VOLUME – IV
SECTION – 11
GEOTECHNICAL REPORT

SOIL INVESTIGATION REPORT FOR THE PROPOSED NORTH JETTY FOR M/S. NAVAL SHIP REPAIR YARD AT INS VENDURUTHY

JANUARY 2013

BY
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CONTENTS

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1.0 INTRODUCTION

1.1 The work of sub-soil exploration for the proposed North Jetty for M/s. Naval Ship Repairing Yard at Naval base, Kochi was entrusted to M/s. Geo Foundations & Structures Pvt. Ltd., 6th Floor, Alpha Plaza, K.P.Vallon Road, Kadavanthra P.O.,Kochi 682 020.

1.2 The soil investigation and laboratory studies were carried out in December-January 2012-2013. This report summarises the investigations and furnishes suggestions for the foundations.

2.0 OBJECT OF INVESTIGATION

2.1 The object of investigation is to ascertain the nature and characteristics of sub-soil below the ground level at the proposed site. The study would include identification of suitable foundation systems for the subject work and assessment of safe bearing capacity.

3.0 SCOPE OF WORK

The scope of work at this site comprised of the following:

3.1 Mobilisation of boring rig with all necessary equipments and personnel.

3.2 Boring of Nine Boreholes (One on land and Eight in Waters) with rotary power drilling equipments through sand, silt, & clay etc. to a maximum depth of 65.0 metres.

3.3 Conducting Standard Penetration tests in bore-holes and collecting the disturbed samples including packing and transportation to laboratory.

3.4 Conducting Vane shear test in soft clays as per IS 4434-1978 in Eighteen location as per the instructions of site in charge.

3.5 To conduct the following laboratory tests on soil samples:

(a) Particle size analysis:

(i) Sieve analysis

(ii) Hydrometer analysis

(b) Index properties:

(i) Liquid limit

(ii) Plastic limit

(c) Dry & wet density

(d) Water content

(e) Specific gravity

(f) Direct shear test

(g) Unconfined Compression test

(h) Tri axial Shear test

(i) Chemical Analysis on Water

(j) Chemical Analysis on soil

3.6 Preparation and submitting detailed report with field and lab results.

4.0 FIELD INVESTIGATIONS

4.1 One boring rig with all requisite equipments and accessories were mobilized at the work site. A team of technical personnel with skilled labours were also deputed.

4.2 Nine boreholes (One on land and Eight in waters) were bored to a maximum depth of 65.0m below the existing ground level. The borehole were made as per IS: 1892- 1979.

4.3 Disturbed samples were collected at every change of strata or about 1.5metres depth interval whichever was earlier. The samples so collected were

carefully sealed and numbered with full particulars for identification and sent to the laboratory.

4.4 Eighteen vane shear tests were conducted at site as per the directions of the site in charge.

4.5 Standard Penetration Tests were conducted in the bore- holes at regular intervals of 1.0m as per IS: 2131-1981. In this test, the standard split spoon sampler is driven into the ground at the required depth by means of standard hammer of 63.5 kgs weight, falling from a height of 75cm. Number of blows for the first 15cm is not taken into consideration because of possible disturbances or presence of settled, suspended matters at the bottom of the bore- holes. The total number of blows for the next 30cm depth of penetration is considered as SPT 'N' values are shown in graphical representation of N value.

5.0 LABORATORY INVESTIGATION

The following laboratory tests were conducted on the selected samples recovered from the test bore-holes:

(a) Particle size analysis:

(i) Sieve analysis

(ii) Hydrometer analysis

(b) Index properties:

(i) Liquid limit

(ii) Plastic limit

(c) Dry & wet density

(d) Water content

(e) Specific gravity

(f) Direct shear test

(g) Unconfined Compression Test

(h) Triaxial Shear test

(i) Chemical analysis on water

(j) Chemical analysis on soil

All the above laboratory tests were carried out as per relevant Indian Standard. All the samples were identified and classified as per IS: 1498-1970.

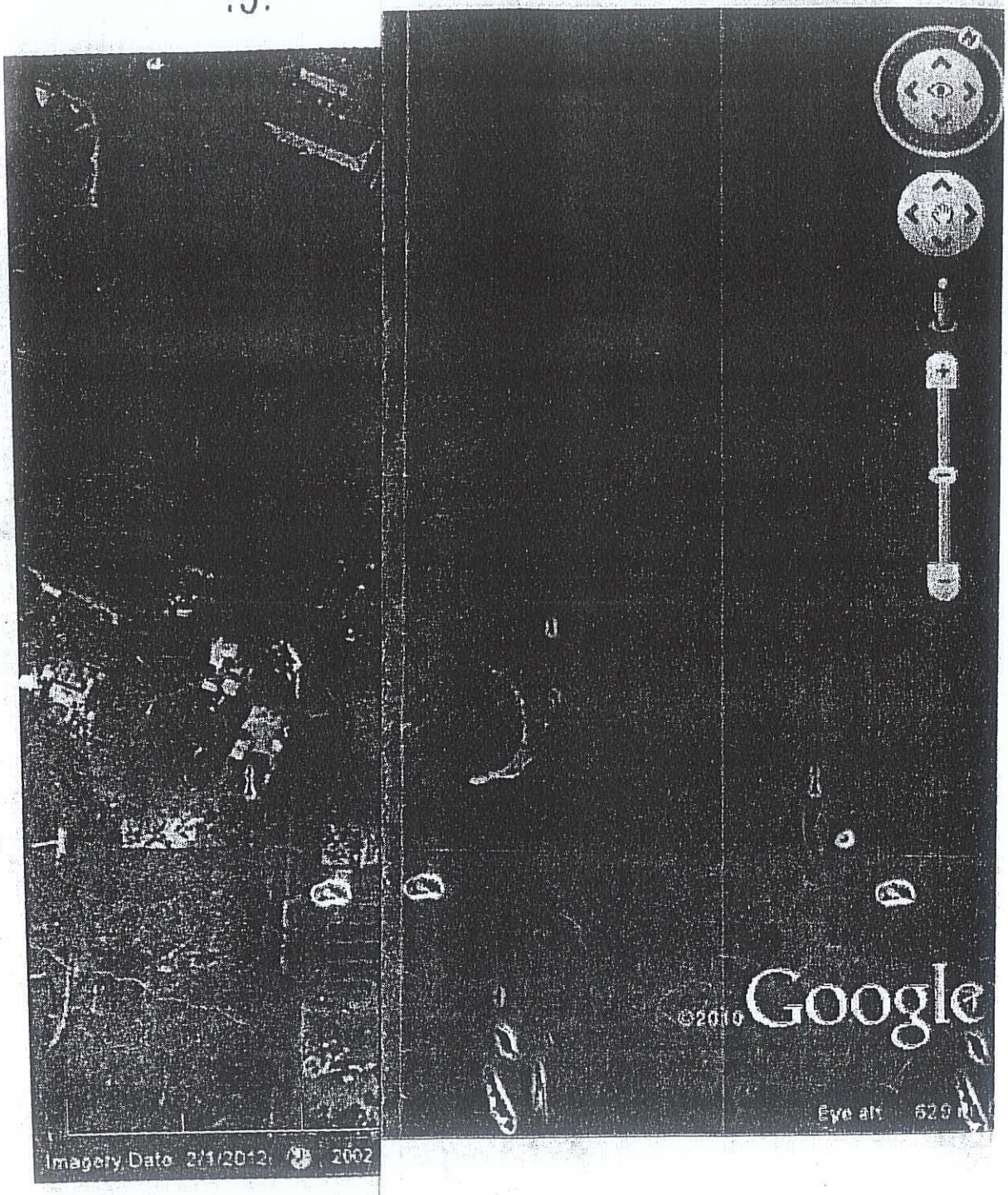

fig :1

Co-ordinates of the Bore Holes

Details of Bore Holes		Lattitude	Longitude
Land Bore Hole-LBH-01		9° 57' 29.94" N	76° 16'42.61" E
Marine Bore Holes	BH-01	9° 57' 34.32" N	76° 16'45.56" E
	BH-02	9° 57' 35.13" N	76° 16'45.30" E
	BH-03	9° 57' 35.75" N	76° 16'44.77" E
	BH-04	9° 57' 36.29" N	76° 16'44.18" E
	BH-05	9° 57' 31.15" N	76° 16'45.17" E
	BH-06	9° 57' 30.78" N	76° 16'44.43" E
	BH-07	9° 57' 28.44" N	76° 16'48.68" E
	BH-08	9° 57' 30.20" N	76° 16'45.26" E

ANNEXURE-01

LBH-01

(LAND BOREHOLE)

6.0 SOIL PROFILE

Soil profile for each bore hole is as given below and the location of the borehole is as given in fig.1

LBH-01: The top 1.0m was filled up waste. From 1.0m to 2.80m loose silty clayey sand of low plasticity was observed. Loose fine sand of non plastic nature was observed from 2.80m to 9.5m followed by soft to medium clayey silt with presence of sand upto 38.0m. Below this the stratum observed was dense sand upto 55.0m. From 55.0m to 60.5 hard clayey silt with presence of gravel was observed. Very dense silty sand was found below this depth upto 65.0m i.e. the termination depth in BH-1.

7.0 DISCUSSION AND TYPE OF FOUNDATION

7.1 The proposed structure coming in this area is the approach of Jetty. From the borelogs and result tables the top strattum was very loose sand/very soft clay. Considering the loads coming from the super structure, deep foundation shall be a feasible foundation system for the proposed structure.

7.2 Bored cast in situ RCC piles by DMC method installed as per the relevant clauses of IS 2911 part1/sec 2 taken to a depth of 64.0m including 3.0m in dense sand shall be provided as the foundation. The borelogs and lab results indicate that the capacity of piles needs to be generated from the skin friction as well as end bearing. Safe carrying capacities for different diameters of piles are tabulated as given below in **Table No.7.1**. A factor of safety of 2.5 is considered for calculating the safe capacities.

Table No: 7.1

Dia (cm)	Safe Capacity (T)
90	315
100	390
120	560

8.0 METHOD OF COMPUTING OF SAFE BEARING CAPACITY FOR R.C.C. BORED CAST IN SITU PILE

Safe capacity of RCC Bored cast-in-situ pile can be computed by using the formula given in IS: 2911 (Part-1/Sec-2)-1979:

Ultimate bearing capacity Qu of piles in Cohesion less soil:

$$Qu = Ap(0.5.D.\gamma.N\gamma + PD.Nq) + \sum_{I=1}^{n} k .PDi .\tan \delta . Asi$$

Where,

Ap= Cross sectional area of pile toe in cm^2

D= Stem dia. in cm

γ= effective unit weight of soil at pile toe in kg /cm^3

PD = effective overburden pressure in Kg / cm^2

$N\gamma$ and Nq = bearing capacity factors depending upon the angle of internal friction Ø at toe

I=n
$\sum$ = Summation of N layers in which pile is installed
I=1

K = Coefficient of earth pressure

PDi = effective overburden pressure in Kg /cm^2 for the ith layer where i varies from 1 to n.

δ= angle of wall friction between pile and soil in degree (may be taken equal to Ø)

Asi= Surface area of pile stem in cm^2 in the ith layer where i varies from 1 to n.

For cohesive soil:-

Safe capacity of pile = 1/F {AP.Nc.Cp + a. C.As)

Where

Ap- c/s area of pile toe in cm^2

Nc- bearing capacity factor

Cp- average cohesion at pile tip in Kg/cm^2

α - Reduction factor

C – average cohesion throughout the length of pile in Kg/cm^2

S- Surface area of pile shaft in cm^2

F - Factor of safety.

9.0 CONCLUDING REMARKS

9.1 RCC bored cast in situ piles shall be provided as the foundation for the proposed structure. Piles shall be taken to a depth of 64.0m from the ground level including 3.0m in dense sand shall be taken as the foundation. The safe capacity for different diameters of piles is given in table No.9.1.

Table No: 9.1

Dia (cm)	Safe Capacity (T)
90	315
100	390
120	560

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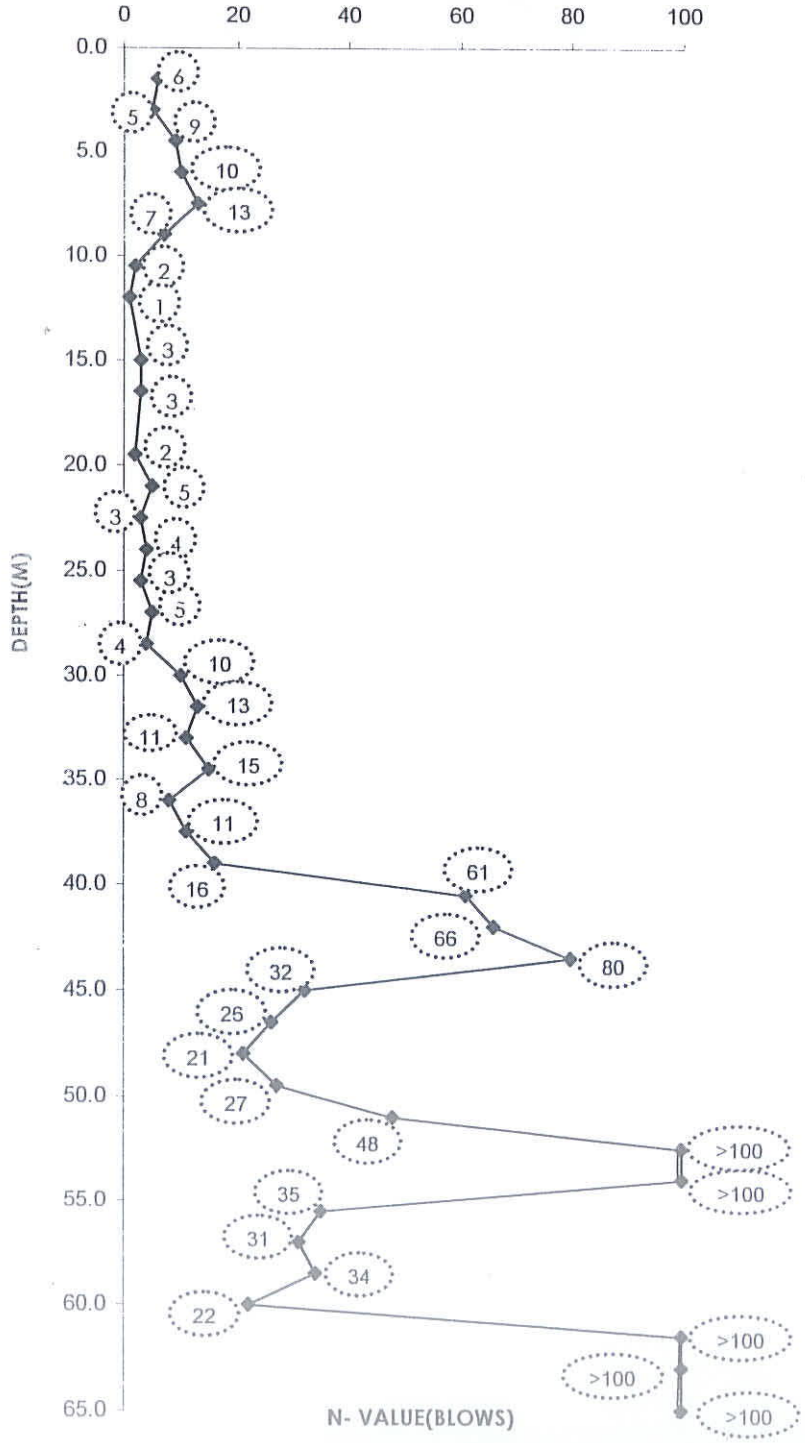
PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY

GEO FOUNDATIONS & STRUCTURES PVT. LTD	Bore Hole No	: BH-01	Boring Started	: 22.11.2012	T-1613
	Type of Boring	: Rotary	Boring Completed	: 27.11.2012	
	Termination Depth	: 65.0 M	Ground Water Level	: 0.80 M	

GRAPHICAL REPRESENTATION OF N VALUE



BORE HOLE TERMINATED AT 65.0 M

FIG. 2

Geo Foundations Structures Pvt. Ltd

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY

GEO FOUNDATIONS & STRUCTURES PVT. LTD

Bore Hole No	: BH-01	Boring Started	: 22.11.2012
Type of Boring	: Rotary	Boring Completed	: 27.11.2012
Termination Depth	: 65.0m	Ground Water Level	: 0.80m
Co-ordinates: Lat - 9° 57' 29.94" N, Long - 76° 16' 42.61" E			

T-1613

LOCATION : INS VENDURUTHY

SOIL PROFILE	THICKNESS OF STRATA (m)	DESCRIPTION OF STRATA	IS CLASSIFICATION	DEPTH (m)	SAMPLES TEST DEPTH IN m	BLOWS/15cm 15cm	15cm	15cm	SPT "N"	Rock Core characteristics C.R (%)	R.Q.D (%)	UCS KG/CM²	REMARKS
	1.00	Filled Weast											
	1.80	Silty Clayey Sand with Presence of Gravel (Grey)	SC	1.50	1.50-1.95	2	3	3	6				
				3.00	3.00-3.45	2	3	2	5				
	6.70	Fine Sand (Grey)	SP-SM	4.50	4.50-4.95	3	4	5	9				
				6.00	6.00-6.45	4	4	6	10				
				7.50	7.50-7.95	4	6	7	13				
				9.00	9.00-9.45	3	3	4	7				
	19.0	Clayey Silt with Presence of Sand (D/Grey)	CH	10.5	10.5-10.95	2	1	1	2				
				12.0	12.0-12.45	1	0	1	1				
				13.5	13.5-13.95	UDS-1							
				15.0	15.0-15.45	1	1	2	3				
				16.5	16.5-16.95	2	1	2	3				
				18.0	18.0-18.45	UDS-2							
				19.5	19.5-19.95	1	1	1	2				
				21.0	21.0-21.45	2	2	3	5				
				22.5	22.5-22.95	1	1	2	3				
				24.0	24.0-24.45	1	2	2	4				
				25.5	25.5-25.95	2	1	2	3				
				27.0	27.0-27.45	2	2	3	5				
				28.5	28.5-28.95	2	2	2	4				

Note : UDS- Undisturbed Sample

SPT "N"-Standard Penetration Test "N"

Fig : 3

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY

GEO FOUNDATIONS & STRUCTURES PVT. LTD

Bore Hole No	: BH-01	Boring Started	: 22.11.2012
Type of Boring	: Rotary	Boring Completed	: 27.11.2012
Termination Depth	: 65.0m	Ground Water Level	: 0.80m

Co-ordinates: Lat - 9° 57' 29.94" N, Long - 76° 16' 42.61" E

T-1613

LOCATION : INS VENDURUTHY

SOIL PROFILE	THICKNESS OF STRATA (m)	DESCRIPTION OF STRATA	IS CLASSIFICATION	DEPTH (m)	SAMPLES TEST DEPTH IN m	BLOWS/15cm 15cm	15cm	15cm	SPT "N"	Rock Core characteristics C.R (%)	R.Q.D (%)	UCS KG/CM²	REMARKS
	9.50	Clayey Silt with Presence of Sand – (D/Brown) / Clayey Silt with Presence of Sand (Grey)	CH	30.0	30.0-30.45	4	4	6	10				
				31.5	31.5-31.95	5	6	7	13				
				33.0	33.0-33.45	3	5	6	11				
				34.5	34.5-34.95	6	7	8	15				
				36.0	36.0-36.45	3	4	4	8				
				37.5	37.5-37.95	4	5	6	11				
				39.0	39.0-39.45	6	8	8	16				
	5.80	Silty Sand (Yellow)	SM	40.5	40.5-40.95	20	26	35	61				
				42.0	42.0-42.95	26	29	37	66				
				43.5	43.5-43.95	31	38	42	80				
	1.30	Fine Sand with Presence of Gravel (Grey)	SP-SM	45.0	45.0-45.45	16	14	18	32				
	5.40	Silty Sand (Grey)	SM	46.5	46.5-46.95	8	12	14	26				
				48.0	48.0-48.45	7	8	13	21				
				50.0	50.0-50.45	10	13	14	27				
	4.50	Fine Sand with Presence of Gravel (Grey)	SP-SM	51.5	51.5-51.95	16	22	26	48				
				53.0	53.0-53.45	66	100	-	>100				28/45cm penetration
				54.5	54.5-54.95	100	-	-	>100				15/45cm penetration
	2.50	Clayey Sandy Silt with Presence of Organic Matter (D/Black)	CI	56.0	56.0-56.45	9	17	18	35				
				57.5	57.5-57.95	10	13	18	31				

Note : UDS- Undisturbed Sample SPT "N"-Standard Penetration Test "N"

Fig : 4

Geo Foundations Structures Pvt Ltd

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY

GEO FOUNDATIONS & STRUCTURES PVT. LTD

Bore Hole No	: BH-01	Boring Started	: 22.11.2012
Type of Boring	: Rotary	Boring Completed	: 27.11.2012
Termination Depth	: 65.0m	Ground Water Level	: 0.80m

Co-ordinates: Lat - 9° 57' 29.94" N, Long - 76° 16' 42.61" E

T-1613

LOCATION : INS VENDURUTHY

SOIL PROFILE	THICKNESS OF STRATA (m)	DESCRIPTION OF STRATA	IS CLASSIFICATION	DEPTH (m)	SAMPLES TEST DEPTH IN m	BLOWS/15cm 15cm	15cm	15cm	SPT "N"	Rock Core characteristics C.R (%)	R.Q.D (%)	UCS KG/CM²	REMARKS
	3.00	Clayey Silt with Presence of Gravel (D/Brown)	CH	59.0	59.0-59.45	14	17	17	34				
				60.0	60.0-60.45	10	10	12	22				
	4.50	Silty Sand (Grey)	SM	61.5	61.5-61.95	56	100	-	>100				29/45cm penetration
				63.0	63.0-63.45	33	49	51	>100				41/45cm penetration
				65.0	65.0-65.45	39	51	49	>100				40/45cm penetration

Termination Depth: 65.0 M

Note : UDS- Undisturbed Sample

SPT "N"-Standard Penetration Test "N"

Fig : 5

NAME OF WORK:SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY

LOCATION: NAVAL BASE | Ground Water Level : 0.80 M | Date of Boring Started : 22.11.2012 | Date of Boring Completed : 27.11.2012 | Termination Depth : 65.0 M | Table No.1 | T-1613

N	DEPTH(M)	SAMPLE	SOIL DESCRIPTION	I.S. CLASSIFICATION	GRAIN SIZE ANALYSIS(%) IS 2720(Part5):1985				NMC(%) IS 2720 (Part2):1973	ATTERBERG'S LIMIT(%)-IS 2720(Part-5): 1985			SL (%)IS 2720(Part6): 1972	FSI (%) IS2720 (Part40):1977	SPG(IS 2720(Part-3/sec1):1980	UNIT WEIGHT (gm/cc)		SHEAR PARAMETERS-IS 2720(Part-13):1986		
					GRA - VEL	SAND	SILT.	CLAY		LL	PL	PI				WET	DRY	METHOD	C kg/cm²	Ø (°)
			BOREHOLE BH/1																	
6	1.50	SPT1	Silty Clayey Sand with Presence of Gravel (Grey)	SC	9	58	13	19	32	39	19	20								
5	3.00	SPT2	Fine Sand (Grey)	SP-SM	0	92	8	0	20	No Limit					2.61	1.71	1.43	DST	0	28
9	4.50	SPT3	Fine Sand (Grey)	SP-SM																
10	6.00	SPT4	Fine Sand (Grey)	SP-SM	0	91	9	0	20	No Limit										
13	7.50	SPT5	Fine Sand (Grey)	SP-SM	0	91	9	0	22	No Limit										
7	9.00	SPT6	Fine Sand (Grey)	SP-SM																
2	10.5	SPT7	Clayey Silt with Presence of Sand (D/Grey)	CH	0	7	61	32	102	136	41	95								
1	12.0	SPT8	Clayey Silt with Presence of Sand (D/Grey)	CH																
-	13.5	UDS1	Clayey Silt with Presence of Sand (D/Grey)	CH	0	5	64	31	98	123	39	84			2.40	1.42	0.72	Triaxial	0.10	0
3	15.0	SPT9	Clayey Silt with Presence of Sand (D/Grey)	CH	0	3	60	37	95											
3	16.5	SPT10	Clayey Silt with Presence of Sand (D/Grey)	CH																
-	18.0	UDS2	Clayey Silt with Presence of Sand (D/Grey)	CH	0	10	60	30	100	127	43	84			2.42	1.41	0.64	UCS	0.12	-
2	19.5	SPT11	Clayey Silt with Presence of Sand (D/Grey)	CH	0	8	60	32	97											
5	21.0	SPT12	Clayey Silt with Presence of Sand (D/Grey)	CH																
3	22.5	SPT13	Clayey Silt with Presence of Sand (D/Grey)	CH	0	5	60	35	96											
4	24.0	SPT14	Clayey Silt with Presence of Sand (D/Grey)	CH	0	3	69	28	94	105	37	68								

NAME OF WORK:SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY

LOCATION: NAVAL BASE | Ground Water Level : 0.80 M | Date of Boring Started : 22.11.2012 | Date of Boring Completed : 27.11.2012 | Termination Depth : 65.0 M | Table No.2 | T-1613

N	DEPTH(M)	SAMPLE	SOIL DESCRIPTION	I.S. CLASSIFICATION	GRAIN SIZE ANALYSIS(%) IS 2720(Part5):1985				NMC(%) IS 2720 (Part2):1973	ATTERBERG'S LIMIT(%)-IS 2720(Part-5): 1985			SL (%)IS 2720(Part6): 1972	FSI (%) IS2720 (Part40):1977	SPG(IS 2720(Part-3/sec1):1980	UNIT WEIGHT (gm/cc)		SHEAR PARAMETERS-IS 2720(Part-13):1986		
					GRA - VEL	SAND	SILT,	CLAY		LL	PL	PI				WET	DRY	METHOD	C kg/cm²	Ø (°)
BOREHOLE BH/1																				
3	25.0	SPT15	Clayey Silt with Presence of Sand (D/Grey)	CH																
5	27.0	SPT16	Clayey Silt with Presence of Sand (D/Grey)	CH	0	6	65	29	103	116	40	76								
4	28.5	SPT17	Clayey Silt with Presence of Sand (D/Grey)	CH																
10	30.0	SPT18	Clayey Sil with Presence of Sand (D/Brown)	CH	0	10	62	29	64	84	32	52			2.45	1.64	1.00	UCS	0.35	-
13	31.5	SPT19	Clayey Sil with Presence of Sand (D/Brown)	CH	0	12	56	32												
11	33.0	SPT20	Clayey Sil with Presence of Sand (D/Brown)	CH																
15	34.5	SPT21	Clayey Sil with Presence of Sand (D/Brown)	CH																
8	36.0	SPT22	Clayey Silt with Presence of Sand (Grey)	CH	0	3	53	45	52	92	34	58								
11	37.5	SPT23	Clayey Silt with Presence of Sand (Grey)	CH	0	2	56	42	50											
16	39.0	SPT24	Clayey Silt with Presence of Sand (Grey)	CH																
61	40.5	SPT25	Silty Sand (Yellow)	SM	0	73	27	0	16	No Limit					2.60	1.96	1.69	DST	0	36
66	42.0	SPT26	Silty Sand (Yellow)	SM	0	75	25	0	17	No Limit										
80	43.5	SPT27	Silty Sand (Yellow)	SM																
32	45.0	SPT28	Fine Sand with Presence of Gravel (Grey)	SP-SM	1	93	6	0	17	No Limit										
26	46.5	SPT29	Silty Sand (Grey)	SM	0	71	29	0	24	No Limit										
21	48.0	SPT30	Silty Sand (Grey)	SM																

NAME OF WORK:SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY

LOCATION: NAVAL BASE

Ground Water Level : 0.80 M

Date of Boring Started : 22.11.2012
Date of Boring Completed : 27.11.2012
Termination Depth : 65.0 M

Table No.3

T-1613

N	DEPTH(M)	SAMPLE	SOIL DESCRIPTION	I.S. CLASSIFICATION	GRAIN SIZE ANALYSIS(%) IS 2720(Part5):1985				NMC(%) IS 2720 (Part2):1973	ATTERBERG'S LIMIT(%)-IS 2720(Part-5): 1985			SL (%)IS 2720(Part6): 1972	FSI (%) IS2720 (Part40):1977	SPG(IS 2720(Part-3/sec1):1980	UNIT WEIGHT (gm/cc)		SHEAR PARAMETERS-IS 2720(Part-13):1986		
					GRA - VEL	SAND	SILT,	CLAY		LL	PL	PI				WET	DRY	METHOD	C kg/cm²	Ø (°)
BOREHOLE BH/1																				
27	50.0	SPT31	Silty Sand (Grey)	SM	0	75	25	0	20	No Limit										
48	51.0	SPT32	Fine Sand with Presence of Gravel (Grey)	SP-SM	1	94	5	0	16	No Limit					2.62	2.06	1.78	DST	0	37
>100	53.0	SPT33	Fine Sand with Presence of Gravel (Grey)	SP-SM																
>100	54.5	SPT34	Fine Sand with Presence of Gravel (Grey)	SP-SM	0	95	5	0	15											
35	56.0	SPT35	Clayey Sandy Silt with Presence of Organic Matter (D/Black)	CI	0	36	42	22	50	46										
31	57.5	SPT36	Clayey Sandy Silt with Presence of Organic Matter (D/Black)	CI																
34	59.0	SPT37	Clayey Silt with Presence of Gravel (D/Brown)	CH	0	2	35	26	37	75	29	46								
22	60.0	SPT38	Clayey Silt with Presence of Gravel (D/Brown)	CH	0	3	33	64	35											
>100	61.5	SPT39	Silty Sand (Grey)	SM	0	76	24	0	14	No Limit					2.61	2.12	1.86	DST	0	38
>100	63.0	SPT40	Silty Sand (Grey)	SM																
>100	65.0	SPT41	Silty Sand (Grey)	SM	0	80	20	0	15	No Limit										

GEO FOUNDATIONS AND STRUCTURES PVT. LTD

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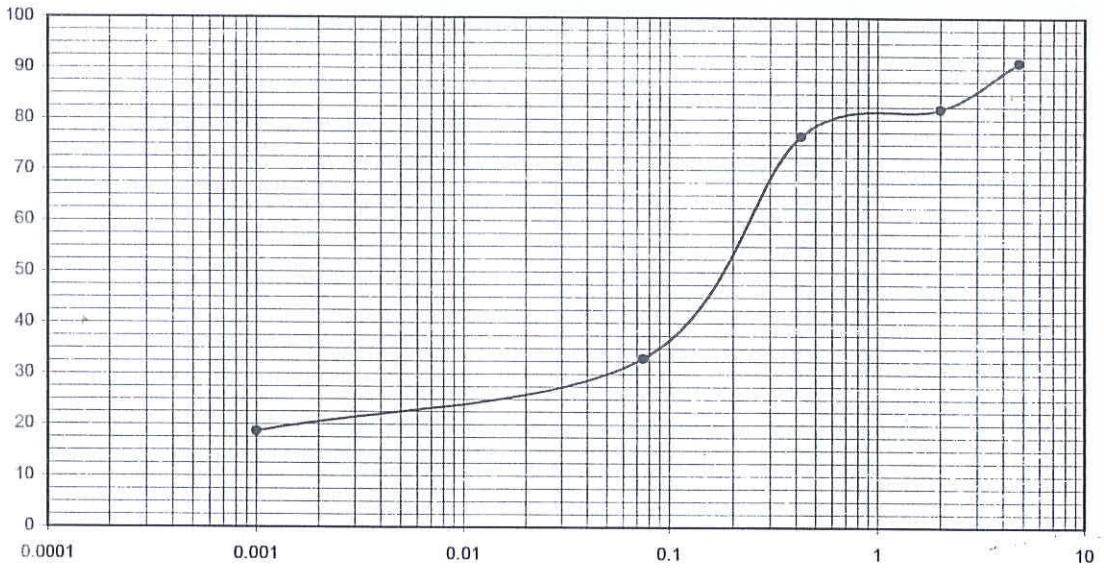
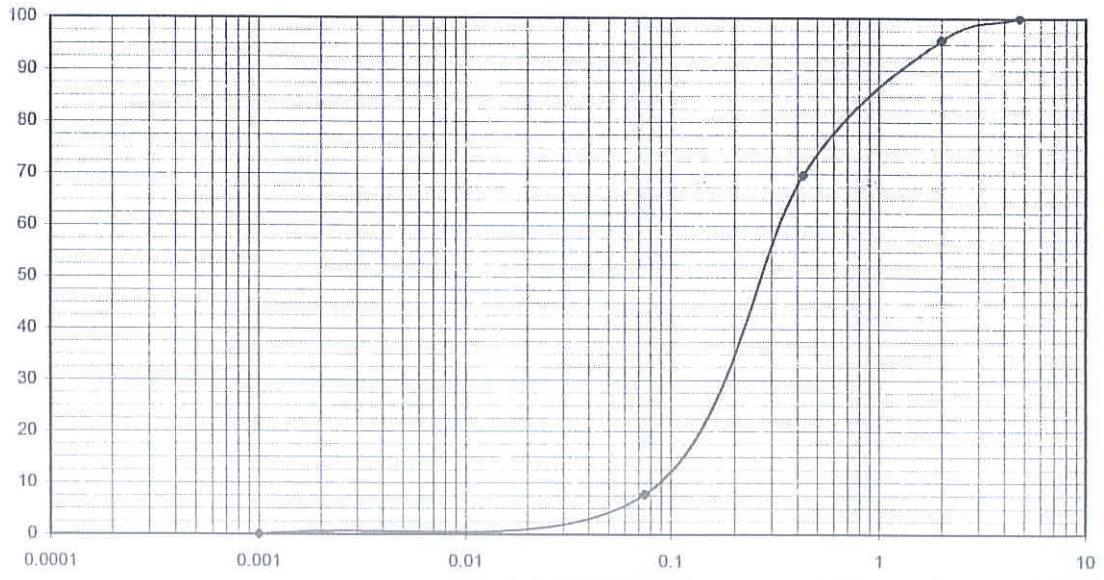
PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY AT NAVAL BASE

GRAINSIZE ANALYSIS TEST



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	Cu
BH-01	1.50	SC	9	58	14	19			



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	D0
BH-01	3.00	SP-SM	0	92	8	0			

FIG. 6

Geo Foundations Structures Pvt Ltd

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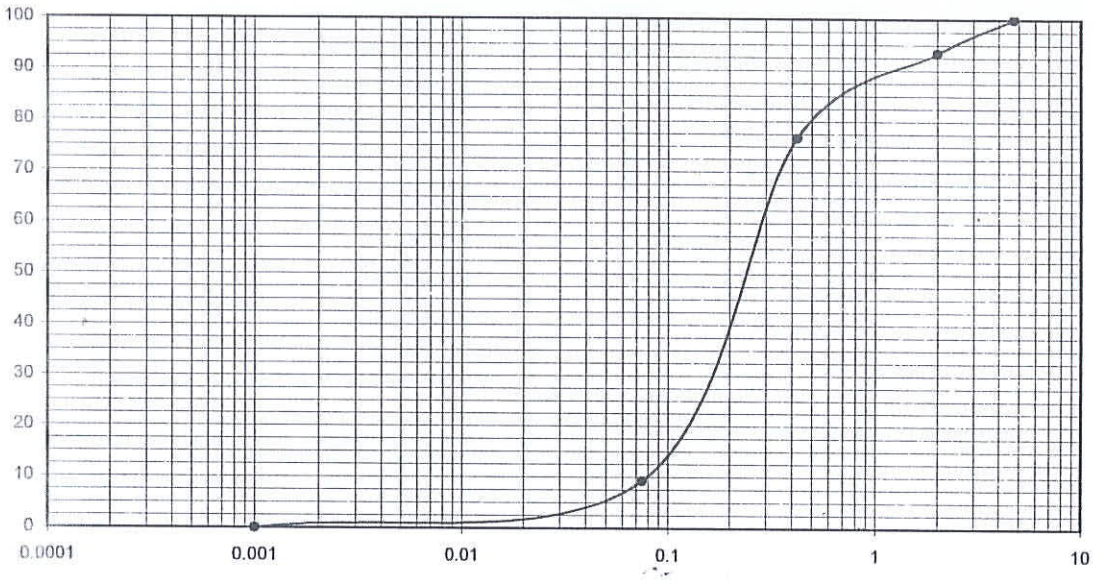
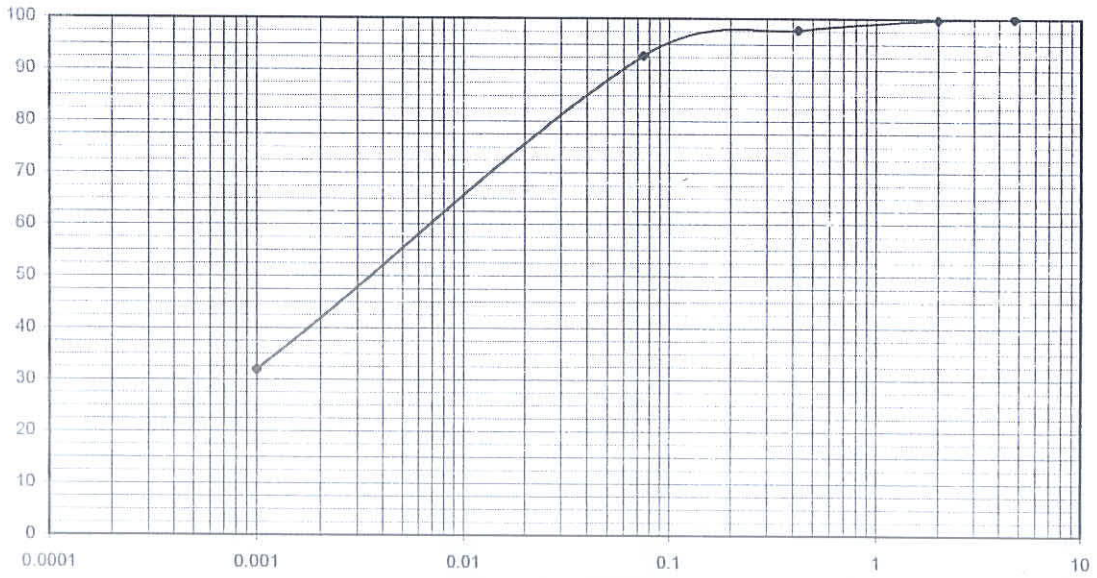
T-1613

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY AT NAVAL BASE

GRAINSIZE ANALYSIS TEST



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	Cu
BH-01	7.50	SP-SM	0	91	9	0			



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	D0
BH-01	10.50	CH	0	7	61	32			

FIG. 7

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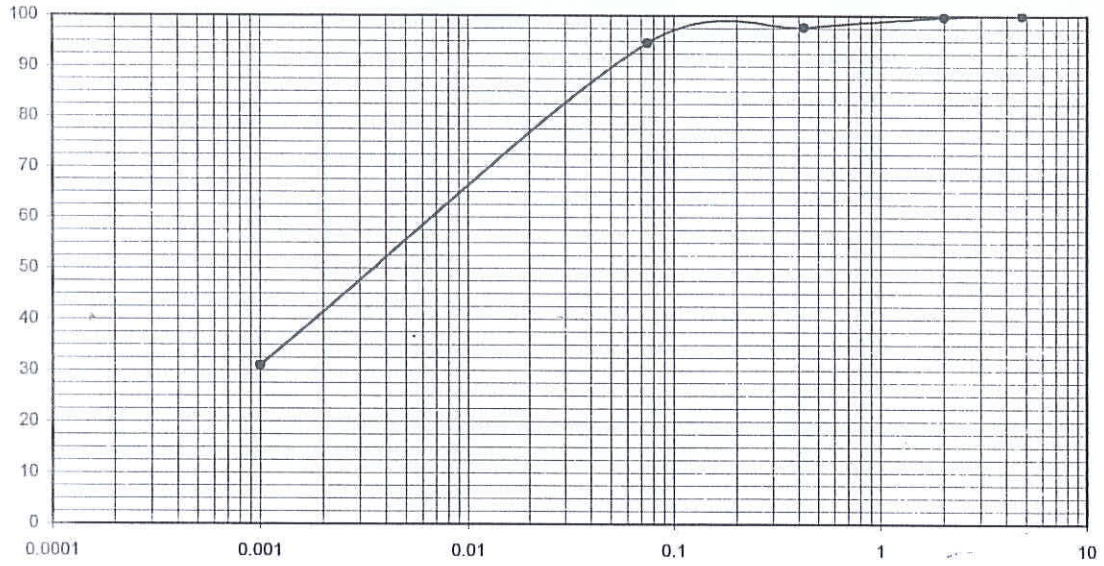
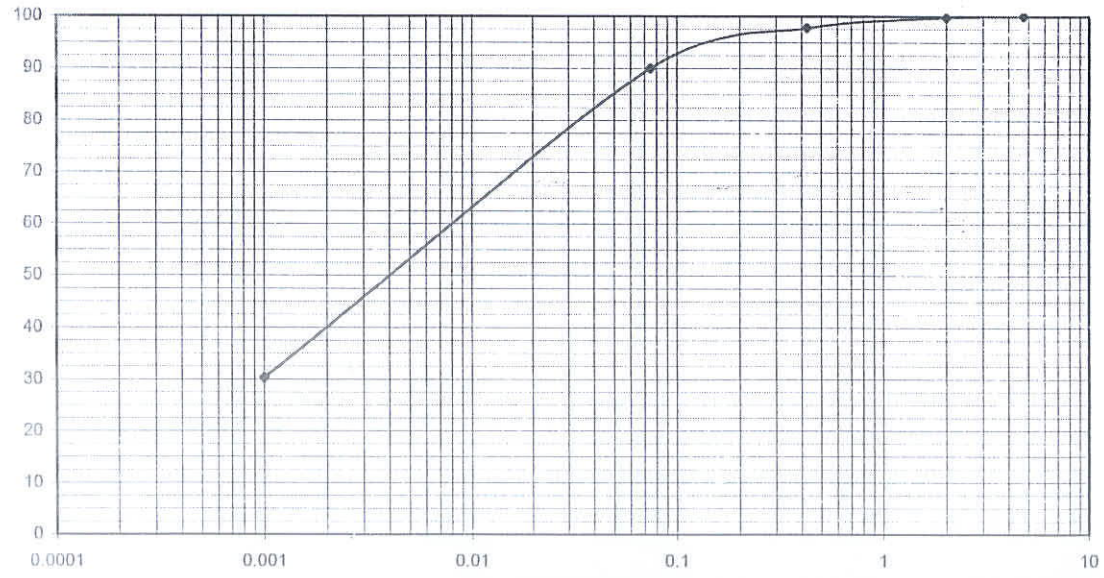
PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY AT NAVAL BASE

GRAINSIZE ANALYSIS TEST



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	Cu
BH-01	13.50	CH	0	5	64	31			



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	D0
BH-01	18.00	CH	0	10	60	30			

FIG. 8

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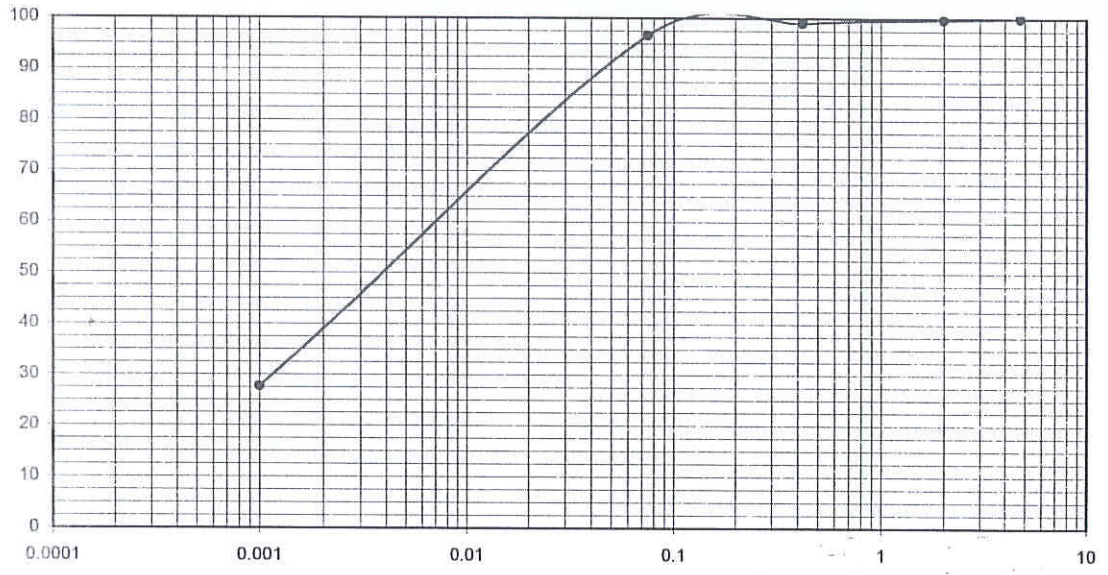
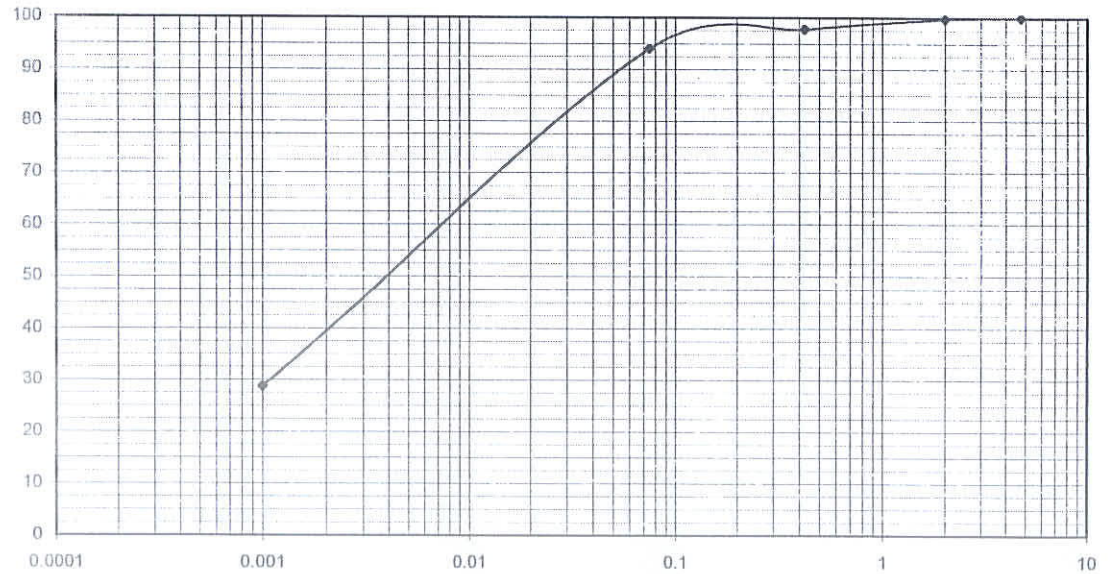
PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY AT NAVAL BASE

GRAINSIZE ANALYSIS TEST



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	Cu
BH-01	24.00	CH	0	3	69	28			



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	D0
BH-01	27.00	CH	0	6	65	29			

FIG. 9

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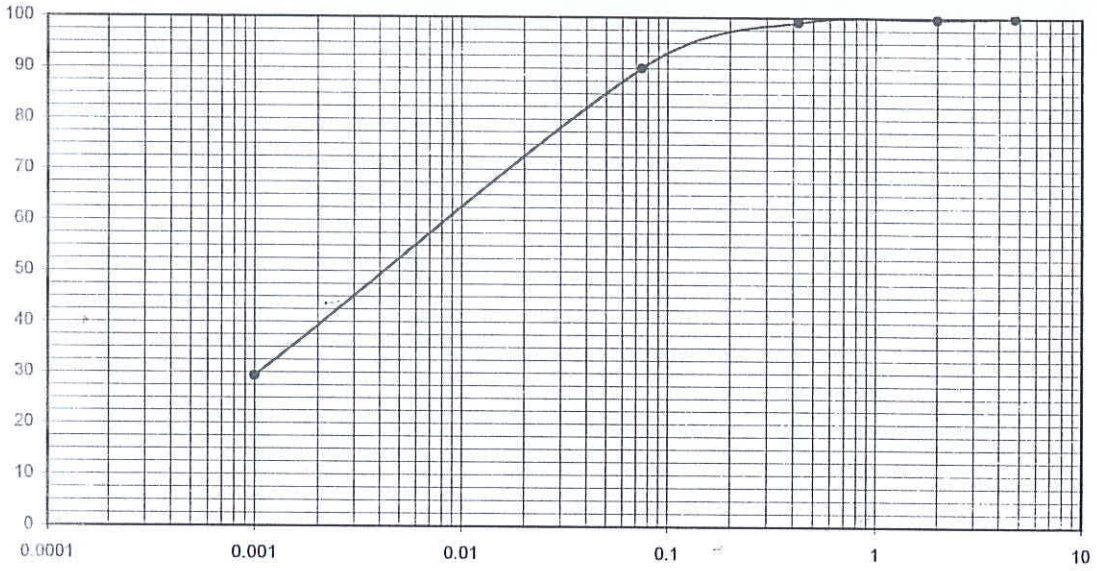
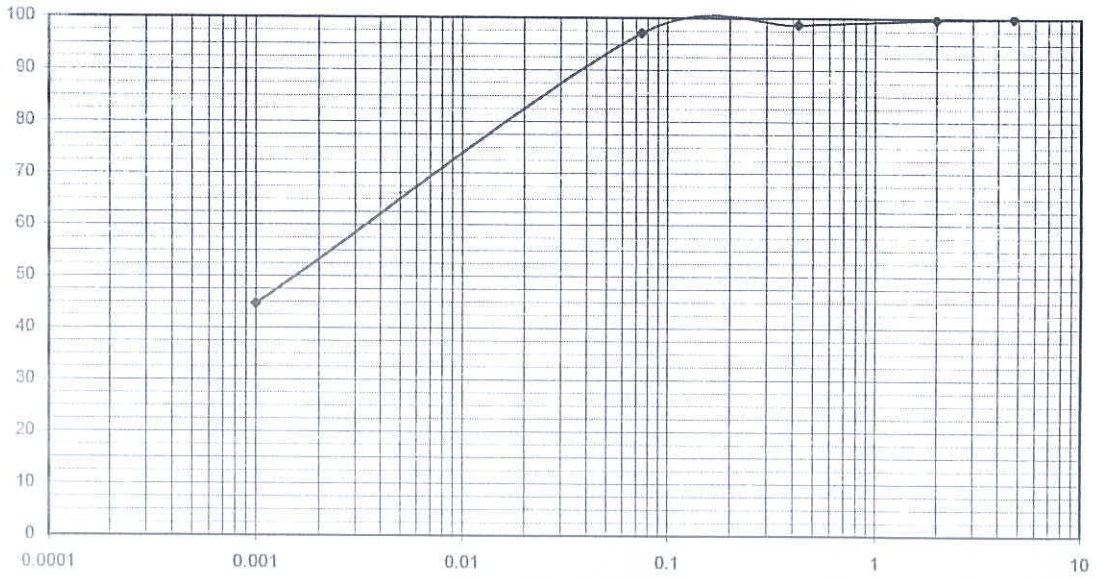
PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY AT NAVAL BASE

GRAINSIZE ANALYSIS TEST



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	Cu
BH-01	30.00	CH	0	10	61	29			



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	D0
BH-01	36.00	CH	0	3	52	45			

FIG. 10

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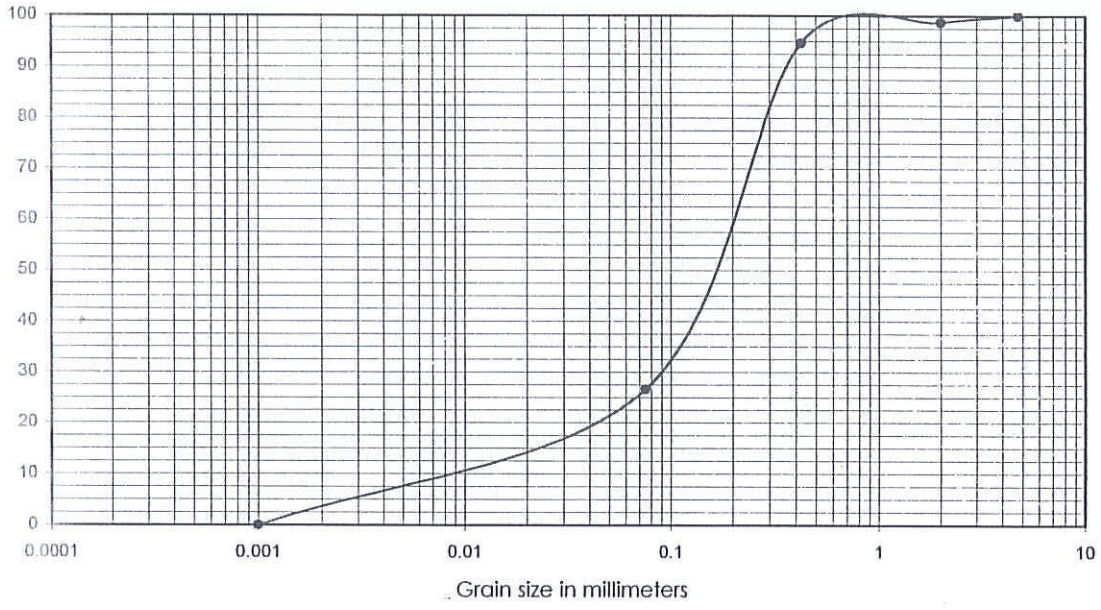
GEO FOUNDATIONS AND STRUCTURES PVT. LTD

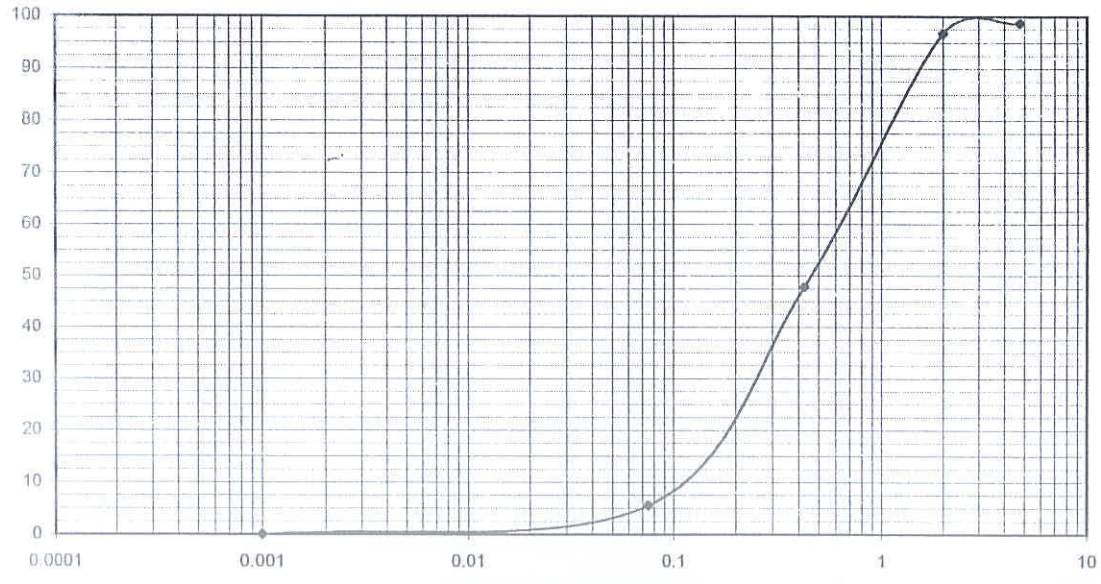
T-1613

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY AT NAVAL BASE

GRAINSIZE ANALYSIS TEST



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	Cu
BH-01	40.50	SM	0	73	27	0			



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	D0
BH-01	45.00	SP-SM	1	93	6	0			

FIG. 11

Geo Foundations Structures Pvt Ltd

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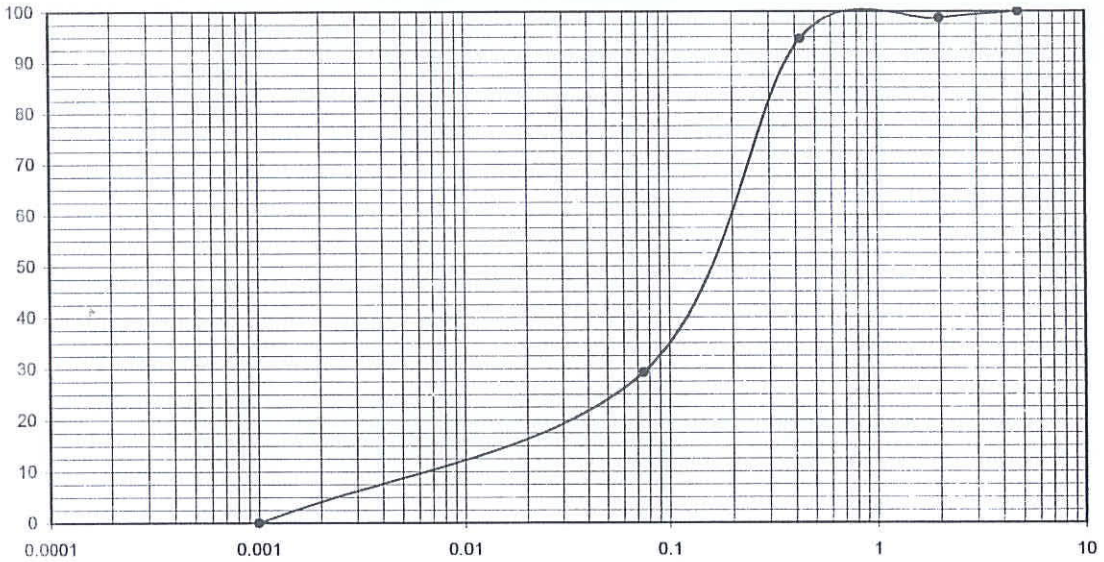
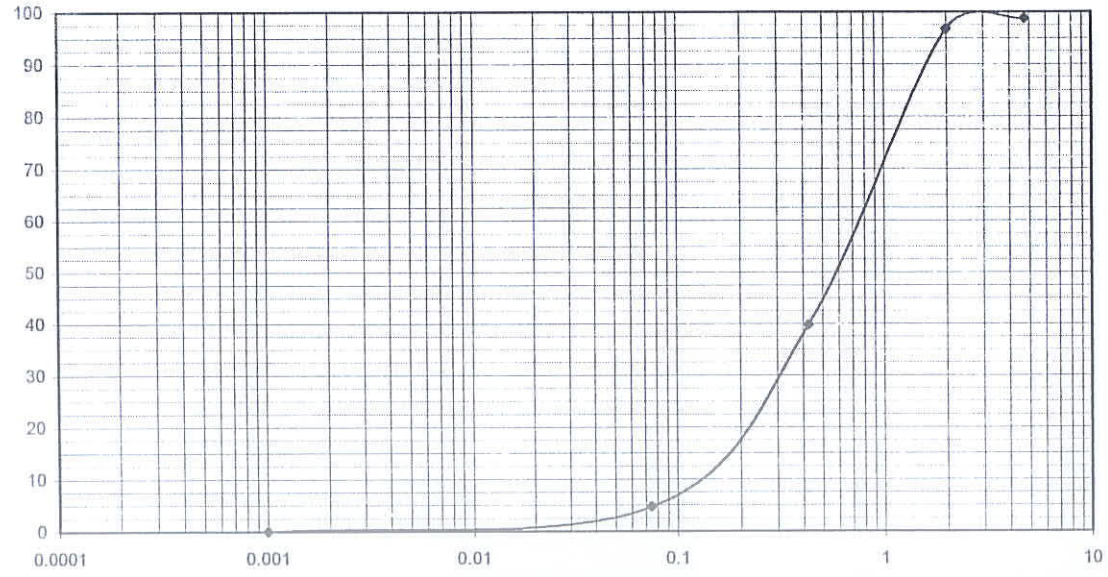
T-1613

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY AT NAVAL BASE

GRAINSIZE ANALYSIS TEST



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	Cu
BH-01	46.50	SM	0	71	29	0			



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	D0
BH-01	51.50	SP-SM	1	94	5	0			

FIG. 12

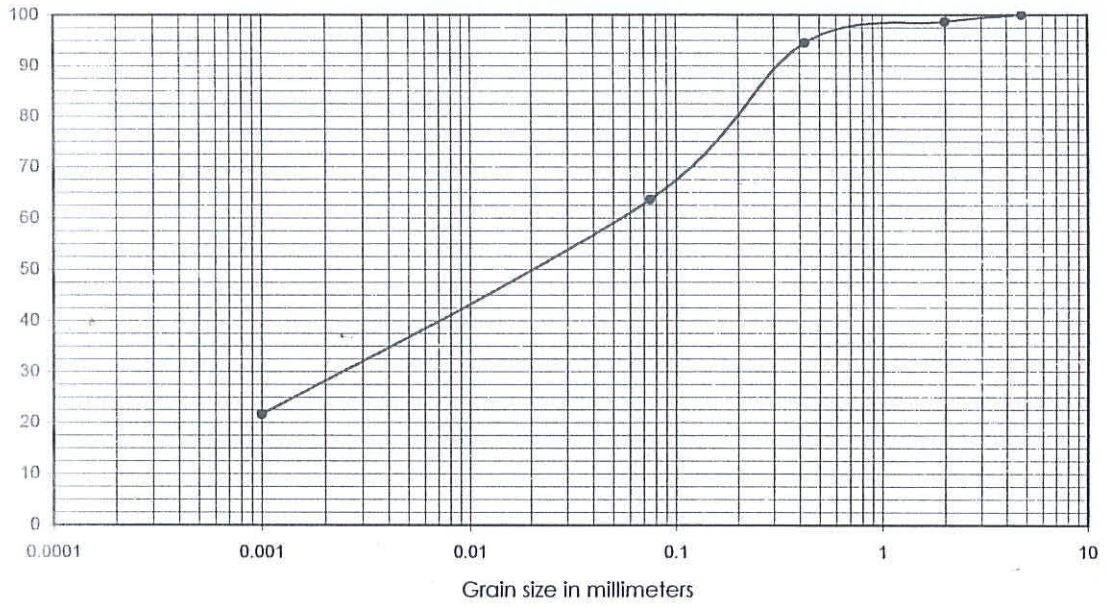
Geo Foundations Structures Pvt Ltd

GEO FOUNDATIONS AND STRUCTURES PVT. LTD

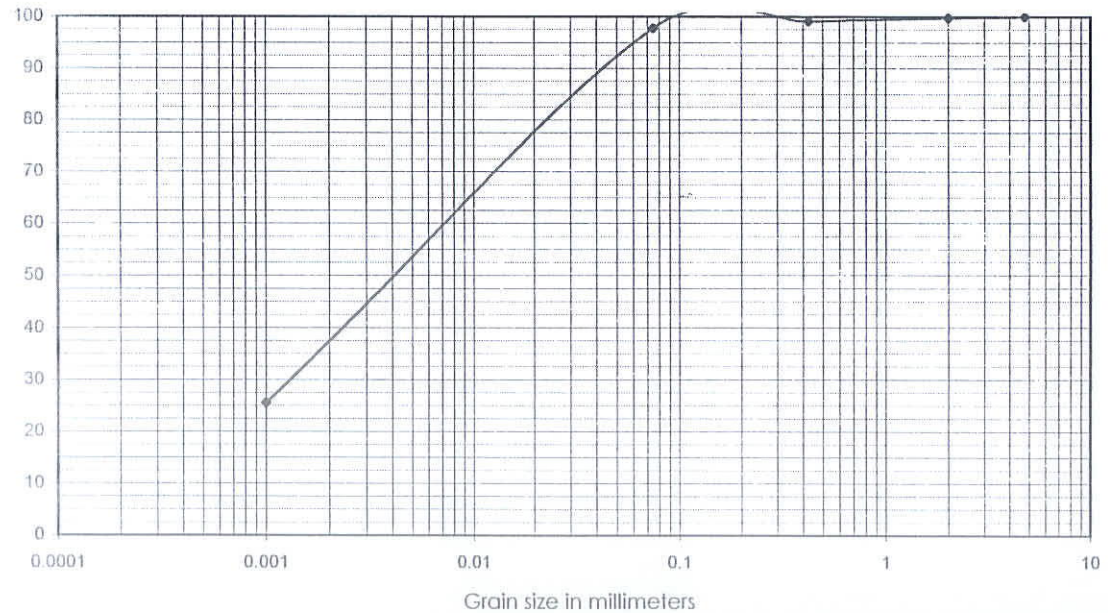
T-1613

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY AT NAVAL BASE

GRAINSIZE ANALYSIS TEST



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	Cu
BH-01	56.00	CI	0	36	42	22			



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	D0
BH-01	59.00	CH	0	2	72	26			

FIG. 13

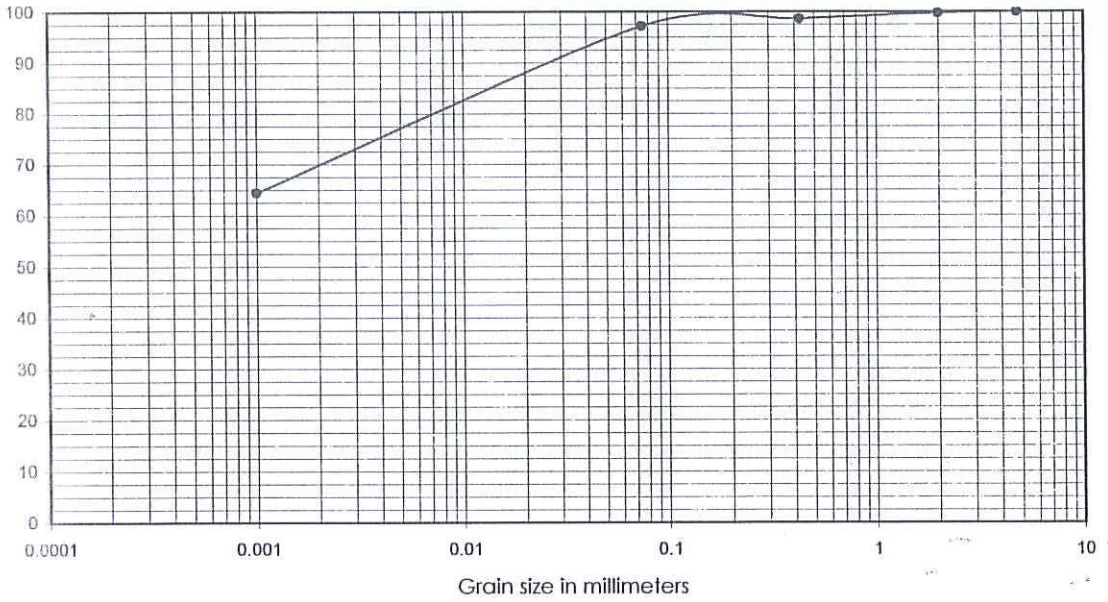
Geo Foundations Structures Pvt Ltd

GEO FOUNDATIONS AND STRUCTURES PVT. LTD

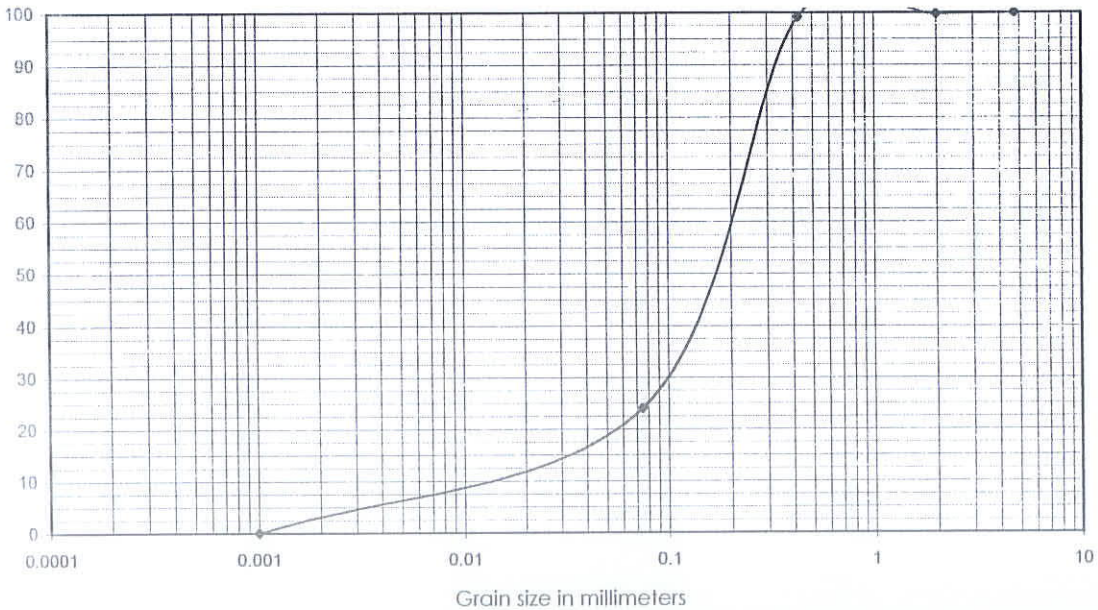
T-1613

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY AT NAVAL BASE

GRAINSIZE ANALYSIS TEST



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	Cu
BH-01	60.00	CH	0	3	33	64			



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	D0
BH-01	61.50	SM	0	76	24	0			

FIG. 14

Geo Foundations Structures Pvt Ltd

DIRECT SHEAR TEST

BORE HOLE NO: BH-01
SAMPLE NO : SPT2
DEPTH : 3.0M
C = 0.0 Kg/cm^2 ϕ = 28^0

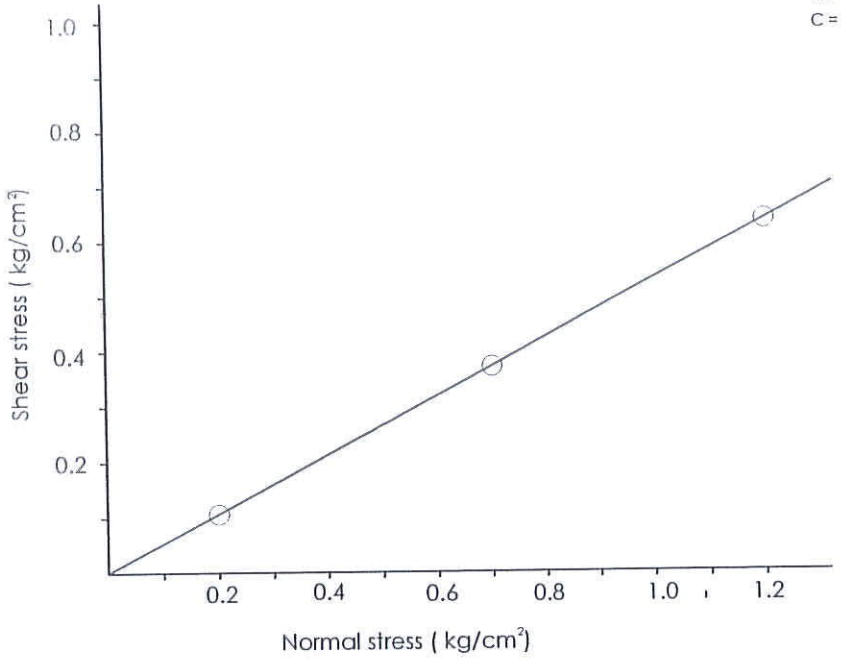


FIG (15)

TRI AXIAL TEST

BORE HOLE NO:BH-01
SAMPLE NO : UDS-1
DEPTH : 13.5 M
C = 0.10 Kg/cm^2 ϕ = 0^0

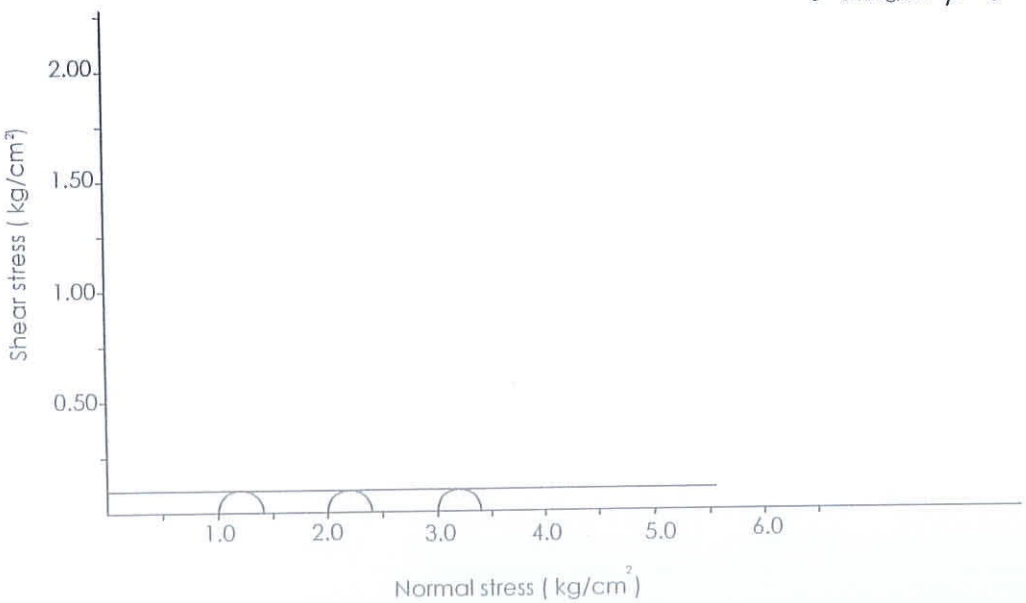


FIG (16)

DIRECT SHEAR TEST

BORE HOLE NO: BH-01
SAMPLE NO : SPT25
DEPTH : 40.5M
C = 0 Kg/cm^2 ϕ = 36^0

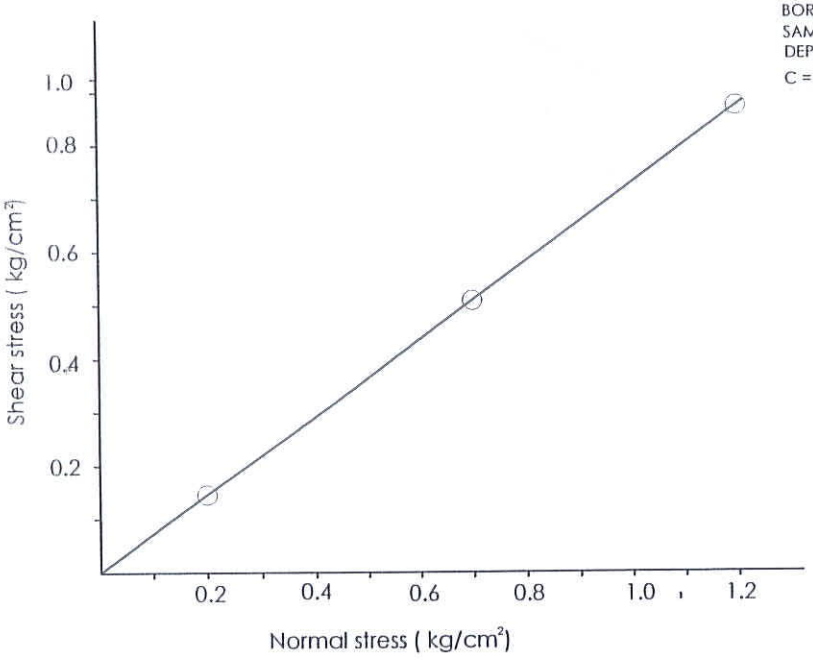


FIG (17)

DIRECT SHEAR TEST

BORE HOLE NO: BH-01
SAMPLE NO : SPT32
DEPTH : 51.0M
C = 0 Kg/cm^2 ϕ = 37^0

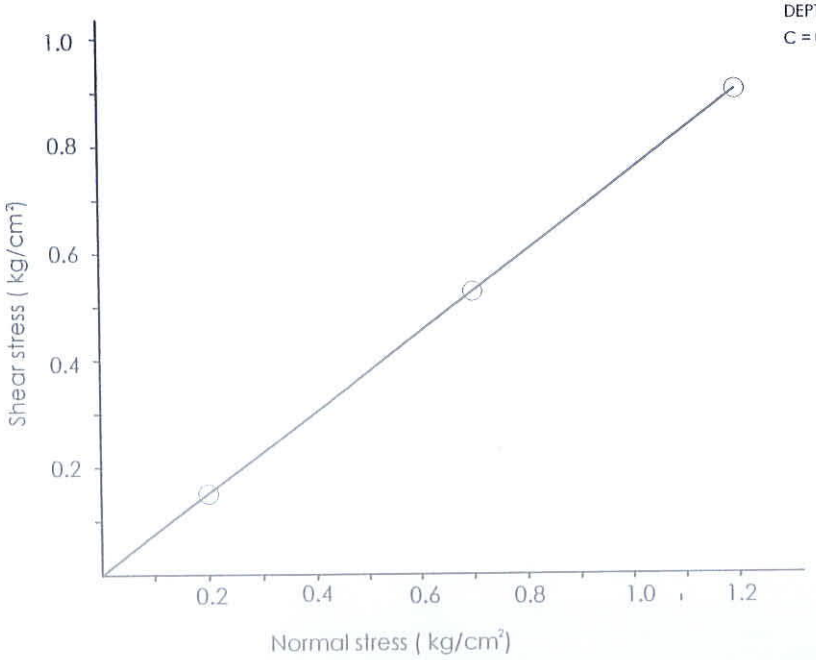


FIG (18)

DIRECT SHEAR TEST

BORE HOLE NO: BH-01
SAMPLE NO : SPT39
DEPTH : 61.5M
C = 0 Kg/cm^2 ϕ = 38^0

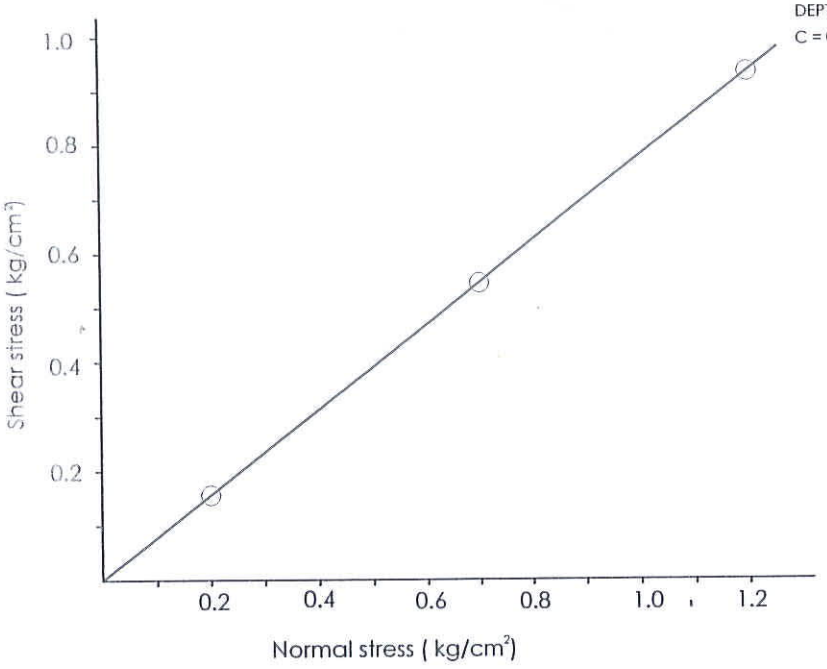


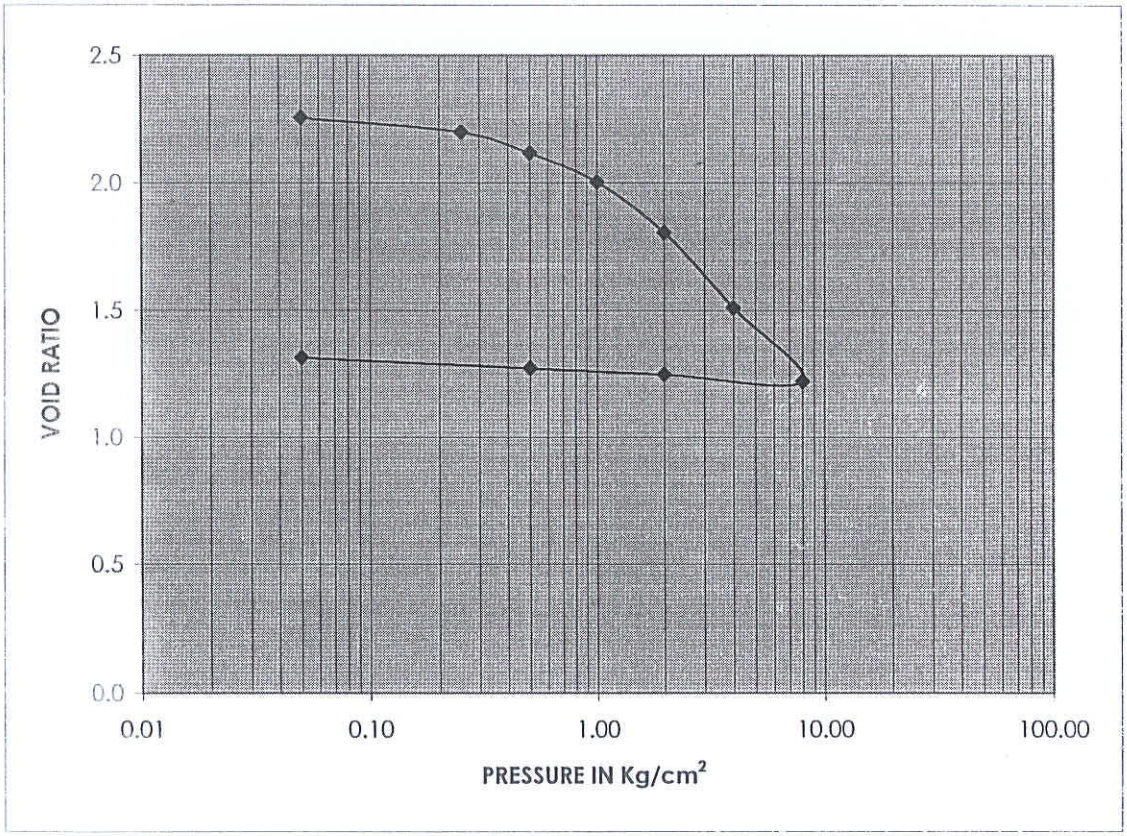
FIG (19)

GEO FOUNDATIONS AND STRUCTURES PVT. LTD

T-1613

Project: Geotechnical Investigation work for the proposed North Jetty

RESULTS OF CONSOLIDATION



VOIDS RATION VS LOG P CURVE

BH NO.	UDS-NO.	DEPTH(M)	Cc	eo
LBH-01	UDS-1	13.50	0.96	2.29

Fig. 20

SOIL INVESTIGATION FOR THE PROPOSED NORTH JETTY

CHEMICAL ANALYSIS ON WATER

BH No.	Test Results		
	Chlorides (PPM)	Sulphates (PPM)	PH Value
1	2870	376	7.5

Permissible Limit as per IS 456:2000

	For PCC	For RCC
Chlorides(PPM)	2000	1000
Sulphates(PPM)	500	500
Ph Value	6 to 9	6 to 9

SOIL INVESTIGATION FOR THE PROPOSED NORTH JETTY

CHEMICAL ANALYSIS ON SOIL

BH No.	Depth(m)	Test Results		
		Chlorides (PPM)	Sulphates (PPM)	PH Value
1	25.5	0.032	Nil	7.5

ANNEXURE-02

BH-01 TO BH-08

(MARINE BOREHOLES)

10.0 SOIL PROFILE

Soil profile for each bore hole is as given below and the location of the borehole is as given in fig.1

BH-01: The top strata upto 29.0m was clayey silt with tracesof sand. Below this very dense silty sand of non plastic nature was observed upto 41.60m. From 41.6m to 49.8m sandy clayey silt with presence of organic matter was encountered followed by very dense silty sand upto 60.0m. The borehole was terminated at 60.0m.

BH-02: The top soil upto 31.90m was clayey silt with traces of sand followed by dense clayey silty sand of low plastic nature upto 43.1m. Below this a layer of hard sandy clayey silt of high plasticity was observed from 43.1m to 48.0m. From 48.0m to 60.0m very dense silty sand of non plastic nature was observed. The borehole was terminated at 60.0m.

BH-03: The top stratum upto 30.5m was sandy clayey silt of medium to high plasticity followed by dense clayey silty sand with presence of organic matter of low plasticity upto 41.9m. From 41.9m to 49.4m hard sandy clayey silt of high plasticity was observed. Very dense silty sand was found from 49.4m to 60.0m i.e. the termination depth in BH-3.

BH-04: In this borehole also the top 26.2m was clayey silt with traces of sand. Below this from 26.2m to 46.0m medium to dense clayey silty sand of low plasticity was observed upto 46.0m. From 46.0m to 60.0m very dense silty sand of non plastic nature was observed.

BH-05: The top 33.1m was clayey silt with traces of sand followed by silty sand with presence of grave and clay upto 47.10m.Below this from 47.1m to 55.0m hard sandy silty clay with gravel of medium plasticity was foound. From 55.0m to

60.0m the stratum observed was silty sand of non plastic nature. The borehole was terminated at 60.0m.

BH-06: The stratum upto 32.1m was sandy clayey silt with presence of gravel followed by dense silty sand wiith presence of gravel upto 47.6m. Below this a layer of decayed wood was found upto 54.0m. From 54.0m to 60.0m again dense sand of non plastic nature was observed. The borehole was terminated at 60.0m.

BH-07: The top soil upto 22.0m was clayey silt with traces of sand of high plasticity followed by medium silty sand of non plastic nature upto 24.5m. From 24.5m to 39.5m medium to very stiff sandy clayey silt of high plasticity was observed. Below this a thin layer of decayed wood ws found upto 41.9m. From 41.9m to 53.4m hard sandy clayey silt of high plasticity was observed followed by silty sand of non plastic nature upto 60.0m i.e.the termination depth in BH-7.

BH-08: The top 5.20m in this borehole was very soft clalyey silt with traces of sand. Belwo this a thin layer of sily sand of non plastic nature was observed from 5.20m to 6.8m followed by medium to very stiff sandy clayey silt of high plasticity upto 33.5m. From 33.5m to 35.8m dense silty sand of non plastic nature was observed. Below this hard sandy clayey silt of medium plasticity was observed upto 43.0m. From 43.0m to 60.0m the stratum was very dense silty sand of non plastic nature. The borehole was terminated at 60.0m.

11.0 DISCUSSION AND TYPE OF FOUNDATION

11.1 The subject study is conducted for the proposal of a Naval Jetty. From the borelogs and result tables it can be obseves that the soil in the shalloe depths is predominently soft clayey strata. The water column is generally varying from 1.90m to 8.7m in the area of study. Considering loads coming from the super

structure, deep foundation shall be a feasible system for the proposed structure.

11.2 With the availability of dense sandy strata(N value >100) at deeper depths, varying from about 44m to 56m below the bed level, cast in situ pile foundation shall be a feasible system.However, to work out the carrying capacity of piles, the borelog data with poor characteristics as generally considered as a design borelog for calculation purposes. In this case, data of BH-08 is considered for the same.

11.3 Bored cast in situ RCC piles by DMC method installed as per the relevant clauses of IS 2911 part1/sec 2 taken upto about 47m including 3.0m in dense sand shall be provided as the foundation. The borelogs and lab results indicate that the capacity of piles needs to be generated from the skin friction as well as end bearing. To ensure the end bearing resistence of pile, care shall be taken to terminate the piles after anchoring them by 3m in dense sandy strata. Safe carrying capacities for different diameters of piles are tabulated as given below in **Table No.11.1**. A factor of safety of 2.5 is considered for calculating the safe capacities.

Table No: 7.1

Dia (cm)	Safe Capacity (T)
90	250
100	310
120	470

11.4 Permenent MS liners may be necessary to facilitate the construction of foundation workas well as to restrict the effect of scouring, if any, during the course of usage of jetty.

12.0 METHOD OF COMPUTING OF SAFE BEARING CAPACITY FOR R.C.C. BORED CAST IN SITU PILE

Safe capacity of RCC Bored cast-in-situ pile can be computed by using the formula given in IS: 2911 (Part-1/Sec-2)-1979:

Ultimate bearing capacity Qu of piles in Cohesion less soil:

$$Qu = Ap(0.5.D.\gamma.N\gamma + PD.Nq) + \sum_{I=1}^{n} k .PDi .\tan \delta . Asi$$

Where,

Ap= Cross sectional area of pile toe in cm^2

D= Stem dia. in cm

γ= effective unit weight of soil at pile toe in kg /cm^3

PD = effective overburden pressure in Kg / cm^2

$N\gamma$ and Nq = bearing capacity factors depending upon the angle of internal friction Ø at toe

$\sum_{I=1}^{I=n}$ = Summation of N layers in which pile is installed

K = Coefficient of earth pressure

PDi = effective overburden pressure in Kg /cm^2 for the ith layer where i varies from 1 to n.

δ= angle of wall friction between pile and soil in degree (may be taken equal to Ø)

Asi= Surface area of pile stem in cm^2 in the ith layer where i varies from 1 to n.

For cohesive soil:-

Safe capacity of pile = 1/F (AP.Nc.Cp + a. C.As)

Where

Ap- c/s area of pile toe in cm^2

Nc- bearing capacity factor

Cp- average cohesion at pile tip in Kg/cm^2

α - Reduction factor

C – average cohesion throughout the length of pile in Kg/cm^2

S- Surface area of pile shaft in cm^2

F - Factor of safety.

13.0 CONCLUDING REMARKS

13.1RCC bored cast in situ piles shall be provided as the foundation for the proposed Jetty. Piles shall be taken to a depth of about 47m including 3m in dense sandy strata (N value >100) shall be taken as the foundation. The safe capacity for different diameters of piles is given in table No.13.1.

Table No: 13.1

Dia (cm)	Safe Capacity (T)
90	250
100	310
120	470

For GEO FOUNDATIONS & STRUCTURES PVT. LTD.

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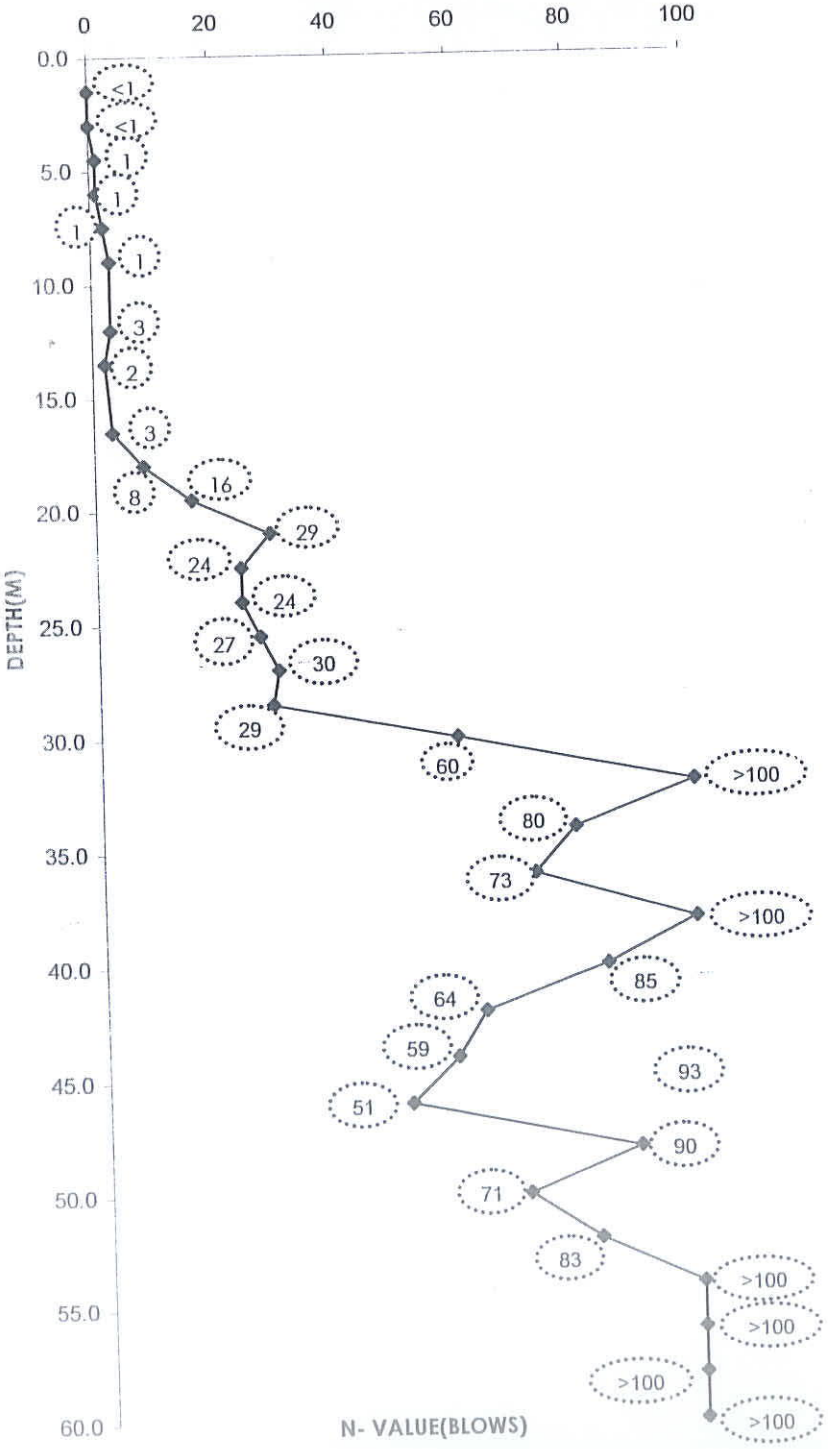
M.Tech (Geotechnical Engg.)
SR. GENERAL MANAGER

Geo Foundations & Structures Pvt. Ltd. * KOCHI 682 020

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED OF NORTH JETTY

GEO FOUNDATIONS & STRUCTURES PVT. LTD	Bore Hole No	: BH-01	Boring Started	: 28.12.2012	T-1613
	Type of Boring	: Rotary	Boring Completed	: 30.12.2012	
	Termination Depth	: 60.00 M	High Tide Water	: 7.40 m	
			Low Tide Water	: 6.80 m	

GRAPHICAL REPRESENTATION OF N VALUE



BORE HOLE TERMINATED AT 60.0 M

FIG. 21

Geo Foundations Structures Pvt. Ltd

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY

GEO FOUNDATIONS & STRUCTURES PVT. LTD

Bore Hole No : **BH-01** | Boring Started : 28.12.2012

Type of Boring : Rotary | Boring Completed : 30.12.2012

Termination Depth : **60.0m** | Length of water column : 7.40m

Co-ordinates: Lat - 9°57'34.32"N, Long - 76°16'45.56"E

T-1613

LOCATION : INS VENDURUTHY(UNDER WATER BORING)

SOIL PROFILE	THICKNESS OF STRATA (m)	DESCRIPTION OF STRATA	IS CLASSIFICATION	DEPTH (m)	SAMPLES	BLOWS/15cm			SPT " N "	Rock Core characteristics			REMARKS
					TEST DEPTH IN m	15cm	15cm	15cm		C.R (%)	R.Q.D (%)	UCS KG/CM²	
	7.40	WATER											
		EXISTING BED LEVEL		0.00									
	24.0	Clayey silt with traces of sand(Grey)		1.50	1.50-1.95	1	0	0	<1				
				3.00	3.00-3.45	1	0	0	<1				
				4.50	4.50-4.95	1	0	1	<1				
				6.00	6.00-6.45	1	0	1	1				
				7.00	7.00-7.45	VST-1							
				7.50	7.50-7.95	1	1	1	2				
				9.00	9.00-9.45	1	1	2	3				
				10.5	10.5-10.95	UDS-1							
				11.0	11.0-11.45	VST-2							
				12.0	12.0-12.45	1	2	1	3				
				13.5	13.5-13.95	1	1	1	2				
				15.0	15.0-15.45	UDS-2							
				16.5	16.5-16.95	1	1	2	3				
				18.0	18.0-18.45	3	4	4	8				
				19.5	19.5-19.95	6	7	9	16				
				21.0	21.0-21.45	8	14	15	29				
				22.5	22.5-22.95	6	11	13	24				
		Clayey silt with traces of sand(Pale grey)		24.0	24.0-25.45	8	10	14	24				

(Contd.....fig. 3)

Note : UDS- Undisturbed Sample

SPT "N"-Standard Penetration Test "N"

Fig : 22

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY

GEO FOUNDATIONS & STRUCTURES PVT. LTD

Bore Hole No	: BH-01	Boring Started	: 28.12.2012
Type of Boring	: Rotary	Boring Completed	: 30.12.2012
Termination Depth	: 60.0m	Length of water column	: 7.40m
Co-ordinates: Lat - 9°57'34.32"N, Long - 76°16'45.56"E			

T-1613

LOCATION : INS VENDURUTHY

SOIL PROFILE	THICKNESS OF STRATA (m)	DESCRIPTION OF STRATA	IS CLASSIFICATION	DEPTH (m)	SAMPLES TEST DEPTH IN m	BLOWS/15cm 15cm	15cm	15cm	SPT "N"	Rock Core characteristics C.R (%)	R.Q.D (%)	UCS KG/CM²	REMARKS
	5.00	Clayey silt with traces of sand(Grey)	CH	25.5	25.5-25.95	7	10	17	27				
				27.0	27.0-27.45	8	13	17	30				
				28.5	28.5-28.95	8	16	13	29				
	12.60	Silty sand(Grey)	SM	30.0	30.0-30.45	14	27	33	60				
				32.0	32.0-32.45	23	51	49	>100				41/45cm penetration
				34.0	34.0-34.45	19	33	47	80				
				36.0	36.0-36.45	17	29	44	73				
				38.0	38.0-38.45	18	49	51	>100				43/45cm penetration
				40.0	40.0-40.45	21	38	47	85				
				42.0	42.0-42.45	19	29	35	64				
	8.20	Sandy clayey silt with presence of organic matter(Yellow)	CH	44.0	44.0-44.45	18	23	36	59				
				46.0	46.0-46.45	16	20	31	51				
				48.0	48.0-48.45	21	37	53	90				
				50.0	50.0-50.45	20	31	40	71				
	10.20	Silty sand(Grey)	SM	52.0	52.0-52.45	23	36	47	83				
				54.0	54.0-54.45	37	41	59	100				
				56.0	56.0-56.45	29	61	39	>100				38/45cm penetration
				58.0	58.0-58.45	31	72	28	>100				33/45cm penetration
				60.0	60.0-60.45	61	100	-	>100				30/45cm penetration

Termination Depth : 60.0m

Note : UDS- Undisturbed Sample

SPT "N"-Standard Penetration Test "N"

Fig : 23

NAME OF WORK:SOIL INVESTIGATION WORK FOR THE PROPOSED RECONSTRUCTION OF NORTH JETTY

LOCATION: NAVAL BASE

Hide Tide Water : 7.40 M
Low Tide water : 6.80 M

Date of Boring Started : 28.12.2012
Date of Boring Completed : 30.12.2012
Termination Depth : 60.00 M

Table No.4

T-1613

Bld-01

N	DEPTH(M)	SAMPLE	SOIL DESCRIPTION	I.S. CLASSIFICATION	GRAIN SIZE ANALYSIS(%) IS 2720(Part5):1985				NMC(%) IS 2720 (Part2):1973	ATTERBERG'S LIMIT(%)-IS 2720(Part-5): 1985			SL (%)IS 2720(Part6): 1972	FSI (%) IS2720 (Part40):1977	SPG(IS 2720(Part-3/sec1):1980	UNIT WEIGHT (gm/cc)		SHEAR PARAMETERS-IS 2720(Part-13):1986		
					GRA - VEL	SAND	SILT,	CLAY		LL	PL	PI				WET	DRY	METHOD	C kg/cm²	Ø (°)
BOREHOLE BH/01																				
<1	1.50	SPT1	Clayey Silt with Traces of Sand (Grey)	CH	0	2	63	35	118	130	36	94								
<1	3.00	SPT2	Clayey Silt with Traces of Sand (Grey)	CH																
1	4.50	SPT3	Clayey Silt with Traces of Sand (Grey)	CH	0	3	49	48	83											
1	6.00	SPT4	Clayey Silt with Traces of Sand (Grey)	CH	0	4	51	45	82	108	33									
-	7.00	VST-1	Clayey Silt with Traces of Sand (Grey)	CH														VST	0.02	-
2	7.50	SPT5	Clayey Silt with Traces of Sand (Grey)	CH																
3	9.00	SPT6	Clayey Silt with Traces of Sand (Grey)	CH	0	5	52	43	80											
-	10.5	UDS1	Clayey Silt with Traces of Sand (Grey)	CH	0	4	51	45	90	98	37				2.36	1.62	0.85	Triaxial	0.16	0
	11.0	VST-2	Clayey Silt with Traces of Sand (Grey)	CH														VST	0.08	-
3	12.0	SPT7	Clayey Silt with Traces of Sand (Grey)	CH																
2	13.5	SPT8	Clayey Silt with Traces of Sand (Grey)	CH	0	4	55	41	75											
-	15.0	UDS2	Clayey Silt with Traces of Sand (Grey)	CH	0	3	50	47	93	104	35				2.35	1.55	0.80	UCS	0.15	-
3	16.5	SPT9	Clayey Silt with Traces of Sand (Grey)	CH																
8	18.0	SPT10	Sandy Silty Clay with Gravel and presence of shell dust (G/Yellow)	CH	12	18	19	51	66											
16	19.5	SPT11	Clayey Silt with Traces of Sand (Grey)	CH	0	5	42	53	62	74	35	39								
29	21.0	SPT12	Clayey Silt with Traces of Sand (Grey)	CH																

NAME OF WORK:SOIL INVESTIGATION WORK FOR THE PROPOSED RECONSTRUCTION OF NORTH JETTY

LOCATION: NAVAL BASE

Hide Tide Water : 7.40 M
Low Tide water : 6.80 M

Date of Boring Started : 28.12.2012
Date of Boring Completed : 30.12.2012
Termination Depth : 60.00 M

Table No.5

T-1613

N	DEPTH(M)	SAMPLE	SOIL DESCRIPTION	I.S. CLASSIFICATION	GRAIN SIZE ANALYSIS(%) IS 2720(Part5):1985				IS NMC(%) 2720 (Part2):1973	ATTERBERG'S LIMIT(%)-IS 2720(Part-5): 1985			SL (%)IS 2720(Part6): 1972	FSI (%) IS2720 (Part40):1977	SPG(IS 2720(Part-3/sec1):1980	UNIT WEIGHT (gm/cc)		SHEAR PARAMETERS-IS 2720(Part-13):1986		
					GRA - VEL	SAND	SILT,	CLAY		LL	PL	PI				WET	DRY	METHOD	C kg/cm²	Ø (°)
BOREHOLE BH/01																				
24	22.5	SPT13	Clayey Silt with Traces of Sand (P/Grey)	CH	0	6	45	49												
24	24.0	SPT14	Clayey Silt with Traces of Sand (P/Grey)	CH	0	8	28	64	59	78	37	41			2.42	1.76	1.11	UCS	0.95	-
27	25.5	SPT15	Clayey Silt with Traces of Sand (Grey)	CH																
30	27.0	SPT16	Clayey Silt with Traces of Sand (Grey)	CH	0	9	30	61	62											
29	28.5	SPT17	Clayey Silt with Traces of Sand (Grey)	CH																
60	30.0	SPT18	Silty Sand (Grey)	SM	0	82	18	0	17	No Limit										
>100	32.0	SPT19	Silty Sand (Grey)	SM																
80	34.0	SPT20	Silty Sand (Grey)	SM	0	62	38	0	28	No Limit					2.61	1.92	1.50	DST	0	35
73	36.0	SPT21	Silty Sand (Grey)	SM																
>100	38.0	SPT22	Silty Sand (Grey)	SM	0	64	36	0	30	No Limit										
85	40.0	SPT23	Silty Sand (Grey)	SM																
64	42.0	SPT24	Sandy Clayey Silt with presence of Organic Matter (Yellow)	CH	0	22	46	32	33	62	28									
59	44.0	SPT25	Sandy Clayey Silt with presence of Organic Matter (Yellow)	CH																
51	46.0	SPT26	Sandy Clayey Silt with presence of Organic Matter (Yellow)	CH	0	25	41	34	29	65	27				2.46	1.82	1.10	UCS	1.46	-
90	48.0	SPT27	Sandy Clayey Silt with presence of Organic Matter (Yellow)	CH																
71	50.0	SPT28	Silty Sand (Grey)	SM	0	66	34	0	17	No Limit										
83	52.0	SPT29	Silty Sand (Grey)	SM	0	68	32	0	16	No Limit										
100	54.0	SPT30	Silty Sand (Grey)	SM	0	77	23	0	15	No Limit										
>100	56.0	SPT31	Silty Sand (Grey)	SM																

NAME OF WORK:SOIL INVESTIGATION WORK FOR THE PROPOSED RECONSTRUCTION OF NORTH JETTY

LOCATION: NAVAL BASE

Hide Tide Water : 7.40 M

Low Tide water : 6.80 M

Date of Boring Started : 28.12.2012

Date of Boring Completed : 30.12.2012

Termination Depth : 60.00 M

Table No.6

T-1613

N	DEPTH(M)	SAMPLE	SOIL DESCRIPTION	I.S. CLASSIFICATION	GRAIN SIZE ANALYSIS(%) IS 2720(Part5):1985				IS NMC(%) 2720 (Part2):1973	ATTERBERG'S LIMIT(%)-IS 2720(Part-5): 1985			SL (%)IS 2720(Part6): 1972	FSI (%) IS2720 (Part40):1977	SPG(IS 2720(Part-3/sec1):1980	UNIT WEIGHT (gm/cc)		SHEAR PARAMETERS-IS 2720(Part-13):1986		
					GRA - VEL	SAND	SILT,	CLAY		LL	PL	PI				WET	DRY	METHOD	C kg/cm²	Ø (°)
BOREHOLE BH/01																				
>100	58.0	SPT32	Silty Sand (Grey)	SM	0	75	25	0	16	No Limit					2.65	2.11	1.82	DST	0	38
>100	60.0	SPT33	Silty Sand (Grey)	SM	0	79	21	0	17	No Limit										

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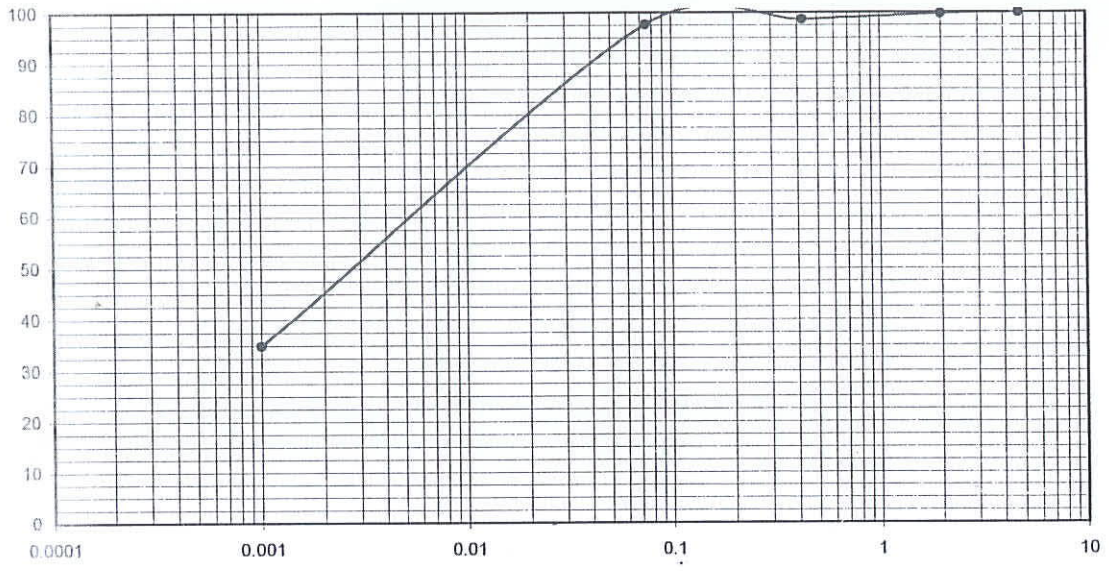
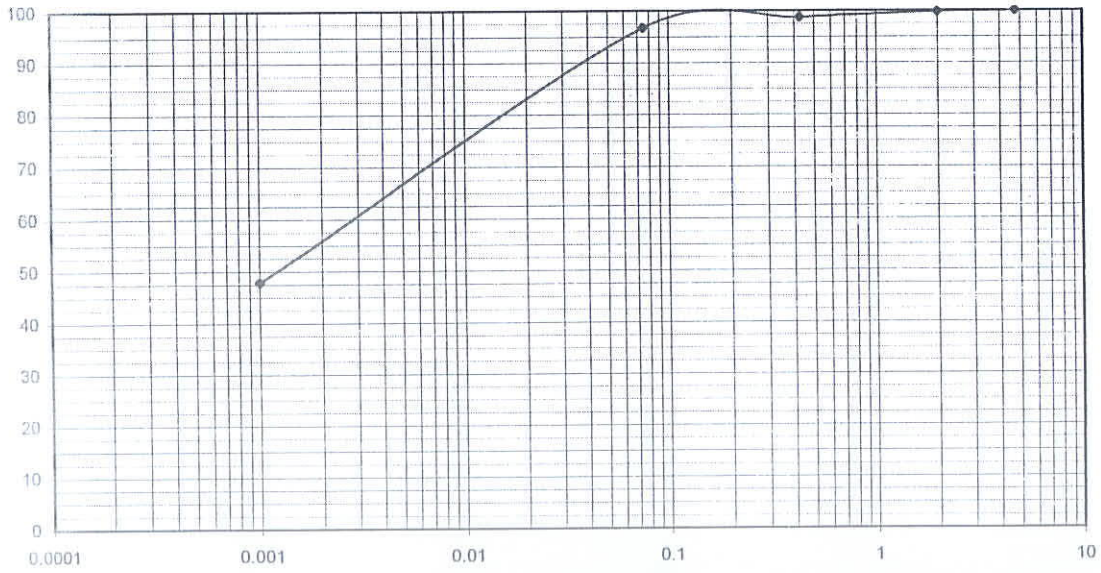
T-1613

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY AT NAVAL BASE

GRAINSIZE ANALYSIS TEST



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	Cu
BH-01	1.50	CH	0	2	63	35			



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	D0
BH-01	4.50	CH	0	3	49	48			

FIG. 24

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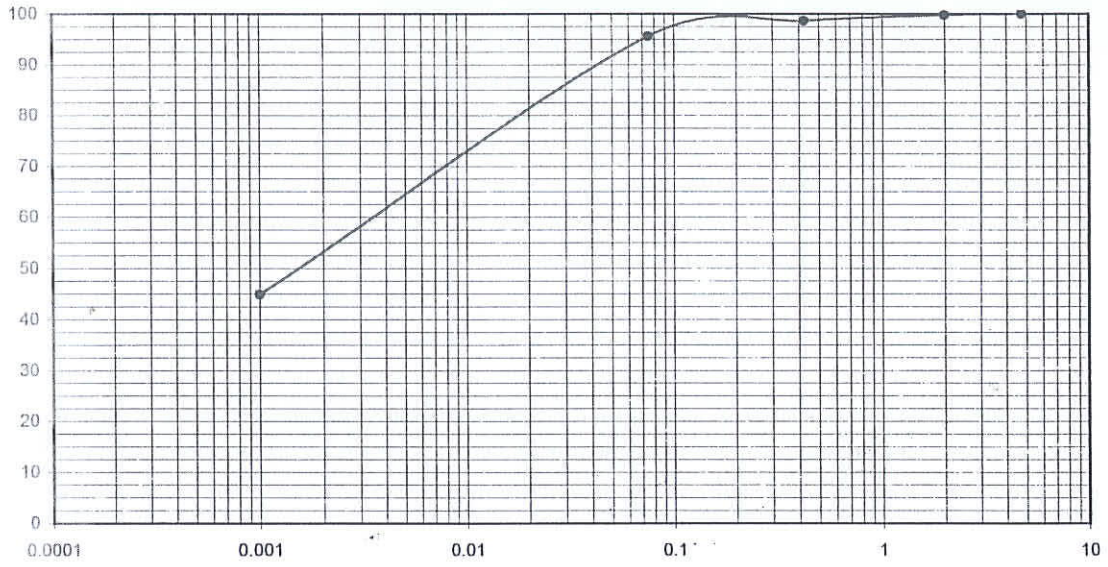
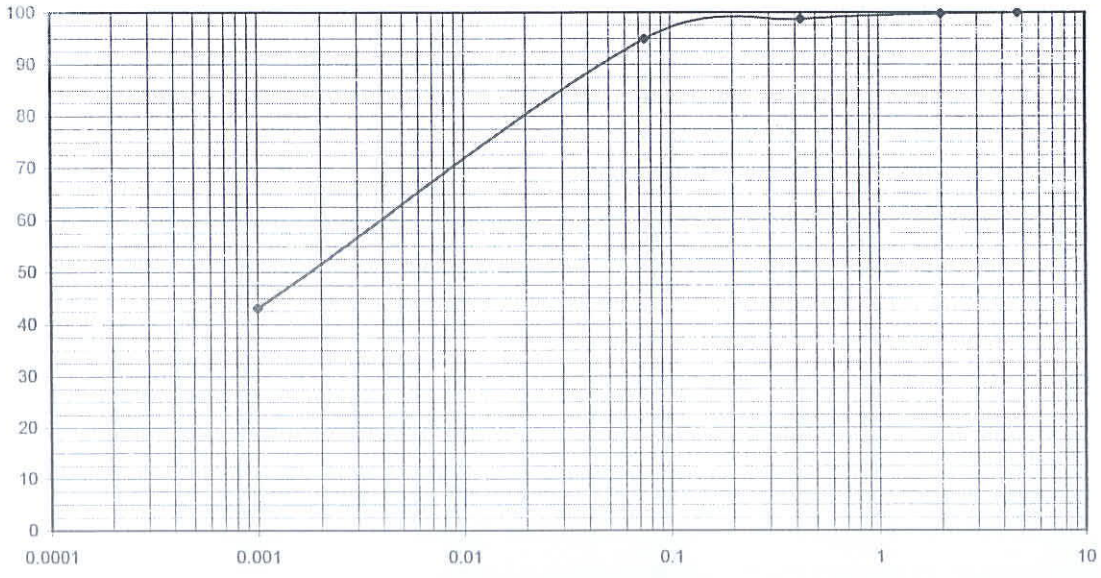
T-1613

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY AT NAVAL BASE

GRAINSIZE ANALYSIS TEST



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	Cu
BH-01	6.00	CH	0	4	51	45			



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	D0
BH-01	9.00	CH	0	5	52	43			

FIG. 25

Geo Foundations Structures Pvt Ltd

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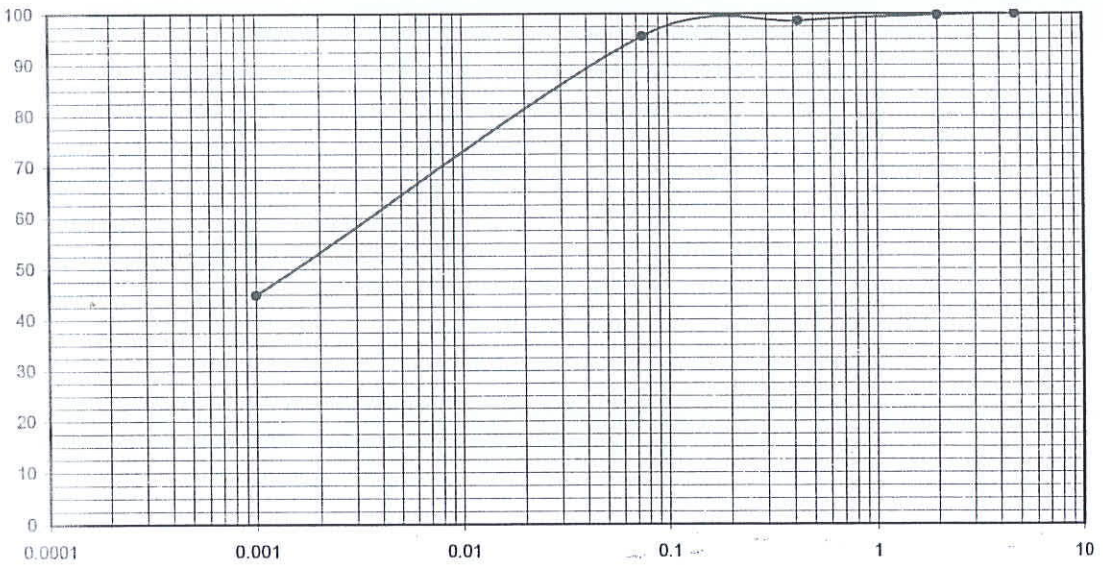
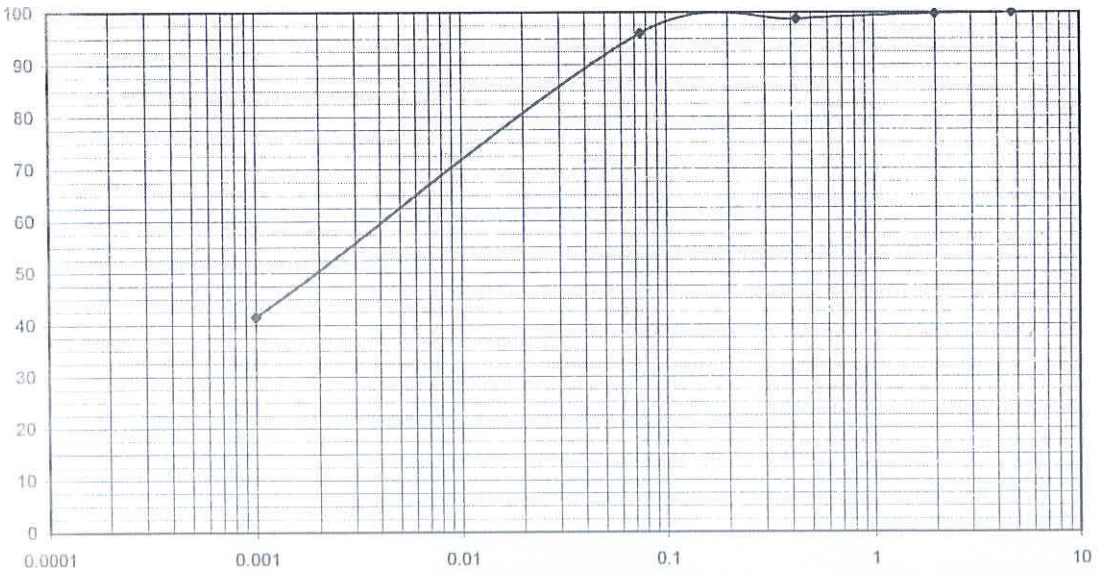
T-1613

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY AT NAVAL BASE

GRAINSIZE ANALYSIS TEST



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	Cu
BH-01	10.50	CH	0	4	51	45			



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	D0
BH-01	13.50	CH	0	4	55	41			

FIG. 26

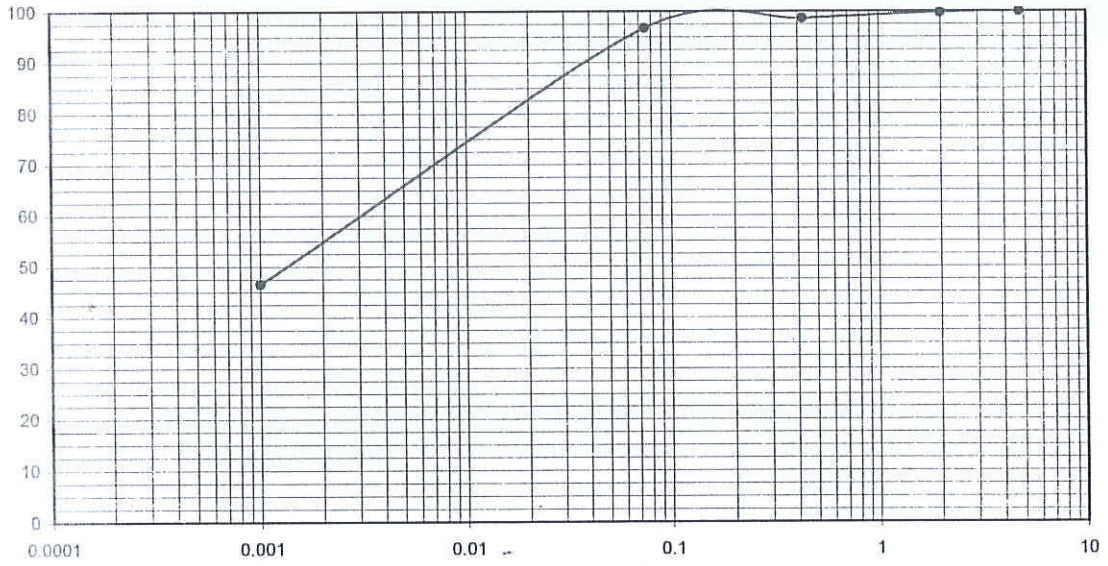
Geo Foundations Structures Pvt Ltd

GEO FOUNDATIONS AND STRUCTURES PVT. LTD

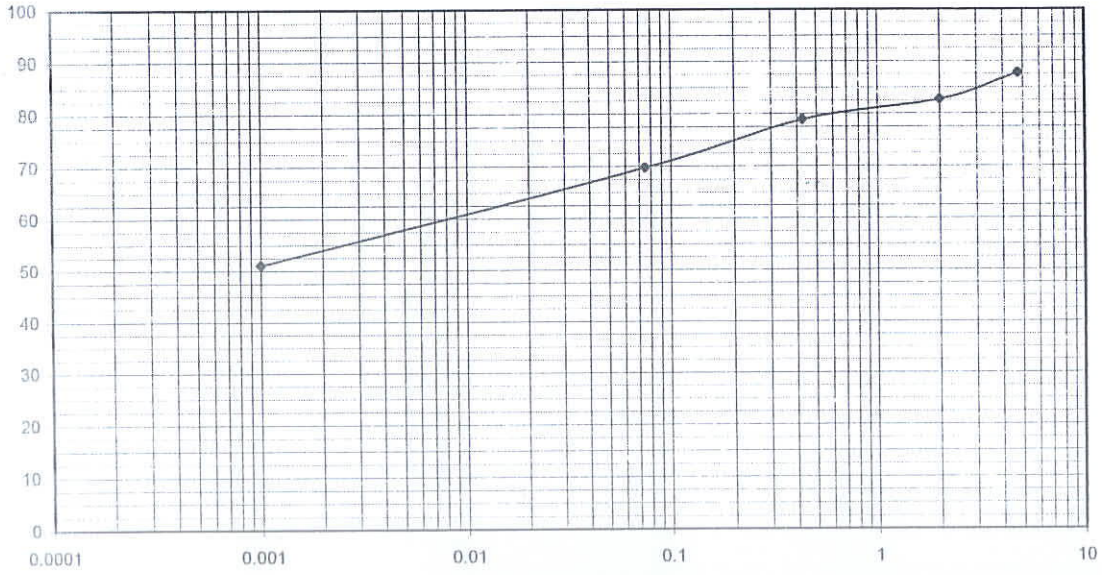
T-1613

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY AT NAVAL BASE

GRAINSIZE ANALYSIS TEST



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	Cu
BH-01	15.00	CH	0	3	50	47			



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	D0
BH-01	18.00	CH	12	18	19	51			

FIG. 27

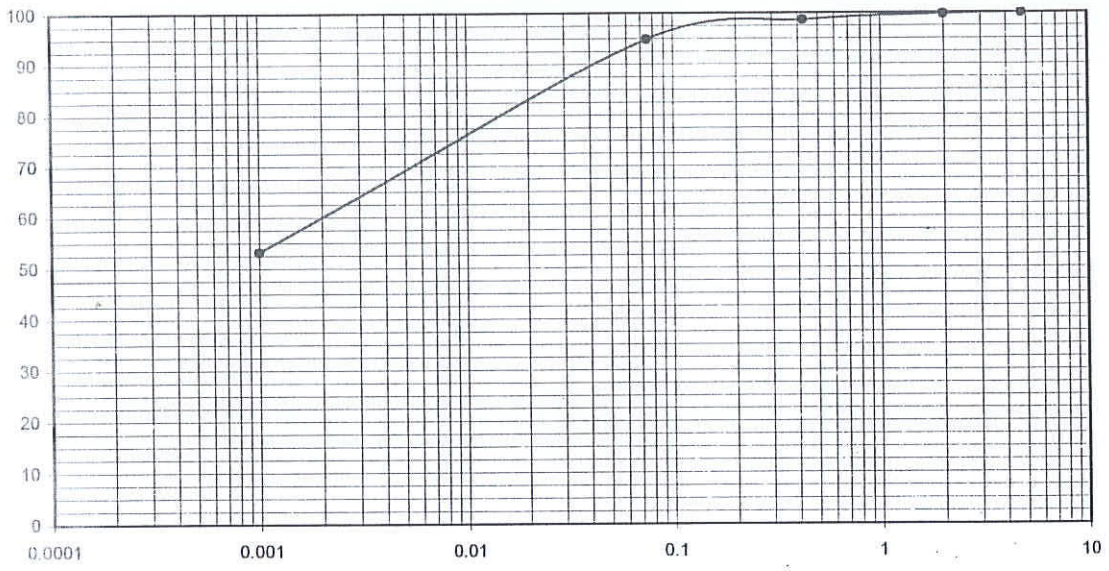
Geo Foundations Structures Pvt Ltd

GEO FOUNDATIONS AND STRUCTURES PVT. LTD

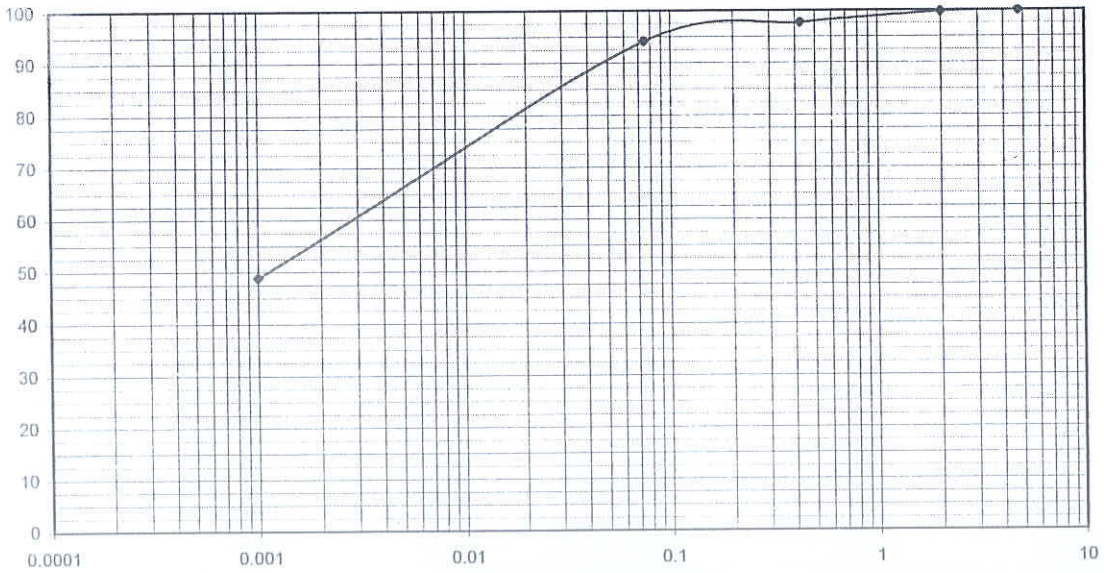
T-1613

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY AT NAVAL BASE

GRAINSIZE ANALYSIS TEST



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	Cu
BH-01	19.50	CH	0	5	42	53			



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	D0
BH-01	22.50	CH	0	6	45	49			

FIG. 28

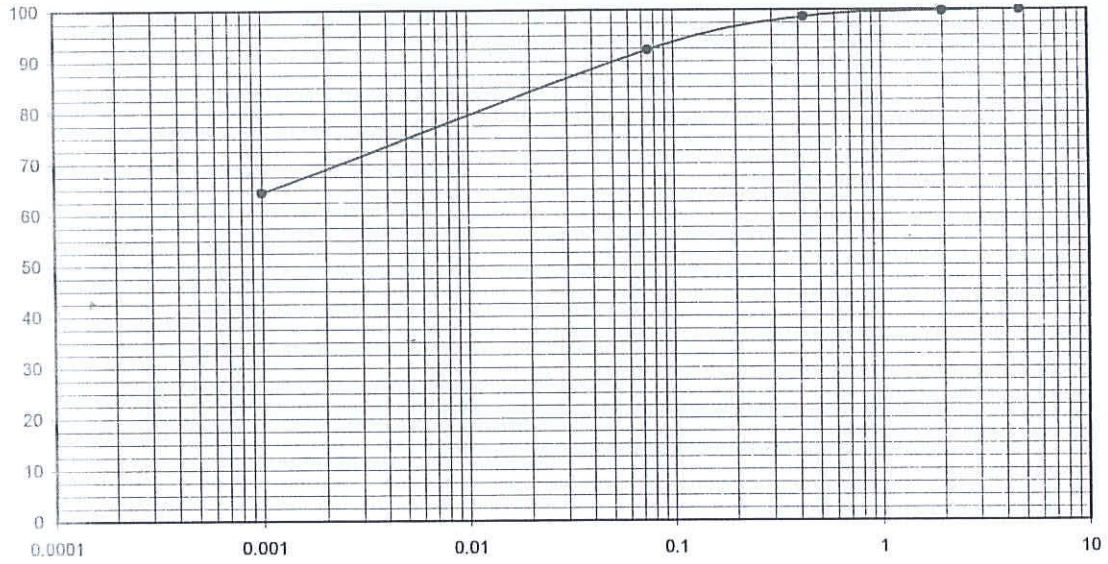
Geo Foundations Structures Pvt Ltd

GEO FOUNDATIONS AND STRUCTURES PVT. LTD

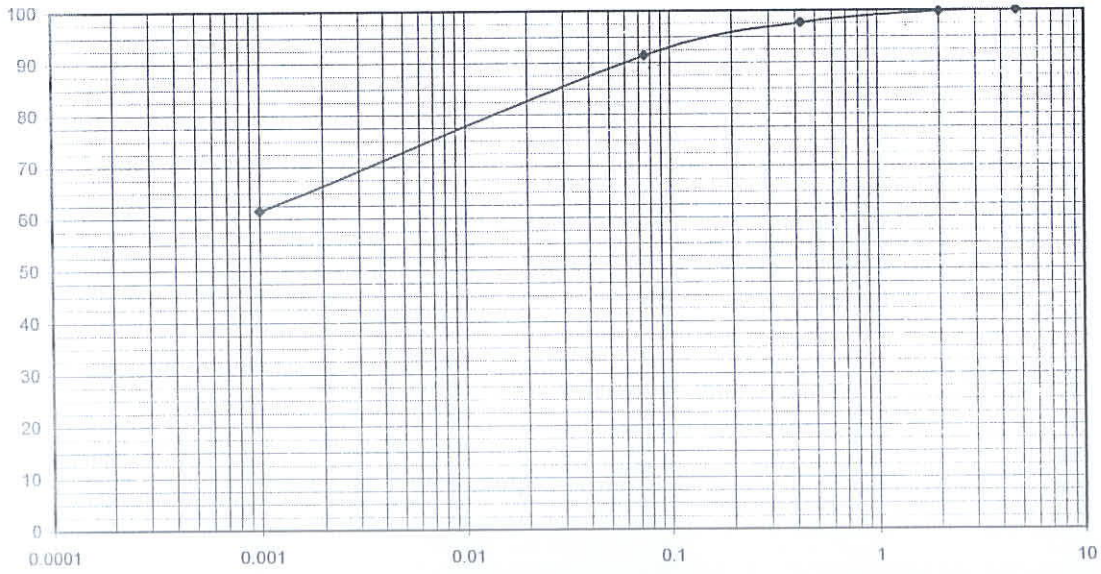
T-1613

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY AT NAVAL BASE

GRAINSIZE ANALYSIS TEST



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	Cu
BH-01	24.00	CH	0	8	28	64			



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	D0
BH-01	27.00	CH	0	9	30	61			

FIG. 29

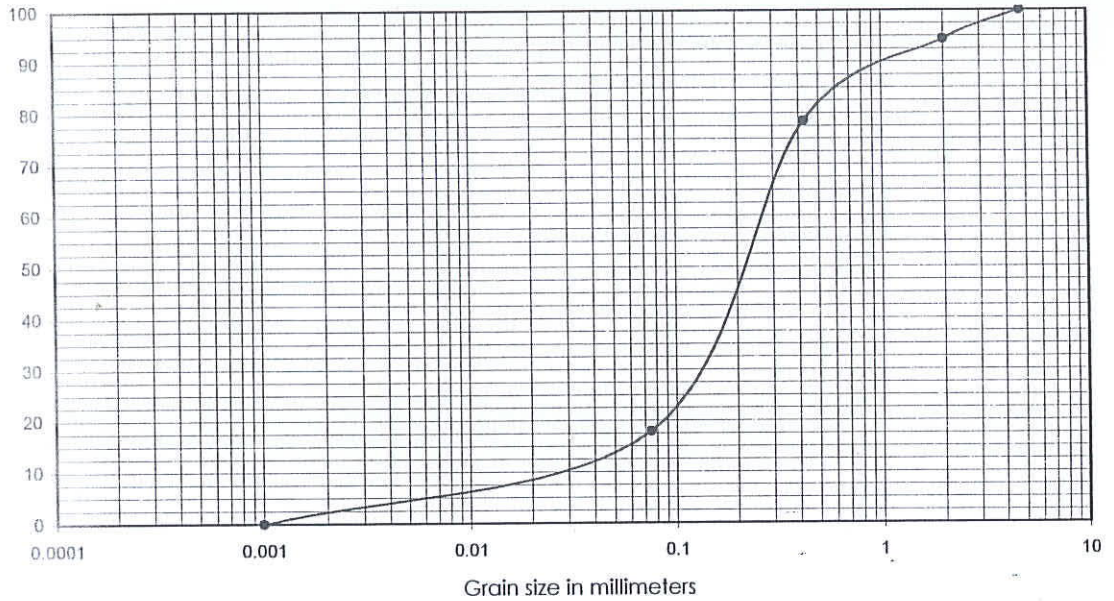
Geo Foundations Structures Pvt Ltd

GEO FOUNDATIONS AND STRUCTURES PVT. LTD

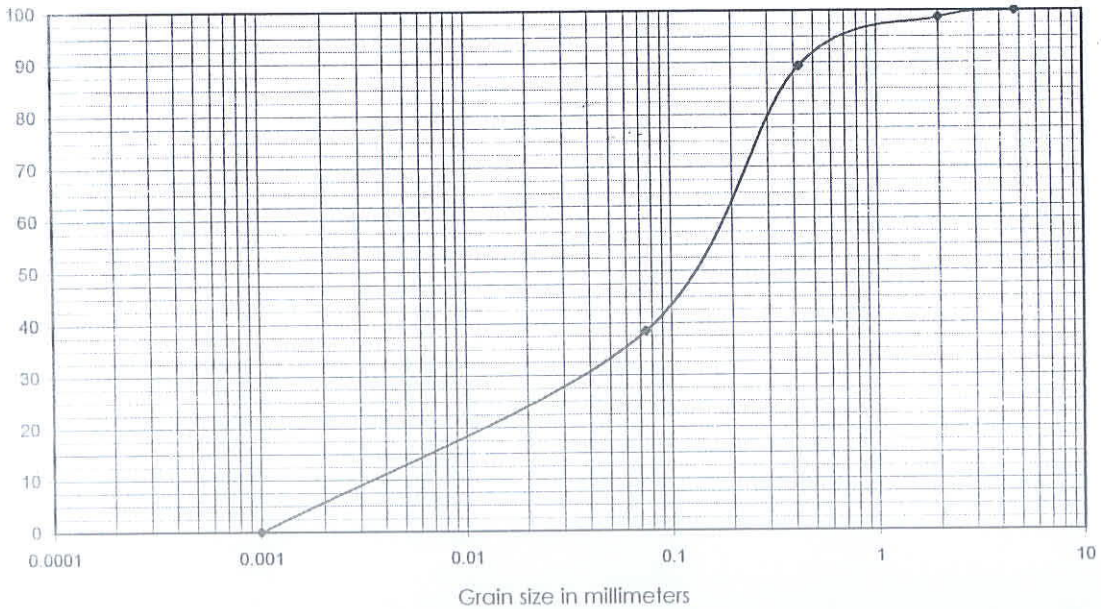
T-1613

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY AT NAVAL BASE

GRAINSIZE ANALYSIS TEST



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	Cu
BH-01	30.00	SM	0	82	18	0			



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	D0
BH-01	34.00	SM	0	62	38	0			

FIG. 30

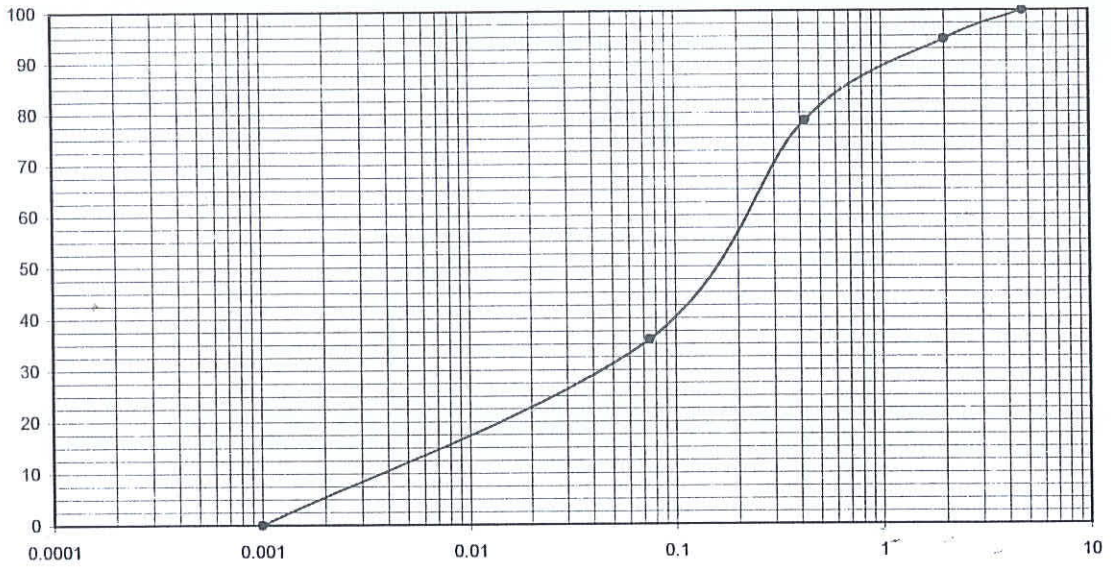
Geo Foundations Structures Pvt Ltd

GEO FOUNDATIONS AND STRUCTURES PVT. LTD

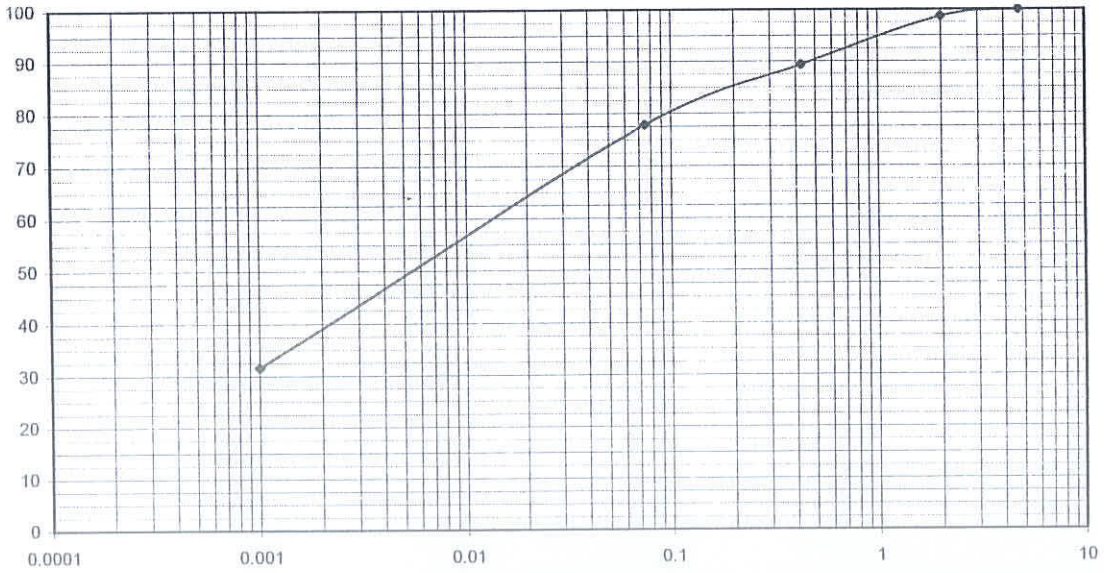
T-1613

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY AT NAVAL BASE

GRAINSIZE ANALYSIS TEST



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	Cu
BH-01	38.00	SM	0	64	36	0			



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	D0
BH-01	42.00	CH	0	22	46	32			

FIG. 31

Geo Foundations Structures Pvt Ltd

GEO FOUNDATIONS AND STRUCTURES PVT. LTD

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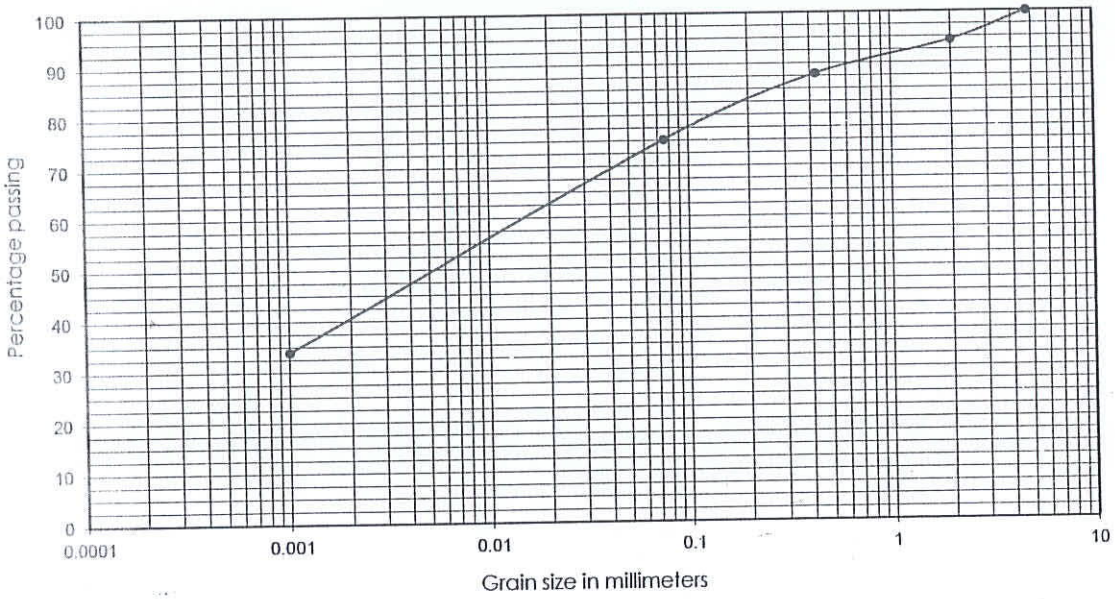
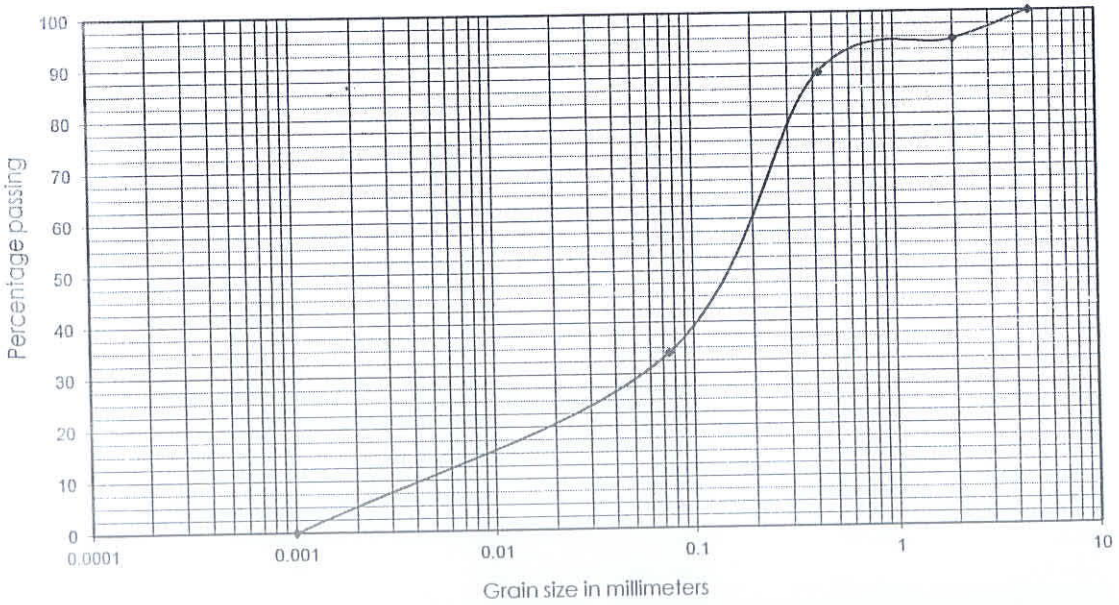
PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY AT NAVAL BASE

GRAINSIZE ANALYSIS TEST



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	Cu
BH-01	46.00	CH	0	25	41	34			



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	D0
BH-01	50.00	SM	0	66	34	0			

FIG. 32

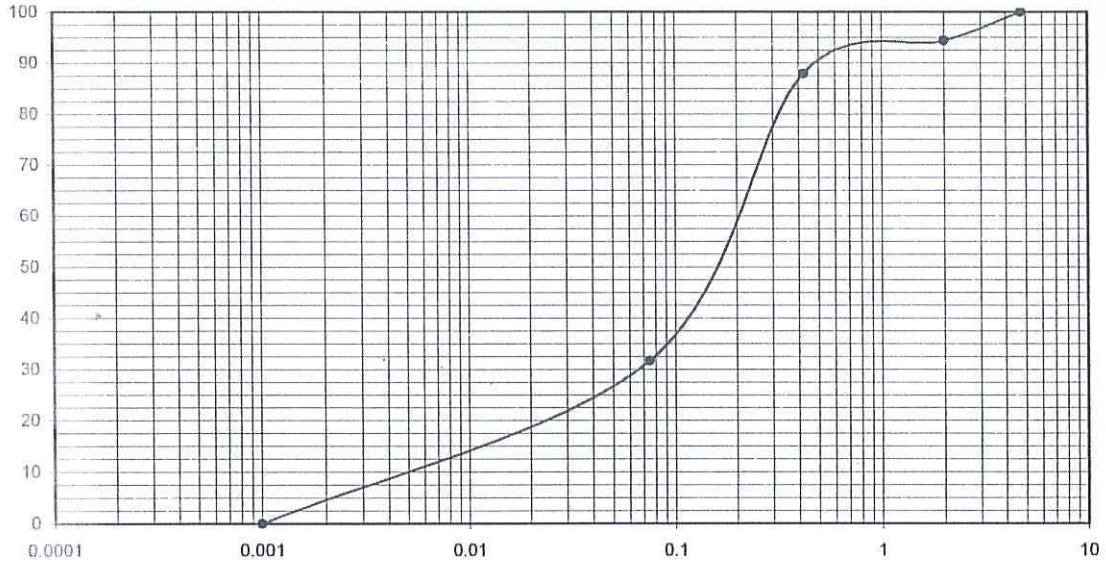
Geo Foundations Structures Pvt Ltd

GEO FOUNDATIONS AND STRUCTURES PVT. LTD

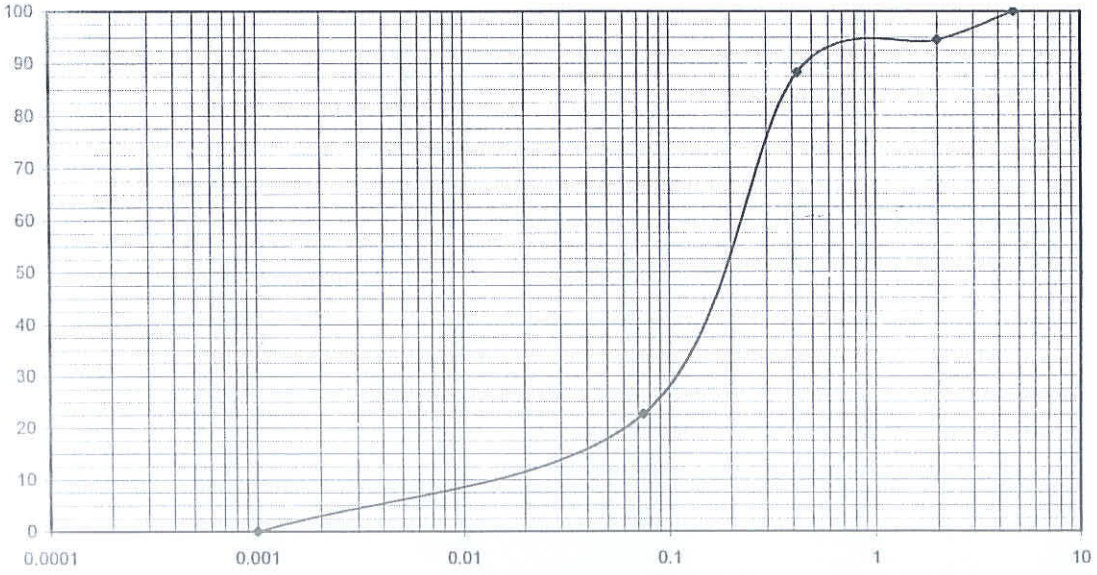
T-1613

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY AT NAVAL BASE

GRAINSIZE ANALYSIS TEST



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	Cu
BH-01	52.00	SM	0	68	32	0			



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	D0
BH-01	54.00	SM	0	77	23	0			

FIG. 33

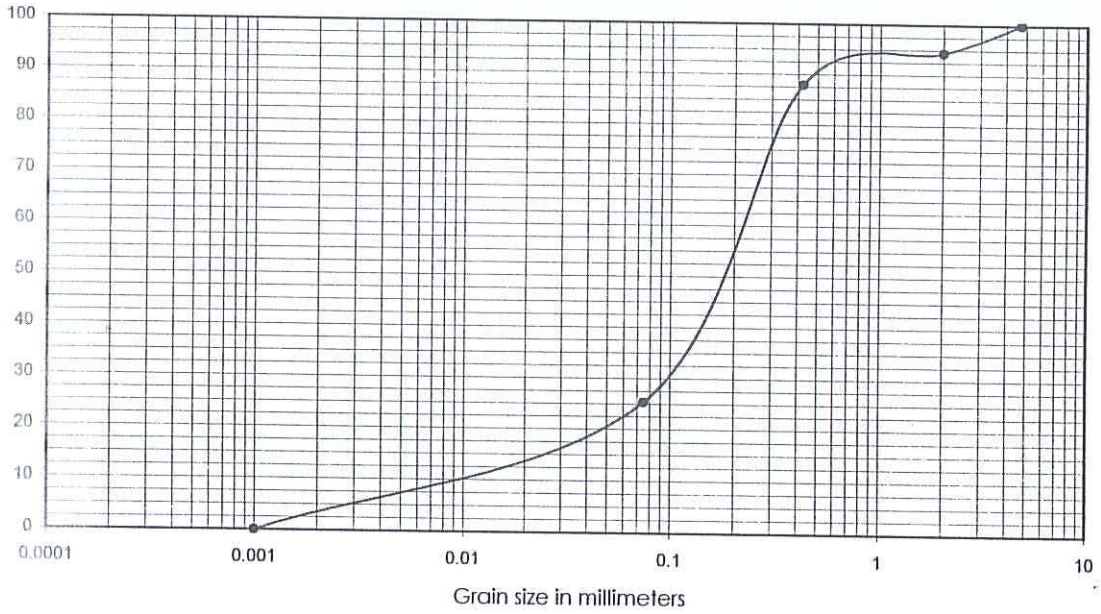
Geo Foundations Structures Pvt Ltd

GEO FOUNDATIONS AND STRUCTURES PVT. LTD

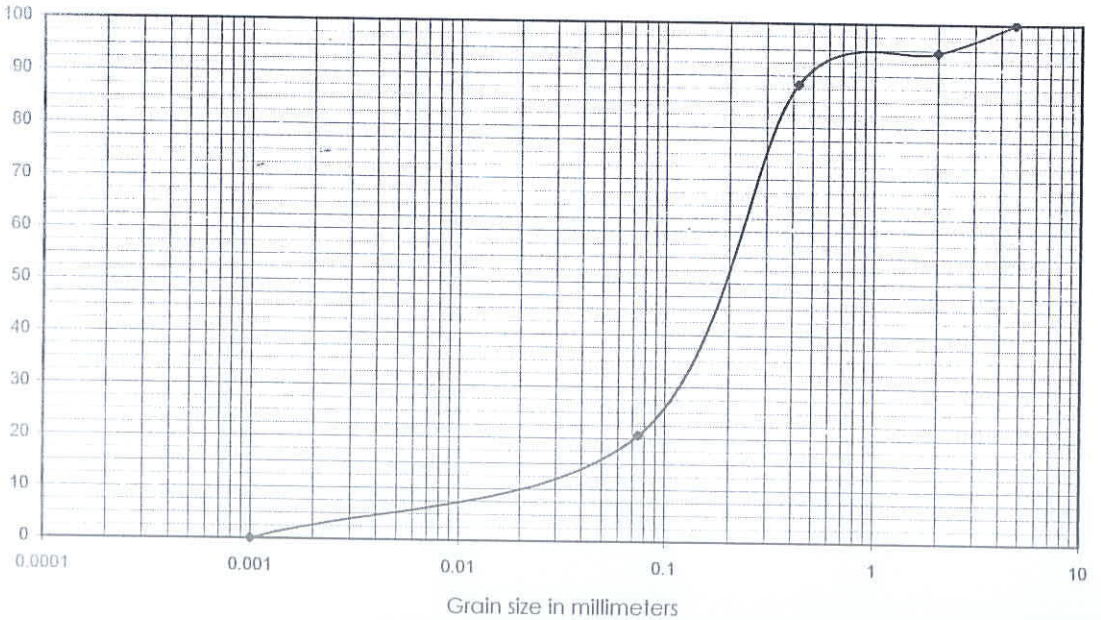
T-1613

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY AT NAVAL BASE

GRAINSIZE ANALYSIS TEST



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	Cu
BH-01	58.00	SM	0	75	25	0			



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	D0
BH-01	60.00	SM	0	79	21	0			

FIG. 34

Geo Foundations Structures Pvt Ltd

TRI AXIAL TEST

BORE HOLE NO:BH-01
SAMPLE NO : UDS-1
DEPTH : 10.5 M
C = 0.16Kg/cm^2 ϕ = 0 ^{0}

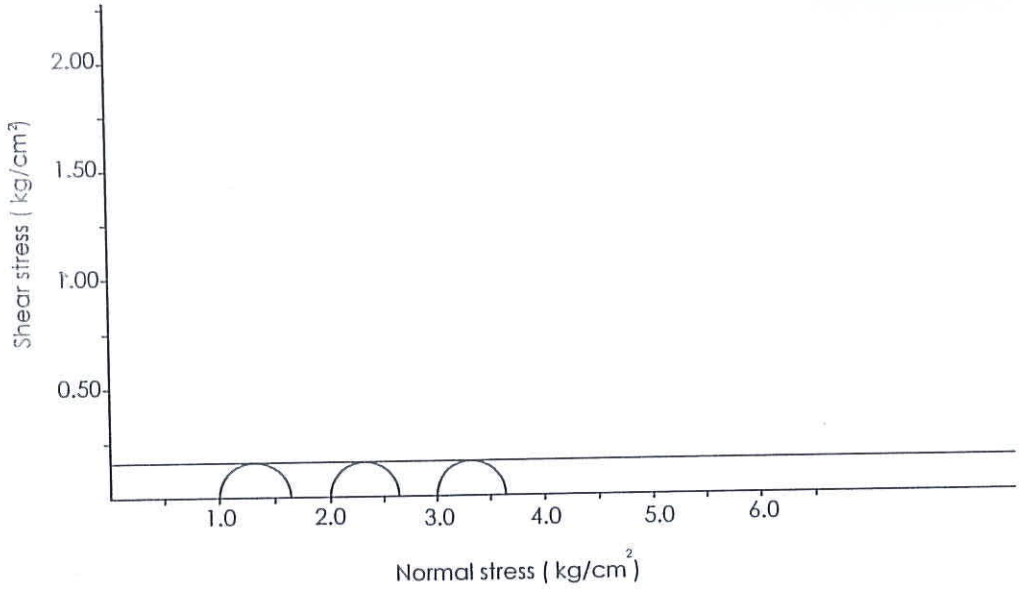


FIG (35)

DIRECT SHEAR TEST

BORE HOLE NO: BH-01
SAMPLE NO : SPT20
DEPTH : 34.0M
C = 0 Kg/cm^2 ϕ = 35^0

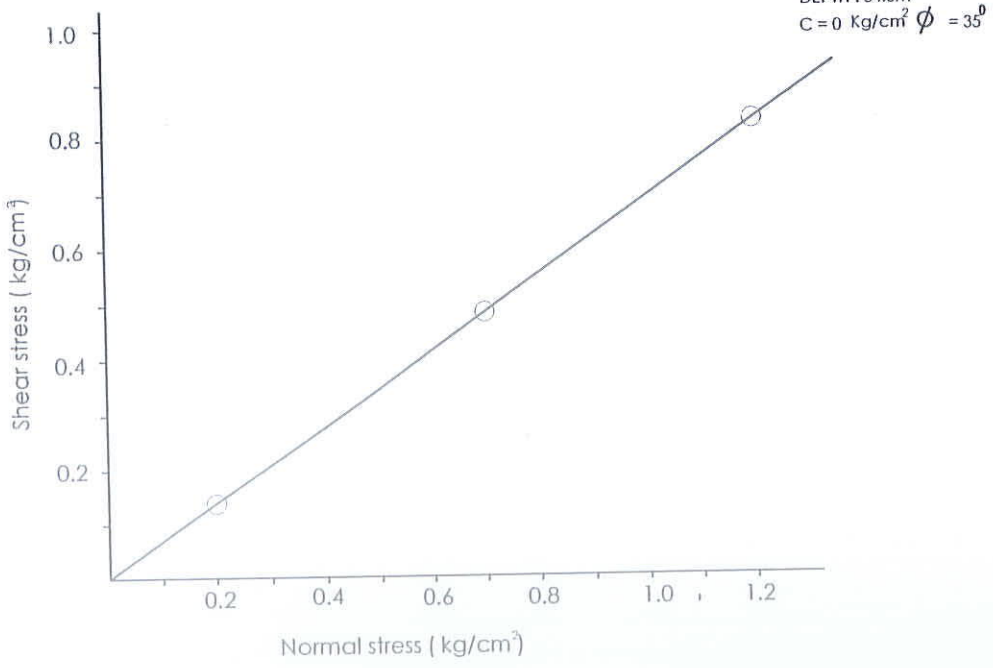


FIG (36)

DIRECT SHEAR TEST

BORE HOLE NO: BH-01
SAMPLE NO : SPT32
DEPTH : 58.0M
C = 0 Kg/cm^2 ϕ = 38^0

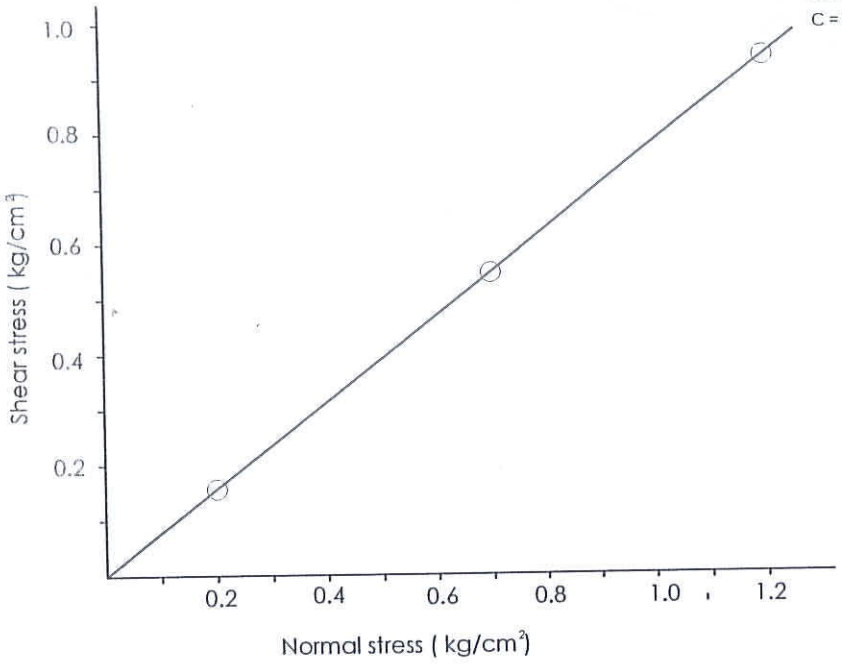


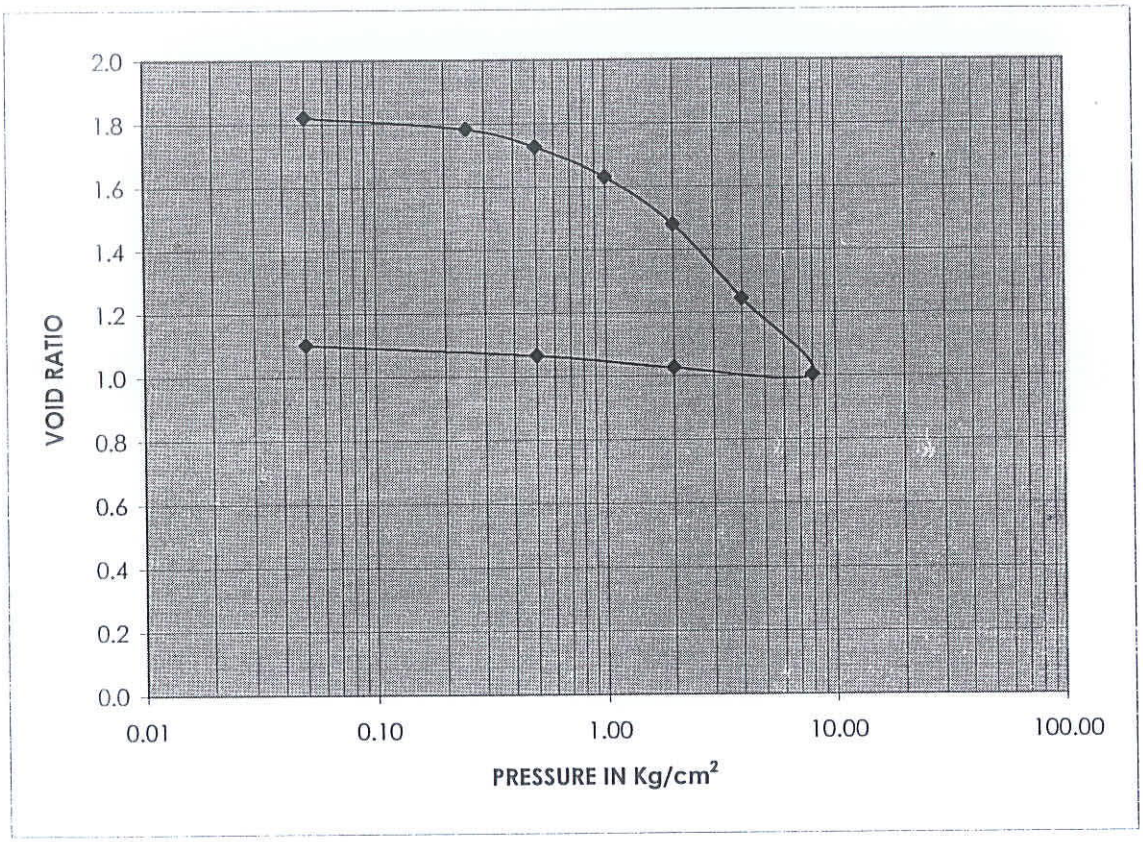
FIG (37)

GEO FOUNDATIONS AND STRUCTURES PVT. LTD

T-1613

Project: Geotechnical Investigation work for the proposed North Jetty

RESULTS OF CONSOLIDATION



VOIDS RATION VS LOG P CURVE

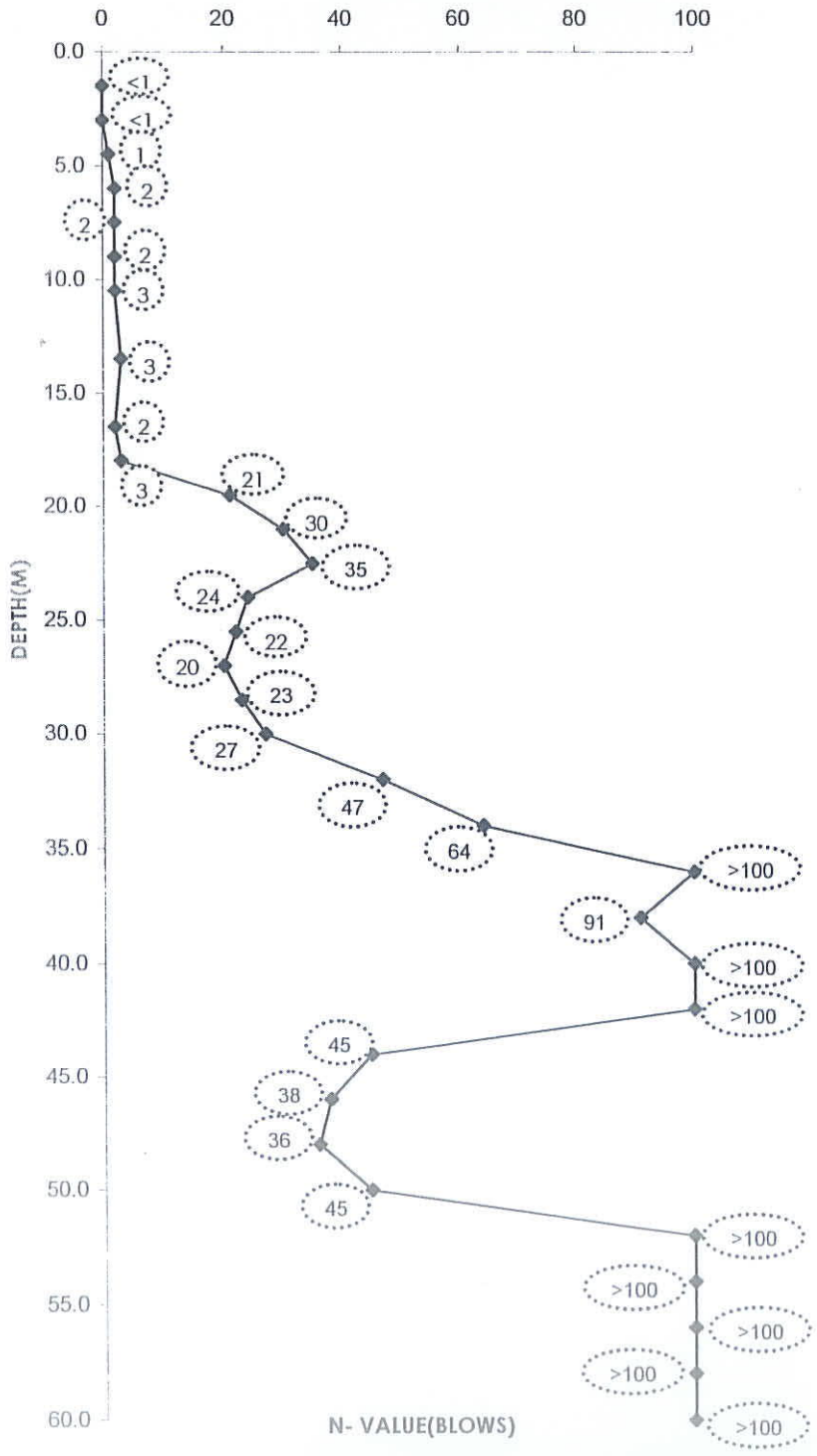
BH NO.	UDS-NO.	DEPTH(M)	Cc	eo
BH-1	UDS-2	15.00	0.80	1.85

Fig.38

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED OF NORTH JETTY

GEO FOUNDATIONS & STRUCTURES PVT. LTD	Bore Hole No	: BH-02	Boring Started	: 31.12.2012	T-1613
	Type of Boring	: Rotary	Boring Completed	: 02.01.2013	
	Termination Depth	: 60.00 M	High Tide Water	: 6.00 m	
			Low Tide Water	: 6.60 m	

GRAPHICAL REPRESENTATION OF N VALUE



BORE HOLE TERMINATED AT 60.0 M

FIG. 39

Geo Foundations Structures Pvt. Ltd

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY

GEO FOUNDATIONS & STRUCTURES PVT. LTD

Bore Hole No	: BH-02	Boring Started	: 31.12.2012
Type of Boring	: Rotary	Boring Completed	: 02.01.2013
Termination Depth	: 60.0m	Length of water column	: 6.60m

Co-ordinates: Lat - 9°57'35.13"N, Long - 76°16'45.30"E

T-1613

LOCATION : INS VENDURUTHY(UNDER WATER BORING)

SOIL PROFILE	THICKNESS OF STRATA (m)	DESCRIPTION OF STRATA	IS CLASSIFICATION	DEPTH (m)	SAMPLES TEST DEPTH IN m	BLOWS/15cm 15cm	15cm	15cm	SPT " N "	Rock Core characteristics C.R (%)	R.Q.D (%)	UCS KG/CM²	REMARKS
	6.00	WATER											
		EXISTING BED LEVEL		0.00									
				1.50	1.50-1.95	1	0	0	<1				
				3.00	3.00-3.45	1	0	0	<1				
				4.50	4.50-4.95	1	0	1	1				
				5.00	5.00-5.45	VST-1							
		Clayey Silt with Traces of Sand (Grey)		6.00	6.00-6.45	1	1	1	2				
				7.50	7.50-7.95	1	1	1	2				
				9.00	9.00-9.45	1	0	2	2				
				10.0	10.0-10.45	VST-2							
				10.5	10.5-10.95	1	1	1	2				
	24.0			12.0	12.0-12.45	UDS-1							
		Clayey Silt with Traces of Sand (P/Grey)		13.5	13.5-13.95	1	2	1	3				
				15.0	15.0-15.45	UDS-2							
				16.5	16.5-16.95	1	1	1	2				
				18.0	18.0-18.45	1	2	1	3				
		Clayey Silt with Traces of Sand (G/Yellow)		19.5	19.5-19.95	7	8	13	21				
				21.0	21.0-21.45	9	13	17	30				
				22.5	22.5-22.95	8	14	21	35				
		Clayey Silt with Traces of Sand (Grey)		24.0	24.0-24.45	7	10	14	24				

(Contd.....fig. 40)

ote : UDS- Undisturbed Sample

SPT "N"-Standard Penetration Test "N"

Fig : 40

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY

GEO FOUNDATIONS & STRUCTURES PVT. LTD

Bore Hole No	: BH-02	Boring Started	: 31.12.2012
Type of Boring	: Rotary	Boring Completed	: 02.01.2013
Termination Depth	: 60.0m	Length of water column	: 6.60m
Co-ordinates: Lat - 9°57'35.13"N, Long - 76°16'45.30"E			

T-1613

LOCATION : INS VENDURUTHY

SOIL PROFILE	THICKNESS OF STRATA (m)	DESCRIPTION OF STRATA	IS CLASSIFICATION	DEPTH (m)	SAMPLES TEST DEPTH IN m	BLOWS/15cm 15cm	15cm	15cm	SPT " N "	Rock Core characteristics C.R (%)	R.Q.D (%)	UCS KG/CM²	REMARKS
	7.90	Clayey Silt with Traces of Sand (Grey)	CH	25.5	25.5-25.95	7	9	13	22				
				27.0	27.0-27.45	8	11	9	20				
				28.5	28.5-28.95	6	10	13	23				
				30.0	30.0-30.45	9	12	15	27				
				32.0	32.0-32.45	10	19	28	47				
	11.20	Clayey Silty Sand (G/Yellow)	SC	34.0	34.0-34.45	18	23	41	64				
				36.0	36.0-36.45	28	50	50	>100				42/45cm penetration
				38.0	38.0-38.45	23	37	54	91				
				40.0	40.0-40.45	26	51	49	>100				40/45cm penetration
				42.0	42.0-42.45	29	46	54	>100				43/45cm penetration
	4.90	Sandy Clayey Silt (Grey)	CH	44.0	44.0-44.45	17	19	26	45				
				46.0	46.0-46.45	12	17	21	38				
				48.0	48.0-48.45	14	16	20	36				
	12.00	Silty sand(Grey)	SM	50.0	50.0-50.45	17	20	25	45				
				52.0	52.0-52.45	53	100	-	>100				25/45cm penetration
				54.0	54.0-54.45	71	100	-	>100				19/45cm penetration
				56.0	56.0-56.45	29	79	21	>100				33/45cm penetration
				58.0	58.0-58.45	100	-	-	>100				15/45cm penetration
				60.0	60.0-60.45	68	100	-	>100				28/45cm penetration

Termination Depth : 60.0m

Note : UDS- Undisturbed Sample

SPT "N"-Standard Penetration Test "N"

Fig : 41

NAME OF WORK:SOIL INVESTIGATION WORK FOR THE PROPOSED OF NORTH JETTY

LOCATION: NAVAL BASE

Hide Tide Water : 6.60 m
Low Tide water : 6.00 m

Date of Boring Started : 31.12.2012
Date of Boring Completed : 02.01.2013
Termination Depth : 60.00 M

Table No7

T-1613

N	DEPTH(M)	SAMPLE	SOIL DESCRIPTION	I.S. CLASSIFICATION	GRAIN SIZE ANALYSIS(%) IS 2720(Part5):1985				NMC(%) IS 2720 (Part2):1973	ATTERBERG'S LIMIT(%)-IS 2720(Part-5): 1985			SL (%)IS 2720(Part6): 1972	FSI (%) IS2720 (Part40):1977	SPG(IS 2720(Part-3/sec1):1980	UNIT WEIGHT (gm/cc)		SHEAR PARAMETERS-IS 2720(Part-13):1986		
					GRA - VEL	SAND	SILT,	CLAY		LL	PL	PI				WET	DRY	METHOD	C kg/cm²	Ø (°)
BOREHOLE BH/02																				
<1	1.50	SPT1	Clayey Silt with Traces of Sand (Grey)	CH	0	3	60	37	118	126	36	90								
<1	3.00	SPT2	Clayey Silt with Traces of Sand (Grey)	CH	0	2	60	38	115											
1	4.50	SPT3	Clayey Silt with Traces of Sand (Grey)	CH																
-	5.00	VST1	Clayey Silt with Traces of Sand (Grey)	CH														VST	0.03	-
2	6.00	SPT4	Clayey Silt with Traces of Sand (Grey)	CH	0	2	63	35	110	117	35	82								
2	7.50	SPT5	Clayey Silt with Traces of Sand (Grey)	CH																
2	9.00	SPT6	Clayey Silt with Traces of Sand (Grey)	CH																
-	10.0	VST-2	Clayey Silt with Traces of Sand (Grey)	CH														VST	0.06	-
2	10.5	SPT7	Clayey Silt with Traces of Sand (P/Grey)	CH	0	4	57	39	109											
-	12.0	UDS1	Clayey Silt with Traces of Sand (P/Grey)	CH	0	3	59	38	107	119	36	83			2.41	1.41	0.68	UCS	0.09	-
3	13.5	SPT8	Clayey Silt with Traces of Sand (P/Grey)	CH																
-	15.0	UDS2	Clayey Silt with Traces of Sand (G/Yellow)	CH	0	6	52	42	99	112	38	74			2.42	1.45	0.64	Triaxial	0.12	0
2	16.5	SPT9	Clayey Silt with Traces of Sand (G/Yellow)	CH	0	5	50	45	95	101	39	62								
3	18.0	SPT10	Clayey Silt with Traces of Sand (G/Yellow)	CH																
21	19.5	SPT11	Clayey Silt with Traces of Sand (G/Yellow)	CH	0	4	41	55	68	72	40	32								
30	21.0	SPT12	Clayey Silt with Traces of Sand (G/Yellow)	CH																
35	22.5	SPT13	Clayey Silt with Traces of Sand (G/Yellow)	CH	0	5	45	50	65											

BH-02

NAME OF WORK:SOIL INVESTIGATION WORK FOR THE PROPOSED OF NORTH JETTY

LOCATION: NAVAL BASE

Hide Tide Water : 6.60 m
Low Tide water : 6.00 m

Date of Boring Started : 31.12.2012
Date of Boring Completed : 02.01.2013
Termination Depth : 60.00 M

Table No.8

T-1613

N	DEPTH(M)	SAMPLE	SOIL DESCRIPTION	I.S. CLASSIFICATION	GRAIN SIZE ANALYSIS(%) IS 2720(Part5):1985				NMC(%) IS 2720 (Part2):1973	ATTERBERG'S LIMIT(%)-IS 2720(Part-5): 1985			SL (%)IS 2720(Part6): 1972	FSI (%) IS2720 (Part40):1977	SPG(IS 2720(Part-3/sec1):1980	UNIT WEIGHT (gm/cc)		SHEAR PARAMETERS-IS 2720(Part-13):1986		
					GRA - VEL	SAND	SILT,	CLAY		LL	PL	PI				WET	DRY	METHOD	C kg/cm²	Ø (°)
BOREHOLE BH/02																				
24	24.0	SPT14	Clayey Silt with Traces of Sand (Grey)	CH	0	1	48	51	57	70	38	32			2.39	1.73	1.10	UCS	0.95	-
22	25.5	SPT15	Clayey Silt with Traces of Sand (Grey)	CH																
20	27.0	SPT16	Clayey Silt with Traces of Sand (Grey)	CH																
23	28.5	SPT17	Clayey Silt with Traces of Sand (Grey)	CH	0	2	52	46	38											
27	30.0	SPT18	Clayey Silt with Traces of Sand (Grey)	CH																
47	32.0	SPT19	Clayey ssilty sand(Grey)	SC	0	51	33	16	23	38	19	19								
64	34.0	SPT20	Clayey ssilty sand(Grey)	SC	0	55	30	15	22											
>100	36.0	SPT21	Clayey ssilty sand(Grey)	SC																
91	38.0	SPT22	Clayey silty sand(G/yellow)	SC	0	55	27	18	26	40	20	20								
>100	40.0	SPT23	Clayey silty sand(G/yellow)	SC	0	58	23	19	25											
>100	42.0	SPT24	Clayey silty sand(G/yellow)	SC																
45	44.0	SPT25	Sandy Clayey Silt (Grey)	CH	0	24	42	34	37	56	25	31			2.46	1.86	1.36	UCS	1.33	-
38	46.0	SPT26	Sandy Clayey Silt (Grey)	CH	0	20	45	35	34											
36	48.0	SPT27	Sandy Clayey Silt (Grey)	CH																
45	50.0	SPT28	Silty Sand (Grey)	SM	0	73	27	0	.11	No Limit										
>100	52.0	SPT29	Silty Sand (Grey)	SM	0	75	25	0	14											
>100	54.0	SPT30	Silty Sand (Grey)	SM																
>100	56.0	SPT31	Silty Sand (Grey)	SM	0	88	12	0	15	No Limit					2.63	2.20	1.91	DST	0	39

NAME OF WORK:SOIL INVESTIGATION WORK FOR THE PROPOSED OF NORTH JETTY

LOCATION: NAVAL BASE

Hide Tide Water : 6.60 m
Low Tide water : 6.00 m

Date of Boring Started : 31.12.2012
Date of Boring Completed : 02.01.2013
Termination Depth : 60.00 M

Table No9

T-1613

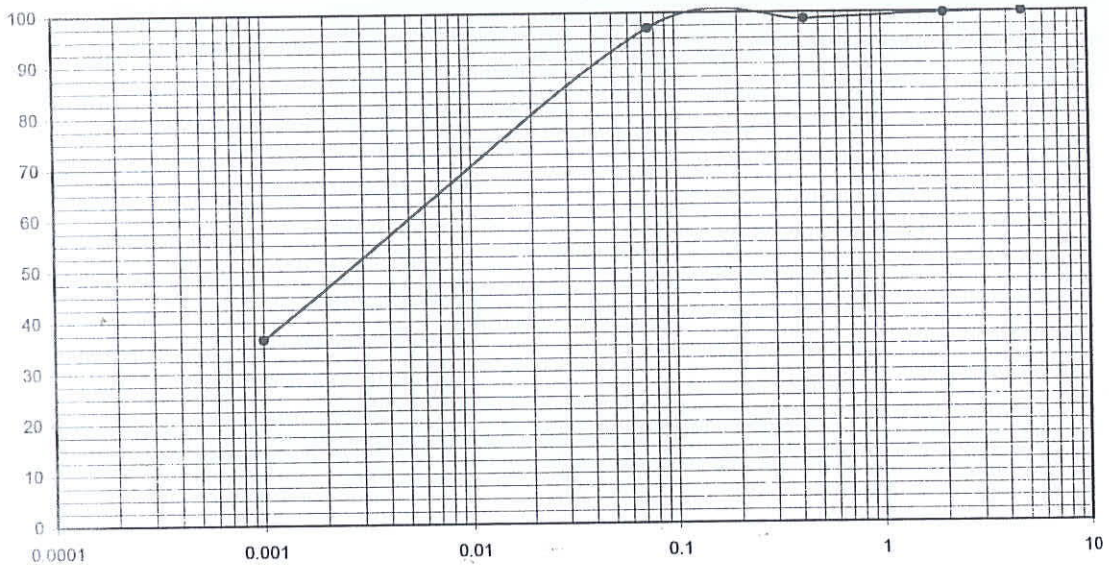
N	DEPTH(M)	SAMPLE	SOIL DESCRIPTION	I.S. CLASSIFICATION	GRAIN SIZE ANALYSIS(%) IS 2720(Part5):1985				NMC(%) IS 2720 (Part2):1973	ATTERBERG'S LIMIT(%)-IS 2720(Part-5): 1985			SL (%)IS 2720(Part6): 1972	FSI (%) IS2720 (Part40):1977	SPG(IS 2720(Part-3/sec1):1980	UNIT WEIGHT (gm/cc)		SHEAR PARAMETERS-IS 2720(Part-13):1986		
					GRA - VEL	SAND	SILT,	CLAY		LL	PL	PI				WET	DRY	METHOD	C kg/cm²	Ø (°)
BOREHOLE BH/02																				
>100	58.0	SPT32	Silty Sand (Grey)	SM																
>100	60.0	SPT33	Silty Sand (Grey)	SM	0	79	21	0	13	No Limit										

GEO FOUNDATIONS AND STRUCTURES PVT. LTD

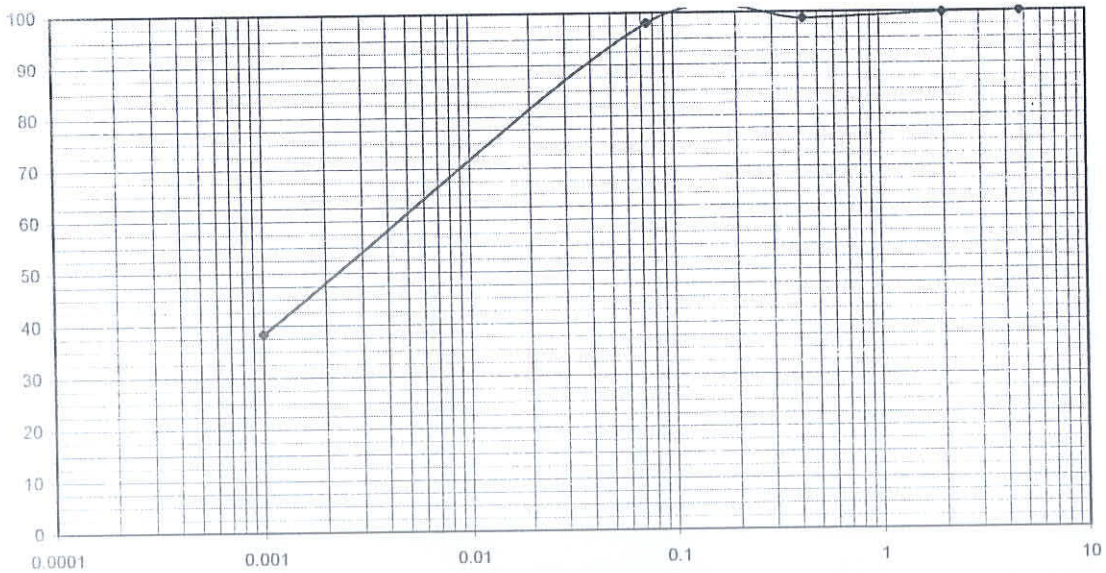
T-1613

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY AT NAVAL BASE

GRAINSIZE ANALYSIS TEST



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	Cu
BH-02	1.50	CH	0	3	60	37			



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	D0
BH-02	4.50	CH	0	2	60	38			

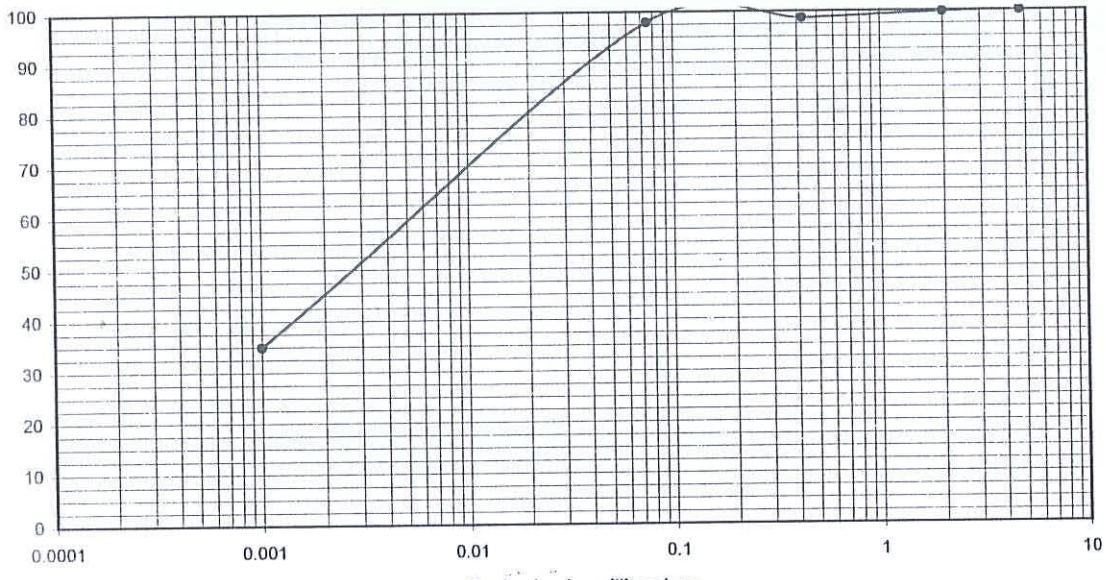
FIG. 42

GEO FOUNDATIONS AND STRUCTURES PVT. LTD

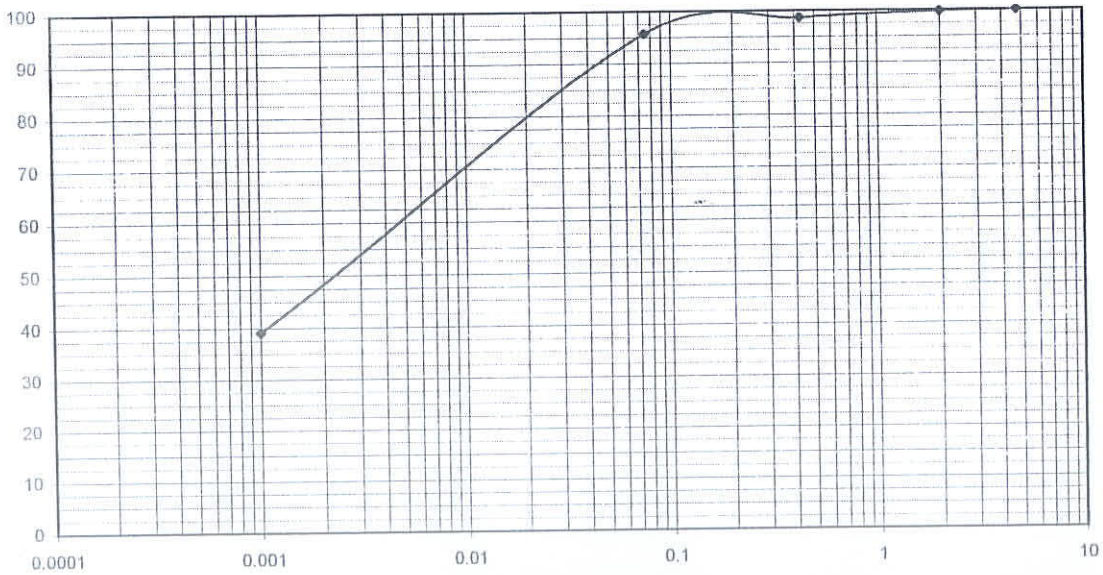
T-1613

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY AT NAVAL BASE

GRAINSIZE ANALYSIS TEST



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	Cu
BH-02	6.00	CH	0	2	63	35			



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	D0
BH-02	10.50	CH	0	4	57	39			

FIG. 43

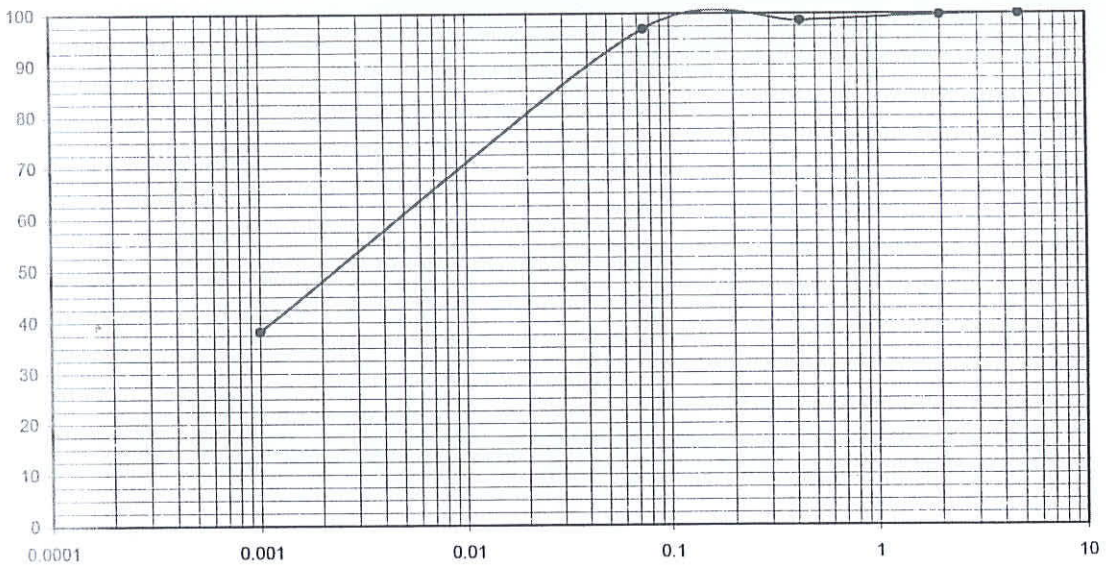
Geo Foundations Structures Pvt Ltd

GEO FOUNDATIONS AND STRUCTURES PVT. LTD

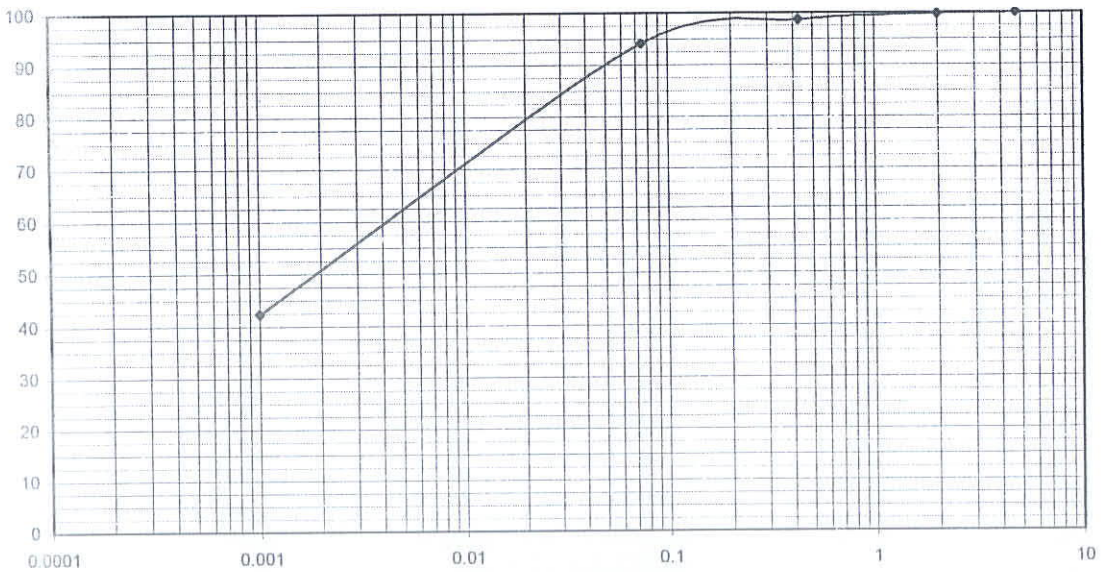
T-1613

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY AT NAVAL BASE

GRAINSIZE ANALYSIS TEST



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	Cu
BH-02	12.00	CH	0	3	59	38			



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	D0
BH-02	15.00	CH	0	6	52	42			

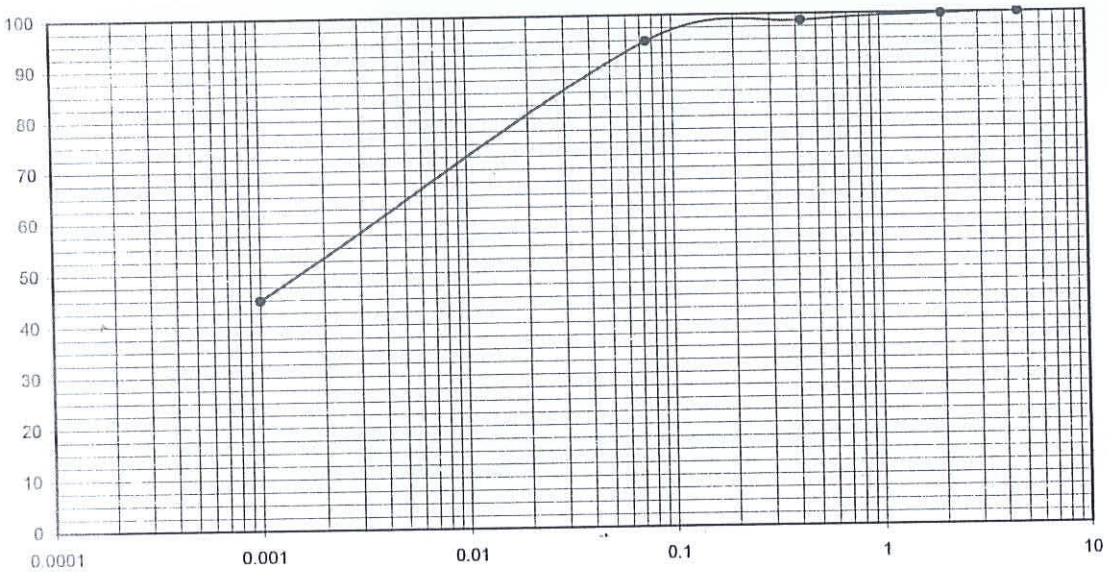
FIG. 44

GEO FOUNDATIONS AND STRUCTURES PVT. LTD

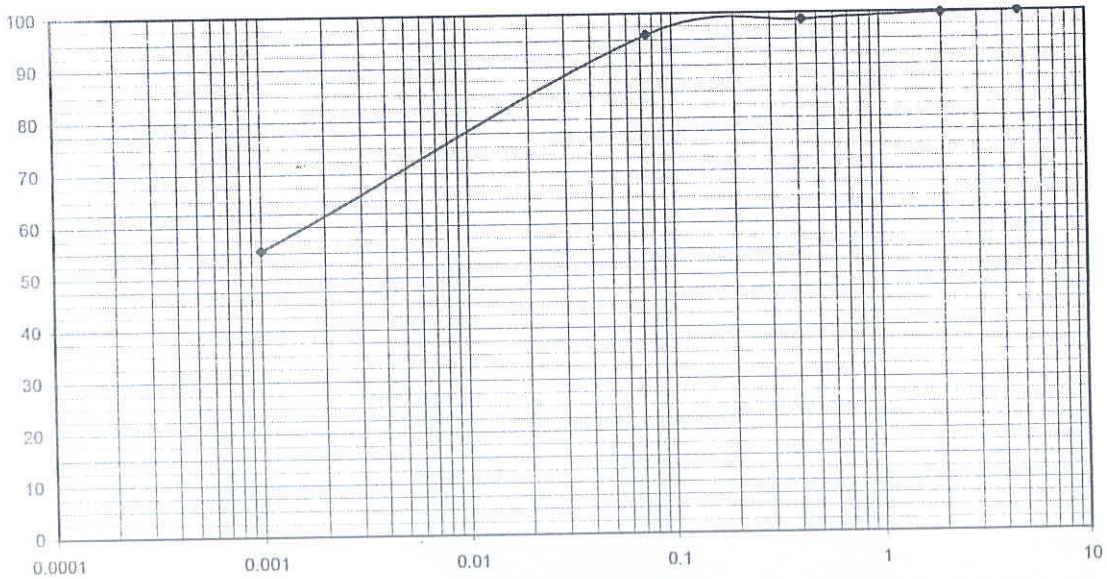
T-1613

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY AT NAVAL BASE

GRAINSIZE ANALYSIS TEST



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	Cu
BH-02	16.50	CH	0	5	50	45			



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	D0
BH-02	19.50	CH	0	4	41	55			

FIG. 45

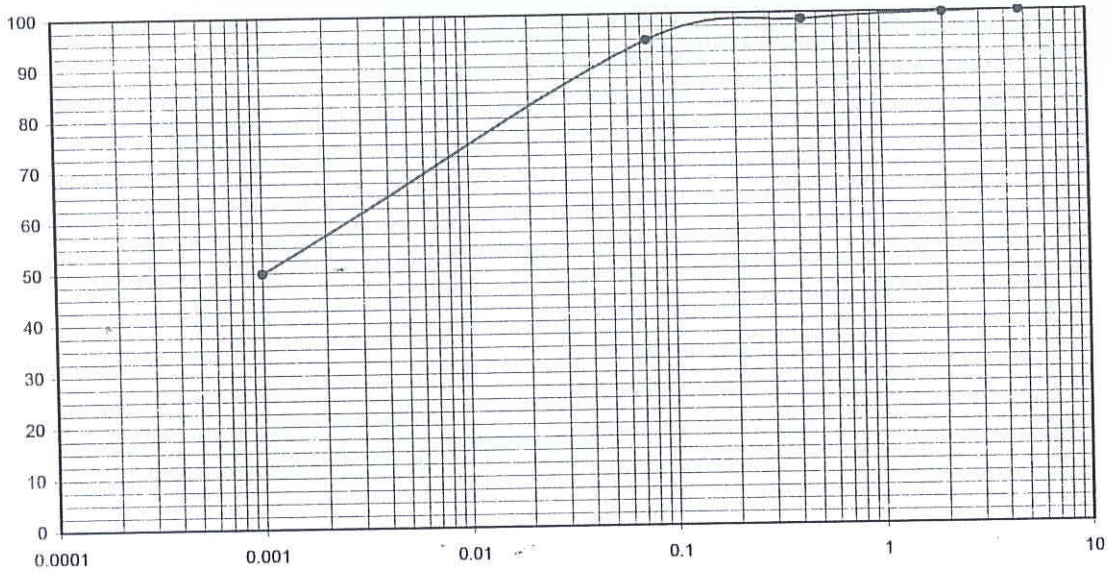
Geo Foundations Structures Pvt Ltd

GEO FOUNDATIONS AND STRUCTURES PVT. LTD

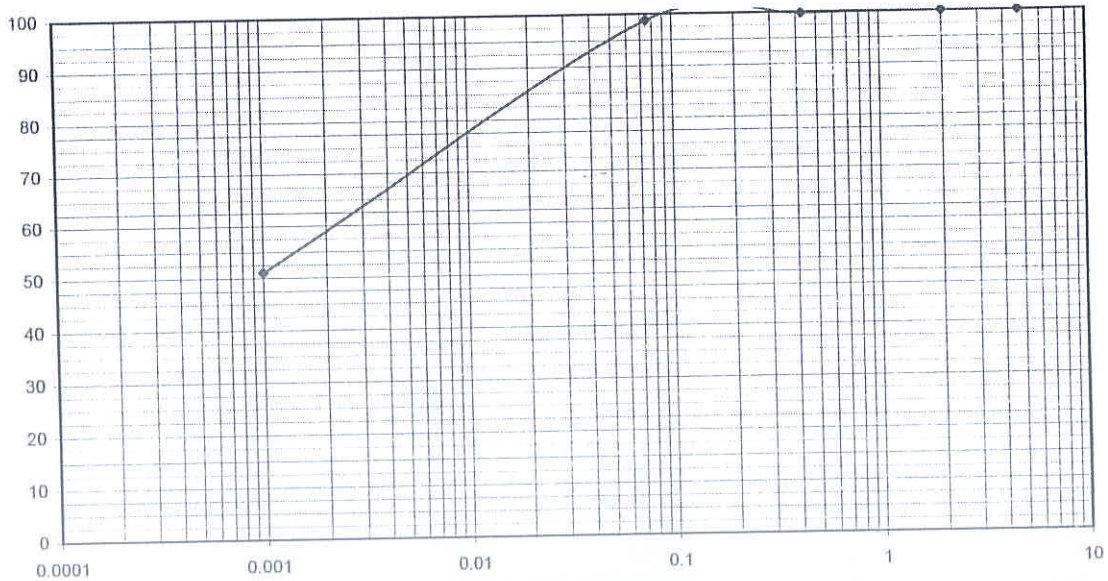
T-1613

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY AT NAVAL BASE

GRAINSIZE ANALYSIS TEST



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	Cu
BH-02	22.50	CH	0	5	45	50			



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	D0
BH-02	24.00	CH	0	1	48	51			

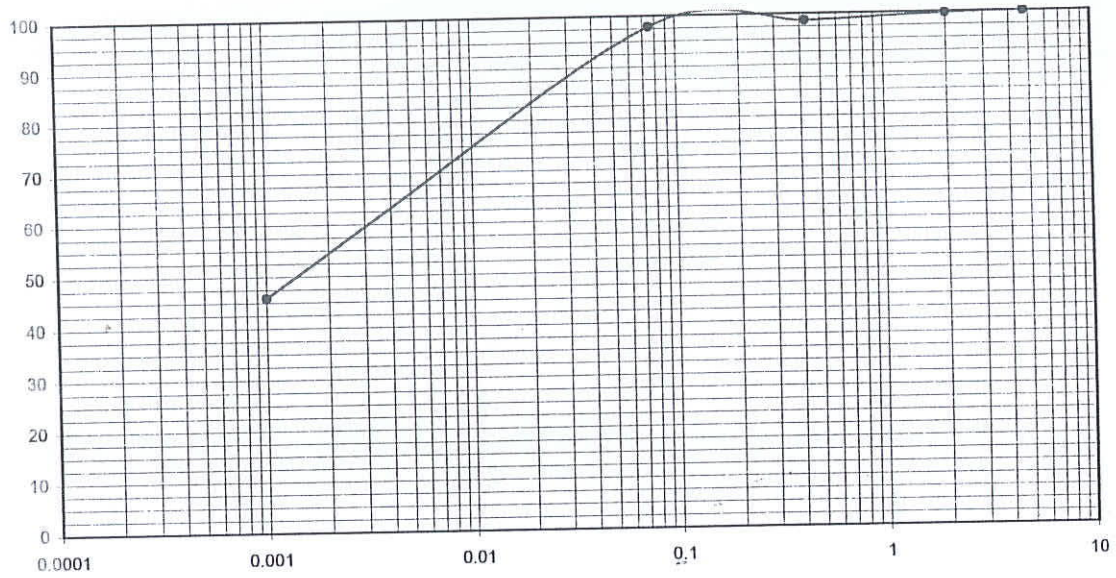
FIG. 46

GEO FOUNDATIONS AND STRUCTURES PVT. LTD

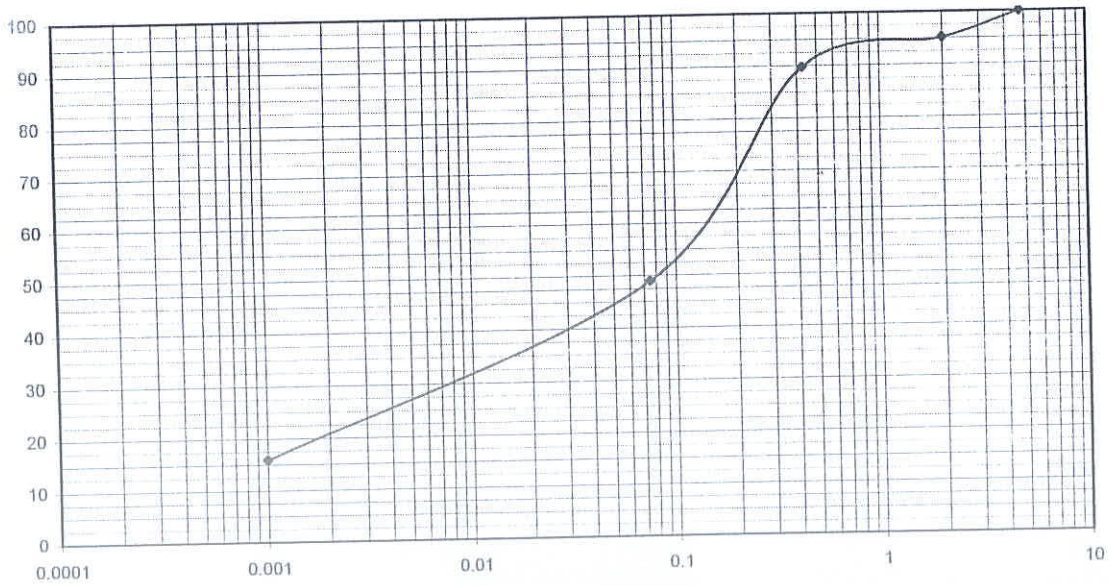
T-1613

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY AT NAVAL BASE

GRAINSIZE ANALYSIS TEST



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	Cu
BH-02	28.50	CH	0	2	52	46			



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	D0
BH-02	32.00	SC	0	51	33	16			

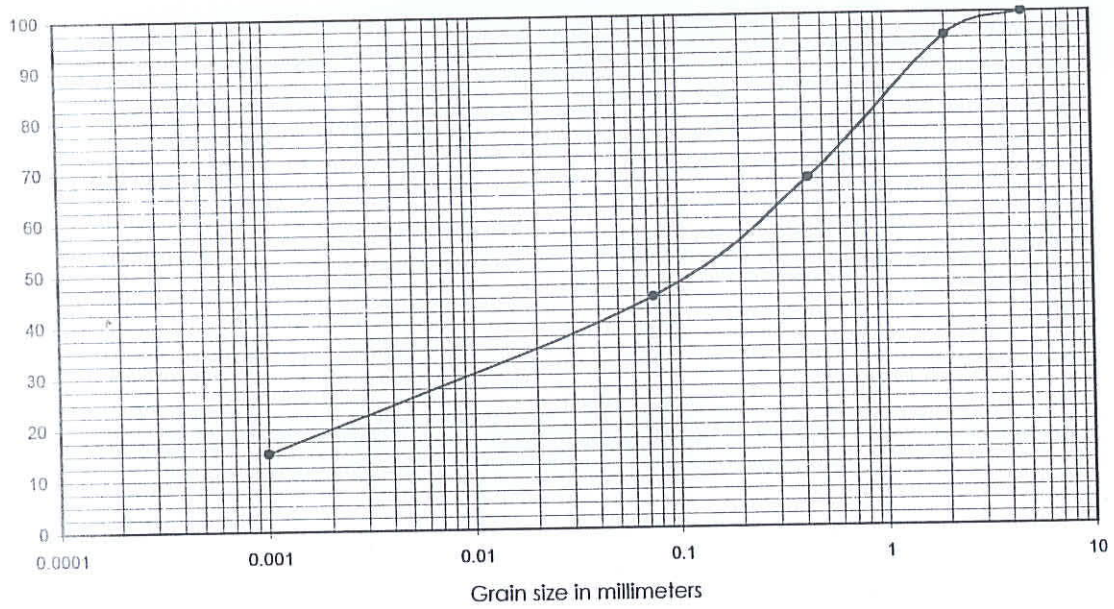
FIG. 47

GEO FOUNDATIONS AND STRUCTURES PVT. LTD

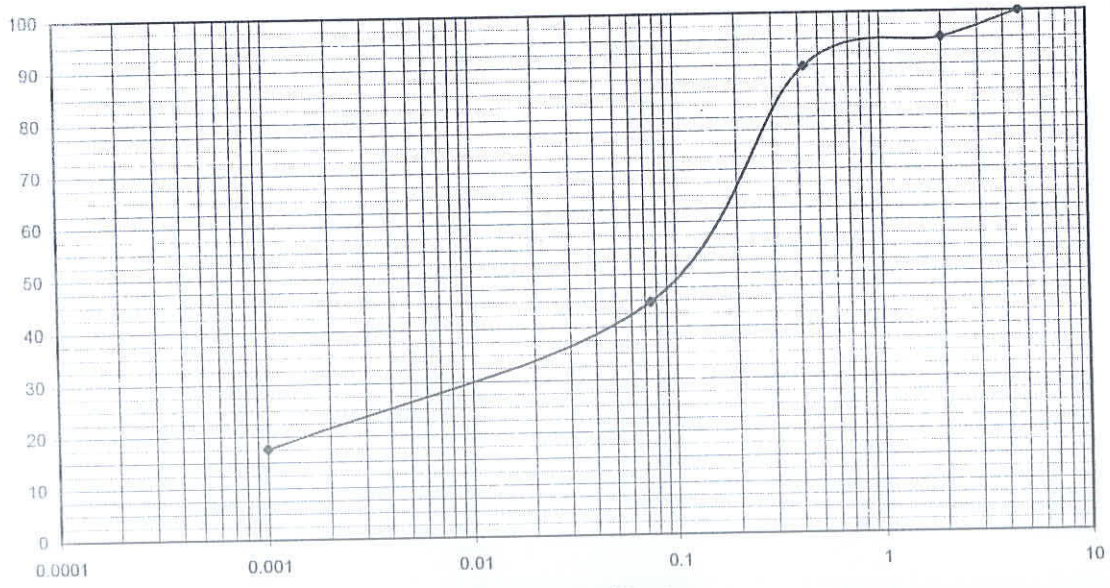
T-1613

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY AT NAVAL BASE

GRAINSIZE ANALYSIS TEST



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	Cu
BH-02	34.00	SC	0	55	30	15			



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	D0
BH-02	38.00	SC	0	55	27	18			

FIG. 48

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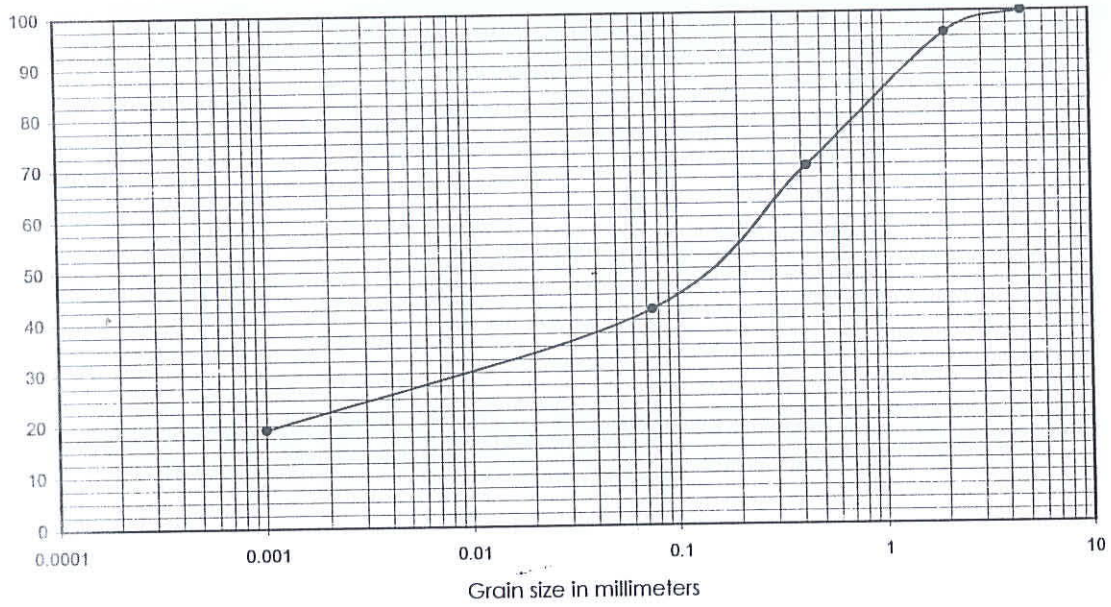
GEO FOUNDATIONS AND STRUCTURES PVT. LTD

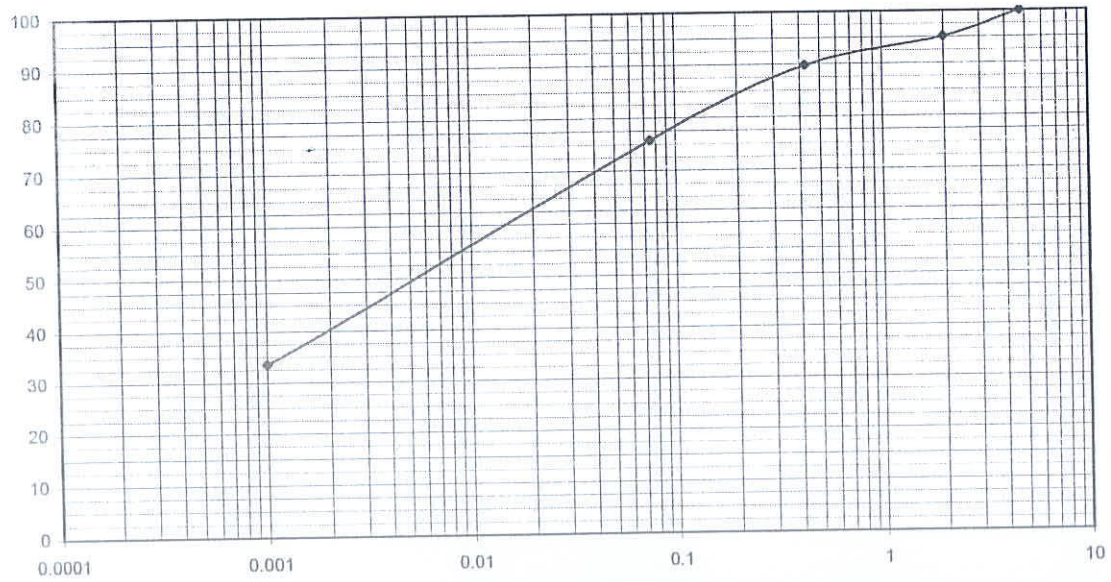
T-1613

PROJECT : SOIL INVESTIGATION WORK FOR THE PROPOSED NORTH JETTY AT NAVAL BASE

GRAINSIZE ANALYSIS TEST



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	Cu
BH-02	40.00	SC	0	58	23	19			



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	D0
BH-02	44.00	CH	0	24	42	34			

FIG. 49

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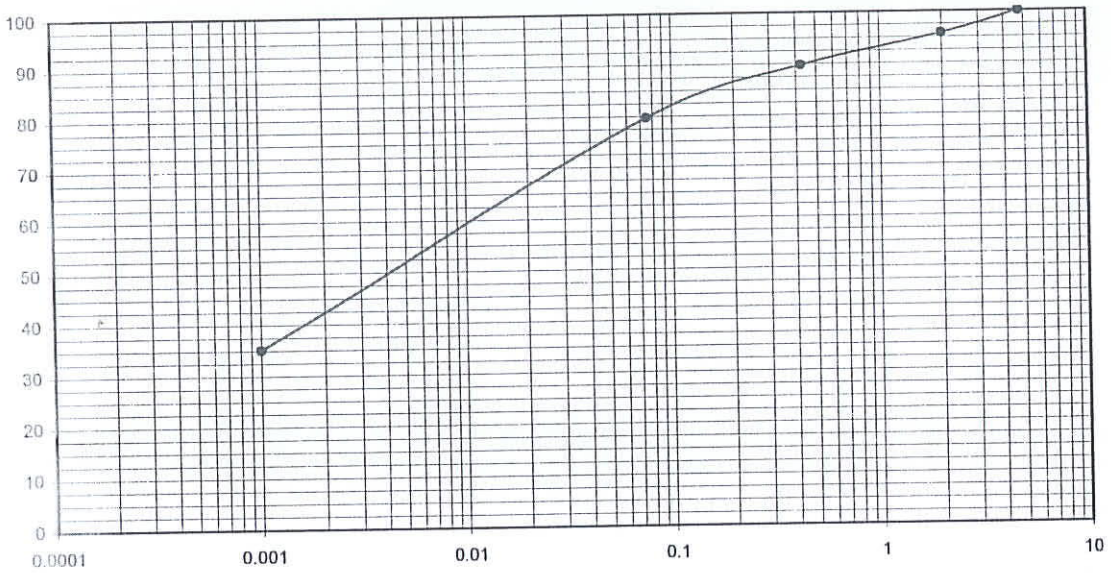
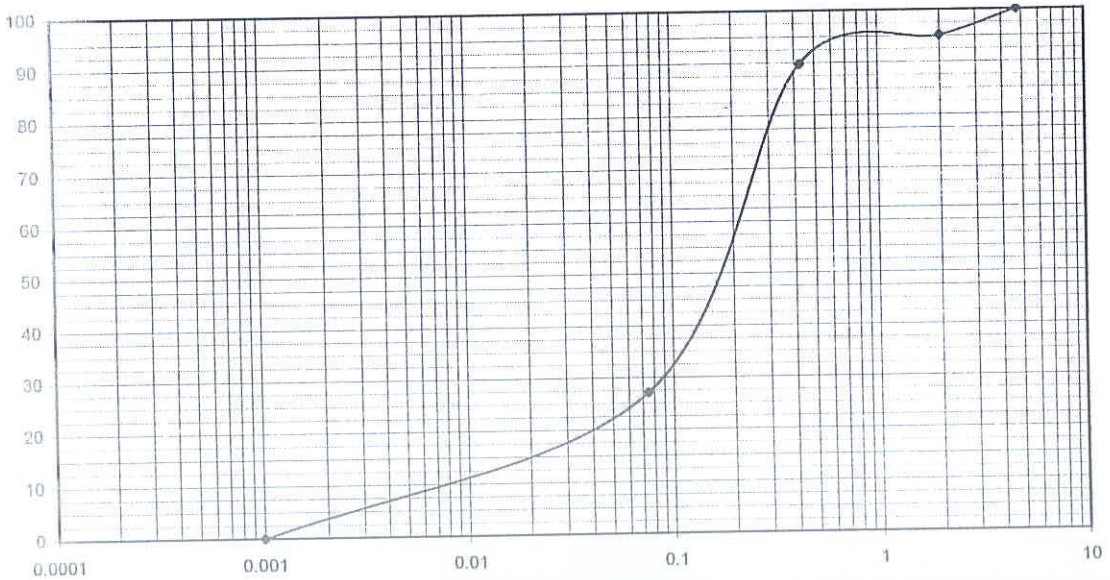
GRAINSIZE ANALYSIS TEST



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	Cu
BH-02	46.00	CH	0	20	45	35			



BH No.	Depth	IS Class	Gravel(%)	Sand(%)	Silt(%)	Clay(%)	D60	D10	D0
BH-02	50.00	SM	0	73	27	0			

FIG. 50

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