GEO TECHNICAL INVESTIGATION REPORT

Project:
Residential Group Housing Project "Gulmohar Residency" at Sy. No. 19, Mallapur (V), GHMC Kapra Circle, Uppal (M), Medchal Dist., Telangana

Client:
M/s Modi Realty Mallapur LLP

July 2019

Prepared by:

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GT / 1648 / 2018-19

GEO TECHNICAL INVESTIGATION REPORT

REPORT No.: **GT / 1648 / 2018-19**

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CLIENT: **M/s Modi Realty Mallapur LLP**

W.O. Ref.: **GT/QUO/Soil/2019-20/101 dt. 8th July 2019**

DURATION: **July 2019**

GEOTECHNICAL CONSULTANTS:

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CONTENTS

1. INTRODUCTION

M/s Modi Realty Mallapur LLP, Hyderabad, have engaged M/s Geo Technologies as Consultant to carryout geotechnical investigation work for proposed Residential Group Housing Project "Gulmohar Residency" at Sy. No. 19, Mallapur (V), GHMC Kapra Circle, Uppal (M), Medchal Dist., Telangana. The proposed project comprises eight Blocks.

Originally, total 11 boreholes were proposed to be drilled. But as some of them were located in abandoned well / mine area with dumped loose boulders, only eight (8) boreholes could be drilled. The results of these eight boreholes are presented in this report.

2. FIELD INVESTIGATIONS

DRILLING:

The bore holes were drilled in the site at the locations specified by the client (Fig.1). Table-1 gives details of the bore holes drilled.

Rotary Drilling was performed as per IS: 1892. The size of the casing used was 150 / 90 mm.

The following information was collected during the drilling operations:

- Nature of strata - Details of soil samples
- Colour of Return Water - Rate of drilling

STANDARD PENETRATION TEST (SPT):

Standard Penetration Tests were conducted at 1.5 m depth intervals in soil, in accordance with IS: 2131-1981. Soil samples were carefully extracted from the split-spoon sampler and preserved in polythene bags.

SAMPLES:

Split-spoon samples and disturbed soil samples were collected from boreholes at frequent intervals. Rock cores were carefully extracted from the core barrel and arranged in core boxes in proper sequence. Core recovery and RQD were recorded.

All the soil and rock samples collected were properly packed, labeled and transported to Geo Technologies Soil Testing Laboratory at Hyderabad.

FIELD BORE LOGS:

All the details collected from the field operations are presented in Logs of Bore holes in Annexure-1 at the end of this Report. These logs contain depth wise strata details, depth and type of soil samples collected, results of Standard penetration Tests, and color of return water etc.

3. LABORATORY TESTING

The following tests were performed on the Soil samples:

- Specific gravity (IS: 2720: part3 – 1980)
- Grain size distribution (IS 2720 part 4 – 1985)
- Atterberg's Limits (IS 2720 part 5 – 1985 and IS 2720 – part 2 – 1973)
- Unit weight (IS 2720 part 29 – 1988)
- Direct Shear test (IS 2720 – part 13 – 1986)

The following tests were conducted on rock core samples:

- Unconfined Compressive Strength test (UCS) of rock cores (IS: 9143 – 1979)
- Specific Gravity (IS: 1124 – 1974)
- Porosity & Water absorption (IS: 1124 – 1974)

4. RESULTS

Table 1 gives the details of boreholes drilled.

Table 2 gives the results of lab tests of soil samples.

Table 3 gives the results of lab tests of rock cores.

Fig. 1 gives the site plan showing the locations of boreholes.

Figs. 2 give the combined Logs of bore holes.

Fig.3 gives soil stabilization scheme for Well area.

Appendix gives the calculations for SBC.

Annexure-1 gives the field bore log charts.

Annexure-2 gives the BIS Codes.

5. SOIL PROFILE

The subsoil profile in the different boreholes is as follows:

S.No	Block	BH No.	Depth below Existing GL, m		EGL	RL		Strata	N	CR%	RQD%
			From	To		From	To				
1	Amenities	1	0.0	2.0	24.250	24.25	22.25	Filling	-	-	-
2	G	2	0.0	3.0	29.606	29.61	26.61	Hard rock	-	98-99	98-99
3	H	3	0.0	4.0	26.190	26.19	22.19	Filling	-	-	-
4	Open Space	5	0.0	3.0	28.904	28.90	25.90	Hard rock	-	99	99
5	B	7	0.0	3.0	26.144	26.14	23.14	Hard rock	-	79-99	79-99
6	C	9	0.0	3.0	28.566	28.57	25.57	Hard rock	-	89-100	36-65
7	A	10	0.0	1.4	25.982	25.98	24.58	Silty gravel	-	-	-
			1.4	4.4		24.58	21.58	Hard rock	-	97-99	97-99
8		11	0.0	5.4	25.337	25.34	19.94	Silty gravel	19-29	-	-
			5.4	8.4		19.94	16.94	Hard rock	-	99-100	56-100

No water was seen at the time of drilling.

6. RECOMMENDATIONS

The following recommendations are made for the proposed Residential Group Housing Project "Gulmohar Residency" at Sy. No. 19, Mallapur (V), GHMC Kapra Circle, Uppal (M), Medchal Dist., Telangana. These are based on eight (8) bore holes.

a) The proposed project comprises 8 blocks – A, B, C, D, E, F, G & H (See Fig.1 – Layout). Two abandoned wells or mine quarries, filled with loose boulders and soil, are observed in the N-W & West parts of the site. Amenities block, part of Block-H, entire Block-E and part of Block-C are situated in the well area. Block-wise numbers of bore holes drilled are as follows:

Block-A: BH-10 & BH-11 drilled

Block-B: BH-7 drilled

Block-C: BH-9 drilled. (BH-8 could not be drilled due to filling of loose boulders)

Block-D: No borehole was allotted

Block-E: BH-4 & BH-6 were marked but could not be drilled due to filling of loose boulders

Block-F: No borehole was allotted

Block-G: BH-2 drilled

Block-H: BH-3 could be drilled only up to 4 m depth due to filling of loose boulders

Open Space: BH-5 drilled.

Amenities Block: BH-1 could be drilled only up to 2 m depth due to filling of loose boulders.

b) The site has been excavated for cellars to different levels in different locations. EGL at the locations of boreholes drilled varies from +24.250 (BH-1) to +28.904 (BH-5).

c) It is understood that the proposed buildings comprise 2 basements + Ground + 5 upper floors. The 2^{nd} basement floor level would be at +27.00 and foundations are proposed at 1.5 m depth below the 2^{nd} basement floor level, i.e., at +25.50.

Soil Profile:

d) The soil profile in the boreholes drilled is given in the previous section (See Fig.2). Subsoils below the proposed foundation level of 25.5 in the boreholes drilled are as follows:

S. No	BH No.	Block	EGL	Strata below Foundation level of 25.50	N	CR%	RQD%
1	1	Amenities	24.250	Filling (Well)	-	-	-
2	2	G	29.606	Hard rock	-	98-99	98-99
3	3	H	26.190	Filling (Well)	-	-	-
4	5	Open Space	28.904	Hard rock	-	99	99
5	7	B	26.144	Hard rock	-	79-99	79-99
6	9	C	28.566	Hard rock	-	89-100	36-65
7	10	A	25.982	Silty gravel	-	-	-
8	11		25.337	Silty gravel	19-29	-	-

No boreholes were allotted in Blocks D & F.

e) No water was seen at the time of drilling.

Foundations & SBC:

f) In view of variations in soil conditions in different parts of the site and since a significant part of the site is covered by filling due to well or mine, separate foundations are recommended for the area outside of the well and for the well area.

Outside of Well / Mine area:

g) SBC for foundations at RL: +25.50 is recommended as follows:

BH No.	Block	Strata below Foundation level of 25.50	SBC, t/m^2
2	G	Hard rock	50
5	Open Space	Hard rock	50
7	B	Hard rock	50
9	C	Hard rock	50
10 & 11	A	Silty gravel	25

It should be noted that the above recommendations are based on only one borehole in each block and are valid only for the borehole locations. In other locations within the same block, soil conditions may be different and these recommendations may not be valid for them. Confirmatory site investigations are recommended for every foundation location.

h) It should also be noted that no boreholes were allotted for drilling in Blocks D & F. As subsoil profile below RL: 25.50 in these blocks is not known, no recommendations can be made for foundations for these blocks.

Well / Mine area: (Blocks C, E, H & Amenities)

i) As already mentioned, Amenities block, Block-H, Block-E and part of Block-C are situated in the well / mine area. Only two boreholes, viz., BH-1 & BH-3 were attempted in this area, but they could not be drilled beyond 2 / 4 m due to filling,

j) The entire filled up area of the well / mine needs proper soil stabilization before laying foundations. The following soil stabilization scheme is recommended. Fig. 3 enclosed shows soil stabilization diagram.

1. The loose filled soil should be excavated to a depth of about 3.5 m below 2nd cellar floor level and replaced with stabilized engineered filling as follows.
   i) A boulder bed (UCRS) of 1 m thickness should be laid at the bottom.
   ii) A 1 m thick well-compacted morum bed should be laid on boulder bed.
   iii) About 1 m thick well-compacted sand bed should be laid over the gravel bed.
   iv) PCC bed should be over the sand bed.
   v) The morum used for gravel filling should not contain boulders and large pebbles. It should be filled in thin layers and compacted thoroughly in the entire area of filling.
2. Raft foundation covering all the columns of a block (in the well area) is recommended.
3. SBC for Raft foundation is recommended as 12 tonnes per sq m.
4. Raft foundation should be tied to nearby footings in natural strata outside the well area.

For ***GEO TECHNOLOGIES***

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TABLE – 1: SUMMARY OF DRILLING

S No.	BH No.	Block	Depth drilled, m	Remarks
1	BH-1	Amenities	2.0	Boulder Filling area
2	BH-2	G	3.0	Hard rock from top 0.0 m
3	BH-3	H	4.0	Boulder Filling area
4	BH-4	E	-	Not drilled due to loose boulders
5	BH-5	Open Space	3.0	Hard rock from top 0.0 m
6	BH-6	E	-	Not drilled due to loose boulders
7	BH-7	B	3.0	Hard rock from top 0.0 m
8	BH-8	C	-	Not drilled due to loose boulders
9	BH-9	C	3.0	Hard rock from top 0.0 m
10	BH-10	A	4.0	Hard rock from 1.4 m
11	BH-11	A	8.4	Hard rock from 5.4 m

TABLE-2: Results of Lab testing of Soil samples

BH No.	Depth, m	Soil	Sp. Gr.	Grain size, Percentage			MC, %	γ KN/ Cum	Direct Shear Test	
				Gr	Sa	Si+Cl			C	Ø
BH-11	1.5	Silty gravel	2.66	33	42	25	2.8	18.4	10	30
	3.0	Silty gravel	-	-	-	-	-	-	12	31

TABLE-3: RESULTS OF TESTS ON ROCK CORES

Rock: Granite

B H No.	DEPTH OF SAMPLE (m)	CR%	RQD%	SPECIFIC GRAVITY	POROSITY (%)	WATER ABSORPTION (%)	UCS kg/ sq cm
BH-2	0.0 – 1.0	98	98	2.71	1.00	0.79	1040
	2.0 – 3.0	99	99	-	-	-	1100
BH-5	0.0 – 1.0	99	99	2.72	1.01	0.75	1050
	2.0 – 3.0	99	99	-	-	-	1060
BH-7	0.0 – 1.0	79	79	2.72	-	-	980
	2.0 – 3.0	99	99	-	1.15	0.90	1060
BH-9	0.0 – 1.0	89	36	-	-	-	780
	2.0 – 3.0	100	65	2.71	-	-	870
BH-10	1.4 – 2.4	97	97	-	0.95	0.75	940
	3.4 – 4.4	99	99	-	-	-	1030
BH-11	5.4 – 6.4	99	56	-	1.05	0.83	880
	7.4 – 8.4	100	100	2.72	-	-	1080

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Appendix: Calculation of SBC

I. Foundations in Harrd Rock:

A. Based on 'N' Values:

a) Shear criterion:

Assumed width of Footings B = 2 m; N = 45, Rw=Rq=0.5

Assumed depth of foundations D = 2.0 m. below cellar floor level

Allowable bearing pressure is: (with F.S. = 3.0)

q (Allowable) = 1/18 [2 x N x N B Rw + 6 (100 + N x N) D Rq] = 933 kN/sq m

b) Settlement Criterion:

For a settlement of 40 mm (N = 45, B = 2 m),

Allowable bearing capacity = 12.25 N [(B + 0.3) / B] = 634 KN/sq m

SBC for foundations resting in hard rock at 1.5 m below 2nd basement floor level is recommended as 50 tonnes per sq m.

II. Foundations in silty gravel: (BH-11)

a) Shear criterion:

Assumed Depth of foundation D = 2.0 m below cellar floor level;

Assumed width of foundation B ... 2.0 m

γ = 18.4 KN/m^3; c = 10 KN/m^2 (Neglected) $\varphi = 32^o$.

Nc = 27.23 Nq = 16.55 Nr = 20.54

Net, Ult B.C. = 1.3 c Nc + r' D (Nq – 1) + 0.4 r' B Nr = 874 KN per sq m

With a F.S. of 3.0, SBC = 291 KN per sq m

b) Settlement Criterion:

Assuming average N value as 20, for permissible settlement of 40 mm,

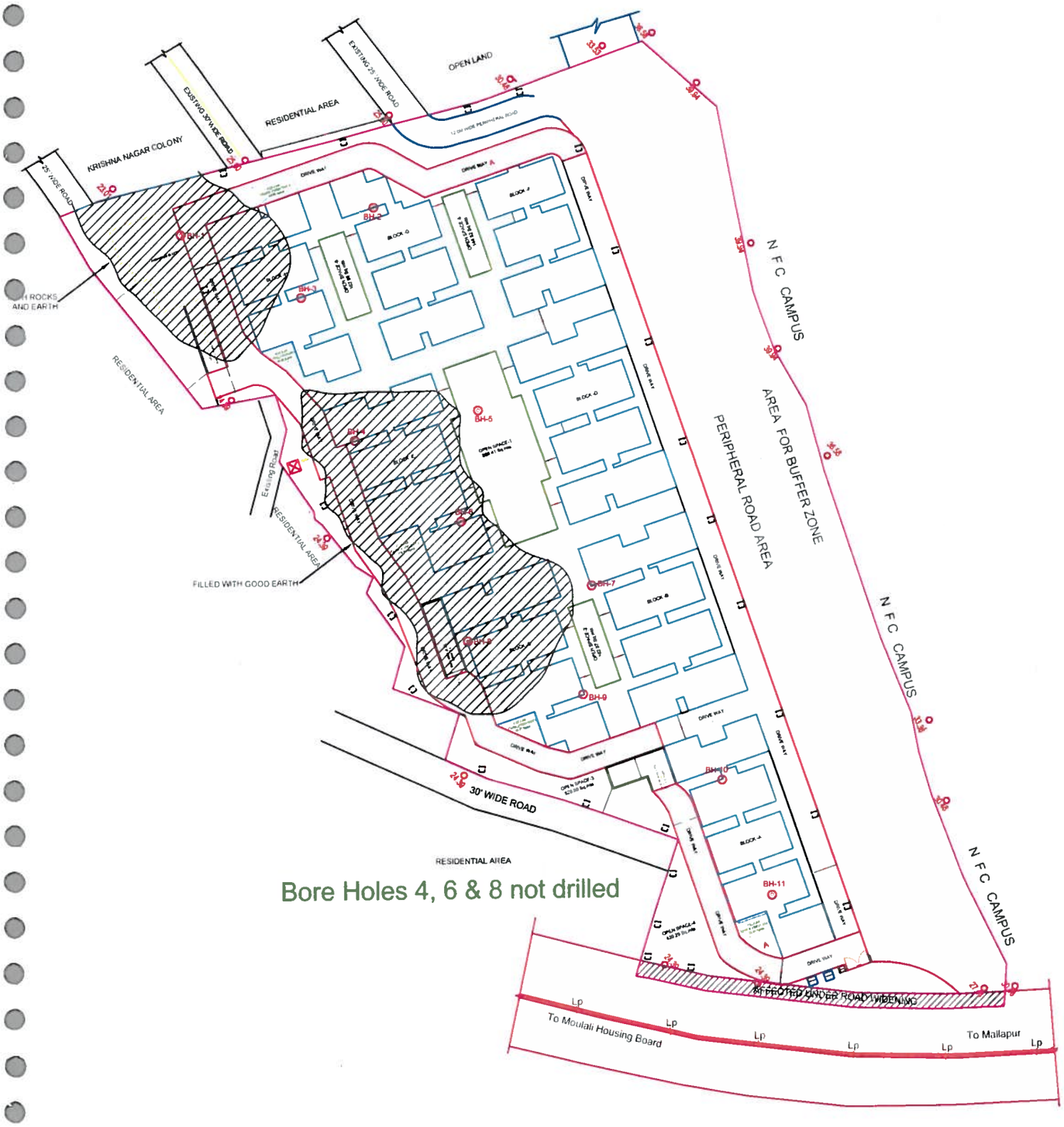
Allowable Bearing Pressure = 12.25 N (B + 0.3) / B = 281 kN / sq m

Recommended Safe Bearing Capacity is 25 t per sq m

FIG:1 SITE PLAN SHOWING THE LOCATIONS OF BORE HOLES

Project: Residential Group Housing Project "Gulmohar Residency"

at Sy. No. 19, Mallapur (V), GHMC Kapra Circle, Uppal (M), Medchal Dist., Telangana



Bore Holes 4, 6 & 8 not drilled

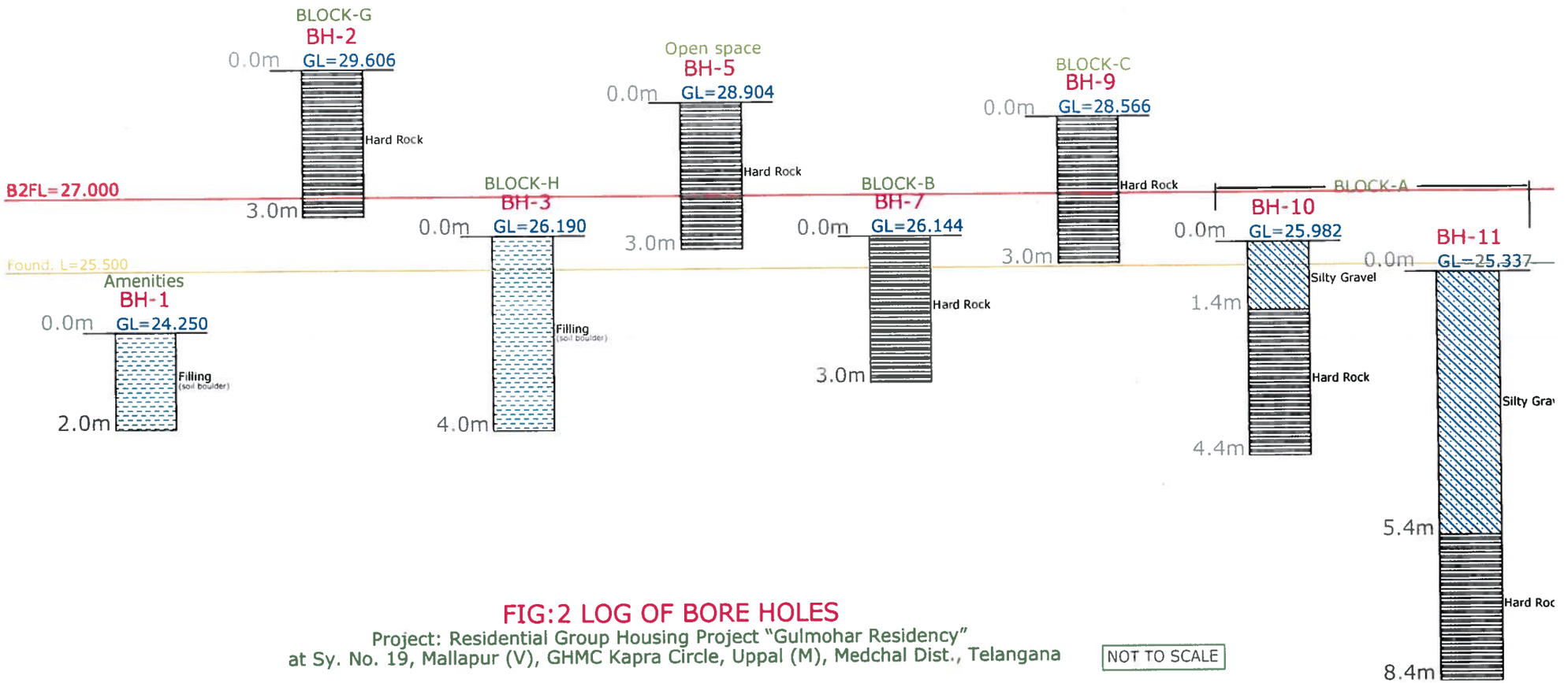


FIG:2 LOG OF BORE HOLES

Project: Residential Group Housing Project "Gulmohar Residency"
at Sy. No. 19, Mallapur (V), GHMC Kapra Circle, Uppal (M), Medchal Dist., Telangana

NOT TO SCALE

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Gulmohar Residency at Mallapur

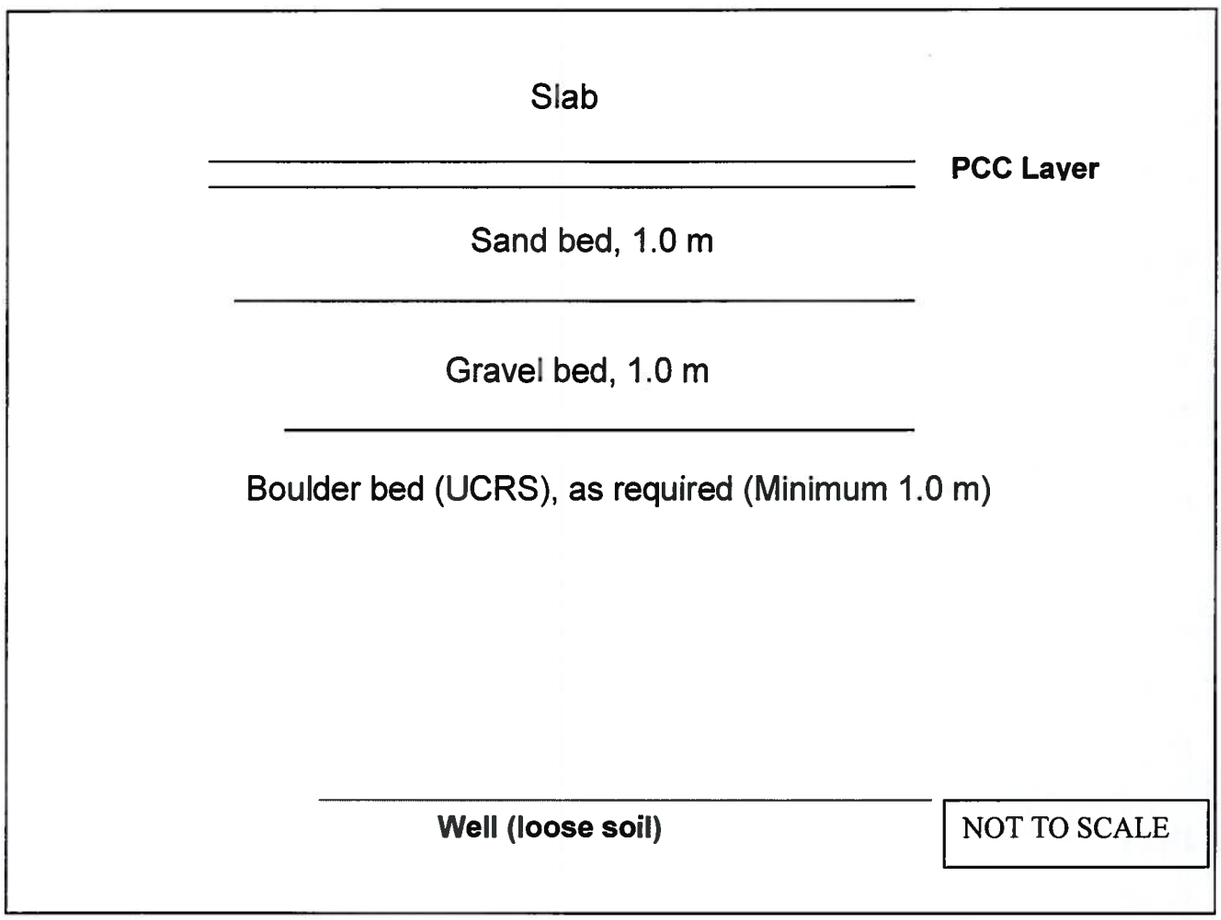

Fig. 3: Soil stabilization scheme for well area

Annexure-1

FIELD BORE CHARTS

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FIELD BORE LOG CHART

Project: Residential Group Housing Project "Gulmohar Residency" at Mallapur	**BORE HOLE NO. 1**	**Ground Level: 24.250**
		Dia. Of Casing: 150mmNX
Date : 16-07-2019		**Water Table:**

Depth (m) From	Depth (m) To	Length of Run (m)	Description	Log of Bore	Sampling Depth (m)	Sampling Type	SPT No. blows for Penetration of (15-30-45)cm	SPT N Value	Details of Rock core >10cm core Pieces(cm)	Details of Rock core Total Length (cm)	Details of Rock core No. of Pieces	Details of Rock core % of core Recovery	RQD Value %	Avg. RQD %	Water colour	Rate of Drill Min/m
0.0	1.5	1.5	Filling (soil boulder)													
1.5	2.0	0.5														

SDR=Soft Disintigrated Rock cm/50= no.of blows sp=Small pieces vsp=Very Small Pieces

GEO TECHNOLOGIES

FIELD BORE LOG CHART

Project: Residential Group Housing Project "Gulmohar Residency" at Mallapur	**BORE HOLE NO. 2**	**Ground Level: 29.606**
Date : 15-07-2019		**Dia. Of Casing: 150mm/NX**
		Water Table:

Depth (m) From	Depth (m) To	Length of Run (m)	Description	Log of Bore	Sampling Depth (m)	Sampling Type	SPT No. blows for Penetration of (15-30-45)cm	SPT N Value	Details of Rock core >10cm core Pieces(cm)	Details of Rock core Total Length (cm)	Details of Rock core No. of Pieces	Details of Rock core % of core Recovery	RQD Value %	Avg. RQD %	Water colour	Rate of Drill Min/m
0.0	1.0	1.0	Hard Rock				Core sample		98	98	1no	98%	98%		Milky	
1.0	2.0	1.0					Core sample		99	99	1no	99%	99%		Milky	
2.0	3.0	1.0					Core sample		99	99	1no	99%	99%		Milky	

SDR=Soft Disintigrated Rock cm/50= no.of blows sp=Small pieces vsp=Very Small Pieces

FIELD BORE LOG CHART

Project: Residential Group Housing Project "Gulmohar Residency" at Mallapur	**BORE HOLE NO. 3**	**Ground Level: 26.190**
		Dia. Of Casing: 150mm/NX
Date : 15-07-2019		**Water Table:**

Depth (m) From	Depth (m) To	Length of Run (m)	Description	Log of Bore	Sampling Depth (m)	Sampling Type	SPT No. blows for Penetration of (15-30-45)cm	SPT N Value	Details of Rock core >10cm core Pieces(cm)	Details of Rock core Total Length (cm)	Details of Rock core No. of Pieces	Details of Rock core % of core Recovery	RQD Value %	Avg. RQD %	Water colour	Rate of Drill Min/m
0.0	1.5	1.5	Filling (soil boulder)													
1.5	3.0	1.5														
3.0	4.0	1.0														

SDR=Soft Disintigrated Rock cm/50= no.of blows sp=Small pieces vsp=Very Small Pieces

FIELD BORE LOG CHART

Project: Residential Group Housing Project "Gulmohar Residency" at Mallapur	**BORE HOLE NO. 5**	**Ground Level: 28.904**
		Dia. Of Casing: 150mm/NX
Date : 16-07-2019		**Water Table:**

Depth (m) From	Depth (m) To	Length of Run (m)	Description	Log of Bore	Sampling Depth (m)	Sampling Type	SPT No. blows for Penetration of (15-30-45)cm	SPT N Value	Details of Rock core >10cm core Pieces(cm)	Details of Rock core Total Length (cm)	Details of Rock core No. of Pieces	Details of Rock core % of core Recovery	RQD Value %	Avg. RQD %	Water colour	Rate of Drill Min/m
0.0	1.0	1.0	Hard Rock				Core sample		99	99	1no	99%	99%		Milky	
1.0	2.0	1.0					Core sample		99	99	1no	99%	99%		Milky	
2.0	3.0	1.0					Core sample		99	99	1no	99%	99%		Milky	

SDR=Soft Disintigrated Rock cm/50= no.of blows sp=Small pieces vsp=Very Small Pieces

FIELD BORE LOG CHART

Project: Residential Group Housing Project "Gulmohar Residency" at Mallapur	**BORE HOLE NO. 7**	**Ground Level: 26.144**
Date : 14-07-2019		**Dia. Of Casing: 150mm/NX**
		Water Table:

Depth (m) From	Depth (m) To	Length of Run (m)	Description	Log of Bore	Sampling Depth (m)	Sampling Type	SPT No. blows for Penetration of (15-30-45)cm	SPT N Value	Details of Rock core >10cm core Pieces(cm)	Details of Rock core Total Length (cm)	Details of Rock core No. of Pieces	Details of Rock core % of core Recovery	RQD Value %	Avg. RQD %	Water colour	Rate of Drill Min/m
0.0	1.0	1.0	Hard Rock				Core sample		20+11+12+15 +21=79	79	5no only	79%	79%		Milky	
1.0	2.0	1.0					Core sample		45+53=98	98	2no only	98%	98%		Milky	
2.0	3.0	1.0					Core sample		40+59=99	99	2no only	99%	99%		Milky	

SDR=Soft Disintigrated Rock cm/50= no.of blows sp=Small pieces vsp=Very Small Pieces

FIELD BORE LOG CHART

Project: Residential Group Housing Project "Gulmohar Residency" at Mallapur	**BORE HOLE NO. 9**	**Ground Level: 28.566**
		Dia. Of Casing: 150mm/NX
Date : 14-07-2019		**Water Table:**

Depth (m) From	Depth (m) To	Length of Run (m)	Description	Log of Bore	Sampling Depth (m)	Sampling Type	SPT No. blows for Penetration of (15-30-45)cm	SPT N Value	Details of Rock core >10cm core Pieces(cm)	Details of Rock core Total Length (cm)	Details of Rock core No. of Pieces	Details of Rock core % of core Recovery	RQD Value %	Avg. RQD %	Water colour	Rate of Drill Min/m
0.0	1.0	1.0	Hard Rock				Core sample		36	89	1no+9 sp	89%	36%		Milky	
1.0	2.0	1.0					Core sample		12+16+15+20 =63	100	4no+ts	100%	63%		Milky	
2.0	3.0	1.0					Core sample		42+13+10=65	100	3no+6 sp	100%	65%		Milky	

FIELD BORE LOG CHART

Project: Residential Group Housing Project "Gulmohar Residency" at Mallapur	**BORE HOLE NO. 10**	**Ground Level: 25.982**
		Dia. Of Casing: 150mm/NX
Date : 13-07-2019		**Water Table:**

Depth (m) From	Depth (m) To	Length of Run (m)	Description	Log of Bore	Sampling Depth (m)	Sampling Type	SPT No. blows for Penetration of (15-30-45)cm	SPT N Value	Details of Rock core >10cm core Pieces(cm)	Details of Rock core Total Length (cm)	Details of Rock core No. of Pieces	Details of Rock core % of core Recovery	RQD Value %	Avg. RQD %	Water colour	Rate of Drill Min/m
0.0	1.4	1.4	Silty Gravel		1.00	D/S									Reddish	
1.4	2.4	1.0	Hard Rock				Core sample		97	97	1no	97%	97%		Milky	
2.4	3.4	1.0					Core sample		98	98	1no	98%	98%		Milky	
3.4	4.4	1.0					Core sample		99	99	1no	99%	99%		Milky	

SDR=Soft Disintigrated Rock cm/50= no.of blows sp=Small pieces vsp=Very Small Pieces

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FIELD BORE LOG CHART

Project: Residential Group Housing Project "Gulmohar Residency" at Mallapur

Date : 13-07-2019

BORE HOLE NO. 11

Ground Level: 25.337

Dia. Of Casing: 150mm/NX

Water Table:

Depth (m) From	Depth (m) To	Length of Run (m)	Description	Log of Bore	Sampling Depth (m)	Sampling Type	SPT No. blows for Penetration of (15-30-45)cm	SPT N Value	Details of Rock core >10cm core Pieces(cm)	Details of Rock core Total Length (cm)	Details of Rock core No. of Pieces	Details of Rock core % of core Recovery	RQD Value %	Avg. RQD %	Water colour	Rate of Drill Min/m
0.0	1.5	1.5	Silty Gravel		1.00 1.50	D/S SPT	9-9-10	19							Reddish	
1.5	3.0	1.5			2.50 3.00	D/S SPT	8-11-12	23							Reddish	
3.0	4.5	1.5			4.00 4.50	D/S SPT	11-13-16	29							Reddish	
4.5	5.4	0.9													Reddish	
5.4	6.4	1.0	Hard Rock				Core sample		12+20+24=56	99	3no+ts	99%	56%		Milky	
6.4	7.4	1.0					Core sample		56+44=100	100	2no only	100%	100%		Milky	
7.4	8.4	1.0					Core sample		48+52=100	100	2no only	100%	100%		Milky	

SDR=Soft Disintigrated Rock cm/50= no.of blows sp=Small pieces vsp=Very Small Pieces

ANNEXURE – 2: IS CODES

1. IS: 1892 – 1962: Code of Practice for Site Investigations for Foundations.
2. IS: 2131 – 1981: Method of Standard Penetration Test for Soils.
3. IS: 2132 – 1986: Code of Practice for thin walled tube sampling of Soils.
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