(CLIENT’S NAME)(FONT SIZE 18)

(PLACE)(FONT SIZE 18)

<NAME OF THE ASSIGNMENT> (FONT SIZE 16)

**TENDER SPECIFICATIONS** (FONT SIZE 18)  **FOR (FONT SIZE 14)
SOIL INVESTIGATION & SURVEY (FONT SIZE 14)
(PACKAGE No. 1). (FONT** SIZE 14)


**STEEL AUTHORITY OF INDIA LIMITED** (FONT SIZE 14) **CENTRE FOR ENGINEERING & TECHNOLOGY** (FONT SIZE 12) **RANCHI – 834002** (FONT SIZE 12)
**JANUARY, 2017** (FONT SIZE 12) **CET/0\_/\_\_/\_\_\_\_/TS/CE/\_\_/R=0(TS NO.)** (FONT SIZE 12)

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| <Name with designation> | <Name with designation> | <Name with designation > |

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Blue with yellow background: Instructions for the respective write-up.

**“Successful bidder”** shall not be used at any place in the TS and only “**bidder”** shall be used.

Red with grey background: To be modified or deleted as per specific requirement.

## INTRODUCTION

* 1. **GENERAL**
		1. (Only specific information related to project should be given like :
1. Brief about concerned plant
2. Brief about the unit to be modified/ upgraded/ new installation)
	1. **OVERVIEW OF THE PROJECT**
		1. As the soil data, current/ layout of the concerned area and underground facilities are not available, which are essentially required for planning the new facilities, it is required to carry out soil testing, survey.
		2. The data generated from this package shall be used as basis for planning and designing of various units / facilities under all other packages as required.
	2. **IMPLEMENTATION**
		1. The complete job of soil investigation & survey is envisaged to be executed through a single package.
		2. This tender specification pertains to soil investigation & survey works to be executed on **Item Rate basis** which includes geodetic survey of the concerned area, soil investigation in order to access various soil properties, to be used as basis of planning & design for the proposed facilities.
	3. **INTENT OF THE SPECIFICATION**
		1. The intent of this tender specification is to furnish required details for enabling the bidder to submit their best bids (technical & commercial) as per the scope of work mentioned at chapter 2.0, technical specifications at chapter 3.0 & Schedule of Quantities.
		2. This tender specification shall be read in conjunction with other documents enclosed with the NIT.
	4. **SITE VISIT AND OTHER REQUIREMENTS**
		1. The bidder shall visit the site, study drawings/ documents and discuss with the employer/ consultant, if required, regarding any technical clarification and get satisfied with respect to the nature and extent of work involved. The bidder shall also obtain first-hand information regarding location, work terrain, climate condition, railways, roads, airports and communication etc. before offering the bid for the job.
		2. Any local factors, if felt by the bidder, must be factored in before quoting for the work. No separate payment shall be made towards this. The quoted rates shall be considered as inclusive of cost towards these factors.
		3. All materials/ equipment/ machinery/ fabricated items used in the subject package shall be according to the specification given herein.
		4. Bidder has to accept all terms and conditions without any exclusions and deviations.
	5. **SCHEDULES TO BE DULY FILLED AND SUBMITTED WITH THE BID**

|  |  |
| --- | --- |
| 1.6-1 | Declaration of site visit |
| 1.6-2 | Details of contact persons for furnishing clarifications during tender evaluation |

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Red with grey background: To be modified or deleted as per specific requirement.

1. **SCOPE OF WORK**
	1. **GENERAL**
		1. The bidder shall be responsible for execution of the jobs envisaged for Soil Investigation & survey on Item Rate basis.
		2. The scope of works includes mobilization of testing equipment at site & laboratory for all tests as below, including hire charges, procurement / purchase cost, transportation charges, taxes/duties, setting up of the equipment, withdrawing samples from soil, preservation, handling etc. The scope covers procurement and supply of all consumables, transportation of sample to laboratory, testing, analysis of the data and presenting the test results and findings in a report.
		3. The scope of work shall cover all works and by-works as mentioned in the schedule of quantities (**Schedule 2.1.3-1** of this document) and supported and supplemented by the specifications mentioned in the document.
		4. The interim report consisting of the survey details and bore logs shall be completed within **45 (forty five)** days from effective date of contract. However, all work shall be completed in all respects and final report submitted for approval within **2 months** from the date of issue of Award Letter / LOI. The observations/comments on the final report from the employer/consultant, if any, shall be incorporated and submitted within 15 days.
		5. Quantities indicated in the schedule of quantities are to be considered for submission of the bids. Actual amount payable shall be based on actual site measurement approved by the employer or their authorised representative. The unit rate quoted by the bidder shall be firm for the total amount irrespective of the quantity variation.
		6. Utmost care shall be taken by the bidder to ensure that no damage is caused to existing underground service lines during boring, excavation etc. The bidder shall make test trenches to ascertain their presence and take appropriate steps to safe guard them. In case any damage is caused to the services, the same will be made good by the bidder without any additional financial implication.
		7. Any existing underground cables, pipes encountered during course of execution shall be suitably taken care of by bidder in consultation with the employer/ consultant.
	2. **SCOPE OF WORK**
		1. **Soil Investigation**

The soil investigation shall be done at the locations of the proposed facilities as indicated in the enclosed **drawing no CET \_\_ \_\_\_\_ CE0 00 001 R=0 and CET \_\_ \_\_\_\_ CE0 00 002 R=0.** The following shall broadly constitute the scope of work:

* + - * 1. Clearing bushes shrubs and other vegetation over the area to enable carrying out the tests as required.
				2. Field tests & investigations as per schedule of quantities & specifications.
				3. Sample collection, preservation & transportation to laboratory.
				4. Laboratory tests as per schedule of quantities & specifications.
				5. Submission of final report incorporating all test results in the form of table/graph/log with complete details and drawings.
				6. Recommendations for selection of type of foundations & allowable bearing capacity at various depths.
				7. Working out of safe load carrying capacity of 600 mm, 550 mm, and 450mm diameter R.C.C bored & cast-in-situ piles in vertical compression, uplift & horizontal shear as alternative to open foundations.
				8. Establishing the depth of water table and first-hand information on aggressiveness of soil and ground water.
				9. Location of all bore wells shall be indicated on the drawings. The bidder shall indicate the location, with coordinates (plant co-ordinate system shall be followed) and existing ground level of the boreholes.
				10. Standard penetration tests
				11. Electrical resistivity tests.
				12. At the location of boreholes, 2.5 m deep inspection pits are to be excavated manually to ascertain the presence of any cables/ pipelines etc., wherever required.
				13. Carrying out laboratory tests in NABL (National Accreditation Board for testing and calibration laboratories) accredited laboratory. In case the bidder does not own an NABL accredited laboratory, he shall get the required testing done from an NABL accredited laboratory elsewhere or from IIT / NIT / other government institutions. The bidder shall get the certificate of testing from the above laboratory/ institute and same shall be attached in the report.
				14. Interpretation of data collected at site and all analysis reports and recommendation thereof by a qualified geotechnical expert having qualification not less than Post Graduation in geotechnical or Soil Engineering or Foundation engineering. In case the bidder does not have such an expert under his own pay roll, he shall get the above interpretation/ recommendation carried out/ certified by and expert having the aforesaid qualification. In support of the above the bidder shall submit the above qualification certificate of the geotechnical expert, along with the soil investigation report.
				15. The location of various field tests as shown in the drawing are tentative & can be suitably shifted at the discretion of the Engineer-in-Charge, if needed so.
		1. **Survey Work**

The following shall broadly constitute the scope of work:

* + - * 1. Clearing bushes, shrubs and other vegetation over the area of surveying to enable carrying out survey work.
				2. Transferring the reference lines and level from the established benchmarks maintained by BSL in the vicinity of the proposed site.
				3. Establishing permanent benchmarks and grid points at suitable locations after transferring the coordinates from a suitable location.
				4. Carry out ground survey & taking spot levels in a grid of 10 m x 10 m over the whole area marked in the enclosed drawing no. **CET \_\_ \_\_\_\_ CE0 00 001 R=0** and the levels of the existing road, rails, drains, pipe lines. The spot levels shall also be taken over the existing road, railway tracks, if any, in the area.
				5. Construction of permanent benchmarks at suitable locations. Survey drawing(s) to be prepared by the bidder, shall indicate the location with coordinates (plant co-ordinate system shall be followed) and levels of existing structures, overhead gas pipe lines, tracks, roads, any big trees, manholes, boundary wall, fencing & facilities within the marked area.
				6. Total Station shall be used in carrying out all surveying activities.
		1. **Drawings and technical documents:**

The following shall broadly constitute the scope of work:

* + - * 1. Submission of soil investigation report incorporating all test results in the form of table/graph/log with complete details. Recommendations covering type of foundations & allowable bearing capacity at various depths & pile capacities for various diameters.
				2. Submission of survey drawings indicating the spot levels, existing facilities etc.
				3. Editable format soft copies on CD/DVD of all drawings and documents shall be supplied by the bidder.
	1. **NUMBER OF RIGS**

Considering time required for doing the soil investigation, the bidder shall engage required no of boring rigs for conducting the soil investigation.

* 1. **HANDING OVER SITE**
		1. On completion of work, all rubbish, debris, temporary supports, enabling structures etc. shall be removed from the site and the site (including the storage site) shall be handed over to employer in a tidy manner. All scrap, muck, etc. shall be dumped suitably at specified places within a lead distance of 2 km, as directed by the employer. If the bidder fails to clean up the site within a reasonable period of completion of erection, the employer may do so at the expense of the bidder.
		2. Throughout the execution of the work, the bidder shall perform cleaning on a day-to-day basis.
1. **TECHNICAL SPECIFICATIONS**
	1. **GENERAL**
		1. **General information on site:**

Durgapur Steel Plant (DSP) is located in West Bengal at about 170 km from Kolkata.

* + 1. **Climatic Condition**

Local climatic conditions are as follows:

|  |  |  |
| --- | --- | --- |
| 1. | Elevation above MSL | 222 m |
| 2. | Maximum temperature | 50oC |
| 3. | Minimum temperature | 8oC |
| 4. | Relative Humidity | 100% (max.) and 22% (min) |

However, maximum temperature and maximum relative humidity shall not occur at the same time.

* + 1. **Connectivity**

The nearest Railway station is Durgapur. The plant site is about 12 km from the Railway station. It is adjacent to the National Highway (NH-2). The nearest domestic and international airport is at Kolkata.

* + 1. **Communication Facilities**

Postal, telegraph, telephone, fax & internet facilities are available at Durgapur.

* 1. **PROCESS AND TECHNOLOGY**
		1. Proposed Scheme

The proposed scheme has been framed to get the details of soil stratification, location of ground water etc. in addition to chemical properties of soil, underground & over-ground structures, structural health and residual life of identified structures. The location of various tests shall be informed to the Bidder at the time of award of contract. At the location of boreholes, inspection pits, 2.5 m deep, are to be excavated manually to ascertain the presence of any cables / pipelines etc., wherever required. The Bidder shall take utmost care so that these facilities are not damaged in course of boring.

* + 1. Standards

Unless specifically mentioned otherwise, all applicable codes and standards (latest revisions) published by the Bureau of Indian Standards and all other such documents as may be published by them up to the commencement of work, shall govern design, workmanship, quality and properties of material and method of field and laboratory testing. Some of the relevant codes are:

IS: 2131-1981 - Method of Standard penetration test for soils.

IS: 2132-1986 - Code of practice for thin walled tube sampling of soils.

IS: 2720-(latest) -Method of tests for soils (All parts).

IS: 2809-1972 - Glossary of terms & symbols relating to Soil Engineering.

* + 1. **Language And Unit**

The soil investigation report shall be in English language. Dimensions in the drawings, technical data and weights furnished shall be in SI units. The glossary of terms & symbols shall conform to IS: 2809-1972.

* 1. **SOIL INVESTIGATION**
		1. **Bore Holes**
			1. Boring shall be done according to IS: 1892-1979. Shell and auger boring (dia. 100-200mm) or rotary drilling (dia. 65mm or more in rocks) shall be conducted and no wash boring will be allowed. Standard equipment to conduct boring in soil and drilling in rocks shall be employed after approval of the engineer. The drilling in rock shall be terminated at 3m inside rock or 20 m from the existing ground level, whichever is minimum for all the boreholes. This is necessary to ascertain the geological type, structure, conditions and extent of the rock mass. Drilling in rock & collection of rock samples shall be in accordance with IS: 4464-1985.
			2. Record of boring shall be maintained in accordance with IS: 1892-1979. The records shall include bore hole number, time and date of start and completion of boring, drilling, existing ground level, sub-soil water level, description and thickness of various strata including depths below existing ground level, N-values, nos. and types of soil samples collected and the depths at which samples were taken and other relevant data. All boring record shall be incorporated in the soil investigation report. The bore holes shall be filled up with sand up to the top after the completion work.
		2. **Ground Water**

Whenever sub-soil water is encountered, the depth at which it is first met with shall be recorded. On completion of each borehole, the static ground water level shall be recorded after allowing sufficient time for the ground water to come to a steady level. In addition to above, records of variations in ground water table, isolated bodies or perched ground water table, presence of aquifer shall be maintained.

* + 1. **Sampling**
			1. Disturbed soil samples shall be collected from bore holes in accordance with IS: 1892-1979 and IS: 2131-1981 at 1.5 m intervals or change of stratum whichever is less.
			2. Undisturbed samples shall be collected from bore holes in accordance with IS: 1892-1979 and IS: 2132-1986 by thin walled tube sampler or similar suitable approved tool at 1.5 m intervals or at every change of stratum whichever is less, taking care to ensure that the sample shall nearly as possible be in the same state as that in which it existed before boring commenced. The interval of collection may be changed to suit the sub-soil condition but with the approval of Engineer.
			3. After recovery of the sample, the tubes shall be cleaned, waxed, capped and labelled properly according to IS: 1892-1979, IS: 2131-1981 and IS: 2132-1986 for onward transmission to the laboratory.
			4. For drilling through rock, cores shall be collected and stored in wooden boxes and properly labelled for transportation to laboratory.
			5. Block samples of different types of soil and rock shall be collected from test pits to ascertain their physical properties.
			6. Water samples shall be collected as per IS: 1892-1979. Care shall be taken in collecting water samples and it shall be ensured that samples collected represent true characteristics of water. Adequate samples shall be taken to conduct the laboratory tests. Standard sampling bottles shall be used to collect samples. They shall be properly sealed and labelled for onward transmission to the laboratory. Label on each sample shall indicate the source, location and depth from where the sample has been collected, date and time of collection and initial of the Bidder's representative collecting the sample.
			7. Laboratory tests shall be conducted on undisturbed/disturbed soil samples. These samples shall be taken out of the boreholes and 3(three) tests shall be conducted for each of the soil sample. However, chemical testing of soil and water shall be restricted to the soil samples collected up to 5m below Ground level. A proper and systematic data of boring shall be maintained and furnished in the form of logs and tables.
		2. **Tests**

The soil shall be investigated for the following details using the procedures specified in the relevant Indian Standard. The list is only indicative and not exhaustive.

* + - * 1. Field Tests:
* Standard Penetration tests.
* In-situ CBR test on soil
* Cyclic Plate Load Test (CPLT)
* Electrical Resistivity Tests (ERT)
	+ - * 1. Laboratory Tests:
* Bulk and dry density determination.
* Liquid limit, plastic limit and shrinkage limit determination.
* Tri-axial Shear.
* Sieve/hydrometer analysis for grain size distribution.
* Specific gravity.
* Chemical analysis of soil and water.
* Consolidation Properties of Soil.
* Unit weight, crushing strength & co-efficient of softening of rock.
* Laboratory CBR test on remoulded soil sample
	+ 1. **Standard Penetration Test**
			1. This test shall be carried out as per IS: 2131-1981 and IS: 9640-1980 in each bore hole at intervals of 1.5 m depth or change of stratum whichever is less. Tests shall be conducted and disturbed/ undisturbed samples shall be taken at various suitable depths, specified or deemed necessary, depending on the condition of the sub-soil. These samples shall be tested for ascertaining the values of various soil properties like C and Ø values. Standard penetration test shall be conducted as per IS: 2131-1981 by means of the split spoon conforming to IS: 9640-1980.
			2. The sampler shall be lowered to the bottom of the borehole. The following information shall be noted and recorded:
				1. Depth of bottom of bore hole below ground level.
				2. Penetration of the sampler into the soil under combined weight of sampler and rods (to be noted from readings of the scale over the drill rod at the top)
				3. Water level in the borehole or casing and depth of bottom of casing below ground level.
			3. The split spoon sampler resting on the bottom of the bore hole should be allowed to sink under its own weight; then the split spoon sampler shall be seated 15cm with blows of the hammer falling through 75cm. Thereafter, the split spoon sampler shall be further driven by 30cm or 50 blows (except that driving shall cease before the split spoon sampler is full). The numbers of blows required to affect each 15 cm of penetration shall be recorded. The first 15cm of drive may be considered to be the seating drive. The total blows required for the second and third 15 cm penetration shall be termed as the penetration resistance no.; the split spoon sampler is driven less than 45cm (total), then the penetration resistance shall be for the last 30cm of penetration (If less than 30cm is penetrated, the logs should state the number of blows penetrated)
			4. The entire sampler may sometimes sink under its own weight when very soft sub-soil stratum is encountered. Under such conditions, it may not be necessary to give any blow to the split spoon sampler and SPT value should be indicated as zero.
			5. If on lowering the sampler by means of a string of rods it is found to rest at level above the bottom of casing, the penetration test and sampling should not be carried out at the stratum.
		2. **Bulk & Dry Density Determination**
			1. The in-situ density of the soil may be determined from the undisturbed soil samples taken from the bore holes by sand replacement method as per IS: 2720(Part 28)-1974
			2. The dry density shall be calculated by drying the sample in an oven at 110+50oC [Refer IS: 2720 (Part 2-1973)].
		3. **Liquid Limit, Plastic Limit And Shrinkage Limit**
			1. The liquid and plastic limit shall be conducted as per IS: 2720 (Part 5)-1985. The mechanical limit device and grooving tool shall conform to IS: 9259-1979. The device for determination of liquid limit of soils shall conform to IS: 11196-1985. The liquid limit of soil shall be determined by Cone penetration method. The shrinkage factor shall be determined as per IS: 2720 (Part-6)-1972 and the apparatus shall conform to IS: 10077-1982.
			2. The observation of the test should be recorded suitably. The liquid limit and plastic limit shall be reported to the nearest whole number. The history of the sample, i.e., natural state, air dried or over dried, the method used for, the test reported and the period of soaking allowed after mixing of water to the soil shall be reported.
			3. The following indices shall also be calculated and reported.
* Plasticity index.
* Liquidity index.
* Consistency index.
* Shrinkage index.
* Volumetric shrinkage.
	+ 1. **Tri-Axial Shear Test**

The tri-axial shear test shall be conducted on undisturbed soil samples collected from boreholes and the shear strength parameters shall be determined. The tests shall be carried out as per IS: 2720 (Part 12)-1981 (Reaffirmed 1987) for consolidated un-drained condition with the measurement of pore pressures.

* + 1. **Grain Size Analysis**
			1. The grain size analysis shall be done as per IS: 2720 (Part-4)-1985. For finding distribution of larger than 75 micron IS sieving shall be adopted only for soils, which do not have an appreciable amount of clay.
			2. For the determination of distribution of grain sizes smaller than 75 microns, the pipette method/hydrometer method shall be followed. The hydrometer method shall not be adopted if less than 10 percent of the material passes 75 micron IS sieve.
			3. The results of the grain size analysis shall be reported in a Performa as indicated in Appendix A of IS: 2720(Part 4)-1985. A grain size distribution curve shall be drawn on semi logarithmic chart, plotting particle size on the log scale against percentage finer than corresponding size on the ordinary scale.
		2. **Specific Gravity**

The specific gravity of fine grained soils shall be determined as per IS: 2720(Part 3/section 1)-1980 and that of medium and course grained soils by IS: 2720(Part 3/section 2)-1980. The average values determined shall be reported to the nearest 0.01. If two results of the sample differ by more than 0.03, the test shall be repeated.

* + 1. **Chemical Analysis of Soil**

The following chemical characteristics shall be determined for the sub-soil.

pH value IS: 2720(Part 26)-1987

Total soluble sulphates IS: 2720(Part.27)-1977

* + 1. **Consolidation Properties of Soil**
			1. The consolidation Properties of soil shall be determined as per IS: 2720 (Part 15)-1986. The main purpose of the consolidation test is to obtain soil data, which are used in predicting the rate and the amount of settlement of the structure.
			2. The apparatus for testing shall conform to IS: 2720 (Part 15)-1986. The specimen shall be prepared from a tube sample or from block sample. In the case of block sample, the soil stratum shall be oriented such that the laboratory test will load the soil in the same direction relative to the stratum as applied in the field.
			3. An alternative procedure for obtaining a specimen from a soil disc as obtained above is to use the consolidation ring as sampling device. The ring shall be gradually inserted into the sample by pressing with hands and carefully removing the material and the ring. This may also be accomplished using a mechanically operated jig.
			4. The soil sample thus obtained as explained above shall be trimmed flush with the top and bottom edges of the ring. For soft to medium soils, excess soils shall be removed using a wire saw and final trimming may be done with a straight edge, if necessary. For stiff soils, a straight edge alone shall be used for trimming. Excessive remoulding of the soil surface by the straight edge shall be avoided. In case of very soft soils, special care shall be taken so that the specimen may not fall out of, or slide inside the ring during trimming.
			5. A sample of soil similar to that in the ring, taken from the trimmings, shall be used for determining moisture content.
			6. After assembling the ring, specimen & consolidometer, the dial gauge shall be clamped into position for recording the relative movement between the base of the consolidation cell and the loading cap. A seating pressure of 0.05 kgf/cm2 shall be applied to the specimen.
			7. The consolidation cell shall be filled with water preferably of the same ionic content as the specimen pore water. If this is not possible, distilled water shall be used. The type of water used shall be noted in the data sheet.
			8. The specimen shall then be allowed to reach equilibrium for 24 hours.
			9. For consolidation testing, the loading sequence shall be such that the stress of 0.1, 0.2, 0.4, 0.8, 1.6, 3.2 kgf/cm2, etc., are applied on the soil specimen. For each loading increment, after application of load, readings of dial gauge shall be taken until the slope of characteristic linear secondary compression portion of the thickness versus log time is apparent, or until the end of primary consolidation is indicated on a square root of time plot.
			10. The final pressure shall be of the order of at least four times the pre-consolidation pressure, and be greater than the maximum effective vertical pressure, which will occur in-situ due to overburden and the proposed construction.
			11. On completion of the final loading stage, the specimen shall be unloaded by pressure decrements, which decrease the load to 1/4th of the last load. In order to minimize swell during disassembly, the last unloading stage shall be to 0.05kgf/cm2, which shall remain on the specimen for 24 h.
			12. The results of the consolidation test shall be presented in the form a set of curves. The value of Cc will also be reported separately.
		2. **Classification Of Soils**

Classification and identification of soils shall be done as per IS: 1498-1970.

* + 1. **Testing of Rock**

The procedure for testing of rock cores shall be as detailed below:

* + - * 1. Unit weight of Rock: These tests shall be conducted on air-dried specimens of height to diameter ratio of about 1:1. The unit weight shall be calculated from the weight so determined and the volume of the specimens.
				2. Compressive strength of Rock: Cylindrical specimens made out of the rock cores (diameter to height ratio of about 1:2) shall be tested.
		1. **Cyclic Plate Load Tests:**

The test shall be conducted as per IS: 5249-1992 and the test result shall indicate the coefficient of elastic uniform compression of soil. Certain basic requirements are given below:

* + - 1. Suitable arrangement for providing reaction of adequate magnitude depending upon size of plate employed should be used. The load mechanism should have facility to apply and remove the loads quickly. A hydraulic jack or any other suitable equipment may be used.
			2. The equipment for the test shall be assembled according to the details given in IS 1888: 1982. The plate shall be located at a depth equal to the depth of the proposed foundation in a pit excavated as given in IS 1888: 1982.
			3. After the set-up has been arranged the initial readings of the dial gauges should be noted and the first increment of static load should be applied to the plate. This load shall be maintained constant throughout for a period till no further settlement occurs or the rate of settlement becomes negligible. The final readings of the dial gauges should then be recorded. The entire load is then removed quickly but gradually and the plate allowed to rebound. When no further rebound occurs or the rate of rebound becomes negligible, the readings of the dial gauges should be again noted. The load shall then be increased gradually till its magnitude acquires a value equal to the proposed next higher stage of loading, which shall be maintained constant and the final dial gauge readings should be noted as mentioned earlier. The entire, load should then be reduced to zero and final dial gauge readings recorded when the rate of rebound becomes negligible.
			4. The cycles of loading, unloading and reloading are continued till the estimated ultimate load has been reached, the final values of dial gauge readings, being noted each time.
			5. The magnitude of the load increment should be such that the ultimate load is reached in five to six increments. The initial loading and unloading cycles up to the safe bearing capacity of the soil should be with smaller increments in load. The duration of each loading and unloading cycle upon the type of soil under investigation.
			6. Coefficient of Elastic Uniform Compression from Cyclic Plate Load Test

Cu = P/Se kgf/cm3

where

P = Corresponding load intensity kg/cm2, and

Se = Elastic rebound corresponding to P in cm.

* + 1. **California Bearing Ratio (CBR) tests:**

The CBR tests shall be carried out as per IS: 2720 (Part XVI)-1979 in field as well as CBR mould in laboratory. CBR values for both soaked and unsoaked samples shall be determined.

* + 1. **Test For Electrical Soil Resistivity**

By the side of bore holes the electrical soil resistivity shall be tested as per IS: 3043-1987 and included in soil investigation report.

* 1. **SURVEYING**
		1. The surveying shall be done by modern three dimensional technological equipment, Total Station or equivalent and data shall be downloaded from the same and necessary survey maps/ drawings shall be prepared both in digitized and Auto CAD form in 2D (i.e ‘Z’ coordinates shall be zero for each entity).
		2. Determination of the location & elevation of all existing features inside the area as shown in the drawing such as big buildings, structures, roads, culverts, big trees, water supply main ( top of pipe line elevation ), including hydrants, Tee flanges, etc. Foundation of pylons for overhead power cables, electrical & telephone line poles, wells, storm water ditches, nullah etc., if any shall be done and marked in the final drawing along with the coordinates. If the outfall/sewage disposal lines are existing in the proximity of the plot, the location & levels of the sewer including man-hole shall be determined for the purpose of the plot drainage.
		3. The level of all the overhead lines (pipes and cables, if any) shall also be indicated. While measuring the exact level of the overhead lines, if due to safety consideration the measurement is not possible / feasible; the tentative location with approximate location of the same shall be indicated in the Survey Drawing.
		4. The location and level of the existing Conveyor trestles / trestle supports, Culverts/water cross-overs and the existing cable tunnel / pipe lines in the area shall also be surveyed and indicated in the drawing. For this available drawings shall also be referred
		5. **(For road, rails, drains, pipe lines etc.)** Three spot levels shall be taken along the route length. One on the middle of a 10m wide corridor and two on each periphery. This shall be done at every 5m interval or at shorter intervals on encountering any features such as existing road, rails, drains, pipe lines, manholes etc.
		6. The location and level of the existing Culverts/water cross-overs and the existing cable tunnel / pipe lines in the area shall also be surveyed and indicated in the drawing. For this available drawings shall also be referred. Along with excavation up to a depth of about 3 m from and the top of the tunnel shall be exposed at a minimum of 4 location along the length of the existing facility and the layout and levels shall be surveyed. Care shall be taken not to damage the existing facilities.
		7. Determination of the reduced spot levels of existing ground levels within the area shown in the attached drawing shall be done.
		8. Spot levels shall be taken at closer grid intervals as directed by the Engineer whenever profile of land suddenly changes. Existing ridges, valleys & rock out-crops etc., within the plot shall be located with elevation to define general plot drainage.
		9. Recording any other features, not specifically covered above but which are required to be taken to prepare work like survey etc., shall be done as directed by the Engineer-in-charge from time to time.
		10. Reduced level of ground, if not available, shall be carried from the nearest railway station.
		11. **Benchmarks**
			1. Coordinate of the permanent benchmark shall be taken as origin for plant coordinate system if not already available.
			2. One (01) permanent bench mark statue at suitable location within the plot shall be established & constructed for the proposed site. Determination of the bench mark elevations with reference to the existing bench mark and determination of plot north with respect to magnetic north shall be done and marked hereby on the permanent benchmarks. The detail drawing of bench mark is indicated in drawing no **CET \_\_ \_\_\_\_ CE0 00 003 R=0.**
			3. Barbed wire fencing (of height 2 m) shall be provided as protective enclosure for the permanent benchmark while ensuring easy accessibility for future reference, as directed by EIC.
			4. In addition to permanent benchmark, local bench marks/co-ordinate pillars at the rate of 100 m x100 m grids shall be constructed. The local bench mark shall be plain concrete pedestal approximately 300 x 300 x 600 mm (depth) size in 1:3:6 (1 cement, 3 sand and 6 coarse aggregates). The co-ordinates & spot level shall be painted on the top of each of this bench mark respectively.
	2. **RESULTS OF SOIL INVESTIGATION**
		1. The results shall be presented in the form of a table/graph for the details of each bore hole sample like bore hole number, sample number, depth of collection, consistency limits, plasticity charts, densities, specific gravity, shear strength, cohesion, angle of internal friction, etc.
		2. The bearing capacities may be worked out for the individual bore-hole locations (for achieving the economical design) and presented in the form of a table for different depths and for different settlement. The shear parameters shall be used for calculation of bearing capacities from shear considerations for different sizes and L/B ratios of 1, 2, 5 & 10.
		3. Considering important nature of the structure, the bearing capacities may be calculated for the following settlements
* 25 mm
* 50 mm
* 75 mm
* 100 mm
	+ 1. For cohesive soil, the effect of long-term settlement considering the consolidation characteristics of the soil shall be taken into account while calculating the bearing capacities. The value of Cc obtained from the consolidation tests shall be used for calculation of the settlement of different layers of soil strata corresponding to the bearing loads on the foundations of different sizes calculated for shear strength considerations. If the total settlement is more than the allowable settlement for the foundation enumerated above then the safe bearing capacity shall be taken as allowable bearing capacity. In case the settlement is more than the permissible limit then back calculation shall be done to find out the loads and the corresponding bearing capacities that satisfy the allowable settlement for the particular type of foundation and that bearing capacity shall be reported as allowable bearing capacity.
	1. **REPORT**

The final report shall contain soil investigation report & survey drawings.

* + 1. **Soil Investigation Report**
			1. After finishing the entire investigation, the bidder shall submit five copies of the draft soil investigation report for approval by the employer / consultant. After incorporation of the comments from employer / consultant, the final report along with the drawings shall be submitted. After approval of the same by the employer the bidder shall submit ten copies of the final report of soil investigation.
			2. The final report shall be the complete compilation and consolidation of available data, tests conducted Bidder’s interpretation of results of all in-situ and laboratory investigations. It shall include general description of site, general geology of the area, investigation procedures, description and characteristics of soil and rock conditions, location of ground water table, description and results of all in-situ and laboratory tests. The Bidder shall ensure that all observations made during field investigation and all laboratory tests are incorporated in the report. Besides, recommendation for allowable bearing capacity, types of foundations and pile capacities shall form part of this report.
			3. The report shall include general assessment of the ground condition and also precaution and special measures, if any, to be taken for protection of concrete foundations against the action of soil and water.
			4. For better readability, the report may be presented in the following manner:
				1. Main body comprising of project details, program of investigations, discussion on the field tests, laboratory tests and results, summary of the results, table indicating the bearing capacities, sample calculation for the bearing capacity for different bore holes / soil strata and conclusions and recommendations.
				2. The test results (both field and the laboratory) and the relevant calculations, bore log data, electrical resistivity test results etc., may be presented in the Annex.
		2. **Survey Drawings**
			1. The results of the surveying shall be presented in form of two drawings. First drawing shall show the contours at 0.5 m interval and also showing the spot level as collected from the site. It shall also show location of the actual field tests. The second survey drawing shall indicate any existing facilities, buildings, equipment, trestles, towers, junction houses, trees etc. and over ground service line, if any, within the boundary. Further, the cross-sections shall be shown at appropriate locations.
			2. Additional information such as the layout of existing facilities such as railway tracks, roads, bench mark locations (along with its value), drains, manhole locations, underground tunnel, trestle support location, pipelines etc., shall also be indicated.
			3. In the final survey drawing, both plant north and true north shall be shown along with their correlation.

**DECLARATION FOR SITE VISIT**

(To be filled up by the Bidder)

I, hereby, declare that I have visited the site to understand the site conditions, and acquainted myself with atmosphere prevalent therein. I have also understood the extent of total works involved for this package.

|  |  |
| --- | --- |
|  | Signature of the Bidder: |
| Seal of company | Name: |
|  | Designation: |

**DETAILS OF AUTHORISED PERSON DURING TENDER EVALUATION STAGE**

1. Name of Project :
2. Tender No. :
3. Name & Address of Bidder :
4. Name of authorised person (TECHNICAL) :
5. Email address :
6. Mobile No. :
7. Name of alternate authorised person (TECH) :
8. Email address :
9. Mobile No. :
10. Name of authorized person (COMMERCIAL) :
11. Email address :
12. Mobile No. :
13. Name of alternate authorised person (COMM) :
14. Email address :
15. Mobile No. :

Authorised Signatory

| **Item No.** | **Description** | **Unit** | **Qty.** | **Rate** | **Amount** |
| --- | --- | --- | --- | --- | --- |
| **SOIL INVESTIGATION & SURVEY** |
| SS-1 | **Mobilization of in-situ test equipment** etc. & personnel and arrangements for testing and de-mobilization on completion and removal from site of work including transfer of level and coordinates from reference points. | Lump sum | lot |  |  |
| SS-2 | Making **test bores of 150mm dia.** as per IS: 1892 on all type of soils, maintaining necessary driving records and presenting test results in bore log form  |  |  |  |  |
| a) Up to 10 metres from existing ground level | RM |  |  |  |
| b) Beyond 10 metres and up to 15 metres from existing ground level. | RM |  |  |  |
| c) Beyond 15 metres and up to 20 metres from existing ground level. | RM |  |  |  |
| SS-3 | **Chiselling through obstruction** at any depth & clearing the borehole. | RM |  |  |  |
| SS-4 | **Drilling through soft or fractured rocks** (excluding hard rock) at all depths, using rotary drilling equipment including recovery of cores & provision of core boxes using TC bits. | RM |  |  |  |
| SS-5 | **Drilling through hard compact rock** at all depths using rotary drilling equipment & diamond bit including recovery of cores & provision of core boxes. | RM |  |  |  |
| SS-6 | Testing of **electrical resistivity of soil** as per IS: 3043-1987. | Nos. |  |  |  |
| SS-7 | Conducting **laboratory tests on soil samples** collected as per item no 2 and performing the following tests (3 tests per specimen) as per relevant standards: The rate is applicable per specimen. |  |  |  |  |
| a) **Hydrometer / Sieve analysis** to determine particle size distribution. | Nos. |  |  |  |
| b) **Consistency limit test** for determination of liquid limit, plastic limit, shrinkage limit and plasticity index for samples of same depth for each borehole in the different stages. | Nos. |  |  |  |
| c) **Bulk density and dry density**. | Nos. |  |  |  |
| d) Test for determining **specific gravity**. | Nos. |  |  |  |
| e) Triaxial Tests to determine **C & Ø values** of soil. | Nos. |  |  |  |
| f) **Chemical analysis of soil samples** to determine pH, chloride & sulphate, organic matters & nitrate contents. | Nos. |  |  |  |
| g) **Chemical analysis of water** for determining pH value, organic matter & determination of chlorides & sulphate. | Nos. |  |  |  |
| h) Determination of **Consolidation Properties.** | Nos. |  |  |  |
| SIS-8 | Testing on **rock samples** for the following: |  |  |  |  |
| a) **Unit weight** of rock | Nos. |  |  |  |
| b) **Crushing strength** of rock in dry & wet conditions. | Nos. |  |  |  |
| c) **Co-efficient of softening** of rock | Nos. |  |  |  |
| SIS-9 | Conducting **SPT and collecting undisturbed / disturbed samples** in all types of soil at various depths as per IS: 2131-1981 and IS: 9640-1980 in each bore hole at intervals of 1.5 m depth or change of stratum whichever is less. | Nos. |  |  |  |
| SIS-10 | Conducting **Cyclic plate load tests** on soil strata as per IS: 5249-1992 and as per the direction of Engineer-in-charge all materials and labour including assembling of equipment & loads and loading arrangement as may be required for successful execution of the test as per IS: 1888-1992 complete and the test result shall indicate the coefficient of elastic uniform compression of soil (Excluding earthwork which shall be as per relevant item of works). |  |  |  |  |
| SIS-11 | Conducting **CBR test** as per IS: 2720 (Part XVI)-1979. | Nos. |  |  |  |
| SIS-12 | Preparation and submission of **soil investigation** report (as per the scope of work) containing field investigation & various test results along with relevant recommendations as well as sample calculations for the recommendations. | Lump sum | Lot |  |  |
| SIS-13 | Conducting **area survey** of the area indicated by EIC by taking spot levels in grid of 10mx10m including transfer of RL from established benchmark and establishing Permanent benchmarks as per enclosed drawing within the area surveyed, Locating the position of existing structures, tanks, pipelines, tracks, roads, drains, manholes, boundary wall, fencing & facilities within the marked area in the survey drawing to be prepared by the bidder, including preparation and submission of drawings. Payment for the construction of benchmarks shall be done separately as per relevant items of work. (10 copies of the drawings, 2 soft copies in AutoCAD drawing format in CD).  | Sqm |  |  |  |
| SIS-14 | Construction of **Permanent Bench Mark** (As per details in drawings) in RCC **and Local Bench Mark** in PCC in grid of 100 m x 100 m (as per Chapter 3 of this TS).(The item includes providing & placing all materials, excavation, PCC, RCC reinforcement, protective enclosure, inserts, shuttering, curing, tools, tackles, consumables, labour etc. complete) | Nos. |  |  |  |
| SIS-15 | **Clearing jungle** including uprooting of rank vegetation, grass, brush wood, saplings, debris, slag, muck etc and removal of rubbish up to a distance of 7km with the plant boundary as per the direction of engineer-in-charge.. | Sqm |  |  |  |
| SIS-16 | **Manual Excavation** in all types of soil including bailing / pumping out of water from the excavated pits and backfilling the excavated pits with soil from after inspection by Engineer-in-charge, all materials and labour complete. The item also includes dismantling of boulder soling; PCC and RCC encountered at the location of boreholes and same shall be restored back after completion of the task and debris etc. disposed off at designated place within a lead of 2 Km. | Cum |  |  |  |