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GEO TECHNICAL INVESTIGATION REPORT

CLIENT

M/S. URBAN TREE REAL ESTATE DEVELOPERS LLP

CHENNAI, TAMIL NADU



REPORT NO.: SI/CHN/21/1588/01

MARCH 2021

GEO FOUNDATIONS & STRUCTURES PVT LTD

GEO TECHNICAL DIVISION CHENNAI

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NAME OF PROJECT

SOIL INVESTIGATION FOR THE PROPOSED (STILT + 5 FLOORS) RESIDENTIAL BUILDING AT SURVEY NO. 429 & 456, MANAPAKKAM MAIN ROAD, MANAPAKKAM, CHENNAI – 600125.

CLIENT

M/s. URBAN TREE REAL ESTATE DEVELOPERS LLP

NUNGAMBAKKAM, CHENNAI, TAMIL NADU.

GEOTECHNICAL CONSULTANT

GEO FOUNDATIONS & STRUCTURES PVT LTD,
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SOIL INVESTIGATION REPORT

1.0 INTRODUCTION

1.1 The work of "Soil Investigation for the Proposed (Stilt + 5 Floors) Residential Building at Survey No. 429 & 456, Manapakkam Main Road, Manapakkam, Chennai.", was entrusted to **M/s. Geo Foundations & Structures (P) Ltd.,** Adyar**,** Chennai – 600 020, by **M/s. URBAN TREE REAL ESTATE DEVELOPERS LLP**, Nungambakkam, Chennai, Tamil Nadu.

1.2 The soil Investigation and laboratory studies were carried out during **February & March 2021.** This report summarizes the results of the soil investigation, and presents recommendations for suitable type of foundations for the proposed (Stilt + 5 Floors) structure.

2.0 OBJECTIVE OF INVESTIGATION

2.1 The objective of soil investigation is to determine the nature and characteristics of sub-soil below the ground level for the proposed (Stilt + 5 Floors) structure. The study includes identification of suitable type of foundations and assessment of safe capacities for the proposed (Stilt + 5 Floors) structure.

3.0 SCOPE OF WORK

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

3.1 Mobilization of boring rig with all necessary equipment and personnel.

3.2 Boring of **Seven** bore holes of 150 mm diameter with Calyx drilling equipment through sand, silt & clay up to 10 m or hard strata (SPT N>100) whichever occurs earlier.

3.3 Conducting Standard Penetration Tests in the bore holes and collecting the disturbed but representative soil samples including packing and transportation to laboratory.

3.4 To conduct the following laboratory tests on soil samples:

(a) Sieve analysis

(b) Index properties:

(i) Liquid limit

(ii) Plastic limit

(d) Moisture content

(e) Specific gravity

(g) Triaxial /Direct Shear Test

(h) Chemical analysis of water

3.5 Preparation and submission of detailed report of field and laboratory results with recommendations for foundations.

4.0 <u>FIELD INVESTIGATIONS-GEO-TECHNICAL STUDIES</u>

4.1 Boring rig with all requisite equipment's and accessories were mobilized at the worksite. A team of technical personnel with skilled labors were also deputed.

4.2 **Seven** boreholes of 150 mm diameter were bored to a maximum depth up to **18 m** below the existing ground level. The bore holes were made as per relevant Indian Standard IS: 1892.

4.3 Representative soil samples were collected at every change of strata or about 1 m depth interval up to 5 m from the existing ground level, followed by 1.5 m up to the termination depth. The samples so collected were sealed and numbered with full particulars for identification and sent to the laboratory for conducting the required tests.

4.4 Standard Penetration tests were conducted in the bore hole at 1 m depth interval up to 5 m from the existing ground level, followed by 1.5 m intervals up to the termination depth, as per the relevant Indian Standard, IS: 2131. In this test, a standard split spoon sampler is driven into the ground at the required depth by means of standard hammer

of 63.5 kgs weight, falling from a height of 75 cm. Number of blows for the first 15 cm is not taken into consideration because of possible disturbances or presence of settled, suspended matters at the bottom of the bore- holes. The total number of blows for the next 30 cm depth of penetration is considered as SPT 'N' value as shown in Figure nos.1 to 7 **(Appendix – 1)**.

5.0 LABORATORY INVESTIGATION

The following laboratory tests were conducted on the selected soil samples collected from the test bore holes:

(a) Sieve analysis

(b) Atterberg Limits:

  (i) Liquid limit

  (ii) Plastic limit

(c) Natural Moisture content

(d) Specific gravity

(e) Free Swell Index

(f) Direct Shear Test

(g) Chemical analysis of water

All the above laboratory tests were carried out as per relevant Indian Standards.

All the soil samples were identified and classified as per relevant Indian Standard, IS: 1498. The results are shown in Table Nos. 1 to 8 **(Appendix – 2 & 3)**.

6.0 SOIL PROFILE

In borehole BH 1, Loose sand occurs from ground level up to 4 m, followed by medium dense sand up to 5 m, stiff clay of medium plasticity up to 6.5 m, very dense clayey sand up to 7.5 m, followed by weathered rock up to **7.8 m** at which depth the bore hole was terminated.

In borehole BH 2, Medium dense clayey sand occurs from ground level up to 2 m, followed by medium dense sand up to 3 m, loose silty sand up to 4 m, medium dense sand up to 5 m, stiff sandy clay of medium plasticity up to 6.5 m, followed by clayey sand up to **7.5 m** at which depth the bore hole was terminated.

In borehole BH 3, Medium dense silty sand occurs from ground level up to 2 m, followed by loose silty sand up to 3 m, loose clayey sand up to 4 m, loose silty sand up to 5 m, medium stiff sandy clay of medium plasticity up to 6.5 m, medium dense silty gravelly sand up to 8 m, dense gravelly silty sand up to 9.5 m, very dense sand up to 12.5 m, very dense silty sand up to 14 m, very dense sand up to 16 m, followed by weathered rock up to **18 m** at which depth the bore hole was terminated.

In borehole BH 4, Medium dense sand occurs from ground level up to 4 m, followed by medium dense silty sand up to 5 m, stiff clay of high plasticity up to 6.5 m, dense silty gravelly sand up to 8 m, followed by fractured hard rock up to **8.9 m** at which depth the bore hole was terminated.

In borehole BH 5, Medium dense sand occurs from ground level up to 5 m, followed by stiff sandy clay of high plasticity up to 6.5 m, very dense gravelly silty sand up to 8 m, followed by weathered rock up to **8.5 m** at which depth the bore hole was terminated.

In borehole BH 6, Medium dense sand occurs from ground level up to 4 m, followed by loose sand up to 5 m, stiff sandy clay of high plasticity up to 6.5 m, dense silty gravelly sand up to 8 m, followed by weathered rock up to **9.5 m** at which depth the bore hole was terminated.

In borehole BH 7, Medium dense sand occurs from ground level up to 5 m, followed by stiff clay of medium plasticity up to 6.5 m, followed by weathered rock up to **8 m** at which depth the bore hole was terminated.

7.0 GROUND WATER TABLE

Ground water levels were met at a depths ranging from **2.7 to 3 m** from the existing ground level at the time of investigation, during continuous boring from **15.02.2021** to **24.02.2021.**

8.0 DISCUSSION ON RESULTS AND RECOMMENDATION ON TYPE OF FOUNDATION

Bore holes were made for soil investigation to assess the nature and strength of the subsoil strata for sustainability of the loads. This report gives the details of the soil strata, suitable type of foundation and safe bearing capacity. Based on the subsoil conditions described in Sl. No. 6, the following recommendations are made for suitable type of foundation for the proposed (Stilt + 5 Floors) structure.

8.1 PILE FOUNDATION:

- Bored cast in situ concrete pile foundations are recommended.
- The pile bore will be terminated at a depth of minimum of 3 times diameter of pile into hard stratum (where four consecutive SPT 'N' values of more than 100 are obtained in each SPT, at depth intervals of one pile diameter).
- To satisfy the above criterion, the pile length will be about **10 m** from the existing ground level.
- In terms of concrete used for the piles, to provide the required factor of safety of **2.5** for stress in the pile concrete, we recommend minimum M 30 Grade Concrete.
- According to the structural strength of concrete for different pile diameters, assume 5 grades less to allow for underwater concreting, consider M 25 grade concrete instead of M 30 grade concrete.
- The recommended safe load carrying capacity of bored cast in situ concrete piles as per IS 2911 (Part 1/Sec2) for different pile diameters are presented in Table 9.

Table 9

Approximate Length of Pile from G.L. (m)	Diameter (cm)	Recommended Safe Vertical Capacity (T)
10	40	70
	50	90
	60	120

8.1.1 R.C.C. BORED CAST IN SITU PILE

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

Ultimate bearing capacity Qu of piles in Cohesion less soil:

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

Where, Ap= Cross sectional area of pile toe in cm²

D= Stem dia. in cm

γ= Effective unit weight of soil at pile toe in kg /cm³

PD = Effective overburden pressure in Kg / cm²

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

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

K = Coefficient of earth pressure

PDi = Effective overburden pressure in Kg /cm² for the ith layer where i varies from 1 to n.

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

Asi=Surface area of pile stem in cm² in the i^{th} layer where i varies from 1 to n.

For cohesive soil:-

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

Where,

Ap- c/s area of pile toe in cm²

Nc- bearing capacity factor

Cp- average cohesion at pile tip in Kg/cm²

α - Reduction factor

C – average cohesion throughout the length of pile in Kg/cm²

s- Surface area of pile shaft in cm²

F - Factor of safety.

9.0 CHEMICAL COMPOSITION OF GROUND WATER

The results of chemical analysis on the water sample collected from the borehole are presented in **Appendix – III** shows that:

- Since the pH value is more than 6, the ground water, in terms of pH value, is suitable for mixing concrete as per Clause 5.4.2 of Indian Standard: 456-2000, (Reaffirmed 2005), plain and reinforced concrete – code of practice (Fourth Revision).

- The organic solid and inorganic solid contents are less than the upper permissible limit of 200 mg/l and 3000 mg/l respectively. Therefore, the ground water is suitable for mixing concrete for RCC.
- The chloride content is less than the permissible upper limit of 500 mg/l for use of ground water for mixing in concrete for RCC, as per IS: 456-2000, (Reaffirmed 2005). Therefore, in terms of chloride content in the ground water, the ground water is suitable for mixing concrete for RCC.
- The sulphate content (expressed as SO3) is less than the permissible upper limit of 400 mg/l for use of ground water for mixing in concrete, as per IS: 456-2000 (Reaffirmed 2005). Therefore, in terms of sulphate content also, the ground water is suitable for mixing concrete for RCC.
- The sulphate content (expressed as SO3) is less than 300 mg/l which comes under Class 1 of "Requirements for concrete exposed to sulphate attack", as per IS: 456-2000, Table 4. For this Class, the requirements are: Ordinary Portland cement or Portland slag cement or Portland pozzolana cement can be used with a minimum cement content of 280 kg/m^3 of concrete and with a maximum free water: cement ratio of 0.55".

  Hence, the ground water is suitable for mixing concrete for Construction purpose.

10.0 The results given in this report are based on the results of the soil investigation carried out. In actual execution, if any variation is found, the consultants may also be referred to.

For GEO FOUNDATIONS & STRUCTURES PVT.LTD.

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M.B.A (Technology Management), MIGS

General Manager (Geo Tech)

APPROVED BY,

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APPENDIX- I

BORELOGS

Project : Soil Investigation for the Proposed (Stilt + 5 Floors) Residential Building at Survey No. 429 & 456, Manapakkam Main Road, Manapakkam, Chennai.

GEO FOUNDATIONS & STRUCTURES PVT. LTD

Bore Hole No	: BH 1
Location	: Manapakkam
Type of Boring	: Calyx
Ground Water Level	: 2.7 m From G.L. on 25.02.2021
UTM Co-ordinates	: 409792 E,1438772 N
Termination Depth	: 7.80 m

Drilling Hole Record-BH 1

Fig No. 01

Start Date : 23.02.2021

End Date : 24.02.2021

SOIL DESCRIPTION	COLOUR	STRUCTURE	GROUND LEVEL (m)	LEGEND	TEST NO	SAMPLE TYPE	DEPTH (m)	TEST DEPTH(m)	PENETRATION VALUES 15cm	30cm	45cm	SPT"N" Blows/300mm	SPT 'N' PROFILE	C.R (%)	R.Q.D(%)	REMARKS
SAND (SP)	Grey	Loose, Granular			SPT-1	SS	1.00	1.00-1.45	4	3	5	8				
					SPT-2	SS	2.00	2.00-2.45	2	3	4	5				
					UDS-1	OT	2.50	2.50-2.95	-	-	-	-				G.W.L
					SPT-3	SS	3.00	3.00-3.45	4	3	4	7				
			4.00		SPT-4	SS	4.00	4.00-4.45	4	5	6	11				
Greyish, Medium Dense, **SAND** (SP)			5.00		SPT-5	SS	5.00	5.00-5.45	4	5	7	12				
CLAY (CI)	Black	Stiff, Layered	6.50		SPT-6	SS	6.50	6.50-6.95	32	42	43	85				
Clayey **SAND** (SC)	Grey	Very Dense, Granular	7.50		SPT-7	SS	7.50	7.50-7.76	42	50	-	>100				50/11 cm Penetration
Weathered Rock			7.80		SPT-8	SS		7.80-7.80	50	-	-	>100				Rebound

SPT 'N' PROFILE scale: 20, 40, 60, 80, 100

G.W.L : 2.7 m From G.L. on 25.02.2021	No of SPT: 8 Nos.	No of UDS : 1 No.	No of CR : Nil	**Remarks**

Note: SPT-Standard Peneration Test; SS-Soil Sample; OT- Open Tube

UDS-Un Disturbed Sample; CS-Core Sample

CR-Core Recovery: RQD-Rock Quality Designation

Project : Soil Investigation for the Proposed (Stilt + 5 Floors) Residential Building at Survey No. 429 & 456, Manapakkam Main Road, Manapakkam, Chennai.

GEO FOUNDATIONS & STRUCTURES PVT. LTD

Bore Hole No	: BH 2
Location	: Manapakkam
Type of Boring	: Calyx
Ground Water Level	: 2.8 m From G.L. on 24.02.2021
UTM Co-ordinates	: 409793 E,1438794 N
Termination Depth	: 7.50 m

Drilling Hole Record-BH 2

Fig No. 02

Start Date : 22.02.2021

End Date : 23.02.2021

SOIL DESCRIPTION	COLOUR	STRUCTURE	GROUND LEVEL (m)	LEGEND	TEST NO	SAMPLE TYPE	DEPTH (m)	TEST DEPTH(m)	PENETRATION VALUES 15cm	30cm	45cm	SPT"N" Blows/300mm	C.R (%)	R.Q.D(%)	REMARKS
Clayey **SAND** (SC)	Grey	Medium Dense, Granular	2.00		SPT-1	SS	1.00	1.00-1.45	4	5	7	12			
					SPT-2	SS	2.00	2.00-2.45	3	5	6	11			
Greyish, Medium Dense, **SAND** (SP)			3.00		UDS-1	OT	2.50	2.50-2.95	-	-	-	-		G.W.L	
					SPT-3	SS	3.00	3.00-3.45	3	4	5	9			
Greyish, Loose, Silty **SAND** (SM)			4.00		SPT-4	SS	4.00	4.00-4.45	5	7	8	15			
Greyish, Medium Dense, **SAND** (SP)			5.00		SPT-5	SS	5.00	5.00-5.45	3	3	5	8			
Sandy **CLAY** (CI)	Dark Grey	Stiff, Layered	6.50		SPT-6	SS	6.50	6.50-6.89	25	30	50	>100			50/9 cm Penetration
Clayey **SAND** (SC)	Grey	Dense, Granular	7.50		SPT-7	SS	7.50	7.50-7.72	42	50	-	>100			50/7 cm Penetration
Weathered Rock			7.72												

SPT 'N' PROFILE: 20, 40, 60, 80, 100

G.W.L : 2.8 m From G.L. on 24.02.2021	No of SPT: 7 Nos.	No of UDS : 1 No.	No of CR : Nil	**Remarks**

Note: SPT-Standard Peneration Test; SS-Soil Sample; OT- Open Tube

UDS-Un Disturbed Sample; CS-Core Sample

CR-Core Recovery: RQD-Rock Quality Designation

Project : Soil Investigation for the Proposed (Stilt + 5 Floors) Residential Building at Survey No. 429 & 456, Manapakkam Main Road, Manapakkam, Chennai.

GEO FOUNDATIONS & STRUCTURES PVT. LTD

Bore Hole No	: BH 3
Location	: Manapakkam
Type of Boring	: Calyx
Ground Water Level	: 3.0 m From G.L. on 17.02.2021
UTM Co-ordinates	: 409777 E, 1438792 N
Termination Depth	: 18.00 m

Drilling Hole Record-BH 3

Fig No. 03

Start Date : 15.02.2021

End Date : 16.02.2021

SOIL DESCRIPTION	COLOUR	STRUCTURE	GROUND LEVEL (m)	LEGEND	TEST NO	SAMPLE TYPE	DEPTH (m)	TEST DEPTH(m)	PENETRATION VALUES 15cm	30cm	45cm	SPT"N" Blows/300mm	C.R (%)	R.Q.D(%)	REMARKS
Silty **SAND** (SM)	Grey	Medium Dense, Granular			SPT-1	SS	1.00	1.00-1.45	4	6	8	14			
			2.00		SPT-2	SS	2.00	2.00-2.45	4	4	4	8			
		Loose, Granular			UDS-1	OT	2.50	2.50-2.95	-	-	-	-			G.W.L
			3.00		SPT-3	SS	3.00	3.00-3.45	4	6	3	9			
Clayey **SAND** (SC)	Grey	Loose, Granular	4.00		SPT-4	SS	4.00	4.00-4.45	3	3	4	7			
Silty **SAND** (SM)	Grey	Loose, Granular	5.00		UDS-2	OT	4.50	4.50-4.95	-	-	-	-			
Sandy **CLAY** (Cl)	Dark Grey	Medium Stiff, Layered	6.50		SPT-5	SS	5.00	5.00-5.45	2	2	3	5			
Silty Gravelly **SAND** (SP)	Grey	Medium Dense, Granular	8.00		SPT-6	SS	6.50	6.50-6.95	12	16	15	31			
Gravelly Silty **SAND** (SM)	Grey	Dense, Granular	9.50		SPT-7	SS	8.00	8.00-8.45	16	18	25	43			
SAND (SP)	Grey	Very Dense, Granular	12.50		SPT-8	SS	9.50	9.50-9.95	18	21	36	57			
					SPT-9	SS	11.00	11.00-11.45	24	31	44	75			
Greyish,Very Dense Silty **SAND** (SM)					SPT-10	SS	12.50	12.50-12.95	28	38	45	83			

SPT 'N' PROFILE: 20, 40, 60, 80, 100

G.W.L : 3.0 m From G.L. on 17.02.2021	No of SPT: 13 Nos.	No of UDS : 2 Nos.	No of CR : Nil	**Remarks**

Note: SPT-Standard Peneration Test; SS-Soil Sample; OT- Open Tube

UDS-Un Disturbed Sample; CS-Core Sample

CR-Core Recovery: RQD-Rock Quality Designation

Project : Soil Investigation for the Proposed (Stilt + 5 Floors) Residential Building at Survey No. 429 & 456, Manapakkam Main Road, Manapakkam, Chennai.

GEO FOUNDATIONS & STRUCTURES PVT. LTD

Bore Hole No	: BH 3
Location	: Manapakkam
Type of Boring	: Calyx
Ground Water Level	: 3.0 m From G.L. on 17.02.2021
UTM Co-ordinates	: 409777 E, 1438792 N
Termination Depth	: 18.00 m

Drilling Hole Record-BH 3

Fig No. 03

Start Date : 15.02.2021

End Date : 16.02.2021

SOIL DESCRIPTION	COLOUR	STRUCTURE	GROUND LEVEL (m)	LEGEND	TEST NO	SAMPLE TYPE	DEPTH (m)	TEST DEPTH(m)	PENETRATION VALUES 15cm	30cm	45cm	SPT"N" Blows/300mm	SPT 'N' PROFILE	C.R (%)	R.Q.D(%)	REMARKS
Silty **SAND** (SM)	Grey	Very Dense, Granular	14.00													
SAND (SP)	Grey	Very Dense, Granular	16.00		SPT-11	SS	14.00	14.00-14.45	37	42	54	96				
Weathered Rock			18.00		SPT-12	SS	16.00	16.00-16.24	47	50	-	>100				50/9 cm Penetration
					SPT-13	SS	18.00	18.00-18.00	50	-	-	>100				Rebound

SPT 'N' PROFILE scale: 20, 40, 60, 80, 100

G.W.L : 3.0 m From G.L. on 17.02.2021	No of SPT: 13 Nos.	No of UDS : 2 Nos.	No of CR : Nil	**Remarks**
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Project : Soil Investigation for the Proposed (Stilt + 5 Floors) Residential Building at Survey No. 429 & 456, Manapakkam Main Road, Manapakkam, Chennai.

GEO FOUNDATIONS & STRUCTURES PVT. LTD

Bore Hole No	: BH 4
Location	: Manapakkam
Type of Boring	: Calyx
Ground Water Level	: 2.8 m From G.L. on 23.02.2021
UTM Co-ordinates	: 409798 E,1438816 N
Termination Depth	: 8.90 m

Drilling Hole Record-BH 4

Fig No. 04

Start Date : 21.02.2021

End Date : 22.02.2021

SOIL DESCRIPTION	COLOUR	STRUCTURE	GROUND LEVEL (m)	LEGEND	TEST NO	SAMPLE TYPE	DEPTH (m)	TEST DEPTH(m)	PENETRATION VALUES 15cm	30cm	45cm	SPT"N" Blows/300mm	SPT 'N' PROFILE	C.R (%)	R.Q.D(%)	REMARKS
SAND (SP)	Grey	Medium Dense, Granular			SPT-1	SS	1.00	1.00-1.45	4	5	6	11				
					SPT-2	SS	2.00	2.00-2.45	3	4	8	12				
					UDS-1	OT	2.50	2.50-2.95	-	-	-	-				G.W.L
					SPT-3	SS	3.00	3.00-3.45	4	7	8	15				
			4.00		SPT-4	SS	4.00	4.00-4.45	5	8	9	17				
Greyish, Medium Dense, Silty **SAND** (SM)			5.00		SPT-5	SS	5.00	5.00-5.45	4	6	7	13				
CLAY (CH)	Dark Grey	Stiff, Layered	6.50		SPT-6	SS	6.50	6.50-6.95	6	9	12	21				
Silty Gravelly **SAND** (SP)	Grey	Dense, Granular	8.00		SPT-7	SS		8.00-8.00	50	-	-	>100				Rebound
Fractured Hard Rock			8.90		CR-1	CS	8.00	8.00-8.90	-	-	-	-		13	Nil	16 Pieces - (6+2+1.5+1+1.5) cm + 11 Small Pieces

G.W.L : 2.8 m From G.L. on 23.02.2021	No of SPT: 7 Nos.	No of UDS : 1 No.	No of CR : 1 No.

Remarks

Note: SPT-Standard Peneration Test; SS-Soil Sample; OT- Open Tube

UDS-Un Disturbed Sample; CS-Core Sample

CR-Core Recovery: RQD-Rock Quality Designation

Project : Soil Investigation for the Proposed (Stilt + 5 Floors) Residential Building at Survey No. 429 & 456, Manapakkam Main Road, Manapakkam, Chennai.

GEO FOUNDATIONS & STRUCTURES PVT. LTD

Bore Hole No	: BH 5
Location	: Manapakkam
Type of Boring	: Calyx
Ground Water Level	: 2.8 m From G.L. on 18.02.2021
UTM Co-ordinates	: 409774 E,1438818 N
Termination Depth	: 8.50 m

Drilling Hole Record-BH 5

Fig No. 05

Start Date : 17.02.2021

End Date : 17.02.2021

SOIL DESCRIPTION	COLOUR	STRUCTURE	GROUND LEVEL (m)	LEGEND	TEST NO	SAMPLE TYPE	DEPTH (m)	TEST DEPTH(m)	PENETRATION VALUES 15cm	30cm	45cm	SPT"N" Blows/300mm	SPT 'N' PROFILE	C.R (%)	R.Q.D(%)	REMARKS
SAND (SP)	Grey & Brown	Medium Dense, Granular			SPT-1	SS	1.00	1.00-1.45	5	8	9	17				
					SPT-2	SS	2.00	2.00-2.45	5	7	9	16				G.W.L
	Grey				SPT-3	SS	3.00	3.00-3.45	5	6	5	11				
					UDS-1	OT	3.50	3.50-3.95	-	-	-	-				
			5.00		SPT-4	SS	4.00	4.00-4.45	6	7	8	15				
Sandy **CLAY** (CH)	Dark Grey	Stiff, Layered	6.50		SPT-5	SS	5.00	5.00-5.45	2	4	5	9				
Gravelly Silty **SAND** (SM)	Grey	Very Dense, Granular	8.00		SPT-6	SS	6.50	6.50-6.95	13	36	48	84				
Weathered Rock					SPT-7	SS	8.00	8.00-8.19	48	50	-	>100				50/4 cm Penetration
			8.50		SPT-8	SS	8.50	8.50-8.50	50	-	-	>100				Rebound

SPT 'N' PROFILE scale: 20, 40, 60, 80, 100

G.W.L : 2.80 m From G.L. on 18.02.2021	No of SPT: 8 Nos.	No of UDS : 1 No.	No of CR : Nil	**Remarks**

Note: SPT-Standard Peneration Test; SS-Soil Sample; OT- Open Tube

UDS-Un Disturbed Sample; CS-Core Sample

CR-Core Recovery: RQD-Rock Quality Designation

Project : Soil Investigation for the Proposed (Stilt + 5 Floors) Residential Building at Survey No. 429 & 456, Manapakkam Main Road, Manapakkam, Chennai.

GEO FOUNDATIONS & STRUCTURES PVT. LTD

Bore Hole No	: BH 6
Location	: Manapakkam
Type of Boring	: Calyx
Ground Water Level	: 2.90 m From G.L. on 19.02.2021
UTM Co-ordinates	: 409776 E, 1438845 N
Termination Depth	: 9.50 m

Drilling Hole Record-BH 6

Fig No. 06

Start Date : 18.02.2021

End Date : 18.02.2021

SOIL DESCRIPTION	COLOUR	STRUCTURE	GROUND LEVEL (m)	TEST NO	SAMPLE TYPE	DEPTH (m)	TEST DEPTH(m)	PENETRATION VALUES 15cm	30cm	45cm	SPT"N" Blows/300mm	C.R (%)	R.Q.D(%)	REMARKS
SAND (SP)	Grey	Medium Dense, Granular		SPT-1	SS	1.00	1.00-1.45	5	8	10	18			
				SPT-2	SS	2.00	2.00-2.45	5	7	8	15			
				UDS-1	OT	2.50	2.50-2.95	-	-	-	-			G.W.L
				SPT-3	SS	3.00	3.00-3.45	5	7	7	14			
			4.00											
		Loose, Granular		SPT-4	SS	4.00	4.00-4.45	6	4	5	9			
			5.00	SPT-5	SS	5.00	5.00-5.45	4	6	6	12			
Sandy **CLAY** (CH)	Black	Stiff, Layered	6.50											
				SPT-6	SS	6.50	6.50-6.95	12	18	23	41			
Silty Gravelly **SAND** (SP)	Grey	Dense, Granular	8.00	SPT-7	SS	8.00	8.00-8.23	42	50	-	>100			50/8 cm Penetration
Weathered Rock														
				SPT-8	SS	9.50	9.50-9.50	50	-	-	>100			Rebound
			9.50											

SPT 'N' PROFILE: 20, 40, 60, 80, 100

G.W.L : 2.90 m From G.L. on 19.02.2021	No of SPT: 8 Nos.	No of UDS : 1 No.	No of CR : Nil	**Remarks**

Note: SPT-Standard Peneration Test; SS-Soil Sample; OT- Open Tube

UDS-Un Disturbed Sample; CS-Core Sample

CR-Core Recovery: RQD-Rock Quality Designation

Project : Soil Investigation for the Proposed (Stilt + 5 Floors) Residential Building at Survey No. 429 & 456, Manapakkam Main Road, Manapakkam, Chennai.

GEO FOUNDATIONS & STRUCTURES PVT. LTD

Bore Hole No	: BH 7
Location	: Manapakkam
Type of Boring	: Calyx
Ground Water Level	: 2.40 m From G.L. on 22.02.2021
UTM Co-ordinates	: 409789 E,1438845 N
Termination Depth	: 8.00 m

Drilling Hole Record-BH 7

Fig No. 07

Start Date : 19.02.2021

End Date : 21.02.2021

SOIL DESCRIPTION	COLOUR	STRUCTURE	GROUND LEVEL (m)	TEST NO	SAMPLE TYPE	DEPTH (m)	TEST DEPTH(m)	PENETRATION VALUES 15cm	30cm	45cm	SPT"N" Blows/300mm	C.R (%)	R.Q.D(%)	REMARKS
SAND (SP)	Grey	Medium Dense, Granular		SPT-1	SS	1.00	1.00-1.45	4	8	6	14			
				SPT-2	SS	2.00	2.00-2.45	2	5	6	11			G.W.L
				UDS-1	OT	2.50	2.50-2.95	-	-	-	-			
				SPT-3	SS	3.00	3.00-3.45	3	8	7	15			
				SPT-4	SS	4.00	4.00-4.45	4	7	9	16			
			5.00											
CLAY (CI)	Black	Stiff, Layered		SPT-5	SS	5.00	5.00-5.45	3	4	6	10			
			6.50	SPT-6	SS	6.50	6.50-6.74	43	50	-	>100			50/9 cm Penetration
Weathered Rock				SPT-7	SS	8.00	8.00-8.04	50	-	-	>100			50/4 cm Penetration
			8.00											

SPT 'N' PROFILE: 20, 40, 60, 80, 100

G.W.L : 2.40 m From G.L. on 22.02.2021	No of SPT: 7 Nos.	No of UDS : 1 No.	No of CR : Nil	**Remarks**

Note: SPT-Standard Peneration Test; SS-Soil Sample; OT- Open Tube

UDS-Un Disturbed Sample; CS-Core Sample

CR-Core Recovery: RQD-Rock Quality Designation

APPENDIX – II

LABORATORY TEST RESULTS

GEO FOUNDATIONS & STRUCTURES PVT LTD	Project :Soil Investigation for the Proposed (Stilt + 5 Floors) Residential Building at Survey No. 429 & 456, Manapakkam Main Road, Manapakkam, Chennai.	Boring Start: 23.02.2021	Termination Depth(m)	Table No.
TEST RESULTS		Boring End : 24.02.2021	7.80	1
		Location	G.W.T (m)	Bore-Hole No.
		Manapakkam	2.70	1

N VALUE	DEPTH (m)	SAMPLE	SOIL DESCRIPTION	IS. CLASSIFICATION	GRAIN SIZE ANALYSIS			ATTERBERG LIMITS			DRY DENSITY, gm/cc	WET DENSITY, gm/cc	WATER CONTENT, %	SPECIFIC GRAVITY	FREE SWELL INDEX, %	SHEAR PARAMETERS		
					GRAVEL, %	SAND, %	SILT & CLAY %	LIQUID LIMIT,%	PLASTIC LIMIT,%	PLASTICITY INDEX						TEST METHOD	C in Kg/cm²	Φ in degrees
8	1.00	SPT-1	**SAND**	SP	0	95	5						18					
5	2.00	SPT-2		SP	1	93	6						16					
-	2.50	UDS-1									1.66	1.93				DS		30
7	3.00	SPT-3		SP	2	93	5						7					
11	4.00	SPT-4		SP	0	95	5						17	2.64				
12	5.00	SPT-5	**CLAY**	CI	0	7	93	42	17	25								
85	6.50	SPT-6	Clayey **SAND**	SC	6	52	42	39	22	17			24		25			
>100	7.50-7.76	SPT-7	**Weathered Rock**															
>100	7.80-7.80	SPT-8																

NOTE: Type of Sample
SPT- Standard Penetration Test
UDS- Un Disturbed Sample

Test Method:
UCS- UnConfined Compressive Strength
DS-Direct Shear
TA - Tri Axial test

GEO FOUNDATIONS & STRUCTURES PVT LTD	Project :Soil Investigation for the Proposed (Stilt + 5 Floors) Residential Building at Survey No. 429 & 456, Manapakkam Main Road, Manapakkam, Chennai.	Boring Start: 22.02.2021	Termination Depth(m)	Table No.
TEST RESULTS		Boring End : 23.02.2021	7.50	2
		Location	G.W.T (m)	Bore-Hole No.
		Manapakkam	2.80	2

N VALUE	DEPTH (m)	SAMPLE	SOIL DESCRIPTION	IS. CLASSIFICATION	GRAIN SIZE ANALYSIS			ATTERBERG LIMITS			DRY DENSITY, gm/cc	WET DENSITY, gm/cc	WATER CONTENT, %	SPECIFIC GRAVITY	FREE SWELL INDEX, %	SHEAR PARAMETERS		
					GRAVEL, %	SAND, %	SILT & CLAY %	LIQUID LIMIT,%	PLASTIC LIMIT,%	PLASTICITY INDEX						TEST METHOD	C in Kg/cm²	Φ in degrees
12	1.00	SPT-1	Clayey **SAND**	SC	0	64	36						10					
11	2.00	SPT-2	**SAND**	SP	1	91	8						16					
-	2.50	UDS-1									1.67	1.94				DS		31
9	3.00	SPT-3	Silty **SAND**	SM	0	90	10						18	2.66				
15	4.00	SPT-4	**SAND**	SP	0	96	4						18					
8	5.00	SPT-5	Sandy **CLAY**	CI	1	43	56	37	19	18			23					
>100	6.50-6.89	SPT-6	Clayey **SAND**	CL	0	56	44	34	19	15			19					
>100	7.50-7.72	SPT-7	**Weathered Rock**															

NOTE: Type of Sample
SPT- Standard Penetration Test
UDS- Un Disturbed Sample

Test Method:
UCS- UnConfined Compressive Strength
DS-Direct Shear
TA - Tri Axial test

GEO FOUNDATIONS & STRUCTURES PVT LTD	Project :Soil Investigation for the Proposed (Stilt + 5 Floors) Residential Building at Survey No. 429 & 456, Manapakkam Main Road, Manapakkam, Chennai.	Boring Start: 15.02.2021	Termination Depth(m)	Table No.
TEST RESULTS		Boring End : 16.02.2021	18.00	3
		Location	**G.W.T (m)**	**Bore-Hole No.**
		Manapakkam	3.00	3

N VALUE	DEPTH (m)	SAMPLE	SOIL DESCRIPTION	IS. CLASSIFICATION	GRAIN SIZE ANALYSIS			ATTERBERG LIMITS			DRY DENSITY, gm/cc	WET DENSITY, gm/cc	WATER CONTENT, %	SPECIFIC GRAVITY	FREE SWELL INDEX, %	SHEAR PARAMETERS		
					GRAVEL, %	SAND, %	SILT & CLAY %	LIQUID LIMIT,%	PLASTIC LIMIT,%	PLASTICITY INDEX						TEST METHOD	C in Kg/cm²	Φ in degrees
14	1.00	SPT-1	Silty **SAND**	SM	7	81	12						13					
8	2.00	SPT-2		SM	0	58	42	23	Non Plastic				15					
-	2.50	UDS-1									1.67	1.92				DS		30
9	3.00	SPT-3	Clayey **SAND**	SC	0	51	49	29	14	15			15					
7	4.00	SPT-4	Silty **SAND**	SM	0	75	25						20					
-	4.50	UDS-2																
5	5.00	SPT-5	Sandy **CLAY**	CI	1	13	86	38	20	18								
31	6.50	SPT-6	Silty Gravelly **SAND**	SP	33	54	13						15					
43	8.00	SPT-7	Gravelly Silty **SAND**	SM	11	67	22						8					
57	9.50	SPT-8	**SAND**	SP	4	94	2						17					
75	11.00	SPT-9		SP	2	94	4						15	2.62				
83	12.50	SPT-10	Silty **SAND**	SM	2	74	24											
96	14.00	SPT-11	**SAND**	SP	1	97	2						17					
>100	16.00-16.24	SPT-12	**Weathered Rock**															
>100	18.00-18.00	SPT-13																

NOTE: Type of Sample
SPT- Standard Penetration Test
UDS- Un Disturbed Sample

Test Method:
UCS- UnConfined Compressive Strength
DS-Direct Shear
TA - Tri Axial test

GEO FOUNDATIONS & STRUCTURES PVT LTD	Project :Soil Investigation for the Proposed (Stilt + 5 Floors) Residential Building at Survey No. 429 & 456, Manapakkam Main Road, Manapakkam, Chennai.	Boring Start: 21.02.2021	Termination Depth(m)	Table No.
TEST RESULTS		Boring End : 22.02.2021	8.90	4
		Location	G.W.T (m)	Bore-Hole No.
		Manapakkam	2.80	4

N VALUE	DEPTH (m)	SAMPLE	SOIL DESCRIPTION	IS. CLASSIFICATION	GRAIN SIZE ANALYSIS			ATTERBERG LIMITS			DRY DENSITY, gm/cc	WET DENSITY, gm/cc	WATER CONTENT, %	SPECIFIC GRAVITY	FREE SWELL INDEX, %	SHEAR PARAMETERS		
					GRAVEL, %	SAND, %	SILT & CLAY %	LIQUID LIMIT.%	PLASTIC LIMIT,%	PLASTICITY INDEX						TEST METHOD	C in Kg/cm²	Φ in degrees
11	1.00	SPT-1	**SAND**	SP	3	97	0						17					
12	2.00	SPT-2		SP	7	92	1						17	2.63				
-	2.50	UDS-1									1.66	1.93				DS		32
15	3.00	SPT-3		SP	1	99	0						16					
17	4.00	SPT-4	Silty **SAND**	SM	1	82	17						17					
13	5.00	SPT-5	**CLAY**	CH	0	8	92	61	29	32								
21	6.50	SPT-6	Silty Gravelly **SAND**	SP	39	42	19						13					
>100	8.00-8.00	SPT-7	**Fractured Hard Rock**															
-	8.00-8.90	CR - 1																

NOTE: Type of Sample
SPT- Standard Penetration Test
UDS- Un Disturbed Sample

Test Method:
UCS- UnConfined Compressive Strength
DS-Direct Shear
TA - Tri Axial test

GEO FOUNDATIONS & STRUCTURES PVT LTD	Project :Soil Investigation for the Proposed (Stilt + 5 Floors) Residential Building at Survey No. 429 & 456, Manapakkam Main Road, Manapakkam, Chennai.	Boring Start: 17.02.2021	Termination Depth(m)	Table No.
TEST RESULTS		Boring End : 17.02.2021	8.50	5
		Location	**G.W.T (m)**	**Bore-Hole No.**
		Manapakkam	2.80	5

N VALUE	DEPTH (m)	SAMPLE	SOIL DESCRIPTION	IS. CLASSIFICATION	GRAIN SIZE ANALYSIS			ATTERBERG LIMITS			DRY DENSITY, gm/cc	WET DENSITY, gm/cc	WATER CONTENT, %	SPECIFIC GRAVITY	FREE SWELL INDEX, %	SHEAR PARAMETERS		
					GRAVEL, %	SAND, %	SILT & CLAY %	LIQUID LIMIT.%	PLASTIC LIMIT,%	PLASTICITY INDEX						TEST METHOD	C in Kg/cm²	Φ in degrees
17	1.00	SPT-1	**SAND**	SP	1	93	6						7					
16	2.00	SPT-2		SP	1	97	2						16					
11	3.00	SPT-3		SP	1	96	3						13					
-	3.50	UDS-1									1.67	1.89				DS		32
15	4.00	SPT-4		SP	2	94	4						16	2.62				
9	5.00	SPT-5	Sandy **CLAY**	CH				50	19	31								
84	6.50	SPT-6	Gravelly Silty **SAND**	SM	10	66	24						17					
>100	8.00-8.19	SPT-7	**Weathered Rock**															
>100	8.50-8.50	SPT-8																

NOTE: Type of Sample
SPT- Standard Penetration Test
UDS- Un Disturbed Sample

Test Method:
UCS- UnConfined Compressive Strength
DS-Direct Shear
TA - Tri Axial test

GEO FOUNDATIONS & STRUCTURES PVT LTD	Project :Soil Investigation for the Proposed (Stilt + 5 Floors) Residential Building at Survey No. 429 & 456, Manapakkam Main Road, Manapakkam, Chennai.	Boring Start: 18.02.2021	Termination Depth(m)	Table No.
TEST RESULTS		Boring End : 18.02.2021	9.50	6
		Location	**G.W.T (m)**	**Bore-Hole No.**
		Manapakkam	2.95	6

N VALUE	DEPTH (m)	SAMPLE	SOIL DESCRIPTION	IS. CLASSIFICATION	GRAIN SIZE ANALYSIS			ATTERBERG LIMITS			DRY DENSITY, gm/cc	WET DENSITY, gm/cc	WATER CONTENT, %	SPECIFIC GRAVITY	FREE SWELL INDEX, %	SHEAR PARAMETERS		
					GRAVEL, %	SAND, %	SILT & CLAY %	LIQUID LIMIT,%	PLASTIC LIMIT,%	PLASTICITY INDEX						TEST METHOD	C in Kg/cm²	Φ in degrees
18	1.00	SPT-1	**SAND**	SP	0	99	1											
15	2.00	SPT-2		SP	1	99	0						18					
-	2.50	UDS-1									1.66	1.96				DS		32
14	3.00	SPT-3		SP	0	98	2						18					
9	4.00	SPT-4		SP	0	97	3						21					
12	5.00	SPT-5	Sandy **CLAY**	CH	7	24	69	51	27	24								
41	6.50	SPT-6	Silty Gravelly **SAND**	SP	22	60	18						13		2.65			
>100	8.00-8.23	SPT-7	**Weathered Rock**															
>100	9.50-9.50	SPT-8																

NOTE: Type of Sample
SPT- Standard Penetration Test
UDS- Un Disturbed Sample

Test Method:
UCS- UnConfined Compressive Strength
DS-Direct Shear
TA - Tri Axial test

GEO FOUNDATIONS & STRUCTURES PVT LTD	Project :Soil Investigation for the Proposed (Stilt + 5 Floors) Residential Building at Survey No. 429 & 456, Manapakkam Main Road, Manapakkam, Chennai.	Boring Start: 19.02.2021	Termination Depth(m)	Table No.
TEST RESULTS		Boring End : 21.02.2021	8.00	7
		Location	**G.W.T (m)**	**Bore-Hole No.**
		Manapakkam	2.40	7

N VALUE	DEPTH (m)	SAMPLE	SOIL DESCRIPTION	IS. CLASSIFICATION	GRAIN SIZE ANALYSIS			ATTERBERG LIMITS			DRY DENSITY, gm/cc	WET DENSITY, gm/cc	WATER CONTENT, %	SPECIFIC GRAVITY	FREE SWELL INDEX, %	SHEAR PARAMETERS		
					GRAVEL, %	SAND, %	SILT & CLAY %	LIQUID LIMIT,%	PLASTIC LIMIT,%	PLASTICITY INDEX						TEST METHOD	C in Kg/cm²	Φ in degrees
14	1.00	SPT-1	**SAND**	SP	0	96	4						6					
11	2.00	SPT-2		SP	0	95	5						9	2.62				
-	2.50	UDS-1									1.67	1.82				DS		31
15	3.00	SPT-3		SP	0	95	5						11					
16	4.00	SPT-4		SP	0	91	9						17					
10	5.00	SPT-5	**CLAY**	CI				48	26	22								
>100	6.50-6.74	SPT-6	**Weathered Rock**															
>100	8.00-8.04	SPT-7																

NOTE: Type of Sample
SPT- Standard Penetration Test
UDS- Un Disturbed Sample

Test Method:
UCS- UnConfined Compressive Strength
DS-Direct Shear
TA - Tri Axial test

APPENDIX-III

CHEMICAL ANALYSIS OF WATER

GEO FOUNDATIONS & STRUCTURES PVT LTD

CHEMICAL ANALYSIS OF WATER

Client : M/s. Urban Tree Infrastructures Private Limited

Name of Work : Soil Investigation for the Proposed (Stilt + 5 Floors) Residential Building at Survey No. 429 & 456, Manapakkam Main Road, Manapakkam, Chennai – 600125

Reference No. : GFS/CHN/SI/21/1588/02

Table No. 8

Sl. No.	Tests	BH - 2	BH - 6	Limits for using the ground water for mixing concrete
1	**Free acidity:** To neutralize 100 ml. of water using Phenolphthalein as indicator.	Nil	Nil	Not more than 5.0ml. of 0.02N NaOH
2	**Alkalinity:** To neutralize 100 ml sample using methylorange as indicator	19	17	Not more than 25.0ml of 0.02 N H2SO4
3	**Organic matters mg/l**	172	168	200 mg/l
4	**Inorganic solids mg/l**	452	462	3000 mg/l
5	**Sulphate as SO_3 mg/l**	171	176	400 mg/l
6	**Chloride as Cl mg/l**	89	95	I.2000 mg/l for Plain concrete II. 500 mg/l for reinforced concrete
7	**Total Suspended matters mg/l**	420	440	2000 mg/l
8	**pH @ 25° C**	7.71	7.86	6.0 Min

APPENDIX-IV

SITE PLAN

GEO FOUNDATIONS & STRUCTURES PVT. LTD.
No.89, I Main Road, Gandhi Nagar, Adyar, Chennai – 600 020.



Client Name :M/s. URBAN TREE REAL ESTATE DEVELOPERS LLP, Nungambakkam, Chennai, Tamil Nadu.

Project Name :Soil Investigation for the Proposed (Stilt + 5 Floors) Residential Building at Survey No. 429 & 456, Manapakkam Main Road, Manapakkam, Chennai – 600125



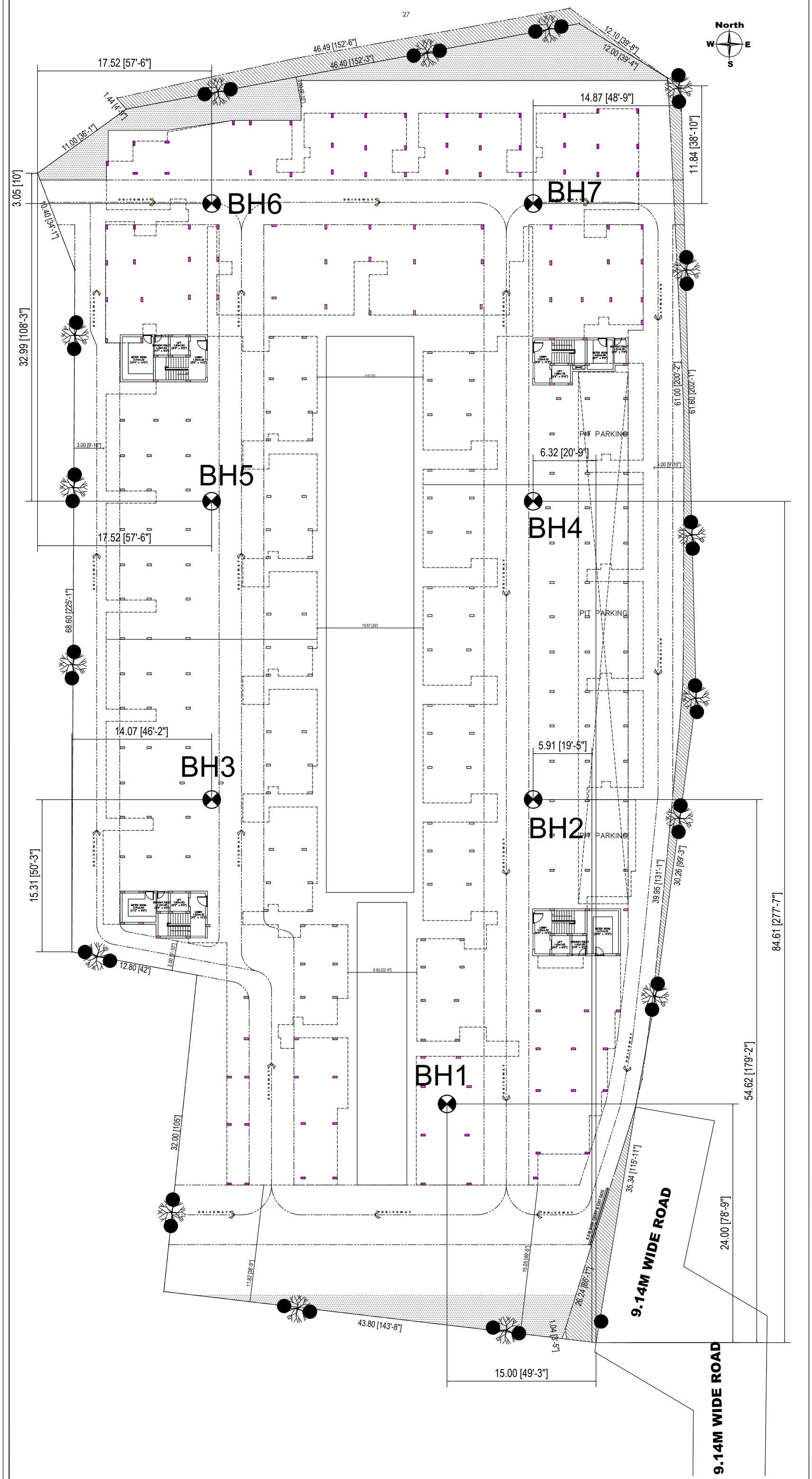
COORDINATES:

Borehole No.	UTM Co-ordinates
BH 1	409792 E, 1438772 N
BH 2	409793 E, 1438794 N
BH 3	409777 E, 1438792 N
BH 4	409798 E, 1438816 N
BH 5	409774 E,1438818 N
BH 6	409776 E, 1438845 N
BH 7	409789 E,1438845 N

Note: The borehole distance & Coordinates are approximate. The image is captured from Google Earth.

APPENDIX-V

BOREHOLE LOCATION DRAWING



PLAN SHOWING BORE HOLES LOCATIONS FOR SOIL INVESTIGATION

NOTES

1. THE LOCATION & COORDINATE OF THE BORE HOLES ARE TENTATIVE WHICH CAN BE SLIGHTLY ADJUSTED AS PER THE SITE CONDITION.

LEGEND

BH1 TO BH7 (BORE HOLES)

DATE - 17-FEB-2021

SHEET TITLE :–	PROMOTER :–	PROJET :–	ARCHITECTS :–
SITE CUM STILT FLOOR PLAN	**URBAN TREE**	**PROPOSED RESIDENTIAL BUILDING AT MANAPAKKAM , IN CHENNAI.**	Z:\Output\OUR LOGO.jpg CHETTINAAI

SITE PHOTOS



Borehole No- 1



Borehole No- 2



Borehole No- 3



Borehole No- 4

APPENDIX- VI

SITE PHOTOS



Borehole No- 5



Borehole No 6



Borehole No 7



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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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