PN – 230911

REPORT ON

GEOTECHNICAL INVESTIGATIONS

FOR THE PROPOSED

G+4, Boys' and Girls' Hostel, Educational Building and Principal-cum-Staff Quarter

at

Vaishali,

DIET Dighi Hajipur, Vaishali

Your Letter No.- BSEIDC/Tech/1960/2018-7138 Patna, Dated – 02.09.2023

Submitted to

The Chief Engineer

BSEIDC, Patna

September, 2023

BIHAR FOUNDATION CONSULTANTS

[A unit of Baidyanath Foundation Consultants Pvt. Ltd.]

Having an

NABL Accredited / ISO 9001: 2015 Certified Laboratory

Ganga Darshan Apartment, Flat No. 403.

West of Sadaquat Ashram, Patna – 10

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G+4, Boys' and Girls' Hostel, Educational Building and Principal-cum-Staff Quarter at Vaishali, Diet Dighi Hajipur, Vaishali

Bihar Foundation Consultants,
Ganga Darshan Apartment, Patna -10.
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PN -230911

CONTENTS

Appendix

[Containing Figures and Tables]

INTRODUCTION

The subsoil investigations reported herein were taken up (vide W.O. No. BSEIDC/Tech/1960/2018-7138 Patna, Dated – 02.09.2023 to find out the nature of subsoil at the site of the proposed construction and to recommend the capacity and type of its foundation. After certain tests on the soil, as detailed below, the desired recommendations have been made on **page 3-4** of this Report.

2. FIELD WORK

The fieldwork consisted of sinking bore holes, collecting soil samples and conducting the necessary field tests.

2.1. Boring

Taking guidance from IS: 1892, 150 mm diameter bore holes were sunk at locations shown in the bore hole location map.

2.2 Sampling

2.2.1 Undisturbed Soil Samples

Open drive samplers of 100-mm diameter and about 450-mm length were used for obtaining undisturbed samples of cohesive soils. The collection, sealing, labeling and transportation of the samples to the laboratory were done as per the IS guide-lines.

2.2.2 Disturbed Soil Samples

Disturbed soil samples were collected at suitable intervals of depth (not more than 2.5 m) and at all depths of change in the nature of the subsoil. These samples were sealed in polythene bags with proper identification labels.

2.3 Field Tests

2.3.1 Standard Penetration Tests (SPT)

These tests were conducted as per IS: 2131 – 1963. The depth interval between two consecutive tests was 1 to 1.5 m. The tests were located in between the levels at which undisturbed soil samples were collected.

3. LABORATORY TESTS

Some or all of the following laboratory tests, as necessary, were done on the collected soil samples. Representative soil samples were selected for this from the different soil strata encountered during boring. The tests were performed as per the relevant Indian Standard Codes of Practice.

(a) Natural moisture content

(b) Bulk density

(c) Grain size analysis (using sieves and / or hydrometer)

(d) Specific gravity of soil solids

(e) Atterberg's limit tests (liquid, plastic and shrinkage limits)

(f) Shear Tests :

- [I] Triaxial compression test (unconsolidated – undrained), generally for fine- grained soils
- [II] Unconfined compression tests, only on cohesive soils
- [III] Direct shear tests, generally for coarse-grained soils

(g) Other tests as and when required.

4. PRESENTATION OF TEST RESULTS

The field and laboratory test results are given in the **Appendix B.**

5. SOIL STRATIFICATION

The results of field tests in three bore holes sunk at the site [vide Location Sketch in App. A] and the results of laboratory tests conducted on the collected soil samples indicate that the soil stratification at the site is as describe below.

The subsoil in all 3 BH's is silty sand / sand [type SM-SP/SP] in layers of different thicknesses and variable sequences up to the investigated depth of 10.5 m bgl.

Ground water table was struck at about 1.30 m to 1.50 m depth below GL in September, 2023. It is subject to seasonal variations.

6. FOUNDATION ANALYSIS

The safe capacity of foundation of any type and size may be determined on the basis of the soil data given in this Report by using the standard methods of foundation design and following the relevant Indian Standard Codes.

7. RECOMMENDATIONS

The design of the foundation for the proposed structure depends on the nature of both [a] the subsoil and [b] the structure.

The subsoil in all 3 BH's is silty sand / sand [type SM-SP/SP] in layers of different thicknesses and variable sequences up to the investigated depth of 10.5 m bgl.

Ground water table was struck at about 1.30 m to 1.50 m depth below GL in September, 2023. It is subject to seasonal variations.

Hence,

1. The proposed structure may be provided with shallow foundation at a depth of 1.5 m or more.
2. The subsoil is silty sand. Hence placement of u/r piles is not desirable. Plane piles of lengths 4.0 m to 10.0 m with shaft diameters 0.30 m, 0.40 m, 0.50 m and 0.60 m may be adopted, using casing pipes wherever needed.

By way of example, the values of safe capacities of

[1] Shallow foundations and [2] Plane piles of the above mentioned sizes and depths have been calculated (vide Samples of Calculations in Appendix F) and the safe capacities are given below in Tables 1 and 2 respectively.

Table 1: Allowable Net Bearing Pressures [q_{na}] and Settlements Expected [s]

Depth (m) below Ground Level	Width (m)	Net allowable bearing pressure (t/m²)			Maximum expected settlement (mm)
		Strip footing	Square footing	Raft footing	
1.5	2	7.1	7.1	…	50
	3	5.6	5.6	…	50
	10	…	…	8.0	75
2.0	2	9.3	9.3	…	50
	3	7.1	7.1	…	50
	10	…	…	8.4	75
2.5	2	10.4	10.4	…	50
	3	8.7	8.7	…	50
	10	…	…	8.7	75
3.0	2	11.6	11.6	…	50
	3	10.6	10.6	…	50
	10	…	…	9.1	75
3.5	2	12.7	12.7	…	50
	3	11.6	11.6	…	50
	10	…	…	12.2	75
4.0	2	13.9	13.9	…	50
	3	12.7	12.7	…	50
	10	…	…	12.7	75
4.5	2	15.0	15.0	…	50
	3	13.8	13.8	…	50
	10	…	…	13.1	75

Table 2. Safe Capacities of Plane Piles
[Factor of safety = 3 in skin friction and bearing]

Pile length [m]	Safe Capacities [tonnes] For Plane Piles of diameters (m) *(SUBJECT TO CHECKING FOR SLENDERNESS RATIO**)*			
	0.30 m	**0.40 m**	**0.50 m**	**0.60 m**
4.0	2.6	4.0	5.7	7.7
6.0	5.0	8.0	11.1	14.7
8.0	7.1	12.1	18.2	23.7
10.0	9.3	15.9	24.1	33.9

**For a preliminary checking of the slenderness ratio, the modulus of subgrade reaction (k)
(a) <u>for cohesive soils</u> may be estimated from the following empirical relation given in IS: 2950-1981 (Second Revision) Table 1.: $k\ (kN/m^3) = 240\ c$, where $c\ (kN/m^2)$ is the value of cohesion of the soil at the concerned depth.
(b) <u>for cohesionless</u> soils the IS Code shall be consulted

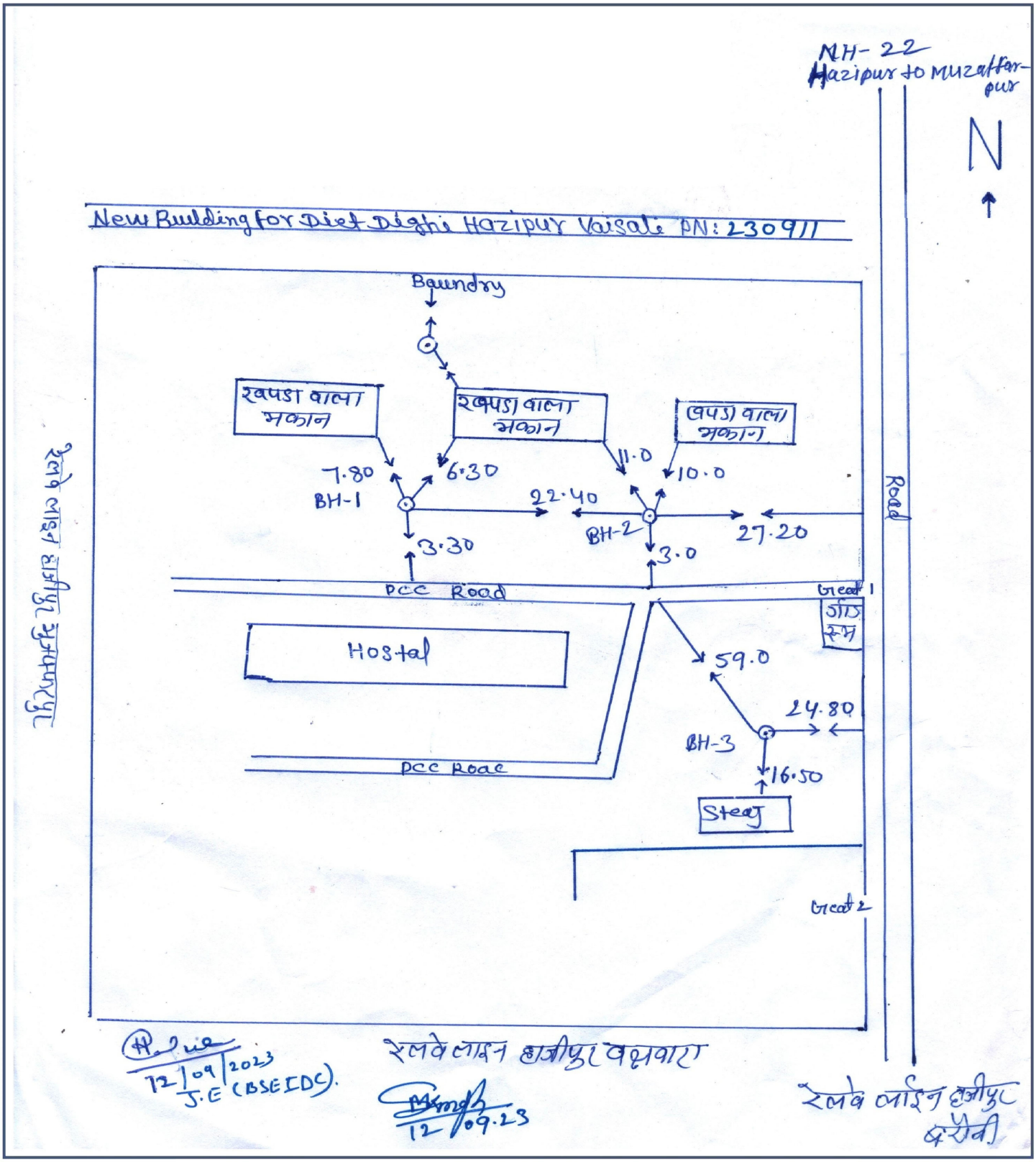
<u>Notes</u>:

1. If a subsoil condition much different from those reported herein is met with during foundation trenching or piling, suitable steps should be taken.
2. If the depth of a shallow foundation is below the water table, dewatering of the foundation trench has to be done, and its side walls of may have to be suitably supported at the time of the construction of the foundation.
3. In case a basement is being provided, its base and side walls have to be safeguarded against the likely ingress of ground-water.
4. If concreting for a pile has to be done under water, DMC and tremie method of concreting should be adopted.
5. As per the provisions of the IS Code, **an appropriate number of piles must be subjected to routine load tests to check the veracity of the above recommended values of the safe capacities of piles.**

For Bihar Foundation Consultants

(Prof. C.N. Sinha, Dr.-Ing., FIE)
Chief Consultant.

G+4, Boys' and Girls' Hostel, Educational Building and Principal-cum-Staff Quarter at Vaishali, Diet Dighi Hajipur, Vaishali



Bihar Foundation Consultants,
Ganga Darshan Apartment, Patna -10.
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PN -230911 **Appendix - A**

NAME OF WORK : Sub soil Investigation for C/O							BORING FINISH DATE : 12.09.2023					WATER TABLE : 1.50 m bgl				
G+4, Boys' and Girls' Hostel, Educational Building and Principal-cum-Staff Quarter at Vaishali, Diet Dighi Hajipur, Vaishali							BORING METHOD : Rotary									
BORE HOLE NO. : 1			Site Incharge - Mukesh Singh				TERMINATION DEPTH : 10.5 m					RECORD ON : 12.09.2023				

Depth Below GL (m)	Sample No.	SPT 'N' Value observation	Visual Description of Soil with IS Classification	Depth(m)		Thickness (m)	Liquid Limit	Plastic Limit	Plasticity Indix,%	Bulk Density (gm/cm3)	Natural Moisture Content (%)	Specific Gravity	Shear Test			Compression Index (C_c)
		Obsr.		from	to								Type of Test	Cohesion, c (kg/cm2)	Friction Angle, ϕ °	
1.0			Greyish silty sand, SM-SP	0.0		10.5										
1.5	S1	9								1.90	30.5	2.63		0.00	28.0	
2.5																
3.0	S2	10								1.90	30.6	2.63		0.00	28.0	
4.0																
4.5	S3	12								1.90	30.8	2.63		0.00	28.2	
5.5																
6.0	S4	15								1.89	31.3	2.62		0.00	28.5	
7.0																
7.5	S5	17								1.88	31.9	2.62		0.00	28.7	
8.5																
9.0	S6	20								1.88	32.2	2.62		0.00	29.0	
10.0																
10.5	S7	23			10.5					1.87	32.9	2.62		0.00	29.3	

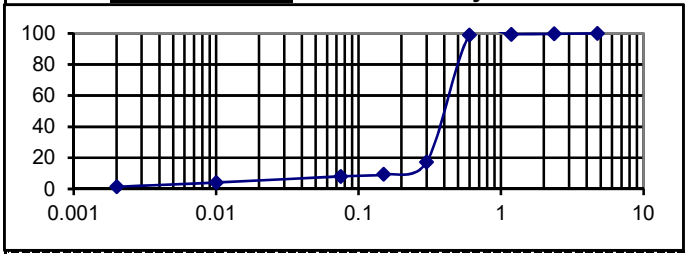
NAME OF WORK : Sub soil Investigation for C/O							BORING FINISH DATE : 12.09.2023					WATER TABLE : 1.50 m bgl				
G+4, Boys' and Girls' Hostel, Educational Building and Principal-cum-Staff Quarter at Vaishali, Diet Dighi Hajipur, Vaishali							BORING METHOD : Rotary									
BORE HOLE NO. : 2			Site Incharge - Mukesh Singh				TERMINATION DEPTH : 10.5 m					RECORD ON : 12.09.2023				

Depth Below GL (m)	Sample No.	SPT 'N' Value observation	Visual Description of Soil with IS Classification	Depth(m)		Thickness (m)	Liquid Limit	Plastic Limit	Plasticity Indix,%	Bulk Density (gm/cm3)	Natural Moisture Content (%)	Specific Gravity	Shear Test			Compression Index (C_c)
		Obsr.		from	to								Type of Test	Cohesion, c (kg/cm2)	Friction Angle, ϕ °	
1.0			Greyish silty sand, SM-SP	0.0		10.5										
1.5	S1	8								1.91	30.4	2.64		0.00	28.0	
2.5																
3.0	S2	9								1.90	30.5	2.63		0.00	28.0	
4.0																
4.5	S3	12								1.90	30.8	2.63		0.00	28.2	
5.5																
6.0	S4	15								1.89	31.3	2.62		0.00	28.5	
7.0																
7.5	S5	16								1.89	31.4	2.62		0.00	28.6	
8.5																
9.0	S6	19								1.88	32.1	2.62		0.00	28.9	
10.0																
10.5	S7	20			10.5					1.88	32.2	2.62		0.00	29.0	

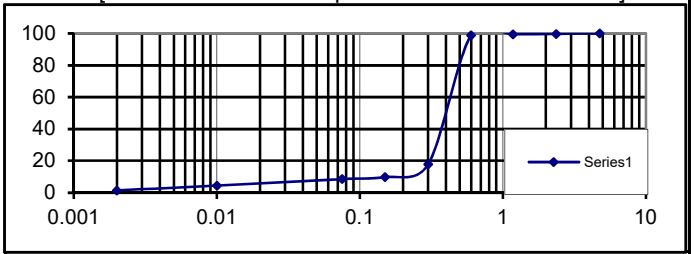
NAME OF WORK : Sub soil Investigation for C/O							BORING FINISH DATE : 13.09.2023					WATER TABLE : 1.30 m bgl				
G+4, Boys' and Girls' Hostel, Educational Building and Principal-cum-Staff Quarter at Vaishali, Diet Dighi Hajipur, Vaishali							BORING METHOD : Rotary									
BORE HOLE NO. : 3			Site Incharge - Mukesh Singh				TERMINATION DEPTH : 10.5 m					RECORD ON : 13.09.2023				

Depth Below GL (m)	Sample No.	SPT 'N' Value observation	Visual Description of Soil with IS Classification	Depth(m)		Thickness (m)	Liquid Limit	Plastic Limit	Plasticity Indix,%	Bulk Density (gm/cm3)	Natural Moisture Content (%)	Specific Gravity	Shear Test			Compression Index (C_c)
		Obsr.		from	to								Type of Test	Cohesion, c (kg/cm2)	Friction Angle, ϕ °	
1.0			Greyish sand, SP	0.0		3.0										
1.5	S1	9								1.90	30.5	2.63		0.00	28.0	
2.5																
3.0	S2	14			3.0					1.89	31.2	2.62		0.00	28.4	
4.0			Greyish silty sand, SM-SP	3.0		7.5										
4.5	S3	16								1.89	31.4	2.62		0.00	28.6	
5.5																
6.0	S4	18								1.88	32.0	2.62		0.00	28.8	
7.0																
7.5	S5	21								1.87	32.7	2.62		0.00	29.1	
8.5																
9.0	S6	24								1.87	33.2	2.62		0.00	29.4	
10.0																
10.5	S7	25			10.5					1.86	33.6	2.62		0.00	29.5	

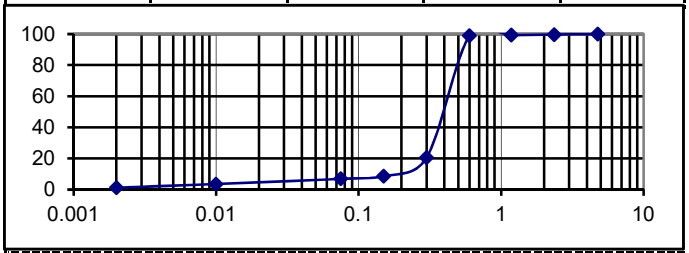
Table 2 [part **B]: Grain Size Analysis Results** [for Bore hole No./ Depth in m shown thus: 1/1.5]



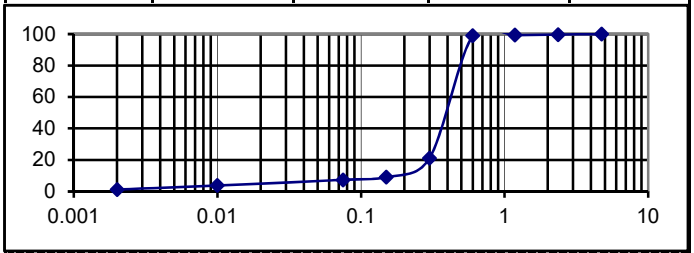
BH/depth,m	*Gravel, %*	*Sand,%*	*Silt, %*	*Clay%*
1/1.5	0.0	91.9	6.7	1.4



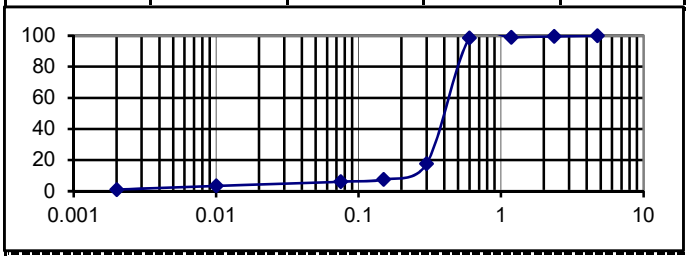
BH/depth,m	*Gravel, %*	*Sand,%*	*Silt, %*	*Clay%*
1/3.0	0.0	91.4	7.1	1.5



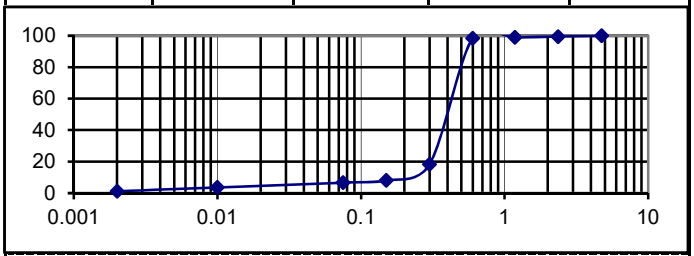
BH/depth,m	*Gravel, %*	*Sand,%*	*Silt, %*	*Clay%*
1/4.5	0.0	93.1	5.7	1.2



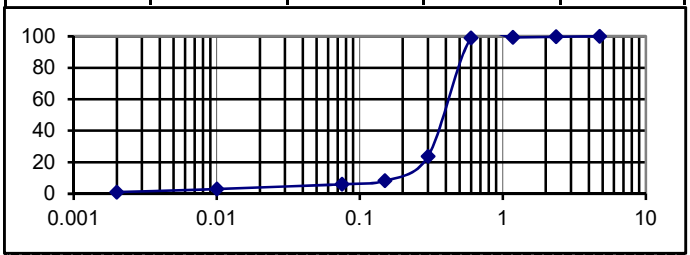
BH/depth,m	*Gravel, %*	*Sand,%*	*Silt, %*	*Clay%*
1/6.0	0.0	92.6	6.1	1.3



BH/depth,m	*Gravel, %*	*Sand,%*	*Silt, %*	*Clay%*
1/7.5	0.0	93.9	5.0	1.1

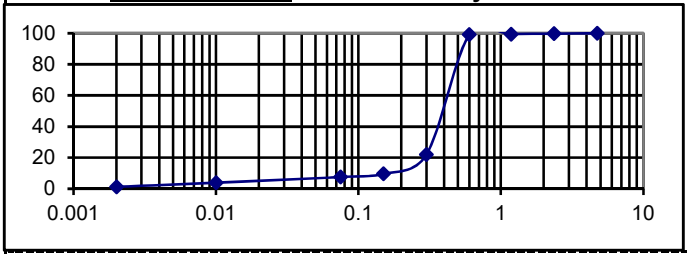


BH/depth,m	*Gravel, %*	*Sand,%*	*Silt, %*	*Clay%*
1/9.0	0.0	93.3	5.5	1.2

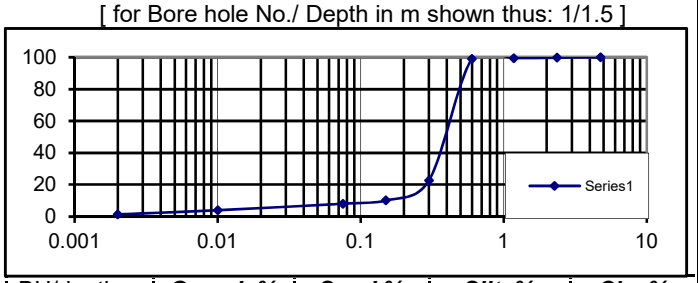


BH/depth,m	*Gravel, %*	*Sand,%*	*Silt, %*	*Clay%*
1/10.5	0.0	94.0	5.0	1.0

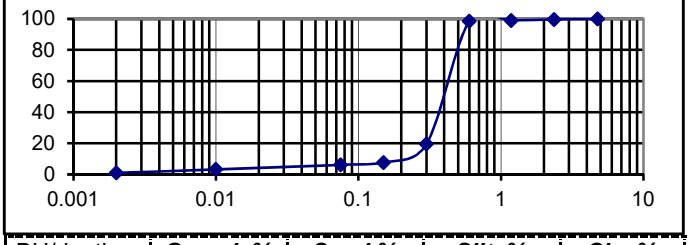
Table 2 [part **B]: Grain Size Analysis Results** [for Bore hole No./ Depth in m shown thus: 1/1.5]



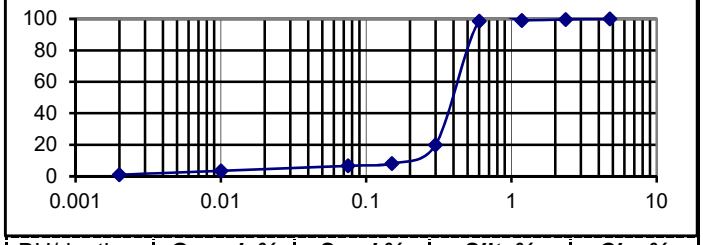
BH/depth,m	*Gravel, %*	*Sand,%*	*Silt, %*	*Clay%*
2/1.5	0.0	92.5	6.2	1.3



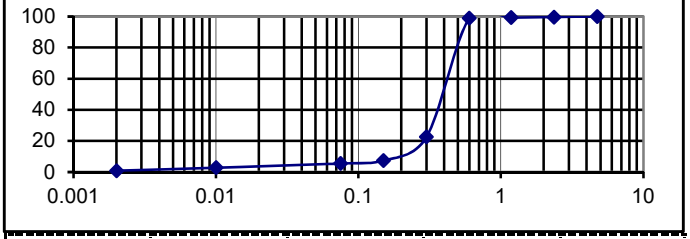
BH/depth,m	*Gravel, %*	*Sand,%*	*Silt, %*	*Clay%*
2/3.0	0.0	91.9	6.7	1.4



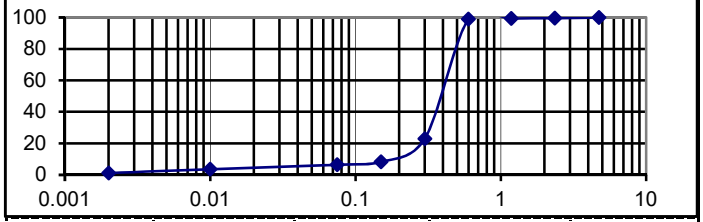
BH/depth,m	*Gravel, %*	*Sand,%*	*Silt, %*	*Clay%*
2/4.5	0.0	93.8	5.2	1.0



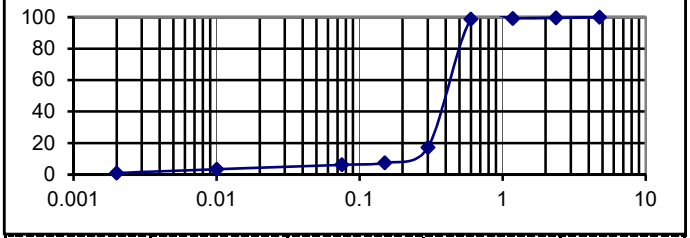
BH/depth,m	*Gravel, %*	*Sand,%*	*Silt, %*	*Clay%*
2/6.0	0.0	93.3	5.6	1.1



BH/depth,m	*Gravel, %*	*Sand,%*	*Silt, %*	*Clay%*
2/7.5	0.0	94.5	4.6	0.9

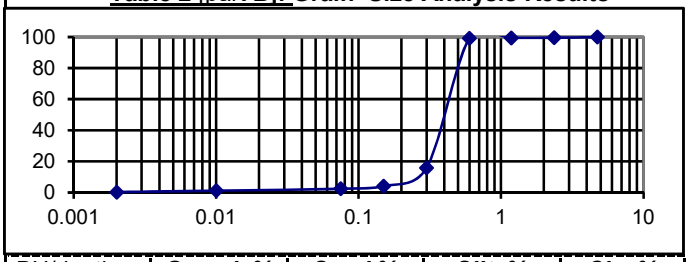


BH/depth,m	*Gravel, %*	*Sand,%*	*Silt, %*	*Clay%*
2/9.0	0.0	93.6	5.2	1.2

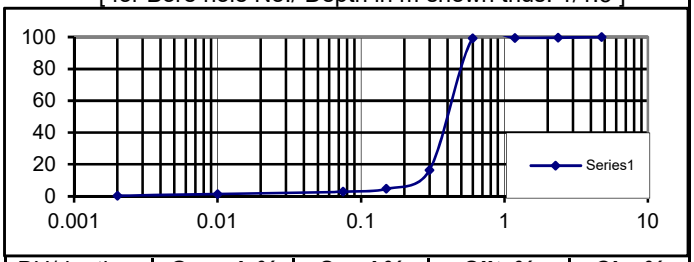


BH/depth,m	*Gravel, %*	*Sand,%*	*Silt, %*	*Clay%*
2/10.5	0.0	93.8	5.1	1.1

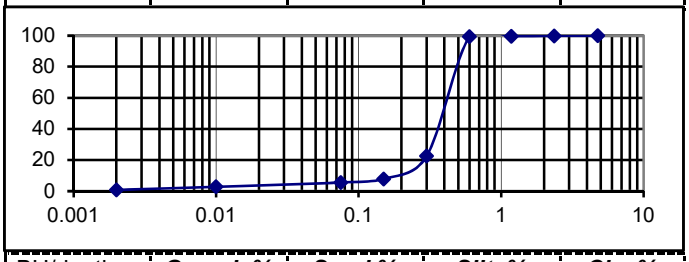
Table 2 [part **B]: Grain Size Analysis Results** [for Bore hole No./ Depth in m shown thus: 1/1.5]



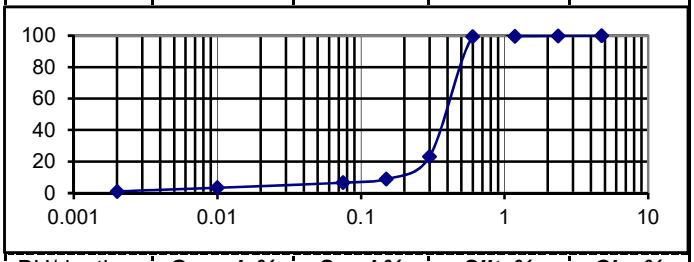
BH/depth,m	*Gravel, %*	*Sand,%*	*Silt, %*	*Clay%*
3/1.5	0.0	97.6	2.1	0.3



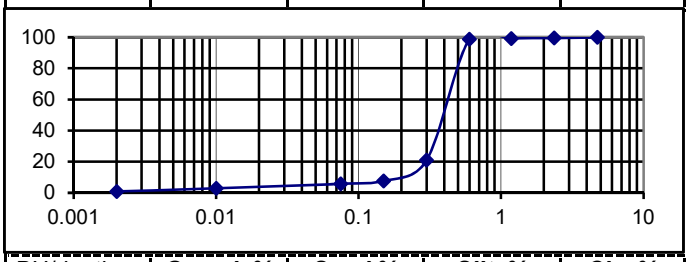
BH/depth,m	*Gravel, %*	*Sand,%*	*Silt, %*	*Clay%*
3/3.0	0.0	97.1	2.5	0.4



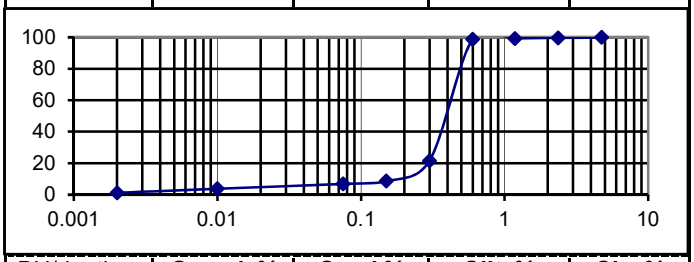
BH/depth,m	*Gravel, %*	*Sand,%*	*Silt, %*	*Clay%*
3/4.5	0.0	94.4	4.8	0.8



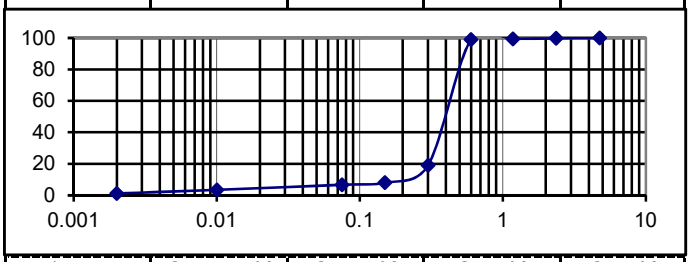
BH/depth,m	*Gravel, %*	*Sand,%*	*Silt, %*	*Clay%*
3/6.0	0.0	93.4	5.5	1.1



BH/depth,m	*Gravel, %*	*Sand,%*	*Silt, %*	*Clay%*
3/7.5	0.0	94.2	4.9	0.9

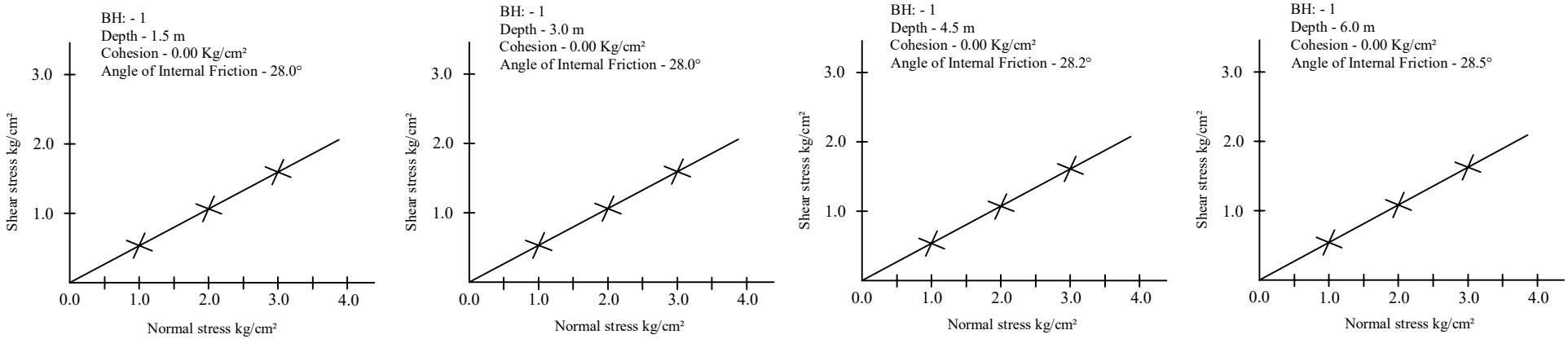


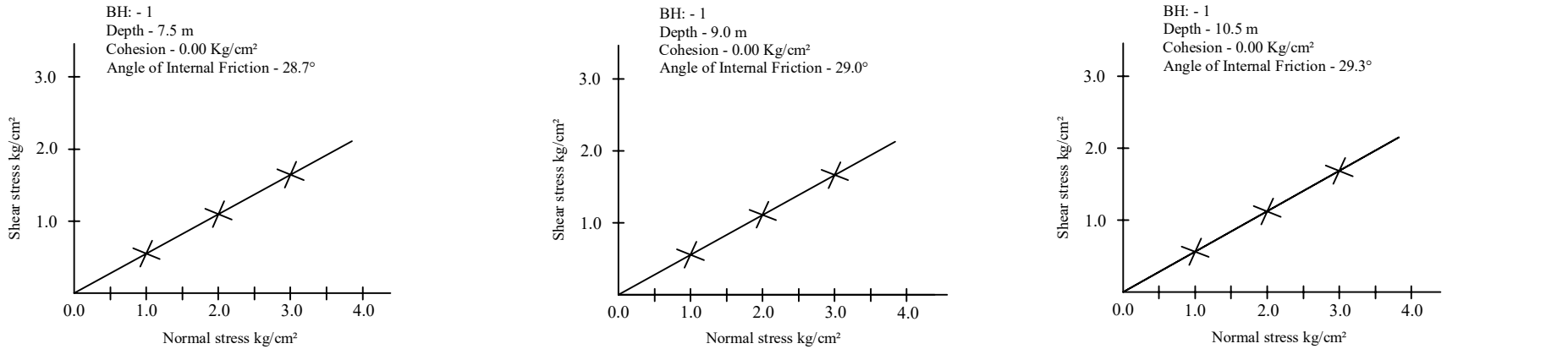
BH/depth,m	*Gravel, %*	*Sand,%*	*Silt, %*	*Clay%*
3/9.0	0.0	93.2	5.5	1.3



BH/depth,m	*Gravel, %*	*Sand,%*	*Silt, %*	*Clay%*
3/10.5	0.0	93.3	5.5	1.2

TRIAXIAL / DIRECT SHEAR TEST PLOTS





Appendix - D1

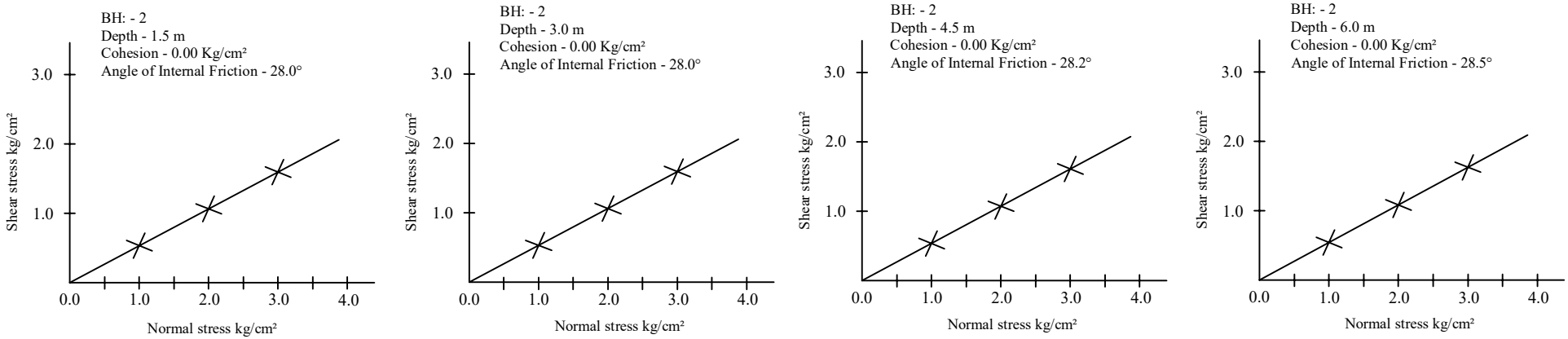
Bihar Foundation Consultants,
[A unit of Baidyanath Foundation Consultants Pvt. Ltd.]

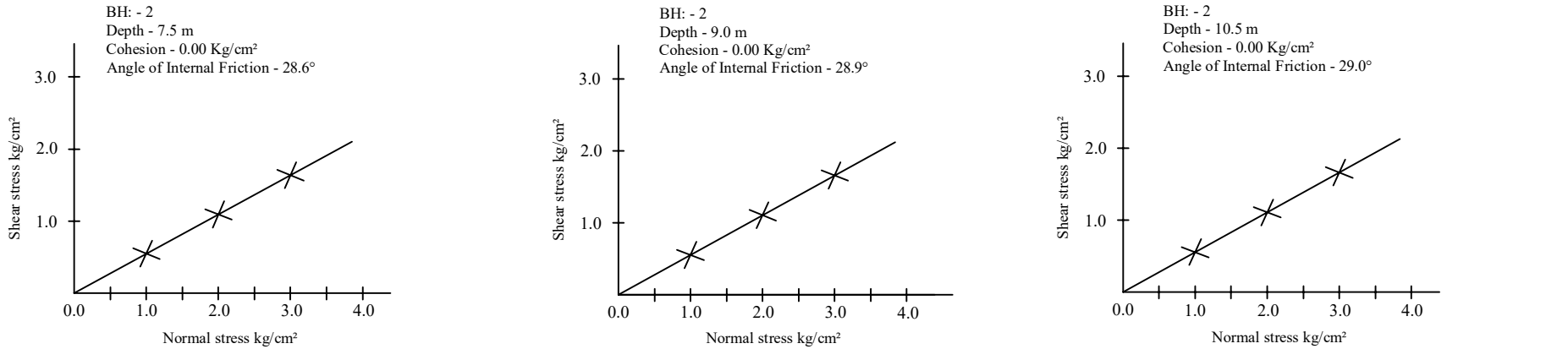
Project No. 220911

For the Proposed

G+4, Boys' and Girls' Hostel, Educational Building and Principal-cum-Staff Quarter at Vaishali, Diet Dighi Hajipur, Vaishali

TRIAXIAL / DIRECT SHEAR TEST PLOTS





Appendix - D2

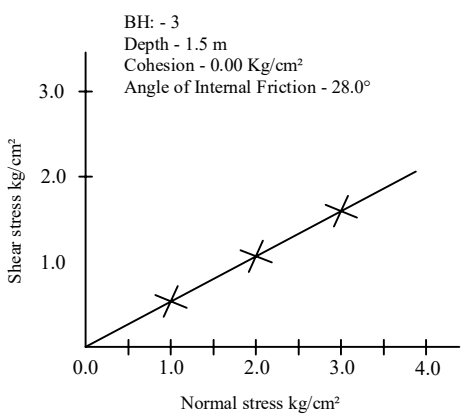
Bihar Foundation Consultants,
[A unit of Baidyanath Foundation Consultants Pvt. Ltd.]

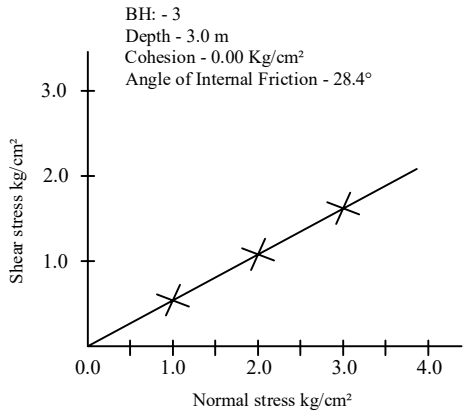
Project No. 220911

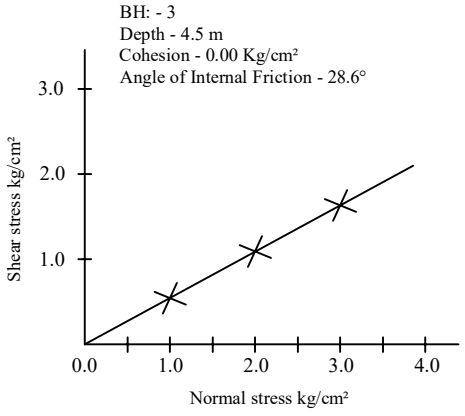
For the Proposed

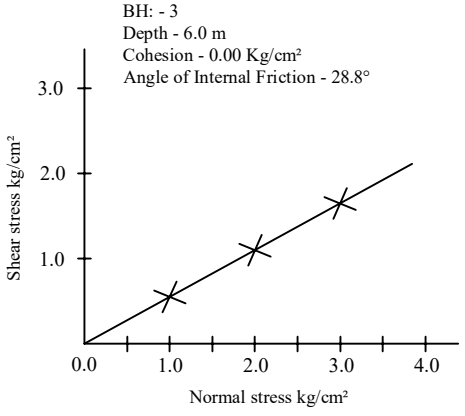
G+4, Boys' and Girls' Hostel, Educational Building and Principal-cum-Staff Quarter at Vaishali, Diet Dighi Hajipur, Vaishali

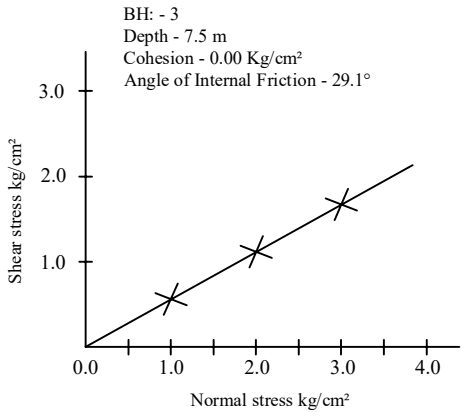
TRIAXIAL / DIRECT SHEAR TEST PLOTS

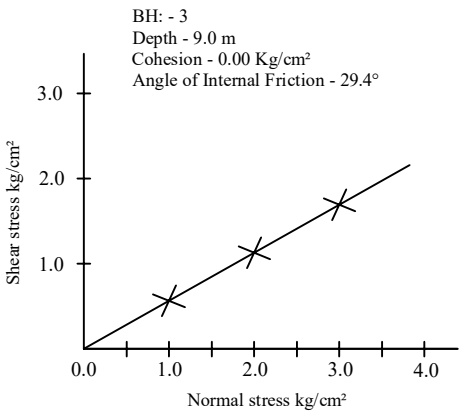


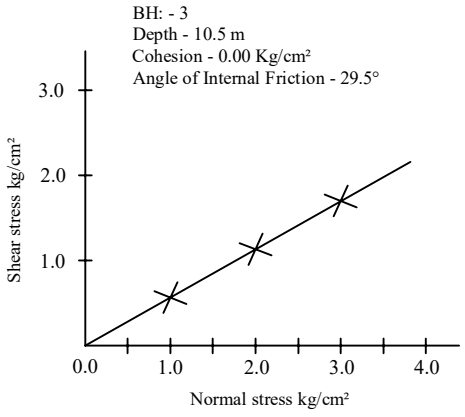












Appendix - D3

Bihar Foundation Consultants,
[A unit of Baidyanath Foundation Consultants Pvt. Ltd.]

Project No. 220911

For the Proposed

G+4, Boys' and Girls' Hostel, Educational Building and Principal-cum-Staff Quarter at Vaishali, Diet Dighi Hajipur, Vaishali

SAMPLE CALCULATION OF BEARING CAPACITY OF SHALLOW FOUNDATION

The determination of the **net safe bearing capacity**, q_{ns}, is done first on the basis of the shear failure criterion after dividing the value of the **net ultimate bearing capacity** q_{nf}, calculated as described below, by a suitable factor of safety. The **net soil pressure,** q_s, for a given permissible settlement is then calculated as explained in the next section. The lower of the two values, q_{ns} and q_s, thus determined is taken as the **allowable bearing capacity** of the soil.

1. Shear Failure Criterion.The **net ultimate bearing capacity** q_{nf} (t/m^2) of a shallow foundation of breadth B (m) and depth D (m) is given as per IS:6403-1981 (Sec.5.1.2) by the following equation :

$$q_{nf} = c\,N_c\,s_c\,d_c\,I_c + q\,(N_q - 1)\,s_q\,d_q\,I_q + 0.5\,\gamma\,B\,N_\gamma\,s_\gamma\,d_\gamma\,I_\gamma\,w$$

where c = cohesion (t/m^2)
q = effective surcharge (t/m^2)
γ = unit weight of subsoil (t/m^3)
N_c, N_γ, N_q = bearing capacity factors, which are functions of ϕ, the angle of internal friction of the soil
s_c, s_q, s_γ = shape factors
d_c, d_q, d_γ = depth factors
I_c, I_q, I_γ = inclination factors
} related to cohesion, surcharge and density of subsoil respectively
w = water table factor (= 0.5 to 1.0) depending on the depth, D_w of water table- vide Table below.

The bearing capacity factors (N's) are functions of ϕ, the angle of internal friction of the soil. Their values are found for general shear failure by referring to standard tables. If subsoil conditions are such as to lead to local shear failure, the values of these factors are found for a reduced value of angle of internal friction (ϕ') given by the equation : $\tan \phi' = 0.67 \tan \phi$. The value of cohesion is also reduced to $c' = 0.67\,c$.

The values of the other factors for usual conditions are as tabulated below :

s_c =	1.3	1+0.2B/L	1	d_c =	$1+0.2\,(N\varphi)^{0.5}\,D/B$		D_w at	G.L.	Fou'dn.Level
s_q =	1.2	1+0.2B/L	1	$d_q = d_\gamma$ =	1	for $\varphi < 10^o$	w =	0.5	1
s_γ =	0.8//0.6	1-0.4B/L	1	$d_q = d_\gamma$ =	$1+0.1(N\varphi)^{0.5}\,D/B$	$\varphi > 10^o$		Interpolation	between
FOR	sq.// O	Rect.	STRIP	I_c, I_q, I_γ = 1 for vertical load				these values	is linear.

In the present case, the representative values of cohesion © and angle of internal friction (ϕ)of the soil may be obtained from the soil data given earlier.

One example of calculation for a certain depth and width of a strip or square footing is given in the **Table A** on the next page. Full submergence of the soil has been assumed. The **safe bearing capacity**, q_{ns} has been obtained by dividing q_{nf} by a **safety factor, 3**. The net safe bearing capacity for a footing of the selected size and depth of footing is to be seen in its last column. Calculations of safe bearing capacities for other depths and widths of footings are done similarly.

2 Calculation of allowable bearing capacity based on settlement criterion

The **net soil pressure,** q_s (t/m^2) for a permissible settlement of 25 mm is give by Teng's formula:

$$q_s = 3.5\,[N'' - 3]\left[\frac{(B + 0.3)}{2B}\right]^2 w'\,F_d \quad t/m^2$$

where N'' = corrected value of N from SPT

F_d = $[1 + D/B] <$ or = 2

D, B and w' are as defined before.

For a permissible settlement of **S** mm, the allowable bearing capacity

$$q'_s = S\, q_s /25$$

The corrected SPT N" values used in the calculations based on the above formula for different depths below G.L. may be found from the recorded data.

The N" value used in any case is to be for the influence zone below the footing, which depends on its width. A sample of calculation of the allowable soil pressure for the chosen size and depth of footing and for the permissible settlement is given in **Table B** in the next section.

The net allowable bearing pressure will be the lower of the values of bearing pressures found in the two Tables A and B.

Table A

Calculation of Net Safe Bearing Pressure [based on **shear failure** criterion]

Shape of Foundation: STRIP			F.S.= 3	γ, t/m³= 1.91		c =	ϕ =	Nc =	Nq =	Nγ =
						0	28.0	25.80	14.72	16.72
D [m]	B [m]	dc	dq = dg	c	q	I Term	II Term	III Term	qnf	qnf /F
1.5	2	1.25	1.125	0	1.433	0.00	22.11	17.94	40.05	13.35

Table B

Calculation of Net Allowable Bearing Pressure [based on **settlement** criterion]

D	B	Fd =	N"	w'	$q_{s=25}$	S	$q_{s=S}$
m	m				t/m²	mm	t/m²
1.5	2.0	1.75	6.5	0.5	3.5439	50	7.0878

The adjoining Table and the comments below it are for a footing of depth, **D = 1.5 m, and width, B [m] = 2.0**

The value of allowable bearing pressure from the above Table for s = 50 mm is = 7.1 t/m²

The value of safe bearing capacity from shear criterion as found from Table A = 13.4 t/m²

Hence the allowable bearing pressure for settlement, s= or < 50 mm will be = **7.1 t/m²**

The calculations for other depths and widths of footing are similar.

Calculations of Capacity of Plane Pile for the proposed
G+4, Boys' and Girls' Hostel, Educational Building and Principal-cum-Staff Quarter at Vaishali, DIET Dighi Hajipur, Vaishali

Based on IS:2911 (Part I, Sec. 2) 2010, Annex B, (Clauses 6.3.1.1 and 6.3.2)
using both cohesion (c), in t/m^2 and angle of internal friction (ϕ^o).

WHEN **Pile diameter, D (m)=** **0.30** Area of pile base, **Ap** (m^2) = 0.071 & circ'mf'r'nce (in m) of pile base, **j =** 3.14 x D = 0.942

Surface area of pile's contact with soil, **A (m^2)** = j x t where t = thickness of soil layer in contact with pile.

In **CLAY:** **Skin friction** in clay, **Qs** $= \alpha$ c A ,
where Reduction factor, **α,depends on c, as given in Fig. 2** of Annex. B of the above IS Code:2911

End bearing, Q_b= A_p c_p N_c, where N_c=9

In **SAND**: **Skin friction, Qs** = $KP_{mid}A \tan \delta$, where K = 1.5
and $\delta = \phi$. **End bearing, Qb** = Ap(0.5 Dγ N_γ + $P_{tip}N_q$),
where P = overburden press.at mid-layer or pile tip , *as the case be,*
and the values of Nq and **Nγ** are to be taken from the IS Code.
*Max'm permissible P[t/m^2] = 15 to 20 X pile diameter (D) X γ_{sub}
= 4.5 to 6 X γ_{sub} t/m^2.
4.05 to 5.4 t/m .

Total Ultimate capacity of pile, Qu = Qs + Qb.
Safe capacity of pile, Qsf = (Qs /f_s + Qb/f_b)

Let factor of safety in
friction, f_s = **3**
bearing, f_b = **3**

Depth of soil layer (m)	Soil type	γ_{sub} t/m^3	c t/m^2	α	φ	t [m]	p = γ x t t/m^2	P_{tip} =Σp t/m^2	Permissible P_{tip} t/m^2	Permissible P_{mid} t/m^2	A = j x t m^2	Qs' (for 1 layer) t	Qs = ΣQs' t	Qb t	Qu t	**Qsf** [runded off] **tonnes**	**Pile Length m**
0.0-0.5	silty sand					0.5	0.00	0.00	0.0	0.0	Not considered due to cut-off and very soft layers.						**0.5**
0.5-2.0	silty sand	0.91	0.00		28.00	1.5	1.37	1.37	1.4	0.7	1.41	0.77	0.77	1.59	2.36		**2.0**
2.0-4.0	silty sand	0.90	0.00		28.05	2.0	1.80	3.17	3.2	2.3	1.88	3.41	4.18	3.55	7.73	**2.6**	**4.0**
4.0-6.0	silty sand	0.90	0.00		28.25	2.0	1.80	4.97	4.1	4.1	1.88	6.15	10.32	4.67	15.00	**5.0**	**6.0**
6.0-8.0	silty sand	0.89	0.00		28.60	2.0	1.78	6.75	4.1	4.1	1.88	6.24	16.56	4.83	21.39	**7.1**	**8.0**
8.0-10.0	silty sand	0.88	0.00		28.90	2.0	1.76	8.51	4.1	4.1	1.88	6.31	22.87	4.89	27.76	**9.3**	**10.0**

Depth,d	γ_{sub}	ϕ^o	* N_γ	**Qb** for ϕ * N_q	# Qb	Qb for c	# Qb
4.0	0.90	28.25	17.33	15.13	3.55	0.00	0.00
6.0	0.89	28.60	18.24	15.73	4.67	0.00	0.00
8.0	0.88	28.90	19.06	16.26	4.83	0.00	0.00
10.0	0.88	29.00	19.34	16.44	4.89	0.00	0.00

बिहार राज्य शैक्षणिक आधारभूत संरचना विकास निगम लिमिटेड
BIHAR STATE EDUCATIONAL INFRASTRUCTURE DEVELOPMENT CORPORATION LTD.
(A Govt. of Bihar Undertaking)
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E-mail: bseidc@gmail.com * Website : http:/www.bseidc.in * CIN: U80301BR2010SGC015859

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प्रेषक,

मुख्य अभियंता
BSEIDC, पटना।

सेवा में,

बिहार फाउंडेशन कंसल्टेन्ट
गंगा दर्शन अपार्टमेंट, फ्लैट नं०–403
सदाकत आश्रम के पश्चिम,
पटना–800010

विषयः– निर्माण स्थल पर मिट्टी जाँच के संबंध में।

प्रसंगः भवन निर्माण विभाग, बिहार, पटना के पत्र सं०–120, दिनांक–31.01.2023

महाशय,

उपर्युक्त बिहार राज्य शैक्षणिक आधारभूत संरचना विकास निगम के अधीन (i) Bhagalpur, DIET Bhagalpur (ii) Gaya, DIET Gaya (iii) Sitamarhi, DIET Dumra Sitamarhi (iv) Vaishali, DIET Dighi Hajipur, Vaishali में बालिका छात्रावास, बालक छात्रावास, शैक्षणिक भवन, प्रींसीपल–सह–स्टॉफ क्वॉटर के G+4 भवन निर्माण प्रस्तावित है। इस भवन निर्माण स्थल पर मिट्टी जाँच कराना है।

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विश्वासभाजन
मुख्य अभियंता
BSEIDC, पटना।

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