

Subject: Construction of Onshore Facilities at 08 Locations in West Bengal under JMVP-II.

Reference: IN-IWAI-411477-CW-RFB-2

CPP Portal Tender no: 2024_IWAWB_805971_1

Response to Pre-bid Queries

S. No	Clause No & page no	Content of RFB requirement	Clarifications sought	Response
1	Point no 5.3 (i), (ii) & (iii), Page No 7The set of bidding documents comprise of the following: i. Layout Drawings of the works. ii. Indicative Structural Details.....	Layout drawings of all the eight locations is not attached in the bidding documents. Structural details of all the eight locations is not attached in the bidding documents. Detailed list of items required for construction of all the eight locations not mentioned in Bill of Quantities.	Please refer the Amendment 1 uploaded on CPP portal on dated 14 th May 2024 for the indicative drawings. For the list of items, please refer the BoQ attached in Appendix to Financial Part: Annexure I, page no 25 to 28 of tender documents.
2	Bill of Quantities	Bill of Quantities	Area of Site Development, Extra Development Works (Paver Block), Toilet Block Civil Works not mentioned in the bidding documents.	Please refer clause no 6.2 of ToR at page no 34-35, the location wise area is given.
3		Drawings	Drawings of all the item of works such as Terminal Building Module I & II, Toilet Block, Paving Work (Terminal Internal Road, Vehicle Parking & Pathway), Kerb Stone, Water Supply System including Over Water Tank, Mechanical, Electrical, Water Supply, Sewerage & Plumbing works, any other works required for successful completion of the project location wise mentioned in Bill of Quantities.	Please refer at sr no 1 of above responses.

4	Scope of work, point no 4.3 (g), page no 33	The major structural & MEP designs & drawings along with soil test reports are also attached with the tender documents. The successful bidder is required to execute the works as per the drawings.	As outlined in the Scope of work on page no 33, point no 4.3 (g), of the tender document, it is stated that these documents are included with tender documents. However, upon reviewing the provided documents, we have observed that these critical documents are missing. Given the importance of these documents in ensuring the successful execution of the project as per specified drawings, we kindly request your urgent clarification on this matter. Timely receipt of these documents will enable us to prepare our bid accurately and ensure compliance with the project requirement.	Please refer the Amendment 1 uploaded on CPP portal on dated 14 th May 2024 for the indicative drawings. Geotechnical Investigation reports are attached as Annexure A. Please also refer clause no 4.1 of Scope of work at page no 33 of tender documents.
5		Detailed List of Items	Following up on our pre-bid meeting, please provide us a comprehensive and detailed Bill of materials (BoM) (detailed estimated items) for each location. The list shall include all necessary construction items in line with the scope of work delineated in the tender document along with their corresponding quantities, but exclude pricing information for planning and preparation processes, ensuring accuracy and efficiency in project implementation.	Please refer clause no 4.1 of Scope of work at page no 33 of tender documents. For the list of items, please refer the BoQ attached in Appendix to Financial Part: Annexure I, page no 25 to 28 of tender documents. The estimated cost of the work is given in tender documents i.e Rs 6,99,95,739.00 exclusive of GST. All the detailed calculation & estimation in terms of quantities shall be done by the Contractor.
6		GST	Confirmation regarding the approximate value of work, amounting to Rs 6,99,95,739.00 as specified in tender documents. Kindly confirm that this value is exclusive of GST and that any applicable	The Estimated cost as mentioned in clause no 1 at page no 5 may be read as: Rs 6,99,95,739.00 exclusive of GST.

			GST will be paid separately as per prevailing regulations.	Please also refer the BoQ attached on the CPP portal, where separate column for quoting amount of GST against each item is given, which is to be filled up by the bidder.
7	Clause no 1 at page no 5	Period of completion: 180 days	Considering the impending monsoon season, numerous festivities, and unforeseen contingencies, we respectfully request an extension of the project completion time from 180 days to 240 days. This will ensure optimal execution, quality assurance and timely delivery without compromising the safety or efficiency.	The subject work is an important work & time is essence to complete the work as per the timeline given in tender documents. Tender conditions prevail.
8		Area of Paver Block & Ramp	Request clarification regarding the site-wise total area of paver block required for the parking area & ramp. This information is not specified in the drawing provided. Accurate data is crucial for precise cost estimation and project planning. Your prompt response will facilitate our bid preparation process effectively.	Please refer at sr no 5 of above responses.
9		Site Visit	Request to provide communication details of any Engineer/ Site Representative for joint site inspection/ visit before bidding for better understanding of the actual site condition.	Please refer clause no 6.2: Site/ Locations details at page no 35 of tender documents. The bidder may visit the site locations in consultation with Director (I/C), IWAI Kolkata for the same. Tele: 8902159698 E-mail: dirkol.iwai@nic.in



REPORT NO. – VMT 129 B/2023-2024
GEOTECH INVESTIGATION
REPORT FOR
PROPOSED CONSTRUCTION
OF
BOAT IN THE IDENTIFIED
COMMUNITY JETTY
AT NARKALBARI IN
WEST BENGAL

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ACKNOWLEDGEMENT

WE ARE GRATEFUL TO M/s KITCO LTD., KERLA FOR PROVIDING US THE OPPORTUNITY TO CARRY OUT THESE INVESTIGATIONS.

THE CO-OPERATION EXTENDED BY THEIR ENGINEERS DURING FIELD INVESTIGATIONS IS THANKFULLY ACKNOWLEDGED.

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**SUB-SOIL INVESTIGATION REPORT FOR PROPOSED CONSTRUCTION OF BOAT
IN THE IDENTIFIED COMMUNITY JETTY AT GARDUARA FERRY GHAT IN WEST
BENGAL**

INTRODUCTION

The work of sub-soil exploration was awarded to us by M/s KITCO LTD., KERLA Order no. – 6777:DP 1083: RG: 2023 dated 21/03/2023. The object of the investigation was to study the geo-technical properties of soil both in field and laboratory and determine safe allowable pressure for the foundation soil.

The fieldwork consisted of 02 bore holes of 10.00 metre depth each. The fieldwork was conducted on 14/04/2023. The location of the bore holes is shown in the Site location.

REFERENCES

1. **IS: 1892-2021** for field work including existent ground water table.
2. **IS: 2132-1986** for sampling in Undisturbed and Disturbed form.
3. **IS: 2131-1981** for Standard Penetration Test.
4. **IS: 2720** for all laboratory tests on soil samples collected.
5. **IS: 6403-1981** for determination of Bearing Capacity.
6. **IS: 8009(Part I)-1976** for calculation of settlement of foundations.
7. **IS: 1904-2021** for permissible maximum settlement, differential settlement and angular distortion.

SCOPE OF WORK

The scope consisted of drilling of boreholes down to maximum depth of 10.00 m in normal soils / rock, Standard Penetration Testing, collection of samples, laboratory testing and preparation and submission of Geotechnical Investigation report.

Summary of the fieldwork					
Sl. No.	Site	Borehole Nos.	Coordinates		Depth below existing ground level (m)
			Latitude	Longitude	
1.	NARKALBARI	BH-01 (LHS)	23.8398374	88.2166931	10.0
2.		BH-02 (LHS)	23.83998184	88.21707834	10.0



SITE LOCATION



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INTERPRETATION OF THE LAB TEST RESULTS

GENERAL NATURE OF SOIL STRATA

The bore hole log charts and lab test results of bore holes 1 and 2 indicate that the strata at the site is found to comprise of both cohesive as well as non-cohesive soil.

The results of classification tests indicate that the natural soil stratum present at the Site is found to comprise of both fine-grained soils comprising of 'CL' and 'CI' group of IS classification (clayey soil) having 79 to 99 percent material finer than 75 micron and coarse-grained soils (sandy soil) comprise of 'ML' and 'SM' group of IS classification having 49 to 61 percent material finer than 75 micron.

The bore hole log charts and lab test results of bore holes 1 indicate that:

first strata, from 0.00 metre to 2.50 metre, consists of a layer of CL group of IS classification which is inorganic clays of low plasticity,

second strata, from 2.50 metre to 7.00 metre, consists of a layer of CI group of IS classification which is inorganic clays of medium plasticity,

third strata, from 7.00 metre to 8.50 metre, consists of a layer of SM group of IS classification which is silty Sand with none plasticity

fourth strata, from 8.50 metre to 10.00 metre, consists of a layer of ML group of IS classification which is inorganic silts with none to low plasticity.

The bore hole log charts and lab test results of bore holes 2 indicate that:

first strata, from 0.00 metre to 4.00 metre, consists of a layer of CL group of IS classification which is inorganic clays of low plasticity,

second strata, from 4.00 metre to 8.50 metre, consists of a layer of CI group of IS classification which is inorganic clays of medium plasticity

third strata, from 8.50 metre to 10.00 metre, consists of a layer of ML group of IS classification which is inorganic silts with none to low plasticity.

S.P.T. VALUES

The S.P.T. values obtained in the respective clayey layer region present as per bore-log charts enclosed are found to range 4 to 8 indicating 'Soft' to 'Medium' consistency.

However, the S.P.T. values obtained in the respective sandy layer region present as per bore-log charts enclosed are found to range from 12 to 14 indicating 'Medium' relative density.

The results of S.P.T. values indicate that the stratum at the Site is 'Loose' to 'Well' compacted.

WATER TABLE

Water Table at the Site was observed at a depth from 3.00 metre to 4.50 metre below ground level on the day of soil investigation during the Third week of April 2023. However, the existing water table may rise by 1.00 metre in the post-monsoon period in general. Therefore, a water table at a depth of 2.00 metre to 3.50 metre below ground level has been adopted for calculation purposes.

RECOMMENDATIONS FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GARDUARA FERRY GHAT IN WEST BENGAL NET SAFE BEARING CAPACITY/SAFE ALLOWABLE PRESSURE

Bore Hole Nos.	Type of Structure	Depth of Foundation (metres)	Size of Footing (L x B) (metres)	Net Safe Bearing Capacity (Tonne/sqm.)	Settlement Produced (mm)	Safe Allowable Pressure for Permissible Settlement 50 mm (Tonne/sqm.)
1	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	7.89	28.02	-
		2.00	1.20 x 1.20	8.95	27.18	-
		2.50	1.20 x 1.20	11.70	29.53	-
		1.50	2.00 x 2.00	7.36	38.24	-
		2.00	2.00 x 2.00	8.17	36.75	-
		2.50	2.00 x 2.00	10.39	39.00	-
		1.50	2.50 x 2.50	7.26	44.52	-
		2.00	2.50 x 2.50	7.97	41.03	-
		2.50	2.50 x 2.50	10.03	45.31	-
2	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	11.21	35.03	-
		2.00	1.20 x 1.20	12.74	33.59	-
		2.50	1.20 x 1.20	13.80	31.52	-
		1.50	2.00 x 2.00	10.57	47.18	-
		2.00	2.00 x 2.00	11.64	44.68	-
		2.50	2.00 x 2.00	12.40	41.68	-
		1.50	2.50 x 2.50	10.34	53.73	9.39
		2.00	2.50 x 2.50	11.34	49.84	-
		2.50	2.50 x 2.50	12.05	48.68	-

NOTE: -

The above recommendations are based on the field investigation data results and the laboratory tests results of the samples collected from the test locations and our experience in this regard. If the actual sub-soil conditions during excavation for the

foundations differ from that has been reported, a reference should be made to us for suggestions.

Further, the recommendations are based on the assumptions as mentioned in the Report and the designer of the Structure should take into consideration all the factors required as per codes. The recommendations should be taken as guidelines for the designer.

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VIVEK MATERIAL TESTING
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BEARING CAPACITY CALCULATIONS

Soil when stressed due to loading, tend to deform. The resistance to deformation of the soil depends upon factors like water content, bulk density, angle of internal friction and the manner in which load is applied on the soil. The maximum load per unit area which the soil or rock can carry without yielding or displacement is termed as the bearing capacity of soils. The Safe Bearing Capacity of the proposed STRUCTURE without any distress is determined from the considerations of the following criteria.

[A] SHEAR CRITERIA

The soil beneath the foundation shall be safe from risk of shear failure.

[B] SETTLEMENT CRITERIA

The settlement due to load is caused basically on account of two factors, namely,

- (i) the soil below footing gets compressed by certain amount and
- (ii) since the foundations cover only a limited area there is a possibility that the concentrated stresses developed are so high as to cause actual rupture (shear failure) and displacement of soil below.

The foundation should not settle or deflect to an extent causing damage to the Structure or impair its usefulness.

The Bearing Capacity Calculations for the Foundation shall be governed as per IS: 6403-1981, IS: 8009(Part-I)-1976 and IS: 1904-2021 on the basis of available information regarding the proposed design.

BEARING CAPACITY ON SHEAR CONSIDERATIONS**ULTIMATE NET BEARING CAPACITY**

As per IS: 6403-1981, the Ultimate Net Bearing Capacity 'qd' on shear consideration for a Structure is given by the formula: -


FOR GENERAL SHEAR FAILURE

$$q_d = c.N_c.Sc.dc.ic + q(N_q - 1).sq.dq.iq + 1/2 B.r.Nr.Sr.dr.ir.W'$$

FOR LOCAL SHEAR FAILURE

$$q'd = 2/3 c.N'c.Sc.dc.ic + q(N'q - 1).Sq.dq.iq + 1/2 B.r.N'r.Sr.dr.ir.W'$$

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981

NAME OF PROJECT																																					
BOREHOLE 01 (L.H.S.)		Depth of borehole	10.00	metre	Water table below borehole level (m)	3.00	Factor of safety	2.50	Water table used for calculation (m)	2.00	Assumed post monsoon rise (m)	1.00																									
Input Parameters												Shearing Resistance Parameters												Ultimate Net Bearing Capacity			Net Safe Bearing Capacity										
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance	Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors						Inclination Factors			General shear	Local shear	Intermediate				
					Bulk		Bulk		c	ϕ	ϕ'	e	q	Nc	Nq	Ny	Nc'	Nq'	Ny'	Sc	Sq	Sy	Dc	Dq	Dy	Dc'		Dq'	Dy'	lc	lq	ly					
		(m)	(m)	(m)	(gms/cc)	(kN/m ³)	(gms/cc)	(kN/m ³)	Kg/cm ²	°	°		kN/m ²																								
1	SQUARE	1.50	1.20	1.20	1.78	17.46	1.78	17.46	0.15	11	7.42	0.699	26.18	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.30	1.15	1.15	1.30	1.15	1.15	1.00	1.00	1.00	290.39	160.41	193.55	77.42		
2	SQUARE	2.00	1.20	1.20	1.78	17.46	1.82	17.85	0.15	11	7.42	0.699	34.91	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.40	1.20	1.20	1.40	1.20	1.20	1.00	1.00	1.00	328.98	181.84	219.36	87.74		
3	SQUARE	2.50	1.20	1.20	1.78	15.50	1.82	15.89	0.20	10	6.74	0.688	38.74	8.34	2.47	1.22	7.03	1.83	0.67	1.30	1.20	0.80	1.50	1.25	1.25	1.50	1.25	1.25	1.00	1.00	1.00	410.93	231.07	286.83	114.73		
4	SQUARE	1.50	2.00	2.00	1.78	17.46	1.78	17.46	0.15	11	7.42	0.699	26.18	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.18	1.09	1.09	1.18	1.09	1.09	1.00	1.00	1.00	270.85	149.53	180.47	72.19		
5	SQUARE	2.00	2.00	2.00	1.78	17.46	1.82	17.85	0.15	11	7.42	0.699	34.91	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.24	1.12	1.12	1.24	1.12	1.12	1.00	1.00	1.00	300.43	165.98	200.26	80.10		
6	SQUARE	2.50	2.00	2.00	1.78	15.50	1.82	15.89	0.20	10	6.74	0.688	38.74	8.34	2.47	1.22	7.03	1.83	0.67	1.30	1.20	0.80	1.30	1.15	1.15	1.30	1.15	1.15	1.00	1.00	1.00	365.05	205.22	254.77	101.91		
7	SQUARE	1.50	2.50	2.50	1.78	17.46	1.78	17.46	0.15	11	7.42	0.699	26.18	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.15	1.07	1.07	1.15	1.07	1.07	1.00	1.00	1.00	267.16	147.45	177.98	71.19		
8	SQUARE	2.00	2.50	2.50	1.78	17.46	1.82	17.85	0.15	11	7.42	0.699	34.91	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.19	1.10	1.10	1.19	1.10	1.10	1.00	1.00	1.00	293.20	161.94	195.41	78.16		
9	SQUARE	2.50	2.50	2.50	1.78	15.50	1.82	15.89	0.20	10	6.74	0.688	38.74	8.34	2.47	1.22	7.03	1.83	0.67	1.30	1.20	0.80	1.24	1.12	1.12	1.24	1.12	1.12	1.00	1.00	1.00	352.42	198.09	245.93	98.37		

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	3.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	77.42	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.78	-	-	-	Depth of foundation						28.02
2	2	CLAY	1.50	3.00	1.50	1.82	0.688	0.135	0.00	39.57	29.32	-	-	28.885	-	
3	3	CLAY	3.00	4.00	1.00	1.86	0.690	0.137	0.00	57.17	10.89	-	-	6.137	-	

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	3.00	(m) bgl		Rigidity factor	0.80		
Width	1.20	metre	Applied Pressure at foundation base	87.74	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.78	0.000	0.000	0.00	Depth of foundation						27.18
2	2	CLAY	2.00	3.50	1.50	1.82	0.688	0.135	0.00	47.25	33.23	-	-	27.745	-	
3	3	CLAY	3.50	4.50	1.00	1.86	0.690	0.137	0.00	63.80	12.34	-	-	6.224	-	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	3.00	(m) bgl		Rigidity factor	0.80		
Width	1.20	metre	Applied Pressure at foundation base	114.73	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.82	0.000	0.000	0.00	Depth of foundation						29.53
2	2	CLAY	2.50	4.00	1.50	1.86	0.690	0.137	0.00	56.46	43.45	-	-	30.138	-	
3	3	CLAY	4.00	5.00	1.00	1.90	0.669	0.130	0.00	72.72	16.13	-	-	6.778	-	

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	3.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	72.19	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement	
		CLAY					e	Cc	N''	P _o	ΔP		W'				
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)	
1	1	CLAY	0.00	1.50	1.50	1.78	-	-	-	Depth of foundation							38.24
2	2	CLAY	1.50	3.00	1.50	1.82	0.688	0.135	0.00	39.57	38.18	-	-	35.191	-		
3	3	CLAY	3.00	4.50	1.50	1.86	0.690	0.137	0.00	59.28	15.99	-	-	12.608	-		

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	3.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	80.10	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.78	0.000	0.000	0.00	Depth of foundation						36.75
2	2	CLAY	2.00	3.50	1.50	1.82	0.688	0.135	0.00	47.25	42.37	-	-	33.349	-	
3	3	CLAY	3.50	5.00	1.50	1.86	0.690	0.137	0.00	65.91	17.74	-	-	12.586	-	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	3.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	101.91	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.82	0.000	0.000	0.00	Depth of foundation						39.00
2	2	CLAY	2.50	4.00	1.50	1.86	0.690	0.137	0.00	56.46	53.90	-	-	35.393	-	
3	3	CLAY	4.00	5.50	1.50	1.90	0.669	0.130	0.00	74.93	22.57	-	-	13.360	-	

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

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	3.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	71.19	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.78	0.000	0.000	0.00	Depth of foundation						44.52
2	2	CLAY	1.50	3.50	2.00	1.82	0.688	0.135	0.00	42.63	36.32	-	-	42.809	-	
3	3	CLAY	3.50	5.25	1.75	1.86	0.690	0.137	0.00	66.46	15.40	-	-	12.841	-	

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

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	3.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	78.16	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.82	0.000	0.000	0.00	Depth of foundation						41.03
2	2	CLAY	2.00	4.00	2.00	1.86	0.690	0.137	0.00	51.49	39.88	-	-	40.384	-	
3	3	CLAY	4.00	5.50	1.50	1.90	0.669	0.130	0.00	73.90	17.72	-	-	10.909	-	


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

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	3.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	98.37	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.82	0.000	0.000	0.00	Depth of foundation						45.31
2	2	CLAY	2.50	4.50	2.00	1.86	0.690	0.137	0.00	59.59	50.19	-	-	43.018	-	
3	3	CLAY	4.50	6.25	1.75	1.90	0.669	0.130	0.00	82.29	21.28	-	-	13.616	-	

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981

NAME OF PROJECT													 VMT <small>GEO-TECH & MATERIAL TESTING</small>
BOREHOLE 02 (L.H.S.)	Depth of borehole	10.00	metre	Water table below borehole level (m)	4.50	Factor of safety	2.50	Assumed post monsoon rise (m)	1.00				
	Water table used for calculation (m)	3.50											

Input Parameters													Shearing Resistance Parameters													Ultimate Net Bearing Capacity			Net Safe Bearing Capacity						
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance		Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors							Inclination Factors			General shear	Local shear	Intermediate
					Bulk		Bulk			c	ϕ			ϕ'	e	N_c	N_q	N_γ	N_c'	N_q'	N_γ'	S_c	S_q	S_γ	D_c	D_q	D_γ	D_c'		D_q'	D_γ'	i_c			
		(m)	(m)	(m)	(gms/cc)	(kN/m ³)	(gms/cc)	(kN/m ³)	Kg/cm ²	°	°		kN/m ²																						

1	SQUARE	1.50	1.20	1.20	1.80	17.65	1.80	17.65	0.20	12	8.11	0.686	26.48	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.31	1.15	1.15	1.31	1.15	1.15	1.00	1.00	1.00	398.10	216.83	274.84	109.94
2	SQUARE	2.00	1.20	1.20	1.80	17.65	1.88	18.44	0.20	12	8.11	0.686	35.31	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.41	1.21	1.21	1.41	1.21	1.21	1.00	1.00	1.00	452.36	246.47	312.35	124.94
3	SQUARE	2.50	1.20	1.20	1.80	17.65	1.88	18.44	0.15	13	8.79	0.660	44.13	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.52	1.26	1.26	1.52	1.26	1.26	1.00	1.00	1.00	455.51	242.40	338.30	135.32
4	SQUARE	1.50	2.00	2.00	1.80	17.65	1.80	17.65	0.20	12	8.11	0.686	26.48	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.19	1.09	1.09	1.19	1.09	1.09	1.00	1.00	1.00	375.52	204.28	259.08	103.63
5	SQUARE	2.00	2.00	2.00	1.80	17.65	1.88	18.44	0.20	12	8.11	0.686	35.31	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.25	1.12	1.12	1.25	1.12	1.12	1.00	1.00	1.00	413.37	225.03	285.30	114.12
6	SQUARE	2.50	2.00	2.00	1.80	17.65	1.88	18.44	0.15	13	8.79	0.660	44.13	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.31	1.16	1.16	1.31	1.16	1.16	1.00	1.00	1.00	409.37	217.64	303.92	121.57
7	SQUARE	1.50	2.50	2.50	1.80	17.65	1.80	17.65	0.20	12	8.11	0.686	26.48	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.15	1.07	1.07	1.15	1.07	1.07	1.00	1.00	1.00	367.53	199.86	253.51	101.40
8	SQUARE	2.00	2.50	2.50	1.80	17.65	1.88	18.44	0.20	12	8.11	0.686	35.31	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.20	1.10	1.10	1.20	1.10	1.10	1.00	1.00	1.00	402.87	219.23	277.99	111.20
9	SQUARE	2.50	2.50	2.50	1.80	17.65	1.88	18.44	0.15	13	8.79	0.660	44.13	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.25	1.13	1.13	1.25	1.13	1.13	1.00	1.00	1.00	398.00	211.47	295.41	118.16

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	109.94	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.80	-	-	-	Depth of foundation						35.03
2	2	CLAY	1.50	3.00	1.50	1.88	0.660	0.130	0.00	40.31	41.63	-	-	36.195	-	
3	3	CLAY	3.00	4.00	1.00	1.91	0.669	0.134	0.00	63.50	15.46	-	-	7.598	-	

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80		
Width	1.20	metre	Applied Pressure at foundation base	124.94	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.80	0.000	0.000	0.00	Depth of foundation						33.59
2	2	CLAY	2.00	3.50	1.50	1.88	0.660	0.130	0.00	49.13	47.31	-	-	34.409	-	
3	3	CLAY	3.50	4.50	1.00	1.91	0.669	0.134	0.00	72.33	17.57	-	-	7.583	-	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80		
Width	1.20	metre	Applied Pressure at foundation base	135.32	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.88	0.000	0.000	0.00	Depth of foundation						31.52
2	2	CLAY	2.50	4.00	1.50	1.91	0.669	0.134	0.00	60.14	51.25	-	-	32.235	-	
3	3	CLAY	4.00	5.00	1.00	1.90	0.701	0.136	0.00	83.02	19.03	-	-	7.166	-	

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2	
Length	2.00	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80			
Width	2.00	metre	Applied Pressure at foundation base	103.63	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.80	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.88	0.660	0.130	0.00	40.31	54.81	-	-	43.803	-	47.18
3	3	CLAY	3.00	4.50	1.50	1.91	0.669	0.134	0.00	68.18	22.95	-	-	15.174	-	

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2	
Length	2.00	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80			
Width	2.00	metre	Applied Pressure at foundation base	114.12	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement	
		CLAY					e	C _c	N''	P _o	ΔP		W'				
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)	
1	1	CLAY	0.00	2.00	2.00	1.80	0.000	0.000	0.00	Depth of foundation						44.68	
2	2	CLAY	2.00	3.50	1.50	1.88	0.660	0.130	0.00	49.13	60.36	-	-	40.881	-		
3	3	CLAY	3.50	5.00	1.50	1.91	0.669	0.134	0.00	76.27	25.27	-	-	14.968	-		

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.00	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	121.57	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.88	0.000	0.000	0.00	Depth of foundation						41.68
2	2	CLAY	2.50	4.00	1.50	1.91	0.669	0.134	0.00	60.14	64.30	-	-	38.032	-	
3	3	CLAY	4.00	5.50	1.50	1.90	0.701	0.136	0.00	86.83	26.92	-	-	14.067	-	

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

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	101.40	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.80	0.000	0.000	0.00	Depth of foundation						53.73
2	2	CLAY	1.50	3.50	2.00	1.88	0.660	0.130	0.00	44.92	51.73	-	-	52.126	-	
3	3	CLAY	3.50	5.25	1.75	1.91	0.669	0.134	0.00	78.52	21.94	-	-	15.034	-	

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

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	92.10	kN/m ²		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.80	0.000	0.000	0.00	Depth of foundation						50.00
2	2	CLAY	1.50	3.50	2.00	1.88	0.660	0.130	0.00	44.92	46.99	-	-	48.702	-	
3	3	CLAY	3.50	5.25	1.75	1.91	0.669	0.134	0.00	78.52	19.92	-	-	13.799	-	

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

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	111.20	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.88	0.000	0.000	0.00	Depth of foundation						49.84
2	2	CLAY	2.00	4.00	2.00	1.91	0.669	0.134	0.00	55.61	56.73	-	-	49.042	-	
3	3	CLAY	4.00	5.50	1.50	1.90	0.701	0.136	0.00	86.97	25.22	-	-	13.260	-	

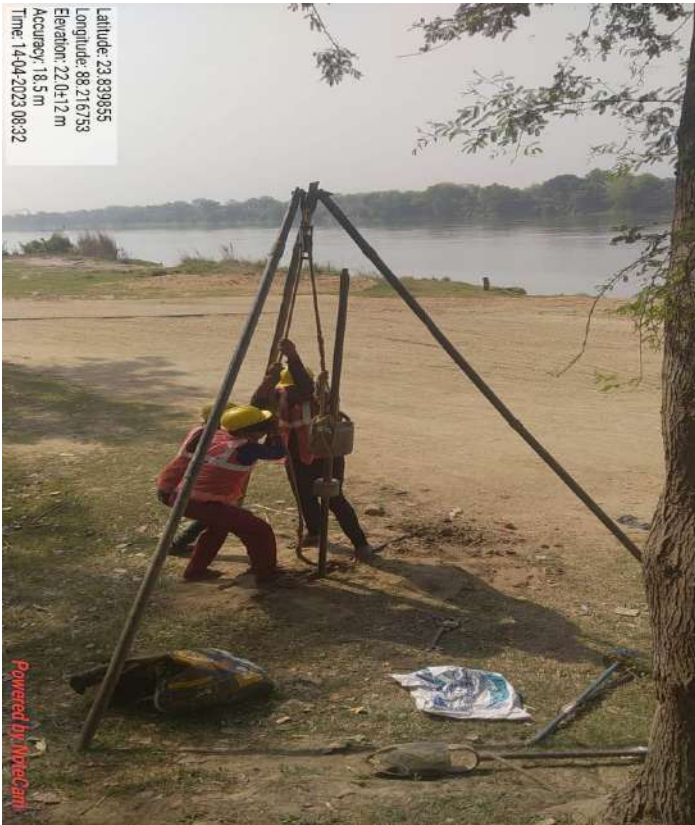
SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 6


Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80			
Width	2.50	metre	Applied Pressure at foundation base	118.16	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.88	0.000	0.000	0.00	Depth of foundation						48.68
2	2	CLAY	2.50	4.50	2.00	1.91	0.669	0.134	0.00	64.82	60.29	-	-	45.853	-	
3	3	CLAY	4.50	6.25	1.75	1.90	0.701	0.136	0.00	91.28	25.56	-	-	15.003	-	


SITE PHOTOS DURING SITE INVESTIGATION



RESULT SHEET

NAME OF THE PROJECT		CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GARDUARA FERRY GHAT IN WEST BENGAL																				
Client Name																						
Bore Hole No.	1 (L.H.S.)	Coordinate	Easting			Depth of Water Level			3.00			VIVEK MATERIAL TESTING LABORATORY							 VMT GEOTECH & MATERIAL TESTING			
Total depth of Bore Hole	10.00		Northing			Commenced on			4/14/2023													
			Elevation			Completed on			4/14/2023													
Depth of Bore Hole	Reduced Level	Types of Samples	% Material Passing IS Sieve				Atterberg Limits			IS group symbol	SPT Value	SPT Value corrected due to overburden	SPT Value corrected due to dilatancy	Wet Bulk Density	Original Moisture	Dry Bulk Density	Specific Gravity	Void Ratio	Shear Characteristics		Compression Index	
			4.750	2.000	0.425	0.075	LL	PL	PI										Cohesion	Angle of Internal Friction		
metre	metre		(mm)	(mm)	(mm)	(mm)	%	%	%		N	N'	N''	(gms/cc)	%	(gms/cc)	(G)		(Kg/sqcm)	(Ø)	(Cc)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
0.00 - 0.50	100.000 - 99.500	DS	100	100	98	90	34	22	12	CL					-	-	-	-	-	-	-	
1.00 - 1.35	99.000 - 98.650	UD	100	100	100	99	33	20	13	CL				1.78	16.2	1.53	2.60	0.699	0.15	11°	0.139	
1.35 - 1.80	98.650 - 98.200	SPT									4	5.49	5.49									
2.50 - 2.85	97.500 - 97.150	UD	100	100	100	99	36	18	18	CI				1.82	18.4	1.54	-	-	-	-	-	
2.85 - 3.30	97.150 - 96.700	SPT									5	7.19	7.19									
4.00 - 4.35	96.000 - 95.650	UD	100	100	100	98	37	20	17	CI				1.86	20.1	1.55	2.62	0.690	0.20	10°	0.137	
4.35 - 4.80	95.650 - 95.200	SPT									5	6.52	6.52									
5.50 - 5.85	94.500 - 94.150	UD	100	100	100	98	39	25	14	CI				1.90	21.2	1.57	-	-	-	-	-	
5.85 - 6.30	94.150 - 93.700	SPT									8	9.63	9.63									
7.00 - 7.35	93.000 - 92.650	UD	100	100	98	49	NON PLASTIC			SM				1.87	22.3	1.53	2.58	0.686	0	29°	-	
7.35 - 7.80	92.650 - 92.200	SPT									12	13.57	13.57									
8.50 - 8.85	91.500 - 91.150	UD	100	100	99	61	NON PLASTIC			ML				1.86	20.7	1.54	-	-	-	-	-	
8.85 - 9.30	91.150 - 90.700	SPT									14	14.99	14.99									
9.30 - 10.00	90.700 - 90.000	DS	100	100	99	54	NON PLASTIC			ML					-	-	-	-	-	-	-	-

RESULT SHEET

NAME OF THE PROJECT CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GARDUARA FERRY GHAT IN WEST BENGAL																							
Client Name																							
Bore Hole No.	2 (L.H.S.)		Coordinate			Easting			Depth of Water Level			4.50			VIVEK MATERIAL TESTING LABORATORY					 VMT GEOTECHNICAL MATERIAL TESTING			
Total depth of Bore Hole	10.00		Northing			100.000			Commenced on			4/14/2023											
Depth of Bore Hole	Reduced Level		% Material Passing IS Sieve				Atterberg Limits			IS group symbol	SPT Value	SPT Value corrected due to overburden	SPT Value corrected due to dilatancy	Wet Bulk Density								Original Moisture	Dry Bulk Density
metre	metre		4.750	2.000	0.425	0.075	LL	PL	PI		N	N'	N''	(gms/cc)	%	(gms/cc)	(G)		(Kg/sqcm)	(θ)	(Cc)		
1	2		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
0.00 - 0.50	100.000	99.500	DS	100	100	99	79	30	16	14	CL												
1.00 - 1.35	99.000	98.650	UD	100	100	100	97	32	22	10	CL				1.80	15.6	1.56	2.63	0.686	0.20	12°	0.138	
1.35 - 1.80	98.650	98.200	SPT									5	6.84	6.84									
2.50 - 2.85	97.500	97.150	UD	100	100	100	99	34	21	13	CL				1.88	18.4	1.59	-	-	-	-	-	
2.85 - 3.30	97.150	96.700	SPT									7	8.11	8.11									
4.00 - 4.35	96.000	95.650	UD	100	100	100	98	38	22	16	CI				1.91	21.8	1.57	2.62	0.669	0.25	9°	0.134	
4.35 - 4.80	95.650	95.200	SPT									6	7.71	7.71									
5.50 - 5.85	94.500	94.150	UD	100	100	100	99	39	26	13	CI				1.90	23.1	1.54	-	-	-	-	-	
5.85 - 6.30	94.150	93.700	SPT									5	5.96	5.96									
7.00 - 7.35	93.000	92.650	UD	100	100	100	99	40	20	20	CI				1.99	24.2	1.60	2.65	0.656	0.15	12°	0.132	
7.35 - 7.80	92.650	92.200	SPT									8	8.89	8.89									
8.50 - 8.85	91.500	91.150	UD	100	100	100	60	NON PLASTIC			ML				1.87	23.3	1.52	-	-	-	-	-	
8.85 - 9.30	91.150	90.700	SPT									13	13.71	13.71									
9.30 - 10.00	90.700	90.000	DS	100	100	100	54	NON PLASTIC			ML												

BORE-LOG CHART



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NAME OF THE PROJECT:- CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GARDUARA
FERRY GHAT IN WEST BENGAL

WATER TABLE 3.00 METRE DEPTH BELOW GROUND LEVEL

BORE HOLE NO.:- 01 (L.H.S.)

DEPTH IN METRES BELOW GROUND LEVEL	VISUAL FIELD OBSERVATIONS	SAMPLE	I.S.		S.P.T. VALUE				S.P.T. VALUES											
			GROUP	HATCHING	N1	N2	N3	N2+N3	10	20	30	40	50	60	70	80	90	100		
0.00-0.50	SILTY-CLAY	D.	CL																	
1.00-1.35	SILTY-CLAY	U.D.	CL																	
1.35-1.80		S.P.T.				1	2	2	4											
2.50-2.85	SILTY-CLAY	U.D.	CI																	
2.85-3.30		S.P.T.				2	2	3	5											
4.00-4.35	SILTY-CLAY	U.D.	CI																	
4.35-4.80		S.P.T.				2	2	3	5											
5.50-5.85	SILTY-CLAY	U.D.	CI																	
5.85-6.30		S.P.T.				2	3	5	8											
7.00-7.35	SILTY-SAND	U.D.	SM																	
7.35-7.80		S.P.T.				3	5	7	12											
8.50-8.85	SANDY-SILT	U.D.	ML																	
8.85-9.30		S.P.T.				5	6	8	14											
9.30-10.00	SANDY-SILT	D.	ML																	

BORE-LOG CHART



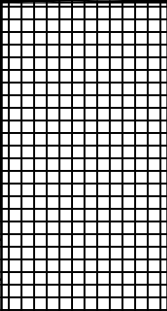
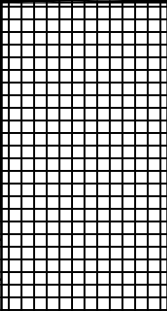
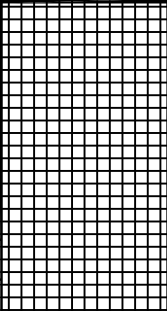
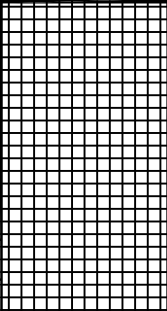
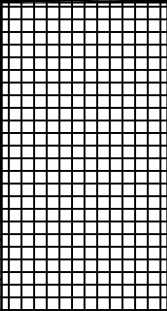
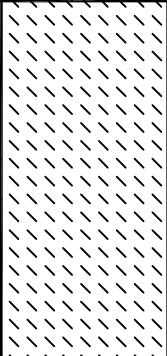
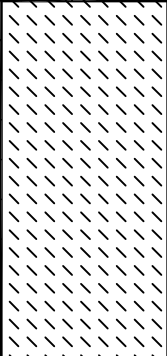
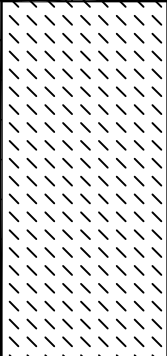
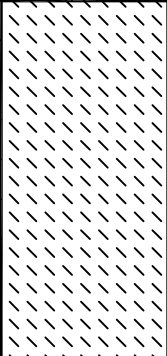
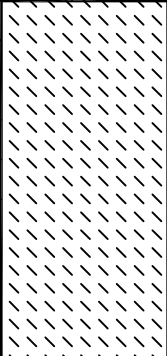
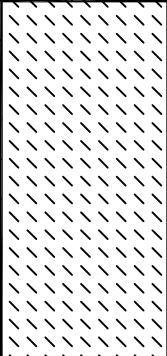
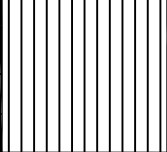
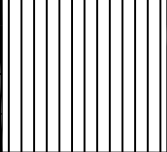
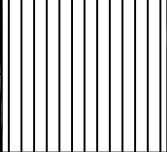
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NAME OF THE PROJECT:- CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GARDUARA
FERRY GHAT IN WEST BENGAL

WATER TABLE 4.50 METRE DEPTH BELOW GROUND LEVEL

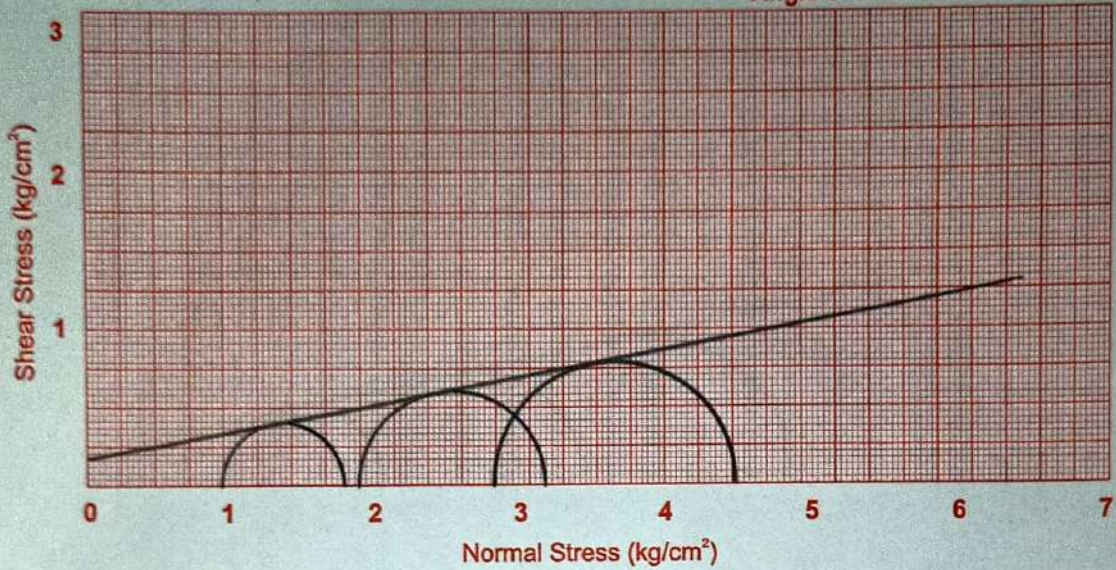
BORE HOLE NO.:- 02 (L.H.S.)

DEPTH IN METRES BELOW GROUND LEVEL	VISUAL FIELD OBSERVATIONS	SAMPLE	I.S.		S.P.T. VALUE				S.P.T. VALUES																			
			GROUP	HATCHING	N1	N2	N3	N2+N3	10	20	30	40	50	60	70	80	90	100										
0.00-0.50	SILTY-CLAY	D.	CL																									
1.00-1.35	SILTY-CLAY	U.D.	CL																									
1.35-1.80		S.P.T.			1	2	3	5																				
2.50-2.85	SILTY-CLAY	U.D.	CL																									
2.85-3.30		S.P.T.			2	3	4	7																				
4.00-4.35	SILTY-CLAY	U.D.	CI																									
4.35-4.80		S.P.T.			2	2	4	6																				
5.50-5.85	SILTY-CLAY	U.D.	CI																									
5.85-6.30		S.P.T.			2	2	3	5																				
7.00-7.35	SILTY-CLAY	U.D.	CI																									
7.35-7.80		S.P.T.			3	4	4	8																				
8.50-8.85	SANDY-SILT	U.D.	ML																									
8.85-9.30		S.P.T.			5	6	7	13																				
9.30-10.00	SANDY-SILT	D.	ML																									



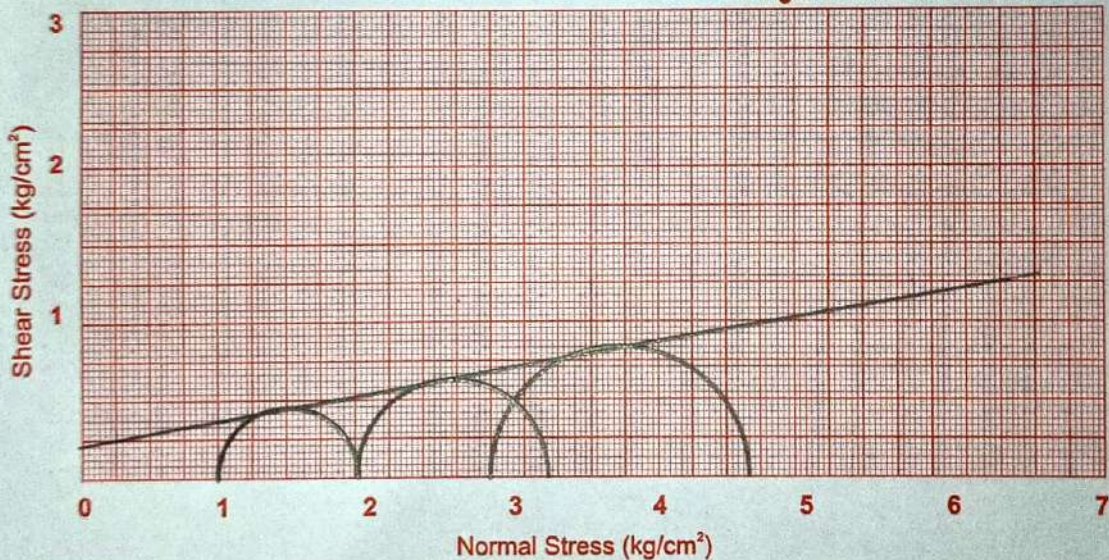
B.H. No. :- 01
Depth :- 1.00-1.35

Cohesion 'c' 0.15 Kg/cm²
Angle of Internal Friction 11°*



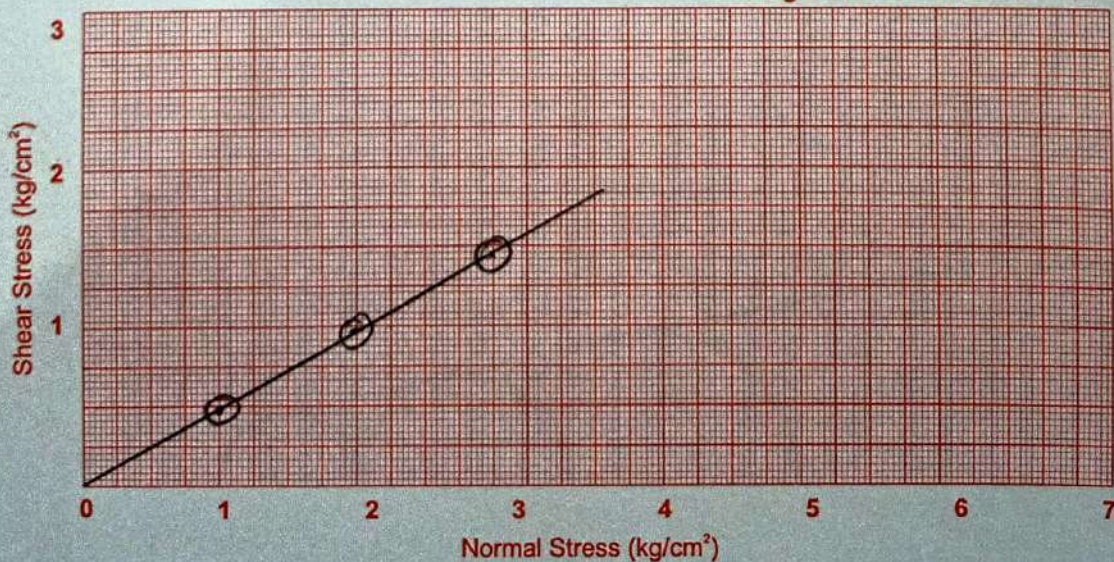
B.H. No. :- 01
Depth :- 4.00-4.35

Cohesion 'c' 0.20 Kg/cm²
Angle of Internal Friction 10°*



B.H. No. :- 01
Depth :- 7.00-7.35

Cohesion 'c' 0.00 Kg/cm²
Angle of Internal Friction 29°*

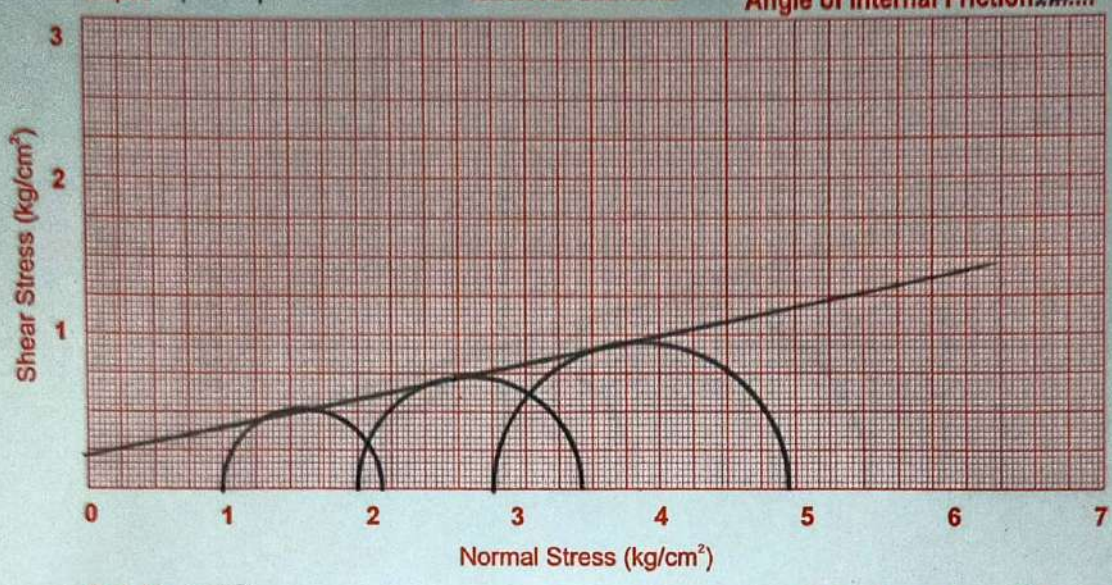




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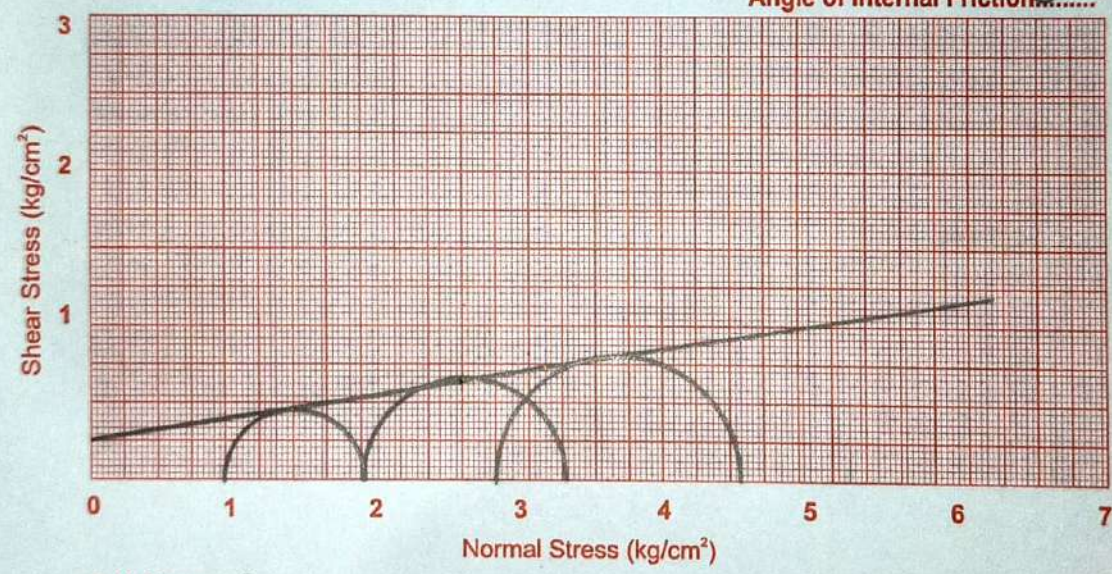
B.H. No. :- 02
Depth - 1.00-1.35

Cohesion 'c' 0.20 Kg/cm²
Angle of Internal Friction 12°*



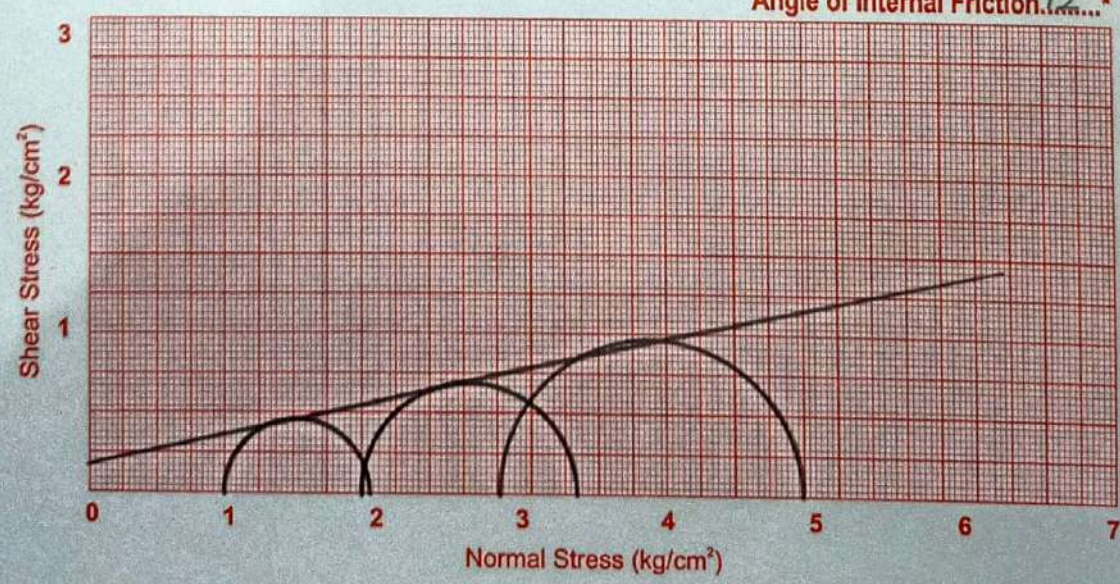
B.H. No. :- 02
Depth :- 4.00-4.35

Cohesion 'c' 0.25 Kg/cm²
Angle of Internal Friction 9°*



B.H. No. :- 02
Depth :- 7.00-7.35

Cohesion 'c' 0.15 Kg/cm²
Angle of Internal Friction 12°*





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IC-8969

REPORT NO. – VMT 129 A/2023-2024

GEOTECH INVESTIGATION

REPORT FOR

PROPOSED CONSTRUCTION

OF

BOAT IN THE IDENTIFIED

COMMUNITY JETTY

AT MAGANPARA IN

WEST BENGAL

Prepared By -

**VIVEK MATERIAL TESTING
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ACKNOWLEDGEMENT

WE ARE GRATEFUL TO M/s KITCO LTD., KERLA FOR PROVIDING US THE OPPORTUNITY TO CARRY OUT THESE INVESTIGATIONS.

THE CO-OPERATION EXTENDED BY THEIR ENGINEERS DURING FIELD INVESTIGATIONS IS THANKFULLY ACKNOWLEDGED.

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**SUB-SOIL INVESTIGATION REPORT FOR PROPOSED CONSTRUCTION OF BOAT
IN THE IDENTIFIED COMMUNITY JETTY AT GARDUARA FERRY GHAT IN WEST
BENGAL**

INTRODUCTION

The work of sub-soil exploration was awarded to us by M/s KITCO LTD., KERLA Order no. – 6777:DP 1083: RG: 2023 dated 21/03/2023. The object of the investigation was to study the geo-technical properties of soil both in field and laboratory and determine safe allowable pressure for the foundation soil.

The fieldwork consisted of 02 bore holes of 10.00 metre depth each. The fieldwork was conducted on 13/04/2023. The location of the bore holes is shown in the Site location.

REFERENCES

1. **IS: 1892-2021** for field work including existent ground water table.
2. **IS: 2132-1986** for sampling in Undisturbed and Disturbed form.
3. **IS: 2131-1981** for Standard Penetration Test.
4. **IS: 2720** for all laboratory tests on soil samples collected.
5. **IS: 6403-1981** for determination of Bearing Capacity.
6. **IS: 8009(Part I)-1976** for calculation of settlement of foundations.
7. **IS: 1904-2021** for permissible maximum settlement, differential settlement and angular distortion.

SCOPE OF WORK

The scope consisted of drilling of boreholes down to maximum depth of 10.00 m in normal soils / rock, Standard Penetration Testing, collection of samples, laboratory testing and preparation and submission of Geotechnical Investigation report.

Summary of the fieldwork					
Sl. No.	Site	Borehole Nos.	Coordinates		Depth below existing ground level (m)
			Latitude	Longitude	
1.	MAGANPARA	BH-01 (RHS)	23.83807188	88.21512401	10.0
2.		BH-02 (RHS)	23.83845431	88.21508244	10.0



SITE LOCATION



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INTERPRETATION OF THE LAB TEST RESULTS

GENERAL NATURE OF SOIL STRATA

The bore hole log charts and lab test results of bore holes 1 and 2 indicate that the strata at the site is found to comprise of both cohesive as well as non-cohesive soil.

The results of classification tests indicate that the natural soil stratum present at the Site is found to comprise of both fine-grained soils comprising of 'CL' group of IS classification (clayey soil) having 95 to 99 percent material finer than 75 micron and coarse-grained soils (sandy soil) comprise of 'SM' group of IS classification having 31 to 49 percent material finer than 75 micron.

The bore hole log charts and lab test results of bore holes 1 indicate that:

first strata, from 0.00 metre to 7.00 metre, consists of a layer of CL group of IS classification which is inorganic clays of low plasticity,

second strata, from 7.00 metre to 10.00 metre, consists of a layer of SM group of IS classification which is silty Sand with none plasticity.

The bore hole log charts and lab test results of bore holes 2 indicate that:

first strata, from 0.00 metre to 2.50 metre, consists of a layer of CL group of IS classification which is inorganic clays of low plasticity,

second strata, from 2.50 metre to 10.00 metre, consists of a layer of SM group of IS classification which is silty Sand with none plasticity.

S.P.T. VALUES

The S.P.T. values obtained in the respective clayey layer region present as per bore-log charts enclosed are found to range 5 to 8 indicating 'Medium' consistency.

However, the S.P.T. values obtained in the respective sandy layer region present as per bore-log charts enclosed are found to range from 9 to 19 indicating 'Loose' to 'Medium' relative density.

The results of S.P.T. values indicate that the stratum at the Site is 'Loose' to 'Well' compacted.

WATER TABLE

Water Table at the Site was observed at a depth from 1.30 metre to 5.40 metre below ground level on the day of soil investigation during the Third week of April 2023. However, the existing water table may rise by 1.00 metre in the post-monsoon period in general. Therefore, a water table at a depth of 0.30 metre to 4.40 metre below ground level has been adopted for calculation purposes.

RECOMMENDATIONS FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GARDUARA FERRY GHAT IN WEST BENGAL NET SAFE BEARING CAPACITY

Bore Hole Nos.	Type of Structure	Depth of Foundation (metres)	Size of Footing (L x B) (metres)	Net Safe Bearing Capacity (Tonne/sqm.)	Settlement Produced (mm)
1	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	9.95	32.09
		2.00	1.20 x 1.20	11.51	31.10
		2.50	1.20 x 1.20	11.98	27.42
		1.50	2.00 x 2.00	9.47	43.50
		2.00	2.00 x 2.00	10.70	41.75
		2.50	2.00 x 2.00	11.09	37.11
		1.50	2.50 x 2.50	9.44	48.39
		2.00	2.50 x 2.50	10.53	45.63
		2.50	2.50 x 2.50	10.80	42.74
2	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	7.92	12.43
		2.00	1.20 x 1.20	9.07	14.23
		2.50	1.20 x 1.20	8.36	11.36
		1.50	2.00 x 2.00	7.48	19.98
		2.00	2.00 x 2.00	8.38	22.38
		2.50	2.00 x 2.00	8.19	18.92
		1.50	2.50 x 2.50	7.44	20.27
		2.00	2.50 x 2.50	8.26	19.72
		2.50	2.50 x 2.50	8.31	19.58

NOTE: -

The above recommendations are based on the field investigation data results and the laboratory tests results of the samples collected from the test locations and our experience in this regard. If the actual sub-soil conditions during excavation for the

foundations differ from that has been reported, a reference should be made to us for suggestions.

Further, the recommendations are based on the assumptions as mentioned in the Report and the designer of the Structure should take into consideration all the factors required as per codes. The recommendations should be taken as guidelines for the designer.

Er. Akhil Singh
TECHNICAL MANAGER
VIVEK MATERIAL TESTING
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BEARING CAPACITY CALCULATIONS

Soil when stressed due to loading, tend to deform. The resistance to deformation of the soil depends upon factors like water content, bulk density, angle of internal friction and the manner in which load is applied on the soil. The maximum load per unit area which the soil or rock can carry without yielding or displacement is termed as the bearing capacity of soils. The Safe Bearing Capacity of the proposed STRUCTURE without any distress is determined from the considerations of the following criteria.

[A] SHEAR CRITERIA

The soil beneath the foundation shall be safe from risk of shear failure.

[B] SETTLEMENT CRITERIA

The settlement due to load is caused basically on account of two factors, namely,

- (i) the soil below footing gets compressed by certain amount and
- (ii) since the foundations cover only a limited area there is a possibility that the concentrated stresses developed are so high as to cause actual rupture (shear failure) and displacement of soil below.

The foundation should not settle or deflect to an extent causing damage to the Structure or impair its usefulness.

The Bearing Capacity Calculations for the Foundation shall be governed as per IS: 6403-1981, IS: 8009(Part-I)-1976 and IS: 1904-2021 on the basis of available information regarding the proposed design.

BEARING CAPACITY ON SHEAR CONSIDERATIONS**ULTIMATE NET BEARING CAPACITY**

As per IS: 6403-1981, the Ultimate Net Bearing Capacity 'qd' on shear consideration for a Structure is given by the formula: -

FOR GENERAL SHEAR FAILURE

$$q_d = c.N_c.S_c.d_c.i_c + q(N_q - 1).S_q.d_q.i_q + 1/2 B.r.N_r.S_r.d_r.i_r.W'$$

FOR LOCAL SHEAR FAILURE

$$q'd = 2/3 c.N'c.S'c.d'c.i'c + q(N'q - 1).S'q.d'q.i'q + 1/2 B.r.N'r.S'r.d'r.i'r.W'$$

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981



NAME OF PROJECT																																				
BOREHOLE 01 (R.H.S.)		Depth of borehole		10.00	metre		Water table below borehole level (m)		5.40	Factor of safety		2.50	Water table used for calculation (m)		4.40	Assumed post monsoon rise (m)		1.00																		
		Input Parameters												Shearing Resistance Parameters												Ultimate Net Bearing Capacity			Net Safe Bearing Capacity							
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance	Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors						Inclination Factors			General shear	Local shear	Intermediate	Net Safe Bearing Capacity		
					Bulk		Bulk		c	ϕ	ϕ'	e	Nc	Nq	Ny	Nc'	Nq'	Ny'	Sc	Sq	Sy	Dc	Dq	Dy	Dc'	Dq'	Dy'	lc	lq	ly						
		(m)	(m)	(m)	(gms/cc)	(kN/m3)	(gms/cc)	(kN/m3)	Kg/cm2	°	°		kN/m2																							
1	SQUARE	1.50	1.20	1.20	1.83	17.95	1.83	17.95	0.15	13	8.79	0.679	26.92	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.31	1.16	1.16	1.31	1.16	1.16	1.00	1.00	1.00	349.63	185.84	243.99	97.60	
2	SQUARE	2.00	1.20	1.20	1.83	17.95	1.85	18.14	0.15	13	8.79	0.679	35.89	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.42	1.21	1.21	1.42	1.21	1.21	1.00	1.00	1.00	404.40	215.07	282.28	112.91	
3	SQUARE	2.50	1.20	1.20	1.83	17.95	1.85	18.14	0.10	16	10.88	0.712	44.87	11.65	4.34	3.06	8.74	2.68	1.41	1.30	1.20	0.80	1.55	1.28	1.28	1.55	1.28	1.28	1.00	1.00	1.00	494.51	246.64	293.74	117.50	
4	SQUARE	1.50	2.00	2.00	1.83	17.95	1.83	17.95	0.15	13	8.79	0.679	26.92	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.19	1.09	1.09	1.19	1.09	1.09	1.00	1.00	1.00	333.20	176.74	232.28	92.91	
5	SQUARE	2.00	2.00	2.00	1.83	17.95	1.85	18.14	0.15	13	8.79	0.679	35.89	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.25	1.13	1.13	1.25	1.13	1.13	1.00	1.00	1.00	376.33	199.75	262.44	104.98	
6	SQUARE	2.50	2.00	2.00	1.83	17.95	1.85	18.14	0.10	16	10.88	0.712	44.87	11.65	4.34	3.06	8.74	2.68	1.41	1.30	1.20	0.80	1.33	1.17	1.17	1.33	1.17	1.17	1.00	1.00	1.00	458.60	227.97	271.79	108.72	
7	SQUARE	1.50	2.50	2.50	1.83	17.95	1.83	17.95	0.15	13	8.79	0.679	26.92	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.15	1.08	1.08	1.15	1.08	1.08	1.00	1.00	1.00	332.34	176.06	231.54	92.62	
8	SQUARE	2.00	2.50	2.50	1.83	17.95	1.85	18.14	0.15	13	8.79	0.679	35.89	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.20	1.10	1.10	1.20	1.10	1.10	1.00	1.00	1.00	370.27	196.33	258.08	103.23	
9	SQUARE	2.50	2.50	2.50	1.83	17.95	1.85	18.14	0.10	16	10.88	0.712	44.87	11.65	4.34	3.06	8.74	2.68	1.41	1.30	1.20	0.80	1.27	1.13	1.13	1.27	1.13	1.13	1.00	1.00	1.00	447.04	221.99	264.75	105.90	

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	5.40	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	97.60	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.83	-	-	-	Depth of foundation						32.09
2	2	CLAY	1.50	3.00	1.50	1.85	0.712	0.136	0.00	40.53	36.96	-	-	33.542	-	
3	3	CLAY	3.00	4.00	1.00	1.91	0.682	0.130	0.00	63.50	13.73	-	-	6.568	-	

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	5.40	(m) bgl		Rigidity factor	0.80		
Width	1.20	metre	Applied Pressure at foundation base	112.91	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.83	0.000	0.000	0.00	Depth of foundation						31.10
2	2	CLAY	2.00	3.50	1.50	1.85	0.712	0.136	0.00	49.50	42.76	-	-	32.220	-	
3	3	CLAY	3.50	4.50	1.00	1.91	0.682	0.130	0.00	72.47	15.88	-	-	6.649	-	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	5.40	(m) bgl		Rigidity factor	0.80		
Width	1.20	metre	Applied Pressure at foundation base	117.50	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.85	0.000	0.000	0.00	Depth of foundation						27.42
2	2	CLAY	2.50	4.00	1.50	1.91	0.682	0.130	0.00	59.41	44.50	-	-	28.148	-	
3	3	CLAY	4.00	5.00	1.00	1.94	0.660	0.129	0.00	82.97	16.52	-	-	6.130	-	

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	5.40	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	92.91	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.83	-	-	-	Depth of foundation						43.50
2	2	CLAY	1.50	3.00	1.50	1.85	0.712	0.136	0.00	40.53	49.14	-	-	41.098	-	
3	3	CLAY	3.00	4.50	1.50	1.91	0.682	0.130	0.00	68.18	20.58	-	-	13.278	-	

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	5.40	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	104.98	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.83	0.000	0.000	0.00	Depth of foundation						41.75
2	2	CLAY	2.00	3.50	1.50	1.85	0.712	0.136	0.00	49.50	55.53	-	-	38.928	-	
3	3	CLAY	3.50	5.00	1.50	1.91	0.682	0.130	0.00	77.16	23.25	-	-	13.261	-	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	5.40	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	108.72	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.85	0.000	0.000	0.00	Depth of foundation						37.11
2	2	CLAY	2.50	4.00	1.50	1.91	0.682	0.130	0.00	59.41	57.50	-	-	34.087	-	
3	3	CLAY	4.00	5.50	1.50	1.94	0.660	0.129	0.00	87.59	24.08	-	-	12.294	-	

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

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	5.40	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	92.62	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.85	0.000	0.000	0.00	Depth of foundation						48.39
2	2	CLAY	1.50	3.50	2.00	1.91	0.682	0.130	0.00	45.95	47.26	-	-	47.482	-	
3	3	CLAY	3.50	5.25	1.75	1.94	0.660	0.129	0.00	81.32	20.04	-	-	13.008	-	

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

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	5.40	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	103.23	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.85	0.000	0.000	0.00	Depth of foundation						45.63
2	2	CLAY	2.00	4.00	2.00	1.91	0.682	0.130	0.00	55.02	52.67	-	-	45.084	-	
3	3	CLAY	4.00	5.50	1.50	1.94	0.660	0.129	0.00	87.88	23.41	-	-	11.954	-	

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

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	5.40	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	105.90	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.85	0.000	0.000	0.00	Depth of foundation						42.74
2	2	CLAY	2.50	4.50	2.00	1.91	0.682	0.130	0.00	64.09	54.03	-	-	41.047	-	
3	3	CLAY	4.50	6.25	1.75	1.94	0.660	0.129	0.00	98.30	22.91	-	-	12.373	-	

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981



NAME OF PROJECT																													Net Safe Bearing Capacity						
BOREHOLE 02 (R.H.S.)		Depth of borehole		10.00	metre		Water table below borehole level (m)		1.30	Factor of safety		2.50		Water table used for calculation (m)		0.30	Assumed post monsoon rise (m)		1.00																
		Input Parameters												Shearing Resistance Parameters												Ultimate Net Bearing Capacity									
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance		Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors						Inclination Factors			General shear	Local shear	Intermediate	
		(m)	(m)	(m)	(gms/cc)	(kN/m3)	(gms/cc)	(kN/m3)	Kg/cm2	φ	φ'	e	q	Nc	Nq	Ny	Nc'	Nq'	Ny'	Sc	Sq	Sy	Dc	Dq	Dy	Dc'	Dq'	Dy'	lc	lq	ly				
1	SQUARE	1.50	1.20	1.20	1.83	10.10	1.83	10.10	0.10	17	11.58	0.695	15.15	12.33	4.77	3.53	9.08	2.86	1.58	1.30	1.20	0.80	1.34	1.17	1.17	1.34	1.17	1.17	1.00	1.00	1.00	308.63	150.94	194.30	77.72
2	SQUARE	2.00	1.20	1.20	1.83	9.61	1.78	9.12	0.10	17	11.58	0.695	19.22	12.33	4.77	3.53	9.08	2.86	1.58	1.30	1.20	0.80	1.45	1.23	1.23	1.45	1.23	1.23	1.00	1.00	1.00	353.09	172.82	222.39	88.96
3	SQUARE	2.50	1.20	1.20	1.83	9.32	1.78	8.83	0.00	26	18.10	0.735	23.29	22.25	11.85	12.53	13.19	5.31	4.12	1.30	1.20	0.80	1.67	1.33	1.33	1.67	1.33	1.33	1.00	1.00	1.00	473.15	183.17	204.92	81.97
4	SQUARE	1.50	2.00	2.00	1.83	10.10	1.83	10.10	0.10	17	11.58	0.695	15.15	12.33	4.77	3.53	9.08	2.86	1.58	1.30	1.20	0.80	1.20	1.10	1.10	1.20	1.10	1.10	1.00	1.00	1.00	291.91	142.29	183.44	73.38
5	SQUARE	2.00	2.00	2.00	1.83	9.61	1.78	9.12	0.10	17	11.58	0.695	19.22	12.33	4.77	3.53	9.08	2.86	1.58	1.30	1.20	0.80	1.27	1.14	1.14	1.27	1.14	1.14	1.00	1.00	1.00	326.87	159.50	205.53	82.21
6	SQUARE	2.50	2.00	2.00	1.83	9.32	1.78	8.83	0.00	26	18.10	0.735	23.29	22.25	11.85	12.53	13.19	5.31	4.12	1.30	1.20	0.80	1.40	1.20	1.20	1.40	1.20	1.20	1.00	1.00	1.00	468.90	179.08	200.82	80.33
7	SQUARE	1.50	2.50	2.50	1.83	10.10	1.83	10.10	0.10	17	11.58	0.695	15.15	12.33	4.77	3.53	9.08	2.86	1.58	1.30	1.20	0.80	1.16	1.08	1.08	1.16	1.08	1.08	1.00	1.00	1.00	290.59	141.36	182.40	72.96
8	SQUARE	2.00	2.50	2.50	1.83	9.61	1.78	9.12	0.10	17	11.58	0.695	19.22	12.33	4.77	3.53	9.08	2.86	1.58	1.30	1.20	0.80	1.22	1.11	1.11	1.22	1.11	1.11	1.00	1.00	1.00	322.50	157.08	202.57	81.03
9	SQUARE	2.50	2.50	2.50	1.83	9.32	1.78	8.83	0.00	26	18.10	0.735	23.29	22.25	11.85	12.53	13.19	5.31	4.12	1.30	1.20	0.80	1.32	1.16	1.16	1.32	1.16	1.16	1.00	1.00	1.00	478.64	181.45	203.74	81.50

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	1.30	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	77.72	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement	
		CLAY					e	Cc	N''	P _o	ΔP		W'				
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)	
1	1	CLAY	0.00	1.50	1.50	1.83	-	-	-	Depth of foundation							12.43
2	2	SAND	1.50	3.00	1.50	1.78	0.000	0.000	12.92	30.70	29.43	0.199	0.500	-	11.727		
3	3	SAND	3.00	4.00	1.00	1.86	0.000	0.000	14.33	40.65	10.93	0.174	0.500	-	3.813		

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2	
Length	1.20	metre	Water Table depth for calculation	1.30	(m) bgl		Rigidity factor	0.80			
Width	1.20	metre	Applied Pressure at foundation base	88.96	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.83	0.000	0.000	0.00	Depth of foundation						14.23
2	2	SAND	2.00	3.50	1.50	1.78	0.000	0.000	12.92	34.77	33.69	0.199	0.500	-	13.423	
3	3	SAND	3.50	4.50	1.00	1.86	0.000	0.000	14.33	44.72	12.51	0.174	0.500	-	4.364	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	1.30	(m) bgl		Rigidity factor	0.80		
Width	1.20	metre	Applied Pressure at foundation base	81.97	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	SAND	0.00	2.50	2.50	1.78	0.000	0.000	0.00	Depth of foundation						11.36
2	2	SAND	2.50	4.00	1.50	1.86	0.000	0.000	14.33	38.20	31.04	0.174	0.500	-	10.829	
3	3	SAND	4.00	5.00	1.00	1.89	0.000	0.000	16.54	48.89	11.53	0.146	0.500	-	3.365	

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	2.00	metre	Water Table depth for calculation	1.30	(m) bgl		Rigidity factor	0.80	
Width	2.00	metre	Applied Pressure at foundation base	73.38	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement	
		CLAY					e	Cc	N''	P _o	ΔP		W'				
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)	
1	1	CLAY	0.00	1.50	1.50	1.83	-	-	-	Depth of foundation							19.98
2	2	SAND	1.50	3.00	1.50	1.78	0.000	0.000	12.92	30.70	38.81	0.235	0.500	-	18.271		
3	3	SAND	3.00	4.50	1.50	1.86	0.000	0.000	14.33	42.76	16.25	0.206	0.500	-	6.698		

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.00	metre	Water Table depth for calculation	1.30	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	82.21	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.83	0.000	0.000	0.00	Depth of foundation						22.38
2	2	SAND	2.00	3.50	1.50	1.78	0.000	0.000	12.92	34.77	43.48	0.235	0.500	-	20.470	
3	3	SAND	3.50	5.00	1.50	1.86	0.000	0.000	14.33	46.83	18.21	0.206	0.500	-	7.504	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	2.00	metre	Water Table depth for calculation	1.30	(m) bgl		Rigidity factor	0.80	
Width	2.00	metre	Applied Pressure at foundation base	80.33	kN/m ²		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	SAND	0.00	2.50	2.50	1.78	0.000	0.000	0.00	Depth of foundation						18.92
2	2	SAND	2.50	4.00	1.50	1.86	0.000	0.000	14.33	38.20	42.49	0.206	0.500	-	17.513	
3	3	SAND	4.00	5.50	1.50	1.89	0.000	0.000	16.54	51.07	17.79	0.172	0.500	-	6.136	

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

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	1.30	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	72.96	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.83	0.000	0.000	0.00	Depth of foundation						20.27
2	2	SAND	1.50	3.50	2.00	1.78	0.000	0.000	12.92	32.61	37.22	0.248	0.500	-	18.475	
3	3	SAND	3.50	5.25	1.75	1.86	0.000	0.000	14.33	47.64	15.78	0.217	0.500	-	6.859	

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

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	1.30	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	81.03	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	SAND	0.00	2.00	2.00	1.78	0.000	0.000	0.00	Depth of foundation						19.72
2	2	SAND	2.00	4.00	2.00	1.86	0.000	0.000	14.33	36.48	41.34	0.217	0.500	-	17.965	
3	3	SAND	4.00	5.50	1.50	1.89	0.000	0.000	16.54	51.46	18.37	0.182	0.500	-	6.681	

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

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	1.30	(m) bgl		Rigidity factor	0.80			
Width	2.50	metre	Applied Pressure at foundation base	81.50	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	SAND	0.00	2.50	2.50	1.78	0.000	0.000	0.00	Depth of foundation						19.58
2	2	SAND	2.50	4.50	2.00	1.86	0.000	0.000	14.33	40.31	41.58	0.217	0.500	-	18.069	
3	3	SAND	4.50	6.25	1.75	1.89	0.000	0.000	16.54	56.38	17.63	0.182	0.500	-	6.411	

SITE PHOTOS DURING SITE INVESTIGATION



VIVEK MATERIAL TESTING LABORATORY

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RESULT SHEET

NAME OF THE PROJECT																					
CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GARDUARA FERRY GHAT IN WEST BENGAL																					
Client Name																					
Bore Hole No.		1 (R.H.S.)		Coordinate			Easting			Depth of Water Level			5.40			 VIVEK MATERIAL TESTING LABORATORY <small>GEOTECHNICAL MATERIAL TESTING</small>					
Total depth of Bore Hole		10.00		Northing			Commenced on			4/13/2023											
				Elevation			100.000			Completed on			4/13/2023								
Depth of Bore Hole	Reduced Level	Types of Samples	% Material Passing IS Sieve				Atterberg Limits			IS group symbol	SPT Value	SPT Value corrected due to overburden	SPT Value corrected due to dilatancy	Wet Bulk Density	Original Moisture	Dry Bulk Density	Specific Gravity	Void Ratio	Shear Characteristics		Compression Index
			4.750	2.000	0.425	0.075	LL	PL	PI										Cohesion	Angle of Internal Friction	
metre	metre		(mm)	(mm)	(mm)	(mm)	%	%	%		N	N'	N''	(gms/cc)	%	(gms/cc)	(G)		(Kg/sqcm)	(ϕ)	(Cc)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
0.00 - 0.50	100.000 - 99.500	DS	98	98	97	95	29	21	8	CL					-	-	-	-	-	-	-
1.00 - 1.35	99.000 - 98.650	UD	100	100	99	98	30	20	10	CL				1.83	17.3	1.56	2.62	0.679	0.15	13°	0.134
1.35 - 1.80	98.650 - 98.200	SPT									6	8.18	8.18								
2.50 - 2.85	97.500 - 97.150	UD	100	100	100	98	32	21	11	CL				1.85	20.8	1.53	-	-	-	-	-
2.85 - 3.30	97.150 - 96.700	SPT									5	5.80	5.80								
4.00 - 4.35	96.000 - 95.650	UD	100	100	100	99	28	20	8	CL				1.91	21.4	1.57	2.64	0.682	0.20	14°	0.130
4.35 - 4.80	95.650 - 95.200	SPT									7	7.21	7.21								
5.50 - 5.85	94.500 - 94.150	UD	100	100	100	99	31	20	11	CL				1.94	22.3	1.59	-	-	-	-	-
5.85 - 6.30	94.150 - 93.700	SPT									8	9.51	9.51								
7.00 - 7.35	93.000 - 92.650	UD	100	100	100	33	NON PLASTIC			SM				1.88	23.1	1.53	2.58	0.686	0	28°	-
7.35 - 7.80	92.650 - 92.200	SPT									13	14.52	14.52								
8.50 - 8.85	91.500 - 91.150	UD	100	100	100	31	NON PLASTIC			SM				1.89	21.1	1.56	-	-	-	-	-
8.85 - 9.30	91.150 - 90.700	SPT									15	15.87	15.44								
9.30 - 10.00	90.700 - 90.000	DS	100	100	99	31	NON PLASTIC			SM					-	-	-	-	-	-	-

RESULT SHEET

NAME OF THE PROJECT		CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GARDUARA FERRY GHAT IN WEST BENGAL																			
Client Name																					
Bore Hole No.	2 (R.H.S.)	Coordinate	Easting			Depth of Water Level			1.30			VIVEK MATERIAL TESTING LABORATORY						 VMT GEOTECH & MATERIAL TESTING			
Total depth of Bore Hole	10.00		Northing			Commenced on			4/13/2023												
			Elevation			Completed on			4/13/2023												
Depth of Bore Hole	Reduced Level	Types of Samples	% Material Passing IS Sieve				Atterberg Limits			IS group symbol	SPT Value	SPT Value corrected due to overburden	SPT Value corrected due to dilatancy	Wet Bulk Density	Original Moisture	Dry Bulk Density	Specific Gravity	Void Ratio	Shear Characteristics		Compression Index
			4.750	2.000	0.425	0.075	LL	PL	PI										Cohesion	Angle of Internal Friction	
metre	metre		(mm)	(mm)	(mm)	(mm)	%	%	%		N	N'	N''	(gms/cc)	%	(gms/cc)	(G)		(Kg/sqcm)	(ϕ)	(Cc)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
0.00 - 0.50	100.000 - 99.500	DS	100	100	100	95	28	18	10	CL					-	-	-	-	-	-	-
1.00 - 1.35	99.000 - 98.650	UD	100	100	100	96	31	20	11	CL				1.83	18.6	1.54	2.61	0.695	0.10	17°	0.136
1.35 - 1.80	98.650 - 98.200	SPT									5	8.15	8.15								
2.50 - 2.85	97.500 - 97.150	UD	100	100	100	38	NON PLASTIC			SM				1.78	21.3	1.47	-	-	-	-	-
2.85 - 3.30	97.150 - 96.700	SPT									9	12.92	12.92								
4.00 - 4.35	96.000 - 95.650	UD	100	100	100	41	NON PLASTIC			SM				1.86	23.2	1.51	2.57	0.702	0	27°	-
4.35 - 4.80	95.650 - 95.200	SPT									11	14.33	14.33								
5.50 - 5.85	94.500 - 94.150	UD	100	100	100	35	NON PLASTIC			SM				1.89	22.1	1.55	-	-	-	-	-
5.85 - 6.30	94.150 - 93.700	SPT									15	18.07	16.54								
7.00 - 7.35	93.000 - 92.650	UD	100	100	100	49	NON PLASTIC			SM				1.91	20.7	1.58	2.56	0.620	0	30°	-
7.35 - 7.80	92.650 - 92.200	SPT									17	19.18	17.09								
8.50 - 8.85	91.500 - 91.150	UD	100	100	100	44	NON PLASTIC			SM				1.89	18.3	1.60	-	-	-	-	-
8.85 - 9.30	91.150 - 90.700	SPT									19	20.27	17.64								
9.30 - 10.00	90.700 - 90.000	DS	100	100	99	38	NON PLASTIC			SM					-	-	-	-	-	-	-

BORE-LOG CHART



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GEOTECH & MATERIAL TESTING

VIVEK MATERIAL TESTING LABORATORY

NAME OF THE PROJECT:- CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GARDUARA FERRY GHAT IN WEST BENGAL

WATER TABLE 5.40 METRE DEPTH BELOW GROUND LEVEL

BORE HOLE NO.:- 01

DEPTH IN METRES BELOW GROUND LEVEL	VISUAL FIELD OBSERVATIONS	SAMPLE	I.S.		S.P.T. VALUE				S.P.T. VALUES																																		
			GROUP	HATCHING	N1	N2	N3	N2+N3	10	20	30	40	50	60	70	80	90	100																									
0.00-0.50	SILTY-CLAY	D.	CL	[Grid Hatching]																																							
1.00-1.35	SILTY-CLAY	U.D.	CL	[Grid Hatching]																																							
1.35-1.80		S.P.T.			2	3	3	6																																			
2.50-2.85	SILTY-CLAY	U.D.	CL	[Grid Hatching]																																							
2.85-3.30		S.P.T.			2	2	3	5																																			
4.00-4.35	SILTY-CLAY	U.D.	CL	[Grid Hatching]																																							
4.35-4.80		S.P.T.			2	3	4	7																																			
5.50-5.85	SILTY-CLAY	U.D.	CL	[Grid Hatching]																																							
5.85-6.30		S.P.T.			3	3	5	8																																			
7.00-7.35	SILTY-SAND	U.D.	SM	[Vertical Lines Hatching]																																							
7.35-7.80		S.P.T.			4	6	7	13																																			
8.50-8.85	SILTY-SAND	U.D.	SM	[Vertical Lines Hatching]																																							
8.85-9.30		S.P.T.			5	7	8	15																																			
9.30-10.00	SILTY-SAND	D.	SM	[Vertical Lines Hatching]																																							

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NAME OF THE PROJECT:- CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GARDUARA FERRY GHAT IN WEST BENGAL

WATER TABLE 1.30 METRE DEPTH BELOW GROUND LEVEL

BORE HOLE NO.:- 02 (R.H.S.)

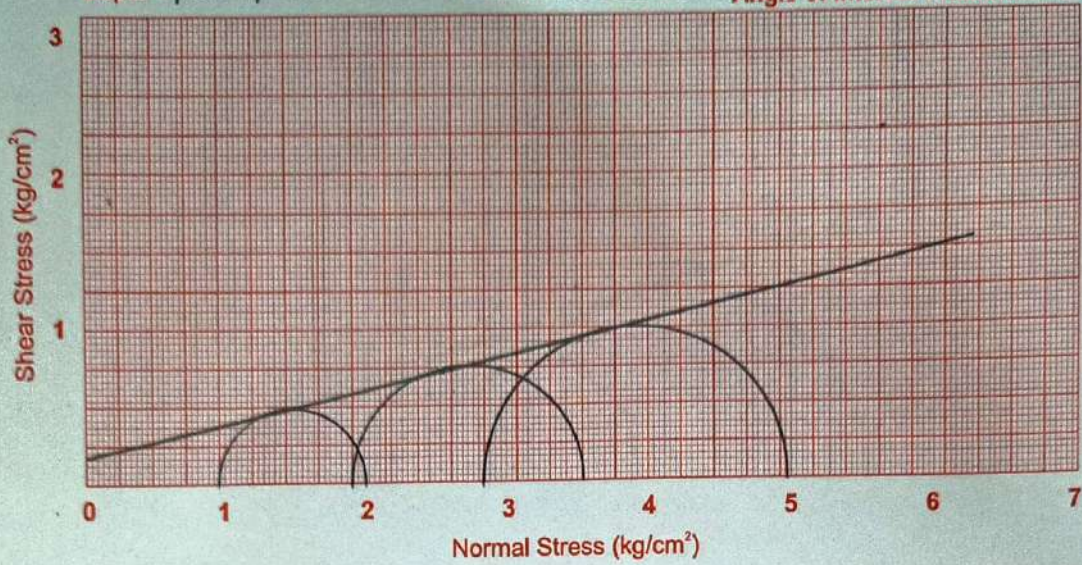
DEPTH IN METRES BELOW GROUND LEVEL	VISUAL FIELD OBSERVATIONS	SAMPLE	I.S.		S.P.T. VALUE				S.P.T. VALUES															
			GROUP	HATCHING	N1	N2	N3	N2+N3	10	20	30	40	50	60	70	80	90	100						
0.00-0.50	SILTY-CLAY	D.	CL																					
1.00-1.35	SILTY-CLAY	U.D.	CL																					
1.35-1.80		S.P.T.			2	2	3	5	10															
2.50-2.85	SILTY-SAND	U.D.	SM																					
2.85-3.30		S.P.T.			3	3	6	9	20															
4.00-4.35	SILTY-SAND	U.D.	SM																					
4.35-4.80		S.P.T.			4	5	6	11	30															
5.50-5.85	SILTY-SAND	U.D.	SM																					
5.85-6.30		S.P.T.			5	7	8	15	40															
7.00-7.35	SILTY-SAND	U.D.	SM																					
7.35-7.80		S.P.T.			6	8	9	17	50															
8.50-8.85	SILTY-SAND	U.D.	SM																					
8.85-9.30		S.P.T.			7	9	10	19	60															
9.30-10.00	SILTY-SAND	D.	SM																					



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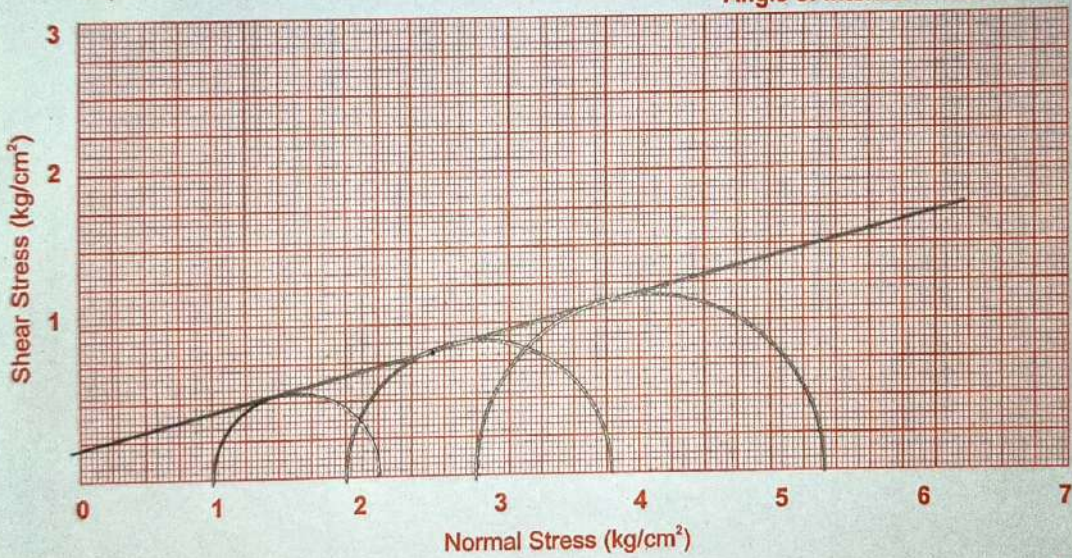
B.H. No. :- 01
Depth :- 1.00 - 1.35

Cohesion 'c' :- 0.15 Kg/cm²
Angle of Internal Friction :- 13°



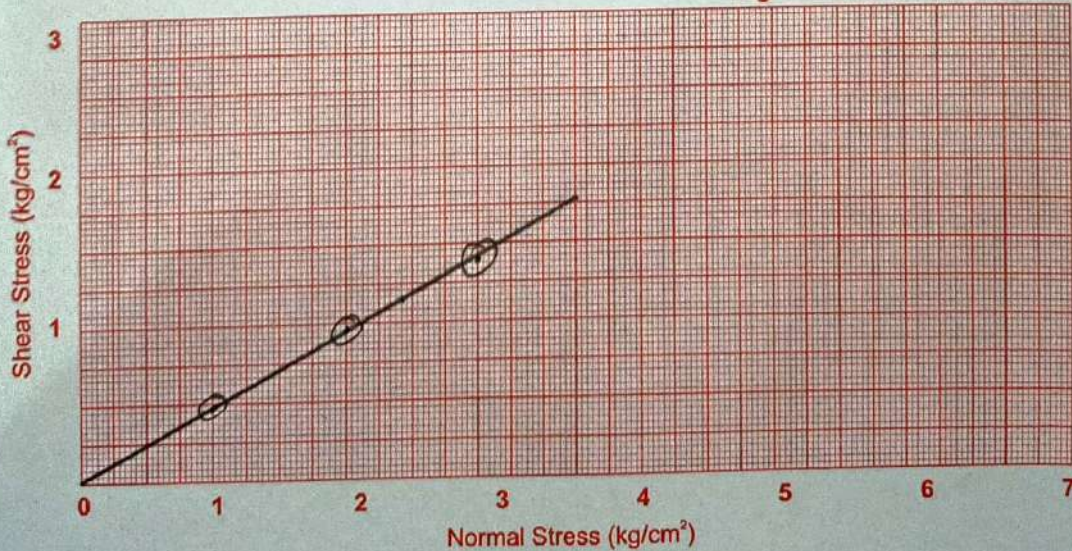
B.H. No. :- 01
Depth :- 4.00 - 4.35

Cohesion 'c' :- 0.20 Kg/cm²
Angle of Internal Friction :- 19°



B.H. No. :- 01
Depth :- 7.00 - 7.35

Cohesion 'c' :- 0 Kg/cm²
Angle of Internal Friction :- 28°

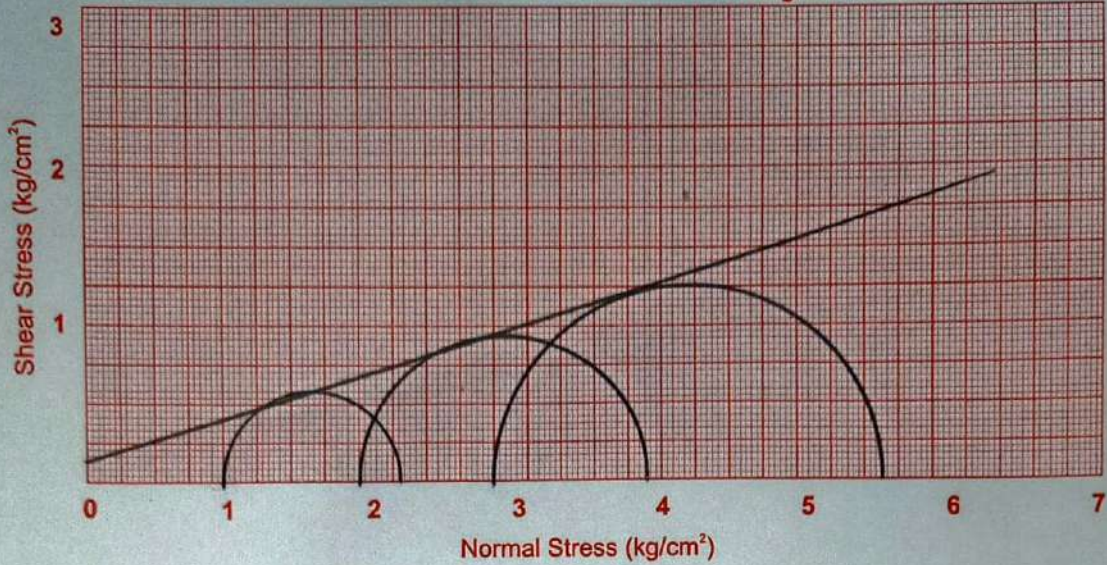




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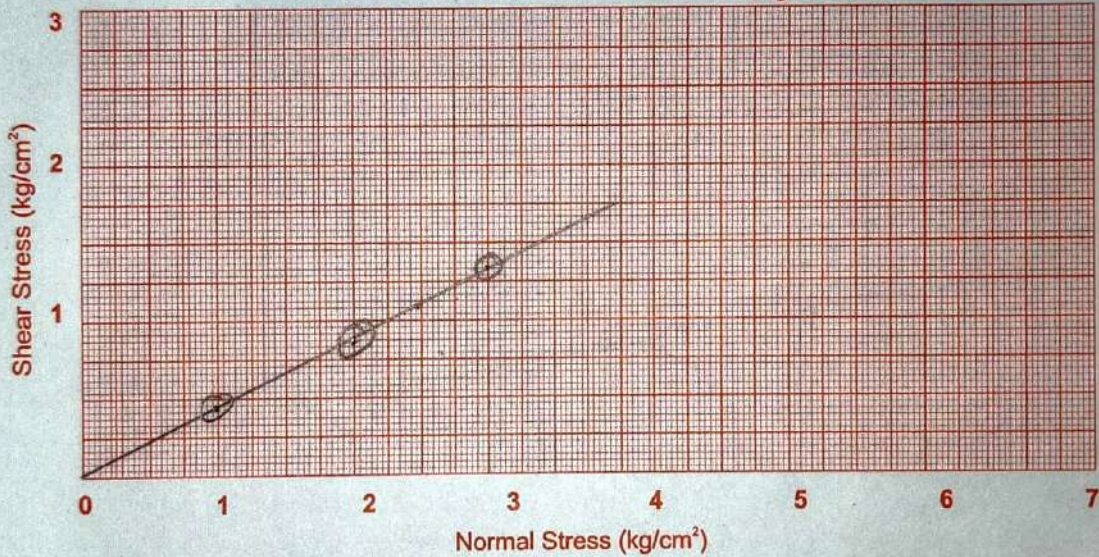
B.H. No. :- 02
Depth - 1.00-1.35

Cohesion 'c' 0.10 Kg/cm²
Angle of Internal Friction 17°*



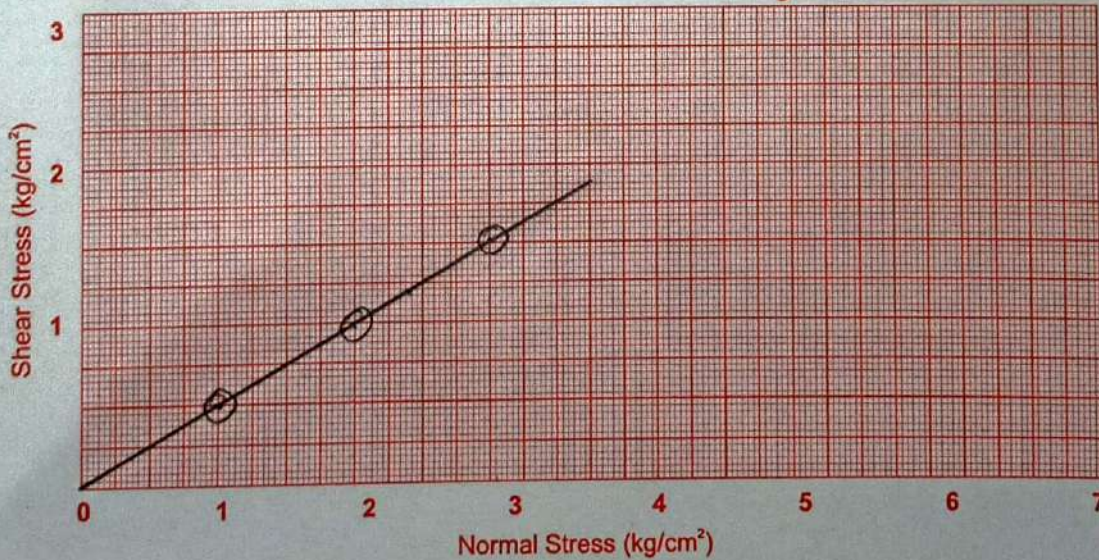
B.H. No. :- 02
Depth :- 4.00-4.35

Cohesion 'c' 0 Kg/cm²
Angle of Internal Friction 27°*



B.H. No. :- 02
Depth :- 7.00-7.35

Cohesion 'c' 0 Kg/cm²
Angle of Internal Friction 30°*

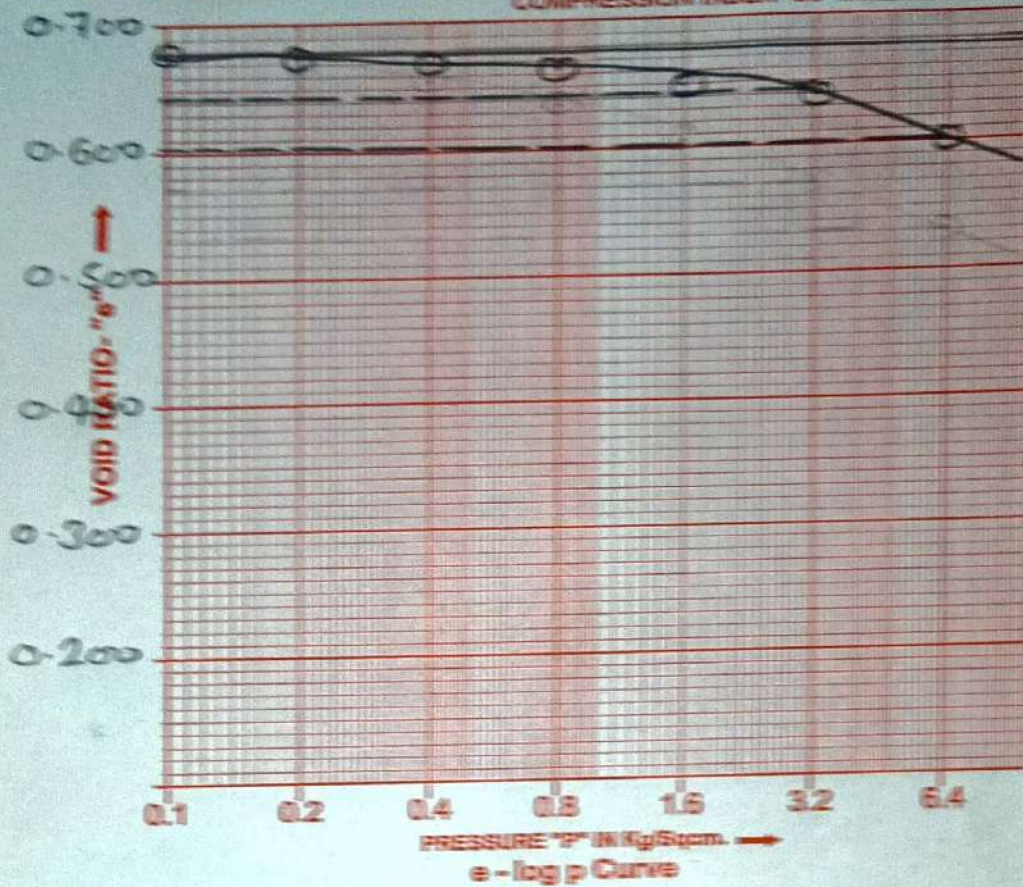




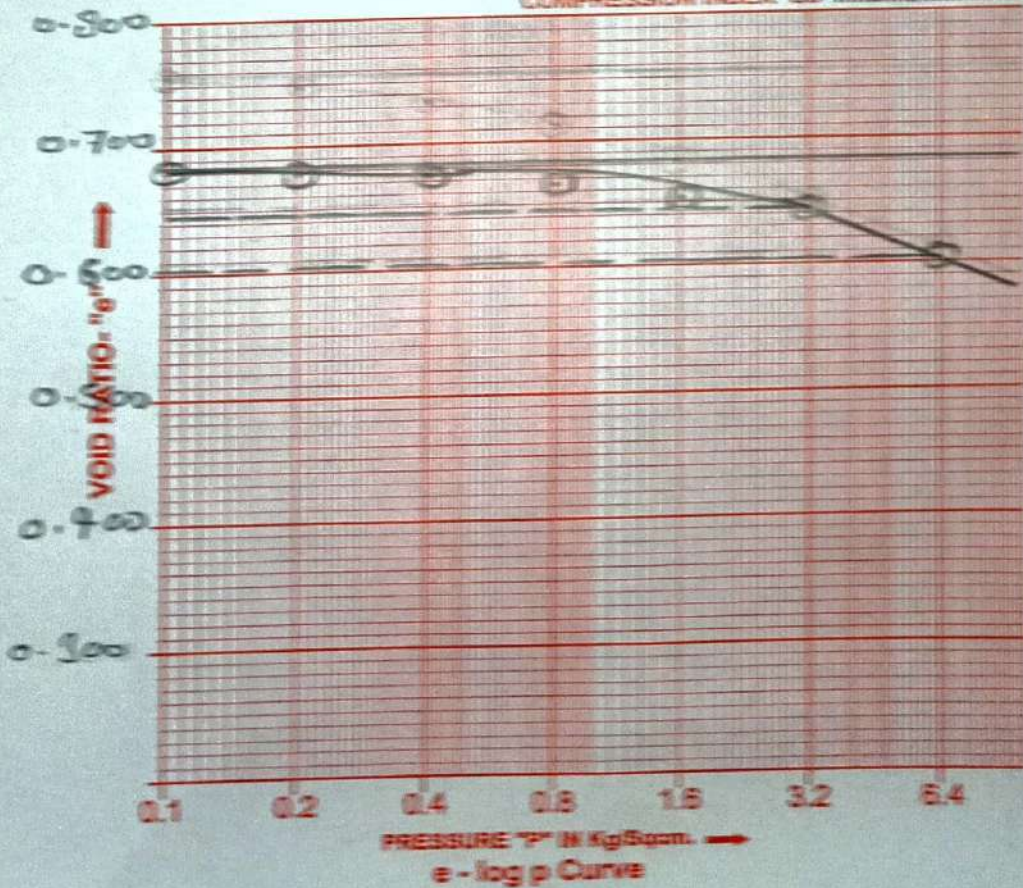
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VIVEK MATERIAL TESTING

BORE HOLE NO. 01
DEPTH 100-135
COMPRESSION INDEX "C_c" 0.134



BORE HOLE NO. 01
DEPTH 400-435
COMPRESSION INDEX "C_c" 0.130

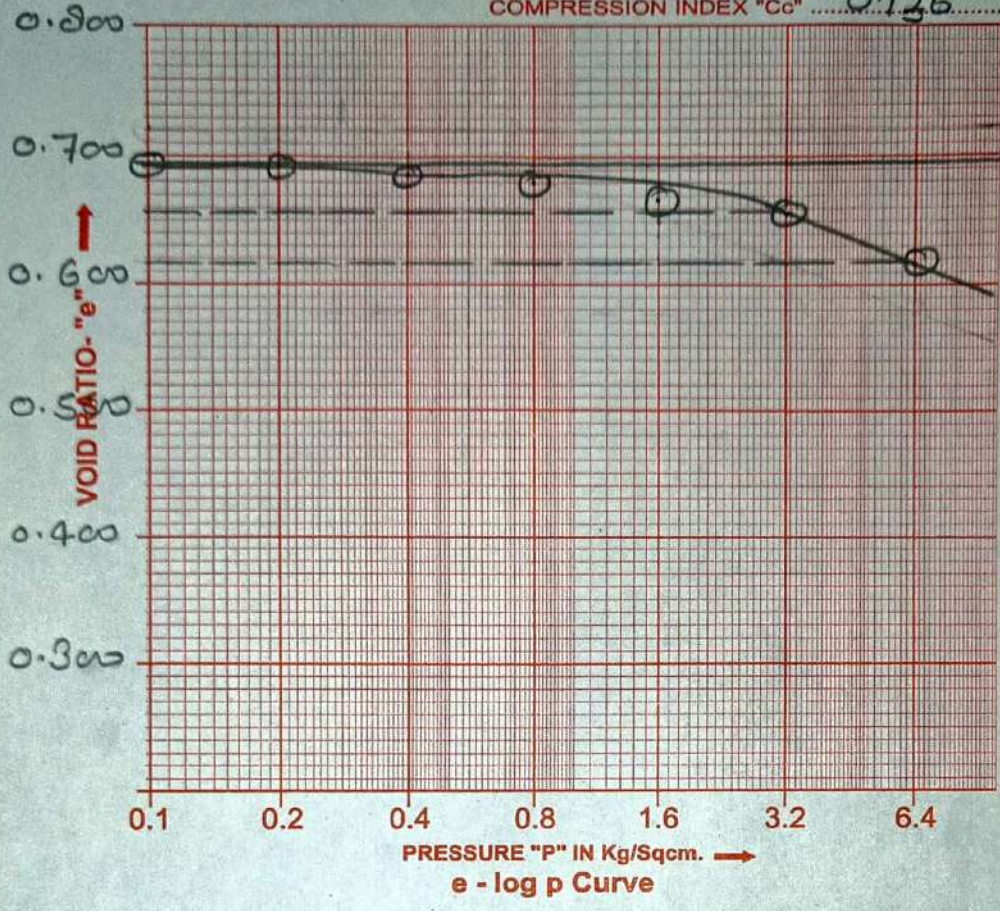




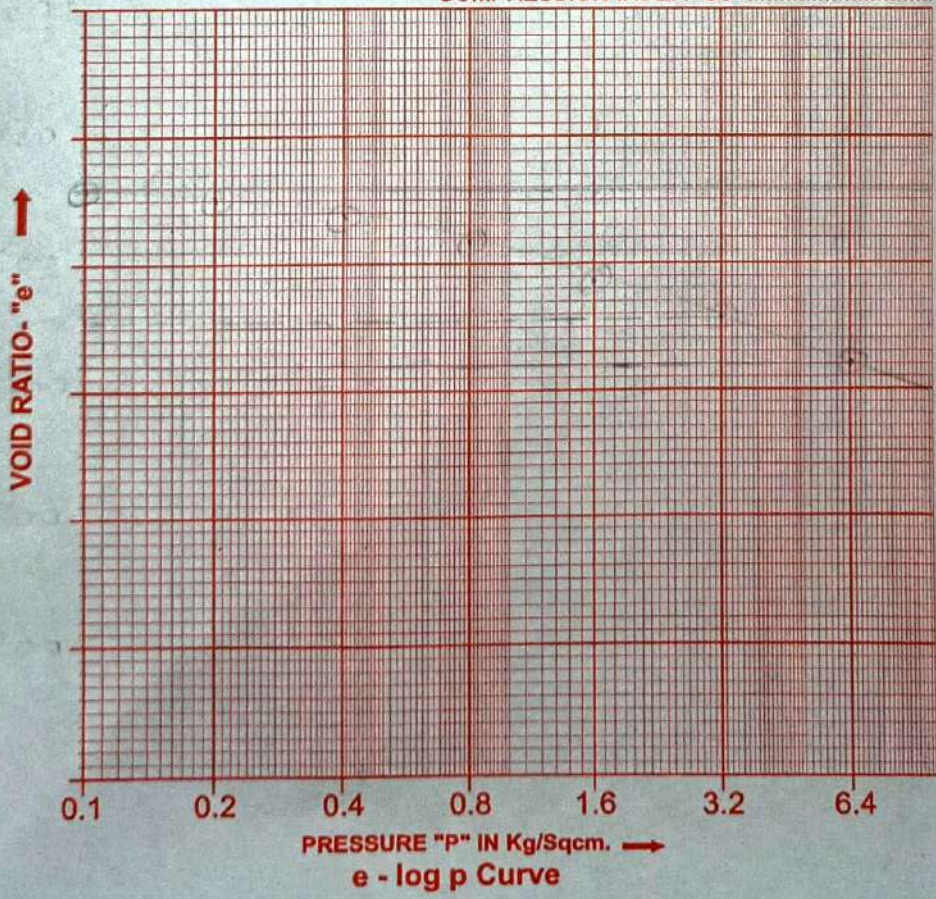
VIVEK MATERIAL TESTING

VMT
GEOTECH & MATERIAL TESTING

BORE HOLE NO. 97
DEPTH 1.00 - 2.35
COMPRESSION INDEX "Cc" 0.126



BORE HOLE NO. 97
DEPTH 1.00 - 2.35
COMPRESSION INDEX "Cc" 0.126





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IC-8969

REPORT NO. – VMT 133 A/2023-2024
GEOTECH INVESTIGATION
REPORT FOR
PROPOSED CONSTRUCTION
OF
BOAT IN THE IDENTIFIED
COMMUNITY JETTY
AT GORAIPARA FERRY
GHAT VILLAGE SIDE
(GORAIPARA OPP.) IN WEST
BENGAL

Prepared By - **VIVEK MATERIAL TESTING**
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ACKNOWLEDGEMENT

WE ARE GRATEFUL TO M/s KITCO LTD., KERLA FOR PROVIDING US THE OPPORTUNITY TO CARRY OUT THESE INVESTIGATIONS.

THE CO-OPERATION EXTENDED BY THEIR ENGINEERS DURING FIELD INVESTIGATIONS IS THANKFULLY ACKNOWLEDGED.

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**SUB-SOIL INVESTIGATION REPORT FOR PROPOSED CONSTRUCTION OF BOAT
IN THE IDENTIFIED COMMUNITY JETTY AT GORAIPARA FERRY GHAT VILLAGE
SIDE IN WEST BENGAL**

INTRODUCTION

The work of sub-soil exploration was awarded to us by M/s KITCO LTD., KERLA Order no. – 6777:DP 1083: RG: 2023 dated 21/03/2023. The object of the investigation was to study the geo-technical properties of soil both in field and laboratory and determine safe allowable pressure for the foundation soil.

The fieldwork consisted of 02 bore holes of 10.00 metre depth each. The fieldwork was conducted on 18/04/2023. The location of the bore holes is shown in the Site location.

REFERENCES

1. **IS: 1892-2021** for field work including existent ground water table.
2. **IS: 2132-1986** for sampling in Undisturbed and Disturbed form.
3. **IS: 2131-1981** for Standard Penetration Test.
4. **IS: 2720** for all laboratory tests on soil samples collected.
5. **IS: 6403-1981** for determination of Bearing Capacity.
6. **IS: 8009(Part I)-1976** for calculation of settlement of foundations.
7. **IS: 1904-2021** for permissible maximum settlement, differential settlement and angular distortion.

SCOPE OF WORK

The scope consisted of drilling of boreholes down to maximum depth of 10.00 m in normal soils / rock, Standard Penetration Testing, collection of samples, laboratory testing and preparation and submission of Geotechnical Investigation report.

Summary of the fieldwork					
Sl. No.	Site	Borehole Nos.	Coordinates		Depth below existing ground level (m)
			Latitude	Longitude	
1.	GORAIPARA FERRY GHAT VILLAGE SIDE	BH-01 (RHS)	24.8051423	87.9049081	10.0
2.		BH-02 (RHS)	24.80510304	87.90486351	10.0



SITE LOCATION



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INTERPRETATION OF THE LAB TEST RESULTS

GENERAL NATURE OF SOIL STRATA

The bore hole log charts and lab test results of bore holes 1 and 2 indicate that the strata at the site is found to comprise of cohesive soil.

The results of classification tests indicate that the natural soil stratum present at the Site is found to comprise of both fine-grained soils comprising of 'CL' and 'CI' group of IS classification (clayey soil) having 95 to 99 percent material finer than 75 micron.

The bore hole log charts and lab test results of bore holes 1 indicate that:

first strata, from 0.00 metre to 4.00 metre, consists of a layer of CL group of IS classification which is inorganic clays of low plasticity,

second strata, from 4.00 metre to 10.00 metre, consists of a layer of CI group of IS classification which is inorganic clays of medium plasticity.

The bore hole log charts and lab test results of bore holes 2 indicate that:

first strata, from 0.00 metre to 4.00 metre, consists of a layer of CL group of IS classification which is inorganic clays of low plasticity,

second strata, from 4.00 metre to 10.00 metre, consists of a layer of CI group of IS classification which is inorganic clays of medium plasticity.

S.P.T. VALUES

The S.P.T. values obtained in the respective clayey layer region present as per bore-log charts enclosed are found to range 4 to 22 indicating 'Soft' to 'Very Stiff' consistency.

The results of S.P.T. values indicate that the stratum at the Site is 'Loose' to 'Well' compacted.

WATER TABLE

Water Table at the Site was observed at a depth from 2.00 metre to 4.50 metre below ground level on the day of soil investigation during the Third week of April 2023. However, the existing water table may rise by 1.00 metre in the post-monsoon period in general. Therefore, a water table at a depth of 1.00 metre to 3.50 metre below ground level has been adopted for calculation purposes.

RECOMMENDATIONS FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GORAIPARA FERRY GHAT VILLAGE SIDE IN WEST BENGAL

NET SAFE BEARING CAPACITY/SAFE ALLOWABLE PRESSURE

Bore Hole Nos.	Type of Structure	Depth of Foundation (metres)	Size of Footing (L x B) (metres)	Net Safe Bearing Capacity (Tonne/sqm.)	Settlement Produced (mm)	Safe Allowable Pressure for Permissible Settlement 50 mm (Tonne/sqm.)
1	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	10.34	35.44	-
		2.00	1.20 x 1.20	11.24	35.65	-
		2.50	1.20 x 1.20	8.81	26.07	-
		1.50	2.00 x 2.00	9.63	47.78	-
		2.00	2.00 x 2.00	10.17	47.48	-
		2.50	2.00 x 2.00	7.84	34.64	-
		1.50	2.50 x 2.50	9.40	55.58	8.16
		2.00	2.50 x 2.50	9.94	51.83	9.47
		2.50	2.50 x 2.50	7.59	40.46	-
2	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	12.56	37.29	-
		2.00	1.20 x 1.20	14.36	35.95	-
		2.50	1.20 x 1.20	16.19	33.83	-
		1.50	2.00 x 2.00	11.85	49.95	-
		2.00	2.00 x 2.00	13.12	47.53	-
		2.50	2.00 x 2.00	14.35	44.05	-
		1.50	2.50 x 2.50	11.63	57.22	9.68
		2.00	2.50 x 2.50	12.76	51.56	12.24
		2.50	2.50 x 2.50	13.84	51.23	13.40

NOTE: -

The above recommendations are based on the field investigation data results and the laboratory tests results of the samples collected from the test locations and our experience in this regard. If the actual sub-soil conditions during excavation for the

foundations differ from that has been reported, a reference should be made to us for suggestions.

Further, the recommendations are based on the assumptions as mentioned in the Report and the designer of the Structure should take into consideration all the factors required as per codes. The recommendations should be taken as guidelines for the designer.

Er. Akhil Singh
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VIVEK MATERIAL TESTING
LABORATORY

Shubham Singh
Dy. TECHNICAL MANAGER/
QUALITY MANAGER
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BEARING CAPACITY CALCULATIONS

Soil when stressed due to loading, tend to deform. The resistance to deformation of the soil depends upon factors like water content, bulk density, angle of internal friction and the manner in which load is applied on the soil. The maximum load per unit area which the soil or rock can carry without yielding or displacement is termed as the bearing capacity of soils. The Safe Bearing Capacity of the proposed STRUCTURE without any distress is determined from the considerations of the following criteria.

[A] SHEAR CRITERIA

The soil beneath the foundation shall be safe from risk of shear failure.

[B] SETTLEMENT CRITERIA

The settlement due to load is caused basically on account of two factors, namely,

- (i) the soil below footing gets compressed by certain amount and
- (ii) since the foundations cover only a limited area there is a possibility that the concentrated stresses developed are so high as to cause actual rupture (shear failure) and displacement of soil below.

The foundation should not settle or deflect to an extent causing damage to the Structure or impair its usefulness.

The Bearing Capacity Calculations for the Foundation shall be governed as per IS: 6403-1981, IS: 8009(Part-I)-1976 and IS: 1904-2021 on the basis of available information regarding the proposed design.

BEARING CAPACITY ON SHEAR CONSIDERATIONS**ULTIMATE NET BEARING CAPACITY**

As per IS: 6403-1981, the Ultimate Net Bearing Capacity 'qd' on shear consideration for a Structure is given by the formula: -

FOR GENERAL SHEAR FAILURE

$$q_d = c.N_c.S_c.d_c.i_c + q(N_q - 1).S_q.d_q.i_q + 1/2 B.r.N_r.S_r.d_r.i_r.W'$$

FOR LOCAL SHEAR FAILURE

$$q'd = 2/3 c.N'c.S'c.d'c.i'c + q(N'q - 1).S'q.d'q.i'q + 1/2 B.r.N'r.S'r.d'r.i'r.W'$$

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981



NAME OF PROJECT																																							
BOREHOLE 01 (R.H.S.)		Depth of borehole	10.00	metre												Water table below borehole level (m)	2.00						Factor of safety		2.50														
														Water table used for calculation (m)	1.00						Assumed post monsoon rise (m)		1.00																
Input Parameters												Shearing Resistance Parameters												Ultimate Net Bearing Capacity			Net Safe Bearing Capacity												
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance		Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors						Inclination Factors			General shear	Local shear	Intermediate	Net Safe Bearing Capacity				
					Bulk	Bulk	c	ϕ		ϕ'	e			Nc	Nq	Ny	Nc'	Nq'	Ny'	Sc	Sq	Sy	Dc	Dq	Dy	Dc'	Dq'	Dy'	Ic	Iq	Iy					kN/m ²	kN/m ²	kN/m ²	kN/m ²
		(m)	(m)	(m)	(gms/cc)	(kN/m ³)	(gms/cc)	(kN/m ³)	Kg/cm ²	°	°		kN/m ²																			kN/m ²	kN/m ²	kN/m ²	kN/m ²				
1	SQUARE	1.50	1.20	1.20	1.82	14.58	1.82	14.58	0.25	9	6.06	0.690	21.87	7.89	2.25	1.03	6.78	1.72	0.58	1.30	1.20	0.80	1.29	1.00	1.00	1.29	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	361.62	207.22	253.54	101.42
2	SQUARE	2.00	1.20	1.20	1.82	12.95	1.86	13.34	0.25	9	6.06	0.690	25.89	7.89	2.25	1.03	6.78	1.72	0.58	1.30	1.20	0.80	1.39	1.00	1.00	1.39	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	392.90	225.16	275.48	110.19
3	SQUARE	2.50	1.20	1.20	1.82	11.96	1.86	12.36	0.15	11	7.42	0.712	29.91	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.51	1.25	1.25	1.51	1.25	1.25	1.00	1.00	1.00	1.00	1.00	1.00	338.72	187.18	215.97	86.39	
4	SQUARE	1.50	2.00	2.00	1.82	14.58	1.82	14.58	0.25	9	6.06	0.690	21.87	7.89	2.25	1.03	6.78	1.72	0.58	1.30	1.20	0.80	1.18	1.00	1.00	1.18	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	336.90	193.03	236.19	94.48
5	SQUARE	2.00	2.00	2.00	1.82	12.95	1.86	13.34	0.25	9	6.06	0.690	25.89	7.89	2.25	1.03	6.78	1.72	0.58	1.30	1.20	0.80	1.23	1.00	1.00	1.23	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	355.67	203.80	249.36	99.74
6	SQUARE	2.50	2.00	2.00	1.82	11.96	1.86	12.36	0.15	11	7.42	0.712	29.91	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.30	1.15	1.15	1.30	1.15	1.15	1.00	1.00	1.00	1.00	1.00	1.00	301.44	166.50	192.14	76.86	
7	SQUARE	1.50	2.50	2.50	1.82	14.58	1.82	14.58	0.25	9	6.06	0.690	21.87	7.89	2.25	1.03	6.78	1.72	0.58	1.30	1.20	0.80	1.14	1.00	1.00	1.14	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	328.68	188.31	230.42	92.17	
8	SQUARE	2.00	2.50	2.50	1.82	12.95	1.86	13.34	0.25	9	6.06	0.690	25.89	7.89	2.25	1.03	6.78	1.72	0.58	1.30	1.20	0.80	1.19	1.00	1.00	1.19	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	347.49	199.10	243.62	97.45
9	SQUARE	2.50	2.50	2.50	1.82	11.96	1.86	12.36	0.15	11	7.42	0.712	29.91	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.24	1.12	1.12	1.24	1.12	1.12	1.00	1.00	1.00	1.00	1.00	1.00	292.13	161.30	186.16	74.46	

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	101.42	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement	
		CLAY					e	Cc	N''	P _o	ΔP		W'				
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)	
1	1	CLAY	0.00	1.50	1.50	1.82	-	-	-	Depth of foundation							35.44
2	2	CLAY	1.50	3.00	1.50	1.86	0.712	0.137	0.00	38.00	38.41	-	-	36.412	-		
3	3	CLAY	3.00	4.00	1.00	1.91	0.686	0.130	0.00	53.69	14.26	-	-	7.888	-		

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80		
Width	1.20	metre	Applied Pressure at foundation base	110.19	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.82	0.000	0.000	0.00	Depth of foundation						35.65
2	2	CLAY	2.00	3.50	1.50	1.86	0.712	0.137	0.00	42.02	41.73	-	-	35.951	-	
3	3	CLAY	3.50	4.50	1.00	1.91	0.686	0.130	0.00	52.81	15.50	-	-	8.616	-	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80		
Width	1.20	metre	Applied Pressure at foundation base	86.39	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.86	0.000	0.000	0.00	Depth of foundation						26.07
2	2	CLAY	2.50	4.00	1.50	1.91	0.686	0.130	0.00	47.39	32.72	-	-	26.366	-	
3	3	CLAY	4.00	5.00	1.00	1.97	0.613	0.123	0.00	58.84	12.15	-	-	6.216	-	

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	94.48	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.82	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.86	0.712	0.137	0.00	38.00	49.97	-	-	43.759	-	47.78
3	3	CLAY	3.00	4.50	1.50	1.91	0.686	0.130	0.00	55.92	20.92	-	-	15.964	-	

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	99.74	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.82	0.000	0.000	0.00	Depth of foundation						47.48
2	2	CLAY	2.00	3.50	1.50	1.86	0.712	0.137	0.00	42.02	52.76	-	-	42.399	-	
3	3	CLAY	3.50	5.00	1.50	1.91	0.686	0.130	0.00	55.04	22.09	-	-	16.947	-	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1	
Length	2.00	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80			
Width	2.00	metre	Applied Pressure at foundation base	76.86	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	C _c	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.86	0.000	0.000	0.00	Depth of foundation						34.64
2	2	CLAY	2.50	4.00	1.50	1.91	0.686	0.130	0.00	47.39	40.65	-	-	31.112	-	
3	3	CLAY	4.00	5.50	1.50	1.97	0.613	0.123	0.00	61.22	17.02	-	-	12.186	-	

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

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	92.17	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.82	0.000	0.000	0.00	Depth of foundation						55.58
2	2	CLAY	1.50	3.50	2.00	1.86	0.712	0.137	0.00	40.81	47.03	-	-	53.279	-	
3	3	CLAY	3.50	5.25	1.75	1.91	0.686	0.130	0.00	62.66	19.94	-	-	16.191	-	

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

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	80.05	kN/m ²		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.82	0.000	0.000	0.00	Depth of foundation						50.00
2	2	CLAY	1.50	3.50	2.00	1.86	0.712	0.137	0.00	40.81	40.84	-	-	48.205	-	
3	3	CLAY	3.50	5.25	1.75	1.91	0.686	0.130	0.00	62.66	17.32	-	-	14.300	-	

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

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	97.45	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	C _c	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.86	0.000	0.000	0.00	Depth of foundation						51.83
2	2	CLAY	2.00	4.00	2.00	1.91	0.686	0.130	0.00	45.41	49.72	-	-	49.530	-	
3	3	CLAY	4.00	5.50	1.50	1.97	0.613	0.123	0.00	61.47	22.10	-	-	15.257	-	

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

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	92.87	kN/m ²		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.86	0.000	0.000	0.000	Depth of foundation						50.00
2	2	CLAY	2.00	4.00	2.00	1.91	0.686	0.130	0.000	45.41	47.38	-	-	47.864	-	
3	3	CLAY	4.00	5.50	1.50	1.97	0.613	0.123	0.000	61.47	21.06	-	-	14.635	-	

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

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1	
Length	2.50	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80			
Width	2.50	metre	Applied Pressure at foundation base	74.46	kN/m2		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.86	0.000	0.000	0.00	Depth of foundation						40.46
2	2	CLAY	2.50	4.50	2.00	1.91	0.686	0.130	0.00	49.62	37.99	-	-	38.072	-	
3	3	CLAY	4.50	6.25	1.75	1.97	0.613	0.123	0.00	66.87	16.11	-	-	12.508	-	

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981



NAME OF PROJECT																																					
BOREHOLE 02 (R.H.S.)		Depth of borehole		10.00	metre		Water table below borehole level (m)		4.50	Factor of safety		2.50	Water table used for calculation (m)		3.50	Assumed post monsoon rise (m)		1.00																			
		Input Parameters												Shearing Resistance Parameters												Ultimate Net Bearing Capacity			Net Safe Bearing Capacity								
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance		Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors						Inclination Factors			General shear	Local shear	Intermediate	Net Safe Bearing Capacity		
					Bulk		Bulk		c	ϕ	ϕ'	e	q	Nc	Nq	Ny	Nc'	Nq'	Ny'	Sc	Sq	Sy	Dc	Dq	Dy	Dc'	Dq'	Dy'	lc	lq	ly						
		(m)	(m)	(m)	(gms/cc)	(kN/m3)	(gms/cc)	(kN/m3)	Kg/cm2	°	°		kN/m2																								
1	SQUARE	1.50	1.20	1.20	1.80	17.65	1.80	17.65	0.20	13	8.79	0.671	26.48	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.31	1.16	1.16	1.31	1.16	1.16	1.00	1.00	1.00	429.68	228.47	307.95	123.18		
2	SQUARE	2.00	1.20	1.20	1.80	17.65	1.87	18.34	0.20	13	8.79	0.671	35.31	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.42	1.21	1.21	1.42	1.21	1.21	1.00	1.00	1.00	491.31	261.33	352.17	140.87		
3	SQUARE	2.50	1.20	1.20	1.80	17.65	1.87	18.34	0.25	10	6.74	0.650	44.13	8.34	2.47	1.22	7.03	1.83	0.67	1.30	1.20	0.80	1.50	1.25	1.25	1.50	1.25	1.25	1.00	1.00	1.00	508.34	285.77	397.06	158.82		
4	SQUARE	1.50	2.00	2.00	1.80	17.65	1.80	17.65	0.20	13	8.79	0.671	26.48	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.19	1.09	1.09	1.19	1.09	1.09	1.00	1.00	1.00	405.65	215.33	290.51	116.20		
5	SQUARE	2.00	2.00	2.00	1.80	17.65	1.87	18.34	0.20	13	8.79	0.671	35.31	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.25	1.13	1.13	1.25	1.13	1.13	1.00	1.00	1.00	448.81	238.45	321.54	128.62		
6	SQUARE	2.50	2.00	2.00	1.80	17.65	1.87	18.34	0.25	10	6.74	0.650	44.13	8.34	2.47	1.22	7.03	1.83	0.67	1.30	1.20	0.80	1.30	1.15	1.15	1.30	1.15	1.15	1.00	1.00	1.00	450.53	253.22	351.88	140.75		
7	SQUARE	1.50	2.50	2.50	1.80	17.65	1.80	17.65	0.20	13	8.79	0.671	26.48	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.15	1.08	1.08	1.15	1.08	1.08	1.00	1.00	1.00	398.43	211.38	285.26	114.10		
8	SQUARE	2.00	2.50	2.50	1.80	17.65	1.87	18.34	0.20	13	8.79	0.671	35.31	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.20	1.10	1.10	1.20	1.10	1.10	1.00	1.00	1.00	436.67	231.88	312.77	125.11		
9	SQUARE	2.50	2.50	2.50	1.80	17.65	1.87	18.34	0.25	10	6.74	0.650	44.13	8.34	2.47	1.22	7.03	1.83	0.67	1.30	1.20	0.80	1.24	1.12	1.12	1.24	1.12	1.12	1.00	1.00	1.00	434.35	244.09	339.22	135.69		

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	123.18	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.80	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.87	0.650	0.127	0.00	40.23	46.65	-	-	38.601	-	37.29
3	3	CLAY	3.00	4.00	1.00	1.93	0.636	0.125	0.00	63.45	17.32	-	-	8.009	-	

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80		
Width	1.20	metre	Applied Pressure at foundation base	140.87	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.80	0.000	0.000	0.00	Depth of foundation						35.95
2	2	CLAY	2.00	3.50	1.50	1.87	0.650	0.127	0.00	49.06	53.35	-	-	36.900	-	
3	3	CLAY	3.50	4.50	1.00	1.93	0.636	0.125	0.00	72.28	19.81	-	-	8.038	-	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80		
Width	1.20	metre	Applied Pressure at foundation base	158.82	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.87	0.000	0.000	0.00	Depth of foundation						33.83
2	2	CLAY	2.50	4.00	1.50	1.93	0.636	0.125	0.00	60.04	60.14	-	-	34.543	-	
3	3	CLAY	4.00	5.00	1.00	1.99	0.596	0.120	0.00	83.51	22.33	-	-	7.739	-	

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2	
Length	2.00	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80			
Width	2.00	metre	Applied Pressure at foundation base	116.20	kN/m2		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement	
		CLAY					e	Cc	N''	P _o	ΔP		W'				
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)	
1	1	CLAY	0.00	1.50	1.50	1.80	-	-	-	Depth of foundation							49.95
2	2	CLAY	1.50	3.00	1.50	1.87	0.650	0.127	0.00	40.23	61.46	-	-	46.495	-		
3	3	CLAY	3.00	4.50	1.50	1.93	0.636	0.125	0.00	68.18	25.73	-	-	15.938	-		

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2	
Length	2.00	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80			
Width	2.00	metre	Applied Pressure at foundation base	128.62	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement	
		CLAY					e	C _c	N''	P _o	ΔP		W'				
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)	
1	1	CLAY	0.00	2.00	2.00	1.80	0.000	0.000	0.00	Depth of foundation						47.53	
2	2	CLAY	2.00	3.50	1.50	1.87	0.650	0.127	0.00	49.06	68.03	-	-	43.618	-		
3	3	CLAY	3.50	5.00	1.50	1.93	0.636	0.125	0.00	76.27	28.48	-	-	15.794	-		

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2	
Length	2.00	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80			
Width	2.00	metre	Applied Pressure at foundation base	140.75	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	C _c	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.87	0.000	0.000	0.00	Depth of foundation						44.05
2	2	CLAY	2.50	4.00	1.50	1.93	0.636	0.125	0.00	60.04	74.45	-	-	40.139	-	
3	3	CLAY	4.00	5.50	1.50	1.99	0.596	0.120	0.00	87.54	31.17	-	-	14.919	-	

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

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	114.10	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.80	0.000	0.000	0.00	Depth of foundation						57.22
2	2	CLAY	1.50	3.50	2.00	1.87	0.650	0.127	0.00	44.82	58.21	-	-	55.652	-	
3	3	CLAY	3.50	5.25	1.75	1.93	0.636	0.125	0.00	78.49	24.68	-	-	15.878	-	

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

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	94.98	kN/m ²		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.80	0.000	0.000	0.00	Depth of foundation						50.00
2	2	CLAY	1.50	3.50	2.00	1.87	0.650	0.127	0.00	44.82	48.46	-	-	49.002	-	
3	3	CLAY	3.50	5.25	1.75	1.93	0.636	0.125	0.00	78.49	20.55	-	-	13.502	-	

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

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	125.11	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	C _c	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.87	0.000	0.000	0.00	Depth of foundation						51.56
2	2	CLAY	2.00	4.00	2.00	1.93	0.636	0.125	0.00	55.61	63.83	-	-	50.737	-	
3	3	CLAY	4.00	5.50	1.50	1.99	0.596	0.120	0.00	87.83	28.37	-	-	13.710	-	

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

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	120.04	kN/m ²		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.87	0.000	0.000	0.000	Depth of foundation						50.00
2	2	CLAY	2.00	4.00	2.00	1.93	0.636	0.125	0.000	55.61	61.24	-	-	49.284	-	
3	3	CLAY	4.00	5.50	1.50	1.99	0.596	0.120	0.000	87.83	27.22	-	-	13.223	-	

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

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80			
Width	2.50	metre	Applied Pressure at foundation base	135.69	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.87	0.000	0.000	0.00	Depth of foundation						51.23
2	2	CLAY	2.50	4.50	2.00	1.93	0.636	0.125	0.00	64.78	69.23	-	-	48.244	-	
3	3	CLAY	4.50	6.25	1.75	1.99	0.596	0.120	0.00	92.20	29.35	-	-	15.795	-	

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

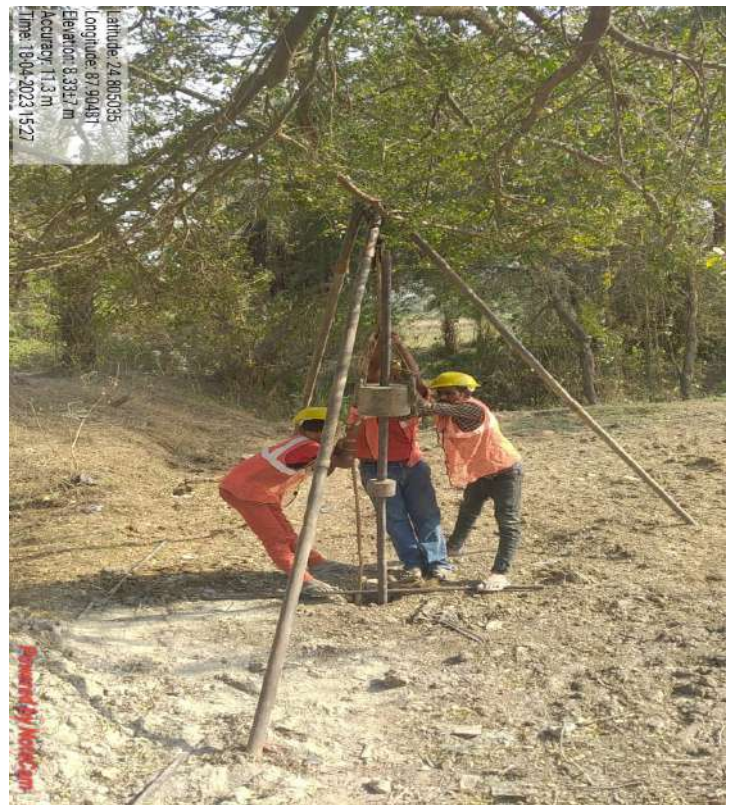
CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	131.38	kN/m ²		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.87	0.000	0.000	0.000	Depth of foundation						50.00
2	2	CLAY	2.50	4.50	2.00	1.93	0.636	0.125	0.000	64.78	67.03	-	-	47.146	-	
3	3	CLAY	4.50	6.25	1.75	1.99	0.596	0.120	0.000	92.20	28.42	-	-	15.355	-	

SITE PHOTOS DURING SITE INVESTIGATION



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RESULT SHEET

NAME OF THE PROJECT CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GORAIPARA FERRY GHAT VILLAGE SIDE IN WEST BENGAL																							
Client Name																							
Bore Hole No.	1 (R.H.S.)		Coordinate			Easting			Depth of Water Level			2.00			VIVEK MATERIAL TESTING LABORATORY						 VMT GEOTECHNICAL MATERIAL TESTING		
Total depth of Bore Hole	10.00		Northing			100.000			Commenced on			4/18/2023											
Depth of Bore Hole	Reduced Level		% Material Passing IS Sieve				Atterberg Limits			IS group symbol	SPT Value	SPT Value corrected due to overburden	SPT Value corrected due to dilatancy	Wet Bulk Density									
metre	metre		4.750	2.000	0.425	0.075	LL	PL	PI		N	N'	N''	(gms/cc)	%	(gms/cc)	(G)		(Kg/sqcm)	(Ø)	(Cc)		
1	2		4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22		
0.00 - 0.50	100.000 - 99.500	DS	100	100	100	99	33	23	10	CL					-	-	-	-	-	-	-		
1.00 - 1.35	99.000 - 98.650	UD	100	100	99	96	29	18	11	CL				1.82	17.1	1.55	2.62	0.690	0.25	9°	0.135		
1.35 - 1.80	98.650 - 98.200	SPT									6	8.20	8.20										
2.50 - 2.85	97.500 - 97.150	UD	100	100	100	99	33	22	11	CL				1.86	21.8	1.53	-	-	-	-	-		
2.85 - 3.30	97.150 - 96.700	SPT									4	5.69	5.69										
4.00 - 4.35	96.000 - 95.650	UD	100	98	97	96	37	26	11	CI				1.91	22.5	1.56	2.63	0.686	0.15	12°	0.130		
4.35 - 4.80	95.650 - 95.200	SPT									7	9.01	9.01										
5.50 - 5.85	94.500 - 94.150	UD	100	100	100	99	39	25	14	CI				1.97	20.9	1.63	-	-	-	-	-		
5.85 - 6.30	94.150 - 93.700	SPT									12	14.23	14.23										
7.00 - 7.35	93.000 - 92.650	UD	100	100	100	97	38	26	12	CI				1.96	18.5	1.65	2.62	0.588	0.30	12°	0.123		
7.35 - 7.80	92.650 - 92.200	SPT									15	16.64	15.82										
8.50 - 8.85	91.500 - 91.150	UD	100	100	100	99	40	22	18	CI				1.95	16.8	1.67	-	-	-	-	-		
8.85 - 9.30	91.150 - 90.700	SPT									18	18.85	16.93										
9.30 - 10.00	90.700 - 90.000	DS	100	100	100	99	41	21	20	CI					-	-	-	-	-	-	-		

RESULT SHEET

NAME OF THE PROJECT		CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GORAIPARA FERRY GHAT VILLAGE SIDE IN WEST BENGAL																			
Client Name																					
Bore Hole No.	2 (R.H.S.)	Coordinate	Easting			Depth of Water Level			4.50			VIVEK MATERIAL TESTING LABORATORY							 VMT GEOTECH & MATERIAL TESTING		
Total depth of Bore Hole	10.00		Northing			Commenced on			4/18/2023												
			Elevation			100.000			Completed on												
Depth of Bore Hole	Reduced Level	Types of Samples	% Material Passing IS Sieve				Atterberg Limits			IS group symbol	SPT Value	SPT Value corrected due to overburden	SPT Value corrected due to dilatancy	Wet Bulk Density	Original Moisture	Dry Bulk Density	Specific Gravity	Void Ratio	Shear Characteristics		Compression Index
			4.750	2.000	0.425	0.075	LL	PL	PI										Cohesion	Angle of Internal Friction	
metre	metre		(mm)	(mm)	(mm)	(mm)	%	%	%		N	N'	N''	(gms/cc)	%	(gms/cc)	(G)		(Kg/sqcm)	(Ø)	(Cc)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
0.00 - 0.50	100.000 - 99.500	DS	100	100	100	97	30	21	9	CL					-	-	-	-	-	-	-
1.00 - 1.35	99.000 - 98.650	UD	100	98	97	96	29	17	12	CL				1.80	13.7	1.58	2.64	0.671	0.20	13°	0.127
1.35 - 1.80	98.650 - 98.200	SPT									8	10.96	10.96								
2.50 - 2.85	97.500 - 97.150	UD	100	100	100	95	28	15	13	CL				1.87	16.8	1.60	-	-	-	-	-
2.85 - 3.30	97.150 - 96.700	SPT									10	11.60	11.60								
4.00 - 4.35	96.000 - 95.650	UD	100	100	98	96	39	22	17	CI				1.93	19.3	1.62	2.65	0.636	0.30	13°	0.125
4.35 - 4.80	95.650 - 95.200	SPT									12	15.43	15.22								
5.50 - 5.85	94.500 - 94.150	UD	100	100	99	98	42	22	20	CI				1.99	20.1	1.66	-	-	-	-	-
5.85 - 6.30	94.150 - 93.700	SPT									15	17.74	16.37								
7.00 - 7.35	93.000 - 92.650	UD	100	100	99	97	40	22	18	CI				1.99	18.6	1.68	2.66	0.583	0.25	14°	0.117
7.35 - 7.80	92.650 - 92.200	SPT									19	20.98	17.99								
8.50 - 8.85	91.500 - 91.150	UD	100	100	100	98	39	23	16	CI				1.98	16.5	1.70	-	-	-	-	-
8.85 - 9.30	91.150 - 90.700	SPT									22	22.91	18.96								
9.30 - 10.00	90.700 - 90.000	DS	100	100	100	99	38	20	18	CI					-	-	-	-	-	-	-



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GEOTECH & MATERIAL TESTING

BORE-LOG CHART

VIVEK MATERIAL TESTING LABORATORY

NAME OF THE PROJECT:- CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GORAI PARA FERRY GHAT VILLAGE SIDE IN WEST BENGAL

WATER TABLE 2.00 METRE DEPTH BELOW GROUND LEVEL

BORE HOLE NO.:- 01 (R.H.S.)

DEPTH IN METRES BELOW GROUND LEVEL	VISUAL FIELD OBSERVATIONS	SAMPLE	I.S.		S.P.T. VALUE				S.P.T. VALUES																
			GROUP	HATCHING	N1	N2	N3	N2+N3	10	20	30	40	50	60	70	80	90	100							
0.00-0.50	SILTY-CLAY	D.	CL																						
1.00-1.35	SILTY-CLAY	U.D.	CL																						
1.35-1.80		S.P.T.			2	3	3	6	□																
2.50-2.85	SILTY-CLAY	U.D.	CL																						
2.85-3.30		S.P.T.			1	2	2	4	□																
4.00-4.35	SILTY-CLAY	U.D.	CI																						
4.35-4.80		S.P.T.			3	3	4	7	□																
5.50-5.85	SILTY-CLAY	U.D.	CI																						
5.85-6.30		S.P.T.			4	5	7	12	□																
7.00-7.35	SILTY-CLAY	U.D.	CI																						
7.35-7.80		S.P.T.			5	7	8	15	□																
8.50-8.85	SILTY-CLAY	U.D.	CI																						
8.85-9.30		S.P.T.			6	8	10	18	□																
9.30-10.00	SILTY-CLAY	D.	CI																						

BORE-LOG CHART



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VIVEK MATERIAL TESTING LABORATORY

NAME OF THE PROJECT:- CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GORAIPARA
FERRY GHAT VILLAGE SIDE IN WEST BENGAL

WATER TABLE 4.50 METRE DEPTH BELOW GROUND LEVEL

BORE HOLE NO.:- 02 (R.H.S.)

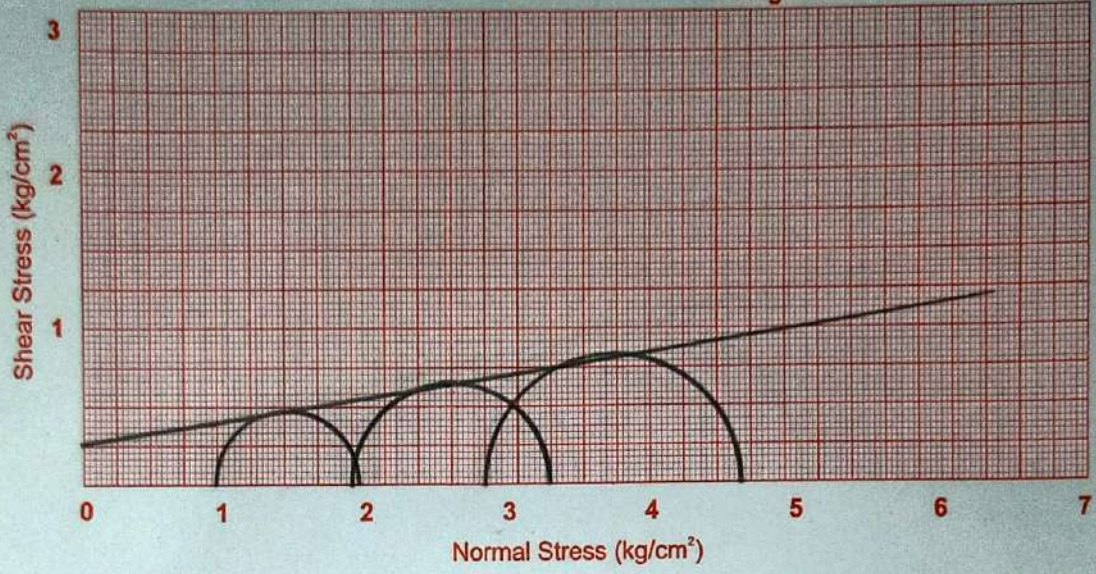
DEPTH IN METRES BELOW GROUND LEVEL	VISUAL FIELD OBSERVATIONS	SAMPLE	I.S.		S.P.T. VALUE				S.P.T. VALUES																											
			GROUP	HATCHING	N1	N2	N3	N2+N3	10	20	30	40	50	60	70	80	90	100																		
0.00-0.50	SILTY-CLAY	D.	CL																																	
1.00-1.35	SILTY-CLAY	U.D.	CL																																	
1.35-1.80		S.P.T.			2	3	5	8																												
2.50-2.85	SILTY-CLAY	U.D.	CL																																	
2.85-3.30		S.P.T.			3	4	6	10																												
4.00-4.35	SILTY-CLAY	U.D.	CI																																	
4.35-4.80		S.P.T.			4	5	7	12																												
5.50-5.85	SILTY-CLAY	U.D.	CI																																	
5.85-6.30		S.P.T.			5	7	8	15																												
7.00-7.35	SILTY-CLAY	U.D.	CI																																	
7.35-7.80		S.P.T.			6	8	11	19																												
8.50-8.85	SILTY-CLAY	U.D.	CI																																	
8.85-9.30		S.P.T.			7	10	12	22																												
9.30-10.00	SILTY-CLAY	D.	CI																																	



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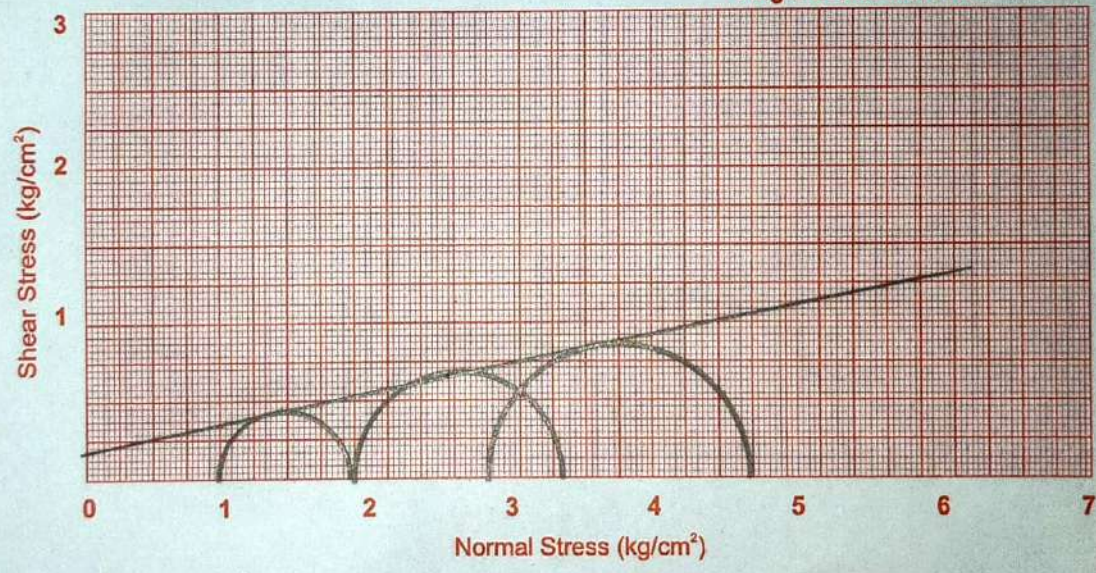
B.H. No. :- 01
Depth - 1.00 - 1.35

Cohesion 'c' 0.25 Kg/cm²
Angle of Internal Friction 9°*



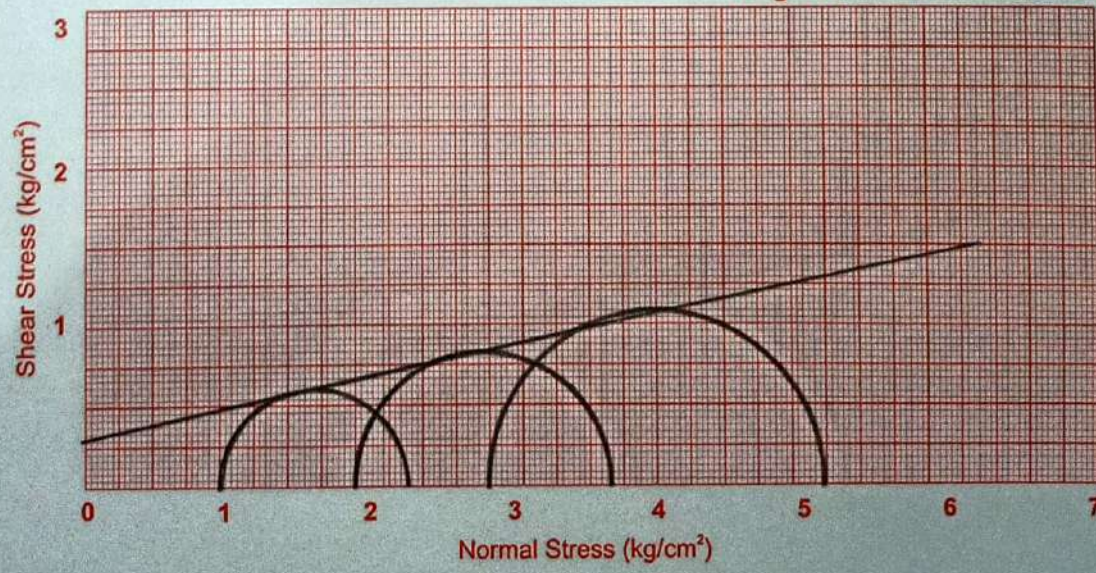
B.H. No. :- 01
Depth :- 4.00 - 4.35

Cohesion 'c' 0.15 Kg/cm²
Angle of Internal Friction 12°*



B.H. No. :- 01
Depth :- 7.00 - 7.35

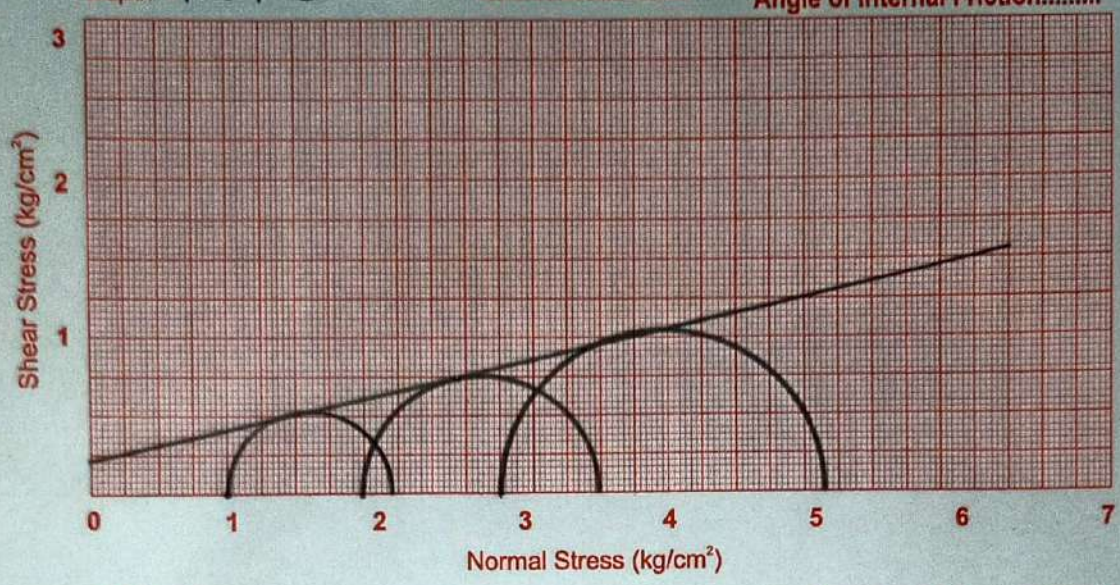
Cohesion 'c' 0.30 Kg/cm²
Angle of Internal Friction 12°*





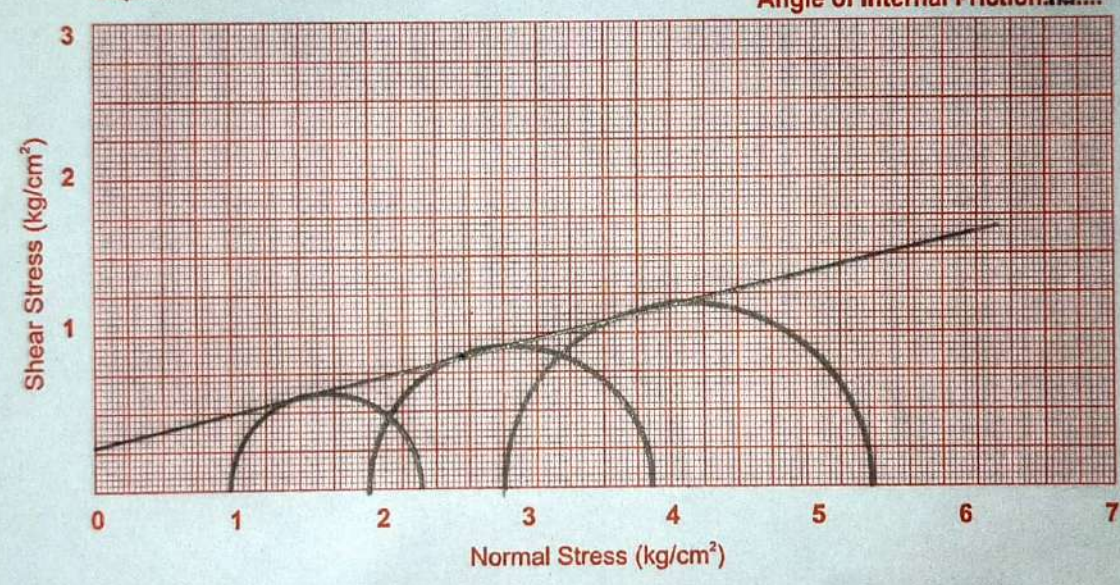
B.H. No. :- 02
Depth :- 1.00-1.35

Cohesion 'c' 0.20 Kg/cm²
Angle of Internal Friction 13° *



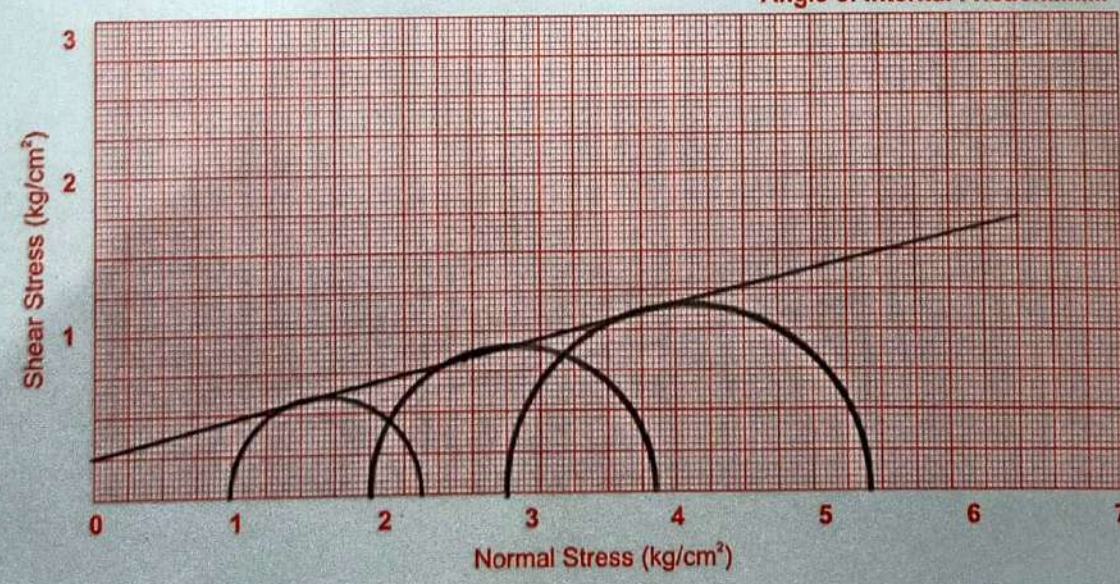
B.H. No. :- 02
Depth :- 4.00-4.35

Cohesion 'c' 0.30 Kg/cm²
Angle of Internal Friction 13° *



B.H. No. :- 02
Depth :- 7.00-7.35

Cohesion 'c' 0.25 Kg/cm²
Angle of Internal Friction 14° *





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TC-8969

REPORT NO. – VMT 133 B/2023-2024

GEOTECH INVESTIGATION

REPORT FOR

PROPOSED CONSTRUCTION

OF

BOAT IN THE IDENTIFIED

COMMUNITY JETTY

AT GORAIPARA FERRY

GHAT (L.H.S.)

IN WEST BENGAL

Prepared By -

**VIVEK MATERIAL TESTING
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ACKNOWLEDGEMENT

WE ARE GRATEFUL TO M/s KITCO LTD., KERLA FOR PROVIDING US THE OPPORTUNITY TO CARRY OUT THESE INVESTIGATIONS.

THE CO-OPERATION EXTENDED BY THEIR ENGINEERS DURING FIELD INVESTIGATIONS IS THANKFULLY ACKNOWLEDGED.

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**SUB-SOIL INVESTIGATION REPORT FOR PROPOSED CONSTRUCTION OF BOAT
IN THE IDENTIFIED COMMUNITY JETTY AT GORAIPARA FERRY GHAT IN WEST
BENGAL**

INTRODUCTION

The work of sub-soil exploration was awarded to us by M/s KITCO LTD., KERLA Order no. – 6777:DP 1083: RG: 2023 dated 21/03/2023. The object of the investigation was to study the geo-technical properties of soil both in field and laboratory and determine safe allowable pressure for the foundation soil.

The fieldwork consisted of 02 bore holes of 10.00 metre depth each. The fieldwork was conducted on 19/04/2023. The location of the bore holes is shown in the Site location.

REFERENCES

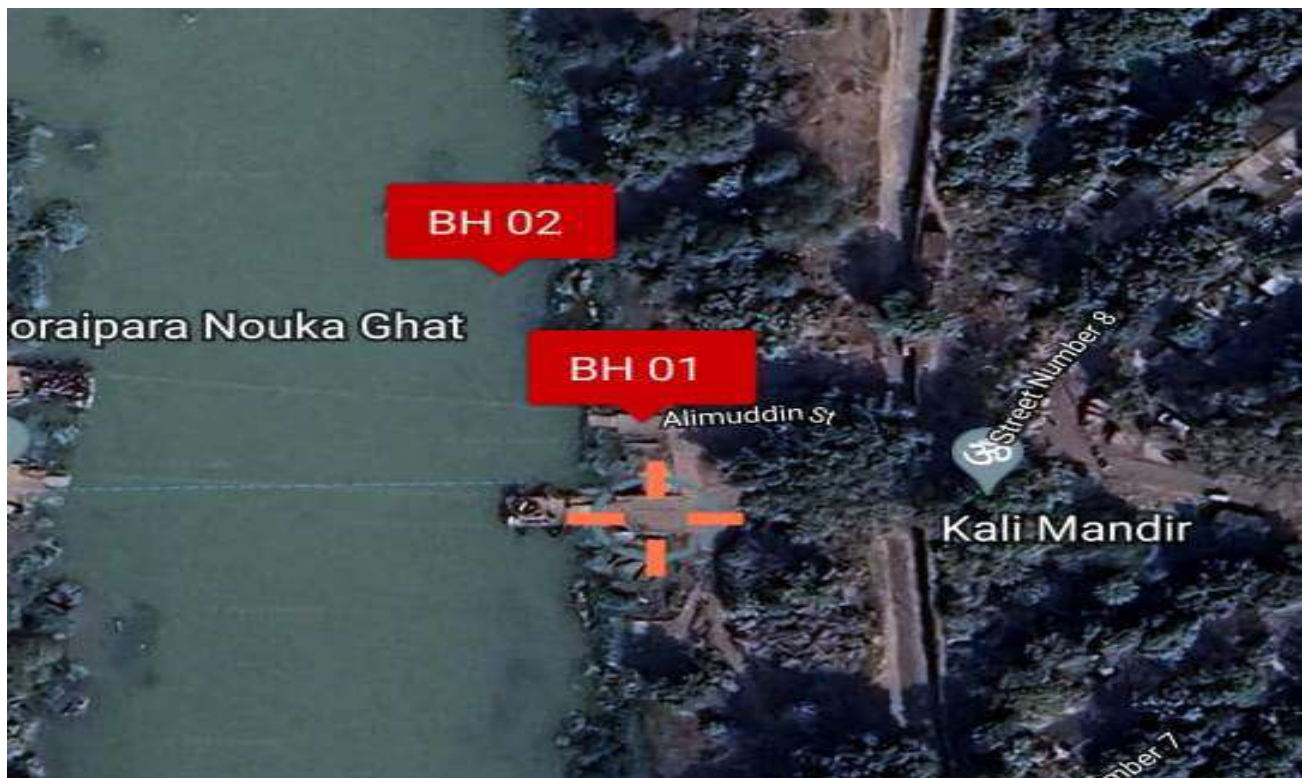
1. **IS: 1892-2021** for field work including existent ground water table.
2. **IS: 2132-1986** for sampling in Undisturbed and Disturbed form.
3. **IS: 2131-1981** for Standard Penetration Test.
4. **IS: 2720** for all laboratory tests on soil samples collected.
5. **IS: 6403-1981** for determination of Bearing Capacity.
6. **IS: 8009(Part I)-1976** for calculation of settlement of foundations.
7. **IS: 1904-2021** for permissible maximum settlement, differential settlement and angular distortion.

SCOPE OF WORK

The scope consisted of drilling of boreholes down to maximum depth of 10.00 m in normal soils / rock, Standard Penetration Testing, collection of samples, laboratory testing and preparation and submission of Geotechnical Investigation report.

Summary of the fieldwork

Sl. No.	Site	Borehole Nos.	Coordinates		Depth below existing ground level (m)
			Latitude	Longitude	
1.	GORAIPARA FERRY GHAT	BH-01 (LHS)	24.80523269	87.90574294	10.0
2.		BH-02 (LHS)	24.80546977	87.90557899	10.0



SITE LOCATION



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INTERPRETATION OF THE LAB TEST RESULTS

GENERAL NATURE OF SOIL STRATA

The bore hole log charts and lab test results of bore holes 1 and 2 indicate that the strata at the site is found to comprise of cohesive soil.

The results of classification tests indicate that the natural soil stratum present at the Site is found to comprise of both fine-grained soils comprising of 'CL' and 'CI' group of IS classification (clayey soil) having 90 to 99 percent material finer than 75 micron.

The bore hole log charts and lab test results of bore holes 1 indicate that:

first strata, from 0.00 metre to 4.00 metre, consists of a layer of CL group of IS classification which is inorganic clays of low plasticity,

second strata, from 4.00 metre to 10.00 metre, consists of a layer of CI group of IS classification which is inorganic clays of medium plasticity.

The bore hole log charts and lab test results of bore holes 2 indicate that:

first strata, from 0.00 metre to 5.50 metre, consists of a layer of CL group of IS classification which is inorganic clays of low plasticity,

second strata, from 5.50 metre to 10.00 metre, consists of a layer of CI group of IS classification which is inorganic clays of medium plasticity.

S.P.T. VALUES

The S.P.T. values obtained in the respective clayey layer region present as per bore-log charts enclosed are found to range 5 to 15 indicating 'Medium' to 'Stiff' consistency.

The results of S.P.T. values indicate that the stratum at the Site is 'Loose' to 'Well' compacted.

WATER TABLE

Water Table at the Site was observed at a depth from 1.50 metre to 5.00 metre below ground level on the day of soil investigation during the Third week of April 2023. However, the existing water table may rise by 1.00 metre in the post-monsoon period in general. Therefore, a water table at a depth of 0.50 metre to 4.00 metre below ground level has been adopted for calculation purposes.

RECOMMENDATIONS FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GORAIPARA FERRY GHAT IN WEST BENGAL

NET SAFE BEARING CAPACITY/SAFE ALLOWABLE PRESSURE

Bore Hole Nos.	Type of Structure	Depth of Foundation (metres)	Size of Footing (L x B) (metres)	Net Safe Bearing Capacity (Tonne/sqm.)	Settlement Produced (mm)	Safe Allowable Pressure for Permissible Settlement 50 mm (Tonne/sqm.)
1	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	15.42	43.11	-
		2.00	1.20 x 1.20	17.37	41.20	-
		2.50	1.20 x 1.20	21.45	42.18	-
		1.50	2.00 x 2.00	14.45	57.24	11.88
		2.00	2.00 x 2.00	15.91	54.29	14.14
		2.50	2.00 x 2.00	19.12	55.07	16.67
		1.50	2.50 x 2.50	14.22	65.75	9.73
		2.00	2.50 x 2.50	15.47	60.21	11.98
		2.50	2.50 x 2.50	18.49	63.55	13.34
2	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	8.36	32.81	-
		2.00	1.20 x 1.20	9.57	33.47	-
		2.50	1.20 x 1.20	10.61	31.97	-
		1.50	2.00 x 2.00	7.89	44.92	-
		2.00	2.00 x 2.00	8.86	45.30	-
		2.50	2.00 x 2.00	9.49	42.37	-
		1.50	2.50 x 2.50	7.84	53.10	7.24
		2.00	2.50 x 2.50	8.74	49.93	-
		2.50	2.50 x 2.50	9.21	49.56	-

NOTE: -

The above recommendations are based on the field investigation data results and the laboratory tests results of the samples collected from the test locations and our experience in this regard. If the actual sub-soil conditions during excavation for the

foundations differ from that has been reported, a reference should be made to us for suggestions.

Further, the recommendations are based on the assumptions as mentioned in the Report and the designer of the Structure should take into consideration all the factors required as per codes. The recommendations should be taken as guidelines for the designer.

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BEARING CAPACITY CALCULATIONS

Soil when stressed due to loading, tend to deform. The resistance to deformation of the soil depends upon factors like water content, bulk density, angle of internal friction and the manner in which load is applied on the soil. The maximum load per unit area which the soil or rock can carry without yielding or displacement is termed as the bearing capacity of soils. The Safe Bearing Capacity of the proposed STRUCTURE without any distress is determined from the considerations of the following criteria.

[A] SHEAR CRITERIA

The soil beneath the foundation shall be safe from risk of shear failure.

[B] SETTLEMENT CRITERIA

The settlement due to load is caused basically on account of two factors, namely,

- (i) the soil below footing gets compressed by certain amount and
- (ii) since the foundations cover only a limited area there is a possibility that the concentrated stresses developed are so high as to cause actual rupture (shear failure) and displacement of soil below.

The foundation should not settle or deflect to an extent causing damage to the Structure or impair its usefulness.

The Bearing Capacity Calculations for the Foundation shall be governed as per IS: 6403-1981, IS: 8009(Part-I)-1976 and IS: 1904-2021 on the basis of available information regarding the proposed design.

BEARING CAPACITY ON SHEAR CONSIDERATIONS**ULTIMATE NET BEARING CAPACITY**

As per IS: 6403-1981, the Ultimate Net Bearing Capacity 'qd' on shear consideration for a Structure is given by the formula: -

FOR GENERAL SHEAR FAILURE

$$q_d = c.N_c.Sc.dc.ic + q(N_q - 1).sq.dq.iq + 1/2 B.r.Nr.Sr.dr.ir.W'$$

FOR LOCAL SHEAR FAILURE

$$q'd = 2/3 c.N'c.Sc.dc.ic + q(N'q - 1).Sq.dq.iq + 1/2 B.r.N'r.Sr.dr.ir.W'$$

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981



NAME OF PROJECT																													Net Safe Bearing Capacity						
BOREHOLE 01 (L.H.S.)		Depth of borehole		10.00	metre		Water table below borehole level (m)		5.00	Factor of safety		2.50		Water table used for calculation (m)		4.00	Assumed post monsoon rise (m)		1.00																
		Input Parameters												Shearing Resistance Parameters												Ultimate Net Bearing Capacity									
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance		Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors						Inclination Factors			General shear	Local shear	Intermediate	
		(m)	(m)	(m)	(gms/cc)	(kN/m3)	(gms/cc)	(kN/m3)	Kg/cm2	φ	φ'	e	q	Nc	Nq	Ny	Nc'	Nq'	Ny'	Sc	Sq	Sy	Dc	Dq	Dy	Dc'	Dq'	Dy'	lc	lq	ly				
1	SQUARE	1.50	1.20	1.20	1.80	17.65	1.80	17.65	0.25	12	8.11	0.640	26.48	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.31	1.15	1.15	1.31	1.15	1.15	1.00	1.00	1.00	475.51	259.03	378.09	151.24
2	SQUARE	2.00	1.20	1.20	1.80	17.65	1.87	18.34	0.25	12	8.11	0.640	35.31	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.41	1.21	1.21	1.41	1.21	1.21	1.00	1.00	1.00	535.59	291.84	425.90	170.36
3	SQUARE	2.50	1.20	1.20	1.80	17.65	1.87	18.34	0.25	13	8.79	0.630	44.13	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.52	1.26	1.26	1.52	1.26	1.26	1.00	1.00	1.00	646.94	344.29	525.88	210.35
4	SQUARE	1.50	2.00	2.00	1.80	17.65	1.80	17.65	0.25	12	8.11	0.640	26.48	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.19	1.09	1.09	1.19	1.09	1.09	1.00	1.00	1.00	445.84	242.62	354.39	141.76
5	SQUARE	2.00	2.00	2.00	1.80	17.65	1.87	18.34	0.25	12	8.11	0.640	35.31	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.25	1.12	1.12	1.25	1.12	1.12	1.00	1.00	1.00	490.57	267.04	389.98	155.99
6	SQUARE	2.50	2.00	2.00	1.80	17.65	1.87	18.34	0.25	13	8.79	0.630	44.13	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.31	1.16	1.16	1.31	1.16	1.16	1.00	1.00	1.00	576.93	306.75	468.86	187.54
7	SQUARE	1.50	2.50	2.50	1.80	17.65	1.80	17.65	0.25	12	8.11	0.640	26.48	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.15	1.07	1.07	1.15	1.07	1.07	1.00	1.00	1.00	438.68	238.56	348.63	139.45
8	SQUARE	2.00	2.50	2.50	1.80	17.65	1.87	18.34	0.25	12	8.11	0.640	35.31	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.20	1.10	1.10	1.20	1.10	1.10	1.00	1.00	1.00	477.04	259.58	379.18	151.67
9	SQUARE	2.50	2.50	2.50	1.80	17.65	1.87	18.34	0.25	13	8.79	0.630	44.13	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.25	1.13	1.13	1.25	1.13	1.13	1.00	1.00	1.00	557.95	296.53	453.38	181.35

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80		
Width	1.20	metre	Applied Pressure at foundation base	151.24	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.80	-	-	-	Depth of foundation						43.11
2	2	CLAY	1.50	3.00	1.50	1.87	0.630	0.125	0.00	40.23	57.27	-	-	44.224	-	
3	3	CLAY	3.00	4.00	1.00	1.93	0.598	0.123	0.00	63.45	21.27	-	-	9.663	-	

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80		
Width	1.20	metre	Applied Pressure at foundation base	170.36	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.80	0.000	0.000	0.00	Depth of foundation						41.20
2	2	CLAY	2.00	3.50	1.50	1.87	0.630	0.125	0.00	49.06	64.52	-	-	41.935	-	
3	3	CLAY	3.50	4.50	1.00	1.93	0.598	0.123	0.00	72.28	23.96	-	-	9.570	-	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80		
Width	1.20	metre	Applied Pressure at foundation base	210.35	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.87	0.000	0.000	0.00	Depth of foundation						42.18
2	2	CLAY	2.50	4.00	1.50	1.93	0.598	0.123	0.00	60.04	79.66	-	-	42.343	-	
3	3	CLAY	4.00	5.00	1.00	1.91	0.648	0.130	0.00	83.60	29.58	-	-	10.378	-	

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1	
Length	2.00	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80			
Width	2.00	metre	Applied Pressure at foundation base	141.76	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement	
		CLAY					e	Cc	N''	P _o	ΔP		W'				
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)	
1	1	CLAY	0.00	1.50	1.50	1.80	-	-	-	Depth of foundation							57.24
2	2	CLAY	1.50	3.00	1.50	1.87	0.630	0.125	0.00	40.23	74.98	-	-	52.560	-		
3	3	CLAY	3.00	4.50	1.50	1.93	0.598	0.123	0.00	68.18	31.39	-	-	18.990	-		

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	116.51	kN/m ²		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.80	-	-	-	Depth of foundation						50.00
2	2	CLAY	1.50	3.00	1.50	1.87	0.630	0.125	0.00	40.23	61.63	-	-	46.40	-	
3	3	CLAY	3.00	4.50	1.50	1.93	0.598	0.123	0.00	68.18	25.80	-	-	16.09	-	

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	155.99	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	C _c	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.80	0.000	0.000	0.00	Depth of foundation						54.29
2	2	CLAY	2.00	3.50	1.50	1.87	0.630	0.125	0.00	49.06	82.51	-	-	49.282	-	
3	3	CLAY	3.50	5.00	1.50	1.93	0.598	0.123	0.00	77.01	34.54	-	-	18.582	-	

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	138.67	kN/m ²		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.80	0.000	0.000	0.00	Depth of foundation						50.00
2	2	CLAY	2.00	3.50	1.50	1.87	0.630	0.125	0.00	49.06	73.35	-	-	45.676	-	
3	3	CLAY	3.50	5.00	1.50	1.93	0.598	0.123	0.00	77.01	30.71	-	-	16.827	-	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1	
Length	2.00	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80			
Width	2.00	metre	Applied Pressure at foundation base	187.54	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	C _c	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.87	0.000	0.000	0.00	Depth of foundation						55.07
2	2	CLAY	2.50	4.00	1.50	1.93	0.598	0.123	0.00	60.04	99.19	-	-	48.905	-	
3	3	CLAY	4.00	5.50	1.50	1.91	0.648	0.130	0.00	87.62	41.53	-	-	19.938	-	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	163.47	kN/m ²		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.87	0.000	0.000	0.00	Depth of foundation						50.00
2	2	CLAY	2.50	4.00	1.50	1.93	0.598	0.123	0.00	60.04	86.46	-	-	44.727	-	
3	3	CLAY	4.00	5.50	1.50	1.91	0.648	0.130	0.00	87.62	36.20	-	-	17.772	-	

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

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1	
Length	2.50	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80			
Width	2.50	metre	Applied Pressure at foundation base	139.45	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement	
		CLAY					e	Cc	N''	P _o	ΔP		W'				
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)	
1	1	CLAY	0.00	1.50	1.50	1.80	0.000	0.000	0.00	Depth of foundation							65.75
2	2	CLAY	1.50	3.50	2.00	1.87	0.630	0.125	0.00	44.82	71.15	-	-	63.325	-		
3	3	CLAY	3.50	5.25	1.75	1.93	0.598	0.123	0.00	79.31	30.17	-	-	18.858	-		

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

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	95.40	kN/m ²		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.80	0.000	0.000	0.00	Depth of foundation						50.00
2	2	CLAY	1.50	3.50	2.00	1.87	0.630	0.125	0.00	44.82	48.67	-	-	48.975	-	
3	3	CLAY	3.50	5.25	1.75	1.93	0.598	0.123	0.00	79.31	20.64	-	-	13.530	-	

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

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	151.67	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	C _c	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.87	0.000	0.000	0.00	Depth of foundation						60.21
2	2	CLAY	2.00	4.00	2.00	1.93	0.598	0.123	0.00	55.61	77.38	-	-	58.297	-	
3	3	CLAY	4.00	5.50	1.50	1.91	0.648	0.130	0.00	87.91	34.39	-	-	16.967	-	

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

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	117.48	kN/m ²		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.87	0.000	0.000	0.000	Depth of foundation						50.00
2	2	CLAY	2.00	4.00	2.00	1.93	0.598	0.123	0.000	55.61	59.94	-	-	48.897	-	
3	3	CLAY	4.00	5.50	1.50	1.91	0.648	0.130	0.000	87.91	26.64	-	-	13.602	-	

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

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1	
Length	2.50	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80			
Width	2.50	metre	Applied Pressure at foundation base	181.35	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.87	0.000	0.000	0.00	Depth of foundation						63.55
2	2	CLAY	2.50	4.50	2.00	1.93	0.598	0.123	0.00	64.78	92.53	-	-	59.317	-	
3	3	CLAY	4.50	6.25	1.75	1.91	0.648	0.130	0.00	98.38	39.23	-	-	20.121	-	

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


CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	130.80	kN/m ²		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.87	0.000	0.000	0.000	Depth of foundation						50.00
2	2	CLAY	2.50	4.50	2.00	1.93	0.598	0.123	0.000	64.78	66.73	-	-	47.345	-	
3	3	CLAY	4.50	6.25	1.75	1.91	0.648	0.130	0.000	98.38	28.30	-	-	15.156	-	

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981

NAME OF PROJECT																																			
BOREHOLE 02 (L.H.S.)	Depth of borehole	10.00	metre			Water table below borehole level (m)			1.50	Factor of safety			2.50	Assumed post monsoon rise (m)			1.00																		
	Water table used for calculation (m)			0.50																															
Input Parameters												Shearing Resistance Parameters												Ultimate Net Bearing Capacity			Net Safe Bearing Capacity								
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance	Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors						Inclination Factors			General shear	Local shear	Intermediate		
		(m)	(m)	(m)	(gms/cc)	(kN/m3)	(gms/cc)	(kN/m3)	Kg/cm2	°	°	e	q	Nc	Nq	Ny	Nc'	Nq'	Ny'	Sc	Sq	Sy	Dc	Dq	Dy	Dc'		Dq'	Dy'	lc	lq	ly	kn/m2	kn/m2	kn/m2
1	SQUARE	1.50	1.20	1.20	1.83	11.41	1.83	11.41	0.10	17	11.58	0.690	17.11	12.33	4.77	3.53	9.08	2.86	1.58	1.30	1.20	0.80	1.34	1.17	1.17	1.34	1.17	1.17	1.00	1.00	1.00	319.01	156.07	204.95	81.98
2	SQUARE	2.00	1.20	1.20	1.83	10.59	1.89	11.18	0.10	17	11.58	0.690	21.18	12.33	4.77	3.53	9.08	2.86	1.58	1.30	1.20	0.80	1.45	1.23	1.23	1.45	1.23	1.23	1.00	1.00	1.00	365.12	178.70	234.63	93.85
3	SQUARE	2.50	1.20	1.20	1.83	10.10	1.89	10.69	0.15	12	8.11	0.665	25.25	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.51	1.26	1.26	1.51	1.26	1.26	1.00	1.00	1.00	352.38	192.09	260.21	104.08
4	SQUARE	1.50	2.00	2.00	1.83	11.41	1.83	11.41	0.10	17	11.58	0.690	17.11	12.33	4.77	3.53	9.08	2.86	1.58	1.30	1.20	0.80	1.20	1.10	1.10	1.20	1.10	1.10	1.00	1.00	1.00	301.67	147.10	193.47	77.39
5	SQUARE	2.00	2.00	2.00	1.83	10.59	1.89	11.18	0.10	17	11.58	0.690	21.18	12.33	4.77	3.53	9.08	2.86	1.58	1.30	1.20	0.80	1.27	1.14	1.14	1.27	1.14	1.14	1.00	1.00	1.00	338.72	165.27	217.31	86.92
6	SQUARE	2.50	2.00	2.00	1.83	10.10	1.89	10.69	0.15	12	8.11	0.665	25.25	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.31	1.15	1.15	1.31	1.15	1.15	1.00	1.00	1.00	315.29	171.74	232.75	93.10
7	SQUARE	1.50	2.50	2.50	1.83	11.41	1.83	11.41	0.10	17	11.58	0.690	17.11	12.33	4.77	3.53	9.08	2.86	1.58	1.30	1.20	0.80	1.16	1.08	1.08	1.16	1.08	1.08	1.00	1.00	1.00	300.17	146.09	192.31	76.92
8	SQUARE	2.00	2.50	2.50	1.83	10.59	1.89	11.18	0.10	17	11.58	0.690	21.18	12.33	4.77	3.53	9.08	2.86	1.58	1.30	1.20	0.80	1.22	1.11	1.11	1.22	1.11	1.11	1.00	1.00	1.00	334.47	162.89	214.36	85.74
9	SQUARE	2.50	2.50	2.50	1.83	10.10	1.89	10.69	0.15	12	8.11	0.665	25.25	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.25	1.12	1.12	1.25	1.12	1.12	1.00	1.00	1.00	306.00	166.59	225.84	90.34

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	1.50	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	81.98	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.83	-	-	-	Depth of foundation						32.81
2	2	CLAY	1.50	3.00	1.50	1.89	0.665	0.130	0.00	33.47	31.05	-	-	33.382	-	
3	3	CLAY	3.00	4.00	1.00	1.91	0.667	0.127	0.00	44.47	11.53	-	-	7.626	-	

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2	
Length	1.20	metre	Water Table depth for calculation	1.50	(m) bgl		Rigidity factor	0.80			
Width	1.20	metre	Applied Pressure at foundation base	93.85	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.83	0.000	0.000	0.00	Depth of foundation						33.47
2	2	CLAY	2.00	3.50	1.50	1.89	0.665	0.130	0.00	37.54	35.54	-	-	33.886	-	
3	3	CLAY	3.50	4.50	1.00	1.91	0.667	0.127	0.00	48.54	13.20	-	-	7.957	-	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	1.50	(m) bgl		Rigidity factor	0.80		
Width	1.20	metre	Applied Pressure at foundation base	104.08	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.89	0.000	0.000	0.00	Depth of foundation						31.97
2	2	CLAY	2.50	4.00	1.50	1.91	0.667	0.127	0.00	43.22	39.41	-	-	32.164	-	
3	3	CLAY	4.00	5.00	1.00	1.94	0.656	0.125	0.00	54.53	14.64	-	-	7.795	-	

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2	
Length	2.00	metre	Water Table depth for calculation	1.50	(m) bgl		Rigidity factor	0.80			
Width	2.00	metre	Applied Pressure at foundation base	77.39	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.83	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.89	0.665	0.130	0.00	33.47	40.93	-	-	40.635	-	44.92
3	3	CLAY	3.00	4.50	1.50	1.91	0.667	0.127	0.00	46.71	17.14	-	-	15.513	-	

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2	
Length	2.00	metre	Water Table depth for calculation	1.50	(m) bgl		Rigidity factor	0.80			
Width	2.00	metre	Applied Pressure at foundation base	86.92	kN/m2		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.83	0.000	0.000	0.00	Depth of foundation						45.30
2	2	CLAY	2.00	3.50	1.50	1.89	0.665	0.130	0.00	37.54	45.97	-	-	40.674	-	
3	3	CLAY	3.50	5.00	1.50	1.91	0.667	0.127	0.00	50.78	19.25	-	-	15.952	-	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2	
Length	2.00	metre	Water Table depth for calculation	1.50	(m) bgl		Rigidity factor	0.80			
Width	2.00	metre	Applied Pressure at foundation base	93.10	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	C _c	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.89	0.000	0.000	0.00	Depth of foundation						42.37
2	2	CLAY	2.50	4.00	1.50	1.91	0.667	0.127	0.00	43.22	49.24	-	-	37.741	-	
3	3	CLAY	4.00	5.50	1.50	1.94	0.656	0.125	0.00	56.83	20.62	-	-	15.220	-	

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

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	1.50	(m) bgl		Rigidity factor	0.80			
Width	2.50	metre	Applied Pressure at foundation base	76.92	kN/m2		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.83	0.000	0.000	0.00	Depth of foundation						53.10
2	2	CLAY	1.50	3.50	2.00	1.89	0.665	0.130	0.00	35.65	39.24	-	-	50.345	-	
3	3	CLAY	3.50	5.25	1.75	1.91	0.667	0.127	0.00	52.19	16.64	-	-	16.026	-	

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

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	1.50	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	71.02	kN/m ²		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.83	0.000	0.000	0.00	Depth of foundation						50.00
2	2	CLAY	1.50	3.50	2.00	1.89	0.665	0.130	0.00	35.65	36.23	-	-	47.563	-	
3	3	CLAY	3.50	5.25	1.75	1.91	0.667	0.127	0.00	52.19	15.36	-	-	14.942	-	

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

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	1.50	(m) bgl		Rigidity factor	0.80			
Width	2.50	metre	Applied Pressure at foundation base	85.74	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	C _c	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.89	0.000	0.000	0.00	Depth of foundation						49.93
2	2	CLAY	2.00	4.00	2.00	1.91	0.667	0.127	0.00	41.09	43.74	-	-	47.971	-	
3	3	CLAY	4.00	5.50	1.50	1.94	0.656	0.125	0.00	56.93	19.44	-	-	14.447	-	

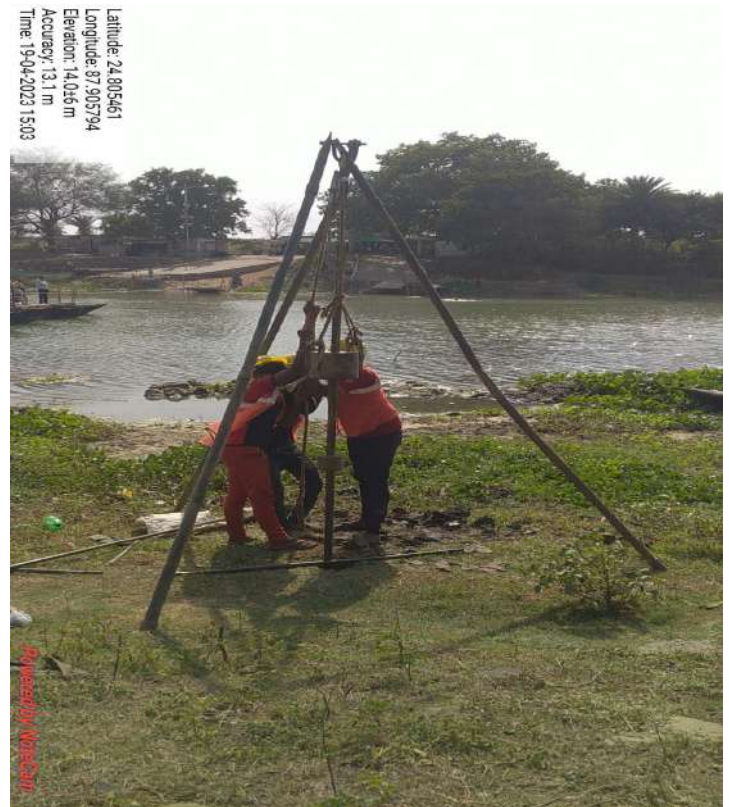
SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 6


Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	1.50	(m) bgl		Rigidity factor	0.80			
Width	2.50	metre	Applied Pressure at foundation base	90.34	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	C _c	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.89	0.000	0.000	0.00	Depth of foundation						49.56
2	2	CLAY	2.50	4.50	2.00	1.91	0.667	0.127	0.00	45.46	46.09	-	-	46.329	-	
3	3	CLAY	4.50	6.25	1.75	1.94	0.656	0.125	0.00	62.45	19.54	-	-	15.621	-	


SITE PHOTOS DURING SITE INVESTIGATION



RESULT SHEET

NAME OF THE PROJECT																						
CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GORAIPARA FERRY GHAT IN WEST BENGAL																						
Client Name																						
Bore Hole No.	1 (L.H.S.)			Coordinate		Easting			Depth of Water Level			5.00			VIVEK MATERIAL TESTING LABORATORY  <small>VMT GEOTECH & MATERIAL TESTING</small>							
Total depth of Bore Hole	10.00			Northing		100.000			Commenced on			4/19/2023										
				Elevation					Completed on			4/19/2023										
Depth of Bore Hole	Reduced Level		Types of Samples	% Material Passing IS Sieve				Atterberg Limits			IS group symbol	SPT Value	SPT Value corrected due to overburden	SPT Value corrected due to dilatancy	Wet Bulk Density	Original Moisture	Dry Bulk Density	Specific Gravity	Void Ratio	Shear Characteristics		Compression Index
				4.750	2.000	0.425	0.075	LL	PL	PI										Cohesion	Angle of Internal Friction	
metre	metre			(mm)	(mm)	(mm)	(mm)	%	%	%		N	N'	N''	(gms/cc)	%	(gms/cc)	(G)		(Kg/sqcm)	(ϕ)	(Cc)
1	2		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
0.00 - 0.50	100.000 - 99.500		DS	100	100	98	93	34	23	11	CL					-	-	-	-	-	-	-
1.00 - 1.35	99.000 - 98.650		UD	100	98	95	90	35	21	14	CL				1.80	12.1	1.61	2.64	0.640	0.25	12°	0.127
1.35 - 1.80	98.650 - 98.200		SPT									11	15.05	15.05								
2.50 - 2.85	97.500 - 97.150		UD	100	100	97	94	34	25	9	CL				1.87	15.3	1.62	-	-	-	-	-
2.85 - 3.30	97.150 - 96.700		SPT									12	13.91	13.91								
4.00 - 4.35	96.000 - 95.650		UD	100	100	100	99	36	18	18	CI				1.93	17.6	1.64	2.62	0.598	0.30	15°	0.123
4.35 - 4.80	95.650 - 95.200		SPT									14	14.40	14.40								
5.50 - 5.85	94.500 - 94.150		UD	100	100	100	98	37	22	15	CI				1.91	20.1	1.59	-	-	-	-	-
5.85 - 6.30	94.150 - 93.700		SPT									8	9.52	9.52								
7.00 - 7.35	93.000 - 92.650		UD	100	100	100	97	39	23	16	CI				1.94	21.3	1.60	2.63	0.644	0.20	12°	0.130
7.35 - 7.80	92.650 - 92.200		SPT									11	12.25	12.25								
8.50 - 8.85	91.500 - 91.150		UD	100	100	100	98	38	25	13	CI				1.95	18.4	1.65	-	-	-	-	-
8.85 - 9.30	91.150 - 90.700		SPT									15	15.77	15.39								
9.30 - 10.00	90.700 - 90.000		DS	100	100	100	99	40	21	19	CI					-	-	-	-	-	-	-

RESULT SHEET

NAME OF THE PROJECT CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GORAIPARA FERRY GHAT IN WEST BENGAL																						
Client Name																						
Bore Hole No.	2 (L.H.S.)		Coordinate			Easting			Depth of Water Level			1.50			VIVEK MATERIAL TESTING LABORATORY					 VMT GEOTECHNICAL MATERIAL TESTING		
Total depth of Bore Hole	10.00		Northing			Completed on			4/19/2023													
Depth of Bore Hole	Reduced Level		% Material Passing IS Sieve				Atterberg Limits			IS group symbol	SPT Value	SPT Value corrected due to overburden	SPT Value corrected due to dilatancy	Wet Bulk Density	Original Moisture	Dry Bulk Density	Specific Gravity	Void Ratio	Shear Characteristics		Compression Index	
metre	metre		4.750	2.000	0.425	0.075	LL	PL	PI										Cohesion	Angle of Internal Friction		
1	2		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
0.00 - 0.50	100.000 - 99.500		DS	100	99	97	95	30	20	10	CL					-	-	-	-	-	-	-
1.00 - 1.35	99.000 - 98.650		UD	100	100	100	98	29	17	12	CL				1.83	18.3	1.55	2.62	0.690	0.10	17°	0.135
1.35 - 1.80	98.650 - 98.200		SPT									5	8.13	8.13								
2.50 - 2.85	97.500 - 97.150		UD	100	100	99	97	28	20	8	CL				1.89	19.6	1.58	-	-	-	-	-
2.85 - 3.30	97.150 - 96.700		SPT									7	9.89	9.89								
4.00 - 4.35	96.000 - 95.650		UD	100	100	98	96	33	21	12	CL				1.91	20.3	1.59	2.65	0.667	0.25	12°	0.127
4.35 - 4.80	95.650 - 95.200		SPT									9	11.53	11.53								
5.50 - 5.85	94.500 - 94.150		UD	100	100	100	99	37	22	15	CI				1.94	21.2	1.60	-	-	-	-	-
5.85 - 6.30	94.150 - 93.700		SPT									9	10.66	10.66								
7.00 - 7.35	93.000 - 92.650		UD	100	100	100	99	38	24	14	CI				1.95	18.6	1.64	2.62	0.598	0.30	13°	0.123
7.35 - 7.80	92.650 - 92.200		SPT									13	14.42	14.42								
8.50 - 8.85	91.500 - 91.150		UD	100	100	100	98	39	25	14	CI				1.95	17.3	1.66	-	-	-	-	-
8.85 - 9.30	91.150 - 90.700		SPT									14	14.66	14.66								
9.30 - 10.00	90.700 - 90.000		DS	100	100	100	97	40	20	20	CI					-	-	-	-	-	-	-

BORE-LOG CHART



VMT
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VIVEK MATERIAL TESTING LABORATORY

NAME OF THE PROJECT:- CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GORAI PARA
FERRY GHAT IN WEST BENGAL

WATER TABLE 5.00 METRE DEPTH BELOW GROUND LEVEL

BORE HOLE NO.:- 01 (L.H.S.)

DEPTH IN METRES BELOW GROUND LEVEL	VISUAL FIELD OBSERVATIONS	SAMPLE	I.S.		S.P.T. VALUE				S.P.T. VALUES										
			GROUP	HATCHING	N1	N2	N3	N2+N3	10	20	30	40	50	60	70	80	90	100	
0.00-0.50	SILTY-CLAY	D.	CL	[Cross-hatch pattern]															
1.00-1.35	SILTY-CLAY	U.D.	CL																
1.35-1.80		S.P.T.			3	5	6	11											
2.50-2.85	SILTY-CLAY	U.D.	CL	[Cross-hatch pattern]															
2.85-3.30		S.P.T.				4	5	7	12										
4.00-4.35	SILTY-CLAY	U.D.	CI	[Diagonal hatch pattern]															
4.35-4.80		S.P.T.				4	6	8	14										
5.50-5.85	SILTY-CLAY	U.D.	CI	[Diagonal hatch pattern]															
5.85-6.30		S.P.T.				3	3	5	8										
7.00-7.35	SILTY-CLAY	U.D.	CI	[Diagonal hatch pattern]															
7.35-7.80		S.P.T.				4	5	6	11										
8.50-8.85	SILTY-CLAY	U.D.	CI	[Diagonal hatch pattern]															
8.85-9.30		S.P.T.				5	7	8	15										
9.30-10.00	SILTY-CLAY	D.	CI	[Diagonal hatch pattern]															

BORE-LOG CHART



VMT
GEOTECH & MATERIAL TESTING

VIVEK MATERIAL TESTING LABORATORY

NAME OF THE PROJECT:- CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GORAIPARA FERRY GHAT IN WEST BENGAL

WATER TABLE 1.50 METRE DEPTH BELOW GROUND LEVEL

BORE HOLE NO.:- 02 (L.H.S.)

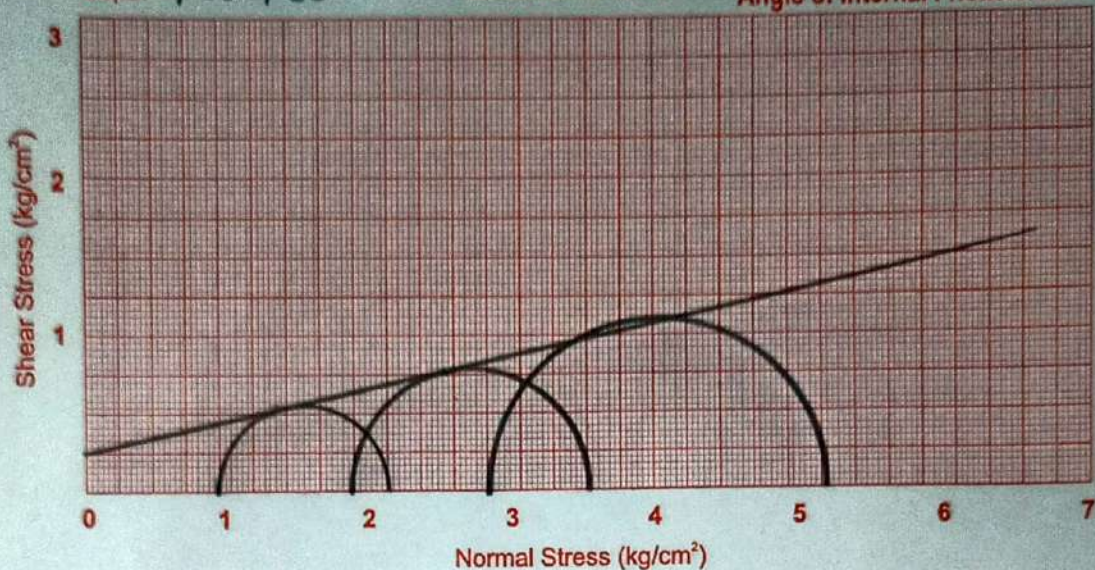
DEPTH IN METRES BELOW GROUND LEVEL	VISUAL FIELD OBSERVATIONS	SAMPLE	I.S.		S.P.T. VALUE				S.P.T. VALUES																		
			GROUP	HATCHING	N1	N2	N3	N2+N3	10	20	30	40	50	60	70	80	90	100									
0.00-0.50	SILTY-CLAY	D.	CL																								
1.00-1.35	SILTY-CLAY	U.D.	CL	[Grid Hatching]																							
1.35-1.80		S.P.T.			2	2	3	5	10																		
2.50-2.85	SILTY-CLAY	U.D.	CL																								
2.85-3.30		S.P.T.			2	3	4	7	10																		
4.00-4.35	SILTY-CLAY	U.D.	CL																								
4.35-4.80		S.P.T.			3	4	5	9	10																		
5.50-5.85	SILTY-CLAY	U.D.	CI		[Diagonal Hatching]																						
5.85-6.30		S.P.T.				4	4	5	9	10																	
7.00-7.35	SILTY-CLAY	U.D.	CI																								
7.35-7.80		S.P.T.				5	6	7	13	10																	
8.50-8.85	SILTY-CLAY	U.D.	CI																								
8.85-9.30		S.P.T.				4	6	8	14	10																	
9.30-10.00	SILTY-CLAY	D.	CI																								



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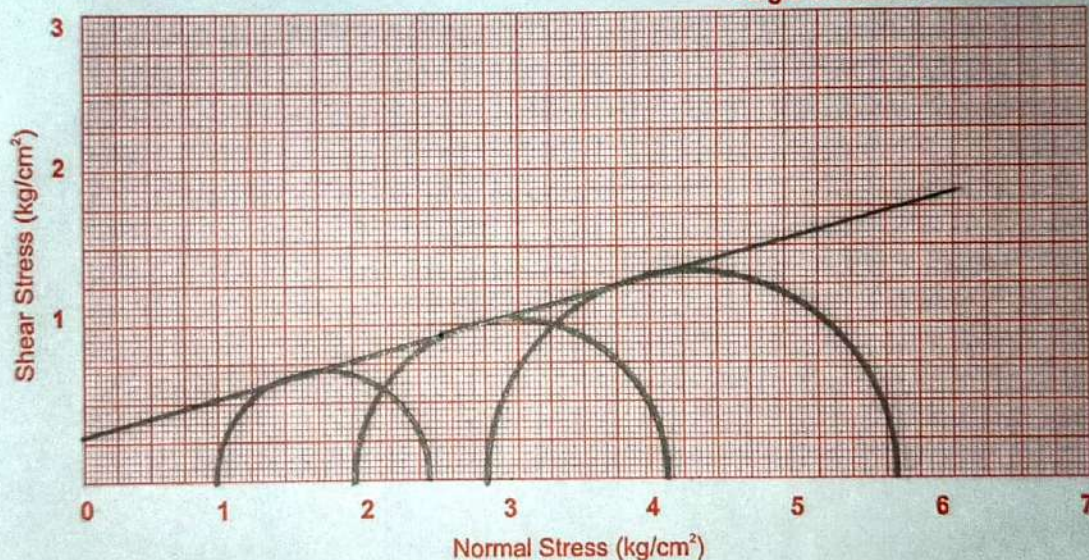
B.H. No. :- 01
Depth :- 1.00 - 1.35

Cohesion 'c' :- 0.25 Kg/cm²
Angle of Internal Friction 12°*



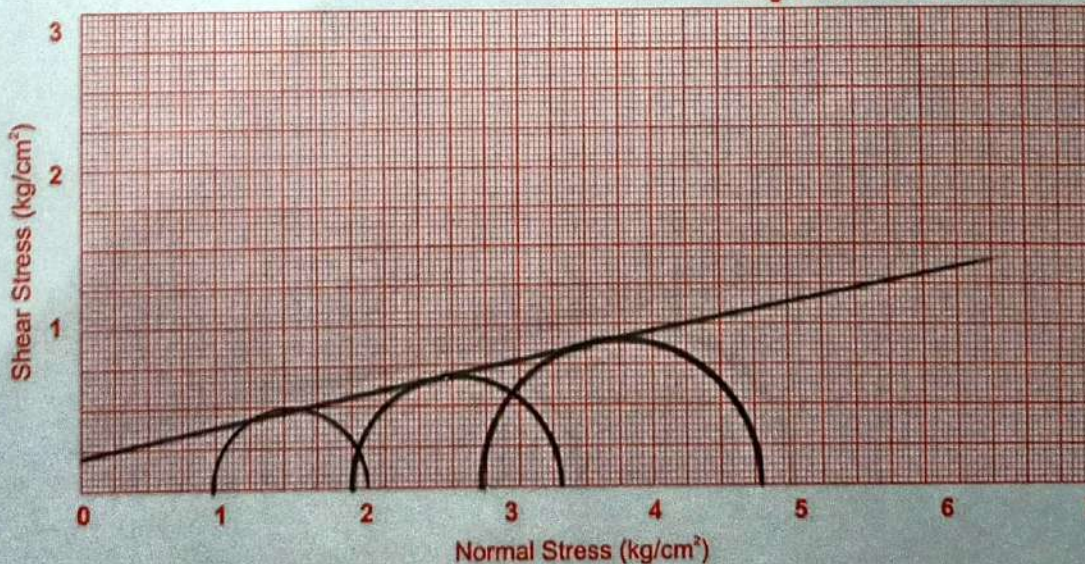
B.H. No. :- 01
Depth :- 4.00 - 4.35

Cohesion 'c' :- 0.30 Kg/cm²
Angle of Internal Friction 15°*



B.H. No. :- 01
Depth :- 7.00 - 7.35

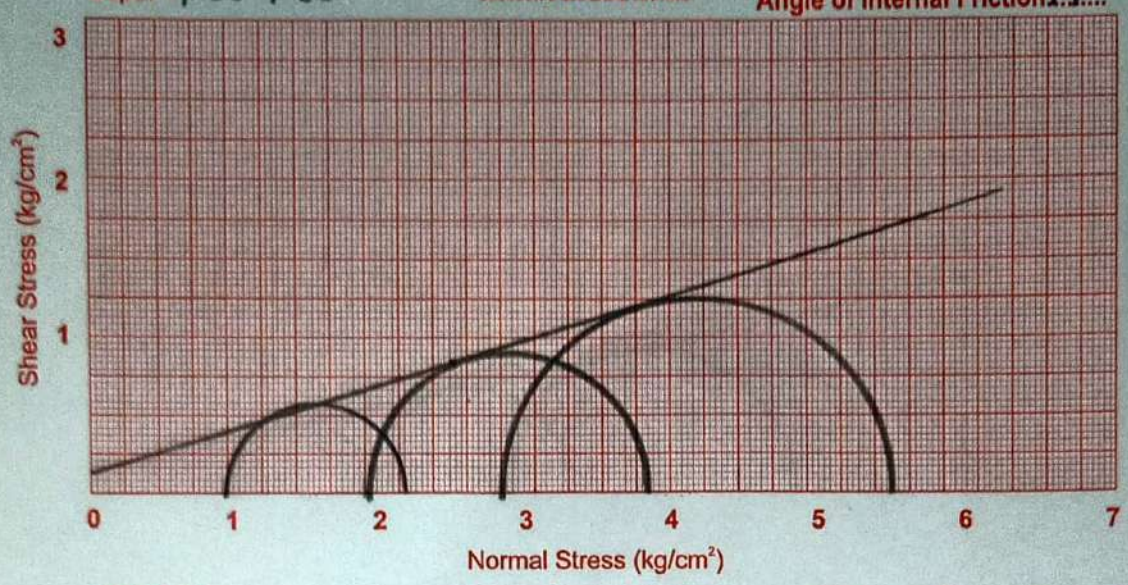
Cohesion 'c' :- 0.20 Kg/cm²
Angle of Internal Friction 12°*





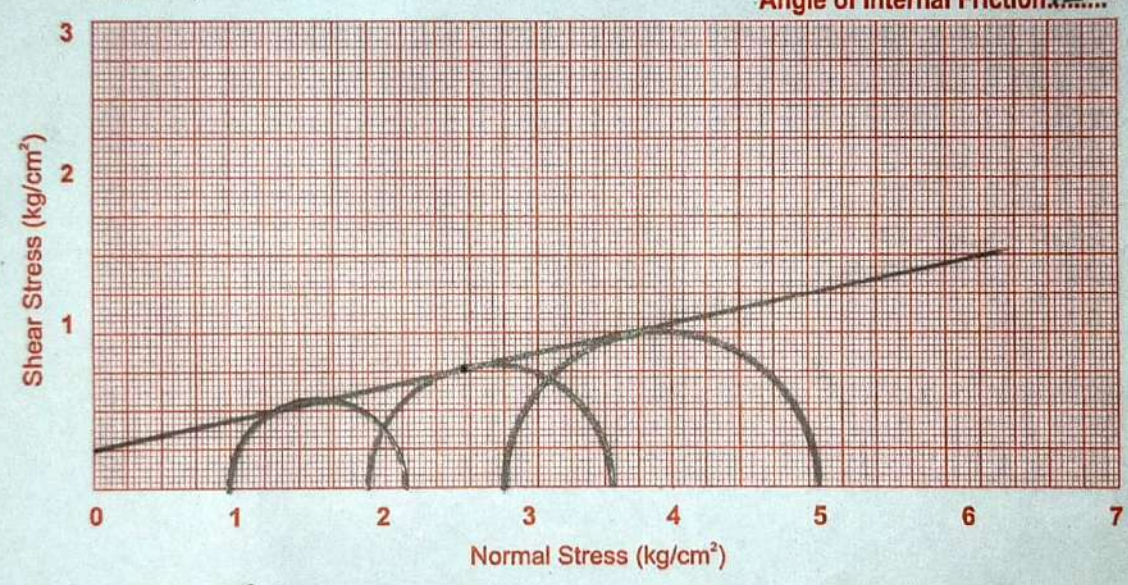
B.H. No. :- 02
Depth :- 1.00 - 1.35

Cohesion 'c' 0.10 Kg/cm²
Angle of Internal Friction 17°*



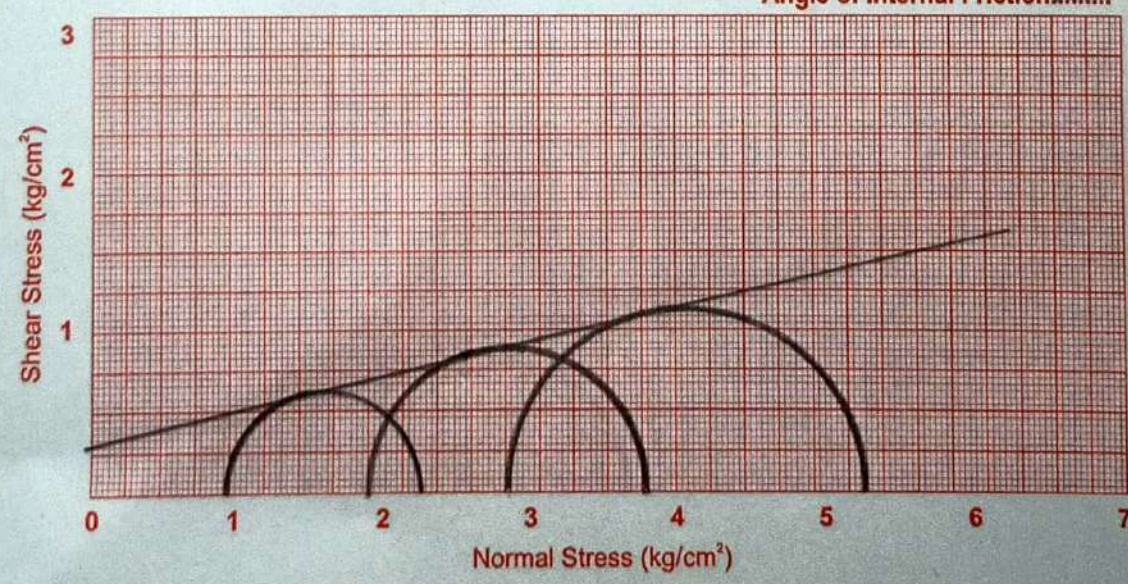
B.H. No. :- 02
Depth :- 4.00 - 4.35

Cohesion 'c' 0.25 Kg/cm²
Angle of Internal Friction 12°*



B.H. No. :- 02
Depth :- 7.00 - 7.35

Cohesion 'c' 0.30 Kg/cm²
Angle of Internal Friction 13°*





VMT

GEOTECH & MATERIAL TESTING



IC-8969

REPORT NO. – VMT 132 A/2023-2024

GEOTECH INVESTIGATION

REPORT FOR

PROPOSED CONSTRUCTION

OF

BOAT IN THE IDENTIFIED

COMMUNITY JETTY

AT LALBAGH FERRY GHAT

(L.H.S.) IN

WEST BENGAL

Prepared By -

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ACKNOWLEDGEMENT

WE ARE GRATEFUL TO M/s KITCO LTD., KERLA FOR PROVIDING US THE OPPORTUNITY TO CARRY OUT THESE INVESTIGATIONS.

THE CO-OPERATION EXTENDED BY THEIR ENGINEERS DURING FIELD INVESTIGATIONS IS THANKFULLY ACKNOWLEDGED.

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**SUB-SOIL INVESTIGATION REPORT FOR PROPOSED CONSTRUCTION OF BOAT
IN THE IDENTIFIED COMMUNITY JETTY AT LALBAGH FERRY GHAT IN WEST
BENGAL**

INTRODUCTION

The work of sub-soil exploration was awarded to us by M/s KITCO LTD., KERLA Order no. – 6777:DP 1083: RG: 2023 dated 21/03/2023. The object of the investigation was to study the geo-technical properties of soil both in field and laboratory and determine safe allowable pressure for the foundation soil.

The fieldwork consisted of 02 bore holes of 10.00 metre depth each. The fieldwork was conducted on 16/04/2023. The location of the bore holes is shown in the Site location.

REFERENCES

1. **IS: 1892-2021** for field work including existent ground water table.
2. **IS: 2132-1986** for sampling in Undisturbed and Disturbed form.
3. **IS: 2131-1981** for Standard Penetration Test.
4. **IS: 2720** for all laboratory tests on soil samples collected.
5. **IS: 6403-1981** for determination of Bearing Capacity.
6. **IS: 8009(Part I)-1976** for calculation of settlement of foundations.
7. **IS: 1904-2021** for permissible maximum settlement, differential settlement and angular distortion.

SCOPE OF WORK

The scope consisted of drilling of boreholes down to maximum depth of 10.00 m in normal soils / rock, Standard Penetration Testing, collection of samples, laboratory testing and preparation and submission of Geotechnical Investigation report.

Summary of the fieldwork					
Sl. No.	Site	Borehole Nos.	Coordinates		Depth below existing ground level (m)
			Latitude	Longitude	
1.	LALBAGH FERRY GHAT	BH-01 (LHS)	24.1706269	88.26898679	10.0
2.		BH-02 (LHS)	24.17039443	88.26892644	10.0



SITE LOCATION



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INTERPRETATION OF THE LAB TEST RESULTS

GENERAL NATURE OF SOIL STRATA

The bore hole log charts and lab test results of bore holes 1 and 2 indicate that the strata at the site is found to comprise of both cohesive as well as non-cohesive soil.

The results of classification tests indicate that the natural soil stratum present at the Site is found to comprise of both fine-grained soils comprising of 'CL' group of IS classification (clayey soil) having 96 to 99 percent material finer than 75 micron and coarse-grained soils (sandy soil) comprise of 'SM' group of IS classification having 40 to 46 percent material finer than 75 micron.

The bore hole log charts and lab test results of bore holes 1 indicate that:

first strata, from 0.00 metre to 7.00 metre, consists of a layer of CL group of IS classification which is inorganic clays of low plasticity,

second strata, from 7.00 metre to 10.00 metre, consists of a layer of SM group of IS classification which is silty Sand with none plasticity.

The bore hole log charts and lab test results of bore holes 2 indicate that:

first strata, from 0.00 metre to 7.00 metre, consists of a layer of CL group of IS classification which is inorganic clays of low plasticity,

second strata, from 7.00 metre to 10.00 metre, consists of a layer of SM group of IS classification which is silty Sand with none plasticity.

S.P.T. VALUES

The S.P.T. values obtained in the respective clayey layer region present as per bore-log charts enclosed are found to range 5 to 11 indicating 'Medium' to 'Stiff' consistency.

However, the S.P.T. values obtained in the respective sandy layer region present as per bore-log charts enclosed are found to range from 13 to 19 indicating 'Medium' relative density.

The results of S.P.T. values indicate that the stratum at the Site is 'Loose' to 'Well' compacted.

WATER TABLE

Water Table at the Site was observed at a depth from 2.15 metre to 2.20 metre below ground level on the day of soil investigation during the Third week of April 2023. However, the existing water table may rise by 1.00 metre in the post-monsoon period in general. Therefore, a water table at a depth of 1.15 metre to 1.10 metre below ground level has been adopted for calculation purposes.

RECOMMENDATIONS FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT LALBAGH FERRY GHAT IN WEST BENGAL
NET SAFE BEARING CAPACITY/SAFE ALLOWABLE PRESSURE

Bore Hole Nos.	Type of Structure	Depth of Foundation (metres)	Size of Footing (L x B) (metres)	Net Safe Bearing Capacity (Tonne/sqm.)	Settlement Produced (mm)	Safe Allowable Pressure for Permissible Settlement 50 mm (Tonne/sqm.)
1	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	10.02	34.05	-
		2.00	1.20 x 1.20	11.01	31.95	-
		2.50	1.20 x 1.20	14.45	37.53	-
		1.50	2.00 x 2.00	9.29	45.87	-
		2.00	2.00 x 2.00	9.99	42.70	-
		2.50	2.00 x 2.00	12.77	49.21	-
		1.50	2.50 x 2.50	9.14	53.57	8.34
		2.00	2.50 x 2.50	9.71	46.73	-
		2.50	2.50 x 2.50	12.30	57.65	10.17
2	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	9.78	33.44	-
		2.00	1.20 x 1.20	11.15	32.27	-
		2.50	1.20 x 1.20	9.80	27.98	-
		1.50	2.00 x 2.00	9.29	45.92	-
		2.00	2.00 x 2.00	10.34	43.89	-
		2.50	2.00 x 2.00	8.72	37.17	-
		1.50	2.50 x 2.50	9.23	54.03	8.32
		2.00	2.50 x 2.50	10.16	48.79	-
		2.50	2.50 x 2.50	8.45	43.56	-

NOTE: -

The above recommendations are based on the field investigation data results and the laboratory tests results of the samples collected from the test locations and our experience in this regard. If the actual sub-soil conditions during excavation for the

foundations differ from that has been reported, a reference should be made to us for suggestions.

Further, the recommendations are based on the assumptions as mentioned in the Report and the designer of the Structure should take into consideration all the factors required as per codes. The recommendations should be taken as guidelines for the designer.

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TECHNICAL MANAGER
VIVEK MATERIAL TESTING
LABORATORY

Shubham Singh
Dy. TECHNICAL MANAGER/
QUALITY MANAGER
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BEARING CAPACITY CALCULATIONS

Soil when stressed due to loading, tend to deform. The resistance to deformation of the soil depends upon factors like water content, bulk density, angle of internal friction and the manner in which load is applied on the soil. The maximum load per unit area which the soil or rock can carry without yielding or displacement is termed as the bearing capacity of soils. The Safe Bearing Capacity of the proposed STRUCTURE without any distress is determined from the considerations of the following criteria.

[A] SHEAR CRITERIA

The soil beneath the foundation shall be safe from risk of shear failure.

[B] SETTLEMENT CRITERIA

The settlement due to load is caused basically on account of two factors, namely,

- (i) the soil below footing gets compressed by certain amount and
- (ii) since the foundations cover only a limited area there is a possibility that the concentrated stresses developed are so high as to cause actual rupture (shear failure) and displacement of soil below.

The foundation should not settle or deflect to an extent causing damage to the Structure or impair its usefulness.

The Bearing Capacity Calculations for the Foundation shall be governed as per IS: 6403-1981, IS: 8009(Part-I)-1976 and IS: 1904-2021 on the basis of available information regarding the proposed design.

BEARING CAPACITY ON SHEAR CONSIDERATIONS**ULTIMATE NET BEARING CAPACITY**

As per IS: 6403-1981, the Ultimate Net Bearing Capacity 'qd' on shear consideration for a Structure is given by the formula: -

FOR GENERAL SHEAR FAILURE

$$q_d = c.N_c.S_c.d_c.i_c + q(N_q - 1).S_q.d_q.i_q + 1/2 B.r.N_r.S_r.d_r.i_r.W'$$

FOR LOCAL SHEAR FAILURE

$$q'd = 2/3 c.N'c.S'c.d'c.i'c + q(N'q - 1).S'q.d'q.i'q + 1/2 B.r.N'r.S'r.d'r.i'r.W'$$

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981



NAME OF PROJECT																																			
BOREHOLE 01 (L.H.S.)		Depth of borehole		10.00	metre		Water table below borehole level (m)		2.15	Factor of safety		2.50	Water table used for calculation (m)		1.15	Assumed post monsoon rise (m)		1.00																	
		Input Parameters											Shearing Resistance Parameters											Ultimate Net Bearing Capacity			Net Safe Bearing Capacity								
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance		Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors						Inclination Factors			General shear	Local shear	Intermediate	
					Bulk		Bulk			c	ϕ			ϕ'	e	Nc	Nq	Ny	Nc'	Nq'	Ny'	Sc	Sq	Sy	Dc	Dq	Dy	Dc'	Dq'	Dy'	lc				
		(m)	(m)	(m)	(gms/cc)	(kN/m3)	(gms/cc)	(kN/m3)	Kg/cm2	°	°		kN/m2																						
1	SQUARE	1.50	1.20	1.20	1.80	15.36	1.80	15.36	0.20	11	7.42	0.686	23.05	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.30	1.15	1.15	1.30	1.15	1.15	1.00	1.00	1.00	353.10	195.06	245.63	98.25
2	SQUARE	2.00	1.20	1.20	1.80	13.48	1.87	14.17	0.20	11	7.42	0.686	26.97	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.40	1.20	1.20	1.40	1.20	1.20	1.00	1.00	1.00	388.15	214.45	270.03	108.01
3	SQUARE	2.50	1.20	1.20	1.80	12.36	1.87	13.04	0.25	10	6.74	0.665	30.89	8.34	2.47	1.22	7.03	1.83	0.67	1.30	1.20	0.80	1.50	1.25	1.25	1.50	1.25	1.25	1.00	1.00	1.00	473.56	266.21	354.33	141.73
4	SQUARE	1.50	2.00	2.00	1.80	15.36	1.80	15.36	0.20	11	7.42	0.686	23.05	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.18	1.09	1.09	1.18	1.09	1.09	1.00	1.00	1.00	327.40	180.79	227.71	91.08
5	SQUARE	2.00	2.00	2.00	1.80	13.48	1.87	14.17	0.20	11	7.42	0.686	26.97	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.24	1.12	1.12	1.24	1.12	1.12	1.00	1.00	1.00	352.05	194.42	244.86	97.94
6	SQUARE	2.50	2.00	2.00	1.80	12.36	1.87	13.04	0.25	10	6.74	0.665	30.89	8.34	2.47	1.22	7.03	1.83	0.67	1.30	1.20	0.80	1.30	1.15	1.15	1.30	1.15	1.15	1.00	1.00	1.00	418.52	235.23	313.13	125.25
7	SQUARE	1.50	2.50	2.50	1.80	15.36	1.80	15.36	0.20	11	7.42	0.686	23.05	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.15	1.07	1.07	1.15	1.07	1.07	1.00	1.00	1.00	322.24	177.89	224.08	89.63
8	SQUARE	2.00	2.50	2.50	1.80	13.48	1.87	14.17	0.20	11	7.42	0.686	26.97	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.19	1.10	1.10	1.19	1.10	1.10	1.00	1.00	1.00	342.42	189.05	238.13	95.25
9	SQUARE	2.50	2.50	2.50	1.80	12.36	1.87	13.04	0.25	10	6.74	0.665	30.89	8.34	2.47	1.22	7.03	1.83	0.67	1.30	1.20	0.80	1.24	1.12	1.12	1.24	1.12	1.12	1.00	1.00	1.00	403.18	226.57	301.63	120.65

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	98.25	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement	
		CLAY					e	Cc	N''	P _o	ΔP		W'				
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)	
1	1	CLAY	0.00	1.50	1.50	1.80	-	-	-	Depth of foundation							34.05
2	2	CLAY	1.50	3.00	1.50	1.87	0.665	0.131	0.00	38.15	37.21	-	-	34.890	-		
3	3	CLAY	3.00	4.00	1.00	1.90	0.671	0.130	0.00	54.23	13.82	-	-	7.668	-		

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80		
Width	1.20	metre	Applied Pressure at foundation base	108.01	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.80	0.000	0.000	0.00	Depth of foundation						31.95
2	2	CLAY	2.00	3.50	1.50	1.87	0.665	0.131	0.00	46.22	40.90	-	-	32.490	-	
3	3	CLAY	3.50	4.50	1.00	1.90	0.671	0.130	0.00	61.55	15.19	-	-	7.452	-	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth		1.50	X Width		Depth factor	1.00		BOREHOLE 1	
Length	1.20	metre	Water Table depth for calculation		2.15	(m) bgl		Rigidity factor	0.80			
Width	1.20	metre	Applied Pressure at foundation base		141.73	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.87	0.000	0.000	0.00	Depth of foundation						37.53
2	2	CLAY	2.50	4.00	1.50	1.90	0.671	0.130	0.00	49.04	53.67	-	-	37.471	-	
3	3	CLAY	4.00	5.00	1.00	1.96	0.640	0.125	0.00	60.36	19.93	-	-	9.445	-	

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1	
Length	2.00	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80			
Width	2.00	metre	Applied Pressure at foundation base	91.08	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement	
		CLAY					e	Cc	N''	P _o	ΔP		W'				
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)	
1	1	CLAY	0.00	1.50	1.50	1.80	-	-	-	Depth of foundation							45.87
2	2	CLAY	1.50	3.00	1.50	1.87	0.665	0.131	0.00	38.15	48.17	-	-	41.854	-		
3	3	CLAY	3.00	4.50	1.50	1.90	0.671	0.130	0.00	56.44	20.17	-	-	15.486	-		

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	97.94	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	C _c	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.80	0.000	0.000	0.00	Depth of foundation						42.70
2	2	CLAY	2.00	3.50	1.50	1.87	0.665	0.131	0.00	46.22	51.80	-	-	38.531	-	
3	3	CLAY	3.50	5.00	1.50	1.90	0.671	0.130	0.00	63.76	21.69	-	-	14.839	-	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	125.25	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	C _c	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.87	0.000	0.000	0.00	Depth of foundation						49.21
2	2	CLAY	2.50	4.00	1.50	1.90	0.671	0.130	0.00	49.04	66.25	-	-	43.325	-	
3	3	CLAY	4.00	5.50	1.50	1.96	0.640	0.125	0.00	62.72	27.74	-	-	18.184	-	

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

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1	
Length	2.50	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80			
Width	2.50	metre	Applied Pressure at foundation base	89.63	kN/m2		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement	
		CLAY					e	Cc	N''	P _o	ΔP		W'				
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)	
1	1	CLAY	0.00	1.50	1.50	1.80	0.000	0.000	0.00	Depth of foundation						53.57	
2	2	CLAY	1.50	3.50	2.00	1.87	0.665	0.131	0.00	41.04	45.73	-	-	51.170	-		
3	3	CLAY	3.50	5.25	1.75	1.90	0.671	0.130	0.00	63.31	19.39	-	-	15.796	-		

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

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	81.77	kN/m ²		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.80	0.000	0.000	0.00	Depth of foundation						50.00
2	2	CLAY	1.50	3.50	2.00	1.87	0.665	0.131	0.00	41.04	41.72	-	-	47.937	-	
3	3	CLAY	3.50	5.25	1.75	1.90	0.671	0.130	0.00	63.31	17.69	-	-	14.568	-	

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

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1	
Length	2.50	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80			
Width	2.50	metre	Applied Pressure at foundation base	95.25	kN/m2		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.87	0.000	0.000	0.00	Depth of foundation						46.73
2	2	CLAY	2.00	4.00	2.00	1.90	0.671	0.130	0.00	50.78	48.60	-	-	45.373	-	
3	3	CLAY	4.00	5.50	1.50	1.96	0.640	0.125	0.00	71.93	21.60	-	-	13.037	-	

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

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1	
Length	2.50	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80			
Width	2.50	metre	Applied Pressure at foundation base	120.65	kN/m2		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.87	0.000	0.000	0.00	Depth of foundation						57.65
2	2	CLAY	2.50	4.50	2.00	1.90	0.671	0.130	0.00	51.24	61.56	-	-	53.319	-	
3	3	CLAY	4.50	6.25	1.75	1.96	0.640	0.125	0.00	68.31	26.10	-	-	18.746	-	

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

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	99.72	kN/m ²		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement	
		CLAY					e	Cc	N''	P _o	ΔP		W'				
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)	
1	1	CLAY	0.00	2.50	2.50	1.87	0.000	0.000	0.000	Depth of foundation						50.00	
2	2	CLAY	2.50	4.50	2.00	1.9	0.671	0.130	0.000	51.24	50.88	-	-	46.598	-		
3	3	CLAY	4.50	6.25	1.75	1.96	0.640	0.125	0.000	68.31	21.57	-	-	15.899	-		

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981



NAME OF PROJECT																																			
BOREHOLE 02 (L.H.S.)		Depth of borehole			10.00 metre			Water table below borehole level (m)			2.20			Factor of safety			2.50			Assumed post monsoon rise (m)			1.00												
								Water table used for calculation (m)			1.20																								
Input Parameters												Shearing Resistance Parameters												Ultimate Net Bearing Capacity			Net Safe Bearing Capacity								
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance		Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors						Inclination Factors			General shear	Local shear	Intermediate	
		(m)	(m)	(m)	(gms/cc)	(kN/m3)	(gms/cc)	(kN/m3)	Kg/cm2	°	°	e	q	Nc	Nq	Ny	Nc'	Nq'	Ny'	Sc	Sq	Sy	Dc	Dq	Dy	Dc'	Dq'	Dy'	lc	lq	ly	kN/m2	kN/m2	kN/m2	kN/m2
1	SQUARE	1.50	1.20	1.20	1.81	15.79	1.81	15.79	0.10	18	12.28	0.695	23.68	13.11	5.26	4.07	9.42	3.05	1.76	1.30	1.20	0.80	1.34	1.17	1.17	1.34	1.17	1.17	1.00	1.00	1.00	385.91	184.23	239.69	95.88
2	SQUARE	2.00	1.20	1.20	1.81	13.83	1.86	14.32	0.10	18	12.28	0.695	27.66	13.11	5.26	4.07	9.42	3.05	1.76	1.30	1.20	0.80	1.46	1.23	1.23	1.46	1.23	1.23	1.00	1.00	1.00	439.83	210.05	273.24	109.30
3	SQUARE	2.50	1.20	1.20	1.81	12.65	1.86	13.14	0.15	11	7.42	0.684	31.63	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.51	1.25	1.25	1.51	1.25	1.25	1.00	1.00	1.00	343.12	189.62	240.28	96.11
4	SQUARE	1.50	2.00	2.00	1.81	15.79	1.81	15.79	0.10	18	12.28	0.695	23.68	13.11	5.26	4.07	9.42	3.05	1.76	1.30	1.20	0.80	1.21	1.10	1.10	1.21	1.10	1.10	1.00	1.00	1.00	367.21	174.71	227.65	91.06
5	SQUARE	2.00	2.00	2.00	1.81	13.83	1.86	14.32	0.10	18	12.28	0.695	27.66	13.11	5.26	4.07	9.42	3.05	1.76	1.30	1.20	0.80	1.28	1.14	1.14	1.28	1.14	1.14	1.00	1.00	1.00	408.96	194.68	253.61	101.44
6	SQUARE	2.50	2.00	2.00	1.81	12.65	1.86	13.14	0.15	11	7.42	0.684	31.63	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.30	1.15	1.15	1.30	1.15	1.15	1.00	1.00	1.00	305.49	168.75	213.87	85.55
7	SQUARE	1.50	2.50	2.50	1.81	15.79	1.81	15.79	0.10	18	12.28	0.695	23.68	13.11	5.26	4.07	9.42	3.05	1.76	1.30	1.20	0.80	1.17	1.08	1.08	1.17	1.08	1.08	1.00	1.00	1.00	365.32	173.47	226.23	90.49
8	SQUARE	2.00	2.50	2.50	1.81	13.83	1.86	14.32	0.10	18	12.28	0.695	27.66	13.11	5.26	4.07	9.42	3.05	1.76	1.30	1.20	0.80	1.22	1.11	1.11	1.22	1.11	1.11	1.00	1.00	1.00	402.04	191.01	249.04	99.62
9	SQUARE	2.50	2.50	2.50	1.81	12.65	1.86	13.14	0.15	11	7.42	0.684	31.63	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.24	1.12	1.12	1.24	1.12	1.12	1.00	1.00	1.00	296.07	163.49	207.24	82.90

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	2.20	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	95.88	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement	
		CLAY					e	Cc	N''	P _o	ΔP		W'				
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)	
1	1	CLAY	0.00	1.50	1.50	1.81	-	-	-	Depth of foundation							33.44
2	2	CLAY	1.50	3.00	1.50	1.86	0.684	0.133	0.00	38.35	36.31	-	-	34.278	-		
3	3	CLAY	3.00	4.00	1.00	1.89	0.686	0.132	0.00	54.43	13.48	-	-	7.525	-		

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	2.20	(m) bgl		Rigidity factor	0.80		
Width	1.20	metre	Applied Pressure at foundation base	109.30	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.81	0.000	0.000	0.00	Depth of foundation						32.27
2	2	CLAY	2.00	3.50	1.50	1.86	0.684	0.133	0.00	46.45	41.39	-	-	32.782	-	
3	3	CLAY	3.50	4.50	1.00	1.89	0.686	0.132	0.00	61.76	15.37	-	-	7.556	-	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	2.20	(m) bgl		Rigidity factor	0.80		
Width	1.20	metre	Applied Pressure at foundation base	96.11	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.86	0.000	0.000	0.00	Depth of foundation						27.98
2	2	CLAY	2.50	4.00	1.50	1.89	0.686	0.132	0.00	49.21	36.40	-	-	28.240	-	
3	3	CLAY	4.00	5.00	1.00	1.95	0.654	0.127	0.00	60.41	13.52	-	-	6.733	-	

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.00	metre	Water Table depth for calculation	2.20	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	91.06	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.81	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.86	0.684	0.133	0.00	38.35	48.16	-	-	41.861	-	45.92
3	3	CLAY	3.00	4.50	1.50	1.89	0.686	0.132	0.00	56.61	20.17	-	-	15.540	-	

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.00	metre	Water Table depth for calculation	2.20	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	101.44	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.81	0.000	0.000	0.00	Depth of foundation						43.89
2	2	CLAY	2.00	3.50	1.50	1.86	0.684	0.133	0.00	46.45	53.65	-	-	39.505	-	
3	3	CLAY	3.50	5.00	1.50	1.89	0.686	0.132	0.00	63.95	22.46	-	-	15.355	-	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.00	metre	Water Table depth for calculation	2.20	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	85.55	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.86	0.000	0.000	0.00	Depth of foundation						37.17
2	2	CLAY	2.50	4.00	1.50	1.89	0.686	0.132	0.00	49.21	45.25	-	-	33.259	-	
3	3	CLAY	4.00	5.50	1.50	1.95	0.654	0.127	0.00	62.74	18.95	-	-	13.199	-	

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

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	2.20	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	90.49	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.81	0.000	0.000	0.00	Depth of foundation						54.03
2	2	CLAY	1.50	3.50	2.00	1.86	0.684	0.133	0.00	41.22	46.17	-	-	51.545	-	
3	3	CLAY	3.50	5.25	1.75	1.89	0.686	0.132	0.00	63.46	19.58	-	-	15.998	-	

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

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	2.20	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	81.61	kN/m ²		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.81	0.000	0.000	0.00	Depth of foundation						50.00
2	2	CLAY	1.50	3.50	2.00	1.86	0.684	0.133	0.00	41.22	41.64	-	-	47.893	-	
3	3	CLAY	3.50	5.25	1.75	1.89	0.686	0.132	0.00	63.46	17.65	-	-	14.605	-	

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

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	2.20	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	99.62	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.86	0.000	0.000	0.00	Depth of foundation						48.79
2	2	CLAY	2.00	4.00	2.00	1.89	0.686	0.132	0.00	50.60	50.83	-	-	47.286	-	
3	3	CLAY	4.00	5.50	1.50	1.95	0.654	0.127	0.00	71.71	22.59	-	-	13.697	-	

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

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	2.20	(m) bgl		Rigidity factor	0.80			
Width	2.50	metre	Applied Pressure at foundation base	82.90	kN/m2		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.86	0.000	0.000	0.00	Depth of foundation						43.56
2	2	CLAY	2.50	4.50	2.00	1.89	0.686	0.132	0.00	51.39	42.30	-	-	40.837	-	
3	3	CLAY	4.50	6.25	1.75	1.95	0.654	0.127	0.00	68.27	17.93	-	-	13.612	-	

SITE PHOTOS DURING SITE INVESTIGATION



VIVEK MATERIAL TESTING LABORATORY

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(Civil Engineering Projects)


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RESULT SHEET

NAME OF THE PROJECT																					
CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT LALBAGH FERRY GHAT IN WEST BENGAL																					
Client Name																					
Bore Hole No.		1 (L.H.S.)		Coordinate		Easting				Depth of Water Level		2.15		VIVEK MATERIAL TESTING LABORATORY  <small>VMT GEOTECH & MATERIAL TESTING</small>							
Total depth of Bore Hole		10.00		Northing				Commenced on		4/16/2023											
				Elevation		100.000		Completed on		4/16/2023											
Depth of Bore Hole	Reduced Level	Types of Samples	% Material Passing IS Sieve				Atterberg Limits			IS group symbol	SPT Value	SPT Value corrected due to overburden	SPT Value corrected due to dilatancy	Wet Bulk Density	Original Moisture	Dry Bulk Density	Specific Gravity	Void Ratio	Shear Characteristics		Compression Index
			4.750	2.000	0.425	0.075	LL	PL	PI										Cohesion	Angle of Internal Friction	
metre	metre		(mm)	(mm)	(mm)	(mm)	%	%	%		N	N'	N''	(gms/cc)	%	(gms/cc)	(G)		(Kg/sqcm)	(Ø)	(Cc)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
0.00 - 0.50	100.000 - 99.500	DS	100	100	100	98	29	20	9	CL					-	-	-	-	-	-	-
1.00 - 1.35	99.000 - 98.650	UD	100	100	99	97	28	19	9	CL				1.80	15.3	1.56	2.63	0.686	0.20	11°	0.133
1.35 - 1.80	98.650 - 98.200	SPT									6	8.21	8.21								
2.50 - 2.85	97.500 - 97.150	UD	100	100	100	99	30	19	11	CL				1.87	18.4	1.58	-	-	-	-	-
2.85 - 3.30	97.150 - 96.700	SPT									7	9.96	9.96								
4.00 - 4.35	96.000 - 95.650	UD	100	100	100	98	32	16	16	CL				1.90	20.2	1.58	2.64	0.671	0.30	7°	0.130
4.35 - 4.80	95.650 - 95.200	SPT									8	10.32	10.32								
5.50 - 5.85	94.500 - 94.150	UD	100	100	100	96	30	16	14	CL				1.96	21.8	1.61	-	-	-	-	-
5.85 - 6.30	94.150 - 93.700	SPT									11	13.07	13.07								
7.00 - 7.35	93.000 - 92.650	UD	100	100	100	41	NON PLASTIC			SM				1.90	23.6	1.54	2.59	0.682	0	29°	-
7.35 - 7.80	92.650 - 92.200	SPT									13	14.50	14.50								
8.50 - 8.85	91.500 - 91.150	UD	100	100	100	40	NON PLASTIC			SM				1.93	22.2	1.58	-	-	-	-	-
8.85 - 9.30	91.150 - 90.700	SPT									17	17.91	16.46								
9.30 - 10.00	90.700 - 90.000	DS	100	100	100	40	NON PLASTIC			SM					-	-	-	-	-	-	-

RESULT SHEET

NAME OF THE PROJECT CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT LALBAGH FERRY GHAT IN WEST BENGAL																					
Client Name																					
Bore Hole No.	2 (L.H.S.)		Coordinate			Easting			Depth of Water Level			2.20			VIVEK MATERIAL TESTING LABORATORY					 VMT GEOTECH & MATERIAL TESTING	
Total depth of Bore Hole	10.00		Northing			100.000			Commenced on			4/16/2023									
			Elevation						Completed on			4/16/2023									
Depth of Bore Hole	Reduced Level	Types of Samples	% Material Passing IS Sieve				Atterberg Limits			IS group symbol	SPT Value	SPT Value corrected due to overburden	SPT Value corrected due to dilatancy	Wet Bulk Density	Original Moisture	Dry Bulk Density	Specific Gravity	Void Ratio	Shear Characteristics		Compression Index
			4.750	2.000	0.425	0.075	LL	PL	PI										Cohesion	Angle of Internal Friction	
metre	metre		(mm)	(mm)	(mm)	(mm)	%	%	%		N	N'	N''	(gms/cc)	%	(gms/cc)	(G)		(Kg/sqcm)	(ϕ)	(Cc)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
0.00 - 0.50	100.000 - 99.500	DS	100	100	100	98	34	22	12	CL					-	-	-	-	-	-	-
1.00 - 1.35	99.000 - 98.650	UD	100	100	98	97	31	20	11	CL				1.81	17.4	1.54	2.61	0.695	0.10	18°	0.135
1.35 - 1.80	98.650 - 98.200	SPT									5	6.84	6.84								
2.50 - 2.85	97.500 - 97.150	UD	100	100	100	98	33	19	14	CL				1.86	20.3	1.55	-	-	-	-	-
2.85 - 3.30	97.150 - 96.700	SPT									6	8.54	8.54								
4.00 - 4.35	96.000 - 95.650	UD	100	100	97	96	34	21	13	CL				1.89	21.4	1.56	2.63	0.686	0.25	11°	0.132
4.35 - 4.80	95.650 - 95.200	SPT									7	9.03	9.03								
5.50 - 5.85	94.500 - 94.150	UD	100	100	100	98	35	21	14	CL				1.95	22.6	1.59	-	-	-	-	-
5.85 - 6.30	94.150 - 93.700	SPT									10	11.90	11.90								
7.00 - 7.35	93.000 - 92.650	UD	100	100	100	43	NON PLASTIC			SM				1.91	23.1	1.55	2.58	0.665	0	28°	-
7.35 - 7.80	92.650 - 92.200	SPT									14	15.62	15.31								
8.50 - 8.85	91.500 - 91.150	UD	100	100	98	44	NON PLASTIC			SM				1.92	20.2	1.60	-	-	-	-	-
8.85 - 9.30	91.150 - 90.700	SPT									19	20.04	17.52								
9.30 - 10.00	90.700 - 90.000	DS	100	100	100	46	NON PLASTIC			SM					-	-	-	-	-	-	-



VMT
GEOTECH & MATERIAL TESTING

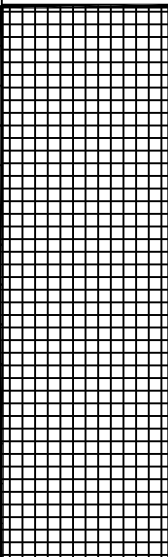
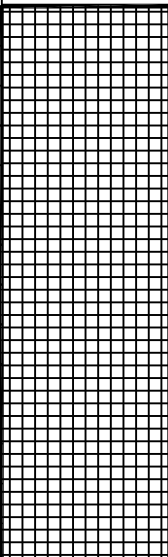

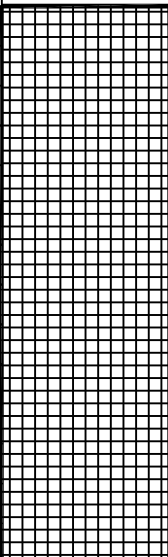

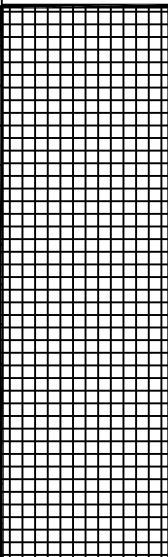

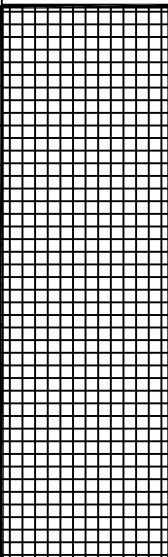

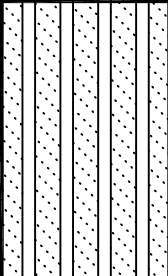

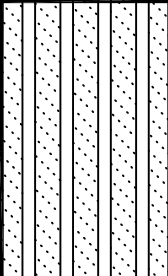

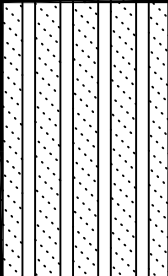
BORE-LOG CHART

VIVEK MATERIAL TESTING LABORATORY

NAME OF THE PROJECT:- CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT LALBAGH FERRY GHAT IN WEST BENGAL

WATER TABLE 2.15 METRE DEPTH BELOW GROUND LEVEL

BORE HOLE NO.:- 01 (L.H.S.)

DEPTH IN METRES BELOW GROUND LEVEL	VISUAL FIELD OBSERVATIONS	SAMPLE	I.S.		S.P.T. VALUE				S.P.T. VALUES													
			GROUP	HATCHING	N1	N2	N3	N2+N3	10	20	30	40	50	60	70	80	90	100				
0.00-0.50	SILTY-CLAY	D.	CL																			
1.00-1.35	SILTY-CLAY	U.D.	CL																			
1.35-1.80		S.P.T.			2	3	3	6														
2.50-2.85	SILTY-CLAY	U.D.	CL																			
2.85-3.30		S.P.T.			2	3	4	7														
4.00-4.35	SILTY-CLAY	U.D.	CL																			
4.35-4.80		S.P.T.			3	4	4	8														
5.50-5.85	SILTY-CLAY	U.D.	CL																			
5.85-6.30		S.P.T.			4	5	6	11														
7.00-7.35	SILTY-SAND	U.D.	SM																			
7.35-7.80		S.P.T.			5	6	7	13														
8.50-8.85	SILTY-SAND	U.D.	SM																			
8.85-9.30		S.P.T.			6	8	9	17														
9.30-10.00	SILTY-SAND	D.	SM																			

BORE-LOG CHART



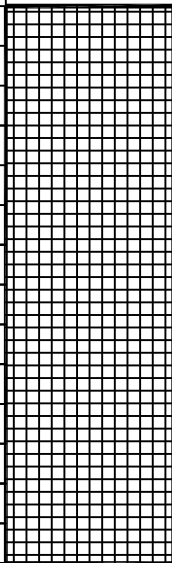
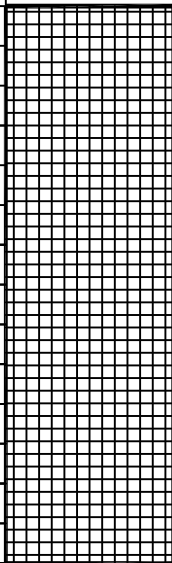
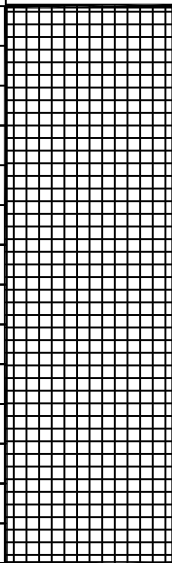
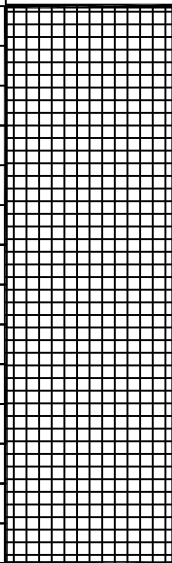
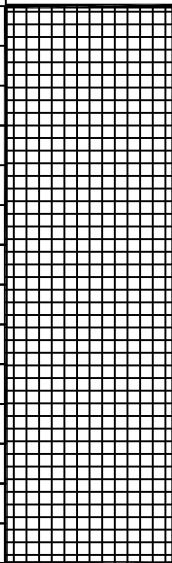
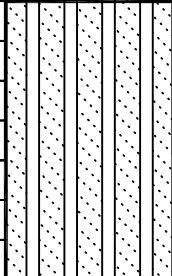
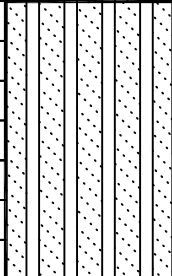
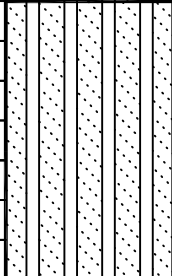
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VIVEK MATERIAL TESTING LABORATORY

NAME OF THE PROJECT:- CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT LALBAGH FERRY GHAT IN WEST BENGAL

WATER TABLE 2.20 METRE DEPTH BELOW GROUND LEVEL

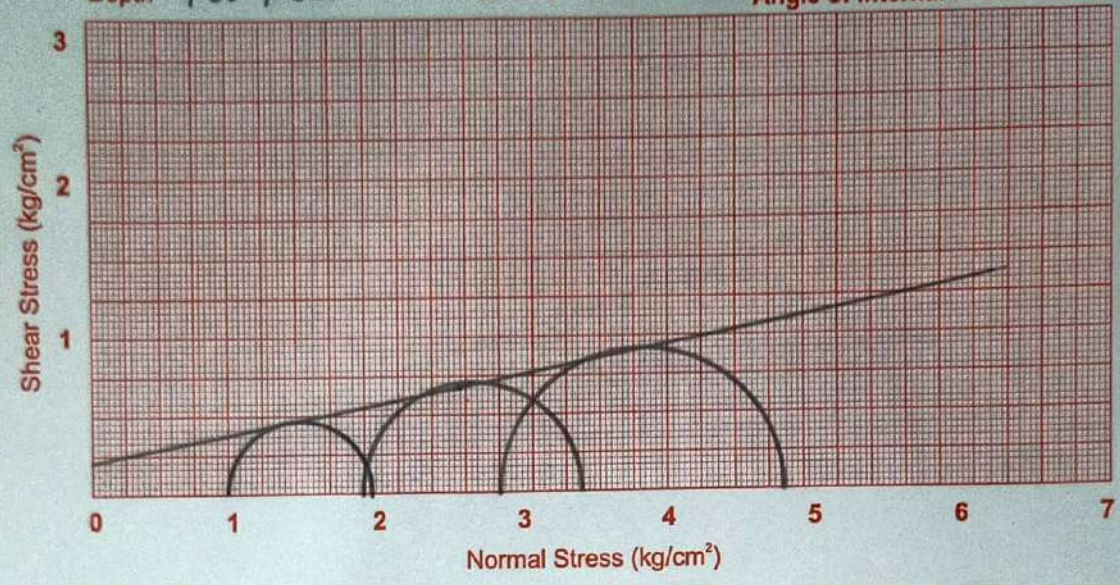
BORE HOLE NO.:- 02 (L.H.S.)

DEPTH IN METRES BELOW GROUND LEVEL	VISUAL FIELD OBSERVATIONS	SAMPLE	I.S.		S.P.T. VALUE				S.P.T. VALUES															
			GROUP	HATCHING	N1	N2	N3	N2+N3	10	20	30	40	50	60	70	80	90	100						
0.00-0.50	SILTY-CLAY	D.	CL																					
1.00-1.35	SILTY-CLAY	U.D.	CL																					
1.35-1.80		S.P.T.			2	2	3	5																
2.50-2.85	SILTY-CLAY	U.D.	CL																					
2.85-3.30		S.P.T.			2	3	3	6																
4.00-4.35	SILTY-CLAY	U.D.	CL																					
4.35-4.80		S.P.T.			2	3	4	7																
5.50-5.85	SILTY-CLAY	U.D.	CL																					
5.85-6.30		S.P.T.			4	5	5	10																
7.00-7.35	SILTY-SAND	U.D.	SM																					
7.35-7.80		S.P.T.			5	7	7	14																
8.50-8.85	SILTY-SAND	U.D.	SM																					
8.85-9.30		S.P.T.			7	9	10	19																
9.30-10.00	SILTY-SAND	D.	SM																					



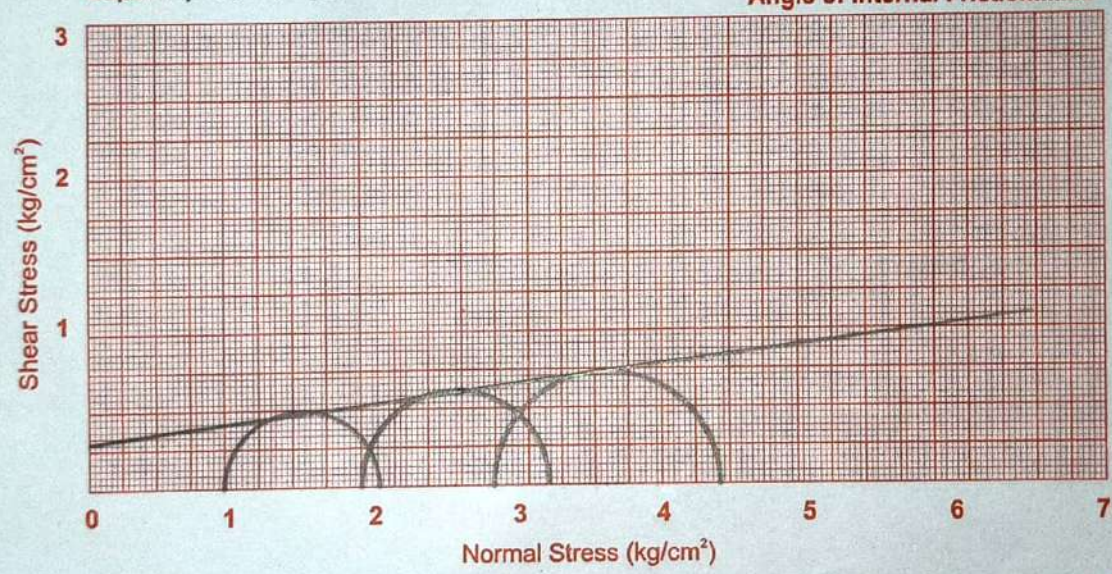
B.H. No. :- 01
Depth - 1.00 - 1.35

Cohesion 'c' 0.20 Kg/cm²
Angle of Internal Friction 11°*



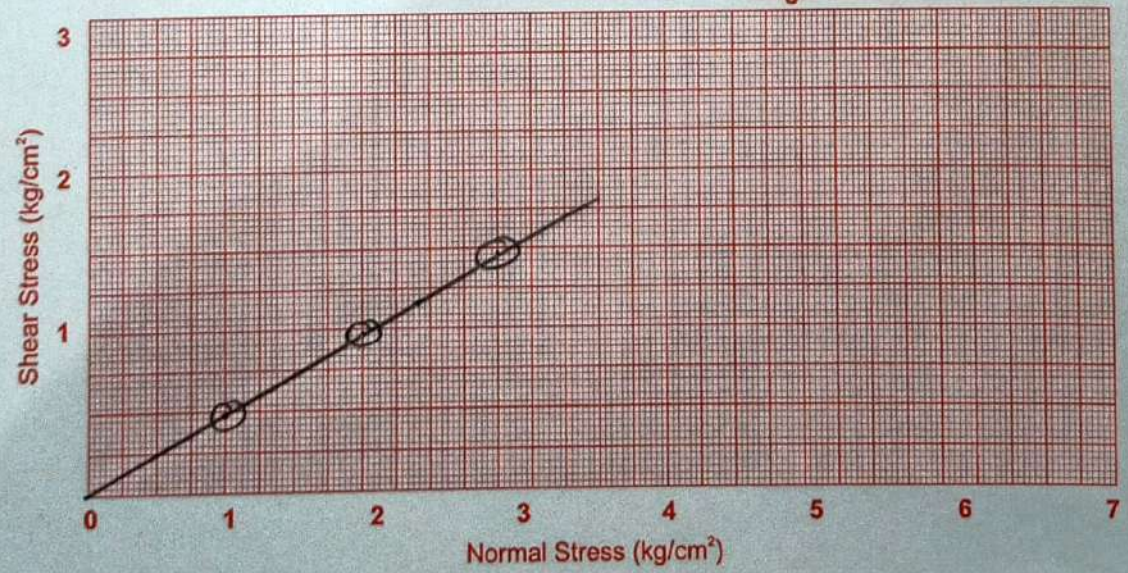
B.H. No. :- 01
Depth :- 4.00 - 4.35

Cohesion 'c' 0.30 Kg/cm²
Angle of Internal Friction 7°*



B.H. No. :- 01
Depth :- 7.00 - 7.35

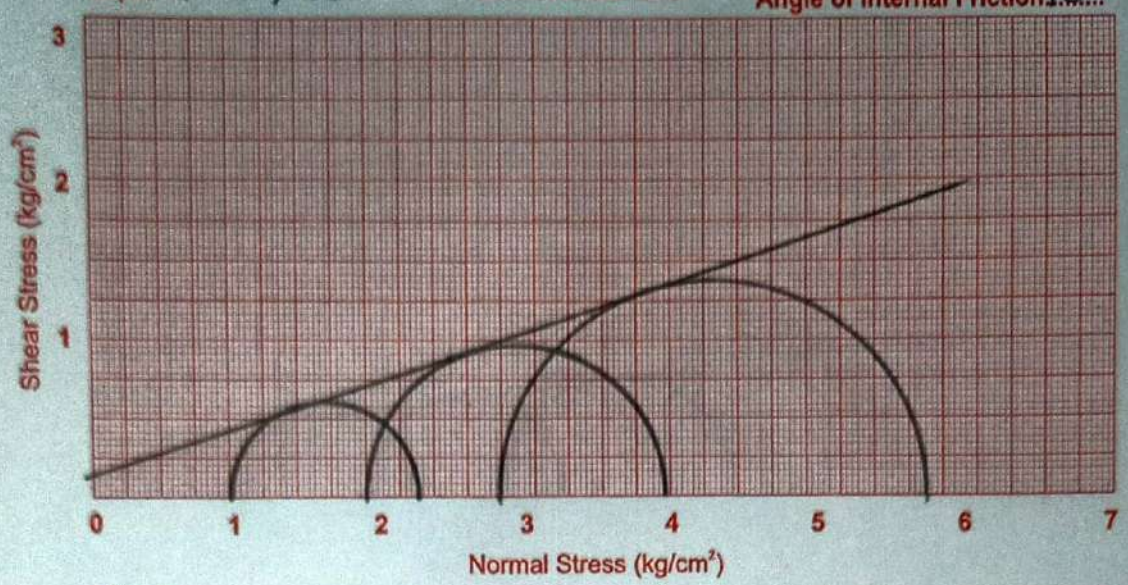
Cohesion 'c' 0.00 Kg/cm²
Angle of Internal Friction 29°*





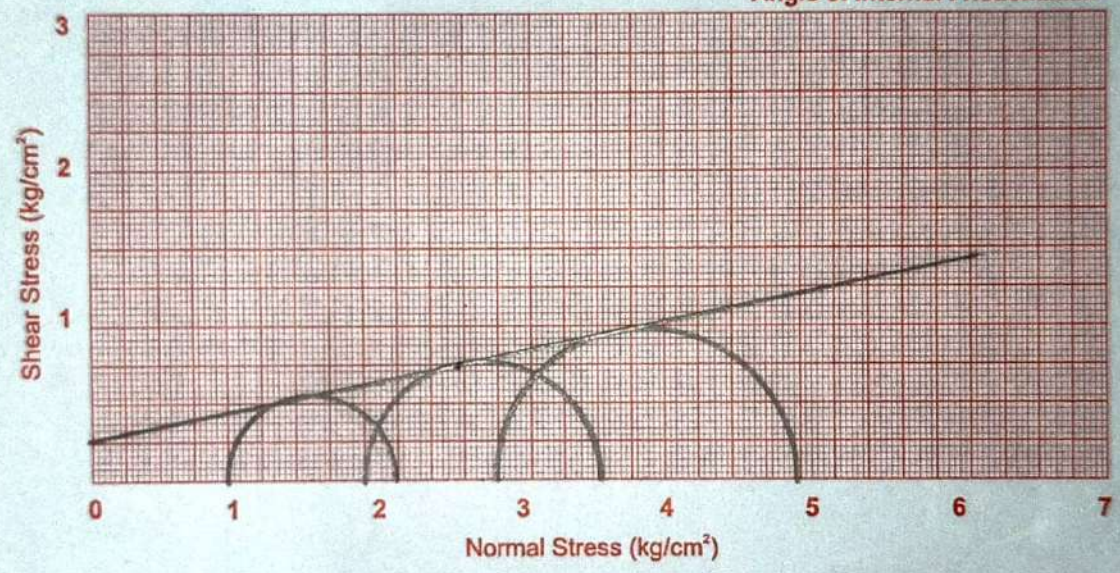
B.H. No. :- 02
Depth - 1.00 - 1.35

Cohesion 'c' :- 1.0 Kg/cm²
Angle of Internal Friction :- 28°*



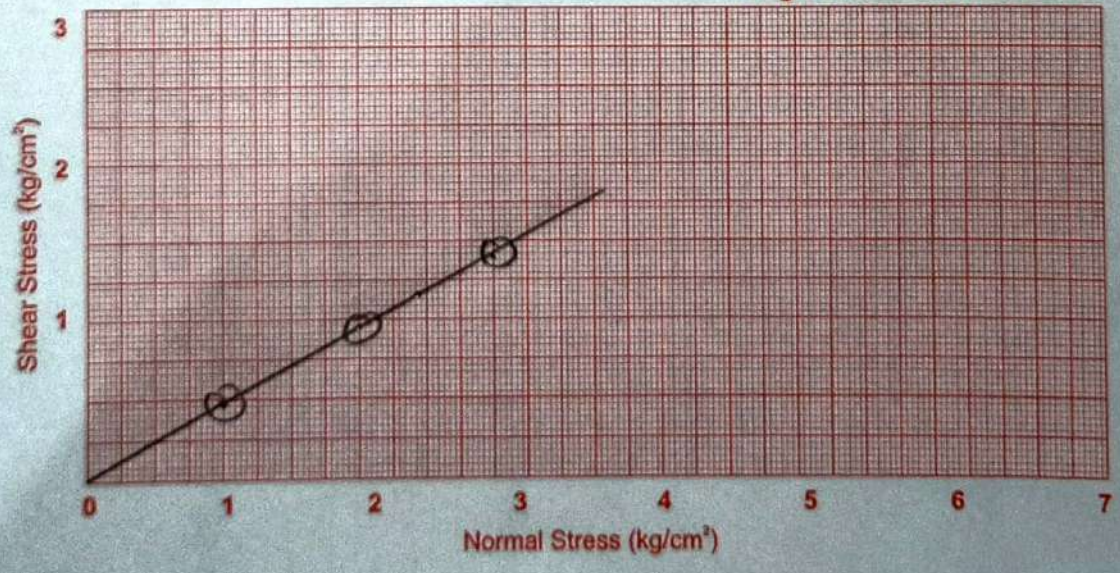
B.H. No. :- 02
Depth :- 4.00 - 4.35

Cohesion 'c' :- 0.25 Kg/cm²
Angle of Internal Friction :- 11°*



B.H. No. :- 02
Depth :- 7.00 - 7.35

Cohesion 'c' :- 0 Kg/cm²
Angle of Internal Friction :- 28°*





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IC-8969

REPORT NO. – VMT 132 B/2023-2024

GEOTECH INVESTIGATION

REPORT FOR

PROPOSED CONSTRUCTION

OF

BOAT IN THE IDENTIFIED

COMMUNITY JETTY

AT LALBAGH FERRY GHAT

OPPOSITE (R.H.S.) IN

WEST BENGAL

Prepared By -

VIVEK MATERIAL TESTING
LABORATORY

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ACKNOWLEDGEMENT

WE ARE GRATEFUL TO M/s KITCO LTD., KERLA FOR PROVIDING US THE OPPORTUNITY TO CARRY OUT THESE INVESTIGATIONS.

THE CO-OPERATION EXTENDED BY THEIR ENGINEERS DURING FIELD INVESTIGATIONS IS THANKFULLY ACKNOWLEDGED.

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**SUB-SOIL INVESTIGATION REPORT FOR PROPOSED CONSTRUCTION OF BOAT
IN THE IDENTIFIED COMMUNITY JETTY AT LALBAGH FERRY GHAT OPOOSITE
IN WEST BENGAL**

INTRODUCTION

The work of sub-soil exploration was awarded to us by M/s KITCO LTD., KERLA Order no. – 6777:DP 1083: RG: 2023 dated 21/03/2023. The object of the investigation was to study the geo-technical properties of soil both in field and laboratory and determine safe allowable pressure for the foundation soil.

The fieldwork consisted of 02 bore holes of 10.00 metre depth each. The fieldwork was conducted on 17/04/2023. The location of the bore holes is shown in the Site location.

REFERENCES

1. **IS: 1892-2021** for field work including existent ground water table.
2. **IS: 2132-1986** for sampling in Undisturbed and Disturbed form.
3. **IS: 2131-1981** for Standard Penetration Test.
4. **IS: 2720** for all laboratory tests on soil samples collected.
5. **IS: 6403-1981** for determination of Bearing Capacity.
6. **IS: 8009(Part I)-1976** for calculation of settlement of foundations.
7. **IS: 1904-2021** for permissible maximum settlement, differential settlement and angular distortion.

SCOPE OF WORK

The scope consisted of drilling of boreholes down to maximum depth of 10.00 m in normal soils / rock, Standard Penetration Testing, collection of samples, laboratory testing and preparation and submission of Geotechnical Investigation report.

Summary of the fieldwork

Sl. No.	Site	Borehole Nos.	Coordinates		Depth below existing ground level (m)
			Latitude	Longitude	
1.	LALBAGH FERRY	BH-01 (RHS)	24.17059937	88.26650675	10.0
2.	GHAT OPOOSITE	BH-02 (RHS)	24.17004572	88.26657582	10.0



SITE LOCATION



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INTERPRETATION OF THE LAB TEST RESULTS

GENERAL NATURE OF SOIL STRATA

The bore hole log charts and lab test results of bore holes 1 and 2 indicate that the strata at the site is found to comprise of both cohesive as well as non-cohesive soil.

The results of classification tests indicate that the natural soil stratum present at the Site is found to comprise of both fine-grained soils comprising of 'CL' and 'CI' group of IS classification (clayey soil) having 95 to 99 percent material finer than 75 micron and coarse-grained soils (sandy soil) comprise of 'ML' group of IS classification having 71 to 88 percent material finer than 75 micron.

The bore hole log charts and lab test results of bore holes 1 indicate that:

first strata, from 0.00 metre to 7.00 metre, consists of a layer of CI group of IS classification which is inorganic clays of medium plasticity,

second strata, from 7.00 metre to 10.00 metre, consists of a layer of ML group of IS classification which is inorganic silts with none to low plasticity.

The bore hole log charts and lab test results of bore holes 2 indicate that:

first strata, from 0.00 metre to 2.50 metre, consists of a layer of CL group of IS classification which is inorganic clays of low plasticity,

second strata, from 2.50 metre to 7.00 metre, consists of a layer of CI group of IS classification which is inorganic clays of medium plasticity,

third strata, from 7.00 metre to 10.00 metre, consists of a layer of ML group of IS classification which is inorganic silts with none to low plasticity.

S.P.T. VALUES

The S.P.T. values obtained in the respective clayey layer region present as per bore-log charts enclosed are found to range 4 to 9 indicating 'Soft' to 'Medium' consistency.

However, the S.P.T. values obtained in the respective sandy layer region present as per bore-log charts enclosed are found to range from 9 to 16 indicating 'Loose' to 'Medium' relative density.

The results of S.P.T. values indicate that the stratum at the Site is 'Loose' to 'Well' compacted.

WATER TABLE

Water Table at the Site was observed at a depth from 2.00 metre to 2.15 metre below ground level on the day of soil investigation during the Third week of April 2023. However, the existing water table may rise by 1.00 metre in the post-monsoon period in general. Therefore, a water table at a depth of 1.00 metre to 1.15 metre below ground level has been adopted for calculation purposes.

RECOMMENDATIONS FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT LALBAGH FERRY GHAT OPOSITE IN WEST BENGAL

NET SAFE BEARING CAPACITY/SAFE ALLOWABLE PRESSURE

Bore Hole Nos.	Type of Structure	Depth of Foundation (metres)	Size of Footing (L x B) (metres)	Net Safe Bearing Capacity (Tonne/sqm.)	Settlement Produced (mm)	Safe Allowable Pressure for Permissible Settlement 50 mm (Tonne/sqm.)
1	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	11.06	37.45	-
		2.00	1.20 x 1.20	11.99	37.67	-
		2.50	1.20 x 1.20	9.87	30.28	-
		1.50	2.00 x 2.00	10.23	50.43	10.11
		2.00	2.00 x 2.00	10.84	50.33	10.74
		2.50	2.00 x 2.00	8.75	39.99	-
		1.50	2.50 x 2.50	10.03	58.87	8.06
		2.00	2.50 x 2.50	10.48	57.04	8.78
		2.50	2.50 x 2.50	8.44	46.69	-
2	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	9.07	32.33	-
		2.00	1.20 x 1.20	10.12	30.62	-
		2.50	1.20 x 1.20	12.10	33.15	-
		1.50	2.00 x 2.00	8.48	43.85	-
		2.00	2.00 x 2.00	9.23	41.10	-
		2.50	2.00 x 2.00	10.77	43.86	-
		1.50	2.50 x 2.50	8.35	51.22	8.09
		2.00	2.50 x 2.50	9.00	44.52	-
		2.50	2.50 x 2.50	10.42	51.39	10.05

NOTE: -

The above recommendations are based on the field investigation data results and the laboratory tests results of the samples collected from the test locations and our experience in this regard. If the actual sub-soil conditions during excavation for the

foundations differ from that has been reported, a reference should be made to us for suggestions.

Further, the recommendations are based on the assumptions as mentioned in the Report and the designer of the Structure should take into consideration all the factors required as per codes. The recommendations should be taken as guidelines for the designer.

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Dy. TECHNICAL MANAGER/
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BEARING CAPACITY CALCULATIONS

Soil when stressed due to loading, tend to deform. The resistance to deformation of the soil depends upon factors like water content, bulk density, angle of internal friction and the manner in which load is applied on the soil. The maximum load per unit area which the soil or rock can carry without yielding or displacement is termed as the bearing capacity of soils. The Safe Bearing Capacity of the proposed STRUCTURE without any distress is determined from the considerations of the following criteria.

[A] SHEAR CRITERIA

The soil beneath the foundation shall be safe from risk of shear failure.

[B] SETTLEMENT CRITERIA

The settlement due to load is caused basically on account of two factors, namely,

- (i) the soil below footing gets compressed by certain amount and
- (ii) since the foundations cover only a limited area there is a possibility that the concentrated stresses developed are so high as to cause actual rupture (shear failure) and displacement of soil below.

The foundation should not settle or deflect to an extent causing damage to the Structure or impair its usefulness.

The Bearing Capacity Calculations for the Foundation shall be governed as per IS: 6403-1981, IS: 8009(Part-I)-1976 and IS: 1904-2021 on the basis of available information regarding the proposed design.

BEARING CAPACITY ON SHEAR CONSIDERATIONS**ULTIMATE NET BEARING CAPACITY**

As per IS: 6403-1981, the Ultimate Net Bearing Capacity 'qd' on shear consideration for a Structure is given by the formula: -


FOR GENERAL SHEAR FAILURE

$$q_d = c.N_c.S_c.d_c.i_c + q(N_q - 1).S_q.d_q.i_q + 1/2 B.r.N_r.S_r.d_r.i_r.W'$$

FOR LOCAL SHEAR FAILURE

$$q'd = 2/3 c.N'c.S'c.d'c.i'c + q(N'q - 1).S'q.d'q.i'q + 1/2 B.r.N'r.S'r.d'r.i'r.W'$$

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981

NAME OF PROJECT																																								
BOREHOLE 01 (R.H.S.)				Depth of borehole	10.00	metre	Water table below borehole level (m)	2.00		Factor of safety	2.50		Water table used for calculation (m)	1.00		Assumed post monsoon rise (m)	1.00																							
Input Parameters													Shearing Resistance Parameters										Ultimate Net Bearing Capacity			Net Safe Bearing Capacity														
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance		Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors						Inclination Factors			General shear	Local shear	Intermediate						
					Bulk		Bulk		c	ϕ	ϕ'	e	q	Nc	Nq	Ny	Nc'	Nq'	Ny'	Sc	Sq	Sy	Dc	Dq	Dy		Dc'	Dq'	Dy'	lc	lq	ly								
		(m)	(m)	(m)	(gms/cc)	(kN/m ³)	(gms/cc)	(kN/m ³)	Kg/cm ²	°	°		kN/m ²																											
1	SQUARE	1.50	1.20	1.20	1.81	14.48	1.81	14.48	0.30	7	4.70	0.690	21.72	7.17	1.88	0.71	6.44	1.53	0.42	1.30	1.20	0.80	1.28	1.00	1.00	1.28	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	376.98	225.79	271.15	108.46	
2	SQUARE	2.00	1.20	1.20	1.81	12.85	1.82	12.95	0.30	7	4.70	0.690	25.69	7.17	1.88	0.71	6.44	1.53	0.42	1.30	1.20	0.80	1.38	1.00	1.00	1.38	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	408.62	244.75	293.91	117.56
3	SQUARE	2.50	1.20	1.20	1.81	11.87	1.82	11.96	0.20	10	6.74	0.724	29.67	8.34	2.47	1.22	7.03	1.83	0.67	1.30	1.20	0.80	1.50	1.25	1.25	1.50	1.25	1.25	1.00	1.00	1.00	1.00	1.00	1.00	1.00	390.93	219.77	242.02	96.81	
4	SQUARE	1.50	2.00	2.00	1.81	14.48	1.81	14.48	0.30	7	4.70	0.690	21.72	7.17	1.88	0.71	6.44	1.53	0.42	1.30	1.20	0.80	1.17	1.00	1.00	1.17	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	348.83	208.92	250.89	100.36	
5	SQUARE	2.00	2.00	2.00	1.81	12.85	1.82	12.95	0.30	7	4.70	0.690	25.69	7.17	1.88	0.71	6.44	1.53	0.42	1.30	1.20	0.80	1.23	1.00	1.00	1.23	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	369.51	221.32	265.78	106.31
6	SQUARE	2.50	2.00	2.00	1.81	11.87	1.82	11.96	0.20	10	6.74	0.724	29.67	8.34	2.47	1.22	7.03	1.83	0.67	1.30	1.20	0.80	1.30	1.15	1.15	1.30	1.15	1.15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	346.65	194.83	214.57	85.83	
7	SQUARE	1.50	2.50	2.50	1.81	14.48	1.81	14.48	0.30	7	4.70	0.690	21.72	7.17	1.88	0.71	6.44	1.53	0.42	1.30	1.20	0.80	1.14	1.00	1.00	1.14	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	341.87	204.74	245.88	98.35	
8	SQUARE	2.00	2.50	2.50	1.81	12.85	1.82	12.95	0.30	7	4.70	0.690	25.69	7.17	1.88	0.71	6.44	1.53	0.42	1.30	1.20	0.80	1.18	1.00	1.00	1.18	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	357.06	213.86	256.82	102.73
9	SQUARE	2.50	2.50	2.50	1.81	11.87	1.82	11.96	0.20	10	6.74	0.724	29.67	8.34	2.47	1.22	7.03	1.83	0.67	1.30	1.20	0.80	1.24	1.12	1.12	1.24	1.12	1.12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	334.50	187.97	207.02	82.81	

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	108.46	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.81	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.82	0.724	0.136	0.00	37.56	41.07	-	-	37.969	-	37.45
3	3	CLAY	3.00	4.00	1.00	1.87	0.695	0.136	0.00	52.76	15.25	-	-	8.848	-	

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80		
Width	1.20	metre	Applied Pressure at foundation base	117.56	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.81	0.000	0.000	0.00	Depth of foundation						37.67
2	2	CLAY	2.00	3.50	1.50	1.82	0.724	0.136	0.00	41.53	44.52	-	-	37.436	-	
3	3	CLAY	3.50	4.50	1.00	1.87	0.695	0.136	0.00	51.83	16.53	-	-	9.647	-	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80		
Width	1.20	metre	Applied Pressure at foundation base	96.81	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.82	0.000	0.000	0.00	Depth of foundation						30.28
2	2	CLAY	2.50	4.00	1.50	1.87	0.695	0.136	0.00	46.12	36.66	-	-	30.577	-	
3	3	CLAY	4.00	5.00	1.00	1.92	0.662	0.130	0.00	57.03	13.61	-	-	7.272	-	

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1	
Length	2.00	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80			
Width	2.00	metre	Applied Pressure at foundation base	100.36	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement	
		CLAY					e	Cc	N''	P _o	ΔP		W'				
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)	
1	1	CLAY	0.00	1.50	1.50	1.81	-	-	-	Depth of foundation							50.43
2	2	CLAY	1.50	3.00	1.50	1.82	0.724	0.136	0.00	37.56	53.08	-	-	45.273	-		
3	3	CLAY	3.00	4.50	1.50	1.87	0.695	0.136	0.00	54.89	22.23	-	-	17.768	-		

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	99.15	kN/m ²		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.81	-	-	-	Depth of foundation						50.00
2	2	CLAY	1.50	3.00	1.50	1.82	0.724	0.136	0.00	37.56	52.44	-	-	44.91	-	
3	3	CLAY	3.00	4.50	1.50	1.87	0.695	0.136	0.00	54.89	21.96	-	-	17.59	-	

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	106.31	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.81	0.000	0.000	0.00	Depth of foundation						50.33
2	2	CLAY	2.00	3.50	1.50	1.82	0.724	0.136	0.00	41.53	56.23	-	-	43.993	-	
3	3	CLAY	3.50	5.00	1.50	1.87	0.695	0.136	0.00	53.96	23.54	-	-	18.924	-	

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	105.35	kN/m ²		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.81	0.000	0.000	0.00	Depth of foundation						50.00
2	2	CLAY	2.00	3.50	1.50	1.82	0.724	0.136	0.00	41.53	55.72	-	-	43.725	-	
3	3	CLAY	3.50	5.00	1.50	1.87	0.695	0.136	0.00	53.96	23.33	-	-	18.781	-	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1	
Length	2.00	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80			
Width	2.00	metre	Applied Pressure at foundation base	85.83	kN/m2		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.82	0.000	0.000	0.00	Depth of foundation						39.99
2	2	CLAY	2.50	4.00	1.50	1.87	0.695	0.136	0.00	46.12	45.40	-	-	35.821	-	
3	3	CLAY	4.00	5.50	1.50	1.92	0.662	0.130	0.00	59.28	19.01	-	-	14.171	-	

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

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1	
Length	2.50	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80			
Width	2.50	metre	Applied Pressure at foundation base	98.35	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement	
		CLAY					e	Cc	N''	P _o	ΔP		W'				
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)	
1	1	CLAY	0.00	1.50	1.50	1.81	0.000	0.000	0.00	Depth of foundation						58.87	
2	2	CLAY	1.50	3.50	2.00	1.82	0.724	0.136	0.00	40.27	50.18	-	-	55.443	-		
3	3	CLAY	3.50	5.25	1.75	1.87	0.695	0.136	0.00	61.38	21.28	-	-	18.148	-		

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

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	79.00	kN/m ²		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.81	0.000	0.000	0.00	Depth of foundation						50.00
2	2	CLAY	1.50	3.50	2.00	1.82	0.724	0.136	0.00	40.27	40.31	-	-	47.524	-	
3	3	CLAY	3.50	5.25	1.75	1.87	0.695	0.136	0.00	61.38	17.09	-	-	14.978	-	

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

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1	
Length	2.50	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80			
Width	2.50	metre	Applied Pressure at foundation base	102.73	kN/m2		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.82	0.000	0.000	0.00	Depth of foundation						57.04
2	2	CLAY	2.00	4.00	2.00	1.87	0.695	0.136	0.00	44.23	52.41	-	-	54.473	-	
3	3	CLAY	4.00	5.50	1.50	1.92	0.662	0.130	0.00	59.53	23.29	-	-	16.828	-	

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

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	86.06	kN/m ²		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.82	0.000	0.000	0.000	Depth of foundation						50.00
2	2	CLAY	2.00	4.00	2.00	1.87	0.695	0.136	0.000	44.23	43.91	-	-	48.053	-	
3	3	CLAY	4.00	5.50	1.50	1.92	0.662	0.130	0.000	59.53	19.51	-	-	14.448	-	

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

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1	
Length	2.50	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80			
Width	2.50	metre	Applied Pressure at foundation base	82.81	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	C _c	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.82	0.000	0.000	0.00	Depth of foundation						46.69
2	2	CLAY	2.50	4.50	2.00	1.87	0.695	0.136	0.00	48.25	42.25	-	-	43.833	-	
3	3	CLAY	4.50	6.25	1.75	1.92	0.662	0.130	0.00	64.68	17.91	-	-	14.535	-	

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981



NAME OF PROJECT																													Net Safe Bearing Capacity								
BOREHOLE 02 (R.H.S.)		Depth of borehole	10.00	metre	Water table below borehole level (m)			2.15	Factor of safety						2.50	Assumed post monsoon rise (m)			1.00																		
		Water table used for calculation (m)			1.15																																
Input Parameters												Shearing Resistance Parameters												Ultimate Net Bearing Capacity													
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance	Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors						Inclination Factors			General shear	Local shear	Intermediate				
					Bulk		Bulk		c	ϕ	ϕ'	e	q	Nc	Nq	Ny	Nc'	Nq'	Ny'	Sc	Sq	Sy	Dc	Dq	Dy	Dc'	Dq'	Dy'	lc	lq	ly						
		(m)	(m)	(m)	(gms/cc)	(kN/m3)	(gms/cc)	(kN/m3)	Kg/cm2	°	°		kN/m2																								
1	SQUARE	1.50	1.20	1.20	1.82	15.56	1.82	15.56	0.15	13	8.79	0.688	23.34	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.31	1.16	1.16	1.31	1.16	1.16	1.00	1.00	1.00	328.48	174.84	222.47	88.99		
2	SQUARE	2.00	1.20	1.20	1.82	13.68	1.88	14.27	0.15	13	8.79	0.688	27.36	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.42	1.21	1.21	1.42	1.21	1.21	1.00	1.00	1.00	366.19	194.94	248.03	99.21		
3	SQUARE	2.50	1.20	1.20	1.82	12.55	1.88	13.14	0.20	12	8.11	0.706	31.38	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.51	1.26	1.26	1.51	1.26	1.26	1.00	1.00	1.00	459.82	250.72	296.72	118.69		
4	SQUARE	1.50	2.00	2.00	1.82	15.56	1.82	15.56	0.15	13	8.79	0.688	23.34	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.19	1.09	1.09	1.19	1.09	1.09	1.00	1.00	1.00	307.12	163.29	207.88	83.15		
5	SQUARE	2.00	2.00	2.00	1.82	13.68	1.88	14.27	0.15	13	8.79	0.688	27.36	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.25	1.13	1.13	1.25	1.13	1.13	1.00	1.00	1.00	334.29	177.77	226.29	90.52		
6	SQUARE	2.50	2.00	2.00	1.82	12.55	1.88	13.14	0.20	12	8.11	0.706	31.38	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.31	1.15	1.15	1.31	1.15	1.15	1.00	1.00	1.00	409.29	223.03	264.01	105.60		
7	SQUARE	1.50	2.50	2.50	1.82	15.56	1.82	15.56	0.15	13	8.79	0.688	23.34	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.15	1.08	1.08	1.15	1.08	1.08	1.00	1.00	1.00	302.65	160.80	204.77	81.91		
8	SQUARE	2.00	2.50	2.50	1.82	13.68	1.88	14.27	0.15	13	8.79	0.688	27.36	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.20	1.10	1.10	1.20	1.10	1.10	1.00	1.00	1.00	326.27	173.38	220.78	88.31		
9	SQUARE	2.50	2.50	2.50	1.82	12.55	1.88	13.14	0.20	12	8.11	0.706	31.38	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.25	1.12	1.12	1.25	1.12	1.12	1.00	1.00	1.00	396.00	215.70	255.37	102.15		

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	88.99	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.82	-	-	-	Depth of foundation						32.33
2	2	CLAY	1.50	3.00	1.50	1.88	0.706	0.139	0.00	38.52	33.70	-	-	33.364	-	
3	3	CLAY	3.00	4.00	1.00	1.92	0.686	0.133	0.00	54.77	12.51	-	-	7.050	-	

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80		
Width	1.20	metre	Applied Pressure at foundation base	99.21	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.82	0.000	0.000	0.00	Depth of foundation						30.62
2	2	CLAY	2.00	3.50	1.50	1.88	0.706	0.139	0.00	46.69	37.57	-	-	31.337	-	
3	3	CLAY	3.50	4.50	1.00	1.92	0.686	0.133	0.00	62.19	13.95	-	-	6.934	-	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2	
Length	1.20	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80			
Width	1.20	metre	Applied Pressure at foundation base	118.69	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.88	0.000	0.000	0.00	Depth of foundation						33.15
2	2	CLAY	2.50	4.00	1.50	1.92	0.686	0.133	0.00	49.43	44.95	-	-	33.237	-	
3	3	CLAY	4.00	5.00	1.00	1.97	0.654	0.129	0.00	60.95	16.69	-	-	8.198	-	

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2	
Length	2.00	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80			
Width	2.00	metre	Applied Pressure at foundation base	83.15	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement	
		CLAY					e	Cc	N''	P _o	ΔP		W'				
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)	
1	1	CLAY	0.00	1.50	1.50	1.82	-	-	-	Depth of foundation							43.85
2	2	CLAY	1.50	3.00	1.50	1.88	0.706	0.139	0.00	38.52	43.98	-	-	40.427	-		
3	3	CLAY	3.00	4.50	1.50	1.92	0.686	0.133	0.00	57.03	18.41	-	-	14.380	-		

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.00	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	90.52	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.82	0.000	0.000	0.00	Depth of foundation						41.10
2	2	CLAY	2.00	3.50	1.50	1.88	0.706	0.139	0.00	46.69	47.88	-	-	37.463	-	
3	3	CLAY	3.50	5.00	1.50	1.92	0.686	0.133	0.00	64.45	20.05	-	-	13.918	-	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.00	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	105.60	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	C _c	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.88	0.000	0.000	0.00	Depth of foundation						43.86
2	2	CLAY	2.50	4.00	1.50	1.92	0.686	0.133	0.00	49.43	55.85	-	-	38.857	-	
3	3	CLAY	4.00	5.50	1.50	1.97	0.654	0.129	0.00	63.33	23.39	-	-	15.968	-	

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

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	81.91	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.82	0.000	0.000	0.00	Depth of foundation						51.22
2	2	CLAY	1.50	3.50	2.00	1.88	0.706	0.139	0.00	41.43	41.79	-	-	49.364	-	
3	3	CLAY	3.50	5.25	1.75	1.92	0.686	0.133	0.00	63.98	17.72	-	-	14.658	-	

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

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	79.36	kN/m ²		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.82	0.000	0.000	0.00	Depth of foundation						50.00
2	2	CLAY	1.50	3.50	2.00	1.88	0.706	0.139	0.00	41.43	40.49	-	-	48.249	-	
3	3	CLAY	3.50	5.25	1.75	1.92	0.686	0.133	0.00	63.98	17.17	-	-	14.252	-	

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

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80			
Width	2.50	metre	Applied Pressure at foundation base	88.31	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	C _c	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.88	0.000	0.000	0.00	Depth of foundation						44.52
2	2	CLAY	2.00	4.00	2.00	1.92	0.686	0.133	0.00	51.17	45.06	-	-	43.274	-	
3	3	CLAY	4.00	5.50	1.50	1.97	0.654	0.129	0.00	72.60	20.02	-	-	12.377	-	

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

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80			
Width	2.50	metre	Applied Pressure at foundation base	102.15	kN/m2		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement	
		CLAY					e	Cc	N''	P _o	ΔP		W'				
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)	
1	1	CLAY	0.00	2.50	2.50	1.88	0.000	0.000	0.00	Depth of foundation						51.39	
2	2	CLAY	2.50	4.50	2.00	1.92	0.686	0.133	0.00	51.68	52.12	-	-	47.781	-		
3	3	CLAY	4.50	6.25	1.75	1.97	0.654	0.129	0.00	69.03	22.10	-	-	16.463	-		

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

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	98.52	kN/m ²		Type of foundation	SQUARE		


FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.88	0.000	0.000	0.000	Depth of foundation						50.00
2	2	CLAY	2.50	4.50	2.00	1.92	0.686	0.133	0.000	51.68	50.27	-	-	46.547	-	
3	3	CLAY	4.50	6.25	1.75	1.97	0.654	0.129	0.000	69.03	21.31	-	-	15.950	-	


SITE PHOTOS DURING SITE INVESTIGATION



RESULT SHEET

NAME OF THE PROJECT																						CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT LALBAGH FERRY GHAT OPOSITE IN WEST BENGAL																					
Client Name																																											
Bore Hole No.		1 (R.H.S.)		Coordinate		Easting			Depth of Water Level			2.00			VIVEK MATERIAL TESTING LABORATORY						 VMT <small>ENGINEERING & MATERIAL TESTING</small>																						
Total depth of Bore Hole		10.00				Northing			Completed on			4/17/2023																															
Bore Hole				Elevation			100.000			4/17/2023																																	
Depth of Bore Hole	Reduced Level		Types of Samples	% Material Passing IS Sieve				Atterberg Limits			IS group symbol	SPT Value	SPT Value corrected due to overburden	SPT Value corrected due to dilatancy	Wet Bulk Density	Original Moisture	Dry Bulk Density	Specific Gravity	Void Ratio	Shear Characteristics		Compression Index																					
				4.750	2.000	0.425	0.075	LL	PL	PI										Cohesion	Angle of Internal Friction																						
metre	metre			(mm)	(mm)	(mm)	(mm)	%	%	%		N	N'	N''	(gms/cc)	%	(gms/cc)	(G)		(Kg/sqcm)	(Ø)	(Cc)																					
1	2		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22																					
0.00 - 0.50	100.000 - 99.500	DS	100	100	98	95	36	21	15	CI					-	-	-	-	-	-	-	-																					
1.00 - 1.35	99.000 - 98.650	UD	100	100	99	97	38	22	16	CI				1.81	16.5	1.55	2.62	0.690	0.30	7°	0.132																						
1.35 - 1.80	98.650 - 98.200	SPT									6	8.21	8.21																														
2.50 - 2.85	97.500 - 97.150	UD	100	100	100	99	39	24	15	CI				1.82	19.7	1.52	-	-	-	-	-	-																					
2.85 - 3.30	97.150 - 96.700	SPT									4	5.73	5.73																														
4.00 - 4.35	96.000 - 95.650	UD	100	100	100	97	40	22	18	CI				1.87	21.4	1.54	2.61	0.695	0.20	12°	0.136																						
4.35 - 4.80	95.650 - 95.200	SPT									5	6.50	6.50																														
5.50 - 5.85	94.500 - 94.150	UD	100	100	100	98	41	25	16	CI				1.92	22.3	1.57	-	-	-	-	-	-																					
5.85 - 6.30	94.150 - 93.700	SPT									7	8.40	8.40																														
7.00 - 7.35	93.000 - 92.650	UD	100	100	100	76	NON PLASTIC			ML				1.82	23.8	1.47	2.56	0.741	0	29°	-																						
7.35 - 7.80	92.650 - 92.200	SPT									9	10.18	10.18																														
8.50 - 8.85	91.500 - 91.150	UD	100	100	100	71	NON PLASTIC			ML				1.86	21.7	1.53	-	-	-	-	-	-																					
8.85 - 9.30	91.150 - 90.700	SPT									13	13.92	13.92																														
9.30 - 10.00	90.700 - 90.000	DS	100	100	100	73	NON PLASTIC			ML					-	-	-	-	-	-	-	-																					

RESULT SHEET

NAME OF THE PROJECT																						CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT LALBAGH FERRY GHAT OPOPOSITE IN WEST BENGAL																					
Client Name																																											
Bore Hole No.		2 (R.H.S.)		Coordinate		Easting			Depth of Water Level			2.15			VIVEK MATERIAL TESTING LABORATORY						 VMT GEOTECHNICAL & MATERIAL TESTING																						
Total depth of Bore Hole		10.00				Northing			Completed on			4/17/2023																															
Depth of Bore Hole		Reduced Level		Types of Samples		% Material Passing IS Sieve				Atterberg Limits			IS group symbol	SPT Value	SPT Value corrected due to overburden	SPT Value corrected due to dilatancy	Wet Bulk Density	Original Moisture	Dry Bulk Density	Specific Gravity	Void Ratio	Shear Characteristics		Compression Index																			
metre		metre				4.750	2.000	0.425	0.075	LL	PL	PI										N	N'		N''	(gms/cc)	%	(gms/cc)	(G)	(Kg/sqcm)	(Ø)	(Cc)											
1		2		3		4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22																			
0.00 - 0.50		100.000 - 99.500		DS		99	98	98	97	34	23	11	CL					-	-	-	-	-	-	-																			
1.00 - 1.35		99.000 - 98.650		UD		100	99	98	97	35	22	13	CL				1.82	18.2	1.54	2.60	0.688	0.15	13°	0.137																			
1.35 - 1.80		98.650 - 98.200		SPT										5	6.83	6.83																											
2.50 - 2.85		97.500 - 97.150		UD		100	100	100	98	38	24	14	CI				1.88	22.7	1.53	-	-	-	-	-																			
2.85 - 3.30		97.150 - 96.700		SPT										4	5.67	5.67																											
4.00 - 4.35		96.000 - 95.650		UD		100	100	100	99	36	22	14	CI				1.92	23.1	1.56	2.63	0.686	0.20	12°	0.133																			
4.35 - 4.80		95.650 - 95.200		SPT										6	7.70	7.70																											
5.50 - 5.85		94.500 - 94.150		UD		100	100	100	97	37	23	14	CI				1.97	24.2	1.59	-	-	-	-	-																			
5.85 - 6.30		94.150 - 93.700		SPT										9	10.64	10.64																											
7.00 - 7.35		93.000 - 92.650		UD		100	100	100	81	NON PLASTIC			ML				1.90	22.8	1.55	2.58	0.665	0	30°	-																			
7.35 - 7.80		92.650 - 92.200		SPT										14	15.55	15.28																											
8.50 - 8.85		91.500 - 91.150		UD		100	100	100	88	NON PLASTIC			ML				1.89	20.3	1.57	-	-	-	-	-																			
8.85 - 9.30		91.150 - 90.700		SPT										16	16.84	15.92																											
9.30 - 10.00		90.700 - 90.000		DS		100	100	100	78	NON PLASTIC			ML				-	-	-	-	-	-	-	-																			

BORE-LOG CHART



VMT
GEOTECH & MATERIAL TESTING

VIVEK MATERIAL TESTING LABORATORY

NAME OF THE PROJECT:- CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT LALBAGH
FERRY GHAT OPOPOSITE IN WEST BENGAL

WATER TABLE 2.00 METRE DEPTH BELOW GROUND LEVEL

BORE HOLE NO.:- 01 (R.H.S.)

DEPTH IN METRES BELOW GROUND LEVEL	VISUAL FIELD OBSERVATIONS	SAMPLE	I.S.		S.P.T. VALUE				S.P.T. VALUES																																														
			GROUP	HATCHING	N1	N2	N3	N2+N3	10	20	30	40	50	60	70	80	90	100																																					
0.00-0.50	SILTY-CLAY	D.	CI																																																				
1.00-1.35	SILTY-CLAY	U.D.	CI																																																				
1.35-1.80		S.P.T.			2	3	3	6																																															
2.50-2.85	SILTY-CLAY	U.D.	CI																																																				
2.85-3.30		S.P.T.			1	2	2	4																																															
4.00-4.35	SILTY-CLAY	U.D.	CI																																																				
4.35-4.80		S.P.T.			2	2	3	5																																															
5.50-5.85	SILTY-CLAY	U.D.	CI																																																				
5.85-6.30		S.P.T.			2	3	4	7																																															
7.00-7.35	SANDY-SILT	U.D.	ML																																																				
7.35-7.80		S.P.T.			3	4	5	9																																															
8.50-8.85	SANDY-SILT	U.D.	ML																																																				
8.85-9.30		S.P.T.			4	6	7	13																																															
9.30-10.00	SANDY-SILT	D.	ML																																																				



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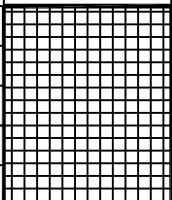
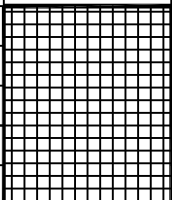
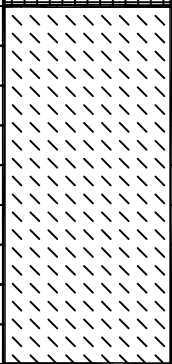
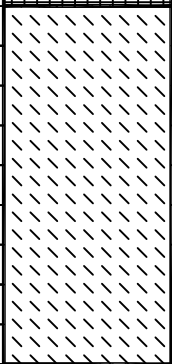
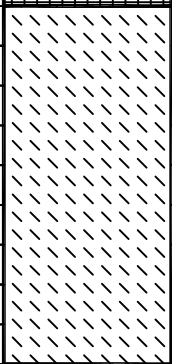
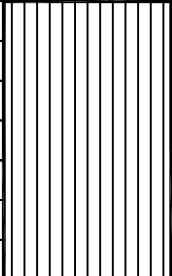
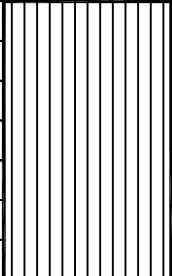
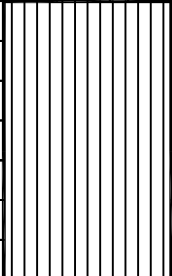
BORE-LOG CHART

VIVEK MATERIAL TESTING LABORATORY

NAME OF THE PROJECT:- CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT LALBAGH
FERRY GHAT OPOOSITE IN WEST BENGAL

WATER TABLE 2.15 METRE DEPTH BELOW GROUND LEVEL

BORE HOLE NO.:- 02 (R.H.S.)

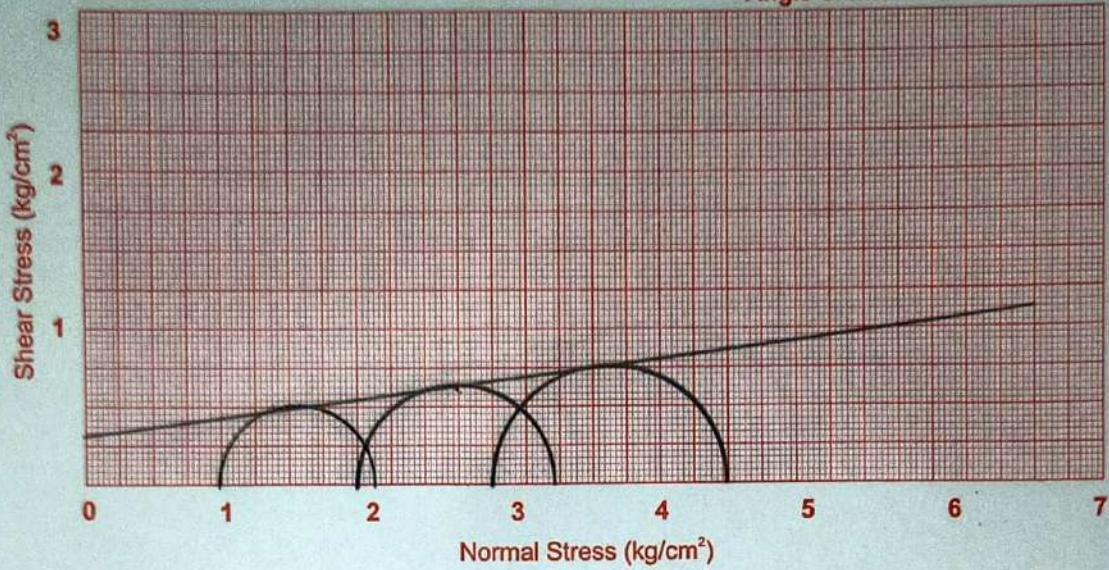
DEPTH IN METRES BELOW GROUND LEVEL	VISUAL FIELD OBSERVATIONS	SAMPLE	I.S.		S.P.T. VALUE				S.P.T. VALUES																	
			GROUP	HATCHING	N1	N2	N3	N2+N3	10	20	30	40	50	60	70	80	90	100								
0.00-0.50	SILTY-CLAY	D.	CL																							
1.00-1.35	SILTY-CLAY	U.D.	CL																							
1.35-1.80		S.P.T.				2	2	3	5	10																
2.50-2.85	SILTY-CLAY	U.D.	CI																							
2.85-3.30		S.P.T.				2	2	2	4	10																
4.00-4.35	SILTY-CLAY	U.D.	CI																							
4.35-4.80		S.P.T.				2	3	3	6	10																
5.50-5.85	SILTY-CLAY	U.D.	CI																							
5.85-6.30		S.P.T.				3	4	5	9	10																
7.00-7.35	SANDY-SILT	U.D.	ML																							
7.35-7.80		S.P.T.				4	6	8	14	10																
8.50-8.85	SANDY-SILT	U.D.	ML																							
8.85-9.30		S.P.T.				5	7	9	16	10																
9.30-10.00	SANDY-SILT	D.	ML																							



VMT
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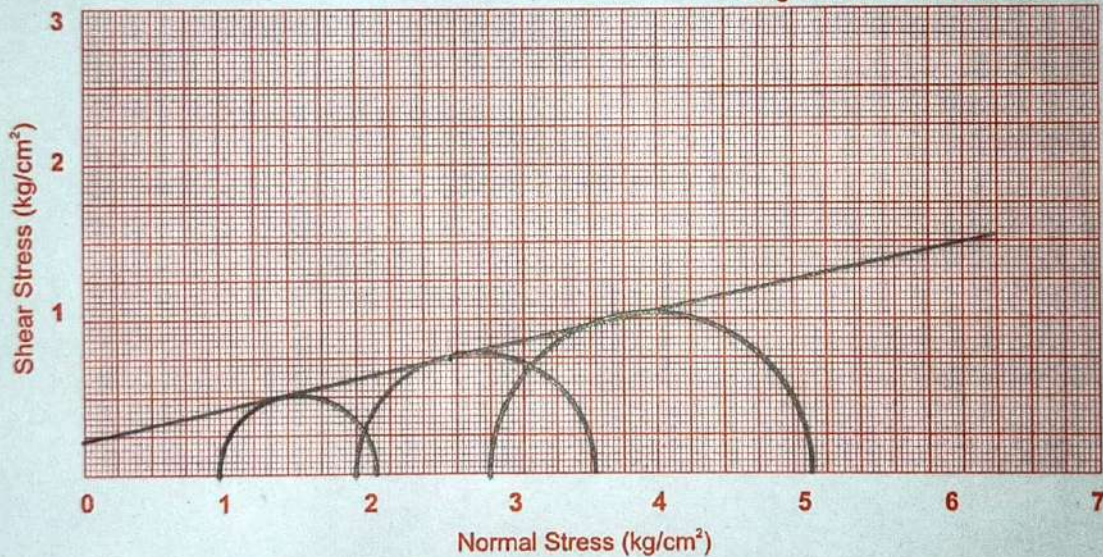
B.H. No. :- 01
Depth - 1.00 - 1.35

Cohesion 'c' 0.30 Kg/cm²
Angle of Internal Friction 7°*



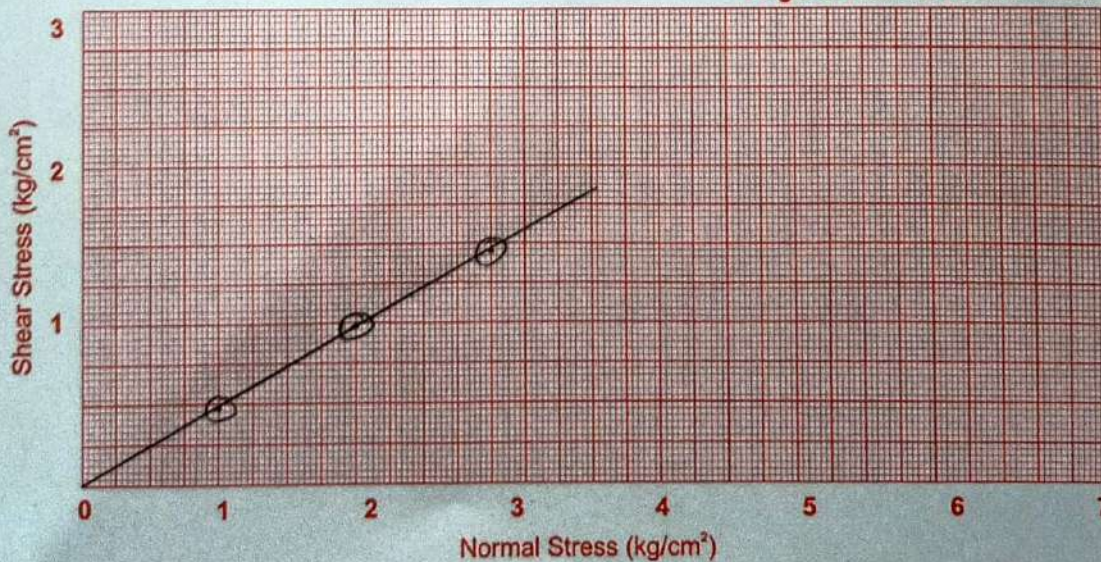
B.H. No. :- 01
Depth :- 4.00 - 4.35

Cohesion 'c' 0.20 Kg/cm²
Angle of Internal Friction 12°*



B.H. No. :- 01
Depth :- 7.00 - 7.35

Cohesion 'c' 0.00 Kg/cm²
Angle of Internal Friction 29°*

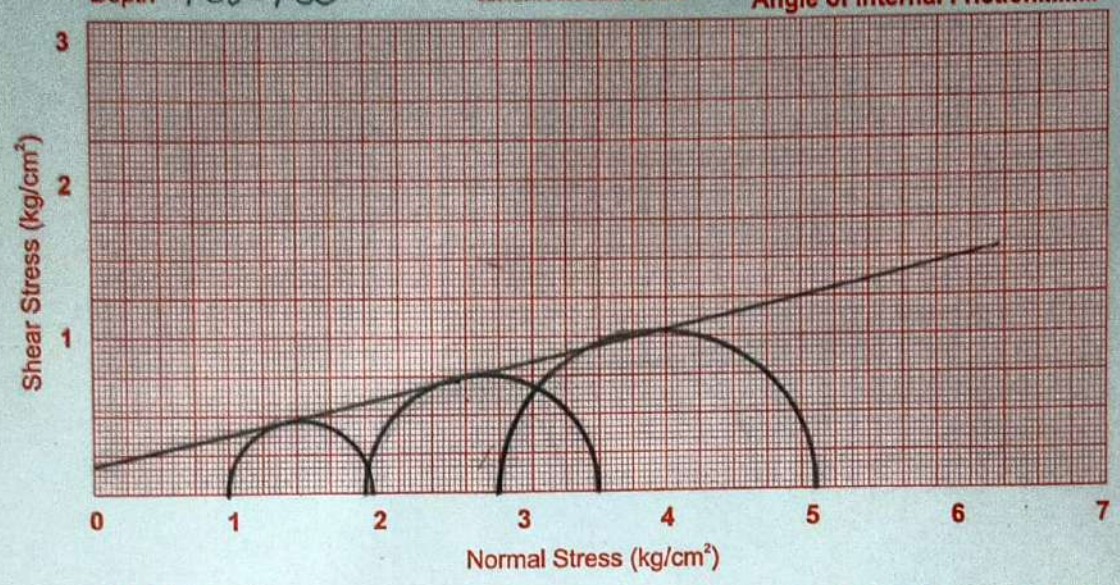




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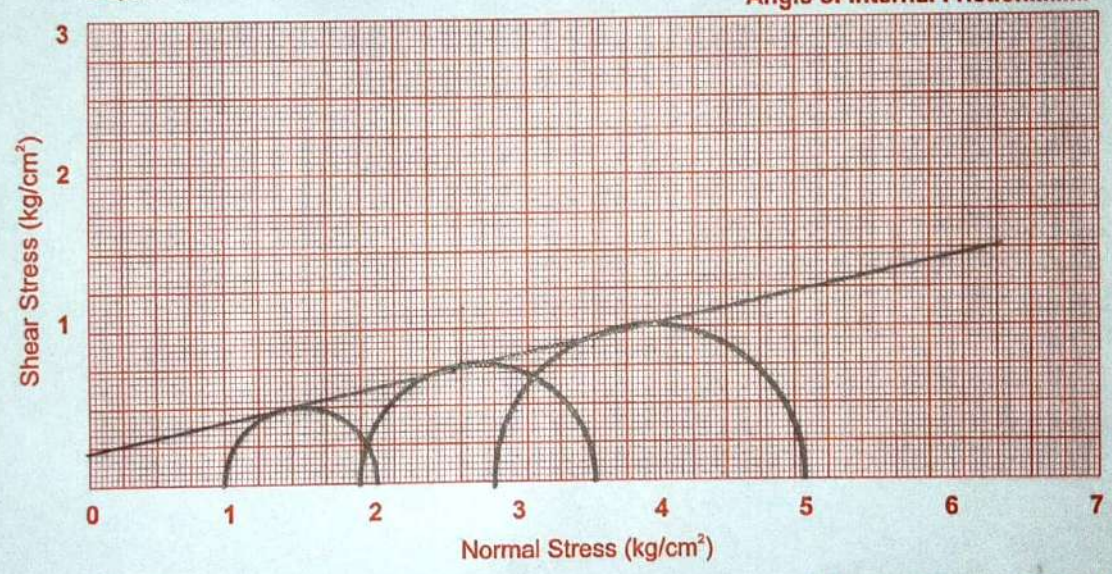
B.H. No. :- 02
Depth - 1.00 - 1.35

Cohesion 'c' 0.15 Kg/cm²
Angle of Internal Friction 13°*



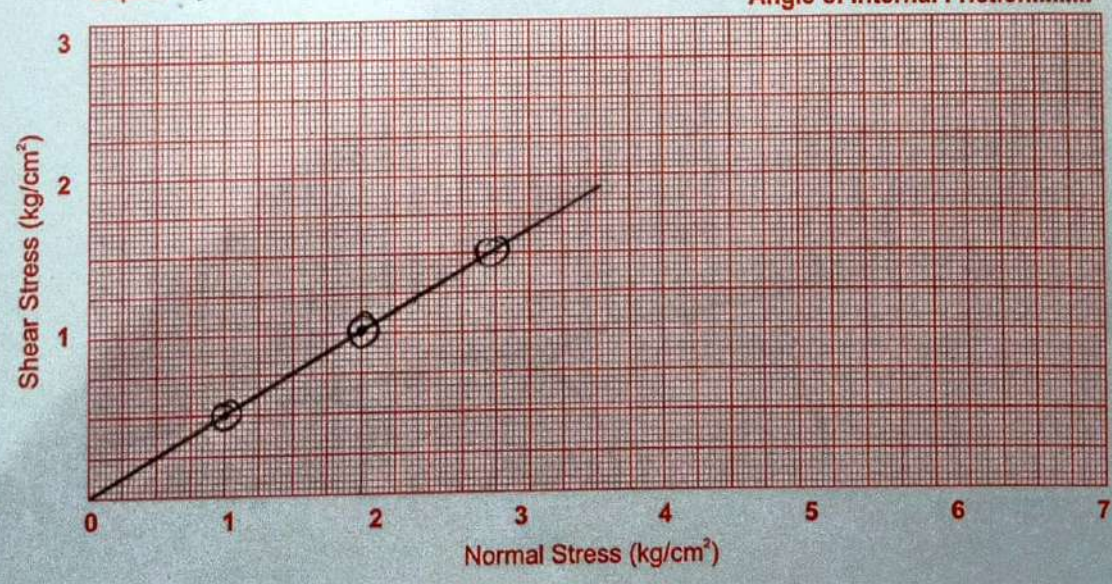
B.H. No. :- 02
Depth :- 4.00 - 4.35

Cohesion 'c' 0.20 Kg/cm²
Angle of Internal Friction 12°*



B.H. No. :- 02
Depth :- 7.00 - 7.35

Cohesion 'c' 0.00 Kg/cm²
Angle of Internal Friction 30°*





VMT

GEOTECH & MATERIAL TESTING



TC-8969

REPORT NO. – VMT 134/2023-2024

GEOTECH INVESTIGATION

REPORT FOR

PROPOSED CONSTRUCTION

OF

BOAT IN THE IDENTIFIED

COMMUNITY JETTY

AT TALTALA GHAT (R.H.S.)

IN

WEST BENGAL

Prepared By -

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ACKNOWLEDGEMENT

WE ARE GRATEFUL TO M/s KITCO LTD., KERLA FOR PROVIDING US THE OPPORTUNITY TO CARRY OUT THESE INVESTIGATIONS.

THE CO-OPERATION EXTENDED BY THEIR ENGINEERS DURING FIELD INVESTIGATIONS IS THANKFULLY ACKNOWLEDGED.

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**SUB-SOIL INVESTIGATION REPORT FOR PROPOSED CONSTRUCTION OF BOAT
IN THE IDENTIFIED COMMUNITY JETTY AT TALTALA GHAT IN WEST BENGAL**

INTRODUCTION

The work of sub-soil exploration was awarded to us by M/s KITCO LTD., KERLA Order no. – 6777:DP 1083: RG: 2023 dated 21/03/2023. The object of the investigation was to study the geo-technical properties of soil both in field and laboratory and determine safe allowable pressure for the foundation soil.

The fieldwork consisted of 02 bore holes of 10.00 metre depth each. The fieldwork was conducted on 20/04/2023. The location of the bore holes is shown in the Site location.

REFERENCES

1. **IS: 1892-2021** for field work including existent ground water table.
2. **IS: 2132-1986** for sampling in Undisturbed and Disturbed form.
3. **IS: 2131-1981** for Standard Penetration Test.
4. **IS: 2720** for all laboratory tests on soil samples collected.
5. **IS: 6403-1981** for determination of Bearing Capacity.
6. **IS: 8009(Part I)-1976** for calculation of settlement of foundations.
7. **IS: 1904-2021** for permissible maximum settlement, differential settlement and angular distortion.

SCOPE OF WORK

The scope consisted of drilling of boreholes down to maximum depth of 10.00 m in normal soils / rock, Standard Penetration Testing, collection of samples, laboratory testing and preparation and submission of Geotechnical Investigation report.

Summary of the fieldwork					
Sl. No.	Site	Borehole Nos.	Coordinates		Depth below existing ground level (m)
			Latitude	Longitude	
1.	TALTALA GHAT	BH-01 (RHS)	24.813268	87.91631855	10.0
2.		BH-02 (RHS)	24.81275552	87.91642584	10.0



SITE LOCATION



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INTERPRETATION OF THE LAB TEST RESULTS

GENERAL NATURE OF SOIL STRATA

The bore hole log charts and lab test results of bore holes 1 and 2 indicate that the strata at the site is found to comprise of cohesive soil.

The results of classification tests indicate that the natural soil stratum present at the Site is found to comprise of both fine-grained soils comprising of 'CL' and 'ML' group of IS classification (clayey soil) having 87 to 99 percent material finer than 75 micron.

The bore hole log charts and lab test results of bore holes 1 indicate that:

first strata, from 0.00 metre to 2.50 metre, consists of a layer of CL group of IS classification which is inorganic clays of low plasticity,

second strata, from 2.50 metre to 4.00 metre, consists of a layer of ML group of IS classification which is inorganic silts with none to low plasticity

third strata, from 4.00 metre to 10.00 metre, consists of a layer of CL group of IS classification which is inorganic clays of low plasticity.

The bore hole log charts and lab test results of bore holes 2 indicate that:

first strata, from 0.00 metre to 10.00 metre, consists of a layer of CL group of IS classification which is inorganic clays of low plasticity.

S.P.T. VALUES

The S.P.T. values obtained in the respective clayey layer region present as per bore-log charts enclosed are found to range 5 to 17 indicating 'Medium' to 'Stiff' consistency.

The results of S.P.T. values indicate that the stratum at the Site is 'Loose' to 'Well' compacted.

WATER TABLE

Water Table at the Site was observed at a depth 7.00 metre below ground level on the day of soil investigation during the Third week of April 2023. However, the existing water table may rise by 1.00 metre in the post-monsoon period in general. Therefore, a water table at a depth of 6.00 metre below ground level has been adopted for calculation purposes.

RECOMMENDATIONS FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT TALTALA GHAT IN WEST BENGAL
NET SAFE BEARING CAPACITY/SAFE ALLOWABLE PRESSURE

Bore Hole Nos.	Type of Structure	Depth of Foundation (metres)	Size of Footing (L x B) (metres)	Net Safe Bearing Capacity (Tonne/sqm.)	Settlement Produced (mm)	Safe Allowable Pressure for Permissible Settlement 50 mm (Tonne/sqm.)
1	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	8.53	28.08	-
		2.00	1.20 x 1.20	9.80	27.09	-
		2.50	1.20 x 1.20	13.87	31.60	-
		1.50	2.00 x 2.00	8.10	38.32	-
		2.00	2.00 x 2.00	9.09	36.60	-
		2.50	2.00 x 2.00	12.91	42.70	-
		1.50	2.50 x 2.50	8.03	43.75	-
		2.00	2.50 x 2.50	8.97	41.40	-
		2.50	2.50 x 2.50	12.79	49.85	-
2	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	13.22	39.05	-
		2.00	1.20 x 1.20	15.14	37.75	-
		2.50	1.20 x 1.20	19.33	39.07	-
		1.50	2.00 x 2.00	12.47	52.29	11.70
		2.00	2.00 x 2.00	13.95	50.14	13.90
		2.50	2.00 x 2.00	17.25	50.96	16.80
		1.50	2.50 x 2.50	12.36	60.06	9.62
		2.00	2.50 x 2.50	13.70	55.05	12.02
		2.50	2.50 x 2.50	16.75	58.86	13.45

NOTE: -

The above recommendations are based on the field investigation data results and the laboratory tests results of the samples collected from the test locations and our experience in this regard. If the actual sub-soil conditions during excavation for the

foundations differ from that has been reported, a reference should be made to us for suggestions.

Further, the recommendations are based on the assumptions as mentioned in the Report and the designer of the Structure should take into consideration all the factors required as per codes. The recommendations should be taken as guidelines for the designer.

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BEARING CAPACITY CALCULATIONS

Soil when stressed due to loading, tend to deform. The resistance to deformation of the soil depends upon factors like water content, bulk density, angle of internal friction and the manner in which load is applied on the soil. The maximum load per unit area which the soil or rock can carry without yielding or displacement is termed as the bearing capacity of soils. The Safe Bearing Capacity of the proposed STRUCTURE without any distress is determined from the considerations of the following criteria.

[A] SHEAR CRITERIA

The soil beneath the foundation shall be safe from risk of shear failure.

[B] SETTLEMENT CRITERIA

The settlement due to load is caused basically on account of two factors, namely,

- (i) the soil below footing gets compressed by certain amount and
- (ii) since the foundations cover only a limited area there is a possibility that the concentrated stresses developed are so high as to cause actual rupture (shear failure) and displacement of soil below.

The foundation should not settle or deflect to an extent causing damage to the Structure or impair its usefulness.

The Bearing Capacity Calculations for the Foundation shall be governed as per IS: 6403-1981, IS: 8009(Part-I)-1976 and IS: 1904-2021 on the basis of available information regarding the proposed design.

BEARING CAPACITY ON SHEAR CONSIDERATIONS**ULTIMATE NET BEARING CAPACITY**

As per IS: 6403-1981, the Ultimate Net Bearing Capacity 'qd' on shear consideration for a Structure is given by the formula: -

FOR GENERAL SHEAR FAILURE

$$q_d = c.N_c.Sc.dc.ic + q(N_q - 1).sq.dq.iq + 1/2 B.r.Nr.Sr.dr.ir.W'$$

FOR LOCAL SHEAR FAILURE

$$q'd = 2/3 c.N'c.Sc.dc.ic + q(N'q - 1).Sq.dq.iq + 1/2 B.r.N'r.Sr.dr.ir.W'$$

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981



NAME OF PROJECT																																					
BOREHOLE 01 (R.H.S.)		Depth of borehole		10.00	metre		Water table below borehole level (m)			7.00	Factor of safety			2.50	Water table used for calculation (m)			6.00	Assumed post monsoon rise (m)			1.00															
Input Parameters												Shearing Resistance Parameters												Ultimate Net Bearing Capacity			Net Safe Bearing Capacity										
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance	Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors						Inclination Factors			General shear	Local shear	Intermediate	Net Safe Bearing Capacity			
					Bulk		Bulk		c	ϕ	ϕ'	e	q	Nc	Nq	Ny	Nc'	Nq'	Ny'	Sc	Sq	Sy	Dc	Dq	Dy	Dc'	Dq'	Dy'	lc	lq	ly						
		(m)	(m)	(m)	(gms/cc)	(kN/m3)	(gms/cc)	(kN/m3)	Kg/cm2	°	°		kN/m2																								
1	SQUARE	1.50	1.20	1.20	1.76	17.26	1.76	17.26	0.15	12	8.11	0.701	25.89	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.31	1.15	1.15	1.31	1.15	1.15	1.00	1.00	1.00	318.72	173.57	209.13	83.65		
2	SQUARE	2.00	1.20	1.20	1.76	17.26	1.82	17.85	0.15	12	8.11	0.701	34.52	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.41	1.21	1.21	1.41	1.21	1.21	1.00	1.00	1.00	366.22	199.52	240.36	96.14		
3	SQUARE	2.50	1.20	1.20	1.76	17.26	1.82	17.85	0.10	17	11.58	0.692	43.15	12.33	4.77	3.53	9.08	2.86	1.58	1.30	1.20	0.80	1.56	1.28	1.28	1.56	1.28	1.28	1.00	1.00	1.00	533.81	261.00	340.11	136.04		
4	SQUARE	1.50	2.00	2.00	1.76	17.26	1.76	17.26	0.15	12	8.11	0.701	25.89	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.19	1.09	1.09	1.19	1.09	1.09	1.00	1.00	1.00	303.11	164.82	198.70	79.48		
5	SQUARE	2.00	2.00	2.00	1.76	17.26	1.82	17.85	0.15	12	8.11	0.701	34.52	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.25	1.12	1.12	1.25	1.12	1.12	1.00	1.00	1.00	340.02	184.98	222.96	89.18		
6	SQUARE	2.50	2.00	2.00	1.76	17.26	1.82	17.85	0.10	17	11.58	0.692	43.15	12.33	4.77	3.53	9.08	2.86	1.58	1.30	1.20	0.80	1.34	1.17	1.17	1.34	1.17	1.17	1.00	1.00	1.00	498.02	242.50	316.60	126.64		
7	SQUARE	1.50	2.50	2.50	1.76	17.26	1.76	17.26	0.15	12	8.11	0.701	25.89	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.15	1.07	1.07	1.15	1.07	1.07	1.00	1.00	1.00	300.57	163.29	196.92	78.77		
8	SQUARE	2.00	2.50	2.50	1.76	17.26	1.82	17.85	0.15	12	8.11	0.701	34.52	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.20	1.10	1.10	1.20	1.10	1.10	1.00	1.00	1.00	335.68	182.46	220.00	88.00		
9	SQUARE	2.50	2.50	2.50	1.76	17.26	1.82	17.85	0.10	17	11.58	0.692	43.15	12.33	4.77	3.53	9.08	2.86	1.58	1.30	1.20	0.80	1.27	1.14	1.14	1.27	1.14	1.14	1.00	1.00	1.00	494.01	239.96	313.63	125.45		

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	83.65	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.76	-	-	-	Depth of foundation						28.08
2	2	CLAY	1.50	3.00	1.50	1.82	0.692	0.128	0.00	39.28	31.68	-	-	29.146	-	
3	3	CLAY	3.00	4.00	1.00	1.89	0.650	0.130	0.00	61.93	11.76	-	-	5.950	-	

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80		
Width	1.20	metre	Applied Pressure at foundation base	96.14	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.76	0.000	0.000	0.00	Depth of foundation						27.09
2	2	CLAY	2.00	3.50	1.50	1.82	0.692	0.128	0.00	47.91	36.41	-	-	27.859	-	
3	3	CLAY	3.50	4.50	1.00	1.89	0.650	0.130	0.00	70.56	13.52	-	-	5.998	-	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80		
Width	1.20	metre	Applied Pressure at foundation base	136.04	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.82	0.000	0.000	0.00	Depth of foundation						31.60
2	2	CLAY	2.50	4.00	1.50	1.89	0.650	0.130	0.00	58.52	51.52	-	-	32.409	-	
3	3	CLAY	4.00	5.00	1.00	1.95	0.630	0.127	0.00	81.99	19.13	-	-	7.097	-	

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	79.48	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement	
		CLAY					e	Cc	N''	P _o	ΔP		W'				
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)	
1	1	CLAY	0.00	1.50	1.50	1.76	-	-	-	Depth of foundation							38.32
2	2	CLAY	1.50	3.00	1.50	1.82	0.692	0.128	0.00	39.28	42.04	-	-	35.862	-		
3	3	CLAY	3.00	4.50	1.50	1.89	0.650	0.130	0.00	66.57	17.60	-	-	12.042	-		

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	89.18	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.76	0.000	0.000	0.00	Depth of foundation						36.60
2	2	CLAY	2.00	3.50	1.50	1.82	0.692	0.128	0.00	47.91	47.17	-	-	33.779	-	
3	3	CLAY	3.50	5.00	1.50	1.89	0.650	0.130	0.00	75.20	19.75	-	-	11.969	-	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	126.64	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.82	0.000	0.000	0.00	Depth of foundation						42.70
2	2	CLAY	2.50	4.00	1.50	1.89	0.650	0.130	0.00	58.52	66.98	-	-	39.158	-	
3	3	CLAY	4.00	5.50	1.50	1.95	0.630	0.127	0.00	86.77	28.04	-	-	14.215	-	

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

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	78.77	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.76	0.000	0.000	0.00	Depth of foundation						43.75
2	2	CLAY	1.50	3.50	2.00	1.82	0.692	0.128	0.00	43.74	40.19	-	-	42.823	-	
3	3	CLAY	3.50	5.25	1.75	1.89	0.650	0.130	0.00	77.81	17.04	-	-	11.859	-	

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

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	88.00	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.82	0.000	0.000	0.00	Depth of foundation						41.40
2	2	CLAY	2.00	4.00	2.00	1.89	0.650	0.130	0.00	54.23	44.90	-	-	41.276	-	
3	3	CLAY	4.00	5.50	1.50	1.95	0.630	0.127	0.00	87.11	19.95	-	-	10.469	-	

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

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	125.45	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.82	0.000	0.000	0.00	Depth of foundation						49.85
2	2	CLAY	2.50	4.50	2.00	1.89	0.650	0.130	0.00	63.16	64.01	-	-	47.893	-	
3	3	CLAY	4.50	6.25	1.75	1.95	0.630	0.127	0.00	98.43	27.14	-	-	14.420	-	

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981



NAME OF PROJECT																																					
BOREHOLE 02 (R.H.S.)		Depth of borehole		10.00	metre		Water table below borehole level (m)		7.00			Factor of safety		2.50			Assumed post monsoon rise (m)		1.00																		
								Water table used for calculation (m)		6.00																											
Input Parameters												Shearing Resistance Parameters												Ultimate Net Bearing Capacity			Net Safe Bearing Capacity										
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance	Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors						Inclination Factors			General shear	Local shear	Intermediate	Net Safe Bearing Capacity			
					Bulk		Bulk		c	ϕ	ϕ'	e	q	Nc	Nq	Ny	Nc'	Nq'	Ny'	Sc	Sq	Sy	Dc	Dq	Dy	Dc'	Dq'	Dy'	lc	lq	ly						
		(m)	(m)	(m)	(gms/cc)	(kN/m3)	(gms/cc)	(kN/m3)	Kg/cm2	°	°		kN/m2																								
1	SQUARE	1.50	1.20	1.20	1.78	17.46	1.78	17.46	0.20	13	8.79	0.654	26.18	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.31	1.16	1.16	1.31	1.16	1.16	1.00	1.00	1.00	428.53	227.87	324.19	129.68		
2	SQUARE	2.00	1.20	1.20	1.78	17.46	1.91	18.73	0.20	13	8.79	0.654	34.91	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.42	1.21	1.21	1.42	1.21	1.21	1.00	1.00	1.00	490.47	260.87	371.08	148.43		
3	SQUARE	2.50	1.20	1.20	1.78	17.46	1.91	18.73	0.25	11	7.42	0.613	43.64	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.51	1.25	1.25	1.51	1.25	1.25	1.00	1.00	1.00	551.65	304.74	473.87	189.55		
4	SQUARE	1.50	2.00	2.00	1.78	17.46	1.78	17.46	0.20	13	8.79	0.654	26.18	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.19	1.09	1.09	1.19	1.09	1.09	1.00	1.00	1.00	404.45	214.70	305.78	122.31		
5	SQUARE	2.00	2.00	2.00	1.78	17.46	1.91	18.73	0.20	13	8.79	0.654	34.91	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.25	1.13	1.13	1.25	1.13	1.13	1.00	1.00	1.00	452.39	240.21	342.06	136.82		
6	SQUARE	2.50	2.00	2.00	1.78	17.46	1.91	18.73	0.25	11	7.42	0.613	43.64	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.30	1.15	1.15	1.30	1.15	1.15	1.00	1.00	1.00	492.42	271.85	422.94	169.18		
7	SQUARE	1.50	2.50	2.50	1.78	17.46	1.78	17.46	0.20	13	8.79	0.654	26.18	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.15	1.08	1.08	1.15	1.08	1.08	1.00	1.00	1.00	400.91	212.60	302.99	121.20		
8	SQUARE	2.00	2.50	2.50	1.78	17.46	1.91	18.73	0.20	13	8.79	0.654	34.91	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.20	1.10	1.10	1.20	1.10	1.10	1.00	1.00	1.00	444.30	235.68	335.82	134.33		
9	SQUARE	2.50	2.50	2.50	1.78	17.46	1.91	18.73	0.25	11	7.42	0.613	43.64	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.24	1.12	1.12	1.24	1.12	1.12	1.00	1.00	1.00	478.30	263.95	410.78	164.31		

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	129.68	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.78	-	-	-	Depth of foundation						39.05
2	2	CLAY	1.50	3.00	1.50	1.91	0.613	0.125	0.00	40.23	49.11	-	-	40.275	-	
3	3	CLAY	3.00	4.00	1.00	1.94	0.598	0.125	0.00	63.79	18.24	-	-	8.541	-	

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2	
Length	1.20	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80			
Width	1.20	metre	Applied Pressure at foundation base	148.43	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.78	0.000	0.000	0.00	Depth of foundation						37.75
2	2	CLAY	2.00	3.50	1.50	1.91	0.613	0.125	0.00	48.96	56.21	-	-	38.598	-	
3	3	CLAY	3.50	4.50	1.00	1.94	0.598	0.125	0.00	72.52	20.87	-	-	8.593	-	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80		
Width	1.20	metre	Applied Pressure at foundation base	189.55	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.91	0.000	0.000	0.00	Depth of foundation						39.07
2	2	CLAY	2.50	4.00	1.50	1.94	0.598	0.125	0.00	61.10	71.78	-	-	39.593	-	
3	3	CLAY	4.00	5.00	1.00	1.93	0.669	0.130	0.00	84.83	26.66	-	-	9.243	-	

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2	
Length	2.00	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80			
Width	2.00	metre	Applied Pressure at foundation base	122.31	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement	
		CLAY					e	Cc	N''	P _o	ΔP		W'				
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)	
1	1	CLAY	0.00	1.50	1.50	1.78	-	-	-	Depth of foundation							52.29
2	2	CLAY	1.50	3.00	1.50	1.91	0.613	0.125	0.00	40.23	64.69	-	-	48.392	-		
3	3	CLAY	3.00	4.50	1.50	1.94	0.598	0.125	0.00	68.55	27.09	-	-	16.968	-		

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.00	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	114.77	kN/m ²		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.78	-	-	-	Depth of foundation						50.00
2	2	CLAY	1.50	3.00	1.50	1.91	0.613	0.125	0.00	40.23	60.70	-	-	46.44	-	
3	3	CLAY	3.00	4.50	1.50	1.94	0.598	0.125	0.00	68.55	25.42	-	-	16.07	-	

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2	
Length	2.00	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80			
Width	2.00	metre	Applied Pressure at foundation base	136.82	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.78	0.000	0.000	0.00	Depth of foundation						50.14
2	2	CLAY	2.00	3.50	1.50	1.91	0.613	0.125	0.00	48.96	72.37	-	-	45.813	-	
3	3	CLAY	3.50	5.00	1.50	1.94	0.598	0.125	0.00	77.28	30.30	-	-	16.857	-	

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.00	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	136.30	kN/m ²		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.78	0.000	0.000	0.00	Depth of foundation						50.00
2	2	CLAY	2.00	3.50	1.50	1.91	0.613	0.125	0.00	48.96	72.09	-	-	45.698	-	
3	3	CLAY	3.50	5.00	1.50	1.94	0.598	0.125	0.00	77.28	30.18	-	-	16.802	-	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2	
Length	2.00	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80			
Width	2.00	metre	Applied Pressure at foundation base	169.18	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement	
		CLAY					e	Cc	N''	P _o	ΔP		W'				
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)	
1	1	CLAY	0.00	2.50	2.50	1.91	0.000	0.000	0.00	Depth of foundation						50.96	
2	2	CLAY	2.50	4.00	1.50	1.94	0.598	0.125	0.00	61.10	89.48	-	-	45.965	-		
3	3	CLAY	4.00	5.50	1.50	1.93	0.669	0.130	0.00	89.56	37.47	-	-	17.733	-		

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.00	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	164.72	kN/m ²		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.91	0.000	0.000	0.00	Depth of foundation						50.00
2	2	CLAY	2.50	4.00	1.50	1.94	0.598	0.125	0.00	61.10	87.12	-	-	45.161	-	
3	3	CLAY	4.00	5.50	1.50	1.93	0.669	0.130	0.00	89.56	36.48	-	-	17.337	-	

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

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	121.20	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.78	0.000	0.000	0.00	Depth of foundation						60.06
2	2	CLAY	1.50	3.50	2.00	1.91	0.613	0.125	0.00	44.92	61.84	-	-	58.273	-	
3	3	CLAY	3.50	5.25	1.75	1.94	0.598	0.125	0.00	80.29	26.22	-	-	16.799	-	

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

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	94.35	kN/m ²		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.78	0.000	0.000	0.00	Depth of foundation						50.00
2	2	CLAY	1.50	3.50	2.00	1.91	0.613	0.125	0.00	44.92	48.14	-	-	49.029	-	
3	3	CLAY	3.50	5.25	1.75	1.94	0.598	0.125	0.00	80.29	20.41	-	-	13.465	-	

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

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	134.33	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.91	0.000	0.000	0.00	Depth of foundation						55.05
2	2	CLAY	2.00	4.00	2.00	1.94	0.598	0.125	0.00	56.49	68.54	-	-	53.979	-	
3	3	CLAY	4.00	5.50	1.50	1.93	0.669	0.130	0.00	89.71	30.46	-	-	14.833	-	

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

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	117.90	kN/m ²		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.91	0.000	0.000	0.000	Depth of foundation						50.00
2	2	CLAY	2.00	4.00	2.00	1.94	0.598	0.125	0.000	56.49	60.15	-	-	49.264	-	
3	3	CLAY	4.00	5.50	1.50	1.93	0.669	0.130	0.000	89.71	26.73	-	-	13.235	-	

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

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	164.31	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	C _c	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.91	0.000	0.000	0.00	Depth of foundation						58.86
2	2	CLAY	2.50	4.50	2.00	1.94	0.598	0.125	0.00	65.85	83.83	-	-	55.788	-	
3	3	CLAY	4.50	6.25	1.75	1.93	0.669	0.130	0.00	101.44	35.55	-	-	17.784	-	

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

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	131.87	kN/m ²		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.91	0.000	0.000	0.000	Depth of foundation						50.00
2	2	CLAY	2.50	4.50	2.00	1.94	0.598	0.125	0.000	65.85	67.28	-	-	47.827	-	
3	3	CLAY	4.50	6.25	1.75	1.93	0.669	0.130	0.000	101.44	28.53	-	-	14.670	-	

SITE PHOTOS DURING SITE INVESTIGATION



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RESULT SHEET

NAME OF THE PROJECT																						CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT TALTALA GHAT IN WEST BENGAL																					
Client Name																																											
Bore Hole No.		1 (R.H.S.)		Coordinate		Easting			Depth of Water Level			7.00			VIVEK MATERIAL TESTING LABORATORY						 VMT <small>VIVEK MATERIAL TESTING</small>																						
Total depth of Bore Hole		10.00				Northing			Completed on			4/20/2023																															
Depth of Bore Hole		Reduced Level		Types of Samples		% Material Passing IS Sieve				Atterberg Limits			IS group symbol	SPT Value	SPT Value corrected due to overburden	SPT Value corrected due to dilatancy	Wet Bulk Density	Original Moisture	Dry Bulk Density	Specific Gravity	Void Ratio	Shear Characteristics		Compression Index																			
metre						metre		4.750	2.000	0.425	0.075	LL										PL	PI		N	N'	N''	(gms/cc)	%	(gms/cc)	(G)	(Kg/sqcm)	(Ø)	(Cc)									
1		2		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22																				
0.00 - 0.50		100.000 - 99.500		DS	100	100	98	97	30	21	9	CL					-	-	-	-	-	-	-																				
1.00 - 1.35		99.000 - 98.650		UD	100	100	100	99	27	18	9	CL				1.76	14.2	1.54	2.62	0.701	0.15	12°	0.136																				
1.35 - 1.80		98.650 - 98.200		SPT									5	6.88	6.88																												
2.50 - 2.85		97.500 - 97.150		UD	100	100	100	87	26	22	4	ML				1.82	16.8	1.56	-	-	-	-	-																				
2.85 - 3.30		97.150 - 96.700		SPT									7	8.18	8.18																												
4.00 - 4.35		96.000 - 95.650		UD	100	100	100	99	33	22	11	CL				1.89	18.3	1.60	2.64	0.650	0.20	14°	0.130																				
4.35 - 4.80		95.650 - 95.200		SPT									9	9.33	9.33																												
5.50 - 5.85		94.500 - 94.150		UD	100	100	99	96	34	20	14	CL				1.95	20.1	1.62	-	-	-	-	-																				
5.85 - 6.30		94.150 - 93.700		SPT									10	9.40	9.40																												
7.00 - 7.35		93.000 - 92.650		UD	100	100	100	97	35	23	12	CL				1.95	19.7	1.63	2.62	0.607	0.25	13°	0.125																				
7.35 - 7.80		92.650 - 92.200		SPT									11	12.32	12.32																												
8.50 - 8.85		91.500 - 91.150		UD	100	100	100	98	34	21	13	CL				1.96	17.3	1.67	-	-	-	-	-																				
8.85 - 9.30		91.150 - 90.700		SPT									17	17.95	16.48																												
9.30 - 10.00		90.700 - 90.000		DS	100	100	100	99	29	18	11	CL																															

RESULT SHEET

NAME OF THE PROJECT																						CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT TALTALA GHAT IN WEST BENGAL																					
Client Name																																											
Bore Hole No.		2 (R.H.S.)		Coordinate		Easting			Depth of Water Level			7.00			VIVEK MATERIAL TESTING LABORATORY						 VMT GEOTECHNICAL & MATERIAL TESTING																						
Total depth of Bore Hole		10.00				Northing			Completed on			4/20/2023																															
Depth of Bore Hole		Reduced Level		Types of Samples		% Material Passing IS Sieve				Atterberg Limits			IS group symbol	SPT Value	SPT Value corrected due to overburden	SPT Value corrected due to dilatancy	Wet Bulk Density	Original Moisture	Dry Bulk Density	Specific Gravity	Void Ratio	Shear Characteristics																					
metre		metre				4.750	2.000	0.425	0.075	LL	PL	PI										Cohesion	Angle of Internal Friction	Compression Index																			
1		2		3		4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22																			
0.00 - 0.50		100.000 - 99.500		DS		100	100	100	99	29	20	9	CL						-	-	-	-	-	-																			
1.00 - 1.35		99.000 - 98.650		UD		100	100	98	98	28	14	14	CL				1.78	12.1	1.59	2.63	0.654	0.20	13°	0.129																			
1.35 - 1.80		98.650 - 98.200		SPT										9	12.35	12.35																											
2.50 - 2.85		97.500 - 97.150		UD		100	100	97	96	30	22	8	CL				1.91	17.3	1.63	-	-	-	-	-																			
2.85 - 3.30		97.150 - 96.700		SPT										11	12.73	12.73																											
4.00 - 4.35		96.000 - 95.650		UD		100	100	99	98	32	20	12	CL				1.94	18.1	1.64	2.62	0.598	0.25	12°	0.125																			
4.35 - 4.80		95.650 - 95.200		SPT										13	13.35	13.35																											
5.50 - 5.85		94.500 - 94.150		UD		100	100	100	97	34	21	13	CL				1.93	23.1	1.57	-	-	-	-	-																			
5.85 - 6.30		94.150 - 93.700		SPT										7	6.53	6.53																											
7.00 - 7.35		93.000 - 92.650		UD		100	100	100	99	33	20	13	CL				1.96	21.2	1.62	2.65	0.636	0.30	10°	0.126																			
7.35 - 7.80		92.650 - 92.200		SPT										11	12.19	12.19																											
8.50 - 8.85		91.500 - 91.150		UD		100	100	100	98	30	16	14	CL				1.99	20.5	1.65	-	-	-	-	-																			
8.85 - 9.30		91.150 - 90.700		SPT										15	15.67	15.34																											
9.30 - 10.00		90.700 - 90.000		DS		100	100	100	99	31	20	11	CL						-	-	-	-	-	-																			

BORE-LOG CHART



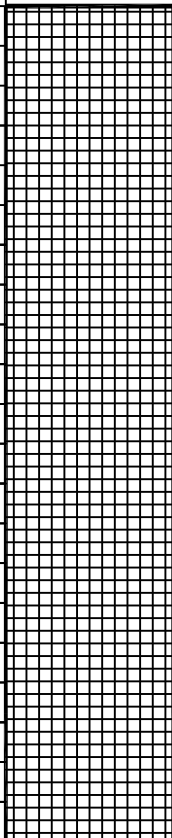
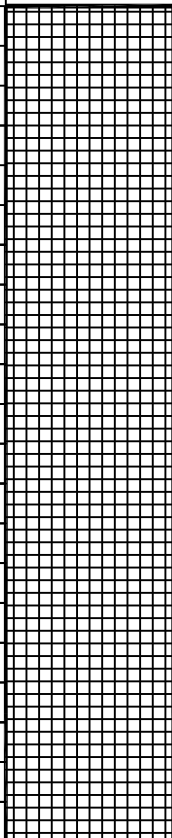
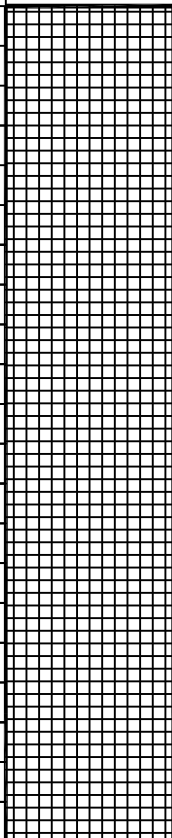
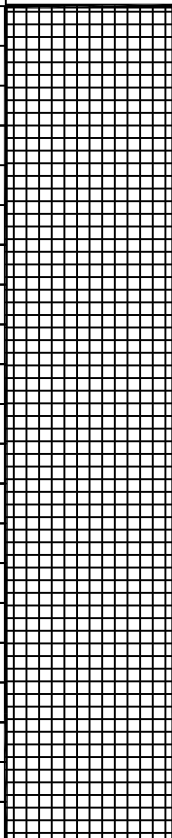
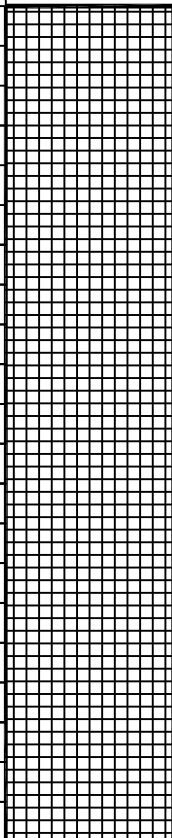
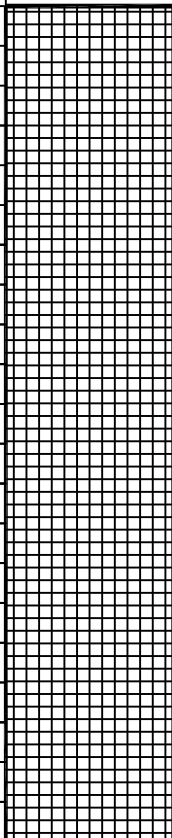
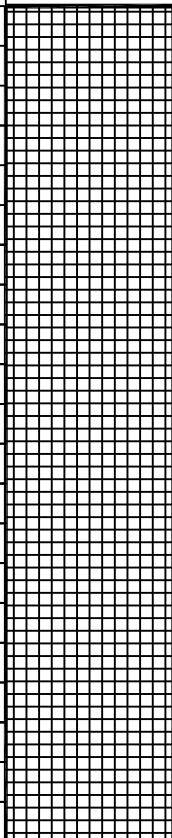
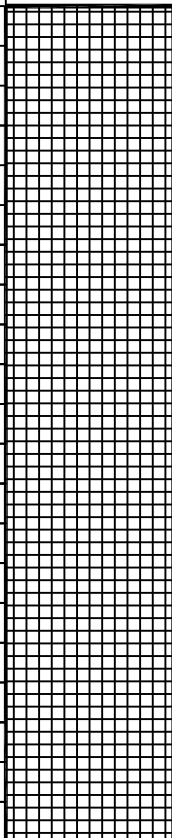
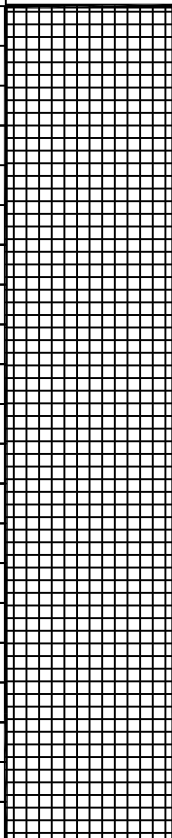
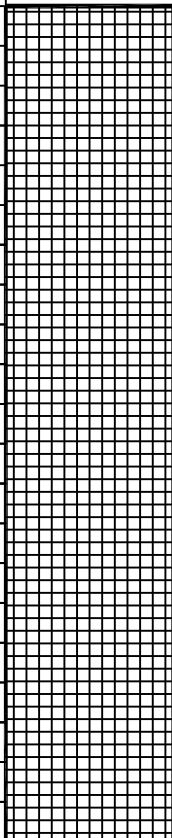
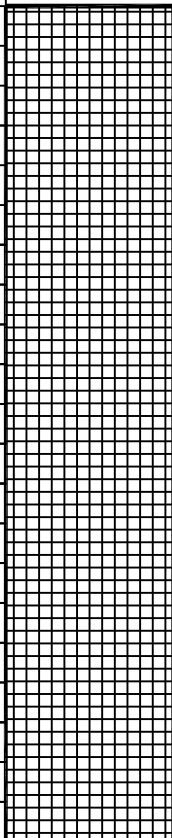
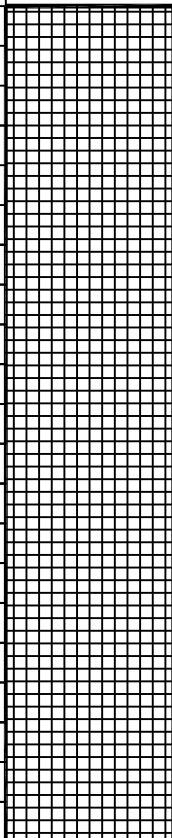
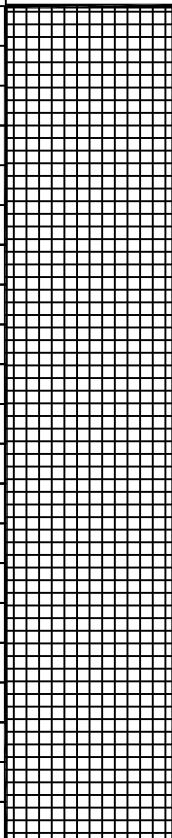
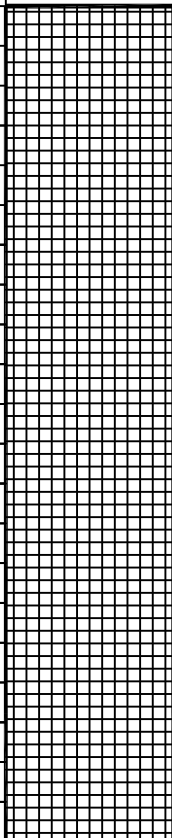
VMT
GEOTECH & MATERIAL TESTING

VIVEK MATERIAL TESTING LABORATORY

NAME OF THE PROJECT:- CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT TALTALA GHAT
IN WEST BENGAL

WATER TABLE 7.00 METRE DEPTH BELOW GROUND LEVEL

BORE HOLE NO.:- 02 (R.H.S.)

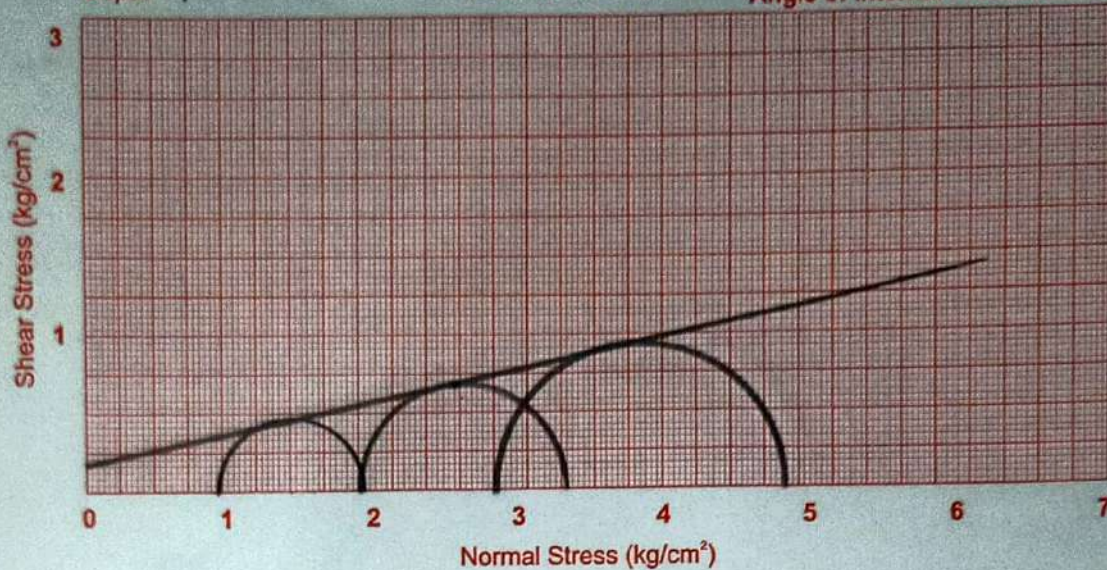
DEPTH IN METRES BELOW GROUND LEVEL	VISUAL FIELD OBSERVATIONS	SAMPLE	I.S.		S.P.T. VALUE				S.P.T. VALUES										
			GROUP	HATCHING	N1	N2	N3	N2+N3	10	20	30	40	50	60	70	80	90	100	
0.00-0.50	SILTY-CLAY	D.	CL																
1.00-1.35	SILTY-CLAY	U.D.	CL																
1.35-1.80		S.P.T.			3	4	5	9											
2.50-2.85	SILTY-CLAY	U.D.	CL																
2.85-3.30		S.P.T.			3	4	7	11											
4.00-4.35	SILTY-CLAY	U.D.	CL																
4.35-4.80		S.P.T.			4	5	8	13											
5.50-5.85	SILTY-CLAY	U.D.	CL																
5.85-6.30		S.P.T.			3	3	4	7											
7.00-7.35	SILTY-CLAY	U.D.	CL																
7.35-7.80		S.P.T.			4	5	6	11											
8.50-8.85	SILTY-CLAY	U.D.	CL																
8.85-9.30		S.P.T.			5	7	8	15											
9.30-10.00	SILTY-CLAY	D.	CL																



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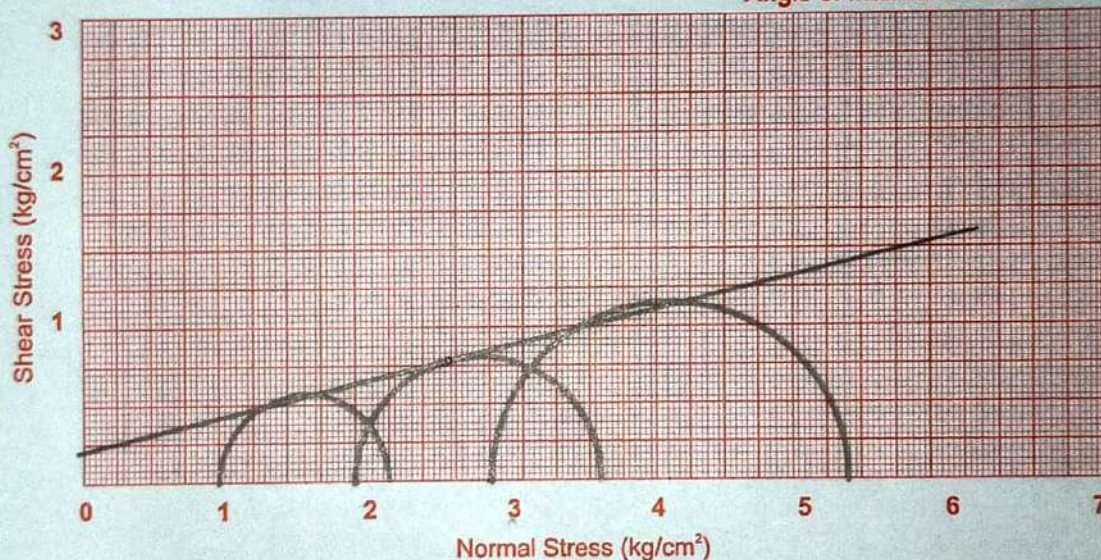
B.H. No. :- 01
Depth :- 1.00 - 1.35

Cohesion 'c' :- 0.15 Kg/cm²
Angle of Internal Friction :- 12°



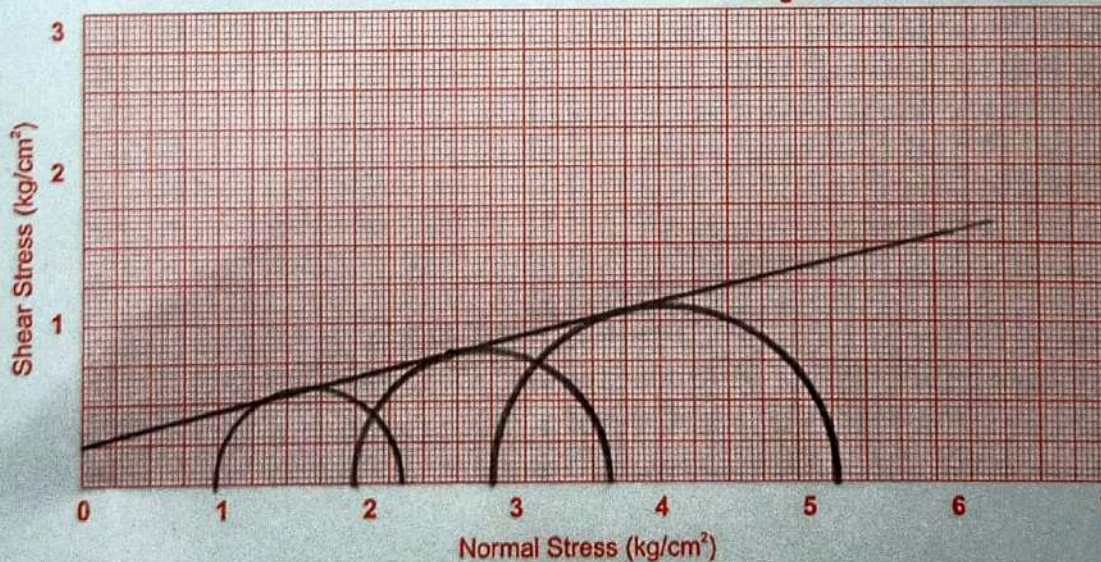
B.H. No. :- 01
Depth :- 4.00 - 4.35

Cohesion 'c' :- 0.20 Kg/cm²
Angle of Internal Friction :- 14°



B.H. No. :- 01
Depth :- 7.00 - 7.35

Cohesion 'c' :- 0.25 Kg/cm²
Angle of Internal Friction :- 13°

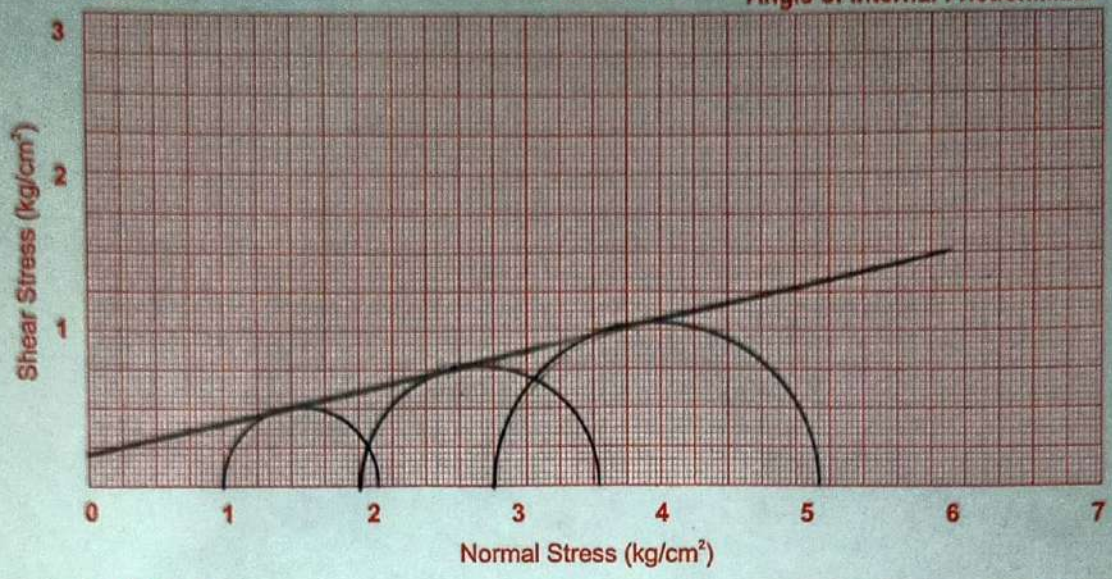




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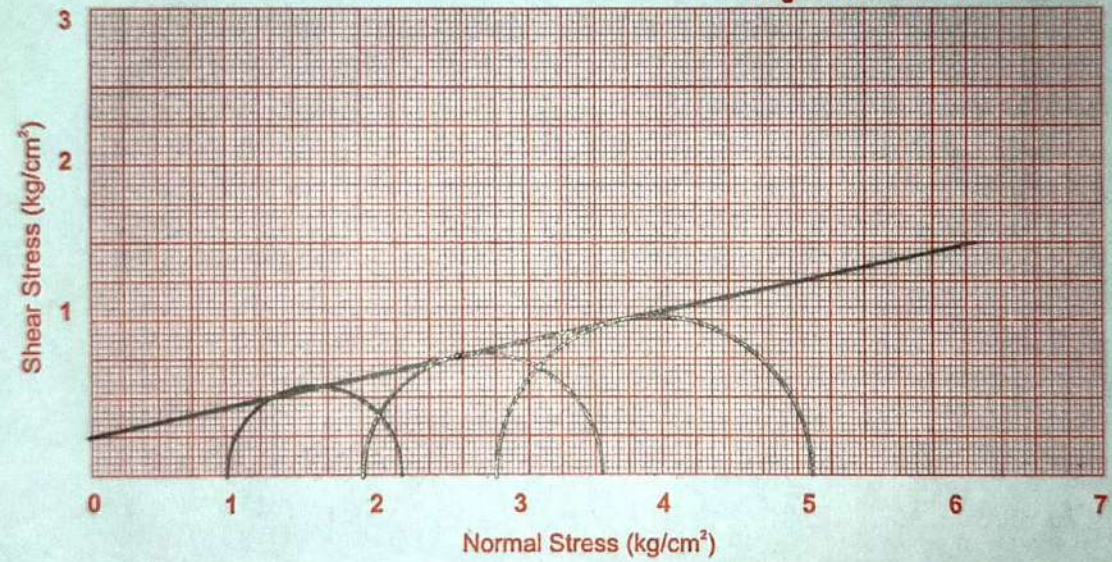
B.H. No. :- 02
Depth :- 1.00 - 1.35

Cohesion 'c' :- 0.20 Kg/cm²
Angle of Internal Friction 13°



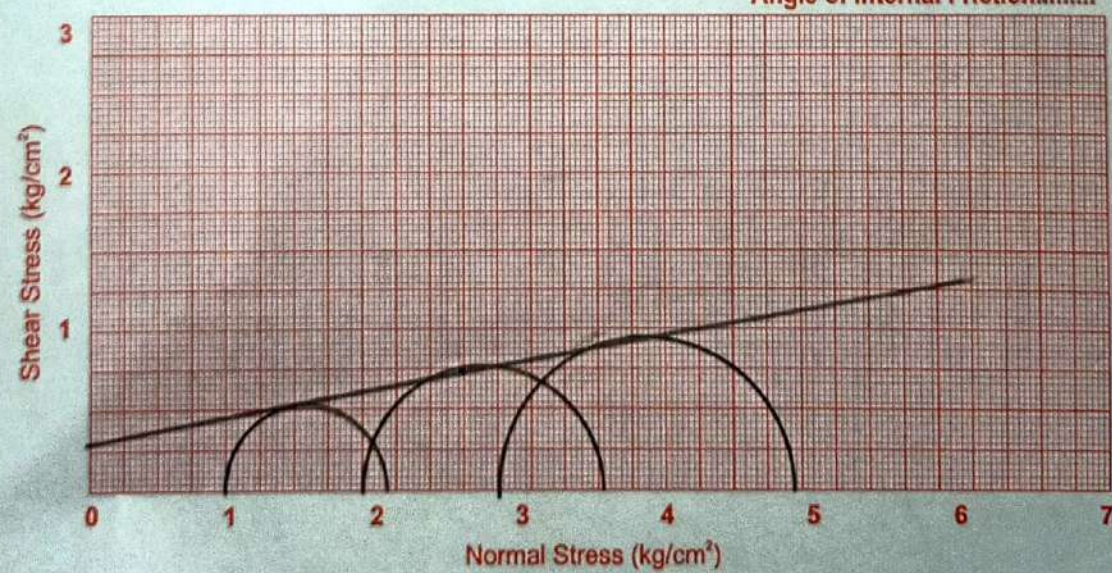
B.H. No. :- 02
Depth :- 4.00 - 4.35

Cohesion 'c' :- 0.25 Kg/cm²
Angle of Internal Friction 12°



B.H. No. :- 02
Depth :- 7.00 - 7.35

Cohesion 'c' :- 0.30 Kg/cm²
Angle of Internal Friction 10°





VMT

GEOTECH & MATERIAL TESTING



IC-8969

REPORT NO. – VMT 130/2023-2024

GEOTECH INVESTIGATION

REPORT FOR

PROPOSED CONSTRUCTION

OF

BOAT IN THE IDENTIFIED

COMMUNITY JETTY

AT GOPAL GHAT (L.H.S.)

IN

WEST BENGAL

Prepared By -

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LABORATORY**

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ACKNOWLEDGEMENT

WE ARE GRATEFUL TO M/s KITCO LTD., KERLA FOR PROVIDING US THE OPPORTUNITY TO CARRY OUT THESE INVESTIGATIONS.

THE CO-OPERATION EXTENDED BY THEIR ENGINEERS DURING FIELD INVESTIGATIONS IS THANKFULLY ACKNOWLEDGED.

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**SUB-SOIL INVESTIGATION REPORT FOR PROPOSED CONSTRUCTION OF BOAT
IN THE IDENTIFIED COMMUNITY JETTY AT GOPAL GHAT IN WEST BENGAL**

INTRODUCTION

The work of sub-soil exploration was awarded to us by M/s KITCO LTD., KERLA Order no. – 6777:DP 1083: RG: 2023 dated 21/03/2023. The object of the investigation was to study the geo-technical properties of soil both in field and laboratory and determine safe allowable pressure for the foundation soil.

The fieldwork consisted of 02 bore holes of 10.00 metre depth each. The fieldwork was conducted on 15/04/2023. The location of the bore holes is shown in the Site location.

REFERENCES

1. **IS: 1892-2021** for field work including existent ground water table.
2. **IS: 2132-1986** for sampling in Undisturbed and Disturbed form.
3. **IS: 2131-1981** for Standard Penetration Test.
4. **IS: 2720** for all laboratory tests on soil samples collected.
5. **IS: 6403-1981** for determination of Bearing Capacity.
6. **IS: 8009(Part I)-1976** for calculation of settlement of foundations.
7. **IS: 1904-2021** for permissible maximum settlement, differential settlement and angular distortion.

SCOPE OF WORK

The scope consisted of drilling of boreholes down to maximum depth of 10.00 m in normal soils / rock, Standard Penetration Testing, collection of samples, laboratory testing and preparation and submission of Geotechnical Investigation report.

Summary of the fieldwork					
Sl. No.	Site	Borehole Nos.	Coordinates		Depth below existing ground level (m)
			Latitude	Longitude	
1.	GOPAL GHAT	BH-01 (LHS)	24.11603815	88.24637409	10.0
2.		BH-02 (LHS)	24.11614128	88.24654642	10.0



SITE LOCATION



VIVEK MATERIAL TESTING LABORATORY

Geotech & Material Testing Consultants
(Civil Engineering Projects)

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INTERPRETATION OF THE LAB TEST RESULTS

GENERAL NATURE OF SOIL STRATA

The bore hole log charts and lab test results of bore holes 1 and 2 indicate that the strata at the site is found to comprise of both cohesive as well as non-cohesive soil.

The results of classification tests indicate that the natural soil stratum present at the Site is found to comprise of both fine-grained soils comprising of 'CL' and 'CI' group of IS classification (clayey soil) having 84 to 99 percent material finer than 75 micron and coarse-grained soils (sandy soil) comprise of 'SM' group of IS classification having 14 to 28 percent material finer than 75 micron.

The bore hole log charts and lab test results of bore holes 1 indicate that:

first strata, from 0.00 metre to 2.50 metre, consists of a layer of CL group of IS classification which is inorganic clays of low plasticity,

second strata, from 2.50 metre to 7.00 metre, consists of a layer of CI group of IS classification which is inorganic clays of medium plasticity,

third strata, from 7.00 metre to 10.00 metre, consists of a layer of SM group of IS classification which is silty Sand with none plasticity.

The bore hole log charts and lab test results of bore holes 2 indicate that:

first strata, from 0.00 metre to 4.80 metre, consists of a layer of **filled up soil (Brick Pieces + Sand)**,

second strata, from 4.80 metre to 10.00 metre, consists of a layer of CI group of IS classification which is inorganic clays of medium plasticity.

S.P.T. VALUES

The S.P.T. values recorded in the filled up soil zone present up to 4.80 metre depth below ground level in borehole 2 are found to range from 5 to 9.

The S.P.T. values obtained in the respective clayey layer region present as per bore-log charts enclosed are found to range 4 to 9 indicating 'Soft' to 'Medium' consistency.

However, the S.P.T. values obtained in the respective sandy layer region present as per bore-log charts enclosed are found to range from 14 to 15 indicating 'Medium' relative density.

The results of S.P.T. values indicate that the stratum at the Site is 'Loose' to 'Well' compacted.

WATER TABLE

Water Table at the Site was observed at a depth from 1.00 metre to 5.00 metre below ground level on the day of soil investigation during the Third week of April 2023. However, the existing water table may rise by 1.00 metre in the post-monsoon period in general. Therefore, a water table at a depth of 0.00 metre to 4.00 metre below ground level has been adopted for calculation purposes.

RECOMMENDATIONS FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GOPAL GHAT IN WEST BENGAL
NET SAFE BEARING CAPACITY/SAFE ALLOWABLE PRESSURE

Bore Hole Nos.	Type of Structure	Depth of Foundation (metres)	Size of Footing (L x B) (metres)	Net Safe Bearing Capacity (Tonne/sqm.)	Settlement Produced (mm)	Safe Allowable Pressure for Permissible Settlement 50 mm (Tonne/sqm.)
1	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	6.69	31.50	-
		2.00	1.20 x 1.20	7.68	31.82	-
		2.50	1.20 x 1.20	9.27	32.09	-
		1.50	2.00 x 2.00	6.33	43.11	-
		2.00	2.00 x 2.00	7.12	43.03	-
		2.50	2.00 x 2.00	8.23	42.23	-
		1.50	2.50 x 2.50	6.29	50.52	6.20
		2.00	2.50 x 2.50	7.00	47.05	-
		2.50	2.50 x 2.50	7.97	49.05	-
2	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	6.33	28.45	-
		2.00	1.20 x 1.20	7.40	27.76	-
		2.50	1.20 x 1.20	9.68	29.43	-
		1.50	2.00 x 2.00	6.08	39.07	-
		2.00	2.00 x 2.00	6.92	37.66	-
		2.50	2.00 x 2.00	8.78	38.95	-
		1.50	2.50 x 2.50	6.07	45.04	-
		2.00	2.50 x 2.50	6.77	40.92	-
		2.50	2.50 x 2.50	7.52	40.63	-

NOTE: -

The above recommendations are based on the field investigation data results and the laboratory tests results of the samples collected from the test locations and our experience in this regard. If the actual sub-soil conditions during excavation for the

foundations differ from that has been reported, a reference should be made to us for suggestions.

Further, the recommendations are based on the assumptions as mentioned in the Report and the designer of the Structure should take into consideration all the factors required as per codes. The recommendations should be taken as guidelines for the designer.

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BEARING CAPACITY CALCULATIONS

Soil when stressed due to loading, tend to deform. The resistance to deformation of the soil depends upon factors like water content, bulk density, angle of internal friction and the manner in which load is applied on the soil. The maximum load per unit area which the soil or rock can carry without yielding or displacement is termed as the bearing capacity of soils. The Safe Bearing Capacity of the proposed STRUCTURE without any distress is determined from the considerations of the following criteria.

[A] SHEAR CRITERIA

The soil beneath the foundation shall be safe from risk of shear failure.

[B] SETTLEMENT CRITERIA

The settlement due to load is caused basically on account of two factors, namely,

- (i) the soil below footing gets compressed by certain amount and
- (ii) since the foundations cover only a limited area there is a possibility that the concentrated stresses developed are so high as to cause actual rupture (shear failure) and displacement of soil below.

The foundation should not settle or deflect to an extent causing damage to the Structure or impair its usefulness.

The Bearing Capacity Calculations for the Foundation shall be governed as per IS: 6403-1981, IS: 8009(Part-I)-1976 and IS: 1904-2021 on the basis of available information regarding the proposed design.

BEARING CAPACITY ON SHEAR CONSIDERATIONS**ULTIMATE NET BEARING CAPACITY**

As per IS: 6403-1981, the Ultimate Net Bearing Capacity 'qd' on shear consideration for a Structure is given by the formula: -

FOR GENERAL SHEAR FAILURE

$$q_d = c.N_c.S_c.d_c.i_c + q(N_q - 1).S_q.d_q.i_q + 1/2 B.r.N_r.S_r.d_r.i_r.W'$$

FOR LOCAL SHEAR FAILURE

$$q'd = 2/3 c.N'c.S'c.d'c.i'c + q(N'q - 1).S'q.d'q.i'q + 1/2 B.r.N'r.S'r.d'r.i'r.W'$$

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981



NAME OF PROJECT																																							
BOREHOLE 01 (L.H.S.)		Depth of borehole		10.00	metre								Water table below borehole level (m)		1.00					Factor of safety		2.50																	
												Water table used for calculation (m)		0.00					Assumed post monsoon rise (m)		1.00																		
Input Parameters												Shearing Resistance Parameters												Ultimate Net Bearing Capacity			Net Safe Bearing Capacity												
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance	Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors						Inclination Factors			General shear	Local shear	Intermediate	Net Safe Bearing Capacity					
					Bulk		Bulk		c	φ	φ'	e	q	Nc	Nq	Ny	Nc'	Nq'	Ny'	Sc	Sq	Sy	Dc	Dq	Dy	Dc'	Dq'	Dy'	lc	lq	ly								
		(m)	(m)	(m)	(gms/cc)	(kN/m3)	(gms/cc)	(kN/m3)	Kg/cm2	°	°		kN/m2																										
1	SQUARE	1.50	1.20	1.20	1.82	8.04	1.82	8.04	0.10	16	10.88	0.706	12.06	11.65	4.34	3.06	8.74	2.68	1.41	1.30	1.20	0.80	1.33	1.17	1.17	1.33	1.17	1.17	1.00	1.00	1.00	269.44	134.32	164.05	65.62				
2	SQUARE	2.00	1.20	1.20	1.82	8.04	1.89	8.73	0.10	16	10.88	0.706	16.08	11.65	4.34	3.06	8.74	2.68	1.41	1.30	1.20	0.80	1.44	1.22	1.22	1.44	1.22	1.22	1.00	1.00	1.00	309.13	154.18	188.27	75.31				
3	SQUARE	2.50	1.20	1.20	1.82	8.04	1.89	8.73	0.15	11	7.42	0.673	20.10	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.51	1.25	1.25	1.51	1.25	1.25	1.00	1.00	1.00	313.69	173.27	227.33	90.93				
4	SQUARE	1.50	2.00	2.00	1.82	8.04	1.82	8.04	0.10	16	10.88	0.706	12.06	11.65	4.34	3.06	8.74	2.68	1.41	1.30	1.20	0.80	1.20	1.10	1.10	1.20	1.10	1.10	1.00	1.00	1.00	255.45	126.97	155.24	62.10				
5	SQUARE	2.00	2.00	2.00	1.82	8.04	1.89	8.73	0.10	16	10.88	0.706	16.08	11.65	4.34	3.06	8.74	2.68	1.41	1.30	1.20	0.80	1.27	1.13	1.13	1.27	1.13	1.13	1.00	1.00	1.00	287.11	142.79	174.54	69.82				
6	SQUARE	2.50	2.00	2.00	1.82	8.04	1.89	8.73	0.15	11	7.42	0.673	20.10	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.30	1.15	1.15	1.30	1.15	1.15	1.00	1.00	1.00	278.49	153.75	201.77	80.71				
7	SQUARE	1.50	2.50	2.50	1.82	8.04	1.82	8.04	0.10	16	10.88	0.706	12.06	11.65	4.34	3.06	8.74	2.68	1.41	1.30	1.20	0.80	1.16	1.08	1.08	1.16	1.08	1.08	1.00	1.00	1.00	254.00	126.02	154.18	61.67				
8	SQUARE	2.00	2.50	2.50	1.82	8.04	1.89	8.73	0.10	16	10.88	0.706	16.08	11.65	4.34	3.06	8.74	2.68	1.41	1.30	1.20	0.80	1.21	1.11	1.11	1.21	1.11	1.11	1.00	1.00	1.00	282.75	140.38	171.70	68.68				
9	SQUARE	2.50	2.50	2.50	1.82	8.04	1.89	8.73	0.15	11	7.42	0.673	20.10	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.24	1.12	1.12	1.24	1.12	1.12	1.00	1.00	1.00	269.83	148.91	195.46	78.18				

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	1.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	65.62	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement	
		CLAY					e	Cc	N''	P _o	ΔP		W'				
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)	
1	1	CLAY	0.00	1.50	1.50	1.82	-	-	-	Depth of foundation							31.50
2	2	CLAY	1.50	3.00	1.50	1.89	0.673	0.132	0.00	28.42	24.85	-	-	32.297	-		
3	3	CLAY	3.00	4.00	1.00	1.92	0.675	0.130	0.00	39.47	9.23	-	-	7.081	-		

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	1.00	(m) bgl		Rigidity factor	0.80		
Width	1.20	metre	Applied Pressure at foundation base	75.31	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.82	0.000	0.000	0.00	Depth of foundation						31.82
2	2	CLAY	2.00	3.50	1.50	1.89	0.673	0.132	0.00	32.44	28.52	-	-	32.426	-	
3	3	CLAY	3.50	4.50	1.00	1.92	0.675	0.130	0.00	43.49	10.59	-	-	7.345	-	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	1.00	(m) bgl		Rigidity factor	0.80		
Width	1.20	metre	Applied Pressure at foundation base	90.93	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.89	0.000	0.000	0.00	Depth of foundation						32.09
2	2	CLAY	2.50	4.00	1.50	1.92	0.675	0.130	0.00	38.39	34.44	-	-	32.369	-	
3	3	CLAY	4.00	5.00	1.00	1.93	0.644	0.128	0.00	49.72	12.79	-	-	7.739	-	

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1	
Length	2.00	metre	Water Table depth for calculation	1.00	(m) bgl		Rigidity factor	0.80			
Width	2.00	metre	Applied Pressure at foundation base	62.10	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.82	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.89	0.673	0.132	0.00	28.42	32.85	-	-	39.485	-	43.11
3	3	CLAY	3.00	4.50	1.50	1.92	0.675	0.130	0.00	41.73	13.75	-	-	14.402	-	

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	1.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	69.82	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	C _c	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.82	0.000	0.000	0.00	Depth of foundation						43.03
2	2	CLAY	2.00	3.50	1.50	1.89	0.673	0.132	0.00	32.44	36.93	-	-	39.069	-	
3	3	CLAY	3.50	5.00	1.50	1.92	0.675	0.130	0.00	45.75	15.46	-	-	14.721	-	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	1.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	80.71	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.89	0.000	0.000	0.00	Depth of foundation						42.23
2	2	CLAY	2.50	4.00	1.50	1.92	0.675	0.130	0.00	38.39	42.69	-	-	37.797	-	
3	3	CLAY	4.00	5.50	1.50	1.93	0.644	0.128	0.00	52.00	17.87	-	-	14.985	-	

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

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	1.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	61.67	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	C _c	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.82	0.000	0.000	0.00	Depth of foundation						50.52
2	2	CLAY	1.50	3.50	2.00	1.89	0.673	0.132	0.00	30.60	31.46	-	-	48.466	-	
3	3	CLAY	3.50	5.25	1.75	1.92	0.675	0.130	0.00	47.22	13.34	-	-	14.678	-	

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

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	1.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	60.84	kN/m ²		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.82	0.000	0.000	0.00	Depth of foundation						50.00
2	2	CLAY	1.50	3.50	2.00	1.89	0.673	0.132	0.00	30.60	31.04	-	-	47.997	-	
3	3	CLAY	3.50	5.25	1.75	1.92	0.675	0.130	0.00	47.22	13.16	-	-	14.503	-	

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

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	1.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	68.68	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.89	0.000	0.000	0.00	Depth of foundation						47.05
2	2	CLAY	2.00	4.00	2.00	1.92	0.675	0.130	0.00	36.29	35.04	-	-	45.560	-	
3	3	CLAY	4.00	5.50	1.50	1.93	0.644	0.128	0.00	52.15	15.57	-	-	13.254	-	

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

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 1	
Length	2.50	metre	Water Table depth for calculation	1.00	(m) bgl		Rigidity factor	0.80			
Width	2.50	metre	Applied Pressure at foundation base	78.18	kN/m2		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.89	0.000	0.000	0.00	Depth of foundation						49.05
2	2	CLAY	2.50	4.50	2.00	1.92	0.675	0.130	0.00	40.65	39.89	-	-	46.092	-	
3	3	CLAY	4.50	6.25	1.75	1.93	0.644	0.128	0.00	57.65	16.91	-	-	15.222	-	

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981



NAME OF PROJECT																													Net Safe Bearing Capacity						
BOREHOLE 02 (L.H.S.)		Depth of borehole		10.00	metre		Water table below borehole level (m)		5.00	Factor of safety		2.50		Water table used for calculation (m)		4.00	Assumed post monsoon rise (m)		1.00																
		Input Parameters												Shearing Resistance Parameters												Ultimate Net Bearing Capacity									
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance		Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors						Inclination Factors			General shear	Local shear	Intermediate	
		(m)	(m)	(m)	Bulk (gms/cc)	(kN/m3)	Bulk (gms/cc)	(kN/m3)	c (Kg/cm2)	φ (°)	φ' (°)	e	q (kN/m2)	Nc	Nq	Ny	Nc'	Nq'	Ny'	Sc	Sq	Sy	Dc	Dq	Dy	Dc'	Dq'	Dy'	lc	lq	ly				
1	SQUARE	1.50	1.20	1.20	1.40	13.73	1.40	13.73	0.10	15	10.18	0.740	20.59	10.97	3.94	2.65	8.41	2.51	1.26	1.30	1.20	0.80	1.33	1.16	1.16	1.33	1.16	1.16	1.00	1.00	1.00	290.55	147.99	155.12	62.05
2	SQUARE	2.00	1.20	1.20	1.40	13.73	1.40	13.73	0.10	15	10.18	0.740	27.46	10.97	3.94	2.65	8.41	2.51	1.26	1.30	1.20	0.80	1.43	1.22	1.22	1.43	1.22	1.22	1.00	1.00	1.00	339.49	173.05	181.37	72.55
3	SQUARE	2.50	1.20	1.20	1.40	13.73	1.40	13.73	0.10	16	10.88	0.730	34.32	11.65	4.34	3.06	8.74	2.68	1.41	1.30	1.20	0.80	1.55	1.28	1.28	1.55	1.28	1.28	1.00	1.00	1.00	432.12	215.61	237.26	94.90
4	SQUARE	1.50	2.00	2.00	1.40	13.73	1.40	13.73	0.10	15	10.18	0.740	20.59	10.97	3.94	2.65	8.41	2.51	1.26	1.30	1.20	0.80	1.20	1.10	1.10	1.20	1.10	1.10	1.00	1.00	1.00	279.77	142.05	148.94	59.58
5	SQUARE	2.00	2.00	2.00	1.40	13.73	1.40	13.73	0.10	15	10.18	0.740	27.46	10.97	3.94	2.65	8.41	2.51	1.26	1.30	1.20	0.80	1.26	1.13	1.13	1.26	1.13	1.13	1.00	1.00	1.00	318.58	161.93	169.76	67.90
6	SQUARE	2.50	2.00	2.00	1.40	13.73	1.40	13.73	0.10	16	10.88	0.730	34.32	11.65	4.34	3.06	8.74	2.68	1.41	1.30	1.20	0.80	1.33	1.17	1.17	1.33	1.17	1.17	1.00	1.00	1.00	392.91	195.62	215.35	86.14
7	SQUARE	1.50	2.50	2.50	1.40	13.73	1.40	13.73	0.10	15	10.18	0.740	20.59	10.97	3.94	2.65	8.41	2.51	1.26	1.30	1.20	0.80	1.16	1.08	1.08	1.16	1.08	1.08	1.00	1.00	1.00	280.00	141.90	148.81	59.52
8	SQUARE	2.00	2.50	2.50	1.40	13.73	1.40	13.73	0.10	15	10.18	0.740	27.46	10.97	3.94	2.65	8.41	2.51	1.26	1.30	1.20	0.80	1.21	1.10	1.10	1.21	1.10	1.10	1.00	1.00	1.00	311.81	158.35	166.02	66.41
9	SQUARE	2.50	2.50	2.50	1.40	13.73	1.40	13.73	0.10	16	10.88	0.730	34.32	11.65	4.34	3.06	8.74	2.68	1.41	1.30	1.20	0.80	1.27	1.13	1.13	1.27	1.13	1.13	1.00	1.00	1.00	382.07	190.04	209.24	83.70

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	62.05	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement	
		CLAY					e	Cc	N''	P _o	ΔP		W'				
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)	
1	1	CLAY	0.00	1.50	1.50	1.40	-	-	-	Depth of foundation							28.45
2	2	CLAY	1.50	3.00	1.50	1.40	0.730	0.140	0.00	30.89	23.50	-	-	29.822	-		
3	3	CLAY	3.00	4.00	1.00	1.45	0.720	0.137	0.00	48.30	8.73	-	-	5.745	-		

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80		
Width	1.20	metre	Applied Pressure at foundation base	72.55	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.40	0.000	0.000	0.00	Depth of foundation						27.76
2	2	CLAY	2.00	3.50	1.50	1.40	0.730	0.140	0.00	37.76	27.47	-	-	28.825	-	
3	3	CLAY	3.50	4.50	1.00	1.45	0.720	0.137	0.00	55.16	10.20	-	-	5.870	-	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2	
Length	1.20	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80			
Width	1.20	metre	Applied Pressure at foundation base	94.90	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.40	0.000	0.000	0.00	Depth of foundation						29.43
2	2	CLAY	2.50	4.00	1.50	1.45	0.720	0.137	0.00	44.99	35.94	-	-	30.465	-	
3	3	CLAY	4.00	5.00	1.00	1.87	0.686	0.131	0.00	64.82	13.35	-	-	6.317	-	

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

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	2.00	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80	
Width	2.00	metre	Applied Pressure at foundation base	59.58	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.40	-	-	-	Depth of foundation						39.07
2	2	CLAY	1.50	3.00	1.50	1.40	0.730	0.140	0.00	30.89	31.51	-	-	37.069	-	
3	3	CLAY	3.00	4.50	1.50	1.45	0.720	0.137	0.00	51.85	13.19	-	-	11.763	-	

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

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2	
Length	2.00	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80			
Width	2.00	metre	Applied Pressure at foundation base	67.90	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.40	0.000	0.000	0.00	Depth of foundation						37.66
2	2	CLAY	2.00	3.50	1.50	1.40	0.730	0.140	0.00	37.76	35.91	-	-	35.239	-	
3	3	CLAY	3.50	5.00	1.50	1.45	0.720	0.137	0.00	58.72	15.04	-	-	11.830	-	

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

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2	
Length	2.00	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80			
Width	2.00	metre	Applied Pressure at foundation base	86.14	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.40	0.000	0.000	0.00	Depth of foundation						38.95
2	2	CLAY	2.50	4.00	1.50	1.45	0.720	0.137	0.00	44.99	45.56	-	-	36.295	-	
3	3	CLAY	4.00	5.50	1.50	1.87	0.686	0.131	0.00	68.74	19.08	-	-	12.396	-	

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

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80			
Width	2.50	metre	Applied Pressure at foundation base	59.52	kN/m ²		Type of foundation	SQUARE			

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.40	0.000	0.000	0.00	Depth of foundation						45.04
2	2	CLAY	1.50	3.50	2.00	1.40	0.730	0.140	0.00	34.32	30.37	-	-	44.548	-	
3	3	CLAY	3.50	5.25	1.75	1.45	0.720	0.137	0.00	60.09	12.88	-	-	11.754	-	

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

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	66.41	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.40	0.000	0.000	0.00	Depth of foundation						40.92
2	2	CLAY	2.00	4.00	2.00	1.45	0.720	0.137	0.00	41.68	33.88	-	-	41.161	-	
3	3	CLAY	4.00	5.50	1.50	1.87	0.686	0.131	0.00	68.99	15.06	-	-	9.994	-	

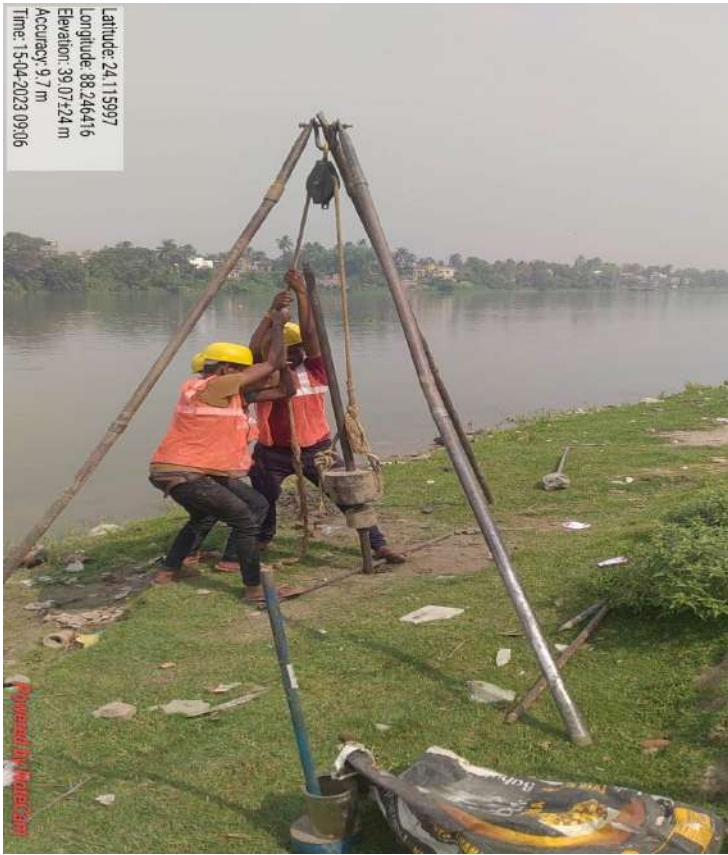
SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	73.70	kN/m ²		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.40	0.000	0.000	0.00	Depth of foundation						40.63
2	2	CLAY	2.50	4.50	2.00	1.45	0.720	0.137	0.00	48.54	37.60	-	-	39.682	-	
3	3	CLAY	4.50	6.25	1.75	1.87	0.686	0.131	0.00	77.10	15.94	-	-	11.100	-	

SITE PHOTOS DURING SITE INVESTIGATION



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RESULT SHEET

NAME OF THE PROJECT		CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GOPAL GHAT IN WEST BENGAL																			
Client Name																					
Bore Hole No.	1 (L.H.S.)	Coordinate	Easting			Depth of Water Level			1.00			VIVEK MATERIAL TESTING LABORATORY							 VMT GEOTECHNICAL MATERIAL TESTING		
Total depth of Bore Hole	10.00		Northing			Commenced on			4/15/2023												
			Elevation			Completed on			4/15/2023												
Depth of Bore Hole	Reduced Level	Types of Samples	% Material Passing IS Sieve				Atterberg Limits			IS group symbol	SPT Value	SPT Value corrected due to overburden	SPT Value corrected due to dilatancy	Wet Bulk Density	Original Moisture	Dry Bulk Density	Specific Gravity	Void Ratio	Shear Characteristics		Compression Index
			4.750	2.000	0.425	0.075	LL	PL	PI										Cohesion	Angle of Internal Friction	
metre	metre		(mm)	(mm)	(mm)	(mm)	%	%	%		N	N'	N''	(gms/cc)	%	(gms/cc)	(G)		(Kg/sqcm)	(ϕ)	(Cc)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
0.00 - 0.50	100.000 - 99.500	DS	98	95	90	84	33	23	10	CL					-	-	-	-	-	-	-
1.00 - 1.35	99.000 - 98.650	UD	100	100	100	99	32	21	11	CL				1.82	18.7	1.53	2.61	0.706	0.10	16°	0.140
1.35 - 1.80	98.650 - 98.200	SPT									4	6.53	6.53								
2.50 - 2.85	97.500 - 97.150	UD	100	100	100	98	38	19	19	CI				1.89	21.4	1.56	-	-	-	-	-
2.85 - 3.30	97.150 - 96.700	SPT									6	8.49	8.49								
4.00 - 4.35	96.000 - 95.650	UD	100	100	100	99	39	25	14	CI				1.92	22.5	1.57	2.63	0.675	0.20	13°	0.130
4.35 - 4.80	95.650 - 95.200	SPT									7	8.97	8.97								
5.50 - 5.85	94.500 - 94.150	UD	100	100	100	99	41	21	20	CI				1.93	20.7	1.60	-	-	-	-	-
5.85 - 6.30	94.150 - 93.700	SPT									9	10.67	10.67								
7.00 - 7.35	93.000 - 92.650	UD	100	100	99	28	NON PLASTIC			SM				1.88	21.3	1.55	2.59	0.671	0	29°	-
7.35 - 7.80	92.650 - 92.200	SPT									14	15.60	15.30								
8.50 - 8.85	91.500 - 91.150	UD	100	100	99	21	NON PLASTIC			SM				1.88	19.6	1.57	-	-	-	-	-
8.85 - 9.30	91.150 - 90.700	SPT									15	15.85	15.43								
9.30 - 10.00	90.700 - 90.000	DS	100	100	98	14	NON PLASTIC			SM					-	-	-	-	-	-	-

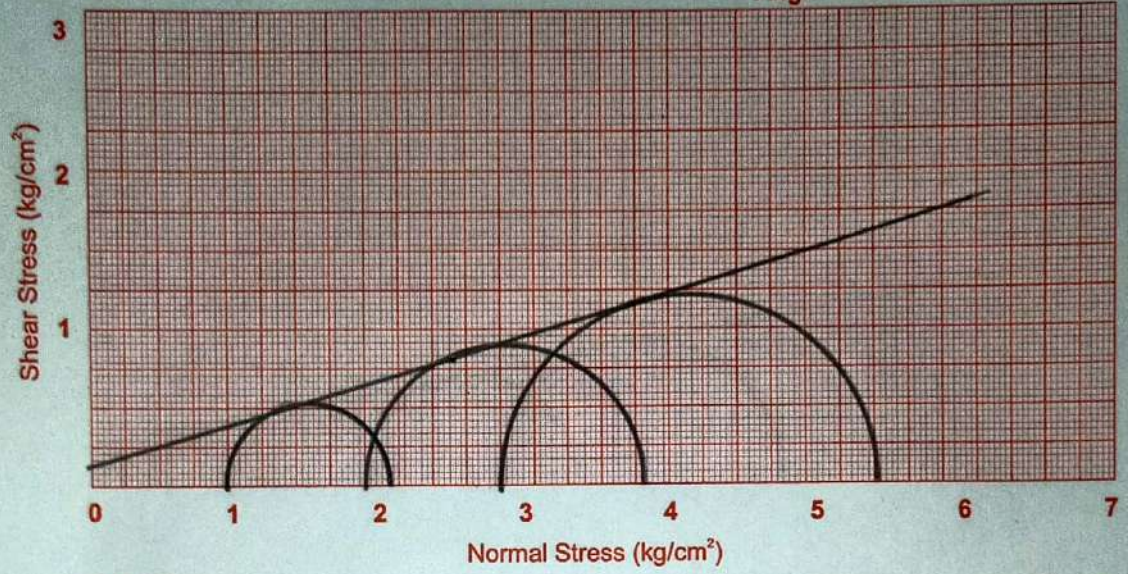
RESULT SHEET

NAME OF THE PROJECT																					
CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GOPAL GHAT IN WEST BENGAL																					
Client Name																					
Bore Hole No.		2 (L.H.S.)		Coordinate		Easting				Depth of Water Level				5.00		VIVEK MATERIAL TESTING LABORATORY  <small>VMT GEOTECH & MATERIAL TESTING</small>					
Total depth of Bore Hole		10.00		Northing				Commenced on				4/15/2023									
				Elevation		100.000		Completed on				4/15/2023									
Depth of Bore Hole	Reduced Level	Types of Samples	% Material Passing IS Sieve				Atterberg Limits			IS group symbol	SPT Value	SPT Value corrected due to overburden	SPT Value corrected due to dilatancy	Wet Bulk Density	Original Moisture	Dry Bulk Density	Specific Gravity	Void Ratio	Shear Characteristics		Compression Index
			4.750	2.000	0.425	0.075	LL	PL	PI										Cohesion	Angle of Internal Friction	
metre	metre		(mm)	(mm)	(mm)	(mm)	%	%	%		N	N'	N''	(gms/cc)	%	(gms/cc)	(G)		(Kg/sqcm)	(Ø)	(Cc)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
0.00 - 0.50	100.000 - 99.500	DS																			
1.00 - 1.35	99.000 - 98.650	UD																			
1.35 - 1.80	98.650 - 98.200	SPT																			
2.50 - 2.85	97.500 - 97.150	UD																			
2.85 - 3.30	97.150 - 96.700	SPT																			
4.00 - 4.35	96.000 - 95.650	UD																			
4.35 - 4.80	95.650 - 95.200	SPT																			
FILLED UP SOIL UP TO 4.80 METRE DEPTH BELOW GROUND LEVEL (BRICK PIECES + SAND)																					
5.50 - 5.85	94.500 - 94.150	UD	100	100	98	97	36	20	16	CI				1.87	20.1	1.56	2.63	0.686	0.25	10°	0.131
5.85 - 6.30	94.150 - 93.700	SPT									7	8.34	8.34								
7.00 - 7.35	93.000 - 92.650	UD	100	100	99	98	38	24	14	CI				1.92	21.3	1.58	-	-	-	-	-
7.35 - 7.80	92.650 - 92.200	SPT									8	8.90	8.90								
8.50 - 8.85	91.500 - 91.150	UD	100	100	100	98	37	23	14	CI				1.97	22.2	1.61	2.64	0.640	0.15	14°	0.127
8.85 - 9.30	91.150 - 90.700	SPT									9	9.40	9.40								
9.30 - 10.00	90.700 - 90.000	DS	100	100	100	97	39	25	14	CI											



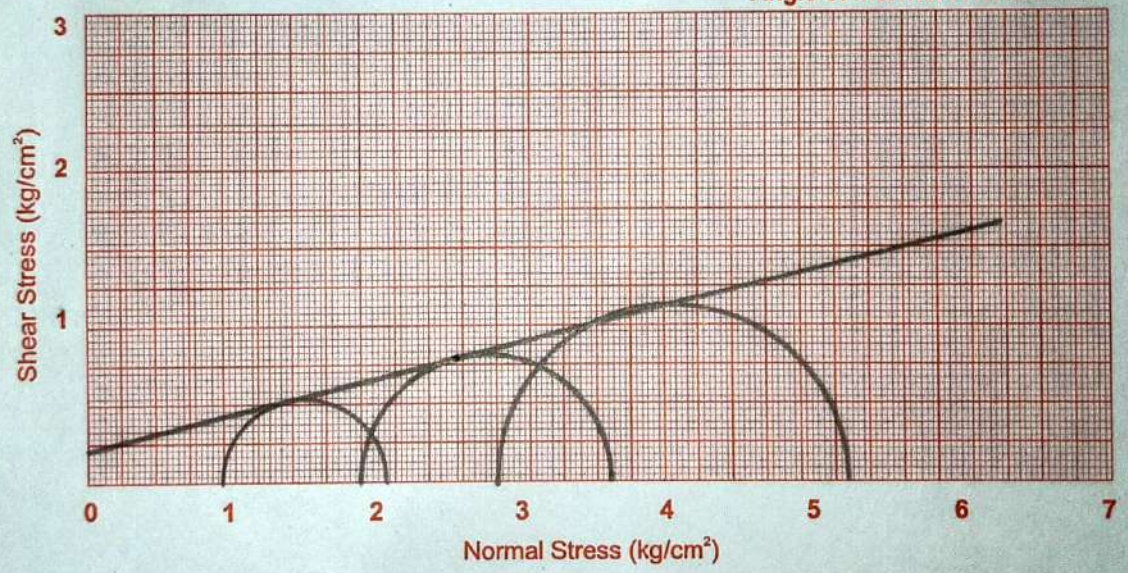
B.H. No. :- 01
Depth - 1.00 - 1.35

Cohesion 'c' :- 0.10 Kg/cm²
Angle of Internal Friction :- 16°*



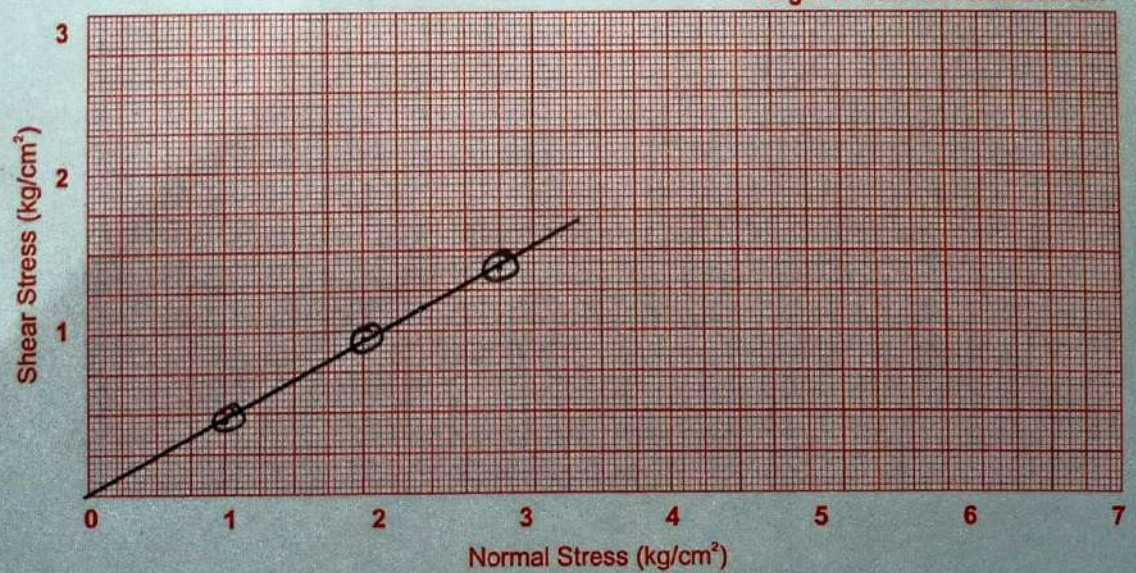
B.H. No. :- 01
Depth :- 4.00 - 4.35

Cohesion 'c' :- 0.20 Kg/cm²
Angle of Internal Friction :- 13°*



B.H. No. :- 01
Depth :- 7.00 - 7.35

Cohesion 'c' :- 0.00 Kg/cm²
Angle of Internal Friction :- 29°*

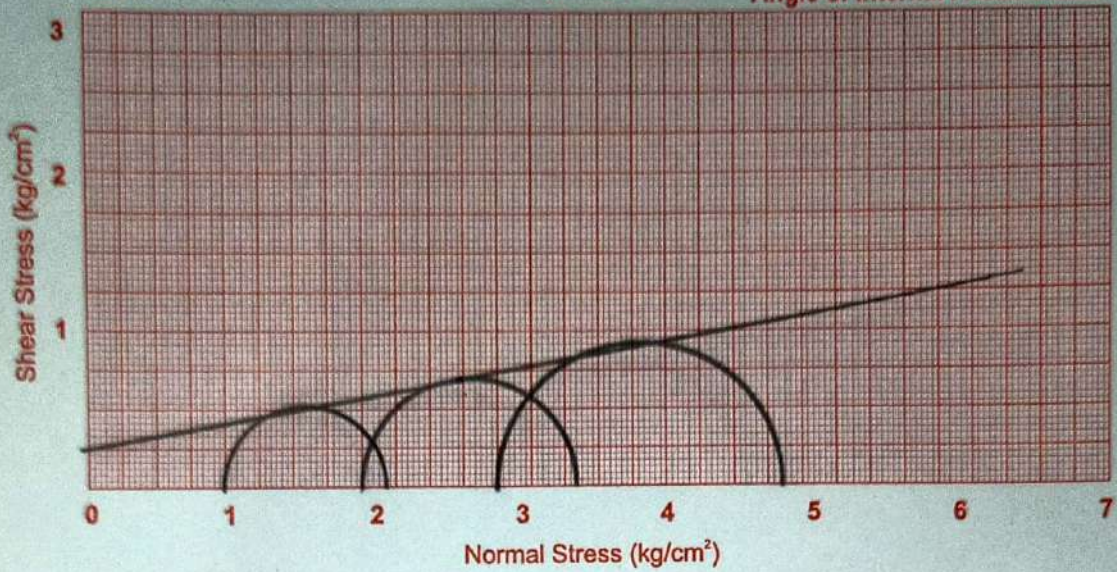




VMT
GEOTECH & MATERIAL TESTING

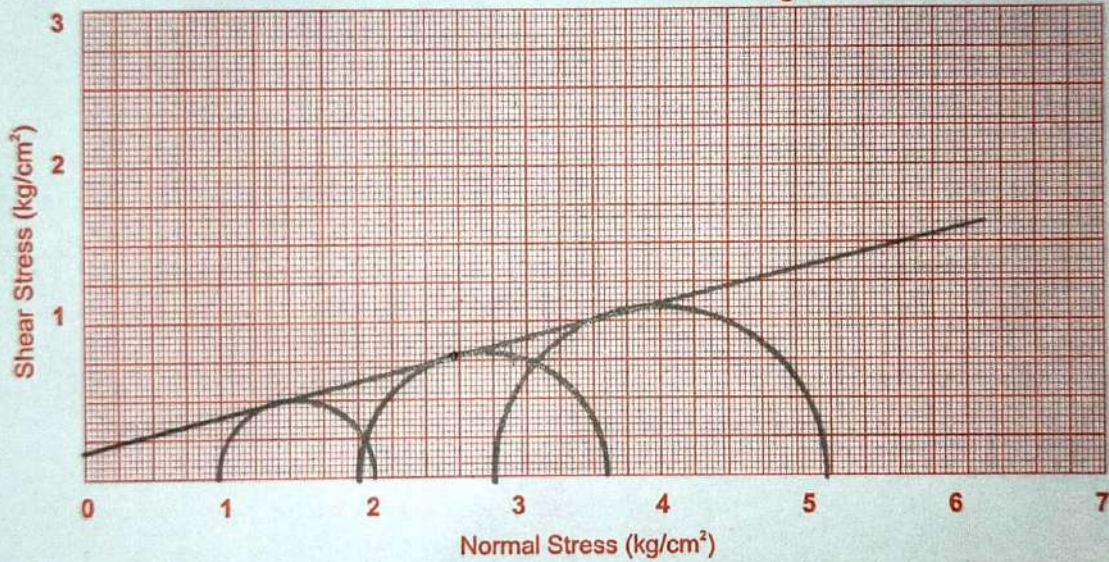
B.H. No. :- 02
Depth :- 5.50 - 5.85

Cohesion 'c' 0.25 Kg/cm²
Angle of Internal Friction 10°*



B.H. No. :- 02
Depth :- 8.50 - 8.85

Cohesion 'c' 0.15 Kg/cm²
Angle of Internal Friction 14°*



B.H. No. :-
Depth :-

Cohesion 'c' Kg/cm²
Angle of Internal Friction *

