**TECHNICAL SPECIFICAITONS**

**FOR CARRYING OUT GEOTECHNICAL INVESTIGATIONS AT GUJARAT PIPAVAV PORT LTD**

# **APM Terminals Pipavav, India**

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# INTRODUCTION

## Project Background

Gujrat Pipavav Port limited (GPPL) managed by APM Terminals is emerging an important gateway port on the West coast of India for handling Mutli Commodities including Containers, Bulk, Liquid and RoRo cargo.

The existing port facilities can handle 1.35 MTEU containers, 5 MTPA bulk cargo, 2 MTPA liquid cargo and 25,000 car equivalent units (ceu) of RoRo cargoes. Based on the demand assessment and growth potential, GPPL proposes to expand the marine and landside facilities with capacity addition of 0.8 MTEU container volumes, 1 MTPA bulk cargo, 4.4 MTPA liquid cargo and 50,000 ceu RoRo. This proposed development constitutes Phase-1 of the longer-term master plan for port expansion being developed by GPPL for a horizon period upto FY48. Currently, GPPL intends to initiate the procedure/ applications for immediate implementation of Phase-1 expansion.

GPPL is now undertaking the construction of New Liquid Jetty-6 as part of initial development of Phase 1 (i.e. Phase 1A) of the port infrastructure to enhance/augment the handling capacity of the Port. GPPL wishes to appoint a competent agency for undertaking the Geotechnical Investigations at the locations of the proposed liquid Jetty, for which the TOR is presented in the following pages.

## Location

Pipavav port is located on the western bank of Gulf of Khambhat in Saurashtra region of Gujarat, at a distance of 140 km south-west of Bhavnagar, and approx. 152 n.miles northwest of Mumbai, Maharashtra. It is situated at a latitude of 20°54'N and a longitude of 71°30' E.

A map of the port of turkey

Description automatically generated

Figure 1.1: Location Map of Pipavav

Pipavav Port is naturally protected from waves by Shiyal Bet and Savai Bet islands, which act as breakwaters providing tranquillity and safe navigation through most of the year.



Figure 1.2: Google Image of APM Terminals Pipavav

# SCOPE OF WORK

The scope of work shall broadly comprise but not limited to

Carrying out One (01) Nos. of land boreholes and Three (03) Nos. of marine boreholes in water depths up to -5.0 CD drilling to specified depth, conducting in-situ test inside boreholes like Standard Penetration Test (SPT) at specified interval or change in strata which occurs earlier as per guidelines given in latest IS 2131 and, collecting undisturbed and disturbed soil samples, conducting laboratory tests like soil classifications, determination of Atterberg limits, unconfined compression tests, tri-axial tests, consolidation tests, direct shear tests, tests on rocks etc. for ascertaining the sub-surface profiles and for establishing the Engineering properties of soil and rock, if any, for the design of Approach Bund.

# SURVEY EXTENTS

The tentative locations of the boreholes to be investigated are indicated in attached **Drawing No. APMT-TD-DWG-GN-001**. The details and coordinates of boreholes are indicated in below table

| **Boreholes** | | | | |
| --- | --- | --- | --- | --- |
| **Location** | **BH Marked** | **Easting** | **Northing** | **Depth of Borehole** |
| GUIDE BUND | CBH01 | 761817.225 | 2315917.437 | 25M BELOW BED LEVEL |
| CBH02 | 761847.676 | 2316033.550 |
| CBH03 | 761876.631 | 2316143.886 |
| CBH04 | 761902.163 | 2316241.179 |

The exact limits and coordinates of the area / locations to be investigated and additional specific requirements, if any, shall be finalized before commencement of surveys in consultation with GPPL.

Any information regarding site conditions etc. provided in this document is provided in good intent and the bidder shall be responsible for verifying it before making the proposal. The bidder may visit the site prior to submitting his quotations, to acquaint himself fully with the nature, type and scope of work and involvement therein. No claims shall be entertained at a later date on the grounds of any discrepancies etc. in the information provided.

# ACCESS TO SITE

Contractor shall plan and provide his own access to the survey site area. Wherever necessary, the contractor shall provide means to and on the site for all the personnel and equipment. The contractor shall not pollute or unnecessarily disturb the water areas, lands, roads and other places in and around the site. The cost of providing site access for carrying out the surveys is deemed to be included in the bid. No claims with respect to providing any site access will be entertained in future.

# EQUIPMENT

## Marine Spread

For the soil investigation to be carried out in marine environment the contractor shall mobilise marine spread in the form of jack up platform to conduct soil investigations. In case of shallow water depths, where investigations by jack up platform are not possible, the marine spread could be in the form staging platform or any other system to suit the site conditions. The mobilised system shall be capable of handling men, equipment and machinery of drilling requirement and it shall have sufficient space for drilling operation. The working platform shall provide a stationery workplace such that the boring operation is smooth. The contractor shall get written approval prior to mobilise the marine spread along with detailed methodology of exploration to suit the environmental conditions at the proposed site.

## Motorised Drilling Rig

The contractor shall mobilise suitable motorised drilling rig for carrying out the drilling operations.

# PERSONNEL

The Contractor shall provide adequate and necessary experienced personnel to carry out and complete the work within the stipulated timelines.

The Contractor shall provide project manager, geotechnical engineers, Party chief and drillers during the entire period of the survey.

# EMPLOYER’S REQUIREMENT

## Codes of Practice

The work shall be carried out generally in accordance with the latest Indian Standards. Where an equivalent Indian Standard is not available, the work shall be carried out in accordance with the relevant British Standards. The codes used must be available at site during investigations for reference. An indicative list of IS standards is as given below.

IS:1892 Code of practice for Site Investigation for Foundation

IS:1498 Classification and Identification of Soils for General Engineering Purpose

IS:8009, Code of practice for calculation of settlement of Shallow Foundation

IS:6403 Code of practice for determination of bearing capacity of shallow foundation

IS:4464 Presentation of Drilling Information

IS:1888 Method of load test on soils

IS:2131 Method of Standard Penetration Test for soils

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

IS:2720 Methods of test for soils, Part 28: Determination of dry density of soils, by the sand replacement method

IS:2720 Methods of test for soils, Part 29: Determination of dry density of soils, by the core cutter method

IS:2720 Methods of test for soils, Part 31: Field determination of California Bearing Ratio

IS:2720 Methods of test for soils, Part 33: Determination of the density in- place by the ring and water replacement method

IS:2720 Methods of test for soils, Part 34: Determination of the density in- place by the rubber-balloon method

IS:2720 Methods of test for soils, Part 39: Direct shear test for soils containing gravel, Section 2 In-situ shear test

IS:4434 Code of practice for *in-situ* vane shear test for soils

IS:4968 Method for subsurface sounding for soils Part 3 Static cone penetration test

IS:8763 Guide for undisturbed sampling of sands

IS:9640 Specification for split spoon sampler

IS:10108 Code of practice for sampling of soils by thin wall sampler with stationary piston

IS:10589 Specification for equipment for subsurface sounding of soils

IS:11594 Specification for mild steel thin-walled sampling tubes and sampler heads

## Positioning of Marine Spread

The marine spread shall be positioned accurately as per the co-ordinates provided for the borehole location by using precise Global Positioning System (GPS). The marine spread shall be aligned in such a way that there should not be any impact on the platform due to waves or currents. The position of the marine spread at the selected borehole location shall be checked and approved by client.

The contractor shall make necessary arrangements to transport Client’s personnel, and officials visiting the site by means of suitable seaworthy boats from land to offshore investigation location and back whenever required during investigations. Suitable care shall be taken during investigation in the offshore by providing life jackets, lifeboats and any other safety devices/ emergency devices to prevent any accident.

## Setting Out of Works

The Contractor is advised to use DGPS for locating marine borehole and Total Station for locating land boreholes points accurately. The required accuracy for horizontal control shall be within 0.5 m of true position and for vertical control within 0.1 m of the true depth. All horizontal and vertical control equipment should be calibrated, and certificates shall be submitted. All levels shall be in meter and with respect to chart datum.

## Boring and Rock Coring

### Boring in Soil

Boring shall be carried out in accordance with the provisions of IS:1892. Minimum diameter of boring shall be 150 mm. While boring above water table, no water shall be introduced in the boreholes. Casing shall be used to support the sides of boreholes in soft to loose soils. Water table in the borehole shall be carefully recorded and reported.

The hard stratum is confirmed by either the refusal from SPT N value greater than 100, or due to resistance during the drilling operation. Once the hard stratum is met with, where core recovery exceeds 10%, further drilling is carried out by Tungsten Carbide/Diamond bits of suitable diameter as per specification. The drilling will be advanced with Nx size double/triple tube core barrel. The work is done generally as per IS 6926-1973.

The contractor shall take care in the use of shell and auger casing and attachments to avoid fracturing or otherwise disturbing rock at the interface between soil and rock/ weathered rock, such that the true level of the surface of rock / weathered rock and its true in-situ quality will be identified.

### Boring in Rock

The contractor shall adopt core drilling with Nx size Tungsten Carbide (TC)/diamond bit for boring in rock.

When Core Recovery (CR) < 10% the material will be treated as soil and this core drilling operation shall be at no extra cost to the owner.

Where core recovery exceeds 10%, TC bits shall be used for coring in soft / weathered rock and diamond bits for hard rock (Rock Quality Designation (RQD) > 50% or core recovery percentage > 75%). Maximum length of coring in rock shall be 1.5 m. In hard rock maximum length of coring shall be restricted to 1.0 m. Double/ Triple tube core barrel shall be used for coring.

The contractor shall ensure that the equipment used for drilling, sampling etc. shall have an adequate capacity to drill bore holes up to specified depth. The contractor shall make his own arrangements to deploy all the necessary equipment to the borehole location. The rates quoted shall be inclusive of this and any extra claims on this account shall not be acceptable.

RQD and CR for each sampler are to be immediately recorded after retrieval of the cores. After recording the details of cores, the drill and cutting shall be marked and preserved carefully in core boxes as per the latest IS:4078 and the selected core samples shall be transported to the laboratory for testing at no additional cost. The cost of core boxes shall be deemed to have been included in the quoted rates. The contractor shall at his own cost transport the core boxes to the place of storage as directed by Client.

### Termination of Boreholes

The bore holes shall be terminated at specified depths or up to refusal level unless specified otherwise by Client. In case, hard strata or Rock is encountered at surface or within the specified boring depth, soil boring operations should be discontinued and drilling operations in rock should be carried out. This drilling operation should however be limited within the specified depth as below:

1. No refusal (SPT N<100) or no rocky strata or strata with core recovery <10% is encountered the bore hole shall be terminated at the specified depth.
2. In case refusal strata with N>100 and no core recovery or conglomerate/boulderly strata is there the bore hole shall be terminated after drilling 15m into refusal strata or specified depth whichever is earlier.
3. In case rocky strata is encountered in between with RQD>20% & < 40% (Weathered Rock) then bore hole should be terminated by drilling up to 5.0m in such strata.
4. In case rocky strata is encountered with RQD > 40% (Hard Rock) for continuous length of 3.0m the bore hole shall be terminated after drilling 3.0m into such strata.
5. As per IS4464-1985: code of practice for presentation of drilling information and core description.

The contractor has to obtain the written permission from GPPL while terminating each borehole. Immediately on completion of a borehole, borelog shall be prepared in the approved proforma and will then be submitted to GPPL for further use.

## In-Situ Tests

### Standard Penetration Tests (SPT)

The SPT shall be conducted in 150 mm in diameter boreholes using a Split spoon sampler. The sampler should conform to IS:9640. The weight of the drop hammer shall be 63.5 Kg and the height of the fall of this hammer should be 75 cm. The sampler should be driven through a length of 450 mm and the number of blows for every 150 mm penetration should be recorded. The first 150 mm of drive may be considered as seating drive. The total blows required for the second and third 150 mm penetration shall be termed as the penetration resistance N.

These shall be conducted in boreholes at interval of 1.5 m upto 15m depth and at intervals of 2.0 m beyond 15 m depth and at every change of strata from borehole. The first penetration test in each borehole shall be conducted either at 1.5 m depth or less from existing ground level and last SPT shall be conducted at the termination depth of borehole.

### Pressure meter Test

A pressure meter applies a uniform radial stress to the bore hole at any desired depth and measures consequent deformation of soils / rocks. Testing and reporting shall be confirmed to IS: 1892 – 1979/ASTM D4719, “Subsurface investigation for foundations”/ “Standard test for prebored Pressure meter Test”. The test involves lowering of an inflatable cylindrical probe to the test depth in a bore hole. The probe is inflated by applying water pressure from a reservoir. Under pressure it presses against the unlined wall of the bore hole and causes volumetric deformation. The stress on the bore-hole wall is the pressure of water applied. The deformation of the bore hole is read in terms of volume corresponding to fall in water level of the reservoir. Both Cyclic and direct pressure meter test should be done. The report should contain pressure meter modulus, limiting pressure and bearing capacity.

## Sampling

### Disturbed Samples (DS)

Disturbed samples shall be collected at every 1.5m upto 15 m depth and at intervals of 2.0 m beyond 15 m depth and at every change of strata from borehole. They shall be fully representative of the zone from which they are taken. Weight of disturbed samples shall not be less than 1 kg and shall be taken according to the Indian Standards. They shall be placed immediately in airtight containers with a minimum of air space so as to maintain the natural moisture content for at least one week.

Identification levels indicating depth, borehole number and visual soil classification shall be affixed on the containers.

### Undisturbed Soil Samples (UDS)

Undisturbed samples shall be taken from the boreholes from representative soils including cores while drilling through rocks, at 3m intervals or at every identifiable change of strata for the boreholes.

For adjacent boreholes, depth of sample collections shall be staggered to cater for full layer. The area ratio of the sampling tubes shall not exceed 20%. In soft deposits, piston sampler shall be used to collect UDS.

Before taking an undisturbed sample the bottom of the boring shall be carefully cleaned of loose materials and where casing is being used the sample shall be collected from bottom of this casing.

In case of sandy silt strata, the intervals of sampling shall be suitably increased. Sampling procedures and samplers for recovering undisturbed samples shall normally conform to IS: 2720 unless otherwise specified and directed by the Employer.

Care shall be taken to minimise sample disturbance while collection of samples. Samples shall be collected preferably by pushing the sampler. Driving by hammer above ground level (like SPT) is not acceptable. However, for stiff / hard soil a sliding hammer can be used for driving the sampler at sampler head.

Where an attempt is made to collect an undisturbed sample, which is aborted because of slippage, the boring shall be cleaned out for the full depth to which the sampling tube has been driven and the recovered soil saved as a disturbed sample. A fresh attempt shall then be made from the level of the base of the aborted attempt, and the contractor may use a core catcher between the cutting shoe and sampling tube; alternatively, an additional sample tube may be coupled. Where full recovery is not achieved the actual length of sample in the sampling tube shall be recorded and the reason for only partial recovery shall be noted. Samples with recovery of less than 60% shall be regarded as disturbed samples.

The depths from which all samples are taken shall be recorded. The level at the top of the sample and the length of the sample obtained shall be given, together with the depth of casing. As soon as the sample is obtained from the borehole, the ends of the sample should be cut and removed to a depth of 2.5 m and molten wax should be applied to each end.

### Ground Water Samples

Samples of ground water shall be taken from each boring in which water is found, or otherwise as directed by the GPPL. Where water has been previously added for boring purposes, the boring shall be bailed out before sampling until only uncontaminated groundwater is present in the boring. The samples shall be stored in watertight containers, which shall be washed out with groundwater before filling. The samples shall be not less than 0.5 litres in volume. In the event that sample contains any suspended sediment, a larger quantity of samples shall be obtained and allowed for sediment settling. The clean water shall then be decanted into the store container. The depth of borehole, depth of casing and water level at the time of sampling and the depth from which the sample is obtained shall be recorded and two labels to be fixed to the samples, using appropriate non-fads waterproof marker pen.

### Rock Samples

Cores from core barrel shall be carefully removed and placed in core boxes of 1.5 m length divided longitudinally by light battens to hold 10 rows of cores. Care should be taken to see that the cores are not turned end to end, but should lie in correct position. Depths below the surface of the ground should be indicated at 1.5 m intervals. Mechanical breakage of core shall be joined and numbered with paint.

## Labelling, Packing and Transport

### Sample Labelling

All samples, irrespective of their type, shall be clearly and permanently labelled with the following information immediately upon recovery:

1. Project name and location
2. Borehole number
3. Depths to top and bottom of sample
4. Date of recovery

All samples shall be fixed with two labels; one on the lid or screw top, the other on the jar or steel tube.

### Packing and Transporting

The contractor shall be responsible for the packing and transport of sample to the laboratory, approved by the GPPL. All collected samples shall be transported at the end of every borehole to the laboratory. The contractor shall ensure that all packing and transport arrangements are suited to the type of sample(s) in question and that the least possible disturbance of the samples will occur during transport. In any event, the contractor shall be held responsible for any damage to samples and will have to recollect the samples in lieu of the damaged ones.

## Laboratory Testing

After collecting disturbed and undisturbed samples from different boreholes at different depths, a laboratory test schedule shall be prepared and submitted to GPPL / Representative. for approval. All lab tests shall be carried out in a NABL accredited laboratory. The test specimen for the various laboratory tests shall be prepared in accordance with the procedures laid down in the relevant IS codes of practice. These tests shall essentially comprise of but not limited to the following:

### Moisture Content Determination

The natural moisture content of all the soil samples brought from the site should be determined as prescribed in IS:2720.

### Dry and Wet Density and Specific Gravity

The dry and wet densities of all soil samples shall be determined as prescribed in IS:2720. The specific gravity shall also be measured.

### Grain Size Distribution

Sieve analysis for given size distribution shall be conducted and undisturbed samples collected from boreholes. The hydrometer analysis should be carried out on fractions less than 75 micron wherever applicable as per IS:2720. For the hydrometer analysis, the hydrometer should be calibrated appropriately and all corrections viz. meniscus, temperature and dispersing agent corrections applied to the readings. The grain size distribution curve i.e. percent finer vs particle diameter should be plotted. The table showing the percentage of various grain sizes (gravel to clay), D10, D60, Uniformity Coefficient Cu and Coefficient of Curvature Cc for each test should be given. Soil classification shall be given as per IS 1498

### Atterberg Limits

These tests shall be carried out on clay fraction (size < 75 microns) for all disturbed and undisturbed samples. The test results should include liquid limit, plastic limit and plasticity index and shrinkage limit of the soil samples tested. These tests shall be conducted as per IS:2720, Parts V & VI. In swelling type of soils, the free index should be determined.

### Test on Swelling Type of Soils

The swell pressure of such soils shall be determined using the Consolidometer method. A plot of the dial gauge reading versus the pressure applied shall be plotted and the pressure corresponding to zero dial gauge reading shall be reported as the swell pressure. A test to determine the differential free swell shall also be conducted and the free swell index reported.

### Consolidation Tests

The tests shall be conducted on undisturbed samples. The coefficient of consolidation(cv), coefficient of volume compressibility (mv) and coefficient of permeability (k) shall be determined and reported The following loading stages shall be employed:

0.1, 0.25, 0.50, 1.0, 2.0, 4.0, 8.0 kg/cm2.

Unloading of specimen shall be done in suitable stages. From e vs log p curves, pre-consolidation pressure shall be determined to establish whether the soil is normally consolidated or over-consolidated. The point (e, p) showing initial condition of the soil under test must be specifically marked on the consolidation curves. Cycle(s) of loading, unloading and reloading shall be applied. The field virgin compression curve shall be established. Settlement predictions based on the field virgin compression curve shall only be acceptable. The procedure adopted in respect of obtaining compression indices from the field curve and that for computing settlements for the type of soil under consideration shall be clearly illustrated in the report.

It is to be noted that deviations from the standard procedure of performing consolidation tests given in IS:2720, Part XV are permissible in order to enable computation of settlements based on the above procedure.

The following curves shall be included in the report:

1. e vs log p
2. e vs p
3. Compression vs log(t) or compression vs square root ‘t’

The choice of relationship in part (c) depends upon the shape of the plot that enables clear determination of Cv, the coefficient of consolidation. The time period required for 50% and 90% primary consolidation shall be given in the report.

Location of pc (pre-consolidation pressure) shall be clearly indicated in the e-log p curve.

Values of mv and Cv shall be furnished for different pressure ranges including the values of eo, Cc & pc in tabular form. Computation of secondary settlements, if significant, shall also be made and included in the report.

### Unconfined Compressive Strength (UCS)

These tests shall be done as per IS-2720, Part X on undisturbed soil samples of saturated (or nearly saturated) non-fissured cohesive soils. The cylindrical soil samples should be tested quickly without allowing for drainage, in vertical compression. The UCS of the samples should be reported.

### Triaxial Tests

These tests shall be done on specimen saturated by the application of back pressure. Only if the water table is at sufficient depth so that chances of its rising to the base of the footing are meagre or nil, the triaxial tests shall be performed on specimens at natural moisture content. The magnitude of the back pressure applied shall be indicated in the report.

All the stress-strain diagrams as well as Mohr’s circle envelopes shall be included in the report. Density and water content of the sample tested and modulus of elasticity along with shear strength parameters shall be reported.

### Direct Shear Test

This test should be performed on remoulded soil specimens of silty sand or fine sand in nature prepared to a density corresponding to in-situ conditions with a minimum particle size of 4.75 mm as per IS:2720 Part XIII. The density to which the sample shall be prepared shall be based on the observed SPT N value and the corresponding relative density. The peak angle of shearing resistance (f) and the ultimate angle of shearing resistance i.e. at constant volume (fcv) should be indicated.

### Point Load Test on Rock Cores

Intact samples of minimum 50 mm diameter and length equal to 1.5 times the diameter should be tested on a Point Load Tester and its point load index shall be determined. The Uniaxial Compressive Strength (UCS) of the sample should be calculated from the point load index. The index as well as the UCS should be reported.

### Uniaxial Compressive Strength of Intact Rock Samples

Intact rock cores of minimum NX size and length 2.5 to 3 times the diameter should be tested for its uniaxial compressive strength. The test should be conducted on perfectly cylindrical sample, which shall be polished and conform to Indian Standard Code of practice. The UCS of the sample should be reported along with the diameter and length of the sample.

### Modulus of elasticity and poisons ratio of Intact Rock Samples

Intact rock cores of minimum NX size and length 2.5 to 3 times the diameter should be tested for its modulus of elasticity and poisons ratio. The test should be conducted on perfectly cylindrical sample, which shall be polished and conform to Indian Standard Code of practice as per IS:9221 -1979 The modulus of elasticity and poisons E value of rock shall be reported.

### Other Test on Rock Samples

The index test of rock (Bulk/wet Density, Specific gravity, Water absorption, hardness) including the crushing strength of rock shall be determined on the collected rock samples and reported in the final report along with other details such as design unit skin friction and bearing values in case of different bored cast-in-situ concrete piles and drilled piles.

### Chemical Tests

Chemical test shall be conducted on soils & water samples as per relevant BIS latest revisions to report the following:

1. pH
2. Chlorides in ppm & percentage
3. Sulphates in ppm and percentage and expressed as SO3 & SO4.
4. Total hydrocarbon present in the soil (in ppm)
5. Calcium content, Potassium and Nitrate Content
6. conductivity and total dissolved solids in water
7. electrical resistivity test to determine the corrosivity properties
8. Specific gravity of water

## Report Preparation

On completion of each borehole, 2 (two) copies of field log sheet shall be submitted to the GPPL/ Representative.. These preliminary bore logs shall show:

1. Ground levels in meter with respect to the Chart Datum
2. The locations of the boreholes, on a plan
3. The preliminary description of each stratum
4. The thickness of each stratum with the levels of the boundaries referred to the Chart Datum.
5. The position, type and identification of each sample and site test with reference to Chart Datum.
6. Any site test results available with reference to Chart Datum.
7. The levels at which each separate ground water level is first encountered at which it comes to rest (standing water level).
8. Site daily report to be submitted

### Draft Report

On completion of all field and laboratory testing, detailed Draft Report shall be prepared and submitted to client. Three copies of detailed draft report are required to be submitted including the AutoCAD drawings of the survey output / maps, in soft copies on Pen drive.

The draft and final reports shall include but not limited to the following:

1. A plot plan showing all the borehole locations with their co-ordinates and reduced levels with reference to chart datum.
2. General geological information of the region.
3. Character and genesis of soil.
4. Procedure of investigations and methods of various tests adopted.
5. Detailed bore logs indicating co-ordinates, reduced ground levels with reference to chart datum, subsoil section along various profiles indicating borehole nos., depth wise in situ tests like SPT, etc.
6. All field and laboratory test results shall be plotted against depth and also in tabular form.
7. Summary of results obtained from various tests and their interpretation to evaluate various soil parameters.
8. A set of longitudinal and transverse soil profile connecting various boreholes showing the variation of soil stratum (fence diagram).
9. Strata-wise recommended soil properties such as water content, Atterberg’s limits, dry and wet densities, shear parameters, Coefficient of volume compressibility (mv) and coefficients of permeability shall be reported.
10. Comments on chemical nature of ground water and soil with due regard to potential deleterious effect on concrete and steel and firm recommendations on protective measures. Also remedial measure for sulphate attack or acidity shall be dealt with in detail giving clear practical recommendations.
11. Analysis and Recommendations –

All field and laboratory test data shall be reviewed and evaluated to provide soil parameters and recommendations. The soil parameters and recommendations shall include but not necessarily be limited to, the parameters indicated in the relevant sections.

### Final Report

Within one week upon receiving the detailed draft report, the comments on the same shall be issued to the Contractor by the client. The detailed final report shall be submitted within next one week incorporating these comments on the detailed draft report. Five copies of detailed final report are required to be submitted including the AutoCAD drawings in hard as well as soft copies on pen drive.

# TIME OF COMPLETION

The contractor shall complete the entire work and submit the draft reports within 10 weeks. The contractor shall finalize and submit the final report within one week of receiving detailed comments from GPPL.

Time is the essence of the contract. The work shall be executed strictly as per time schedule indicated below:

|  |  |
| --- | --- |
| Mobilization | * 01 week from the date of LOI |
| Complete Field Work for Land and Marine Borholes | * 02 weeks after mobilization |
| Draft Analysis and Reports | * 01 week after field work of respective investigation |
| Final survey report | * Within 01 week on receipt of comments on the Draft Report |

The comments on the draft survey report shall be furnished within 07 days on receipt.

# OBLIGATION OF CLIENT AND CONTRACTOR

The contractor shall provide necessary facilities to GPPL to perform the following:

I) GPPL shall have access to all data collected onboard including positioning information and other data.

ii) GPPL may at any time object and require the Contractor to remove from the site a supervisor or any other authorized representative or employee of the Contractor or any of the Contractor’s Contractor, if in the opinion of GPPL the person in question has misconducted himself or his employment is otherwise considered undesirable.

iii) The Contractor shall provide necessary support to the GPPL’s personnel present during the survey for QA/QC of the data collection procedure.

iv) The Contractor shall be responsible for paying all duties, custom duties, charges and pilotage, if any, wherever applicable. The Contractor shall obtain the necessary permission from the local authorities to carry out the survey work for which the GPPL shall provide only the recommendation letters, etc.

v) GPPL will not be liable for any loss / damage / injury of any personnel / life and equipment / equipment / service during survey. Necessary insurance coverage shall be provided by the Contractor, for its equipment and personnel at his own cost.

vi) The Contractor shall use existing shore control stations or establish suitable new stations, if required, through a local triangulation from established survey points of the Survey of India.

vii) The Contractor shall report to GPPL before mobilization, during survey and on completion about the progress of work.

viii) No payments shall be made for the data collected/generated in the field when the data has not been satisfactory. In such area the Contractor shall undertake to repeat surveys to obtain acceptable data at his own cost.

# GENERAL TERMS AND CONDITIONS

## Guarantee / Liability

CONTRACTOR to guarantee for the work carried out. In case of any fault in CONTRACTOR’s work, for reasons attributable to CONTRACTOR, CONTRACTOR shall take necessary actions required to rectify such faults, without any commercial implications to GPPL, within shortest possible time.

## Termination by GPPL

Notwithstanding what is stated herein above, GPPL shall have the right to terminate the CONTRACT with CONTRACTOR forthwith by giving 15 days prior notice in writing addressed to CONTRACTOR at its last known address, in case of happening or occurrence of events including but not restricted to the following:

1. breach of any of the material terms or conditions or non-performance of obligations, SCOPE of WORK by CONTRACTOR and such breach/ non-performance is not cured within of such period of notice by CONTRACTOR;
2. if the appointment or continuance of CONTRACTOR under the CONTRACT is likely to result in loss of goodwill or reputation of GPPL;
3. If CONTRACTOR commits any misconduct, fraud, cheating, misappropriation or any act lacking in good faith.

In case of such termination, CONTRACTOR will be paid their fees for all the work carried out by them up to date of termination based on milestone achieved by them.

## Force Majeure

a. Notwithstanding the provisions of clauses contained in this CONTRACT; CONTRACTOR shall not be liable for its performance and penalty for default, if CONTRACTOR is unable to fulfil its obligation and SCOPE of WORK under the WORKORDER due to Force Majeure circumstances.

b. For purpose of this CONTRACT, "Force Majeure" shall means an event beyond the reasonable control of CONTRACTOR and not involving CONTRACTOR fault or negligence and not foreseeable, either in its sovereign or contractual capacity. Such events may include but are not restricted to acts of God, war (declared or undeclared), earthquake, volcanic eruption, landslide, flood, cyclone, typhoon, tornado, military operations of any character, blockade, prohibitions of exports and imports, Government regulations, restrictions, notifications, ban, workers’ strike, bandh, riots, curfew, terrorist act or any other local disturbance. Whether a "Force Majeure" situation exists or not, shall be decided by the Management of GPPL & the decision taken by Management of GPPL shall be final and binding on CONTRACTOR and all other concerned.

c. If a Force Majeure situation arises, CONTRACTOR shall notify to GPPL in writing promptly (at the most within 3 days from the date such situation arises). After examining the cases GPPL shall decide and grant suitable addition time for the completion of the work.

d. For other justified cases also, not covered under Force Majeure conditions, GPPL may consider the request of CONTRACTOR. If it is deemed fit to GPPL, additional time for completion of work may be granted at GPPL’s discretion.

e. If any of the Party to the CONTRACT be prevented from fulfilling their obligations provided for under CONTRACT by the existence of a cause of Force Majeure lasting continuously for a period of three (2) months, the Parties shall mutually decide upon the future course of action.

## Disputes Resolution

Notwithstanding anything contained to the contrary in CONTRACT, all disputes or differences whatsoever arising between the Parties in connection with or arising out of the validity, construction, performance and termination of CONTRACT (or any terms thereof), which the Parties are unable to resolve themselves within 30 (thirty) days of notice by one Party to another, followed by meeting of senior officials of both the Parties, shall be finally settled by arbitration proceedings in accordance with the Indian Arbitration and Conciliation Act, 1996 or any statutory amendment or re-enactment thereof for the time being in force and Rules framed there under. The seat and venue of arbitration shall be Vadodara, Gujarat, India. The language of the Arbitration proceedings shall be English. During the pendency of arbitration, CONTRACTOR shall continue to perform its obligations under the CONTRACT. The arbitral award shall be final and binding upon GPPL and CONTRACTOR. The principles of natural justice must be observed in the arbitration proceedings.

## Interpretation & Jurisdiction

The provisions, terms and conditions of CONTRACT and all the questions of construction, validity and performance shall be governed by and in accordance with the laws of India. Competent courts of Gandhinagar, Gujarat, India shall have the exclusive jurisdiction relating to matters relating to CONTRACT.

## Assignment

CONTRACTOR shall not assign, in whole or in part, its obligations to perform under the CONTRACT, except with GPPL's prior written consent.

## Miscellaneous

No variation in or modification of the terms of the CONTRACT shall be accepted except by amendment issued by GPPL. The Parties will negotiate in good faith, as far as feasible, alternative provisions which will be binding and enforceable and which will reflect the original intentions of the Parties.

## Validity

Validity of proposal should be minimum 03 months from date of proposal submission.

## CONTRACTOR to inform himself

CONTRACTOR shall be deemed to have satisfied himself about the detailed job content, the conditions and circumstances affecting the CONTRACT prices and the possibility of executing the works as shown and described in this CONTRACT.

## Gate pass and Fire & Safety

Necessary precautions in respect of fire and safety shall have to be observed / maintained as per the rules and regulations of GPPL.

If the job is to be carried out within the plant area, necessary permit / gate pass from time to time, from the plant personnel or any competent authority shall be taken by CONTRACTOR in consultation with GPPL and CONTRACTOR shall comply with all the requirements in connection with the issue of permits. The safety permit issued by competent authority shall have to be renewed on daily basis or twice a day or even more.

# PAYMENT TERMS

1. All payments shall be made through NEFT / RTGS on 30th day from the date of acceptance of submitted valid and undisputed invoice approved by GPPL’s concerned authority with attached evidences, supporting documents, invoices / challans, etc. Invoice shall mention relevant bank details for effecting the necessary payments.
2. Payment Milestone: -

* On acceptance of Draft Report – 50% of the estimated cost of the assignment
* On acceptance of Final Report – 50% of the estimated cost of the assignment

1. The payment will be made based on the rates quoted for each item in the BOQ. The quantities in the BOQ are approximate and may be vary. Payment will be made upon the basis of actual work executed at site.
2. The contractor should note that there may be any variation in the quantities mentioned in the BOQ and deletion of some items/ quantities. The rates and prices set down against the items in the Bill of Quantities shall be fixed for the entire duration of the Contract and shall be for the full inclusive value of the finished work described including profit, all obligations and liabilities of every kind arising under the Contract. The Contractor shall not claim any variation in rate due to change in quantities indicated in BOQ. The Contractor is deemed to include the expenses related to satisfactory execution of the work. The rate quoted shall include all the expenses related to materials, labor, equipment, taxes, expenses related to all approvals, etc. as required to complete the work as directed.

# BILL OF QUANTITIES

## Preamble

1. The Bill of Quantities must be read with the Conditions of Contract, the Specifications and Drawings and the contractor is deemed to have examined the documents and to have acquainted himself with the detailed description of the works to be done and the way in which they are to be carried out.
2. The quantities set down against the items in this Bill of Quantities are an estimate of how much of each kind of work is intended to be done in the Contract and are given for the convenience of forming common basis for evaluation and comparing tenders. They are not to be taken as a guarantee that the quantities scheduled will be carried out or required. The quantities shall therefore not be considered as representing the final measurement, it being the intention of the Contract (except where otherwise specifically stated) that all works embraced therein shall be measured up by the GPPL on completion and paid for at the prices and rates entered in the Bill of Quantities by the Contractor. Payment will be made upon the basis of actual work executed at site.
3. Each item in the Bill of Quantities is to be priced or if any of the items is left unpriced, it will be assumed that the value of the work or commitments described thereunder is allowed for elsewhere in the Bill.
4. The Contractor’s attention is particularly directed to the fact that conditions of contract do not include a variation in price of labour or materials. This should be allowed for in the rates stated by the Contractor in the Bill of Quantities.
5. The rates set down against the items are to be the full inclusive value of the work described thereunder and are to include for profit and for the cost of every description of work and materials together with all costs in connection therewith or arising from the completion of the works as specified. They are to include (but not by way of limitation) for all labour, transport, cartage, materials, plant, equipment, floating crafts, pumps, generators, engines, lifting devices, cables, plain and perforated linings, measuring devices and taking of records, machinery and appliances, staging, medical and welfare facilities, housing accommodation for Contractor’s staff and employees fuel, water, lighting, drainage, pumping, all costs in dues, all taxes (including sales tax) unless specifically mentioned to have been excluded elsewhere in these documents, establishment charges, bond, royalties, rents, telephone services, watching and assistance, their messing, kit allowances and all contingent expenses, liabilities and responsibilities mentioned and referred to or to be inferred from the Conditions of Contract, Drawings. Specifications, Bill of Quantities or other contract Documents annexed thereto.
6. The Contractor shall be deemed to have inspected the site and to have obtained on his own responsibility and at his own expense all the information which may be necessary for making his Tender. He is deemed to have the knowledge of the available weather window in which he can carry out his works to the required specifications and the time frame.
7. None of the possible variation in survey area and number of boreholes shall affect either the validity of the contract or the rates quoted herein.
8. Any downtime on account of weather, equipment positioning, or breakdown shall be to the Contractor’s account and no additional payment will be made on this account.
9. The Contractor should submit the following details as part of their **Technical proposal** along with his Tender.

a) Time to commence, time to complete on site, time to submit report.

b) Details of equipment.

c) A detailed programme for carrying out the work.

## Bill of Quantities

| **S. No.** | **Description** | **Unit** | **Est. Qty.** | **Rate (Rs.)** | **Amount (Rs.)** |
| --- | --- | --- | --- | --- | --- |
|  | **Section – I: General (Mobilization and Demobilization)** |  |  |  |  |
| 1. | Mobilising and demobilising of boring equipment, personnel and all other necessary machinery for boring works including jack up platform / barges / hydraulic rigs, transportation, shifting of equipment from location to location for boreholes, etc. and all complete. | LS |  |  |  |
|  | **Section – II : Boring Sampling and Field Testing in Soil and Rock (Field Works)** |  |  |  |  |
| 2.1 | Move the boring equipment etc. and position at the location of each borehole including accurate positioning and erection/ dismantling of rig etc. | No. | 4 |  |  |
| 2.2 | Boring through soils and rock including conducting field tests such as Standard Penetration Tests (SPT),Pressure meter, collecting packing and transporting disturbed, undisturbed soil samples , rock samples and ground water samples, as per technical specifications and as directed by GPPL. |  |  |  |  |
| a) | Soil | RM | 82 |  |  |
| b) | Weathered/Soft Rock | RM | 12 |  |  |
| c) | Hard Rock | RM | 6 |  |  |
| 2.3 | Collection of Disturbed samples | Nos. | 51 |  |  |
| 2.4 | Collection of Undisturbed Samples | Nos. | 27 |  |  |
| 2.5 | Carrying out field SPT | Nos. | 51 |  |  |
| 2.6 | Carrying out vane shear test | Nos. | 4 |  |  |
| 2.7 | Pressure meter Test | Nos. | 2 |  |  |
|  | **Section – III : Laboratory Tests on Soil** |  |  |  |  |
| 3.1 | Determination of Natural Moisture Content | Nos. | 27 |  |  |
| 3.2 | Determination of Bulk & Dry Density | Nos. | 27 |  |  |
| 3.3 | Determination of Specific Gravity | Nos. | 43 |  |  |
| 3.4 | Determination of Grain Size distribution  a) By Sieve Analysis (for sandy soils)  b) By Hydrometer (for silty to clay soils) | Nos. | 43  43 |  |  |
| 3.5 | Determination of Atterberg’s limits | Nos. | 27 |  |  |
| 3.6 | Carry out Consolidation tests as specified. | Nos. | 7 |  |  |
| 3.7 | Carry out Unconfined compression tests as specified : | Nos. | 7 |  |  |
| 3.8 | Carry out Tri-axial compression tests as specified :  a) Unconsolidated Undrained  b) Consolidated Undrained | Nos.  Nos. | 7  7 |  |  |
| 3.9 | Determination of Elastic Modulus and Poission ratio of soil | Nos. | 7 |  |  |
| 3.10 | Carry out Direct Shear Test | Nos. | 31 |  |  |
| 3.11 | Carrying out Chemical Tests on soil samples as per the specifications. | Nos. | 2 |  |  |
| 3.12 | Carrying out Chemical Tests on water samples as per the specifications. | Nos | 2 |  |  |
|  | **Section – III : Laboratory Tests on Rock** |  |  |  |  |
| 4.1 | Determination of Bulk/Dry density, specific gravity, Water absorption | Nos. | 6 |  |  |
| 4.2 | Determination of Hardness, Porosity UCS, Deformation modulus, Elastic modulus | Nos. | 5 |  |  |
| 4.3 | Determination of Brazilian Tensile strength, Point Load Index | Nos. | 2 |  |  |
|  | **Section – III : Reporting** |  |  |  |  |
| 5. | Submitting complete report consisting of each and every detail of locations, borehole profiles and cross sections, description of soil strata, Compilation and analysis of laboratory and field test results for the entire work all as per technical specifications complete. | LS | 1 |  |  |
| **Grand Total (in words) Rupees** | | | | |  |

Notes:

1. All quantities mentioned above are tentative and subject to variation depending upon the types of results of investigations and Project requirements.

2. The Contractor must make his own arrangement for travel, stay, food etc. within his mobilization cost.

3. In submitting the offer the Bidder is deemed to have visited the site at his own expense and made himself familiar with the Scope of Work and the site conditions. No additional fees/reimbursements will be considered for this in the tender.

4. Any downtime or expenses on account of weather, equipment/vessel/ positioning etc. shall be borne by the Contractor

Priced Commercial Proposal shall be submitted before the due date and in a separate properly sealed envelope super scribed with the enquiry details and shall be addressed to;