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SOIL INVESTIGATION REPORT

CLIENT

M/s. ARUN EXCELLO REALTY PVT. LTD.

ROYAPETTAH, CHENNAI



PROJECT LOCATION

PERUMALERI VILLAGE, KANCHEEPURAM DISTRICT

REPORT NO.: SI/CHN/23/1729/01

OCTOBER 2023

GEO FOUNDATIONS & STRUCTURES PVT LTD

GEO TECHNICAL DIVISION CHENNAI

Email: soil@geo.net.in

NAME OF PROJECT

SOIL INVESTIGATION FOR THE PROPOSED RESIDENTIAL (BUILDING GROUND+ 1 FLOOR) CONSTRUCTION AT SURVEY Nos. 221/14A1A3, 221/14A1A4, 220/2A1B IN PERUMALERI VILLAGE, VADAKADAMPADI PANCHAYAT, THIRUKAZUKUNDRAM TALUK, KANCHEEPURAM DISTRICT.

CLIENT

ARUN EXCELLO

M/s. ARUN EXCELLO REALTY PRIVATE LIMITED
BHATTAD TOWER 18 , WEST COTT ROAD,
ROYAPETTAH, CHENNAI - 600 014

GEOTECHNICAL CONSULTANT

GEO FOUNDATIONS & STRUCTURES PVT LTD,
No.89, 1ST MAIN ROAD, GANDHI NAGAR,
ADYAR, CHENNAI - 600 020

PROJECT No.: 1729					
Rev. No.	**Date**	**Description**	**Created by**	**Verified by**	**Approved by**
FR/01	20.10.2023	Final Report	NAMRITHA RAVI M.Sc (UK)	A. SURESH KUMAR, M. Tech - (Geotechnical)	DR. K. MUTHUKRISHNAIAH M. Tech., Ph.D.,
			Engineer	General Manager	Chief Consultant

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SOIL INVESTIGATION REPORT

1.0 INTRODUCTION

1.1 The work of "Soil Investigation for the Proposed Residential (Building Ground + 1 Floor) Construction at Survey Nos. 221/14A1A3, 221/14A1A4, 220/2A1B in Perumaleri Village, Vadakadampadi Panchayat, Thirukazukundram Taluk, Kancheepuram District." was entrusted to **M/s. Geo Foundations & Structures (P) Ltd., Adyar, Chennai - 600 020**, by **M/s. Arun Excello Realty Private Limited, Royapettah, Chennai - 600 014.**

1.2 The soil investigation (field investigation) works were carried out during **13th to 16th October 2023.** This report summarizes the results of the soil investigation, and presents recommendations for suitable type of foundations for the proposed (G+1 Floor) structures.

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 (G+1 Floor) structures. The study includes identification of suitable type of foundations and assessment of safe bearing capacities for the proposed (G+1 Floor) structures.

3.0 SCOPE OF WORK

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

3.1 Mobilization of Calyx drilling machine with all necessary equipments and personnel.

3.2 Boring of **3** bore holes of 150 mm diameter with Calyx drilling equipments through sand, silt, clay & weathered rock.

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 Collecting ground water sample in the boreholes for chemical analysis.

3.5 To conduct the following laboratory tests on soil samples which are applicable to the type of soil to be tested.

(a) Grain size analysis

(b) Index properties:

(i) Liquid limit

(ii) Plastic limit

(iii) Shrinkage limit

(c) Moisture content

(d) Dry and bulk density

(e) Specific Gravity

(f) Free Swell Index

(g) Triaxial / Direct Shear Test

(h) Unconfined Compressive Strength

(i) Chemical Analysis of Ground Water

3.6 Preparation and submission of detailed report of field and laboratory results with recommendations for suitable type of foundations.

4.0 FIELD INVESTIGATIONS-GEO-TECHNICAL STUDIES

4.1 Boring rig, with all requisite equipments and accessories, were mobilized at the worksite. A team of technical personnel with skilled laborers were also deputed.

4.2 **Three** bore holes of 150 mm diameter were bored to a maximum depth up to **5 m** below the existing ground level (up to hard stratum). The bore holes were made as per relevant Indian Standard IS: 1892: 2021. The boreholes location drawing is shown in Fig. No. 1**(Appendix I).**

4.3 Representative soil samples were collected at every change of strata or at about 1 m depth intervals, up to 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 holes at 1 m depth intervals, up to termination depth, as per the relevant Indian Standard, IS: 2131-1981(Reaffirmed 2021). 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. 02 to 04 **(Appendix II).**

5.0 LABORATORY INVESTIGATION

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

(a) Grain size analysis

(b) Index properties on clayey and silty soil samples

  (i) Liquid limit

  (ii) Plastic limit

(c) Natural Moisture content

(d) Chemical Analysis of Ground 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: 1498-1970(Reaffirmed 2021).The results are shown in Table Nos.1 to 3 **(Appendix III).** The results of the chemical analysis of ground water are presented in Table No.4 **(Appendix IV).**

6.0 SOIL PROFILE

In borehole BH 1, Dense silty gravelly sand occurs from ground level up to 2 m, followed by weathered rock up to 3 m, boulders up to **4 m,** at which depth the bore hole was terminated.

In borehole BH 2, Very dense silty gravelly sand occurs from ground level up to 2 m, followed by weathered rock up to 3 m, boulders up to **4 m,** at which depth the bore hole was terminated.

In borehole BH 3, Dense silty gravelly sand occurs from ground level up to 2 m, followed by dense clayey sand up to 3 m, weathered rock up to 4 m, followed by boulders up to **5 m,** at which depth the bore hole was terminated.

7.0 GROUND WATER TABLE

Ground water levels were met at a depth of **1.0 m to 1.5 m** from the existing ground level at the time of investigation in all the 3 boreholes, during continuous boring on **13.10.2023 to 16.10.2023.**

8.0 RECOMMENDATIONS FOR SUITABLE TYPE OF FOUNDATIONS:

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 foundations and safe bearing capacity. Based on the subsoil conditions described in Sl. No. 6, the following recommendations are made for suitable type of foundations for the proposed (G+1 Floor) Structures.

8.1 Open Foundations (G+1 Floor)

- Open Foundations (individual column footings or combined footings if there are two or more columns close to each other, or Strip Raft combining each row of columns, if each row of columns are close to each other when compared to the distance or span between the rows of columns, or raft foundation) are recommended.

- Excavation shall be made up to a depth of at least **1.5 m** below the ground level which existed at the time of soil investigation for all foundations, irrespective of the importance of the column or the loading on the column.
- After thorough compaction of the bottom of excavation, PCC for the foundations can be laid on the compacted layer, at **1.5 m** depth below the ground level which existed at the time of soil investigation.
- A safe bearing capacity of **17.5 t/m²** is recommended under the foundations. However, the width of any column footing or strip raft shall not be less than 1 m.

- At the time of excavation for foundations, if ground water table occurs within the recommended depth of excavation, sumps may be made to an additional depth of 0.3 m at one or more corners of the foundation pits for column footings/combined footings or at desired locations along the periphery of excavation for strip raft/raft foundation, and the water collected in the sumps may be bailed out. At the time of laying the PCC, the bottom of excavation shall be relatively dry (not slushy). Dewatering shall be maintained until that part of the concrete in the foundations, which comes below the ground water table level, sets.

9.0 CHEMICAL COMPOSITION OF GROUND WATER

The results of chemical analysis of the ground water samples collected from the boreholes, presented in **Appendix – IV** show 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 2021), plain and reinforced concrete – code of practice (Fourth Revision).

- 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 2021).

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 SO_3) 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 2021). Therefore, in terms of sulphate content, the ground water is suitable for mixing concrete for RCC. The sulphate content (expressed as SO_3) is less than 300 mg/l which comes under Class 1 of "Requirements for concrete exposed to sulphate attack", as per IS:456-2000 (Reaffirmed 2021), 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 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.

APPROVED BY,

Dr. K. Muthukrishnaiah BE (Hons), M.Tech., Ph.D.,
(Professor & Head, Ocean Engineering Dept. IIT Madras)(Rtd).
(Chief Consultant)

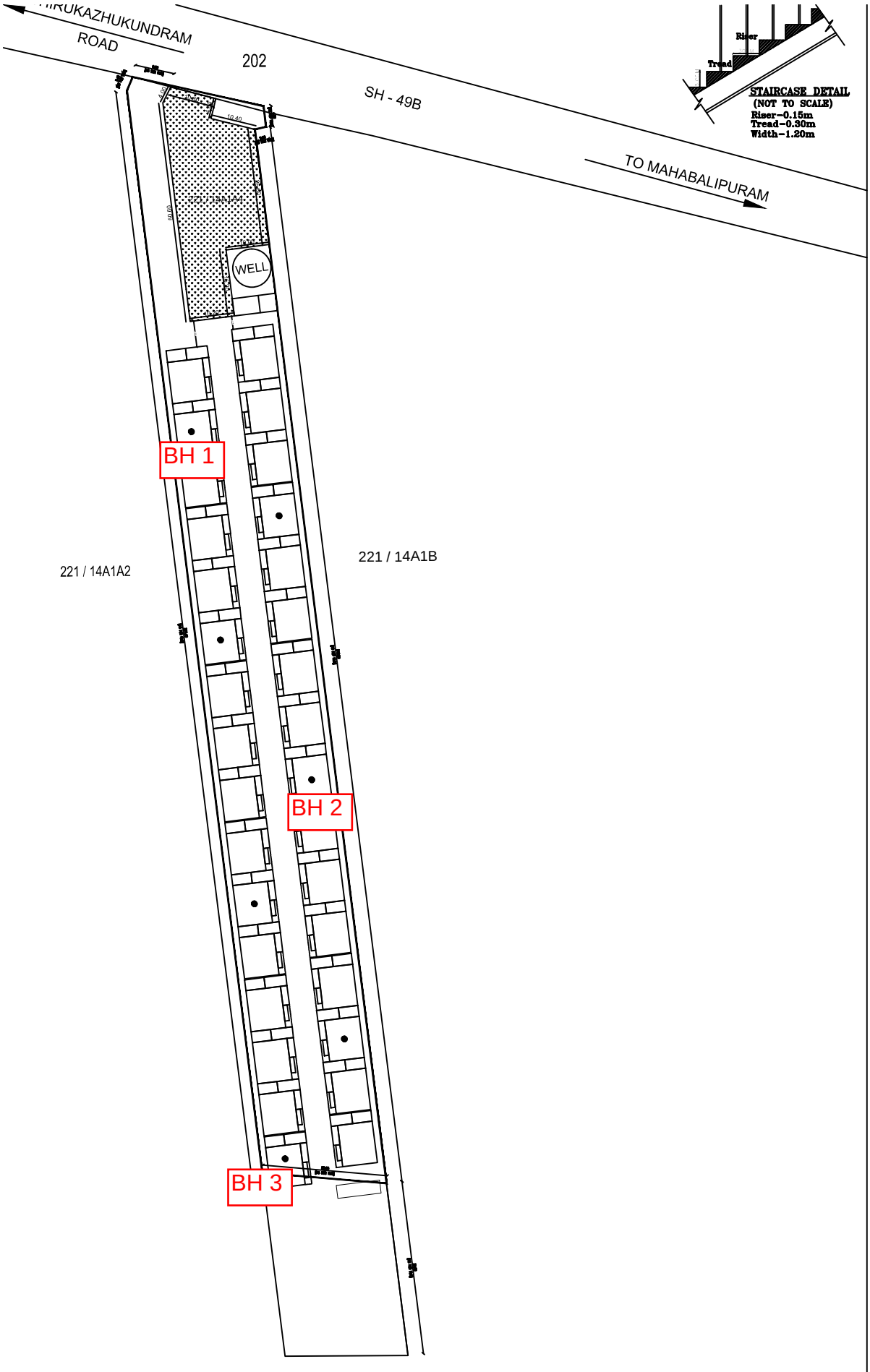
For GEO FOUNDATIONS & STRUCTURES PVT.LTD.

Anala Suresh Kumar, M.Tech (Geo technical),**M.B.A**(T.M)
General Manager(Geo Technical)

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APPENDIX- I

BOREHOLE LOCATIONS DRAWING



GIFT DEED No: 1386/2021 DT - 25/02/2021

MATERIAL SPECIFICATION OF PROPOSED WORK

1. FOUNDATION IN P.C.C 1:5:10 OVER SAND FILLING.
2. SUPER STRUCTURE IN BLOCK WORK.
3. FOUNDATION WITH R.C.C COLUMNS M25 MIX
4. FLOORING IN CEMENT CONCRETE 1:4:8 MIX IN UTILITY AREA
5. INTERNAL PLASTERING OF 12mm THK. C.M. 1:3 AND EXTERNAL PLASTERING OF 18mm THK. C.M 1:6
6. RCC ROOF SLAB OF M25 WITH REQUIRED DEPTH.
7. RCC LINTEL OF M25 WITH REQUIRED DEPTH 8. WEATHERING COURSE PROVIDED OVER ROOF SLAB
9. JOINERY - UPVC/ALUMINIUM GLAZED WINDOWS, VENTILATORS AND DOORS

PHASE - 3
1. 221/1A4A3 = 6264.00SQM (AS PER PATTA NO 2981)
2. 221/1A4A4 = 826.00SQM (OSR) (AS PER PATTA NO 3702)
3. 220/3A1PT = 1152.16SQM (AS PER CADD)(PATTAFMB YET TO RECEIVE)
TOTAL = 8242.16SQM (2.04 ACRES)

SITE PLAN

SCALE : 1:300

SHEET : NO: 01/07

DATE :

ORIENTATION

REFERENCE :

PROPOSAL :

SITE BOUNDARY :

ROAD :

NOTE: ALL DIMENSIONS ARE IN METERS

OWNER'S SIGNATURE

LICENSED SURVEYOR

STRUCTURAL ENGINEER

APPENDIX-II

BORE LOGS

Project : Soil Investigation for the Proposed Residential (Building Ground + 1 Floor) Construction at Perumaleri Village, Vadakadampadi Panchayat, Thirukazukundram Taluk, Kancheepuram District.

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Bore Hole No	: BH 1	**Drilling Hole Record-BH 1**	
Location	: Villas	**Fig No. 02**	
Type of Boring	: Calyx	Reduced Level	: 100.0
Ground Water Level	: 1.0 m from E.G.L on 15.10.2023	Start Date	: 13.10.2023
UTM Co-ordinate	: 408651 E, 1395153 N	End Date	: 14.10.2023
Termination Depth	: 4.0 m		

SOIL DESCRIPTION	COLOUR	STRUCTURE	DEPTH BELOW GROUND LEVEL (m)	REDUCED LEVEL (m)	LEGEND	TEST NO	SAMPLE TYPE	DEPTH BELOW GROUND LEVEL (m)	TEST DEPTH	PENETRATION VALUES 15cm	30cm	45cm	SPT 'N' Blows/300mm	SPT 'N' PROFILE	C.R (%)	R.Q.D(%)	REMARKS
Silty Gravelly **SAND** (SP)	Red	Very Dense, Granular	2.00			SPT-1	SS	1.00	1.00-1.45	21	15	38	53				G.W.L
						SPT-2	SS	2.00	2.00-2.39	32	40	>50	>100				50/9 cm Penetration
Weathered Rock			4.00			SPT-3 CR-1	SS CS	3.00	3.00-3.00	>50	-	-	>100				Rebound Small Pieces
									3.00-4.00	-	-	-	-				

G.W.L: 1.0 m from E.G.L on 15.10.2023	No of SPT: 3 Nos.	No of UDS : Nil.	No of CR : 1 No.	**Remarks**

Project : Soil Investigation for the Proposed Residential (Building Ground + 1 Floor) Construction at Perumaleri Village, Vadakadampadi Panchayat, Thirukazukundram Taluk, Kancheepuram District.

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Bore Hole No	: BH 2	**Drilling Hole Record-BH 2**	
Location	: Villas	**Fig No. 03**	
Type of Boring	: Calyx	Reduced Level	: 100.0
Ground Water Level	: 1.5 m from E.G.L on 15.10.2023	Start Date	: 14.10.2023
UTM Co-ordinate	: 408655 E, 1395067 N	End Date	: 14.10.2023
Termination Depth	: 4.0 m		

SOIL DESCRIPTION	COLOUR	STRUCTURE	DEPTH BELOW GROUND LEVEL (m)	REDUCED LEVEL (m)	LEGEND	TEST NO	SAMPLE TYPE	DEPTH BELOW GROUND LEVEL (m)	TEST DEPTH	PENETRATION VALUES 15cm	30cm	45cm	SPT 'N' Blows/300mm	SPT 'N' PROFILE	C.R (%)	R.Q.D(%)	REMARKS
Silty Gravelly **SAND** (SP)	Red	Very Dense, Granular	2.00			SPT-1	SS	1.00	1.00-1.45	6	27	40	67				G.W.L
						SPT-2	SS	2.00	2.00-2.06	>50	-	-	>100				50/06 cm Penetration
Weathered Rock			4.00			SPT-3 CR-1	SS CS	3.00	3.00-3.00	>50	-	-	>100				Rebound Small Pieces
									3.00-4.00	-	-	-	-				

G.W.L: 1.5 m from E.G.L on 15.10.2023	No of SPT: 3 Nos.	No of UDS : Nil.	No of CR : 1 No.	**Remarks**

Note: SPT-Standard Peneration Test
SS-Split Spoon Sample
OT- Open Tube

UDS-Un Disturbed Sample
CS-Core Sample

CR-Core Recovery
RQD-Rock Quality Designation

Project : Soil Investigation for the Proposed Residential (Building Ground + 1 Floor) Construction at Perumaleri Village, Vadakadampadi Panchayat, Thirukazukundram Taluk, Kancheepuram District.

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Bore Hole No	: BH 3	Drilling Hole Record-BH 3	
Location	: Villas	Fig No. 04	
Type of Boring	: Calyx	Reduced Level	: 100.0
Ground Water Level	: 1.5 m from E.G.L on 17.10.2023	Start Date	: 16.10.2023
UTM Co-ordinate	: 408630 E, 1394988N	End Date	: 16.10.2023
Termination Depth	: 5.0 m		

SOIL DESCRIPTION	COLOUR	STRUCTURE	DEPTH BELOW GROUND LEVEL (m)	REDUCED LEVEL (m)	LEGEND	TEST NO	SAMPLE TYPE	DEPTH BELOW GROUND LEVEL (m)	TEST DEPTH	PENETRATION VALUES 15cm	30cm	45cm	SPT 'N' Blows/300mm	SPT 'N' PROFILE	C.R (%)	R.Q.D(%)	REMARKS
Silty Gravelly **SAND** (SP)	Red	Medium Dense, Granular				SPT-1	SS	1.00	1.00-1.45	14	14	15	29				G.W.L
			2.00			SPT-2	SS	2.00	2.00-2.45	10	20	41	61				
Clayey **SAND** (SC)	Grey	Very Dense, Granular	3.00			SPT-3	SS	3.00	3.00-3.04	>50	-	-	>100				50/04 cm Penetration
Weathered Rock						SPT-4	SS	4.00	4.00-4.00	>50	-	-	>100				Rebound
						CR-1	CS		4.00-5.00	-	-	-	-				Small Pieces
			5.00														

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

G.W.L: 1.5 m from E.G.L on 17.10.2023	No of SPT: 4 Nos.	No of UDS : Nil.	No of CR : 1 No.	**Remarks**

Note: SPT-Standard Peneration Test
SS-Split Spoon Sample
OT- Open Tube

UDS-Un Disturbed Sample
CS-Core Sample

CR-Core Recovery
RQD-Rock Quality Designation

APPENDIX-III

LABORATORY TEST RESULTS

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LABORATORY TEST RESULTS

Project : Soil Investigation for the Proposed Residential (Building Ground + 1 Floor) Construction at Perumaleri Village, Vadakadampadi Panchayat, Thirukazukundram Taluk, Kancheepuram District.

Boring Start : 13.10.2023 | **Table No. 1**

Boring End : 14.10.2023 | **Bore-Hole No. 1**

Location | **G.W.T: 1.0 m**

Villas | **Termination Depth: 4.0 m**

Site Recorded N Value	Corrected 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	SHRINKAGE LIMIT, %						TEST METHOD	C in Kg/cm²	Φ in degrees
53	49	1.00	SPT-1	Silty Gravelly **SAND**	SP	33	46	21							11					
>100	>100	2.00-2.39	SPT-2	**Weathered Rock**		59	23	18							10					
>100	>100	3.00-3.00	SPT-3																	
-	-	3.00-4.00	CR-1	**Boulders**																

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LABORATORY TEST RESULTS

Project : Soil Investigation for the Proposed Residential (Building Ground + 1 Floor) Construction at Perumaleri Village, Vadakadampadi Panchayat, Thirukazukundram Taluk, Kancheepuram District.

Boring Start : 14.10.2023 | **Table No. 2**

Boring End : 14.10.2023 | **Bore-Hole No. 2**

Location | **G.W.T: 1.5 m**

Villas | **Termination Depth: 4.0 m**

Site Recorded N Value	Corrected 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	SHRINKAGE LIMIT, %						TEST METHOD	C in Kg/cm²	Φ in degrees
67	>100	1.00	SPT-1	Silty Gravelly **SAND**	SP	25	56	19							11					
>100	>100	2.00-2.06	SPT-2	**Weathered Rock**		25	60	15							14					
>100	>100	3.00-3.00	SPT-3																	
-	-	3.00-4.00	CR-1	**Boulders**																

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 **LABORATORY TEST RESULTS**				**Project : Soil Investigation for the Proposed Residential (Building Ground + 1 Floor) Construction at Perumaleri Village, Vadakadampadi Panchayat, Thirukazukundram Taluk, Kancheepuram District.**																	
Boring Start : 16.10.2023																		**Table No. 3**			
Boring End : 16.10.2023																		**Bore-Hole No. 3**			
Location																		**G.W.T: 1.5 m**			
Villas																		**Termination Depth: 5.0 m**			
						GRAIN SIZE ANALYSIS			**ATTERBERG LIMITS**										**SHEAR PARAMETERS**		
Site Recorded N Value	**Corrected N Value**	**DEPTH (m)**	**SAMPLE**	**SOIL DESCRIPTION**	**IS. CLASSIFICATION**	**GRAVEL, %**	**SAND, %**	**SILT & CLAY %**	**LIQUID LIMIT,%**	**PLASTIC LIMIT,%**	**PLASTICITY INDEX**	**SHRINKAGE LIMIT, %**	**DRY DENSITY, gm/cc**	**WET DENSITY, gm/cc**	**WATER CONTENT, %**	**SPECIFIC GRAVITY**	**FREE SWELL INDEX, %**	**TEST METHOD**	**C in Kg/cm²**	**Φ in degrees**	
29	44	1.00	SPT-1	Silty Gravelly **SAND**	SP	25	61	14							17						
61	50	2.00	SPT-2	Clayey **SAND**	SC	1	59	40	46	22	24				12						
>100	>100	3.00-3.04	SPT-3	**Weathered Rock**																	
>101	>100	4.00-4.00	SPT-4																		
-	-	4.00-5.00	CR-1	**Boulders**																	

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-IV

CHEMICAL ANALYSIS OF GROUND WATER

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CHEMICAL ANALYSIS OF GROUND WATER

Project. No.	**: 1729**
Name of Project	**: Soil Investigation for the Proposed Residential (Building Ground + 1 Floor) Construction at Perumaleri Village, Vadakadampadi Panchayat, Thirukazukundram Taluk, Kancheepuram District.**
Ref. No.	**: SI/CHN/22/1729/01**

Table No. 4

Sl. No.	Tests	BH 1	BH 2	Limits for using the ground water for mixing concrete
1	**Sulphate as SO_3 mg/l**	Nil	Nil	400 mg/l
2	**Chloride as Cl mg/l**	190	187	I.2000 mg/l for Plain concrete II. 500 mg/l for reinforced concrete
3	**pH @ 25° C**	7	7	6.0 Min



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