REPORT BY

SHREENATH SOIL & MATERIAL TESTING LABORATORY

SOIL INVESTIGATION OF SOIL IN CONNECTION WITH RAIL CONNECTIVITY TO OLD BEDI PORT IN DISTRICT JAMNAGAR, GUJARAT

Submitted to:

G-RIDE, GANDHINAGAR

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1. Introduction:

In order to understand the sizing of foundation, it was necessary to understand the soil at the project site. Hence, geotechnical investigation was planned for these works. For the same purpose, G-RIDE, GANDHINAGAR (Hereafter ”Client”) appointed Shreenath Soil and Material Testing Laboratory (Hereafter ”Consultant”) as their geotechnical investigation consultants.

2. Scope of Works:

The purpose of this study is to carry out the geotechnical investigation at the site, and to develop geotechnical recommendations for design and construction of foundations for the proposed project and associated facilities.

The scope of work at the project site compraised of the following:

- Mobilization of necessary equipment and personnel to carry out all the works and demobilization after completing the work.
- Drilling boreholes to specified depths, in order to evaluate the stratigraphy, and to collect soil and groundwater samples for laboratory testing.
- Conducting SPT in bore-hole at regular depth interval of 1.0 Mts and 3.0 Mts along with standard field and laboratory test
- Collecting disturbed/undisturbed soil sample from bore-hole at regular depth interval along with standard field and laboratory test.
- Transferring soil samlpes to the laboratory with utmost care.
- Performing various soil investigations testing in geotechnical laboratory as per various Indian code provisions (IS 2720 various parts).
- Analyzing all field and laboratory data to develop geotechnical recommendations for foundations.
- Preparation of soil investigation report with recommendations for foundation.

3. Field Investigation:

The Geotechnical investigation had been divided mainly in two parts (1) Field Investigaiton works and (2) Laboratory Investigation works.

Field investigation works are essential as it helps in collecting various disturbed and undisturbed samples through it. The collected samples are used for visual inspection and classification of soil samples. Moreover, the collected samples can be tested in laboratory to evaluate their various parameters used for classification and soil strength evaluation. In addition to this, the field investigation works include performing standard penetration test, which helps in evaluating ground conditions.

3.1 Borehole Drilling & Sampling:

Four boreholes of 150 mm diameter were drilled up to exploration depth of 6.00 m. The work was in general accordance with IS: 1892 – 1997.

3.1.1 Method of Sampling

Sampler is coupled together with a sampler head to form a sampling assembly. The sampler head provide a non-flexible connection between the sampling tube and the drill rods. Vent holes are provided in the sampler head to allow escape of water from the top of sampler tube during penetration. The sampling tubes are made free from dust and rust. Coating of oil is applied on both sides to obtain the undisturbed samples in best possible manner.

The sampler is then lowered inside the bore hole on a string of rods and driven to a pre- determined level. On completion of driving the sampler is first rotated within the borehole to shear the soil sample at bottom and then pulled out. Upon removal of the sampling tubes, the length of sample in the tube is recorded. The disturbed material in the upper end of the tube, if any, is completely removed before sealing.

The soil at the lower end of the tube is trimmed to a distance of about 10 to 20 mm. After cleaning and inserting an impervious disc at each end, both ends are sealed. The empty space in the sampler, if any, is filled with the moist soil, and the ends covered with tight wrapper. The identification mark is then made on each sample.

3.1.2 Disturbed Samples:

Disturbed representative samples were collected, logged, labeled and placed in polythene bags. The borehole was terminated when adequate depth of drilling was completed in consultation with the Site-in-charge as per technical specification. The tests were conducted in accordance with IS 2132-1981.

3.1.3 Undisturbed Samples:

Undisturbed soil samples are not collected in 100 mm diameter thin walled samplers (Shelby tube) due to sandy and rocky strata.

3.1.4 Standard Penetration Test:

Due to weathered rock from shallow depth SPT were not performed.

3.1.5 Ground water table:

Water table was found in borehole.

4. Laboratory test:

In order to understand various geotechnical parameters and to understand the physical properties of soil, varoius laboratory testing was performed on the samples collected from site. Following tests were performed as per relevent Indian standard Procedures.

(1) Grain size analysis (Sieve Analysis)
(2) Dry Density and Bulk Density
(3) Natural Moisture content.
(4) Specific Gravity.
(5) Porosity
(6) Direct Shear test.

5. Findings of Geotechnical Investigation:

The classification of subsoil strata met at site was done according to IS:1498 – 1970. The test results can be summarized as mentioned in annexure 2:

5.1 Borehole wise Summary:

BH-03 to BH-06 : Borehole- 03 to 06 was drilled upto maximum depth of exploration equal to 6.00m. The typical soil profile indicated Slightly weathered Basalt Rock upto depth of 6.00m. After that boring is terminated due to fractured basalt rock is come upto the depth of 6.00 m.

6. Effect of Seismicity on the soil observed at site

- The water table is found during exploration of soil.
- It is essential to note that the site falls in zone-IV as per IS 1893 with maximum risk. As water table is not encountered within top 2.0m, the site is not expected to liquify.
- Hence, Based on above information, the rise of liquefaction assesment shall not be considered while desiging foundation system.
- The present recommendations are based on consideration that liquefaction will not occur at site.

7. Discussion on selection of Foundation System

Considering the type of structure and Higher loading on the ground, open foundations are considered suitable for this site. Open foundation (Isolated / combined footings and raft foundations) are generally economical for such constructions. The allowable bearing pressure is calculated for a give fooring dimension for Shear criterion

Shear criterion ensures that soil doesn't result in any catastropic failure of the foundation. The details of these criterion in explaine in 7.1.

7.1 Shear failure

Shear failure being catastrophic, an adequate factor of safety is applied to ultimate bearing capacity that can initiate this type of failure. BIS recommends a value of FOS = 2.5 to obtain the net safe bearing capacity qns by using the physical characteristics of the foundation and relevant shear strength parameter of soil accordance with I.S. 6403-1981

Net Ultimate bearing capacity for general shear failure,

$$q_{nu} = C\, N_c\, S_c\, d_c + q\,(Nq-1)\, S_q\, d_q + \tfrac{1}{2}\, B.\, \gamma\, N_\gamma\, S_\gamma\, D_\gamma\, W'$$

Net Ultimate bearing capacity for local shear failure,

$$q_{nu} = 2/3\, C\, N'_c\, S'_c\, d'_c + q\,(N'q-1)\, S'_q\, d'_q + \tfrac{1}{2}\, B.\, \gamma\, N'_\gamma\, S'_\gamma\, D'_\gamma\, W'$$

Where,

c	=	Cohesion
q	=	Overburden Pressure
Y	=	Density
B	=	Width of the Footing
N_c, N_q, N_Y	=	Bearing capacity Factor
S_c, S_q, S_Y	=	Shape Factor
d_c, d_q, d_Y	=	Depth Factor

The calculations are shown in annexure 3.

8. GEOLOGY

Geology of Proposed Location at Chainage 2336.72 (BH-3(A1)), 2350.33 (BH-4(P2)), 2364.66 (BH-5(P5)) & 2379.42 (BH-6(A2)), Old Bedi Port in District Jamnagar, Gujarat.

- Generally at Jamnagar region, at top (up to 1 meter) accepting ground level Sandy Clay with no fine is followed.
- Deccan Traps of western and central India having more and more dense state of basalt is available, as the depth of borehole increases to gain of core recovery as well as RQD of samples. The area of interest is represented by western most extent of massive volcanic eruption of basaltic rock.

Table 1 Scale of Weathering Grades of Rock Mass

Terms (IS : 4464)	Description (IS : 4464)	Grade (IS : 4464)	Interpretation
Fresh	No visible sign of rock material weathering, perhaps slight discoloration on major discontinuity surfaces.	I	CR > 90 %
Slightly Weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering.	II	CR between 70% to 90%
Moderately Weathered	Less than half of the rock material is decomposed or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as core stones.	III	CR between 50% to 70%
Highly Weathered	More Than half of the rock material is decomposed or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as core stones.	IV	CR between 10% to 50%
Completely Weathered	All rock material is decomposed and / or disintegrated to soil. The original mass structure is still largely intact.	V	CR between Zero to 10%
Residual Soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.	VI	CR = Zero% But N > 50

'Interpretation' in above table has been done based on his understanding of above table & experience and is **NOT** a part of original table and observation of entire of rock mass instead of individual rock pieces.

Table 2 Relation between RQD and in-situ Rock Quality IS: 13365-part-1

RQD Classification	RQD%
Excellent	90-100
Good	75-90
Fair	50-75
Poor	25-50
Very Poor	00-25

9. TYPICAL CALCULATION OF S.B.C. OF SOIL AND ROCK

Typical S.B.C Based on Rock mass rating (RMR)-IS: 13365 (Part1)1998

- Highly weather to weather rocky strata from ground level observed during sub surface investigation using core drilling boring at Proposed Site, Jamnagar.
- In absence of Triaxial for rock, pressure meter and plate load test SBC is calculated based on Rock mass rating (RMR) in embedment rock.
- Considering disintegrated soft rocks obtain in crushed form depth of foundation is suggested for borehole location. Considering subsoil condition shallow foundation – footing foundation. SBC of this shallow foundation based on RMR is estimated and reported.

Typical calculation of BH-3, BH-4, BH-5 & BH-6 at 06 m from ground level based on RMR is shown in Table no.3.

Table 3 BH-3 3 m from ground level to 6 m. depth

Sr. No.	Description	Condition	Rating
1.	Strength or intact rock material	Average	5
2.	Rock Quality Designation	Fair	10
3.	Spacing of Discontinuities	Very Close	5
4.	Condition of Discontinuity	5mm wide Continues discontinuity	0
5.	Ground Water Condition	Flowing	0
6.	Oriented of discontinuity	Favorable	0
		RMR	20

Table 3 BH-4 3 m from ground level to 6 m. depth

Sr. No.	Description	Condition	Rating
1.	Strength or intact rock material	Average	5
2.	Rock Quality Designation	Fair	13
3.	Spacing of Discontinuities	Very Close	5
4.	Condition of Discontinuity	5mm wide Continues discontinuity	0
5.	Ground Water Condition	Flowing	0
6.	Oriented of discontinuity	Favorable	0
		RMR	23

Table 3 BH-5 3 m from ground level to 6 m. depth

Sr. No.	Description	Condition	Rating
1.	Strength or intact rock material	Average	4
2.	Rock Quality Designation	Fair	11
3.	Spacing of Discontinuities	Very Close	5
4.	Condition of Discontinuity	5mm wide Continues discontinuity	0
5.	Ground Water Condition	Flowing	0
6.	Oriented of discontinuity	Favorable	0
		RMR	19

Table 3 BH-6 3 m from ground level to 6 m. depth

Sr. No.	Description	Condition	Rating
1.	Strength or intact rock material	Average	4
2.	Rock Quality Designation	Fair	9
3.	Spacing of Discontinuities	Very Close	5
4.	Condition of Discontinuity	5mm wide Continues discontinuity	0
5.	Ground Water Condition	Flowing	0
6.	Oriented of discontinuity	Favorable	0
		RMR	18

10. Conclusion & Recommendation

On the basis of above geotechnical investigaion the following recommendations are suggested.

- The sub soil strata at this site is preliminary fractured rock.
- The present report covers the Geotechnical investigation carried out for One borehole location at site.
- Strata of sand clay should be removed.
- Fair Condition for foundation of the building should be available at the depth of 2 meter or more than 2 meters.
- Suitability of Soil for back filling: The second layer of soil (soft murram) is suitable for structural back filling.
- The above report is based on the strata encountered at a depth of investigation i.e., maximum up to 6 m for four bore holes.
- The above recommendations are based on the collected field data, laboratory tests results conducted on soil samples recovered from the test locations. However, if the actual subsoil condition during

execution vary from what has been represented in this report, the client/agency may be referred to us for suggestions.

- The typical soil profile indicated Slightly Weathered Basalt Rock observed at a depth of 3.0m to 6.0m.

Bore Hole No.	Type of Foundation	Foundation Depth (m)	Foundation Size (L x B) m	Recommended Safe Bearing Capacity (T/m^2)
BH 03	RCC Raft Footing	1.5	7 X 5	23.42
			7 X 6	26.43
			7 X 7	29.44
		2	7 X 5	26.22
			7 X 6	29.22
			7 X 7	30.57
		3	7 X 5	31.80
			7 X 6	34.81
			7 X 7	37.82
		4	7 X 5	37.39
			7 X 6	40.40
			7 X 7	43.41
BH 04	RCC Raft Footing	1.5	7 X 5	23.18
			7 X 6	26.16
			7 X 7	29.13
		2	7 X 5	25.95
			7 X 6	28.93
			7 X 7	31.90
		3	7 X 5	31.48
			7 X 6	34.64
			7 X 7	37.44
		4	7 X 5	37.02
			7 X 6	39.99
			7 X 7	42.97

Bore Hole No.	Type of Foundation	Foundation Depth (m)	Foundation Size (L x B) m	Recommended Safe Bearing Capacity (T/m^2)
BH 05	RCC Raft Footing	1.5	7 X 5	24.63
			7 X 6	27.80
			7 X 7	30.97
		2	7 X 5	27.55
			7 X 6	30.72
			7 X 7	33.90
		3	7 X 5	33.40
			7 X 6	36.57
			7 X 7	39.74
		4	7 X 5	39.24
			7 X 6	42.42
			7 X 7	45.59
BH 06	RCC Raft Footing	1.5	7 X 5	22.22
			7 X 6	25.06
			7 X 7	27.91
		2	7 X 5	24.88
			7 X 6	27.73
			7 X 7	30.57
		3	7 X 5	30.51
			7 X 6	33.05
			7 X 7	35.90
		4	7 X 5	35.53
			7 X 6	38.38
			7 X 7	41.22

Abbreviations

BH	=	Borehole
DS	=	Disturbed Sample
UDS	=	Undisturbed Sample
N	=	Observed SPT value
C_N	=	Correction factor
N_N	=	Corrected SPT values
γ	=	Bulk unit weight
γ'	=	Submerged unit weight
γ_d	=	Dry unit weight
γ_{sat}	=	Saturated unit weight
G	=	Specific gravity of soil
W_L	=	Liquid limit
W_P	=	Plastic limit
IP	=	Plasticity index
Q_u	=	Unconfined compressive strength
Cu	=	Undrained shear strength
C	=	Effective cohesional parameter
Ø	=	Effective angle of shearing resistance
$Ø_m$	=	Mobilized angle of shearing resistance
$N_ø$	=	Flow value $\tan^2 (45 + Ø / 2)$
GSF	=	General shear failure
LSF	=	Local shear failure
Cc	=	Compression index
B	=	Width of foundation
L	=	Length of foundation
D	=	Depth of foundation
q	=	Effective surcharge

N_γ, N_q, & N_c =		Bearing capacity factors
S_γ, S_q, & S_c	=	Shape factors
d_γ, d_q, & d_c	=	Depth factors
W'	=	W.T. correction factor
σ'_o	=	Original effective overburden pressure
e_o	=	Original void ratio
w	=	Water content
D_f	=	Depth factor
q_{nf}	=	Net ultimate bearing capacity
q_{ns}	=	Net safe bearing capacity against shear failure
qn	=	Net foundation loading intensity for a given settlement
q_a	=	Allowable bearing capacity
WT	=	Water table
S_t	=	Total settlement
S_a	=	Maximum allowable settlement
GW	=	Well graded gravels
GP	=	Poorly graded gravels

Referances

1.	IS : 1498 – 1970	Classification and Identification of soils for general engineering purpose
2.	IS : 1892 – 1979	Code of practice for sub surface investigation for foundations
3.	IS : 2131 – 1981	Method of Standard Penetration Tests for soils.
4.	IS : 2132 – 1986	Code of practice for thin walled tube sampling of soils
5.	IS 2720 – 1983 (Part – 1)	Methods of test for soils : Preparation of dry soil sample for various tests
6.	IS : 2720 – 1980 (Part – 2)	Method of test for soils : Determination of water content
7.	IS : 2720 – 1980 (Part – 3)	Method of test for soils : Determination of Specific Gravity Fine Grained Soils.
8.	IS : 2720 – 1980 (Part – 3)	Method of test for soils : Determination of Specific Gravity : Fine, Medium, Coarse Grained Soils
9.	IS : 2720 – 1985 (Part – 4)	Method of test for soils : Grain Size Analysis.
10.	IS : 2720 – 1985 (Part – 5)	Method of test for soils : Determination of liquid & plastic limit
11.	IS : 2720 – 1986 (Part – 15)	Method of test for soils : Determination of consolidation properties
12.	IS : 2809 – 1972	Method of test for soils : Glossary of terms & symbols relating to soil engineering.
13.	IS 2720 – 1983 (Part – 1)	Methods of test for soils : Preparation of dry soil sample for various tests
14.	IS 6403 – 1981	Code of practice for determination of bearing capacity of shallow foundations.
15.	IS 8009 – 1976 (Part – 1)	Code of practice for calculations of settlements of foundations : shallow foundations subject to symmetrical static vertical loads.
16.	IS 13365 – 1998 (Part – 1)	Quantitative Classification Systems Of Rock Mass — Guidelines
17.	IS 12070 – 1987	Code of practice for Design and constructlon of shallow Gr 4 Foundations on rocks
18.	IS 1904 – 1986	Code of practice for Design and construction of Foundations in soils : general Requirements
19.	IS 11315 – 1985 (Part – 11)	Method for the Quantitative Discriptions of Discontinueties in Rock Masses : Core Recovery and Rock Quality Designation

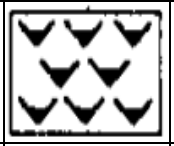
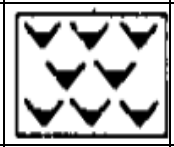
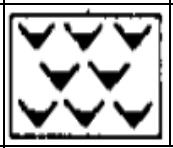
Annexure -1

Bore Log

SHREENATH SOIL & MATERIAL TESTING LABORATORY-RAJKOT
BORE LOG

Project: Rail Connectivity To Old Bedi Port In District Jamnagar
Client: G-Ride, Gandhinagar

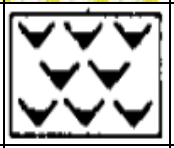
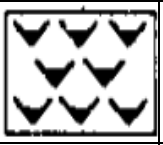
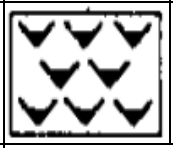
Borehole No.: 3 (A1) **Type**: Rotary **Boring Depth**: 6.00 m	**Date of Boring**: 15-02-2021 **Bore diameter**: 150 mm **River Bed Level:** 3.45m (RL)	**Core Barrel**: Single Tube **Location**: Chainage 2336.720, Old Bedi Port, Jamnagar

Sr. No.	Depth of bore log (m)	Legend	Soil/Rock description	% RQD	N Value
1	0.0 to 1.50 (RL 1.95 m)		Soil Overburden	-	41
2	1.50 to 2.00 (RL 1.45 m)		Soft Rock	-	54(3mt) 55(4.5 mt)
3	2.00 to 3.00 (RL 0.45 m)		Soft Rock	0 to 25	
4	3.00 to 4.00 (RL -0.55 m)		Hard Rock	25 to 50	
5	4.00 to 5.00 (RL -1.55 m)		Hard Rock		
6	5.00 to 6.00 (RL -2.55 m)		Hard Rock		
	Terminated Depth				

SHREENATH SOIL & MATERIAL TESTING LABORATORY-RAJKOT
BORE LOG

Project: Rail Connectivity To Old Bedi Port In District Jamnagar
Client: G-Ride, Gandhinagar

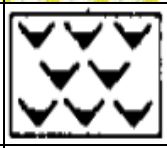
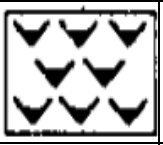
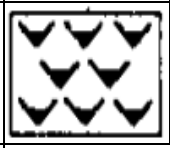
Borehole No.: 4(P2) **Type**: Rotary **Boring Depth**: 6.00 m	**Date of Boring**: 15-02-2021 **Bore diameter**: 150 mm **River Bed Level:** 3.45m (RL)	**Core Barrel**: Single Tube **Location**: Chainage 2350.33 , Old Bedi Port, Jamnagar

Sr. No.	Depth of bore log (m)	Legend	Soil/Rock description	% RQD	N Value
1	1.0 to 1.50 (RL 1.95 m)		Soil Overburden	-	39
2	1.50 to 2.00 (RL 1.45 m)		Soft Rock	-	55(3mt) 52(4.5 mt)
3	2.00 to 3.00 (RL 0.45 m)		Soft Rock	0 to 25	
4	3.00 to 4.00 (RL -0.55 m)		Hard Rock	25 to 50	
5	4.00 to 5.00 (RL -1.55 m)		Hard Rock		
6	5.00 to 6.00 (RL -2.55 m)		Hard Rock		
	Terminated Depth				

SHREENATH SOIL & MATERIAL TESTING LABORATORY-RAJKOT
BORE LOG

Project: Rail Connectivity To Old Bedi Port In District Jamnagar
Client: G-Ride, Gandhinagar

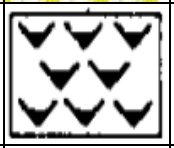
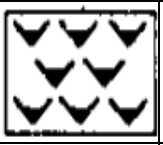
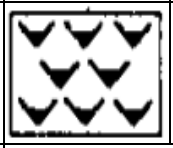
Borehole No.: 5(P5) **Type**: Rotary **Boring Depth**: 6.00 m	**Date of Boring**: 15-02-2021 **Bore diameter**: 150 mm **River Bed Level:** 3.45m (RL)	**Core Barrel**: Single Tube **Location**: Chainage 2364.66, Old Bedi Port, Jamnagar

Sr. No.	Depth of bore log (m)	Legend	Soil/Rock description	% RQD	N Value
1	2.0 to 1.50 (RL 1.95 m)		Soil Overburden	-	42
2	1.50 to 2.00 (RL 1.45 m)		Soft Rock	-	50(3mt) 56(4.5 mt)
3	2.00 to 3.00 (RL 0.45 m)		Soft Rock	0 to 25	
4	3.00 to 4.00 (RL -0.55 m)		Hard Rock	25 to 50	
5	4.00 to 5.00 (RL -1.55 m)		Hard Rock		
6	5.00 to 6.00 (RL -2.55 m)		Hard Rock		
	Terminated Depth				

SHREENATH SOIL & MATERIAL TESTING LABORATORY-RAJKOT
BORE LOG

Project: Rail Connectivity To Old Bedi Port In District Jamnagar
Client: G-Ride, Gandhinagar

Borehole No.: 6(A2) **Type**: Rotary **Boring Depth**: 6.00 m	**Date of Boring**: 15-02-2021 **Bore diameter**: 150 mm **River Bed Level:** 3.45m (RL)	**Core Barrel**: Single Tube **Location**: Chainage 2379.420, Old Bedi Port, Jamnagar

Sr. No.	Depth of bore log (m)	Legend	Soil/Rock description	% RQD	N Value
1	3.0 to 1.50 (RL 1.95 m)		Soil Overburden	-	40
2	1.50 to 2.00 (RL 1.45 m)		Soft Rock	-	51(3mt) 53(4.5 mt)
3	2.00 to 3.00 (RL 0.45 m)		Soft Rock	0 to 25	
4	3.00 to 4.00 (RL -0.55 m)		Hard Rock	25 to 50	
5	4.00 to 5.00 (RL -1.55 m)		Hard Rock		
6	5.00 to 6.00 (RL -2.55 m)		Hard Rock		
	Terminated Depth				

Annexure -2

Laboratory Test Report

Result Summary

SHREENATH SOIL & MATERIAL TESTING LABORATORY-RAJKOT			Bore hole No.	BH-03 (A1)
Project:	RAIL CONNECTIVITY TO OLD BEDI PORT IN DISTRICT JAMNAGAR		Location	Chainage 2336.720, Old Bedi Port in District Jamnagar
			Bore hole Depth	6.0 m
Client:	G-RIDE, GANDHINAGAR		Ground water Table	Found

Depth Below G.L (m)	Type of sample	Observed SPT-N Value	In situ bulk density (gm/cm³)	Dry unit Wt.(gm/cm³)	In situ water content (%)	Sieve Analysis						Atterberg Limit			I.S. Classification	Shear Parameter		Specific Gravity	Remarks
						Gravel (%)	Sand			Silt (%)	Clay (%)	Liquid limit (%)	Plastic limit (%)	Plasticity Index (%)		*C (kg/cm2)	*Φ (^{0})		
							Coarse (%)	Medium (%)	Fine (%)										
1	2	3	4	5	6	7	8	9	10	11		12	13	14	15	16	17	18	2
1.5	DS	-	2.10	1.94	-	75	20	05	-	-		-	-	-	-	0	29.5	2.62	
2.0	DS	-	2.18	2.15	1.41	-	-	-	-	-		-	-	-	-	0	29.5	2.65	
3.0	DS	-	2.16	2.08	1.30	-	-	-	-	-		-	-	-	-	0	29.5	2.67	
4.0	DS	-	1.93	1.85	0.05	-	-	-	-	-		-	-	-	-	0.38	29.5	2.61	
5.0		-	1.630	1.60	-	-	-	-	-	-		-	-	-	-	0	29.5		
6.0			1.644	1.62	1.18	-	-	-	-	-		-	-	-	-	0	29.5	2.71	

Result Summary

SHREENATH SOIL & MATERIAL TESTING LABORATORY-RAJKOT		Bore hole No.	BH-04 (P2)
Project:	RAIL CONNECTIVITY TO OLD BEDI PORT IN DISTRICT JAMNAGAR	Location	Chainage 2350.33, Old Bedi Port in District Jamnagar
		Bore hole Depth	6.0 m
Client:	G-RIDE, GANDHINAGAR	Ground water Table	Found

Depth Below G.L (m)	Type of sample	Observed SPT-N Value	In situ bulk density (gm/cm³)	Dry unit Wt.(gm/cm³)	In situ water content (%)	Sieve Analysis						Atterberg Limit			I.S. Classification	Shear Parameter		Specific Gravity	Remarks
						Gravel (%)	Sand			Silt (%)	Clay (%)	Liquid limit (%)	Plastic limit (%)	Plasticity Index (%)		*C (kg/cm2)	*Φ (°)		
							Coarse (%)	Medium (%)	Fine (%)										
1	2	3	4	5	6	7	8	9	10	11		12	13	14	15	16	17	18	2
1.5	DS	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	
2.0	DS	-	2.12	2.15	1.41	-	-	-	-	-		-	-	-	-	0	29.4	2.69	
3.0	DS	-	2.10	2.08	1.30	-	-	-	-	-		-	-	-	-	0	29.4	2.78	
4.0	DS	-	1.96	1.85	0.05	-	-	-	-	-		-	-	-	-	0.38	29.4	2.68	
5.0		-	1.75	1.60	-	-	-	-	-	-		-	-	-	-	0	29.4		
6.0			1.67	1.62	1.18	-	-	-	-	-		-	-	-	-	0	29.4	2.68	

SHREENATH SOIL & MATERIAL TESTING LABORATORY-RAJKOT			Bore hole No.	BH-05 (P5)
Project:	RAIL CONNECTIVITY TO OLD BEDI PORT IN DISTRICT JAMNAGAR		Location	Chainage 2364.66, Old Bedi Port in District Jamnagar
			Bore hole Depth	6.0 m
Client:	G-RIDE, GANDHINAGAR		Ground water Table	Found

Depth Below G.L (m)	Type of sample	Observed SPT-N Value	In situ bulk density (gm/cm³)	Dry unit Wt.(gm/cm³)	In situ water content (%)	Sieve Analysis						Atterberg Limit			I.S. Classification	Shear Parameter		Specific Gravity	Remarks
						Gravel (%)	Sand			Silt (%)	Clay (%)	Liquid limit (%)	Plastic limit (%)	Plasticity Index (%)		*C (kg/cm2)	*Φ (^{0})		
							Coarse (%)	Medium (%)	Fine (%)										
1	2	3	4	5	6	7	8	9	10	11		12	13	14	15	16	17	18	23
1.5	DS	-	1.57	1.50	-	-	-	-	-	-		-	-	-	-	-	-	-	
2.0	DS	-	1.56	1.51	1.41	-	-	-	-	-		-	-	-	-	0	30	2.69	
3.0	DS	-	1.46	1.43	1.30	-	-	-	-	-		-	-	-	-	0	30	2.78	
4.0	DS	-	1.45	1.37	0.05	-	-	-	-	-		-	-	-	-	0.38	30	2.68	
5.0		-	1.34	1.34	-	-	-	-	-	-		-	-	-	-	0	30		
6.0			1.33	1.33	1.18	-	-	-	-	-		-	-	-	-	0	30	2.68	

SHREENATH SOIL & MATERIAL TESTING LABORATORY-RAJKOT																			Bore hole No.	BH-06 (A2)
Project:	RAIL CONNECTIVITY TO OLD BEDI PORT IN DISTRICT JAMNAGAR																		Location	Chainage 2379.4200, Old Bedi Port in District Jamnagar
																			Bore hole Depth	6.0 m
Client:	G-RIDE, GANDHINAGAR																		Ground water Table	Found

Depth Below G.L (m)	Type of sample	Observed SPT-N Value	In situ bulk density (gm/cm³)	Dry unit Wt.(gm/cm³)	In situ water content (%)	Sieve Analysis						Atterberg Limit			I.S. Classification	Shear Parameter		Specific Gravity	Remarks
						Gravel (%)	Sand			Silt (%)	Clay (%)	Liquid limit (%)	Plastic limit (%)	Plasticity Index (%)		*C (kg/cm2)	*Φ (°)		
							Coarse (%)	Medium (%)	Fine (%)										
1	2	3	4	5	6	7	8	9	10	11		12	13	14	15	16	17	18	23
1.5	DS	-	1.58	1.56	-	-	-	-	-	-		-	-	-	-	-	-	-	
2.0	DS	-	1.59	1.56	1.41	-	-	-	-	-		-	-	-	-	0	30	2.69	
3.0	DS	-	1.38	1.35	1.30	-	-	-	-	-		-	-	-	-	0	30	2.78	
4.0	DS	-	1.37	1.33	0.05	-	-	-	-	-		-	-	-	-	0	30	2.68	
5.0		-	2.07	1.96	-	-	-	-	-	-		-	-	-	-	0	30	2.67	
6.0			2.130	2.10	1.18	-	-	-	-	-		-	-	-	-	0	30	2.68	

* Testing has performed on remoulded Samples

Annexure – 3

Silt Factor

Silt Factor

BH NO	Depth (m)	Size of Sieve	Weight Retained (gms)	Percentage Retained	Average size of Sieve	% Retained X avg Size of Sieve	Mean Dia/100	Silt Factor
03	1	2.36	56	5.60	-	-	0.778	1.473
		1.18	188	18.80	1.77	33.276		
		0.600	297	29.70	0.89	24.433		
		0.425	242	24.20	0.5125	12.4025		
		0.300	85	8.50	0.3625	3.0812		
		0.150	105	10.50	0.225	2.3625		
		0.075	23	2.30	0.1125	0.25875		
		Pan	4	0.40	-	-		
	2	2.36	50	5.00	-	-	0.763	1.537
		1.18	191	19.10	1.77	33.807		
		0.600	260	26.00	0.89	23.14		
		0.425	240	24.00	0.5125	12.3		
		0.300	116	11.60	0.3625	4.205		
		0.150	112	11.20	0.225	2.52		
		0.075	25	2.50	0.1125	0.28125		
		Pan	6	0.60	-	-		
	3	2.36	3.2	0.32	-	-	0.229	0.962
		1.18	11.4	1.14	1.77	2.0178		
		0.600	60	6.00	0.89	5.34		
		0.425	176.2	17.62	0.5125	9.03025		
		0.300	177.4	17.74	0.3625	6.43075		
		0.150	169.2	16.92	0.225	3.807		
		0.075	286.8	28.68	0.1125	3.2265		
		Pan	115.8	11.58	-	-		
	4	2.36	9.8	0.98	-	-	0.365	1.063
		1.18	27	2.70	1.77	4.77		
		0.600	66.3	6.63	0.89	5.90		
		0.425	221	22.10	0.51	11.32		
		0.300	198.4	19.84	0.36	7.19		
		0.150	180.6	18.06	0.225	4.06		
		0.075	290.9	29.09	0.112	3.27		
		Pan	6	0.60	-	-		

Silt Factor

BH NO	Depth (m)	Size of Sieve	Weight Retained (gms)	Percentage Retained	Average size of Sieve	% Retained X avg Size of Sieve	Mean Dia/100	Silt Factor
04	1	2.36	66	6.60	-	-	0.776	1.550
		1.18	195	19.50	1.77	34.515		
		0.600	290	29.00	0.89	25.81		
		0.425	230	23.00	0.5125	11.7875		
		0.300	68	6.80	0.3625	2.465		
		0.150	125	12.50	0.225	2.8125		
		0.075	18	1.80	0.1125	0.2025		
		Pan	8	0.80	-	-		
	2	2.36	59	5.90	-	-	0.790	1.564
		1.18	202	20.20	1.77	35.754		
		0.600	289	28.90	0.89	25.721		
		0.425	232	23.20	0.5125	11.89		
		0.300	85	8.50	0.3625	3.08125		
		0.150	100	10	0.225	2.25		
		0.075	30	3.0	0.1125	0.3375		
		Pan	3	3	-	-		
	3	2.36	70	7.00	-	-	0.773	1.547
		1.18	200	20.00	1.77	35.4		
		0.600	272	27.20	0.89	24.208		
		0.425	195	19.50	0.5125	9.99375		
		0.300	150	15.00	0.3625	5.4375		
		0.150	88	8.80	0.225	1.98		
		0.075	23	2.30	0.1125	0.25875		
		Pan	2	0.20	-	-		
	4	2.36	9.8	0.98	-	-	0.365	1.063
		1.18	27	2.70	1.77	4.77		
		0.600	66.3	6.63	0.89	5.90		
		0.425	221	22.10	0.51	11.32		
		0.300	198.4	19.84	0.36	7.19		
		0.150	180.6	18.06	0.22	4.06		
		0.075	290.9	29.09	0.11	3.27		
		Pan	6	0.60	-	-		

Silt Factor

BH NO	Depth (m)	Size of Sieve	Weight Retained (gms)	Percentage Retained	Average size of Sieve	% Retained X avg Size of Sieve	Mean Dia/100	Silt Factor
05	1	2.36	6.74	0.67	-	-	0.351	1.043
		1.18	18	1.80	1.77	3.186		
		0.600	52	5.20	0.89	4.628		
		0.425	230	23.00	0.51	11.787		
		0.300	230	23.00	0.36	8.337		
		0.150	171.88	17.19	0.22	3.867		
		0.075	289	28.90	0.11	3.251		
		Pan	2.38	0.24	-	-		
	2	2.36	10.2	1.02	-	-	0.352	1.044
		1.18	21	2.10	1.77	3.17		
		0.600	61.5	6.15	1.77	5.47		
		0.425	220	22.00	0.89	11.27		
		0.300	200	20.00	0.51	7.25		
		0.150	186.3	18.63	0.36	4.19		
		0.075	294	29.40	0.22	3.30		
		Pan	7	0.70	0.11	-		
	3	2.36	3.2	0.32	-	-	0.229	0.962
		1.18	11.4	1.14	1.77	2.0178		
		0.600	60	6.00	0.89	5.34		
		0.425	176.2	17.62	0.5125	9.03025		
		0.300	177.4	17.74	0.3625	6.43075		
		0.150	169.2	16.92	0.225	3.807		
		0.075	286.8	28.68	0.1125	3.2265		
		Pan	115.8	11.58	-	-		
	4	2.36	2.36	50	5.00	-	- 33.807 23.14 12.3 4.205 2.52 0.28125 -	0.763
		1.18	1.18	191	19.10	1.77		
		0.600	0.600	260	26.00	0.89		
		0.425	0.425	240	24.00	0.5125		
		0.300	0.300	116	11.60	0.3625		
		0.150	0.150	112	11.20	0.225		
		0.075	0.075	25	2.50	0.1125		
		Pan	Pan	6	0.60	-		

Silt Factor

BH NO	Depth (m)	Size of Sieve	Weight Retained (gms)	Percentage Retained	Average size of Sieve	% Retained X avg Size of Sieve	Mean Dia/100	Silt Factor
06	1	2.36	2.36	9.8	0.98	-	-	0.365
		1.18	1.18	27	2.70	1.77	4.77	
		0.600	0.600	66.3	6.63	0.89	5.90	
		0.425	0.425	221	22.10	0.51	11.32	
		0.300	0.300	198.4	19.84	0.36	7.19	
		0.150	0.150	180.6	18.06	0.225	4.06	
		0.075	0.075	290.9	29.09	0.112	3.27	
		Pan	Pan	6	0.60	-	-	
	2	2.36	78	7.80	-	-	0.728	1.502
		1.18	170	17.00	1.77	30.09		
		0.600	255	25.50	0.89	22.695		
		0.425	280	28.00	0.5125	14.35		
		0.300	70	7.00	0.362	2.537		
		0.150	135	13.50	0.225	3.03		
		0.075	10	1.00	0.112	0.112		
		Pan	2	0.20	-	-		
	3	2.36	80	8.00	-	-	0.714	1.487
		1.18	160	16.00	1.77	28.32		
		0.600	257	25.70	0.89	22.87		
		0.425	284	28.40	0.51	14.55		
		0.300	67	6.70	0.36	2.42		
		0.150	136	13.60	0.22	3.06		
		0.075	12	1.20	0.11	0.135		
		Pan	4	0.40	-	-		
	4	2.36	70	7.00	-	-	0.773	1.547
		1.18	200	20.00	1.77	35.4		
		0.600	272	27.20	0.89	24.208		
		0.425	195	19.50	0.5125	9.99375		
		0.300	150	15.00	0.3625	5.4375		
		0.150	88	8.80	0.225	1.98		
		0.075	23	2.30	0.1125	0.25875		
		Pan	2	0.20	-	-		

Annexure – 4

Soil Bearing Capacity Sample Calculation

Typical calculation for SBC of Soil as per IS CODE 6403

- $Q_{nu} = C\ N_cS_c\ d_ci_c + q(N_q\text{-}1)\ S_qd_qi_q + 0.5\ B\ \gamma N_\gamma S_\gamma d_\gamma i_\gamma\ RW'$
- For computing bearing capacity at 2 m depth below GL following in BH-3, Foundation parameters are considered 7 X 7 Square footing:

Considering General Shear Failure. Calculations: as per IS: 6403-1981

N_c = 24.49	S_c = 1.3	d_c = 1.0	i_c = 1	D_f = 02	γ = 1.77
N_q = 13.76	S_q = 1.2	d_q =1.0	i_q = 1	C' = 0.25	RW' = 01
N_γ = 15.49	S_γ = 0.8	d_γ = 1.0	i_γ = 1	Φ' = 29.5	q = 1.386

$Q_{nu} =$ $C\ N_cS_c\ d_ci_c + q(N_q\text{-}1)\ S_qd_qi_q + 0.5\ B\ \gamma N_\gamma S_\gamma d_\gamma i_\gamma\ RW'$

$Q_{nu} =$ 76.43

$Q_{nsafe} =$ 30.57 T/m^2

Final SBC = 30.57 T/m^2

Considering Factor of Safety 2.5 as per IS 1904- 1986

- For computing bearing capacity at 2 m depth below GL following in BH-3, Foundation parameters are considered 7 X 7 Square footing:

Considering Local Shear Failure. Calculations: as per IS: 6403-1981

N_c = 15.27	S_c = 1.3	d_c = 1.0	i_c = 1	D_f = 02	γ = 1.886
N_q = 6.72	S_q = 1.2	d_q =1.0	i_q = 1	C' = 0.25	RW' = 01
N_γ = 5.80	S_γ = 0.8	d_γ = 1.0	i_γ = 1	Φ' =29.5	q = 1.4

$Q_{nu} =$ $C\ N_cS_c\ d_ci_c + q(N_q\text{-}1)\ S_qd_qi_q + 0.5\ B\ \gamma N_\gamma S_\gamma d_\gamma i_\gamma\ RW'$

$Q_{nu} =$ 13.67 T/m^2

$Q_{nsafe} =$ 5.47 T/m^2

Final SBC = 5.47 T/m^2

Considering Factor of Safety 2.5 as per IS 1904- 1986

Typical calculation for SBC of Soil as per IS CODE 6403

- $Q_{nu} = C\ N_cS_c\ d_ci_c + q(N_q\text{-}1)\ S_qd_qi_q + 0.5\ B\ \gamma N_\gamma S_\gamma d_\gamma i_\gamma\ RW'$
- For computing bearing capacity at 2 m depth below GL following in BH-3, Foundation parameters are considered 7 X 5 Rectangle footing:

Considering General Shear Failure. Calculations: as per IS: 6403-1981

N_c = 29.20	S_c = 1.3	d_c = 1.0	i_c = 1	D_f = 11	γ = 1.77
N_q = 17.63	S_q = 1.2	d_q =1.0	i_q = 1	C' = 0.25	RW' = 01
N_γ = 21.25	S_γ = 0.8	d_γ = 1.0	i_γ = 1	Φ' = 29.5	q = 1.4

Q_{nu} = $C\ N_cS_c\ d_ci_c + q(N_q\text{-}1)\ S_qd_qi_q + 0.5\ B\ \gamma N_\gamma S_\gamma d_\gamma i_\gamma\ RW'$

Q_{nu} = 65.54

Q_{nsafe} = 26.22 T/m^2

Final SBC = 26.22 T/m^2

Considering Factor of Safety 2.5 as per IS 1904- 1986

- For computing bearing capacity at 2 m depth below GL following in BH-3, Foundation parameters are considered 7 X 5 Rectangle footing:

Considering Local Shear Failure. Calculations: as per IS: 6403-1981

N_c = 15.73	S_c = 1.3	d_c = 1.0	i_c = 1	D_f = 2	γ = 1.866
N_q = 7.05	S_q = 1.2	d_q =1.0	i_q = 1	C' = 0.25	RW' = 01
N_γ = 6.22	S_γ = 0.8	d_γ = 1.0	i_γ = 1	Φ' =29.5	q = 1.4

Q_{nu} = $C\ N_cS_c\ d_ci_c + q(N_q\text{-}1)\ S_qd_qi_q + 0.5\ B\ \gamma N_\gamma S_\gamma d_\gamma i_\gamma\ RW'$

Q_{nu} = 14.52 T/m^2

Q_{nsafe} = 5.81 T/m^2

Final SBC = 5.81 T/m^2

Considering Factor of Safety 2.5 as per IS 1904- 1986

Typical calculation for SBC of Soil as per IS CODE 6403

- $Q_{nu} = C\ N_cS_c\ d_ci_c + q(N_q\text{-}1)\ S_qd_qi_q + 0.5\ B\ \gamma N_\gamma S_\gamma d_\gamma i_\gamma\ RW'$
- For computing bearing capacity at 2 m depth below GL following in BH-4, Foundation parameters are considered 7 X 5 Rectangle footing:

Considering General Shear Failure. Calculations: as per IS: 6403-1981

N_c = 29.01	S_c = 1.3	d_c = 1.0	i_c = 1	D_f = 2	γ = 1.77
N_q = 17.47	S_q = 1.2	d_q =1.0	i_q = 1	C' = 0.25	RW' = 01
N_γ = 21.02	S_γ = 0.8	d_γ = 1.0	i_γ = 1	Φ' = 29.4	q = 1.4

Q_{nu} = $C\ N_cS_c\ d_ci_c + q(N_q\text{-}1)\ S_qd_qi_q + 0.5\ B\ \gamma N_\gamma S_\gamma d_\gamma i_\gamma\ RW'$

Q_{nu} = 62.20

Q_{nsafe} = 64.87 T/m^2

Final SBC = 25.95 T/m^2

Considering Factor of Safety 2.5 as per IS 1904- 1986

- For computing bearing capacity at 2 m depth below GL following in BH-4, Foundation parameters are considered 7 X 5 Rectangle footing:

Considering Local Shear Failure. Calculations: as per IS: 6403-1981

N_c = 15.63	S_c = 1.3	d_c = 1.0	i_c = 1	D_f = 2	γ = 1.866
N_q = 6.98	S_q = 1.2	d_q =1.0	i_q = 1	C' = 0.25	RW' = 01
N_γ = 6.14	S_γ = 0.8	d_γ = 1.0	i_γ = 1	Φ' =29.4	q = 1.4

Q_{nu} = $C\ N_cS_c\ d_ci_c + q(N_q\text{-}1)\ S_qd_qi_q + 0.5\ B\ \gamma N_\gamma S_\gamma d_\gamma i_\gamma\ RW'$

Q_{nu} = 14.35 T/m^2

Q_{nsafe} = 5.74 T/m^2

Final SBC = 5.74 T/m^2

Considering Factor of Safety 2.5 as per IS 1904- 1986

Typical calculation for SBC of Soil as per IS CODE 6403

- $Q_{nu} = C\ N_cS_c\ d_ci_c + q(N_q\text{-}1)\ S_qd_qi_q + 0.5\ B\ \gamma N_\gamma S_\gamma d_\gamma i_\gamma\ RW'$
- For computing bearing capacity at 2 m depth below GL following in BH-4, Foundation parameters are considered 7 X 7 Square footing:

Considering General Shear Failure. Calculations: as per IS: 6403-1981

N_c = 29.01	S_c = 1.3	d_c = 1.0	i_c = 1	D_f = 02	γ = 1.77
N_q = 17.47	S_q = 1.2	d_q =1.0	i_q = 1	C' = 0.25	RW' = 01
N_γ = 21.02	S_γ = 0.8	d_γ = 1.0	i_γ = 1	Φ' = 29.4	q = 1.4

$Q_{nu} =$ $C\ N_cS_c\ d_ci_c + q(N_q\text{-}1)\ S_qd_qi_q + 0.5\ B\ \gamma N_\gamma S_\gamma d_\gamma i_\gamma\ RW'$

$Q_{nu} =$ 79.75

$Q_{nsafe} =$ 31.90 T/m^2

Final SBC = 31.90 T/m^2

Considering Factor of Safety 2.5 as per IS 1904- 1986

- For computing bearing capacity at 2 m depth below GL following in BH-4, Foundation parameters are considered 7 X 7 Square footing:

Considering Local Shear Failure. Calculations: as per IS: 6403-1981

N_c = 15.63	S_c = 1.3	d_c = 1.0	i_c = 1	D_f = 02	γ = 1.886
N_q = 6.98	S_q = 1.2	d_q =1.0	i_q = 1	C' = 0.25	RW' = 01
N_γ = 6.14	S_γ = 0.8	d_γ = 1.0	i_γ = 1	Φ' =29.4	q = 1.4

$Q_{nu} =$ $C\ N_cS_c\ d_ci_c + q(N_q\text{-}1)\ S_qd_qi_q + 0.5\ B\ \gamma N_\gamma S_\gamma d_\gamma i_\gamma\ RW'$

$Q_{nu} =$ 16.07 T/m^2

$Q_{nsafe} =$ 6.43 T/m^2

Final SBC = 6.43 T/m^2

Considering Factor of Safety 2.5 as per IS 1904- 1986

Typical calculation for SBC of Soil as per IS CODE 6403

- $Q_{nu} = C\ N_cS_c\ d_ci_c + q(N_q\text{-}1)\ S_qd_qi_q + 0.5\ B\ \gamma N_\gamma S_\gamma d_\gamma i_\gamma\ RW'$
- For computing bearing capacity at 2 m depth below GL following in BH-5, Foundation parameters are considered 7 X 5 Rectangle footing:

Considering General Shear Failure. Calculations: as per IS: 6403-1981

N_c = 30.14	S_c = 1.3	d_c = 1.0	i_c = 1	D_f = 02	γ = 1.77
N_q = 18.40	S_q = 1.2	d_q =1.0	i_q = 1	C' = 0.25	RW' = 01
N_γ = 22.40	S_γ = 0.8	d_γ = 1.0	i_γ = 1	Φ' = 30	q = 1.4

Q_{nu} = $C\ N_cS_c\ d_ci_c + q(N_q\text{-}1)\ S_qd_qi_q + 0.5\ B\ \gamma N_\gamma S_\gamma d_\gamma i_\gamma\ RW'$

Q_{nu} = 68.88

Q_{nsafe} = 27.55 T/m^2

Final SBC = 27.55 T/m^2

Considering Factor of Safety 2.5 as per IS 1904- 1986

- For computing bearing capacity at 2 m depth below GL following in BH-5, Foundation parameters are considered 7 X 5 Rectangle footing:

Considering Local Shear Failure. Calculations: as per IS: 6403-1981

N_c = 16.18	S_c = 1.3	d_c = 1.0	i_c = 1	D_f = 2	γ = 1.866
N_q = 7.38	S_q = 1.2	d_q =1.0	i_q = 1	C' = 0.25	RW' = 01
N_γ = 6.65	S_γ = 0.8	d_γ = 1.0	i_γ = 1	Φ' =30	q = 1.36

Q_{nu} = $C\ N_cS_c\ d_ci_c + q(N_q\text{-}1)\ S_qd_qi_q + 0.5\ B\ \gamma N_\gamma S_\gamma d_\gamma i_\gamma\ RW'$

Q_{nu} = 15.37 T/m^2

Q_{nsafe} = 6.15 T/m^2

Final SBC = 6.15 T/m^2

Considering Factor of Safety 2.5 as per IS 1904- 1986

Typical calculation for SBC of Soil as per IS CODE 6403

- $Q_{nu} = C\ N_cS_c\ d_ci_c + q(N_q\text{-}1)\ S_qd_qi_q + 0.5\ B\ \gamma N_\gamma S_\gamma d_\gamma i_\gamma\ RW'$
- For computing bearing capacity at 2 m depth below GL following in BH-5, Foundation parameters are considered 7 X 7 Square footing:

Considering General Shear Failure. Calculations: as per IS: 6403-1981

N_c = 30.14	S_c = 1.3	d_c = 1.0	i_c = 1	D_f = 02	γ = 1.77
N_q = 18.40	S_q = 1.2	d_q =1.0	i_q = 1	C' = 0.25	RW' = 01
N_γ = 22.40	S_γ = 0.8	d_γ = 1.0	i_γ = 1	Φ' = 30	q = 1.4

Q_{nu} = $C\ N_cS_c\ d_ci_c + q(N_q\text{-}1)\ S_qd_qi_q + 0.5\ B\ \gamma N_\gamma S_\gamma d_\gamma i_\gamma\ RW'$

Q_{nu} = 84.74

Q_{nsafe} = 33.90 T/m^2

Final SBC = 33.90 T/m^2

Considering Factor of Safety 2.5 as per IS 1904- 1986

- For computing bearing capacity at 2 m depth below GL following in BH-5, Foundation parameters are considered 7 X 7 Square footing:

Considering Local Shear Failure. Calculations: as per IS: 6403-1981

N_c = 16.18	S_c = 1.3	d_c = 1.0	i_c = 1	D_f = 2	γ = 1.866
N_q = 7.38	S_q = 1.2	d_q =1.0	i_q = 1	C' = 0.25	RW' = 01
N_γ = 6.65	S_γ = 0.8	d_γ = 1.0	i_γ = 1	Φ' =30	q = 1.36

Q_{nu} = $C\ N_cS_c\ d_ci_c + q(N_q\text{-}1)\ S_qd_qi_q + 0.5\ B\ \gamma N_\gamma S_\gamma d_\gamma i_\gamma\ RW'$

Q_{nu} = 17.23 T/m^2

Q_{nsafe} = 6.89 T/m^2

Final SBC = 6.89 T/m^2

Considering Factor of Safety 2.5 as per IS 1904- 1986

Typical calculation for SBC of Soil as per IS CODE 6403

- $Q_{nu} = C\ N_cS_c\ d_ci_c + q(N_q\text{-}1)\ S_qd_qi_q + 0.5\ B\ \gamma N_\gamma S_\gamma d_\gamma i_\gamma\ RW'$
- For computing bearing capacity at 2 m depth below GL following in BH-6, Foundation parameters are considered 7 X 5 Rectangle footing:

Considering General Shear Failure. Calculations: as per IS: 6403-1981

N_c = 28.26	S_c = 1.3	d_c = 1.0	i_c = 1	D_f = 11	γ = 1.77
N_q = 16.85	S_q = 1.2	d_q =1.0	i_q = 1	C' = 0.25	RW' = 01
N_γ = 20.10	S_γ = 0.8	d_γ = 1.0	i_γ = 1	Φ' = 29	q = 1.4

$Q_{nu} =$ $C\ N_cS_c\ d_ci_c + q(N_q\text{-}1)\ S_qd_qi_q + 0.5\ B\ \gamma N_\gamma S_\gamma d_\gamma i_\gamma\ RW'$

$Q_{nu} =$ 62.20

Q_{nsafe} = 24.88 T/m^2

Final SBC = 24.88 T/m^2

Considering Factor of Safety 2.5 as per IS 1904- 1986

- For computing bearing capacity at 2 m depth below GL following in BH-6, Foundation parameters are considered 7 X 5 Rectangle footing:

Considering Local Shear Failure. Calculations: as per IS: 6403-1981

N_c = 15.27	S_c = 1.3	d_c = 1.0	i_c = 1	D_f = 2	γ = 1.866
N_q = 6.72	S_q = 1.2	d_q =1.0	i_q = 1	C' = 0.25	RW' = 01
N_γ = 5.80	S_γ = 0.8	d_γ = 1.0	i_γ = 1	Φ' =29	q = 1.36

$Q_{nu} =$ $C\ N_cS_c\ d_ci_c + q(N_q\text{-}1)\ S_qd_qi_q + 0.5\ B\ \gamma N_\gamma S_\gamma d_\gamma i_\gamma\ RW'$

$Q_{nu} =$ 13.67 T/m^2

Q_{nsafe} = 5.47 T/m^2

Final SBC = 5.47 T/m^2

Considering Factor of Safety 2.5 as per IS 1904- 1986

Typical calculation for SBC of Soil as per IS CODE 6403

- $Q_{nu} = C\ N_cS_c\ d_ci_c + q(N_q\text{-}1)\ S_qd_qi_q + 0.5\ B\ \gamma N_\gamma S_\gamma d_\gamma i_\gamma\ RW'$
- For computing bearing capacity at 2 m depth below GL following in BH-6, Foundation parameters are considered 7 X 7 Square footing:

Considering General Shear Failure. Calculations: as per IS: 6403-1981

N_c = 28.26	S_c = 1.3	d_c = 1.0	i_c = 1	D_f = 11	γ = 1.77
N_q = 16.85	S_q = 1.2	d_q =1.0	i_q = 1	C' = 0.25	RW' = 01
N_γ = 20.10	S_γ = 0.8	d_γ = 1.0	i_γ = 1	Φ' = 29	q = 1.4

Q_{nu} = $C\ N_cS_c\ d_ci_c + q(N_q\text{-}1)\ S_qd_qi_q + 0.5\ B\ \gamma N_\gamma S_\gamma d_\gamma i_\gamma\ RW'$

Q_{nu} = 76.43

Q_{nsafe} = 30.57 T/m^2

Final SBC = 30.57 T/m^2

Considering Factor of Safety 2.5 as per IS 1904- 1986

- For computing bearing capacity at 2 m depth below GL following in BH-6, Foundation parameters are considered 7 X 7 Square footing:

Considering Local Shear Failure. Calculations: as per IS: 6403-1981

N_c = 15.27	S_c = 1.3	d_c = 1.0	i_c = 1	D_f = 2	γ = 1.866
N_q = 6.72	S_q = 1.2	d_q =1.0	i_q = 1	C' = 0.25	RW' = 01
N_γ = 5.80	S_γ = 0.8	d_γ = 1.0	i_γ = 1	Φ' =29	q = 1.36

Q_{nu} = $C\ N_cS_c\ d_ci_c + q(N_q\text{-}1)\ S_qd_qi_q + 0.5\ B\ \gamma N_\gamma S_\gamma d_\gamma i_\gamma\ RW'$

Q_{nu} = 16.26

Q_{nsafe} = 15.29 T/m^2

Final SBC = 6.12 T/m^2

Considering Factor of Safety 2.5 as per IS 1904- 1986