APPENDIX-3

Geological Survey Report

ORIENTAL CONSULTANTS
Global Consulting for Sustainable Development

Draft Report

On

Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

JOB NO. : IDEAL/028/015

August, 2015

Submitted By: **IDEAL GEOSERVICES PVT. LTD.**

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Geotechnical Investigation Report

THE PREPARATORY SURVEY ON THE PROJECT FOR CONSTRUCTION OF MUMBAITRANS HARBOUR LINK, MUMBAI

For

ORIENTAL CONSULTANTS
Global Consulting for Sustainable Development

6F, 3-12-1 Honmachi
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Japan

Submitted By

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Project No. IDEAL-028-015

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Revision Control					
Revision No.	**Description**	**Prepared By**	**Checked By**	**Approved By**	**Issue Date**
0	The Preparatory Survey on the Project For Construction of Mumbai Trans Harbour link, Mumbai	VN	KB	ST	18.08.2015

SQP Volume Description		
Volume Title	**Volume Title**	**Contents**
N/A	The Preparatory Survey on the Project For Construction of Mumbai Trans Harbour link, Mumbai	Results of Field and Laboratory Geotechnical Investigation

Service Warranty

The data presented within the report and associated charts/drawings have been acquired and processed to meet the requirements of the contract as agreed by the **Oriental Consultants Global Co. Ltd**. Any unauthorised use of the information presented within this report and charts/drawings is prohibited. Ideal Geoservices Pvt. Ltd. will not accept any liability if the data is used for purposes other than those agreed in the contract.

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Abbreviations & Acronyms

The following list of abbreviations and acronyms may be present within the document:

BARC	Bhabha Atomic Research Centre
CD	Chart Datum
dGPS	Differential Global Positioning System
IGPL	Ideal Geoservices Pvt Ltd
JNPT	Jawaharlal Nehru Port Trust
JUB	Jack Up Barge
MPT	Mumbai Port Trust
SBL	Sea Bed Level
SPT	Standard Penetration Test
TD	Termination Depth
UTM	Universal Transverse Mercator
UCS	Unconfined Compressive Strenght
WGS	World Geodetic System
WRT	With Respect To

Reference Colour Code

The following reference colour coding may be used within this procedure:

XXX	Reference to an independent external document.
XXX	Reference to another section or article within this document.
XXX	Important Note / Caution.

EXECUTIVE SUMMARY

Site Location: MTHL – Proposed Alignment

Investigation Date: Commenced from 3rd June 2015.

Key observations:

The sea bed level at the locations where the boreholes are carried out varies from +0.9m CD to -5.60m CD.

The sub sea bed stratigraphy encountered is heterogeneous along the proposed alignment based on the boreholes drilled.

The sub sea bed stratigraphy comprises of top Layer of very soft CLAY in all boreholes except BH-04 and BH-06.

In BH-04 and BH-06 the top layer comprises of SAND.

The sub sea bed in general comprises of overburden followed by weak, highly weathered BASALT underlain by moderatley strong, fresh BASALT.

In BH-03 and BH-06 the rock is encountered at relatively shallow level of -7.40m CD.

In BH04 even at levels below -29.0m CD the rock encountered is weak with UCS value between 5.47MPA to 8.59MPA.

The reason for this relatively low compressive strength is as given below

BH. No	Elevation wrt CD(m)	Reason for low strength	Image
BH-04	-29.54	Because of secondary infillings of the vugs. Secondary infillings are of minerals like calcite, chlorite etc	
BH-04	-30.80	Because weathering extends through out the rock. In some part of the core the rock material is friable	

1. INTRODUCTION

Oriental Consultants Global Co. Ltd (Client) contracted **Ideal Geoservices Pvt. Ltd (Contractor)** to provide Geotechnical Investigation services for "The Preparatory Survey on the Project For Construction of Mumbai Trans Harbour link, Mumbai.

This report '**IDEAL-028-015 Geoechnical Investigation Report_Rev 0.**' presents the data obtained from the field as well as laboratory investigation along the proposed alignment. The Geotechnical Investigation field work was commenced on 3rd June 2015.

1.1. Reference Documentation

1. **Service Agreement dated April 30, 2015.**
2. **Technical Specifications document no *"The Preparatory Survey on the Project for Construction of Mumbai Trans Harbor Link Terms of Reference"*.**

1.2. Scope of Work

The principal objectives of the investigation were to obtain adequate information on the sub sea bed stratigraphy, the type and strength of the soils / rocks below the seabed and other geotechnical details of relevance to enable arriving at the design parameters for foundation of the proposed new structures and to ascertain the compressibility of soil. The entire work was carried out under the supervision of "**Oriental Consultants Global Co. Ltd** representatives.

In order to accomplish the above objectives the scope of work was to drill six (6) Nos. of boreholes upto a depth of 35.0/50.0m below the sea bed or 5.0m into rock with RQD >50% which ever is shallower. The scope of work also includes carrying out standard penetration tests, collection of disturbed and undisturbed samples of soils, logging visually identifiable lithological and engineering characteristics of the soil and rock samples, testing the samples in laboratory for their classification, index and engineering properties and preparation and submission of Geotechnical Investigation report.

The list of the geotechnical boreholes carried out at locations of various proposed structures is presented in **Table-1**.

Sr. No.	Proposed Structure	Boreholes
1	MTHL Bridge Alignment	BH-01 thru BH-06

Table 1: Details of Field Test Locations w.r.t. Proposed Structures

1.3. Schedule of Activities

Investigation Schedule, MTHL, Mumbai			
Sr. No.	Date		Detail of Activities
	From	To	
01	01-05-2015	05-06-2015	Obtaining Permissions from Reliance, MPT,JNPT,BARC, Police, Ambuja cements
02	03-06-2015	10-06-2015	Standby at BH-06 location due to objection by Reliance
03	11-06-2015	10-07-2015	Carrying out 6 Boreholes
04	11-07-2015	17-08-2015	Laboratory Testing, preparation and submission of report

Note: The work was intermittently stopped due to inclement weather and unfavourable sea conditions on account of monsoon and cyclonic activities

Table 2: Schedule of Activities

2. FIELD INVESTIGATION

The field investigation involves mobilization of Marine Spread with drilling rigs and drilling accessories mounted on it, marking the field test location and shifting the marine spread at the designated location, boring in soil, drilling in rock, carry out SPT, collection of UDS. A brief description of the various activities is given below.

2.1. Marine Spread

The marine spread comprises of JUB and two tug boats. The details of these are given below.

2.1.1. Jack Up barge – Aqua Star

A hydraulically elevated JUB "**Aqua Star"** having deck size 12.0m x 10.0m with spuds of length 24.0m was mobilized at the site. A Percussion boring rig along with a hydraulically operated rig supported with water pumps was mounted on the deck. The JUB was assembled at Reti Bunder in Belapur and was towed to the site and from one borehole to another using two Tug Boats named **"MV Dev Raj"** and **"MV Padma Gandha".**

2.2. Position Services

The coordinates of borehole locations were given by the client. The locations were identified at the site using **"Leica 420"** dGPS.

2.3. Setting up at Field Test Location

The location coordinates of the boreholes were supplied by the client. The borehole location was identified in the field using dGSP. A Markey buoy was then dropped at the designated location from the advance boat using dGPS.

The JUB was then towed to the location of the marker buoy using tug boats and was positioned at that location by lowering the hydraulically operated spuds. After Jacking at the location the location coordinates were again observed near the moonpool using the dGPS and these were then recorded as the actual location coordinate of that field test and are presented in Table 3.

The list of proposed and actual coordinates of the borehole locations is given in Table-3.

Sr. No.	B.H. No	Proposed		Actual		Remarks
		Easting (m)	Northing (m)	Easting (m)	Northing (m)	
1	BH-01	276633.00	2101870.00	284389.00	2101122.00	Location shifted because at the original location even during high tide water depth was not sufficient to tow the JUB
2	BH-02	281893.00	2100979.00	281555.00	2100932.00	Location shifted on the instruction of MPT as the original location was falling in the channel of the Old Pir Pau Jetty.
3	BH-03	286953.00	2100893.00	286953.00	2100893.00	
4	BH-04	287119.00	2100824.00	286846.00	2100932.00	Location shifted on the instruction of Ambuja Cement as the original location was falling at the centre of their channel
5	BH-05	287282.00	2100749.00	287282.00	2100749.00	
6	BH-06	288918.00	2099540.00	288918.00	2099540.00	

Table 3: Borehole Location Coordinates

2.4. Boring in Soil

Boring was done in accordance with *IS: 1892 -1979*. A Standard boring winch of 1.5 ton was used for boring in the overburden strata (soil strata) with 150mm dia boreholes. A standard boring winch consists of a drum with rotating wheel where the wire rope was released and tight and one end is through pulley mounted on the tripod. Other end of the wire rope was fixed with sinker bar and shell to bore in the soil. Percussion method was used for boring in the overburden. The winch deployed was generally suitable for all Geotechnical Investigation work and had an arrangement for driving and extraction of casing, boring with percussion method. The boring was continued upto the termination of the borehole.

2.5. Drilling in Rock

The borehole in rock was advanced using rotary drilling technique with the help of a hydraulic feed machine. The coring was done using a NX size double tube core barrel giving a borehole of size 76.0mm and core diameter of 54.5mm. The cores obtained were sequentially stored in the custom built core boxes.

2.6. Standard Penetration Tests (SPT)

SPT's were carried out using a split spoon sampler complete with a drive shoe and drive head fitted with a non-return valve. The basis of the test consists of dropping a hammer of mass 63.5 kg (623N) on to a drive head from a height of 750 mm (as specified in I.S. Code of Practice). An auto trip hammer capable of dropping the weight freely on the anvil over a fixed height of 750mm was used to assure the quality of the test. The number of such blows (SPT "N") necessary to achieve a penetration of the split spoon sampler of 300mm (after its penetration under gravity and below the seating drive) is regarded as the penetration resistance. The blow counts for each 150 mm penetration were recorded. Small disturbed samples were obtained from the split spoon sampler after completion of the tests.

2.7. Undisturbed Soil Samples

Undisturbed Soil Samples were collected in cohesive soil using thin walled Shelby tubes having nominal diameter of 100mm and minimum length of 450mm.

2.8. Disturbed Soil Samples

Disturbed soil samples were collected from the bailer of the percussion boring.

3. LABORATORY TESTING

Selected soil samples, collected during boring of the boreholes were subjected to laboratory tests to determine the index and engineering characteristics as specified. The samples to be tested, type and

number of laboratory tests to be carried out were decided so as to derive the maximum relevant information. Disturbed samples in SPT split spoons and undisturbed samples in thin walled tubes were collected from the boreholes. The soil samples were visually identified and described in accordance with relevant IS codes and thereafter packed, labelled, sealed and dispatched to the laboratory. The classification, index property, NMC, specific gravity, density, chemical test, shear strength and consolidation tests were carried out on the soil samples. All these tests were carried out in our laboratory at Navi Mumbai, in accordance with relevant parts of Indian Standard Code of Practice. The list of IS and BS codes used is presented in **Table 4** below. The summary of the laboratory test results is presented on Appendix- B in plates B1 through B8. A brief discussion on the laboratory tests conducted is presented in the following sections.

Test Designation	Qty	Applicable Standards	Results Presented in
Tests on soil samples:			
Sieve Analysis	47	IS:2720 (PART -4)	Plates C-1 thru C-16
Hydrometer Analysis	31	-DO-	Do
Atterberg Limit	27	IS:9259 (PART- 5)	Plates C-17 to C-32
Specific Gravity	31	IS:2720 (PART-3)	Plates B-1 thru B-6
Natural Moisture Content	2	IS:2720 (PART-2)	Plates B-1 thru B-6
Bulk & Dry Density	2	IS:2720 (PART-10)	Plates B-1 thru B-6
Unconfined Compressive Strength Test	2	IS:2720 (PART-10)	Plates D-1 to D-2
Consolidation Test	2	IS:2720 (PART-15)	Plates E-1 thru E-2
Uniaxial Compressive Strength of	18	IS 9143	Plates B-7 thru B-8
Point load strength index test on	3	IS 8764	Plates B-7 thru B-8
Porosity, unit weight and water	21	IS 13013	Plates B-7 thru B-8

Table 4: List of IS. Standards and related Tests on Soil & Rock Samples

The samples were tested and the test parameters were selected as per the contract and project requirement. The following tests were performed:

3.1. Laboratory Tests on Soil Samples

3.1.1. Moisture Content & Density

Moisture content, bulk and dry densities were determined for a total of two (2) soil samples, in accordance with the procedures of IS: 2720.

3.1.2. Particle Size Distribution

The particle size distribution was determined for a total of forty seven (47) soil samples in accordance with the method described in IS:2720 (Part 4). Compliance with the Standard, with respect to minimum sample quantity is dependent on the maximum sample available from the field test.

In particular, for downhole hammer/ SPT samples, the quantity of soil available for testing is typically about 100g. This sample quantity is considered representative where grain sizes range up to 4.75mm (i.e. to coarse sand size). Where significant quantities of coarser particles are present, the particle size distribution obtained from such samples should be regarded as indicative only.

3.1.3. Sedimentation/Hydrometer Analysis

Sedimentation analyses have been performed for a total of thirty one (31) soil samples in accordance with the hydrometer method described in IS: 2720 (Part 4). The analysis provides an estimate of the particle size distribution for the fine fraction (<75µm) of a soil sample. The analysis is performed by monitoring the rate of settlement of soil particles initially suspended uniformly in distilled water. The rate of settlement, which is monitored by observing the change in fluid density with the hydrometer device, is theoretically related to the size of particles setting out of suspension.

3.1.4. Atterberg Limits

The Atterberg Limits comprising liquid limit, plastic limit and plasticity index were determined for a total of twenty seven (27) soil samples in accordance with the relevant methods described in IS: 2720 (Part 5). The liquid limit has been determined using the Casagrande apparatus method. The soil sample preparation, in accordance with the code of practice, included removal of soil particles retained on the 425µm sieve. Accordingly, where a significant quantity of coarser particles was present, it should be recognized that the Atterberg Limits results are representative of the relatively fine soil fraction, and not of the complete soil sample.

3.1.5. Particle Density/Specific Gravity

The particle density was determined for a total of thirty one (31) samples in accordance with the small pycknometer method described in IS: 2720 (Part 3/Sec 1). Prior to testing, samples were ground down, if necessary, so as to pass the 2mm sieve.

3.1.6. Consolidation Test

The Consolidation properties of soil were determined by vertical drainage both to top and bottom surfaces. Volume change after every stress application is recorded at intervals of 0, ½, 1, 4, 9, 16, 25, 36, 49, 64min; 1½, 2, 4, 8 and 24 hours. The consolidation test was conducted on two (2) soil sample in accordance with the method of IS:2720 (PART-15.

3.1.7. Unconfined Compressive Strength Test:

Unconfined Compressive strength tests were carried out on two (2) samples as per IS 2720 Part 10.

3.2. Laboratory Tests on Rock Samples

3.2.1. Unit Weight & Specific Gravity of Rock

Unit Weight & Specific Gravity of Rock specimen were determined for a total of twenty one (21) rock samples by using saturation and buoyancy technique, in accordance with the methods of IS: 13030.

3.2.2. Uniaxial Compressive Strength Test

Uniaxial compressive strength for a total of eighteen (18) cylindrical rock specimens was determined, in accordance with the methods of ISRM. The uniaxial compressive strength of the specimens were corrected for a height to diameter ratio of two for specimens whose height to diameter ratio was other than two using the following relationship

q_c (corrected) = (q_c 0.889)/(0.778+(0.222D/H))

Where q_c = Uncorrected Uniaxial Compressive Strength

D = Diameter of the specimen tested

APPENDIX-A - ENGINEERING ILLUSTRATIONS

Project : **Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link**

Job No. : IGPL/028/015

BOREHOLE LOCATION

IDEAL GEOSERVICES PVT. LTD.

BOREHOLE NO. : BH-01

Geotech Contractor : IDEAL GEOSERVICES PVT. LTD.	Job No. : IDEAL/028/015	CLIENT : ORIENTAL CONSULTANTS (ORICONSUL) Global Consulting for Sustainable Development
Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link		SHEET 01 of 03

T.D. (m)	: -28.82 CD	SBL (m)	: -3.32 CD	Equipment Record	: AQUA STAR - JACKUP BARGE
Date Commenced	: 06-07-2015	Circulation Fluid	: Sea Water	Type of Rig	: Hydraulic Rig
Date Completed	: 10-07-2015	Drilling Orientation	: Vertical	Details of Casing (mm)	: SX / HX / NX
				Core-Diameter (mm)	: 54.10

Co- Ordinates E : 284389.00 N : 2101122.00

WATER TABLE

Date	Time	Mtrs.
06-07-2015	03.45 PM	8.00

Sampling Details				Standard Penetration Test (SPT)				Details of Rock core					Symbol	Depth in (m)	Details of Stratum	Soil Clasiification (USC)	Grain Size Analysis (%)				Consistency Limits (%)			Strength Test (kPa)			Consolidation Test			Remarks
	TYPE	From (m)	To (m)	150	300	450	"N" VALUE	TCR %	SCR %	RQD %	W.G	F.I.			Strata Description		GRAVEL	SAND	SILT	CLAY	LIQUID (w_L)	PLASTIC (w_P)	PLASTICITY INDEX (I_P)	UCS C_u	UU c_u, ϕ_u	CU c', ϕ'	PreConsolidation Pressure (kPa)	Commpression Index (Cc)	Initial Void Ratio (e^0)	
0		-3.32	-3.82											-3.32	Very soft, dark grey CLAY	CH	0	8	48	44	66	27	39							
1																														
2		-4.82	-5.27	0	0	0	0									CH	0	1	52	47	71	16	55							
3		-6.32	-6.77													CH	0	2	46	52	87	38	49	16			130	0.62	1.699	
4																														
5		-7.82	-8.27	7	11	15	26							-7.82	Very stiff, light yellowish grey CLAY	CH	0	4	72	24	78	32	46							
6		-9.32	-9.77	8	10	17	27									CH	12	2	29	57	79	32	47							
7																														
8		-10.82	-11.27	8	16	24	40									CH	8	6	34	52	82	28	54							
9		-12.32	-12.67	17	28	50 blows/ 5cm	>100							9.00	Hard, yellowish grey, CLAY with sand and gravels	CH	25	15	27	33	79	32	47							
10																														

Abbreviations & Symbols :

□ - SPT ■ - UDS ◪ - DS

W_L - Liquid Limit I_P - Plasticity Index MC - Moisture Content

▥ - Rock Recovery ▨ - No Recovery

TCR - Total Core Recovery SCR - Solid Core Recovery RQD - Rock Quality Designation

⊗ - Field Vane Shear ● - Sample Slipped

W.I. - Weathering Grade F.I. Fractural Index

C.D. Chart Datum, T.D. : Termination Depth, MSL : Mean Sea Level
SBL : Sea Bed Level, EGL : Existing Ground Level, R.L. : Reduced Level

Prepared By : V.N.
Checked By : S.D.
Approved By : S.T.

AP3-18

Plate-A1

IDEAL GEOSERVICES PVT. LTD.

BOREHOLE NO. : BH-01

Geotech Contractor : IDEAL GEOSERVICES PVT. LTD.	Job No. : IDEAL/028/015	CLIENT : ORIENTAL CONSULTANTS Global Consulting for Sustainable Development
Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link		SHEET 02 of 03

T.D. (m)	: -28.82 CD	SBL (m)	: -3.32 CD	Equipment Record	: AQUA STAR - JACKUP BARGE
Date Commenced	: 06-07-2015	Circulation Fluid	: Sea Water	Type of Rig	: Hydraulic Rig
Date Completed	: 10-07-2015	Drilling Orientation	: Vertical	Details of Casing (mm)	: SX / HX / NX
				Core-Diameter (mm)	: 54.10

Co- Ordinates E : 284389.00 N : 2101122.00

WATER TABLE

Date	Time	Mtrs.
06-07-2015	03.45 PM	8.00

Sampling Details				Standard Penetration Test (SPT)				Details of Rock core					Symbol	Depth in (m)	Details of Stratum	Soil Clasification (USC)	Grain Size Analysis (%)				Consistency Limits (%)			Strength Test (kPa)			Consolidation Test			Remarks
	TYPE	From (m)	To (m)	150	300	450	"N" VALUE	TCR %	SCR %	RQD %	W.G	F.I.			Strata Description		GRAVEL	SAND	SILT	CLAY	LIQUID (w_L)	PLASTIC (w_P)	PLASTICITY INDEX (I_P)	UCS C_u	UU c,ϕ	CU c',ϕ'	PreConsolidation Pressure (kPa)	Commpression Index (Cc)	Initial Void Ratio (e_0)	
10						50 blows/ 10cm									Hard, yellowish grey, CLAY with sand and gravels															
		-13.82	-14.22	16	40		>100									CH	12	14	61	13	66	32	34							
11																														
12		-15.32	-15.82	10	25	38	63									CL	12	14	42	32	43	22	21							
13		-16.82	-17.07	40	52 blows/ 10cm	-	>100																							
14																														
15				65 blows/ 5cm																										
		-18.32	-18.37		-	-	>100																							
16		-18.32	-19.82					20	15	-	IV	3.3		-18.32	Very weak, highly weathered, highly fractured, light brownish BASALT															
17		-19.82	-21.32					19	3	-	IV	6.7																		
18		-21.32	-22.82					70	60	- -	IV	>10																		
19																														
20		-22.82	-24.32					81	70	-	IV	>10																		

AP3-19

Abbreviations & Symbols :

- SPT - UDS - DS
- Rock Recovery - No Recovery
- Field Vane Shear - Sample Slipped

W_L - Liquid Limit I_P - Plasticity Index MC - Moisture Content

TCR - Total Core Recovery SCR - Solid Core Recovery RQD - Rock Quality Designation

C.D. Chart Datum, T.D. : Termination Depth, MSL : Mean Sea Level
SBL : Sea Bed Level, EGL : Existing Ground Level, R.L. : Reduced Level

W.I. - Weathering Grade F.I. Fractural Index

Prepared By : V.N.
Checked By : S.D.
Approved By : S.T.

Plate-A2

IDEAL GEOSERVICES PVT. LTD.

BOREHOLE NO. : BH-01

Geotech Contractor : IDEAL GEOSERVICES PVT. LTD. | Job No. : IDEAL/028/015 | CLIENT : ORIENTAL CONSULTANTS Global Consulting for Sustainable Development | SHEET 03 of 03

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

T.D. (m)	: -28.82 CD	SBL (m)	: -3.32 CD	Equipment Record	: AQUA STAR - JACKUP BARGE	
Date Commenced	: 06-07-2015	Circulation Fluid	: Sea Water	Type of Rig	: Hydraulic Rig	
Date Completed	: 10-07-2015	Drilling Orientation	: Vertical	Details of Casing (mm)	: SX / HX / NX	
				Core-Diameter (mm)	: 54.10	

Co- Ordinates E : 284389.00 N : 2101122.00

WATER TABLE

Date	Time	Mtrs.
06-07-2015	03.45 PM	8.00

Sampling Details				Standard Penetration Test (SPT)				Details of Rock core					Symbol	Depth in (m)	Details of Stratum	Soil Clasification (USC)	Grain Size Analysis (%)				Consistency Limits (%)			Strength Test (kPa)			Consolidation Test			Remarks
	TYPE	From (m)	To (m)	150	300	450	"N" VALUE	TCR %	SCR %	RQD %	W.G	F.I.			Strata Description		GRAVEL	SAND	SILT	CLAY	LIQUID (w_L)	PLASTIC (w_P)	PLASTICITY INDEX (I_P)	UCS C_u	UU c, ϕ	CU c', ϕ'	PreConsolidation Pressure (kPa)	Commpression Index (Cc)	Initial Void Ratio (e_0)	
20															Very weak, highly weathered, highly fractured, light brownish BASALT															
21		-24.32	-25.82					100	100	95	II	4		-24.32	Moderately strong to strong, fresh, bluish grey, BASALT															
22																														
23		-25.82	-27.32					100	100	100	II	27																		
24																														
25		-27.32	-28.82					100	100	100	III	3.3																		
26															BOREHOLE TERMINATED DEPTH AT -28.82 (m)															
27																														
28																														
29																														
30																														

AP3-20

Abbreviations & Symbols :

□ - SPT ■ - UDS ◥ - DS | W_L - Liquid Limit I_P - Plasticity Index MC - Moisture Content

▥ - Rock Recovery ▨ - No Recovery | TCR - Total Core Recovery SCR - Solid Core Recovery RQD - Rock Quality Designation

⊗ - Field Vane Shear ● - Sample Slipped | W.I. - Weathering Grade F.I. Fractural Index

C.D. Chart Datum, T.D. : Termination Depth, MSL : Mean Sea Level
SBL : Sea Bed Level, EGL : Existing Ground Level, R.L. : Reduced Level

Prepared By : V.N.
Checked By : S.D.
Approved By : S.T.

Plate-A3

IDEAL GEOSERVICES PVT. LTD.

BOREHOLE NO. : BH-02

Geotech Contractor : IDEAL GEOSERVICES PVT. LTD. | Job No. : IDEAL/028/015 | CLIENT : ORIENTAL CONSULTANTS Global Consulting for Sustainable Development | SHEET 01 of 03

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

T.D. (m)	: -28.54 CD	SBL (m)	: -3.04 CD	Equipment Record	: AQUA STAR - JACKUP BARGE	
Date Commenced	: 02-07-2015	Circulation Fluid	: Sea Water	Type of Rig	: Hydraulic Rig	
Date Completed	: 06-07-2015	Drilling Orientation	: Vertical	Details of Casing (mm)	: SX / HX / NX	
				Core-Diameter (mm)	: 54.10	

Co- Ordinates E : 281555.00 N : 2100932.00

WATER TABLE

Date	Time	Mtrs.
02-07-2015	12.01 PM	7.50

Sampling Details				Standard Penetration Test (SPT)				Details of Rock core					Symbol	Depth in (m)	Details of Stratum	Soil Clasification (USC)	Grain Size Analysis (%)				Consistency Limits (%)			Strength Test (kPa)			Consolidation Test			Remarks
	TYPE	From (m)	To (m)	150	300	450	"N" VALUE	TCR %	SCR %	RQD %	W.G	F.I.			Strata Description		GRAVEL	SAND	SILT	CLAY	LIQUID (w_L)	PLASTIC (w_P)	PLASTICITY INDEX (I_P)	UCS C_u	UU c, ϕ	CU c', ϕ'	PreConsolidation Pressure (kPa)	Commpression Index (Cc)	Initial Void Ratio (e_0)	
0		-3.04	-3.54											-3.04	Very soft, dark grey CLAY	CH	0	0	55	45	58	33	25							
1																														
2		-4.54	-4.99	0	0	0	0									CH	0	1	50	49	65	32	33							
3		-6.04	-6.49	0	0	0	0									CH	0	1	52	47	63	29	34							
4																														
5		-7.54	-7.99													CH	0	1	59	40	80	36	44	4			46	0.85	2.308	
6		-9.04	-9.49	0	0	1	1									CH	0	1	79	20	59	25	24							
7																														
8		-10.54	-10.99	0	0	1	1									CH	0	1	50	49	59	29	30							
9																														
10		-12.04	-12.49	0	1	1	2									CH	0	2	52	46	62	29	33							

AP3-21

Abbreviations & Symbols :

□ - SPT ■ - UDS ◥ - DS | W_L - Liquid Limit | I_P - Plasticity Index | MC - Moisture Content

C.D. Chart Datum, T.D. : Termination Depth, MSL : Mean Sea Level
SBL : Sea Bed Level, EGL : Existing Ground Level, R.L. : Reduced Level

▥ - Rock Recovery ▨ - No Recovery | TCR - Total Core Recovery | SCR - Solid Core Recovery | RQD - Rock Quality Designation | W.I. - Weathering Grade F.I. Fractural Index

⊗ - Field Vane Shear ● - Sample Slipped

Prepared By : V.N.
Checked By : S.D.
Approved By : S.T.

Plate-A4

IDEAL GEOSERVICES PVT. LTD.

BOREHOLE NO. : BH-02

Geotech Contractor : IDEAL GEOSERVICES PVT. LTD. | Job No. : IDEAL/028/015 | CLIENT : ORIENTAL CONSULTANTS Global Consulting for Sustainable Development | SHEET 02 of 03

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

T.D. (m)	: -28.54 CD	SBL (m)	: -3.04 CD	Equipment Record	: AQUA STAR - JACKUP BARGE	
Date Commenced	: 02-07-2015	Circulation Fluid	: Sea Water	Type of Rig	: Hydraulic Rig	
Date Completed	: 06-07-2015	Drilling Orientation	: Vertical	Details of Casing (mm)	: SX / HX / NX	
				Core-Diameter (mm)	: 54.10	

Co- Ordinates E : 281555.00 N : 2100932.00

WATER TABLE

Date	Time	Mtrs.
02-07-2015	12.01 PM	7.50

Sampling Details				Standard Penetration Test (SPT)				Details of Rock core					Symbol	Depth in (m)	Details of Stratum	Soil Clasification (USC)	Grain Size Analysis (%)				Consistency Limits (%)			Strength Test (kPa)			Consolidation Test			Remarks
	TYPE	From (m)	To (m)	150	300	450	"N" VALUE	TCR %	SCR %	RQD %	W.G	F.I.			Strata Description		GRAVEL	SAND	SILT	CLAY	LIQUID (w_L)	PLASTIC (w_P)	PLASTICITY INDEX (I_P)	UCS C_u	UU c,ϕ	CU c',ϕ'	PreConsolidation Pressure (kPa)	Commpression Index (Cc)	Initial Void Ratio (e_0)	
10															Very soft, dark grey CLAY															
11		-13.54	-13.99	7	11	13	24							-13.54	Very stiff, greyish brown sandy CLAY with gravels	CH	15	31	26	28	54	23	31							
12		-15.04	-15.54	27	31	38	69							-15.04	Very dense, brownish, SAND with gravels	SP	6	94		0	-	NP	-							
13		-16.54	-16.86	30	35	50 blows/ 20cm	>100									SP	12	87		1	-	NP	-							
14																														
15																														
16		-18.04	-18.49	18	24	28	52									SP	10	88		2	-	NP	-							
17		-19.54	-19.99	17	24	34	58								- gravels not found below -19.45 m CD	SP	0	99		1	-	NP	-							
18		-21.04	-21.24	28	54 blows/ 5cm	-	>100									SP	0	99		1	-	NP	-							
19		-22.54	-22.79	35	54 blows/ 10cm	-	>100									SP	0	99		1	-	NP	-							
20																														

Abbreviations & Symbols :

- SPT - UDS - DS
- Rock Recovery - No Recovery
- Field Vane Shear - Sample Slipped

W_L - Liquid Limit I_P - Plasticity Index MC - Moisture Content

TCR - Total Core Recovery SCR - Solid Core Recovery RQD - Rock Quality Designation

C.D. Chart Datum, T.D. : Termination Depth, MSL : Mean Sea Level
SBL : Sea Bed Level, EGL : Existing Ground Level, R.L. : Reduced Level

W.I. - Weathering Grade F.I. Fractural Index

Prepared By : V.N.
Checked By : S.D.
Approved By : S.T.

AP3-22

Plate-A5

IDEAL GEOSERVICES PVT. LTD.

BOREHOLE NO. : BH-02

Geotech Contractor : IDEAL GEOSERVICES PVT. LTD.	Job No. : IDEAL/028/015	CLIENT : ORIENTAL CONSULTANTS Global Consulting for Sustainable Development

SHEET 03 of 03

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

T.D. (m)	: -28.54 CD	SBL (m)	: -3.04 CD	Equipment Record	: AQUA STAR - JACKUP BARGE
Date Commenced	: 02-07-2015	Circulation Fluid	: Sea Water	Type of Rig	: Hydraulic Rig
Date Completed	: 06-07-2015	Drilling Orientation	: Vertical	Details of Casing (mm)	: SX / HX / NX
				Core-Diameter (mm)	: 54.10

Co- Ordinates E : 281555.00 N : 2100932.00

WATER TABLE

Date	Time	Mtrs.
02-07-2015	12.01 PM	7.50

Sampling Details				Standard Penetration Test (SPT)				Details of Rock core					Symbol	Depth in (m)	Details of Stratum	Soil Clasification (USC)	Grain Size Analysis (%)				Consistency Limits (%)			Strength Test (kPa)			Consolidation Test			Remarks
	TYPE	From (m)	To (m)	150	300	450	"N" VALUE	TCR %	SCR %	RQD %	W.G	F.I.			Strata Description		GRAVEL	SAND	SILT	CLAY	LIQUID (w_L)	PLASTIC (w_P)	PLASTICITY INDEX (I_P)	UCS C_u	UU c, ϕ	CU c', ϕ'	PreConsolidation Pressure (kPa)	Commpression Index (Cc)	Initial Void Ratio (e^0)	
20															Very dense, brownish, SAND with gravels															
21		-24.04	-24.12	52 blows/ 10cm	-	-	>100																							
22		-24.04	-25.54					97	91	55	III	>10		-24.04	Moderately strong, moderately weathered, moderately fractured light greyish amygdaloidal BASALT	SM	0	85	15		-	NP	-							
23		-25.54	-27.04					99	98	79	III	>10																		
24		-27.04	-28.54					93	92	66	II	5.3																		
25																														
26															BOREHOLE TERMINATED DEPTH AT -28.54 (m)															
27																														
28																														
29																														
30																														

AP3-23

Abbreviations & Symbols :

- SPT - UDS - DS
- Rock Recovery - No Recovery
- Field Vane Shear - Sample Slipped

W_L - Liquid Limit I_P - Plasticity Index MC - Moisture Content

TCR - Total Core Recovery SCR - Solid Core Recovery RQD - Rock Quality Designation

C.D. Chart Datum, T.D. : Termination Depth, MSL : Mean Sea Level
SBL : Sea Bed Level, EGL : Existing Ground Level, R.L. : Reduced Level

W.I. - Weathering Grade F.I. Fractural Index

Prepared By : V.N.
Checked By : S.D.
Approved By : S.T.

Plate-A6

IDEAL GEOSERVICES PVT. LTD.

BOREHOLE NO. : BH-03

Geotech Contractor : IDEAL GEOSERVICES PVT. LTD.	Job No. : IDEAL/028/015	CLIENT : ORIENTAL CONSULTANTS Global Consulting for Sustainable Development

SHEET 01 of 03

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

T.D. (m)	: -28.40 CD	SBL (m)	: -2.90 CD	Equipment Record	: AQUA STAR - JACKUP BARGE
Date Commenced	: 11-07-2015	Circulation Fluid	: Sea Water	Type of Rig	: Hydraulic Rig
Date Completed	: 16-07-2015	Drilling Orientation	: Vertical	Details of Casing (mm)	: SX / HX / NX
				Core-Diameter (mm)	: 54.10

Co- Ordinates E : 286953.00 N : 2100893.00

WATER TABLE

Date	Time	Mtrs.
11-07-2015	10.35 AM	6.00

Sampling Details				Standard Penetration Test (SPT)				Details of Rock core					Symbol	Depth in (m) w.r.t.(CD)	Details of Stratum	Soil Classification (USC)	Grain Size Analysis (%)				Consistency Limits (%)			Strength Test (kPa)			Consolidation Test			Remarks
	TYPE	From (m)	To (m)	150	300	450	"N" VALUE	TCR %	SCR %	RQD %	W.G	F.I.			Strata Description		GRAVEL	SAND	SILT	CLAY	LIQUID (w_L)	PLASTIC (w_P)	PLASTICITY INDEX (I_P)	UCS C_u	UU c, ϕ	CU c', ϕ'	PreConsolidation Pressure (kPa)	Commpression Index (Cc)	Initial Void Ratio (e_0)	
0		-2.90	-3.40											-2.90	Very soft, dark grey, CLAY	CH	0	2	57	41	62	26	36							
1																														
2		-4.40	-4.85	0	0	0	0									CH	0	1	57	42	62	43	19							
3		-5.90	-6.35																											
4																														UDS Slipped
5		-7.40	-7.52	54 blows/ 12cm	-	-	>100																							
		-7.40	-8.90					37	11	Nil	II	4		-7.40	Weak, moderately weathered, highly fractured light greyish amygdaloidal BASALT															
6																														
		-8.90	-10.40					43	13	Nil	II	3.3																		
7																														
8		-10.40	-11.90					33	11	Nil	II	4.7																		
9																														
		-11.90	-13.40					27	15	Nil	II	3.3			- colour changes to reddish grey below -11.90m CD															
10																														

AP3-24

Abbreviations & Symbols :

□ - SPT ■ - UDS ▨ - DS

W_L - Liquid Limit I_P - Plasticity Index MC - Moisture Content

▥ - Rock Recovery ▨ - No Recovery

TCR - Total Core Recovery SCR - Solid Core Recovery RQD - Rock Quality Designation

⊗ - Field Vane Shear ● - Sample Slipped

W.I. - Weathering Grade F.I. Fractural Index

C.D. Chart Datum, T.D. : Termination Depth, MSL : Mean Sea Level
SBL : Sea Bed Level, EGL : Existing Ground Level, R.L. : Reduced Level

Prepared By : V.N.
Checked By : S.D.
Approved By : S.T.

Plate-A7

IDEAL GEOSERVICES PVT. LTD.

BOREHOLE NO. : BH-03

Geotech Contractor : IDEAL GEOSERVICES PVT. LTD.	Job No. : IDEAL/028/015	CLIENT : ORIENTAL CONSULTANTS Global Consulting for Sustainable Development

SHEET 02 of 03

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

T.D. (m)	: -28.40 CD	SBL (m)	: -2.90 CD	Equipment Record	: AQUA STAR - JACKUP BARGE
Date Commenced	: 11-07-2015	Circulation Fluid	: Sea Water	Type of Rig	: Hydraulic Rig
Date Completed	: 16-07-2015	Drilling Orientation	: Vertical	Details of Casing (mm)	: SX / HX / NX
				Core-Diameter (mm)	: 54.10

Co- Ordinates E : 286953.00 N : 2100893.00

WATER TABLE

Date	Time	Mtrs.
11-07-2015	10.35 AM	6.00

Sampling Details				Standard Penetration Test (SPT)				Details of Rock core					Symbol	Depth in (m) w.r.t.(CD)	Details of Stratum	Soil Clasification (USC)	Grain Size Analysis (%)				Consistency Limits (%)			Strength Test (kPa)			Consolidation Test			Remarks
	TYPE	From (m)	To (m)	150	300	450	"N" VALUE	TCR %	SCR %	RQD %	W.G	F.I.			Strata Description		GRAVEL	SAND	SILT	CLAY	LIQUID (w_L)	PLASTIC (w_P)	PLASTICITY INDEX (I_P)	UCS C_u	UU c,ϕ	CU c',ϕ'	PreConsolidation Pressure (kPa)	Commpression Index (Cc)	Initial Void Ratio (e_0)	
10															Weak, moderately weathered, highly fractured light greyish amygdaloidal BASALT															
11		-13.40	-14.90					19	7	Nil	III	2.7																		
12		-14.90	-16.40					17	Nil	Nil	III	0.7																		
13																														
14		-16.40	-17.90					21	3	Nil	IV	2																		
15																														
16		-17.90	-19.40					39	28	8	IV	4.7																		
17		-19.40	-20.90					36	2	Nil	IV	>10																		
18																														
19		-20.90	-22.40					49	42	17	II	4.7		-20.90	Moderately strong, moderately weathered, moderately fractured reddish amygdloidal BASALT															
20		-22.40	-23.90					47	32	19	III	6																		

Abbreviations & Symbols :

□ - SPT ■ - UDS ◪ - DS

W_L - Liquid Limit I_P - Plasticity Index MC - Moisture Content

▥ - Rock Recovery ▨ - No Recovery

⊗ - Field Vane Shear ● - Sample Slipped

TCR - Total Core Recovery SCR - Solid Core Recovery RQD - Rock Quality Designation

C.D. Chart Datum, T.D. : Termination Depth, MSL : Mean Sea Level
SBL : Sea Bed Level, EGL : Existing Ground Level, R.L. : Reduced Level

W.I. - Weathering Grade F.I. Fractural Index

Prepared By : V.N.
Checked By : S.D.
Approved By : S.T.

AP3-25

Plate-A8

IDEAL GEOSERVICES PVT. LTD.

BOREHOLE NO. : BH-03

Geotech Contractor : IDEAL GEOSERVICES PVT. LTD.	Job No. : IDEAL/028/015	CLIENT : ORIENTAL CONSULTANTS Global Consulting for Sustainable Development	SHEET 03 of 03

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

T.D. (m)	: -28.40 CD	SBL (m)	: -2.90 CD	Equipment Record	: AQUA STAR - JACKUP BARGE
Date Commenced	: 11-07-2015	Circulation Fluid	: Sea Water	Type of Rig	: Hydraulic Rig
Date Completed	: 16-07-2015	Drilling Orientation	: Vertical	Details of Casing (mm)	: SX / HX / NX
				Core-Diameter (mm)	: 54.10

Co- Ordinates E : 286953.00 N : 2100893.00

WATER TABLE

Date	Time	Mtrs.
11-07-2015	10.35 AM	6.00

Sampling Details				Standard Penetration Test (SPT)				Details of Rock core					Symbol	Depth in (m) w.r.t.(CD)	Details of Stratum	Soil Clasification (USC)	Grain Size Analysis (%)				Consistency Limits (%)			Strength Test (kPa)			Consolidation Test			Remarks
	TYPE	From (m)	To (m)	150	300	450	"N" VALUE	TCR %	SCR %	RQD %	W.G	F.I.			Strata Description		GRAVEL	SAND	SILT	CLAY	LIQUID (w_L)	PLASTIC (w_P)	PLASTICITY INDEX (I_P)	UCS C_u	UU c, ϕ	CU c', ϕ'	PreConsolidation Pressure (kPa)	Commpression Index (Cc)	Initial Void Ratio (e_0)	
20															Moderately strong, moderately weathered, moderately fractured reddish amygdloidal BASALT															
21		-23.90	-25.40					94	94	80	II	4.7		-23.90	Strong, fresh, slightly fractured greyish BASALT															
22																														
23		-25.40	-26.90					83	80	59	II	6.7																		
24		-26.90	-28.40					100	100	86	III	4.7																		
25																														
26															BOREHOLE TERMINATED AT -28.40 (m) BELOW CD														
27																														
28																														
29																														
30																														

Abbreviations & Symbols :

□ - SPT ■ - UDS ◥ - DS

W_L - Liquid Limit I_P - Plasticity Index MC - Moisture Content

▥ - Rock Recovery ▨ - No Recovery

⊗ - Field Vane Shear ● - Sample Slipped

TCR - Total Core Recovery SCR - Solid Core Recovery RQD - Rock Quality Designation

C.D. Chart Datum, T.D. : Termination Depth, MSL : Mean Sea Level
SBL : Sea Bed Level, EGL : Existing Ground Level, R.L. : Reduced Level

W.I. - Weathering Grade F.I. Fractural Index

Prepared By : V.N.
Checked By : S.D.
Approved By : S.T.

AP3-26

Plate-A9

IDEAL GEOSERVICES PVT. LTD.

BOREHOLE NO. : BH-04

Geotech Contractor : IDEAL GEOSERVICES PVT. LTD.	Job No. : IDEAL/028/015	CLIENT : ORIENTAL CONSULTANTS (Global Consulting for Sustainable Development)
Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link		SHEET 01 of 03

T.D. (m)	: -31.85 CD	SBL (m)	: -5.60 CD	Equipment Record	: AQUA STAR - JACKUP BARGE
Date Commenced	: 22-06-2015	Circulation Fluid	: Sea Water	Type of Rig	: Hydraulic Rig
Date Completed	: 27-06-2015	Drilling Orientation	: Vertical	Details of Casing (mm)	: SX / HX / NX
				Core-Diameter (mm)	: 54.10

Co- Ordinates E : 286846.00 N : 2100932.00

WATER TABLE

Date	Time	Mtrs.
26-06-2015	10.20 AM	7.50

Sampling Details				Standard Penetration Test (SPT)				Details of Rock core					Symbol	Depth in (m)	Details of Stratum	Soil Clasification (USC)	Grain Size Analysis (%)				Consistency Limits (%)			Strength Test (kPa)			Consolidation Test			Remarks
	TYPE	From (m)	To (m)	150	300	450	"N" VALUE	TCR %	SCR %	RQD %	W.G	F.I.			Strata Description		GRAVEL	SAND	SILT	CLAY	LIQUID (w_L)	PLASTIC (w_P)	PLASTICITY INDEX (I_P)	UCS C_u	UU c, ϕ	CU c', ϕ'	PreConsolidation Pressure (kPa)	Commpression Index (Cc)	Initial Void Ratio (e_0)	
0		-5.60	-6.10											-5.60	Very loose, dark grey, clayey SAND	SC	5	53	25	17	36	24	12							
1																														
2		-7.10	-7.55	0	0	1	1							-7.10	Very soft, dark grey CLAY with sand	CL	0	23	38	39	47	26	21							
3		-8.60	-9.05																											UDS Slipped
4																														
5		-10.10	-10.55	5	11	18	29							-10.10	Medium dense, yellowish grey, clayey SAND with gravel	SC	11	52	20	17	49	27	22							
6		-11.60	-12.05	8	13	19	32							-11.60	Hard, yellowish grey CLAY with sand and gravels	CH	13	15	22	50	58	27	31							
7																														
8		-13.10	-13.55	23	24	34	58							-13.10	Very dense, yellowish brown, silty SAND	SM	3	76	14	7	-	NP	-							
9																														
10		-14.60	-14.87	18	55 blows/ 12cm	-	>100							-14.60	Very dense, yellowish brown,gravelly SAND with silt	SP	39	51		10	-	NP	-							

Abbreviations & Symbols :

- SPT, UDS, DS
- W_L - Liquid Limit, I_P - Plasticity Index, MC - Moisture Content
- Rock Recovery, No Recovery
- TCR - Total Core Recovery, SCR - Solid Core Recovery, RQD - Rock Quality Designation
- Field Vane Shear, Sample Slipped
- W.I. - Weathering Grade, F.I. Fractural Index

C.D. Chart Datum, T.D. : Termination Depth, MSL : Mean Sea Level
SBL : Sea Bed Level, EGL : Existing Ground Level, R.L. : Reduced Level

Prepared By : V.N.
Checked By : S.D.
Approved By : S.T.

AP3-27

Plate-A10

IDEAL GEOSERVICES PVT. LTD.

BOREHOLE NO. : BH-04

Geotech Contractor : IDEAL GEOSERVICES PVT. LTD.	Job No. : IDEAL/028/015	CLIENT : ORIENTAL CONSULTANTS Global Consulting for Sustainable Development

SHEET 02 of 03

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

T.D. (m)	: -31.85 CD	SBL (m)	: -5.60 CD	Equipment Record	: AQUA STAR - JACKUP BARGE
Date Commenced	: 22-06-2015	Circulation Fluid	: Sea Water	Type of Rig	: Hydraulic Rig
Date Completed	: 27-06-2015	Drilling Orientation	: Vertical	Details of Casing (mm)	: SX / HX / NX
				Core-Diameter (mm)	: 54.10

Co- Ordinates E : 286846.00 N : 2100932.00

WATER TABLE

Date	Time	Mtrs.
26-06-2015	10.20 AM	7.50

Sampling Details				Standard Penetration Test (SPT)				Details of Rock core					Symbol	Depth in (m)	Details of Stratum	Soil Clasiffication (USC)	Grain Size Analysis (%)				Consistency Limits (%)			Strength Test (kPa)			Consolidation Test			Remarks
	TYPE	From (m)	To (m)	150	300	450	"N" VALUE	TCR %	SCR %	RQD %	W.G	F.I.			Strata Description		GRAVEL	SAND	SILT	CLAY	LIQUID (w_L)	PLASTIC (w_P)	PLASTICITY INDEX (I_P)	UCS C_u	UU c,ϕ	CU c',ϕ'	PreConsolidation Pressure (kPa)	Commpression Index (Cc)	Initial Void Ratio (e_0)	
10															Very dense, yellowish brown,gravelly SAND with silt															
		-16.10	-16.45	25	28	55 blows/ 5cm	>100									SP	37	55		8	-	NP	-							
11		-16.10	-17.60					25	12	-	V	>10		-16.10	Very weak, highly weathered, highly fractured, greyish BASALT															
12		-17.60	-18.10					19	12	-	V	>10																		
		-18.10	-19.60					45	32	8	IV	>10																		
13																														
14		-19.60	-21.10					55	30	8	IV	>10																		
15																														
16		-21.10	-22.60					67	57	7	IV	>10																		
17																														
18		-22.60	-24.10					90	60	29	IV	>10		-22.60	Moderately strong, moderately weathered, moderately fractured reddish amygdaloidal BASALT															
19		-24.10	-25.60					77	52	-	V	>10																		
20																														

AP3-28

Abbreviations & Symbols :

- SPT - UDS - DS
- Rock Recovery - No Recovery
- Field Vane Shear - Sample Slipped

W_L - Liquid Limit I_P - Plasticity Index MC - Moisture Content

TCR - Total Core Recovery SCR - Solid Core Recovery RQD - Rock Quality Designation

C.D. Chart Datum, T.D. : Termination Depth, MSL : Mean Sea Level
SBL : Sea Bed Level, EGL : Existing Ground Level, R.L. : Reduced Level

W.I. - Weathering Grade F.I. Fractural Index

Prepared By : V.N.
Checked By : S.D.
Approved By : S.T.

IDEAL GEOSERVICES PVT. LTD.

BOREHOLE NO. : BH-04

Geotech Contractor : IDEAL GEOSERVICES PVT. LTD. | Job No. : IDEAL/028/015 | CLIENT : ORIENTAL CONSULTANTS Global Consulting for Sustainable Development | SHEET 03 of 03

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

T.D. (m)	: -31.85 CD	SBL (m)	: -5.60 CD	Equipment Record	: AQUA STAR - JACKUP BARGE	
Date Commenced	: 22-06-2015	Circulation Fluid	: Sea Water	Type of Rig	: Hydraulic Rig	
Date Completed	: 27-06-2015	Drilling Orientation	: Vertical	Details of Casing (mm)	: SX / HX / NX	
				Core-Diameter (mm)	: 54.10	

Co- Ordinates E : 286846.00 N : 2100932.00

WATER TABLE

Date	Time	Mtrs.
26-06-2015	10.20 AM	7.50

Sampling Details				Standard Penetration Test (SPT)				Details of Rock core					Symbol	Depth in (m)	Details of Stratum	Soil Clasification (USC)	Grain Size Analysis (%)				Consistency Limits (%)			Strength Test (kPa)			Consolidation Test			Remarks
	TYPE	From (m)	To (m)	150	300	450	"N" VALUE	TCR %	SCR %	RQD %	W.G	F.I.			Strata Description		GRAVEL	SAND	SILT	CLAY	LIQUID (w_L)	PLASTIC (w_P)	PLASTICITY INDEX (I_P)	UCS C_u	UU c,ϕ	CU c',ϕ'	PreConsolidation Pressure (kPa)	Commpression Index (Cc)	Initial Void Ratio (e_0)	
20		-25.60	-27.10					82	39	21	IV	>10		-25.60	Moderately strong, moderately weathered, moderately fractured reddish amygdaloidal BASALT															
21		-27.10	-28.60					98	97	81	III	4.7		-27.10	Weak to moderately strong, slightly weathered, greyish BASALT															
22																														
23		-28.60	-30.10					93	90	60	III	5.3			- secondary infilling of the vugs are noticed and some part of the rock materials is friable															
24																														
25		-30.10	-31.60					97	96	60	III	>10																		
26		-31.60	-31.80					100	100	60	III	1.3																		
27															BOREHOLE TERMINATED DEPTH AT -31.80 (m)														
28																														
29																														
30																														

Abbreviations & Symbols :

- SPT - UDS - DS
- Rock Recovery - No Recovery
- Field Vane Shear - Sample Slipped

W_L - Liquid Limit I_P - Plasticity Index MC - Moisture Content

TCR - Total Core Recovery SCR - Solid Core Recovery RQD - Rock Quality Designation

C.D. Chart Datum, T.D. : Termination Depth, MSL : Mean Sea Level
SBL : Sea Bed Level, EGL : Existing Ground Level, R.L. : Reduced Level

W.I. - Weathering Grade F.I. Fractural Index

Prepared By : V.N.
Checked By : S.D.
Approved By : S.T.

AD3-29

Plate-A12

IDEAL GEOSERVICES PVT. LTD.

BOREHOLE NO. : BH-05

Geotech Contractor : IDEAL GEOSERVICES PVT. LTD. | Job No. : IDEAL/028/015 | CLIENT : ORIENTAL CONSULTANTS Global Consulting for Sustainable Development | SHEET 01 of 03

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

T.D. (m)	: -25.34 CD	SBL (m)	: -3.10 CD	Equipment Record	: AQUA STAR - JACKUP BARGE	
Date Commenced	: 13-06-2015	Circulation Fluid	: Sea Water	Type of Rig	: Hydraulic Rig	
Date Completed	: 16-06-2015	Drilling Orientation	: Vertical	Details of Casing (mm)	: SX / HX / NX	
				Core-Diameter (mm)	: 54.10	

Co- Ordinates E : 287282.00 N : 2100749.00

WATER TABLE

Date	Time	Mtrs.
13-06-2015	10.30 AM	7.00

Sampling Details				Standard Penetration Test (SPT)				Details of Rock core					Symbol	Depth in (m) w.r.t.(CD)	Details of Stratum	Soil Classification (USC)	Grain Size Analysis (%)				Consistency Limits (%)			Strength Test (kPa)			Consolidation Test			Remarks
	TYPE	From (m)	To (m)	150	300	450	"N" VALUE	TCR %	SCR %	RQD %	W.G	F.I.			Strata Description		GRAVEL	SAND	SILT	CLAY	LIQUID (w_L)	PLASTIC (w_P)	PLASTICITY INDEX (I_P)	UCS C_u	UU c,ϕ	CU c',ϕ'	PreConsolidation Pressure (kPa)	Commpression Index (Cc)	Initial Void Ratio (e_0)	
0		-3.10	-3.60											-3.10	Very soft, greyish sandy CLAY with gravels	CL	7	43	28	22	42	22	20							
1																														
2		-4.60	-5.05																											
3		-6.10	-6.20	50 blows/ 10cm	-	-	>100							-6.10	Very dense, greyish silty SAND with gravels	SM	6	67	22	5	-	NP	-							
4																														
5		-7.60	-8.05													SM	6	68	21	5	-	NP	-							
6		-9.10	-9.35	45	50 blows/ 10cm	-	>100									SP	19	73	8		-	NP	-							
7																														
8		-10.60	-10.83	35	50 blows/ 8cm	-	>100							-10.60	Very dense, brownish sandy GRAVELS	GP	56	43	1		-	NP	-							
9		-12.10	-12.55	42	50	52	>100								- with silt	GC	40	27	28	5	32	20	12							
10																														

Abbreviations & Symbols :

- SPT - UDS - DS
- Rock Recovery - No Recovery
- Field Vane Shear - Sample Slipped

W_L - Liquid Limit I_P - Plasticity Index MC - Moisture Content

TCR - Total Core Recovery SCR - Solid Core Recovery RQD - Rock Quality Designation

C.D. Chart Datum, T.D. : Termination Depth, MSL : Mean Sea Level
SBL : Sea Bed Level, EGL : Existing Ground Level, R.L. : Reduced Level

W.I. - Weathering Grade F.I. Fractural Index

Prepared By : V.N.
Checked By : S.D.
Approved By : S.T.

AP3-30

Plate-A13

IDEAL GEOSERVICES PVT. LTD.

BOREHOLE NO. : BH-05

Geotech Contractor : IDEAL GEOSERVICES PVT. LTD. | Job No. : IDEAL/028/015 | CLIENT : ORIENTAL CONSULTANTS Global Consulting for Sustainable Development | SHEET 02 of 03

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

T.D. (m)	: -25.34 CD	SBL (m)	: -3.10 CD	Equipment Record	: AQUA STAR - JACKUP BARGE	
Date Commenced	: 13-06-2015	Circulation Fluid	: Sea Water	Type of Rig	: Hydraulic Rig	
Date Completed	: 16-06-2015	Drilling Orientation	: Vertical	Details of Casing (mm)	: SX / HX / NX	
				Core-Diameter (mm)	: 54.10	

Co- Ordinates E : 287282.00 N : 2100749.00

WATER TABLE

Date	Time	Mtrs.
13-06-2015	10.30 AM	7.00

Sampling Details				Standard Penetration Test (SPT)				Details of Rock core					Symbol	Depth in (m) w.r.t.(CD)	Details of Stratum	Soil Clasification (USC)	Grain Size Analysis (%)				Consistency Limits (%)			Strength Test (kPa)			Consolidation Test			Remarks
	TYPE	From (m)	To (m)	150	300	450	"N" VALUE	TCR %	SCR %	RQD %	W.G	F.I.			Strata Description		GRAVEL	SAND	SILT	CLAY	LIQUID (w_L)	PLASTIC (w_P)	PLASTICITY INDEX (I_P)	UCS C_u	UU c, ϕ	CU c', ϕ'	PreConsolidation Pressure (kPa)	Commpression Index (Cc)	Initial Void Ratio (e_0)	
10															Very dense, brownish sandy GRAVELS															
		-13.60	-14.05	35	38	43	81							-13.60	Hard, brownish sandy, CLAY with gravels	CL	5	35	53	7	41	22	19							
11																														
12		-15.10	-15.22	56 blows/ 12cm	-	-	>100							-15.10	Very dense, brownish, fine to medium SAND	SP	0	90	10		-	NP	-							
13																														
		-16.60	-16.68	60 blows/ 8cm	-	-	>100									SM	2	78	14	6	-	NP	-							
14		-16.60	-18.10					67	53	7	IV	>10		-16.60	Very weak to weak, highly to completely weathered, reddish to greyish BASALT															
15		-18.10	-19.60					67	54	8	IV	>10																		
16																														
17		-19.60	-21.10					100	100	53	IV	>10		-19.60	Weak to moderately strong moderately weathered, horizontal fractured, greyish amygdaloidal BASALT															
18																														
		-21.10	-22.60					100	95	52	III	>10																		
19																														
20		-22.60	-24.10					100	100	55	III	6.7																		

Abbreviations & Symbols :

□ - SPT ■ - UDS ▨ - DS | W_L - Liquid Limit | I_P - Plasticity Index | MC - Moisture Content

C.D. Chart Datum, T.D. : Termination Depth, MSL : Mean Sea Level
SBL : Sea Bed Level, EGL : Existing Ground Level, R.L. : Reduced Level

▥ - Rock Recovery ▨ - No Recovery | TCR - Total Core Recovery | SCR - Solid Core Recovery | RQD - Rock Quality Designation | W.I. - Weathering Grade F.I. Fractural Index

⊗ - Field Vane Shear ● - Sample Slipped

Prepared By : V.N.
Checked By : S.D.
Approved By : S.T.

AP3-31

Plate-A14

IDEAL GEOSERVICES PVT. LTD.

BOREHOLE NO. : BH-05

Geotech Contractor : IDEAL GEOSERVICES PVT. LTD.	Job No. : IDEAL/028/015	CLIENT : ORIENTAL CONSULTANTS Global Consulting for Sustainable Development	SHEET 03 of 03

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

T.D. (m)	: -25.34 CD	SBL (m)	: -3.10 CD	Equipment Record	: AQUA STAR - JACKUP BARGE
Date Commenced	: 13-06-2015	Circulation Fluid	: Sea Water	Type of Rig	: Hydraulic Rig
Date Completed	: 16-06-2015	Drilling Orientation	: Vertical	Details of Casing (mm)	: SX / HX / NX
				Core-Diameter (mm)	: 54.10

Co- Ordinates E : 287282.00 N : 2100749.00

WATER TABLE

Date	Time	Mtrs.
13-06-2015	10.30 AM	7.00

Sampling Details				Standard Penetration Test (SPT)				Details of Rock core					Symbol	Depth in (m) w.r.t.(CD)	Details of Stratum	Soil Clasification (USC)	Grain Size Analysis (%)				Consistency Limits (%)			Strength Test (kPa)			Consolidation Test			Remarks
	TYPE	From (m)	To (m)	150	300	450	"N" VALUE	TCR %	SCR %	RQD %	W.G	F.I.			Strata Description		GRAVEL	SAND	SILT	CLAY	LIQUID (w_L)	PLASTIC (w_P)	PLASTICITY INDEX (I_P)	UCS C_u	UU c,ϕ	CU c',ϕ'	PreConsolidation Pressure (kPa)	Commpression Index (Cc)	Initial Void Ratio (e_0)	
20															Weak to moderately strong moderately weathered, horizontal fractured, greyish amygdaloidal BASALT															
21		-24.10	-25.30					96	88	23	III	>10		-24.10	Moderately strong, slightly weathered, greyish BASALT															
22																														
23															BOREHOLE TERMINATED AT -25.30 (m) BELOW CD															
24																														
25																														
26																														
27																														
28																														
29																														
30																														

Abbreviations & Symbols :

- SPT - UDS - DS
- Rock Recovery - No Recovery
- Field Vane Shear - Sample Slipped

W_L - Liquid Limit I_P - Plasticity Index MC - Moisture Content

TCR - Total Core Recovery SCR - Solid Core Recovery RQD - Rock Quality Designation

C.D. Chart Datum, T.D. : Termination Depth, MSL : Mean Sea Level
SBL : Sea Bed Level, EGL : Existing Ground Level, R.L. : Reduced Level

W.I. - Weathering Grade F.I. Fractural Index

Prepared By : V.N.
Checked By : S.D.
Approved By : S.T.

AP3-32

Plate-A15

IDEAL GEOSERVICES PVT. LTD.

BOREHOLE NO. : BH-06

Geotech Contractor : IDEAL GEOSERVICES PVT. LTD. | Job No. : IDEAL/028/015 | CLIENT : ORIENTAL CONSULTANTS Global Consulting for Sustainable Development | SHEET 01 of 03

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

T.D. (m)	: -22.11 CD	SBL (m)	: 0.09 CD	Equipment Record	: AQUA STAR - JACKUP BARGE	
Date Commenced	: 11-06-2015	Circulation Fluid	: Sea Water	Type of Rig	: Hydraulic Rig	
Date Completed	: 12-06-2015	Drilling Orientation	: Vertical	Details of Casing (mm)	: SX / HX / NX	
				Core-Diameter (mm)	: 54.10	

Co- Ordinates E : 288918.00 N : 2099540.00

WATER TABLE

Date	Time	Mtrs.
11-06-2015	9.30 AM	3.00

Sampling Details				Standard Penetration Test (SPT)				Details of Rock core					Symbol	Depth in (m) w.r.t.(CD)	Details of Stratum	Soil Clasification (USC)	Grain Size Analysis (%)				Consistency Limits (%)			Strength Test (kPa)			Consolidation Test			Remarks
	TYPE	From (m)	To (m)	150	300	450	"N" VALUE	TCR %	SCR %	RQD %	W.G	F.I.			Strata Description		GRAVEL	SAND	SILT	CLAY	LIQUID (w_L)	PLASTIC (w_P)	PLASTICITY INDEX (I_P)	UCS C_u	UU c_u, ϕ_u	CU c', ϕ'	PreConsolidation Pressure (kPa)	Commpression Index (Cc)	Initial Void Ratio (e_0)	
0		0.09	-0.41											0.09	Loose, greyish SAND with shells	SP	2	98	0		-	NP	0							UDS Slipped
1																														
2		-1.41	-1.86																											
3		-2.91	-3.36	14	24	32	56							-2.91	Very dense, greenish grey silty SAND	SM	0	65	30	5	44	27	17							
4																														
5		-4.41	-4.86	7	24	52 blows/ 8cm	>100									SP	0	97	3		-	NP	-							
6		-5.91	-6.30	12	45	54 blows/ 9cm	>100																							
7																SM	0	85	15		-	NP	-							
		-7.41	-7.51	50 blows/ 10cm	-	-	>100								-with gravels															
8		-7.41	-8.91					20	Nil	Nil	V	>10		-7.41	Very weak, highly weathered, light brownish BASALT	SM	14	71	15		-	NP	-							
9		-8.91	-10.41					11	Nil	Nil	IV	4																		
10																														

Abbreviations & Symbols :

□ - SPT ■ - UDS ◥ - DS | W_L - Liquid Limit I_P - Plasticity Index MC - Moisture Content

▥ - Rock Recovery ▨ - No Recovery | TCR - Total Core Recovery SCR - Solid Core Recovery RQD - Rock Quality Designation

⊗ - Field Vane Shear ● - Sample Slipped | W.I. - Weathering Grade F.I. Fractural Index

C.D. Chart Datum, T.D. : Termination Depth, MSL : Mean Sea Level
SBL : Sea Bed Level, EGL : Existing Ground Level, R.L. : Reduced Level

Prepared By : V.N.
Checked By : S.D.
Approved By : S.T.

AP3-33

Plate-A16

IDEAL GEOSERVICES PVT. LTD.

BOREHOLE NO. : BH-06

Geotech Contractor : IDEAL GEOSERVICES PVT. LTD. | Job No. : IDEAL/028/015 | CLIENT : ORIENTAL CONSULTANTS Global Consulting for Sustainable Development | SHEET 02 of 03

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

T.D. (m)	: -22.11 CD	SBL (m)	: 0.09 CD	Equipment Record	: AQUA STAR - JACKUP BARGE	
Date Commenced	: 11-06-2015	Circulation Fluid	: Sea Water	Type of Rig	: Hydraulic Rig	
Date Completed	: 12-06-2015	Drilling Orientation	: Vertical	Details of Casing (mm)	: SX / HX / NX	
				Core-Diameter (mm)	: 54.10	

WATER TABLE

Date	Time	Mtrs.
11-06-2015	9.30 AM	3.00

Co- Ordinates E : 288918.00 N : 2099540.00

Sampling Details				Standard Penetration Test (SPT)				Details of Rock core					Symbol	Depth in (m) w.r.t.(CD)	Details of Stratum	Soil Clasification (USC)	Grain Size Analysis (%)				Consistency Limits (%)			Strength Test (kPa)			Consolidation Test			Remarks
	TYPE	From (m)	To (m)	150	300	450	"N" VALUE	TCR %	SCR %	RQD %	W.G	F.I.			Strata Description		GRAVEL	SAND	SILT	CLAY	LIQUID (w_L)	PLASTIC (w_P)	PLASTICITY INDEX (I_P)	UCS C_u	UU c, ϕ	CU c', ϕ'	PreConsolidation Pressure (kPa)	Commpression Index (Cc)	Initial Void Ratio (e_0)	
10															Very weak, highly weathered, light brownish BASALT															
		-10.41	-11.91					23	Nil	Nil	IV	>10																		
11																														
12		-11.91	-13.41					40	Nil	Nil	IV	>10																		
13																														
		-13.41	-14.91					51	33	20	III	>10		-13.41	Weak to moderately strong, highly to moderately weathered, highly fractured, brownish grey BASALT															
14																														
15		-14.91	-16.41					100	67	44	III	>10																		
16																														
		-16.41	-17.91					100	100	71	III	6.7		-16.41	Moderately strong, moderately weathered, reddish brown, amygdaloidal BASALT															
17																														
18		-17.91	-19.41					97	84	47	IV	>10																		
19																														
20		-19.41	-20.91					100	100	76	III	5.3																		

Abbreviations & Symbols :

- SPT - UDS - DS
- Rock Recovery - No Recovery
- Field Vane Shear - Sample Slipped

W_L - Liquid Limit I_P - Plasticity Index MC - Moisture Content

TCR - Total Core Recovery SCR - Solid Core Recovery RQD - Rock Quality Designation

C.D. Chart Datum, T.D. : Termination Depth, MSL : Mean Sea Level
SBL : Sea Bed Level, EGL : Existing Ground Level, R.L. : Reduced Level

W.I. - Weathering Grade F.I. Fractural Index

Prepared By : V.N.
Checked By : S.D.
Approved By : S.T.

AP3-34

Plate-A17

IDEAL GEOSERVICES PVT. LTD.

BOREHOLE NO. : BH-06

Geotech Contractor : IDEAL GEOSERVICES PVT. LTD.	Job No. : IDEAL/028/015	CLIENT : ORIENTAL CONSULTANTS Global Consulting for Sustainable Development	SHEET 03 of 03

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

T.D. (m)	: -22.11 CD	SBL (m)	: 0.09 CD	Equipment Record	: AQUA STAR - JACKUP BARGE
Date Commenced	: 11-06-2015	Circulation Fluid	: Sea Water	Type of Rig	: Hydraulic Rig
Date Completed	: 12-06-2015	Drilling Orientation	: Vertical	Details of Casing (mm)	: SX / HX / NX
				Core-Diameter (mm)	: 54.10

Co- Ordinates E : 288918.00 N : 2099540.00

WATER TABLE		
Date	Time	Mtrs.
11-06-2015	9.30 AM	3.00

Sampling Details				Standard Penetration Test (SPT)				Details of Rock core					Symbol	Depth in (m) w.r.t.(CD)	Details of Stratum	Soil Clasification (USC)	Grain Size Analysis (%)				Consistency Limits (%)			Strength Test (kPa)			Consolidation Test			Remarks
	TYPE	From (m)	To (m)	150	300	450	"N" VALUE	TCR %	SCR %	RQD %	W.G	F.I.			Strata Description		GRAVEL	SAND	SILT	CLAY	LIQUID (w_L)	PLASTIC (w_P)	PLASTICITY INDEX (I_P)	UCS C_u	UU c_u, ϕ_u	CU c', ϕ'	PreConsolidation Pressure (kPa)	Commpression Index (Cc)	Initial Void Ratio (e_0)	
20															Moderately strong, moderately weathered, reddish brown, amygdaloidal BASALT															
21		-20.91	-22.11					100	100	96	III	4																		
22																														
23															BOREHOLE TERMINATED AT -22.11 (m) BELOW CD														
24																														
25																														
26																														
27																														
28																														
29																														
30																														

AP3-35

Abbreviations & Symbols :

- SPT - UDS - DS
- Rock Recovery - No Recovery
- Field Vane Shear - Sample Slipped

W_L - Liquid Limit I_P - Plasticity Index MC - Moisture Content

TCR - Total Core Recovery SCR - Solid Core Recovery RQD - Rock Quality Designation

C.D. Chart Datum, T.D. : Termination Depth, MSL : Mean Sea Level
SBL : Sea Bed Level, EGL : Existing Ground Level, R.L. : Reduced Level

W.I. - Weathering Grade F.I. Fractural Index

Prepared By : V.N.
Checked By : S.D.
Approved By : S.T.

Project: Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

Job No. : IDEAL/028/015

SPT v/s DEPTH [Corrected]

DATE : 06/07/15 to 10/07/15	CLIENT : Oriental Consultants	Location : BH-01

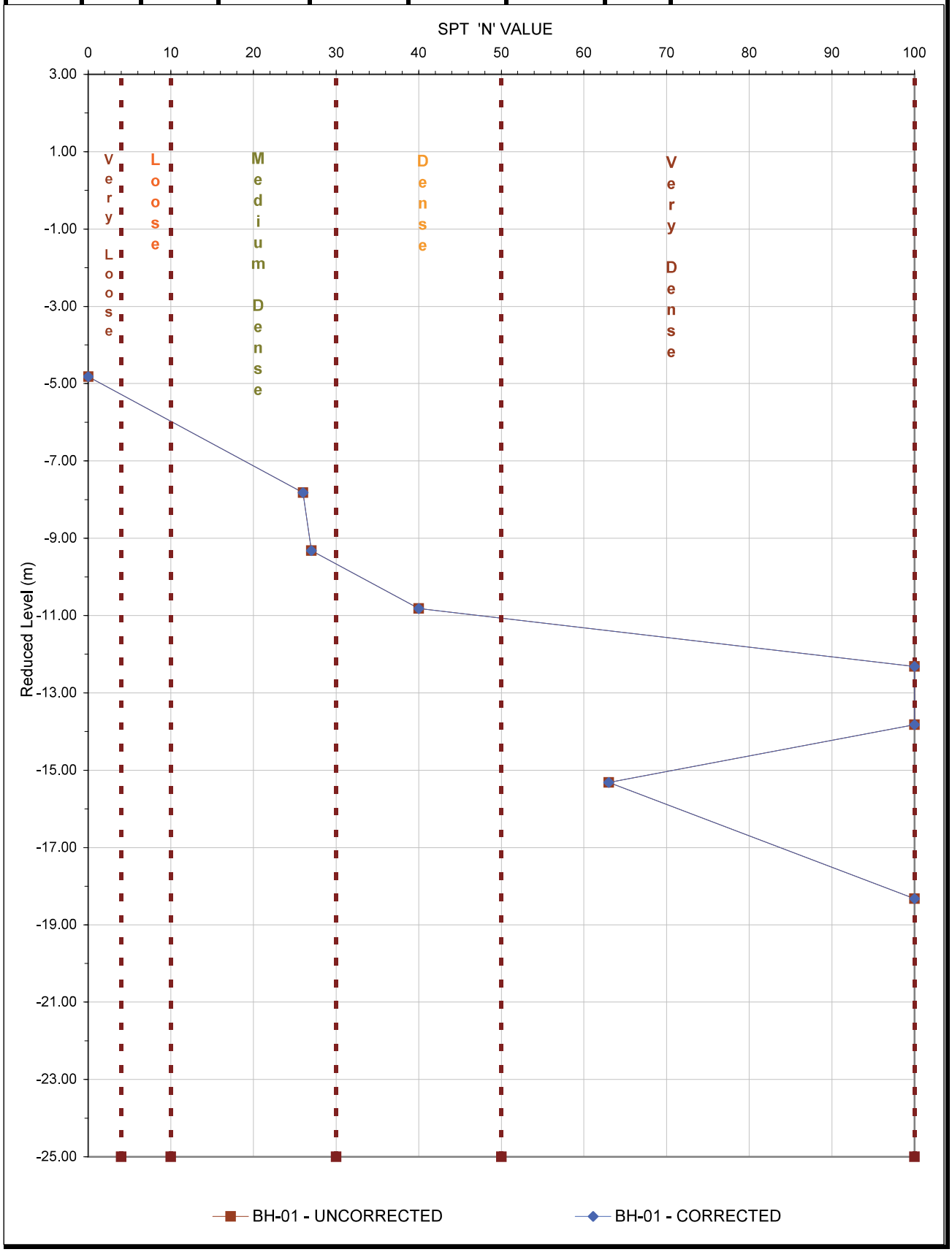


Plate-A19

Project: Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

Job No. : IDEAL/028/015

SPT v/s DEPTH [Corrected]

DATE : 02/07/15 to 06/07/15	CLIENT : Oriental Consultants	Location : BH-02

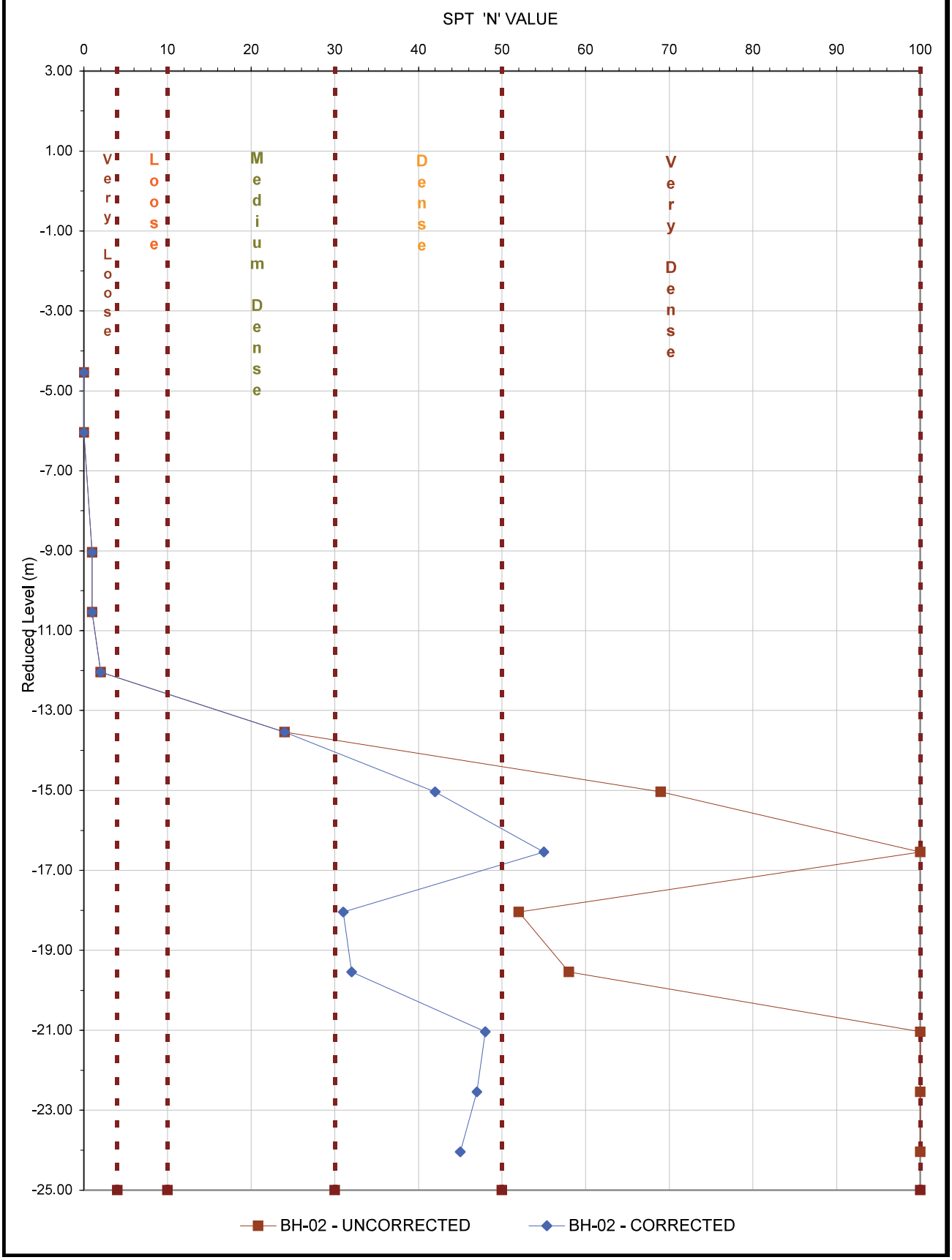


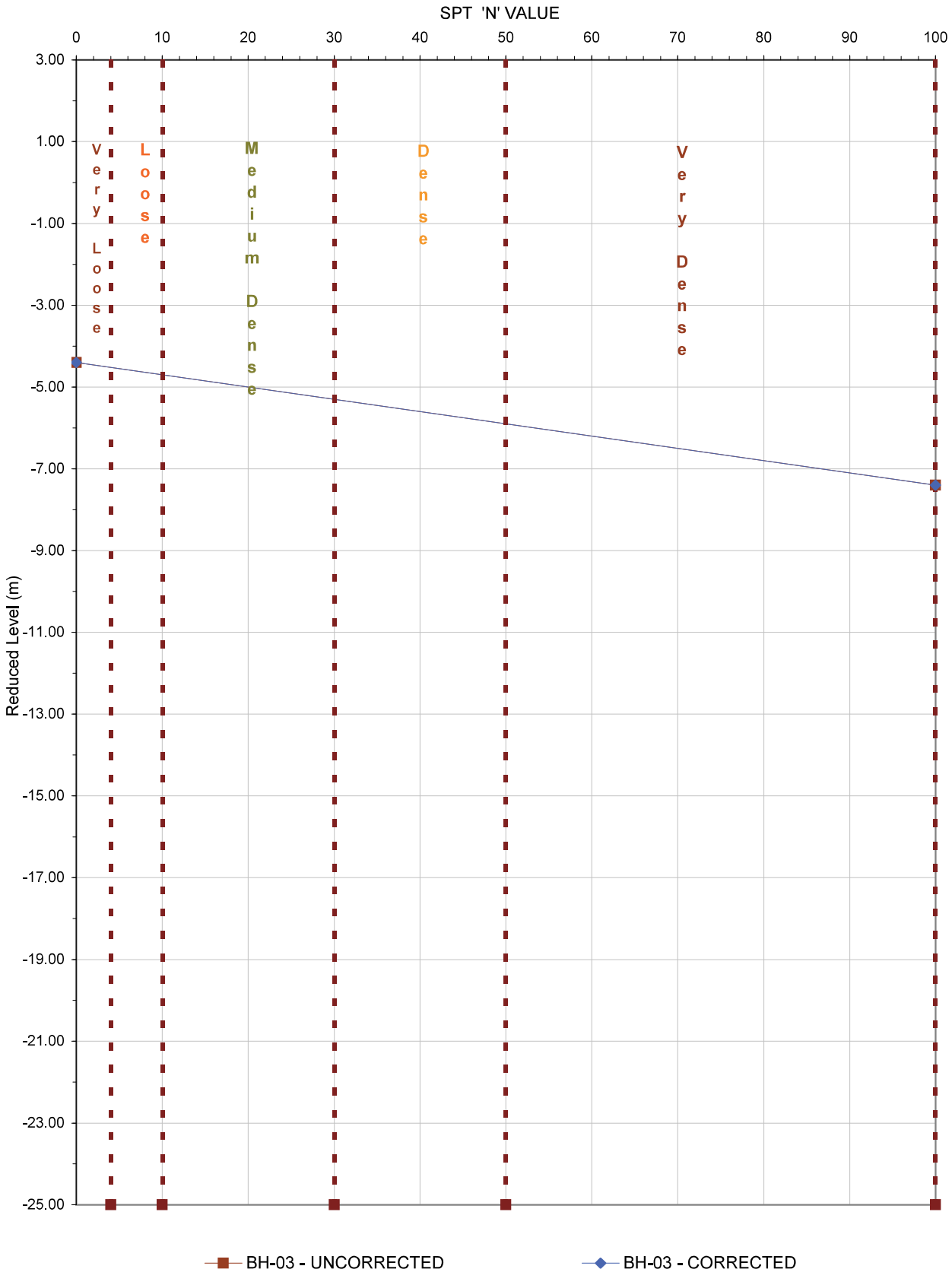
Plate-A20

Project: Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

Job No. : IDEAL/028/015

SPT v/s DEPTH [Corrected]

DATE : 11/07/15 to 16/07/15	CLIENT : Oriental Consultants	Location : BH-03



Project: Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

Job No. : IDEAL/028/015

SPT v/s DEPTH [Corrected]

DATE : 22/06/15 to 27/06/15	CLIENT : Oriental Consultants	Location : BH-04

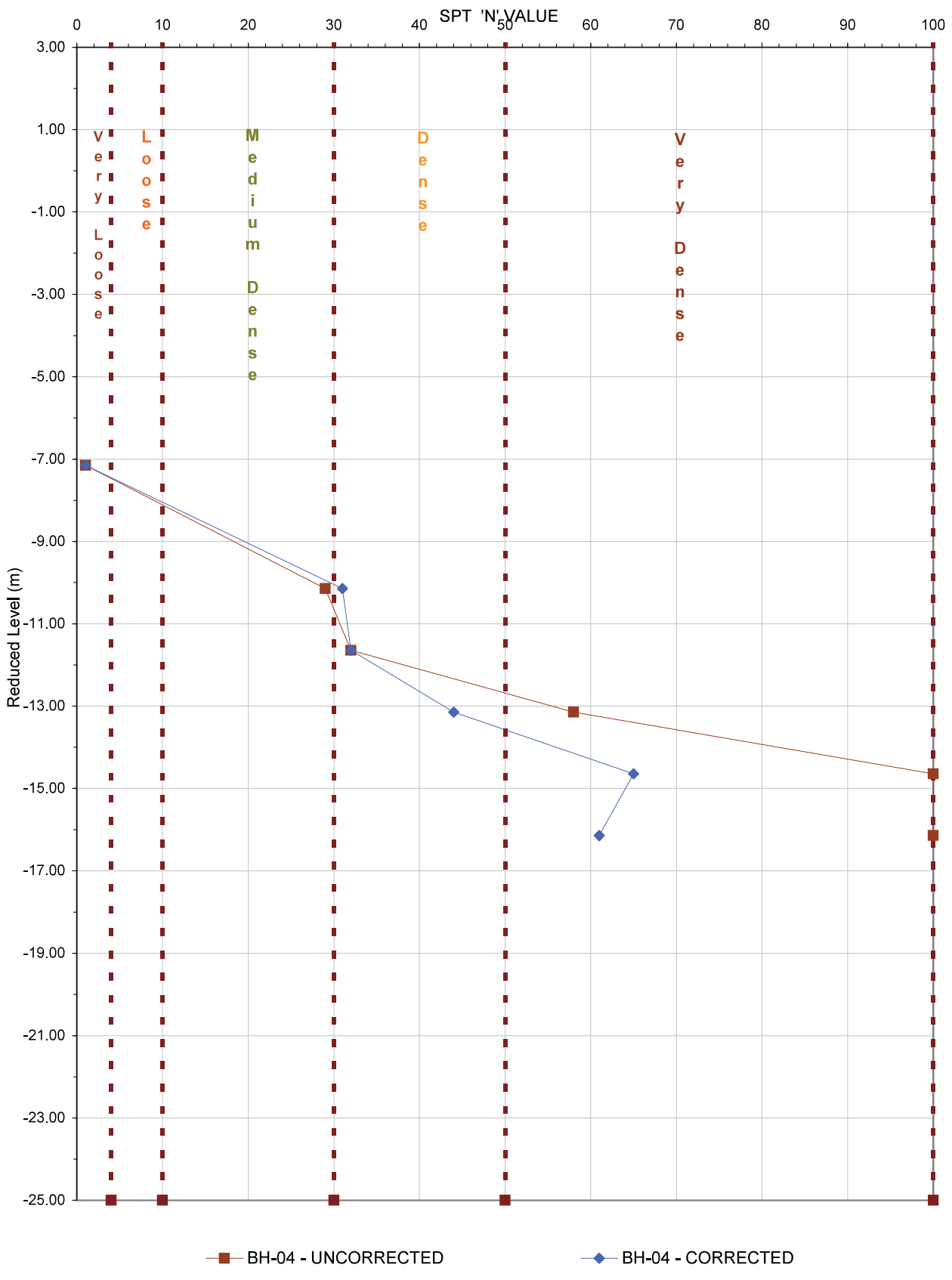


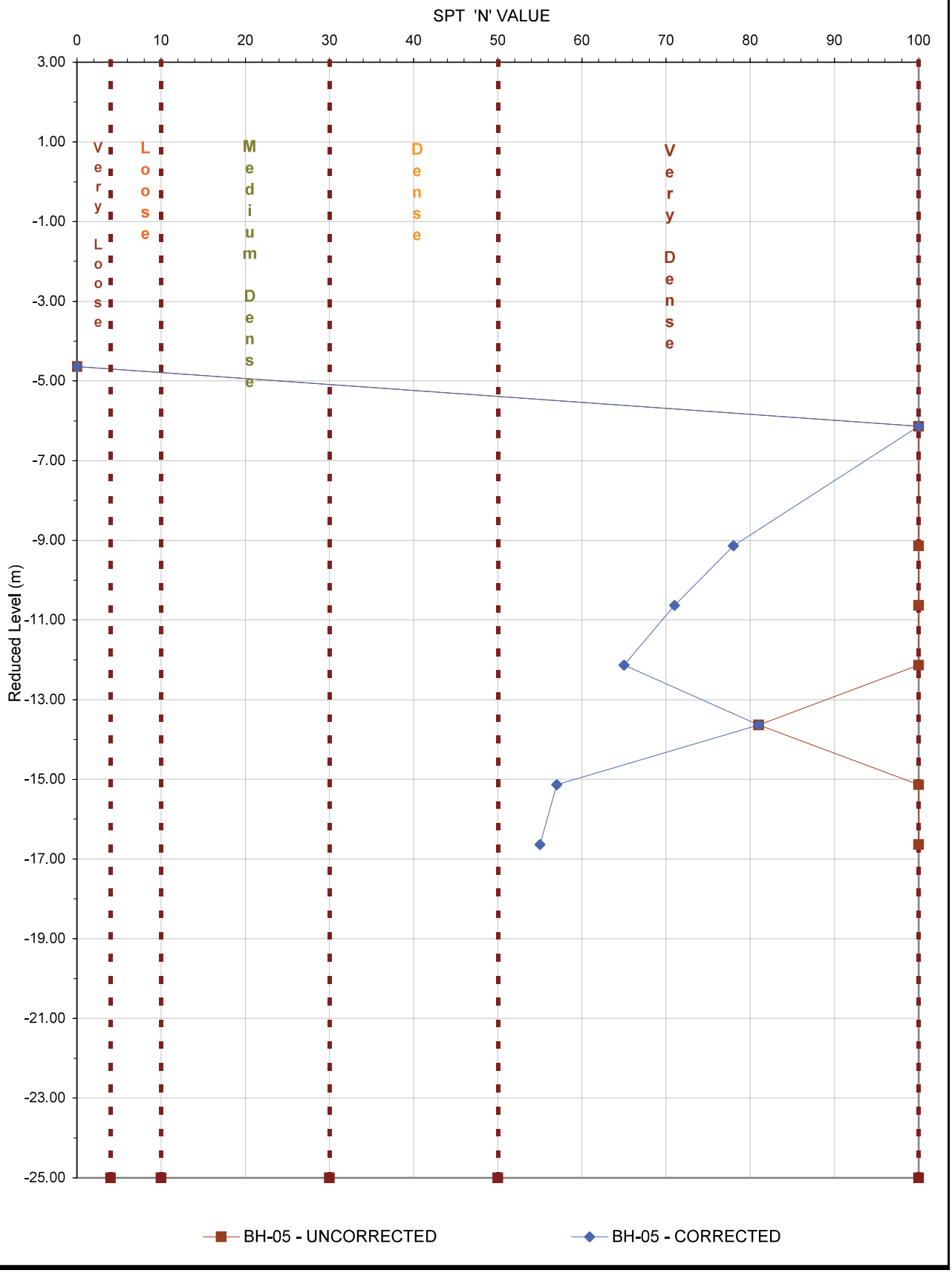
Plate-A22

Project: Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

Job No. : IDEAL/028/015

SPT v/s DEPTH [Corrected]

DATE : 13/06/15 to 16/06/15	CLIENT : Oriental Consultants	Location : BH-05

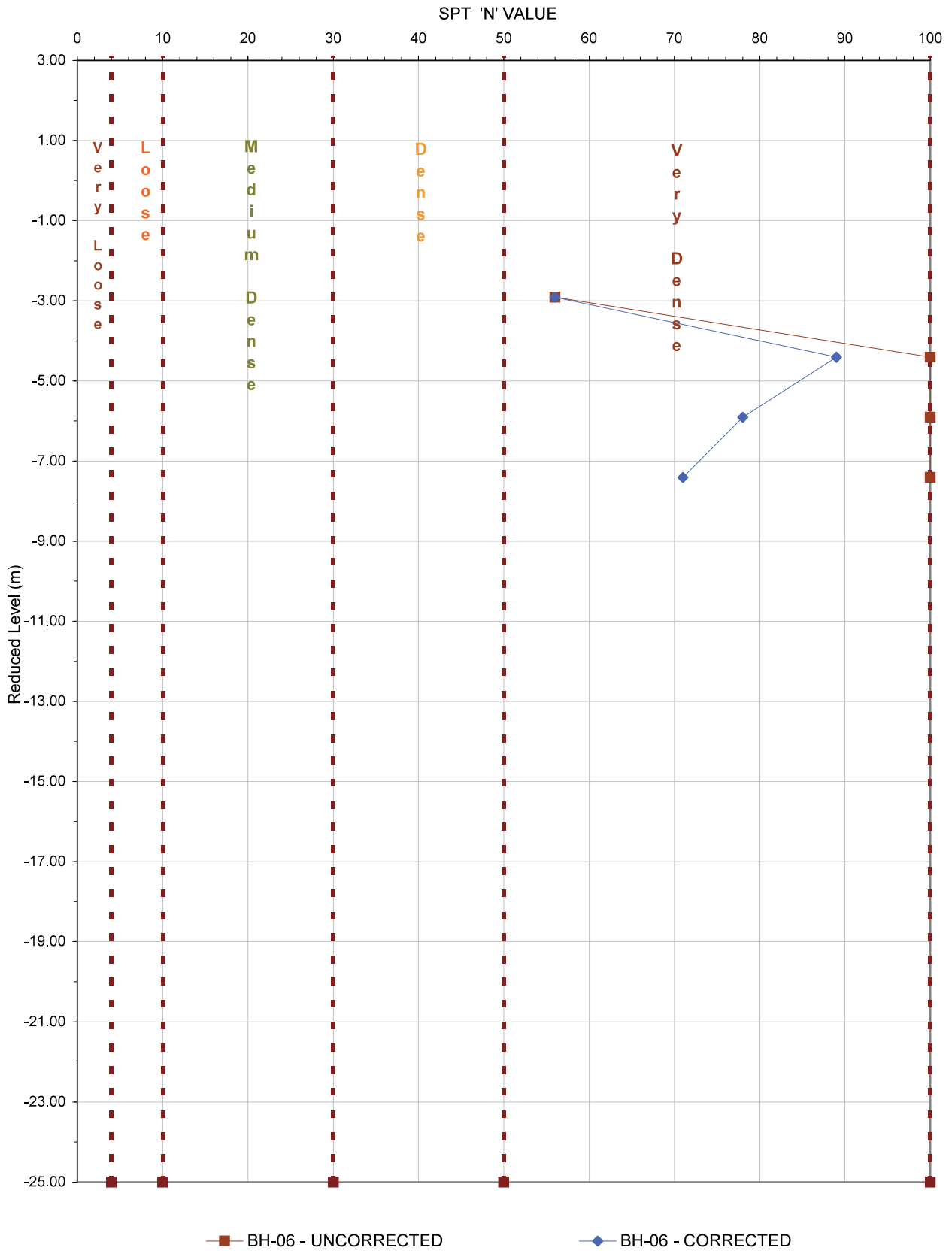


Project: Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

Job No. : IDEAL/028/015

SPT v/s DEPTH [Corrected]

DATE : 11/06/15 to 12/06/15	CLIENT : Oriental Consultants	Location : BH-06



APPENDIX-B - SUMMARY OF LABORATORY TEST RESULTS

SUMMARY OF LABORATORY TEST RESULTS ON SOIL SAMPLES

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

Client: ORIENTAL CONSULTANTS — Global Consulting for Sustainable Development

Job Number : IDEAL/028/015

BOREHOLE - NO.	TestDepth (m)		Sample Type (D/S/SPT/UDS)	DENSITY & MOISTURE CONTENT			Soil Clasification (USC)	CLASSIFICATION TESTS								STRENGTH TESTS (kPa)							CONSOLIDATION TEST			CHEMICAL TEST						
				Moisture Content (%)	Density (Kg/cm^3)			Sp. Gravity	Atterberg Limits(%)			Particle Size Distribution(%)				UCS	UU		CU		Lab Shear Vane		Pre-Consolidation Pressure (kPa)	Commpression Index (Cc)	Initial Void Ratio (e^0)	Soil (%)				Water (mg/l)		
	From	To			Wet	Dry			W_L	W_P	I_P	Gravel	Sand	Silt	Clay	C_u	c	ϕ	c'	ϕ'	τ_v	τ_{vr}				SO_3	SO_4	CL	pH	SO_4	CL	pH
BH-01	-3.32	-3.82	D/S				CH	2.61	66	27	39	0	8	48	44																	
	-4.82	-5.27	SPT				CH	2.60	71	16	55	0	1	52	47																	
	-6.32	-6.77	UDS	67	1.60	0.96	CH	2.58	87	38	49	0	2	46	52	16							130	0.619	1.699							
	-7.82	-8.27	SPT				CH	2.61	78	32	46	0	4	72	24																	
	-9.32	-9.77	SPT				CH	2.59	79	32	47	12	2	29	57																	
	-10.82	-11.27	SPT				CH	2.61	82	28	54	8	6	34	52																	
	-12.32	-12.67	SPT				CH	2.59	79	32	47	25	15	27	33																	
	-13.82	-14.22	SPT				CH	2.60	66	32	34	12	14	61	13																	
	-15.32	-15.77	SPT				CL	2.61	43	22	21	12	14	42	32																	

PREPARED BY : **V.N.** CHECKED BY : **S.D** APPROVED BY : **S.T.**

AP3-43

Plate-B1

SUMMARY OF LABORATORY TEST RESULTS ON SOIL SAMPLES

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

Job Number : IDEAL/028/015

Client: ORIENTAL CONSULTANTS — Global Consulting for Sustainable Development

BOREHOLE - NO.	TestDepth (m)		Sample Type (D/S/SPT/UDS)	DENSITY & MOISTURE CONTENT			Soil Clasification (USC)	CLASSIFICATION TESTS								STRENGTH TESTS (kPa)							CONSOLIDATION TEST			CHEMICAL TEST						
				Moisture Content (%)	Density (Kg/cm^3)			Sp. Gravity	Atterberg Limits(%)			Particle Size Distribution(%)				UCS	UU		CU		Lab Shear Vane		Pre-Consolidation Pressure (kPa)	Commpression Index (Cc)	Initial Void Ratio (e^0)	Soil (%)				Water (mg/l)		
	From	To			Wet	Dry			W_L	W_P	I_P	Gravel	Sand	Silt	Clay	C_u	c	ϕ	c'	ϕ'	τ_v	τ_{vr}				SO_3	SO_4	CL	pH	SO_4	CL	pH
BH-02	-3.04	-3.54	D/S				CH	2.60	58	33	25	0	0	55	45																
	-4.54	-4.99	SPT				CH	2.61	65	32	33	0	1	50	49																
	-6.04	-6.49	SPT				CH	2.59	63	29	34	0	1	52	47																
	-7.54	-7.99	UDS	122	1.60	0.72	CH	2.54	80	36	44	0	1	59	40	4							46	0.851	2.308							
	-9.04	-9.49	SPT				CH	2.57	59	25	24	0	1	79	20																
	-10.54	-10.99	SPT				CH	2.59	59	29	30	0	1	50	49																
	-12.04	-12.49	SPT				CH	2.60	62	29	33	0	2	52	46																
	-13.54	-13.99	SPT				CH	2.58	54	23	31	15	31	26	28																
	-15.04	-15.49	SPT				SP	-	-	NP	-	6	94	0																	
	-16.54	-16.86	SPT				SP	-	-	NP	-	12	87	1																	
	-18.04	-18.49	SPT				SP	-	-	NP	-	10	88	2																	
	-19.54	-19.99	SPT				SP	-	-	NP	-	0	99	1																	
	-21.04	-21.24	SPT				SP	-	-	NP	-	0	99	1																	
	-22.54	-22.79	SPT				SP	-	-	NP	-	0	99	1																	
	-24.04	-24.12	SPT				SM	-	-	NP	-	0	85	15																	

PREPARED BY : **V.N.** CHECKED BY : **S.D** APPROVED BY : **S.T.**

AP3-44

Plate-B2

SUMMARY OF LABORATORY TEST RESULTS ON SOIL SAMPLES

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

Client: ORIENTAL CONSULTANTS — Global Consulting for Sustainable Development

Job Number : IDEAL/028/015

BOREHOLE - NO.	TestDepth (m)		Sample Type (D/S/SPT/ UDS)	DENSITY & MOISTURE CONTENT			Soil Clasiification (USC)	CLASSIFICATION TESTS								STRENGTH TESTS (kPa)							CONSOLIDATION TEST			CHEMICAL TEST						
				Moisture Content (%)	Density (Kg/cm^3)			Sp. Gravity	Atterberg Limits(%)			Particle Size Distribution(%)				UCS	UU		CU		Lab Shear Vane		Pre-Consolidation Pressure (kPa)	Commpression Index (Cc)	Initial Void Ratio (e^0)	Soil (%)				Water (mg/l)		
	From	To			Wet	Dry			W_L	W_P	I_P	Gravel	Sand	Silt	Clay	C_u	c	ϕ	c'	ϕ'	τ_v	τ_{vr}				SO_3	SO_4	CL	pH	SO_4	CL	pH
BH-03	-2.90	-3.40	D/S				CH	2.60	62	26	36	0	2	57	41																
	-4.40	-4.85	SPT				CH	2.60	62	43	19	0	1	57	42																

PREPARED BY : V.N. CHECKED BY : S.D APPROVED BY : S.T.

AP3-45

Plate-B3

SUMMARY OF LABORATORY TEST RESULTS ON SOIL SAMPLES

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

Client: ORIENTAL CONSULTANTS — Global Consulting for Sustainable Development

Job Number : IDEAL/028/015

BOREHOLE - NO.	TestDepth (m)		Sample Type (D/S/SPT/ UDS)	DENSITY & MOISTURE CONTENT			Soil Clasification (USC)	CLASSIFICATION TESTS								STRENGTH TESTS (kPa)							CONSOLIDATION TEST			CHEMICAL TEST						
				Moisture Content (%)	Density (Kg/cm^3)			Sp. Gravity	Atterberg Limits(%)			Particle Size Distribution(%)				UCS	UU		CU		Lab Shear Vane		Pre-Consolidation Pressure (kPa)	Commpression Index (Cc)	Initial Void Ratio (e^0)	Soil (%)				Water (mg/l)		
	From	To			Wet	Dry			W_L	W_P	I_P	Gravel	Sand	Silt	Clay	C_u	c	ϕ	c'	ϕ'	τ_v	τ_{vr}				SO_3	SO_4	CL	pH	SO_4	CL	pH
BH-04	-5.60	-6.10	D/S				SC	2.52	36	24	12	5	53	25	17																	
	-7.10	-7.55	SPT				CL	2.54	47	26	21	0	23	38	39																	
	-10.10	-10.55	SPT				SC	2.50	49	27	22	11	52	20	17																	
	-11.60	-12.05	SPT				CH	2.52	58	27	31	13	15	22	50																	
	-13.10	-13.55	SPT				SM	2.52	-	NP	-	3	76	14	7																	
	-14.60	-14.87	SPT				SP	-	-	NP	-	39	51	10																		
	-16.10	-16.55	SPT				SP	-	-	NP	-	37	55	8																		

PREPARED BY : **V.N.** CHECKED BY : **S.D** APPROVED BY : **S.T.**

SUMMARY OF LABORATORY TEST RESULTS ON SOIL SAMPLES

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

Job Number : IDEAL/028/015

Client: ORIENTAL CONSULTANTS — Global Consulting for Sustainable Development

BOREHOLE - NO.	TestDepth (m)		Sample Type (D/S/SPT/ UDS)	DENSITY & MOISTURE CONTENT			Soil Clasification (USC)	CLASSIFICATION TESTS								STRENGTH TESTS (kPa)							CONSOLIDATION TEST			CHEMICAL TEST						
				Moisture Content (%)	Density (Kg/cm^3)			Sp. Gravity	Atterberg Limits(%)			Particle Size Distribution(%)				UCS	UU		CU		Lab Shear Vane		Pre-Consolidation Pressure (kPa)	Commpression Index (Cc)	Initial Void Ratio (e^0)	Soil (%)				Water (mg/l)		
	From	To			Wet	Dry			W_L	W_P	I_P	Gravel	Sand	Silt	Clay	C_u	c	ϕ	c'	ϕ'	τ_v	τ_{vr}				SO_3	SO_4	CL	pH	SO_4	CL	pH
BH-05	-3.10	-3.60	D/S				CL	2.53	42	22	20	7	43	28	22																	
	-6.10	-6.20	SPT				SM	2.48	-	NP	-	6	67	22	5																	
	-7.60	-8.05	UDS				SM	2.53	-	NP	-	6	68	21	5																	
	-9.10	-9.35	SPT				SP	-	-	NP	-	19	73	8																		
	-10.60	-10.83	SPT				GP	-	-	NP	-	56	43	1																		
	-12.10	-12.55	SPT				GC	2.52	30	20	10	40	27	28	5																	
	-13.60	-14.05	SPT				CL	2.54	41	22	19	5	35	53	7																	
	-15.10	-15.22	SPT				SP	-	-	NP	-	0	90	10																		
	-16.60	-16.68	SPT				SM	2.49	-	NP	-	2	78	14	6																	

PREPARED BY : **V.N.** CHECKED BY : **S.D** APPROVED BY : **S.T.**

AP3-47

Plate-B5

SUMMARY OF LABORATORY TEST RESULTS ON SOIL SAMPLES

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

Client: ORIENTAL CONSULTANTS — Global Consulting for Sustainable Development

Job Number : IDEAL/028/015

BOREHOLE - NO.	TestDepth (m)		Sample Type (D/S/SPT/ UDS)	DENSITY & MOISTURE CONTENT			Soil Clasification (USC)	CLASSIFICATION TESTS								STRENGTH TESTS (kPa)						CONSOLIDATION TEST			CHEMICAL TEST						
				Moisture Content (%)	Density (Kg/cm^3)			Sp. Gravity	Atterberg Limits(%)			Particle Size Distribution(%)				UCS	UU		CU		Lab Shear Vane		Pre-Consolidation Pressure (kPa)	Commpression Index (Cc)	Initial Void Ratio (e^0)	Soil (%)				Water (mg/l)		
	From	To			Wet	Dry			W_L	W_P	I_P	Gravel	Sand	Silt	Clay	C_u	c	ϕ	c'	ϕ'	τ_v	τ_{vr}				SO_3	SO_4	CL	pH	SO_4	CL	pH
BH-06	0.09	-0.41	D/S				SP	-	-	NP	-	2	98	0																		
	-2.91	-3.36	SPT				SM	2.54	44	27	17	0	65	30	5																	
	-4.41	-4.79	SPT				SP	-	-	NP	-	0	97	3																		
	-5.91	-6.30	SPT				SM	-	-	NP	-	0	85	15																		
	-7.41	-7.51	SPT				SM	-	-	NP	-	14	71	15																		

PREPARED BY : **V.N.** CHECKED BY : **S.D** APPROVED BY : **S.T.**

AP3-48

Plate-B6

SUMMARY OF LABORATORY TEST RESULTS ON ROCK SAMPLES

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

Job No. IDEAL/028/015

Client : ORIENTAL CONSULTANTS Global Consulting for Sustainable Development

DATE : 26-06-2015

BH No.	Depth(m)	Length (cm)	Diameter (cm)	Test Condition	Moisture Absorption (%)	Porosity (%)	Unit Weight (g/cm^3)	Specific Gravity	Point Load Index Strength(Mpa)	Uniaxial Compressive Strength (MPa)	Corrected Uniaxial Compressive Strength (MPa)	Modulus of Elasticity	Brazilian Test	Remarks
BH-01	-25.63 - -25.82	10.20	5.40	SOAKED	1.01	2.65	2.63	2.46	-	25.85	25.66	-	-	
	-26.84 - -26.95	10.00	5.40	SOAKED	0.84	2.27	2.70	2.57	-	18.86	18.68	-	-	
	-28.32 - -28.55	10.30	5.40	SOAKED	0.56	1.53	2.72	2.68	-	52.00	51.69	-	-	
BH-02	-24.46 - -24.58	10.00	5.40	SOAKED	1.34	3.49	2.60	2.49	-	32.75	32.42	-	-	
	-26.87 - -27.04	10.10	5.40	SOAKED	0.92	2.51	2.74	2.64	-	46.07	45.67	-	-	
	-27.43 - -27.60	10.00	5.40	SOAKED	0.91	2.53	2.78	2.65	-	25.33	25.07	-	-	
BH-03	-22.63 - -22.74	9.50	5.40	SOAKED	0.68	1.93	2.85	2.69	-	43.84	43.10	-	-	
	-25.03 - -25.24	10.00	5.40	SOAKED	0.40	1.14	2.84	2.71		60.47	59.88	-	-	
	-26.07 - -26.24	10.10	5.40	SOAKED	0.22	0.65	2.88	2.78	-	113.09	112.12	-	-	
	-27.85 - -28.04	10.00	5.40	SOAKED	0.61	1.66	2.72	2.59	-	61.44	60.83	-	-	

SUMMARY OF LABORATORY TEST RESULTS ON ROCK SAMPLES

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

Job No. IDEAL/028/015

Client : ORIENTAL CONSULTANTS Global Consulting for Sustainable Development

DATE : 26-06-2015

BH No.	Depth(m)	Length (cm)	Diameter (cm)	Test Condition	Moisture Absorption (%)	Porosity (%)	Unit Weight (g/cm^3)	Specific Gravity	Point Load Index Strength(Mpa)	Uniaxial Compressive Strength (MPa)	Corrected Uniaxial Compressive Strength (MPa)	Modulus of Elasticity	Brazilian Test	Remarks
BH-04	-22.67 - -22.81	10.00	5.40	SOAKED	1.33	3.49	2.63	2.51	-	38.29	37.91	-	-	
	-26.38 - -26.58	10.00	5.40	SOAKED	0.70	1.88	2.70	2.58	-	43.36	42.93	-	-	
	-29.40 - -29.60	10.20	5.40	SOAKED	0.60	1.67	2.79	2.71	0.39	-	8.59	-	-	
	-30.75 - -30.93	7.10	5.40	SOAKED	0.38	1.05	2.75	2.79	0.25	-	5.47	-	-	
BH-05	-21.60 - -21.73	10.10	5.40	SOAKED	1.16	3.07	2.65	2.45	-	17.55	17.40	-	-	
	-22.95 - -23.05	10.20	5.40	SOAKED	1.21	3.08	2.55	2.48	-	17.12	16.99	-	-	
	-24.60 - -25.75	10.20	5.40	SOAKED	0.85	2.23	2.63	2.67	-	34.19	33.94	-	-	
BH-06	-13.41 - -13.54	10.20	5.40	SOAKED	0.46	1.28	2.81	2.74	-	69.21	68.70	-	-	
	-17.29 - -17.41	10.20	5.40	SOAKED	1.45	3.64	2.52	2.45	-	14.32	14.22	-	-	
	-22.23 - -22.41	10.10	5.40	SOAKED	1.06	2.68	2.53	2.44	-	11.61	11.51	-	-	

Prepared By : V.N. **Checked By: S.D** **Approved by : ST**

APPENDIX-C - CLASSIFICATION TEST RESULTS

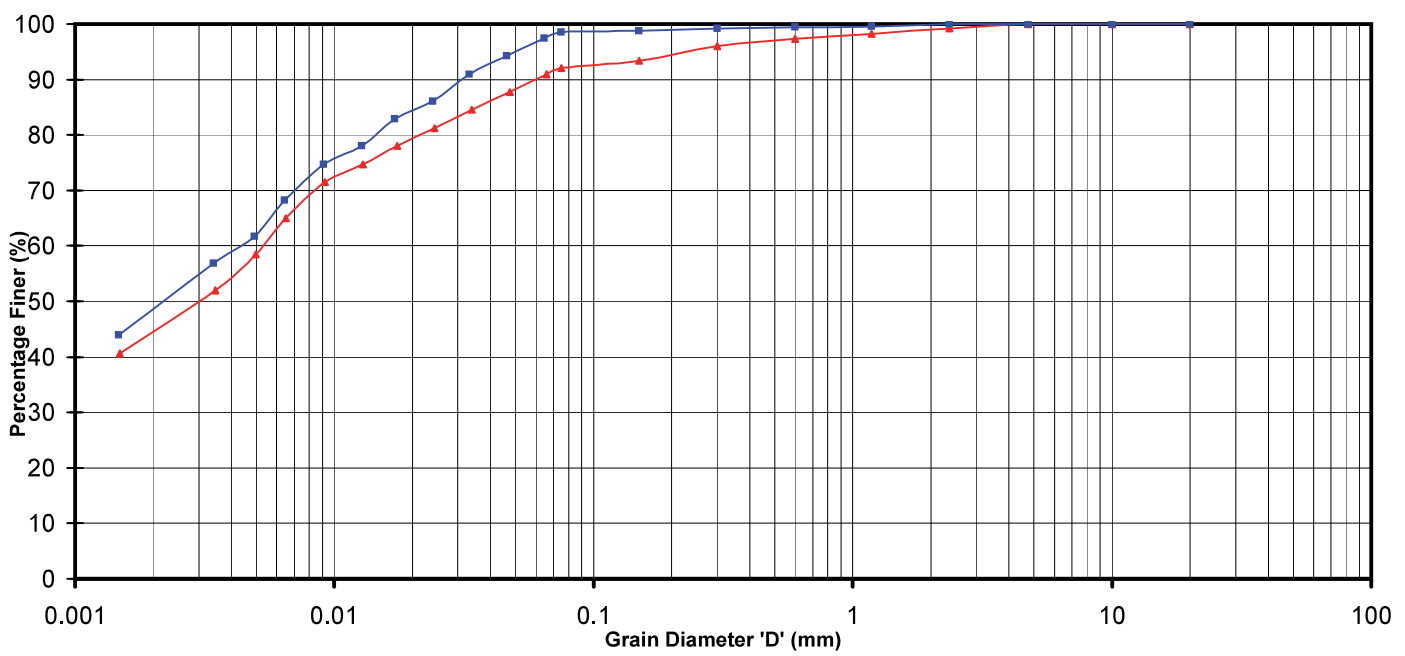
PARTICLE SIZE DISTRIBUTION

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link
Job No. : IDEAL/028/015

As Per IS:2720

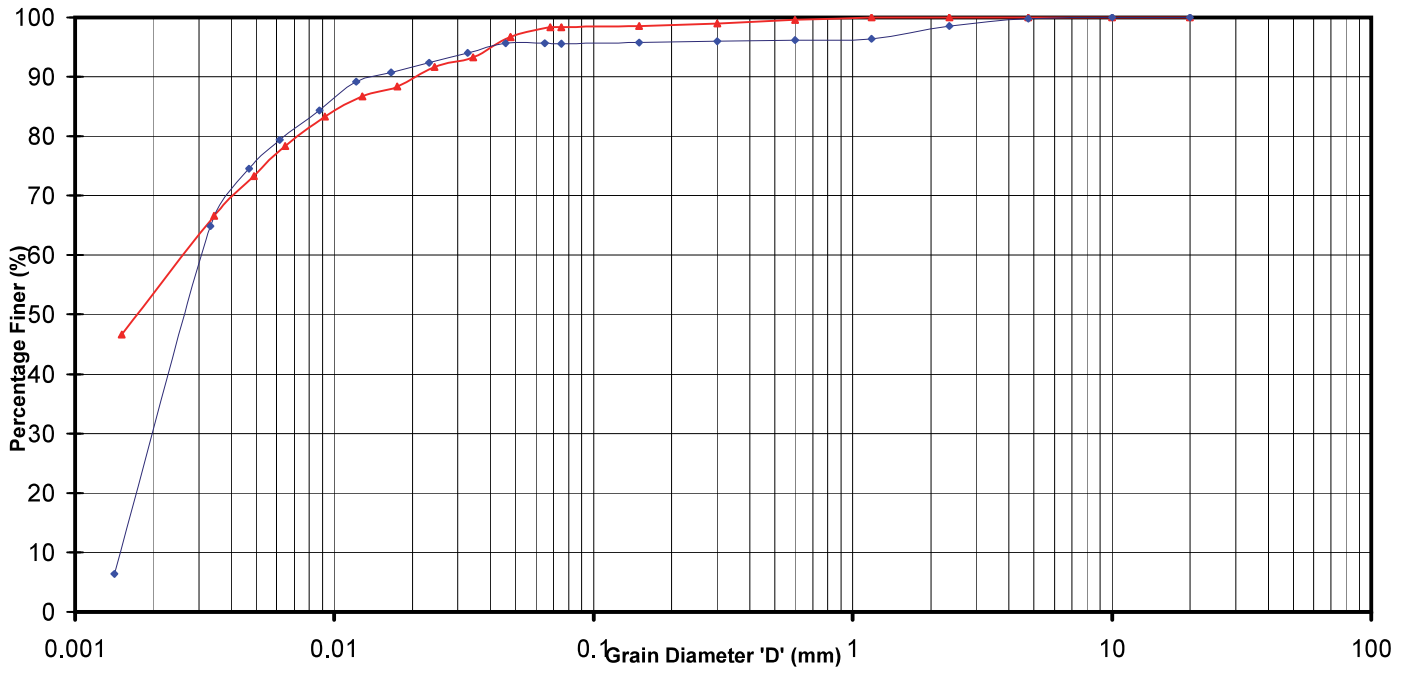
BH NO.: **BH-01** Depth (m) : **-3.32 - -3.82** ▲ **-4.82 - -5.27** ■

	CLAY	SILT	SAND			GRAVEL
			FINE	MEDIUM	COARSE	
▲	44	48	5	2	1	0
■	47	52	0	1	0	0



BH NO.: **BH-01** Depth (m) : **-6.32 - -6.77** ▲ **-7.82 - -8.27** ■

	CLAY	SILT	SAND			GRAVEL
			FINE	MEDIUM	COARSE	
▲	52	46	1	1	0	0
■	24	72	0	2	2	0



Tested By : **P.M.** Prepared By :**V.N.** Checked By :**S.D.** Approved By :**S.T.**

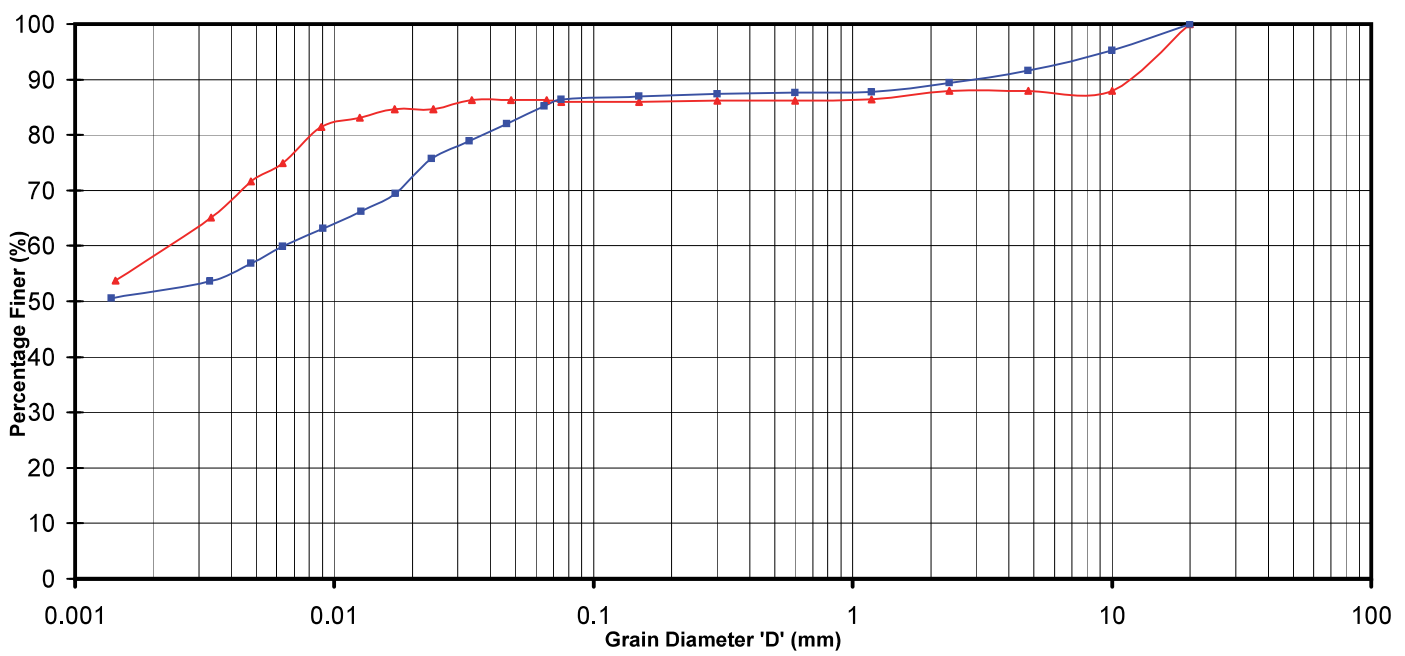
PARTICLE SIZE DISTRIBUTION

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link
Job No. : IDEAL/028/015

As Per IS:2720

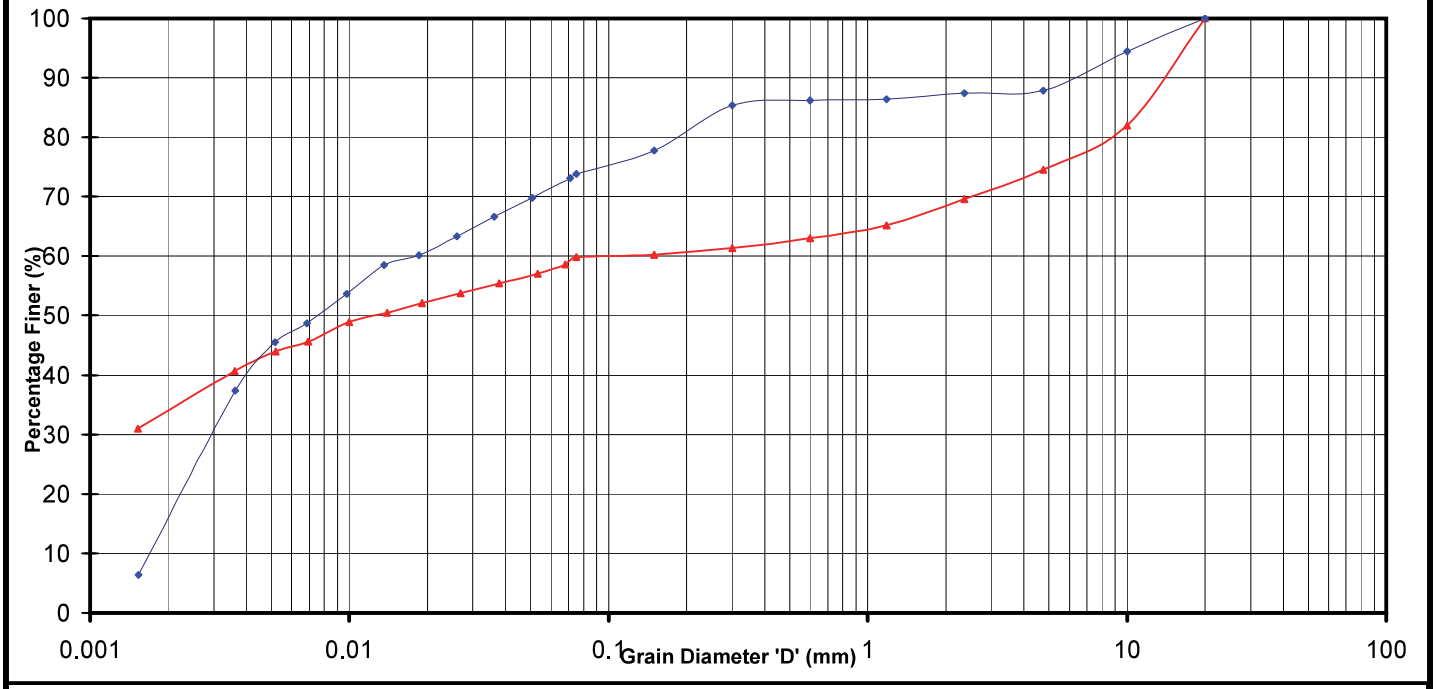
BH NO.: **BH-01** Depth (m) : **-9.32 - -9.77** ▲ **-10.82 - -11.27** ■

	CLAY	SILT	SAND			GRAVEL
			FINE	MEDIUM	COARSE	
▲	57	29	0	2	0	12
■	52	34	1	2	3	8



BH NO.: **BH-01** Depth (m) : **-12.32 - -12.67** ▲ **-13.82 - -14.22** ■

	CLAY	SILT	SAND			GRAVEL
			FINE	MEDIUM	COARSE	
▲	33	27	2	6	7	25
■	13	61	12	1	1	12



Tested By : **P.M.** Prepared By :**V.N.** Checked By :**S.D.** Approved By :**S.T.**

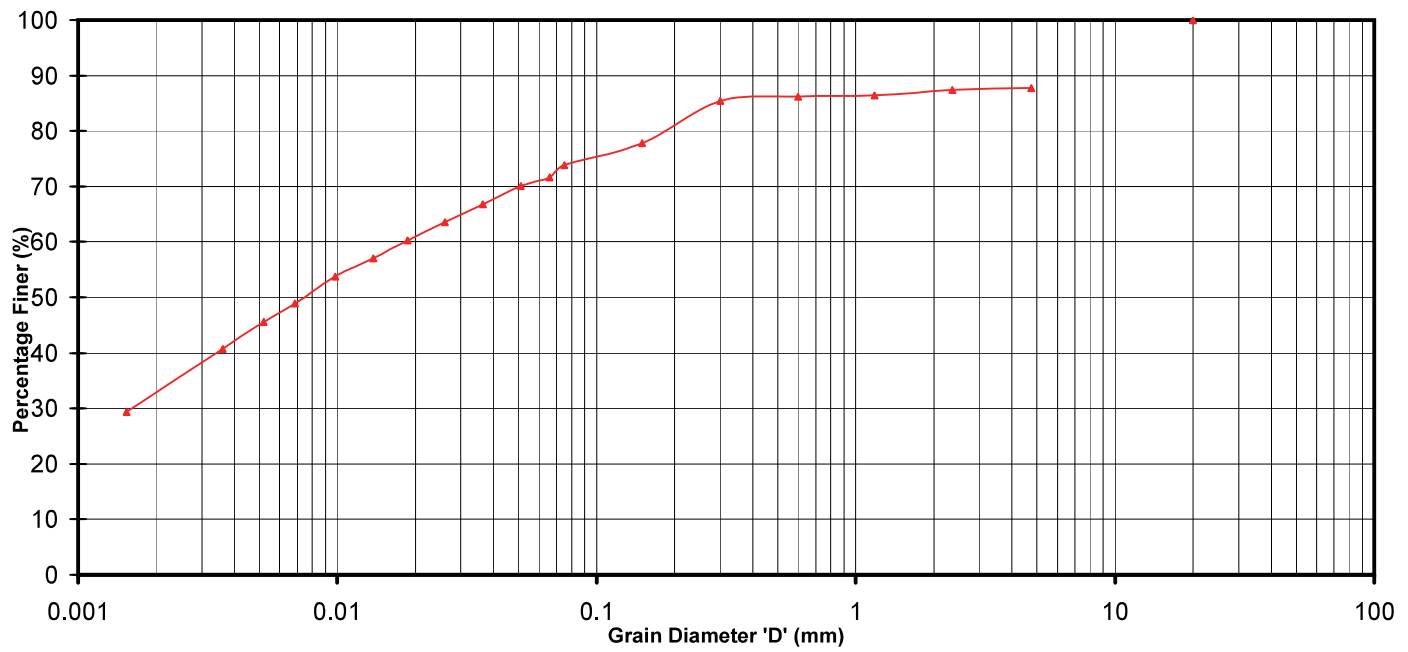
PARTICLE SIZE DISTRIBUTION

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link
Job No. : IDEAL/028/015

As Per IS:2720

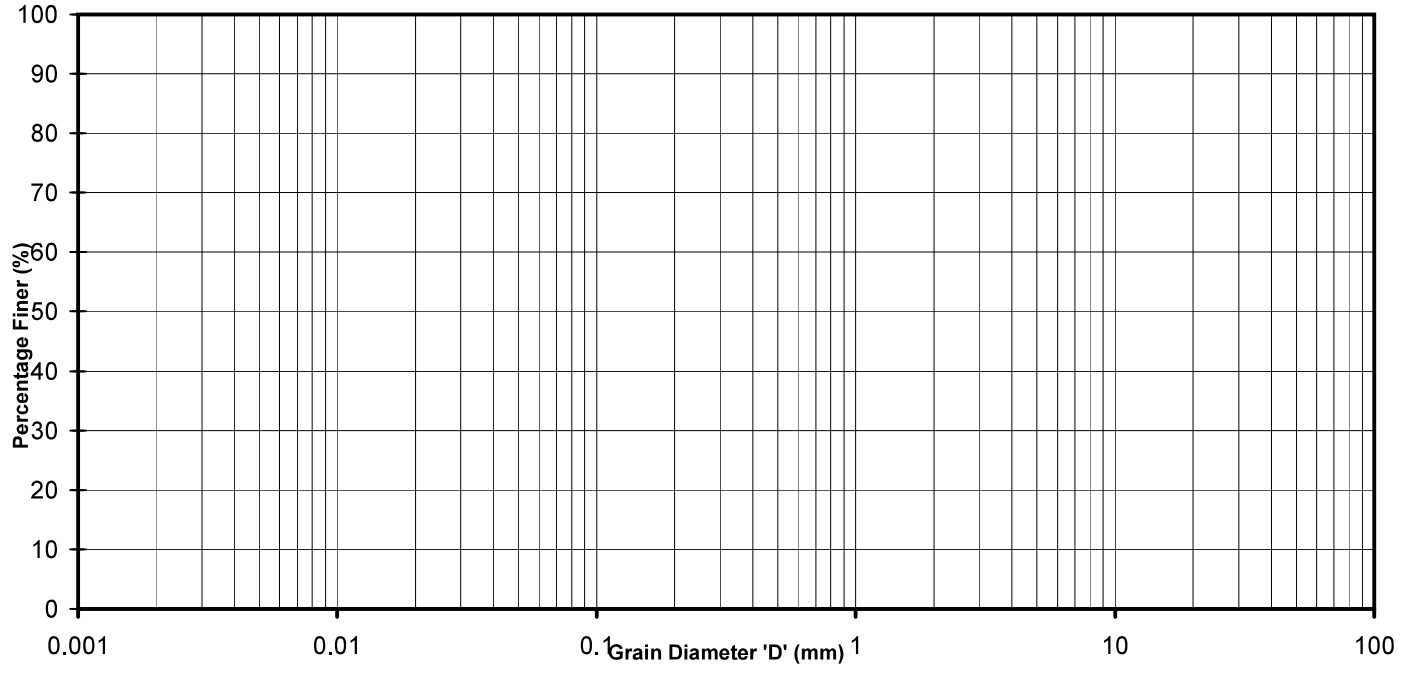
BH NO.: **BH-01** Depth (m) : **-13.82 - -14.22**

	CLAY	SILT	SAND			GRAVEL
			FINE	MEDIUM	COARSE	
▲	32	42	12	1	1	12
■						



BH NO.: Depth (m) :

	CLAY	SILT	SAND			GRAVEL
			FINE	MEDIUM	COARSE	
▲						
■						



Tested By : **P.M.** Prepared By :**V.N.** Checked By :**S.D.** Approved By :**S.T.**

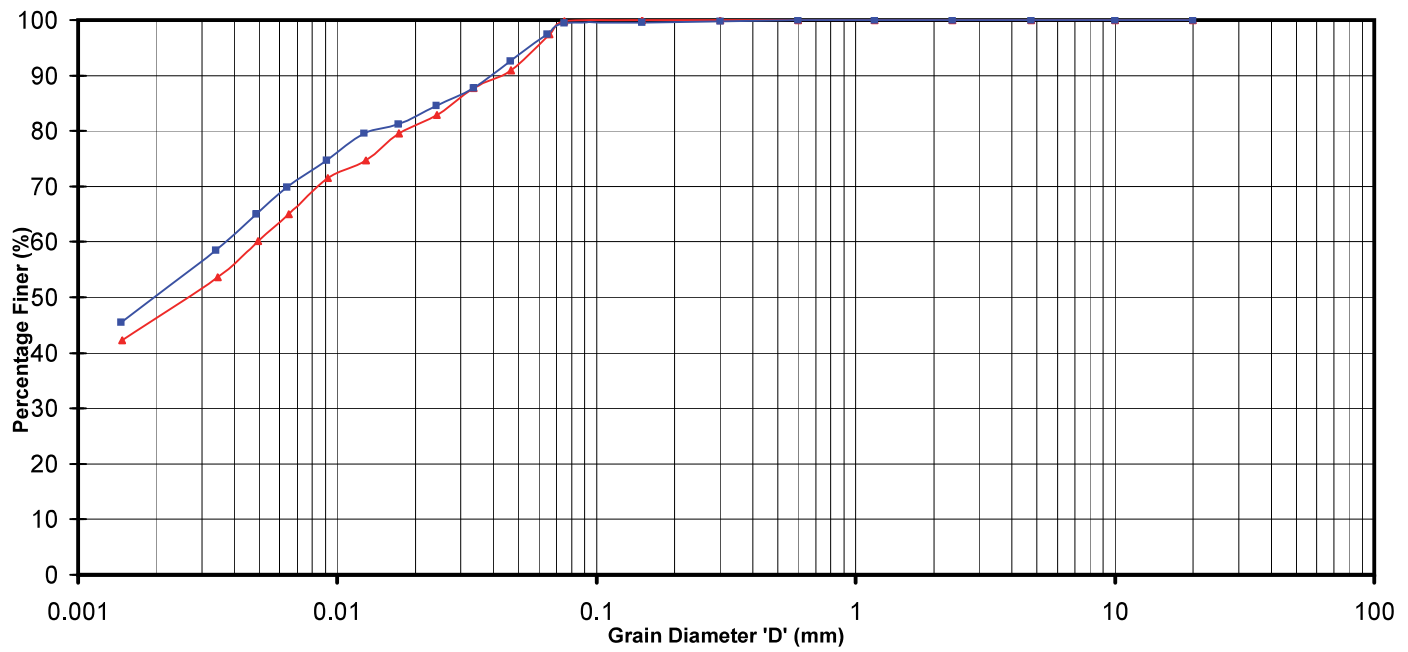
PARTICLE SIZE DISTRIBUTION

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link
Job No. : IDEAL/028/015

As Per IS:2720

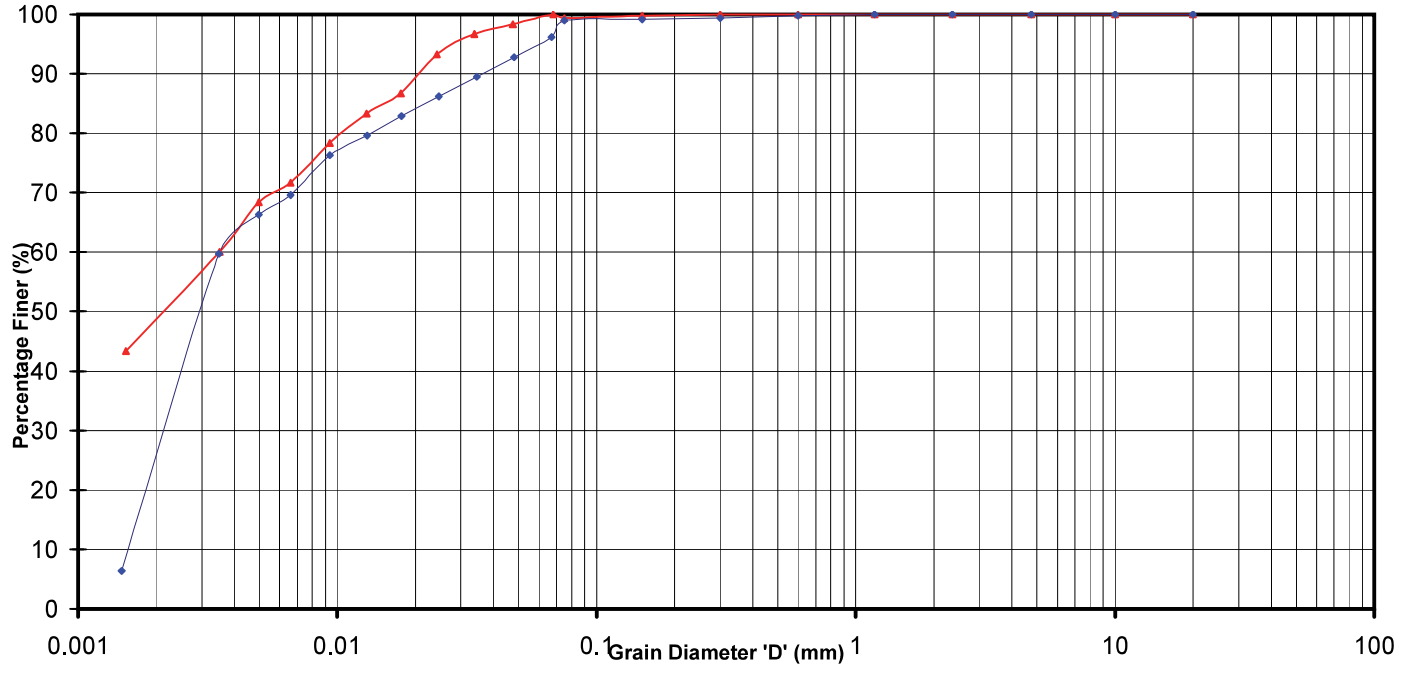
BH NO.: **BH-02** Depth (m) : **-3.04 - -3.54** **-4.54 - -4.99**

	CLAY	SILT	SAND			GRAVEL
			FINE	MEDIUM	COARSE	
▲	45	55	0	0	0	0
■	49	50	1	0	0	0



BH NO.: **BH-02** Depth (m) : **-6.04 - -6.49** **-9.04 - -9.49**

	CLAY	SILT	SAND			GRAVEL
			FINE	MEDIUM	COARSE	
▲	47	52	1	0	0	0
■	20	79	1	0	0	0



Tested By : **P.M.** Prepared By :**V.N.** Checked By :**S.D.** Approved By :**S.T.**

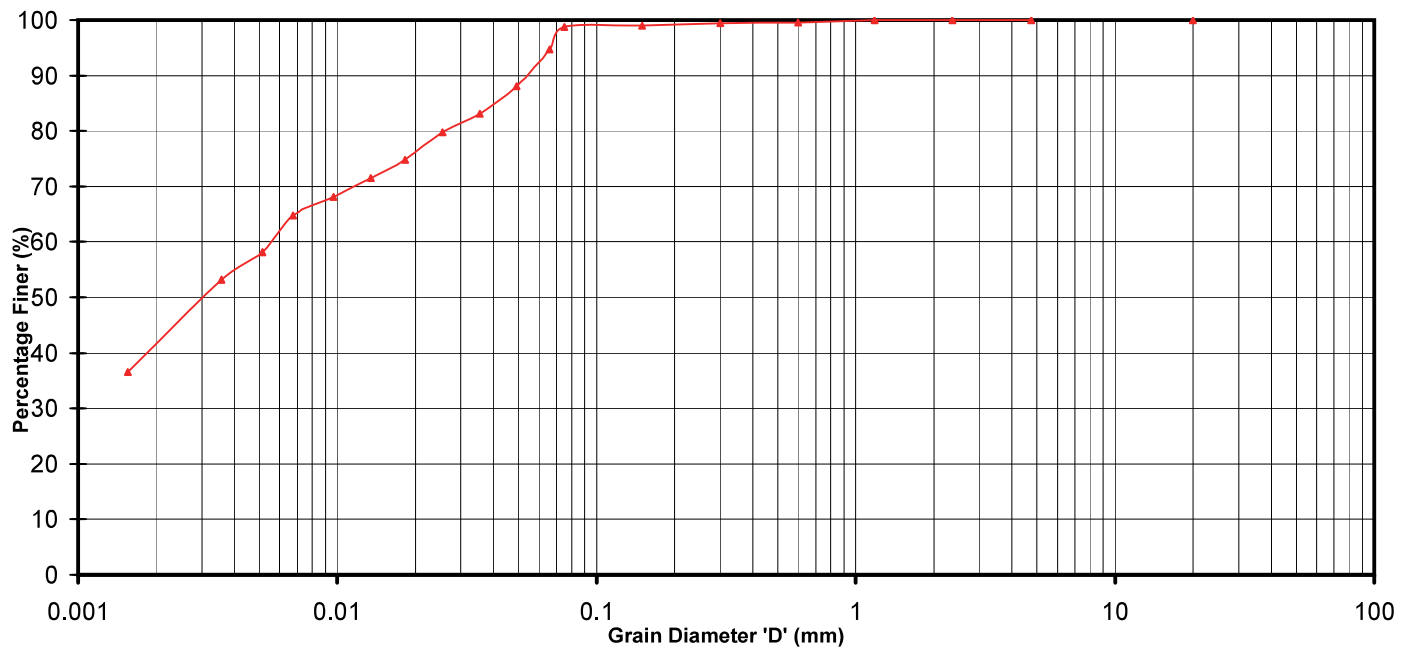
PARTICLE SIZE DISTRIBUTION

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link
Job No. : IDEAL/028/015

As Per IS:2720

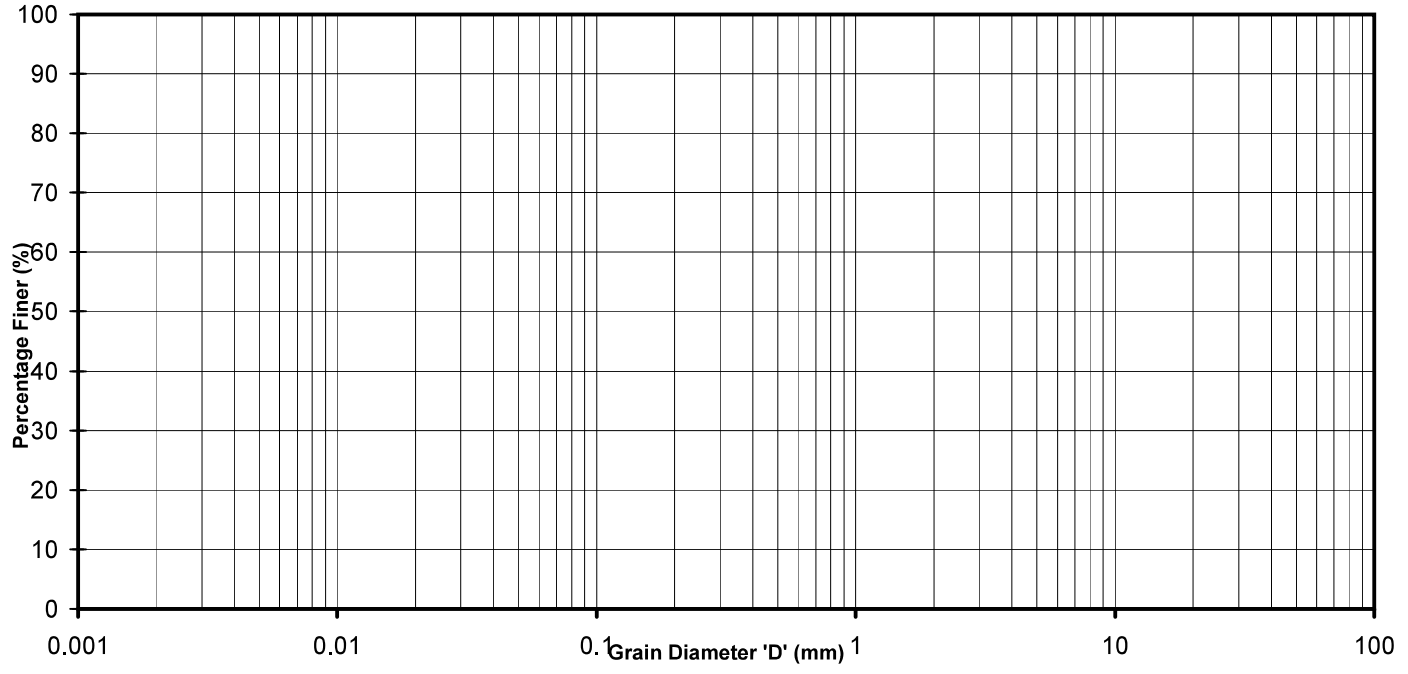
BH NO.: **BH-02** Depth (m) : **-7.54 - -7.99** **-4.54 - -4.99**

	CLAY	SILT	SAND			GRAVEL
			FINE	MEDIUM	COARSE	
▲	40	59	0	1	0	0
■						



BH NO.: Depth (m) :

	CLAY	SILT	SAND			GRAVEL
			FINE	MEDIUM	COARSE	
▲						
■						



Tested By : **P.M.** Prepared By :**V.N.** Checked By :**S.D.** Approved By :**S.T.**

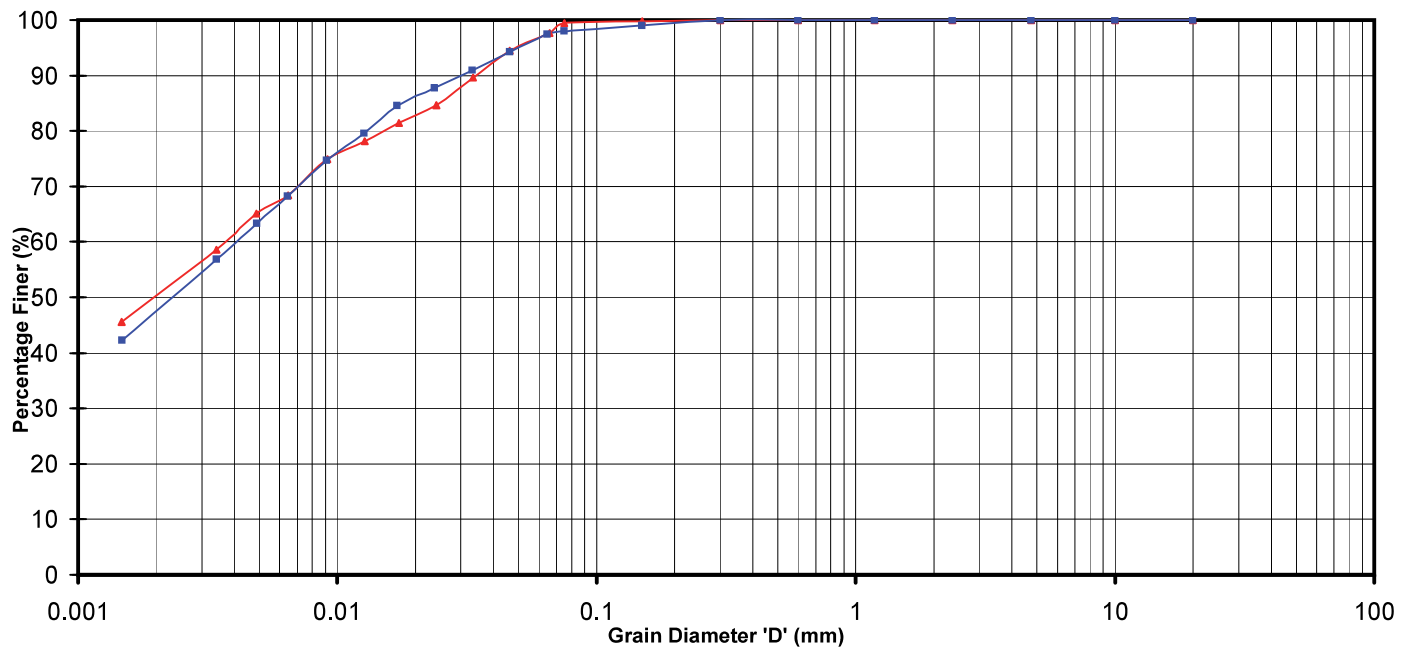
PARTICLE SIZE DISTRIBUTION

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link
Job No. : IDEAL/028/015

As Per IS:2720

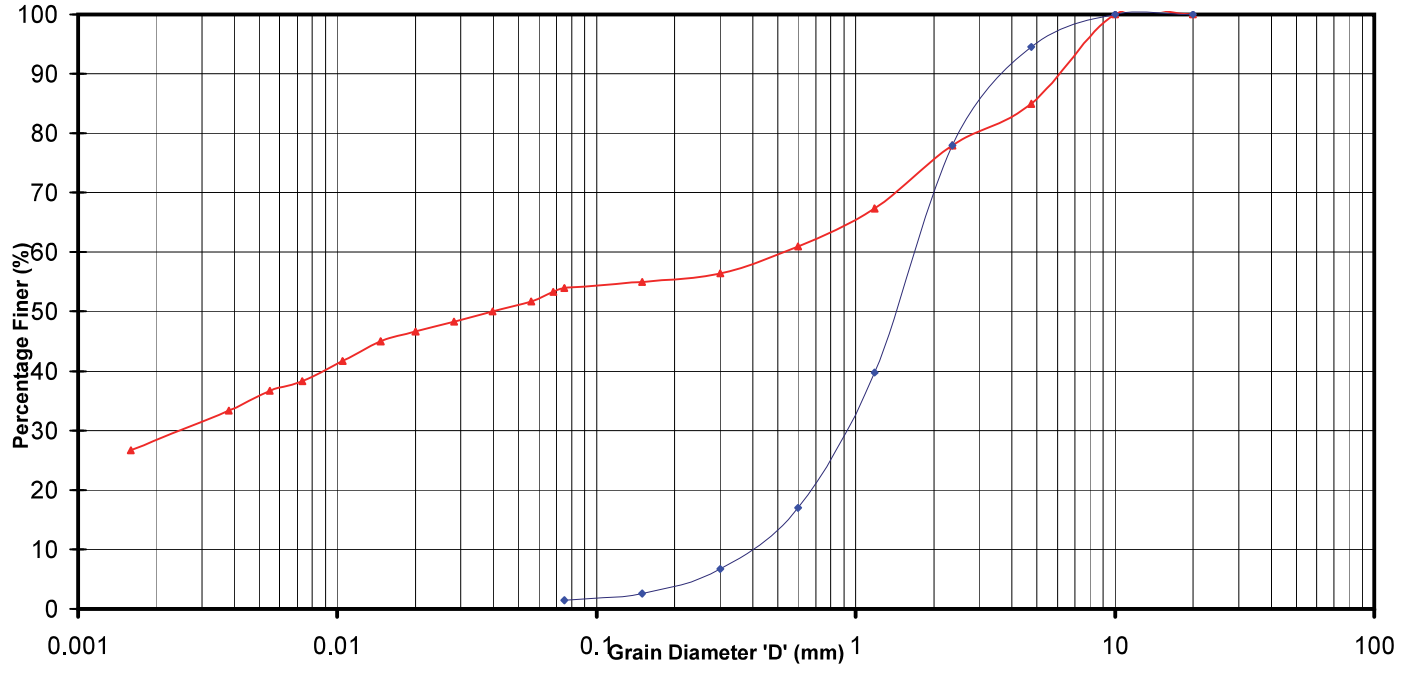
BH NO.: **BH-02** Depth (m) : **-10.54 - -10.99** ▲ **-12.04 - -12.49** ■

	CLAY	SILT	SAND			GRAVEL
			FINE	MEDIUM	COARSE	
▲	49	50	1	0	0	0
■	46	52	2	0	0	0



BH NO.: **BH-02** Depth (m) : **-13.54 - -13.99** ▲ **-15.04 - -15.49** ■

	CLAY	SILT	SAND			GRAVEL
			FINE	MEDIUM	COARSE	
▲	28	26	4	17	10	15
■	0		10	55	29	6



Tested By : **P.M.** Prepared By :**V.N.** Checked By :**S.D.** Approved By :**S.T.**

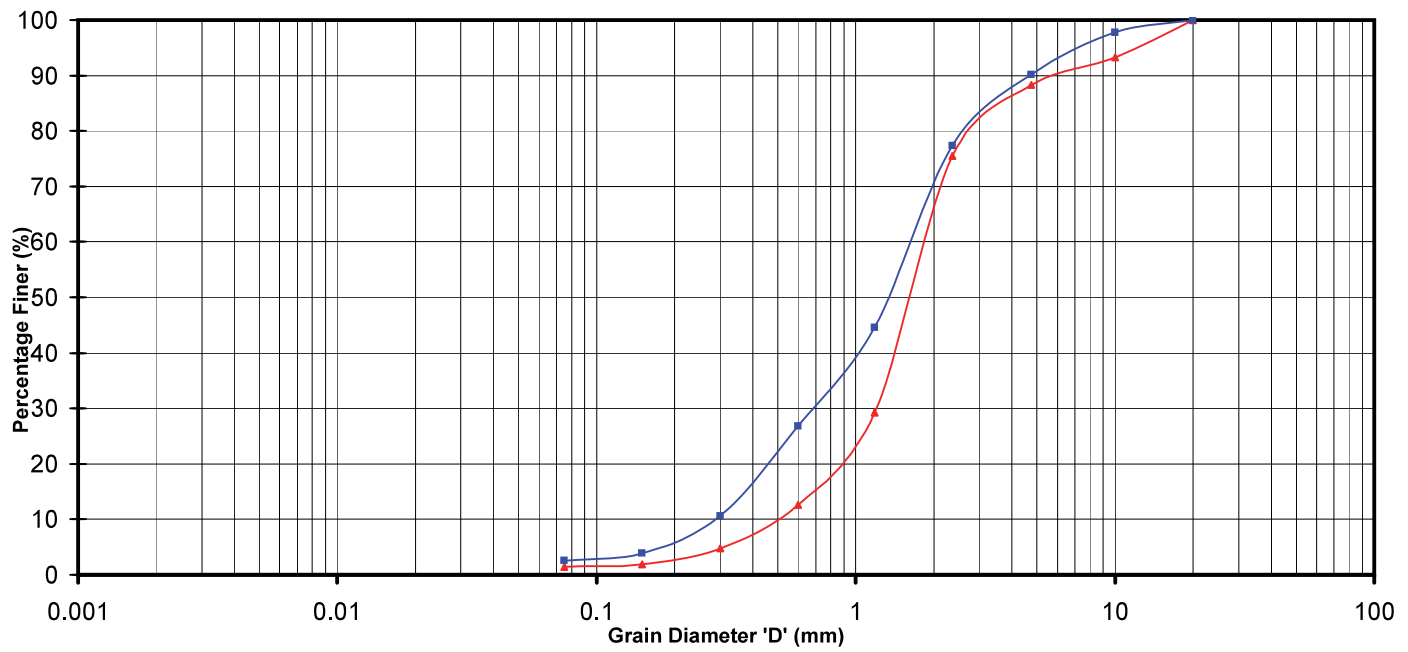
PARTICLE SIZE DISTRIBUTION

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link
Job No. : IDEAL/028/015

As Per IS:2720

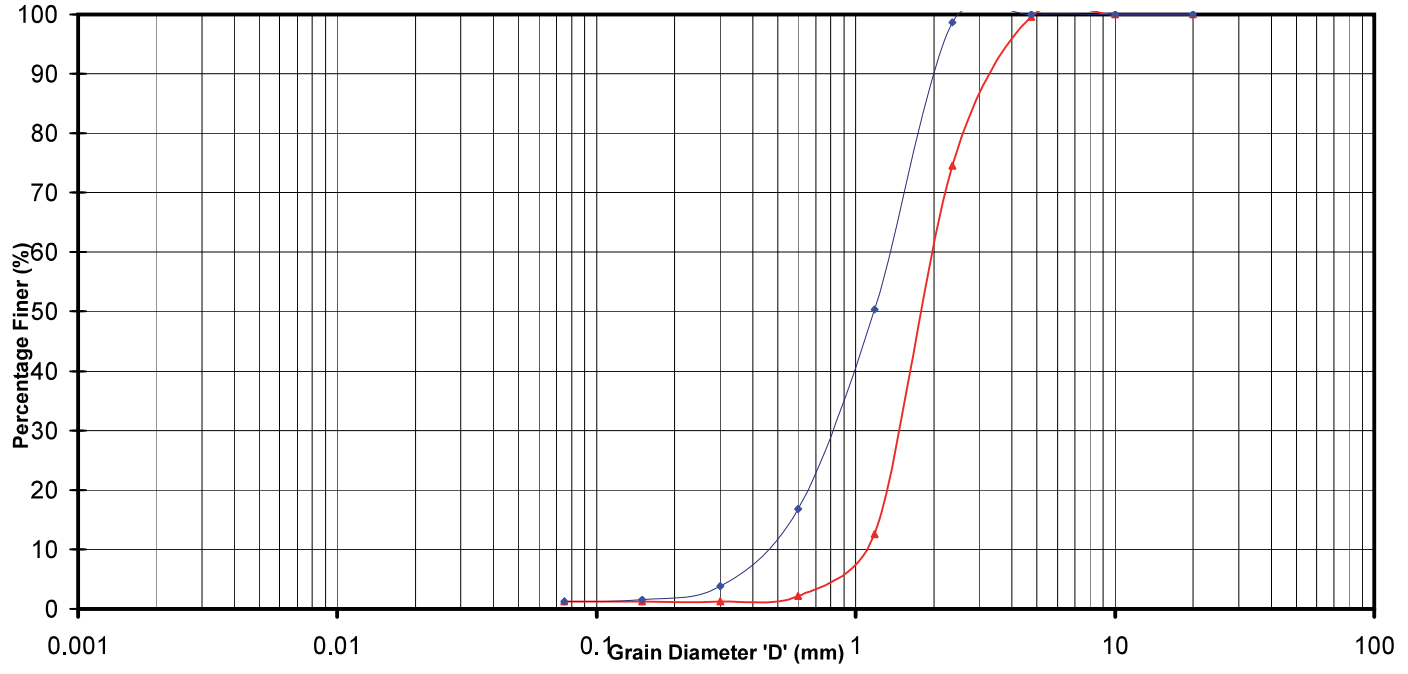
BH NO.: **BH-02** Depth (m) : **-16.54 - -16.86** **-18.04 - -18.49**

	CLAY & SILT	SAND			GRAVEL
		FINE	MEDIUM	COARSE	
1	7	53	27	12	
2	15	50	23	10	



BH NO.: **BH-02** Depth (m) : **-19.54 - -19.99** **-21.04 - -21.24**

	CLAY & SILT	SAND			GRAVEL
		FINE	MEDIUM	COARSE	
1	1	54	44	0	
1	8	75	16	0	



Tested By : **P.M.** Prepared By :**V.N.** Checked By :**S.D.** Approved By :**S.T.**

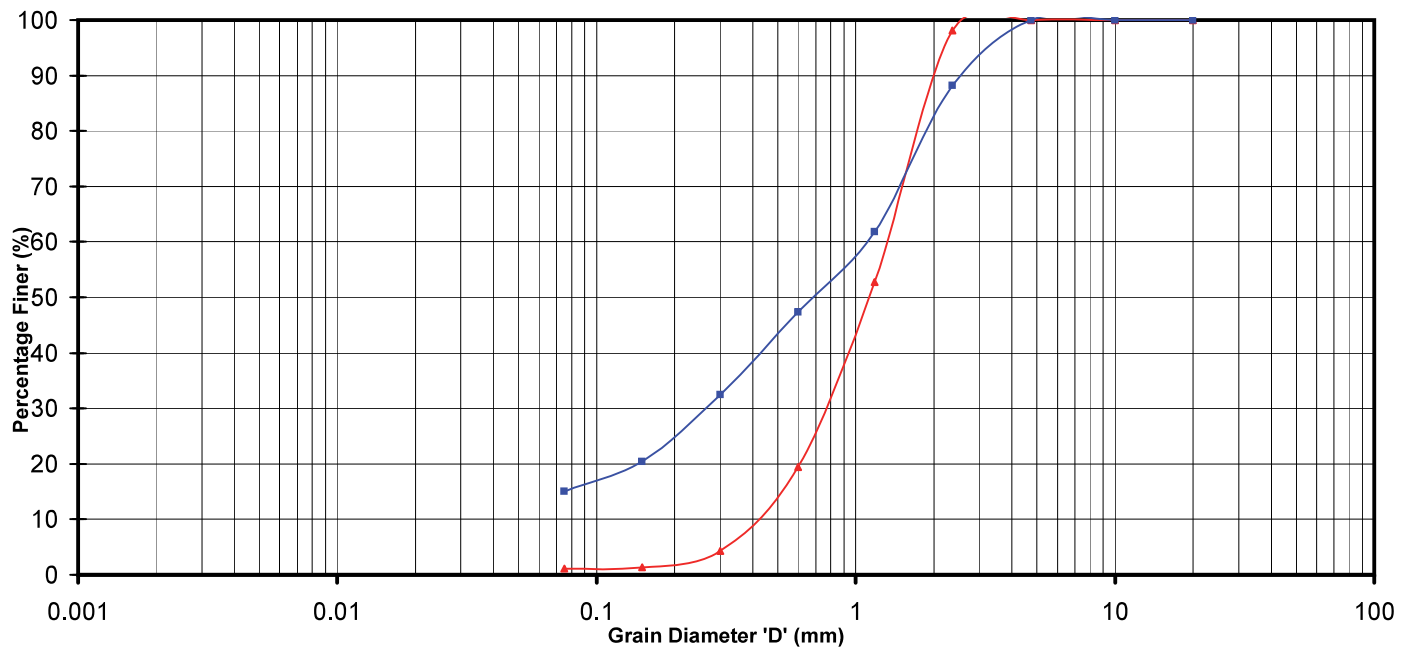
PARTICLE SIZE DISTRIBUTION

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link
Job No. : IDEAL/028/015

As Per IS:2720

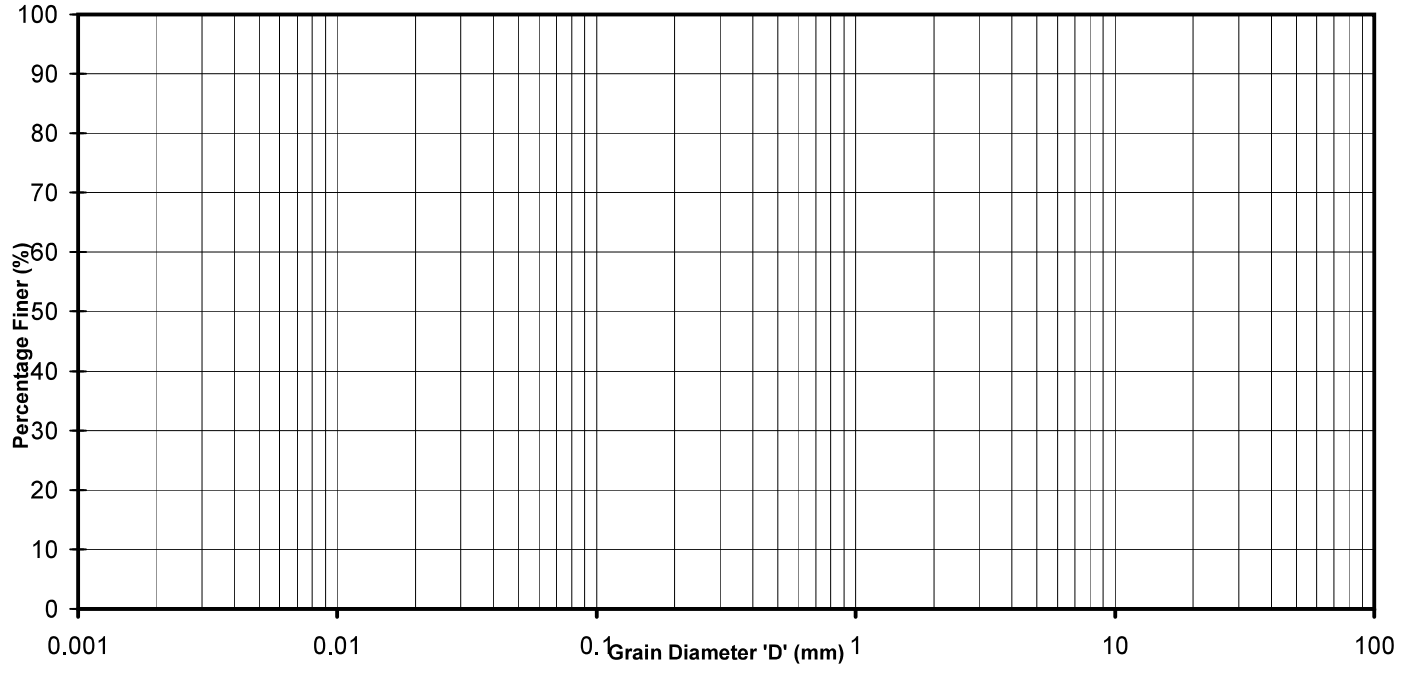
BH NO.: **BH-02** Depth (m) : **-22.54- -22.79** **-24.04 - -24.12**

	CLAY & SILT	SAND			GRAVEL
		FINE	MEDIUM	COARSE	
▲	1	10	73	16	0
■	15	24	41	20	0



BH NO.: Depth (m) :

	CLAY	SILT	SAND			GRAVEL
			FINE	MEDIUM	COARSE	
▲						
■						



Tested By : **P.M.** Prepared By :**V.N.** Checked By :**S.D.** Approved By :**S.T.**

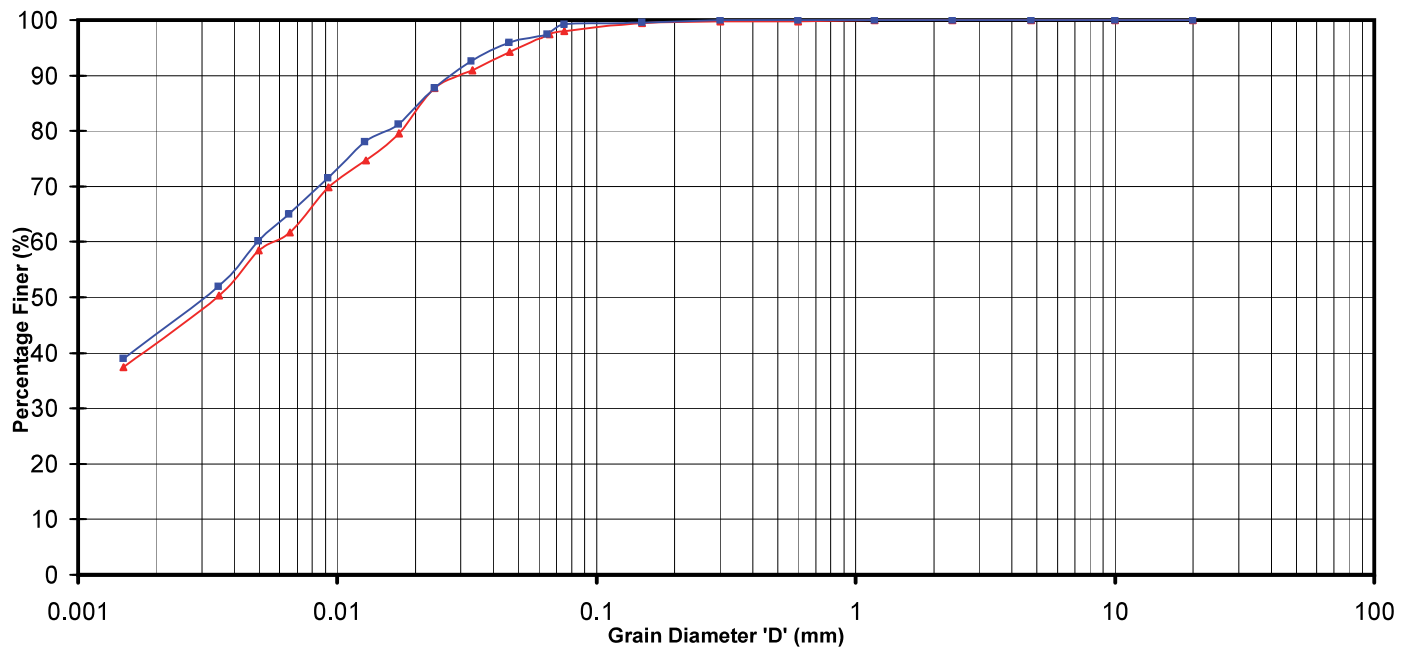
PARTICLE SIZE DISTRIBUTION

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link
Job No. : IDEAL/028/015

As Per IS:2720

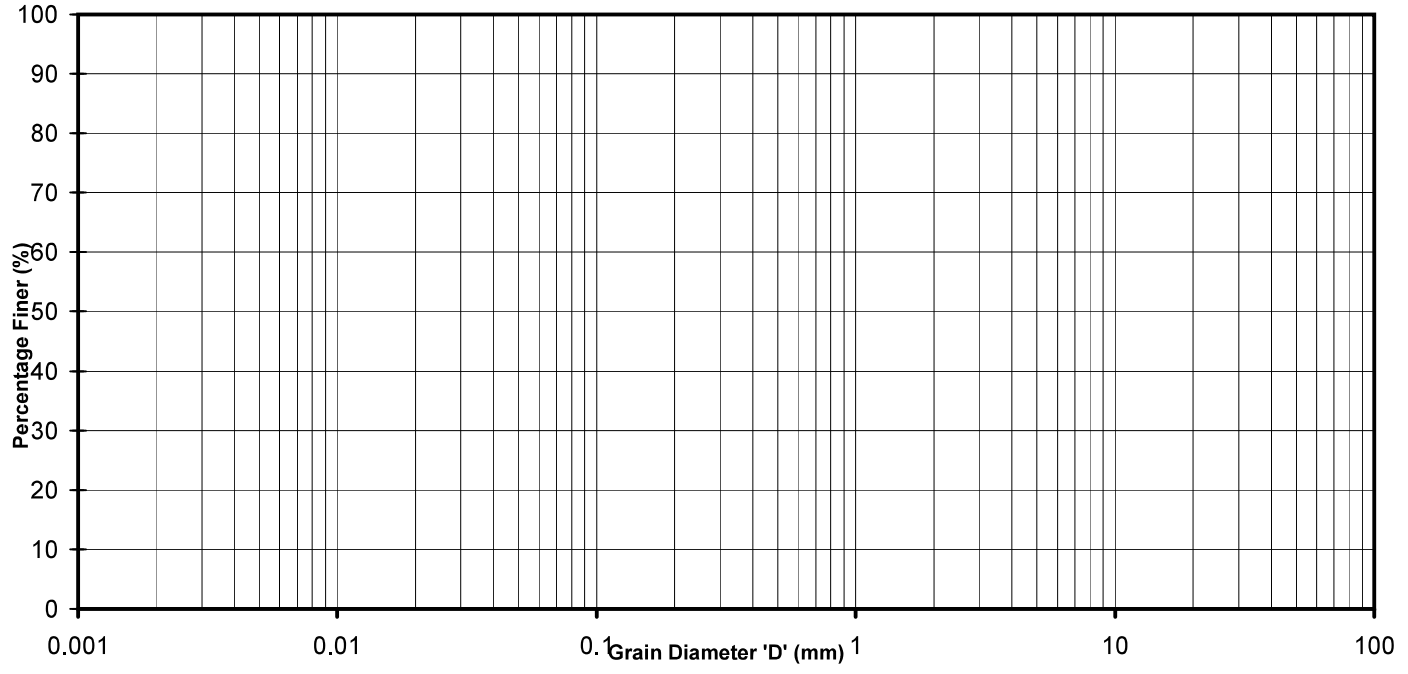
BH NO.: **BH-03** Depth (m) : **-2.90 - -3.40** **-4.40 - -4.85**

	CLAY	SILT	SAND			GRAVEL
			FINE	MEDIUM	COARSE	
▲	41	57	2	0	0	0
■	42	57	1	0	0	0



BH NO.: Depth (m) :

	CLAY	SILT	SAND			GRAVEL
			FINE	MEDIUM	COARSE	
▲						
■						



Tested By : **P.M.** Prepared By :**V.N.** Checked By :**S.D.** Approved By :**S.T.**

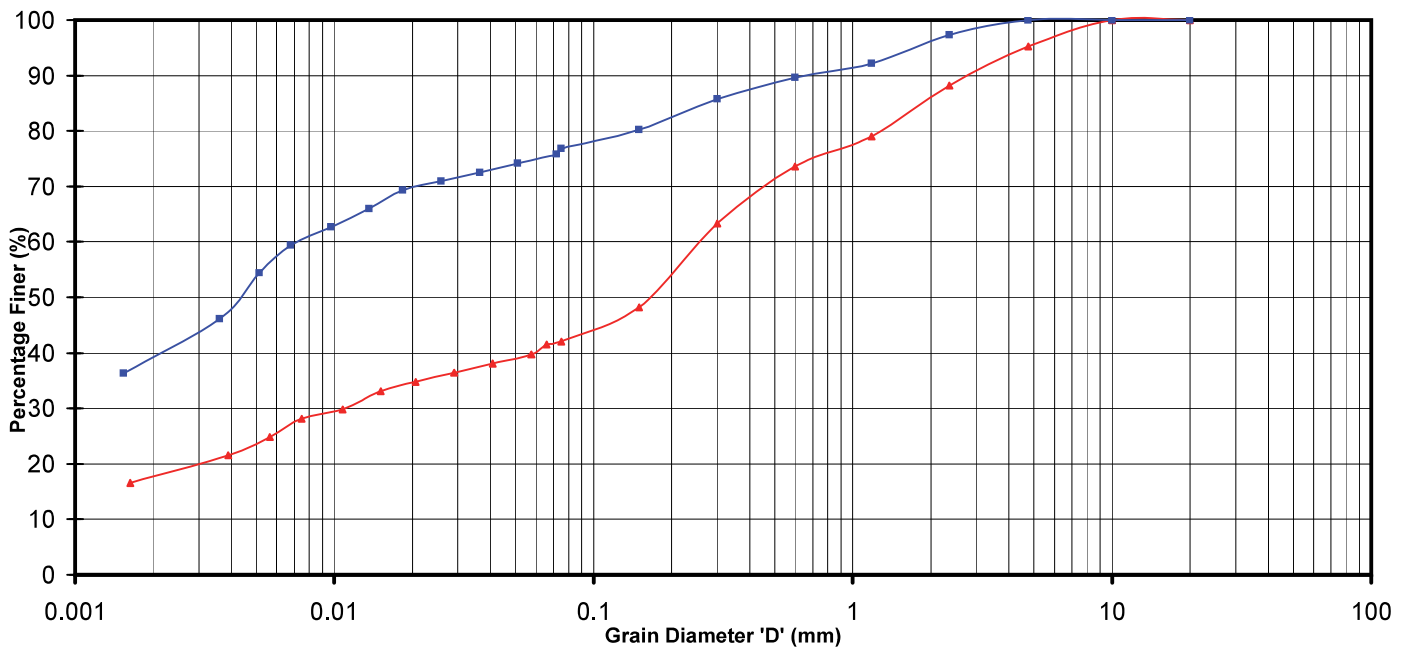
PARTICLE SIZE DISTRIBUTION

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link
Job No. : IDEAL/028/015

As Per IS:2720

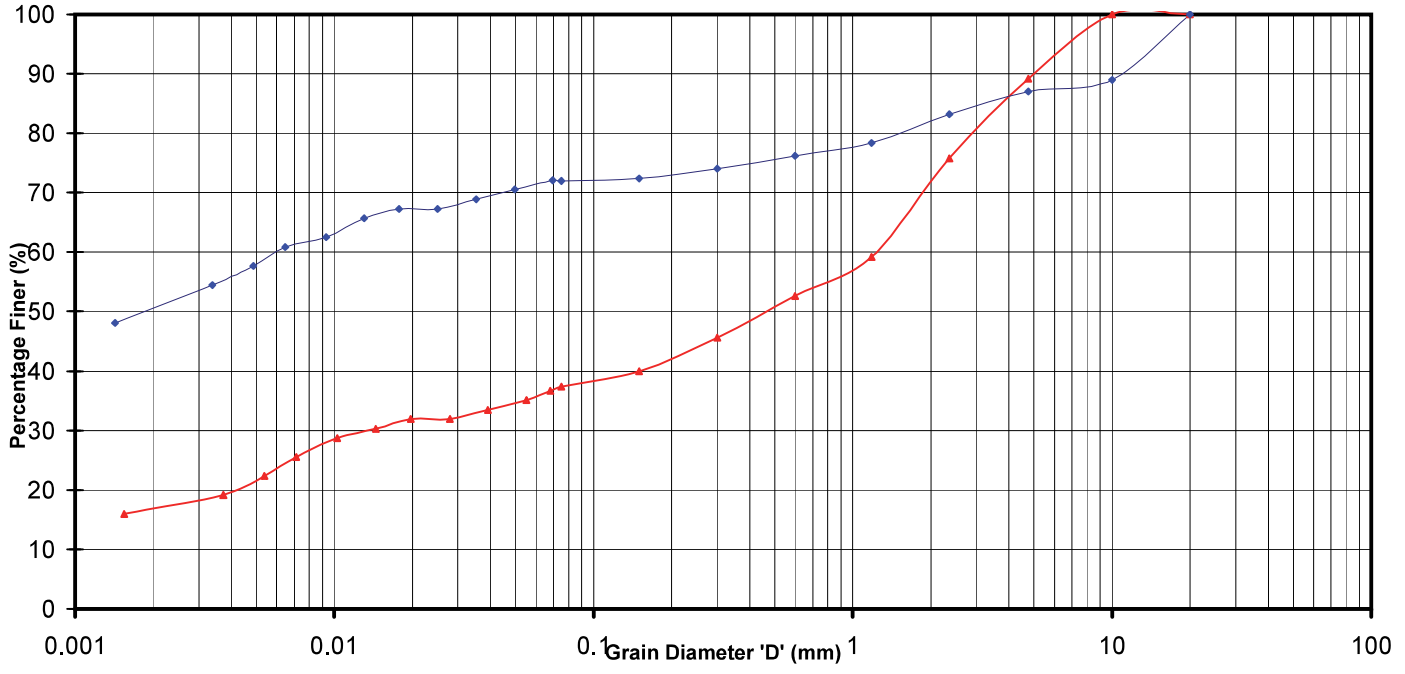
BH NO.: **BH-04** Depth (m) : **-5.60 - -6.10** **-7.10 - -7.55**

	CLAY	SILT	SAND			GRAVEL
			FINE	MEDIUM	COARSE	
▲	17	25	26	17	10	5
■	39	38	10	9	4	0



BH NO.: **BH-04** Depth (m) : **-10.10 - -10.55** **-11.60 - -12.05**

	CLAY	SILT	SAND			GRAVEL
			FINE	MEDIUM	COARSE	
▲	17	20	12	22	18	11
■	50	22	3	7	5	13



Tested By : **P.M.** Prepared By :**V.N.** Checked By :**S.D.** Approved By :**S.T.**

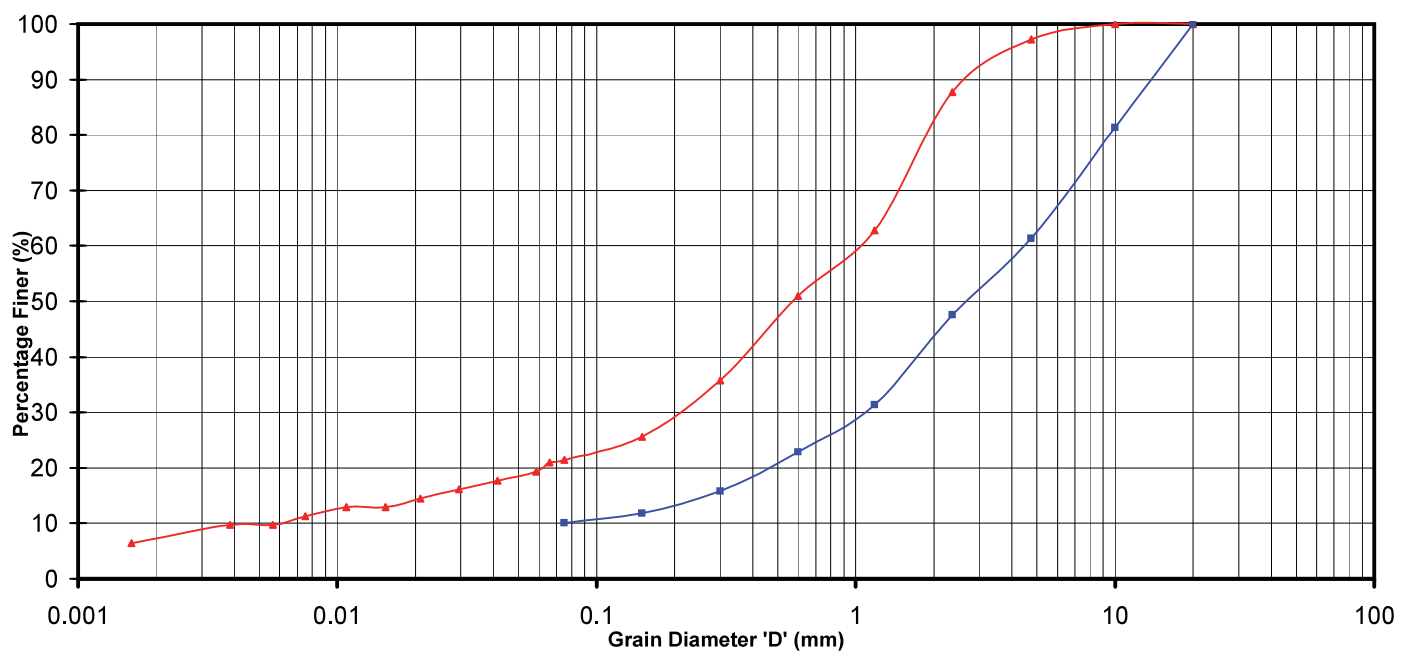
PARTICLE SIZE DISTRIBUTION

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link
Job No. : IDEAL/028/015

As Per IS:2720

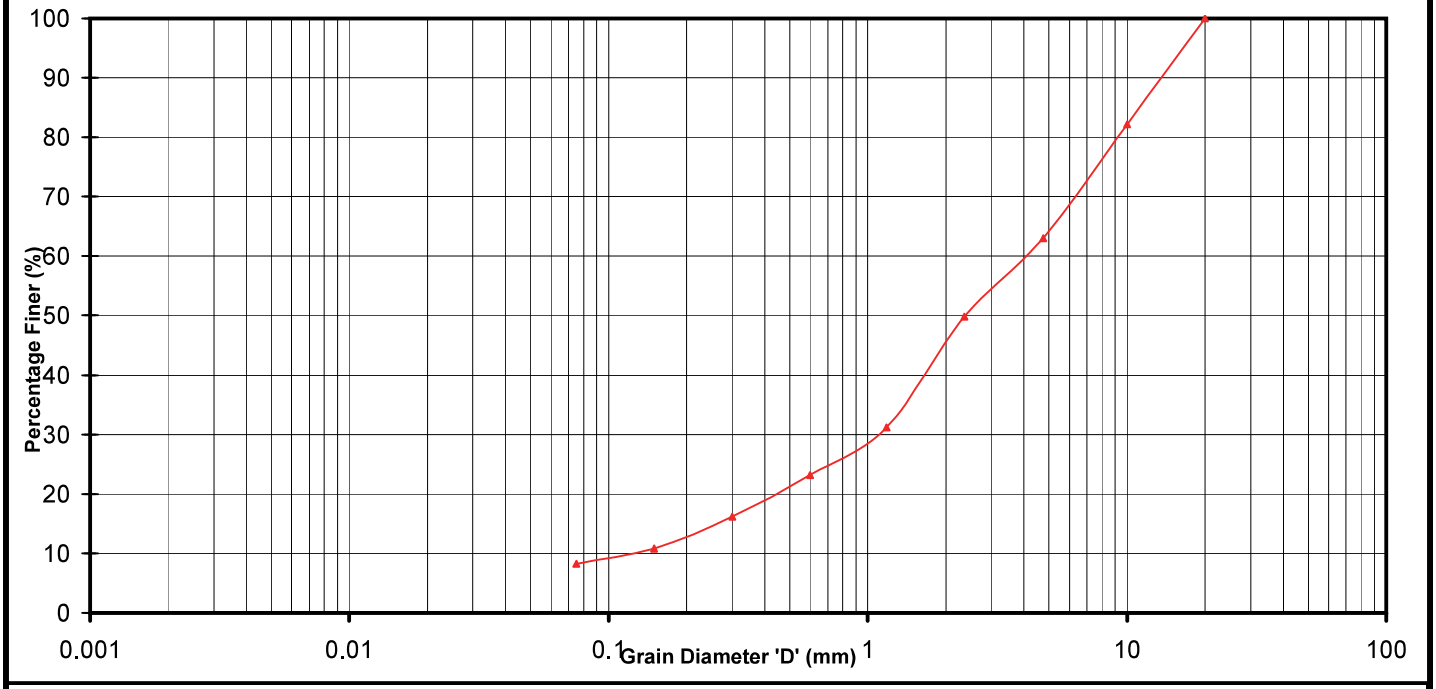
BH NO.: **BH-04** Depth (m) : **-13.10 - -13.55** ▲ **-14.60 - -14.87** ■

	CLAY	SILT	SAND			GRAVEL
			FINE	MEDIUM	COARSE	
▲	7	14	21	38	17	3
■	10		9	24	18	39



BH NO.: **BH-04** Depth (m) : **-16.10 - -16.55** ▲ ■

	CLAY & SILT	SAND			GRAVEL
		FINE	MEDIUM	COARSE	
▲	8	11	25	19	37
■					



Tested By : **P.M.** Prepared By :**V.N.** Checked By :**S.D.** Approved By :**S.T.**

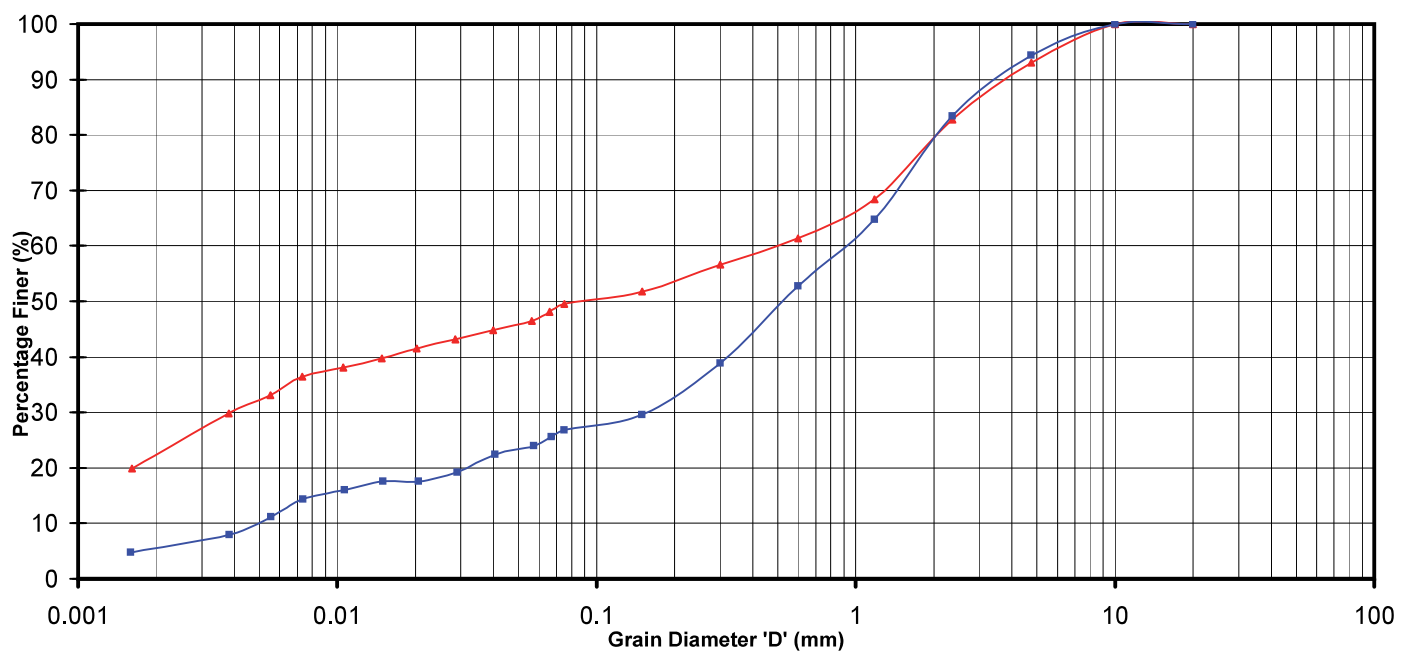
PARTICLE SIZE DISTRIBUTION

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link
Job No. : IDEAL/028/015

As Per IS:2720

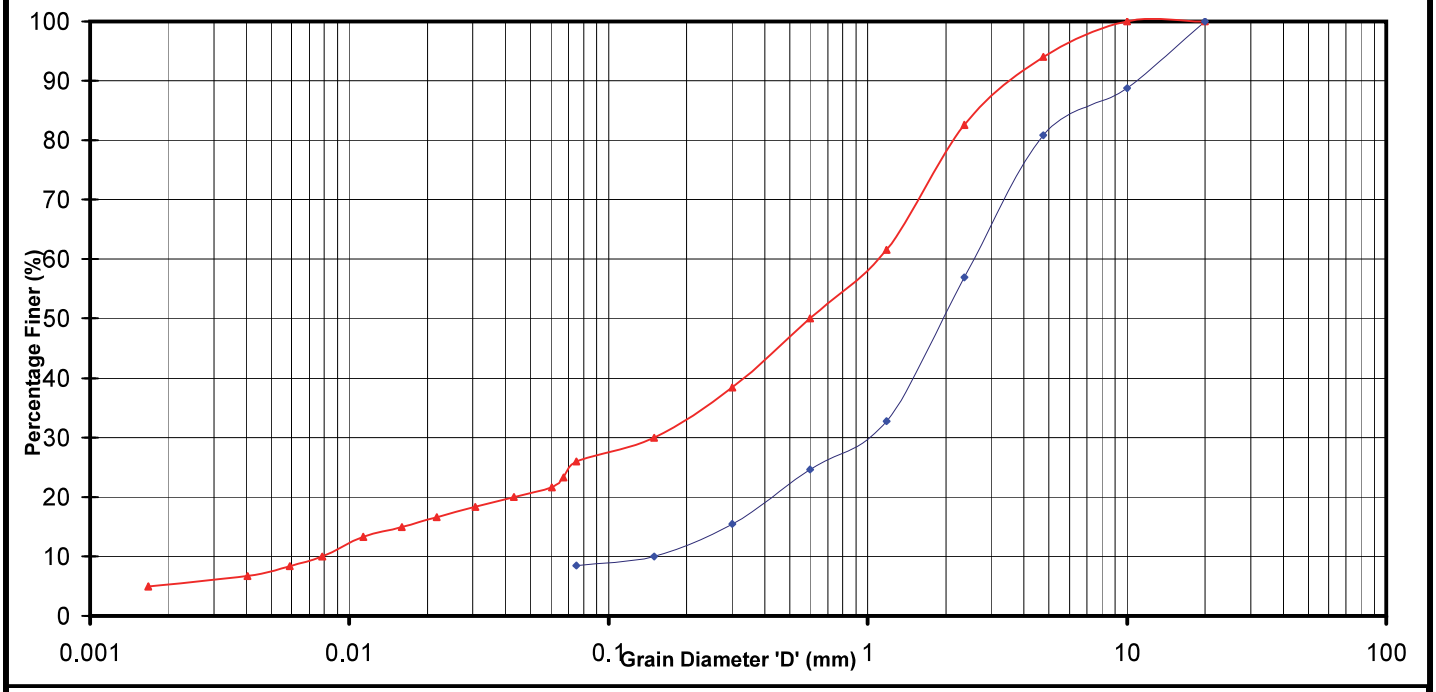
BH NO.: **BH-05** Depth (m) : **-3.10 - -3.60** ▲ **-6.10 - -6.20** ■

	CLAY	SILT	SAND			GRAVEL
			FINE	MEDIUM	COARSE	
▲	22	28	9	19	15	7
■	5	22	18	33	16	6



BH NO.: **BH-05** Depth (m) : **-7.60 - 8.05** ▲ **-9.10 - -9.35** ■

	CLAY	SILT	SAND			GRAVEL
			FINE	MEDIUM	COARSE	
▲	5	21	17	33	18	6
■	8		11	31	31	19



Tested By : **P.M.** Prepared By :**V.N.** Checked By :**S.D.** Approved By :**S.T.**

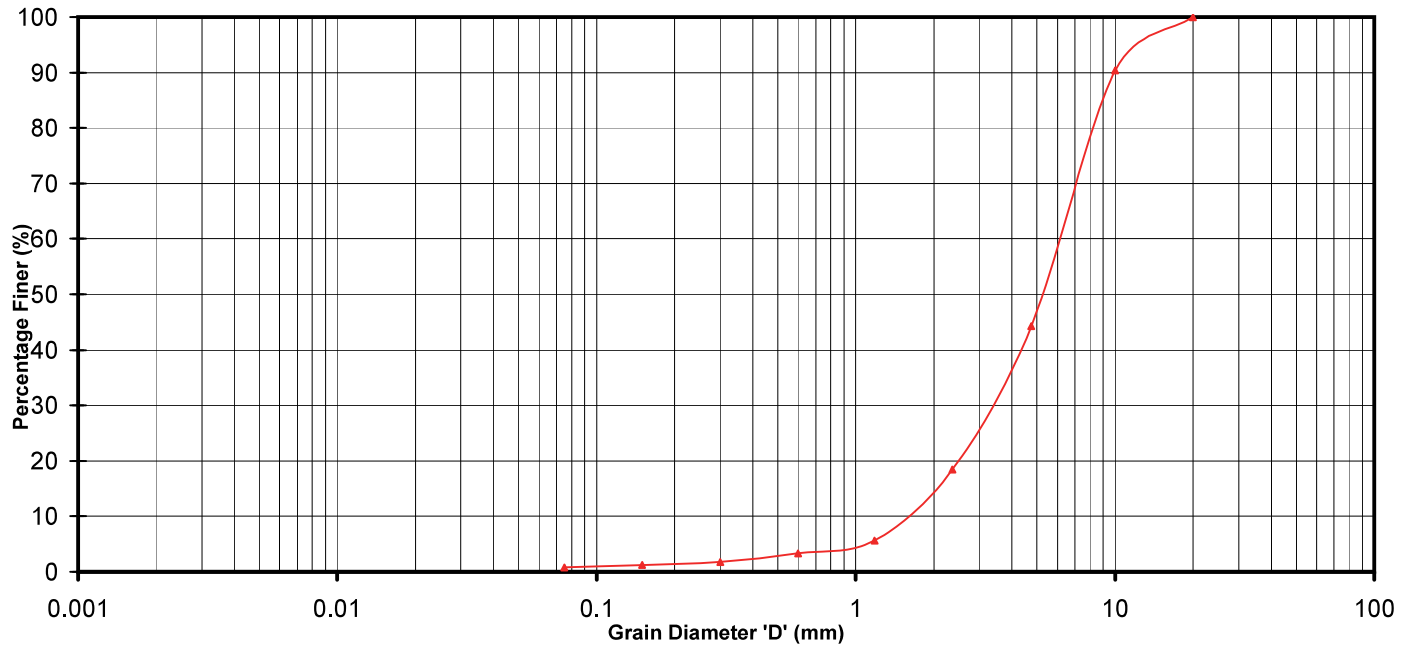
PARTICLE SIZE DISTRIBUTION

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link
Job No. : IDEAL/028/015

As Per IS:2720

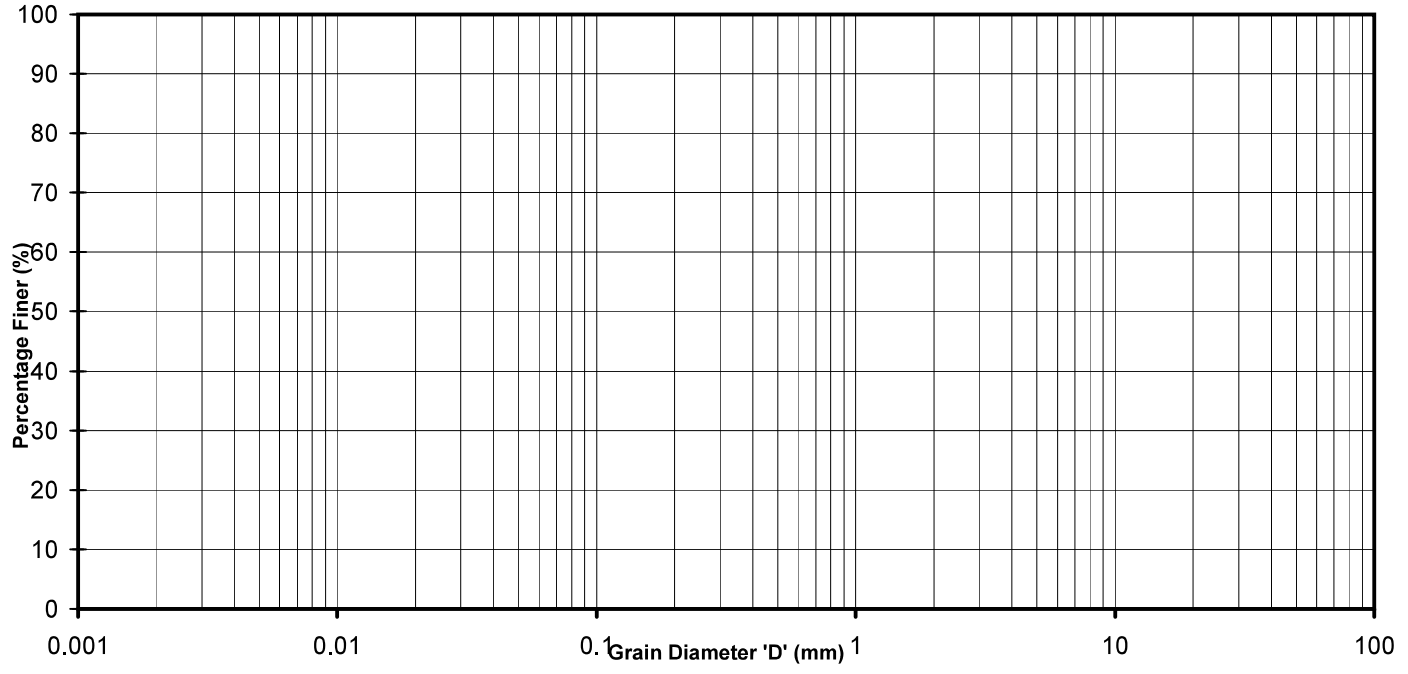
BH NO.: **BH-05** Depth (m) : **-10.60 - -10.83**

	CLAY & SILT	SAND			GRAVEL
		FINE	MEDIUM	COARSE	
▲	1	1	12	30	56
■					



BH NO.: Depth (m) :

	CLAY	SILT	SAND			GRAVEL
			FINE	MEDIUM	COARSE	
▲						
■						



Tested By : **P.M.** Prepared By :**V.N.** Checked By :**S.D.** Approved By :**S.T.**

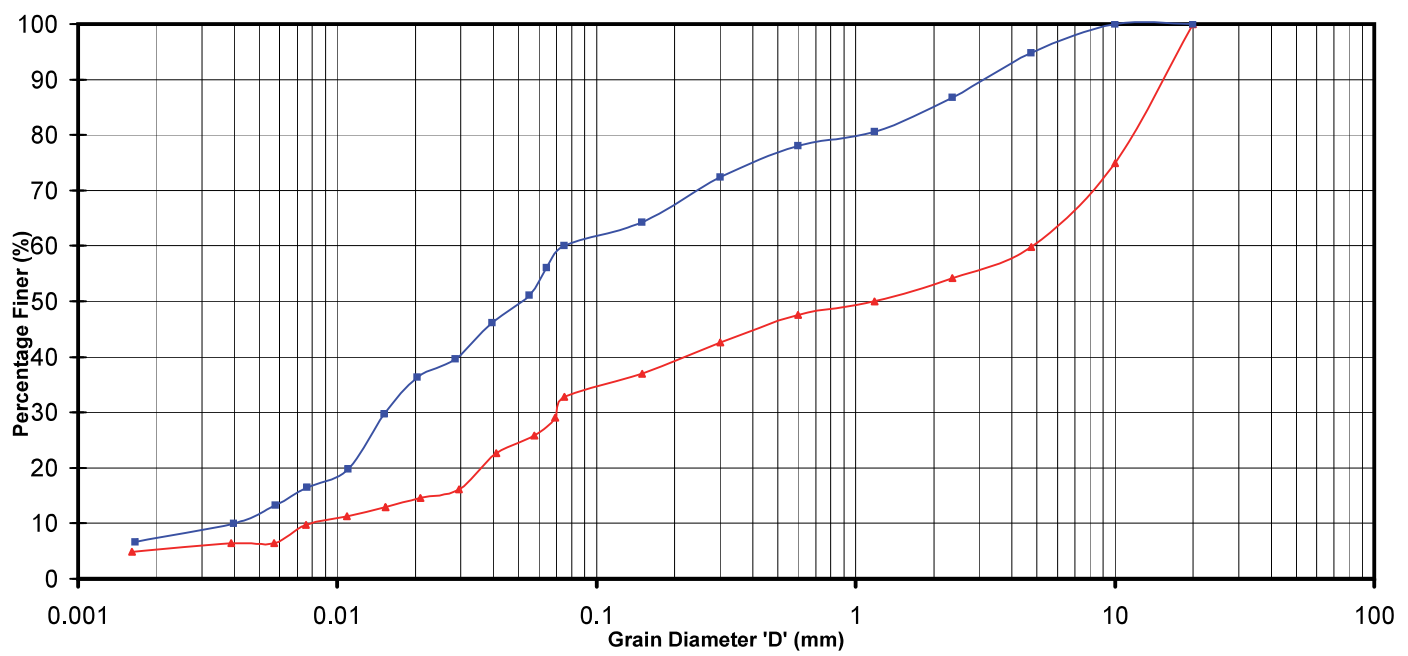
PARTICLE SIZE DISTRIBUTION

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link
Job No. : IDEAL/028/015

As Per IS:2720

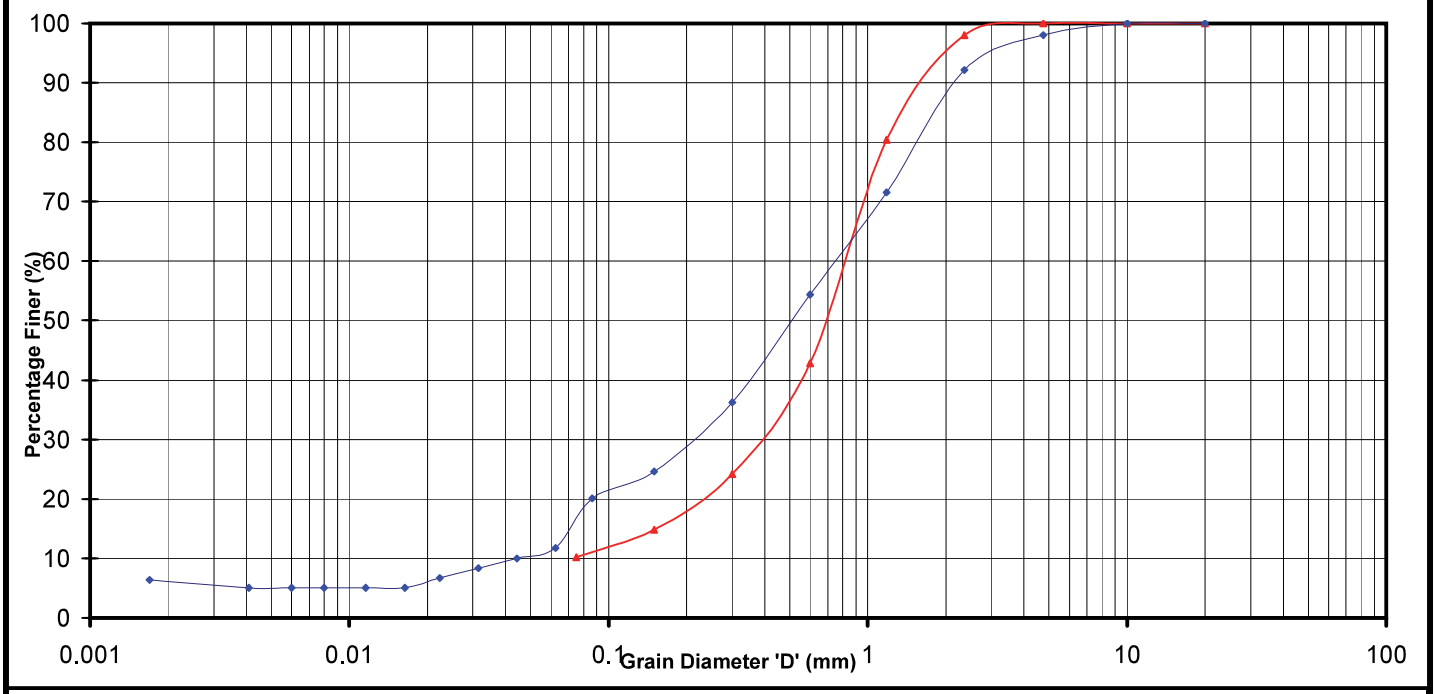
BH NO.: **BH-05** Depth (m) : **-12.10 - -12.55** **-13.60 - -14.05**

	CLAY	SILT	SAND			GRAVEL
			FINE	MEDIUM	COARSE	
▲	5	28	12	8	7	40
■	7	53	15	10	10	5



BH NO.: **BH-05** Depth (m) : **-15.10 - -15.22** **-16.60 - -16.68**

	CLAY	SILT	SAND			GRAVEL
			FINE	MEDIUM	COARSE	
▲	10		22	61	7	0
■	6	14	24	42	12	2



Tested By : **P.M.** Prepared By :**V.N.** Checked By :**S.D.** Approved By :**S.T.**

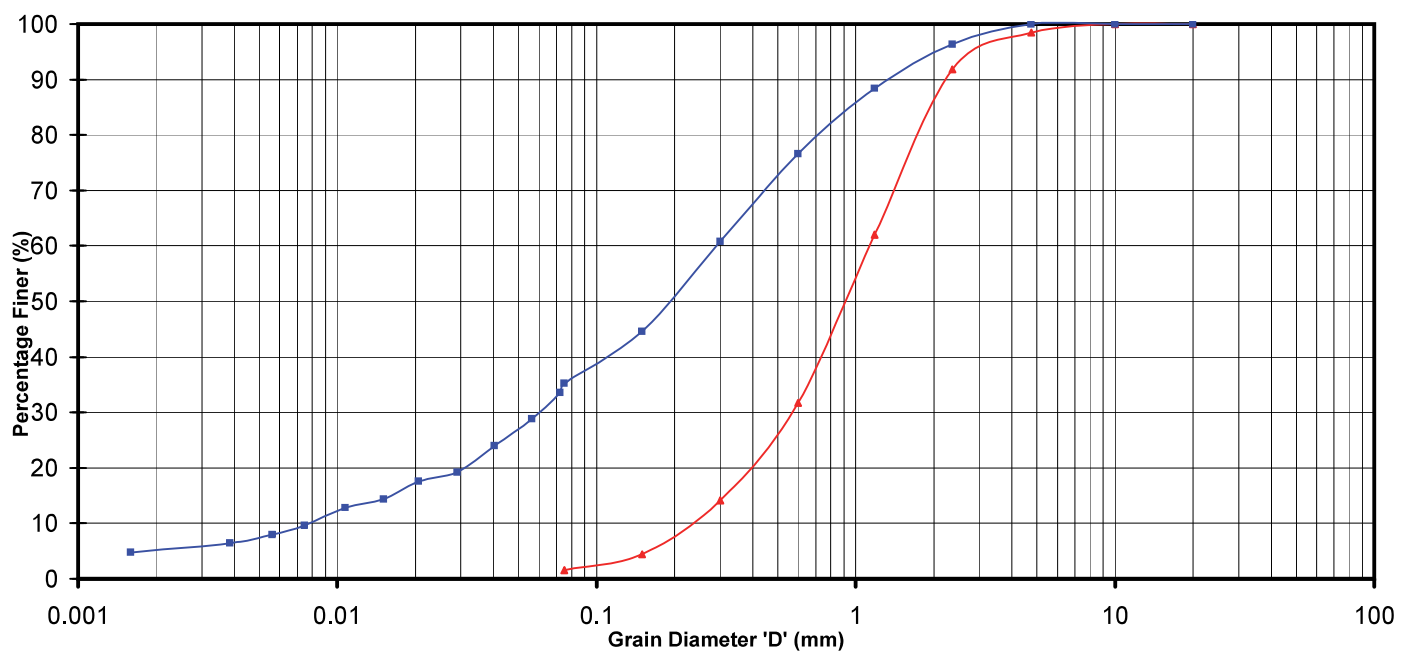
PARTICLE SIZE DISTRIBUTION

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link
Job No. : IDEAL/028/015

As Per IS:2720

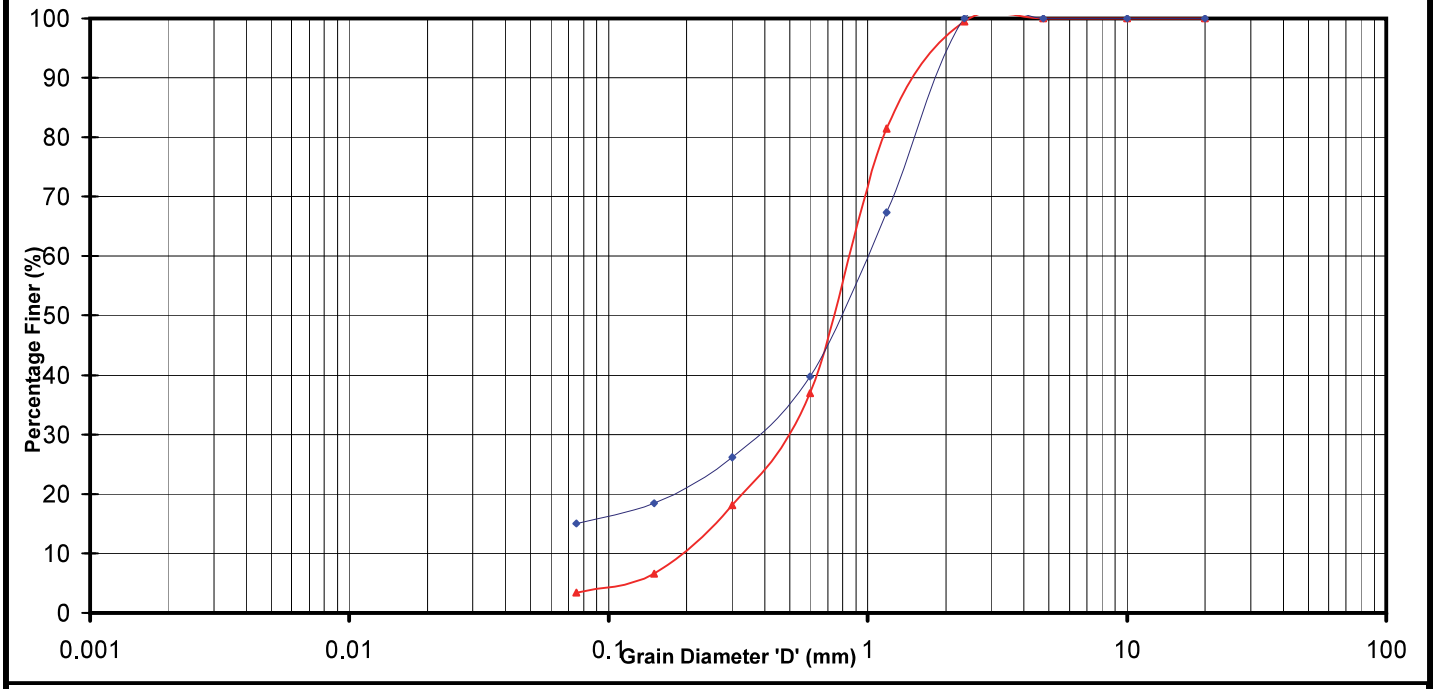
BH NO.: **BH-06** Depth (m) : **0.09 - -0.41** **-2.91 - -3.36**

	CLAY	SILT	SAND			GRAVEL
			FINE	MEDIUM	COARSE	
▲		0	20	62	16	2
■	5	30	32	27	6	0



BH NO.: **BH-06** Depth (m) : **-4.41 - -4.79** **-5.91 - -6.30**

	CLAY & SILT	SAND			GRAVEL
		FINE	MEDIUM	COARSE	
▲	3	23	68	6	0
■	15	17	58	10	0



Tested By : **P.M.** Prepared By :**V.N.** Checked By :**S.D.** Approved By :**S.T.**

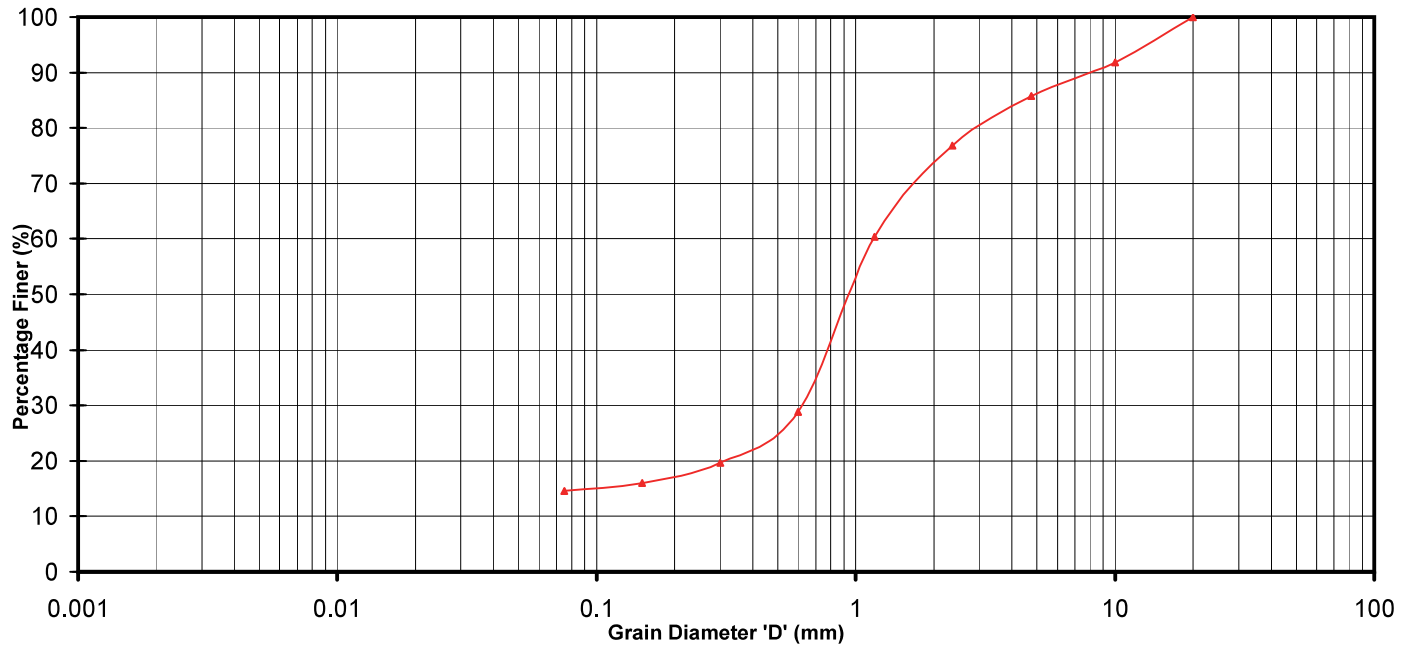
PARTICLE SIZE DISTRIBUTION

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link
Job No. : IDEAL/028/015

As Per IS:2720

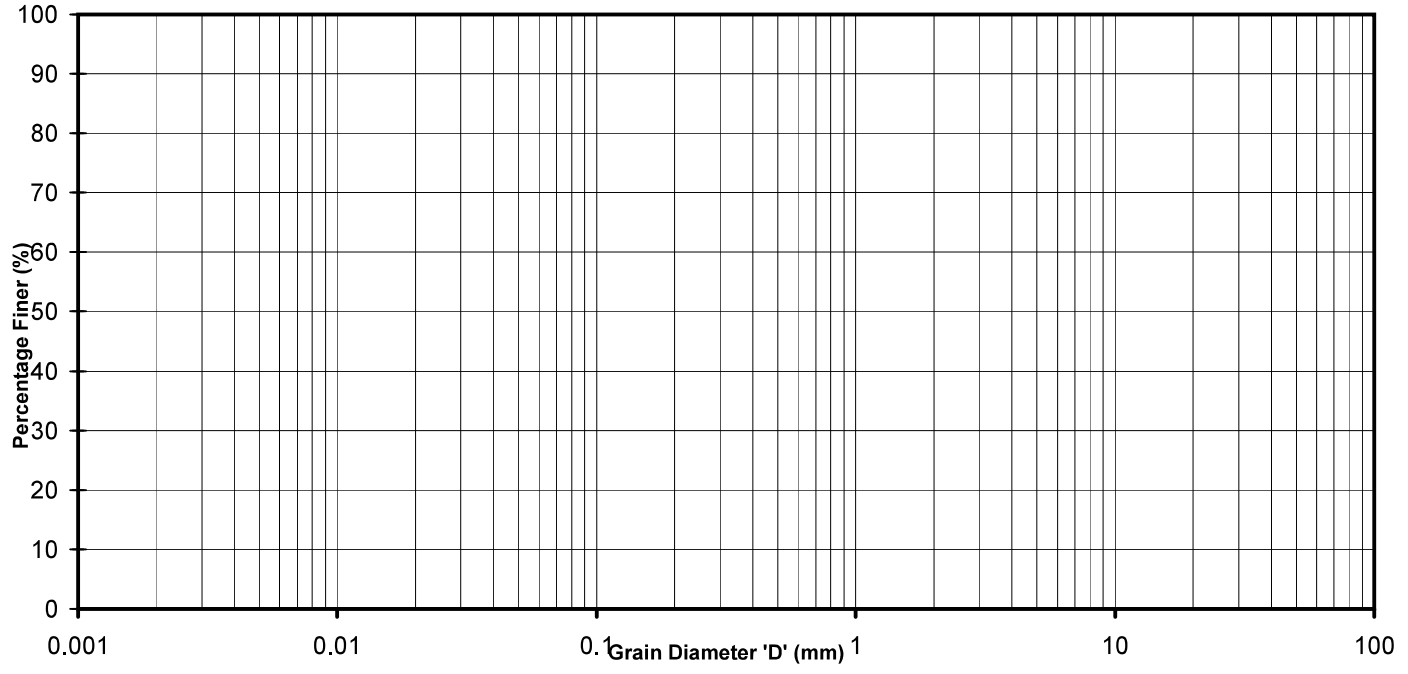
BH NO.: **BH-06** Depth (m) : **-7.41 - -7.51**

	CLAY & SILT	SAND			GRAVEL
		FINE	MEDIUM	COARSE	
▲	15	8	49	14	14
■					



BH NO.: **BH-06** Depth (m) :

	CLAY	SILT	SAND			GRAVEL
			FINE	MEDIUM	COARSE	
▲						
■						



Tested By : **P.M.** Prepared By :**V.N.** Checked By :**S.D.** Approved By :**S.T.**

Liquid Limit *(Casagrande method)* and Plastic Limit

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

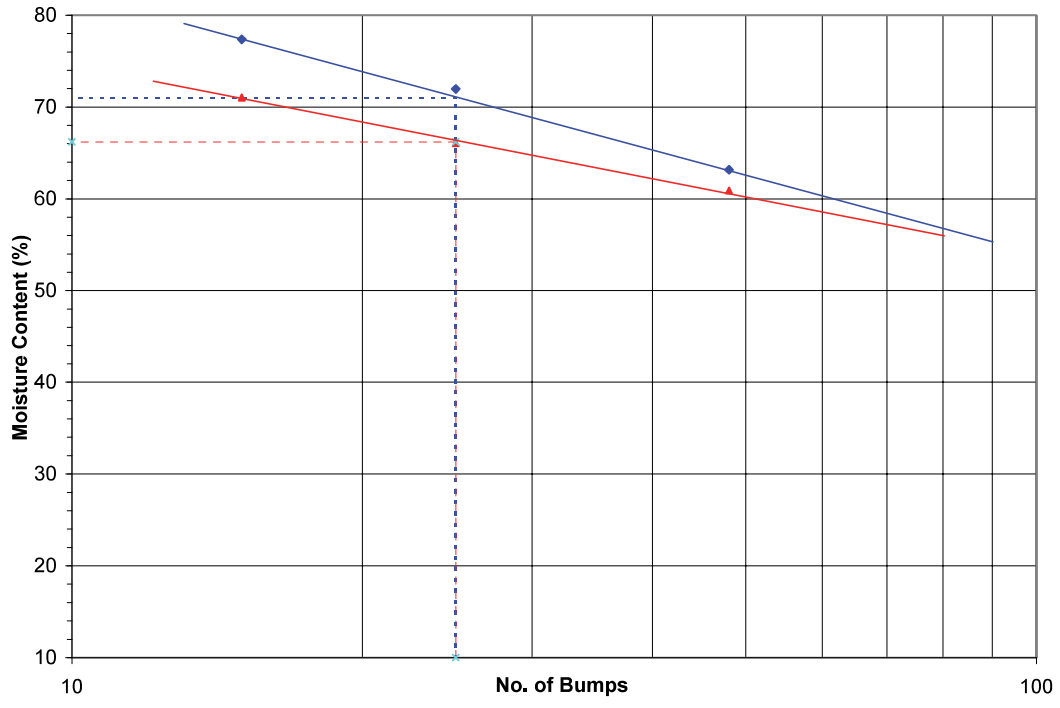
Job No. IDEAL/028/015

BH NO. :	Sample Depth(m) :		Sample No. :		Date :	
BH-01		-3.32 - -3.82		ID-M-BH-01-D0000		21-07-2015
BH-01		-4.82 - -5.27		ID-M-BH-01-S1500		21-07-2015

Test method : **IS 2720 : Part 5**

PLASTIC LIMIT	Test no.	1	2	Average	1	2	Average
Container no.		A44	A61		A38	A57	
Mass of wet soil + container	g	24.20	22.40		23.50	27.70	
Mass of dry soil + container	g	23.20	21.40		22.20	25.50	
Mass of container	g	19.44	17.81		18.28	18.97	
Mass of moisture	g	1.00	1.00		1.30	2.20	
Mass of dry soil	g	3.76	3.59		3.92	6.53	
Moisture Content	%	**26.60**	**27.86**	**27.23**	**33.16**	**33.69**	**33.43**

LIQUID LIMIT	Test no.	1	2	3	1	2	3
Number of bumps		15	25	48	15	25	48
Container no.		A19	A36	A29	A28	A2	A17
Mass of wet soil + container (m_3)	g	37.20	37.50	36.70	42.40	31.80	34.40
Mass of dry soil + container (m_2)	g	32.00	33.90	32.70	35.50	26.90	30.10
Mass of container (m_1)	g	24.68	28.45	26.13	26.58	20.09	23.29
Mass of moisture ($m_3 - m_2$)	g	5.20	3.60	4.00	6.90	4.90	4.30
Mass of dry soil ($m_2 - m_1$)	g	7.32	5.45	6.57	8.92	6.81	6.81
Water Content	%	**71.04**	**66.06**	**60.88**	**77.35**	**71.95**	**63.14**



Sample preparation	
washed on 425 μ m sieve oven dried at 105 °C	
Liquid limit	66 %
Plastic limit	27 %
Plasticity index	39 %
Liquid limit	71 %
Plastic limit	33 %
Plasticity index	38 %

Operator	Checked	Approved
P.M.	K.B.	S.T.

Liquid Limit *(Casagrande method)* and Plastic Limit

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

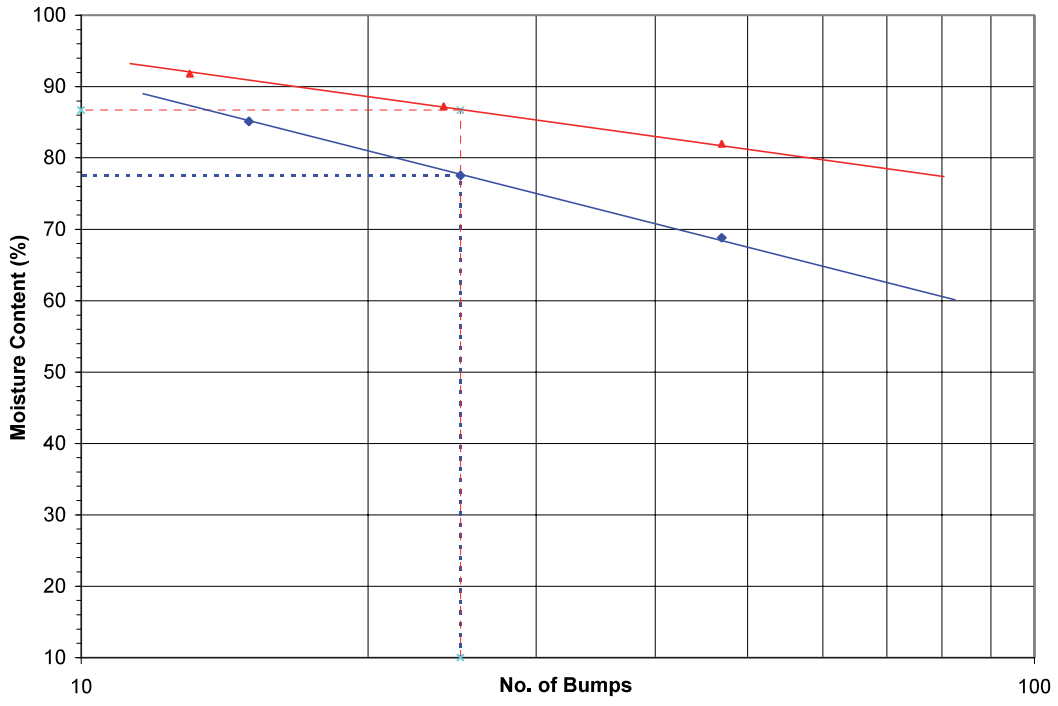
Job No. IDEAL/028/015

BH NO. :		Sample Depth(m) :					
	BH-01		-6.32 - -6.77	Sample No. :	ID-M-BH-01-S3000	Date :	21-07-2015
	BH-01		-7.82 - -8.27	Sample No. :	ID-M-BH-01-S4500	Date :	21-07-2015

Test method : **IS 2720 : Part 5**

PLASTIC LIMIT	Test no.	1	2	Average	1	2	Average
Container no.		A38	A51		A51	A55	
Mass of wet soil + container	g	27.50	29.60		21.80	22.30	
Mass of dry soil + container	g	25.00	26.40		20.90	21.50	
Mass of container	g	18.28	18.03		18.03	18.98	
Mass of moisture	g	2.50	3.20		0.90	0.80	
Mass of dry soil	g	6.72	8.37		2.87	2.52	
Moisture Content	%	37.20	38.23	37.72	31.36	31.75	31.55

LIQUID LIMIT	Test no.	1	2	3	1	2	3
Number of bumps		13	24	47	15	25	47
Container no.		A42	A64	A39	A25	A10	A5
Mass of wet soil + container (m_3)	g	35.60	32.90	32.00	37.60	36.20	34.40
Mass of dry soil + container (m_2)	g	29.20	26.00	25.90	32.10	30.40	29.50
Mass of container (m_1)	g	22.23	18.09	18.46	25.64	22.92	22.38
Mass of moisture ($m_3 - m_2$)	g	6.40	6.90	6.10	5.50	5.80	4.90
Mass of dry soil ($m_2 - m_1$)	g	6.97	7.91	7.44	6.46	7.48	7.12
Water Content	%	91.82	87.23	81.99	85.14	77.54	68.82



Sample preparation	
washed on 425 μ m sieve oven dried at	105 °C
Liquid limit	87 %
Plastic limit	38 %
Plasticity index	49 %
Liquid limit	78 %
Plastic limit	32 %
Plasticity index	46 %

Operator	Checked	Approved
P.M.	K.B.	S.T.

Liquid Limit *(Casagrande method)* and Plastic Limit

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

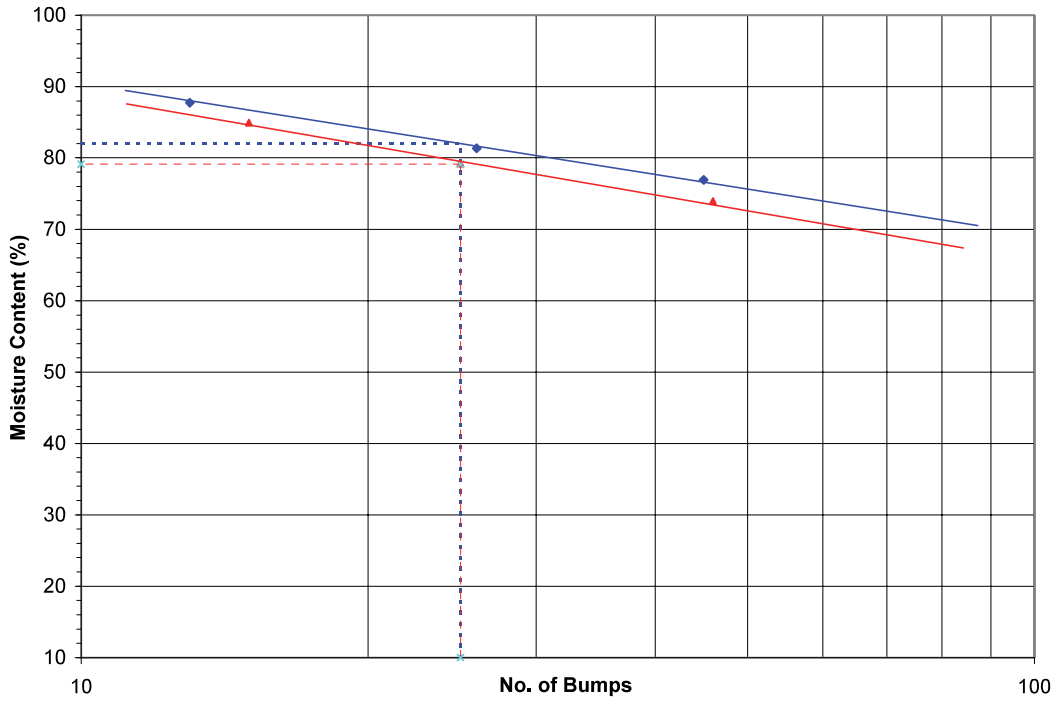
Job No. IDEAL/028/015

BH NO. :		Sample Depth(m) :					
	BH-01		-9.32 - -9.77	Sample No. :	ID-M-BH-01-S6000	Date :	22-07-2015
	BH-01		-10.82 - -11.27	Sample No. :	ID-M-BH-01-S7500	Date :	22-07-2015

Test method : **IS 2720 : Part 5**

PLASTIC LIMIT	Test no.	1	2	Average	1	2	Average
Container no.		A4	A18		A48	A42	
Mass of wet soil + container	g	28.20	28.40		24.50	26.40	
Mass of dry soil + container	g	27.00	27.30		23.00	25.50	
Mass of container	g	23.29	23.78		17.70	22.23	
Mass of moisture	g	1.20	1.10		1.50	0.90	
Mass of dry soil	g	3.71	3.52		5.30	3.27	
Moisture Content	%	**32.35**	**31.25**	**31.80**	**28.30**	**27.52**	**27.91**

LIQUID LIMIT	Test no.	1	2	3	1	2	3
Number of bumps		15	25	46	13	26	45
Container no.		A8	A1	A32	A12	A22	A33
Mass of wet soil + container (m_3)	g	39.50	29.90	41.80	34.30	37.00	41.10
Mass of dry soil + container (m_2)	g	31.20	25.40	35.20	28.80	31.90	34.90
Mass of container (m_1)	g	21.43	19.72	26.28	22.53	25.63	26.84
Mass of moisture ($m_3 - m_2$)	g	8.30	4.50	6.60	5.50	5.10	6.20
Mass of dry soil ($m_2 - m_1$)	g	9.77	5.68	8.92	6.27	6.27	8.06
Water Content	%	**84.95**	**79.23**	**73.99**	**87.72**	**81.34**	**76.92**



Sample preparation		
washed on 425 μ m sieve oven dried at 105 °C		
Liquid limit	79	%
Plastic limit	32	%
Plasticity index	47	%
Liquid limit	82	%
Plastic limit	28	%
Plasticity index	54	%

Operator	Checked	Approved
P.M.	K.B.	S.T.

Liquid Limit *(Casagrande method)* and Plastic Limit

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

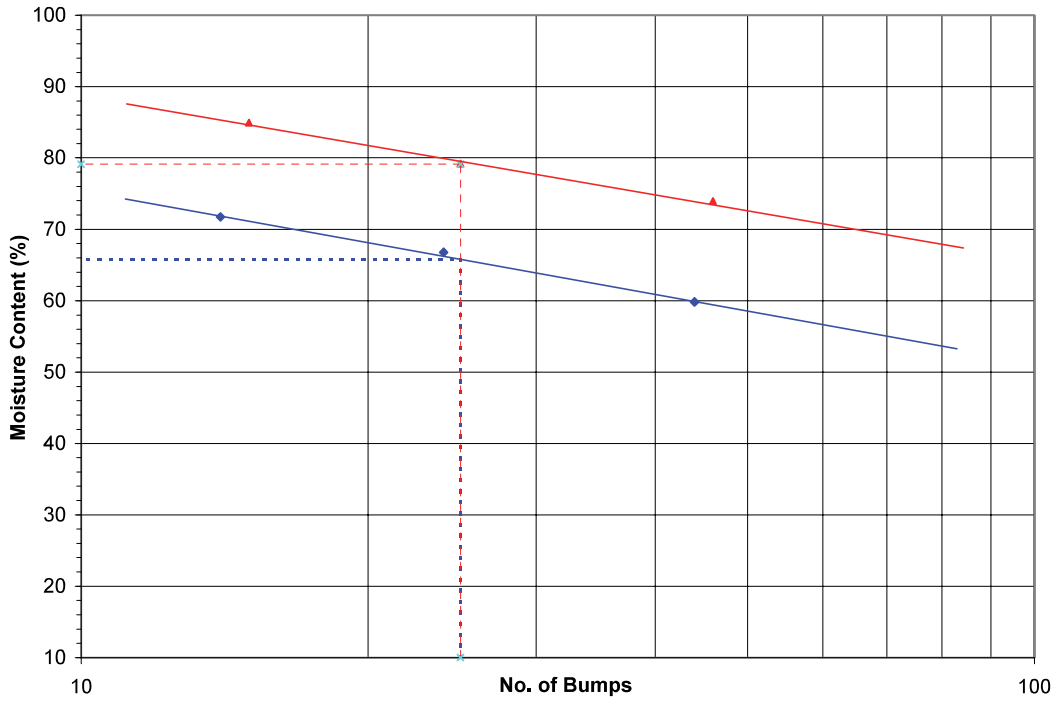
Job No. IDEAL/028/015

BH NO. :		Sample Depth(m) :					
	BH-01		-12.32 - -12.67	Sample No. :	ID-M-BH-01-S9000	Date :	22-07-2015
	BH-01		-13.82 - -14.22	Sample No. :	ID-M-BH-01-S1050	Date :	22-07-2015

Test method : **IS 2720 : Part 5**

PLASTIC LIMIT	Test no.	1	2	Average	1	2	Average
Container no.		A4	A18		A47	A64	
Mass of wet soil + container	g	28.20	28.40		21.80	22.60	
Mass of dry soil + container	g	27.00	27.30		20.60	21.50	
Mass of container	g	23.29	23.78		16.87	18.09	
Mass of moisture	g	1.20	1.10		1.20	1.10	
Mass of dry soil	g	3.71	3.52		3.73	3.41	
Moisture Content	%	32.35	31.25	31.80	32.17	32.26	32.21

LIQUID LIMIT	Test no.	1	2	3	1	2	3
Number of bumps		15	25	46	14	24	44
Container no.		A8	A1	A32	A45	A49	A43
Mass of wet soil + container (m_3)	g	39.50	29.90	41.80	29.80	32.20	30.70
Mass of dry soil + container (m_2)	g	31.20	25.40	35.20	24.80	26.80	26.10
Mass of container (m_1)	g	21.43	19.72	26.28	17.83	18.71	18.41
Mass of moisture ($m_3 - m_2$)	g	8.30	4.50	6.60	5.00	5.40	4.60
Mass of dry soil ($m_2 - m_1$)	g	9.77	5.68	8.92	6.97	8.09	7.69
Water Content	%	84.95	79.23	73.99	71.74	66.75	59.82



Sample preparation		
washed on 425 μ m sieve oven dried at 105 °C		
Liquid limit	79	%
Plastic limit	32	%
Plasticity index	47	%
Liquid limit	66	%
Plastic limit	32	%
Plasticity index	34	%

Operator	Checked	Approved
P.M.	K.B.	S.T.

Liquid Limit *(Casagrande method)* and Plastic Limit

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

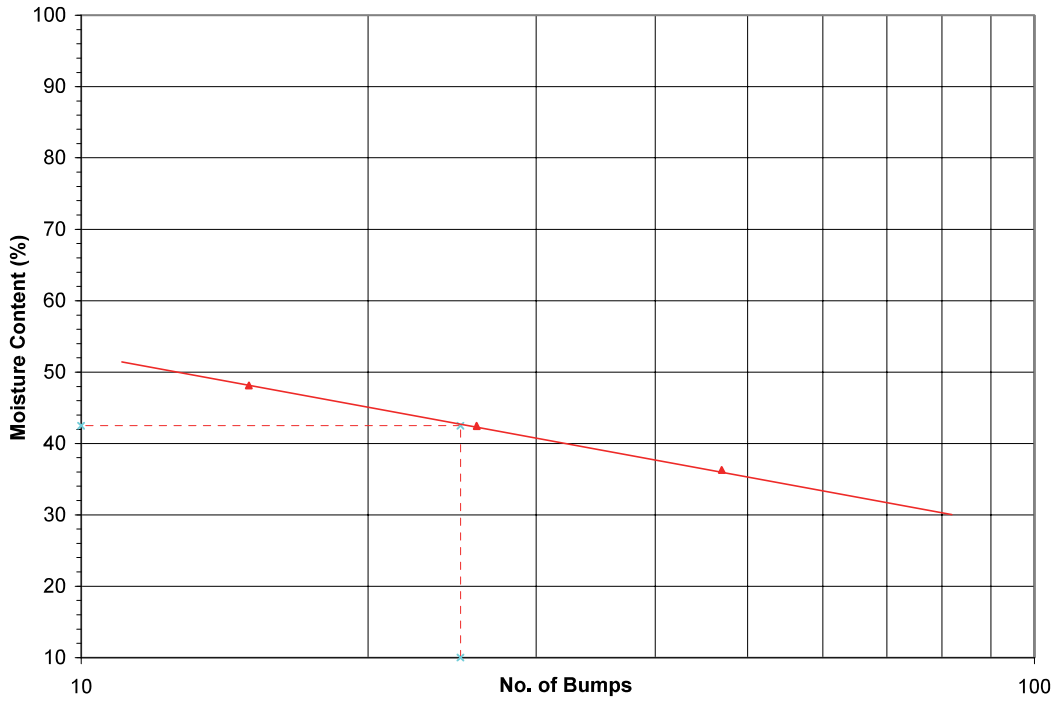
Job No. IDEAL/028/015

BH NO. :	BH-01	Sample Depth(m) :	-15.32 - -15.77	Sample No. :	ID-M-BH-01-S1200	Date :	22-07-2015

Test method : **IS 2720 : Part 5**

PLASTIC LIMIT	Test no.	1	2	Average	1	2	Average
Container no.		A39	A54				
Mass of wet soil + container	g	23.00	27.70				
Mass of dry soil + container	g	22.20	26.70				
Mass of container	g	18.46	22.16				
Mass of moisture	g	0.80	1.00				
Mass of dry soil	g	3.74	4.54				
Moisture Content	%	21.39	22.03	21.71			

LIQUID LIMIT	Test no.	1	2	3	1	2	3
Number of bumps		15	26	47			
Container no.		A63	A58	A59			
Mass of wet soil + container (m_3)	g	36.60	30.80	36.20			
Mass of dry soil + container (m_2)	g	30.70	26.60	32.40			
Mass of container (m_1)	g	18.44	16.71	21.93			
Mass of moisture ($m_3 - m_2$)	g	5.90	4.20	3.80			
Mass of dry soil ($m_2 - m_1$)	g	12.26	9.89	10.47			
Water Content	%	48.12	42.47	36.29			



Sample preparation
washed on 425 μ m sieve oven dried at 105 °C
.
Liquid limit 43 %
Plastic limit 22 %
Plasticity index 21 %
Liquid limit %
Plastic limit %
Plasticity index %

Operator	Checked	Approved
P.M.	K.B.	S.T.

Liquid Limit *(Casagrande method)* and Plastic Limit

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

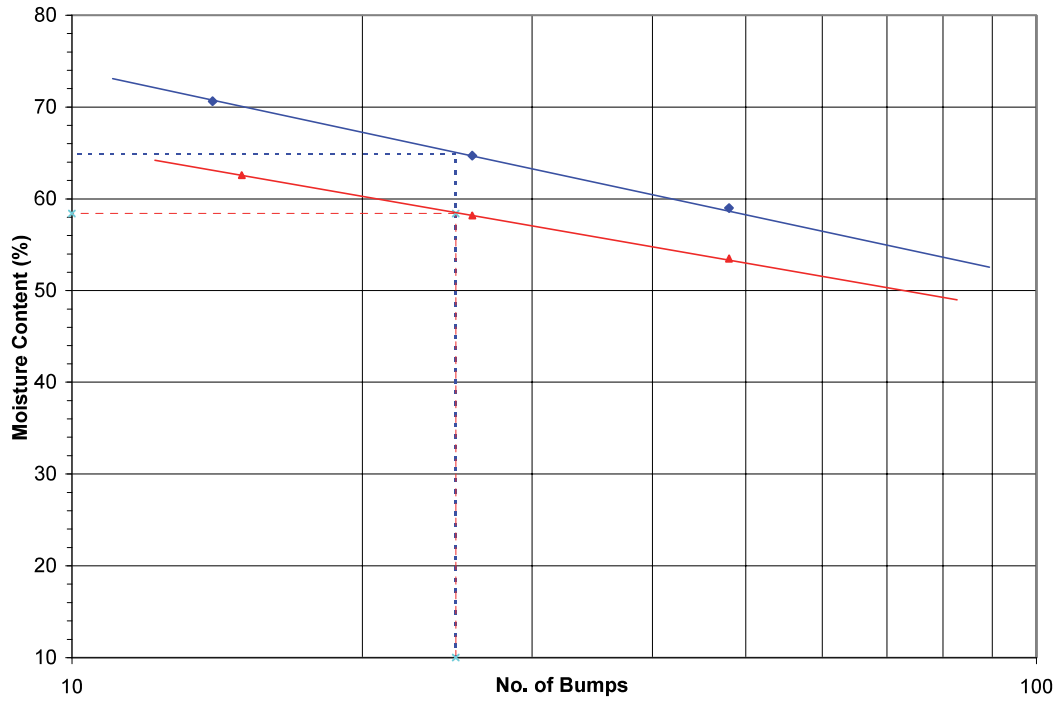
Job No. IDEAL/028/015

BH NO. :		Sample Depth(m) :					
	BH-02		-3.04 - -3.54	Sample No. :	ID-M-BH-02-D0000	Date :	08-07-2015
	BH-02		-4.54 - -4.99	Sample No. :	ID-M-BH-02-S1500	Date :	08-07-2015

Test method : **IS 2720 : Part 5**

PLASTIC LIMIT	Test no.	1	2	Average	1	2	Average
Container no.		A50	A37		A62	A64	
Mass of wet soil + container	g	27.30	28.63		30.21	28.20	
Mass of dry soil + container	g	24.64	25.68		27.38	25.74	
Mass of container	g	16.60	16.72		18.57	18.09	
Mass of moisture	g	2.66	2.95		2.83	2.46	
Mass of dry soil	g	8.04	8.96		8.81	7.65	
Moisture Content	%	**33.08**	**32.92**	**33.00**	**32.12**	**32.16**	**32.14**

LIQUID LIMIT	Test no.	1	2	3	1	2	3
Number of bumps		15	26	48	14	26	48
Container no.		A20	A35	A26	A60	A44	A48
Mass of wet soil + container (m_3)	g	38.21	39.59	35.83	29.22	30.64	28.67
Mass of dry soil + container (m_2)	g	33.13	35.08	32.37	24.07	26.24	24.60
Mass of container (m_1)	g	25.01	27.33	25.90	16.78	19.44	17.70
Mass of moisture ($m_3 - m_2$)	g	5.08	4.51	3.46	5.15	4.40	4.07
Mass of dry soil ($m_2 - m_1$)	g	8.12	7.75	6.47	7.29	6.80	6.90
Water Content	%	**62.56**	**58.19**	**53.48**	**70.64**	**64.71**	**58.99**



Sample preparation		
washed on 425 μ m sieve oven dried at	105 °C	
Liquid limit	58	%
Plastic limit	33	%
Plasticity index	25	%
Liquid limit	65	%
Plastic limit	32	%
Plasticity index	33	%

Operator	Checked	Approved
P.M.	K.B.	S.T.

Liquid Limit *(Casagrande method)* and Plastic Limit

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

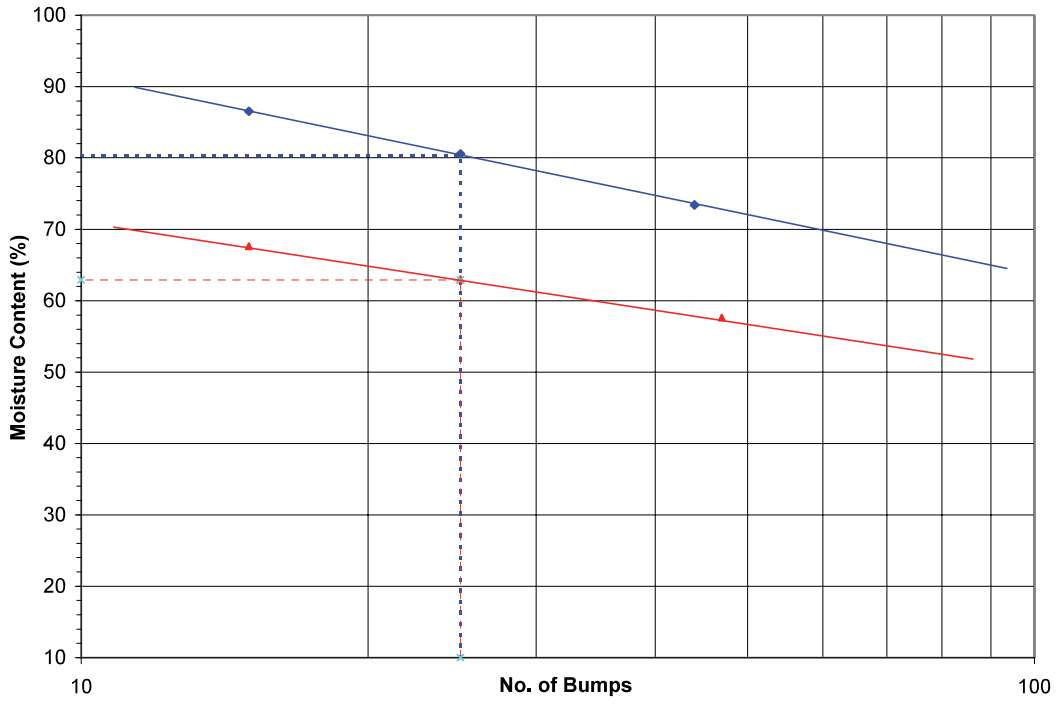
Job No. IDEAL/028/015

BH NO. :	Sample Depth(m) :		Sample No. :		Date :	
BH-02	-6.04 - -6.49		Sample No. :	ID-M-BH-02-S3000	Date :	08-07-2015
BH-02	-7.54 - -7.99		Sample No. :	ID-M-BH-02-U4500	Date :	22-07-2015

Test method : **IS 2720 : Part 5**

PLASTIC LIMIT	Test no.	1	2	Average	1	2	Average
Container no.		A55	A54		A57	A44	
Mass of wet soil + container	g	32.51	35.29		33.00	30.40	
Mass of dry soil + container	g	29.43	32.32		29.30	27.50	
Mass of container	g	18.98	22.16		18.97	19.44	
Mass of moisture	g	3.08	2.97		3.70	2.90	
Mass of dry soil	g	10.45	10.16		10.33	8.06	
Moisture Content	%	**29.47**	**29.23**	**29.35**	**35.82**	**35.98**	**35.90**

LIQUID LIMIT	Test no.	1	2	3	1	2	3
Number of bumps		15	25	47	15	25	44
Container no.		A16	A10	A3	A47	A48	A50
Mass of wet soil + container (m_3)	g	37.30	36.01	33.43	33.90	30.70	35.50
Mass of dry soil + container (m_2)	g	31.58	30.95	29.46	26.00	24.90	27.50
Mass of container (m_1)	g	23.12	22.92	22.57	16.87	17.70	16.60
Mass of moisture ($m_3 - m_2$)	g	5.72	5.06	3.97	7.90	5.80	8.00
Mass of dry soil ($m_2 - m_1$)	g	8.46	8.03	6.89	9.13	7.20	10.90
Water Content	%	**67.61**	**63.01**	**57.62**	**86.53**	**80.56**	**73.39**



Sample preparation	
washed on 425 μ m sieve oven dried at 105 °C	
Liquid limit	63 %
Plastic limit	29 %
Plasticity index	34 %
Liquid limit	80 %
Plastic limit	36 %
Plasticity index	44 %

Operator	Checked	Approved
P.M.	K.B.	S.T.

Liquid Limit *(Casagrande method)* and Plastic Limit

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

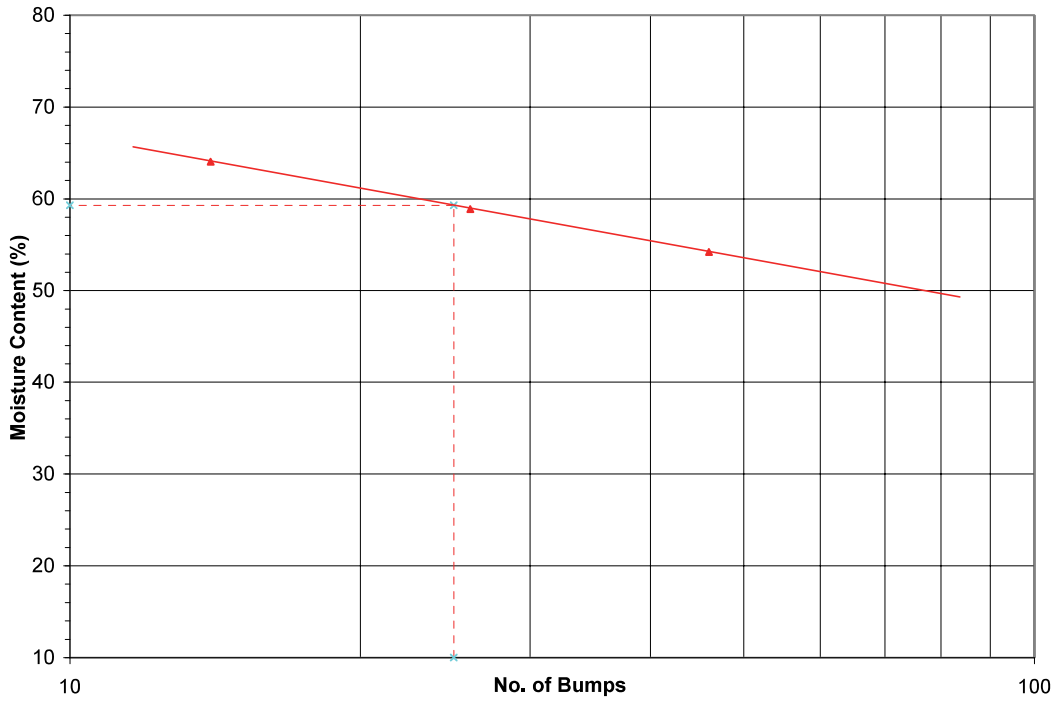
Job No. IDEAL/028/015

BH NO. :	BH-02	Sample Depth(m) :	-9.04 - -9.49	Sample No. :	ID-M-BH-02-S6000	Date :	08-07-2015

Test method : **IS 2720 : Part 5**

PLASTIC LIMIT	Test no.	1	2	Average	1	2	Average
Container no.		A47	A52				
Mass of wet soil + container	g	28.77	30.21				
Mass of dry soil + container	g	26.44	27.93				
Mass of container	g	16.87	19.14				
Mass of moisture	g	2.33	2.28				
Mass of dry soil	g	9.57	8.79				
Moisture Content	%	**24.35**	**25.94**	**25.14**			

LIQUID LIMIT	Test no.	1	2	3	1	2	3
Number of bumps		46	26	14			
Container no.		A11	A36	A4			
Mass of wet soil + container (m_3)	g	33.40	39.19	35.51			
Mass of dry soil + container (m_2)	g	29.79	35.21	30.74			
Mass of container (m_1)	g	23.13	28.45	23.29			
Mass of moisture ($m_3 - m_2$)	g	3.61	3.98	4.77			
Mass of dry soil ($m_2 - m_1$)	g	6.66	6.76	7.45			
Water Content	%	**54.20**	**58.88**	**64.03**			



Sample preparation
washed on 425 μ m sieve oven dried at 105 °C
.

Liquid limit	59	%
Plastic limit	25	%
Plasticity index	34	%
Liquid limit		%
Plastic limit		%
Plasticity index		%

Operator	Checked	Approved
P.M.	K.B.	S.T.

Liquid Limit *(Casagrande method)* and Plastic Limit

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

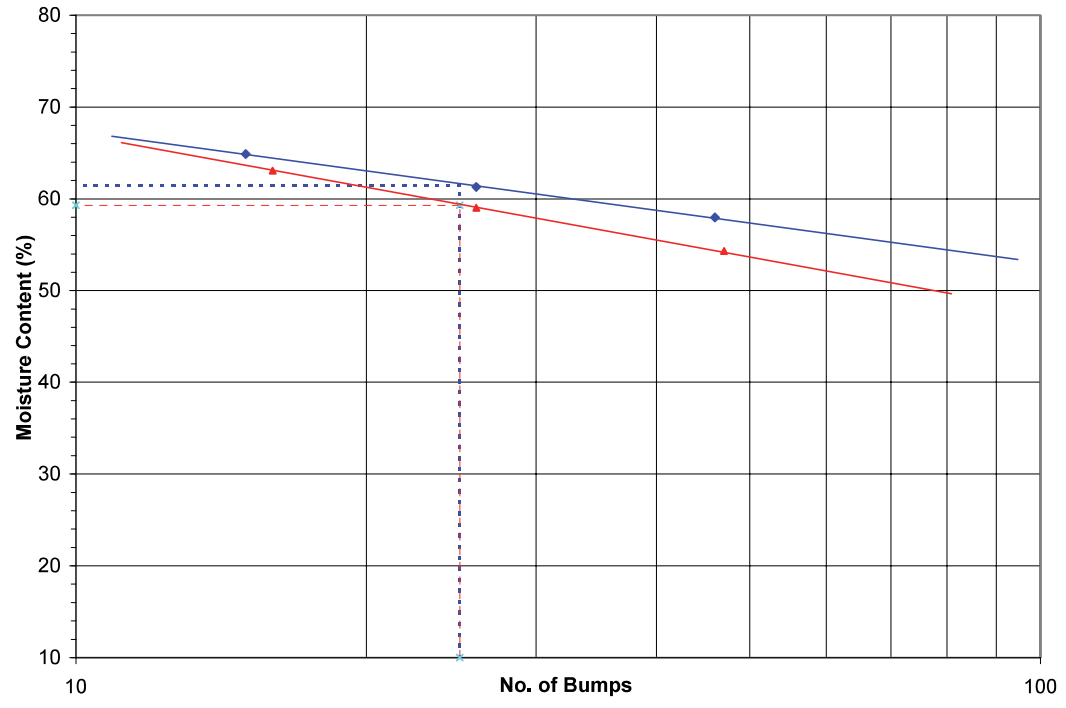
Job No. IDEAL/028/015

BH NO. :	Sample Depth(m) :		Sample No. :		Date :	
BH-02	-10.54 - -10.99		ID-M-BH-02-S7500		08-07-2015	
BH-02	-12.04 - -12.49		ID-M-BH-02-S9000		08-07-2015	

Test method : **IS 2720 : Part 5**

PLASTIC LIMIT	Test no.	1	2	Average	1	2	Average
Container no.		A42	A53		A39	A41	
Mass of wet soil + container	g	34.41	28.88		29.62	29.40	
Mass of dry soil + container	g	31.64	26.35		27.15	26.73	
Mass of container	g	22.23	17.55		18.46	17.55	
Mass of moisture	g	2.77	2.53		2.47	2.67	
Mass of dry soil	g	9.41	8.80		8.69	9.18	
Moisture Content	%	29.44	28.75	29.09	28.42	29.08	28.75

LIQUID LIMIT	Test no.	1	2	3	1	2	3
Number of bumps		26	47	16	15	26	46
Container no.		A5	A27	A19	A51	A61	A45
Mass of wet soil + container (m_3)	g	34.10	37.98	37.17	32.29	30.10	31.70
Mass of dry soil + container (m_2)	g	29.75	33.72	32.34	26.68	25.43	26.61
Mass of container (m_1)	g	22.38	25.88	24.68	18.03	17.81	17.83
Mass of moisture ($m_3 - m_2$)	g	4.35	4.26	4.83	5.61	4.67	5.09
Mass of dry soil ($m_2 - m_1$)	g	7.37	7.84	7.66	8.65	7.62	8.78
Water Content	%	59.02	54.34	63.05	64.86	61.29	57.97



Sample preparation	
washed on 425 μ m sieve oven dried at 105 °C	
Liquid limit	59 %
Plastic limit	29 %
Plasticity index	30 %
Liquid limit	62 %
Plastic limit	29 %
Plasticity index	33 %

Operator	Checked	Approved
P.M.	K.B.	S.T.

Liquid Limit *(Casagrande method)* and Plastic Limit

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

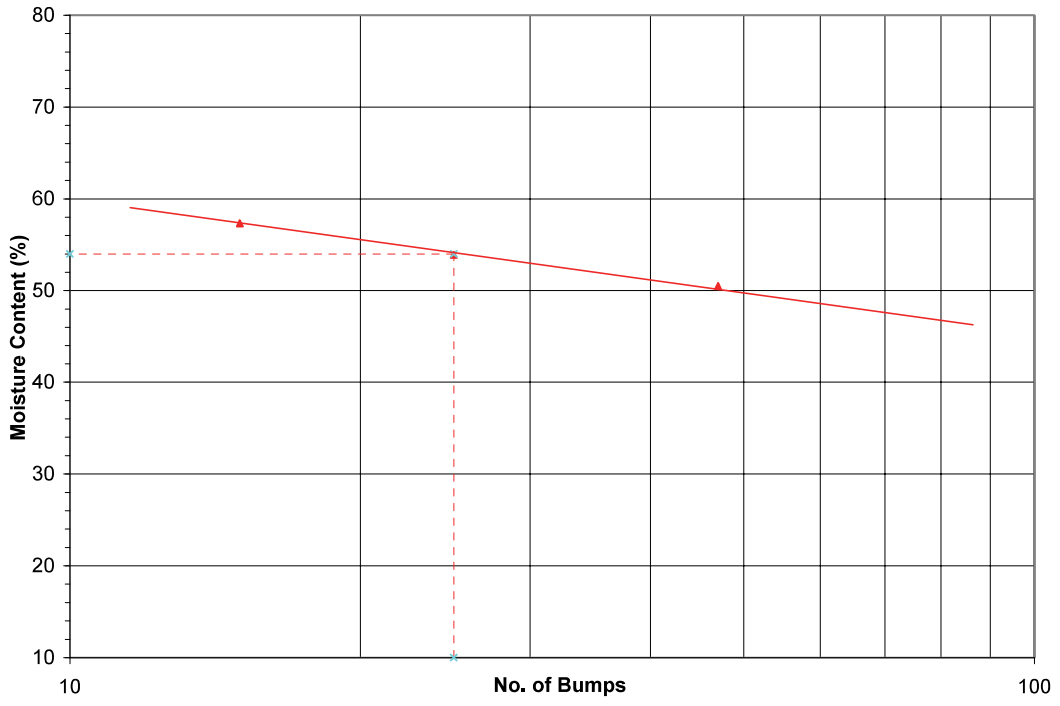
Job No. IDEAL/028/015

BH NO. :	BH-02	Sample Depth(m) :	-13.54 - -13.99	Sample No. :	ID-M-BH-02-S1050	Date :	08-07-2015

Test method : **IS 2720 : Part 5**

PLASTIC LIMIT	Test no.	1	2	Average	1	2	Average
Container no.		A49	A38				
Mass of wet soil + container	g	29.58	29.38				
Mass of dry soil + container	g	27.53	27.29				
Mass of container	g	18.71	18.28				
Mass of moisture	g	2.05	2.09				
Mass of dry soil	g	8.82	9.01				
Moisture Content	%	**23.24**	**23.20**	**23.22**			

LIQUID LIMIT	Test no.	1	2	3	1	2	3
Number of bumps		15	25	47			
Container no.		A7	A30	A28			
Mass of wet soil + container (m_3)	g	34.90	38.87	35.70			
Mass of dry soil + container (m_2)	g	30.20	34.44	32.64			
Mass of container (m_1)	g	22.00	26.22	26.58			
Mass of moisture ($m_3 - m_2$)	g	4.70	4.43	3.06			
Mass of dry soil ($m_2 - m_1$)	g	8.20	8.22	6.06			
Water Content	%	**57.32**	**53.89**	**50.50**			



Sample preparation	
washed on 425 μ m sieve oven dried at	105 °C
Liquid limit	54 %
Plastic limit	23 %
Plasticity index	31 %
Liquid limit	%
Plastic limit	%
Plasticity index	%

Operator	Checked	Approved
P.M.	K.B.	S.T.

Liquid Limit *(Casagrande method)* and Plastic Limit

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

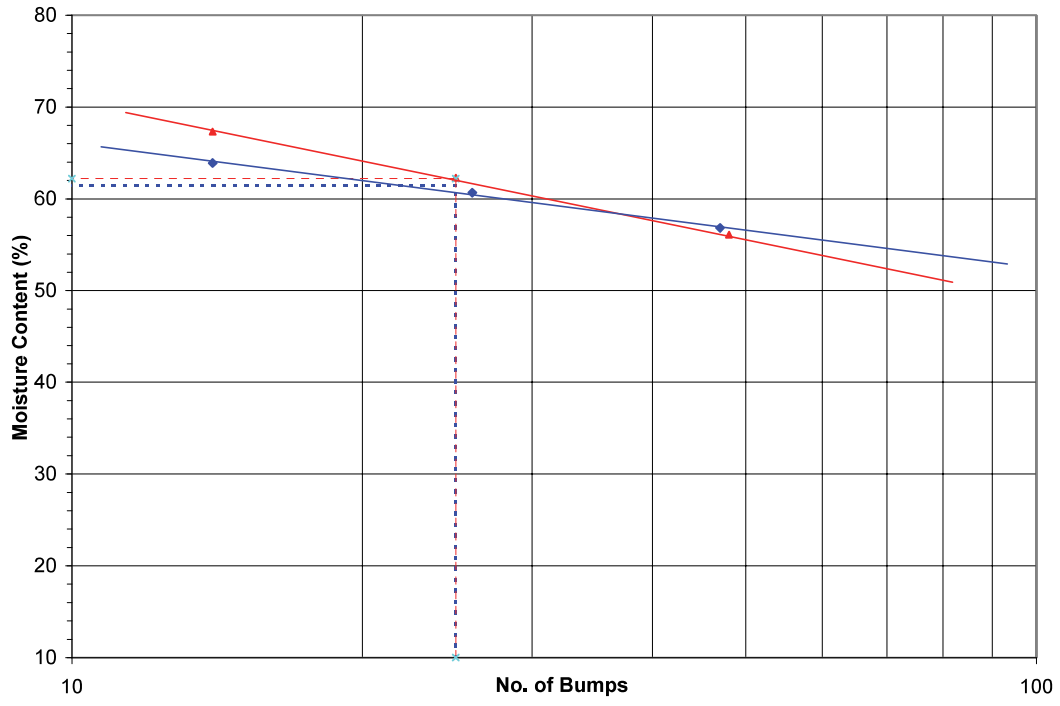
Job No. IDEAL/028/015

BH NO. :	BH-03	Sample Depth(m) :	-2.90 - -3.40	Sample No. :	ID-M-BH-01-S0000	Date :	22-07-2015
	BH-03		-4.40 - -4.85	Sample No. :	ID-M-BH-01-D1500	Date :	22-07-2015

Test method : **IS 2720 : Part 5**

PLASTIC LIMIT	Test no.	1	2	Average	1	2	Average
Container no.		A62	A52		A41	A65	
Mass of wet soil + container	g	27.70	26.90		23.50	23.60	
Mass of dry soil + container	g	25.80	25.30		21.70	21.80	
Mass of container	g	18.57	19.14		17.55	17.53	
Mass of moisture	g	1.90	1.60		1.80	1.80	
Mass of dry soil	g	7.23	6.16		4.15	4.27	
Moisture Content	%	**26.28**	**25.97**	**26.13**	**43.37**	**42.15**	**42.76**

LIQUID LIMIT	Test no.	1	2	3	1	2	3
Number of bumps		14	25	48	14	26	47
Container no.		A11	A27	A9	A35	A14	A24
Mass of wet soil + container (m_3)	g	36.80	35.00	33.50	39.90	31.60	33.20
Mass of dry soil + container (m_2)	g	31.30	31.50	29.40	35.00	27.70	30.00
Mass of container (m_1)	g	23.13	25.88	22.09	27.33	21.27	24.37
Mass of moisture ($m_3 - m_2$)	g	5.50	3.50	4.10	4.90	3.90	3.20
Mass of dry soil ($m_2 - m_1$)	g	8.17	5.62	7.31	7.67	6.43	5.63
Water Content	%	**67.32**	**62.28**	**56.09**	**63.89**	**60.65**	**56.84**



Sample preparation	
washed on 425 μ m sieve oven dried at 105 °C	
Liquid limit	62 %
Plastic limit	26 %
Plasticity index	36 %
Liquid limit	62 %
Plastic limit	43 %
Plasticity index	19 %

Operator	Checked	Approved
P.M.	K.B.	S.T.

Liquid Limit *(Casagrande method)* and Plastic Limit

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

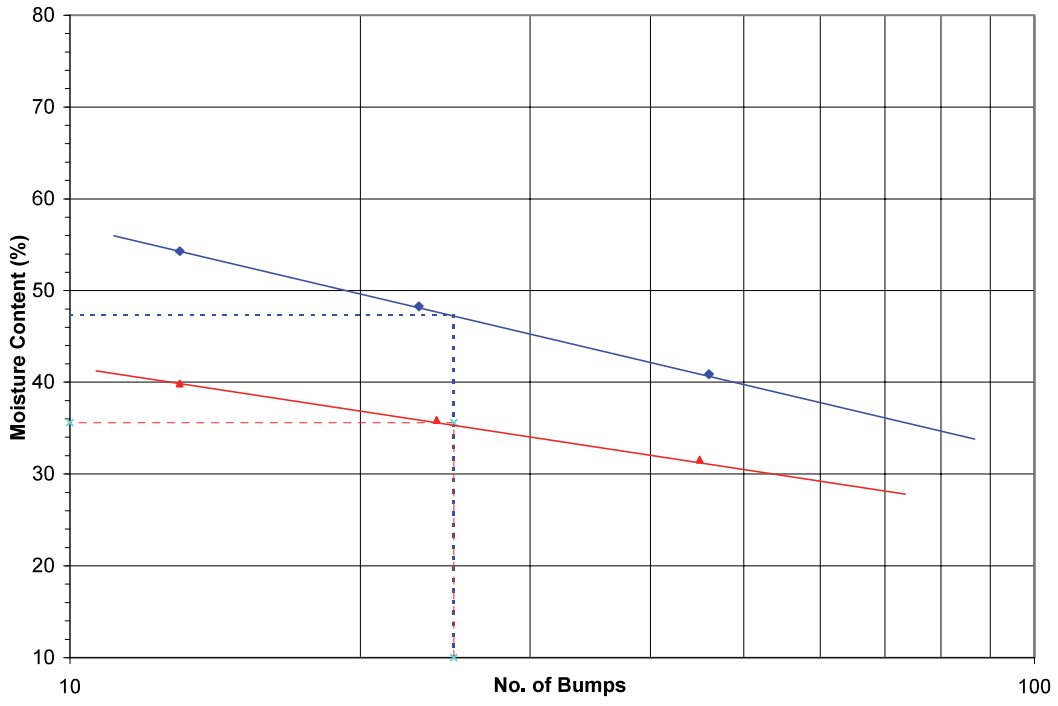
Job No. IDEAL/028/015

BH NO. :		Sample Depth(m) :			Sample No. :		Date :	
	BH-04		-5.60 - -6.10		Sample No. :	ID-M-BH-04-D0000	Date :	02-07-2015
	BH-04		-7.10 - -7.55		Sample No. :	ID-M-BH-04-S1500	Date :	02-07-2015

Test method : **IS 2720 : Part 5**

PLASTIC LIMIT	Test no.	1	2	Average	1	2	Average
Container no.		A37	A60		A56	A50	
Mass of wet soil + container	g	27.00	27.00		29.44	26.57	
Mass of dry soil + container	g	25.03	25.01		27.31	24.51	
Mass of container	g	16.72	16.78		19.07	16.60	
Mass of moisture	g	1.97	1.99		2.13	2.06	
Mass of dry soil	g	8.31	8.23		8.24	7.91	
Moisture Content	%	23.71	24.18	23.94	25.85	26.04	25.95

LIQUID LIMIT	Test no.	1	2	3	1	2	3
Number of bumps		45	24	13	46	23	13
Container no.		A55	A61	A48	A65	A45	A41
Mass of wet soil + container (m_3)	g	27.90	25.46	32.47	24.18	26.49	27.10
Mass of dry soil + container (m_2)	g	25.76	23.44	28.26	22.25	23.67	23.74
Mass of container (m_1)	g	18.98	17.81	17.70	17.53	17.83	17.55
Mass of moisture ($m_3 - m_2$)	g	2.14	2.02	4.21	1.93	2.82	3.36
Mass of dry soil ($m_2 - m_1$)	g	6.78	5.63	10.56	4.72	5.84	6.19
Water Content	%	31.56	35.88	39.87	40.89	48.29	54.28



Sample preparation		
washed on 425 μ m sieve oven dried at	105 °C	
Liquid limit	36	%
Plastic limit	24	%
Plasticity index	12	%
Liquid limit	47	%
Plastic limit	26	%
Plasticity index	21	%

Operator	Checked	Approved
P.M.	K.B.	S.T.

Liquid Limit *(Casagrande method)* and Plastic Limit

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

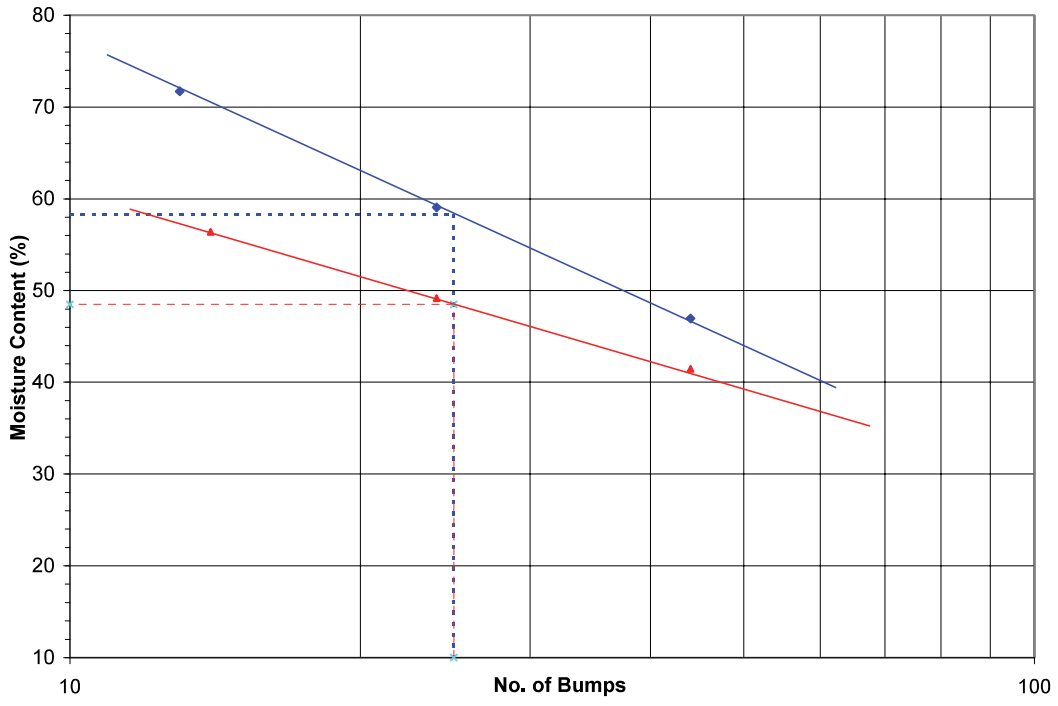
Job No. IDEAL/028/015

BH NO. :		Sample Depth(m) :					
	BH-04		-10.10 - -10.55	Sample No. :	ID-M-BH-04-S4500	Date :	02-07-2015
	BH-04		-11.60 - -12.05	Sample No. :	ID-M-BH-04-S6000	Date :	02-07-2015

Test method : **IS 2720 : Part 5**

PLASTIC LIMIT	Test no.	1	2	Average	1	2	Average
Container no.		A42	A53		A38	A47	
Mass of wet soil + container	g	32.60	26.93		27.77	25.61	
Mass of dry soil + container	g	30.38	24.91		25.72	23.75	
Mass of container	g	22.23	17.55		18.28	16.87	
Mass of moisture	g	2.22	2.02		2.05	1.86	
Mass of dry soil	g	8.15	7.36		7.44	6.88	
Moisture Content	%	**27.24**	**27.45**	**27.34**	**27.55**	**27.03**	**27.29**

LIQUID LIMIT	Test no.	1	2	3	1	2	3
Number of bumps		44	24	14	24	44	13
Container no.		A28	A15	A27	A26	A7	A34
Mass of wet soil + container (m_3)	g	34.80	34.42	38.14	35.22	30.20	35.93
Mass of dry soil + container (m_2)	g	32.39	31.06	33.72	31.76	27.58	32.03
Mass of container (m_1)	g	26.58	24.23	25.88	25.90	22.00	26.59
Mass of moisture ($m_3 - m_2$)	g	2.41	3.36	4.42	3.46	2.62	3.90
Mass of dry soil ($m_2 - m_1$)	g	5.81	6.83	7.84	5.86	5.58	5.44
Water Content	%	**41.48**	**49.19**	**56.38**	**59.04**	**46.95**	**71.69**



Sample preparation	
washed on 425 μ m sieve oven dried at	105 °C
Liquid limit	49 %
Plastic limit	27 %
Plasticity index	22 %
Liquid limit	58 %
Plastic limit	27 %
Plasticity index	31 %

Operator	Checked	Approved
P.M.	K.B.	S.T.

Liquid Limit *(Casagrande method)* and Plastic Limit

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

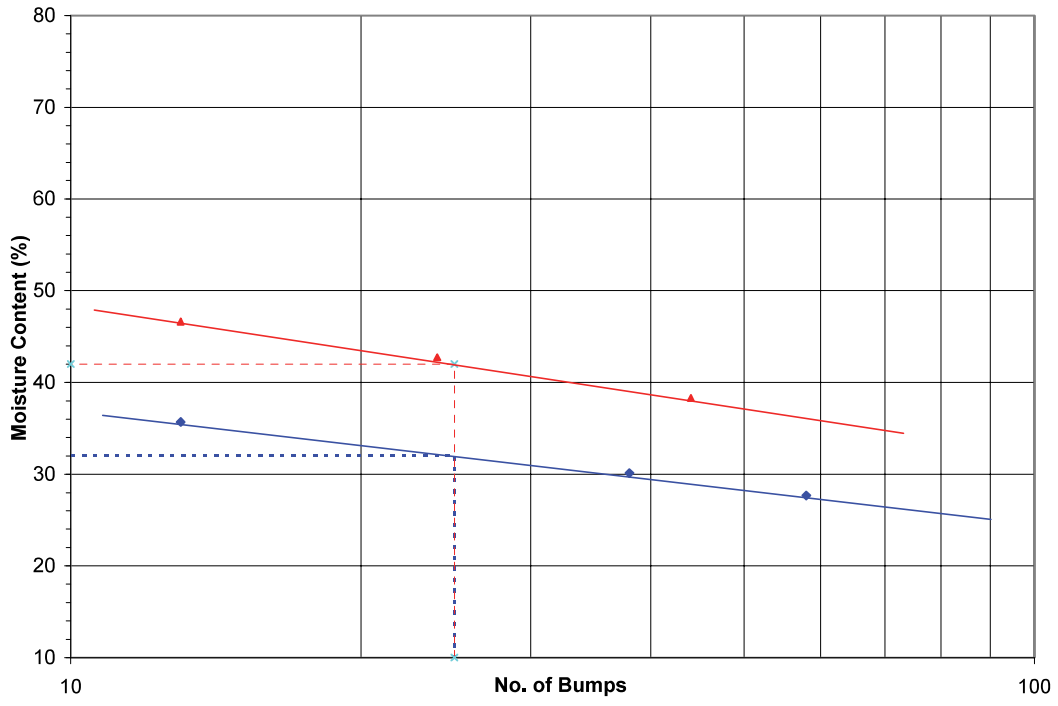
Job No. IDEAL/028/015

BH NO. :	Sample Depth(m) :		Sample No. :		Date :	
BH-05	-3.10 - -3.60		ID-M-BH-05-D0000		02-07-2015	
BH-05	-12.10 - -12.55		ID-M-BH-05-S9000		02-07-2015	

Test method : **IS 2720 : Part 5**

PLASTIC LIMIT	Test no.	1	2	Average	1	2	Average
Container no.		A39	A51		A59	A52	
Mass of wet soil + container	g	27.32	27.25		34.12	29.93	
Mass of dry soil + container	g	25.69	25.57		32.05	28.12	
Mass of container	g	18.46	18.03		21.93	19.14	
Mass of moisture	g	1.63	1.68		2.07	1.81	
Mass of dry soil	g	7.23	7.54		10.12	8.98	
Moisture Content	%	**22.54**	**22.28**	**22.41**	**20.45**	**20.16**	**20.31**

LIQUID LIMIT	Test no.	1	2	3	1	2	3
Number of bumps		13	24	44	13	38	58
Container no.		A16	A20	A9	A11	A19	A40
Mass of wet soil + container (m_3)	g	37.11	35.10	31.40	34.50	38.03	34.50
Mass of dry soil + container (m_2)	g	32.66	32.08	28.82	31.51	34.94	31.00
Mass of container (m_1)	g	23.12	25.01	22.09	23.13	24.68	18.36
Mass of moisture ($m_3 - m_2$)	g	4.45	3.02	2.58	2.99	3.09	3.50
Mass of dry soil ($m_2 - m_1$)	g	9.54	7.07	6.73	8.38	10.26	12.64
Water Content	%	**46.65**	**42.72**	**38.34**	**35.68**	**30.12**	**27.69**



Sample preparation	
washed on 425 μ m sieve oven dried at	105 °C
Liquid limit	42 %
Plastic limit	22 %
Plasticity index	20 %
Liquid limit	32 %
Plastic limit	20 %
Plasticity index	12 %

Operator	Checked	Approved
P.M.	K.B.	S.T.

Liquid Limit *(Casagrande method)* and Plastic Limit

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

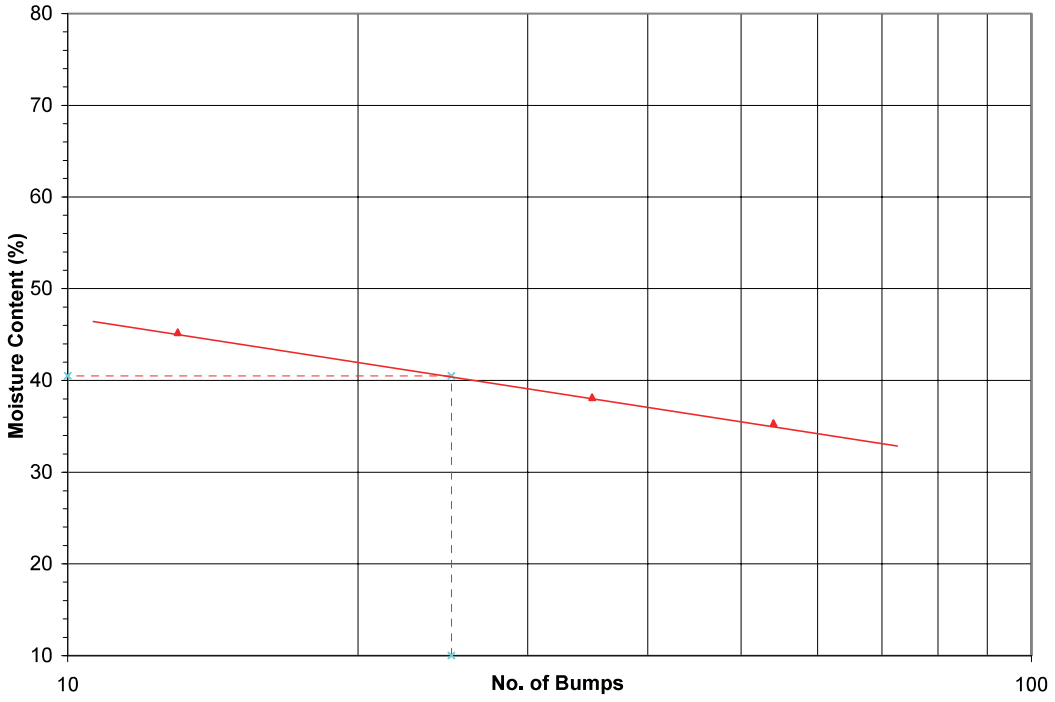
Job No. IDEAL/028/015

BH NO. :	BH-05	Sample Depth(m) :	-13.60 - -14.05	Sample No. :	ID-M-BH-05-D1050	Date :	26-06-2015

Test method : **IS 2720 : Part 5**

PLASTIC LIMIT	Test no.	1	2	Average	1	2	Average
Container no.		A44	A46				
Mass of wet soil + container	g	29.23	29.00				
Mass of dry soil + container	g	27.45	27.07				
Mass of container	g	19.44	18.37				
Mass of moisture	g	1.78	1.93				
Mass of dry soil	g	8.01	8.70				
Moisture Content	%	22.22	22.18	22.20			

LIQUID LIMIT	Test no.	1	2	3	1	2	3
Number of bumps		13	35	54			
Container no.		A6	A17	A9			
Mass of wet soil + container (m_3)	g	30.80	34.04	31.20			
Mass of dry soil + container (m_2)	g	27.89	31.07	28.82			
Mass of container (m_1)	g	21.46	23.29	22.09			
Mass of moisture ($m_3 - m_2$)	g	2.91	2.97	2.38			
Mass of dry soil ($m_2 - m_1$)	g	6.43	7.78	6.73			
Water Content	%	45.26	38.17	35.36			



Sample preparation	
washed on 425 μ m sieve oven dried at	105 °C
Liquid limit	41 %
Plastic limit	22 %
Plasticity index	19 %
Liquid limit	%
Plastic limit	%
Plasticity index	%

Operator	Checked	Approved
P.M.	K.B.	S.T.

Liquid Limit *(Casagrande method)* and Plastic Limit

Project : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

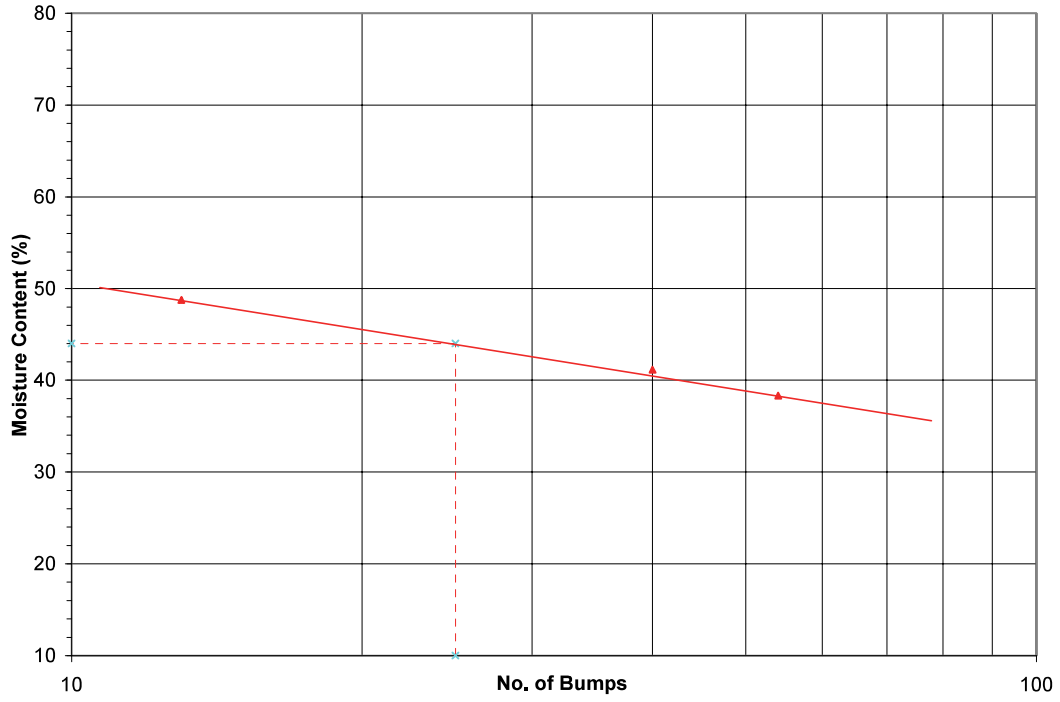
Job No. IDEAL/028/015

BH NO. :	BH-06	Sample Depth(m) :	-2.91 - -3.36	Sample No. :	ID-M-BH-06-D0000	Date :	26-06-2015

Test method : **IS 2720 : Part 5**

PLASTIC LIMIT	Test no.	1	2	Average	1	2	Average
Container no.		A49	A62				
Mass of wet soil + container	g	29.90	30.34				
Mass of dry soil + container	g	27.49	27.80				
Mass of container	g	18.71	18.57				
Mass of moisture	g	2.41	2.54				
Mass of dry soil	g	8.78	9.23				
Moisture Content	%	27.45	27.52	27.48			

LIQUID LIMIT	Test no.	1	2	3	1	2	3
Number of bumps		13	40	54			
Container no.		A29	A5	A9			
Mass of wet soil + container (m_3)	g	38.70	36.20	31.40			
Mass of dry soil + container (m_2)	g	34.58	32.17	28.82			
Mass of container (m_1)	g	26.13	22.38	22.09			
Mass of moisture ($m_3 - m_2$)	g	4.12	4.03	2.58			
Mass of dry soil ($m_2 - m_1$)	g	8.45	9.79	6.73			
Water Content	%	48.76	41.16	38.34			



Sample preparation	
washed on 425 μ m sieve oven dried at 105 °C	
Liquid limit	44 %
Plastic limit	27 %
Plasticity index	17 %
Liquid limit	%
Plastic limit	%
Plasticity index	%

Operator	Checked	Approved
P.M.	K.B.	S.T.

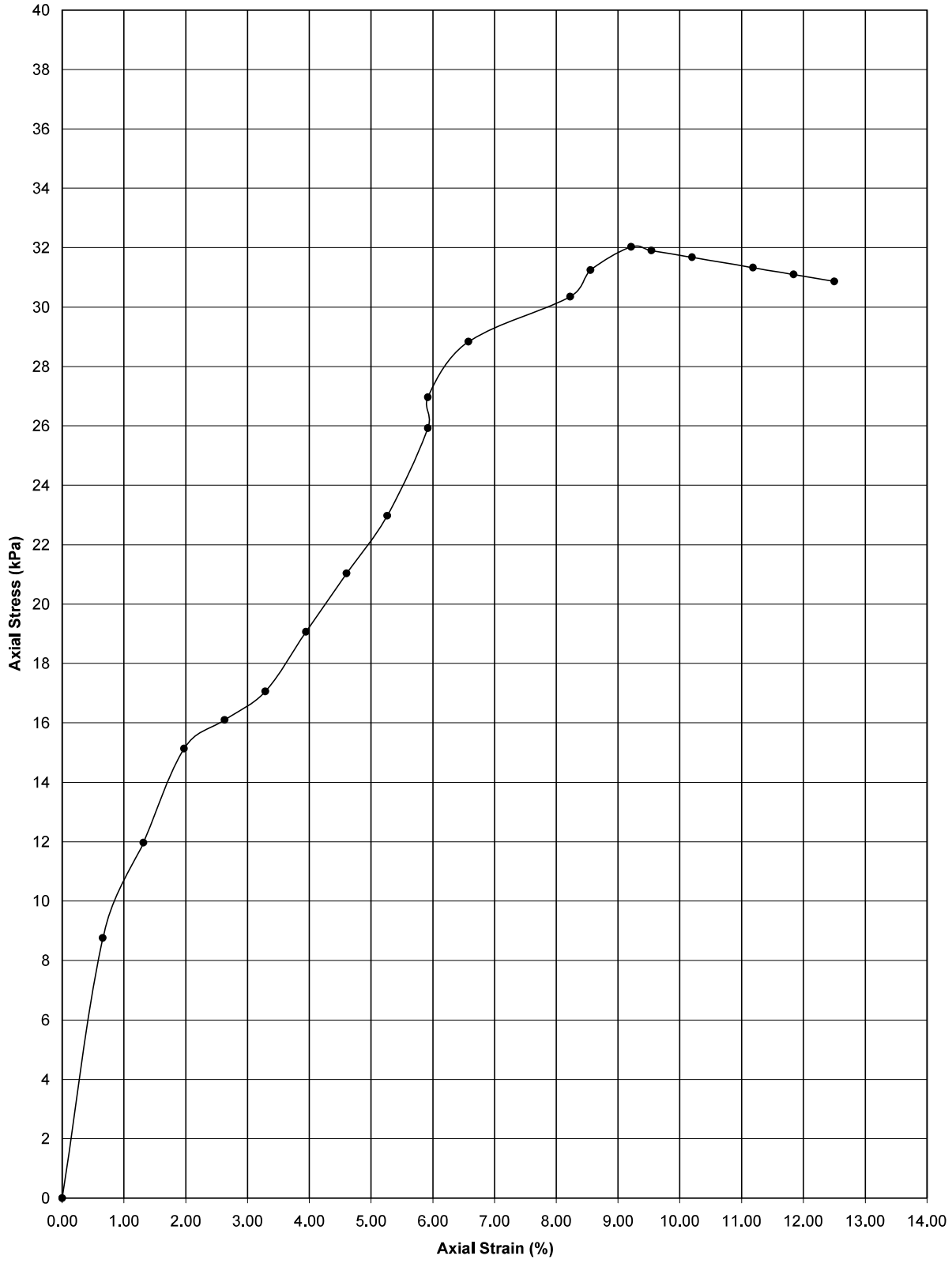
APPENDIX-D - STRENGTH TEST RESULTS

PROJECT : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

Job No.: IDEAL/028/015

Unconfined Compression Test

Borehole:	BH-1	Sample Diameter (mm):	38	Bulk Density(g/cm^3)	1.60	q_u :	32.0 kPa
Depth (m):	-6.32 - -6.77	Sample Height (mm):	76	Dry Density (g/cm^3)	0.96	c_u:	16.0 kPa



qu = Unconfined Compressive Strength
cu = Undrained Cohesion

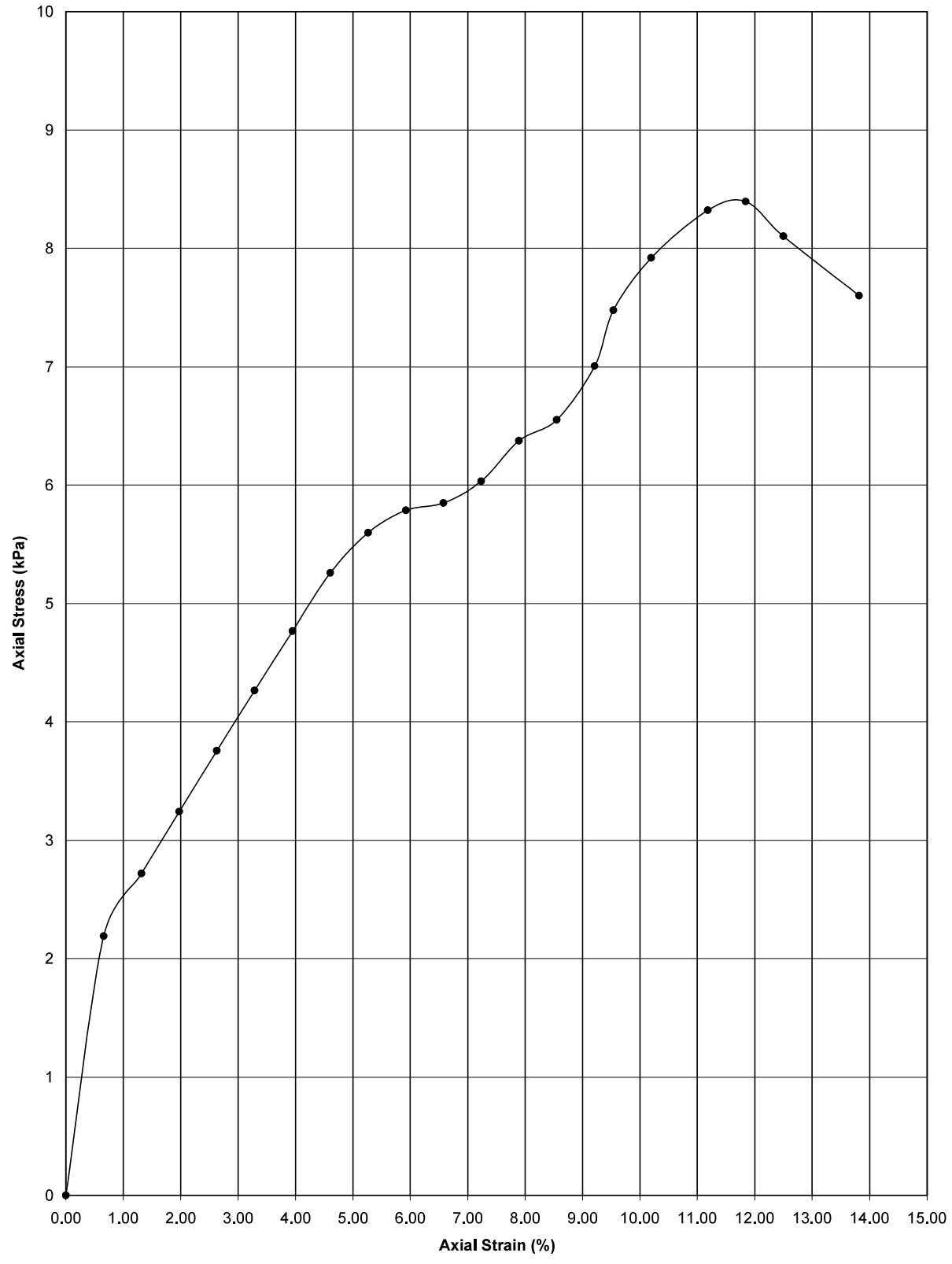
Plate-D1

PROJECT : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

Job No.: IDEAL/028/015

Unconfined Compression Test

Borehole:	BH-2	Sample Diameter (mm): 38	Bulk Density(g/cm^3) 1.60	q_u : 8.0	kPa
Depth (m):	-7.54 - -7.99	Sample Height (mm): 76	Dry Density (g/cm^3) 0.72	c_u: 4.0	kPa



qu = Unconfined Compressive Strength
cu = Undrained Cohesion

Plate-D2

APPENDIX-E - COMPRESSIBILITY TEST RESULTS

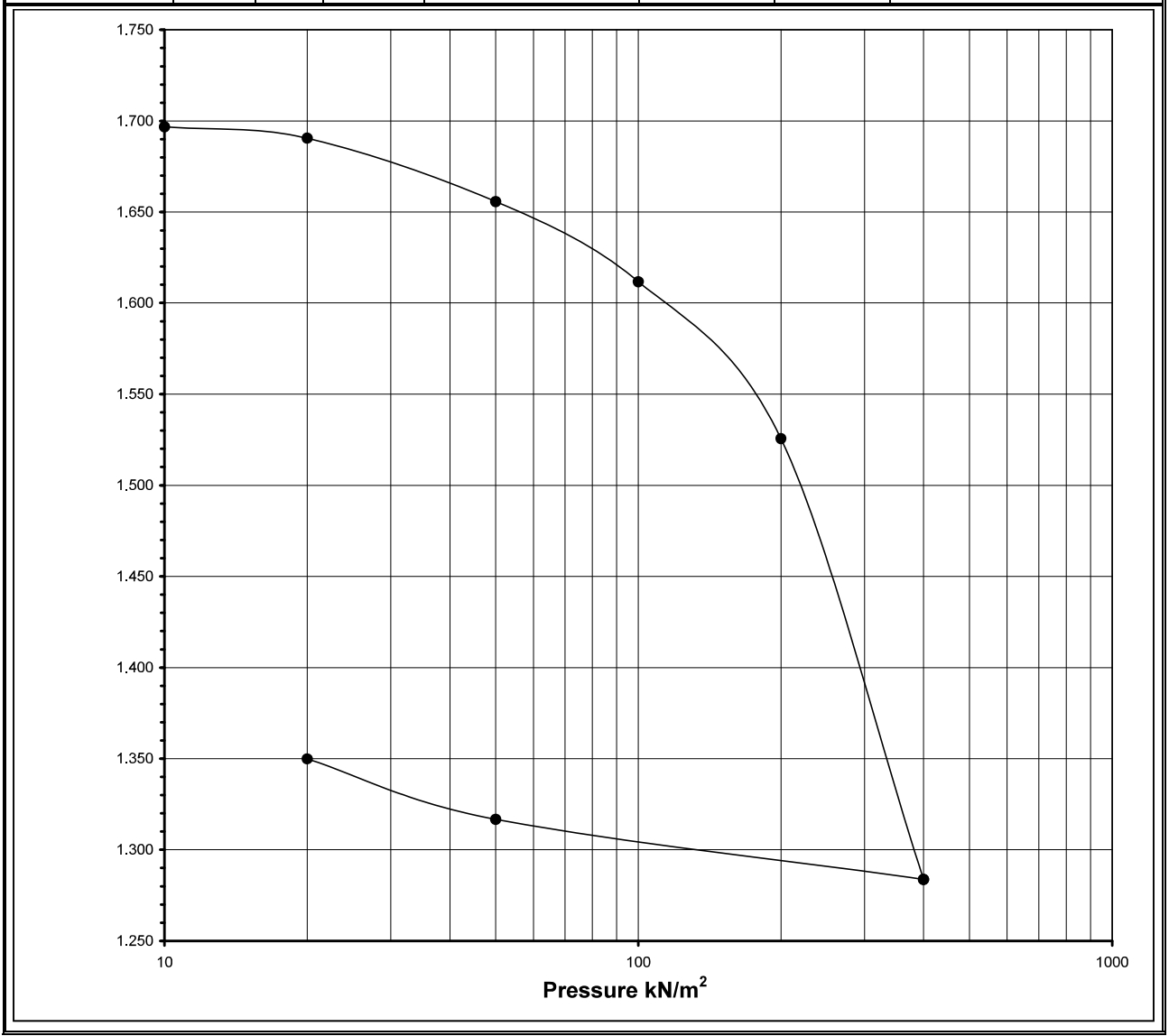
CONSOLIDATION TEST RESULTS

Project:Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

Job No.: IDEAL/028/015

BH-No	: BH-01	Diameter of Specimen(cm)	6		
Depth (m)	: -6.32 - -6.77	Area of Specimen,A (cm^2)	27.94	σ_c	: 130 KN/m²
Wt. of Dry Soil (gm)	53.40	Specific Gravity of Sample	: 2.58	C_C	: 0.619
Dial Gauge L.C.,mm	0.002mm	Initial Height of Sample (H_o)	: 20.0	e_0	: 1.699
		Height of Solids (H_s)	: 7.41		

Applied Pressure σ (kN/m^2)	Final Dial Reading	Dial Change	Dial Change ΔH(mm)	Specimen Height ($H=H_1+\Delta H$) (mm)	Height of voids= $H-H_s$(mm)	Void Ratio $e=(H-H_s)/H_s$	Coefficient of Volume Change $M_v=(\Delta e/1+e_o)/\Delta\sigma(m^2/kN)$
0	3500	-10	-0.02	20.000	12.59	1.699	
10	3490	-23	-0.05	19.980	12.57	1.697	1.0000E-04
20	3467	-129	-0.26	19.934	12.53	1.691	2.3023E-04
50	3338	-163	-0.33	19.676	12.27	1.656	4.3142E-04
100	3175	-319	-0.64	19.350	11.94	1.612	3.3137E-04
200	2856	-896	-1.79	18.712	11.30	1.526	3.2972E-04
400	1960	122	0.24	16.920	9.51	1.284	4.7884E-04
50	2082	123	0.25	17.164	9.76	1.317	4.1202E-05
20	2205	-185	-0.37	17.410	10.00	1.350	4.7774E-04
0	2020						



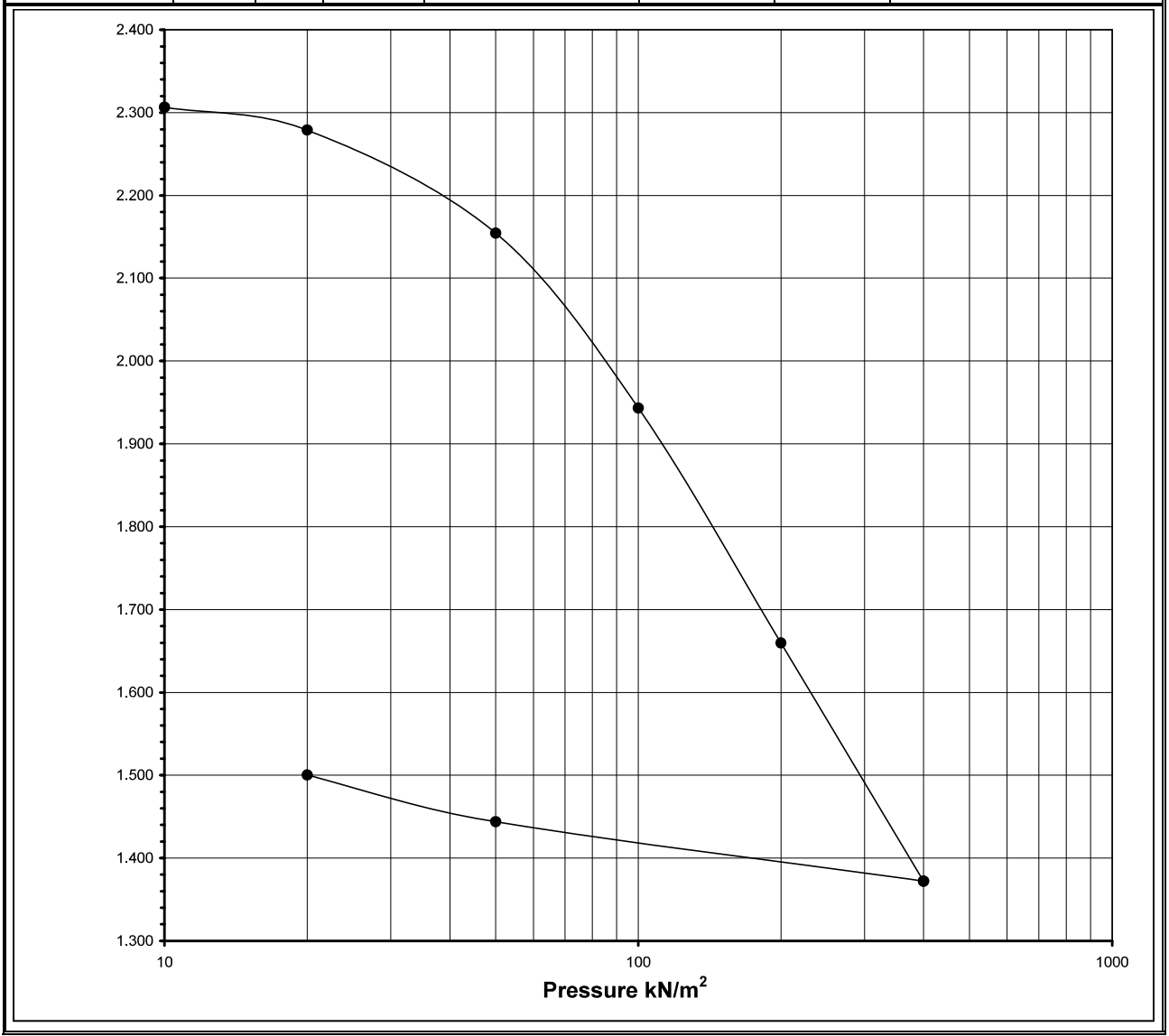
CONSOLIDATION TEST RESULTS

Project:Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

Job No.: IDEAL/028/015

BH-No	: BH-02	Diameter of Specimen(cm)	6		
Depth (m)	: -7.54 - -7.99	Area of Specimen,A (cm^2)	27.94	σ_c	: 46 KN/m²
Wt. of Dry Soil (gm)	42.90	Specific Gravity of Sample	: 2.54	C_C	: 0.851
Dial Gauge L.C.,mm	0.002mm	Initial Height of Sample (H_o)	: 20.0	e_0	: 2.308
		Height of Solids (H_s)	: 6.05		

Applied Pressure σ (kN/m^2)	Final Dial Reading	Dial Change	Dial Change ΔH(mm)	Specimen Height ($H=H_1+\Delta H$) (mm)	Height of voids= $H-H_s$(mm)	Void Ratio $e=(H-H_s)/H_s$	Coefficient of Volume Change $M_v=(\Delta e/1+e_o)/\Delta\sigma(m^2/kN)$
0	3500	-5	-0.01	20.000	13.95	2.308	
10	3495	-83	-0.17	19.990	13.94	2.306	5.0000E-05
20	3412	-376	-0.75	19.824	13.78	2.279	8.3042E-04
50	3036	-639	-1.28	19.072	13.03	2.155	1.2645E-03
100	2397	-857	-1.71	17.794	11.75	1.943	1.3402E-03
200	1540	-869	-1.74	16.080	10.03	1.660	9.6325E-04
400	671	217	0.43	14.342	8.30	1.372	5.4042E-04
50	888	170	0.34	14.776	8.73	1.444	8.6459E-05
20	1058	146	0.29	15.116	9.07	1.500	7.6701E-04
0	1204						



APPENDIX-F - CORE BOX PHOTOGRAPHS

PROJECT : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

Job No. : IDEAL/028/015

CLIENT

ORIENTAL CONSULTANTS
Global Consulting for Sustainable Development

BOREHOLE NO. : BH-01

Depth (m) : -19.82 - -27.32 Core Box 01 of 02

BOREHOLE NO. : BH-01

Depth (m) : -27.32 - -28.82 Core Box 02 of 02

PROJECT : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

Job No. : IDEAL/028/015

CLIENT

ORIENTAL CONSULTANTS
Global Consulting for Sustainable Development

BOREHOLE NO. : BH-02

Depth (m) : -24.04 - -28.54 Core Box 01 of 01

PROJECT : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

Job No. : IDEAL/028/015

CLIENT

ORIENTAL CONSULTANTS
Global Consulting for Sustainable Development

BOREHOLE NO. : BH-03

Depth (m) : -7.40 - -22.40 Core Box 01 of 03

BOREHOLE NO. : BH-03

Depth (m) : -23.90 - -26.90 Core Box 02 of 03

PROJECT : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

Job No. : IDEAL/028/015

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BOREHOLE NO. : BH-03

Depth (m) : -26.90 - -28.40 Core Box 03 of 03

PROJECT : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

Job No. : IDEAL/028/015

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Global Consulting for Sustainable Development

BOREHOLE NO. : BH-04

Depth (m) : -16.10 - -25.60 Core Box 01 of 02

BOREHOLE NO. : BH-04

Depth (m) : -25.60 - -31.80 Core Box 02 of 02

PROJECT : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

Job No. : IDEAL/028/015

CLIENT

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Global Consulting for Sustainable Development

BOREHOLE NO. : BH-05

Depth (m) : -16.60 - -22.60 Core Box 01 of 02

BOREHOLE NO. : BH-05

Depth (m) : -22.60 - -25.30 Core Box 02 of 02

PROJECT : Geological Survey for the Preparatory Survey on the Project for Construction of Mumbai Trans Harbour Link

Job No. : IDEAL/028/015

CLIENT

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BOREHOLE NO. : BH-06

Depth (m) : -7.41 - -17.91 Core Box 01 of 02

BOREHOLE NO. : BH-06

Depth (m) : -17.91 - - 22.11 Core Box 02 of 02