing upwards. The tube samples shall be properly trimmed at both ends and sealed with molten paraffin wax at both ends immediately after extracting the samples from the bore hole and suitably capped on both sides.

d) When the Contractor fails to collect the undisturbed soil sample at a specified depth the reason for the same shall be indicated in the bore log and the bore hole shall be advanced by 0.5 M. Subsequently, for cohesion less soil Standard Penetration Test shall be performed and for very soft cohesive soil field vane shear test shall be performed.

e) Precaution shall be taken to ensure that there shall not be any change in moisture content and disturbance of the soil samples and they shall be placed in a temporary store at the end of the day 's work. All the samples shall be kept over a bed of sand, jute bags, saw dust, etc. and covered over on top with similar material. The bed and top cover shall be kept moist till they are properly packed in wooden boxes. The Contractor shall be responsible for packing and transporting of all the samples from site to the laboratory within seven days after sampling with proper protection against loss and damage.

f) The CONTRACTOR shall properly store all the samples at site till they are transported to his laboratory for testing. Sampling tubes containing undisturbed soil samples shall not be exposed to direct sun and shall be kept
in a shade covered with wet gunny bags All the samples shall be packed in wooden boxes using sand, saw dust etc. all around the samples before transportation to laboratory for testing.

g) The rock cores obtained by drilling shall be carefully removed from the core barrel and placed in a properly constructed wooden core boxes with hinged wooden covers as specified above. The cores shall be placed in the boxes in the correct sequence and with each run segregated accurately by labelled wooden blocks 25 mm thick. No box shall contain more than 6 M of core. Depths of all runs shall be marked on the portions with paint.

h) The CONTRACTOR shall transport all samples to his testing laboratory as quickly as possible and test the samples.

ii. Disturbed sample:

a) Disturbed soil samples shall be collected in bore holes at regular intervals to provide complete description of soil profile and its variation. Jar samples weighing approximately 10 N shall be collected in bore holes at 0.5 m intervals starting from a depth of 0.5 m below ground level and at every identifiable

change of strata to supplement the boring records. Samples shall be immediately stored in air tight jars or polythene bags and labelled with bore hole number and depth.

b) In elevated areas, if superficial material is available in plenty, then bulk samples from a depth of about 0.5 m below ground level shall be collected to establish all the required properties to use it as a fill material. Disturbed samples weighing about 250 N shall be collected at shallow depths and immediately stored in polythene bags as per IS: 1892. The bags shall be sealed properly and they shall be kept in wooden boxes.

iii. Undisturbed Samples:

a) In each bore hole undisturbed sample shall be collected at every change of strata and at regular intervals of 3.0 m and as directed by the PMC. The starting depth of collection of UDS shall be between ground level and 1.0 m below ground level and as decided by the PMC. The starting depth shall be staggered in alternate boreholes. In cohesive soils collection of UDS shall be preferred in place of SPT. The depth interval between the top level of undisturbed sampling and standard penetration test shall be at least 0.5m.

b) Undisturbed samples shall be 100 mm dia and 450 mm length. Samples shall be collected in such a manner that the structure of the soil and its moisture content do not get altered. The specifications for the accessories required for sampling and the sampling procedure shall conform to IS: 1892 and IS: 2132. Undisturbed sampling in sand shall be done using compressed air technique mentioned in IS: 8763.

c) Thin-walled sampler shall be used to collect undisturbed samples by pushing the tube into the soil. The sampling tube shall have a smooth finish on both surfaces and minimum effective length of 450 mm. The area ratio of sampling tubes shall be less than 12.5%. However, in case of very stiff soils, area ratio up to 20% shall be permitted.

a) Undisturbed Sampling in cohesive soil:

Undisturbed samples in soft to stiff cohesive soils shall be obtained using a thin-walled sampler. In order to reduce the wall friction, suitable precautions such as oiling the surfaces shall be taken. The bore hole shall be cleaned and the depth of sampling below the ground level shall be noted. The sampler shall then be attached to the bottom of the boring rods and lowered into the bore hole. The sampler shall be pushed into the clay layer by hand or by jacking and soil sample of specified length shall be collected without disturbing the soil. The distance by which the sampler penetrates into the soil strata shall be checked. Care being taken to ensure that the sampler is not driven too far as this will compress the

soil. The sampler shall be rotated to break the core at the bottom of the sampler and then steadily drawn up.

b) Undisturbed sampling using Piston sampler:

Undisturbed samples in very loose saturated sandy and silty soils and very soft clays shall be obtained by using a piston sampler consisting of a sampling cylinder and piston system. In soft clays and silty clays, with water standing in the casing pipe, piston sampler shall be used to collect undisturbed samples. During this method of sampling expert supervision is called for.

The interior surface of the sampler shall be smooth, clean and corrosion resistant. Its cutting edge and the ring seals shall be inspected for wear and rejected if worn. Check shall be done to ensure that the moving parts of the sampler function freely before the sampler is lowered into the bore hole. While pushing the system into the soil and till the beginning of the sampling operations, the bottom of the piston shall be flush with the cutting edge of the sampler. At the depth of sampling, the piston should be fixed relative to the ground and the sampler cylinder shall be independently pressed down smoothly and continuously into the ground. If an obstruction is met, the sampler shall be withdrawn and another sample taken after the obstruction is removed.

Accurate measurements of the depth of sampling, height of sampler, stroke and length of sample recovery shall be recorded. After the sampler is pushed to the required depth, both the sampler cylinder and piston system shall be drawn up together ensuring that there shall not be any disturbance to the sample which shall then be protected from changes in moisture content.

c) Undisturbed sampling in Cohesion Less Soils:

Undisturbed samples in cohesion less soils shall be obtained as per the procedure given in IS: 8763. Compressed air sampler shall be used to take samples of cohesion less soil below water table. Precautions shall be taken to clear the borehole before sampling. Thin-walled tube samplers of 60 mm internal diameter shall be used. The height and other dimensions of the sampler shall be recorded before use. Proper care shall be taken to maintain the water level slightly above the ground water table before and during sampling operations. Immediately after the sample is obtained, the ends of the sample shall be waxed and capped to avoid moisture content changes.

iv Relaxation During Sampling:

a) The Sampler shall be pushed into the soil and driving of sampler shall be resorted to only when it cannot be pushed into the soil. This shall be done only with the permission of the Engineer and all the details about the same shall be recorded into the bore logs.
b) In clays when N value is above 50, undisturbed samples may be replaced by standard penetration test.

v Ground Water:

1. One of the following methods shall be adopted for determining the ground water table in bore holes as per IS:6935 and as per the instructions of the PMC.

a) In permeable soils, the water level in the bore hole shall be allowed to stabilize after lowering it adequately by bailing. When the water level inside the bore hole is found to be stable, the depth of water level below ground level shall be measured. Stability of sides and bottom of the bore hole shall be ensured at all times.
b) For both permeable and impermeable soils, the following method shall be suitable. The bore hole shall be filled with water and then bailed out to various depths. Observations on the rise or fall of water level shall be made at each depth. The level at which neither a fall nor a rise is observed shall be considered as the water table elevation. This shall be established by three successive readings of water level taken at an interval of two hours.

2. In case any variation in the ground water level is observed in any specific boreholes, then the water level in these bore holes shall be recorded daily during the course of the field investigation. Levels in nearby wells, streams, etc. if any, shall be noted whenever these readings are taken.

3. If so called for, observation wells shall be drilled for the purpose of long term studies of the fluctuation in ground water levels and pressure. Either a Stand pipe or Piezometer shall be installed in selected previously drilled or specially drilled bore holes covering the complete site area. These shall be at specified depths as per the specifications and instructions of the Engineer. Daily water level readings shall be recorded immediately following the installation up to the time of leaving the site. At the end of field work, these installations shall be handed over in satisfactory working condition to the Engineer without disturbing their position so that the PMC can continue further observations. It is important to install some Stand pipes and Piezometers prior to the coming

monsoon, in order to record the local effects and variations in the ground water level during the period.

4. Stand pipes and Piezometers shall consist of 19 mm internal diameter rigid plasticised (UPVC) tubing. All the joints in the tubing shall be made of coupling sleeves. The top of UPVC tubing shall be enclosed in a 75mm diameter galvanized steel pipe of 1.5m length having a galvanized steel screw cap with well-greased threads and the caps shall be tightened such that it would be impossible to loosen by hand. The lower end of the pipe shall have four legs of 6mm thick and 100mm long and welded to have projection of 25mm. The pipe shall be sealed into the ground with cement grout so that it does not rotate. The top end of the pipe shall project about 300 mm above ground level unless otherwise specified by the PMC

5. The perforated tubing for the porous element shall be surrounded by a response zone of well graded sand from 500 mm below to 150 mm above the lower end of the Stand pipe or Piezometer, and the bore hole above the response zone shall be back filled with natural soil or well graded sand. The latter shall compose of particles that vary in amount according to the size in such a manner that the void space formed by the larger particles can be filled by smaller size particles.

a) Stand pipe:

Stand pipes shall be installed to measure the water level in soils with high permeability such as sand and gravel. The stand pipe shall consist of a perforated tubing attached to the bottom of the UPVC tubing. The perforated tube shall be 150 mm long having perforation of diameter not greater than 1 mm.

b) Piezometers:

Piezometers shall be installed to measure the pore pressures in soil with medium to low permeability. Piezometers shall consist of a porous filter attached to the bottom of the UPVC tubing. The filter shall be 300 mm length and shall be placed in the bore hole and sealed at top and bottom by grouting. Hydraulic Piezometers with double line to be used to remove the air trapped in the system.

6. Sub-soil Water Samples:

a) Sub-soil water samples shall be collected for carrying out chemical analysis. Representative samples of ground water shall be collected when it is first encountered in bore holes before the addition of water to aid boring or drilling.

Water samples shall not be collected when bentonite slurry or mud has been used for drilling operations. If water has been added for drilling purpose or if ground water has been diluted by surface rain water, then the bore hole shall be dewatered and water allowed to rise from which the sample may be taken.

b) The sampling apparatus shall be such that the water at the desired depth can be collected directly without any disturbance and any change in the concentration of the constituents like dissolved gases, etc. Undue agitation shall be avoided. An ordinary suction pump with its suction end inserted up to the required depth in the bore hole shall be used for this purpose.
c) The sample shall be collected in a clean vessel and allowed to settle so that the supernatural liquid can be poured into a clean well rinsed glass or polythene bottle. Sufficient quantity and number of samples shall be collected to carry out the chemical analysis and sent to a laboratory in airtight bottles with proper labelling. Chemical analysis of water samples shall include determination of pH value; turbidity; sulphate, carbonate, nitrate and chloride; presence of organic matter and suspended solids.
d) In some cases, constituents may be mixed and analysed later as specified in the specific test methods. Chemical preservatives may be added to the sample for cases as specified in the test method/IS codes. This shall only be done if analysis cannot be conducted within an hour of collection and shall have the prior written permission and approval of the PMC.

LABORATORY TESTING:

(i) Essential Requirements

a) All laboratory tests shall be conducted in an approved laboratory using approved apparatus complying with the requirements and specification of Indian Standards or other approved standards for this class of work. It shall
be checked that the apparatus is in good working condition before starting the laboratory tests. Calibration of all the instruments and their accessories shall be done carefully and precisely.
b) Depending on the type of sub strata encountered, appropriate laboratory tests shall be conducted on soil and rock samples collected in the field. Laboratory tests shall be scheduled and performed by qualified and experienced personnel who are thoroughly conversant with the work. Tests indicated in the schedule of items shall be performed on soil, water and rock samples as per relevant IS Codes indicated in para 4.0. One copy of all the laboratory test data records shall be submitted to the PMC progressively every week. Laboratory tests shall be carried out concurrently with field investigation since initial laboratory test results could

be useful in planning the later part of field work. **A schedule of laboratory tests shall be established by the Contractor and the same shall be submitted and got approved by the Engineer before starting of laboratory tests**.

c) All samples, whether undisturbed or disturbed, shall be extracted, prepared and examined by competent personnel, properly trained and experienced in soil sampling, examination, testing and in using the apparatus as per the specified standards.

d) Undisturbed soil samples retained in liners or seamless tube samplers shall be taken out without causing any disturbance to the samples using suitably designed extruder just prior to actual testing. If the extruder is horizontal, proper support shall be provided to prevent the sample from breaking. For screw type extrudes, the pushing head shall be free from the screw shaft so that no torque is applied to the soil sample in contact with the pushing head. For soft clay samples, the sample from tube shall be cut by means of a high speed hacksaw to specified test length and placed over the mould before pushing the sample into it with a suitable piston.

e) While extracting a sample from a liner or tube, care shall be taken to see that its direction of movement is the same as that during sampling to avoid stress reversal.

f) On all undisturbed soil samples tested for bulk density, water content, grain size distribution, liquid limit and plastic limit tests shall also be performed.

g) On all rock samples tested for unconfined compression test, bulk density, water absorption, point load index tests shall also be performed.

(ii) Tests:

Tests as indicated in this specification and as called for by the Engineer shall be conducted. These tests shall include the following:

a) Tests on Undisturbed and Disturbed Samples

- Visual and Engineering Classification
- Sieve Analysis and Hydrometer Analysis
- Liquid, Plastic, and Shrinkage limits
- Specific Gravity
- Chemical Analysis
- Swell pressure and Free Swell index determination
- Proctor Compaction test
- California Bearing Ratio

b) Test on Undisturbed Samples

- Bulk Density and Moisture Content
- Relative Density (for sand)

- Unconfined Compression Test
- Box Shear Test (in case of cohesion less and c- soil)
- Triaxle Shear Tests: (depending on the type of soil and field conditions on undisturbed or remoulded samples) i) Unconsolidated undrained.

ii) Consolidated Undrained Test with the Measurement of Pore Water Pressure.

iii) Consolidated Drained.

- Consolidation test.
- Laboratory Permeability Test

Chemical Analysis of Subsoil and Ground Water

(iii) Salient Test Requirements:

a) Remoulded soil specimen, whenever desired, shall be fully reworked at field density and moisture content. For conducting CBR test and triaxle test for dyke/road material the sample shall be remoulded to 95% of standard proctor density.

b) Triaxle shear test shall be conducted on undisturbed soil samples, saturated by the application of back pressure. Only if the water table is at sufficient depth such that chances of its rising to the base of the footing are meagre or nil, the triaxle tests shall be performed on specimens at natural moisture content. Each test shall be carried out on a set of three test specimens from one sample at cell pressures equals to 100, 200 and 300 kN/Sqm or as required depending on the soil conditions.

c) Effective stress triaxle shear test could be either consolidated drained or consolidated undrained with pore water pressure measurement. The test shall be conducted at cell pressures of 100, 200 and 300 kN/Sqm ensuring complete consolidation at each stage.

d) Direct shear test shall be conducted on undisturbed soil samples. The three normal vertical stresses for each test shall be 100, 200 and 300 kN/Sqm or as required as per the soil conditions.

e) Consolidation test shall have loading stages of 10, 25, 50, 75, 100, 200, 400 and 800 kN/Sq.m. Rebound curve shall be recorded for all the samples by unloading the specimen at the in-situ stress of the specimen. Additional rebound curves shall also be recorded whenever desired by the Engineer.

f) Chemical analysis of sub-soil shall include determination of pH value; carbonate, sulphate (both SO3 and SO4), chloride and nitrate contents; organic matter, chemicals salinity and any other chemicals harmful to the foundation material. The contents in soil shall be indicated as percentage (%).

g) Chemical analysis of sub-soil water sample shall include the determination of the properties such as colour, odour, turbidity, pH value and Specific conductivity,

both at 25 deg. C and chemical contents such as Carbonates, Sulphates (both SO3 and SO4), Chlorides, Nitrates, Organic matter and any other chemical harmful to the foundation material. The contents such as Sulphates, etc. shall be indicated as ppm by weight.

h) The lab CBR test shall be performed on undisturbed and remoulded sample for soaked and unoaked condition.

i) The lab permeability test shall be performed on undisturbed and remoulded (blended with bentonite) samples as approved by the engineer. The percentage of bentonite shall be varied to achieve permeability less than 1x10-6 cm/sec.

REPORT:

(i) <u>General</u>

a) On completion of all the field and laboratory work, the Contractor shall submit a draft/Interim report containing Geological information of the region, procedure adopted for investigation, field observations, summarised test data, statistical average parameters for each identified layer. The report shall include detailed bore logs, subsoil sections, field test results, laboratory observations and test results both in tabular as well as graphical form, practical and theoretical considerations for the interpretation of test results, the supporting calculations/ documents for the conclusions drawn, etc. Initially, the Contractor shall submit three copies of the report in draft form for the PMC ‘s review. The abstract of the sub-soil stratification of the project shall also be included in the report.

b) The Contractor ‘s qualified Geotechnical engineer shall visit the PMC ‘s Corporate Office for a detailed discussion on the draft report based on the comments of the PMC. **Before submission of draft report, the Contractor's qualified Geotechnical Engineer shall give the presentation on the site investigation work completed, contents of draft report, discussion on soil strata/foundation system etc. at PMC's Engineering Office.** During the discussions, it shall be decided as to the modifications that need to be done in the draft report. Thereafter the Contractor shall incorporate in the report the agreed modifications as suggested by the PMC and submit the revised draft report for PMC‘s approval. Upon PMC‘s approval, the final report shall be submitted in five hard copies. The approved report shall also be submitted on three computer compatible compact discs (CDs).

c) The detailed final report based on field observations, in - situ and laboratory tests shall encompass theoretical as well as practical considerations to arrive at foundations of different types of structures envisaged in the area under investigation. The Contractor shall acquaint himself about the type of structures, foundation loads and other information required from the PMC.

(ii) Data to be furnished

The report shall also include but not be limited to the following:

a) A plot plan showing the locations and reduced levels of all field tests e.g. bore holes, trial pits, static cone penetration tests, dynamic cone penetration tests, plate load tests, etc., properly drawn to scale and dimensioned with reference to the established grid lines.

b) Geological information of the area such as geomorphology, geological structure, lithology, stratigraphy and tectonics faults, seismicity of the region and site, core recovery and rock quality designation, etc.

c) Past observations and historical data, if available, for the area or for other areas with similar soil profile with similar structures in the surrounding areas.

d) A true cross section of all individual boreholes and trial pits with reduced levels and coordinates showing the classification and thickness of individual stratum, position of ground water table, various in-situ tests conducted and samples collected at different depths and the rock stratum, if met with. All soil profiles shall be presented using any latest software package.

e) A set of longitudinal and transverse soil/rock profiles vertical scale 1:200, horizontal scale 1:2000 connecting various bore holes in order to give a clear picture of the various of the subsoil strata as per IS: 6065.

f) Water level contours and Rock level contours shall be presented in any latest software package.

g) Plot of Standard Penetration Test (N values both uncorrected and corrected) with depth for identified areas.

h) Results of all laboratory tests summarised (i) for each sample (as per Table-1 and Table 2 for soil and rock respectively) as well as (ii) a consolidated table giving the layer wise soil and rock properties in a format similar to Table 1 and 2. All the relevant charts, tables, graphs, figures, supporting calculations, conclusions and photographs of representative rock cores and trial pits shall be furnished.

i) For all triaxle shear tests, stress v/s strain diagrams as well as Mohr's circle envelopes shall be furnished. If back pressure is applied for saturation, the magnitude of the same shall be indicated. The value of modulus of elasticity, E shall be furnished for all tests along with relevant calculations.

j) For all consolidation test, the following curves shall be furnished:
Void ratio VS pressure (plotted on log scale)
Void ratio VS pressure and
Compression VS time (plotted on log scale) or
Compression VS square root of time (depending upon the shape of the plot for proper determination of coefficient of consolidation)

The point showing the initial condition (Eo, Po) of the soil shall be marked on the curves.

k) Values of compression index, coefficient of volume compressibility shall be furnished. The procedure adopted for calculating the compression index from the field curve and settlement of soil strata shall be clearly specified. The time required for 50% and 90% primary consolidation along with secondary settlement, if significant, shall also be calculated.

l) Pressure meter tests, the following shall be furnished: Calibration Record including:
Description of membrane and sheath on probes, Dimensions of thick-walled cylinder, Length of flexible tubing, Calibration curves, Temperature.

Drilling Record including:

Borehole number, Method of making borehole, log of soil type and condition, Depth of water in borehole, weather and temperature.

Test Record:

Type of test, Date and time, Depth of Centre Point of probe, Volume readings at 30 and 60 second elapsed time and corresponding pressure readings. Notes on any deviation from standard test procedure.

Field Pressure meter, creep and air calibration curves indicating P_o, P_f and P_l. Corrected pressure meter and creep curves indicating P_0, P_f, P_l, along with calculation for the corrections.

m) Values of cohesion, angle of internal friction, pressure meter modulus, shear modulus and coefficient of sub-grade reaction along with sample calculation. Calculation for allowable bearing pressures and corresponding total settlements, for shallow foundations mentioned in para 8.3 (b) and load capacity calculation of piles in various modes.

(iii) <u>Recommendation</u>

a. The recommendations shall be based on observations and test results and shall encompass theoretical as well as practical considerations for foundations for type of structures envisaged and other relevant systems as indicated by the ENGINEER, in the area under investigation. The CONTRACTOR shall be acquainted with, with the help of the PMC, about type of structures proposed and their functions.

b. Geological description of the site including that of faults, folds, etc. if any, based on published literature and investigation carried out.

c. Seismic history of site including brief description of previous earthquakes, if any, giving time, period, duration, magnitude, epicentre location, damage done, maximum ground acceleration produced etc. and relevant details about design earthquake.
d. Special considerations, if any, adopted in design of previous structures of the region because of seismicity, faults, folds etc.
e. Recommended types of foundations.
f. Allowable or safe bearing capacities in different strata for shallow foundations indicating relevant design criteria adopted, methods of analysis adopted and weightage assigned to different methods.
g. For pile foundations, type of piles recommended with reasons for the same; length, diameter, allowable capacity (both lateral and vertical) of individual and groups of piles.
h. Recommendations for values for Modulus of Subgrade reaction for foundation design by elastic method.
i. Estimate of magnitude and rate of settlement of the proposed foundations.
j. Behaviour of proposed foundations under seismic conditions including analysis for possibility of liquefaction and expected settlement under earthquake.
k. Negative skin friction, if any; magnitude of estimated negative skin friction. Methods to minimize or eliminate negative skin friction.
l. Analysis and recommendations for machine foundations and other foundations subject to vibratory actions.
m. Comments on chemical nature of subsoil and groundwater with due regards to potential deleterious effects on concrete, steel and other substructure materials and recommended measures to overcome deleterious effects, if any.
n. Recommendations for subsoil treatment such as sand drains or stone columns, if any needed, giving reasons for such treatment, available and recommended method(s) of treatment. Mention shall be made of studies/trials to be carried out, if any, prior to selection of a method/methods of treatment.
o. Recommendations in regard to use of subsurface material for various construction activities and methods for quarrying the same.
p. Topographical details of site and recommendations related to site preparation including classification, source, placement and compaction of fill materials required to bring the general site levels to final grade level, if so warranted; recommendations regarding excavation, stable slopes for excavation, dewatering etc
q. Recommendation regarding design and construction of roads and other paved area
r. Recommendation regarding site drainage.

s. Recommendations regarding any special construction procedure/precaution to be adopted/taken, method of dewatering, if any required, etc.

t. Recommendations regarding construction of soak pits, lagoons and reservoirs including comments on water retaining characteristics and recommendations for linings, etc. and other treatment if required.

u. Recommended side slopes for cutting and embankment, if any.

v. Recommendations on lateral earth pressures as relevant.

w. Past observations and historical data, if available, for structures resting in the area under consideration or for other areas with similar profiles.

x. Precautions to be taken such that relevant construction activities do no cause damage in any way to adjoining structures, in relation to subsurface characteristics.

y. Recommendations for additional investigation, beyond the scope of the present work, if the CONTRACTOR considers such investigation is necessary

(iv) <u>Analysis and Discussion of Results</u>

The following shall be furnished in the report.

a) Analysis of results, comparison of field and laboratory data, discussion of results, statistical average of soil parameters, viz. engineering and physical, for each identified layer.

b) For shallow foundations necessary information shall be provided to arrive at the following:

i) Net safe allowable bearing pressure for isolated square footings and continuous strip footings of sizes 1.0 to 5.0m at different founding depths of 1.0 to 5.0m, below ground level considering both shear failure and settlement criteria.

ii) Net safe allowable bearing pressure for raft foundations of widths greater than 6 m at 2.0, 3.0, 4.0 and 5.0m depth below ground level considering both shear failure and settlement criteria.

iii) Modulus of subgrade reaction, modulus of elasticity from plate load test results along with time settlement curves and load settlement curve in both natural and log-log graph.

c) For piling necessary information shall be provided to arrive at the following:

i) Type of pile.

ii) Suitable founding strata for the pile.

iii) Estimated length of pile for 500 kN (400 mm dia), 750 kN (450 mm dia), 1000 kN (500 mm dia) 1400 kN (600 mm dia), 2500 kN (760 mm dia)

and 4500 kN (1070 mm dia) capacities along with relevant sample calculation.

iv) Magnitude of negative skin friction, if any.

d) Coefficient of permeability of various sub soil and rock strata based on in-situ permeability tests.

e) Cone resistance, frictional resistance, total resistance and settlement analysis for different sizes of foundation as specified in para b (i) above based on static cone penetration test.

f) Electrical resistivity of sub-soil based on electrical resistance tests including electrode spacing vs commutative resistivity curve.

g) Dynamic soil properties such as dynamic shear modulus, Poisson 's ratio based on cross-hole shear and seismic refraction test data.

h) Suitability of the soil for construction of roads and pavements, their stable slopes for shallow and deep excavations, active and passive earth pressures at rest and modulus of elasticity as a function of depths for use in the design of underground structures.

i) Suitability of locally available soils at site for filling and back filling purposes.

j) If expansive soil is met with removal/retainment of the same under the structures/roads etc. shall be given. In the latter case, detailed specifications of any special treatment required including specifications for materials to be used, construction method, equipment's to be deployed, etc. shall be furnished.

k) Chemical nature of soil and ground water with due regard to potential deleterious effects on concrete, steel and other building materials, etc. shall be dealt in detail.

l) Susceptibility of sub soil strata to liquefaction, if any, in the event of an earthquake. (Liquefaction Analysis)

m) Any other information of special significance like dewatering schemes, etc.

n) Additional soil investigation beyond the scope of the present work if the Contractor considers such investigation is necessary.

(v) <u>Rates</u>

a) The item of work in the Schedule of Quantities describes the work very briefly. The various items of the Schedule of Quantities shall be read in conjunction with the corresponding sections in the technical specifications including amendments and additions, if any. For each item in the Schedule of Quantities the bidder 's rates shall include for the activities covered in the description of the items as well as for all necessary operations in details described in this technical specification.

b) No claims shall be entertained if the details shown on the released for construction drawings differ in any way (e. g. location and depth for tests, number of tests, etc.) from shown on the tender drawings, if any.

c) The unit rates quoted shall include minor details which are obviously and fairly intended, and which may not have been included in these documents but are essential for the satisfactory completion of the work.

d) The bidders quoted rates shall be inclusive of providing all plant equipment's, men, materials, skilled and unskilled labour; making observations, mobilisation of men and materials, establishing the ground level and coordinates at location of each bore hole, test pit, etc., by carrying levels from one established bench mark and distances from one set of grid lines furnished by the PMC. Also, no extra payments shall be made for conducting the Standard Penetration Test; Collecting, packing, transporting of all samples and cores; recording of all results and submitting them in approved formats.

e) The quoted rates for pits/plate load test shall be inclusive of shoring / strutting, dewatering and backfilling.

f) Rates quoted for pump out test shall be inclusive of boring of well of 400 mm dia, providing and installation of perforated GI pipe and observation pipes etc. for draw down depth as specified in the drawings, and as per specification.

g) Rates quoted for conducting cross hole shear test shall be inclusive of boring providing PVC pipes, preparation of bore including shot hole and receiver holes, providing geo-phones, measurement through seismograph, etc. up to the depth specified and as per specification.

h) The quoted rates for drilling in rock, shall satisfy the requirements as given in the scope of work

j) The rates quoted by the bidder for laboratory tests shall include preparation of sample, performing tests, recording and analysis of data and submission of one set of the above information to PMC's Corporate Office, every week after completion of tests.

k) The rates quoted by the bidder geotechnical investigation report soft copy as well as 03 sets of hard copy of detail geotechnical report along with recommendation and analysis as per Specifications.

l) Topographic survey drawing should be submitted in both hard copy (one copy in tracing, 2 sets of good quality colour prints Minimum A2 size) as well as Soft copy (editable- ACAD, KML format) and non-editable (PDF)

m) The quoted rates shall be firm for entire contract period and shall not be subject to any escalation in price, idle charges for labour, machinery, overhead expanses etc.

vi) Measurements:

a) All measurement shall be in Sl units.
b) Length shall be measured in meters (m) correct to two places of decimals. Areas shall be worked out in square meters (Sqm.) and volume in cubic meters (Cum), rounded off to two decimals.
c) Certain tests have to be conducted in bore holes, trial pits, etc. Such bore holes, trial pits, etc., shall be measured only once and not again just because tests are conducted therein.
d) The depth of penetration due to SPT at the bottom of bore hole shall not be considered for the measurement of bore hole depth.
e) Measurement for the item of pump out test shall be done in numbers.
f) Pits shall be measured in Cum. The lateral dimension for measurement purposes shall be the least of the following:

    i. actual excavation outline
    ii. 0.3 m on all sides beyond the pit size of 2 m x 2m for depths up to 1.0 below existing grade and 1.0 m on all sides beyond the pit size of 2 m x 2 m at the bottom for depth more than 1.0 m below existing grade.

g) For measurement purposes the sides shall be considered vertical with the lateral dimension indicated above. Northing extra would be payable for slope etc. irrespective of whatever is provided.
h) Pre-boring done for carrying out Static Cone Penetration Test shall not be measured.
i) Coring in rock with diamond bit shall be measured in length in metres (m) correct to two places of decimal for the actual cored length satisfying the criteria of clause mentioned in the tender.

vii) Deliverables / Reports

The final report in three hard copies and in two soft copies in separate Pen drives including site photographs before during and after the Geotechnical Investigation for each bore hole.

viii) Statutory Responsibility

The Contractor shall comply with all applicable laws, by laws, rules, and regulations and shall procure and maintain their validity all necessary Municipal, Panchayat and Government permits & licenses etc. at its own cost.

OTHER GENERAL CONDITIONS OF CONTRACT

i) Delay in Execution or Failure to complete the Contract

i. Any delay in completion of the work shall attract liquidated damage/ penalty for late completion as per PMC choice.

ii. If the Contractor fails to complete the entire work (as specified in scope of work) or fails to start the work within specified time frame after issue of LoI or fails to carry out the work as per agreed schedule or leaves the work site after partial execution of the work, PMC shall have the right to get the work done through any other agency at the risk and cost of the Contractor. Further to this, PMC may, without prejudice to the right of the Contractor to recover damages for breach of trust of the Contract, may impose penalties.

iii. Notwithstanding anything contained in this tender document, bidders to note that Completion time of all work as per the prescribed timeline/schedule is the essence of the Contract. It is envisaged that Contractor shall plan and achieve progress of the work on or before the prescribed timeline/schedule without fail.

ii) Termination for Default

i. The PMC may, without prejudice to any other remedy for breach of Contract, by written notice of default sent to the Contractor, terminate the Contract in whole or in part if the Contractor fails to deliver or execute any or all of the works within the time period(s) under the Contract or any extension thereof granted by AHIDMS pursuant to the clause for Delay in Execution or Failure to Supply or, If the Contractor fails to perform any other obligations(s) under the Contract.

ii. In the event the PMC terminates the Contract in whole or in part, pursuant to above, the PMC may procure, upon such terms and in such manner as it deems appropriate, goods similar to those undelivered, the Contractor shall be liable to the PMC for any excess costs for such similar goods. However, the Contractor shall continue the performance of the Contract to the extent not terminated.

iii) Terms of Payment

Based on the Milestones achieved at each site the payment for respective site location shall be released as per the below schedule:

Sr. No.	Milestone for Works	Payable Amount
1	Advance Payment against **(i)** Acceptance of LOI and Mobilization of sufficient resources to complete the work at minimum 3 site location **(ii)** Submission of Advance Bank Guarantee of equivalent amount **(iii)** Submission of Bank Guarantee for	20% of the total Quoted lumpsum amount

	Performance Security of 10% of the Quoted amount	
2	Completion of the identified work and certification by the Engineer.	40% of the Quoted lumpsum rate for respective site location
3	On submission of draft report to the PMC and presentation at PMC office RITES-MUKESH JV	30%of the Quoted lumpsum rate for respective site location
4	On acceptance of the final report by the PMC	10% of the Quoted lumpsum rate for respective site location

(iv) Payments Procedure

Subject to any deduction which the PMC may be authorized to make under this Contract, and or to any additions or deductions provided for in this Contract, the Contractor shall be entitled to payment as follows

a. All payments shall be made in Indian Rupees (INR), unless otherwise specified in the LoI/Work Order. All payment shall be made on the basis of actual measurement for the quantified items as per schedule of works.
b. The Contractor shall submit the bill for claim in three copies with all supporting documents as per the Contract condition to PMC. After due verification and recommendation, PMC shall process verified bills for release of payment. Payments shall be released in 20 (Twenty) days by online / RTGS/ NEFT from date of submission of clear invoice.
c. The Contractor shall submit the bill / invoice for the work executed showing separately GST and any other statutory levies in the bill / invoice.
d. All taxes and deductions shall be applicable as per prevailing income tax and other statutory rules and provisions in force.
e. In case Contractor fails to submit the invoice with all the required documents to process payments, PMC reserves the right to hold the payment of the Contractor against such bills.

(v) Arbitration

i. All matters, questions, disputes, differences and / or claims arising out of and / or concerning, and /or in connection with, and /or in consequence of, and /or relating to this contract which may arise between the parties in connection with the Contract or any matter arising out of or in relation thereto shall be reported time to time.

ii. The Arbitrator may, from time to time, with the consent of the parties to the contract enlarge the time for making the award. The venue of the arbitration shall be the place from which the acceptance of offer is issued or such other place as the Arbitrator, in his discretion, may determine.

iii. **Force Majeure**. No Party shall be liable or responsible to the other Party, nor be deemed to have defaulted under or breached this Agreement, for any failure or delay in fulfilling or performing any term of this Agreement. When and to the extent such failure or delay is caused by or results from acts beyond the impacted Party's ("Impacted Party") reasonable control. ("**Force Majeure** Event(s)" that frustrates the purpose of this Agreement: (a) acts of God; (b) flood, fire, earthquake or explosion; (c) war, invasion, hostilities (whether war is declared or not), terrorist threats or acts, riot or other civil unrest; (d) government order or law; (e) actions, embargoes or blockades in effect on or after the date of this Agreement; (f) action by any governmental authority; (g) national or regional emergency; (h) strikes, labour stoppages or slowdowns or other industrial disturbances; (i) epidemic, pandemic etc.

vi) Court of Competent Jurisdiction:

The high Court of Guwahati for the PMC shall have exclusive jurisdiction in all matters arising under the Contract.

Time Schedule for Completion of Work:

The complete Geo-Technical Investigation along with submission of reports should be completed within 30 days for all the 4 Site locations namely i) Jorhat, ii) Diphu , iii) Mangoldai, iv). Haflong From the date of issue of work order.

Geo-Technical Investigation should be simultaneously carried for all four Site locations and completed within 14 days and Reports should be submitted within 7 days from completion of the Geo-Technical Investigation.

Quotation Format:

The bidder should quote their lumpsum rates in the below format after understanding the complete scope of work and accepting to the all above conditions:

Sl. No.	Location of Site	Depth (m)	Number of Boreholes	Lump Sum Rate Excluding GST (in Rs.)	Total Amount including GST (in Rs.)
1	Jorhat Medical College andHospital, Jorhat.	30	6		
2	Diphu Medical College and Hospital, Diphu.	30	6		
3	Halflong Civil Hospital, Halflong	30	6		
4	Mangoldai Civil Hospital, Darrang.	30	6		
	Grand Total				

Points to be noted while quoting rates:

The Lump Sum rate quoted for the work shall be inclusive of all taxes, duties, charges and levies as applicable but excluding GST.