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GEOTECHNICAL SITE INVESTIGATION

BORING 1 THROUGH 27

PROPOSED RESIDENTIAL APARTMENTS AND VILLA BUILDINGS SITE

S. NO. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4

VENGAIVASAL VILLAGE, TAMBARAM TALUK

KANCHEEPURAM DISTRICT, TN.

Report to

M/s. Emerald Haven Realty Ltd.
1st Floor Greenways Towers
No. 119, St. Mary's Road
Abhiramapuram, Chennai 600 018, TN.

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821 (Old No. 439/4) Poonamallee High Road, Arumbakkam, Chennai 600 106.
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Report No. 204/GI/18-19.
December 12, 2018.

M/s. Emerald Haven Realty Ltd.
1st Floor Greenways Towers
No. 119, St. Mary's Road
Abhiramapuram, Chennai 600 018, TN.

Geotechnical Site Investigation
Boring 1 through 27
Proposed Residential Apartment and Villa Buildings Site
S. No. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4
Vengaivasal Village, Tambaram Taluk
Kancheepuram District, TN.

The Prasad Armstrong Yen GEC (P) Ltd., Chennai is pleased to submit this report on our geotechnical site investigation conducted at the above location. This work was authorized by your Work Order No. WO/002/EHR/VGVL dated November 10, 2018.

Estimated capacities of the foundations recommended for the proposed buildings are presented here in final form together with a summary of laboratory and field data.

We appreciate the opportunity to be of service to you on this project. Please call us if you have any questions or when we can be of further assistance.

Sincerely,

PRASAD ARMSTRONG YEN GEC (P) Ltd.

B. Ram Prasad ME, PhD (Texas A&M)
Managing Director

(204brpt)
Copies Submitted: (3)

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SUMMARY

Prasad Armstrong Yen GEC (P) Ltd. performed a geotechnical site investigation at the Proposed Residential Apartment and Villa Buildings Site, S. No. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4, Vengaivasal Village, Tambaram Taluk, Kancheepuram District, TN. The primary purpose of this investigation was to obtain data to develop foundation design recommendations for the proposed villa buildings and Stilt + 7 floors apartment buildings. This investigation was performed to identify variability in soil stratification of the site, and select suitable foundation, and estimate load carrying capacities of the considered foundation. For the proposed buildings typical maximum column load will be about 150 tons. These details were used only for estimating the preliminary foundation size and type of foundation.

The field investigation was performed November 28 through December 7, 2018. Number and location of borings were selected to cover the proposed buildings area as per the layout plan provided by the client. Boring 1 through 27 were drilled between 5- to 8-M penetration below the Existing Ground Level (EGL). Drilling of the borings was terminated after encountering hard stratum with SPT "N" $\geq$ 75 in at least three successive tests below the expected foundation level or on high core recovery at termination depth. NX TC bit and Diamond bit core barrels were used for drilling through the rocky formation. In most of the borings rock core pieces were recovered at bore termination depth. Tests were conducted to determine the pertinent index and engineering properties of the soils and rock encountered. We then performed engineering analyses to develop the required design data.

Natural topography of the site reflects a relatively flat terrain. Visual observation infers that EGL of the site was about 0.5- to 1.2-M below the Existing Road Level (ERL) of road near the site. A few trees and many bushes and shrubs were present in the site. Fencing stones, boundary stones were present along various parts of the site boundaries. Proposed construction will be the first major construction activity to cover this site. Soil stratigraphy at the borings is tabulated below:

Typical Site Soil Profile:

Stratum	Penetration, M From	To	Description
I	0	1.0-2.0	Silty Fine to Coarse Sand / Stiff Clay
II	1.0-2.0	5.0-8.0+	Weathered Rock / Hard Granite

Data from borings indicate presence of weathered rock with high SPT "N" values from shallow depth. **For the proposed villa and apartments buildings** it was **recommended** to provide **Isolated Column Footing** foundation at 2-M below EGL with at least 1-M thick site filling above EGL. The footing should have at least 3-M of **embedment around the footings**. A minimum footing width of 1.5-M was considered in analysis. For the considered foundation the **estimated ultimate and recommended allowable capacities were 89 and 25 tons/M^2**, respectively. Estimated total settlement was about 6 mm, less than 60 mm, the IS: 1904 - 2006 code limiting settlement for isolated column footings of framed structures with panel walls on granular soil. All the footings should be interconnected in both directions. It was also recommended to provide continuous lintels in each floor

for better resistance to seismic forces and differential settlements. **In case of footings on or near the filled open wells or locations with loose soils at 2-M level then the loose soils upto lower level hard layer should be replaced with well compacted lean concrete. Also footings around these wells should be made into "Combined Footings" with a maximum bearing pressure limited to 15 tons/M^2**. Pile foundation for these filled up open well areas was not recommended as the installation of piles into these hard rocky formation will be very difficult.

Groundwater was present in the borings at highly variable depths from 1-M below EGL to completely dry borings. This is very likely due to recent rains and presence of rocky formation at variable depth in the site. An 8.25-M diameter and unknown depth open well of was present in the site at about 27.7-M from Boring 7 with groundwater at 2.1-M below EGL. Groundwater sample was collected from this open well for construction suitability test as per IS: 456 - 2000 guidelines. Test results inferred that groundwater from the open well was **suitable** for construction purposes. Groundwater from the site should be checked at regular intervals from the beginning and during construction period to confirm groundwater's construction suitability.

We do not expect construction problems at this site due to soil and groundwater conditions in non rainy seasons. Site's EGL was at about 0.5- to 1.2-M below ERL of road near the site. In order to minimize future site and building flooding from road it was recommended to raise FGL of the site by **at least 0.6-M above ERL** of roads in front of the site. The Finished Floor Level (FFL) of **stilt floor** should be 0.2-M above FGL of the site. This will minimize rainwater runoff flooding into the site and building.

Backfilling of the foundation excavations should be done with granular soil, and fill should be compacted properly to achieve proper densification to avoid settlements in flooring. Exposed bottom surface of the foundation excavation must be properly compacted with heavy duty rammer or heavy roller to compact the exposed surface that gets loosened by mechanical excavation activities. This is to minimize the settlements that can arise if the loosened soil in foundation excavation is not removed or compacted. New foundations should rest on virgin soil and not on old foundations or filled up soils.

At some boring locations (Boring 2 and 12) soils were in loose state with SPT "N" $\leq$ 7 even at 2-M inferring possible filled-up shallow pits. Since the site is a large open land, there may some filled-up large diameter open wells or rainwater collection ponds. Therefore, during construction care must be taken to inspect and confirm that the soil foundation level was **dense to very dense weathered rock** and not loose material easy to excavate with back-hoe. In case of columns located at site open wells or pits or ditches or any other filled up pockets that may be encountered should be filled with well compacted lean concrete (PCC) after removal of loose material present inside these areas completely. Excavated sandy soil and weathered rock can be used for back filling and site filling purposes.

All structures have to be designed for higher seismic forces (**Zone III**) due to increased seismic activity in peninsular India in the last decade and half. Seismic events of 7.9 magnitude on April 25, 2015, 6.0 magnitude on May 21, 2014, 8.4 magnitude on April 11, 2012, 7.2 magnitude on June 13, 2010, and 7.6 magnitude on August 11, 2009 with epicenters in Himalayas, Bay of Bengal, and near Andaman Islands were felt at Chennai. It is recommended to provide rigid plinth beams in ground level, shear walls in the structure, and continuous lintels in each floor. Lintels must be integrated into

columns of the structure. Plinth beams must be designed to be rigid to allow redistribution of loads in case of differential settlements. The site soil profile infers **"No"** seismic susceptibility. Under a seismic event of **6.5 Richter scale**, and peak ground acceleration of **0.08g** the total estimated vertical settlement was 0 cms and total horizontal displacement was about 0 cms. Iwasaki liquefaction potential was 0.0 inferring "**No Liquefaction**." As per IS code for **Zone III** design horizontal acceleration was **0.08g**.

INTRODUCTION

Purpose and Scope

Prasad Armstrong Yen GEC (P) Ltd. performed a geotechnical site investigation at the Proposed Residential Apartment and Villa Buildings Site, S. No. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4, Vengaivasal Village, Tambaram Taluk, Kancheepuram District, TN. The primary purpose of this investigation was to obtain data to develop foundation design recommendations for the proposed villa buildings and Stilt + 7 floors apartment buildings. This investigation was performed to identify variability in soil stratification of the site, and select suitable foundation, and estimate load carrying capacities of the considered foundation. For the proposed buildings typical maximum column load will be about 150 tons. These details were used only for estimating the preliminary foundation size and type of foundation. To accomplish these purposes, the following tasks were performed:

(1) Boring 1 through 27 were drilled 5- to 8-M to explore subsurface stratigraphy and obtain soil and rock samples for laboratory testing;

(2) Field and laboratory tests were conducted to evaluate the pertinent index and engineering properties of the foundation materials; and

(3) Engineering analyses were performed to develop foundation design information for the proposed building.

Report Format

The initial sections of this report contain brief descriptions of the field and laboratory phases of our study. A general soils description is then presented, followed by discussions of foundation design recommendations followed by a brief on construction considerations for this project.

FIELD AND LABORATORY INVESTIGATIONS

Exploratory Borings

Soil conditions at the site were explored by Boring 1 through 27. Boring location details are presented on Plate 1. Number and location of borings were selected to cover the proposed buildings area as per the layout plan provided by the client. Boring 1 through 27 were drilled between 5- to 8-M penetration below EGL. Drilling of the borings was terminated after encountering hard stratum with SPT "N" $\geq$ 75 in at least three successive tests below the expected foundation level or on high core recovery at termination depth. NX TC bit and Diamond bit core barrels were used for drilling through the rocky formation. In most of the borings rock core pieces were recovered at bore termination depth. Groundwater was seen at 2.1-M below EGL in site's open well. Log of Boring are presented on Plate 2 through 28.

Field and Laboratory Tests

Boring was drilled using Calyx drilling unit. In the boring SPT was performed at 1-M interval. Soil samples for laboratory tests were collected from SPT split spoon sampler. SPT consists of driving a standard split spoon sampler, 50.8-mm outside diameter and 35-mm inside diameter into soil under the blows of a drop hammer of 63.5 kg falling weight freely through 75-cm. The number of blows required for 30-cm of penetration of sampler in soil is designated as N value and it is termed as the SPT blow count. Detailed information regarding SPT can be found in the IS: 2131 code of practice.

Soil-testing program was designed to evaluate pertinent index and engineering properties of the foundation soils and rock. During field operations soil samples were collected at 1-M interval either disturbed or undisturbed as the case may be. All soil and rock samples were shipped to our Chennai laboratory where pertinent index properties - grain size analyses, natural water content Atterberg limit tests were performed on collected soil samples. All the test results are tabulated on the Summary of Test Results on Plate 29. Grain size distribution curves of tested soil are presented on Plate 30. Summary of Water Test Results are presented on Plate 31.

GENERAL SOIL CONDITIONS

Topography

Natural topography of the site reflects a relatively flat terrain. Visual observation infers that EGL of the site was about 0.5- to 1.2-M below ERL of road near the site. A few trees and many bushes and shrubs were present in the site. Fencing stones, boundary stones were present along various parts of the site boundaries. Proposed construction will be the first major construction activity to cover this site.

Soil Stratigraphy

Soil stratigraphy disclosed by our field and laboratory investigations of the boring are presented on the Log of Boring on Plate 2 through 28. Soil stratigraphy is based on classification of soil samples recovered from the boring, and our observations during drilling operations. A generalized summary of the major soil strata is tabulated below:

Boring – 1:

Stratum	Penetration, M From	To	Description
I	0	1.0	Brown Gray Fine to Coarse Sand with Silt Gravel and Roots
II	1.0	3.0	White Brown Weathered Rock
III	3.0	5.0+	Brown Blue Jointed Granite

Boring – 2:

Stratum	Penetration, M From	To	Description
I	0	3.0	White Brown Silty Fine to Coarse Sand
II	3.0	7.0+	Gray Brown Weathered Rock

Boring – 3:

Stratum	Penetration, M From	To	Description
I	0	1.0	Red Brown Fine to Medium Sand with Silt
II	1.0	7.0+	Gray Brown Weathered Rock

Boring – 4:

Stratum	Penetration, M From	To	Description
I	0	1.0	Brown Fine to Medium Sand with Silt
II	1.0	6.0+	Gray Brown Weathered Rock

Boring – 5:

Stratum	Penetration, M From	To	Description
I	0	1.0	Brown Silty Fine to Medium Sand
II	1.0	6.0+	Gray Brown Weathered Rock

Boring – 6:

Stratum	Penetration, M From	To	Description
I	0	1.0	Brown Stiff Clay
II	1.0	2.0	White Brown Fine to Coarse Sand with Silt
III	2.0	6.0+	White Blue Brown Weathered Rock

Boring – 7:

Stratum	Penetration, M From	To	Description
I	0	1.0	Brown Silty Fine to Medium Sand with Gravel
II	1.0	6.0+	White Blue Brown Weathered Rock

Boring – 8:

Stratum	Penetration, M From	To	Description
I	0	1.0	Gray Brown Fine to Medium Sand with Silt and Gravel
II	1.0	7.0+	White Blue Brown Weathered Rock

Boring – 9:

Stratum	Penetration, M From	To	Description
I	0	1.0	Brown Fine to Medium Sand with Silt and Roots
II	1.0	6.0+	White Blue Brown Weathered Rock

Boring – 10:

Stratum	Penetration, M From	To	Description
I	0	1.0	Brown Silty Fine to Medium Sand with Roots
II	1.0	3.2	Brown Weathered Rock
III	3.2	5.0+	Gray Granite

Boring – 11:

Stratum	Penetration, M From	To	Description
I	0	1.0	Brown Silty Fine to Medium Sand with Roots
II	1.0	2.0	Brown Fine to Coarse Sand with Silt
III	2.0	7.0+	Brown Gray Weathered Rock

Boring – 12:

Stratum	Penetration, M From	To	Description
I	0	2.0	White Brown Fine to Coarse Sand with Silt and Gravel
II	2.0	7.0+	White Blue Brown Weathered Rock

Boring – 13:

Stratum	Penetration, M From	To	Description
I	0	1.0	Brown Stiff Clay
II	1.0	7.0+	Gray Brown Weathered Rock

Boring – 14:

Stratum	Penetration, M From	To	Description
I	0	2.0	Brown Fine to Coarse Sand with Silt
II	2.0	7.0+	White Blue Brown Weathered Rock

Boring – 15:

Stratum	Penetration, M From	To	Description
I	0	1.0	Brown Fine to Medium Sand with Silt
II	1.0	7.0+	White Blue Brown Weathered Rock

Boring – 16:

Stratum	Penetration, M From	To	Description
I	0	1.0	Brown Fine to Medium Sand with Silt
II	1.0	7.0+	Gray White Brown Weathered Rock

Boring – 17:

Stratum	Penetration, M From	To	Description
I	0	1.0	Brown Gray Silty Fine to Medium Sand with Roots and Gravel
II	1.0	6.0+	White Blue Brown Weathered Rock

Boring – 18:

Stratum	Penetration, M From	To	Description
I	0	1.0	Brown Gray Silty Fine to Medium Sand with Roots and Gravel
II	1.0	7.0+	White Blue Brown Weathered Rock

Boring – 19:

Stratum	Penetration, M From	To	Description
I	0	1.0	Gray Brown Fine to Medium Sand with Silt and Gravel
II	1.0	6.0+	White Blue Brown Weathered Rock

Boring – 20:

Stratum	Penetration, M From	To	Description
I	0	1.0	Brown Fine to Medium Sand with Silt and Roots
II	1.0	7.0+	Gray White Brown Weathered Rock

Boring – 21:

Stratum	Penetration, M From	To	Description
I	0	1.0	Gray Brown Very Stiff Silty Clay
II	1.0	2.0	White Brown Fine to Coarse Sand with Silt
III	2.0	8.0+	White Blue Brown Weathered Rock

Boring – 22:

Stratum	Penetration, M From	To	Description
I	0	2.0	Brown Silty Fine to Medium Sand
II	2.0	7.0+	White Blue Brown Weathered Rock

Boring – 23:

Stratum	Penetration, M From	To	Description
I	0	1.0	Brown Silty Fine to Medium Sand
II	1.0	6.6+	White Blue Brown Weathered Rock

Boring – 24:

Stratum	Penetration, M From	To	Description
I	0	2.0	Gray Brown Silty Fine to Medium Sand
II	2.0	7.0+	White Blue Brown Weathered Rock

Boring – 25:

Stratum	Penetration, M From	To	Description
I	0	1.0	Gray Brown Silty Fine to Medium Sand
II	1.0	7.0+	White Blue Brown Weathered Rock

Boring – 26:

Stratum	Penetration, M From	To	Description
I	0	2.0	Gray White Brown Fine to Coarse Sand with Gravel
II	2.0	7.0+	White Blue Brown Weathered Rock

Boring – 27:

Stratum	Penetration, M From	To	Description
I	0	1.0	Brown Fine to Coarse Sand with Silt
II	1.0	7.0+	White Blue Brown Weathered Rock

Detailed soil descriptions that include textural variations and inclusions are noted on the log of boring presented on Plate 2 through 28.

Interpretation of Soil Properties

Shear strength parameters for cohesionless soils were selected based on the SPT, and grain size distribution analyses. Shear strength parameters for cohesive soils were selected based on the SPT results. Unit weight (soil density) profiles of soils in the borings were developed from estimated values based on correlations of unit weight with particle size gradation and field test results (Bowles, 1982.)

Recommendations presented herein for the proposed buildings were based on the soil properties encountered in Boring 3 and 22. **There may be a need to drill additional borings to investigate soil variability if encountered during the foundation work.** Based on the field and laboratory test results the following are the properties for soils encountered in the boring.

Boring – 1:

Stratum	Penetration, M From	To	Properties
I	0	1.0	$\phi = 31^o$; $\gamma_{sat} = 1.7$ tons/M^3
II	1.0	3.0	$\phi = 39^o$; $\gamma_{sat} = 2.25$ tons/M^3
III	3.0	5.0+	$\phi = 40^o$; $\gamma_{sat} = 2.3$ tons/M^3

Boring – 2:

Stratum	Penetration, M From	To	Properties
Ia	0	1.0	$\phi = 30^o$; $\gamma_{sat} = 1.6$ tons/M^3
Ib	1.0	1.75	$\phi = 32^o$; $\gamma_{sat} = 1.7$ tons/M^3
Ic	1.75	3.0	$\phi = 26^o$; $\gamma_{sat} = 1.5$ tons/M^3
IIa	3.0	4.0	$\phi = 38^o$; $\gamma_{sat} = 2.2$ tons/M^3
IIb	4.0	7.0+	$\phi = 39^o$; $\gamma_{sat} = 2.25$ tons/M^3

Boring – 3:

Stratum	Penetration, M From	To	Properties
I	0	1.0	$\phi = 33^o$; $\gamma_{sat} = 1.75$ tons/M^3
IIa	1.0	3.0	$\phi = 33^o$; $\gamma_{sat} = 1.75$ tons/M^3
IIb	3.0	4.0	$\phi = 38^o$; $\gamma_{sat} = 2.2$ tons/M^3
IIc	4.0	7.0+	$\phi = 39^o$; $\gamma_{sat} = 2.25$ tons/M^3

Boring – 4:

Stratum	Penetration, M From	To	Properties
I	0	1.0	$\phi = 27^o$; $\gamma_{sat} = 1.55$ tons/M^3
IIa	1.0	2.0	$\phi = 33^o$; $\gamma_{sat} = 1.75$ tons/M^3

IIb	2.0	5.0	$\phi = 39^o$; $\gamma_{sat} = 2.25$ tons/M^3
IIc	5.0	6.0+	$\phi = 40^o$; $\gamma_{sat} = 2.3$ tons/M^3

Boring – 5:

	Penetration, M		
Stratum	From	To	Properties
I	0	1.0	$\phi = 30^o$; $\gamma_{sat} = 1.65$ tons/M^3
IIa	1.0	2.0	$\phi = 32^o$; $\gamma_{sat} = 1.7$ tons/M^3
IIb	2.0	4.0	$\phi = 37^o$; $\gamma_{sat} = 2.1$ tons/M^3
IIc	4.0	5.0	$\phi = 39^o$; $\gamma_{sat} = 2.25$ tons/M^3
IId	5.0	6.0+	$\phi = 40^o$; $\gamma_{sat} = 2.3$ tons/M^3

Boring – 6:

	Penetration, M		
Stratum	From	To	Properties
I	0	1.0	$C_u = 6$ tons/M^2; $\gamma_{sat} = 1.6$ tons/M^3
II	1.0	2.0	$\phi = 34^o$; $\gamma_{sat} = 1.85$ tons/M^3
IIIa	2.0	5.0	$\phi = 39^o$; $\gamma_{sat} = 2.25$ tons/M^3
IIIb	5.0	6.0+	$\phi = 40^o$; $\gamma_{sat} = 2.3$ tons/M^3

Boring – 7:

	Penetration, M		
Stratum	From	To	Properties
I	0	1.0	$\phi = 28^o$; $\gamma_{sat} = 1.6$ tons/M^3
IIa	1.0	2.0	$\phi = 32^o$; $\gamma_{sat} = 1.7$ tons/M^3
IIb	2.0	3.0	$\phi = 38^o$; $\gamma_{sat} = 2.2$ tons/M^3
IIc	3.0	5.0	$\phi = 39^o$; $\gamma_{sat} = 2.25$ tons/M^3
IId	5.0	6.0+	$\phi = 40^o$; $\gamma_{sat} = 2.3$ tons/M^3

Boring – 8:

	Penetration, M		
Stratum	From	To	Properties
I	0	1.0	$\phi = 30^o$; $\gamma_{sat} = 1.6$ tons/M^3
IIa	1.0	2.0	$\phi = 32^o$; $\gamma_{sat} = 1.7$ tons/M^3
IIb	2.0	4.0	$\phi = 38^o$; $\gamma_{sat} = 2.2$ tons/M^3
IIc	4.0	7.0+	$\phi = 39^o$; $\gamma_{sat} = 2.25$ tons/M^3

Boring – 9:

	Penetration, M		
Stratum	From	To	Properties
I	0	1.0	$\phi = 29^o$; $\gamma_{sat} = 1.6$ tons/M^3
IIa	1.0	2.0	$\phi = 32^o$; $\gamma_{sat} = 1.7$ tons/M^3
IIb	2.0	3.0	$\phi = 38^o$; $\gamma_{sat} = 2.2$ tons/M^3
IIc	3.0	6.0+	$\phi = 39^o$; $\gamma_{sat} = 2.25$ tons/M^3

Boring – 10:

	Penetration, M		
Stratum	From	To	Properties
I	0	1.0	$\phi = 31^o$; $\gamma_{sat} = 1.65$ tons/M^3
IIa	1.0	2.0	$\phi = 33^o$; $\gamma_{sat} = 1.75$ tons/M^3
IIb	2.0	3.2	$\phi = 38^o$; $\gamma_{sat} = 2.2$ tons/M^3
III	3.2	5.0+	$\phi = 42^o$; $\gamma_{sat} = 2.35$ tons/M^3

Boring – 11:

Stratum	Penetration, M From	To	Properties
I	0	1.0	$\phi = 29^o$; $\gamma_{sat} = 1.6$ tons/M^3
II	1.0	2.0	$\phi = 31^o$; $\gamma_{sat} = 1.65$ tons/M^3
IIIa	2.0	3.0	$\phi = 37^o$; $\gamma_{sat} = 2.1$ tons/M^3
IIIb	3.0	7.0+	$\phi = 39^o$; $\gamma_{sat} = 2.25$ tons/M^3

Boring – 12:

Stratum	Penetration, M From	To	Properties
I	0	2.0	$\phi = 27^o$; $\gamma_{sat} = 1.55$ tons/M^3
IIa	2.0	3.0	$\phi = 38^o$; $\gamma_{sat} = 2.2$ tons/M^3
IIb	3.0	7.0+	$\phi = 39^o$; $\gamma_{sat} = 2.25$ tons/M^3

Boring – 13:

Stratum	Penetration, M From	To	Properties
I	0	1.0	$C_u = 5$ tons/M^2; $\gamma_{sat} = 1.6$ tons/M^3
IIa	1.0	2.0	$\phi = 32^o$; $\gamma_{sat} = 1.7$ tons/M^3
IIb	2.0	4.0	$\phi = 38^o$; $\gamma_{sat} = 2.2$ tons/M^3
IIc	4.0	7.0+	$\phi = 39^o$; $\gamma_{sat} = 2.25$ tons/M^3

Boring – 14:

Stratum	Penetration, M From	To	Properties
Ia	0	1.0	$\phi = 27^o$; $\gamma_{sat} = 1.55$ tons/M^3
Ib	1.0	2.0	$\phi = 35^o$; $\gamma_{sat} = 1.95$ tons/M^3
IIa	2.0	3.0	$\phi = 36^o$; $\gamma_{sat} = 2.0$ tons/M^3
IIb	3.0	7.0+	$\phi = 39^o$; $\gamma_{sat} = 2.25$ tons/M^3

Boring – 15:

Stratum	Penetration, M From	To	Properties
I	0	1.0	$\phi = 31^o$; $\gamma_{sat} = 1.65$ tons/M^3
IIa	1.0	2.0	$\phi = 32^o$; $\gamma_{sat} = 1.7$ tons/M^3
IIb	2.0	4.0	$\phi = 38^o$; $\gamma_{sat} = 2.2$ tons/M^3
IIc	4.0	7.0+	$\phi = 39^o$; $\gamma_{sat} = 2.25$ tons/M^3

Boring – 16:

Stratum	Penetration, M From	To	Properties
I	0	1.0	$\phi = 31^o$; $\gamma_{sat} = 1.65$ tons/M^3
IIa	1.0	2.0	$\phi = 29^o$; $\gamma_{sat} = 1.6$ tons/M^3
IIb	2.0	3.0	$\phi = 36^o$; $\gamma_{sat} = 2.05$ tons/M^3
IIc	3.0	4.0	$\phi = 38^o$; $\gamma_{sat} = 2.2$ tons/M^3
IId	4.0	7.0+	$\phi = 39^o$; $\gamma_{sat} = 2.25$ tons/M^3

Boring – 17:

Stratum	Penetration, M From	To	Properties
I	0	1.0	$\phi = 30^o$; $\gamma_{sat} = 1.6$ tons/M^3

IIa	1.0	2.0	$\phi = 37^o$; $\gamma_{sat} = 2.1$ tons/M^3
IIb	2.0	4.0	$\phi = 38^o$; $\gamma_{sat} = 2.2$ tons/M^3
IIc	4.0	6.0+	$\phi = 39^o$; $\gamma_{sat} = 2.25$ tons/M^3

Boring – 18:

	Penetration, M		
Stratum	From	To	Properties
I	0	1.0	$\phi = 30^o$; $\gamma_{sat} = 1.6$ tons/M^3
IIa	1.0	2.0	$\phi = 34^o$; $\gamma_{sat} = 1.85$ tons/M^3
IIb	2.0	7.0+	$\phi = 39^o$; $\gamma_{sat} = 2.25$ tons/M^3

Boring – 19:

	Penetration, M		
Stratum	From	To	Properties
I	0	1.0	$\phi = 30^o$; $\gamma_{sat} = 1.6$ tons/M^3
IIa	1.0	2.0	$\phi = 34^o$; $\gamma_{sat} = 1.85$ tons/M^3
IIb	2.0	6.0+	$\phi = 39^o$; $\gamma_{sat} = 2.25$ tons/M^3

Boring – 20:

	Penetration, M		
Stratum	From	To	Properties
I	0	1.0	$\phi = 31^o$; $\gamma_{sat} = 1.65$ tons/M^3
IIa	1.0	2.0	$\phi = 34^o$; $\gamma_{sat} = 1.85$ tons/M^3
IIb	2.0	3.0	$\phi = 38^o$; $\gamma_{sat} = 2.2$ tons/M^3
IIc	3.0	7.0+	$\phi = 39^o$; $\gamma_{sat} = 2.25$ tons/M^3

Boring – 21:

	Penetration, M		
Stratum	From	To	Properties
I	0	1.0	$C_u = 13$ tons/M^2; $\gamma_{sat} = 1.75$ tons/M^3
II	1.0	2.0	$\phi = 32^o$; $\gamma_{sat} = 1.7$ tons/M^3
IIIa	2.0	3.0	$\phi = 38^o$; $\gamma_{sat} = 2.2$ tons/M^3
IIIb	3.0	8.0+	$\phi = 39^o$; $\gamma_{sat} = 2.25$ tons/M^3

Boring – 22:

	Penetration, M		
Stratum	From	To	Properties
Ia	0	1.0	$\phi = 28^o$; $\gamma_{sat} = 1.6$ tons/M^3
Ib	1.0	2.0	$\phi = 31^o$; $\gamma_{sat} = 1.65$ tons/M^3
IIa	2.0	3.0	$\phi = 33^o$; $\gamma_{sat} = 1.75$ tons/M^3
IIb	3.0	4.0	$\phi = 38^o$; $\gamma_{sat} = 2.2$ tons/M^3
IIc	4.0	7.0+	$\phi = 39^o$; $\gamma_{sat} = 2.25$ tons/M^3

Boring – 23:

	Penetration, M		
Stratum	From	To	Properties
I	0	1.0	$\phi = 29^o$; $\gamma_{sat} = 1.6$ tons/M^3
IIa	1.0	2.0	$\phi = 34^o$; $\gamma_{sat} = 1.85$ tons/M^3
IIb	2.0	6.6+	$\phi = 39^o$; $\gamma_{sat} = 2.25$ tons/M^3

Boring – 24:

Stratum	Penetration, M From	To	Properties
I	0	2.0	$\phi = 29^o$; $\gamma_{sat} = 1.6$ tons/M^3
IIa	2.0	3.0	$\phi = 37^o$; $\gamma_{sat} = 2.1$ tons/M^3
IIb	3.0	4.0	$\phi = 38^o$; $\gamma_{sat} = 2.2$ tons/M^3
IIc	4.0	7.0+	$\phi = 39^o$; $\gamma_{sat} = 2.25$ tons/M^3

Boring – 25:

Stratum	Penetration, M From	To	Properties
I	0	1.0	$\phi = 29^o$; $\gamma_{sat} = 1.6$ tons/M^3
IIa	1.0	2.0	$\phi = 38^o$; $\gamma_{sat} = 2.2$ tons/M^3
IIb	2.0	7.0+	$\phi = 39^o$; $\gamma_{sat} = 2.25$ tons/M^3

Boring – 26:

Stratum	Penetration, M From	To	Properties
Ia	0	1.0	$\phi = 30^o$; $\gamma_{sat} = 1.65$ tons/M^3
Ib	1.0	2.0	$\phi = 32^o$; $\gamma_{sat} = 1.7$ tons/M^3
IIa	2.0	4.0	$\phi = 37^o$; $\gamma_{sat} = 2.1$ tons/M^3
IIb	4.0	7.0+	$\phi = 39^o$; $\gamma_{sat} = 2.25$ tons/M^3

Boring – 27:

Stratum	Penetration, M From	To	Properties
I	0	1.0	$\phi = 32^o$; $\gamma_{sat} = 1.7$ tons/M^3
IIa	1.0	2.0	$\phi = 36^o$; $\gamma_{sat} = 2.05$ tons/M^3
IIb	2.0	7.0+	$\phi = 39^o$; $\gamma_{sat} = 2.25$ tons/M^3

DESIGN INFORMATION

Data from borings indicate presence of weathered rock with high SPT "N" values from shallow depth. **For the proposed villa and apartments buildings** it was **recommended** to provide **Isolated Column Footing** foundation at 2-M below EGL with at least 1-M thick site filling above EGL. The footing should have at least 3-M of **embedment around the footings**. A minimum footing width of 1.5-M was considered in analysis. The ultimate bearing capacity of the soil was estimated as per IS: 6403 Code of Practice Method using the following equation and soil parameters presented above sections:

$$q_{ult} = CN_c s_c d_c i_c + q(N_q - 1) s_q d_q i_q + 0.5B\gamma' N_\gamma s_\gamma d_\gamma i_{\gamma\delta}$$

Where

B = Width of Footing;
q_{ult} = Ultimate Bearing Capacity of the Soil;
C = Avg. Soil Undrained Shear Strength;
N_c , N_q & N_γ = Bearing Capacity Factors;
q = Eff. Vertical Pressure at Footing Level
γ' = Eff. Unit Weight of Soil;
s_c, s_q, s_γ = Shape Factors;
d_c, d_q, d_γ = Depth Factors;
i_c, i_q, i_γ = Inclination Factors; and

For the considered foundation the **estimated ultimate and recommended allowable capacities were 89 and 25 tons/M^2**, respectively. Estimated total settlement was about 6 mm, less than 60 mm, the IS: 1904 - 2006 code limiting settlement for isolated column footings of framed structures with panel walls on granular soil. All the footings should be interconnected in both directions. It was also recommended to provide continuous lintels in each floor for better resistance to seismic forces and differential settlements. **In case of footings on or near the filled open wells or locations with loose soils at 2-M level then the loose soils upto lower level hard layer should be replaced with well compacted lean concrete. Also footings around these wells should be made into "Combined Footings" with a maximum bearing pressure limited to 15 tons/M^2**. Pile foundation for these filled up open well areas was not recommended as the installation of piles into these hard rocky formation will be very difficult. Foundation capacity calculations were presented on Plate 32.

GROUNDWATER

Groundwater was present in the borings at highly variable depths from 1-M below EGL to completely dry borings. This is very likely due to recent rains and presence of rocky formation at variable depth in the site. An 8.25-M diameter and unknown depth open well of was present in the site at about 27.7-M from Boring 7 with groundwater at 2.1-M below EGL. Groundwater sample was collected from this open well for construction suitability test as per IS: 456 - 2000 guidelines. Test results inferred that groundwater from the open well was **suitable** for construction purposes. Groundwater from the site should be checked at regular intervals from the beginning and during construction period to confirm groundwater's construction suitability. Summary of ground water test results is presented on Plate 31.

CONSTRUCTION CONSIDERATIONS

We do not expect construction problems at this site due to soil and groundwater conditions in non rainy seasons. Site's EGL was at about 0.5- to 1.2-M below ERL of road near the site. In order to minimize future site and building flooding from road it was recommended to raise FGL of the site by **at least 0.6-M above ERL** of roads in front of the site. FFL of **stilt floor** should be 0.2-M above FGL of the site. This will minimize rainwater runoff flooding into the site and building.

Backfilling of the foundation excavations should be done with granular soil, and fill should be compacted properly to achieve proper densification to avoid settlements in flooring. Exposed bottom surface of the foundation excavation must be properly compacted with heavy duty rammer or heavy roller to compact the exposed surface that gets loosened by mechanical excavation activities. This is to minimize the settlements that can arise if the loosened soil in foundation excavation is not removed or compacted. New foundations should rest on virgin soil and not on old foundations or filled up soils.

At some boring locations (Boring 2, and 12) soils were in loose state with SPT "N" $\leq$ 7 even at 2-M inferring possible filled-up shallow pits. Since the site is a large open land, there may some filled-up large diameter open wells or rainwater collection ponds. Therefore, during construction care must be taken to inspect and confirm that the soil foundation level was **dense to very dense weathered rock** and not loose material easy to excavate with back-hoe. In case of columns located at site open wells or pits or ditches or any other filled up pockets that may be encountered should be filled with well compacted lean concrete (PCC) after removal of loose material present inside these areas

completely. Excavated sandy soil and weathered rock can be used for back filling and site filling purposes.

All structures have to be designed for higher seismic forces (**Zone III**) due to increased seismic activity in peninsular India in the last decade and half. Seismic events of 7.9 magnitude on April 25, 2015, 6.0 magnitude on May 21, 2014, 8.4 magnitude on April 11, 2012, 7.2 magnitude on June 13, 2010, and 7.6 magnitude on August 11, 2009 with epicenters in Himalayas, Bay of Bengal, and near Andaman Islands were felt at Chennai. It is recommended to provide rigid plinth beams in ground level, shear walls in the structure, and continuous lintels in each floor. Lintels must be integrated into columns of the structure. Plinth beams must be designed to be rigid to allow redistribution of loads in case of differential settlements. The site soil profile infers **"No"** seismic susceptibility. Under a seismic event of **6.5 Richter scale**, and peak ground acceleration of **0.08g** the total estimated vertical settlement was 0 cms and total horizontal displacement was about 0 cms. Iwasaki liquefaction potential was 0.0 inferring "**No Liquefaction**." As per IS code for **Zone III** design horizontal acceleration was **0.08g**. Liquefaction Analysis results are presented on Plate 33.

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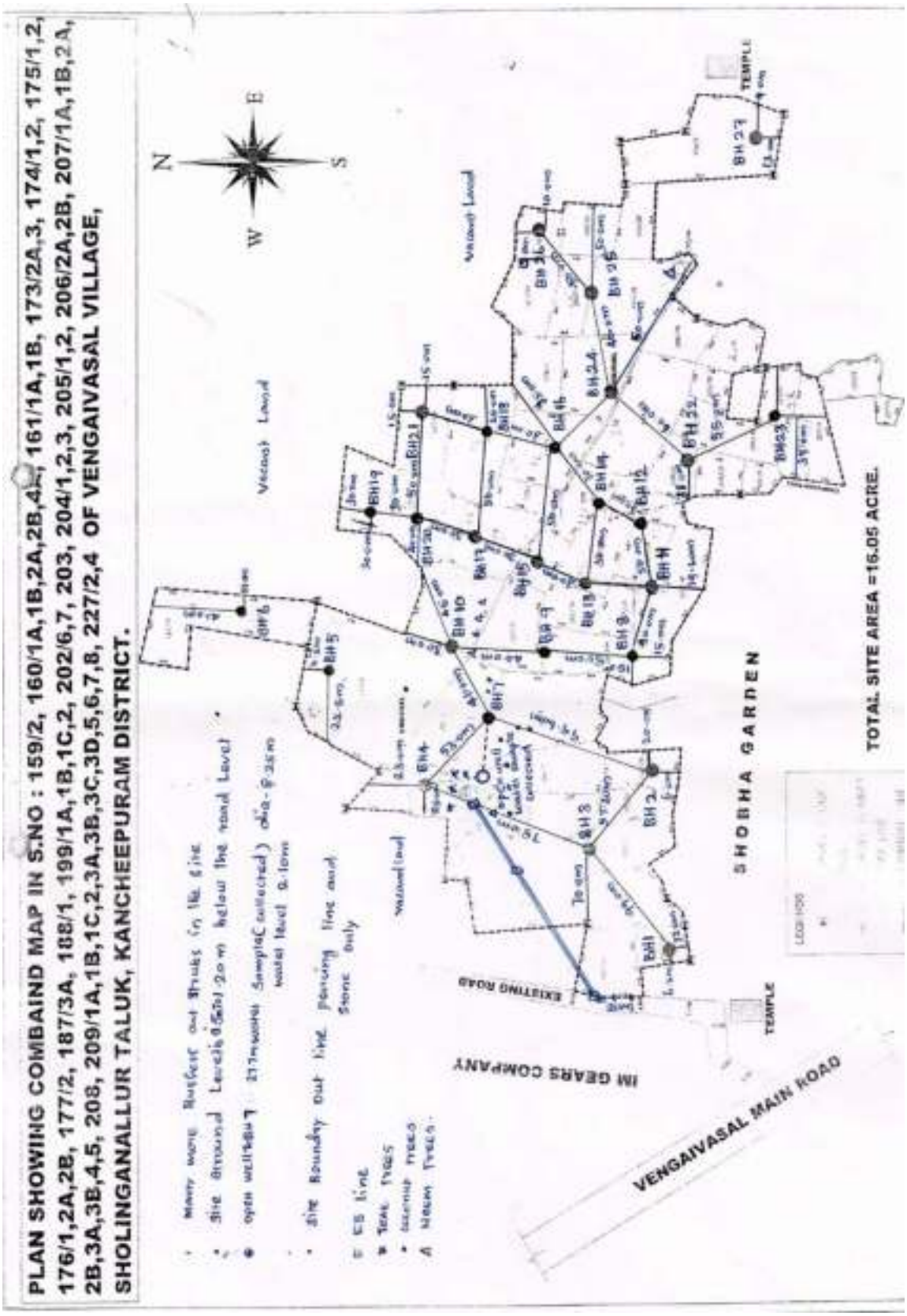
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(Not To Scale)

Site EGL = 0.5- to 1.2-M Below ERL Road In Front of Site.

SITE PLAN WITH BORE LOCATION DETAILS.

PLATE 1

LOG OF BORING

Project: Proposed Residential Apartments and Villa Buildings Site, S. No. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4, Vengaivasal Village, Tambaram Taluk, Kancheepuram District, TN.

Bore Hole No.: 1 **Type of Boring:** Calyx Drill **Dia. of Hole:** 150 mm
Started on: 30-11-'18 **Ended on:** 30-11-'18 **Field Work In Charge:** M Munivel
Final Depth: 5.0-M **Depth to G W S:** 2.1-M **Remarks:** GWL in Open Well.

DEPTH, M	SOIL DESCRIPTION	SPT / VANE & SAMPLE	SPT "N" PROFILE 25 50 75	INDEX TEST DATA 25 50 75
	BROWN GRAY FINE TO COARSE SAND with silt, gravel and roots (To 1.0-M) (N_{avg} = 14)	SPT @ 0.25 M 4/6/8 = 14 Blows		■♦
	0.0- to 1.0-m – $\phi = 31^o$; $\gamma_t = 1.7$ tons/M^3			
1.0	-NX TC bit drilling from 1-m	SPT @ 1 M (SNR)		
	WHITE BROWN WEATHERED ROCK (To 3.0-M)	2 cms for 20 Blows (Hammer Rebound)		
	-drilled from 1- to 2-m in 40 minutes	SPT @ 2 M (SNR)		
2.0	-NX Diamond bit drilling from 2-m	1 cm for 10 Blows		
GWL	1.0- to 3.0-m – $\phi = 39^o$; $\gamma_t = 2.25$ tons/M^3 (N_{avg} >> 100)	1 cm for 10 Blows (Hammer Rebound)		
		SPT @ 3 M (SNR)		
3.0		0.5 cms for 5 Blows		
	BROWN BLUE JOINTED GRANITE (Below 3.0-M)	0 cms for 5 Blows (Hammer Rebound)		
	-drilled from 3- to 4-m in 140 minutes	SPT @ 4 M (SNR)		
4.0	-61 cms rock core recovered drilling to 4-m	0 cms for 5 Blows		
	3.0- to 5.0-m – $\phi = 40^o$; $\gamma_t = 2.3$ tons/M^3 (N_{avg} >> 100)	(Hammer Rebound)		
	-drilled from 4- to 5-m in 115 minutes	SPT @ 5 M (SNR)		
5.0	-73 cms rock core recovered drilling to 5-m	0 cms for 5 Blows		
		(Hammer Rebound)		
6.0				
7.0				
8.0				
9.0				
10.0				

BORE HOLE TERMINATED AT 5.0-M.

SPT=Standard Penetration Test; DS=Disturbed Sample; UDS = UnDisturbed Sample; WS=Water Sample; SNR=Sample Not Recovered; LS = Liner Sample; +----+ = Plastic and Liquid Limits; ♦ = N M C; ■ = % -75μ Size

PLATE 2

LOG OF BORING

Project: Proposed Residential Apartments and Villa Buildings Site, S. No. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4, Vengaivasal Village, Tambaram Taluk, Kancheepuram District, TN.

Bore Hole No.: 2 **Type of Boring:** Calyx Drill **Dia. of Hole:** 150 mm
Started on: 29-11-'18 **Ended on:** 29-11-'18 **Field Work In Charge:** R Murugesan
Final Depth: 7.0-M **Depth to G W S:** 2.1-M **Remarks:** GWL in Open Well.

DEPTH, M	SOIL DESCRIPTION	SPT / VANE & SAMPLE TYPE	SPT "N" PROFILE 25 50 75	INDEX TEST DATA 25 50 75
	WHITE BROWN SILTY FINE TO COARSE SAND (To 3.0-M)	SPT @ 0.25 M 3/4/6 = 10 Blows		
	0.0- to 1.0-m – $\phi = 30^o$; $\gamma_t = 1.6$ tons/M^3 ($N_{avg} = 10$)	SPT @ 1 M 5/7/10 = 17 Blows		
1.0				
	1.0- to 1.75-m – $\phi = 32^o$; $\gamma_t = 1.7$ tons/M^3 ($N_{avg} = 17$)			
		SPT @ 2 M 2/2/5 = 7 Blows		
2.0				
GWL	1.75- to 3.0-m – $\phi = 26^o$; $\gamma_t = 1.5$ tons/M^3 ($N_{avg} = 7$)			
		SPT @ 3 M 2 cms for 10 Blows		
3.0				
	GRAY BROWN WEATHERED ROCK (Below 3.0-M)	2 cms for 10 Blows (Hammer Rebound)		
	3.0- to 4.0-m – $\phi = 38^o$; $\gamma_t = 2.2$ tons/M^3 ($N_{avg} > 100$)	SPT @ 4 M (SNR) 1 cm for 10 Blows		
4.0				
	-NX TC bit drilling from 4-m	1 cm for 10 Blows (Hammer Rebound)		
		SPT @ 5 M (SNR) 1 cm for 10 Blows		
5.0	-drilled from 4- to 5-m in 30 minutes			
	-NX Diamond bit drilling from 5-m	0 cms for 5 Blows (Hammer Rebound)		
	4.0- to 7.0-m – $\phi = 39^o$; $\gamma_t = 2.25$ tons/M^3 ($N_{avg} >> 100$)	SPT @ 6 M (SNR) 0.5 cms for 5 Blows		
6.0	-drilled from 5- to 6-m in 60 minutes			
	-wea. rock pieces recovered drilling to 6-m	0 cms for 5 Blows (Hammer Rebound)		
		SPT @ 7 M (SNR) 0 cms for 5 Blows		
7.0	-drilled from 6- to 7-m in 75 minutes			
	-25 cms gray rock core recovered drilling to 7-m	(Hammer Rebound)		
8.0				
9.0				
10.0				

BORE HOLE TERMINATED AT 7.0-M.

SPT=Standard Penetration Test; DS=Disturbed Sample; UDS = UnDisturbed Sample; WS=Water Sample; SNR=Sample Not Recovered; LS = Liner Sample; +----+ = Plastic and Liquid Limits; ♦ = N M C; ■ = % -75μ Size

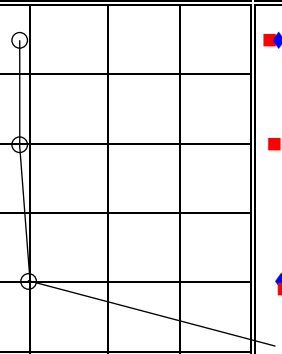
PLATE 3

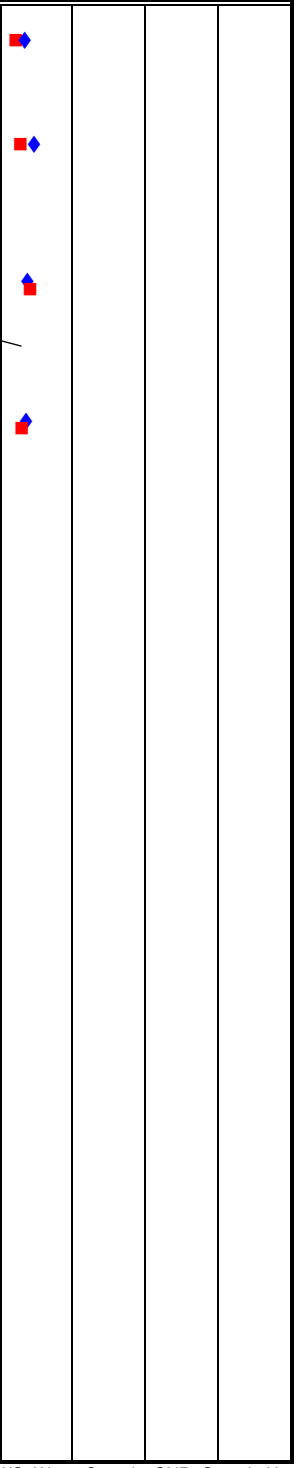
LOG OF BORING

Project: Proposed Residential Apartments and Villa Buildings Site, S. No. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4, Vengaivasal Village, Tambaram Taluk, Kancheepuram District, TN.

Bore Hole No.: 3 **Type of Boring:** Calyx Drill **Dia. of Hole:** 150 mm
Started on: 29-11-'18 **Ended on:** 29-11-'18 **Field Work In Charge:** R Murugesan
Final Depth: 7.0-M **Depth to G W S:** 2.1-M **Remarks:** GWL in Open Well.

DEPTH, M	SOIL DESCRIPTION	SPT / VANE & SAMPLE TYPE
	RED BROWN FINE TO MEDIUM SAND with silt (To 1.0-M)	SPT @ 0.25 M 4/7/16 = 23 Blows
	0.0- to 1.0-m – $\phi = 33^{o}$; $\gamma_t = 1.75$ tons/M^3	SPT @ 1 M
1.0	($N_{avg} = 23$)	10/10/13 = 23 Blows
	GRAY BROWN WEATHERED ROCK (Below 1.0-M)	
		SPT @ 2 M
2.0	1.0- to 3.0-m – $\phi = 33^{o}$; $\gamma_t = 1.75$ tons/M^3	4/7/18 = 25 Blows
GWL	($N_{avg} = 24$)	
		SPT @ 3 M 30/
3.0		3 cms for 10 Blows
		2 cms for 10 Blows
	3.0- to 4.0-m – $\phi = 38^{o}$; $\gamma_t = 2.2$ tons/M^3	(Hammer Rebound)
	($N_{avg} > 100$)	SPT @ 4 M (SNR)
4.0	-NX TC bit drilling from 4-m	0.5 cms for 10 Blows
		0 cms for 5 Blows
		(Hammer Rebound)
		SPT @ 5 M (SNR)
5.0	-drilled from 4- to 5-m in 30 minutes	1 cm for 10 Blows
	-NX Diamond bit drilling from 5-m	1 cm for 10 Blows
	4.0- to 7.0-m – $\phi = 39^{o}$; $\gamma_t = 2.25$ tons/M^3	(Hammer Rebound)
	($N_{avg} >> 100$)	SPT @ 6 M (SNR)
6.0	-drilled from 5- to 6-m in 40 minutes	0.5 cms for 5 Blows
		0 cms for 5 Blows
		(Hammer Rebound)
		SPT @ 7 M (SNR)
7.0	-drilled from 6- to 7-m in 50 minutes	0 cms for 5 Blows
	-29 cms gray rock core recovered drilling to 7-m	(Hammer Rebound)
8.0		
9.0		
10.0		





BORE HOLE TERMINATED AT 7.0-M.

SPT=Standard Penetration Test; DS=Disturbed Sample; UDS = UnDisturbed Sample; WS=Water Sample; SNR=Sample Not Recovered; LS = Liner Sample; +----+ = Plastic and Liquid Limits; ♦ = N M C; ■ = % -75μ Size

PLATE 4

LOG OF BORING

Project: Proposed Residential Apartments and Villa Buildings Site, S. No. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4, Vengaivasal Village, Tambaram Taluk, Kancheepuram District, TN.

Bore Hole No.: 4 **Type of Boring:** Calyx Drill **Dia. of Hole:** 150 mm
Started on: 29-11-'18 **Ended on:** 29-11-'18 **Field Work In Charge:** R Murugesan
Final Depth: 6.0-M **Depth to G W S:** 2.1-M **Remarks:** GWL in Open Well.

DEPTH, M	SOIL DESCRIPTION	SPT / VANE & SAMPLE TYPE	SPT "N" PROFILE 25 50 75	INDEX TEST DATA 25 50 75
	BROWN FINE TO MEDIUM SAND with silt (To 1.0-M)	SPT @ 0.25 M 2/2/4 = 6 Blows		
	0.0- to 1.0-m – $\phi = 27^o$; $\gamma_t = 1.55$ tons/M^3	SPT @ 1 M		
1.0	($N_{avg} = 6$)	6/9/15 = 24 Blows		
	GRAY BROWN WEATHERED ROCK (Below 1.0-M)			
	1.0- to 2.0-m – $\phi = 33^o$; $\gamma_t = 1.75$ tons/M^3	SPT @ 2 M		
2.0	($N_{avg} = 24$)	3 cms for 15 Blows		
GWL		0.5 cms for 5 Blows (Hammer Rebound)		
		SPT @ 3 M (SNR)		
3.0	-NX TC bit drilling from 3-m	1.5 cms for 15 Blows		
		0 cms for 5 Blows		
	2.0- to 5.0-m – $\phi = 39^o$; $\gamma_t = 2.25$ tons/M^3	(Hammer Rebound)		
	($N_{avg} >> 100$)	SPT @ 4 M (SNR)		
4.0	-drilled from 3- to 4-m in 35 minutes	0.5 cms for 10 Blows		
	-NX Diamond bit drilling from 4-m	0 cms for 5 Blows (Hammer Rebound)		
		SPT @ 5 M (SNR)		
5.0	-drilled from 4- to 5-m in 60 minutes	0.5 cms for 10 Blows		
	-29 cms wea. rock core recovered drilling to 5-m	0 cms for 5 Blows		
	5.0- to 6.0-m – $\phi = 40^o$; $\gamma_t = 2.3$ tons/M^3	(Hammer Rebound)		
	($N_{avg} >> 100$)	SPT @ 6 M (SNR)		
6.0	-drilled from 5- to 6-m in 90 minutes	0 cms for 5 Blows		
	-60 cms wea. rock core recovered drilling to 6-m	(Hammer Rebound)		
7.0				
8.0				
9.0				
10.0				

BORE HOLE TERMINATED AT 6.0-M.

SPT=Standard Penetration Test; DS=Disturbed Sample; UDS = UnDisturbed Sample; WS=Water Sample; SNR=Sample Not Recovered; LS = Liner Sample; +----+ = Plastic and Liquid Limits; ♦ = N M C; ■ = % -75μ Size

PLATE 5

LOG OF BORING

Project: Proposed Residential Apartments and Villa Buildings Site, S. No. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4, Vengaivasal Village, Tambaram Taluk, Kancheepuram District, TN.

Bore Hole No.: 5 **Type of Boring:** Calyx Drill **Dia. of Hole:** 150 mm
Started on: 30-11-'18 **Ended on:** 30-11-'18 **Field Work In Charge:** R Murugesan
Final Depth: 6.0-M **Depth to G W S:** 2.1-M **Remarks:** GWL in Open Well.

DEPTH, M	SOIL DESCRIPTION	SPT / VANE & SAMPLE TYPE	SPT "N" PROFILE 25 50 75	INDEX TEST DATA 25 50 75
	BROWN SILTY FINE TO MEDIUM SAND (To 1.0-M)	SPT @ 0.25 M 3/4/6 = 10 Blows		♦ ■
	0.0- to 1.0-m – $\phi = 30^o$; $\gamma_t = 1.65$ tons/M^3	SPT @ 1 M 5/7/8 = 15 Blows		
1.0	($N_{avg} = 10$)			■♦
	GRAY BROWN WEATHERED ROCK (Below 1.0-M)			
	1.0- to 2.0-m – $\phi = 32^o$; $\gamma_t = 1.7$ tons/M^3	SPT @ 2 M 13/30/		
2.0	($N_{avg} = 15$)	6 cms for 15 Blows		♦■
GWL		1 cm for 5 Blows (Hammer Rebound)		
		SPT @ 3 M		
3.0	-NX TC bit drilling from 3-m	6 cms for 15 Blows		♦■
	2.0- to 4.0-m – $\phi = 37^o$; $\gamma_t = 2.1$ tons/M^3	1 cm for 5 Blows (Hammer Rebound)		
	($N_{avg} \sim 100$)	SPT @ 4 M (SNR)		
4.0	-drilled from 3- to 4-m in 35 minutes	1.5 cms for 15 Blows		
	-NX Diamond bit drilling from 4-m	0 cms for 5 Blows		
	4.0- to 5.0-m – $\phi = 39^o$; $\gamma_t = 2.25$ tons/M^3	(Hammer Rebound)		
	($N_{avg} >> 100$)	SPT @ 5 M (SNR)		
5.0	-drilled from 4- to 5-m in 60 minutes	0.5 cms for 10 Blows		
	-19 cms wea. rock core recovered drilling to 5-m	0 cms for 5 Blows		
	5.0- to 6.0-m – $\phi = 40^o$; $\gamma_t = 2.3$ tons/M^3	(Hammer Rebound)		
	($N_{avg} >> 100$)	SPT @ 6 M (SNR)		
6.0	-drilled from 5- to 6-m in 90 minutes	0 cms for 5 Blows		
	-62 cms rock core recovered drilling to 6-m	(Hammer Rebound)		
7.0				
8.0				
9.0				
10.0				

BORE HOLE TERMINATED AT 6.0-M.

SPT=Standard Penetration Test; DS=Disturbed Sample; UDS = UnDisturbed Sample; WS=Water Sample; SNR=Sample Not Recovered; LS = Liner Sample; +----+ = Plastic and Liquid Limits; ♦ = N M C; ■ = % -75μ Size

PLATE 6

LOG OF BORING

Project: Proposed Residential Apartments and Villa Buildings Site, S. No. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4, Vengaivasal Village, Tambaram Taluk, Kancheepuram District, TN.

Bore Hole No.: 6 **Type of Boring:** Calyx Drill **Dia. of Hole:** 150 mm
Started on: 30-11-'18 **Ended on:** 30-11-'18 **Field Work In Charge:** M Munivel
Final Depth: 6.0-M **Depth to G W S:** 2.1-M **Remarks:** GWL in Open Well.

DEPTH, M	SOIL DESCRIPTION	SPT / VANE & SAMPLE TYPE	SPT "N" PROFILE 25 50 75	INDEX TEST DATA 25 50 75
	BROWN STIFF CLAY (To 1.0-M)	SPT @ 0.25 M		♦ +---------+
	0.0- to 1.0-m – C_u = 6 tons/M^2; γ_t = 1.6 tons/M^3	3/4/10 = 14 Blows		
	(N_{avg} ~ 10)	SPT @ 1 M		
1.0		9/15/18 = 33 Blows		♦
	WHITE BROWN FINE TO COARSE SAND with silt (To 2.0-M)			
	1.0- to 2.0-m – ϕ = 34°; γ_t = 1.85 tons/M^3	SPT @ 2 M		
2.0	(N_{avg} = 33)	2 cms for 10 Blows		♦■
GWL	**WHITE BLUE BROWN WEATHERED ROCK (Below 2.0-M)**	1 cm for 10 Blows		
	-NX TC bit drilling from 2.4- to 3-m in 40 minutes	(Hammer Rebound)		
3.0		SPT @ 3 M (SNR)		
	-NX Diamond bit drilling from 3-m	0.5 cms for 5 Blows		
	2.0- to 5.0-m – ϕ = 39°; γ_t = 2.25 tons/M^3	0 cms for 5 Blows		
	(N_{avg} > 100)	(Hammer Rebound)		
4.0	-drilled from 3- to 4-m in 100 minutes	SPT @ 4 M (SNR)		
	-31 cms wea. rock core recovered drilling to 4-m	0 cms for 5 Blows		
		(Hammer Rebound)		
5.0	-drilled from 4- to 5-m in 50 minutes	SPT @ 5 M (SNR)		
	-wea. rock pieces recovered drilling to 5-m	0 cms for 5 Blows		
	5.0- to 6.0-m – ϕ = 40°; γ_t = 2.3 tons/M^3	(Hammer Rebound)		
	(N_{avg} >> 100)	SPT @ 6 M (SNR)		
6.0	-drilled from 5- to 6-m in 105 minutes	0 cms for 5 Blows		
	-41 cms wea. rock core recovered drilling to 6-m	(Hammer Rebound)		
7.0				
8.0				
9.0				
10.0				

BORE HOLE TERMINATED AT 6.0-M.

SPT=Standard Penetration Test; DS=Disturbed Sample; UDS = UnDisturbed Sample; WS=Water Sample; SNR=Sample Not Recovered; LS = Liner Sample; +----+ = Plastic and Liquid Limits; ♦ = N M C; ■ = % -75μ Size

PLATE 7

LOG OF BORING

Project: Proposed Residential Apartments and Villa Buildings Site, S. No. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4, Vengaivasal Village, Tambaram Taluk, Kancheepuram District, TN.

Bore Hole No.: 7 **Type of Boring:** Calyx Drill **Dia. of Hole:** 150 mm
Started on: 1-12-'18 **Ended on:** 1-12-'18 **Field Work In Charge:** M Munivel
Final Depth: 6.0-M **Depth to G W S:** 2.1-M **Remarks:** GWL in Open Well.

DEPTH, M	SOIL DESCRIPTION	SPT / VANE & SAMPLE TYPE	SPT "N" PROFILE 25 50 75	INDEX TEST DATA 25 50 75
	BROWN SILTY FINE TO MEDIUM SAND with gravel (To 1.0-M)	SPT @ 0.25 M 2/4/4 = 8 Blows		♦ ■
	0.0- to 1.0-m – $\phi = 28^o$; $\gamma_t = 1.6$ tons/M^3	SPT @ 1 M		
1.0	($N_{avg} = 8$)	4/6/10 = 16 Blows		■ ♦
	WHITE BLUE BROWN WEATHERED ROCK (Below 1.0-M)			
	1.0- to 2.0-m – $\phi = 32^o$; $\gamma_t = 1.7$ tons/M^3	SPT @ 2 M 20/		
2.0	($N_{avg} = 16$)	3 cms for 10 Blows		■
GWL		2 cms for 10 Blows		
	2.0- to 3.0-m – $\phi = 38^o$; $\gamma_t = 2.2$ tons/M^3	(Hammer Rebound)		
	($N_{avg} > 100$)	SPT @ 3 M (SNR)		
3.0		1 cm for 10 Blows		
	-NX TC bit drilling from 3- to 3.3-m in 30 minutes	1 cm for 10 Blows		
	-NX Diamond bit drilling from 3.3-m	(Hammer Rebound)		
	-drilled from 3.3- to 4-m in 45 minutes	SPT @ 4 M (SNR)		
4.0	-13 cms wea. rock core recovered drilling to 4-m	0.5 cms for 5 Blows		
	3.0- to 5.0-m – $\phi = 39^o$; $\gamma_t = 2.25$ tons/M^3	0 cms for 5 Blows		
	($N_{avg} >> 100$)	(Hammer Rebound)		
		SPT @ 5 M (SNR)		
5.0	-drilled from 4- to 5-m in 100 minutes	0 cms for 5 Blows		
	-28 cms wea. rock core recovered drilling to 5-m	(Hammer Rebound)		
	5.0- to 6.0-m – $\phi = 40^o$; $\gamma_t = 2.3$ tons/M^3			
	($N_{avg} >> 100$)	SPT @ 6 M (SNR)		
6.0	-drilled from 5- to 6-m in 135 minutes	0 cms for 5 Blows		
	-56 cms wea. rock core recovered drilling to 6-m	(Hammer Rebound)		
7.0				
8.0				
9.0				
10.0				

BORE HOLE TERMINATED AT 6.0-M.

SPT=Standard Penetration Test; DS=Disturbed Sample; UDS = UnDisturbed Sample; WS=Water Sample; SNR=Sample Not Recovered; LS = Liner Sample; +----+ = Plastic and Liquid Limits; ♦ = N M C; ■ = % -75μ Size

PLATE 8

LOG OF BORING

Project: Proposed Residential Apartments and Villa Buildings Site, S. No. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4, Vengaivasal Village, Tambaram Taluk, Kancheepuram District, TN.

Bore Hole No.: 8 **Type of Boring:** Calyx Drill **Dia. of Hole:** 150 mm
Started on: 5-12-'18 **Ended on:** 5-12-'18 **Field Work In Charge:** M Munivel
Final Depth: 7.0-M **Depth to G W S:** 2.1-M **Remarks:** GWL in Open Well.

DEPTH, M	SOIL DESCRIPTION	SPT / VANE & SAMPLE TYPE	SPT "N" PROFILE 25 50 75	INDEX TEST DATA 25 50 75
	GRAY BROWN FINE TO MEDIUM SAND with silt and gravel (To 1.0-M)	SPT @ 0.25 M 2/4/6 = 10 Blows		■ ♦
	0.0- to 1.0-m – $\phi = 30^o$; $\gamma_t = 1.6$ tons/M^3	SPT @ 1 M		
1.0	($N_{avg} = 10$)	6/8/10 = 18 Blows		■♦
	WHITE BLUE BROWN WEATHERED ROCK (Below 1.0-M)			
	1.0- to 2.0-m – $\phi = 32^o$; $\gamma_t = 1.7$ tons/M^3	SPT @ 2 M		
2.0	($N_{avg} = 18$)	4 cms for 10 Blows		■♦
GWL		2 cms for 10 Blows (Hammer Rebound)		
	-NX TC bit drilling from 3-m	SPT @ 3 M		
3.0	2.0- to 4.0-m – $\phi = 38^o$; $\gamma_t = 2.2$ tons/M^3	3 cms for 10 Blows		♦ ■
	($N_{avg} > 100$)	2 cms for 10 Blows (Hammer Rebound)		
		SPT @ 4 M (SNR)		
4.0	-drilled from 3- to 4-m in 40 minutes	1 cm for 10 Blows		
	-NX Diamond bit drilling from 4-m	1 cm for 10 Blows (Hammer Rebound)		
		SPT @ 5 M (SNR)		
5.0	-drilled from 4- to 5-m in 30 minutes	0.5 cms for 5 Blows		
		0 cms for 5 Blows		
	4.0- to 7.0-m – $\phi = 39^o$; $\gamma_t = 2.25$ tons/M^3	(Hammer Rebound)		
	($N_{avg} >> 100$)	SPT @ 6 M (SNR)		
6.0	-drilled from 5- to 6-m in 50 minutes	0 cms for 5 Blows		
	-4 cms wea. rock core recovered drilling to 6-m	(Hammer Rebound)		
		SPT @ 7 M (SNR)		
7.0	-drilled from 6- to 7-m in 55 minutes	0 cms for 5 Blows		
	-9 cms wea. rock core recovered drilling to 7-m	(Hammer Rebound)		
8.0				
9.0				
10.0				

BORE HOLE TERMINATED AT 7.0-M.

SPT=Standard Penetration Test; DS=Disturbed Sample; UDS = UnDisturbed Sample; WS=Water Sample; SNR=Sample Not Recovered; LS = Liner Sample; +----+ = Plastic and Liquid Limits; ♦ = N M C; ■ = % -75μ Size

PLATE 9

LOG OF BORING

Project: Proposed Residential Apartments and Villa Buildings Site, S. No. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4, Vengaivasal Village, Tambaram Taluk, Kancheepuram District, TN.

Bore Hole No.: 9 **Type of Boring:** Calyx Drill **Dia. of Hole:** 150 mm
Started on: 4-12-'18 **Ended on:** 4-12-'18 **Field Work In Charge:** M Munivel
Final Depth: 6.0-M **Depth to G W S:** 2.1-M **Remarks:** GWL in Open Well.

DEPTH, M	SOIL DESCRIPTION	SPT / VANE & SAMPLE TYPE	SPT "N" PROFILE 25 50 75	INDEX TEST DATA 25 50 75
	BROWN FINE TO MEDIUM SADN with silt and roots (To 1.0-M)	SPT @ 0.25 M 3/3/6 = 9 Blows		
	0.0- to 1.0-m – $\phi = 29^o$; $\gamma_t = 1.6$ tons/M^3	SPT @ 1 M		
1.0	($N_{avg} = 9$)	6/8/10 = 18 Blows		
	WHITE BLUE BROWN WEATHERED ROCK (Below 1.0-M)			
	1.0- to 2.0-m – $\phi = 32^o$; $\gamma_t = 1.7$ tons/M^3	SPT @ 2 M 22/		
2.0	($N_{avg} = 18$)	3 cms for 10 Blows		
GWL		2 cms for 10 Blows (Hammer Rebound)		
	-NX TC bit drilling from 3- to 3.4-m in 30 minutes	SPT @ 3 M		
3.0	-NX Diamond bit drilling from 3.4-m	6 cms for 15 Blows		
	2.0- to 3.0-m – $\phi = 38^o$; $\gamma_t = 2.2$ tons/M^3	1 cm for 5 Blows		
	($N_{avg} > 100$)	(Hammer Rebound)		
		SPT @ 4 M (SNR)		
4.0	-drilled from 3.4- to 4-m in 30 minutes	0.5 cms for 5 Blows		
	-wea. rock pieces recovered drilling to 4-m	0 cms for 5 Blows (Hammer Rebound)		
	-drilled from 4- to 5-m in 45 minutes	SPT @ 5 M (SNR)		
5.0	-14 cms wea. rock core recovered drilling to 5-m	0 cms for 5 Blows		
	4.0- to 6.0-m – $\phi = 39^o$; $\gamma_t = 2.25$ tons/M^3	(Hammer Rebound)		
	($N_{avg} >> 100$)			
		SPT @ 6 M (SNR)		
6.0	-drilled from 5- to 6-m in 50 minutes	0 cms for 5 Blows		
	-12 cms wea. rock core recovered drilling to 6-m	(Hammer Rebound)		
7.0				
8.0				
9.0				
10.0				

BORE HOLE TERMINATED AT 6.0-M.

SPT=Standard Penetration Test; DS=Disturbed Sample; UDS = UnDisturbed Sample; WS=Water Sample; SNR=Sample Not Recovered; LS = Liner Sample; +----+ = Plastic and Liquid Limits; ♦ = N M C; ■ = % -75μ Size

PLATE 10

LOG OF BORING

Project: Proposed Residential Apartments and Villa Buildings Site, S. No. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4, Vengaivasal Village, Tambaram Taluk, Kancheepuram District, TN.

Bore Hole No.: 10 **Type of Boring:** Calyx Drill **Dia. of Hole:** 150 mm
Started on: 1-12-'18 **Ended on:** 1-12-'18 **Field Work In Charge:** R Murugesan
Final Depth: 5.0-M **Depth to G W S:** 2.1-M **Remarks:** GWL in Open Well.

DEPTH, M	SOIL DESCRIPTION	SPT / VANE & SAMPLE TYPE	SPT "N" PROFILE 25 50 75	INDEX TEST DATA 25 50 75
	BROWN SILTY FINE TO MEDIUM SAND with roots (To 1.0-M)	SPT @ 0.25 M 4/6/7 = 13 Blows		
	0.0- to 1.0-m – $\phi = 31^o$; $\gamma_t = 1.65$ tons/M^3	SPT @ 1 M		
1.0	($N_{avg} = 13$)	8/10/14 = 24 Blows		
	BROWN WEATHERED ROCK (To 3.2-M)			
	1.0- to 2.0-m – $\phi = 33^o$; $\gamma_t = 1.75$ tons/M^3			
	($N_{avg} = 24$)	SPT @ 2 M		
2.0		6 cms for 15 Blows		
GWL		1 cm for 5 Blows		
	2.0- to 3.2-m – $\phi = 38^o$; $\gamma_t = 2.2$ tons/M^3	(Hammer Rebound)		
	($N_{avg} > 100$)	SPT @ 3 M (SNR)		
3.0	-NX TC bit drilling from 3- to 3.2-m in 30 minutes	1.5 cms for 15 Blows		
	-NX Diamond bit drilling from 3.2-m	0 cms for 5 Blows		
	GRAY GRANITE (Below 3.2-M)	(Hammer Rebound)		
	-drilled from 3.2- to 4-m in 140 minutes	SPT @ 4 M (SNR)		
4.0	-90 cms granite rock core recovered drilling to 4-m	0 cms for 5 Blows		
	3.2- to 5.0-m – $\phi = 42^o$; $\gamma_t = 2.35$ tons/M^3	(Hammer Rebound)		
	($N_{avg} >> 100$)			
		SPT @ 5 M (SNR)		
5.0	-drilled from 4- to 5-m in 100 minutes	0 cms for 5 Blows		
	-80 cms granite rock core recovered drilling to 5-m	(Hammer Rebound)		
6.0				
7.0				
8.0				
9.0				
10.0				

BORE HOLE TERMINATED AT 5.0-M.

SPT=Standard Penetration Test; DS=Disturbed Sample; UDS = UnDisturbed Sample; WS=Water Sample; SNR=Sample Not Recovered; LS = Liner Sample; +----+ = Plastic and Liquid Limits; ♦ = N M C; ■ = % -75μ Size

PLATE 11

LOG OF BORING

Project: Proposed Residential Apartments and Villa Buildings Site, S. No. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4, Vengaivasal Village, Tambaram Taluk, Kancheepuram District, TN.

Bore Hole No.: 11 **Type of Boring:** Calyx Drill **Dia. of Hole:** 150 mm
Started on: 5-12-'18 **Ended on:** 5-12-'18 **Field Work In Charge:** R Murugesan
Final Depth: 7.0-M **Depth to G W S:** 2.1-M **Remarks:** GWL in Open Well.

DEPTH, M	SOIL DESCRIPTION	SPT / VANE & SAMPLE TYPE	SPT "N" PROFILE 25 50 75	INDEX TEST DATA 25 50 75
	BROWN SILTY FINE TO MEDIUM SAND with roots (To 1.0-M)	SPT @ 0.25 M 3/4/5 = 9 Blows		
	0.0- to 1.0-m – $\phi = 29^o$; $\gamma_t = 1.6$ tons/M^3	SPT @ 1 M		
1.0	($N_{avg} = 9$)	5/6/8 = 14 Blows		
	BROWN FINE TO COARSE SAND with silt (To 2.0-M) ($N_{avg} = 14$)			
	1.0- to 2.0-m – $\phi = 31^o$; $\gamma_t = 1.65$ tons/M^3	SPT @ 2 M 15/28/		
2.0	-NX TC bit drilling from 2-m	6 cms for 15 Blows		
GWL	BROWN GRAY WEATHERED ROCK	1 cm for 5 Blows		
	(Below 2.0-M) ($N_{avg} > 75$)	(Hammer Rebound)		
	2.0- to 3.0-m – $\phi = 37^o$; $\gamma_t = 2.1$ tons/M^3	SPT @ 3 M (SNR)		
3.0	-drilled from 2- to 3-m in 35 minutes	1 cm for 10 Blows		
	-NX Diamond bit drilling from 3-m	0.5 cms for 5 Blows (Hammer Rebound)		
		SPT @ 4 M (SNR)		
4.0	-drilled from 3- to 4-m in 55 minutes	0.5 cms for 10 Blows		
	-9 cms wea. rock core recovered drilling to 4-m	0 cms for 5 Blows (Hammer Rebound)		
		SPT @ 5 M (SNR)		
5.0	-drilled from 4- to 5-m in 45 minutes	0 cms for 5 Blows		
	3.0- to 7.0-m – $\phi = 39^o$; $\gamma_t = 2.25$ tons/M^3	(Hammer Rebound)		
	($N_{avg} >> 100$)			
		SPT @ 6 M (SNR)		
6.0	-drilled from 5- to 6-m in 45 minutes	0.5 cms for 5 Blows		
	-wea. rock pieces recovered drilling to 6-m	0 cms for 5 Blows (Hammer Rebound)		
		SPT @ 7 M (SNR)		
7.0	-drilled from 6- to 7-m in 60 minutes	0 cms for 5 Blows		
	-24 cms rock core recovered drilling to 7-m	(Hammer Rebound)		
8.0				
9.0				
10.0				

BORE HOLE TERMINATED AT 7.0-M.

SPT=Standard Penetration Test; DS=Disturbed Sample; UDS = UnDisturbed Sample; WS=Water Sample; SNR=Sample Not Recovered; LS = Liner Sample; +----+ = Plastic and Liquid Limits; ♦ = N M C; ■ = % -75μ Size

PLATE 12

LOG OF BORING

Project: Proposed Residential Apartments and Villa Buildings Site, S. No. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4, Vengaivasal Village, Tambaram Taluk, Kancheepuram District, TN.

Bore Hole No.: 12 **Type of Boring:** Calyx Drill **Dia. of Hole:** 150 mm
Started on: 5-12-'18 **Ended on:** 5-12-'18 **Field Work In Charge:** M Munivel
Final Depth: 7.0-M **Depth to G W S:** 2.1-M **Remarks:** GWL in Open Well.

DEPTH, M	SOIL DESCRIPTION	SPT / VANE & SAMPLE TYPE	SPT "N" PROFILE 25 50 75	INDEX TEST DATA 25 50 75
	WHITE BROWN FINE TO COARSE SAND with silt and gravel (To 2.0-M)	SPT @ 0.25 M 2/3/4 = 7 Blows		■♦
1.0	0.0- to 2.0-m – $\phi = 27^o$; $\gamma_t = 1.55$ tons/M^3 ($N_{avg} = 7$)	SPT @ 1 M 2/3/4 = 7 Blows		■ ♦
2.0		SPT @ 2 M 3 cms for 10 Blows		■♦
GWL	WHITE BLUE BROWN WEATHERED ROCK (Below 2.0-M)	2 cms for 10 Blows (Hammer Rebound)		
3.0	2.0- to 3.0-m – $\phi = 38^o$; $\gamma_t = 2.2$ tons/M^3 ($N_{avg} > 100$)	SPT @ 3 M 1 cm for 10 Blows		
	-NX TC bit drilling from 3- to 3.6-m in 40 minutes	1 cm for 10 Blows (Hammer Rebound)		
4.0	-NX Diamond bit drilling from 3.6-m -drilled from 3.6- to 4-m in 30 minutes	SPT @ 4 M (SNR) 0.5 cms for 5 Blows		
		0 cms for 5 Blows (Hammer Rebound)		
5.0	-drilled from 4- to 5-m in 40 minutes -wea. rock pieces recovered drilling to 5-m	SPT @ 5 M (SNR) 0.5 cms for 5 Blows		
	3.0- to 7.0-m – $\phi = 39^o$; $\gamma_t = 2.25$ tons/M^3 ($N_{avg} >> 100$)	0 cms for 5 Blows (Hammer Rebound)		
6.0	-drilled from 5- to 6-m in 45 minutes -wea. rock pieces recovered drilling to 6-m	SPT @ 6 M (SNR) 0 cms for 5 Blows (Hammer Rebound)		
7.0	-drilled from 6- to 7-m in 40 minutes -5 cms rock core recovered drilling to 7-m	SPT @ 7 M (SNR) 0 cms for 5 Blows (Hammer Rebound)		
8.0				
9.0				
10.0				

BORE HOLE TERMINATED AT 7.0-M.

SPT=Standard Penetration Test; DS=Disturbed Sample; UDS = UnDisturbed Sample; WS=Water Sample; SNR=Sample Not Recovered; LS = Liner Sample; +----+ = Plastic and Liquid Limits; ♦ = N M C; ■ = % -75μ Size

PLATE 13

LOG OF BORING

Project: Proposed Residential Apartments and Villa Buildings Site, S. No. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4, Vengaivasal Village, Tambaram Taluk, Kancheepuram District, TN.

Bore Hole No.: 13 **Type of Boring:** Calyx Drill **Dia. of Hole:** 150 mm
Started on: 4-12-'18 **Ended on:** 4-12-'18 **Field Work In Charge:** R Murugesan
Final Depth: 7.0-M **Depth to G W S:** 2.1-M **Remarks:** GWL in Open Well.

DEPTH, M	SOIL DESCRIPTION	SPT / VANE & SAMPLE TYPE	SPT "N" PROFILE 25 50 75	INDEX TEST DATA 25 50 75
	BROWN STIFF CLAY (To 1.0-M)	SPT @ 0.25 M		
	0.0- to 1.0-m – C_u = 5 tons/M^2; γ_t = 1.6 tons/M^3	2/3/5 = 8 Blows		
	(N_{avg} ~ 8)	SPT @ 1 M		
1.0		5/8/11 = 19 Blows		
	GRAY BROWN WEATHERED ROCK (Below 1.0-M)			
	1.0- to 2.0-m – ϕ = 32°; γ_t = 1.7 tons/M^3	SPT @ 2 M 28/		
2.0	(N_{avg} = 19)	2 cms for 10 Blows		
GWL		2 cms for 10 Blows		
		(Hammer Rebound)		
	-NX TC bit drilling from 3-m	SPT @ 3 M 30/		
3.0	2.0- to 4.0-m – ϕ = 38°; γ_t = 2.2 tons/M^3	2 cms for 10 Blows		
	(N_{avg} > 100)	2 cms for 10 Blows		
		(Hammer Rebound)		
4.0	-drilled from 3- to 4-m in 25 minutes	SPT @ 4 M (SNR) 0.5 cms for 10 Blows		
	-NX Diamond bit drilling from 4-m	0 cms for 5 Blows		
		(Hammer Rebound)		
5.0	-drilled from 4- to 5-m in 45 minutes	SPT @ 5 M (SNR) 0.5 cms for 10 Blows		
		0 cms for 5 Blows		
	4.0- to 7.0-m – ϕ = 39°; γ_t = 2.25 tons/M^3	(Hammer Rebound)		
	(N_{avg} >> 100)	SPT @ 6 M (SNR)		
6.0	-drilled from 5- to 6-m in 45 minutes	0 cms for 5 Blows		
	-12 cms wea. rock core recovered drilling to 6-m	(Hammer Rebound)		
		SPT @ 7 M (SNR)		
7.0	-drilled from 6- to 7-m in 40 minutes	0.5 cms for 10 Blows		
	-14 cms wea. rock core recovered drilling to 7-m	0 cms for 5 Blows		
		(Hammer Rebound)		
8.0				
9.0				
10.0				

BORE HOLE TERMINATED AT 7.0-M.

SPT=Standard Penetration Test; DS=Disturbed Sample; UDS = UnDisturbed Sample; WS=Water Sample; SNR=Sample Not Recovered; LS = Liner Sample; +----+ = Plastic and Liquid Limits; ♦ = N M C; ■ = % -75μ Size

PLATE 14

LOG OF BORING

Project: Proposed Residential Apartments and Villa Buildings Site, S. No. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4, Vengaivasal Village, Tambaram Taluk, Kancheepuram District, TN.

Bore Hole No.: 14 **Type of Boring:** Calyx Drill **Dia. of Hole:** 150 mm
Started on: 4-12-'18 **Ended on:** 4-12-'18 **Field Work In Charge:** R Murugesan
Final Depth: 7.0-M **Depth to G W S:** 2.1-M **Remarks:** GWL in Open Well.

DEPTH, M	SOIL DESCRIPTION	SPT / VANE & SAMPLE TYPE	SPT "N" PROFILE 25 50 75	INDEX TEST DATA 25 50 75
	BROWN FINE TO COARSE SAND with silt (To 2.0-M)	SPT @ 0.25 M 2/3/3 = 6 Blows		
1.0	0.0- to 1.0-m – $\phi = 27^o$; $\gamma_t = 1.55$ tons/M^3 ($N_{avg} = 6$)	SPT @ 1 M 4/16/19 = 35 Blows		
	1.0- to 2.0-m – $\phi = 35^o$; $\gamma_t = 1.95$ tons/M^3 ($N_{avg} = 35$)			
2.0		SPT @ 2 M 12/20/24 = 44 Blows		
GWL	WHITE BLUE BROWN WEATHERED ROCK (Below 2.0-M)			
3.0	2.0- to 3.0-m – $\phi = 36^o$; $\gamma_t = 2.0$ tons/M^3 ($N_{avg} = 44$)	SPT @ 3 M (SNR) 1.5 cms for 15 Blows		
	-NX TC bit drilling from 3-m	0 cms for 5 Blows (Hammer Rebound)		
4.0	-drilled from 3- to 4-m in 40 minutes	SPT @ 4 M (SNR) 0.5 cms for 5 Blows		
	-NX Diamond bit drilling from 4-m	0 cms for 5 Blows (Hammer Rebound)		
5.0	-drilled from 4- to 5-m in 40 minutes -20 cms wea. rock core recovered drilling to 5-m	SPT @ 5 M (SNR) 0 cms for 5 Blows		
	3.0- to 7.0-m – $\phi = 39^o$; $\gamma_t = 2.25$ tons/M^3 ($N_{avg} >> 100$)	(Hammer Rebound)		
6.0	-drilled from 5- to 6-m in 35 minutes	SPT @ 6 M (SNR) 0 cms for 5 Blows		
	-6 cms wea. rock core recovered drilling to 6-m	(Hammer Rebound)		
7.0	-drilled from 6- to 7-m in 50 minutes	SPT @ 7 M (SNR) 0 cms for 5 Blows		
	-21 cms wea. rock core recovered drilling to 7-m	(Hammer Rebound)		
8.0				
9.0				
11.0				

BORE HOLE TERMINATED AT 7.0-M.

SPT=Standard Penetration Test; DS=Disturbed Sample; UDS = UnDisturbed Sample; WS=Water Sample; SNR=Sample Not Recovered; LS = Liner Sample; +----+ = Plastic and Liquid Limits; ♦ = N M C; ■ = % -75μ Size

PLATE 15

LOG OF BORING

Project: Proposed Residential Apartments and Villa Buildings Site, S. No. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4, Vengaivasal Village, Tambaram Taluk, Kancheepuram District, TN.

Bore Hole No.: 15 **Type of Boring:** Calyx Drill **Dia. of Hole:** 150 mm
Started on: 3-12-'18 **Ended on:** 3-12-'18 **Field Work In Charge:** M Munivel
Final Depth: 7.0-M **Depth to G W S:** 2.1-M **Remarks:** GWL in Open Well.

DEPTH, M	SOIL DESCRIPTION	SPT / VANE & SAMPLE TYPE	SPT "N" PROFILE 25 50 75	INDEX TEST DATA 25 50 75
	BROWN FINE TO MEDIUM SADN with silt (To 1.0-M)	SPT @ 0.25 M 4/6/8 = 14 Blows		
	0.0- to 1.0-m – $\phi = 31^o$; $\gamma_t = 1.65$ tons/M^3	SPT @ 1 M		
1.0	($N_{avg} = 14$)	6/8/10 = 18 Blows		
	WHITE BLUE BROWN WEATHERED ROCK (Below 1.0-M)			
	1.0- to 2.0-m – $\phi = 32^o$; $\gamma_t = 1.7$ tons/M^3	SPT @ 2 M 12/22/		
2.0	($N_{avg} = 18$)	3 cms for 10 Blows		
GWL		2 cms for 10 Blows (Hammer Rebound)		
	2.0- to 4.0-m – $\phi = 38^o$; $\gamma_t = 2.2$ tons/M^3	SPT @ 3 M		
3.0	($N_{avg} > 100$)	3 cms for 10 Blows		
	-NX TC bit drilling from 3- to 3.4-m in 35 minutes	2 cms for 10 Blows		
	-NX Diamond bit drilling from 3.4-m	(Hammer Rebound)		
4.0	-drilled from 3.4- to 4-m in 25 minutes	SPT @ 4 M (SNR) 0.5 cms for 10 Blows		
	-4 cms wea. rock core recovered drilling to 4-m	0 cms for 5 Blows (Hammer Rebound)		
5.0	-drilled from 4- to 5-m in 55 minutes	SPT @ 5 M (SNR) 0 cms for 5 Blows		
	-9 cms wea. rock core recovered drilling to 5-m	(Hammer Rebound)		
	4.0- to 7.0-m – $\phi = 39^o$; $\gamma_t = 2.25$ tons/M^3			
	($N_{avg} >> 100$)	SPT @ 6 M (SNR)		
6.0	-drilled from 5- to 6-m in 70 minutes	0 cms for 5 Blows		
	-12.5 cms wea. rock core recovered drilling to 6-m	(Hammer Rebound)		
7.0	-drilled from 6- to 7-m in 40 minutes	SPT @ 7 M (SNR) 0 cms for 5 Blows		
	-5 cms wea. rock core recovered drilling to 7-m	(Hammer Rebound)		
8.0				
9.0				
10.0				

BORE HOLE TERMINATED AT 7.0-M.

SPT=Standard Penetration Test; DS=Disturbed Sample; UDS = UnDisturbed Sample; WS=Water Sample; SNR=Sample Not Recovered; LS = Liner Sample; +----+ = Plastic and Liquid Limits; ♦ = N M C; ■ = % -75μ Size

PLATE 16

LOG OF BORING

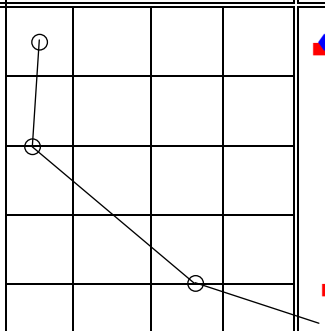
Project: Proposed Residential Apartments and Villa Buildings Site, S. No. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4, Vengaivasal Village, Tambaram Taluk, Kancheepuram District, TN.

Bore Hole No.: 16 **Type of Boring:** Calyx Drill **Dia. of Hole:** 150 mm
Started on: 3-12-'18 **Ended on:** 3-12-'18 **Field Work In Charge:** R Murugesan
Final Depth: 7.0-M **Depth to G W S:** 2.1-M **Remarks:** GWL in Open Well.

DEPTH, M	SOIL DESCRIPTION	SPT / VANE & SAMPLE TYPE
	BROWN FINE TO MEDIUM SAND with silt (To 1.0-M)	SPT @ 0.25 M 4/6/7 = 13 Blows
	0.0- to 1.0-m – $\phi = 31^o$; $\gamma_t = 1.65$ tons/M^3	SPT @ 1 M
1.0	($N_{avg} = 13$)	3/3/5 = 8 Blows
	GRAY WHITE BROWN WEATHERED ROCK (Below 1.0-M)	
	1.0- to 2.0-m – $\phi = 29^o$; $\gamma_t = 1.6$ tons/M^3	SPT @ 2 M 11/28/
2.0	($N_{avg} = 8$)	4 cms for 10 Blows
GWL		4 cms for 10 Blows
	2.0- to 3.0-m – $\phi = 36^o$; $\gamma_t = 2.05$ tons/M^3	
	($N_{avg} \sim 65$)	SPT @ 3 M
3.0	-NX TC bit drilling from 3-m	3 cms for 10 Blows
		2 cms for 10 Blows
	3.0- to 4.0-m – $\phi = 38^o$; $\gamma_t = 2.2$ tons/M^3	(Hammer Rebound)
	($N_{avg} > 100$)	SPT @ 4 M (SNR)
4.0	-drilled from 3- to 4-m in 30 minutes	1.5 cms for 15 Blows
	-NX Diamond bit drilling from 4-m	0 cms for 5 Blows
	-brownish gray color, 4- to 7-m	(Hammer Rebound)
		SPT @ 5 M (SNR)
5.0	-drilled from 4- to 5-m in 50 minutes	0.5 cms for 10 Blows
	-wea. rock pieces recovered drilling to 5-m	0 cms for 10 Blows
	4.0- to 7.0-m – $\phi = 39^o$; $\gamma_t = 2.25$ tons/M^3	(Hammer Rebound)
	($N_{avg} >> 100$)	SPT @ 6 M (SNR)
6.0	-drilled from 5- to 6-m in 65 minutes	0.5 cms for 10 Blows
		0 cms for 5 Blows
		(Hammer Rebound)
		SPT @ 7 M (SNR)
7.0	-drilled from 6- to 7-m in 75 minutes	0 cms for 5 Blows
	-wea. rock pieces recovered drilling to 7-m	(Hammer Rebound)
8.0		
9.0		
10.0		

SPT "N" PROFILE: 25 50 75

INDEX TEST DATA: 25 50 75



BORE HOLE TERMINATED AT 7.0-M.

SPT=Standard Penetration Test; DS=Disturbed Sample; UDS = UnDisturbed Sample; WS=Water Sample; SNR=Sample Not Recovered; LS = Liner Sample; +----+ = Plastic and Liquid Limits; ♦ = N M C; ■ = % -75μ Size

PLATE 17

LOG OF BORING

Project: Proposed Residential Apartments and Villa Buildings Site, S. No. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4, Vengaivasal Village, Tambaram Taluk, Kancheepuram District, TN.

Bore Hole No.: 17 **Type of Boring:** Calyx Drill **Dia. of Hole:** 150 mm
Started on: 2-12-'18 **Ended on:** 2-12-'18 **Field Work In Charge:** M Munivel
Final Depth: 6.0-M **Depth to G W S:** 2.1-M **Remarks:** GWL in Open Well.

DEPTH, M	SOIL DESCRIPTION	SPT / VANE & SAMPLE TYPE	SPT "N" PROFILE 25 50 75	INDEX TEST DATA 25 50 75
	BROWN GRAY SILTY FINE TO MEDIUM SAND with roots and gravel (To 1.0-M)	SPT @ 0.25 M 3/4/6 = 10 Blows		
	0.0- to 1.0-m – $\phi = 30^o$; $\gamma_t = 1.6$ tons/M^3	SPT @ 1 M 12/18/		
1.0	($N_{avg} = 10$)	3 cms for 10 Blows		
	WHITE BLUE BROWN WEATHERED ROCK (Below 1.0-M) ($N_{avg} > 75$)	2 cms for 10 Blows (Hammer Rebound)		
	1.0- to 2.0-m – $\phi = 37^o$; $\gamma_t = 2.1$ tons/M^3	SPT @ 2 M (SNR)		
2.0	-NX TC bit drilling from 2- to 2.6-m in 40 minutes	1.5 cms for 10 Blows		
GWL		1 cm for 10 Blows		
	-NX Diamond bit drilling from 2.6-m	(Hammer Rebound)		
		SPT @ 3 M (SNR)		
3.0	-drilled from 2.6- to 3-m in 30 minutes	3 cms for 10 Blows		
	-wea. rock pieces recovered drilling to 3-m	2 cms for 10 Blows		
	2.0- to 4.0-m – $\phi = 38^o$; $\gamma_t = 2.2$ tons/M^3	(Hammer Rebound)		
	($N_{avg} > 100$)	SPT @ 4 M (SNR)		
4.0	-drilled from 3- to 4-m in 80 minutes	0.5 cms for 5 Blows		
	-22 cms wea. rock core recovered drilling to 4-m	0 cms for 5 Blows (Hammer Rebound)		
	-drilled from 4- to 5-m in 65 minutes	SPT @ 5 M (SNR)		
5.0	-25.5 cms wea. rock core recovered drilling to 5-m	0 cms for 5 Blows		
	4.0- to 6.0-m – $\phi = 39^o$; $\gamma_t = 2.25$ tons/M^3	(Hammer Rebound)		
	($N_{avg} >> 100$)			
		SPT @ 6 M (SNR)		
6.0	-drilled from 5- to 6-m in 80 minutes	0 cms for 5 Blows		
	-29.5 cms wea. rock core recovered drilling to 6-m	(Hammer Rebound)		
7.0				
8.0				
9.0				
10.0				

BORE HOLE TERMINATED AT 6.0-M.

SPT=Standard Penetration Test; DS=Disturbed Sample; UDS = UnDisturbed Sample; WS=Water Sample; SNR=Sample Not Recovered; LS = Liner Sample; +----+ = Plastic and Liquid Limits; ♦ = N M C; ■ = % -75μ Size

PLATE 18

LOG OF BORING

Project: Proposed Residential Apartments and Villa Buildings Site, S. No. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4, Vengaivasal Village, Tambaram Taluk, Kancheepuram District, TN.

Bore Hole No.: 18 **Type of Boring:** Calyx Drill **Dia. of Hole:** 150 mm
Started on: 3-12-'18 **Ended on:** 3-12-'18 **Field Work In Charge:** M Munivel
Final Depth: 7.0-M **Depth to G W S:** 2.1-M **Remarks:** GWL in Open Well.

DEPTH, M	SOIL DESCRIPTION	SPT / VANE & SAMPLE TYPE	SPT "N" PROFILE 25 50 75	INDEX TEST DATA 25 50 75
	BROWN GRAY SILTY FINE TO MEDIUM SAND with roots and gravel (To 1.0-M)	SPT @ 0.25 M 3/4/6 = 10 Blows		
	0.0- to 1.0-m – $\phi = 30^o$; $\gamma_t = 1.6$ tons/M^3	SPT @ 1 M		
1.0	($N_{avg} = 10$)	8/12/17 = 29 Blows		
	WHITE BLUE BROWN WEATHERED ROCK (Below 1.0-M)			
	1.0- to 2.0-m – $\phi = 34^o$; $\gamma_t = 1.85$ tons/M^3	SPT @ 2 M		
2.0	($N_{avg} = 29$)	3 cms for 10 Blows		
GWL	-NX TC bit drilling from 2- to 2.45-m in 35 minutes	1 cm for 10 Blows		
	-NX Diamond bit drilling from 2.45-m	(Hammer Rebound)		
		SPT @ 3 M (SNR)		
3.0	-drilled from 2.45- to 3-m in 30 minutes	0.5 cms for 5 Blows		
		0 cms for 5 Blows		
		(Hammer Rebound)		
		SPT @ 4 M (SNR)		
4.0	-drilled from 3- to 4-m in 65 minutes	0.5 cms for 5 Blows		
	-5 cms wea. rock core recovered drilling to 4-m	0 cms for 5 Blows		
	2.0- to 7.0-m – $\phi = 39^o$; $\gamma_t = 2.25$ tons/M^3	(Hammer Rebound)		
	($N_{avg} >> 100$)	SPT @ 5 M (SNR)		
5.0	-drilled from 4- to 5-m in 40 minutes	0 cms for 5 Blows		
	-wea. rock pieces recovered drilling to 5-m	(Hammer Rebound)		
		SPT @ 6 M (SNR)		
6.0	-drilled from 5- to 6-m in 55 minutes	0 cms for 5 Blows		
	-6 cms wea. rock core recovered drilling to 6-m	(Hammer Rebound)		
		SPT @ 7 M (SNR)		
7.0	-drilled from 6- to 7-m in 40 minutes	0 cms for 5 Blows		
	-wea. rock pieces recovered drilling to 7-m	(Hammer Rebound)		
8.0				
9.0				
10.0				

BORE HOLE TERMINATED AT 7.0-M.

SPT=Standard Penetration Test; DS=Disturbed Sample; UDS = UnDisturbed Sample; WS=Water Sample; SNR=Sample Not Recovered; LS = Liner Sample; +----+ = Plastic and Liquid Limits; ♦ = N M C; ■ = % -75μ Size

PLATE 19

LOG OF BORING

Project: Proposed Residential Apartments and Villa Buildings Site, S. No. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4, Vengaivasal Village, Tambaram Taluk, Kancheepuram District, TN.

Bore Hole No.: 19 **Type of Boring:** Calyx Drill **Dia. of Hole:** 150 mm
Started on: 1-12-'18 **Ended on:** 1-12-'18 **Field Work In Charge:** M Munivel
Final Depth: 6.0-M **Depth to G W S:** 2.1-M **Remarks:** GWL in Open Well.

DEPTH, M	SOIL DESCRIPTION	SPT / VANE & SAMPLE TYPE	SPT "N" PROFILE 25 50 75	INDEX TEST DATA 25 50 75
	GRAY BROWN FINE TO MEDIUM SAND with silt and gravel (To 1.0-M)	SPT @ 0.25 M 3/3/7 = 10 Blows		
	0.0- to 1.0-m – $\phi = 30^o$; $\gamma_t = 1.6$ tons/M^3	SPT @ 1 M		
1.0	($N_{avg} = 10$)	8/12/16 = 28 Blows		
	WHITE BLUE BROWN WEATHERED ROCK (Below 1.0-M)			
	1.0- to 2.0-m – $\phi = 34^o$; $\gamma_t = 1.85$ tons/M^3	SPT @ 2 M (SNR)		
2.0	($N_{avg} = 28$)	1.5 cms for 15 Blows		
GWL	-NX TC bit drilling from 2- to 2.5-m in 45 minutes	0 cms for 5 Blows		
	-NX Diamond bit drilling from 2.5-m	(Hammer Rebound)		
		SPT @ 3 M (SNR)		
3.0	-drilled from 2.5- to 3-m in 40 minutes	0.5 cms for 5 Blows		
	-wea. rock pieces recovered drilling to 3-m	0 cms for 5 Blows		
		(Hammer Rebound)		
	-drilled from 3- to 4-m in 65 minutes	SPT @ 4 M (SNR)		
4.0	-6 cms wea. rock core recovered drilling to 4-m	0 cms for 5 Blows		
	2.0- to 6.0-m – $\phi = 39^o$; $\gamma_t = 2.25$ tons/M^3	(Hammer Rebound)		
	($N_{avg} >> 100$)			
		SPT @ 5 M (SNR)		
5.0	-drilled from 4- to 5-m in 40 minutes	0 cms for 5 Blows		
		(Hammer Rebound)		
		SPT @ 6 M (SNR)		
6.0	-drilled from 5- to 6-m in 90 minutes	0 cms for 5 Blows		
	-36 cms wea. rock core recovered drilling to 6-m	(Hammer Rebound)		
7.0				
8.0				
9.0				
10.0				

BORE HOLE TERMINATED AT 6.0-M.

SPT=Standard Penetration Test; DS=Disturbed Sample; UDS = UnDisturbed Sample; WS=Water Sample; SNR=Sample Not Recovered; LS = Liner Sample; +----+ = Plastic and Liquid Limits; ♦ = N M C; ■ = % -75μ Size

PLATE 20

LOG OF BORING

Project: Proposed Residential Apartments and Villa Buildings Site, S. No. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4, Vengaivasal Village, Tambaram Taluk, Kancheepuram District, TN.

Bore Hole No.: 20 **Type of Boring:** Calyx Drill **Dia. of Hole:** 150 mm
Started on: 2-12-'18 **Ended on:** 2-12-'18 **Field Work In Charge:** R Murugesan
Final Depth: 7.0-M **Depth to G W S:** 2.1-M **Remarks:** GWL in Open Well.

DEPTH, M	SOIL DESCRIPTION	SPT / VANE & SAMPLE TYPE	SPT "N" PROFILE 25 50 75	INDEX TEST DATA 25 50 75
	BROWN FINE TO MEDIUM SAND with silt and roots (To 1.0-M)	SPT @ 0.25 M 4/6/8 = 14 Blows		
	0.0- to 1.0-m – $\phi = 31^o$; $\gamma_t = 1.65$ tons/M^3	SPT @ 1 M		
1.0	($N_{avg} = 14$)	8/10/16 = 26 Blows		
	GRAY WHITE BROWN WEATHERED ROCK (Below 1.0-M)			
	1.0- to 2.0-m – $\phi = 34^o$; $\gamma_t = 1.85$ tons/M^3	SPT @ 2 M 30/		
2.0	($N_{avg} = 26$)	3 cms for 10 Blows		
GWL		2 cms for 10 Blows		
	2.0- to 3.0-m – $\phi = 38^o$; $\gamma_t = 2.2$ tons/M^3	(Hammer Rebound)		
	($N_{avg} > 100$)	SPT @ 3 M (SNR)		
3.0	-NX TC bit drilling from 3- to 3.5-m in 35 minutes	1 cm for 15 Blows		
		0 cms for 5 Blows		
	-NX Diamond bit drilling from 3.5-m	(Hammer Rebound)		
		SPT @ 4 M (SNR)		
4.0	-drilled from 3.5- to 4-m in 55 minutes	0.5 cms for 10 Blows		
	-wea. rock pieces recovered drilling to 4-m	0 cms for 5 Blows		
		(Hammer Rebound)		
	-drilled from 4- to 5-m in 50 minutes	SPT @ 5 M (SNR)		
5.0	-6 cms wea. rock core recovered drilling to 5-m	0.5 cm for 10 Blows		
	3.0- to 7.0-m – $\phi = 39^o$; $\gamma_t = 2.25$ tons/M^3	0 cms for 5 Blows		
	($N_{avg} >> 100$)	(Hammer Rebound)		
		SPT @ 6 M (SNR)		
6.0	-drilled from 5- to 6-m in 55 minutes	0.5 cms for 10 Blows		
		0 cms for 5 Blows		
		(Hammer Rebound)		
		SPT @ 7 M (SNR)		
7.0	-drilled from 6- to 7-m in 60 minutes	0 cms for 5 Blows		
	-28 cms wea. rock core recovered drilling to 7-m	(Hammer Rebound)		
8.0				
9.0				
10.0				

BORE HOLE TERMINATED AT 7.0-M.

SPT=Standard Penetration Test; DS=Disturbed Sample; UDS = UnDisturbed Sample; WS=Water Sample; SNR=Sample Not Recovered; LS = Liner Sample; +----+ = Plastic and Liquid Limits; ♦ = N M C; ■ = % -75μ Size

PLATE 21

LOG OF BORING

Project: Proposed Residential Apartments and Villa Buildings Site, S. No. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4, Vengaivasal Village, Tambaram Taluk, Kancheepuram District, TN.

Bore Hole No.: 21 **Type of Boring:** Calyx Drill **Dia. of Hole:** 150 mm
Started on: 2-12-'18 **Ended on:** 2-12-'18 **Field Work In Charge:** M Munivel
Final Depth: 8.0-M **Depth to G W S:** 2.1-M **Remarks:** GWL in Open Well.

DEPTH, M	SOIL DESCRIPTION	SPT / VANE & SAMPLE TYPE	SPT "N" PROFILE 25 50 75	INDEX TEST DATA 25 50 75
	GRAY BROWN VERY STIFF SILTY CLAY (To 1.0-M)	SPT @ 0.25 M 4/9/12 = 21 Blows		+♦--------+
	0.0- to 1.0-m – C_u = 13 tons/M^2; γ_t = 1.75 tons/M^3	SPT @ 1 M		
1.0	(N_{avg} = 21)	5/7/10 = 17 Blows		■ ♦
	WHITE BROWN FINE TO COARSE SAND with silt (To 2.0-M) (N_{avg} = 17)			
	1.0- to 2.0-m – ϕ = 32°; γ_t = 1.7 tons/M^3	SPT @ 2 M		
2.0	-NX TC bit drilling from 2-m	3 cms for 10 Blows		■ ♦
GWL	WHITE BLUE BROWN WEATHERED ROCK (Below 2.0-M) (N_{avg} > 100)	2 cms for 10 Blows (Hammer Rebound)		
	2.0- to 3.0-m – ϕ = 38°; γ_t = 2.2 tons/M^3	SPT @ 3 M		
3.0	-drilled from 2- to 3-m in 40 minutes	3 cms for 15 Blows		♦ ■
	-NX Diamond bit drilling from 3-m	0.5 cms for 5 Blows (Hammer Rebound)		
4.0	-drilled from 3- to 4-m in 40 minutes	SPT @ 4 M 2 cms for 10 Blows		♦ ■
		1 cm for 10 Blows (Hammer Rebound)		
5.0	-drilled from 4- to 5-m in 50 minutes	SPT @ 5 M (SNR) 0.5 cms for 5 Blows		
	3.0- to 8.0-m – ϕ = 39°; γ_t = 2.25 tons/M^3	0 cms for 5 Blows (Hammer Rebound)		
	(N_{avg} >> 100)	SPT @ 6 M (SNR)		
6.0	-drilled from 5- to 6-m in 45 minutes	0.5 cms for 5 Blows		
		0 cms for 5 Blows (Hammer Rebound)		
7.0	-drilled from 6- to 7-m in 45 minutes	SPT @ 7 M (SNR) 0 cms for 5 Blows		
		(Hammer Rebound)		
8.0	-drilled from 7- to 8-m in 35 minutes	SPT @ 8 M (SNR) 0 cms for 5 Blows		
	-wea. rock pieces recovered drilling to 8-m	(Hammer Rebound)		
9.0				
10.0				

BORE HOLE TERMINATED AT 8.0-M.

SPT=Standard Penetration Test; DS=Disturbed Sample; UDS = UnDisturbed Sample; WS=Water Sample; SNR=Sample Not Recovered; LS = Liner Sample; +----+ = Plastic and Liquid Limits; ♦ = N M C; ■ = % -75μ Size

PLATE 22

LOG OF BORING

Project: Proposed Residential Apartments and Villa Buildings Site, S. No. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4, Vengaivasal Village, Tambaram Taluk, Kancheepuram District, TN.

Bore Hole No.: 22 **Type of Boring:** Calyx Drill **Dia. of Hole:** 150 mm
Started on: 7-12-'18 **Ended on:** 7-12-'18 **Field Work In Charge:** R Murugesan
Final Depth: 7.0-M **Depth to G W S:** 2.1-M **Remarks:** GWL in Open Well..

DEPTH, M	SOIL DESCRIPTION	SPT / VANE & SAMPLE	SPT "N" PROFILE 25 50 75	INDEX TEST DATA 25 50 75
	BROWN SILTY FINE TO MEDIUM SAND (To 2.0-M)	SPT @ 0.25 M 3/4/4 = 8 Blows		
	0.0- to 1.0-m – $\phi = 28^{o}$; $\gamma_t = 1.6$ tons/M^3	SPT @ 1 M		
1.0	($N_{avg} = 8$)	5/6/8 = 14 Blows		
	1.0- to 2.0-m – $\phi = 31^{o}$; $\gamma_t = 1.65$ tons/M^3			
	($N_{avg} = 14$)	SPT @ 2 M		
2.0		7/8/13 = 21 Blows		
GWL	**WHITE GRAY BROWN WEATHERED ROCK (Below 2.0-M)**			
	2.0- to 3.0-m – $\phi = 33^{o}$; $\gamma_t = 1.75$ tons/M^3	SPT @ 3 M 30/		
3.0	($N_{avg} = 21$)	3 cms for 10 Blows		
	-NX TC bit drilling from 3-m	2 cms for 10 Blows		
	3.0- to 4.0-m – $\phi = 38^{o}$; $\gamma_t = 2.2$ tons/M^3	(Hammer Rebound)		
	($N_{avg} > 100$)	SPT @ 4 M (SNR)		
4.0	-drilled from 3- to 4-m in 35 minutes	0.5 cms for 10Blows		
	-NX Diamond bit drilling from 4-m	0 cms for 5 Blows (Hammer Rebound)		
		SPT @ 5 M (SNR)		
5.0	-drilled from 4- to 5-m in 55 minutes	0.5 cms for 10Blows		
		0 cms for 5 Blows		
	4.0- to 7.0-m – $\phi = 39^{o}$; $\gamma_t = 2.25$ tons/M^3	(Hammer Rebound)		
	($N_{avg} >> 100$)	SPT @ 6 M (SNR)		
6.0	-drilled from 5- to 6-m in 70 minutes	0 cms for 5 Blows		
	-11 cms wea. rock core recovered drilling to 6-m	(Hammer Rebound)		
		SPT @ 7 M (SNR)		
7.0	-drilled from 6- to 7-m in 65 minutes	0 cms for 5 Blows		
	-13 cms wea. rock core recovered drilling to 7-m	(Hammer Rebound)		
8.0				
9.0				
11.0				

BORE HOLE TERMINATED AT 7.0-M.

SPT=Standard Penetration Test; DS=Disturbed Sample; UDS = UnDisturbed Sample; WS=Water Sample; SNR=Sample Not Recovered; LS = Liner Sample; +----+ = Plastic and Liquid Limits; ♦ = N M C; ■ = % -75μ Size

PLATE 23

LOG OF BORING

Project: Proposed Residential Apartments and Villa Buildings Site, S. No. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4, Vengaivasal Village, Tambaram Taluk, Kancheepuram District, TN.

Bore Hole No.: 23 **Type of Boring:** Calyx Drill **Dia. of Hole:** 150 mm
Started on: 7-12-'18 **Ended on:** 7-12-'18 **Field Work In Charge:** M Munivel
Final Depth: 6.6-M **Depth to G W S:** 2.1-M **Remarks:** GWL in Open Well.

DEPTH, M	SOIL DESCRIPTION	SPT / VANE & SAMPLE TYPE	SPT "N" PROFILE 25 50 75	INDEX TEST DATA 25 50 75
	BROWN SILTY FINE TO MEDIUM SAND (To 1.0-M)	SPT @ 0.25 M 3/4/6 = 10 Blows		
	0.0- to 1.0-m – $\phi = 29^o$; $\gamma_t = 1.6$ tons/M^3	SPT @ 1 M		
1.0	($N_{avg} = 10$)	8/12/16 = 28 Blows		
	WHITE BLUE BROWN WEATHERED ROCK (Below 1.0-M)			
	1.0- to 2.0-m – $\phi = 34^o$; $\gamma_t = 1.85$ tons/M^3	SPT @ 2 M (SNR)		
2.0	($N_{avg} = 28$)	1 cm for 10 Blows		
GWL	-NX TC bit drilling from 2-m	1 cm for 10 Blows (Hammer Rebound)		
		SPT @ 3 M (SNR)		
3.0	-drilled from 2- to 3-m in 40 minutes	0.5 cms for 5 Blows		
	-NX Diamond bit drilling from 3-m	0 cms for 5 Blows (Hammer Rebound)		
		SPT @ 4 M (SNR)		
4.0	-drilled from 3- to 4-m in 55 minutes	0 cms for 5 Blows (Hammer Rebound)		
	2.0- to 6.6-m – $\phi = 39^o$; $\gamma_t = 2.25$ tons/M^3			
	($N_{avg} >> 100$)	SPT @ 5 M (SNR)		
5.0	-drilled from 4- to 5-m in 65 minutes	0 cms for 5 Blows		
	-rock pieces recovered drilling to 5-m	(Hammer Rebound)		
		SPT @ 6 M (SNR)		
6.0	-drilled from 5- to 6-m in 80 minutes	0 cms for 5 Blows		
	-15 cms wea. rock core recovered drilling to 6-m	(Hammer Rebound) SPT @ 6.6 M (SNR)		
	-drilled from 6- to 6.6-m in 45 minutes	0 cms for 5 Blows		
7.0	-6 cms wea. rock core recovered drilling to 6.6-m	(Hammer Rebound)		
8.0				
9.0				
10.0				

BORE HOLE TERMINATED AT 6.6-M.

SPT=Standard Penetration Test; DS=Disturbed Sample; UDS = UnDisturbed Sample; WS=Water Sample; SNR=Sample Not Recovered; LS = Liner Sample; +----+ = Plastic and Liquid Limits; ♦ = N M C; ■ = % -75μ Size

PLATE 24

LOG OF BORING

Project: Proposed Residential Apartments and Villa Buildings Site, S. No. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4, Vengaivasal Village, Tambaram Taluk, Kancheepuram District, TN.

Bore Hole No.: 24 **Type of Boring:** Calyx Drill **Dia. of Hole:** 150 mm
Started on: 7-12-'18 **Ended on:** 7-12-'18 **Field Work In Charge:** M Munivel
Final Depth: 7.0-M **Depth to G W S:** 2.1-M **Remarks:** GWL in Open Well.

DEPTH, M	SOIL DESCRIPTION	SPT / VANE & SAMPLE TYPE	SPT "N" PROFILE 25 50 75	INDEX TEST DATA 25 50 75
	GRAY BROWN SILTY FINE TO MEDIUM SAND (To 2.0-M)	SPT @ 0.25 M 3/4/5 = 9 Blows		
1.0	0.0- to 2.0-m – $\phi = 29^o$; $\gamma_t = 1.6$ tons/M^3 ($N_{avg} = 9$)	SPT @ 1 M 4/5/5 = 10 Blows		
2.0		SPT @ 2 M 18/ 4 cms for 10 Blows		
GWL	WHITE BLUE BROWN WEATHERED ROCK (Below 2.0-M)	3 cms for 10 Blows (Hammer Rebound)		
3.0	2.0- to 3.0-m – $\phi = 37^o$; $\gamma_t = 2.1$ tons/M^3 ($N_{avg} > 75$)	SPT @ 3 M 25/ 3 cms for 10 Blows		
	-NX TC bit drilling from 3-m	2 cms for 10 Blows (Hammer Rebound)		
	3.0- to 4.0-m – $\phi = 38^o$; $\gamma_t = 2.2$ tons/M^3 ($N_{avg} > 100$)	SPT @ 4 M (SNR)		
4.0	-drilled from 3- to 4-m in 40 minutes	1.5 cms for 15 Blows		
	-NX Diamond bit drilling from 4-m	0 cms for 5 Blows (Hammer Rebound)		
5.0	-drilled from 4- to 5-m in 50 minutes	SPT @ 5 M (SNR) 0.5 cms for 5 Blows		
	-wea. rock pieces recovered drilling to 5-m	0 cms for 5 Blows (Hammer Rebound)		
	4.0- to 7.0-m – $\phi = 39^o$; $\gamma_t = 2.25$ tons/M^3 ($N_{avg} >> 100$)	SPT @ 6 M (SNR)		
6.0	-drilled from 5- to 6-m in 65 minutes	0 cms for 5 Blows		
	-wea. rock pieces recovered drilling to 6-m	(Hammer Rebound)		
7.0	-drilled from 6- to 7-m in 50 minutes	SPT @ 7 M (SNR) 0 cms for 5 Blows		
	-wea. rock pieces recovered drilling to 7-m	(Hammer Rebound)		
8.0				
9.0				
10.0				

BORE HOLE TERMINATED AT 7.0-M.

SPT=Standard Penetration Test; DS=Disturbed Sample; UDS = UnDisturbed Sample; WS=Water Sample; SNR=Sample Not Recovered; LS = Liner Sample; +----+ = Plastic and Liquid Limits; ♦ = N M C; ■ = % -75μ Size

PLATE 25

LOG OF BORING

Project: Proposed Residential Apartments and Villa Buildings Site, S. No. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4, Vengaivasal Village, Tambaram Taluk, Kancheepuram District, TN.

Bore Hole No.: 25 **Type of Boring:** Calyx Drill **Dia. of Hole:** 150 mm
Started on: 6-12-'18 **Ended on:** 6-12-'18 **Field Work In Charge:** M Munivel
Final Depth: 7.0-M **Depth to G W S:** 2.1-M **Remarks:** GWL in Open Well.

DEPTH, M	SOIL DESCRIPTION	SPT / VANE & SAMPLE TYPE	SPT "N" PROFILE 25 50 75	INDEX TEST DATA 25 50 75
	GRAY BROWN SILTY FINE TO MEDIUM SAND with gravel (To 1.0-M)	SPT @ 0.25 M 3/4/5 = 9 Blows		♦■
	0.0- to 1.0-m – $\phi = 29^o$; $\gamma_t = 1.6$ tons/M^3	SPT @ 1 M 22/		
1.0	($N_{avg} = 9$)	3 cms for 10 Blows		■ ♦
	WHITE BLUE BROWN WEATHERED ROCK (Below 1.0-M)	2 cms for 10 Blows (Hammer Rebound)		
	1.0- to 2.0-m – $\phi = 38^o$; $\gamma_t = 2.2$ tons/M^3	SPT @ 2 M (SNR)		
2.0	($N_{avg} > 100$)	2 cms for 20 Blows		
GWL	-NX TC bit drilling from 2-m	(Hammer Rebound)		
		SPT @ 3 M (SNR)		
3.0	-drilled from 2- to 3-m in 40 minutes	0.5 cms for 10 Blows		
	-NX Diamond bit drilling from 3-m	0 cms for 5 Blows (Hammer Rebound)		
		SPT @ 4 M (SNR)		
4.0	-drilled from 3- to 4-m in 45 minutes	0.5 cms for 10 Blows		
	-wea. rock pieces recovered drilling to 4-m	0 cms for 5 Blows		
	2.0- to 7.0-m – $\phi = 39^o$; $\gamma_t = 2.25$ tons/M^3	(Hammer Rebound)		
	($N_{avg} >> 100$)	SPT @ 5 M (SNR)		
5.0	-drilled from 4- to 5-m in 40 minutes	0 cms for 5 Blows		
	-wea. rock pieces recovered drilling to 5-m	(Hammer Rebound)		
		SPT @ 6 M (SNR)		
6.0	-drilled from 5- to 6-m in 60 minutes	0 cms for 5 Blows		
	-12 cms wea. rock core recovered drilling to 6-m	(Hammer Rebound)		
		SPT @ 7 M (SNR)		
7.0	-drilled from 6- to 7-m in 55 minutes	0 cms for 5 Blows		
	-20 cms wea. rock core recovered drilling to 7-m	(Hammer Rebound)		
8.0				
9.0				
10.0				

BORE HOLE TERMINATED AT 7.0-M.

SPT=Standard Penetration Test; DS=Disturbed Sample; UDS = UnDisturbed Sample; WS=Water Sample; SNR=Sample Not Recovered; LS = Liner Sample; +----+ = Plastic and Liquid Limits; ♦ = N M C; ■ = % -75μ Size

PLATE 26

LOG OF BORING

Project: Proposed Residential Apartments and Villa Buildings Site, S. No. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4, Vengaivasal Village, Tambaram Taluk, Kancheepuram District, TN.

Bore Hole No.: 26 **Type of Boring:** Calyx Drill **Dia. of Hole:** 150 mm
Started on: 6-12-'18 **Ended on:** 6-12-'18 **Field Work In Charge:** M Munivel
Final Depth: 7.0-M **Depth to G W S:** 2.1-M **Remarks:** GWL in Open Well.

DEPTH, M	SOIL DESCRIPTION	SPT / VANE & SAMPLE TYPE	SPT "N" PROFILE 25 50 75	INDEX TEST DATA 25 50 75
	GRAY WHITE BROWN FINE TO COARSE SAND with gravel (To 2.0-M)	SPT @ 0.25 M 4/5/6 = 11 Blows		
	0.0- to 1.0-m – $\phi = 30^o$; $\gamma_t = 1.65$ tons/M^3	SPT @ 1 M		
1.0	($N_{avg} = 11$)	7/8/10 = 18 Blows		
	1.0- to 2.0-m – $\phi = 32^o$; $\gamma_t = 1.7$ tons/M^3			
	($N_{avg} = 18$)	SPT @ 2 M 30/		
2.0		3 cms for 10 Blows		
GWL	WHITE BLUE BROWN WEATHERED ROCK (Below 2.0-M)	2 cms for 10 Blows (Hammer Rebound)		
	-NX TC bit drilling from 3- to 3.55-m in 30 minutes	SPT @ 3 M		
3.0	-NX Diamond bit drilling from 3.55-m	4 cms for 10 Blows		
	2.0- to 4.0-m – $\phi = 37^o$; $\gamma_t = 2.1$ tons/M^3	3 cms for 10 Blows		
	($N_{avg} > 100$)	(Hammer Rebound)		
		SPT @ 4 M (SNR)		
4.0	-drilled from 3.55- to 4-m in 30 minutes	0.5 cms for 10 Blows		
	-6.5 cms wea. rock core recovered drilling to 4-m	0 cms for 5 Blows (Hammer Rebound)		
		SPT @ 5 M (SNR)		
5.0	-drilled from 4- to 5-m in 50 minutes	0 cms for 5 Blows		
	-14.5 cms wea. rock core recovered drilling to 5-m	(Hammer Rebound)		
	4.0- to 7.0-m – $\phi = 39^o$; $\gamma_t = 2.25$ tons/M^3			
	($N_{avg} >> 100$)	SPT @ 6 M (SNR)		
6.0	-drilled from 5- to 6-m in 50 minutes	0 cms for 5 Blows		
	-22 cms wea. rock core recovered drilling to 6-m	(Hammer Rebound)		
		SPT @ 7 M (SNR)		
7.0	-drilled from 6- to 7-m in 55 minutes	0 cms for 5 Blows		
	-35 cms wea. rock core recovered drilling to 9-m	(Hammer Rebound)		
8.0				
9.0				
10.0				

BORE HOLE TERMINATED AT 7.0-M.

SPT=Standard Penetration Test; DS=Disturbed Sample; UDS = UnDisturbed Sample; WS=Water Sample; SNR=Sample Not Recovered; LS = Liner Sample; +----+ = Plastic and Liquid Limits; ♦ = N M C; ■ = % -75μ Size

PLATE 27

LOG OF BORING

Project: Proposed Residential Apartments and Villa Buildings Site, S. No. 159/2, 160/1A, 1B, 2A, 2B, 4A, 1A, 1B, 2A, 173/3, 174/1, 2, 175/1, 2, 176/1, 2A, 2B, 177/2, 187/3(A), 188/1, 199/1A, 1B, 1C, 2, 202/6, 7, 203, 204/1, 2, 3, 205/1, 2, 206/2A, 2B, 207/1A, 1B, 2A, 2B, 3A, 3B, 4, 5, 208, 209/1A, 1B, 1C, 209/2, 3A, 3B, 3C, 3D, 5, 6, 7, 8, 227/2, 4, Vengaivasal Village, Tambaram Taluk, Kancheepuram District, TN.

Bore Hole No.: 27 **Type of Boring:** Calyx Drill **Dia. of Hole:** 150 mm
Started on: 6-12-'18 **Ended on:** 6-12-'18 **Field Work In Charge:** M Munivel
Final Depth: 7.0-M **Depth to G W S:** 2.1-M **Remarks:** GWL in Open Well.

DEPTH, M	SOIL DESCRIPTION	SPT / VANE & SAMPLE TYPE	SPT "N" PROFILE 25 50 75	INDEX TEST DATA 25 50 75
	BROWN FINE TO COARSE SAND with silt (To 1.0-M)	SPT @ 0.25 M 6/8/8 = 16 Blows		■♦
	0.0- to 1.0-m – $\phi = 32^o$; $\gamma_t = 1.7$ tons/M^3	SPT @ 1 M 12/16/		
1.0	($N_{avg} = 16$)	4 cms for 10 Blows		♦
	WHITE BLUE BROWN WEATHERED ROCK (Below 1.0-M)	3 cms for 10 Blows (Hammer Rebound)		
	1.0- to 2.0-m – $\phi = 36^o$; $\gamma_t = 2.05$ tons/M^3	SPT @ 2 M (SNR)		
2.0	($N_{avg} \sim 62$)	2 cms for 20 Blows		
GWL	-NX TC bit drilling from 2-m	(Hammer Rebound)		
		SPT @ 3 M (SNR)		
3.0	-drilled from 2- to 3-m in 35 minutes	0.5 cms for 5 Blows		
	-NX Diamond bit drilling from 3-m	0 cms for 5 Blows (Hammer Rebound)		
		SPT @ 4 M (SNR)		
4.0	-drilled from 3- to 4-m in 35 minutes	0.5 cms for 5 Blows		
		0 cms for 5 Blows		
	2.0- to 7.0-m – $\phi = 39^o$; $\gamma_t = 2.25$ tons/M^3	(Hammer Rebound)		
	($N_{avg} >> 100$)	SPT @ 5 M (SNR)		
5.0	-drilled from 4- to 5-m in 55 minutes	0 cms for 5 Blows		
	-wea. rock pieces recovered drilling to 5-m	(Hammer Rebound)		
		SPT @ 6 M (SNR)		
6.0	-drilled from 5- to 6-m in 40 minutes	0 cms for 5 Blows		
	-wea. rock pieces recovered drilling to 6-m	(Hammer Rebound)		
		SPT @ 7 M (SNR)		
7.0	-drilled from 6- to 7-m in 40 minutes	0 cms for 5 Blows		
	-wea. rock pieces recovered drilling to 7-m	(Hammer Rebound)		
8.0				
9.0				
10.0				

BORE HOLE TERMINATED AT 7.0-M.

SPT=Standard Penetration Test; DS=Disturbed Sample; UDS = UnDisturbed Sample; WS=Water Sample; SNR=Sample Not Recovered; LS = Liner Sample; +----+ = Plastic and Liquid Limits; ♦ = N M C; ■ = % -75μ Size

PLATE 28

SUMMARY OF TEST RESULTS

Boring	Depth,	w %	PL	LL	-75μ%	SAND			GRAVEL	IS
No.	M					Fine%	Medium%	Coarse%	%	CLASS.
1	0.25	12			5	45	40	10	0	SP
	1.0	SNR								
	2.0	SNR								
	3.0	SNR								
	4.0	SNR	rock	core	pieces					
	5.0	SNR	rock	core	pieces					
2	0.25	8			12					
	1.0	15			16					
	2.0	15			11	52	24	10	3	SP-SM
	3.0	10			12	55	19	5	9	SM
	4.0	SNR								
	5.0	SNR								
	6.0	SNR	rock	pieces						
	7.0	SNR	rock	core	pieces					
3	0.25	8			5					
	1.0	13			6					
	2.0	9			11	52	23	10	4	SP-SM
	3.0	8			7	34	21	15	23	SW
	4.0	SNR								
	5.0	SNR								
	6.0	SNR								
	7.0	SNR	rock	core	pieces					
4	0.25	11			8					
	1.0	15			12	47	31	8	2	SM
	2.0	8			9	50	17	24	0	SP-SM
	3.0	SNR								
	4.0	SNR								
	5.0	SNR	rock	core	pieces					
	6.0	SNR	rock	core	pieces					
5	0.25	11			19					
	1.0	14			11					
	2.0	7			13	57	20	6	4	SM
	3.0	9			13	56	22	9	0	SM
	4.0	SNR								
	5.0	SNR	rock	core	pieces					
	6.0	SNR	rock	core	pieces					
6	0.25	12	17	43						CL
	1.0	12			10	53	26	7	4	SP-SM
	2.0	14			17	48	22	9	4	SM
	3.0	SNR								
	4.0	SNR	rock	core	pieces					
	5.0	SNR	rock	pieces						
	6.0	SNR	rock	core	pieces					
7	0.25	10			16					
	1.0	17			13	58	23	6	0	SM
	2.0	8			12	54	24	7	3	SM
	3.0	SNR								
	4.0	SNR	rock	core	pieces					
	5.0	SNR	rock	core	pieces					
	6.0	SNR	rock	core	pieces					

PLATE 29a

SUMMARY OF TEST RESULTS

Boring No.	Depth, M	w %	PL	LL	-75μ%	SAND			GRAVEL %	IS CLASS.
						Fine%	Medium%	Coarse%		
8	0.25	15			6					
	1.0	10			6					
	2.0	14			8	41	24	7	20	SP
	3.0	10			17	45	32	6	0	SM
	4.0	SNR								
	5.0	SNR								
	6.0	SNR	rock	core	pieces					
	7.0	SNR	rock	core	pieces					
9	0.25	18			10					
	1.0	15			13					
	2.0	16			13	59	21	5	2	SM
	3.0	9			22	42	16	12	8	SM
	4.0	SNR	rock	pieces						
	5.0	SNR	rock	core	pieces					
	6.0	SNR	rock	core	pieces					
10	0.25	11			12					
	1.0	16			8	41	36	12	3	SP
	2.0	10			9	35	43	13	0	SP-SM
	3.0	SNR								
	4.0	SNR	rock	core	pieces					
	5.0	SNR	rock	core	piece					
11	0.25	17			14					
	1.0	19			7	42	37	13	1	SP
	2.0	8			8	31	21	15	25	SW
	3.0	SNR								
	4.0	SNR	rock	core	pieces					
	5.0	SNR								
	6.0	SNR	rock	pieces						
	7.0	SNR	rock	core	pieces					
12	0.25	12			7					
	1.0	20			5	38	38	14	5	SP
	2.0	17			12	44	15	5	24	SM
	3.0	SNR								
	4.0	SNR								
	5.0	SNR	rock	pieces						
	6.0	SNR	rock	pieces						
	7.0	SNR	rock	core	pieces					
13	0.25	20	17	48						CL
	1.0	19			4					
	2.0	3			12	47	26	8	7	SM
	3.0	4			8	34	15	8	35	SP
	4.0	SNR								
	5.0	SNR								
	6.0	SNR	rock	core	pieces					
	7.0	SNR	rock	core	piece					
14	0.25	11			9					
	1.0	11			5	37	41	16	1	SP
	2.0	20			16	44	17	12	11	SM
	3.0	SNR								
	4.0	SNR								
	5.0	SNR	rock	core	pieces					

PLATE 29b

SUMMARY OF TEST RESULTS

Boring No.	Depth, M	w %	PL	LL	-75μ%	SAND			GRAVEL	IS CLASS.
						Fine%	Medium%	Coarse%	%	
14	6.0	SNR	rock	core	pieces					
	7.0	SNR	rock	core	pieces					
15	0.25	9			7					
	1.0	15			5					
	2.0	15			11	43	26	12	8	SP-SM
	3.0	13			14	60	19	5	2	SM
	4.0	SNR	rock	core	piece					
	5.0	SNR	rock	core	pieces					
	6.0	SNR	rock	core	pieces					
	7.0	SNR	rock	core	piece					
16	0.25	9			7					
	1.0	14			14					
	2.0	15			13	44	14	7	22	SM
	3.0	8			5	16	22	11	46	SP
	4.0	SNR								
	5.0	SNR	rock	pieces						
	6.0	SNR								
	7.0	SNR	rock	pieces						
17	0.25	11			13					
	1.0	4			12	56	24	5	3	SM
	2.0	SNR								
	3.0	SNR	rock	pieces						
	4.0	SNR	rock	core	pieces					
	5.0	SNR	rock	core	pieces					
	6.0	SNR	rock	core	pieces					
18	0.25	10			6					
	1.0	19			7					
	2.0	4			7	14	9	10	60	GW
	3.0	SNR								
	4.0	SNR	rock	core	piece					
	5.0	SNR	rock	pieces						
	6.0	SNR	rock	core	pieces					
	7.0	SNR	rock	pieces						
19	0.25	10			9					
	1.0	10			7	39	31	20	3	SP
	2.0	SNR								
	3.0	SNR	rock	pieces						
	4.0	SNR	rock	core	pieces					
	5.0	SNR								
	6.0	SNR	rock	core	pieces					
20	0.25	13			8					
	1.0	14			4					
	2.0	7			5	25	21	11	39	SW
	3.0	SNR								
	4.0	SNR	rock	pieces						
	5.0	SNR	rock	core	pieces					
	6.0	SNR								
	7.0	SNR	rock	core	pieces					
21	0.25	14	11	36						CL
	1.0	25			7	24	36	21	12	SW
	2.0	28			12	52	22	12	2	SM

PLATE 29c

SUMMARY OF TEST RESULTS

Boring No.	Depth, M	w %	PL	LL	-75μ%	SAND			GRAVEL	IS CLASS.
						Fine%	Medium%	Coarse%	%	
21	3.0	15			16					
	4.0	17			17	53	26	4	0	SM
	5.0	SNR								
	6.0	SNR								
	7.0	SNR								
	8.0	SNR	rock	pieces						
22	0.25	12			14					
	1.0	13			4					
	2.0	23			6	39	31	15	9	SP
	3.0	12			15	58	14	5	8	SM
	4.0	SNR								
	5.0	SNR								
	6.0	SNR	rock	core	pieces					
	7.0	SNR	rock	core	pieces					
23	0.25	11			11					
	1.0	17			6	35	39	13	7	SP
	2.0	SNR								
	3.0	SNR								
	4.0	SNR								
	5.0	SNR	rock	pieces						
	6.0	SNR	rock	core	pieces					
	7.0	SNR	rock	core	pieces					
24	0.25	14			15					
	1.0	18			8	59	30	3	0	SP
	2.0	21			12	68	17	2	1	SM
	3.0	18			15	48	28	7	2	SM
	4.0	SNR								
	5.0	SNR	rock	pieces						
	6.0	SNR	rock	pieces						
	7.0	SNR	rock	pieces						
25	0.25	12			17					
	1.0	22			8	34	31	20	7	SP
	2.0	SNR								
	3.0	SNR								
	4.0	SNR	rock	pieces						
	5.0	SN2R	rock	pieces						
	6.0	SNR	rock	core	pieces					
	7.0	SNR	rock	core	pieces					
26	0.25	12			10					
	1.0	15			5					
	2.0	16			4	45	27	11	13	SP
	3.0	8			10	41	27	16	6	SP-SM
	4.0	SNR	rock	core	pieces					
	5.0	SNR	rock	core	pieces					
	6.0	SNR	rock	core	pieces					
	7.0	SNR	rock	core	pieces					
27	0.25	11			7					
	1.0	16			18	65	15	1	1	SM
	2.0	SNR								
	3.0	SNR								
	4.0	SNR								

PLATE 29d

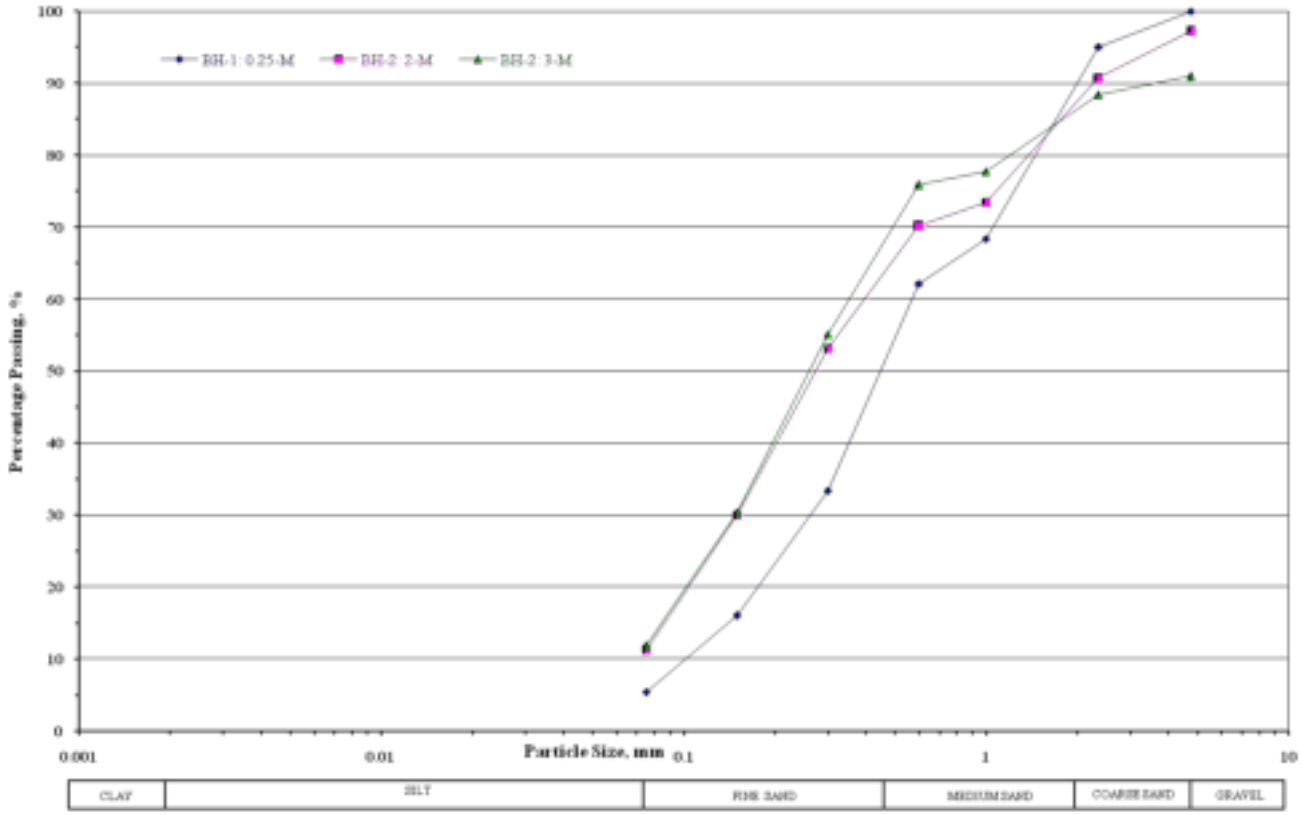
SUMMARY OF TEST RESULTS

Boring No.	Depth, M	w %	PL	LL	-75μ%	SAND			GRAVEL %	IS CLASS.
						Fine%	Medium%	Coarse%		
27	5.0	SNR	rock	pieces						
	6.0	SNR	rock	pieces						
	7.0	SNR	rock	pieces						

FREE SWELL INDEX TEST RESULTS

BORE NO.	DEPTH, M	FREE SWELL INDEX, %
6	**0.25**	**183**
13	**0.25**	**233**
21	**0.25**	**150**

Grain Size Distribution Curves
Boring 1 & 2



Grain Size Distribution Curves
Boring 3 & 4

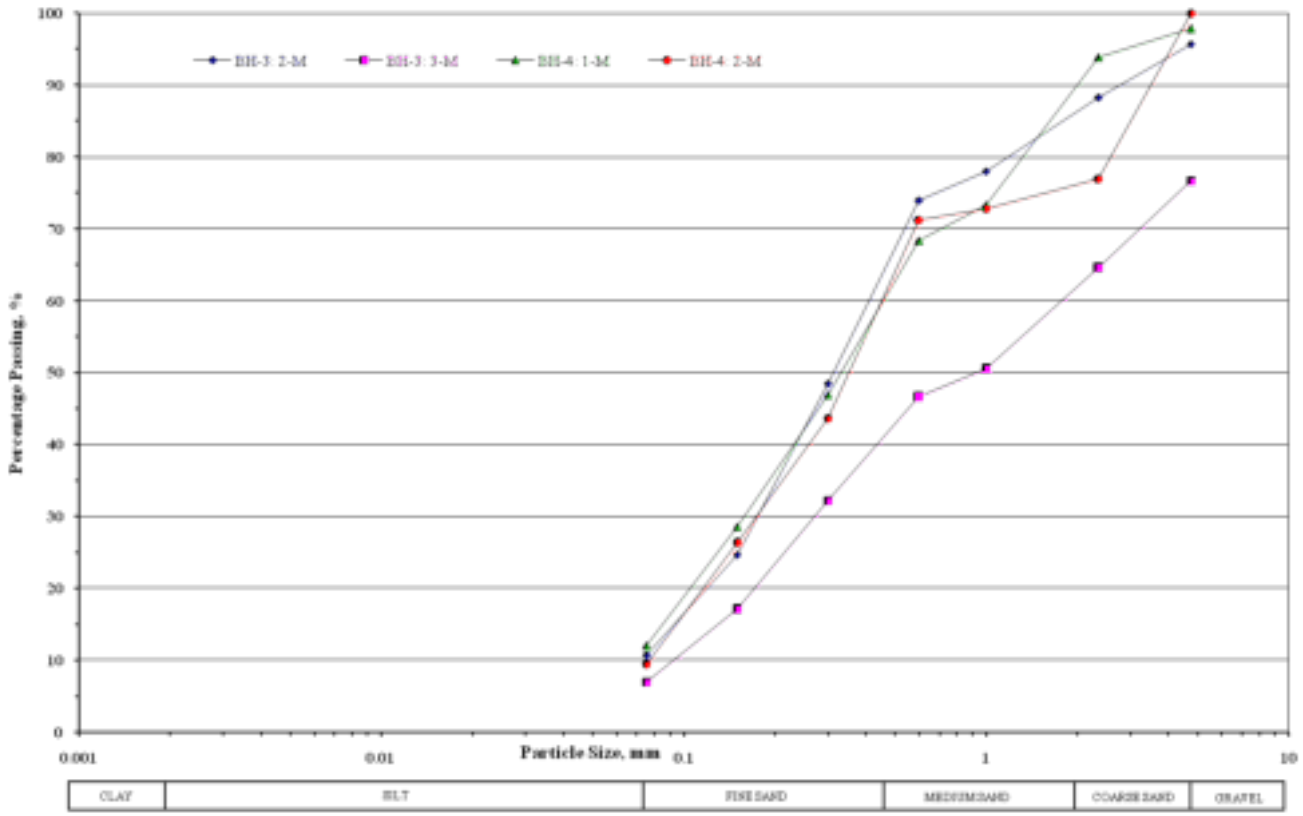
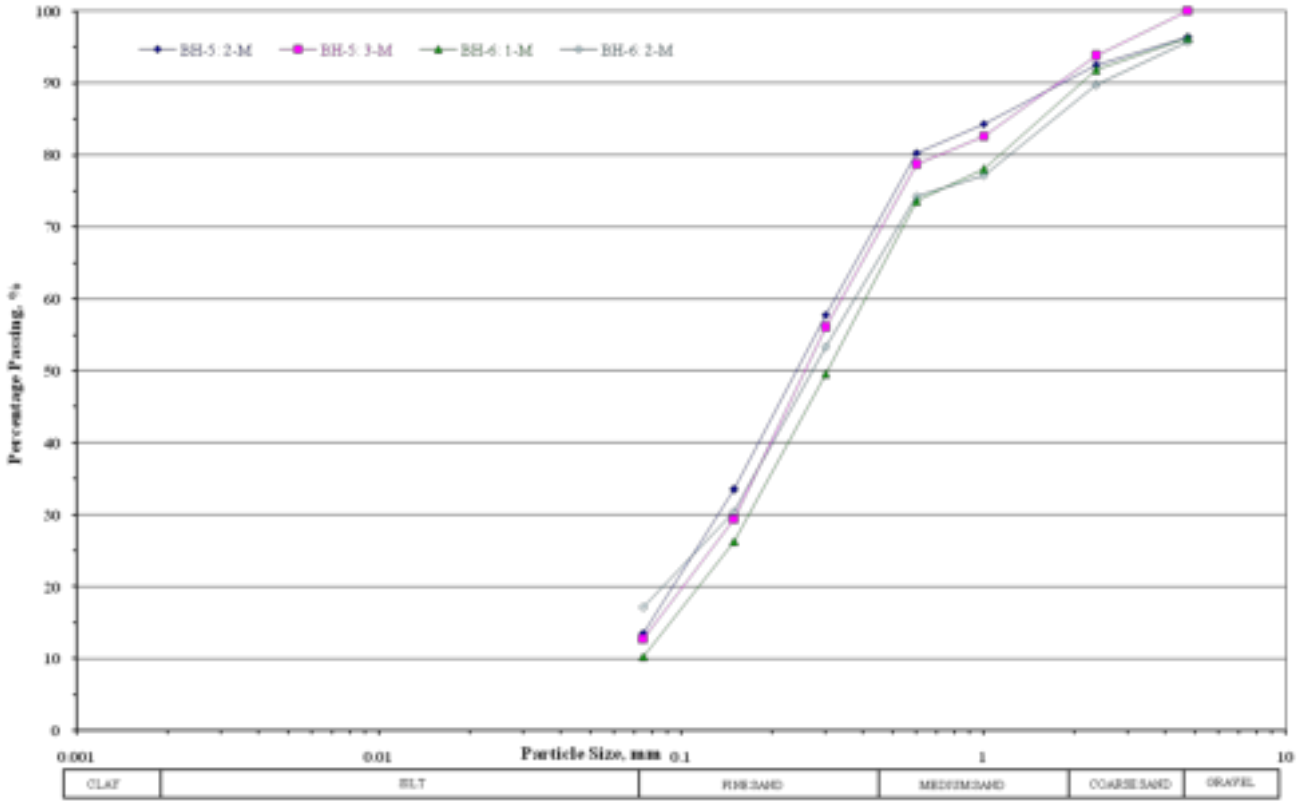


PLATE 30a

Grain Size Distribution Curves
Boring 5 & 6



Grain Size Distribution Curves
Boring 7 & 8

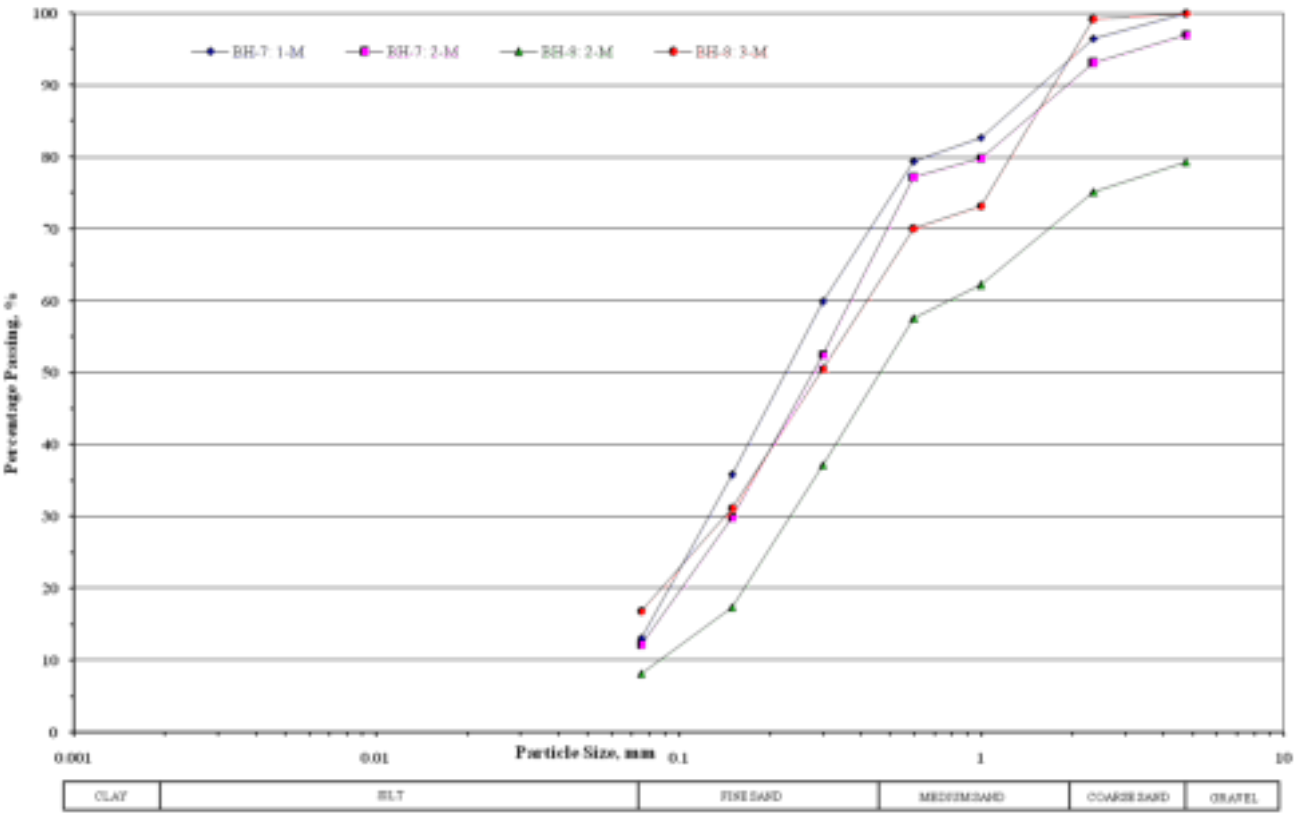
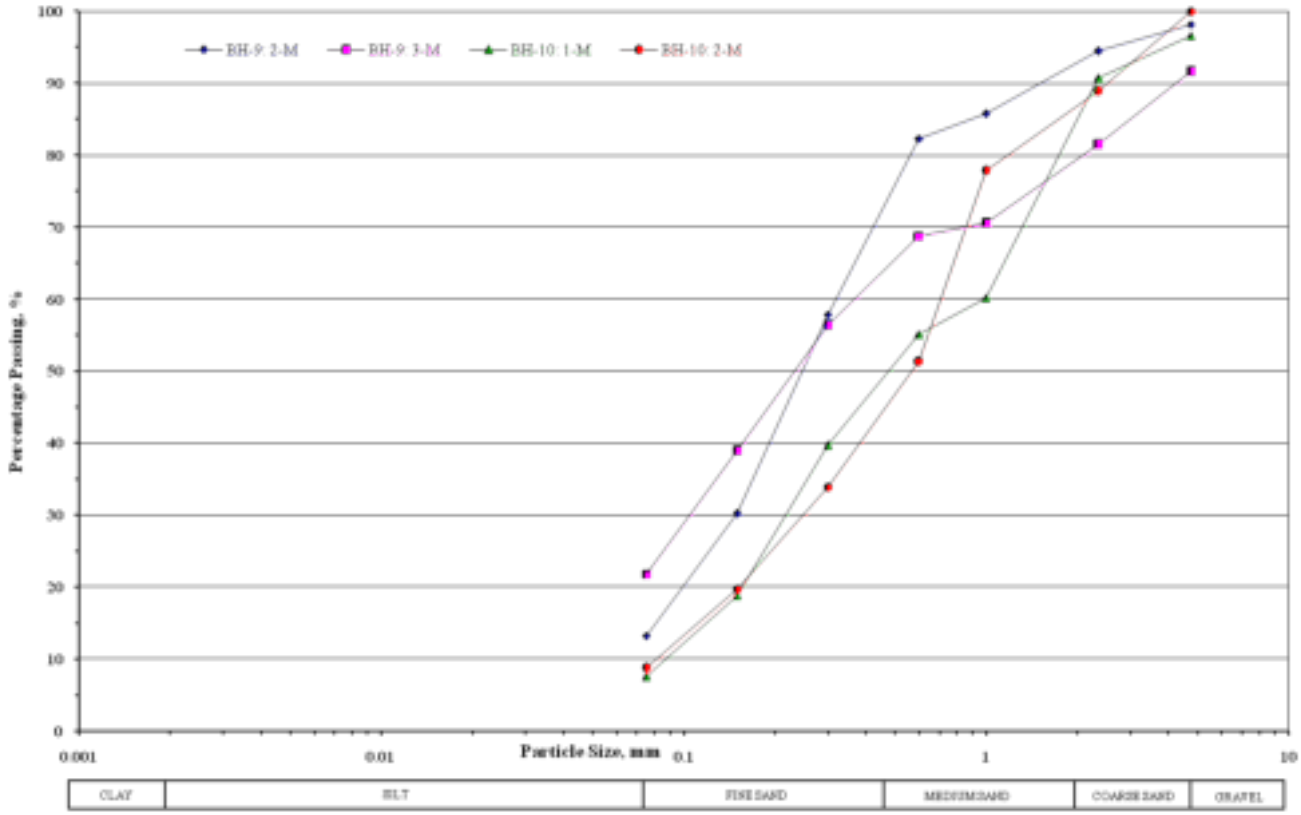


PLATE 30b

Grain Size Distribution Curves
Boring 9 & 10



Grain Size Distribution Curves
Boring 11 & 12

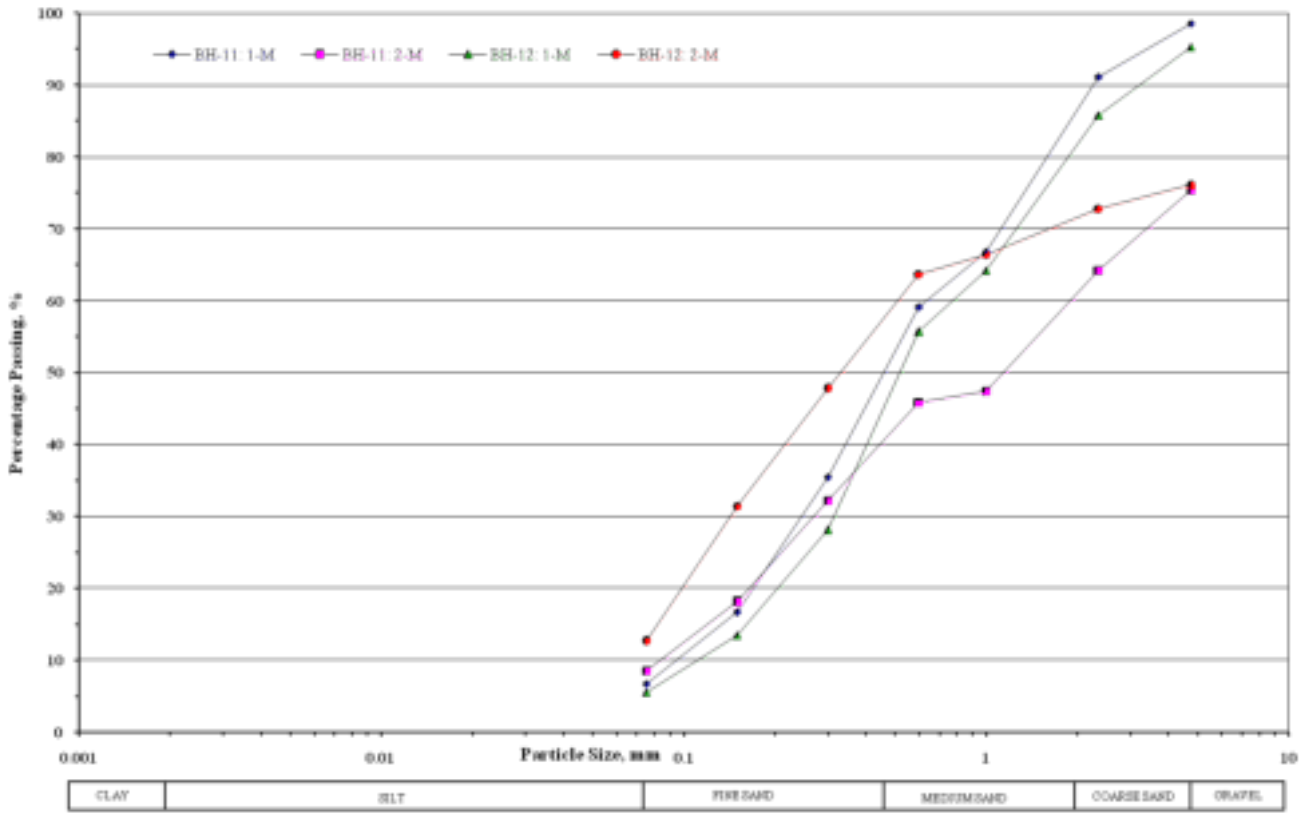
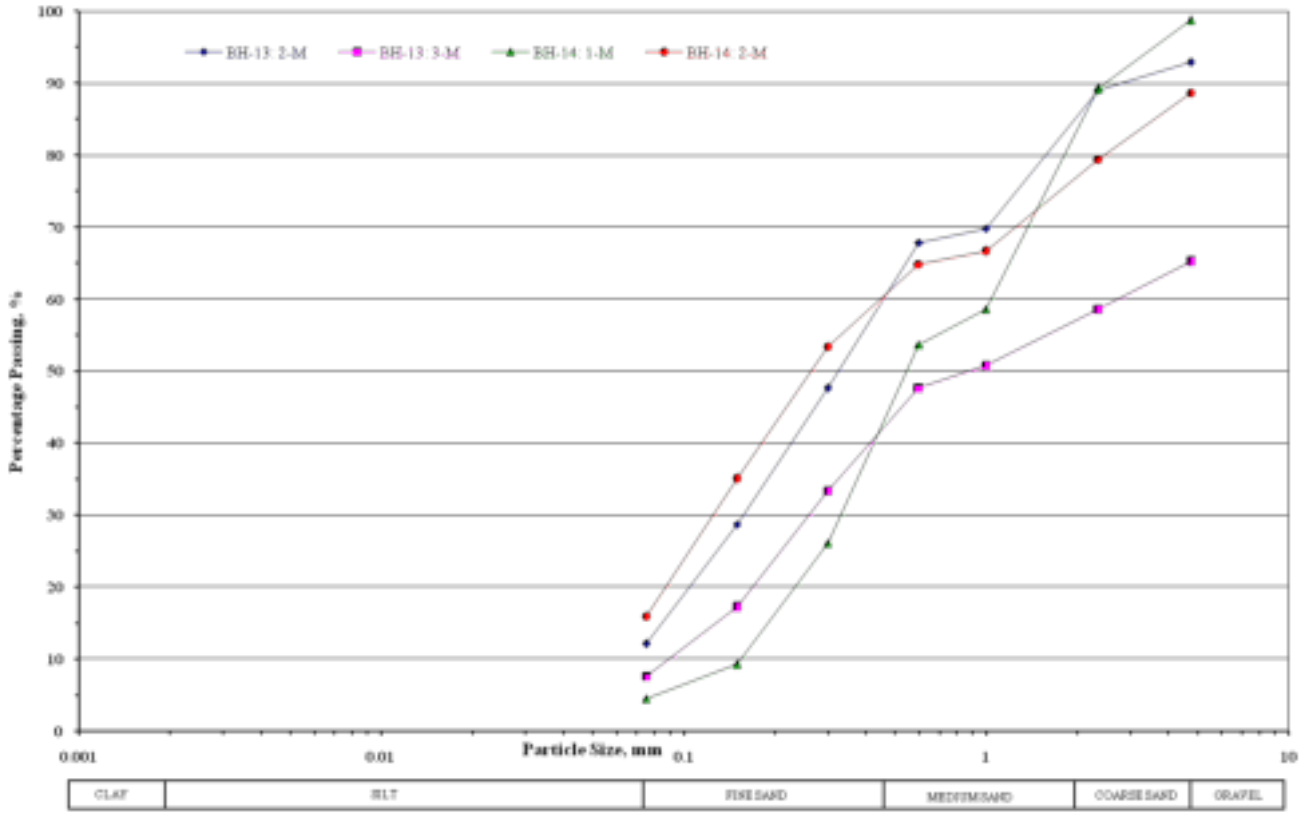


PLATE 30c

Grain Size Distribution Curves
Boring 13 & 14



Grain Size Distribution Curves
Boring 15 & 16

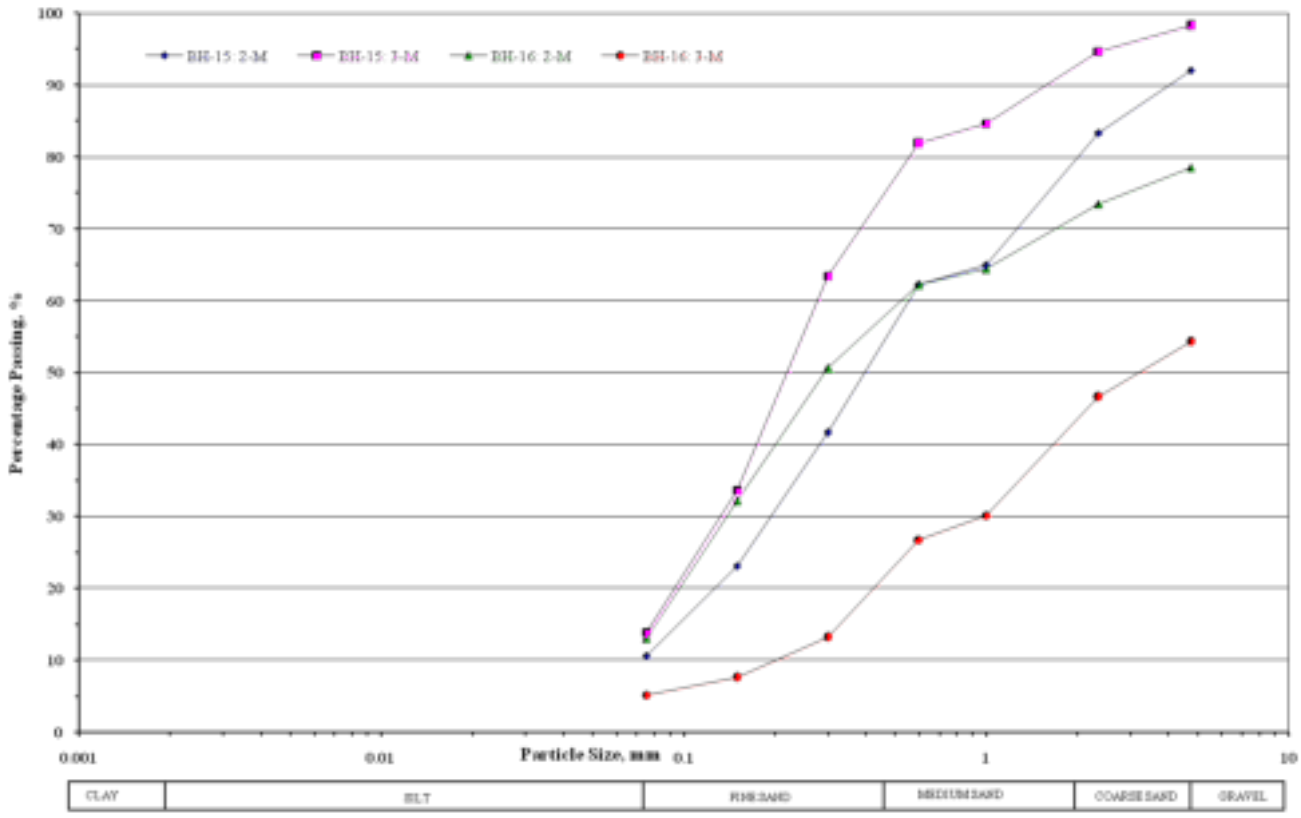
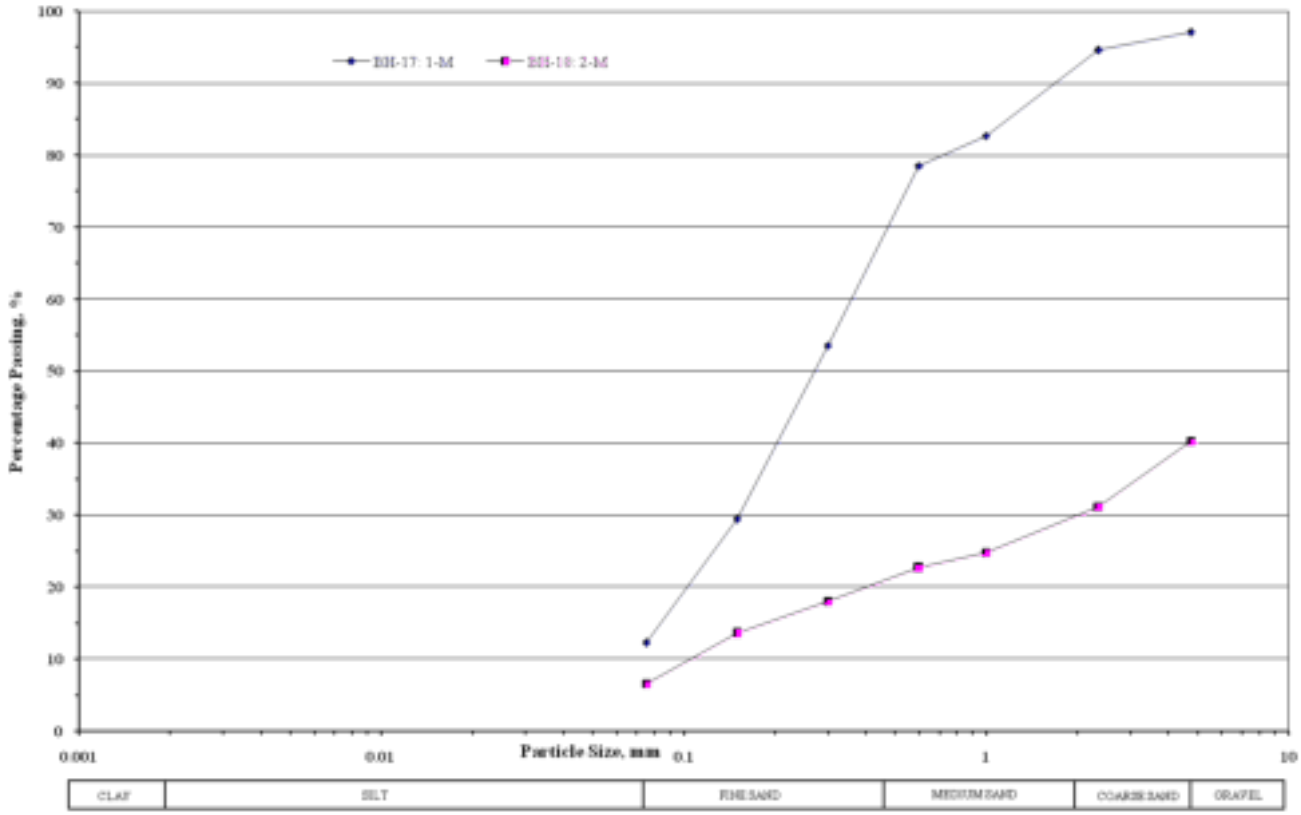


PLATE 30d

Grain Size Distribution Curves
Boring 17 & 18



Grain Size Distribution Curves
Boring 19 & 20

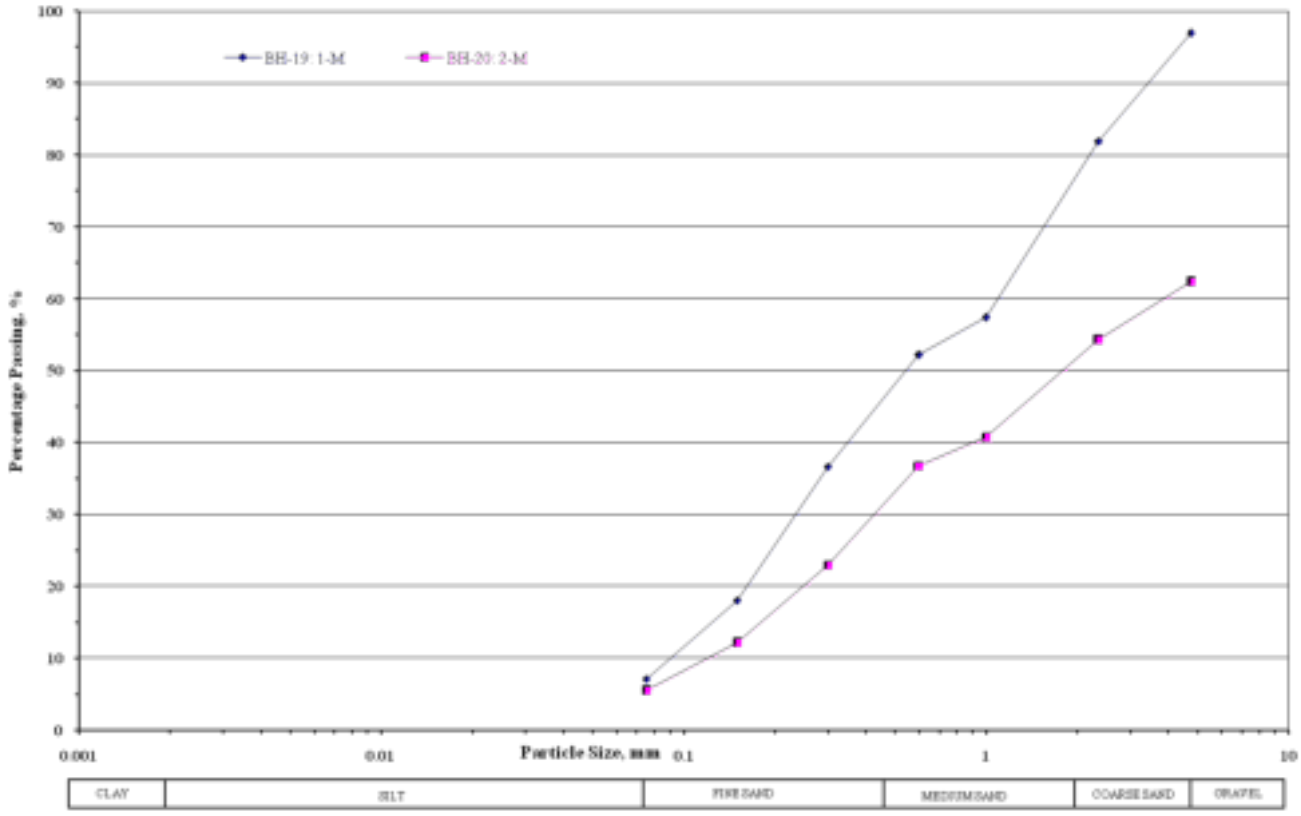
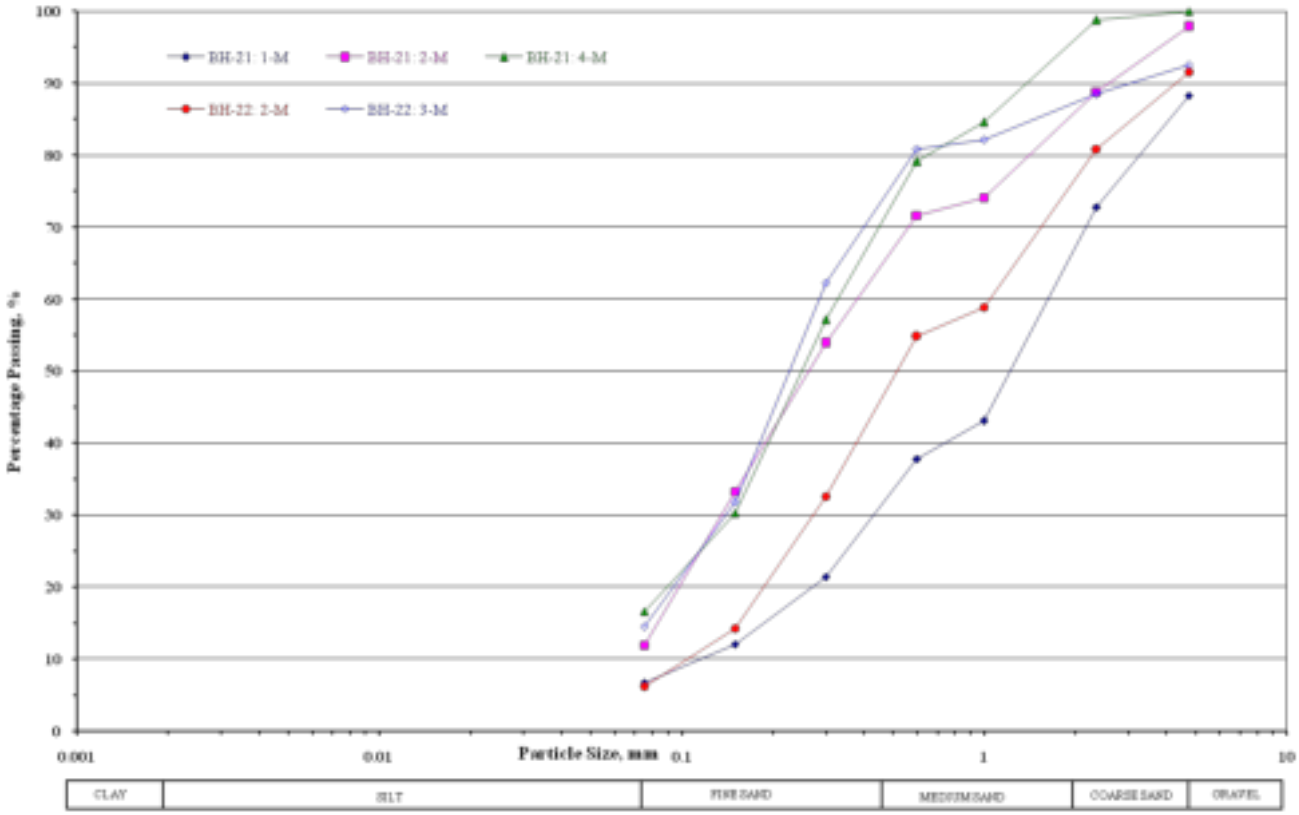


PLATE 30e

Grain Size Distribution Curves
Boring 21 & 22



Grain Size Distribution Curves
Boring 23 & 24

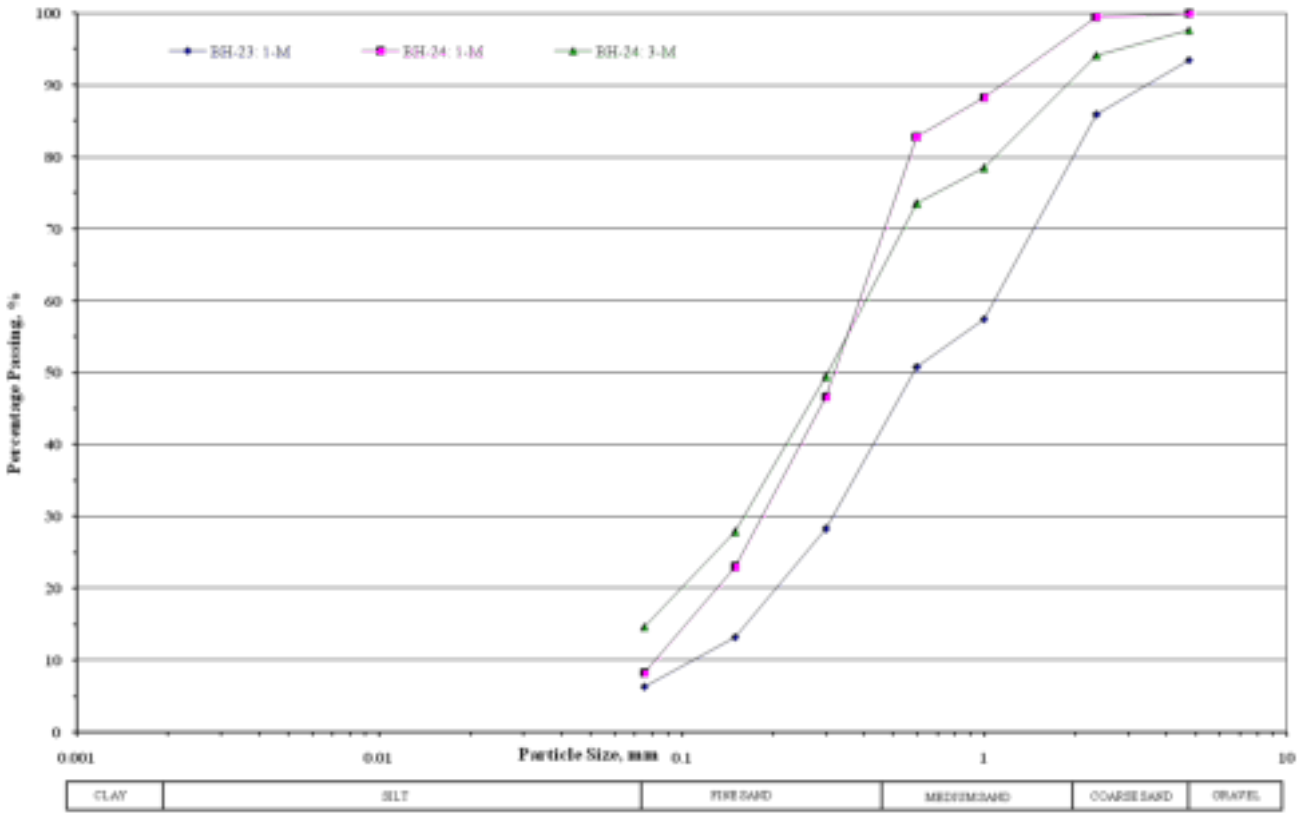


PLATE 30f

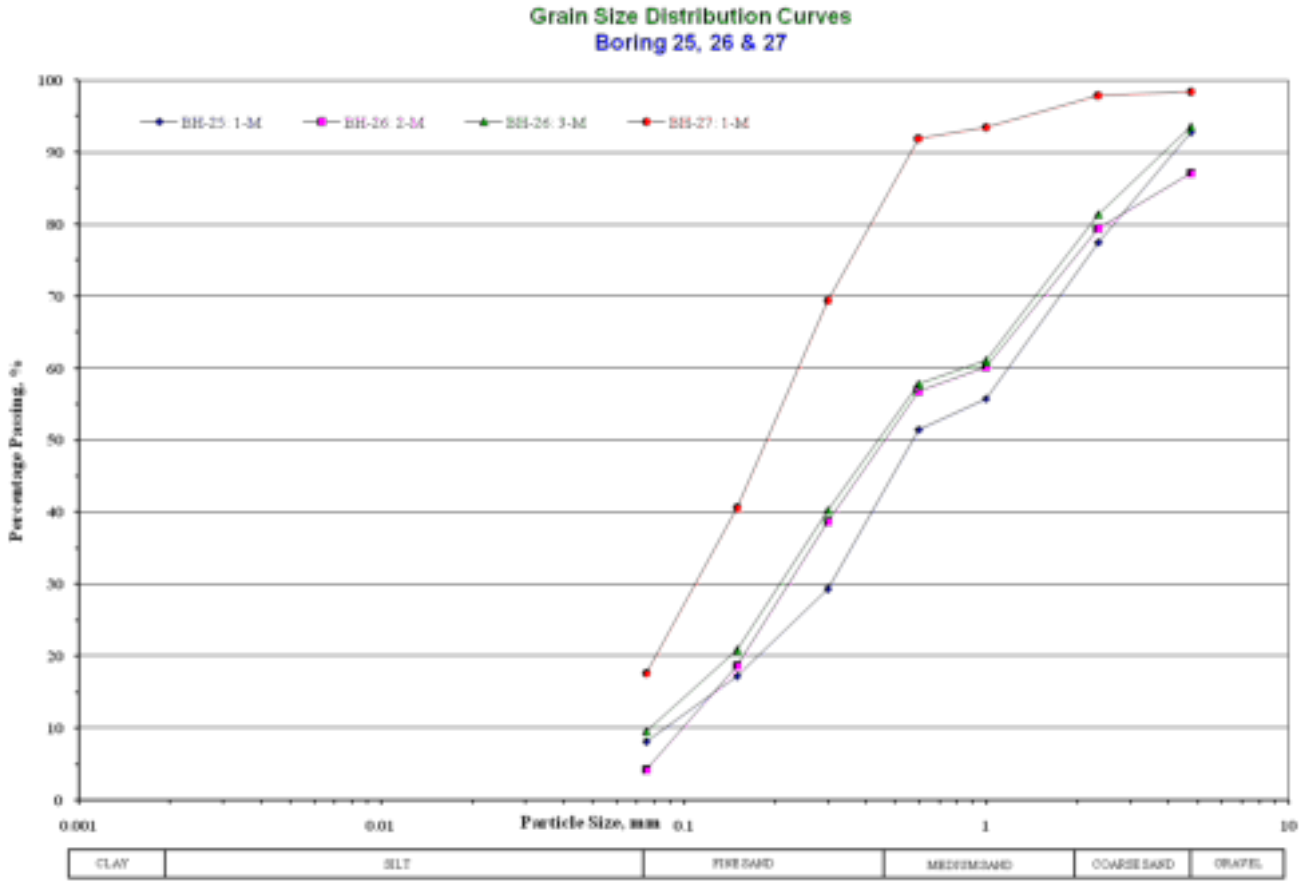

Grain Size Distribution Curves
Boring 25, 26 & 27
BH-25: 1-M
BH-26: 2-M
BH-26: 3-M
BH-27: 1-M
Percentage Passing, %
Particle Size, mm
0.001
0.01
0.1
1
10
CLAY
SILT
FINE SAND
MEDIUM SAND
COARSE SAND
GRAVEL

PLATE 30g

SUMMARY OF WATER TEST RESULTS

PLOT'S OPEN WELL; DIAMETER = 8.25-M;

WATER LEVEL = 2.1-M; DISTANCE FROM BORING 7 ~ 27.7-M.

S. No.		Description	Results Obtained	As per IS:456 – 2000
1		To neutralize 100 cc of water using phenolphthalein as indicator	0.6 ml	Not more than 5 ml of 0.02N NaOH
2		To neutralize 100 cc of water using methyl orange as indicator	24.0 ml	Not more than 25 ml of 0.02N H_2SO_4
3	a	Organic Solids, mg/liter	28	200 Max.
	b	Inorganic Solids, mg/liter	780	3,000 Max.
	c	Sulphates as SO_3, mg/liter	80	400 Max.
	d	Chlorides as Cl, mg/liter	230	2,000 Max. - Plain Concrete 500 Max. RCC
	e	Suspended Solids, mg/liter	0	2,000 Max.
	f	pH	7.35	6 Min.

Remarks: Sample meets the requirements of all above clauses.
Hence water can be used for construction purposes as per IS 456 - 2000.

SAMPLE CALCULATIONS FOR RECOMMENDED FOUNDATION

For the existing footings with short pile below load carrying capacity was estimated using soil properties from Boring 3 and 22. Following is a list of design assumptions:

Type of Foundation	=	Isolated Column Footing Foundation;
Foundation Depth below EGL	=	2-M below EGL;
Min. Site Filling Above EGL	=	1-M;
Foundation Depth below FGL	=	3-M (2.0 + 1.0);
Worst Case Ground Water Level	=	At EGL;
Minimum Footing Size	=	1.5- by 1.5-M;
Expected Max. Column Load	=	150 tons.

Bearing Capacity Calculations:

Ultimate Bearing Pressure $q_{ult} = C_u*N_c*S_c*D_c + q'(N_q - 1)*S_q*d_q + 0.5*B*\gamma'*N_\gamma* S_\gamma*d_\gamma$

ϕ	=	33º
C_u (Undrained Shear Strength)	=	0 tons/M^2
N_c (Bearing Capacity Factor)	=	N/A
N_q (Bearing Capacity Factor)	=	27.34
N_γ (Bearing Capacity Factor)	=	37.78
S_c (Shape Factor)	=	1 + 0.2*(B/L) = 1.0 + 0.2*(1.5/1.5) = 1.2;
D_c (Depth Factor)	=	1 + 0.2*D_f/B*tan (45 + ϕ/2) = 1.37
S_q (Shape Factor)	=	1 + 0.2*(B/L) = 1.0 + 0.2*(1.5/1.5) = 1.2;
d_q (Depth Factor)	=	1 + 0.1*D_f/B*tan (45 + ϕ/2) = 1.18
S_γ (Shape Factor)	=	1 - 0.4*(B/L) = 1.0 - 0.4*(1.5/1.5) = 0.60;
d_γ (Depth Factor)	=	1 + 0.1*D_f/B*tan (45 + ϕ/2) = 1.18
q'(O B @ Footing)	=	(1.7-1)*1.0 + (1.6-1)*1.0 + (1.7-1)*1.0 = 2.0 tons/M^2

Note: Ground water is assumed to rise to EGL of the site.

q_{ult} = 0 + 2.0*(27.34-1)*1.20*1.18 + 0.5*0.7*1.5*37.78*0.60*1.18 = 88.64 ~ 89 tons/M^2

$q_{all} = q_{ult} / 2.5 = 89 / 2.5$ = 35.6 tons/M^2 **Use and Limit q_{all} = 25 tons/M^2**

Footing Size required for 150 tons = 150/25 = 6-M^2 or L = B = 2.45-M.
Therefore, 2.45- by 2.45-M footing will be required for 150 tons column load.

Settlement Calculations:

In case of isolated column footing foundation the "Zone of Influence" will extend to "2B" depth below raft, i.e., 2*2.45 = 4.9-M below footing or 6.9-M below EGL or upto hard stratum level, whichever is earlier. There will be only elastic (immediate) settlement and no consolidation (long term) settlements as profile had only weathered rock and hard rock in the zone of influence.

Elastic or Immediate Settlement:-

1. 2.0- to 3.0-M = H_1 = 1.0-M; SPT "N" = 21; (Wea. Rock); E_s = 3,500 tons/M^2
2. 3.0- to 4.0-M = H_2 = 1.0-M; SPT "N" > 100; (Wea. Rock); E_s = 8,500 tons/M^2
3. 4.0- to 7.0-M = H_3 = 3.0-M; SPT "N" > 300; (Wea. Rock); E_s = 10,000 tons/M^2

E_{savg} = (1.0*3500 + 1.0*8500 + 3.0*10000)/5.0 = 8,400 tons/M^2

q_0 = 25 tons/M^2; H/B' = 5.0/1.25 = 4.0; L/B = 2.45/2.45 = 1.0; μ = 0.2; E_s = 8,400 tons/M^2

I_f = 0.90; I_1 = 0.403; I_2 = 0.078; I_s = 0.436;

$\Delta H_E = 4*25.0*1.225*(1-0.2^2)/8400*0.90*0.436*1000 =$ **5.49 mm**
Total Elastic Settlement $\Delta H_E = 5.49$ mm.

Consolidation Settlement: None.

Total Consolidation Settlement $\Delta H_C = 0.00$ mm.

Total Combined Settlement $\mathbf{\Delta H} = \Delta H_E + \Delta H_C = 5.49 + 0.00 =$ **5.49 ~ 6 mm**.

Estimated total settlement for a 2.45- by 2.45-M isolated column footing foundation at 2-M below EGL and 3-M below FGL (with at least 1-M thick site filling) was about 6 mm for a bearing pressure of 25 tons/M^2. The estimated total settlement was less than 60 mm – allowable limits for the total settlements for isolated column footing foundations on granular soils for framed structures with panel walls as per IS: 1904 - 2006 code.

Horizontal Acceleration, A_h = 0.08g

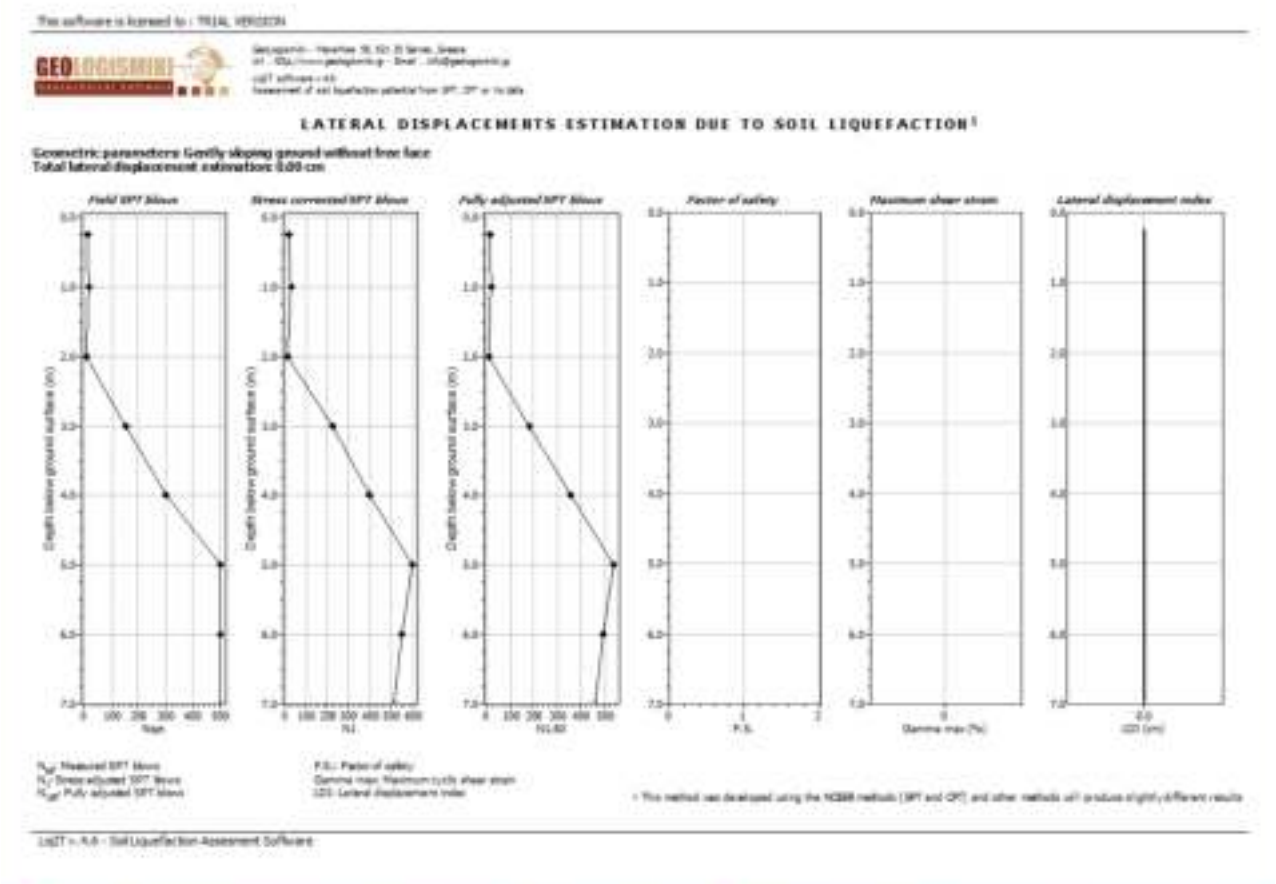


PLATE 33b

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