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CLIENT	VGK PROPERTY DEVELOPERS PVT. LTD., CHENNAI
PROJECT	PROPOSED CONSTRUCTION OF RESIDENTIAL APARTMENT (STILT+04 FLOORS/05 FLOORS PART) AT OLD DOOR NO: 19, NEW DOOR NO: 36/48, VALMIKI STREET, GANAPATHI COLONY, EAST TAMBARAM, CHENNAI-600059
TITLE	GEOTECHNICAL INVESTIGATION REPORT

REV.	DATE	REPORT NUMBER	PREP. BY
		For Geo Mines Engineers Pvt Ltd	
		Director	
0	27-07-2023	GMEPL/VGK PROPERTY DEVELOPERS PVT. LTD./238/2023-24	

DISCLAIMER

We've been asked to look into the ground and identify and quantify everything that mother nature has put there and predict how those materials will react to construction and long-term performance of a facility - and we may fall short of this lofty goal.

We have made reasonable and prudent conclusions but a cloud of uncertainty inherently looms over the project as per the pre and post facilities laid and their elemental behaviour on the mother soil.

Also, the variable nature of soil strata and it's varying characteristics may make the recommended foundation system disqualify and hence it's recommended that special care shall be taken by the owner during and after the construction is complete and during the run period of the building.

GEOMINES ENGINEERS (P) LTD., GMEPL Chennai

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CHAPTER-1

INTRODUCTION

1.0 Preamble

VGK Property Developers Pvt. Ltd., Chennai proposed to construct a **Residential Apartment (Stilt+04 Floors/05 Floors Part) at Old Door No: 19, New Door No: 36/48, Valmiki Street, Ganapathi Colony, East Tambaram, Chennai-600059.**

For the purpose of designing the foundations, the responsibility of carrying out suitable soil investigation was entrusted to **M/s. Geo Mines ENGINEERS Pvt. Ltd., Chennai.**

This report contains the field and laboratory test results along with Design computations and recommendations for suitable foundation systems.

1.1 Scope of Work

- Sinking Two Standard Soil investigation bore holes of 150mm diameter up to a depth below existing ground level where SPT>100 or as directed by the engineer-in-charge.
- Conducting Standard Penetration Test (SPT) at regular depth intervals.
- Collection of Split Spoon Samples or Disturbed Soil Samples
- Collection of water samples from each bore hole.
- Conducting relevant laboratory test results.

1.2 Structure of the Report

- Contents
- Introduction
- Investigation Methodology & Test Results
- Figures & Tables
- Sub-Surface Stratification
- Foundation Systems
- Recommendations
- Annexure (Design Computations)

CHAPTER-2

INVESTIGATION METHODOLOGY & TEST RESULTS

2.0 Field Testing:

2.1 Preamble:

Two standard soil investigation boreholes were put. The equipment used and the methodology adopted to carry out the fieldwork is described below.

2.2 Equipment Used and Method of Drilling:

2.2.1 Equipment Used

The equipment used for performing the drilling operations is a Calyx Rotary Drill Rig with direct mud circulation technique. The drill mud used was made out of Sodium Bentonite.

2.2.2 Methodology of drilling

In the soil strata, the drilling operations have been carried out using special drill bits and cutters coupled with direct mud circulation.

2.3 In-Situ Strength Tests:

2.3.1 Standard Penetration Test:

Standard penetration tests were conducted at the borehole locations, in accordance with IS: 2131. The tests were conducted at every change of strata up to the depth of termination of the borehole as directed by the engineer-in-charge.

2.4. Collection of Samples:

2.4.1 Disturbed Soil Samples

The SPT-samples collected were used as disturbed soil samples. These samples were used for visual and physical identification and for conducting laboratory classification tests as per I.S.1498-1970.

2.4.2 Ground Water

For conducting suitable chemical tests, the ground water sample was collected from the respective borehole.

2.5 Summary of Field Work

The location of the borehole is shown in site plan given in Fig. 2.0. The soil profiles obtained at each location is shown in Fig. 2.1 & 2.2.

2.6 Laboratory Testing:

2.6.1 Coarse Grained Samples:

2.6.1.1 Grain size Analysis Tests:

On the coarse-grained soil samples, grain size distribution tests were conducted as per I.S.2720 (Part 4)-1985, to know the gradation characteristics and to classify them. These results are presented in Tables 2.1 & 2.2.

2.6.2 Fine Grained Samples:

2.6.2.1 Index Property – Free Swell Tests:

Atterberg Limits were carried out on fine grained soil samples to evaluate the limits of different consistency states. Generally Liquid limits, Plastic limits and Shrinkage Limits tests were conducted as per I.S.2720 (Part-5)-1985 and I.S.2720 (Part 6)-1972. As no such type of soil strata encountered at the investigation locations, no such tests could be conducted.

2.6.3 Chemical Analysis Tests:

2.6.3.1 Water Samples (Open Well):

On representative water samples (Open Well), chemical analysis tests were conducted to estimate pH, Chlorides and Sulphates. These results are presented in Table-2.3.

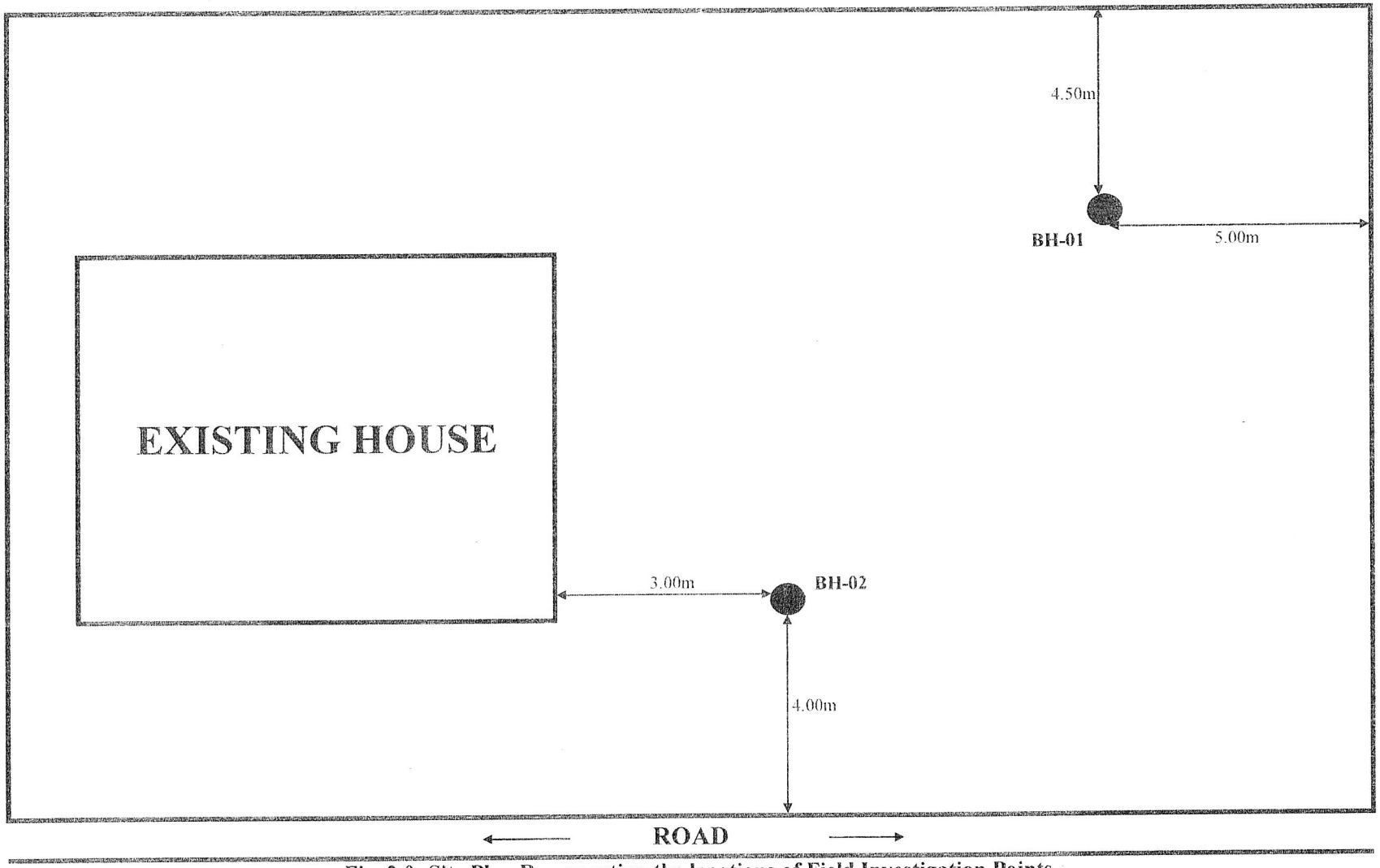


Fig. 2.0: Site Plan Representing the locations of Field Investigation Points

Project : Proposed Construction of Residential Apartment (Stilt+04 Floors/05 Floors Part) at Old Door No: 19, New Door No: 36/48, Valmiki Street, Ganapathi Colony, East Tambaram, Chennai-600059.

Location: BH-01

Started On : 25/07/2023; Ended On : 25/07/2023 G.W.T: 9.20m below existing ground level (Open Well)

R.L of Layer (m)	G.W.T. (m)	Soil Profile	Engineering Description of Soil	SPT - Details: Depth of SPT below E.G.L (m)	0-15 cm	15-30 cm	30-45 cm	N-Value	Graphical Representation (0 1 2 3 4 5 6 7 8 9)	Relative Density/Consistency	Type of Sample
1.00			Brownish Medium Dense Silty Fine Sand	1.50	18	24	30	54		M.Dense	DS
2.50			Soft Disintegrated Rock							V.Dense	SS
4.00			Weathered Rock	3.00	SPT Hammer Rebounded					V.Dense	SS
				4.00	SPT Hammer Rebounded					V.Dense	SS

Bore Hole Terminated at a depth of 4.00m below the existing grou

Fig. 2.1 Soil Profile at BH-01 Location

Project : Proposed Construction of Residential Apartment (Stilt+04 Floors/05 Floors Part) at Old Door No: 19, New Door No: 36/48, Valmiki Street, Ganapathi Colony, East Tambaram, Chennai-600059.

Location: BH-02

Started On : 25/07/2023; Ended On : 25/07/2023 G.W.T: 9.20m below existing ground level (Open Well)

R.L of Layer (m)	G.W.T. (m)	Soil Profile	Engineering Description of Soil	Depth of SPT below E.G.L (m)	SPT - Details 0-15 cm	15-30 cm	30-45 cm	N-Value	lical Representation o 0 1 2 3 4 5 6 7 8 9	Relative Density/Consistency	Type of Sample
1.30			Brownish Loose Silty Fine Sand							Loose	DS
2.70			Soft Disintegrated Rock	1.50	15	19	30	49		Dense	SS
4.50			Weathered Rock	3.00	06cm Penetration for 50Blows					V.Dense	SS
				4.50	SPT Hammer Rebounded					V.Dense	SS

Bore Hole Terminated at a depth of 4.50m below the existing grou

Fig. 2.2 Soil Profile at BH-02 Location

Table 2.1: Laboratory Test Results on the Soil Samples Collected from BH-01

Depth of Sample below E.G.L. (m)	SPT of Sample	Type of Sample	Engineering Description of Soil	NMC(%)	Natural Density (g/cc)	Clay					Relative Density/ Consistency	Sieve Analysis						IS-Classification
						LL (%)	PL (%)	PI	I_c	FS		Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	
0.00 to 1.00	-	DS	Silty Fine Sand	-	1.7	-	-	-	-	-	M.Dense	0	0	8	69	23	0	SM
1.00 to 2.50	54	SS	Soft Disintegrated Rock	-	2.0	-	-	-	-	-	V.Dense	29	18	22	21	10	0	SDR
2.50 to 4.00	>100	SS	Weathered Rock	-	2.0	-	-	-	-	-	V.Dense	43	29	11	13	4	0	SDR

Table 2.2: Laboratory Test Results on the Soil Samples Collected from BH-02

Depth of Sample below E.G.L. (m)	SPT of Sample	Type of Sample	Engineering Description of Soil	NMC (%)	Natural Density (g/cc)	Clay					Relative Density/ Consistency	Sieve Analysis						IS-Classification
						LL (%)	PL (%)	PI	[illegible]	FS		Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	
0.00 to 1.30	-	DS	Silty Fine Sand	-	1.5	-	-	-	-	-	Loose	0	0	9	66	25	0	SM
1.30 to 2.70	49	SS	Soft Disintegrated Rock	-	2.0	-	-	-	-	-	Dense	17	27	29	19	8	0	SDR
2.70 to 4.50	>100	SS	Weathered Rock	-	2.0	-	-	-	-	-	V.Dense	39	13	26	18	4	0	SDR

Table 2.3: Chemical Analysis Results conducted on Open Well Water Samples collected from BH-01 & BH 02

Location	Depth of Sample below E.G.L. (m)	pH	Chlorides (ppm)	Sulphates (ppm)
BH-01	9.20	6.67	255.32	141.95
BH-02	9.20	6.66	260.06	139.51

CHAPTER-3

SUB-SURFACE STRATIFICATION

3.0 Preamble

The sub surface stratification at borehole locations, with respect to foundation/geotechnical engineering application are derived based on the visual identification, laboratory classification tests and field in-situ strength tests. Further, the strength parameters are estimated based on the in-situ strength test results as per the following correlation.

* **For Coarse Grained Samples, Ref. Fig.1, IS: 6403 to estimate Angle of Shearing Resistance.**
* **For Fine Grained Samples, Ref. Terzaghi & Peck, 1948, to estimate Unconfined Compressive Strength.**

3.1 Sub Surface Stratification:

3.1.1 Soil Profile at BH-01 Location

(At BH-01 Location, as presented in Site plan)

* **Layer-1 (from E.G.L to 1.00m depth)**

Type of Strata	Silty Fine Sand
Colour	Brownish
Thickness of Layer	1.00m
SPT of the layer	-
Relative Density	Medium Dense
Angle of Shearing Resistance, ϕ	-

* **Layer-2 (from 1.00m to 2.50m depth)**

Type of Strata	Soft Disintegrated Rock
Colour	-
Thickness of Layer	1.50m
SPT of the layer	54
Relative Density	Very Dense
Angle of Shearing Resistance, ϕ	41.60^0

* **Layer-3 (from 2.50m to 4.00m depth)**

Type of Strata	Weathered Rock
Colour	-
Thickness of Layer	1.50m
SPT of the layer	>100
Relative Density	Very Dense
Angle of Shearing Resistance, ϕ	42.50^0

Ground Water

In an open well, ground water table was encountered at a depth of 9.20m below the existing ground level during the last week of July 2023.

3.1.2 Soil Profile at BH-02 Location

(At BH-02 Location, as presented in Site plan)

* **Layer-1 (from E.G.L to 1.30m depth)**

Type of Strata	Silty Fine Sand
Colour	Brownish
Thickness of Layer	1.30m
SPT of the layer	-
Relative Density	Loose
Angle of Shearing Resistance, ϕ	-

* **Layer-2 (from 1.30m to 2.70m depth)**

Type of Strata	Soft Disintegrated Rock
Colour	-
Thickness of Layer	1.40m
SPT of the layer	49
Relative Density	Dense
Angle of Shearing Resistance, ϕ	40.775^0

* **Layer-3 (from 2.70m to 4.50m depth)**

Type of Strata	Weathered Rock
Colour	-
Thickness of Layer	1.80m
SPT of the layer	>100
Relative Density	Very Dense
Angle of Shearing Resistance, ϕ	42.50^0

Ground Water

In an open well, ground water table was encountered at a depth of 9.20m below the existing ground level during the last week of July 2023.

CHAPTER-4

FOUNDATION SYSTEM

4.0 Preamble

The foundation system design is an interface between super structure and the sub soil bearing strata characteristics. A sound foundation system should be safe against bearing strata shear response under the super structure load intensity. Similarly, the stability of the foundation system is governed by the bearing strata deformation response under the super structure load intensity. In addition, as a combined system of super structure and foundation, the overall stability is also governed by the super structure arrangement.

Considering the above aspects of foundation design, the suitable type of foundation system with respect to the sub soil conditions encountered at the borehole locations is presented in the subsequent sections.

4.1 Bearing Strata Characteristics

From field investigations, it can be observed that the sub-soil strata encountered at shallow depths are uniformly stratified coarse-grained type and good from both shear strength characteristics and deformation considerations to act as bearing strata for proposed impending loads from structure.

If the recommended bearing strata are coarse-grained type, the safe bearing capacity of open foundation system will be a function of least width of footing and effective over burden pressure on the bearing strata.

Considering the above, suitable foundation system is presented below.

4.2 Foundation System

4.2.1 Open Foundation System (BH-02)

Considering the bearing strata characteristics of sub-soil strata encountered at shallow depths, open foundation system of isolated column footing type located at a least depth of 2.20m below existing ground level (E.G.L) can be adopted.

The safe bearing capacity of open foundation at least recommended depth of 2.20m below E.G.L is computed and presented below which can be adopted for foundation design purposes.

S. No.	Type of Open Foundation System	Depth of Footing below Existing Ground Level (m)	Observed Thickness of Fill (m)	Depth of Footing below Natural Ground Level (m)	Type of Bearing Strata	Safe Bearing Capacity (MT/m^2)	Elastic Settlements <50mm (mm)
1	Isolated Column Footing	2.20	0.00	2.20	Soft Disintegrated Rock	30	15

The computations for above are annexed to this report.

CHAPTER5

CONCLUSIONS & RECOMMENDATIONS

1. Open foundation system of isolated column footing type located at shallow depths over coarse-grained strata can be adopted for foundation design purposes.
2. Safe bearing capacity presented in Clause 4.2.1, Chapter-IV can be adopted for open foundation design purposes.
3. **In no case, the least depth of footing shall be less than 2.20m below Natural Ground Level.**
4. Care shall be taken so that the ultimate bearing strata are none other than coarse-grained **Soft Disintegrated Rock** type.
5. Excavated coarse-grained soil encountered at shallow depths can be used for back filling purposes.
6. Safe bearing capacity presented above is computed considering any rise in the ground water table at or above the level of footing/raft.
7. **It is recommended to connect the grade beams so that the structure can act as a single unit against any differential settlements in between the individual footings/raft.**
8. Special provisions to contain any lateral collapse of soil from the walls of excavated foundation pits are required up to the recommended depths of open foundation system.
9. In case, the ground water table is encountered within the recommended depths of foundation system, the same shall be bailed out continuously to keep the sub-grade well consolidated.
10. As the chlorides and sulphates present in the open well water samples are within the permissible limits, no special steel or cement is required to be used for foundation construction purposes.

For Geo Mines Engineers Pvt Ltd

Director

DESIGN OF OPEN FOUNDATION SYSTEM (Ref. BH-02)

1 COMPUTATION OF BEARING CAPACITY AS PER IS:6403

1.1 Geometrical Data :

Type of Foundation System:	Isolated Column Footing	
R.L of the top of Borehole (m):	0.00	m
Depth of Foundation below existing ground level (D_f):	2.20	m
Observed Thickness of fill at site:	0.00	m
Effective Depth of Foundation below natural ground level (D_f):	2.20	m
Design Width of Foundation (B):	1.50	m
Thickness of Foundation (T) :	0.25	m

1.2 Soil Data :

Type of Bearing Strata :	Soft Disintegrated Rock	
Design SPT-value of the Bearing Strata : (considered based upon the density of the strata)	49	
Type of Shear Failure:	General	
Angle of Shearing Resistance - Limited to a Maximum of:	40.78	Deg.

1.3 Design Parameters:

Bulk Density of Soil above the foundation depth (γ_{bulk})	19.00	kN/m^3
Effective Overburden pressure at foundation level (q)	19.80	kPa
Water Table Correction Factor (w')	0.50	

Bearing Capacity Factors:

N_c = N/A

N_q = 75.16

N_γ = 134.57

Shape Factors:

S_c = N/A

S_q = 2.29

S_γ = 0.40

Depth Factors :

D_c = N/A

D_q = 1.00

D_γ = 1.00

Inclination Factor:

I_c = N/A

I_q = 1.00

I_γ = 1.00

1.4 Ultimate Bearing Capacity (Qu) :

$Qu = Cu*Nc*Sc*D_C*I_C+q*(Nq-1)*Sq*Dq*Iq + 0.5*B*\gamma*N\gamma*S\gamma*D\gamma*Ig*w'$

Q_u = 3796.62 kPa

1.5 Safe Bearing Capacity (Qsafe) :

Factor of Safety (F.S.) :	2.50
Qsafe :	1518.65 kPa
Recommended Safe Bearing Capacity:	300.00 kPa

1.6 Settlements

Since, the bearing strata are coarse-grained type, the settlements under the allowable safe bearing pressure 300kPa will be of immediate elastic nature. The elastic settlements corresponding to a safe bearing pressure of 300kPa and average SPT of 49 considering extent of pressure bulb below bottom level of footing are computed to be in the order of 15mm which is within the permissible limits of 50mm for isolated column footings/raft as per I.S:1904.



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Vastu & Property Management Tools

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