

SOIL INVESTIGATION REPORT

Client: Gujarat Industries Power Company Limited

PMC: -

Design Consultant: -

EPC: -.

Project: Geotechnical Investigation for proposed Solar plant at Surat Lignite Power Plant, Village: Nani Naroli, Tal: Mangrol, Dist: Surat.

Project No.
2122222

Riv.:
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Notes:

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Annexure:

- ❖ Field & Laboratory Test Results
- ❖ Summary of Geotechnical Exploration

ABSTRACT

In the following pages, is presented the report with analysis, prepared from the thorough study of geotechnical investigation results.

The detailed scope of work was decided after the discussion with client. The test location detail is shown in layout plan submitted with report.

A complete geotechnical investigation work was undertaken to obtain the required subsurface information to study and define the nature and behavior of soil. Such information was obtained through following steps:

- By making test bores and other field tests.
- By observing ground water table in boreholes
- By performing required in-situ tests
- By testing the soil in laboratory to classify it and to determine the engineering properties of soil.

DISCLAIMER

We have employed accepted geotechnical engineering procedures and our opinions and conclusions are made in accordance with generally accepted principles and practices of these professions. The contents of this report are valid as of the date of preparation. However, changes in the condition of the site can occur over time as a result of either natural processes or human activity. In addition, advancements in the practice of geotechnical engineering, engineering and changes in applicable practice codes may affect the validity of this report. Consequently, this report should not be relied upon after an elapsed period of 12 months without a review by this firm for verification of validity. Our investigation did not include the evaluation or assessment of any potential environmental hazards or groundwater contamination that may be present. Soil being a heterogeneous material, any deviation in soil strata encountered after foundation excavation shall refer to us for further consultation.

1.0 INTRODUCTION:

Gujarat Industries Power Company Limited appointed M/s Unique Engineering Testing & Advisory Services as Geotechnical Investigating Agency for above mentioned Project.

1.1 PROJECT DESCRIPTION:

The proposed site is located at Surat Lignite Power Plant, Village: Nani Naroli, Tal: Mangrol, Dist: Surat. It is a construction project of Solar plant.

2.0 SCOPE OF WORK:

The principal objective of the exploration work was to determine the soil profile and to provide foundation recommendation.

The entire field testing was carried out as per relevant IS codes and/or as per the instructions of the representatives of the clients. The samples collected from various test locations, were sealed, labelled and transported to our laboratory at Udhna, Surat. The required laboratory tests were conducted as per relevant IS codes.

This report has been prepared after careful study of the field and laboratory test results.

2.1 FIELD TESTS PERFORMED:

- Drilling 6 no. of 150 mm dia. bore hole with casing whenever required up to maximum depth of 15.0 m from ground level or hard strata.
- Carry out Standard penetration Test (SPT) at every 1.0/1.5 m interval alternate to undisturbed sampling or continuous SPT at 1.0/1.5 m depending on cohesive & non-cohesive formation.
- Collecting disturbed soil sample at every meter interval or as per the stratification of soil and recording depth at which soil changes.
- Collecting undisturbed samples (UDS) at 1.0/1.5 m interval alternate to S P Test.
- Observation of ground water table using drilled holes.
- Conducting 2 Nos. of Electrical Resistivity Test
- Excavating 2 Nos. of Trail Pits.

2.2 LABORATORY TEST PERFORMED:

- Natural moisture content.
- Field Density, Moisture content and Dry Density of undisturbed samples.
- Grain size Analysis of SPT samples, UD samples and disturbed samples covering each soil strata.
- Atterburg's Limit for samples as per above. (LL, PL, SL)
- Specific gravity Test for Undisturbed samples.
- Diff. Free Swell Index/Swelling Pressure Test
- Consolidation Test
- Modified Proctor Test
- Soak CBR Test
- Test for shear properties of selected samples.
 - a) Unconfined compressive Strength on saturated cohesive soils.
 - b) Triaxial Shear Test/Direct Shear Test (As per soil condition) under UU condition without Pore pressure measurement as per in situ conditions. Normally Soft cohesive saturated samples will be consolidated at average Overburden pressure.

2.3 DRILLING:

Drilling of 150 mm ϕ borehole is carried out by ~~manual shell & auger boring method~~/mechanical rotary drilling machine. Care is taken before conducting S P Test or Collecting U D Samples that the bore is cleaned properly.

Casing is required to be lowered if the boreholes do not retain its shape. Care is taken that ground water level is maintained during the drilling and particularly before testing or sampling levels. In no case casing was allowed to advance below the bottom of borehole.

2.4 STANDARD PENETRATION TEST:

The Standard Penetration Tests are carried out as per I. S. 2131: 1981. In general, the tests are conducted at 1.0/1.5 m interval alternate to the undisturbed sampling or as dictated by existing soil strata.

Before testing, the borehole is cleaned properly, and Split Spoon Sampler is centrally seated in borehole. In case of SPT to be conducted below water table care is taken that casing position is above the borehole depth. The water level in borehole is maintained above or at least at the water table.

A standard hammer (Donut type) of 63.5 kg is dropped from a height of 75 cm. and the no. of blows for penetration of Split Spoon Sampler for 0-15, 15-30 and 30-45 cms are noted. Standard Penetration Test Value N_s is considered for 15-45 cms penetration values. Sample for moisture content is collected in moisture cans. For non-plastic silts and fine Sands N_s value is corrected for effective overburden pressure and dilatancy Correction is added for tests conducted below water table.

2.5 DISTURBED AND UNDISTURBED SAMPLES:

Disturbed samples from shell or from Split Spoon Sampler is collected in polythene bags with proper labels.

Undisturbed samples in 70 mm ϕ Shelby tubes are collected alternate to Standard Penetration Test at 1.5 m. interval. The sampling tube is connected to the rod adopter with ball check valve. Before lowering the sampler, the bore is cleaned properly, and sampling tube is lightly oiled from inner and outer side.

Sampling tube is pushed into the borehole by pressure hammering as per the soil stiffness. The sampling tube is immediately waxed after covering with aluminum foil.

In case of medium to coarse, non-cohesive, sand samples, where sampling is unsuccessful, Standard Penetration Test is carried out on cleaning the borehole.

2.6 LABORATORY TEST:

Disturbed, undisturbed and S P Test samples from the field are brought to the laboratory with care and are grouped according to observations in the fields. On completion of shear, compressibility, permeability etc. tests on U D samples, these samples are placed in oven along with the S P Test samples and disturbed samples. Samples are selected such that each soil strata is adequately represented by the physical properties. The representative samples are dried in oven for 24 hours at $110 \pm 5^\circ\text{C}$.

2.6.1 PHYSICAL PROPERTIES:

The moisture cans collected from S P T samples from the field are weighed and placed in oven for drying to determine natural moisture content (NMC).

U D samples are extracted using extractor and samples are prepared as per the required sizes of the test to be performed. Before extracting from tube, weight and volume of sample are noted. Average bulk density is calculated in laboratory and samples are placed in oven to get the field moisture content for computing the dry density.

Specific gravity with specific gravity bottle / pycnometer is calculated as per I. S. 2720 (part – 3, section 1&2): 1980. From the results of dry density and specific gravity the saturation of sample in % is calculated which is a useful data for deciding the condition of triaxial shear test

Grain size analysis is made by I. S. sieves. I.S sieves commonly used are 4.75 mm, 2.00 mm, 1.00 mm 425 microns, 250 microns and 75 microns. For the coarse grain soil a graph of partial size v/s cumulative % finer is plotted. For fine grain soil wet analysis is made and material fine than 75 microns is found out by hydrometer test. Mechanical digital single pan balance of 1 kg capacity with 0.1 gram least count is used.

Liquid limits and Plastic limits tests are carried out with distilled water as per I. S. 2720 (part – 5): 1985. The samples are tested at a minimum of 24 hours after the addition of water. For liquid limit test cone penetration method is adopted but occasionally value is checked on Casagrande standard.

For the foundation soil sample showing high plasticity are checked for swelling and shrinkage. Firstly for rough estimate, free swell test as per I. S. 2720 (part – 40): 1977 is being carried out and getting positive indication of swelling. Shrinkage limit test is carried out as per I. S. 2720 (part – 6): 1972.

2.6.2 SHEAR PROPERTIES:

Shear tests are carried out by three methods.

- 1) Unconfined compressive strength as per I. S. 2720 (part – 10): 1973 for the saturated plastic soil undisturbed samples and cores of SPT samples.

- 2) Triaxial shear test is carried out on sample size of 38 mm ϕ and 76 mm in height on motorized 30-speed load frame with digital display arrangements for load and pore-pressure. The confining pressure σ_3 is applied to the cell by oil-water constant pressure system. The test is carried out for Unconsolidated Undrained (UU) test without pore-pressure measurement as per I.S. 2720 (part – 11): 1971.

The graph for triaxial shear test is plotted by modified method where X-axis represents $\frac{1}{2} (\sigma_1 + \sigma_3)$ and Y-axis represents $\frac{1}{2} (\sigma_1 - \sigma_3)$.

3.0 FOUNDATION RECOMMENDATION:

1. Standing water or groundwater was not encountered till termination depth below ground level in BH-01 to BH-06 during the subsurface exploratory boreholes in January 2022. It should be noted that groundwater levels might change and can vary with seasonal rainfall patterns, long-term climate fluctuations and with the influence of local site conditions.
2. Three boreholes (BH-1, BH-2 & BH-3) were conducted on virgin soil and three boreholes (BH-4, BH-5 & BH-6) were conducted on filled up soil. This filling is done with fairly uniform nature of soil but have varying stiffness.
3. Soil strata are as described in “Summary of Geotechnical Exploration” of this report.

For BH-01, predominantly soil strata are reddish stiff high plastic clay with sand followed by reddish very stiff plastic clayey sand with gravel to reddish very stiff high plastic clay with sand.

For BH-02, predominantly soil strata are brownish silt with medium to coarse sand and gravel followed by yellow very stiff plastic clayey sand to reddish hard high plastic clay with sand.

For BH-03, predominantly soil strata are yellow sandy gravel (highly weathered rock) followed by yellow dense silty medium to coarse sand with boulders to boulders. Strata thereafter are yellow cemented high plastic clay with sand.

For BH-04, neglecting top filling predominantly soil strata are black stiff high plastic clay with sand followed by reddish stiff high plastic clay with sand to black stiff high plastic clay.

For BH-05, neglecting top filling predominantly soil strata are reddish stiff high plastic clay followed by black very stiff high plastic clay with sand to yellowish stiff high plastic clay.

For BH-06, neglecting top filling predominantly soil strata are yellow firm high plastic clay with sand followed by black stiff high plastic clay with sand to reddish yellow stiff to very stiff high plastic clay with sand.

4. Top 4.0 m soil has high swelling potential in BH-01 & 06. Depth 2.0 m to 3.0 m soil has high swelling potential in BH-02. Depth 1.0 m to 2.0 m soil has high swelling potential in BH-03. Top 1.0 m and depth 2 m to 3 m soil has high swelling potential in BH-04. It shall not be used for back-filling purposes without treatment.
5. For both the location shallow foundation proposed at 2.5 m or below from NGL. As per client's request, bearing capacity calculation provided for foundation depth above 2.5 m.
6. For foundation resting on soil having high swelling potential (Up to 3 m depth), the pit shall be excavated up to foundation level + 500 mm below existing ground level and shall be backfilled with 500 mm thick compacted selected soil (non-cohesive soil/GSB) in layers. Foundation shall be placed on this compacted modified soil layer. Extent of the selected soil layer shall be 300 mm extra on all sides of the foundation.
7. Pile capacity as per suggested load and dia. combination is also given below. Pile capacity shall be confirmed as site by conducting static pile load test as per IS 2911-Part-4.
8. IS 3764-1992 shall be followed as a Safety Code for excavation work.

SUMMARY OF ALLOWABLE BEARING CAPACITY CALCULATIONS

1) For BH-01, 02 & 03 (VASTAN SOUTH)-

1.1) For Square Footing –

Design Data :

Foundation Type	: Square Footing
Width of Footing	: 1.00 m to 5.00 m, (increment = 1.00 m)
Depth of Footing	: 1.00 m to 5.00 m, (increment = 1.00 m)
Failure Mode	: General Shear Failure
Shape and Depth Factors	: To be considered
Load inclination	: 0.00 Deg
Water Table	: 1.00 m (Assumed)
Factor of Safety	: 3.00
Permissible Settlement	: 50.00 mm

Soil	From	To	C	Ø	γ_b	m_v	E
Strata	(m)	(m)	(Kg/cm ²)	(deg)	(g/cc)	(cm ² /Kg)	(Kg/cm ²)
SC	0.00	3.00	0.30	14.0	1.77	1.54e-02	65.00
SC	3.00	7.50	0.45	16.0	1.80	1.05e-02	95.00
CH	7.50	10.50	1.10	-	1.90	6.70e-03	150.00

Calculations:, Water Table at a depth of 1 m

For General Shear Failure, Ultimate Bearing Capacity is given by

$$q_d = c N_c s_c d_c i_c + q (N_q - 1) s_q d_q i_q + \frac{1}{2} B \gamma N_\gamma s_\gamma d_\gamma i_\gamma W'$$

Where

N_c, N_q, N_γ are Bearing Capacity Factors from Table-1 [IS:6403-1981],

s_c, s_q, s_γ are Shape Factors,

d_c, d_q, d_γ are Depth Factors,

i_c, i_q, i_γ are Inclination Factors,

c = Cohesion in Kg/cm²,

q = Effective surcharge at base of Fdn in Kg/cm²,

B = Width of Fdn in cms,

γ = Bulk unit weight of foundation soil in Kg/cm³,

W' = Correction factor for location of water table (at a depth of 100 cms)

Safe Bearing Capacity (Considering a Factor of Safety of 3), is given by :

$$q_{safe} = q_d / 3$$

Immediate Settlement in Cohesive Layer from 0 to 3 m (S_i)

$$= p B (1 - \mu^2) I / E$$

Where

p = Foundation Pressure in Kg/cm²

B = Width of footing in cm

μ = Poisson's ratio = 0.5 for clay

I = Influence factor depending on L/B and H_f/B is obtained from Fig 11 [IS 8009 (Part 1)]

E = Young's Modulus of elasticity = 65 Kg/cm²

Settlement in Pre-Compressed Cohesive Layer from 0 to 3 m (S₁)

$$= \Delta p \times m_v \times H$$

Where

Δp = Pressure increment in kg/cm² at a depth 0.75 m below Foundation [obtained from B-1.3 and Fig 17, IS 8009 Part 1]

= p x I_B x number of Influence Areas

m_v = Coefficient of volume compressibility = 0.0154 cm²/kg

H = Thickness of compressible stratum from foundation level

Total Settlement

$$S_f = S_i + S_1$$

Applying Correction for Effect of Depth of Foundation

$$S_{fd} = S_f \times \text{Depth Factor}$$

Where

Depth Factor = 0.72 (from Fox's Correction Curves for $\sqrt{(L/B)} / D = 1$ and L/B = 1)

Results of Bearing Capacity

Sl No	Width (m)	Depth (m)	q _{safe} T/m ²	Settlement (mm)	Remarks
1	1.00	1.00	19.5	20.7	-
2	1.00	2.00	24.3	26.5	-
3	1.00	3.00	48.0	30.7	-
4	1.00	4.00	56.5	34.0	-
5	1.00	5.00	65.2	36.8	-
6	2.00	1.00	17.5	49.8	q _{safe} reduced for Settlement Criteria
7	2.00	2.00	20.7	42.8	-

8	2.00	3.00	37.7	49.9	q _{safe} reduced for Settlement Criteria
9	2.00	4.00	41.3	50.0	
10	2.00	5.00	38.2	50.0	
11	3.00	1.00	12.3	49.7	
12	3.00	2.00	16.9	50.0	
13	3.00	3.00	21.8	49.8	
14	3.00	4.00	23.1	49.8	
15	3.00	5.00	25.3	49.8	
16	4.00	1.00	9.9	49.6	
17	4.00	2.00	12.2	49.9	
18	4.00	3.00	15.3	49.9	
19	4.00	4.00	17.0	49.9	
20	4.00	5.00	20.0	49.8	
21	5.00	1.00	8.1	49.8	
22	5.00	2.00	9.9	49.6	
23	5.00	3.00	12.1	49.8	
24	5.00	4.00	14.1	49.8	
25	5.00	5.00	17.2	49.9	

1.2) Summary of Pile Capacity Table For Bored Cast-In Situ Pile – (For Structures)

Pile Dia. in mm	Pile Depth* in m	Axial (Comp.) Capacity in T	Axial (Uplift) Capacity in T	Lateral Capacity in T (Fix Head)	Depth of Fixity in m
400	9	16	14	2.7	4
450	9	19	17	3.5	5
500	9	22	19	4.3	5
600	9	28	24	6.1	6

* From cut-off level.

Note:

- a. Cut-off level considered at 1.0 m below EGL.

Summary of Pile Capacity Table For Bored Cast-In Situ Pile – (For Solar Panel)

Pile Dia. in mm	Pile Depth* in m	Axial (Comp.) Capacity in T	Axial (Uplift) Capacity in T	Lateral Capacity in T (Free Head) – 5 mm deflection	Depth of Fixity in m
300	1.5	3	2	0.6	3.0
	2.0	4	4	0.6	3.0
	3.0	7	6	0.6	3.0

* From cut-off level.

Note:

- Cut-off level considered at 0.0 m below EGL.
- Top 3 m soil has high swelling potential. Designer should check for this aspect. Pile capacities provided as per client's requirement.

2) For BH-04, 05 & 06 (VASTAN)-

2.1) For Square Footing –

Design Data :

Foundation Type	: Square Footing
Width of Footing	: 1.00 m to 5.00 m, (increment = 1.00 m)
Depth of Footing	: 1.00 m to 5.00 m, (increment = 1.00 m)
Failure Mode	: Local Shear Failure (Considering filled-up soil)
Shape and Depth Factors	: To be considered
Load inclination	: 0.00 Deg
Water Table	: 1.00 m (Assumed)
Factor of Safety	: 3.00
Permissible Settlement	: 50.00 mm

Soil	From	To	C	Ø	γ_b	m_v	E
Strata	(m)	(m)	(Kg/cm ²)	(deg)	(g/cc)		
CH	0.00	4.00	0.60	-	1.78	2.00e-02	50.00

CH	4.00	10.00	0.77	-	1.80	1.25e-02	80.00
CH	10.00	15.00	0.90	-	1.90	7.10e-03	140.00

Calculations : Water Table at a depth of 1 m

For Local Shear Failure, Ultimate Bearing Capacity is given by

$$q_d = \frac{2}{3} c N'_c s_c d_c i_c + q (N'_q - 1) s_q d_q i_q + \frac{1}{2} B \gamma N'_\gamma s_\gamma d_\gamma i_\gamma W'$$

Where

N'_c, N'_q, N'_γ are Bearing Capacity Factors from Table-1 [IS:6403-1981],

s_c, s_q, s_γ are Shape Factors,

d_c, d_q, d_γ are Depth Factors,

i_c, i_q, i_γ are Inclination Factors,

c = Cohesion in Kgf/cm²,

q = Effective surcharge at base of Fdn in Kgf/cm²,

B = Width of Fdn in cms,

γ = Bulk unit weight of foundation soil in Kgf/cm³,

W' = Correction factor for location of water table (at a depth of 100 cms)

Safe Bearing Capacity (Considering a Factor of Safety of 3), is given by :

$$q_{safe} = q_d / 3$$

Immediate Settlement in Cohesive Layer from 0 to 4 m (S_i)

$$= p B (1 - \mu^2) I / E$$

Where

p = Foundation Pressure in Kg/cm²

B = Width of footing in cm

μ = Poisson's ratio = 0.5 for clay

I = Influence factor depending on L/B and H_f/B is obtained from Fig 11 [IS

8009 (Part 1)]

E = Young's Modulus of elasticity = 50 Kg/cm²

Settlement in Pre-Compressed Cohesive Layer from 0 to 4 m (S_1)

$$= \Delta p \times m_v \times H$$

Where

Δp = Pressure increment in kg/cm² at a depth 0.75 m below Foundation

[obtained from B-1.3 and Fig 17, IS 8009 Part 1]

$= p \times I_B \times \text{number of Influence Areas}$

m_v = Coefficient of volume compressibility = 0.02 cm²/kg

H = Thickness of compressible stratum from foundation level

Total Settlement

$$S_f = S_i + S_1$$

Applying Correction for Effect of Depth of Foundation

$$S_{fd} = S_f \times \text{Depth Factor}$$

Where

$$\text{Depth Factor} = 0.72 \left(\text{from Fox's Correction Curves for } \sqrt[3]{(L/B)} / D = 1 \text{ and } L/B = 1 \right)$$

Results of Bearing Capacity

Sl No	Width (m)	Depth (m)	q_{safe} T/m ²	Settlement (mm)	Remarks
1	1.00	1.00	10.7	15.4	-
2	1.00	2.00	12.5	14.7	-
3	1.00	3.00	14.3	18.8	-
4	1.00	4.00	20.6	15.5	-
5	1.00	5.00	22.9	16.7	-
6	2.00	1.00	9.8	35.9	-
7	2.00	2.00	10.7	33.7	-
8	2.00	3.00	11.6	27.8	-
9	2.00	4.00	16.0	24.7	-
10	2.00	5.00	17.2	25.0	-
11	3.00	1.00	8.6	49.5	q_{safe} reduced for Settlement Criteria
12	3.00	2.00	10.1	46.9	-
13	3.00	3.00	10.7	36.7	-
14	3.00	4.00	14.5	34.8	-
15	3.00	5.00	15.2	33.7	-
16	4.00	1.00	6.8	49.4	q_{safe} reduced for Settlement Criteria
17	4.00	2.00	8.5	49.7	
18	4.00	3.00	10.3	45.3	-
19	4.00	4.00	13.7	49.8	-
20	4.00	5.00	14.3	49.6	-

21	5.00	1.00	5.8	49.4	q _{safe} reduced for Settlement Criteria
22	5.00	2.00	7.1	49.4	
23	5.00	3.00	8.4	49.6	
24	5.00	4.00	10.3	49.7	
25	5.00	5.00	11.1	49.9	

2.2) Summary Of Pile Capacity Table For Bored Cast-In Situ Pile –(For Structures)

Pile Dia. in mm	Pile Depth* in m	Axial (Comp.) Capacity in T	Axial (Uplift) Capacity in T	Lateral Capacity in T (Fix Head)	Depth of Fixity in m
400	14	36	36	2.6	4
450	14	42	41	3.3	5
500	14	47	46	4.1	5
600	14	58	57	5.9	6

From cut-off level.

Note:

- a. Cut-off level considered at 1.0 m below EGL.

Summary of Pile Capacity Table For Bored Cast-In Situ Pile – (For Solar Panel)

Pile Dia. in mm	Pile Depth* in m	Axial (Comp.) Capacity in T	Axial (Uplift) Capacity in T	Lateral Capacity in T (Free Head) – 5 mm deflection	Depth of Fixity in m
300	1.5	3	2	0.6	3.0
	2.0	3	3	0.6	3.0
	3.0	6	5	0.6	3.0

From cut-off level.

Note:

- a. Cut-off level considered at 1.0 m below EGL.
- b. Top 3 m soil has high swelling potential. Designer should check for this aspect.
Pile capacities provided as per client's requirement.

RESULT TABLE - SUBGRADE SOIL SAMPLE

Sr. No	Test	Result		Test Method
		S. No. 212209955 *Vastan Mines	S. No. 212209956 *Vastan South Mines	
1	Grain Size Analysis			
	Gravel %	04	09	IS 2720 (Part-4) 2015
	Coarse Sand %	06	07	
	Medium Sand %	23	14	
	Fine Sand %	23	25	
	Silt + Clay %	44	45	
2	Atterberg's Limit			
	Liquid Limit in %	73	55	IS 2720 (Part-5) 2015
	Plastic Limit in %	30	29	
	Plasticity Index in %	43	26	
3	I.S. Classification	SC	SC	-
4	Modified Proctor Test			
	Maximum Dry Density in gms/cc	1.64	1.93	IS 2720 (Part-8) 2015
	Optimum Moisture Content in %	19.00	17.00	
5	CBR (Soak) Value in %	1.9	2.5	IS 2720 (Part-16) 2016
6	Free Swell Index in %	67	56	IS 2720 (Part-40) 2016

RESULT TABLE – TRIAL PIT – VASTAN SITE

Sr. No.	Test	Result			Test Method
		S. No. 212209957 *(Trial Pit- 1m)	S. No. 212209958 *(Trial Pit- 2m)	S. No. 212209959 *(Trial Pit- 3m)	
1	Moisture Content in %	22.72	33.46	31.32	IS 2720 (Part-2) 2015
2	Grain Size Analysis Gravel % Coarse Sand % Medium Sand % Fine Sand % Silt + Clay %	04 04 05 10 81	00 05 07 18 70	04 06 05 11 74	IS 2720 (Part-4) 2015
3	Atterberg's Limit Liquid Limit in % Plastic Limit in % Plasticity Index in %	47 23 24	79 34 45	61 29 32	IS 2720 (Part-5) 2015
4	I.S. Classification	CI	CH	CH	-
5	Free Swell Index in %	50	75	64	IS 2720 (Part-40) 2016

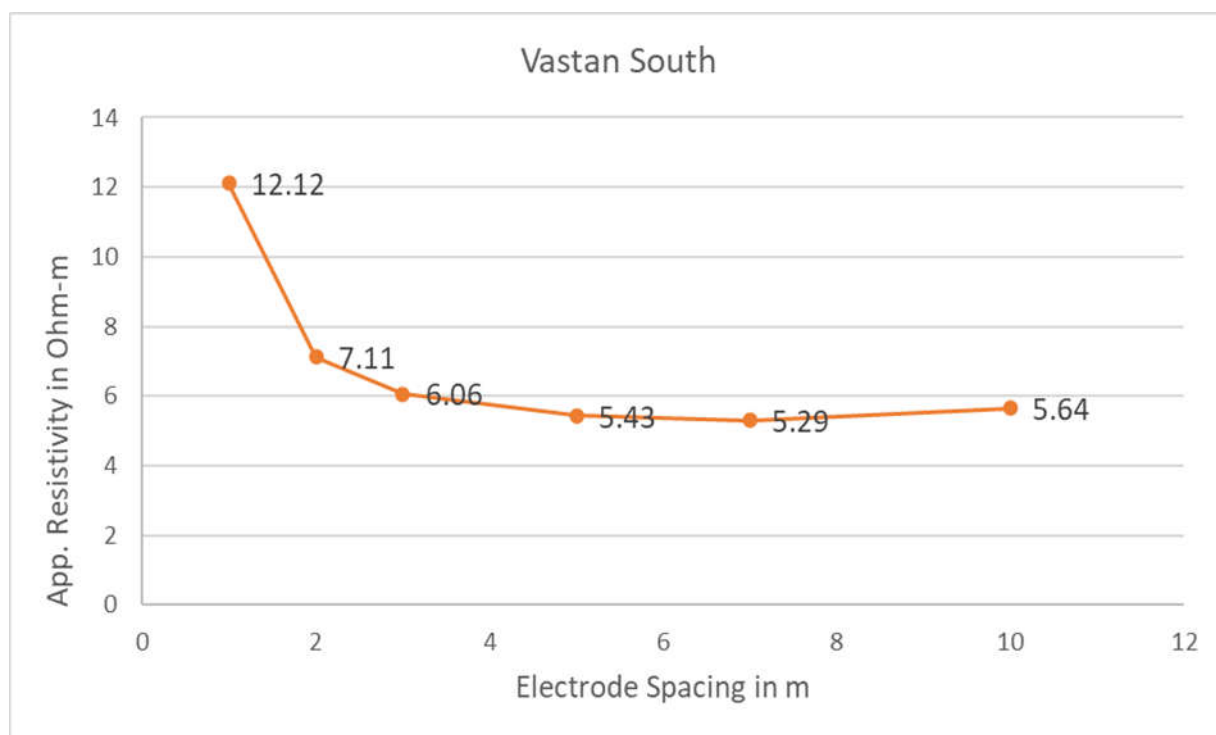
RESULT TABLE – TRIAL PIT – VASTAN SOUTH SITE

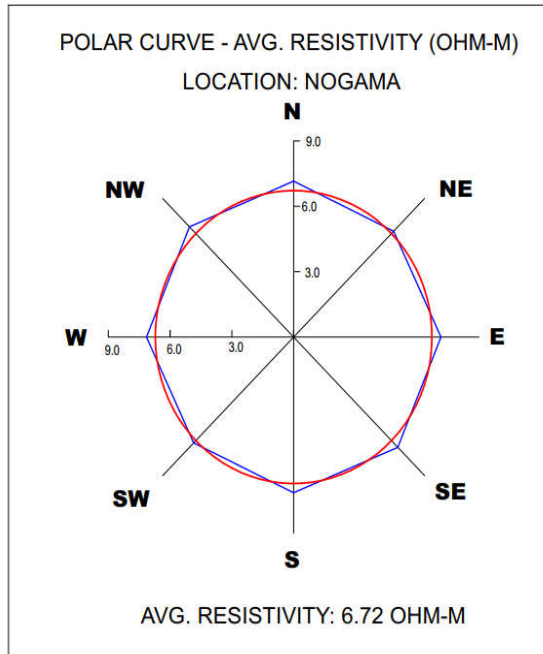
Sr. No.	Test	Result			Test Method
		S. No. 212209960 *(Trial Pit- 1m)	S. No. 212209961 *(Trial Pit- 2m)	S. No. 212209962 *(Trial Pit- 3m)	
1	Moisture Content in %	14.99	12.36	19.98	IS 2720 (Part-2) 2015
2	Grain Size Analysis Gravel % Coarse Sand % Medium Sand % Fine Sand % Silt + Clay %	21 12 18 20 29	30 10 11 17 32	11 11 20 17 41	IS 2720 (Part-4) 2015
3	Atterburg's Limit Liquid Limit in % Plastic Limit in % Plasticity Index in %	48 24 24	45 24 21	59 30 29	IS 2720 (Part-5) 2015
4	I.S. Classification	SC	SC	SC	-
5	Free Swell Index in %	27	27	55	IS 2720 (Part-40) 2016

ELECTRICAL RESISTIVITY TEST RESULTS

ERT-1 (Vastan South)

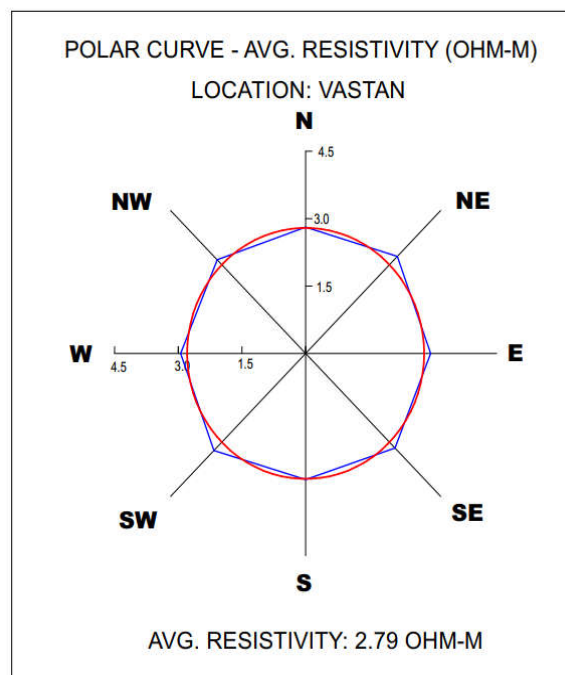
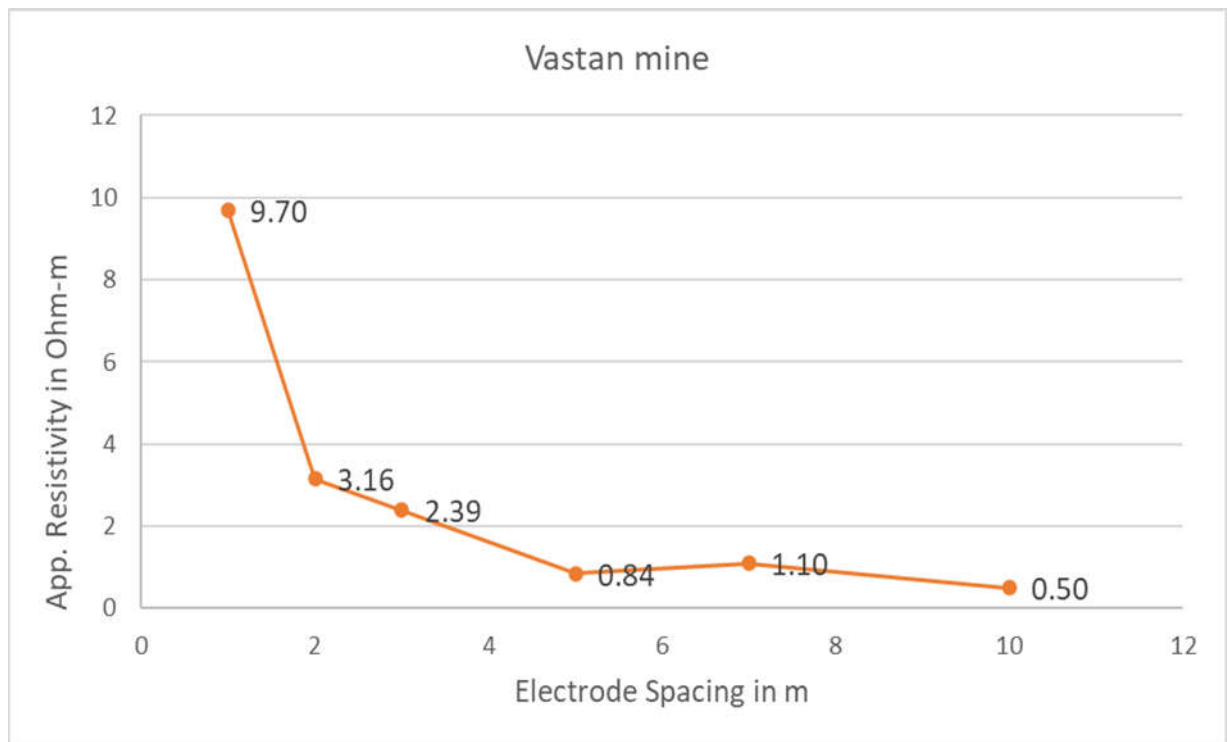
Test Location	Electrode Spacing in m.	N-S		NW-SE		E-W		SW-NE	
		R in Ohm	Apparent Resistivity in ohm-m	R in Ohm	Apparent Resistivity in ohm-m	R in Ohm	Apparent Resistivity in ohm-m	R in Ohm	Apparent Resistivity in ohm-m
Vastan South, N-21°23'20.0", E-73°04'51.0"	1.0	1.88	11.8	1.79	11.2	1.88	11.8	2.17	13.6
	2.0	0.55	7.0	0.59	7.4	0.58	7.3	0.54	6.8
	3.0	0.32	6.0	0.35	6.6	0.32	6.0	0.30	5.6
	5.0	0.16	5.0	0.18	5.6	0.18	5.6	0.18	5.5
	7.0	0.13	5.6	0.12	5.4	0.11	4.7	0.12	5.5
	10.0	0.10	6.0	0.08	4.9	0.09	5.8	0.09	5.9





ERT-2 (Vastan)

Test Location	Electrode Spacing in m.	N-S		NW-SE		E-W		SW-NE	
		R in Ohm	Apparent Resistivity in ohm-m	R in Ohm	Apparent Resistivity in ohm-m	R in Ohm	Apparent Resistivity in ohm-m	R in Ohm	Apparent Resistivity in ohm-m
Vastan mine, N-21°25'45.7", E-73°06'47.5"	1.0	1.48	9.3	1.51	9.5	1.57	9.9	1.61	10.1
	2.0	0.23	2.9	0.26	3.3	0.25	3.1	0.26	3.3
	3.0	0.12	2.3	0.13	2.5	0.12	2.3	0.13	2.5
	5.0	0.03	0.8	0.03	0.9	0.03	0.8	0.03	0.8
	7.0	0.02	1.1	0.03	1.1	0.02	1.1	0.03	1.1
	10.0	0.01	0.5	0.01	0.5	0.01	0.5	0.01	0.5



For Unique Engineering Testing
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I. S. CLASSIFICATION

GW: Well graded gravels, gravel-sand mixture or no fines.

GP: Poorly graded gravels or gravel sand mixture, little or no fines.

GM: Silty gravels, poorly graded gravel-sand-silt mixtures.

GC: Clayey gravels, poorly graded gravel-sand-clay mixtures.

SW: Well-graded sands, gravelly sands; little or no fines.

SP: Poorly graded sands or gravelly sands, little or no fines.

SM: Silty sands, poorly graded sand-silt mixtures.

SC: Clayey sands, poorly graded sand-clay mixtures.

ML: Inorganic silt and very fine sands rock flour; silty or clayey fine sands or clayey silts with non-to low plasticity.

CL: Inorganic clays, gravelly clays, sandy clays, silty clays, lean clays of low plasticity.

OL: organic silts and organic silty clay of low plasticity.

MI: Inorganic silts, silty or clayey fine sands or clayey silts of medium plasticity.

CI: Inorganic clays, gravelly clays, sandy clays, silty clays, lean clays of medium plasticity.

OI: Organic silts and organic silty clays of medium plasticity.

MH: Inorganic silt of highly compressibility, micaceous or diatomaceous fine sandy or silty soils, elastic silts.

CH: Inorganic clays of high plasticity, fat clays.

OH: Organic Clays of medium to high plasticity.

Pt: Peat and other highly organic soil with very high compressibility.

TABLE - 3
RESULTS OF STANDARD PENETRATION TEST

Project No. 2122222

Bore Hole No. 1

RL in mts.	No. of Blows for Penetration			Ns (Blows /300 mm)	Nc(Corrected value of Ns)	N. M. C. (in %)
	0 - 150 mm	150 - 300 mm	300 - 450 mm			
44.23	03	04	06	10	10	24.78
43.23						25.90
42.23	03	07	08	15	15	26.01
41.23						26.54
40.23	05	08	10	18	18	24.93
39.23						27.10
37.73	07	09	14	23	23	28.67
36.23						29.64
35.23	08	11	17	28	28	28.30

TABLE - 5
PARTICLE SIZE ANALYSIS

Project No. : 2122222

Bore Hole No. : 1

Soil Strata	RL Sample Type	Gravel in % (>4.75 mm)	Sand in %			Silt in % + Clay in %
			(4.75 - 2 mm)	(2mm - 425μ)	(425 - 75 μ)	
45.23 to 43.23	44.23/S	4	29	30	6	31
43.23 to 41.23	43.23/U	4	17	8	13	30 + 28
43.23 to 41.23	42.23/S	0	12	18	18	52
41.23 to 39.23	41.23/U	20	20	10	15	22 + 13
41.23 to 39.23	40.23/S	3	17	20	20	40
39.23 to 34.73	39.23/U	1	5	2	8	36 + 48
39.23 to 34.73	37.73/S	0	4	5	12	79
39.23 to 34.73	36.23/U	2	10	9	11	32 + 36
39.23 to 34.73	35.23/S	0	5	9	4	82

TABLE - 7A
UNCONFINED COMPRESSION TEST TABLE

Project No. : 2122222

Bore Hole No. : 1

RL Sample (mts.)	Type of Sample (UD/Rm)	Qu (Kg/cm ²)	Cu (Kg/cm ²)
41.23	UD(Undisturbed)	1.76	
39.23	UD(Undisturbed)	2.34	
36.23	UD(Undisturbed)	3.17	

TABLE - 7B

TRIAXIAL SHEAR TEST

Project No. : 2122222

Bore Hole No. : 1

RL Sample	Sample Type (UD/Rm)	Normal Stress at Failure	Cell Pressure (Kg/cm ²)	Pore Pressure (Kg/cm ²)	Shear Values from Graph	
					Cuu (Kg/cm ²)	Øuu (Kg/cm ²)
43.23	Undisturbed	2.67	0.50	0.00	0.75	11.64
	Undisturbed	3.27	1.00	0.00		
	Undisturbed	4.93	2.00	0.00		

MOHR CIRCLE

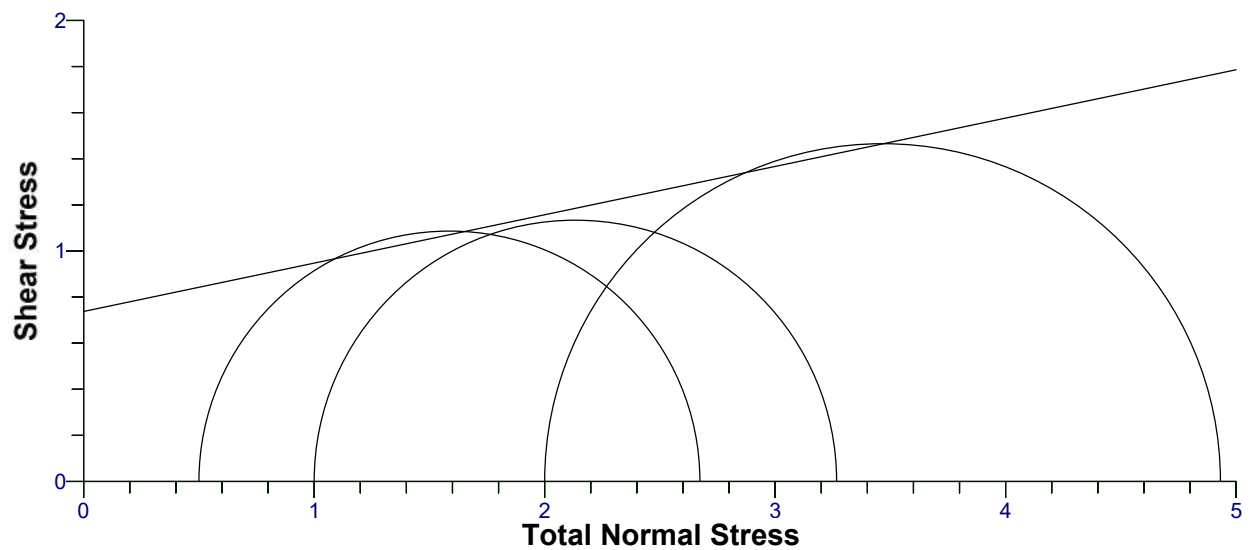


TABLE - 8
CONSOLIDATION TEST

Project No. : 2122222

RL : 41.23 mt

Specific Gravity : 2.93

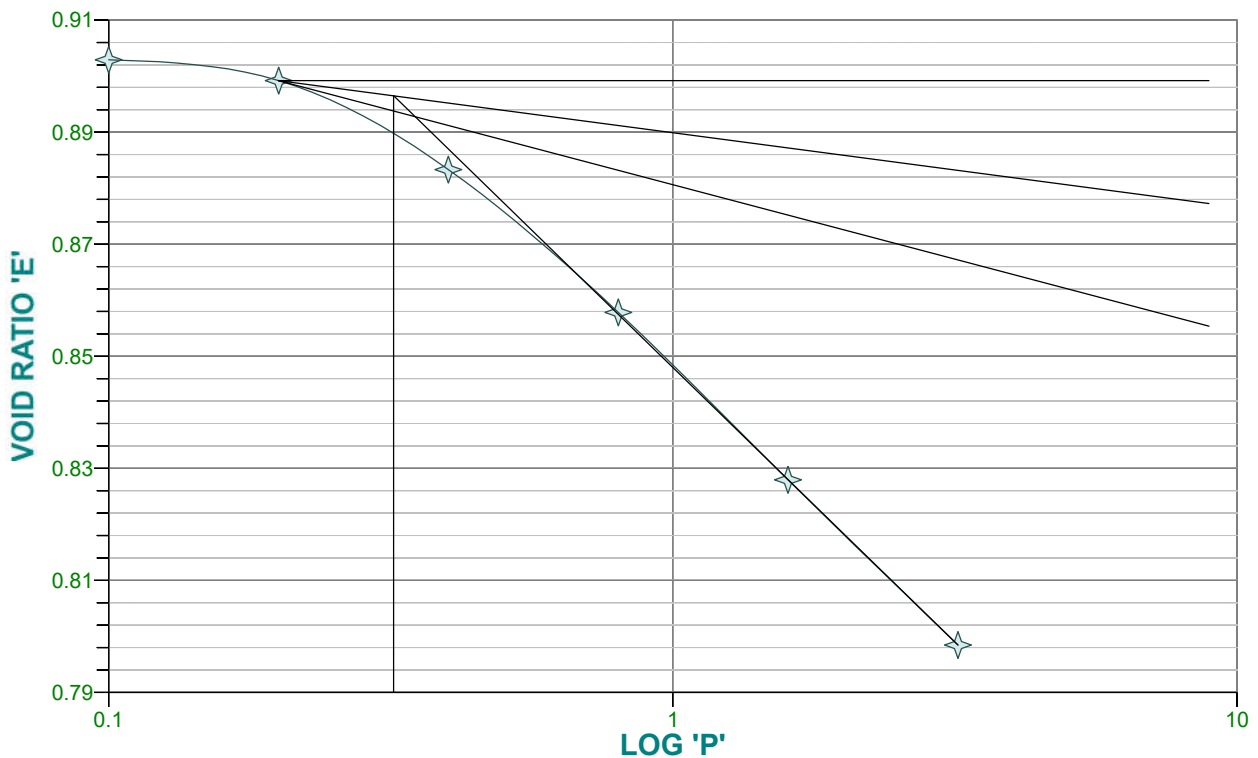
Bore Hole No. : 1

Final Moisture Content 28.16 %

Pressure in Kg/cm ²	Final Readings	Change of Height in mm	Height of Sample in mm	Change in Ht. in mm	Void Ratio	Coeff. of Vol. Change Mv (cm ² /Kg)	T90 in mins	Coeff. of Consolidation Cv (cm ² /sec)
0.10	10.769	-0.0390	20.0000	-0.0037	0.9029	1.9500e-02		
0.20	10.730	-0.1670	19.9610	-0.0159	0.8992	4.1832e-02		
0.40	10.563	-0.2680	19.7940	-0.0255	0.8833	3.3849e-02		
0.80	10.295	-0.3140	19.5260	-0.0299	0.8578	2.0101e-02		
1.60	9.981	-0.3100	19.2120	-0.0295	0.8280	1.0085e-02		
3.20	9.671	0.2120	18.9020	0.0202	0.7985	4.6732e-03		
0.80	9.883	0.0680	19.1140	0.0065	0.8186	5.0823e-03		
0.10	9.951		19.1820		0.8251			

Pre-Consolidation Pressure in kg/cm²: 0.33

Cc: 0.09



SUMMARY OF GEOTECHNICAL EXPLORATIONS

Project No. :2122222				Project : GIPCL																								
Bore Hole No. :1				Bore Hole Started on 23-01-22 Completed on : 23-01-22										Depth of Water Table : Below Termination Level														
Method of Drilling :ROTARY DRILLING				Diameter of Bore Hole : 150 mm					R. L. of Ground Level :45.23 mt					Location of Bore Hole :N-2365935.75, E-300710.89														
RL in metres	I. S. Classi- fication	Visual Soil Description	Field Test /Samples		Ns No. of Blows per 300 mm	Rock Properties		Natural Moist. Content %	Density (in gms/cc)		Spec- ific Gra- vity	Particle Size Analysis			Atterberg Limits			Shrinkage Lim. %	Free swell Indx %	(VASTAN SOUTH) Shear Properties			Additional Tests or Remarks					
			SPT VST	UDS DS		C.R. %	RQD %		Bulk	Dry		Gr. %	Sn %	Silt+ Clay	LL %	PL %	PI %			Test Type	C (Kg/ cm²)	Ø in Deg.						
45.23	SC	BLACK STIFF PLASTIC CLAYEY SAND		DS																								
44.23		SPT	DS	10			24.78					4	65	31	60	29	31		64									
43.23	CH	REDDISH STIFF HIGH PLASTIC CLAY WITH SAND		UDS				25.90	1.85	1.47	2.97	4	38	30+28	67	33	34		50	Tuu	0.75	11.6°						
42.23		SPT	DS	15			26.01					0	48	52	62	24	38		58									
41.23	SC	REDDISH VERY STIFF PLASTIC CLAYEY SAND WITH GRAVEL		UDS				26.54	1.89	1.50	2.93	20	45	22+13	49	23	26			UCC								
40.23		SPT	DS	18			24.93					3	57	40	39	23	16											
39.23	CH	REDDISH VERY STIFF HIGH PLATIC CLAY WITH SAND		UDS				27.10	1.91	1.51	2.84	1	15	36+48	83	33	50			UCC								
37.73		SPT	DS	23			28.67					0	21	79	76	33	43											
36.23			UDS				29.64	1.97	1.52	3.14	2	30	32+36	59	30	29			UCC									
35.23		SPT	DS	28			28.30					0	18	82	55	28	27											
34.73		TERMINATION																										
SPT - Standard Penetration Test		UDS - Undisturbed Sample		DS - Disturbed Sample		VST - Vane Shear Test		Gr - Gravel		Sn - Sand		LL - Liquid Limit		PL - Plastic Limit		PI - Plasticity Index		C, Ø - Shear Parameters		Cv - Coeff. of Consolidation		Mv - Coeff. of Volume Change		C.R. - Core Recovery		RQD - Rock Quality Designation		

UNIQUE ENGINEERING TESTING AND ADVISORY SERVICES

216,Road No. 6-F,New Estate, Udhna,Surat-394210, Gujarat, India

TABLE - 3
RESULTS OF STANDARD PENETRATION TEST

Project No. 2122222

Bore Hole No. 2

RL in mts.	No. of Blows for Penetration			Ns (Blows /300 mm)	Nc(Corrected value of Ns)	N. M. C. (in %)
	0 - 150 mm	150 - 300 mm	300 - 450 mm			
48.02	02	07	09	16	25	19.98
47.02						18.63
46.02	06	09	14	23	23	19.38
45.02						19.18
44.02	06	09	16	25	25	22.47
43.02						23.86
41.52	10	13	20	33	33	27.00
40.02						26.29
39.02	14	19	25	44	44	26.67

TABLE - 5
PARTICLE SIZE ANALYSIS

Project No. : 2122222

Bore Hole No. : 2

Soil Strata	RL Sample Type	Gravel in % (>4.75 mm)	Sand in %			Silt in % + Clay in %
			(4.75 - 2 mm)	(2mm - 425μ)	(425 - 75 μ)	
49.016 to 48.016	49.02/D	19	20	15	7	39
48.016 to 47.016	48.02/S	27	35	26	3	9
47.016 to 41.516	47.02/U	8	35	17	5	22 + 13
47.016 to 41.516	46.02/S	7	30	23	6	34
47.016 to 41.516	45.02/U	5	26	19	10	18 + 22
47.016 to 41.516	44.02/S	8	23	25	8	36
47.016 to 41.516	43.02/U	8	22	18	10	17 + 25
41.516 to 38.516	41.52/S	1	11	14	14	60
41.516 to 38.516	40.02/U	2	9	10	10	31 + 38
41.516 to 38.516	39.02/S	1	15	17	16	51

TABLE - 7A
UNCONFINED COMPRESSION TEST TABLE

Project No. : 2122222

Bore Hole No. : 2

RL Sample (mts.)	Type of Sample (UD/Rm)	Qu (Kg/cm²)	Cu (Kg/cm²)
47.02	UD(Undisturbed)	0.92	
43.02	UD(Undisturbed)	2.18	
40.02	UD(Undisturbed)	2.83	

TABLE - 7B

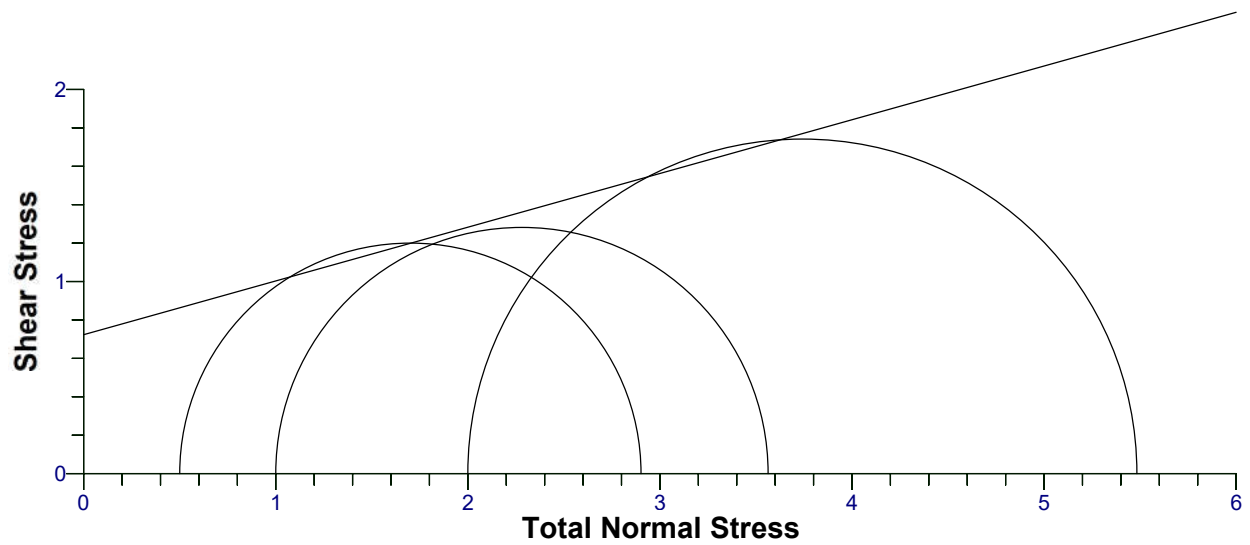
TRIAXIAL SHEAR TEST

Project No. : 2122222

Bore Hole No. : 2

RL Sample	Sample Type (UD/Rm)	Normal Stress at Failure	Cell Pressure (Kg/cm ²)	Pore Pressure (Kg/cm ²)	Shear Values from Graph	
					Cuu (Kg/cm ²)	Øuu (Kg/cm ²)
45.02	Undisturbed	2.90	0.50	0.00	0.73	15.95
	Undisturbed	3.56	1.00	0.00		
	Undisturbed	5.48	2.00	0.00		

MOHR CIRCLE



SUMMARY OF GEOTECHNICAL EXPLORATIONS

Project No. :2122222				Project : GIPCL																									
Bore Hole No. :2				Bore Hole Started on 21-01-22 Completed on : 21-01-22										Depth of Water Table : Below Termination Level															
Method of Drilling :ROTARY DRILLING				Diameter of Bore Hole : 150 mm					R. L. of Ground Level :49.02 mt					Location of Bore Hole :N-2366409.57, E-300954.22															
RL in metres	I. S. Classi- fication	Visual Soil Description	Field Test /Samples		Ns No. of Blows per 300 mm	Rock Properties		Natural Moist. Content %	Density (in gms/cc)		Spec- ific Gra- vity	Particle Size Analysis			Atterberg Limits			Shrinkage Lim. %	Free swell Indx %	Shear Properties			Additional Tests or Remarks						
			SPT VST	UDS DS		C.R. %	RQD %		Bulk	Dry		Gr. %	Sn %	Silt+ Clay	LL %	PL %	PI %			Test Type	C (Kg/ cm²)	Ø in Deg.							
49.02	SC	REDDISH YELLOW PLASTIC CLAYEY SAND WITH GRAVEL		DS								19	42	39	35	22	13		30										
48.02	SW-SM	BROWNISH SILT WITH MEDIUM TO COARSE SAND AND GRAVEL	SPT	DS	16			19.98				27	64	9		-	-												
47.02		YELLOW VERY STIFF PLASTIC CLAYEY SAND		UDS				18.63	1.85	1.56	2.77	8	57	22+13	51	27	24		55	UCC									
46.02			SPT	DS	23			19.38				7	59	34	55	28	27		41										
45.02				UDS				19.18	1.91	1.60	2.78	5	55	18+22	63	31	32			Tuu	0.73	16.0°							
44.02	SC		SPT	DS	25			22.47				8	56	36	63	31	32												
43.02				UDS				23.86	1.98	1.60	2.80	8	50	17+25	62	30	32			UCC									
41.52		REDDISH HARD HIGH PLASTIC CLAY WITH SAND	SPT	DS	33			27.00				1	39	60	53	26	27												
40.02	CH			UDS				26.29	1.97	1.56	2.99	2	29	31+38	58	29	29			UCC									
39.02			SPT	DS	44			26.67				1	48	51	52	26	26												
38.52		TERMINATION																											
SPT - Standard Penetration Test		UDS - Undisturbed Sample		DS - Disturbed Sample		VST - Vane Shear Test		Gr - Gravel		Sn - Sand		LL - Liquid Limit		PL - Plastic Limit		PI - Plasticity Index		C, Ø - Shear Parameters		Cv - Coeff. of Consolidation			Mv - Coeff. of Volume Change			C.R. - Core Recovery		RQD - Rock Quality Designation	

UNIQUE ENGINEERING TESTING AND ADVISORY SERVICES

216,Road No. 6-F,New Estate, Udhna,Surat-394210, Gujarat, India

TABLE - 3
RESULTS OF STANDARD PENETRATION TEST

Project No. 2122222

Bore Hole No. 3

RL in mts.	No. of Blows for Penetration			Ns (Blows /300 mm)	Nc(Corrected value of Ns)	N. M. C. (in %)
	0 - 150 mm	150 - 300 mm	300 - 450 mm			
42.17	03	05	07	12	12	19.23
41.17	10	10	13	23	30	13.72
40.17	30	50/200	-	50/200	59/200	19.92
39.17						22.69
37.17	07	11	18	29	27	15.68
34.17	38	58/200	-	58/200	58/200	28.24
33.17	50/150	-	-	50/150	50/150	35.88

TABLE - 5
PARTICLE SIZE ANALYSIS

Project No. : 2122222

Bore Hole No. : 3

Soil Strata	RL Sample Type	Gravel in % (>4.75 mm)	Sand in %			Silt in % + Clay in %
			(4.75 - 2 mm)	(2mm - 425μ)	(425 - 75 μ)	
43.165 to 41.165	43.17/D	2	6	4	9	79
43.165 to 41.165	42.17/S	0	10	9	10	71
41.165 to 40.165	41.17/S	63	13	8	7	9
40.165 to 34.165	40.17/S	5	58	19	2	16
40.165 to 34.165	39.17/D	2	31	46	6	15
40.165 to 34.165	37.17/S	5	22	23	26	24
34.165 to 32.665	34.17/S	5	8	8	12	67
34.165 to 32.665	33.17/S	0	4	1	11	84

SUMMARY OF GEOTECHNICAL EXPLORATIONS

Project No. :2122222				Project : GIPCL																			
Bore Hole No. :3				Bore Hole Started on :19-01-22 Completed on : 20-01-22										Depth of Water Table : Below Termination Level									
Method of Drilling :SHELL & AUGER				Diameter of Bore Hole : 150 mm					R. L. of Ground Level :43.17 mt					Location of Bore Hole :N-2366995.48, E-301486.95									
RL in metres	I. S. Classi- fication	Visual Soil Description	Field Test /Samples		Ns No. of Blows per 300 mm	Rock Properties		Natural Moist. Content %	Density (in gms/cc)		Speci- fic Gra- vity	Particle Size Analysis			Atterberg Limits			Shrinkage Lim. %	Free swell Indx %	(VASTAN SOUTH) Shear Properties			Additional Tests or Remarks
			SPT VST	UDS DS		C.R. %	RQD %		Bulk	Dry		Gr. %	Sn %	Silt+ Clay	LL %	PL %	PI %			Test Type	C (Kg/ cm²)	Ø in Deg.	
43.17	CH	BLACK STIFF HIGH PLASTIC CLAY WITH SAND		DS								2	19	79	52	28	24		43				
42.17		SPT	DS	12			19.23				0	29	71	64	28	36		50					
41.17	GW-GM	YELLOW SANDY GRAVEL (HIGHLY WEATHERED ROCK)	SPT	DS	23			13.72				63	28	9		-	-						
40.17		SPT	DS	50/200			19.92				5	79	16	24	-	-							
39.17	SM	YELLOW DENSE SILTY MEDIUM TO COARSE SAND WITH BOULDERS		DS				22.69				2	83	15	23	-	-						
38.17			DS																				
37.17		SPT	DS	29			15.68				5	71	24	27	-	-							
35.67			DS																				
34.17	CH	YELLOW CEMENTED HIGH PLASTIC CLAY WITH SAND	SPT	DS	58/200			28.24				5	28	67	71	31	40						
33.17		SPT	DS	50/150			35.88				0	16	84	74	32	42							
32.67		TERMINATION																					
SPT - Standard Penetration Test			DS - Disturbed Sample			Gr - Gravel			LL - Liquid Limit			PI - Plasticity Index			Cv - Coeff. of Consolidation			C.R. - Core Recovery					
UDS - Undisturbed Sample			VST - Vane Shear Test			Sn - Sand			PL - Plastic Limit			C, Ø - Shear Parameters			Mv - Coeff. of Volume Change			RQD - Rock Quality Designation					

UNIQUE ENGINEERING TESTING AND ADVISORY SERVICES

216,Road No. 6-F,New Estate, Udhna,Surat-394210, Gujarat, India

TABLE - 3
RESULTS OF STANDARD PENETRATION TEST

Project No. 2122222

Bore Hole No. 4

RL in mts.	No. of Blows for Penetration			Ns (Blows /300 mm)	Nc(Corrected value of Ns)	N. M. C. (in %)
	0 - 150 mm	150 - 300 mm	300 - 450 mm			
53.81	02	04	09	13	13	26.45
52.81						23.10
51.81	03	05	07	12	12	24.30
50.81						24.51
49.81	05	06	09	15	15	25.25
48.81						26.82
47.31	03	04	06	10	10	24.57
45.81						28.87
44.31	04	06	08	14	14	29.78
42.81	05	08	09	17	17	27.62
41.31						26.74
39.81	07	09	11	20	20	27.15

TABLE - 5
PARTICLE SIZE ANALYSIS

Project No. : 2122222

Bore Hole No. : 4

Soil Strata	RL Sample Type	Gravel in % (>4.75 mm)	Sand in %			Silt in % + Clay in %
			(4.75 - 2 mm)	(2mm - 425μ)	(425 - 75 μ)	
54.81 to 51.81	54.81/D	1	5	13	10	71
54.81 to 51.81	53.81/S	3	4	14	15	64
54.81 to 51.81	52.81/U	0	6	5	12	34 + 43
51.81 to 48.81	51.81/S	0	5	2	15	78
51.81 to 48.81	50.81/U	0	5	3	15	37 + 40
51.81 to 48.81	49.81/S	0	0	8	13	79
48.81 to 42.81	48.81/U	0	6	8	16	26 + 44
48.81 to 42.81	47.31/S	0	10	11	5	74
48.81 to 42.81	45.81/U	0	4	3	9	23 + 61
48.81 to 42.81	44.31/S	0	5	6	9	80
42.81 to 39.31	42.81/S	0	4	30	11	55
42.81 to 39.31	41.31/U	0	6	4	7	26 + 57
42.81 to 39.31	39.81/S	0	5	8	5	82

TABLE - 7A
UNCONFINED COMPRESSION TEST TABLE

Project No. : 2122222

Bore Hole No. : 4

RL Sample (mts.)	Type of Sample (UD/Rm)	Qu (Kg/cm ²)	Cu (Kg/cm ²)
52.81	UD(Undisturbed)	0.99	
48.81	UD(Undisturbed)	1.23	
45.81	UD(Undisturbed)	0.94	
41.31	UD(Undisturbed)	1.65	

TABLE - 7B

TRIAXIAL SHEAR TEST

Project No. : 2122222

Bore Hole No. : 4

RL Sample	Sample Type (UD/Rm)	Normal Stress at Failure	Cell Pressure (Kg/cm ²)	Pore Pressure (Kg/cm ²)	Shear Values from Graph	
					Cuu (Kg/cm ²)	Øuu (Kg/cm ²)
50.81	Undisturbed	2.47	0.50	0.00	0.73	11.34
	Undisturbed	3.33	1.00	0.00		
	Undisturbed	4.71	2.00	0.00		

MOHR CIRCLE

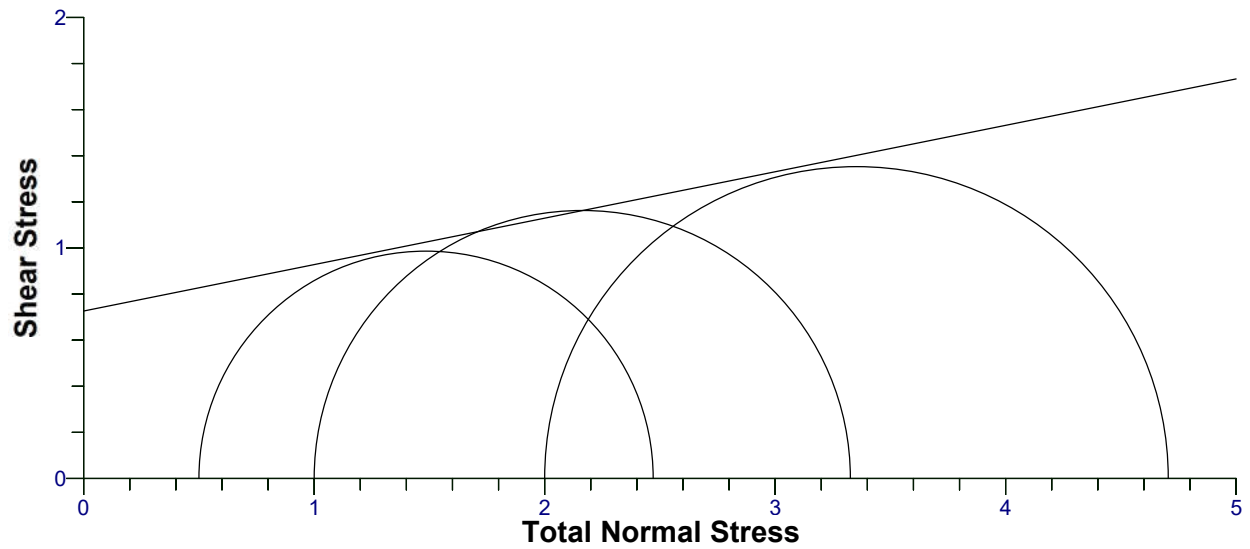


TABLE - 8
CONSOLIDATION TEST

Project No. : 2122222

Bore Hole No. : 4

RL : 50.81 mt

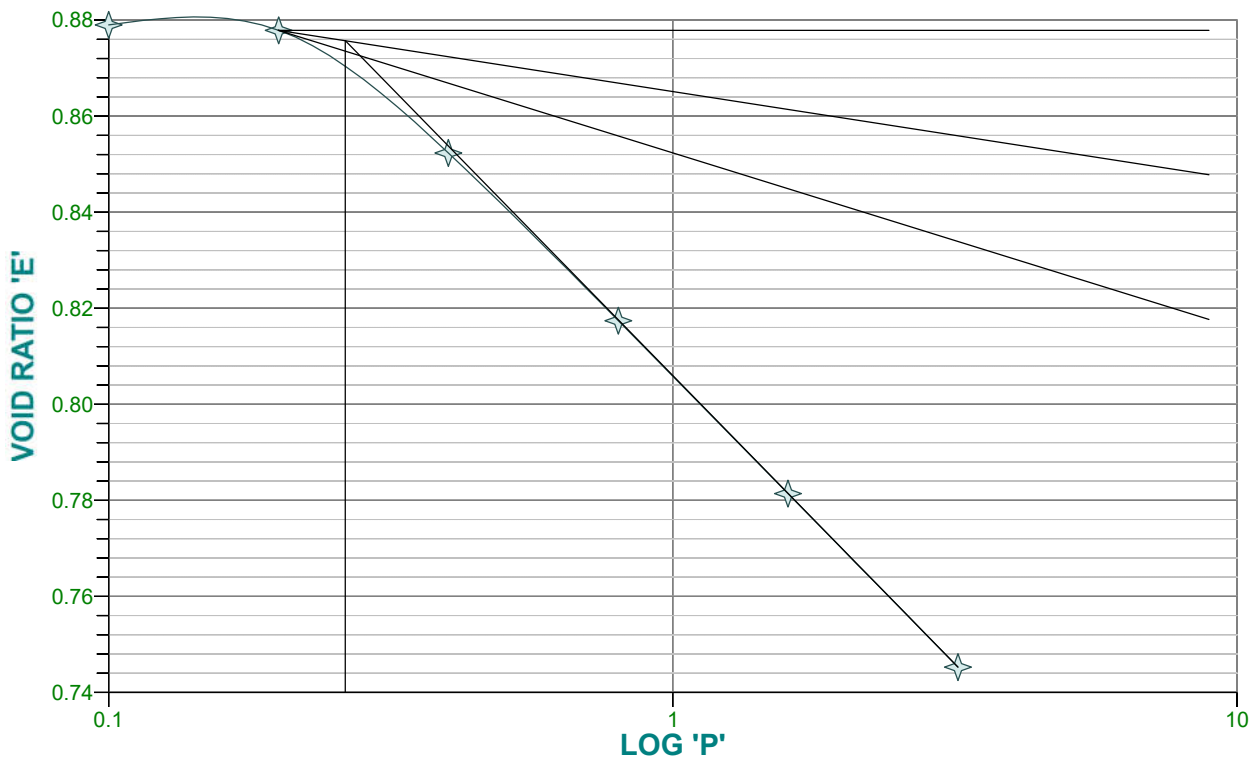
Specific Gravity : 2.93

Final Moisture Content 26.72 %

Pressure in Kg/cm ²	Final Readings	Change of Height in mm	Height of Sample in mm	Change in Ht. in mm	Void Ratio	Coeff. of Vol. Change Mv (cm ² /Kg)	T90 in mins	Coeff. of Consolidation Cv (cm ² /sec)
0.10	9.851	-0.0120	20.0000	-0.0011	0.8790	6.0000e-03		
0.20	9.839	-0.2720	19.9880	-0.0256	0.8779	6.8041e-02		
0.40	9.567	-0.3720	19.7160	-0.0349	0.8523	4.7170e-02		
0.80	9.195	-0.3830	19.3440	-0.0360	0.8174	2.4749e-02		
1.60	8.812	-0.3850	18.9610	-0.0362	0.7814	1.2691e-02		
3.20	8.427	0.2670	18.5760	0.0251	0.7452	5.9889e-03		
0.80	8.694	0.1450	18.8430	0.0136	0.7703	1.0993e-02		
0.10	8.839		18.9880		0.7839			

Pre-Consolidation Pressure in kg/cm²: 0.26

Cc: 0.12



SUMMARY OF GEOTECHNICAL EXPLORATIONS

Project No. :2122222				Project : GIPCL																				
Bore Hole No. :4				Bore Hole Started on :24-01-22 Completed on : 25-01-22										Depth of Water Table : Below Termination Level										
Method of Drilling :ROTARY DRILLING				Diameter of Bore Hole : 150 mm R. L. of Ground Level :54.81 mt										Location of Bore Hole :N-2370585.72, E-304656.24										
RL in metres	I. S. Classi- fication	Visual Soil Description	Field Test /Samples		Ns No. of Blows per 300 mm	Rock Properties		Natural Moist. Content %	Density (in gms/cc)		Spe- cific Gra- vity	Particle Size Analysis			Atterberg Limits			Shrinkage Lim. %	Free Swell Indx %	Shear Properties (VASTAN)			Additional Tests or Remarks	
			SPT VST	UDS DS		C.R. %	RQD %		Bulk	Dry		Gr. %	Sn %	Silt+ Clay	LL %	PL %	PI %			Test Type	C (Kg/ cm²)	Ø in Deg.		
54.81	CH	YELLOWSTIFF HIGH PLASTIC CLAY WITH SAND(FILLING)		DS								1	28	71	70	33	37		50					
53.81			SPT	DS	13			26.45				3	33	64	56	28	28		38					
52.81				UDS				23.10	1.79	1.46	2.84	0	23	34+43	69	33	36		56	UCC				
51.81	CH	BLACK STIFF HIGH PLASTIC CLAY WITH SAND	SPT	DS	12			24.30				0	22	78	63	31	32							
50.81				UDS				24.51	1.84	1.48	2.93	0	23	37+40	59	30	29			Tuu	0.73	11.3°		
49.81			SPT	DS	15			25.25				0	21	79	63	30	33							
48.81	CH	REDDISH STIFF HIGH PLASTIC CLAY WITH SAND		UDS				26.82	1.89	1.49	2.84	0	30	26+44	72	33	39			UCC				
47.31			SPT	DS	10			24.57				0	26	74	82	36	46							
45.81				UDS				28.87	1.84	1.43	2.87	0	16	23+61	86	37	49			UCC				
44.31	CH	BLACK STIFF HIGH PLASTIC CLAY	SPT	DS	14			29.78				0	20	80	85	35	50							
42.81			SPT	DS	17			27.62				0	45	55	68	31	37							
41.31				UDS				26.74	1.91	1.50	2.88	0	17	26+57	77	34	43			UCC				
39.81	CH	TERMINATION	SPT	DS	20			27.15				0	18	82	65	31	34							
39.31																								
SPT - Standard Penetration Test		DS - Disturbed Sample		Gr - Gravel		LL - Liquid Limit		PI - Plasticity Index		Cv - Coeff. of Consolidation		C.R. - Core Recovery		Mv - Coeff. of Volume Change		RQD - Rock Quality Designation								
UDS - Undisturbed Sample		VST - Vane Shear Test		Sn - Sand		PL - Plastic Limit		C, Ø - Shear Parameters																

UNIQUE ENGINEERING TESTING AND ADVISORY SERVICES

216,Road No. 6-F,New Estate, Udhna,Surat-394210, Gujarat, India

TABLE - 3
RESULTS OF STANDARD PENETRATION TEST

Project No. 2122222

Bore Hole No. 5

RL in mts.	No. of Blows for Penetration			Ns (Blows /300 mm)	Nc(Corrected value of Ns)	N. M. C. (in %)
	0 - 150 mm	150 - 300 mm	300 - 450 mm			
48.85	03	03	04	07	07	24.62
47.85						23.90
46.85	03	06	05	11	11	23.93
45.85						24.12
44.85	06	09	11	20	20	25.68
43.85						25.89
42.35	07	10	13	23	23	25.29
40.85						25.65
39.35	06	09	12	21	21	25.19
37.85						26.16
36.35	07	11	15	26	26	26.78
34.85	06	10	17	27	27	26.84

TABLE - 5
PARTICLE SIZE ANALYSIS

Project No. : 2122222

Bore Hole No. : 5

Soil Strata	RL Sample Type	Gravel in % (>4.75 mm)	Sand in %			Silt in % + Clay in %
			(4.75 - 2 mm)	(2mm - 425μ)	(425 - 75 μ)	
49.85 to 47.85	49.85/D	0	4	12	12	72
49.85 to 47.85	48.85/S	0	6	6	4	84
47.85 to 44.85	47.85/U	0	0	5	7	41 + 47
47.85 to 44.85	46.85/S	0	6	6	5	83
47.85 to 44.85	45.85/U	1	5	6	5	41 + 42
44.85 to 37.85	44.85/S	1	7	1	9	82
44.85 to 37.85	43.85/U	4	8	4	4	39 + 41
44.85 to 37.85	42.35/S	0	6	6	9	79
44.85 to 37.85	40.85/U	3	4	3	7	44 + 39
44.85 to 37.85	39.35/S	0	5	5	6	84
37.85 to 34.35	37.85/U	0	6	2	6	30 + 56
37.85 to 34.35	36.35/S	0	6	5	6	83
37.85 to 34.35	34.85/S	0	6	2	3	89

TABLE - 7A
UNCONFINED COMPRESSION TEST TABLE

Project No. : 2122222Bore Hole No. : 5

RL Sample (mts.)	Type of Sample (UD/Rm)	Qu (Kg/cm²)	Cu (Kg/cm²)
47.85	UD(Undisturbed)	1.02	
43.85	UD(Undisturbed)	2.06	
40.85	UD(Undisturbed)	2.38	
37.85	UD(Undisturbed)	3.05	

TABLE - 7B

TRIAXIAL SHEAR TEST

Project No. : 2122222

Bore Hole No. : 5

RL Sample	Sample Type (UD/Rm)	Normal Stress at Failure	Cell Pressure (Kg/cm ²)	Pore Pressure (Kg/cm ²)	Shear Values from Graph	
					Cuu (Kg/cm ²)	Øuu (Kg/cm ²)
45.85	Undisturbed	2.32	0.50	0.00	0.76	6.49
	Undisturbed	2.97	1.00	0.00		
	Undisturbed	4.21	2.00	0.00		

MOHR CIRCLE

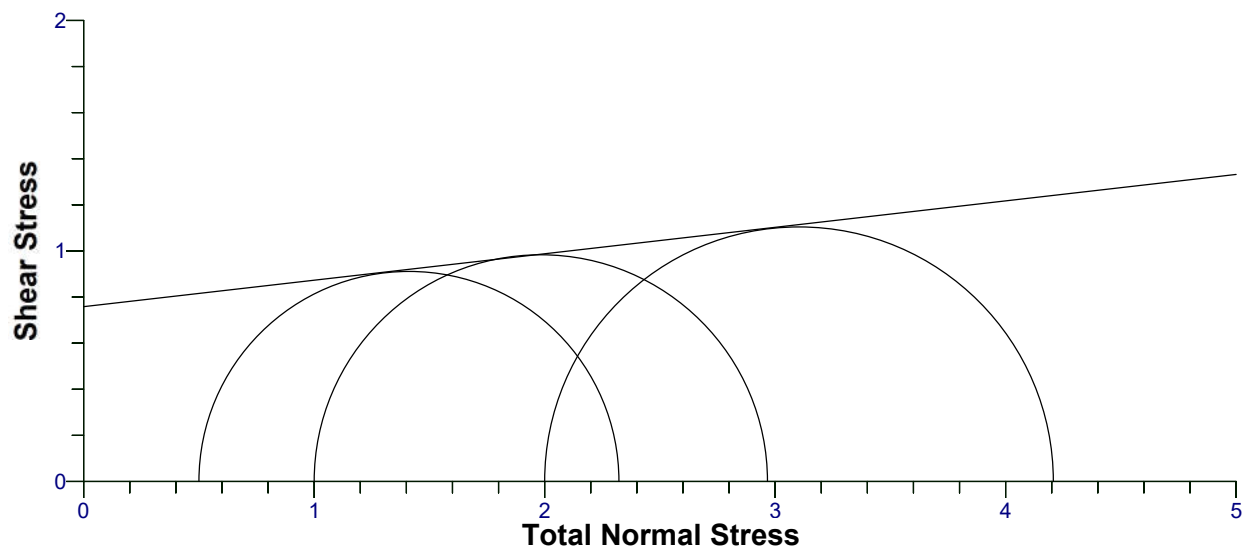


TABLE - 8
CONSOLIDATION TEST

Project No. : 2122222

RL : 43.85 mt

Specific Gravity : 2.93

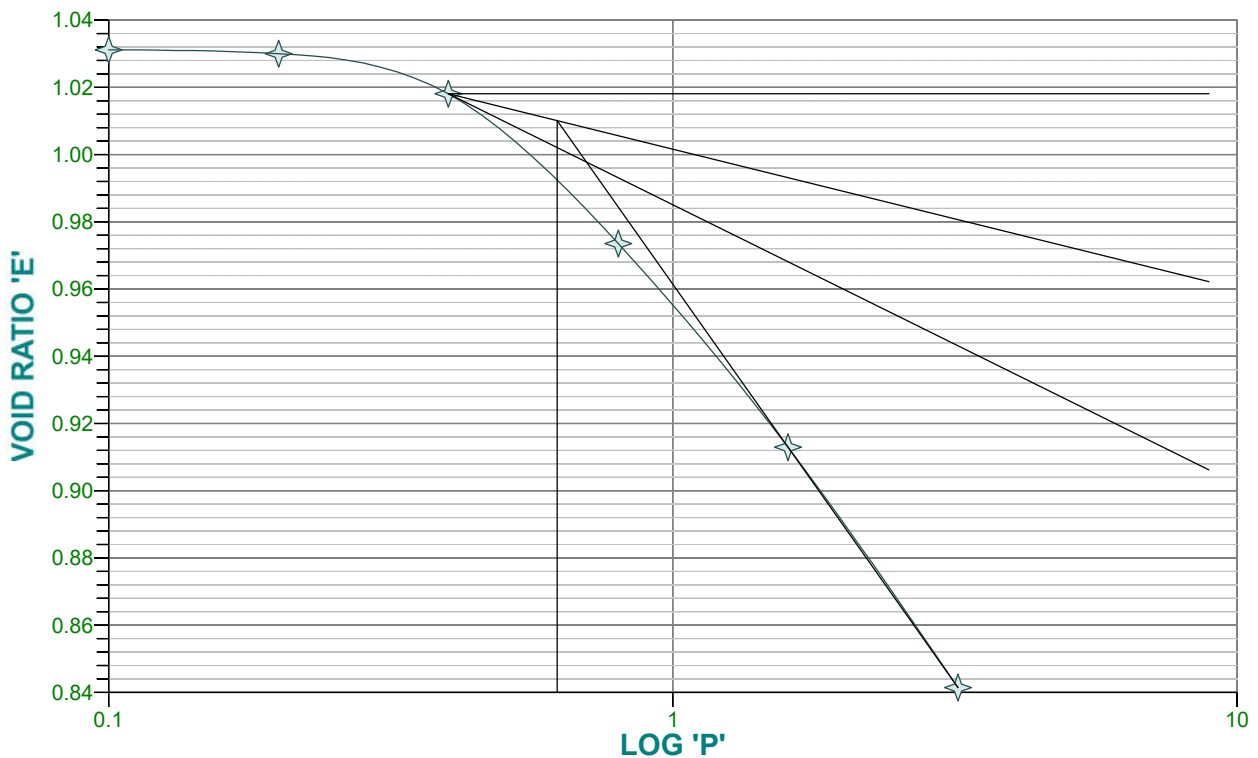
Bore Hole No. : 5

Final Moisture Content 29.14 %

Pressure in Kg/cm ²	Final Readings	Change of Height in mm	Height of Sample in mm	Change in Ht. in mm	Void Ratio	Coeff. of Vol. Change Mv (cm ² /Kg)	T90 in mins	Coeff. of Consolidation Cv (cm ² /sec)
0.10	8.853	-0.0110	20.0000	-0.0011	1.0312	5.4999e-03		
0.20	8.842	-0.1180	19.9890	-0.0120	1.0300	2.9516e-02		
0.40	8.724	-0.4390	19.8710	-0.0446	1.0181	5.5231e-02		
0.80	8.285	-0.5960	19.4320	-0.0605	0.9735	3.8339e-02		
1.60	7.689	-0.7040	18.8360	-0.0715	0.9129	2.3360e-02	2.06	2.8447e-03
3.20	6.985	0.0950	18.1320	0.0096	0.8415	2.1831e-03		
0.80	7.080	0.0340	18.2270	0.0035	0.8511	2.6648e-03		
0.10	7.114		18.2610		0.8546			

Pre-Consolidation Pressure in kg/cm²: 0.62

Cc: 0.22



SUMMARY OF GEOTECHNICAL EXPLORATIONS

Project No. :2122222					Project : GIPCL																					
Bore Hole No. :5					Bore Hole Started on 26-01-22 Completed on : 27-01-22										Depth of Water Table : Below Termination Level											
Method of Drilling :ROTARY DRILLING					Diameter of Bore Hole : 150 mm					R. L. of Ground Level :49.85 mt					Location of Bore Hole :N-2371087.04, E-304576.03											
RL in metres	I. S. Classi- fication	Visual Soil Description	Field Test /Samples		Ns No. of Blows per 300 mm	Rock Properties		Natural Moist. Content %	Density (in gms/cc)		Speci- fic Gra- vity	Particle Size Analysis			Atterberg Limits			Shrinkage Lim. %	Free swell Indx %	(VASTAN) Shear Properties			Additional Tests or Remarks			
			SPT VST	UDS DS		C.R. %	RQD %		Bulk	Dry		Gr. %	Sn %	Silt+ Clay	LL %	PL %	PI %			Test Type	C (Kg/ cm²)	Ø in Deg.				
49.85	CH	YELLOW FIRM HIGH PLASTIC CLAY WITH SAND (FILLING)		DS								0	28	72	51	26	25		25							
48.85		SPT	DS	07			24.62					0	16	84	59	30	29		21							
47.85	CH	REDDISH STIFF HIGH PLASTIC CLAY		UDS				23.90	1.79	1.44	2.91	0	12	41+47	59	29	30		33	UCC						
46.85		SPT	DS	11			23.93					0	17	83	59	28	31		42							
45.85			UDS				24.12	1.85	1.49	3.00		1	16	41+42	52	26	26			Tuu	0.76	6.5°				
44.85	CH	BLACK VERY STIFF HIGH PLASTIC CLAY WITH SAND	SPT	DS	20			25.68				1	17	82	60	28	32									
43.85			UDS				25.89	1.90	1.51	2.93		4	16	39+41	59	30	29			UCC						
42.35		SPT	DS	23			25.29					0	21	79	65	31	34									
40.85	CH			UDS				25.65	1.92	1.53	3.01	3	14	44+39	56	29	27			UCC						
39.35		SPT	DS	21			25.19					0	16	84	55	27	28									
37.85			UDS				26.16	1.95	1.54	2.94		0	14	30+56	70	32	38			UCC						
36.35	CH		SPT	DS	26			26.78				0	17	83	67	32	35									
34.85	CH		SPT	DS	27			26.84				0	11	89	81	34	47									
34.35			TERMINATION																							
SPT - Standard Penetration Test		DS - Disturbed Sample		Gr - Gravel		LL - Liquid Limit		PI - Plasticity Index		Cv - Coeff. of Consolidation		C.R. - Core Recovery		Mv - Coeff. of Volume Change		RQD - Rock Quality Designation										
UDS - Undisturbed Sample		VST - Vane Shear Test		Sn - Sand		PL - Plastic Limit		C, Ø - Shear Parameters																		

UNIQUE ENGINEERING TESTING AND ADVISORY SERVICES

216,Road No. 6-F,New Estate, Udhna,Surat-394210, Gujarat, India

TABLE - 3
RESULTS OF STANDARD PENETRATION TEST

Project No. 2122222

Bore Hole No. 6

RL in mts.	No. of Blows for Penetration			Ns (Blows /300 mm)	Nc(Corrected value of Ns)	N. M. C. (in %)
	0 - 150 mm	150 - 300 mm	300 - 450 mm			
56.19						24.80
55.19	03	03	04	07	07	24.54
54.19						25.33
53.19	02	05	06	11	11	24.67
52.19						25.09
51.19	03	06	08	14	14	25.17
49.69						24.81
48.19	05	06	09	15	15	25.67
46.69						25.40
45.19	07	08	11	19	19	25.71
43.69						26.02
42.19	06	10	13	23	23	26.95

TABLE - 5
PARTICLE SIZE ANALYSIS

Project No. : 2122222

Bore Hole No. : 6

Soil Strata	RL Sample Type	Gravel in % (>4.75 mm)	Sand in %			Silt in % + Clay in %
			(4.75 - 2 mm)	(2mm - 425μ)	(425 - 75 μ)	
57.19 to 56.19	57.19/D	3	6	7	6	78
56.19 to 54.19	56.19/U	0	4	5	7	25 + 59
56.19 to 54.19	55.19/S	0	5	5	5	85
54.19 to 52.19	54.19/U	0	5	6	11	25 + 53
54.19 to 52.19	53.19/S	1	8	5	5	81
52.19 to 41.69	52.19/U	5	5	3	7	30 + 50
52.19 to 41.69	51.19/S	2	5	4	3	86
52.19 to 41.69	49.69/U	10	9	3	8	33 + 37
52.19 to 41.69	48.19/S	0	7	5	7	81
52.19 to 41.69	46.69/U	4	7	5	6	31 + 47
52.19 to 41.69	45.19/S	0	8	2	2	88
52.19 to 41.69	43.69/U	10	8	8	6	28 + 40
52.19 to 41.69	42.19/S	0	10	7	5	78

TABLE - 7A
UNCONFINED COMPRESSION TEST TABLE

Project No. : 2122222

Bore Hole No. : 6

RL Sample (mts.)	Type of Sample (UD/Rm)	Qu (Kg/cm ²)	Cu (Kg/cm ²)
56.19	UD(Undisturbed)	0.75	
52.19	UD(Undisturbed)	1.32	
49.69	UD(Undisturbed)	1.58	
46.69	UD(Undisturbed)	2.08	
43.69	UD(Undisturbed)	2.75	

TABLE - 7B

TRIAXIAL SHEAR TEST

Project No. : 2122222

Bore Hole No. : 6

RL Sample	Sample Type (UD/Rm)	Normal Stress at Failure	Cell Pressure (Kg/cm ²)	Pore Pressure (Kg/cm ²)	Shear Values from Graph	
					Cuu (Kg/cm ²)	Øuu (Kg/cm ²)
54.19	Undisturbed	2.31	0.50	0.00	0.58	12.86
	Undisturbed	2.96	1.00	0.00		
	Undisturbed	4.63	2.00	0.00		

MOHR CIRCLE

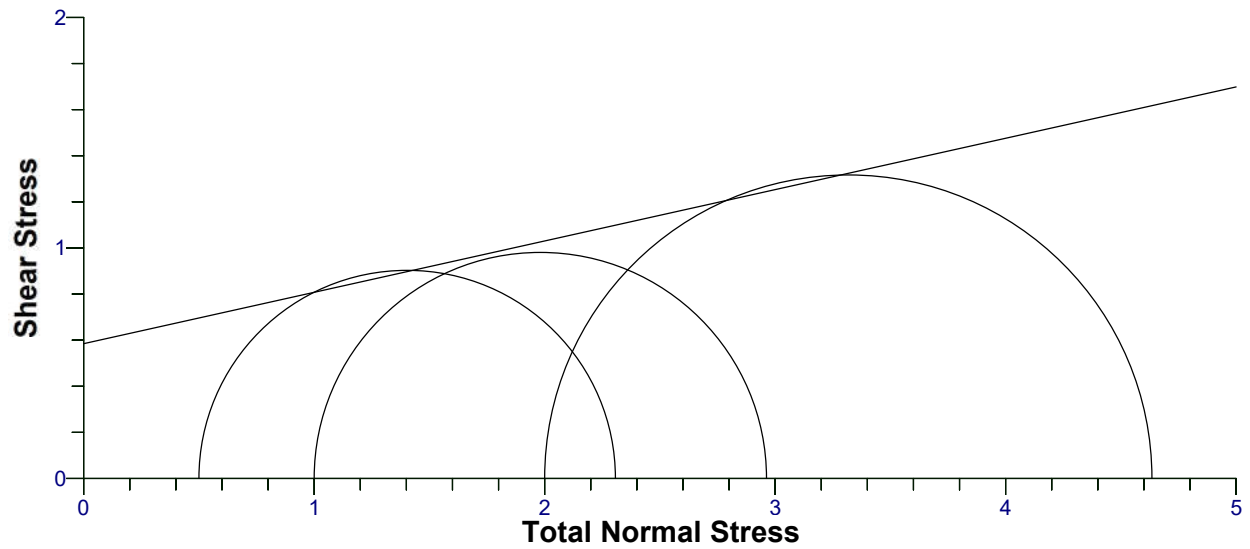


TABLE - 8
CONSOLIDATION TEST

Project No. : 2122222

Bore Hole No. : 6

RL : 52.19 mt

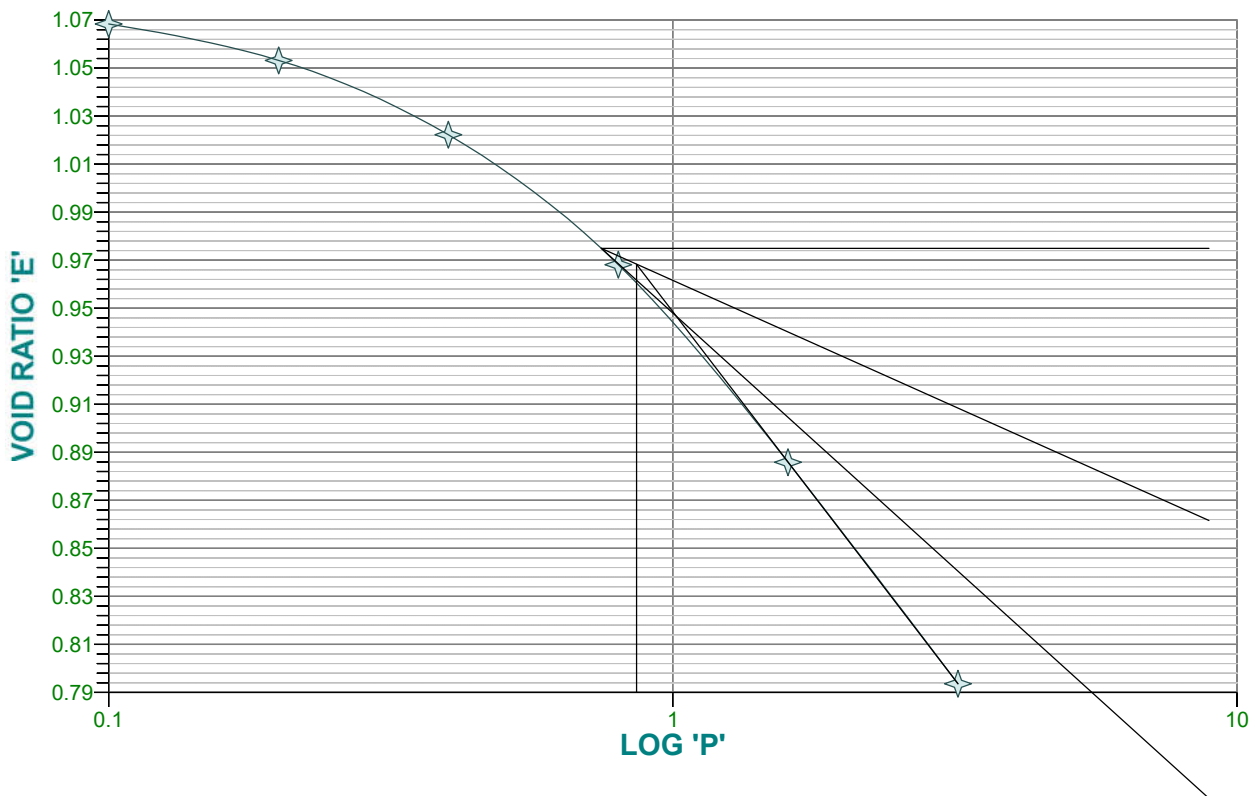
Specific Gravity : 2.91

Final Moisture Content 28.55 %

Pressure in Kg/cm ²	Final Readings	Change of Height in mm	Height of Sample in mm	Change in Ht. in mm	Void Ratio	Coeff. of Vol. Change Mv (cm ² /Kg)	T90 in mins	Coeff. of Consolidation Cv (cm ² /sec)
0.10	6.711	-0.1470	20.0000	-0.0152	1.0685	7.3500e-02		
0.20	6.564	-0.3000	19.8530	-0.0310	1.0533	7.5555e-02		
0.40	6.264	-0.5230	19.5530	-0.0541	1.0222	6.6870e-02		
0.80	5.741	-0.7950	19.0300	-0.0822	0.9681	5.2220e-02		
1.60	4.946	-0.8930	18.2350	-0.0924	0.8859	3.0607e-02	1.75	3.6508e-03
3.20	4.053	0.0740	17.3420	0.0077	0.7936	1.7780e-03		
0.80	4.127	0.2920	17.4160	0.0302	0.8012	2.3952e-02		
0.10	4.419		17.7080		0.8314			

Pre-Consolidation Pressure in kg/cm²: 0.86

Cc: 0.29

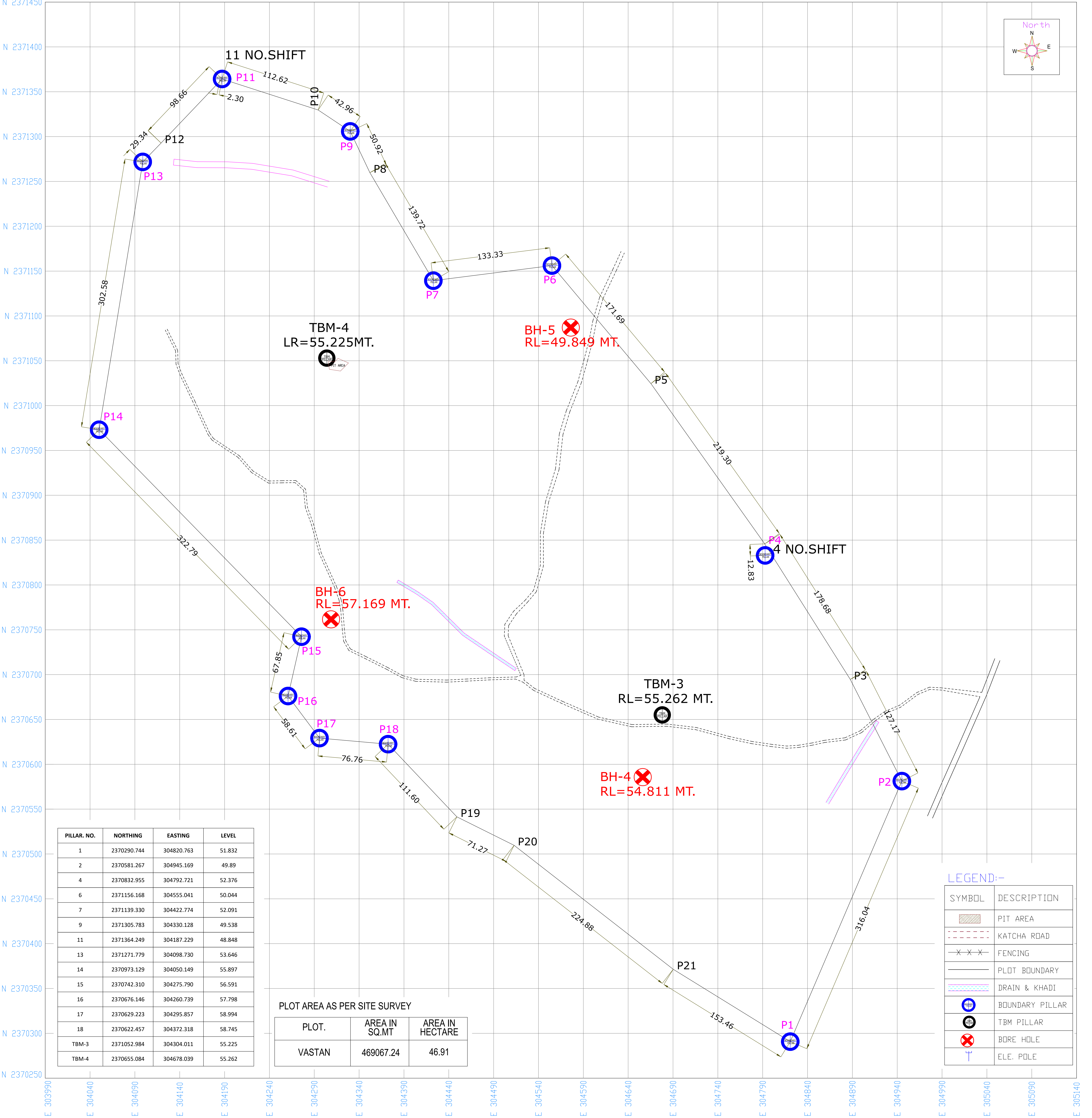


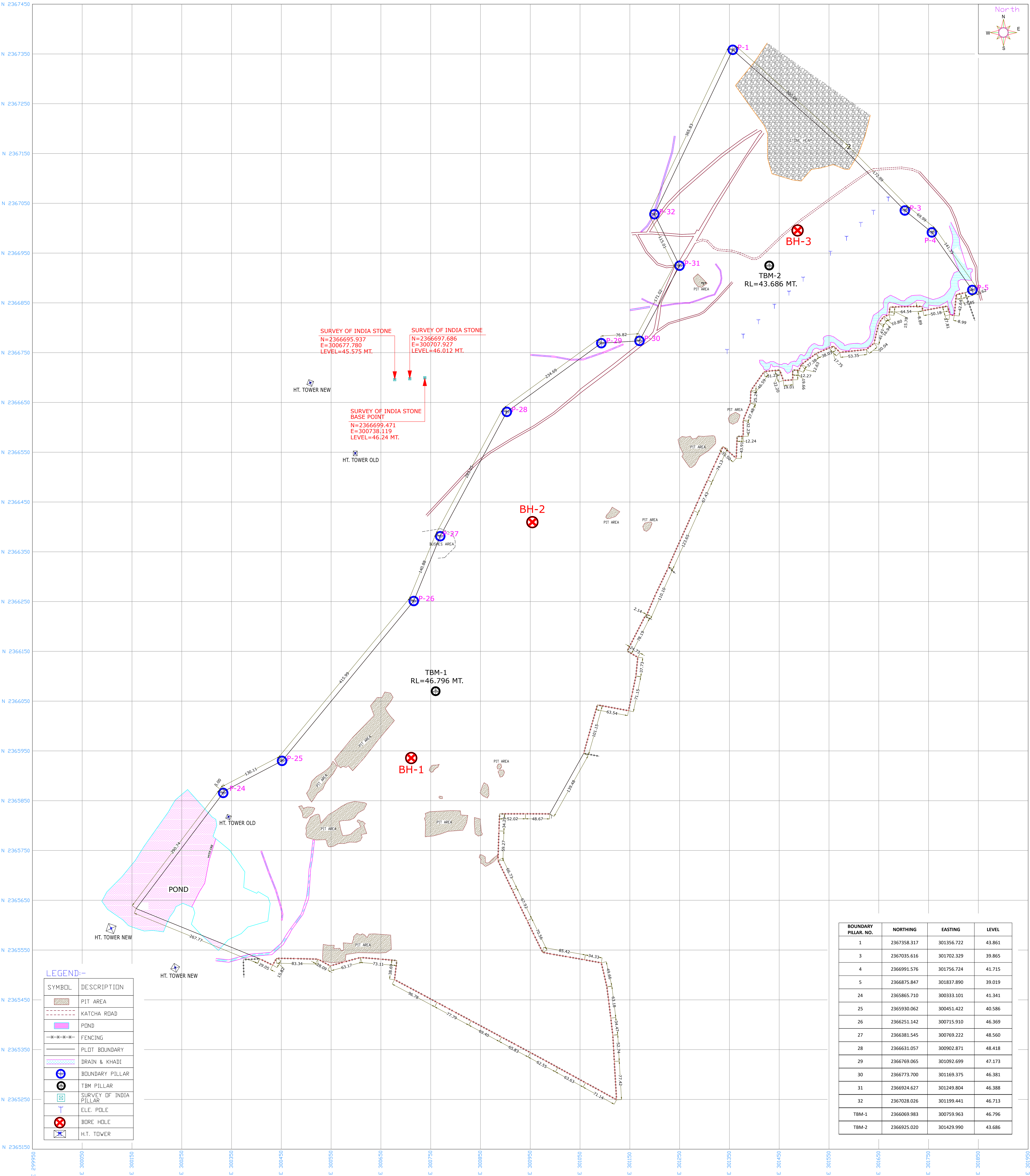
SUMMARY OF GEOTECHNICAL EXPLORATIONS

Project No. :2122222				Project : GIPCL																				
Bore Hole No. :6				Bore Hole Started on 27-01-22 Completed on : 28-01-22										Depth of Water Table : Below Termination Level										
Method of Drilling :ROTARY DRILLING				Diameter of Bore Hole : 150 mm R. L. of Ground Level :57.19 mt										Location of Bore Hole :N-2370761.65, E-304308.73										
RL in metres	I. S. Classi- fication	Visual Soil Description	Field Test /Samples		Ns No. of Blows per 300 mm	Rock Properties		Natural Moist. Content %	Density (in gms/cc)		Spe- cific Gra- vity	Particle Size Analysis			Atterberg Limits			Shrinkage Lim. %	Free swell Indx %	Shear Properties			Additional Tests or Remarks	
			SPT VST	UDS DS		C.R. %	RQD %		Bulk	Dry		Gr. %	Sn %	Silt+ Clay	LL %	PL %	PI %			Test Type	C (Kg/ cm²)	Ø in Deg.		
57.19	CH	FILLING		DS								3	19	78	55	28	27		50					
56.19			YELLOW FIRM HIGH PLASTIC CLAY WITH SAND		UDS				24.80	1.83	1.47	2.93	0	16	25+59	60	31	29		82	UCC			
55.19	CH			SPT	DS	07			24.54				0	15	85	69	33	36		100				
54.19	CH	BLACK STIFF HIGH PLASTIC CLAY WITH SAND		UDS				25.33	1.86	1.49	2.84	0	22	25+53	67	32	35		67	Tuu	0.58	12.9°		
53.19				SPT	DS	11			24.67				1	18	81	62	31	31						
52.19		REDDISH YELLOW STIFF TO VERY STIFF HIGH PLASTIC CLAY WITH SAND		UDS				25.09	1.88	1.50	2.91	5	15	30+50	56	28	28			UCC				
51.19				SPT	DS	14			25.17				2	12	86	61	31	30						
49.69	CH			UDS				24.81	1.91	1.53	3.04	10	20	33+37	60	29	31			UCC				
48.19			SPT	DS	15			25.67				0	19	81	60	30	30							
46.69					UDS				25.40	1.93	1.54	3.00	4	18	31+47	61	30	31			UCC			
45.19				SPT	DS	19			25.71				0	12	88	58	28	30						
43.69				UDS				26.02	1.96	1.55	3.02	10	22	28+40	59	29	30			UCC				
42.19			SPT	DS	23			26.95				0	22	78	56	28	28							
41.69		TERMINATION																						
SPT - Standard Penetration Test		DS - Disturbed Sample		Gr - Gravel		LL - Liquid Limit		PI - Plasticity Index		Cv - Coeff. of Consolidation		C.R. - Core Recovery		Mv - Coeff. of Volume Change		RQD - Rock Quality Designation								
UDS - Undisturbed Sample		VST - Vane Shear Test		Sn - Sand		PL - Plastic Limit		C, Ø - Shear Parameters																

UNIQUE ENGINEERING TESTING AND ADVISORY SERVICES

216,Road No. 6-F,New Estate, Udhna,Surat-394210, Gujarat, India





TOTAL PLOT AREA AS PER SITE SURVEY

PLOT.	AREA IN SQ.MT	AREA IN HECTARE
NOGAMA	963092.44	98.31

CHKD	K.J.Parmar
DATE	12.01.2022

SCALE:
1CM.=25.0 MT.

UNIQUE Engineering Testing & Advisory Services
216, Bridge Road No.6-F New Estate, Udhaygaganagar
Udhay, Surat-394 210 ph-02612278205, 2278310
Mail ID : unique@uniquesurat.com
Surveyed by : K.J.Parmar (98241 74691)

CLIENT:
GIPCL (NANI NAROLI)
Surveyed by :- K.J.PARMAR (98241 74691)
Mail ID : ganesurvey_kjp@yahoo.com

NAME OF WORK:
TOPOGRAPHY SURVEY OF GIPCL NOGAMA PLOT AT NANI NAROLI, SURAT.
Location:-
UNIQUE ENGINEERING TESTING & ADVISORY SERVICES, 216, BRIDGE ROAD NO.6-F NEW ESTATE, UDHAYGAGANAGAR, UDHAY, SURAT-394 210 PH-02612278205, 2278310 MAIL ID : unique@uniquesurat.com

TITLE:
PLAN SHOWING TOPOGRAPHY SURVEY.
SHEET NO: 01
REV. 00