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DIVISION OF SOIL MECHANICS AND FOUNDATION ENGINEERING
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Professor & Head

Dr. V.K. STALIN, M.E., Ph.D.
Professor

Date:02.06.2022

To

The Executive Engineer
Division - V, Tamil Nadu Urban Habitat Development Board,
No.5, Kamarajar Salai,
Chennai – 600 005.

Sir,

Sub: Interim Soil Investigation Report – Construction of Multi-storied Tenements at Pillaiyar Kovil Thottam in Zone IX, Division V, Greater Chennai Corporation - Reg.

The Tamil Nadu Urban Habitat Development Board (TNUHDB), Division – V, Kamarajar Salai, Chennai – 600 005 has proposed to Construct Multi-storied Tenements at Pillaiyar Kovil Thottam in Zone IX, Division V, Greater Chennai Corporation. The officials of TNUHDB, Division – V, Kamarajar Salai, Chennai – 600 005 have approached the Division of Soil Mechanics and Foundation Engineering, Department of Civil Engineering, College of Engineering, Guindy (CEG), Anna University, Chennai - 25 to carryout soil investigation in the proposed construction site and to recommend the most suitable foundation system for the construction of Multi-storied Tenements at Pillaiyar Kovil Thottam in Zone IX, Division V, Greater Chennai Corporation. Accordingly, the work was taken up and field investigation was carried out by M/s VRR Engineering Consultancy, Chennai – 91 during 11th May to 26th May 2022 under the supervision of Professor of Division of Soil Mechanics and Foundation Engineering, Department of Civil Engineering, Anna University, Chennai - 25 in the presence of Officials of TNUHDB, Division – V, Kamarajar Salai, Chennai – 600 005. The Interim Soil Investigation Report is enclosed herewith based on the In-situ test results.

2/6/22

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Encl: Interim Soil Report

INTERIM SOIL INVESTIGATION REPORT

Recommendations based on the In-Situ Test Results

1) It is recommended to provide **PILE FOUNDATION.**
2) The recommended type of pile foundation is ***"Bored Cast-In-Situ Pile"***
3) The recommended safe vertical and lateral pile carrying capacity of the 32.0 m to 35.0 m length of 'bored cast in-situ pile' for varying diameter is shown in Table 1. The required number of piles may be varied with respect to the varying column loads.
4) The bored cast in-situ pile shall be terminated at 32.0 m to 35.0 in Greyish Charnockite Stratum.
5) With regard to execution of bored cast-in-situ pile, procedure outlined in IS 2911 Part 1 Section 2: 2010 may be referred and scrupulously followed.
6) Pile load test shall be conducted to ensure the designed pile carrying capacity. The minimum grade of concrete for pile foundation shall be M 30 to M 40.

TABLE 1 Safe Load carrying capacity and Lateral Load Capacity of Bored Cast-In-Situ Pile for varying diameter and for a length of 32.0 to 35.0 m from the existing ground level (Borehole level)

Diameter of Pile (mm)	Recommended Safe Load carrying capacity of Bored Cast-In-Situ Piles, (kN)	Recommended Lateral Load Capacity for 5 mm deflection, (kN)	Depth of fixity from bore-hole level (m)
450	1100	87.20	3.36
500	1300	103.70	3.65
600	1800	138.10	4.23
700	2400	177.30	4.78
900	3600	264.30	5.85

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IN-SITU GEOTECHNICAL BORE LOG

BORE-HOLE No.	BH01
SHEET No.	(1/3)

Project:	Geotechnical Investigation for the Reconstruction of Tenements at Pillaiyar Kovil Thottam in Zone IX, Division V, Greater Chennai Corporation.
Co-ordinates:	N - 1440560 ; E - 420396
Started:	11-05-2022
Location:	Pillaiyar Kovil Thottam
Completed:	17-05-2022
Elevation (RL):	-
Ground Water Level:	1.6 m
Dia of Boring:	Px Size in Soil & Nx Size in Rock
Type of Core Barrel:	Nx Size Core Barrel
Casing Depth:	-
Water Loss Depths :	-
Type of Boring:	Rotary – Auto Trip SPT
Total Drill Depth:	34.75 m (33.25 m - Soil and 1.5 m - Rock)

Depth from EGL (m)	Log	Lithology	Description / Classification of Soil and Rock / Weathering Grade of Rock as per IS 4464 / Special Observations and Interpretations	Standard Penetration Test (SPT) / UDS / Core Drilling						Relative Density / Consistency of Soil / Strength of Rock
				0-15 cm	15-30 cm	30-45 cm	SPT-N	TCR (%)	RQD (%)	
								0 30 60 90 120 150 180		
1.0	1.0		Filling Soil	-	-	-	-			Very Loose
2.0	2.0		Brownish Silty Sand	3	4	5	9			Loose
3.0	3.0		Brownish Silty Sand	4	8	12	20			Medium Dense
4.0	4.0		Brownish Silty Sand	8	11	14	25			Medium Dense
5.0	5.0		Brownish Silty Sand	10	13	18	31			Dense
6.0	6.0		Brownish Silty Sand	10	16	23	39			Dense
7.5	7.0		Brownish Silty Sand	24	55 (10 cm) Rebound		>100			Very Dense
9.0	8.0 9.0		Brownish Silty Sand	35	55 (8 cm) Rebound		>100			Very Dense
10.5	10.0		Brownish Silty Sand	40	55 (8 cm) Rebound		>100			Very Dense
12.0	11.0 12.0		Brownish Grey Silty Sand	16	18	21	39			Dense
13.5	13.0		Brownish Grey Silty Sand	13	22	36	58			Very Dense
15.0	14.0		Blackish Silty Clay	3	3	4	7			Medium Stiff

IN-SITU GEOTECHNICAL BORE LOG

BORE-HOLE No.	BH 01
SHEET No.	(2/3)

Project:	Geotechnical Investigation for the Reconstruction of Tenements at Pillaiyar Kovil Thottam in Zone IX, Division V, Greater Chennai Corporation.
Co-ordinates:	N - 1440560 ; E - 420396
Location:	Pillaiyar Kovil Thottam
Elevation (RL):	-
Dia of Boring:	Px Size in Soil & Nx Size in Rock
Casing Depth:	-
Type of Boring:	Rotary – Auto Trip SPT
Started:	11-05-2022
Completed:	17-05-2022
Ground Water Level:	1.6 m
Type of Core Barrel:	Nx Size Core Barrel
Water Loss Depths :	-
Total Drill Depth:	34.75 m (33.25 m - Soil and 1.5 m - Rock)

Depth from EGL (m)	Log	Lithology	Description / Classification of Soil and Rock / Weathering Grade of Rock as per IS 4464 / Special Observations and Interpretations	Standard Penetration Test (SPT) / UDS / Core Drilling: 0-15 cm	15-30 cm	30-45 cm	SPT-N	TCR (%)	RQD (%)	Relative Density / Consistency of Soil / Strength of Rock
								0 30 60 90 120 150 180		
16.5	16.0		Blackish Silty / Clayey Sand	2	2	2	4			Loose
18.0	17.0		Blackish Silty Clay	2	2	3	5			Medium Stiff
19.5	19.0		Blackish Silty Clay	2	2	2	4			Soft
21.0	20.0		Greyish Silty / Clayey Sand	3	3	3	6			Loose
22.5	22.0		Greyish Silty Sand	10	31	17	48			Dense
24.0	23.0		Greyish Silty / Clayey Sand	2	2	10	12			Medium Dense
25.5	25.0		Brownish Grey,Charnockite, Completely Weathered (Grade V / VI)	55 (1 cm) Rebound			>100	0.0	0.0	Hard / Very Weak
27.0	26.0		Greyish Silty Sand	55 (5 cm) Rebound			>100			Very Dense
28.5	28.0		Greyish Silty Sand	55 (7 cm) Rebound			>100			Very Dense
30.0	29.0		Greyish Silty Sand	10	12	17	29			Medium Dense

IN-SITU GEOTECHNICAL BORE LOG

BORE-HOLE No.	BH-01
SHEET No.	(3/3)

Project:	Geotechnical Investigation for the Reconstruction of Tenements at Pillaiyar Kovil Thottam in Zone IX, Division V, Greater Chennai Corporation.		
Co-ordinates:	N - 1440560 ; E - 420396	**Started:**	11-05-2022
Location:	Pillaiyar Kovil Thottam	**Completed:**	17-05-2022
Elevation (RL):	-	**Ground Water Level:**	1.6 m
Dia of Boring:	Px Size in Soil & Nx Size in Rock	**Type of Core Barrel:**	Nx Size Core Barrel
Casing Depth:	-	**Water Loss Depths :**	-
Type of Boring:	Rotary – Auto Trip SPT	**Total Drill Depth:**	34.75 m (33.25 m - Soil and 1.5 m - Rock)

Depth from EGL (m)	Log	Lithology	Description / Classification of Soil and Rock / Weathering Grade of Rock as per IS 4464 / Special Observations and Interpretations	Standard Penetration Test (SPT) / UDS / Core Drilling						Relative Density / Consistency of Soil / Strength of Rock
				0-15 cm	15-30 cm	30-45 cm	SPT-N	TCR (%)	RQD (%)	
								0 30 60 90 120 150 180		
31.5	31.0		Greyish Silty Sand	30	55 (12 cm) Rebound		>100			Very Dense
33.0	32.0		Greyish Silty Sand with Gravel		55 (13 cm) Rebound		>100			Very Dense
33.25	33.0		Brownish Grey,Charnockite, Completely Weathered (Grade V / VI)		55 (0 cm) Rebound		>100	0.0	0.0	Hard / Very Weak
34.75	34.0		Greyish, Charnockite, Highly Weathered (Grade IV)					31.0	26.0	Moderately Weak

Dept. of Soil Mech. & Foundation Engg. CEGC Anna University Chennai-25

IN-SITU GEOTECHNICAL BORE LOG

BORE-HOLE No. BH 02
SHEET No. 1 (2)

Project:	Geotechnical Investigation for the Reconstruction of Tenements at Pillaiyar Kovil Thottam in Zone IX, Division V, Greater Chennai Corporation.
Co-ordinates:	N - 1440594 ; E - 420424
Started:	14-05-2022
Location:	Pillaiyar Kovil Thottam
Completed:	19-05-2022
Elevation (RL):	-
Ground Water Level:	1.8 m
Dia of Boring:	Px Size in Soil & Nx Size in Rock
Type of Core Barrel:	Nx Size Core Barrel
Casing Depth:	-
Water Loss Depths :	-
Type of Boring:	Rotary – Auto Trip SPT
Total Drill Depth:	33.5 m (30.5 m - Soil and 3.0 m - Rock)

Depth from EGL (m)	Log	Lithology	Description / Classification of Soil and Rock / Weathering Grade of Rock as per IS 4464 / Special Observations and Interpretations	Standard Penetration Test (SPT) / UDS / Core Drilling						Relative Density / Consistency of Soil / Strength of Rock
				0-15 cm	15-30 cm	30-45 cm	SPT-N	TCR (%)	RQD (%)	
								0 30 60 90 120 150 180		
1.0	1.0		Filling Soil	-	-	-	-			Very Loose
2.0	2.0		Brownish Silty Sand	7	8	10	18			Medium Dense
3.0	3.0		Brownish Silty Sand	7	8	9	17			Medium Dense
4.0	4.0		Brownish Silty Sand	9	10	16	26			Medium Dense
5.0	5.0		Brownish Silty Sand	7	8	11	19			Medium Dense
6.0	6.0		Brownish Silty Sand	35	55 (14 cm) Rebound		>100			Very Dense
7.5	7.0		Brownish Silty Sand	30	55 (13 cm) Rebound		>100			Very Dense
9.0	8.0 9.0		Brownish Silty Sand	32	55 (13 cm) Rebound		>100			Very Dense
10.5	10.0		Brownish Silty Sand	32	55 (10 cm) Rebound		>100			Very Dense
12.0	11.0 12.0		Greyish Silty / Clayey Sand	4	7	10	17			Medium Dense
13.5	13.0		Greyish Brown Silty Sand	13	17	18	35			Dense
15.0	14.0 15.0		Greyish Brown Silty Sand	7	12	22	34			Dense

IN-SITU GEOTECHNICAL BORE LOG

BORE-HOLE No. BH-02
SHEET No. (2/2)

Project:	Geotechnical Investigation for the Reconstruction of Tenements at Pillaiyar Kovil Thottam in Zone IX, Division V, Greater Chennai Corporation.		
Co-ordinates:	N - 1440594 ; E - 420424	**Started:**	14-05-2022
Location:	Pillaiyar Kovil Thottam	**Completed:**	19-05-2022
Elevation (RL):	-	**Ground Water Level:**	1.8 m
Dia of Boring:	Px Size in Soil & Nx Size in Rock	**Type of Core Barrel:**	Nx Size Core Barrel
Casing Depth:	-	**Water Loss Depths :**	-
Type of Boring:	Rotary – Auto Trip SPT	**Total Drill Depth:**	33.5 m (30.5 m - Soil and 3.0 m - Rock)

Depth from EGL (m)	Log	Lithology	Description / Classification of Soil and Rock / Weathering Grade of Rock as per IS 4464 / Special Observations and Interpretations	Standard Penetration Test (SPT) / UDS / Core Drilling						Relative Density / Consistency of Soil / Strength of Rock
				0-15 cm	15-30 cm	30-45 cm	SPT-N	TCR (%)	RQD (%)	
								0 30 60 90 120 150 180		
16.5	16.0		Greyish Silty Clay	2	2	4	6			Medium Stiff
18.0	17.0 / 18.0		Greyish Silty / Clayey Sand	8	5	7	12			Medium Dense
19.5	19.0		Greyish Silty Clay	2	2	4	6			Soft
21.0	20.0 / 21.0		Greyish Silty Clay	2	3	5	8			Soft
22.5	22.0		Greyish Silty Clay	2	3	4	7			Soft
24.0	23.0 / 24.0		Greyish Silty / Clayey Sand	4	6	10	16			Medium Dense
25.5	25.0		Greyish Silty / Clayey Sand	3	5	6	11			Medium Dense
27.0	26.0 / 27.0		Greyish Silty Sand	10	12	15	27			Medium Dense
28.5	28.0		Greyish Silty Sand	12	13	15	28			Medium Dense
30.0	29.0 / 30.0		Greyish Silty Sand	13	16	22	38			Dense
30.5			Greyish Brown, Charnockite, Completely Weathered (Grade V / VI)	55 (0 cm) Rebound			>100	0.0	0.0	Hard / Very Weak

IN-SITU GEOTECHNICAL BORE LOG

BORE-HOLE No.	BH 02
SHEET No.	2 (2)

Project:	Geotechnical Investigation for the Reconstruction of Tenements at Pillaiyar Kovil Thottam in Zone IX, Division V, Greater Chennai Corporation.		
Co-ordinates:	N - 1440594 ; E - 420424	**Started:**	14-05-2022
Location:	Pillaiyar Kovil Thottam	**Completed:**	19-05-2022
Elevation (RL):	-	**Ground Water Level:**	1.8 m
Dia of Boring:	Px Size in Soil & Nx Size in Rock	**Type of Core Barrel:**	Nx Size Core Barrel
Casing Depth:	-	**Water Loss Depths :**	-
Type of Boring:	Rotary – Auto Trip SPT	**Total Drill Depth:**	33.5 m (30.5 m - Soil and 3.0 m - Rock)

Depth from EGL (m)	Log	Lithology	Description / Classification of Soil and Rock / Weathering Grade of Rock as per IS 4464 / Special Observations and Interpretations	Standard Penetration Test (SPT) / UDS / Core Drilling						Relative Density / Consistency of Soil / Strength of Rock
				0-15 cm	15-30 cm	30-45 cm	SPT-N	TCR (%)	RQD (%)	
								0 30 60 90 120 150 180		
32.0	31.0 – 32.0		Greyish, Charnockite, Moderately Weathered (Grade III)					44.0	32.0	Moderately Strong
33.5	33.0		Greyish, Charnockite, Highly Weathered (Grade IV)					67.0	30.0	Moderately Weak

IN-SITU GEOTECHNICAL BORE LOG

BORE-HOLE No.	BH 03
SHEET No.	(1/3)

Project:	Geotechnical Investigation for the Reconstruction of Tenements at Pillaiyar Kovil Thottam in Zone IX, Division V, Greater Chennai Corporation.		
Co-ordinates:	N - 1440570 ; E - 420415	**Started:**	19-05-2022
Location:	Pillaiyar Kovil Thottam	**Completed:**	26-05-2022
Elevation (RL):	-	**Ground Water Level:**	1.5 m
Dia of Boring:	Px Size in Soil & Nx Size in Rock	**Type of Core Barrel:**	Nx Size Core Barrel
Casing Depth:	-	**Water Loss Depths :**	-
Type of Boring:	Rotary – Auto Trip SPT	**Total Drill Depth:**	36.0 m (33.0 m - Soil and 3.0 m - Rock)

Depth from EGL (m)	Log	Lithology	Description / Classification of Soil and Rock / Weathering Grade of Rock as per IS 4464 / Special Observations and Interpretations	Standard Penetration Test (SPT) / UDS / Core Drilling						Relative Density / Consistency of Soil / Strength of Rock
				0-15 cm	15-30 cm	30-45 cm	SPT-N	TCR (%)	RQD (%)	
								0 30 60 90 120 150 180		
1.0	1.0		Filling Soil	-	-	-	-			Very Loose
2.0	2.0		Brownish Silty Sand	11	12	15	27			Medium Dense
3.0	3.0		Brownish Silty Sand	8	10	12	22			Medium Dense
4.0	4.0		Brownish Silty Sand	3	4	7	11			Medium Dense
5.0	5.0		Brownish Silty Sand	12	13	15	28			Medium Dense
6.0	6.0		Brownish Silty Sand	15	19	27	46			Dense
7.5	7.0		Brownish Silty Sand	20	27	30	57			Very Dense
9.0	8.0 9.0		Greyish Brown Silty Sand	20	23	55 (11 cm) Rebound	>100			Very Dense
10.5	10.0		Blackish Brown Silty Sand	18	20	31	51			Very Dense
12.0	11.0 12.0		Blackish Brown Silty Sand	17	25	34	59			Very Dense
13.5	13.0		Brownish Silty Sand	10	15	22	37			Dense
15.0	14.0		Brownish Silty Sand	9	12	18	30			Medium Dense

IN-SITU GEOTECHNICAL BORE LOG

BORE-HOLE No.	BH 03
SHEET No.	(2/3)

Project:	Geotechnical Investigation for the Reconstruction of Tenements at Pillaiyar Kovil Thottam in Zone IX, Division V, Greater Chennai Corporation.
Co-ordinates:	N - 1440570 ; E - 420415
Location:	Pillaiyar Kovil Thottam
Elevation (RL):	-
Dia of Boring:	Px Size in Soil & Nx Size in Rock
Casing Depth:	-
Type of Boring:	Rotary – Auto Trip SPT
Started:	19-05-2022
Completed:	26-05-2022
Ground Water Level:	1.5 m
Type of Core Barrel:	Nx Size Core Barrel
Water Loss Depths :	-
Total Drill Depth:	36.0 m (33.0 m - Soil and 3.0 m - Rock)

Depth from EGL (m)	Log	Lithology	Description / Classification of Soil and Rock / Weathering Grade of Rock as per IS 4464 / Special Observations and Interpretations	Standard Penetration Test (SPT) / UDS / Core Drilling: 0-15 cm	15-30 cm	30-45 cm	SPT-N	TCR (%)	RQD (%)	Relative Density / Consistency of Soil / Strength of Rock
								0 30 60 90 120 150 180		
16.5	16.0		Greyish Silty / Clayey Sand	2	3	3	6			Loose
18.0	17.0		Blackish Silty Clay	2	2	2	4			Soft
19.5	19.0		Blackish Silty Clay	2	2	3	5			Medium Stiff
21.0	20.0		Blackish Silty / Clayey Sand	2	2	3	5			Loose
22.5	22.0		Greyish Silty Clay	3	3	4	7			Medium Stiff
24.0	23.0		Greyish Silty Clay	8	10	12	22			Very Stiff
25.5	25.0		Greyish Silty / Clayey Sand	3	3	3	6			Loose
27.0	26.0		Greyish Silty Sand	11	15	20	35			Dense
28.5	28.0		Greyish Silty Sand	12	18	25	43			Dense
30.0	29.0		Greyish Silty Sand	12	13	55 (12 cm) Rebound	>100			Very Dense

Dept. of Soil Mech. & Foundation Engg. CEGC Anna University Chennai-25

IN-SITU GEOTECHNICAL BORE LOG

BORE-HOLE No.	BH 03
SHEET No.	(3/3)

Project:	Geotechnical Investigation for the Reconstruction of Tenements at Pillaiyar Kovil Thottam in Zone IX, Division V, Greater Chennai Corporation.
Co-ordinates:	N - 1440570 ; E - 420415
Started:	19-05-2022
Location:	Pillaiyar Kovil Thottam
Completed:	26-05-2022
Elevation (RL):	-
Ground Water Level:	1.5 m
Dia of Boring:	Px Size in Soil & Nx Size in Rock
Type of Core Barrel:	Nx Size Core Barrel
Casing Depth:	-
Water Loss Depths :	-
Type of Boring:	Rotary – Auto Trip SPT
Total Drill Depth:	36.0 m (33.0 m - Soil and 3.0 m - Rock)

Depth from EGL (m)	Log	Lithology	Description / Classification of Soil and Rock / Weathering Grade of Rock as per IS 4464 / Special Observations and Interpretations	Standard Penetration Test (SPT) / UDS / Core Drilling						Relative Density / Consistency of Soil / Strength of Rock
				0-15 cm	15-30 cm	30-45 cm	SPT-N	TCR (%)	RQD (%)	
							0 30 60 90 120 150 180			
31.5	31.0		Greyish Silty Sand	18	29	55 (10 cm) Rebound	>100			Very Dense
33.0	32.0		Greyish Brown, Charnockite, Completely Weathered (Grade V / VI)	55 (0 cm) Rebound			>100	0.0	0.0	Hard / Very Weak
34.5	34.0		Greyish, Charnockite, Completely Weathered (Grade V)					37.0	7.0	Hard / Weak
36.0	35.0		Greyish, Charnockite, Moderately Weathered (Grade III)					44.0	36.0	Moderately Strong

IN-SITU GEOTECHNICAL BORE LOG

BORE-HOLE No.	BH 04
SHEET No.	(1/2)

Project:	Geotechnical Investigation for the Reconstruction of Tenements at Pillaiyar Kovil Thottam in Zone IX, Division V, Greater Chennai Corporation.		
Co-ordinates:	N - 1440581 ; E - 420444	**Started:**	20-05-2022
Location:	Pillaiyar Kovil Thottam	**Completed:**	26-05-2022
Elevation (RL):	-	**Ground Water Level:**	1.6 m
Dia of Boring:	Px Size in Soil & Nx Size in Rock	**Type of Core Barrel:**	Nx Size Core Barrel
Casing Depth:	-	**Water Loss Depths :**	-
Type of Boring:	Rotary – Auto Trip SPT	**Total Drill Depth:**	34.0 m (31.0 m - Soil and 3.0 m - Rock)

Depth from EGL (m)	Log	Lithology	Description / Classification of Soil and Rock / Weathering Grade of Rock as per IS 4464 / Special Observations and Interpretations	Standard Penetration Test (SPT) / UDS / Core Drilling						Relative Density / Consistency of Soil / Strength of Rock
				0-15 cm	15-30 cm	30-45 cm	SPT-N	TCR (%)	RQD (%)	
								0 30 60 90 120 150 180		
1.0	1.0		Filling Soil	-	-	-	-			Very Loose
2.0	2.0		Greyish Brown Silty Sand	10	12	14	26			Medium Dense
3.0	3.0		Greyish Brown Silty / Clayey Sand	14	6	3	9			Loose
4.0	4.0		Brownish Black Silty / Clayey Sand	12	10	7	17			Medium Dense
5.0	5.0		Brownish Grey Silty Sand	9	7	14	21			Medium Dense
6.0	6.0		Brownish Silty Sand	9	7	10	17			Medium Dense
7.5	7.0		Brownish Silty Sand	12	15	17	32			Dense
9.0	8.0 9.0		Brownish Silty Sand	12	21	55 (11 cm) Rebound	>100			Very Dense
10.5	10.0		Brownish Silty Sand	22	55 (14 cm) Rebound		>100			Very Dense
12.0	11.0 12.0		Greyish Brown Silty Sand	19	28	55 (7 cm) Rebound	>100			Very Dense
13.5	13.0		Greyish Brown Silty Sand	15	22	55 (11 cm) Rebound	>100			Very Dense
15.0	14.0		Greyish Silty Sand	36	55 (7 cm) Rebound		>100			Very Dense

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IN-SITU GEOTECHNICAL BORE LOG

BORE-HOLE No.	BH 04
SHEET No.	(2/2)

Project:	Geotechnical Investigation for the Reconstruction of Tenements at Pillaiyar Kovil Thottam in Zone IX, Division V, Greater Chennai Corporation.
Co-ordinates:	N - 1440581 ; E - 420444
Started:	20-05-2022
Location:	Pillaiyar Kovil Thottam
Completed:	26-05-2022
Elevation (RL):	-
Ground Water Level:	1.6 m
Dia of Boring:	Px Size in Soil & Nx Size in Rock
Type of Core Barrel:	Nx Size Core Barrel
Casing Depth:	-
Water Loss Depths :	-
Type of Boring:	Rotary – Auto Trip SPT
Total Drill Depth:	34.0 m (31.0 m - Soil and 3.0 m - Rock)

Depth from EGL (m)	Log	Lithology	Description / Classification of Soil and Rock / Weathering Grade of Rock as per IS 4464 / Special Observations and Interpretations	Standard Penetration Test (SPT) / UDS / Core Drilling						Relative Density / Consistency of Soil / Strength of Rock
				0-15 cm	15-30 cm	30-45 cm	SPT-N	TCR (%)	RQD (%)	
								0 30 60 90 120 150 180		
16.5	16.0		Greyish Silty Sand	32	37	55 (3 cm) Rebound	>100			Very Dense
18.0	17.0		Blackish Silty Clay	3	3	4	7			Medium Stiff
19.5	19.0		Greyish Silty / Clayey Sand	3	4	5	9			Loose
21.0	20.0		Greyish Silty / Clayey Sand	10	20	22	42			Dense
22.5	22.0		Greyish Silty / Clayey Sand	5	4	4	8			Loose
24.0	23.0		Greyish Silty Clay	2	3	3	6			Medium Stiff
25.5	25.0		Greyish Silty / Clayey Sand	5	6	9	15			Medium Dense
27.0	26.0		Greyish Silty Sand	14	22	23	45			Dense
28.5	28.0		Greyish Silty Sand	23	55 (11 cm) Rebound		>100			Very Dense
30.0	29.0		Greyish Silty Sand	23	55 (12 cm) Rebound		>100			Very Dense
31.0			Greyish Brown, Charnockite, Completely Weathered (Grade V / VI)	55 (0 cm) Rebound			>100			Hard / Very Weak

IN-SITU GEOTECHNICAL BORE LOG

BORE-HOLE No.	BH 04		
SHEET No.	(3/2)		

Project:	Geotechnical Investigation for the Reconstruction of Tenements at Pillaiyar Kovil Thottam in Zone IX, Division V, Greater Chennai Corporation.		
Co-ordinates:	N - 1440581 ; E - 420444	**Started:**	20-05-2022
Location:	Pillaiyar Kovil Thottam	**Completed:**	26-05-2022
Elevation (RL):	-	**Ground Water Level:**	1.6 m
Dia of Boring:	Px Size in Soil & Nx Size in Rock	**Type of Core Barrel:**	Nx Size Core Barrel
Casing Depth:	-	**Water Loss Depths :**	-
Type of Boring:	Rotary – Auto Trip SPT	**Total Drill Depth:**	34.0 m (31.0 m - Soil and 3.0 m - Rock)

Depth from EGL (m)	Log	Lithology	Description / Classification of Soil and Rock / Weathering Grade of Rock as per IS 4464 / Special Observations and Interpretations	Standard Penetration Test (SPT) / UDS / Core Drilling						Relative Density / Consistency of Soil / Strength of Rock
				0-15 cm	15-30 cm	30-45 cm	SPT-N	TCR (%)	RQD (%)	
								0 30 60 90 120 150 180		
32.5	32.0		Greyish, Charnockite, Moderately Weathered (Grade III)					44.0	37.0	Moderately Strong
34.0	33.0		Greyish, Charnockite, Highly Weathered (Grade IV)					37.0	17.0	Moderately Weak

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LOAD-CARRYING CAPACITY OF PILES — STATIC ANALYSIS - IS 2911 : 2010

PILES IN GRANULAR SOILS

The ultimate load capacity (Q_u) of piles, in kN, in granular soils is given by the following formula:

$$Q_u = A_p(\tfrac{1}{2} D\gamma N_\gamma + P_D N_q) + \sum_{i=1}^{n} K_i P_{Di} \tan\delta_i A_{si}$$

The first term gives end-bearing resistance and the second term gives skin friction resistance.

where

A_p = cross-sectional area of pile tip, in m^2;

D = diameter of pile shaft, in m;

γ = effective unit weight of the soil at pile tip, in kN/m^3;

N_γ and N_q = bearing capacity factors depending upon the angle of internal friction, ϕ at pile tip;

P_D = effective overburden pressure at pile tip, in kN/m^2 (*see* Note 5);

$\sum_{i=1}^{n}$ = summation for layers 1 to n in which pile is installed and which contribute to positive skin friction;

K_i = coefficient of earth pressure applicable for the ith layer (*see* Note 3);

P_{Di} = effective overburden pressure for the ith layer, in kN/m^2;

δ_i = angle of wall friction between pile and soil for the ith layer; and

A_{si} = surface area of pile shaft in the ith layer, in m^2.

NOTES

1 N_γ factor can be taken for general shear failure according to IS 6403.

2 N_q factor will depend on the nature of soil, type of pile, the L/B ratio and its method of construction. The values applicable for bored piles are given in Fig. 1 of IS 2911 : 2010 Part I

3 K_i, the earth pressure coefficient depends on the nature of soil strata, type of pile, spacing of pile and its method of construction. For driven piles in loose to dense sand with ϕ varying between 30° and 40°, K_i values in the range of 1 to 1.5 may be used.

4 δ, the angle of wall friction may be taken equal to the friction angle of the soil around the pile stem.

5 In working out pile capacity by static formula, the maximum effective overburden at the pile tip should correspond to the critical depth, which may be taken as 15 times the diameter of the pile shaft for $\phi \leq 30°$ and increasing to 20 times for $\phi \geq 40°$.

6 For piles passing through cohesive strata and terminating in a granular stratum, a penetration of at least twice the diameter of the pile shaft should be given into the granular stratum.

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PILES IN COHESIVE SOILS

The ultimate load capacity (Q_u) of piles, in kN, in cohesive soils is given by the following formula:

$$Q_u = A_p N_c c_p + \sum_{i=1}^{n} \alpha_i c_i A_{si}$$

The first term gives the end-bearing resistance and the second term gives the skin friction resistance.

where

A_p = cross-sectional area of pile tip, in m²;

N_c = bearing capacity factor, may be taken as 9;

c_p = average cohesion at pile tip, in kN/m²;

$\sum_{i=1}^{n}$ = summation for layers 1 to n in which the pile is installed and which contribute to positive skin friction;

α_i = adhesion factor for the ith layer depending on the consistency of soil, (*see* Note);

c_i = average cohesion for the ith layer, in kN/m²; and

A_{si} = surface area of pile shaft in the ith layer, in m².

B-3.3 Ultimate skin friction resistance can be approximated to local side friction (f_s), in kN/m², obtained from static cone resistance as given in Table 1.

Table 1 Side Friction for Different Types of Soil

Sl No. (1)	Type of Soil (2)	Local Side Friction, f_s kN/m² (3)
i)	q_c less than 1 000 kN/m²	$q_c/30 < f_s < q_c/10$
ii)	Clay	$q_c/25 < f_s < 2q_c/25$
iii)	Silty clay and silty sand	$q_c/100 < f_s < q_c/25$
iv)	Sand	$q_c/100 < f_s < q_c/50$
v)	Coarse sand and gravel	$q_c/100 < f_s < q_c/150$

q_c = cone resistance, in kN/m².

USE OF STATIC CONE PENETRATION DATA

When full static cone penetration data are available for the entire depth, the following correlation may be used as a guide for the
0.6 determination of ultimate load capacity of a pile.

Ultimate end bearing resistance (q_u), in kN/m², may be obtained as:

$$q_u = \frac{\frac{q_{c0} + q_{c1}}{2} + q_{c2}}{2}$$

where

q_{c0} = average static cone resistance over a depth of $2D$ below the pile tip, in kN/m²;

q_{c1} = minimum static cone resistance over the same $2D$ below the pile tip, in kN/m²;

q_{c2} = average of the envelope of minimum static cone resistance values over the length of pile of $8D$ above the pile tip, in kN/m²; and

D = diameter of pile shaft.

NOTE — The value of adhesion factor, α_i depends on the undrained shear strength of the clay and may be obtained from Fig. 2 of IS 2911 : 2010 Part I

Table 2 Co-relation Between N and q_c for Different Types of Soil

Sl No. (1)	Type of Soil (2)	q_c/N (3)
i)	Clay	150-200
ii)	Silts, sandy silts and slightly cohesive silt-sand mixtures	200-250
iii)	Clean fine to medium sand and slightly silty sand	300-400
iv)	Coarse sand and sands with little gravel	500-600
v)	Sandy gravel and gravel	800-1 000



Annexure - 1 (DETERMINATION OF PILE CARRYING CAPACITY AS PER IS 2911:2010)

PILE CARRYING CAPACITY BASED ON SHEAR STRENGTH PARAMETERS ('c' and 'Φ') (IS 2911: 2010)

$$Q_u = A_p (cN_c + P_D N_q + 0.5\gamma D N_\gamma) + \Sigma A_{si}(\alpha_i c_i + K P_{Di} \tan\Phi)$$

Where,

Q_u	-	Ultimate Pile Capacity, kN
A_p	-	Cross Sectional Area of Pile, m^2
c_i	-	Cohesion value of soil at pile base, kN/m^2
P_D	-	Effective overburden pressure at pile base , kN/m^2
γ	-	Unit weight of soil, kN/m^3
D	-	Diameter of pile, m
A_{si}	-	Surface Area of Pile at respective soil layers, m^2
α_i	-	Adhesion factor
c	-	Cohesion value of soil at respective soil layers, kN/m^2
K_i	-	Co-efficient of earth pressure at respective soil layers
P_{Di}	-	Effective overburden pressure at respective soil layers, kN/m^2
Φ	-	Friction angle, degrees
N_c, N_q, N_γ	-	Bearing capacity factors based on IS 2911: 2010 and IS 6403 -1981

PILE CARRYING CAPACITY OF SOCKETED PILES BY COLE AND STROUD APPROACH (1977) - IS 2911 : 2010

$$Q_a = c_{u1} N_c \cdot \frac{\pi B^2}{4F_s} + \alpha\, c_{u2} \cdot \frac{\pi B L}{F_s}$$

where

c_{u1} = shear strength of rock below the base of the pile, in kN/m^2 (*see* Fig. 3);

Type of Soil	Limiting Frictional Resistance (t/m^2)
Sand	6
Silt	6
Clay	7

N_c = bearing capacity factor taken as 9;

F_s = factor of safety usually taken as 3;

α = 0.9 (recommended value);

c_{u2} = average shear strength of rock in the socketed length of pile, in kN/m^2 (*see* Fig 3);

B = minimum width of pile shaft (diameter in case of circular piles), in m; and

L = socket length of pile, in m.

Limiting End Bearing Resistance (t/m^2) as per IS 2911	
Bored Piles	**Driven Piles**
1000 - 1100	1500



Annexure - 1 (Determination of Pile Carrying Capacity as Per IS 2911:2010)

DETERMINATION OF PILE CARRYING CAPACITY AS PER IS 2911 : 2010

Length of Pile (L), m	=	35.00	m				From Existing Borehole Level
Angle of Internal Friction (φ) in Degrees	=	45.00					
Undraind cohesion value at PileTip (c_p), kN/m^2	=	0.00	kN/m^2				
Submerged Unit Weight at PileTip (Υ_p), kN/m^2	=	13.12	kN/m^2				
Ground Water Table Depth (GWT), m	=	0.00	m				Submerged Condition
Bearing Capacity Factor (N_c)	=	9.00					
Bearing Capacity Factor (N_q)	=	350.00					Taken from Figure 1 of IS 2911:2010 Part 1 Sec.2
Bearing Capacity Factor (N_γ)	=	271.75					
Factor of Safety (FS)	=	2.50					
Diameter of Pile (D), mm	=	450		500	600	700	900
Critical Depth of Pile (20 x D), m	=	9		10	12	14	18
End Bearing Resisrtnce of Pile (q_p), kN/m^2 using 'N' values	=	80000.00		80000.00	80000.00	80000.00	80000.00
Limiting End Bearing Resisrtnce of Pile (q_p), kN/m^2	=	11000.00		11000.00	11000.00	11000.00	11000.00
Ultimate End Bearing Capacity of Pile (Q_p), kN using 'N' values	=	1749.47		2159.84	3110.18	4233.30	6997.90
Safe End Bearing Capacity of Pile ($Q_{p\text{-}safe}$), kN using 'N' values	=	699.79		863.94	1244.07	1693.32	2799.16
Ultimate Frictional Capacity of Pile (Q_f), kN using 'N' values	=	1930.90		2145.45	2574.54	3003.62	3861.80
Negetive Skin Friction of Pile (Q_{nf}), kN using 'N' values	=	294.52		327.25	392.70	458.15	589.05
Safe Frictional Capacity of Pile ($Q_{f\text{-}Safe}$), kN using 'N' values	=	477.84		530.93	637.11	743.30	955.67
Safe Pile Carrying Capacity of Pile (Q_{safe}), kN ('N' values)	=	1178		1395	1881	2437	3755



Annexure - 1 (Determination of Pile Carrying Capacity as Per IS 2911:2010)

Depth (m)	Soil Description	Ultimate Frictional Capacity, kN using 'N' values						N' Value
		q_s (kN/m^2)	450 mm	500 mm	600 mm	700 mm	900 mm	
2.00	Brownish Silty Sand	15.00	42.41	47.12	56.55	65.97	84.82	9
3.00	Brownish Silty Sand	33.33	47.12	52.36	62.83	73.30	94.25	20
4.00	Brownish Silty Sand	41.67	58.90	65.45	78.54	91.63	117.81	25
5.00	Brownish Silty Sand	51.67	73.04	81.16	97.39	113.62	146.08	31
6.00	Brownish Silty Sand	65.00	84.82	94.25	113.10	131.95	169.65	39
7.50	Brownish Silty Sand	166.67	127.23	141.37	169.65	197.92	254.47	100
9.00	Brownish Silty Sand	166.67	127.23	141.37	169.65	197.92	254.47	100
10.50	Brownish Silty Sand	166.67	127.23	141.37	169.65	197.92	254.47	100
12.00	Brownish Grey Silty Sand	65.00	127.23	141.37	169.65	197.92	254.47	39
13.50	Brownish Grey Silty Sand	96.67	127.23	141.37	169.65	197.92	254.47	58
15.00	Blackish Silty Clay	35.00	74.22	82.47	98.96	115.45	148.44	7
16.50	Blackish Silty / Clayey Sand	6.67	14.14	15.71	18.85	21.99	28.27	4
18.00	Blackish Silty Clay	25.00	53.01	58.90	70.69	82.47	106.03	5
19.50	Blackish Silty Clay	20.00	42.41	47.12	56.55	65.97	84.82	4
21.00	Greyish Silty / Clayey Sand	10.00	21.21	23.56	28.27	32.99	42.41	6
22.50	Greyish Silty Sand	240.00	127.23	141.37	169.65	197.92	254.47	48
24.00	Greyish Silty / Clayey Sand	20.00	42.41	47.12	56.55	65.97	84.82	12
25.50	Brownish Grey,Charnockite, Completely Weathered (Grade V / VI)	166.67	127.23	141.37	169.65	197.92	254.47	100
27.00	Greyish Silty Sand	166.67	127.23	141.37	169.65	197.92	254.47	100
28.50	Greyish Silty Sand	166.67	127.23	141.37	169.65	197.92	254.47	100
30.00	Greyish Silty Sand	48.33	102.49	113.88	136.66	159.44	204.99	29
31.50	Greyish Silty Sand	166.67	127.23	141.37	169.65	197.92	254.47	100
33.00	Greyish Silty Sand with Gravel	166.67	127.23	141.37	169.65	197.92	254.47	100
33.25	Brownish Grey,Charnockite, Completely Weathered (Grade V / VI)	250.00	21.21	23.56	28.27	32.99	42.41	150
34.75	Greyish, Charnockite, Highly Weathered (Grade IV)	333.33	148.44	164.93	197.92	230.91	296.88	200

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DETERMINATION OF LATERAL PILE CARRYING CAPACITY AS PER IS 2911 : 2010

Length of Pile (L), m	=	**35.00 m**					From Existing Borehole Level
Type of Fixity	=	**Fixed Head by Pile Cap**					
Cantilever Length above Ground Level (e), m	=	**0.00 m**					Point of appilcation of Lateral Load (Assumed)
Allowable Deflection as per IS 2911 Part 4 : 1985, Page No. 10 in mm	=	**5.00 mm**					
Modulus of Subgrade Reaction of Soil (η_h)	=	3200.00 kN/m^3					From Table 3 of IS 2911 Part 1 Sec. 2
Grade of Concrete	=	**30.00 N/mm^2**					M 30
Young's Modulus of Pile Materia (E), kN/m^2	=	27386127.88 kN/m^2					
Diametr of Pile (D), mm	=	450	500	600	700	900	
Moment of Inertia of Pile Section (I), m^4	=	0.00201	0.00307	0.00636	0.01179	0.03221	
Stiffness Factor, (T)	=	1.77	1.92	2.22	2.52	3.08	
Criteria for Behaviour of Pile as per Table 5 of IS 2911 Part I Sec. 2	=	Long Pile	Long Pile	Long Pile	Long Pile	Long Pile	
(e/R)	=	0.00	0.00	0.00	0.00	0.00	
(Z_f/T) from Fig.4 of IS 2911 Part 1 Sec.2	=	1.90	1.90	1.90	1.90	1.90	
Depth of Fixity (Z_f), m	=	3.36	3.65	4.23	4.78	5.85	
Allowable Deflection as per IS 2911 Part 4 : 1985, Page No. 10 in mm	=	5.00	5.00	5.00	5.00	5.00	
Lateral Load Capacity of Pile (H), kN	=	**87.20**	**103.70**	**138.10**	**177.30**	**264.30**	



Appendix – C
Site Photographs

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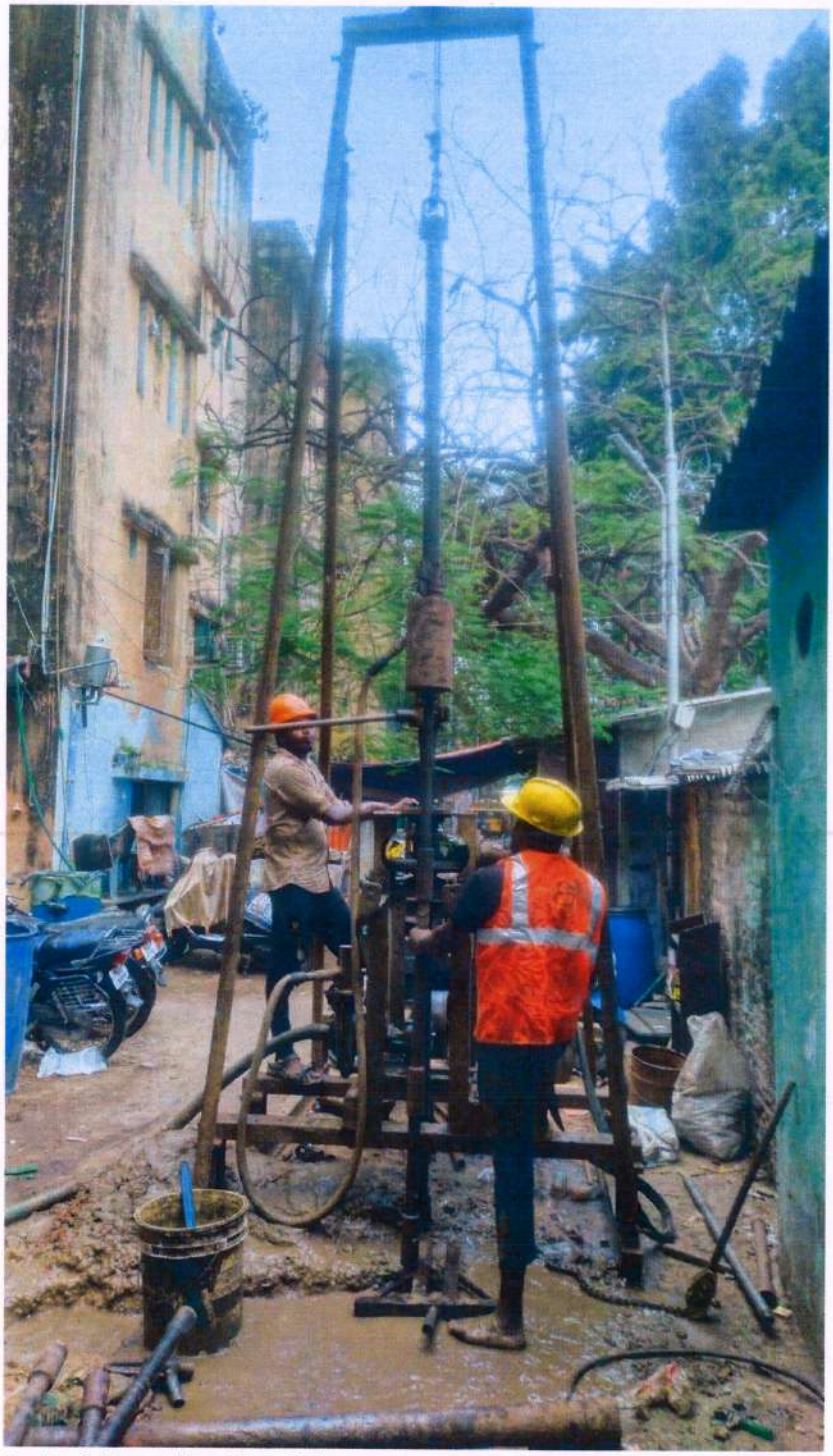
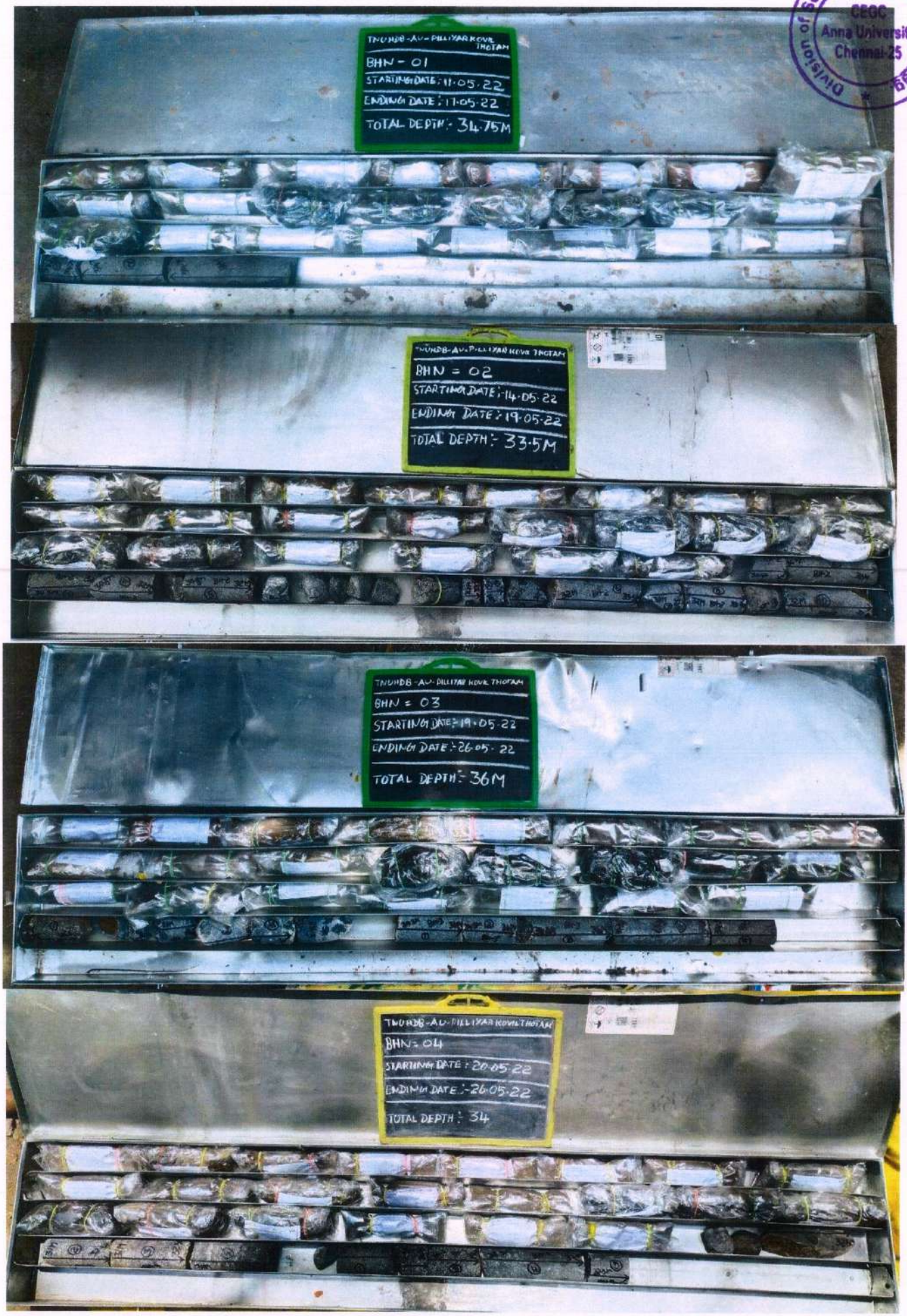


Figure 1 Geo-technical Investigation is in progress at Construction of Multi-storied Building Road Old in Zone IX, Division V, Greater Chennai Corporation.



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Figure 2 View of Soil and Rock Samples collected at the Proposed Site

Annexure – 1 View of Soil / Rock Samples collected in BH 1 to BH 4 Locations of the Reconstruction of Tenements at Pillaiyar Kovil Thottam in Zone IX, Division V, Greater Chennai Corporation.

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Plate – 1 Soil / Rock Samples Collected in BH-01 Location



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Plate – 2 Soil / Rock Samples Collected in BH-02 Location



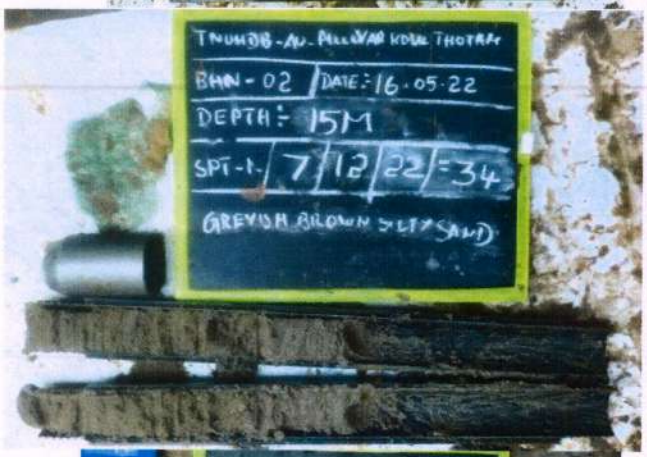
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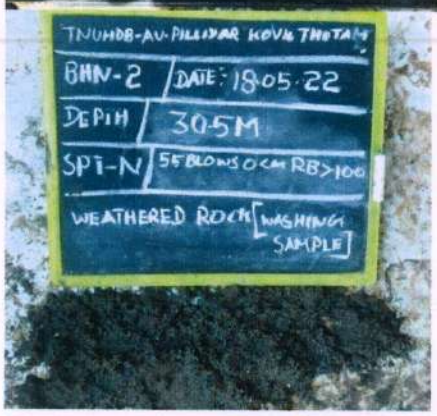
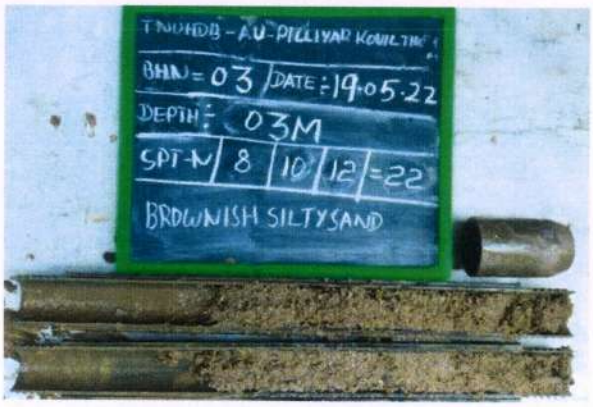






Plate – 3 Soil / Rock Samples Collected in BH-03 Location

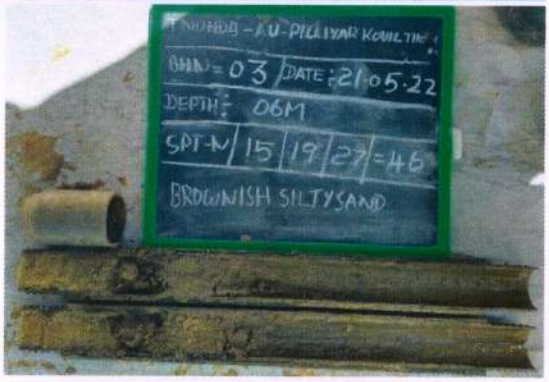




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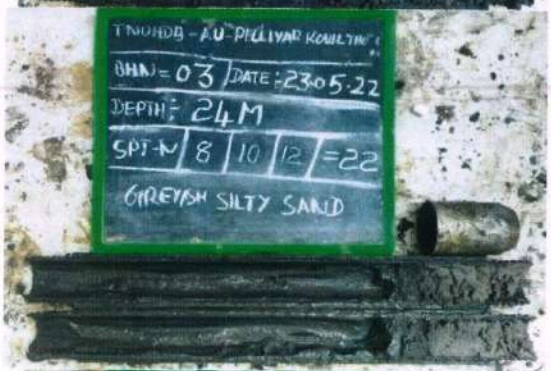
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Plate – 4 Soil / Rock Samples Collected in BH-04 Location



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Property Valuation & Cost Estimation

Guideline Value, Apartment Composite Value, Stamp Duty & Registration Fees Calculator, Building Value Calculator, Capital Gains Calculator, Area Unit Converter, Length Unit Converter

Ownership, Compliance & Legal Verification

Encumbrance Certificate (EC) Search, Find Your SRO, Temple Property Check, WAQF Property Check, View Patta/Chitta, View FMB, Patta Analyzer, EC Analyzer

Zoning & Land Use Analysis

Land Use Zone Finder, CRZ Zone Check, Aquifer Zone Check, CBA Check, EWS Check, Road Width Check, Proposed Road Widening Check, FSI Calculator

Property Documentation & Workflow Tools

Forms & Templates, Document Generator, Document Translation, Dictionary

Vastu & Property Management Tools

Home Vastu Shastra, Plot Vastu Shastra, Property Management

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